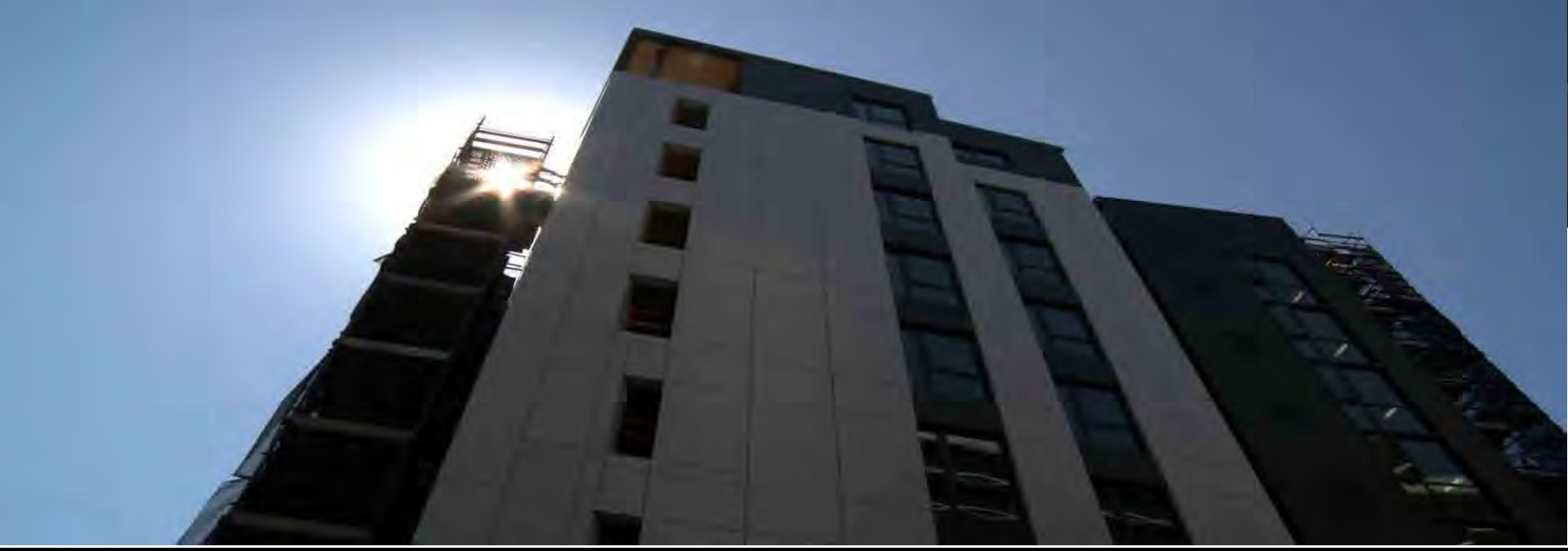


NCC 2016 & Mid-rise Timber Buildings

Dr Alastair Woodard

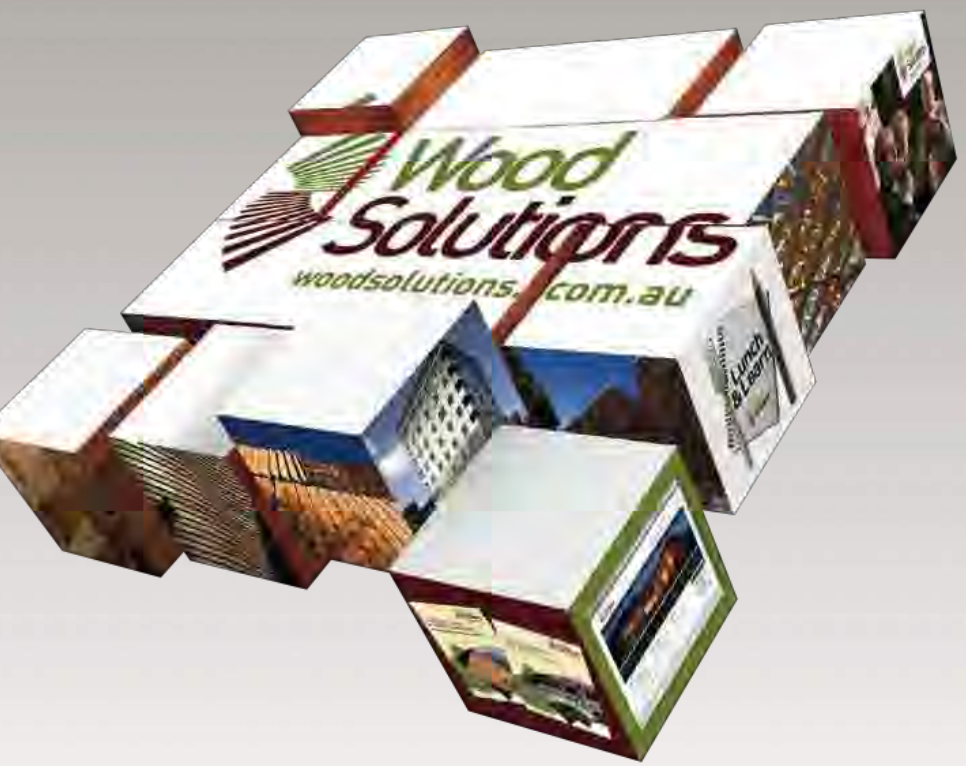
Program Manager, WoodSolutions

RMIT UNIVERSITY

Timber Industry Forum – To Create a More Sustainable Australia
8th Dec 2016

Wood Solutions
design and build
www.woodsolutions.com.au

WoodSolutions™: Who we are



An Australian industry initiative, resourced by Forest and Wood Products Australia (FWPA) –

For architects, engineers, designers and other building professionals

- inspiration
- information & resources
- education
- CPD.

Alastair Woodard

WoodSolutions Program Manager Vic

Wood Solutions™
design and build
woodsolutions.com.au

What WoodSolutions provides

Events

Interactive Website

www.woodsolutions.com.au

Sponsorships

Technical Tutorials

Wood Solutions™
design and build
woodsolutions.com.au

Content of this Presentation

- Overview of new 2016 NCC Changes for Mid-rise Timber Buildings.
- Timber Construction Options
  - General Timber Systems
  - Massive Timber Systems
  - Prefabricated and Modular Systems
- Examine the Specific NCC Timber Related Changes for ‘Fire’
- Further Information and Resources

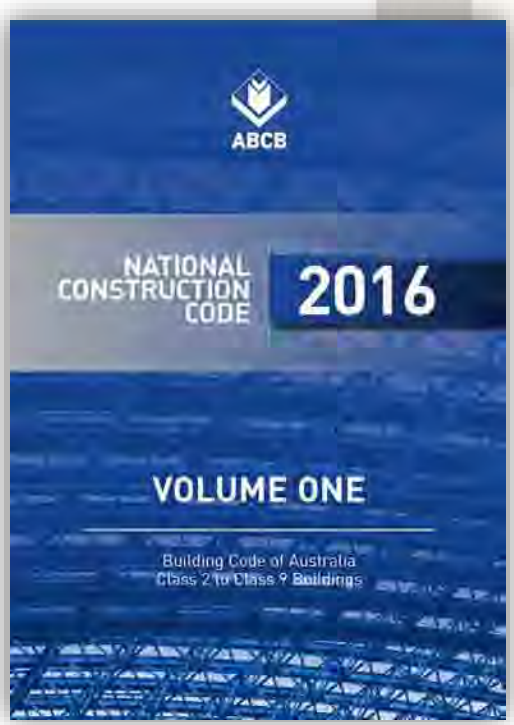
Wood Solutions™
design and build
woodsolutions.com.au

NCC 2016 – A Game Changer

The National Construction Code **(NCC)** is the regulatory framework for determining the minimum design and construction requirements for buildings in Australia.

NCC Volume 1
the Building Code of Australia
Class 2 to Class 9 Buildings

is the document relevant to
mid-rise timber buildings
(hereon referred to simply as the NCC)



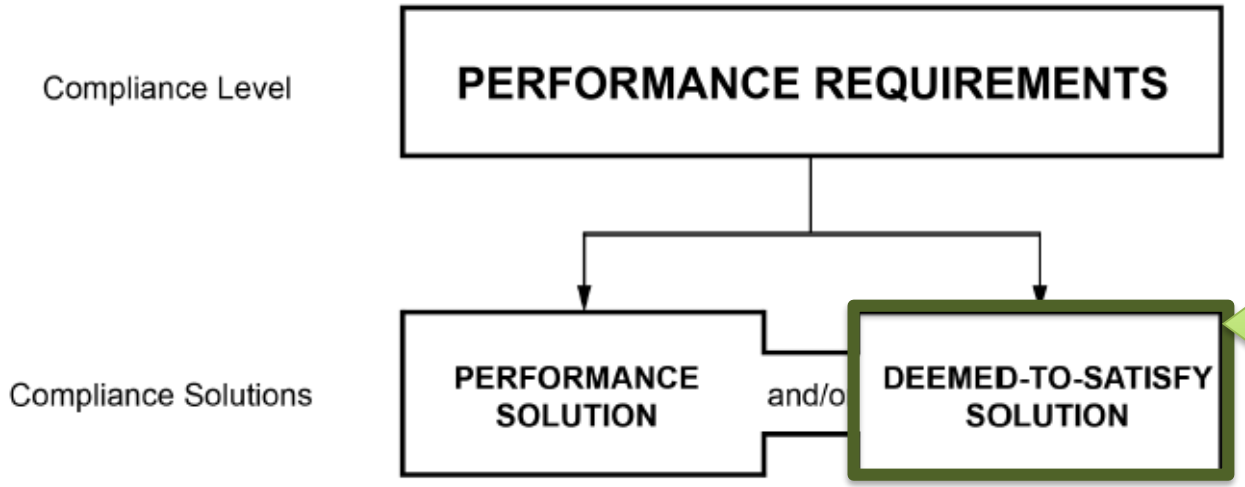
Wood Solutions™
design and build
woodsolutions.com.au

2016 NCC Compliance Pathways

Two pathways are available under the NCC to demonstrate performance

Figure A0.2

NCC COMPLIANCE STRUCTURE



Note:

1. The term *Performance Solution* was formerly known as *Alternative Solution*.
2. The terms *Performance Solution* and *Deemed-to-Satisfy Solution* were formerly used under the term *Building Solution*.

Wood Solutions™
design and build
woodsolutions.com.au

NCC 2016 – Proposal for Change: Timber Construction

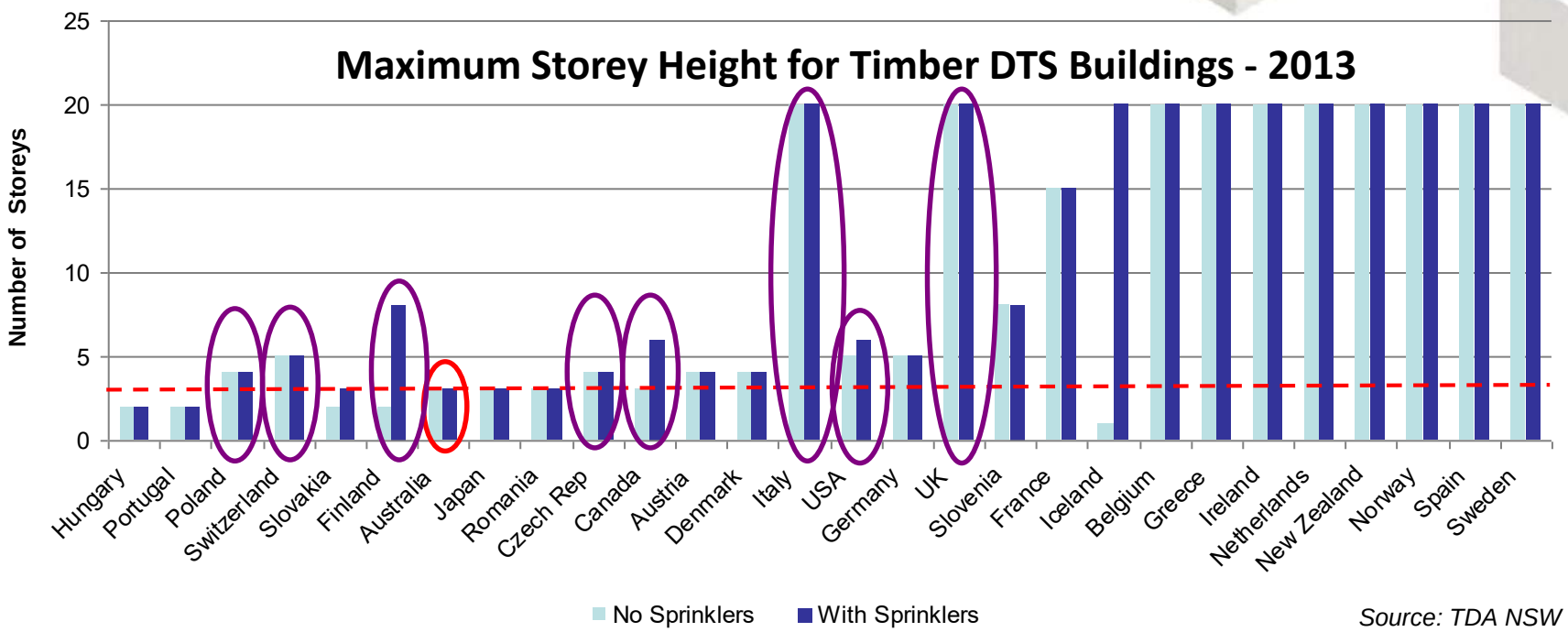
Prior to NCC 2016, timber construction systems in Australia have been restricted to 3 storeys under the Deemed-to-Satisfy (DTS) provisions with higher buildings requiring an 'Alternative Solution' pathway for compliance purposes.

Project :: Ruskin St Townhouses
Architect :: Marcus O'Reilly Architect
Location :: Elwood, VIC
Photographer :: Dianna Snape

Project: Forte Living
Builder: Lend Lease
Location: Docklands ,Melbourne

Wood Solutions™
design and build
woodsolutions.com.au

NCC 2016 – Proposal for Change: Timber Construction



Source: TDA NSW

Globally, many countries now allow construction of timber systems well above 3 storeys.

Wood Solutions™
design and build
woodsolutions.com.au

NCC 2016 – New Timber Construction Provisions

The 2016 NCC, has been amended to now allow under the Deemed-to-Satisfy (DTS) provisions the use of fire-protected timber construction systems in

- ✓ Class 2 (apartments),
- ✓ Class 3 (eg hotels) and
- ✓ Class 5 (offices) buildings

up to 25 metres in effective height (herein termed '*mid-rise construction*').

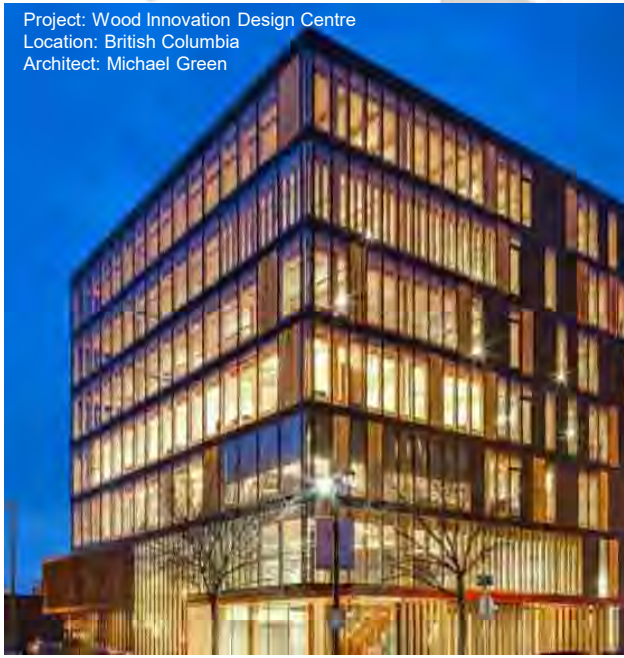
Wood Solutions™
design and build
woodsolutions.com.au

Major New Opportunity

Apartments (Class 2)

eg Hotels (Class 3)

Office Buildings (Class 5)



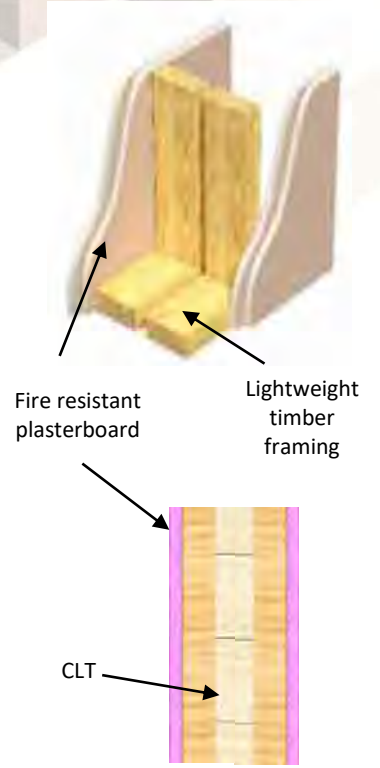
- A major new opportunity for a wide range of timber products and systems

Wood Solutions™
design and build
woodsolutions.com.au

Summary - New DTS Provisions

- The new DTS provisions cover both
  - traditional 'lightweight timber framing' and
  - new 'massive timber systems' such as cross laminated timber (CLT)

and consist of the use of appropriate layers of fire resistant plasterboard – to provide'*fire- protected timber*' - and the use of compliant automatic sprinkler systems.



Key Issues - Fire & Sound Protection

- A range of factors need to be considered as part of the design of these types of construction, but particularly the key issues of: fire protection and sound attenuation.

Appropriate fire-resisting construction is critical to providing acceptable levels of **fire safety**

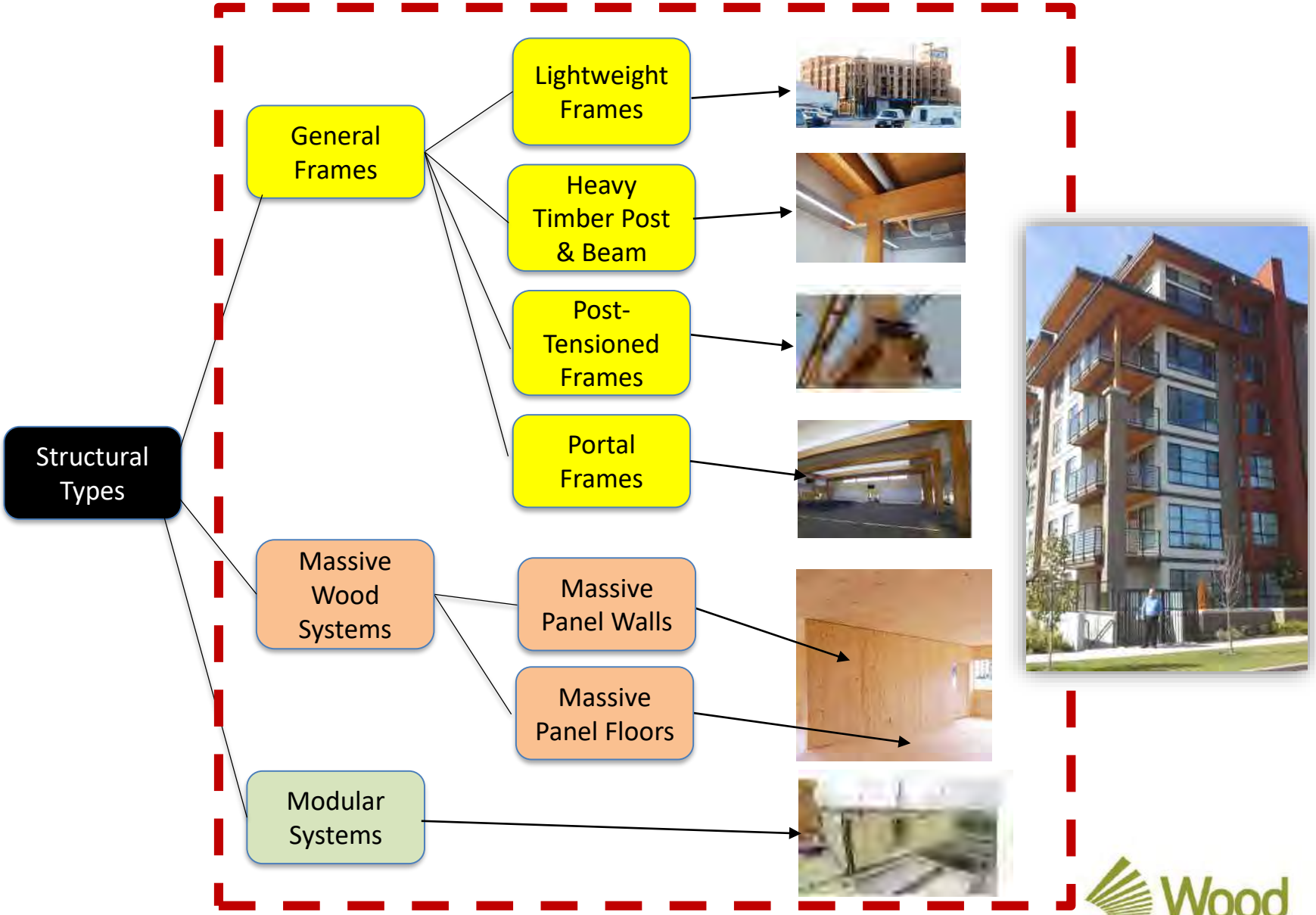
Sound insulation is important because of its daily impact on the **quality of life**.

Wood Solutions™
design and build
woodsolutions.com.au

Design of Mid-Rise Timber Buildings

Timber Construction Options for Mid-rise Timber Buildings

Wood Solutions™
design and build
woodsolutions.com.au



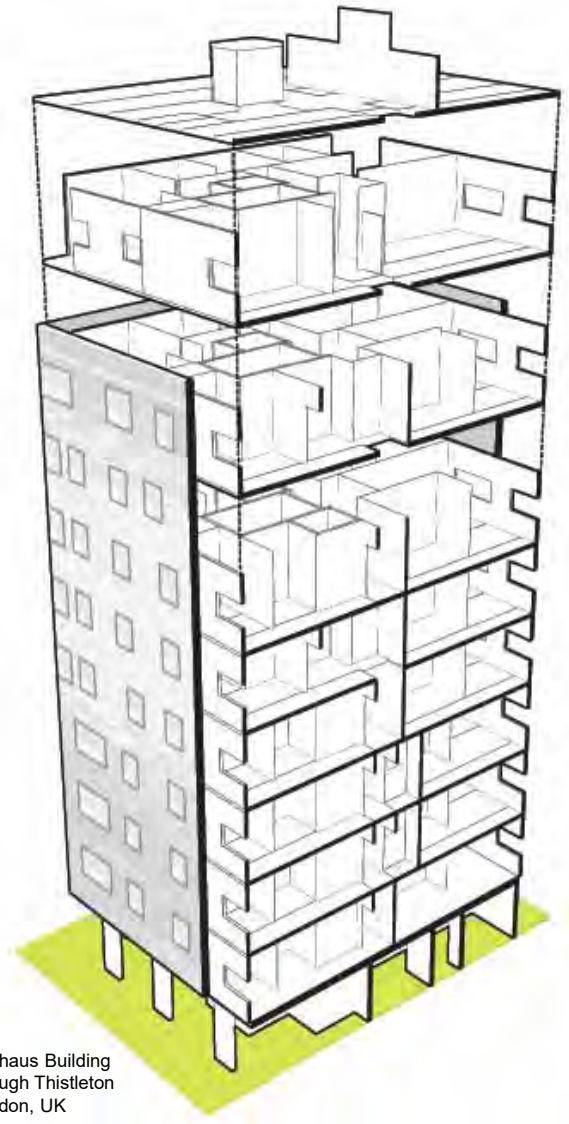
Timber Construction - **Lots of Options**

Wood Solutions™
design and build
woodsolutions.com.au

Building Form – Class 2 or 3: Multi-residential or Hotels

Class 2 - Apartments and Class 3 – eg Hotels tend to be honeycombed type structures with many closely spaced walls.

There are a number of ways these could be constructed



Project: Stadthaus Building
Architect: Waugh Thistleton
Location: London, UK

Building Form – Class 2 or 3: Multi-residential or Hotels

Multi-Res Apartments

1-6 Storeys

Lightweight Timber

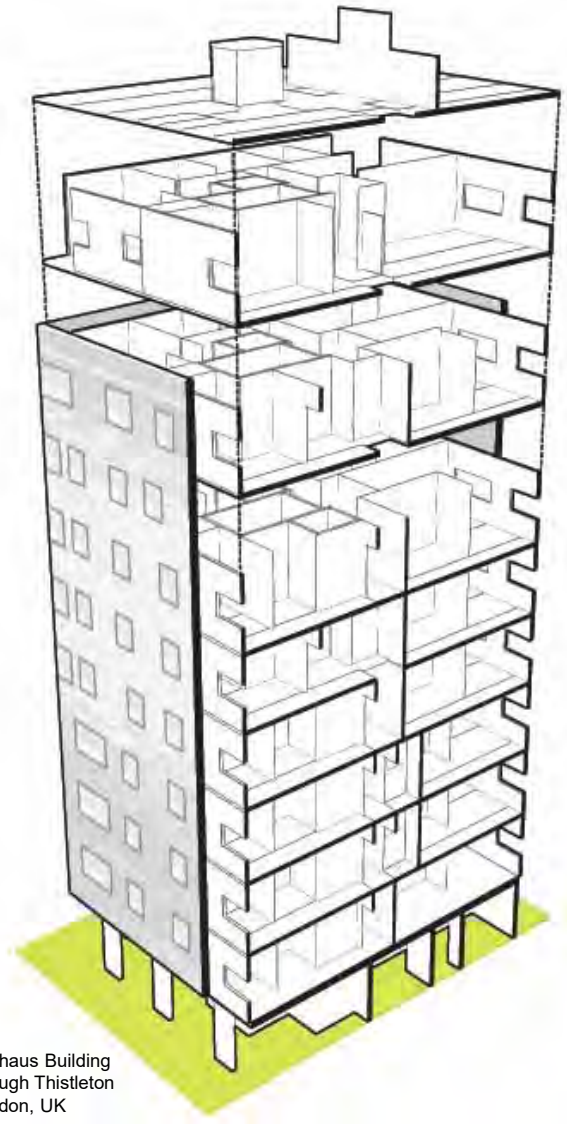
Conventional framing upper walls closer stud centres lower walls

Multi-Res Apartments

6 - 12 Storeys

Massive Timber

(CLT)



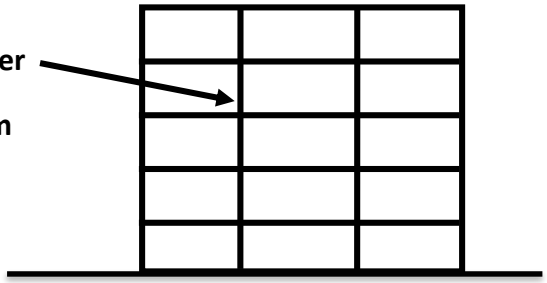
Project: Stadthaus Building
Architect: Waugh Thistleton
Location: London, UK

Building Form – Class 5 Offices

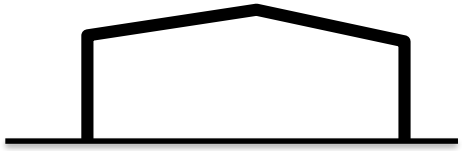
Heavy Timber

Post & Beam

(Glulam)



Portal Frames



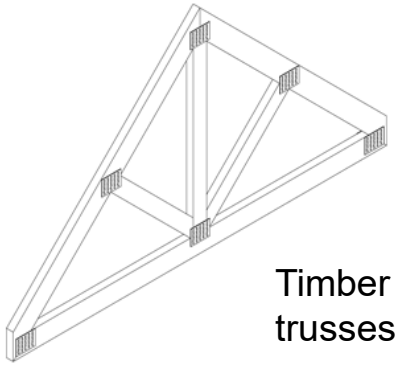
Efficiencies & Cost Benefits of Timber Systems

- Direct savings from faster methods of construction compared to traditional steel and concrete structures due to both:
  - increased scope for off-site prefabrication
  - lighter and more easily manipulated and installed materials
- Reduced foundation requirements due to lighter above-ground structure;
- Reduced on-site costs & OH&S issues, particularly with a shift to more prefabricated solutions;
- Increased ability to commence follow-on trades earlier in the construction process, reducing the overall construction program time to completion;
- Reduced on-site construction infrastructure *(preliminary costs)* such as fixed cranes, site accommodation, storage areas, scaffolding and edge protection, hoists and so on ; and
- Increased accessibility of the construction site and far lower impacts on noise and site activities on local neighbourhoods (less truck movements); a major benefit for suburban multi-residential developments.

General Timber Systems - Lightweight

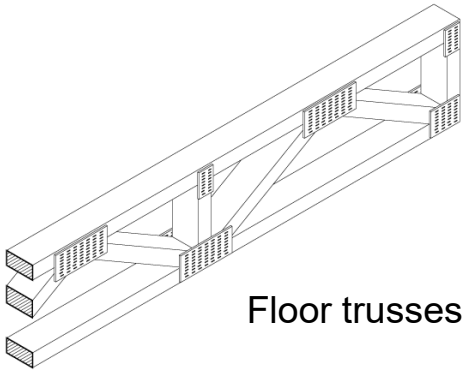
Wood Solutions™
design and build
woodsolutions.com.au

Lightweight Timber Products

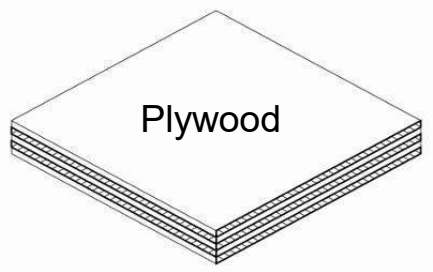


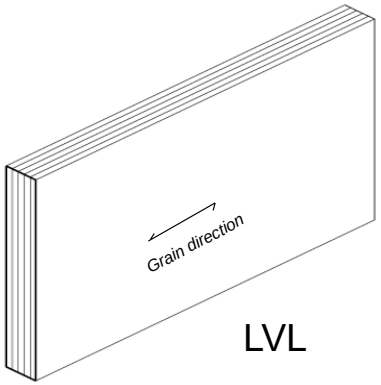
Timber roof trusses

Sawn timber

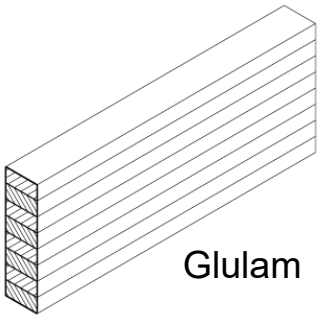


Floor trusses

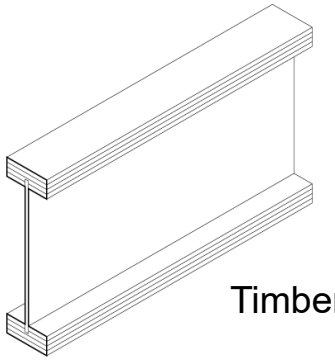




LVL



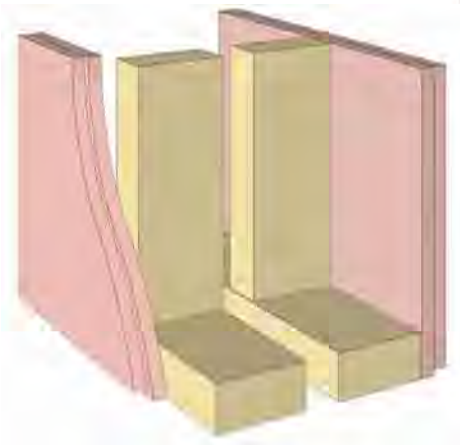
Glulam



Timber I-beams

Wood Solutions

Lightweight Timber Systems



Small section timber framing plus fire-rated plasterboard lining

Wood Solutions™
design and build
woodsolutions.com.au

The Green Parkville, Victoria

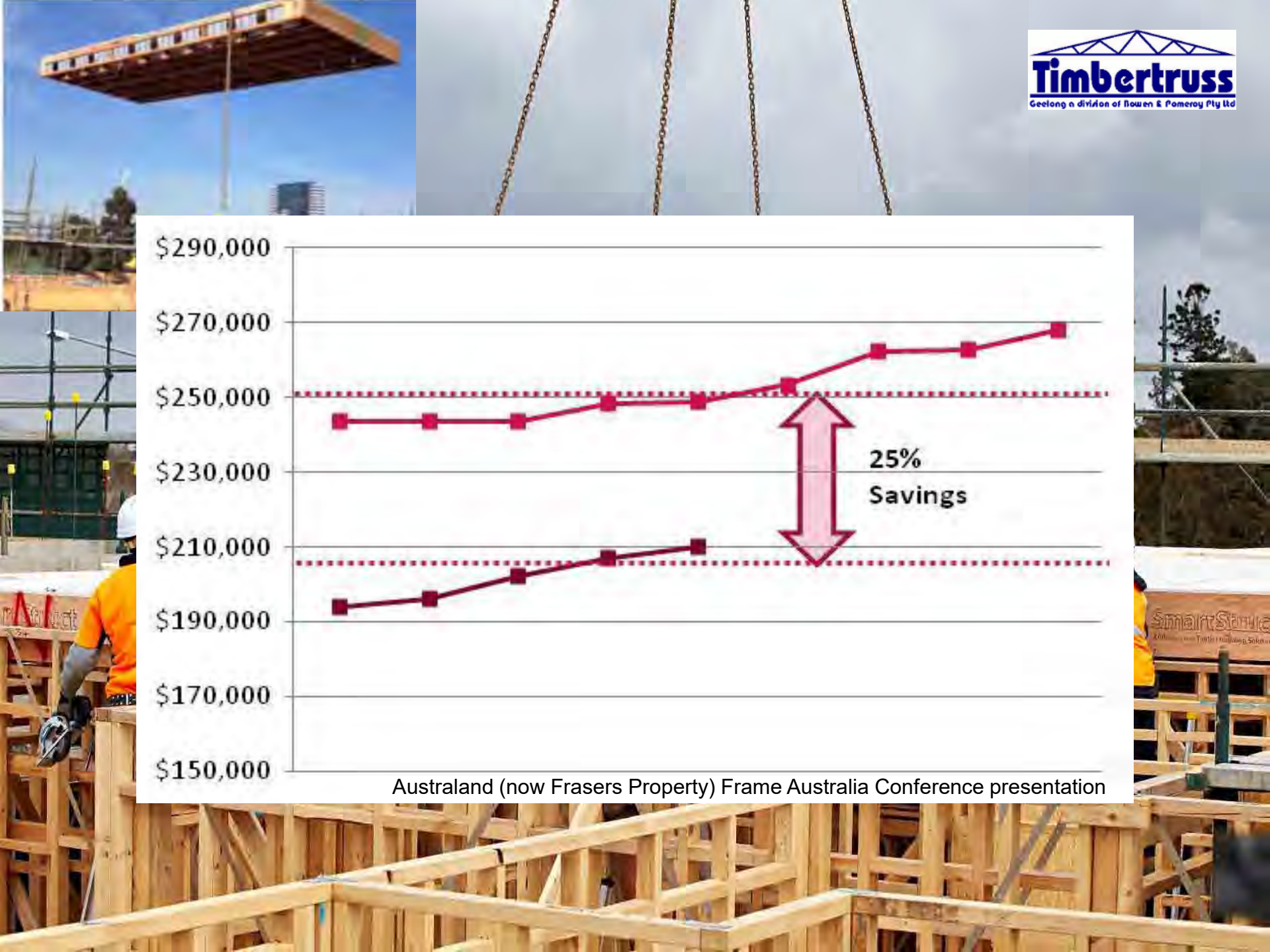
Design Team
IrwinConsult
TimberTruss & SmartStruct

Timber Systems
TecBeam Floor Cassette & Prefabricated Wall Frames

Build Period
Floor System – 1.5 Days per Level
Wall System – 5.0 Days per Level

Project: The Green
Builders: Frasers Property (prev Australand)
Location: Parkville, Melb, Vic

Wood Solutions™
design and build
woodsolutions.com.au



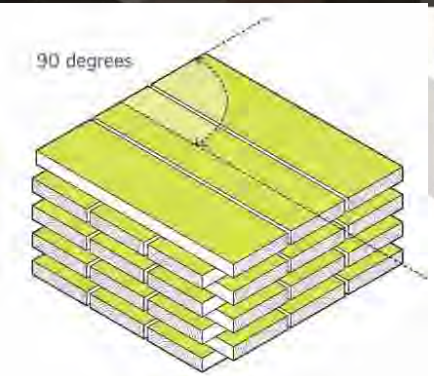
Australand (now Frasers Property) Frame Australia Conference presentation

Massive Wood Panel Systems

Wood Solutions™
design and build
woodsolutions.com.au

Cross Laminated Timber

Multiple layers of laminated timber cross at each laminate i.e. “Jumbo plywood”



Typical Dimensions:

Thickness: 50 to 500 mm

Widths: 0.6 m, 1.2 m and 3 m

Lengths: up to 18 m but transport issues affect length, i.e. 12 m is normal max.

Wood Solutions™
design and build
woodsolutions.com.au

807 Bourke St
Victoria Harbour

10 storeys
23 apartments
4 townhouses

Project: Forte Living
Builders: Lend Lease
Location: Melbourne, Vic

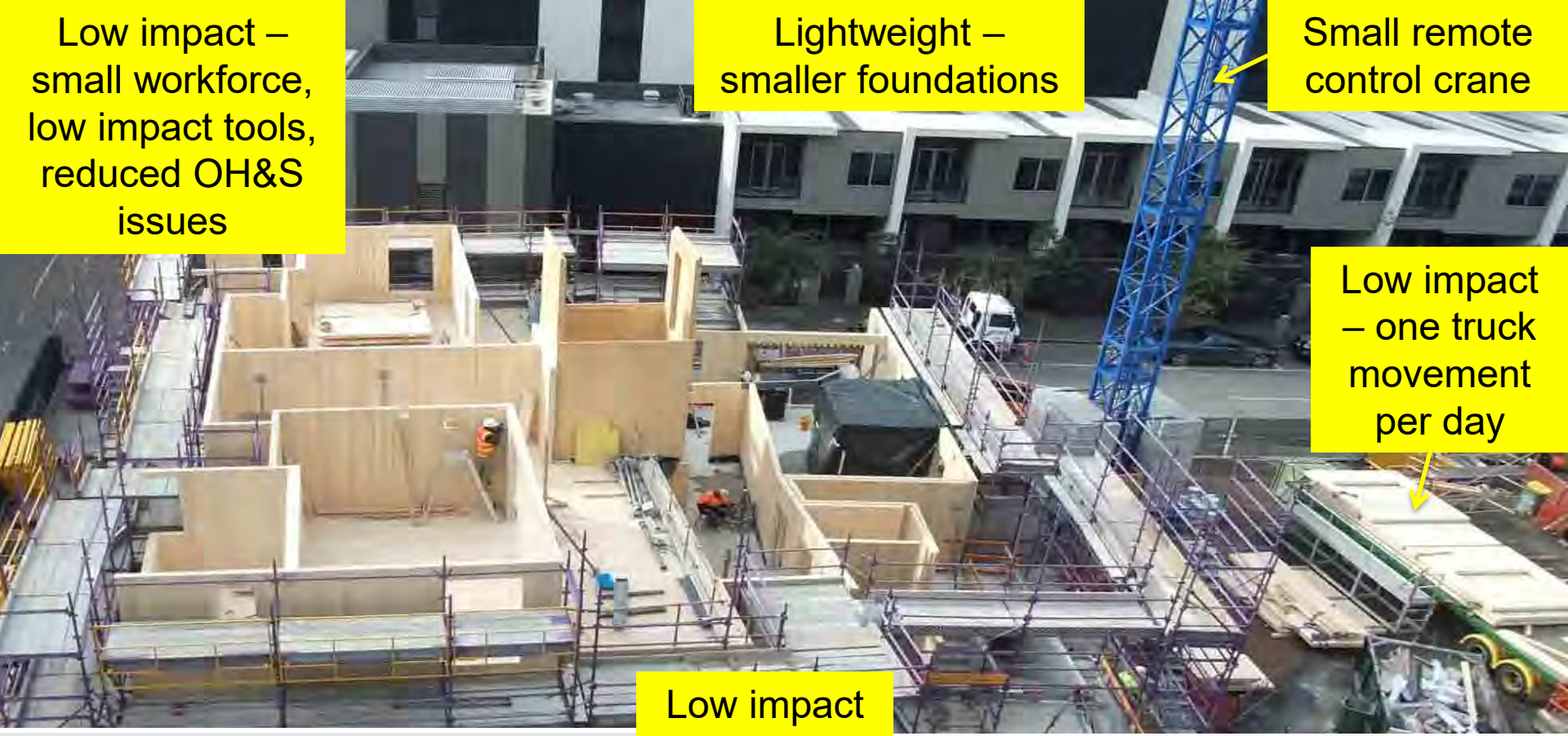
Wood Solutions™
design and build
woodsolutions.com.au

Full timber construction including lift shafts

Simple screwed connections

Project: Forte Living
Builders: Lend Lease
Location: Melbourne, Vic

Wood Solutions™
design and build
woodsolutions.com.au



32.17M HIGH THE WORLD'S TALLEST TIMBER APARTMENT BUILDING

5★ GREEN STAR EXPECTED TO BE THE FIRST RESIDENTIAL BUILDING TO ACHIEVE THIS

485 TONNES OF **TIMBER**

759 CLT PANELS

Low impact – very quick: 1/3 of the time of a concrete building

34,550 SCREWS

5,500 ANGLE BRACKETS

SHIPPED IN **25** CONTAINERS

ON 2SHIPS

BUILT WITH **2** LL APPRENTICES

SAVING **1,451** TONNES OF CARBON

Low carbon footprint

Prefabricated & Modular Wood Systems

Wood Solutions™
design and build
woodsolutions.com.au

Prefabricated Cassette Floor Systems

Photo: A. Woodard

Photo: A. Woodard

The Green, Parkville
Frasers Property Australia

- Typical Size: 3m wide up to 12m long
- Very fast installation times
- Dramatically reduces ‘fall-from-height’ risks

Wood Solutions™
design and build
woodsolutions.com.au

Timber/Concrete Composite Floors

- For acoustic and vibration control & composite structural performance

XPAN STRUCTURAL TIMBER SOLUTIONS

Wood Solutions™ design and build woodsolutions.com.au

Panelised Elements



Image source: Drouin West Timber & Truss

- Panelised elements either partially or fully enclosed
- Electrical & plumbing pre-fitted off-site

Wood Solutions™
design and build
woodsolutions.com.au

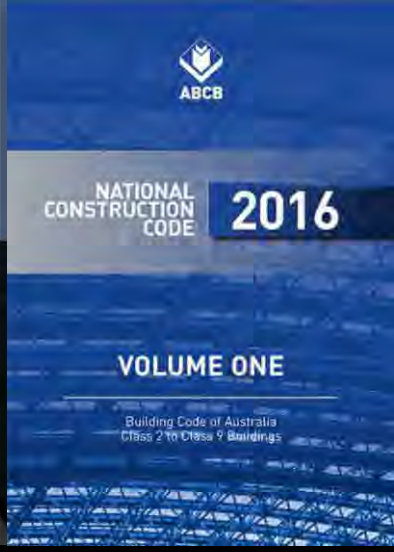
Modular Timber Systems

Treet Apartments, Norway
Kodumaja Constructions

Winter Olympic Village Torino

- Full off-site prefabricated volumetric modules

Wood Solutions™
design and build
woodsolutions.com.au



Design of Mid-Rise Timber Buildings

2016 NCC Changes for Mid-rise Timber Buildings - Fire

Wood Solutions™
design and build
woodsolutions.com.au

Summary of NCC Changes for Timber Construction

Provide in **Section A General Provisions, Part A1 Interpretations,** new definitions in **Clause A1.1 Definitions** for *Fire Protected Timber* and *Massive Timber*

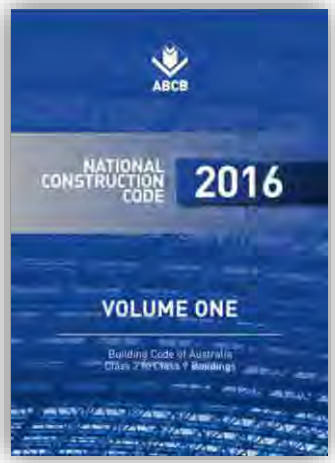
Provide in **Section A General Provisions** a new **Specification A1.1 Fire Protected Timber** defining the required performance of fire protected timber and method of verification with deemed to satisfy plasterboard solutions

Add to **Section C Fire Resistance, Part C1 Fire Resistance and Stability** a new clause- **Clause C1.13 Fire Protected Timber: Concession** to deem fire-protected timber non combustible subject to appropriate controls

Amend **Section C Fire Resistance** , **Specification C1.1 Fire-resisting Construction, Clauses 3.1 Type A Fire Resisting Construction and 4.1 Type B Fire Resisting Construction** to permit the use of fire-protected timber subject to appropriate controls in list of concrete and masonry elements

Provide to **Section C Fire Resistance** a new **Specification C1.13 Cavity Barriers for Fire Protected Timber** defining locations and required performance of cavity barriers to address risk of spread through cavities

6 major clause changes or inclusions



Wood Solutions™
design and build
woodsolutions.com.au

Summary of NCC Changes for Timber Construction

C1.13 Fire-protected timber: Concession

Fire-protected timber in a Class 2, 3 or 5 building may be used wherever an element is *required* to be *non-combustible*, provided—

(a) the building is—

(i) a separate building; or

(ii) a part of a building—

(A) which only occupies part of a *storey*, and is separated from the remaining part by a *fire wall*; or

(B) which is located above or below a part not containing *fire-protected timber* and the floor between the adjoining parts is provided with an FRL not less than that prescribed for a *fire wall* for the lower *storey*; and

(b) the building has an *effective height* of not more than 25 m; and

(c) the building has a sprinkler system throughout complying with **Specification E1.5**; and

(d) any insulation installed in the cavity of the timber building element *required* to have an FRL is *non-combustible*; and

(e) cavity barriers are provided in accordance with **Specification C1.13**.

DtS Solution for Mid-rise Timber Buildings

Automatic sprinkler suppression system
to *suppress a fire before*
the timber structure is threatened
which greatly reduces the fire risk to
people and property.

<u>High Success Rate</u>:
BRANZ - sprinkler reliability may range from 95% - 98%; the higher value also reported being supported by the US National Sprinkler Association.

BRANZ, 2000, Fire Protection for High Rise Buildings, a report prepared by BRANZ, March 2000

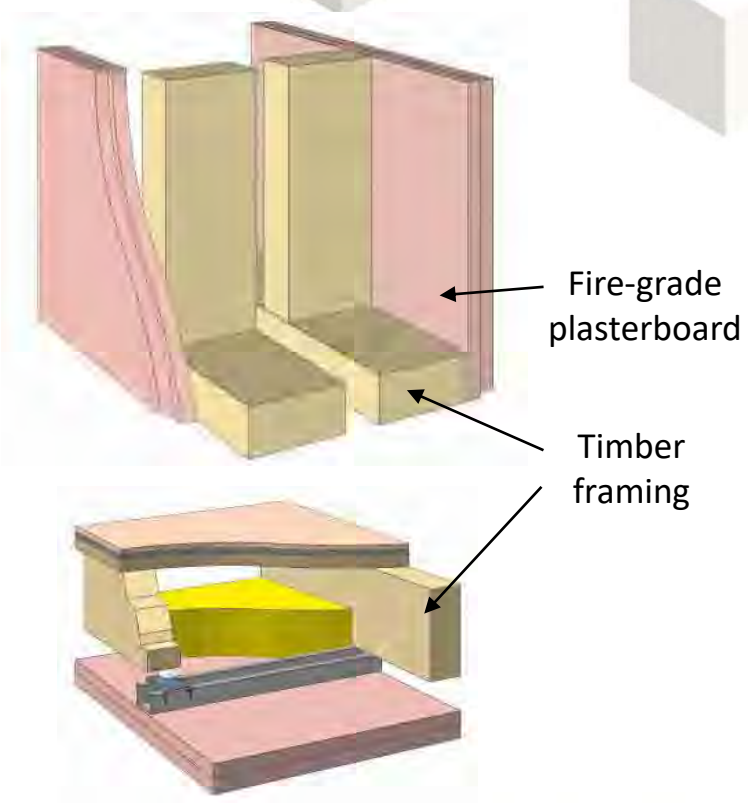
Wood Solutions™
design and build
woodsolutions.com.au

DtS Solution for Mid-rise Timber Buildings

Fire-protected timber

Use of fire-grade plasterboard to prevent or delay ignition of the timber structural members,

in the low probability event of sprinkler failure, so that the response to an enclosure fire will be similar to non-combustible elements, (i.e. masonry or concrete) during the growth period and prior to fire brigade intervention.



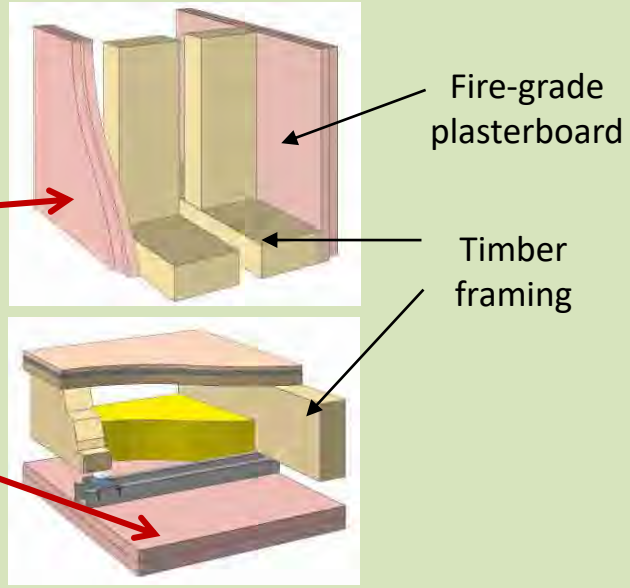
Wood Solutions™
design and build
woodsolutions.com.au

Fire-Protected Timber – Lightweight Timber

General Timber *(High level of protection to timber)*

- FRL lightweight timber-framed construction
  e.g. 90, 120, 140 x 45mm

- Fire-grade plasterboard linings required (typical solution):
  - 2 x **13mm** fire-grade plasterboard for walls, and
  - 2 x **16mm** fire-grade plasterboard for ceilings

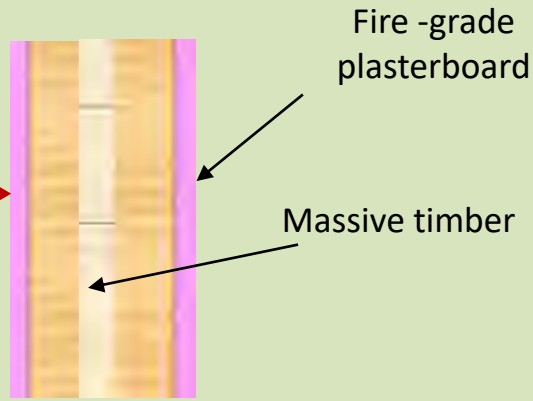


Fire-Protected Timber – Massive Timber

Massive Timber *(Lower level of protection to timber)*

- Minimum 75mm thickness of massive timber element, with required FRL, with no concealed spaces between plasterboard coverings and timber
  e.g. CLT, Glulam, LVL

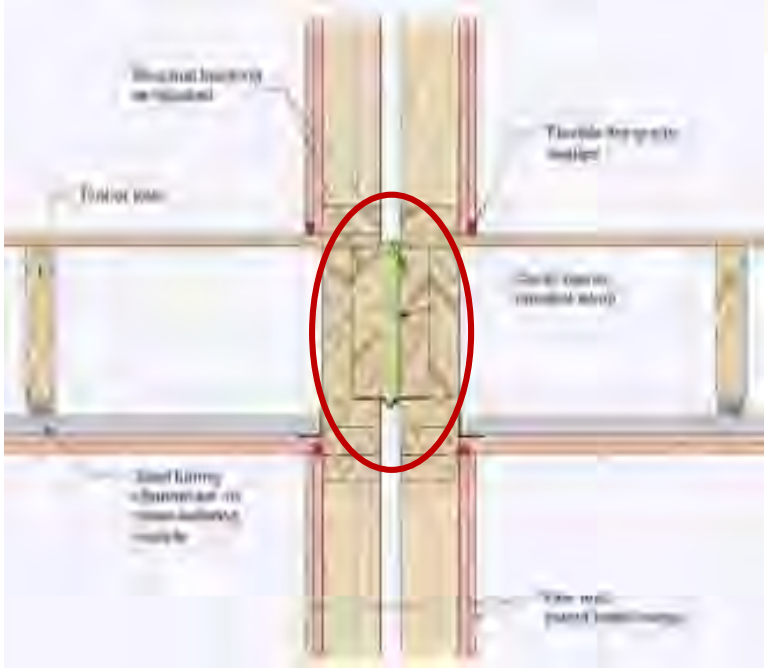
- Fire protective covering required:
  - Element with appropriate layers of fire protective covering, generally 1 layer of **16mm** fire-grade plasterboard for walls and ceilings



DtS Solution for Mid-rise Timber Buildings

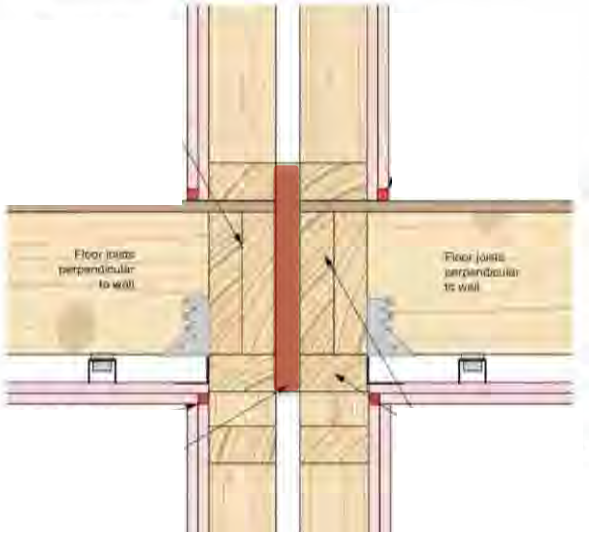
Cavity Barriers

to prevent uncontrolled spread of fire through cavities in the low probability events of either failure of the protective covering or fire starting within the cavity.

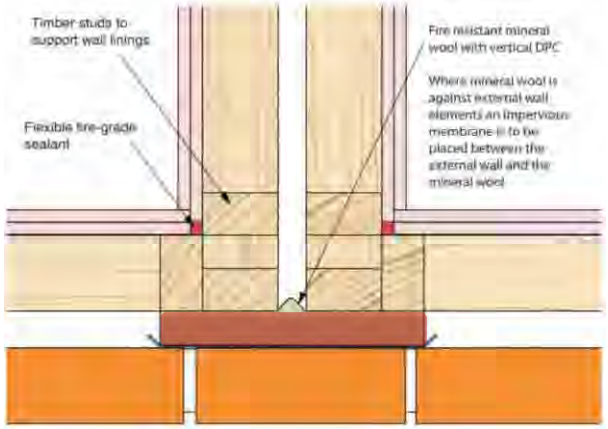


Wood Solutions™
design and build
woodsolutions.com.au

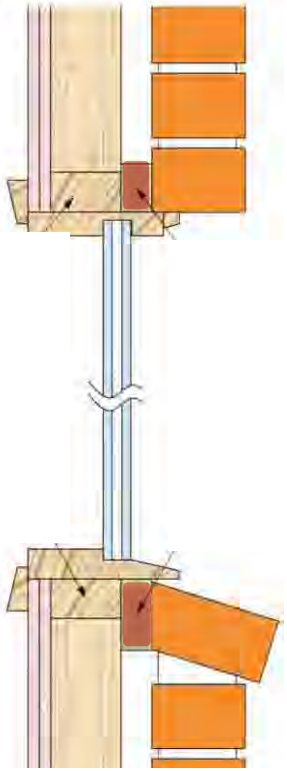
Cavity Barriers



Floor/Wall Junction

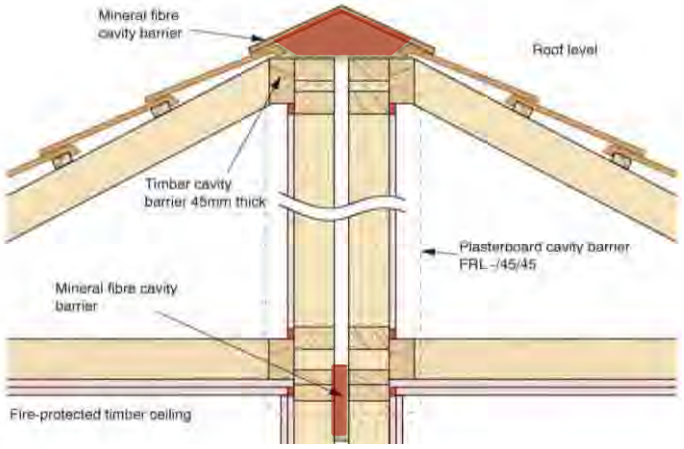


External Brick Veneer Wall



Windows

Cavity Barriers
Must be installed in all required locations



Roof Space

Wood Solutions™
design and build
woodsolutions.com.au

DtS Solution for Mid-rise Timber Buildings

Non-Combustible Insulation

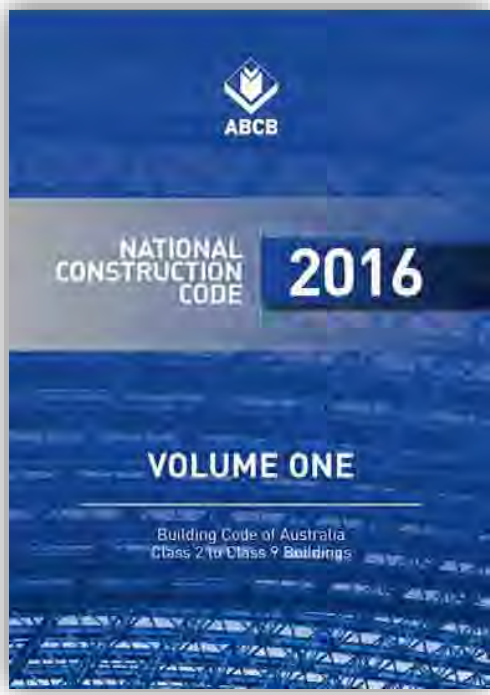
to minimise the risk of fire spread through cavities by removing a potential source of fuel i.e. combustible insulating materials.

Wood Solutions™
design and build
woodsolutions.com.au

DtS Solution for Mid-rise Timber Buildings

- If, the building or building part is Class 2, 3 or 5.
- the building has an *effective height* of not more than 25m;
- and utilises:
  - *automatic sprinkler systems*
  - *fire-protected timber*
  - *cavity barriers*
  - *non-combustible insulation*

Then it meets the DtS Solution for Mid-rise Timber Buildings



Key Roles & Responsibilities

Roles & responsibilities of the project team need to be clear and agreed from the start

• Design & documentation	Architect, building designer, engineer, service designers, prefabricator
• Assessment/certification	Building surveyor, planner, regulators
• Building construction	Builder
• Construction inspection	Building surveyor, engineer(s), regulators
• Building commissioning	Builder, design team rep, Owner
• Ongoing maintenance and oversight	

Note: may vary depending on specific State and Territory regulations

Wood Solutions™
design and build
woodsolutions.com.au

WoodSolutions: Assistance & Resources

Wood Solutions™
design and build
woodsolutions.com.au

WS Design Guide 37: New DtS Requirements

New Technical Guide No 37 detailing the NCC DtS requirements for lightweight and massive systems in Mid-rise Timber Buildings

Wood Solutions™
design and build
woodsolutions.com.au

WS: On-line Education Resource

New video based education resource detailing the DTS requirements for lightweight and massive systems

WoodSolutions Campus

Wood Solutions™
design and build
woodsolutions.com.au

WS Design Guide 38: Fires Safety Design

Provides the basis for the timber and fire related changes in the 2016 National Construction Code

Wood Solutions™
design and build
woodsolutions.com.au

WS Design Guide 39: Robustness in Structures

"... Buildings need to be designed to sustain local damage, with the structural system as a whole remaining stable and not being damaged to an extent disproportionate to the original local damage"

Figure 1.1: NCC Clause BP1.1(a)(iii)

Figure 1.2: Ronan Point, UK – progressive collapse of one side of building due to gas explosion.

Wood Solutions™
design and build
woodsolutions.com.au

WS Design Guide 20: Fires During Construction

A major consideration during construction.

Only addressed to a limited extent in BCA

Guide published June 2014 – being referenced by contractors

Wood Solutions™
design and build
woodsolutions.com.au

WS Design Guide 26-29: Costing Case Studies

Costing case study guides also available for: apartments, offices, aged care and industrial buildings

Wood Solutions™
design and build
woodsolutions.com.au

WS Mid-rise Advisory Team – Vic Pilot

WoodSolutions technical staff (engineers, architects) on the ground to provide face-to-face assistance to building professionals in getting new timber buildings specified and constructed

Wood Solutions™
design and build
woodsolutions.com.au

Discover WoodSolutions

www.woodsolutions.com.au

Thank You for Your Attention