basic knowledge of swelling behaviour of uncompressed and compressed wood was carried out. The next step was to formulate the hypotheses and to find out a suitable experimental set up. Subsequently, this should be used to examine the species of spruce and beech regarding their swelling pressure behaviour. Also data of correlation between wood density (undensified/densified) and the swelling pressure of various research was gathered for further evaluation of the test results. In order to humidify the wood samples simultaneously with the measurement of the swelling pressure, the test was carried out within a climatic chamber. Since there is no standard for the investigation of the swelling pressure of compressed wood, DIN 52 192 and DIN 52 184 for the determination of swelling and shrinkage were used. One of the objectives of this research is to identify the shape memory force and swelling pressure. Therefore, the investigations were performed on two wood species: beech and spruce. For each species uncompressed, middle (beech: 25% and spruce 34%) and high (beech: 45% and spruce: 68%) compression ratio samples were tested. From the literature and the test results, a description of the spring back and swelling pressure behaviour can be derived. About 50 samples were tested. In the first step, the samples were weighed, measured and photographed. If they had visual defects or inhomogeneity, it was documented. After the preparations, the samples were clamped in the devices. The preload was in the range of 0.15 to 0.30 N / mm². It took about 30 minutes for the target air conditioning (T = 20 ° C, RH = 85%) to be achieved. The swelling forces were recorded every minute. Depending on the test series, the experiment was either completed after reaching a constant swelling pressure or continued through a subsequent drying interval (T = 40 ° C., RH = 10%). After the exponential function has been determined as a suitable approach function for the moistening phase, a prognosis for several moistening cycles was made. Since the swelling pressure in the drying phase drops very rapidly, only the moistening cycle was modelled. By comparing the two predictions, it becomes apparent that the tangential and radial beech samples behave very similarly in the predefined alternating climate. Therefore, for both cases, with an increasing number of humidification intervals, the maximum swelling pressure is also reduced. The experiment results showed the swelling pressure increases significantly with the increase of density and therefore compressed woods have higher swelling pressure. If the samples are dried after the humidification period, the swelling stress is rapidly and completely reduced. Furthermore, the influence of the free deformation on the swelling pressure behaviour is worthy of further investigation.

369 | An investigation of the structural behaviour of beam-beam connections systems utilising compressed wood dowels and plates

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Modern construction consumes large quantities of building materials, energy and other resources which impacts negatively on the environment. Current construction trends are focused on tightening environmental regulations to reduce carbon emissions through the use of materials with a reduced embodied energy content. These targets stem from compelling threats of global climate change and require the use of more renewable, environmentally-conscious materials. The use of such materials has increased in the last decade across the world. As one of the most sustainable and renewable building materials, wood is increasingly being utilised in modern construction replacing steel and concrete in some cases. Recent developments in timber engineering have resulted in the development of engineered wood products with improved structural performance, form and reliability allowing them to be utilised in large-scale, mass timber building projects. Enhancement of the properties of wood using modification techniques, such as thermal compression, is an emerging field. Compression of wood results in increased density, decreased porosity and significantly improved material strength, stiffness and dimensional stability. The improvement in the wood material properties suggests that compressed wood fasteners may be a green alternative to the adhesives and metallic fasteners currently used in modern timber construction. The aim of this study is to provide a low embodied energy, adhesive-free and non-metallic timber-timber connection system for mass timber building projects. In this study, two different design configurations for spliced beam-beam moment connection systems were developed and manufactured using compressed wood dowels and slotted-in compressed wood plates. The cross-sectional area of the connected beams was 115 mm x 157.5 mm and the length of each beam was 1575 mm. Vertically orientated grooves were routed at the end of each beam to house the slotted-in compressed wood plates. When spliced together the test span of the beam-beam element was 2835 mm. The first spliced connection configuration comprised two vertically orientated compressed wood plates which extended the entire depth of the beam. The second configuration comprised four smaller slotted-in compressed wood plates, two in the compression zone and two in the tension zone of the beam, which did not extend the entire depth of the beam. Both connection configurations utilised compressed wood dowels of 10 mm

diameter and compressed wood plates of 10 mm thickness. The compressed wood elements were made from softwoods that were compressed in the radial direction with a compression ratio of approximately 68%. Each connection system was examined under four-point bending and the load carrying capacity, typical failure modes, moment resistance and rotational stiffness of both connection systems were compared based on experimental results. The connections with the deeper, full-height plates failed in a brittle fashion whereas the connection with the smaller plate displayed a more ductile response and had a higher load bearing capacity. However, the connection stiffness was higher for the connection with the full-height plate.

ANALYSIS OF COMPOSITE BEAMS, PLATES AND SHELLS

007 | The dynamic response of a nonlinear composite plate with initial geometric imperfection to harmonic excitation

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This paper deals with nonlinear static and dynamic response of geometric imperfect plain-woven ceramic-based composite plates under a combination of thermal and harmonic excitations. The formulations use classical Kirchhoff plate theory taking into account geometrical nonlinearity, initial geometrical imperfection and non-ideal in-plane boundary condition of the simply supported plate. A theoretical model is developed using four spatial modes and stress function. Galerkin's method is employed to derive the nonlinear governing equations of the problem with quadratic and cubic nonlinearities associated with geometrical imperfection and mid-plane stretching. The thermal buckling, post-buckling behavior and vibration behavior of imperfect plates under a harmonic excitation are obtained through the fourth-order Runge-Kutta algorithm. Several analysis techniques including time series, phase plot and power spectra are used to characterize the dynamic response. The effect of the applied harmonic loading, temperature, geometrical imperfection and non-ideal in-plane boundary condition on the static and steady-state dynamic response have been investigated through a detail parametric study.

013 | Mixed-mode buckling of thick-walled composite beams

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This paper presents an analysis method for the mixed-mode buckling, i.e. the interaction between simultaneous global and local buckling modes, of thick-walled composite beams under uniaxial compression. The analysis consists of two buckling approaches, namely local and global analyses. The local buckling approach employs Reddy's third-order shear deformation theory for the local buckling behavior of flanges and webs of open-profile cross-sections with arbitrary symmetric layups and is based on the Ritz-method using adequate series expansions for the out-of-plane displacements and cross-sectional rotations. The global approach uses well-known energy formulations for Euler-type buckling, torsional buckling and flexural torsional buckling and relies on effective cross-sectional properties based on the individual laminate layups of webs and flanges. The current analysis approach is compared to finite element simulations and is shown to be much more efficient in terms of computational efficiency while delivering results of comparable accuracy. Analysis of composite beams, plates and shells.

040 | The studies of bending behavior of composite T-joint of Auto body

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Nowadays CFRP (carbon fiber reinforced plastic) has been regarded as an attractive candidate for achieving lightweight of auto-body due to its excellent comprehensive characteristics. The T-joint at the lower end of vehicle B-pillar is closely related to vehicle stiffness and passive safety because of its unique structural attributes. Our project is to study failure modes and failure mechanism of the T-joint, and their influence on the transverse bending behavior of this structure. Besides, the influence of different size parameters and laying number on the structure behavior is also analyzed. In this study, a simplified single hat shaped composite T-joint made up of a