COMPLETE BRACING SYSTEMS - WALLS

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To effectively brace a building against wind forces it is import to understand how these forces are transferred through the building to the footings.

The effect of wind blowing over a building generates both vertical and horizontal loads on the structure.

Truss design programs calculate the value uplift forces, which enables the type of tie down to be easily determined.

These loads are transferred directly to the footings or to elements of the building until the dead weight of those elements exceed the uplift forces.

Which, in the case of timber framed construction in high wind areas, means all the way to the footings.

So in many cases securing the truss to the top plate without checking top plate to stud, stud to bottom plate and bottom plate to footing connections is not sufficient.

With horizontal loads the load path is not as direct and obvious.

Horizontal loads are transmitted through roof trusses, ceiling diaphragms braced wall panels, floor diaphragms and eventually to the footings.

It is important that all these elements are tied together adequately to restrain these loads.

As you can see there are many elements in the bracing system and it is a case of the system only being as strong as its weakest link.

A 3.0 kN/m bracing wall must have fixing at adjoining walls, ceiling and floor diaphragms to restrain similar loads. (Refer to Figure 1.)

"AS1684 Residential Timber Framed Construction" has a number of examples of typical fixing details and their load carrying capacities.

It is essential that the appropriate details be used in each case.

Typically, fixing to the ceiling diaphragm is made by connecting the truss bottom chords to the bracing wall as shown in Figure 2.

The truss must be allowed to move vertically while transmitting horizontal racking forces to the wall.

It is important that the ceiling diaphragm is fixed firmly to the truss bottom chord, e.g. glued and nailed direct or fixed via ceiling battens. (Refer to Figure 3.)

Trusses with exposed bottom chords, suspended ceilings or "fixed via" metal clips to furring channels, do not transfer loads to the ceiling diaphragm and will require additional bracing members in the plane of the bottom chord.

In these cases you should seek advice from a structural engineer.

It is also important to ensure that the spacing and distribution of bracing walls is adequate as shown in Figure 4.

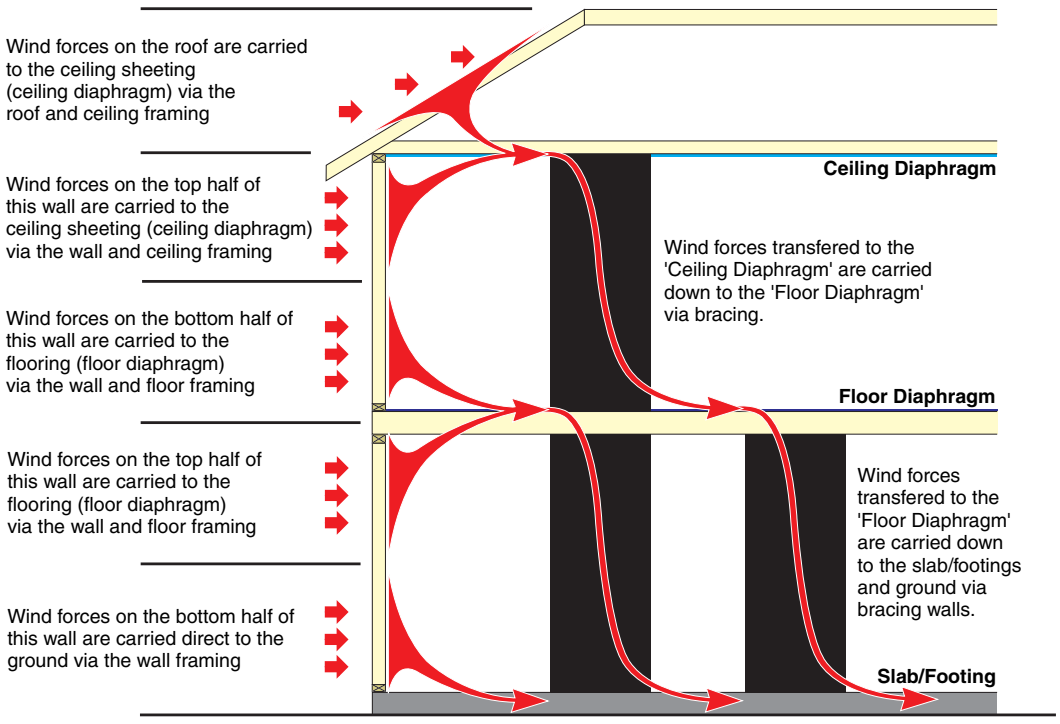

Figure 1
Distribution of Wind Racking Forces

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If the bracing walls are spaced too far apart (9m maximum depending on roof pitch and ceiling depth) the ceiling may not be sufficient to transfer the bracing loads between the brace walls.

In recent times open plan living has become more popular.

In addition it is common to have larger openings for windows and doors, with the openings often located close to the corners of the building. This results in fewer walls in which bracing can be placed.

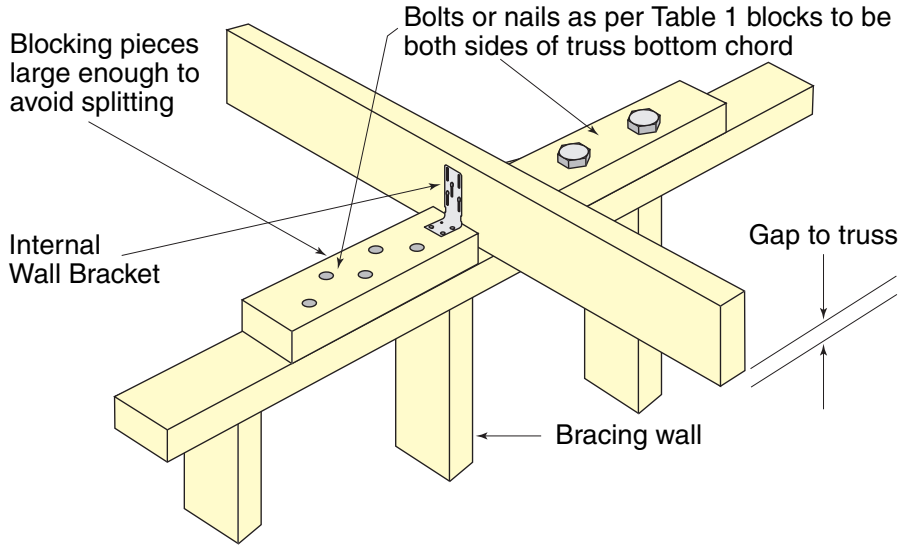
To overcome this problem additional bracing forces need to be distributed through the structure, or special high load capacity braced panels employed.

In these applications engineers should be consulted to determine the bracing forces and to design the bracing system.

Conclusion

As you can see, wind bracing systems are only as strong as their weakest link. When detailing the bracing required for a building, be sure you follow the load path right down to the footing and select the appropriate detail from AS 1684 for each link.

References: AS1684 "Residential Timber Framed Construction"; AS1684 User Guide 10 "Distribution of Raking Forces via Diaphragms and Bracing Walls".



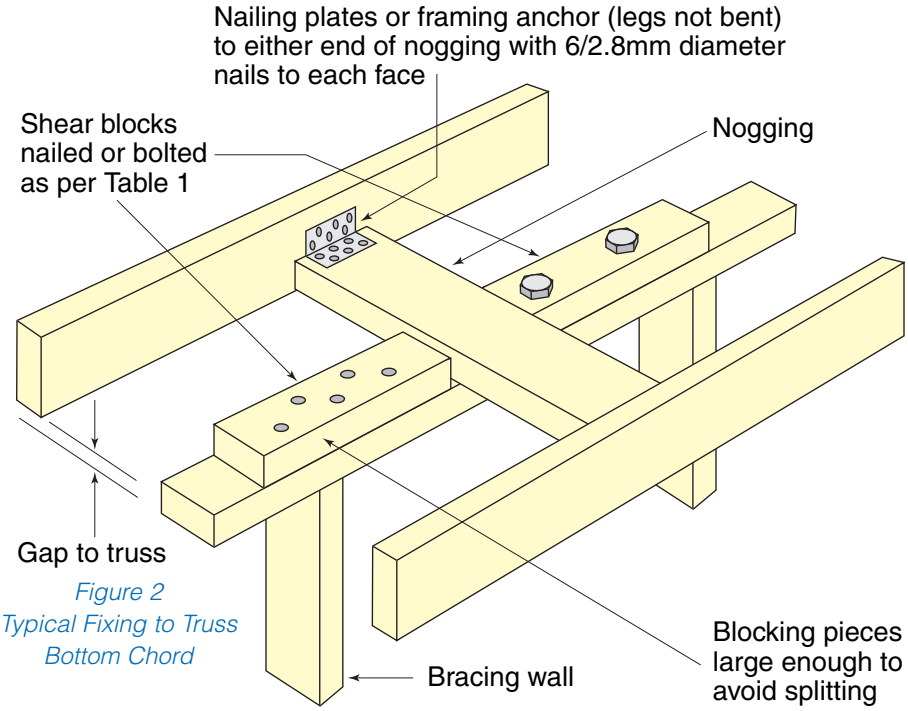


Figure 2
Typical Fixing to Truss Bottom Chord

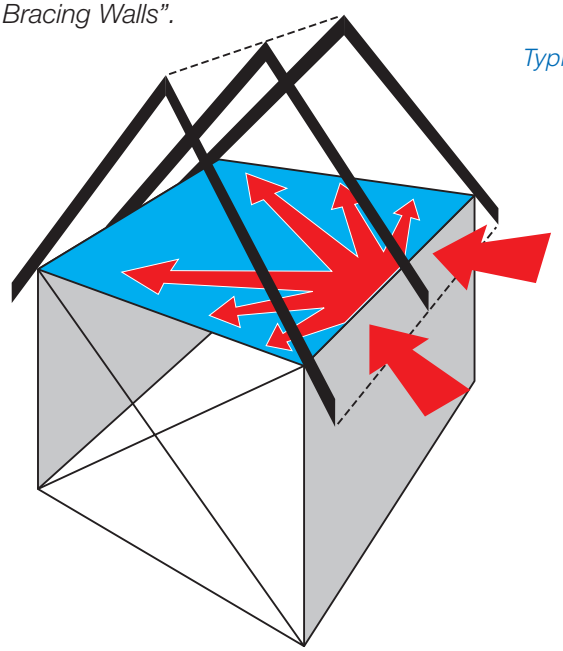


Figure 3
Transfer of Loads through the Ceiling Diaphragm

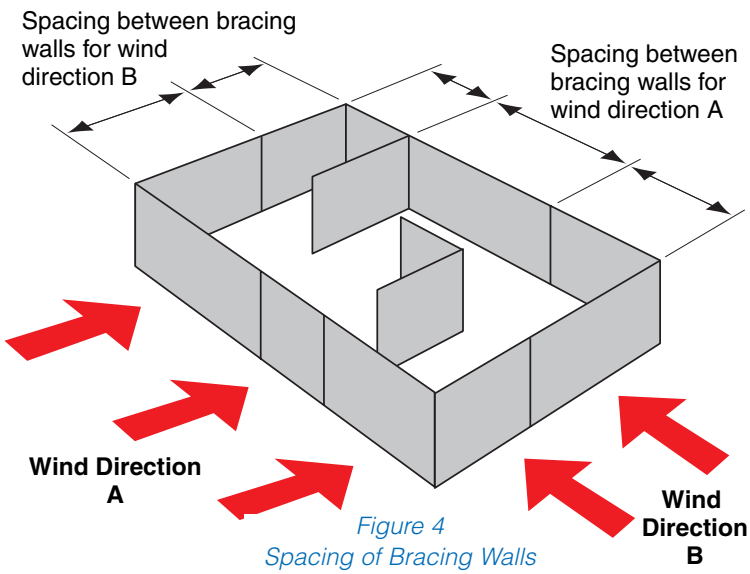


Figure 4
Spacing of Bracing Walls