The Next Frontier – Improving the Seismic Resilience of Non-Structural Components.

Helen Ferner – Technical Director Structural Engineering
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Recent NZ earthquakes
NZ Design standards for Non-structural components

New Zealand

- NZS1170.5 – Parts and Components
  - ULS – risk to life safety
  - SLS – risk to operational continuity
- NZS4219 – Seismic Performance of Engineering Systems in Buildings
- AS/NZS2785 – Suspended Ceilings – Design and Installation
# California Hospital Performance

## Northridge Hospital Performance

<table>
<thead>
<tr>
<th>Performance of all Buildings at 23 Hospital Sites with One or More Yellow or Red Tagged Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Damage</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td><strong>Structural Damage</strong></td>
</tr>
<tr>
<td>Red tagged</td>
</tr>
<tr>
<td>Yellow tagged</td>
</tr>
<tr>
<td>Green tagged</td>
</tr>
<tr>
<td><strong>Nonstructural Damage</strong></td>
</tr>
<tr>
<td>Major</td>
</tr>
<tr>
<td>Minor</td>
</tr>
<tr>
<td><strong>Total Buildings</strong></td>
</tr>
</tbody>
</table>

From “Seismic Vulnerability of Hospitals based on Historical Performance in California”; 8th National Conference on Earthquake Engineering, by William T Holmes and Lawrence Burkett.
Why are seismic restraints not being installed in NZ?

- Cost
- “Just in Time” Design Timing
- Procurement
- Construction Process and Programme
- Engagement of Consultants
- Existing Buildings
- Code compliance
### EERI Industry Survey of Issues

#### Figure 4.1.11 Reasons for Noncompliance and Their Relative Importance, Summary from All Respondent Groups

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No one is adequately trained to make sure the standards are complied with</td>
<td>44%</td>
</tr>
<tr>
<td>There is little regulatory enforcement of compliance with the standards</td>
<td>42%</td>
</tr>
<tr>
<td>No one knows who is ultimately responsible for compliance</td>
<td>40%</td>
</tr>
<tr>
<td>There is a communication breakdown between the parties involved in constructing the building that contributes to noncompliance</td>
<td>25%</td>
</tr>
<tr>
<td>Compliance just falls through the cracks</td>
<td>23%</td>
</tr>
<tr>
<td>Everyone just assumes someone else will make sure the compliance occurs</td>
<td>21%</td>
</tr>
<tr>
<td>Everyone passes the buck to someone else, so compliance doesn’t occur</td>
<td>20%</td>
</tr>
<tr>
<td>The standards are too difficult to understand</td>
<td>20%</td>
</tr>
<tr>
<td>There is little incentive to comply with the standards</td>
<td>22%</td>
</tr>
<tr>
<td>Reasonable for noncompliance isn’t severe enough to make compliance a high priority</td>
<td>20%</td>
</tr>
<tr>
<td>It is too time consuming to comply with these standards</td>
<td>17%</td>
</tr>
<tr>
<td>There is a lack of compensation for oversight compliance</td>
<td>15%</td>
</tr>
</tbody>
</table>

(Each respondent could select up to three choices.)
Suggested Approaches to Improve the Situation

1. Make clear the design and inspection requirements for bracing of non-structural components

Example - St Louis “Seismic Block”
2. Add a role to the design team - someone responsible for considering the seismic protection of non-structural components

Example – Non-Structural Seismic Coordinator

- The University of California introduced the role for Stanley Hall,
- The role is now a codified requirement for courts projects in California

For each project, the AOC shall designate a Nonstructural Seismic Coordinator, knowledgeable and experienced in the seismic protection of non-structural components and systems ……….
Suggested Approaches to Improve the Situation

3. Include seismic restraint of non structural components as part of a Holistic Design Approach

Example – AUT ETD Services Racetrack
AUT ETD - Service Support Frames

[Diagram of a service support frame with dimensions and annotations]

- 1600x400 supply duct
- 400 spf
- 600 HHW
- Lights mounted off 300mm power tray
- 450 mm data tray
Wellington International Airport

Primary structure

Primary structure plus secondary structure to support non structural components
Wellington International Airport
Victoria University Faculty of Architecture
Refurbishment

NO CONNECTION BETWEEN OFFICE POD AND SOFFIT

SEISMIC GAP TO COLUMNS (TO MATCH INTERSTOREY DRIFT)

OFFICE POD (ISOLATED FROM COLUMNS AND SOFFIT)

SERVICES PROVIDED WITH FLEXIBLE CONNECTIONS

FLOOR ABOVE OFFICE POD FREE TO DISPLACE WITHOUT AFFECTING OFFICE POD

SERVICES RIGIDLY FIXED TO CEILING OF POD

AIM: ABOVE FLOOR DISPLACEMENT HAS NO EFFECT ON OFFICE POD

Beca
Conclusions

- Generally implementation of non structural seismic protection is poor in New Zealand
- Change is possible
- Improvements can be made by assigning responsibility and by designing buildings in a holistic manner including considering non structural components from the early stages in design
- Costs of design and construction will inevitably rise; but
- Damage and economic losses caused from non structural damage in earthquakes will fall.
Thank you

- Helen Ferner, Technical Director Structural Engineering

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