

For most house designs and construction options, timber roof trusses provide the most cost and time efficient system to achieve a structurally sound roof system. This applies in both cyclonic and non-cyclonic areas and is equally applicable for sheet or tile roofs. As trusses are, in effect the equivalent of very deep slender 'beams', their installation, bracing and lateral stability requires special attention to ensure manufacturer's specifications and installation details are followed. The following advice highlights some of the more important requirements that need to be considered.

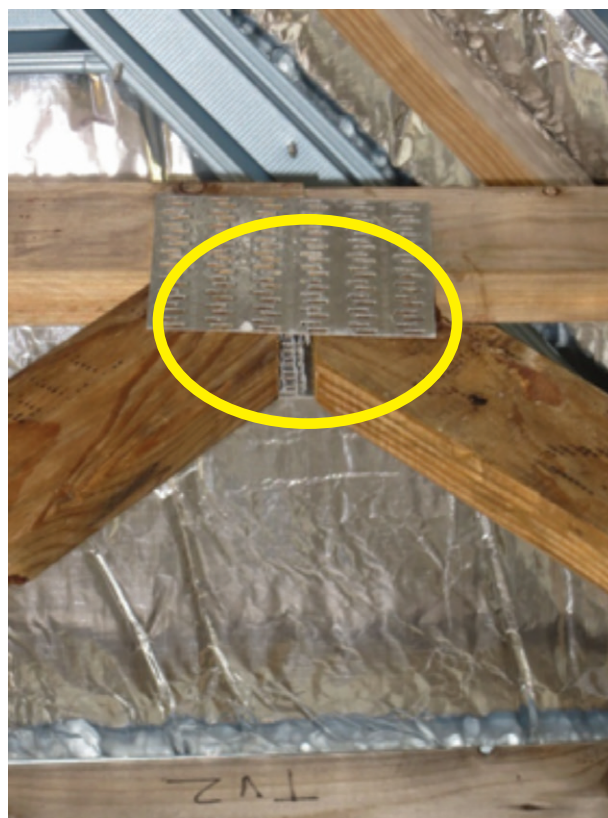
AT TIME OF SUPPLY

When trusses are supplied to site, ensure they are off-loaded onto level gluts clear of the ground and evenly supported so there are no deflections or sags. Prolonged weather exposure will damage trusses. Check that there are no obvious manufacturing defects in the trusses supplied such as plate misalignment, short or broken webs, missing plates or similar. Where concerns are noted, contact the truss supplier immediately to address issues as it much easier and cost effective to do this before erection.



Photograph 1 – Don't install site damaged trusses or those with manufacturing faults. Replace or repair before erecting

When trusses are delivered to site, they should be accompanied with the manufacturer's general truss installation details as well as detailed lay-out plans and specific details and advice for support, bracing, tie-down and any special requirements. This information is required to be kept on site at all times as regular reference to it will be required by both the builder and the certifier at the time of frame inspection.



Photograph 2 – Misplaced or short web



Figure 1 – Truss Installation Guides and Specifications must be followed

The literature typically supplied to site, as well as covering general installation requirements, will also address any specific matters relevant to the roof system supplied including:

- Truss layout plans
- Truss tie-down points and uplift loads
- Any intermediate support points and uplift loads
- For long slender webs, any additional lateral ties and diagonal bracing requirements
- Where structural fascias are required
- Roof bracing details
- Special details for support of identified solar systems, HVAC, stacker doors etc.

If the installation details supplied are not followed or adhered to, then the 'Form 15' provided for the truss roof system will be void. For comprehensive advice and information on installation and bracing of trusses, including truss to truss connection details, reference should be made to AS 4440 – Installation of nail-plated timber roof trusses.

TRUSS INSTALLATION

Lifting

Trusses should be lifted with spreader beams or slings not more than 60° apart. The slings should be located at top chord panels between half span to third span apart.

Photograph 3 shows severe bending stresses being induced on the horizontal top chord of the truncated truss, and strong pull out forces on the nailplate at the apex of the standard truss.

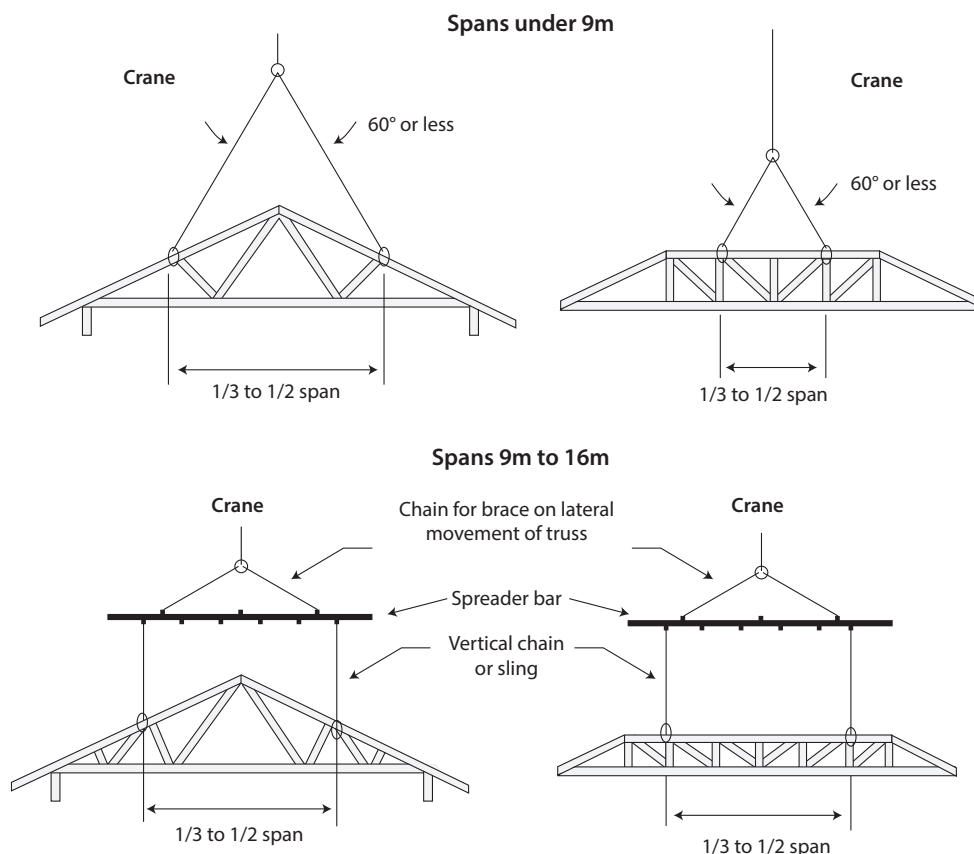


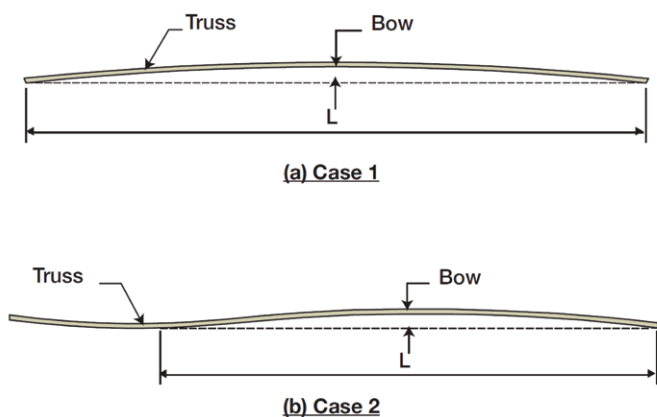
Figure 2 – Correct lifting of trusses



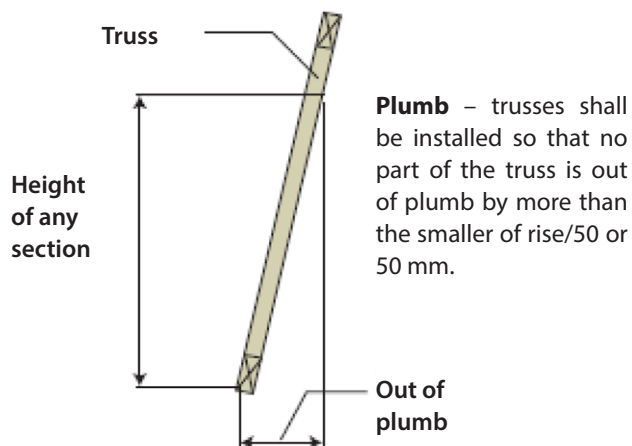
Photograph 3 – Incorrect lifting of trusses

Tolerances

Crucial to the satisfactory performance of trussed roofs is to install them straight and plumb. Trusses that are leaning, bowed or buckled can result in excessive deflection or in the worst case structural failure. Maximum tolerances are as per Figure 3.



Bow – trusses shall be installed with bow not exceeding the smaller of span/200 nor 50mm.



Plumb – trusses shall be installed so that no part of the truss is out of plumb by more than the smaller of rise/50 or 50 mm.

Figure 3 - Installation Tolerances

COMMON SITE ISSUES

Temporary Bracing

During installation, trusses must be adequately braced. The first truss should be plumbed and securely anchored to the ground or some other rigid building element. Subsequent trusses should be spaced and tied to that first truss with adequate numbers of top and bottom chord binders about 2.5m apart. Diagonal bracing should be added as bays of trusses have been installed. Failure to comply with this simple rule can result in dangerous and costly truss collapses.



Photograph 4 – Dangers of not providing temporary bracing

Top Chord Restraint

Trusses are unstable and prone to buckling if they do not have positive restraints to the top chords

- The horizontal top chords of all truncated girder trusses must be fixed to the rafters with at least one framing anchor.
- The roof battens must be fixed to each and every ply of a double or triple truss.
- The batten fixing must be positive and inflexible. Some metal battens are fixed with a nail over the crown that may rotate and may not provide adequate restraint for larger girders.
- Do not splice too many battens over the same truss. Not more than a third of the battens over a truss may be spliced and none of the splicing must be adjacent to each other.



Photograph 5 – Inadequately fixed roof battens resulting in lateral buckling failure of girder truss

Roof Bracing

Battens on their own are inadequate to restrain truss top chords from buckling unless they are in turn restrained by diagonal roof bracing properly anchored onto bracing walls.

Snaking roof tiles as shown in the building below are an indication of top chords gradually moving sideways, which if left unchecked could lead to eventual failure and collapse.

Special bracing details are required to connect the roof bracing to the wall bracing for cantilevered, cut-off and half trusses.



Photograph 6 – Distorted rows of roof tiles and trusses due to inadequate roof bracing

Girder Brackets

After placing a truss on a girder bracket, the bottom chord of the girder and bracket must be plumbed and hard against the supported truss before drilling and fixing the boot. If the bottom chord is allowed to twist, unwanted stresses accumulate on the girder that will lead to excessive deflection and possible failure.

At the very least, the ceiling finish will be poor and unsightly.

The correct sized bolts and screws supplied with the bracket should always be used and not substituted with possibly unsuitable alternatives.



Photograph 7 – Girder brackets not installed correctly

Web Ties and Stiffeners

Some long webs are prone to buckling under load. These are usually marked on the trusses by the fabricator to have web binders installed on site.

Web binders must also be accompanied by diagonal cross bracing every 10m to give them rigidity.

T-stiffeners or other web stiffeners installed during fabrication may be specified instead of web binders to avoid mistakes on site. Details for these can be obtained from your fabricator.



Photograph 8 – Web ties may be required for long webs. Check the specifications

Suspended Ceiling Systems

Plasterboard ceilings that are not directly attached to the trusses, and ceiling battens that are not directly fixed to the bottom chords constitute suspended ceilings. These include grid systems hung from the trusses or furring channels with clipped hangers. Such ceiling systems do not provide a structural ceiling diaphragm required for building stability.

It should not be assumed that the fabricator will be aware and automatically include the solution for such requirements in his quote and supply, even if the fabricator does eventually supply nominal bottom chord bracing such as binders and cross bracing for the purpose of truss stability that is not necessarily sufficient for overall building stability.

In this situation, it is the responsibility of the building designer and builder to provide a suitable engineered ceiling bracing system and for the certifier to check that this has been installed correctly.

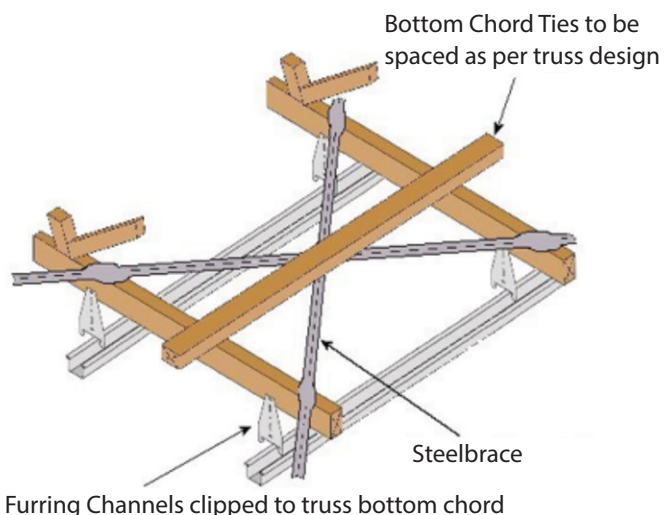


Figure 4 – Additional ceiling bracing required where suspended ceilings are used

Structural Fascias

Truss overhangs are usually designed to depend on the presence of a structural fascia to load share. Most metal fascias are not designed for this purpose.

The fabricator should be notified if non-structural metal fascias are to be used as it affects truss design.

If such metal fascias are used, structural timber fascias will still have to be fitted behind them to provide support to creeper jacks at overhang corners.



Photograph 9 – Ensure structural fascias are installed in accordance with the truss design and specifications

Installing Trusses Plumb and Straight

It might seem obvious that trusses should be fixed plumb and straight into position, but haste and carelessness can result in poor installation. This is especially so when inadequate temporary binders and/or bracing are installed and where reliance is misplaced on the roofing installer to plumb the trusses before fixing off his battens.

Twisted trusses will sag and result in uneven roof and ceiling finishes. It may even result in truss failures and collapse.

The responsibility is upon the builder to make sure the trusses are properly plumbed and fully braced and restrained before loading the roof.



Photograph 10 – A pronounced example of incorrect installation leading to trusses being twisted and out of plumb

Parapet Construction

A current popular design trend is for shallow roofs with box gutters and parapets.

Parapet construction can be approached in a number of ways but two of the more common approaches are either for the builder to frame it on site or to have the truss fabricator deal with the issue and build them into the truss.

As parapets are outside the scope of AS 1684, the build-on-site option may create some issues for the builder.



Photograph 11 – Structurally deficient parapets



Photograph 12 – Parapet restrained back to roof with purpose designed metal angle

SUMMARY

Fortunately, with trussed roofs, cases of total structural collapse and failure are rare – but they do happen. It is however far more common that poor installation practices and not adhering to manufacturer's details and specifications leads to roof systems that require rectification after the building has been completed.

This can be difficult, frustrating and costly.

Ensuring that the roof truss installer is conversant with AS4440 and follows the manufacturer's details supplied to site, and making sure that these requirements are adhered to will result in structurally adequate roofs that perform to expectations.

ACKNOWLEDGEMENTS

The contributions by MiTek, Multinail and Pryda for some of the images and content included in this Data Sheet are gratefully acknowledged.

SAFE WORKING

Working with timber produces dust particles. Protection of the eyes, nose and mouth when sanding, sawing and planing is highly recommended. Refer to tool manufacturers for safe working recommendations for particular items of equipment.

DISPOSAL OF OFFCUTS AND WASTE

As with all treated timber, do not burn offcuts or sawdust. Preservative treated offcuts and sawdust should be disposed of by approved local authority methods.



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