WIND ZONES AND NZS 3604

Often wind determines the bracing requirement for timber-framed buildings. We walk through how to find the correct wind zone for a site using NZS 3604:2011.

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Figure 1: Built-up residential areas are generally defined as urban.

Figure 2: Sites adjacent to an open space such as a playing field are defined as exposed. The buildings more than two rows back are defined as sheltered.

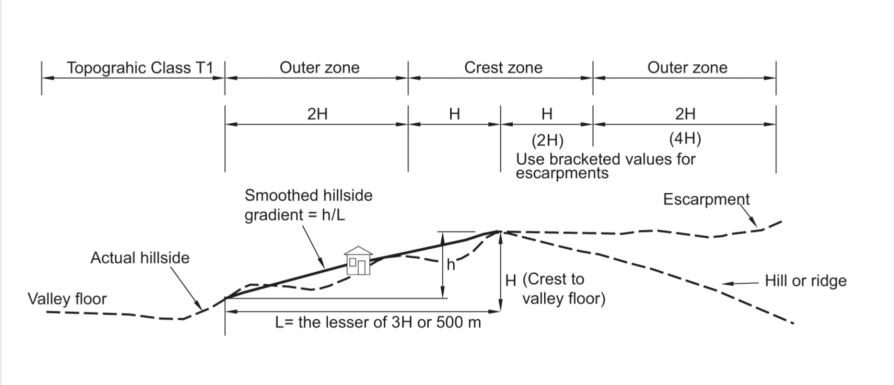

Figure 3: Topography (including escarpment conditions). Figure 5.2 from NZS 3604:2011. (Reproduced with permission from Standards New Zealand.)

Foundations and walls of timber-framed buildings must be braced to resist the horizontal forces from earthquakes and wind. When designing bracing, calculations of both earthquake and wind forces (called bracing demand) must be made and the building constructed to withstand the stronger of the calculated forces (called bracing capacity). Although New Zealand lies in a region of high seismic activity, it is often the horizontal forces imposed by wind that determine the bracing requirement.

The shape, size and level (whether basement, ground or first floor) of the building, as well as its actual location, all affect the wind bracing demand, but in order to calculate the bracing demand, the wind zone, rated as low (L) to extra high (EH) wind speed, must first be determined.

Six steps to determine wind zone

A means of determining the wind zone for a specific location is in NZS 3604:2011 Table 5.1 (see Table 1). This describes a six-step process.

STEP 1 – WIND REGION

The first step is to identify the wind region for the building from NZS 3604:2011 Figure 5.1. This map divides the country into two wind regions – A and W – based on wind speed data from the New Zealand MetService.

The regions are too general, however, as land formations can modify and create significant localised variations to wind speeds. For example, wind speed will increase as it passes over and between hills and decrease when passing over rough ground.

Table 1: Procedure for determination of wind zones. Table 5.1 from NZS 3604:2011. (Reproduced with permission from Standards New Zealand.)

Steps	Action	Reference	Values available
1	Determine wind region	Figure 5.1	A, W
2	Determine if in a lee zone	Figure 5.1	See Table 5.4
3	Determine ground roughness	Paragraph 5.2.3	Urban terrain Open terrain
4	Determine site exposure	Paragraph 5.2.4	Sheltered, exposed
5	Determine topographic class	From Tables 5.2, 5.3 and Figure 5.2	Gentle to steep
6	Determine wind zone	Table 5.4	L, M, H, VH, EH

STEP 2 – IN A LEE ZONE?

Determine if the site is in a lee zone. These are shown as hatched areas in Figure 5.1. Lee zones may have higher wind speeds.

STEP 3 – GROUND ROUGHNESS

Determine the ground roughness from the two options defined by NZS 3604 paragraph 5.2.3:

- Urban terrain – more than 10 obstructions over 3 m high, such as houses or trees, per hectare.
- Open terrain – open areas with only isolated trees or shelter, such as adjacent to fields or beaches and open bodies of water.

Generally, any built-up residential area (see Figure 1) or any forested area will be defined as urban. A site adjacent to farmland or other open space will be defined as open terrain.

Where a site is within 500 m of the boundary between urban and open terrain, it must be considered as open terrain.

STEP 4 – SITE EXPOSURE

Determine site exposure from the two options in paragraph 5.2.4:

- Sheltered – a site surrounded by at least two rows of obstructions that are permanent, similar in size and at the same ground level.
- Exposed – a site that is steep (as defined in Table 5.2) or adjacent to an open space such as a playing field (see Figure 2) or beach or adjacent to a wind channel that is more than 100 m wide.

Comment C5.2.4 states that typical suburban developments on flat or near-flat ground are generally classified as sheltered (see Figure 1).

STEP 5 – TOPOGRAPHIC CLASS

Determine the topographic class (T1–T4), from Table 5.2 and Figure 5.2 (see Figure 3).

This consists of a number of steps (see Table 5.2):

i. If not flat ground, determine if the ground is:

- a hill – land rises to a crest or high point then falls again on the other side
- an escarpment – a steep slope or cliff separating two relatively level regions of ground that are at different elevations. Note that NZS 3604 5.2.5 defines an escarpment as the region beyond a crest where the gradient is less than 1 in 20.

ii. Next, determine the smoothed gradient from Figure 5.2. This requires the gradients of the upper part of the hill to be considered:

- The smoothed gradient of the hill is assessed over the horizontal upwind distance between the crest of the hill and the lesser of three times the height of the hill (H) or 500 metres (L).
- The smoothed gradient is the elevation (h) divided by the relevant distance (L).

EXAMPLE 1:

H (height of hill from crest to valley floor) = 180 m. L = the lesser of 3H or 500 m, 3H = 540, so L is 500 m.

So, if h (elevation of the site) = 100 m, h/L = 100/500 = 0.2 or 1:5. Therefore, the gradient of the site is 'steep' (from Table 5.2).

Or if h = 50 m, h/L = 50/500 = 0.1 or 1:10. Therefore, the gradient of the site is 'low' (from Table 5.2).

iii. Determine the location of the site as T1 (valley floor), outer zone or crest zone. In example 1, the building is located 250 m from the crest of the hill, which is more than H (= 180 m) so it is outside the crest zone. However, it is within the outer zone (<500 m).

iv. The topographic class (T) must be determined from Table 5.3. In example 1, with steep gradient in outer zone, the topographic class is T3; with the low gradient in outer zone, the topographic class is T1.

If the site does not fall within an outer or crest zone, it is classified as T1, but there are some exceptions.

STEP 6 – NOW FIND WIND ZONE

It is now possible to determine the wind zone from Table 5.4 using the information gathered – wind region, ground roughness, topographic class and site exposure.

EXAMPLE 2:

From Table 5.4, a site in region W classified as T4 (moderate crest zone), urban and exposed, is in wind zone EH (extra high wind speed – maximum 55 m/s).

Calculate wind bracing demand

The wind zone can now be applied to calculate the wind bracing demand from NZS 3604:2011, Tables 5.5, 5.6 and 5.7. These tables give wind bracing demands (BU/m) for the subfloor structure and the walls of single and upper floors and the lower of two-storeys.

Where the zone is not high (H), the multiplier for the relevant wind zone is used to calculate the correct wind bracing demand.

Where wind zone is above extra high (from Table 5.4), the wind zone is SED or specific engineering design and is beyond the scope of NZS 3604.