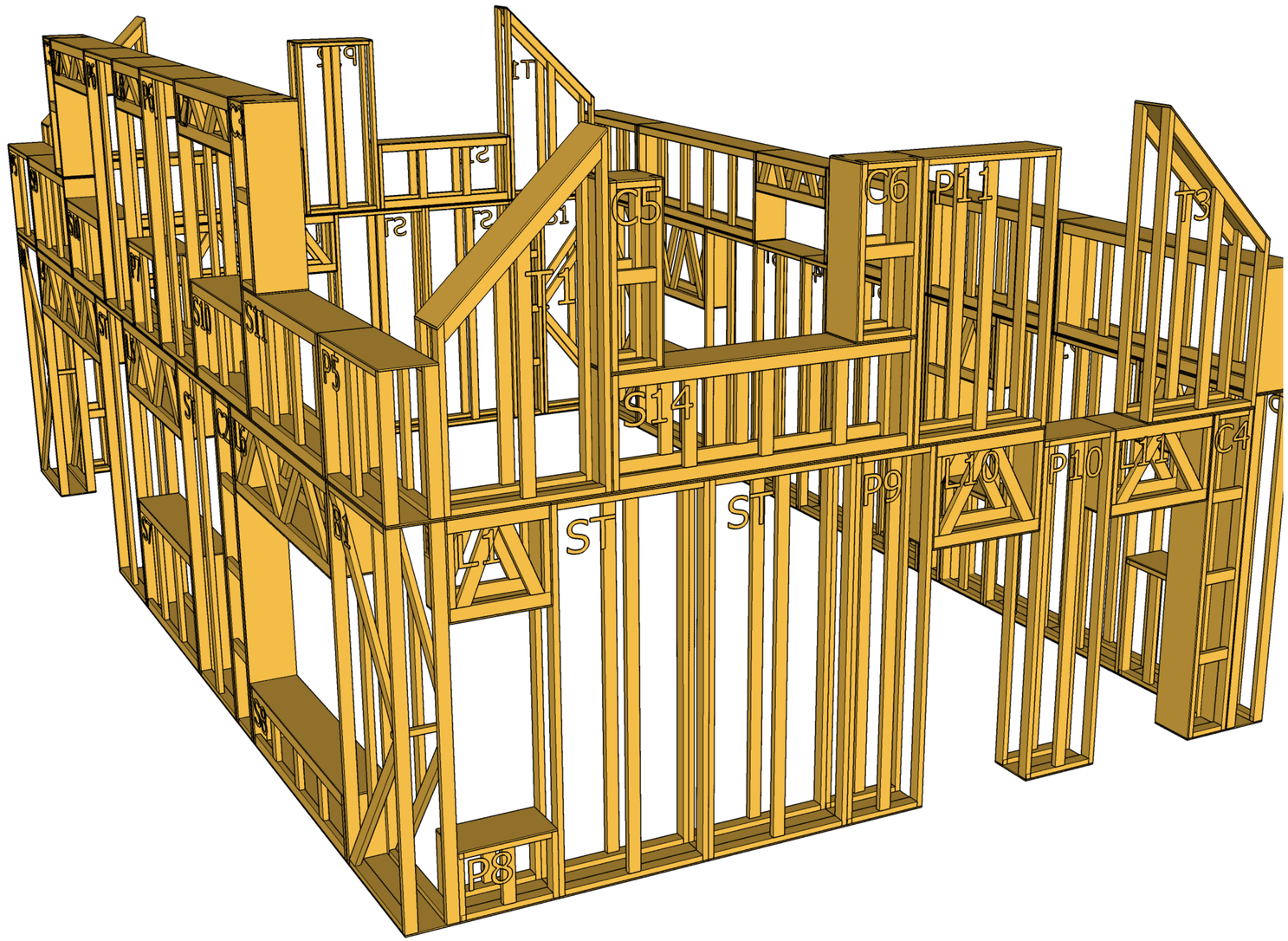
C5a Structural Design

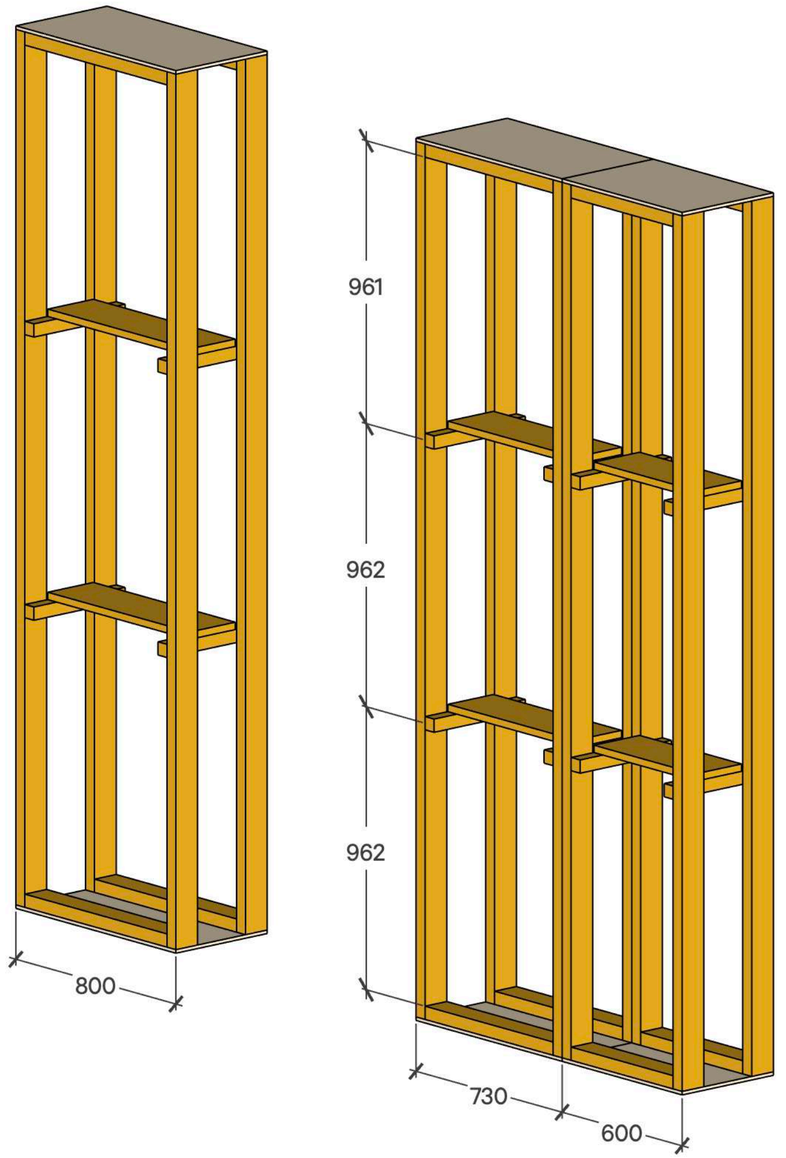
Load-bearing construction: wood



Only wooden construction is used for structural calculation.

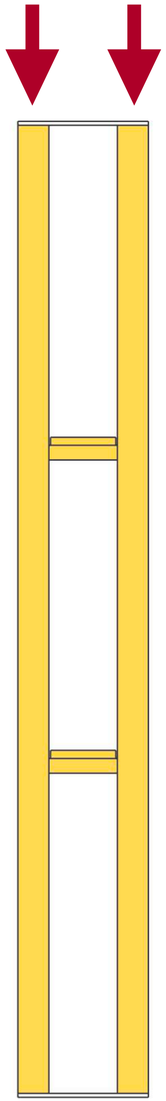
» Any engineer used to wooden construction can calculate the load-bearing capacity based on Eurocode rules

Typical panel construction



- A single post 45x95 mm in each corner supports the panel
- A non-load-bearing middle column is added if panel is wider than 80 cm
- When two panels are connected, a double post 90x95 mm is the result
- Every 100 cm there is a horizontal reinforcement against buckling of the posts

Double load-bearing structure

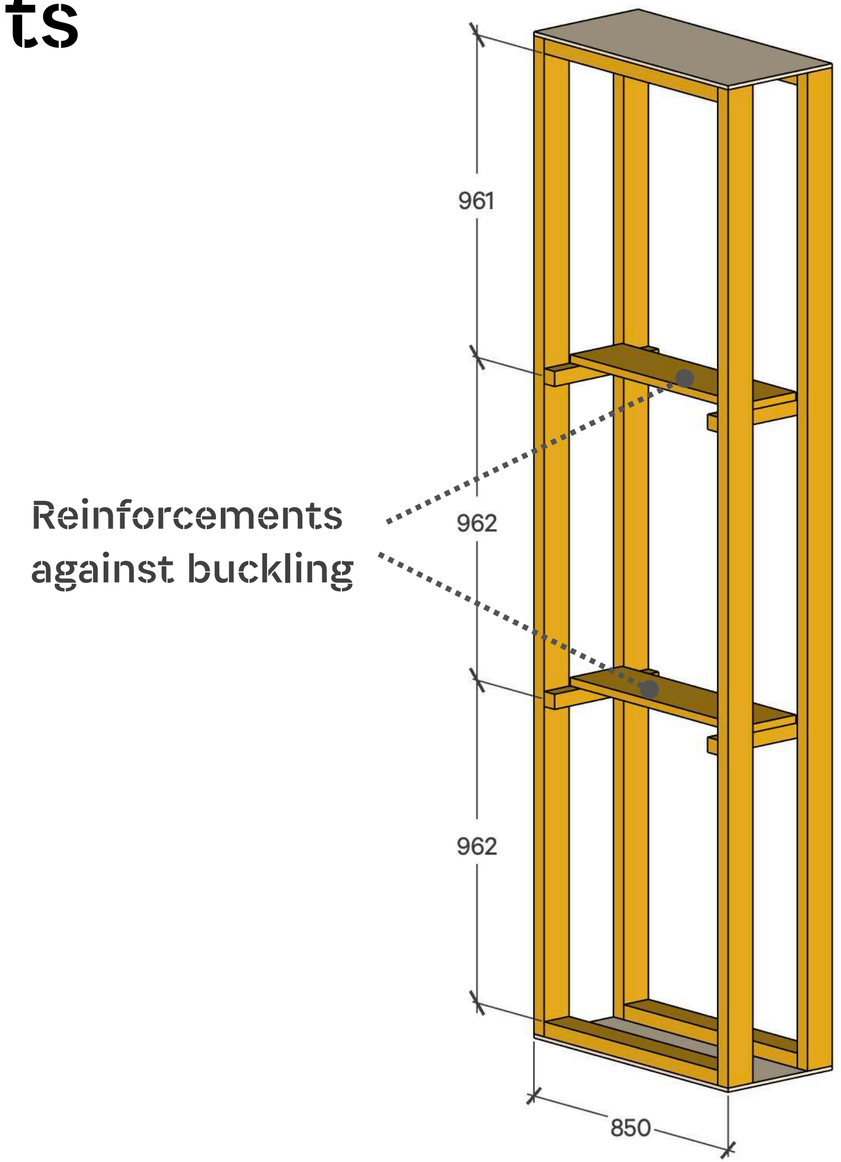


The double load-bearing construction provides support for load on the inside as well as the outside posts

Note:

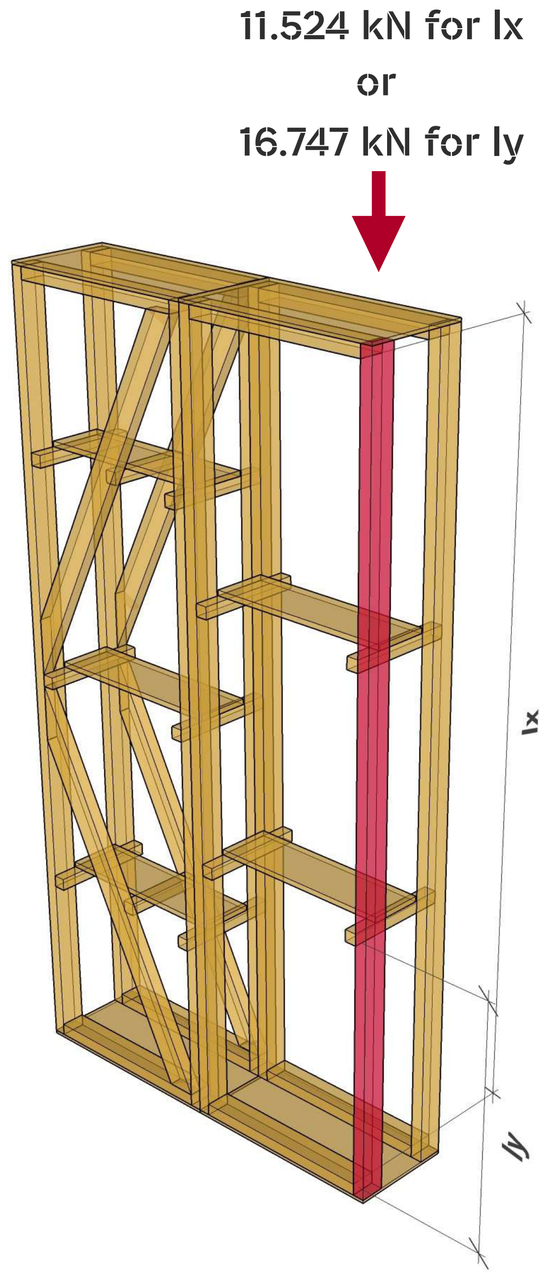
» All example calculations are made considering load on just one side!

Horizontal reinforcements against buckling



- Regular horizontal reinforcements are added to minimize buckling length to max 1000 mm
- This is taken into account for the post and double post calculation

Single post



» A single 45x95 mm post protected against buckling every 288.6 cm (lx) can carry 11.524 kN

» A 45x95 mm post supported against buckling every 96.2 cm (ly) can carry 16.747 kN

Note

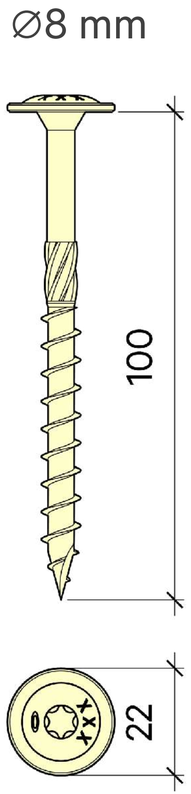
» Strength of posts depend on buckling length taken into consideration

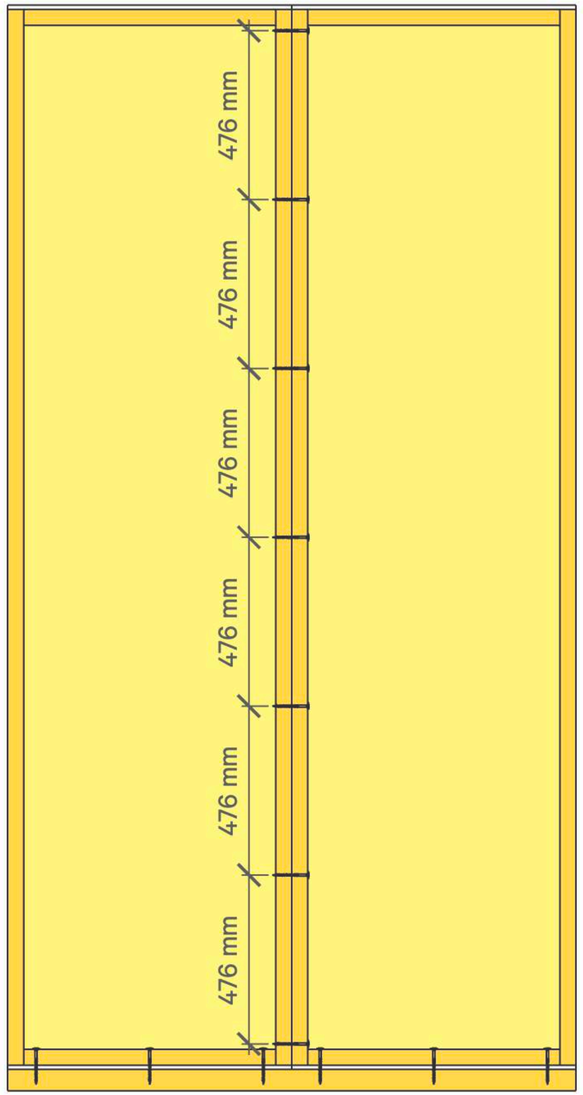
Explained

» 1 kN is the equivalent of 1000 N = approx. load of 100 kg

» 10 kN are approx. 1 ton = 1000 kg

Connecting two panels



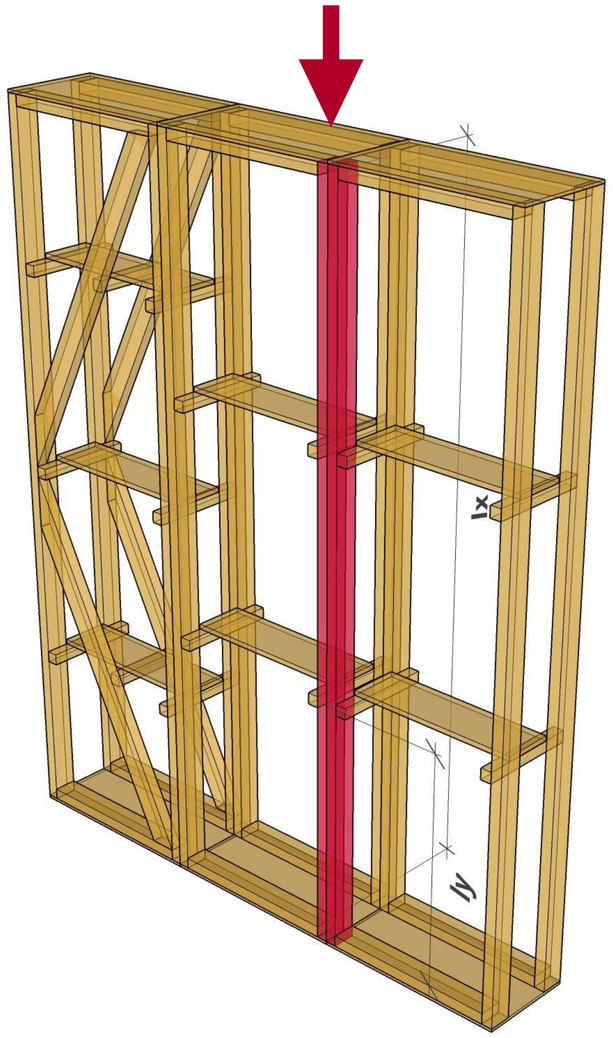


Double post

23.048 kN for lx

or

55.767 kN for ly

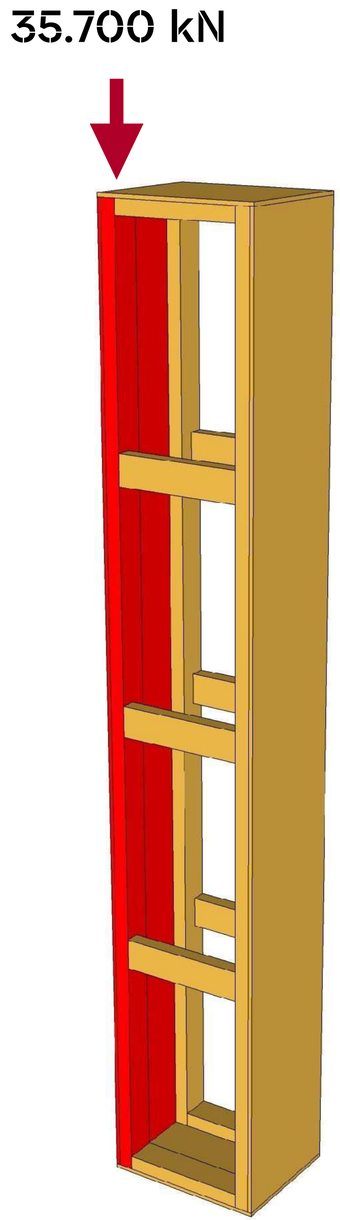


- A double 2x45x95 mm post that is protected against buckling every 288.6 cm (lx) can carry 23.048 kN
- A double 2x45x95 mm post supported against buckling every 96.2 cm (ly) can carry 55.767 kN

Note

- Strength of post depends on buckling length. If that is shorter, the load can be many times higher

Special element: column

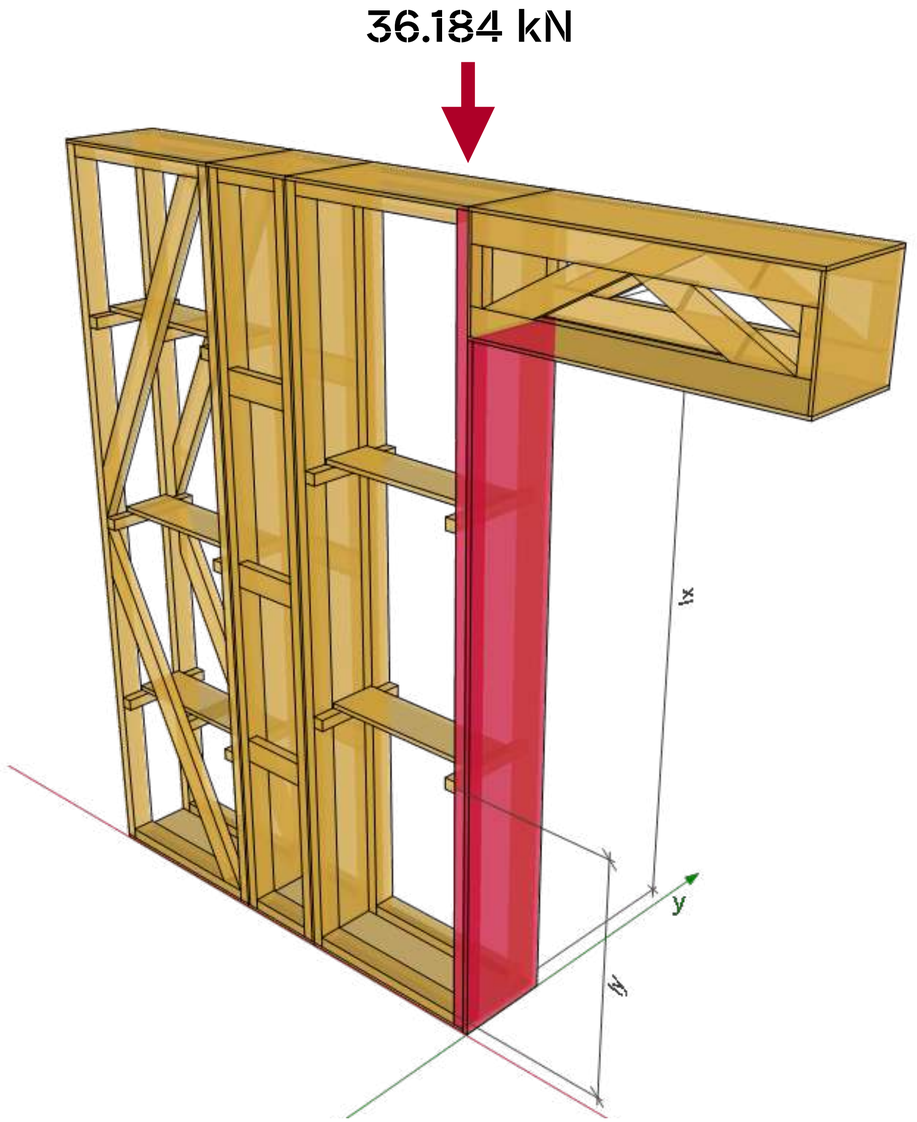


- A single 45x95 mm post is reinforced with a 12 mm plywood
- There is a horizontal bar max. every 80 cm, protecting against buckling
- A single 45x95 mm post that is reinforced with a 12 mm plywood against buckling can carry 35.700 kN

Note

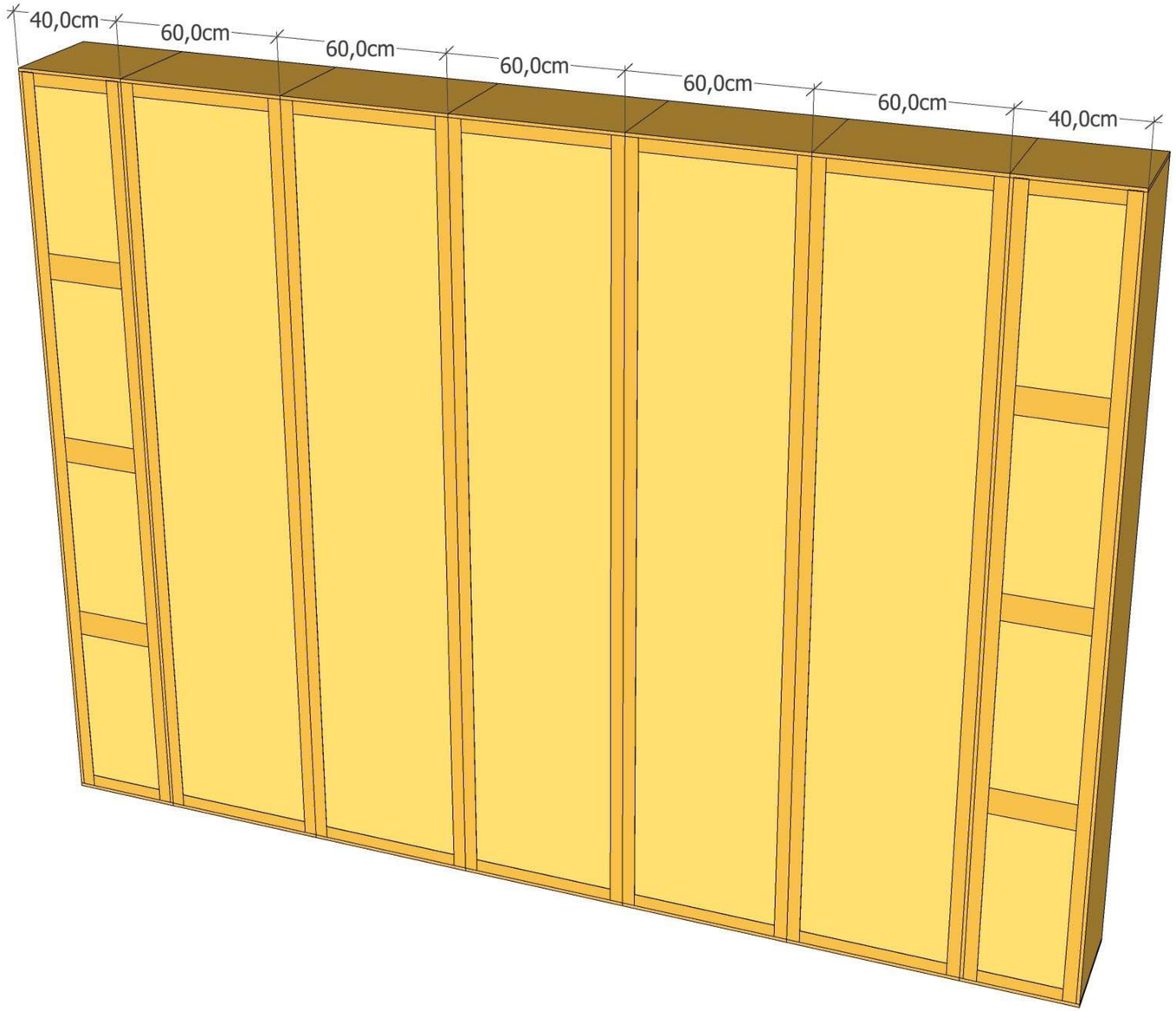
- Used for short wall segments or for high pointed loads.

Plywood reinforced opening



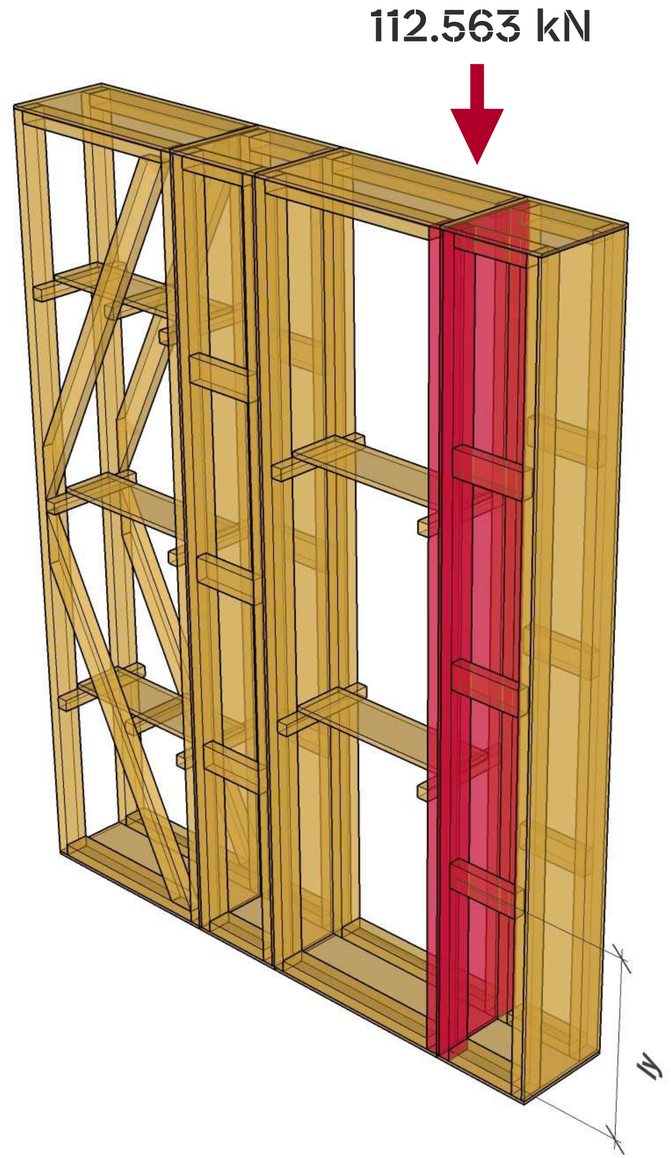
- Openings are reinforced with 18 mm plywood
- This significantly increases the load-bearing capacity
- A single 45x95 mm post that is reinforced with a 18 mm plywood can carry 36.184 kN
- Calculations are done case by case

Possible reinforcement: Narrower panels



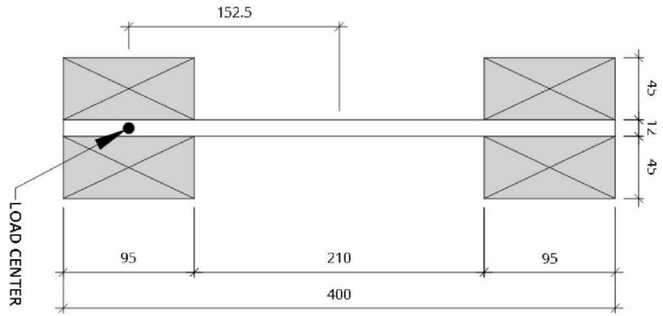
- Using narrower panels brings the double posts closer to each other
- A construction with a double post every 60 cm can take **93 kN/m** on one side of the panels
- Columns 40x40 cm can be used at the end of the wall or in corners

Possible reinforcement: Using columns



Using columns for every second panel adds a plywood layer between the panels.

The buckling strength increases dramatically and the construction can take much larger loads.



Note

» Plywood sheets can be also be added separately between panels in the construction phase - it is not absolutely necessary to produce columns

Post/plywood compression strength

- The plywood is fixed directly to the post
- The surface of one post is 45x95 mm, or 42.75 cm^2 at 5.25 N/mm^2
- The compression strength of plywood and wood on **one** post without deformation is 22.444 kN

Note:

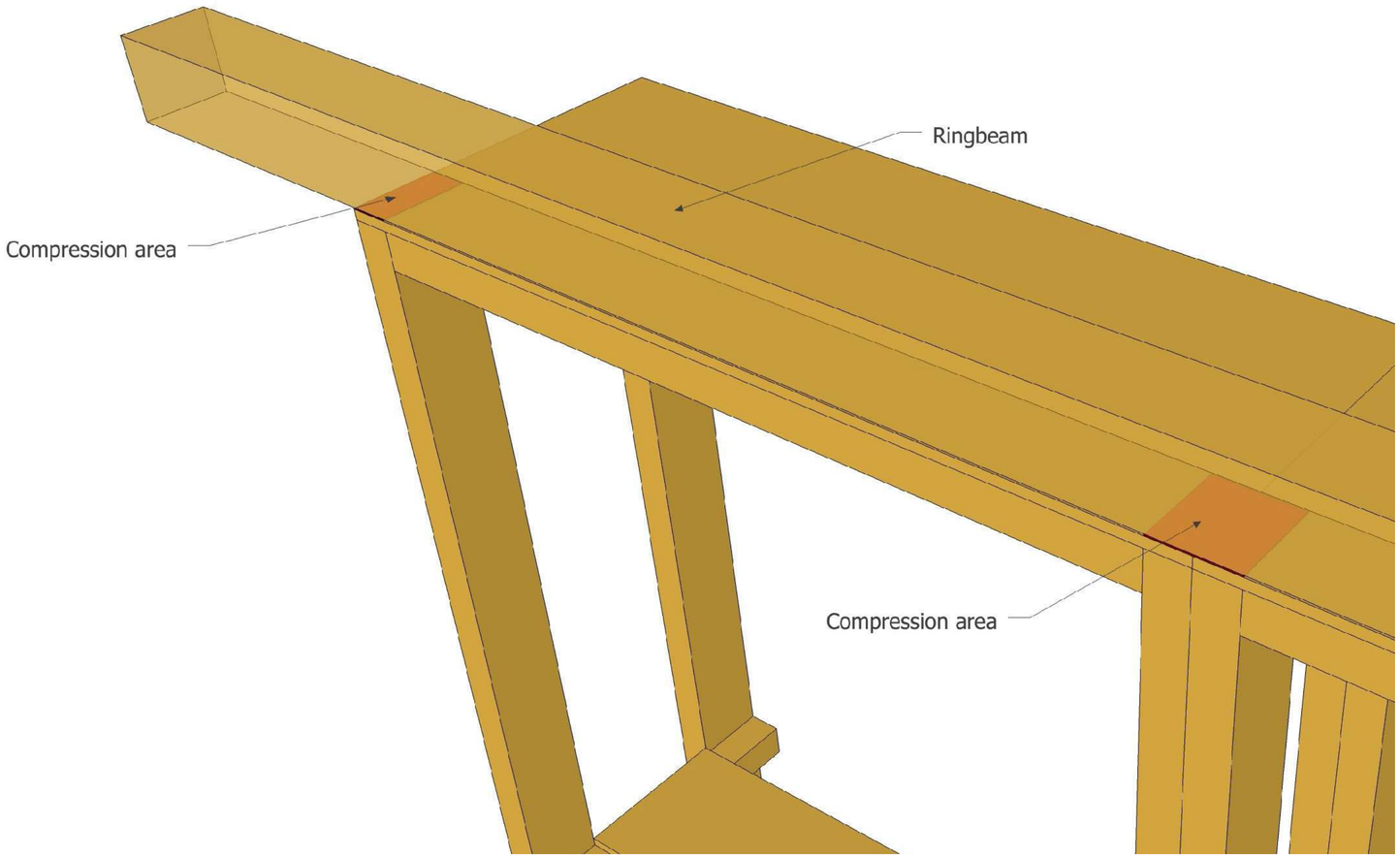
- Compression of wood parallel to the grain is much smaller than if load is applied perpendicularly to the grain
- Plywood also has a stronger compression coefficient than soft wood

Ring beam compression strength

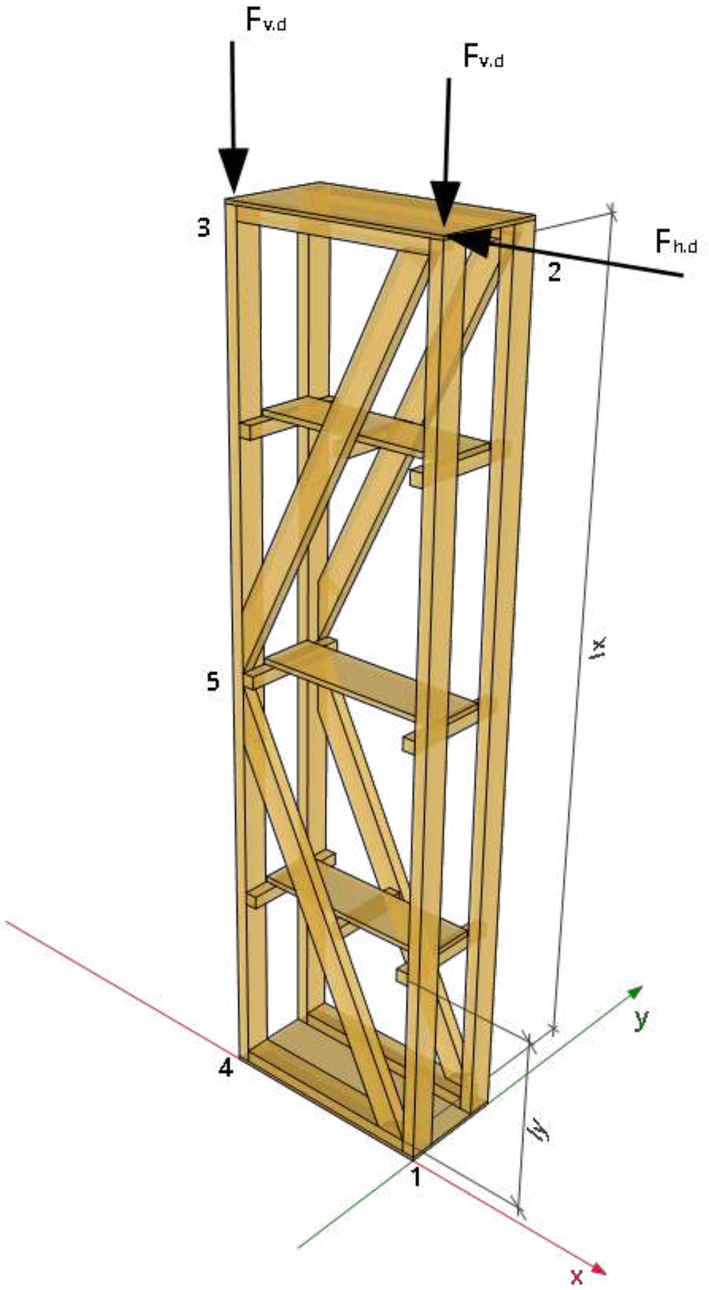
- The ring beam placed on the posts / plywood will also experience higher compression above posts areas
- The compression area for 1 post is 4 275 mm^2 and 8550 mm^2 respectively
- The wood in the ring beam is layered horizontally: the strength of the wood is weaker
- For soft wood like spruce the max. longterm load is 5.25 N/mm^2
- The compression strength of plywood and wood on **one** post without deformation is 22.444 kN
- The compression strength of plywood and wood on a **double** post without deformation is 44.888 kN

Note

- This compression will be decisive only for higher buildings

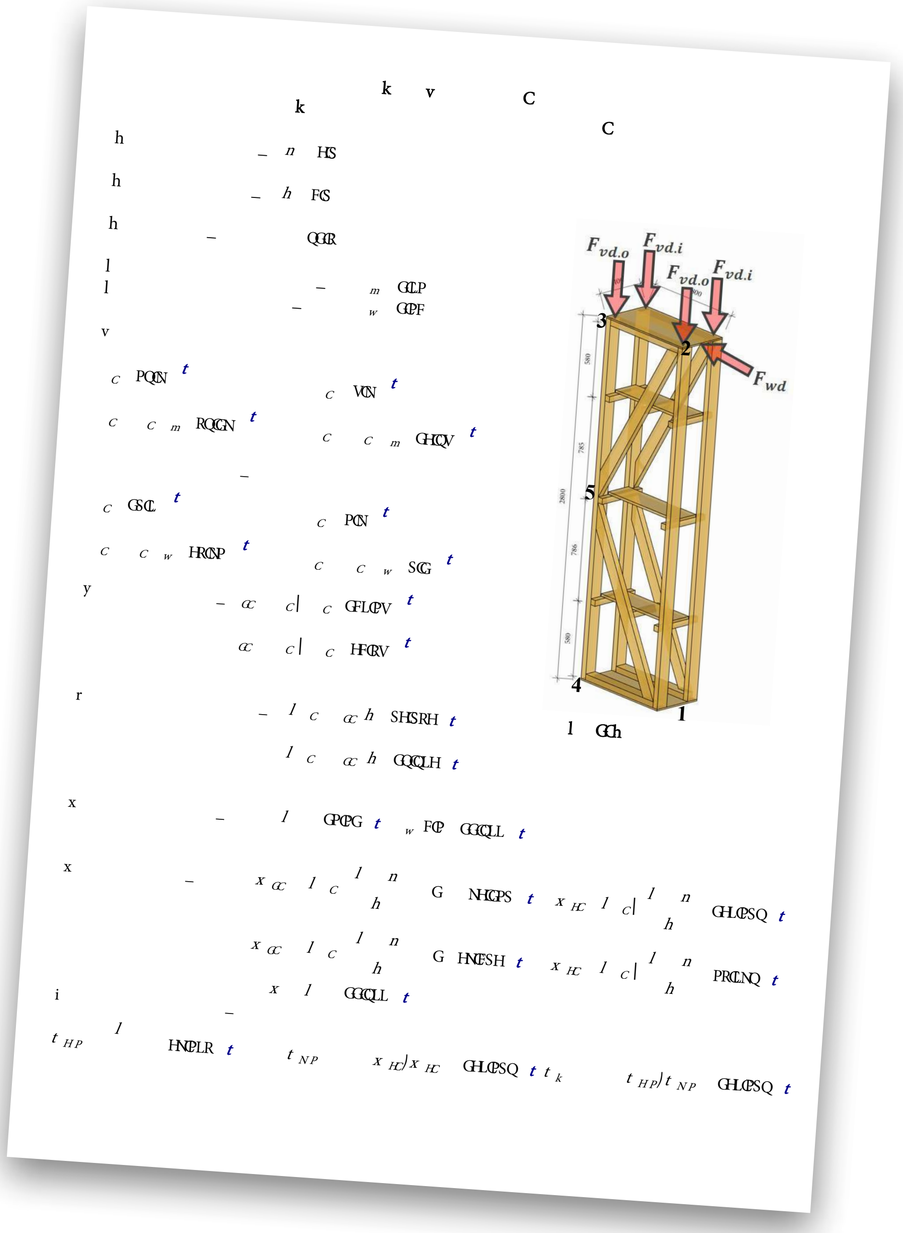


Special elements: Braced panels



- Braced panels are good to take lateral load in construction
- Usually two braced panels are used opposite each other
- These calculations will be done together with the Panel Project based on loading values given by the local engineer

Braced panel calculations

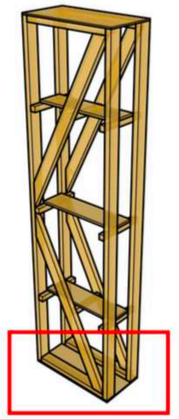


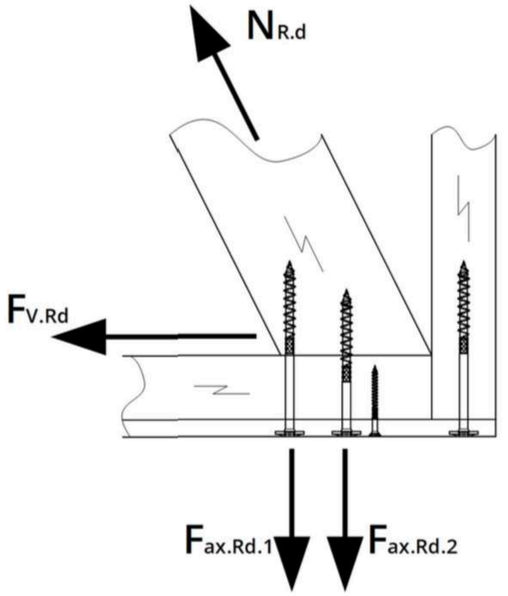
Our engineer can verify with a separate calculation if the loads can be absorbed by the braced panels.

Note:

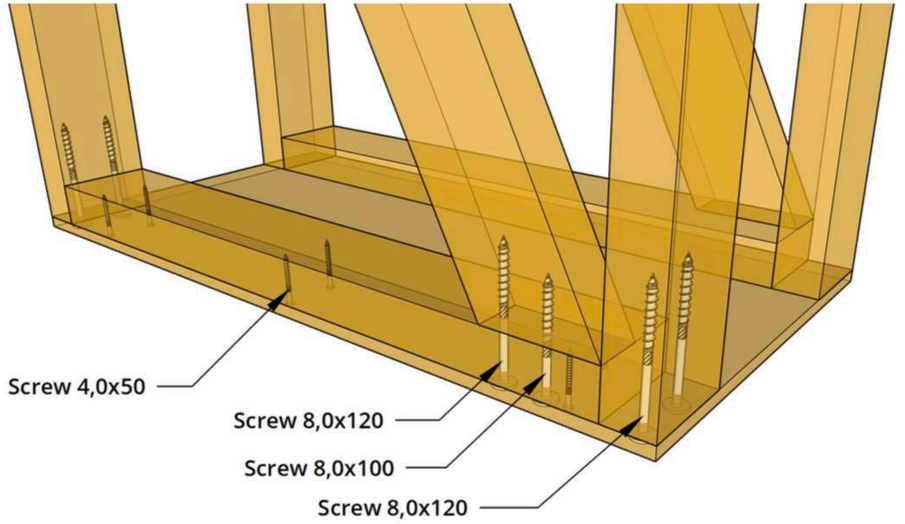
» These calculations will be done together with the panel project based on loading values given by the local engineer

Stress on screw connections





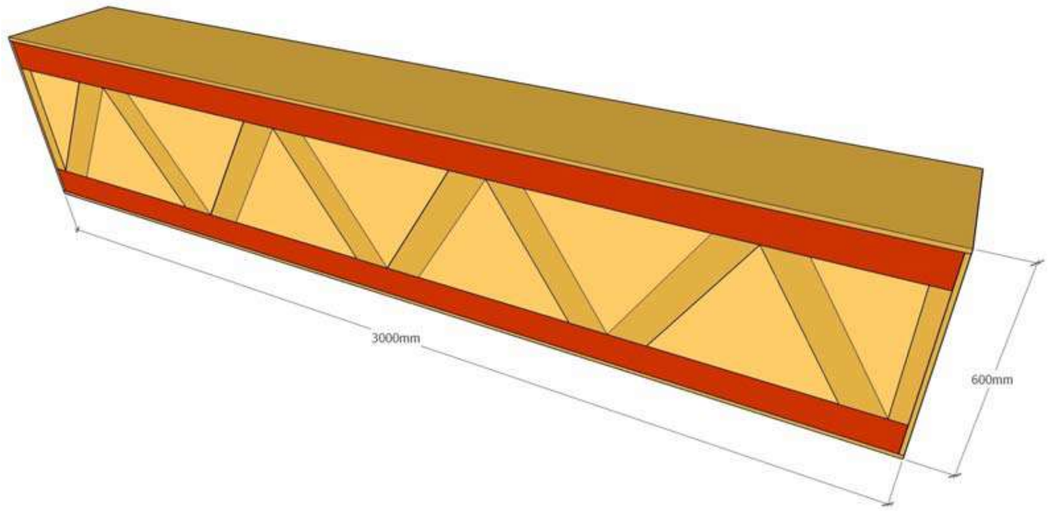
A separate calculation to verify the stress on the connecting screws can be made.



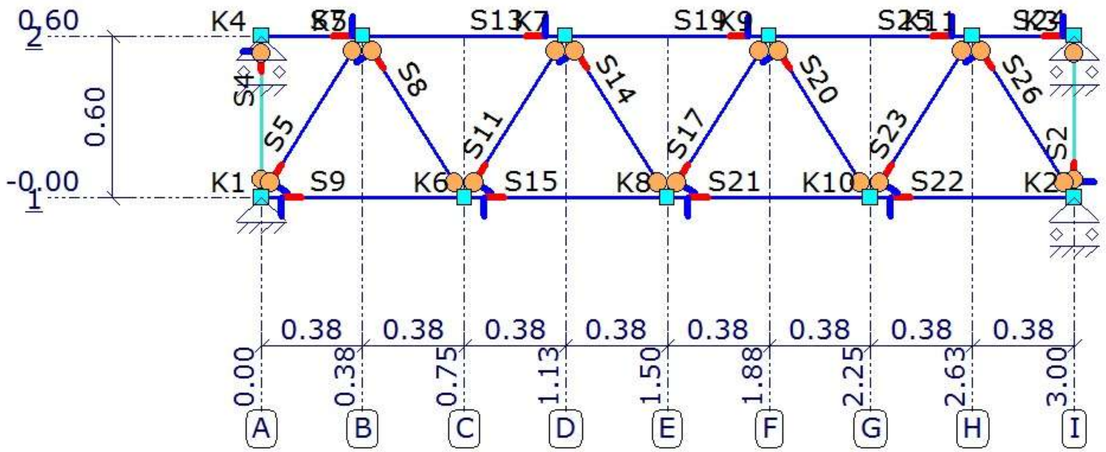
Note:

» These calculations will be made together with the panel project based on loading values given by the local engineer

Load-bearing lintels



Our engineer can verify with a separate calculation if the loads can be absorbed by the lintels.

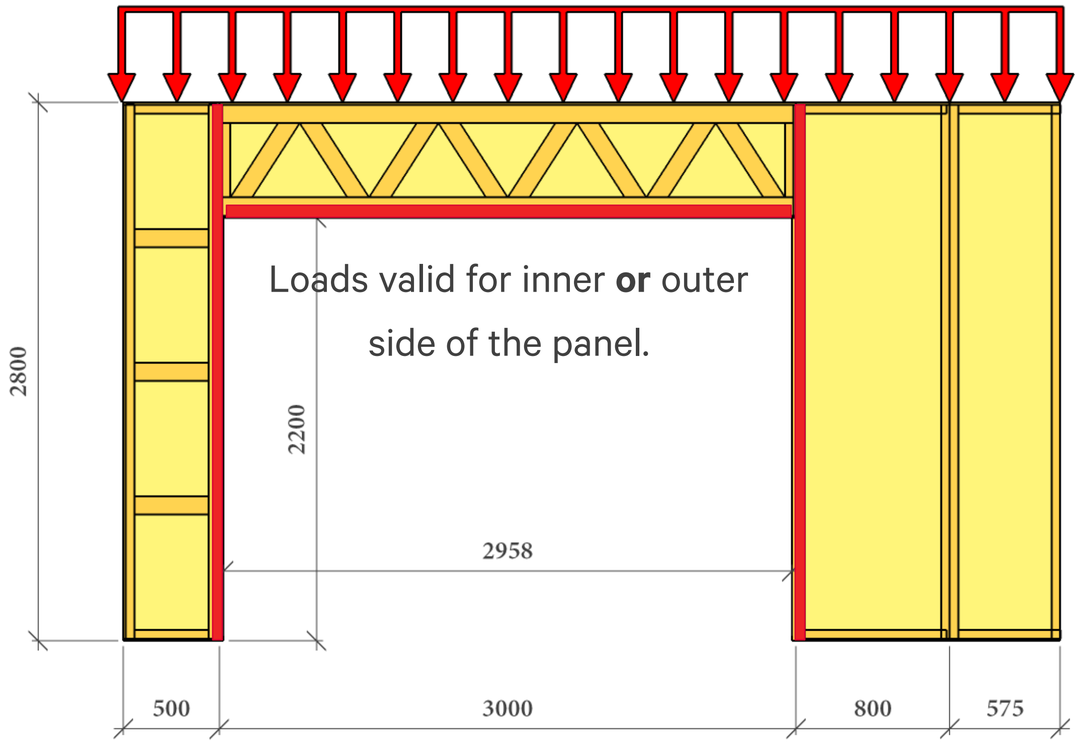


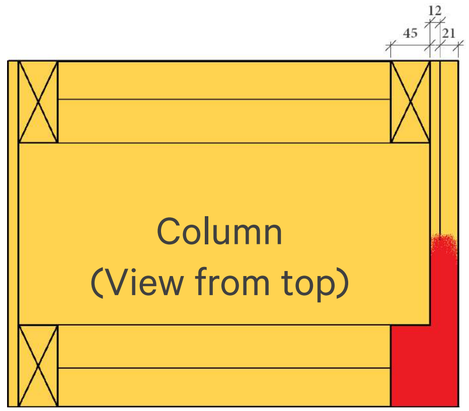
Note:

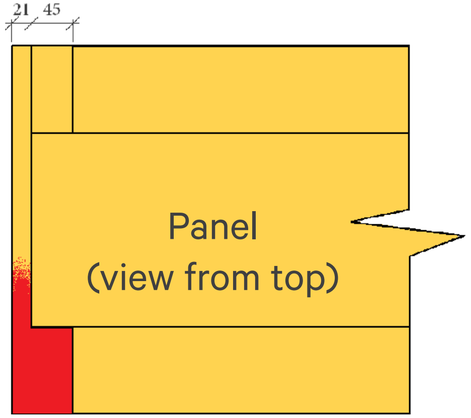
» These calculations will be made together with the panel project based on loading values given by the local engineer

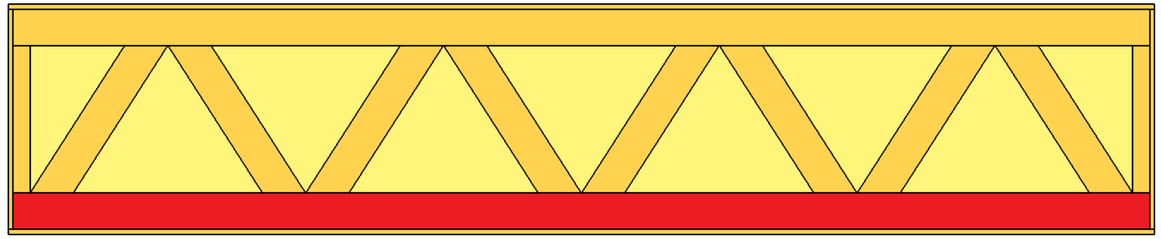
Sample calculation

Panel type	Weakest point	Max linear load kN/m	Breaking factor
Panel	Post	19.04	Axial force
Column	Post	22.24	Axial force
Lintel 60 cm height	Bottom flange	29.55	Bending moment



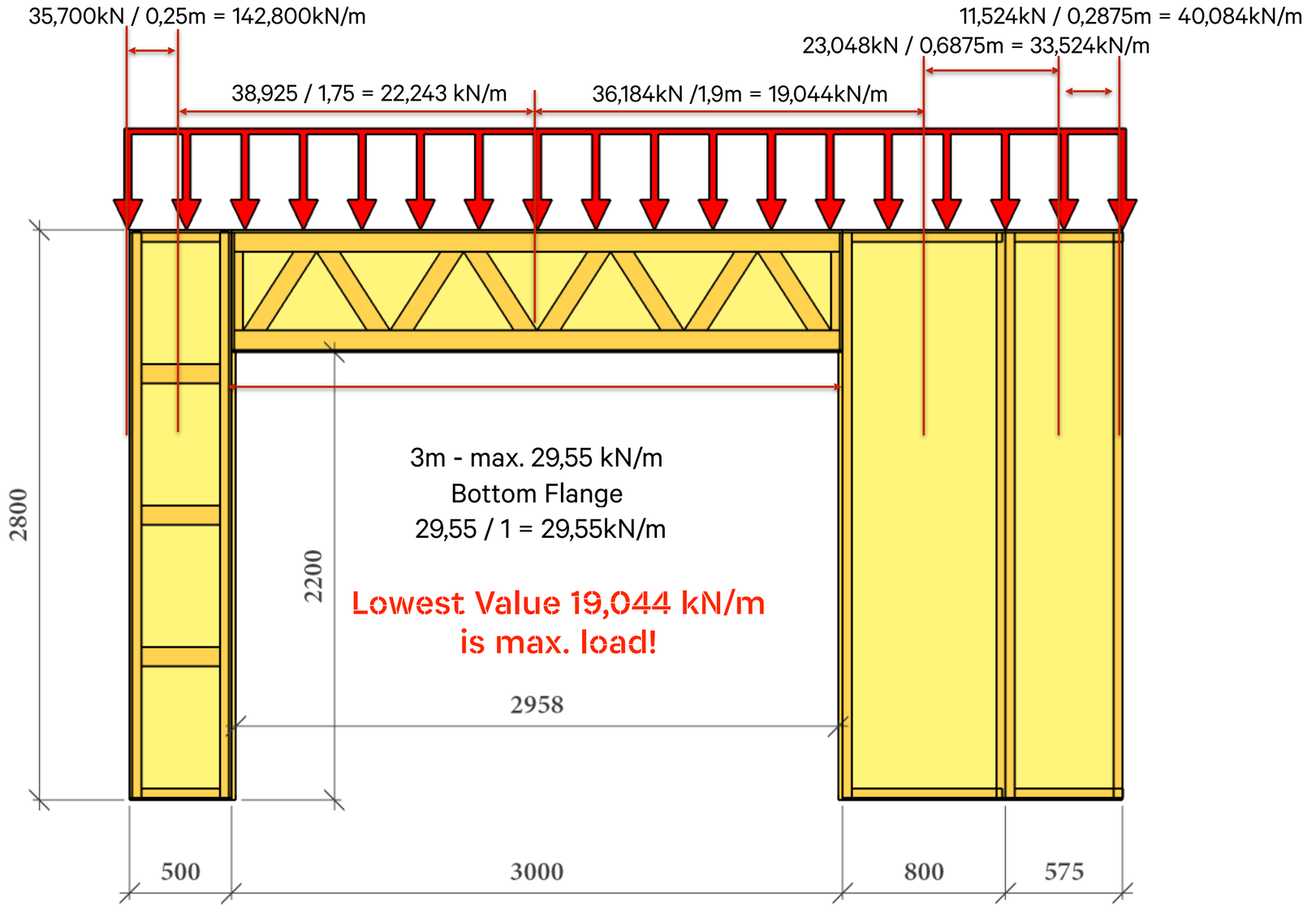




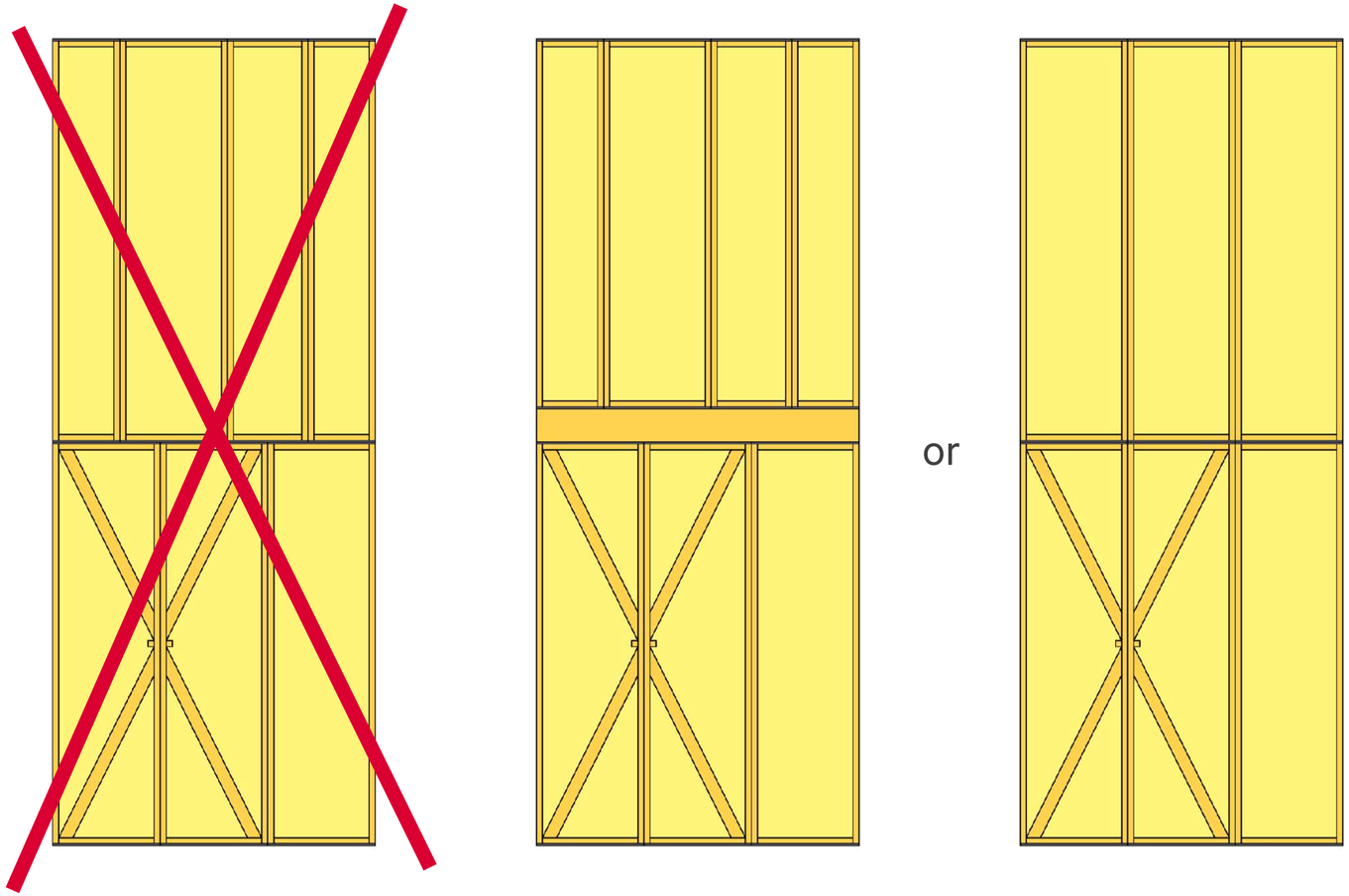


Lintel (side view)

Sample calculation



Panel supporting another panel



» Posts should be in one line if 2nd floor panels are supported directly on 1st floor panels.