SESSION 12

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

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

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12A	TESP- Engineering Experimental Investigations	Timber Engineering & Structural Performance - Engineering Focus	EXPERIMENTAL STUDY ON THE SHEAR STRENGTH OF ULTRA-HIGH LOAD BEARING CAPACITY TIMBER MULTI-LAYERED BEARING WALLS AND ASSEMBLED COLUMNS	Our research group embarked on a study of the horizontal resistance mechanisms of ultra-high load-bearing capacity timber bearing walls and assembled columns, composed of multi-layered wooden adhesive panels, aimed at achieving carbon neutrality, which contributes to solving environmental issues, and realizing medium and high-rise buildings. In this study, assuming wall-type structures for medium and high-rise buildings, the research focuses on the structural surface of timber multi-layered bearing walls, and for rigid-frame structures, the framework composed of timber multi-layered bearing walls, assembled columns, and beams. The research objectives include experimentally elucidating the loading-displacement relationship, destruction properties, equivalent viscous damping constant, and historical area through full-scale horizontal loading tests of timber multi-layered bearing walls and assembled columns. Furthermore, by conducting FEM (Finite Element Method) analysis that represents the shear buckling of plywood and the contact between plywood layers, we clarify the shear stress distribution and propose a mechanical model. As a result, we conducted horizontal loading tests on ultra-high load-bearing capacity timber multi-layered bearing walls, varying parameters such as the number of wooden adhesive panels, plywood thickness, and the presence of vertical load, thereby revealing their mechanical properties. Additionally, horizontal loading tests were performed on ultra-high load-bearing capacity timber multi-layered assembled columns, constructed with multiple layers of wooden adhesive panels, elucidating their mechanical properties. FEM analysis was employed to model the contact between plywood layers, successfully replicating the shear force-shear deformation angle relationship (within the elastic range), shear force-out-of-plane deformation relationship, and in-plane and within-layer shear stress distribution.	Ren	Ikezumi	Meiji University
12A	TESP- Engineering Experimental Investigations	Timber Engineering & Structural Performance - Engineering Focus	Experimental investigation on trusses made of glulam and birch plywood gusset plates	This paper investigates the load-carrying capacity of trusses consisting of glulam elements joined through birch plywood plates by means of either gluing or steel dowels. A total of 6 trusses with a span of approximately 7 meters were tested in three-point bending, 3 trusses for each connection type, the thickness of the plywood plates varied between 9 and 21 mm. The main purpose of this research was to gain a better understanding of the failure mode of birch plywood subjected to multi-axial stress state with loads from multiple directions. Therefore, the truss specimens were designed in such a way that failure occurred in the central plywood plate, which was subjected to a multi-axial stress states. As expected, the experimental results showed an increase in the load-carrying capacity with increasing plywood plate thickness. Furthermore, the glued specimens generally exhibited higher load-carrying capacity and elastic stiffness than those using mechanical connectors. For bonded specimens with 12 and 21 mm thick plywood, failure occurred at the bonded interface between plywood and glulam, rather than in the plywood itself. For both glued and mechanically connected specimens, the thickness of the plywood plate did not show a significant influence on the stiffness.	Mattia	Debertolis	KTH Royal Institute of Technology
12B	MPD / TESP - Engineering - Material Behaviour	Session Chair: A/PROF BENOIT GILBERT					
12B	MPD / TESP - Engineering - Material Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	EMPIRICAL FORMULA PREDICTING EMBEDMENT STRENGTH OF COCONUT WOOD	This research aims to find the best analytical model to predict the embedment strength of coconut wood (monocot). The investigation employed the dowels with the diameters of 10 mm and 14 mm, incorporating the data of 12 mm and 16 mm from previous studies. Single variate, multivariate, linear regression, nonlinear regression, and cross-validation methods were implemented. The findings suggested that multivariate equations provided the best fit andreliability, and nonlinear regression models showed the superiority. The significance of wood density and dowel diameter as the predictors of embedment strength was confirmed.	Lili	Jia	University of Canterbury
12B	MPD / TESP - Engineering - Material Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Mechanical performance analysis of CLT and structural timber rails under compression tests	Prefabricated timber modules can help make the building sector more sustainable by reducing greenhouse gas emissions. However, structural challenges, like the buckling of timber studs on timber rails still limit the height of tall timber buildings. These challenges are affected by how studs and rails interact. More research is needed to understand this interaction better. This study aims therefore to investigate this interaction by experimental tests and finite element (FE) modelling of five-layer Cross Laminated Timber (CLT) and structural timber (C24) bottom rails under compression loads applied via vertical structural timber (C24) studs. Preliminary results show that CLT bottom rails have a much higher loading-bearing capacity compared to structural timber bottom rail. Additionally, local penetrations were observed in the contact zone between stud and rail which is aimed to be included in the FE models.	Marcus Vinícius	Tavares da Costa	Karlstad University
12B	MPD / TESP - Engineering - Material Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Evaluation for ultimate strength for steel-plate-inserted joint with drift-pins at the end of glulam beams	This study focuses on the ultimate strength for steel-plate-inserted joints with drift-pins in wood structures. The ultimate strength of those joints is defined to be splitting or shear failure. From another perspective, it is very difficult to evaluate the fracture of a wood joint. Some structural designers have commented that the relationship between fracture properties and design formulas is difficult. In this study, shear loading tests of joints with different arrangements of drift pins were conducted, and the characteristics of splitting and shear failures were defined from test observations. In addition, tests were conducted to determine the fracture parameter and shear strength again in order to obtain the material values to be input into the strength equation. Shear tests were conducted in accordance with the HOWTEC method. The shear strength of 5% lower limit from those test results was approximately 1.4 times greater than the values indicated in the Japanese structural timber standard. The results of these tests were input into a strength equation, which was used to determine the fracture type, and the results showed that the fracture properties of the joints could be determined more accurately than in the current standard. This means that the design equation can more accurately determine the ultimate failure state, and the calculated ultimate strength is closer to the experimental value than the current standard.	Wataru	Kambe	Kanto Gakuin University

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12B	MPD / TESP - Engineering - Material Behaviour	Timber Engineering & Structural Performance - Engineering Focus	AN ENTIRELY WOOD FLOOR SYSTEM DESIGNED FOR BIOGENIC CARBON STORAGE, ADAPTABILITY, AND END OF LIFE DE/RE/CONSTRUCTION – ASSEMBLY DESIGN	This ongoing research aims to develop an innovative mass timber composite floor system designed to enhance biogenic carbon storage, adaptability, and efficiency in construction. The system features 3-ply CLT for top and bottom flange and GLT webs, utilizing two main connection types: screw with adhesive and screw with sharp metal plates. These connections were chosen for their performance in structural integrity and cost-effectiveness. The system accommodates service access through strategically placed holes along the span, facilitating maintenance and inspection. Experimental evaluation involves testing two specimen configurations under specified loads to validate their structural performance. The test setup includes measurement tools like potentiometers to monitor deflection and slip between CLT and GLT components. Anticipated results include failure analysis at connection interfaces and subsequent bending failure, informing analytical validations crucial for drafting optimization guidelines. The research addresses limitations of mass timber construction regarding span capacity compared to traditional materials like steel and concrete. By exploring innovative connection methods, this study contributes to advancing sustainable building practices while expanding the application of mass timber in larger commercial structures. Future outcomes aim to provide practical insights and design recommendations to optimize composite floor systems, supporting broader adoption in the construction industry.	Dr. Wechiang	Pang	Clemson University
12B	MPD / TESP - Engineering - Material Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Moisture diffusion analysis for timber structures based on physics-informed neural network	The moisture content greatly affects the long-term creep and time-dependent deformation of timber structures. Therefore, monitoring and predicting the moisture content of timber structures are crucial. The variation of moisture content was obtained through long-term service experiments. An analysis method based on the physics-informed neural networks (PINN) was proposed. The moisture diffusion model based on Fick's second diffusion law and the boundary condition were incorporated into the PINN simulation. The coefficients in the model were also set as trainable parameters, avoiding complex calculations and ensuring accuracy. Additionally, transfer learning was applied to achieve satisfactory prediction with small data samples. The predicted results were compared with the experiments. Compared with the previous numerical models, the PINN-based method shows coefficient independence, higher efficiency and accuracy.	Yijing	Wang	Tongji University
12B	MPD / TESP - Engineering - Material Behaviour	Material Performance & Durability - Engineering Focus	Effect of dimension on the mechanical behavior of wood scrimber	This study investigates the influence of cross-sectional area and stressed length on the mechanical behavior of wood scrimber. Wood scrimber, a type of reconstituted engineered wood product, has been increasingly used in construction due to its superior mechanical properties and sustainability. Understanding how dimensions affect performance is essential for optimizing its use in structural applications. However, there is a lack of corresponding research. This paper presents experimental results on the compressive and tensile strength of wood scrimber specimens of different sizes. The study shows that both the size and aspect ratio of the samples significantly influence the mechanical behavior of wood scrimber. Specifically, the cross-sectional area and tensile length have different effects on tensile strength, and the impact of size on tensile strength and compressive strength differs. Using the weakest link theory, the tensile and compressive size effects of wood scrimber were quantified. These findings provide critical insights for the design and application of wood scrimber in various engineering structures.	Guofang	Wu	Research Institute of Wood Industry, Chinese Academy of Forestry
12B	MPD / TESP - Engineering - Material Behaviour	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Influence of cracks on the embedment strength of dowel-type fasteners in glulam timber structures	Cracks caused by the environment and loads can reduce the mechanical properties of timber dowel-type connections and lead to brittle failure of structural members. This study investigated the impact of various crack lengths, widths, and depths on the embedment strength of dowel-type fasteners in glulam timber. Eight groups with different artificial cracks and one undamaged reference group were prepared and tested. The embedment properties of each group were obtained from the load-displacement curves, and the differences in embedment strength between groups were analysed by SPSS. Results showed that crack width and depth had a more severe impact on the embedment strength than crack length. In addition, a crack across the specimen's cross-section demonstrated a more significant reduction in embedment strength. The results of this study serve as a starting point in evaluating the impact of cracks in connections of existing glulam timber structures requiring maintenance and reinforcement.	Cong	Zhang	Beijing University of Technology
12C	TESP/MPD/TABD - Engineering / Architectural	Session Chair: PAOLO ASCHIERI / THECA TIMBER					
12C	TESP/MPD/TABD - Engineering / Architectural	Timber Engineering & Structural Performance - Engineering Focus	GROUND IMPROVEMENT EFFECT OF TIMBER PILES BURIED IN DIFFERENT SANDY CLAY SOIL	To understand the utilization of timber piles in ground reinforcement, it's crucial to assess their efficacy and sustainability in consolidating and compacting the ground post-burial, considering soil characteristics. This study employs simple soundings to analyze changes in penetration resistance around timber piles buried in different soil layers over time, aiming to evaluate solidification and improvement extent. Field tests reveal a notable initial increase in penetration resistance near timber piles, with subsequent expansion of consolidation zones over time regardless to the type of soil. The buried piles serve as drainage columns, inducing deep-seated consolidation phenomena, with greater effects observed over prolonged burial periods. These findings affirm the effectiveness and durability of timber piles in ground reinforcement, suggesting their promising role in disaster prevention and carbon sequestration efforts. Active utilization of timber piles holds potential for mitigating ground-related disasters and combating global warming through carbon storage in the soil.	Tadashi	Hara	Kochi University, Japan

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12C	TESP/MPD/TABD - Engineering / Architectural	Timber Engineering & Structural Performance - Engineering Focus	COST-PERFORMANCE EVALUATION OF A PRES-LAM CASE-STUDY BUILDING IN ITALY	The socio-economic and environmental impact of recent earthquakes has underscored the need for advanced and sustainable technological solutions in new buildings. The use of engineered timber in construction has gained growing interest in the last years, especially in Italy; nevertheless, it usually comes in the form of conventional platform constructions with CLT (Cross-Laminated Timber) walls. Despite the ongoing research to enhance the performance and reduce post-earthquake damage of this system, CLT buildings are often characterized by rigid interior spaces. In contrast, the timber low-damage post-tensioned structural system, known as Pres-Lam technology, offers large open spaces and high-seismic performance with negligible damage and recentering characteristics. Although Pres-Lam has been implemented in various countries worldwide, its adoption in Italy is still at the first stages. This is primarily due to the lack of awareness and information about the technology, limited familiarity of engineers, architects and clients with the use of timber for multi-storey buildings, as well as perceived high costs. Through an Academic-Industry research partnership, this paper presents a case-study of a Pres-Lam adaptable building. A real CLT platform-frame building is re- designed using Pres-Lam technology, and its cost is assessed and compared with the original solution through a bill of quantities. The seismic performance is evaluated through non-linear static analyses, and the low environmental impact is demonstrated by performing a Life-Cycle Assessment of the building. The versatility of Pres-Lam is further emphasized by proposing a change in building use from residential to office space.	Giada	Formichetti	Sapienza University of Rome
12C	TESP/MPD/TABD - Engineering / Architectural	Timber Engineering & Structural Performance - Engineering Focus	One-storey timber-framed shear walls with window openings as part of the lateral force-resisting system.	For lateral force-resisting systems of multi-storey timber-framed buildings, the usual policy of current standards in Europe is to only consider wall segments continuous from the ground floor to the top edge of the building and to neglect wall elements with openings. Developing a design method that allows taking wall elements with window openings into account, would make the lateral force-resisting system more efficient and respective buildings more economic. This paper presents experimental investigations on horizontally loaded one-storey wall elements with large window openings. Different window opening sizes, sheathing-to-framing connection types and reinforcement measures were investigated. The results show that timber-framed shear walls with window openings have sufficient stiffness and strength potential to act contributingly to the the lateral force-resisting system.	Nadja	Manser	Empa - Materials Science and Technology
12C	TESP/MPD/TABD - Engineering / Architectural	Material Performance & Durability - Engineering Focus	AUSTRALIAN NATIONAL 2023 IN-GRADE SAWN TIMBER STUDY	Mills producing machine stress graded softwood sawn timber in Australia are responsible for the compliance of their products. Stress grading is covered in the AS/NZS 1748 performance standards with ongoing verification covered in AS/NZS 4490. Mills operate custom configurations of stress grading equipment with tailored grading and verification processes to suit their incoming timber resource and output product stress-grade mix. This paper presents the outcomes of a comprehensive national study completed in 2023 (2023 In-Grade Study) with 13 mills participating, accounting for ~90% of national production across Australia. The 2023 In-Grade Study comprised >17,000 tests and provided key insights into the relative performance of the structural properties (indicator and inferred) tested to AS/NZS 4063.1 and characterised to AS/NZS 4063.2. Structural property distributions are discussed with relative performance between indicator and inferred properties presented. The study reports characteristic densities and proposes a relationship between characteristic density and MOE for use with developing connection design models. The 2023 In-Grade Study led to follow-on projects further investigating compression and shear test methods to AS/NZS 4063.1.	Jon	Shanks	TimberED Services
12C	TESP/MPD/TABD - Engineering / Architectural	Timber Engineering & Structural Performance - Engineering Focus, Exemplars & Construction Case Studies - Engineering Focus	DPG MEDIA HEADQUARTERS IN AMSTERDAM: A SHOWCASE OF TIMBER-CONCRETE COMPOSITE FLOOR TECHNOLOGY	The DPG Media headquarters in Amsterdam is a recent example of using Timber-Concrete Composite (TCC) floors in a hybrid timber structure. This project demonstrates how combining timber and concrete can enhance structural performance, improve acoustic properties, and allow spans up to 8.1 meters, creating a comfortable office environment. However, the project also highlighted the limitations and disadvantages of this technology. Handling timber creep and concrete shrinkage was challenging, as TCC floors did not significantly reduce deformations compared to Cross-Laminated Timber (CLT) floors of the same thickness. Applying pre-camber and managing point loads due to temporary propping slowed construction, and manually installing over 175,000 coach screws impacted the timeline. Prefabrication benefits were offset by the installation of connectors and concrete pouring, adding considerable time. The inclusion of two levels of underground parking created water pressure, necessitating a heavier structure. This issue led to the use of TCC floors, whose concrete component increased the building's Global Warming Potential (GWP) and raised concerns about long-term dismantling. Overall, the DPG Media headquarters project showcases the potential of hybrid timber construction while also revealing its limitations. This project provides valuable insights into managing composite systems, optimizing construction processes, and balancing structural performance with sustainability goals.	Benoît	Hargot	WOW Engineering
12C	TESP/MPD/TABD - Engineering / Architectural	Timber Architecture & Biophilic Design - Architectural Focus	EXPLORING REACTIONS TO WOOD DEFECTS: A STUDY INVESTIGATING PSYCHOLOGICAL/ PHYSIOLOGICAL RESPONSES AND CULTURAL DIFFERENCES TO IMPERFECTIONS IN WOOD	Biophilia refers to the innate human tendency to connect with nature, stemming from our evolutionary need for natural environments for survival. In architecture, biophilic design incorporates natural elements to enhance well-being. Wood, in particular, has significant restorative effects, improving mood, reducing stress, and boosting cognitive performance when used in architectural spaces.Research shows that wood interiors positively impact human psychology and physiology, though studies often lack comprehensive cultural perspectives and the effects of wood defects. Cultural backgrounds significantly affect how individuals perceive and react to wood. Eastern and Western cultures exhibit different values and behaviors that influence their interaction with natural materials. This study categorizes participants into these broad cultural groups to understand how cultural nuances shape responses to wood and its defects.The study involves 60 students from diverse cultural backgrounds, split into Eastern and Western categories. Experiments will be conducted in two cubicles, one with defect-free White Pine and the other with wood featuring defects. Physiological data, including heart rate and skin conductance, will be collected using wristbands, while psychological data will be gathered through questionnaires and interviews.Pre- and post-experiment questionnaires and tests will assess changes in psychological states and cognitive performance. Open-ended interviews will provide qualitative insights. The data will be statistically analyzed to identify patterns and correlations between cultural background and responses to wood defects.The study aims to correlate psychological and physiological responses to wood with and without defects and determine if these responses are culturally influenced.This research aims to contribute to biophilic design knowledge by examining the intersection of architecture, wood science, and environmental psychology.	Aayusha	Chapagain	SUNY College of Environmental Science and Forestry

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12C	TESP/MPD/TABD - Engineering / Architectural	Timber Architecture & Biophilic Design - Architectural Focus	BioHeal: Tree upcycling for architectural healing	Felled tree upcycling is crucial not only for reducing carbon emissions but also as a valuable renewable material in resource-scarce Singapore. The Bioheal™ project aims to pilot test the challenges and opportunities of tree upcycling for a rapidly aging population, with the goal of aiding faster patient recovery through biophilic architectural installations of upcycled timber at a public hospital extension project. To preserve the public's fond memories of its natural environment and historical importance, it is required to install upcycled timber sourced only from the designated construction site within the campus. A "Trees to Design" approach (as opposed to the typical "Designs come first" process), born out of necessity, was developed to address the limited and unpredictable supply of species, sizes, and quantities of upcycled timber. This approach maximizes the potential and highlights the uniqueness of upcycled trees as biophilic design features. These features include: 1. Sequential live edge partitions, 2. CNC-carved biomorphic columns, and 3. Mass-customized modular feature walls representing the diversity of the tropical timber species upcycled. To promote the use of felled trees for commercial construction practices, it is recommended to establish a common public stockyard for upcycling trees. This would buffer the irregular but significant constant supply of felled trees from roadsides and construction site clearings, enabling clients and contractors to integrate upcycled timber into their practices in a more controlled and predictable manner, ensuring a sustainable and resource-efficient construction industry.	Shinya	Okuda	National University of Singapore
12C	TESP/MPD/TABD - Engineering / Architectural	Timber Architecture & Biophilic Design - Architectural Focus	USE OF AMAZONIAN HARDWOOD IN TIMBER STRUCTURES - BRAZIL	The Mato Grosso Timber Production and Export Industries Centre (CIPEM) is the union of eight forest-based employers' unions, whose purpose is to organize and strengthen the sector. It encourages the productivity and conscious consumption of wood and its forest-based products regarding the current legislation and in a sustainable basis. Cipem covers 100% of the native wood producing municipalities of Mato Grosso state and it is at vanguard of sustainable forest management in Brazil. Aiming to demonstrate the several possibilities of building with Amazonian hardwood, some structural systems were designed and built to be exposed in national and international fairs, highlighting the use of lesser-known species. Their main characteristics are the fast assembling based on its constructive rationalization, with the maximum exposure of the huge variability of Amazonian species managed by Cipem. Wood species were selected according to market strategies and their physical and mechanical properties were considered. Each wood piece used in the timber structures was properly identified by management control protocols. The visual experience of the timber structures is enriched by the several colours and textures that are typical from Amazonian woods. The design and build of Amazonian timber structures is evidence of the flexibility of this sustainable and locally sourced materials. Also, wood is the only choice for a renewable and sustainable building material and forest-based materials are desirable for their strength, durability, beauty, and cost-effective construction.	ROBERTO	LECOMTE DE MELLO	Casacerta Architecture Design & Building
12D	EIC - Innovation & Testing	Session Chair: PROFESSOR YING HUI CHUI / UNIVERSITY OF ALBERTA					
12D	EIC - Innovation & Testing	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	MULTI-LAYER STRAND-BASED WOOD MATERIALS IN CONSTRUCTION: MECHANICAL PROPERTIES AND TEST METHODS	Unplanned and planned deforestation as well as forest management regimes and forest degradation influence the current and more importantly the future supply of wood. Given the high demand for wood products, it is crucial to optimize the utilisation of low-quality, non-sawable wood, and wood sidestreams, which are currently predominantly combusted. Strand-based engineered wood products provide a viable solution but are typically used in single-layer configurations. There is limited research on their multi-layer performance, particularly for use as structural material in multi-story buildings, highlighting the need for further investigation. The present study examines the mechanical properties of multi-layer strand-based wood materials, specifically six-layer oriented strand board (OSB) and a novel three-layer Unistrand material. Comprehensive experiments evaluate the bending, shear, and compression properties, as well as the elastic constants and strength properties, of both materials, clearly showing the suitability of these material to be used in construction. These findings serve as a basis for modeling and design and fill a critical gap in literature by providing detailed data on multi-layer strand-based wood materials. Additionally, insights into the most suitable test methods for these materials are given, guiding future applications and developments in the construction industry.	Benjamin	Kromoser	University of Natural Resources and Life Sciences (BOKU)
12D	EIC - Innovation & Testing	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	Tubular veneer timber: structural testing and flat pack self-shaping for ultralight, cylindrical wood components	Tubular Veneer Timber (TVT) offers a sustainable solution for low-carbon construction by addressing inefficiencies in traditional, solid wood, structural elements. Unlike solid wood elements that waste material and are difficult to transport, TVT uses hollow, cylindrical geometries that maximize compressive strength while minimizing material usage and weight. By leveraging the natural properties of wood fibers, TVT can be manufactured and transported efficiently, significantly reducing the carbon footprint. TVT's innovation lies in its ability to self-shape from flat-packed panels into cylindrical components when exposed to specific moisture conditions. This process allows TVT to be transported in a flat, compact form, reducing transportation emissions by up to 90%. Upon reaching the construction site, the panels can be dried, transforming them into lightweight, deployable structures such as trusses or columns. The research focuses on the structural capabilities of TVT, particularly its compressive strength. Initial tests involved manufacturing and self-shaping five tubes, followed by compression loading tests at Oregon State University. The results demonstrated an average maximum compressive stress of 36 MPa with a standard deviation of 3 MPa, indicating consistent performance. Failures observed during testing included cracking and lamination warping. Background studies have shown the potential of self-shaping wood veneer structures, but challenges remain in ensuring long-term stability and environmental resistance. The integration of these self-shaping properties with hollow cylindrical structures aims to fill a gap in existing research. The ongoing experimental work looks to explore different lamination thicknesses and configurations to enhance the compressive strength and practical applications of TVT.	Helene	Brehl	University of Oregon - School of Architecture & Environment

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
12D	EIC - Innovation & Testing	Timber Engineering & Structural Performance - Engineering Focus	EVALUATION OF MOMENT CONNECTION WITH GLUED-IN ROD IN TIMBER	Glued-in Rod (GIR) connection is recognized for their robust strength and stiffness as representative moment connections for timber frame. However, GIR typically resists both shear and moment forces simultaneously, with perpendicular shear forces against the grain reducing their moment performance. To enhance GIR's effectiveness, a new connection was developed to separate shear and moment resistance. This innovation combines GIR with a dowel connection known as Slotted-in Plate (SIP), renowned for its excellent shear resistance. The moment strength of the developed connection increased by 30.87%, while rotational stiffness decreased slightly by 6.64% compared to the existing GIR connection without SIP. These results imply that the developed connection can serve as a more reliable joint in structural applications.	Min-Jeong	Kim	Seoul National University
12D	EIC - Innovation & Testing	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus, Education, Innovation & Challengers - Engineering Focus	Innovative Testing Machine for Creep Tests on a Structural Scale Under High Constant Load	In multi-story timber buildings using platform framing, most vertical deformations occur at the floor joints. In these areas, the floor and, in the case of timber frame constructions, the top and bottom plates are loaded perpendicular to the grain. The stiffness of the timber members in this direction is considerably low. Moreover, the literature reveals that deformations due to creep are significantly higher in this direction compared to loading parallel to grain. However, most studies have been conducted on small-scale specimens, as creep test setups for tests on a structural level necessitating high loads are challenging to manage or costly. Towards this objective, a testing machine was developed that employs the principle of dead weight, combined with multiple levers to amplify the load. This machine can provide a high, constant load over a long time.	Christian	Bertram	Timber Structures and Building Construction, Karlsruhe Institute of Technology (KIT)
12D	EIC - Innovation & Testing	Education, Innovation & Challengers - Engineering Focus	CCLT – Further development of a CLT based sandwich structure with a bamboo honeycomb (COMBOO)	This document reports of extended investigations of a CLT sandwich construction. The required large amount of timber and the high weight of conventional CLT boards can be reduced by integration of a layer of bamboo rings forming a honeycomb structure (called COMBOO) between outer layers of CLT boards (=CCLT). After a transfer from GFRP sandwich applications via model scale tests, this document contains manufacturing and tests of full scale CCLT boards. First, a comparison between self-made CLT boards and CLT boards from manufacturer KLH (Austria) was made, to gather experience with handling and estimation the difference in bending strength due to much lower compression force during gluing. In the second step the CCLT boards were created which opened more new questions or tasks, followed by 4-point bending tests. Hereby was found that manufacturing method influences the bending strength, but the chosen manufacturing method can be used for CLT production and hence CCLT production. Bending strength varied between 30.6 N / mm2 (KLH -CLT) and 8.9 N / mm2 (CCLT). A wider field of new tasks and extend tests was identified to create a suitable building material at industrial scale.	Andreas	Loth	Berliner Hochschule für Technik
12D	EIC - Innovation & Testing	Education, Innovation & Challengers - Architectural Focus	GREY ZONES: UNVEILING CHALLENGES AND SOLUTIONS IN DESIGNING, PLANNING, AND CONSTRUCTING WOODEN BUILDINGS FOR DEVELOPING COUNTRIES.	This article is the result of the systematic registration and identification of the so-called "grey areas", understood as sectors of an ambiguous nature in the face of the challenges and solutions in the design, planning and construction of wooden buildings for developing countries and which prevent the initiation and development of this type of projects in developing countries such as those in Latin America. Through recent architectural and engineering design work - Tamango Building, a 12-story building in wood not yet built and Piloto Tamango, a 1-story building with a LVL load-bearing structure already built in the far south of Chile - and consulting work - Roadmap for Social Housing in Wood in Uruguay and evaluation of new projects for an important local mass timber industry - it was possible to carry out a survey of current practices in this region of the planet - with problems regarding construction productivity and strong challenges around sustainability goals for the coming years - delivering a diagnosis that identifies key actions and a realistic path to be followed specifically by professional offices, through the development of the so-called "Digital Twin".	Gerardo	Armanet	Centro Nacional de Excelencia para la Industria de la Madera (CENAMAD)
12D	EIC - Innovation & Testing	Education, Innovation & Challengers - Engineering Focus	DEVELOPMENT OF SAFE DESIGN PROCEDURES FOR PRODUCTS, ASSEMBLIES, AND SYSTEMS IN WOOD CONSTRUCTION	The Canadian government and its provinces are implementing climate strategies and regulations to decarbonize the building construction sector through nature-based solutions, such as using sustainable and renewable construction materials. Measures include promoting wood education and research, "Wood First" provincial policies, modernizing sustainable forest management, and strengthening the timber supply chain. In line with these efforts, in 2023, the Quebec Ministry of Natural Resources and Forests funded the authors of this paper to develop safe design procedures for products and systems in wood construction. The research program will be executed over five years at Université Laval and McGill University in collaboration with twelve industry partners through a series of planned research tasks. The tasks encompass developing 1) novel connection systems for mass timber buildings, 2) new timber-steel braced frames, 3) low-damage rocking timber frame braced systems, and 4) seismic and wind design guidelines for the new systems through numerous experimental campaigns and extensive numerical studies. This paper provides an overview of the project, its status, and upcoming tasks.	Alexander	Salenikovich	Université Laval
12E	EIC/TESP/MPD-Engineering - Fire	Session Chair: DR SHENGDONG ZHANG / TONGJI UNIVERSITY					
12E	EIC/TESP/MPD-Engineering - Fire	Timber Engineering & Structural Performance - Engineering Focus	A MULTI-FIDELITY APPROACH BASED THERMO-MECHANICAL CAPACITY ASSESSMENT OF GLULAM TIMBER CONNECTIONS SUBJECTED TO FIRE HAZARD	This research develops a innovative multi-fidelity approach based assessment method to conduct comprehensive thermo-mechanical analysis of glulam timber connections exposed to standard fire conditions. The framework is specifically designed to integrate low-fidelity features derived from finite element models with high-fidelity experimental data. This integration allows for the efficient utilization of both data types to achieve a rapid and accurate prediction across the entire domain, significantly improving the prediction accuracy and reducing computational costs. The heat transfer within the wood is analyzed based on the results of finite element models (low-fidelity model database) and experimental data (high-fidelity model database), and temperature-dependent properties such as thermal conductivity, specific heat capacity and density are determined. Variou factors such as bolt count, diameter, beam thickness, and wood density are taken into account to predict temperature distribution within connections. Additionally, using Johansen's yield theory, load-bearing capacity was analyzed to determine fire resistance of connections, establishing a comprehensive understanding of their structural resilience in fire scenarios. This approach provides analysts with accurate connection data while significantly reducing the time and computational resources required, enhancing the efficiency of structural fire safety evaluations.	Jing	Luo	Shanghai Normal University

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

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

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

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

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

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

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

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