

Bracing Calculation Sheets For Foundations and Walls

**For use with NZS 3604:2011
October 2012**

The enclosed calculation sheets A and B may be used to determine the wall and foundation bracing elements required to satisfy the requirements of NZS 3604: 2011 (including amendments) and may also be used to form part of the documentation required for a building consent application.

INSTRUCTIONS FOR SHEET A

NAME: Name of building consent applicant.
 SITE ADDRESS: Street address of site including city, town or LOT and D.P. number

BOX 1

LOCATION of STOREY/BLOCK: The subfloor/storey or part of the building for which the demand is being assessed.
 Note: a separate set of sheets needs to be completed for each storey and /or part.

BOX 2 WIND

(Note: all table and figure references relate to those in NZS 3604:2011)

WIND ZONE: Determine the "Wind zone" from the procedure in Table 5.1
BUILDING HEIGHT (H) This is measured from the ridge to the lowest ground adjacent to the foundations. See Figure 5.3
ROOF HEIGHT (h): Vertical dimension between the ridge and roof eaves. See Figure 5.3.
W: Refer to Table 5.5 for subfloor and Tables 5.6 & 5.7 for walls to find " W_{across} " and " W_{along} ".
 See Figure 5.3 for clarification of across and along directions.
 (Note that across ridge column of tables to be used for both directions if the roof is hipped.)

BOX 3 EARTHQUAKE

(Note: all Clause references relate to clauses in NZS 3604:2011)

EARTHQUAKE ZONE: Refer to Figure 5.4.
WEIGHT OF ROOF CLADDINGS; Refer to Clause 1.3 for definition of "light" and "heavy" roof claddings.
 Note that the weight of sarking should be included when determining roof weight.
ROOF PITCH: For roofs with unequal pitches use the average pitch.
WEIGHT OF WALL CLADDINGS: Refer to Clause 1.3 for definition of "light", "medium" and "heavy" wall claddings.
CONCRETE SLAB: If the building is on a concrete slab-on-ground, use Table 5.10 for bracing demand.
PART STOREY in ROOF SPACE: When up to 50% of the roof space is developed, add 4 Bracing Bu/m² to the values in Tables 5.8 to 5.10 (refer to Clause 5.3.4.3).
PART STOREY BASEMENT: For a part storey in a basement (refer Clause 5.3.4.4) treat as 2 separate buildings, with sheet A & B for each storey of each. For the common wall add the demand calculated for each building.
CHIMNEY: For a chimney relying on the building for support, refer to Clause 5.3.4.5.
WINGS/BLOCKS: For a wing projecting more than 6m (see Clause 5.1.5) treat as a separate building with sheets A & B for each. For the common wall, add the demand calculated for each building.
DECK: For bracing of decks, refer to Clause 7.4.2.
E: Refer Table 5.8 for single storey, 5.9 for two-storey and 5.10 for slab-on-ground.

BOX 4 DIMENSIONS

ROOF or BUILDING LENGTH for wind across ridge (L)
 ROOF or BUILDING WIDTH for wind along ridge (W)
 GROSS FLOOR AREA (GFA)



Refer to clause 5.2.6 determine whether roof or building dimensions are to be used.

BOX 5 CALCULATION

WIND BRACING DEMAND (ACROSS) Multiply " W_{across} " (from Box 2) x "L" (from Box 4) to find the Bracing Units required to resist wind across the ridge.
 Transfer this value to the appropriate box halfway down column 7 of sheet B.
WIND BRACING DEMAND (ALONG): Multiply " W_{along} " (from Box 2) x "W" (from Box 4) to find the Bracing Units required to resist wind along the ridge.
 Transfer this value to the appropriate box at bottom of column 7 of sheet B.
EARTHQUAKE BRACING DEMAND: Multiply "E" (from Box 3) x "GFA" (from Box 4) to find the number of Bracing Units required to resist earthquake. The same amount is required in each direction.
 Transfer this value to the appropriate boxes of column 11 of sheet B.

On the floor plan for each storey mark external walls and bracing lines (refer to Clauses 5.4 & 5.5).
 Identify the lines ACROSS with letters A, B, C, etc. and ALONG with letters M, N, O, etc.

INSTRUCTIONS FOR SHEET B

NOTE: The floor plan should show the bracing lines and position, length and type of wall bracing elements. This plan, together with the calculation sheets, **MUST** form part of the consent application.

Make sure that the "Bracing Demand" values are transferred from Sheet A to the appropriate ACROSS and ALONG sections in sheet B.

In the top box circle the location of the storey / block to which the assessment applies.

ACROSS This is for earthquakes or wind forces **ACROSS** the ridge.

STEP 1: Column 1 refers to bracing lines A, B etc.

In column 8 enter the "minimum bracing demand" for **each** bracing line, being the greatest applicable from the options below:

- a) for external wall lines: 15 times the wall length in metres (refer Clause 5.4.2.3 for subfloor, and 5.5.6.1 for other levels).
- b) for internal bracing lines: 100 BU's (refer Clause 5.5 for subfloor and 5.4.7 for other levels)
- c) 50% of the total demand divided by the number of bracing lines (both along and across)
- d) If the wall brace line supports a diaphragm, the greater of 100 BU's or 15 BU's per metre of diaphragm dimension at right angles to the wall being considered (refer Clause 5.6.2)
(for walls supporting 2 diaphragms, refer Clause 5.6.2b)

STEP 2: Starting with bracing line A, determine position of bracing elements and number these 1, 2, 3 etc. in column 2.

Select type of bracing element and enter in column 3. (For subfloor elements select from Table 5.11 or manufacturer's literature and for wall brace elements select from Table 8.1 or manufacturer's literature).

In column 4, enter the length of each wall element (leave blank for subfloor elements).

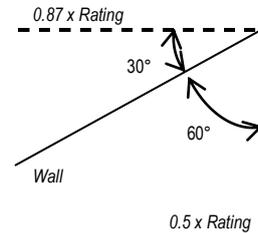
In columns 5 (wind) and 9 (earthquake) enter the bracing units per element (foundations) or per metre (walls).

For variations in wall height refer to Clause 8.3.1.4.

NOTE: For walls at an angle to a bracing line multiply the rating by:

<u>angle off line:</u>	<u>factor</u>
30°	0.87
45°	0.7
60°	0.5

(see clause 5.4.4 © for other angles)



STEP 3: Multiply the rating in column 5 by the length in column 4 to obtain the number of bracing units achieved – enter these in column 6. For subfloors simply transfer the rating per element in column 5 to column 6. Add the number of BU's achieved in the bracing line and enter in column 7.

Check that the number of BU's achieved in column 7 equals or exceeds the minimum demand in each wall or bracing line in column 8.

If this is not achieved for the bracing line either (1) add extra bracing elements or (2) change the bracing type to one with a greater BU/m or (3) extend the length of bracing elements.

STEP 4: Complete steps 2 & 3 for all other bracing lines.

Add the values in column 7 and enter this sum as the "Total Bracing Achieved" halfway down the sheet.

The "Total Bracing Achieved" must equal or exceed the number of BU's within the "Total Bracing Demand for Wind Across".

STEP 5: Repeat steps 3 & 4 for earthquake in columns 9, 10 and 11.

ALONG Repeat steps 1 to 5 for ALONG the ridge.

SHEET A

Name of Applicant: Site Address:
 City/Town or District:
 Street and Number:
 Or Lot and D.P. Number:

Box 1			
LOCATION OF STOREY / BLOCK BEING ASSESSED			
FOUNDATION	SINGLE STOREY or UPPER STOREY	LOWER STOREY	LOCATION IN BUILDING
Use one sheet for each and circle the appropriate location			

Box 2 Wind Bracing Demand (Table 5.5, 5.6 or 5.7)			
Wind zone (Table 5.1)	L / M / H / VH / EH		Note: Tables 5.5, 5.6, 5.7 relate to High wind zone. In other wind zones, multiply the value by the appropriate factor.
Building height to apex (H)	m		
Roof height above eaves (H)	m		
$W_{\text{across}} =$	(value from tables) x	$\left\{ \begin{array}{l} L \quad 0.5 \\ M \quad 0.7 \\ VH \quad 1.3 \\ EH \quad 1.6 \end{array} \right\}$	= Bu/m
$W_{\text{along}} =$	x		= Bu/m
			Transfer to Box 5

Box 3 Earthquake Bracing Demand (Table 5.8, 5.9, 5.10)				
Earthquake zone (Figure 5.4)	1 / 2 / 3 / 4	Concrete slab	(Table 5.10)	YES / NO
Weight of roof cladding	Light / Heavy	Part storey in roof space	(Cl. 5.3.4.3)	YES / NO
Roof pitch (degrees)	0-25 / 26-45 / 46-60	/ Part storey basement	(Cl. 5.3.4.4)	YES / NO
Weight of upper (or single) storey cladding	Light / medium / heavy	Chimney	(Cl. 5.3.4.5)	YES / NO
Weight of lower storey cladding	Light / medium / heavy	Wings / blocks	(Cl. 5.1.5)	YES / NO
Weight of subfloor cladding	Light / medium / heavy	Deck projecting more than 2 m	(Cl. 7.4.2.2)	YES / NO
$E =$	(value from tables 5.8, 5.9, 5.10) x	(multiplication factor below)	=	BU /m ² Transfer to Box 5
NOTE: Tables 5.8, 5.9, 5.10 relate to soil type D/E in Earthquake zone 3, for multiplication factors for other soil types see below				
Soil Class	Earthquake Zone			
	1	2	3	4
A & B Rock	0.3	0.5	0.6	0.9
C Shallow	0.4	0.6	0.7	1.1
D/E Deep / Soft	0.5	0.8	1.0	1.5

Box 4 Building plan dimensions (Figure 5.3)				
Roof or building length for wind across ridge	(L)	=	m	Transfer to Box 5
Roof or building length for wind along ridge	(W)	=	m	
Gross Floor Area	(GFA)	=	sq m	

Box 5 Calculation of demand					
	(Value)	(Box 4 Dimension)			
Wind Load Across	(from box 2)	=	x	=	BU Transfer to Sheet B
Wind Load Along	(from box 2)	=	x	=	BU
Earthquake Load (both directions)	(from Box 3)	=	x	=	BU

