NZS4219 Design Approach

Possible Future Direction for NZS4541?

January 2015

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Background

- NZS4219 :2009
  - Provides seismic design requirements for services in buildings
  - Excludes Sprinkler System Piping
    - When written, NZS4541 had it right
  - Wellington 2013 Earthquake
    - Did the Fire Industry get it right?
    - Anecdotal evidence
      - Other trades did not!
  - Not withstanding
    - Standard for Sprinkler Systems likely to increase

NZS4541:2013

- Clause 403.12.2

All pipework shall be designed to resist repeated forces due to seismic acceleration of 1.0 g acting on the mass of the pipework in any direction in addition to the gravity force.

NOTE - This load may be greater than the requirements of NZS 1170.5, and may increase the support size but it eliminates the need for a more detailed study.

Aon is aware that some parties consider:

- This clause is an inadvertent error
- This clause is inadequate

- Proposal to amend NZBC
  - Replace 1.0g by the factor C calculated by NZS4219 Equation 3.2

NZS4219 Seismic Design Coefficients

- A guide to its use
- How to find the information you need?

NZS4219 Equation 3.2

$C = 2.7\ C_H Z C_p R_c$

- C_H= 3.0 above ground floor, or 1.0 at or below ground floor
- Z= seismic zone factor (Location based) Slide 5
- C_p= Performance Factor Slide 6
- R_c= Component Performance Factor Slide 7 & 8

Seismic Z Factor

- Refer
  - – Informative
    - NZS4541:2013 Appendix Q
  - – Normative
    - NZS4219 Table 3 or figure 2

Examples

- Auckland – 0.13
- Rotorua - 0.24
- Wellington – 0.40
- **Arthur's Pass – 0.60**
- Christchurch – 0.30
- Dunedin – 0.13

APPENDIX Q – *Z* VALUES AND SHORTEST MAJOR FAULT DISTANCES *D* FOR NEW ZEALAND

(Informative)

Q1 REPRODUCED FROM NZS 1170.5 AND VERIFICATION METHOD B1/VM1 OF THE COMPLIANCE DOCUMENTS TO THE NZBC

Users should refer to the current version of NZS 1170.5 for authoritative information.

Table Q1 – *Z* values and shortest major fault distances *D* for New Zealand locations (north to south)

#	Location	*Z*	*D* (km)*
1	Kaitaia	0.13	–
2	Paihia/Russell	0.13	–
3	Kaikohe	0.13	–
4	Whangarei	0.13	–
5	Dargaville	0.13	–
6	Warkworth	0.13	–
7	Auckland	0.13	–
8	Manukau City	0.13	–
9	Waiuku	0.13	–
10	Pukekohe	0.13	–
11	Thames	0.16	–
12	Paeroa	0.18	–
13	Waihi	0.18	–
14	Huntly	0.15	–
15	Ngaruawahia	0.15	–
16	Morrinsville	0.18	–
17	Te Aroha	0.18	–
18	Tauranga	0.20	–
19	Mount Maunganui	0.20	–
20	Hamilton	0.16	–
21	Cambridge	0.18	–
22	Te Awamutu	0.17	–
23	Matamata	0.19	–
24	Te Puke	0.22	–
25	Putaruru	0.21	–
26	Tokoroa	0.21	–
27	Otorohanga	0.17	–
28	Te Kuiti	0.18	–
29	Mangakino	0.21	–
30	Rotorua	0.24	–
31	Kawerau	0.29	–
32	Whakatane	0.30	–
33	Opotiki	0.30	–
34	Ruatoria	0.33	–
35	Murupara	0.30	–
36	Taupo	0.28	–
37	Taumarunui	0.21	–
38	Turangi	0.27	–
39	Gisborne	0.36	–
40	Wairoa	0.37	–
41	Waitara	0.18	–
42	New Plymouth	0.18	–
43	Inglewood	0.18	–
44	Stratford	0.18	–
45	Opunake	0.18	–
46	Hawera	0.18	–
47	Patea	0.19	–
48	Raetihi	0.26	–
49	Ohakune	0.27	–
50	Waiouru	0.29	–
51	Napier	0.38	–
52	Hastings	0.39	–
53	Wanganui	0.25	–
54	Waipawa	0.41	–
55	Waipukurau	0.41	–
56	Taihape	0.33	–
57	Marton	0.30	–
58	Bulls	0.31	–
59	Feilding	0.37	–
60	Palmerston North	0.38	8 – 16
61	Dannevirke	0.42	10
62	Woodville	0.41	≤ 2
63	Pahiatua	0.42	8
64	Foxton/Foxton Beach	0.36	–
65	Levin	0.40	–
66	Otaki	0.40	–
67	Waikanae	0.40	15 – 20
68	Paraparaumu	0.40	14 – 20
69	Masterton	0.42	6 – 10
70	Porirua	0.40	8 – 12
71	Wellington CBD (north of Basin Reserve)	0.40	≤ 2
72	Wellington	0.40	0 – 8

C_p Performance factor

- Anchors fixings or fastners
  - C_p= 0.85

- Braces and Supports (for category P4 components)

  - C_p = 0.85 or from Appendix C

- Appendix C
  - Steel Pipe flanged, welded or grooved
    - C_p= 0.45
  - Steel Pipe, screwed joints
    - C_p= 0.65

Building Importance Levels

- NZS4219 Appendix A

- IL 1 – Structures with low hazard to life
  - Farm Buildings, towers in rural situations, Buildings less then 30m^2
    - *Unlikely* to be sprinklered.
- IL2 - Normal Buildings not IL 1,3 or 4
  - Single family dwellings, car parks
  - Careful review of potential IL3 buildings to see if IL4?
- IL3 - Structures that may contain people in crowds, contents of high value to the community or pose risks to people in crowds
  - More that 300 people in one area, primary schools with a capacity greater than 250, public assembly greater than 1,000m^2, or commercial buildings with gross area greater than 10,000m^2
- IL4 – Structures with special post disaster functions
  - Medical emergency or surgical facilities
  - Police and fire stations
  - Buildings containing hazardous materials capable of causing hazardous conditions past boundary
- IL5 – Special structures posing catastrophic risk to the community
  - Major dams.

R_c Component Risk Factor

- Fire Fighting Systems (other than sprinkler systems) are a Part Category P4
  - Treat Sprinklers as P4

Component Risk Factor for Part Category 4		
Building Importance Factor		
1 & 2	3	4
1.0	1.30	1.80

Example 1 - Single level primary school in Northland - 200 students

$$C = 2.7\ C_H Z C_p R_c$$

- Single level building, therefore $C_H = 1.0$
- Northland Z=0.13
- Fastners, $C_p = 0.85$
  - Threaded Pipe, from Appendix C, $C_p = 0.65$.
- IL2 Building, $R_c = 1.0$

- C= 2.7 x 1.0 x 0.13 x .085 x 1.0
  = 0.3g

Example 2 – Multi-Level Major Hospital in Wellington/Christchurch

$C = 2.7\ C_H Z C_p R_c$

- Multi level building, therefore $C_H = 3.0$
- Wellington Z=0.40
- Fasteners, $C_p = 0.85$
  - Threaded Pipe, from Appendix C, $C_p = 0.65$
  - Grooved pipe, from Appendix C, $C_p = 0.45$
- IL4 Building, $R_c = 1.8$

- $C = 2.7 \times 3.0 \times 0.40 \times 0.85 \times 1.8$

  $= 4.95\ g$

King Canute