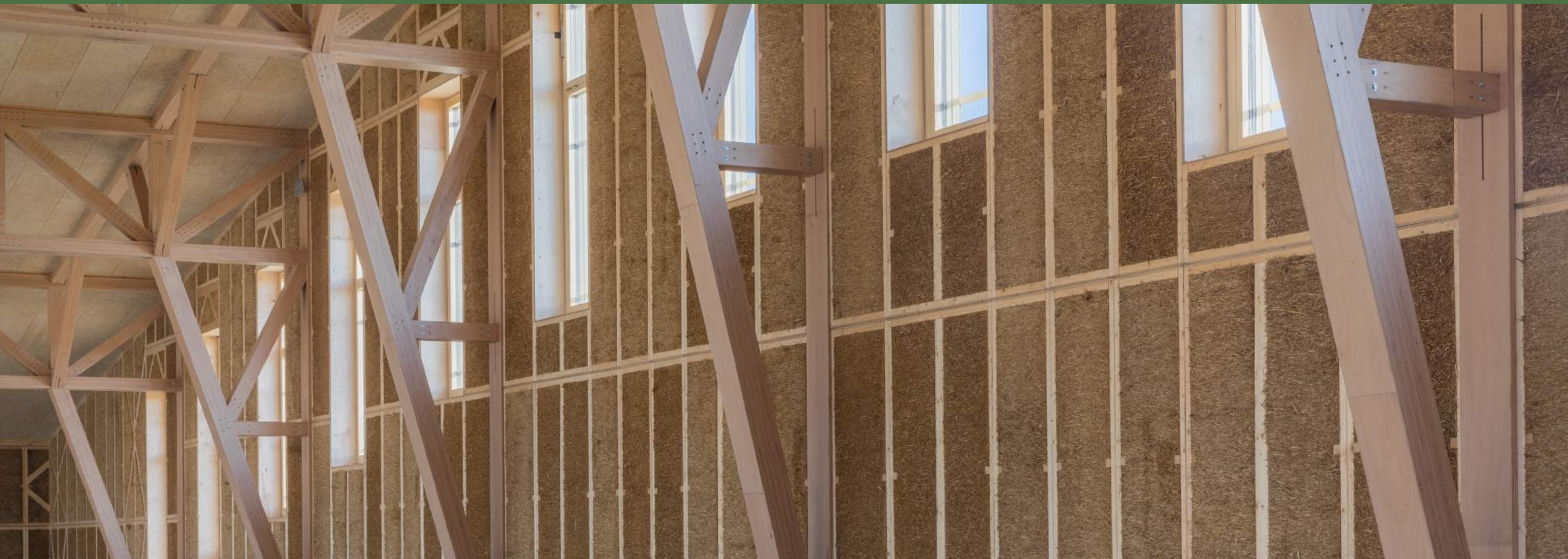
EcoCocon Structural Engineering Guide

ECOCOCON® STRAW WALL SYSTEM

Updated: 2026-07-28



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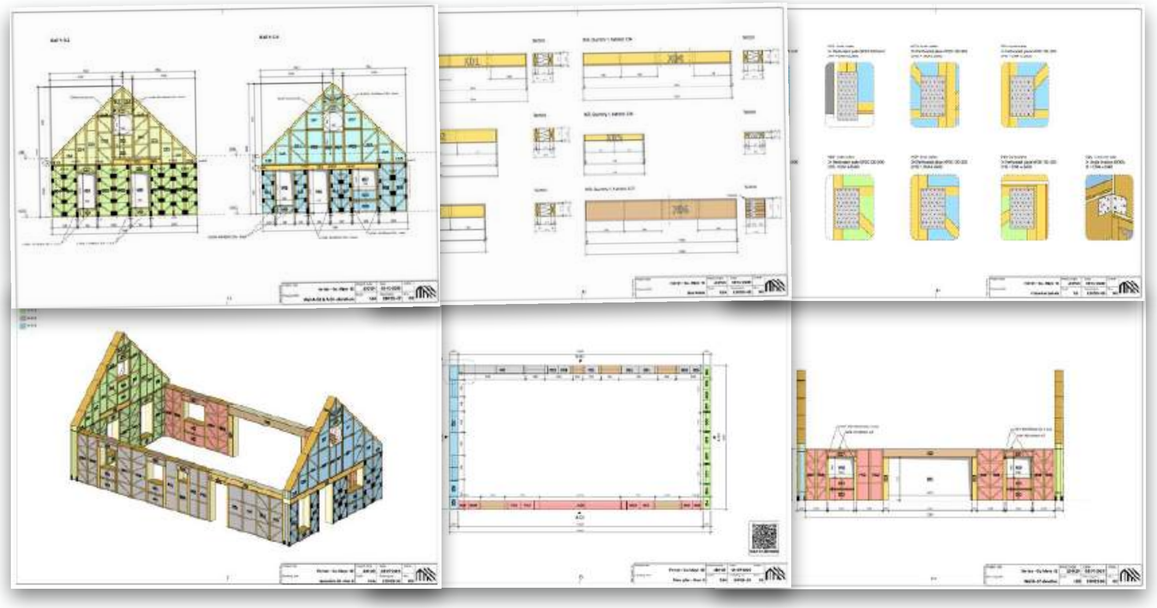
01 Introduction to Design and Design Process

Introduction to Design

EcoCocon is responsible only for the **detailed design and calculation of external EcoCocon wall elements.** This includes the preparation of detailed wall drawings, connection details, and necessary structural calculations required for fabrication and assembly.



Preparation

- The EcoCocon Technical Sales Consultant advises client's engineer and architect on EcoCocon products and how to apply them.
- The client's structural engineer and architect develop a conceptual building design in accordance with the guidelines provided by EcoCocon.
- The client's structural engineer prepares all required information for the EcoCocon design team in accordance with the Project Submission Requirements document.

Creation

- EcoCocon's design process begins only after the **completion of the Preliminary Design phase.** All architectural and structural inputs necessary for detailed wall design must be finalized and approved prior to the start of EcoCocon's work.
- EcoCocon structural engineer calculates wall members according to given loads and prepares a calculation package.
- EcoCocon technician prepares the Panel Project.

Authorisation

- Client's Designer checks Panel Project and approves it.
- Client's structural engineer reviews Panel Project calculation package and approves it.
- EcoCocon prepares a quotation and a contract for a digital signature.
- On behalf of the client a competent person (Builder, Designer, Engineer) verifies Panel Project with signature.

Design Process

During step 4, only minor adjustments are allowed. Any design change from the client may require full recalculation and a new Panel Project, causing delays and extra fees.

Preparation

Creation

Authorisation

Client's Designer & Structural Engineer

1

Designer & Structural Engineer prepare conceptual design referring to the EcoCocon Designer Guide & EcoCocon Structural Engineer Guide (and details in downloads).

2

Designer & Structural Engineer must provide fully coordinated wall outlines, details and loads in accordance with the Project Submission Requirements document.

3

Designer checks 3D outlines; provides comments, requests consultation if needed.

4

Designer verifies Panel Project, **Structural Engineer** reviews Calculation Package and both provide comments if necessary.

5

On behalf of the client a competent person (Builder, Designer, Engineer) verifies Panel Project with signature.

Preliminary design → Detailed design & Panel Project Preparation → Panel Order

EcoCocon Technical Sales Consultant (TSC)

TSC sends Panel Project Information document. Provides support and consultations, initiates meeting between **Client's Engineer and EcoCocon Engineer.**

TSC sends 3D outlines in SketchUp or IFC.

TSC sends Panel Project & Calculation Package.

TSC coordinates all parties and technical consultations, arranges corrections regarding EcoCocon. If convenient, the Client's and EcoCocon Engineers can communicate directly.

TSC sends final Panel Project, Quotation, & Calculation package.

EcoCocon Engineering & Technician team

Technical consultations by EcoCocon Engineer.

The EcoCocon Structural Engineer calculates wall members from the given loads and prepares a calculation package, while the EcoCocon Technician develops the Panel Project and makes corrections if needed.

Client's Structural Engineer takes responsibility for the overall structural engineering.

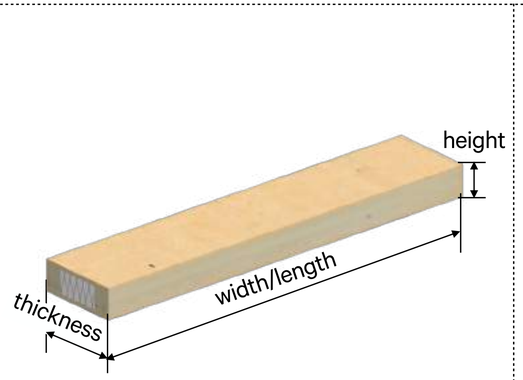
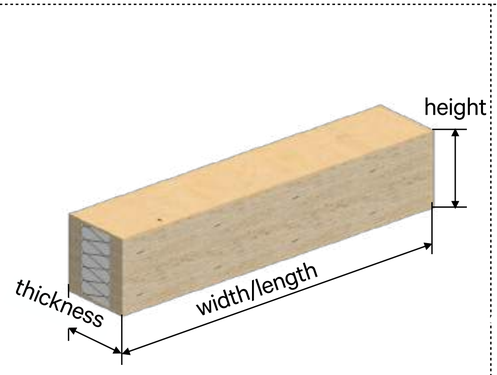
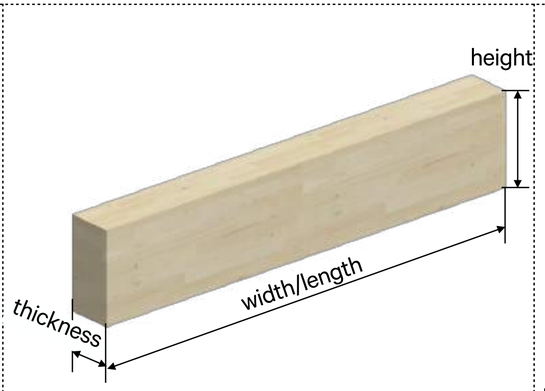
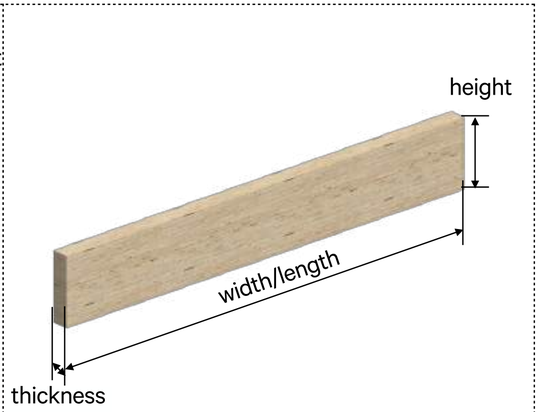
02

Product Description & Use

Panel Types

Picture							
Type	P Panel	B Panel	C Panel	I Panel	I Panel (braced)	S Panel	L Panel
Description	Standard Panel	Braced Panel	Reinforced Standard Panel for higher loads	Inclined Panel	Braced Inclined Panel	Sill Panel (under window)	Lintel Panel
Thickness (mm)	300 - 400						
Min. width - max. width (mm)	400 - 850	400 - 850	424 - 550	400 - 850	400 - 850	850 - 3000	600 - 3000
Min. height - max. height (mm)	400 - 3000	400 - 3000	400 - 3000	400 - 2800	400 - 2800	424 - 850	424 - 850

EcoCocon Box & Timber Elements

Picture				
Type	Box Element	Glulam Box Element	Glulam member	LVL member
Description	C24	GL24h	GL24h	Kerto LVL: Q-panel, L-panel**
Thickness (mm)	300 - 400		80 - 300 (in 20 mm increments)	21**, 45, 75
Min. height - Max. height (mm)	100 - ≤ 250	150 - ≤ 600*	120 - ≤ 1200 (in 40 mm increments)	300 - 400
Min. width/length - Max. width/length (mm)	600 - ≤ 4000	600 - ≤ 9000*	400 - ≤ 13000	400 - ≤ 13000

*For other sizes check availability

**Kerto LVL, L-panel thickness

Intended Uses/ Range of Application

The EcoCocon panels can be used as loadbearing structure and as infill panels.

Range of application:

- Loadbearing panel structure
- Non-load bearing walls (Infill panels)
- Self supporting structures

Self supporting structure (façade renovation).

Loadbearing panel structure.

Non-load bearing walls (infill panels).

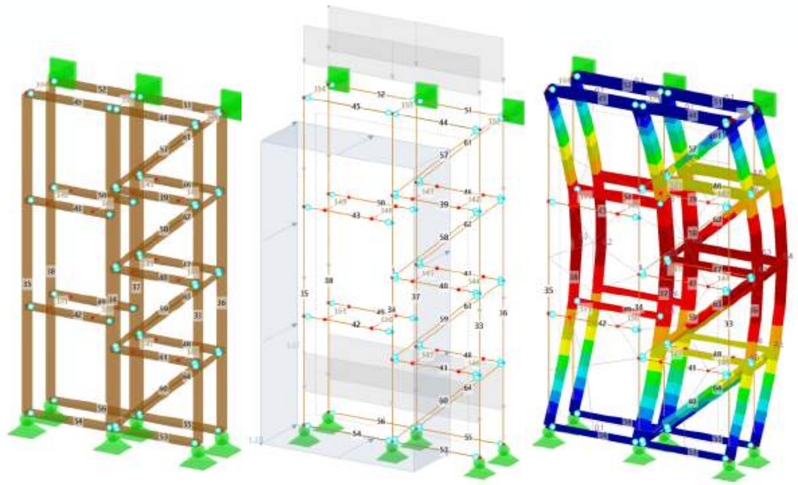
Self supporting structure (pre-assembled panels fixed to loadbearing steel frame).

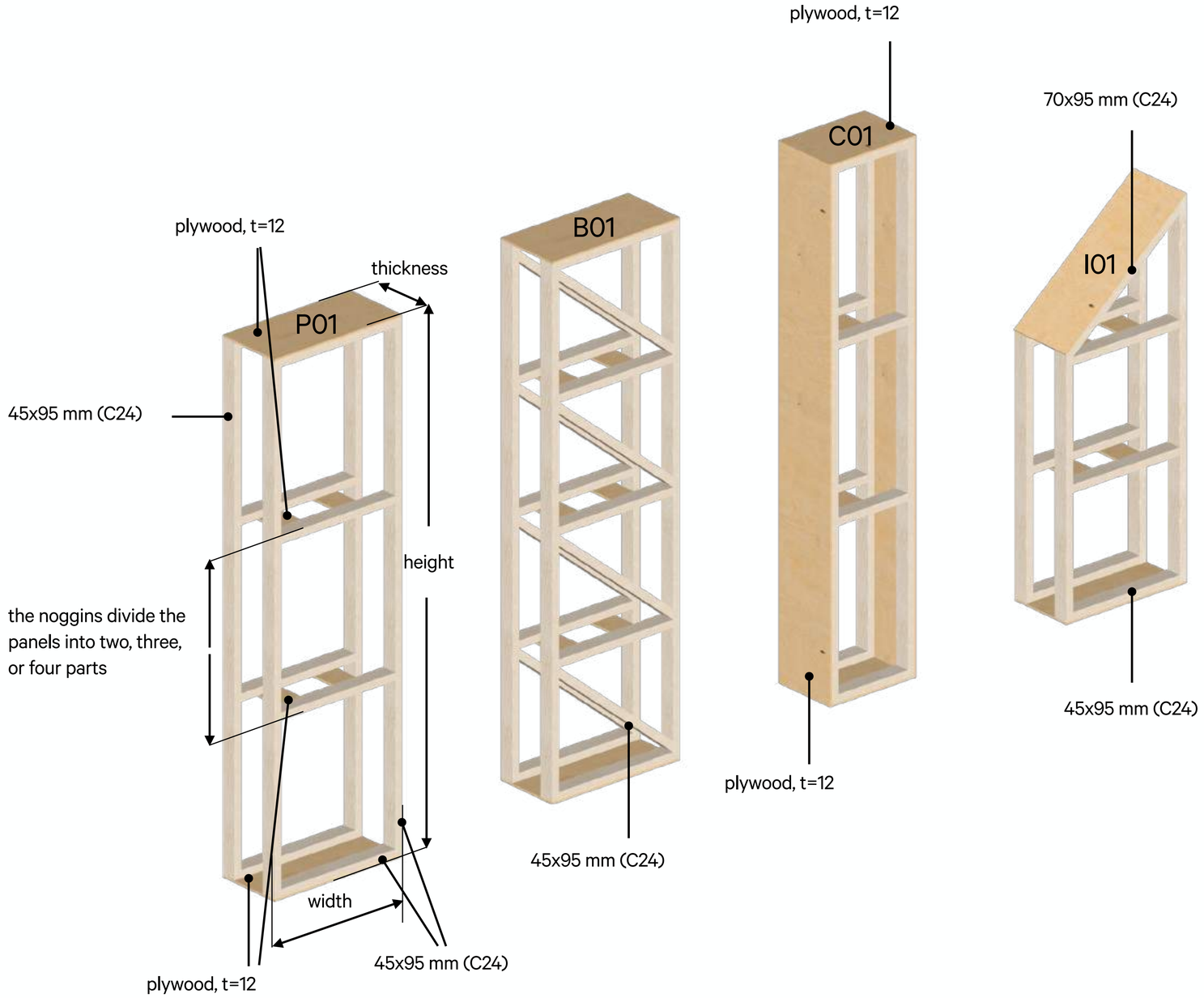
Load-Bearing Walls

EcoCocon panel system with internal and external studs, each capable of carrying loads independently.

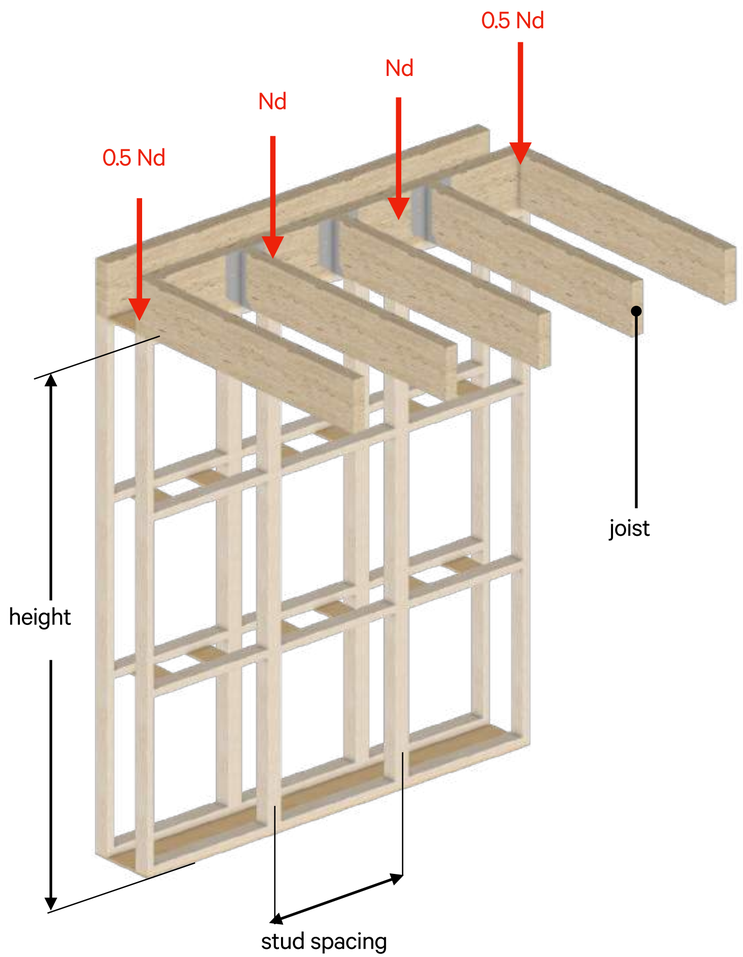
Panels use vertical timber 45×95 mm studs at max. 805 mm centres, secured to non-continuous wall and base plates. Wall strength is primarily derived from the studs.

- Studs oriented with their strong axis (y–y) parallel to the wall face
- In-plane restraint via diagonal bracing members
- Horizontal noggins 45×95 mm at max. 977 mm centres
- Loads must be placed directly over studs, otherwise, a transfer beam above shall be provided to adequately transfer loads





Stud Design Tables



Design table for a twin stud subjected to permanent concentric load and uniformly distributed lateral wind load

Stud	Height, mm	Stud spacing, mm	Characteristic wind load, kN/m²	Design Axial Load Nd, kN
Double 45 x 95 mm	2500	850	0.50	27.26
			0.75	27.26
			1.00	23.48
	2750		0.50	22.40
			0.75	21.06
			1.00	16.20
	3000		0.50	18.62
			0.75	15.38
			1.00	10.26
	2500	400	0.50	28.62
			0.75	28.62
			1.00	28.62
	2750		0.50	23.76
			0.75	23.76
			1.00	23.76
	3000		0.50	19.98
			0.75	19.98
			1.00	19.98

The table above shows the load-bearing capacity of a stud under a permanent concentric load and uniformly distributed lateral wind load. The main assumptions are as follows:

- Studs are calculated according to EN 1995. Load eccentricity is not considered.
- Different combinations of stud heights, spacing, and wind loads were assessed.
- Given the load-bearing capacity of one EcoCocon side.
- Equivalent member lengths: Lcr,y = full stud length, Lcr,z = one-third of the stud length.
- Self-weight of EcoCocon panel (0.78kN/m2) is included.

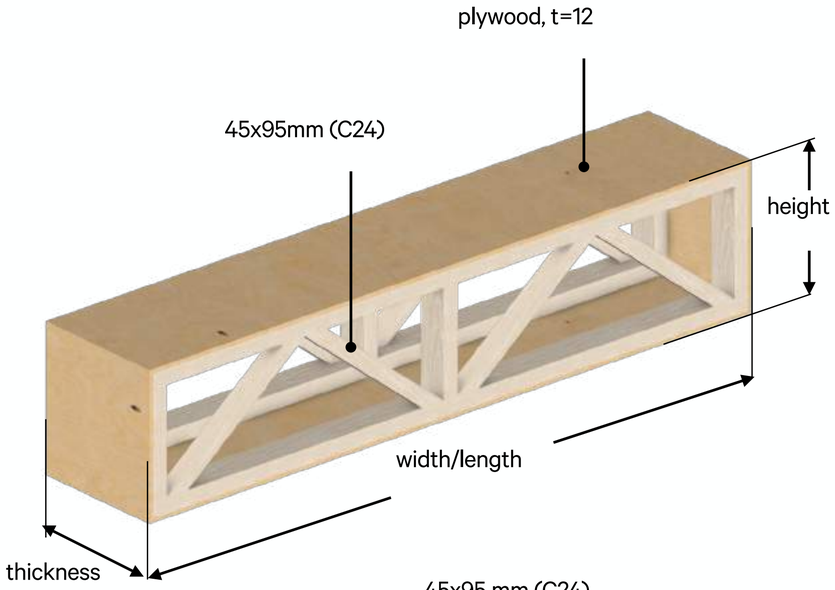
Sill and Lintel Panels

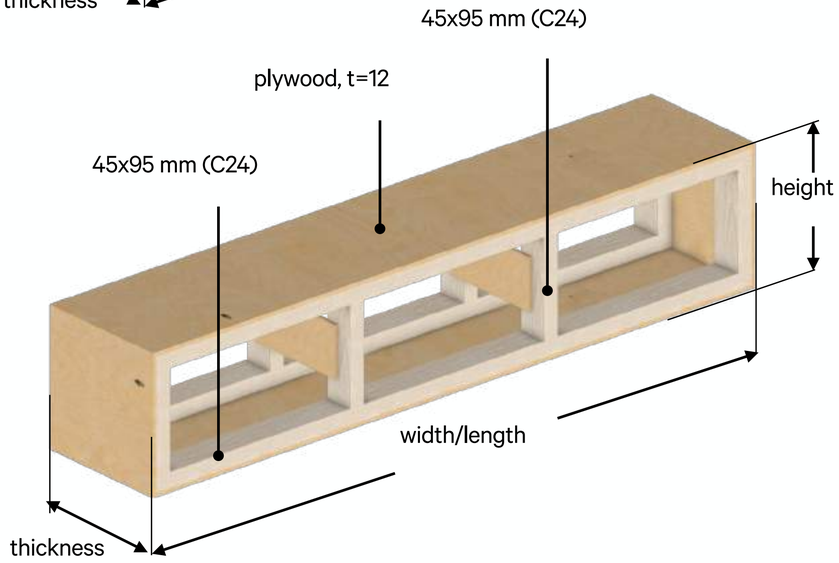
Range of application:

- Sill (S) Panels are used under windows and for parapets where loads are low.
- Lintel (L) Panels are used as lintels over openings.

Main composition:

- Vertical timber 45×95 mm studs of S and L panels at max. 1000 mm centres, secured to continuous top and bottom plates; stronger axis (y–y) parallel to wall face.
- Diagonals at 35–55° between posts to resist tensile and compressive forces.
- Sides joined with 12 mm plywood and noggins, fixed with screws.
- Cavities densely filled with straw during factory production.



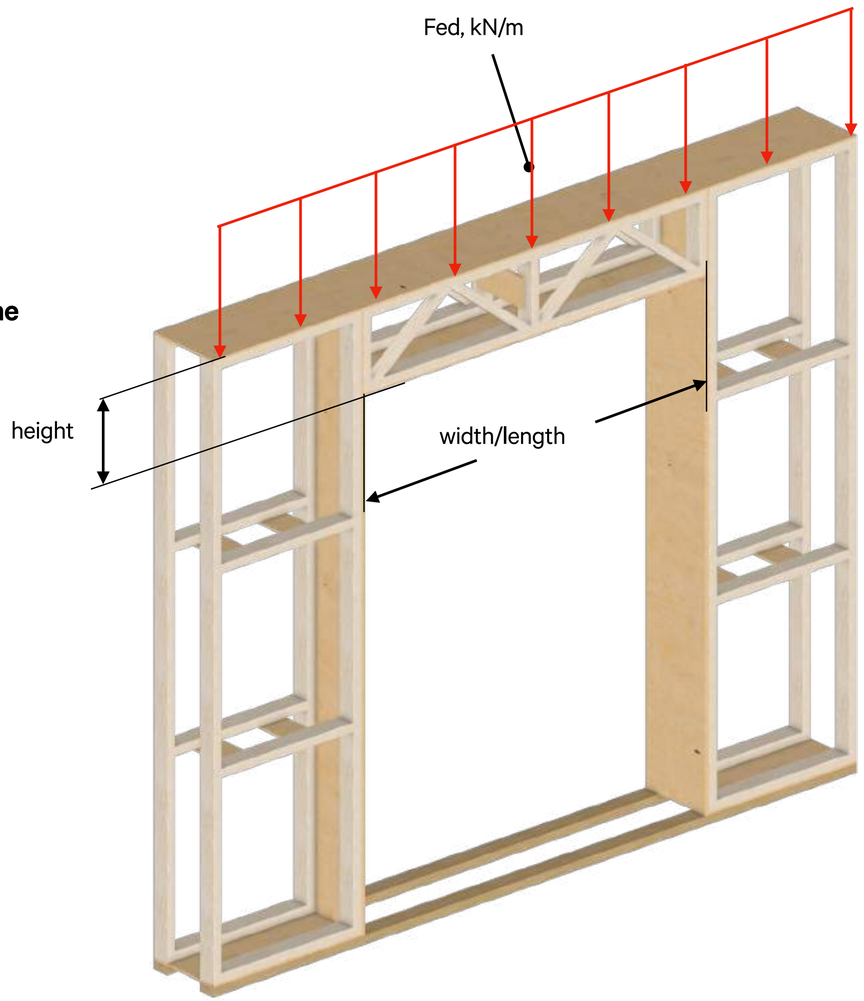


Lintel Design Tables

The load-span table displays the load-bearing capacities of L-type lintels for five different lengths.

- 424 x 3000
- 424 x 2500
- 424 x 2000
- 424 x 1500
- 424 x 1000

Loading scheme



Load-span table for L type panels

Height (mm)	Width/Length (mm)	**Factored Load F_{Rd}, kN/m**
424	3000	**2.25**
424	2500	**2.90**
424	2000	**8.05**
424	1500	**14.10**
424	1000	**16.10**

The main assumptions considered in the calculation of the lintels:

- The lintel capacity F_{Rd} was calculated assuming that the factored load consists of **42%** dead load, **37%** live load, and **21%** snow load.
- Only the Ultimate Limit State (ULS) is considered, the Serviceability Limit State (SLS) is not taken into account due to reasons that deflections are minor.
- The dead weight of the lintels is included: for an external side 0.67 kN/m²; for an internal side 0.78 kN/m².
- Lintel capacity is limited by the connection between diagonal members and chord design. Max. tensile force in the diagonal is limited to 3.457 kN.
- Additional strength due to plywood is not taken into account in the design of the members.
- Load eccentricity from the floor loading is not included.

Box Elements

Used for higher loads when greater capacity is required:

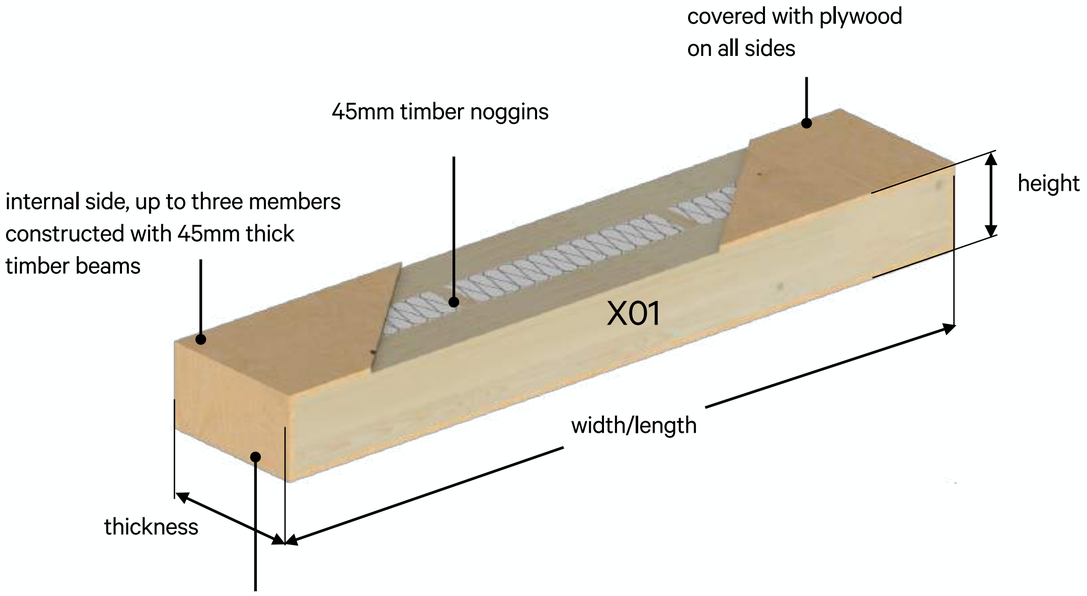
- Used as columns to support point loads.
- Used as lintels where the L panel's load-bearing capacity is insufficient.

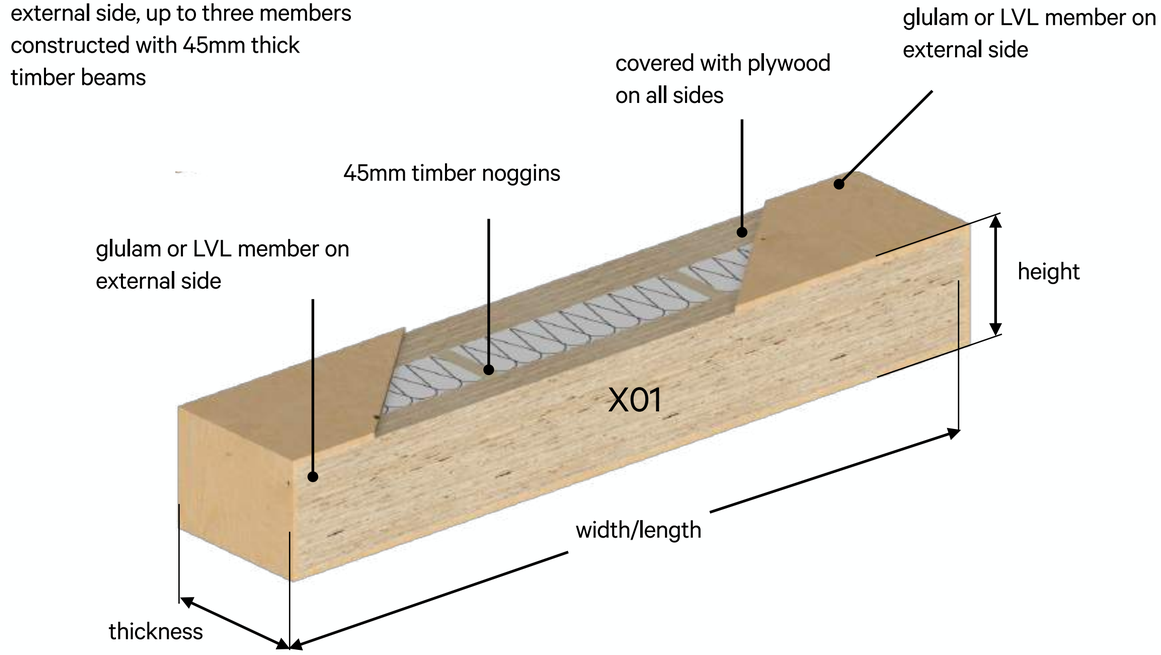
Main composition of box element:

- The internal and external sides are constructed from 45 mm C24 timber, with 1–3 beams per side and a maximum total thickness of 135 mm per side. This rule applies only to C24 box elements; for glulam or LVL box elements, a single element per side is used.
- The sides are connected using 45 mm C24 noggins and plywood, with all components fastened using screws.
- Spaces between beams insulated with soft wood fibre board.
- Higher loads: C24 beams replaceable with glulam or LVL.
- For box elements wider than 225 mm, glulam or LVL is used.

Main assumptions:

- Internal and external beams carry loads independently.
- Load-bearing capacity provided solely by timber beams; plywood excluded.

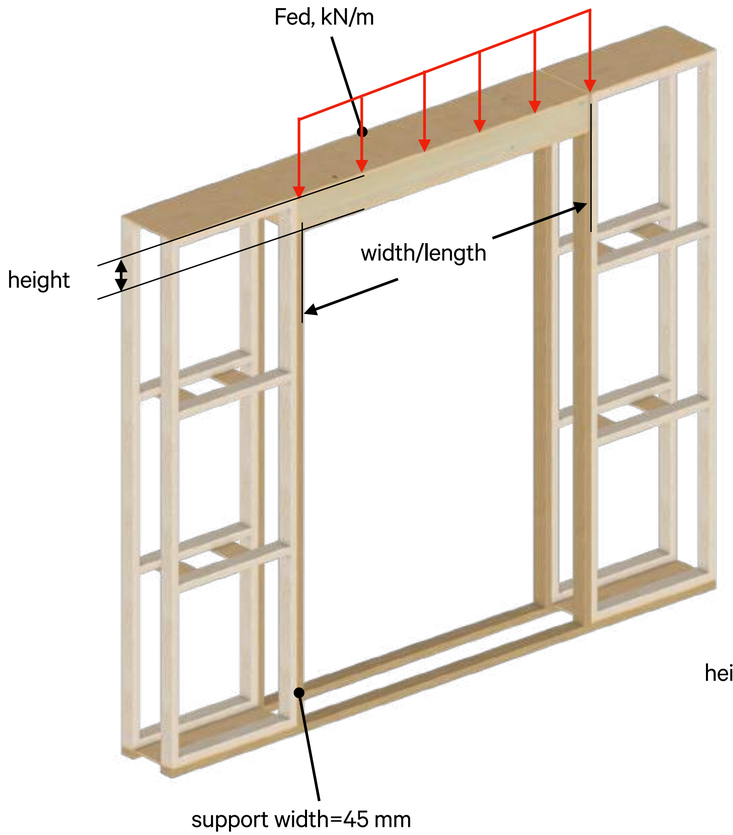


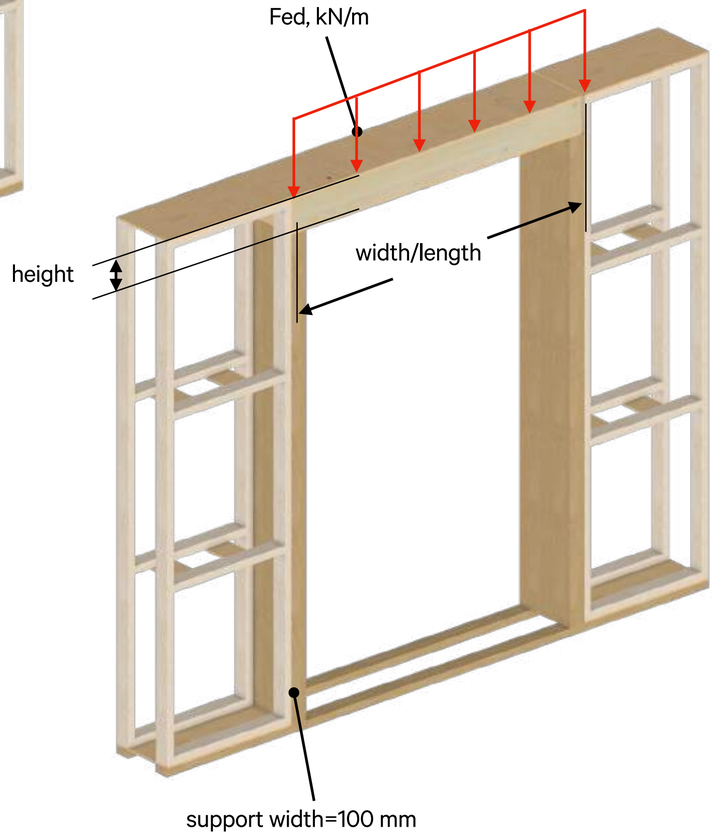


Load-Span Tables for Lintel Box Elements

Load-span table for box elements using: **C24 timber with support width:**

			45 mm	**100 mm**
Composition (one side)	Height (mm)	Width/Length (mm)	**Factored Load F_{Rd} (kN/m)**	
2 * 45x90 mm	120	1000	**14.10**	**14.10**
2 * 45x140 mm	170	1000	**27.39**	**27.39**
2 * 45x190 mm	220	1000	**30.61**	**36.25**
2 * 45x90 mm	120	1500	**5.24**	**5.24**
2 * 45x140 mm	170	1500	**15.30**	**15.30**
2 * 45x190 mm	220	1500	**20.14**	**24.17**
2 * 45x90 mm	120	2000	**2.01**	**2.01**
2 * 45x140 mm	170	2000	**8.06**	**8.06**
2 * 45x190 mm	220	2000	**15.30**	**15.30**
2 * 45x140 mm	170	2500	**4.03**	**4.03**
2 * 45x190 mm	220	2500	**9.67**	**9.67**
2 * 45x140 mm	170	3000	**2.01**	**2.01**
2 * 45x190 mm	220	3000	**4.83**	**4.83**
2 * 45x190 mm	220	3500	**2.58**	**2.58**





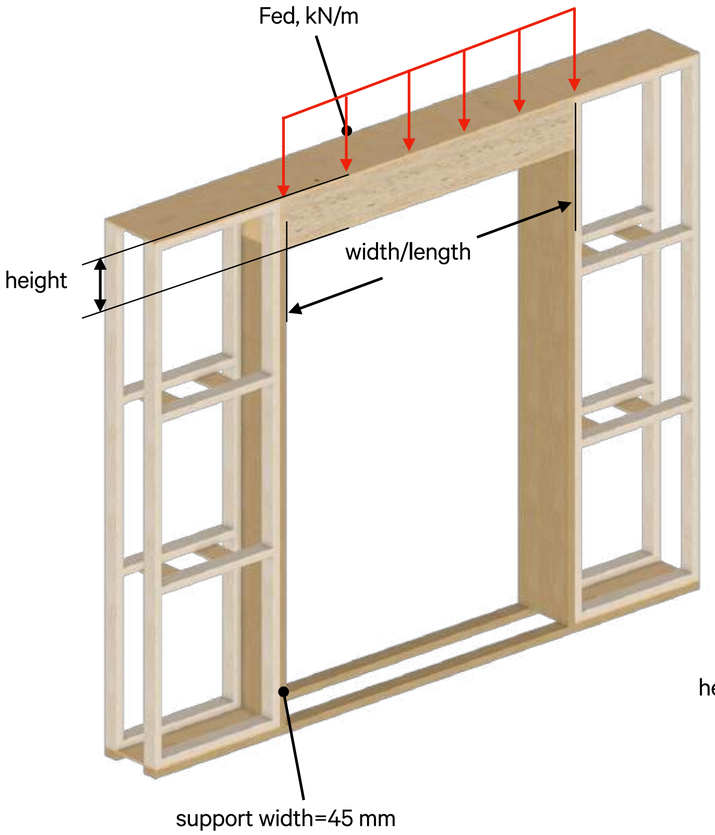
The main assumptions considered in the calculation of the lintels:

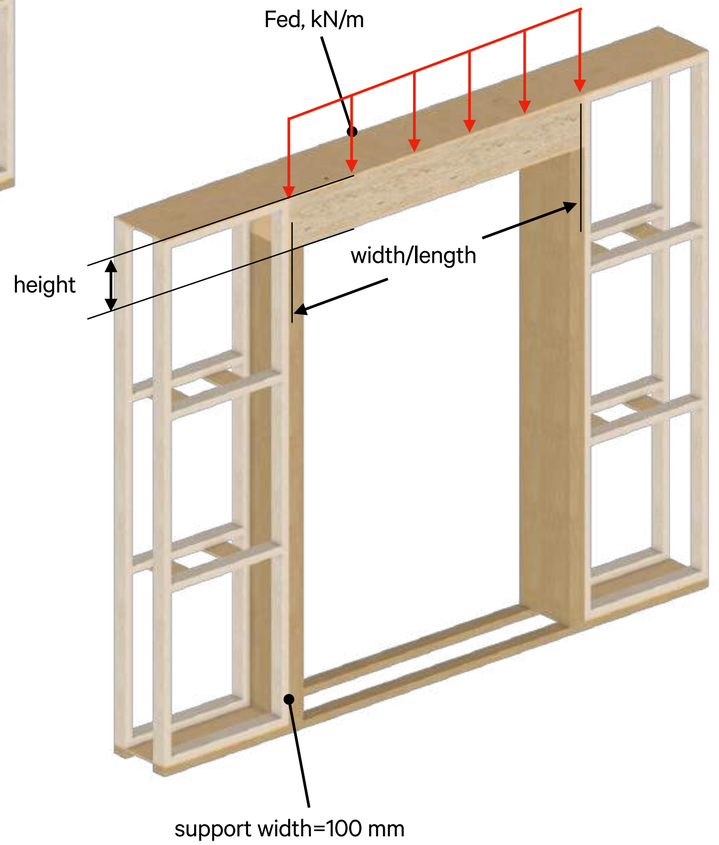
- The box element capacity F_{Rd} was calculated assuming that the factored load consists of **42%** dead load, **37%** live load, and **21%** snow load.
- Given the load-bearing capacity of one EcoCocon element side.

Load-Span Tables for Lintel Glulam Box Elements

Load-span table for box elements using: **glulam timber with support width:**

			45 mm	**100 mm**
Composition (one side)	Height (mm)	Width/Length (mm)	**Factored Load F_{Rd} (kN/m)**	
100 x 280 mm	310	1000	**41.89**	**55.58**
100 x 360 mm	390	1000	**41.89**	**71.69**
100 x 400 mm	430	1000	**41.89**	**72.50**
100 x 280 mm	310	1500	**26.58**	**37.05**
100 x 360 mm	390	1500	**26.58**	**47.52**
100 x 400 mm	430	1500	**26.58**	**48.33**
100 x 280 mm	310	2000	**20.14**	**27.39**
100 x 360 mm	390	2000	**20.14**	**35.44**
100 x 400 mm	430	2000	**20.14**	**35.44**
100 x 280 mm	310	2500	**16.11**	**21.75**
100 x 360 mm	390	2500	**16.11**	**28.19**
100 x 400 mm	430	2500	**16.11**	**29.00**
100 x 280 mm	310	3000	**13.69**	**17.72**
100 x 360 mm	390	3000	**13.69**	**23.36**
100 x 400 mm	430	3000	**13.69**	**24.17**
100 x 280 mm	310	3500	**11.28**	**12.89**
100 x 360 mm	390	3500	**11.28**	**20.14**
100 x 400 mm	430	3500	**11.28**	**20.14**





The main assumptions considered in the calculation of the lintels:

- The box element capacity F_{Rd} was calculated assuming that the factored load consists of **42%** dead load, **37%** live load, and **21%** snow load.
- Given the load-bearing capacity of one EcoCocon element side.

Self-Supporting Structures

EcoCocon self-supporting wall panels share the same construction as load-bearing panels but carry only their own weight, façade load from roof to ground, and wind load. They do not support any other vertical or horizontal loads.

Key factors:

- Unlike non-load-bearing walls, these panels carry their full self-weight continuously from roof to foundation.
- EcoCocon has delivered projects with walls exceeding 20 metres, with the design team developing a bespoke solution for each complex case.

Self-supporting structure (façade renovation).

Self-supporting façade walls.

Self-supporting façade walls (external insulation façade).

Self-supporting structure (façade renovation).

Non-Load-Bearing Walls (Infill Panels)

The non-load-bearing wall panels supplied by EcoCocon are identical to the loadbearing wall panels, but are typically manufactured in greater widths—usually 800 mm or 850 mm.

When designing non-load-bearing walls, the connection between the wall and the structural floor must be carefully evaluated and detailed accordingly, with a gap provided where required. It should also be assessed:

- Panel tolerances: **±5 mm per 10 m wall**
- The stud spacing is typically 755 mm centre-to-centre for an 800 mm wide panel and 805 mm centre-to-centre for an 850 mm wide panel. If required, the spacing can be reduced to accommodate façade installation requirements.

EcoCocon infill panels between concrete frame.

EcoCocon infill panels between timber frame.

EcoCocon infill panels between concrete frame.

EcoCocon infill panels between timber frame.

03

Structural Loads & Standards

Standards/Documents Used in Design

EcoCocon designs its buildings in compliance with the Eurocodes:

- Eurocode 0 – EN 1990: Basis of Structural Design
- Eurocode 1 – EN 1991: Actions on Structures
- Eurocode 5 – EN 1995: Design of Timber Structures

All loads must be provided in accordance with the following Eurocode standards:

- Dead Load (EN 1991-1-1)
- Live Load (EN 1991-1-1)
- Snow Load (EN 1991-1-3)
- Wind Load (EN 1991-1-4)
- Seismic Load (EN 1998-1)
- Loads must be calculated considering country-National Annexes (NA) for Eurocode.

A 12-storey residential building in Malmö. Glulam and CLT superstructure is combined with EcoCocon external walls.

Self-Weight of EcoCocon Panels

A 400 mm EcoCocon panel without additional layers weighs approximately **80 kg/m²**. With finishes, the weight varies — the table below shows an example with clay plaster internally and ventilated wood cladding externally, giving a total panel weight of 1.659 kN/m². For alternative finishes, the weights should be updated accordingly.

EcoCocon 400 mm panel with finishes	Thickness, mm	Load, kN/m²
Internal finishes		
Clay plaster “brown clay”, density 1800 kg/m³, reinforced	30	0.53
EcoCocon panel (core)		
Thermal insulation (straw) – both sides	400	0.498
Full timber structure – both sides	400	0.294
External finishes		
Wood fibre insulation board (270 kg/m³)	60	0.159
Vertical battens 25x50, c/c 800mm, density 290 kg/m³	25	0.004
Horizontal battens 25x50, c/c 400mm, density 290 kg/m³	25	0.004
Wood siding, density 500 kg/m³	20	0.098
SUM (characteristic value)		**1.659**

When performing the calculations, both layers are considered separately, so the weight of the EcoCocon panel core can be divided equally between the two sides. For example, for the inner layer: thermal insulation (straw), one side: 0.498 kN / 2 = 0.249 kN, timber structure, one side: 0.294 kN / 2 = 0.147 kN. Therefore, the total weight on the internal side is: 0.53 kN + 0.249 kN + 0.147 kN = 0.926 kN.

EcoCocon walls with clay plaster as the interior finish.

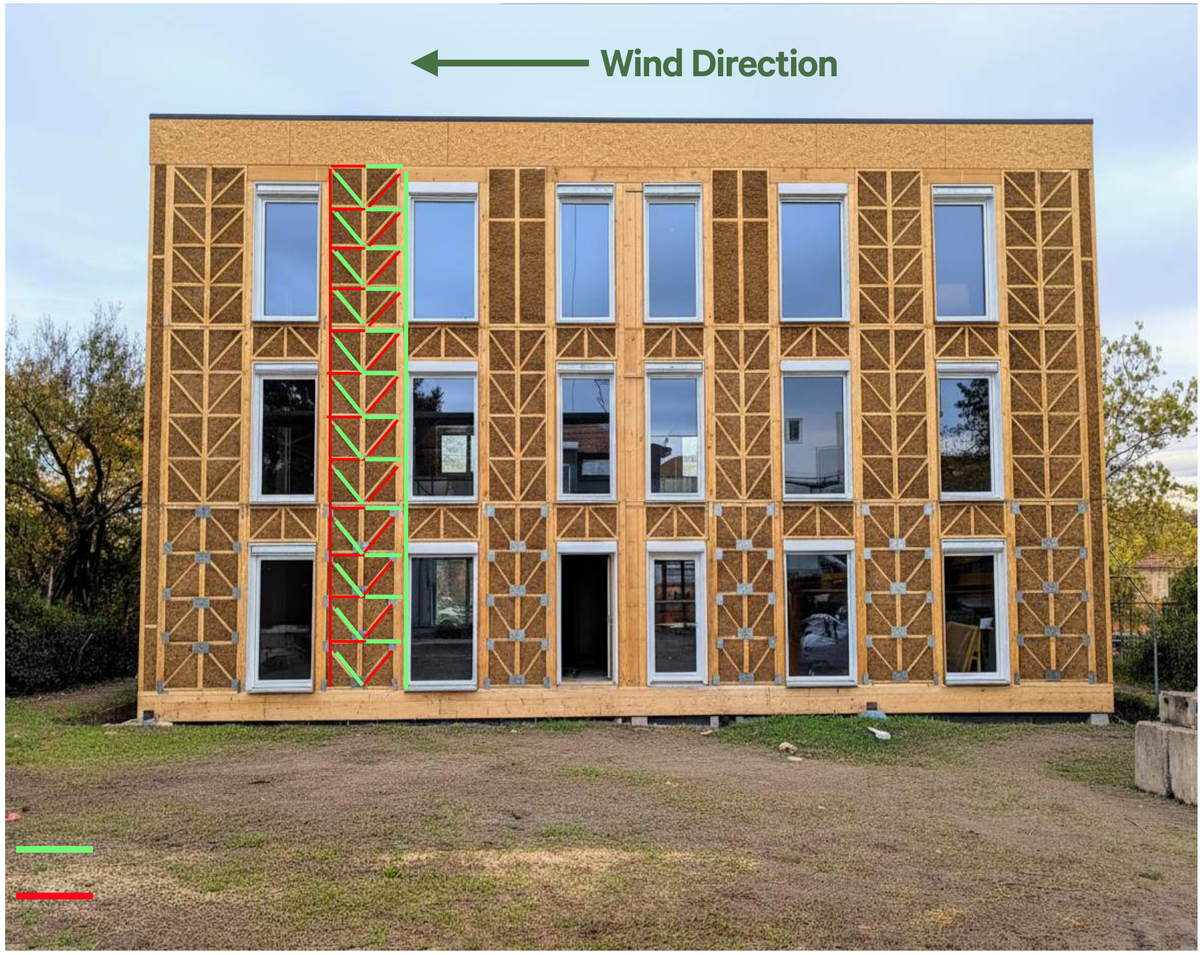
Wind Loading Philosophy

Wind loads on the front, rear, and side elevations are transferred through the roof and floor deck diaphragms to the externally and internally braced walls down to ground level. Internal shear walls are the responsibility of the client's structural engineer and must be designed and installed in accordance with EcoCocon requirements.

Key principles:

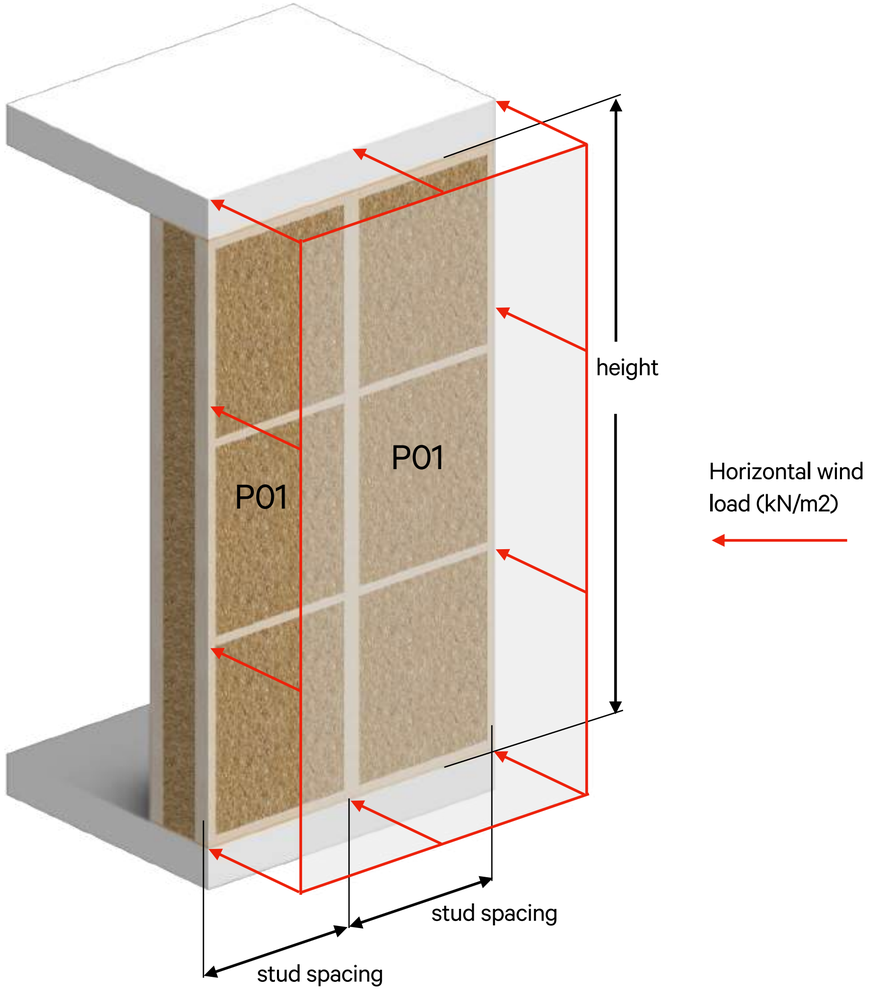
- The decking is assumed to work as horizontal diaphragm at each floor level and an effective horizontal tie to the building. The horizontal diaphragm spans as a deep beam between braced loadbearing shear walls perpendicular to the diaphragm, where the shear forces are transferred by screws through the studs and top/bottom plate of the timber panel
- The diagonal bracing on this panel then transfers this force, in tension/ compression, down to the bottom plate of the same panel, where shear from the next diaphragm is added in before it is transferred again through the bracing on the panel below to reach the next floor level. At ground floor slab level, the total shear and any net tension is transferred by anchor bolts to the foundations.
- The design of base plate and fixings to foundations must be provided by the client's engineer. For further information, refer to the Project Submission Requirements document.

The figure on the right displays a diagram of axial forces in one building segment, highlighting the members in tension and compression.



Existing building with a well-arranged EcoCocon wall bracing system:
studs are aligned throughout all storeys, and the bracing is symmetric.

Serviceability Limit State



The serviceability condition is typically not a governing factor, since the panel has both an internal and an external side; as a result, deflections caused by wind are generally not critical. The table presents deflection values for wind loads between 1 kN/m² and 2 kN/m², with stud spacing varying from 400 mm to 850 mm.

Deflection table for a twin stud subjected to uniformly distributed lateral wind load

Stud	Height, mm	Stud spacing, mm	Characteristic wind load, kN/m²	Horizontal deflection, mm
Double 45 x 95 mm	2500	850	1.00	3.1
			1.50	4.6
			2.00	6.2
	2750		1.00	4.5
			1.50	6.8
			2.00	9
	3000		1.00	6.4
			1.50	9.6
			2.00	12.9
	2500	400	1.00	1.5
			1.50	2.2
			2.00	2.9
	2750		1.00	2.1
			1.50	3.2
			2.00	4.2
	3000		1.00	3.0
			1.50	4.5
			2.00	6.1

Fire Resistance

EcoCocon has carried out multiple loadbearing fire tests on walls to EN standards. The main tests determining fire properties are listed below:

EcoCocon panel without plaster or board covering:

- Reaction to fire classification: E according to LST EN 13501-1:2019 chapter 11
- RE 45 / REI 45 / REW 45 according to EN 1365-1: 2012/AC: 2013 (The exterior wall surface covered with the diffusion-open membrane SOLITEX MENTO 3000)

Covered EcoCocon panel (Clay plaster - EC panel 250mm - membrane - STEICO Protect H) according to EN 13501-2: 2016:

- RE 120 / REI 120 / REW 120 (Valid for fire action on internal wall face covered with clay base plaster,t=30mm)

Covered EcoCocon panel (Gypsum plaster - EC panel 250mm - membrane) according to EN 13501-2: 2016:

- RE 90 / REI 90 / REW 90 (Valid for fire action on internal wall face covered with gypsum plaster Knauf MP75, t=25mm)

This page provides only the key figures; detailed and complete information should be obtained from the fire test report or assessment.

EcoCocon panel post-test.

At minute 49 during the EcoCocon panel fire test.

Structural Integrity/ Robustness

The required level of robustness is dependent on the building class, which is related to the size, type and use of the building. The same building classification system is given in EN 1991-1-7. A summary of the robustness requirements for each building class is given below:

- **Class 1** – Provided the building has been designed and constructed in accordance with the rules given in EN 1990 to EN 1999 for satisfying stability in normal use, no further requirements.
- **Class 2A** – Effective horizontal ties should be provided
- **Class 2B** – There are three alternative design methods:
  - Tying
  - Notional removal
  - Key element
- **Class 3** – A systematic risk assessment should be carried out

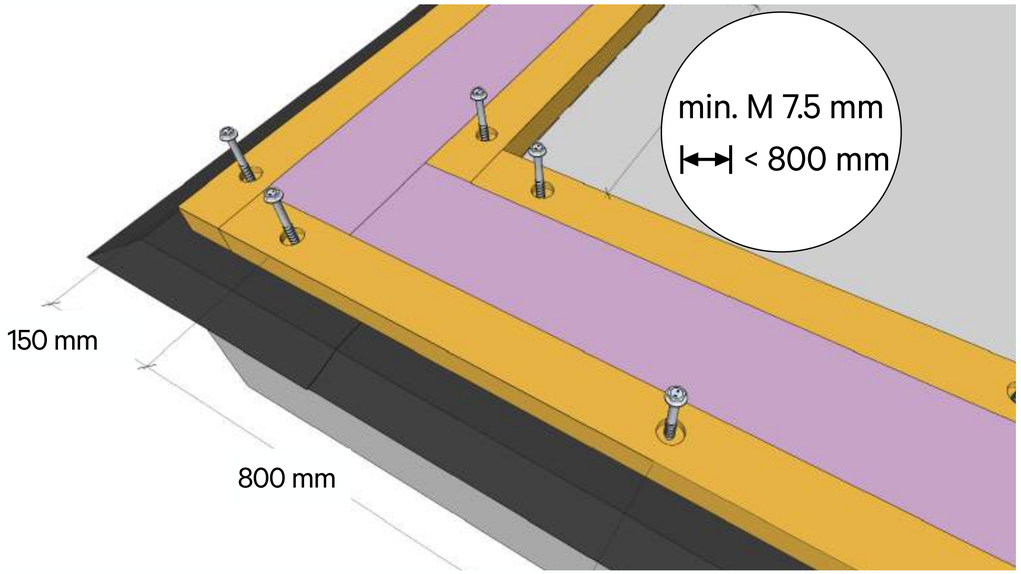
The EcoCocon panel system does not include standard site installation details that ensure compliance with horizontal or vertical tying requirements for all projects. However, the system can be engineered to resist these tie forces. The client's structural engineer must provide all relevant information regarding robustness requirements and required tying loads.

04 Structural Considerations

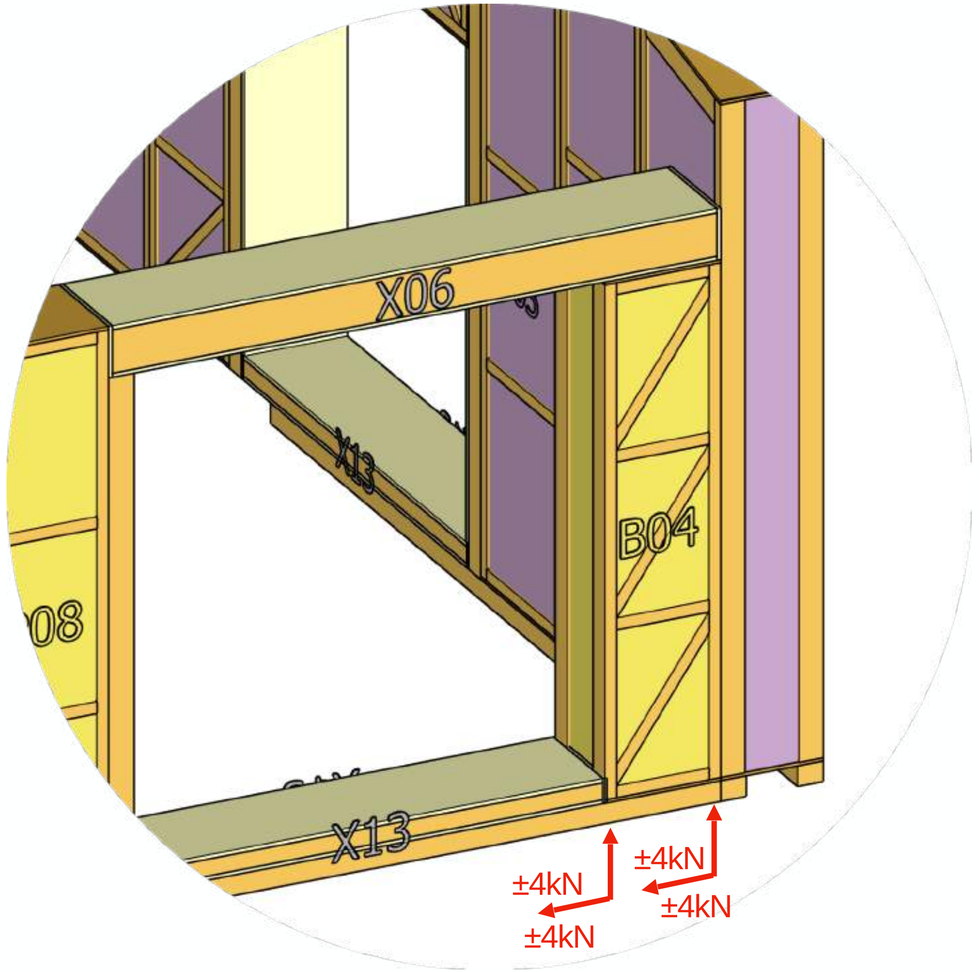
Anchorage

General anchorage provisions

Minimum base fixity is to be provided based on the following:



» EcoCocon recommends that all baseplates to external perimeter walls shall be fixed to the supporting sub-structure using suitable expanding bolts (minimum M 7.5) and/or self-tapping concrete screws, installed at maximum 800 mm centres. The selected fixing type and spacing shall be verified for face wind loading.

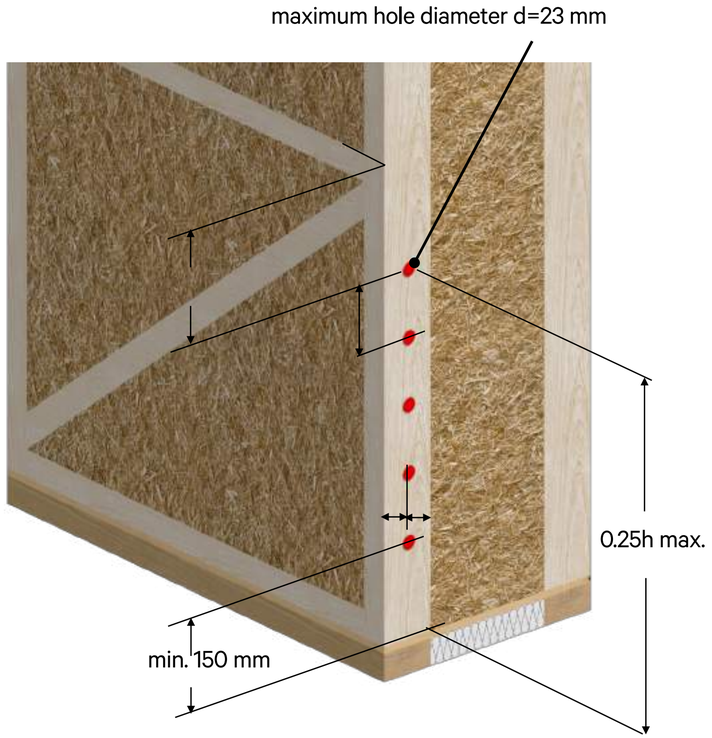


» Baseplates at bracing locations shall be additionally fixed to the supporting base using a minimum M7.5 expanding anchor or an equivalent arrangement of multiple concrete screws. Fixings shall be designed to resist point loads of ±4 kN in both the vertical and horizontal directions. **In certain cases, the loads may be higher and are specified in the calculation package.**

Holes Through Members

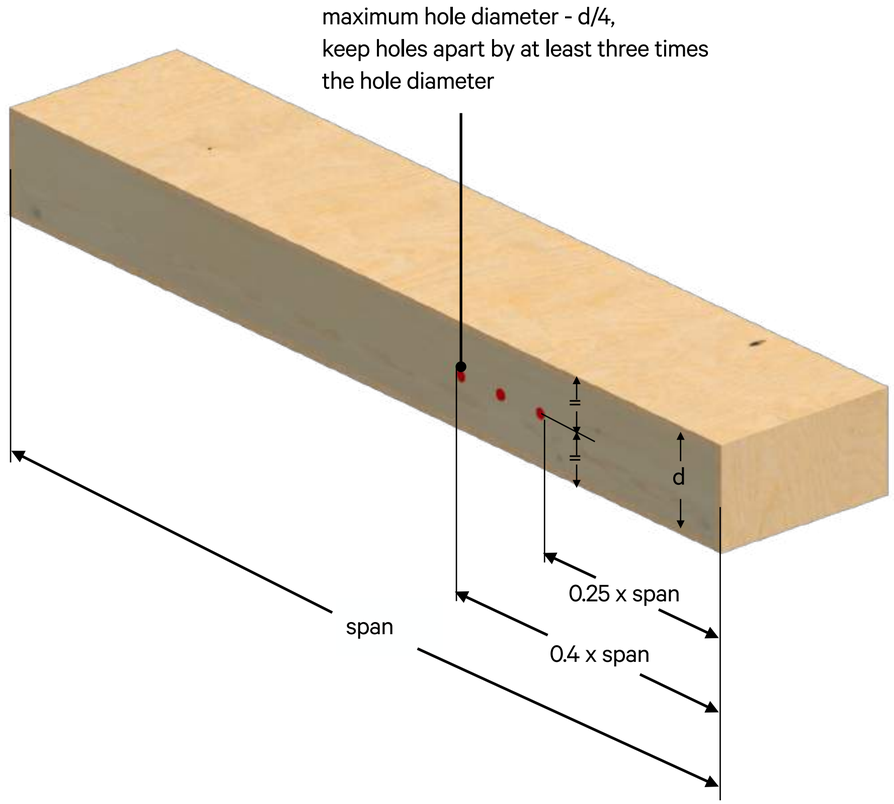
Basic requirements for holes in wall panels

- Holes drilled only in range from 150 mm to 0.25 h.The rule applies to both the bottom and the top of the panel.
- Drillings on centreline only
- Hole diameters not greater than 0.25 stud width
- Hole centres not closer than 4d (d=hole diameter)



Basic requirements for holes in box elements

- Holes drilled only in range from 0.25 x span to 0.4 x span
- Maximum hole diameter - d/4
- Rules are for element depth up to 250 mm, for a deeper element assume d=250 mm
- Keep holes apart by at least three times the hole diameter

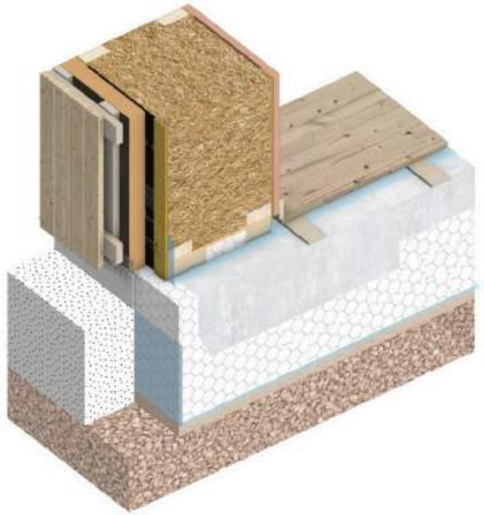


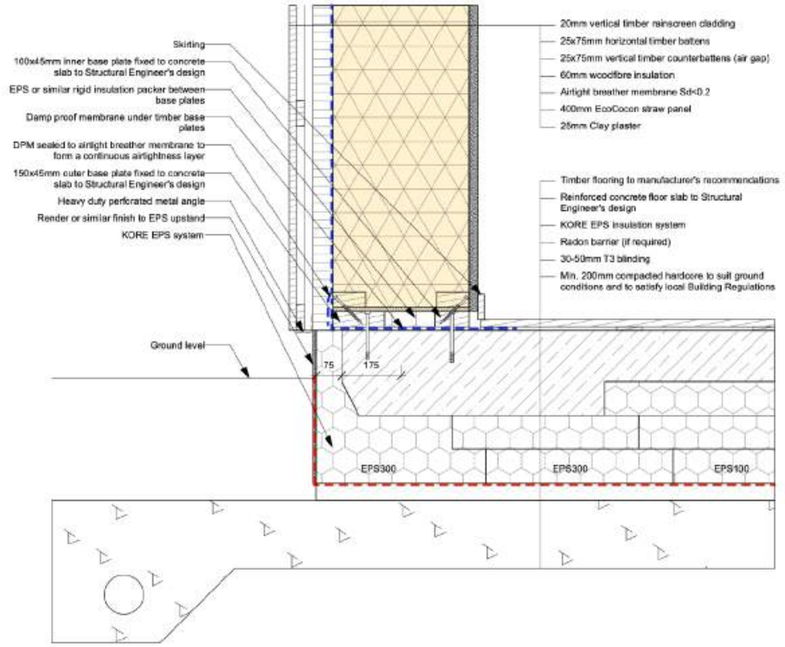
Typical Details / Drawings

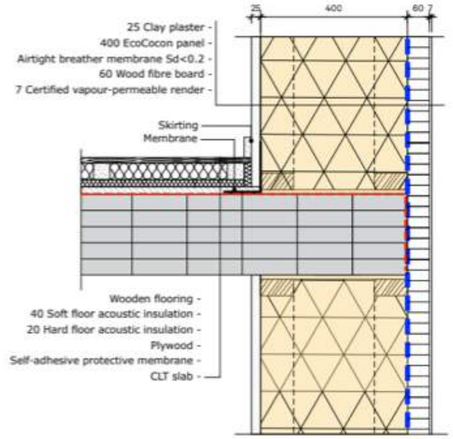
The EcoCocon typical details catalog contains the main details that can be used when designing projects with EcoCocon walls:

- External EcoCocon wall to the foundation
- External EcoCocon wall to roof structure
- External EcoCocon wall to intermediate floor structure

Please note that these details are provided for guidance only; each project requires adapting them to its specific conditions.







Refer to the Details on ecococon.eu

05 Annexes

Timber Specification

EcoCocon panels are produced using certified graded materials.

- C24 and higher strength class timber is used for the manufacture of panels.
- For box elements with a height of 225 mm or greater, glued laminated timber of at least strength class GL24h is used.
- The minimal requirements for the plywood used by EcoCocon are detailed in the table on the right.

Minimal requirements for the plywood used in EcoCocon panels:

	N/mm²
Characteristic bending strength f_{m},plate,0,k, parallel	40.0
Characteristic bending strength f_{m},plate,90,k, perpendicular	30.0
Characteristic bending strength f_{m},wall,0,k, edge, parallel	29.0
Characteristic bending strength f_{m},wall,90,k, edge, perpendicular	31.0
Characteristic compression strength f_{c},wall,0,k, parallel	21.0
Characteristic compression strength f_{c},wall,90,k, perpendicular	22.0
Characteristic compression strength f_{c},plate,k	9.0
Characteristic tension strength f_{t},wall,0,k, parallel	29.0
Characteristic tension strength f_{t},wall,90,k, perpendicular	31.0
Characteristic shear strength in panel shear f_{v},wall,k	9.5
Characteristic shear strength in panel shear f_{v},plate,k	2.2
Characteristic rolling shear strength f^{R},k	2.2
Main modulus of elasticity $E_{pl_{a}t_{e}}$,0, parallel	6000
Main modulus of elasticity $E_{pl_{a}t_{e}}$,90, perpendicular	4000
Main modulus of elasticity Ewall,0, parallel	4400
Main modulus of elasticity Ewall,90, perpendicular	4700
Mean shear modulus Gyz	150
Mean shear modulus Gxz	150
Mean shear modulus Gxy	600
Characteristic density, kg/m³: 600	
Mean density, kg/m³: 700	
Coefficient of thermal expansion, α, 1/°C: 0.000005	