



Connection of roof battens to timber rafters in light weight metal roof sheet construction

The aim of this technical note is to provide information regarding a common area of failure occurring at the connection between roof battens and rafters used in the construction of light weight metal sheet roofs attached to timber framing in Class 1 and 10 buildings.

There is documented evidence that shows the connection between the roof battens and rafters is a common area of failure during wind events at below the design wind speed for the building.

Failure of batten to rafter connections during wind events occur in most years in the Perth Metropolitan and South West regions of WA. Several examples of failure can be found in Cyclone Testing Station, James Cook University, Technical reports, TR 54 on high winds in the Perth Metropolitan area in 2008.

The loss of roofs is considered a high risk event as it can cause damage to surrounding buildings, injury to persons, and significant distress and loss to the building occupants.

General Inspection of roofs under construction in the Perth Metropolitan area by the Building Commission has revealed that a high percentage of timber roof frames are not constructed in accordance with the applicable building standards and/or manufacturer fixing details.

The applicable building standards, namely the Building Code of Australia Volume Two (BCA), contains acceptable construction manuals (ACM) which provide ready-made deemed to satisfy construction details including Australian Standards such as AS1684.2 Residential Timber Framed Construction Non-cyclonic 2010. Where fixing details are not explicit within an ACM suitable testing or other evidence to support the material or form of construction may be necessary to demonstrate compliance with the BCA. In some cases an alternative solution may need to be developed particularly where proposed details are not within the parameters of the ACM or deviate from the deemed to satisfy provisions.

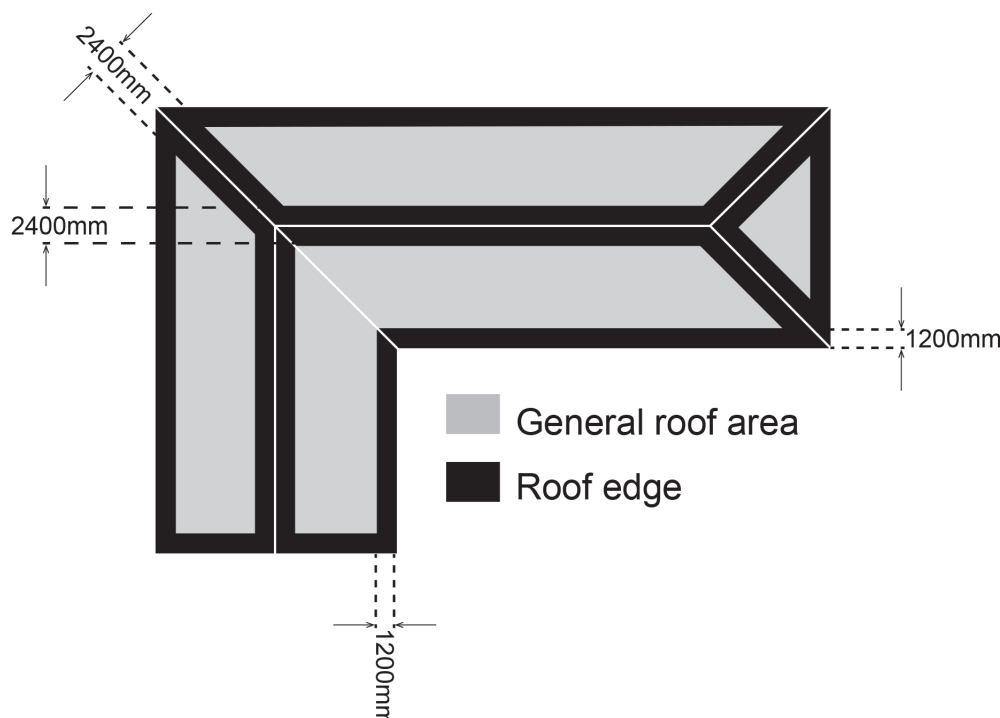


Diagram above: black areas indicate edges where a greater capacity connection is required. For battens spaced at 900 mm centres, 2 battens fall within the greater capacity area.

When assessing the required capacity of the batten rafter connection AS1684.2-2010 divides the roof into two areas; edges (within 1200 mm of the building edges, includes ridges, hips, perimeter) and general areas (all other areas of the roof not included in edges). As there is greater uplift at the edges a higher capacity connection is required for these areas when compared to the general area.

Timber battens.

AS 1684.2-2010 Residential Timber Framed Construction Non-cyclonic provides details on connection procedures for wind classifications N1 to N4. Prior to using the standard the wind classification must be established.

The fixing requirements for battens must be applied in conjunction and within the context of all the other requirements within whichever standard is being used i.e. compliance with all of AS1684.2.

When determining an appropriate connection the following items need to be assessed:

- Wind classification – with N1 being a lower design wind speed area and N4 being a higher design wind speed area requiring a stronger fixing detail.
- Timber species, stress grade and joint group,
- Type of roof covering,
- Batten spacing,
- Maximum batten span and overhang.

Section 9 of AS 1684.2 provides deemed to satisfy provisions for general fixing and tie down details for timber roof battens and rafters. The uplift capacity of the connection in AS 1684.2-2010 Table 9.25 must be greater than the uplift force in Table 9.14.

It has been observed on various construction sites that two plain shank machine driven 75 mm x 3.05 mm nails are used to connect a 35 mm thick batten to the rafters. AS 1684.2-2010 Section 9 Fixings and tie-down design shows that for roof battens and rafters spaced at 900 mm centres, wind rating N1, in joint group JD5 two plain shank 75 mm long nails do not provide a compliant Edge or General area batten to rafter connection.

Please note AS1684.2-2010 Table 9.25 Uplift capacity of roof batten tie-down connections provides connection details for roof battens up to 38 mm thick. If the battens being used are thicker than 38 mm, for example a 45 mm thick batten, the connection capacities provided in AS1684.2-2010 do not apply. In this case the fixing method must be assessed and determined as satisfactory by an appropriately qualified person such as a structural engineer.

Some timber suppliers/manufacturers provide fixing details for 45mm thick battens that may be appropriate if they have determined compliance by a suitable means. For example one manufacturer recommends the use of a 75 mm long No 14 Type 17 screw when fixing 45 mm thick battens to all areas of the roof for N1 and N2 wind zones.

Metal Battens

The metal battens used in the Perth and surrounds are generally 40 mm high with a base metal thickness of 0.55 mm. These battens have been found to be fixed to the timber rafters using a variety of methods that include screwed connections and various types and sizes of machine driven nails.

A number of manufacturers of the metal battens have been contacted by the Building Commission and advised that their recommended fixing is via screws and generally they will not warranty their product if fixing is by any other method.

Not complying with the manufacturers recommendations may result in the roof system failing at below the design wind speed. The Building Commission is aware of cases of such failure. This includes a metal sheet roof to a house at Shoalwater, WA in 2008 where the roof blew off. The battens had been fixed to the rafters via nails. The connection failed when the batten tore off from around the nail head rather than the nail being pulled out of the timber rafter.

When using metal battens the following aspects should be considered:

- Confirm that the fixing method adopted is in accordance with the manufacturer's recommendations.
- If the installation method is not in accordance with the manufacturer's recommendations suitable evidence should be provided to demonstrate compliance with applicable building standards. This may require testing where a like for like comparative is not possible.
- The batten fixings should have suitable corrosion protection. By not doing so the metal batten may rapidly sacrifice its own protective coating to protect the fixing. This may lead to accelerated corrosion of the batten adjacent to the fixing and therefore a reduced service life.
- If metal battens being fixed to timber rafters are to be assessed on the basis of an alternative solution, the alternative solution should be noted on the plans and or documentation prior to submission to and approval by a building surveyor. The various assessment methods for an alternative solution can be found in provision 1.0.9 Assessment Methods of the Building Code of Australia Volume Two.

In addition general inspections by the Building Commission has shown that in a number of cases machine driven nails have damaged and weakened the metal batten by being overdriven.

Conclusion

This information has been provided to highlight that the batten to rafter connection in light weight roof construction is a critical connection in preventing roof failure. Therefore all parties involved in the design, approval and construction need to familiarise themselves with and ensure the minimum fixing requirements are complied with.

Disclaimer

Note that the information in this bulletin does not warrant compliance of any specific application. The examples used are common examples for the Perth metro area but do not include all specific design requirements.

Where unsure you should consult with a suitably qualified person for example a structural engineer, with knowledge and experience of the particular roof construction.

Please contact the Building Commission Audit branch, building inspectorate for further information or comment.

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The information contained in this technical note is provided as general information only and should not be relied upon as legal advice or as an accurate statement of the relevant legislation provisions. If you are uncertain as to your legal obligations you should obtain independent legal advice.