



Red Stag Wood Solutions (Red Stag)

is the leading independent manufacturer of the Cross Laminated Timber (CLT), timber frames, trusses and prefabricated building solutions for residential, commercial and industrial construction in New Zealand.

Factory Overview

Red Stag Wood Solutions Limited (Red Stag) exists to help transform timber construction through technology, to further support the building industry, which is vital to the environment and the social fabric of our communities. Red Stag is focused on developing new products and solutions to drive productivity, while drastically reducing the carbon footprint of construction, in parallel with providing relief for housing shortages and affordability.

Red Stag is the legal entity within the Red Stag Group focusing on structural Engineered Wood Products (EWP), including but not limited to Cross Laminated Timber (CLT), Glue Laminated Timber (GLT), Frame and Truss (F&T), advanced stick panellisation and cassette systems. Red Stag has constructed the first phase of New Zealand's largest and most advanced CLT plant. The scale facility has the ability to manufacture panels up to 16.9 x 4.9 x 0.42 m (Length x Width x Depth). *Figure 1* shows sections of the new Red Stag EWP plant.





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Figure 1: Red Stag's manufacturing line; (a) 17 meter lamella out of the Finger Jointing (FJ) machine, (b) CLT pressing machine and the panel handling.

Cross Laminated Timber (CLT)

CLT is fundamentally changing the way buildings are designed, manufactured, and constructed. Red Stag's investment and innovation will help CLT become the backbone for future generations of high-performance, low-carbon construction, in traditional mid and high rise buildings.



CLT Panels

CLT is a high-performance mass wood product that is generated by utilising graded boards, which are glued together in a cross-layered (each layer orientated 90 degrees to each other) orientation. Red Stag CLT is manufactured from New Zealand renewable FSC certified forestry, typically in three layers, with a common thickness of 126 mm to achieve the structural requirements for the majority of sub and mid floors (refer to *Figures 4 - 5*). The benefits of CLT include design flexibility and versatility, fast installation, lightweight, exceptionally good structural properties, outstanding seismic performance and a very good fire rating (Fire Resistance Level of 60/60/60). CLT is highly cost-effective in these applications compared to concrete and steel and is a significant sequester of carbon, making it an environmentally friendly solution.



CLT Floor Panels

CLT has exceptional structural performance for floor and mid-floor applications for both dry and wet areas. Benefits of CLT flooring include the following when compared to:

- a. Concrete: Removes the need for reinforcement for concrete casting, no curing delays and weighs approximately 20% of concrete, reducing foundation design and costs.
- b. Timber floors: Reduced number of joists, I-beams, ply, strand board or particle board sheets. Many of these products are currently in short supply. No additional sheet material is required for the structural floor, saving on materials, labour and fall protection (as soon as the CLT is installed, it is safe to work on and under).
- c. Piling: Grid patterns for piling can typically be much greater, reducing the number of piles and associated labour. Typically, there is no need for both bearers and joists, saving on materials and labour.

As shown in *Figures 4* and *5*, CLT panels are supported by perpendicular beams or supporting walls for mid floors. The standard Red Stag CLT floor panel has a thickness of 126 mm, which will span up to ~4.2 m when applied in a double span (refer to *Figures 4, 5,* and *Table 1*). This is

ideal for a floor on a raised foundation, typical mid-floor or mezzanine. If the original floor design has not been completed in CLT, Red Stag can organise a Producer Statement to support in substituting traditional floors to Red Stag CLT. *Table 1* provides span details for single and double span CLT Floors under three different loading conditions.





Figure 5: CLT floor and beam configuration.

CLT Panel Title		Dead Load = 0.5 kPa Live Load (Imposed Load)			Dea	d Load = 1.0	kPa	Dead Load = 1.5 kPa		
					Live Load (Imposed Load)			Live Load (Imposed Load)		
		2 kPa	3 kPa	5 kPa	2 kPa	3 kPa	5 kPa	2 kPa	3 kPa	5 kPa
Single Span*	CLT 3/126	3.82 m	3.59 m	3.27 m	3.54 m	3.37 m	3.12 m	3.33 m	3.19 m	2.98 m
Double Span**	CLT 3/126	4.00 m	4.00 m	4.00 m	4.00 m	4.00 m	4.00 m	4.00 m	4.00 m	4.00 m
Single Span*	CLT ^{plus} 3/126 ^d	3.92 m	3.74 m	3.39 m	3.76 m	3.51 m	3.23 m	3.45 m	3.32 m	3.09 m
Double Span**	CLT ^{plus} 3/126 ^d	4.14 m	4.14 m	4.14 m	4.14 m	4.14 m	4.14 m	4.14 m	4.14 m	4.14 m

a) CLT Floors are designed based on 500 kg/m³ for CLT.

b) CLT Floors are designed for vibration.

c) Red Stag design limits for floors are not constrained to this table. If specific floor designs are required, please contact Red Stag.

d) The bottom layer in CLT^{Plus} 3/126 is strengthed with 10 GPa boards. This new scheduled EWP configuration is under inverstigation with the support of a third party laboratory.



Table 1: 126 mm thick 3 ply CLT floor maximum spans based on design and load conditions ^{a, b, c,}

NOTE

The 4.0 m span for double span configuration is limited by the vibration, not deflection. Subject to the fixing method and client requirements, there is the possibility to span greater than 4.0 m with a 126 mm CLT panel. If greater spans are required for the configurations in *Table 1* Red Stag can engineer a solution to suit the project's requirements (e.g. greater spans, loads, etc). CLT can also be used to create ceiling/roof planes, supporting in enclosing structures faster and providing a robust subrstate for roof system installations, alliviating the need for safety nets in most scenarios.

CLT Connections

There are a wide range of CLT connection methods, fasteners and types of joint details to support CLT floor assemblies. Self-tapping screws provide the most common and simplest connection solution. A series of CLT screw connection examples are illustrated below (*Figure 6* to *Figure 8*). Red Stag can support with the supply of specialised screws suitable for use with CLT.





Figure 7: CLT floor panel to Light Timber Frame (LTF) wall or timber beam connection; (a) L Shape connection for boundaries, (b) T Shape connection for intermediate walls/beams.



Figure 8: CLT floor panel to steel beam connection, (a) Steel Channel beam connection, (b) Steel I beam connection.

Lap joints (half-lap joint) and spline joints are commonly used to connect CLT floor panels together, secured with short self-tapping screws (*Figure 9* to *Figure 10*). The option exists for Red Stag to supply panels with a standard square edge (any machining or adjustments completed on-site), lap or spline joints.



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CLT floor panels simplify the installation of sub floor utilities and services, reducing time and cost on-site. This can include, but not be limited to Mechanical and HVAC ducting, plumbing services, electrical systems, etc (Refer to *Figures 11* and *12*).



Figure 11: Cross-section view of the suspended utilities under CLT flooring systems.

Note : Wall intersect for ceiling line will require additional nogging for wall lining fixing under suspended ceiling.

Depending on the design, CLT can be left exposed. Suspended ceilings or bulkheads could be used only where service runs are required, typically under upper storey bathrooms. If some specialised machining is required, it is possible; however, these will need to be coordinated and supplied directly via Red Stag due to the complexity. Examples of more detailed machining options are illustrated in *Figures 11 & 12*.



CLT Treatment Options

H1.2 Boron: The standard CLT panel from Red Stag will be H1.2 boron treated. Red Stag sources its timber feedstock from Red Stag Timber (RST). RST complete all milling, grading, treatment and drying for Red Stag to ensure that the treatment is fit for purpose. As CLT is occasionally exposed (typically internal walls and underside of floors), Red Stag H1.2 treatment is transitioning to clear as opposed to being dyed pink as required for structural timber.

H3.2 CCA: For wet areas (e.g. bathroom floors or similar), Red Stag has the option of providing H3.2 treated panels.

CLT Fire & Acoustic Performance

Red Stag has conducted full scale loaded fire testing on its CLT floor system. Testing and fire reports have demonstrated that the 105 mm thick (35-35-35) CLT achieves a 60/60/60 fire rating. For standard residential and commercial floors, Red Stag proposes a 126 mm (42-42-42) floor, ensuring that the system maintains a 60/60/60 performance level. *Table 2*, details the calculated acoustic performance of five standard configurations of a CLT floor system. In standard sub and midfloor scenarios with no intertenancy, this should not be required; however, is applicable for intertenancy and commercial applications.

Calculated STC Rating	Floor Depth ¹	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6
36	126 mm	Carpet ²	Carpet Underlay³	126 mm CLT	N/A	N/A	N/A
58	260 mm	Carpet ²	Carpet Underlay³	126 mm CLT	Insulation⁴	13 mm Plasterboard	N/A
58	320 mm	Carpet ²	Carpet Underlay³	126 mm CLT	Insulation ⁴	13 mm Plasterboard	N/A
59	260 mm	Carpet ²	Carpet Underlay ³	126 mm CLT	Insulation ⁴	Acoustic Isolators⁵	13 mm Plasterboard
59	320 mm	Carpet ²	Carpet Underlay ³	126 mm CLT	Insulation ⁴	Acoustic Isolators⁵	13 mm Plasterboard

¹ Floor Depth is measured from the top face of the CLT to the plaster board contact plane.

² 12 mm carpet.

³ Carpet underlay grade/specification is 8 mm Chipfoam underlay.

- ⁴ Insulation grade/specification is based on 90 mm Glasswool Batts (min 14 kg/m³).
- ⁵ Acoustic isolators based on Resilient Mounts (cc 1200 mm x 600 mm).

Table 2: Five typical floor configurations and their calculated acoustic performance (STC rating).

CLT Panel Configurations & Project Supply

Red Stag has the ability to provide standard panels at three and four meters wide, or custom sizes to suit the width of the specific project as required. To support developers, merchants and builders in the first phase, Red Stag will tailor sub and midfloor CLT designs to suit the specific project and offer an alternate solution with Producer Statement to support a direct CLT substitution with traditional floors.

To ensure the client's needs are optimised, Red Stag will balance the maximum panel width and length relative to the client's requirements (accommodating site restrictions, crane/hiab capacities, transportation costs, number of panels, minimisation of connections, buildability, etc). To simplify this process, clients simply need to email through the consented/final project plans/engineering details with the requested scope (e.g. subfloor, midfloor, maximum panel width, etc) and Red Stag will mark up and provide a quotation for the CLT supply.

Red Stag is currently working through the CodeMark process to allow the supply of generic panels into projects that did not specify CLT at the consenting phase, to avoid the need for secondary Producer Statements. Standard panel lengths will likely be:

Thickness (mm)	Width (m)	Length (m) Options	Treatment Options	\sim
126	2.4	4.8, 6.0, 7.2, 8.4	H1.2, H3.2	
126	3.0	6.0, 8.0, 10, 12	H1.2, H3.2	\sum
126	4.0	6.0, 8.0, 10, 12, 14, 16	H1.2, H3.2	\sum

Table 3: CLT Floor panel specifications.

Loads over 3.1 m wide overall will require piloting for transport; however, this can allow for entire mid/subfloors to be completed in as little as a single panel/lift. For apartments and multi-unit developments, this generates transportation efficiencies and the time saving will outweigh the additional piloting costs for most projects.

CLT Stairs

CLT stairs compliment the CLT floor systems, allowing for stairs to be installed in as little as 15 minutes, providing safe access to the upper level(s) immediately after the floor panels are installed. This removes the need for temporary scaffolding stairs, ladders, or similar, improving construction efficiency and site safety. Red Stag can support in designing the stairs to accommodate construction loads, providing more flexibility immediately following the floor installation to support the balance of the build. CLT stairs are machined out of a solid panel, allowing for temporary handrails and ancillary fixings to be screwed on anywhere with ease.



Figure 13: Example of Red Stag manufactured stairs.

CLT Floor Panel Lifting System



It is essential for lift safety and lifting screw performance that the lifting angle to a spreader bar is precisely at 45 degrees (refer to *Figures 14a* and *14d*). All lifting calculations and performance is based on these requirements. The number of lifting screws is dependent on the dimensions of the panels, but will generally range between 4 to 14 screws (3 x 6 m panel; 4 x 16 m panel respectively).

CLT Benefits

CLT is extremely fast to install, with many mid floors only requiring between 1 - 4 panels/lifts to complete (*Figure 14*). The fewer the panels, the lower the crane time, reduced screw fixings and associated labour. In many projects, mid floors can be completed in 1 - 3 hours, allowing for the second storey frames to be installed on the same day, improving the speed of building enclosure.

- a. CLT is available now, whilst supply constraints on concrete, steel, timber joists, I-beams, particle board and strand board are to set continue for the foreseeable future.
- b. CLT provides a safe substrate to work from immediately after installation. This avoids the need for safety nets etc. As required, temporary edge protection can be screwed to the edge of the CLT panels before they are lifted into place at height.
- c. CLT is significantly lighter than concrete and steel alternates, reducing the foundation design, saving additional time and money.
- d. CLT is an environmentally friendly solution, sequestering carbon. Red Stag is currently working through the auditing process to obtain certification confirming Red Stag products are Carbon Zero. CLT also reduces site waste and noise considerably, in contrast with alternate materials.
- e. CLT has exceptional structural performance.
- f. CLT floors can achieve a 60/60/60 fire rating (60 minutes under load).
- g. CLT complies with Building for Climate Change regulations being introduced in coming years, as well as the 2025 deadline for government departments and agencies to be carbon neutral.





Customer Enquiries

Email

Red Stag is excited about the benefits its floor and stairs systems can provide to the residential and commercial markets and look forwards to supporting with your projects.

Please do not hesitate to contact Red Stag if you have any queries via the following:

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