Smoke Hazards of Tall Timber Buildings with New Products

Subjects: Others

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Timber buildings can now stand very tall using new products. As timber materials are expected to be easily ignitable, the fire hazard of timber is a concern. Charring of the timber surface would maintain structural stability, but would also be accompanied by smoke. Although treating timber products with fire retardants would delay the ignition time under low radiative heat flux, toxic combustion products and unburnt fuel would be emitted immediately upon burning. More smoke and higher toxic gas concentrations such as carbon monoxide would be given off upon burning some fire retardants under high flashover heat fluxes. Due to the fast upward movement of smoke under stack effect, spreading of toxic smoke in tall timber buildings would lead to a hazardous environment. Engineered timber consists of derivative timber products. New engineered timber products are manufactured with advanced technology and design, including cross-laminated-timber (CLT), laminated veneer lumber (LVL) and glue-laminated timber (Glulam). The fire behaviour of timber products has been studied for several decades. However, the smoke hazards of using new timber products in building construction should be monitored. The objective of this study is to inspire stakeholders in fire safety of timber buildings, inter alia smoke hazards, to use new timber products to build tall buildings.

Keywords: tall timber buildings ; fire hazards ; smoke hazards ; public concerns ; new timber products

Timber buildings using engineered wood have become more and more popular [1][2][3][4] over the past few decades due to its sustainability, light weight, lower amount of greenhouse gas emissions, energy demand and shorter duration in the construction phase. Lower amounts of greenhouse gas emission and energy demand are conducive to producing a green environment. Timber buildings can be much taller than before [5][6][7][8], with new products including cross-laminated-timber (CLT), laminated veneer lumber (LVL) and glue-laminated timber (Glulam). Fire safety concerns for timber buildings have been reported in many open forums [2][9][10][11][12] for 20 years. With the advancement of technologies and designs of engineered timber products throughout the last 25 years, wood fibre is used in new engineered timber products [4]. The strength and stiffness of the new products are often achieved by using thin veneers or timber studs and applying adhesives to form composite materials with greater structural strength than the individual elements [13]. CLT is an engineered composite product that consists of multiple layers of boards that are adhered perpendicularly to each other to achieve strength in multiple directions. In some countries, it is referred to as “solid timber”, “solid timber panels” or “mass timber”. It is most commonly used for load-bearing walls and floors. LVL is the most widely used engineered structural composite lumber. It consists of multiple layers of thin wood veneers (approximately 3 mm thick) that are laminated parallel to each other under heat and pressure. The resulting LVL product demonstrates improved structural performance compared to solid timber members. Glulam is an engineered composite product that consists of smaller pieces of stress-graded wood (nominally 50 mm × 100 mm) that are adhered, or laminated, together. This produces a product that is stronger than solid timber. Glulam elements are most commonly used as posts and beams [13]. Although the fire behaviour of timber products has been well analysed in many studies, the fire hazard of timber remains a concern and constitutes an obstacle to its use in construction. Wood can be ignited easily to emit heat and smoke, which consists of toxic combustion products and unburnt fuel. The smoke generated will spread to different parts of a tall timber apartment due to stack effect. Although charring of the timber surface would maintain structural stability, smoke hazard is a threat. There is conflict commonly existing between fire safety and environmentally friendly design.

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