FTMA TECH TALK

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BRACE YOURSELVES – STRUCTURAL CEILING DIAPHRAGM

All structures must be adequately braced to resist applied forces and maintain stability. It is well known that both roofs and walls require bracing – but what exactly are we bracing against, and how are these forces transferred from the roof to the walls, and ultimately to the foundation?

There are two types of forces that necessitate bracing.

The first is the lateral (racking) forces, which result from externally applied horizontal forces, such as those from wind or seismic. Refer to Fig. 1 below.

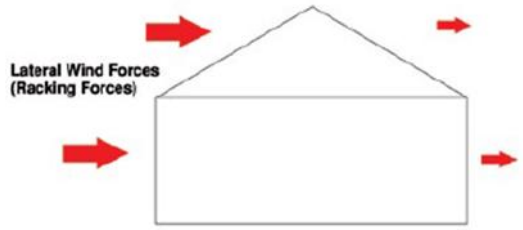
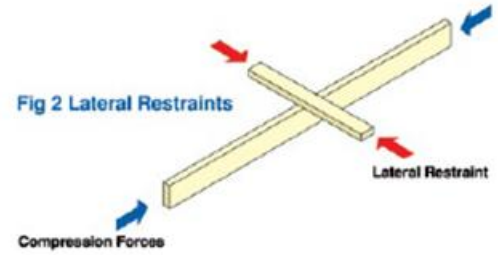


Fig.1 Lateral Force - Wind Loads on Structure.

The second type of force results from the impact on specific elements of the structure as they resist externally applied horizontal forces.

The second type of force arises from the impact on individual structural elements as they resist these horizontal actions. For instance, a slender member under compression may buckle unless stabilised by suitable restraints – such as roof battens on truss chords or noggings on wall studs.

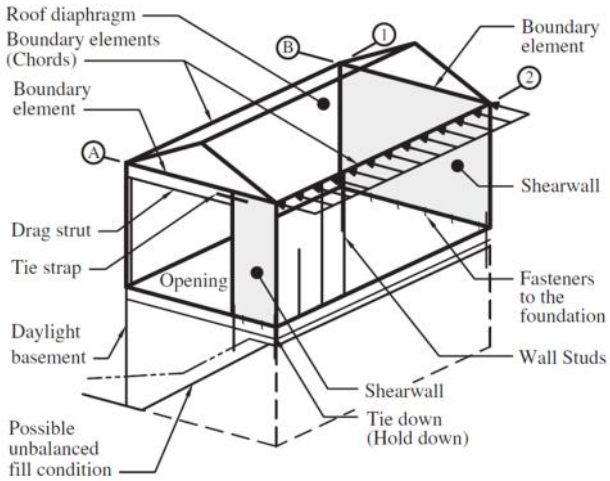
Refer to Fig. 2.



The forces applied to these lateral restraints must be transferred back through the structure.

In typical timber-framed residential construction, the structure and its bracing are designed in accordance with AS1684. A fundamental assumption is that lateral forces are transferred through the ceiling, which acts as a structural diaphragm, and into the bracing walls.

To do this effectively, the ceiling diaphragm must be sufficiently stiff and properly fixed to boundary elements, such as the bottom chords



Battened ceilings or ceilings fixed directly to the bottom chords of trusses are generally deemed to provide enough connectivity to transfer lateral forces through the diaphragm. However, for a battened ceiling to act as a structural diaphragm, the battens must be securely attached to the truss bottom chords.
Although furring channels are increasingly used in residential construction, the clips and fixings commonly used with these systems are not considered adequate for transferring lateral forces. In such cases, additional bracing is required.

Scenarios that require extra consideration include:

- Exposed trusses
- Suspended ceilings
- Clipped furring channels

Bracing wall location and distribution requirements as outlined in AS1684
The additional bracing may include bottom chord ties, as specified in the truss design, and diagonal bracing. Diagonal bracing can be provided using Speedbrace fixed to the truss bottom chord and supporting structure, as per AS4440. Refer to Fig. 4.

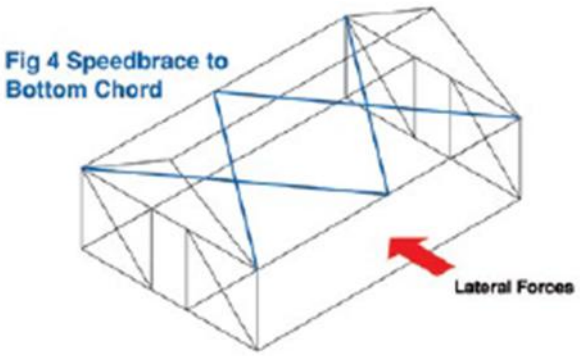


Fig 4 Speedbrace to Bottom Chord

An alternative method is the use of wind trusses (Fig. 5), specified by the project engineer and installed in accordance with MiTek GN Guidelines 144 by Sunil Narsey.

Where ceiling diaphragms are located above internal bracing walls, connections must have sufficient capacity to transfer forces across shearwalls. Shear blocks or proprietary products that allow for vertical truss movement, such as BraceWall Brackets, must be used.

To ensure the structural system performs as intended, the design of the additional bracing must clearly detail all connections and allow for a complete understanding of the structural load path. The engineering documentation should include, at a minimum:

- The responsible person who carried out the design
- The assumptions used in the design
- Details of all fixings

These elements must be captured and complied with before or during construction to ensure structural stability.

Ranville Marmeto, is a skilled design engineer supporting MiTek customers with design solutions. With a Bachelor's in Civil Engineering and 16 years of experience across multi-storey and residential construction, Ranville's journey with timber engineering began in 2015.

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