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

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

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10B	TESP - Engineering Shear Performance	Session Chair: PROFESSOR MINJUAN HE / TONGJI UNIVERSITY					
10B	TESP - Engineering Shear Performance	Timber Engineering & Structural Performance - Engineering Focus	SHEAR PERFORMANCE OF WOODEN RESISTING WALLS WITH DECAY DAMAGE	In this study, the shear tests were performed on full-scale wall specimens with decay treatment to experimentally confirm residual performance. Based on the obtained data, the reduction rate of each strength characteristic value was calculated, and a reduction factor of the shear capacity was proposed. In addition to the points directly related to the expression of the shear capacity, such as the ends connections of the brace and the nail joints of the plywood wall, a significant reduction in strength property values was observed when the column-sill joints, which are subject to pull-out forces, deteriorated. An analysis of the seismic response of wooden house using the skeleton curves of the deteriorated shear walls obtained in the experiment confirmed that the response deformation was larger than that in the sound case.	Ryo	Inoue	Kumamoto Univ.
10B	TESP - Engineering Shear Performance	Timber Engineering & Structural Performance - Engineering Focus	CALCULATION METHOD FOR IN-PLANE SHEAR PROPERTIES OF NLT	NLT (Nail Laminated Timber) was tested to verify its in-plane shear properties and to derive a method to calculate the load deformation relationship of NLT. The NLT test specimens was composed of 20 pieces of Japanese Cypress lumbers of cross section size 45mm x 120mm and length 1900mm. And 75mm length common nails were nailed to connect the lumbers. As NLT is composed of lumbers connected with nail joints the load deformation relationship of NLT was derived by applying incremental displacement analysis with concern of the load deformation relationship of the nail joints. The calculated result well traced the load deformation curve of the test results at smaller deformation level and underestimated the load at larger deformation level. The under estimation of the load at the larger deformation level was supposed to be caused by the embedment of the adjoining lumbers. Based on this assumption the effect of the embedment of the lumbers was considered and included in the calculation. The calculated result almost well estimated the test results both at the smaller and larger deformation level. The results indicate that the in-plane shear properties of NLT can be evaluated though incremental displacement analysis with concern of the load deformation relationship of the nail joints and the embedment of the lumbers.	TIANJUN	XIE	Utsunomiya University
10B	TESP - Engineering Shear Performance	Timber Engineering & Structural Performance - Engineering Focus	DIFFERENCES IN SHEAR PERFORMANCE OF TIMBER MOMENT RESISTING JOINT DUE TO DIFFERENT JOIT TYPES	The timber buildings with semi rigid frame structures are increasing. They have concern to the shear failure because it has large shear stress at the panel zone. The diversity of joints has led to experimental verification of the shear performance of different joints, this is not easy due to the need to conduct experiments on each joint, which increases the costs and the material size of the experiments. In this study, as a first step towards proposing a material experiment to simulate the joint, the behavior of the tensile bolt joint was reproduced using FEM analysis and compared with experimental and estimated values. The results suggest that it is generally possible to reproduce the behavior by analysis.	Kaito	Yamagata	Hiroshima University
10B	TESP - Engineering Shear Performance	Timber Engineering & Structural Performance - Engineering Focus	THE LENGTH OF PLYWOOD SHEAR WALLS MATTERS	Timber-framed construction is a very common method for detached dwelling construction in Australia. In this method, lateral forces caused by wind and earthquakes are resisted by shear wall systems with various sheathing types. The plywood shear wall systems in AS1684, which typically allow builders to achieve full racking capacity with walls as short as 900mm, were validated in experimental testing of walls having a standard length of 2400mm. This study performs 27 shear wall panel tests with length ranges from 450 mm to 2700mm to examine the effect of length on the performance of plywood shear wall systems. Variables of the study include two bracing details from AS1684 and two types of plywood. The findings show that the unit strength and stiffness of timber-framed plywood shear walls varies with respect to the shear wall length. This finding raises concerns that an over-reliance on many short-length bracing walls in a building may be problematic.	Craig	Cowled	Queensland University of Technology
10B	TESP - Engineering Shear Performance	Timber Engineering & Structural Performance - Engineering Focus	TESTING THE INFLUENCE OF SYSTEM EFFECTS ON THE LATERAL RESPONSE IN T-SHAPED WOOD FRAME SHEAR WALLS	This paper examines the impact of transverse shear walls (TSW), out-of-plane bending stiffness of diaphragms (FDIA), and axial (gravity) loading (AXL) on the lateral response of strong wood-frame shear walls (SWs) in multistory light frame timber buildings (LFTBs). Experimental tests assessed the lateral cyclic response of T-shaped SW assemblies with and without diaphragms and gravity load. Tests showed that the TSW effect enhances the lateral stiffness and strength but reduce the deformation capacity. The FDIA and AXL effects further influence the stiffness and strength, and compensate in part the reduction of the deformation capacity due to the TSW effect. Diaphragms also made the T-shaped SW response more symmetrical and improved the evolution of secant stiffness, cumulative dissipated energy, and equivalent viscous damping as the lateral drift increases. Numerical analyses of a theoretical building model with T-shaped SWs showed significant reductions in lateral drift and uplift compared to those of planar SWs alone, highlighting the importance of considering system effects in the seismic design of LFTBs.	Diego	Valdivieso	Centro Nacional de Excelencia para la Industria de la Madera (CENAMAD-CIM UC)
10C	MPD - Architectural / Engineering / Practitioner	Session Chair: DR YUTAKA GOTO / CHALMERS UNIVERSITY OF TECHNOLOGY					
10C	MPD - Architectural / Engineering / Practitioner	Material Performance & Durability - Architectural Focus	Durability performance of Eucalyptus nitens impregnated using supercritical Carbon Dioxide	Wood remains one of our most important carbon neutral structural materials, but many wood species are susceptible to biodegradation. Preservative treatment can minimize degradation, but some species are exceptionally resistant to preservative penetration. An excellent example is shining gum, Eucalyptus nitens, which is globally planted and especially abundant in Tasmania. This species has low decay durability and is exceedingly difficult to effectively treat using conventional processes. One alternative approach is to modify the treatment media using supercritical carbon dioxide (SC-CO). A previous study showed that shining gum could be effectively treated using a mixture of fungicides in SC-CO. However, the ability to deliver biocides into the wood may not necessarily translate into biological performance. The impregnated materials were subjected to laboratory decay tests using a brown rot fungus and above-ground proximity field tests in Queensland and Tasmania, Australia. Laboratory tests were inconsistent, owing to the wide variations in preservative retention. Field trials are three years old and beginning to show results on the untreated controls.	Kyra	Wood	Centre for Sustainable Architecture with Wood

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

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

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10E	EIC - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus, Education, Innovation & Challengers - Architectural Focus	Mass Timber Furniture Designs for Optimizing Panel Yield; An Upcycling Strategy to Intercept Mass Timber Drop Concurrent in Panel Manufacturing Production	In the translation of architectural designs to mass timber panel layouts, invariably each job results in a percentage of remnant panel material. The research team is running a case study analysis of a small sample size (3-5) of project cut jobs to identify drop percentages/areas, and explore opportunity to nest small parts for use in modular product designs. Following the case study exercise, an automated nesting script is developed which can be implemented by panel manufacturers interested in reducing their panel waste while simultaneously offering a collection of design objects and furniture as a value-add byproduct. A range of existing and developing mass timber furniture designs enables an optimization of part catalog options to respond to individual panel conditions.	Cory	Olsen	University Of Oregon
10E	EIC - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus, Education, Innovation & Challengers - Engineering Focus, Education, Innovation & Challengers - Architectural Focus	ADVANCING INTEGRATED DESIGN EDUCATION AND CIRCULAR ECONOMY IN WOOD CONSTRUCTION: KIT-OF-PARTS FOR FAST-DEPLOYABLE AND RELOCATABLE STRUCTURES.	This paper describes the development of a methodology for designing reusable wood-based kit-of-parts intended for rapidly deployable structures. This methodology was developed within an interdisciplinary educational framework. In a collaborative design studio, students from two universities explore how modular building systems can meet diverse needs through elements designed for disassembly and reuse. The course underscores the role of technology on wood design, simulation, and construction, describing approaches to designing with and for wood reuse. In the latest course iterations, reciprocal frames were introduced to enhance flexibility and reusability. An improved understanding of machining processes from one year to the next led to a refined design focus. This simplified design constraint expedited the consolidation of multiple design proposals, and streamlined the detailing, prefabrication, and assembly of the final modular structure.	Mariapaola	Riggio	Oregon State University
10E	EIC - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus, Education, Innovation & Challengers - Engineering Focus, Education, Innovation & Challengers - Architectural Focus	Waste Utilization Panels - Design optimization for geometry, structure and material in mass plywood panels additively constructed from offcuts	Mass Timber panels represent a growing sustainable design and structural alternative to steel and concrete as both floor and wall systems. However, mass timber panels made from cross-laminated timber or mass plywood panels, are typically produced in standardized rectilinear volumes with continuous thickness due to both design and manufacturing constraints. This results in excess material compared to the functional needs of the panel. In this research, we propose an additive approach to designing and optimizing the use of fiber and material volume in a mass plywood panel constructed from thin panels combined with linear offcuts. A parametric model with simple fabrication constraints is combined with structural optimization to determine the best material placement, adding depth and directionality to the thin plate. Preliminary results in the design phase show a dramatic reduction in material can be achieved by utilizing an existing typology of linear offcuts. Structural testing is planned to verify the stiffness of the geometrically optimized panels, as well as an initial study on the vibration and acoustic performance of the WUP panels.	Braden Dylan	Lawrie Wood	University of Oregon - Wood Lab
10F	MPD / TESP - Engineering - Fire or Moisture Hazards	Session Chair: DR DAVID LANGE / THE UNIVERSITY OF QUEENSLAND					
10F	MPD / TESP - Engineering - Fire or Moisture Hazards	Material Performance & Durability - Engineering Focus	MODELLING THE SELF-SUSTAINED SMOULDERING OF COPPER BASED PRESERVATIVE TREATED TIMBER	Copper-based preservatives are widely used to enhance timber's resistance to fungal and insect infestations. Our previous studies have demonstrated that these treatments also promote self-sustained smouldering post-fire. To investigate the effects of various conditions and material properties on smouldering, this study develops a model using the Generalized Pyrolysis Model (Gpyro) for self-sustained smouldering of timber treated with Chromated Copper Arsenate (CCA). The model successfully replicated self-sustained smouldering scenarios observed in previous laboratory experiments, highlighting Gpyro's ability to assess smouldering behaviour in preservative-treated timber. Future work will incorporate additional experimental data to further explore the influence of other parameters on smouldering dynamics, aiming to provide a fast prediction tool to optimize fire resilience and durability strategies in wildfire-prone regions.	Wenxuan	Wu	The University of Queensland
10F	MPD / TESP - Engineering - Fire or Moisture Hazards	Material Performance & Durability - Engineering Focus	FIRE AND CLT: LINEAR JOINTS	The topic of fire safety in multi-story buildings has become increasingly important in the field of wood engineering. As wood construction continues to push the boundaries of height and design, it is essential to ensure that buildings are protected from the risks associated with fire. When exposed to fire, wood can release heat, produce smoke, and spread flames quickly, making it critical to design and construct buildings considering fire safety. One key aspect is the sealing of linear joints, which can be vulnerable to heat transfer and ignition. The effectiveness of these seals depends on several factors, including the quality of the sealant material, the thickness of the wooden elements, and the width of the joint. This study aims to investigate the insulation and fire resistance of linear joints in CLT slabs and walls. By characterizing the performance of these joints under various conditions, it would be easier to design and construct buildings that meet the demands of modern architecture. The objective of this research project is to investigate the performance of cross-laminated timber (CLT) in different thicknesses, joint types, and sealing methods. To achieve this goal, three experimental campaigns were conducted. The first campaign tested two CLT slabs with a thickness of 200 mm, employing simple joints, half lapped joints and spline boards and different kind of sealant. In the second campaign, CLT with a thickness of 100 mm in vertical wall configuration was used while also incorporating a wider gaps and different solutions to facilitate prefabrication and simplify installation. The last campaign featured CLT with a thickness of 120 mm, combining the experience of the two previous campaigns. The results of these experiments provide valuable insights into the optimal configuration for CLT construction in various applications.	Sebastian	Jaimes	Rothoblaas
10F	MPD / TESP - Engineering - Fire or Moisture Hazards	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	IGNITION OF A TIMBER CEILING: ANALYSING CONVECTIVE AND RADIATIVE HEATING EFFECTS	Engineered timber buildings require a holistic fire design methodology to address the interaction between the fire-involved structure and the compartment fire dynamics, upon which the required performance of the building's fire safety strategy is predicated. However, research gaps persist, limiting our ability to provide a truly holistic design. The ignition of an exposed timber ceiling can cause rapid fire spread and abrupt change in compartment fire conditions; this directly impacts the available evacuation time. Recently, the authors undertook a bench-scale experimental campaign to study the ignition of a cross-laminated timber specimen at an inverted (ceiling) orientation. This baseline study focused on the impact of radiative heating only. The next stage of the work will also incorporate convective heating to more appropriately represent a series of timber compartment fire scenarios. We anticipate the range of possible results to provide much-needed context to better understand and predict exposed timber ceiling ignition for a range of compartment fire scenarios, to facilitate quantitative and holistic performance-based design.	Joshua	Madden	The University of Queensland

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

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10G	TESP - Engineering - Performance of Hybrid Structures	Timber Engineering & Structural Performance - Engineering Focus	ALTERNATIVE SEISMIC DESIGN OF MULTI-STOREY TIMBER STRUCTURES	Research on the structural response of large, multi-story timber buildings under horizontal loading conditions, such as wind and earthquakes, remains limited in the existing literature. A significant gap in recent developments is the lack of experimental evidence, particularly on fundamental topics such as hysteretic energy damping characteristics, deformation capacity, and their relationship to the soil-structure interaction (SSI) phenomenon. In multi-story timber structures, energy dissipation occurs at element-to-element connections or timber-to-foundation connections through energy-dissipating connectors and hold-downs. The HYSTERESIS project, as detailed in this paper, tackles these critical challenges by employing geographically distributed hybrid testing. This innovative approach distributes the complex experimental setup across two continents and four countries for simultaneous testing. This paper outlines the design principles of a 3D pilot structure, balancing realistic timber design practices with experimental and numerical limitations. In preparation of the design specimen, various 3D multi-storey structures were designed against seismic actions, and the major findings are discussed in this paper.	Eleni	Smyrou	Hanze University of Applied Sciences
10H	TABD - Architectural	Session Chair: DR EUGENIA GASPARRI / THE UNIVERSITY OF SYDNEY					
10H	TABD - Architectural	Timber Architecture & Biophilic Design - Architectural Focus	Timber Industrial Heritage	Industrial heritage has recently become a tourist and cultural resource, without forgetting its social aspect. Timber was widely used in the industrial sector during the pre-industrial era and the early stage of the Industrial Revolution. In more recent times, steel and concrete have significantly displaced timber in the industrial sector. However, timber was and is still used in certain industrial applications due to its advantages over other structural materials, such as high strength/density rate, durability, cost-effectiveness, and, more recently, sustainability and aesthetic aspects. Some examples include saltworks and phosphate factories, where the aggressive nature of the product provides timber with a clear durability advantage compared to steel or concrete. Timber species were selected depending on the industrial use (structure, machinery) based on economical and durability reasons. Recent interventions in timber industrial heritage are mainly related to a change of use (museums, offices, libraries, etc.). Protection policies depend on countries and regions, and some elements are protected under inclusion in the World Heritage List.	Daniel	Fernandez Llana	Universidad Politécnica de Madrid (UPM), Spain
10H	TABD - Architectural	Timber Architecture & Biophilic Design - Architectural Focus	PREPARED SYNTHETIC WOOD BEAMS: THEIR FEASIBILITY AND POSSIBLE DEVELOPMENTS IN ARCHITECTURAL DESIGN	This paper is to illustrate the idea of "Prepared Synthetic Wood Beam" which has deformed section prepared for special use as an architectural element, such as for roofs, claddings, and louvers. We developed various sections which might be used in architectural project, while it serve as ecological equipment of heat collection, water preservation, as natural light fixture, and so forth.	Yoshito	Tomioka	Mie University
10H	TABD - Architectural	Timber Architecture & Biophilic Design - Architectural Focus	TOWARDS RECIPROCAL FEEDBACK BETWEEN TIMBER ARCHITECTURE, ENGINEERING AND ADDITIVE MANUFACTURING BY STRATOCONCEPTION®	Additive manufacturing (AM), recently adopted by the construction industry to enhance productivity and efficiency, is not yet fully recognized as a production method that challenges conventional approaches to designing architectural components. The Stratoconception® additive manufacturing process presents an opportunity to merge AM's inherent potentials with the existing technical and material capabilities of the timber construction industry. This study examines how timber parametric design practices and the Stratoconception® process influence and enhance each other to address the limitations of timber construction. Using a research-by-design methodology, it compares two different CADCAM workflows to deepen the understanding of the reciprocal feedback between design and production processes. The first workflow highlights the extensive feedback required to reconcile freeform, mass-customized architectural components with industrial production constraints. To streamline this process, we propose a new digital file-free continuum using Rhino.Inside TopSolid, integrated within Grasshopper parametric models to interact directly with TopSolid'Strato add-in. This approach aims to establish a more efficient framework for developing innovative architectural components that meet contemporary challenges.	Anwar	NEHLAWI	LERMAB, URM MAP-CRAI & Université de Lorraine
10H	TABD - Architectural	Timber Architecture & Biophilic Design - Architectural Focus, Timber Architecture & Biophilic Design - Practitioner Focus, Exemplars & Construction Case Studies - Architectural Focus	ADDRESSING CHALLENGES IN MANUFACTURING IRREGULAR WOODEN POLES: A PRACTICAL EXPLORATION ON ACCURACY, EFFICIENCY, AND COST	The primary challenge in advancing the practical application of wood-wood connections lies in addressing the deficiency in performance metrics of manufacturing irregular wooden poles, such as accuracy, efficiency and cost. This study aims to address the above challenges. Initially, a comparative experiment was conducted between robotic and manual workflow to evaluate the performance differences of manufactured irregular wooden poles. A series of improvement strategies based on the evaluation results was formulated, including optimization of connection details, integration of machinery and craftsmanship, and pre-planning of workflows. These strategies effectively addressed the challenges associated with manufacturing irregular wooden poles through verification in a practical timber dome project, aligning with the growing trend of design for manufacture and assembly strategies, timber modular construction, and mass customization. Moreover, this study served as a reference for fabricating wood-wood connections with irregular poles and indicated a potential integrated application of appropriate machinery and craftsmanship.	Harrison	Huang	Zhejiang University
10H	TABD - Architectural	Material Performance & Durability - Architectural Focus	HOLISTIC HYGROTHERMAL PERFORMANCE ASSESSMENT OF EMERGING TIMBER ENVELOPES: FIELD TESTING AND TRANSIENT BUILDING SIMULATIONS.	The use of timber in construction brings multiple benefits, such as reducing the environmental impacts of buildings, as it often presents a lower embodied carbon alternative. However, when timber-based construction systems (external walls and roofs) are not designed correctly, they can present a high mould risk, compromising building performance and occupant health. This research focused on assessing the resilience of multi-layered timber envelopes to moisture and mould growth by conducting field testing. PHEBE (Prototype of Highly Efficient Building Envelopes) is a test facility created by the Façade Research Group at Sydney University`s School of Architecture Design and Planning with the objective of evaluating the hygrothermal performance of emerging envelope solutions. This study presents a holistic evaluation by comparing different construction solutions under real climatic conditions, as PHEBE presents different configurations for insulation, membranes, and boards. Each configuration is equipped with wireless sensors to monitor temperature, relative humidity and water content at different construction layer interfaces. Expected results will provide insights into current design and construction trends, providing quantitative evidence that will allow for improvements and recommendations for moisture-resilient, durable, and healthy buildings in Australia.	Natalia	Saavedra	University of Sydney