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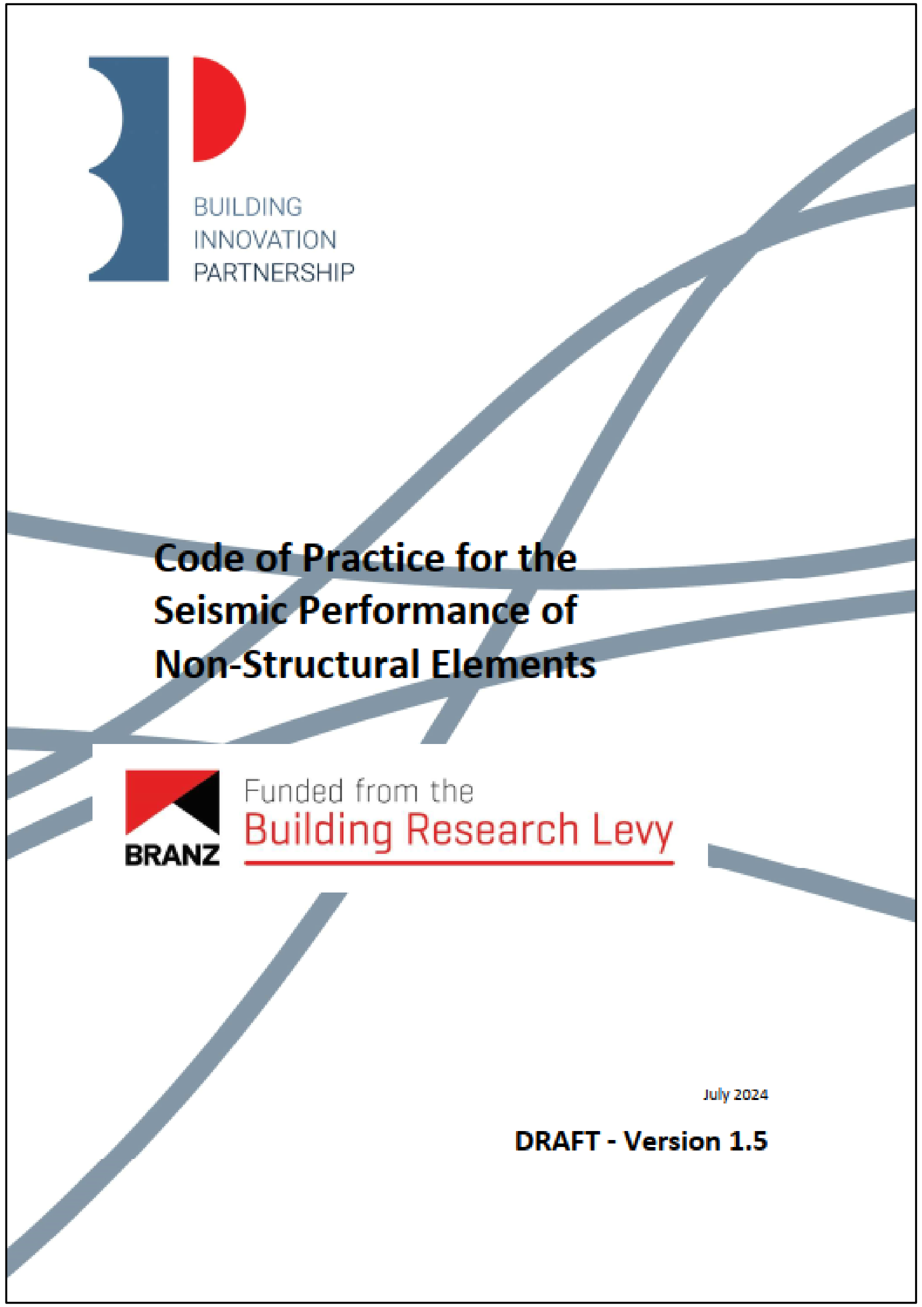
Code of Practice for the Seismic Performance of NSEs

UC
UNIVERSITY OF
CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Summary

1. Draft Version provided in shared NZ-Chile documents folder.

2. Keen for feedback by mid-August.


BUILDING
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Code of Practice for the Seismic Performance of Non-Structural Elements

BRANZ Funded from the Building Research Levy

July 2024

DRAFT - Version 1.5

High level summary of NSE CoP

Design Methodology/coordination

What? → Who? → How? → In/Out -put

A 4.1 | A 4.3 | A 4.4 | A 4.4

CLIENT PROJECT BRIEF – BLG PURPOSE & PERFORMANCE REQUIREMENTS (1)

Link into flowchart task	Design Stage	Design Step	Required Input	Client	Project Manager	Quantity Surveyor	Design Manager	Cultural Advisor	Sustainability Consult.	BIM Manager	Architect	Façade Engineer	Fire Engineering	Structural	Civil	NSE Seismic Design	Mechanical	Electrical	ICT Consultants	Plumbing & Drainage	Fire Protection	Main Contractor	Other	Scope of output	Reference documentation and additional notes
1	Concept Design	Project Brief																						Report	Part A.4.4.1 of NSE CoP
2	Concept Design	Classify Building Importance Level	Project Brief (1)																					Report	Section 3.3.1 of NZS 4219
3	Concept Design	Identify and list NSE & critical contents in the building	Project Brief (1)																					Memo	Section 3.3.2 of NZS 4219, Part A 2.2. from NSE CoP, Facade Engineer could be Architect
4	Concept Design	Building services reticulation strategy options	Architectural plans and cross sections, Project Brief (1)																					Options Report & plans & cross section markups to identify reticulation options (not full reticulation design) for main services runs, risers, plantrooms and general services distribution	
5	Concept Design	Fire engineering strategy options	Architectural plans and cross sections, Project Brief (1)																					Options Report & plan & cross section markups	
6	Concept Design	Building movement strategy options	Architectural plans and cross sections, Project Brief (1)																					Options Report & plans & cross section markups, individual movement strategy input into combined report to outline all	

ALL DISCIPLINES CONCEPT DESIGN REPORT (14)

Figure A-2: Concept Design Process Flowchart

Table A-3: Inter-story drift interfaces

	Responsibility
	Structural Designer
	NSE Seismic Designer
	Building Services Designer, Architect
	NSE Seismic Designer
	Building Services Designer, Architect, Specialist Supplier
	Building Services Designer, Architect
	NSE Seismic Designer
Selection of suitable passive fire products that can accommodate movement	Passive Fire Designer, Specialist Supplier

High level summary of NSE CoP

Technical Guidance first Version

Timber partitions Cold-form steel partitions
Exposed grid suspended ceilings Concealed grid suspended ceilings
Suspended ductwork, electrical cable trays, mechanical heating/cooling pipework, plumbing and drainage pipework
Fans, VAV boxes, heat exchangers, cassette units, grilles, diffusers, chilled beams
Emergency generators, chillers, boilers, furnaces, pumps, air handling units (AHUs), transformers, outdoor condenser units, heat exchangers, control panels, motor controls, switchgear, distribution panels, fans/blowers/filters, air compressors
Suspended fire protection piping, sprinklers & risers
Curtain wall, spider glazing

Technical Guidance future Versions

Distribution panels, high wall units
Vents, flues, antennae, solar panels
Water tanks, hot water cylinders, buffer tanks, fuel tanks hazardous storage tanks
Lifts, escalators, conveyors, motor, controls
Precast cladding, light-framed cladding
Storage racks, battery racks
Pendant lighting, exterior lighting, ceiling-mounted lighting
Pendants, Specialist medical gas equipment
Wall, parapets, chimney,
Compressed gas cylinders (O2, CO2, NH3, etc), batteries,
Raised access floor
Large computer and comms equip (speakers, monitors), artwork (e.g. museum pieces),

Technical Guidance – Part C

Each NSE section is structured in the following format:

1. Description – overview of the NSE included in the section.
2. Design Methodology – description of the best-practice design methodology based on applicable design standards.
3. Performance Characterisation – table which provides performance descriptions for specific NSE related to performance states (drift and/or acceleration demands).
4. Performance Considerations – list of considerations that affect the seismic performance.
5. References – references to related content, Standards, Codes, papers

Technical Guidance – Suspended Ceilings

C.2.2.2. Design Methodology

Suspended ceiling seismic design primarily considers the horizontal acceleration of the ceiling and the transfer of these forces back to the structure via the grid, connections, and bracing elements.

There are two typical approaches to transfer these forces:

1. Perimeter restraint – transfer of the seismic forces to the structure via the grid to the perimeter structure (typically partition walls). This is typically achieved by connecting on two adjacent walls and allowing the ceiling to 'float' on the opposing two walls.

2. Back-bracing – transfer of the seismic forces to the structure via the grid and diagonal braces to the structure above. In this configuration the ceiling is typically floating on all sides.

In both approaches, the capacity of the ceiling grid, connections and the overall system needs to be sufficient to transfer seismic loads. Where ceilings are back-braced, the capacity of the back-bracing element should be designed to transfer the seismic load from the tributary area associated with the brace. The connection between the back-brace and the grid should also be sufficient to transfer the seismic load of the brace.

Design guidance is provided by the Association of Wall and Ceiling Industries (AWCI) for Design, Installation and Seismic Restraint of Suspended Ceilings (AWCI, 2015).

Technical Guidance – Suspended Ceilings

Table C-2: Seismic performance characterisation of suspended ceilings

Engineering Demand Parameter	Performance State	Performance Description	Design Limit State	Recommended Criteria or Design Limit
Floor Acceleration	Lateral demands on ceiling system	Damage to ceiling system that could lead to disruption in function	DCLS / SLS2	Seismic restraint of ceiling as per AS/NZS2785[1]
		Loss of support of ceiling	ULS	Seismic restraint of ceiling as per AS/NZS2785[1]
Interstorey Drift	Seismic gap movement requirements	Onset of damage to ceiling system	SLS1	Relative drift between floor and ceiling at Design Limit State[2]
		Damage to ceiling system that could lead to disruption in function	DCLS / SLS2	Relative drift between floor and ceiling at Design Limit State[2]
		Loss of support of ceiling	ULS	Relative drift between floor and ceiling at Design Limit State[2]

[1] – AS/NZS 2785:2020 Suspended Ceilings – Design and Installation.

[2] – Association of Wall & Ceiling Industries (AWCI) Code of Practice for Design, Installation and Seismic Restraint of Suspended Ceilings (AWCI, 2015).

Technical Guidance – Suspended Ceilings

C.2.2.4. Performance Considerations

The following considerations apply in the design, construction, assessment and testing of suspended ceiling systems:

- The seismic design of suspended ceilings is typically limited by connections between grid members or connections to structure. It is necessary to check the capacity of ceiling system includes:
  - Axial capacity of main tee / cross tee
  - Connection capacity of grid connections, including splices
  - Connection of perimeter bracket to perimeter wall (if perimeter restrained)
  - Connection of back-brace to grid (if back-braced)
  - Axial capacity of back-brace (if back-braced)
  - Connection of back-brace to structure (if back-braced)
- As ceilings grids are proprietary products, it is often necessary to rely on the capacity of the above elements and connections from suppliers. Unfortunately, there is limited information available from supplier's and this information may not be supported by appropriate testing or similar validation. Care should be taken when determining ceiling capacity is sufficient for seismic loads. If the technical information from the supplier is insufficient for the designer to have confidence that the ceiling system meets the requirements of the Building Code, there may be an opportunity to require further technical information under the MBIE Building Code Compliance '*Product Assurance and Certification Scheme*', refer B.3.6 of this guideline.
- If ceilings are perimeter restrained, the perimeter structure needs to be sufficient to withstand the seismic load of the ceiling. Where lightweight partitions are the perimeter structure, these should be designed with an allowance for this ceiling load. If unsure, a line load of 1kN/m is a reasonable ceiling load assumption based on the capacity of ceiling perimeter connections.
- The minimum services load allowance of 3kg/m^2 prescribed in AS/NZS 2785 may not be sufficient, and advice should be sought from the services engineer for an appropriate project specific allowance.
- Vertical accelerations are not explicitly included in suspended ceiling design, however, shake table testing has found that the vertical component of earthquake shaking may have a significant effect on the behaviour of grid and tile ceilings (Ryan 20222) and therefore consideration should be given to vertical accelerations if these are expected to be significant. This might include more robust hangers or ensuring tiles are clipped.
- Where clipping can be practically achieved without interfering with maintenance requirements, its use is encouraged. Otherwise, strategies for securing tiles should ensure any tiles containing fittings such as sprinkler heads, lighting and electrical fittings, ventilation diffusers and the like cannot become dislodged. This is particularly true for ceilings where tile loss could adversely impact post-disaster function, such as key egress routes.

THANK YOU

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This document has been prepared by:

- Jan Stanway – WSP (co-lead)
- Andrew Baird – Beca (co-lead)
- Muhammad Rashid, Silvester Clark Ltd
- Sara Hinz – WSP
- Greg Preston – BIP

The reference group comprised:

- Prof Tim Sullivan – UC
- Rajesh Dhakal – UC
- Corde Rhodes – WSP
- Ignatius Black – Silvester Clarke Ltd
- Brad Sara – Warren & Mahoney
- Jonathon Hill – Kaizon
- Mayank Tripathi – GIB
- Richard Arkinstall – AWCI
- Stephen Ridder – AON
- Andrew Reid – Pedersen Reid
- Andrew Marshall – HRS
- Amanda Bachelor – Naylor Love

Coordination with other related activities has been provided by

- Prof Ken Elwood, Chief Engineer, Resilience, MBIE
- Dave Brunsdon, Kestrel Group, HEAG
- Mark Willard, MoE
- Jared Keen, Beca, HEAG
- Paul Campbell, WSP, Low Damage Design