

6.2 Garden Walls

Introduction

Concrete masonry garden walls can provide many useful functions – privacy, separation, protection, ornamentation, shade and shelter from wind.

With a wide variety of concrete masonry shapes sizes and finishes available the design possibilities for walls are virtually unlimited.

Garden walls designed to this section should not form part of either a building structure or an earth retaining structure.

Use of this Document

This publication provides design charts and construction details for two main types of concrete masonry garden walls:

- cantilevered walls; and
- reinforced masonry pilasters supporting infill panels.

Options are provided for either symmetrical spread footings, or for narrower pile footings where there is a requirement to construct close to boundaries or bounding features.

Walls of up to 2.0 m height are considered. Where walls higher than this are required it is recommended that specialist engineering advice be sought.

Structural Design

These concrete masonry walls have been structurally designed in accordance with the appropriate New Zealand Standards and recognised codes of practice. To allow designers and Territorial Authorities to choose and confirm the structural adequacy of designs, options are provided aligning wind and earthquake actions with the *Timber Framed Buildings* Standard NZS 3604. Wind actions in the Extra High wind category are excluded as is Earthquake Zone 4.

Foundation conditions are also aligned to the requirements of NZS 3604.

The strength of masonry is very sensitive to the quality of workmanship. Therefore, every effort must be made to ensure the workmanship is of the highest standard. It is recommended that

construction be carried out by a *Licensed Building Practitioner, Bricklaying and Blocklaying*.

Building Consents

The circumstance when a building consent is required is set out in Schedule 1 of the Building Act 2004. That clause explains that a consent is not required for a fence or garden wall provided:

1. It is not a retaining wall.
2. The height does not exceed 2.5 m.
3. It is not a fence as defined in section 2 of the Fencing of Swimming Pools Act 1987.

The height is to be measured from the lowest point of the adjoining ground to the highest level of the fence. If a capping is to be incorporated in the design, then it too should be within the total height of 2.0 m.

If there is any doubt regarding the interpretation of these requirements in relation to a particular proposal, the matter should be discussed with the territorial authority.

Design Charts

Selection of Environmental Design Actions

The principal actions governing the design of garden walls arises from wind or earthquake effects. The wall must be designed to withstand the forces arising from these phenomena.

Both wind and earthquake actions vary throughout the country. Design tables have been produced to enable designers to assess these actions by the methods used in the *Timber Framed Buildings* Standard, NZS 3604. Some territorial authorities have web maps available with NZS 3604 classification Wind speed categories identified for specific areas or on a property by property basis. This will enable rapid identification of the appropriate factor. Extra High and Specific Design categories have been excluded from the design tables and it is recommended professional engineering design advice should be sought in these cases.

Figure 1 (pages 6-7) provides a map of the seismic zones given in NZS 3604. Amendment 10 of compliance document B1/AS1 alters zoning to the Canterbury region which now extends the Zone 2 status to Waimakariri and Selwyn districts including

Banks Peninsular. Users of the designs in these areas are advised to contact the appropriate Territorial Authority for final confirmation of the seismic zone for their project.

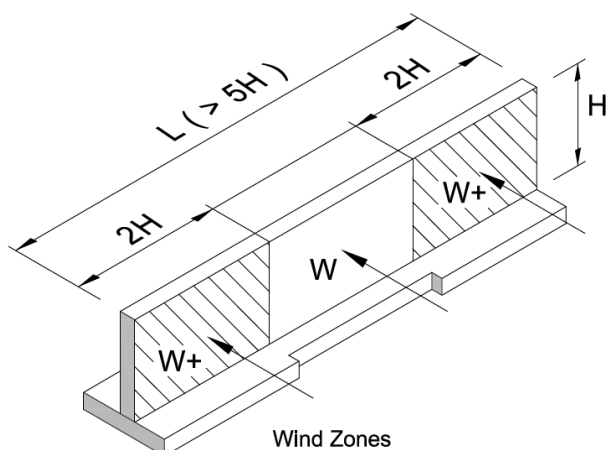
Users should seek professional engineering advice should they wish to design in the highest earthquake risk Zone 4.

Design for the garden walls has included for the appropriate Importance Level from the *Structural Design Actions* Standard, AS/NZS 1170, this being a lesser risk than that of a habitable structure. The

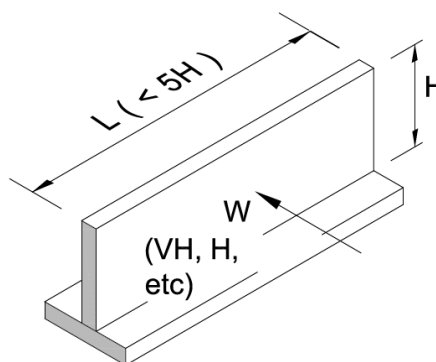
wall designs provided herein should not be used where the wall is intended to form part of a building structure.

Choice of Wall Type

Having identified the Environmental Design Actions, the tables will provide details for either of the wall types, i.e. cantilevered walls, or reinforced pilasters with infill panels. Designers must **choose the worst case** of either Wind or Earthquake actions for the particular site, within each table.



Wind Zones
When $L/H > 5$ use "+" Wind Zones, eg. L+, M+ etc, for 2H End Zone wall and footing selection. Use site derived Wind Zone, eg. L, M etc, for mid section wall and footing selection.



When $L/H < 5$, use derived site Wind Zone for wall and footing selection throughout

Wind actions on end regions of longer walls can be higher than those on shorter walls and on mid-regions of longer walls. End regions extend for the length equivalent of 2 x wall height, and apply at each end of longer walls. To account for this the tables contain '+' wind zones, e.g. L+, M+, H+ etc., which should be used wherever a continuous wall length is greater than five times its height above ground. On such walls find the wind zone applicable for the site, e.g. H, and use the table entry for the corresponding 'W+' zone, e.g. H+, for the design of the end regions. The mid-region of the wall can either be configured for the derived site wind zone, e.g. H, for economy especially if the wall is long, or left at the 'W+' detailing for ease of interpretation by the builder. These provisions are shown pictorially in the following diagram and an example of applicability is also provided at the end of the commentary.

As well as providing shallow foundation design details for concentric/symmetrical walls, options are now given to build walls close to boundaries, or other obstructions, by the use of bored concrete

piles supporting offset wall construction for both wall types. These are shown in Figures 3 and 10, for cantilever and pilaster wall types, respectively.

Cantilevered Walls

These are free-standing walls on a symmetrical concrete strip footing. They must be reinforced and be of all cells filled construction.

Reinforced Walls are made of plain concrete masonry blocks, uniformly reinforced vertically and horizontally. In this respect they are similar to a bearing wall or retaining wall.

Refer to Figures 2 to 4 (pages 8-10) for construction details.

Reinforced Masonry Pilasters Supporting Infill Panels

These walls consist of reinforced pilasters supporting masonry infill panels, refer to Figures 5 and 6 (pages 11-12) for layout details. The pilasters

may also be used to support other types of lightweight panel such as timber, profiled sheet steel, insulated sandwich panel, etc., the design of which is not covered in this manual.

Three pilaster types, which are shown in Figures 7, 8 and 9 (pages 13-15), have been grouped according to their strength characteristics. Type C, being the strongest, can be used in any situation. Types B and A are of lesser capacity and are restricted to less demanding applications shown in the tables.

The infill panels may be constructed from a wide range of masonry types, or other materials such as timber or fibre cement board.

Masonry panels require a minimum reinforcing as indicated and should be all cells filled construction.

Construction Details

Reference should be made to the tables and diagrams appropriate to the particular zone and type of wall.

General

These tables and diagrams provide recommendations for fences and garden walls up to 2.0 m in height. They do not apply to structural bearing walls, nor to retaining walls.

Footings

The base for all footings must be not less than 300 mm below the surrounding ground. The soil must be equivalent to "Good Ground" having an ultimate rupture capacity of no less than 300 kPa as defined in the *Timber Framed Buildings* Standard NZS 3604. Ground should not slope away from the front of the footing more than 10° from the horizontal for a distance equal to two times the height of the wall.

Cantilevered walls, refer Figure 2 (page 8), are constructed on continuous strip footings of minimum depth 200 mm. The footings must be symmetrical about the centre of the wall and the width not less than indicated in the Tables. Figure 3 (page 9), provides details for incorporating screen blocks into the top section of panels.

Alternative offset wall and pile footings are shown in Figure 3, and Tables 2 and 3).

For pilaster and infill panel type walls (Figure 5 on page 11 and Figure 10 on page 16), the footing should be sufficient to support the infill panel

selected and to act as a tie between pilasters. It should be not less than 200 mm deep and reinforced with two D12 bars which extend into the pilaster footings. The width of the strip footing should be at least 100 mm wider than the blockwork it supports.

Footings for pilasters may be either "pad" type or "bored pile" type. Dimensions and reinforcing details must be in accordance with Figures 5, 6, 10 and Table 5 (page 12).

All concrete used in footings shall be 25 MPa strength and 80 mm slump. It must be thoroughly compacted and the finish on the upper scabbled, surface suitable for keying the blockwork.

Masonry

Concrete Masonry units shall comply with AS/NZS 4454. Masonry construction shall comply with NZS 4210, and in particular:

- Mortar shall consist of one part Portland cement thoroughly mixed with 3-4 parts of building sand.
- Grout infill to all cells shall have a spread of 340-530 mm and a strength of 20 MPa.
- All joints shall be adequately filled with mortar which shall be compacted by joint tooling after the initial set.
- Masonry walls should follow a running bond pattern.

Pilasters and Infill Panels

Pilaster types A, B or C should be selected for the strength requirements indicated in Table 4 on page 12.

Within each type alternative construction details are given. These are minimum requirements, but one of the stronger types can be selected if desired. Thus, where a type A pilaster is recommended any of the details of types A, B or C can be selected.

For a reference type B, the choice is either type B or C, but only type C can be used where this is specified in the Tables. The infill panel between pilasters must have reinforcing as shown in the tables and shall be of all cells filled construction.

Dimensions given for infill panels refer to the length of the panel itself between pilasters.

It should be noted that masonry units are manufactured to a 400 mm module (half block 200

mm) and screen blocks may well be some other dimension.

Reinforcing

All reinforcing shall be deformed bars of the diameters indicated, except for bars designated 'R', which are to be plain round.

In cantilevered walls, the vertical reinforcing should be full height in a single length, being located under the horizontal bars of the strip footing and extending into the top bond beam. A D12 horizontal bar shall be located in the top course, with the remaining bars being uniformly distributed through the height of the wall.

Reinforcement for screen blocks shall be hot dip galvanised 2/R4 lattice, e.g. Eagle Wire Products Limited *Bricklock STR 1000/2000*, laid in the fresh mortar in the centre of horizontal joints where indicated in the diagrams or Table 1. Rods shall be continuous through pilasters and lapped as indicated on Figure 4.

Control Joints

Vertical control joints should be provided in the following positions:

- (a) in reinforced cantilevered walls the spacing should not exceed 6.0 m.
- (b) in pilaster and infill panel walls, a vertical control joint should be provided at the junction of panel and pilaster, at no more than 6.0 m centres.

Control joints should be formed to the provisions of NZS 4210.

Example 1(A): Cantilever Walls

An 11.0 m long by 2.0 m high cantilever wall is to be constructed on a level building site in Hamilton. Site testing in accordance with NZS 3604 has been carried out and it was established that 'good ground' conditions exist at the location of the wall.

By reference to Figure 1 the site is in Zone 1 earthquake zone. By reference to the territorial authority GIS it is determined the site is located in an M medium wind zone. As the wall length is greater than five times its height the design must be for M+ in the end regions (extending for 2 x 2.0 m height = 4.0 m at each end).

With reference to Table 1/Figure 2, (page 8) M+ wind zone requirements are greater than earthquake Zone 1 and therefore take precedence. Thus a 190

thick wall is required, with D12-400 vertical reinforcing and D10-600 horizontal reinforcing (D12 top trim) in end regions. The concentric strip footing is 850 mm wide by 200 mm thick, reinforced with D12-500 both ways, plus SE62 mesh. The central wind zone, 3.0 m in length, could be designed for M wind zone requirements, these being the same as earthquake Zone 1, and would result in a footing width reduction to 650 mm overall width, if desired.

Example 1(B): Piled Cantilever Walls

Alternatively, a piled foundation can be used by reference to Figure 3/Table 3 (wall is in the range 1,500-2,000 high), using a 450 by 350 capping beam, 400 mm diameter piles at 1.5 m centres (because the wall is 190 thick/D12-400 vertical reinforcing) and all to the reinforcing details shown.

Example 1(C): Cantilever Walls, Screen Block Infill Option

Screen blocks can be incorporated into the cantilever wall by following the detailed provisions of Figure 4 (page 10).

Example 2(A): Pilaster Walls

An 18.0 m long by 1.8 m high pilaster wall is to be constructed along a site boundary on a level building site in Napier. The adjacent neighbours have indicated they do not want footings projecting into their property outside the bounds of a normal post footing. Site testing in accordance with NZS 3604 has been carried out and it was established that 'good ground' conditions exist at the location of the wall.

By reference to Figure 1 the site is in Zone 3 earthquake zone. By site-specific analysis to the provisions of Section 5.2 in NZS 3604, or in some areas, by reference to the territorial authority GIS, it is determined the site is located in a Very High wind zone. As the wall length is greater than five times its height the VH+ wind zone must be referenced in the tables for the end regions (but may be carried through the mid-region for consistency of construction and appearance).

With reference to Table 4, Earthquake Zone 3 (Z3-Z1) and VH+ govern this case. Thus, for the 140 mm thick block infill panel option the maximum panel width is 2.2 m for end zones, and it can be supported by Type C pilasters.

For mid-regions of the wall the VH wind zone applies and as Earthquake Zone 3 is also still covered under this lower wind zone the panel width can be increased to 2.6 m.

The foundation for this example where boundary conditions were specified, is a piled foundation Figure 10 (page 16) for 1800 mm high Walls with spacing at 2.2 m in the end zone and 2.6 m centres in the middle section. Pilaster starter bars are required to be cast in the top of the pile/pile cap.

Example 2(B): Pilaster Walls

If the pilaster wall was not built on the boundary then an alternative foundation could be used following the provisions for Type C Pilaster Table 5 with details in Figure 6 (page 12) and connecting footing details in Figure 5 (page 11).

Example 3: Screen Block/Pilaster Walls

The determination of wind and earthquake requirements follows the previous examples.

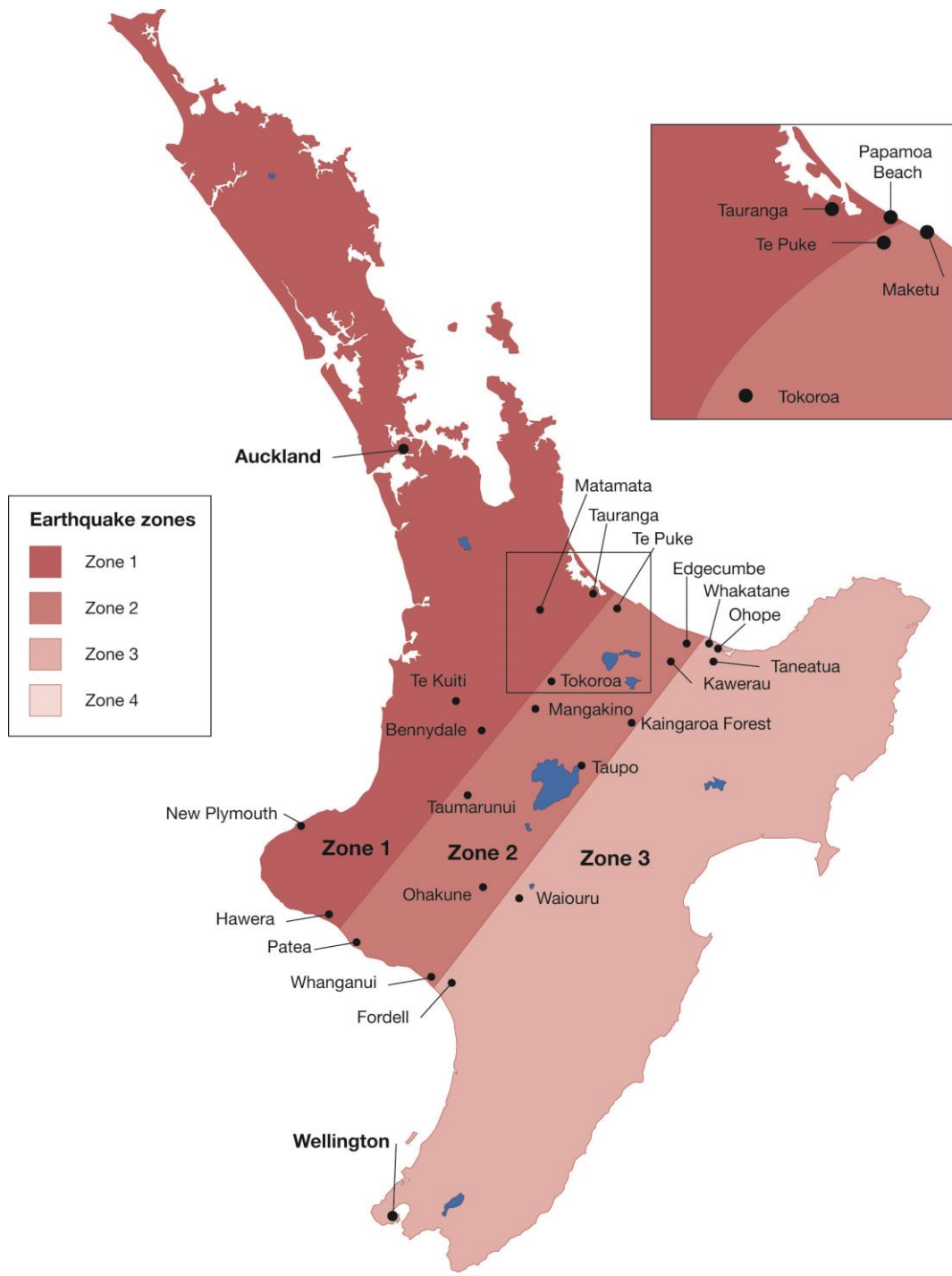
For screen block walls the selection is limited to the first row of Table 4 (page 12). Horizontal

reinforcement is included in the mortar joint with the Wind/EQ combination determining pilaster spacing from 1.5 m to 2.4 m. Foundations for pilasters can follow either pad footings or piled foundations using A, B or C pilaster details as determined from Table 4.

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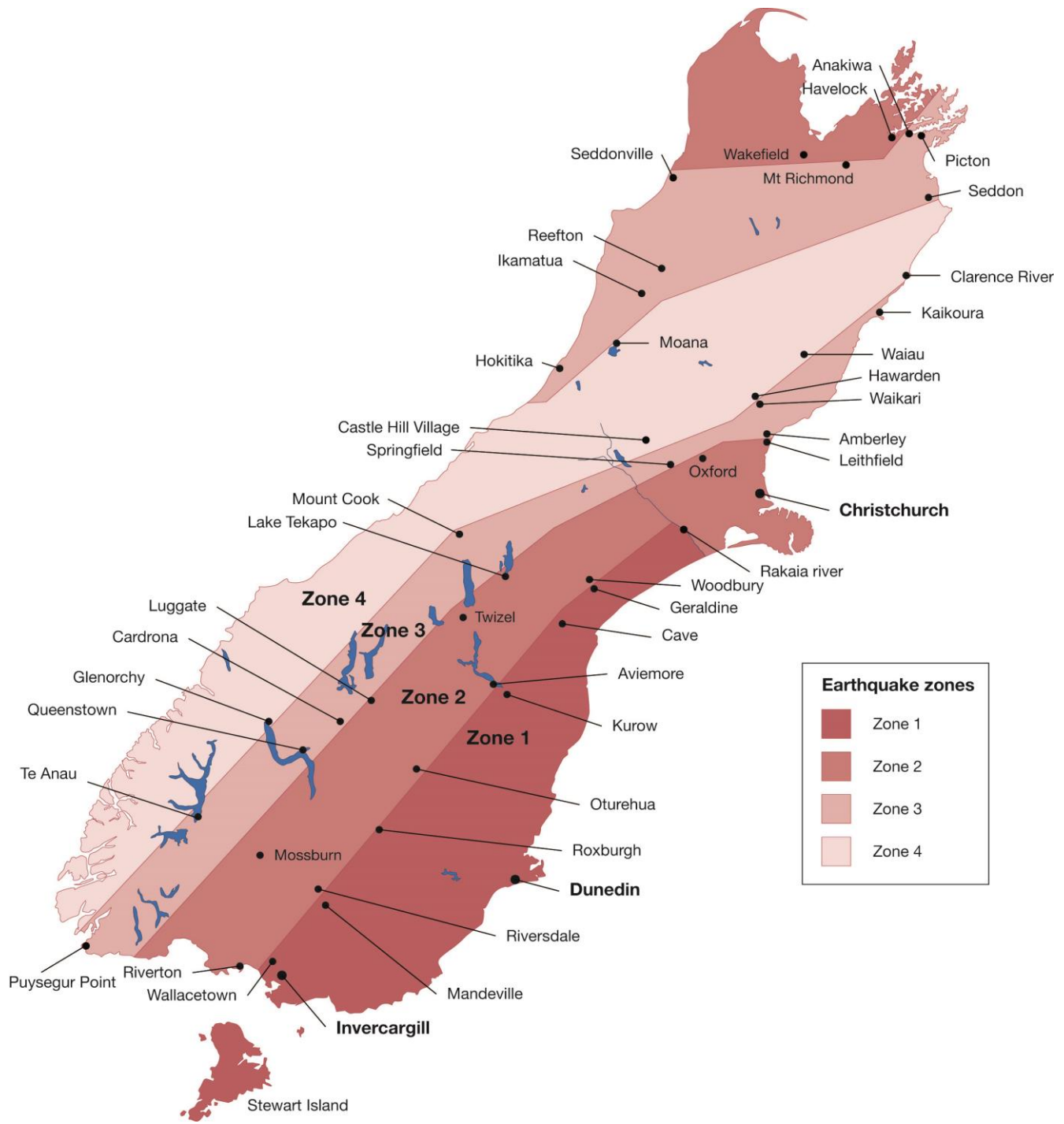


NOTE – This figure is taken from NZS 3604:2011 and incorporates a correction to the zoning of Whakatane.

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Figure 1: Earthquake Zones





NOTE – This figure is taken from NZS 3604:2011 and incorporates changes to the Canterbury earthquake region.

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Figure 1: Earthquake Zones (continued)



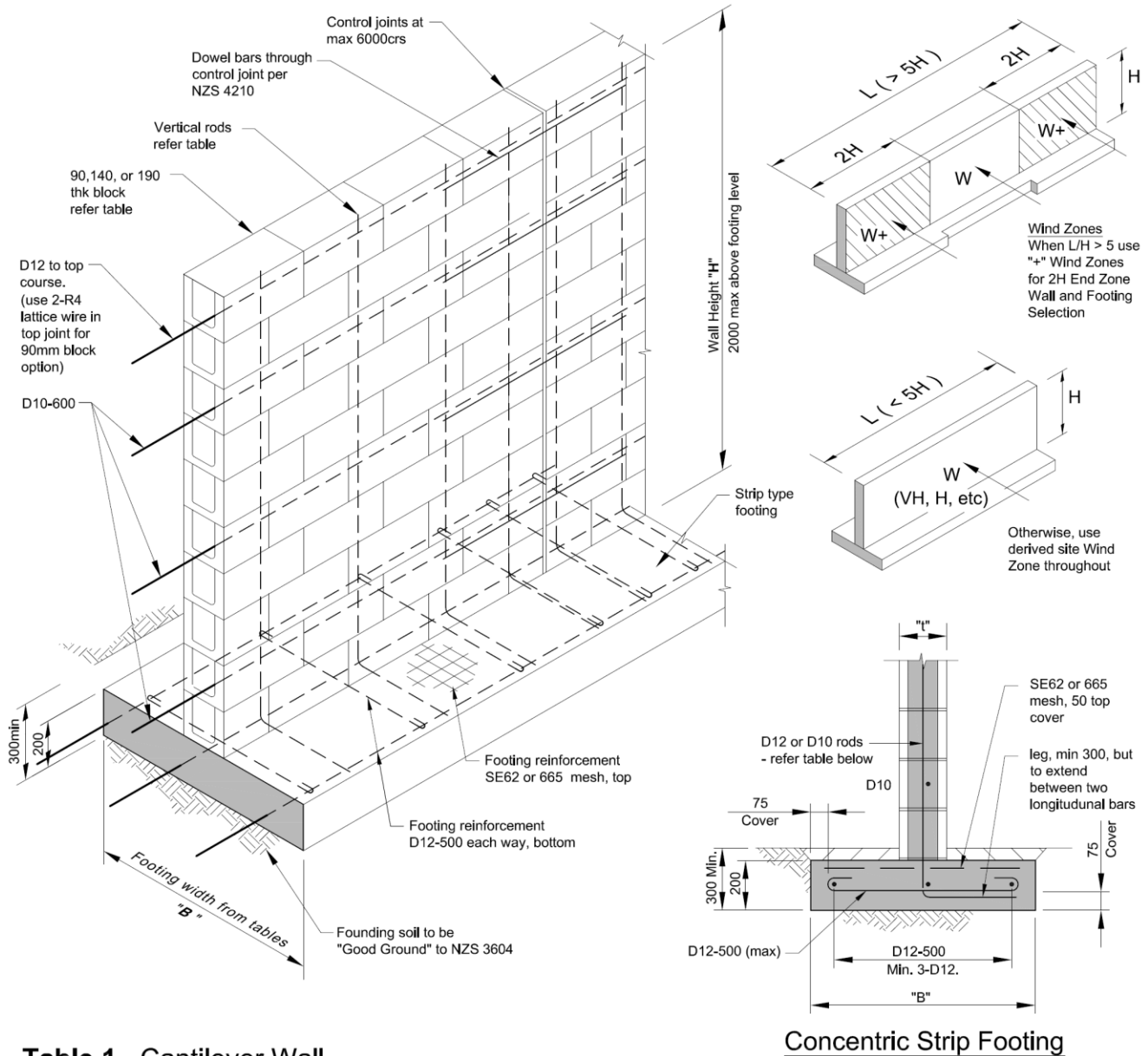


Table 1 Cantilever Wall

Concentric Strip Footing

Wall Height (mm) "H"	Block Thickness (mm) "t"	Wind: VH+ / H+ E/Q: Z3		Wind: M+ / VH		Wind: H / L+ E/Q: Z2		Wind: M / L E/Q: Z1	
		Footing Width (mm) "B"	Wall Vertical Reinforcing	Footing Width (mm) "B"	Wall Vertical Reinforcing	Footing Width (mm) "B"	Wall Vertical Reinforcing	Footing Width (mm) "B"	Wall Vertical Reinforcing
600	90	450	D10-600	400	D10-600	400	D10-600	400	D10-600
800	90	600	D10-600	600	D10-600	600	D10-600	600	D10-600
1000	140	700	D12-600	600	D12-600	600	D12-600	600	D12-600
1200	140	850	D12-600	650	D12-600	650	D12-600	650	D12-600
1400	140	1000	D12-400	650	D12-600	650	D12-600	650	D12-600
1600	190	1050	D12-400	700	D12-400	700	D12-400	650	D12-400
1800	190	1200	D12-400	750	D12-400	750	D12-400	650	D12-400
2000	190	1400	D12-400	850	D12-400	850	D12-400	650	D12-400

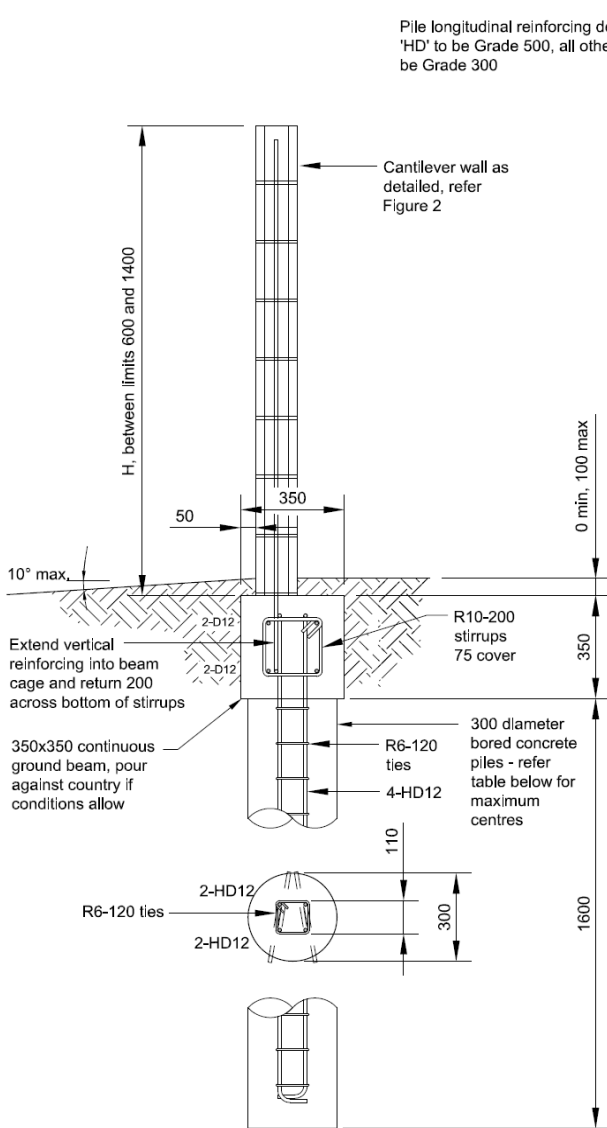
NOTE: Select the greater requirement of either Wind or Earthquake

Figure 2: Cantilever Wall

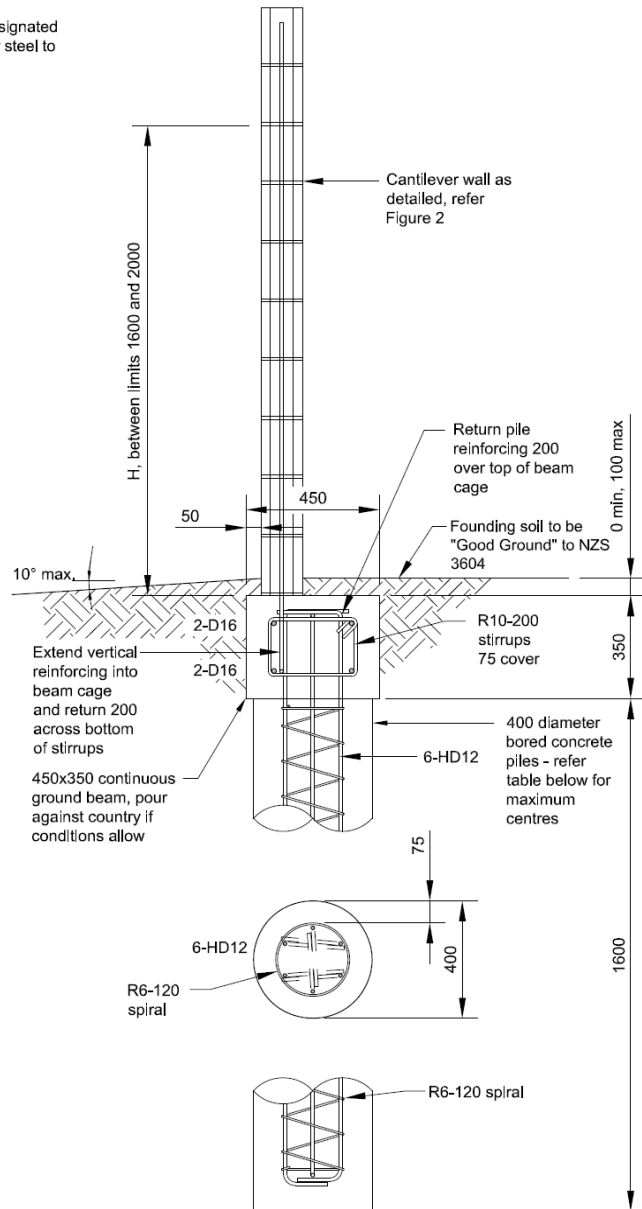
Note:

Ground conditions to meet minimum 'Good Ground' criteria per NZS 3604

Pile longitudinal reinforcing designated 'HD' to be Grade 500, all other steel to be Grade 300



Walls 600 to 1400 High



Walls 1500 to 2000 High

Table 2 300Ø Pile Spacing

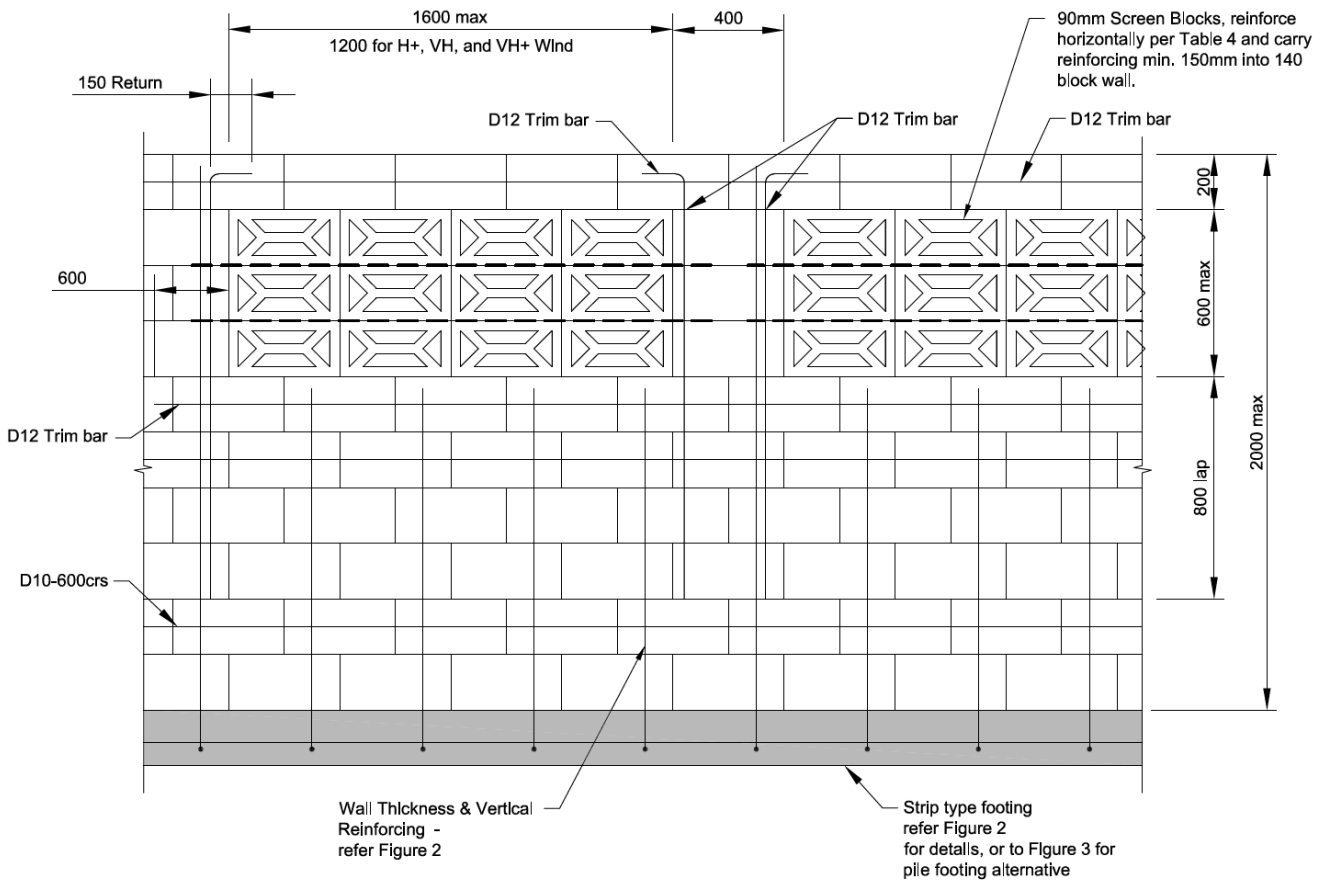
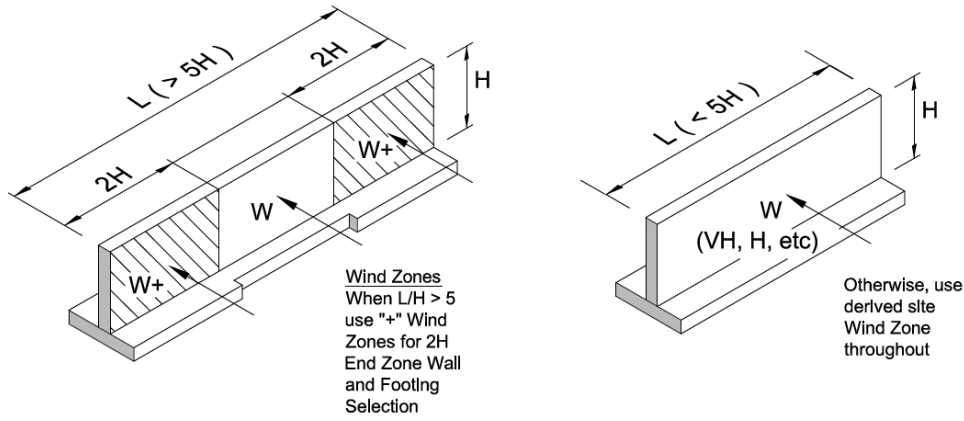
300 Diameter Piles	
Wall / Vertical Reinforcing (from Fig. 2)	Pile Spacing (m) "S"
90 - D10-800	3.2
90/140 - D10-600	2.5
140 - D12-600	1.5

Table 3 400Ø Pile Spacing

400 Diameter Piles	
Wall / Vertical Reinforcing (from Fig. 2)	Pile Spacing (m) "S"
140 - D12-600	2.2
190 - D12-400	1.5

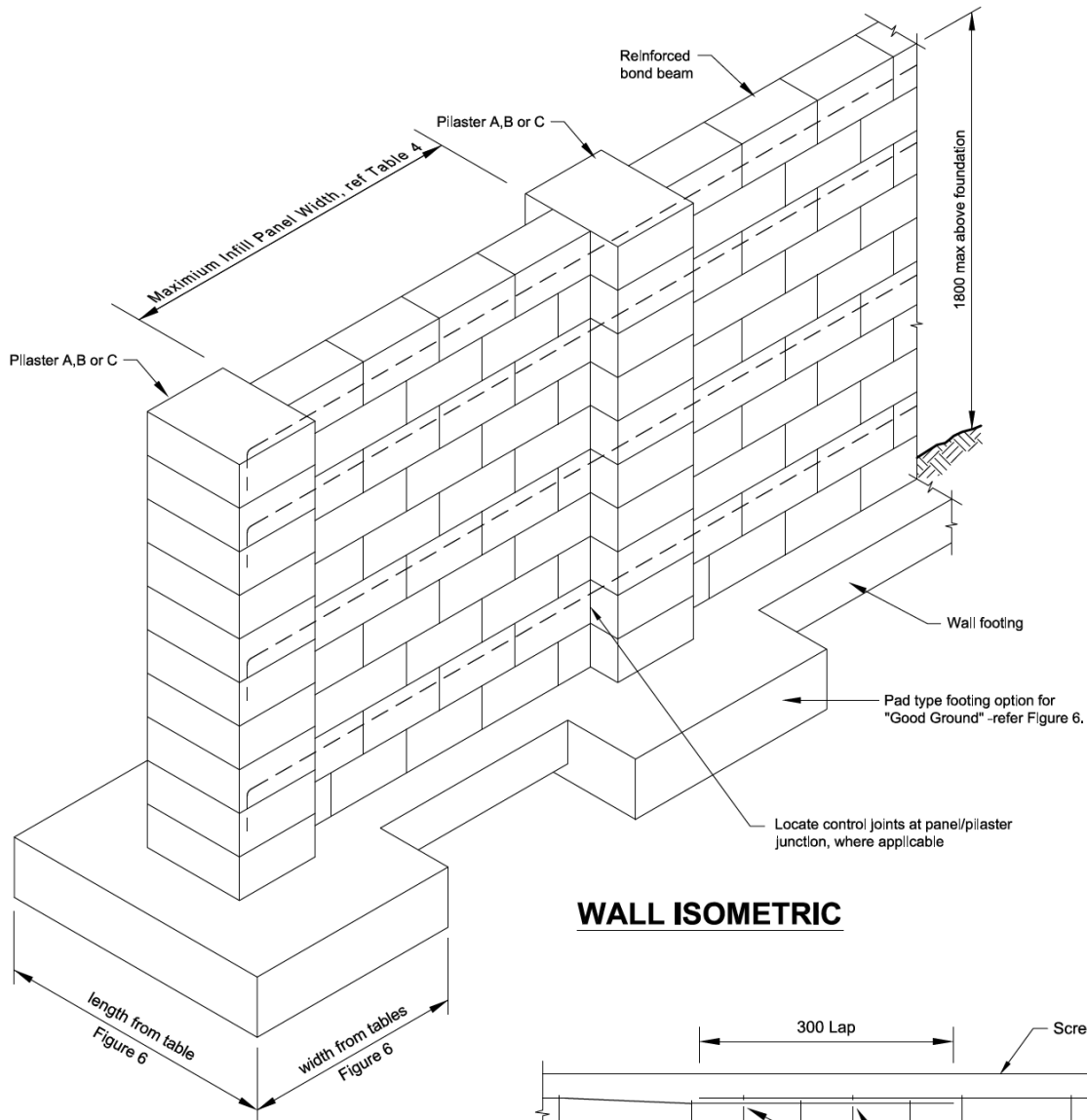
Note: Wind and earthquake zone definitions and "Good Ground" foundation soil conditions, are to be assessed in accordance with NZS 3604:2011, Timber Framed Buildings Standard.

Figure 3: Piled Cantilever Wall Details

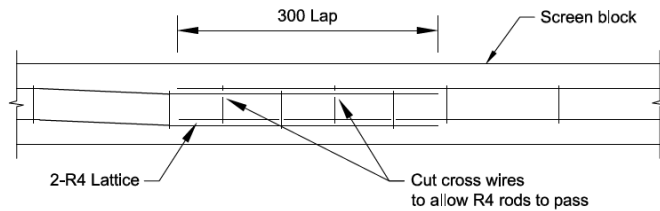


PART WALL ELEVATION

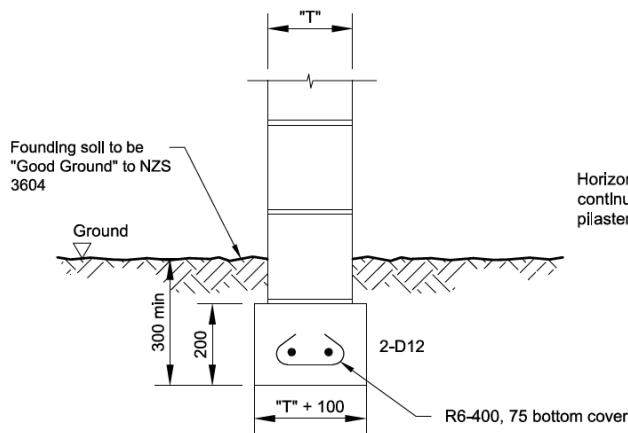
Figure 4: Cantilever Wall, Screen Block Infill Option



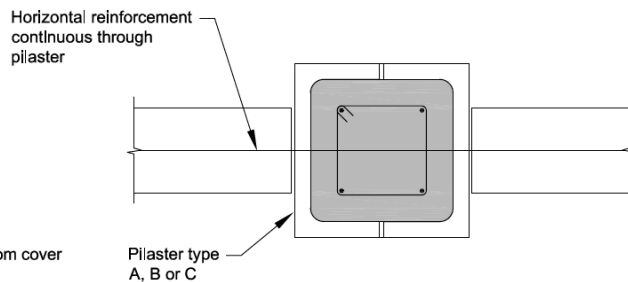
WALL ISOMETRIC



LAP JOINT FOR SCREEN BLOCK REINFORCING



WALL FOOTING



PILASTER JOINT

Figure 5: Infill Panel Wall

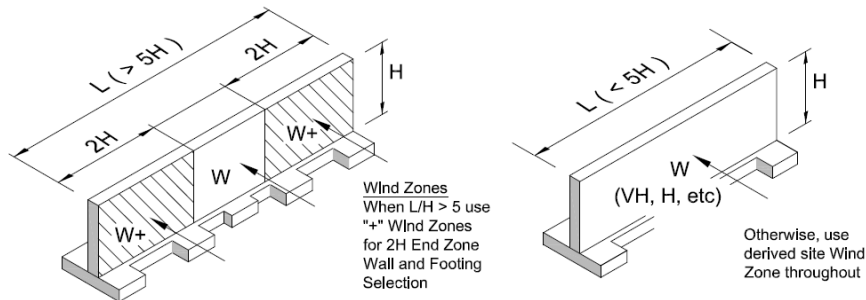


Table 4 Pilaster Wall Details (1.8m High, Maximum)

Infill Type	Block Thickness (mm)	Wind / E/Q Zone		Wind / E/Q Zone		Wind / E/Q Zone		Wind / E/Q Zone	
		Max. Panel Width	Pilaster Type	Max. Panel Width	Pilaster Type	Max. Panel Width	Pilaster Type	Max. Panel Width	Pilaster Type
Horizontal Reinforcing									
Screen	90	VH+ / Z3 - Z1		H+ / Z3 - Z1		VH / H / M+ / Z3 - Z1		M / L+ / L / Z3 - Z1	
2/R4 Galv. - 400		1.5	B/C	1.5	A/B/C	2.1	A/B/C	2.4	A/B/C
90 Block	90	VH+ / H+ / Z3 - Z1		VH / M+ / Z3 - Z1		H / L+ / Z3 - Z1		M / L / Z2 & Z1	
D10 - 600		2.0	C	2.6	B/C	3.0	B/C	3.6	A/B/C
140 Block	140	VH+ / H+ / Z3 - Z1		VH / M+ / Z3 - Z1		H / L+ / Z2 & Z1		M / L / Z1	
D10 - 600		2.2	C	2.6	C	3.2	B/C	3.8	B/C
190 Block	190	VH+ / Z3 - Z1		H+ / Z2 & Z1		VH / M+ / Z2 & Z1		H / L+ / M / L / Z1	
D12 - 600		2.8	C	3.6	C	4.0	C	4.6	C
240 Block	240	Z3 - Z1		VH+ / Z2 & Z1		H+ / M+ / Z2 & Z1		VH / H / L+ / M / L / Z1	
D12 - 600		2.4	C	2.8	C	3.8	C	4.6	C

For any Infill type choose the lower maximum panel width given for the Wind and Earthquake zones applicable for the chosen site. Refer to Figures 7 to 9 for definitions and construction details for the various pilaster types. 2/R4 in the table refers to double R4 rod lattice as per Eagle Wire Products *Bricklock STR 1000/2000 Lattice*, or equivalent. Refer to Figure 5 and details below for pad footing schedule and details, or otherwise to Figure 10 for piled foundation details.

1.2m High Pilaster Wall Option

Select panel type and maximum width from table above, according to wind and earthquake requirements. Pilaster and foundation may be Type A for all Wind and Earthquake zones.

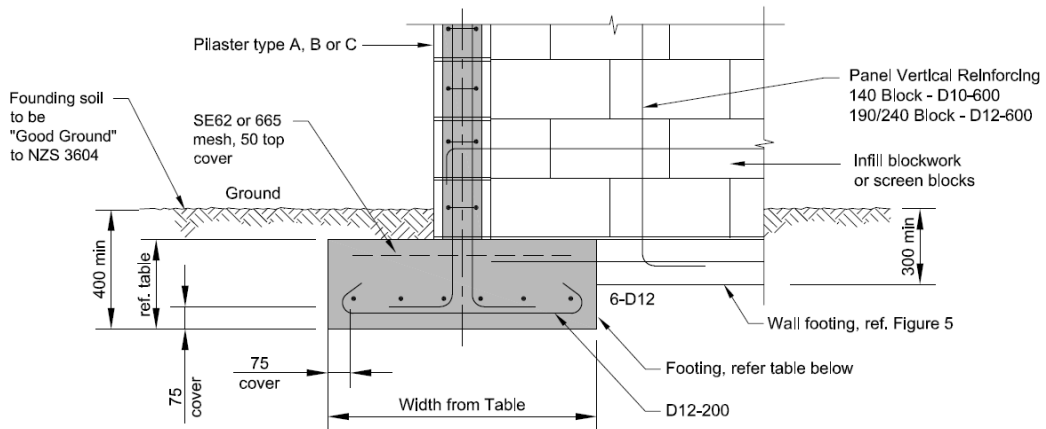
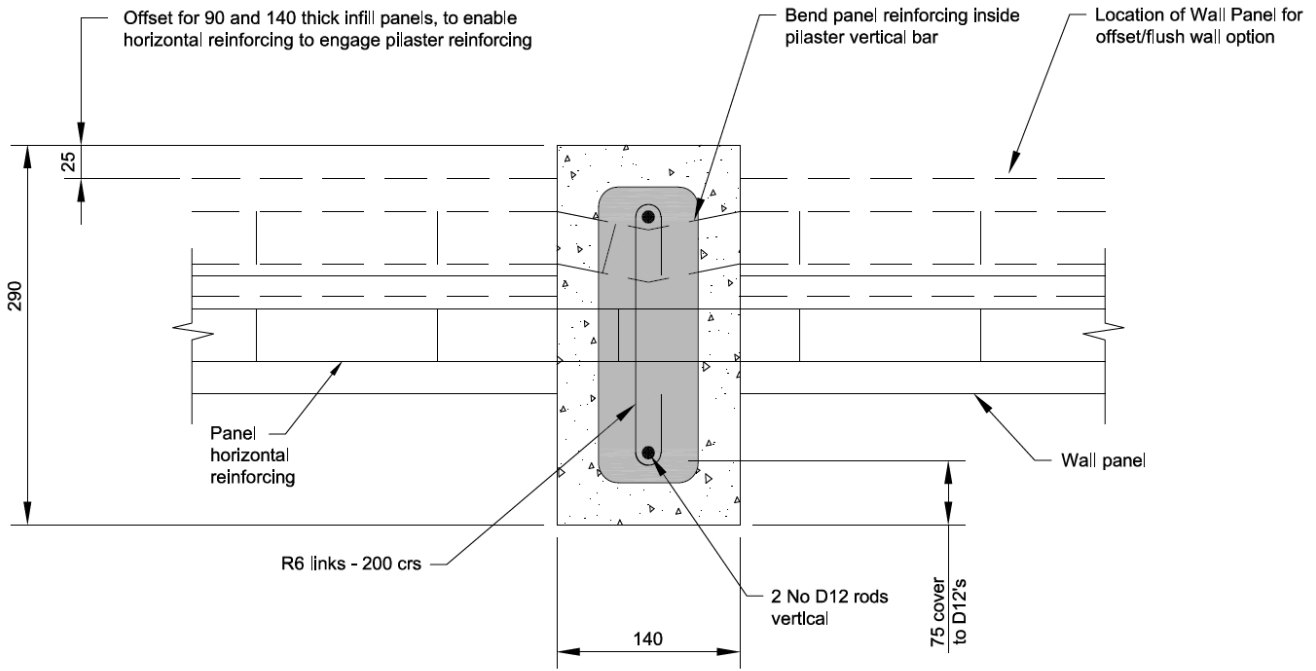


Table 5 Pilaster Wall Foundation Details

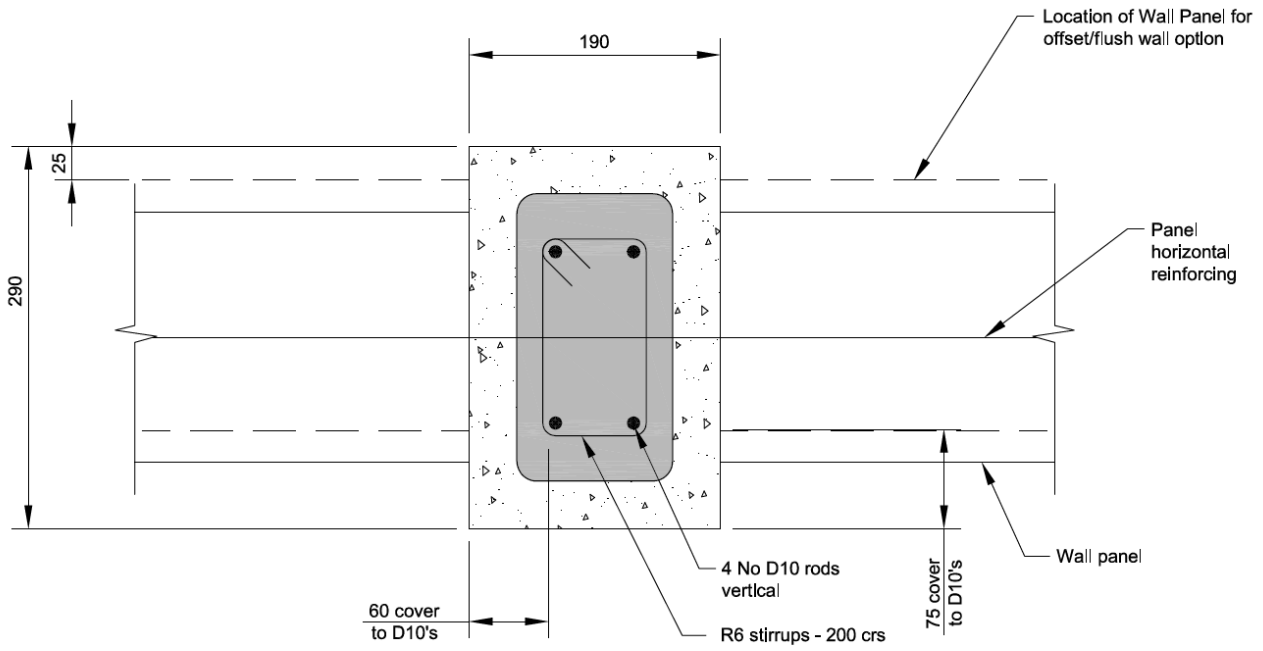
Pilaster Type	Dimensions mm			D12 Reinforcing	
	Length (across wall)	Width (along wall)	Thickness	Length Direction (normal to wall)	Width Direction (parallel with wall)
A	1200	1000	300	6 No	6 No
B	1400	1000	300	6 No	7 No
C	2000	1000	350	6 No	10 No

Figure 6: Pad Type Footing

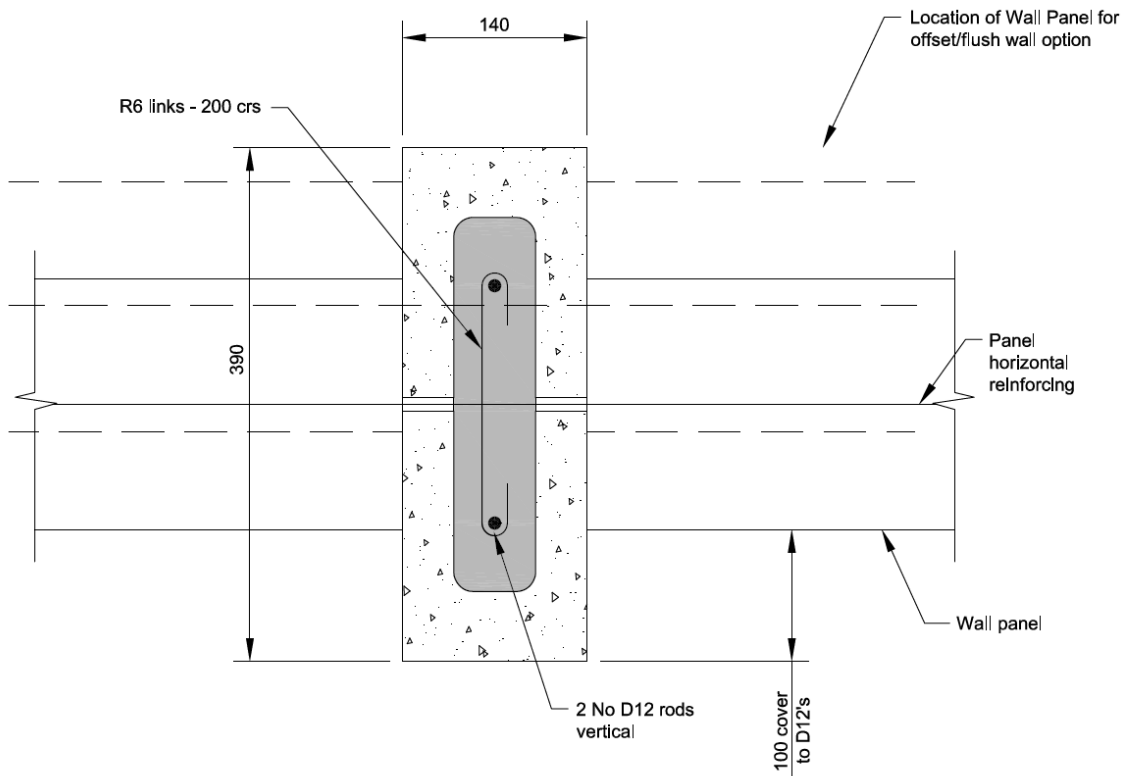


15.19 THREE QUARTER BLOCK

Figure 7: Pilaster Type 'A' Details

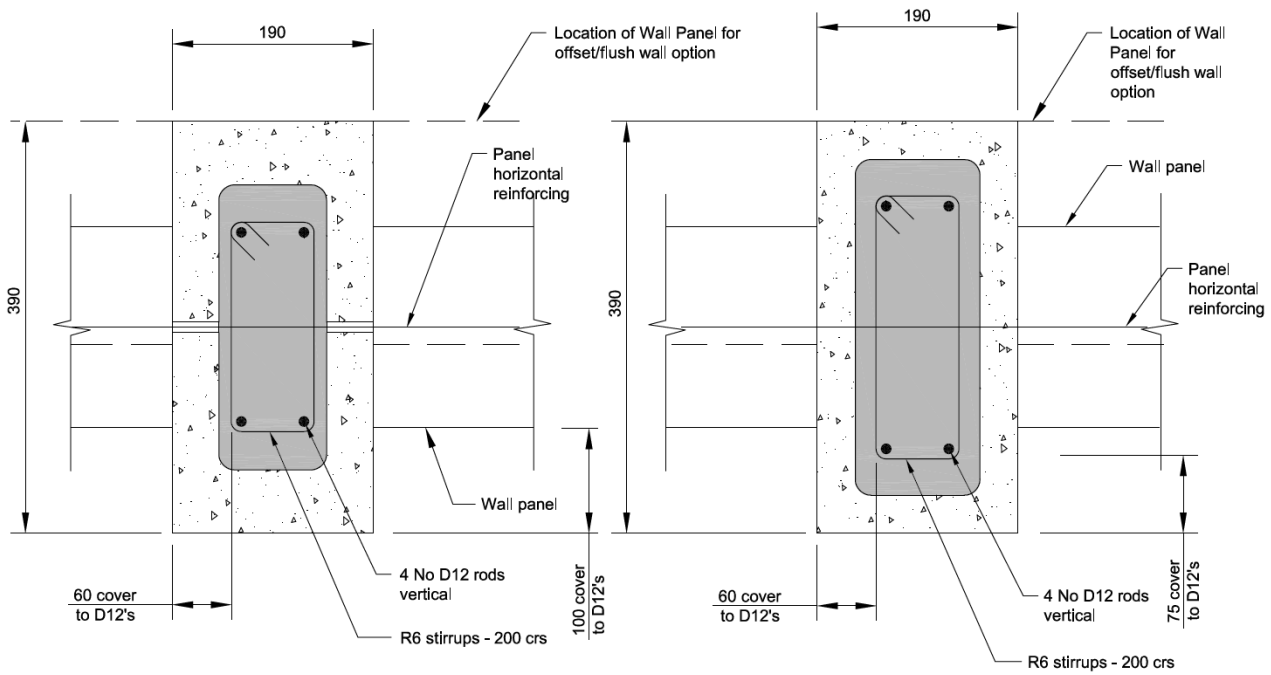


20.19 THREE QUARTER BLOCK



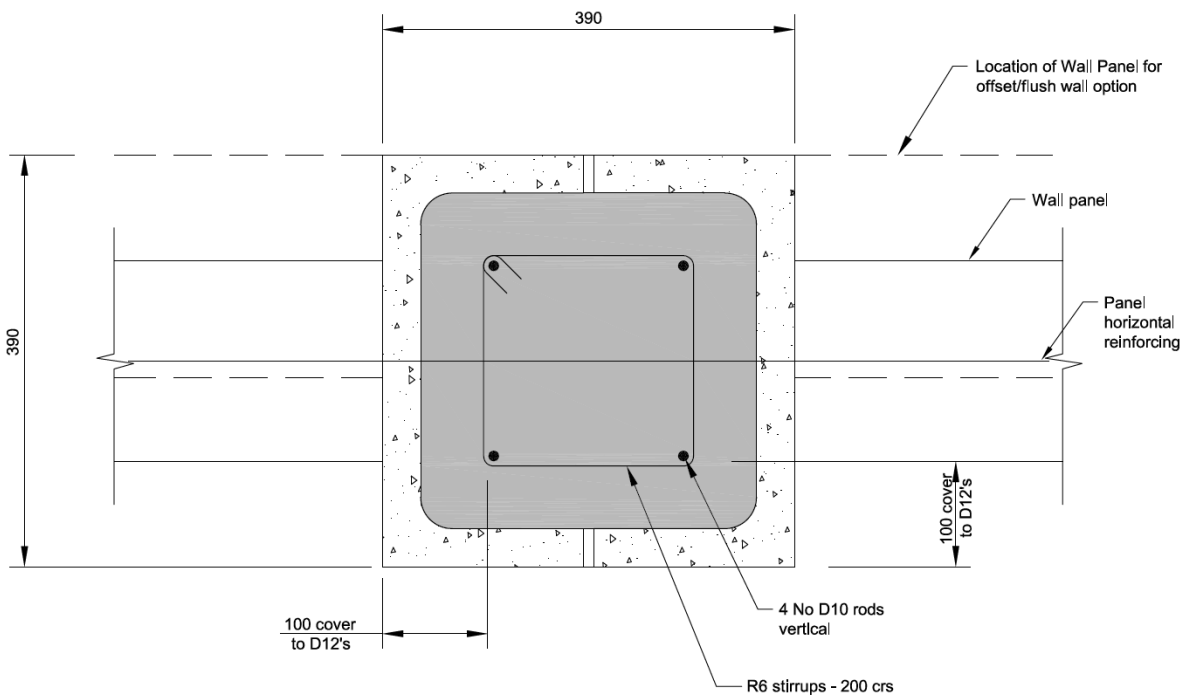
2 x 15.12 STANDARD LINTEL BLOCK

Figure 8: Pilaster Type 'B' Details



2 x 20.12 STANDARD LINTEL BLOCKS

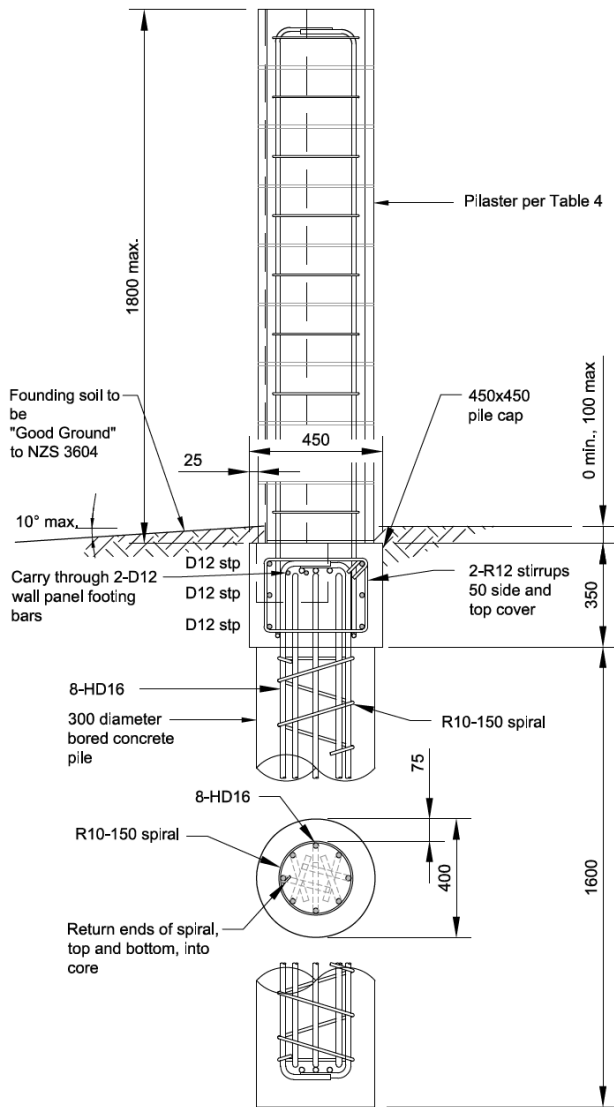
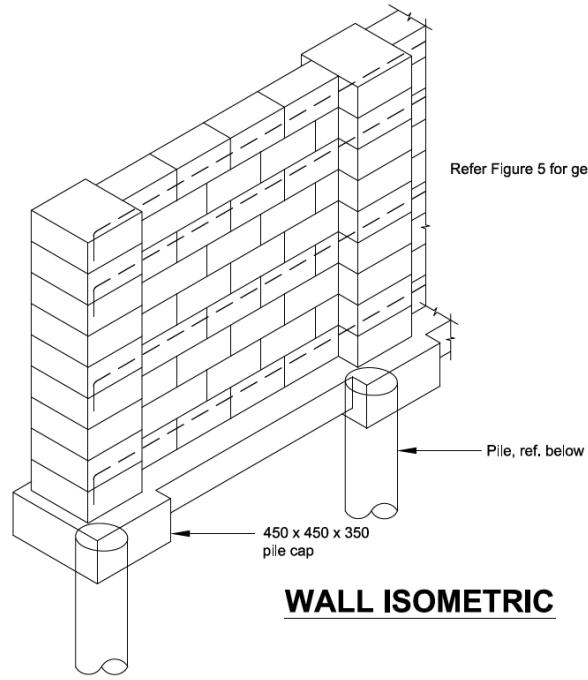
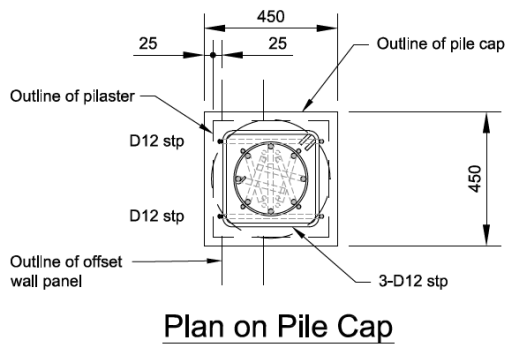
20.30 PIER BLOCK



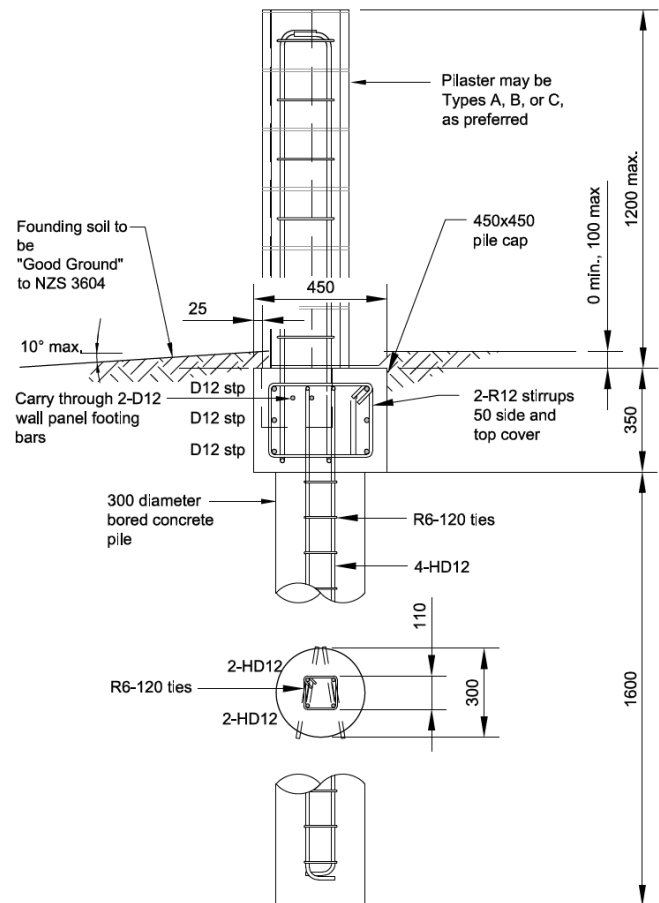
**20.34 PILASTER C TYPE
(ALSO KNOWN AS 20.36A)**

Figure 9: Pilaster Type 'C' Details





Pile Foundation for Max. 1.8m High Pilaster Wall



Pile Foundation for Max. 1.2m High Pilaster Wall

Figure 10: Piled Pilaster Wall Details

