

Session No.	Session Topic	Abstract Topic	Submission Title	Summary	First Name	Last Name	Company
7A	TESP- Engineering - Bridges / Beams	Session Chair: DR CHRISTOPHE SIGRIST / UNIVERSITY OF APPLIED SCIENCES, BFH/AHB					
7A	TESP- Engineering - Bridges / Beams	Timber Engineering & Structural Performance - Engineering Focus	VIBRATION SERVICEABILITY OF A TIMBER ARCH PEDESTRIAN BRIDGE CONSIDERING DETERIORATION OVER TIME	The vibration serviceability of pedestrian bridges is an important indicator to ensure that pedestrians feel safe and comfortable by crossing the bridge. However, much less studies have been done on the influence of localized decay of timber materials by aging on vibration serviceability. In this study, a numerical analysis model was proposed considering the Young's modulus and degradation state of the bridge members that had been in service for about 30 years. The vibration serviceability before and after degradation was investigated through time history response analysis. As a result, the RMS (Root Mean Square) values of response velocity were significantly higher during 2.2Hz and 2.3Hz (crowd walking), indicating an influence on vibration serviceability.	Daisuke	OIKAWA	Akita University
7A	TESP- Engineering - Bridges / Beams	Timber Engineering & Structural Performance - Engineering Focus	OPTIMIZATION OF THE STRUCTURAL INSPECTION OF TIMBER BRIDGES USING DIGITAL MODELS	The introduction of the new version IFC4.3 that defines the IfcBridge class supports for the first time supports the use of the BIM method in infrastructure construction. However, wooden bridges have not yet been considered in the IfcBridge class and the focus is currently still on the planning and construction phases. The subsequent digital generation of as-maintained models is necessary so that BIM can also be used in the maintenance of infrastructure constructions. On the one hand, efficient methods are necessary for generating these digital building models with a required level of detail. On the other hand, options for modeling damage characteristics are missing in the existing IFC standard. This article presents pilot applications for the manual and parametric generation of digital as-maintained models of timber bridges and shows possibilities for the implementation of results from structural inspections of timber bridges in particular. It focuses on the modeling of wood-specific damage and measurement data from non-destructive testing. Two different methods were adapted for the implementation of damage and measurement data in digital building models, which enable fast and error-free localization and thus a complete logging of damage over the life cycle of a structure. An increase in efficiency can be expected for structural inspection of timber bridges when consequently using digital models. By using BIM, the quality, schedule and costs of a construction can be optimized as part of life cycle-oriented construction management in bridge construction.	Antje	Simon	University Of Applied Sciences Erfurt
7A	TESP- Engineering - Bridges / Beams	Timber Engineering & Structural Performance - Engineering Focus	Monitoring of a Toll Bridge made from Timber – Changes in Moisture Content, Timber Strains and Connection Forces after approximately 1.5 Years of Service	Timber is a key factor in the ongoing decarbonization of the building sector. Consequently, the use of timber is continuously expanded to applications with more demanding environmental conditions. One example for such an exposed structure are so-called gantries, which – used as toll bridges or to mount traffic signs – are an integral part of today's infrastructure worldwide. These gantries are exposed to harsh environmental conditions - in particular to significant changes in temperature and relative humidity, different forms of precipitation, chemical stresses in the form of mist containing de-icing salt as well as dynamic loads induced by wind and traffic. In order to gain knowledge about the behavior of timber constructions with such an exposedness, a test station in the form of a wooden gantry with in total 43 sensors has been erected within the research project "GREEN_GANTRY". The paper at hand will present the development of the moisture content, strains in the timber and changes in connection forces due to the environmental conditions of the past 1.5 years of operation. Results show that, so far, the protective layer in the form of wooden sheathing made of larch performs well as the glulam beam within the protective layer experienced a slight drying with a moisture content of currently ~ 11 %. Regarding the resulting forces in the connections it can be seen that the trend roughly follows the development of the moisture content.	David	Glaser	University Of Technology Graz
7A	TESP- Engineering - Bridges / Beams	Timber Engineering & Structural Performance - Engineering Focus	An Experimental Investigation on the Long-term Behavior of Prestressed Glulam Beams	The flexural behavior of glulam beams could be efficiently enhanced by the prestressing technology. However, there is still limited research on the long-term flexural behavior of prestressed glulam beams. To address this challenge, this study presents an experimental investigation on the long-term flexural behavior of internal prestressed glulam beams. Two groups of prestressed glulam beams, unloaded or loaded by four-point bending, were continuously measured for over 300 days in an uncontrolled in-door environment. The influences of environmental factors (relative humidity and temperature) and loading patterns on prestressing force and deflection were examined. Test results showed that prestressing force exhibits a similar variation trend to relative humidity. The inelastic variation of prestressing force were 0%- 8.93% and -4.93% - 1.72% for loaded and unloaded beams, respectively. The prestressing force of loaded beams showed a higher positive variation ratio up to 8.93% compared with unloaded ones. As for deflection, the loading pattern had significant influence on the entire trend. There were creep deflection up to -1.19 mm and 1.41 mm, respectively, for loaded and unloaded beams. The presented results aim to provide technical basis for the design and application of prestressed glulam beams.	Minjuan	He	Tongji university
7A	TESP- Engineering - Bridges / Beams	Timber Engineering & Structural Performance - Engineering Focus	BENDING PERFORMANCE OF I-JOISTS COMPOSED BY DIFFERENT ENGINEERED WOOD PRODUCTS	This study is part of the "Agenda Transform" project, which focuses on enhancing sustainable construction techniques through the evaluation of I-joist beams made with a combination of different web and flange materials. The I-joists analyzed in this research were constructed using OSB (Oriented Strand Board), Particle Board, and High Densified Board for the webs, paired with flanges made from Pinus pinaster, LVL (Laminated Veneer Lumber), and LSL (Laminated Strand Lumber) [1]. Bending tests were conducted according to EN 408:2012 standards to assess the structural integrity, load distribution, and failure mechanisms of these I-joist configurations. The results showed significant variability in performance based on the material combinations, with certain configurations demonstrating superior structural efficiency and load-bearing capacity. These findings support the project's goal of promoting innovative material use in sustainable construction practices within the Portuguese industry [2].	Jorge	Branco	University of Minho, Department of Civil Engineering
7A	TESP- Engineering - Bridges / Beams	Timber Engineering & Structural Performance - Engineering Focus	NUMERICAL INVESTIGATION OF CLT COMPOSITE DOUBLE T-BEAM	A Cross Laminated Timber (CLT) composite double T-beam is a composite section that is comprised of two CLT composite T-beams that are tied to each other side by side by using a single solid CLT flange. An adequate number of screws are used to build an exceptional connection which performs as structural shear keys in CLT composite section. This combination makes it a cost-efficient structural system for roof or floor applications that is capable of carrying high loads in relatively long spans. The CLT and LVL are two well-known high-performance massive engineered wood products that consist of layered lumber boards stacked and glued into place crosswise at 90-degree angles and parallel respectively. An experimentally verified numerical model of the CLT composite T-beam has been used to study the behavior of CLT composite double T-beams. The detailed parametric study of CLT composite double T-beams showed that the effective flange width would increase with any changes that increase the ratio of the transverse layer depth to the longitudinal layer depth of the CLT flange. Additionally, using a CLT flange with a higher modulus of elasticity slightly improves the effective flange width. The benefit of the wider effective flange width in the optimized CLT composite T-beam allows the designers to increase the span along the beam and spacing between the webs of the CLT composite double T-beam for a more cost-efficient design. The comprehensive numerical parametric study shows that the CLT composite double T-beam has the potential to be used widely for long-span roof or floor applications in mass timber constructions for residences and commercial projects.	Reza	Masoudnia	Red Stag Timber Lab

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

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7C	TESP - Engineering - Performance of Hybrid Connections	Timber Engineering & Structural Performance - Engineering Focus	ROOM-SCALE TESTS WITH EXPOSED TIMBER	The influence on fire growth from varying the amount of exposed timber at both the wall and ceiling has been studied through completion of room-scale fire tests, utilizing test standard NFPA 286 (Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth). Three tests were completed that were compliant with the 2021 International Building Code. To understand the impacts on early fire growth conditions, four additional tests with exposed timber on the ceiling consisting of 40%, 60%, 80% and 100% of the floor area were conducted. Instrumentation included thermocouples, a heat flux transducer, a heat release rate exhaust hood and for each test the propane burner profile was identical. Based on the time to flashover criteria in the standard, flashover was not observed in any of the tests where exposed timber met with the IBC limits. By increasing the area of exposed to timber at the ceiling to 40% and 60% of the floor area, flashover was also not observed. Where the exposed timber was 80% and 100% of the floor area, flashover was reached.	David	Barber	Arup
7C	TESP - Engineering - Performance of Hybrid Connections	Timber Engineering & Structural Performance - Engineering Focus	EVALUATIONS FROM MULTIPLE PERSPECTIVES ON TIMBER-CONCRETE COMPOSITE SLABS FOCUSING ON ADHESION WATERPROOF COATINGS	This study provides a comprehensive examination of Timber-Concrete Composite (TCC) floors, which are a combination of wooden materials used for formwork and concrete slabs. TCC floors have been gaining popularity due to their structural advantage of enabling thinner slab thickness and the recent trend towards the use of wood in buildings. In practical construction scenarios, wooden formwork laid on beams is temporarily left outdoors, making it desirable to apply waterproof paint on the upper surface of the wooden formwork (the boundary between the wooden formwork and the concrete slab). The waterproof coating also serves to prevent the moisture in the concrete from penetrating the wooden formwork. Through the course of the research, it was found that waterproof coatings based on vinyl ester contribute to the integration of the wooden formwork and the concrete slab. Floors in buildings are required to have not only structural performance but also fire resistance, living performance, and sound insulation performance. Therefore, a multifaceted evaluation of TCC floors, considering the adhesion of the waterproof coating, was attempted. Specifically, element tests and four-point bending tests were conducted with the parameters of wooden members, concrete slab thickness, and joint conditions. In addition, long-term creep tests for half a year, living performance tests by heel impact and walking vibration measurement, and tests for heavy and lightweight floor impact sound insulation performance were carried out.	Yukiko	Nakatsu	NIKKEN SEKKEI Ltd.
7C	TESP - Engineering - Performance of Hybrid Connections	Timber Engineering & Structural Performance - Engineering Focus	Form-Fitting Mass Timber Connections: Woodworking For the New Age	Current mass-timber projects rely on proprietary and carbon-intensive connectors (e.g., self-tapping screws, concealed hangers, column-to-column pillars) to resolve structural loads. Tall-wood structures in Europe and Asia built with heavy-sawn timber and form-fitting connections have demonstrated the ability to withstand numerous earthquakes and the effects of time. Despite this and recent research revealing the potential of form-fitting connections to meet structural demands and fire performance, the mass timber industry has not adopted these connections due to the lack of knowledge and perceived additional manufacturing costs, resulting in punitive strength reductions and limited design guidelines. Furthermore, the industry is increasingly interested in employing novel form-fitting connections to resolve structural forces, with recent projects showcasing unique form-fitting timber geometries. The research into joinery cultures alongside small-scale rapid prototyping prior to larger specimen testing of semi-rigid form-fitting mass timber connections shows the potential for large-scale implementation as a substitute for proprietary connectors.	Maxime	Daviau	University of Waterloo
7C	TESP - Engineering - Performance of Hybrid Connections	Timber Engineering & Structural Performance - Engineering Focus	IN-PLANE SHEAR PROPERTIES OF DISINTEGRATED HYBRID CROSS-LAMINATED TIMBER	Disintegrated hybrid cross-laminated timber is a material-saving alternative to conventional cross-laminated timber (CLT). In the present investigations, the disintegrated hybrid cross-laminated timber (DH CLT) consists of spruce wood, beech wood of inferior quality and a layer of modified cottonid, which acts as a fire protection layer. As the beech wood shows good mechanical properties despite its inferior quality, the lamellas can be arranged inside the components at a distance from each other. This is called disintegration. In addition to the reference test series featuring conventional CLT, three test series with different structure were tested. The tests were carried out in a newly developed picture frame test construction. It was shown that the test setup is well suited for testing DH CLT. The stiffness and strength of the hybrid specimens are little below the reference of conventional CLT. Torsional failure of the intersections was the governing failure mechanism.	SCHUMACHER	NILS	TECHNICAL UNIVERSITY OF MUNICH
7C	TESP - Engineering - Performance of Hybrid Connections	Material Performance & Durability - Engineering Focus Timber Engineering & Structural Performance - Engineering Focus	FEASIBILITY OF CROSS LAMINATING HIGH DENSITY EUCALYPTUS	This study explored the viability of making cross laminated timber (CLT) using Eucalyptus bosistoana, a naturally durable and high-stiffness species. As an initial step towards introducing a stiff CLT, the bonding performance of E.bosistoana CLT is examined. Following the conventional CLT manufacturing procedure, three-layered CLT panels were fabricated using E. bosistoana with a mean density of 1095 kg/m3 and one-component polyurethane adhesive. To further investigate its application in CLT, it was also consolidated with radiata pine, which has a lower density. The results of delamination and block shear tests revealed that the high-density property of E. bosistoana limited glue penetration so that the delamination rate and wood failure percentage (WFP) stood at 100% and 1%, respectively. In comparison with the eucalyptus CLT, the mixed-species configurations with pine demonstrated increased WFP from 1% to just above 20% and improved block shear strength from 3 MPa to 4.6 MPa, while their delamination rates were 82% and 74% for pine-core and surface configurations, respectively.	Milad	Lezgi	University of Canterbury
7D	MPD - Engineering - Monitoring timber decay	Session Chair: PROFESSOR EMERITUS JEFF MORRELL / OREGON STATE UNIVERSITY					
7D	MPD - Engineering - Monitoring timber decay	Material Performance & Durability - Engineering Focus	TIMBER BALCONY MONITORING PLAN: REVIEW AND STEP-BY-STEP PROCEDURE	This paper presents a detailed step-by-step procedure to create a monitoring plan for timber balconies focusing on controlling fungal decay over time to prevent serious damage. Applicable to all types of timber balconies, the procedure includes four main steps: preliminary study, inspection, calculation to forecast degradation using an optimized decay prediction model and definition of the monitoring plan. Standardization of the entire process through a procedural flowchart includes coding rule development, revision and correction of the time interval formula, new forms for each stage and inspection methods tailored to the specific type of balcony under consideration. This approach is useful to improve the longevity and safety of timber balconies. The paper also includes the application of the methodology to a real-world case study demonstrating the practical effectiveness of the proposed monitoring plan.	Daniele	Salzani	University of Trento

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7D	MPD - Engineering - Monitoring timber decay	Material Performance & Durability - Engineering Focus	QUANTITATIVE EVALUATION OF DETERIORATION OF TRADITIONAL TIMBER BUILDING MEMBERS BY NON-DESTRUCTIVE EVALUATION	Wooden buildings designated as cultural properties in Korea are often hundreds of years old. Maintenance and repair of wooden cultural properties is based on the principle of reusing original members. For the reuse of original members, it is important to detect performance degradation due to decay or weathering of major members as early as possible. This is because early detection of decay or deterioration can be decision criteria for determining the repair, reinforcement, or replacement of major structural members. In other words, if minor deterioration that does not affect structural performance can be repaired, and if the structural performance is reduced but the structural performance can be maintained then the original member can be reinforced for reuse. However, if the performance degradation is remarkable and the structural performance cannot be maintained by reinforcement treatment, it must be replaced by a new structural timber member. The performance evaluation of the above members can be performed in a non-destructive way. This study was conducted to quantitatively evaluate the performance degradation of wood members by applying ultrasonic waves and stress waves.	Kugbo	Shim	Chungbuk National University
7D	MPD - Engineering - Monitoring timber decay	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	HUMIDITY IMPACT ON TIMBER CONNECTION STRENGTH	The effects of climate change in several regions of the world include increased rainfall, which can lead to moisture ingress into buildings. This issue is particularly problematic for timber structures due to potential defects in waterproofing that can lead to direct contact with water, which can cause timber decay and a decrease in strength, as moisture becomes trapped between permeable and impermeable surfaces (e.g. within a timber frame wall panel). While the effect of moisture on timber strength properties is well known, its impact on timber connections is less studied. Timber connections usually involve dowel-type fasteners, creating a tight-fit joint where any expansion of wood due to increased moisture content is hindered by the fastener holding the members together. This study will examine the effect of moisture on the strength of timber connections, particularly focusing on the additional stresses in the connection, caused by hindered expansion of wood in two scenarios: 1) timber with high moisture content and 2) timber subjected to cyclic changes in moisture content. The experimental testing that will be conducted, will focus on the withdrawal properties under the two humidity scenarios. The tests are expected to demonstrate that the restriction of expansion in such connections leads to additional strength loss, beyond that caused by high humidity and cyclic changes alone	Dominika	Malkowska	University of Bristol
7D	MPD - Engineering - Monitoring timber decay	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	REVIEWING AND ENHANCING FLOOD DAMAGE ASSESSMENT METHODOLOGIES IN NEW ZEALAND	This study investigates how flood damage is assessed in New Zealand, comparing current practices with those in the United States and the United Kingdom. It identifies significant gaps in assessing flood-damaged timber structures that are frequently used in New Zealand residential buildings. The study, therefore, emphasizes the need to update assessment guidelines as there is an increase in the frequency of floods caused by climate change, such as the North Island flood of 2023. Existing guidelines in New Zealand, including the Rapid Building Assessment Field Guide and BRANZ Bulletin 666, need more detailed information on timber structures. The research supports more data-driven approaches are required to improve precision and efficiency in flood damage assessment to expedite recovery efforts. Therefore, this research aims to suggest modifications to current methodologies that will help improve the assessment process for effective reconstruction planning and resource allocation.	Parisa	Sedighzadeh	University of Canterbury
7D	MPD - Engineering - Monitoring timber decay	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Analysis and prediction of sapwood and heartwood proportions in wooden foundation piles in relation to bacterial decay	In the historic city centre of Amsterdam (NL), the most widespread foundation system consists of wooden piles. Since these foundations are fully below the water table, they are mostly subjected to bacterial decay. This biodegradation phenomenon proceeds slowly over time, and usually involves the less durable sapwood, with heartwood remaining sound. Hence, obtaining an estimate of sapwood and heartwood proportions in wooden piles can provide information on how deep in the cross section bacterial decay is expected to proceed. This is relevant, for instance, when developing service life models, since the remaining sound cross section of a pile can be estimated. Thus, the present work involves a comprehensive investigation on sapwood and heartwood proportions in spruce, pine and fir wooden foundation piles from different construction periods. The amount of sapwood and heartwood was determined with computed tomography (CT) scans on 49 wet discs retrieved from the piles. Such measured sapwood width was then compared with that predicted with an empirical model from literature, based on the number of annual rings and growth rate, obtaining a successful validation. Finally, micro-drilling measurements were conducted on the discs to identify decayed portions, which appeared to always affect (part of) the sapwood only.	Michele	Mirra	Delft University of Technology
7D	MPD - Engineering - Monitoring timber decay	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	Effect of fungal decay on withdrawal capacity of nail connections in radiata pine	This study investigated the effects of early fungal decay and corrosion on the performance of timber connections. Radiata pine sapwood blocks, fastened with either stainless steel or galvanised nails were subjected to decay induced by two types of fungi, a brown-rot (<i>Fomitopsis ostreiformis</i>) and a white-rot (<i>Pycnoporus coccineus</i>). Decay stages used for testing corresponded to mass losses of 2.5%, 5%, and 10%. To evaluate connection performance, withdrawal tests were performed. Additionally, nail corrosion was assessed both visually and quantitatively. The data for wood mass loss, maximum withdrawal capacity, and corrosion levels were subjected to an Analysis of Variance. This research will enhance our understanding of how early stages of decay and corrosion impact timber connection performance. Ultimately, the findings are intended to inform the development of strategies to mitigate these detrimental effects.	Camilo	Montoya	The University of Queensland
7E	TABD - Architectural	Session Chair: PENELOPE MITCHELL / USC					
7E	TABD - Architectural	Timber Architecture & Biophilic Design - Architectural Focus	Prototyping a Small Mass Timber House	In the United States (U.S.) state of Oregon, a lack of affordable housing led to new legislation encouraging increased housing density by allowing for accessory dwelling units (ADUs) and "cottage clusters" (small stand-alone houses assembled around a courtyard) on sites formerly zoned for single-family houses on urban sites. This legislation coincided with the state's interest in reviving its timber economy and in mitigating increasing wildfires exacerbated by climate change through the production and application of mass timber, which can utilize fiber from small diameter trees from forest restoration projects, thereby contributing to reduction of wildfire risk. These two state challenges converged leading to significant interest in the development of a prefabricated mass timber small house prototype. In the U.S., however, it has not been demonstrated that mass timber construction can compete on cost in the low-rise housing market with the typical construction system, light-wood-frame, particularly in single-house projects. This project investigated the potential for mass timber at small scale to achieve affordability through pre-fabrication, while also creating higher quality, more thermally and natural hazard (wind, seismic, fire) resilient housing to better respond to increasing threats from climate change.	Judith	Sheine	University of Oregon

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7E	TABD - Architectural	Timber Architecture & Biophilic Design - Architectural Focus	LOW-COST BIOMASS CONSTRUCTION TECHNOLOGY SYSTEMS WITH SMALL-DIAMETER ROUND TIMBER AS MAIN MATERIAL AND ITS CARBON REDUCTION EFFICIENCY	Modern wood architecture conforms to the theme of ecological sustainable development, but the shortage of forest resources restricts the development process of modern wood architecture. Hence, low-cost and biomass construction systems are critically needed to broaden the range of structural timber and improve material efficiency. Cheap and easily available small-diameter round timber shows broad application prospects, which main sources are wood products from plantation, fast-growing forest, the forest harvesting residues, sub-small fuel wood and logs that do not reach the structural standard. The purpose of this paper is to provide a technical system of small-diameter round timber as main material, which aims at saving materials and reducing cost in small to medium scale buildings, and further improves the carbon reduction efficiency of wood structure buildings. Through the research path of architectural typology, that is, Construct technology system -- Technical performance verification and Carbon reduction efficiency analysis -- Translation and extension, both model analysis and data calculation for the single-rod lattice system were performed. The main contents are as follows: Firstly, a construct technology system based on small-diameter round timber is proposed, and its material methods, joint nodes and construction methods are described. Secondly, using SAP2000 and Design Builder modeling analysis, the threshold of suitability space construction of the system was defined. The efficiency of building materials and economizing analysis were used to compare their comprehensive suitability. Finally, the architectural form of the construction system was expanded. And practical design methods and construction strategies were proposed for further optimization and application.	Ying	wu	School of Architecture and Design, Harbin Institute of Technology; Key Laboratory of Cold Region Urb
7E	TABD - Architectural	Timber Architecture & Biophilic Design - Architectural Focus	BIMwood - timber construction planning processes	One of the challenges facing the construction industry is the digital transformation of planning and construction processes. Building Information Modeling (BIM) is becoming a key driver of progress. BIMwood focuses on BIM-supported planning solutions of prefabricated timber constructions. However, planning methods remain a bottleneck due to the non-standardized data exchange between planners and timber manufacturers. BIMwood identifies specific requirements for prefabricated timber structures and develops solutions for a range of aspects in a timber construction-specific BIM process. The BIMwood reference process is developed analogously to established planning phases on the basis of a simulative methodological approach, which includes two levels of observation: the descriptive level describes the structured multidisciplinary data, the procedural level describes the exchange processes in the context of assigned roles and responsibilities. Furthermore, the basics for the creation of 3D models are devised with regard to geometric specifications. The demands on the models are clarified concerning the necessary component data. The proposed solutions provides the basis for developing an implementation strategy to improve data exchange between planners and contractors to complete the process chain from planning to production. BIMwood has developed an implementation strategy for BIM-based planning and data management processes for prefabricated timber construction. The reference process defines relevant multidisciplinary data sets and regulates data exchange, taking into account role concepts and responsibilities. The necessary information requirements for geometric characteristics and relevant data along the planning phases were defined for the individual specialist models. Based on BIM as a key technology in Architecture, Engineering and Construction, BIMwood solutions and recommendation for action can now be integrated into planning practice.	Frank	Lattke	Nuremberg Institute of Technology Georg Simon Ohm
7E	TABD - Architectural	Sustainability and Timber in a Circular Economy - Architectural Focus, Timber Architecture & Biophilic Design - Architectural Focus	ARE WOOD BUILDINGS MORE CIRCULAR? A COMPARATIVE STUDY ON BUILDING CIRCULARITY BETWEEN TIMBER AND REINFORCED CONCRETE STRUCTURES	Given the global emphasis on sustainable development, the construction industry is increasingly prioritising advancements in building circularity (BC). This study conducted a comparative analysis on BC of multi-storey reinforced concrete (RC) and timber frame structural systems: developing two digital models, a RC structure utilising conventional materials and a timber structure employing wood-based materials; performing structural analysis to establish comparable foundations; and quantitatively assessing the circularity performances of the two structure types across four levels: materials, elements, systems and the building as a whole. The results highlighted the significant advantages of wood-based materials in enhancing BC at specific levels. This study offers architects and practitioners new perspectives and theoretical foundations for design decisions and material selection.	Harrison	Huang	Zhejiang University
7E	TABD - Architectural	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Architectural Focus, Timber Architecture & Biophilic Design - Architectural Focus	RESEARCH ON CONVERTING SfM 3D POINT CLOUD TO 3D COORDINATE SYSTEM USING STLP POINT CLOUD CONNECTION DEVICE IN THE "JODO-SHU SAINEN JI HONDOU"	Automated driving technology uses SfM (Structure from Motion) technology to generate a 3D point cloud of the surrounding environment using images and then determines the distance of surrounding objects from the point cloud while evaluating whether the object is a person or not. By replacing traditional on-site surveys with 3D point clouds generated using SfM from photographs, this research seeks to clarify the impact of the STLP (Stereo Tags-Platform Leveling) point cloud connection device on the generated 3D point clouds. Additionally, it aims to verify the method of creating architectural drawings from the generated 3D point clouds and to assess the accuracy of these drawings. In this study, the STLP point cloud connection device was installed in the main hall of temple which is captured from both inside and outside, with the device's top surface set to level. The STLP point cloud connection device consists of a tripod, leveling device, clamp, stereo tags, and level, and the height of device, the dimensions, material, design of the stereo marker are adjustable. After photographing the interior, exterior, and roof, the STLP device automatically linked the three sets of 3D point clouds to generate a 3D model of the main hall. With the program recognized the markers in the point clouds, we can adjust the scale and leveling of the 3D point cloud, and generated a 3D model. Coordinates of pillars and earthen walls in the main hall were extracted from the 3D model, then we determined the dimensions and positions, use the program displayed structural elements, dimensions, and reference lines in the 3D coordinate system. This experiment demonstrated the utility of the 3D point clouds generated from photographs using the STLP point cloud connection device. Furthermore, the research clarified the method of converting the 3D model into CAD drawings and verified their accuracy.	zhixing	wang	Meiji University
7F	TESP - Engineering - Robustness	Session Chair: A/PROF BENOIT GILBERT					
7F	TESP - Engineering - Robustness	Timber Engineering & Structural Performance - Engineering Focus	DEVELOPMENT AND SEISMIC DESIGN OF NOVEL HYBRID TIMBER-STEEL ECCENTRICALLY BRACED FRAMES	Described in this paper is the development of a novel hybrid timber-steel eccentrically braced frame (TS-EBF), that has significant benefits in terms of seismic performance and sustainability. This new seismic-force-resisting system (SFRS) aims to combine the sustainability and lateral stiffness of timber-braced frames with the excellent energy dissipation capacity of steel links for enhanced seismic performance. The system uses structural steel for deformation-controlled elements (ductile shear links) and engineered wood products for force-controlled elements (beams, columns, and diagonal braces). A six-storey archetype building that uses this novel SFRS was designed using both force- and displacement-based seismic design approaches for the seismicity of Victoria, British Columbia, Canada. Numerical models were developed for ductile shear links in ABAQUS finite element software and validated with full-scale quasi-static cyclic tests. In addition, a two-dimensional fiber-based numerical model of the prototype six-storey building was developed in OpenSeesPy. Performance assessment was carried out using static pushover and nonlinear response history analyses using thirty-three hazard-consistent ground motion records. Overall, this study demonstrated the effectiveness of this new lateral system, indicating its potential as an alternative SFRS in Canada's high-seismic risk regions.	Matiyas	Bezabeh	McGill University

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7F	TESP - Engineering - Robustness	Material Performance & Durability - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	EVALUATION OF MATERIAL PROPERTIES OF CHAMAECYPARIS OBUTUSA VAR(TAIWAN HINOKI) USED IN TRADITIONAL ARCHITECTURE TAISHO-PERIODO	This research focused on Chamaecyparis obutusa var. formosana(Taiwan hinoki) using traditional wooden architecture columns, we conducted bending tests using full-sized timber, bending tests using small clear specimens, compression parallel grain tests, compression perpendicular to the grain tests, and partial compression perpendicular to the grain tests to understand the material properties. The bending Young's modulus of the full-sized material was 9.48GPa, and the bending strength was 43.01MPa. When compared to wood used in domestic cultural property buildings, its bending strength was equivalent to that of the Cryptomeria japonica of tower gate of Aso Shrine. When compared with other tree species in the world, the bending strength was equivalent to that of Atlantic white cedar.	Rina	Kurahashi	Toyo University
7F	TESP - Engineering - Robustness	Timber Engineering & Structural Performance - Engineering Focus	Experimental determination of the combined loading behaviour of scaled timber frame walls subjected to bending and shear	The shift towards using more and higher timber structures comes with more questions regarding their structural behaviour. For instance, structural robustness and racking resistance are two important themes currently being researched more thoroughly. Within the context of structural robustness, timber walls could become self-supporting due to damage occurring to the underlying supporting elements. In such a scenario, timber walls are subjected to bending and possibly horizontal (shear) loads, a combination of load cases for which little knowledge has been developed in the context of timber frame construction. Therefore, in this contribution, an experimental and numerical campaign is presented in which six timber frame walls were tested. Two walls were loaded solely under in-plane horizontal loads until failure, and four walls were subjected to a combination of in-plane vertical (bending) and horizontal loads. Results showed that increasing the vertical loading lowered the horizontal load (or racking) resistance of the timber frame wall. The interaction behaviour was also visible in the load-displacement diagram, which depicted a faster decrease in stiffness in the elastoplastic and plastic area of the wall and decreased ductility whenever more vertical loading was applied. This interaction behaviour was similar to the predictions according to mesoscale finite element models.	Dries	Byloos	Hasselt University
7F	TESP - Engineering - Robustness	Timber Engineering & Structural Performance - Engineering Focus	MACQUARIE UNIVERSITY AINSWORTH BUILDING (SYDNEY)	The Ainsworth Building at Macquarie University, a flagship for the Medicine and Health Sciences Faculty, exemplifies advanced mass-timber construction, blending education, research, and medical practice. This four-storey building, completed in July 2020, provides dynamic, flexible spaces and state-of-the-art learning environments. Constructed on a constrained site in Sydney, the building's erection took just over a year, with three months dedicated to installing the timber elements. The structure integrates glulam European spruce for internal columns and beams, CLT European spruce for floors and shear walls, and glulam Victorian ash hardwood for external columns. Lateral stability is ensured by CLT floors and walls, supplemented by Victorian ash W columns. A robust structural strategy was developed by assessing element removal and substantiating alternate load paths. Precise BIM coordination facilitated pre-cut timber fabrication, minimizing campus impact. The design reduces embodied carbon and promotes efficient, quieter construction methods.	Kengo	Takamatsu	Arup
7F	TESP - Engineering - Robustness	Timber Engineering & Structural Performance - Engineering Focus	COLUMN LOSS ANALYSES FOR POST-AND-BEAM SUBASSEMBLIES	As the size and complexity of timber buildings grow, so do the consequences of a collapse, making robustness a key requirement in the structural design. However, the response of timber buildings to initial local damage, i.e., their robustness, is not yet well understood. To investigate the ability of timber beam-column frames to develop alternative load paths in a column removal scenario, a numerical model was developed and verified against large-scale quasi-static column removal experiments. The nonlinear numerical model was used to examine the quasi-static pushdown as well as the dynamic behavior of timber frame subassemblies. The investigation focused on laterally loaded dowel-type beam-to-column connections with continuous slotted-in steel plates. The main influencing parameters were the stiffness of the horizontal restraint, the rotational stiffness of the beam-to-column connection, and the speed of the member removal in the dynamic case. The results show that dowel-type beam-to-column connections with continuous steel plates through the column may enable some load redistribution through catenary action.	Katharina	Sroka	Empa
7F	TESP - Engineering - Robustness	Timber Engineering & Structural Performance - Engineering Focus	Development of GIR System with High Toughness Coupler	In this study, the Glued-in-Rod (GIR) System with High Toughness Coupler was developed for constructing mid-rise wooden buildings. The toughness connector previously developed in our laboratory needs to be manufactured in different lengths depending on the cross-section of laminated timber used, which is very costly and time-consuming. To solve these problems, the GIR joint system was developed, which consists of two commercially available full-threaded bolts and a coupler with toughness performance. The tensile yield strength of this coupler was 75kN and the deformation capacity was more than 20mm. It was also confirmed that the compressive yield strength was about the same. These test results confirmed that this coupler not only had the desired stiffness but also had the ability to deform. Therefore, moment resistance tests on beam-column joints for mid-rise wooden buildings using this GIR system will be carried out.	Kota	Nagai	Oita Univ.
7G	ECCS - Australian Hybrid-Timber Exemplars (Atlassian & T3 Collingwood)	Session Chair: PROFESSOR KEITH CREWS / THE UNIVERSITY OF QUEENSLAND					
7G	ECCS - Australian Hybrid-Timber Exemplars (Atlassian & T3 Collingwood)	Sustainability and Timber in a Circular Economy - Architectural Focus, Education, Innovation & Challengers - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	Structural Innovations in Atlassian Central: Pioneering Hybrid Timber High-Rise Construction in Commercial Developments	Hybrid timber and concrete structures are known for their structural, environmental, and prefabrication advantages but are underutilized in premium commercial high-rise developments in Australia. The Atlassian Central project in Sydney, designed by BVN and SHoP architects, represents a significant and world-leading advancement in this field. Co-owned by Atlassian and Dexus, Atlassian Central is a 42-level, 59100 sqm commercial tower aiming to reduce upfront embodied carbon by 50% during construction, operate on 100% renewable energy, and achieve substantial operational energy savings through considered climatic engineering solutions and significant 'park' zones of naturally ventilated floorspace. The general tower structure is a hybrid timber structure developed in partnership with project engineers Eckersley O'Callaghan and TTW. It is comprised of seven 'habitats', each four stories high and contained within a structure of steel framed 'mega-floors' and load-bearing perimeter diagonal frame 'Exoskeleton'. The intermediate floors of each 'habitat' are constructed from mass timber and are supported at each Megafloor. The lower seven floors of the tower use a different structural strategy designed to transfer the loads of the Exoskeleton structure and façade back to the concrete core and two primary columns. This approach minimises the footprint of the building and retains the legibility of an existing heritage building on the site. This paper will explore in detail the key design features of the Atlassian Central hybrid timber strategy, identifying opportunities and advantages and addressing design and construction challenges. The findings illustrate the feasibility and benefits of hybrid timber structures in commercial high-rises, highlighting timber's potential in facilitating sustainable commercial development in dense urban environments.	Tim Peter	Crawshaw Titmuss	BVN BVN

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

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7H	TESP - Practitioner	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus	The Challenges of Designing a High-Capacity Ductile CLT Shear Wall System for a 6-Storey CLT Building	To design mass timber buildings to moderate or high seismic demands, strong, stiff, and ductile lateral load-resisting systems are required. One such system recently developed and tested at the University of Canterbury is the mixed-angle screw hold-down connection for Cross Laminated Timber (CLT) shear walls. Through the use of large European self-tapping screws installed at mixed angles with respect to the grain, the strong and stiff performance of screws installed at 45° can be combined with the ductility and displacement capacity of screws installed at 90° to the grain, providing an overall strong, stiff, and ductile connection. This paper explores the design of mixed-angle screw hold-down connections for CLT shear walls in a 6-storey (Concrete podium, 5-storey CLT wall) structure designed for a high seismic hazard. Key challenges from the design of this building and their associated learnings are presented. Challenges that had to be overcome included design strength prediction, overstrength prediction, stiffness prediction, and possible requirements for displacement amplification due to pinched hysteretic behaviour. These challenges are discussed in detail with reference to research findings, and some future outlooks for design are given.	Thomas	Wright	ENGCO
7H	TESP - Practitioner	Timber Engineering & Structural Performance - Engineering Focus, Timber Engineering & Structural Performance - Practitioner Focus	LIMITATIONS AND ERRORS IN THE TORSION AND SHEAR FIELD TEST SETUP SPECIFIED IN THE EN 408:2010+A1:2012 FOR TIMBER BEAMS	The current torsion and shear field test method specified in BS EN 408:2010+A1:2012 [1] for timber beams has evident limitations and minor errors that may lead to significant inaccuracies when measuring sample rotation. The maximum gauge distance specified in the current test standard is still too close to the clamps at both ends. The end effect significantly impacts the rotation of the cross-section where the gauges are located. This paper first presents a study on the minimum gauge distance required to avoid the end effect. Secondly, it reviews various techniques for measuring sample rotation and proposes two potential new approaches for measuring the rotation of samples. Additionally, the shear field test method contains a critical error that could result in substantial miscalculations of the shear modulus.	Hexin	Zhang	Edinburgh Napier university