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

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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

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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

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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

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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