

THE RIGHT WAY TO BOLT



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The humble bolt is one of the oldest and most popular methods of joining timber members. Most people would consider a bolted joint to be a very straightforward fastening method.

However, a few subtle points in the manner a bolt is manufactured and installed can make a big difference to its load carrying capacity.

In simple terms, the strength of a bolt loaded in shear comes from the bearing of the steel shaft against the timber fibres. The larger the bolt diameter and the thicker the timber member, the greater the bearing surface and therefore a higher load carrying capacity.

However, that is not the full story.

The drawing shows an exaggerated condition of a bolt under load and illustrates its behaviour.

The skewing of the bolt reduces the bearing area against the critical side of the hole. The load capacity is enhanced if the skewing is reduced as this improves the bearing area available to restrain the load.

Closer inspection of the drawing reveals that the skewing of the bolt is accompanied with similar movement of the bolt head.

The presence of a substantial washer reduces the head rotation thereby improving joint stiffness and load capacity. The bigger and thicker the washer, the greater the resistance there is to the bolt and head movement.

The standard bolt shear capacity in the timber code is based on a minimum washer size, which should be present in all structural timber connections. The minimum size of washers required with different bolt diameters is shown on the table below.

This washer size is different to the washers normally supplied with engine bolts.

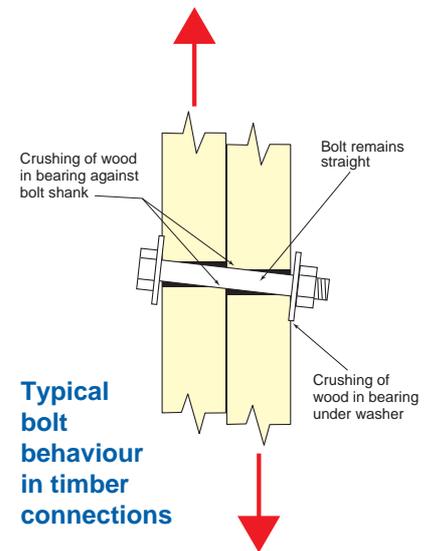
Washers are not required if the bolt head or nut were already against a steel cleat face.

Cup head bolts have an enlarged head and collar but do not achieve the same resistance to rotation as normal heads with washers. Although washers could be used with dome head coach bolts, they do not sit as squarely as hexagonal heads and are best avoided altogether in structural connections.

Naturally, bolts should be sufficiently tightened to reduce the head against movement. However, they should not be over-tightened so as to crush the timber beneath the washers. Crushing could also lead to premature timber fracturing and splitting.

Likewise, bolts should be adequately spaced apart, about five times the diameter, and have adequate distance from the timber edges.

With unseasoned timbers, bolts should be regularly tightened as the timber seasons and shrinks, otherwise the



drilled hole should not exceed the root diameter of the thread, and the required penetration into the second member could be up to 12 times the bolt diameter.

Another feature that contributes to bolt shear capacity is the steel grade. While the most common grade is mild steel grade 4.6, in some special cases, high strength steel bolts are called for. These have enhanced tensile strength, bending resistance and stiffness over mild steel and should be used where specified.

In summary, where bolted connections

Bolt Size	Washer Size (mm)		
	Thickness	Min diameter (Round washer)	Min side length (Square washer)
M6	1.6	30	25
M8	2.0	36	32
M10	2.5	45	40
M12	3.0	55	50
M16	4.0	65	57
M20	5.0	75	65

connection will loosen causing a reduction in strength.

Many bolts are manufactured using a rolling process to form the thread. With these bolts, the overall thread diameter is greater than the shank diameter. Holes drilled to accommodate the bolts should be no more than the bolt shank diameter plus 10 per cent, as an oversized hole will result in the bolt rocking before any load is resisted.

Coach screws operate in the same manner as bolts except that the pre-

are used in structural timber, the following rules should be observed.

1. Pre-drill the correct hole size
2. Adequately space bolts apart
3. Keep well away from timber edges
4. Use hexagonal head bolts
5. Place correct washers under heads and nuts
6. Tighten and maintain bolt tension

By following these rules the integrity of your timber connection will not be compromised.