WCTE 2025 THEMES

MPD - Material Performance & Durability
STCE - Sustainability and Timber in a Circular Economy
TESP - Timber Engineering & Structural Performance
TABD - Timber Architecture & Biophilic Design
EIC - Education, Innovation & Challenges
ECCS - Exemplars & Construction Case Studies

Session 1 - 11am to 1pm Presentations are 15 minutes each	1A	1B	1C	1D	1E	1F	1G	1H	1I
	TESP - Engineering - Eurocode 5 - recent developments	TESP - Architectural	TESP/TABD - Engineering - Shearwalls & Panels / Structrual Behaviour	TESP / MPD / STCE - Engineering - Seismic	TESP Engineering Fire Engineering	TESP / MPD - Engineering - Digital Imaging Correlation	TESP - Engineering - modular construction	ECCS - Engineering - Structural Behaviour	TESP - Engineering - Protective Design
		8	8	7	8	7	7	8	7
Session 2 - 2pm to 3:30pm Presentations are 15 minutes each	2A	2B	2C	2D	2E	2F	2G	2H	2I
	TESP - Engineering - Dynamic testing and monitoring of wood buildings: A global perspective	STCE - Architectural	TESP / MPD - Engineering - Bamboo	MPD - Engineering - Protective Design - moisture safety in timber buildings and construction processes.	TESP/ MPD- Engineering - Bridges	MPD - Engineering - thermal behaviour	TESP - Engineering Seismic Behaviour	ECCS - Architectural case studies	STCE - Practitioner
	6	6	6	6	6	6	5	6	5
Session 3 - 4pm to 5:30pm Presentations are 15 minutes each	3A	3B	3C	3D	3E	3F	3G	3H	
	TESP - Architectural	TESP - Engineering - Protective Design	TESP / MPD - Engineering - CLT Walls	TESP - Engineering Numerical Investigations	TESP / MPD - Engineering use of hardwoods	TESP - Engineering - Automation / Software	ECCS - Practitioner / Engineering	EIC - Practitioner	
Poster Session 1 - 1:30pm to 2pm Presentations are 4 minutes each	Poster 1A	Poster 1B	Poster 1C						
	EIC & ECCS (Engineering)	MPD & TABD (Architectural/ Engineering)	TESP (Engineering)						

Session 4 - 8:30am to 10:30am Presentations are 15 minutes each	4A	4B	4C	4D	4E	4F	4G	4H	4I
	TESP - Engineering - Codes and modelling	TESP- Engineering Vibrations & Acoustics	TESP - Engineering - Connections	TESP - Engineering - Composites & Hybrids	MPD - Engineering - material properties	MPD - Engineering - fracture mechanics & wood fibre	STCE - Engineering	ECCS Engineering	EIC - Engineering Applications & Architecture
Session 5 - 11am to 1pm Presentations are 15 minutes each	5A	5B	5C	5D	5E	5F	5G	5H	5I
	TESP - Engineering - structural components	TESP- Engineering Structural Modelling	TESP- Engineering Vibrations and Acoustics	STCE/TESP - Engineering - Material Properties / Codes & Regulatory Framework	MPD - Engineering - characterising material properties, incl LOGGO presentation	MPD - Engineering	STCE - Engineering	ECCS/STCE - Engineering	STCE - Architectural
Session 6 - 2pm to 3:30pm Presentations are 15 minutes each	6A	6B	6C	6D	6E	6F	6G	6H	
	TESP - Engineering - Resilient solutions for Mid-rise mass timber building in high seismic regions	TESP - Engineering - Floor systems	TESP - Case Studies	MPD - Engineering - Protective Design - moisture safety in timber buildings and construction processes.	MPD - Architectural	STCE - Engineering	ECCS/TESP - Engineering	EIC - Practitioner	
Session 7 - 4pm to 5:30pm Presentations are 15 minutes each	7A	7B	7C	7D	7E	7F	7G	7H	
	TESP- Engineering - Bridges / Beams	TESP - Engineering - behaviour of dowel connections	TESP - Engineering - Performance of hybrid connections	MPD - Engineering - Monitoring timber decay	TABD - Architectural	TESP - Engineering - Robustness	ECCS - Australian Hybrid-Timber Exemplars (Atlassian & T3 Collingwood)	TESP - Practitioner	
Poster Session 2 - 1:30pm to 2pm Presentations are 4 minutes each	Poster 2A	Poster 2B	Poster 2C						
	MPD (Engineering)	STCE (Engineering)	TESP (Engineering)						

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Session 8 - 11am to 1pm Presentations are 15 minutes each	8A	8B	8C	8D	8E	8F	8G	8H	8I
	TESP - Engineering	TESP - Engineering Connections	TESP - Engineering Flooring , incl Gottstein Study Tour Presentation	TESP - Engineering - design challenges for timber buildings	EIC / STCE - Engineering - Design for Wind & Seismic load events / Structural Behaviour	MPD - Engineering - structural behaviour	STCE - Engineering / Architecture - Advancing the Circular Economy	TESP - Engineering - Dynamic Testing & Fire Engineering	TESP - Practitioner / Engineering
Session 9 - 2pm to 3:30pm Presentations are 15 minutes each	9A	9B	9C	9D	9E	9F	9G	9H	9I
	ECCS / EIC / TESP - Practitioner / Engineering	TESP- Engineering Fire Engineering	TESP- Engineering Connections	TESP - Engineering Structural behaviour	STCE - Engineering - Advancing the Circular Economy in Europe	TESP Engineering - Connections	TESP - Engineering	TESP - Engineering - Seismic / Vibrations	ECCS - Architectural
Session 10 - 4pm to 5:30pm	10A	10B	10C	10D	10E	10F	10G	10H	
	TESP- Engineering Seismic Performance	TESP - Engineering Shear Performance	MPD - Architectural / Engineering / Practitioner	TESP - Engineering	EIC - Architectural	MPD / TESP - Engineering - fire or moisture hazards	TESP - Engineering - perfomance of Hybrid structures	TABD - Architectural	
Poster Session 3 - 1:30pm to 2pm Presentations are 4 minutes each	Poster 3A	Poster 3B	Poster 3C						
	EIC, STCE (Engineering/ Practitioner)	TESP (Architectural)	MPD (Engineering)						

Session 11 - 120 mins Presentations are 15 minutes each	11A	11B	11C	11D	11E	11F	11G	11H	11I
	TESP - Engineering Connections	TESP - Engineerng Robustness & Natural Disaster Resilient Structures	TESP - Engineering - Material Properties	TESP - Engineering - Concentrated loading & reinforcing methods	ECCS/STCE - Architectural / Engineering	MPD - Engineering - Fire	TESP/STCE/EIC - Sustainability	TABD/STCE - Case Studies, incl Sydney Fish Market Presentation by Rubner / Theca	EIC/MPD - Engineering / Architectural
Session 12 - 120 mins Presentations are 15 minutes each	12A	12B	12C	12D	12E	12F	12G	12H	
	TESP- Engineering Experimental investigations	MPD/TESP - Engineering - Material Behaviour	TESP/MPD/TABD - Engineering / Architectural	EIC - Engineering - Innovation & Testing	EIC/TESP/MPD- Engineering - Fire	EIC/STCE/ECCS - Architectural / Engineering / Practitioner	STCE - Engineering	TABD - Engineering	
Poster Session 4- Presentations are 4 minutes each	Poster 4A	Poster 4B	Poster 4C						
	TESP (Engineering)	MPD & TESP (Engineering)	TESP (Engineering)						

SESSION 1
Monday 23rd June 2025
11am to 1pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
1A	TESP - Engineering - Eurocode 5 - recent developments	Session Chair: PROFESSOR ERIK SERRANO / LUND UNIVERSITY					
1A	TESP - Engineering - Eurocode 5 - recent developments	Timber Engineering & Structural Performance - Engineering Focus	DESIGN OF HOLES IN BEAMS – A NEW SECTION FOR EUROCODE 5	Architectural reasons or user-specific requirements often require that pipes for water, ventilation, heating etc. are arranged in the plane of the load-bearing structure. As a result, holes are required in the beams which significantly influence the load-bearing behaviour. The current edition of Eurocode 5 (EC 5) does not contain standardized rules for the design of holes in beams. Hence such design rules had to be included as non contradictory complementary information (NCCI) in National Annexes (NA) to EC 5. However, the design rules currently contained in specific NAs feature considerable restrictions with regard to the size, position and distance of holes in beams. In order to close the obvious gap in Eurocode 5, the design of holes in beams was prioritised for the revision of Eurocode 5. This paper will report on the new and extended rules for the design of holes in beams in Eurocode 5. Compared to current national rules, these rules extend the possibilities to holes with larger diameters, holes with eccentric arrangement and holes arranged in groups. The standard text illustrated in this contribution is complemented by extensive background information and literature.	Philipp	Dietsch	Karlsruhe Institute of Technology - Timber Structures and Building Construction
1A	TESP - Engineering - Eurocode 5 - recent developments	Timber Engineering & Structural Performance - Engineering Focus	THE SECOND GENERATION OF EUROCODE 5 – FIRE DESIGN	The European Commission has a strong interest on the further development of the Eurocodes to achieve a further harmonization of design rules in Europe and the revision process of all Eurocodes has started 2015. The second generation of the Eurocodes is expected to be published starting from 2025. The main objectives of the revision are the improvement of the Ease-of-Use of the Eurocodes for practical users, the reduction of National Determined Parameters and the further harmonization and inclusion of state-of-the-art. After an intensive discussion within CEN/TC250 it was defined that the Eurocodes are addressed to competent civil, structural and geotechnical engineers, typically qualified professionals able to work independently in relevant fields. This paper provides an overview to the second generation of the European design standard EN 1995-1-2 entitled Eurocode 5: Design of timber structures — Part 1-2: Structural fire design	Alar	Just	TalTech
1A	TESP - Engineering - Eurocode 5 - recent developments	Timber Engineering & Structural Performance - Engineering Focus	THE TIMBER CHAPTER OF THE NEW EUROCODE 8 – PART 1-2: NEW FEATURES AND FUTURE IMPROVEMENTS	The revision of the new Timber Chapter (i.e. Chapter 13 and Annex L) of Eurocode 8 (prEN1998-1-2) started almost 10 years ago, and significant changes have been introduced with respect to the current version bringing this chapter to almost 50 pages in total with respect to the 4 pages of the current version (i.e. Chapter 8 of EN1998-1). These changes which have been extensively described in at least five papers published in the last six years, will include new engineered wood products, provisions for dissipative zones, new and existing structural systems, all of them including extensive and detailed rules for capacity-based design (at the local/connection, wall and building level), together with the values of the overstrength factors and a new table with the default values of the behaviour factors for medium dissipative (ductility class 2) and highly dissipative (ductility class 3) structures which was recently updated. Also a new Annex have been included (Annex L) with the provisions for non-linear static analyses on timber buidings, and lately some improvements including the introduction of provisions for bonded-in rods. However still some improvements are needed, which will probably follow after the publication of the new standard in future updates after a period of application of the code, in order to possibly slightly reduce the values of the overstrength factors which currently limit the design of tall timber buildings in high seismicity areas and to further enrich the seismic detailing rules and simplication of some design formula for the application of capacity design.	Massimo Martina	Fragiacomo Sciomenta	University of L'Aquila
1A	TESP - Engineering - Eurocode 5 - recent developments	Timber Engineering & Structural Performance - Engineering Focus	OVERVIEW OF THE WORK WITHIN CEN TC 250/ SC5/ WG12 ASSESMENT AND RETROFITTING OF THE TIMBER EXISTING STRUCTURES	CEN/TC250 had taken the initiative to prepare a document to evaluate the purpose and justification for new European technical rules and related standards for evaluation and retrofitting of existing structures. The corresponding document was produced by the advisory committee of the former president. The ongoing discussions in CEN/TC250 confirmed the need to form first a CEN working group WG2 and after that CEN TC 250 SC10 WG4 for the further development of the subject. A preliminary discussions within CEN/TC250/SC5 resulted in a forming AHG Timber existing structures which was transformed in WG12 Assesment and retrofitting of the existing timber structures. This article will show a basis for the future work program	Vlatka	Rajčić	University of Zagreb Faculty of Civil Engineering
1A	TESP - Engineering - Eurocode 5 - recent developments	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	EUROCODE 5: FROM MANDATE TO SECOND GENERATION – REVIEW, INSIGHT AND OUTLOOK	The second generation of European timber design standards, known as Eurocode 5, is scheduled for publication in August 2025. This paper provides comprehensive insights into the final state of this new generation including background documents and training material. Additionally, this document dedicates a chapter on lessons learned to review the standardization process and the challenges encountered. Furthermore, the paper offers an outlook on upcoming documents, potential developments and the next generation of design standards. Finally, it discusses the interaction with the ongoing revision of the European Construction Products Regulation (CPR), focusing on its future implications for a harmonized European building market.	Stefan	Winter	Technical University Of Munich
1A	TESP - Engineering - Eurocode 5 - recent developments	Timber Engineering & Structural Performance - Engineering Focus	THE 2ND GENERATION OF THE EUROCODE FOR TIMBER BRIDGES	The design of timber bridges is regulated by Eurocode 5 part 2 (EN 1995-2), which has been extensively updated to fullfill the requirement of 100 years service life. The paper will show the structure and content, highlighting the improvements especially for durability and sustainability. Furthermore, it will present the new content regarding timber-concrete composite and integral bridges, laminated timber decks, bracings, bearings and foundations as well as the topics of serviceability limit states (deflections, vibration and damping) and fatigue.	Antje	Simon	University Of Applied Sciences Erfurt
1A	TESP - Engineering - Eurocode 5 - recent developments	Timber Engineering & Structural Performance - Engineering Focus	The new chapter on timber structures in the second generation of EN 1998-3	This presenttion explores the newly introduced chapter on timber structures in the second generation of European Standard EN 1998-3, "Eurocode 8 — Design of Structures for Earthquake Resistance - Part 3: Assessment and Retrofitting of Buildings and Bridges," which is anticipated to be published by 2026/2027. Following a brief introduction to the rationale behind the development of Chapter 10, the presentation delves into the main aspects in detail, providing contextual background on the motivations for these key components. To clarify the framework from which the new provisions originated and to aid their application in specific scenarios beyond those covered in the standard, extensive references to pertinent literature are also included.	Ivan	Giongo	University of Trento
1B	TESP - Architectural	Session Chair: PROFESSOR EMERITUS JEFF MORRELL / OREGON STATE UNIVERSITY					

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
1B	TESP - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus, Timber Engineering & Structural Performance - Architectural Focus	OPTIMIZING MASS TIMBER STRUCTURAL GRID FOR FUNCTIONAL ADAPTABILITY	The paper discusses extending the lifespan of mass timber (MT) buildings to enhance carbon sequestration, emphasizing adaptability in achieving this goal. Building adaptability involves designing structures that can accommodate future modifications, which is critical because more than half of buildings are demolished prematurely, before reaching their physical end-of-life. This premature demolition generates waste and results in the use of additional energy and resources for new constructions. The research introduces a novel industry-informed workflow to optimize three-dimensional structural grids, a key aspect of enhancing building adaptability. This workflow emphasizes multidisciplinary collaboration among architects, structural designers, and building service engineers, incorporating material constraints and capabilities from manufacturers and fabricators. The system's ability to generate optimized structural configurations for gravity load-bearing systems is demonstrated through a case study featuring glulam post-and-beam structures with CLT floor panels, utilizing databases of standard market products. The study finds that the multi-objective optimization workflow can extend grid spans and increase ceiling-to-floor clearance while meeting structural performance criteria. The parametric design approach facilitates the exploration of various design possibilities across different structural systems and fitness functions, suggesting that this methodology can be replicated and extended. The paper concludes by recommending the adoption of this optimization methodology in early-stage design processes for MT buildings, suggesting that further validation through real-world case studies could refine and validate the system's practical applications. This convergent design strategy has the potential to create adaptable buildings with longer lifespans, thereby contributing to sustainable construction practices.	Mariapaola	Riggio	Oregon State University
1B	TESP - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus, Timber Engineering & Structural Performance - Architectural Focus	DESIGN AND FABRICATION OF A WOODEN PAVILION USING UNDERUTILIZED LUMBER AND PROPOSAL FOR CONVERSION	The aging of planted forest resources and the decline in the population of forest managers have resulted in a lack of access to these resources, and trees are dying and wood that could be used for building materials is being turned into chips and fuel. Through collaboration between universities, towns, and companies, it was possible to safely create pavilions and furniture using unused trees, off-specification sizes, and species, thereby promoting the utilization of forest resources. The method of conducting parametric studies using the Young's modulus of the analytical model as a variable was also proposed to enable the use of wood with a Young's modulus that would otherwise go unused.	Ayano	Kodera	Toyo University
1B	TESP - Architectural	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Architectural Focus	EXPERIMENTAL AND ANALYTICAL STUDY ON THE SEISMIC PERFORMANCE OF LOAD-BEARING WALLS WITH DIAGONAL WOODEN LATHS AND PLASTER FINISH	This paper reports the results of experimental and analytical investigations into the structural performance of bearing walls with diagonal wooden lath boards and plaster finish, which were frequently used in early modern Japanese wooden buildings. Full-scale tests were conducted on lathboard walls with a width of 50 mm, a clearance of 6 mm and attached to the wall body by nailing, confirming a high bearing capacity of about 6 times the wall magnification equivalent in Japan. Elemental tests on a single lath board were carried out and the results were used to estimate the structural performance of the full-scale wall. An analytical calculation model that takes into account the shear performance and deformation of the nails at the joints was used to estimate the initial stiffness and bearing capacity with good accuracy. It was also quantitatively shown that the plaster finish contributes to the stiffness and bearing capacity increase in the early stages of deformation.	Naoyuki	Matsumoto	Tohoku University
1B	TESP - Architectural	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Architectural Focus	STATIC LOADING TESTS OF THE SINGLE-STORY CLT ROCKING SHEAR WALL STRUCTURE	We propose a structural system utilizing cost-effective residential hardware instead of the expensive, high-performance hardware typically employed in contemporary CLT panel construction methods. This system is designed to ensure no damage under moderate seismic events while relying on restoring forces to resist collapse during massive seismic events. This study aims to obtain fundamental insights into the lateral resisting mechanism, collapse limits. To this end, a single-story full-scale CLT building equipped with existing residential hardware was subjected to deformation exceeding 1/3 rad. The experimental results confirmed the addition of lateral resistance by hardware, a consistent negative slope of elastic restoring forces, and collapse limit displacement of over 910mm. Furthermore, it was observed that rocking behavior caused the weight concentration on the CLT walls. These findings were verified by numerical analysis.	So	Momose	Kyoto University
1B	TESP - Architectural	Timber Engineering & Structural Performance - Architectural Focus	Study on effective of controlled wooden houses based on energy balance	In this study analyzes a typical wooden house with added hystertic dampers as lumped mass system and discusses the effectiveness and design methods of vibration control devices using cumulative plastic deformation, ductility and equivalent loading coefficient. The analysis models are a typical 1-3 story ZHE wooden house. The parameters are include the number of storys, seismic elements, damper yield displacement and ratio for the structure, as well as the input earthquake and number of repeated earthquakes.The input waves are the 6 earthqukake. The n significantly decrease when the number of repeated earthquakes from 1 to 2, however no significant decrease was observed from 2 to 3. The n of epicental earthquake KobeNS, has a tendency to small.	Mai	Kunikyo	Sugiyama Jogakuen University
1B	TESP - Architectural	Timber Engineering & Structural Performance - Architectural Focus	Concept to Construction: Co-Design and Integrative Development Processes for the IntCDC Multi-Story Timber Building System	In the context of the climate crisis and increasing urbanization, there is an urgent necessity to expand the typological possibilities in timber construction. Wide-span, point-supported timber systems for multi-story buildings offer the potential to substitute CO_2-intensive construction materials such as concrete and steel, utilize buildings as carbon sinks, and provide additional qualitative living and working spaces in urban areas. The development and incremental refinement of bespoke systems from initial conceptualization to technical feasibility and regulatory approval require the integration and coordination of comprehensive expert knowledge. A highly integrative approach and interdisciplinary exchange of expert knowledge within the research team, as well as iterative and reciprocal expert knowledge exchange with innovative stakeholders from the construction industry, are imperative. This paper presents the development of a co-design framework for the IntCDC Multi-Story Timber Building System (MSTBS), which facilitates reciprocal and iterative knowledge exchange within the interdisciplinary core research team, as well as between researchers and stakeholders from the construction industry. The research demonstrates how an organizational co-design framework fosters the methodical collaboration between research and industry partners and enables the development of a novel timber building system, contributing to the transition towards more sustainable building practices.	Simon Lorenz	Treml Riedel	University of Stuttgart; Institute for Computational Design and Construction
1B	TESP - Architectural	Timber Engineering & Structural Performance - Architectural Focus	MUSASHINO UNIVERSITY SCHOOL GYMNASIUM: DESIGN AND TESTING OF A TIMBER-STEEL HYBRID BEAM STRING STRUCTURE	This paper discusses the design and construction of the gymnasium at Musashino University's Musashino Campus in Tokyo, Japan. The project integrates a hybrid section combining steel and European redwood, addressing the need to blend the building harmoniously with the campus's lush greenery. A key design challenge was to incorporate wood as a significant structural element while adhering to Japan's stringent fire regulations. The solution involved a T-shaped steel section with a timber sandwich, preventing steel web buckling and achieving superior structural performance. Approximately 50 cubic meters of timber were used, enhancing both the aesthetic appeal and the environmental sustainability of the project. The hybrid approach allowed the beam string structure to meet design load requirements effectively. Full-scale testing confirmed the structural integrity and load-bearing capacity of the hybrid section, matching those of a full steel section.	Nicolas	Giron	Nikken Sekkei Ltd

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1B	TESP - Architectural	Timber Engineering & Structural Performance - Architectural Focus, Education, Innovation & Challengers - Engineering Focus, Education, Innovation & Challengers - Architectural Focus	HygroShell – Material Programming for in-situ self-shaping timber construction	While curved, surface active shell structures are well known for their structural performance and material efficiency, construction is typically from amorphous materials such as concrete and steel that can be shaped onto elaborate onsite curved formworks. The HygroShell demonstrates an alternative approach, generating curved surface geometry through the natural hydromorphic, anisotropic shrinking and swelling of wood. Flat pack, cross ply, bilayer components are manufactured with programed arrangements of boards based on wood moisture content and fiber orientations with the weather proofing and shingle cladding applied in the flat configuration. With the shape encoded into the flat components they are wrapped and transported to the site. Once positioned and opened, the wings of the components slowly unfurl autonomously through air drying. The components interlock forming a rigid shell structure spanning 10 meters with a structural thickness of just 28 mm. By deploying self-shaping in the construction of the shell, extensive formwork is avoided while simultaneously reducing the amount of kiln	Dylan	Wood	University of Oregon
1C	TESP/TABD - Engineering - Shearwalls & Panels / Structrual Behaviour	Session Chair: DR LISA OTTENHAUS / THE UNIVERSITY OF QUEENSLAND					
1C	TESP/TABD - Engineering - Shearwalls & Panels / Structrual Behaviour	Timber Engineering & Structural Performance - Engineering Focus	Dynamic and long-term performance of friction-based connectors with wooden dowels	Shear walls in wood construction typically exhibit pinched hysteresis loop resulting in limited energy absorption, which is important for seismic performance. Thus, in order to develop a connection with high energy absorption using wood friction, shake table tests of a shear wall with friction-base connectors were conducted. To evaluate a long-term performance of the wood clamping force that generates the frictional force in an analytical model, coefficients related to pure creep and mechano-sorptive creep, which are required in the model, were obtained. Using these coefficients, the loss of wood clamping force under temperature and humidity fluctuations was evaluated by the analytical model. This paper presents the results of these tests and analyses.	Yoshiaki	Wakashima	Toyama Prefectural Agricultural, Forestry and Fisheries Research Center
1C	TESP/TABD - Engineering - Shearwalls & Panels / Structrual Behaviour	Timber Engineering & Structural Performance - Engineering Focus	INVESTIGATING THE MECHANICAL BEHAVIOUR OF MULTI-PANEL BALLON-TYPE CLT SHEARWALLS THROUGH FULL-SCALE TESTS	Balloon-type Cross-Laminated Timber (CLT) shearwall systems are widely used in construction due to its ability to overcome issues associated with perpendicular-to-grain compression failure and vertical shrinkage typically encountered in platform-type shearwall construction. Despite its widespread use and ease of assembly, research on this system is limited, and current timber codes lack specific design provisions. This paper presents an experimental study of the mechanical behavior of multi-panel balloon-type CLT shearwalls, where effects of variables such as panel aspect ratios, connection stiffness, and number of panels are investigated.	Ghasan	Doudak	The University of Ottawa
1C	TESP/TABD - Engineering - Shearwalls & Panels / Structrual Behaviour	Timber Engineering & Structural Performance - Engineering Focus	Optimized lumber arrangement in NLT subject to in-plane shear force	Nail-Laminated Timber (NLT) is a wooden panel utilizing lumbers fastened with nails, traditionally used in Canada and the United States. Despite its widespread use, the effects of lumber grade, length, placement, and nail stiffness on structural performance during in-plane deformation is not well understood. This study employs numerical analysis to investigate the effect of member arrangement on the structural performance of NLT panels, particularly for a continuous wall. The analysis focused on optimized lumber arrangement to improve shear stiffness while reducing material usage. The results show that some arrangements provide shear stiffness more efficiently than full-volume walls. Additionally, the lumber arrangement evolves into a diamond shape as the volume decreases, with each side functioning like a brace. This study provides insights into more economical and structurally efficient NLT panel designs.	Yuki	Takahashi	Tokyo University of Science
1C	TESP/TABD - Engineering - Shearwalls & Panels / Structrual Behaviour	Timber Engineering & Structural Performance - Engineering Focus	DEVELOPMENT OF OVERSTRENGHT FACTORS FOR MULTI-PANEL CLT SHEARWALLS BASED ON PANEL-TO-PANEL CONNECTIONS	This study presents the results of a study with the aim to develop overstrength factors for multi-panel CLT shearwalls. A new hierarchy of failure has been introduced in the new edition of the Canadian Engineering Design in Wood (CSA O86) standard, in which dissipative and non-dissipative components are required to be designed based on the strength variation of the panel-to-panel vertical joint connections. Experimental results from three monotonic and ten cyclic tests on spline-joint for various connections typically used as vertical joints and stemming from different manufacturers will be presented. A framework for the development of overstrength factors based on the experimental results will be discussed in the full-length paper.	Antoine	Bérubé	University of Ottawa
1C	TESP/TABD - Engineering - Shearwalls & Panels / Structrual Behaviour	Timber Engineering & Structural Performance - Engineering Focus	MECHANICAL PROPERTIES AND FAILURE CRITERIA OF WOOD UNDER COMBINED NORMAL-SHEAR LOADING	In this study, combined normal-shear behaviors of six type of specimens were conducted. An auxiliary device was designed and equipped to testing machine to help achieving combined normal-shear loading. Failure modes, and shear stress-strain curves under different normal stresses were obtained. The applicability of several commonly used orthotropic strength criteria including Hill, Tsai-Hill, Tsai-Wu, Hoffman, et al. to predict the combined tension/compression and longitudinal shear failure were systematically assessed according to test data from the experiment as well as existing literature. Results indicated that normal stress greatly affects the shear failure mode and performance. The best applicable normal stress ranges of the examined failure criteria were confirmed.	LI-PENG	ZHANG	Xi'an University of Architecture and Technology
1C	TESP/TABD - Engineering - Shearwalls & Panels / Structrual Behaviour	Timber Engineering & Structural Performance - Engineering Focus	Development of GIR system Improved on-site workability	In this study, moment resistance experiments on joints of four-story rigid-frame building as the new GIR joint system are carried out. This specimen showed yield behavior at a rotation angle of 1/50 radian and did not break even at a rotation angle of 1/15 radian. These results indicate that the toughness connectors did not rupture and exhibited high structural performance even use the cast iron cubes. The experiments on other types of joints, such as column-foundation joints, cross-shaped joints, and L-shaped joints will be carried out.	YUTA	MORI	Oita Univ.
1C	TESP/TABD - Engineering - Shearwalls & Panels / Structrual Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Timber Architecture & Biophilic Design - Engineering Focus	Validation of Empirical Models and Simplified Testing Approach for Predicting Pull-out Strength of Glued-in Rods in Japanese Larch Timber	This paper investigates the validity of existing regression equations for predicting the pull-out strength of Glued-in Rods (GiR) in Japanese larch timber and explores a simplified testing approach based on the GIROD model. Key points of the research: 1. Tested various rod diameters (16mm, 19mm, and 24mm) and anchorage lengths (200mm, 300mm, and 400mm) for GiR specimens. 2. Aims to verify if existing regression models are applicable to Japanese larch GiR 3. Conducted small glued wood block shear tests to determine bond layer properties for the GIROD model and assess whether simplified shear tests can accurately predict GiR strength . The paper mentions several existing empirical models for predicting GiR strength, including those by Riberholt, Gerold, and Rossignon. The GIROD model, based on Gustafsson's "Generalized Volkersen theory," is also introduced as an analytical approach. The study used Japanese larch glued-laminate timber with threaded rods bonded using two-component epoxy adhesive. Pull-out tests were conducted at a loading rate of 2 mm/min. Small glued wood block shear tests were performed according to the KS F 2209 test method to calculate shear strength and fracture energy of the bond layer for the GIROD model.	Gwang-Ryul	Lee	Seoul National University

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1C	TESP/TABD - Engineering - Shearwalls & Panels / Structrual Behaviour	Timber Architecture & Biophilic Design - Engineering Focus, Timber Architecture & Biophilic Design - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	Think in concrete but build in wood - Modern Living with Sustainability and TS3 technology	The example of the Zelgstrasse Uster development shows that even after the contract for the construction of a residential building in concrete has been awarded, it is possible to "plan in concrete but build in wood" by using TS3 technology and involving all parties. The TS3 technology shows how it is possible to switch from concrete to timber, thus making an important contribution to climate change. It shows the organisation, logistics and quality assurance on a large construction site and the positive impact on the CO2 balance compared to building in wood instead of concrete. This project is an impressive example of how sustainability and innovative construction technologies can go hand in hand.	Stefan	Zoellig	Timbatec Timber Engineers International AG
1D	TESP / MPD / STCE - Engineering - Seismic	Session Chair: CARMEN SANDHAAS / KARLSRUHE INSTITUTE OF TECHNOLOGY					
1D	TESP / MPD / STCE - Engineering - Seismic	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Experimental Study and Finite Element Analysis of Racking Resistance subjected to varied mortise-tenon joints and wedge configurations	This study is about invetiagating racking resistance of column-Nuki joints in tradtional timber structure with varied types of mortise-tenon joint and wedge configuration, cross-shaped specimens were assembled for lateral reciprocating static tests. In order to develop a systematic evalution method on aseismic performance of varied column-Nuki joints, 3-D nonlinear finite element model of each specimen was established respectively to verify the applicability of finite element analysis, and realized accurate prediction on racking resistance by quantitatively comparing simulations with corresponding experimental results such as initial stiffness and bearing capacity.	CHEN	Jiuzhang	0
1D	TESP / MPD / STCE - Engineering - Seismic	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	COMPARISON OF CYCLIC LOADING PROTOCOLS AND CYCLIC BENDING PERFORMANCES OF SELF-TAPPING SCREWS	Load-displacement behavior of joints against cyclic loading is important especially for seismic area. There are several kinds of standards for fastener bending test and joint shear test, but the relationship between them is unclear. In this study, we investigated the relationship between joint testing methods and repeated bending testing methods. Cyclic shear test with full thread screw and cyclic bending test of the screw under the same loading protocols were conducted. Failure lifetime of the screw was estimated using cyclic bending parameters obtained form cyclic bending test. Estimated failure lifetime showed good agreement with the hysteresis bending test and joint test results.	Kenji	Kobayashi	The University of Tokyo
1D	TESP / MPD / STCE - Engineering - Seismic	Sustainability and Timber in a Circular Economy - Engineering Focus	COMPARISON OF A SEISMIC DESIGN OF A 10-STORY ALL TIMBER BUILDING AND OF A 10-STOREY HYBRID STEEL-FRAME CLT FLOORS BUILDING USING RESILIENT TECHNOLOGY	Environmental awareness is a major challenge for our generations, especially in the construction sector which is notorious for its polluting impact. This awareness is stimulating the development of new construction techniques in which the optimization of materials is a priority. Concrete stands out for its excellent resistance to compression, water, and heat, while steel offers advantageous properties in compression and tension. At the same time, timber, and its derivatives, such as CLT, are emerging as credible alternatives to concrete in certain situations. By combining these materials, we can exploit advantages of each, developing composite structure. However, a major challenge in construction is the safety of occupants and their surroundings, especially in the face of hazards such as earthquakes The aim of this document is to demonstrate the differences in outcomes when constructing a multi-story building either constructed entirely of timber or combining steel and CLT, and both using resilient seismic technology in earthquake-prone zones in Europe. To achieve that, a case study prototype building was conducted using resilient braces as the lateral load resisting members. The seismic analysis consisted in performing a lateral forces analysis, a pushover and a nonlinear time history analysis following European standards. This paper shows the design outcomes, particularly the amount of timber and steel used, the amount of carbon emissions and the overall structural performance for	Pierre	Quenneville	The University of Auckland
1D	TESP / MPD / STCE - Engineering - Seismic	Timber Engineering & Structural Performance - Engineering Focus	Applicability of mid-rise timber structures in the metropolitan area	To advance the goal of a zero-carbon society, promoting the use of wood in building construction is increasingly recognized as a viable solution. Current efforts are directed towards enabling medium to high-rise and large-scale timber buildings. This study aims to evaluate the applicability of steel and timber rigid frame, which offer greater spatial flexibility, in terms of their structural performance and environmental sustainability in urban areas. In this paper, the seismic performance of steel and timber structures is presented and compared by eigenvalue analysis, static incremental analysis, and time history analysis. At the same time, the two models are also used to compare carbon dioxide emissions.	Chia-Lung	Yeh	Kyushu University
1D	TESP / MPD / STCE - Engineering - Seismic	Timber Engineering & Structural Performance - Engineering Focus	Investigation of undesirable brittle failure observed in high-capacity shear walls	The building height limit for light wood-frame construction has been increased from four to six stories in 2015 National Building Code of Canada. In addition, the seismic design spectra in the 2020 NBCC has increased substantially for all site classes. These increases in building height and seismic loads have raised the demand for a stronger shear wall system for construction of midrise wood-frame buildings, especially for those located in high seismic zones. To respond to the demand for higher strength shear wall systems, a new high-capacity shear wall system with multiple rows of nails along sheathing edges has been jointly developed by FPInnovations and the University of Victoria. Shear walls with two and three rows of nails along sheathing edges were designed and tested in 2020, 2021 and 2022. In this paper, test results of high-capacity shear walls conducted in previous years were summarized. Brittle failure modes observed in previous test programs were investigated and causes for these brittle failure modes were discussed. New construction details for high-capacity shear walls to prevent these undesirable brittle failures were recommended	Ruite	Qiang	University of Victoria
1D	TESP / MPD / STCE - Engineering - Seismic	Timber Engineering & Structural Performance - Engineering Focus	CASE STUDY: SEISMIC AND GRAVITATIONAL DESIGN OF 15-STORY OFFICE AND RESIDENTIAL BUILDING ARCHETYPES WITH A SEMI-RIGID CLT DIAPHRAGM AND REINFORCED CONCRETE SHEAR WALLS IN CHILE	This study is part of the "Ciudad Madera" technological consortium, which seeks to promote widespread wood construction in Chile, whose seismic code provides no guidance for cross-laminated-timber (CLT) seismic diaphragms. Currently, this lack of a design methodology for Hybrid Mass-Timber–Reinforced-Concrete (HMT-RC) buildings, has pushed a tendency for structural designers to solely rely on the concrete topping as the seismic horizontal diaphragm element. This study validates HMT – RC and develops a seismic-design method for buildings up to 15 stories high, with CLT floor system performing as the seismic diaphragm. Twenty monotonic/cyclic connector tests and six full-scale 4 m × 4 m Radiata-pine CLT diaphragm tests will calibrate nonlinear models of office and residential building archetypes, analyzed in a 72-case parametric matrix (height, seismic zone, soil class, design philosophy). Findings show: (i) RC-core and coupling-beam detailing governs drift, (ii) flooring size is controlled by a vibration criterion, and (iii) commercial timber column-to-column splices meet seismic inter-story rotation demands	Jairo Alonso	Montaño Castañeda	Centro Nacional de Excelencia para la Industria de la Madera (CENAMAD-CIM UC)

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
1D	TESP / MPD / STCE - Engineering - Seismic	Timber Engineering & Structural Performance - Engineering Focus	A STUDY ON THE COLLAPSE LIMIT OF CLT PANEL CONSTRUCTION BASED ON STATIC LATERAL LOADING TESTS	There is no example of seismic collapsing behaviour of CLT panel constructions in past earthquakes and shake table tests even in Japan as a high seismic area, leading true collapse limit still unknown. It causes the seismic design standard in Japan probably too conservative. In-plane stiffness and strength of CLT walls are generally larger than the other wooden walls, and the gravitational restoring force from wall rocking is also larger. Therefore, the collapse limit deformation of CLT constructions is expected large. In this paper, based on static lateral loading tests of 2-story models, the lateral load carrying capacity under large deformation, and its causal factors are examined. As results, it is confirmed that the ultimate story drift angle of the test models is 1/4.0-1/3.3rad, indicating the probability of escaping collapse against sever seismic motion. And the restoring force in the region of large deformation mainly depends on tensile resistance of orthogonal walls and moment resistance of lintel-wall connections. These knowledges are useful for optimization of the seismic design standard of CLT panel constructions in the future.	Tatsuya	Miyake	Nihon System Sekkei Architects & Engineers
1E	TESP Engineering Fire Engineering	Session Chair: A/PROF DAVID LANGE / THE UNIVERSITY OF QUEENSLAND					
1E	TESP Engineering Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	SIMPLIFIED ENGINEERING METHOD TO ESTABLISH STRUCTAL ADEQUACY OF MASS TIMBER COLUMNS FOR FULL FIRE DURATION	Data from mass timber research has shown that thermal penetration continues into a load-bearing member well after peak temperatures from fire exposure are reached. Using results from the CodeRed series of experiments, the authors have developed an engineering methodology to assess the impact of thermal penetration on structural adequacy during fire growth and decay, for an exposed mass timber column. The methodology specifically addresses the thermal degradation of strength and stiffness that occurs in-depth behind the char layer. Columns are particularly vulnerable given the potential of four-sided exposure and compressive strength parallel to the grain reducing substantially and irreversibly at temperatures over 140ºC, a relatively low temperature in the context of fire exposure. The results show that where the thermally impacted timber is included in the assessment of structural adequacy, the load-bearing resistance of a column is much reduced when compared with the calculated resistance of a column using just char depth and a zero-strength layer. This is of concern for current engineering design of high-rise mass timber buildings and when an assessment of structural adequacy is based on char depth at the time of cessation of flaming.	David	Barber	Arup
1E	TESP Engineering Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	SOLID TEMPERATURE PREDICTION FOR CLT WALLS IN FIRE USING SUPERVISED MACHINE LEARNING	Machine learning (ML) tools have proven valuable in predicting the fire behaviour of structural elements, including timber elements, under standard fire conditions, but limited ML analysis is available for structural timber elements under non-standard fire exposure. The study explored the viability of using ML models to predict in-solid temperatures over time and depth in structural timber elements, specifically axially loaded cross-laminated timber (CLT) walls. The study compared two supervised ML approaches: time-series forecasting and symbolic regression. The dataset used in the study was comprehensive, including 7 variables for each test. These variables covered a range of factors, including time, adhesive type, number of layers, heat flux, thickness, thermocouple depth, and temperature. Symbolic regression emerged as the superior method, offering a promising future for using simpler models in predicting in-solid temperatures of timber in fire.	Arwa	Abougharib	Department of Wood Science, Faculty of Forestry, University of British Columbia
1E	TESP Engineering Fire Engineering	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Temperature dependent bending mechanical properties of densified wood	Thermo-hydro-mechanical (THM) densified wood is rarely used in construction, although its mechanical properties are excellent in many cases [1]. The reason behind its rare use is not only due to its set-recovery, which reduces the degree of densification over time thereby the mechanical properties deteriorate, but also our knowledge of the fire-performance of densified timber is insufficient. For wood products, the inherent combustibility is always the main challenge which restrict its role in construction applications [2]. Therefore, the implementation of engineering modification processes to improve wood with regards to durability or other properties should not overlook how these processes influence the fire safety. In terms of fire safety classifications in wooden constructions, "reaction to fire" (EN13501-1) and "fire resistance" (EN 13501-2) are the two main test standards used in the European Union [3]. When subjected to elevated temperatures, wood surface will be thermally degraded into zero-strength charred layer and the mechanical properties of beneath unburned pyrolysis zone also monotonously decrease with the increase in temperature. Therefore, the reduced cross-section method is normally adopted in the fire design of timber structural elements to estimate the residue load-bearing capacity and fire resistance [3]. It should be kept in mind that wood starts to lose its strength and stiffness at temperature as low as 65°C. According to Eurocode 5, when the temperature of the wood rose from 50°C to 100 °C, its tension, shear and compression strength parallel to grain will only be about 65%, 40%, and 25% of its original value respectively. The continued penetration of the heat inside the timber construction elements may result in additional hazard in the cooling phase of a fire due to such mechanical properties loss.Knowledge of the temperature-dependent reduction behavior of strength and stiffness properties is an important precondition for determination of the resistance of wood construction in-fire and post-fire. The unexplored potential high mechanical properties of densified wood at elevated temperature could provide extra residue load-	Lei	Han	InnoRenew CoE
1E	TESP Engineering Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	Structural Design of Timber Columns in Realistic Fires	This paper describes numerical modelling to predict the strength of glued laminated (glulam) timber columns during and after fire exposure. This modelling is necessary because of the thermal wave propagation beyond the charred depth in the decay phase of the fire. The elevated temperatures inside a column will reduce the strength and stiffness, potentially causing the column to buckle under compression loads even after the fire has been extinguished. The literature contains results of experimental testing and numerical modelling of various timber columns, and the research highlights the importance and suitability of numerical models such as SAFIR for simulating the changes in heat transfer and residual structural capacity. This paper focuses on the simulated fire performance of non-encapsulated free-standing glulam timber columns using the SAFIR software, with a sensitivity analysis on design variables relating to the growth and decay phases of a parametric fire. This paper describes the analysis and design process for a typical mass timber building. Such a process is a possible path for compliance with Clause B1 of the New Zealand Building Code, to obtain a Building Consent from the local authority, following guidance in the New Zealand Commentary to the FSUW Global Design Guide.	Cameron	Douglas	PTL | Structural & Fire

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
1E	TESP Engineering Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	New Encapsulation Technique for Strengthening and Enhanced Fire Resistance of Mass Timber Structural Elements	The rising use of mass timber in tall wood construction necessitates effective fire safety measures and strategies. This study introduces a new encapsulation technique for mass timber sections using a fabric-reinforced cementitious matrix (FRCM) composite system with enhanced thermal insulation and fire resistance. Mortar mixes incorporating Portland cement, aerated Portland cement, Portland-slag blended cement, and aerated Portland-slag blended cement are thoroughly investigated for this new FRCM system. Compressive strength tests have been conducted on the different mixes to evaluate their mechanical properties. Preliminary results indicate the potential of selected mixes to meet the target strength criteria of 24 MPa at 28 days of moist curing as per ACI guidelines (AC 434). Thermal conductivity analysis and high-temperature compressive strength testing are conducted to identify a low thermal conductivity mix (targeting < 0.3 W/m·K) with high strength retention at elevated temperatures. Upon exposing FRCM-encapsulated glulam columns to standard fire, the encapsulation and fire-resistance ratings are evaluated. The experimental results demonstrate that the FRCM systems, particularly those using aerated Portland cement, Portland-slag blended cement, and aerated Portland-slag blended cement, significantly delay the ignition of the glulam columns. This delay provides superior fire resistance and structural integrity for a longer duration. The potential of the proposed FRCM systems in enhancing mass timber elements' fire safety and structural resilience is significant, potentially enabling their broader adoption in high-rise building construction.	Sam	Salem	Lakehead University
1E	TESP Engineering Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	Fire Endurance Tests on Optimized CLT-Concrete Composite Floor Slabs with Individual Notch Shear Connections	Although CLT-concrete composite floors with shear connections demonstrate enhanced flexural performance in fire conditions, achieving optimal flexural efficiency across serviceability, ultimate, and fire limit states remains a significant challenge. Placing an interlayer between the CLT slab and the top concrete layer, such as an insulation layer, not only enhances the thermal and acoustic characteristics of such composite floor systems but also increases their strength and stiffness by providing a more extended lever arm for their resisting moment. Unlike shear connections mainly made of metal fasteners, notch shear connections can easily accommodate such an interlayer without compromising the composite section's efficiency and are renowned for their robustness and cost-effectiveness. This paper presents the results of fire endurance tests on two full-size, one-way CLT-concrete composite floor slabs exposed to elevated temperatures conforming to the CAN/ULC-S101 standard time-temperature curves while subjected to a total service load of 9.80 kPa. The obtained experimental results demonstrate the high flexural efficiency of the CLT-concrete composite slabs with the two proposed configurations of individual notch shear connections with an interlayer of insulation. Both test slabs successfully enhanced the fire resistance of the 143-mm, 5-ply CLT floor panel from one to two hours with increased service loads from 4.40 to 9.80 kPa.	Sam	Salem	Lakehead University
1E	TESP Engineering Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	CASE STUDY OF ENGINEERING THERMAL AND STRUCTURAL ANALYSIS OF TIMBER IN OFFICE TRAVELLING FIRE – FIRE DYNAMICS SIMULATOR AND SAFIR	This work presents a case study of traveling fire in an office containing exposed timber. The fire performance of a composite timber-concrete floor system is evaluated in terms of heat impact, flame spread and heat release contribution. Real fire scenarios were implemented for determining the heat impact on the exposed wooden surfaces using computational fluid dynamics. An engineering pyrolysis model allowed for determining the combustible material heat release contribution to the fire, as well as its charring, which is directly related to its loss in structural performance. Different fire scenarios and different configurations of the wood/concrete system, representing different levels of combustible surface exposure were compared in terms of the calculated flammability quantities.	Alain	Coimbra	CSTB
1E	TESP Engineering Fire Engineering	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	COMPARING IN-DEPTH TEMPERATURE MEASUREMENT TECHNIQUES IN LARGE-SCALE TIMBER FIRE EXPERIMENTS	Large-scale timber fire experiments commonly utilize solid-phase thermocouples inserted from the 'back' of the timber elements, perpendicular to the heated surface, to estimate charring rates and characterise the heat transfer through the section. This thermocouple orientation can induce significant measurement errors, but it is often chosen due to the difficulty of inserting thermocouples from the 'side' in large panels. This paper investigates an alternative method of inserting thermocouples parallel to the heated surface in instrumented timber cylinders, which can be inserted into larger panels. This method was applied in a large-scale timber compartment fire experiment and compared with measurements from thermocouples inserted from the back. Thermocouples inserted from the back initially underpredicted the charring rate and in-depth temperature rise, but this error decreased over time. By minimising the thermal disturbance error, the instrumented cylinders provide more accurate temperature measurements during the early heating phase, but over time, they can induce other errors unless they are specifically designed to avoid this.	Ian	Pope	DBI - The Danish Institute of Fire and Security Technology
1F	TESP / MPD - Engineering - Digital Imaging Correlation	Session Chair: PROFESSOR LECH MUSZYNSKI / OREGON STATE UNIVERSITY					
1F	TESP / MPD - Engineering - Digital Imaging Correlation	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Derivation of shear modulus of the RPF adhesive layer in block shear tests using Digital Image Correlation	In order accurately to evaluate the strength of wood-based materials, not only the physical properties of wood but also the shear performance of the adhesive layer are important. However, since the adhesive layer is much thinner than the element, it has been difficult to observe the behavior of the adhesive layer. On the other hand, recent developments in optical and image processing technologies made a non-contact strain measurement method called Digital Image Correlation (DIC) more familiar. DIC is a measurement technique using a camera and it is possible to measure strain in small areas such as the adhesive layer, depending on the camera performance. Therefore, the purpose of this study was to determine the shear modulus of the adhesive layer of a block shear specimen by measuring the shear strain of the adhesive layer using DIC. The specimens were made from three types of softwoods (Japanese cedar, Japanese cypress, Japanese larch) and resorcinol phenol formaldehyde (RPF) resin adhesive. The laminas were divided into two parts along the LT surface, and the cut surfaces were glued together using RPF to prepare the specimens. Specimens without the adhesive layer were also machined from the same lamina, and the effect of the adhesive layer on the shear modulus was considered. The test results showed that there was no significant difference in shear modulus between glued and unglued specimens of either species. One possible reason for this phenomenon is that the shear modulus of RPF adhesive may be similar to that of wood. However, since little is known about the shear modulus of RPF itself, further research is needed. Conversely, when Japanese cedar and Japanese larch were used, the coefficients of variation (C.V.) of the shear modulus for glued specimens were smaller than unglued specimens.	Koki	Kawano	Forestry and Forest Products Research Institute

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
1F	TESP / MPD - Engineering - Digital Imaging Correlation	Timber Engineering & Structural Performance - Engineering Focus	Wood based fasteners for a timber earth slab	One method of constructing timber-earth slabs involves using small timber cross-sections with interstitial spaces filled with an earth mix. The earth enhances construction physics properties and naturally regulate indoor climate, while the timber structure carries the loads. Local mechanical connections are employed to facilitate geometrically unrestricted robotic manufacturing and potential material reuse. This study investigates the efficacy of beech nails, staples (each with and without adhesive), and beech dowels as fasteners. Conventional bonded intersections serve as the reference. Push-out tests were conducted on specimens featuring two shear joints each. Displacement transducers and digital image recording capture relative displacement while the forces at each shear joint are measured. The fracture failure is analyzed photographically. For small intersections, nail-bonded connections promise high stiffness and load bearing values combined with robotic manufacturing, although reuse is limited.	Dominik	Merk	Technical University of Munich
1F	TESP / MPD - Engineering - Digital Imaging Correlation	Timber Engineering & Structural Performance - Engineering Focus	Understanding the Effect of Lamination Thickness Variations on Bond Integrity in Cross-Laminated Timber (CLT)	Integrity of the adhesive bond is an imperative criterion for qualifying layered engineered wood-based composites (EWP) for structural use. In cross laminated timber (CLT) even moderate variations in lamination thickness within the same layer can significantly affect the pressure distribution at the intersections of laminations, this study aims to address the strict criteria set by the North American CLT product performance standard ANSI/APA PRG320, which are not yet supported by theoretical or experimental data. By employing Digital Image Correlation (DIC) techniques, the goal of this study is to determine the effect of thickness variation in CLT laminations on bond formation and the resulting integrity in CLT lay-up while also addressing a critical knowledge gap regarding the fundamental aspects of cross-laminated panel construction, ultimately providing valuable insights for CLT manufacturers. The approach in this study involves the use of empirical tests and coupled with numerical modelling. The specific objectives were to (1) determine the effect of thickness variation in adjacent lamination on pressure transfer and adhesive bond formation between layers (2) measurement of adhesive bond integrity distribution in lab specimens with known thickness variation, (3) determination of structural performance in panels fabricated with lamella of known thickness tolerance. The research expects that CLT with tight thickness tolerance have a better pressure transfer and bond integrity.	Samson M.	Idoghor	OREGON STATE UNIVERSITY
1F	TESP / MPD - Engineering - Digital Imaging Correlation	Timber Engineering & Structural Performance - Engineering Focus	Enhancing the Racking Resistance of Timber Shear Walls with Structural Glass: An Experimental and Computational Study	This work analyses the behaviour of structural timber-glass wall elements by carrying out experimental shear wall tests and calibrating a finite element model. Hybrid timber-glass wall elements are a novel structural solution to increase the in-plane stiffness of façades in timber frame buildings. The solution is particularly interesting when large glass façades are desired in buildings with fewer inner structural walls. Therefore, this study investigates a hybrid system that activates the stiffness of the glass windows, using a structural silicone adhesive, to increase the structural stability of the timber façade. For these timber-glass systems, no existing design codes are applicable. A finite element model is developed in this contribution, simulating the mechanical behaviour of the system, including the timber-glass connections. This model is calibrated using small-scale connection tests. Additionally, eight shear experiments are performed on timber-glass façade elements to evaluate the strength and stiffness of the system. The behaviour of the various materials and connections is precisely captured using multiple measurement techniques, including Fibre Bragg Gratings embedded in the glass panes, Digital Image Correlation, and strain gauges. The experimental results are compared to the numerical model to assess its suitability.	Tine	Engelen	Hasselt University
1F	TESP / MPD - Engineering - Digital Imaging Correlation	Timber Engineering & Structural Performance - Engineering Focus	INFLUENCE OF KNOTS ON STRAIN DISTRIBUTIONS IN GLUED LAMINATED TIMBER BEAMS	A glued laminated timber (GLT) beam is an engineered wood product made by gluing finger-jointed timber boards (lamellae) to create structural elements for various construction applications. The mechanical properties of GLT beams depend significantly on the mechanical properties of the timber boards and local defects, such as knots. This paper examines the influence of knots on the mechanical behavior (strain distributions) of GLT beams. Twenty-two GLT beams (5 m long) were tested in four-point bending. Strains were measured in the constant bending moment region of the beams using the digital image correlation (DIC) method. The effect of knots on the longitudinal and the transversal strain distributions is investigated. The paper focuses on the knots and their interactions that cause significant strain concentrations extending to adjacent lamellae. Moreover, the ratio between the transversal and the longitudinal strains in the knot zones is studied.	Farid	Vafadar	Aalto University
1F	TESP / MPD - Engineering - Digital Imaging Correlation	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	FRICTIONAL CHARACTERISTICS OF THE SURFACE OF HINOKI OLD WOOD TAKEN FROM JAPANESE TRADITIONAL WOODEN BUILDINGS IN THE LATE EDO PERIOD	In this study, friction tests were conducted using two methods: the sliding method and the horizontal method. The aim was to determine the actual friction coefficient of old and new hinoki wood taken from a traditional wooden building built about 350 years ago and to clarify the surface characteristics. The results showed that the surface friction coefficient of the old wood was 0.57, while that of the new wood was 0.43, indicating that the old wood had a coefficient 1.33 times higher. Scanning electron microscope (SEM) images were also taken to observe the morphology, fine irregularities, and dents of the wood surface. The surface of the old wood was more irregular than that of the new wood, and degradation and fluff of the cell walls were observed. This suggests that the degradation of the old wood may contribute to the increase in the surface friction coefficient.	JUNGYEON	HONG	Toyo University
1F	TESP / MPD - Engineering	Timber Engineering & Structural Performance - Engineering Focus	COMPRESSIVE STRENGTH AND STIFFNESS OF GLULAM IN CONTACT WITH MORTAR	In recent years, many kinds of timber-concrete composite components have been introduced in large-scale timber buildings. In the design process of these components, it is important to accurately evaluate the behavior of the contact surface between glulam in parallel to grain direction and concrete under compression. However, there is no established method to evaluate such behavior. This study investigates the compressive behavior of glulam in contact with several materials (steel plate, mortar, mortar with epoxy adhesive, and mortar with waterproof paint) near the butt-end and proposes an effect factor of the materials in contact with glulam. Compression tests were conducted on Fourteen series with a combination of parameters and a total of 108 specimens. The test results showed that, compared to the glulam-only specimens, the strength and the stiffness of the specimens in direct contact with mortar decreased, and those of the specimens with a waterproof layer between the mortar and glulam were almost the same. As for the specimens with an epoxy adhesive layer between the mortar and glulam, the strength and stiffness significantly increased. Our study revealed that, based on the results of the specimens with a waterproof layer, the reduction in the compressive strength and stiffness could be caused by moisture in the mortar and, the results of the specimens with an epoxy adhesive layer show that epoxy adhesive affects increasing stiffness. Future works include applying the rate of change to actual building design and proposing design methodologies.	Yuichi	Kanaya	Chiba University
1G	TESP - Engineering - modular construction	Session Chair: CALIL NETO / REWOOD					

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
1G	TESP - Engineering - modular construction	Timber Engineering & Structural Performance - Engineering Focus	SUSTAINABLE AND TEMPORARY USE OF VACANT BUILDINGS AND SITES THROUGH SIMPLE AND MODULAR STRUCTURAL MEASURES	Temporary uses increase the attractiveness of a location, generate added value for society and conserve the resource of building land. Thanks to a modular system developed by researchers at BFH, it will be possible to quickly and easily "furnish" vacant spaces and areas on a temporary basis. The modules consist of very light timber elements and layers as they must be mounted by hand by two persons only. Clever connections allow to erect, dismantle and adapt the modules for upcoming usages many times. A central component is a digital planning, fabrication and visualization tool. The conversion of vacant buildings and sites is of great importance to society. Such vacancies often hide great potential for temporary uses where innovative and dynamic work and creative spaces create new identities. Resources are further developed and sustainably valorized, leading to ecological, economic and social added value. In a first step house in house solutions are developed that may be adapted for outside applications. The scalable modular system offers a huge market potential for flexible structures for recurring uses such as (sports) events, emergency accommodation and temporary living in unused spaces. The goal of the project is to bring the modules to market maturity.	Christophe	Sigrist	BFH
1G	TESP - Engineering - modular construction	Timber Engineering & Structural Performance - Engineering Focus	COMPARATIVE STUDY OF CONVENTIONAL CONNECTIONS AND NOVEL INTERLOCKING CONNECTIONS IN CLT SHEAR WALLS	The study compares conventional and novel interlocking connections in Cross Laminated Timber (CLT) shear walls. CLT, popular for its environmental benefits and efficiency, faces challenges with traditional connections that are labor-intensive and mechanically limited. The new interlocking system simplifies construction, enhances reusability, and maintains mechanical integrity with less damage. Overall, the numerical shear wall analyses showed that this system offers better ductility in a damage-controlled manner, though lower stiffness was also found. This suggests that the interlocking connections improve robustness and sustainability in modular CLT constructions, while further geometric refinement is needed.	Zhengyao	Li	University of Leeds
1G	TESP - Engineering - modular construction	Timber Engineering & Structural Performance - Engineering Focus	A novel hybrid wooden structural system for multi-storey buildings in seismic prone areas	Timber structures have become a valuable alternative to traditional materials, mainly due to their light weight, speed of construction and the high strength-to-weight ratio of timber, especially in seismic prone areas. The use of timber structures, however, has been mainly confined to low to mid-rise buildings, mainly due to limited resistance of proprietary mechanical anchors. The HyWood4Buildings project aims to overcome the existing constraints in the timber sector, proposing a novel hybrid structural system for taller timber buildings. This system combines two distinct but interacting components: a modular hybrid steel-timber lateral load resisting (HyST-LaR) system and a solid-sawn wall (SoN-Wall) system. The HyST-LaR bracing system consists of a multi-storey steel frame coupled with CLT panels. HyST-LaR connections between the CLT panel and steel frame are subjected to shear load only, whereas the tensile load due to the cumulative bending moment of the shearwall is transferred directly to the foundation by the steel columns. Experimental shearwall tests and numerical analyses are being carried out in order to investigate the behaviour of HyWood4Buildings proposed systems.	Matilde	Benatti	National Research Council of Italy (CNR-IBE)
1G	TESP - Engineering - modular construction	Timber Engineering & Structural Performance - Engineering Focus	Advanced Seismic-Resilient Connection for Modular Mass Timber Structures	Recent studies conducted on a series of shake table test has revealed that CLT PMMT buildings constructed with prefabricated CLT panels are relatively stiff, and the connection between the prefabricated CLT panels solely provides the ductility and energy dissipation in the system. Additionally, the SOFIE project also reported a floor acceleration of 3.8g at the upper level (7th level) of the building due to the stiff nature of the building. Such high acceleration could lead to serious injuries and fatalities to the building occupants. Moreover, a quasi static experimental test on a two-story CLT house also revealed that ductility as high as 3.0 can be achieved with conventional connections. However, the reduction in stiffness and strength could compromise the system's structural integrity, making it vulnerable to aftershock. Nails and self-tapping screws with metal brackets is the most established method for wall-to-wall connections, while bolts and metal hold-downs are used to connect the walls to the floors in a Prefabricated Modular Mass Timber (PMMT) construction. However, these conventional connection methods have a significant drawback. When subjected to lateral loads during seismic events, the connections have to yield to dissipate the earthquake-induced energy and provide the necessary ductility in the system. The yielding of the metal connections exhibits considerable strength and stiffness degradation. This irreversible damage conflicts with the principles of seismic resilience, which aim to minimize post-earthquake repair and downtime. The current connection systems, therefore, fall short of achieving true seismic resilience in PMMT buildings.	Rajnil	Lal	The University of Auckland
1G	TESP - Engineering - modular construction	Timber Engineering & Structural Performance - Engineering Focus	Vibration Response of Cross-Laminated Timber-Steel Composite Floors with Sand Infill	The sensitivity of lightweight timber-based floors to human activity is well documented in the literature, and their design is often governed by serviceability limit state considerations such as deflection and vibration performance requirements specified in codes. Vibration mitigation measures such as addition of concrete topping, deployment of active damping mechanisms, increase in the thickness of floor slabs, and breaking floor spans have been proffered in the literature with varied results. In this study, the vibration response of a modular prefabricated cross-laminated timber-steel composite floor was investigated, considering the sand-infill of beams as a passive damping solution. Improvements in the vibration serviceability metrics of the floor were observed, revealing the potential of sand in mitigating objectionable vibration in such high-performance lightweight floors.	Cristiano	Loss	The University of British Columbia
1G	TESP - Engineering - modular construction	Timber Engineering & Structural Performance - Engineering Focus	BENCHMARKING OF A FINITE ELEMENT MODELLING METHODOLOGY FOR TIMBER CONNECTIONS	Mass timber modular construction requires high detail of their components during the design process. Special attention is given to intermodular connections, which are required to transfer the gravity loads from one module to another and provide horizontal continuity as a floor diaphragm to maintain the modules together while they transfer the lateral loads, playing an important role in the seismic performance of high-rise modular buildings. This research focuses on the finite element methodology used to simulate intermodular connections for volumetric mass timber modular buildings and the evaluation of the designed intermodular connection. A previously developed user subroutine based on continuum damage mechanics was used to simulate damage in mass timber bolted connections. Similar methodologies used to simulate steel modular connections and bolted timber joints were applied to evaluate the influence of the geometric configuration of the designed connection through a parametric analysis. The finite element model of the connection was subjected to monotonic and cyclic loading to estimate the shear and moment capacity. The connection stiffness was controlled by the number of bolts at the columns and the geometric configuration of the intermediate connection plate.	Erica	Fischer	Oregon State University

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
1G	TESP - Engineering - modular construction	Timber Engineering & Structural Performance - Engineering Focus	ALTERNATIVE LOAD PATH ANALYSIS OF TIMBER POST-AND-BEAM MODULAR BUILDINGS	Timber modular buildings are an emerging construction method, due to the environmental and construction speed benefits. However, the inherent discontinuity and limited deformation capacity, hinders the ability to effectively redistribute loads under accidental load cases and thus, their robustness. A method to quantify the robustness of a building is to assess its behavior under notional element removal. In order to understand the overall robustness of this building typology, the behavior of a hypothetical five-story timber post-and-beam modular building was numerically simulated under accidental load cases represented by notional element removals. Five element removal scenarios were considered, two full-module and three individual column removals. It was found that the structure could develop sufficient alternative load paths to carry the accidental limit state loading for most removal scenarios, except for the double intermediate façade column removal. For this scenario, it was found that the preferred load redistribution mechanism was catenary action, thus the inter-module connection was redesigned to provide sufficient deformation capacity. It was found that the optimal method for redesigning the inter-module connection for catenary action was the implementation of a fuse element, increasing the ductility of the system. These findings can contribute to further implementation of modular buildings in practice.	Maria	Felicita	Empa
1H	ECCS - Engineering - Structural Behaviour	Session Chair: PROF BENOIT GILBERT / GRIFFITH UNIVERSITY					
1H	ECCS - Engineering - Structural Behaviour	Exemplars & Construction Case Studies - Engineering Focus	PERFORMANCE-BASED SEISMIC DESIGN OF STEEL-TIMBER COMPOSITE STRUCTURES USING ENDURANCE TIME METHOD	This study covers the experimental measurement and numerical modelling of vibration and noise transmission in prefabricated timber-framed townhouses in Australia. The studied structures utilize fully finished prefabricated walls and floors, transported, and assembled on-site using a crane and a minimal work crew. Operational modal analysis was employed to characterize the floor vibration response, providing essential data for the refinement of a numerical model constructed in Abaqus. Impact and airborne noise transmission assessments were conducted in accordance with ISO standards, evaluating acoustic performance between laterally adjacent tenancies and vertically adjacent rooms. Findings are benchmarked against both Australian and international building code standards. This comprehensive study elucidates the acoustic and vibrational dynamics of prefabricated timber construction, offering critical insights for advancing construction practices to meet rigorous building performance criteria.	Alireza	Chiniforush	University of Melbourne
1H	ECCS - Engineering - Structural Behaviour	Timber Engineering & Structural Performance - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	VIBRATION BEHAVIOR OF CLT FLOORS IN A 5-STORY BUILDING PROTOTYPE UNDER HUMAN-INDUCED EXCITATION	This paper presents the results of the vibration performance of 4 CLT slabs in a 5-story building. The CLT slabs are 165 mm thick, 4.2 m long, and 6.6 m wide, with different non-structural cladding on their top and bottom faces. The experimental campaign considered two types of vibration tests. The first was a modal impact test to determine the main dynamic properties of the slabs. For this purpose, seven uniaxial accelerometers were installed on the slabs. The second was a walking test in which people of different body masses walked on the CLT slabs at different step frequencies along a predefined trajectory. The vibration dose value (VDV) indicator was used to evaluate the vibration level. Three relevant dynamic properties were detected, with vibration frequencies between 23 Hz and 36 Hz and damping ratios between 2.4% and 4.2%. On the other hand, the VDV obtained were in intermediate ranges, predicting a low probability of generating adverse comments from users. The results suggest that in real buildings, the vibration performance of CLT floors could be better than the estimations from some standards; therefore, future work is required to calibrate the numerical models of the CLT slabs to have more accurate predictions.	Alexander	Opazo-Vega	Universidad del Bío-Bío
1H	ECCS - Engineering - Structural Behaviour	Timber Engineering & Structural Performance - Engineering Focus	Vibration Tests on Long-Span CLT-GLT Composite Floor	The focus of this experimental study is on the vibrational behaviour of a long-span Cross-Laminated Timber (CLT) and Glued-Laminated timber (GLT) composite floor system. The research includes the fabrication of two full-scale 12.2 m clear span length floors with a CLT panel with 2.44 m width at the top, another CLT panel with 1.83 m at the bottom of the floor system, and two GLT beams between these CLT panels. To connect these pieces together, screws with adhesive and screws with sharp metal have been used. Then, vibrational tests before and after cutting openings on CLT and GLT will be conducted so the effects of openings on vibrational behaviour will be explored. The excitation includes heel drop at a specified point on the floor, and data acquisition includes collecting force through three load cells and acceleration through twelve sensors. In the post-processing stage, the data will be analyzed through mathematical methods, and the frequency of the floor, damping ratio, and mode shapes of the floor system will be extracted.	Weichiang	Pang	Clemson university
1H	ECCS - Engineering - Structural Behaviour	Timber Engineering & Structural Performance - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	Case Study of a Base-Isolated 6-Storey Timber Frame Building in a High Seismic Region	This paper will present a case study for a high profile 6-storey mass timber office building located in Wellington, New Zealand. The region has very high seismicity and innovative approaches were taken to maximise the use of mass timber in the building. Key requirements of the project brief included Importance Level 4 (1.8 times higher loads than a standard office building), as well as very high sustainability goals (targeting Greenstar 6 and Carbon Net Zero) and low damage seismic design. These combined goals resulted in a mass timber frame (braced frame and post-tensioned moment frame in the two orthogonal directions) with CLT diaphragms supported on a damped base-isolated podium. The paper will present various detailing and design considerations encountered during the design, preconstruction, and construction process for this unique project.	Kiran	Makan	Holmes NZ LP
1H	ECCS - Engineering - Structural Behaviour	Timber Engineering & Structural Performance - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	TIMBER ROOF STRUCTURE WITH COMBINATION OF RIGIDITY INCREASE EFFECT OF FOLDED PLATE SHAPES AND RECIPROCAL SUPPORT EFFECT OF LATTICE FRAME	The Toyota Mobility Shin-Osaka Neyagawa Store is a construction project for a single-story automobile dealership in Osaka Prefecture, Japan. The structural type is a hybrid of timber and steel, with the steel frame resisting seismic forces. The showroom portion of the building utilized the rigidity effect of the folded-plate structure and the mutual support effect of the two-way lattice beams to achieve a large-span timber roof structure. The orientation of the two-way lattice beams was determined by considering the structurally optimal placement based on geometric shapes utilizing computational design and the preferred placement from an architectural design perspective. Throughout the phases from design to manufacturing, the workflow was established around 3D modeling, and we as designers collaborated with the fabricator and the constructor from an early stage. This collaborative approach allowed for accurate modeling with both quality and workability. As a result, manufacturing problems were solved smoothly, and a foundation for digital fabrication of timber components was established.	Yui	Amano	Takenaka Corporation
1H	ECCS - Engineering - Structural Behaviour	Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	Balloon-type CLT shear wall construction - a review of current projects and design challenges	With the ever-expanding use of mass timber in buildings, new timber structural systems and typologies are regularly developed and implemented. One such system to resist lateral loads is CLT shear wall construction with a balloon-type framing approach. Designed to achieve structural efficiency and avoid high perpendicular-to-grain compression stresses experienced in traditional platform-type framing, balloon-type CLT shear walls could allow the development of taller CLT buildings. However, balloon-framed CLT shear walls are still in their nascency and have only been used in a limited number of projects internationally. This study discusses the value proposition of the technology and investigates current projects that have implemented it. Relevant research and experimental testing projects are also reviewed. Finally, current design challenges that hinder more widespread adoption of this system are discussed.	Kilian	Krauss	The University of British Columbia

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
1H	ECCS - Engineering - Structural Behaviour	Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	DESIGN UNCERTAINTY IN LONG SPAN MASS TIMBER FLOORS: PROPOSED BAND-BEAM SOLUTION	One of the challenges open plan, long span construction poses for mass timber floors is accommodating the large depth of panels and support beams used to satisfy vibration performance criteria, therefore increasing the floor-to-floor height. Seeking a solution which allows for shallower beams with design flexibility and comparable floor stiffness, cross-laminated timber (CLT) band-beams are considered as a design solution and as an alternative to traditional post-and-beam configurations. This study has been comprised of several phases: (1) mass timber floors designed to traditional spans (6 m) were experimentally assessed in-situ returning the first natural frequency (~11.7 Hz), acceleration (< 0.5 %/g), and damping (~3.3%) within the limits prescribed by the American Institute of Steel Construction (AISC) Design Guide 11. This study then (2) evaluated the satisfactory serviceability performance of CLT band-beams through static deflection testing (0.26 mm under 1 kN point load) according to Australian Standard AS 1170.0. Numerical modelling (3) was then applied to propose a re-designed version of the in-situ floor(s) from (1) using the CLT band-beam performance from (2) to extend the span beyond 6 m while still conforming to the standards.	Adam	Faircloth	Department of Agriculture and Fisheries
1I	TESP - Engineering - Protective Design	Session Chair: DR GARY RAFTERY / THE UNIVERSITY OF AUCKLAND					
1I	TESP - Engineering - Protective Design	Timber Engineering & Structural Performance - Engineering Focus	Impact behaviour of hybrid timber beams	Recent technological developments in the manufacturing of engineered wood products (EWP) have positioned mass solid timber (MST) systems as front-runners as a viable alternative construction material due to their lightweight character and low carbon footprint. Key limitations associated with the MST systems are their brittle behaviour and low stiffness. These limitations are exacerbated in the event of a critical structural member's failure due to deliberate or accidental extreme loads, such as impacts and blasts, which could lead to the progressive collapse of a building. This study aims to investigate the performance of timber beams specifically laminated veneer lumber (LVL) and the effects of hybridizing timber beams with fibre-reinforced polymer (FRP) and steel as a solution to overcome these shortcomings. A series of control and hybrid beams, fabricated with commercially available LVL, were studied under impact load conditions. The LVL beams were strengthened with surface-mounted carbon fibre-reinforced polymer (CFRP) sheets, near-surface mounted glass fibre-reinforced polymer (GFRP) rods, and screwed-in steel sheets. Dynamic impact loads were simulated using a free-falling drop hammer test setup, with a high-speed data acquisition system recording the impact loads and associated displacements. Additionally, a high-speed 3D Digital Image Correlation (DIC) system was employed to capture a comprehensive three-dimensional strain field and inspect the modes of failure. This allowed for a thorough examination and comparative assessment of the performance levels of the hybrid timber beams under dynamic impact loads.	Bryan	Thevarajah	University of Wollongong
1I	TESP - Engineering - Protective Design	Timber Engineering & Structural Performance - Engineering Focus	Impact behaviour of hybrid CLT panels	Recent advancements in construction materials have led to an increased interest in Cross-Laminated Timber (CLT) panels as sustainable alternatives to traditional building materials as they are less carbon intensive and significant potential for recycling at the end of life cycle. The brittle failure mechanisms of CLT can be critical in an extreme loading event and lead to progressive collapse of the timber building. Combining CLT with a high-strength materials in a complementing way could produce a sustainable and resilient hybrid system. This study investigates the performance of CLT panels under dynamic impact loads, focusing on both control panels and hybrid panels strengthened with surface mounted Carbon Fiber Reinforced Polymer (CFRP) fabric and steel sheets. Commercially available CLT panels were tested using a free-falling drop hammer setup to simulate impact loads of varying intensity. A high-speed data acquisition system recorded impact forces, associated midspan displacements, and strain measurements, while a high-speed camera captured the modes of failure. The experimental setup and methodology enabled detailed analysis of impact resistance and structural response. Preliminary findings indicate enhanced impact resistance and increased ductility in the CFRP and steel-strengthened CLT panels compared to control panels.	Bryan	Thevarajah	University of Wollongong
1I	TESP - Engineering - Protective Design	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	ARENA BLAST TESTING OF REINFORCED CROSS-LAMINATED TIMBER	Previous studies involving blast, ballistic, and forced entry testing on Cross-Laminated Timber (CLT) indicated that CLT provides greater protection than conventional wood construction, but that it needs some form of reinforcement to comply with stringent antiterrorism requirements. Recent quasi-static testing has shown that embedding steel plates in CLT can increase both the flexural strength and ductility of the panel, which implies an improved blast response when compared to an unreinforced panel. This paper describes a test program in which six CLT panels were reinforced with embedded steel plates and subjected to blast loading. Prior to dynamic testing, three of the six panels were subjected to six months of outdoor weathering to investigate dimensional stability and the potential for delamination under temperature and moisture cycling that could occur during construction. The six panels were then subjected to arena blast testing to demonstrate the ability of reinforced CLT (RCLT) to exhibit a ductile post-peak response. The RCLT panels generally exhibited qualitative damage that was consistent with Heavy Damage or better for significant blast loads. This paper describes the selection and fabrication of the panels, documents the observed degradation during the weathering period, and provides results from the blast tests.	Eric	Kjolsing	Karagozian And Case
1I	TESP - Engineering - Protective Design	Timber Engineering & Structural Performance - Engineering Focus	Overview of the Behaviour of Mass-Timber Members Subjected to Contact Charge Detonations and Near-field Blast Loads	Research on the performance of timber structures subjected to near-field blast loads and contact charge detonations is lacking, and a holistic approach is required in order to develop effective design guidelines and retrofits. A comprehensive research programme is currently underway to investigate the performance of mass-timber structural elements subjected to extreme dynamic loads using full-scale experimental testing and high-fidelity modelling. This paper provides an overview on some of the initial experimental results of an ongoing research programme investigating cross-laminated timber (CLT) panels. Key results on the effect of these loads on the material behaviour, including localized and global failure modes, are discussed. The overarching results of this research programme will provide the knowledge required to develop design methods for mass-timber structures subjected to contact charge detonations and near-field blast loads, as well as develop and validate simplified analytical and high-fidelity modelling tools.	Christian	Viau	Carleton University
1I	TESP - Engineering - Protective Design	Timber Engineering & Structural Performance - Engineering Focus	High-Fidelity Finite Element Modelling of Mass-Timber Members Subjected to Simulated Far-Field Blast Loads	This paper presents a numerical study using the finite element (FE) method through LS-DYNA investigating the behaviour of glued laminated timber (glulam) beams and cross-laminated timber (CLT) panels subjected to shock-tube simulated blast loads. The modeling approach is validated with experimental shock-tube test results. The study shows that the FE models capture the overall failure modes and damage extent for glulam and CLT members with reasonable accuracy. Additionally, high-fidelity modelling shows the potential to accurately predict the dynamic behaviour of heavy timber elements in terms of displacement-time history and resistance curves, which is important for designing safer timber structures subjected to far-field blast loads.	Mehdi	Saloo	Carleton University

SESSION 1
Monday 23rd June 2025
11am to 1pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
1I	TESP - Engineering - Protective Design	Timber Engineering & Structural Performance - Engineering Focus	Modelling of Cross-Laminated Timber Panels Subjected to Contact Charge Detonations and Near-Field Blast Loads	Despite recent progress in terms of developing protective design provisions and standards for mass-timber structures against far-field blast loads, little to no work has been conducted on how these relatively novel systems behave under close-in live explosives. This paper presents the results of a numerical study investigating the behaviour of cross-laminated timber (CLT) panels subjected to contact charge detonations and near-field blast explosions. The finite element software LS-DYNA was utilized, with material inputs derived from the built-in model and recent experimental test programs. Experimental contact and near-field blast testing was conducted to be used for the validation of the model, where the modelling results showed good agreement. This numerical modelling tool will allow for the response of mass-timber elements subjected to contact charge detonations and near-field explosions to be predicted without the need for costly experimental blast testing.	Mehdi	Saloo	Carleton University
1I	TESP - Engineering - Protective Design	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Timber Architecture & Biophilic Design - Engineering Focus	OPTIMIZING TARGET PROXIMITY FOR CROSS-LAMINATED TIMBER (CLT) MULTI-IMPACT BALLISITIC EXPERIMENTS	Cross-laminated timber (CLT) is an engineered, multi-layered wood product with alternating ply orientations. This innovative material has gained traction in the United States due to its sustainability, constructability, and high strength-to-weight ratio. Recent research indicates that CLT performs exceptionally well under extreme loading conditions, such as blast and ballistic impacts, and therefore, has high potential to be implemented into force-protected infrastructure. However, integrating CLT into defensive structures requires extensive data collection to fully characterize its ballistic and blast resistance. Current ballistic testing standards for CLT are based on pervious experiments with thin metallic plates, despite their fundamentally different properties. Unlike steel, CLT exhibits more localized damage, allowing for a greater density of projectile impacts within a single specimen. In contrast, metallic plates require increased spacing between impact sites to prevent shot path interactions. To optimize multi-impact ballistic testing on CLT, seven Loblolly CLT panels were tested with varying projectile target proximities and subjected to 96 shots using 0.50-inch (1.27 cm) steel sphere projectiles. Results suggest that no shot path interaction occurs when impacts are spaced at least 2-inches (5-cm) apart. Consequently, this study recommends reducing the standard shot spacing for future CLT partial penetration tests with 0.50-inch (1.27 cm) steel spherical projectiles from 7-inches (17.78 cm) to a minimum of 2-inches (5-cm). This experiment provides a significant contribution to the field by establishing a more efficient ballistic testing methodology tailored to CLT. The optimized approach allows for the collection of substantially more data while improving resource efficiency and reducing testing time.	Juliet	Swinea	Georgia Institute of Technology

SESSION 2
Monday 23rd June 2025
2pm to 3:30pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
2A	TESP - Engineering - Dynamic testing and monitoring of wood buildings: A global perspective	Session Chair: A/PROF BEATRICE FAGGIANO / UNIVERSITY OF NAPLES FEDERICO II					
2A	TESP - Engineering - Dynamic testing and monitoring of wood buildings: A global perspective	Timber Engineering & Structural Performance - Engineering Focus	THREE DECADES OF US-LEAD FULL-SCALE WHOLE BUILDING SHAKE TABLE TESTING: FROM LIGHT-FRAME WOOD TO MASS TIMBER	The history of whole-building full-scale shake table testing in the United States over the last three decades is the focus of this paper beginning with the CUREE-Caltech Woodframe Project and ending with the 10-story Tallwood and six-story Converging Design test programs in 2023 and 2024. The breath of projects includes assessing the performance of typical engineered light-frame wood construction and ending with advanced technologies such as post-tensioned timber rocking walls. These tests also ranged from small rectangular buildings to buildings as large as 1200 m² living/working area. This paper provides a brief history documenting each of these test programs, namely their objectives and results, and provides the connectivity between them as they threaded their way through almost 30 years of wood building research history, each having impacts through not only the U.S. but with international collaborations across the globe. Finally, the authors provide some key thoughts on what may be next in the U.S. and beyond.	John	van de Lindt	Colorado State University
2A	TESP - Engineering - Dynamic testing and monitoring of wood buildings: A global perspective	Timber Engineering & Structural Performance - Engineering Focus	Large scale shake table testing of wood buildings -Historical review and recent tests-	This paper will present historical review and resent shaking tablet test. A brief overview of the relationship between Japan's seismic requirements and actual ground shaking will be given to understand why these tests are necessary.	Hiroshi	Isoda	Kyoto University
2A	TESP - Engineering - Dynamic testing and monitoring of wood buildings: A global perspective	Timber Engineering & Structural Performance - Engineering Focus	DESIGN, CONSTRUCTION AND INSTRUMENTATION OF A SIX-STORY ENGINEERED MASS BAMBOO BUILDING	This paper introduces the design, construction and instrumentation of the world first tall engineered mass bamboo building. The building has six story bamboo structure with a rooftop attic, reaching a total height of 20.3 meters and a total building area of approximately 800 square meters. The main structure of the building is composed of heavy engineering bamboo frames, and braces and walls for lateral resistance. The dimensions of the structural components were designed following current timber design methods however with experimental data of engineered bamboo. The structural analysis confirmed that the structure meets the requirements of existing standards for seismic and wind design. The construction of the building combined the “frame” and “platform” procedures used in wooden building construction, effectively ensuring installation efficiency. Instrumentations have been carried out to obtain the vibration modes and building behavior under strong wind loadings.	Yan	Xiao	Zhejiang Univ. - Univ. of Illinois Joint Institute (ZJUI), Zhejiang University
2A	TESP - Engineering - Dynamic testing and monitoring of wood buildings: A global perspective	Timber Engineering & Structural Performance - Engineering Focus	Continuous Monitoring of a Five-Story Cross-Laminated Timber Building in a Seismic-Prone Region	The use of cross-laminated timber panels in timber building construction has gained interest in recent years, mainly due to their minimal carbon emissions, construction speed process, and structural performance. Nevertheless, understanding the dynamic properties of Cross-Laminated Timber structures remains a challenge, in particular in countries with seismic hazards. This study aims to determine the dynamic properties of a five-story cross-laminated timber building through vibration-based monitoring. The study case is made of low structural grade radiata pine CLT panels, combines two construction systems, and features irregularly distributed openings. Continuous monitoring measurements with operational modal analysis (OMA) techniques were employed to identify the building’s modal properties under operational conditions. The results suggest that the predominant frequencies vary over time due to environmental conditions. In particular, there is a strong correlations R^2 > 0.93 between the moisture content and the natural frequency of the building. Another relevant finding is that the frequencies of the fundamental modes vary during a seismic event. These findings contribute valuable data for the development of structural design standards for CLT buildings in seismic regions.	Alan	Jara	Universidad del Bío Bío
2A	TESP - Engineering - Dynamic testing and monitoring of wood buildings: A global perspective	Timber Engineering & Structural Performance - Engineering Focus	TWO YEARS DYNAMIC MONITORING OF AN EIGHT-STOREY CLT BUILDING	This study focuses on the extensive monitoring of a Cross-laminated Timber (CLT) building that stands eight stories tall. The monitoring encompasses rooftop acceleration readings, coupled with measurements of outside temperature, humidity, and wind speed. In addition, the study tracks the moisture levels of the wood in various parts of the building, especially in the middle and edge walls. The identification of modal parameters is based on the automatic Stochastic Subspace Identification. The core aim of this research is to understand how environmental elements, temperature, wood moisture, and wind speed, influence the building's modal characteristics and its response to vibrations. The findings reveal a marked connection between the modal parameters and both temperature and wood moisture levels. Building on this, the researchers use a refined Finite Element (FE) model of the structure to explore the interplay between critical physical factors, particularly moisture and temperature, and their impact on the identified modes. This leads to the development of an empirical formula for predicting the stiffness of CLT, which is based on temperature and moisture data gathered from long-term observation of a timber structure.	Yue	Wang	Royal Institute of Technology
2A	TESP - Engineering - Dynamic testing and monitoring of wood buildings: A global perspective	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	STRUCTURAL HEALTH MONITORING OF HISTORICAL TIMBER POST AND BEAM STRUCTURES IN NORWAY AND JAPAN	This paper present the results of vibration measurement on four Stave Churches in Norway. The study was realized by the joint research team from Norway and Japan. The two countries share important characteristics from the perspective of architecture: the richness in timber resources, technological advancement in timber engineering and the existence of ancient architectural heritage of timber post and beam construction. Four Stave churches in Norway were investigated through multiple monitoring; vibration, temperature, humidity, moisture content measurements and 3D scanning. From these results the application to structural health monitoring on timber architectural heritage is discussed.	Kaori	Fujita	Department of Architecture, School of Engineering, The University of Tokyo
2B	STCE - Architectural	Session Chair: DR DANIEL F. LLANA / TECHNICAL UNIVERSITY OF MADRID					

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
2B	STCE - Architectural	Sustainability and Timber in a Circular Economy - Engineering Focus, Sustainability and Timber in a Circular Economy - Architectural Focus	QUANTIFICATION OF WOOD MASS IN THE URBAN ENVIRONMENT - WOOD STOCK IN SANTIAGO DE CHILE+G8:M13	The advantages of wood construction from a sustainability and carbon capture perspective are widely recognized. Consequently, multiple countries are seeking to promote wood constructions in their cities through various public policies. However, there remain questions in many countries about the prevalence and spatial distribution of wood constructions in urban areas. This is crucial for quantifying benefits such as carbon capture and for developing circular economy frameworks. Thus, the present work aims to conduct an exercise in this regard using the city of Santiago de Chile and its 39 municipalities as a case study. The results show that while wood constructions have a significant participation and can be as old as 100 years, they are limited to low-rise houses of medium-low quality. Moreover, studying their spatial distribution reveals that older municipalities with higher density have a smaller wood surface area compared to those with lower density. Furthermore, the wood construction surface area would drastically depend on urban planning and the availability of timber construction technologies for the development of taller buildings.	Felipe	Victorero	CENAMAD
2B	STCE - Architectural	Sustainability and Timber in a Circular Economy - Engineering Focus, Sustainability and Timber in a Circular Economy - Architectural Focus	DESIGN FOR LOW MATERIAL PROCESSING: SHOWCASES USING SALVAGED TIMBER	Sustainable use of wood-based products in building construction is essential to fully leverage the environmental benefit offered by the limited natural resource wood. One possible approach is to give timber “waste” a second life by salvaging it for new applications, particularly for structural purposes. Due to the inherent characteristics of salvaged timber, which often comes with random and short lengths, its value is often considered significantly lower compared to raw materials, and therefore not preferable for further processing. Design difficulties occur when using salvaged timber for structural applications due to such limitation. Consequently, novel approaches are required for designing efficient structures with a particular focus on low material processing. In this paper, concepts of design for low material processing (DfLMP) are explored based on a brief historic review. By integrating structural and architectural design with considerations of fabrication and assembly processes, we intend to construct structures with little to no processing and easy (dis)assembly. The paper includes built design cases using salvaged timber and demonstrates the practical possibility of the DfLMP concept, aiming to enable further discussions and explorations on the topic.	Gengmu	Ruan	Aalto University
2B	STCE - Architectural	Sustainability and Timber in a Circular Economy - Engineering Focus, Sustainability and Timber in a Circular Economy - Architectural Focus	CIRCULARITY IN TIMBER CONSTRCUTION: CRITERIA DEVELOPMENT AND BIM INTEGRATION	The ecological benefits and functional properties of wood are crucial for the transformation of the construction sector. To maximise its ecological impact, wood must remain in the material cycle for as long as possible. To achieve this goal, buildings must be designed in a way that they can be repaired and deconstructed at the end of their lifespan. To effectively assess the recyclability of buildings, building parts and components, specific criteria and indicators are required. In this study, assessment criteria are developed based on the principle of Design for Disassembly (DfD). These assessment criteria quantify the reusability of timber buildings and make an important contribution to the circular economy in the construction sector. The paper analyses and defines indicators for the circular economy in order to establish evaluation criteria. In addition, the study looks at accessibility and traceability and examines the possibilities of correspondingly digital documentation.	Marieke	Stritzke	TU München
2B	TESP Engineeing Sustainability and Timber in a Circular Economy	Timber Engineering & Structural Performance - Engineering Focus	EFFICIENT CONNECTIONS FOR MODULAR PREFABRICATED TIMBER BUILDINGS TO HELP RECONSTRUCTION IN UKRAINE	The project presented in the paper aims at the development of a new solution for an universal connector in Cross-laminated timber structures, which offers the possibility of quick and easy installation and assembly, as well as easy disassembly and reuse. This solution shall contribute to the necessary reconstruction of the damages in Ukraine and facilitate the quick restoration of housing as well as providing a long-lasting sustainable and circular connection solutions. The developed connector is a unit in the form of a steel plate on glued-in rods, that are embedded in the CLT panels. This allows to connect CLT panels in various arrangements together or to other building parts such as foundations or concrete cores. Connections with glued-in rods are widely used in Eastern European countries, especially in long-span timber structures for buildings of various types.	Robert	Jockwer	TUD Dresden University of Technology
2B	STCE - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus	DESIGN FOR DISASSEMBLY IN PANELIZED LIGHT TIMBER FRAMING TOWARDS CARBON NEUTRALITY: THE 4PROTRU SHOWHOUSE	Construction and Demolition Waste (CDW) accounts for more than one-third of total waste generated a consequence of the linear production and consumption model based on take, make, and dispose. As an alternative, the Circular Economy, through Design for Disassembly (DfD), facilitates the recovery and reuse of components. In this context, 4PROTRU showhouse, a rural panelized house, was built in the Biobío region of Chile. Designed to achieve carbon neutrality by 2050, the house features high hygrothermal performance, low carbon footprint, and disassembly capability. After two years of monitoring, it will be dismantled into two-dimensional (2D) elements and relocated to its final site to be used as a single-family house. This study assessed DfD principles established in the international standard ISO 20887:2020 to identify limitations and challenges in the strategies applied. These included reversible connections with metal plates and screws, along with the “shearing layers” concept to ensure component independence. Both were used to facilitate disassembly. Although enabling disassembly requires additional economic, technical, and knowledge-based resources, this approach contributes to national carbon neutrality targets by reducing construction waste and extending the service life of buildings through design.	Valentina	Torres	Candidate, Advanced Forest Research Doctorate Program - Universidad Politécnica de Madrid
2B	STCE - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus	Re-Use of Mass Timber: A Case Study	The American Institute of Architects’(AIA) Architecture & Design Materials Pledge calls for the preferential use of building products that reduce carbon emissions by sequestering carbon and support a circular economy by designing for resiliency, adaptability, disassembly, and re-use with zero-waste. Environmental impact assessments demonstrate that timber-based materials, including mass timber, store carbon and have a smaller carbon footprint than reinforced concrete or steel; however, few case studies exist on the re-use of mass timber. This paper documents the reuse potential of mass timber using a three-story mass timber structural test specimen that employed a variety of approaches to lateral force-resisting systems using vertical splines. The project utilized mass ply panels (MPP) in floor and wall elements, LVL beams and columns, and steel connections. Working with engineering and architecture faculty, an architecture graduate student cataloged the mass timber elements projected to be undamaged after testing and removing connections, along with the re-usable steel connections. This catalog was shared with design professionals to find a suitable project for the material re-use. An architecture firm took up this challenge, and a majority of the mass ply panels were re-fabricated for installation in an adaptive re-use of an existing building.	Judith	Sheine	University of Oregon
2C	TESP / MPD - Engineering - Bamboo	Session Chair: PROFESSOR KAY-UWE SCHOBER / MAINZ UNIVERSITY OF APPLIED SCIENCES					

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
2C	TESP / MPD - Engineering - Bamboo	Timber Engineering & Structural Performance - Engineering Focus	ALTERNATIVE STRUCTURAL FIRE MODEL FOR PREDICTING BENDING CAPACITY IN LAMINATED BAMBOO BEAMS AND CROSS-LAMINATED TIMBER (CLT) HARDWOOD PANELS	The use of laminated bamboo as a primary load-bearing material has been limited due to a lack of understanding of its structural performance during a fire. Additionally, in wood products like Cross-Laminated Timber (CLT), the bending capacity is determined by charring rates and the reduced cross-section method. However, these methods don't consider the reduced mechanical properties behind the char layer or the non-elastic behaviour of these materials in bending. To address these limitations, an analytical structural model has been developed to assess the bending capacity of laminated bamboo beams and cross-laminated timber panels during a fire, considering the change in bamboo or timber's mechanical response as described by constitutive stress-strain models at elevated temperatures and the non-elastic behaviour of both materials. Experimental data obtained from fire tests were used to determine the temperature gradients across the cross-section of the bamboo and timber elements. The proposed structural model is based on a discretised fibre section analysis, incorporating stress-strain relationships at elevated temperatures at each time step. Furthermore, the accuracy of the models was verified by comparing the model predictions of stress and strain profiles and the predicted bending capacity with experimental test results from testing laminated bamboo beams exposed to a constant heat flux of 60 kW/m2 and CLT panels exposed to a standard fire test as per AS 1530.4. This methodology lays the basis for an accurate and more precise alternative method utilising constitutive stress-strain relationships at elevated temperatures and heat transfer models to estimate the thermo-mechanical response of materials such as timber and bamboo under fire conditions.	Cristian	Maluk	DAMA Engineers
2C	TESP / MPD - Engineering - Bamboo	Timber Engineering & Structural Performance - Engineering Focus	Mechanical performance of dowelled steel-to-timber connections reinforced locally with bamboo scrimber	Engineered bamboo, manufactured from the natural eco-material of bamboo, has gained increasing attention due to its favorable mechanical performance, sustainability, and low-carbon properties. This study investigated the feasibility of using bamboo scrimber as a local reinforcement in dowelled steel-to-timber connections. A total of twenty groups of specimens, with various dowel diameter and thickness of bamboo scrimber reinforcement in single dowelled steel-to-timber connection, were designed and tested under static loading. The theoretical models based on the theories of beam on elastic foundation and European Yield Model were developed to calculate the connection stiffness and load-bearing capacity of the connections, respectively. The test results indicated a significant enhancement in the load-bearing capacity, stiffness, and ductility of the connections when applying the bamboo scrimber reinforcement. Moreover, it was found that the reinforcing effects was considerably influenced by the thickness of bamboo scrimber and dowel diameter. The comparisons of the theoretical and experimental results confirmed the satisfactory accuracy of the theoretical models in predicting the mechanical performance of the connections.	Huifeng	Yang	Nanjing Tech University
2C	TESP / MPD - Engineering - Bamboo	Timber Engineering & Structural Performance - Engineering Focus	BAMBOO SCRIMBER DOWEL-TYPE JOINTS FOR ENGINEERED WOOD OR BAMBOO PRODUCT ASSEMBLIES AND TIMBER STRUCTURES	This research delves into dowel-type joints with bamboo scrimber as an innovative alternative to traditional wooden fasteners. The focus is on their application in connecting timber elements of medium density suitable for engineered wood or bamboo product assemblies and timber structures. The test results showed that bamboo scrimber can be ideal for dowel-type joint applications. The mechanical performances of such joints (such as the failure mode, carrying capacity, and slip modulus) are significantly dependent on the ratio of side laminate thickness to dowel diameter and the embedment strength of the laminate. A small ratio of side laminate thickness to dowel diameter is found to result in a ductile failure mode and high capacity, small joint slip.	Jianbin	Yang	Edinburgh Napier University, United Kingdom; Dongguan University of Technology, China
2C	TESP / MPD - Engineering - Bamboo	Timber Engineering & Structural Performance - Engineering Focus	DOWEL TYPE CONNECTIONS IN LAMINATED BAMBOO WITH MULTIPLE SLOTTED-IN STEEL PLATES	Laminated bamboo can be produced in sizes which are similar to glued laminated timber. As a result, large connections with multiple dowels and slotted-in steel plates are similarly possible with bamboo. MOSO bamboo was used, with a density of around 660 kg/m3, potentially creating connections having higher load carrying capacity than softwood. In this project, a large experimental campaign was set-up in order to determine the mechanical properties of connections with various ratios of dowel diameter to bamboo thickness and with single and double steel plates. Furthermore, influences of the density of the material, related to the embedding strength for fasteners, as well as the splitting sensitivity are playing crucial roles with respect to the load carrying capacity. Therefore, multiple test series on large bamboo connections have been performed in order to study various possible failure modes, as dependent on embedding strength, steel grade, number of fasteners in a row, and the influence of multiple steel plates. The various failure modes have been analysed analytically with the Johansen equations, similar to the design equations proposed for the upcoming version of Eurocode 5 for multiple steel plate connections, confirming their applicability to bamboo.	Jan-Willem	van de Kuilen	TU Munich / TU Delft
2C	TESP / MPD - Engineering - Bamboo	Material Performance & Durability - Engineering Focus	The Effect of Size and Core Shape on the Physical and Mechanical Properties of Bamboo Sandwich Panel	Light-weight but durable materials are currently preferred for furniture and building products. Composite wood technology is one such example. The goal of developing materials having a sandwich structure is to create materials that are extremely stiff and strong while being lightweight. The purpose of this study is to ascertain the impact of core size and core shape on the mechanical and physical characteristics of sandwich panels composed of thin bamboo strip. Physical properties like density, water content, water absorption capability, and thickness expansion were measured. Using a universal testing machine (UTM), mechanical tests were performed on compressive strength, modulus of rupture and modulus elasticity both on parallel to and perpendicular to the fiber, and internal bond. Three, four, and five centimeters are the differences of dimension core size (small, medium and large sized); hexagon, square, and triangle are the variances in the core shape. The best test samples contain triangular-shaped, medium-sized (4 cm) cores, according to the data collected and analysis performed.	Naresworo	Nugroho	Department of Forest Products, Faculty of Forestry and Environment, IPB University, Indonesia
2C	TESP / MPD - Engineering - Bamboo	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	World's First Bamboo-Timber Composite Gridshell: From Design to Full Scale Construction	Actively bent bamboo-timber composite gridshell is an advanced spatial structural concept as it does not require pre-fabricate curved members, light weight, uses sustainable material, and has simple joint design. Despite its potential, this application of this type of structures is limited by the availability of the effective methods of analysis. Although research on elastic gridshells is increasing, there are few effective methods for modelling the non-linear behaviour of such structures and has no capacity of adopting more accurate constitutive models for bamboo and timber materials. This paper presents a novel method for analysing the form-finding process of composite gridshells through active-bending and its proof-of-concept design and construction of World's first bamboo-timber composite gridshell. A numerical model is proposed to simulate joint's complex mechanical behaviours. The comprehensive details of this full size construction are detailed in this paper. A finite element analysis(FEA) package was developed for this type of gridshell structures and its results were validated in ABAQUS.	Yanghao	Pei	Edinburgh Napier University

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
2D	MPD - Engineering - Protective Design - moisture safety in timber buildings and construction processes.	Session Chair: PROFESSOR EMERITUS JEFF MORRELL / OREGON STATE UNIVERSITY					
2D	MPD - Engineering - Protective Design - moisture safety in timber buildings and construction processes.	Material Performance & Durability - Engineering Focus	A MULTISCALE ANALYSIS OF HYGROEXPANSION IN WOOD	A better use of material is possible in structural design with a deeper fundamental understanding of hygroexpansion in wood with a multiscale approach ranging from nano to macro material level. A multiscale analysis strategy is proposed, which combines atomistic with continuum modelling through material property prediction. The models are built and validated using a multiscale experimental approach based on small- and wide-angle scattering and full-field computed tomography to incorporate material variability and obtain reliable material properties. The study provides a full set of moisture dependent and hygro expansion properties for finite element modelling based on molecular dynamics. The results showed that scattering assisted atomistic simulation provide a deep nanoscale characterization of shrinkage of wood, where tomographic aided continuum modelling gave detailed insight into cellular changes during shrinkage.	Sara	Florisson	Uppsala University
2D	MPD - Engineering - Protective Design - moisture safety in timber buildings and construction processes.	Material Performance & Durability - Engineering Focus	MOISTURE DEPENDENCE OF MECHANICAL PROPERTIES OF BEECH AND BIRCH IN COMPRESSION PERPENDICULAR TO GRAIN AND ROLLING SHEAR	The forests in Europe are changing in response to climate resulting in an increased proportion of hardwood species in mixed forests. Hardwood properties, an understudied area in the past, are now gaining prominence in research. Our experimental investigation of moisture dependence of mechanical strength of South Swedish hardwood encompassed the species beech and birch and relative humidity levels of 40, 65, and 85% at 20 degrees Celsius. Mechanical strength was determined on two different scales, i.e. the board level, which considers the annual ring structure, and the material level, where the annual ring structure is negligible. Due to these different scales, different experimental setups were used, but the experimental evaluation was done similarly for both scales. Results showed that compressive strength perpendicular to the grain increased with decreasing moisture content at both scales. Material level tests resulted in higher compressive strengths compared to the board level. Conversely, rolling shear strength was consistently higher on the board level than on the material level. Rolling shear strength dependence on moisture content was distinct on the board level, but not on the material level.	Elisabet	Kuck	Karlsruhe Institute of Technology KIT
2D	MPD - Engineering - Protective Design - moisture safety in timber buildings and construction processes.	Material Performance & Durability - Engineering Focus	Moisture-induced Variations in Withdrawal Capacity of Pin-shaped Electrodes in Wood: Experimental Insights and Correlations	Withdrawal testing is being used for various reasons such as testing hypotheses on durability or developing new connectors using various screw-types or nails. New research questions extend these testing methods to other topics such as rammed-in electrodes for moisture content determination by the electrical resistance method. Three Australian wood species, Corymbia maculata, Eucalyptus nitens, and Pinus radiata D. Don., are therefore investigated using a fixed pull-out rate. This paper outlines the methodologies employed in withdrawal testing and highlights key findings. Preliminary results indicate that moisture variations affect the fit of any pin-shaped object in wood, impacting their withdrawal load peak values. These findings contribute to understanding the impact of moisture on contact pressure and withdrawal capacity, crucial not only for designing reliable timber connections in construction, but also other applications such as wood moisture determination.	Zidi	Yang	The University of Queensland
2D	MPD - Engineering - Protective Design - moisture safety in timber buildings and construction processes.	Material Performance & Durability - Engineering Focus	EXPERIMENTAL STUDY OF MOISTURE MOVEMENT INSIDE CLT USED FOR WOOD FOUNDATIONS	Permanent wood foundation (PWF) has been in use in Canada for a few decades in basement or foundation of housing and small buildings. Cross-laminated timber (CLT) is a mass timber product that can be used for PWF, which can provide higher load resistance, compared with the traditional PWF that is constructed with light wood frames. One area of concern when using CLT in foundation is the moisture movement in CLT. Laboratory experiments have been conducted by measuring the moisture movement through CLT. Two set-ups were used. One was with the water entering the CLT surface from the top and the other with water entering the CLT surface from the bottom. Two methodologies have suggested attaching water onto CLT, or underneath CLT so that confirm the influence of gravity in terms of absorbing and drying water. The results of the experiment showed that the moisture content reached was related to the distance of the position from the source of water. It is logical to note that the rate of moisture content increase was slower when CLT absorbs water without gravity.	MAHIRO	KAWAMOTO	Hiroshima University
2D	MPD - Engineering - Protective Design - moisture safety in timber buildings and construction processes.	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	The Development of Composite Cross Laminated Timber Panels Manufactured Using C16 Irish Sitka Spruce	This paper discusses the proposal of using local timber resources of Irish Sitka Spruce with a strength class of C16 for use in the manufacture of cross laminated timber. The discussion extends to determine how reinforcement can be incorporated into cross laminated timber panels and how this affects the panels performance in bending tests.	Emily	McAllister	Queen's University Belfast
2D	MPD - Engineering - Protective Design - moisture safety in timber buildings and construction processes.	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	a study on moisture migration in the multiple direction in laminated glulams exposed to fire including moisture migration across finger joints and adhesive lines	Wooden laminated glulams were heated in a small furnace to analyze moisture migration into the inner part of the laminated glulams and across finger joints and adhesive lines by measuring changes of temperature and moisture content. From the experiments, moisture content increased in the internal direction according to the heat increase. This shows that moisture migrated into the inner part of the laminated glulams. In addition, moisture content did not change in unheated side relative to the finger joints around farther parts from the heated surface although moisture content of the same location increased if there were no finger joints. However, the changes of moisture content and temperature around the heated surface showed the same tendency regardless of the presence of finger joints. Therefore, the finger joints hinder moisture migration around farther parts from the heated surface although moisture migrated across the finger joints around the heated surface. This suggests that the difference of temperature between the finger joints around the heated surface was high enough to cause moisture migration while the difference of temperature between the finger joints around farther parts from the heated surface was low to cause moisture migration. The results imply that moisture migration can be influenced by finger joints and adhesive lines. Therefore, moisture migration should be considered when formulating large cross-sectional members. The authors plan to heat the laminated timbers that are stacked in parallel to the heated surface to analyze moisture migration across adhesive lines. In addition, the authors plan to heat laminated glulams which have measurement points in farther parts to analyze moisture migration in deeper parts when cooling.	Kotaro	Ara	Waseda University

SESSION 2
Monday 23rd June 2025
2pm to 3:30pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
2E	TESP/MPD- Engineering - Bridges	Session Chair: DR BETTINA FRANKE / TIMBAGROUP HOLDING AG					
2E	TESP/MPD- Engineering - Bridges	Timber Engineering & Structural Performance - Engineering Focus	Development of an openable deck timber bridge to reduce snow loading	Akita Prefecture, located in the northeastern part of Japan, receives a large amount of snowfall in the winter, causing pedestrian bridges over mountainous areas to deform and fall due to the snow loads that cover the bridge. Therefore, we developed an openable deck timber bridge, which can reduce snow loads by changing the bridge's structure during the winter season. Outdoor exposure tests were conducted at two locations in Akita Prefecture to determine the actual snow accumulation on the bridge. Snow accumulation was limited to about 60–80 cm at the top of the girders and the top of the raised deck slabs at a snow depth of about 100 cm, and no snow accumulation was observed covering the rest of the bridge. The estimated snow load on the open deck bridge was approximately 46% of that with the deck closed, demonstrating that the structure reduces the snow load. We also found that accumulated snow melts faster off the openable deck than off the closed slab.	Ryu	NODA	Institute of Wood Technology, Akita Prefectural University
2E	TESP/MPD- Engineering - Bridges	Timber Engineering & Structural Performance - Engineering Focus	Investigation of the Performance of Cross-Laminated Timber Deck Panels on Longitudinal Steel Bridge Girders	Cross-laminated timber (CLT) has become more popular with many advances stemming from completed research and construction projects in Europe. CLT has been utilized in vertical construction projects where many of its inherent features have been maximized. CLT is prefabricated, relatively lightweight, dimensionally stable, and environmentally sustainable. Despite these advances, the use of CLT in bridge structures has been limited, and the adoption of CLT into governing bridge design codes has been slow in North America. CLT shows promise as a construction material for bridge decks. This project aimed to assess using CLT as a primary structural material for highway bridge applications. Laboratory tests were conducted to assess the strength and serviceability of transverse CLT panels on steel girders when subjected to typical highway loads. The structural characteristics of the panels lend well to using them for highway bridge structures. The data prove the performance to be uniform and predictable. Overall, the structural performance of CLT panels under highway-type loads is consistent with other allowable bridge types of similar size.	Justin	Dahlberg	Iowa State University
2E	TESP/MPD- Engineering - Bridges	Material Performance & Durability - Engineering Focus	ANALYSIS OF THE DURABILITY OF THE ADHESIVE JOINT OF TIMBER-CONCRETE COMPOSITE BRIDGES	The technology of adhesively bonded timber-concrete composites (ATCC) is a promising approach to building ecological and economical road bridges. The use of adhesives for the composite layer between wood and concrete offers economic and mechanical advantages. However, the effects of humidity and temperature in outdoor conditions need to be analysed in detail to ensure the durability of the adhesive joint for the service life of the bridge. Currently, no standard tests exist for the determination of these influences on an ATCC structure. However, the durability of glued wood products can be verified using delamination tests. These tests are designed to analyse the long-term influence of temperature and humidity changes in a time lapse. Therefore, delamination tests are performed with a large number of glued wood and adhesively bonded TCC specimens. The paper describes the production of the specimens, the tests and its results. Finally, recommendations are given in particular for the surface finish of the concrete and the orientation of the wooden lamellas in relation to the adhesive joint.	Johannes	Koch	University Of Applied Sciences Erfurt
2E	TESP/MPD- Engineering - Bridges	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	INVESTIGATIONS ON ADHESIVELY BONDED TCC-SPECIMENS UNDER TENSILE, CYCLIC TEMPERATURE AND SHEAR LOADING	To date, timber playes a minor role in the design of road bridges. However, in Germany the traffic infrastructure is dominated by short and medium span bridges (10 - 30 m), where adhesively bonded timber-concrete composite (ATCC) structures represent an ecologically and economically viable alternative to conventional, solid constructions. With respect to the design service life of 100 years, the long term mechanical behavior of ATCC structures crucially depends on the durability of the adhesive joint. This contribution presents investigations on the bonding behaviour, particularly results of short term and high cycle fatigue compression shear tests with and without cyclic temperature preloading.	Andreas	Kirchner	Bauhaus-University Weimar/ MFPA Weimar
2E	TESP/MPD- Engineering - Bridges	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	ADHESIVELY BONDED TIMBER-CONCRETE COMPOSITE BRIDGES – ANALYSIS OF THERMAL ACTIONS ON THE SUPERSTRUCTURE	Timber-Concrete Composite (TCC) bridges are ecologically and economically appropriate alternatives to conventional, solid bridges, especially in the span range of 10 to 30 m. The collaborative research Project 'HBVSens' aims to establish a new type of road bridge with continuous adhesive bonding between timber main girders and prefabricated concrete deck elements using a highly filled, tolerance-compensating polymer mortar. Based on initial investigations on a robust manufacturing technology and a suitable concept for quality assurance and structural health monitoring, an adhesively bonded timber concrete composite (ATCC) superstructure segment is set up for analysing the climatic impacts and evaluating the capability of different integrated sensors under environmental conditions. In this study, the manufacturing process of the hybrid superstructure element, the monitoring concept, and the sensor integration are elucidated. With a focus on the measured temperature changes and the corresponding structural reactions of the superstructure, first results of the investigations are presented.	Andreas	Kirchner	Bauhaus-University Weimar/ MFPA Weimar
2E	TESP/MPD- Engineering - Bridges	Timber Engineering & Structural Performance - Engineering Focus	CASE STUDY OF AN INTEGRAL TIMBER-CONCRETE ROAD BRIDGE WITH SPECIAL CONSIDERATION OF THE INFLUENCES OF CREEP, SHRINKAGE AND TEMPERATURE IN THE PRE-DIMENSIONING PHASE	In order to achieve the climate targets, everyone must make their contribution. This means that the public sector must also implement the planned infrastructure measures while taking the ecological footprint into account. There are currently hardly any road bridges in Austria that involve timber. For this reason, Austrian railroad company OEBB commissioned two newly planned reinforced concrete composite bridges as an alternative in timber-concrete composite variants. For one of these bridges, the case study focused on the key static criteria for the design. This bridge is a road bridge with a span of approx. 42 meters to be realized as an integral bridge. Since this integral bridge is a statically indeterminate system, special attention must be paid to the load cases of shrinkage, creep and temperature. Experience has shown that these load cases can cause decisive internal forces. Therefore, the focus of this work is primarily on these load cases.	Alex	Müllner	TU Wien, Department for Structural Design and Timber Engineering
2F	MPD - Engineering - Thermal Behaviour	Session Chair: DR SHENGDONG ZHANG / TONGJI UNIVERSITY					

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
2F	MPD - Engineering - Thermal Behaviour	Material Performance & Durability - Engineering Focus	OAK TREE BARK AS A SUSTAINABLE MATERIAL FOR THERMAL INSULATION	The increasing demand for sustainable and natural building materials has driven significant interest in alternative, new, eco-friendly insulation solutions. Using wood residues for insulation is promising yet under-research topic. According to green policies at EU-level, wood and its components, e.g., bark, should be used for long-lasting products and not as an energy source. Oak wood bark offers a renewable and natural resource with several advantageous properties for insulation. The study aimed to investigate the thermal properties of Oak tree bark embedded in the exterior walls and compare the U-values of the exterior walls with mineral wool (MW), a standardized and well-known insulating material. Preliminary results show that the U-values of experimental wall compositions were 0.22 W/m2K for the wall with mineral wool (MW) and 0.29 W/m2K for the wall with Oak tree bark. According to Technical Regulation on the Rational Use of Energy and Thermal Insulation in Buildings, the maximum U- value for external walls in Croatia is 0,30 W/m2K. However, the U value was 24% lower with bark; according to the environmental impact assessment, the economic value and sustainability of using Oak tree bark as insulation are still promising.	Andrija	Novosel	University of Zagreb, Faculty of Forestry and Wood Technology
2F	MPD - Engineering - Thermal Behaviour	Material Performance & Durability - Engineering Focus	FINGER JOINTING OF THERMALLY COMPRESSED OIL PALM WOOD	Poor mechanical properties of low density oil palm wood has been successfully improved using thermal compression. In this work, finger jointing performance of this modified material was explored. Thermally compressed oil palm wood was manufactured from low (TC_LD) and medium (TC_MD) density wood, and the same type of wood samples were then finger jointed with two different finger orientations; vertical and horizontal fingers. The preliminary result showed that finger jointed TC_MD had higher tensile strength than finger jointed TC_LD. However, both values were found to be relatively low compared with the un-jointed ones, which might be due to the insufficient effective glue joint area, and some possible micro-cracks that might be generated in soft parenchyma cells during manufacturing process. The loss of tensile strength of TC_LD joint was larger than that of TC_MD joint due to the presence of fractured fingers in TC_LD occurred during finger profiling stage. To improve finger jointing performance of TC-oil palm wood, exploring the optimum manufacturing parameters for producing finger jointed TC-oil palm wood is recommended for the future work.	suthon	srivaro	Walailak University
2F	MPD - Engineering - Thermal Behaviour	Material Performance & Durability - Engineering Focus	Natual Exposure of Untreated and Thermally Treated European Aspen (Populus Tremula)	To gain further knowledge of how to best utilize hardwoods such as European aspen in future timber constructions, specimens of aspen were exposed naturally outdoors during a period of 16 months in southern Sweden. Half of the specimens were thermally treated, while the others were left completely untreated. After the exposure, the specimens were assessed based on their change in mass, total color change, and crack development. The results show that the color of the untreated specimens and thermally treated specimens became similar after the exposure, as the thermally treated specimens got lighter, and the untreated specimens got darker. The mass gain caused by surface mold was relatively similar in both specimen groups. The total crack development appeared to be much greater in the thermally treated specimens, this could be attributed to the chemical changes occurring during the treatment, thus lowering the tensile strength perpendicular to the grain. Further validation of different thermal intensities is necessary to find suitable treatments for different exposure scenarios.	Sebastian	Svensson Meulmann	Linnaeus University
2F	MPD - Engineering - Thermal Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	THERMAL PERFORMANCE CHARACTERISATION OF A NOVEL HYBRID FIBRE REINFORCED TIMBER (HFT) COMPOSITE WALL SYSTEM USING THE TRANSIENT DATA ASSIMILATION (TDA) METHOD	Building envelope thermal performance requirements are becoming stricter to support the government commitments to reduce greenhouse gas emissions (GHG). To effectively achieve such obligations, current standard methods used by designers to characterize insulating properties like the thermal resistance (R-value) may not be enough. This study demonstrated such approach by comparing the overall R-value of a novel Hybrid Fibre reinforced Timber (HFT) composite wall system calculated using standard analytical methods and the Transient Data Assimilation (TDA) method. During the process, it evaluated the contribution of the HFT elements and its air cavities to its overall R-value. The study showed that the air cavities of a timber made building envelope component may conduct more heat than the structural elements, despite that it is generally acknowledged that they contribute positively to the overall R-value. Further, the study revealed that the insulating properties of air cavities calculated by means of standard analytical methods may underestimate the Heating, Ventilation, and Air Conditioning (HVAC) loads needed to keep comfort conditions in a building, resulting in an unexpected increased use of energy and associated GHG. These are findings that not only influence the HFT design decision process but also suggest revisiting existing standard methods.	Gerardo Miguel	Soret Cantero	The University of Queensland
2F	MPD - Engineering - Thermal Behaviour	Material Performance & Durability - Engineering Focus	NATURAL EXPOSURE COMPARISON OF TIMBER JOINTS BONDED WITH POLYURETHANE ADHESIVE IN TWO CLIMATIC CONDITIONS	This study examines the bonding characteristics of European beech (Fagus sylvatica) and Radiata pine under natural weathering conditions in Slovenia and New Zealand, respectively. It compares untreated, preservative-treated, and mineralized wood specimens. Double cantilever beams were used to assess fracture energy through Mode I fracture tests at various ageing stages, while FTIR analysis monitored chemical changes in the PUR adhesive and wood. The results showed that fracture energy release rates for untreated radiata pine remained stable during ageing, while preservative-treated radiata pine exhibited suboptimal bonding but no significant changes in fracture energy. Mineralized beech wood showed lower fracture energy due to increased brittleness. FTIR analysis revealed significant effects of UV radiation and weathering on the bond line, with wood degradation being more pronounced than adhesive degradation. The study concludes that natural weathering differs significantly from accelerated ageing tests, with UV radiation playing a crucial role in altering bond properties. The findings indicate greater complexity and variability in the natural weathering of beech due to its higher shrinkage and swelling. These insights enhance understanding of the interactions between wood durability, ageing, and adhesive performance, contributing to the durability and sustainability of timber structures.	Martin	Capuder	ZAG
2F	MPD - Engineering - Thermal Behaviour	Timber Engineering & Structural Performance - Engineering Focus	ANALYSIS OF CARBONIZED SPEED AND RESIDUAL SECTION OF STEEL-TIMBER CONNECTION	In general, connecting hardware on Timber Connection is frequently used to increase rigidity. In timber architecture, cases in which various space site are possible using hardware are introduced. The Connection hardware material is mostly steel(or aluminum) with high thermal conductivity to maintain the moment rotation angle of the Timber structural connection. In order to evaluate the fire safety of high-rise timber buildings, it is necessary to evaluate the heat transfer distribution of members exposed to direct high temperatures. As a result, the heat transfer rate in the cross-section increased rapidly due to the connecting hardware, and the pyrolysis section was extended. As a result of evaluating the residual cross section excluding the 300°C cross section in which the carbonized, the It was difference 1.5 to 2.0 times depending on each variable.	Sung-Mo	Choi	University Of Seoul, Korea

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
2G	TESP - Engineering Seismic Behaviour	Session Chair: PROFESSOR PIERRE QUENNEVILLE / THE UNIVERSITY OF AUCKLAND					
2G	TESP - Engineering Seismic Behaviour	Timber Engineering & Structural Performance - Engineering Focus	SEISMIC BEHAVIOUR OF HILLSIDE LIGHT TIMBER FRAMED HOUSES	A significant percentage of houses in New Zealand (NZ) is hillside houses but seismic designs of hillside houses are mainly informed by research on flat site. The earthquake damage evidence during the recent NZ earthquakes revealed that houses on flat sites performed better than similar houses on hillsides, provided that the liquefaction was not a factor. This provided significant impetus for the research about the seismic performance of hillside houses because there is little research available in this space. The objectives of the study reported are (1) to categorize the typical engineering practice in constructing hillside houses over times; (2) to investigate the critical engineering issues about hillside houses, in comparison with houses on flat sites; and (3) to develop hypotheses of adequate seismic design of hillside houses.	Angela	Liu	BRANZ Ltd
2G	TESP - Engineering Seismic Behaviour	Timber Engineering & Structural Performance - Engineering Focus	APPLICATION OF SEISMIC BASE ISOLATION IN A TIMBER MULTI-STORY FRAME BUILDING	With the aim of continuing the progress being made in using wood as a structural material, this paper explores the application of seismic protection technologies to multi-story timber buildings, with a particular focus on base isolation. It examines the challenges and issues that can arise in practical design. The current literature does not provide in-depth coverage on this topic, which limits the confidence in using isolation techniques for wooden structures. This research looks into a practical case study of an eight-story residential condominium exploiting a hybrid timber-steel frame with specifically developed nodes connecting steel columns and glulam beams. After accurately modeling the structure, both linear and nonlinear analysis are performed. Four different structural conditions are analyzed to assess the effects of nodes and infill walls stiffness and to evaluate the effectiveness of the isolation system.	Edoardo	Giacobbo	National Research Council of Italy, Institute of BioEconomy (CNR IBE)
2G	TESP - Engineering Seismic Behaviour	Timber Engineering & Structural Performance - Engineering Focus	STRUCTURAL PERFORMANCE OF TIMBER FRAMES WITH CONCRETE BEAM-COLUMN JOINT EXPOSED TO CYCLIC LOADING	In recent years, as environmental considerations have gained importance, attention has turned to reducing CO_2 emissions through the carbon fixation effect of wood. Traditionally, timber frame connections have been designed as pin or semi-rigid in structural design due to the wood's week properties perpendicular to the grain. This has made it challenging to implement timber frame structures in high seismic regions. However, there is room where more effective moment transmission at connections allows for flexible floor plans and rational structural designs with fewer lateral resisting components. In this study, we developed a new beam-column joint consisting of reinforced concrete (RC) and Glued in Rod (GIR) with high rigidity. We evaluated the structural properties by conducting full-scale partial frame tests. The results showed that the timber frames exhibited high stiffness, strength, and excellent ductility. Additionally, the theoretical equation adopted for the joint accurately estimated both the stiffness and yield strength.	Tomoyuki	Hayashi	Kajima corporation
2G	TESP - Engineering Seismic Behaviour	Timber Engineering & Structural Performance - Engineering Focus	EVALUATING THE SEISMIC PERFORMANCE OF HYBRID REINFORCED CONCRETE FRAMES WITH CLT SHEAR WALLS: EXPERIMENTAL AND ANALYTICAL APPROACHES	New hybrid systems, such as using Cross Laminated Timber (CLT) walls in conjunction with Reinforced Concrete (RC) buildings, are considered promising for reducing CO2 and achieving a carbon-neutral society. Using CLT walls in reinforced concrete buildings offers two key advantages: First, in case of earthquake damage, they can be easily replaced, reducing repair time. Second, CLT walls possess high strength, enhancing the building's overall structural integrity. The primary objective of this study is to investigate the seismic performance of RC frames infilled with CLT walls through experimental testing and to develop a simplified analytical model to simulate the behavior of these hybrid structures accurately. The research focuses on the seismic capacity and potential advantages of using CLT shear walls, particularly their ability to enhance lateral strength, stiffness and energy dissipation in RC frames. Two specimens of RC frames with CLT-infilled walls were tested under static cyclic loading, with one specimen featuring shear keys and the other without. The findings from these tests were used to validate a macro model representing CLT walls as diagonal braces (axial springs), providing a practical tool for structural design.	Hamood	AlWashali	Okayama University
2G	TESP - Engineering Seismic Behaviour	Timber Engineering & Structural Performance - Engineering Focus	SEISMIC PERFORMANCE EVALUATION OF MASS TIMBER FRAMES REINFORCED WITH WOODEN SHEAR WALLS	As wooden buildings gradually become taller, lateral force resistance performance of wooden frames is required. Therefore, this paper presents the results of a cyclic behavior study on mass timber frames reinforced with CLT or SIP shear walls. As a result of the cyclic loading test, the lateral performance of the wooden frame infilled with CLT shear wall was excellent because the strength of CLT was higher. However, when the failure mode of a specimen of wooden frame infilled with SIP shear wall was investigated, the strength of the SIP was sufficiently exhibited because the failure of the SIP occurred without fracture of steel connections. Therefore, if the joint stiffness between GLT frames and CLT shear wall is increased, it is considered that the structural design can fully exhibit the strength of CLT.	Keunyeong	Oh	Korea Institute of Civil Engineering and Building Technology
2H	ECCS - Architectural Case Studies	Session Chair: ADAM SHEARS / THECA TIMBER					
2H	ECCS - Architectural Case Studies	Exemplars & Construction Case Studies - Architectural Focus	GLUED GLVL PANELS FOR A NEW TIMBER FOOTBRIDGE OVER THE BRUSSELS RING	As part of the R0 East ring optimization in Brussels, a 67.5-meter span timber footbridge is being constructed over the Vier Armen intersection to provide a direct connection for cyclists and pedestrians. The footbridge features glued GLVL panels as the main structural material, showcasing a novel approach to the construction of covered timber bridges.	Benoît	Hargot	WOW Engineering
2H	ECCS - Architectural Case Studies	Exemplars & Construction Case Studies - Architectural Focus	INNOVATIVE SELF-SHAPING TIMBER CONSTRUCTION: THE WANGEN TOWER	The Wangen Tower, constructed for the Landesgartenschau 2024 in Wangen im Allgäu, Germany, represents a groundbreaking advancement in timber architecture and engineering. This 23-meter-tall structure is the world's first multi-level, walkable building utilizing self-shaped, structural timber components. The project highlights how integrating scientific research, material-aware computational design, digital prefabrication, and expert craftsmanship can expand the possibilities of sustainable timber architecture. This paper presents the innovative design process, construction techniques, and outcomes of this pioneering project, demonstrating the potential of renewable, locally sourced, and resource-effective timber in contemporary architectural design.	MARTIN	ALVAREZ	ICD - Institute for Computational Design and Construction

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
2H	ECCS - Architectural Case Studies	Timber Architecture & Biophilic Design - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	LAMINATED NODES FOR A ROUND TIMBER STRUCTURE	This research investigates the design and fabrication of a laminated timber node connection in a branched round wood structure. The node was designed using parametric modeling and digital fabrication to resolve complex 3dimensional non-coplanar connections between round timber members in a columnar frame structure, designed and fabricated to be realized in 1:1 exhibition pavilion . Using bespoke laminations of LVL billets arranged in an optimized 3-dimensional layup, the node design investigates novel techniques to maximize the billet overlap for structural integrity while minimizing the amount of timber wastage. A key innovation in the node design was the sophisticated 3-dimensional resolution of the non-coplanar mitering of branch arms, resulting in a semi rigid connection with a high degree of moment resistance, but also an elegant expression of the timber grain in the node, as it maintains tangential direction corresponding to the intersecting round timber member.	Kim	Baber	School of Architecture, University of Queensland
2H	ECCS - Architectural Case Studies	Exemplars & Construction Case Studies - Architectural Focus	Using the DfMA approach in the early integration of actors for the design of an industrialized timber building - case study	Design for Manufacture and Assembly (DfMA) is a methodology that optimizes the design process to facilitate manufacturing and assembly, promoting more efficient and cost-effective construction. This study describes the process of early integration of actors in a case study of an industrialized timber building in Chile, framed in the Housing Emergency Plan. Involving architects, engineers, manufacturers, and builders from the early stages, the DfMA methodology was applied to improve communication and coordination between all actors. Five design stages were identified based on the RIBA guide, and BIM and modeling tools were used to integrate information from all participants. The results indicate that, although design time increases, production is more efficient, with fewer errors and rework, and higher construction quality. This study provides a framework for future projects in the construction industry, highlighting the importance of early integration and use of digital tools. Future work should validate time and cost savings, reduction in waste, improvement in quality and processes in manufacturing and construction phases.	Daniela	Méndez	CENAMAD
2H	ECCS - Architectural Case Studies	Timber Architecture & Biophilic Design - Architectural Focus, Education, Innovation & Challengers - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	Retrofitting low-rise building stock through mass timber additions and performance-based fire engineering: The Darlinghurst Workplace	The Darlinghurst Workplace is a unique showcase of advanced performance-based fire engineering design for it's size and type of building. It is demonstrative of a retrofit model using mass timber to reduced embodied carbon, construction time and improved safety while meeting project constraints and exceeding aesthetic expectations. The need for adaptive reuse to increase density is critical for reducing embodied carbon emissions in construction. Though mass timber presents a lower carbon alternative to conventional Australian construction (reinforced concrete), the embodied carbon of existing building fabric is of great value to retain. This paper aims to a case study that demonstrates how mass timber can be used to extend the lifespan of existing structures; Furthermore, how through performance-driven fire engineering the timber could remain exposed to gain both environmental and social benefits. The two case studies are located within Australia and are built upon low-rise commercial buildings. The use of mass timber enables a light-touch addition of structure and additional floors being supported primarily by existing structure. Whereas if conventional construction was employed, significant redesign of the base structure, or complete demolition may be required to meet desired density. Through advanced performance-based fire engineering design, we could achieve an architectural outcome that is typically impossible when following prescriptive fire certification pathways, acting as a benchmark for future projects to deliver flexibility and community conscious outcomes that minimise material use and maximise benefits of exposed timber structure.	Adrian	Taylor	BVN
2H	ECCS - Architectural Case Studies	Exemplars & Construction Case Studies - Engineering Focus, Exemplars & Construction Case Studies - Architectural Focus	Mass Engineered Timber Buildings in Southeast Asia: Overcoming Obstacles and Unlocking Opportunities	The tropical rainforests of Southeast Asia provide a rich natural resource and the region has hundreds of years of experience and expertise in traditional timber construction. Furthermore, states such as Sarawak on the island of Borneo are committed to the development of renewable rapid growth hardwood plantations as a key pillar of their carbon trading strategies, whilst the likes of Singapore are making increasingly challenging demands on developers to deliver more modular low carbon buildings. And yet, the delivery of modern, mass engineered timber (MET) buildings remains rare outside of a handful of exemplar projects supported by research institutions, hampered, in part, by lack of specialist expertise, regulatory inertia and supply chain difficulties. Through a series of case studies, the speakers will explain how they have overcome these challenges to deliver some of Southeast Asia's most notable modern timber buildings, and the efforts they are making to work with governments and industry to help build a modern, economically sustainable, indigenous MET ecosystem for the region.	Andrew Callum	Magub Lillywhite	KIRK Studios Aurecon
2I	STCE - Practitioner	Session Chair: PENELOPE MITCHELL / USC					
2I	STCE - Practitioner	Sustainability and Timber in a Circular Economy - Engineering Focus, Sustainability and Timber in a Circular Economy - Architectural Focus, Sustainability and Timber in a Circular Economy - Practitioner Focus	STUDY ON EMBODIED CARBON FOOTPRINT OF MULTI-UNIT RESIDENTIAL BUILDINGS	Numerous studies highlight the importance of reducing embodied carbon, which includes greenhouse gas (GHG) emissions from the production of building materials, as a critical strategy in fighting climate change. Nonetheless, to evaluate the GHG emissions avoided using low carbon design strategies, such as the integration of a wood structure, a baseline scenario using a conventional structural system must be modelled. To reduce the costs of such evaluations, comparisons could be made using average GHG emission thresholds developed for different building types and structural materials. This study aims at calculating average embodied carbon footprints, expressed in kg CO2-eq/m² of total floor area, for midrise Multi-Unit Residential Building (MURB), considering four different structural systems: reinforced concrete, light-gauge steel frame, light wood frame, and mass timber. Despite the diverse sizes of the buildings studied, the results indicate that the embodied carbon footprint associated with structural materials is relatively consistent for buildings with the same type of structural system when measured per square meter of total floor area (m²).	Samuel	Cuerrier Auclair	Fpinnovations

SESSION 2
Monday 23rd June 2025
2pm to 3:30pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
2I	STCE- Practitioner	Sustainability and Timber in a Circular Economy - Engineering Focus, Sustainability and Timber in a Circular Economy - Architectural Focus, Sustainability and Timber in a Circular Economy - Practitioner Focus	Advancing Sustainable Timber Management: The Role of Responsible Wood Certification	This presentation explores the transformative potential of Responsible Wood certification in promoting sustainable forest management within the timber industry. By adhering to globally recognised standards, Responsible Wood ensures that forest products positively impact both the environment and society. The abstract emphasises the pivotal role of Responsible Wood certification in enhancing the sustainability credentials of timber products. Key benefits include biodiversity conservation, carbon sequestration, and ecosystem services, promoting a balanced approach to environmental, social, and economic sustainability. Responsible Wood, an Australian not-for-profit organisation, licenced by Standards Australia and member of PEFC, advocates for sustainable forest management through its rigorous certification scheme. Aligned with ISO standards and the UN Sustainable Development Goals, Responsible Wood prioritises transparency, impartiality, and robustness in its certification process. Responsible Wood certification enables the timber industry to achieve improved market competitiveness, brand credibility, and regulatory compliance. The abstract concludes by advocating for broader industry participation in Responsible Wood membership to drive sustainable practices and foster stakeholder collaboration. In summary, this presentation by Matt de Jongh underscores the significant role of Responsible Wood certification in advancing sustainable timber management, ensuring environmental stewardship, and promoting socio-economic benefits through rigorous and transparent certification processes.	Matt	de Jongh	Responsible Wood
2I	STCE - Practitioner	Sustainability and Timber in a Circular Economy - Engineering Focus, Sustainability and Timber in a Circular Economy - Architectural Focus, Sustainability and Timber in a Circular Economy - Practitioner Focus	Circular Timber | Timber on the Way to a Sustainable Circular Economy	The circular economy requires systemic changes within the economic system and is a key element for climate-friendly resource consumption in the construction sector. The future circular use of resources will consist of interconnected legal, ecological, financial and technical subsystems. Due to the currently unclear legal and technical framework conditions in the construction industry, despite existing solutions especially in timber construction, the transformation of the linear economic system into a circular economy has not yet been achieved. The European Union is currently in the process of revising old legislation and enacting new laws to help achieve the targeted emission reductions. The European Union Taxonomy defines which economic activities are to be classified as sustainable. In the first phase of the research project “Circular Timber”, meta-studies and analyses of the taxonomy impact on timber construction are carried out. Circular economy strategies and recommendations for the further development of technical building regulations are planned, particularly take-back concepts, evaluation of used components and evaluation of buildings considering existing building certification systems. Based on this, the second phase of the research project will present the successful examples to provide an overview of the technical solutions and concepts for reuse and recycling in timber construction.	Marius	Valente	TU Wien | Vienna University of Technology
2I	STCE - Practitioner	Sustainability and Timber in a Circular Economy - Engineering Focus, Sustainability and Timber in a Circular Economy - Architectural Focus, Sustainability and Timber in a Circular Economy - Practitioner Focus	Marketing of timber design and construction from a sound sustainability basis.	Timber is the most used and accepted sustainably sourced building material. However, greater acceptance and use of sustainably sourced timber may be impeded by the small proportion of poorly and harvested, or illegally logged materials and products entering global supply chains. This presentation gives an overview of systems currently available to verify sustainable management and origin to provide designers and practitioners confidence in a supplier’s claims of sustainability. The presentation will include an update on recent developments, both Nationally and Globally to ensure that forest products are in compliance with the EU Deforestation Regulation. Once the origin and sustainability claims have been verified, it is possible to communicate and market the sustainability values of the material or construction project.	Simon	Dorries	Responsible Wood
2I	STCE - Practitioner	Sustainability and Timber in a Circular Economy - Engineering Focus, Sustainability and Timber in a Circular Economy - Architectural Focus, Sustainability and Timber in a Circular Economy - Practitioner Focus	THE ROLE OF TIMBER BUILDINGS IN CIRCULAR BIO-BASED CITIES	Humanity's demand for ecological resources exceeds the planet's regenerative capacity. Decoupling environmental benefits from economic stagnation is necessary to transition towards more resource-efficient economic models and sustainable lifestyles. A circular city is a vision aimed at achieving growth without exceeding planetary boundaries, but defining and implementing circular cities remains a subject of debate. We argue that a broader definition of circularity is needed to include the use of timber as a building material. Timber is well-accepted as a renewable construction material if sourced from sustainably managed forests. However, traditional definitions of circularity focus on materials that can be recycled, a criterion that construction timber often does not meet. The goal of this presentation is to stimulate international discussion and strategic implementation of circular cities that go beyond the concepts of reuse, refurbishment, and recycling. We propose the concept of the "Circular Bio-based City," which aims to minimize environmental degradation by combining circularity and the use of bio-based materials (with timber as a main player) to create global regenerative loops. The goal is to foster symbiotic relationships between cities and natural ecosystems, moving towards fully integrated regenerative urban systems.	Diego	Elustondo	Scion New Zealand Crown Research Institute

SESSION 3
Monday 23rd June 2025
4pm to 5:30pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
3A	TESP - Architectural	Session Chair: PROFESSOR GREGORY NOLAN / UNIVERSITY OF TASMANIA					
3A	TESP - Architectural	Timber Engineering & Structural Performance - Architectural Focus	ASO KUMAMOTO AIRPORT: WOODEN TRUSS ROOF USING METAL PLATE CONNECTORS AND WOOD SCREWS	During the April 2016 earthquakes in Kumamoto prefecture, Japan, the Kumamoto airport, along with several other buildings, suffered damage. Due to the aging infrastructure of the airport and the importance of symbolizing the recovery of Kumamoto prefecture, it was decided to construct a new airport with enhanced earthquake resistance, incorporating local timber into the design. Japanese cedar dimensional lumber from Kumamoto prefecture was selected as a primary structural material to form the box-shaped beams supporting the airport's roof. These beams consist of two parallel wooden double-layer trusses connected at the bottom with plywood and at the top by the roof, creating a sturdy box-shaped structure capable of integrating mechanical, electrical, and plumbing systems. Depending on the required strength at each connection, metal plate connectors (for lower strength) and wood screws with LVL gussets (for higher strength) were utilized. Structural computations were performed, and testing for wood screw connections and the full-scale box-shaped beam was conducted to evaluate safety measures and gather data for future research or projects.	Azusa	Mimatsu	NIKKEN SEKKEI LTD
3A	TESP - Architectural	Timber Engineering & Structural Performance - Architectural Focus	COMPRESSIVE LOADING TEST AND BURNING TEST OF STEEL BAR-TIMBER COMPOSITE COLUMNS	We have been developing a frame system consisting of steel bar-timber composite members which can perform better than those of reinforced concrete structure. The steel bar is deformed bar, which is embedded near outer in cross-section of the composite member and bonded with epoxy resin adhesive. Bending stiffness of the composite member is estimated to be approximately five times as much as conventional glulam timber for beam and approximately twice for column. Also, the bending capacity of the composite member is estimated to be approximately three times for beam and approximately twice for column. Compression tests were conducted to determine the compression capacity of columns, including buckling capacity, and 90-minute heat test under loading. This paper presents the experimental tests, their results, and estimations of the capacities.	RIN	KAMIMAKISE	Kagoshima University
3A	TESP - Architectural	Timber Engineering & Structural Performance - Architectural Focus	The Duality of the Protruding Joint Member in Korean Traditional Wooden Architecture	One of the main characteristics of post-and-beam construction in wooden architecture is that structure and decoration are not separated. By assembling large and small wooden members, the structure of wooden buildings can be achieved, and the exposed structure often serves as a design in itself. In Korean traditional wooden buildings, there are members that have protruding joints, including lintels (changbang), purlins (dori), and beams (bo). Their ends usually play an important role in showing visual details of monumental buildings. However, there has been no research yet on whether these parts are purely decorative or what structural role it plays, and it is also unclear which parts can be included in the protruding joint member. Therefore, this paper will examine traditional wooden buildings in South Korea to clarify the definition and scope of the protruding joint members, and to categorize them. Also, the purpose of this paper is to track the process in which the protruding joints were created and gradually became decorative. In addition, by comparing to wooden buildings found in areas other than Northeast Asia, it will reveal the general characteristics of the protruding joints and the special characteristics that only appear in Korean traditional architecture.	Woohee	Kim	Seoul National University Department of Architecture & Architectural Engineering
3A	TESP - Architectural	Timber Engineering & Structural Performance - Architectural Focus	MOCKUP OF PREFABRICATED CLT MODULES FOR SMALL SOCIAL CONDOS: EVALUATION OF MACHINING, MANUFACTURING, ASSEMBLY, AND PERFORMANCE FOR STANDARDIZATION IN CHILE.	Due to the growing housing deficit, Chile developed an initiative to densify well-located 9x18 meter lots through "small social housing condominiums." So, the question arises: What can we improve from industrialization to make this opportunity more efficient, better, and more massive? This work arises from the observation that the main gaps in the awarding of subsidies in this country are the speed of response from the executors, construction times, insecurity in the neighborhoods, access to qualified labor, quality of construction, and flexibility in design. In response to these gaps, the "Industrialized Building 4 CLT modules" proposes a permanent stock of prefabricated housing, more than 90% prefabrication of the works, zero storage on site, maximum productivity in manufacturing lines, quality control in the factory and flexible modular design.	Juan José	Ugarte Gurruchaga	Centro Nacional de Excelencia para la Industria de la Madera (CENAMAD)
3A	TESP - Architectural	Timber Engineering & Structural Performance - Architectural Focus	TYPOLOGICAL OPTIMIZATION FOR REAL ESTATE DEVELOPMENTS: 8-9 STORY MASS-TIMBER BUILDINGS FOR SEISMIC ZONES.	In recent decades, different types of mass timber construction have been developed. These can be grouped according to materials -all timber, timber-concrete, timber-steel, timber-concrete-steel- and types -panels, posts-beams, and 3D modules-. After a process based on research and specific projects developed by the authors of this work, through the design with the post-and-beam typology, CLT slabs, and reinforced concrete cores and a methodology that included interviews with different real estate developers, this work resulted in a building of between 8 and 9 floors that is efficient from the point of view of the industry, that responds to seismic, cost and architectural program requirements.	Gerardo	Armanet	Centro Nacional de Excelencia para la Industria de la Madera (CENAMAD)
3A	TESP - Architectural	Timber Engineering & Structural Performance - Architectural Focus	Possibilities for Timber Structure in Stadia – Fire Engineering Approach	The demand for mass timber in construction is increasing as society seeks to build with more sustainable materials. As a result, there has been an increase in the number of mass timber buildings with these largely being commercial (office), education, and residential use. Although a few examples exist globally, an area where timber is yet to be used at scale is in stadia design. Stadia are typically large-scale structures where utilizing mass timber construction could provide sustainability and aesthetic benefits for designers. There is a perception that timber construction represents an unmanageable fire risk due to its combustible nature. In the context of stadia this is driven by catastrophic historic fires, such as the Bradford City Stadium Fire in the United Kingdom. As a result of such events, current safety and design standards introduce additional constraints for stadia where combustible structure is used which is inhibiting the uptake of timber in designs. This paper will explore the possibilities for timber in stadia and proposes a design methodology to allow mass timber construction to be used while still satisfying the intent of the globally recognized design guidance (Guide to Safety at Sports Ground, Sixth Edition - commonly known as the 'Green Guide').	Cameron	Creamer	Arup
3B	TESP - Engineering - Protective Design	Session Chair: DR CHRISTIAN VIAU / CARLETON UNIVERSITY					

SESSION 3
Monday 23rd June 2025
4pm to 5:30pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
3B	TESP - Engineering - Protective Design	Timber Engineering & Structural Performance - Engineering Focus	Blast Test of a Mass Timber Facade for Diplomatic Facilities	The U.S. Department of State's (DOS) Bureau of Overseas Buildings Operations (OBO), in collaboration with DOS' Bureau of Diplomatic Security, initiated a multi-phase applied research effort to assess the feasibility of incorporating mass timber into U.S. diplomatic facilities. As diplomatic facilities have stringent blast, ballistic, and forced entry resistance requirements, a primary objective of this effort was to demonstrate that mass timber systems can meet these requirements while still complying with the operations and logistics considerations inherent with DOS facilities. As a capstone to this effort, a full-scale two-story mock-up of a mass timber façade comprised of cross-laminated timber (CLT) panels, a ribbon window, a punched window, and a door was constructed at Tyndall Air Force Base. This mock-up was exposed to a large blast load to demonstrate its blast resistance and ability to maintain its forced entry and ballistic resistance envelope following a blast event. The results of this test indicated that the mock-up façade did indeed accomplish this objective. While the CLT panels exhibited various levels of rupture, they were shown capable of resisting the applied blast load without generating hazardous debris on the protected side of the façade. Furthermore, the self-drilling screw connections tying the panels, windows, and door elements together performed well, which serves to validate the analytical methods utilized to design the test article and its connections. The successful demonstration of this mock-up highlights the ability of CLT systems to effectively resist significant blast loads.	Mark	Weaver	Karagozian & Case
3B	TESP - Engineering - Protective Design	Timber Engineering & Structural Performance - Engineering Focus	COMPRESSIVE MECHANICAL PROPERTIES OF RADIATA PINE GRADED SAWN TIMBER CONSIDERING STRAIN RATE EFFECTS IN PROGRESSIVE COLLAPSE AND EARTHQUAKE EVENTS	The mechanical properties of timber were shown to be sensitive to the loading rate. Understanding the loading rate effects are essential to design safe timber structures with robust beam-to-column connections against dynamic loads. Consequently, this study experimentally examines the influence of the strain rate on the compressive and tensile mechanical properties of Machine Graded Pine (MGP) radiata pine (Pinus radiata) MGP10 boards, considering strain rates experienced during progressive collapse and earthquake events. In compression, the compressive strength, Modulus of Elasticity (MOE) and ductility were recorded. In tension, only the tensile strength was measured. All tests were performed both parallel and perpendicular to the grain, and under four different loading rates, with failure reached between 200 s and 0.2 s. In total 320 tests were performed. The variation of the compressive and tensile mechanical properties with the strain rates are reported and discussed in the paper.	Ayon	Das	Griffith University
3B	TESP - Engineering - Protective Design	Timber Engineering & Structural Performance - Engineering Focus	PROGRESSIVE COLLAPSE AND EARTHQUAKE STRAIN RATE EFFECT ON THE EMBEDMENT PROPERTIES OF DOWEL TYPE FASTENERS IN LAMINATED VENEER LUMBER (LVL)	Embedment strength refers to the capacity of wood to withstand deformation under the pressure exerted by a fastener and it is one of the key values in determining the design capacity of timber connections in the Eurocode 5. As this property has been shown to be sensitive to the loading rate, this study experimentally investigates the influence of the strain rate typically exhibited during earthquake and progressive collapse events on the embedment mechanical properties of dowel type fasteners inserted into softwood laminated veneer lumber (LVL) elements. Embedment tests parallel and perpendicular to the grain, with two distinct dowel diameters and using the full-hole test method outlined in the European standard EN 383 (2007), were performed under four different loading rates, with failure reached between 200 s and0.4 s. In total 320 embedment tests were carried out. The embedment strength, stiffness and ductility were calculated, and are reported and discussed in this paper.	Ayon	Das	Griffith University
3B	TESP - Engineering - Protective Design	Timber Engineering & Structural Performance - Engineering Focus	SEISMIC AND PROGRESSIVE COLLAPSE STRAIN RATE EFFECTS ON THE WITHDRAWAL STRENGTH OF SCREWS IN GLUED LAMINATED TIMBER	This study explores how the mechanical properties of timber change under varying strain rates, focusing on the dynamic behavior of screwed connections in Glued Laminated Timber (glulam) during events like seismic and progressive collapse incidents. Beam-to-column connections are crucial for the robustness of mass timber buildings, making it essential to understand their response to dynamic loads. The research examines the pull-through and pull-out strengths of screws under four strain rates, ranging from failure occurring in 200 seconds to 0.2 seconds. The paper first describes the experimental test setup and then discusses the results. While many studies have examined other effective parameters on withdrawal strength of timber under quasi-static loads, the impact of strain rates on withdrawal strength has not been previously considered. This study provides preliminary insights into the effects of dynamic loads on the pull-through and pull-out strengths of screws in glulam.	Nasim	Ghasemi	Griffith University
3B	TESP - Engineering - Protective Design	Timber Engineering & Structural Performance - Engineering Focus	SEISMIC AND PROGRESSIVE COLLAPSE STRAIN RATE EFFECTS ON THE COMPRESSIVE AND TENSILE MECHANICAL PROPERTIES OF SOFTWOOD LAMINATED VENEER LUMBERS (LVL)	This study investigates how intermediate strain rates, encountered during seismic and progressive collapse events, affect the compressive and tensile properties of softwood laminated veneer lumbers (LVL). Experimental tests were performed in both parallel and perpendicular directions to the grain at four different strain rate levels. The findings reveal that the mechanical properties of LVL change with varying strain rates. Understanding these changes is essential for designing safe and reliable timber structures with strong beam-to-column connections. The research specifically examines the influence of intermediate strain rates on the compressive strength, ductility, modulus of elasticity, and tensile strength of LVL, a material commonly used in residential and commercial timber buildings.	Nasim	Ghasemi	Griffith University
3B	TESP - Engineering - Protective Design	Timber Engineering & Structural Performance - Engineering Focus	Proposed Approach for the Design of Timber Connections Subjected to Blast Loading	A near-decade-long comprehensive test program on timber connections subjected to shock tube simulated blast loads has been undertaken. A generalized capacity-based blast design methodology is presented, based on the experimental test results, aimed at promoting ductility in connections and a sequence of failure that seeks to minimize occupant harm during extreme load events. Key results on connection behaviour, typical failure modes observed, as well as overstrength factors for capacity-protected structural elements will be discussed, and a generalized design approach for the design of timber connections will be presented. The proposed generalized design methodology is also evaluated using pressure-impulse diagrams, in which the potential enhancement in the performance and energy dissipation of timber assemblies, designed with proper failure hierarchy in the connections and load-bearing timber elements, is demonstrated. The main outcome of this research program will guide the development and paradigm shift in blast design guidelines for timber connections.	Antoine	Bérubé	University of Ottawa
3C	TESP / MPD - Engineering - CLT Walls	Session Chair: HARALD KRENN / KLH Massivholz GmbH					
3C	TESP / MPD - Engineering - CLT Walls	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	FIRE BEHAVIOUR OF CLT FLOOR TO WALL CONNECTIONS: FINDINGS FROM THE WOODWISE PROJECT	Mass timber floor-to-wall connections provide stability to the building throughout a fire condition. These connections often are often constructed with steel plates and screws thereby making the thermal penetration and heat transfer through the connection complicated due to the mixed materials. Previous research on these connections has demonstrated that there is a potential for smouldering hotspots in these connections during the decay phase of the fire. This study will investigate the fire behaviour of Cross-Laminated Timber (CLT) floor-to-wall connections as part of the WOODWISE project (Wood Optimization for Occupant Safety, Design Innovation, Wood Engineering, Smouldering, and Emissions). The research will focus on the performance of these connections during the heating and decay phases of large-scale compartment fires. Two types of connections will be tested in four fire scenarios, each with varying levels of encapsulation and fuel loads. Key findings will include the temperature profiles, the potential smouldering hotspots during the decay phase, and the impact on structural integrity.	Erica	Fischer	Oregon State University

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
3C	TESP / MPD - Engineering - CLT Walls	Timber Engineering & Structural Performance - Engineering Focus	CROSS-LAMINATED TIMBER WITH GAPS FOR WALL ELEMENTS	CLT as a building material is one of the most relevant modern mass-timber products with continuous growth in worldwide market share. The increased demand of CLT products, however, goes hand in hand with an increasing use of raw material. Among various approaches to minimize the use of timber, the reduction of material within the CLT lay-up is pursued in the work presented here. It is targeted to decrease structural overperformances of standard CLT elements, which is evident within CLT walls, where fire resistance is the decisive design factor and an underutilization of the load-bearing capacity is present. Towards this aim, an experimental study was performed to examine the effects of CLT lay-ups with gaps on mechanical properties such as strength and stiffness. Focussing on structural wall components, tests of bending and buckling behavior as well as in-plane shear properties were performed. A variation of lay-ups with different gap widths and board dimensions was investigated. It was shown that the material reduction led to an disproportionate decrease of strength capacities and element stiffness. From a certain extent of gaps in the cross-layers, shear deformations have an impact on the buckling capacity. In bending tests, rolling shear was the predominant failure mode, despite analytical calculations estimating a bending failure in some cases. Concluding, gaps in a CLT lay-up lead to a significant reduction of material, while at the same time satisfying structural requirements for load-bearing wall elements.	Philipp	Dietsch	Karlsruhe Institute of Technology (KIT)
3C	TESP / MPD - Engineering - CLT Walls	Timber Engineering & Structural Performance - Engineering Focus	Experimental Testing of an In-Situ Strengthening Process for CLT Panels	During construction or the in-service stage of a building's life, it is possible for CLT panels to be damaged. This could result from a mechanical impact during transportation or installation, damage caused by long-term exposure to moisture resulting from failed waterproofing or building envelope or damage due to fire. If damage to CLT panels does occur, the strength or stiffness of the panel may be reduced in the region of damage and may need to be repaired using a validated process. The strength of the repaired panel will need to be determined relative to the original manufactured specification so the panel may be assessed by the structural engineer. This study presents testing of a repair process that has been developed by XLam for use with CLT wall and floor panels. The goal is to develop a general repair process that can be effectively carried out on site to achieve stiffness and strength equivalent to the original panel. The structural and glue line integrity testing indicate that a site-based repair process with an appropriately controlled process for applying the adhesive has the potential to achieve effective replacement of the outer lamellas and restore capacity of CLT panels should damage occur. Development of robust panel repair methodologies may assist building owners/managers and structural engineers to expand the use of CLT in projects.	Tom	Watts	XLam
3C	TESP / MPD - Engineering - CLT Walls	Timber Engineering & Structural Performance - Engineering Focus	Evaluation of CLT Seismic Resistant Walls with Arbitrary Arranged GIR Joints	GIR joints with steel bars are a relatively inexpensive method of joining high strength and rigidity to wood materials, and can be used to join CLT seismic walls to surrounding framing to achieve high strength CLT walls. In a previous report[1], cyclic loading test results of CLT walls with GIR joints were presented, showing that high bearing capacity and energy absorption can be obtained and that the performance under cyclic loading can be predicted by numerical calculations. In this paper, an evaluation formula is proposed to predict the stiffness and bearing capacity at the wall footings for an arbitrary GIR joint arrangement by hand calculations, and the results are compared with previous experimental results. In past experiments, GIR joints close to the surface of the CLT sometimes failed to exhibit the expected bearing capacity because of crack failure when large tensile forces due to rocking of the wall legs were applied to the GIR joints. We have developed a cracking reinforcement method for GIR joints using steel tubes and long screws, which can exhibit the designed bearing capacity and toughness.	Daisuke	Kadono	NIKKEN SEKKEI LTD
3C	TESP / MPD - Engineering - CLT Walls	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	PUSH-OUT TESTING OF ADHESIVELY BONDED LIGHT GAUGE STEEL AND FRP TO TIMBER CONNECTIONS: AN EXPERIMENTAL STUDY	This study investigates the cyclic behaviour of STC connections with mechanical shear connectors. Twelve STC joints were fabricated by connecting the cross-laminated timber (CLT) panels to the flanges of a steel profile and the joints were subjected to low-cycle high-amplitude loading regime. Effects of the shear connector type (i.e. screw, high strength bolt), shear connector size and the orientation of CLT panels (outer lamellas parallel and/or perpendicular) with respect to the direction of the load were considered in the experimental program. The ductility, strength impairment and equivalent viscous damping which characterise the performance of a mechanical shear connector under cyclic loading conditions in steel-timber composite connections were assessed. The results of the cyclic tests demonstrated the high ductility and energy dissipating capacity of the steel-timber composite connections. A simple hysteretic model was proposed for steel-to-CLT composite connections with bolt and screw shear connectors and the model was calibrated against the results of laboratory experiments.	Alireza	Chiniforush	University of Melbourne
3C	TESP / MPD - Engineering - CLT Walls	Timber Engineering & Structural Performance - Engineering Focus	Ribbed CLT Elements with cut-backs	The use of cross laminated timber (CLT) in combination with glulam ribs has become increasingly popular in timber construction. Especially in cases with relatively large spans or higher loads, this solution is even necessary to compete with oder building materials. To simplify the process in platform frame type constructions, the ribs may be cut-back so the wall-floor-wall interface is still easily manageable on site. The described cut-back is causing additional stresses in the CLT-element wich can quickly become of high relevance. To bring this potentially critical situation to the attention of the designing engineer and to evaluate the magnitude of these stresses (mainly rolling-shear), using a simplified engineering model, are the aims of this paper.	Harald	Krenn	KLH Massivholz GmbH
3D	TESP - Engineering - Numerical Investigations	Session Chair: PROFESSOR MASSIMO FRAGIACOMO / UNIVERSITY OF L'AQUILA					
3D	TESP - Engineering - Numerical Investigations	Timber Engineering & Structural Performance - Engineering Focus	SHEAR FORCE CAPACITY OF CROSS LAMINATED TIMBER BEAMS – NUMERICAL INVESTIGATIONS OF FRACTURE BEHAVIOUR	This paper deals with numerical investigations of cross laminated timber (CLT) beams. Previous investigations have revealed discrepancies between experimental test results and suggested design methods regarding shear force capacity of such beams. To gain further understanding of the failure behaviour and the shear force capacity of CLT beams, nonlinear finite element analyses using a cohesive zone approach for representation of the fracture behaviour of the bonding between laminations have been performed. Numerical results, analytical model predictions and findings from experimental tests will be compared regarding the influence of different beam geometry parameters. The aim of the present work is to gain further understanding of the failure behaviour and shear force capacity. Such knowledge is needed for development of rationally based and reliable design methods for CLT beams.	Erik	Serrano	Lund University

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
3D	TESP - Engineering - Numerical Investigations	Timber Engineering & Structural Performance - Engineering Focus	SHEAR PERFORMANCE INVESTIGATION ON THE NOTCH-SCREW CONNECTIONS FOR TIMBER-UHPC COMPOSITE STRUCTURES	This paper presents the shear behavior of notch-screw shear connectors used in glulam-UHPC composite (GUCC) structures. Seven groups of push-out specimens with different notch length, notch depth and the shear length in front of the notch were prepared and tested in direct shear under monotonic loading conditions. The experimental determination of the strength, the slip modulus and the failure modes were made by push-out tests. Subsequently, a numerical modeling using ABAQUS was carried out in order to develop a three-dimensional numerical model that represented the connection. The results indicated that direct UHPC shear failure was the main failure mode for the notched connections. The notch length and notch depth significantly influenced the load-carrying capacity and slip stiffness of the specimens combining a notch and two screws. Comparing numerical and experimental results demonstrated that the numerical model could accurately predict the failure load and the slip modulus of the connection.	Jiajia	Ou	China Southwest Architectural Design and Research Institute Corp. Ltd.
3D	TESP - Engineering - Numerical Investigations	Timber Engineering & Structural Performance - Engineering Focus	NUMERICAL ANALYSIS OF THE GAP BETWEEN SHEATHING PANELS AND FRAMES FOR SHEAR WALL SYSTEMS	A basic wood-frame shear wall consists of a wood-frame, a sheathing panel and fasteners connecting the frame and the panel. Traditionally, there is no gap required between sheathing panels from adjacent shear walls for structural purposes. There is no issue if adjacent walls move in the same direction or at the same magnitude. However, if adjacent walls do not move in the same direction or at the same magnitude, sheathing may pond each other, resulting in performance different from that of a single wall or breakage around corners of the panels. This study aims to provide a solution about the distance between the corners of the frame and the corners of the sheathing when the frame deforms under lateral loads. Five different wall aspect ratios are studied for the distances. The results are summarized in a table. The results of the distance can be used to guide engineering practice of wood-frame shear walls about the gap between sheathing panels of wood frame shear walls and other wall systems. Moreover, the results can be used to examine other configurations of new wall systems.	James	Gu	TRU
3D	TESP - Engineering - Numerical Investigations	Timber Engineering & Structural Performance - Engineering Focus	NUMERICAL MODELING OF CROSS-LAMINATED TIMBER SHEAR WALLS	This paper reviews and proposes improvements to numerical models predicting the seismic response of Cross-Laminated Timber (CLT) shear walls. Current models, which focus on individual components, fail to account for global phenomena and second-order effects like friction forces and shear-axial interactions in connections. The enhanced model uses Bayesian methods to select the most suitable constitutive material model and optimize parameters for commonly used hysteretic models such as Pinching4, Bilinear, and SAWS. The study emphasizes the importance of considering both component responses and global effects to improve seismic behavior predictions for mass timber buildings. By incorporating friction forces and axial-shear stress interactions, the proposed model significantly enhances the accuracy of seismic performance assessments.	Ramin	Sarange	University of California, San Diego
3D	TESP - Engineering - Numerical Investigations	Timber Engineering & Structural Performance - Engineering Focus	LATERAL TORSIONAL BUCKLING TESTS AND NUMERICAL SIMULATION OF GLUED LAMINATED TIMBER BEAMS	The out-of-plane stability of slender timber beams under flexural bending is a key aspect in their structural design. The effects of lateral torsional buckling can be verified either using the equivalent member method or by determining the internal forces according to second order theory and considering equivalent imperfections. As in some cases the results of the two approaches leads to different results, experimental investigations were performed to deepen our understanding of the phenomenon. This paper presents tests investigating lateral torsional buckling effects on glued laminated timber beams leveraging well known material properties. During fabrication of the glued laminated timber beams, the material properties of the timber boards as well as the position of the boards in the beam were meticulously documented. The experimental sequence included assessment of bending and torsional stiffness, geometrical imperfection measurements, bending strength evaluation and lateral torsional buckling test on glued laminated timber beams. The boundary and loading conditions were very close to the idealized assumptions. Based on the experimental results, numerical models were calibrated and validated. In addition, preliminary values for equivalent imperfections crucial for designing according to second order theory were derived by this study.	Vera	Wilden	RWTH Aachen University, Institute of Steel Construction
3D	TESP - Engineering - Numerical Investigations	Timber Engineering & Structural Performance - Engineering Focus	EFFECT OF CONNECTION NONLINEARITY ON WIND PERFORMANCE OF TALL MASS TIMBER BUILDINGS	Mass timber products have gained significant recognition in the construction of tall buildings, providing a sustainable solution for urban development. As those products have shown high in-plane strength and stiffness, energy dissipation and ductility of lightweight and flexible tall mass timber structures under lateral loads rely on metal connectors. Those connectors are commonly treated as nonlinear in conventional seismic analysis but are often simplified as linear in wind assessment. However, under extreme wind hazards, excessive wind-induced vibrations may push the mass timber building beyond serviceability level and drive connections into nonlinear stage. This paper investigates the impact of nonlinear connections on wind performance of tall mass timber buildings. To improve the efficiency of traditional discrete connectors modelling in cross-laminated timber (CLT) wall panels, a novel nonlinear “continuous zone” modelling approach is proposed to integrate all connectors, including hold-downs, shear brackets, and spline joints. The modelling is calibrated and validated with full-scale shake table test data from a 3-story CLT building and is applied for wind assessment of a 30-story mass timber building using numerical fluid-structure interaction technology at different wind intensities.	Chi	ZHANG	The Hong Kong University of Science and Technology
3E	TESP / MPD - Engineering use of Hardwoods	Session Chair: PROFESSOR ROBERT JOCKWER / TU DRESDEN					
3E	TESP / MPD - Engineering use of Hardwoods	Material Performance & Durability - Engineering Focus	MECHANICAL PROPERTIES OF HIGH-PERFORMANCE LVL MADE FROM EUCALYPTUS GLOBULUS L.	Eucalyptus globulus Labill. is a fast-growing hardwood with excellent mechanical properties and natural durability. Despite these qualities, the use of solid wood-based products from this species is constrained by challenges associated with sawing and drying processes, making it primarily intended for the paper and pulp industry. This study focuses on the experimental evaluation of laminated veneer lumber (LVL) made from E. globulus from Spain, a promising product that significantly reduces these processing hurdles. The main mechanical properties in bending, tension, compression and shear have been determined, taking into account the influence of different lay-ups. The results are quite encouraging, revealing a very high-performing structural timber product of great potential.	Almudena	Majano-Majano	Technical University of Madrid
3E	TESP / MPD - Engineering use of Hardwoods	Material Performance & Durability - Engineering Focus	Potential for high-stiffness engineered wood products from Eucalyptus fastigata	Utilizing a novel resource, such as fast grown hardwoods, for engineered wood products may provide an opportunity to utilize existing manufacturing capability produce greater volumes of high stiffness wood products. Here laminated veneer lumber was produced from 23-year-old Eucalyptus fastigata in a commercial radiata pine mill. Mechanical properties were very promising (e.g. average stiffness 14 GPa compared to 10 GPa for typical radiata pine production). Property testing showed boards met or exceeded the New Zealand LVL13 grade for most of the properties tested. While the results are promising, there is scope to improve the manufacturing process, and to understand the performance of LVL manufactured under production conditions, rather than in a scientific trial which involved delays and frequent manual handling of veneers, both of which are known to degrade the veneers and affect gluing performance.	Rosie	Sargent	Scion

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
3E	TESP / MPD - Engineering use of Hardwoods	Material Performance & Durability - Engineering Focus	IDENTIFICATION OF MATERIALS AND BONDING PARAMETERS FOR CROSS-LAMINATED PANELS MADE IN ASIA	This study investigates adhesive bond performance in cross-laminated panels (CLT) made from timber, bamboo, and palm, addressing the rising demand for sustainable construction materials in Asia. It expands on previous research by including eucalyptus, acacia, rubber wood, and coconut tree fibers, all sourced from the Asian region. Specimens were bonded using polyurethane (PUR), melamine-urea-formaldehyde (MUF), and phenol-resorcinol-formaldehyde (PRF) adhesives and tested for shear strength and bending under clamping pressures of 0.6 to 1.0 MPa. The Multi-Criteria Decision Making (MCDM) method identified the best solutions based on mechanical properties, adhesive performance, and production costs. Eucalyptus and acacia fibers showed strong bonding and mechanical performance, especially with PUR and PRF at 0.8 to 1.0 MPa. Bamboo, particularly in laminated and scrimber forms, demonstrated high strength with MUF and PRF at 0.6 to 0.8 MPa. Rubber wood and coconut fibers showed moderate performance, with coconut facing compatibility issues. Optimal bonding generally occurred at 0.8 MPa. The findings suggest these wood species have significant potential for sustainable CLT production in Asia, particularly in regions lacking traditional timber. This study emphasizes the big potential for Asia-made CLT panels, providing a crucial foundation for developing high-performance, eco-friendly construction materials. The results highlight the importance of selecting appropriate adhesives and bonding conditions to optimize performance, offering a valuable resource for advancing sustainable construction practices in the region.	Karol	Sikora	Neacemka
3E	TESP / MPD - Engineering use of Hardwoods	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Study of the slip performance of screws in Eucalyptus nitens (E. nitens) from Tasmanian fibre-managed plantations	This study focuses on the slip performance of screws in E. nitens products, a critical factor for their application in timber-based composite constructions. By examining the influence of screw geometry, timber properties and effective penetration length on slip performance, this research aims to optimise their application in engineering and timber-based composite constructions such as Timber-Concrete Composite (TCC) systems. Experiments conducted on E. nitens sawn boards (535 valid samples) and E. nitens GLTs (199 valid samples) using six types of screws revealed that screw nominal diameter, flank distance, effective penetration length, screw material and timber density can affect screw slip performance. These findings provide valuable insights into the mechanical properties of E. nitens products, informing the design and application of fastening systems in sustainable construction materials. Preliminary findings revealed significant insights into the relationship between screw geometry and axial slip resistance in E. nitens products. The analysis showed that a larger flank distance (P) allows more movement between the screw and timber. Furthermore, a larger thread geometry ratio (a/r), defined as the ratio of thread height (a) to thread depth (r), was found to reduce axial slip resistance (Kser,ax). Additionally, the results indicated a positive effect of timber density (ρ12) at 12% MC on screw axial slip resistance. However, this positive effect diminished as the screw nominal diameter (do) increased.	Zhiqian	Zhong	University of Tasmania
3E	TESP / MPD - Engineering use of Hardwoods	Timber Engineering & Structural Performance - Engineering Focus	GLULAM AND LAMINATED VENEER LUMBER STRUCTURAL PRODUCTS MANUFACTURED FROM AUSTRALIAN SOUTHERN BLUE GUM GROWN FOR WOODCHIPS	Demand for wood products is growing internationally, and new initiatives are necessary to sustainably meet this demand. This paper presents such an initiative investigating the possibility of manufacturing glued laminated timber (glulam) and laminated veneer lumber (LVL) structural products from Australian southern blue gum (Eucalyptus globulus) plantation logs traditionally grown for woodchips purposes. 120 logs were harvested from two different plantations (15-year-old and 19-year-old) and processed at the Salisbury Research Facility into rotary peeled veneers (80 logs) and sawn boards (40 logs). The modulus of elasticity and visual grade distributions of the recovered veneers were assessed, as well as the compressive, tensile, shear, and bending strengths, density and modulus of elasticity of 240 sawn boards. The characteristic data were then used to assess the product grades which could be manufactured from the resources using different construction scenarios. Glulam and LVL were finally manufactured and experimentally tested to confirm the potential of the resources in the production of suitable engineered wood products. This conference paper focusses on presenting the key data on the raw material, specifically the modulus of elasticity distribution of the veneers, and the tensile and compressive strengths of the sawn boards. The results from selected manufactured glulam and LVL are also presented and discussed.	Benoit	Gilbert	Griffith University
3F	TESP - Engineering - Automation / Software	Session Chair: A/PROF JOE GATTAS / THE UNIVERSITY OF QUEENSLAND					
3F	TESP - Engineering - Automation / Software	Timber Engineering & Structural Performance - Engineering Focus	NET-ZERO TIMBER BUILDING DESIGN TYPOLOGIES	Digital transformation is not only changing business models, working methods, production, and construction processes but also impacts automation-compatible designs and material systems. The project seeks to establish collaboration between architects, engineers, and software specialists to enable sustainable buildings. It aims to facilitate early-stage decision-making by providing validated and informed building typologies and material systems, supported by statistical analysis. DBF has created an easy-to-use, online software for architects and city planners to explore and validate building design concepts. Alongside its enterprise software business, DBF regularly conducts and publishes research activities; with a specific focus on innovative generative design methodologies and approaches to improve project sustainability outcomes. The Bern University of Applied Sciences (AHB/BFH) engages in innovative scientific R&D in multi-storey timber and hybrid construction, focusing on typologies for grids, floor / wall / roof, and general construction systems. The collaboration aims to create algorithms for generating site-specific typologies for multi-storey wood buildings and identify timber construction use cases at various scales. The DBF platform will integrate static concepts for vertical and horizontal load transfer and constructive solutions to specify suitable bracing systems for tall buildings, assign structural elements and floor systems to address structural design issues. Additionally, the project aims to specify the most suitable materials and combinations for fire safety, energy efficiency and sustainability at the predesign stage, thereby aiding decision-making processes.	Christophe	Sigrist	BFH
3F	TESP - Engineering - Automation / Software	Timber Engineering & Structural Performance - Engineering Focus	RECLAIMED TIMBER ASSESSMENT SUPPORTED BY LIDAR SCANNING	A pipeline for predicting mechanical properties of reclaimed timber based on element scans acquired through LIDAR scans and combined with photogrammetry, image analysis, and structural analysis with numerical model generated for finite element method is proposed and tested on a set of historical timber beams from Norway. Automation of the process is prioritized for efficiency of deployment on building site and real time feedback for decision-making on reuse potential of the timber building components.	Jan	Pelczynski	Warsaw University of Technology

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3F	TESP - Engineering - Automation / Software	Timber Engineering & Structural Performance - Engineering Focus	PREFABRICATED MASS TIMBER HYBRID SYSTEMS: INVESTIGATION ON ADOPTING CNC-MADE CARPENTRY JOINTS TO INDUSTRIALIZED LONG-SPAN FLOORS	Automation in Construction 4.0 encompasses the use of robotics, machinery and automated processes to enhance production efficiency and manufacturing accuracy. While automation in the design and assembly of timber structures has been extensively discussed in the field of architecture, most implementations are limited to small-scale demonstration projects. Modularized prefabricated timber assemblies can benefit greatly from automation; however, challenges persist in the proper design of connection systems, especially for large-scale structural systems. Despite current manufacturer capabilities in producing prefabricated wall assemblies, there remains an opportunity to develop higher-level prefabricated assemblies in factory settings. CNC-made carpentry joints are optimal candidates for assessing this design problem. Integrated design is needed to meet structural demands in modern constructions and manufacturing restraints in CNC machinery. However, most discoursed designs fail to use a standardized digital environment. This paper addresses these gaps by proposing a workflow for the development of innovative CNC-made carpentry joints for use in long-span CLT-glulam composite flooring systems, testing such a digital environment via the structural design and fabrication of full-scale bamboo tenon-type shear connectors. This innovation highlights the potential for integrating automation in the future mass production of carpentry joints for prefabricated mass timber assemblies.	Cristiano	Loss	The University of British Columbia
3F	TESP - Engineering - Automation / Software	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	STRUCTURAL PERFORMANCE ANALYSIS OF HOLLOW GLUE-LAMINATED TIMBER	Recently, innovative systems for the construction of prefabricated timber houses have been developed worldwide. The aim of most manufacturers is to develop elements that simplify construction, i.e. achieve maximum speed and economy. The cavities significantly reduce the weight of the GLT elements, making them easy to transport, which not only eliminates the need for cranes and machinery, but also makes construction cheaper. An experimental and numerical analysis of the effects of perforation on the behavior of the GLT elements (softwood and hardwood) under ambient conditions was carried out. In addition, a parametric FEM analysis was carried out by varying the number and arrangement of holes in the cross-section of the timber element. Hollow GLT elements made of softwood (degree of perforation 28%), achieved 69.65% of the load-bearing capacity of the solid cross-section specimens. Hollow GLT elements made of hardwood achieved an average of 72.63% of the load-bearing capacity of the solid cross-section samples. Furthermore, it was shown that the degree of cavity formation is proportional to the CSPG regardless of the type of wood. The experimental investigations (bending and compression perpendicular to the grain) were confirmed by the FEM analysis.	Nikola	Perković	Faculty of Civil Engineering, University of Zagreb
3F	TESP - Engineering - Automation / Software	Timber Engineering & Structural Performance - Engineering Focus	EQUIVALENT SHELL MODEL FOR CLT SHEAR WALLS	A proposal for a numerical model of low computational cost using an orthotropic material on a shell element is presented to model CLT Shear Walls. The model was developed taking in consideration a theoretical model to predict CLT shear walls displacements, which takes into account the influence of the overturning on the horizontal displacement, and was compared with other commonly used simplified models, which neglect this effect. A FEA software was used to model a simple building to compare three different models, where the overall displacement and the deformation is presented.	Sebastian	Carcamo	Centro Nacional de Excelencia para la Industria de la Madera (CENAMAD-CIM UC)
3G	ECCS - Practitioner / Engineering	Session Chair: PROFESSOR KEITH CREWS / THE UNIVERSITY OF QUEENSLAND					
3G	ECCS - Practitioner / Engineering	Timber Engineering & Structural Performance - Engineering Focus	ANALYTICAL EVALUATION OF PLATFORM-TYPE MULTI-STOREY CLT SHEAR WALLS	Many preceding studies have focused on investigating the seismic behaviour of platform-type single-storey cross-laminated timber (CLT) shear walls, encompassing both experimental investigations and analytical developments. However, no experimental validation has been conducted for analytical expressions related to lateral resistance, deflection of multi-storey shear walls, and the associated capacity-based design procedure. In this study, two examples of two-storey experimental tests are compared with analytical solutions. Subsequently two six-storey shear wall case studies were analytically examined to study the contribution of various components, i.e. the different connections, to the lateral behaviour. A recently proposed capacity-based design procedure was used to verify the yielding sequence and ensure protected elements remain elastic. The significant influence of aspect ratio of shear wall panels was also observed. With an appropriate connection design, rocking deformation was dominant, while bending deformation accounted for less than 30% of the total deflection, meeting the requirements of the Canadian Wood Engineering Design Standard.	Mohammad	Masroor	University of Northern British Columbia
3G	ECCS - Practitioner / Engineering	Timber Engineering & Structural Performance - Practitioner Focus, Exemplars & Construction Case Studies - Practitioner Focus	A VERTICAL INSTALLATION METHOD OF CROSS LAMINATED TIMBER (CLT) FOR REINFORCING SOFT GROUND	In order to expand the use of CLT in civil engineering, the vertical installation of CLT into the ground for soft ground reinforcement was considered. A full-scale experiment was carried out in the field to study the workability of a construction method for CLT installation into the ground. The results show that the vertical installation of CLT was possible by applying a mid-depth slurry ground improvement method called the WILL method, in combination with the setting of a special frame on the surface as a countermeasure against CLT uplift.	Hong Son	NGUYEN	Hazama Ando Corporation
3G	ECCS - Practitioner / Engineering	Timber Engineering & Structural Performance - Practitioner Focus, Exemplars & Construction Case Studies - Practitioner Focus	From Lab to Field: Implementing Adhesive Bonded Timber-Concrete-Composites Ceilings - A Pilot Project	The global need for sustainable solutions, particularly in the field of building construction, presents a significant challenge that has to be addressed in near future. A promising solution are timber-concrete-composite (TCC) ceiling systems. The company fischerwerke GmbH & Co. KG and the Institute of Green Civil Engineering are currently together developing a new system focusing on a glued bond line. The system is based at a dry prefabrication process which allows the preproduction of the concrete and timber parts independently before they are joined together either just before the ceiling elements are delivered or directly on site. This paper focuses on the transitioning from laboratory conditions to a first practical application within a prototype construction project. The objective is to assess the system's suitability in a real-world production and installation scenario and identify the challenges associated with its implementation. Within the project 153m² ceiling (solid slab glued together with timber beams) could be successfully produced and installed. The large-scale pilot project demonstrated the feasibility and advantages of adhesive bonded TCC elements. Furthermore, the developed prefabrication process likely resulted in reduction of production time and labor costs. These findings indicate a promising future for the broader application of bonded TCC elements in both the renovation of existing buildings and the construction of new structures.	Florian	Brosch	BOKU University
3G	ECCS - Practitioner / Engineering	Exemplars & Construction Case Studies - Engineering Focus	NEW PERFORMING ARTS VENUE CROSS-LAMINATED TIMBER AUDITORIUM	The New Performing Arts Venue (NPAV) adopts Cross Laminated Timber (CLT) for all of its 1500 seats. Timber offered unique benefits to the project, allowing improved control of sightlines, reduced weight of cantilever balconies, and a construction sequence that took placement of tiered seating off the critical path. The project demonstrates that there is a use for timber on many projects, including large scale public buildings and is not confined to multi-storey mass timber structures. The adoption of the material on this major project brought many lessons and experience presented here.	Carsten	Moeller	ARUP PTY LIMITED

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
3G	ECCS - Practitioner / Engineering	Exemplars & Construction Case Studies - Engineering Focus	IMPLEMENTATION OF ADAPTABLE DESIGN PRINCIPLES FOR HIGH-PERFORMANCE LIGHT TIMBER FRAMED PANELISED BUILDINGS: AN AUSTRALIAN CASE STUDY	Australia faces a housing crisis marked by high mortgages for oversized, underperforming homes, making home ownership increasingly inaccessible for younger generations. Adaptable housing allows homes to evolve with household needs and incorporates future-proof design principles. This paper present findings of research aimed to explore the technical feasibility of adaptable housing in Southeast Queensland using a modular, reconfigurable, and relocatable light timber framed design that can respond to changing occupant needs. Design considerations, technical challenges and corresponding solutions, are presented with focus on structural and hygrothermal design.	Zidi	Yan	The University of Queensland
3H	EIC - Practitioner	Session Chair: TOBY HODSDON / ARUP					
3H	EIC - Practitioner	Education, Innovation & Challengers - Practitioner Focus	Innovation Diffusion of Mass Engineered Timber (MET) Construction: Assessing Key Parameters through a Survey of Building Industry Professionals	Mass Engineered Timber (MET) has emerged as an innovative strategy for sustainable construction. However, more built examples are found in Europe and North America, with far fewer in Asia. This research explores the reasons by measuring building industry practitioners' perceptions across three regions with different levels of MET adoption: Europe and North America (early adopters), Australia and New Zealand (early developing) and South-east Asia (under developed). Based on literature review, a parameter framework composed of comprehensive attributes grouped into four "Enabling Parameters" and four "Decision-making Parameters" were formulated. A detailed survey (comprising of 27 questions with a total of 81 attributes) was then completed by 186 individuals showing that building practitioners' perception, knowledge and experience of MET are the lowest in South-east Asia (most responses from Hong Kong and Singapore). Protection against fire and water damage, ease of repair and maintenance, and doubt of its suitability for high-rise building types are primary concerns in the region. This research identifies specific needs to improve perception and adoption of MET, considered in the context of the region's market acceptance, and its climate and built environment. Further research is on-going by the authors for focused interviews and case studies of prominent projects to examine the parameters at city and project levels. This survey and the case studies form part of the PhD thesis of the first author in the University of New South Wales.	Florence	Wong	UNSW Australia
3H	EIC - Practitioner	Education, Innovation & Challengers - Practitioner Focus	MOVING TOWARDS THE MAINSTREAM MARKET ADOPTION OF MASS TIMBER IN THE UNITED STATES	Over the past decade in the United States (U.S.) there has been a consistent and sustained effort to significantly increase wood product's share of the multi-family, commercial, and institutional segments. New building systems utilizing mass timber have begun to shift the market to wood solutions. This paper examines the current state of wood construction in these markets, the growth of mass timber projects, and successes and challenges of adoption. Key to the mainstream adoption of mass timber is the education of not only engineers and architects but also contractors and developers. All project decision makers must be educated and understand their role in creating a successful mass timber building solution.	Bill	Parsons	WoodWorks - Wood Products Council
3H	EIC - Practitioner	Timber Engineering & Structural Performance - Practitioner Focus, Education, Innovation & Challengers - Engineering Focus, Education, Innovation & Challengers - Practitioner Focus	Product Development for a Range of Innovative Mass Timber Connectors	This paper describes the development of a range of innovative mass timber connection products by Holmes Solutions LP in New Zealand. Extensive research of Key Customer Requirements identified opportunities for connection systems to deliver both high levels of structural performance and more efficient assembly. Speed and complexity of on-site connector installation were identified as a key factor driving the total cost of ownership (TCO) of state-of-the-art mass timber buildings. Laboratory testing of various typical connection products in realistic assembly situations generated data to quantify evidence-based requirements for the new family of products driven by Design for Manufacture and Assembly (DfMA). A lack of globally applicable technical data for fire protection and seismic compatibility was also identified, restricting the suitability of currently available connectors in certain key markets. In partnership with a major global construction systems supplier, Holmes Solutions has developed a novel range of beam and column connections which address these opportunities. Part of this technology family has been successfully installed in a four storey commercial building currently under construction in New Zealand, establishing confidence for further pilot projects and worldwide market launch.	Jon	Roebuck	Holmes Solutions Lp
3H	EIC - Practitioner	Education, Innovation & Challengers - Practitioner Focus	ADVANCING TALL WOOD BUILDINGS WITHIN CANADIAN PROVINCIAL BUILDING CODES	The National Building Code of Canada (NBC) has historically limited residential and office buildings of combustible construction up to 6 storeys and required noncombustible construction for structures exceeding this limit. The 2020 NBC introduced a new construction type, encapsulated mass timber construction (EMTC), which enabled the design and construction of tall wood buildings up to 12 storeys. Since then, there has been an increased demand from the Canadian industry professionals to expand the applicability of EMTC to allow greater design flexibility and provide more options for achieving sustainability goals. While new editions of the NBC are published every 5 years, the expansion of prescriptive EMTC Code provisions was deferred to 2030 due to resource constraints during the 2020-2025 Code development cycle. As provincial governments in Canada have the authority to regulate building design and construction within their jurisdictions, several provinces agreed to jointly expedite the development of expanded EMTC Code provisions to meet pressing provincial needs, ahead of and outside the national framework. This paper summarizes expedited Code changes (e.g., permitted occupancies, building heights and areas, new encapsulation requirements etc.) accepted by participating provinces as of April 2024, and discusses the underlying justification used to support them.	Marc	Alam	Canadian Wood Council
3H	EIC - Practitioner	Sustainability and Timber in a Circular Economy - Practitioner Focus, Education, Innovation & Challengers - Practitioner Focus, Exemplars & Construction Case Studies - Practitioner Focus	Opportunities and Barriers Associated with the Use of Timber Products in Commercial Buildings in Tasmania, Australia	The forest poduct sector is a key contributor to regional Tasmanian economy. Although opportunities have been identified for the production and supply of structural and appearance timber products from forest resources in the state, many of these markets are highly competitive. Many questions are faced by the forest and timber product sector with changes in access and resource supply. This necessitates the requirement to better understand the holistic nature of the projects and the factors concerning the selection of contruction materials. Extensive research exists on the opportunities and barriers of using timber products in buildings. However, most of these studies are based on online questionnaire surveys with large sample sizes and provide only general conclusions. In contrast, this study is specifically focused on several key commercial buildings recently developed in Tasmania, with a view of capturing the experiences of the stakeholders when using timber products. This paper evaluates the feedback from interviews associated with six commercial buildings, conducted with clients, builders, project managers, architects, engineers, quantity surveyors, researchers and suppliers. An improved understanding of the timber source and use, availability and challenges in supply will be invaluable in understanding future opportunities for supply chain, infrastructure planning and policy development.	Kuluni	Millaniyage	UTAS

SESSION 3
Monday 23rd June 2025
4pm to 5:30pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
3H	EIC - Practitioner	Timber Engineering & Structural Performance - Practitioner Focus, Education, Innovation & Challengers - Practitioner Focus, Exemplars & Construction Case Studies - Practitioner Focus	Implementation of a prefabricated timber-hybrid building system showcased with four case studies	In the face of climate crises and urbanization, the construction industry has to provide regenerative multistorey building solutions at a rapid pace. Timber as a building material, clever designs, and prefabrication address these challenges effectively and seem like the obvious solution. However, given the lethargy of the construction industry, several factors create obstacles on this path. These include limited production capacities, international availability, price disparities, existing standards, and the openness and willingness of designers and constructors to adopt new solutions. Consequently, designs for prefabricated timber solutions rarely win out against traditional concrete and steel designs. In this context, CREE has developed a prefabricated timber-hybrid building system that leverages the benefits of prefabrication and the sustainability of timber while integrating traditional concrete and steel to meet existing performance standards to bridge the gap towards sustainable building solutions. This paper presents four case studies that were designed using this timber-hybrid system. The entire process, from design to the use of the buildings, is critically analyzed and compared to traditional building methods and mass-engineered timber solutions.	Julia	Köhler	CREE GmbH

SESSION 4
Tuesday 24th June 2025
8:30am to 10:30am

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
4A	TESP - Engineering - Codes and Modelling	Session Chair: PROFESSOR KEITH CREWS / THE UNIVERSITY OF QUEENSLAND					
4A	TESP - Engineering - Codes and Modelling	Timber Engineering & Structural Performance - Engineering Focus	Preliminary design framework of low-to-midrise buildings with low-to-no steel, subtractive fabrication, carpentry joints milled with robotic arms into whole tree trunks	Following an exhaustive evaluation of the limitations of whole-timber carpentry connections in low-to-midrise buildings, recommendations therein have been extracted and applied to a small preliminary experimental investigation of four potential connection details. These connections include two steel-free and two steel-minimised connections, each with compressive reinforcement, which are compliant with Eurocode guidelines. To learn the potential of each connection, the four joints have been preliminarily tested in moment-rotation, pull-out, and excessive gravity loading to better understand connection behaviour and guide decisions related to future testing. State-of-the-art distributed optic fibre sensors (DOFS) installed directly into specimens using two different installation methods for comparison, and digital image correlation (DIC) are used to identify strain distributions most critical to connection failure modes. Additionally, preliminary design and construct methods uncover the various challenges with robotic integration into fabrication, allowances for hygroscopic deformation, and anticipating the difficulties of construction using natural-form structural elements with minimised fabrications and non-uniform geometries. The results of the tests highlight key weaknesses to be addressed in the design, fabrication, and construction methodologies prior to a large-scale campaign intended to provide structural results necessary for real-world applications. The findings of these investigations are considered in a sequential study, of which the final framework is intended to be transferrable to research involving similar evaluations.	Serena	van Nimwegen	l'Universite catholique de Louvain
4A	TESP - Engineering - Codes and Modelling	Timber Engineering & Structural Performance - Engineering Focus	Overall stability safety factor of K6-type timber reticulated shells	To study the global stability of K6-type single-layer spherical timber reticulated shell structures with semirigid joints, the slip stiffness and the bearing capacity for bolted fasteners were calculated according to formulas in the Eurocode EN 1995-1-1, and the simplified bending moment-rotation curves of slotted-in plate joints which are commonly used in practical engineering were determined. The bending semi-rigidity characteristics of the joints were simulated by the nonlinear spring element COMBIN39 in ANSYS software. The effects of different parameters on first order linear buckling coefficient, elastic and elasto-plastic ultimate bearing capacity factors considering initial defects and plastic reduction factor were analyzed. The results of single-variable parameter analysis show that height-span ratio, span, cross-section size and initial defect have great influence on the stability bearing capacity, and the layout of joint fasteners reduce the variation range of the joint stiffness which limits the influence of the semi-rigidity of joints. By 6480 calculation cases with varying parameters, the plastic reduction factors under different height-span ratios and joint stiffness reduction factors are calculated, and results show that all the values of plastic reduction factors are smaller than 0.47 which is the recommended value of the steel reticulated shell specification.	Jiajia	Ou	China Southwest Architectural Design and Research Institute Corp. Ltd.
4A	TESP - Engineering - Codes and Modelling	Timber Engineering & Structural Performance - Engineering Focus	SEISMIC TIMBER FRAMES WITH STEEL LINK: MECHANICAL CHARACTERIZATION THROUGH NUMERICAL INVESTIGATION	Since timber has an elastic-fragile behavior, for the design of seismic resistant timber frame structures the dissipative capacity is usually concentrated into steel connections. However, these are components with an important role in the structural system, so they should be preserved by damage. To this purpose, with regards to heavy timber framed structures, innovative timber joints with steel link, with a dissipation function based on cycles of plastic deformation, can be introduced. In this context, the paper focuses on the mechanical characterization of a dissipative Moment Resisting Frame (MRF) structure, equipped with steel links at the joints, through a monotonic non-linear static analysis by using the ABAQUS structural program. The results confirmed the achievement of the plastic deformation in the link before joints and timber members failures, validating both the efficiency of the system and the proposed design method. The topic is relevant nowadays also in the context of the ongoing activity for the improvement of the chapter 8 of Eurocode 8, dedicated to timber structures in seismic area. The study provides a significant contribution for the design of dissipative timber structures, aiming at the definition and validation of design rules. The results have demonstrated the efficiency of the steel links, it ensuring the required dissipation under seismic actions, involving the reduction of structural mass, improving the seismic performance and thus allowing the increase of the building resilience against earthquake. The work is in progress toward the extended investigation on multi-storey multi-span seismic resistant dissipative timber structures, for the complete characterization and standardization of the study systems.	Giacomo	Iovane	University of Naples Federico II
4A	TESP - Engineering - Codes and Modelling	Timber Engineering & Structural Performance - Engineering Focus	NOVEL TIMBER-CONCRETE COMPOSITE SLABS USING BEECH DOWELS AS CONNECTION ELEMENTS	Timber-concrete composite slabs are state of the art since many years and may now also find their way into the future EUROCODE 5 with the technical specification CEN/TS 19103. In particular, notches as a composite solution with screws as lift-off protection are described in detail in this standard for design and application. Despite this progress, this construction method has not yet been widely used. This could be due to the very high number of screws required, which is why the increased effort is often avoided. An alternative to this is a novel timber-concrete composite system using beech wood dowels. This composite solution enables a high degree of prefabrication and more efficient use thanks to shorter construction times. Further increases in efficiency are achieved by dispensing reinforcement of the concrete layer, which also leads to ecological advantages and should make it easier to dismantle. With regard to the load-bearing behavior of the new composite solution, experimental and numerical investigations were carried out in order to create the basis for practical applicability on the basis of CEN/TS 19103.	Michael	Mikoschek-Muggendorfer	Technical University of Applied Sciences Augsburg
4A	TESP - Engineering - Codes and Modelling	Timber Engineering & Structural Performance - Engineering Focus	NUMERICAL SIMULATION OF FASTENER FORCE DISTRIBUTION AND CRACK PROPAGATION IN MULTI DOWEL TIMBER CONNECTIONS EXPOSED TO MOMENT AND MOISTURE LOADING	In design of multi dowel timber connections exposed to dominating in-plane moment action during varying environmental condition, correct calculation of fastener forces and their directions are difficult to perform manually. The problem is that during progressive plasticization of the dowel group the dowel force direction of every individual fastener joint is significantly varying during increased loading. Since the (plastic) load carrying capacity values according to Eurocode 5 (EC5) are also direction depended, it becomes problematic to find the correct force angles where the first plasticization will occur in the dowel joints. A disadvantage of the EC5 method is that it does not consider design of wood connections failing in a brittle manner through cracking of the wood material. These brittle failure modes are for example quite common in mechanical moment loaded connections. The overall objective of this work is to develop a new effective, flexible, and advanced finite element model to simulate progressive joint plasticization and possible crack propagation in mechanically jointed timber structures. The model was used to simulate bending deformations, elasto-plastic fastener force distribution and crack growth in a jointed glulam beam exposed to drying and strong bending.	Sigurdur	Ormarsson	Linnaeus University
4A	TESP - Engineering - Codes and Modelling	Timber Engineering & Structural Performance - Engineering Focus	THE EFFECT OF DISPLACEMENT RATE ON THE AXIAL LOAD CAPACITY OF STEEL RODS GLUED INTO GLULAM BEAMS	Glued-in rod (GiR) connections are increasingly used in timber structures for their high axial stiffness and load transmission, making them suitable for transferring high tying loads under a disproportionate collapse scenario. This study investigates the impact of different displacement rates (DRs) on the axial load capacity of M12 threaded steel rods glued into GL24 glulam beams. Specimens were tested at 1, 10, 100, and 1000 mm/min displacement rates. The results showed that the axial load capacity and stiffness of GiRs increased with higher DRs, with the maximum capacity observed at 1000 mm/min. Pull-out failures were the most common, with a trend toward timber-splitting failures at higher DRs. The study proposes modification factors for Eurocode 5 to better predict connection behaviour under different displacement rates.	Eleni	Toumpanaki	University of Bristol

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
4A	TESP - Engineering - Codes and Modelling	Timber Engineering & Structural Performance - Engineering Focus	SOFTWARE DEVELOPMENT FOR CAPACITY-BASED DESIGN OF TIMBER BRACED FRAMES: METHODOLOGY AND PERFORMANCE EVALUATION	Timber structures are receiving increasing attention due to their environmental benefits, renewability, and alignment with low-carbon construction goals. Among timber-based lateral load-resisting systems (LLRS), timber-braced frames (TBFs) are gaining prominence due to their simplicity, cost-effectiveness, and ability to provide adequate resistance to seismic loads. Despite these advantages, the broader adoption of TBFs is limited by the absence of clear design guidance in the Canadian Standard for Engineering Design in Wood (CSA O86), particularly regarding ductility targets and capacity-based design procedures. Additionally, there is a lack of dedicated software and practical tools to support structural designers in the design of such systems. Therefore, this study proposes a comprehensive design methodology for TBFs, enabling engineers to achieve required ductility levels through appropriate detailing. The methodology is implemented in a custom-developed software that facilitates capacity-protected design following the National Building Code of Canada (NBCC) and CSA O86. A design example of a TBF with limited and moderate ductility levels is presented and Nonlinear Time History Analyses (NLTHA) have been conducted. The results demonstrate that the proposed procedure and software ensure seismic compliance and structural integrity of TBFs under lateral loading conditions.	Nastaran	Cheshmehkabodi	University of Alberta
4A	TESP - Engineering - Codes and Modelling	Timber Engineering & Structural Performance - Engineering Focus	SEISMIC RESPONSE OF BRACED TIMBER FRAMES WITH BOLTED CONNECTIONS	Braced timber frames (BTFs) are one of the most efficient structural systems to resist lateral loads induced by earthquakes or winds. In the National Building Code (NBC) of Canada, BTFs are included as a seismic force resisting system (SFRS) with two ductility categories and corresponding R-factors. No design guidelines for BTFs, however, currently exist in CSA O86, the Canadian Standard for Engineering Design in Wood, making the system out of reach of the average designer. To remedy the situation, FPInnovations has initiated a multi-year research project to determine the seismic behaviour of BTFs as a SFRS and generate the technical information needed for development of design guidelines for BTFs in CSA O86. This paper presents a study on the seismic response of BTFs with bolted connections located in Montreal, Canada. Typical archetypes will be designed following the proposed design provisions, including capacity design and column tree design methethology. Nonlinear finite element models will be developed with Pinching4 for bolted connections at the ends of diagoal braces on OpenSees. Incremental dynamic analysis will be conducted, with 11 far-field ground motions that were selected and scaled to a Montreal spectrum, to investigated the seismic response of designed BTF archetypes. The seismic performance of the investigated archetypes will be evaluated following a simplified version of FEMA P695 methodology.	Zhiyong	Chen	FPInnovations
4B	TESP- Engineering Vibrations & Acoustics	Session Chair: ANDREW DUNN / TIMBER DEVELOPMENT ASSOCIATION					
4B	TESP- Engineering Vibrations & Acoustics	Timber Engineering & Structural Performance - Engineering Focus	Acceptability Criteria Of Timber Floor Vibration: A Subjective Evaluation	There is a pressing concern due to timber floors' susceptibility to vibration issues exacerbated by trends towards larger, open spaces. This study aims to investigate criteria for acceptable timber floor vibration by establishing a correlation between human response and floor vibration levels across different environments. By utilising Virtual Reality (VR) technology to simulate environments and recruiting participants from the UK and China, the research evaluates subjective vibration perceptions in private (bedrooms) and public (gyms) use, highlighting the influence of building function and cultural background on comfort levels. Findings examined existing standards, highlighted the need for criteria that covers a broader range of building functions, and demonstrated significant cultural differences in vibration tolerance. The study laid foundations in terms of refining criteria for facilitating the use of timber floors.	Haoyu	Huang	Newcastle University
4B	TESP- Engineering Vibrations & Acoustics	Timber Engineering & Structural Performance - Engineering Focus	Balancing Fastener Spacing, Acoustics, and Span Length in Exposed CLT Floor-Ceiling Assemblies	While mass timber construction has many well documented benefits, two common challenges designers struggle with in mass timber buildings are tight structural grids and excessive sound transmission. Both issues are largely due to the lightweight nature of timber panels, which can result in floor vibration and poor acoustics. Timber-Concrete Composite (TCC) floor systems are one method sometimes used to alleviate the vibration-controlled restriction on span length. However, connecting a concrete topping to the timber panel underneath with mechanical fasteners harms the acoustic performance of the floor assembly. In this paper, the relationship between fastener spacing, composite slab behavior, and sound transmission is investigated to simultaneously optimize span lengths and acoustic performance in Timber-Concrete Composite floor-ceiling assemblies. Ultimately, a model is developed which analyzes span and acoustic performance at once as a function of only fastener spacing. The two curves for span and sound transmission as a function of fastener spacing vary in an opposite manner. There is a point of intersection for each unique floor-ceiling assembly at a certain fastener spacing which provides a span length and acoustic rating with minimized losses across the two criteria. This could be viewed as the optimal fastener spacing depending on the design targets for span length and acoustic performance. With continued testing of multiple assemblies, varied fastener spacings, and the validation of an FE model, there is the opportunity to justify a method for simultaneously meeting desired acoustic performance and maximizing spans, allowing for more open spaces in mass timber buildings.	Simon	Cleghorn	Pliteq
4B	TESP- Engineering Vibrations & Acoustics	Timber Engineering & Structural Performance - Engineering Focus	BEHAVIOUR OF TIMBER-TO-TIMBER CONNECTIONS WITH INTERPOSED RESILIENT SOUNDPROOFING PROFILE	This paper reports the main outcomes of an ongoing research, supported by ROTHO BLAAS S.r.l. company, aimed at the experimental and theoretical characterization of timber-to-timber screwed connections with interposed an acoustic resilient profile for flanking noise reduction. The research is developed on two levels: experimental and analytical. An extended experimental campaign conducted on timber-to-timber screwed connections is presented and obtained result critically discussed. Experimental results were used to validate analytical models available in literature and specialized to account for the effect of acoustic interlayer on stiffness and load-carrying capacity.	Luca	Sestigiani	Rotho Blaas
4B	TESP- Engineering Vibrations & Acoustics	Timber Engineering & Structural Performance - Engineering Focus	PENDULUM-ROLLING SEISMIC ISOLATION SYSTEM (PR-SIS) FOR MEDIUM AND LOW-RISE WOODEN STRUCTURES: NUMERICAL RESULTS AND EXPERIMENTAL VALIDATION IN SHAKING TABLE TESTS	Base isolation is currently the most efficient and wide-ranging seismic protection technology available worldwide. However, its use in residential timber buildings is generally complicated by the high cost of conventional devices (e.g. rubber isolators or frictional isolators). To reduce the cost of implementing base isolation systems in low- and mid-rise timber structures, a pendulum-rolling isolation system (PR-SIS) is proposed, offering an easy-to-implement, low-cost, and high-performance solution. The devices consist of two facing concave surfaces that act as rolling surfaces (RS), and a polyurethane-coated steel sphere, which acts as a rolling element (RE). The RS provide the pendulum or self-centering effect, and the RE provide the dissipative effect. To validate the behavior of the proposed isolation system, tests were conducted on a shaking table using a 1:2 scale model of a 3-story light-frame timber building equipped with four pendulum-rolling isolation devices. White noise, harmonic and seismic inputs were imposed. The experimental results showed that the system has an excellent performance, reaching story drift smaller than 1/1000 even for large magnitude earthquakes (MCE). Numerical models results indicate that the system can be applied to low-rise buildings (e.g. up to three stories) by placing isolators only at the ends of the walls, or in mid-rise buildings (e.g. between four and eight stories) by placing isolators distributed along the walls. Taken together, these results indicate that the proposed isolation system has great potential for use in regions of high seismic demand due to its excellent performance and the significant savings in steel connectors for timber buildings.	Jose Luis	Almazan	Pontificia Universidad Católica de Chile

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
4B	TESP- Engineering Vibrations & Acoustics	Timber Engineering & Structural Performance - Engineering Focus	EFFECT OF BRACING IRREGULARITY ON SEISMIC PERFORMANCE OF L-SHAPED LIGHT TIMBER-FRAMED RESIDENTIAL HOUSES	Lessons from previous earthquakes indicate that light timber-framed (LTF) residential houses are at high risk of suffering unrepairable damage in major earthquakes. The bracing irregularity is an essential factor affecting the seismic performance of the entire structure, and current design standards specify several limits to ensure that the bracing elements are evenly distributed along bracing lines. However, the effect of bracing irregularity is likely to be greater in L-shaped structures and there is no specific irregularity limit for L-shaped LTF houses. The aim of this paper is to quantify the effect of bracing irregularity on seismic performance of L-shaped LTF residential houses. Three single-storey L-shaped LTF cases study houses in New Zealand with different irregularity levels were selected and modelled. Incremental dynamic analyses (IDA) were then conducted for these cases study structures. The simulation results showed that the L-shaped house with bracing arrangements reached the irregularity limits in NZS3604 had much greater interstorey drift ratios and significant torsion in earthquakes than the regularly braced house.	Kexin	Wang	University of Canterbury
4B	TESP- Engineering Vibrations & Acoustics	Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Mechanical properties of axially-loaded threaded rods after dis- and reassembly	This study investigates the mechanical properties of axially loaded threaded rods, screwed-in parallel and perpendicular to grain into glulam elements. Withdrawal stiffness and capacity were determined in service-level cyclic loading and monotonic tensile loading until failure. A further aim of this study was to determine the suitability of screwed-in threaded rods in terms of disassembly for possible future reuse of structural elements. Therefore, different manufacturing processes and preloading conditions were tested. The obtained withdrawal stiffness and capacity, show that threaded rods can be used very effectively in high performance connections. The ease of disassembly and versatility of use, which indicate good reusability, are emphasized by the determined mechanical properties after reassembly in this study.	Alisa Tanja	Resch	NTNU - Norwegian University of Science and Technology
4B	TESP- Engineering Vibrations & Acoustics	Timber Engineering & Structural Performance - Engineering Focus	SEISMIC PERFORMANCE EVALUATION OF CLT BALLOON-TYPE SHEAR WALLS WITH HIGH-CAPACITY DOWELED AND SCREWED HOLD DOWNS	There has been an increased focus on the lateral performance of balloon-type mass timber walls due to the growing recognition of the advantages of balloon construction in mid to high-rise buildings over platform-type construction. This paper evaluates and compares the seismic performance of mid- to high-rise CLT balloon-type shear wall prototypes with high-capacity doweled and mixed angle screwed hold-downs. Several prototypes are designed considering different parameters, including prototype wall height, seismicity level, and magnitude of gravity loads. Robust finite element models are developed in ABAQUS software to capture the complex nonlinear behavior at the base of rocking CLT walls. Subsequently, nonlinear finite element models of the prototypes are developed using OpenSees. The rocking base behavior is calibrated using the results of the robust model subjected to pushover analysis. The nonlinear models of high-capacity doweled and mixed angle screwed hold-downs are calibrated using available test data. The seismic performance of the prototype CLT shear walls is investigated following the FEMA-P695 procedure. A suite of ground motions suitable for the sites is selected and incrementally scaled. Then, a series of incremental dynamic analyses (IDAs) are conducted to quantify the adjusted collapse margin ratio (ACMR). Results show the sufficiency of the designed prototypes by comparing ACMR with the acceptable limits recommended by FEMA P695.	Amir	Ghahremani Baghmisheh	The University of British Columbia
4C	TESP - Engineering - Connections	Session Chair: DR CHRISTIAN VIAU / CARLETON UNIVERSITY					
4C	TESP - Engineering - Connections	Timber Engineering & Structural Performance - Engineering Focus	Uncertainty quantification of four phenomenological hysteretic timber models	This article measures the uncertainty of four phenomenological-based hysteretic timber models from the literature: SAWS/MSTEW, DowelType, modified Richard–Abbott, and ASPID. These models can simulate various timber connections and assemblies, including pinching, strength/stiffness symmetry/asymmetry and degradation, and low-cycle fatigue phenomena. The models were validated through four experimental benchmark timber tests using an optimized parameter identification process for all cases. The study compared characteristic mechanical parameters such as stiffness, strength capacity, ductility, and energy dissipation. Additionally, two goodness-of-fit metrics for force and dissipated energy history were evaluated. The numerical results indicated low errors for strength capacity and total dissipated energy, while the energy dissipation history fits better than the force one in almost all models.	Pablo	Guindos	Universidad de A Coruña
4C	TESP - Engineering - Connections	Timber Engineering & Structural Performance - Engineering Focus	MOMENT RESISTANT CONNECTIONS WITH GLUED-IN RODS IN GLUELAM	This paper reports an experimental and theoretical study of moment resistant connections with glued-in rods. For road sign structures in the Netherlands timber portal frames are developed made of gluelam elements with a span of approximately 20 meters. Due to limited space the columns are designed moment rigid connected to the foundation. Twenty Glued-in Rods (M16-8.8) are used to connect the timber hollow square tube moment rigid to the steel foundation. A calculation model is developed to predict the strength wich is validated with full size experiments in the laboratory.	Wim	de Groot	SHR stichting hout research
4C	TESP - Engineering - Connections	Timber Engineering & Structural Performance - Engineering Focus	Seismic performance evaluation of timber moment frames with reinforced dowel-type connections	Mass timber buildings are increasingly favoured due to their high strength-to-mass ratio, the decarbonizing nature of wood, and the superior prefabrication capabilities compared to other construction materials. Traditionally, timber moment-resisting frames (TMRFs), made with semi-rigid beam-to-column connections, are susceptible to brittle failure at the connections due to the weakness of timber in perpendicular-to-grain tension and longitudinal shear. It is believed that reinforcing these types of connections with self-tapping screws can enhance their behaviour in terms of moment and rotational capacity. Moment-resisting bolted connections with slotted-in steel plates are used in gravity load-resisting frames due to their relatively simple prefabrication; however, their application as part of a seismic force-resisting system (SFRS) involves additional challenges. This study evaluates the seismic performance of timber moment frames with both reinforced and unreinforced dowel-type connections using simplified numerical models. Seismic response parameters, including inter-story drift ratio, peak floor acceleration, and collapse fragilities, are obtained via incremental dynamic analysis. The ductility-related force modification factor (Rd) is also determined to assess the level of ductility provided by the reinforcement to compare with the different levels of ductility specified in the National Building Code of Canada for TMRF as an SFRS. Based on these evaluations, recommendations are made regarding their seismic performance.	Ali	Yazdi Moghaddam	University of Alberta
4C	TESP - Engineering - Connections	Timber Engineering & Structural Performance - Engineering Focus	Difference in mechanical properties due to inhibition techniques of friction applied to lateral tests of timber joints	In modern timber buildings, dowel-type connections are commonly used. An evaluation of the mechanical characteristics of timber joints is essential for designing the buildings. To evaluate the lateral characteristics of the dowel-type joints with high accuracy, the influence of the friction that occurs between members on the evaluation results should be clarified. This report aims to reveal the differences in the mechanical properties owing to the inhibition techniques of friction applied to lateral tests of dowel-type joints. Our previous report applied only a perfect elasto-plastic model. This report applies three methods for determining the characteristics of the test results.	Keita	Ogawa	Shizuoka University

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
4C	TESP - Engineering - Connections	Timber Engineering & Structural Performance - Engineering Focus	ANALYTICAL SEISMIC PERFORMANCE ASSESSMENT OF BRACED TIMBER FRAMES WITH SHAPE MEMORY ALLOY FASTENERS	Braced timber frames (BTFs) can efficiently resist earthquake forces; however, their performance significantly relies on the brace connection behavior that absorbs seismic forces by yielding fasteners and wood crushing. This behavior can result in significant stiffness and strength degradation with large residual deformations post-seismic events. Recent research shows that dowel-type and bolted wood-steel connections with superelastic NiTi (nickel titanium) Shape Memory Alloys (SMAs) fasteners offer substantial self-centering (SC) ability under cyclic loading compared to steel fasteners. This study evaluates the potential of the system-level response using SMA connections when compared to traditional steel ones using experimentally obtained hysteresis connection-level results. Pushover analysis in OpenSees were conducted for system-level analyses. The seismic analysis of wood-frame structures (SAWS) model available in OpenSees was used to simulate the NiTi SMA connections within the BTFs and it was calibrated to match experimental behavior. The frame responses were also compared with numerical relationships developed between the connection and system ductility of BTFs. Overall, this investigation shows that the BTF structures with SMA fasteners present an important SC ability and reduced permanent deformation in contrast with BTF buildings with steel fasteners. The effect of the building height on the SC behavior and deformation performance is also discussed.	Javier	Fierro	University of Waterloo
4C	TESP- Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	BRITTLE FAILURE MODES IN CONNECTIONS WITH SELF-TAPPING SCREW IN GLULAM AND CLT	Self-tapping screws (STS) have become the fastener of choice for mass timber construction. They are used either as laterally or axially loaded fasteners. In lateral loading, STS connections are generally designed using the European Yield Model, which considers embedment and fastener yielding. Brittle failure modes, influenced by geometric factors such as end and edge distances and fastener spacing, are checked separately. As part of developing STS design provisions for the Canadian timber design standard (CSA O86), thirty STS connection configuraitons in glulam timber and cross-laminated timber (CLT) were tested in order to determine their behaviour and failure modes. The results show that STS connections generally tend towards yield failures when recommended fastener distances and spacing are used. However, connections in CLT are prone to brittle failure modes if fastener arrangements in the outer layers are unfavourable.	Ying	Hei Chui	University of Alberta
4C	TESP- Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	Timber-based retrofit strategies for existing URM and RC structures: insight from ReLUIS-DPC project	The use of timber for seismic reinforcement of existing structures is gaining significant attention, thanks to recent developments in engineered wood products such as CLT and LVL. This study, carried out within the framework of the RELUIS WP5 2022-2024 project, explores various reinforcement techniques including timber strong-backs, light timber frames sheathed with OSB panels, CLT panel coatings, endoskeletons, and exoskeletons. Each method is evaluated for its advantages, disadvantages, and applicability, with a focus on sustainability and intervention effectiveness. Results show that timber solutions offer significant improvements in the strength and deformation capacity of reinforced structures, presenting a promising option for integrated and sustainable seismic retrofitting.	Ivan	Giongo	University of Trento
4C	TESP- Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	In-plane shear of CLT: Design of a new Picture Frame Test Configuration	The current in-plane shear test methods only apply to some variations of cross-laminated timber in development. This research aimed to design a test configuration to gauge a wide range of wood panel products. The chosen method is the picture frame test based on its potential to generate a pure shear field. Therefore, a connection is required that enables a uniform shear force transmission to the edges of the wooden specimen. Notches along all four edges were designed. By calculation, the number, arrangement, and size of those notches were chosen to maximise the load-bearing capacity. The performance of practical tests validated the resulting test configuration. Series of 3- and 5-layer CLT were tested with a total of eight specimens. Results show that this kind of picture frame is effective and provides plausible values for the shear modulus, which aligns with the literature. In addition, model-accurate shear stiffnesses can be determined, which are used in structural calculations. Furthermore, preliminary tests with mechanically laminated timber, including diagonal lamination, were performed, and an in-plane shear failure could be achieved. Further tests will be necessary for parameter studies and statements about the potential applicability of other wood-based materials.	Nills	Schumacher	Technical University of Munich
4D	TESP - Engineering - Composites & Hybrids	Session Chair: DR CRISTIANO LOSS / UNIVERSITY OF BRITISH COLUMBIA					
4D	TESP - Engineering - Composites & Hybrids	Timber Engineering & Structural Performance - Engineering Focus	AN EXPERIMENTAL STUDY ON THE CHARACTERISTICS OF A HORIZONTAL RESISTANT MECHANISM USING A CHECKERED PATTERN HYBRID BEARING WALL WITH A PLYWOOD AND STEEL FRAME	In recent years, the use of natural resources has been recognized as a way to reduce environmental impacts, such as climate change. The Japanese government has also promoted the use of domestically produced timber. Composite structures combining wood and steel offer various patterns and provide a wide range of characteristics, including design, environmental friendliness, and structural integrity. This paper examines the resistance mechanism and structural performance of a sandwich panel, where a steel column is positioned between structural plywood sheets and connected to steel frames through rings welded to the steel columns. In this paper, horizontal loading tests were conducted to clarify the mechanisms of bearing resistance, destructive properties, and stress transfer. The results show that the specimen with structural plywood exhibits higher strength and rigidity compared to the steel specimen. Damaged walls caused by natural disasters, such as earthquakes, can be restored through wood panel replacement.	Rieko	NAGAO	Tokyo University of Science
4D	TESP - Engineering - Composites & Hybrids	Timber Engineering & Structural Performance - Engineering Focus	ESTIMATION OF TEMPERATURE PROFILE WITHIN STEEL BAR-TIMBER COMPOSITE BEAM USING DATA OF COMBUSTION TEST	Recently, timber buildings are desired from a viewpoint of global warming, and moreover, in severe earthquake prone zones, such as Japan, they are more desired on the grounds of light weight of timber members. We are developing a frame system formed by hybrid timber members strengthened with deformed steel bars (i.e. rebars) using epoxy resin adhesive. In order to practice the system, it is necessary to investigate fire resistance performance of the members. As a trial, we conducted a 60-minute combustion test of one relatively small cross section of the composite beam and reported a new calculation method for temperature profile within the beam in previous WCTE 2023. Now, for practical use, we have conducted a 60-minute combustion test of three beams with relatively large cross sections and reports the experiments and results in WCTE 2025. By further improving the method proposed in previous and including this experiment, the temperature distribution in the beams was calculated by the method, and strength capacity and failure form of the beam tested were examined. This report describes the improved method and results of the investigation of the calculated capacity and fracture type.	Shinichi	Shioya	Kagoshima University

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
4D	TESP - Engineering - Composites & Hybrids	Timber Engineering & Structural Performance - Engineering Focus	EDGE CONNECTION FOR CROSS LAMINATED TIMBER SLABS – A SOLUTION USING TIMBER CONCRETE COMPOSITE	To achieve a rigid edge connection between two cross laminated timber (CLT) panels, which is, for instance, required in point-supported flat slabs, literature often suggests on-site gluing solutions. This study presents an alternative adhesive-free method using a timber-concrete composite system. Standard fasteners, such as fully threaded screws or threaded rods with wooden threads, are partially inserted into the narrow faces of the CLT to form a lap splice between adjacent elements. This splice is then reinforced and filled with concrete. Once the concrete hardens, the internal forces in the CLT panels are transmitted via this connection. This study experimentally investigates the behavior of the connection under two primary load directions. Four-point bending tests evaluate the load-bearing capacity and rotational stiffness under a pure bending moment, while asymmetric four-point bending tests assess the out-of-plane shear loadbearing capacity. These experimental results are well represented by the proposed analytical approaches, which can be used to design the connection. The findings show that the connection has sufficient load-bearing capacity and stiffness to realise point-supported flat slabs made of timber.	Thomas	Stieb	University of Innsbruck
4D	TESP - Engineering - Composites & Hybrids	Timber Engineering & Structural Performance - Engineering Focus	PREFABRICATED HOLLOW FLOOR SYSTEMS USING MASS PLY PANEL AND SCREW-GLUING	Floor construction can account for up to 70% of the wood used in mass timber buildings. Given that solid mass timber systems are not structurally efficient for long spans, there is increasing interest in composite floor systems. Structural composite lumber (SCL), which has a higher yield rate than lumber-based mass timber products, presents significant opportunities for mass timber construction. This study proposes a prefabricated hollow floor system based on SCL, utilizing a screw-gluing method. The efficacy of screw-glued joints in mass ply panel (MPP) was experimentally assessed, focusing on variations in screw spacing and screw types (partially and fully threaded self-tapping screws). Two types of polyurethane structural adhesives were also evaluated. Furthermore, a structural optimization algorithm was developed using Rhino/Grasshopper, employing a genetic algorithm for nonlinear optimization. Optimization targets included achieving optimal cross-sections while considering constraints such as load, span, geometry, and structural efficiency. Experimental results showed that the screw-glued joints can provide high shear connection capacity and stiffness with 100% wood failure, which can ensure almost full composite action for hollow floors. The optimization results demonstrated that MPP-based hollow floors significantly reduce material usage compared to traditional solid CLT and MPP systems, while maintaining or enhancing structural performance.	Jianhui	Zhou	University of Northern British Columbia
4D	TESP - Engineering - Composites & Hybrids	Timber Engineering & Structural Performance - Engineering Focus	Long-term behavior of novel solid wood-concrete-composite floors with combined shear connectors	The possible significance of natural and sustainable building materials and their application both in the existing and new building stock is the question of overriding importance in modern building trade. With a special focus on wood-based structural components, it can generally be explored on two levels: 1) Adaptation of existing wood structures in consideration of a sustainable design concept, 2) Development of new wood-based building components and optimization of its manufacturing processes. To combine these two approaches and with the objective to improve the structural performance of wood-based composite floor systems, a new combination of solid woods and reinforced concrete, inspired by the traditional “Dippelbaumdecke” (dowel beam floor), is developed and investigated by means of its load-bearing and deflection behavior. As the overall project-related research activities thereby generally cover a wide range of investigations, this paper primarily focusses only on the related long-term static load-bearing and deflection behavior of the assessed novel structural system. The presented publication withal aggregates the results of the related experimental and analytical long-term investigations and gives an insight into the consequential time-dependent load-bearing behaviour of the examined structural system under short-term loads, as well as into the arisen deflection behaviour of the structural component and its related creep mechanisms under permanent long-term loads.	Alex	Müllner	TU Wien, Department for Structural Design and Timber Engineering
4D	TESP - Engineering - Composites & Hybrids	Timber Engineering & Structural Performance - Engineering Focus	FLEXURAL BEHAVIOR OF PROPOSED STEEL-TIMBER-CONCRETE COMPOSITE FLOOR SYSTEMS FOR MID-TO-HIGH-RISE BUILDINGS	Floor structures using Timber are lighter and more environmentally friendly than traditional concrete slabs and deck slabs. Recently, practical research has been actively conducted in line with the trend of reducing carbon emissions. Therefore, this study aims to propose structurally and economically efficient sections by constructing composite floors combining Timber with various materials such as steel and concrete. For three sections consisting of Steel-Timber-Concrete, theoretical flexural strength was analyzed, and actual composite floors were fabricated for two-point loading tests to compare the flexural strength. The composite behavior and improvement in flexural performance of the composite floor structures were confirmed through this comparison. Additionally, to confirm the increase in flexural performance depending on the type of shear connector, load-slip tests were conducted using STS hex bolts and nails as shear connectors. Through these tests, we aim to identify the relationship between the composite behavior through shear connectors and the flexural performance of the floor structures, thereby proposing sections that can secure economical and efficient structural performance.	Sung-Mo	Choi	University Of Seoul, Korea
4D	TESP - Engineering - Composites & Hybrids	Timber Engineering & Structural Performance - Engineering Focus	Experimental Analysis of Timber-Concrete Composites with Innovative FRP Connectors	This research investigates the structural behaviour of timber-concrete composite (TCC) with innovative fibre-reinforced polymer (FRP) connectors. These include T-shaped plates and helically wrapped rods made from carbon FRP (CFRP) and glass FRP (GFRP), compared against SFS screws and perforated steel plates. Eighteen push-out tests were conducted on symmetric TCC joints to evaluate their load-slip behaviour, load-carrying capacity, stiffness and failure modes. As a result, GFRP rod connectors exhibited superior performance, achieving the highest load-carrying capacity and stiffness among all tested samples. T-shaped GFRP plates and CFRP connectors also showed enhanced performance compared to conventional steel connectors, though slightly less effective than GFRP rods. The study confirms that FRP connectors significantly enhance the structural performance of TCC connections over their traditional steel counterparts in terms of load-carrying capacity and stiffness. This research work will provide deeper insights into sustainable and efficient construction technologies.	Songnan	Li	The University of Sydney
4D	TESP - Engineering - Composites & Hybrids	Timber Engineering & Structural Performance - Engineering Focus	ASSESSING THE STRUCTURAL BEHAVIOUR OF TIMBER-STEEL COMPOSITE BEAMS USING DISTRIBUTED FIBRE OPTIC SENSORS	Composite steel-concrete floor slab systems, composed of steel beams, a steel deck, and a concrete topping, are prevalent due to their high strength-to-weight ratio and ease of construction. However, the need to reduce greenhouse gas emissions in the construction industry, particularly from concrete production, is pressing. Additionally, there is a demand for quicker and more efficient construction methods, prompting the development of structural flooring systems that use less concrete and can be installed without temporary shoring. These challenges can be addressed with the use of timber-steel composite floor systems, composed of steel beams and cross-laminated timber (CLT) slabs. Steel-concrete composite design is primarily based on the geometry of the composite beam, the effective width of the slab, and strength of the connection at the interface between the two layers. These parameters have been well studied for steel-concrete systems, but limited research has focused on timber-steel composite systems. Ultimately, knowledge gaps remain surrounding the structural behaviour of steel-timber composite beams, including identifying the optimal shear connector, studying composite action, and developing design equations for their use. To satisfy these knowledge gaps, an experimental program was developed to identify optimal connections for composite timber-steel beams using push-off (direct shear) tests and to study the behaviour of full-scale beams using static load tests. In full-scale tests, the influence of CLT orientation on the behaviour of timber-steel composite beams is investigated. To develop new fundamental knowledge on the behaviour of timber-steel composite beams, full-scale specimens are instrumented with distributed sensing technology.	Brendan	Deeves	Queen's University

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
4E	MPD - Engineering - Material Properties	Session Chair: CALIL NETO / REWOOD					
4E	MPD - Engineering - Material Properties	Material Performance & Durability - Engineering Focus	Durability of plantation Hinoki	Hinoki (Chamaecyparis obtusa) has been used in Japan for thousands of years owing to its excellent mechanical properties and resistance to biodegradation. There is an increasing volume of plantation Hinoki coming on the market. While old growth Hinoki is known for its decay resistance, there are questions about the durability of the faster grown plantation material. There is increasing evidence that second growth plantation heartwood of some species is less durable than old growth material, but this has not been studied with Hinoki. The durability of second growth Hinoki heartwood was assessed in laboratory tests against two brown rot fungi. Heartwood from these plantations was highly decay resistant and compared with western redcedar (Thuja plicata). While further tests are underway, the results support the continued use of this species in exterior applications.	Jeffrey	Morrell	Forestry Centre of Excellence University of South Australia
4E	MPD - Engineering - Material Properties	Material Performance & Durability - Engineering Focus	Densification of New Zealand-grown Redwood for improved mechanical properties	Redwood (Sequoia sempervirens) has attractive, naturally durable timber, and is an emerging plantation species in New Zealand. Redwood has low density timber, and correspondingly low stiffness and surface hardness. Thermomechanical densification was used to increase the density of the wood surface, with the aim of improving the mechanical properties to make it suitable for a wide range of end uses. Densification created a density peak >900kg/m3 located 1-3mm below the wood surface. Two densification processes were trialled, and both significantly increased the surface hardness of the wood, as well as the modulus of elasticity. This suggests potential for the densified wood to be used in applications where redwood is currently unable to meet performance requirements.	Rosie	Sargent	Scion
4E	MPD - Engineering - Material Properties	Material Performance & Durability - Engineering Focus	DYNAMIC MECHANICAL ANALYSIS OF PUR BONDED BEECH WOOD AT VARIOUS TEMPERATURES	Dynamic Mechanical Analysis (DMA) was used to explore the properties of polyurethane (PUR) adhesives and European beech wood (Fagus sylvatica L) at various temperatures and frequencies. The study involved testing beech wood, different PUR adhesives, and composite samples consisting of three layers (beech:PUR). Testing was conducted using a 3-point bending geometry, with frequencies ranging from 1 to 10 Hz and temperatures from -120°C to 140°C. Results from the DMA revealed clear differences between the PUR adhesives and the characteristics of beech wood. In particular, the thermal stability and bonding capabilities of PUR adhesives were highlighted. When temperatures exceeded the tan δ of the adhesive, the composite properties began to diverge from those of pure wood, indicating that the adhesive's performance affects the overall composite behavior. Frequency analysis showed that the storage modulus of the composite was significantly reduced at higher frequencies (10 Hz) after reaching the tan δ peak of the adhesive. This suggests that the dynamic behavior of the composites changes with frequency, impacting their stiffness and performance. Overall, DMA proved to be a valuable tool for evaluating the dynamic behavior of materials under different conditions. The study confirmed that PUR adhesives have potential for use in wooden structures due to their thermal stability and strong adhesion properties. However, it also highlighted the need for further research on additional samples, different wood species, and adhesive types to fully understand the interactions and optimize performance.	Martin	Capuder	ZAG
4E	MPD - Engineering - Material Properties	Material Performance & Durability - Engineering Focus	EFFECT OF ADHESIVE AND SPECIES ON INTERFACE PROPERTIES OF TIMBER LAMINATES	The interface properties between thin veneer sheets are examined in this study by means of Mode I fracture testing. At first, European beech, laminated using 1-part polyurethane, was compared against bio-epoxy laminated beech veneers. Bio-epoxy was selected to increase the sustainability aspect of the laminated timber products which contained 77% plant-based ingredients. To diversify the use of various species in laminated timber products, interface properties between other species were also investigated. Two hardwood (European birch and Tasmanian oak) and one softwood (Hoop pine) species were considered in this regard. Mode I interlaminar fracture energies of the interfaces containing various combination of these species were determined and compared.	Mahbube	Subhani	Deakin University
4E	MPD - Engineering - Material Properties	Material Performance & Durability - Engineering Focus	QUANTITATIVE EVALUATION OF THE MECHANISM OF ADHESIVE-INDUCED LOAD INCREASE IN PLYWOOD AND LVL UNDER FULL AND PARTIAL COMPRESSIVE STRESS	Partial compressive performance of adhesively layered wood-based material was affected by the adhesive layer. Two types of mechanisms were assumed in this study. Mechanism I occurred because of simple compressive resistance of adhesive impregnated into wood and adhesive layers themselves. Mechanism II occurred because of deformative constraint from adjacent layers when the fiber direction of a layer was perpendicular to that of the adjacent layer due to the difference of deformation. In this study, plywood and LVL were targeted. A compressive test was conducted with the existence of an additional length, existence of adhesive, layer composition and wood species as parameters. Mechanism I and II were respectively evaluated quantitatively. As a result, Mechanism I varied by wood species and fiber direction. Mechanism II varied by the height of specimen and wood species.	Ryutaro	Sudo	Okayama University
4E	MPD - Engineering - Material Properties	Material Performance & Durability - Engineering Focus	COMPARISON OF CRACKING PROCESS IN TROPICAL WOOD FOR MOBILITY	This work addresses wood cracking for mobility. Japanese Magnolia, the wood species used for the Lignosat microsatellite, is compared in opening mode and mixed mode to Khaya Ivorensis, a tropical species from Benin. The study is performed with MMCG (Mixed Mode Crack Growth) specimens mounted in an Arcan system and placed in an electromechanical testing machine. Cracking parameters are studied using the LSA, a new method that accurately measures strain and displacement fields near the crack through image analysis. The energy release rate is evaluated and compared using the compliance method with imposed displacement in crack opening.	Rostand	Moutou-Pitti	Universite Clermont Auvergne
4E	MPD - Engineering - Material Properties	Material Performance & Durability - Engineering Focus, Material Performance & Durability - Practitioner Focus	A NEW APPROACH TO WOOD - WOOD CONNECTIONS THAT FULFIL STATIC, FIRE PROTECTION AND ACOUSTIC REQUIREMENTS	Basic knowledge of timber-timber connections for bar-shaped components is available in timber construction. Can such connections also be used for flat elements such as cross laminated timber (CLT)? This scientific paper presents the "double dovetail tenon" system connector. It consists of two dovetail-shaped tenons that are 180 degrees opposite each other on their overlapping surface. The joint is characterised by the fact that both, the orientation of the veneers and the inclination of the flanks can be variably selected. No additional screws or other metallic parts are required for the connection. The CLT elements are joined by hooking them together. The system connector is made of softwood veneer layers (LVL) [1]. The basic shape of the system connector's tenons is based on the requirements of Z-9.1-649 [2] for dovetail tenons milled onto bars. The LVL veneer layers can be orientated edgewise (HK) or flatwise (FK). For both veneer arrangements, geometry optimisations lead to load increases of 50%. In addition to the structural investigations, the fire protection and sound insulation were analysed. Fire protection properties were analysed in three stages: the connector, the cross laminated timber and the combination in the installed state. The sound insulation was tested under real building conditions with the new hook-in system connector. The results of the tests fulfil the Austrian requirements of standards and guidelines.	Anton	Kraler	University Of Innsbruck

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
4E	MPD - Engineering - Material Properties	Material Performance & Durability - Engineering Focus, Material Performance & Durability - Practitioner Focus	Decay Performance of Cross Laminated Timber Connections	The effect of brown rot decay fungi on mechanical properties of Cross Laminated Timber (CLT) connection assemblies was investigated. CLT connections evaluated were assembled with US code approved angle bracket connectors and modelled floor-to-wall systems in mass timber buildings. Physical changes, mass loss and quasi-static cyclic tests were used to assess the performance of connection assemblies up to 40 weeks after fungal inoculation. Peak load, stiffness, energy dissipation and ductility of connections were characterized based on force-displacement data generated from destructive tests of connections. Assemblies experienced up to 57 % loss in load carrying capacity and 90 % loss in energy dissipating capacity of the connections after 40 weeks of fungal exposure. Connection stiffness was only slightly impacted over this period but wetting and redrying caused significant degradation to connection ductility. The results highlight the importance of fungal attack on connection properties in mass timber.	Arijit	Sinha	Oregon State University
4F	MPD - Engineering - Fracture Mechanics & Wood Fibre	Session Chair: DR GARY RAFTERY / THE UNIVERSITY OF AUCKLAND					
4F	MPD - Engineering - Fracture Mechanics & Wood Fibre	Material Performance & Durability - Engineering Focus	PROPAGATION IN WOOD OF A CRACK DEVIATED FROM THE DIRECTION OF THE FIBERS	This work focuses on carrying out fracture tests on wood, particularly silver fir (Abies alba), to follow crack propagation with camera-based methods and to examine the influence of the orientation of fibers on this spread. Mixed Mode Crack Growth (MMCG) and cantilever-type specimens with different fiber orientations were considered to evaluate the energy release rate by the imposed displacement method in opening mode. Finite element software Cast3M is used to model and simulate these tests, to compare and decrypt numerical results through experimental data. Finally, a scanning electron microscope (SEM) will allow local cracking processes to be observed, to determine whether the bifurcation of the crack is induced by a mechanical effect or by the oriented fibrous structure of the material. This study deepens our understanding of the mechanisms of crack propagation in wood and the influence of fiber orientation, by combining experimental tests, numerical simulations, and microscopic observations.	Nicolas	Sauvat	Clermont Auvergne University
4F	MPD - Engineering - Fracture Mechanics & Wood Fibre	Material Performance & Durability - Engineering Focus	EFFECT OF WOOD RELAXATION ON NAIL WITHDRAWAL CAPACITY	Nails are the most widely used fasteners in timber structures, providing lateral resistance and withdrawal capacity. Wood fibres generate compressive stresses as nails are driven into the wood, but this compression may be relieved over time. Wood relaxation may significantly affect nail withdrawal capacity (NWC) by reducing stress; however, its impact is often neglected. This study investigates the impacts of wood relaxation on the NWC of smooth-shank nails in radiata pine. Nails were driven into wood conditioned to 9%, 12% or 18% moisture content (MC) and withdrawn after up to 28 days while wood MC was kept constant. NWC decreased after several days and then stabilized depending on the original moisture condition. While the NWC of nails withdrawn after 28 days from wood at 9 and 12% MC reduced by 41 or 44%, respectively, the NWC increased by 10% over the same period in the wood at 18% MC. The results illustrate the differential effects of wood MC on NWC and warrant further studies to better understand the nature of these changes.	Yuhao	Zhang	The University of Queensland
4F	MPD - Engineering - Fracture Mechanics & Wood Fibre	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Cyclic behavior of the components of a dowel type assembly - variability	The whole vibration behaviour of a wooden building is partly governed by the assemblies. Non-linearity is a characteristic of rod-type connectors, this behaviour is thus transposed to the building. Among the rod-type assemblies, the dowel-type assembly allows connections with smooth rods with a metal plate fitting inserted into the wood. This type of assembly makes possible to transmit forces between two wooden elements by shearing the dowels. Energy dissipation is possible thanks to the plasticization of dowels and the wood in contact with the dowel. Because of the superposition of different phenomena, the behavior of such assembly has an important variability, it increases the difficulty to characterize key parameters. In this study, the assembly is divided into their components; Each component is tested under a cyclic load with four increasing amplitudes. Wood samples are tested with loads parallel to the grain. The results obtained show an important variability in the force displacement response of test including wood. The energy dissipation is obtained per loading amplitude, showing the linear behavior of the dowel before yielding and a nonlinear behavior for all the other components. These results are the base for an implementation of statistical approach for the calculation of key parameters and to establish suitable models for each component of the assembly.	Dalmer	Gomez	Navier Laboratory, ENPC
4F	MPD - Engineering - Fracture Mechanics & Wood Fibre	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Measuring cohesive law of wood adhesive bonds for engineering of timber joints and products	Accurate prediction of crack growth and strength in glued timber joints and components can be achieved by using cohesive law in constitutive models. This law, representing the traction-separation relationship that measures the stress transmitted between crack faces in a cohesive zone, can be obtained directly from experiments. However, studies on measuring the cohesive law of wood adhesive bonds are scarce, not standardized, and not commonly used in practice. This work aims to evaluate two methods for determining the cohesive law of wood adhesive bonds directly from experiments: (1) The "J integral approach" on double cantilever beam specimens loaded with pure bending moments, and (2) "Direct tension" tests on small specimens loaded in pure tension. Method 1 has proven valuable for fiber-reinforced composites but has not been used on wood-adhesive bonds. Method 2 has been proven on wood-adhesive bonds but is neither widely used by researchers nor the industry. Experimental work is currently underway. The analysis focuses on the accuracy and reliability of the results, and the practicality of the experimental methods, including data reduction. The results will contribute to developing a material property database necessary for predicting bond strength in timber engineering design, and to wood adhesive and timber joints and product development.	Joran	van Blokland	Swedish University of Agricultural Sciences
4F	MPD - Engineering - Fracture Mechanics & Wood Fibre	Material Performance & Durability - Engineering Focus	A study on the Bending Behavior of Moment-Resisting Joints with LSB and GIR under High Axial Forces	In this paper, we focus on the column-base joints used in mid- to high-rise wooden buildings, and conducted bending experiments under compressive axial force, and verify the fracture characteristics and mechanical properties. As test specimens, wooden moment-resisting joints with LSB and GIR are used. In the case where there was no axial force, brittle fracture occurred due to the LSB and GIR being pulled out, but as the axial force increased, nonlinearity was observed in the load deformation relationship when the wood underwent compressive failure, and deformation continued to progress even after the maximum load was reached while the load decreased. Using the compressive strength of the wood and the tensile strength of the LSB and GIR, the N-M interaction at the yield strength was calculated and compared with the experimental results, and the corresponding results for the failure mode were obtained.	Hwisu	Kim	Osaka Institute of Technology
4F	MPD - Engineering - Fracture Mechanics & Wood Fibre	Material Performance & Durability - Engineering Focus	EVALUATION OF THE ADHESION BEHAVIOR OF KHAYA IVORENSIS WOOD TO MANUFACTURE GLUED PRODUCTS	The present paper aimed at evaluate the adhesion behavior of Khaya ivorensis (African mahogany) to produce glued products. Nine 10-years old thinning trees (25 cm DHB and 13 m height) were cut. The logs were sawed to obtain specimens to evaluate glue-line shear strength (fgv,0) and finger-joint flexure strength (fmg) according to ASTM standards. For fgv,0 tests, two adhesives (PVAc and PUR) at same spread rate (200g/m2), two surface preparations (sand and planer) and two pressure level (0.7 and 1.0 MPa) were evaluated. It was found that PVAc yielded statistically higher fgv,0 values than PUR, however both adhesives types showed higher fgv,0 values than that observed in solid wood. PVAc fgv,0 values were not affected by surface preparation nor pressure level. On the other hand, PUR samples presented higher fgv,0 values were significantly higher when surface was sanded and pressure about 1.0 MPa was applied. Wood failure of at least 65% was observed for all samples tested. PVAc bonded finger-joints showed be stronger and stiffer than those bonded with PUR. It could be concluded that the wood material tested here showed a great potential to manufacture glued products.	Cláudio	Del Menezzi	University of Brasilia

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
4F	MPD - Engineering - Fracture Mechanics & Wood Fibre	Material Performance & Durability - Engineering Focus	Machine Learning Informed Simulation of Uncertainties for Progressive Damage Evaluation in Wood Veneer Laminates	This study presents the key steps in developing a robust computational framework that can represent the inherent uncertainties of mechanical properties in wood veneer laminates subjected to progressive fracture tests. A large dataset derived from efficient finite element simulations of compact tension tests serves as the foundation for developing a machine learning surrogate model by means of Gaussian process regression. This fast, yet accurate surrogate model is then coupled with a Markov Chain Monte Carlo method and statistical measurements from experiments to estimate the uncertainty of each finite element input parameter that contributes to the measured uncertainty of the experiments. This framework combines various computational methods to account for uncertainties in the simulation of thin wood veneer laminates, hence paving the way for efficient and realistic finite element simulations of wooden materials that can guide the design of safe and reliable structures.	Johannes	Reiner	Deakin University
4F	MPD - Engineering - Fracture Mechanics & Wood Fibre	Timber Engineering & Structural Performance - Engineering Focus	EFFECT OF THREAD SHAPE ON WITHDRAWAL PERFORMANCE OF LAGSCREWBOLT INSERTED INTO PERPENDICULAR TO GRAIN	Lagscrewbolts (LSB) are screwed fastener that feature high strength and stiffness and used in beam-column and column base joints of wooden structures. The purpose of this study is to verify the effect of thread diameter and thread pitch on the withdrawal performances of LSB inserted into perpendicular to the grain direction. The withdrawal test of LSB with 3 thread diameters and 3 thread pitches inserted into perpendicular to the grain of glulam was carried out. Experimental results decipts that the withdrawal capacity tended to be higher the larger thread diameter or the smaller thread pitch. The overall failure mode was withdrawal failure accompanied by rising up of the surface fibers, different failure modes were observed on the each grain direction orientation, TR and LR cross sections. Considering these results, the withdrawal performances might be estimated using the shear performances of the LR and TR sections on the force applied perpendicular to the grain.	Keita	Sogabe	Hiroshima University
4G	STCE - Engineering	Session Chair: PHILIPP DIETSCH / KARLSRUHE INSTITUTE OF TECHNOLOGY					
4G	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus	3DP Biowalls: From Concept to Reality	Resources on our planet, whether bio- or mineral-based, are finite. These limitations are and further will not only lead to severe environmental consequences but also result in economic impacts, such as rapidly increasing prices. Therefore, from both ecological and economic perspectives, it is imperative to optimize the use and recycling of materials, particularly in the construction industry. With this motivation, the 3DPBiowalls project focuses on the development of a fully recyclable and bio-based material blend for the production of walls using a new additive manufacturing process. Within this paper the feasibility is proven, focusing on small-scale wall elements produced using an industrial robot as a carrier system for the additive manufacturing tool. A bio-adhesive is mixed with the fresh wood particles (approx. 50 wt.%) to create the bulk material. For the manufacturing process, two counter-rotating belts in the reservoir dispose the bulk layer-wise. each layer - having a rectangular cross section with variable height – is continuously compressed from the initial to an end layer height of appr. 1cm, before the next layer is added. This process is repeated for every new layer until the targeted height of the wall element is reached.	Benjamin	Kromoser	BOKU University
4G	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	Industrial Robots for GLT Machining: Basics and Beyond	With the increased timber construction's share due to environmental benefits in combination with the skilled labour shortage within the industry, developments of more efficient production processes are necessary. A promising approach is digitalising the process chain and implementing new production methods. Currently, specialised joinery machines process glued laminated timber beams. This paper examines how standard multi-axis industrial robots, as used in other industries and applications for decades, could be used to enhance production efficiency in timber construction. Current technology was analysed before the industrial robot capabilities were identified followed by machining trials to com-pare the machining quality with joinery machines. Furthermore, workspace utilisation with a workpiece location system was investigated in combination with modelling and machining multi-part stacks. The analysis revealed that applicabil-ity for machining tasks depends significantly on the end-effector specifications. Hence, the study focused on milling operations using the industrial robot of the BOKU University, showing that machining quality, in terms of surface quali-ty and dimensional accuracy, is competitive with joinery machines. The large workspace was utilised effectively, most-ly without exceeding accuracy requirements, presenting opportunities such as stack machining or machining on mobile robot platforms. Ultimately, the developed workpiece-stack-optimisation model reduced the machining time by up to 16%.	Benjamin	Kromoser	BOKU University
4G	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	DESIGN OF TIMBER STRUCTURES IN VIEW OF SUSTAINABILITY BASED ON THE COMPONENT METHOD	The component method is a flexible and easy-to-use design concept that offers significant advantages for safe and economical design. Considering both the load-bearing capacity and the rotational joint stiffness, this design concept leads to high-performance and resource-efficient structures. This paper presents an approach for implementing the component method in the structural design of timber structures. A first draft of a component catalogue for timber joints has been developed. The application of the component catalogue is exemplified by three different frame corner joints, two of which are reusable. It is shown in this paper, that different types of timber joints can be broken down into a spring model consisting only of basic components. However, further investigations, including experimental validation, are required to improve the component properties and evaluate their influence on the moment-rotation behaviour. Ongoing research at the University of Stuttgart aims to validate the derived spring models through tests on the presented frame corner joints and their basic components, to extend the component catalogue and to support the implementation of the component method in the design of timber construction to increase the application of timber as a building material in complex structures.	Lea	Buchholz	University of Stuttgart
4G	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus	A 3D Printed Joining System for Assembling Reciprocal Frame Structures with Irregular Natural Wood	A 3D printed joining system is designed to utilize irregular natural wood, such as small-diameter wood and curved wood, as components in buildings and furniture. Based on the data of wood captured by 3D scanning, the joints are manufactured by computer and 3D printing, making it possible to join irregularly shaped natural materials without damage. In addition, by making the joints dismountable, the natural base materials can be reused. The system does not standardize the properties of each material; rather, it utilizes the properties of each material as they are. One of the issues related to the current forest resource cycle and its funding is that wood that does not meet specifications, such as small-diameter wood and curved wood, has limited uses and is usually unused. By finding value in using irregular natural wood as building and furniture components, the 3D printed joining system will contribute to sustainability in a circular economy by expanding the cycle of forest resources and supporting their funding. This paper adopts reciprocal frame structures to construct space for people using irregular natural wood. Assembling reciprocal frame structures allows the construction of large spaces even with short members, and avoids concentrating of members at joints. Contribute to sustainability in the circular economy by assembling reciprocal frame structures from irregular natural wood that has limited use or is unused with the 3D printed joining system.	Yusuke	Hozumi	Tokyo University of Science

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
4G	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	EXPERIMENTAL CHARACTERIZATION OF THE INNOVATIVE RADIAL CONNECTION SYSTEM	The mechanical behavior of the innovative connector named RADIAL is investigated by means of a large experimental campaign and an analytical design method was developed. Series of monotonic tests in both tensile (F1) and in-plane shear (F2/3) configuration have been performed on three different typologies of RADIAL connector (namely RADIAL90, RADIAL60D and RADIAL60S). The connector consists of a half pipe steel element, with one or two welded steel flanges, and it has to be screwed in a special semicircular hole made in a timber element (i.e. Glulam or Cross Laminated Timber). The screws are radially arranged with respect to the center of the connector and are subjected primarily to tensile forces. RADIAL elements may be used both as panel-to-panel joint or anchorage point for CLT panel as well as the central hinged connection between two glulam elements in a three-hinged arch. Results showed that all the three typologies of RADIAL connectors are characterized by high strength and stiffness in different load configurations. The complete overview of the tests will be presented in the full paper.	Ernesto	Callegari	Rotho Blaas
4G	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	RING CONNECTOR: A NEW CONNECTION SYSTEM FOR PREFABRICATION AND DFD IN CLT STRUCTURES	The mechanical characterization of the innovative RING connector will be presented and discussed in this paper. The connector has been designed for timber-to-timber joints or for timber-to-steel (e.g. hybrid structures) and timber-to-concrete connections. The RING system has been conceived starting from Design for Disassembly concepts and may be adopted in timber prefabricated structures. Several monotonic and cyclic tests will be presented and discussed: results showed that RING can be use in low to mid-rise timber buildings. Strength, stiffness and ductility make the connectors a valuable alternative also in seismic prone areas.	Pietro	Rigo	University of Bologna
4G	STCE - Engineering - Advancing the Circular Economy in Europe	Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	STRUCTURAL FIRE DESIGN WITH AGED RECLAIMED TIMBER: SMALL-SCALE CHARRING PERFORMANCE ASSESSMENT	Timber can play a vital role in the circular economy when reusing materials from deconstruction in new buildings, but modern design constraints hinder its widespread use. Despite efforts to promote reuse of reclaimed timber in construction, its fire performance is not well understood. Current Eurocode 5-1-2 guidelines do not specifically address aged timber of the same species, posing challenges for structural fire design. Limited research on heritage timber shows it chars faster than new timber, influenced by factors like radial cracks. This paper aims to assess reclaimed timber's charring performance compared to virgin timber, using a systematic approach across different origins, age groups, and densities. Small-scale fire testing and thermogravimetric analysis are used to evaluate ignition time, charring rate, moisture content, and thermal decomposition of wood. The results aim to extend the current knowledge and to provide a database for design recommendations to enable adequate fire design for aged reclaimed timber in structural applications.	Maria	Pernits	Tallinn University of Technology
4G	STCE - Engineering	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus	REUSE: GUIDELINE ON THE ASSESSMENT OF THE TECHNICAL INTEGRITY OF DISASSEMBLED TIMBER MEMBERS	Developments towards a safe and regulated re-use of structural timber elements are key factors to enable timber structures to contribute to a circular construction sector. To establish confidence amongst designers in the re-use of structural elements, questions on degradation of timber members during service life must be addressed. This requires measures to verify the technical integrity of such structural members. While moisture content and density can be determined within a narrow range, residual strength- and stiffness properties of timber members need to be predicted non-destructively, so that their reliability in a new structure matches the required level. The paper presents ideas for the identification of the potential for re-use and measures based on non-destructive testing (NDT) to predict mechanical properties. The objective is to enable re-use of used structural timber members and to strengthen circular economy in the timber building sector.	Philipp	Dietsch	Karlsruhe Institute of Technology - Timber Structures and Building Construction
4H	ECCS Engineering	Session Chair: DAVID ZHANG / MULTINAIL					
4H	ECCS Engineering	Timber Engineering & Structural Performance - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	STRUCTURAL PERFORMANCE, ECONOMIC BENEFITS, AND ENVIRONMENTAL IMPACT BETWEEN STEEL STRUCTURE, STEEL -TIMBER HYBRID STRUCTURE, AND TIMBER STRUCTURE IN HIGH SEISMIC ZONE	Globally, the construction industry is a major source of carbon emissions. Studies show that using low-carbon engineered wood in the building sector helps reduce environmental impact. However, hybrid structural systems may be more efficient and economical than full timber structures in high seismic zones. In this study, an existing building was adopted, and a hybrid structural system was proposed by replacing parts of the structural components with wood. This includes a steel structural system, a hybrid steel-timber structural system, and a timber structural system. A comparative analysis of environmental and economic benefits was conducted, including construction cost, carbon content in materials, and so on. The results show that the steel-timber hybrid structural system can reduce structural weight by 51%, while the timber structure can reduce it by 60% compared to the steel structure. In terms of total embodied carbon, the steel structural system, steel-timber hybrid structural system, and timber structural system account for 1,024.4 tons, 692.6 tons, and 551.9 tons of CO2e, respectively. Incorporating partial timber structures in hybrid structural systems helps reduce costs and achieve better environmental benefits.	ChengChieh	HSU	National Taiwan University of Science and Technology
4H	ECCS Engineering	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	Lessons Learnt for Mass Timber Building Design for Fire in Australia	This paper explores lessons learnt in designing mass timber buildings for fire safety in Australia, focusing on regulatory requirements, detailing challenges, and case studies. The National Construction Code (NCC) requires a fire resistance level (FRL) of at least 120 minutes for commercial or assembly buildings. Timber structures do not need to be non-combustible unless specified for elements like external walls. Compliance can be demonstrated through Performance Solutions by fire engineers, offering flexibility but presenting approval challenges. Exposed mass timber buildings undergo rigorous scrutiny from authorities, requiring higher proof of safety for larger structures. The current regulations lack enough specific guidelines for detailing for fire resistance. The use of the B-Risk software for modeling fire dynamics in mass timber buildings will also be discussed, which enables designers to consider phenomena such as delamination of CLT panels and the contribution of timber to the compartment fire. Challenges remain in finding suitable fire-stopping products tested to Australian Standards. Performance Solutions can incur additional costs and delays due to site constraints. Early planning and detailed design are crucial in mass timber construction, emphasizing the need for readily available fire-tested products and proactive regulatory engagement to ensure compliance and safety.	Lukas	Rutkauskas	Holmes
4H	TESP Engineering - Construction Case Studies	Exemplars & Construction Case Studies - Practitioner Focus	Comparison of operational and regulatory environment affecting residential multi-story timber buildings in Finland and New Zealand	Given the significant contribution of construction to global greenhouse gas emissions, transforming the building sector is essential for climate change mitigation. Industrial timber construction is gaining popularity worldwide due to its potential to reduce construction-related emissions substantially. This study examines the differences in regulatory and operational environments affecting residential multi-story timber buildings (RMSTB) in Finland and New Zealand (NZ). Finland, with its long-standing tradition in timber construction, has made notable advancements in industrial timber building, supported by state initiatives. In contrast, NZ, despite sharing similar demographic and economic characteristics with Finland, lags in utilizing its extensive forest resources for value creation and timber construction. The research involves interdisciplinary teams from both countries analyzing regulations related to sustainability, architecture, structural engineering, fire safety, and acoustics, and assessing the impacts of these on RMSTB. Furthermore, it explores the roles of government support programs, financing models, and land allocation conditions in promoting RMSTB. By comparing the findings, this study aims to facilitate the application of proven Finnish practices to the NZ context, enhancing the country's ability to process local timber into sustainable construction products. This comparison helps foster international collaboration and knowledge transfer to promote the sustainable use of timber in construction.	Ninni	Westerholm	Tampere University

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
4H	TESP Engineering - Construction Case Studies	Timber Engineering & Structural Performance - Engineering Focus	FRAGILITY CURVE FOR WOODEN BUILDINGS BASED ON RESPONSE ANALYSIS USING SEISMIC ASSESSMENT RESULTS IN KYOTO CITY	In Japan, the Evacuation Safety Index evaluates the likelihood of safe evacuation in vulnerable urban areas during earthquake disasters, considering road blockages due to the collapse of wooden buildings. This index is calculated using the fragility curve based on building damage surveys conducted during the 1995 Hyogo-ken Nanbu Earthquake (Murao and Yamazaki). However, there are concerns that the vulnerable urban areas under evaluation may have differences in regional characteristics. To address this issue, Kyoto City, which contains numerous vulnerable regions, was selected as a case study. A fragility curve was developed based on seismic assessment results specific to Kyoto City. This Kyoto City-specific fragility curve was then compared with the fragility curve based on the 1995 Hyogo-ken Nanbu Earthquake damage survey to evaluate its validity in reflecting regional characteristics.	HARUNA	UNNO	Kyoto University
4H	ECCS Engineering	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	ASSESSMENT OF HYGROTHERMAL PERFORMANCE OF TRADITIONAL AND INSULATED CORDWOOD MASONRY	Cordwood masonry is a traditional building method using wood logs mortared with clay, oriented with the fibre direction perpendicularly to the wall's length. This technique, using affordable and low emission materials, supports circularity through timber reuse and design for disassembly. In this study, experimental investigation of the hygrothermal performance of a cordwood wall has been conducted in a laboratory. In particular, the U-value of a cordwood wall was measured experimentally and compared it with theoretical calculations. The risk for mould growth in both traditional (uninsulated) and insulated cordwood walls was examined with validated numerical simulations. The results show that a traditional cordwood wall is poorly insulated and effectively dissipates moisture, making it suitable for structures like cabins and sheds with less demanding energy efficiency requirements. Furthermore, an insulated cordwood wall without a vapour barrier is highly vapour-permeable but could potentially be used in buildings with low indoor moisture excess.	Mattis Mendoza	Sveinhaug	Sweco Norway AS
4H	ECCS Engineering	Material Performance & Durability - Engineering Focus, Exemplars & Construction Case Studies - Engineering	The Hygrothermal Performance and Durability of a one-story Cross-laminated Timber and Wood Fiber Insulation School Building Located in Belfast, Maine	In-situ hygrothermal and energetic monitoring of a CLT and wood fiber insulation hybrid building in a cold US climate. Data was used to calibrate a hygrothermal modeling, and long term durability and mold risk analysis was performed.	Liam	O'Brien	University of Maine
4H	ECCS Engineering	Exemplars & Construction Case Studies - Engineering Focus	Monitoring timber moisture content in timber-concrete hybrid construction: St Lukes Health Insurance mid-rise office building.	The St Lukes Health Insurance building in Launceston, Tasmania is one of Australia's latest mass timber buildings to be constructed. This seven-storey, 7000m2 building will be the largest office dwelling in Launceston, Tasmania. Constructed with European spruce post and beams, Victorian radiata pine CLT and local Tasmanian Eucalyptus nitens CLT, the speed of construction and natural beauty of this project is unprecedented. The research presented in this article is about the monitoring of the change in moisture content (MC) in the concrete capped CLT composite solution used on the level five ceiling to level six floor. This hybrid solution provided a platform for a garden terrace located on level six. The change in moisture content (MC) of the radiata pine CLT structure post concrete capping, was measured to the point of structural cure (28 days) and beyond to ensure the timber structure returned to an acceptable MC. Several months of data collection highlighted the initial peak in MC as a result of the concrete capping and the gradual decline in timber MC over 2023/24 period. This article acts as an exemplar study that future scholars and practitioners can adopt to monitor change in mass timber MC during construction and post hybridisation solutions.	Greg	Nolan	University of Tasmania
4I	EIC - Engineering Applications & Architecture	Session Chair: CARMEN SANDHAAS / KARLSRUHE INSTITUTE OF TECHNOLOGY					
4I	EIC - Engineering Applications & Architecture	Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	DISCRETE OPTIMIZATION OF TIMBER STRUCTURES WITH M I N L P	The mini paper deals with the discrete optimization of timber structures. Mixed-integer non-linear programming (MINLP) is applied. For each structure, a MINLP superstructure of various structural alternatives and an optimization model are developed. The cost or mass objective function of the structure is subjected to the constraints of inner forces, stresses and dimensioning. The defined problem is solved with a Modified Outer-Approximation/Equality-Relaxation (OA/ER) algorithm. Cost optimizations of a timber-concrete composite floor system, a timber floor joist and a timber-steel hall structure are briefly presented here. For given input data and unit prices, the minimal self-manufacturing costs of the structures are determined together with the optimal number of structural elements and their sizes. MINLP proves to be a valuable method for the optimization of timber structures. Structural optimization is suitable for teaching at universities as well as for use in research and engineering practice.	Stojan	Kravanja	University of Maribor
4I	EIC - Engineering Applications & Architecture	Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	Experimental Characterization of Moment-Rotation Behavior of Reinforced Disassemblable Mortise and Tenon Joints	In the context of sustainability, circular design, and modern robotic fabrication possibilities, traditional disassemblable Mortise-Tenon Joints (MTJs) composed primarily of timber are becoming increasingly relevant. However, in current European design practice, most traditional MTJs are still modeled as full hinges due to limited knowledge of their moment-rotation behavior and the inherent weakness of wood in compression perpendicular to the grain. This study examines the experimental moment-rotation behavior of MTJs reinforced with splitting wedges, polymer concrete, and screws, ensuring easy disassemblability. While initial moment-rotation stiffness remained largely unaffected by the different reinforcement methods, the cyclic envelope and energy dissipation exhibited significant differences, highlighting the potential for tailored engineered moment-rotation behaviour.	Sanoop	Siby	Materialprüfungsanstalt Universität Stuttgart - Abteilung Holzkonstruktionen
4I	EIC - Engineering Applications & Architecture	Education, Innovation & Challengers - Engineering Focus	ADRESSING THE CHALLENGES IN THE HOLISTIC DESIGN OF TALLER TIMBER BUILDINGS – COST ACTION HELEN	Designing timber multi-storey buildings is often more demanding than concrete and steel buildings. It is therefore crucial to address taller multi-storey timber buildings from a collaborative and interdisciplinary perspective, considering static, dynamic, fire, acoustic, human health and other aspects in parallel and not in isolation. Only through interdisciplinary analysis and interaction can a set of holistic design guidelines be developed that will enable safe and economic construction of taller timber buildings, as well as respect comfort and human wellbeing demands. In this paper, the work carried out in COST Action HELEN will be presented, and the main activities and outcomes will be discussed.	Robert	Jockwer	TUD Dresden University of Technology
4I	EIC - Engineering Applications & Architecture	Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	All-in-one industrialized active façade for deep building retrofit: timber engineering process and performances analysis	This article illustrates the development, engineering, realization, and validation process which resulted in the definition of an all-in-one timber-based envelope solution for deep building renovation, called "energy and air-fresh distribution kit." The results of the timber engineering process to integrate the HVAC system in the façade and the related numerical and experimental analyses carried out to evaluate the performance of this integrated solution are reported. From such analysis, it emerges that the kit can be used to provide insulation as well as fresh air and air-based heating or cooling, thanks to the HVAC integration, with no mould and condensation risks during cold and hot conditions for both the balcony parapet and façade-integrated solutions. The engineering process and the performance analysis result in a viable solution ready for real-case implementation.	Martino	Gubert	Eurac Research
4I	EIC - Engineering Applications & Architecture	Education, Innovation & Challengers - Architectural Focus	Restoration Methodology for Medieval Wooden Structures Based on Excavated Remains in Seoul	This study aims to propose a restoration design process for traditional wooden buildings from medieval Korea and analyze various methods of displaying the resulting restoration plans. Focusing on the nine building sites excavated from the entire site of Gongpyeong Districts 15 and 16 in central Seoul, the study seeks to present an analytical method and restoration process that can accurately reconstruct the original forms of the excavated remains. Through this, the study aims to establish a methodology for estimating East Asian wooden buildings and discuss effective exhibition strategies to showcase the results.	HYUNTAE	JOO	Seoul National University

SESSION 4

Tuesday 24th June 2025
8:30am to 10:30am

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
4I	EIC - Engineering Applications & Architecture	Education, Innovation & Challengers - Architectural Focus	Assessing the Factors Behind the Depletion of Korean Traditional Wooden Building 'Hanok' in Metropolis Seoul	This study investigates hanoks, Korean traditional wooden buildings, in Seoul—a densely populated metropolis where they comprise only 5 percent of buildings and face rapid disappearance. Our goal is to assess the risk faced by individual hanoks, focusing on urban and architectural factors. Using causal inference and statistical methodologies, we analyze variables influencing hanok demolition and derive a risk index. Data from surveys conducted between 2014 and 2023 provide a foundation for our analysis. The findings aim to inform systematic conservation policies, offering insights into urban and architectural conditions crucial for hanok preservation amidst high-pressure development. Furthermore, the study contributes to global discussions on preserving historic wooden architecture by drawing parallels with similar challenges faced by cities worldwide. The results are expected to guide future research and policy initiatives aimed at safeguarding cultural heritage in urban settings.	Seongjun	Koo	dept. of Architecture, Seoul National University
4I	EIC - Engineering Applications & Architecture	Education, Innovation & Challengers - Engineering Focus, Education, Innovation & Challengers - Architectural Focus	Building Bridges Between Architecture and Engineering - Timber Education at the University of Queensland	The University of Queensland is one of few universities in Australia to offer a dedicated structural timber engineering course. For several years, this course has been taught in parallel with an architecture design studio. In an interdisciplinary group project, teams of architecture and engineering students design timber bridges at various locations across South East Queensland. They learn about a range of topics, such as timber as structural material, timber durability, Indigenous stakeholder engagement, and forest stewardship, while working in diverse interdisciplinary teams with expert guidance from industry professionals. Through hands-on prototyping and problem-based learning, students develop both technical proficiency and practical skills as future design professionals.	Lisa-Mareike	Ottenhaus	The University of Queensland
4I	EIC - Engineering Applications & Architecture	Education, Innovation & Challengers - Architectural Focus	ACQUIRING, THINKING & GENERATING KNOWLEDGE: PROGRESSIVE EDUCATIONAL FRAMEWORK FOR TIMBER ARCHITECTURE	The timber architecture education framework at Zhejiang University (ZJU), driven by Lab MUGO, is a comprehensive tripartite structure that includes undergraduate basic training, postgraduate advanced training, and doctoral research training. Over the course of four years, this framework has achieved significant milestones, including pedagogical innovations like tiered curricula, groundbreaking doctoral research, national competition successes, and international initiatives such as global summer schools. This paper examines the implementation of the framework, evaluates its achievements and experiences, and proposes strategic improvements through curriculum restructuring and enhanced global competency. These enhancements strive to consolidate ZJU's role as a key player in timber architecture education in China, propelling sustainable architectural development across China and extending its influence globally.	Harrison	Huang	Zhejiang University

SESSION 5
Tuesday 24th June 2025
11:00am to 1:00pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
5A	TESP - Engineering - Structural Components	Session Chair: DR SHENGDONG ZHANG / TONGJI UNIVERSITY					
5A	TESP - Engineering - Structural Components	Timber Engineering & Structural Performance - Engineering Focus	INFLUENCE OF RECTANGULAR WEB OPENINGS ON LOAD-CARRYING CAPACITY OF TIMBER I-JOISTS	This paper presents test results of experimental work conducted to evaluate the influence of rectangular web openings on the structural performance of timber I-joists fabricated from solid wood flanges and oriented-strand board web. Four-point bending tests were conducted on specimens with and without openings. Test samples span was equal to 9 times the depth of the I-joists with openings made at various locations in turn related to the joist depth. Effects of the size and opening locations on the load-carrying capacity of the I-joists were determined. Test results revealed that an increase in the height and width of the openings significantly reduced the load-carrying capacity when openings were placed outside pure bending areas (i.e. up to 58% when I-joist with the largest opening tested). In contrast, openings within the pure bending area have a negligible influence on the capacity.	Sini	Lu	Edinburgh Napier University
5A	TESP - Engineering - Structural Components	Timber Engineering & Structural Performance - Engineering Focus	NUMERICAL APPLICATION OF LOAD-BEARING DOUBLE-SKIN FACADE ELEMENTS IN HIGH-RISE TIMBER BUILDINGS	The paper presents a numerical application of a new developed load-bearing prefabricated light timber-framed elements with doubled-pane glazing called as double-skin façade (DSF) elements in a specially selected high-rise timber construction. Prefabricated DSF elements basically combine sustainable solutions with improved energy efficiency and living quality, however, mostly all these transparent façade elements because of energy benefits are primary asymmetrical oriented in the building envelope and if they are considered following the current standards as non-resisting against a horizontal load impact, a strong torsion effects in the building can appear. The problem of structural stability against a strong horizontal load impact of such modern timber buildings especially increase in a case of high-rise timber structures where additional bracing elements have to be used. The new developed load-bearing DSF elements can be a good answer on all these requirements. In our previous experimental and numerical studies a possible benefit of such load-bearing DSF elements was already presented, however they were not applicated yet in any high-rise timber structure at all. Therefore, in the presented study a specially selected 10-storey prefabricated timber building constructed in a cross-laminated timber (CLT) structural wall system is analysed using the developed DSF elements as additional bracing elements in a sense to increase a structural lateral stability of the whole timber building. The obtained results evidently highlight the importance of the application of the new-developed load-bearing DSF elements, as their incorporation can have a significant impact on the overall structural behaviour of the high-rise structure through their influence on the evidently improved racking stiffness properties.	Miroslav	Premrov	University of Maribor, Faculty of Civil Engineering, Transportation Engineering and Architecture
5A	TESP - Engineering - Structural Components	Timber Engineering & Structural Performance - Engineering Focus	PERFORMANCE BASED DESIGN METHOD FOR TIMBER UNIT LOAD-BEARING WALL COMPOSED OF CURVED MEMBERS CONSIDERING GEOMETRIC NONLINEARITY AND PERFORMANCE OF JOINTS	This study proposes a load-bearing wall system composed of curved wooden member units, allowing designers to freely control stiffness and strength. This system allows for independent control of stiffness and strength by adjusting the unit size, sectional dimensions, or curvature. Additionally, a performance-based design method is proposed, grounded in solving an inverse problem. Applying this system to older traditional wooden buildings enables the design of load-bearing walls that accommodate the high deformation performance of these structures. Moreover, it is possible to alter the appearance without affecting performance. By considering geometric nonlinearity and the performance of bolted joints, we achieve a model that closely approximates real-world phenomena. The validity of the design method is evaluated by comparing experimental results with analytical results.	Shion	KUBOTA	0
5A	TESP - Engineering - Structural Components	Timber Engineering & Structural Performance - Engineering Focus	MOMENT JOINTS IN THE MINOR STRENGTH AXIS OF CLT PANELS	When cross-laminated timber (CLT) panels are used in buildings with irregular component geometries, the loading conditions may deviate from the major or minor strength axis of the panel. This study examines the bending stiffness of CLT panels under different cross-angles using experimental, analytical, and numerical methods. Panels with three lay-ups (3-ply, 4-ply, and 5-ply) and five cross-angles (ranging from 0 ° to 90 °) were tested under three-point bending. The results demonstrated a nonlinear relationship between cross-angle and bending stiffness. The lowest bending stiffness was observed at intermediate cross-angles, rather than along the minor strength direction. The proposed analytical model combines the shear analogy with the Hankinson equation to approximate the bending stiffness. The model was validated through numerical simulations and used to predict the out-of- plane cross-angle bending stiffness of various CLT panel lay-ups.	Xiaoyue	Zhang	School of Civil Engineering, Chongqing University
5A	TESP - Engineering - Structural Components	Timber Engineering & Structural Performance - Engineering Focus	SCREW REINFORCEMENT AND REPAIR OF POINT-SUPPORTED CLT	Self-tapping screws (STS) can be used for shear reinforcement of point-supported Cross-laminated timber (CLT) floors; however, the effect of reinforcement zone, level, and strength axis directions are not yet fully understood. Moreover, there is a lack of understanding of the post-failure performance of point-supported CLT floors and the feasibility of repair by means of screw reinforcement. In this research, STS-reinforced intact and STS-repaired CLT panels were tested under punching shear to study the impact of different reinforcement parameters. Re-tested panels without reinforcement reached up to 85% of their initial capacity. STS reinforcement increased the load-carrying capacity of intact panels by up to 42%. And reinforced re-tested panels reached up to 96% to 124% of their initial load-carrying capacity. The non-repaired and reinforced re-tested panels reached up to 61% and 78% of their initial elastic stiffness, respectively, and repaired CLT recovered up to 90% and 98% of stiffnesses, respectively.	Houman	Ganjali	University of Northern British Columbia
5A	TESP - Engineering - Structural Components	Timber Engineering & Structural Performance - Engineering Focus	EXPERIMENTAL STUDY OF BRITTLE FAILURE OF LATERALLY LOADED CROSS-LAMINATED TIMBER CONNECTIONS WITH INCLINED SELF-TAPPING SCREWS	Self-tapping screws (STSs) are one of the most commonly used fasteners in modern mass timber construction. The new STS provision in CSA O86-24 does not formally address brittle failure of inclined STS connections due to a lack of research data. To fill this knowledge gap, a series of tests on Steel-to-CLT connections with STSs at different insertion angles, penetration lengths and lateral load directions were conducted. This study aims to develop predictive equations for plug-step shear failure mode and evaluate if the equations adopted for 90-degree STS connections in the new provision are also applicable for inclined STS connections. This study is expected to enhance the understanding of the behavior of Steel-to-CLT connections with STSs in various configurations and contribute to the development of design provisions for brittle failure of inclined STS connections.	HUIQI	WANG	University of Victoria
5A	TESP - Engineering - Structural Components	Timber Engineering & Structural Performance - Engineering Focus	EXPERIMENTAL STUDY ON GLULAM POST-BEAM JOINTS WITH INCLINED SELF-TAPPING SCREWS UNDER CYCLIC LOAD	To study the seismic performance of timber post-beam joints connected with inclined long self-tapping screws, an experimental study was carried out. 8 groups of specimens fabricated with nominal 13 mm diameter WRT self-tapping screws of SFS intec. and Douglas fir GLULAM with 2 replicates in each group under cyclic load were tested. Impact factors such as number of screws, inclined angle, rows of screws, edge distance of screws, etc. were taken into account. The results show that the failure mode is tension failure of screws when the embedment length is long enough, the ductility coefficients of the joints are in the range of 1.70~2.52, the edge distance and the number of screws have impact on the capacities of the joints, but the inclined angles of the screws have no significant influence.	Shengdong	Zhang	Tongji University

SESSION 5
Tuesday 24th June 2025
11:00am to 1:00pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
5B	TESP- Engineering Structural Modelling	Session Chair: DR SARDAR MALEK / UNIVERITY OF VICTORIA					
5B	TESP- Engineering Structural Modelling	Timber Engineering & Structural Performance - Engineering Focus	Development of an innovative structural system for multistorey timber buildings with increased service life – the CRESTIMB project	CRESTIMB aims to develop an innovative timber system for multi-storey buildings with open spaces. The system will include softwood or hardwood glued-laminated timber (glulam) columns and beams connected with innovative moment resisting connections, and dowel-laminated floors. This paper focuses on the description and identification of the gravity and lateral load-resisting system, in addition to the experimental programme that aims to assess the short- and long-term performance of the system components, which includes mechanical tests on small wood samples, and full-scale tests. Test results will serve as input to an advanced numerical model to investigate the long-term behaviour of the selected components considering the complex rheological behaviour of wood under variable indoor climates, with the objective being to ensure an increased service life and the possibility of reuse.	Martina	Sciomenta	University Of L'aquila
5B	TESP- Engineering Structural Modelling	Timber Engineering & Structural Performance - Engineering Focus	DYNAMIC RESPONSE OF DIAGONAL LAMINATED TIMBER – PARAMETER STUDIES AND MODELLING APPROACHES	The paper provides an overview and preliminary results from the InnoTLT research project. The objective of InnoTLT is to evolve cross-laminated timber (CLT) into the next generation of Tailored Laminated Timber (TLT) by exploring concepts that optimize mechanical performance while simultaneously ensuring adherence to circular economy principles. The current study aims at investigating the potential in terms of Diagonal Laminated Timber (DLT), where adjacent layers are oriented at a non-orthogonal direction relative to each other. Finite element parameter studies were performed, showing differences in dynamic behaviour for DLT compared to CLT. The study highlights the potential of using DLT as a means of tailoring the vibration performance. In addition, the paper discusses pros and cons as regards different modelling approaches in terms of model detailing and choice of element types.	Erik	Serrano	Lund University
5B	TESP- Engineering Structural Modelling	Timber Engineering & Structural Performance - Engineering Focus	Evaluation of the Effective Flange Width of Mass Timber Composites T-Beams Using Digital Image Correlation and Finite Element Modelling	Mass timber composites (MTCs) often consist of CLT slabs and glulam beams compositely connected with a shear connection consisting of adhesive, mechanical fasteners, or a combination thereof. The large spacing between beams in MTC panels results in longitudinal stresses in the flange(s) over the voided areas, lagging those close to the beams. This non-linear strain distribution is typically accounted for in design with an effective flange width (EFW) factor. This study evaluates the EFW for three 4.5m CLT-glulam T-beams compositely connected with a screw-glued connection. Longitudinal strains across the top of the CLT flange are obtained using digital image correlation, finite element (FE) modelling, and discrete strain gauges, and used to determine the EFW for each specimen. Overall, the DIC technique presented herein was able to provide valuable strain and deformation data which had good agreement with the discrete strain gauges and FE modelling. The EFW results showed that proposed design code guidance was not able to accurately predict the EFW of MTC panels.	Tyler	Hull	University of Waterloo
5B	TESP- Engineering Structural Modelling	Timber Engineering & Structural Performance - Engineering Focus	EXPERIMENTAL STUDY OF STRUCTURAL PERFORMANCE OF TIMBER-CONCRETE COMPOSITES USING RECYCLED AGGREGATES	This study investigates the load-slip behaviour of timber-concrete composite (TCC) with recycled aggregates within concrete constituent. Push-out tests were conducted, and the load-slip behaviour was obtained from TCC specimens made from cross-laminated timber in conjunction with normal and recycled aggregate concrete. The recycled aggregates were Incinerator Bottom Ash Aggregates. The composite actions were achieved by using screw connectors at 30°,45° and 90° orientations. The results reveal comparable structural behaviour of TCC specimens with normal and recycled aggregate concrete layer, however, a slight reduction in slip-modulus and an increase in slip were observed in TCC with recycled aggregate concrete. Furthermore, cross-screws at 30° and 45° enhanced the load-slip performance with minimal concrete cracking. The results demonstrate that incorporating recycled aggregate material in TCC has the potential as a viable alternative to promoting sustainability in construction.	Daniel	Kumah	Edinburgh Napier University
5B	TESP- Engineering Structural Modelling	Timber Engineering & Structural Performance - Engineering Focus	A RESILIENT CLT SHEAR WALL SYSTEM FOR TIMBER BUILDINGS	Balloon-framed cross-laminated timber (CLT) shear walls are a promising solution as the primary lateral force resisting system (LFRS) for tall mass timber buildings. But this LFRS is not specified in current Canadian and American codes, and engineers have to go through lengthy peer reviews to get a balloon-type design approved. To support practitioners, this research aims to develop a practical guide to facilitate the numerical analysis of balloon-framed CLT buildings under high seismicity. Proper modelling strategies are essential to accurately predict the system performance; therefore, an overview of modelling approaches appropriate to capture the lateral response of CLT panels and connections is presented. An archetype building based on real design practice is presented and a nonlinear model is established. The model, validated with experimental data from connection and shear wall tests, will be used to simulate the seismic performance of balloon-framed CLT shear wall buildings.	Fei	Tong	University of Northern British Columbia
5B	TESP- Engineering Structural Modelling	Timber Engineering & Structural Performance - Engineering Focus	STRUCTURAL MODELING OF A NOVEL HYBRID TIMBER FLOOR SYSTEM	To maximize the amount of carbon-sequestering mass timber and demonstrate the potential for mass timber across a range of building types and scales, DIALOG and EllisDon have developed a Hybrid Timber Floor System (HTFS) that is composed of post-tensioned (PT) concrete beams, cross laminated timber (CLT) panel, and concrete topping connected to each other through self-tapping screws and kerf plates. This paper presents a study of the structural performance of this novel HTFS through a combination of testing and modelling conducted at FPInnovations. The structural performance of the self-tapping screw (STS) and kerf plate connections was tested and used as key modelling input. A refined and comprehensive three-dimensional (3D) finite element model was developed and verified against deflection and vibration measurements obtained from the full-size HTFS. The verified model was utilized to investigate the structural performance of HTFS under out-of-plane loading. The connection tests and the simulation results give an insight into the structural performance of this novel HTFS.	Zhiyong	Chen	FPInnovations
5B	TESP- Engineering Structural Modelling	Timber Engineering & Structural Performance - Engineering Focus	Numerical modelling of high-capacity shear walls with multiple rows of nails: failure modes and parametric study	A new high-capacity wood frame shear wall system with two and three rows of nails was developed in collaboration between the University of Victoria and FPInnovations in response to the increased demand for stronger shear wall systems. Test programs were carried out over a three-year period. Results showed that the proposed high-capacity shear wall system can achieve lateral resistance proportional to the number of rows of nails on sheathing edges compared to a standard shear wall. A detailed 3D numerical model of high-capacity shear walls with multiple rows of nails was developed in ABAQUS. The model was verified by the test results with good agreement. This study presents a parametric study considering wall configurations that are not included in the test programs. High-capacity shear walls with different aspect ratios, stud sizes, sheathing orientation, and hold-down types were modelled. The results were analysed in terms of load-displacement response and failure modes.	Ruite	Qiang	University of Victoria
5C	TESP- Engineering Vibrations and Acoustics	Session Chair: PROFESSOR YING HUI CHUI / UNIVERSITY OF ALBERTA					

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
5C	TESP- Engineering Vibrations and Acoustics	Timber Engineering & Structural Performance - Architectural Focus, Education, Innovation & Challengers - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	The application of hybrid timber systems to challenge conventional building typologies in an emerging market: 2 Castle Street 'Workplace Hub'	One of the key differentiators of mass timber workplace buildings from more entrenched methods of construction is it's unique, inherent structural performance. This paper explores how the knowledge developed during the design and construction of the Oakhill Innovation Hub is being applied to evolve both education and commercial building typologies. This knowledge is being applied directly to design process of a new office tower, the 2 Castle Street 'Workplace Hub', which at completion will be one of the southern hemisphere's largest commercial buildings by both height and area metrics. The primary ambitions of the Workplace Hub presented two challenges to contemporary Australian commercial buildings. Firstly, the need for use of timber for its low carbon and high strength to weight ratio when compared to concrete, allowing for a larger building than would conventionally be possible above a rail corridor. Second is the emerging demand for 'post-covid' workplaces where occupants have access entirely outdoor spaces within a commercial floorplate. In isolation each of these could be solved easily through established mass timber systems, or conventional construction, respectively. In combination, however, they require a structural and procurement strategy that demands growth of the Australian construction sector. This case study responds to project specifics and support the maturity of mass timber within Australia. The design journey follows through multiple lenses and design implications of a hybrid mass timber structure in a commercial/workplace context.	Adrian	Taylor	BVN
5C	TESP- Engineering Vibrations and Acoustics	Timber Engineering & Structural Performance - Engineering Focus	EVALUATION OF THE INFLUENCE OF SYSTEM EFFECTS ON THE LATERAL RESPONSE OF BUILDINGS WITH L- AND U-SHAPED WOOD FRAME SHEAR WALLS THROUGH SHAKE TABLE TESTS	This paper presents part of the findings of a shake table test on a 3-story, 1:2 scale Light Frame Timber Building (LFTB), examining the influence of system effects. Here system effects refer to: a) the effect of transverse walls in non-planar shear wall configurations; b) out-of-plane bending diaphragm interaction with the shear walls; and c) gravity load. The study contributes to the comprehension and quantification of system effects, highlighting the benefits of component interaction in LFTBs subjected to lateral loads. Test results demonstrate that system effects significantly reduce story drift demands by increasing the lateral stiffness and damping ratio of the building with respect to those of a building in which there are no system effects. For instance, the experimental first-floor secant stiffness was higher than the value predicted by assuming planar shear walls. This underestimation decreases at higher stories, indicating that the gravity load further enhances the benefits of transverse shear walls and out-of-plane bending stiffness interaction. These findings have implications for the design and analysis of LFTBs in seismic regions: their incorporation into seismic design procedures might promote widespread adoption of LFTBs as a sustainable and resilient construction solution.	Diego	Valdivieso	Centro Nacional de Excelencia para la Industria de la Madera (CENAMAD-CIM UC)
5C	TESP- Engineering Vibrations and Acoustics	Timber Engineering & Structural Performance - Engineering Focus	ASSESSING VIBRATIONAL PERFORMANCE IN DIFFERENT TIMBER FLOOR CONFIGURATIONS: AN EXPERIMENTAL STUDY	The construction of timber structures offers a significant advantage in reducing the carbon footprint associated with building activities. However, to fully realize this benefit, it is essential to enable the construction of large and tall timber buildings. Achieving this goal presents certain engineering challenges, particularly concerning human-induced vibrations on timber floors, which are more pronounced in large-span or office spaces. The lightweight and lower stiffness of timber floors result in vibrating frequencies that fall within the range easily perceptible by humans. Therefore, designing timber floors with optimal vibrational characteristics, such as predominant frequency and damping, is crucial for ensuring comfort and constructability. This research investigates these challenges through a series of experiments on six timber floors, each constructed with three different structural combinations and two varying finishing conditions. The experimental procedures included heel drop, weight drop, human walking, crowd walking, and quasi-static deflection tests. This paper presents the preliminary results from these experiments, offering insights into the vibrational behavior of timber floors and their implications for future construction practices.	Ihsan Engin	Bal	Hanze University of Applied Sciences
5C	TESP- Engineering Vibrations and Acoustics	Timber Engineering & Structural Performance - Engineering Focus	LONG -TERM LOADING CREEP TEST ON A FULL -SCALE STEEL BAR TIMBER COMPOSITE BEAM	We have been developing a frame system formed by timber members strengthened by deformed steel bars using epoxy resin adhesive. We have reported the creep test of small-scaled specimens of composite timber beams in WCTE2018 and WCTE2021. We have been conducting, from December 2023, a new creep test for a full-scale creep test for one full-scale section- and large-span-composite beam specimen and one full-scale section glulam timber beam specimen under a natural-variable environment by 4-point bending loading. They have been adjusted to be subjected to same long-term allowabe bending moment of wood at mid span and allowable shear force at both shear spans by slecting the lengths of beam and the shear spans. This paper reports approximately one-year results of the creep test of full-scale beam specimens and curvature-elapsed time curve, for the composite beam, calculated by using curvature-elapsed time curve of the glulam timber beam.	TAKESHI	IZAKI	Kagoshima University
5C	TESP- Engineering Vibrations and Acoustics	Timber Engineering & Structural Performance - Engineering Focus	EXPERIMENTAL INVESTIGATION OF CLT PANELS REINFORCED WITH GFRP BARS	When it comes to designing timber structures the limiting factors are usually stiffness properties of the wood products. Stiffness requirements within the serviceability limit state (deformations and vibrations) are often the most relevant criterion for the design of timber elements subjected to bending. This paper shows an experimental study undertaken to investigate the effectiveness of glass fiber reinforced polymers (GFRP) as flexural reinforcement of cross laminated timber (CLT) panels. Five panels reinforced with GFRP bars and five unreinforced (control) panels were tested up to failure in a four-point bending configuration. Identical reinforcement arrangement in both tensile and compressive zones was considered in order to achieve the maximum increase in stiffness. The mechanical properties of reinforced panels are compared to those of unreinforced panels with regard to the load-deflection behaviour, failure mode, load-carrying capacity, deformability, bending stiffness values, as well as strain distribution along the panels' depth. The experimental results demonstrated the beneficial effect of the proposed reinforcing solution in terms of strength, stiffness and ductility. No issues were evident regarding the integrity of the bond between CLT and GFRP bars.	Nađa	Simović	Faculty of Civil Engineering, University of Belgrade
5C	TESP- Engineering Vibrations and Acoustics	Timber Engineering & Structural Performance - Engineering Focus	VIBRATION BEHAVIOUR OF A STRESSED LAMINATED TIMBER DECK PEDESTRIAN BRIDGE	Timber has gained popularity as an alternative construction material for pedestrian bridges. However, the lightweight and low mass of structural timber systems make them prone to high vibrations. Information for assessing pedestrian comfort on timber bridges is limited. Field experiments were carried out on a stress laminated timber deck pedestrian bridge using highly developed dynamic analysis methods to evaluate the vibration characteristics of the structure. Focus was on natural frequencies, mode shapes damping ratios and time history responses which are indicative parameters for assessing the vibration serviceability of structural systems.	Mohammadreza	Salehi	Norwegian University of Life Sciences

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
5C	TESP- Engineering Vibrations and Acoustics	Timber Engineering & Structural Performance - Engineering Focus	Experimental Investigation of Vibration Performance of a Glulam Deck Floor Supported on Glulam Beams	As mass timber panels become increasingly prevalent in mid-rise and high-rise wood structures, ensuring satisfactory floor vibration performance is essential for occupant comfort. Current design methods often overlook the impact of support conditions, assuming rigid supports and neglecting the effects of beam flexibility on floor vibration. Additionally, concrete topping on mass timber floors is a common practice for improving acoustic and fire performance, but its impact on floor vibration performance remains uncertain. This study investigates the dynamic properties and vibration performance of a full-scale glulam deck floor through experimental tests, considering the effects of beam-supported condition, non-structural sheathing panel, and concrete topping.The results indicate a significant decrease in the fundamental natural frequency when transitioning from rigid to beam support, leading to resonant responses under human walking. Although the addition of concrete topping improved vibration performance from marginal to acceptable level, measured acceleration levels exceeded AISC DG11 recommendations by four to six times, contradicting subjective evaluations. These findings illustrate the significant impact of support conditions and concrete topping on the vibration performance of mass timber floor structures, underscoring the necessity of considering these factors in future design methods. The experimental data provide practical insights for the real construction of such floor structures. More detailed data and discussion will be presented in the full paper.	Chenyue	Guo	University of Alberta; University of Northern British Columbia
5C	TESP- Engineering Vibrations and Acoustics	Timber Engineering & Structural Performance - Engineering Focus	Signal Denoising for Timber Bridge Structural Health Monitoring Using Optimized Variational Mode Decomposition	Operational and measurement noise presents a major challenge to the accuracy and reliability of structural health monitoring (SHM) systems, particularly in timber bridge applications. This study investigates the effectiveness of Variational Mode Decomposition (VMD), an advanced signal processing technique, in enhancing the quality of response measurements from a laboratory-scale pedestrian timber bridge. Acceleration and strain signals were collected under both intact and damaged conditions to perform a detailed signal analysis. VMD was applied to decompose the signals into narrowband intrinsic mode functions (IMFs), enabling the isolation of structural responses from noise. The method yielded high cross-correlation values (above 0.998) between original and reconstructed signals, confirming that critical features were preserved. Furthermore, energy retention analysis across IMFs revealed distinct patterns reflective of structural condition, with meaningful content concentrated in the lower-order modes and noise primarily captured by the final components. These findings confirm the potential of VMD as a robust preprocessing tool for noise reduction within SHM frameworks, supporting improved interpretation of structural responses in timber bridge structures.	Farshid	Abdoli	Western Sydney University
5D	STCE/TESP - Engineering - Material Properties / Codes & Regulatory Framework	Session Chair: PROFESSOR ALEXANDER SALENIKOVICH / UNIVERSITE LAVAL					
5D	STCE/TESP - Engineering - Material Properties / Codes & Regulatory Framework	Sustainability and Timber in a Circular Economy - Engineering Focus	CONTRIBUTION TO CLIMATE CHANGE MITIGATION THROUGH SOIL LIQUEFACTION COUNTERMEASURES USING LOGS	The authors propose the use of logs in liquefaction countermeasures. The major advantage of this method is that it captures carbon dioxide from the atmosphere and stocks it underground. Thus, in addition to reducing carbon dioxide emissions, atmospheric carbon dioxide would also be reduced. This is the same as creating a forest underground. This paper describes the mechanism by which the proposed liquefaction countermeasure mitigates climate change, and discusses the effects of the liquefaction countermeasure and carbon stock. Finally, the carbon stocking effect of the liquefaction countermeasures is described based on 22 cases of liquefaction countermeasures using log piles. As a result, it was found that the amount of carbon stocks in the logs driven into the ground was more than 10 times larger than the amount of carbon dioxide emitted by the construction.	Atsunori	NUMATA	Soilwood
5D	STCE/TESP - Engineering - Material Properties / Codes & Regulatory Framework	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Advancements on the Structural Timber Optimizer (STO)	While wood-based building materials can lower emissions of the construction industry, the increased use will have impacts on forests and their ecosystems. The Structural Timber Optimizer (STO) was developed to reduce the overall material usage for wood-based building components with high structural performance. This paper presents insights on the current findings of implementing STO in the structural optimization of a multi-layered wall element made from oriented strand board. Building on prior research, the structural modelling approach was further developed to accurately represent separate parts of the components and their contact domains. While the part-based modelling approach allows for accurate structural modelling, the increased complexity and the required explicit dynamic solver increases computation time. To reduce this computation time several strategies are presented. Furthermore, the influence of objective, variables and constraints on the results of the genetic algorithm as well as other optimization parameters are analyzed and discussed in this context. With the findings of this research, optimization results with the STO are more robust, leading the way to practical applications of structurally-optimized wood-based building components.	Benjamin	Kromoser	Institute of Green Civil Engineering, University of Natural Resources and Life Sciences
5D	STCE/TESP - Engineering - Material Properties / Codes & Regulatory Framework	Sustainability and Timber in a Circular Economy - Engineering Focus	ESTIMATION OF STIFFNESS OF STANDING TREES BY VIBRATION CHARACTERISTICS	The area of Japanese forests planted with trees has remained constant in contrast to the increase in the area logged. This seems due to the fact that forest owners are unable to quantitatively evaluate the value of standing timber. The value of timber used for building materials in the Japanese timber distribution system is determined by measuring Young's modulus only after the timber has been cut from the mountain, leaves the forest owner's hands, and is sawn into lumber at a sawmill. The ultimate goal of this study was to estimate Young's modulus after sawing, in the standing timber condition so that the value of the timber could be determined at a stage when the owner of the forest could know the value of the timber. In order to clarify the possibility of estimating Young's modulus from vibration characteristics using natural frequencies of a standing tree, The Young's modulus estimated by forced bending test of the tree was compared with the Young's modulus estimated from the natural frequency of the tree. As a result, a correlation between theirs was obtained. In this study, the position of the center of gravity and weight of the tree were estimated values, but if theirs are estimated more correctly, it may be possible to measure them more precisely.	Kazuma	Kitamura	Osaka Metropolitan University
5D	STCE/TESP - Engineering - Material Properties / Codes & Regulatory Framework	Sustainability and Timber in a Circular Economy - Engineering Focus	Enhancing the role of timber through green public procurement (GPP): Establishing a framework and list of products and services for the Irish construction industry.	Green Public Procurement (GPP) is an increasingly popular environmental policy tool being implemented across EU to meet carbon reduction targets. GPP could be leveraged to promote the use of timber through several different avenues in the procurement process. This paper establishes a framework as part of a holistic overview of procurement and how different decision steps in procurement are influenced. In addition, the paper also identifies different list of products and services used by the public authority (PA) in the Irish construction sector. The paper identifies the use of GPP to promote green criteria, ecolabels, certification targets, lifecycle assessment (LCA) and various other steps associated with greener procurement may help promote the use of timber in construction.	Mohammed Zajeer	Ahmed	University of Galway

SESSION 5
Tuesday 24th June 2025
11:00am to 1:00pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
5D	STCE/TESP - Engineering - Material Properties / Codes & Regulatory Framework	Timber Engineering & Structural Performance - Engineering Focus	A performance design and stochastic analysis method for determining the allowable percentage of exposed structural mass timber in a building.	Use of structural timber in buildings, is an important way of complying with new environm ental regulations and meeting global and national low carbon pathways. Conversely, in light of the expansion of timber construction, prescriptive fire regulations, with required degree of passive and active protection of structural timber members can counter to the economy of construction and reduction of carbon footprint. Using recently developed predictive method of stability of exposed mass timber under natural fire in building, a method to conduct parametric and stochastic studys allowing to define, for a given type of construction, a percentage of exposed structural timber reaching target of tolerable risk is presented. The definition of absolute value targets based on the level of reliability required by Eurocodes and relative value targets (deemed-to-satisfy solutions) are discussed. The construction of scenarios, parameters and their distribution and calculation of total failure probability per lifetime for relevant criteria are defined. The implementation of the method for a given typology of construction, allowing to reach compliance with performance-based building code requirements is presented.	Francois	Consigny	Cstb / ENPC (Paris, France)
5D	STCE/TESP - Engineering - Material Properties / Codes & Regulatory Framework	Timber Engineering & Structural Performance - Engineering Focus	FEM-BASED ENGINEERING APPROACH TO ASSESS THE BEARING STRENGTH OF GLT MEMBERS WITH HOLES AND NOTCHES	In recent years, engineered timber construction has grown rapidly, with complex geometries now being erected. Advances in simulation technologies have enhanced our understanding of wood's mechanical behavior, yet this progress is not fully reflected in building codes, creating a gap for practitioners. This paper addresses how commercial finite element (FE) software bridges this gap, particularly for glued laminated timber (GLT) members not covered by Eurocode 5 (EC5). Our approach uses 2D-FE elements and linear elastic orthotropic material properties to model GLT members with holes and notches, identifying stress singularities. These calculations serve as the basis for applying linear elastic fracture mechanics (LEFM). We demonstrate that potential energy release rates GI and GII at stress singularities can be calculated using just one linear elastic 2D-FE model and mean stresses in the potential crack direction. For validation, we used several experiments of GLT beams with notches or rectangular holes found in the literature. The results showed that the proposed approach is capable of predicting the maximum loads observed in the experiments. We also conducted parameter studies to analyze the impact of meshing, element size at the notch, and the detailed geometric shape of the notch on the results. Due to the ease of use and general applicability of this approach, we recommend it for the further design of GLT members with holes and/or notches when using FE analysis.	Markus	Detter	TU Wien (Vienna University of Technology)
5D	STCE/TESP - Engineering - Material Properties / Codes & Regulatory Framework	Timber Engineering & Structural Performance - Engineering Focus	EXPERIMENTAL TESTS ON CONNECTIONS WITH DOWELS AND SLOTTED-IN STEEL PLATES UNDER CYCLIC LOADING.	In dowel-type connections, the occurrence of brittle failure modes before yielding can limit the ductility and energy dissipation of the structural system during a major earthquake. To address these challenges, experimental cyclic tests are conducted on glulam timber connections with dowels installed in single and double slotted-in steel plates. These connections are designed in various configurations based on the CSA O86 and Eurocode 5 standards. The objectives are to determine the stiffness, resistance, ductility, energy dissipation, and failure modes of the connections, and to compare the test results with the predictions of the two design standards.	Kiavash	Gholamizoj	Université Laval
5E	MPD - Engineering - characterising material properties	Session Chair: PROFESSOR KAY-UWE SCHOBER / MAINZ UNIVERSITY OF APPLIED SCIENCES					
5E	MPD - Engineering - characterising material properties	Material Performance & Durability - Engineering Focus	EXPERIMENTAL AND NUMERICAL INVESTIGATION OF THE BENDING PROPERTIES OF OIL PALM BASED CROSS LAMINATED TIMBER	Increased population figures are leading to higher demand for palm oil and construction products. As a by-product of palm oil production, large quantities of oil palm wood (OPW) are harvested in the near future. The potential of OPW is only utilised to a limited extent. A possible field of application is the use in construction products. The usability of OPW in cross laminated timber (CLT) is therefore being investigated. Lamellas are graded according to their density and dynamic MOE, five-layer (5L) CLT elements are manufactured and subjected to bending tests. In addition, the tests are modelled using the finite element method and compared with the results of the gamma and shear analogy method. The results of the numerical and analytical methods show good agreement (R^2 = 0.987 – 0.996) and suggest their applicability for OPW CLT. A comparison with Norway spruce CLT shows slightly lower bending parameters (4 – 10 %) for high-performance OPW-CLT. The applicability of OPW in load-bearing building products can therefore be confirmed.	Martin	Hackel	OWL University of Applied Sciences and Arts (TH OWL)
5E	MPD - Engineering - characterising material properties	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Factors Influencing the Finger Joint Strength in Double Laminated Beech Glu-lam	Previous research on high strength glulam produced using Fagus sylvatica (European Beech) showed that the finger joints are governing the bending strength of structural sized specimens. In single laminated glulam each finger joint represents a weakening of the lamella over the whole width. In case of a double laminated glulam this can be avoided and depending on the quality and the number of lamination the weakening can be reduced significantly. The aim of the presented research is to investigate parameters that influence the finger joint strength in double laminated glulam produced using Fagus sylvatica. The results showed that the strength of the finger joints is increasing at least over the first four weeks after production and that the arrangement of finger joints in a double laminated glulam influences its strength.	Martin	Lehmann	Bern University of Applied Sciences
5E	MPD - Engineering - characterising material properties	Material Performance & Durability - Engineering Focus	EXPERIMENTAL INVESTIGATION ON THE ROLLING SHEAR PROPERTIES OF TIMBER	The rolling shear properties of timber are important for wood products with orthogonal layups, such as Cross Laminated Timber (CLT). In this study, rolling shear tests are conducted on silver birch timber board segments for the determination of rolling shear strength and stiffness. The test setup applied is an adaptation of the longitudinal shear tests setup described in the European standard EN 408. Where the standard method requires steel loading plates glued to the wooden test specimen, in this study birchwood longitudinal elements are glued to the birchwood rolling shear test specimens. The efficacy of utilizing all-wood specimens in investigated. For determination of the rolling shear modulus, optical point tracking is employed to measure deformations on the loading plates and on the rolling shear test specimen. Results indicate the setup to be suitable for rolling shear testing, however, the bond-line quality is found to be influential for determination of the strength and stiffness properties.	Steven	Collins	Aalto University
5E	MPD - Engineering - characterising material properties	Material Performance & Durability - Engineering Focus	Mechanical characterization of the short- and long-term behavior of glued-in rods in laminated bamboo lumber	This research contributes to the qualification of bamboo as a sustainable substitute for commonly used materials in the building industry, such as concrete or steel. The Phyllostachys edulis (Moso) bamboo is further processed into laminated bamboo lumber (LBL) to eliminate naturally grown flaws and thus, bringing it closer to technical applications. LBL exhibited strengths comparable to those of wooden materials, which underlines the suitability of bamboo as a material for the building industry. Besides the material parameters of LBL, it is from central importance to know about suitable connection types in the suggested fields of use. Glued-in rods (GiR) are a commonly used connection type in relation to building with wood. Through various material tests conducted in the course of this work, the GiR should be qualified for engineered bamboo materials as well.	Pascal	Franck	RheinMain University of Applied Sciences

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
5E	MPD - Engineering - characterising material properties	Material Performance & Durability - Engineering Focus	HARDWOOD STRENGTH GRADING – CONSIDERATIONS FOR DENSITY AND COMPRESSION STRENGTH	It can be a challenge to achieve effective sorting of temperate hardwoods for density when using visual strength grading rules and some types of machine grading. Different solutions have been proposed, including using a single conservative density across hardwood strength classes, or declaring density based on direct measurements without reference to a strength class. These solutions would also affect secondary properties that are estimated from assigned density. In the European Standards, compression strength perpendicular to grain is one example. In this study, grading of a sample of UK-grown sycamore maple was simulated, using dynamic stiffness as the indicating property (IP). Characteristic (5th percentile) values of density and compression strength perpendicular to grain could not effectively be raised by rejecting pieces with low IP values. If density is used as an IP, higher compression strengths can be graded for. As expected, characteristic values for compression strength via EN 384 are much below what was observed in this study.	Marlene	Cramer	Edinburgh Napier University
5E	MPD - Engineering - characterising material properties	Material Performance & Durability - Engineering Focus	Grades and strength characteristics of low-density hardwood, Yellow poplar	The Yellow poplar tree is well-suited to the climate and soil of Korea and exhibits high growth characteristics. In Korea, however, Yellow poplar trees are consumed as low-value materials such as wood pellets, pulp, mushroom logs, and so on. Efforts have been underway to enhance its value by investigating its potential as a structural material in Korea. This study was conducted to confirm the feasibility of Yellow poplar usage as a structural member by investigating the characteristic value of bending and tensile strength. Full-size lumber was graded by machine grading. The majority of grades of Yellow poplar lumber having a cross-section of 89 × 38 mm2 were E8, E9, E10, E11, and E12. In the lowest grade, E8, among the majority of grades, the characteristic value of the modulus of rupture was smaller than the allowable stress in the Korean Design Standard. It was needed to restrict the diameter ratio of knot in wide side of the lumber, and the value of the diameter ratio of knot was 0.5. With the restriction, all of characteristic values of strength of Yellow poplar were larger than the allowable stress. In further studies, other properties for structural purposes will be investigated.	Chul-Ki	Kim	National Institute of Forest Science
5E	MPD - Engineering - characterising material properties	Material Performance & Durability - Engineering Focus	LOGGO Building System	Loggo is in the process of developing a building system to respond to the needs of the housing shortage affecting many parts of the world. The system utilises low value timber and forest bi-products to produce engineered wood products that have the potential to be used for multi-storey residential construction by deploying a modular column system in concert with a cassette flooring system for rapid on site erection. This presentation will explain the origin, applications, benefits and opportunities for this unique laminated engineered wood product. Please Note: Loggo is an industry partner of the Australian Research Council Research Hub to Advance Timber for Australia's Future Built Environment (ARC Advance Future Timber Hub). Its concepts ideally reflect the Hub's VALUE-CHAIN INNOVATION Research Node, the overarching theme being: “to develop opportunities for small diameter log resources in high-value markets. Thinnings from plantation hardwood estates will be prioritised along with residual peeler cores and other small diameter logs”.	Peter	Blair	SPMA Pty Ltd (LOGGO Representative)
5F	MPD - Engineering	Session Chair: PROFESSOR PIERRE QUENNEVILLE / THE UNIVERSITY OF AUCKLAND					
5F	MPD - Engineering	Material Performance & Durability - Engineering Focus	THE BENDING PERFORMANCE OF BIONICS-INSPIRED LIGHTWEIGHT WOOD-BASED SANDWICH PANELS	The use of lightweight wood-based sandwich panels (LWSPs) is gaining traction in the construction industry due to their environmental friendliness. These panels consume fewer resources, apply smaller loads on foundations, and reduce transportation costs and CO2 emissions. This study was focused on the development of LWSPs of the core structure inspired by natural structures. The study involves designing LWSPs with aspen wood cores and plywood surface layers, and assessing their physical and mechanical properties, including bending capacity and bond quality. The results will provide insights into the durability and performance of these composite panels, offering recommendations for their application in structural contexts like access floor systems.	Elena	Vladimirova	University of New Brunswick
5F	MPD - Engineering	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Finite element-based evaluation of walking-induced vibrations in timber-concrete composite floors	Long spans Timber-Concrete Composite (TCC) floors can often achieve adequate performance when considering ultimate limit state behaviour; however, serviceability criteria, such as vibrations, are usually governing in the design process. Although design codes and standards usually present vibration using simplistic expressions, the vibration performance of TCC floors is complex and involves multiple variables. In this study, a finite element (FE) modelling technique is established for CLT-concrete composite panels with screws and notched connections. The models are validated against experimental results and a parametric study is carried out to investigate the effect of multiple variables on the dynamic behaviour of those floors.	Fernanda	Scussiato Lago	University of Ottawa
5F	MPD - Engineering	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Evaluating the Effect of Coastal Deterioration on Structural Integrity of Cross-laminated Timber	Cross-laminated Timber (CLT) is a sustainable building Mass Timber (MT) material made of a biological origin; wood. Since its introduction to North America, the biological durability of the material has been challenged due to the lack of investigation in different climates and deterioration zones. Almost all parts of the Pacific Northwest and most parts of the North Eastern regions of the United States have a high (4 out of 5) coastal deterioration zoning for wooden materials. Therefore, studying the effects of coastal deterioration such as salt-spray effects on the MT products' properties would provide helpful information and job-site measures for using these products. This work investigates the coastal deterioration of MT by measuring the effect of continuous salt spray exposure on the dimensional and mechanical properties of CLT panel samples with and without any industry-standard coating. The CLT specimens’ initial density, dimensions, and bending stiffness are compared with the ones acquired after being tested and exposed to the continuous salt spray and controlled simulated moisture content, humidity, and temperature for two weeks. In addition, a Finite Element Model is assessed to provide a numerical evaluation for the experimental results. This work presents preliminary predictions for how much CLT deterioration and mass loss due to exposure to coastal salt spray could result in loss of mechanical properties.	Shay	Kurzinski	Roger Williams University
5F	MPD - Engineering	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	New dimensions - Timber projects and connections	The current trend in timber construction is towards new dimensions. The decisive dimensions in timber construction are mainly determined by the connections. The performance of different types of connections in timber construction is demonstrated in 3 different projects: In architectural construction, the new Volvo Group headquarters "World of Volvo" in Gothenburg; in classic industrial construction, the Edeka central warehouse in Marktredwitz; and in multi-storey office construction, the offices of a Bundesliga football club in Leipzig. These are steel plate to timber connections with wood screws that can be pulled out, classic rod to dowel connections with internal steel plates and, in multi-storey timber construction, the use of system connectors wherever possible.	Patric	Walter	WIEHAG Timber Construction GmbH

SESSION 5
Tuesday 24th June 2025
11:00am to 1:00pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
5F	MPD - Engineering	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	EFFECT OF NAIL JOINT STIFFNESS ON THE IN-PLANE SHEAR AND OUT-OF-PLANE BENDING PROPERTIES OF NLT	Nail Laminated Timber (NLT) is constructed using layers of lumber connected by nail joints. To develop design methods for NLT considering the stiffness of the nail joints NLT composed of steel or aluminum nails, which have different stiffness, were produced and tested for their in-plane shear and out-of-plane bending properties. The shear strength and initial stiffness of NLT with aluminum nails were 60-65% of those with steel nails. NLT was modeled as to verify the ratio of embedment work to the total work that is the summation work caused by the shear deformation of nail joints between lumber pieces, embedment of lumber into the mudsill and beam and bearing pressure and friction between lumbers. NLT with lower stiffness nail joints showed a higher rate of embedment work compared to that with higher stiffness nail joints. The bending stiffness and strength of NLTs with aluminum nails were nearly equivalent to those with steel nails. NLT was also modeled as to verify the ratio of bending deformation and rotational deformation of butt jointed lumbers. Lumber jointed by lower stiffness nails exhibited a higher rate of rotational deformation than those jointed by higher stiffness nails.	kazuki	Ito	Utsunomiya University
5F	MPD - Engineering	Material Performance & Durability - Engineering Focus, Material Performance & Durability - Practitioner Focus	DURABILITY: MEMBRANES AND TAPES FOR WOOD PROTECTION	This work originated from the desire to gain a deeper understanding of the long-term resistance of materials used for wood protection, specifically membranes and tapes. The projects described in this article all focus on durability but approach the issue from different perspectives, using various methods to achieve a high degree of ageing. This approach has provided us with a diverse array of data, obtained through different techniques, which has helped us gain a more comprehensive overview of the contributions of various factors. The products tested include membranes and adhesive tapes, which were evaluated both separately and in combination to better understand the impact of each product on overall durability of the tape-membrane system.	Sebastian	Jaimes	Rothoblaas
5F	MPD - Engineering	Material Performance & Durability - Engineering FocusMaterial Performance & Durability - Practitioner Focus	Chemical Migration and Redistribution of CCA Components in Eucalyptus nitens Heartwood: Implications for Durability Under Accelerated Weathering	Chromated copper arsenate (CCA) has historically been widely used for wood preservation and remains a key industrial timber treatment despite regulatory restrictions. Its efficacy is attributed to chromium's role in binding CCA components to the wood, reducing leachability while immobilizing copper and arsenic. However, when exposed to moisture, small quantities of CCA components remain mobile, inhibiting fungal growth in untreated wood exposed through surface checks. This mechanism has been credited with enhancing the durability of shallow-treated Canadian softwoods. To determine whether a similar process occurs in hardwoods, this study investigated the migration of CCA components in Eucalyptus nitens heartwood under repeated wet/dry cycles. Results indicated that arsenic exhibited the highest leaching rates, while chromium was the least mobile, with peak leaching occurring during the initial rainfall cycles. Comparative analysis with previous studies confirmed consistent leaching patterns, reinforcing the low leachability and strong fixation of CCA. While copper and chromium levels in untreated check surfaces increased by nearly threefold, their concentrations remained below the fungitoxic threshold required to inhibit spore germination. These findings suggest that CCA migration in refractory hardwoods is insufficient to provide the same secondary protection observed in softwoods, highlighting the need for alternative treatment strategies to enhance durability in E. nitens for exterior applications.	Juan Roberto	Vargas	National Centre for Timber Durability and Design Life
5F	MPD - Engineering	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	A TEST METHOD FOR ROLLING SHEAR CREEP CHARACTERISTICS IN CROSS-LAMINATED TIMBER	One of the consequences of cross-lamination of layers in CLT elements is that all laminations in shear walls and the transverse layers in floor elements transfer shear stress in the radial–tangential plane, or rolling shear, which has a non-negligible effect on elastic and strength behavior of the laminates. However, the shear characteristics that account for out-of-plane shear deformations in laminated panels are based on sparse and outdated empirical data. Even less data exists on the shear creep behavior of wood. This study aims to develop an efficient and replicable method for the measurement of elastic rolling shear modulus and time-dependent rolling shear creep compliance in cross-laminated sections of clear wood and of structural lumber, including natural inhomogeneities characteristic for grades used in the production of CLT.	Lech	Muszynski	Oregon State University
5G	STCE - Engineering	Session Chair: DR YUTAKA GOTO / CHALMERS UNIVERSITY OF TECHNOLOGY					
5G	STCE - Engineering	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	DIGITAL TWINNING FOR ENHANCING TRANSPARENCY IN SUSTAINABILITY, SAFETY, HEALTH AND SERVICEABILITY OF TALL TIMBER STRUCTURES	Digital twin technology has recently emerged as a transformative approach in building management, enhancing transparency, sustainability, safety, health, and comfort. This paper explores how the European HORIZON project BUILDCHAIN leverages this technology to promote the use of timber as a viable material even for taller buildings, emphasizing its sustainability benefits and improving its safety and serviceability metrics. The BUILDCHAIN project integrates diverse data sources, including 4D, 5D, and 6D Building Information Models (BIM), Finite Element (FE) models, and real-time sensor data, to create dynamic, real-time virtual replicas of physical buildings. These digital twins provide a comprehensive and accessible view of building properties and performance, facilitating continuous monitoring and updating of FE models based on real-world data to ensure ongoing structural health and safety. Through the case study of two tall buildings made of CLT panels, we demonstrate the practical application of this technology and discuss how integrating data from multiple buildings can refine and re-evaluate existing design procedures and standards. This offers a new paradigm in building design validation. By enhancing transparency and incorporating advanced monitoring capabilities, the BUILDCHAIN project paves the way for more resilient, efficient, and sustainable building practices.	Noemi	Friedman	HUN-REN Institute for Computer Science and Control (SZTAKI)
5G	STCE - Engineering	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	PRELIMINARY INVESTIGATION ON THE STRUCTURAL AND HYGROTHERMAL PERFORMANCES OF CLT WITH AIRGAPS	Cross laminated timber (CLT) has been a major contributor of the expansion of the technical possibilities of timber constructions. While CLT has advantages, the production of CLT requires extensive raw material input compared to the actual needs regarding structural capacity. The required load bearing capacity can be achieved by using less raw material if the timber lamellas are arranged properly with gaps in between. Different configurations with different material efficiency result in different structural and hygrothermal performance of the panels. The overall goal of the project described in this paper is to investigate the raw material saving potential for a multi-storey structure with CLT panel with airgaps. For this purpose, the shear, bending, and water vapour permeability performances of 3-ply and 5-ply CLT panels with various airgap configurations have been examined in experiments and in numerical and analytical models. Based on the results, the load bearing structure of an 8-story residential building was designed with CLT panels with airgaps. The structure was designed to satisfy the performance requirements in ULS and SLS according to Eurocodes and for moisture safety. The result show that the material saving potential is at maximum 46% for the floor and 29% for the wall. In order to further optimize the CLT panels and verify the results, more experiments on more variety of airgap configurations will be needed.	Yutaka	Goto	Chalmers University of Technology/Tohoku University

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
5G	STCE - Engineering	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Structural Properties of Lumber from Small Logs Generated in Forest Thinning Operations	In the western United States, large quantities of small diameter logs are continuously generated through the restoration thinning operations which are performed to control forest fires. These small logs contain high proportions of juvenile wood, which differs from mature wood in terms of mechanical properties. Enabling the use of lumber from small diameter logs in structural products, such as cross laminated timber (CLT) panels, would add substantial market value to this material. However, most sawmills consider processing small logs unprofitable and the resulting lumber not qualifying for structural uses. The reason is that the design values listed in National Design Specifications (NDS) are based on commercial harvesting operations which yield high proportions of large diameter logs (containing higher proportions of mature wood). One species of particular interest is Ponderosa Pine, which grows in many regions where large-scale restoration thinning operations are currently conducted. However, results from a prior study indicate that No 2 lumber from small diameter Ponderosa Pine logs does not meet NDS requirements. The validity of these conclusions will be further investigated in the current study. Mechanical testing will be conducted using Ponderosa Pine lumber which primarily consists of juvenile wood. The sampling range is intended to cover regions where large-scale restoration thinning operations are currently carried out. Certain properties, including modulus of elasticity (MOE) will be estimated through testing of visually graded dimension lumber, while other properties will be estimated using small clear specimens. The results from this study (a set of near-minimum and mean property estimates) will be compared with the current NDS values in order to determine whether or not this lumber meets the current specifications.	Michelle	Jayawickrama	Oregon State University
5G	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus	CCLT – Development of a CLT based sandwich structure with bamboo rings as core materials	This document reports early investigations of an improvement of conventional CLT structures. The massive timber consumption and the relatively high weight of conventional CLT boards can be encountered by creating a sandwich structure using an alternative core material combined with timber top and bottom sheets. There-fore, a honeycomb core of bamboo rings called COMBOO is an option which is currently under investigation. The approach was called CCLT (COMBOO Cross Laminated Timber) and can reduce timber consumption and weight by the hollow bamboo combs. After previously received interesting results of compression tests of bamboo rings itself or bamboo rings with different top and bottom sheets and different bending tests with COMBOO and GFRP layers, the combination of the work with 4-point bending tests of the CCLT-structure is the element of this paper. A scaled approach with reduced height of the CCLT board has been chosen in this case. It contains the description of manufacturing and gives insight to the results from mechanical testing. During experiments it was found, that bending strength depends on number of layers and bamboo ring size. The results of bending tests were promising even if manufacturing of components and structure is difficult and requires transfer to industrial scale.	Andreas	Loth	Berliner Hochschule für Technik
5G	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	ENHANCING MULTI-STOREY BUILDINGS WITH CLT CORES USING LVL TECHNOLOGY: DESIGN AND TESTING	Mass timber (MT) construction is gaining popularity worldwide for multi-story buildings. However, it's important to note that despite this trend, these buildings still rely on concrete or steel cores for additional strength and stability. No one has yet succeeded in creating a timber core solution, and there is no published evidence of a timber core solution with the necessary stiffness to withstand wind or earthquake loads beyond ten levels. Preliminary research and calculations at the UoA indicate that a hybrid product that uses LVL to make CLT can be made considerably stronger and more than ten times stiffer than conventional CLT; allowing timber building cores up to twenty levels. This paper will present results of an initial experimental study carried out to verify the feasibility of using LVL-CLT shear cores in multi-storey timber buildings. The experimental study consist of testing 2 different configurations of LVL-CLT panels for stiffness and comparing these results with the stiffness of a tested ordinary CLT panel. From these results, recommendations for potential timber shearwall cores will be made.	Dr Ferdinand	Oswald	School of Architecture and Planning, University of Auckland, New Zealand
5G	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	STRENGTH AND STIFFNESS OF (RELAMINATED) CLT EDGETRIMMED OFF-CUTS	Timber construction can significantly reduce the embodied carbon of buildings, but mass timber production creates non-biodegradable waste. This study investigates using cross-laminated timber edge trimming off-cuts as standard boards and relaminated timber. Four-point bending tests show comparable strength and stiffness to reference materials, but with greater covariance. Results suggest that such off-cut material could be considered even for structural purposes and, in the process, contribute to reduced waste generation and even lower embodied carbon.	Johann	van der Merwe	University of Pretoria
5G	STCE - Engineering	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	POST-FIRE STRUCTURAL REHABILITATION OF MASS TIMBER ELEMENTS	Post-fire rehabilitation of modern mass timber buildings has seen little research attention. Developing clear methodologies to rehabilitate char-damaged mass timber elements is crucial since mass timber buildings are becoming considerably more common and as such, the risk of having fire-damaged mass timber buildings is increasing. Preliminary investigation was performed in 2023 to quantify the amount of wood that needs to be removed beyond the char layer. Following this study, full-scale bending test of char-damaged mass timber glue-laminated timber decking elements reinforced with laminated veneer lumber were evaluated. The main objective of this study is to quantify the effect of different reinforcing methodologies and to validate calculation methodologies. From the test campaign, it is found that the mechanically jointed beam theory (gamma method) predicts well the level of composite action when fully threaded screws are used. When partially threaded screws are used, the friction between timber elements is sufficient to create an almost perfect composite action under low load.	Samuel	Cuerrier Auclair	Fpinnovations
5H	ECCS/STCE - Engineering	Session Chair: DR LISA OTTENHAUS / THE UNIVERSITY OF QUEENSLAND					
5H	ECCS/STCE - Engineering	Exemplars & Construction Case Studies - Engineering Focus	Design of Indoor Structures Using Small-Section timber Assembly Frame and Practice of Material Recycling	There are two main types of wood use methods in architecture: construction of timber structure and wooden interior. In order to make the latter type of wooden interior, we developed a wood-based construction method "T-WOOD® SPACE Light (TWSL) " that enables the construction of indoor structures in a short period of time by utilizing a new jointing method of wood members. In this construction method, a frame unit consisting of four small-section sawn timbers is inserted from three directions to form a joint, making it easy to assemble and dismantle, and the hollow-section frame unit is lightweight and easy to transport and construct. Several interior spaces using this construction method were designed and constructed. They were exhibition booths, display panels, and on-board spaces of a trailer. In the design of the vehicle space, we designed a load-bearing wall and clarified the in-plane shear performance by shearing tests. In addition, a part of the exhibition booth was used to reuse it for partition walls, tables, and storage baskets, and the problems that arise from practicing material recycling were identified.	Tomoaki	Soma	TAISEI Corporation
5H	ECCS/STCE - Engineering	Exemplars & Construction Case Studies - Engineering Focus	Towards Sustainable Timber Construction: A Case Study of Waste Generation, Management, and Circular Strategies in Australian Sawmilling and Prefabrication Manufacturing	This paper explores a case study on waste generation during the log conversion process and waste management approaches. The study examines various types of timber-based waste generated during different sawmilling operations and how each of these types are managed in sawmilling yards in Australia. This research aims to propose recommendations for enhancing sustainability and reducing the environmental impact of the Australian sawmilling industry through proper waste management.	Harshani Dissanayake	Dissanayake Mudiyanselage	The University of Melbourne

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
5H	ECCS/STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	DECARBONISATION STRATEGIES USING TIMBER IN NON-TRADITIONAL APPLICATIONS	Decarbonisation targets are looming large across all industries, many of which rely on carbon intensive infrastructure to support their business functions. Operational Carbon has traditionally been targeted as a key to reducing emissions and many businesses are well advanced in the pursuit of their Operational Carbon targets. As the opportunities to further reduce Operational Carbon become more and more difficult to achieve, the focus will shift to Embodied Carbon, potentially as "lower hanging fruit" in the pursuit of net-zero aspirations. Substituting timber for concrete and steel is an effective strategy in the reduction of Embodied Carbon. This paper explores the opportunities for the increased uptake of Timber in non-traditional applications primarily as a decarbonisation tool and considers the risks and opportunities that present as a result. Through a series of case studies this paper will highlight where timber is helping decarbonise our infrastructure – and where opportunities exist to go further. KEYWORDS: timber, decarbonisation, Embodied Carbon	Ralph	Belperio	Aurecon
5H	ECCS/STCE - Engineering	Timber Engineering & Structural Performance - Engineering Focus	ADVANCED STRUCTURAL DESIGN OF TIMBER BUILDINGS IN JAPAN	Since the "Act on Promotion of the Use of Wood in Buildings, etc. to Contribute to the Realization of a Decarbonized Society" came into force in Japan in 2021, Japanese companies have proposed various solutions for medium- to large-scale attractive wooden buildings. The use of timber-steel hybrid structures, in particular, is recognized as an effective structural planning strategy that complies with the Japanese fire safety regulations related to fire resistance and safety during a major earthquake and also attracts interest as an effective solution for the decarbonization of airport facilities that have specifically high CO2 emissions. According to the Japanese Building Standards Law, load-bearing timber structures must have fireproof coatings/claddings. If the timber structure only resists lateral forces like seismic and wind, it can be left exposed. Currently, Japanese architecture firm, Azusa Sekkei is working on a wooden terminal building project at Haneda Airport, the busiest airport in Japan. It will be the first building with a wooden main structure at a large airport in Japan. According to the fire regulations, all three timber-steel hybrid frame systems designed for Haneda Airport Domestic Terminal have fireproof claddings. To keep the structural timber members exposed for future projects, Azusa developed an advanced solution for a timber-steel hybrid frame system called CROSS-WOOD that allows the exposure of wooden members while enhancing the aesthetic and sustainable appeal. The concept combines traditional Japanese wood joinery techniques like "nuki" (mortise and tenon joints) and "awasebari" (flitch beams) with modern technology solutions by passing the wooden beams through the holes in the wooden columns to improve the bending strength and rotational stiffness of joints. Furthering and expanding the research and the implementation of structural wood, new wooden joinery techniques have also been developed for the "Ring Project" at Osaka Expo 2025.	Yoshiko	Kanai	Azusa Sekkei Co. Ltd.
5H	ECCS/STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	Sustainable Reuseable Timber-concrete Composite Structural Flooring System	With the objective to improve reusable performance and efficiency of timber-based composite floor systems, combinations of various composite materials by numerous sorts of connections, are studied. This paper illustrates the general structural design idea and the manufactural research findings and is intended to provide a first insight into related ongoing structural research activities. The objective of the studies is to develop application-optimized multi-layered structural composite floor systems with a special focus on the joint design of the various thereby used connection types between the coupled composite layers. In simultaneous regard to structural, economical and resource efficiency on overall component level, the extent of interrelationships in the development of complex optimized system solutions can be shown. Additionally, decisive design criteria for the application of the composite floor systems shall be derived thereof. Based on this, the results of the research project present the successful technical solutions and concepts for reuse and recycling in timber construction.	Alireza	Fadai	TU Wien | Vienna University of Technology
5H	ECCS/STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	ENHANCING DESIGN AND PRODUCTION IN MODULAR TIMBER ARCHITECTURE WITH COMPUTATIONAL DESIGN TOOLS	This research explores integrating computational design tools to enhance design and production in modular timber architecture. It focuses on two main aspects: integrating existing analysis tools for better-informed decisions and automating modeling, analysis, and CNC fabrication of various design variations. Computational tools in modular timber construction can improve quality and productivity while allowing for architectural uniqueness. This flexibility enables creating unique solutions with the same effort as standardized ones. The research developed a computational design system with tools for structural analysis, energy simulations, cost evaluation, weight assessment, environmental impact analysis, and design-to-production processes, all integrated into a parametric planning platform. The project "àDisposition" (Innosuisse, 59217.1 IP-SBM) exemplifies this approach, aiming to develop a modular timber construction kit optimized for easy transport and temporary use of vacant buildings. Outcomes are showcased by a user-friendly configurator for planning, visualizing, analyzing, and preparing production files.	Joaquim	Escoda Llorens	University of Applied Sciences, BFH / AHB
5H	ECCS/STCE - Engineering	Timber Engineering & Structural Performance - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	INTERACTIVE PARAMETRIC STRUCTURAL DESIGN AND OPTIMISATION TOOL FOR DESIGN FOR FRP-REINFORCED MASS TIMBER BUILDINGS	The inherent material properties of mass timber can restrict its serviceability performance, particularly for for long-span floor system applications,. This paper introduces a parametric analysis tool designed to compare traditional mass timber constructions with advanced hybrid fiber-reinforced polymer (FRP)-timber composites with enhanced static and dynamic serviceability behaviour. The tool evaluates span capacities for both pure mass timber and FRP-reinforced mass timber flexural elements in a typical post-and-beam building configuration. These span capacities are then integrated within a parametric computer-aided design (CAD) tool to enable interactive structural size optimisation for variable building grid size, height, number of stories, loading condition, and element spans. Since long-span timber elements are often constrained by serviceability requirements, CFRP reinforcements are assessed for their potential to increase stiffness and natural frequencies, and thus enable longer spans for the same element thickness; or reduced element thickness for the same span.	Tomas	Bravo	UQ - CIVIL
5I	STCE - Architectural	Session Chair: A/PROF MARIAPAOLA RIGGIO / OREGON STATE UNIVERSITY					

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
5I	STCE - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus	The Study on Mechanical Performance and Structural Applications of Adhesive Free Engineered Wood	Regarding the issue of global change, based on the full life cycle carbon footprint assessment, engineered wood is also facing the development towards net-zero sustainability. Although many advanced modern engineered woods have excellent mechanical properties, they also have relatively high Carbon footprint, therefore, this study conducted a series of mechanical experiments on wood structural elements of beams and plates constructed without gluing. In addition to comparing different construction methods, it also found out the basic performance for future structural engineering design, and based on A full-scale experimental structure is an example of future practical applications. This study also conducted a carbon footprint assessment analysis for this example. The research content includes DLT (Dowel Laminated Timber) and NLT (Nail Laminated Timber) For two different Adhesive-Free Engineered Wood (AFEW) systems, collecting relevant international research literatures in the past few years, The research also conducted mechanical experiments on four-point bending moments to obtain different rigidity and Modulus of Elasticity. We also analyzed the failure mode and the damage causes as well from different configurations of specimen. In addition, a full-scale demonstration structure was constructed to explain the possible applications in architectural design.	CHI-JEN	CHEN	National University of Kaohsiung, Taiwan
5I	STCE - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus	THE ACOUSTIC PERFORMANCE OF LONG-SPAN HOLLOW MASSIVE TIMBER FLOOR CASSETTES DESIGNED FOR CIRCULARITY	Massive timber structures present a particularly compelling case for circularity in the built environment due to the prefabricated nature of the system components, the manner in which those components are connected, and the importance of retaining sequestered carbon. However, the conventional inclusion of concrete topping slabs atop mass timber floor panels presents a significant barrier to the deconstructability and reuse of the panels and supporting framing. A massive timber floor cassette developed and studied at Clemson University aims to combine long-spanning structural capacity with building systems integration, all while excluding conventional concrete toppings and promoting ease of disassembly and reuse. Critical to this low-carbon, timber-only approach is the acoustic performance of the system, as sound attenuation has often been a motivator for the inclusion of concrete. This paper details the planning, construction and validation of a new two-story acoustic testing chamber, followed by the results from airborne and structure-borne sound transmission tests performed on assemblies involving the experimental timber floor cassettes.	Dustin	Albright	Clemson University
5I	STCE - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus	CIRCULAR DESIGN FOR URBAN DENSIFICATION THROUGH EXTENSION CONSTRUCTION	Buildings constructed in the past century are confronted with a dilemma of outdated equipment that fails to meet the needs of contemporary usage. In costly areas, retrofitting is preferable to demolition for cultural and economic development. The proposal will use wooden modules as expansions, which have the potential to be reused and will increase the usability of the original structure, resulting in a sustainable retrofit solution. The application context of the proposal is the implementation of a vertical extension project using volumetric timber modules. Subsequently, a workflow for the implementation of a combinatorial design for modular timber products will be presented. The research scenarios will encompass multiple design influences to assess the feasibility of applying functional alterations in modular products.	Kayee Jiayi	Li	Aarhus University
5I	STCE - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus	ASSESSING THE REUSE POTENTIAL OF MASS TIMBER CONSTRUCTION USING A TEN-STORY SHAKE TABLE CASE STUDY	The continual growth in mass timber construction has stimulated discussion about how mass timber products can drive sustainability through the end-of-life stage, shifting the building sector towards a circular economy that reduces the overall demand on virgin forest resources. Moreover, the potential for mass timber buildings to function as effective carbon sinks depends on extending the service life of mass timber members via reuse. Through a collaborative effort between the University of Oregon and Oregon State University faculty, working together in the TallWood Design Institute, this study developed a framework for the reuse potential of mass timber members using the Natural Hazards Engineering Research Infrastructure (NHERI) ten-story shake-table specimen for seismic testing at the University of California San Diego. The test structure was analyzed using a digital model to determine mass timber reuse efficiency across panel type and scenarios that span a range of material reprocessing intensity, incorporating fully engineered and modelled connections as an additional parameter to reuse constraints. Finally, this project quantified reuse material efficiencies based on selected strategy and highlighted the opportunities and challenges of reuse.	Jason	Stenson	University of Oregon
5I	STCE - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus	Forest to Facade: Using Mass Timber Panels to Retrofit Low-Rise Commercial Buildings to Improve Resilience	Buildings are significant contributors to anthropogenic emissions of greenhouse gases through their construction and operations. Commercial low-rise office buildings represent a substantial subset of buildings in the United States and the majority were constructed before more stringent energy and seismic codes on the U.S. West Coast were adopted. Thus, the University of Oregon Department of Architecture and Oregon State University College of Engineering collaborated with industry partners Swinerton and Timberlab through the TallWood Design Institute to develop a low-carbon bio-based façade retrofit solution that simultaneously upgrades building resilience (i.e., energy efficiency, daylighting, passive ventilation), building aesthetics, and seismic restraint. The system was developed using a four-story steel frame case study building and employs a post-tensioned “rocking wall” mass timber lateral force resisting system (LFRS) on the building façade.	Mark	Fretz	University of Oregon
5I	STCE - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus	Parametric Library of Japanese Joinery	This research explores Japanese joinery for its potential in modern reversible architecture. The objective is to create a parametric library of Japanese joints by compiling typologies from various sources and modeling them into parametric Revit family file. These models can be integrated into BIM projects and shared across BIM software via IFC models. The goal of this study is to enhance modern building practices with sustainable and reversible design solutions inspired by traditional Japanese joinery.	Lynda	Itatahine	Kyoto University
5I	STCE - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus	OFF-SITE MANUFACTURING FOR A NEW MODULAR WOODEN ARCHITECTURE MADE IN ITALY	The industrial development project “SU.PRE.MO – from Super X-Lam To Prefabrication and 2D/3D Modularity”, organised with the support of the Provincia Autonoma di Trento, focused on modular homes for selfbuild and emergency situations, using the prefabricated CLT products of the Trento-based company. XLAM Dolomiti was the project leader. This paper describes the design activities relating to the modular house kits designed in versions from 20m2 to 120m2 by the Politecnico di Torino, in cooperation with XLAM Dolomiti. A combination of off-site manufacturing and the standard products of XLAM Dolomiti was used to produce a digital catalogue of the various building concepts with a number of possible configurations for the modular homes.	Albino	Angeli	Xlam Dolomiti S.p.A.

SESSION 5
Tuesday 24th June 2025
11:00am to 1:00pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
5I	STCE - Engineering	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus	Mechanical properties of secondary lumber of Norway spruce	Extending the service life of the building components is essential for a circular economy. Wood as a renewable raw material, plays a crucial role in this process due to its mechanical properties and easy processing. In current studies, the focus is on the reuse of building materials. However, it is important to investigate cases where reuse is not possible due to changing dimensional requirements or damages. This study examines the bending properties of recovered wood, particularly battens with dimensions of 30/50 mm and 40/60 mm, which were processed from rafters originating from building demolition and roof truss deconstruction sites in Germany, to demonstrate their potential for structural applications. The bending tests are performed and interpreted regarding the damages from the prior use and the background information on the lumber pieces. In addition, the collected data is compared to the bending test data of battens without any prior use history. Therefore, the specimens are matched in terms of quality characteristics, dimensions, age, and wood species. The results of this study demonstrate that recovered wood can be, despite its damages from prior use and its age, a sustainable driver toward a circular orientation of the construction sector. Furthermore, adjusted criteria for the visual grading are discussed.	Florian	Böhm	Technical University of Munich

SESSION 6
Tuesday 24th June 2025
2:00pm to 3:30pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
6A	TESP - Engineering - Resilient solutions for Mid-rise mass timber building in high seismic regions	Session Chair: PROFESSOR MASSIMO FRAGIACOMO / UNIVERSITY OF L'AQUILA					
6A	TESP - Engineering - Resilient solutions for Mid-rise mass timber building in high seismic regions	Timber Engineering & Structural Performance - Engineering Focus	Experimental Characterisation of Lateral Performance of a 3-storey Mass Timber Building Constructed with Veneer Based Products	This paper presents an overview of a multi-phase experimental study, in which a three-storey mass timber (MT) building structure was designed, constructed, and tested at Oregon State University (OSU) under quasi-static cyclic loading. The gravity system of the building structure included laminated veneer lumber (LVL) beams and columns and Mass Ply Panel (MPP) diaphragms. Three different veneer-based MT lateral force-resisting systems (LFRSs) were tested: (1) an MPP pivoting wall with steel buckling-restrained boundary elements (BRB) as energy dissipators; (2) an MPP self-centering rocking wall with U-shaped flexural plates (UFPs) and steel bounding columns; and (3) veneer laminated timber (VLT) coupled self-centering rocking wall with UFPs. There was a total of five testing phases. These included two sub-phases of testing of gravity system only before the LFRS was engaged with the gravity system. Subsequently, each phase entailed testing of the building for Phase 1 with the MPP-BRB pivoting wall, Phase 2 with the UFP-MPP rocking wall with bounding columns, and Phase 3 with the VLT-UFP coupled rocking wall. In all five phases the building was subjected to quasi-static cyclic tests following the CUREE protocol up to maximum 4% roof drift ratio. A summary of building design, experimental setup, and key results will be presented at the conference.	Arijit	Sinha	Oregon State University
6A	TESP - Engineering - Resilient solutions for Mid-rise mass timber building in high seismic regions	Timber Engineering & Structural Performance - Engineering Focus	Glued-in Rod Splice Connection for Mass Timber Shear Walls in a Six-Story Shake-Table Test Structure	Mass Timber (MT) shear walls are a viable option for resisting lateral forces from hazards such as earthquakes and wind. When implemented in buildings over four stories, a single MT panel may be too long to ship without special costly transportation requirements. This leads to the need for stacking multiple panels vertically to achieve a design intention of a continuous walls over the height of the building, such as in balloon-type construction of self-centering rocking walls. For these tall balloon-type shear walls, a strong, ductile wall splice connection is critical. One promising solution for this connection involves installing Glued-in Rods (GiRs) vertically along the axis of the panel. However, the existing body of experimental research is limited, and no testing is available to evaluate this connection's performance under earthquake loads. This paper presents an implementation of a GiR connection for balloon-type mass ply panel shear walls installed in a full-scale, six-story shake-table test building. Utilizing results from component testing, a procedure for designing GiR wall splice connections is proposed and lessons learned from construction of this splice connection on a full-scale, six-story mass timber shake-table specimen are described. The response of the connection is then presented based on observations from a series of shake-table tests. Results show that the design approach of the GiR splice connection led to a safe and resilient design solution for vertically splicing MT shear walls.	Steven	Kontra	Oregon State University
6A	TESP - Engineering - Resilient solutions for Mid-rise mass timber building in high seismic regions	Timber Engineering & Structural Performance - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	Response of Mass Ply Panel, Self-centering Rocking Walls with Buckling Restrained Boundary Elements as Energy Dissipators in Shake Table Testing	To target both sustainability and seismic resilience, the design of buildings needs to be customized to meet targeted objectives able to account for multiple performance metrics. By combining the stable energy dissipation properties of steel with the environmental and aesthetic advantages of wood, mass timber self-centering rocking walls with buckling-restrained boundary elements (BRBs) can begin to address both sustainable and seismic performance goals. A full-scale, six-story, mass timber building including mass ply panel (MPP) self-centering rocking walls with BRBs was tested at the Large High-Performance Outdoor Shake Table (LHPOST) at the University of California, San Diego. Measured sensor and derived data included global responses, such as floor displacements and accelerations, along with local responses, such as BRB deformation, estimates of BRB fatigue life, post-tensioning force, and wall uplift, among others. The three-dimensional shaking testing program included 23 ground motion records with intensities of shaking ranging from Service to Risk-Targeted Maximum Considered Earthquake (MCER) levels. Results highlighted that: [i] the drift response was near uniform along the height of the building, [ii] the acceleration response included large contributions from the higher modes, [iii] the BRBs developed full, stable hysteretic response, and [iv] the self-centering system resulted in negligible residual drifts. Qualitative observations from construction and testing were also cataloged to further support the feasibility of implementing the lateral system in practice. By mixing and matching traditional steel BRBs and post-tensioning with MPP rocking elements, the system was able to meet enhanced seismic performance goals. Future work will seek to define both resilience and sustainability targets for designs incorporating multiple performance objectives.	Morgan	McBain	Stanford University
6A	TESP - Engineering - Resilient solutions for Mid-rise mass timber building in high seismic regions	Timber Engineering & Structural Performance - Engineering Focus	Full-Scale Shake Table Test of Resilient Six-Story Hybrid Mass Timber and Steel Structure	Mass timber solutions are becoming viable for high-seismic regions while remaining sustainable, efficient, and affordable. Yet, the industry is driving innovation and leading to the development of resilient hybrid steel-mass timber solutions that can minimize post-earthquake losses and downtime. A six-story hybrid mass timber structure with laminated veneer lumber (LVL) beams and columns, a cross-laminated timber (CLT) self-centering rocking wall (SCRW) in one direction, and a resilient steel moment-resisting frame/concentric braced frame (MRF/CBF) in the other was tested at the University of California, San Diego (UCSD) large high-performance outdoor shake-table facility. The innovative design allowed the MRF to remain essentially elastic, while the CBF was designed to provide stable and controlled hysteretic energy dissipation. The dynamic testing included uni-, bi-, and tri-directional ground motion time histories applied at a range of intensities including 43- and 225-year hazard level, design earthquake level, and risk-targeted maximum considered earthquake level per ASCE 7-16 for a location in Seattle, Washington. Four (4) design earthquakes and two (2) risk-targeted maximum considered tri-directional earthquakes were applied to the structure. Testing resulted in maximum drift ratios in the SCRW direction of 2.4% and 1.4% in the MRF/CBF direction. After testing, residual drifts were smaller than 1.6 mm (1/16") at the roof, showing promise that resilient steel lateral force-resisting systems (LFRS) alongside mass timber gravity and lateral systems are viable. This paper presents the specimen design and reports the results from the shake-table testing.	Tanner	Field	Oregon State University
6A	TESP - Engineering - Resilient solutions for Mid-rise mass timber building in high seismic regions	Timber Engineering & Structural Performance - Engineering Focus	MODAL CHARACTERISTICS OF TWO MID-RISE MASS TIMBER-STEEL HYBRID BUILDINGS UTILIZING AMBIENT VIBRATION TESTS	Modal characteristics of buildings are fundamental properties for their seismic and wind design. In this study, AVTs were conducted to measure the dynamic properties, including natural frequencies, mode shapes, and damping ratio, of two hybrid mass timber buildings located in Canada. The structural system of both the 12-story (The Vue) and 5-story (Terminus) timber buildings includes mass timber elements and steel braces for the gravity and lateral force resisting systems, respectively. The modal characteristics of the buildings were extracted by operational modal analysis (OMA) using both the Stochastic Subspace Identification (SSI) and Frequency Domain Decomposition (FDD) techniques. The measured fundamental periods and the ranges of damping ratios were compared with the values recommended in the National Building Code of Canada (NBCC) and the Canadian CLT Handbook. The differences in the measured frequencies by SSI and FDD were less than 3%, while more discrepancy was found in damping ratios. The result of the study showed a discrepancy of up to 37% between the experimental fundamental period and the design values. Up to eight frequencies were obtained for the buildings, providing a more comprehensive understanding of the buildings' dynamic behavior, including higher modes, which can be used for improving numerical structural analysis in the future.	Samira	Mohammadyzadeh	UNBC

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
6A	TESP - Engineering - Resilient solutions for Mid-rise mass timber building in high seismic regions	Timber Engineering & Structural Performance - Engineering Focus	MULTI-STOREY LIGHT-WOOD FRAME SHEARWALL LATERAL DEFLECTION: INVESTIGATION OF THE CUMULATIVE ROTATION EFFECT IN SEISMIC DESIGN	Multi-storey light-wood frame structures are one of the most efficient types of constructions, as they require cost-effective materials to build structures in a timely manner. However, their seismic design faces challenges with higher seismic hazard introduced in the National Building Code of Canada 2020. The study herein has targeted one approach to reduce design forces using mechanic-based period calculations permitted in the building code. This approach relies on the elastic deflection calculations of multi-storey shearwalls, including the effects of cumulative rotation as recommended in Annex A of CSA O86 Engineering Design in Wood. While cumulative rotations are likely to happen in the elastic domain, the racking movement characteristic of light-frame shearwalls would prevent this rotation from continuing in the inelastic domain. This study compares deflection calculations in Annex A of CSA O86 with linear and non-linear dynamic analyses and investigates the effects of ignoring the cumulative rotations in the inelastic domain. The preliminary results suggest that not amplifying the cumulative rotation in the inelastic domain (i.e., using RdRo force modification factors) leads to more realistic results, as confirmed in the non-linear analysis.	Diego	Flores	Canadian Wood Council
6B	TESP - Engineering - Floor Systems	Session Chair: DR CHRISTOPHE SIGRIST / UNIVERSITY OF APPLIED SCIENCES, BFH/AHB					
6B	TESP - Engineering - Floor Systems	Timber Engineering & Structural Performance - Engineering Focus	Reliability of smartphone sensors for the vibration comfort assessment of existing timber floors	This work faces the issue of the reliability of smartphone sensors for the confort assessment of exisiting timber floors. A real-scale floor was built and will be subjected to human-induced actions. The response of the structure will be measured by means of MEMS and smartphone accelerometers and the data will be analysed in terms of peak and RMS accelerations and frequencies, and the outcomes will be then compared.	MARTINA	SCIOMENTA	University Of Trieste
6B	TESP - Engineering - Floor Systems	Timber Engineering & Structural Performance - Engineering Focus	Comparison of the calculated and measured vibration behaviour of long span timber floors	The demand for longer spans in timber floors is increasing steadily. Modern materials facilitate these from a load-bearing perspective, serviceability concerns, particularly vibration analysis, remain crucial. Current design practises often result in over-designed cross-sections to mitigate perceived vibration issues, although in-situ floors typically surpass the calculation. This study aims to analyse up to 50 existing timber floors to empirically demonstrate this discrepancy between theoretical predictions and in-situ performance. By comparing measured data with computational models, this research seeks so refine design methodologies for more accurate vibration analysis, potentially reducing material usage without compromising structural integrity.	Johannes	Ruf	Biberach University Of Applied Sciences | Institute for Timber Design
6B	TESP - Engineering - Floor Systems	Timber Engineering & Structural Performance - Engineering Focus	Moment joints in the minor strength axis of CLT panels	The structural performance of joints in the minor strength axis of cross-laminated timber (CLT) panels was experimentally assessed using four-point and three-point bending tests. Four different joints were tested: S1) screwed plywood splines; S2) glued plywood splines; S3) T-joints; and S4) X-fix shear keys. The glued splines provided the highest rotational stiffness, while the screwed splines and T-joints exhibited larger ductility. Subsequently, a numerical model, validated by the experiments, was used to evaluate the joint demands. It was shown that increasing the rotational stiffness from 500 to 5000 kNm/rad/m significantly improved floor performance, specifically reducing the deflection by approximately 50%. However, further increases in rotational stiffness only resulted in incremental performance gains.	Jianhui	Zhou	University of Northern British Columbia
6B	TESP - Engineering - Floor Systems	Timber Engineering & Structural Performance - Engineering Focus	Experimental and analytical investigation of a novel adhesive-free timber-steel composite using eucalyptus globulus hardwood	The objective of this study is to investigate the structural behaviour of a novel adhesive-free timber-steel composite (AFTSC) system as a high-performance floor panel for sustainable mid- and high-rise construction. Local plantation eucalyptus globulus timber boards and laser cut mild-steel were used to fabricate the test specimens. Four-point bending tests were carried out to experimentally record the force, displacement, and failure mechanism of the panels. An analytical model informed by material grading tests was generated and compared against the experimental results. The novel AFTSC panels maintained near full composite action past 40% of ultimate load and consistently exhibited substantial ductile behaviour. In addition, the effective ultimate bending capacity of the timber components was found to increase by up to 25% when included in the AFTSC panels. This demonstrates the high-performance credentials of the novel AFTSC system along with the potential to valorise plantation hardwoods such as eucalyptus globulus.	Richard	Nero	University of Melbourne
6B	TESP - Engineering - Floor Systems	Timber Engineering & Structural Performance - Engineering Focus	ADVANCED TIMBER COMPOSITE FLOOR PANELS USING PLANTATION EUCALYPTUS HARDWOOD	The Advanced Timber Composite (ATC) floor panel combines low carbon, locally available materials to span further than conventional mass timber floor plates. ATC panels consist of; PEFC-certified local hardwood glulam for the joists, visual grade structural plywood for construction stage and soffit finish, and green concrete for durability to the finished floor. By utilizing composite action, these panels remove material from low efficiency areas and provide greater structural performance using less fibre. ATC provides a deemed to satisfy solution to Australia's often difficult to navigate fire code, while still ensuring the well-known installation speed of prefabricated mass timber elements. The low compressive strength required for the concrete screed provides the opportunity to use green concrete while still increasing vibration and acoustic performance and providing a continuous diaphragm and waterproof membrane to the floor design.	Daniel	Watson	Australian Sustainable Hardwoods
6C	TESP - Case Studies	Session Chair: GIANLUIGI TRAETTA / RUBNER					
6C	TESP - Case Studies	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus, Exemplars & Construction Case Studies - Engineering Focus	Recorded natural frequencies of timber buildings – A review	The structural design of multi-storey timber buildings is often governed by serviceability criteria limiting wind-induced vibration. To perform a serviceability check, the natural frequencies of the building need to be estimated, for which empirical equations are proposed by building codes. Their accuracy is not validated for timber buildings. This paper is a review of 21 measured natural frequencies of timber and hybrid timber buildings of heights between 16 m and 80 m. The natural frequencies together with building heights are used for validating the empirical equations. The considered empirical equations are from the Eurocode, the ASCE, Canadian, and Japanese building codes.	Carl	Larsson	Linnaeus University

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
6C	TESP - Case Studies	Timber Engineering & Structural Performance - Architectural Focus, Timber Architecture & Biophilic Design - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	LATTICIZING AXIALLY COMPRESSED MEMBERS IN TIMBER STRUCTURES: A METHOD FOR USING SMALL DIMENSIONAL LUMBER AS ALTERNATIVE OF MASS TIMBER PRODUCTS	China's reliance on imported timber stems from the limited mechanical properties of domestic wood species, leading to the predominant use of mass timber products from imported wood in modern timber structures. To address this issue, innovative design approaches are needed to integrate domestically sourced timber into construction projects. This study explored the feasibility of using domestic wood species for small structural elements in axially compressed members as a potential alternative to mass timber products. The proposed latticization method, which integrates engineering mechanics with architectural design, aims to reduce material consumption and enhance structural stability and load-bearing capacity. This method's effectiveness was validated through a case study of Future City Experience Hall in Hangzhou, China, where its performance was evaluated in terms of structural safety, cost-effectiveness, and environmental impact. By demonstrating the sustainable use of local forest resources, this study contributed significantly to the design of axially compressed timber members, offering a pathway to reduce reliance on imported timber and minimize environmental footprint in China.	Harrison	Huang	Zhejiang University
6C	TESP - Case Studies	Timber Engineering & Structural Performance - Practitioner Focus	Practical Design Considerations for TCC-Elements with CLT-Slabs	The timber-concrete composite (TCC) construction method can look back to a long period of use in building and with the availability of planar elements like cross-laminated timber (CLT), also flat TCC-elements are being used increasingly in construction practice. These TCC-elements may be designed according to CEN/TS 19103:2021 [1] or other regulations [3], when notches are used to transfer the shear forces between the two parts of the composite element. One of the often controversially discussed points with respect to this design method is the uplift-force acting in the notched connection. This paper tries to evaluate the amount of uplift-force acting in real design situations.	Harald	Krenn	KLH Massivholz GmbH
6C	TESP - Case Studies	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus, Education, Innovation & Challengers -	VIBRATION SERVICEABILITY OF MASS TIMBER COMPOSITE CLT-GLULAM TIMBER FLOOR WITH MECHANICAL SHEAR PLAT	Mass timber products are increasingly used in modern construction due to their strength and light weight, yet their use in large-span floors is restricted by serviceability issues related to floor vibrations. Existing vibration assessment guidelines do not suitably address mass timber composite (MTC) floors, lacking a unified approach. This study aims to close this gap by analyzing the dynamic behavior of MTC floors under various excitations, refining design guidelines, and advancing sustainable building practices, thus enhancing predictive models for MTCs.	Sultani Mulk	Khan	University of Waterloo
6C	TESP - Case Studies	Exemplars & Construction Case Studies - Practitioner Focus	UTILIZING WOOD RESIDUES FOR HIGH ADDED-VALUE MODULAR BUILDINGS – A CASE STUDY	The purpose of this experimental building is to carry out research and continuous monitoring on insulation material, wood paneling and cladding as well as on load-bearing parts, and to use the building as presenting area for the results of research and testing. We used oak wood residues wherever possible - triangular lath for cladding, residual veneer for interior paneling, wood bark for insulation of exterior walls, and ash wood for load bearing beams and columns. Measurements of thermal conductivity of exterior walls with oak bark have demonstrated its suitability as insulation material in a moderate continental climate. In addition, measurements of thermal conductivity and acoustic properties of paneling products proved their suitability for interior paneling.	Vjekoslav	Živković	University of Zagreb Faculty of Forestry and Wood Technology
6C	TESP - Case Studies	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus	Vibration Assessment and Numerical Modelling of Mass Timber Floors: Insights From Building Tests	Mass timber construction is increasingly favored by developers and architects due to sustainability concerns compared to conventional concrete and steel systems. Several design guides worldwide aid practitioners in utilizing mass timber products effectively. However, methodologies for assessing vibration in mass timber floors proposed by these guidelines have not been thoroughly validated in real-world scenarios. Existing methodologies often rely on laboratory tests which may not directly applicable to vibration design of actual buildings with various connections and presence of partition walls and furniture. Recently, a detailed experimental campaign was conducted on real buildings in California to investigate these methodologies. This study compares a range of vibration tests (hammer, heel-drop, and human walking tests) in real mass timber buildings to modelling predictions, examining the influence of parameters and assumptions outlined in the US mass timber design guide on dynamic response of tested floors. The effects of damping, gamma factor, timber-to-timber and timber-to-concrete connections, and different boundary conditions such as beam-to-beam, beam-to-column, and adjacent bays, along with considerations in EI calculations are discussed.	Sardar	Malek	University of Victoria (UVic)
6D	MPD - Engineering - Protective Design - moisture safety in timber buildings and construction processes.	Session Chair: CALIL NETO / REWOOD					
6D	MPD - Engineering - Protective Design - moisture safety in timber buildings and construction processes.	Material Performance & Durability - Engineering Focus	MOISTURE INGRESS AND MOVEMENT PATTERN IN AUSTRALIAN CLT PANELS – A PILOT STUDY	Australian Radiata CLT panels were subjected to different methods aiming to increase the overall moisture content. These methods were chosen to simulate scenarios of free water contact and high humidity, which are common in subtropical climates like Australia. To mimic free water exposure, CLT samples were submersed in water, while environmental chambers were used to simulate high humidity events over different duration. Specific moisture targets were set at 20% MC for high humidity and 30% MC for free water. After achieving the desired moisture levels, the distribution of moisture through CLT panels was assessed for each method. A grid system was developed to map moisture pockets within the panels and identify pathways for moisture ingress. The study also examined the impact of density, grain and cutting patterns on moisture content. The findings indicate that CLT panels are unlikely to reach moisture contents above 20% MC when exposed to high humidity. However, exposure to free water resulted in a rapid increase in moisture content well above 30% MC. This suggest that rain events and leaks pose significant concern for CLT, warranting further investigation.	Claudia	Roder	University of the Sunshine Coast
6D	MPD - Engineering - Protective Design - moisture safety in timber buildings and construction processes.	Material Performance & Durability - Engineering Focus	Moisture monitoring of a mass timber building - study of condition variation and building environment design	Exposure to moisture in mass timber structures, can result in higher moisture content (MC) and moisture gradients within the panel structure. This exposure can occur either during (heavy rain, flash flooding) or post construction (condensation, plumbing leaks). Adding to this, mass timber products like cross-laminated timber (CLT) have a higher capacity to absorb and store moisture when compared to light timber framing (LTF). Prolonged exposure and high MC in products like CLT can lead to decay, necessitating drying, repairs, or replacement of panel sections. It is crucial to incorporate moisture management and safety into building design and construction planning to prevent issues such as dimensional variation, structural changes, and product degradation during and after construction. However few studies have focused on the impacts these preventative solutions can have on mass timber structures, specific to the Australian climatic conditions. To address the lack of data on the moisture content of mass timber construction in hot and humid climates, wireless moisture monitoring sensors were installed in a mass timber building in Queensland to monitor potential variations in moisture during different phases of the building's life. The project aimed to develop a detailed understanding of condition variations throughout a calendar year and the effects of varying indoor and outdoor environmental conditions on CLT panel characteristics. Moisture content data collected over the buildings' service life within the mass timber assemblies were used to simulate mould growth index predictions and evaluate the drying capacity of the mass timber assemblies associated with certain design variables. The modelling results were calibrated using initial material conditions as well as internal and external boundary conditions to verify statements about moisture safety planning and risk assessment.	Maryam	Shirohammadi	Department of Agriculture and Fisheries, Queensland Government

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6D	MPD - Engineering - Protective Design - moisture safety in timber buildings and construction processes.	Material Performance & Durability - Practitioner Focus	MOISTURE INTRUSION PATTERNS IN SMALL-SCALE MASS PLY PANEL FLOORS	Moisture intrusion in mass timber structures poses a major challenge, especially during erection. Understanding the degree of intrusion can help define the problem and help encourage practical prevention strategies. The degree of water penetration in Douglas-fir cross laminated timber (CLT) and mass plywood panels (MPP) was examined following short term wetting exposures. Moisture intrusion in MPP was limited to a few veneers inward from the exposed surface, while intrusion in CLT concentrated around the non-edge glued joints. The results highlight the differential behaviour of these materials during construction and emphasize the importance of moisture management during construction.	Jeffrey	Morrell	Oregon State University
6D	MPD - Engineering - Protective Design - moisture safety in timber buildings and construction processes.	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	ENVIRONMENTAL, ECONOMIC AND MOISTURE RELATED ASPECTS OF LARGE SPAN TIMBER STRUCTURES IN HIGHLY CORROSIVE SURROUDINGS	The material choice for swimming facilities is a complex and demanding process. In the soon to be finished "Tøyen-bath" in Oslo - Norway, both steel and timber were compared in the early design-phase of the project. The city of Oslo's strong environmental policy emphasizes increased use of timber in public buildings. Comparisons were made regarding both costs and LCA. This paper will address the material design strategy of designing large roof structures in corrosive surroundings like swimming hall facilities. The paper will also show this comparison and explain the follow up process and on-site moisture-measurements during the building process. Furthermore, the paper will give an insight into the moisture measurement approach chosen for the wooden parts of the innovative roof construction.	Tim	Skotheimsvik	Multiconsult
6D	MPD - Engineering - Protective Design - moisture safety in timber buildings and construction processes.	Material Performance & Durability - Engineering Focus	RESEARCH ON THE DURABILITY OF ORTHOGONAL GLUED CROSS-LAMINATED TIMBER UNDER GROUND CONDITIONS	This research aims to clarify the durability of Cross-laminated timber (CLT) in complex geotechnical environments and promote its broader use in both civil engineering and construction. CLT boasts superior isotropic performance not seen in conventional timber, thanks to its orthogonal arrangement of alternating layers, which addresses the inherent strength anisotropy of wood. This lightweight material is expected to streamline construction processes, reduce construction time, and enhance transportation efficiency, making it particularly advantageous for civil engineering projects in mountainous regions and river basins. To encourage the use of timber in civil engineering, it is crucial to evaluate its durability under various exposure conditions distinct from those typically encountered in conventional building structures. However, there is still a lack of data on the degradation characteristics of CLT in harsh environments exposed to soil moisture, water, soil organic matter, etc. This paper examines the degradation characteristics of CLT in a geotechnical environment after two years of exposure. To evaluate the integrity and strength properties of CLT in both air and soil exposure environments, CLT block specimens were placed in various locations across Japan. Approximately two years after installation, the deterioration of the collected block samples was assessed through visual inspection. Following this, longitudinal compression tests and block shear tests were performed, and the results were compared with the initial values recorded before installation.The results showed that longer exposure periods led to increased cracking and delamination of the laminae. Adhesive delamination and lamina cracking progressed irrespective of variations in solar radiation, rainfall and soil composition, with the extent of deterioration varying according to climatic conditions. The mechanical properties of the specimens decreased as the exposure period lengthened.	YUKO	MIZOBUCHI	The United Graduate School of Agricultural Sciences, Ehime University
6E	MPD - Architectural	Session Chair: A/PROF MARIAPAOLA RIGGIO / OREGON STATE UNIVERSITY					
6E	MPD - Architectural	Material Performance & Durability - Architectural Focus, Timber Engineering & Structural Performance - Architectural Focus	HYGROTHERMAL PERFORMANCE AND WATER VAPOUR DIFFUSION RESISTIVITY OF AUSTRALIAN PLANTATION-GROWN TIMBER	This research is investigating the hygrothermal performance of Cross-Laminated Timber (CLT) and solid wood products manufactured from Australian grown plantation timber. Over the past three decades, the use of plantation softwood and hardwood, and engineered wood products within Australian buildings has significantly increased. However, wood products can also provide a good food source for the growth of mould in climatically inappropriate external wall (façade) systems. High quality data about solid wood products physical properties, including water vapour diffusion resistivity, is needed to complete multi-year transient hygrothermal and mould growth calculations. This paper provides a review of the current knowledge about, and methods to establish, the water vapour diffusion resistivity properties of solid wood products. The research identified there is a significant lack of data about the water vapour diffusion resistivity of Australian-grown timbers and solid wood products. The review also assessed laboratory-based evaluation methods to quantify water vapour diffusion resistivity properties and methods to empirically validate hygrothermal simulation results within full-scale buildings. By establishing high-quality water vapour diffusion resistivity input data for hygrothermal simulations, this research aims to support building design professionals and regulators in making informed decisions, leading to energy-efficient, healthy, sustainable, and durable buildings. KEYWORDS: Water vapour diffusion resistivity, Mould Index, plantation timber, Pinus radiata, Eucalyptus nitens	Mark	Dewsbury	University of Tasmania
6E	MPD - Architectural	Material Performance & Durability - Architectural Focus, Sustainability and Timber in a Circular Economy - Architectural Focus, Timber Engineering & Structural Performance - Architectural Focus	LOW-CARBON INTENSITY TIMBER FAÇADE SYSTEMS FOR MID-RISE BUILDINGS	Since 2010 there has been an increasing presence of surface and interstitial moisture and mould within single- and multi-residential buildings in Australia. The increasing presence of moisture and mould has coincided with the adoption of national energy efficiency regulations, which have aimed to reduce the energy needed to heat and/or cool new buildings. The energy efficiency regulations have led to increased amounts of insulation within façade systems, combined with a greater focus on exterior weather-tightness and interior building-sealing (airtightness). Furthermore, most Australian mid-rise façade systems comprise composite structures of high-embodied energy concrete, steel and clay brick components. This research seeks to establish what the built fabric requirements for timber-framed and solid-wood mid-rise high-performance façade systems may need to comprise for Australia's warm-humid, temperate and cool temperate climates such that they do not accumulate moisture or support surface or interstitial mould growth.	Mark	Dewsbury	University of Tasmania
6E	MPD - Architectural	Material Performance & Durability - Architectural Focus, Timber Architecture & Biophilic Design - Architectural Focus	MOULD GROWTH RISKS FOR LOW-RISE TIMBER-FRAMED RESIDENTIAL BUILDINGS IN SOUTHERN AUSTRALIA	Since 2010 there has been an increasing presence of surface and interstitial moisture and mould within single- and multi-residential buildings in Australia. The increasing presence of moisture and mould has conincided with the adoption of national energy efficiency regulations, which have aimed to reduce the energy needed to heat and/or cool new dwellings. Whilst the research until 2012 focused on international practices for the design and construction of modern façade systems, in 2013 several thousand non-transinent moisture calculations were completed to identify typical external wall systems that may be at risk of moisture accumulation. Recognising the deficieny of this method, in 2017 the research adopted transient hygrothermal and mould growth calculation methods. Through a mix of State and Industry funded research activities transient moisture and mould risk assessments have been completed for hot and humid, warm-humid, temperate and cool temperate climates in Australia. This paper reports on the most recent research that explored simulated Mould Index calculations for the temperate and cool-temperate climates of Victoria and Tasmania. The research identified significant deficieincies in the regulatory framework and the need for significant changes in design and construction practices to ensure timber-framed dwellings are durable, sustainable and provide healthy interior environments.	Mark	Dewsbury	University of Tasmania

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6E	MPD - Architectural	Material Performance & Durability - Architectural Focus, Sustainability and Timber in a Circular Economy - Architectural Focus, Timber Engineering & Structural Performance - Engineering Focus	A design methodology considering acoustic prediction model and LCA: A comparative study of different CLT-based assemblies	This paper aims to develop an acoustic design methodology for CLT floor assemblies using artificial neural networks approach by integration of life cycle assessment (LCA). 72 Lab-based measurements are used to develop the acoustic prediction tool. They are related to 29 different CLT-based floor assemblies. The weighted sound reduction index (Rw), and the weighted normalized impact sound pressure level (Ln,w) are estimated with an accuracy of 2 dB. Then a LCA study is conducted on assemblies that are used to test the network model. The acoustic performance and their environmental impacts are compared to highlight trends that may guide decision-makers in the design phase. This paper initially found that CLT-based floor assemblies generally increase the environmental impacts to achieve better acoustic insulation. However, a good sound attenuation can be reached by selecting suitable acoustic solutions.	Sylvain	Ménard	University of Quebec at Chicoutimi
6E	MPD - Architectural	Material Performance & Durability - Architectural Focus, Timber Engineering & Structural Performance - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	PARAMETRIC IMPLEMENTATION OF STRUCTURAL ANALYSIS DATA IN THE CONSTRUCTION OF A COMPLEX CURVED TIMBER STAIRCASE	This paper presents the use of advanced computational techniques to generate and integrate structural analysis data for the Atrium staircase at the new Blumer-Lehmann head office in Erlenhof, Switzerland. The project, realised through a collaborative effort among architects, structural engineers, and digital fabrication experts, exemplifies the application of parametric tools in enhancing structural integrity and material efficiency. Parametric modelling tools, such as Grasshopper; a visual programming language and environment for the Rhinoceros 3D design software, and Python scripting, were used to create detailed 3D and structural design models to perform iterative design adjustments. This project highlights the practical benefits these computational techniques bring for developing efficient and precise CNC manufacturing for complex curved timber structures.	Stefan	Rick	SJB
6F	STCE - Engineering	Session Chair: PROFESSOR GREG NOLAN / UNIVERSITY OF TASMANIA					
6F	STCE - Engineering	Sustainability and Timber in a Circular Economy - Practitioner Focus	Upcycling CLT cut-offs into modular building blocks: LCSA case study, adopting a multiple-cycles approach at building element level	This study delves into the sustainability impacts of circular timber construction products, with a particular focus on REbläkk, a modular building system developed by OMTRE AS. REbläkks are crafted from upcycled cross-laminated timber (CLT) cut-offs. These cut-offs, reclaimed from CLT manufacturing waste, are transformed into versatile building blocks for partition and load-bearing walls. The research employs a Life Cycle Sustainability Assessment (LCSA) to comprehensively evaluate REbläkk across multiple use cycles, assessing its environmental, social, and economic dimensions. By adopting a circular business model, REbläkk not only extends the service life of CLT but also enhances carbon sequestration. This contrasts sharply with traditional timber products that often end up incinerated for energy. The study evaluates the sustainability benefits of REbläkk compared to traditional timber products through LCSA at the building element level. It also proposes a methodological framework for practitioners in the early phases of designing climate-smart and socially inclusive circular wood solutions for construction, suggesting initial assessments before involving a third party for the final assessment of the complete commercial product. Given the complexity of assessing circularity and sustainability, the study aims to demonstrate that REbläkk offers a superior circular solution to conventional practices.	Francisco	Tienda	OMTRE AS
6F	STCE - Engineering	Timber Engineering & Structural Performance - Engineering Focus	Cyclic Behavior of Composite Steel-Cross-Laminated-Timber Structural System	In pursuit of achieving near-net-zero carbon buildings, this project investigates the development of a new structural system for high seismic zones that consists of steel framing with cross-laminated timber (CLT) floor diaphragms acting compositely with the steel floor framing. A Design for Deconstruction (DfD) design strategy is incorporated into the structural system to allow all primary structural components to be reused rather than recycled or scrapped at the end of the useful life of the structure. One of the key objectives is to develop a deconstructable connection strategy that connects the CLT to the steel beams to enable composite action. The system incorporates the use of high-strength bolted connectors to achieve composite action and explore construction benefits. A complete set of tests, including material tests, full cyclic connectors tests, composite beam tests, and large-scale composite diaphragm tests, aims to advance the understanding of the structural behavior of this hybrid system. Some additional work on this projects includes the investigation of material aspect (characterization of low-value species) for future uses, architectural considerations (e.g., fire safety, acoustic, vibration, floor framing plans, etc.), and using life cycle assessment (LCA) to inform sustainable design decisions. The presentation will emphasize the structural performance achieved by utilizing high-strength bolted connectors in steel-CLT hybrid structures, supplemented by experimental tests results, and highlights future planned work.	Baiyu	Chen	Northeastern University
6F	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus	LIFE CYCLE ASSESSMENT OF END-OF-LIFE OPTIONS OF DEMOLITION WASTE WOOD IN NEW ZEALAND	The concept of circular economy (CE) in construction has become significantly more important and is recently gaining increasing attention. The concept of CE proposes a change in mindset in which waste can be valued as an additional resource rather than an issue to manage and send for disposal. The approach prolongs the value of useful materials and optimises supply chains. This research study investigates the potential of reusing demolition waste wood to counteract climate change. A life cycle assessment (LCA) was conducted to quantify the environmental impacts of managing waste wood across different avenues in the New Zealand construction environment. A range of alternatives, such as remanufacturing the waste wood into glued-laminated timber (GLT), cross-laminated timber (CLT) and dowel-laminated timber (DLT) products, recycling for chipboards, and energy recovery, were examined. The LCA results revealed that all the alternative scenarios were beneficial regarding global warming potential (GWP) and abiotic depletion potential - fossil fuels (ADPF), while the remanufacturing scenarios also had substantial reductions in the acidification potential of land and water (AP), eutrophication potential (EP), and photochemical ozone creation potential (POCP). These results advocated for adopting remanufacturing strategies in waste wood management systems to enhance sustainability and resource efficiency in New Zealand's construction industry.	Hao	Liang	University of Auckland
6F	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus	A WEB-BASED LIFE CYCLE ASSESSMENT PLATFORM FOR IMPORTED TIMBER PRODUCTS	Under the dual pressure of increasing housing demand and carbon reduction commitment, timber has been suggested as one of the easily implemented solutions for Irish construction. However, the incomplete life cycle assessment (LCA) practices for Irish timber products could impede the promotion of timber construction. Currently, the customised LCA for Irish-imported timber products is missing. Based on the actual trade and environmental data, this research successfully develops the upfront global warming potential (GWP) values for Irish-imported timber products, covering the production, transportation, and construction stages. Due to its timely updates, the UN Comtrade database was selected as the source of trade data for the last decade. Through analysing trade data, regions producing Irish-imported timber products are determined and then corresponding environmental data is applied from environmental product declarations and generic lifecycle inventory databases. After data quality integration, suggestions are given for applying the generated GWP values in building LCA.	Song	Ge	University of Galway

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6F	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus	Engineered Wood Panels from Recycled Timber: A Sustainable Solution for Australian Construction	The rising demand for sustainable construction materials has highlighted the potential of engineered wood panels to be made from recycled timber. This study explores the benefits of utilising these panels in Australia, a nation committed to reducing its carbon footprint and promoting sustainable practices and embracing a circular economy. Data was collected from various sources regarding the demand for engineered wood panels, the availability of recycled wood and the feasibility of these panels, supported by successful case studies. Detailed statistical analysis and forecasting were performed, demonstrating that these panels offer a viable solution to both the increasing wood waste problem and the wood supply shortage for wood panel production in the country. Despite some challenges, these panels provide significant environmental, economic, and technical benefits. The paper concludes with recommendations to enhance the adoption of engineered wood panels, highlighting their crucial role in advancing Australia's sustainable construction initiatives.	Isuri	Amarasinghe	The University of Melbourne
6F	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus	REIMAGINING TIMBER: AN INTEGRATED APPROACH OF RESOURCE EFFICIENT FABRICATION PROCESS FOR TOPOLOGICALLY OPTIMISED CROSS-LAMINATED TIMBER SLABS	Timber, recognised for its sustainable properties including renewability, carbon sequestration, and low embodied energy, plays a vital role in modern construction. This project focuses on using a standard timber product to make structurally optimised irregular slabs in a resource-efficient manner. This research develops an innovative computational workflow integrating architecture, computational design, structural engineering, and advanced manufacturing technologies to create complex laminated timber form with both structural and resource efficiency. The methodology combines topology optimisation, discrete assembly, and bin-packing algorithms within a comprehensive framework. Through prototype development and testing, the research demonstrates very high (>95) material efficiency through production, while maintaining structural integrity and design flexibility. The research establishes new pathways for sustainable timber construction, contributing to improved resource efficiency and environmental sustainability in architectural practice.	Lingju	Wu	The University of Queensland
6G	ECCS/TESP - Engineering	Session Chair: PROFESSOR ALEXANDER SALENIKOVICH / UNIVERSITE LAVAL					
6G	ECCS/TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	Timber as bridge between past and future: structural upgrading and conservation of the ancient timber and masonry venetian sawmill of Vallaro (Brescia, Italy)	This work presents an extensive static and seismic retrofitting intervention performed on a relevant historic case-study building, the Venetian sawmill of Vallaro (Brescia, Italy). This heritage construction from the end of the 19th century features three building portions, two realized in timber and one consisting of a masonry structure with timber floors and roofs. The building had been neglected for decades and was in a poor state of conservation, despite representing a valuable example of the typical historic architectures of the mountainy area in the Province of Brescia. With the support of the local municipality, a complete restoration of the sawmill has started, with the objective of transforming it into a territorial museum. To this end, a series of reversible and compatible timber-based interventions were planned in consultation with the local superintendence for architectural heritage. The structural design aimed at preserving the historic value of the sawmill, especially in its original timber components, such as trusses, braced columns, and diaphragms. The present case study enables to showcase the advantages of the applied strengthening methods in such a complex architectural restoration and the importance of tailored structural detailing, combining the improvement in static and seismic performance with the protection and preservation of ancient timber members.	Michele	Mirra	Delft University of Technology
6G	ECCS/TESP - Engineering	Exemplars & Construction Case Studies - Engineering Focus	In-plane stiffness of large-area framed floor diaphragms constructed with oriented strand board panel sheathing using a Swiss case study	In a case study of a Swiss building, wood structural panels made from oriented strand board (OSB) are stapled continuously on the top side of a hollow-core timber slab to create one large-area framed floor diaphragm measuring 41.1 x 50 m2. The diaphragm acts as horizontal bracing structure for six 41.1 m long steel trusses. The in-plane stiffness is investigated due to the internal stability load of the trusses in the ultimate limit state. A finite element model is developed using linear elastic material behaviour. The numerical total in-plane displacements are compared to the analytical results of the design method based on the shear field beam theory. The stiffness of the sheathing-to-framing connection and the size of the OSB panels are decisive factors for limiting the total in-plane displacement, which easily exceeds the limit value.	Miriam	Kleinhenz	Basler & Hofmann AG
6G	ECCS/TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	SPIRAL CLT-CONCRETE COMPOSITE STAIR CLEAR SPANS 21m	Using a special application of timber-concrete-composite (TCC), the KF Aerospace Spiral Stair is comprised of doubly curved and warped CLT with a structural concrete topping throughout the full spiral. Creating composite action between the concrete and the CLT significantly increases the overall stiffness and strength of the stair. This removes the requirement for any support columns along the 21m (70ft) clear span and maintains a highly aesthetic structure that serves as a welcoming showcase for the KF Aerospace museum, and a tribute to continually pushing the boundaries of what is possible with timber construction. The added mass of the concrete improves the vibration performance and ensures comfort for people ascending and descending the stairs. A Finite-Element orthotropic shell model was created to predict the structural performance of the TCC system which relies on composite action both in-plane and out-of-plane. This bi-axial composite application is highly innovative for TCC systems and required unconventional analysis and design methods.	Ben	Moerman	StructureCraft
6G	ECCS/TESP - Engineering	Exemplars & Construction Case Studies - Engineering Focus	TOWARDS MANUFACTURING OF FULL SCALE WOOD VENEER AUTOMOTIVE PANEL	This study investigates the ability to manufacture automotive body panels using wood veneers. Creating wood preforms similar to the composite manufacturing industry was found to be the ideal approach, with the challenges of controlling moisture during forming and drying prior to adding adhesive. In this study, preforming was conducted using steam and hot water. Experiments to date show the feasibility is not restricted by the material, rather by the complexity and longer manufacturing process. Various techniques are currently deployed to minimise the issues associated with complexity of layup.	Matt	Jennings	Deakin University
6G	ECCS/TESP - Engineering	Exemplars & Construction Case Studies - Engineering Focus	WALMART HOME OFFICE – CONSTRUCTION MOCK-UP CASE STUDY	The Walmart Home Office in Bentonville, Arkansas, serves as a pioneering case study in the field of large-scale, commercial building development with twenty buildings and over 2-million square feet of mass timber construction. This case study delves into the intricacies and outcomes of employing a construction mock-up to evaluate connections, and other critical elements of the mass timber system for cost and construction efficiency including approximately thirty-five gravity connections and over fifteen-lateral connections, with four different lateral systems evaluated.	Carla	Dickof	Fast + Epp
6H	EIC - Practitioner	Session Chair: PROFESSOR KEITH CREWS / THE UNIVERSITY OF QUEENSLAND					

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6H	EIC - Practitioner	Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Architectural Focus, Education, Innovation & Challengers - Practitioner Focus	Innovative Approaches to Optimization and Sustainability in Timber Construction: Insights from the Austrian Research Project Sys.Wood	The research project Sys.Wood addresses the entire life cycle of timber buildings aiming to develop new interfaces, methods, and principles for system optimization in Austrian timber construction. The goal of Sys.Wood is to transform the value chain by optimizing processes and methods at every stage, including design, manufacture, use, maintenance, reuse, and disposal. Key objectives are sustainability, digitalization, and quality management. A particular focus is on enabling small and medium-sized enterprises to participate competitively in larger projects by integrating manufacturing expertise early in the planning process. This integration intends to ensure a sustainable value chain from the outset. This paper outlines the strategy and objectives of the project and presents findings from the first of three years planned, setting the stage for ongoing and future research to the timber construction industry.	Benjamin	Kromoser	Universität für Bodenkultur Wien
6H	EIC - Practitioner	Sustainability and Timber in a Circular Economy - Practitioner Focus, Education, Innovation & Challengers - Practitioner Focus, Exemplars & Construction Case Studies - Practitioner Focus	ALIGNING NEEDS AND SUSTAINABILITY: A CASE STUDY OF BIO-BASED TEMPORARY HOUSING	As a result of repeated natural disasters in the last decade, Australia has an acute need for innovative and scalable models for provision of temporary housing. Common criticisms of currently available housing systems revolve around their high production costs and a heavy reliance on imported building solutions. To address these limitations, a model for temporary post-disaster housing has been developed to utilise locally available and renewable timber resources, to enable faster, cheaper, low-carbon, and scalable temporary housing delivery options for Australian disaster recovery. This paper presents the developed "TCS House", as the result of a significant collaborative effort between academics, government, industry, and community partners. It is constructed using a novel hybrid timber-cardboard sandwich (TCS) composite, fabricated from a laminated cardboard core sandwiched between two plywood face layers. The cardboard core can be made from waste or recycled materials, and the TCS panels are combined with a number of other residue and recycled timber products, available from local manufacturers, to provide other building performance functions related to weatherproofing, robustness, thermal comfort and aesthetics. A full-scale prototype is built to benchmark the affordability, sustainability, design flexibility, fabrication complexity, embodied carbon, and durability of the TCS House system. The prototype is also used to explore strategies to maximise the use of renewable and recycled materials in temporary housing construction, by providing direct links between local communities and the forestry and wood products sector.	Mahmoud	Abu-Saleem	The University of Queensland
6H	EIC - Practitioner	Sustainability and Timber in a Circular Economy - Practitioner Focus, Education, Innovation & Challengers - Practitioner Focus	Increasing Carbon Literacy within the Design Sector	Increased attention on the embodied carbon impact of buildings has brought the topic of life cycle assessment to a new audience of design professionals. It is imperative for the wood industry to provide resources that clearly demonstrate the carbon benefits of wood in a way that is easy for designers to understand and implement into their typical design process. WoodWorks developed and continues to expand such a library of resources which addresses topics like biogenic carbon and comparative life cycle assessments for wood buildings. These resources have seen great success in the U.S., being referenced by several influential design firms and industry organizations, helping designers to understand the sustainability of wood construction and giving them the tools to be able to quantify the carbon benefits of their wood designs. Although these resources are written specifically for the U.S. audience, a similar approach could be used in other countries.	Ashley	Cagle	WoodWorks - Wood Products Council
6H	EIC - Practitioner	Education, Innovation & Challengers - Engineering Focus, Education, Innovation & Challengers - Architectural Focus, Education, Innovation & Challengers - Practitioner Focus	Fundamental Study on Using of Motion Confirmation and Gaze Measurement for Preserving Carpentry Technique	In order to maintain the value of historical buildings such as cultural properties for a long time, proper daily management and regular repair are necessary. Therefore, preservation and repair require in-depth knowledge, techniques and skills to pass on the value of a building to future generations. In addition, the high level of preservation and repair techniques in Japan is known, and such techniques have been designated as an Intangible Cultural Heritage. At present, however, there are few young talents and the number of carpenters is insufficient. The reasons for this include the need for a long period of training and many sensuous teaching methods. In this study, we focused on "planing," which is difficult and requires a long training period among carpentry jobs, and examined the conservation of techniques and the efficiency of education. As an experimental method, the work was visualized by gaze measurement and motion measurement for specialists and unspecialist workers. For the amateurs, changes before and after instruction were also measured. From the experimental results, it became clear that the expert gazed at the cutting edge when adjusting the plane, and alternately checked the operating point and the plane when planing, and that the time of watching the plane was about 20%. On the other hand, the amateurs person tended to pay attention to the place to strike when adjusting the plane, but he became able to pay attention to the cutting edge after receiving instruction. In addition, during the planing operation, the line of sight was widely dispersed before the personal guidance, but after the personal guidance, the line of sight dispersion was reduced by correcting the posture. These results suggest that data collection by gaze and motion measurement is effective for preserving technology and improving educational efficiency.	Akiko	Ohtsuka	Akita Prefectural University
6H	EIC - Practitioner	Education, Innovation & Challengers - Engineering Focus, Education, Innovation & Challengers - Architectural Focus, Education, Innovation & Challengers - Practitioner Focus	EUROPEAN POLICIES INFLUENCING WOOD PRODUCTION IN THE CONSTRUCTION SECTOR IN SCENARIOS UNTIL 2050	Wood products can play an important role to achieve the European Commission's policies for climate neutrality by fostering a decarbonisation of the construction sector. The study analyses how different policies may impact wood demand forecasted for the sawmill and wood-based panels industry, based on past trends in statistics and expert insights gained through surveys, workshops, and interviews. Two generic scenarios were portrayed: increasing production versus stagnation until 2040. The results indicate an increase of demand for sawnwood, and wood-based panels leading to a potential high raw material and supply competition. We point out policy needs and perspectives for research and innovation addressing both resource efficiency and circular uses of materials, products and building systems.	Uwe	Kies	InnovaWood
6H	EIC - Practitioner	Timber Engineering & Structural Performance - Engineering Focus	Fire engineering challenges and solutions in Mass Timber construction	This presentation will explore the challenges of fire engineering in mass timber buildings. It will address analysis and design methods, as well as mitigation strategies that can reduce the specific risks associated with this type of construction. In this context, it will examine how mass timber can influence the fundamental principles of designing and constructing safe buildings, ensuring an appropriate response in the event of a fire. In addition, regulatory and performance-based design approaches will be presented, along with specific strategies and provisions to enhance fire safety in mass timber buildings.	Cristian	Maluk	DAMA Engineering Consultants

SESSION 7
Tuesday 24th June 2025
4:00pm to 5:30pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
7A	TESP- Engineering - Bridges / Beams	Session Chair: DR CHRISTOPHE SIGRIST / UNIVERSITY OF APPLIED SCIENCES, BFH/AHB					
7A	TESP- Engineering - Bridges / Beams	Timber Engineering & Structural Performance - Engineering Focus	VIBRATION SERVICEABILITY OF A TIMBER ARCH PEDESTRIAN BRIDGE CONSIDERING DETERIORATION OVER TIME	The vibration serviceability of pedestrian bridges is an important indicator to ensure that pedestrians feel safe and comfortable by crossing the bridge. However, much less studies have been done on the influence of localized decay of timber materials by aging on vibration serviceability. In this study, a numerical analysis model was proposed considering the Young's modulus and degradation state of the bridge members that had been in service for about 30 years. The vibration serviceability before and after degradation was investigated through time history response analysis. As a result, the RMS (Root Mean Square) values of response velocity were significantly higher during 2.2Hz and 2.3Hz (crowd walking), indicating an influence on vibration serviceability.	Daisuke	OIKAWA	Akita University
7A	TESP- Engineering - Bridges / Beams	Timber Engineering & Structural Performance - Engineering Focus	OPTIMIZATION OF THE STRUCTURAL INSPECTION OF TIMBER BRIDGES USING DIGITAL MODELS	The introduction of the new version IFC4.3 that defines the IfcBridge class supports for the first time supports the use of the BIM method in infrastructure construction. However, wooden bridges have not yet been considered in the IfcBridge class and the focus is currently still on the planning and construction phases. The subsequent digital generation of as-maintained models is necessary so that BIM can also be used in the maintenance of infrastructure constructions. On the one hand, efficient methods are necessary for generating these digital building models with a required level of detail. On the other hand, options for modeling damage characteristics are missing in the existing IFC standard. This article presents pilot applications for the manual and parametric generation of digital as-maintained models of timber bridges and shows possibilities for the implementation of results from structural inspections of timber bridges in particular. It focuses on the modeling of wood-specific damage and measurement data from non-destructive testing. Two different methods were adapted for the implementation of damage and measurement data in digital building models, which enable fast and error-free localization and thus a complete logging of damage over the life cycle of a structure. An increase in efficiency can be expected for structural inspection of timber bridges when consequently using digital models. By using BIM, the quality, schedule and costs of a construction can be optimized as part of life cycle-oriented construction management in bridge construction.	Antje	Simon	University Of Applied Sciences Erfurt
7A	TESP- Engineering - Bridges / Beams	Timber Engineering & Structural Performance - Engineering Focus	Monitoring of a Toll Bridge made from Timber – Changes in Moisture Content, Timber Strains and Connection Forces after approximately 1.5 Years of Service	Timber is a key factor in the ongoing decarbonization of the building sector. Consequently, the use of timber is continuously expanded to applications with more demanding environmental conditions. One example for such an exposed structure are so-called gantries, which – used as toll bridges or to mount traffic signs – are an integral part of todays infrastructure worldwide. These gantries are exposed to harsh environmental conditions - in particular to significant changes in temperature and relative humidity, different forms of precipitation, chemical stresses in the form of mist containing de-icing salt as well as dynamic loads induced by wind and traffic. In order to gain knowledge about the behavior of timber constructions with such an exposedness, a test station in the form of a wooden gantry with in total 43 sensors has been erected within the research project “GREEN_GANTRY”. The paper at hand will present the development of the moisture content, strains in the timber and changes in connection forces due to the environmental conditions of the past 1.5 years of operation. Results show that, so far, the protective layer in the form of wooden sheathing made of larch performs well as the glulam beam within the protective layer experienced a slight drying with a moisture content of currently ~ 11 %. Regarding the resulting forces in the connections it can be seen that the trend roughly follows the development of the moisture content.	David	Glasner	University Of Technology Graz
7A	TESP- Engineering - Bridges / Beams	Timber Engineering & Structural Performance - Engineering Focus	An Experimental Investigation on the Long-term Behavior of Prestressed Glulam Beams	The flexural behavior of glulam beams could be efficiently enhanced by the prestressing technology. However, there is still limited research on the long-term flexural behavior of prestressed glulam beams. To address this challenge, this study presents an experimental investigation on the long-term flexural behavior of internal prestressed glulam beams. Two groups of prestressed glulam beams, unloaded or loaded by four-point bending, were continuously measured for over 300 days in an uncontrolled in-door environment. The influences of environmental factors (relative humidity and temperature) and loading patterns on prestressing force and deflection were examined. Test results showed that prestressing force exhibits a similar variation trend to relative humidity. The inelastic variation of prestressing force were 0%- 8.93% and -4.93% - 1.72% for loaded and unloaded beams, respectively. The prestressing force of loaded beams showed a higher positive variation ratio up to 8.93% compared with unloaded ones. As for deflection, the loading pattern had significant influence on the entire trend. There were creep deflection up to -1.19 mm and1.41 mm, respectively, for loaded and unloaded beams. The presented results aim to provide technical basis for the design and application of prestressed glulam beams.	Minjuan	He	Tongji university
7A	TESP- Engineering - Bridges / Beams	Timber Engineering & Structural Performance - Engineering Focus	BENDING PERFORMANCE OF I-JOISTS COMPOSED BY DIFFERENT ENGINEERED WOOD PRODUCTS	This study is part of the “Agenda Transform” project, which focuses on enhancing sustainable construction techniques through the evaluation of I-joist beams made with a combination of different web and flange materials. The I-joists analyzed in this research were constructed using OSB (Oriented Strand Board), Particle Board, and High Densified Board for the webs, paired with flanges made from Pinus pinaster, LVL (Laminated Veneer Lumber), and LSL (Laminated Strand Lumber) [1]. Bending tests were conducted according to EN 408:2012 standards to assess the structural integrity, load distribution, and failure mechanisms of these I-joist configurations. The results showed significant variability in performance based on the material combinations, with certain configurations demonstrating superior structural efficiency and load-bearing capacity. These findings support the project’s goal of promoting innovative material use in sustainable construction practices within the Portuguese industry [2].	Jorge	Branco	University of Minho, Department of Civil Engineering
7A	TESP- Engineering - Bridges / Beams	Timber Engineering & Structural Performance - Engineering Focus	NUMERICAL INVESTIGATION OF CLT COMPOSITE DOUBLE T-BEAM	A Cross Laminated Timber (CLT) composite double T-beam is a composite section that is comprised of two CLT composite T-beams that are tied to each other side by side by using a single solid CLT flange. An adequate number of screws are used to build an exceptional connection which performs as structural shear keys in CLT composite section. This combination makes it a cost-efficient structural system for roof or floor applications that is capable of carrying high loads in relatively long spans. The CLT and LVL are two well-known high-performance massive engineered wood products that consist of layered lumber boards stacked and glued into place crosswise at 90-degree angles and parallel respectively. An experimentally verified numerical model of the CLT composite T-beam has been used to study the behavior of CLT composite double T-beams. The detailed parametric study of CLT composite double T-beams showed that the effective flange width would increase with any changes that increase the ratio of the transverse layer depth to the longitudinal layer depth of the CLT flange. Additionally, using a CLT flange with a higher modulus of elasticity slightly improves the effective flange width. The benefit of the wider effective flange width in the optimized CLT composite T-beam allows the designers to increase the span along the beam and spacing between the webs of the CLT composite double T-beam for a more cost-efficient design. The comprehensive numerical parametric study shows that the CLT composite double T-beam has the potential to be used widely for long-span roof or floor applications in mass timber constructions for residences and commercial projects.	Reza	Masoudnia	Red Stag Timber Lab

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
7B	TESP - Engineering - behaviour of dowels	Session Chair: DR LISA OTTENHAUS / THE UNIVERSITY OF QUEENSLAND					
7B	TESP - Engineering - behaviour of dowels	Timber Engineering & Structural Performance - Engineering Focus	HOW INTERACTION OF INTERNAL FORCES AND MOMENTS INFLUENCE THE LOAD-BEARING CAPACITY OF DOWELS	In connections with laterally loaded dowel-type fasteners, high density leads to increased load-bearing capacities and influences load-bearing behavior. Material properties and system parameters like embedment strength and withdrawal capacity affect connection performance and failure modes. In hardwood connections, failure mechanisms may include fastener failure due to higher stresses during lateral loading. Multi-axial stress occurs as fasteners are subjected to bending moments, shear forces, and normal forces, which vary with fastener type and geometry, potentially leading to shear or tensile failure. The executed test programme aims at investigating fastener failure in connections with laterally loaded dowels.	Elisabet	Kuck	Karlsruhe Institute of Technology KIT
7B	TESP - Engineering - behaviour of dowels	Timber Engineering & Structural Performance - Engineering Focus	A NOVEL BUCKLING-RESTRAINED CONNECTION FOR MASS TIMBER BRACED FRAMES AND CLT SHEAR WALL HOLD DOWNS	The goal of this research is to design, construct, and test a novel buckling-restrained connection (BRC) for mass timber braced frames. This connection combines a typical glued-in-rod (GIR) connection with buckling restrained axial fuse braces , to create a new connection type and the potential for a high ductility lateral force resisting system (LFRS), with ductility related modification factors that are comparable to those that might be used in steel-only construction. Studies in the literature have examined the performance of several connections for timber braced frames, including riveted and dowel-type connections. More recently, research has examined the possibility for more ductile connections using perforated steel plates or buckling restrained braces However, these systems continue to exhibit some pinching or instability in their hysteretic behaviour or cannot achieve the high-strength and ductility required for tall timber frames. Preliminary experimental results show that this novel connection is able to achieve target design strengths while exhibiting high-stiffness, ductility, and energy dissipation capacity. Results show stable hysteretic response without the pinching or premature pull-out of the glued-in-rods. This connection was found to be replaceable following testing demonstrating the potential for reuse.	Dylan	Neves	Queen's University
7B	TESP - Engineering - behaviour of dowels	Timber Engineering & Structural Performance - Engineering Focus	SEISMIC PERFORMANCE AND NONLINEAR MODEL OF MASS TIMBER BUCKLING RESTRAINED BRACED FRAME	A timber frame with mass ply lam (MPL) beams and columns and a timber buckling restrained brace (TBRB) was subjected to cyclic loads according to the AISC qualification procedure for conventional buckling restrained braces (BRB). The TBRBs met the requirements for qualification of conventional BRBs; the steel core reached a maximum strain of 3.1% in both tension and compression and the braced frame reached a maximum drift ratio of 4.5%. A numerical OpenSees model of a single-story timber frame with a TBRB was built and validated by TBRB component tests and MPL beam-column joint tests with slotted-in steel plates and steel dowels. The single-story TBRB braced frame model was expanded to an eight-story frame and analyzed using static, cyclic, and earthquake loads. The building experienced a peak inter-story drift equal to 2.54% and a peak floor acceleration equal to 1.7F. The numerical model of the timber braced frame with TBRBs could be used to design TBRB braced frames as a ductile lateral force resisting system for mass timber buildings in seismic regions.	Han-Erik	Blomgren	Timberlab
7B	TESP - Engineering - behaviour of dowels	Timber Engineering & Structural Performance - Engineering Focus	SEISMIC PARAMETERS EVALUATION FOR TIMBER BRACED FRAMES	The utilization of mass timber as a renewable material in buildings is gaining significant attention, particularly for its application in lateral load-resisting systems. This study focuses on timber braced frames (TBFs), which are recognized as a cost-effective solution for resisting seismic and wind loads. The absence of specific seismic performance parameters in building codes has limited their widespread adoption. A comprehensive literature review highlights the current understanding of TBFs, emphasizing the importance of dowel connection configurations in enhancing ductility. Experimental results indicate that optimized spacing of dowel connections is a crucial parameter for improving system performance. System ductility of TBFs can be determined by using the equation validated through 2D non-linear analyses, suggesting moderate seismic capacity for TBFs. Future research will involve 3D dynamic analysis of timber braced archetype buildings as per FEMA P695 guidelines to establish reliable seismic parameters.	Daiki	Hinata	Oregon State University
7B	TESP - Engineering - behaviour of dowels	Timber Engineering & Structural Performance - Engineering Focus	NUMERICAL SIMULATION OF WOODEN DOWEL UNDER COMPRESSION	The compression behavior of wooden dowels, particularly in the form of dowel-laminated timber, is garnering increasing attention from researchers. The performance of dowels under compression is critical, especially regarding the embedment performance of joints. In this study, southern yellow pine wooden dowels tested in compression in literature was studied, and their compression properties were collected. Subsequently, numerical models utilizing MAT-143 in LS-DYNA were employed to validate the experimental results. Additionally, a parametric study was conducted by varying the diameter and density of the dowels. This research is particularly significant for understanding the embedment behavior of dowels	Inayat Ullah	Khan	Deakin University
7B	TESP - Engineering - behaviour of dowels	Timber Engineering & Structural Performance - Engineering Focus	PARAMETRIC STUDY ON THE BENDING PERFORMANCE OF WOODEN DOWELS	Wooden dowels offer a sustainable and cost-effective solution, prompting extensive research into their mechanical properties. This study validates the performance of wooden dowels, previously examined in the literature, using the LS-DYNA software with material model MAT-143. A parametric analysis was conducted on southern yellow pine dowels, varying their diameter, and density, to evaluate their performance under these conditions. Results indicated that increasing density slightly enhances bending capacity but also causes a minor shift from ductile to brittle behavior. Similarly, increasing the diameter of the dowels improves bending capacity with a slight tendency towards brittle behavior.	Inayat Ullah	Khan	Deakin University
7C	TESP - Engineering - Performance of Hybrid Connections	Session Chair: PROFESSOR ZHENG LI / TONGJI UNIVERSITY					
7C	TESP - Engineering - Performance of Hybrid Connections	Timber Engineering & Structural Performance - Engineering Focus	Behaviour of Glued-In Rod Connections in Mass Timber Structures – A state-of-the-art review	In high-rise buildings, beam-to-column connections are always one of the most critical components and, thus, their failure can lead to catastrophic collapse of the entire structure. Accordingly, in tall wood buildings, careful consideration for the design of connectors used in beam-to-column connections is critical for the overall structural integrity of such buildings. Using glued-in steel or FRP rods as connectors in mass timber frame connections can enhance the performance of such connections in mid and high-rise timber buildings. Although such innovative types of connections have been successfully utilized in mass timber construction, there is still no consistency in their design approaches. This hinders their use in broader applications, particularly concerning their behaviour as moment-resisting connections and in fire conditions. In this paper, state-of-the-art research on glued-in rod connections is presented, and the structural behaviour of various connection configurations utilizing glued-in rods at ambient and elevated temperatures is discussed.	Sam	Salem	Lakehead University

SESSION 7
Tuesday 24th June 2025
4:00pm to 5:30pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
7C	TESP - Engineering - Performance of Hybrid Connections	Timber Engineering & Structural Performance - Engineering Focus	ROOM-SCALE TESTS WITH EXPOSED TIMBER	The influence on fire growth from varying the amount of exposed timber at both the wall and ceiling has been studied through completion of room-scale fire tests, utilizing test standard NFPA 286 (Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth). Three tests were completed that were compliant with the 2021 International Building Code. To understand the impacts on early fire growth conditions, four additional tests with exposed timber on the ceiling consisting of 40%, 60%, 80% and 100% of the floor area were conducted. Instrumentation included thermocouples, a heat flux transducer, a heat release rate exhaust hood and for each test the propane burner profile was identical. Based on the time to flashover criteria in the standard, flashover was not observed in any of the tests where exposed timber met with the IBC limits. By increasing the area of exposed to timber at the ceiling to 40% and 60% of the floor area, flashover was also not observed. Where the exposed timber was 80% and 100% of the floor area, flashover was reached.	David	Barber	Arup
7C	TESP - Engineering - Performance of Hybrid Connections	Timber Engineering & Structural Performance - Engineering Focus	EVALUATIONS FROM MULTIPLE PERSPECTIVES ON TIMBER-CONCRETE COMPOSITE SLABS FOCUSING ON ADHESION WATERPROOF COATINGS	This study provides a comprehensive examination of Timber-Concrete Composite (TCC) floors, which are a combination of wooden materials used for formwork and concrete slabs. TCC floors have been gaining popularity due to their structural advantage of enabling thinner slab thickness and the recent trend towards the use of wood in buildings. In practical construction scenarios, wooden formwork laid on beams is temporarily left outdoors, making it desirable to apply waterproof paint on the upper surface of the wooden formwork (the boundary between the wooden formwork and the concrete slab). The waterproof coating also serves to prevent the moisture in the concrete from penetrating the wooden formwork. Through the course of the research, it was found that waterproof coatings based on vinyl ester contribute to the integration of the wooden formwork and the concrete slab. Floors in buildings are required to have not only structural performance but also fire resistance, living performance, and sound insulation performance. Therefore, a multifaceted evaluation of TCC floors, considering the adhesion of the waterproof coating, was attempted. Specifically, element tests and four-point bending tests were conducted with the parameters of wooden members, concrete slab thickness, and joint conditions. In addition, long-term creep tests for half a year, living performance tests by heel impact and walking vibration measurement, and tests for heavy and lightweight floor impact sound insulation performance were carried out.	Yukiko	Nakatsu	NIKKEN SEKKEI Ltd.
7C	TESP - Engineering - Performance of Hybrid Connections	Timber Engineering & Structural Performance - Engineering Focus	Form-Fitting Mass Timber Connections: Woodworking For the New Age	Current mass-timber projects rely on proprietary and carbon-intensive connectors (e.g., self-tapping screws, concealed hangers, column-to-column pillars) to resolve structural loads. Tall-wood structures in Europe and Asia built with heavy-sawn timber and form-fitting connections have demonstrated the ability to withstand numerous earthquakes and the effects of time. Despite this and recent research revealing the potential of form-fitting connections to meet structural demands and fire performance, the mass timber industry has not adopted these connections due to the lack of knowledge and perceived additional manufacturing costs, resulting in punitive strength reductions and limited design guidelines. Furthermore, the industry is increasingly interested in employing novel form-fitting connections to resolve structural forces, with recent projects showcasing unique form-fitting timber geometries. The research into joinery cultures alongside small-scale rapid prototyping prior to larger specimen testing of semi-rigid form-fitting mass timber connections shows the potential for large-scale implementation as a substitute for proprietary connectors.	Maxime	Daviau	University of Waterloo
7C	TESP - Engineering - Performance of Hybrid Connections	Timber Engineering & Structural Performance - Engineering Focus	IN-PLANE SHEAR PROPERTIES OF DISINTEGRATED HYBRID CROSS-LAMINATED TIMBER	Disintegrated hybrid cross-laminated timber is a material-saving alternative to conventional cross-laminated timber (CLT). In the present investigations, the disintegrated hybrid cross-laminated timber (DH CLT) consists of spruce wood, beech wood of inferior quality and a layer of modified cottonid, which acts as a fire protection layer. As the beech wood shows good mechanical properties despite its inferior quality, the lamellas can be arranged inside the components at a distance from each other. This is called disintegration. In addition to the reference test series featuring conventional CLT, three test series with different structure were tested. The tests were carried out in a newly developed picture frame test construction. It was shown that the test setup is well suited for testing DH CLT. The stiffness and strength of the hybrid specimens are little below the reference of conventional CLT. Torsional failure of the intersections was the governing failure mechanism.	SCHUMACHER	NILS	TECHNICAL UNIVERSITY OF MUNICH
7C	TESP - Engineering - Performance of Hybrid Connections	Material Performance & Durability - Engineering Focus Timber Engineering & Structural Performance - Engineering Focus	FEASIBILITY OF CROSS LAMINATING HIGH DENSITY EUCALYPTUS	This study explored the viability of making cross laminated timber (CLT) using Eucalyptus bosistoana, a naturally durable and high-stiffness species. As an initial step towards introducing a stiff CLT, the bonding performance of E.bosistoana CLT is examined. Following the conventional CLT manufacturing procedure, three-layered CLT panels were fabricated using E. bosistoana with a mean density of 1095 kg/m3 and one-component polyurethane adhesive. To further investigate its application in CLT, it was also consolidated with radiata pine, which has a lower density. The results of delamination and block shear tests revealed that the high-density property of E. bosistoana limited glue penetration so that the delamination rate and wood failure percentage (WFP) stood at 100% and 1%, respectively. In comparison with the eucalyptus CLT, the mixed-species configurations with pine demonstrated increased WFP from 1% to just above 20% and improved block shear strength from 3 MPa to 4.6 MPa, while their delamination rates were 82% and 74% for pine-core and surface configurations, respectively.	Milad	Lezgi	University of Canterbury
7D	MPD - Engineering - Monitoring timber decay	Session Chair: PROFESSOR EMERITUS JEFF MORRELL / OREGON STATE UNIVERSITY					
7D	MPD - Engineering - Monitoring timber decay	Material Performance & Durability - Engineering Focus	TIMBER BALCONY MONITORING PLAN: REVIEW AND STEP-BY-STEP PROCEDURE	This paper presents a detailed step-by-step procedure to create a monitoring plan for timber balconies focusing on controlling fungal decay over time to prevent serious damage. Applicable to all types of timber balconies, the procedure includes four main steps: preliminary study, inspection, calculation to forecast degradation using an optimized decay prediction model and definition of the monitoring plan. Standardization of the entire process through a procedural flowchart includes coding rule development, revision and correction of the time interval formula, new forms for each stage and inspection methods tailored to the specific type of balcony under consideration. This approach is useful to improve the longevity and safety of timber balconies. The paper also includes the application of the methodology to a real-world case study demonstrating the practical effectiveness of the proposed monitoring plan.	Daniele	Salzani	University of Trento

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
7D	MPD - Engineering - Monitoring timber decay	Material Performance & Durability - Engineering Focus	QUNTITATIVE EVALUATION OF DETERIORATION OF TRADITIONAL TIMBER BUILDING MEMBERS BY NON-DESTRUCTIVE EVALUATION	Wooden buildings designated as cultural properties in Korea are often hundreds of years old. Maintenance and repair of wooden cultural properties is based on the principle of reusing original members. For the reuse of original members, it is important to detect performance degradation due to decay or weathering of major members as early as possible. This is because early detection of decay or deterioration can be decision criteria for determining the repair, reinforcement, or replacement of major structural members. In other words, if minor deterioration that does not affect structural performance can be repaired, and if the structural performance is reduced but the structural performance can be maintained then the original member can be reinforced for reuse. However, if the performance degradation is remarkable and the structural performance cannot be maintained by reinforcement treatment, it must be replaced by a new structural timber member. The performance evaluation of the above members can be performed in a non-destructive way. This study was conducted to quantitatively evaluate the performance degradation of wood members by applying ultrasonic waves and stress waves.	Kugbo	Shim	Chungbuk National University
7D	MPD - Engineering - Monitoring timber decay	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	HUMIDITY IMPACT ON TIMBER CONNECTION STRENGTH	The effects of climate change in several regions of the world include increased rainfall, which can lead to moisture ingress into buildings. This issue is particularly problematic for timber structures due to potential defects in waterproofing that can lead to direct contact with water, which can cause timber decay and a decrease in strength, as moisture becomes trapped between permeable and impermeable surfaces (e.g. within a timber frame wall panel). While the effect of moisture on timber strength properties is well known, its impact on timber connections is less studied. Timber connections usually involve dowel-type fasteners, creating a tight-fit joint where any expansion of wood due to increased moisture content is hindered by the fastener holding the members together. This study will examine the effect of moisture on the strength of timber connections, particularly focusing on the additional stresses in the connection, caused by hindered expansion of wood in two scenarios: 1) timber with high moisture content and 2) timber subjected to cyclic changes in moisture content. The experimental testing that will be conducted, will focus on the withdrawal properties under the two humidity scenarios. The tests are expected to demonstrate that the restriction of expansion in such connections leads to additional strength loss, beyond that caused by high humidity and cyclic changes alone	Dominika	Malkowska	University of Bristol
7D	MPD - Engineering - Monitoring timber decay	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	REVIEWING AND ENHANCING FLOOD DAMAGE ASSESSMENT METHODOLOGIES IN NEW ZEALAND	This study investigates how flood damage is assessed in New Zealand, comparing current practices with those in the United States and the United Kingdom. It identifies significant gaps in assessing flood-damaged timber structures that are frequently used in New Zealand residential buildings. The study, therefore, emphasizes the need to update assessment guidelines as there is an increase in the frequency of floods caused by climate change, such as the North Island flood of 2023. Existing guidelines in New Zealand, including the Rapid Building Assessment Field Guide and BRANZ Bulletin 666, need more detailed information on timber structures. The research supports more data-driven approaches are required to improve precision and efficiency in flood damage assessment to expedite recovery efforts. Therefore, this research aims to suggest modifications to current methodologies that will help improve the assessment process for effective reconstruction planning and resource allocation.	Parisa	Sedighizadeh	University of Canterbury
7D	MPD - Engineering - Monitoring timber decay	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Analysis and prediction of sapwood and heartwood proportions in wooden foundation piles in relation to bacterial decay	In the historic city centre of Amsterdam (NL), the most widespread foundation system consists of wooden piles. Since these foundations are fully below the water table, they are mostly subjected to bacterial decay. This biodegradation phenomenon proceeds slowly over time, and usually involves the less durable sapwood, with heartwood remaining sound. Hence, obtaining an estimate of sapwood and heartwood proportions in wooden piles can provide information on how deep in the cross section bacterial decay is expected to proceed. This is relevant, for instance, when developing service life models, since the remaining sound cross section of a pile can be estimated. Thus, the present work involves a comprehensive investigation on sapwood and heartwood proportions in spruce, pine and fir wooden foundation piles from different construction periods. The amount of sapwood and heartwood was determined with computed tomography (CT) scans on 49 wet discs retrieved from the piles. Such measured sapwood width was then compared with that predicted with an empirical model from literature, based on the number of annual rings and growth rate, obtaining a successful validation. Finally, micro-drilling measurements were conducted on the discs to identify decayed portions, which appeared to always affect (part of) the sapwood only.	Michele	Mirra	Delft University of Technology
7D	MPD - Engineering - Monitoring timber decay	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Effect of fungal decay on withdrawal capacity of nail connections in radiata pine	This study investigated the effects of early fungal decay and corrosion on the performance of timber connections. Radiata pine sapwood blocks, fastened with either stainless steel or galvanised nails were subjected to decay induced by two types of fungi, a brown-rot (Fomitopsis ostreiformis) and a white-rot (Pycnoporus coccineus). Decay stages used for testing corresponded to mass losses of 2.5%, 5%, and 10%. To evaluate connection performance, withdrawal tests were performed. Additionally, nail corrosion was assessed both visually and quantitatively. The data for wood mass loss, maximum withdrawal capacity, and corrosion levels were subjected to an Analysis of Variance. This research will enhance our understanding of how early stages of decay and corrosion impact timber connection performance. Ultimately, the findings are intended to inform the development of strategies to mitigate these detrimental effects.	Camilo	Montoya	The University of Queensland
7E	TABD - Architectural	Session Chair: PENELOPE MITCHELL / USC					
7E	TABD - Architectural	Timber Architecture & Biophilic Design - Architectural Focus	Prototyping a Small Mass Timber House	In the United States (U.S.) state of Oregon, a lack of affordable housing led to new legislation encouraging increased housing density by allowing for accessory dwelling units (ADUs) and “cottage clusters” (small stand-alone houses assembled around a courtyard) on sites formerly zoned for single-family houses on urban sites. This legislation coincided with the state’s interest in reviving its timber economy and in mitigating increasing wildfires exacerbated by climate change through the production and application of mass timber, which can utilize fiber from small diameter trees from forest restoration projects, thereby contributing to reduction of wildfire risk. These two state challenges converged leading to significant interest in the development of a prefabricated mass timber small house prototype. In the U.S., however, it has not been demonstrated that mass timber construction can compete on cost in the low-rise housing market with the typical construction system, light-wood-frame, particularly in single-house projects. This project investigated the potential for mass timber at small scale to achieve affordability through pre-fabrication, while also creating higher quality, more thermally and natural hazard (wind, seismic, fire) resilient housing to better respond to increasing threats from climate change.	Judith	Sheine	University of Oregon

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
7E	TABD - Architectural	Timber Architecture & Biophilic Design - Architectural Focus	LOW-COST BIOMASS CONSTRUCTION TECHNOLOGY SYSTEMS WITH SMALL-DIAMETER ROUND TIMBER AS MAIN MATERIAL AND ITS CARBON REDUCTION EFFICIENCY	Modern wood architecture conforms to the theme of ecological sustainable development, but the shortage of forest resources restricts the development process of modern wood architecture. Hence, low-cost and biomass construction systems are critically needed to broaden the range of structural timber and improve material efficiency. Cheap and easily available small-diameter round timber shows broad application prospects, which main sources are wood products from plantation, fast-growing forest, the forest harvesting residues, sub-small fuel wood and logs that do not reach the structural standard. The purpose of this paper is to provide a technical system of small-diameter round timber as main material, which aims at saving materials and reducing cost in small to medium scale buildings, and further improves the carbon reduction efficiency of wood structure buildings. Through the research path of architectural typology, that is, Construct technology system -- Technical performance verification and Carbon reduction efficiency analysis -- Translation and extension, both model analysis and data calculation for the single-rod lattice system were performed. The main contents are as follows: Firstly, a construct technology system based on small-diameter round timber is proposed, and its material methods, joint nodes and construction methods are described. Secondly, using SAP2000 and Design Builder modeling analysis, the threshold of suitability space construction of the system was defined. The efficiency of building materials and economizing analysis were used to compare their comprehensive suitability. Finally, the architectural form of the construction system was expanded. And practical design methods and construction strategies were proposed for further optimization and application.	Ying	wu	School of Architecture and Design, Harbin Institute of Technology; Key Laboratory of Cold Region Urb
7E	TABD - Architectural	Timber Architecture & Biophilic Design - Architectural Focus	BIMwood - timber construction planning processes	One of the challenges facing the construction industry is the digital transformation of planning and construction processes. Building Information Modeling (BIM) is becoming a key driver of progress. BIMwood focuses on BIM-supported planning solutions of prefabricated timber constructions. However, planning methods remain a bottleneck due to the non-standardized data exchange between planners and timber manufacturers. BIMwood identifies specific requirements for prefabricated timber structures and develops solutions for a range of aspects in a timber construction-specific BIM process. The BIMwood reference process is developed analogously to established planning phases on the basis of a simulative methodological approach, which includes two levels of observation: the descriptive level describes the structured multidisciplinary data, the procedural level describes the exchange processes in the context of assigned roles and responsibilities. Furthermore, the basics for the creation of 3D models are devised with regard to geometric specifications. The demands on the models are clarified concerning the necessary component data. The proposed solutions provides the basis for developing an implementation strategy to improve data exchange between planners and contractors to complete the process chain from planning to production. BIMwood has developed an implementation strategy for BIM-based planning and data management processes for prefabricated timber construction. The reference process defines relevant multidisciplinary data sets and regulates data exchange, taking into account role concepts and responsibilities. The necessary information requirements for geometric characteristics and relevant data along the planning phases were defined for the individual specialist models. Based on BIM as a key technology in Architecture, Engineering and Construction, BIMwood solutions and recommendation for action can now be integrated into planning practice.	Frank	Lattke	Nuremberg Institute of Technology Georg Simon Ohm
7E	TABD - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus, Timber Architecture & Biophilic Design - Architectural Focus	ARE WOOD BUILDINGS MORE CIRCULAR? A COMPARATIVE STUDY ON BUILDING CIRCULARITY BETWEEN TIMBER AND REINFORCED CONCRETE STRUCTURES	Given the global emphasis on sustainable development, the construction industry is increasingly prioritising advancements in building circularity (BC). This study conducted a comparative analysis on BC of multi-storey reinforced concrete (RC) and timber frame structural systems: developing two digital models, a RC structure utilising conventional materials and a timber structure employing wood-based materials; performing structural analysis to establish comparable foundations; and quantitatively assessing the circularity performances of the two structure types across four levels: materials, elements, systems and the building as a whole. The results highlighted the significant advantages of wood-based materials in enhancing BC at specific levels. This study offers architects and practitioners new perspectives and theoretical foundations for design decisions and material selection.	Harrison	Huang	Zhejiang University
7E	TABD - Architectural	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Architectural Focus, Timber Architecture & Biophilic Design - Architectural Focus	RESEARCH ON CONVERTING SFM 3D POINT CLOUD TO 3D COORDINATE SYSTEM USING STLP POINT CLOUD CONNECTION DEVICE IN THE "JODO-SHU SAINEN-JI HONDOU"	Automated driving technology uses SfM (Structure from Motion) technology to generate a 3D point cloud of the surrounding environment using images and then determines the distance of surrounding objects from the point cloud while evaluating whether the object is a person or not. By replacing traditional on-site surveys with 3D point clouds generated using SfM from photographs,this research seeks to clarify the impact of the STLP (Stereo Tags-Platform Leveling) point cloud connection device on the generated 3D point clouds.Additionally, it aims to verify the method of creating architectural drawings from the generated 3D point clouds and to assess the accuracy of these drawings.In this study, the STLP point cloud connection device was installed in the main hall of temple which is captured from both inside and outside,with the device's top surface set to level.The STLP point cloud connection device consist of a tripod, leveling device, clamp, stereo tags, and level,and the height of device,the dimensions,material,design of the stereo marker are adjustable.After photographing the interior, exterior, and roof, the STLP device automatically linked the three sets of 3D point clouds to generate a 3D model of the main hall.With the program recognized the markers in the point clouds, we can adjusted the scale and leveling of the 3D point cloud, and generated a 3D model.Coordinates of pillars and earthen walls in the main hall were extracted from the 3D model,then we determined the dimensions and positions,use the program displayed structural elements, dimensions, and reference lines in the 3D coordinate system.This experiment demonstrated the utility of the 3D point clouds generated from photographs using the STLP point cloud connection device.Furthermore, the research clarified the method of converting the 3D model into CAD drawings and verified their accuracy.	zhixing	wang	Meiji University
7F	TESP - Engineering - Robustness	Session Chair: A/PROF BENOIT GILBERT					
7F	TESP - Engineering - Robustness	Timber Engineering & Structural Performance - Engineering Focus	DEVELOPMENT AND SEISMIC DESIGN OF NOVEL HYBRID TIMBER-STEEL ECCENTRICALLY BRACED FRAMES	Described in this paper is the development of a novel hybrid timber-steel eccentrically braced frame (TS-EBF), that has significant benefits in terms of seismic performance and sustainability. This new seismic-force-resisting system (SFRS) aims to combine the sustainability and lateral stiffness of timber-braced frames with the excellent energy dissipation capacity of steel links for enhanced seismic performance. The system uses structural steel for deformation-controlled elements (ductile shear links) and engineered wood products for force-controlled elements (beams, columns, and diagonal braces). A six-storey archetype building that uses this novel SFRS was designed using both force- and displacement-based seismic design approaches for the seismicity of Victoria, British Columbia, Canada. Numerical models were developed for ductile shear links in ABAQUS finite element software and validated with full-scale quasi-static cyclic tests. In addition, a two-dimensional fiber-based numerical model of the prototype six-storey building was developed in OpenSeesPy. Performance assessment was carried out using static pushover and nonlinear response history analyses using thirty-three hazard-consistent ground motion records. Overall, this study demonstrated the effectiveness of this new lateral system, indicating its potential as an alternative SFRS in Canada's high-seismic risk regions.	Matiyas	Bezabeh	McGill University

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
7F	TESP - Engineering - Robustness	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	EVALUATION OF MATERIAL PROPERTIES OF CHAMAECYPARIS OBUTUSA VAR(TAIWAN HINOKI) USED IN TRADITIONAL ARCHITECTURE TAISHO-PERIODO	This research focused on Chamaecyparis obutusa var. formosana(Taiwan hinoki) using traditional wooden architecture columns, we conducted bending tests using full-sized timber, bending tests using small clear specimens, compression parallel grain tests, compression perpendicular to the grain tests, and partical compression perpendicular to the grain tests to understand the material properties. The bending Young's modulus of the full-sized material was 9.48GPa, and the bending strength was 43.01MPa. When compared to wood used in domestic cultural property buildings, its bending strength was equivalent to that of the Cryptomeria japonica of tower gate of Aso Shrine. When compared with other tree species in the world, the bending strength was equivalent to that of Atlantic white cedar.	Rina	Kurahashi	Toyo University
7F	TESP - Engineering - Robustness	Timber Engineering & Structural Performance - Engineering Focus	Experimental determination of the combined loading behaviour of scaled timber frame walls subjected to bending and shear	The shift towards using more and higher timber structures comes with more questions regarding their structural behaviour. For instance, structural robustness and racking resistance are two important themes currently being researched more thoroughly. Within the context of structural robustness, timber walls could become self-supporting due to damage occurring to the underlying supporting elements. In such a scenario, timber walls are subjected to bending and possibly horizontal (shear) loads, a combination of load cases for which little knowledge has been developed in the context of timber frame construction. Therefore, in this contribution, an experimental and numerical campaign is presented in which six timber frame walls were tested. Two walls were loaded solely under in-plane horizontal loads until failure, and four walls were subjected to a combination of in-plane vertical (bending) and horizontal loads. Results showed that increasing the vertical loading lowered the horizontal load (or racking) resistance of the timber frame wall. The interaction behaviour was also visible in the load-displacement diagram, which depicted a faster decrease in stiffness in the elastoplastic and plastic area of the wall and decreased ductility whenever more vertical loading was applied. This interaction behaviour was similar to the predictions according to mesoscale finite element models.	Dries	Byloos	Hasselt University
7F	TESP - Engineering - Robustness	Timber Engineering & Structural Performance - Engineering Focus	MACQUARIE UNIVERSITY AINSWORTH BUILDING (SYDNEY)	The Ainsworth Building at Macquarie University, a flagship for the Medicine and Health Sciences Faculty, exemplifies advanced mass-timber construction, blending education, research, and medical practice. This four-storey building, completed in July 2020, provides dynamic, flexible spaces and state-of-the-art learning environments. Constructed on a constrained site in Sydney, the building's erection took just over a year, with three months dedicated to installing the timber elements. The structure integrates glulam European spruce for internal columns and beams, CLT European spruce for floors and shear walls, and glulam Victorian ash hardwood for external columns. Lateral stability is ensured by CLT floors and walls, supplemented by Victorian ash W columns. A robust structural strategy was developed by assessing element removal and substantiating alternate load paths. Precise BIM coordination facilitated pre-cut timber fabrication, minimizing campus impact. The design reduces embodied carbon and promotes efficient, quieter construction methods.	Kengo	Takamatsu	Arup
7F	TESP - Engineering - Robustness	Timber Engineering & Structural Performance - Engineering Focus	COLUMN LOSS ANALYSES FOR POST-AND-BEAM SUBASSEMBLIES	As the size and complexity of timber buildings grow, so do the consequences of a collapse, making robustness a key requirement in the structural design. However, the response of timber buildings to initial local damage, i.e., their robustness, is not yet well understood. To investigate the ability of timber beam-column frames to develop alternative load paths in a column removal scenario, a numerical model was developed and verified against large-scale quasi-static column removal experiments. The nonlinear numerical model was used to examine the quasi-static pushdown as well as the dynamic behavior of timber frame subassemblies. The investigation focused on laterally loaded dowel-type beam-to-column connections with continuous slotted-in steel plates. The main influencing parameters were the stiffness of the horizontal restraint, the rotational stiffness of the beam-to-column connection, and the speed of the member removal in the dynamic case. The results show that dowel-type beam-to-column connections with continuous steel plates through the column may enable some load redistribution through catenary action.	Katharina	Sroka	Empa
7F	TESP - Engineering - Robustness	Timber Engineering & Structural Performance - Engineering Focus	Development of GIR System with High Toughness Coupler	In this study, the Glued-in-Rod (GIR) System with High Toughness Coupler was developed for constructing mid-rise wooden buildings. The toughness connector previously developed in our laboratory needs to be manufactured in different lengths depending on the cross-section of laminated timber used, which is very costly and time-consuming. To solve these problems, the GIR joint system was developed, which consists of two commercially available full-threaded bolts and a coupler with toughness performance. The tensile yield strength of this coupler was 75kN and the deformation capacity was more than 20mm. It was also confirmed that the compressive yield strength was about the same. These test results confirmed that this coupler not only had the desired stiffness but also had the ability to deform. Therefore, moment resistance tests on beam-column joints for mid-rise wooden buildings using this GIR system will be carried out.	Kota	Nagai	Oita Univ.
7G	ECCS - Australian Hybrid-Timber Exemplars (Atlassian & T3 Collingwood)	Session Chair: PROFESSOR KEITH CREWS / THE UNIVERSITY OF QUEENSLAND					
7G	ECCS - Australian Hybrid-Timber Exemplars (Atlassian & T3 Collingwood)	Sustainability and Timber in a Circular Economy - Architectural Focus, Education, Innovation & Challengers - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	Structural Innovations in Atlassian Central: Pioneering Hybrid Timber High-Rise Construction in Commercial Developments	Hybrid timber and concrete structures are known for their structural, environmental, and prefabrication advantages but are underutilized in premium commercial high-rise developments in Australia. The Atlassian Central project in Sydney, designed by BVN and SHoP architects, represents a significant and world-leading advancement in this field. Co-owned by Atlassian and Dexus, Atlassian Central is a 42-level, 59100 sqm commercial tower aiming to reduce upfront embodied carbon by 50% during construction, operate on 100% renewable energy, and achieve substantial operational energy savings through considered climatic engineering solutions and significant 'park' zones of naturally ventilated floorspace. The general tower structure is a hybrid timber structure developed in partnership with project engineers Eckersley O'Callaghan and TTW. It is comprised of seven 'habitats', each four stories high and contained within a structure of steel framed 'mega-floors' and load-bearing perimeter diagonal frame 'Exoskeleton'. The intermediate floors of each 'habitat' are constructed from mass timber and are supported at each Megafloor. The lower seven floors of the tower use a different structural strategy designed to transfer the loads of the Exoskeleton structure and façade back to the concrete core and two primary columns. This approach minimises the footprint of the building and retains the legibility of an existing heritage building on the site. This paper will explore in detail the key design features of the Atlassian Central hybrid timber strategy, identifying opportunities and advantages and addressing design and construction challenges. The findings illustrate the feasibility and benefits of hybrid timber structures in commercial high-rises, highlighting timber's potential in facilitating sustainable commercial development in dense urban environments.	Tim Peter	Crawshaw Titmuss	BVN BVN

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
7G	ECCS - Australian Hybrid-Timber Exemplars (Atlassian & T3 Collingwood)	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus, Exemplars & Construction Case Studies - Engineering Focus	STRUCTURAL FIRE ENGINEERING FOR ATLASSIAN CENTRAL	This paper will present the fire engineering design for the Atlassian Central building that will be built in Sydney, Australia. At 39 storeys tall, and adjacent to Sydney's Central Train Station, it will be the tallest hybrid-timber commercial tower in Australia. The building features four-storey mass timber habitat structures located between megafloors located on every fifth floor, which are supported by a perimeter steel diagrid structure. The authors will discuss the fire engineering and structural fire engineering strategy of this unique and complex building to produce a robust design. The key points of consideration of the fire engineering strategy are the location of the building in a land-locked site adjacent to Australia's largest train station, Sydney Central Station, the presence of the mass timber structure, consideration of the ever-changing state-of-the-art knowledge of mass timber structures in fire, safe occupant egress and safe fire fighter access into the tower. Non-linear thermal and structural finite element analyses were utilised to test the effects of severe fires and subsequent cooling on the timber structures and the diagrid structure, to inform the fire protection strategy. For such complex and tall structures, the paper will highlight the need to consider more detailed forms of analysis to inform the structural design for fire resistance, beyond standard and simple analysis methods that are prescribed by the building code.	Linus	Lim	Holmes
7G	ECCS - Australian Hybrid-Timber Exemplars (Atlassian & T3 Collingwood)	Exemplars & Construction Case Studies - Architectural Focus	T3 Collingwood - Melbourne Australia	In 2023, Hines completed the development of T3 Collingwood, The tallest mass timber office building in Melbourne. T3 Collingwood, a hybrid timber at the heart of Melbourne, is Jackson Clements Burrows' (JCB) aim at demonstrating clarity in composition and programme that will engage with its surrounding context and community in a new and positive way, whilst being sympathetic to the existing local heritage.	Chris Nigel	Botterill Burdon	JCB AECOM
7G	ECCS - Australian Hybrid-Timber Exemplars (Atlassian & T3 Collingwood)	Exemplars & Construction Case Studies - Practitioner Focus	T3 COLLINGWOOD - OPTIMISING DESIGN OF TALL GLULAM STRUCTURES USING HARDWOOD	T3 Collingwood is a 15-storey hybrid mass timber building in Victoria, Australia built using hardwood glue-laminated timber, softwood CLT, and concrete. The prominent feature of this building is the use of hardwood bearing connections to provide the most efficient structure possible from a material, manufacturing, and installation perspective. The hybrid scheme, consisting of a 9-storey mass timber tower on top of a 6-storey concrete podium, also provides a unique opportunity to accurately compare mass timber design and construction against traditional concrete methods. The building's conventional layout and identity as an office building aims to prove that timber no longer needs to be reserved for 'special use cases' and should be considered alongside concrete and steel as a standard structural material for modern construction. Overall, T3 Collingwood acts as a role model for conventional commercial high-rise buildings to show that tall structures can be built effectively and efficiently using mass timber instead of concrete.	Jack	Hill	Australian Sustainable Hardwoods (ASH)
7G	ECCS - Australian Hybrid-Timber Exemplars (Atlassian & T3 Collingwood)	Timber Engineering & Structural Performance - Engineering Focus	MASSLAM SEATED BEARING CONNECTION	The seated bearing connection epitomises the synergy between Design for Manufacture and Assembly (DfMA) and structural performance. By leveraging the inherent and unique strengths of hardwood glue-laminated timber (GLT), an optimal connection solution is achieved. This approach enhances load-bearing capacity and safety-in-design while celebrating the beauty in the simplicity of traditional timber-to-timber connection. Projects such as T3 Collingwood at 36 Wellington Street - Hines' first T3 project in Australia – benefited from enhanced speed of construction thanks to the seated bearing connection. Impressively, a mere three minutes on average was all it took to install each beam - by far the quickest installation of GLT beams ever completed by the specialist installer. The seated bearing connection is very cost-efficient in comparison with proprietary and custom bracketry, accounting for cost-savings due to enhance speed of construction makes this a very desirable detail. Embracing the beauty of simplicity in timber-to-timber bearing connections, this solution embodies both strength and grace, setting a new standard for structural engineering innovation and excellence.	Nathan	Benbow	Australian Sustainable Hardwoods (ASH)
7H	TESP - Practitioner	Session Chair: HARALD KRENN / KLH Massivholz GmbH					
7H	TESP - Practitioner	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus	IN-PLANE RACKING STRENGTH TESTS OF WOOD-FRAME WOOD STRUCTURAL PANEL SHEAR WALLS USING DIFFERENT END POST AND HOLD-DOWN DETAILS	In the United States, the 2021 ANSI/AWC Special Design Provisions for Wind and Seismic (SDPWS) standard serves as a primary code resource for the design of wood structural panel (WSP) shear walls. Studies that were used in developing the ASTM D7989 standard on demonstrating equivalent seismic performance to wood-frame wood structural panel shear walls in SDPWS used typical detailing for these walls that included the use of eccentric hold-downs attached to the inside face of the shear wall end posts. These walls defined the empirical lower bounds for shear wall strength and the "benchmark" performance database of ASTM D7989 that is used to judge seismic equivalency. The objective of this investigation was to evaluate whether small changes in end post configuration detailing could be used to improve the performance of the "benchmark" wall configuration. The findings in this study resulted in the 2021 SDPWS consensus standard imposing an 8% strength penalty for conventional wood shear walls with 10d common nails using traditional hold-downs on the inside face of end posts. It is important to note that other sheathing nail sizes with hold-downs on the inside face of the posts, and shear wall designs with threaded hold-down rods do not require any strength reduction.	Phil	Line	American Wood Council
7H	TESP - Practitioner	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus	EXPERIMENTAL TESTING OF HIGH-CAPACITY WOOD-FRAME WOOD STRUCTURAL PANEL SHEAR WALLS	In the United States, the 2021 ANSI/AWC Special Design Provisions for Wind and Seismic (SDPWS) standard serves as a primary code resource for the design of wood structural panel (WSP) shear walls. At present, 12697 N/m (870 plf) is the highest SDPWS allowable stress design (ASD) in-plane unit shear capacity for a one-sided sheathed WSP shear wall in a seismic design application. The objective of this test program was to further explore the potential to develop a one-sided shear wall system that, similar to a high-capacity diaphragm, uses multiple rows of nails at panel edges to increase capacity. The shear wall racking tests were conducted in accordance with ASTM E2126. The tested walls were then evaluated based on the ASTM D7989 standard that is used to judge seismic equivalency to WSP shear walls in SDPWS. Tests of high-capacity wood-frame WSP shear walls with two rows of 8d common nails at panel edges demonstrated failure modes associated with typical wood-frame WSP shear walls with single row of fasteners at panel edges. The seismic equivalency parameters calculated from the cyclic tests of these walls also met the equivalency criteria outlined in ASTM D7989.	Phil	Line	American Wood Council
7H	TESP - Practitioner	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus	A DESIGN MODEL FOR CROSS-LAMINATED TIMBER SHEAR WALLS WITH SINGLE CUT-OUT DOOR OPENINGS	This study builds on an existing analytical model previously proposed in literature to develop new mathematical equations for the design and verification of monolithic cross-laminated timber (CLT) shear walls with openings. These equations address the limitations of current methodologies by providing more accurate predictions of lateral stiffness and elastic displacements in shear walls under lateral loads. The study focuses on the behavior of lintels and wall base connections, assuming elastic behavior and structural continuity. The proposed equations offer a novel approach to ensuring the structural reliability of monolithic CLT shear walls with openings, validated through experimental and numerical methods.	Ghasan	Doudak	University of Ottawa, Faculty of Civil Engineering

SESSION 7

Tuesday 24th June 2025
4:00pm to 5:30pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
7H	TESP - Practitioner	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus	The Challenges of Designing a High-Capacity Ductile CLT Shear Wall System for a 6-Storey CLT Building	To design mass timber buildings to moderate or high seismic demands, strong, stiff, and ductile lateral load-resisting systems are required. One such system recently developed and tested at the University of Canterbury is the mixed-angle screw hold-down connection for Cross Laminated Timber (CLT) shear walls. Through the use of large European self-tapping screws installed at mixed angles with respect to the grain, the strong and stiff performance of screws installed at 45° can be combined with the ductility and displacement capacity of screws installed at 90° to the grain, providing an overall strong, stiff, and ductile connection. This paper explores the design of mixed-angle screw hold-down connections for CLT shear walls in a 6-storey (Concrete podium, 5-storey CLT wall) structure designed for a high seismic hazard. Key challenges from the design of this building and their associated learnings are presented. Challenges that had to be overcome included design strength prediction, overstrength prediction, stiffness prediction, and possible requirements for displacement amplification due to pinched hysteretic behaviour. These challenges are discussed in detail with reference to research findings, and some future outlooks for design are given.	Thomas	Wright	ENGCO
7H	TESP - Practitioner	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus	LIMITATIONS AND ERRORS IN THE TORSION AND SHEAR FIELD TEST SETUP SPECIFIED IN THE EN 408:2010+A1:2012 FOR TIMBER BEAMS	The current torsion and shear field test method specified in BS EN 408:2010+A1:2012 [1] for timber beams has evident limitations and minor errors that may lead to significant inaccuracies when measuring sample rotation. The maximum gauge distance specified in the current test standard is still too close to the clamps at both ends. The end effect significantly impacts the rotation of the cross-section where the gauges are located. This paper first presents a study on the minimum gauge distance required to avoid the end effect. Secondly, it reviews various techniques for measuring sample rotation and proposes two potential new approaches for measuring the rotation of samples. Additionally, the shear field test method contains a critical error that could result in substantial miscalculations of the shear modulus.	Hexin	Zhang	Edinburgh Napier university

SESSION 8

Wednesday 25th June 2025
11:00am to 1:00pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
8A	TESP - Engineering	Session Chair: PROFESSOR ERIK SERRANO / LUND UNIVERSITY					
8A	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	AN EXPERIMENTAL INVESTIGATION INTO THE STRUCTURAL PERFORMANCE OF TIMBER I-JOISTS WITH CIRCULAR WEB OPENINGS	This study investigates the structural behaviour of I-joists with circular openings of various sizes at different locations along the length of joist. The concepts of high shear zone, combined shear bending zone and pure bending zone were introduced in this research. A four-point bending test was conducted to determine the load-carrying capacity, stiffness and failure modes of I-joists with and without openings. It was found that openings in high shear and combined shear bending zones had a similar impact on the capacity of I-joists with larger openings leading to higher reductions. Most of the joists with an opening located in the high shear and combined shear bending zone exhibited brittle shear failure. In contrast, the presence of openings in the pure bending zone has no effect on the load-carrying capacity of joists and resulted in the failure modes similar to I-joist with no holes.	Sini	Lu	Edinburgh Napier University
8A	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	AN EXPERIMENTAL STUDY ON DIFFERENT SHEAR RESISTANCE MECHANISMS OF JAPANESE CLT CONCRETE COMPOSITE SLABS	Japan has fewer examples of TCC design than other countries, and a general design method has not yet been established. In this paper, to compare the structural performance of different TCC slab shear keys and to obtain basic data on the structural performance when incorporated into floor slabs. Elemental and full-scale bending tests were conducted with two types of shear keys, a notch type and a inclined screw type. While the notch type has greater stiffness and bearing capacity, the results was not so large when compared as TCC slabs.	yuka	konishi	Ove Arup & Partners Japan Ltd
8A	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	DESIGN AND STRUCTURAL PERFORMANCE OF WOOD FRAMING WITH “FLEXIBLE WOOD”	Aiming to expand new possibilities for the use of wood, this study focused on " Flexible Wood " a composite material made by laminating and bonding wood veneers with a adhesive sheet. This wood material is freely deformable, allowing curved surfaces and curvilinear designs to be constructed without advanced processing or technology. However, its use has been limited to furniture and other applications due to its characteristic of deforming easily when bending stress is applied. Therefore, in order to expand the use of this material, this study devised a method of using it as a face material that serves as a resistance element to in-plane shear forces where bending stress does not act, and attempted to use it as a structural member. A wooden pergola was designed and prototyped by attaching strips of "Flexible Wood " to a laminated wood frame in such a way as to weave them into the front and back of the frame using curves. The full-scale wooden pergola was subjected to experiments to confirm its fracture performances and to compare its strength and stiffness values with those calculated by the assumed resistance mechanism.	Eito	Atsuzawa	TAISEI Corporation
8A	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	Effect of design configuration on global stiffness of volumetric timber modules	Volumetric modules are promising in terms of their potential for reusability. Currently, the industry is confronted with the challenge of ensuring the structural capability of volumetric modules while simultaneously fulfilling the criteria for creating large openings for façades and windows. Therefore, this study examines the impact of design configurations on the structural performance of volumetric timber modules to enhance their application in buildings, utilising practical data from the Danish building industry. Numerical analyses of the volumetric product are carried out using a high-fidelity model including the fasteners to determine the response to different external loads. The original model is subjected to various design configurations to investigate their impact on the overall stiffness of the volumetric module.	Kayee Jiayi	Li	Aarhus University
8A	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	Development of Simple Seismic Reinforcement Method of Traditional Wooden -Application of Lattice Bearing Wall-	In Japan, many buildings prior to the revision of seismic standards lack seismic performance. In order to promote seismic retrofitting, a simple and cost-effective seismic retrofitting method was developed. The test specimens are compared with the existing specimens and the newly constructed and reinforced specimens to evaluate the strength of the specimens. Based on the test results, we can select method based on the required strength and cost.	TANI	TATSUYA	Osaka Metropolitan University
8A	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	Use of Trembling Aspen Lumber to Produce Glued-laminated Timber Beams: Bending Performance	Trembling aspen (Populus tremuloides) is known for its rapid growth and widespread distribution in North America. Given the significant standing volume of trembling aspen in Alberta, Canada, this research was aimed at exploring the feasibility of using trembling aspen lumber to produce high-value engineered wood products - Glued-laminated Timber Beam.	Meng	Gong	Faculty of Forestry & Environmental Management, University of New Brunswick
8A	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	Large-scale in-plane testing of timber-frame diaphragms and comparison of performance with design models	Large-scale diaphragm tests representative of current Australian practice for timber-framed buildings are undertaken to determine the in-plane ultimate capacity, stiffness, and failure mechanism. Tests are conducted for two diaphragm specimens with a span of 6.3 m and a width of 2.4 m. The specimens are constructed using particleboards fastened to timber trusses with metal webs using screws. The observed failure mode included splitting of the top chord of open-web joists, shear failure of screws, tearing-out failure of particleboard near edge screws, and flexural failure of the particleboard. The shear capacity and displacement of the diaphragm specimens are compared with existing design models, including principles of mechanics using the sheathing-to-framing connection shear strength. The mean strength prediction using the connection shear strength values over predicts the ultimate load recorded in the experiments. Further, the displacement predicted by the design equation developed for blocked diaphragms needs to be amplified to match the displacements observed in the experiment.	Anita	Amirsardari	Swinburne University of Technology
8A	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	EFFECT OF CONNECTION GEOMETRY ON THE JOINT CAPACITY OF AN LVL LOADED PERPENDICULAR TO THE GRAIN	The geometry of timber connections significantly affects the joint capacity of timber loaded perpendicular to the grain, which is essential for the structural integrity of timber constructions. However, Australian standards primarily focus on bolt properties and spacing to determine connection strength, potentially neglecting the influence of connection geometry. This study investigated how variations in connection width and height impact the tensile capacity of bolted timber connections while adhering to Australian standard bolt spacing. Additionally, it examined the effect on tensile capacity when bolt spacing was reduced below the standard. The study compared design values of connection strength according to Australian standards with experimental results to assess load limits under different bolt column and row spacing configurations and bolt diameters. Alongside the standard bolt spacing for perpendicular-to-grain tensile strength, two alternative bolt spacing configurations were tested in this experimental study of LVL timber bolted connections. This study's findings highlighted the impact of using reduced bolt spacing, deviating from Australian standards, on the tensile capacity of bolted timber connections. Furthermore, it revealed limitations in the standard's ability to predict joint capacity in such cases accurately. An image-based analysis was also used to explore the strain field within the bolted timber connection, providing insights into connection behavior and failure patterns.	SAFAT	AL-DEEN	The University of New South Wales
8B	TESP - Engineering Connections	Session Chair: PROFESSOR ALEXANDER SALENIKOVICH / UNIVERSITE LAVAL					

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
8B	TESP - Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	Rotional performance of pre-engineered slotted beam-hanger connection	An innovative pre-engineered slotted beam-hanger (PSBH) connection, mainly used for mass timber buildings, was proposed. This paper presents an experimental investigation on the rotational behavior of the PSBH connections designed for glulam timber frame structures. Four full-scale post-to-beam connection specimens were tested to examine the effect of tensile screw length and stiffener shapes on the rotational behavior of the PSBH connections. Their failure modes, rotational stiffness, and moment resistance capacity were analyzed. When the length of the tensile screws increased from 155 mm to 220 mm, there was a significant enhancement in moment resistent and rotational stiffness due to a change in the failure mode. However, the ultimate moment and rotational stiffness of the rectangular-stiffened connection are slightly higher than those of the trapezoid-stiffened connection. Comparing numerical and experimental results demonstrated that the numerical model could accurately predict the failure modes of the connection.	Xiaoyue	Zhang	School of Civil Engineering, Chongqing University
8B	TESP - Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	STEEL PLATE CONNECTIONS FOR TWO-WAY SPANNING CLT - CONCRETE COMPOSITE FLOORS	In this study, steel plate connections for two-way spanning cross-laminated timber (CLT)-concrete composite floors (CLTCC) were investigated. Initially, the impact of shear connections between the CLT panel and the concrete layer in both strength directions, as well as the moment connection between CLT panels in the minor strength direction, on the structural performance of point-supported CLTCC floors was studied numerically. Subsequently, shear tests were conducted for the connection properties of the proposed steel plate connections in both major and minor directions. Additionally, four-point bending tests were performed on both CLT and CLTCC beams in the minor strength direction, featuring a moment joint at mid-span. The numerical results indicated that the two-way action of the CLTCC floors was predominantly influenced by the connection shear and rotational stiffness along the minor strength axis. Experimental results showed that the T-bar steel plate with self-tapping screws provided twice the shear connection stiffness compared to the steel kerf plate in the minor strength direction. The bending performance of CLT beams in the minor strength direction with a bottom laminated veneer lumber (LVL) spline and a top steel T-bar plate approached that of continuous CLT. CLTCC beams with the steel T-bar plate serving as both the shear and moment connections exhibited approximately three times the moment capacity and nine times the bending stiffness compared to bare CLT beams.	Jianhui	Zhou	University of Northern British Columbia
8B	TESP - Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	STRUCTURAL PERFORMANCE OF MENGKULANG LAMINATED VENEER LUMBER (LVL) TRUSS JOINTS USING PUNCHED-METAL-PLATE CONNECTIONS: EXPERIMENTAL AND NUMERICAL STUDY.	This study investigated the structural performance of Mengkulang laminated veneer lumber (LVL) truss joints with punched-metal-plate connections, focusing on load-carrying capacity and joint behaviour. The inherent mechanical properties of Mengkulang LVL as a stand alone material such as shear, tensile, and compressive strengths were assessed in accordance with BS EN 408 and ASTM D143. The values were determined based on EN 384 and subsequently used for the numerical analysis of the joints. The joints were evaluated for their load carrying capacity and deformation behaviour under forces applied both parallel and perpendicular to the timber grain according to BS EN 1075 and EN 26891. Results showed a non-linear load-slip relationship, with failures including plate tearing, buckling, and teeth withdrawal due to wood grain failure. Compression joints exhibited ductile behaviour, whereas tension joints displayed brittleness. Numerical validation of the three-dimensional geometry models using ANSYS Workbench showed good agreement with experimental results, with failure evaluations confirming the characteristics of the joints. The validated models facilitated a parametric study on plate orientation at the heel joint. Future research should enhance numerical analysis approaches and consider additional parameters.	Nor Azizah	Muhammad	Public Works Department Malaysia
8B	TESP - Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	ENHANCING THE SEISMIC PERFORMANCE OF HOLD-DOWN TIMBER TO CONCRETE CONNECTIONS VIA DUCTILE ANCHORS	Providing ductility in mass timber building connections is currently the best strategy to build seismic resistant timber buildings able to dissipate seismic energy. Borrowing from the steel-baseplate arena, ductile anchor connections are proposed in this paper to enhance mass-timber buildings' seismic performance by providing a reliable ductile mechanism at the wall-concrete footing location. Ductile-anchor connections are shown to sustain large deformation by energy absorption and hysteretic behavior, without significant loss of strength and capacity, hence protecting the connection from premature and unwanted brittle failures. The experimental program described in this paper collects relevant data in support of the design of connections able to exhibit a superior ductility in response to seismic loading and extreme excitations, preserving the integrity of mass timber buildings.	Ramin	Sarange	San Diego State University
8B	TESP - Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	Brittle failure of CLT connections with inclined self-tapping screws	Cross-laminated timber (CLT) is increasingly used in construction, but its brittle nature under tension or shear poses design challenges since the crosswise layup makes CLT behave differently from solid timber or glulam. Self-tapping screws (STS) are versatile fasteners in timber construction, acting in shear when installed perpendicular to the connection interface or in withdrawal when inclined. The 2024 edition of the Canadian Standard for Engineering Design in Wood (CSA O86) includes design provisions for STS, but guidance on estimating brittle failures of STS connections in CLT remains limited. This paper presents experimental investigations assessing the performance of CLT connections with inclined STS and steel side plates. Multiple configurations, considering CLT layup, screw penetration length, and screw edge distance were tested. The results were compared to CSA O86 predictions, providing insights for accounting for the brittle failure of CLT connections with inclined STS.	Alexander	Salenikovich	Université Laval
8B	TESP - Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	Experimental investigation on the performance of novel bolted glulam beam-to-column connections under the coupling effects of tension and bending	This paper aims to enhance the resilience of structural progressive collapse resistance by optimizing the connection performance under large deformation. Two novel bolted glulam beam-to-column connections were proposed: the one with supplementary bolts and the one with supplementary hold-downs. To simulate the stress condition of large deformation during the structural progressive collapse and to validate the effectiveness of various methods, monotonic tests considering the coupling effects of tension and bending were performed on 4 groups of specimens, including the standard bolted beam-to-column connection, the self-tapping screws reinforced connection, and the two novel ones. Then, the failure modes and primary performance parameters were analyzed. The results indicate that the ductility of the self-tapping screws reinforced connection is increased by 28% compared with the standard connection. In addition, the connection with supplementary bolts exhibits a significant enhancement, boasting a 158% increase in moment capacity and a 56% increase in maximum rotational angle over the standard one. Moreover, the connection with supplementary hold-downs has reached the highest effective stiffness improvement at 71% in comparison to the standard connection.	Xuebing	Zhao	Tongji University
8B	TESP - Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	PRESS GLUED CONNECTIONS WITH STAPLES AND NAILS – AN EFFICIENT ALTERENATIVE TO CURRENT STANDARDISATION?	Current European standards do not permit the use of staples or nails for structural press glued connections. Neverthe-less, this method has the potential to offer a quick and cost effective alternative to the already established screw press bonding technique. The objective of this study was to examine the influence of the pressing pressure that can be gener-ated on a portal system through the utilisation of staples or nails, as well as the influence of manufacturing tolerances. The findings indicate that bonding this way can deliver acceptable results as long as there are no production inaccura-cies. However, the typical level of inaccuracy results in insufficient bonding.	Valentin	Räber	Bern University of Applied Sciences

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
8C	TESP - Engineering Flooring , incl Gottstein & Timber Queensland Study Tour Presentation	Session Chair: DR SARDAR MALEK / UNIVERITY OF VICTORIA					
8C	TESP - Engineering Flooring , incl Gottstein & Timber Queensland Study Tour Presentation	Timber Engineering & Structural Performance - Engineering Focus	Dynamic performance assessment of full-scale CLTand CLT-concrete composite floors	This study investigates the dynamic performance of full-scale CLT and CLT-concrete composite floors through comprehensive vibration testing, including walking and impact hammer tests. Experimental 8-meter-long flooring systems were fabricated and instrumented with a dense network of 21 accelerometers to capture vibration responses induced by walking and impact excitations. Experimental modal analysis was employed to extract dynamic properties such as natural frequencies and damping ratios, as well as to determine peak accelerations. The findings highlight the potential of CLT-concrete composite floors in modern construction to improve the vibration performance of lightweight timber floors and to meet rigorous serviceability criteria.	Ulrike	Dackermann	University of New South Wales
8C	TESP - Engineering Flooring , incl Gottstein & Timber Queensland Study Tour Presentation	Timber Engineering & Structural Performance - Engineering Focus	Vibration performance of a Beamless Cross Laminated Timber-Concrete Composite Slab Band Floor System in 10-storey Limberlost Place	Solid cross-laminated timber (CLT) panels are not suitable for long-span floors due to their relatively low density and bending stiffness, which lead to issues with deflection and vibration. Timber-concrete composite (TCC) floor systems can offer enhanced strength and stiffness, thereby improving serviceability. Fast + Epp developed an innovative large-span beamless structural system comprising CLT-concrete composite slab bands with perpendicular CLT infill panels. This study examines the vibrational properties of the proposed beamless floor system through both laboratory and field tests. Dynamic characteristics were evaluated using experimental modal analysis and ambient vibration tests. Additionally, subjective evaluations and acceleration responses to human walking were collected. Preliminary results indicate that the types of shear connections have minimal impact on the natural frequencies of the slab bands. While the standalone slab bands exhibited unacceptable vibration performance in the lab tests, the complete composite floor system demonstrated acceptable performance in field tests. These experimental findings provide practical insights for the vibration design of such floor structures. More detailed data and discussion will be presented in the full paper.	Chenyue	Guo	University of Alberta; University of Northern British Columbia
8C	TESP - Engineering Flooring , incl Gottstein & Timber Queensland Study Tour Presentation	Timber Engineering & Structural Performance - Engineering Focus	NUMERICAL MODELING OF ROCKING CLT SHEAR WALL CONSIDERING THE WALL-TO-FLOOR INTERACTIONS	The rocking behavior of cross-laminated timber (CLT) shear walls is a crucial kinematic motion that significantly contributes to efficient energy dissipation in CLT buildings. During rocking behavior, the shear wall inevitably interacts with adjacent members; and, consequently, wall-to-floor interactions can cause localized damage on floors, alter force demands on connectors, and generate unexpected forces in secondary structural members. However, many studies on the rocking CLT shear walls have treated them as independent components of the lateral force-resisting system. To achieve a realistic structural simulation of the rocking wall, this work first develops the beam-spring model incorporating the inelastic properties of floors. The beam-spring representation is then integrated into a 3D model, which is used to compare structural response based on varying floor properties to assess wall-to-floor interactions. Simulation results are validated against the test data. It is confirmed that the deformability of the CLT floor affects the lateral response of the rocking wall, primarily due to shifted demands of deformation and energy dissipation among different connectors.	Chaoyue	Zhang	The Hong Kong University of Science and Technology
8C	TESP - Engineering Flooring , incl Gottstein & Timber Queensland Study Tour Presentation	Timber Engineering & Structural Performance - Engineering Focus	AN INVESTIGATION INTO THE INFLUENCE OF TRANSVERSE BRIDGING SPINES ON THE VIBRATIONAL PERFORMANCE OF TIMBER FLOORS	Adding bridging elements between joists that form transverse bridging spines is an effective method of minimising excessive vibration levels in wood floors associated with human discomfort. The effectiveness of a bridging spine depends upon its flexural rigidity which accounts for the bridging element rigidity and its connection mechanism to the joist. This paper presents an experimental study that was conducted to quantify a broad range of flexural rigidities of bridging spines. A ribbed-plate model which requires the spine flexural rigidity was used to predict static deflection and fundamental natural frequency of a timber floor by taking into account the measured flexural rigidities. Results show that an increase in briding flexural rigidity to some extent can reduce up to 40% of static deflection. It was found that all types of transverse bridging spines have a small influence on fundamental natural frequency.	Aamir	Khokhar	Edinburgh Napier University, United Kingdom
8C	TESP - Engineering Flooring , incl Gottstein & Timber Queensland Study Tour Presentation	Timber Engineering & Structural Performance - Engineering Focus	PUNCHING SHEAR PERFORMANCE OF POINT SUPPORTED CLT	Cross-laminated timber (CLT) is a suitable material for point-supported floors where panels are directly supported by columns. Punching shear capacity is a key property in the design of point-supported CLT floors. CLT punching shear is directly related to the rolling shear (RS) strength of the boards and is enhanced by concurrent compression perpendicular to grain stresses. In this research, through punching shear tests on a total of 193 full-scale panels, the effect of various parameters on the punching shear capacity of CLT floors was investigated. Furthermore, the adjustment factor of RS strength in punching shear was determined. Having a center column, support area, timber species, and the out-of-plane stiffness of the load distribution plate were the main factors affecting the punching shear capacity of the panels.	Houman	Ganjali	University of Northern British Columbia
8C	TESP - Engineering Flooring , incl Gottstein & Timber Queensland Study Tour Presentation	Timber Engineering & Structural Performance - Engineering Focus	Gottstein & Tmber Queensland Study Tour Outcomes for Vibration and Acoustic Knowledge on Mass Timber Structures and Future Research Directions.	As a result of a comprehensive study tour conducted by Mr Faircloth (funded by both the Gottstein Fellowship and Timber Queensland) current designing practices and preferences for mass timber structures have been documented. These trends across 13 countries, generated by 112 individual discussions, were evaluated against a literature review concentrated on vibration and acoustic advancements on mass timber products and structures. Join this talk to hear about these findings in more detail.	Adam	Faircloth	Queensland Department of Primary Industries
8D	TESP - Engineering - Design Challenges for Timber Buildings	Session Chair: ANDREW DUNN / TIMBER DEVELOPMENT ASSOCIATION					
8D	TESP - Engineering - Design Challenges for Timber Buildings	Timber Engineering & Structural Performance - Engineering Focus	A SURVEY ON THE DYNAMIC PROPERTIES OF MID- AND HIGH-RISE MASS TIMBER BUILDINGS	Understanding the dynamic properties of timber buildings is crucial for optimal and safe designs. However, there is no specific formula in the building codes to estimate the elastic period of timber buildings. Different vibration testing on the existing timber buildings allows researchers and engineers to form a database for developing empirical formulas for fundamental period estimation to assist future design. This study surveys the ambient and forced vibration tests on 31 buildings in both field and lab scale conducted on timber buildings with various structural systems. The measured fundamental periods and damping ratios are compared with the recommended values in the building codes. The results showed timber buildings with the same height but different structural systems do not have identical fundamental frequencies, which indicated the necessity of either deriving specific empirical formulas for timber buildings with different lateral force resisting systems (LFRS) or adding other general properties of the building, such as plan dimensions in the empirical formulas.	Samira	Mohammadyzadeh	UNBC

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
8D	TESP - Engineering - Design Challenges for Timber Buildings	Timber Engineering & Structural Performance - Engineering Focus	SEISMIC DESIGN OF TIMBER BUILDINGS IN NZ - THE NEW NZS AS 1720.1	This paper describes and reviews the new building code requirements for seismic design of timber buildings in New Zealand. The new design requirements are based on a hierarchy of seismic design, allowing the choice of varying levels of ductility, ranging from fully elastic design to nominal ductile, limited ductile, or fully ductile structures. A capacity design procedure is then used to ensure that ductility occurs in certain selected Potential Ductile Elements (PDEs), while more vulnerable elements known as Capacity Protected Elements (CPEs), are protected by overstrength calculations. The paper describes the new design process as used in New Zealand, its uniqueness as a performance based design method, and identifies significant gaps in knowledge where future research is required.	Daniel	Moroder	PTL | Structural & Fire
8D	TESP - Engineering - Design Challenges for Timber Buildings	Timber Engineering & Structural Performance - Engineering Focus	Demonstrating Lateral System Equivalence of a Novel Mass Timber Material through a FEMA P795 Methodology	A test program was designed and implemented to demonstrate equivalency between a novel veneer-based mass timber material and cross-laminated timber (CLT) shear walls. Full-scale 2.4 m by 2.4 m walls were tested reverse-cyclically using Special Design Provisions for Wind and Seismic (SDPWS) prescribed connections to characterize lateral performance. Three different materials, the novel veneer-based panel and two CLT layups with different species, and two panel aspect ratios, 2:1 and 4:1, were investigated. Additionally, the walls were tested on a steel base and loading arm to better standardize the testing approach, compared to the previous research that used CLT boundary conditions. Equivalency was determined following the FEMA P795 methodology. The walls exhibited higher strength and displacement capacity at the 4:1 aspect ratio compared to the 2:1 aspect ratio for all materials. The novel material met equivalence parameters at a 2:1 aspect ratio with the Code prescribed nail and met equivalence parameters at both aspect ratios with a shorter nail.	Ian	Morrell	Tennessee Technological University
8D	TESP - Engineering - Design Challenges for Timber Buildings	Timber Engineering & Structural Performance - Engineering Focus	FINITE ELEMENT ANALYSIS OF REPLACEABLE STEEL PERFORATED PLATE FUSES IN TIMBER BRACED FRAMES	Mass timber braced frames enhance the resilience and ductility of tall timber buildings in seismic areas. Traditional mechanical fastener systems often fail due to material variability and prediction model limitations. To address this, a novel End Brace Connection (EBC) system using perforated steel plates has been introduced as seismic fuses. This system aims to effectively dissipate seismic energy, minimize damage to timber elements, and allow for easy post-seismic replacement. This study employs finite element analysis (FEA) to explore the behavior of replaceable steel perforated end plate connections in timber braced frames. The objective is to identify the optimal failure mechanisms and perforation configurations that maximize ultimate deformation. The research builds upon previous experimental work, which demonstrated that different perforation shapes impact performance. Long oval configurations were identified as promising but required further validation through numerical simulations. Finite element models were developed using Abaqus® to replicate experimental conditions and stress-strain behaviors. The models were calibrated using tensile coupon tests and subjected to cyclic loading protocols to ensure accuracy. A mesh independence study determined the optimal mesh configuration for balance between accuracy and computational efficiency. The results showed that increasing the slot length significantly improved ultimate deformation, though it reduced energy dissipation. Conversely, increasing the number of slots enhances energy dissipation. Combining both parameters achieved 100% of the reference deformation under monotonic loading while maintaining equivalent energy dissipation. The study confirms the potential of perforated steel plates as effective seismic fuses in timber braced frames, offering a promising approach for improving structural integrity and sustainability in earthquake-prone regions.	Yahia	Ahmed	University of alberta
8D	TESP - Engineering - Design Challenges for Timber Buildings	Timber Engineering & Structural Performance - Engineering Focus	GLUED-IN WOODEN ROD AND LAMINATED DENSIFIED WOODEN ROD AS REINFORCEMENT FOR COMPRESSION PERPENDICULAR TO THE GRAIN	For the design of high-rise timber buildings, the accumulation of self-mass and the resultant permanent deformation is a critical matter, especially at the occurrence of compression perpendicular to the grain (CPG). Metal fasteners, e.g., self-tapping screws, are conventional reinforcements against CPG deformation in timber members. This study investigates the technique of utilizing glued-in wooden rods and laminated densified wooden (LDW) rods as CPG reinforcements. Test series are first planned to characterize the single-fastener behavior by applying direct loading on a single glued-in wooden or LDW rod. Thereafter, the global behavior of utilizing one single wooden or LDW rod as CPG reinforcement for glulam members is planned to be investigated. Possible associated failure modes are planned to be observed and then classified to propose analytical prediction formulas. Experiments on multiple numbers of glued-in wooden or LDW rods as CPG reinforcements are also planned, both to validate afore-derived analytical formulas and to investigate the effective numbers when applying multiple fasteners.	Yue	Wang	KTH Royal Institute of Technology
8D	TESP - Engineering - Design Challenges for Timber Buildings	Timber Engineering & Structural Performance - Engineering Focus	ANALYZING COMPLEX TIMBER DIAPHRAGMS USING AN EQUIVALENT TRUSS METHOD	This paper introduces an efficient, yet accurate analysis method that can be used to model the real stiffness of timber diaphragms in a 3D model. Known as Equivalent Truss Method (ETM), this approach employs truss elements to simulate the sheathing shear stiffness and the nail slip, beam elements to model framing members (including chords, drags, and boundary studs), and springs to represent splices. The ETM enables accurate analysis of irregular diaphragms with multiple re-entrant corners, cantilevers, out-of-plane offset in walls, and buildings with non-parallel wings. The full 3D model of the building, assembled using ETM, distributes lateral loads based on relative stiffness of diaphragms and shear walls (semi-rigid analysis), while considering torsional effects. To calibrate and validate the model, the data from previous tests on diaphragms, as well as the data from a new series of tests that was performed as part of this project, are used. The calibrated model is then used to analyze a complex building assuming rigid, semi-rigid, and flexible diaphragms and to compare the lateral load distribution to vertical elements and the building deformation under each assumption. Results show that analyzing timber buildings assuming fully flexible or rigid diaphragms can result in underestimating overall building deflection and inaccurate load distribution.	Esmaeel	Rahmani	MiTek
8D	TESP - Engineering - Design Challenges for Timber Buildings	Timber Engineering & Structural Performance - Engineering Focus	Prolam PLX Portal Frame for Residential Buildings	Prowood is a market lead innovative wood lamination company based in Motueka, New Zealand, who manufacture the Prolam range of products. The companies main products are glulam posts and beams, however it has recently developed new innovative products in response to market demand, using lower grade Radiata Pine timber. The first PLX product developed was a PLX20 Lintel that utlises SG6 timber and steel flanges expoxied together to from a lintel with an equivalent stiffness of 21GPa. Following this the company developed a PLX Portal that is customizable to fit any opening up to 6.0m which can be rapidly assembled on site. The development team went through extensive testing to develop a portal system that can be supplied via mechants, specified by architects, provides >150BUs (7.5kN) bracing capacity, minimizes thermal bridging and meets the building regulations. The PLX Portal has been tested to the BRANZ P21 methology and is a structural bracing solution within the scope of NZS3604 Residential Timber Buildings. The product has been in the New Zealand market for 1.5 years and is being specified on an every increasing number for projects.	John	Woodman	Prolam NZ

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
8E	EIC / STCE - Engineering - Design for Wind & Seismic load events / Structural Behaviour	Session Chair: PROFESSOR PIERRE QUENNEVILLE / THE UNIVERSITY OF AUCKLAND					
8E	EIC / STCE - Engineering - Design for Wind & Seismic load events / Structural Behaviour	Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	Reduction of floor vibrations using wooden and other dampers	The vibration behaviour of floors is gaining increasing importance. As the cross-sections of large span floors are often very material-intensive due to the vibration design, other methods to reduce the vibrations should be searched for. In bridge constructions, dampers often are used to reduce vibrations. Observations from our research indicate, that large span floors have similarities to footbridges. Therefore, various dampers were tested on a large floor test bench. Following initial successes, the study was extended to investigate a total of four different damper configurations. The results demonstrate that dampers can significantly reduce vibrations at resonance frequencies. However, no clear trend was observed for transient vibrations.	Johannes	Ruf	Biberach University Of Applied Sciences | Institute for Timber Design
8E	EIC / STCE - Engineering - Design for Wind & Seismic load events / Structural Behaviour	Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	ACTIVE VIBRATION CONTROL OF TIMBER FLOORS AND HUMAN-INDUCED EXCITATIONS	The significance of the vibration characteristics of floors is established across the entire construction sector. However, the low self-weight of timber, which has positive effects in many aspects, is also a reason why provisions towards sound insulation must oftentimes be undertaken. One approach to solve this challenge is to provide additional mass. This practice, in turn, impairs the dynamic behaviour in the low frequency range and highlights the relevance of related solutions for timber construction. To manipulate the dynamic response of structures is a challenge that can be solved in different ways. The variability of excitation and the randomness of human-induced vibrations with respect to time and location placed the focus of the present research on active controlled damping systems. It has already been shown that the floor vibrations can be actively influenced in a specific manner. Regarding the fundamentals of active vibration control, it is possible to act against unwanted vibrations. The objective of the research presented here is to show how different active vibration dampers can positively influence the vibration characteristics and ensure the comfort or rather serviceability of the floors. Of great interest is the performance of these active dampers with respect to the challenging human-induced excitations. Experimental investigations with cross laminated timber (CLT) panels and corresponding floor structures in combination with active vibration reduction will be presented. Benchmarked by measurements, appropriate calculation models are of practical interest. Furthermore, the comparison between experimental tests and numerical analysis is also part of this research.	Thomas	Hillberger	Universität Innsbruck (UIBK)
8E	EIC / STCE - Engineering - Design for Wind & Seismic load events / Structural Behaviour	Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	A Bayesian model updating framework for seismic damage identification in mortise and tenon connections	The performance degradation of traditional timber structures caused by man-induced or natural hazards is a pressing issue for the preservation and protection of historical timber structures . A reliable numerical model capable of identifying structural damages is key for seismic assessment of the existing traditional timber structures. However, damage identification based on Finite Element (FE) models usually requires a great deal of computation effort, and updated models can hardly be applied for performance evaluation. This paper proposes damage parameters for mortise and tenon connections, considering the seismic damage characteristics of the wooden tower. The Bayesian method is embedded into a parameterized model to automate the updating process, and the bottom-level timber frames of a Tang-style wooden pagoda in Shanghai is considered for modeling and damage identification. The predicted results agree well with actual damage results, confirming the suitability and stability of the proposed Bayesian framework in identifying damage of joints. Earthquake disaster investigations have indicated that underlying timber frames are more susceptible to damage. This paper takes the bottom-layer frame of a seven-story Tang-style timber pagoda in Shanghai as research object and builds a numerical model to identify and evaluate the damage status of mortise and tenon joints. Several timber structure models are built, which simulate seismic damage with cyclic loading. Models contain different loads and boundary conditions, and thus the robustness of the proposed approach is verified. The identified parameters fix well with the predefined severity of actual damage, and the updated model demonstrates energy dissipation capabilities similar to real damaged conditions. The proposed framework have narrowed down damage parameters, while effectively assessed the hysteresis behavior of damaged timber frame in the updated model.	Jingliang	Dong	Tongji University
8E	EIC / STCE - Engineering - Design for Wind & Seismic load events / Structural Behaviour	Education, Innovation & Challengers - Engineering Focus, Education, Innovation & Challengers - Architectural Focus, Education, Innovation & Challengers - Practitioner Focus	Wood products for climate change mitigation in the Asia-Pacific region	Global use of wood products is growing with increasing demand for housing, furniture, clothing, paper, packaging, chemicals and other products. Increasing stocks of carbon in wood products can reduce CO2 emissions and mitigate climate change. These climate mitigation benefits of wood products depend on wood being produced in sustainably managed forests in which carbon stocks are maintained. Emission reduction can be achieved by optimizing harvest to increase wood supply while maintaining carbon stocks and providing ecosystem services, more efficiently processing and using wood; extending wood product lifetimes, including through recycling and reuse and substituting wood for energy intensive materials. The Seoul Forest Declaration at the 2022 World Forestry Congress called for the full potential of legal, sustainably produced wood to support transformation of the building sector, to provide renewable energy and to supply innovative new materials. At the Congress, a Ministerial Forum called for a significant increase in use of sustainable wood-based solutions within Nationally Determined Contributions (NDCs) under the Paris Agreement. Focussed on the Asia-Pacific region, this paper provides considerations in on factors to consider in including harvested wood products in NDCs and other climate policies.	Rodney	Keenan	Food and Agriculture Organization of the United Nations
8E	EIC / STCE - Engineering - Design for Wind & Seismic load events / Structural Behaviour	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	EXPLORING CORRELATIONS BETWEEN NON-DESTRUCTIVE AND DESTRUCTIVE TESTS FOR THE MECHANICAL CHARACTERIZATION OF EXISTING TIMBER STRUCTURES	The paper focuses on the mechanical characterization and assessment of the state of preservation of existing timber structures. Non-destructive tests (NDT) have great potential in estimating the mechanical properties of wood through in situ investigations, offering an alternative to destructive laboratory tests (DT). However, their effectiveness depends on the presence of reliable correlations between the NDT parameters and the physical and mechanical properties of wood estimated through DT. In this study, a statistical analysis of data obtained from NDT and DT on a sample of ancient timber members in structural dimension from South Italy is presented and the corresponding correlations are showed. The paper includes a brief description of the sample, a focus on the statistical methodology and the results. It also offers a critical analysis of the correlation laws, highlighting those most reliable for in situ investigation.	Beatrice	Faggiano	University of Naples Federico II

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
8E	EIC / STCE - Engineering - Design for Wind & Seismic load events / Structural Behaviour	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	The effect of heating time on the mechanical properties of wooden structural members after heating and cooling for continuous use after fire	In this study, the effects of heating time on mechanical properties of Japanese cedar after heating-cooling were clarified for the continuous use of medium-large scale wooden buildings after fire. The authors clarified the effects of heating time on modulus of elasticity (MOE), modulus of rupture (MOR) and equilibrium moisture content (EMC) in the air-dried condition after heating-cooling. The effects of heating time on MOE and MOR were large, at 210°C for 30 minutes and 8 hours MOE was 0.95, 0.85 and MOR was 0.92, 0.52, when the value of 60°C was set to 1.00. The effect of heating time on EMC was also large, at 210°C for 30 minutes and 8 hours EMC was 9.16%, 7.34%. The effect of heating time on mechanical properties in the air-dried condition has been clarified, so the effects of heating time on mechanical properties in the oven-dried condition after heating-cooling are clarified. Furthermore, the full paper will clarify the effects of heating time and moisture content on mechanical properties after heating and cooling by comparing mechanical properties as a parameter of heating time in air-dried and oven-dried conditions. Ultimately, the effects of heating time, heating temperature and moisture content on mechanical properties of wood will be clarified to contribute to the verification method for continuous use after fire.	Souichirou	Yamashita	Waseda University
8E	EIC / STCE - Engineering - Design for Wind & Seismic load events / Structural Behaviour	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Mechanical properties of recycled vs new high-density Australian hardwoods	Native Australian hardwoods are among the densest, strongest, and most durable timber species in the world. These exceptional properties, as well as their relatively scarce availability as new sawn timber, means that they are often sourced as high-value recycled timbers when used in contemporary construction. However, the structural potential of this material is limited by the relatively scarce available data on their mechanical properties. Preliminary testing on this topic indicates that re-processing recycled timber increases its mechanical properties closer to that of virgin timber, and that current grading limitations on Australia's recycled hardwoods can be relaxed.	Duncan	Hossy	University of Queensland
8F	MPD - Engineering - Structural Behaviour	Session Chair: PROFESSOR KEITH CREWS / THE UNIVERSITY OF QUEENSLAND					
8F	MPD - Engineering - Structural Behaviour	Material Performance & Durability - Engineering Focus	REAL-LIFE PERFORMANCE OF SHAPE-OPTIMIZED TIMBER BEAMS	The creation of sustainable living spaces drives the utilisation of mass timber products like GLT and CLT across the globe. They not only sequester significant amounts of carbon but also effectively complement fossil-based building materials in mid- to high-rise buildings. However, they also require a significant amount of raw material. In order to improve their resource efficiency, the optimisation of the shape in order to account for the actual stress distribution within the building member is a promising approach to get more out of the natural resource wood. The presented investigation shows the real-life performance of three-dimensionally optimized GLT beams under four-point bending. Two shape optimisations were conducted and a total of 34 samples (17 reference and 17 optimised beams) where tested until failure. The maximum force, deflection and deformation was recorded and compared with the reference cross-section. The results showed that real-life material savings of about 30% can be achieved without any loss of the load-carrying capacity or the deflection limits of GLT beams.	Paul	Mayencourt	BOKU University, UC Berkeley
8F	MPD - Engineering - Structural Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	IMPROVING STRUCTURAL ROUNDWOOD CLASSIFICATION BY DIGITAL 3D-MEASUREMENT	The paper addresses the use of small-diameter oak logs as a sustainable construction material. Knowledge of the mechanical properties is essential for structural applications. Therefore, the modulus of rupture has been investigated to provide one part of the missing knowledge to the construction industry. In the first step, the raw material was characterized by a quality assessment. Half of the logs were partially sawn for an easier use in construction. Subsequently, the geometries of the logs were measured using 3D laser triangulation technology, followed by destructive bending tests. A program developed in the Python programming language calculated the moment of inertia from these geometries. The results of the calculated modulus of rupture using the moment of inertia derived from the measured geometries have been compared with those received from calculation rules given in European normative testing standards. The different calculation results scatter less when the moment of inertia is derived by 3D measurement of the geometries. The influence of the sawing process aligns with similar tests on softwood logs. This knowledge will contribute to a more efficient use of round hardwoods in construction.	Maximilian L.	Müller	Mainz University of App Sc, Holzbauforschung Mainz, Germany
8F	MPD - Engineering - Structural Behaviour	Timber Engineering & Structural Performance - Engineering Focus	FATIGUE OF TIMBER CONNECTIONS: A COMPREHENSIVE REVIEW OF FAILURE MECHANISMS AND DESIGN LIMITATIONS	Fatigue is a critical factor affecting the long-term structural integrity of buildings, particularly in load-bearing components subjected to frequent cyclic loading. As the use of engineered timber expands in high-rise structures, bridges, and other infrastructure, understanding fatigue performance is crucial for ensuring structural reliability and safety. Despite its significance, fatigue remains an under-investigated issue in timber construction, with no standardized design guidelines available. Timber connections play crucial roles in overall fatigue performance, and the fatigue behavior of which is highly influenced by timber's anisotropic structure, natural defects, moisture variations, and creep effects, contributing to complex damage accumulation. This paper presents a comprehensive review of fatigue mechanisms in timber structures, focusing on fatigue strength and fatigue-induced damage mechanisms of different kinds of timber connections, highlighting gaps in fatigue performance for timber structures. The findings of this review help bridge the knowledge gap, promoting the necessity of developing of fatigue-resistant design guidelines for improved long-term performance of timber structures.	Zhengyao	Li	Chalmers University of Technology
8F	MPD - Engineering - Structural Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	TORSION OF REINFORCED GLUE LAMINATED TIMBER BEAM	The construction industry urgently needs to reduce greenhouse gas emissions by promoting the more efficient use of carbon and energy-intensive construction materials like steel and concrete in conjunction with materials such as sustainably sourced timber with significantly lower carbon and energy footprint than conventional construction materials. Despite extensive research on timber composite systems (i.e., timber-concrete, steel-timber, and timber-timber), the effect of torsional loading on timber composite sections is unexplored. Most of the previous studies on timber composites have focused on bending moment and shear force (predominantly plane stress state). There is a big gap in understanding the structural behaviour of composite timber beams subjected to loadings that involve torsion. This study investigated the behaviour of a Glue Laminated Timber (GLT) beam with threaded bar reinforcement and reinforced concrete (RC) blocks at the ends under torsional loading. The RC blocks represent fixed supports (torsional restraints) and are only connected with the GLT beams with threaded bars. From this test, we explored how the torsion is transferred from the GLT beams to fixed-end supports. Also, finite element modelling (FEM) of the specimen was performed using ABAQUS and the results from the analysis showed that the maximum shear stress on the GLT beam corresponding to 50 mm displacement was 1.83 MPa without the GLT beam failing.	Rumia	Tasmim	UNSW

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
8F	MPD - Engineering - Structural Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	DEVELOPMENT OF UHPC NODES FOR TIMBER STRUCTURES	The use of mass timber structures is becoming more commonplace as sustainable systems. During fire incidents, however, the conventionally used metallic connectors could be the weakest link. To overcome this, innovative precast ultra-high-performance concrete (UHPC) nodes are introduced. This paper introduces the concept and the details of fabrication, testing and experimental results of specimens tested at Fast + Epp's Concept Lab in Vancouver. A finite-element model (FEM) using ABAQUS, which was validated against tests, was used to perform a parametric study. This was followed by additional experiments to evaluate the use of deformed rebars in the proposed nodes. The initial results showed a high potential, with an increase in capacity up to 243% with the addition of rebars. This study also proposed analytical models to estimate the load capacity of the UHPC nodes.	Md	Shahnewaz	Fast + Epp Structural Engineers Inc.
8F	MPD - Engineering - Structural Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	EFFECT OF THICKNESS OF ADHESIVE ON SHEAR PROPERTIES OF WOOD-STEEL JOINT	To contribute to achieving carbon neutrality 2050 by increasing the use of harvested wood products, the Korean Forest Service is trying to expand public wood buildings. Since public wood buildings often require large spans, it is important to ensure the rigidity of the structural materials, and various studies are being conducted in Korea. One of them is considering wood-steel joints using adhesives, and this paper contains the results of a study to establish the basic shear properties of wood-steel joints composed of epoxy. To investigate the influence of the thickness of the adhesive layer on the shear property of wood-steel joints, pull-out tests were performed on joints made with four different adhesive layer thicknesses. The results showed that the highest shear performance was achieved when the adhesive layer thickness was 1.5 mm, with shear strength and shear stiffness of 23.0 kN and 248.2 kN/mm, respectively. Further research is being conducted to calculate the shear modulus of wood and adhesive by using digital image correlation, and to predict the shear modulus of wood-steel joints.	Chul-Ki	Kim	National Institute of Forest Science
8G	STCE - Engineering / Architecture - Advancing the Circular Economy	Session Chair: DR YUTAKA GOTO / CHALMERS UNIVERSITY OF TECHNOLOGY					
8G	STCE - Engineering / Architecture - Advancing the Circular Economy	Sustainability and Timber in a Circular Economy - Engineering Focus	REUSE OF WOOD IN STRUCTURAL PRODUCTS – A GAIN?	There is increasing interest in the reuse and recycling of wood in construction, but still many important unsolved questions about how it should be done safely and economically. Some important research projects, carried out in recent years, have addressed some of these questions, and the first conclusions have appeared. One major challenge of this research is the variability of the resource, and the difficulty of obtaining representative sampling. It is even more important than it is for new timber, to be able to meaningfully compare results across projects and draw insights from combined analysis. This paper summarises results about performance of reuse and recycling of wood in timber products, focusing on advantages and limitations in order to promote cascading processes in the timber industry.	DANIEL	FERNANDEZ LLANA	Timber Construction Research Group - Universidad Politécnica de Madrid (GICM - UPM), Spain
8G	STCE - Engineering / Architecture - Advancing the Circular Economy	Sustainability and Timber in a Circular Economy - Engineering Focus	Recovered Timber Grading System	There is a big amount of timber to potentially recover from construction and demolition sector that could be suitable for reusing or recycling as structural material. Recovered timber should be properly graded before reuse it and the current standards for new timber are not fitting well for recovered timber. Recently, several research projects tested recovered timber for grading purposes. Regarding mechanical properties, a combination of non destructive testing, mainly based on longitudinal vibration, and some visual parameters (knots and slope of grain) was shown as a promising method to estimate them. Furthermore, there are other reusability aspects that should be taken into account (length, cross-section, warp, pregrading, metals, hazardous substances, degradation due to insects, etc.). Most of the research studies were performed over a limited number of specimens due to the difficulties to recover a big batch of timber from the same structure. There is new European project called TiReX dealing with an extensive recovered timber testing campaign using timber from several locations in Europe.	DANIEL	FERNANDEZ LLANA	Universidad Politécnica de Madrid (UPM), Spain
8G	STCE - Engineering / Architecture - Advancing the Circular Economy	Sustainability and Timber in a Circular Economy - Engineering Focus, Sustainability and Timber in a Circular Economy - Architectural Focus, Sustainability and Timber in a Circular Economy - Practitioner	CAN THE SIRKTRE CONSORTIUM FACILITATE FOR 8% OF THE NORWEGIAN PARIS CLIMATE TARGETS WITH THEIR CIRCULAR SOLUTIONS?	The Norwegian SirkTRE project was initiated to accelerate the circular economy transition in the Norwegian timber construction and beyond. The project will in 2025. SirkTRE aims to enable a value cycle that adopts reuse and material recycling of post-consumer wood in Norway. The ambition, proposed in 2021, is to facilitate for ½ of today's wood waste into building products by 2030, which would result in the reduction of the Norwegian climate footprint by 8% CO_2-e. This publication explains the calculation of the expected impact and compares these with the new insights about the project impact by reflecting and collecting environmental impact data on experiences and achievements in SirkTRE.	Kristine	Nore	OMTRE AS
8G	STCE - Engineering / Architecture - Advancing the Circular Economy	Sustainability and Timber in a Circular Economy - Engineering Focus	THE REUSE POTENTIAL OF RECLAIMED LOGS AND GLULAM BEAMS FOR OPTIMISED ENGINEERED WOOD PRODUCTS	The ongoing work presented in this paper aims to optimally use reclaimed logs and glulam beams to produce new engineered wood products. The procedure includes preparing the source material, mapping the geometry and determining the strength and stiffness properties of the new boards by visual and non-destructive mechanical grading. According to a combinatorially optimised distribution, new elements will be glued to a new product. For the final products, the stiffness and strength of the member, the shear strength of the glue line, and the integrity of the bond line in fire will be determined.	Sandra	Kaljula	Tallinn University of Technology
8G	STCE - Engineering / Architecture - Advancing the Circular Economy	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	ASSESSMENT OF STRENGTH AND STIFFNESS PROPERTIES OF RECLAIMED STRUCTURAL TIMBER OF NORWAY SPRUCE	This study researches 56 reclaimed Norway spruce timber specimens (48x98 mm) using both destructive and non-destructive testing methods. It evaluates these specimens against three visual grading standards (INSTA 142, UNI 11119, NS 3691-3) and destructive tests, focusing on enhancing grading precision by locally grading specimens near the destructive test breaking point (destructive zone). Despite extensive research on aged timber grading, the study underscores the ongoing need for further refinement of these methods. The primary goal was to accurately assess old timber to prevent unnecessary demolition of structurally sound material. Knot measurements were pivotal in visual grading, with UNI 11119 noted for simplicity while other standards offered more comprehensive approaches. Among the standards evaluated, INSTA 142 provided the highest estimation of bending strength, reaching up to strength class C30. However, the visual grading strength values were still significantly lower than the actual test results. On average, the standards underestimated bending strength by 50-54%, with the Norwegian NS 3691-3 standard showing the greatest underestimation. The velocity measurements of sound wave propagation, conducted locally and across the fiber, were highly sensitive to the wood's condition (e.g., defects, damage), potentially leading to significant variations within specimens. Thus, this method can not be considered to reliably predict timber strength properties. In conclusion, it can be stated that visual strength grading standards can conservatively estimate wood into strength classes up to C24 or C30. This method is reliable and leaves room for error in favor of the assessor but may result in the structure being significantly over-dimensioned from a material optimization perspective.	Maarja	Kauniste	Tallinn University of Technology

SESSION 8
Wednesday 25th June 2025
11:00am to 1:00pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
8G	STCE - Engineering / Architecture - Advancing the Circular Economy	Sustainability and Timber in a Circular Economy - Architectural Focus	A Digital Framework for Robotic Processing of Reclaimed Timber	Reusing timber elements in construction is a promising path toward extending its lifecycle and easing the pressure on forest resources. Direct use of elements from disassembled timber buildings in new construction offers the path of least energy expenditure. However, such direct use of reclaimed timber elements presents challenges due to material degradation, inconsistent changes in form due to environmental exposure, and existing cutouts for joints or other features. While the automated production and processing of timber elements is a mature field, it generally relies on material consistency and standardization of dimensions and properties. Therefore, this research prototypes a digital framework that leverages 3d laser scanning and robotic fabrication to detect geometric variations, cutouts, and material inconsistencies in reclaimed timber elements and account for them in the design process of new timber buildings. The method identifies existing joint cutouts and features such as cracks and wane and incorporates them into a digital mapping of the available resources onto the digital design model. Further processing is thus concentrated only on necessary areas, and existing joints are machined into new connection details as much as possible. The resultant framework demonstrates an adaptive and surgical approach to processing reclaimed timber elements, mitigating the challenges of their reuse and increasing the number of elements that can be included in new construction.	You-Wei	Yen	Royal Danish Academy
8G	STCE - Engineering / Architecture - Advancing the Circular Economy	Sustainability and Timber in a Circular Economy - Engineering Focus	LIFE CYCLE CARBON FOOTPRINT ANALYSIS OF CROSS-LAMINATED TIMBER (CLT) MULTI-STOREY BUILDING: IMPACT OF MATERIAL OPTIMISATION AND SUBSTITUTION STRATEGIES	Cross-laminated timber (CLT) is increasingly proposed as a low-carbon alternative to steel or concrete in mid-rise multi-storey structures. In this study, the embodied carbon footprint of a CLT multi-storey building is analysed in a life cycle perspective, and strategies to optimise the carbon footprint are explored, based on material optimisation and substitution. The analysis show that the production stage accounts for 72% of the life cycle embodied carbon footprint, and the effective post-use management of the materials arising from the end-of-life stage can give a significant climate benefit. A reduction of up to 5.5% of the life cycle carbon footprint can be achieved when employing the material optimisation and substitution strategies. This, together with effective post-use management of the building materials results in a reduction of up to 19% of the life cycle carbon footprint of the studied CLT building. Overall, this study shows that the life cycle embodied carbon footprint of a CLT building can be further reduced through material-related strategies.	Carl	Larsson	Linnaeus University
8G	STCE - Engineering / Architecture - Advancing the Circular Economy	Sustainability and Timber in a Circular Economy - Architectural Focus	FIRST BUILDING - SETTING A NEW BENCHMARK	As the inaugural building of Bradfield City Centre, the First Building, Advanced Manufacturing Readiness Facility (AMRF) is more than a high-performance facility. It is a prototype for circular, future-focused urban development. At its core, the project rethinks the life cycle of buildings, embedding circular economy principles through a design that prioritises adaptability, reuse, and material stewardship. Conceived as a modular,prefabricated timber structure, the building is designed for disassembly, with every component mechanically fixed for future relocation, reconfiguration or repurposing. This approach not only reduces construction waste and embodied carbon, but establishes a scalable framework for resilient, regenerative architecture in emerging cities. Bradfield's 'First Building' marks a defining moment in the creation of Australia's newest city in 100 years. It is a bold statement about the future of the built environment - designed with adaptability, circularity, and resilience, it sets a new benchmark for how cities can grow sustainably.	Jeff Morgan, Liz Yann Frampton	Westgarth &	Hassell Studio
8H	TESP - Engineering - Dynamic Testing & Fire Engineering	Session Chair: PROFESSOR HIROSHI ISODA / KYOTO UNIVERSITY					
8H	TESP - Engineering - Dynamic Testing & Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus	MAJOR FINDINGS FROM SHAKE TABLE TESTS OF A FULL-SCALE TEN STORY MASS TIMBER BUILDING	Mass timber construction is a relatively new way of utilizing wood material for modern, high-performance buildings at both large and small scales. It gives rise to the currently trending conception of wooden sky-scrapers. This presentation will provide an overview of a multi-year research project towards seismically resilient tall wood buildings. Specially, the major results and findings will be discussed from the NSF-funded NHERI TallWood Project which aims at developing a resilience-based seismic design methodology for tall wood buildings. The project team completed a series of shake table tests on a full-scale 10-story mass timber building in 2023, which represents the world's tallest full-scale building ever tested on a shake table. Due to the timing of the test program, only preliminary outcome was presented in the 2023 WCTE. This presentation will be focused on detailed results and findings based on analysis of the data obtained from the test program.	Shiling	Pei	Colorado School of Mines
8H	TESP - Engineering - Dynamic Testing & Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	NUMERICAL MODELING OF THE SEISMIC PERFORMANCE OF A 10-STORY MASS TIMBER BUILDING	Mass timber buildings with post-tensioned rocking wall lateral force-resisting systems are now possible in areas of high seismicity and offer benefits such as fast construction, architectural uniqueness, reduced carbon footprint, and the potential for design for deconstruction. Additionally, these systems provide an opportunity to improve upon the usual collapse prevention performance for buildings in large earthquakes by developing design methods that enable resilient performance while maintaining an efficient design, creating a competitive lateral force-resisting system. To better understand the behavior and performance of seismically resilient mass timber buildings with mass timber rocking wall lateral force-resisting systems, the Natural Hazards Engineering Research Infrastructure (NHERI) TallWood Project designed and tested a 10-story building specimen at the NHERI outdoor shake table (LHPOST) at the University of California, San Deigo. The walls were initially designed using a linear force-based procedure and were then validated using nonlinear response history analysis in OpenSees. This presentation will compare the nonlinear numerical analysis predictions of seismic performance with the experimental results. Results indicate that the nonlinear modeling methods provide a good prediction of seismic performance while also highlighting areas that can be improved.	Jeffrey	Berman	University of Washington
8H	TESP - Engineering - Dynamic Testing & Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	Experimental Fire Testing of STS-Retrofitted Glulam Beam Connections with Minimal Fire Protection	The main objective of this study is to investigate the enhancement of the fire behaviour of damaged glulam beam connections retrofitted using self-tapping screws (STS). In this paper, the results of fire endurance tests on two full-size glulam beam-end bolted connections with two different wood-steel-wood (WSW) configurations retrofitted using STS after being deliberately damaged through physical testing are presented. In both configurations, the metal connecting components, bolt's heads and nuts and steel plates were protected with wood plugs and strips, respectively, to provide minimal fire protection using eco-friendly material like wood. Based on the fire test results, the utilization of STS prevented any propagation of the already existing splits in the damaged connections at elevated temperatures. Ultimately, this resulted in full recovery of the fire resistance time of the STS-retrofitted connections. Accordingly, a simple yet effective STS retrofitting technique has been experimentally proven to enhance the fire resistance of damaged glulam beam-end bolted connections with the two WSW connection configurations presented in this paper.	Sam	Salem	Lakehead University

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
8H	TESP - Engineering - Dynamic Testing & Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	NUMERICAL STUDY ON FIRE PERFORMANCE OF TIMBER-CONCRETE COMPOSITE BEAMS	The timber-concrete composite is a useful example of timber hybrid structures following the recent increase in medium and large timber structures. However, there are very few studies on the mechanical behaviour of timber-concrete composite beams in fire. Therefore, the high resistance and heat-absorbing capacity of RC slabs are generally ignored in fire design. If the high fire performance of the timber-concrete composite can be taken into account, a more reasonable design can be achieved, e.g. a more extended span for the same beam cross-section. Therefore, in this paper, the influence of RC slabs on glulam beams in a fire is numerically evaluated by thermal stress analysis and the mechanism behind the enhanced fire resistance of timber-concrete composite beams is clarified using the cross-sectional stress distribution. The characteristic mechanical phenomena between slab and beam with different thermal properties are discussed using the temperature distribution in the cross-section. The issues to be considered in the design process are clarified. A four-point bending test analysis was conducted on a glulam beam exposed to ISO standard fire. Two types of cross-sectional models were used: fully timber-concrete composite beam and glulam beam. The fire resistance time of the composite beam was approximately twice that of the glulam beam under the same load. The reason is that most of the cross-section of the RC slab was still effective even at 120 min, whereas the glulam beam lost most of its strength due to charring. The RC slab carried high compressive stresses at the compression edges, which remained close to ambient temperature, even at the end of the heating. The entire cross-section of the glulam beam resisted the tensile stress. As a result, the composite beam maintained a larger distance between the centers of compressive and tensile stresses in the ultimate fire condition than the glulam beam, resulting in a higher bending resistance in the fire.	Taiga	Iwase	Chiba university
8H	TESP - Engineering - Dynamic Testing & Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	FLEXURAL PERFORMANCE OF STEEL-TIMBER-CONCRETE COMPOSITE FLOORS EXPOSED TO 2 HOURS OF STANDARD FIRE	Revitalizing long-span, high-rise wood buildings is essential to achieving a carbon-neutral 2050. In order to solve the strength deviation problem of wood, composite members of steel and concrete are being researched. In this study, we propose a steel-timber-concrete composite floor structures that can be applied to high-rise wood buildings. The proposed system utilizes a lightweight deck plate system to improve constructability, and is expected to improve bending performance and fire resistance by compounding Z-type steel and concrete joists. For this purpose, non-loaded furnace experiments and FEM heat transfer analysis were conducted to analyze the temperature rise tendency over time and the bending performance at room temperature and fire. If Z-type steel or concrete joists are composited with CLT, the bending performance at room temperature can be improved, and the latent heat effect of concrete can be expected to provide fire resistance for 1-3 hours in a standard fire.	Sung-Mo	Choi	University Of Seoul, Korea
8H	TESP - Engineering - Dynamic Testing & Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	BURNABILITY OF WOODEN LOUVERS AND ITS FACTORS: FLAME SPREAD ALONG PARALLEL WOODEN BOARDS	A series of simple flame-spreading tests along a channel was conducted to investigate fire risks of wooden vertical louvers. A pair of wood boards (either MDF or sugi) were burnt facing each other, and flame spread was observed. It was found that flame do not extinguish within the height of 6 times the source flame if blades 112mm wide are aligned approximately every 100mm or denser. Over 6kW/m2 of incident heat flux was observed even at the H (height) > 1.5Lf (flame height). This value was considerably higher compared to a flat wall configuration. It was also found that the increase in heat flux values in Lf < H region was well estimated from radiative heat flux from the opposing blade.	Ryo	Takase	Forestry and Forest Products Research Institute
8H	TESP - Engineering - Dynamic Testing & Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	Resilient Seismic Design of Tall Mass Timber Buildings: Comparison of Two Full-Scale Tri-Axial Shake Table Tests	This paper details the design, construction, testing, and focuses on a systematic comparison of full-scale shake table testing of a 10-story and subsequently a 6-story mass timber building as part of the NHERI TallWood and NHERI Converging Design research projects at the largest shake table in the United States. The primary goal of these projects was to develop and validate seismic design approaches for tall and mid-rise wood buildings in high seismic regions. Advancements in materials, components, and building systems over the past decade have enabled the construction of taller mass timber structures. However, many current mass timber buildings often rely on concrete cores or steel bracing for lateral force resistance as they are built taller and taller due to limited mass timber options approved by codes and industry preferences for traditional systems. This paper focuses on a systematic comparison of structural responses between the 10-story and 6-story buildings to examine the differences and similarities in dynamic behavior.	John	van de Lindt	Colorado State University
8I	TESP - Practitioner / Engineering	Session Chair: DR MARK DEWSBURY / UNIVERSITY OF TASMANIA					
8I	TESP - Practitioner / Engineering	Timber Engineering & Structural Performance - Engineering Focus	CREEP BAHAVIOR OF CROSS-LAMINATED TIMBER-CONCRETE COMPOSITE FLOOR SYSTEM ON FIXED END CONDITION.	Some research is being conducted on cross laminated timber-concrete composite (TCC) floor as a new technology. In this study, the long-term performance evaluation of TCC floor with fixed-end conditions under the uncontrolled condition was investigated as a creep test. In the fixed-end condition, the upper concrete part of the fixed end has tensile force, so the concrete and timber part are borne the both the tensile and the compressive force. Based on the characteristic, it was calculated flexural stiffness by using γ-method and the calculated value was higher than the experimental value. It is necessary to consider the concrete cracks, the fixed stiffness of end part and so on, to fill the gap.	kentarou	hatachi	Hiroshima University
8I	TESP - Practitioner / Engineering	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus, Education, Innovation & Challengers - Engineering Focus	Design and testing of ductile moment-resisting timber frame connections	The use of wood products in large-scale residential and commercial construction has grown significantly in recent years. However, limitations still exist, particularly in the context of moment-resisting frames, where a lack of efficient connection systems has made design challenging. This paper presents the development of a new moment-resisting beam-column connection (BCC) for large-scale timber frames. This new connection was developed using key performance targets, considering structural performance, cost, and environmental impacts. It was tested with glue-laminated timber (GLT) and laminated veneer lumber (LVL) beams and columns at three different scales. Using capacity design principles, ductile failure modes in the steel elements were achieved. A full design process is presented together with design tables to support the uptake and application of this new technology.	Kilian	Krauss	The University of British Columbia

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
8I	TESP - Practitioner / Engineering	Timber Engineering & Structural Performance - Practitioner Focus	The Advanced Manufacturing Facility First Building	The Advanced Manufacturing Research Facility (AMRF) First Building is due for completion in August 2024 in the Western Sydney Aerotropolis containing a locally sourced mass timber mezzanine floor and roof which covers the 3,500 square metre building footprint. This paper describes the engineering design of the mass timber structure, which feature a softwood cassette floor system supporting a green roof and twin timber beams in a layered grillage system spanning up to 18 metres. Through the design and delivery of this project it was found that the Australian timber manufacturing industry has matured to the point that both simple and complex mass timber structural typologies can be delivered using locally sourced timber, which may help to alleviate concerns about the supply chain of mass timber structures for future projects. It was also found that the Australian Standard AS1720.1 is not adequate for the design of large-scale mass timber buildings due to the limited methods for designing timber connections, and it is recommended that this standard is updated to be in line with the Eurocode 5 standard to reduce barriers to the design of mass timber structures in Australia.	Nicholas Matthew	Boey Burke	Northrop & Savcon
8I	TESP - Practitioner / Engineering	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus	Bonding performance of MUF and PUR adhesives for glued laminated timber	Beech wood still has a lot of untapped potential in timber construction, despite its good mechanical properties. It has a high density and strength, but at the same time is not biologically durable and is dimensionally unstable. Beech wood can be successfully bonded with typical wood adhesives, but problems often occur in delamination tests due to unfavourable shrinkage and swelling when the bonded components are exposed to moisture fluctuations or immersed in water. The aim of this study was to determine the bonding performance of melamine-urea-formaldehyde (MUF) and polyurethane (PUR) adhesives in the production of beech GLULAM and hybrid GLULAM made from beech and spruce. The experiment was divided into two sections. In the first part, beech lamellas were bonded with MUF, PUR and PUR in combination with a primer to form a GLULAM. In the second part, hybrid GLULAMs made of beech and spruce were bonded with the same adhesives. To test the adhesives, small beams with five 20 mm thick lamellas were produced. The two outer lamellas were made of beech wood, while the three inner ones were made of spruce wood. For beech GLULAM only, all adhesive bonds were found to have a much higher shear strength (about 14 MPa) than required by the EN 14080:2013 standard. All adhesive bonds in a hybrid GLULAM made of beech and spruce also met the requirements, but the shear strength was lower (about 10 MPa). Adhesive bonds between spruce and beech achieved slightly higher average strength values than adhesive bonds between spruce only. The highest shear strengths were achieved with PUR adhesives in combination with a primer, followed by MUF and PUR adhesives without primer. The results show that beech and spruce wood can be successfully bonded to form a hybrid beam using MUF and PUR adhesives. The adhesive bonds between beech and spruce wood show an effective bonding performance and fulfil the standard requirements.	Milan	Šernek	University of Ljubljana, Biotechnical Faculty
8I	TESP - Practitioner / Engineering	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus	DEVELOPMENT OF AN INTEGRATED SESMIC SIMULATION SYSTEM FOR TIMBER STRUCTURES	Timber structures are characterised by a lighter weight than other structural types, and the lateral load level for checking the ultimate behaviors is relatively low. Consequently, many shaking table tests to investigate that ultimate behaviors using full-scale wooden houses have been conducted. Since 2005, a series of shaking table tests have been conducted utilising the E-Defense shaking table and other tables capable of inducing complete structural collapse. This has resulted in the accumulation of a substantial corpus of experimental data, which can be subjected to comparative analysis with numerical simulations. The experimental data has been used to verify and improve the accuracy of numerical analysis methods that can track a building until collapse. This report will present a numerical analysis method developed for the purpose of reproducing the strongly nonlinear behaviour of wooden buildings in response to extremely large earthquake motions. It will also provide an example of the application of this method as software. In particular, it will introduce a method for visualising the seismic performance of low-rise wooden houses based on time history response analysis. It will then present an example of linking this method with CAD for wooden houses sold in Japan, and finally, it will demonstrate the application of this method as structural design software for mid-rise wooden structures.	Takafumi	Nakagawa	Kyoto University
8I	TESP - Practitioner / Engineering	Timber Engineering & Structural Performance - Engineering Focus	NUMERICAL AND EXPERIMENTAL INVESTIGATIONS ON LATERAL PERFORMANCE OF A 3-STORY CLT STRUCTURE	The Japanese CLT Manual proposed a structural modeling approach for the lateral design of CLT panel construction. However, its accuracy has yet to be validated. This study aims to validate the proposed modeling method by numerical modeling based on the CLT Manual and comparing it with the results from a quasi-static cyclic test conducted on a 3-story narrow-panel platform-type CLT structure. This paper focuses on comparing the hysteresis of story drift and the local deformation behavior of rocking walls obtained from the numerical model and experimental tests. The story drift of the numerical model is significantly larger than the experimental value, and the rotation of rocking walls exceeded the target 1/200 radian under the predicted lateral load level during testing. The numerical model is considered to be conservative. Modifications to the material strength and connection stiffness parameters are recommended to improve the predictive accuracy of the numerical modeling method in the CLT Manual.	Minchih	Hou	Kyoto University
8I	TESP - Practitioner / Engineering	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus	Experimental study on the dynamic progressive collapse response of post-and-beam mass timber buildings	This paper presents an experimental study on a 3D post-and-beam scaled mass timber substructure subjected to a sudden interior column removal. The experimental design and setup are introduced and the preliminary results of the tested substructure, focusing on understanding its dynamic behavior, the load redistribution mechanisms under large displacements and the contributions of different elements in resisting progressive collapse are presented and discussed.	Nikshan	Amatya	Griffith University

SESSION 9

Wednesday 25th June 2025
2:00pm to 3:30pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
9A	ECCS / EIC / TESP - Practitioner / Engineering	Session Chair: DR MARK DEWSBURY / UNIVERSITY OF TASMANIA					
9A	ECCS / EIC / TESP - Practitioner / Engineering	Exemplars & Construction Case Studies - Practitioner Focus	QFES North Coast Regional Headquarters and Maryborough Fire and Rescue Station	The Maryborough Fire and Rescue Station, and North Coast Regional Headquarters facility comprises 3 new purpose-built timber buildings and the alterations and additions to an existing 1950's Art Deco Fire Station. The new Regional Headquarters and training tower, and the new Fire Station turnout and Engine Room are entirely built from Cross Laminated Timber and Glu-Laminated Timber. The project is a demonstration of the use of sustainable, renewable materials in a State Government Building, an exemplar for future buildings of this typology that seek to genuinely reduce carbon emissions, with this building saving approximately 500 Tonnes of CO2 from entering the atmosphere.	Kim	Baber	School of Architecture, University of Queensland
9A	ECCS / EIC / TESP - Practitioner / Engineering	Timber Engineering & Structural Performance - Engineering Focus, Exemplars & Construction Case Studies - Architectural Focus, Exemplars & Construction Case Studies - Practitioner Focus	Timber basements – From challenge to technology and proofed solution	Due to the need of more suistanable solutions in the construction sector, even timber construction should start with a timber basement! Concrete basements are standard today - this should change for sustainable buildings. Timber basements are more environmentally friendly and can be installed in much less time. However, we need a proven concept, proper waterproofing and long-term performance. New parameters have to be determined, especially for structural aspects, because of the light weight. For the long-term behaviour, various building physics estimates are made. The results were validated by experimental test series, a monitoring campaign and a pilot project on five apartment buildings. The results confirm that timber basements are feasibleand reliable.	Bettina	Franke	Timbatec
9A	ECCS / EIC / TESP - Practitioner / Engineering	Exemplars & Construction Case Studies - Practitioner Focus	CASE STUDIES FROM FINLAND: IMPROVING THE PRODUCTIVITY OF INDUSTRIAL WOOD APARTMENT BUILDING CONSTRUCTION	Since the early 1990s, Finland has been actively engaged in the development of multi-story timber-frame buildings. According to the size specifications outlined in the current Finnish fire regulations as of January 1, 2018, it is feasible to build residential, office, hotel, and care center with timber frames and facades, extending up to 8-story. As of June 2024, Finland has completed the construction of 180 wooden apartments buildings exceeding 2-story, totaling about 6,000 apartments. Despite positive feedback from residents, clients, and builders, wooden apartment buildings have not yet achieved sufficient competitiveness for widespread adoption. To enhance the productivity and competitiveness of industrial wooden apartment building construction in Finland by 20%, a two-year research project was undertaken from (2020-2022). This project was funded by both the industry and the Finnish Ministry of the Environment. It included two extensive case studies in Finland, utilizing modular volumetric construction methods and encompassing about 770 apartments in total. The study concluded that competitiveness of wooden apartment buildings can be significantly improved by standardizing design solutions and optimizing both industrial modular manufacturing and on-site operations. Furthermore, productivity gains can be realized through enhanced design management, the implementation of effective project and contract models, and improved site logistics.	Markku	Karjalainen	Tampere University
9A	ECCS / EIC / TESP - Practitioner / Engineering	Education, Innovation & Challengers - Practitioner Focus	GLUED WIDE-SPAN TIMBER TRUSSES – A DESIGN AND EXPERIMENTAL APPROACH	The aim of this research work is to develop a resource-efficient, economical, and aesthetically sophisticated timber structure for wide-span hall constructions. Based on the idea of a resolved timber truss, a completely new type of load-bearing structure has been developed. This structure relies fundamentally on glued truss nodes to transfer occuring tensile forces. To enable a largely moment-free construction, a special compression contact joint has also been designed for transferring compression forces. As a result of this design process, the system axes align ideally in a single point of intersection. Gluing timber trusses has long been an enormous challenge, often investigated but never fully successful. This has now been made possible thanks to the newly developed truss geometry and accompanying glued truss nodes. A complex, parameterized structural design model has been developed and the results of the calculations were validated through extensive tests using specially developed test setups. Easy disassemby for a circular economy has also been considered.	Jan L.	Wenker	Brüninghoff Group
9A	ECCS / EIC / TESP - Practitioner / Engineering	Timber Engineering & Structural Performance - Engineering Focus	DEVELOPMENT OF AN ENGINEERED WOOD PRODUCT BASED ON A MARKET STUDY	The mass timber products have benefits related to sustainability, prefabrication, costs, and flexibility in construction planning and execution. However, in Brazil, when compared to other market solutions, they still have a higher cost. The engineered product that uses the largest quantity of cubic meters per square meter is the slab, which has three solutions: CLT (Cross Laminated Timber), NLT (Nail Laminated Timber), and the structured composite board (wall board). The wall board, being a simpler solution, is more financially accessible, with a lower cost per square meter. However, most of the time, it does not meet the aesthetic requirements of architecture, thus requiring an additional finish (ceiling). In this context, this work aims to develop a product that is structurally and financially viable for mass timber structures, thereby being competitive with other materials in the market.	Carlito	Calil Neto	Rewood | @brarewood
9B	TESP- Engineering Fire Engineering	Session Chair: PROFESSOR SAM SALEM / LAKEHEAD UNIVERSITY					
9B	TESP- Engineering Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	ROBUSTNESS ANALYSIS OF TALL TIMBER BUILDING SUBJECTED TO COMPARTMENT FIRE	The construction of tall timber building is gaining popularity around the world leveraging on its inherent characteristics such as renewablility and high strength-to-weight ratio. But timber is prone to the fire damage due to its combustibility. The robustness of timber building exposed to fire is still not well understood. This paper presents the robustness analysis of a 12-story timber frame-core wall building subjected to compartment fire. First, component-level numerical models (column model and beam model) exposed to standard fire heating are developed and validated by the experimental tests. Subsequently, a numerical model of the timber building is developed based on the calibrated component models. The developed building model is subjected to the compartment fire after imposed dead load and live load. Finally, the framework to assess the robustness of timber building exposed to the compartment fire is proposed. The robustness of the designed timber building exposed to fire is quantified through calculating the robustness index considering different fire scenarios and direct failure and indirect failure caused by the fire damage.	Tongchen	Han	0

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
9B	TESP- Engineering Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	Fire safe design of hybrid steel-timber construction systems	As part of the research project "BraStaHo" (Fire safety of hybrid steel-timber construction systems), two hybrid steel-timber construction systems are being investigated under fire exposure using the standard fire curve. The primary objective is to evaluate the fire protection capacity of timber claddings for steel beams over various time periods and assess the factors influencing its effectiveness. Initial validation tests have demonstrated that different construction configurations impact the fire protection capacity of solid timber cladding. By utilizing different profile sizes in ongoing tests, a robust data set will be generated, which will be validated and verified through numerical simulations. The goal is to establish construction details and cladding thicknesses to meet various fire resistance requirements. Additionally, slim floor type construction systems are being examined. Experimental investigations have provided initial insights into the combustion behavior of these systems, with a particular focus on the support conditions and cavities, as these parts pose the highest risk for component failure and smoke propagation. The deformation behavior of the floor under fire conditions has also been studied. The aim of these tests is to develop fire-safe support details and predict the thermal behavior of this construction in the event of a fire.	Patrick	Dumler	TUM Chair of Timber Structures and Building Construction
9B	TESP- Engineering Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	Investigating the thermal penetration in structural timber elements exposed to natural fires	Fire safety concerns, particularly the combustibility of wood, pose significant challenges for the advancement of modern timber buildings. Traditional fire safety assessments often overlook the cooling phase of fires, during which timber structures can continue to lose strength and stiffness. This study employs numerical models and experimental data to analyse the thermal penetration in structural timber elements throughout a fire, considering both heating and cooling phases. The findings show that, during the cooling phase, the load-bearing capacity of timber elements decreases due to ongoing heat penetration, with the zero-strength layer playing a critical role. The research emphasises the need to include the cooling phase in fire safety assessments for timber structures, particularly for columns. Ignoring this phase can lead to unsafe underestimations of structural risks, highlighting the importance of considering thermal penetration and the resulting heated timber with reduced mechanical properties.	Andrea	Lucherini	Slovenian National Building and Civil Engineering Institute (ZAG)
9B	TESP- Engineering Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	Quantifying Fire Behaviour in Gaps in CLT Panel-to-Panel Connections	The tolerances of mass timber construction results in small gaps between mass timber panels. The Fire Design Specification prescribes that when gaps within elements exceed 3 mm the mass timber within the gap must be treated as fully fire-exposed surfaces. Therefore, many of these gaps must be filled with fire protection material. However, the process of protecting these gaps is time consuming and costly. To evaluate the influence of gaps on fire dynamics and char propagation, the authors performed a series of experiments on cross laminated timber panel-to-panel connections to evaluate the influence of connection type and gap size. Temperatures and airflow were measured to quantify the fire behavior of the mass timber connections. Each specimen was exposed to the standard fire (ASTM E119) for up to two hours and then allowed to cool naturally. This testing methodology quantifies temperatures and airflow throughout both heating and smoldering. The testing results will inform the future design of mass timber buildings.	Wyatt	Garrett	Oregon State University
9B	TESP- Engineering Fire Engineering	Timber Engineering & Structural Performance - Engineering Focus	PREDICTIVE CAPABILITIES OF FIRE DYNAMICS SIMULATOR OF FLAME SPREAD ON TIMBER IN ENGINEERING APPLICATIONS: AN EVALUATION	Predicting ignition and fire growth of engineered timber products holds significant relevance in the fire safety community, given the extensive application of these materials as structural elements in buildings. Furthermore, understanding the charring process of wooden materials is crucial for predicting their structural performance when exposed to a fire hazard. This article presents an effort to evaluate the engineering code Fire Dynamics Simulator (FDS) in terms of predicting heat impact, fire spread and charring on intermediate-scale wooden panels. Experimental tests were carried out on combustible (spruce wood) panels, representing fire spread on wooden surfaces. The samples were exposed to a propane burner with a power ranging from 30 to 100 kW. The model parameters were calibrated against the experimental results, allowing good qualitative prediction of the incident heat flux on the panel. A coupled engineering pyrolysis model was then used to characterize the flame spread, in terms of charring depth and heat release contribution of the combustible surface.	Alain	Coimbra	CSTB
9C	TESP- Engineering Connections	Session Chair: MATT SMITH / SIMPSON STRONG-TIE					
9C	TESP- Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	ROBUSTNESS ANALYSIS OF INNOVATIVE CONNECTIONS FOR POST-AND-BEAM MASS TIMBER BUILDINGS	The paper focuses on characterizing innovative beam-to-column connections with slotted holes to facilitate structural assembling, ensure hinged structural behavior and promote catenary behaviour under large deformations, particularly in scenarios involving column removal. The research unfolds in three stages: 1) Experimental characterization of the connection's constitutive laws; 2) Parametric study varying beam and slotted hole lengths referring to a simplified 2D post-and-beam subassembly; 3) Robustness analyses of a 3D post-and-beam archetype building under column removal scenarios using Alternative Load Path Linear and NonLinear Analyses. Results indicate that slotted holes, proposed in the innovative beam-to-column connections, enhances the structural robustness facilitating effective activation of Alternative Load Paths such as catenary effects. Finally, structural robustness of a 4-storey post-and-beam building assembled using the prosed innovative beam-to-column connection was numerically analyzed considering Alternative Load Path shenarios.	Ernesto	Callegari	Rotho Blaas
9C	TESP- Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	Connections with small diameter fasteners in European hardwoods	In Europe, it is expected that the availability of hardwood species as construction material will increase in the coming decades due to climate change and the resulting forest conversion. When building with hardwoods, also connections with relevant European hardwood species such as beech and birch are necessary, where dowel-type fasteners with small diameters play a special role, as such fasteners are usually inserted without predrilling. A feasibility study to identify suitable fasteners that can be inserted without predrilling was carried out, leading to selection criteria based on the ratio of fastener diameter to insertion length. Used fasteners were staples and nails, and used hardwood products were laminated veneer lumber made of beech and birch solid timber. For selected fasteners, input parameters needed for the design of timber connections were determined and used to calculate expected load-carrying capacities of connections between hardwood products and wood-based panels. Comparing experimental with calculated values, the applicability of the European Yield Model for connections with small diameter fasteners in European hardwoods could be confirmed.	Carmen	Sandhaas	Karlsruhe Institute of Technology

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9C	TESP- Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	STEEL BAR-TIMBER COMPOSITE BEAM-COLUMN CONNECTION ADOPTING STEEL DAMPER	We have been developing a frame system consisting of steel bar-timber composite members which can perform better than those of reinforced concrete structure. The steel bar is deformed bar, which is embedded near outer in cross-section of the composite member and bonded with epoxy resin adhesive. Bending stiffness of the composite member is estimated to be approximately five times as much as conventional glulam timber for beam and approximately twice for column. Also, the bending capacity of the composite member is estimated to be approximately three times for beam and approximately twice for column. We developed wet and dry method for connecting column and beam, and now we have been improving the latter method. The improvements include a new manufacturing process for the composite timber, a change to threaded steel bar, a change in the shape of the steel parts used for the connection, and a change to steel damper. This paper presents the improvements, those advantages, and a loading test to investigate the performance of the improved connection.	MASANORI	NAKAMURA	0
9C	TESP- Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	Stiffness of timber connections with dowel-type fasteners under lateral load	When designing structural timber systems, serviceability limit states (SLS) can govern the final design solutions. Deformations in mechanical timber connections play a key role in controlling common SLS, such as vibration and deflection, which are dependent on the stiffness of the connections. Therefore, reliable models to predict the deformation or stiffness of timber connections are required for design purposes. Early timber connection stiffness models were largely based on the theory of beam on elastic foundation (Winkler foundation). Winkler theory tends to lead to an over-estimation of the deformation due to not considering shear effects. Recently, new theories, such as semi-infinite elastic foundation, were applied to address the limitations of Winkler foundation theory. In this project, models based on the semi-infinite elastic foundation are being developed to predict deformations in connections.	Tao	Gui	University of Alberta
9C	TESP- Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	HIGH CYCLE FATIGUE AND STIFFNESS DEGRADATION OF A CROSS-LAMINATED TIMBER SCREWED CONNECTION	A series of monotonic, short-cycle fatigue, and high-cycle fatigue tests were conducted on a cross-laminated timber (CLT) connection using self-tapping fully-threaded screws. The CLT-to-CLT connection was loaded in pure shear and both reverse and non-reverse cyclic tests were performed. The data from these tests were used to characterize the high-cycle fatigue behavior. A S-N curve was fitted to the data and compared to the fatigue verification values from EuroCode 5 as well as other studies. Additionally, the stiffness degradation of the connection was quantified and curves corresponding to the Palmgren-Miner damage were determined.	Wechiang	Pang	Clemson University
9D	TESP - Engineering Structural Behaviour	Session Chair: PROFESSOR ARIJIT SINHA / OREGON STATE UNIVERSITY					
9D	TESP - Engineering Structural Behaviour	Timber Engineering & Structural Performance - Engineering Focus	PRESTRESSING AS A METHOD OF REDUCING THE EFFECT OF CONCRETE SHRINKAGE IN ADHESIVELY BONDED CLT-CONCRETE COMPOSITE PANELS	Gluing timber panels and fresh concrete for shear connection can be considered very effective and almost perfectly rigid, but the effect of concrete shrinkage has a negative effect on the increase in deflection. It is only possible to eliminate these deformations with sufficient cambering, which cannot be achieved with normal support during construction, but only with the help of prestressing. The technical solution of the prestressed adhesively bonded CLT-concrete composite panel consisted of arching the CLT panel in the anchoring device up to the level of 1/100 of the span and subsequent application of glue and fresh concrete. After the concrete hardened and the anchorage was released, prestress was introduced into the composite panel. The measurements confirmed that the chosen value of camber at the level of achieving the design resistance of the CLT panels in bending proved to be adequate to eliminate the deflection due to self-weight and concrete shrinkage and to overcome the negative effect of the fresh concrete gluing.	Viktoria	Bajzecerova	TU Kosice, Faculty Of Civil Engineering
9D	TESP - Engineering Structural Behaviour	Timber Engineering & Structural Performance - Engineering Focus	Analysis of Cross Laminated Timber Floors with the Vierendeel Method	Simply supported and continuous cross laminated timber (CLT) floors with uniformly distributed loads and point loads were analysed using the Strut-Tie Method (STM). The resulting deflections and stresses were compared against the results from the Gamma Method, the Shear Analogy Method and a 2D plane strain continuum finite element method (FEM) model. This research has been undertaken as part of a larger research project to establish a simplified and flexible method of analysing complex timber-concrete composite (TCC) floors. The STM has been recommended in literature as an ideal method for practical analysis and design as it overcomes many of the limitations of the Gamma and Shear Analogy Method while remaining simpler in it's application than 3D FEM commonly used in TCC research, however there is limited information published on its usage. The STM models were created using different end release conditions and element formulations. Comparing results of the STM, Gamma and Shear Analogy Method models against the 2D FEM model, it was found that the STM with rigid connections between the CLT layers and the Timoshenko beam formulation performed as well as the more common Gamma and Shear Analogy methods and is therefore recommended for future use of the STM. Recommendations for future research are made for extending this method such that it can be used for analysing timber-concrete-composite floors that use CLT as the timber component.	Nicholas	Boey	Northrop Consulting Engineers
9D	TESP - Engineering Structural Behaviour	Timber Engineering & Structural Performance - Engineering Focus	Experimental Testing of an In-Situ Strengthening Process for CLT Panels	The primary uses of CLT in building projects is when used as a floor, wall or roof element. In these applications, the behaviour and load bearing potential of CLT elements is driven by the cross-section stiffness in the out-of-plane direction of the CLT panels whether this is in 3 layer, 5 layer or 7 layer panels. Situations frequently arise in the design of CLT buildings where the in-plane bending of CLT panels needs to be considered. Most commonly this occurs where a CLT panel is acting as a beam or lintel. Other situations also arise where CLT is acting as a shear wall, CLT is applied as a floor diaphragm or a CLT wall is acting as a deep beam. In beam-type applications, CLT potentially offers some interesting advantages resulting from the cross-laminated structure including and improved resistance to splitting around supports, penetrations and connections and improved bearing capacity at supports. While well-established calculation and design methods for out-of-plane section properties of CLT are available, there is comparatively little information available to designers when calculating the in-plane bending and shear strength. The material properties and manufacturing processes mean that CLT cannot be calculated using the same approach as a solid timber or glulam section. XLam has carried out testing of CLT beams to investigate in-plane failure modes of CLT. Increased understanding of the in-plane behaviour of CLT could encourage designers to consider a greater number of beam-type applications such as portal frames, deep/long span rafters.	Tom	Watts	XLam

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9D	TESP - Engineering Structural Behaviour	Timber Engineering & Structural Performance - Engineering Focus	STRUCTURAL BEHAVIOUR OF TIMBER-CONCRETE COMPOSITES INCORPORATING RIBBED CONCRETE LAYER	This study investigates the structural applicability of lighter and stiffer timber-concrete composites employing ribbed concrete layers. Push-out tests were conducted and the structural performance of the composites was assessed by examining the applied load and the relative slips between timber and concrete. Specimens fabricated from cross-laminated timber in conjunction with ribbed concrete sections with interlayer screw connections of orientation at 30°,45° and 90°. The findings reveal that timber-ribbed concrete composites have similar structural characteristics to those with solid concrete layers but with a minor reduction in ultimate slip modulus and an increase in the slip of the composites. In contrast to screws at 90°, cross-inclined screws at 30° and 45° resulted in improved load-slip performance and reduced concrete cracking. The results show the potential of using a ribbed concrete layer as an appropriate approach to improving efficiency in timber-concrete composite structures.	Aamir	Khokhar	Edinburgh Napier University, United Kingdom
9D	TESP - Engineering Structural Behaviour	Timber Engineering & Structural Performance - Engineering Focus	Determination of the racking strength and stiffness of CLT panels manufactured from C16-grade Irish timber	This study examines the racking strength and stiffness of CLT panels manufactured from C16-grade timber using Irish Sitka spruce. The timber obtained from Sitka spruce in Ireland is typically graded as C16. In Europe, CLT is primarily manufactured with C24-grade timber and most of the research available is for C24-grade material. Full-scale panels using C16-grade CLT are subjected to racking resistance tests. Subsequently, finite element models are developed for parametric studies, which are validated using the experimental results. These experimental results and numerical models shall inform the use of C16-grade in combination with typical connections used in a mass timber system.	Rimjhim	Kashyap	University of Galway
9D	TESP - Engineering Structural Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	CHARACTERIZATION OF THE FIRE PERFORMANCE OF TROPICAL TIMBERS FOR STRUCTURAL USE IN COLOMBIA	Wood is an extremely versatile material, widely used in structural applications. However, it also presents various attributes related to combustion and flammability. The wood's response to fire is not uniform across all species; it varies considerably depending on the type of wood and its specific characteristics. Factors such as anatomical structure, density, hardness, and moisture content play a crucial role in how wood reacts to fire. In particular, some tropical woods with relatively low densities may perform better than those with higher densities, influenced by additional characteristics such as the content of extractives and minerals. The aim of this study is to evaluate the fire response of six tropical species found in Colombia, which are used in structural design. To achieve this, laboratory tests	César	Rengifo	Universidad Distrital Francisco José de Caldas
9E	STCE - Engineering - Advancing the Circular Economy in Europe	Session Chair: DR DANIEL F. LLANA / TECHNICAL UNIVERSITY OF MADRID					
9E	STCE - Engineering - Advancing the Circular Economy in Europe	Sustainability and Timber in a Circular Economy - Engineering Focus, Sustainability and Timber in a Circular Economy - Practitioner Focus, Exemplars & Construction Case Studies - Practitioner Focus	Pilot Project: Modular Construction with Secondary Materials in a Circular Economy	Our research has shown the technical feasibility of using secondary timber, recovered from demolition, as feedstock for the manufacture of mass timber. In this pilot project, we apply our research in the context of a case study modular building. The pilot demonstrates circular economy innovation at building scale. Timber has been gathered that would otherwise have entered demolition waste streams and been chipped and incinerated or downcycled. The timber has instead been prepared for reuse and manufactured into 'glued-laminated secondary timber' (glulamST), as the building's structural frame, and 'cross-laminated secondary timber' (CLST), as wall and floor panels. The components are developed as a kit-of-parts that can be adapted for application to other building typologies, and are designed for disassembly, upgrade and future reuse. The physical manifestation of the pilot will be presented using images of its exhibition at various locations. Findings relating to cost and carbon will be presented. We conclude with a discussion of next steps and the potential to scale this innovation to an industrial level.	Colin	Rose	University College London
9E	STCE - Practitioner- Advancing the Circular Economy in Europe	Sustainability and Timber in a Circular Economy - Practitioner Focus	Towards a circular value chain of wood from existing buildings in the UK	The reuse of timber is one of the opportunities identified in the UK timber in construction policy roadmap published in 2023 for reducing the GHG emissions associated with the construction sector. New design approaches can facilitate deconstruction and thus reuse of timber elements in the future, but the reuse of timber from current existing buildings remains a complex problem, requiring a different approach. This paper investigates the challenges and opportunities of salvaging timber from existing buildings and reusing timber for structural purposes. It considers opportunities for both direct reuse of timber members, and the use of the reclaimed material for the manufacturing of new engineered wood products. The research is based on a review of the literature and a series of interviews with stakeholders of the demolition and construction sectors in the UK. The perceived challenges for salvaging and reusing wood were found to be interdependent and related to the time and logistics for enabling reclamation, the reconditioning of the reclaimed wood and a supply chain for sourcing the materials. We outline the key challenges identified and explore the potential opportunities that could be paving the way for a circular timber construction now.	Martha	Godina	University of Cambridge
9E	TESP - Engineering - Advancing the Circular Economy in Europe	Timber Engineering & Structural Performance - Engineering Focus	Pure-Timber Connections with Beech, Birch, and Laminated Densified Wooden Dowels: Experimental and Analytical Investigations	The use of wood dowels has been expanding in recent years within timber engineering, particularly in the development of adhesive-free engineered wood products. Adhesive-free timber structures offer advantages such as enhanced recyclability, improved reusability, and a reduced environmental impact. Typically, metal fasteners e.g. screws, dowels or the like are employed in timber engineering applications, mainly due to issues such as mechanical performance, ease of application and economy. Despite the proven performance and widespread adoption of metal connectors, the timber industry is increasingly considering wood-based connectors, such as wood dowels (also referred to as "pegs"), as eco-friendly alternatives. This paper concerns an experimental and analytical investigation on connections with birch gusset plates and dowels of various wood species. In particular, the study presents a mechanical characterization of the proposed connection along with a description of the failure modes observed. The investigations include dowels made of beech, birch and densified wod. For the sake of comparison, a number of connections with birch plywood and and screws made of steel were also tested. Based on the results obtained by testing the proposed connections, along with results from additional embedment tests, the authors have developed a model to predict the strength of the proposed connection. The model takes into account not only the bending and enbedding capacity of the dowel but also its shear strength.	Yue	Wang	KTH Royal Institute of Technology

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9E	ECCS - Engineering - Advancing the Circular Economy in Europe	Exemplars & Construction Case Studies - Engineering Focus	Production feasibility study on studs from reclaimed timber	The study explores the feasibility of reclaimed timber as glulam lamellae. Reclaimed timber was collected at a waste management site, cleaned, and visually strength graded according to the Nordic INSTA 142 and according to a proposed grading standard for reclaimed timber. The grading results show a systematic downgrading of the best timber quality according to the proposed standard. In general the quality of the RT is good as more than 90% of the 85 pieces fulfilled the requirements of the best two strength classes. Seven protoypes of glued studs, 250 cm in length, with selected layers of reclaimed timber, were produced in an industrial line using a state-of-the-art 1k-polyurethane adhesive. The use of reclaimed timber as supplement for 1st generation timber was possible without adjustments of the industrial production process. The studs` modulus of elasticity, bending strength, density as well as the shear strength of the bond lines will be investigated. The mechanical properties of the different prototypes are expected to challenge the current rules for grading of reclaimed timber.	Karl-Christian	Mahnert	Norwegian Institute of Wood Technology
9E	TESP - Engineering - Advancing the Circular Economy in Europe	Timber Engineering & Structural Performance - Engineering Focus	RECENT DEVELOPMENTS ON TAILORED LAMINATED TIMBER	The paper gives an overview of the research project InnoTLT and preliminary results. The aim of InnoTLT is to develop cross-laminated timber (CLT) into next generation Tailored Laminated Timber (TLT) by studying concepts to optimize the mechanical performance while, at the same time, assuring compliance with principles of a circular economy. A general objective is to reach a 20% improvement in performance-to-material usage ratio, in relation to standard CLT of today. Walls and floors are the main areas of studies, early results from these studies are presented. An approach for early product design in terms of real-time and combined evaluation of LCA and structural response is also presented. The results show a great potential for the industry to optimize their products, both in terms of technical performance, and in terms of environmental and climatic impact.	Erik	Serrano	Lund University
9E	STCE - Practitioner - Advancing the Circular Economy in Europe	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus	AN INNOVATIVE FOUNDATION SYSTEM FOR TIMBER BUILDINGS: STEEL WELDMESH GABION BOXES INFILLED WITH AGGREGATES	An adequate foundation systems for timber buildings has to guarantee both bearing capacity and durability of the wooden elements, providing a clear separation layer between the ground and the upper structure. Commonly, designers use reinforced concrete (slab or beams) to realize this structural detail. Concrete foundations, often casted directly into the ground, provide an adequate solution but, at the same time, is in conflict with the main properties of timber constructions as prefabrication, lightness and low environmental impact. This paper presents an innovative prefabricated foundation system realized with steel weldmesh gabion boxes infilled with stone aggregates developed to be removed at the end of life of timber structure. The results of the experimental tests, conducted to characterize the mechanical behaviour of the foundation system, are presented in this paper.	Matilde	Benatti	National Research Council of Italy (CNR-IBE)
9F	TESP Engineering - Connections	Session Chair: NICHOLAS BENECKE / SPAX INTERNATIONAL					
9F	TESP Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	BEHAVIOUR OF PERFOBOND CONNNECTIONS IN TIMBER-CONCRETE COMPOSITES	Adhesively bonded plates in timber-concrete composites (TCC) are gaining popularity due to their high strength and stiffness. Such advanced mechanical performance is targeted for long span solutions with the use of timber as a construction material. In this work, perfobond connectors, commonly used in steel-concrete composites (SCC) have been investigated both at the connection and beam level by means of experimental tests. The results are then used to validate a finite element model and, subsequently, further complement the experiments in the understanding of the behaviour of TCC floor beams integrating these connectors. The study has concluded/highlights the properties necessary for a strong, stiff and a ductile perfobond plate.	Elif	Appavuravther	Hasselt University
9F	TESP Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	Experimental study on the performance of wood connections under simulated wind/earthquake rate of loading	This paper presents the effects of simulated seismic and wind loading rates on the performance of mass timber connections and light wood frame connections/systems. Monotonic tests and reversed cyclic tests were conducted on Cross Laminated Timber (CLT) connections, specifically spline joints, hold-down connections, and angle brackets. Furthermore, additional tests were conducted, including light wood frame stud-to-sheathing connections/walls, and Glulam-CLT diaphragm connections. For each configuration, two groups of specimens were tested under two different loading rates. One group was tested at a regular/standard rate of loading, resulting in failure within 5 to 10 minutes, while the other group was subjected to a high rate of loading, simulating seismic or wind loads, with failure occurring within 2 to 10 seconds. The results of the tests revealed that for most connections, the average peak load increased under the higher loading rate compared to the regular loading rate.	Jianan	Chen	University of British Columbia
9F	TESP Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	THE EFFECT OF SPECIMEN SIZE ON WETTING-INDUCED STRESS IN SELF-TAPPING SCREWS IN STEEL-TO-WOOD CONNECTIONS	When a steel-to-wood connection fabricated with self-tapping screws (STSs) is subjected to wetting exposure, due to the hygroscopic characteristics of wood, tensile stress develops in the STSs, meanwhile compressive stress arises in the wood. The wetting-induced stress may lead to the failure of the STS, typically characterized by the fracture of the STS. This type of failure has been typically attributed to the excessively long STS penetration and/or extensive increases of moisture content in wood. However, for a steel-to-wood connection with single STS, the size of the wood specimen may also play a critical role in the magnitude of the wetting-induced stress in STS and wood. In this study, numerical analysis was performed based on 8 mm and 13 mm diameter STSs, and wood specimens with different size were included. By investigating the relationship between the peak wetting-induced stress in STSs and the size of the specimen, size effect of specimen on wetting-induced stress in STS was revealed, which will facilitate the development of analytical tools for this problem.	Lina	Zhou	University of Victoria
9F	TESP Engineering Connections	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Enhancing Mechanical Performance of Dowel Laminated Timber through Dowel Configuration and Bolted System Integration	Dowel Laminated Timber (DLT) is an all-wood engineered product made from layers of laminae and hardwood dowels. DLT uses hardwood dowels driven into pre-drilled holes in laminae, as the dowels absorb moisture and expand, they mechanically fasten the layers together by friction. The primary function of wooden dowels is to secure laminae positions through volume changes and friction, maintaining DLT integrity and performance. Therefore, this study will explore improvements in DLT manufacturing process to optimize its mechanical performance. The species use as laminae and dowels are Japanese cedar and Taiwan acacia, both domestically sourced in Taiwan. Improvements to DLT performance are primarily achieved through two methods: (1) configuring the insertion angles of dowels to prevent laminae from loosening, and (2) increasing the number of dowels to increase the surface area that secures the laminae together. Additionally, this study will integrate with industrial products and propose a high-performance DLT that uses a bolted system in a non-adhesive setup. Performance enhancements in DLT will be assessed by experimental variables such as the angle of dowel insertion, the number of dowels, and differences in nut tightness.	Yu-Liang	Hsu	National Cheng Kung University

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9F	TESP Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	ADHESIVELY BONDED AND HYBRID CLT PANEL-TO-PANEL JOINTS	Cross-laminated timber (CLT) panels are increasingly used in floor construction with the individual panels often connected with self-tapping screws (STS) through surface spline, half-lap, and butt joints. An alternative solution is provided by using the TS3 technology which connects butt joints through adhesives and creates a near-rigid connection, enabling the utilization of the two-way resistance of CLT panels. However, TS3 joints fail in a brittle manner. In this study, the mechanical properties of screwed, TS3, and hybrid TS3-screw connections between CLT in the major and minor strength directions were investigated using out-of-plane 3-point and 4-point bending and in-plane shear tests. The tests showed that the failure is brittle for TS3 joints and ductile for STS joints, while the hybrid joints had similar stiffness as the TS3 joints and can reach similar ductility as the screwed joints.	Houman	Ganjali	University of Northern British Columbia
9F	TESP Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	Impact of Timber Growth Conditions on Screw Withdrawal Capacity	Ductility in timber structures is primarily achieved through connections. While the Australian mass timber industry is growing radpidly, the current Australian Timber Standard AS1720.1 – 2010 contains outdated connection design methods based on experimental research from the 1970s. European-made metal fasteners, such as self-tappings screws (STSs), are popular in Australian mass timber construction, but have shown discrepancies between experimental and predicted screw withdrawal capacity. It is therefore critical to examine the characteristic of Australian timber products that affect behaviour of European STSs to understand and better predict performance. This research is focused on a) identifying influencing factors of screw withdrawal capacity, b) establishing a link between timber origin, including the growth conditions, on withdrawal capacity, and c) evaluating predictive models to suggest improvements for current design standards such as AS1720.1 – 2010.	Lisa-Mareike	Ottenhaus	The University of Queensland
9G	TESP - Engineering	Session Chair: A/PROF BEATRICE FAGGIANO / UNIVERSITY OF NAPLES FEDERICO II					
9G	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	DEVELOPMENT OF RIGID STRUCTURES USING CROSS-SECTIONAL COLUMNS WITH STANDARD MATERIALS FOR WOODEN FRAME CONSTRUCTION	The purpose of this research is to develop a wooden rigid frame structure using standard materials and hardware. Using wooden frame construction method columns, the columns are fastened to each other in a cross-shaped cross-sectional view to form a cross-sectional column. The cross-sectional columns are used for the column portion of the gate-type rigid frame to form a wooden rigid frame structure. The parameters are the method of joining the columns and the distance between the screws for timber structures. The test results showed that the initial stiffness was low for all the tested specifications. This is due to compression perpendicular to the grain in the wood. Therefore, the current specifications have low initial stiffness, making it difficult to realize a cross-column rigid-frame structure. Therefore, it is effective to reduce compression perpendicular to the grain in the wood to improve the initial stiffness.	Ryota	Kawashima	Nippon Institute of Technology
9G	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	Machine learning-aided performance-based plastic design of multi-story cross-laminated timber buildings	The construction sector is a major contributor to greenhouse gas emissions, posing significant threats to ecosystems and human livelihoods, highlighting the urgent need for sustainable construction practices. Timber, particularly cross-laminated timber (CLT), presents a promising solution due to its ability to sequester carbon dioxide, offering an environmentally friendly alternative to concrete and steel. Recently, CLT made of rubber and coconut wood has successfully been developed. This research aims to apply the CLT material to develop innovative seismic-resistant structures. The research involves developing finite element models, performing nonlinear dynamic analysis (NRHA), and applying Machine learning (ML) to optimize structural design. Ultimately we propose a performance-based plastic design method for multi-story CLT buildings.	Eknara	Junda	Nakhon Pathom Rajabhat University
9G	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	New innovative resource-efficient timber-concrete-composite ceiling system – experimental and analytical investigations	Timber-concrete-composite (TCC) ceiling systems have enjoyed increased popularity in recent years. The fundamental concept involves utilizing materials based on their inherent properties: concrete to withstand the compression forces occurring at the top of the composite slab and timber to resist the tension forces occurring at the bottom. Of the many existing systems, a majority consists of a continuous concrete and timber layer with solid cross sections. In this paper, a newly developed TCC system focusing on the most efficient use of materials by creating a neutral, material-saving zone between the concrete and timber layers, is presented. In order to transfer the occurring shear forces between timber and concrete, special vault shaped molds are used as lost formwork to create shear cams. The first part of the paper deals with a brief introduction of the new system as well as the preliminary design process. Subsequently, large-scale experiments in the form of bending tests under a uniform distributed load are shown to determine the actual load-bearing behaviour. Initial results from small scale slip-block tests aimed at defining the shear performance, required for the later design process, are also discussed. The results serve as a foundation for further studies and for determining an appropriate design basis for this novel system.	Philipp	Holzhaider	0
9G	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	RELIABILITY EVALUATION OF TIMBER-CONCRETE COMPOSITE FLOOR SYSTEMS WITH RESPECT TO TIMBER SHEAR FAILURE	Timber-concrete composite (TCC) floors are popular design in mass timber buildings due to their enhanced acoustic and thermal performance. Self-tapping screws (STSs) are particularly effective connectors in TCC floors because they can provide a high degree of composite action. Despite their prevalent use, the structural reliability of TCC floors has not been properly evaluated. In this study, reliability analyses of a wide range of TCC floors with STSs as connectors were conducted using the first-order reliability method (FORM) with respect to timber shear failure. This paper discusses results from the reliability analysis study which was part of a larger study that considered all ultimate and serviceability limit states. The reliability indices of the timber shear limit state showed that the current design was unconservative when using the current resistance factor of 0.9 in the Canadian timber design standard. A resistance factor of 0.7 is more appropriate for timber shear design in TCC floors.	Yue	Li	University of Alberta
9G	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	DEVELOPMENT OF HYBRID MULTI-ANGLED LAMINATED TIMBER PLATE FOR MITIGATING ORTHOTROPY	Recently, as global efforts intensify against climate change and the pursuit of carbon neutrality gains prominence, timber is getting more attention for its low embodied energy. Accordingly, timber, as a construction material, is gaining popularity. Even though timber has excellent strength to weight ratio, among other properties, all the current engineered timber products are designed to carry load in one direction. Even cross-laminated timber is designed as beam element, while the cross-layer provides dimensional stability. For complex loading scenario, such as, bi-axial bending or membrane loading, various stacking sequence with different fibre orientation can overcome this limitation. This study focuses on developing structural timber element that mitigate the orthotropic effect by laminating thin timber veneers with different fiber orientation. The research aims to compare stiffness and strength of multi-angle laminated timber models against other conventional laminated configurations. The results indicate that multi-angle laminated timber exhibits relatively high stiffness compared to other models and approaches nearly isotropic properties.	Mahbube	Subhani	Deakin University

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9H	TESP - Engineering - Seismic / Vibrations	Session Chair: DR SARDAR MALEK / UNIVERITY OF VICTORIA					
9H	TESP - Engineering - Seismic / Vibrations	Timber Engineering & Structural Performance - Engineering Focus	EFFECT OF SPRAY-APPLIED RIGID POLYURETHANE FOAM ON SEISMIC PERFORMANCE OF TIMBER HOUSE	Rigid Polyurethane Foam (RPF) is widely used as insulation in Japan. Though the RPF is a non-structural member, it was said that there was a possibility it increases the seismic performance of plywood shear walls. For this reason, to clarify the effect of RPF, a static shear loading test of two plywood shear wall specimens was conducted, where one specimen was sprayed with RPF. Compared with the non-RPF plywood specimen, it was found that RPF confines the rotation of plywood. With the confining effect of RPF, the shear stiffness and the maximum shear force of the plywood specimen increased to approximately 170% and 130% respectively. To estimate the effect of RPF in an existing timber house, with the test result, the earthquake response of a two-storied timber house was calculated by the time history response analysis. The response story drift was 0.0230 rad without RPF, while the one with RPF was 0.0036 rad under the JMA Kobe earthquake wave in 1995. It came to be clarified that there is an effect of RPF on the seismic performance of plywood shear walls in this study, it is needed to estimate the influence of the thickness and temperature of RPF in further research.	Tomoki	Furuta	Aichi Shukutoku University
9H	TESP - Engineering - Seismic / Vibrations	Timber Engineering & Structural Performance - Engineering Focus	INFLUENCE OF FLOOR EFFECTS ON THE SEISMIC PERFORMANCE OF CROSS-LAMINATED TIMBER STRUCTURES	Despite the seismic performance of cross-laminated timber (CLT) structures having been widely investigated, detailed influence mechanisms of floors on seismic performance of CLT structures is still lacking. In this paper, the influence of nail-laminated timber-concrete composite (NLTCC) floors on the seismic behaviour of CLT structures was investigated. Nonlinear finite element models for CLT structures were developed, within the Open System for Earthquake Engineering Simulation (OpenSees). A series of parametric analyses was conducted, considering stiffness of wall-to-floor connections and in-plane stiffness of NLTCC floors. The structural mode shapes and periods were compared. The seismic performance, such as inter-story drift, displacement, and peak floor acceleration, were obtained from nonlinear dynamic time history analyses. The influence of stiffness of wall-to-floor connections and in-plane stiffness of NLTCC floors on structural seismic performance was quantified.	xiaowei	qu	Tongji University
9H	TESP - Engineering - Seismic / Vibrations	Timber Engineering & Structural Performance - Engineering Focus	FREQUENCY CONTRIBUTIONS TO DYNAMIC RESPONSES OF JOISTED TIMBER FLOORS: A WAVELET TRANSFORM APPROACH	Vibration performance of timber floors is a key aspect of designing this floor. Due to the lightweight property of the timber floors, the presence of imposed loads such as furniture can be expected to change the vibration performance of the floor. This study aims to evaluate the contribution of frequency bands to the vibrational performance of joisted wood floors due to the effect of different furniture arrangements. For this purpose, the study presents an experimental investigation of the dynamic responses of a joisted wood floor under human-induced excitation. Two signal processing tools, the discrete wavelet transform (DWT) and continuous wavelet transform (CWT), have been used to analyse the dynamic responses. The DWT decomposes a signal into different frequency bands and quantifies the contribution of each frequency band to the overall energy content of the signal. The CWT performs time-frequency analysis, offering a detailed insight into how the frequency content of the signal varies over time.	Mohammadreza	Salehi	Norwegian University of Life Sciences
9H	TESP - Engineering - Seismic / Vibrations	Timber Engineering & Structural Performance - Engineering Focus	ANALYSIS OF THE PREDICTED COLLAPSE DIRECTION TENDENCIES OF HOUSES CAUSED BY THE 2024 NOTO PENINSULA EARTHQUAKE	Recently, earthquakes have occurred frequently in the Noto Peninsula of Ishikawa Prefecture, resulting in significant damage to numerous wooden buildings. Japanese seismic standards have been continuously refined based on past earthquake experiences; however, the seismic performance required now is different from the standards in place at the time of the buildings' construction. A field survey conducted following the 2024 Noto Peninsula Earthquake revealed severe damage to wooden houses constructed before 1981. To predict seismic damages, it is important to find out the seismic performance of the existing buildings. In addition, it is necessary to obtain accurate structural characteristics of all the target buildings to evaluate their performance. Consequently, a survey utilizing the method proposed after the 2007 Noto Peninsula Earthquake was conducted to predict the structural damage to buildings following the 2024 Noto Peninsula Earthquake. In this study, limit capacity calculation and time-history response analysis were conducted by the analysis software "wallstat," incorporating seismic data from the 2024 Noto Peninsula Earthquake. The results of the analysis were compared to determine the tendencies of their seismic response to predict the typical structural damage in the Noto Peninsula.	Yuki	Hashimoto	Kyoto University
9H	TESP - Engineering - Seismic / Vibrations	Timber Engineering & Structural Performance - Engineering Focus	IMPACTS OF BEAM HANGER ROTATIONAL STIFFNESS ON COLUMN RESISTANCE AND LATERAL DESIGN OF POST-AND-BEAM FRAMES	Mass timber frames with deep beams are being increasingly adopted to reduce floor vibrations and deflections. At beam-to-column joints, pre-engineered beam hangers provide shear capacity and allow for fast installation. In current design practice, a pinned condition is typically assumed for such shear connections, permitting columns to be designed as axially-loaded members. However, when frames undergo lateral deflections, these beam hangers may display rotational stiffness due to various interlocking mechanisms, inducing bending moments to columns. Subjected to combined moments and axial forces, columns may provide a lower resistance than designed for. This issue has drawn concerns of building authorities and practicing engineers. In this project, beam-hanger-induced moments and their impacts on column design are investigated through finite element analysis and full-scale experimental tests on a one-storey two-bay frame. Parametric analyses are used to determine the influence of semi-rigid connections on the design of columns and the lateral-force-resisting system.	Fei	Tong	University of Northern British Columbia
9H	TESP - Engineering - Seismic / Vibrations	Timber Engineering & Structural Performance - Engineering Focus	EVALUATION OF SEISMIC PERFORMANCE OF MID-RISE TIMBER BUILDINGS WITH SLIDING BASE SYSTEM	This research proposes a sliding base system for mid-rise timber buildings and evaluate its seismic performance by the time history seismic response analysis. The sliding base system is one of the base isolation system, consisting of base concrete, sliding materials, and raft foundation. The case study building is a four-story timber frame building designed in accordance with the Japanese building standard act. A two-dimensional model for the case building was developed in OpenSees to perform time history response analysis. The sliding base was modelled by Coulomb friction elements to consider the variation of friction forces caused by pressure variation between the sliding elements. The coefficient of friction was set to 0.2 based on the mechanical property of the sliding material. The maximum story drift angle and acceleration response of the building subjected to severe earthquakes were significantly reduced by installing a sliding base system, indicating that the proposed system is effective to enhance seismic performance of mid-rise timber buildings. This result provides practitioners with alternative solutions for timber buildings constructed in earthquake-prone areas.	Al	TOMITA	Kyoto University
9I	ECCS - Architectural	Session Chair: PROFESSOR GREGORY NOLAN / UNIVERSITY OF TASMANIA					

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9I	ECCS - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	DIGITAL ARTISAN: AUGMENTED REALITY AIDED UPCYCLING FOR RECLAIMED TIMBER BOARDS	This research employs augmented reality (AR) to assist artisans in upcycling reclaimed timber boards into free-form structures. It proposes a tailored AR-aided workflow that prioritizes human judgment and creativity in construction processes by evaluating different scenarios. This cyclical workflow iterates through surveying, nesting, cutting, and assembling. The approach bypasses the need for extensive inventory management and labeling processes by surveying limited knowledge of the material stock in each iteration. With the assistance of AR, artisans can make intuitive decisions on material nesting and get clear instructions for cutting and assembling. The AR application involves visualization, model processing, user interface design, and algorithm development, fostering an environment that values human input alongside technological advancements. It visualizes nesting boundaries and material efficiency, documents nesting patterns, updates cutting lines, and designates assembly locations, thus ensuring a seamless integration of digital feedback into the physical construction process. Overall, the proposed workflow facilitates the integration of digital and physical processes, revealing the potential of AR technology in advancing circular construction practices.	Qiming	Sun	ETH Zurich
9I	ECCS - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus, Timber Engineering & Structural Performance - Engineering Focus, Exemplars & Construction Case Studies - Architectural Focus	Inventory-Constrained Design Method for Whole Tree Branching Structures	Timber sourced from plantation forests is an in-demand resource, being natural, renewable, and possessing low embodied carbon.However, it is a finite resource, so the efficient material and structural use of timber in architecture is essential for maximising economic and carbon storage value.This paper introduces a digital design methodology for branching structures, aiming to design a branching structural system supporting a given canopy area and constructed from a given inventory of whole trees. The proposed methodology encompasses three key stages: space-filling canopy distribution, branching topology generation, and inventory-constrained form-finding. The latter is based on the Combinatorial Equilibrium Method (CEM) and incorporates a material length constraint such that each structure uses a single entire tree from a forest inventory. The developed digital design tool could be applied to case studies, using material efficiency benchmarks for inventory utilisation and residue waste generation from part processing. Findings of this study support improved material design efficiency in timber and whole timber construction.	Joe	Gattas	The University of Queensland
9I	ECCS - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	Bloque M-Experimental: Timber as an alternative to build housing projects in Colombia.	Bloque M-Experimental is a 4-story multifamily housing project, built in timber. The 11.5 meter high structure was built with columns and glulam timberen beams up to 12.5 meters in length. Walls and floor plates are a mixture of solid timber and OSB sheets. It is the first housing building fully designed and built in timber in Colombia, and possibly one of the few experiences in South America. The design process began in 2013, as a laboratory to demonstrate that timber could be a technical and financially viable alternative, compared to traditional concrete and ceramic masonry technologies. With the development of the project, problems related to structural calculation issues, construction license, availability and supply of timber, labor, construction process, facilities, finishes, acceptance by users, etc. were identified. The project was completed and began to be inhabited in February 2018. Within the results obtained, it was demonstrated that a housing project with these characteristics was technically and financially feasible to build. The final cost, considering that it is the first building of its kind, was similar to one built in concrete and masonry.	Diego	Velandia	Universidad de Los Andes.
9I	ECCS - Architectural	Exemplars & Construction Case Studies - Practitioner Focus	Green Commons - APU new university building , Beppu, Oita , Japan	“Green Commons”, Ritsumeikan Asia Pasific University(APU), is a university building in Beppu City, Oita Prefecture. The symbol of this building is the three-story Atrium in the center called "Commons", which is designed with a wooden frame structure that have the warmth of wood and openness. Glued-in-rod connction are used for the column-beam joints. Large spans are achived by using semi-rigid joints in the gable roof structure and the Vierendeel structure.	Yasuhito	Kinoshita	Takenaka Coporation
9I	ECCS - Architectural	Timber Engineering & Structural Performance - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	Grafting of Traditional Chinese Roofing Structures among Modern China’s Catholic Church Buildings in the Late 19th Century from the Lens of Ningbo Jiangbei Church	The late 19th century marked a significant transformation in China's society, transitioning into a semi-colonial and semi-feudal society. The influx of Western culture and architectural technology had a significant impact on indigenous traditional Chinese construction. Church buildings in this era, as symbols of Western culture, combined Western and Chinese architectural elements and techniques, forming a unique architectural style. Based on the Ningbo Jiangbei Church, compared with other Gothic churches in the same era(1840-1919), the study highlights how Western and Chinese architectural elements were grafted, particularly in the use of traditional Chinese roofing structures. The research reveals that despite the Gothic facade, the church maintained significant traditional Chinese architectural features, reflecting the adaptability of Chinese construction techniques to meet Western design requirements. These buildings, to some extent, demonstrate the attitudes and responses of traditional craftsmen to foreign technological influence, providing clues for the development of modern Chinese timber architecture. The application of traditional frameworks in modern buildings also heralded the transition of traditional timber structures towards modern adaptations.	Rongzhu	Gu	Shanghai Jiao Tong University
9I	ECCS - Architectural	Exemplars & Construction Case Studies - Architectural Focus	Living House – CLT Affordable, fast to build and Carbon Zero House	The scope of the project was to develop an affordable 3-bedroom house that could be built in 6 weeks and achieve negative carbon whole of life certification. The proposal develops a 36 CLT panel ‘flat pack’ CLT mass timber house that has been optimised to become an ultra-low labour, fast-to-build house. The average NZ traditional timber frame house cost is 40% labour, 60% materials, Living House is only 10% labour. The average cost of a government-built 3-bedroom house in NZ is NZ$585,000, and a Living House is NZ$335,000. In April 2025 we completed building a prototype house in Rotorua, NZ. It was proven that it could be completed in 6 weeks for NZ$335,000 and it has been certified negative 140kg/CO2/m2.	Rich	Naish	RTA Studio

SESSION 10
Wednesday 25th June 2025
4:00pm to 5:30pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
10A	TESP- Engineering Seismic Performance	Session Chair: A/PROF MINGHAO LI / UNIVERSITY OF BRITISH COLUMBIA					
10A	TESP- Engineering Seismic Performance	Timber Engineering & Structural Performance - Engineering Focus	EXPERIMENTAL STUDY ON SEISMIC RETROFIT USING SEISMIC RESPONSE CONTROL DEVICES IN A TEMPLE	Temples have a tendency to have very low seismic performance due to the extremely heavy weight of the roofs, small seismic resistance, and few walls. In this study, as a seismic retrofit technique for such temples, we proposed and developed reinforcement using dampers with high-damping rubber that contribute to the improvement of strength, stiffness, and damping performance without significantly changing the layout. This reinforcement can be applied anywhere between columns, and full-scale horizontal excitation tests confirmed that it has high strength and high damping performance. However, a challenge remained that unexpected deformation occurred due to the slip of the frame joints. Therefore, we proposed an improved version that fits the frame members together and clarified the structural performance through full-scale horizontal excitation tests. Additionally, the purpose was to construct a mechanical model and compare it with the experimental results to clarify its applicability and usefulness. By comparing the obtained loading-displacement relationship, standard skeleton curve, and hysteresis area with the data before the improvement, it was found that the deformation of the frame was reduced and the shear deformation mode due to the high-damping rubber of the dampers was increased. Therefore, it is considered that the energy absorbing efficiency of the proposed damper has improved. However, further improvements should be continuously considered to pursue the optimal balance. The establishment of reinforcement using dampers with high-damping rubber is expected to become one of the proposed seismic retrofit methods in temple architecture, leading to further research in the future.	Hokuto	Suzuki	Meiji Univ
10A	TESP- Engineering Seismic Performance	Timber Engineering & Structural Performance - Engineering Focus	DETERMINATION OF CANADIAN SEISMIC FORCE MODIFICATION FACTORS FOR POST-TENSIONED ROCKING CLT WALLS	Post-tensioned cross-laminated timber (PT-CLT) walls coupled with energy dissipation devices (EDDs) have proved to be a low-damage seismic force-resisting system (SFRS) due to their self-centring capability and energy dissipation. Previous studies have also demonstrated the satisfactory performance of such systems in high seismic-risk zones. Nonetheless, this low-damage and resilient structural system can only be designed as an alternative solution in Canada. This is due to the absence of seismic force modification factors (i.e., overstrength-related factor Ro and ductility-related factor Rd) for PT-CLT walls in the latest version of the National Building Code of Canada (NBCC). Therefore, in this paper, to supplement the NBCC, Ro and Rd were developed using the performance-based unified (PBU) procedure. The PBU method validates the proposed Ro and Rd factors using a numerical approach. Nonlinear analyses, such as pushover, response history, and incremental dynamic analysis (IDA) were carried out to assess if the system possesses adequate performance margin ratios (PMRs), including collapse. Overall, this study demonstrated that an Ro of 1.5 and Rd of 5 can be used to design PT-CLT shear wall buildings in Canada.	Huanru	Zhu	McGill University
10A	TESP- Engineering Seismic Performance	Timber Engineering & Structural Performance - Engineering Focus	Seismic Evaluation of Wood-Frame Shear Wall on Podium	The Two-Stage analysis procedure is a design methodology used where a flexible building is placed atop a rigid platform. ASCE 7-22 allows both portions of the structure to be designed independently using this methodology if the lateral stiffness ratio between the lower portion (Podium) and the upper portion (Tower) is at least ten, and if the period of the whole structure is smaller than 1.1 times the Tower's period. Implicitly, this procedure relies on the fact that the acceleration at the top of the Podium is approximately equal to the ground acceleration, which is true if the Podium is rigid enough to cause the relative acceleration to be zero. Multi-story wood-frame towers over concrete podiums are the most common combination of tower-podium structures. This investigation evaluates the seismic performance of a 5-story wood-frame structure with wood structural panel shear wall vertical elements atop a 2-story Concrete Podium using the FEMA P-695 methodology. Two important outcomes were obtained from the study. First, the ground acceleration is amplified at the top of the Podium, and its frequency is modified. Second, if the podium-tower lateral stiffness ratio is large enough, the collapse performance of the Tower is unaffected by the Podium.	Phil	Line	American Wood Council
10A	TESP- Engineering Seismic Performance	Timber Engineering & Structural Performance - Engineering Focus	TRADITIONNAL SEISMIC FUSES IN TIMBER STRUCTURES – PROS AND CONS	In earthquake-prone zones, timber structures are subjected to earthquake loadings that may govern their design. In order to reduce those loads, it is customary to induce ductility and this can only be done through the connections as timber tends to fail mostly in a brittle manner (in tension, parallel and perpendicular, in shear and in bending). Traditionnal seismic fuses or Potential Ductile Elements (PDEs) are designed with small diameter fasteners with material characteristics that ensure repeated strength capacity under cyclic loads. In this paper, the design principles used to detail PDEs are listed and the pros and cons of the different fasteners available to timber designers are provided and explained.	Pierre	Quenneville	The University of Auckland
10A	TESP- Engineering Seismic Performance	Timber Engineering & Structural Performance - Engineering Focus	Seismic performance evaluation of platform-type coupled-panel CLT shear wall systems	This paper presents the assessment and quantification of the seismic performance of platform-type coupled-panel CLT shear wall systems. Numerical models of components will be developed and calibrated using experimental or simulation results, and simplified models of the shear wall system will also be developed. Subsequently, a series of incremental nonlinear dynamic analysis will be conducted on selected archetypes to evaluate the ductility-related (Rd) and over-strength-related (Ro) seismic force modification factors. Those factors will be considered for implementation in the National Building Code of Canada (NBCC) to quantify the seismic performance more accurately. This analysis will adhere to one of the recognized methodologies and account for various uncertainties inherent in seismic performance prediction. Furthermore, this study aims to provide detailed insights into the behavior of coupled-panel CLT shear wall systems under seismic loads, thereby improving the safety and resilience of timber structures.	Jianan	Chen	University of British Columbia
10A	TESP- Engineering Seismic Performance	Timber Engineering & Structural Performance - Engineering Focus	LIFESHELL: CLT FURNITURE AS LIFE-SAVING TECHNOLOGIES	Several seismic events occur every year, causing severe damage to poorly constructed buildings. This project aims to develop affordable wooden furniture that act as shelters to protect humans from building collapse during an earthquake. The concept, named Lifeshell (life in a shell), is based on the use of Cross Laminated Timber (CLT) to create robust and economical furniture (e.g. desk and closet). This system serves as a local survival cell inside existing buildings when there are neither funds nor time for their expensive refurbishments or rebuilding. A preliminary design of a school desk has been projected, modeled, and will then be tested. After defining the geometric characteristics of the desk for load-bearing capacity and ergonomics, non-linear analyses were performed. Following the estimation of static and dynamic behavior, monotonic and impact tests are planned. The data was then processed in an optimal design cycle to obtain a refined version of the desk and its variants. The project also aims to establish a standard proposal for testing and evaluating the capabilities of such furniture.	Edoardo	Giacobbo	National Research Council of Italy, Institute of BioEconomy (CNR IBE)

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
10B	TESP - Engineering Shear Performance	Session Chair: PROFESSOR MINJUAN HE / TONGJI UNIVERSITY					
10B	TESP - Engineering Shear Performance	Timber Engineering & Structural Performance - Engineering Focus	SHEAR PERFORMANCE OF WOODEN RESISTING WALLS WITH DECAY DAMAGE	In this study, the shear tests were performed on full-scale wall specimens with decay treatment to experimentally confirm residual performance. Based on the obtained data, the reduction rate of each strength characteristic value was calculated, and a reduction factor of the shear capacity was proposed. In addition to the points directly related to the expression of the shear capacity, such as the ends connections of the brace and the nail joints of the plywood wall, a significant reduction in strength property values was observed when the column-sill joints, which are subject to pull-out forces, deteriorated. An analysis of the seismic response of wooden house using the skeleton curves of the deteriorated shear walls obtained in the experiment confirmed that the response deformation was larger than that in the sound case.	Ryo	Inoue	Kumamoto Univ.
10B	TESP - Engineering Shear Performance	Timber Engineering & Structural Performance - Engineering Focus	CALCULATION METHOD FOR IN-PLANE SHEAR PROPERTIES OF NLT	NLT (Nail Laminated Timber) was tested to verify its in-plane shear properties and to derive a method to calculate the load deformation relationship of NLT. The NLT test specimens was composed of 20 pieces of Japanese Cypress lumbers of cross section size 45mm x 120mm and length 1900mm. And 75mm length common nails were nailed to connect the lumbers. As NLT is composed of lumbers connected with nail joints the load deformation relationship of NLT was derived by applying incremental displacement analysis with concern of the load deformation relationship of the nail joints. The calculated result well traced the load deformation curve of the test results at smaller deformation level and underestimated the load at larger deformation level. The under estimation of the load at the larger deformation level was supposed to be caused by the embedment of the adjoining lumbers. Based on this assumption the effect of the embedment of the lumbers was considered and included in the calculation. The calculated result almost well estimated the test results both at the smaller and larger deformation level. The results indicate that the in-plane shear properties of NLT can be evaluated though incremental displacement analysis with concern of the load deformation relationship of the nail joints and the embedment of the lumbers.	TIANJUN	XIE	Utsunomiya University
10B	TESP - Engineering Shear Performance	Timber Engineering & Structural Performance - Engineering Focus	DIFFERENCES IN SHEAR PERFORMANCE OF TIMBER MOMENT RESISTING JOINT DUE TO DIFFERENT JOIT TYPES	The timber buildings with semi rigid frame structures are increasing. They have concern to the shear failure because it has large shear stress at the panel zone. The diversity of joints has led to experimental verification of the shear performance of different joints, this is not easy due to the need to conduct experiments on each joint, which increases the costs and the material size of the experiments. In this study, as a first step towards proposing a material experiment to simulate the joint, the behavior of the tensile bolt joint was reproduced using FEM analysis and compared with experimental and estimated values. The results suggest that it is generally possible to reproduce the behavior by analysis.	Kaito	Yamagata	Hiroshima University
10B	TESP - Engineering Shear Performance	Timber Engineering & Structural Performance - Engineering Focus	THE LENGTH OF PLYWOOD SHEAR WALLS MATTERS	Timber-framed construction is a very common method for detached dwelling construction in Australia. In this method, lateral forces caused by wind and earthquakes are resisted by shear wall systems with various sheathing types. The plywood shear wall systems in AS1684, which typically allow builders to achieve full racking capacity with walls as short as 900mm, were validated in experimental testing of walls having a standard length of 2400mm. This study performs 27 shear wall panel tests with length ranges from 450 mm to 2700mm to examine the effect of length on the performance of plywood shear wall systems. Variables of the study include two bracing details from AS1684 and two types of plywood. The findings show that the unit strength and stiffness of timber-framed plywood shear walls varies with respect to the shear wall length. This finding raises concerns that an over-reliance on many short-length bracing walls in a building may be problematic.	Craig	Cowled	Queensland University of Technology
10B	TESP - Engineering Shear Performance	Timber Engineering & Structural Performance - Engineering Focus	TESTING THE INFLUENCE OF SYSTEM EFFECTS ON THE LATERAL RESPONSE IN T-SHAPED WOOD FRAME SHEAR WALLS	This paper examines the impact of transverse shear walls (TSW), out-of-plane bending stiffness of diaphragms (FDIA), and axial (gravity) loading (AXL) on the lateral response of strong wood-frame shear walls (SWs) in multistory light frame timber buildings (LFTBs). Experimental tests assessed the lateral cyclic response of T-shaped SW assemblies with and without diaphragms and gravity load. Tests showed that the TSW effect enhances the lateral stiffness and strength but reduce the deformation capacity. The FDIA and AXL effects further influence the stiffness and strength, and compensate in part the reduction of the deformation capacity due to the TSW effect. Diaphragms also made the T-shaped SW response more symmetrical and improved the evolution of secant stiffness, cumulative dissipated energy, and equivalent viscous damping as the lateral drift increases. Numerical analyses of a theoretical building model with T-shaped SWs showed significant reductions in lateral drift and uplift compared to those of planar SWs alone, highlighting the importance of considering system effects in the seismic design of LFTBs.	Diego	Valdivieso	Centro Nacional de Excelencia para la Industria de la Madera (CENAMAD-CIM UC)
10C	MPD - Architectural / Engineering / Practitioner	Session Chair: DR YUTAKA GOTO / CHALMERS UNIVERSITY OF TECHNOLOGY					
10C	MPD - Architectural / Engineering / Practitioner	Material Performance & Durability - Architectural Focus	Durability performance of Eucalyptus nitens impregnated using supercritical Carbon Dioxide	Wood remains one of our most important carbon neutral structural materials, but many wood species are susceptible to biodegradation. Preservative treatment can minimize degradation, but some species are exceptionally resistant to preservative penetration. An excellent example is shining gum, Eucalyptus nitens, which is globally planted and especially abundant in Tasmania. This species has low decay durability and is exceedingly difficult to effectively treat using conventional processes. One alternative approach is to modify the treatment media using supercritical carbon dioxide (SC-CO). A previous study showed that shining gum could be effectively treated using a mixture of fungicides in SC-CO. However, the ability to deliver biocides into the wood may not necessarily translate into biological performance. The impregnated materials were subjected to laboratory decay tests using a brown rot fungus and above-ground proximity field tests in Queensland and Tasmania, Australia. Laboratory tests were inconsistent, owing to the wide variations in preservative retention. Field trials are three years old and beginning to show results on the untreated controls.	Kyra	Wood	Centre for Sustainable Architecture with Wood

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
10C	MPD - Architectural / Engineering / Practitioner	Material Performance & Durability - Architectural Focus	EFFECT OF ACCELERATED AGING ON THE FIRE REACTION PERFORMANCE OF TWO TYPES OF MODIFIED WOOD	This study aims to evaluate the effects of the degradation caused by atmospheric agents' exposure over time (weathering) simulated in an accelerated aging chamber and the fire behaviour of two types of modified wood: thermo-treated and acetylated. The samples were exposed to accelerated aging cycles, combining condensation, UV radiation, and spraying for four weeks following the protocols based on UNE-EN 927-6:2019 standard. After the aging process, the colour variation was analysed, and the appearance of deformations and splitting was also observed. Flammability tests were also carried out to investigate the fire reaction behaviour of the samples as a function of the exposure time in the accelerated aging chamber. The results showed progressive lightening and colour loss intensity in both types of modified wood after aging. However, the appearance of cracks was more noticeable in the thermotreated wood. Acetylated wood samples exhibited worse fire behaviour than thermotreated, especially before the aging process. The aging process improved the reaction to fire of all the pieces, especially its autoignition capacity.	Eduard	Correal	CTFC - INCAFUST
10C	MPD - Architectural / Engineering / Practitioner	Material Performance & Durability - Engineering Focus	BASIC STUDY OF GLUED LAMINATED BAMBOO (GLB)	In a context of sustainable building construction, bamboo has been paid attention as a promising building material because of its high renewability. However, at the moment, bamboo is not allowed to be utilized as a structural material in the Japanese building code.This paper studies material and joint strength of glued laminated bamboo; GLB, based on the test methods for timber.To clarify the material strength, typical material properties in bending, compression, and shear were tested. In addition, simple joint with screws were tested to clarify its properties. The results showed basic properties of GLB and its screwed joints. It was also confirmed that the test method for timber works well for GLB.	Haruto	MITSUZONO	0
10C	MPD - Architectural / Engineering / Practitioner	Material Performance & Durability - Engineering Focus, Material Performance & Durability - Architectural Focus, Material Performance & Durability - Practitioner Focus	The surface temperature of outdoor undercover glued laminated timber	Glued laminated timber used in outdoor undercover conditions can deteriorate when exposed to the energy of heated air masses and to direct solar radiation. Knowledge of the surface temperature of exposed glued laminated timber can help designers predict deterioration and improve structure performance. The energy equalization of radiation heating and convection cooling can be applied to examine and model surface temperature arising from exposure conditions, including the use of surface finishes. Four surface finishes were studied; a black spirit based stain, an oil based liming white, a clear epoxy resin and no finish. A total of 40 glued laminated timber beams where exposed in sub-tropical Australia and evaluated at three different times, including a summer and a winter solstice. A total of 16 surfaces where orientated horizontally facing upwards with 4 facing downwards, while two sets of 12 beams where oriented vertically with one set facing northwards and one set facing southwards. A model using publicly available weather station data (air temperature, wind speed, solar radiation) was applied for estimating surface absorptivity and for predicting the temperature of exposed glued laminated timber in outdoor undercover conditions.	Geoff	Stringer	University of Queensland
10C	MPD - Architectural / Engineering / Practitioner	Material Performance & Durability - Practitioner Focus, Timber Engineering & Structural Performance - Practitioner Focus, Exemplars & Construction Case Studies - Practitioner Focus	Timber-Masonry Interaction Mechanics: Old Buildings, New Approaches	Working on hybrid timber/masonry buildings a number of recurring problems related to the load response of timber diaphragms and flexural members on the masonry gravity load resisting walls have been identified. Structural distress is particularly pronounced on early modern architectural masonry assemblies such as rain walls, for example, from the late 1800s where the form, materials and construction techniques appear to be incompatible. In this discussion three timber/masonry buildings are examined, looking at how unintended long-term loads have imposed stresses on the connected masonry structural elements, of which climate plays a prominent role. Considering these buildings and their structural problems we review the distinct analytical, stabilization and repair approaches warranted by each of these unique buildings, from the simple and inexpensive to the highly computational. We also consider the role of structural health monitoring and modelling in diagnosis and remediation of structural pathologies and the challenges posed by timber. This also delves into practical considerations from structural engineering practitioner's perspective, especially one working in remote locations. Among these are permitting, training of tradespeople and the availability of materials. These and others play major roles in shaping our solutions to timber engineering problems.	Douglas	La Prairie	Strake Engineering Ltd
10C	MPD - Architectural / Engineering / Practitioner	Material Performance & Durability - Engineering Focus	Ageing resistance of preservative-treated cross-laminated timber under high humidity environmental condition	This study explores the durability of one-component polyurethane (1C-PUR) adhesives in engineered wood products, increasingly used for their technical merits. Focused on their application in preservative-treated softwood, the research compares 1C-PUR with traditional resorcinol formaldehyde (RF) adhesives. Using Mode I fracture energy tests in a single-end notched beam configuration, cross-laminated specimens of both preservative-treated and untreated Radiata pine from New Zealand were tested. These specimens underwent accelerated ageing in conditions of high humidity and temperature every three months for up to nine months. Initial results revealed that a significant reduction in initiation fracture load was noted after three months of ageing. 1C-PUR adhesives perform comparably to RF adhesives, and exhibited a similar reduction range in fracture energy. Fourier Transform Infrared Spectroscopy (FTIR) analysis showed no significant chemical changes in the adhesive layers, though minor spectral deviations were observed.	Weixi	Wang	University of Auckland
10D	TESP - Engineering	Session Chair: MATT SMITH / SIMPSON STRONG-TIE					
10D	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	PERFORMANCE OF NAIL-LAMINATED TIMBER ASSEMBLED WITH WOOD-BASED FASTENERS	The use of mass timber construction is disrupting the construction industry. Traditional environmental impacts from the production of construction materials can be greatly reduced by using carbon sequestering materials, such as timber. However, this disruption of the industry provides a unique opportunity to further improve the construction process, by considering the end-of-life impacts of these processes. A circular approach would allow for material reuse at the end of a building's initial life. To explore this opportunity, this study created a mass timber planar element (Nail Laminated Timber panels) using timbers boards and timber-based fasteners. The result of this approach is a 100% bio-based panel which can be disassembled for adaptation and reuse at the end of life. However, the structural performance of Nail Laminated Timber (NLT) with bio-based fasteners must be clearly understood for this method to be accepted by designers and code officials. This created a theoretical model for the out-of-plane flexural strength and stiffness of these panels based on the beam on elastic foundation theory. To complement and expand on the theoretical model, and analytical model based on the finite element method was created. Using this model, various panel configurations (fastener spacing and location) were considered. The results from the theoretical and analytical model were then verified by lab testing using 5-ply, 16' length Eastern white pine NLT panels. At this time the theoretical and analytical models are complete, and the laboratory based testing will be completed by December of 2024.	Paul	Crovella	SUNY College of Environmental Science and Forestry

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
10D	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	OPTIMIZED DESIGN AND STRUCTURAL PERFORMANCE OF STEEL-ENCASED TIMBER COMPOSITE (SETC) BEAMS	This study examines the influence of timber grades and Cold-Formed Steel (CFS) parameters on Steel Encased Timber Composite (SETC) beams constructed using three assembly techniques: Screwed, Glued, and Plain (Screw-free and Glue-free). The composite interaction between steel and timber in SETC elements enhances their performance under axial loads. The steel initially carries more load due to its higher stiffness and strength, but as deformation increases, the timber assumes a greater role, improving ductility and load-bearing resilience. The experimental program involved 24 beam tests with variations in timber grades, CFS thicknesses, profiles, and screw spacing, as well as different composite assembly methods. Novel bonding strategies were introduced for Plain SETC beams to improve bonding strength and structural efficiency. Key findings: 1. Screwed SETC: Closer screw spacing significantly increased load-bearing capacity, but need more cost specially in labour work. 2. Glued SETC: Strong bonding led to higher load capacities, but unreliable in the bonding strength. 3. Plain SETC: Higher timber grades and thicker CFS profiles enhanced structural performance. The study emphasizes the critical role of optimizing assembly techniques and understanding influential parameters to achieve enhanced structural integrity and performance in SETC beams. Recommendations include further research on dynamic response, long-term durability, and simulations to optimize materials. Overall, the findings highlight the importance of assembly methods and material selection in maximizing the structural benefits of SETC systems, which combine the strengths of steel and timber for lightweight design and cost savings.	Mohamed	Eldeib	University of south Australia
10D	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	Study on the effect of shear stiffness and strength by screw angle and wood grain direction	Ection as parameters. Previous studies have investigated the effect of screw angle on load-deformation performance and stiffness. However, no data have been accumulated on the study of inclined screws driven in different grain direction. In this paper, experimental studies on inclined screws driven in different grain directions are conducted, and regression equations are obtained from the obtained numerical values. The results were compared with the regression equation proposed by Sakata et al[1]. As a result of the comparison, it was found that a highly accurate regression could not be obtained for certain angles, and this problem was solved by multiplying a new reduction factor. This paper compared the test results by using screws and setting the screw insertion angle and wood grain direction as parameters. In conclusion, when using incline screwing to increase shear stiffness, it is necessary to pay attention to the grain direction and in particular to the direction of the side member. In addition,screw insertion angle give the influence on shear stiffness tends to be large, the influence on the maximum load tends to be small.	KOSUKE	FUTABA	SYNEGIC co.,ltd.
10D	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus	MEASUREMENT AND NUMERICAL REPRODUCTION OF HEAT AND WATER TRANSFER IN FULL-SCALE WOODEN BEAMS EXPOSED TO FIRE HEATING	In this study, time variations in the local moisture content of full-scale wooden members exposed to fire heating were measured using a measurement system developed by us. Moreover, we compared the full-scale test results with previous small-scale test results to verify whether the moisture measurement results of the full-scale test can be reproduced in a small-scale test. Moisture content is an important factor affecting the fire resistance of wooden members. Because the moisture content varies because of evaporation, transfer, and recondensation, the temperature dependence of the mechanical properties of wood increases significantly under high moisture content conditions owing to thermal softening of the wooden members exposed to fire.	Tatsuro	Suzuki	Waseda University
10D	TESP - Engineering	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus	Short-Term Performance of Reinforced Glulam Beams	Timber, as a natural and eco-friendly material, is widely used in construction to replace traditional steel and concrete. Moreover, engineered wood products (EWPs) such as glue-laminated timber, have a relatively high strength-to-density ratio while it is easy to assemble and dismantle. This research explored a series of short-term bending tests on steel-reinforced glue-laminated timber beams.	Shuyi	Yang	0
10E	EIC - Architectural	Session Chair: CARMEN SANDHAAS / KARLSRUHE INSTITUTE OF TECHNOLOGY					
10E	EIC - Architectural	Education, Innovation & Challengers - Engineering Focus, Education, Innovation & Challengers - Architectural Focus	TRENDS IN THE DEVELOPMENT OF INNOVATIVE TIMBER PRODUCTS ON THE CONSTRUCTION MARKET IN EUROPE	Extending the existing knowledge of timber construction to new design challenges (multi-storey buildings, complex shaped structures, design for disassembly, resource efficiency, sustainability or affordability, among others) requires innovation. This work aims to analyse the trends in the development of innovative timber products and systems on the market for the timber construction sector. To this end, a descriptive statistical analysis of construction products regulated by the EU's Construction Products Regulation (CPR) was carried out. Both, mature products with CE marking developed under harmonised standards of the European Standardisation Committee (CEN), and innovative products with European Technical Assessment (ETA) certification obtained on the basis of European Assessment Documents (EAD) of the European Organisation for Technical Assessment (EOTA), were included. The results show a trend towards diversification in both softwood and hardwood species for structural applications, and an increase trend in sawnwood and wood-based panels production, mainly from softwoods. Innovative products with ETA certification also show an increasing trend since 2015, produced in Europe and internationally. Most of these are connector for structural applications, building kits, structural wood products and thermal insulation materials.	Uwe	Kies	InnovaWood
10E	EIC - Architectural	Education, Innovation & Challengers - Engineering Focus, Education, Innovation & Challengers - Architectural Focus	STRATEGIC TRAINING DESIGN AND IMPLEMENTATION FOR TIMBER CONSTRUCTION IN URUGUAY.	Within the framework of the Inter-American Development Bank (IDB) and the Uruguayan Ministry of Housing and Territorial Planning (MVOT), this study examines educational strategies employed in timber construction across Canada, Chile, Finland, and Japan. It aims to benchmark diverse methodologies for developing human capital in Uruguay´s construction sector. The research supports strategic planning recommendations to enhance Uruguay´s timber construction industry, addressing education, training, and skills development transversely academia, public and private sectors.	Sol	Villanustre Coppola	Aalto University CENAMAD

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
10E	EIC - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus, Education, Innovation & Challengers - Architectural Focus	Mass Timber Furniture Designs for Optimizing Panel Yield; An Upcycling Strategy to Intercept Mass Timber Drop Concurrent in Panel Manufacturing Production	In the translation of architectural designs to mass timber panel layouts, invariably each job results in a percentage of remnant panel material. The research team is running a case study analysis of a small sample size (3-5) of project cut jobs to identify drop percentages/areas, and explore opportunity to nest small parts for use in modular product designs. Following the case study exercise, an automated nesting script is developed which can be implemented by panel manufacturers interested in reducing their panel waste while simultaneously offering a collection of design objects and furniture as a value-add byproduct. A range of existing and developing mass timber furniture designs enables an optimization of part catalog options to respond to individual panel conditions.	Cory	Olsen	University Of Oregon
10E	EIC - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus, Education, Innovation & Challengers - Engineering Focus, Education, Innovation & Challengers - Architectural Focus	ADVANCING INTEGRATED DESIGN EDUCATION AND CIRCULAR ECONOMY IN WOOD CONSTRUCTION: KIT-OF-PARTS FOR FAST-DEPLOYABLE AND RELOCATABLE STRUCTURES.	This paper describes the development of a methodology for designing reusable wood-based kit-of-parts intended for rapidly deployable structures. This methodology was developed within an interdisciplinary educational framework. In a collaborative design studio, students from two universities explore how modular building systems can meet diverse needs through elements designed for disassembly and reuse. The course underscores the role of technology on wood design, simulation, and construction, describing approaches to designing with and for wood reuse. In the latest course iterations, reciprocal frames were introduced to enhance flexibility and reusability. An improved understanding of machining processes from one year to the next led to a refined design focus. This simplified design constraint expedited the consolidation of multiple design proposals, and streamlined the detailing, prefabrication, and assembly of the final modular structure.	Mariapaola	Riggio	Oregon State University
10E	EIC - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus, Education, Innovation & Challengers - Engineering Focus, Education, Innovation & Challengers - Architectural Focus	Waste Utilization Panels - Design optimization for geometry, structure and material in mass plywood panels additively constructed from offcuts	Mass Timber panels represent a growing sustainable design and structural alternative to steel and concrete as both floor and wall systems. However, mass timber panels made from cross-laminated timber or mass plywood panels, are typically produced in standardized rectilinear volumes with continuous thickness due to both design and manufacturing constraints. This results in excess material compared to the functional needs of the panel. In this research, we propose an additive approach to designing and optimizing the use of fiber and material volume in a mass plywood panel constructed from thin panels combined with linear offcuts. A parametric model with simple fabrication constraints is combined with structural optimization to determine the best material placement, adding depth and directionality to the thin plate. Preliminary results in the design phase show a dramatic reduction in material can be achieved by utilizing an existing typology of linear offcuts. Structural testing is planned to verify the stiffness of the geometrically optimized panels, as well as an initial study on the vibration and acoustic performance of the WUP panels.	Braden Dylan	Lawrie Wood	University of Oregon - Wood Lab
10F	MPD / TESP - Engineering - Fire or Moisture Hazards	Session Chair: DR DAVID LANGE / THE UNIVERSITY OF QUEENSLAND					
10F	MPD / TESP - Engineering - Fire or Moisture Hazards	Material Performance & Durability - Engineering Focus	MODELLING THE SELF-SUSTAINED SMOULDERING OF COPPER BASED PRESERVATIVE TREATED TIMBER	Copper-based preservatives are widely used to enhance timber's resistance to fungal and insect infestations. Our previous studies have demonstrated that these treatments also promote self-sustained smouldering post-fire. To investigate the effects of various conditions and material properties on smouldering, this study develops a model using the Generalized Pyrolysis Model (Gpyro) for self-sustained smouldering of timber treated with Chromated Copper Arsenate (CCA). The model successfully replicated self-sustained smouldering scenarios observed in previous laboratory experiments, highlighting Gpyro's ability to assess smouldering behaviour in preservative-treated timber. Future work will incorporate additional experimental data to further explore the influence of other parameters on smouldering dynamics, aiming to provide a fast prediction tool to optimize fire resilience and durability strategies in wildfire-prone regions.	Wenxuan	Wu	The University of Queensland
10F	MPD / TESP - Engineering - Fire or Moisture Hazards	Material Performance & Durability - Engineering Focus	FIRE AND CLT: LINEAR JOINTS	The topic of fire safety in multi-story buildings has become increasingly important in the field of wood engineering. As wood construction continues to push the boundaries of height and design, it is essential to ensure that buildings are protected from the risks associated with fire. When exposed to fire, wood can release heat, produce smoke, and spread flames quickly, making it critical to design and construct buildings considering fire safety. One key aspect is the sealing of linear joints, which can be vulnerable to heat transfer and ignition. The effectiveness of these seals depends on several factors, including the quality of the sealant material, the thickness of the wooden elements, and the width of the joint. This study aims to investigate the insulation and fire resistance of linear joints in CLT slabs and walls. By characterizing the performance of these joints under various conditions, it would be easier to design and construct buildings that meet the demands of modern architecture. The objective of this research project is to investigate the performance of cross-laminated timber (CLT) in different thicknesses, joint types, and sealing methods. To achieve this goal, three experimental campaigns were conducted. The first campaign tested two CLT slabs with a thickness of 200 mm, employing simple joints, half lapped joints and spline boards and different kind of sealant. In the second campaign, CLT with a thickness of 100 mm in vertical wall configuration was used while also incorporating a wider gaps and different solutions to facilitate prefabrication and simplify installation. The last campaign featured CLT with a thickness of 120 mm, combining the experience of the two previous campaigns. The results of these experiments provide valuable insights into the optimal configuration for CLT construction in various applications.	Sebastian	Jaimes	Rothoblaas
10F	MPD / TESP - Engineering - Fire or Moisture Hazards	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	IGNITION OF A TIMBER CEILING: ANALYSING CONVECTIVE AND RADIATIVE HEATING EFFECTS	Engineered timber buildings require a holistic fire design methodology to address the interaction between the fire-involved structure and the compartment fire dynamics, upon which the required performance of the building's fire safety strategy is predicated. However, research gaps persist, limiting our ability to provide a truly holistic design. The ignition of an exposed timber ceiling can cause rapid fire spread and abrupt change in compartment fire conditions; this directly impacts the available evacuation time. Recently, the authors undertook a bench-scale experimental campaign to study the ignition of a cross-laminated timber specimen at an inverted (ceiling) orientation. This baseline study focused on the impact of radiative heating only. The next stage of the work will also incorporate convective heating to more appropriately represent a series of timber compartment fire scenarios. We anticipate the range of possible results to provide much-needed context to better understand and predict exposed timber ceiling ignition for a range of compartment fire scenarios, to facilitate quantitative and holistic performance-based design.	Joshua	Madden	The University of Queensland

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
10F	MPD / TESP - Engineering - Fire or Moisture Hazards	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	WOODWISE: Large-scale compartment fire tests examining sustainability, smoldering, and emissions	In the United States, timber is a common building material in low and medium-rise construction, up to 25.9m (85ft). Through research and innovation, code changes were enacted in 2021 that eliminated barriers to high-rise mass timber buildings. However, some stakeholders have observed that major technical barriers remain. Specifically, the structural performance of wood during all phases of a fire and resulting emissions from buildings using combustible construction. This paper summarizes a multi-disciplinary research program designed to address the challenges in a holistic and systematic manner through four large-scale fire tests within mass timber compartments with fuel loads of 800 MJ/m2 of real furnishings, with and without encapsulation. The results of this research will be used to improve engineering design methodologies and demonstrate the role these structures play in meeting the sustainability targets of the building construction industry.	Ines	Pitari	Oregon State University
10F	MPD / TESP - Engineering - Fire or Moisture Hazards	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	STRENGTH GRADING OF SATURATED ROUND TIMBER FOR STRUCTURAL APPLICATIONS	Timber foundations piles were historically adopted in Europe to support buildings constructed on weak soils. Nowadays, timber piles are gaining renewed interest in Europe's circular construction, although no design values are present in the timber standard: Eurocode 5 (EC5), 2013. A large testing campaign was conducted on 70 water-saturated European spruce and pine piles. The influence of the most influencing visually- and experimentally-determined material properties on the compressive strength was studied. Possible strength classes for the characteristic compressive strength of spruce and pine piles were proposed and design values were calculated according to the new EC5.	Giorgio	Pagella	Delft University of Technology
10G	TESP - Engineering - Performance of Hybrid Structures	Session Chair: TOBY HODSDON / ARUP					
10G	TESP - Engineering - Performance of Hybrid Structures	Timber Engineering & Structural Performance - Engineering Focus	An Experimental Study of Wood-Steel Hybrid Seismic Wall with Tapered Joints	In recent years, there has been a growing movement to promote the use of wood in Japan, and examples of medium- and high-rise wooden buildings are on the rise. Using this hybrid construction concept, a seismic wall system has been devised that incorporates wood panels in a steel frame to resist earthquakes. These methods use bolts or insert steel plates through slits in the wood to integrate the wood and steel. The concern with this method is that cracking of the steel frame and wood panels may occur during and after construction due to drying shrinkage, resulting in reduced structural performance of the seismic wall. A hybrid seismic wall using tapered joints (referred to as the "existing method") was proposed as a joint type that solves the above problems. The existing method is to integrate wood panels and steel frames by tapered joints. However, this existing construction method left issues such as tracking performance during shear deformation, use of special cross-sections of steel frames, and difficulty in panel fabrication. Therefore, a new seismic wall was developed, and wood compression tests and shear wall tests were conducted to determine the wall's structural performance. Wood panel tests confirmed the relationship between the compressive performance of wood panels and fiber angle. As a result of the full-scale shear test, we obtained basic data for the practical application of this seismic wall.	Ryo	Sasaki	Graduate School of Tokyo Denki university
10G	TESP - Engineering - Performance of Hybrid Structures	Timber Engineering & Structural Performance - Engineering Focus	IMPROVING BENDING PERFORMANCE OF HYBRID STRUCTURE WITH GLUED LAMINATED TIMBER AND STEEL TENSION BAR	The use of wood in the construction sector is recognized as important to achieve the goal of carbon-neutral 2050, globally. Wooden product, produced from trees, is a carbon storage that stores carbon. Wooden product for construction requires less energy in the process of producing, transportation and installation than high energy demand construction materials such as cement and steel widely used in Korea. This is why wooden buildings are expanding abruptly around the world. Various designs should be possible to expand demand of wooden buildings. If a large span is required in some public buildings, a hybrid structure with timber and other materials could be solution to elongate the span without increasing cross-section dimension of timber beams. In this study, the hybrid structure with glued laminated timber and steel tension bar was designed and tested to expand timber structure application. The hybrid beam was designed as inverted king post truss structure. The structure was loaded as three point bending. The results showed the possibility of elongate span with half of cross section dimension of glued laminated timber. It shows the possibility of timber and steel hybrid structure for various applications such as long span public construction designs.	Kugbo	Shim	Chungbuk National University
10G	TESP - Engineering - Performance of Hybrid Structures	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	NONLINEAR MODELING OF CLT-STEEL DIAPHRAGMS WITH SPLINE CONNECTIONS	Cross laminated timber (CLT) and timber hybrid structural systems offer reliability, safety, and sustainability as the environmental benefits and lightweight of mass timber are combined with the high-strength capabilities of structural steel. This study numerically assessed the in-plane behavior of CLT diaphragms connected to steel beams using a high-fidelity finite element (FE) analysis. The design of panel-to-panel spline connections in CLT diaphragms and panel-steel connections made with self-tapping screw (STS) fasteners become crucial in these hybrid systems especially when subjected to extreme lateral loads as these connections need to have adequate strength, stiffness, and ductility. Thus, in order to understand the behavior and performance of these connections and the nonlinear behavior of the hybrid system, the connections were modeled as zero length nonlinear spring elements using the Pinching4 hysteretic material model. The influence of connection design was evaluated by conducting a parametric study to better understand the in-plane deflection, load path, and failure pattern in CLT diaphragms. The results obtained obtained will help establish better guidlines for designing CLT diaphragms for hybrid CLT-steel in North America.	Della	Thomas	Virginia Polytechnic Institute and State University
10G	TESP - Engineering - Performance of Hybrid Structures	Timber Engineering & Structural Performance - Engineering Focus	Experimental Study on the Synergistic Lateral Resistance of CLT Walls and Tension-only Braced Frame	This paper proposes a novel structural system—Beam-through steel-timber hybrid structure—leveraging the high ductility of tension-only braces and the ease of installation inherent to floor-by-floor construction methods. To investigate the collaborative lateral resistance between CLT walls and tension-only braces within this system, two full-scale specimens consisting of a combination of CLT wall and tension-only braced frame were designed and subjected to low-cycle repeated loading tests. The experimental results demonstrate that the tension-only brace, serving as the first line of seismic defense, contributes over 70% of the initial lateral stiffness in the elastic stage of the structure. When the inter-story drift ratio reaches 1/50, the shear force contribution from the CLT wall in both specimens exceeds 50%, indicating their potential to function as the second line of seismic defense.	Yuan	Gao	Tongji University

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
10G	TESP - Engineering - Performance of Hybrid Structures	Timber Engineering & Structural Performance - Engineering Focus	ALTERNATIVE SEISMIC DESIGN OF MULTI-STOREY TIMBER STRUCTURES	Research on the structural response of large, multi-story timber buildings under horizontal loading conditions, such as wind and earthquakes, remains limited in the existing literature. A significant gap in recent developments is the lack of experimental evidence, particularly on fundamental topics such as hysteretic energy damping characteristics, deformation capacity, and their relationship to the soil-structure interaction (SSI) phenomenon. In multi-story timber structures, energy dissipation occurs at element-to-element connections or timber-to-foundation connections through energy-dissipating connectors and hold-downs. The HYSTERESIS project, as detailed in this paper, tackles these critical challenges by employing geographically distributed hybrid testing. This innovative approach distributes the complex experimental setup across two continents and four countries for simultaneous testing. This paper outlines the design principles of a 3D pilot structure, balancing realistic timber design practices with experimental and numerical limitations. In preparation of the design specimen, various 3D multi-storey structures were designed against seismic actions, and the major findings are discussed in this paper.	Eleni	Smyrou	Hanze University of Applied Sciences
10H	TABD - Architectural	Session Chair: DR EUGENIA GASPARRI / THE UNIVERSITY OF SYDNEY					
10H	TABD - Architectural	Timber Architecture & Biophilic Design - Architectural Focus	Timber Industrial Heritage	Industrial heritage has recently become a tourist and cultural resource, without forgetting its social aspect. Timber was widely used in the industrial sector during the pre-industrial era and the early stage of the Industrial Revolution. In more recent times, steel and concrete have significantly displaced timber in the industrial sector. However, timber was and is still used in certain industrial applications due to its advantages over other structural materials, such as high strength/density rate, durability, cost-effectiveness, and, more recently, sustainability and aesthetic aspects. Some examples include saltworks and phosphate factories, where the aggressive nature of the product provides timber with a clear durability advantage compared to steel or concrete. Timber species were selected depending on the industrial use (structure, machinery) based on economical and durability reasons. Recent interventions in timber industrial heritage are mainly related to a change of use (museums, offices, libraries, etc.). Protection policies depend on countries and regions, and some elements are protected under inclusion in the World Heritage List.	Daniel	Fernandez Llana	Universidad Politécnica de Madrid (UPM), Spain
10H	TABD - Architectural	Timber Architecture & Biophilic Design - Architectural Focus	PREPARED SYNTHETIC WOOD BEAMS: THEIR FEASIBILITY AND POSSIBLE DEVELOPMENTS IN ARCHITECTURAL DESIGN	This paper is to illustrate the idea of "Prepared Synthetic Wood Beam" which has deformed section prepared for special use as an architectural element, such as for roofs, claddings, and louvers. We developed various sections which might be used in architectural project, while it serve as ecological equipment of heat collection, water preservation, as natural light fixture, and so forth.	Yoshito	Tomioka	Mie University
10H	TABD - Architectural	Timber Architecture & Biophilic Design - Architectural Focus	TOWARDS RECIPROCAL FEEDBACK BETWEEN TIMBER ARCHITECTURE, ENGINEERING AND ADDITIVE MANUFACTURING BY STRATOCONCEPTION®	Additive manufacturing (AM), recently adopted by the construction industry to enhance productivity and efficiency, is not yet fully recognized as a production method that challenges conventional approaches to designing architectural components. The Stratoconception® additive manufacturing process presents an opportunity to merge AM's inherent potentials with the existing technical and material capabilities of the timber construction industry. This study examines how timber parametric design practices and the Stratoconception® process influence and enhance each other to address the limitations of timber construction. Using a research-by-design methodology, it compares two different CADCAM workflows to deepen the understanding of the reciprocal feedback between design and production processes. The first workflow highlights the extensive feedback required to reconcile freeform, mass-customized architectural components with industrial production constraints. To streamline this process, we propose a new digital file-free continuum using Rhino.Inside TopSolid, integrated within Grasshopper parametric models to interact directly with TopSolid'Strato add-in. This approach aims to establish a more efficient framework for developing innovative architectural components that meet contemporary challenges.	Anwar	NEHLAWI	LERMAB, URM MAP-CRAI & Université de Lorraine
10H	TABD - Architectural	Timber Architecture & Biophilic Design - Architectural Focus, Timber Architecture & Biophilic Design - Practitioner Focus, Exemplars & Construction Case Studies - Architectural Focus	ADDRESSING CHALLENGES IN MANUFACTURING IRREGULAR WOODEN POLES: A PRACTICAL EXPLORATION ON ACCURACY, EFFICIENCY, AND COST	The primary challenge in advancing the practical application of wood-wood connections lies in addressing the deficiency in performance metrics of manufacturing irregular wooden poles, such as accuracy, efficiency and cost. This study aims to address the above challenges. Initially, a comparative experiment was conducted between robotic and manual workflow to evaluate the performance differences of manufactured irregular wooden poles. A series of improvement strategies based on the evaluation results was formulated, including optimization of connection details, integration of machinery and craftsmanship, and pre-planning of workflows. These strategies effectively addressed the challenges associated with manufacturing irregular wooden poles through verification in a practical timber dome project, aligning with the growing trend of design for manufacture and assembly strategies, timber modular construction, and mass customization. Moreover, this study served as a reference for fabricating wood-wood connections with irregular poles and indicated a potential integrated application of appropriate machinery and craftsmanship.	Harrison	Huang	Zhejiang University
10H	TABD - Architectural	Material Performance & Durability - Architectural Focus	HOLISTIC HYGROTHERMAL PERFORMANCE ASSESSMENT OF EMERGING TIMBER ENVELOPES: FIELD TESTING AND TRANSIENT BUILDING SIMULATIONS.	The use of timber in construction brings multiple benefits, such as reducing the environmental impacts of buildings, as it often presents a lower embodied carbon alternative. However, when timber-based construction systems (external walls and roofs) are not designed correctly, they can present a high mould risk, compromising building performance and occupant health. This research focused on assessing the resilience of multi-layered timber envelopes to moisture and mould growth by conducting field testing. PHEBE (Prototype of Highly Efficient Building Envelopes) is a test facility created by the Façade Research Group at Sydney University`s School of Architecture Design and Planning with the objective of evaluating the hygrothermal performance of emerging envelope solutions. This study presents a holistic evaluation by comparing different construction solutions under real climatic conditions, as PHEBE presents different configurations for insulation, membranes, and boards. Each configuration is equipped with wireless sensors to monitor temperature, relative humidity and water content at different construction layer interfaces. Expected results will provide insights into current design and construction trends, providing quantitative evidence that will allow for improvements and recommendations for moisture-resilient, durable, and healthy buildings in Australia.	Natalia	Saavedra	University of Sydney

SESSION 11
Thursday 26th June 2025
8:30am to 10:30am

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
11A	TESP - Engineering Connections	Session Chair: PROFESSOR ALEXANDER SALENIKOVICH / UNIVERSITE LAVAL					
11A	TESP - Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	LOOPED STRAP CONNECTIONS	The uplift forces on roofs can be quite severe, particularly in cyclonic regions. Roof-to-wall connections (RWCs) must be robust enough to safely resist expected loads from high wind events. Several RWC details in the Australian Standard for residential timber-framed construction AS1684 describe a steel strap wrapped over a rafter, looped under the top plate, and nailed into the back of the top plate. Supporting data could not be found for these details. We tested 21 different configurations of looped strap RWCs and found that the design load of 13kN in AS1684 is appropriate if quality steel strap is used.	Craig	Cowled	Queensland University of Technology
11A	TESP - Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	EXPERIMENTAL INVESTIGATION OF SLOTTED-IN PLATE MOMENT CONNECTIONS IN TIMBER FRAME BUILDINGS	The use of bolts in slotted-in plate moment connections is a common practice in timber construction. In the past decades, the number of research work explaining the load transfer mechanism of moment connections has increased. However, the design and application guidelines are still limited. In this paper, bolted slotted-in plate moment connections with multiple configurations are experimentally tested. The results are used to verify the EN 1995-1-1 equations and to investigate the service conditions. First, shear tests on single bolt are conducted followed by single moment connection and then by a double moment connection. The results showed that the connections are controlled by the fastener behaviour, therefore a sufficient prediction is necessary. The deviations with the rigid model approach has shown the need for an improved model.	Elif	Appavuravther	Hasselt University
11A	TESP - Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	INVESTIGATING NOVEL STEEL-TIMBER CONNECTIONS AND THE EFFECTS OF KNURLING THROUGH EXPERIMENTAL DIRECT SHEAR TESTING	Throughout the U.S., engineers are coupling steel beams and girders with mass timber panel floors for building construction. However, even though these designs are being constructed, there are knowledge gaps as it pertains to (1) stiffness of the floors for vibration and (2) diaphragm design for seismic applications. Most of the previous research on steel-timber hybrid floors has investigated the flexural strength of the floors and there is limited data on the stiffness characteristics of these floors for serviceability limit states (e.g., vibration). This research will (1) quantify and investigate the in-plane force-slip behaviour of connectors for steel-timber hybrid diaphragms and (2) examine how CLT deck orientation can influence the potential for composite action for beams and girders. A comprehensive testing plan has been developed to quantify the behaviour of composite connectors for steel-timber hybrid floors at low amplitude loading. Three different connectors were tested: (1) 90-degree self-tapping screws to be installed from below the CLT, (2) powder actuated fasteners driven through the CLT and into the steel beam from above, and (3) MTC screws installed from above. The experimental investigation consists of individual beam tests subjected to three different loading scenarios. The three tests are, first, a hammer test that provided data for the vibrational characteristics of the steel-timber hybrid by exciting a range of mode shapes. Second, a low amplitude cyclic flexural test loaded the specimen to 40% of the theoretical maximum flexural capacity of the beam providing composite action characteristics as service level loading. Lastly, a direct shear test was performed, loading the specimen to failure, and providing valuable post peak data for seismic design. The results from the tests described will provide valuable data for numerical simulations and inform design methodologies for steel-timber hybrid floors under varying loading conditions.	Detlef	Laughery	Oregon State University
11A	TESP - Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	PERFORMANCE OF TWO-STOREY PLATFORM-TYPE CLT SHEAR WALLS	This paper presents an experimental parameter study on the lateral performance of two-storey platform-type cross-laminated timber (CLT) shear wall structures using self-tapping screw connections. The test program included five reversed cyclic tests to investigate the effects of three key factors: additional floor mass, different angle bracket connections between floors, and different tension strap connections between floors. The findings demonstrated a notable influence of TS on the flexibility of the second floor and its role in promoting consistent drift behavior throughout the building's height. Sliding and panel distortion exhibited minimal influence on overall lateral deflection. Additionally, an enhancement in lateral resistance was evident upon the introduction of gravity loads.	Mohammad	Masroor	University of Northern British Columbia
11A	TESP - Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	Block Tear-Out Resistance of High-Performance Hybrid Grout-Steel-CLT Connections for Balloon-type Shear Walls: Experimental Study	This study aims to evaluate the performance of a novel hybrid grout-steel connection for balloon-type cross-laminated timber (CLT) shear walls. Three different connection configurations with various grout diameters were fabricated and tested. The connections were subjected to pull-out shear loading in the direction parallel to the face laminations of the CLT panel. The objective of the testing campaign was to determine the effect of end-distance and grout diameter on the connection's performance, namely the initial stiffness, the yield and maximum load-carrying capacity, the failure mode, and post-peak behavior. This information will be used further to set minimum end-distance requirements to avoid brittle failure of the joints under static loading. The research outcomes are expected to provide a reliable dataset for the development of design equations for designing resilient, high-performance connections for mass timber buildings.	Cristiano	Loss	The University of British Columbia
11A	TESP - Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	EVALUATION OF WOOD-TO-WOOD CONNECTIONS OF THE SPECIES Campnosperma panamense Standl. USING BOLTS AND NAILS SUBJECTED TO LATERAL LOADING	The present work presents the behavior of wood-to-wood connections with bolted and nailed connections subjected to lateral load using air-dried wood from Campnosperma panamenes Standl., a native Colombian species of low density, for the adaptation of the connection design methodology in the new Colombian Seismic Resistant Standard. Ten (10) experimental tests were carried out per connector, observing that bolted connections presented a higher safety factor with respect to nailed connections, where for bolted connections, where for bolted connections, a single value below the minimum safety factor was obtained, while for nailed joints three (3) cases were presented. In addition, they found significant differences between the densities worked, indicating that the density of the wood used in the calculations has a considerable impact on safety factors.	Diana	Ibáñez	Universidad Distrital Francisco José de Caldas
11A	TESP - Engineering Connections	Timber Engineering & Structural Performance - Engineering Focus	NUMERICAL SIMULATION OF THE EFFECTIVE NUMBER OF FASTENERS IN DOWEL-TYPE TIMBER CONNECTIONS	Standard design codes implicitly address brittle failure modes in single-row multiple-dowel connections by considering an effective number of fasteners. This parameter accounts for the group effect, which considers the load distribution and interaction among the dowels. Consequently, the load-carrying capacity of a single-row in multiple-dowel connections is lower than the sum of the capacities of individual dowels. Empirical expressions for the effective number of fasteners have been proposed in the literature and are currently used in the design. This study investigates the parameters influencing the effective number of fasteners of timber-to-timber and steel-to-timber connections with stocky dowels, meaning they do not undergo plastic deformations, through a numerical approach grounded in linear fracture mechanics. The numerical model aligns well with previous experimental results and provides a novel approach for predicting crack initiation and assessing the group effect based on a realistic load distribution among the dowels, while taking advantage of high computational efficiency.	Jorge	Branco	University of Minho, Department of Civil Engineering
11B	TESP - Engineerng Robustness & Natural Disaster Resilient Structures	Session Chair: PROFESSOR HIROSHI ISODA / KYOTO UNIVERSITY					

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
11B	TESP - Engineerng Robustness & Natural Disaster Resilient Structures	Timber Engineering & Structural Performance - Engineering Focus	RELIABILITY ANALYSIS OF WIND EXCITED TALL MASS-TIMBER BUILDINGS WITH ROCKING POST TENSIONED CROSS LAMINATED TIMBER SHEAR WALLS	The current code-based wind design of main wind force resisting systems (MWFRSs) only considers buildings' linear-elastic capacity, resulting in costly designs requiring commercially unavailable timber cross sections. In contrast, performance-based wind design (PBWD) enables optimal design solutions by allowing nonlinear-inelastic deformation in components of MWFRSs and reliability analysis. In this paper, a stochastic simulation-based PBWD framework is proposed to design and estimate the wind reliability of tall mass-timber buildings with rocking post-tensioned cross-laminated timber (PT-CLT) shear walls. The framework integrates stochastically generated wind tunnel-based load time histories, nonlinear response history analysis (NLRHA) using three-dimensional numerical models, and a stratified sampling scheme to propagate uncertainties. Experimental tests of ductile links in PT-CLT walls were conducted using newly developed wind-loading protocols to determine modelling parameters for NLRHA. The framework was implemented to design and perform a reliability analysis of a 16-storey prototype wind-excited mass-timber building hypothetically located in Toronto, Canada. The results indicate that the proposed PBWD framework is practical and effective for designing and analyzing wind reliability of tall mass-timber buildings with PT-CLT shear walls as MWFRS.	Nahom	Berile	McGill University
11B	TESP - Engineerng Robustness & Natural Disaster Resilient Structures	Timber Engineering & Structural Performance - Engineering Focus	BUCKLING PERFORMANCE OF NAIL LAMINATED TIMBER FOR BEARING SHEAR WALL, BUCKLING TESTS AGAINST VERTICAL LOAD FOR LOAD-BEARING WALLS	The goal of this study is to construct a formula that will serve as a design standard for NLT load-bearing walls. As a first step in this research, we assumed a case in which NLT was used as a load-bearing wall, and verified the buckling load due to vertical loads, structural performance, and behavior. Tests were conducted using parameters such as the number of butt joints, differences in nail pitch, and the presence or absence of plasterboard.	Runa	Kato	Nippon Institute of Technology
11B	TESP - Engineerng Robustness & Natural Disaster Resilient Structures	Timber Engineering & Structural Performance - Engineering Focus	STUDY ON ESTIMATION OF SHEAR STRENGTH OF PLYWOOD SHEATHED SHEAR WALLS WITH SMALL OPENINGS	In recent years, the expansion within medium and large scale wooden buildings has received much attention. However, the change from residential scale to medium and large scale brings challenges in various aspects, such as changes in building design methods and preparation of codes. Small openings are made in interior walls to install ducts, outlet boxes, switch boxes, etc. In the past, for small residential buildings, it was not a problem to consider shear walls with small openings as non-shear walls. This was because the entire building had a surplus of earthquake resistance. However, as buildings have become larger, the required earthquake resistance has increased. There is no longer a margin for the earthquake resistance of the entire building, and it is necessary to verify the loss of performance due to small openings. In addition, the current standards for small openings have no experimental or theoretical basis, and their applicability to high-strength shear walls is also unclear. It is urgent to establish a new method to accurately calculate the performance of shear walls with small openings in order to promote medium and large wooden buildings and create a sustainable society. Therefore, the purpose of this study is to verify the effect of small openings on the shear capacity of plywood shear walls and to propose a method for calculating the capacity of plywood sheathed shear walls with small openings. No reduction in shear capacity due to small openings was observed for walls with low maximum strength on the residential scale or for small openings that did not require reinforcement. On the other hand, shear walls with high maximum strength, such as those used in medium- to large-sized wood-frame buildings, showed reduced shear capacity due to small openings that required reinforcement. Shear failure of the plywood was the primary cause of the reduction in maximum strength. It was confirmed that the remaining width of the plywood bore the shear strength.	Yuta	Sakai	National Institute for Land and Infrastructure Management
11B	TESP - Engineerng Robustness & Natural Disaster Resilient Structures	Timber Engineering & Structural Performance - Engineering Focus	Full-scale experimental testing of a low-damage, resilient, two-storey Cross Laminated Timber (CLT) wall structure	A full-scale, two-story Cross-Laminated Timber (CLT) structure is being constructed at the University of Auckland, designed with a focus on low-damage and resiliency. The structure's design incorporates innovative low-damage wall-to-floor shear keys, among other innovative connections. The performance of the structure will be tested in-plane, out-of-plane, and bi-directionally to obtain a realistic assessment of the system. This approach will allow for the observation and examination of the intended design of connections, shear keys, and the overall structure. The goal is to demonstrate that the structure can endure significant drifts while maintaining complete displacement and force compatibility, without any damage to the CLT members and without yielding any of the connections and fasteners.	Pierre	Quenneville	The University of Auckland
11B	TESP - Engineerng Robustness & Natural Disaster Resilient Structures	Timber Engineering & Structural Performance - Engineering Focus	A STUDY ON DISPLACEMENT ESTIMATION OF LATH-MORTAR UNDER EARTHQUAKE	The lath-mortar as an external facing member is to be constructed onto several overlapping members, such as plywood, furring strips, and wooden laths, where these members are attached to a timber frame by nails. Therefore, there was an issue that made it complicated to evaluate the differential displacement between a lath-mortar and a timber frame under earthquakes. Therefore, the goal of this study was set to establish a structural model of the external wall with lath-mortar for enabling FEM analysis. Firstly, static shear loading tests of lath-mortar external wall specimens were conducted to understand the behavior of a lath-mortar under earthquakes, where it was found that plywood between a timber framework and a lath-mortar increases the maximum shear force remarkably. Next, the analysis of a joint, which consists of several overlapping members attached by some nails, was carried out, and the shear force-displacement relationship of the combined nail joint was clarified. Finally, the shear force-drift angle relationships of the lath-mortal external wall specimens could be estimated successfully by FEM analysis using the shear force-displacement relationships of the combined nail joint.	Masato	Nakao	Yokohama National University
11B	TESP - Engineerng Robustness & Natural Disaster Resilient Structures	Timber Engineering & Structural Performance - Engineering Focus	SEISMIC COLLAPSE ASSESSMENT OF TIMBER BRACED FRAMES WITH FRICTION JOINTS USING FEMA P695 METHODOLOGY	Little research has been conducted on the behaviour of timber seismic load resisting systems using friction joints (FJs), particularly those involving timber braced frames (TBFs). This paper proposes seismic design parameters for timber braced frames with friction joints (TBFFJs) and evaluates their performance using the FEMA P695 methodology. A hysteresis model is developed and implemented in OpenSees and validated against existing experimental results. A total of three multi-storey (3-, 6-, and 12-storey) structures with TBFFJs were analyzed using the proposed model to validate the design methodology. Static pushover and incremental dynamic analyses using 44 ground motions were conducted and adjusted collapse margin ratio were compared with allowable limits provided in FEMA P695. Response modification factors are determined and proposed based on the results of these analyses.	Christian	Viau	Carleton University
11B	TESP - Engineerng Robustness & Natural Disaster Resilient Structures	Timber Engineering & Structural Performance - Engineering Focus	INNOVATIVE ADHESIVE BONDING IN TIMBER-CONCRETECOMPOSITE SYSTEMS: TOWARDS A COMPETITIVE CEILING SYSTEM	The construction industry is facing increased pressure to adopt resource-efficient practices due to escalating global sustainability challenges. This has led to a search for innovative and eco-friendly building materials, designs, and processes to address these concerns. One promising approach is the development of timber-concrete-composite (TCC) ceiling systems. TCC systems offer significant potential by combining the advantages of timber and concrete, providing enhanced structural performance while addressing ecological and economic aspects. This method has the potential to overcome various challenges associated with traditional TCC systems, such as reliability, durability and affordability. Despite the recognized potential of the continuous bonding of concrete and timber, a significant knowledge gap remains due to the lack of comprehensive data on the adhesive joint's structural performance. For a full understanding of how these hybrid components performs under load, a systematic investigation is essential to generate reliable data for future design approaches. The presented study includes a series of experimental investigations on full-scale ceiling elements, with different lengths, bonding techniques, as well as cross sections. Each specimen was subjected to a full scale four-point bending test to evaluate its load-bearing behavior until failure. The experimental results demonstrate a high bending stiffness of the investigated systems, directly affecting the serviceability. The results underline the significant potential of adhesive bonded TCC ceiling systems, declaring them as a competitive option based on the high structural performance. It shows that further research is required, particularly regarding the long-term behavior and its limitations in design.	Florian	Brosch	BOKU University

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
11C	TESP - Engineering - Material Properties	Session Chair: PROFESSOR ARIJIT SINHA / OREGON STATE UNIVERSITY					
11C	TESP - Engineering - Material Properties	Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	Investigations on STCC-Shallow floor beams: comparison between strain-based derived bending resistances and results of numerical models	To limit the emission of greenhouse gases, the 'Green Deal' and the Taxonomy Regulation were introduced in the European Union. This inevitably leads to a change in the construction industry, with the aim of reducing carbon dioxide emissions to (net) zero by 2050. The consideration of constructional timber can also be purposeful. For steel construction, this means expanding the composite construction method from steel-concrete to steel-timber and possibly also steel-timber-concrete composite (STCC) solutions. While for steel-concrete composite (SCC) shallow floor beam design rules are being proposed [3], so far for steel-timber composite (STC) there exists no design rules. In this contribution, STCC shallow floor beams are investigated, targeting a reduction of the floor height and so either a reduction of the building height or the construction of more floors for a same building height. In the investigated solutions, timber is replacing the steel sheet and most of the concrete met in traditional steel-concrete beams. This change in material results in a different load bearing behavior and different mechanical characteristics which need to be accounted for when evaluating the overall bending capacity. The paper shows the results of investigations on steel-timber-concrete shallow floor beams using a strain limit approach for the prediction of the bending capacity and	Adil	Ahmad	University of Luxembourg
11C	TESP - Engineering - Material Properties	Timber Engineering & Structural Performance - Engineering Focus	INFLUENCE OF MATERIAL PROPERTIES OF COMPONENTS ON ROOF CURVE IN TEMPLE ARCHITECTURE	The roof curve of Japanese traditional architecture called "Nokizori" influences the proportions of the architecture and is one of the most important aspects. The traditional Japanese wooden roof construction method developed from ancient times to the early modern period and reached its perfection. The roof is divided into two layers, and the eaves are supported by an element called "Hanegi", which is placed between the two roofs. As the eaves deflect under the weight of the roof, changes in the material properties of the components are thought to cause changes in Nokizori. We investigated Nokizori at the renovation site and performed static deadweight analysis to understand the effect of the Young's modulus of the components on Nokizori. The results of the analysis indicated that the component that could affect Nokizori was Hanegi.	Natsuki	Horie	Toyo University
11C	TESP - Engineering - Material Properties	Timber Engineering & Structural Performance - Engineering Focus	COMPARATIVE STUDY OF CREEP MODELS FOR WOOD AND TIMBER EXTRAPLOATED OVER 100 YEARS IN CONSTANT CLIMATE	This work examines the accuracy of some creep models to determine which one is better able to capture the rheological deformation of spruce over medium and long time periods. A series of analytical works were done to determine a model that not only fits the best with the available experimental data but also has a lower number of elements and parameters among the examined creep models.	Mohsen	Naghdinasab	Materials Testing Institute (MPA), University of Stuttgart
11C	TESP - Engineering - Material Properties	Timber Engineering & Structural Performance - Engineering Focus	Experimental Analysis of the Influence of the Fastener Material and Loaded End and Edge Distances on the Embedment Strength Parallel to the Grain in Glued Laminated Timber	Embedment strength is an important parameter that governs the ductile load-carrying capacity of timber joints with dowel-type fasteners. This property is dependent upon several factors, such as the fastener material and the size of the test specimens. Therefore, this paper tested the embedment strength parallel to the grain using smooth steel dowels and densified wood dowels with a diameter (d) of 12mm, in glued laminated timber with different loaded end distances (4d, 7d, 8d, 9d) and edge distances (2d, 3d, 4d). It was found that the embedment strengths of the specimens using smooth dowels with edge distance of 2d were significantly lower than those of the specimens with edge distance of 3d, and the embedment strengths of the specimens using smooth steel dowels and densified wood dowels did not show statistically significant difference, when the edge distance of specimens is not less than 3d.	Hongfang	Guo	Dalian University of Technology
11C	TESP - Engineering - Material Properties	Timber Engineering & Structural Performance - Engineering Focus	Study On Flexural Behavior Of Cold Formed Steel-Oriented Strand Board Composite Joists	An environmentally friendly composite joist was proposed, which is comprised of top and bottom flanges made of cold-formed thin-walled hat-section steel connected with a web made of oriented strand board (OSB) by fasteners.The push-out tests were firstly carried out to compare the load-carrying capacity and stiffness of the cold-formed steel-OSB joints with different fasteners, i.e., cross slot countersunk head self-drilling self-tapping screws, hexagon flange head self-drilling self-tapping screws and hexagon bolts. It was found that the joints with the cross slot countersunk head self-drilling self-tapping screws have the best mechanical performances. Then, the composite joists were tested under the four-point bending, and their flexural performance was compared with that of I-joists. The load-carrying capacity of composite joists with a screw spacing of 50 mm was 90% of that of I-joists, and their flexural stiffness was higher than that of I-joists.	Shi-Yuan	Jiao	Dalian University of Technology
11C	TESP - Engineering - Material Properties	Timber Engineering & Structural Performance - Engineering Focus	Statistical Length Effect on the Compression Strength of Australian Radiata Pine Solid Sawn Timber	This study investigates the length effect on the compression strength of Australian Radiate Pine solid sawn timber. Using Monte Carlo simulation, 8,816 samples with dimensions of 35 x 90 mm and grades of MGP10, MGP12, and MGP15 were analysed. Results showed a significant length effect on compression strength, affecting both the 50th and 5th percentiles, with a slight grade dependence. Additionally, a two-parameter lognormal distribution for different grades and lengths was proposed for application in stochastic structural design approaches.	Abbas	Abbara	University of South Australia (UniSA)
11C	TESP - Engineering - Material Properties	Timber Engineering & Structural Performance - Engineering Focus	EVALUATION OF EQUIVALENT SHEAR STIFFNESS AT EACH RENOVATION STAGE IN THE TRADITIONAL WOODEN BUILDING	In this study, we investigated the vibration characteristics of traditional wooden buildings in the renovation stage. We conducted constant microtremor measurements of the building three times: (1) before the roof frame was constructed, (2) after the roof frame was constructed, and (3) after the roof was tiled, and compared the natural frequencies and natural vibration modes. Furthermore, by calculating the equivalent shear stiffness of the target building and comparing the results of each measurement, we confirmed the influence of the building's equivalent stiffness on the vertical load of the roof weight. In addition, the results of a parametric study in which the equivalent stiffness of the vertical structural surface was replaced with the rotational stiffness of the joint, showed that when changing from (2) after the roof frame was constructed to (3) after the roof was tiled, the equivalent stiffness of the vertical structural surface is 2.08 times.	Hina	Takizawa	Toyo University
11C	TESP - Engineering - Material Properties	Timber Engineering & Structural Performance - Engineering Focus	Process combination peeling and sawing of large-diameter timber: thick peeled products for yield-optimized structural laminated timber products	Coniferous roundwood of common qualities is usually industrially processed in chipping-sawing lines which are widely limited to log diameters of < 45 cm. The raising stock of large-diameter softwood in the DACH region, especially of Norway spruce, necessiates to rethink the processing to sawn wood and thereof produced products. This paper discusses a process combination of rotary-peeling and sawing for large-diameter roundwood of Norway spruce. Thereby, the aims are a higher yield, extended thickness range of thick peeled products (TPPs; thickness > 6 mm) by also providing a first physical / mechanical characterization of them and thereof produced laminated peeled products (LPPs) demonstrating, exemplarily, also their high-potential for the production of linear and planar structural laminated timber products (SLTPs).	Markus	Tripolt	Institute of Timber Engineering and Wood Technology, Graz University of Technology
11D	TESP - Engineering - Concentrated loadings & reinforcing methods	Session Chair: PHILIPP DIETSCH / KARLSRUHE INSTITUTE OF TECHNOLOGY					

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
11D	TESP - Engineering - Concentrated loadings & reinforcing methods	Timber Engineering & Structural Performance - Engineering Focus	Quantification of Positional Imperfections of Self-drilling Screws and Examination of the Technical Causes	Unwanted contact and collision between adjacent screws are technical problems with respective safety relevance. They are being caused by positional imperfections which arise both systematically and randomly during insertion. To investigate the underlying mechanisms of such imperfections, approximately 1000 screw-in tests were carried out in GLT, CLT, and LVL. For varying parameters, the deviation between the planned and actual exit points of the screws were determined. The results show that the angle α between the screw axis and the grain direction of the wood, the screw slenderness and tip design influence the magnitude of positional imperfections significantly.	Eva	Baldauf	Timber Structures and Building Construction, KIT
11D	TESP - Engineering - Concentrated loadings & reinforcing methods	Timber Engineering & Structural Performance - Engineering Focus	A NEW NODE-FOCUSED EXPERIMENTAL APPROACH TO INVESTIGATE LOAD-BEARING BEHAVIOR IN TIMBER TRUSSES	To investigate the complex load-bearing behavior of trusses, particularly at the nodes, tests of complete trusses or partial sections of trusses would be necessary. However, these tests can require significant effort. Therefore, a new test method was developed to examine individual nodes, focusing on the most stressed ones. A test setup was designed to generate the internal force and moment ratios found in real trusses. It allows for variations in the connection angles of the individual members with manageable effort. Additionally, it enables adjustments in the ratio of internal forces and moments of the components in order to investigate the effects of moment loadings in trusses that deviate from ideal frameworks. Consequently, the numerous varying parameters enable a comprehensive analysis of the load-bearing behavior of a truss joint, while significantly reducing the effort compared to commonly used methods.	Lisa	Stimpfle	Materials Testing Institute, University of Stuttgart
11D	TESP - Engineering - Concentrated loadings & reinforcing methods	Timber Engineering & Structural Performance - Engineering Focus	EXPERIMENTAL STUDY ON PULL—OUT STRENGTH OF TIMBER JOINTS INCORPORATING HIGH-DAMPING RUBBER ~EFFECTS OF EMBEDMENT LENGTH AND THICKNESS OF HIGH-DAMPING RUBBER~	This study examined wooden structural joints incorporating high damping rubber, with the objective of achieving wooden structural joints possessing high strength, rigidity, toughness and damping performance for use in medium/high-rise and medium/large-scale wooden structural buildings. The joints improve toughness by shear failure of the high-damping rubber layer prior to shear failure of the adhesive layer and timber. The study conducted pull-out test on wooden structural joints of varied the diameter of steel rod, embedded depth, thickness of high damping rubber, and adhesion area of high-damping rubber. And elucidated the load-displacement relationship and destruction characteristics. The study also elucidated the effects of the parameters on pull-out strength and rigidity, for the purpose of proposing a mechanical model that takes the effects of the parameters into consideration. The experimental results will contribute to the development of the mechanical model.	Komei	Morimune	Meiji Univ
11D	TESP - Engineering - Concentrated loadings & reinforcing methods	Timber Engineering & Structural Performance - Engineering Focus	Influence on the load-bearing behavior of screws using toothed metal inserts in shear planes	In addition to economic efficiency, the performance of fasteners in timber structures is primarily determined by load-carrying capacity, stiffness, ductility, and the required minimum end and edge distances. Engineering-type fasteners can be distinguished between dowel-type fasteners, area-measured connections, and bonding systems. Actual timber constructions mainly use dowel-type fasteners, particularly self-tapping, fully- or partially-threaded screws. Screws offer many advantages, including their flexibility and versatility, as well as their reasonable load-carrying capacities. However, they have some disadvantages, including their relatively low stiffness, especially in shear load applications, and the fact that they require quite large end and edge distances in timber elements. In contrast to dowel-type fasteners, toothed plate connectors and nail plates demonstrate considerably higher load-carrying capacities and stiffnesses. However, the installation of these shear connectors frequently necessitates the use of hydraulic devices to press the tooth into the timber elements. The following work demonstrates a potential method for optimising the geometry and tooth shape of common nail plates in a way that enables the generation of required press-in forces by self-tapping, partially-threaded screws with washer heads. The use of this technology, consisting of simple steel strips with toothed surfaces, to reinforce conventional screw connections in shear planes offers a wide range of potential applications with enhanced efficiency resulting primarily from a significant increase in stiffness.	Roland	Maderebner	University of Innsbruck
11D	TESP - Engineering - Concentrated loadings & reinforcing methods	Timber Engineering & Structural Performance - Engineering Focus	REINFORCEMENT FOR COMPRESSION PERPENDICULAR TO THE GRAIN BY MEANS OF ADHESIVELY BONDED BIRCH TIMBER PRODUCTS	The strength of timber when loaded perpendicular to the grain is significantly lower than when being loaded parallel to the grain. For softwoods, the compression strength perpendicular to the grain is approximately one-tenth of the strength parallel to the grain. Typical methods to increase the bearing strength of a timber beam at the supports include enlarging the support length and/or inserting reinforcing screws at the beam's support. In this study, two new methods of reinforcement for stress perpendicular to the grain are investigated through laboratory tests and analytical methods. The proposed methods utilize birch timber products which are adhesively bonded to the beam at the supports, i.e., where high bearing stresses occur. The adopted birch products are two, namely: plywood with varying thicknesses and rods with a diameter of 19 mm. The laboratory test results show that the bearing capacity of softwood beams can be significantly increased if reinforced either by means of birch plywood plates or bonded-in birch rods. The results pave the way for a new eco-friendly reinforcement technique. A simple analytical model to predict the load-bearing capacity for stress perpendicular to the grain of beams reinforced with the proposed technique is also proposed.	Tianxiang	Wang	KTH Royal Institute of Technology
11D	TESP - Engineering - Concentrated loadings & reinforcing methods	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Large-scale experiment of a new hollow-core timber slab system	The state of development of a new hollow-core slab system is presented. This concept enables large spans as well as the placement of columns at arbitrary positions, thanks to an integrated reinforcement concept. The system considers CLT plates as flanges and a discrete set of GLT elements in the inside, serving as web elements. The reinforcement for the point supports is based on a large LVL block placed between both CLT plates. The paper presents the results of a full-sized experiment set to study the performance of the connection in the region of the point support. The experimental results are compared to a finite element model, which is then used to better understand the failure behavior of the slab.	Cristóbal	Tapia	Materials Testing Institute, University of Stuttgart
11D	TESP - Engineering - Concentrated loadings & reinforcing methods	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	MEASUREMENT OF RESIDUAL STRESSES USING THE DRILL HOLE METHOD AND STRAIN GAUGES ON TIMBER MATERIALS	Internal stresses are of great importance in the design of modern machine parts. This applies to metal components in mechanical engineering as well as wood products. The state of the art is to measure internal stresses in metallic alloys using the hole-drilling method. In addition to metallic alloys wood products are also highly stressed components. Therefore, the aim is to determine the stresses in wood samples using the hole-drilling method. Two types of wood materials are tested for their internal stresses, the first being natural laminated wood with 5 layers per millimetre. The second material is press laminated wood with a layer thickness of 3 mm. The laminated wood has a very thin structure and is therefore considered to be quasi-isotropic in an exceptional way. The study found significant stresses in tested wood materials. A proposal for the measurement of anisotropic materials is made.	Christian	Heikel	Ostfalia University of Applied Science
11E	ECCS/STCE - Architectural/ Engineering	Session Chair: DR EUGENIA GASPARRI / THE UNIVERSITY OF SYDNEY					

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
11E	ECCS/STCE - Architectural/ Engineering	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	Experimental and analytical study of connections for light and pure timber constructions with bent wood	This research focuses on developing connections for an innovative pavilion demonstrator using bent wood. The techniques of bending and compressing wood are employed here. The starting point for the demonstrator design was a spherical polyhedron with 132 pentagonal faces (132-Pentagon Polyhedron), which offers a highly symmetrical geometry from only three different shapes. The core of this work is to demonstrate the load-bearing capacity of the entire structure and especially the connections. For this purpose, models were created using the finite element method program. These models were used to determine the internal forces and stress distributions, which were then utilized for the design. Based on these results, the connections used in the structure were designed. Two types of mechanical connections are being tested: one purely wood-based (utilizing compressed wood) and the other incorporating steel bolts. The experimental phase involves bending, shear and push-out tests on the samples to evaluate their performance. This study aims to enhance the sustainability and structural efficiency of timber constructions by reducing reliance on adhesives. Key findings and methodologies are detailed in this paper, providing insights into the mechanical properties and feasibility of these connections	Siavash	Mahjourian Namari	TU Dresden
11E	ECCS/STCE - Architectural/ Engineering	Sustainability and Timber in a Circular Economy - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	Timber-Based Prefabricated Systems in Deep Renovation: A Circular Economy Perspective on Case Studies and Insights for the Australian Context	The building and construction industry, as a major contributor to global energy consumption and carbon emissions, plays a critical role in achieving the United Nations' carbon neutrality target by 2050. With a significant portion of the current building stock expected to remain in use within this timeframe, extensive renovation efforts are essential to enhance energy performance and sustainability. Prefabricated elements are considered a pivotal technology for renovations, characterized by reduced construction time, minimized waste, and improved quality control. Timber-based prefabricated systems are particularly advantageous due to their low embodied carbon, ease of processability, and adaptability. While the traditional linear approach of 'take-make-use-dispose' can lead to negative environmental impacts, integrating circular economy principles—featuring waste reduction, material efficiency, and product recycling—provides a more sustainable solution, yet these principles often not widely recognized or systematically implemented. This report analyzes case studies of deep renovation projects utilizing timber-based prefabricated systems through a circular economy lens, highlighting their potential to significantly enhance sustainability in building renovations. Insights are specifically tailored to the Australian context, providing valuable guidance for practitioners and stakeholders. By emphasizing the integration of circular economy principles, this review underscores the importance of innovative renovation practices in achieving long-term environmental goals.	yingnan	chen	The University of Sydney
11E	ECCS/STCE - Architectural/ Engineering	Sustainability and Timber in a Circular Economy - Architectural Focus	Comparative Study of Unitised Curtain Wall and Unitised Timber Envelope Systems: Pathways to Reducing Embodied Carbon and Enhancing Circularity in Facade Design	About 40% of global greenhouse gas emissions stem from building activities, and nearly one-third of material consumption is linked to construction and demolition processes. Shifting from linear (take-make-dispose) economic models to a circular model is key to reducing the environmental impact of buildings and minimizing waste. Facades play an important role in reducing building carbon footprints. Timber facades could offer significant benefits thanks to timber's circular potential as a natural and renewable material lightweight and easy to manufacture, assemble and disassemble. To date, there is a lack of circular facade design. This paper addresses this knowledge gap, investigating the role of timber-based facades in reducing resource consumption, carbon emissions and waste in construction. Using quantitative methods, the study validates facade design strategies to reduce global warming potential (GWP) and waste. The findings will contribute to informing the facade industry on the key benefits of timber facades and the implementation of design strategies towards more sustainable and circular buildings.	Hamad	Alabdulrazzaq	The University of Sydney
11E	ECCS/STCE - Architectural/ Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Performance of particleboard incorporating recycled rubber from waste tyres	Recycling end-of-life tyres (EOLT) is a critical global challenge, aggravated by the increasing demand for tyres and their short lifespan. This study explored the effect of incorporating recycled rubber particles from EOLT into particleboard on the properties of the resulting panels. Particleboard panels were manufactured and tested for performance according to the Australian Standard AS/NZS 4266.1 (2017), and the results were benchmarked against Australian Standards (AS 1859.1 2017). These tests included bending strength and stiffness, density, thickness swelling, internal bond, and other key performance properties. The findings demonstrated that particleboards incorporating recycled rubber reduced the bending stiffness but still can meet/exceed the requirements for standard (STD) and moisture-resistant (MR) particleboard. Internal bond strength and moisture resistance for all particleboards tested surpassed the requirement for STD and MR particleboard. Increasing the rubber content improved moisture resistance, and it was observed that particleboards with rubber could meet moisture resistance and high-performance standards without the need for added wax.	Chandan	Kumar	Department of Agriculture and Fisheries
11E	ECCS/STCE - Architectural/ Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus	Multi-parametric evaluation of innovative CLT connections developed for DfMA and DfD	The environmental impact of the construction industry largely contributes to the total human footprint. Several studies have shown that the use of timber products as construction material can lead to a substantial reduction of the environmental impact, but this alone is not enough. A change in the construction industry toward a Circular Economy (CE) is necessary, maximizing reuse and recycling. To achieve this, the disassembly phase must be considered at an early stage in the design of a structure. Recently the standard ISO 20887, presenting the principles regarding the Design for Disassembly (DfD), has been published: the standard highlights the central role of connections to permit disassembly and presents many principles of DfD that are common to Design for Manufacture and Assembly (DfMA). This paper has two main goals. In the first part, a holistic approach is presented to identify the key parameters that make a connection suitable for DfAM and DfD. These parameters were obtained considering the principles provided in the ISO 20887 standard. A comparison is then presented between innovative and traditional connections taken as case studies, in order to evaluate their advantages and disadvantages.	Pietro	Rigo	University of Bologna
11E	ECCS/STCE - Architectural/ Engineering	Exemplars & Construction Case Studies - Engineering Focus	THE GRADING OF THE MODULUS OF ELASTICITY OF WOOD FOR THE MANUFACTURING OF GLULAM BEAMS TO MEET ARCHITECTURAL CONFIGURATIONS	The grading of timber allows for the selection and placement of each lamella in the cross-section of the structural element according to its strength class. Through the evaluation of the modulus of elasticity and visual grading, it is possible to manufacture pieces with the same cross-section but different mechanical resistance capacities, determined based on the structural design calculation. The objective of this work was to demonstrate how the method of timber grading by the modulus of elasticity enabled the architectural configuration of beams with the same cross-section to span different lengths, optimizing costs and the built environment. The preliminary grading method ensures the physical and mechanical characterization in the use of the material, as well as enables the maximum utilization of the material.	Carlito	Calil Neto	Rewood | @brarewood
11E	ECCS/STCE - Architectural/ Engineering	Exemplars & Construction Case Studies - Engineering Focus	CONTRIBUTING TO CANADA'S EFFORTS TO DECARBONIZE THE CONSTRUCTION SECTOR USING WOOD	In Canada, several recent initiatives by industry and governments to expand the use of wood in construction have led to an increase in the number of mass timber buildings across the country and enhanced manufacturing capability. To support this momentum, the Government of Canada launched the Green Construction through Wood (GCWood) program in 2017 to help expedite market acceptance and foster commercial uptake of wood-based products and systems. Given the uptake and success of the GCWood program, the Government of Canada renewed the GCWood program for three more years starting April 2023. The renewed GCWood program is structured and delivered through two main streams: demonstration projects and accelerating construction transformation. This paper provides an overview of the GCWood program activities, focusing on showcasing the design and construction of several demonstration projects and ongoing efforts and activities funded by the program to accelerate construction market transformation.	Ying	Hei Chui	University of Alberta

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11F	MPD - Engineering - Fire	Session Chair: HARALD KRENN / KLH Massivholz GmbH					
11F	MPD - Engineering - Fire	Material Performance & Durability - Engineering Focus	X-ray Computed Tomography Based Estimation of Charring Around Knots in Sawn Timber	The charring behavior in and around knot regions has not been studied as exensively as clearwood, leaving a knowledge gap regarding its characterization. This study aims to investigate the charring behavior in and around knots in Scots pine and Norway spruce using computed tomography (CT) scanning, which enables a noninvasive 3D evaluation of charred regions in the proximity of knots. In our study, the impact of extractives and fiber orientation on charring rates and depths was quantified. Samples containing knots were charred by surface contact to a heated steel cuboid. Semi-automatic image processing tools were developed to identify charred regions and quantify charring depths. This paper discusses the experimental setup, data processing techniques, and the implications of extractives content in the charring behavior of wood. The results show that there is a positive correlation between higher extractive content in knot wood and lower charring rates and reduced surface hardness in samples before and after burning.	Rostand	Moutou-Pitti	Universite Clermont Auvergne
11F	MPD - Engineering - Fire	Material Performance & Durability - Engineering Focus	THE INFLUENCE OF ELEVATED TEMPERATURE ON THE STRENGTH AND STIFFNESS OF TIMBER	Besides charring and the temperature distribution within a fire-exposed cross-section of a timber element, the temperature influence on the mechanical properties (strength and stiffness) is crucial for precise analytical and numerical fire design methods. Most research in the past focused on the behaviour of timber at elevated temperatures or while the temperature rises, but the research on the behaviour of the material properties when cooling down again is limited. Therefore, small-scale experiments on almost flawless timber were carried out. The results show two antidromic effects that occur simultaneously. Their strength depends on the material temperature and the kind of structural loading.	Christoph	Kurzer	TUM
11F	MPD - Engineering - Fire	Material Performance & Durability - Engineering Focus	Thermal analysis of glulam for the development of new reduction factors for strength and stiffness in fire	This paper presents the thermal results from several unloaded fire tests of glued laminated timber beams with various cross-sections. The temperature measurements from the tests are used for calibration of new effective thermal properties of timber needed to later numerically estimate the mechanical behavior of the one-side fire exposed beams loaded in bending. The basic one-dimensional charring rate of the tested beams is determined based on the temperature measurements from the tests, and also from 3D models of the cleaned burnt specimens. Using the calibrated effective thermal properties of timber, the temperature profiles of the cross-sections as well as the mechanical behavior of one-side fire exposed beams loaded in bending are successfully numerically simulated.	Alar	Just	TalTech
11F	MPD - Engineering - Fire	Material Performance & Durability - Engineering Focus	Experimental Determination of Timber Char Rates Under Simulated Fully Developed Fire Exposure Conditions	Char rates of timber exposed to the standard fire-resistance heating regime are well documented. However, char rate data for timber exposed to more severe heating regimes, that better represent fires in modern buildings, is limited. To generate data to address this knowledge gap, standardised test configurations, thermocouple arrays and test procedures were developed. Radiata pine specimens were exposed to the standard heating regime, as a benchmark, and the more severe hydrocarbon heating regime (H1100) and a H1200 heating regime, the latter being similar to the hydrocarbon heating regime but with an increased steady state temperature of 1200°C, from which char rates and temperature profiles were obtained. The tests demonstrated that a single char rate could be derived for timber exposed to the standard heating regime. However, significantly higher char rates were observed for the more severe heating regimes and three char rates were required to adequately define the charring behaviour with the highest char rate occurring in the first 15 to 20 minutes, reducing to an intermediate level and final steady state rate through the remainder of the test. Sections of the test specimens were also protected with 1- and 2-layers of fire-grade plasterboard to obtain indicative char rate data applicable to these protected specimens. The test program has developed a simplified test configuration, instrumentation and test procedures to facilitate the derivation of char rates for wood products under a range of fire exposures. The results confirmed the need to evaluate the performance of elements of construction under a range of test conditions rather than using a single heating regime. Indicative results on the impact of fire protective board coverings were also obtained but it should be noted that retention of board systems is not easily modelled at smaller scale and board failure (fall-off times) still needs to be verified at full-scale.	BORIS	ISKRA	Forest and Wood Products Australia
11F	MPD - Engineering - Fire	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	COMPARISON OF PERFORMANCES OF BOND LINES IN DIFFERENT SMALL-SCALE TESTS	The evolution of fire testing methodologies for engineered wood products is transitioning from traditional large-scale timber fire tests to more efficient and cost-effective small-scale testing techniques. So far, large-scale fire tests have been essential for evaluating the fire behavior of timber. However, these tests require a lot of resources and are time-consuming and complex. To address these challenges, alternative approaches like tension and shear tests at elevated temperatures or cone heater tests are being investigated. This study explored the aforementioned small-scale testing methods, using different adhesive families for comparison. The results of the small-scale test methods were compared with model scale fire tests and better correlations were seen when comparing the fire tests to cone heater tests and tests conducted at elevated temperatures near the temperature of charring (~270°C). Weaker or no correlations were found at lower elevated temperatures. Another objective of this study is to identify whether there is a correlation between the small-scale cone heater tests and the tests conducted at elevated temperatures themselves, in order to evaluate the potential of testing at elevated temperatures to serve as an alternative for cone heater fire testing.	Jane Liise	Vihmann	Tallinn University of Technology
11F	MPD - Engineering - Fire	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	THE INFLUENCE OF ADHESIVES, WOOD SPECIES AND MANUFACTURING TECHNIQUES ON THE FIRE PERFORMANCE OF ENGINEERED WOOD	The fire performance of engineered wood products is crucial to ensure safety and reliability in timber buildings. Key factors such as adhesives, wood species, manufacturing technologies, etc. can impact the fire performance significantly. Adhesives with high thermal strength are essential for maintaining structural integrity under fire conditions. The choice of wood species affects density and combustion properties, both important when it comes to the ignition and charring of wood. Different manufacturing techniques can contribute to the thermal performance and structural resilience in fire. To ensure accurate predictions of fire resistance, it is crucial to standardize fire testing protocols, considering and controlling as many factors as possible (like moisture content, heat flux, environmental conditions alongside with previously mentioned factors). This research dives deeper into the influence of adhesives, wood species, and manufacturing technologies on the fire performance of engineered wood products. By understanding and controlling these parameters, we can enhance the fire safety of engineered wood products. The three aforementioned parameters are examined, emphasizing the need for controlled fire testing to compare results and predict the behavior of engineered wood elements in physical buildings.	Jane Liise	Vihmann	Tallinn University of Technology

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
11F	MPD - Engineering - Fire	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Experimental study on the bending resistance of cross-laminated timber exposed to ISO 834-1 standard fire	In a fire, the load-bearing capacity of a timber structure is influenced not only by charring but also by the elevated temperatures behind the char layer. The Eurocode accounts for this increased temperature in solid timber by subtracting a compensating zero strength layer (ZSL) from the cross-section in addition to the char depth. However, this approach does not directly apply to cross-laminated timber (CLT) structures, which have transverse layers that do not carry load in the direction of the span and feature glue lines. If the glue fails to keep the lamellae in place during a fire, the charring performance and temperature distribution differ from solid timber. This paper assesses the load-bearing capacity of a CLT panels exposed to a standard fire conditions, including falling off the charred layers. The assessment is based on fire tests conducted on two different CLT structures and the measured temperatures within the CLT panels. The structural capacity is compared to the value calculated using the ZSL method. The findings indicate that the glue failure significantly increases the charring rate, impacting the equivalent ZSL differently when glue lines do not hold the layers. The fire test revealed that glue lines led to falling lamellae, increased charring rates, and affected load-bearing capacity and ZSL height.	Mika	Alanen	Tampere University
11F	MPD - Engineering - Fire	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	CHARRING CHARACTERISTICS OF TIMBER ELEMENTS EXPOSED TO NATURAL FIRE	This paper analyzes the charring behavior of timber exposed to natural fire using the advanced PYCIF model, which integrates heat and mass transfer model with pyrolysis reaction. Timber cross-sections are exposed to fire curves generated by Ozone software, and key metrics such as final charring depth, onset, and end times of charring are monitored. The analysis identifies strong correlations: the final charring depth links to the fire curve maximum temperature, while the onset and end times of charring correspond to the fire curve reaching 300 °C during heating and cooling phases. These findings highlight the potential for simplified methods to predict charring in timber elements exposed to natural fires.	Robert	Pečenko	University of Ljubljana, Faculty of Civil and Geodetic Engineering
11G	TESP/STCE/EIC - Sustainability	Session Chair: TOBY HODSDON / ARUP					
11G	TESP/STCE/EIC - Sustainability	Timber Engineering & Structural Performance - Engineering Focus	Adaptive Timber Exoskeletons: Sustainable Seismic Retrofitting with CLT Panels	The extensive renovation of existing buildings is essential to mitigate seismic risk and environmental impacts. To prioritize safety and sustainability, retrofit strategies should minimize disruption and adopt a Life Cycle Thinking (LCT) approach to reduce long-term costs and impacts. Timber-based materials, particularly CLT panels, offer significant potential for seismic retrofitting due to their mechanical, thermal, and environmental properties. This paper explores timber exoskeletons as a possible solution for seismic retrofitting, emphasizing the need for re-engineering connections to meet specific design criteria such as damage control, ease of assembly/disassembly, and flexibility. Exoskeletons, as external lateral force resisting systems, provide superior performance and displacement control by collecting the building inertia forces at floor levels and transferring the seismic action to the foundations. The design process emphasizes damage control at the Life Safety Limit State (LSLS), for which adaptive solutions appear to be optimal. Numerical simulations using a reference 3-story RC building demonstrate the superior performance of shell configurations. Overall, timber exoskeletons represent a promising solution for sustainable seismic retrofitting, with significant potential for application to low-rise buildings.	Jacopo	Zanni	University of Bergamo
11G	TESP/STCE/EIC - Sustainability	Timber Engineering & Structural Performance - Engineering Focus	AUSTRALIAN PLANTATION EUCALYPTUS NITENS AS AN ALTERNATIVE BUILDING MATERIAL	Eucalyptus, Australia's iconic hardwood tree genus, offers a promising option for the development of new building materials. Research by Australian and international universities has focused on unlocking the full potential of fast-growing plantation Eucalyptus species beyond traditional wood pulp production. This paper discusses the key research activities by researchers at the University of Tasmania related to the use of plantation-grown Eucalyptus nitens (E. nitens) in fabricating engineered wood products. The results of previous research have demonstrated there are more uses for plantation E.nitens, increasing its value and making it a more versatile resource to be used in EWPs. It also shows the ongoing transformation of plantation Eucalypts use in Australia and worldwide. The narrative highlights key findings, challenges, and potentials related to producing timber products such as CLT and GLT from E. nitens. It discusses the research efforts in evaluating the material, product performance, and capacity to utilise plantation E. nitens in making engineered wood products, which is a crucial process for designing effective and reliable EWPs. By analysing research findings, this paper aims to explore how previous findings on plantation E. nitens have both restrained and expanded the critical role it may play in the development of more sustainable and diversified EWPs for the Australian and global building industry.	Azin	Ettelaei	University of Tasmania
11G	TESP/STCE/EIC - Sustainability	Sustainability and Timber in a Circular Economy - Practitioner Focus	TIMBER CIRCULARITY: SOLUTIONS FOR END-OF-LIFE TIMBER IN A CIRCULAR BIOECONOMY	Timber is an ideal resource for the circular bioeconomy with the potential to aid the transition towards a net positive future. Timber products, including preservative treated timber (PTT) and engineered wood products (EWP), can allow greater high value use of wood resources, have increased strength and durability, and store carbon. Adhesives and treatments become problematic however when resources are to be circulated into new applications. With the Australian Government calling for a circular economy by 2030, it is vital that solutions for end-of-life timber are determined. The circular economy requires resources to be reused or recycled rather than moving linearly from use to landfill. The Australian context is unique in terms of regulatory issues and the vast distances between cities, requiring a variety of solutions which may include scalable or mobile technology. The Timber Circularity project is a three-year national project that aims to understand end-of-life resources available and potential solutions that will meet regulatory and logistical challenges. A matrix of solutions has been developed based on a hierarchy of high- to low-value opportunities. Three solutions of different values in the matrix have been examined for pilot projects which will begin in early 2025.	Penelope	Mitchell	University of the Sunshine Coast
11G	TESP/STCE/EIC - Sustainability	Timber Engineering & Structural Performance - Engineering Focus	SHEAR PROPERTIES OF ADHESIVE JOINTS FOR I-SHAPED SECTION TIMBER-GLASS COMPOSITE BEAMS	Timber-glass as a novel composite structure, which has gained widespread attention in timber engineering due to its advantages in sustainability, low-carbon footprint, light transmission, and aesthetic appeal. To better understand the performance of adhesive joints between timber flange and glass web for I- shaped section timber-glass composite beams, multiple single shear connection joints were designed and next they were subjected to monotonic loading test studies and finite element simulations. The parameters studied included bonding width, bonding length, adhesive layer thickness, and timber grain direction. The failure modes, load-bearing capacity, stiffness, and ductility of the connected joints under these parameters are discussed and analyzed, which will provide a valuable reference for the design of the joints.	Huifeng	Yang	Nanjing Tech University
11G	TESP/STCE/EIC - Sustainability	Sustainability and Timber in a Circular Economy - Engineering Focus, Sustainability and Timber in a Circular Economy - Practitioner Focus, Timber Engineering & Structural Performance - Engineering Focus	ROTATIONAL BUTT FRICTION WELDING OF BAMBOO AND WOOD	Natural, renewable raw materials such as wood or bamboo are increasingly important for industrial applications as they are environmentally friendly to produce and dispose of. The use of renewable raw materials allows for substitution of petroleum-based products and can significantly reduce CO2 emissions. Renewable raw materials generally decompose much faster than most petroleum-based plastics, provided that no chemical adhesives are used to bond the natural, renewable raw materials. In order to reduce the proportion of petroleum-based adhesives, investigations into the rotational butt welding of bamboo and wood were carried out. This article presents further fundamental investigations of rotational butt welding of various woods, bamboo and their joints.	Ralf	Förster	BHT Berlin

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11G	TESP/STCE/EIC - Sustainability	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	DEVELOPMENT OF A PREFABRICATED ADHESIVELY BONDED JOINT FOR BAMBOO STRUCTURES	Despite its ecological benefits, bamboo's application in modern construction is limited due to the complexities of connecting its round cross-sections. The construction industry is a significant contributor to global warming due to its environmental impact. As a result, responsible builders are implementing sustainability measures to limit their carbon footprint and improve other environmental aspects of their operations. Continuing our previous research on connecting Douglas fir (Pseudotsuga menziesii Franco.) roundwood in a material-appropriate way for large-span truss structures, the promising results led to an expansion of the round-to-round jointing topic to other renewable building materials with a particular emphasis on sustainable bamboo structures made from Guadua angustifolia Kunth. This paper explores the development and testing of adhesive bonding techniques for bamboo structures, focusing on the inner layer bonded with biocomposites. The research includes the implementation of ecologically harmless adhesives and experimental research of the bond strength between biocomposite and inner bamboo layer and results in a joint that avoids punctual splitting by the absence of fasteners. The preliminary results demonstrate a robust bond. The evaluations have not finished yet and will be presented in the full paper.	Kay-Uwe	Schober	Mainz University of App Sc, Holzbauforschung Mainz, Germany
11H	TABD/STCE - Case Studies, incl Sydney Fish Market Presentation by Rubner / Theca	Session Chair: A/PROF MINGHAO LI / UNIVERSITY OF BRITISH COLUMBIA					
11H	TABD/STCE - Case Studies, incl Sydney Fish Market Presentation by Rubner / Theca	Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Timber Architecture & Biophilic Design - Engineering Focus	Engineering Alchemy - Turning Concrete Into Timber: The Galkangu Bendigo GovHub Story	Galkangu Bendigo GovHub is a state-of-the-art community asset and workplace in central Victoria, and Australia's largest mass timber frame using 100% Australian supplied Glue Laminated Timber (glulam) and Cross-Laminated Timber (CLT). This paper explores how Arup's collaborative approach and design innovation enabled the client's aspirations to be met, with significant use of highly sustainable construction materials and advanced off-site construction techniques.	Mark	Ayers	Arup
11H	TABD/STCE - Case Studies, incl Sydney Fish Market Presentation by Rubner / Theca	Timber Architecture & Biophilic Design - Engineering Focus, Timber Architecture & Biophilic Design - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	Urban densification - Case study of a school expansion using TS3 technology	Many school building need expansion for capacity. So does the school building in Richterswil, CH, which needed an expansion of 1500 square meters during the five weeks of summer holidays. This could only be realized by two additional timber structure storeys with the TS3 technology. A biaxial load-bearing flat ceilings with spans of 7×10 metres could be installed on the same load-bearing structure of the existing concrete building. The floor-wall system allowed the façade to be designed independently of the supporting structure. The timber construction and closing of the building was realized during the summer break, while the less noisy interior work was done during the school operation with no negative influence. All advantages of timber construction in addition with the specialized TS3 technolgy were convincing for the expansion.	Bettina	Franke	Timbatec
11H	TABD/STCE - Case Studies, incl Sydney Fish Market Presentation by Rubner / Theca	Sustainability and Timber in a Circular Economy - Engineering Focus	Advanced LCA methods for sustainable timber solutions: A review	This presentation, as part of a wider report, provides a focused review of the latest advancements in the life cycle assessment (LCA) methods for timber. Given the rising severity of natural disturbances, it has become increasingly important to consider the suitability of current forest management practices and to adopt approaches that promote forest resilience. This work argues that current best practice LCA methods lack the resolution needed to compare different forest management approaches when assessing timber products. Therefore, methods that go beyond current best practice are reviewed. These methods relate to both the improved accounting of forest carbon fluxes and the biodiversity impacts of land use. The limitations of these methods are discussed along with the future opportunities they present.	Matthew	Leeder	University of Bristol
11H	TABD/STCE - Case Studies, incl Sydney Fish Market Presentation by Rubner / Theca	Sustainability and Timber in a Circular Economy - Engineering Focus	TIMBERTRACKER: AN OPEN-SOURCE WEB FRAMEWORK FOR VISUALISING SUPPLY AND DEMAND IN FUTURE CONSTRUCTION TIMBER VALUE CHAINS	The future development of Australia's built environment must tackle two key challenges: improving access to affordable housing and transitioning to net-zero in construction. Given that the majority of Australian housing is built using timber framing, a key barrier to addressing these challenges is the growing gap between the escalating market demand and the limited supply of sustainably-sourced structural sawn timber. This paper presents an open-source, interactive web framework developed to communicate and visualize this resource gap, termed 'TimberTracker". The website integrates open data sources available for timber supply, building design, and urban planning information ecosystems, to enable better understanding of the timber resources required for Australia's current and future housing ambitions. The timber consumption data analyses consider demand-side factors contributing to Australia's growing need for structural timber. The timber production data analyses supply-side factors affecting domestic timber availability. Evaluated information is reported through an interactive geospatial map, for timber resource supply and demand requiredments for Australian Local Government Areas up to 2050.	Joseph	Gattas	School of Civil Engineering, University of Queensland
11H	TABD/STCE - Case Studies, incl Sydney Fish Market Presentation by Rubner / Theca	Sustainability and Timber in a Circular Economy - Engineering Focus	Carbon Accounting on the Production of Timber-based Products	Carbon accounting of wood products involves assessing the carbon stored in wood products, considering factors such as production, consumption, and end-use. If we focus on the production stage, forestry carbon accounting is still in its infancy. This study first reviews current methods for carbon emissions (CE) calculations and finds that life cycle assessment (LCA) is the most used approach. The functional units of existing studies are not uniform, and there is no consensus on biogenic carbon calculations. Therefore, it is important to improve the transparency of the planting stage to provide a more comprehensive assessment inventory. In addition, dynamic LCA studies including temporal and spatial aspects are expected to improve the accuracy of carbon accounting. Finally, regulations or guidance are encouraged to eliminate uncertainties and improve comparability between wood products.	Yi	Qian	The University of Melbourne
11H	TABD/STCE - Case Studies, incl Sydney Fish Market Presentation by Rubner / Theca	Timber Architecture & Biophilic Design - Architectural Focus	Fisher & Paykel Global HQ Campus – Mass Timber Diagrid Innovation - delivering so much more than environmental sustainability	The scope of the project was to rebuild the global headquarters corporate and product development campus of Fisher & Paykel Appliances on a new site in Auckland, New Zealand. The principal building is a 10,000msq mass timber diagrid 2 & 3 story office building suspended above the land and enclosing an oasis of regenerated native NZ flora. The proposal develops a repetitive elemental low-carbon construction system to demonstrate global innovation consistent with the clients' core values. The project has achieved a fast to build componentized mass timber system delivering a campus wide carbon neutral outcome. It has also employed, biophilic design principles, indigenous people's consultation, and high amenity staff facilities to deliver a socially, culturally, and environmentally sustainable outcome.	Rich	Naish	RTA Studio

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11H	TABD/STCE - Case Studies, incl Sydney Fish Market Presentation by Rubner / Theca	SPECIAL SESSION - 30 MINUTE PRESENTATION	SYDNEY FISH MARKET	Located in Blackwattle Bay, Pyrmont—just two kilometres west of Sydney's CBD—the market is the third-largest fish market in the world. A standout feature of the new market is its striking 230-metre-long, wave-like timber roof, engineered by Theca Timber's partners, Rubner. Made from 1,800 m^3 of spruce glue-laminated timber (GLT) and over 50 tons of steel, the roof's sweeping form ties the entire structure together, giving the market a bold and elegant identity. More than just an architectural statement, the roof plays a crucial role in the market's sustainability strategy. Designed to collect rainwater for reuse and harness solar energy, it also uses natural ventilation to extract warm air while shielding workers from harsh southerly winds. Sustainability extends to logistics. The European GLT beams were shipped as single elements in the hull of a bulk cargo carrier and delivered by barge—never touching Australian roads. This approach minimised pollution and reduced disruption to the local community. As Rubner's partners in Australia, Theca Timber was involved from the early stages, providing expertise to help Multiplex accurately price the project during the tender phase. The key challenge was ensuring the most efficient and sustainable transport method while enabling rapid manufacuring and on-site assembly. Theca Timber and Rubner supported Multiplex with advanced timber construction expertise, Design for Manufacture and Assembly (DfMA) strategies, and a sophisticated transport methodology—playing a crucial role in securing the winning bid.	Florian Gianluigi Paolo Adam	Hitthaler Traetta Aschieri Shears	Rubner / Theca Timber
11I	EIC/MPD - Engineering / Architectural	Session Chair: DAVID ZHANG / MULTINAIL					
11I	EIC/MPD - Engineering / Architectural	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	ENHANCING MATERIAL DURABILITY AND SUSTAINABILITY: INVESTIGATING TIMBER MOISTURE MANAGEMENT IN TIMBER STORAGE FACILITIES.	This study investigates effective moisture management strategies within timber storage facilities, focusing on their critical role in enhancing timber's durability and sustainability. Utilizing a mixed-methods approach, the study combines quantitative moisture content (MC) measurements of timber products across six facilities in Adelaide with qualitative insights from twelve semi-structured interviews with industry experts. The research highlights the dynamic nature of timber moisture levels due to varying environmental conditions and storage practices. The findings reveal that, although significant seasonal variations in MC were not observed, differences in storage conditions within facilities led to varying moisture levels, with MC ranging from 4.9% to 21.3%. Proper storage practices, such as adequate protective measures and appropriate stacking, are emphasized as essential for maintaining consistent MC levels. Facilities with controlled environments reported fewer issues related to both excessive dryness and wetness. The study concludes that stable moisture content is vital for preserving timber quality and structural integrity. It highlights the importance of continuous monitoring and optimized storage practices to prevent degradation. By contributing valuable knowledge to timber management, this research supports the advancement of sustainable practices in the construction industry.	Oluyimide	Akinnawonu	University of South Australia
11I	EIC/MPD - Engineering / Architectural	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	IMPACT OF OPAQUE AND TRANSPARENT THIN INTUMESCENT COATINGS ON THE HEAT RELEASE RATE OF MASS TIMBER	Exposed timber remains a challenge in the safe construction of mid- to high-rise mass timber buildings. During a fire, heat that is released from the flaming combustion of timber elements can significantly alter the intensity and duration of the fire event. Therefore, understanding the Heat Release Rate (HRR) of mass timber during the different phases of a fire is key, as it can impact both the fire growth and thermal exposure severity to the structure. This study examines the influence of opaque and transparent thin intumescent coatings on the HRR of timber by deriving critical flammability properties, to provide insights into the fire behaviour of bare and coated timber. Bench-scale fire experiments of CLT (cross-laminated timber) blocks were conducted using a calorimetry apparatus under three constant incident radiant heat fluxes of 25, 50, and 75 kW/m2. For the coated timber samples, different coating types were used – two opaque (A, B) and one transparent (C) at varied thicknesses. The results suggest that opaque coatings (A, B) contribute to improved fire performance of mass timber during both the early and fully developed fire phases, whereas transparent Coating C is primarily effective in the early phase, delaying ignition, limiting flame spread, and reducing heat release.	Stavros	Spyridakis	The University of Queensland
11I	EIC/MPD - Engineering / Architectural	Education, Innovation & Challengers - Engineering Focus	Comprehensive Analysis of Point Supported Timber Construction: Structural and Fire Safety Insights	With the introduction of Tall Mass Timber construction types to the Codes in the United States in 2021, there has been an increase in the exploration and construction of these types of buildings. While the new construction types provide a prescriptive path to approval, they also require a series of new, often nuanced, structural and fire safety requirements. At the same time there is an increase in the demand for affordable housing, particularly in urban areas. Point-support, beam-less, mass timber systems have emerged as a popular solution in the 8 to 18 stories range. Sandy Pine, a 12-story building in Portland, Oregon, is one such project to utilize this system and is unique in the fact that over 60% of the CLT ceiling surface will be exposed. To demonstrate compliance, the structural and fire engineers relied upon existing and project specific testing, and worked closely together, particularly on the structural and fire performance of the building's connections.	Eric	McDonnell	Holmes
11I	EIC/MPD - Engineering / Architectural	Education, Innovation & Challengers - Engineering Focus, Education, Innovation & Challengers - Architectural Focus, Education, Innovation & Challengers - Practitioner Focus	ASSET OWNER RESEARCH: ROADBLOCKS TO TIMBER USE	One of the primary objectives of Timber Unlimited is to accelerate the adoption and increase the volume of timber used in commercial construction, aiming to boost the number of buildings with low carbon footprints. This study conducted by Timber Unlimited in 2023 explored the motivations and barriers faced by asset owners in Aotearoa New Zealand when considering timber as a primary material for commercial buildings, beyond its aesthetic benefits. The goal was to provide insights that will positively influence decision-makers' perceptions and choices, thereby creating more opportunities for timber use. The study uncovered significant gaps in knowledge and best practices related to building with timber among asset owners. While many recognize timber's strong sustainability credentials, they often struggle to find hands-on expertise, which leads to the perception that timber is "exclusive." The study found that it is essential to facilitate the transfer of knowledge from experienced practitioners to those less familiar with timber. Highlighting hybrid construction projects, which combine timber with other materials, can also help ease the transition. Furthermore, improving regulatory frameworks is crucial to streamline the building consent process for timber construction.	Lisa	Oliver	Holmes & NZ Timber Design Society
11I	MPD - Engineering - Adhesives	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	MODE I FRACTURE ENERGY OF HARDWOOD GLUELINES VIA TESTS	The engineered wood products (EWPs) are characterized for a wide use of structural adhesives. The glue-lines between the board's faces play a key role to guarantee the stability and load-bearing features of structural elements. One of the most revealing properties to assess the bonding quality and behavior is the fracture energy (or toughness), which could be estimated by performing suitable tests. Previous works were focused on the bonding properties of structural adhesives with softwood species, nevertheless, the widespread interest on hardwoods and the major bonding issues of those species, led to focus on two of the most interesting species in Europe and Italy: beech and chestnut. The fracture toughness behavior of two different categories of adhesives for structural applications was investigated, namely melamine-urea-formaldehyde (MUF) and phenol-resorcinol-formaldehyde (PRF). The results revealed different fracture toughness behavior between the various adhesives and bond line thickness. The fractured surfaces are also characterized by means of optical microscopy.	Martina	Sciomenta	University Of L'aquila

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
11I	MPD - Engineering - Adhesives	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	MODIFICATION OF MELAMINE FORMALDEHYDE-BASED ADHESIVES FOR THE MANUFACTURING OF CROSS-LAMINATED TIMBER (CLT) FROM JABON WOOD	Adhesive is an essential element that requires meticulous consideration throughout the production process of Cross-Laminated Timber (CLT). This study aims to investigate the bonding performance of jabon wood-CLT manufactured with modified melamine formaldehyde (MF)-based adhesives for cold-pressing applications. The commercial MF adhesives (MF-0) and modified ones (MF-1) at three different rates, 250, 280, and 300 g/m2 were applied in this study. The MF-1 was composed of MF-0 by adding 5% citric acid, 3% polymeric 4,4-methylene diphenyl diisocyanate (pMDI), and 10% wheat flour. The results show that the MF adhesive can be modified by incorporating citric acid and PMDI, enabling it to be utilized in the production of CLT using cold pressing aplication. Adding these substances enhanced the adhesive viscosity and shortened the gelation time. In comparison to MF-0, MF-1 has a larger contact angle and a lower K-value due to its increased viscosity. However, this modification results in adhesive performance of MF-1 (300 g/m2) that complies with EN 16531:2021. Increased spread of the MF-1 led to improved bonding strength, reduced delamition, and enhanced wood failure. MF-1 demonstrated a higher stress-strain curve and stiffness compared to MF-0 indicates that it provides enhanced performance for bonded wood products as CLT.	Naresworo	Nugroho	Department of Forest Products, Faculty of Forestry and Environment, IPB University, Indonesia
11I	MPD - Engineering - Adhesives	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Long-term behavior of rods glued in hardwoods under static loading, elevated temperatures and humidity environment	Glued-in rods (GiR) are nowadays an integral part of timber engineering's catalogue of joints. While of widespread use, there are still open topics to be addressed, e.g., the behavior under elevated temperatures and humidity. First the adhesives are tested for their suitability by a dynamic mechanical analysis (DMA) and their individual glass transition temperature Tg is determined. Most adhesives in industry exhibit a glass transition temperature, which is close to the temperatures relevant for design. At temperatures close to Tg a significant drop in the load capacity of adhesives is to be expected. Afterwards, the pull-out strength of different hardwood-adhesive-combinations is tested under laboratory conditions, as well as higher temperatures. The results of the preliminary tests are then used to design testing rigs for the long-term investigations of the GiR. Service classes I to III are to be explicitly examined as part of the investigations in order to characterize the performance of the GiR under increased environmental conditions.	Pascal	Franck	RheinMain University of Applied Sciences

SESSION 12

Thursday 26th June 2025
11:00am to 1:00pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
12A	TESP- Engineering Experimental Investigations	Session Chair: Dr. Peggi Clouston / UMass, Amherst					
12A	TESP- Engineering Experimental Investigations	Timber Engineering & Structural Performance - Engineering Focus	EXPERIMENTAL STUDY INTO MECHANICAL PROPERTIES OF A NOVEL MASS TIMBER T-BEAM SYSTEM.	This study investigates the bending stiffness and strength of a novel mass timber floor system featuring 6-layer T-beams made from spruce-pine-fir (SPF). These T-beams, integrally reinforced with small glulam beams, aim to mitigate rolling shear weakness by using longitudinal boards within the flange cross-layer, enhancing the major axis stiffness and strength of the panel system. Five prototype 6-layer T-beams were fabricated following ANSI/APA PRG 320 standards, each measuring 165mm thick × 305mm wide and 3048mm long. The Shear Analogy Method was used to predict and compare the bending stiffness (Eleff) and strength (FbSeff) of the beams. Flexural long-span bending tests were conducted according to ASTM D198 protocols, measuring mid-span deflection, bending stiffness, and strength. Results showed that the mean experimental bending stiffness of the 6-layer T-beams was 3961.5 x 109 N·mm^2/m, slightly exceeding the predicted value, suggesting that using Eleff is a suitable method for estimating T-beam stiffness. The mean experimental bending strength was 140.4 x 106 N·mm/m, significantly higher than the design value, indicating the potential of the 6-layer T-beams for commercial building applications. In conclusion, the 6-layer T-beams tested in this study demonstrate promise as a viable and efficient option for structural applications. Future research could focus on the mechanical performance of other species and configurations to develop stronger, stiffer, and more consistent structural elements.	Ayomide Deborah	Ayodele	University of Massachussets, Amherst
12A	TESP- Engineering Experimental Investigations	Timber Engineering & Structural Performance - Engineering Focus	Investigating the Effects of Straight and Bent GFRP Bars on the Flexural Behaviour of Glulam Beams	Included is an overview on the behaviour of glulam beams reinforced with varying configurations of FRP bars. The current study specifically investigates the potential of bent bars in comparison to straight bars and the effects of varying reinforcement length. A total of 12 glulam beams were tested to failure under static loading, which included 4 unreinforced beams and 8 reinforced beams with 4 differing retrofit configurations. A comparison and analysis of results between the varying reinforcement configurations will be provided to understand the effects of reinforcement length and type have on the flexural behaviour and failure modes of glulam beams.	Herry	Chen	University of Waterloo
12A	TESP- Engineering Experimental Investigations	Timber Engineering & Structural Performance - Engineering Focus	EXPERIMENTAL STUDY ON THE BENDING PROPERTIES OF GLULAM MADE BY FAST-GROWING CHINESE FIR	To better utilize the vast fast-growing forest resources in China， the bending properties of glulam made from domestically produced machine graded laminates of fast-growing Chinese fir were studied. The results show that the production of laminates with strength grade M22 and M18 accounts for more than 80%. The bending properties of glulam are significantly influenced by the grade and lay-up methods of the laminates， and the coefficient of variation of the bending properties is significantly reduced compared to individual lamina. The highest strength grade of glulam made by domestic fast-growing Chinese fir is TCT40, and TCT32 or TCYD32 accounted for most of the production, and the design value of bending strength exceeded the value specified in GB50005—2017 Standard for design of timber structures.	Weiguo	Long	China Southwest Architectural Design and Research Institute Corp. Ltd
12A	TESP- Engineering Experimental Investigations	Timber Engineering & Structural Performance - Engineering Focus	ANALYTICAL INVESTIGATION ON ROTATIONAL BEHAVIOR OF BEAM-COLUMN DOVETAIL JOINTS IN TRADITIONAL CHINESE TIMBER ARCHITECTURE	In this study, we theoretically analyzed the rotational behavior of beam-column dovetail joints in traditional Chinese timber frames. An analytical model of dovetail joints at both the column head and body, was designed by clarifying the moment generation mechanism and effect of rotational embedment yielding in timber perpendicular to the grain on the rotational behavior of joints. An asynchronous manifestation of rotational embedment deformation across the column surface, tenon cheeks, and upper and lower surfaces of the tenon head was analyzed, and the corresponding characteristic yield points and consequent reduction in rotational stiffness were derived in the model. The Inayama embedment theory was used to clarify the effect of rotational embedment with varying end lengths on the movement of the joint rotation center and asymmetric moment generated in different rotation directions of the column head joint. The precision of the analytical model was validated through a comparative analysis by involving nine sets of experimental data, for estimating the initial stiffness, post-yield stiffness, and identified yield points. The implications of the parameters, including the initial gap between the tenon and mortise, geometric dimensions of the dovetail tenon, and friction coefficient were also discussed.	Zherui	LI	Xi'an University of Architecture and Technology
12A	TESP- Engineering Experimental Investigations	Timber Engineering & Structural Performance - Engineering Focus	Experimental study on rotational behavior of CLT shear wall-I steel link beam connections	This paper presents the experimental results of rotational behavior of CLT shear wall-I steel link beam connections. Three full-scale connection specimens were prepared and tested under monotonic and reversed cyclic loading. Test results indicated that the typical failure modes of the specimens were tensile fracture failure of the flange at the bottom of the I-beam and shear failure of the web. No obvisous damage occurred in the CLT shear wall. This demonstrated that the steel link beams can effectively reduce seismic damage to the CLT shear walls and serve as the first line of seismic defense. At the initial stage of loading, the bending moment-rotation angle curve of each specimen showed a linear stage. Different from the rotational performance of the bolted glulam beam-to-column connections, there was no obvious low-stiffness slip section in the specimens during the initial loading period. When the load level was over 60% of the peak load, the specimen entered the nonlinear stress stage. When the tensile fracture failure of the flange occurred, the moment bearing capacity of the specimens reduced significantly. The bending capacity of the monotonically loaded specimen was 8.8% higher than the average values of the reversed cyclic loading specimens. The ductility ratio of each specimen was close to 3.0, indicating that the the steel link beam connection exhibited excellent ductility.	Mingqian	Wang	Shanghai Research Institute of Building Sciences Co. Ltd

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
12A	TESP- Engineering Experimental Investigations	Timber Engineering & Structural Performance - Engineering Focus	EXPERIMENTAL STUDY ON THE SHEAR STRENGTH OF ULTRA-HIGH LOAD BEARING CAPACITY TIMBER MULTI-LAYERED BEARING WALLS AND ASSEMBLED COLUMNS	Our research group embarked on a study of the horizontal resistance mechanisms of ultra-high load-bearing capacity timber bearing walls and assembled columns, composed of multi-layered wooden adhesive panels, aimed at achieving carbon neutrality, which contributes to solving environmental issues, and realizing medium and high-rise buildings. In this study, assuming wall-type structures for medium and high-rise buildings, the research focuses on the structural surface of timber multi-layered bearing walls, and for rigid-frame structures, the framework composed of timber multi-layered bearing walls, assembled columns, and beams. The research objectives include experimentally elucidating the loading-displacement relationship, destruction properties, equivalent viscous damping constant, and historical area through full-scale horizontal loading tests of timber multi-layered bearing walls and assembled columns. Furthermore, by conducting FEM (Finite Element Method) analysis that represents the shear buckling of plywood and the contact between plywood layers, we clarify the shear stress distribution and propose a mechanical model. As a result, we conducted horizontal loading tests on ultra-high load-bearing capacity timber multi-layered bearing walls, varying parameters such as the number of wooden adhesive panels, plywood thickness, and the presence of vertical load, thereby revealing their mechanical properties. Additionally, horizontal loading tests were performed on ultra-high load-bearing capacity timber multi-layered assembled columns, constructed with multiple layers of wooden adhesive panels, elucidating their mechanical properties. FEM analysis was employed to model the contact between plywood layers, successfully replicating the shear force-shear deformation angle relationship (within the elastic range), shear force-out-of-plane deformation relationship, and in-plane and within-layer shear stress distribution.	Ren	Ikezumi	Meiji University
12A	TESP- Engineering Experimental Investigations	Timber Engineering & Structural Performance - Engineering Focus	Experimental investigation on trusses made of glulam and birch plywood gusset plates	This paper investigates the load-carrying capacity of trusses consisting of glulam elements joined through birch plywood plates by means of either gluing or steel dowels. A total of 6 trusses with a span of approximately 7 meters were tested in three-point bending, 3 trusses for each connection type, the thickness of the plywood plates varied between 9 and 21 mm. The main purpose of this research was to gain a better understanding of the failure mode of birch plywood subjected to multi-axial stress state with loads from multiple directions. Therefore, the truss specimens were designed in such a way that failure occurred in the central plywood plate, which was subjected to a multi-axial stress states. As expected, the experimental results showed an increase in the load-carrying capacity with increasing plywood plate thickness. Furthermore, the glued specimens generally exhibited higher load-carrying capacity and elastic stiffness than those using mechanical connectors. For bonded specimens with 12 and 21 mm thick plywood, failure occurred at the bonded interface between plywood and glulam, rather than in the plywood itself. For both glued and mechanically connected specimens, the thickness of the plywood plate did not show a significant influence on the stiffness.	Mattia	Debertolis	KTH Royal Institute of Technology
12B	MPD / TESP - Engineering - Material Behaviour	Session Chair: A/PROF BENOIT GILBERT					
12B	MPD / TESP - Engineering - Material Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	EMPIRICAL FORMULA PREDICTING EMBEDMENT STRENGTH OF COCONUT WOOD	This research aims to find the best analytical model to predict the embedment strength of coconut wood (monocot). The investigation employed the dowels with the diameters of 10 mm and 14 mm, incorporating the data of 12 mm and 16 mm from previous studies. Single variate, multivariate, linear regression, nonlinear regression, and cross-validation methods were implemented. The findings suggested that multivariate equations provided the best fit andreliability, and nonlinear regression models showed the superiority. The significance of wood density and dowel diameter as the predictors of embedment strength was confirmed.	Lili	Jia	University of Canterbury
12B	MPD / TESP - Engineering - Material Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Mechanical performance analysis of CLT and structural timber rails under compression tests	Prefabricated timber modules can help make the building sector more sustainable by reducing greenhouse gas emissions. However, structural challenges, like the buckling of timber studs on timber rails still limit the height of tall timber buildings. These challenges are affected by how studs and rails interact. More research is needed to understand this interaction better. This study aims therefore to investigate this interaction by experimental tests and finite element (FE) modelling of five-layer Cross Laminated Timber (CLT) and structural timber (C24) bottom rails under compression loads applied via vertical structural timber (C24) studs. Preliminary results show that CLT bottom rails have a much higher loading-bearing capacity compared to structural timber bottom rail. Additionally, local penetrations were observed in the contact zone between stud and rail which is aimed to be included in the FE models.	Marcus Vinícius	Tavares da Costa	Karlstad University
12B	MPD / TESP - Engineering - Material Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Evaluation for ultimate strength for steel-plate-inserted joint with drift-pins at the end of glulam beams	This study focuses on the ultimate strength for steel-plate-inserted joints with drift-pins in wood structures. The ultimate strength of those joints is defined to be splitting or shear failure. From another perspective, it is very difficult to evaluate the fracture of a wood joint. Some structural designers have commented that the relationship between fracture properties and design formulas is difficult. In this study, shear loading tests of joints with different arrangements of drift pins were conducted, and the characteristics of splitting and shear failures were defined from test observations. In addition, tests were conducted to determine the fracture parameter and shear strength again in order to obtain the material values to be input into the strength equation. Shear tests were conducted in accordance with the HOWTEC method. The shear strength of 5% lower limit from those test results was approximately 1.4 times greater than the values indicated in the Japanese structural timber standard. The results of these tests were input into a strength equation, which was used to determine the fracture type, and the results showed that the fracture properties of the joints could be determined more accurately than in the current standard. This means that the design equation can more accurately determine the ultimate failure state, and the calculated ultimate strength is closer to the experimental value than the current standard.	Wataru	Kambe	Kanto Gakuin University

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
12B	MPD / TESP - Engineering - Material Behaviour	Timber Engineering & Structural Performance - Engineering Focus	AN ENTIRELY WOOD FLOOR SYSTEM DESIGNED FOR BIOGENIC CARBON STORAGE, ADAPTABILITY, AND END OF LIFE DE/RE/CONSTRUCTION – ASSEMBLY DESIGN	This ongoing research aims to develop an innovative mass timber composite floor system designed to enhance biogenic carbon storage, adaptability, and efficiency in construction. The system features 3-ply CLT for top and bottom flange and GLT webs, utilizing two main connection types: screw with adhesive and screw with sharp metal plates. These connections were chosen for their performance in structural integrity and cost-effectiveness. The system accommodates service access through strategically placed holes along the span, facilitating maintenance and inspection. Experimental evaluation involves testing two specimen configurations under specified loads to validate their structural performance. The test setup includes measurement tools like potentiometers to monitor deflection and slip between CLT and GLT components. Anticipated results include failure analysis at connection interfaces and subsequent bending failure, informing analytical validations crucial for drafting optimization guidelines. The research addresses limitations of mass timber construction regarding span capacity compared to traditional materials like steel and concrete. By exploring innovative connection methods, this study contributes to advancing sustainable building practices while expanding the application of mass timber in larger commercial structures. Future outcomes aim to provide practical insights and design recommendations to optimize composite floor systems, supporting broader adoption in the construction industry.	Dr. Wechiang	Pang	Clemson University
12B	MPD / TESP - Engineering - Material Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Moisture diffusion analysis for timber structures based on physics-informed neural network	The moisture content greatly affects the long-term creep and time-dependent deformation of timber structures. Therefore, monitoring and predicting the moisture content of timber structures are crucial. The variation of moisture content was obtained through long-term service experiments. An analysis method based on the physics-informed neural networks (PINN) was proposed. The moisture diffusion model based on Fick's second diffusion law and the boundary condition were incorporated into the PINN simulation. The coefficients in the model were also set as trainable parameters, avoiding complex calculations and ensuring accuracy. Additionally, transfer learning was applied to achieve satisfactory prediction with small data samples. The predicted results were compared with the experiments. Compared with the previous numerical models, the PINN-based method shows coefficient independence, higher efficiency and accuracy.	Yijing	Wang	Tongji University
12B	MPD / TESP - Engineering - Material Behaviour	Material Performance & Durability - Engineering Focus	Effect of dimension on the mechanical behavior of wood scrimber	This study investigates the influence of cross-sectional area and stressed length on the mechanical behavior of wood scrimber. Wood scrimber, a type of reconstituted engineered wood product, has been increasingly used in construction due to its superior mechanical properties and sustainability. Understanding how dimensions affect performance is essential for optimizing its use in structural applications. However, there is a lack of corresponding research. This paper presents experimental results on the compressive and tensile strength of wood scrimber specimens of different sizes. The study shows that both the size and aspect ratio of the samples significantly influence the mechanical behavior of wood scrimber. Specifically, the cross-sectional area and tensile length have different effects on tensile strength, and the impact of size on tensile strength and compressive strength differs. Using the weakest link theory, the tensile and compressive size effects of wood scrimber were quantified. These findings provide critical insights for the design and application of wood scrimber in various engineering structures.	Guofang	Wu	Research Institute of Wood Industry, Chinese Academy of Forestry
12B	MPD / TESP - Engineering - Material Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Influence of cracks on the embedment strength of dowel-type fasteners in glulam timber structures	Cracks caused by the environment and loads can reduce the mechanical properties of timber dowel-type connections and lead to brittle failure of structural members. This study investigated the impact of various crack lengths, widths, and depths on the embedment strength of dowel-type fasteners in glulam timber. Eight groups with different artificial cracks and one undamaged reference group were prepared and tested. The embedment properties of each group were obtained from the load-displacement curves, and the differences in embedment strength between groups were analysed by SPSS. Results showed that crack width and depth had a more severe impact on the embedment strength than crack length. In addition, a crack across the specimen's cross-section demonstrated a more significant reduction in embedment strength. The results of this study serve as a starting point in evaluating the impact of cracks in connections of existing glulam timber structures requiring maintenance and reinforcement.	Cong	Zhang	Beijing University of Technology
12C	TESP/MPD/TABD - Engineering / Architectural	Session Chair: PAOLO ASCHIERI / THECA TIMBER					
12C	TESP/MPD/TABD - Engineering / Architectural	Timber Engineering & Structural Performance - Engineering Focus	GROUND IMPROVEMENT EFFECT OF TIMBER PILES BURIED IN DIFFERENT SANDY CLAY SOIL	To understand the utilization of timber piles in ground reinforcement, it's crucial to assess their efficacy and sustainability in consolidating and compacting the ground post-burial, considering soil characteristics. This study employs simple soundings to analyze changes in penetration resistance around timber piles buried in different soil layers over time, aiming to evaluate solidification and improvement extent. Field tests reveal a notable initial increase in penetration resistance near timber piles, with subsequent expansion of consolidation zones over time regardless to the type of soil. The buried piles serve as drainage columns, inducing deep-seated consolidation phenomena, with greater effects observed over prolonged burial periods. These findings affirm the effectiveness and durability of timber piles in ground reinforcement, suggesting their promising role in disaster prevention and carbon sequestration efforts. Active utilization of timber piles holds potential for mitigating ground-related disasters and combating global warming through carbon storage in the soil.	Tadashi	Hara	Kochi University, Japan

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
12C	TESP/MPD/TABD - Engineering / Architectural	Timber Engineering & Structural Performance - Engineering Focus	COST-PERFORMANCE EVALUATION OF A PRES-LAM CASE-STUDY BUILDING IN ITALY	The socio-economic and environmental impact of recent earthquakes has underscored the need for advanced and sustainable technological solutions in new buildings. The use of engineered timber in construction has gained growing interest in the last years, especially in Italy; nevertheless, it usually comes in the form of conventional platform constructions with CLT (Cross-Laminated Timber) walls. Despite the ongoing research to enhance the performance and reduce post-earthquake damage of this system, CLT buildings are often characterized by rigid interior spaces. In contrast, the timber low-damage post-tensioned structural system, known as Pres-Lam technology, offers large open spaces and high-seismic performance with negligible damage and recentering characteristics. Although Pres-Lam has been implemented in various countries worldwide, its adoption in Italy is still at the first stages. This is primarily due to the lack of awareness and information about the technology, limited familiarity of engineers, architects and clients with the use of timber for multi-storey buildings, as well as perceived high costs. Through an Academic-Industry research partnership, this paper presents a case-study of a Pres-Lam adaptable building. A real CLT platform-frame building is re- designed using Pres-Lam technology, and its cost is assessed and compared with the original solution through a bill of quantities. The seismic performance is evaluated through non-linear static analyses, and the low environmental impact is demonstrated by performing a Life-Cycle Assessment of the building. The versatility of Pres-Lam is further emphasized by proposing a change in building use from residential to office space.	Giada	Formichetti	Sapienza University of Rome
12C	TESP/MPD/TABD - Engineering / Architectural	Timber Engineering & Structural Performance - Engineering Focus	One-storey timber-framed shear walls with window openings as part of the lateral force-resisting system.	For lateral force-resisting systems of multi-storey timber-framed buildings, the usual policy of current standards in Europe is to only consider wall segments continuous from the ground floor to the top edge of the building and to neglect wall elements with openings. Developing a design method that allows taking wall elements with window openings into account, would make the lateral force-resisting system more efficient and respective buildings more economic. This paper presents experimental investigations on horizontally loaded one-storey wall elements with large window openings. Different window opening sizes, sheathing-to-framing connection types and reinforcement measures were investigated. The results show that timber-framed shear walls with window openings have sufficient stiffness and strength potential to act contributingly to the the lateral force-resisting system.	Nadja	Manser	Empa - Materials Science and Technology
12C	TESP/MPD/TABD - Engineering / Architectural	Material Performance & Durability - Engineering Focus	AUSTRALIAN NATIONAL 2023 IN-GRADE SAWN TIMBER STUDY	Mills producing machine stress graded softwood sawn timber in Australia are responsible for the compliance of their products. Stress grading is covered in the AS/NZS 1748 performance standards with ongoing verification covered in AS/NZS 4490. Mills operate custom configurations of stress grading equipment with tailored grading and verification processes to suit their incoming timber resource and output product stress-grade mix. This paper presents the outcomes of a comprehensive national study completed in 2023 (2023 In-Grade Study) with 13 mills participating, accounting for ~90% of national production across Australia. The 2023 In-Grade Study comprised >17,000 tests and provided key insights into the relative performance of the structural properties (indicator and inferred) tested to AS/NZS 4063.1 and characterised to AS/NZS 4063.2. Structural property distributions are discussed with relative performance between indicator and inferred properties presented. The study reports characteristic densities and proposes a relationship between characteristic density and MOE for use with developing connection design models. The 2023 In-Grade Study led to follow-on projects further investigating compression and shear test methods to AS/NZS 4063.1.	Jon	Shanks	TimberED Services
12C	TESP/MPD/TABD - Engineering / Architectural	Timber Engineering & Structural Performance - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	DPG MEDIA HEADQUARTERS IN AMSTERDAM: A SHOWCASE OF TIMBER-CONCRETE COMPOSITE FLOOR TECHNOLOGY	The DPG Media headquarters in Amsterdam is a recent example of using Timber-Concrete Composite (TCC) floors in a hybrid timber structure. This project demonstrates how combining timber and concrete can enhance structural performance, improve acoustic properties, and allow spans up to 8.1 meters, creating a comfortable office environment. However, the project also highlighted the limitations and disadvantages of this technology. Handling timber creep and concrete shrinkage was challenging, as TCC floors did not significantly reduce deformations compared to Cross-Laminated Timber (CLT) floors of the same thickness. Applying pre-camber and managing point loads due to temporary propping slowed construction, and manually installing over 175,000 coach screws impacted the timeline. Prefabrication benefits were offset by the installation of connectors and concrete pouring, adding considerable time. The inclusion of two levels of underground parking created water pressure, necessitating a heavier structure. This issue led to the use of TCC floors, whose concrete component increased the building's Global Warming Potential (GWP) and raised concerns about long-term dismantling. Overall, the DPG Media headquarters project showcases the potential of hybrid timber construction while also revealing its limitations. This project provides valuable insights into managing composite systems, optimizing construction processes, and balancing structural performance with sustainability goals.	Benoît	Hargot	WOW Engineering
12C	TESP/MPD/TABD - Engineering / Architectural	Timber Architecture & Biophilic Design - Architectural Focus	EXPLORING REACTIONS TO WOOD DEFECTS: A STUDY INVESTIGATING PSYCHOLOGICAL/ PHYSIOLOGICAL RESPONSES AND CULTURAL DIFFERENCES TO IMPERFECTIONS IN WOOD	Biophilia refers to the innate human tendency to connect with nature, stemming from our evolutionary need for natural environments for survival. In architecture, biophilic design incorporates natural elements to enhance well-being. Wood, in particular, has significant restorative effects, improving mood, reducing stress, and boosting cognitive performance when used in architectural spaces.Research shows that wood interiors positively impact human psychology and physiology, though studies often lack comprehensive cultural perspectives and the effects of wood defects. Cultural backgrounds significantly affect how individuals perceive and react to wood. Eastern and Western cultures exhibit different values and behaviors that influence their interaction with natural materials. This study categorizes participants into these broad cultural groups to understand how cultural nuances shape responses to wood and its defects.The study involves 60 students from diverse cultural backgrounds, split into Eastern and Western categories. Experiments will be conducted in two cubicles, one with defect-free White Pine and the other with wood featuring defects. Physiological data, including heart rate and skin conductance, will be collected using wristbands, while psychological data will be gathered through questionnaires and interviews.Pre- and post-experiment questionnaires and tests will assess changes in psychological states and cognitive performance. Open-ended interviews will provide qualitative insights. The data will be statistically analyzed to identify patterns and correlations between cultural background and responses to wood defects.The study aims to correlate psychological and physiological responses to wood with and without defects and determine if these responses are culturally influenced.This research aims to contribute to biophilic design knowledge by examining the intersection of architecture, wood science, and environmental psychology.	Aayusha	Chapagain	SUNY College of Environmental Science and Forestry

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
12C	TESP/MPD/TABD - Engineering / Architectural	Timber Architecture & Biophilic Design - Architectural Focus	BioHeal: Tree upcycling for architectural healing	Felled tree upcycling is crucial not only for reducing carbon emissions but also as a valuable renewable material in resource-scarce Singapore. The Bioheal™ project aims to pilot test the challenges and opportunities of tree upcycling for a rapidly aging population, with the goal of aiding faster patient recovery through biophilic architectural installations of upcycled timber at a public hospital extension project. To preserve the public's fond memories of its natural environment and historical importance, it is required to install upcycled timber sourced only from the designated construction site within the campus. A "Trees to Design" approach (as opposed to the typical "Designs come first" process), born out of necessity, was developed to address the limited and unpredictable supply of species, sizes, and quantities of upcycled timber. This approach maximizes the potential and highlights the uniqueness of upcycled trees as biophilic design features. These features include: 1. Sequential live edge partitions, 2. CNC-carved biomorphic columns, and 3. Mass-customized modular feature walls representing the diversity of the tropical timber species upcycled. To promote the use of felled trees for commercial construction practices, it is recommended to establish a common public stockyard for upcycling trees. This would buffer the irregular but significant constant supply of felled trees from roadsides and construction site clearings, enabling clients and contractors to integrate upcycled timber into their practices in a more controlled and predictable manner, ensuring a sustainable and resource-efficient construction industry.	Shinya	Okuda	National University of Singapore
12C	TESP/MPD/TABD - Engineering / Architectural	Timber Architecture & Biophilic Design - Architectural Focus	USE OF AMAZONIAN HARDWOOD IN TIMBER STRUCTURES - BRAZIL	The Mato Grosso Timber Production and Export Industries Centre (CIPEM) is the union of eight forest-based employers' unions, whose purpose is to organize and strengthen the sector. It encourages the productivity and conscious consumption of wood and its forest-based products regarding the current legislation and in a sustainable basis. Cipem covers 100% of the native wood producing municipalities of Mato Grosso state and it is at vanguard of sustainable forest management in Brazil. Aiming to demonstrate the several possibilities of building with Amazonian hardwood, some structural systems were designed and built to be exposed in national and international fairs, highlighting the use of lesser-known species. Their main characteristics are the fast assembling based on its constructive rationalization, with the maximum exposure of the huge variability of Amazonian species managed by Cipem. Wood species were selected according to market strategies and their physical and mechanical properties were considered. Each wood piece used in the timber structures was properly identified by management control protocols. The visual experience of the timber structures is enriched by the several colours and textures that are typical from Amazonian woods. The design and build of Amazonian timber structures is evidence of the flexibility of this sustainable and locally sourced materials. Also, wood is the only choice for a renewable and sustainable building material and forest-based materials are desirable for their strength, durability, beauty, and cost-effective construction.	ROBERTO	LECOMTE DE MELLO	Casacerta Architecture Design & Building
12D	EIC - Innovation & Testing	Session Chair: PROFESSOR YING HUI CHUI / UNIVERSITY OF ALBERTA					
12D	EIC - Innovation & Testing	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	MULTI-LAYER STRAND-BASED WOOD MATERIALS IN CONSTRUCTION: MECHANICAL PROPERTIES AND TEST METHODS	Unplanned and planned deforestation as well as forest management regimes and forest degradation influence the current and more importantly the future supply of wood. Given the high demand for wood products, it is crucial to optimize the utilisation of low-quality, non-sawable wood, and wood sidestreams, which are currently predominantly combusted. Strand-based engineered wood products provide a viable solution but are typically used in single-layer configurations. There is limited research on their multi-layer performance, particularly for use as structural material in multi-story buildings, highlighting the need for further investigation. The present study examines the mechanical properties of multi-layer strand-based wood materials, specifically six-layer oriented strand board (OSB) and a novel three-layer Unistrand material. Comprehensive experiments evaluate the bending, shear, and compression properties, as well as the elastic constants and strength properties, of both materials, clearly showing the suitability of these material to be used in construction. These findings serve as a basis for modeling and design and fill a critical gap in literature by providing detailed data on multi-layer strand-based wood materials. Additionally, insights into the most suitable test methods for these materials are given, guiding future applications and developments in the construction industry.	Benjamin	Kromoser	University of Natural Resources and Life Sciences (BOKU)
12D	EIC - Innovation & Testing	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	Tubular veneer timber: structural testing and flat pack self-shaping for ultralight, cylindrical wood components	Tubular Veneer Timber (TVT) offers a sustainable solution for low-carbon construction by addressing inefficiencies in traditional, solid wood, structural elements. Unlike solid wood elements that waste material and are difficult to transport, TVT uses hollow, cylindrical geometries that maximize compressive strength while minimizing material usage and weight. By leveraging the natural properties of wood fibers, TVT can be manufactured and transported efficiently, significantly reducing the carbon footprint. TVT's innovation lies in its ability to self-shape from flat-packed panels into cylindrical components when exposed to specific moisture conditions. This process allows TVT to be transported in a flat, compact form, reducing transportation emissions by up to 90%. Upon reaching the construction site, the panels can be dried, transforming them into lightweight, deployable structures such as trusses or columns. The research focuses on the structural capabilities of TVT, particularly its compressive strength. Initial tests involved manufacturing and self-shaping five tubes, followed by compression loading tests at Oregon State University. The results demonstrated an average maximum compressive stress of 36 MPa with a standard deviation of 3 MPa, indicating consistent performance. Failures observed during testing included cracking and lamination warping. Background studies have shown the potential of self-shaping wood veneer structures, but challenges remain in ensuring long-term stability and environmental resistance. The integration of these self-shaping properties with hollow cylindrical structures aims to fill a gap in existing research. The ongoing experimental work looks to explore different lamination thicknesses and configurations to enhance the compressive strength and practical applications of TVT.	Helene	Brehl	University of Oregon - School of Architecture & Environment

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12D	EIC - Innovation & Testing	Timber Engineering & Structural Performance - Engineering Focus	EVALUATION OF MOMENT CONNECTION WITH GLUED-IN ROD IN TIMBER	Glued-in Rod (GIR) connection is recognized for their robust strength and stiffness as representative moment connections for timber frame. However, GIR typically resists both shear and moment forces simultaneously, with perpendicular shear forces against the grain reducing their moment performance. To enhance GIR's effectiveness, a new connection was developed to separate shear and moment resistance. This innovation combines GIR with a dowel connection known as Slotted-in Plate (SIP), renowned for its excellent shear resistance. The moment strength of the developed connection increased by 30.87%, while rotational stiffness decreased slightly by 6.64% compared to the existing GIR connection without SIP. These results imply that the developed connection can serve as a more reliable joint in structural applications.	Min-Jeong	Kim	Seoul National University
12D	EIC - Innovation & Testing	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	Innovative Testing Machine for Creep Tests on a Structural Scale Under High Constant Load	In multi-story timber buildings using platform framing, most vertical deformations occur at the floor joints. In these areas, the floor and, in the case of timber frame constructions, the top and bottom plates are loaded perpendicular to the grain. The stiffness of the timber members in this direction is considerably low. Moreover, the literature reveals that deformations due to creep are significantly higher in this direction compared to loading parallel to grain. However, most studies have been conducted on small-scale specimens, as creep test setups for tests on a structural level necessitating high loads are challenging to manage or costly. Towards this objective, a testing machine was developed that employs the principle of dead weight, combined with multiple levers to amplify the load. This machine can provide a high, constant load over a long time.	Christian	Bertram	Timber Structures and Building Construction, Karlsruhe Institute of Technology (KIT)
12D	EIC - Innovation & Testing	Education, Innovation & Challengers - Engineering Focus	CCLT – Further development of a CLT based sandwich structure with a bamboo honeycomb (COMBOO)	This document reports of extended investigations of a CLT sandwich construction. The required large amount of timber and the high weight of conventional CLT boards can be reduced by integration of a layer of bamboo rings forming a honeycomb structure (called COMBOO) between outer layers of CLT boards (=CCLT). After a transfer from GFRP sandwich applications via model scale tests, this document contains manufacturing and tests of full scale CCLT boards. First, a comparison between self-made CLT boards and CLT boards from manufacturer KLH (Austria) was made, to gather experience with handling and estimation the difference in bending strength due to much lower compression force during gluing. In the second step the CCLT boards were created which opened more new questions or tasks, followed by 4-point bending tests. Hereby was found that manufacturing method influences the bending strength, but the chosen manufacturing method can be used for CLT production and hence CCLT production. Bending strength varied between 30.6 N / mm2 (KLH -CLT) and 8.9 N / mm2 (CCLT). A wider field of new tasks and extend tests was identified to create a suitable building material at industrial scale.	Andreas	Loth	Berliner Hochschule für Technik
12D	EIC - Innovation & Testing	Education, Innovation & Challengers - Architectural Focus	GREY ZONES: UNVEILING CHALLENGES AND SOLUTIONS IN DESIGNING, PLANNING, AND CONSTRUCTING WOODEN BUILDINGS FOR DEVELOPING COUNTRIES.	This article is the result of the systematic registration and identification of the so-called "grey areas", understood as sectors of an ambiguous nature in the face of the challenges and solutions in the design, planning and construction of wooden buildings for developing countries and which prevent the initiation and development of this type of projects in developing countries such as those in Latin America. Through recent architectural and engineering design work - Tamango Building, a 12-story building in wood not yet built and Piloto Tamango, a 1-story building with a LVL load-bearing structure already built in the far south of Chile - and consulting work - Roadmap for Social Housing in Wood in Uruguay and evaluation of new projects for an important local mass timber industry - it was possible to carry out a survey of current practices in this region of the planet - with problems regarding construction productivity and strong challenges around sustainability goals for the coming years - delivering a diagnosis that identifies key actions and a realistic path to be followed specifically by professional offices, through the development of the so-called "Digital Twin".	Gerardo	Armanet	Centro Nacional de Excelencia para la Industria de la Madera (CENAMAD)
12D	EIC - Innovation & Testing	Education, Innovation & Challengers - Engineering Focus	DEVELOPMENT OF SAFE DESIGN PROCEDURES FOR PRODUCTS, ASSEMBLIES, AND SYSTEMS IN WOOD CONSTRUCTION	The Canadian government and its provinces are implementing climate strategies and regulations to decarbonize the building construction sector through nature-based solutions, such as using sustainable and renewable construction materials. Measures include promoting wood education and research, "Wood First" provincial policies, modernizing sustainable forest management, and strengthening the timber supply chain. In line with these efforts, in 2023, the Quebec Ministry of Natural Resources and Forests funded the authors of this paper to develop safe design procedures for products and systems in wood construction. The research program will be executed over five years at Université Laval and McGill University in collaboration with twelve industry partners through a series of planned research tasks. The tasks encompass developing 1) novel connection systems for mass timber buildings, 2) new timber-steel braced frames, 3) low-damage rocking timber frame braced systems, and 4) seismic and wind design guidelines for the new systems through numerous experimental campaigns and extensive numerical studies. This paper provides an overview of the project, its status, and upcoming tasks.	Alexander	Salenikovich	Université Laval
12E	EIC/TESP/MPD-Engineering - Fire	Session Chair: DR SHENGDONG ZHANG / TONGJI UNIVERSITY					
12E	EIC/TESP/MPD-Engineering - Fire	Timber Engineering & Structural Performance - Engineering Focus	A MULTI-FIDELITY APPROACH BASED THERMO-MECHANICAL CAPACITY ASSESSMENT OF GLULAM TIMBER CONNECTIONS SUBJECTED TO FIRE HAZARD	This research develops a innovative multi-fidelity approach based assessment method to conduct comprehensive thermo-mechanical analysis of glulam timber connections exposed to standard fire conditions. The framework is specifically designed to integrate low-fidelity features derived from finite element models with high-fidelity experimental data. This integration allows for the efficient utilization of both data types to achieve a rapid and accurate prediction across the entire domain, significantly improving the prediction accuracy and reducing computational costs. The heat transfer within the wood is analyzed based on the results of finite element models (low-fidelity model database) and experimental data (high-fidelity model database), and temperature-dependent properties such as thermal conductivity, specific heat capacity and density are determined. Variou factors such as bolt count, diameter, beam thickness, and wood density are taken into account to predict temperature distribution within connections. Additionally, using Johansen's yield theory, load-bearing capacity was analyzed to determine fire resistance of connections, establishing a comprehensive understanding of their structural resilience in fire scenarios. This approach provides analysts with accurate connection data while significantly reducing the time and computational resources required, enhancing the efficiency of structural fire safety evaluations.	Jing	Luo	Shanghai Normal University

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12E	EIC/TESP/MPD-Engineering - Fire	Timber Engineering & Structural Performance - Engineering Focus	TOWARDS AN IMPROVED METHOD FOR PREDICTING THE CONTRIBUTION TO FIRE GROWTH AND STABILITY OF STRUCTURAL MASS TIMBER IN NATURAL FIRES.	The use of mass timber in construction is becoming increasingly prevalent, particularly in the context of mid- and high-rise buildings. This is due to the need to decarbonise the building sector and recent amendments to public policies that support the development of bio-sourced materials. However, these significant environmental and comfort benefits are often precluded by restrictive prescriptive provisions in local or national regulations which typically require structural timber to be completely encapsulated by fire protection components. In addressing this challenge, an enhanced methodology for quantifying the impact of exposed mass timber on fire dynamics, including the charring rate and total char depth, has been developed. This approach builds upon existing two-zone fire dynamics models, which facilitate fast and accessible calculations. The effectiveness of the method, verified against 53 compartment fire experiments totalling 85 char depth measurements are discussed in addition to future work to improve the accuracy of the predictive calculation in a wide range of timber construction typologies and configurations. The method could then be utilised to evaluate the absence of fire spread (both internal and external) and the load-bearing capacity of exposed timber for the requisite minimum specified period under natural fire conditions, as part of a performance-based design approach.	Francois	Consigny	Cstb / ENPC (Paris, France)
12E	EIC/TESP/MPD-Engineering - Fire	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	STRUCTURAL INTEGRITY OF HOLLOW GLUE-LAMINATED TIMBER BEAMS IN FIRE	This study deals with hollow glulam elements developed for prefabricated building systems. The lamellas are made from recycled waste material and the sawdust produced when cutting the cavity can be reused as insulation material or processed into pellets. Beams with varying degrees of perforation were tested, with the maximum degree of perforation being around 30%. This system is compared with existing systems to highlight the main characteristics and behavior of the hollow glulam elements under fire conditions. Due to the geometry of the hollow GLT elements and the thin vertical timber segments between the cavities, fire exposure can lead to irregular residual cross-sections with greater charring depth compared to standard GLT elements. The research consists of an experimental part and a FEM analysis. The research has shown that the reduced cross-sectional area of the timber element and the possibility of air circulation through the cavities accelerate the combustion process. In addition, the reduced bond area of the laminated joint can lead to delamination, which was found to be the main reason for the failure of hollow beams in this research. A simplified calculation model was developed to determine the charring depth and the zero strength layer. The experimental investigations were confirmed by the FEM analysis.	Nikola	Perković	Faculty of Civil Engineering, University of Zagreb
12E	EIC/TESP/MPD-Engineering - Fire	Material Performance & Durability - Engineering Focus	THE EFFECT OF NATURAL AGEING ON THE PROPERTIES OF OAK WOOD FROM NOTRE DAME DE PARIS CATHEDRAL	The fire at Notre Dame Cathedral in Paris (NDP) was a disaster that nevertheless led to a number of scientific breakthroughs. The remains of the roof frame constitute a large stock of oak wood dating from the 12th to the 19th century, offering a rare opportunity to study the ageing properties of wood. Following on several research initiatives, the results presented here aimed in particular at 1- consolidating matching techniques to compare old and recent wood, 2- assessing instantaneous elastic properties, 3- determining the hygroscopic behavior, 4- estimating the effects of aging on fracture and time-dependent behavior. The disturbance depth of the fire was assessed using color analysis. Preliminary 3-points bending tests performed on a small number of samples from the 12th to 19th century highlighted the considerable variability of such material and the need to manage a diverse sample to reach reliable conclusions.	Nicolas	Sauvat	Clermont Auvergne University
12E	EIC/TESP/MPD-Engineering - Fire	Material Performance & Durability - Engineering Focus	Identification of smouldering inhibitors for copper-based treated timbers	Bushfires are increasingly common globally and have major effects on infrastructure, especially the electrical networks. Timber poles are widely used to support networks in Australia, and the most used preservative is chromate copper arsenate (CCA). While highly effective against fungal and insect attacks, CCA is susceptible to self-sustaining smouldering due to the catalytic effect of the metals present in the preservative. This study investigated the potential addition of smouldering inhibitors to inhibit bushfire-associated smouldering. The addition of diammonium phosphate, chlorinated paraffin wax %70 and silicone oil were first assessed using thermogravimetric analysis at a laboratory scale. Temperature of the oxidation process, the differences in pyrolysis and oxidation process temperatures, the CO/CO2 concentration ratio in the gas products, and the mass of char produced after pyrolysis were used to select potential candidates. DAP (0.2% wt/wt) produced the most significant reduction in smouldering. Selected candidates were evaluated on bench scale tests (cone calorimetry) in a future stage.	Zeinab	Darabi	University of Queensland, The
12E	EIC/TESP/MPD-Engineering - Fire	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	FULL-SCALE EXPERIMENTAL STUDY OF COMPARTMENT FIRES IN MASS TIMBER STRUCTURES	In 2022, the Canadian Wood Council partnered with key stakeholders to conduct a series of full-scale fire tests under the Mass Timber Demonstration Fire Test Program (MTDFTP) aimed toward advancing current understanding of compartment fire dynamics, fire safety during construction, and impact of exposed mass timber surfaces on fire severity and duration. A total of five tests with varying degrees of encapsulation, ventilation conditions, and fuel loads were performed in a two-storey, multi-compartment structure constructed of cross-, dowel- and glued-laminated mass timber elements. The test structure, its configuration, and contents were intended to represent parts of an encapsulated mass timber building undergoing construction and areas with residential and open-plan office uses in the finished building. The test rig was well-instrumented with temperature probes, heat flux gauges, infrared and video cameras to capture the various stages of fire development throughout a test. All five tests were conducted without sprinkler protection or firefighter intervention, illustrating rare scenarios where suppression operations would be ineffective in controlling the fire. This paper presents the project background, objectives, methodology, key findings, conclusions, and recommendations from the MTDFTP's full-scale fire testing series.	Marc	Alam	Canadian Wood Council
12E	EIC/TESP/MPD-Engineering - Fire	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	INFLUENCE OF FUEL TYPE AND LOAD ON FIRE INTENSITY: RESULTS FROM FULL-SCALE FIRE TESTS FROM THE WOODWISE PROJECT	Over the past decade, several large-scale fire tests have been conducted by research teams across the world to evaluate the fire performance of mass timber structures to support the adoption of larger and taller mass timber. However, the tests conducted to date have a mobile fuel load of 680 MJ/m2 or less. Additionally, the mobile fuel load used was often cellulose-based and made of either wood furniture or wood cribs. The WOODWISE project aims to enhance the understanding of fire dynamics in mass timber structures with the inclusion of modern mobile fuels and higher fuel loads. Four large-scale mass timber compartment fires will be conducted in the fall of 2024. For the tests, the mobile fuel load will be 800 MJ/m2, which includes everything except the fixed structure (mass timber). This higher fuel load more closely represents an average dwelling. Three of the tests will include furniture, electronics, appliances, and household chemicals and will be compared against one test with wood cribs. The heat release rate and gas layer temperatures will be measured to evaluate the fire dynamics and provide results to compare between each compartment and previous tests.	David	Barber	Arup

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12E	EIC/TESP/MPD-Engineering - Fire	Timber Engineering & Structural Performance - Engineering Focus	THE HIGH-DUCTILITY CLASS (DC3) DESIGN PROCEDURE IN THE NEW EUROCODE 8 FOR CLT BUILDINGS: A CASE STUDY	This study aims to discuss the high ductility (DC3) design procedure for Cross-Laminated Timber (CLT) multi-storey buildings included in the draft document of the second generation of Eurocode 8. Through the analysis of the individual steps, possible issues in the interpretation and application of the rules of the DC3 design protocol are highlighted and resolved. Furthermore, a new method for medium ductility design (DC2+) is proposed; the goal is to define a simplified calculation method for segmented walls that allows the use of a higher behaviour factor than the one proposed for the DC2 and a lower computational burden than the DC3. The main steps of this phase have been the verification of the proposed behaviour factor through a pushover analysis on various single wall structural archetypes, and the impact of the new method on the connection design and on the computational difficulty.	Massimo Martina	Fragiacomo Sciomenta	University of L'Aquila
12F	EIC/STCE/ECCS - Architectural / Engineering / Practitioner	Session Chair: PROFESSOR SAM SALEM / LAKEHEAD UNIVERSITY					
12F	EIC/STCE/ECCS - Architectural / Engineering / Practitioner	Sustainability and Timber in a Circular Economy - Practitioner Focus	Forest product demand and supply in a bioeconomy transition: The possible role of timber for climate change mitigation	There is limited understanding at both the regional and global levels of the likely supply and demand outlook for forest products in a functioning and growing forest-based bioeconomy. A recent study commissioned by the Food and Agriculture Organization seeks to fill that gap by providing an up to date and overall understanding of the impact of global megatrends, particularly those related to the drive to decarbonise industrial supply chains, on the likely supply and demand for forest products. As the building and construction sector shows substantial promise for reducing emissions and significantly impacting the demand for wood fibre, the study will pay particular attention on policy, product and process innovations that have the most potential for impacting forest product supply and demand dynamics in the built environment. The study will include a review of existing literature and provide results from scenario-based forecasting analyses. This presentation will present the findings and key recommendations of this study including safeguard considerations and policy recommendations, including opportunities and limitations for integrating forest products in NDCs. It will also provide guidance for the future research agenda to guide decision making that will impact the supply and demand dynamics of forest products in a growing bioeconomy.	Rodney	Keenan	Food and Agriculture Organization of the United Nations
12F	EIC/STCE/ECCS - Architectural / Engineering / Practitioner	Education, Innovation & Challengers - Architectural Focus	WOODEN CITIES FOR CHILE: RESEARCH AND PROJECT WORKSHOP TO OPT FOR THE TITLE OF ARCHITECT AND MASTER DEGREE.	After completing a three-year cycle, the "Wooden Cities" Research and Project Workshop proposed a field of experimentation that went back and forth between the training of a professional specialized in wood and an intellectual capable of looking at the cultural dimension of his work, providing valuable tools for professional life, linking theory and practice. From the premise of the existence of an adequate scale for new construction with wood - the district - and the knowledge of two main drivers of construction with this renewable resource - sustainability and productivity - the students designed master plans for medium-sized cities or suburbs, well connected and aimed at a new generation of professionals; and also medium-rise wooden buildings, mixed-use and different typologies that - with criteria of structures, sustainability, and construction management - were able to accommodate this new demand. This teaching methodology trained a new generation of professionals with tools for designing, calculating, and detailing new projects. It gave rise to a new formulation of this workshop, focusing on densification in consolidated cities, whose results are also part of this article.	Juan José	Ugarte Gurruchaga	Centro Nacional de Excelencia para la Industria de la Madera (CENAMAD)
12F	EIC/STCE/ECCS - Architectural / Engineering / Practitioner	Education, Innovation & Challengers - Architectural Focus	COMPARATIVE PERSPECTIVES ON THE FEASIBILITY OF PROMOTING TIMBER CONSTRUCTION IN SOUTH AFRICA	The study explores the perceptions, barriers, and drivers influencing the adoption of timber in South Africa's construction industry. An online survey was conducted to gather insights from construction industry stakeholders on perceptions of timber compared to conventional materials, barriers to adoption, and recommendations for increased adoption. Thereafter, responses from architects were compared to responses from other industry stakeholders to investigate any similarities or differences. Perceived barriers identified include negative perceptions, cost concerns, and cultural preferences for traditional building methods, while some proposed solutions include education, investment in the timber construction sector, and pilot projects. The study offers valuable insights into the perceptions and challenges surrounding timber construction in South Africa from multiple perspectives, and future research could empirically test the relevance and actual impact of these findings by examining real-world projects and data.	Johann	van der Merwe	University of Pretoria
12F	EIC/STCE/ECCS - Architectural / Engineering / Practitioner	Education, Innovation & Challengers - Engineering Focus, Education, Innovation & Challengers - Architectural Focus	FOSTERING INTERDISCIPLINARY INNOVATIONS BY DEISGN-BUILD PROJECT WITH DIGITAL FABRICATION TECHNOLOGIES	The construction industry is facing a major transition in promoting sustainability and adopting digital technologies. To address such challenges and foster innovations, one effective method is to nourish future professionals through education. The Adaptation to Future Environments course at Chalmers University of Technology aims to address the emerging challenges of adaptating to the rapidly changing socio-technological environments. The course brings students together to collaborate and solve real-world challenges. 16 students participated in the course project through February to June 2024. The goal of the project was to design and build a pavilion using digital fabrication. The materials used were solid timber and wood-polymer composites. Through collaboration among different work groups, the design was developed by applying a free-form ring structure made of glulam with the cladding made of 3D-printed composite elements. The production method of both elements was developed with the aid of digital tools. As a result, the pavilion was successfully constructed through close communications among all the groups with appropriate supervision. The project effectively addressed real-life challenges in interdisciplinary innovations in the construction industry. It is concluded that such a hands-on design-build project is a highly pedagogical activity, that can be adopted in various teaching environments in timber engineering.	Yutaka	Goto	Chalmers University of Technology/Tohoku University
12F	EIC/STCE/ECCS - Architectural / Engineering / Practitioner	Sustainability and Timber in a Circular Economy - Architectural Focus, Education, Innovation & Challengers - Architectural Focus	Measuring and modelling of process induced discoloration in Tasmanian Blackwood (Acacia melanoxylon)	Process induced discoloration of Tasmanian Blackwood (Acacia melanoxylon) has a significant economic impact on the timber industry in Tasmania Australia. This research aims to reduce hardwood timber discolouration caused by Tasmanian Blackwood drying processes as practiced in Tasmania, Australia which affect the amount of solid timber production waste from sawmill operations.	David	Tanton	University of Tasmania

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12F	EIC/STCE/ECCS - Architectural / Engineering / Practitioner	Exemplars & Construction Case Studies - Architectural Focus	Phases of Architectural Design in the Development of a Modular and Panelized Wooden Building with Early Integration Process	The article analyzes a wood architecture project as a sustainable solution for the construction of industrialized social housing buildings in Chile. It highlights the importance of early integration of architectural and engineering teams. The project, a 4-story light wood frame building, this presents the need for standardization and precision in manufacturing to avoid transportation and assembly issues. A design divided into four phases is proposed: conceptualization, schematic design, architectural design, and manufacturing adjustments. Each phase involves collaboration among various professionals to optimize design and construction. The case study analysis presents early integration and standardization as essential factors to improve quality, efficiency, and reduce costs in the construction of wooden buildings, proposing them as a viable and sustainable option in the Chilean urban context.	Daniela	Méndez	CENAMAD
12F	EIC/STCE/ECCS - Architectural / Engineering / Practitioner	Sustainability and Timber in a Circular Economy - Engineering Focus Exemplars & Construction Case Studies - Engineering Focus	Green Public Procurement and Timber in Construction for a Circular Economy	This research investigates the role of Green Public Procurement (GPP) in advancing sustainable timber construction within Ireland's built environment, aligning with the EU Circular Economy Action Plan. Through an extensive literature review and a detailed Life Cycle Assessment (LCA) of residential buildings, the study evaluates the environmental benefits of substituting conventional materials with timber-based alternatives. A structured GPP inventory, encompassing 106 products and 12 services, facilitates the integration of engineered wood products and mass timber systems into procurement policies, reinforcing their viability as low-carbon alternatives. The LCA findings from a case study in County Galway demonstrate substantial embodied carbon reductions when replacing traditional concrete masonry blocks with timber-based solutions, particularly in the raw material supply and manufacturing phases. By incorporating biogenic carbon storage into sustainability assessments, the research strengthens the case for prioritizing timber in public infrastructure projects. Public procurement emerges as a key driver for fostering industry-wide adoption of advanced timber technologies, stimulating supply chain innovation, and aligning procurement mechanisms with evidence-based sustainability metrics. The adaptability of the proposed GPP inventory ensures continued relevance as sustainability standards evolve. This study provides policymakers and industry stakeholders with a robust framework for integrating LCA and Environmental Product Declarations (EPDs) into procurement processes, supporting Ireland's climate objectives and the transition toward a circular, low-carbon built environment.	MUHAMMAD KHIZAR	BARAKZAI	University of Galway
12F	EIC/STCE/ECCS - Architectural / Engineering / Practitioner	Education, Innovation & Challengers - Practitioner Focus	Timber Concrete Node: A New Paradigm for Post and Beam Timber Connections	Post and beam timber connections that cannot be realized with direct timber-to-timber bearing traditionally rely on metal hangers to transfer load from the beam to the column. Metal hangers must be entirely concealed within the timber or covered with supplemental fire protection to retain their load carrying capacity during a fire event. Very tight tolerances are therefore required to fit the components together to protect the metal hangers, or gaps must be sealed with intumescent caulk/tape to provide supplemental protection. The Timber Concrete Node (TCN) provides an alternative to metal hangers, by using a reinforced concrete bearing node to connect timber post and beam structures. The TCN can be left fully exposed to view and to fire, or it can be partially or fully covered by timber depending on the architectural vision. By leveraging a simple kit of parts and affordable materials, the TCN can be used to make easy, cost-effective, and high-capacity connections in mass timber structures. The paper explores the background research and the design features of the TCN, and provides comparison to standard and bespoke metal hangers. The fabrication, supply, testing, and installation of the first TCNs in a mass timber building will be covered in detail as a case study to demonstrate the benefits of the TCN in post and beam construction.	Md	Shahnewaz	Fast+Epp
12G	STCE - Engineering	Session Chair: A/PROF JOE GATTAS / THE UNIVERSITY OF QUEENSLAND					
12G	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus	The interrelations of Intermediate Floor Beam Structures, Structural Spans, material efficiency and greenhouse gas emissions in Finnish Mid-Rise timber Apartment Buildings	The built environment contributes significantly to climate change, and Finland's aim for carbon neutrality by 2035 includes promoting wooden multi-story construction due to timber's lower greenhouse gas emissions compared to conventional materials. This study explores the technical challenges and carbon footprint of timber-structured intermediate floors in Finnish mid-rise apartment buildings. These components are often thick and multi-layered, making them relatively carbon-intensive. The research focuses on understanding the interrelations between intermediate floor beam structures, longest structural spans, material efficiency, and global warming potential (GWP). Analyzing data from 21 Finnish mid-rise timber apartment buildings constructed between 2018 and 2022, the study assesses the material efficiency and emissions per square meter of apartment space. By comparing these factors across various case studies, the research provides insights into more efficient and sustainable structural designs. This includes examining the longest structural spans, load-bearing directions, and material data from design documents, and conducting life cycle assessments of the intermediate floor components. The total thickness of intermediate floors ranged from 450 mm to 700 mm, revealing potential interrelations between floor beam structures, their spans, material efficiency, and GWP. The results are presented through bar charts and graphs that illustrate the load-bearing span, volume of materials used, and GWP per square meter, allowing for a comparative analysis of different floor structure types. The findings highlight practices that achieve certain spans with less material and emissions. The results can also improve the accuracy of preliminary planning for structural spans and the dimensioning of floor structures, helping to prevent design revisions.	Antti	Tuure	Tampere University

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12G	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus	Developing carbon crediting methods to promote timber engineering designs	Innovative mass timber engineering designs for large-scale buildings can significantly reduce embodied carbon emissions in the construction sector. International advancements in mass timber construction (MTC) have led to new carbon crediting methodologies being proposed globally, including under the Australian Carbon Credit Unit (ACCU) Scheme, which recognizes, issues, and trades greenhouse gas emission reductions. The ACCU Scheme method proposal would enable Australian construction developers to use a growing range of timber products, including mass timber, for large-scale buildings. This can substantially reduce embodied carbon emissions compared to conventional materials like reinforced concrete and steel. Although leading examples of such buildings exist in Australia and worldwide, the use of MTC remains relatively limited, comprising less than 2% of the mid-rise and above construction market in Australia. Thus, developers adopting MTC designs to reduce greenhouse gas emissions and promote sustainable buildings are clearly going beyond business-as-usual practices. The method proposed for Australia is directly aligned with the commitment made at COP28 in Dubai by Australia and 16 other countries, to increase the use of timber in the built environment by 2030. Under the auspices of the Forest and Climate Leaders' Partnership Coalition on 'Greening Construction with Sustainable Wood', signatory countries committed to advancing policies and approaches that support low carbon construction and increase the use of wood from sustainably managed forests in the built environment. This paper discusses the design for a proposed carbon crediting methodology associated with innovative timber engineering in construction, with reference to Australia's offset	Joe	Gattas	The University of Queensland
12G	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus	KEY ASPECTS FOR ECONOMIC FEASIBILITY OF IMPLEMENTING DESIGN FOR STRUCTURAL ADAPTATION IN THE AUSTRALIAN TIMBER INDUSTRY	Extending the service lives of timber buildings is a key aspect of maintaining sustainable forestry and prolonging carbon storage. One strategy to facilitate this is to invest in the structure's adaptability, to Design for Structural Adaptation (DfSA). Yet, stakeholders are uncertain regarding the economic feasibility of such an investment. This study addresses this by investigating which factors are key in determining the economic feasibility of DfSA in an Australian multi-residential light-frame timber building. A cost-benefit analysis is performed to compare a structurally adaptable building to a business-as-usual alternative, where the uncertainty of future adaptation needs is considered in the model. The results provide valuable insights for future efforts to implement adaptable timber design, as key aspects for economic feasibility are identified.	Vera	Öberg	Chalmers Unversity Of Technology
12G	STCE - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus	URBAN TRANSITION WITH WOOD FOR ENHANCED RESILIENCE OF CITIES AND FOREST – GLOBAL VISION AND PATHWAY	In light of climate change and global sustainability challenges, the forest and timber construction sector offer opportunities for positive change. The aim of this research project is to establish visions for a sustainable and resilient future society and pave the pathway by setting up the research agendas and policy proposals in the utilization of wood in urban environments from both local and global perspectives. This is achieved through deep exchanges among various stakeholders with varying backgrounds from multiple regions (Europe, Oceania, Asia, and Noth America) in a local workshop series (Japan, Australia, and Sweden) and a global workshop in Japan in November 2024. The research agendas and policy proposals will be formulated in different areas, for example echnology implementation in construction, sustainability impact assessment, and production system optimization.	Masaki	Maeda	Tohoku University
12G	STCE - Engineering	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus	EXPERIMENTAL STUDY ON APPLICABILITY OF LOW-QUALITY LOGS AS REINFORCED GROUND	Sustainable forest management and long-term and high-volume use of wood are effective climate change mitigation measures. However, the reforestation rate in Japan is low, and sustainable forest management has not been achieved. One of the reasons for this is the low value of low-quality logs, so it is important to enhance the value of these logs. This study investigated low-quality logs, and vertical bearing capacity characteristics by loading tests to verify their applicability to a potential new market for reinforced ground materials. As a result, it was found that the presence or absence of a knot had no effect on the vertical bearing capacity, and although the vertical bearing capacity of a jointed log was smaller than that of a single log, the vertical bearing capacity increased as the length of the bottom log increase.	Takumi	Murata	Tobishima Corporation
12G	STCE - Engineering	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus	Analysis of Mechanical Properties and Failure Behaviour of Reclaimed and Fresh Wood Using Three Point Flexure Test	The growing demand for sustainable construction has increased interest in reusing reclaimed wood collected from demolished buildings. To aid this, reclaimed wood needs to be investigated for its potential as a sustainable building material in line with circular economy principles. However, ageing has an impact on the mechanical performance of reclaimed wood which affects its performance; the extent of which is not known. Therefore, this study evaluates the mechanical properties and failure behavior of reclaimed wood in contrast to fresh wood via three-point flexure tests, strain evolution and scanning electron microscopy (SEM) analysis. The results show that reclaimed wood has a 35% decreased elasticity and strength likely as a result of hemicellulose degradation, lignin oxidation, and acquired building service-life defects. The prominent failure mechanism in reclaimed wood is brittle cross-growth ring fractures as opposed to fresh wood's ductile interlayer delamination-like failure. Findings of the SEM analysis correlates with these variations as it shows damaged cellulose microfibrils and eroded surfaces in the reclaimed wood samples. The results of this study show the importance of a thorough comprehensive of defect assessment in reclaimed wood, and the extent to which they affect the performance and structural integrity when reusing this material.	Nametso Linda	Moumakwa	Aalto University
12G	STCE - Engineering	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus	Scrimber - A contribution to climate protection	Timber construction is a growing trend driven by an increase in global demand for wood and the urgent need for environmentally friendly and resource-saving materials. In response to this need, Scrimber technology has been advanced to convert low-grade wood, which has traditionally been used as energy wood, into high-quality, load-bearing components. This innovative approach not only enhances the utilisation of wood from 30% to 90%, but also significantly contributes to the reduction of CO2 emissions. The Scrimber process is aligned with the principles of a circular economy, which ensures the prolonged carbon sequestration and the potential for direct reuse or reintegration into the Scrimber production cycle. This makes a substantial contribution to a sustainable development and climate change mitigation.	Stefan	Zoellig	Timbatec Timber Engineers International AG
12H	TABD - Engineering	Session Chair: DAVID ZHANG / MULTINAIL					

SESSION 12
Thursday 26th June 2025
11:00am to 1:00pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
12H	TABD - Engineering	Timber Engineering & Structural Performance - Engineering Focus, Timber Architecture & Biophilic Design - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	Design of a timber diagrid seismic structural system	This study outlines the design approach of a 3-storey unconventionally shaped office building at Fisher & Paykel Appliances new headquarters in Auckland, New Zealand, using the recently published NZS AS1720.1:2022 - Timber Structures Part 1: Design Methods. When completed, the diagrid building will be one of the largest mass timber office buildings in New Zealand, with a floor area of over 12000m2. Due to the unusual geometry of the building, the application of EYM and brittle failure mechanisms were verified through two full scale tests of the node of the lateral load resisting diagrid structure. The testing demonstrated the brittle failure mechanisms in NZS AS1720.1 were suppressed, but identified an additional brittle failure mode – splitting. This study also concluded that the screw stiffness appears lower than that calculated using both NZS AS1720.1 and Eurocode, EN-1995-1-1:2004+A2:2014.	Jaimie	Whitehead	Dunning Thornton Consultants
12H	TABD - Engineering	Timber Engineering & Structural Performance - Engineering Focus, Timber Architecture & Biophilic Design - Engineering Focus	EXPERIMENTAL STUDY OF TIMBER COMPOSITE 1D ELEMENTS USING DENSIFIED WOOD AND HARDWOOD WELDED DOWELS	This paper is a part of an extensive research of multi-layered timber structural elements made without glue or metal fasteners. The paper focuses on the research of beam and column real dimension elements. The elements are formed in different connection designs, from timber lamellas connected by densified wood dowels as well as by dowels that are welded on the basis of friction between wooden parts. This method of connection, which provides inter-layer shear resistance, was tested for beams in bending and columns in axial compression, with different arrangement of dowels and lamellas. The main originality of this study is defining the optimal way of joining, considering the practical difficulties encountered in constructing deeper multi-layer beams. The significance of this research is the demonstrated ability to produce multi-layer timber 1D elements that are structurally efficient and, at the same time, completely favorable for reuse or recycling.	Vlatka	Rajčić	University of Zagreb, Faculty of Civil Engineering
12H	TABD - Engineering	Timber Architecture & Biophilic Design - Engineering Focus	PARAMETER IDENTIFICATION FOR FULL-SCALE SHAKING TABLE TEST OF 5-STORY WOODEN STRUCTURE AND ANALYTICAL STUDY	All over the world, the movement for the mid- and high- rise wooden building has been activated to aim for sustainable society. To promote these activities, the dynamic behavior of such buildings should be cralifised and an analysis method for such building should be verified. In this study, we targeted the full-scale shaking table test of 5-story wooden structure and analytical study was conducted. But, it is difficult to conduct analysis accurately and verification is time-consuming. One of verification method of the analysis is parameter identification. At present, the paremeter identification has been applied to detailed analysis model for buildings. This needs a lot of time if the common identification method is used, so we applied the efficient parameter identification method using quality engineering and interpretable machine learning “SHAP”. Adopted method is based on comprehensive parameter search using quality engineering and “SHAP” is useful for efficient parameter search to evaluate parameter influence. The identification results showed good agreement with experiental results. Based on the results, we conducuted analytical study.	Tokikatsu	Namba	Kyoto University
12H	TABD - Engineering	Timber Architecture & Biophilic Design - Engineering Focus	MERGING STANDARDIZATION AND ADAPTABILITY FOR EFFICIENT MODULAR CONSTRUCTION SOLUTIONS	Modular timber construction represents a groundbreaking and eco-friendly advancement in the building sector. Recent innovations in manufacturing technologies and engineered wood products (EWP), have positioned timber as a viable alternative to conventional materials such as concrete, masonry, and steel. The lightweight and versatile nature of timber, coupled with the efficiency of factory-based production, accelerates modular construction processes and meets the industry's growing sustainability demands. This study introduces a novel construction system that employs prefabricated two-dimensional (2D) and three-dimensional (3D) timber units as primary components of a modular system. By addressing contemporary needs for sustainability and efficiency, this project contributes to the evolution of building practices focused on resource conservation, waste reduction, and the promotion of a more sustainable and resilient built environment, while provides a solution for the current housing crisis.	Jorge	Branco	University of Minho, Department of Civil Engineering
12H	TABD - Engineering	Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Architecture & Biophilic Design - Engineering Focus	SURVEY RESULTS OF POTENTIAL USERS' PREFERENCES AND PERCEPTIONS ON THE RECONSTRUCTION OF COLONEL BY HALL (CBY) USING MASS TIMBER ELEMENTS	This study is a component of a larger investigation into the potential reconstruction of Colonel By Hall (CBY), the home of the Faculty of Engineering at the University of Ottawa. The primary aim was to assess various structural archetypes (including concrete, steel, timber as well as timber-hybrid structures) that could potentially replace the current building. In order to evaluate the feasibility of integrating Mass Timber Products (MTP) into educational facilities and engage potential users in the decision-making process, a survey was conducted among 332 participants to gauge their awareness and perceptions of the surrounding built environment. The survey results revealed there is a significant aesthetic preference for buildings with exposed elements or finishes using wood. Respondents tended to choose environments with exposed wood elements to help reduce stress, as it makes them feel relaxed, energetic, cheerful and calm. Most respondents indicated that environments featuring exposed timber offer a comfortable space for social interaction and help against mental exhaustion. However, numerous misconceptions about wood's performance capabilities were also identified.	Fernanda	Scussiato Lago	University of Ottawa
12H	TABD - Engineering	Sustainability and Timber in a Circular Economy - Architectural Focus, Timber Architecture & Biophilic Design - Engineering Focus, Exemplars & Construction Case Studies - Architectural Focus	The Interlocking Dowel System - Ecobalance and Scope of Application	This paper discusses the ecobalance (material consumption and carbon sequestration) and scope of application (regarding the load bearing behaviour) of a novel mono-mterial timber wall design that uses diagonally arranged beech dowels to connect the shell elements of prefabricated hollow section wall units. It shows different robotic manufacturing approaches that help to ensure a snug fit anchorage of the beech dowels, strong enough to create a load bearing, interlocking structure. The work also presents a series of experiments that were necessary to explore the geometrical and mechanical scope of the innovative, resource saving construction system and at the same time helped to develop targets for the ongoing attempt of establishing it next to conventional timber constructions that are being considered for large-area domestic construction in Europe.	Felix	Schmidt-Kleespies	Leipzig University of Applied Sciences | FLEX

SESSION 12
Thursday 26th June 2025
11:00am to 1:00pm

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
12H	TABD - Engineering	Timber Architecture & Biophilic Design - Architectural Focus, Education, Innovation & Challengers - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	Wood as the Principle: Research on the flexible Standardization of Traditional Large-Scale Wooden Residential Structures in Chinese Tubao	This paper uses the 17th-century late Qing dynasty Tubao structures "Dafuzhen" and "Guangyubao" as typical examples to explore the standardized construction paths of traditional large-scale wooden residential buildings in China. Tubao in the hilly areas of Fujian, southern China, is a local type of traditional building. Built on hilly terrain, it accommodates a large population, serving ceremonial, residential, and storage needs, and has defensive functions. The timber frame units of Tubao exhibit consistent repetition, influencing the terraced planning and the treatment of rammed earth walls. The study first analyzes the construction logic of Tubao, establishing a "standard modular system" with wood as the "modular source" and other "standard models" for materials and building parts. It explains the "development logic" of Tubao based on traditional construction and the synergy of wood, rammed earth, and stone, summarizing methods from small components to site and cluster modular dimensions. It further discusses the flexibility of Tubao standardization, revealing differences in the origin and meaning of "standardization" between East and West, offering insights into the flexibility of standardized wooden residential construction for modern applications. The study reveals the uniqueness of the standardization in Tupu construction and the differences in the depth and breadth of standardization between China and the West. Studying traditional architectural examples like Tupu can provide new perspectives on adaptive standardization, further expanding the concept of "standards" as defined by Western industrial production models.	Xingtong	Zhu	Zhejiang University
12H	TABD - Engineering	Timber Architecture & Biophilic Design - Engineering Focus	How Office Workers Evaluate Computer-Generated (CG) Images of Wooden Office Spaces: Examining Gender and Age Differences	An interview survey was conducted to understand the evaluation structure of office spaces using wood as the structural frame. Sixteen types of computer-generated (CG) office spaces were created with factors such as the presence or absence of columns and beams and whether the components were wooden or not, and the spaces were evaluated using the evaluation grid method. ANOVA test was conducted for each factor and gender or age on the scores for “office I would like to work in.” The results showed an interaction between the presence or absence of columns and gender and age. The results indicate that in case of wooden buildings, it may be necessary to identify the demographic features of the office workers at the structural design stage.	Takashi	Shima	Kajima Technical Research Institute

POSTER SESSION 1

Monday, 23rd June 2025 - 1:30pm to 2pm

Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
Poster Session 1A - EIC & ECCS (Engineering)	Education, Innovation & Challengers - Engineering Focus	ENHANCING ENGINEERING WOOD DESIGN EDUCATION IN CANADA: ADDRESSING THE LACK OF MASS TIMBER DESIGN IN CURRICULA	The growing demand for larger wood-based structures has significantly expanded the market for mass timber but has also exposed a shortage of trained professionals in engineering design, project management, and construction. Accredited civil engineering programs often lack mandatory wood or timber courses, contributing to this shortage. This study analyzes the state of wood design education in Canada, with a focus on mass timber, and proposes strategies to enhance university-level civil engineering curricula to include more mass timber design.	Blériot	Feujofack	Canadian Wood Council
Poster Session 1A - EIC & ECCS (Engineering)	Education, Innovation & Challengers - Engineering Focus	ENGAGING ARTIFICIAL INTELLIGENCE CONTENT GENERATORS IN THE CONTEXT OF A GRADUATE TECHNICAL COURSE: 2ND ITERATION	For better or worse the artificial intelligence (AI) became inescapable part of the academic environment and of our lives and the fact cannot and should not be ignored. There seems to be growing consensus that the use of AI as a tool in any aspect of research activity should be referred to not only by the name of the tool, but with a thorough description of the purpose and approach. That consensus has to be promptly communicated to students through class materials and practical exercises encouraging a curated engagement of AI tools and critical analysis of the outcomes in all aspects of the field related work where students may, rightly or not, perceive their utilities. The purpose of this presentation is to communicate an attempt of such curated AI Engage exercise in the context of a graduate level hybrid course on foundations of Scientific Methodology for graduate students in Wood Science and Engineering program at Oregon State University.	Lech	Muszynski	Oregon State University
Poster Session 1A - EIC & ECCS (Engineering)	Education, Innovation & Challengers - Engineering Focus	Risk Identification in Industrialized Timber Construction	Risk identification is critical for managing industrialized timber construction projects due to their specific characteristics. Proper risk identification through the project life cycle allows for mitigating events that can negatively impact the project's success. Seminal research provides relevant information regarding risk identification in traditional construction projects. However, this approach is underdeveloped in industrialized timber construction. This research aims to identify risks in the phases of the project life cycle in industrialized timber construction (i.e., design, manufacturing, transport, assembly, and operation). A systematic literature review was conducted to identify risks that were classified based on the industrialized timber construction life cycle, such as manufacturing, assembly, logistics, and transportation. Once classified, these risks were validated through interviews with experts in different stages of the industrialized timber construction life cycle. The findings present a list and classification of specific risks in timber construction. Identifying these risks will contribute to effective project management, optimizing performance across different stages of industrialized timber construction projects.	Manuela	Lopez	CENAMAD / Pontificia Universidad Católica de Chile
Poster Session 1A - EIC & ECCS (Engineering)	Exemplars & Construction Case Studies - Engineering Focus, Exemplars & Construction Case Studies - Practitioner Focus	USE OF CLT (CROSS LAMINATED TIMBER) IN CIVIL ENGINEERING	Japan is a "forestry nation" with forests covering 70% of the country's land area. Utilizing wood as a domestic resource leads to regional development. As part of this, CLT (Cross Laminated Timber) has come to be widely used as a structural and interior material for buildings. However, it has not been used much in civil engineering structures. In response to this, the Japan CLT Association has launched the project for utilizing CLT in civil engineering. we report on products of floorboards, snow fences, and railway platforms made by CLT. In order to use CLT in the civil engineering, prototype CLT floorboards, snow fences and railway platforms were produced and compared with existing steel floorboards, steel snow fences and reinforced concrete platforms, respectively. The CLT floorboards were trialed at civil engineering construction sites and related materials and equipments were developed. The snow protection function of the CLT snow fences was confirmed by wind tunnel tests, before being trial installed on a public road. A model railway platform was also prototyped, and load tests were conducted to confirm that it fully met the strength standards. Currently, the only guideline available for structural design using CLT is for the architecture in Japan. When using CLT in civil engineering, specifications such as appearance, stress, and adhesive function differ from those for architecture. Hence, it is desirable to develop CLT specialized for civil engineering that is cost-effective, for example by using non-standard woods or lamina that do not meet JAS (Japanese Agricultural Standards) .	IKEDA	YUTAKA	HAZAMA ANDO CORPORATION
Poster Session 1B - MPD & TABD (Architectural/ Engineering)	Material Performance & Durability - Architectural Focus	A Study on the Physical Properties and Flame Retardant Performance of High-Concentration Boron-Based Flame Retardant PB with Amino Resin Additives	In this study, high-concentration boron-based flame retardants were developed utilizing amino resins (Urea-Formaldehyde resin(UF) and Melamine-Formaldehyde resin(MF)) as carriers. These flame retardants were applied to particleboard using a flame retardant-resin blending method. The efficacy of the flame retardants was evaluated in terms of flame retardancy, as well as physical and mechanical properties. Preliminary experiments indicated that MF resin exhibited superior flexural strength compared to UF resin and offered approximately 13% enhanced water resistance. Consequently, subsequent experiments were conducted using MF resin as the carrier. Under the 2% MF resin condition, the addition of the flame retardant led to a 60% increase in flexural strength and a 20.3% improvement in water resistance compared to the untreated control. Furthermore, with respect to flame retardancy—an essential criterion for wooden furniture and construction materials—the material met the KS F 2819 standard, thereby confirming its applicability as a construction material.	Halim	Park	Chungnam National University
Poster Session 1B - MPD & TABD (Architectural/ Engineering)	Material Performance & Durability - Architectural Focus, Sustainability and Timber in a Circular Economy - Architectural Focus, Education, Innovation & Challengers - Architectural Focus	Systematic Review on The Environmental Impact And Cost Competitiveness Of Mass Timber Construction	In recent decades, mass timber has emerged as a sustainable building technology, drawing increased attention to assess the potential advantages and challenges of mass timber construction (MTC), aiming to facilitate its broader market penetration. The majority of these studies focus on high-rise commercial timber structures, leveraging the relatively lighter weight of timber compared to steel and concrete. This review article systematically examined relevant literature and categorized them into two key domains: (1) environmental impact, and (2) cost competitiveness. Publications from 2013 to 2023 were identified via Google Scholar. After two phases of screening, additional articles were added from references for the final analysis. Although extensive research remains imperative across the two domains, the results underscore the promising environmental impact of MTC compared to conventional materials, with notable advantages in terms of carbon footprint reduction, with Life Cycle Assessment (LCA) as the main tool to assess the environmental impact of MTC. The cost competitiveness review highlights the need for comprehensive comparisons across various design configurations. Future research should explore additional factors such as fire safety, moisture management, acoustics, and biophilia benefits to provide a more comprehensive understanding of the potential applications of mass timber technology.	Ramtin	Mirmohammad Sadeghi	University of Oklahoma

Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
Poster Session 1B - MPD & TABD (Architectural/ Engineering)	Timber Architecture & Biophilic Design - Architectural Focus	WOOD IN HOSPITAL INTERIORS: A SCOPING REVIEW	Background. Hospitals, together with the rest of the building sector must shift towards more sustainable solutions to meet the global climate goals. Wood is seen as an environmental friendly material, and may have positive health effects on users. Because of the material's organic properties this material needs special concideration when implemented in complex buildings as hospitals. Objective. The purpose of this scoping review is to give an overview of the research field on the use of wooden material for interior purposes in hospital buildings. The desired result is a knowledge base that may facilitate the design process and decision-making for the use of wood in hospital environments. Design. The search was conducted in online databases as a Boolean search, restricted to peer reviewed, journal articles from the last ten years in english. Because of the small number of articles in the initial search, the eligibility criteria's were modified by removing the time restriction and to include conference articles in addition to journal articles. Results. The literature search to current date contains 14 sources, divided on four main themes. The sources vary in method, and both qualitative, quantitative and mixed-method studies are included. Conclusions. This scoping review implies a research field in its early beginning. As the number of sources are few, the findings of this study is highly contextual, and the study offer no general conclusions to the use of wood in hospitals. The number of articles is not enough to claim evidence, though successful implication implies beneficial effects on users of hospitals.	Anders Qvale	Nyrud	Norwegian University of Life Sciences
Poster Session 1B - MPD & TABD (Architectural/ Engineering)	Timber Architecture & Biophilic Design - Architectural Focus	USE OF EUCALYPTUS POLES IN TIMBER STRUCTURES - BRAZIL	The use of eucalyptus wood in the building site is intensifying in Brazil, consolidating it as an alternative to the native tropical wood. Nowadays, planted forests occupy only 0.6% of Brazilian territory and supply about 85% of all forest-based products found in the market. Pinus and eucalyptus are the main fast-growth species that occur in our country. The structural performance and linearity of the rounded pieces result in a crescent use of eucalyptus treated wood, especially in rural constructions and fences, as well as in country houses and high standard beach houses and hotels. The pressure-treated wood market is becoming more and more attractive, due to its profitability and crescent demand by the building sector. Eucalyptus rounded shape results in a cost-effective application of the material, besides providing an economical form of construction. Starting from the experience of several timber structures executed in central Brazil, it was proposed the use of pressure-treated eucalyptus poles as the main structural material in different building types as restaurants, wineries, homes, and facilities in natural areas. The buildings were designed according to bioclimatic guidelines, to be fully adapted to local climate. Some requirements as natural ventilation and illumination, thermal inertia, green covering, and protection against sunlight in the facades were added to the architectural designs, aiming to build "sustainable constructions".	ROBERTO	LECOMTE DE MELLO	Casacerta Architecture Design & Building
Poster Session 1B - MPD & TABD (Architectural/ Engineering)	Timber Engineering & Structural Performance - Engineering Focus Timber Architecture & Biophilic Design - Engineering Focus	Fiber structures and tensile out-of-interface properties of natural Ficus inosculated connections	Trees can adapt to external loads and form inosculated connections (i.e., self-growing connections). During this process, the connection can optimize its shape and internal fiber morphology to fulfill its physiological and mechanical functions. This self-optimization can inspire nature-based design, but it requires a deeper understanding of fiber features and the resulting mechanical strength of a connection. This paper focused on the connections of living trees fused by Ficus benjamina L. To describe connections' growth stages, the interface curvature was proposed and measured. Fiber structures were characterized by optical microscopy. Tensile-out-of-interface tests were designed and conducted to measure the tensile strength and maximum resistance. Curved merged fibers at the interface primarily provided bonding strength and structural integrity to a connection. Tensile strength ranged from 0.29 to 1.3 MPa depending on the growth stage of a connection. The interface curvature of a connection was found to be negatively correlated with its strength. Meanwhile, it could distinguish failure modes from failure at the interface to failure across stems at around 60%. The tensile failure of a connection was mainly caused by the combination of rolling shear and perpendicular tension of the merged fibers. By studying these self-optimized anisotropic structures, the research aims to develop strategies for resource-efficient use and nature-inspired design.	Xiuli	Wang	Forschungszentrum Jülich
Poster Session 1C - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	Prediction of Nonlinear Behaviors of Light-Frame Wood Shear Walls by Nail Connection	In light-frame wood construction, a shear wall is an important component that provides lateral force resistance. Lateral loads acting on shear wall are transmitted to horizontal diaphragm, distrubutting the load to provide stability to the structure. Shear walls of light-frame construction consist of stud, sheathing, nails and anchorage. Therefore, the performance of a shear wall vary depending on the methods used to compose these four elements (studs, sheathing, nails and anchorage). The lateral resistance of a shear wall can be expressed as the deformation by the sum of four elements, including the effect of bending of studs, shear of sheathing, nail slip, and anchorage deformation. According to APA (American Plywood Association) and CWC (Canadian Wood Council) researches, among the four elements, the nail slip between sheathing and stud contributed approximately 65% ~ 75% of the overall deformation of shear walls. Other elements such as bending of studs, shear of sheathing, and anchorage deformation do not contribute significatly to the total racking deformation of a shear wall. In this study, the nonlinear behavior of light-frame wood shear walls resulting from nail connection between studs and sheathing among the four elements was predicted, and the results were compared with those of the shear wall deformation obtained through experimental testing.	Hyung Woo	Lee	National Institute of Forest Science
Poster Session 1C - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	VERTICAL AND SHEARING PERFORMANCE OF KUMIMONO USED IN TRADITIONAL WOODEN STRUCTURES	In this study, we focused on the structural performance of Kumimono for structural analysis of traditional wooden architecture such as five storied pagodas, temples amd shrines. Kumimono is called bracket complexes in English, and is a component between columns and a roof. In a previous research, it is said that vertical perfrmance of Kumimono has an influence of the vertical motion of a whole building. However the vertical stiffness of Kumimono is not clear quantitatively. Therefore we conducted compression tests for one Kumimono at first. In the tests, we had some various test cases changing how to apply vertical load because the parts in actural traditional buildings have a possibility to have some gap due to deterioration over time and vertical load way can change. Furthermore, horizontal loading tests applying moment and shearing force for two Kumimono. We verified the evaluation method for the compression performance and shearing performance applying vertical load based on those experimental results.	Iuko	Tsuwa	Japan
Poster Session 1C - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	SHEAR STRENGTH AND STIFFNESS OF CLT SPECIMENS WITH DIFFERENT SPECIES-ADHESIVES COMBINATIONS	Cross Laminated Timber (CLT) is used in several countries in Europe and North America and also in Brazil. Its bending design is governed by the rolling shear effect, which occurs with the rolling of the layers of the central wooden lamellae that form the element due to shear stresses. This manuscript presents a study of the strength (fvt) and stiffness (Gvt) to rolling shear in CLT specimens made with 4 species of Brazilian wood and polyurethane adhesive. The tests were carried out on two models of shear test specimens (vertical and inclined) taken from CLT panels, and also on elements subject to bending. The results showed that there were no major differences between rolling shear strength (fvt) values, with the greatest differences observed for stiffness values (Gvt). Rolling shear strength results ranged from 2.05 MPa to 4.02 MPa and stiffness results from 82 MPa to 365 MPa. These values exceeded normative recommendations that propose variations between 0.8 and 1.2 MPa for strength fvt and 50 MPa for stiffness Gvt.	Julio Cesar	Molina	University of São Paulo

Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
Poster Session 2A - MPD (Engineering)	Material Performance & Durability - Engineering Focus	FRACTIONAL ORDER DERIVATIVE APPROACH OF VISCOELASTIC BEHAVIOR OF TROPICAL WOOD	For some time now, wood has offered itself as an alternative to other modern construction materials, and has become the material of choice for structures, mainly because of its renewable nature, durability and ease of shaping. However, once in service, even at room temperature and under low stresses, it deforms and faces the problems of creep and recovery. The objective of our work is to model and predict the viscoelastic deformations of Entandrophragma cylindricum (Sapelli) wood by a rheological approach based on fractional calculus theory. Zener and Burger fractional models were used to elucidate these phenomena. The simulations show that the proposed models fit the creep experimental data with an average reliability of 97% and the recovery process with a reliability of 99%.	NGUEDJIO	Loic Chrislin	Clermont Auvergne University (France), University of Dschang (Cameroon)
Poster Session 2A - MPD (Engineering)	Material Performance & Durability - Engineering Focus	Study on Charring Properties of Engineered Wood Exposed to High Temperature according to Adhesive Type	"Poster only" To confirm the charring properties of engineered wood exposed to high temperature according to adhesive type, we fabricated test specimens with two adhesives (resorcinol and polyurethane) used in glued laminated timber(GLT) or cross-laminated timber(CLT) from the Republic of Korea, and performed a full-scale fire resistance test. When GLT was laminated with polyurethane and resorcinol adhesives, respectively, exposed to high temperature, we confirmed that the charring depth of GLT using polyurethane increased by approximately 40% compared to that of GLT using resorcinol. Similarly, the charring depth of CLT adhered with polyurethane showed a tendency to increase about 60% compared to that of CLT bonded with resorcinol. Engineered wood bonded with resorcinol showed a uniform char layer without separation from specimens when exposed to high temperatures, but engineered wood adhered with polyurethane showed separation of the char layer from the bonding surface, which was found to be detrimental to fire resistance.	Yun-Jeong	Choi	Korea Institute of Civil Engineering and Building Technology (KICT)
Poster Session 2A - MPD (Engineering)	Material Performance & Durability - Engineering Focus Sustainability and Timber in a Circular Economy - Engineering Focus Timber Engineering & Structural Performance - Engineering Focus	INNOVATIVE CONNECTION SOLUTIONS FOR TCC FLOOR SYSTEMS: MECHANICAL AND ENVIRONMENTAL ASSESSMENT	In recent years, Cross-laminated timber (CLT) has gained popularity in construction sector, attributable to its advantageous structural performance and associated environmental benefits. The application of CLT in timber-concrete-composite (TCC) floor systems has been increasingly explored, especially on the connection type and composite actions. However, existing building codes and standards may not be entirely adapted to the utilization of CLT and TCC systems. This limits design options, while simultaneously fostering opportunities for innovation within the field. This study investigates the feasibility of a novel connection solution for CLT-concrete composite floor (CCCF) systems, emphasizing both mechanical performance and environmental sustainability. Lab experiments and life cycle assessment (LCA) are conducted, to get the mechanical properties of the new connector and relevant environmental impact. Manufacturing, installation, and end-of-life stages are enclosed for the LCA calculation. Consequently, these results are compared with a functionally equivalent hollow core slab floor system. The results highlight its potential as a viable alternative to conventional concrete slabs, together with reduced environmental impact and strong structural properties. Relevant reusability is also discussed.	Cristina	Dachin	HAMK
Poster Session 2A - MPD (Engineering)	Material Performance & Durability - Engineering Focus, Material Performance & Durability - Architectural Focus, Timber Engineering & Structural Performance - Engineering Focus	INTRODUCTION OF NON-DESTRUCTIVE TESTING FOR NOVEL COMPOSITES AND JOINTS OF TIMBER AND BAMBOO	Due to increasing demand for sustainability, manifold efforts are made to reduce CO2 emissions. Renewable raw materials such as timber and bamboo even have a negative carbon footprint when it comes to procurement, making them very attractive for industrial use in terms of environmental targets. New material concepts with these renewable materials or combinations of both, additionally, a particular visually appealing alternative with glass fibre reinforced polymer, are analysed to develop adequate NDT (Non-Destructive Testing) solutions for the quality control in later production processes. NDT offers special opportunities in terms of cost savings compared to destructive testing procedures. The presented efforts to develop solutions for new renewable material applications are embedded in a comprehensive proceeding for NDT introduction to later series production. Prior evaluation of selected NDT methods with particular potential for testing renewable material concepts like radiographic computed tomography, ultrasonic testing, microwave or terahertz testing as well as thermography determines the specific strengths and limitations of each method. Experimental investigations with active thermography clarify the general suitability of different excitation sources that can be used for timber and bamboo. Practical results provide information about detectable material inhomogeneities and structural defects. The findings are supplemented by finite element calculations to estimate corresponding defect characteristics. Finally, main influences on thermographic testing that need to be considered in order to achieve robust quality control are pointed out as a preview of the next steps required to complete NDT qualification.	Ulrike	Siemer	Berliner Hochschule für Technik
Poster Session 2A - MPD (Engineering)	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus, Sustainability and Timber in a Circular Economy - Practitioner Focus	BAMBOO BENDING WITH STEAM	Bamboo can be bended successfully with steam. Detailed analysis of the mechanical properties shows the characteristics of the steam-bended bamboo shapes (hardness, indention, analysis of diameter after bending, tensile strength) and their dependance4 of the parameters of the bending process.	Ralf	Förster	BHT Berlin
Poster Session 2A - MPD (Engineering)	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	COMPRESSIVE BEHAVIOR OF TIMBER AT DIFFERENT ORIENTATIONS TO THE GRAIN	Wood is orthotropic in three main directions, namely longitudinal (L), radial (R), and tangential (T). In practical uses of timbers as a construction material, loading cases under compression, especially in timber connections, can occur at various orientations to the grain, not only in the three main directions. Off-axis compressive strength and stiffness, including a spreading effect, are essential to design timber structures. In this paper, compression and partial compression tests at different orientations were conducted to clear the influence of a fiber direction, spreading effect, and damage zones. The dependences of the Young's modulus and strength on the loading angle for the longitudinal direction are shown. The deformation and failure behavior were also strongly influenced by the loading angle. A kink band failure often occurred in the specimens at the loading angle of 0 degrees, shear failure often occurred at 15 and 30 degrees, and compressive failure perpendicular to the grain often occurred at 45, 60, and 90 degrees. The spreading effect increased with decreasing the loading angles in the strength and Young's modulus. We proposed an evaluation method of the off-axis compressive strength and stiffness, including a spreading and damage zone effect, using Hankinson's equation.	Marina	TOTSUKA	Chiba University

Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
Poster Session 2B - STCE (Engineering)	Sustainability and Timber in a Circular Economy - Engineering Focus	Shaking table tests on the traditional timber structure of the stage on the cliff using the model of a 3D printer	This study investigates the seismic performance of traditional timber structures, with a focus on the stage of the main pavilion at Kiyomizu-dera temple in Japan. Traditional timber connections in East Asia, including Japan, use notching and fitting techniques, resulting in superior seismic performance due to larger structural members compared to residential buildings. The research involved creating a 1/50 scale model of the pavilion and stage using a 3D printer, based on static loading tests. The foundation of the model was made from structural plywood, corresponding to the actual structure's column lengths. Seismic tests included white noise, simulated seismic waves from the Building Center of Japan, and 1995 Kobe earthquake data. Test observations revealed natural frequencies, damping, and load-deformation relationships. Results showed that the main pavilion's natural frequencies matched microtremor observations, while the stage's frequencies were lower. Additionally, reduced stiffness was found between the pavilion and the stage, suggesting a structural distinction between the two parts. The study concludes that the main pavilion and stage have different seismic characteristics, highlighting the complex dynamics of traditional Japanese timber structures.	Atsushi	TABUCHI	0
Poster Session 2B - STCE (Engineering)	Sustainability and Timber in a Circular Economy - Engineering Focus	CHRONOLOGICAL AND GEOGRAPHICAL DISTRIBUTION OF CONVENTIONAL TIMBER FRAME CONSTRUCTION TECHNIQUES OBSERVED IN EXISTING HOUSES IN MIE PREFECTURE, JAPAN	This study aims to understand the diversity of conventional construction methods for timber houses in Mie Prefecture, Japan. These methods, which have evolved over time to accommodate local conditions, exhibit distinct chronological and geographical distributions. A questionnaire survey was conducted among inhabitants of timber houses in six districts: Hokusei, Chusei, Iga, Nansei, Shima, and Higashikishu area. The survey collected data on foundation, floor, wall, and roofing to identify patterns of adoption and regional variations. Comparative analysis with Kanto-region revealed distinct patterns in the adoption of modern materials and techniques. Kanto showed gradual transition to modern construction methods, while Mie rapidly adopted them after 2000. Exterior finish and roofing materials retained traditional elements and regional variations in both areas, suggesting these elements preserve local architectural characteristics.	WAKANA	MATSUMOTO	MIE UNIVERSITY
Poster Session 2B - STCE (Engineering)	Sustainability and Timber in a Circular Economy - Engineering Focus	MELALEUCA RHAPHIOPHYLLA BARK HARVEST CONDITIONS FOR SUSTAINABLE ENGINEERED BARK BOARD PRODUCTION	This study investigated sustainable bark harvesting from swamp paperbark (Melaleuca rhaphiophylla) in order to produce engineered wood products, namely bark boards. The influence of bark condition on bark board properties and when to harvest bark were investigated. Bark was manually harvested on five occasions between October 2022 and February 2025 from seven different trees at a site in the South-West of Western Australia. The moisture content and weathered condition of the bark were assessed. A total of 70 kg of bark was harvested across the 29-month period with up to 18 kg of bark being harvested from a single tree. The influence of bark condition on bark properties has permitted recommendations to be made on when bark should be harvested, and which bark is better suited to the manufacture of bark boards. It has been possible to sustainably harvest bark over the period without causing fatality to the trees despite the Southwest being in drought during that period. This study suggests that bark should be harvested after a four-week period of low rainfall and humidity, with at least 18 months in between harvest to allow bark to weather, with the first harvest occurring when the girth of the tree is between 900 mm and 1800 mm.	William	Richards	The University of Western Australia
Poster Session 2C - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	TIMBER FAILURE AT SCREW TIPS ON GLULAM REINFORCED BY SELF-TAPPING SCREWS	Recently, the development of high-strength and -stiffness joints has become increasingly prevalent due to the expanding utilization of timber structures for medium to large-scale buildings. At column-beam joints in timber structures, bearing strength and stiffness perpendicular to the grain are often dominant. Consequently, increasing the bearing strength and stiffness perpendicular to the grain is essential for achieving high strength and stiffness joints. One method for enhancing bearing capacity and stiffness is reinforcement by self-tapping screws like piles in a loaded area on beams. This paper investigates one of the failure modes of glulam beams reinforced by self-tapping screws: timber compressive failure perpendicular to the grain at screw tips. We conducted experiments on 9 or 36 specimens for central or corner column-beam joints. For central column-beam joints, the experimental values were 1.77-1.92 times the calculation values from the previous model in the bearing capacity. We then proposed a bearing capacity model that could correctly evaluate the experimental values. For corner column-beam joints, the mechanism of compressive stress spreading in the specimens is different from that for central column-beam joints, and a new evaluation method was proposed.	Junki	TATEYAMA	Chiba University
Poster Session 2C - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	Analysis of Stress Distribution in Contact Area of Cross Laminated Timber Shear Wall to Floor Connection	This paper investigates the behavior of shear walls in multi-story wooden buildings constructed with Cross-Laminated Timber (CLT) in relation to the stiffness of the floor structure. Numerical models were compiled and a series of experiments were prepared to determine the influence of the floor panel's contact area in compression perpendicular to plain on the stress and deformation of the wall panels. It can be seen from the analysis that the loading of the lower wall panel by the upper wall panel is uneven. This is contrary to classic models which consider the uniform loading of the upper edge of the lower panel along its entire length. The stiffness of the floor panel also affects the load on the tension anchors. As the thickness of the floor slabs increases, the horizontal deformation decreases. Additionally, the bending deformation of the wall panel in the vertical direction influences the length of the compressed area, which also affects the load on the anchors.	Lukas	Velebil	Czech Technical University in Prague - University Centre for Energy Efficient Buildings
Poster Session 2C - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	PUSH-OUT TESTS ON TIMBER-TO-TIMBER COMPOSITE (TTC) SYSTEMS MADE OF HARDWOOD	This paper presents the results of experimental investigations on push-out specimens realized with glulam beams and boards made of Italian short supply chain timber and inclined screws. The main aim is to define the fasteners' stiffness, strength, static ductility and failure modes and so, to assess their goodness for the timber-to-timber composite (TTC) floor use. The specimens are tested according to the EN 26891 under quasi-static monotonic loading.	Martina	Sciomenta	University Of L'aquila
Poster Session 2C - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	GLUED IN PLATES: NEW POSSIBLE SOLUTION FOR SLAB-COLUMN CONNECTION IN POINT SUPPORTED TIMBER-BASED SLABS	The current push from the scientific and engineering community, for high-span point-supported slabs from timber-based materials, requires reinforcement solutions for punching the slab. This paper explores new possible methods of reinforcement with glued-in plates. It describes a new product for slab-column connection and describes a project with the aim to develop and optimising this product with numerical analysis and experimental methods. The major challenge is the resistance of a timber-glue-steel connection. Preliminary analysis indicates that the proposed punching reinforcement method effectively enhances the slab's punching capacity.	Michal	Kázsmér	Slovak University of Technology in Bratislava

POSTER SESSION 2

Tuesday, 24th June 2025 - 1:30pm to 2pm

Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
Poster Session 2C - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	NON-DESTRUCTIVE AND SEMI-DESTRUCTIVE METHODS FOR WOOD GRADING VIA ASSESMENT OF STANDING TREES AND LOGS	POSTER - The high demand for spruce timber has led to the expansion of Norway spruce monocultures outside its natural ecological area in central Europe; it results in a wide-range and gradual variation of wood properties. The wood quality plays an important role in timber structure properties thus the individual selection of material is the first important step of traditional carpentry. The selection of trees in the forest should be emphasized to reach a balance between properties for better processing and material properties. Therefore, simple and reliable methods for in-situ assessment of standing trees or logs are searched. The goal of this study is to test standing trees and logs by several methods and to describe relationships between the evaluated material parameters. The trees from stand in Czech Republic with optimal ecological conditions for Norway spruce were felled during 3 seasons, consequently milled to logs and tested by several methods. Wood densities, sound velocities, dynamic moduli of elasticity, micro-drilling and indentation resistances were measured. The visual assessment was carried out as well. The relationships between properties were statistically tested to determine the reliability of used non-destructive and semi-destructive methods to predict wood quality and also to describe the significance of harvest period.	Michal	Kloiber	Czech Academy of Sciences Institute

POSTER SESSION 3

Wednesday, 25th June 2025- 1:30pm to 2pm

Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
Poster Session 3A - EIC, STCE (Engineering/ Practitioner)	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	STATIC CALCULATION AND CONSTRUCTION OF GLUED LAMINATED ANTENNA TOWER	***POSTER***Antenna towers with telecommunication equipment surround us, and they are often perceived as structures that disrupt the environment. Glued laminated timber is a material with exceptional mechanical and visual characteristics, offering great durability due to appropriately designed construction details. This paper will present the static calculations and the construction process of a 40-meter tall antenna tower with telecommunication equipment made of glued laminated timber. One important aspect is the significantly lower carbon footprint of such towers, which will play an increasingly significant role in the future.	Šime	Serdarević	University of Applied Science
Poster Session 3A - EIC, STCE (Engineering/ Practitioner)	Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	CONSIDERATION OF FLUID FORCES ACTING ON PARTS OF WOOD HOUSE UNDER FLOOD	Floods are occurring frequently due to climate change, and it has become difficult to protect residential areas with levees alone, so the Japanese government has shifted its policy to basin flood control. It is necessary to ensure the safety of wood houses even in flooded areas, so we subjected to the model of wood house to investigate the structural safety of wooden houses under the fluid forces caused by flood disaster. To ensure structural safety under fluid forces, it is necessary to ensure horizontal shear capacity and prevent sliding and overturning, and past research has shown that sliding is the most severe problem for ordinary wood houses. Additionally, the 2021 Ministry of Land, Infrastructure, Transport and Tourism Notification No. 1392 stipulates that the fluid force acting on a building is calculated from the fluid resistance formula. On the other hand, the past survey of flood damage to wood houses have shown that in wood houses whose openings or mud walls have been destroyed in advance, the horizontal force calculated by the fluid resistance formula does not match whether the sliding will occur or not. Therefore, the hydraulics model test employing the scaled-down models of wood houses with and without openings were conducted to study the possibility of applying a reduction factor for the pressure-receiving area of house with openings. As a result, it was suggested that if there is an opening of similar size on the side where fluid force acts and on the opposite side, it may be possible to reduce the pressure receiving area on examining the sliding. However, it was found that on examining the overturning using the fluid resistance formula, it may not be possible to reduce the pressure-receiving area.	Takahiro	Tsuchimoto	Building Research Institute
Poster Session 3A - EIC, STCE (Engineering/ Practitioner)	Sustainability and Timber in a Circular Economy - Engineering Focus, Sustainability and Timber in a Circular Economy - Architectural Focus, Exemplars & Construction Case Studies - Engineering Focus	HOW TO BUILD INDUSTRIALLY SCALABLE VALUE CREATION FROM TIMBER CONSTRUCTION BY-PRODUCTS IN NEW ZEALAND	Global economies seek solutions for a circular economy and climate change mitigation. Forest biomass and sawn timber processing by-products offer several value-added components to replace unrenewable carbon-intensive materials. Generally, sawn goods utilize only approximately half of the harvested timber volume. When aiming for circular and zero waste construction, it is not enough to use local wood sources for timber construction unless all the wood-derived molecules are fully utilized. Numerous projects worldwide are developing biomass-based biorefineries, but the upscaling of these technologies require cross-sectoral and multidisciplinary partnerships. In this paper, we propose a holistic approach to analyse and visualise value-creation possibilities in the New Zealand (NZ) context, targeting locally sourced, underevaluated and undervalued wood species that can be used in construction and finishing. The focus is on finding economically, socially, and ecologically sustainable solutions. Additionally, we present cases of industrial value-chains and by-products, to provide a baseline understanding on the scale-up potential with techno-economic feasibility.	Tuula	Jyske	University of Helsinki
Poster Session 3A - EIC, STCE (Engineering/ Practitioner)	Sustainability and Timber in a Circular Economy - Practitioner Focus	Assessing the regional end-of-life impacts of wood waste in the United States	The environmental impacts of four end-of-life scenarios for wood waste (recycling, composting, incinerating, and landfilling) were evaluated on national and regional levels across the United States (U.S.). The distribution of wood waste in the four scenarios was assessed by analyzing waste characterization reports for each state. Then, transportation from cities to waste processing facilities was modeled in geospatial software to estimate the transportation distances and associated environmental impacts for each scenario in each region. The environmental impacts of waste processing, waste disposal, and new product manufacturing were estimated for each region, as well as the carbon storage benefits and substitution benefits of displacing fossil products. Summing these impacts and benefits revealed a clear climate benefit for the recycling scenario. The distribution of wood to the four scenarios and the transportation distances varied substantially across regions, producing variations in environmental impacts. This research has improved the understanding of how differing wood waste practices across the U.S. produce different environmental impacts, which highlights areas for improvement in terms of climate and waste reduction goals.	Christina	Bjarvin	University of Washington
Poster Session 3B - TESP & TABD (Architectural)	Timber Engineering & Structural Performance - Architectural Focus	A SIMPLIFIED APPROACH FOR ESTIMATING THE BACKBONE RESPONSE OF TIMBER-FRAMED PARTITION WALLS	This study investigates the seismic behaviour of a timber-framed partition wall subjected to unidirectional quasi-static lateral cyclic tests and quantifies associated drift thresholds at various damage levels. This study outlines the construction and testing of a multi-winged timber-framed partition wall, designed to reflect common New Zealand building practices. Moreover, theoretical formulations predicting ultimate strength, initial stiffness, and drifts corresponding to screw damage and plasterboard buckling are scrutinized and refined using experimental data from previous tests. The predicted bi-linear shear force vs. drift backbone curve, using the refined formulations, reasonably capture the experimental backbone curve, validating the reliability of the simplified approach.	Jitendra	Bhatta	University of Canterbury
Poster Session 3B - TESP & TABD (Architectural)	Timber Engineering & Structural Performance - Architectural Focus	EXPERIMENTAL EVALUATION OF HYGROTHERMAL PROPERTIES OF CHILEAN RADIATA PINE CROSS-LAMINATED TIMBER PANELS FOR CONSTRUCTION APPLICATIONS	One of the main challenges with Cross-Laminated Timber (CLT) is its sensitivity to moisture. As a hygroscopic material, wood exchanges moisture with the environment, causing dimensional changes that affect the stability and energy efficiency of CLT constructions. This study analyzes the thermal conductivity, density, and thermal transmittance of CLT manufactured with radiata pine timber grown in Chile. The results showed that the adhesive used in the panels increased the thermal conductivity compared to pine wood alone, although it did not significantly alter the apparent density. Despite the higher conductivity, the thermal transmittance was adequate for insulation in construction. It is suggested to investigate adhesives and treatments to optimize the thermal performance of CLT.	Paula	Salgado	0
Poster Session 3B - TESP & TABD (Architectural)	Timber Engineering & Structural Performance - Architectural Focus	EXPERIMENT ON AXIAL CAPACTY-BENDING CAPACITY RELATIONSHIP OF PLASITC HINGE OF STEEL BAR-TIMBER COMPOSITE COLUMN	In light of the current climate crisis, there has been much recent interest in using timber structural members in large buildings, since timber is as renewable natural resource, and moreover, in severe earthquake prone, such as Japan, they are more desired on the grounds of light weight of timber members. We are developing a frame system formed by timber members reinforced by deformed steel bars (i.e. rebars) using epoxy resin adhesive. We have already a technique for the connection between column of ground floor and reinforced concrete foundation. However, behavior of the column subjected to bending under higher axial force was not investigated. In previous WCTE 2023, bending characteristic of the other portion except hinge of the column derived from loading test and a calculation method for the bending moment capacity was reported [1]. We have planned an experiment to investigate bending characteristic of the hinge of the column under bending and higher axial force. This paper reports the experiment, its results, and comparison of the experiment result and calculation on bending moment capacity.	RIN	KAMIMAKISE	Kagoshima University

Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
Poster Session 3B - TESP & TABD (Architectural)	Timber Architecture & Biophilic Design - Architectural Focus	Occupant outcomes in timber-rich environments: A review	Occupant outcomes are an important area of research into the effects of building design and material selections, especially amongst green buildings. In these buildings, views to the outside and natural materials, including timber among others, are associated with numerous benefits for occupants, including increased productivity, the experience of biophilia, and other indicators of positive feelings. These benefits point to the importance of well-designed buildings, not only for sustainability and health but also for human psychological well-being. However, few studies focus specifically on occupant outcomes from timber as a structural or interior material. This research will use a robust literature review methodology to seek, select, and review existing literature on occupant outcomes, focusing on those studies that offer findings about timber and wood interiors. Findings most relevant to industry will be presented at the conference.	Georgia	Lindsay	University of Tasmania
Poster Session 3B - TESP & TABD (Architectural)	Timber Engineering & Structural Performance - Architectural Focus	LCA COMPARISON OF A MASS TIMBER BUILDING WITH AN EQUIVALENT STEEL ALTERNATIVE	This study presents the results of a comparative life cycle assessment (LCA) between a mass timber and steel structural design for Adohi Hall at the University of Arkansas. The study shows that utilizing mass timber results in a 19% lower embodied carbon footprint than steel for the same building design, when considering modules A1-A4 (cradle to construction site). The mass timber design stores approximately 2757 tonnes of CO2 eq, further contributing to climate change mitigation. These findings highlight the environmental potential of mass timber construction as a decarbonization pathway in institutional buildings.	Mahboobeh	Hemmati	University of Arkansas
Poster Session 3C - MPD (Engineering)	Material Performance & Durability - Engineering Focus	EVALUATION OF GROWTH STRESSES IN LIVING TREES OF Corymbia citriodora Hill & Johnson (Eucalyptus citriodora Hook) USED FOR STRUCTURES BY DETERMINING THE LONGITUDINAL RESIDUAL STRAIN	The equipment called extensometer is the responsible for the measurement of longitudinal residual strain (LRS). The objective of this study was to measure the LRS in Corymbia citriodora Hill & Johnson, checking in four different positions in the tree and their correlation with diameter at breast height (DBH), height and thickness of the bark. Eight trees of Corymbia citriodora were chosen randomly. In each tree, the following measurements were taken: DBH, bark thickness, tree height and the LRS in four different positions. A low correlation between LRS and the variables DBH, height and thickness of the bark was found. It can be concluded that there is a need, for a more accurate evaluation, a large number of trees are evaluated to provide a better understanding of the correlates of longitudinal residual strain and other variables in the population evaluated.	Alexandre	Carvalho	Federal Rural University of Rio de Janeiro
Poster Session 3C - MPD (Engineering)	Material Performance & Durability - Engineering Focus	INTERLAMINAR SHEAR FAILURE DAMAGE EVOLUTION PROCESS OF CLT BASED ON ACOUSTIC EMISSION TECHNOLOGY ANALYSIS	Cross laminated timber (CLT) was recognized as alternative to traditional construction materials. In this study, CLT was prepared by the plantation Chinese fir using one component polyurethane. Acoustic emission technology was used to evaluate the damage evolution and failure mode of CLT interlayer shear during load process. The variation of acoustic emission (AE) energy could accurately reflect the evolution of CLT interlayer shear damage. The results showed that the CLT interlayer shear failure mode was mainly the rolling shear failure of the transverse laminate, and the failure mainly occurs at the wheel position and the wood ray position at the junction of the morning and evening wood. In the deformation stage, the AE energy signal was less, the wood fiber bundle buckling, tensile microcracks start to sprout. In the crack propagation stage, the cumulative energy of AE increased linearly, and the shear crack signals with high RA value and low AF value increased. In the failure stage, AE energy signals form a local peak value, and the fracture form of CLT changes from tension-type failure to tension-shear composite failure.	haiqing	ren	Chinese Academy of Forestry
Poster Session 3C - MPD (Engineering)	Material Performance & Durability - Engineering Focus	ENHANCEMENT OF FIRE PROPERTIES IN WOOD FIBER-BASED THERMAL INSULATION FOR ECOLOGICAL NEW CONSTRUCTION AND RENOVATION PROJECTS	The significance of environmental considerations in construction is steadily rising on a global scale, particularly within the construction regulations of all EU countries. This trend is driving the increased adoption of ecological and renewable building materials and enhancing the energy efficiency of buildings, such as through improved thermal insulation. Although wood fiber-based thermal insulation presents a viable option for broader use, its application is typically restricted in buildings over two stories high in many countries due to fire regulations. Currently, the most commonly used building thermal insulations are A2 fire class mineral wools (glass and rock wool), which are energy and emission intensive to produce. However, wood fiber-based thermal insulation can achieve a fire class B rating when treated with fire retardants. This paper focuses on the development and investigation of new fire-resistant, wood fiber-based thermal insulations for both new construction and renovations. It also examines their potential applications, prerequisites, and environmental impacts as integral components of low-carbon industrial wood construction.	Hüseyin Emre	Ilgın	Tampere University
Poster Session 3C - MPD (Engineering)	Material Performance & Durability - Engineering Focus	TECHINICAL PERFORMANCE OF INNOVATIVE DOVETAIL MASSIVE TIMBER BOARD SLABS	The application of bonding agents and metallic joiners is crucial in formation of engineered timber products (ETPs). Nonetheless, the employment of adhesives presents sustainability issues owing to the release of harmful emissions. Likewise, metal connectors adversely affect the disposal, reuse, and recyclability of ETPs. A different approach that solely utilizes natural wood, referred to as dovetail massive timber board slabs (DMTBSs), obviates the necessity for adhesives and metal joiners, inspired from one of the ancient joining techniques. Nonetheless, current research on DMTBSs has concentrated on deficient empirical assessment of joint details, rather than examining performance of an entire load-bearing members. Our experimental research examined fire, airborne sound insulation, and air permeance performances of these innovative elements. Model-scale test specimens with dimensions of 200x950x950, 200x1160x1190, and 1160x1160x200 mm (as the smallest element) were utilized, respectively. The results highlighted the superior performance of DMTBSs, with the average charring rates between 0.65-070 mm/min, an Rw value of 43 dB, and q50 values of 1.4-9.9 $m^3/(m2h)$. Although the commercial and structural applications of the dovetail concept are currently quite limited, our goal is to promote its widespread adoption through studies such as ours.	Hüseyin Emre	Ilgın	Tampere University
Poster Session 3C - MPD (Engineering)	Material Performance & Durability - Engineering Focus	Natural weathering of traditional linseed oil paints	"POSTER ONLY" Linseed oil paints have been in use in interior and exterior decorating for a long period of time, but they died out due to the explosive growth of the petrochemical industry in the second half of the 20th century and due to disadvantages like more demanding application, long time of drying and related time consumption and labour costs. In Czech Republic, the preservationists interest in traditional coatings is increasing and the effort for resuming of their usage in historical monuments restoration appeared. Nevertheless, they are falling on cost orientated companies' dislike to work with traditional oil paint due to time-consuming process or more likely absolute ignorance of its correct application. Norway spruce (Picea abies) samples were brushed in two layers by handmade prepared linseed oil based coating. Four different types of pigments were used. All samples were exposed to natural weathering for five years without any maintenance. The change in paints color was evaluated, together with moisture content changes caused by rain and air relative humidity. The influence of paint color on the surface temperature was also determined. The type of used pigment has a fundamental influence on the resulting properties of traditional oil paint. There is significant difference between paints in moisture absorption. The colour darkness affects the surface temperature, which can accelerate sample drying. The coating color is relatively stable during weathering, but the appearance is influenced by chalking and dirt deposition, especially in case of white coating.	Jan	Baar	Mendel university in Brno

POSTER SESSION 4

Thursday, 26th June 2025 - 1:30pm to 2pm

Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
Poster Session 4A - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	Enhancing end-grain bonding of timber components under low-temperature curing conditions	Timber Structures 3.0 (TS3) technology developed during the last 10 years represents an emerging method in timber engineering, focusing on end-grain bonding of timber components. For a wider application, this study investigates the effects of low curing temperatures on tensile strength of the bond and explores mitigation strategies. Results indicate that low curing temperatures adversely affect mechanical properties, while using heated casting resin significantly improves bonding strength. The findings provide design-relevant tensile strength values and effective bonding strategies for low ambient temperatures.	Steffen	Franke	IBK Institute of Structural Engineering
Poster Session 4A - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	EFFECT OF AXIAL FORCE ON NATURAL FREQUENCIES OF COLUMNS ATTACHED TO TIMBER BUILDINGS	The effect of axial stress on the natural frequency of columns was investigated in the evaluation of Young's modulus for columns attached to existing buildings. First, elemental tests revealed that the natural frequency of wood increased when axial stress was applied to the wood, and then showed a downward trend when the axial stress was 1.5 kN/mm2. When the side pressure at the end of the wood was increased, the natural frequency increased up to the natural frequency of the fixed end in the first-order mode, and increased to 63 % of the natural frequency of the fixed end in the third-order mode. Next, tests on an existing building revealed that the attachment of beams to columns other than at the ends of the columns caused vibration modes similar to harmonics in the column vibration modes. In addition, it was confirmed that the natural frequency of the columns increased when the second-story floor beams were loaded. Although a similar relationship between axial stress and natural frequencies obtained from elemental tests was confirmed, differences in the natural frequencies obtained were caused by differences in the Young's modulus of the wood.	Hiroki	Yoshinuma	Toyo University
Poster Session 4A - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	Performance-Based Seismic Design of High-Rise Timber Office Buildings	As interest in carbon reduction and sustainable architecture grows, timber buildings are gaining attention. In South Korea, with the relaxation of regulations on timber buildings in 2020, interest in high-rise timber buildings has increased. However, according to the current structural standards (KDS), there are difficulties in designing mid- to high-rise buildings. This study aims to establish a performance-based seismic design procedure applicable to timber buildings of 13 stories or more, composed of RC shear walls and GLT frames, using the KDS performance design method based on the potential application of engineered wood. The structure's performance is evaluated through nonlinear static analysis. Specific procedures for designing according to the KDS performance design method were established, and allowable criteria for engineered wood members were presented. The basic design of the target building can follow current structural standards, and in order to determine the satisfaction of performance goals, the allowable criteria for each member and the creation of a nonlinear analysis model must properly reflect the actual nonlinear behavior of each member.	Huijin	Kim	TI Structural Engineers
Poster Session 4A - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	FEASIBILITY OF CROSS-LAMINATED TIMBER PANEL FOR BRIDGES APPLICATION: PRELIMINARY EXPERIMENTAL, NUMERICAL AND ANALYTICAL STUDY	Application of CLT in both structural and non-structural elements of bridges has increased globally. The CLT panel comprises several layers of timber boards which are stacked crosswise at 90 degrees and glued together on the wider face of timber boards. Although CLT panel has played a significant role in the current progress of timber mass construction in Pasefic area, there is not even one notable bridge CLT project. Therefore, this paper investigates the feasibility of using CLT panels in bridge applications, based on local material. This research examines the structural performance of CLT experimentally, numerically, and analytically. Experimental test results demonstrate that CLT and CLT composite double T-beams are sufficiently strong to carry structural loads for bridge applications. A numerical parametric study, based on an experimentally verified ABAQUS model, confirmed that a bare CLT panel and CLT composite elements which are fabricated from locally grown Radiata Pine are structurally ideal for short to intermediate span bridge application. This study revealed that the CLT bridge has potential for factory prefabrication which makes site assembly faster. Additionally, majority of non-structural bridge elements could be supplied from wasted CLT material. Ultimately, the CLT bridge is an excellent, environmentally friendly alternative to concrete bridges with a lower environmental impact.	Reza	Masoudnia	Red Stag Timber Lab
Poster Session 4B - MPD & TESP (Engineering)	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	EVALUATION OF PARAMETRIC FIRE MODELS FOR UNDER-VENTILATED MASS TIMBER COMPARTMENTS	Timber burns but is efficient for building structures with unusual yet beneficial thermal properties. Research suggest that the timber structural elements can contribute to a fire event and add to the compartment's fuel load. This results in a more hazardous and intense fire event. Despite these challenges, the search for analytical method(s) for fire safe design using timber can create pathways for mass timber structures. This paper critically investigates the assumptions and analytical methods in developing parametric fire curves for timber fire compartments. This involves reproducing parametric time-temperature curves, comparing to historical experimental results, and observe the fire dynamics within exposed timber compartments. By highlighting key governing factors during fire, Amanda will bring society a step closer to a universally acceptable method for structural timber design and enable progress towards fire safe complex timber building structures.	Jasmin	Goldberg	Aurecon
Poster Session 4B - MPD & TESP (Engineering)	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Bending strength of cross-nail-laminated timber assembly with wooden nails	In these times of climate crisis, the construction sector is increasing the use of engineered wood products (EWPs) in the buildings since it is a more ecological and sustainable material. Among the different wood products that exist there is cross-nail-laminated timber (CNLT) with aluminum nails that is used as a structural wall. In addition, densified wooden nails comparable to aluminum nails have appeared on the market. Therefore, this study aims to analyze the bending strength of CNLT with wooden nails. The results show that this product has a low modulus of elasticity to function as a slab, so that it can be used as a wall, with the advantage is a more ecological product than NCLT with aluminum nails, since only use wood in its manufactured.	Eduard	Correal	Forest Science and Technology Centre of Catalonia (CTFC)
Poster Session 4C - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	EVALUATION ON THE BEHAVIOR OF SCREWED CONNECTIONS BETWEEN CROSS-LAMINATED TIMBER PANELS AND STEEL PLATES	Despite the extensive use of steel-to-CLT screwed connections in CLT structures, there is still a lack of detailed knowledge on the mechanical performance of these connections. This paper presents experimental and analytical investigations on the behavior of screwed connections between cross-laminated timber panels and steel plates. Experimental tests were conducted on a series of steel-to-CLT screwed connection specimens designed with different distances between narrow faces and screws. Failure modes, load-displacement responses, capacities, stiffnesses, and ductility of the specimens were obtained and compared. The deformation inside the specimens was evaluated based on the X-ray digital radiography method. The effects of narrow faces and orthogonally placed layers on the connection behavior were studied. An analytical model was then developed to predict the capacity of the screwed connection. The models were validated by the test results and can serve as a convenient tool for designing such connections.	Xijun	Wang	Tongji University

POSTER SESSION 4

Thursday, 26th June 2025 - 1:30pm to 2pm

Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
Poster Session 4C - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	Comparative Analysis of Existing Models on Pull-out Stiffness of Glued-in Rod in Glulam	Glued-in Rod (GIR) is gaining recognition for its efficiency and innovative approach in timber joint applications. GIR joints offer high withdrawal capacity, rigid stiffness, fire and corrosion resistance, and aesthetic advantages due to the concealment of the rods within the timber. Despite over 30 years of research, a universal design standard for GIR has not been established. Moreover, design equations for predicting pull-out stiffness do not fully account for certain critical influences or are too complex for practical use. This study proposes a simplified equation to predict GIR pull-out stiffness, addressing the gaps in existing models. Experimental validation was conducted using various GIR geometries under pull-out loading conditions. The proposed equation aims to provide a practical design tool that includes the consideration of timber shear deformation, facilitating the effective design and implementation of moment-resisting joints in timber structures.	Lee	Gwang	Seoul National University
Poster Session 4C - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	IMPACT OF INTER-PANEL CONNECTIONS ON VIBRATIONS OF CLT FLOORS	Cross-laminated timber (CLT) floors are typically composed of multiple CLT panels. At design stage, such floors are usually modelled numerically either as a single solid slab or more frequently as a set of independent panels with no inter-panel connections. This paper aims to demonstrate numerically a significant effect of two common inter-panel connections, i.e. single surface spline and half-lapped joint, on vibration modes of CLT floors composed of two and three panels. The connections are modelled as an equivalent 2D elastic strip nested in-between the CLT panels. This relatively simple yet robust numerical model can be used conveniently in design offices, regardless finite element (FE) software. The matching monolithic slabs and floors without the inter-panel connections are studied for comparison. The results showed that the difference is far too big to ignore.	Nađa	Simović	Faculty of Civil Engineering, University of Belgrade
Poster Session 4C - TESP (Engineering)	Timber Engineering & Structural Performance - Engineering Focus	60-MINUTE COMBUSTION TEST UNDER LOADING OF STEEL BAR-TIMBER COMPOSITE BEAMS	POSTER ONLY Recently, timber buildings are desired from a viewpoint of global warming, and moreover, in severe earthquake prone zones, such as Japan, they are more desired on the grounds of light weight of timber members. We are developing a frame system formed by hybrid timber members strengthened with deformed steel bars (i.e. rebars) using epoxy resin adhesive. In order to practice the system, it is necessary to investigate fire resistance performance of the members. As a trial, we conducted a 60-minute burn test of one relatively small cross section of a steel bar-timber composite beam and and reported its results in previous WCTE 2023. Now, for practical use, we have conducted a 60-minute burn test of three beams with relatively large cross sections. This paper reports the experiments and results.	Shinichi	Shioya	Kagoshima University

Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
Poster Only - No Presentation	Material Performance & Durability - Engineering Focus	Diffusion Analysis of Protective Pigment Oil Coatings	The conservation of historic wooden structures is challenging due to their susceptibility to environmental degradation. This research investigates the diffusion properties of nine commercially available protective pigment oil coatings using a Dynamic Vapor Sorption (DVS) analyzer. By understanding these properties, we aim to improve coating performance and extend the lifespan of treated wood, thereby enhancing conservation strategies for wooden cultural heritage.	Jakub	Dömény	Mendel University in Brno
Poster Only - No Presentation	Exemplars & Construction Case Studies - Engineering Focus	Construction Tests of a Folding Timber Bridge	"POSTER ONLY" Serious disasters from earthquakes, typhoons, pouring rain, debris flow and so on often occur in Japan. Such disasters almost always cause roads and bridges to break. If the traffic and lifelines are shut off, citizens are isolated from the other areas and their daily life is damaged. It may be necessary to rescue injured persons rapidly. For the quick recovery from natural disasters, emergency bridges are sometimes constructed. In this case, the construction time should be as short as possible. This study presents a new emergency bridge with short construction time, which is a folding bridge. The bridge type is Howe truss, and the span length is 9.9m. The hinges which can make the bridge to fold are attached between truss panels. Outdoor tests of this bridge construction were executed on the ground in the Hakodate National College of Technology. In the tests, the bridge was assembled by modifying from folded condition to unfolded condition. A pseudo river and a construction site were settled in the ground and the unfolded bridge was erected by using 13tf rough terrain crane. It took only 2 hour and 30 minutes to complete this timber bridge.	Hideyuki	Hirasawa	Hakodate National College of Technology
Poster Only - No Presentation	Timber Engineering & Structural Performance - Engineering Focus	INTERNAL STRESS WITHIN TIMBER—STEEL BAR COMPOSITE BEAM DUE TO CHANGING OF TEMPERATURE AND MOISTURE CONTENT	POSTER ONLY We have been developing a frame system formed by timber members reinforced by deformed steel bar(rebar) using epoxy resin adhesive. Two major problems of the composite timber member are that its timber and rebar have different coefficients of thermal expansion and that timber expands and contracts due to variations in moisture content. Due to these factors, there is a need for a generalized method that can assess the variation of stress and strain in the wood and the rebar inside the member due to variations in wood temperature and moisture content. This paper proposes equations to estimate the internal stress of the wood and the rebar according the variation in those temperature and wood's moisture content.	TAKESHI	IZAKI	Kagoshima University
Poster Only - No Presentation	Timber Engineering & Structural Performance - Engineering Focus	COMPRESSIVE STABILITY STUDY OF FOUR-SIDED SIMPLY-SUPPORTED CONSTRAINED CLT WALL	This paper aims to investigate the compressive stability performance of CLT walls. In actual engineering, CLT walls often have lateral restraints, but none of the current studies consider the effect of lateral restraints on the compressive stability performance. CLT wall was regarded as a type of orthotropic plate formed via construction, assuming a four-sided simply supported constraint, based on the orthotropic plate buckling theory , a method for calculating the buckling capability of CLT walls under uniform-compression is derived in this paper. Formulas for determining the boundary between the elasto-plastic instability and elastic instability was also proposed.The accuracy of the calculation method was verified by the CLT walls numerical models, and the overall error was found to be small. The proposed equations offer accurate predictions of the buckling capability of CLT walls under uniform-compression.	DI	CHEN	China Southwest Architectural Design and Research Institute Co. Ltd
Poster Only - No Presentation	Timber Engineering & Structural Performance - Engineering Focus	A Study on Charring Properties of GLT Beams using Domestic Larch	The main structural members of a building shall secure fire resistance performance in order to prevent the collapse of structure in the fire accident. In Korea building laws and regulations require building structure members of a certain size or larger to have a fire resistant structures. Fire resistant structures refer to members or structural forms that maintain performance even when the main structural members of a building are exposed to high-temperatures for a certain period of time during a fire, and fire resistant structures should also be applied to structural members used in wood structures. Internationally, timber structure fire resistance measures apply the charring rate and charring depth of wood exposed to high temperatures to fire resistance design and are considered to have secured fire resistance performance through cross-sectional design with a charring depth. In Korea, the criteria for recognizing the fire resistance structure of wood members are charring depth per hour, and the member design should be applied by applying the charring depth for wood structure buildings. In this study, fire resistance performance tests are performed on structural beams made of domestic larch, and charring properties are analyzed and the results. To this end, Load bearing fire test was conducted on the structural member(GLT). The results of the fire resistance test considered the are charring depth according to the fire resistance time, the charring depth change according to the charring rate and the load	Kwon Hyuk	Baik	Korea Institute of Civil Engineering and Building Technology (KICT)
Poster Only - No Presentation	Timber Engineering & Structural Performance - Engineering Focus	Status of stadardization of fire-resistant structures according to the Korean Building Act for glued laminated timber using Korean larch	In wooden structures, it is widely known that the level of fire resistance is determined by a charring rate or charring depth, and their results are adopted for the design of fire resistance. In this study, specimens of Korea larch column with a lamination wooden type are prepared and the properties of fire resistance such as the charring depth, load ratio and the specific charring rate suggested by EN Code are investigated. In Korea, in order to apply to fire-resistant structures of buildings, fire resistance performance is certificated for each structure and can be used. The Koera standardization status for applying glued laminated timber as a fire-resistant structure according to the Korean Building Act is introduced and the current progress is introduced.	Jae Hong	An	Korea Institute of Civil Engineering and Building Technology (KICT)
Poster Only - No Presentation	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	A Study on Charring Depth of Cross-Laminated Timber(CLT) Walls according to the Fire Resistance Time under Non-Load Bearing Fire Test	In this paper, we investigated the charring depth of cross-laminated timber(CLT) walls under non-load bearing fire test, and observed the effect of fire resistive covering on the charring depth. The fire resistance test was conducted with five test specimens at 30-minute intervals from 1 to 3 hours, and the wall thickness was fixed to 210 mm. In addition, a fire resistance test was conducted for 2 hours using dry fireproof boards as fire resistive covering, and verified by the charring depth and internal specimen temperature. This study presented a domestic charring depth for a 3-hour fire-resistant structure of CLT walls under non-load conditions, and the effect of dry fire protection covering was observed. As time increased under non-load bearing fire test without fire protection covering, the charring depth of CLT walls increased steadily, and a decrease in the charring depth was observed depending on the dry fire protection covering. It is judged that it can be used as basic data for applying the domestic fire-resistant structure of CLT walls in the future, and it can be cited as comparative analysis data for fire resistive covering materials for CLT walls and loading tests of CLT walls.	Suho	Kim	Korea Institute of Civil Engineering and Building Technology (KICT)

Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
Poster Only - No Presentation	Timber Engineering & Structural Performance - Engineering Focus	Numerical Study on Timber-timber composite (TTC) floors	Timber-timber composite floors are becoming popular due to their lightweight and environmentally sustainable construction. Recent studies demonstrate concepts for achieving long spans with superior stiffness and vibration performance. However, there are no comprehensive studies investigating the impact of different parameters on the ultimate capacity and serviceability stiffness of floor systems. Additionally, the effective width is not clearly defined for engineers to use in analytical models. In this study, a finite element (FE) model using SAP2000 is employed to simulate cross-laminated timber (CLT) panels connected to laminated veneer lumber (LVL) as a floor system. The FE model is validated using data from push-out experiment conducted on this floor system, accurately capturing the load-deflection and peak load of the beams compared to existing experimental results. The validated model is then used for a parametric study to examine the effects of different parameters, including panel width, thickness, stiffness of shear connectors, their spacing, and the breadth and depth of LVL beams. Additionally, design equations and tables are suggested for engineers in this study.	Alireza	Chiniforush	The University of Melbourne
Poster Only - No Presentation	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	STRAIN RATE EFFECTS ON FRACTURE ENERGY AND STRENGTH PROPERTIES OF RADIATA PINE AND SPOTTED GUM	Recent advancements in mass-engineered timber products have enabled the construction of tall buildings in earthquake-prone areas. Additionally, scenarios such as progressive collapse and accidental member failure necessitate a thorough understanding of tim ber materials under high strain rate loadings. In this study, locally sourced Machine Graded Pine (MGP10) timber was used to fabricate test specimens. The compressive test specimens were designed according to ASTM D143-22 standards, and the tensile tests followed ASTM D3500 -20 guidelines. Compressive tests examined the effect of grain direction and loading rate on mechanical properties, using specimens cut parallel, tangential, and radial to the grain direction. Tensile tests were conducted on specimens cut parallel to the grain direction, subjected to various loading rates. The study also investigated the size effect on specimens under compression and tension, detailing specific sizes and shapes for the tests. The tests utilized MTS and Instron testing machines, measuring strains with laser transducers and extensometers. Results showed variations in ultimate stress and energy absorption based on loading rate and direction, highlighting the influence of grain orientation and specimen size on mechanical behaviour. The study concluded with an analysis of typical failure modes observed during compression and tension tests.	Alireza	Chiniforush	The University of Melbourne
Poster Only - No Presentation	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Retrofitting of Cracks in Connections with Glued-in Rods in Beech Glulam	Glued-in rods can provide efficient connections with a high loadbearing capacity and can be regarded as state of the art for softwood glulam. The use in combination with hardwood glulam is still quite seldom and further investigations are needed to get it accepted more widely. Several methods are known to avoid failure due to tension stress perpendicular to the grain during the service live of glued-in rod connections. Fully threaded screws are often used to reinforce or retrofit timber for tension perpendicular to the grain. Therefore, this method could present a convenient technique to retrofit cracks parallel to the rods in connections with glued-in rods. Tension tests using specimens with artificial cracks along the glued-in rods showed that the full loadbearing and yield capacity could be attained in case the cracks were retrofitted using fully threaded screws.	Martin	Lehmann	Bern University of Applied Sciences