Post-Incident Planning
What and How to be Prepared For
“The Big One” – Earthquake Readiness for Stratas

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Read Jones Christoffersen Ltd.
Creative Thinking Practical Results
Presentation Outline

- Overview of “Incidents” - Potential Disasters
- Seismic Events and Building Performance
- Pre-Earthquake Assessments
- Planning and Preparation
- Post-Earthquake – What Happens?
- Q & A / Discussion
What are “potential disasters”?

- Storms
- Floods
- Fires
- Landslides
- Earthquakes
How big is the Big One?

- The Cascadia Subduction Zone earthquake.
- Believed to be Richter Magnitude 8+.
- Buildings will react differently based on age, construction, location, duration, etc.

https://en.wikipedia.org/wiki/Cascadia_subduction_zone
If it happened here today?

- Some damage will occur

If it happened here today?


Seismic events - probability

- Earthquakes and/or ETS occur every day in western Canada.
- Some % chance in 50 years that we will get an earthquake damaging to buildings...
- Simply put, we are coming up to being due.

Seismic activity occurs every day

Tiny tremors (not felt) return to #VancouverIsland. More than 150 during the past 24 hours - stretching from the #AlberniValley to #Cowichan. Stay tuned to see if this might be ETS 2018:

More than 250 tiny tremors (not felt) blanketed south-central Vancouver Island during the past 24 hours, extending from #PortAlberni to #CowichanLake, and slowly moving towards # Bamfield. This is starting to look like the expected (and regular) ETS event: earthquakescanada.nrcan.gc.ca/pprs-pprp/pubs...

Here is a recap of the ~1500 tiny tremors on #VancouverIsland this week... They are now moving slowly towards the northwest. The #NRCan GPS "slip" monitor is here: earthquakescanada.nrcan.gc.ca/etools/etsmon--...
Check out the latest PNSN blog here: pnsn.org/tremor/tremor--...
Thx to @pnsn1 and A. Wech.
Present and past...

Favourite hard question to structural engineers

- “What Richter Scale quake can my building withstand?”
- Building performance in a seismic event influenced by many factors.
- Goal of current code is to allow safe evacuation.

Managing Principal – RJC Structural
Seismic events - severity (how is it measured)

- Does the size of an earthquake mean anything?
  - Yes... but it depends.
  - Magnitude ≠ Intensity.
# Intensity - The Modified Mercalli (MM) Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description/Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
<td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td>
</tr>
</tbody>
</table>
Intensity - The Modified Mercalli (MM) Scale

**MM VI.  (MM 6)**

Felt by all, indoors and outdoors. Frightened many, excitement general, some alarm, many ran outdoors. Awakened all. Persons made to move unsteadily. Trees, bushes, shaken slightly to moderately. Liquid set in strong motion. Small bells rang -church, chapel, school etc. Damage slight in poorly built buildings. Fall of plaster in small amount. Cracked plaster somewhat, especially fine cracks chimneys in some instances. Broke dishes, glassware, in considerable quantity, also some windows. Fall of knick-knacks, books, pictures. Overturned furniture, in many instances. Moved furnishings of moderately heavy kind.

Intensity - The Modified Mercalli (MM) Scale

Will my building be safe? Will my family be OK?

- Building performance and safety is affected by many factors.
- Many of these factors are in your control.
- Both pre- and post-disaster.
Who will be there to help?
Assessing building performance

- What might visible damage mean?
- Is your building safe for continued occupancy?


“Break”
Taking Action – Prepare and Plan

By failing to prepare, you are preparing to fail.

Benjamin Franklin - Smart guy
Many resources to assist with planning
Seismic Upgrades?
Optimize your preparedness!

- **Create manuals, review manuals, practice manuals**
- Evacuation and response planning – who goes where and does what?
- Emergency supplies and kit – you’re likely to be on your own for a while – is 72 hours (or even 7 days) enough?
- **Assess your building** – do you know what to look for before and after an earthquake?
Pre-Disaster Assessment

Seismic Mitigation Assessments

- **Assess your preparedness.** Identify – what are your risks? Plan to Mitigate – start building your overall plan.

- Evacuation plans, muster stations, emergency supplies
- Service connections, shut-offs and restarts
- Structural, non-structural, and cladding concerns
- Operational and Functional Components (OFC)
Base structure and cladding are important

- Base-building structural condition is important.
- Claddings are very important too.
- Assess for allowable safe egress.
Seismic risk reduction of operational and functional components (OFCs) of buildings

“Earthquakes pose a serious threat to safety and have rendered many buildings unusable due to extensive damage to their operational and functional components (OFCs). In fact, the main cause of casualties and property damage in the event of an earthquake is often the failure of these OFCs. In many cases, the losses associated with damage to these components are considerably greater than damage to the structural system.”

http://shop.csa.ca/en/canada/structures/s832-14/invt/27014872014
Identify Risks

- Catch the “easy” stuff. OFC and non-structural restraints. Low dollar investments for potentially high returns in life and safety.

- An earthquake that doesn’t cause structural damage could still result in an uninhabitable building.
OFC and Non-structural components matter


https://www.slideshare.net/GasUtility/meter-sets/12

© Home Mechanical Room Design
Reporting – Risk-based priority and planning

Seismic Mitigation Component Evaluation List - Risk Based Priority List

<table>
<thead>
<tr>
<th>Component Number</th>
<th>Photo</th>
<th>GEI Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.23</td>
<td></td>
<td>Pumps - Roof Mounted</td>
</tr>
<tr>
<td>5.22</td>
<td></td>
<td>Compressor</td>
</tr>
<tr>
<td>5.26</td>
<td></td>
<td>Expansion Tank - Large</td>
</tr>
<tr>
<td>5.36</td>
<td></td>
<td>Expansion Tank - Suspended</td>
</tr>
<tr>
<td>5.57</td>
<td></td>
<td>Pipes - Medium Diameter</td>
</tr>
<tr>
<td>5.38</td>
<td></td>
<td>Lights - Suspended</td>
</tr>
<tr>
<td>5.39</td>
<td></td>
<td>Lava Lamp</td>
</tr>
</tbody>
</table>
Reporting – Dollars and sense?

**TABLE 2: SUMMARY OF OFC ITEMS BY RISK RATINGS**

<table>
<thead>
<tr>
<th>Priority</th>
<th>Risk Rating</th>
<th>Number of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High</td>
<td>&gt; 128</td>
<td>7</td>
</tr>
<tr>
<td>High</td>
<td>127 to 65</td>
<td>71</td>
</tr>
<tr>
<td>Moderate</td>
<td>64 to 33</td>
<td>49</td>
</tr>
<tr>
<td>Low/Negligible</td>
<td>≤ 32</td>
<td>402</td>
</tr>
</tbody>
</table>

**TABLE 3: OPINIONS OF PROBABLE COST TO ADDRESS OFC’S BY PRIORITY**

<table>
<thead>
<tr>
<th>Risk Rating &gt;128</th>
<th>Risk Rating 127 to 65</th>
<th>Risk Rating 64 to 33</th>
<th>Risk Rating &lt;32</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>$35,000</td>
<td>$160,000</td>
<td>$115,000</td>
<td>-</td>
<td>$310,000</td>
</tr>
</tbody>
</table>

**TABLE 4: OPINIONS OF PROBABLE COST TO ADDRESS OFC’S BY CATEGORY**

<table>
<thead>
<tr>
<th>Segment</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Suppression</td>
<td>$45,000</td>
</tr>
<tr>
<td>Electrical, Power, Lights</td>
<td>$90,000</td>
</tr>
<tr>
<td>Mech. (HVAC &amp; Plumbing)</td>
<td>$65,000</td>
</tr>
<tr>
<td>Arch. Finishes and Specialty Equip. (Property Protection)</td>
<td>$110,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$310,000</td>
</tr>
</tbody>
</table>
Taking Action – OFC restraint and upgrades
Taking Action – Masonry / cladding restraint

- Common upgrade for heritage building condos
- If you live in a heritage building work like this is likely already complete (requirement at the time of renovation)

Pre-disaster Assessment complete!

- What’s next?
- Consider incorporating structural information into your emergency preparedness plan.
- How and why could this information help?
Planning for after the earthquake

- **Who will assess your building?**
  - The CRD core municipalities may have hundreds (?) of staff in their Building Departments that are prepared and tasked with the responsibility for rapid damage assessment of buildings.
  - The CRD has thousands of commercial, light industrial, and multi-tenant residential buildings not including houses.
  - This will take some time…
Planning for post-earthquake assessment

- What?
- How?
- How long?
- Who?
What is ATC-20?
Some background... Structural Safety Evaluation

- In 1988 The Applied Technology Council (ATC) brought together the best ideas of affected constituents into a single document.
- The project known as **ATC-20** produced "**Procedures for Post-earthquake Safety Evaluation of Buildings**".
ATC-20 – Levels of Evaluation

- **Rapid Evaluation / Screening**
  - Immediate response activity.
  - 30 minutes +/- to size up the situation by looking for key indicators.

- **Detailed Evaluation**
  - Building that do not readily “pass” rapid screening subject to detailed visual evaluation.
  - 1 to 4 hours with experienced eyes.

- **Engineering Evaluation**
  - At this point you need tools and a calculator!
  - Days or weeks depending on damage state.

https://www.atcouncil.org/atc-20
ATC-20 - When you need to move rapidly...

[Image of ATC-20 Rapid Evaluation Safety Assessment Form]

https://www.atcouncil.org/pdfs/rapid.pdf
ATC-20 - Posting Placards
ATC-20 - Who does the evaluating?

- **Rapid Evaluation/Screening:**
  - Building Engineering Professionals are ideal.
  - Individuals with experience in building construction.
  - Emergency first responders.
  - Anyone nominated by Authority Having Jurisdiction.

- **Detailed and Engineering Evaluations** are assumed to involve building engineering professionals.
Rapid Damage Assessments by Owners?

- With the appropriate training and tools, building owners and managers can self assess their buildings.
- Self assessment does not replace the work of the Authority with Jurisdiction.
- Liability addressed by the Emergency Program Act we believe.
ATC-20 - Customized Complement

- Building specific *Rapid Damage Assessment Guide (RDA)*
- Custom information and forms specific to a building.
- Custom inventory of key building elements, both structural and non-structural.
RDA - Content

- **1.0 First Steps**
  - Sequence of events leading to posting of the building.

- **2.0 Post Earthquake Building Safety Evaluation Form**
  - Formatted form and quick reference drawings.

- **3.0 Building Specific Technical Info**
  - Back up information.
RDA - Reference Plans
RDA - Reference Photographs

POST "UNSAFE" IF BUILDING OR STOREY LEAN NOTICEABLE

CHECK FOR LOOSE OR BROKEN GLASS OR BRICKS THAT COULD AFFECT EXIT/ENTRY SAFETY AT EACH ACCESS DOOR.

POST "AREA UNSAFE" AND USE ALTERNATE ACCESS TO BUILDING IF ENTRY STRUCTURE IS DAMAGED.

GENERAL REVIEW OF EXTERIOR. POST "RESTRICTED USE" IF LOOSE CLADDING OR BROKEN GLASS IS OBSERVED.
RDA - Reference Photographs

- **Typical Painted Concrete Shearwall Inside Stairwell**: Look for cracks and check crack widths.

- **Look for Possible Sliding at Floor Level Construction Joint**: Shearwall inside building stairwell.

- **Concrete Shearwall in Parkade**: Look for cracks and check crack widths.

- **Exposed Shearwall in Parkade**: Shear wall in residential unit.

- **Exposed Shear Wall on Some Balconies (Refer to Floor Plans)**: Look for cracks and check crack widths.

- **Clad Shear Wall**: Look for cracks in drywall as an indication of damage to the shear wall.
RDA - Evaluation Forms / Checklists
RDA - Placards
Will my building be safe? Will my family be OK?

- With assessment and planning, most or all of these factors can be considered.
- Be as prepared as you can be.
Don’t forget... prepare, plan and practice.
Earthquake!

- Remember your plan! Your practice drills! Your training!
  - https://www.crd.bc.ca/prepare-yourself
  - https://www.shakeoutbc.ca/resources/
When the shaking stops...

- Assure safety, evacuate as necessary.
- Implement your plan.
- At some point, someone will assess your building.
- ATC-20 or customized Rapid Screening first level of evaluation.
ATC-20: Rapid Screening

- Condition 1 - Has the building collapsed?

ATC-20: Rapid Screening

- Condition 2 - Building or storey out of plumb?

[Images of damaged buildings]


ATC-20: Rapid Screening

- Condition 3 - Obvious severe damage to primary structure?


ATC-20: Rapid Screening

- Condition 4 - Obvious severe hazards to the public?


ATC-20: Rapid Screening

- Condition 5 - Foundation damage resulting from geotechnical hazard?


ATC-20: Rapid Screening

- Condition 6 – Other hazards that may be present...?

Using the RDA to assist with rapid evaluation
ATC-20: Rapid Screening

- Record observations and post
ATC-20: Rapid Screening Posting
ATC-20: Communicate Results

- Post Disaster Communication and Records – Who has looked at your building and how closely?
- Strategy of the local Authorities Having Jurisdiction is not clear at this time.
- What’s next?

https://www.nap.edu/read/24608/chapter/4#8
ATC-20: Next Steps...

- Structure identified for evaluation
- Rapid Evaluation
  - Post INSPECTED
    - Apparently OK
    - Only building exterior may have been inspected
    - At the discretion of the Building Department
  - Post LIMITED ENTRY RESTRICTED USE
    - Questionable
  - Post UNSAFE
    - Obviously unsafe
- Detailed Evaluation

Creative Thinking Practical Results
ATC-20: Detailed Evaluation...

https://www.nap.edu/read/24608/chapter/4#8
Using the RDA to assist with detailed evaluation
ATC-20: Engineering Evaluation...
Using the RDA for engineering evaluation?
Summary / Takeaways

- Assess
- Plan & Prepare
- Practice
Summary / Takeaways

Assessment + Planning & Preparation + Practice =