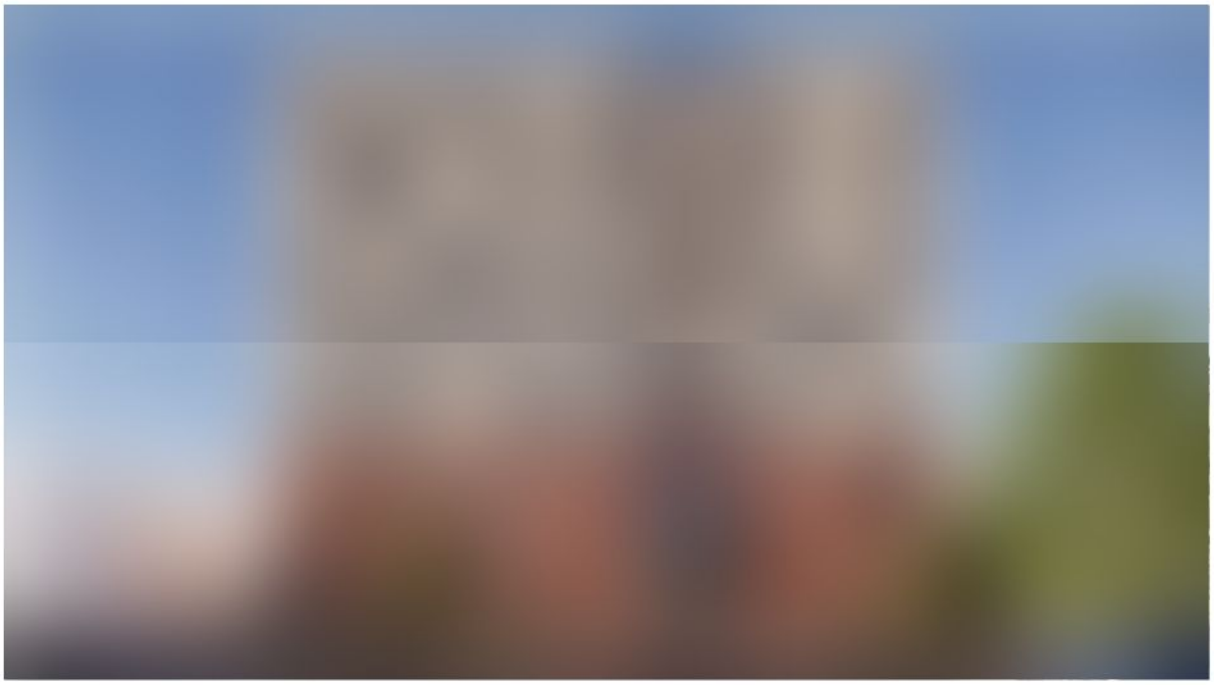
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[redacted]

Timber Structure Feasibility Report



Document History

Revision	Date	Comments
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1 Introduction

Arboralis were commissioned by [redacted] to conduct a short feasibility study into the potential use of prefabricated timber systems for the proposed building at [redacted] in [redacted]. The report in addition to the scheme drawings attached in the appendix provide a high-level review of the project, structural sizing to support some budget pricing from material suppliers and is intended to support a broader assessment of the feasibility of the project to progress as a timber solution.

1.1 Structure Description

The structure is a square plan building with 7 floors. The layout on ground floor and level 1 includes various community and services spaces, while the upper levels are consistent and contains the accommodation and a community area on each floor.

We have considered the building as a good candidate for a timber option for the upper levels due to the following characteristics:

- Consistent floor layout between levels, removing complex transfers
- Modest structural spans suiting timber solutions
- Simple building shape with a square plan, meaning stability can be achieved simply through the timber walls and floors, or by utilising the substantial core as concrete

1.2 Exclusions

The scope of this report is focused on the structure from level 2 and above. We have assumed that the level 2 slab and below will be constructed from conventional structure (i.e. concrete) and this is excluded from this study.

2 Structural Systems

2.1 Systems Considered

In assessing a timber structural solution for the upper levels there are several potential systems which could be employed, all of which have different pros and cons. We have considered the following solutions as part of the process in order to develop our initial scheme proposal. The unique supply chain to [redacted] means that the relative cost of some options will vary compared to the eastern states and we have drawn on our recent experience with suppliers to WA to inform our designs.

2.1.1 CLT walls and floors

Cross-laminated timber (CLT) loadbearing walls and floors. This is a relatively common system around the world for timber residential buildings, utilising the speed and accuracy of fabrication as well as the lightweight nature of timber to quickly create the building structure



Pros:

- Very fast and simple to construct, with standard brackets screws being able to deal with most items
- A single supplier for floors and walls means less to coordinate across different companies, presenting less risk of clashes or compliance issues.
- A high level of inherent fire and acoustic performance compared to other timber options, with the solid nature of the panels providing strong benefits

Cons:

- While floors can be relatively efficient, walls can be expensive due to the amount of timber fibre in them. At five storeys tall the building is at the tipping point of CLT walls being required for structural reasons
- Limited ability to add other items to the walls (windows, linings, cladding etc) prior to install, without double handling. While this does happen on some projects it's unlikely to be offered by the suppliers directly, resulting in the need to double handle. Many CLT buildings are installed and then clad conventionally via scaffolding

2.1.2 Timber frame walls and floors

Using traditional timber frame walls with varying degrees of prefabrication possible. Floors could be either CLT or a timber floor cassette. This is commonly used in Europe and the US but is less common in Australia with only a few projects built in this way (The Green in Parkville, Melbourne and Phoenix Apartments in Sydney).

At five levels, the structural demands on the walls and floors are starting to increase the sizing for frames. Using materials like LVL instead of softwood, reducing centres of studs etc, as well as additional bracing elements is likely to be required at 5 storeys.

Our scheme for this option assumes that the timber walls contribute to the stability of the building. This will potentially require further bracing/tie details, but we believe would make the overall solution more effective the build. We would still propose the lift walls in CLT for this scheme for simplicity of detailing.

2.1.3 Glulam (GLT) post and beam with CLT floors

While this is more commonly used for office buildings, it is still used for some residential buildings, as it offers advantages around layout flexibility and uses the loadbearing structure where it's most efficient.



Pros:

- Material efficiency in terms of timber with only used in areas where structural load is high
- Flexibility of form for walls below. These can be lightweight non-loadbearing partitions

Cons:

- Head heights are reduced with glulam beams sitting lower than the structure in the loadbearing wall options.
- Further coordination with services is required around beams

2.1.4 ASH ATC

Australian Sustainable Hardwoods (ASH) have developed a timber-concrete composite floor system to complement their glulam offering, creating a sole-sourced solution they are pitching towards apartments. It's relatively new and has not yet been delivered on a project, but there is strong interest.

2.1.6 Not considered

- CLT post and plate – not used yet in Australia and presents compliance risk. Relies on far larger panel widths (3m+ which is less likely to be economic in [redacted])
- Steel frame and CLT floor hybrid – possible for more commercial buildings, but there are challenges with coordination on a small scale and mixing of trades
- Timber-concrete composite – possible for the floor, but slows down construction due to back-propping and presents more compliance challenges

2.2 Schemes chosen for feasibility study

Ultimately, we have chosen the following schemes to document in more detail.

- Loadbearing CLT walls and CLT floors
    - A sub-option included for timber frame sizing for this option as the overall structural system is the same
- GLT post and beam with CLT floors

In our experience these offered the best balance between the likely cost, breadth of the supply chain and material efficiency out of all those considered. Further discussion of the supply chain for each is included in Section 3.

We've chosen to document the sizes in European grades for the CLT and GLT as we believe these would likely be the most cost-effective for supply into [redacted], due to the costs of shipping from the east coast mass timber suppliers.

4 Pricing and Other Considerations

4.1 Pricing

Pricing timber solutions is challenging as there are a lot of aspects which are different from conventional construction and in our experience, it can take a few revisions of a cost plan to fully understand some of the benefits for timber construction.

Wood Solutions have provided some guidance on pricing these buildings and though they are a little out of date in terms of figures, they do talk to the broader benefits and where savings can be found. The relevant guides are #27 and #28 for apartments and [redacted] respectively, and are freely available on their website. Some areas to focus on include:

- Reduced foundations/transfer structures due to lower building weight
- Speed of construction, smaller crews
- Lower holding costs + faster handover
- Lower scaffolding costs
- Reduced cranage costs
- Avoiding compounding differences between baseline scheme comparisons with contingencies/prelims etc based of % of base build costs

Our drawings have provided some information on expected floor and wall buildups for some of the key components to achieve fire and acoustic requirements, but these should be confirmed with a relevant professional as required.

4.2 Opportunities

We have allowed to expose the timber in the common area by designing these elements to provide a 120-minute FRL through charring alone, allowing the timber soffits of the beams/floors to be exposed if required. We felt that this could be an attractive option for the client. The internal rooms are assumed to be covered with fire-rated plasterboard and include services etc.

The fire resistance level (FRL) of 120 minutes for the structure is high for timber. In many timber buildings it has been possible to use a fire engineering approach to reduce the FRL to 90 minutes, which can result in some thinner elements or reduced finishes. This could be explored if the design progresses.

The roof is currently documented in CLT which may be more expensive, but offers a fast to install roof and a single supplier. A more traditional pitched roof with cassettes or trusses might be possible if coordinated well, and offer some cost savings.

5 Conclusions

The proposed [redacted] development at [redacted] in [redacted] offers some opportunities for a timber-based solution for the upper five levels of accommodation. The combination of relatively short spans, repeated layout and lower acoustic requirements mean that timber solutions could readily be adopted and provide a great outcome for the project.

Our preferred solution is the loadbearing CLT solution, with a potential hybrid option with loadbearing timber stud walls and CLT floors being a secondary one, which is more heavily dependent on a specific supply partner in [redacted].

Benefits to the client of a timber solution include:

- Low-carbon structure to support ESD requirements
- Faster and low impact installation process
- Biophilic benefits of exposed timber structure for residents
- Lightweight structure reducing in-ground costs

Should you wish to discuss any further aspects of this report, or wish to expand upon the study to gather more detail then Arboralis would be happy to support.

Notes:
1. These structural concepts are provided to assist initial feasibility and cost-planning and any sizing is based on a limited assessment of the building performance, architecture and other technical requirements. Where possible assumptions have been referenced, but it is the responsibility of the client to ensure that any information provided is suitable for their purposes and we accept no liability for financial decisions made on the basis of this limited assessment.
2. Any quantities provided are approximate only, do not account for waste, and should be confirmed by tendering parties
3. These drawings do not constitute a construction ready design

Balconies are nominally Hardie plank, Hebel planks or similar interlocking cementitious based system on steel framing (assuming no fire egress requirement). Frame is articulated such that the timber frame can shrink relative to the steel columns, with the steel frame bringing between. Construct steel frame such that there is a slight fall away from the building that corrects as the timber takes on load. Aim for screed free build-up both to reduce weight and to remove wet trades from height.

Glulam beam and columns to balcony - designed as thicker for 120 minute FRL through charring to allow them to be exposed

240mm thk CLT panel: thickness is driven by vibration requirements. It also works out that the 240mm thk can perform structurally for a 120min fire event, potentially enabling a exposed feature CLT ceiling in the common seating areas. (subject to appropriate fire strategy)

With the exception of the 240mm thick panels, the scheme intent is that all CLT is encapsulated in fire resistant plasterboard that prevents the CLT from off gassing and contributing to the fire event for the full 120 minute fire design period.

Walls between rooms provide primary stability system resisting horizontal loads in bending in shear. The large number of walls between the individual SOUs make the stability of the building achievable with CLT walls, without particularly onerous tie down requirements. The distribution of the walls over the floorplate helps to reduce concentrations of loads within the diaphragm too, which helps to control the number of screws/fixings within the floorplate connections.

Suggest that services strategy distributes key services in ceiling voids along corridor lines, improving service access and minimising acoustic/fire detailing. Services then distribute to individual rooms through bathroom wall, with bulkhead over bathroom.

Suggest that bathrooms formed in CNC polyurethane trays accommodated within depth of acoustic floor build-up, additional acoustic measures can potentially be accommodated within bulkhead under. Preformed tray reduces requirement for wet trades at height and reduces loading on CLT slabs.

Interior load bearing walls are generally:
Podium- 4th floor 140mm thk, 5 lamellas.
4th floor-roof 120mm thk, 5 lamellas.

Around lifts and stairs: 140mm thk 5 lamellas.

CLT spans arranged so as to avoid passing vibrations from corridors into room areas.

Stair core considered fire sterile and controlled as part of fire strategy, permitting CLT stairs and landings. Can alternatively use drop in steel stair system instead if preferred.

Lift walls in CLT. This means all of the superstructure moves as one, for example responding to thermal/moisture changes, and minimises differential movement that can be a challenge with an equivalent concrete core. Also improves procurement/site route, as all timber installed at same time and don't need to wait for cores to go up first.

Corridor support arranged so as to avoid downstand beams crossing corridor to aid services distribution.

If easier for procurement/construction can make 140mm thk slab throughout corridor and rooms, keeping the span arrangement the same as shown.

Walls not highlighted are not rquired structurally. They could be procured as CLT, or alternatively infill studwork.

Specialist acoustic advice is required should this framing approach be progressed. It is likely that an acoustically isolating wall detail will be required between units. Allow for a secondary wall on acoustic mounts to one side of the CLT, and for acoustic control strips to the top and bottom of each wall. Care will be required to develop an appropriate floor build up which is able to provide an appropriate degree of acoustic control.

Balcony nominally Hardie plank or similar interlocking cementitious based system on steel framing (assuming no fire egress requirement). This bay spans between the adjacent CLT walls and does not require additional steel columns. Aim for screed free build-up both to reduce weight and to remove wet trades from height.

240 thk
140 thk
120 thk
(W01)
(W02)
(W03)
(W04)

Legend

Description	Quantity	Unit
150x150x6 SHS	4	Count
200x22.3 UB	5	m
200x22.3 UB	36	m
230x75x25 PFC	34	m
CLT Floor TL 140mm thk	650	sq m
CLT Floor TL 240mm thk (ss)	74	sq m
CLT Floor TT 120mm thk	84	sq m
CLT Wall 120/5	296	m
CLT Wall 140/5	62	m
Fibre Cement Floor	14	sq m
Fibre Cement Floor	26	sq m
GLT Column 300x300xGL24h	2	Count
Timber Beam 360x120 GL24c	51	m
Timber Beam 360x400 GL 24c	9	m

STUD FRAME ALTERNATIVE:

It is possible to switch from CLT to timber studs either completely or in part as an alternative construction approach. Equivalent sizes as follows:

WALLS
Podium to 4th floor: E13 LVL 170x45 studs at 300mm c/c
4th floor to roof: E13 LVL 150x45 studs at 400mm c/c, both cases noggins at max 1.2m vertical centres (or sheathed)

Allow for additional studs around openings, particularly on facade lines.

FLOORS
Generally timber cassettes comprising of E13 LVL 300x45 joists at 400 c/c for roof, rooms and corridors. Open plan communal space E13 LVL 400x45 joists at 400 c/c.

If using stud walls and floors it is crucial to use a distributed stability strategy, and an allowance should be made for using a compensated bolt system such as the Simpson Strongtie Strong-Rod ATS system or similar.

Exact stud spacings/sizes would likely develop with the design to accommodate exact floor/ceiling build ups, acoustic requirements, material availability etc.

Option A- Loadbearing CLT

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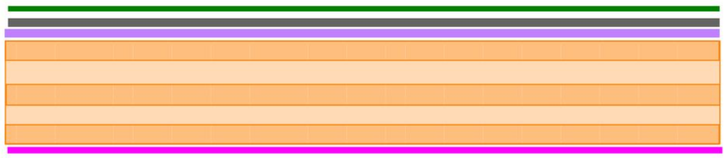
Project: [redacted]
Client: [redacted]
Job Number: [redacted]

Engineered by: NH
Drawn By: NH
Date: 08/10/2025

Drawing Title: Floor Plan - Levels 3-6
Drawing Number: S130

Revision: P1
Scale: NTS

CLT Floor Option 1 - Buildup on top



Floor finishes (direct fix)
18mm FC Sheet (total)
10mm Regupol or similar
140mm CLT
16mm FR plasterboard

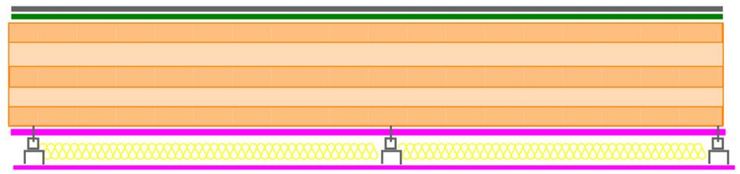
Note. To expose the CLT beneath the floor becomes a minimum of 200mm thick

Pros:
- Simpler ceiling construction
- More 'MMC' solution
- Very limited acoustic rating is very good for CLT option (though may wish to target higher performance)

Cons:
- Services below may require ceiling anyway
- Set-downs for bathrooms TBC - may require a larger buildup to avoid stepping panels

Acoustic performance required : Rw>45dB (TBC. Also no impact rating?)
Fire performance required: 120/120/120

CLT Floor Option 2 - Suspended Ceiling

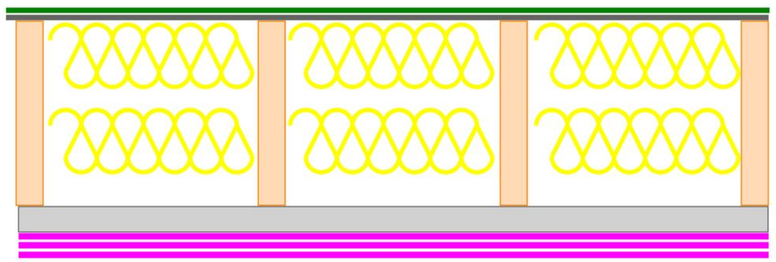


Floor finishes + underlay
140mm CLT
16mm FR plasterboard
Furring channels + insulation
13mm standard plasterboard on resilient mounts

Pros:
- Less expensive floor buildup
- Services can run in ceiling (can also use a larger suspended ceiling void)

Cons:
- More site work for ceilings
- Bathroom/balcony set downs become more difficult and structure likely to need to step
- Wall construction becomes more difficult due to steps in wall and lifting challenges

Timber Floor Cassette - Suspended Ceiling



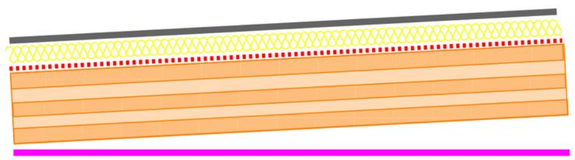
Floor finishes
Flooring (particleboard/CFC/MGO)
300x45 LVL joists @ 400cts (or posi struts/similar)
Insulation
Furring channels
3x16mm FR plasterboard

Based on Red Book

Pros:
- Less expensive floor buildup
- Services can run in ceiling (can also use a larger suspended ceiling void)

Cons:
- More site work for ceilings
- Bathroom/balcony set downs become more difficult and structure likely to need to step
- Wall construction becomes more difficult due to steps in wall and lifting challenges

CLT Roof Option - Standard

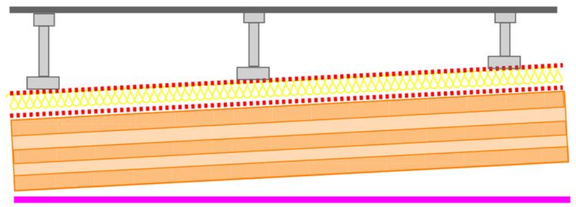


Roof sheeting to fall
Insulation/battens
Membrane
120/140mm CLT to falls
Cavity + insulation
13mm plasterboard

Pros:
- Same construction as floors
- Quick to install CLT and get to watertight

Cons:
- CLT is heavy for roof loads. Could be thinned down structurally, but kept same as floor for repetition
- CLT shown to falls, but may not be simplest for construction/finishes. Alternative is flat CLT with tapered insulation, but we recommend a secondary membrane to avoid risk of standing water on CLT

CLT Roof Option - Terrace



Pod/Pavers
Membrane
Rigid Insulation
Membrane
120/140mm CLT to falls
Cavity + insulation
13mm plasterboard

Pros:
- Easier to inspect/remediate waterproofing if required
- Quick to install CLT and get to watertight

Cons:
- Insulation/details for pod and paver need work
- CLT shown to falls, but may not be simplest for construction/finishes. Alternative is flat CLT with tapered insulation, but we recommend a secondary membrane to avoid risk of standing water on CLT

Option A- Loadbearing CLT

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Project:
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Client:
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Job Number:
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Engineered by:
NH
Drawn By:
NH
Date:
08/10/2025

Drawing Title:
Roof/Floor Sections
Drawing Number:
S210

Revision:
P1
Scale:
NTS