BUILD RIGHT

Joining roof trusses

Most timber trusses are delivered to site as one-piece building components. However, occasionally they are delivered in sections and must be joined on site. Correct installation of these is critical to maintain the designed load paths.

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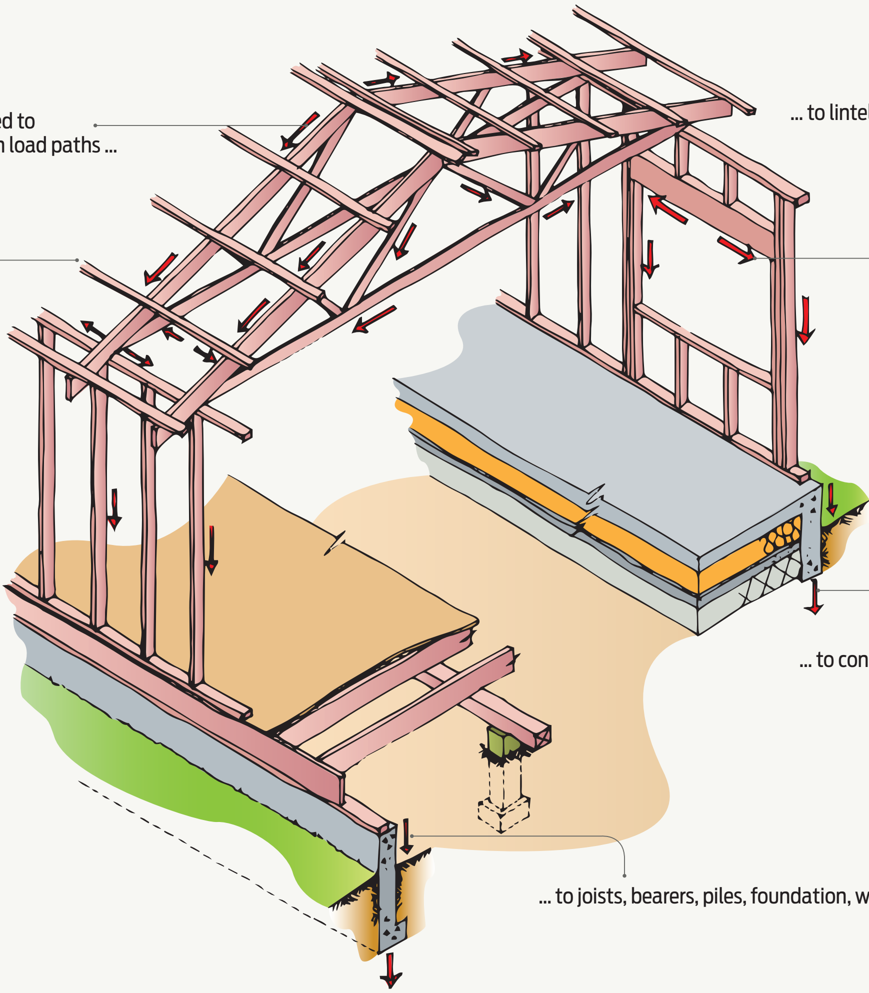

Figure 1 **Typical vertical load paths.**

DESIGN OF TIMBER TRUSSES is outside the scope of NZS 3604:2011 *Timber-framed buildings.* They are considered alternative methods and designed with proprietary software using several design loads in accordance with AS/NZS 1170:2002 *Structural design actions*.

Loads used in truss design

Dead load (G) created by:

- lightweight roof, e.g. galvanised iron
- medium-weight roof, e.g. asphalt on plywood
- heavyweight roof, e.g. concrete and clay tile.

Live load (Q) generated by:

- uniform distributed load of 0.25 kPa (kilo Pascal = kilo Newton/m^2)
- point load of 1.1 kN (man load) anywhere on the top chord or overhang
- point load of 1.4 kN on the bottom chord (reduced to 0.9 kN for headroom less than 1.2 m)

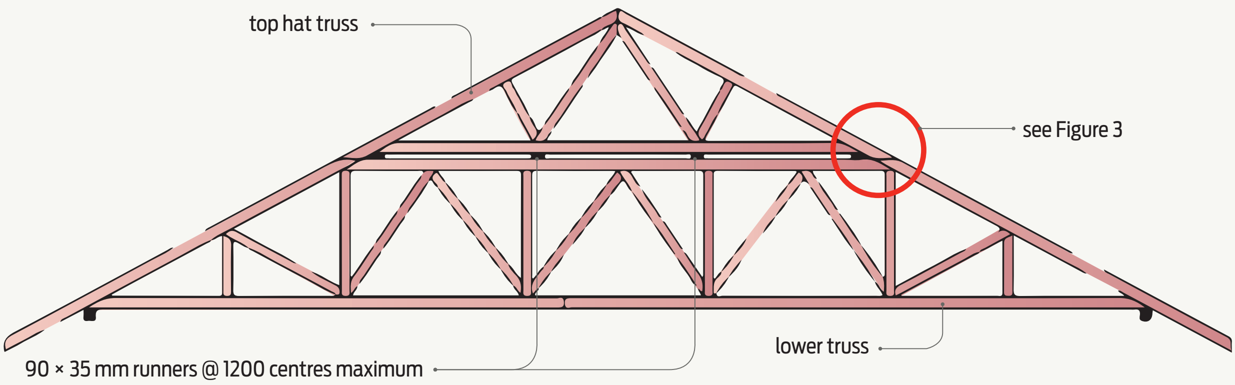

Figure 2 **Top hat on overheight roof truss.**

- light storage – 0.5 kPa (about 50 kg/m²) on the bottom chord
- attic trusses – 1.5 kPa on the bottom chord.

Wind load (W) from NZS 3604:2011:

- Low wind (32 m/s), medium (37 m/s), high (44 m/s), very high (50 m/s), extra high (55 m/s) or specific engineering design (>55 m/s).
- For a typical roof truss design, the wind is considered blowing from the left, from the right and along the ridge.

Snow load (Su) from AS/NZS 1170.3:2003:

- Regions N1 to N5.
- Ground snow (Sg) varies from 0.9 to 3.0 kPa or more depending on altitude or elevation.

Earthquake loads are generally not considered in roof truss design. The only consideration is the roof bracing, which needs to be designed in accordance with NZS 3604:2011.

Ultimate limit state

These loads are combined in ultimate limit state (ULS) design with these load combinations:

- Dead load only = 1.35G
- Dead + live loads = 1.2G + 1.5Q
- Dead + wind loads (for uplift design) = 0.9G + W
- Dead + live + snow loads = 1.2G + 0.4Q + Su.

All roof trusses have to pass the design of all load combinations.

Buildable truss layout

In a typical buildable truss layout, all external walls are shown and are loadbearing. Roof trusses are generally designed to span between external walls.

Some girder trusses or long rafter trusses will need an internal support so the trusses can be designed using reasonable size timber members.

Only the internal walls shown on the buildable truss layout are used as loadbearing. Internal walls that are not shown on this drawing are considered non-loadbearing. Hence, the top plates of all external walls and any internal loadbearing walls need to be fixed to studs in accordance with clause 8.7.6 and Table 8.18 of NZS 3604:2011.

Follow the load paths

Designers and engineers design buildings from the roof down using the design loads to be imposed on the structure in service.

Roof loads are transferred to the foundations through load paths. For vertical loads, these are typically from purlins to trusses (or rafters and beams) to top plates to wall studs to bottom plates and then to either concrete floor and foundations or to joists and bearers and then piles and footings (see Figure 1). Where trusses land on lintels, the loads are transferred sideways to the trimmer and understuds at both ends.

The reverse happens when the roof is subject to uplift during wind action. The correct fixings and connections are needed between all the different structural elements to maintain that load path.

For a hip roof, there is usually a truncated girder truss supporting the shorter jack trusses. If this truncated girder truss (or any other girder truss) lands on a lintel, this lintel will require specific engineering design. Lintels supporting point loads are not covered in NZS 3604:2011. Some proprietary lintel manufacturers provide selection tables for this situation. Studs supporting these lintels and the associated fixings (to lintel and to foundation) also require specific design.

Wind and earthquake also cause lateral loads on buildings. These loads are resisted by roof bracing, wall bracing and subfloor bracing in two orthogonal directions.

Joining trusses on site

Trusses may need to be joined on site if they are:

- overheight (>3.1 m)
- overlength (>12 m)
- one of several trusses meeting over an open space.

All site joints are specific engineering design to carry all member forces across the joints. The site joining and fixing is carefully documented to maintain the load path, and this must be followed on site. ➤

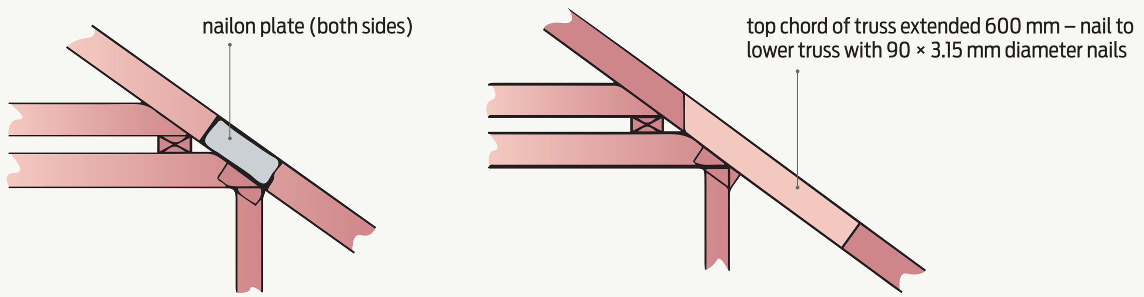

Figure 3 **Two options for fixing top truss to lower truss.**

Top hat trusses

For ease of transportation, overheight trusses are split into two, with the 'top hat' being fixed on site to the lower truncated truss. There are two options (see Figure 2) for fixing top truss to lower truss:

- Butting top chords and using nailon plates both sides.
- Overlapping top chords and nailing or screwing them together.

Overlength

Over length trusses can be fabricated in two halves to assist delivery on winding roads or to sites with difficult access.

If possible, the site joints are located over an internal loadbearing wall. If not, the joints are located at a suitable section of the truss, and a temporary platform will be required to support the truss while the joints are fixed together. Fixing is usually with nailon plates (see Figure 3).

Circular and hexagonal buildings where roof trusses meet in the centre may be designed with no support walls nearby. Again, a temporary platform will be required to support all the trusses while they are being bolted together to a steel ring with multiple fins to top and bottom chords.