

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

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

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2C	TESP / MPD - Engineering - Bamboo	Timber Engineering & Structural Performance - Engineering Focus	ALTERNATIVE STRUCTURAL FIRE MODEL FOR PREDICTING BENDING CAPACITY IN LAMINATED BAMBOO BEAMS AND CROSS-LAMINATED TIMBER (CLT) HARDWOOD PANELS	The use of laminated bamboo as a primary load-bearing material has been limited due to a lack of understanding of its structural performance during a fire. Additionally, in wood products like Cross-Laminated Timber (CLT), the bending capacity is determined by charring rates and the reduced cross-section method. However, these methods don't consider the reduced mechanical properties behind the char layer or the non-elastic behaviour of these materials in bending. To address these limitations, an analytical structural model has been developed to assess the bending capacity of laminated bamboo beams and cross-laminated timber panels during a fire, considering the change in bamboo or timber's mechanical response as described by constitutive stress-strain models at elevated temperatures and the non-elastic behaviour of both materials. Experimental data obtained from fire tests were used to determine the temperature gradients across the cross-section of the bamboo and timber elements. The proposed structural model is based on a discretised fibre section analysis, incorporating stress-strain relationships at elevated temperatures at each time step. Furthermore, the accuracy of the models was verified by comparing the model predictions of stress and strain profiles and the predicted bending capacity with experimental test results from testing laminated bamboo beams exposed to a constant heat flux of 60 kW/m <sup>2</sup> and CLT panels exposed to a standard fire test as per AS 1530.4. This methodology lays the basis for an accurate and more precise alternative method utilising constitutive stress-strain relationships at elevated temperatures and heat transfer models to estimate the thermo-mechanical response of materials such as timber and bamboo under fire conditions.	Cristian	Maluk	DAMA Engineers
2C	TESP / MPD - Engineering - Bamboo	Timber Engineering & Structural Performance - Engineering Focus	Mechanical performance of dowelled steel-to-timber connections reinforced locally with bamboo scrimber	Engineered bamboo, manufactured from the natural eco-material of bamboo, has gained increasing attention due to its favorable mechanical performance, sustainability, and low-carbon properties. This study investigated the feasibility of using bamboo scrimber as a local reinforcement in dowelled steel-to-timber connections. A total of twenty groups of specimens, with various dowel diameter and thickness of bamboo scrimber reinforcement in single dowelled steel-to-timber connection, were designed and tested under static loading. The theoretical models based on the theories of beam on elastic foundation and European Yield Model were developed to calculate the connection stiffness and load-bearing capacity of the connections, respectively. The test results indicated a significant enhancement in the load-bearing capacity, stiffness, and ductility of the connections when applying the bamboo scrimber reinforcement. Moreover, it was found that the reinforcing effects was considerably influenced by the thickness of bamboo scrimber and dowel diameter. The comparisons of the theoretical and experimental results confirmed the satisfactory accuracy of the theoretical models in predicting the mechanical performance of the connections.	Huifeng	Yang	Nanjing Tech University
2C	TESP / MPD - Engineering - Bamboo	Timber Engineering & Structural Performance - Engineering Focus	BAMBOO SCRIMBER DOWEL-TYPE JOINTS FOR ENGINEERED WOOD OR BAMBOO PRODUCT ASSEMBLIES AND TIMBER STRUCTURES	This research delves into dowel-type joints with bamboo scrimber as an innovative alternative to traditional wooden fasteners. The focus is on their application in connecting timber elements of medium density suitable for engineered wood or bamboo product assemblies and timber structures. The test results showed that bamboo scrimber can be ideal for dowel-type joint applications. The mechanical performances of such joints (such as the failure mode, carrying capacity, and slip modulus) are significantly dependent on the ratio of side laminate thickness to dowel diameter and the embedment strength of the laminate. A small ratio of side laminate thickness to dowel diameter is found to result in a ductile failure mode and high capacity, small joint slip.	Jianbin	Yang	Edinburgh Napier University, United Kingdom; Dongguan University of Technology, China
2C	TESP / MPD - Engineering - Bamboo	Timber Engineering & Structural Performance - Engineering Focus	DOWEL TYPE CONNECTIONS IN LAMINATED BAMBOO WITH MULTIPLE SLOTTED-IN STEEL PLATES	Laminated bamboo can be produced in sizes which are similar to glued laminated timber. As a result, large connections with multiple dowels and slotted-in steel plates are similarly possible with bamboo. MOSO bamboo was used, with a density of around 660 kg/m <sup>3</sup> , potentially creating connections having higher load carrying capacity than softwood. In this project, a large experimental campaign was set-up in order to determine the mechanical properties of connections with various ratios of dowel diameter to bamboo thickness and with single and double steel plates. Furthermore, influences of the density of the material, related to the embedding strength for fasteners, as well as the splitting sensitivity are playing crucial roles with respect to the load carrying capacity. Therefore, multiple test series on large bamboo connections have been performed in order to study various possible failure modes, as dependent on embedding strength, steel grade, number of fasteners in a row, and the influence of multiple steel plates. The various failure modes have been analysed analytically with the Johansen equations, similar to the design equations proposed for the upcoming version of Eurocode 5 for multiple steel plate connections, confirming their applicability to bamboo.	Jan-Willem	van de Kuilen	TU Munich / TU Delft
2C	TESP / MPD - Engineering - Bamboo	Material Performance & Durability - Engineering Focus	The Effect of Size and Core Shape on the Physical and Mechanical Properties of Bamboo Sandwich Panel	Light-weight but durable materials are currently preferred for furniture and building products. Composite wood technology is one such example. The goal of developing materials having a sandwich structure is to create materials that are extremely stiff and strong while being lightweight. The purpose of this study is to ascertain the impact of core size and core shape on the mechanical and physical characteristics of sandwich panels composed of thin bamboo strip. Physical properties like density, water content, water absorption capability, and thickness expansion were measured. Using a universal testing machine (UTM), mechanical tests were performed on compressive strength, modulus of rupture and modulus elasticity both on parallel to and perpendicular to the fiber, and internal bond. Three, four, and five centimeters are the differences of dimension core size (small, medium and large sized); hexagon, square, and triangle are the variances in the core shape. The best test samples contain triangular-shaped, medium-sized (4 cm) cores, according to the data collected and analysis performed.	Naresworo	Nugroho	Department of Forest Products, Faculty of Forestry and Environment, IPB University, Indonesia
2C	TESP / MPD - Engineering - Bamboo	Material Performance & Durability - Engineering Focus, Sustainability and Timber in a Circular Economy - Engineering Focus, Timber Engineering & Structural Performance - Engineering Focus	World's First Bamboo-Timber Composite Gridshell: From Design to Full Scale Construction	Actively bent bamboo-timber composite gridshell is an advanced spatial structural concept as it does not require pre-fabricate curved members, light weight, uses sustainable material, and has simple joint design. Despite its potential, this application of this type of structures is limited by the availability of the effective methods of analysis. Although research on elastic gridshells is increasing, there are few effective methods for modelling the non-linear behaviour of such structures and has no capacity of adopting more accurate constitutive models for bamboo and timber materials. This paper presents a novel method for analysing the form-finding process of composite gridshells through active-bending and its proof-of-concept design and construction of World's first bamboo-timber composite gridshell. A numerical model is proposed to simulate joint's complex mechanical behaviours. The comprehensive details of this full size construction are detailed in this paper. A finite element analysis (FEA) package was developed for this type of gridshell structures and its results were validated in ABAQUS.	Yanghao	Pei	Edinburgh Napier University

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

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

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

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

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2H	ECCS - Architectural Case Studies	Timber Architecture & Biophilic Design - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	LAMINATED NODES FOR A ROUND TIMBER STRUCTURE	This research investigates the design and fabrication of a laminated timber node connection in a branched round wood structure. The node was designed using parametric modeling and digital fabrication to resolve complex 3dimensional non-coplanar connections between round timber members in a columnar frame structure, designed and fabricated to be realized in 1:1 exhibition pavilion . Using bespoke laminations of LVL billets arranged in an optimized 3-dimensional layout, the node design investigates novel techniques to maximize the billet overlap for structural integrity while minimizing the amount of timber wastage. A key innovation in the node design was the sophisticated 3-dimensional resolution of the non-coplanar mitering of branch arms, resulting in a semi rigid connection with a high degree of moment resistance, but also an elegant expression of the timber grain in the node, as it maintains tangential direction corresponding to the intersecting round timber member.	Kim	Baber	School of Architecture, University of Queensland
2H	ECCS - Architectural Case Studies	Exemplars & Construction Case Studies - Architectural Focus	Using the DfMA approach in the early integration of actors for the design of an industrialized timber building - case study	Design for Manufacture and Assembly (DfMA) is a methodology that optimizes the design process to facilitate manufacturing and assembly, promoting more efficient and cost-effective construction. This study describes the process of early integration of actors in a case study of an industrialized timber building in Chile, framed in the Housing Emergency Plan. Involving architects, engineers, manufacturers, and builders from the early stages, the DfMA methodology was applied to improve communication and coordination between all actors. Five design stages were identified based on the RIBA guide, and BIM and modeling tools were used to integrate information from all participants. The results indicate that, although design time increases, production is more efficient, with fewer errors and rework, and higher construction quality. This study provides a framework for future projects in the construction industry, highlighting the importance of early integration and use of digital tools. Future work should validate time and cost savings, reduction in waste, improvement in quality and processes in manufacturing and construction phases.	Daniela	Méndez	CENAMAD
2H	ECCS - Architectural Case Studies	Timber Architecture & Biophilic Design - Architectural Focus, Education, Innovation & Challengers - Architectural Focus, Exemplars & Construction Case Studies - Architectural Focus	Retrofitting low-rise building stock through mass timber additions and performance-based fire engineering: The Darlinghurst Workplace	The Darlinghurst Workplace is a unique showcase of advanced performance-based fire engineering design for its size and type of building. It is demonstrative of a retrofit model using mass timber to reduced embodied carbon, construction time and improved safety while meeting project constraints and exceeding aesthetic expectations.  The need for adaptive reuse to increase density is critical for reducing embodied carbon emissions in construction. Though mass timber presents a lower carbon alternative to conventional Australian construction (reinforced concrete), the embodied carbon of existing building fabric is of great value to retain. This paper aims to a case study that demonstrates how mass timber can be used to extend the lifespan of existing structures; Furthermore, how through performance-driven fire engineering the timber could remain exposed to gain both environmental and social benefits. The two case studies are located within Australia and are built upon low-rise commercial buildings. The use of mass timber enables a light-touch addition of structure and additional floors being supported primarily by existing structure. Whereas if conventional construction was employed, significant redesign of the base structure, or complete demolition may be required to meet desired density. Through advanced performance-based fire engineering design, we could achieve an architectural outcome that is typically impossible when following prescriptive fire certification pathways, acting as a benchmark for future projects to deliver flexibility and community conscious outcomes that minimise material use and maximise benefits of exposed timber structure.	Adrian	Taylor	BVN
2H	ECCS - Architectural Case Studies	Exemplars & Construction Case Studies - Engineering Focus, Exemplars & Construction Case Studies - Architectural Focus	Mass Engineered Timber Buildings in Southeast Asia: Overcoming Obstacles and Unlocking Opportunities	The tropical rainforests of Southeast Asia provide a rich natural resource and the region has hundreds of years of experience and expertise in traditional timber construction. Furthermore, states such as Sarawak on the island of Borneo are committed to the development of renewable rapid growth hardwood plantations as a key pillar of their carbon trading strategies, whilst the likes of Singapore are making increasingly challenging demands on developers to deliver more modular low carbon buildings. And yet, the delivery of modern, mass engineered timber (MET) buildings remains rare outside of a handful of exemplar projects supported by research institutions, hampered, in part, by lack of specialist expertise, regulatory inertia and supply chain difficulties. Through a series of case studies, the speakers will explain how they have overcome these challenges to deliver some of Southeast Asia's most notable modern timber buildings, and the efforts they are making to work with governments and industry to help build a modern, economically sustainable, indigenous MET ecosystem for the region.	Andrew Callum	Magub Lillywhite	KIRK Studios Aurecon
2I	STCE - Practitioner	Session Chair: PENELOPE MITCHELL / USC					
2I	STCE - Practitioner	Sustainability and Timber in a Circular Economy - Engineering Focus, Sustainability and Timber in a Circular Economy - Architectural Focus, Sustainability and Timber in a Circular Economy - Practitioner Focus	STUDY ON EMBODIED CARBON FOOTPRINT OF MULTI-UNIT RESIDENTIAL BUILDINGS	Numerous studies highlight the importance of reducing embodied carbon, which includes greenhouse gas (GHG) emissions from the production of building materials, as a critical strategy in fighting climate change. Nonetheless, to evaluate the GHG emissions avoided using low carbon design strategies, such as the integration of a wood structure, a baseline scenario using a conventional structural system must be modelled. To reduce the costs of such evaluations, comparisons could be made using average GHG emission thresholds developed for different building types and structural materials. This study aims at calculating average embodied carbon footprints, expressed in kg CO <sub>2</sub> -eq/m <sup>2</sup> of total floor area, for midrise Multi-Unit Residential Building (MURB), considering four different structural systems: reinforced concrete, light-gauge steel frame, light wood frame, and mass timber. Despite the diverse sizes of the buildings studied, the results indicate that the embodied carbon footprint associated with structural materials is relatively consistent for buildings with the same type of structural system when measured per square meter of total floor area (m <sup>2</sup> ).	Samuel	Cuerrier Audair	Fpinnovations

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