BRACING USING NZS 3604:2011 – PART 1

Providing sufficient bracing capacity for wind and earthquake is an integral part of the design process. This series starts by looking at the information needed for bracing calculations.

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Bracing for a timber-framed building is required to resist horizontal wind and earthquake forces. The bracing demand to resist wind is expressed in bracing units (B/Us) per lineal metre and bracing units per square metre for earthquakes.

Before starting bracing calculations, the designer will need to collect the following information for the specific building.

NZS 3604:2011

Is the building being considered within the scope of NZS 3604:2011? For this, it must be no more than 2-storeys and a maximum height of 10 m from the lowest ground level to the uppermost portion of the roof.

Designs within the scope of NZS 3604:2011 must provide bracing capacity that exceeds the *higher* of the minimum requirements in NZS 3604:2011 for:

- wind demand – Tables 5.5, 5.6 and 5.7
- earthquake demand – Tables 5.8, 5.9 and 5.10.

Wind zone

Some territorial authorities have maps with wind zones. Otherwise, see NZS 3604:2011 5.2.1 to work out the wind zone. Steps to do this are also in *Build* 128 February/March 2012, pages 24–25, or consult an engineer.

When the structure is situated in a lee zone, also see the increased requirements in the notes at the bottom of Table 5.4.

Earthquake zone

Establish the earthquake zone from NZS 3604:2011 Figure 5.4. For Christchurch, refer to Building Code clause B1 3.1.2.

Floor plan area

What is the floor plan area in square metres at the level being considered? This is needed for →

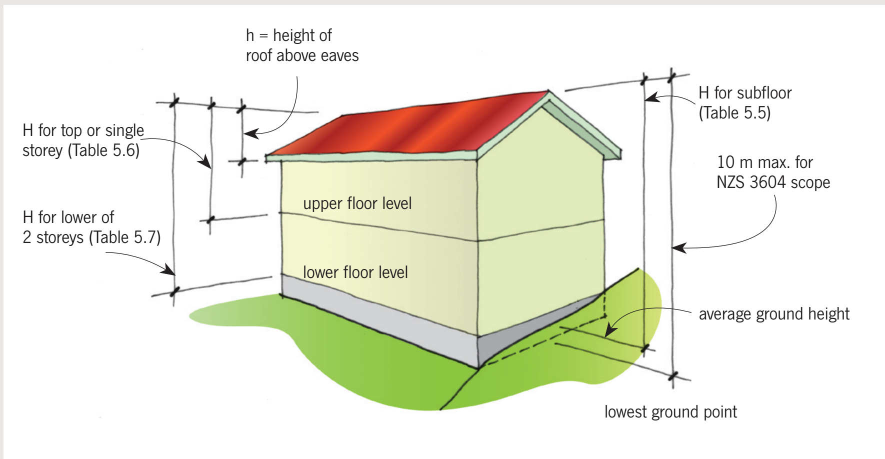

Figure 1: How to work out H and h.

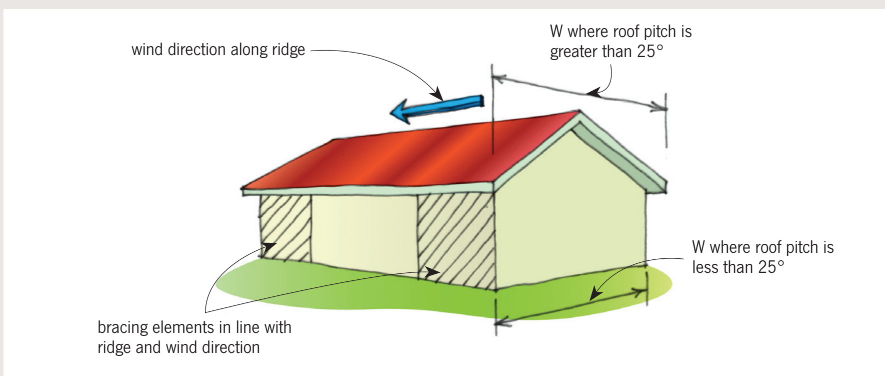

Figure 2: Bracing for wind along the ridge.

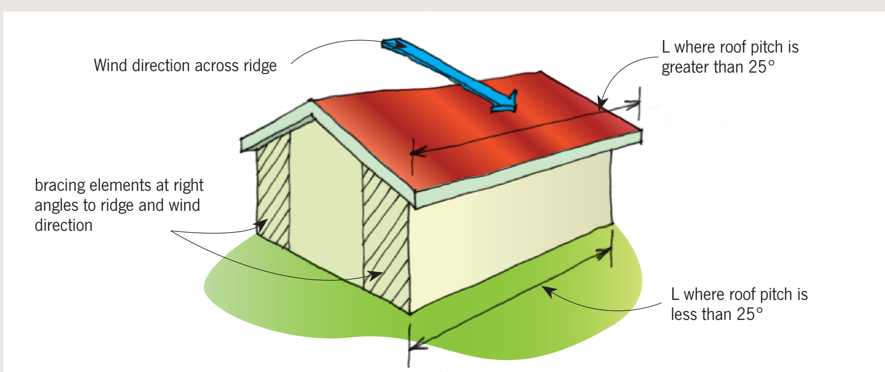

Figure 3: Bracing for wind across the ridge.

earthquake demand calculations – the total floor area of the level being considered is multiplied by the values given in Tables 5.8, 5.9 and 5.10.

Weight of claddings

Wall claddings are separated into:

- light wall cladding – has a mass up to 30 kg/m², for example, weatherboards
- medium wall cladding – has a mass over 30 kg/m² and up to 80 kg/m², for example, stucco
- heavy wall cladding – has a mass over 80 kg/m² and up to 220 kg/m², for example, clay and concrete veneers (bricks).

Roofs are either:

- light roof – has roofing material (and sarking where required) with a mass up to 20 kg/m² of roof area, for example, profiled metal roofing
- heavy roof – has roofing material (and sarking where required) with a mass over 20 kg/m² and up to 60 kg/m² of roof area, for example, concrete or clay tiles, slates.

Site subsoil class for earthquake calculations

Site subsoils are classified in NZS 3604:2011 C5.3.3 as:

- class A – strong rock
- class B – rock
- class C – shallow soil sites
- class D – deep or soft sites
- class E – very soft soil sites.

Territorial authorities often have maps with the soil classifications. If this information is not available, site subsoil classification class E must be used or specific engineering design carried out.

The type of soil class is needed to calculate the bracing units required to resist earthquakes. For multiplication factors for soil types see:

- Table 5.8 – single storey on subfloor framing for various wall and roof claddings
- Table 5.9 – 2-storey on subfloor framing for various wall and roof claddings
- Table 5.10 – single and 2-storey on slab for various wall and roof claddings.

Building shape

What is the building shape? NZS 3604:2011 clause 5.1.5 sets out the requirements for buildings that have:

- wings or blocks that extend more than 6 m from the building – these need sufficient bracing individually

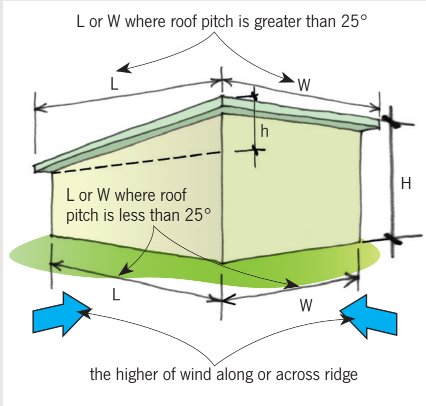

Figure 4: Dimensions for mono-pitched roofs.

- split-level floors – each level to have sufficient bracing individually and to have wall and subfloor bracing at the position of the discontinuity
- floors or ceilings with a step more than 100 mm in the finished levels – a *bracing line* is required in the storey below at the location of the discontinuity, and the *bracing element* in the storey below must run continuously from the storey below to the underside of the upper levels.

Heights of buildings

Use NZS 3604:2011 Figure 5.3 to establish heights H and h for bracing applications. H may have different values for different sections of the same building (see Figure 1), for example:

- for subfloor bracing requirements, H = the average height of finished ground level to the roof apex (use Table 5.5)
- for a single or upper floor level, H = single or upper finished floor level to roof apex (use Table 5.6)
- for lower finished floor level, H = lower finished floor level to roof apex (use Table 5.7)
- for roof height above the eaves, h = apex of roof to bottom of eaves (use Table 5.5, 5.6 and 5.7).

Roof types

What is the type(s) of roof? NZS 3604:2011 Figure 5.3 shows where bracing needs to be in relation in wind direction.

GABLE ROOF – WIND ALONG RIDGE

Bracing elements to resist wind are placed in line with the ridge and wind direction (see Figure 2).

To calculate the required bracing units along the building, multiply W by the value in the right-hand 'Along' column in NZS 3604:2011 Table 5.5 (subfloor), 5.6 (upper or single-level walls) or 5.7 (lower of 2 storeys). These tables are for high wind zone. In other zones, use the multiplying factor for the relevant wind zone found at the bottom of the relevant table.

GABLE ROOF – WIND ACROSS RIDGE

Bracing elements for wind across the building are positioned in line with the wind direction and at right angles to the ridge line (see Figure 3).

To calculate the bracing units required in the across direction, multiply L by the value in the 'Across' column in NZS 3604:2011 Table 5.5 (subfloor), 5.6 (upper or single level walls) or 5.7 (lower of 2 storeys). As above, if not in a high wind zone use the relevant wind zone multiplying factor at the bottom of the table.

HIP ROOFS

Use 'Across' values in NZS 3604:2011 Tables 5.5, 5.6 and 5.7 for along and across directions.

MONO-PITCHED ROOFS

Roof height above the eaves is taken as the difference between lower eaves height and roof apex (see Figure 4).

When roof pitch is:

- 25° or less, use wall width or length
- greater than 25°, use roof dimensions.

To calculate the bracing units required, use the higher value of the along and across calculations in NZS 3604:2011 Tables 5.5, 5.6 and 5.7 is used.

Limitations on bracing allocation

Based on hold-down capabilities, there are some maximum ratings for bracing elements that can be used in calculations. The maximum for:

- timber floors is 120 bracing units/metre
- concrete floors is 150 bracing units/metre.

The bracing design should evenly distribute the bracing throughout the building rather than concentrating them in ends of buildings or outside walls.

Extra B/Us for part storey and chimneys

Where there is a part storey contained in a:

- timber-framed basement, regard the building as two buildings for demand calculations — one 2-storey (has basement underneath) and one single-storey – and use the appropriate tables
- roof space, the bracing demand values in Tables 5.8, 5.9 and 5.10 (earthquake) must be increased by 4 bracing units/square metre.

Where a masonry or concrete chimney is dependent on the building structure for lateral support, additional demand is also required – see B1/AS3.