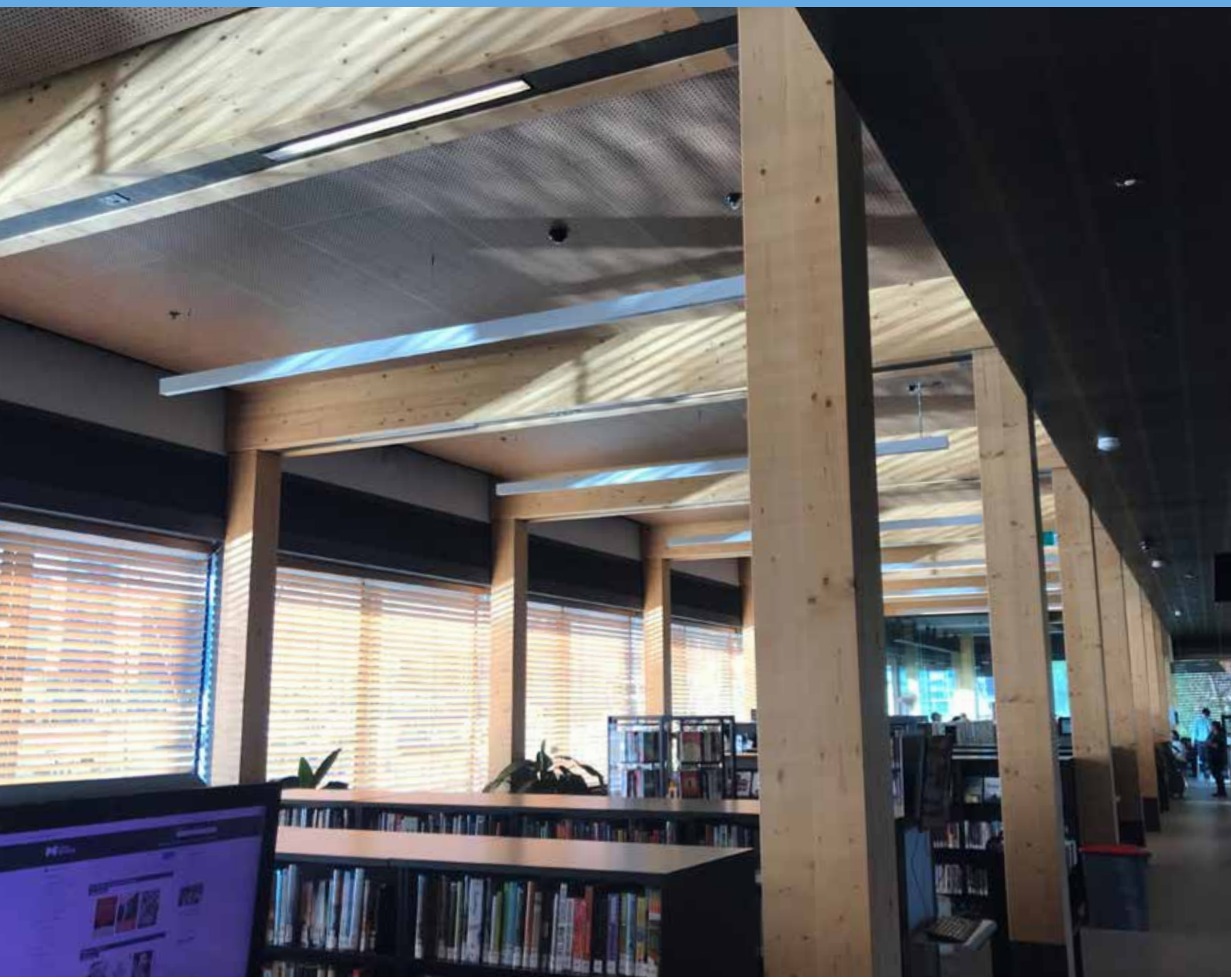
ENGINEERED FOR SAFETY:
PASSIVE FIRE PROTECTION SYSTEMS FOR CROSS LAMINATED TIMBER



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INTRODUCTION

As the construction industry searches for more sustainable building methods, the popularity of structural timber is growing. While not always recognised as a viable structural material, this growth in popularity has coincided with the 2016 changes to the National Construction Code (NCC), which enabled timber construction up to 8 storeys (25m) high for certain building classes.

The changes were also accompanied by the conditions that sprinklers must be used in buildings over 3 storeys, and fire-resistant, non-combustible materials must be used to cover any exposed timber.[1] This change has led to increased uptake of engineered timber in particular, such as Cross Laminated Timber (CLT) due to its significant dimensional stability and high strength-to-weight ratio. CLT has been used in a number of recent projects across the country, including 25 King Street Brisbane, which is currently the world's tallest timber office building.[2]

While the code changes and move toward timber provide designers and specifiers with new opportunities for sustainable design and construction. They do pose a number of unique challenges, chief amongst which is fire protection.

In this whitepaper, we take a closer look at CLT and the fire protection considerations that Australian architects and specifiers must bear in mind when designing timber-structured buildings.

WHAT IS CROSS-LAMINATED TIMBER?

CLT was developed in Europe over 40 years ago, but has only recently entered the mainstream Australian construction market.[3] Unlike solid timbers, CLT is an engineered timber – meaning that it is a composite material (typically comprised of timber and glue), engineered to precise design specifications. Similar to plywood, CLT is made of multiple layers of timber glued together so that the grain of each layer runs perpendicular to the next.

This method, when paired with the sheer thickness of a CLT beam, gives CLT similar strength characteristics to pre-cast concrete panels in both tension and compression, but without the weight.[4] Furthermore, the same manufacturing method means that CLT has substantially more dimensional stability than natural timbers, preventing it from warping over time or distorting due to wear or weather conditions.[5]

When it comes to sustainability credentials, CLT remains ahead of the curve. While steel and concrete are responsible for approximately 5 and 8 per cent of total global carbon emissions respectively, each cubic metre of CLT sequesters "about a tonne of carbon", as Arup engineer Craig Gibbons told the ABC.[6,7] Coupled with CLT's high strength, durability, versatility, and its ability to be mostly prefabricated off site makes CLT the ideal choice for contemporary Australian construction across both the commercial and residential sectors.

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UNDERSTANDING PASSIVE FIRE PROTECTION

Unlike active fire protection, which seeks to extinguish live flames and quell heat, passive fire protection (PFP) methods aim to both contain a fire at its point of origin, and maximise the containment of heat and smoke. PFP achieves this in four key ways:[8]

- **Structurally** – protecting structural components and joints from flames and heat;
- **Compartmentation** – dividing up the interior space using barriers, which limit the spread of fire and smoke, allowing for any occupants' safe exit;
- **Opening protection** – through the installation of fire rated windows and doors, which could otherwise compromise the careful PFP in other areas;
- **Fire-stopping materials** – used wherever services such as plumbing, HVAC and electrical must penetrate an otherwise fire resistant wall.

However, it is not enough to ensure that one area of PFP is completely met and assume the others are less important or not relevant to the project. Failing to adequately meet the demands of each of the four PFP areas can have disastrous consequences, leading to the spread of fire and smoke throughout a building just as rapid as if there were no measures in place at all. For instance, failing to implement fire-stopping materials around service penetrations can lead to the spread of fire and smoke via HVAC ducts, openings caused by plastic pipes melting or further incidents as it comes into contact with electricity. A holistic approach is required; architects and specifiers cannot rely on one method of PFP alone.

When using CLT systems, designers and specifiers must be mindful of the passive fire protection of service openings in panels, and carefully consider these to ensure compliance with the relevant standards. Materials that may play a role in PFP such as walls, floors and service penetrations, amongst others, are given a 'Fire Resistance Level' (FRL) according to AS 1530.4. While the ability to prevent the passage of smoke is covered separately, under AS 1530.7, the FRL dictates the amount of time in minutes for which an element can contain fire whilst maintaining structural adequacy, integrity, and insulation. Wherever relevant, these characteristics define any element's ability to maintain its load bearing ability, resist the passage of flames and hot gases, and limit temperature rise on a face unexposed to flame. Understanding these figures is critical to ensuring adequate PFP.

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REQUIREMENTS FOR PASSIVE FIRE PROTECTION

A typical CLT fire-protected system is made up of two key elements: the CLT structural members such as joists, bearers and similar; the fire-protected cross-laminate timber panels (either horizontal or vertical, depending on purpose); and fire-grade plasterboard facings, the size and number of which are determined by their presumed proximity to fire sources.[9]

WoodSolutions recommends the minimisation of penetrations through fire-resistant construction, although this is not always practical - particularly in today's construction climate, where enhanced design technologies have led to more complex and more efficient integrated systems configurations.[10] To counter this, any necessary penetrations through fire-resistant construction should be grouped together and treated appropriately, optimising the task and minimising the chances of disaster further down the line.

Furthermore, penetrations through fire rated elements must also meet the requirements of BCA Clause C3.15: Openings for service installations. Of critical importance is the need to specify approved systems for PFP, which have been tested in accordance with section 10 of AS 1530.4. What is eventually installed must be identical to the tested system, including the building element through which services pass, the service, and the protection method used. Section 10 also includes "permissible variations", the most relevant clauses of which are 10.12.2 (d) and (e).

Together, these clauses permit the application of test results from framed walls (e.g. plasterboard) to other walls of a similar material with the same thickness or greater. However, at this stage these permissible variations do not apply to CLT systems, with tests undertaken on a CLT panel currently only applicable to another panel that is identical in terms of thickness, construction, timber type and glue type. In a practical sense, this means that manufacturers and resellers of CLT and related PFP measures must have their own testing for penetration seals, doors and the like.

PROMAT AUSTRALIA

For more than 60 years, Promat has led the global industry in sophisticated fire science and passive fire protection strategies. In Australia, Promat has earned a reputation for reliable, unrivalled fire performance across a breadth of sectors and project types, including mid-rise projects featuring CLT and alternative engineered timbers. Promat's drive toward innovation is bolstered by an innovative, experienced research and development team that marries design skills with the latest technology. Their successes have led to the development of industry leading solutions for protection against fire, smoke, fumes and heat.

Promat's range of products includes a suite of passive fire protection products that have been tested and identified as compliant for CLT systems from multiple manufacturers and suppliers including XLam, Strongbuild, Multiplex and Lend Lease. While these tests cannot be applied across the board, they represent a valuable source of information and provide a critical advantage over other manufacturers and suppliers who are unable to supply their own penetration details.

- **PROMASEAL® Retrofit Collars** are designed for use around previously installed pipes passing through floor slabs. They have been tested with uPVC, pipes up to 100mm in diameter,.
- **PROMASEAL® Conduit Collars** are designed for retrofitting around small plastic conduit pipes that pass through fire floor or wall slabs, up to 32mm in diameter.
- **PROMASEAL® Floor Waste Retrofit Collars** are designed to provide fire resistance wherever floor wastes penetrate wet areas, retrofitted to provide integrity and insulation to uPVC pipes of 100mm diameter.
- **PROMASEAL® Grafitex** is a fire resistant intumescent compound used to back fill the retrofit fire collars. Once cured, it is unaffected by water and moisture and is designed to expand when exposed to fire, filling any gaps around the penetrating services.
- **PROMASEAL®-A Acrylic Sealant** is a low-VOC, water based acrylic sealant used for penetration seals and control joint protection. Once cured, it can be painted over for a seamless appearance.
- **PROMASEAL® Bulkhead Sealer System** is a coated high-density mineral wool that forms a barrier against the passage of flame, smoke and toxic gases through the bulkhead.
- **PROMASEAL® FlexiWrap** is a fire-resistant intumescent wrap designed for use wherever thermal insulation around metal pipes is combustible.
- **PROMASEAL® SupaWrap40** is designed to provide compliant insulation criteria to metal pipes, cables and cable trays.
- **PROMASEAL® Fyrestrip** is a combination foam and intumescent strip designed to protect movement joints within structures that still required fire resistance
- **PROMASEAL® IBS™** is a fire rated foam backing rod designed to fill joints between panels where only low movement is expected but fire resistance is still required.

As well as penetration seals, Promat's broad range of products in the areas of steel protection and compartmentation means that any fire protection application that arises on site can be solved.

For more information, visit Promat's website at http://www.promat.com.au/en/products

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