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TN002 – New Zealand Seismic Installation Guide

New Zealand Building Code clause B1 Structure requires all building elements to have a low probability of failure when exposed to loads likely to be experienced within the building's usable life. the most common way to meet the requirements of clause B1 Structure is to use Verification Method B1/VM1. This cites NZS 4219:2009 Seismic performance of engineering systems in buildings, which contains prescriptive and specific engineering design options for restraining a variety of engineering systems.

The objective of NZS 4219:2009 is to safeguard people from injury and to minimise damage by preventing failure of engineering systems when subject to earthquake actions. To do this, the standard provides requirements for designing engineering systems in buildings to achieve seismic performance. The criteria for seismic performance relates to a building's function and covers restraint systems, flexibility to cater for differential movement and clearance to avoid adverse interactions resulting from differential movement.

The standard applies to:

- All engineering systems necessary to ensure compliance with the Building Code
- All engineering systems essential for the normal operation of the building
- Building compliance schedule items.

The provisions of NZS 4219:2009 may be used for services in new or existing buildings and for the purpose of retrofitting engineering systems into existing buildings.

Sonnen NZS 4219 Component Classification

In accordance with Appendix B – Component Classification of NZ4219 the sonnen system/s are to be classed as 'Electrical Supply' and as such have P7 category status.

5.11 NON-ESSENTIAL ELECTRICAL SERVICE

All components comprising the electrical supply and distribution system, including resilient mountings, shall be designed and installed in accordance with section 4 or 3.4 of NZS 4219 to resist the forces determined from 3.8 of the same standard.

Components of electrical supply shall be classified P7 as applicable (see NZS 4219 table 2).

Electrical reticulation in the form of cable or busbar, together with associated ducting, conduit, or similar supporting methods, shall be designed and installed to allow relative movement of the building, or electrical apparatus to which it is connected, or both, without damage to the electrical reticulation apparatus or building.

Cable trays suspended more than 400 mm below their structural support shall be restrained against seismic forces determined in accordance with this Standard.

Cable trays not requiring restraint shall be installed with a clearance of 150 mm from hangers and braces for suspended ceiling systems or other adjacent suspended components.

Where a cable enters the building through a foundation, a sleeved penetration shall be used to accommodate movement of at least 25 mm in all directions.

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Cables, conduit, and cable trays crossing a structural separation shall be provided with sufficient flexibility to accommodate horizontal and vertical movement determined in accordance with 4.2.2 of NZS 4219.

All electrical components contained within cabinets, shall be positively restrained with straps, bars, bolts, and similar devices.

Switchboards shall not contain mercury switches or other gravity-operated devices if their incorrect operation during an earthquake would cause danger to life or property.

Cabinets shall have hinged or sliding doors fitted with top and bottom catches.

C5;1.1

Electrical supply includes the main distribution board and all cabinets and equipment between the main distribution board and supply point, considered to be 1m from the building. These services provide a greater risk of hazard and therefore they require a High risk category.

Where it is necessary to cross building seismic joints with cables, the crossing should occur at the lowest possible floor. Additional draw-in boxes with sufficient flex should be provided in long conduit runs to avoid tensioning of the conductors.

Lift-off panels may fall on live terminals during earthquakes.

Building Importance Levels

The following taken from Appendix A of NZS 4219 provides a description and examples of building importance levels for New Zealand that may contain a sonnen installation.

Importance Level	Comment	Example
1	Structures presenting a low degree of hazard to life and other property	Structures with a total floor area of <30 m2 Farm buildings, isolated structures, towers in rural situations Fences, masts, walls, in-ground swimming pools
2	Normal structures and structures not in other importance levels	Buildings not included in importance levels 1, 3 or 4 Single family dwellings Car parking buildings
3	Structures that, as a whole, may contain people in crowds, or contents of high value to the community or pose risks to crowds	Buildings and facilities as follows: (a) Where more than 300 people can congregate in one area (b) Day-care facilities with a capacity greater than 150; (c) Primary school or secondary school facilities with a capacity greater than 250; (d) Colleges or adult education facilities with a capacity greater than 500; (e) Healthcare facilities with a capacity of 50 or more resident patients, without surgery or emergency treatment facilities; (f) Airport terminals and principal railway stations with a capacity greater than 250; (g) Correctional institutions;

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		(h) Multi-occupancy residential, commercial (including shops), industrial, office and retailing buildings designed to accommodate more than 5 000 people and with a gross area greater than 10000 m2; (I) Public assembly buildings, theatres, and cinemas of greater than 1 000 m2.
		Emergency medical and other emergency facilities not designated as post-disaster
		Power-generating facilities, water treatment and waste water treatment facilities, and other public utilities not designated as post-disaster
		Buildings and facilities not designated as post-disaster containing hazardous materials capable of causing hazardous conditions that do not extend beyond the property boundaries
4	Structures with special post disaster functions	Buildings and facilities designated as essential facilities
		Buildings and facilities with special post-disaster function
		Medical emergency or surgical facilities Emergency service facilities such as fire and police stations, and emergency vehicle garages
		Utilities or emergency supplies or installations required as backup for buildings and facilities of importance level 4
		Designated emergency shelters, designated emergency Centres and ancillary facilities
		Buildings and facilities containing hazardous materials capable of causing hazardous conditions that extend beyond the property boundaries

Building Performance Factors

The following taken from Appendix C of NZS 4219 provides performance factors for specific and sonnen installation relevant components and their specific type for installation in New Zealand.

Component	Type	Restraint	Performance factor, Cp
Cable tray		Suspended and braced to the structure	0.45
Metal cabinet (such as electrical, communication, rack mounted computer equipment)		Floor mounted	0.45
		Braced to structure	0.55

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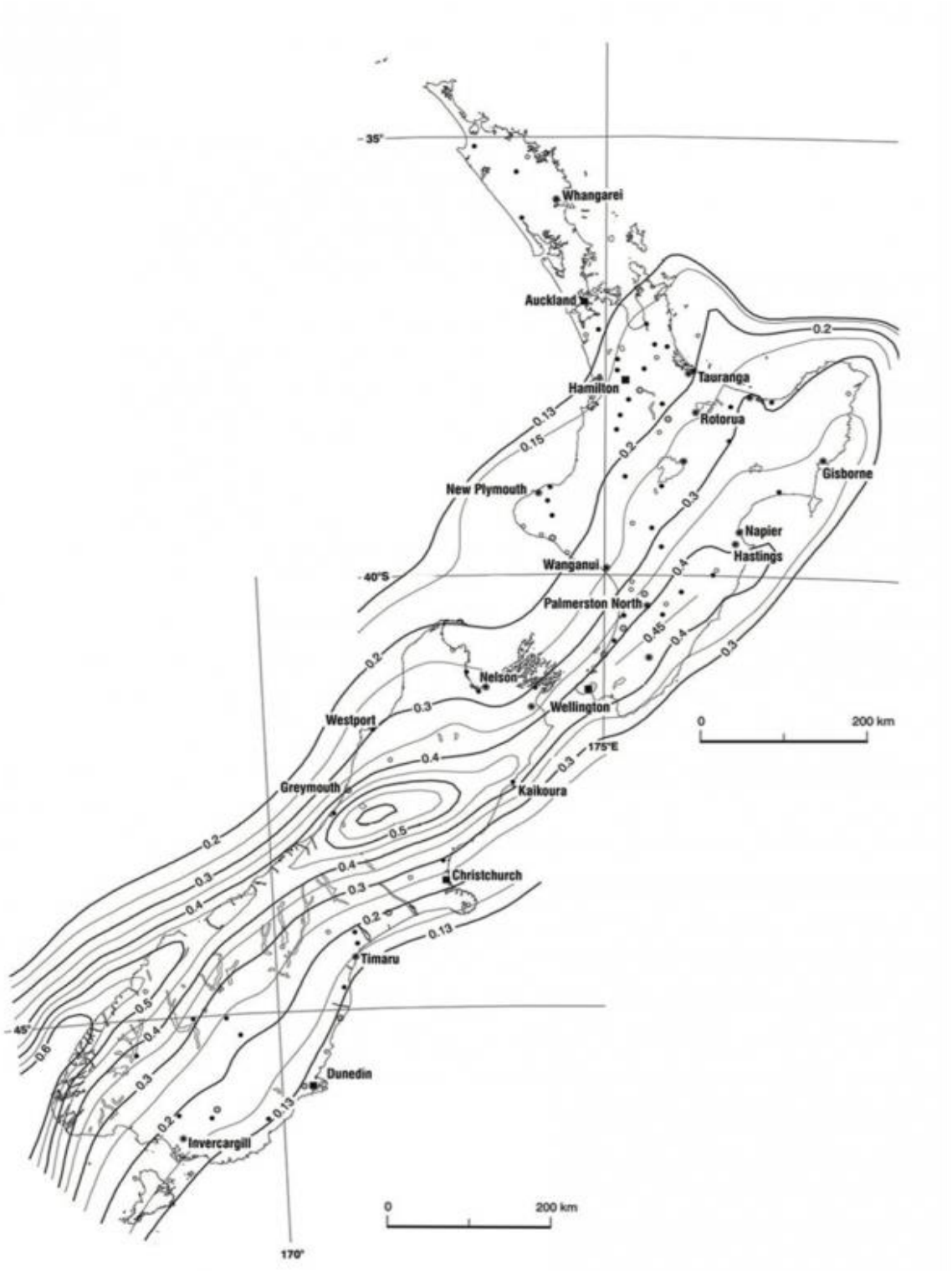
New Zealand Seismic Zone Map

Using the NZS 4219 Standard as a references the following map helps to illustrate the various earthquake zoning regions for New Zealand. Further information and a specific list of all main centres is found within clause 3.4.1 of the Standard.



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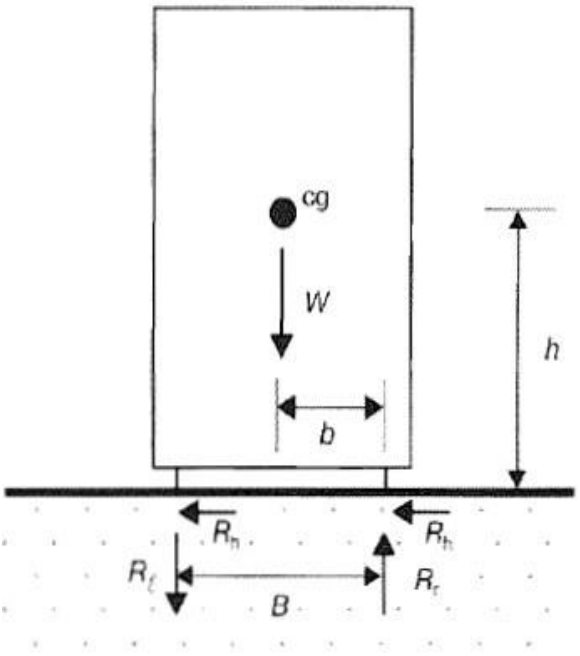
Installation Design Solution Calculation

Using the NZS 4219 Standard to calculate an appropriate design solution to restrain and support a typical sonnen system installation Claus D14 has been selected as the Electrical Cabinet scenario is the most relevant.

Sonnen eco8.16 – Installation Scenario

The full 16 kWh sonnen eco8.2/16 system which is to be installed on the ground floor of a single family domestic dwelling in Wellington. The cabinet is 64cm wide, 184 cm high, and 22cm deep. The mass of the cabinet is 255 kg.



The overall requirement is to determine the number and size of hold-down anchors / fixings utilised and/or in addition to the standard fixings detailed by sonnen.

Calculation Step 1 – Classify the building and the component

The building is a normal single family home. The importance level is 2 (see table 1 of NZS 4219).

The component poses a hazard to individual life within the building. The category is P3 (see table 2 of NZS 4219).

NOTE:

In accordance with 5.12, components of electrical supply will be classified P1, P2, or P3 as applicable.

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Calculation Step 2 – Determine the load demand (see clause 3.4 of NZS 4219 for further clarification)

The cabinet is on the ground floor,	CH	1.0		
Seismic zone factor,	Z	0.4.		(NZS 4219 Table 3)
Performance factor,	Cp	0.45	(floor mounted, metal)	(NZS 4219 App C)
Performance factor,	Cp	0.55	(braced to structure, metal)	(NZS 4219 App C)
Component risk factor,	Rc	0.9	(for IL2 and P3)	(NZS 4219 Table 5)

Therefore, the seismic coefficient, C = 2.6 x 1.0 x 0.4 x 0.45 x 0.9
= 0.42

NOTE - The Cp value of 0.55 would only apply for anchors if ductile fixings were used,

Weight of the cabinet, W = 255 kg x 9.81 Nkg-1
= 2.5 kN

The lateral force on the cabinet, F = C x W
= 0.42 x 2.5
= = 1.05 kN

Forces on the restraint anchors:
Floor mounted component (see 3.7)

The cabinet has the following dimensions:

h	1.84 m
D	0.64 m
d	0.22 m

Provide three anchors each high side (n 3, N = 6) using equation 3.6 in NZS 4219.

Horizontal force on each anchor: $R_h = \frac{CW}{N}$

$= \frac{1.05}{6}$

= 0.175 kN

Vertical tensional force on each anchor: $R_v = \frac{CWh}{nD} + \frac{W}{N}$

$= \frac{1.0 \times 1.8}{3 \times 0.6} + \frac{2.5}{6}$

= 0.58 kN

The edge distance for the anchors will be 100 mm, so see figure 10(b) you could choose M8 anchor bolts. Therefore, provide 3 M8 anchor bolts front and back of the cabinet.

It may be more suitable for this cabinet to be braced to the structure. So the option would be to provide 3 horizontal braces to the top of the cabinet with bolt fixings to a structural wall behind the cabinet. Attachment height of the brace, H, is 2.0.

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From equation 3.27:

$$P = \frac{CWh}{H\cos\theta}$$

$$= \frac{1.05 \times 1.84}{2.0 \times 1.0}$$

= 0.96 kN (0.32 kN per brace)

Calculation Step 3 – Determine the fixings to withstand these loads

From table 11, one M12 bolt fixing embedded 100 mm into a masonry wall will be satisfactory.

Alternatively, from table 8, an 8-gauge woodscrew penetrating 30 mm into a timber stud is an ideal option.

NOTE: If the cabinet is fixed to a timber frame wall, the project structural engineer should check the wall capacity.

If you have any further questions about the appropriate fixing or securing of the sonnen systems within earthquake prone region, please contact us at any time for further support or assistance.

Yours faithfully,

James Sturch
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