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AN ENGINEER'S INTERPRETATION OF TECHNICAL REPORT No 44

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Cyclonic conditions in the northern reaches of Australia demand particular attention to the detail of hold down brackets to support roof trusses from severe uplift.

In most cases, specific engineering details are called for to provide adequate resistance against such loads.

The quality of such details depends on adequate research to verify their performance.

This year marks the twentieth anniversary of the Cyclone Structural Testing Station at the James Cook University of North Queensland.

As a leading research institute into the study of building performance under high wind loads, a special investigative team comprising Greg Reardon and David Henderson was formed to study the performance of bolted steel angled brackets to anchor roof trusses.

The pair investigated different bracket variations including using softwood and hardwood trusses, different steel thickness, bolt size and steel grade, single or double cleats, and the use of a steel strap to wrap over the truss.

Their findings were published in Technical Report No. 44, dated October, 1996.

This article does not seek to re-iterate or summarise the contents of this report.

Readers are encouraged to obtain and read the stated report themselves in order to better understand the behaviour of such brackets.

Instead, this article represents one engineer's interpretation of the behaviour of bolted steel angle brackets to restrain trusses as demonstrated in the light of these tests that were undertaken at the institute.

It also proposes a simplified table of hold down details drawn from the test results that could be used by truss plants and other detailers for standardising truss support fixings under high uplift loads.

The University report explains in great detail the effect of different variations to basic hold down bracket as to the expected failure load and failure mechanism.

From a designer's perspective, the following observations summarise some of the main highlights.

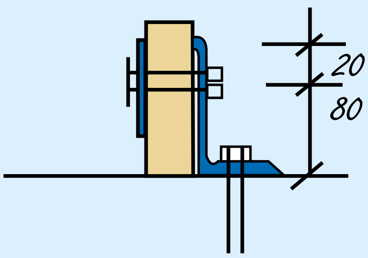
- *The presence of a nail plate at the truss heel significantly increases the bolt holding capacity by at least fifty per cent. It does not matter whether the bolt passes through the plate or whether it is located directly above it.*
- *The inclusion of a steel strap over the truss helps to increase the uplift capacity of hardwood trusses by around 40 per cent and although the results on softwood is less clear, this writer believes the increase can be estimated around the same magnitude. The steel strap must be wrapped tightly around the truss and the bolt has to pass through it on both sides.*
- *Only small, relatively insignificant gains in uplift loads are achieved when the angle brackets are paired (unless a steel strap over is included). However, they do significantly reduce displacement and distortion under full load.*
- *Double component trusses increase the uplift capacity of a single component truss by at least 50 per cent.*

For practical application, the following table summarises this engineer's proposal for simplified hold down details drawn from this report.

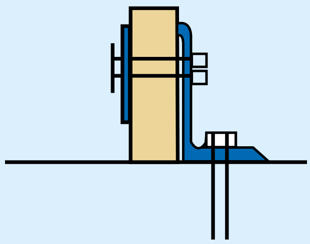
As a certain amount of engineering discretion has been applied, the proposed details and corresponding loads do not strictly adhere to the tested bracket details or report findings.

The steel angle shown may each be substituted with a 60x6mm flat steel plate cast into masonry bond beams as an alternative bracket detail.

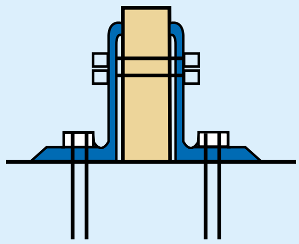
Single or Double Bracket



Single Bracket plus strap



Double Bracket plus strap



	Single or Double Bracket	Single Bracket plus strap	Double Bracket plus strap
Steel Angle	100x75x8mm x60mm long	100x75x10mm x60mm long	100x75x10mm x60mm long
Bolt size	M12 plus washer	M16(HT) plus washer	M16(HT)
Steel Strap	None	50x2mm	50x2mm
Rod Anchor	1x16 dia rod or or 1x12 dia rods	1x16 dia HT rod or 1x20 dia rod	2x16 dia rods
Timber		**Uplift Capacity**	
35mm JD4 Softwood	12kN(*1)	17kN(*3)	22kN(*4)
70mm JD4 Softwood	18kN(*4)	27kN	33kN
35mm J1 Hardwood	15kN(*2)	21kN	30kN(*4)
70mm J1 Hardwood	22kN(*4)	37kN	46kN

Notes:

*(*1) With a deeper steel angle than that used in the test, the bolt would usually be located above the heel plate. (*2) the test indicated an average bolt shear failure of 30kN with M12 and could not achieve timber failure. (*3) This increase is based on larger bolts than those tested. (*4) Double component trusses achieve about 50 per cent higher loads than single components. 5. The bolt must be located at a minium distance of 25mm from the timber edge of the top chord. 6. The steel strap must be tightly wrapped around the top chord and be bolted through on both side of the truss. 7. The user must check the ability of the supporting structure to resist the design uplift. 8. For JD5 Softwood, use 70 per cent of JD4 softwood capacity. 9. For J2 Hardwood, use 80 per cent of J1 hardwood capacity.*