Post-Incident Planning
What and How to be Prepared For

“The Big One” – Earthquake Readiness for Stratas

June 24, 2018

Presented by: Terry Bergen, CTech, CCCA, LEED®AP, CPHC

Prepared by: Dennis Gam, M.Eng., P.Eng. & Ryan Hix, M.Eng., P.Eng.

Read Jones Christoffersen Ltd.
Creative Thinking **Practical Results**

Presentation Outline

- Overview of ~~"Incidents"~~ Potential Disasters"
- Seismic Events and Building Performance

1

- Pre-Earthquake Assessments
- Planning and Preparation

2

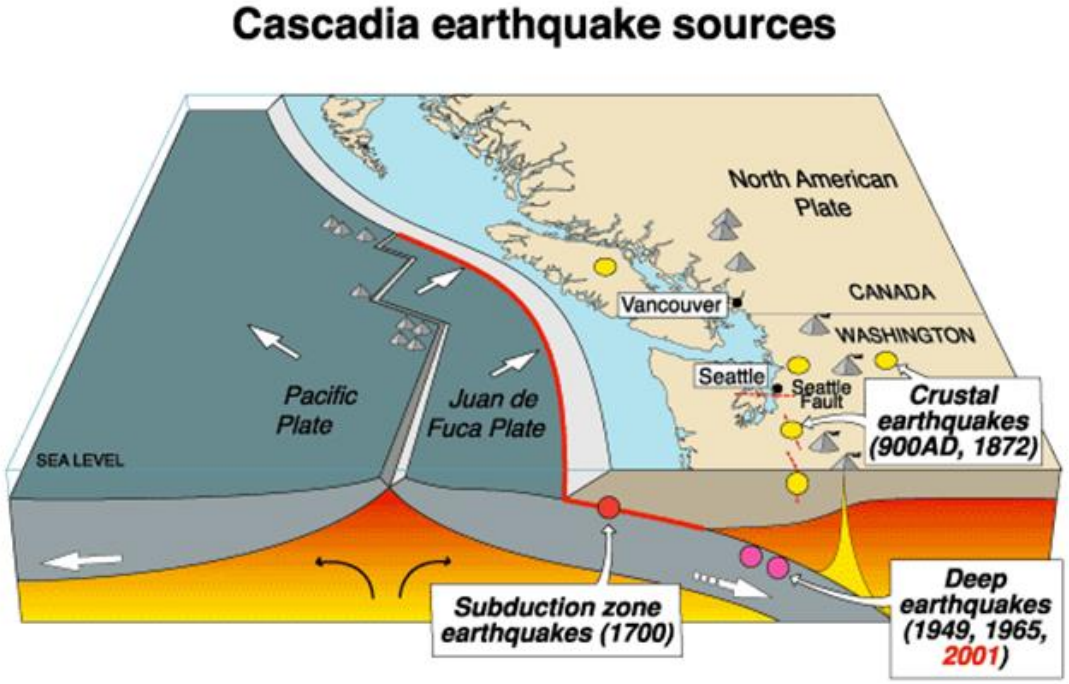
- Post-Earthquake – What Happens?
- Q & A / Discussion

3

What are “potential disasters”?

- Storms
- Floods
- Fires
- Landslides
- Earthquakes

How big is the Big One?



Source	Affected area	Max. Size	Recurrence
Subduction Zone	W.WA, OR, CA	M 9	500-600 yr
Deep Juan de Fuca plate	W.WA, OR,	M 7+	30-50 yr
Crustal faults	WA, OR, CA	M 7+	Hundreds of yr?

- 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?

https://nzhistory.govt.nz/media/photo/dust-clouds-above-christchurch - Accessed Jun 2017

- Some damage will occur

If it happened here today?

http://www.stuff.co.nz/the-press/news/christchurch-earthquake-2011/66404258/Christchurch-quake-survivors-lives-irrevocably-changed - Accessed Jun 2017

https://leelcampbell.files.wordpress.com/2011/02/cashel-st-mall-area1.jpg - Accessed Jun 2017

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.

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

June 24, 2018

Site: 48.4284 N, 123.3656 W User File Reference: Victoria

Requested by: ,

National Building Code ground motions: 2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.05)	Sa(0.1)	**Sa(0.2)**	Sa(0.3)	**Sa(0.5)**	**Sa(1.0)**	**Sa(2.0)**	**Sa(5.0)**	**Sa(10.0)**	**PGA (g)**	**PGV (m/s)**
0.708	1.081	**1.298**	1.299	**1.152**	**0.672**	**0.395**	**0.123**	**0.043**	**0.578**	**0.828**

Notes. Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC 2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are specified in **bold** font. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. ***These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.***

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.05)	0.165	0.370	0.505
Sa(0.1)	0.253	0.570	0.780
Sa(0.2)	0.308	0.691	0.937
Sa(0.3)	0.303	0.689	0.938
Sa(0.5)	0.248	0.594	0.822
Sa(1.0)	0.118	0.312	0.454
Sa(2.0)	0.061	0.171	0.259
Sa(5.0)	0.012	0.038	0.071
Sa(10.0)	0.0040	0.013	0.024
PGA	0.134	0.306	0.418
PGV	0.149	0.393	0.567

References

National Building Code of Canada 2015 NRCC no. 56190;
Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

User's Guide - NBC 2015, Structural Commentaries NRCC no. xxxxxx (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites *www.EarthquakesCanada.ca* and *www.nationalcodes.ca* for more information

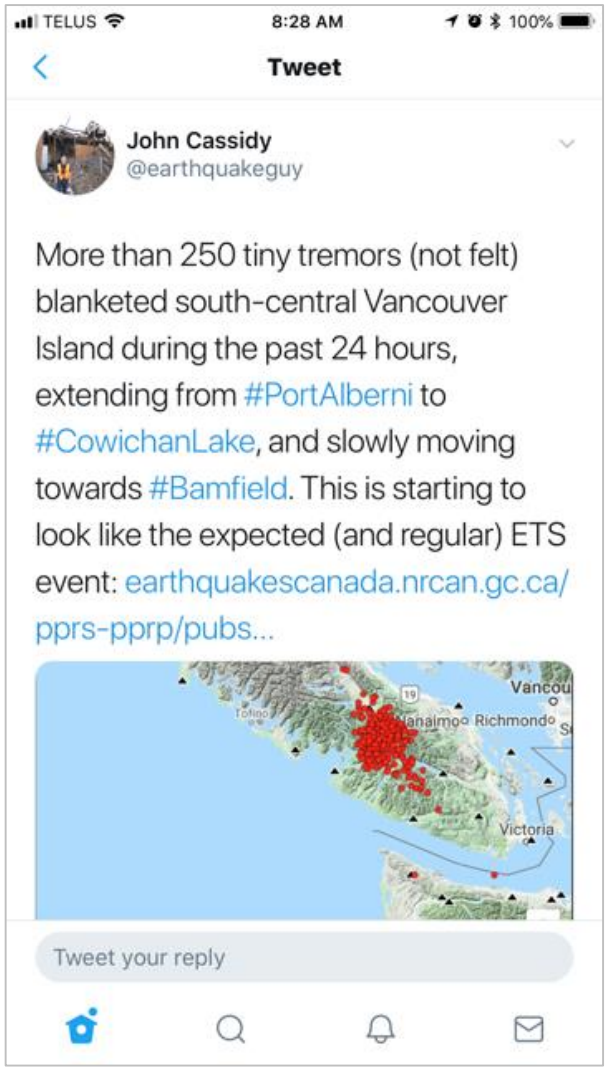
Aussi disponible en français

Natural Resources Canada Ressources naturelles Canada

Canada

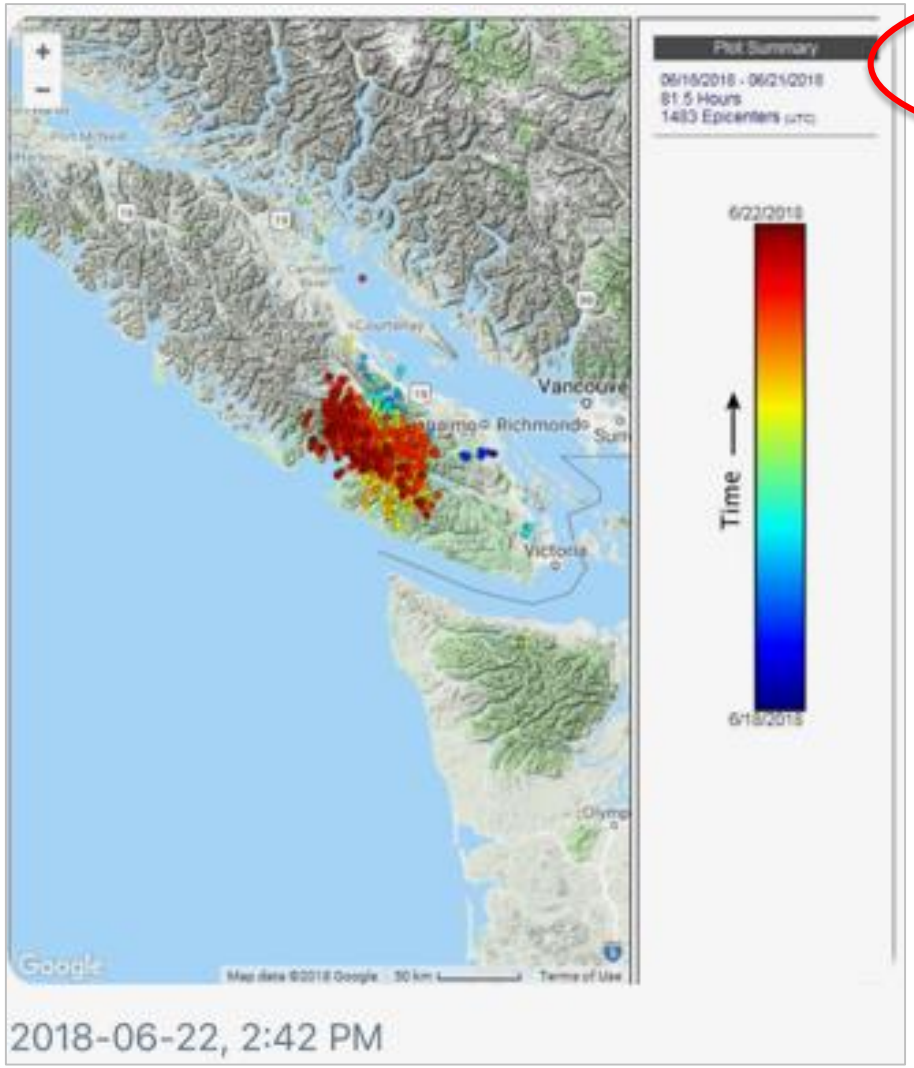
http://www.earthquakescanada.nrcan.gc.ca/recent/index-en.php
http://www.earthquakescanada.nrcan.gc.ca/pprs-pprp/pubs/GF-GI/GEOFACT_ETS_e.pdf

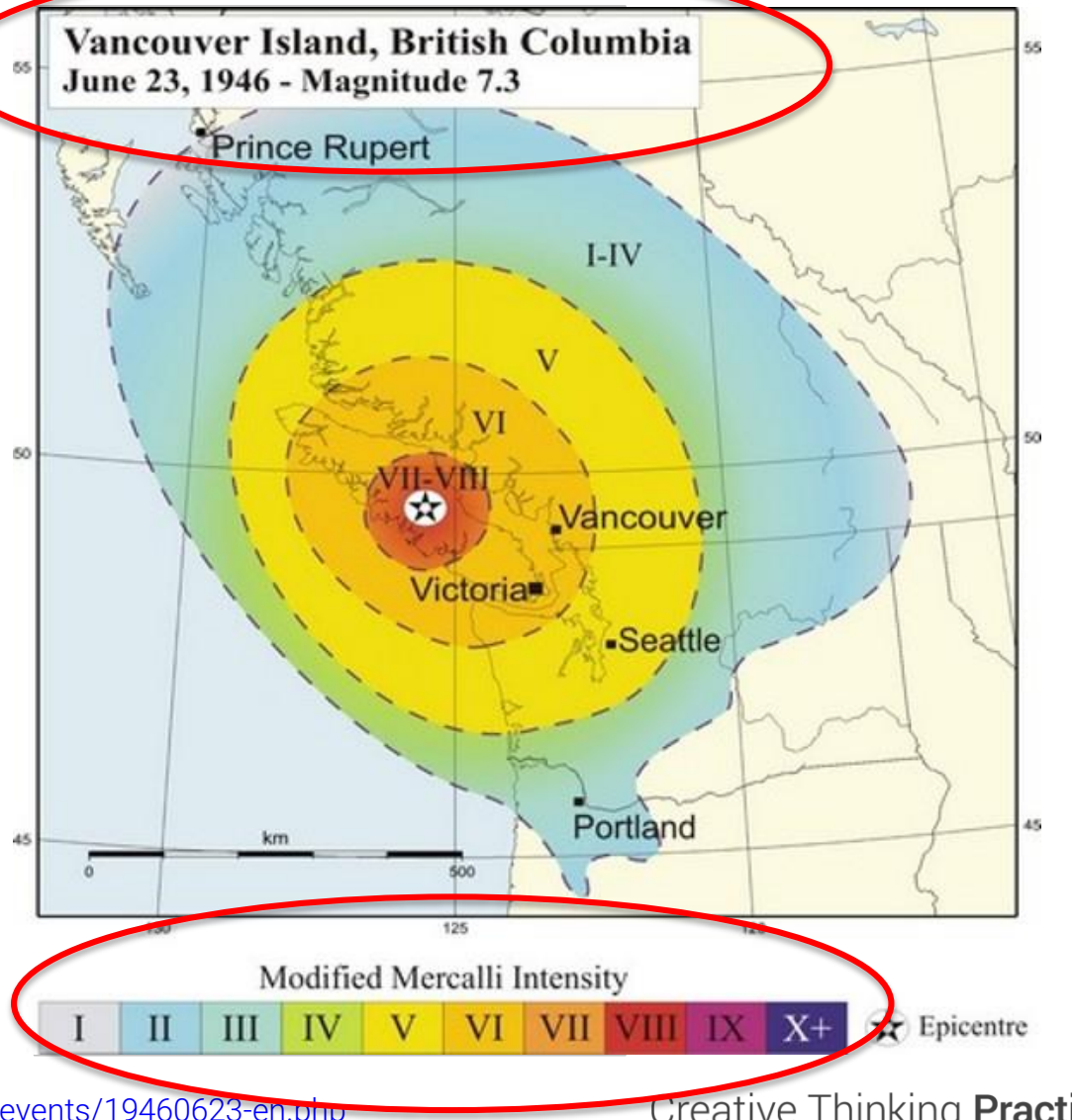
Seismic activity occurs every day



Twitter - @earthquakeguy

Present and past…





http://www.earthquakescanada.nrcan.gc.ca/historic-historique/events/19460623-en.php

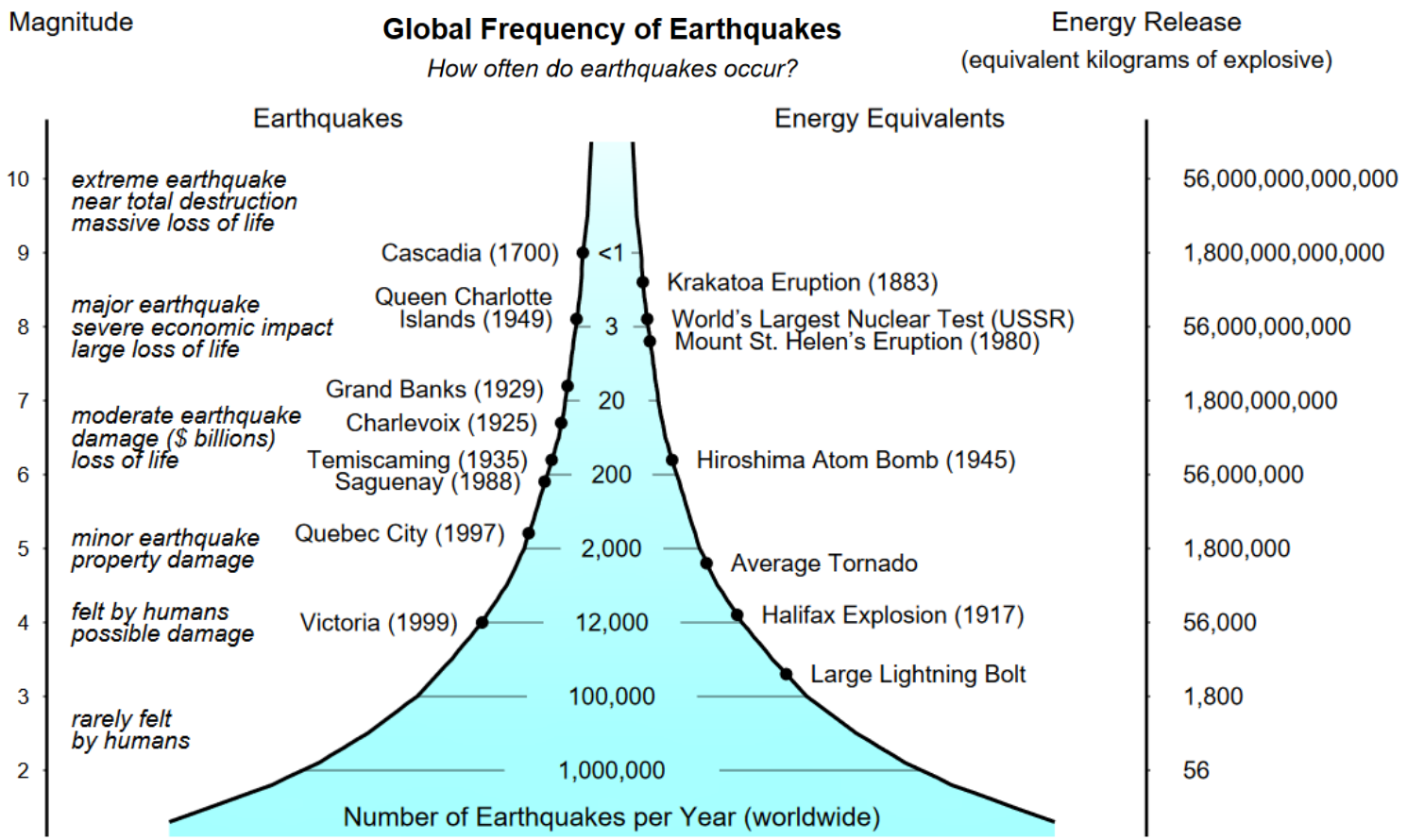
Favourite hard question to structural engineers

- “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.

Leon Plett, P.Eng., MIStructE, Struct.Eng., LEED®AP
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.



Natural Resources Canada Ressources naturelles Canada

Canada

Intensity - The Modified Mercalli (MM) Scale

Intensity	Shaking	Description/Damage
I	Not felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest,especially on upper floors of buildings.
III	Weak	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.
IV	Light	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.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Very strong	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.
VIII	Severe	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.
IX	Violent	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.
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

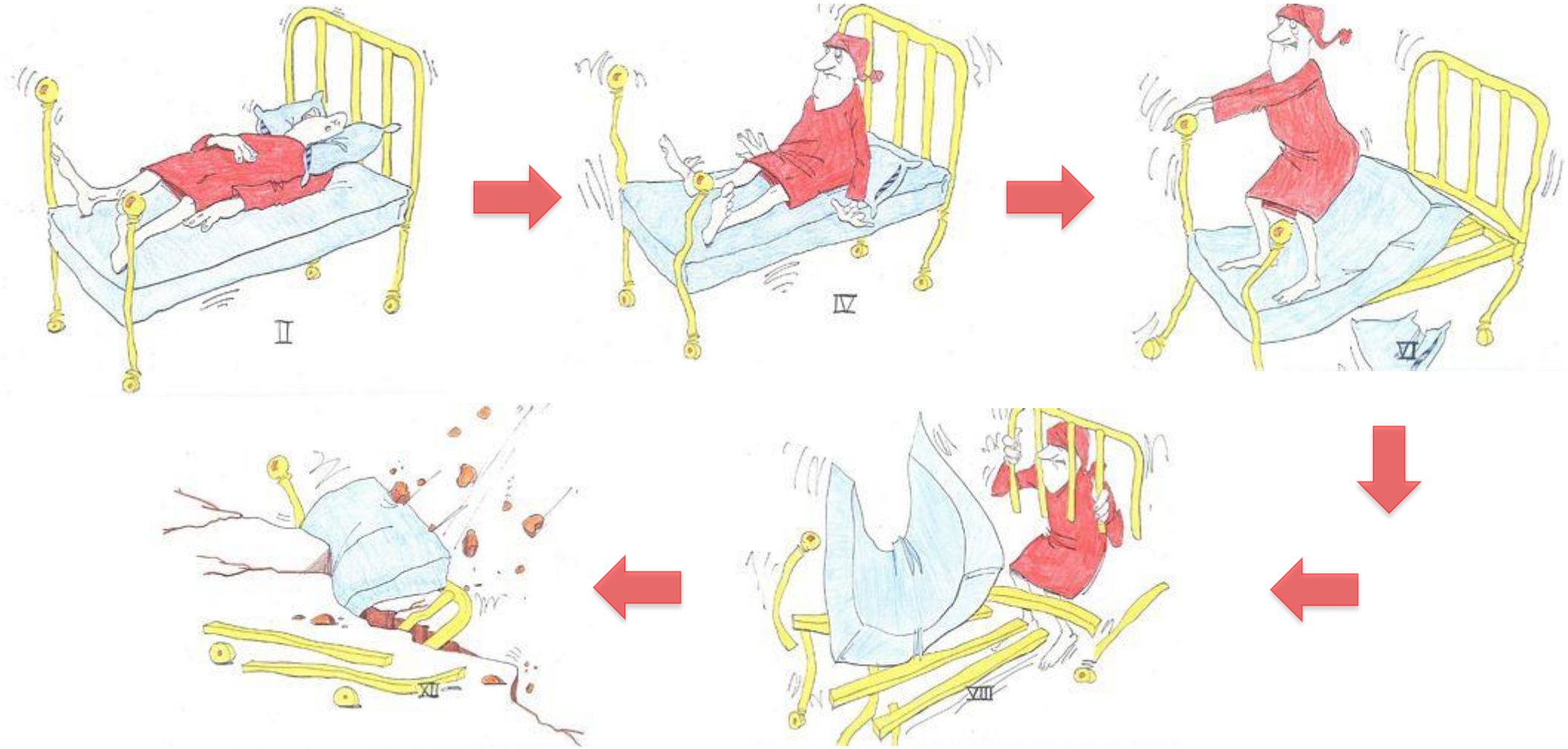
Intensity - The Modified Mercalli (MM) Scale

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.

http://www.earthquakescanada.nrcan.gc.ca/info-gen/scales-echelles/mercalli-en.php

Intensity - The Modified Mercalli (MM) Scale



http://www.earthquakescanada.nrcan.gc.ca/info-gen/scales-echelles/mercalli-en.php

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

- Building performance and safety is affected by many factors.
- Many of theses factors are in your control.
- Both pre- and post-disaster.

Who will be there to help?

Assessing building performance

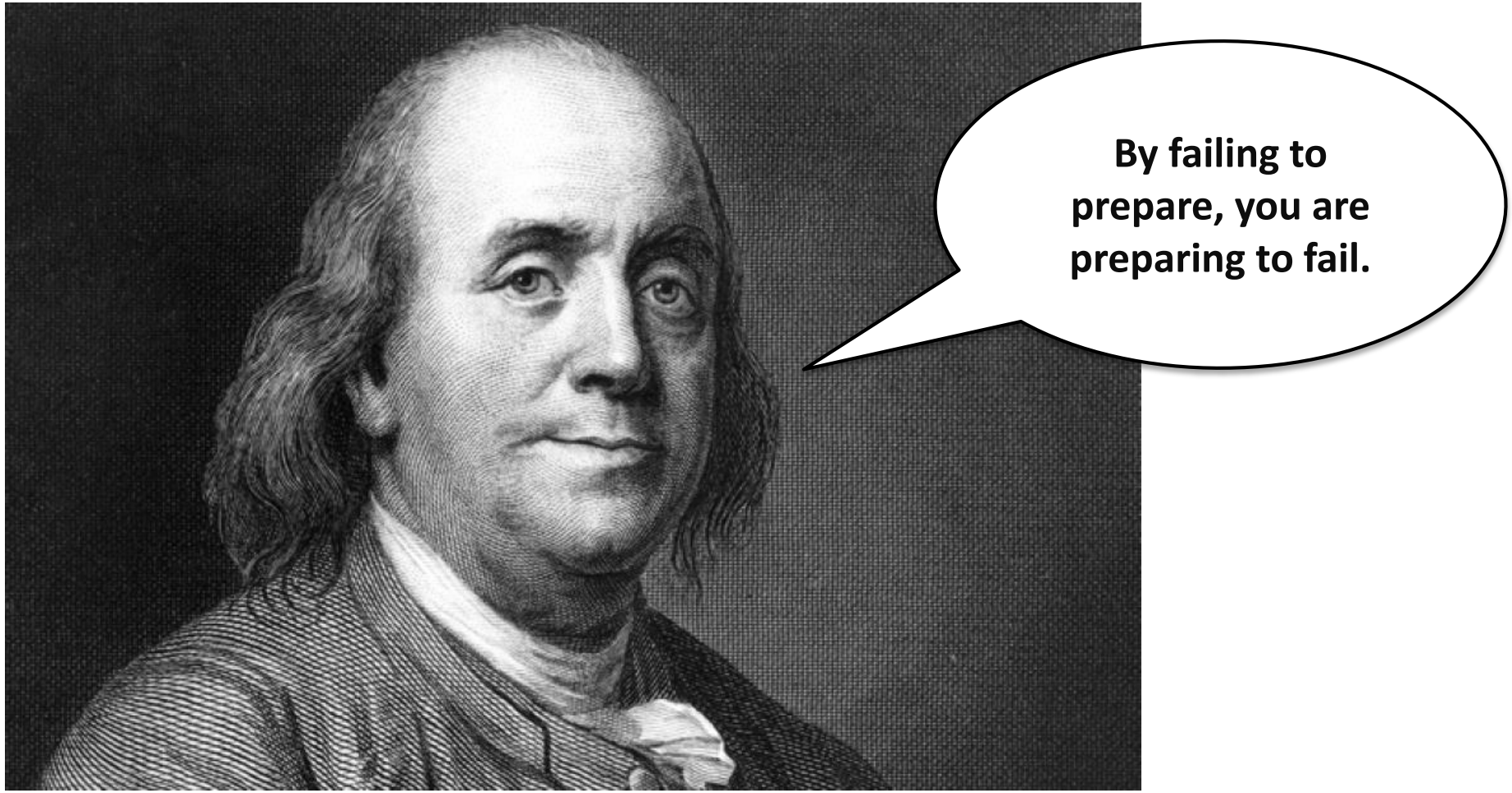
- What might visible damage mean?
- Is your building safe for continued occupancy?

http://nsmp.wr.usgs.gov/data_sets/20010228_1/images/Seattle - Accessed Jan 2011

http://www.eqclearinghouse.org/2011-02-22-christchurch/ - Accessed Feb 2015

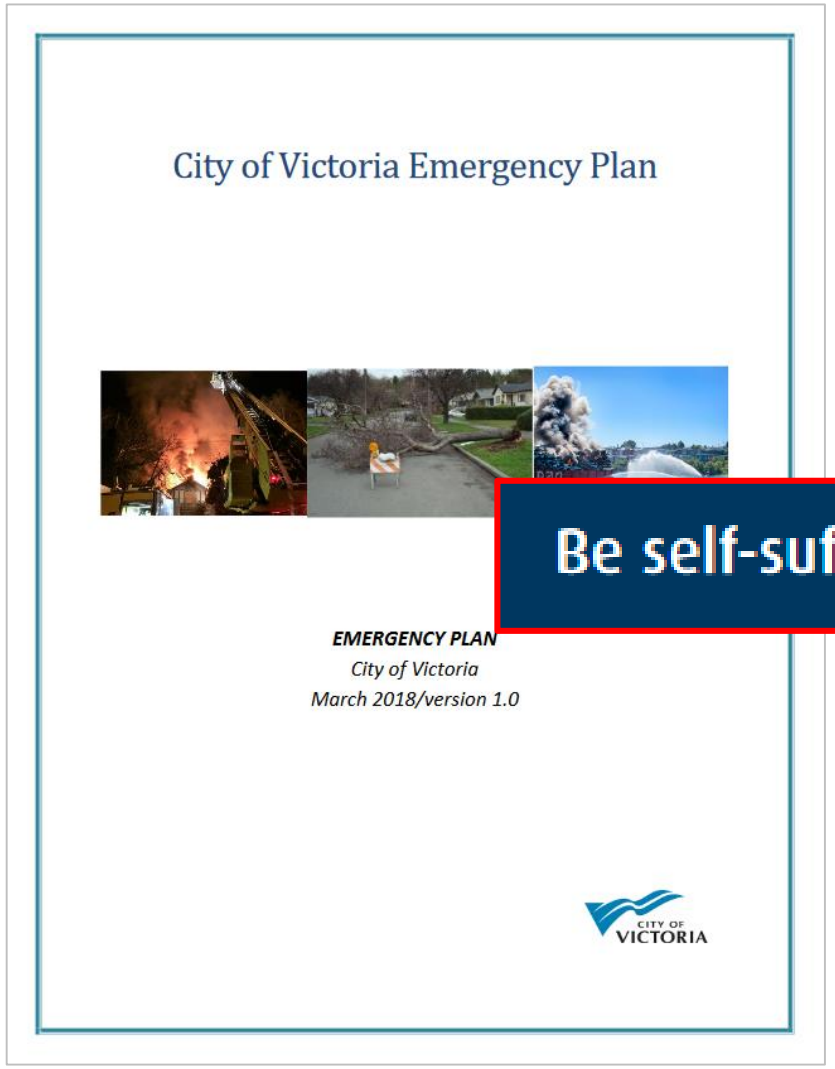
“Break”

Taking Action – **Prepare and Plan**



Benjamin Franklin - Smart guy

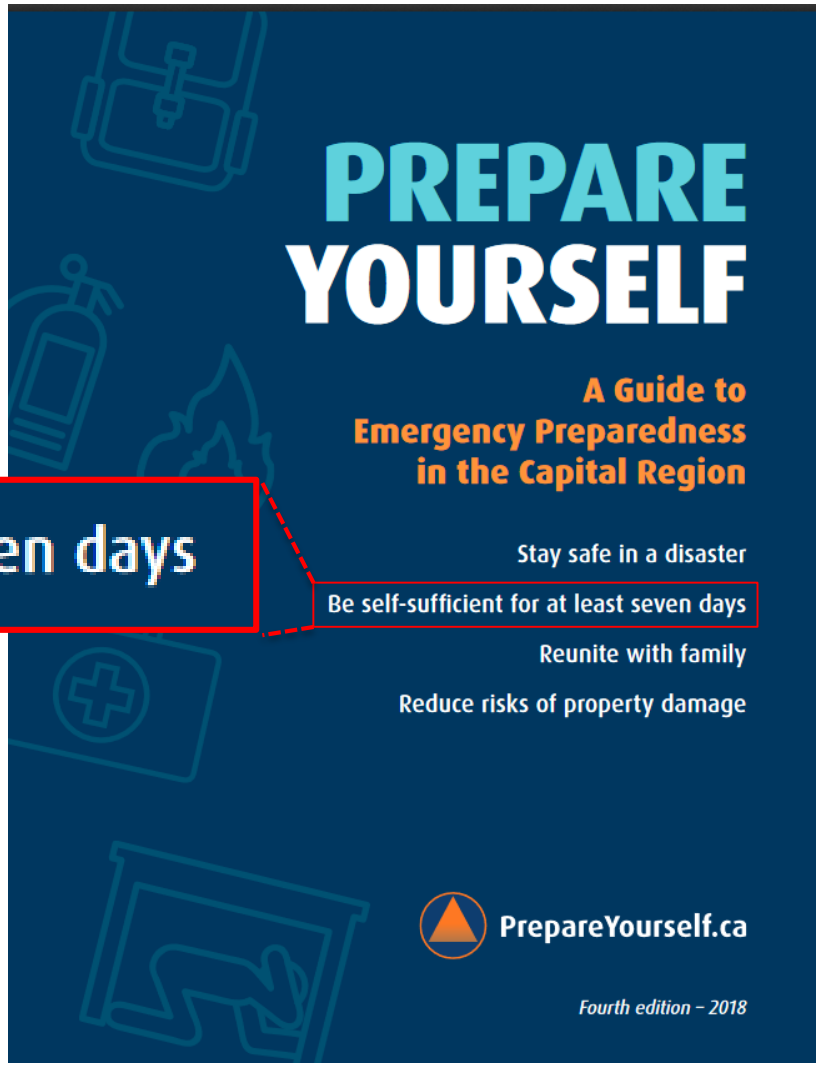
Many resources to assist with planning



VictoriaReady
Community Powered Emergency Preparedness

Be self-sufficient for at least seven days

GetMyKit.ca



Seismic Upgrades?

Optimize your preparedness!

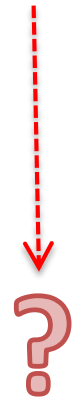
- **Create manuals, review manuals, practice manuals**
- Evacuation and response planning – who goes where and does what?
- Emergency supplies and kit – you're likely to be on your own for a while – is 72 hours (or even 7 days) enough?
- **Assess your building** – do you know what to look for before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



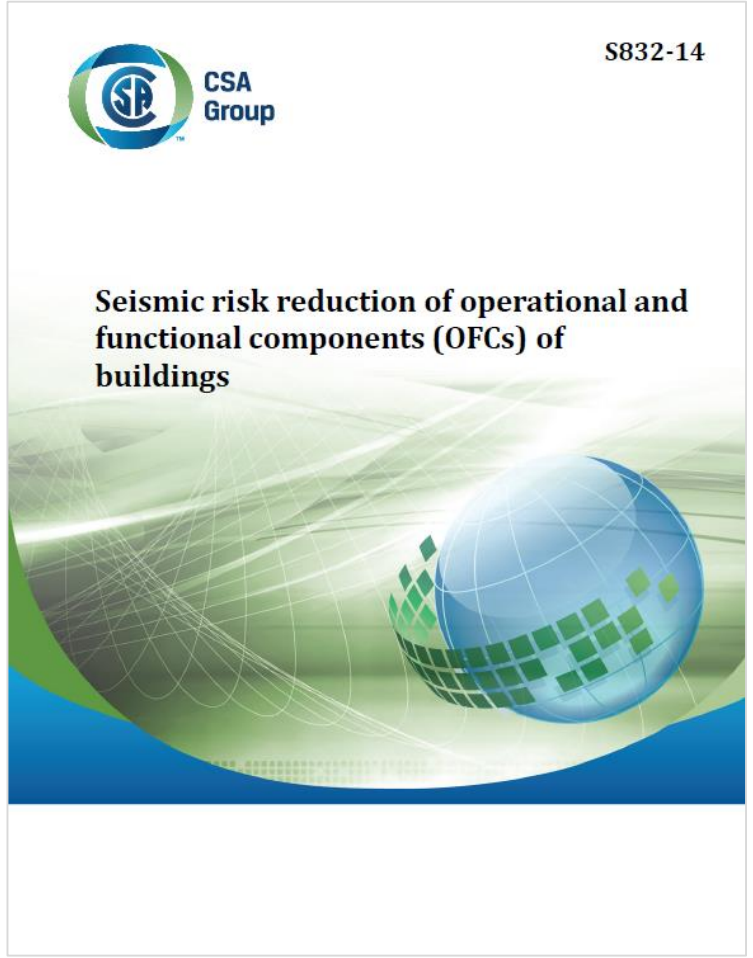
Base structure and cladding are important

- Base-building structural condition is important.
- Claddings are very important too.
- Assess for allowable safe egress.

Non-structural / OFC – CSA S832-14

- **Seismic risk reduction of operational and functional components (OFCs) of buildings**

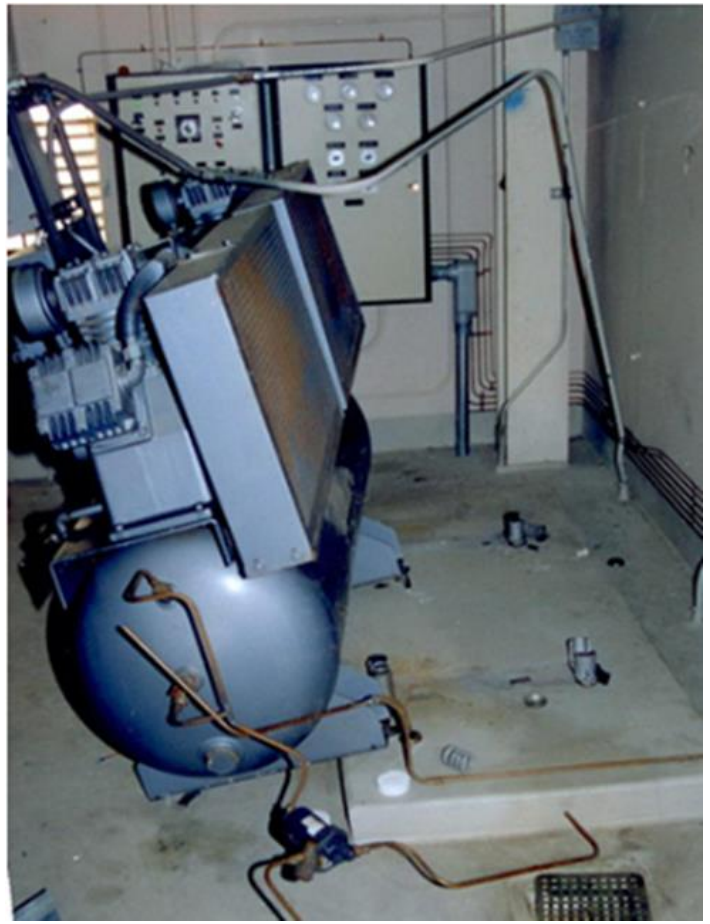
"Earthquakes pose a serious threat to safety and have rendered many buildings unusable due to extensive damage to their operational and functional components (OFCs). In fact, the main cause of casualties and property damage in the event of an earthquake is often the failure of these OFCs. In many cases, 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

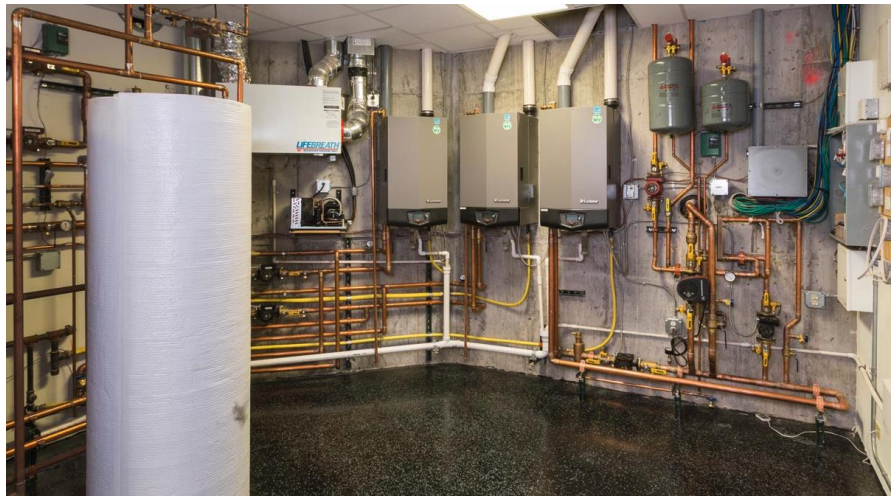
- Catch the “easy” stuff. OFC and non-structural restraints. Low dollar investments for potentially high returns in life and safety.
- An earthquake that doesn’t cause structural damage could still result in an uninhabitable building.



OFC and Non-structural components matter

http://www.fema.gov/plan/prevent/earthquake/fema74/index.shtm - accessed Feb 2011

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

RJC Project Name:
RJC Project No.:
Survey Dates:

Ground Characteristics Index, VG = 0.75 F_a = 1.00
Building Characteristics Index, VB = 1.30 $S_a(0.2)$ = 0.94

				Vulnerability Score						Consequence Score							
Component Number	OFC Description	Quantity	Objective / OFC Performance	Restraint (4/20/40) (RS1 x WF1)	Impact (3/30) (RS2 x WF2)	Overturning (2/20) (RS3 x WF3)	Flexibility and Location (1/5/10) (RS4 x WF4)	OFC Characteristics Index VE Σ(RS x WF)	OFC Seismic Vulnerability Index, V (VG x VB x VE)/10	Life Safety (1,5,10) (RS)	Functionality (0/1/3/5/10) (RS)	Property Protection (0-10) (RS)	OFC Consequence Index, C Σ(RS)	OFC Seismic Risk Index, R (V x C)	Seismic Risk Level	Mitigation Recommended?	Site Observations
1.00	**Main Roof**																
1.03	Pipes - Large Diameter	1	LF	40	30	20	10	100	9.78	5	1	0	6	59	M	Yes	
1.07	Duct - Vertical	1	LF	20	30	20	10	80	7.82	5	1	0	6	47	M	Yes	Only 3 cable braces at top of duct
1.01	Transformers	2	FF	4	3	2	10	19	1.86	5	10	0	15	28	L	No	
1.08	Satellite	4	PP	4	3	2	10	19	1.86	5	0	10	15	28	L	No	
1.02	Cooling Towers	2	LF	4	3	2	10	19	1.86	5	1	0	6	12	N	No	
1.04	AC units	2	LF	4	3	2	10	19	1.86	5	1	0	6	12	N	No	
1.05	Exhaust Fan	1	LF	4	3	2	10	19	1.86	5	1	0	6	12	N	No	
1.06	Duct - Floor Mounted	1	LF	4	3	2	10	19	1.86	5	1	0	6	12	N	No	
2.00	**Penthouse - Women's Washroom Fan Room**																
2.08	Fire Extinguisher	1	FF	40	30	2	10	82	8.02	1	10	0	11	89	H	Yes	
2.02	Lights - Suspended	3	LF	40	30	2	10	82	8.02	1	3	0	4	33	M	Yes	
2.03	Sprinkler - Distribution	1	FF	4	3	2	10	19	1.86	1	10	0	11	21	L	No	
2.04	Panel	1	FF	4	3	2	10	19	1.86	1	10	0	11	21	L	No	
2.06	Server Cabinet	1	FF	4	3	2	10	19	1.86	1	10	0	11	21	L	No	
2.01	Exhaust Fan	1	LF	4	3	2	10	19	1.86	1	1	0	2	4	N	No	

1

Component Number	Photo	OFC Description
5.03		Pumps - Floor Mounted
5.04		Compressor
5.05		Expansion Tank - Large
5.06		Expansion Tank - Suspended
5.07		Pipes - Medium Diameter
5.08		Lights - Suspended
5.09		Inline Pump

Reporting – Dollars and sense?

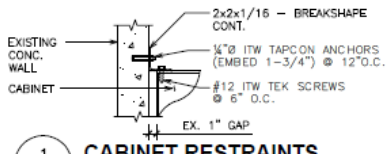
TABLE 2: SUMMARY OF OFC ITEMS BY RISK RATINGS		
Priority	**Risk Rating**	**Number of Items**
Very High	> 128	7
High	127 to 65	71
Moderate	64 to 33	49
Low/Negligible	≤ 32	402

TABLE 3: OPINIONS OF PROBABLE COST TO ADDRESS OFC'S BY PRIORITY				
Risk Rating >128	**Risk Rating 127 to 65**	**Risk Rating 64 to 33**	**Risk Rating <32**	**TOTAL**
$35,000	$160,000	$115,000	-	$310,000

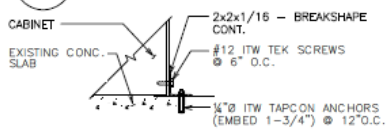
Example for large mixed-use residential/ commercial complex

TABLE 4: OPINIONS OF PROBABLE COST TO ADDRESS OFC'S BY CATEGORY				
Fire Suppression	**Electrical, Power, Lights**	**Mech. (HVAC & Plumbing)**	**Arch. Finishes and Specialty Equip. (Property Protection)**	**TOTAL**
$45,000	$90,000	$65,000	$110,000	$310,000

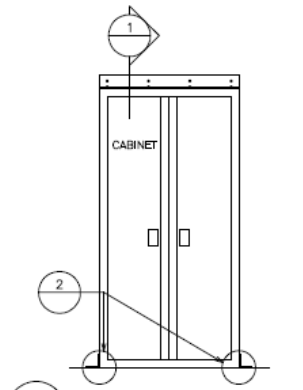
Taking Action – OFC restraint and upgrades



1 **CABINET RESTRAINTS**
1" = 1'=0"



2 **CABINET RESTRAINTS**
1" = 1'=0"



3 **CABINET ELEVATION**
1/2" = 1'=0"

rjc Engineers

Project Name
Sketch Title **CABINET RESTRAINT**
Dwg. Ref. N/A
Scale N.T.S
Date
Project No.
Sketch Number **SR-8.1.14**
Rev.

NOTE:
FRAMING SHOWN IN THIS SKETCH IS INTENDED FOR THE BACKSIDE OF THE FIRE PUMP CONTROL PANELS.

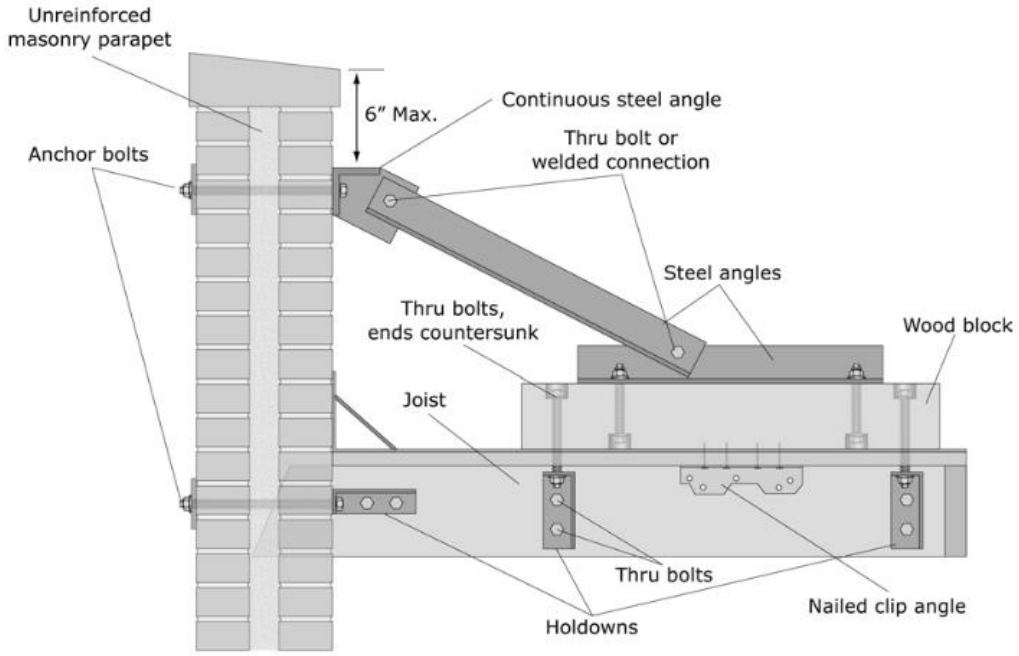
rjc Engineers

Project Name
Sketch Title **ITEM 66.02 - FIRE PUMP CONTROL PANELS**
Dwg. Ref. N/A
Scale N.T.S
Date
Project No.
Sketch Number **SR-8.2**
Rev.

rjc Engineers

Project Name
Sketch Title **FAN ROOM - SUSPENDED TRANSFORMER**
Dwg. Ref. N/A
Scale N.T.S
Date
Project No.
Sketch Number **SR-8.3**
Rev.

Taking Action – Masonry / cladding restraint



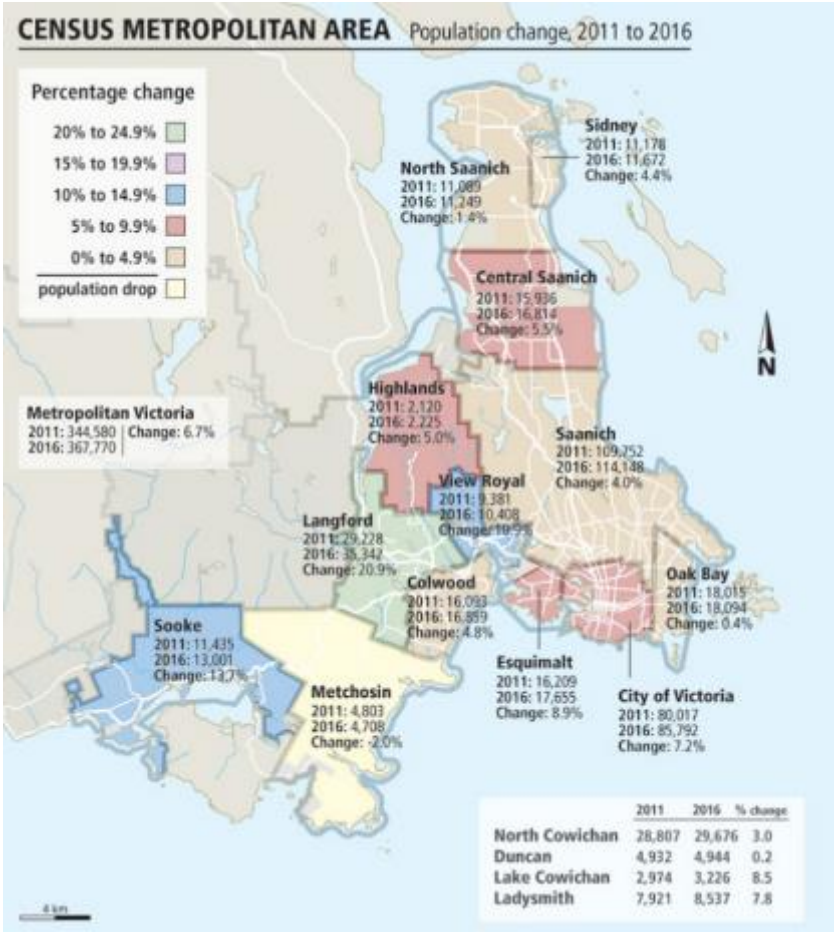
https://www.fema.gov/sites/default/files/orig/plan/prevent/earthquake/fema74/pdf/chapter6_3_5/chapter6_3_5_1.pdf - Accessed Jun 2017

- 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

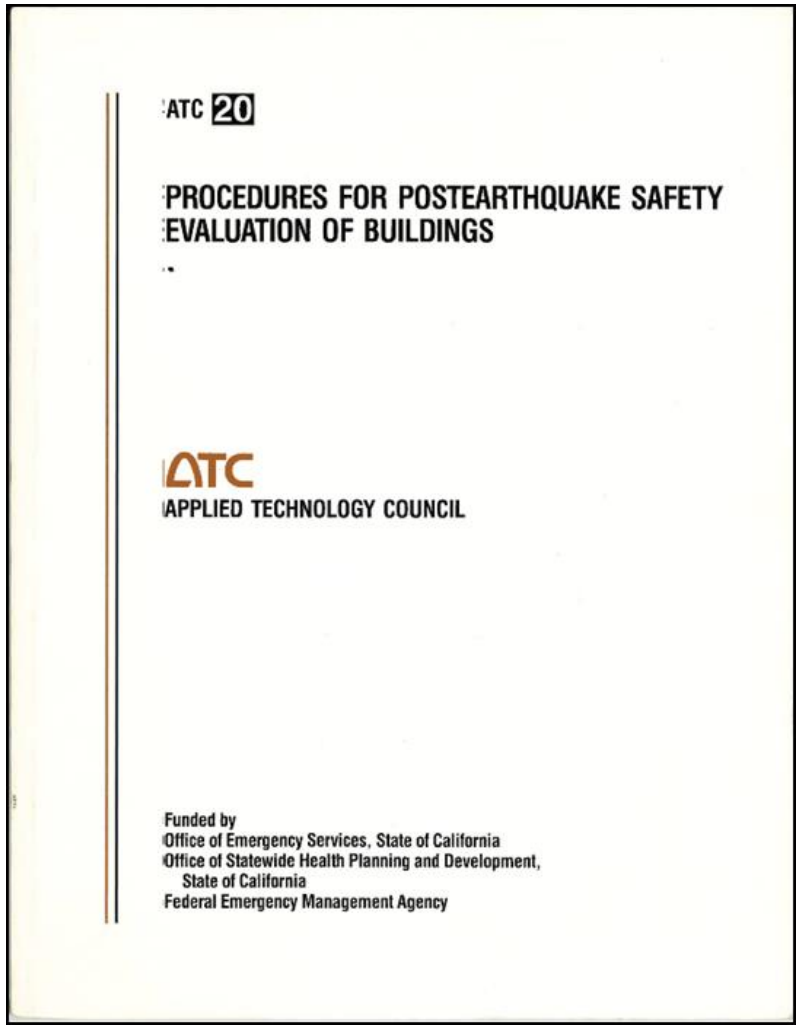


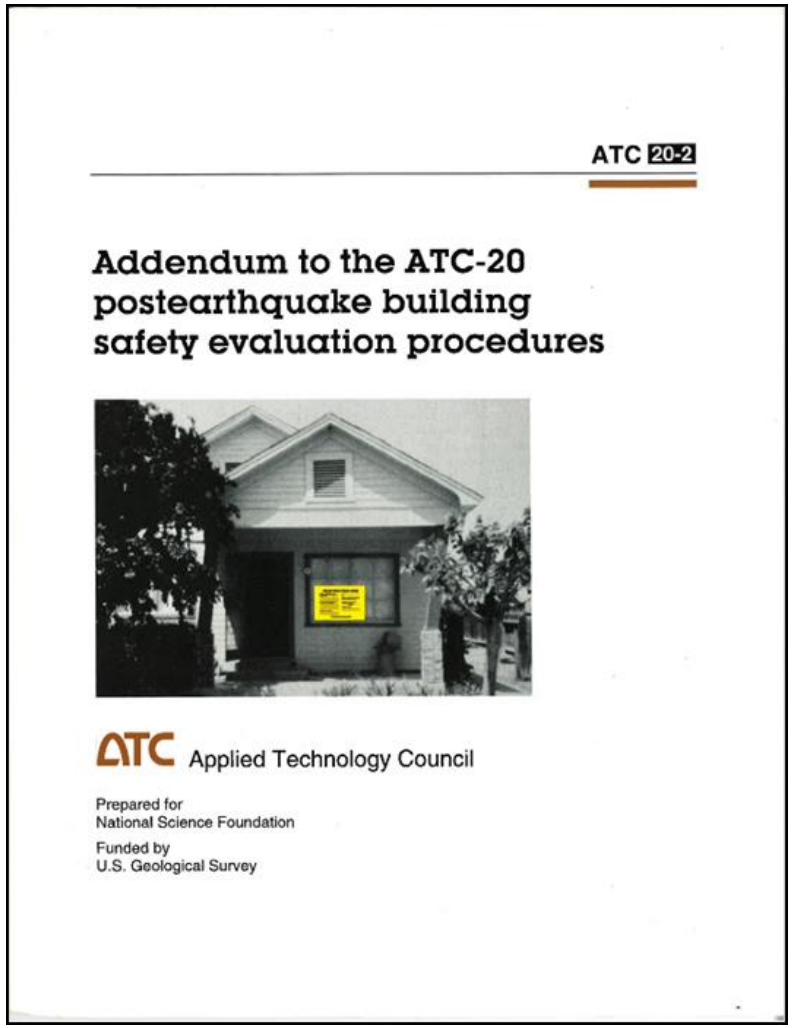
- **Who will assess your building?**
  - The CRD core municipalities may have hundreds (?) of staff in their Building Departments that are prepared and tasked with the responsibility for rapid damage assessment of buildings.
  - The CRD has thousands of commercial, light industrial, and multi-tenant residential buildings not including houses.
  - EGBC / SEABC? – Willing volunteers pending willing to help. Implementation still a question.
  - This will take some time…

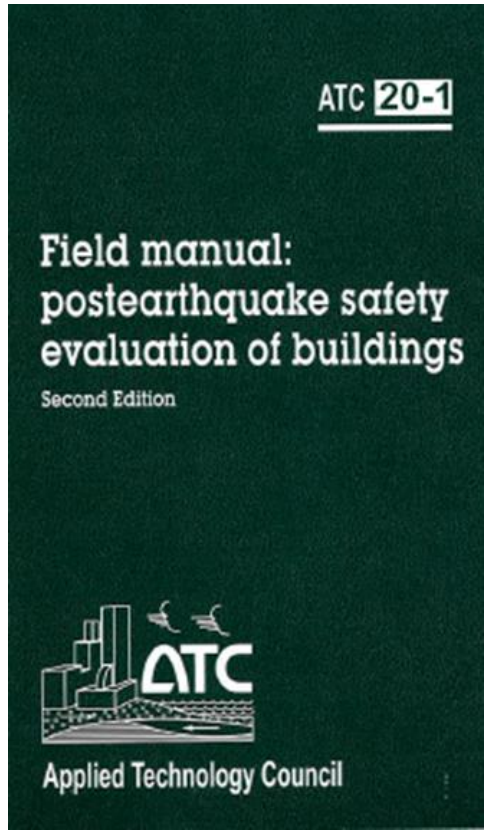
Planning for post-earthquake assessment

- What?
- How?
- How long?
- Who?

What is ATC-20?







Some background… Structural Safety Evaluation

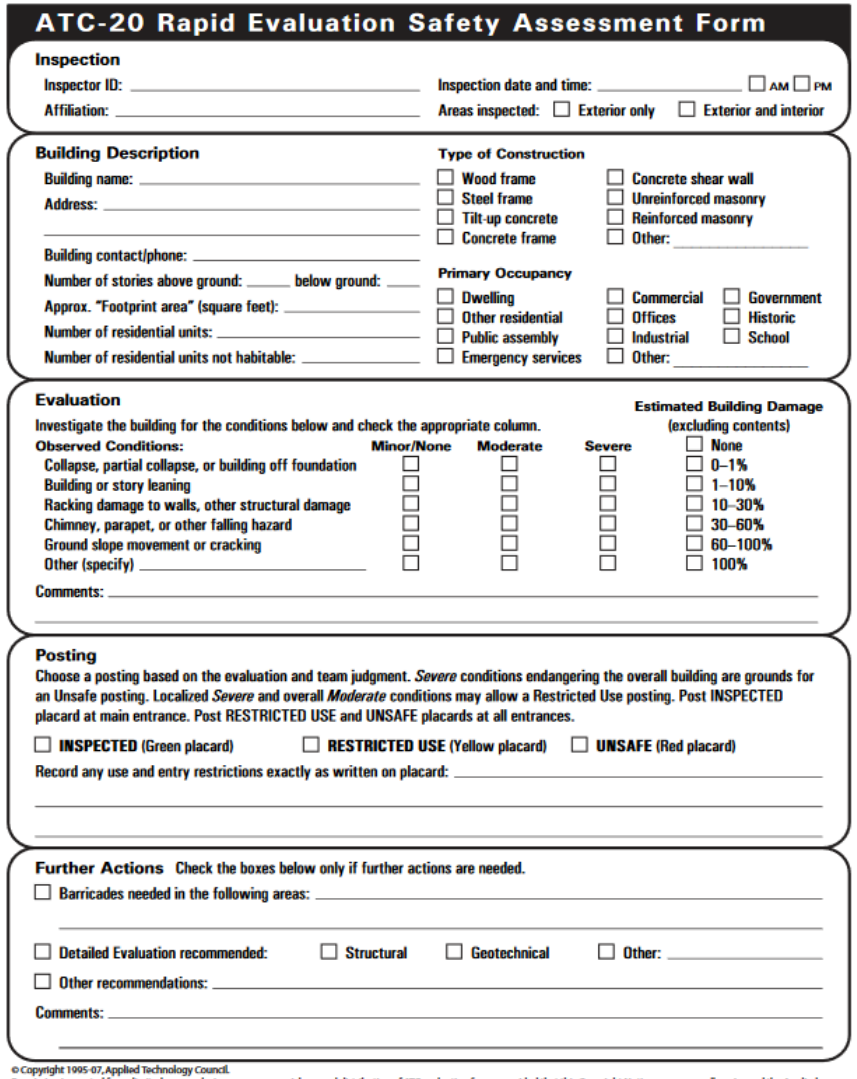
- In 1988 The Applied Technology Council (ATC) brought together the best ideas of affected constituents into a single document.
- The project known as ***ATC-20*** produced ***"Procedures for Post-earthquake Safety Evaluation of Buildings"***.

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…



ATC-20 Rapid Evaluation Safety Assessment Form

Inspection

Inspector ID: _____ Inspection date and time: _____ ☐ AM ☐ PM

Affiliation: _____ Areas inspected: ☐ Exterior only ☐ Exterior and interior

Building Description

Building name: _____

Address: _____

_____

Building contact/phone: _____

Number of stories above ground: _____ below ground: _____

Approx. "Footprint area" (square feet): _____

Number of residential units: _____

Number of residential units not habitable: _____

Type of Construction

☐ Wood frame ☐ Concrete shear wall

☐ Steel frame ☐ Unreinforced masonry

☐ Tilt-up concrete ☐ Reinforced masonry

☐ Concrete frame ☐ Other: _____

Primary Occupancy

☐ Dwelling ☐ Commercial ☐ Government

☐ Other residential ☐ Offices ☐ Historic

☐ Public assembly ☐ Industrial ☐ School

☐ Emergency services ☐ Other: _____

Evaluation

Investigate the building for the conditions below and check the appropriate column.

Observed Conditions:	Minor/None	Moderate	Severe
Collapse, partial collapse, or building off foundation	☐	☐	☐
Building or story leaning	☐	☐	☐
Racking damage to walls, other structural damage	☐	☐	☐
Chimney, parapet, or other falling hazard	☐	☐	☐
Ground slope movement or cracking	☐	☐	☐
Other (specify) _____	☐	☐	☐

Estimated Building Damage (excluding contents)

☐ None

☐ 0–1%

☐ 1–10%

☐ 10–30%

☐ 30–60%

☐ 60–100%

☐ 100%

Comments: _____

_____

Posting

Choose a posting based on the evaluation and team judgment. *Severe* conditions endangering the overall building are grounds for an Unsafe posting. Localized *Severe* and overall *Moderate* conditions may allow a Restricted Use posting. Post INSPECTED placard at main entrance. Post RESTRICTED USE and UNSAFE placards at all entrances.

☐ **INSPECTED** (Green placard) ☐ **RESTRICTED USE** (Yellow placard) ☐ **UNSAFE** (Red placard)

Record any use and entry restrictions exactly as written on placard: _____

_____

_____

Further Actions Check the boxes below only if further actions are needed.

☐ Barricades needed in the following areas: _____

_____

☐ Detailed Evaluation recommended: ☐ Structural ☐ Geotechnical ☐ Other: _____

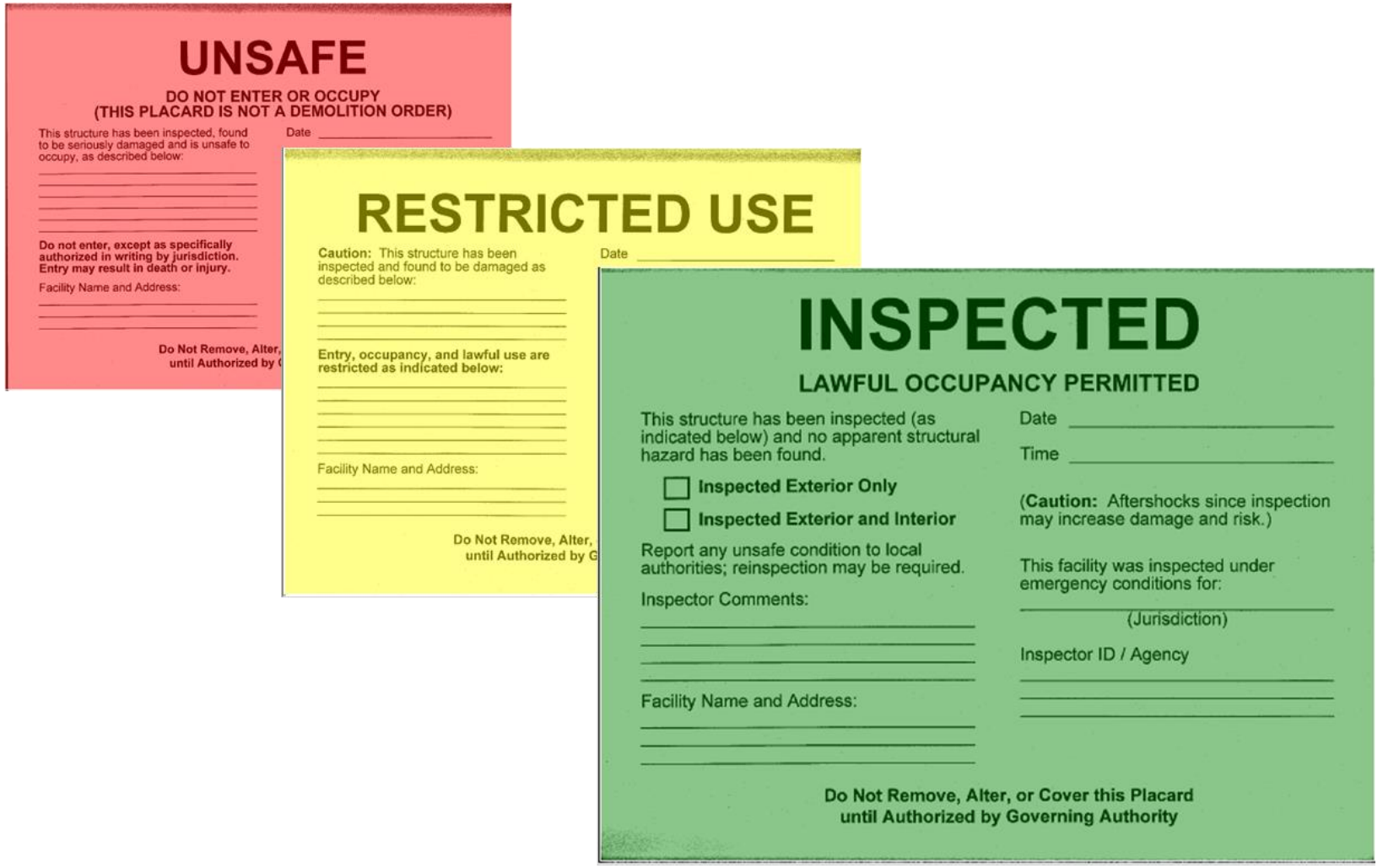
☐ Other recommendations: _____

Comments: _____

_____

https://www.atcouncil.org/pdfs/rapid.pd

ATC-20 - Posting Placards



UNSAFE

DO NOT ENTER OR OCCUPY
(THIS PLACARD IS NOT A DEMOLITION ORDER)

This structure has been inspected, found to be seriously damaged and is unsafe to occupy, as described below:

Date _____

Do not enter, except as specifically authorized in writing by jurisdiction. Entry may result in death or injury.

Facility Name and Address:

Do Not Remove, Alter, until Authorized by

RESTRICTED USE

Caution: This structure has been inspected and found to be damaged as described below:

Date _____

Entry, occupancy, and lawful use are restricted as indicated below:

Facility Name and Address:

Do Not Remove, Alter, until Authorized by G

INSPECTED

LAWFUL OCCUPANCY PERMITTED

This structure has been inspected (as indicated below) and no apparent structural hazard has been found.

Date _____

Time _____

☐ **Inspected Exterior Only**

☐ **Inspected Exterior and Interior**

(**Caution:** Aftershocks since inspection may increase damage and risk.)

Report any unsafe condition to local authorities; reinspection may be required.

This facility was inspected under emergency conditions for:

_____
(Jurisdiction)

Inspector Comments:

Inspector ID / Agency

Facility Name and Address:

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

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.

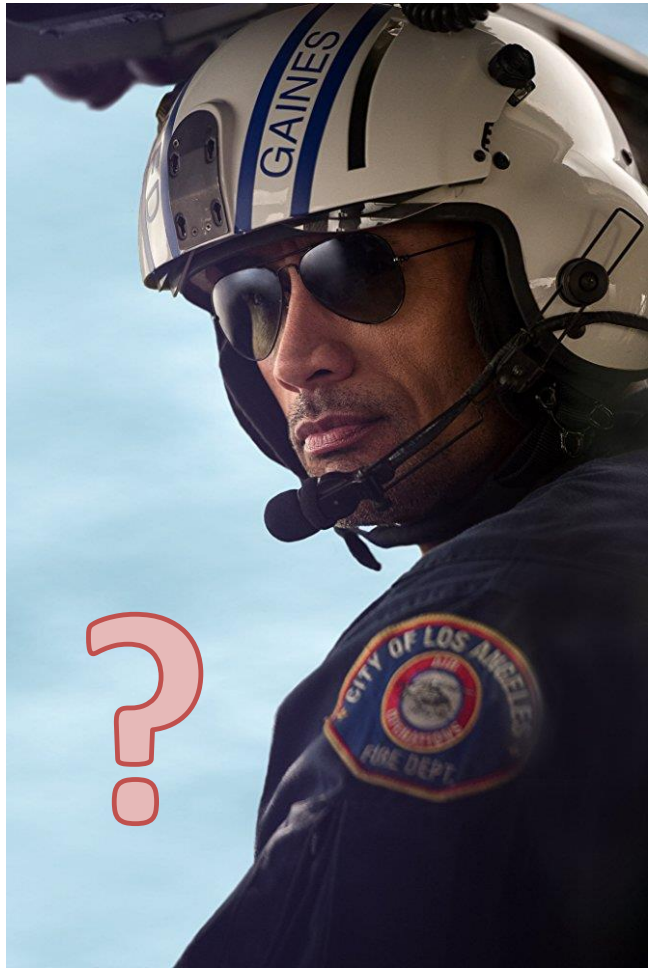


Image © Warner Bros.

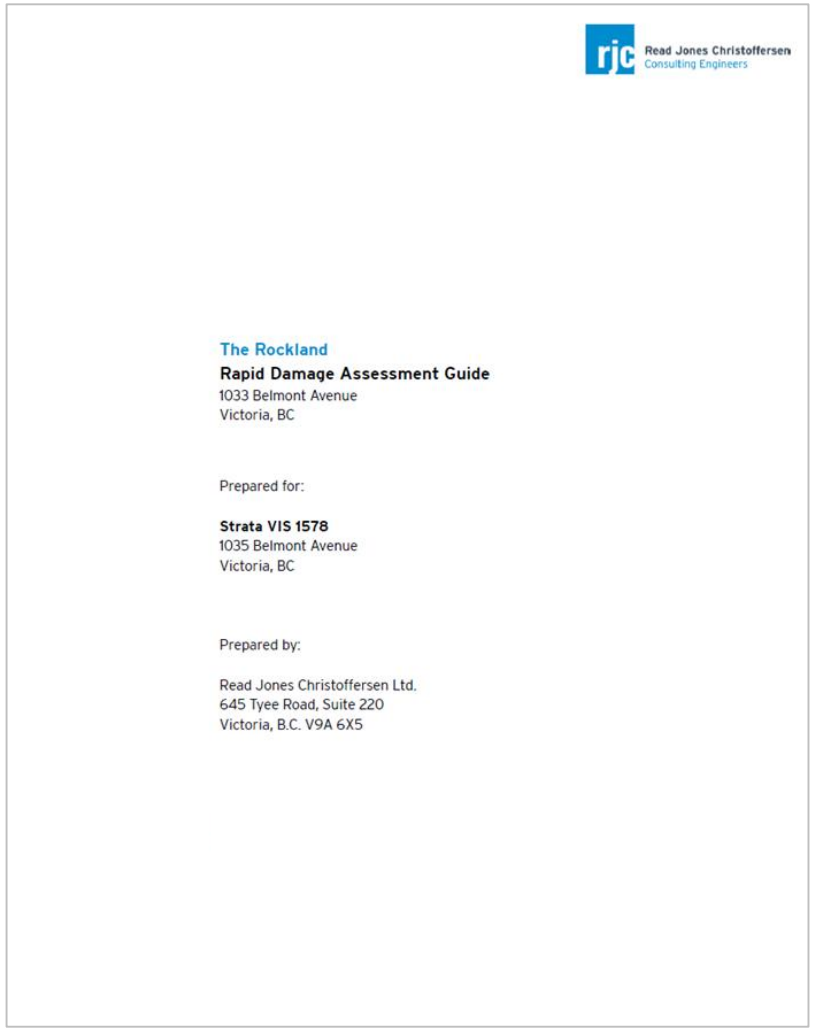
Rapid Damage Assessments by Owners?

FEMA – News photo

- 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

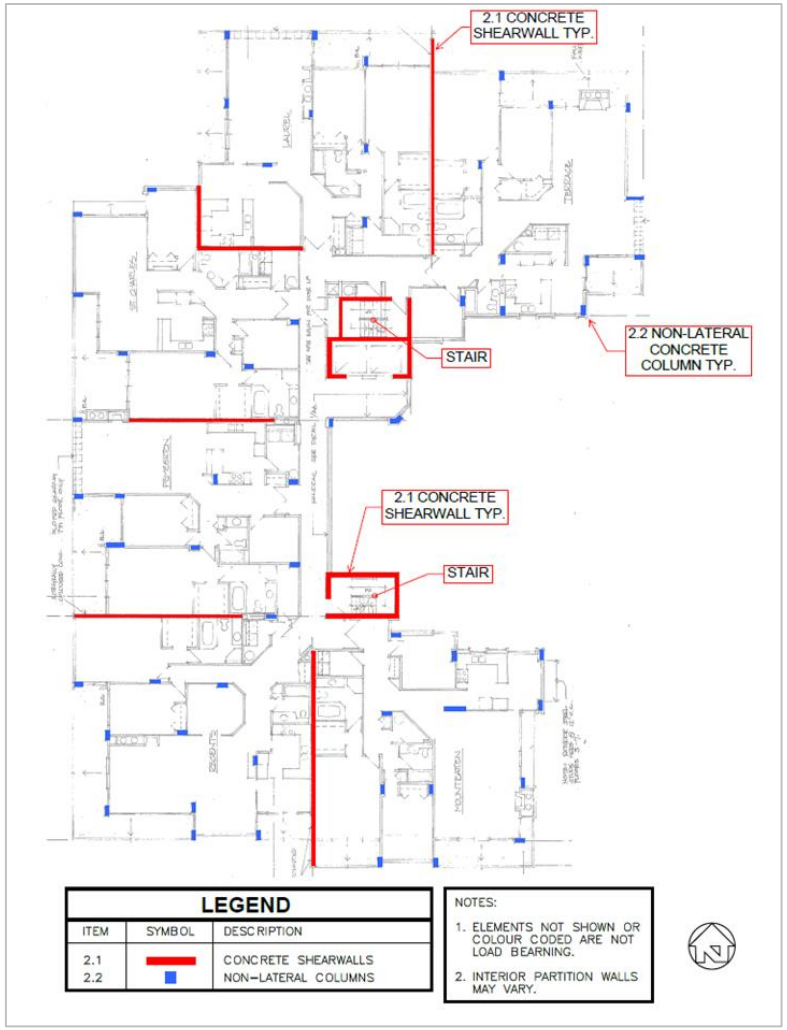
- 1.0 First Steps
  - Sequence of events leading to posting of the building.
- 2.0 Post Earthquake Building Safety Evaluation Form
  - Formatted form and quick reference drawings.
- 3.0 Building Specific Technical Info
  - Back up information.

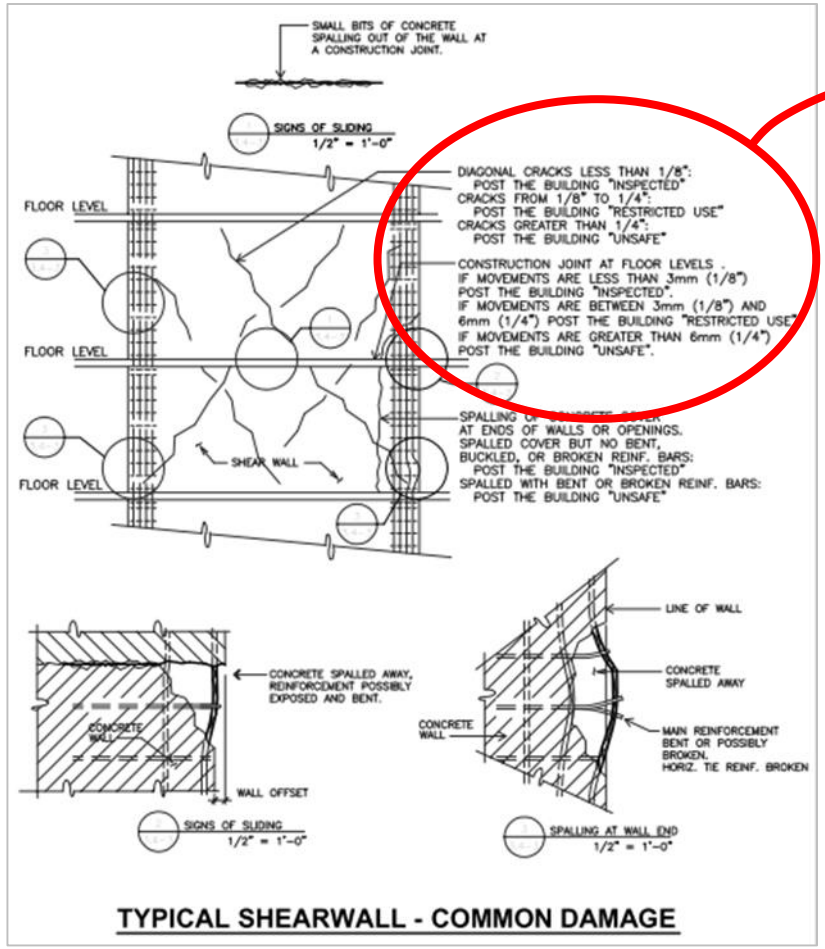
The Rockland
Rapid Damage Assessment Guide 1033 Belmont Avenue

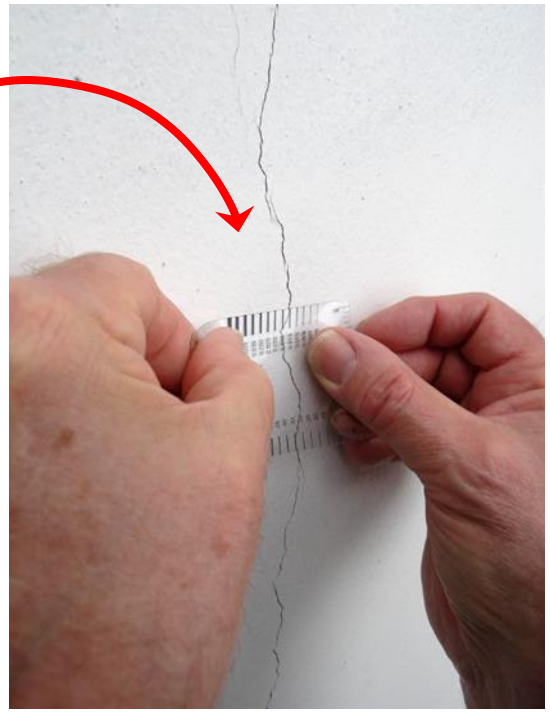
October 02, 2015
RJC No.:VIC.022098.0008

TABLE OF CONTENTS

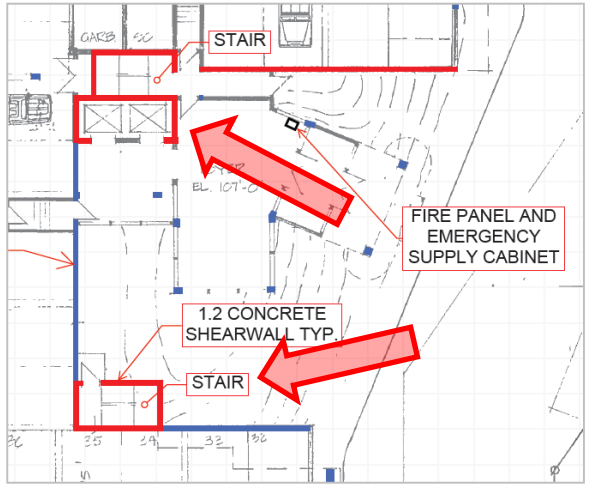
RDA - Reference Plans







RDA - Reference Photographs



RDA - Reference Photographs

SHEARWALL INSIDE BUILDING STAIRWELL

EXPOSED SHEARWALLS IN PARKADE

SHEAR WALL IN RESIDENTAL UNIT

RDA - Evaluation Forms / Checklists

POST-EARTHQUAKE BUILDING SAFETY EVALUATION FORM

Page 1 of 8

Evaluator: _____ Date and Time: _____

Item No.	POTENTIAL STRUCTURAL DAMAGE	INSPECTED	RESTRICTED USE	AREA UNSAFE	UNSAFE	Location of Deficiency
	EXTERIOR REVIEW					
1.1	**General Outside Observation (Exterior).**	☐	☐	☐	☐	
	Building has visibly collapsed or partially collapsed. **Post Unsafe.** Building has a noticeable lean. **Post Unsafe.** Visible settlement of the structure or surrounding soil. **Post Restricted Use.** Visible damage to glass and brick cladding. **If access and egress paths no longer safely accessible, post Unsafe. Otherwise barricade area, post building Restricted Use.** Visible flooding, fire, discharge of hazardous material, or electrical damage. **If access and egress paths are no longer safely accessible, post Unsafe. Otherwise barricade area and post building Restricted Use.**					
1.2	**Concrete Shear Wall (Exterior)**	☐	☐	☐	☐	
	Visible cracks greater than 1/4" (6.0 mm). **Post Unsafe.** Visible cracks greater than 1/8" (3.0 mm). **Post Restricted Use.** Visible cracks less than 1/8" (3.0 mm). **Post Inspected.** **See Section 3.4 for additional information.**					
1.3	**Non-Lateral Columns**	☐	☐	☐	☐	
	Diagonal cracks through the concrete columns greater than 1/16" (1.5 mm). **Post Unsafe.** Spalled concrete at the top or bottom of the concrete columns with vertical reinforcing exposed. **Post Unsafe.** **See Section 3.7 for additional information.**					

Received by Strata: _____ Date and Time: _____

Read Jones Christoffersen Ltd.

POST-EARTHQUAKE BUILDING SAFETY EVALUATION FORM

Page 2 of 8

Evaluator: _____ Date and Time: _____

Item No.	POTENTIAL STRUCTURAL DAMAGE	INSPECTED	RESTRICTED USE	AREA UNSAFE	UNSAFE	Location of Deficiency
	PARKADE (LOWER LEVEL AND ENTRY LEVEL) REVIEW					
1.2	**Concrete Shear Walls**	☐	☐	☐	☐	
	Visible cracks greater than 1/4" (6.0 mm). **Post Unsafe.** Visible cracks greater than 1/8" (3.0 mm). **Post Restricted Use.** Visible cracks less than 1/8" (3.0 mm). **Post Inspected.** **See Section 3.4 for additional information.**					
1.3	**Columns**	☐	☐	☐	☐	
	Diagonal cracks through the concrete columns greater than 1/16" (1.5 mm). **Post Unsafe.** Spalled concrete at the top or bottom of the concrete columns with vertical reinforcing exposed. **Post Unsafe.** **See Section 3.4 and 3.7 for additional information.**					
1.4	**Slab Band Shear Wall Transfer Beams**	☐	☐	☐	☐	
	Cracks through the beam greater than 1/16" (1.5 mm). **Post Unsafe.** Signs of vertical sliding or spalling at column or wall. **Post Unsafe.** Spalled concrete with bent or broken reinforcing bars. **Post Unsafe.** Noticeable spalling with exposed reinforcing bars, but no visible distress to the bars. **Post Restricted Use and barricade affected area if spalled concrete represents a falling debris hazard.** **See Section 3.4 for additional information.**					
1.5	**Non-Lateral Concrete Walls**	☐	☐	☐	☐	
	Cracking in the walls greater than 1/16" (1.5 mm). **Post Restricted Use.** **See Section 3.7 for additional information.**					
1.6	**Building Services Check & Non-Structural Elements**	☐	☐	☐	☐	
	Fire, discharge of hazardous material. **Post Unsafe.** Uncontrolled flooding due to pipe breakage, and loss of electrical service. **Post Unsafe.** Visible damage to attachment anchors for equipment and fixtures. **If access and egress paths no longer safely accessible, post Unsafe.**					

Received by Strata: _____ Date and Time: _____

Read Jones Christoffersen Ltd.

POST-EARTHQUAKE BUILDING SAFETY EVALUATION FORM

Page 8 of 8

Evaluator: _____ Date and Time: _____

Detailed List of Mechanical and Electrical Equipment on Roof:	Equipment Damaged?				Comments
	No, Operable	No, Inoperable	Yes, Operable	Yes, Inoperable	
Elevator Controls	☐	☐	☐	☐	
Other Items:					

ROOF SUMMARY

Record any use & entry restrictions exactly as written on placard:

Further Actions (i.e. Barricades needed):

POST THE BUILDING

☐ **INSPECTED** ☐ **RESTRICTED USE** ☐ **UNSAFE**

Received by Strata: _____ Date and Time: _____

Read Jones Christoffersen Ltd.

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.

RJC Engineers
@RJC_Engineers

Follow

Congrats to the #Rockland in #YYJ practicing post-calamity assessment drills for safety and rapid damage assessment. Leaders in #strata living! #proactive #seismic #planning #RJC #engineers #architects #DisasterRelief #PlanAhead

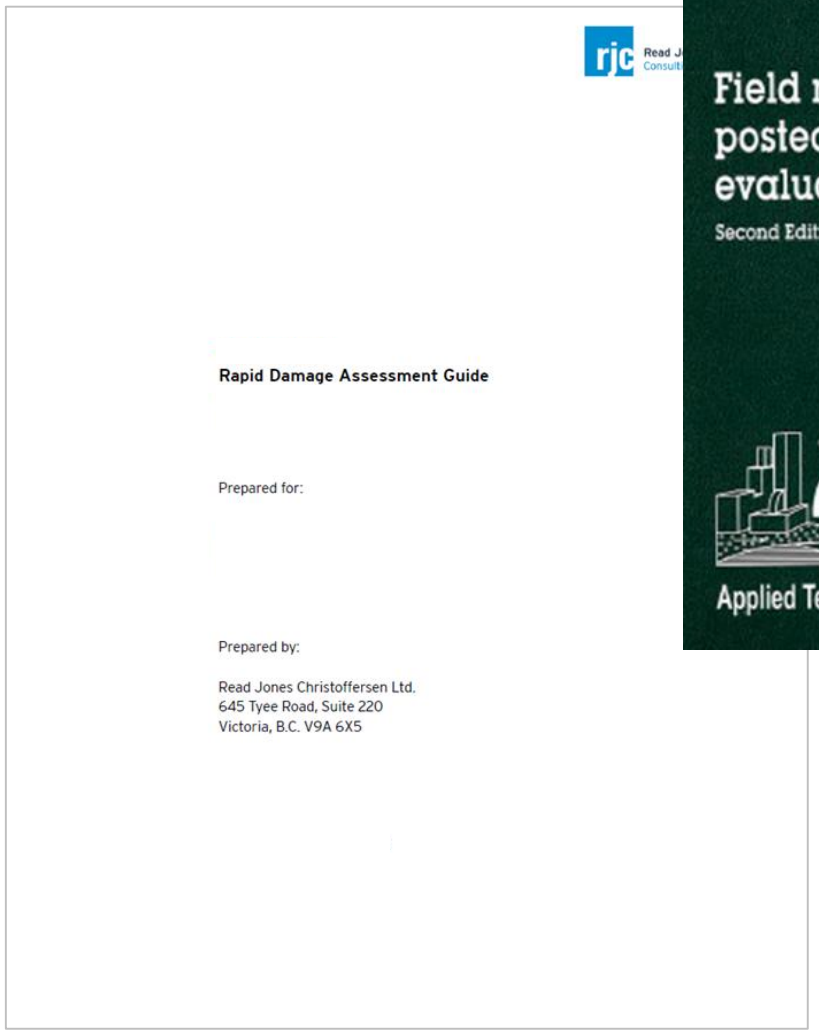
“Break”

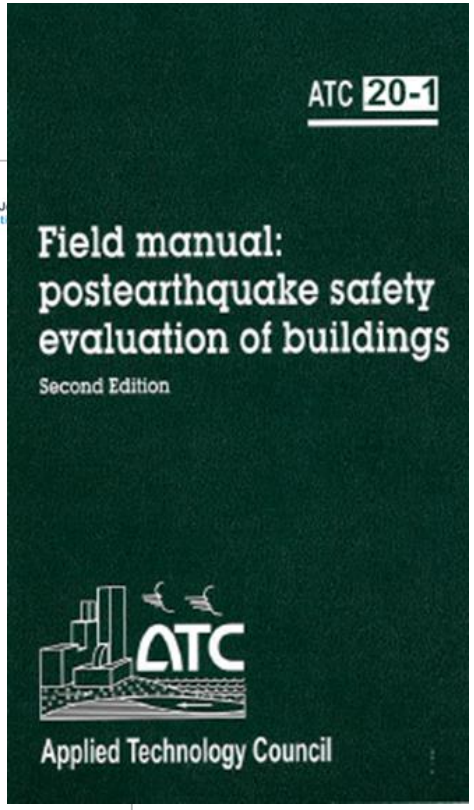
Earthquake!

- **Remember your plan! Your practice drills! Your training!**
- http://www.victoria.ca/EN/main/residents/public-safety/emergency-management.html
- 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?

http://environment.nationalgeographic.com/environment/photos/earthquake-general/#/sf-earthquake_21_600x450.jpg - Accessed Jan 2011

ATC-20: Rapid Screening

- Condition 2 - Building or storey out of plumb?

http://gallery.usgs.gov/sets/1989_Loma_Prieta,_California_Earthquake - Accessed Jan 2011

http://www.miyamotointernational.com/documents/Niigata-Chuetsu-Oki-Japan-Report.pdf - Accessed Jan 2011

ATC-20: Rapid Screening

- Condition 3 - Obvious severe damage to primary structure?

http://news.nationalgeographic.com/news/2010/09/photogalleries/100903-new-zealand-earthquake-christchurch-pictures/ - Accessed Jan 2011

http://news.nationalgeographic.com/news/2010/02/photogalleries/100227-chile-earthquake-2010-hawaii-tsunami-warning-pictures/#/chile-earthquake-apartment-building-windows_13195_600x450.jpg Accessed Jan 2011

ATC-20: Rapid Screening

- Condition 4 - Obvious severe hazards to the public?

http://nsmp.wr.usgs.gov/data_sets/20010228_1/images/Seattle - Accessed Jan 2011

http://nsmp.wr.usgs.gov/data_sets/20010228_1/images/Seattle - Accessed Jan 2011

ATC-20: Rapid Screening

- Condition 5 - Foundation damage resulting from geotechnical hazard?

http://environment.nationalgeographic.com/environment/photos/earthquake-general/#/asphalt-crack_4_600x450.jpg - Accessed Jan 2011

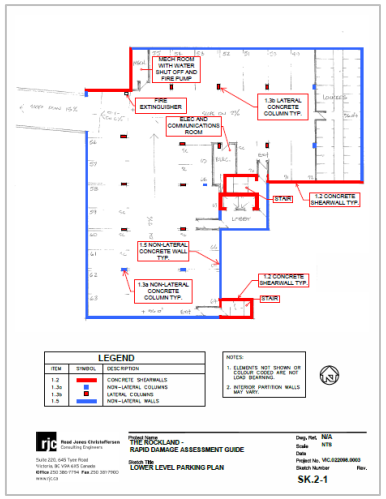
http://gallery.usgs.gov/photos/mQHs38Vjj1_53 - Accessed Jan 2011

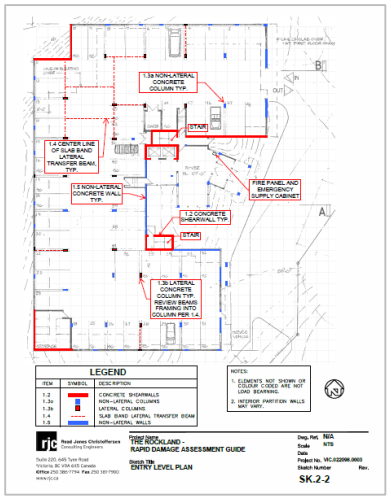
ATC-20: Rapid Screening

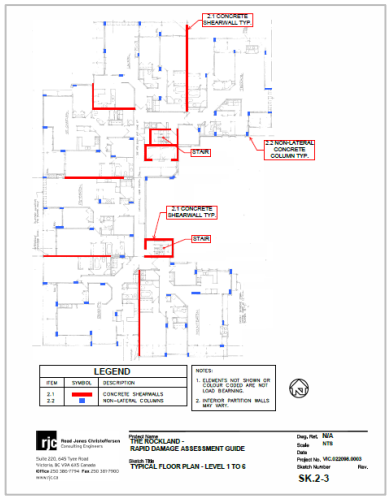
- Condition 6 – Other hazards that may be present…?

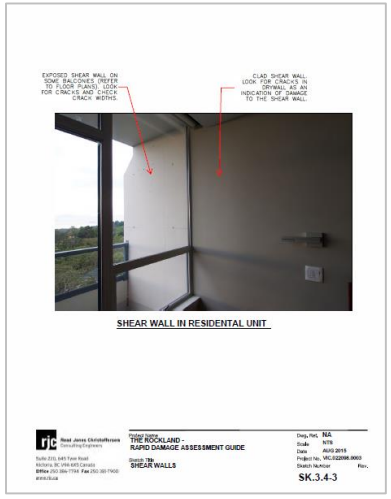
http://geopubs.wr.usgs.gov/circular/c1242/ - Accessed Jan 2011

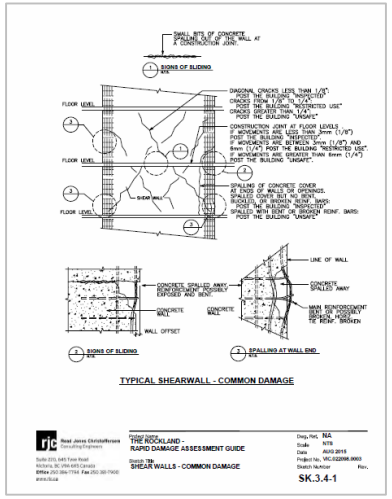
Using the RDA to assist with rapid evaluation

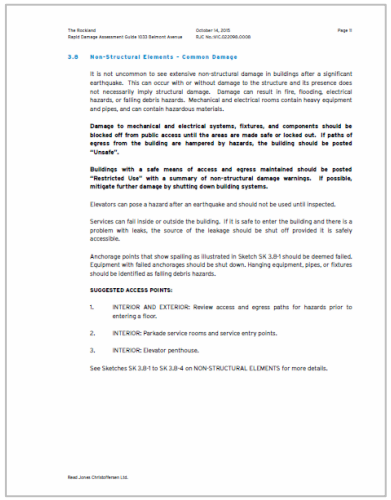











3.8 Non-Structural Elements - Common Damage

It is not uncommon to see extensive non-structural damage in buildings after a significant earthquake. This can occur with or without damage to the structure and its presence does not necessarily imply structural damage. Damage can result in fire, flooding, electrical hazards, or falling debris hazards. Mechanical and electrical rooms contain heavy equipment and pipes, and can contain hazardous materials.

Damage to mechanical and electrical systems, fixtures, and components should be blocked off from public access until the areas are made safe or locked out. If paths of egress from the building are hampered by hazards, the building should be posted "Unsafe".

Buildings with a safe means of access and egress maintained should be posted "Restricted Use" with a summary of non-structural damage warnings. If possible, mitigate further damage by shutting down building systems.

Elevators can pose a hazard after an earthquake and should not be used until inspected.

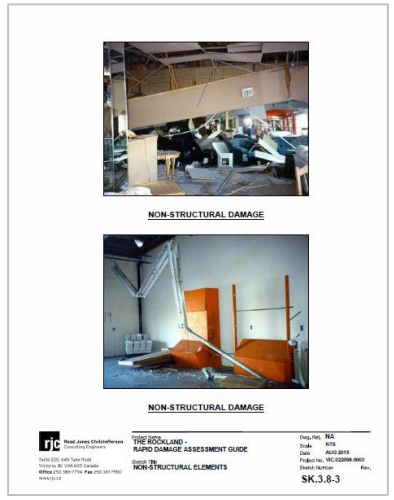
Services can fall inside or outside the building. If it is safe to enter the building and there is a problem with leaks, the source of the leakage should be shut off provided it is safely accessible.

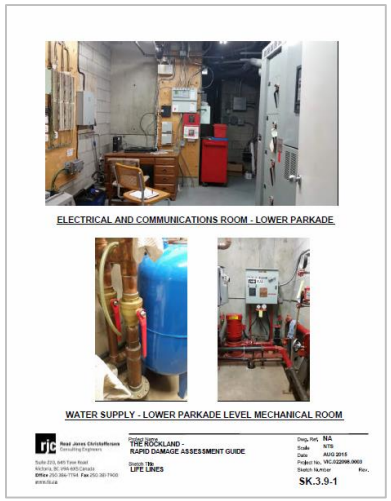
Anchorage points that show spalling as illustrated in Sketch SK 3.8-1 should be deemed failed. Equipment with failed anchorages should be shut down. Hanging equipment, pipes, or fixtures should be identified as falling debris hazards.

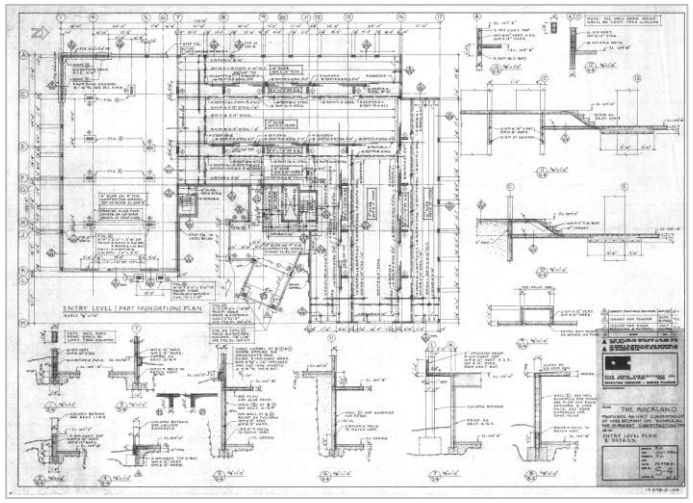
SUGGESTED ACCESS POINTS:

1. INTERIOR AND EXTERIOR: Review access and egress paths for hazards prior to entering a floor.
2. INTERIOR: Parkade service rooms and service entry points.
3. INTERIOR: Elevator penthouse.

See Sketches SK 3.8-1 to SK 3.8-4 on NON-STRUCTURAL ELEMENTS for more details.

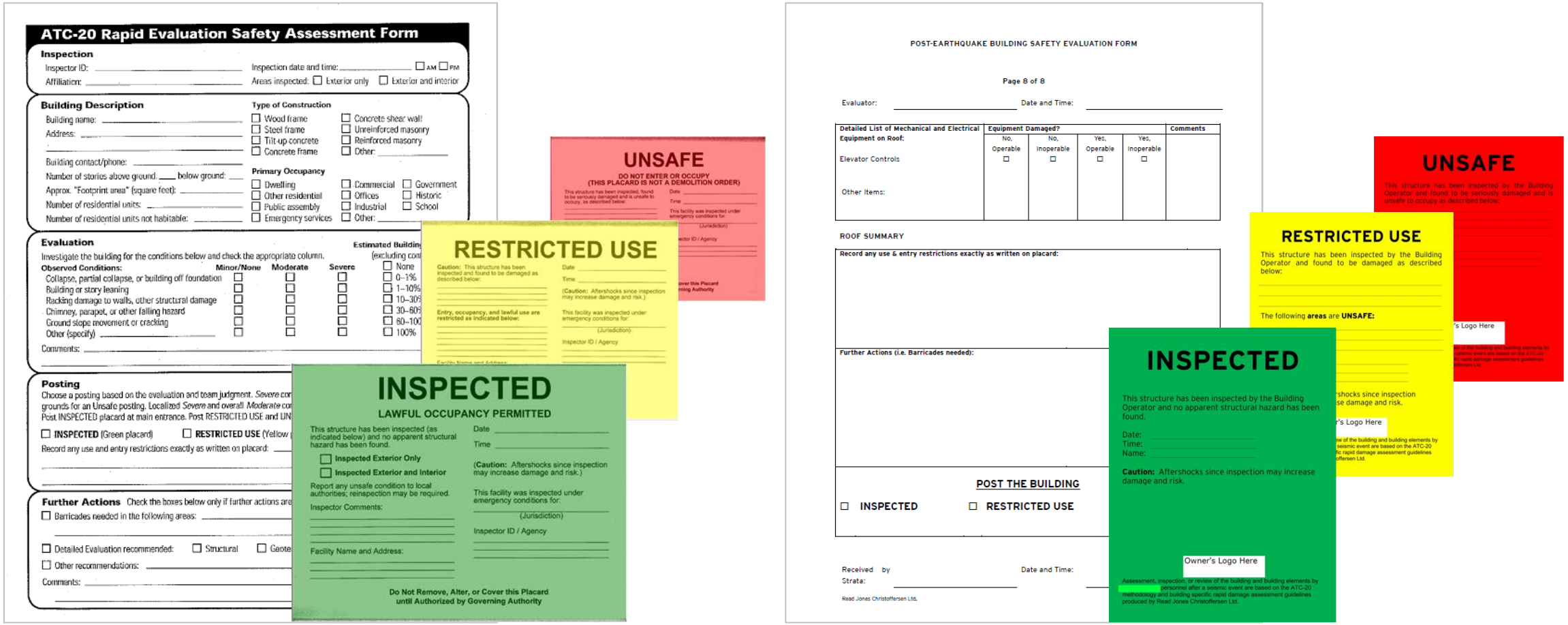






ATC-20: Rapid Screening

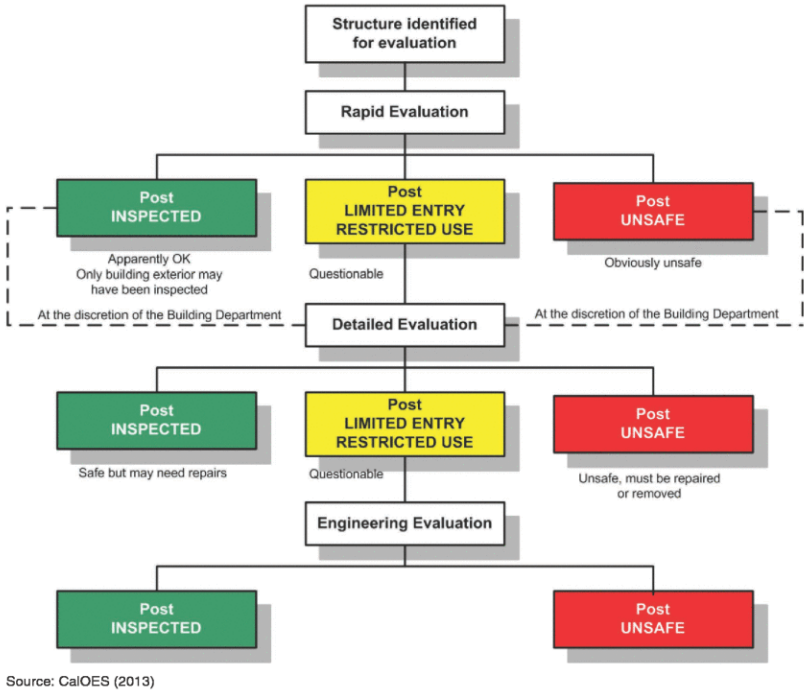
- Record observations and post



ATC-20: Rapid Screening Posting

ATC-20: Communicate Results

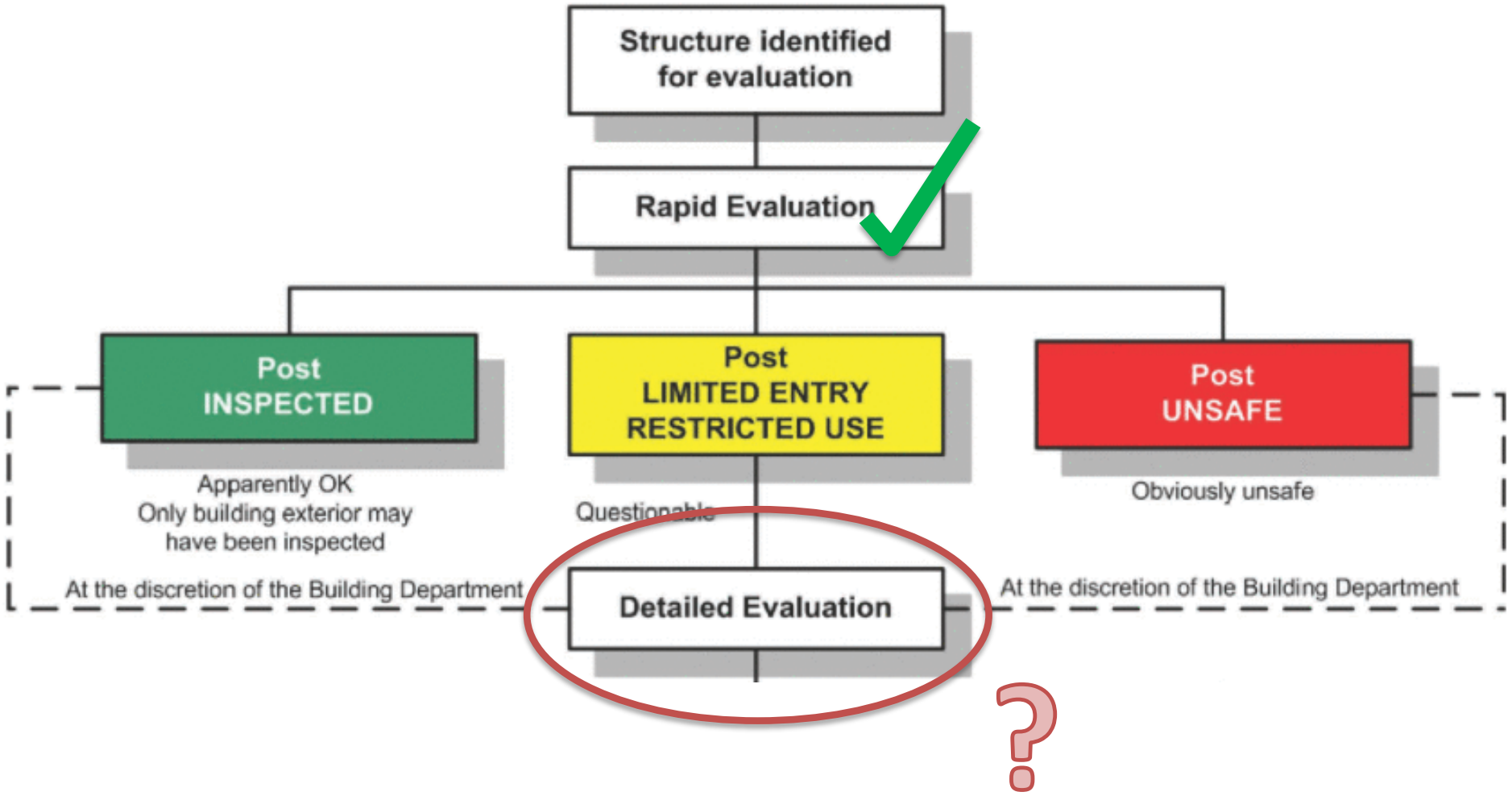
- Post Disaster Communication and Records – Who has looked at your building and how closely?
- Strategy of the local Authorities Having Jurisdiction is not clear at this time.
- What's next?



Source: CalOES (2013)

https://www.nap.edu/read/24608/chapter/4#8

ATC-20: Next Steps…



ATC-20: Detailed Evaluation…


The Rockland
Rapid Damage Assessment Guide
1033 Belmont Avenue
Victoria, BC

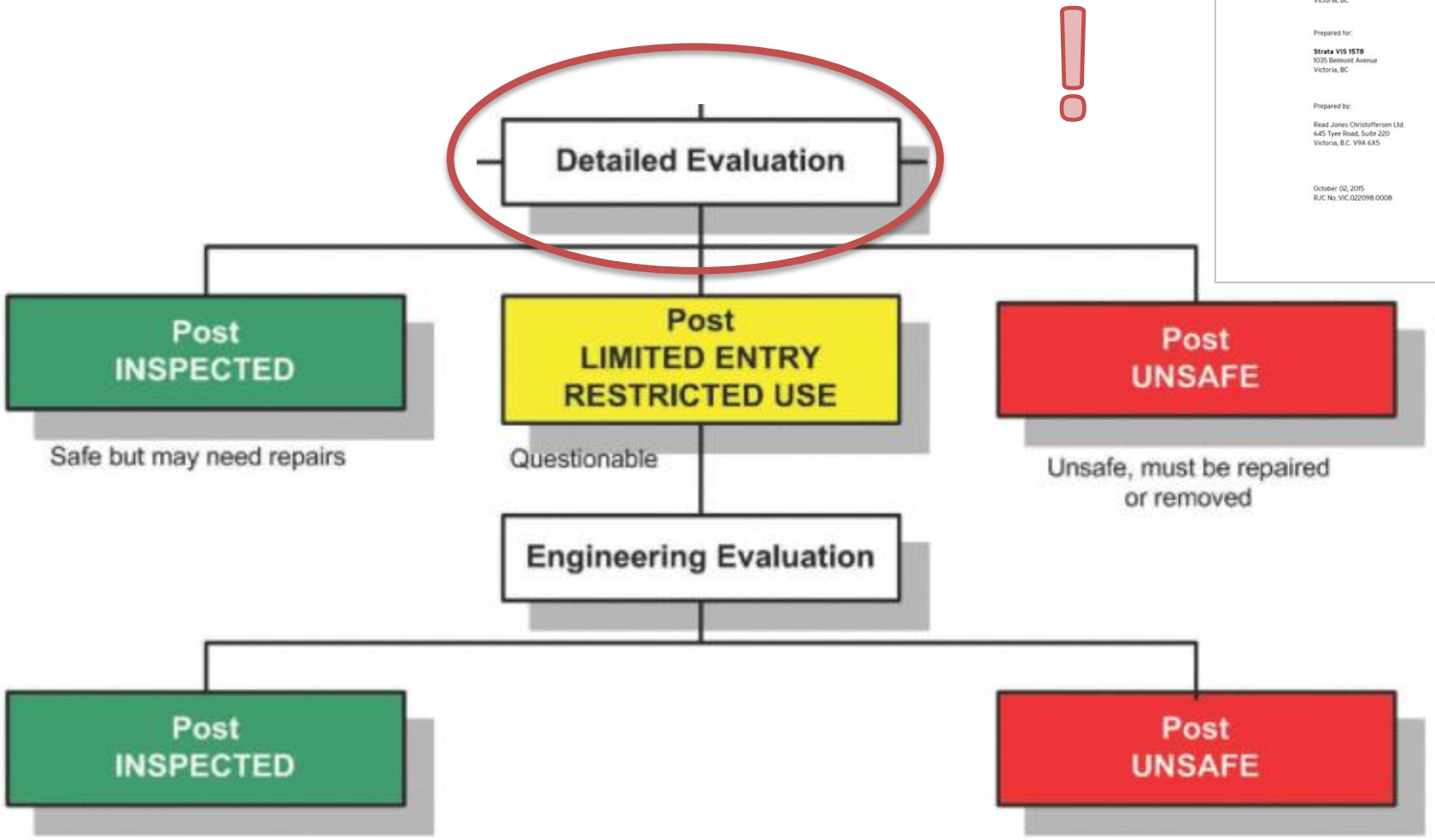
Prepared for:

Strata VIS 1578
1035 Belmont Avenue
Victoria, BC

Prepared by:

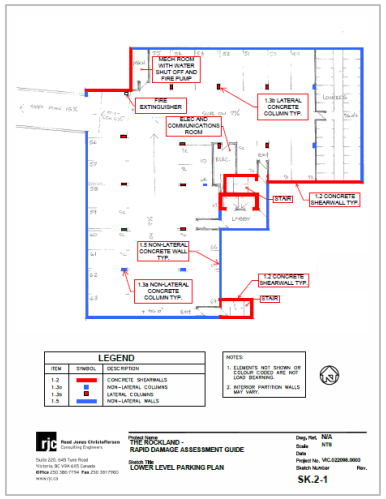
Read Jones Christoffersen Ltd.
645 Tyee Road, Suite 220
Victoria, B.C. V9A 6X5

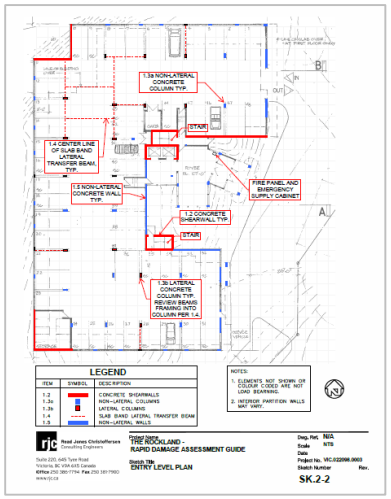
October 02, 2015
RJC No.VIC.022098.0008

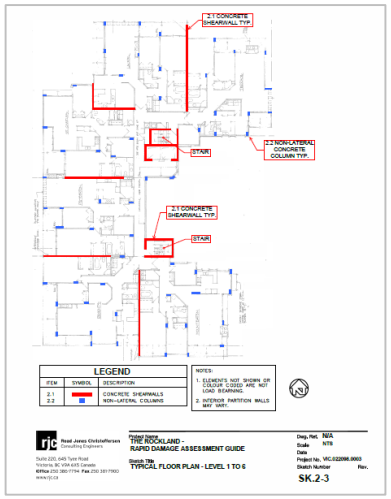


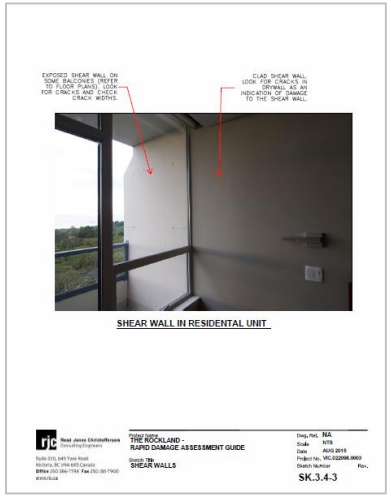
https://www.nap.edu/read/24608/chapter/4#8

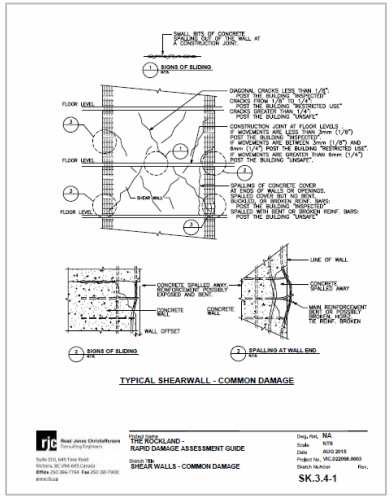
Using the RDA to assist with detailed evaluation

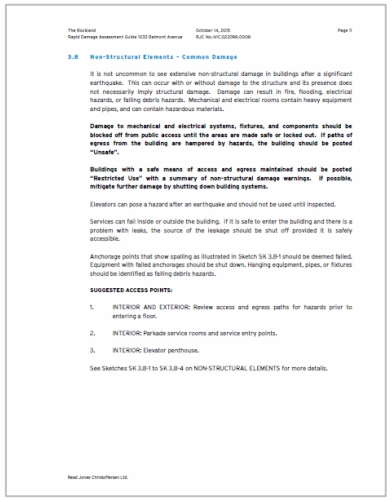


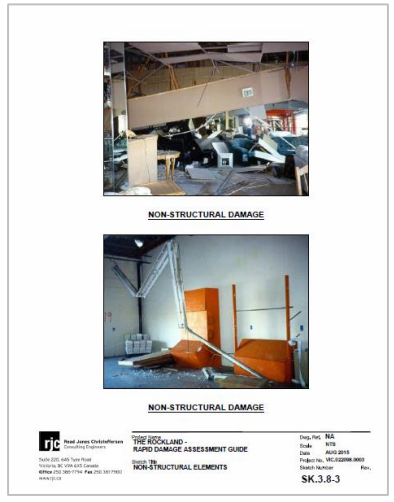


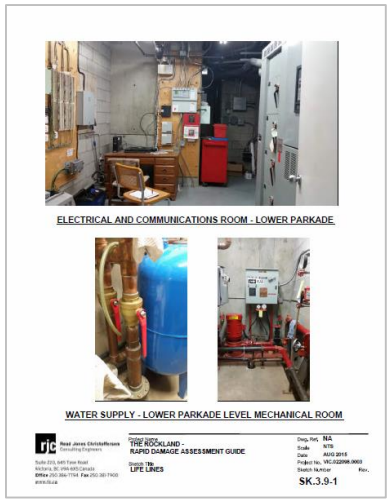


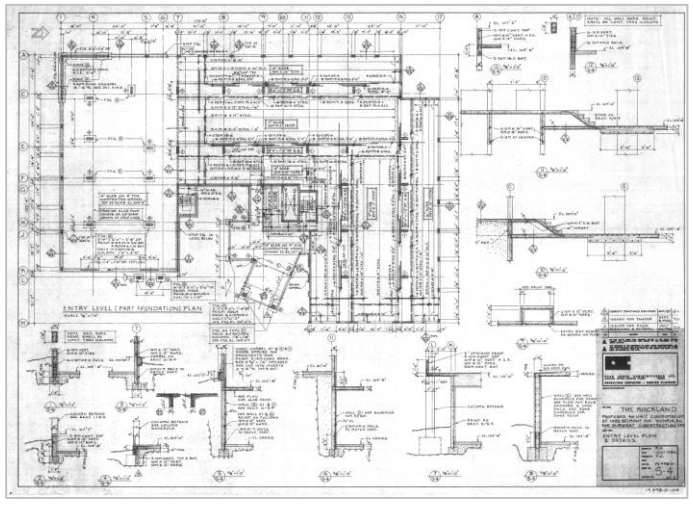




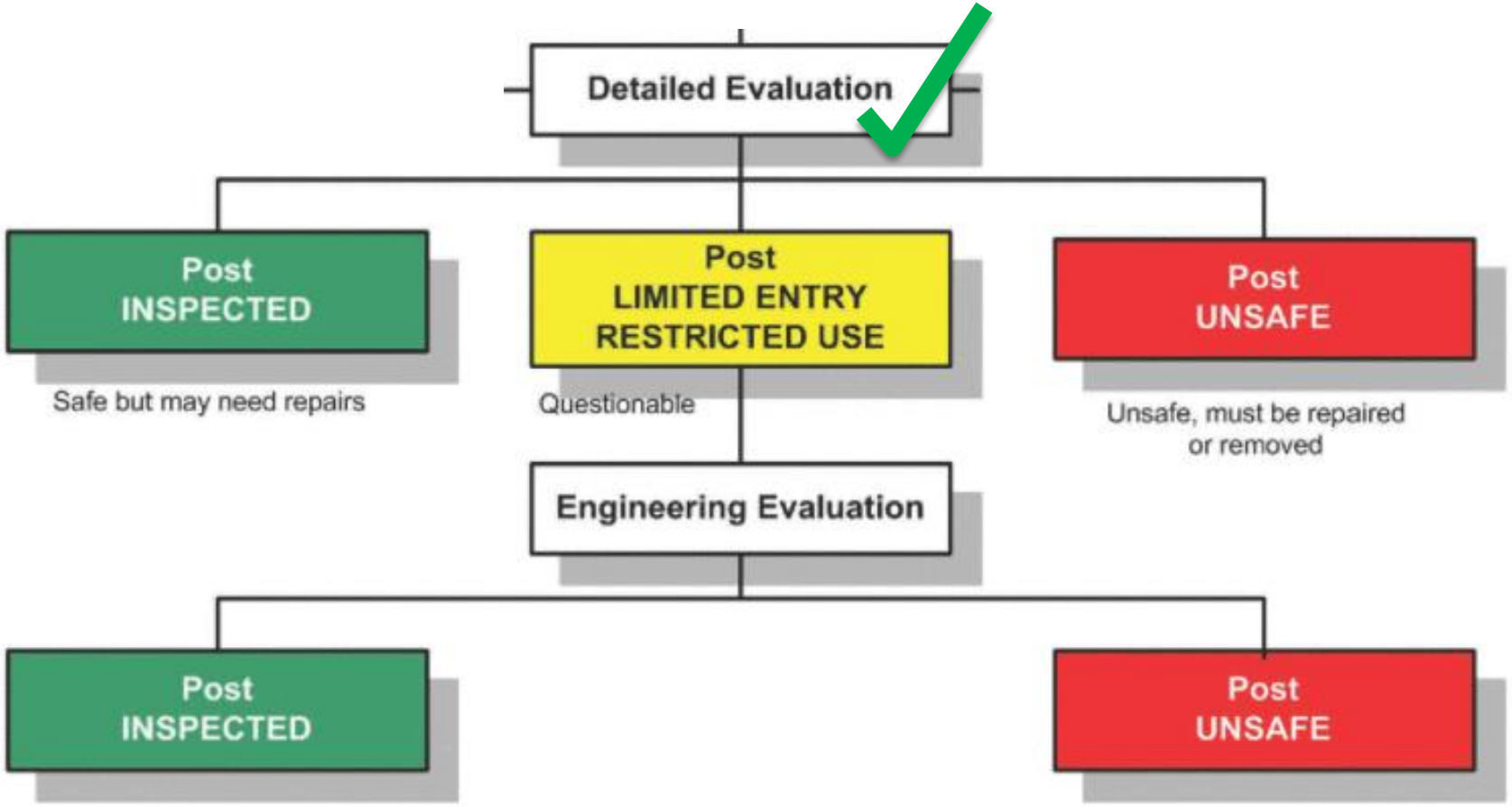






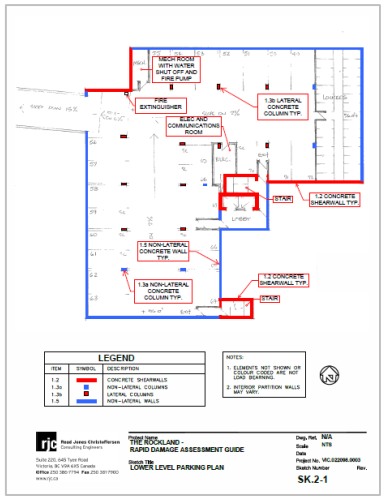


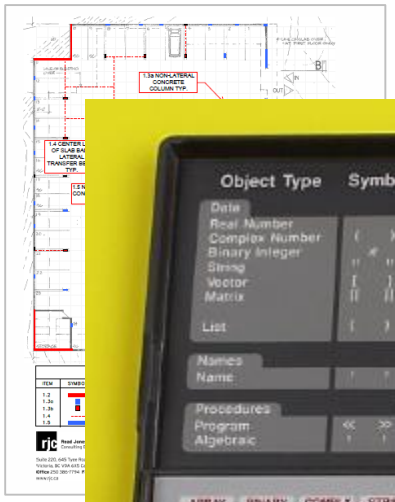
ATC-20: Engineering Evaluation…

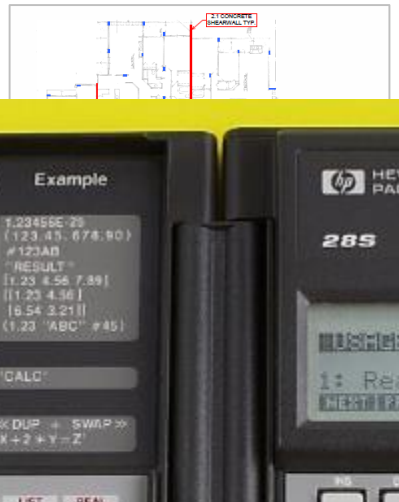


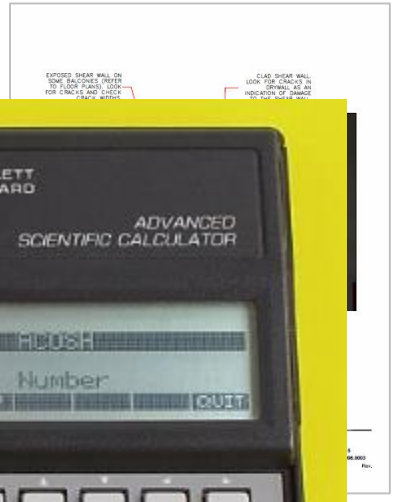
https://www.nap.edu/read/24608/chapter/4#8

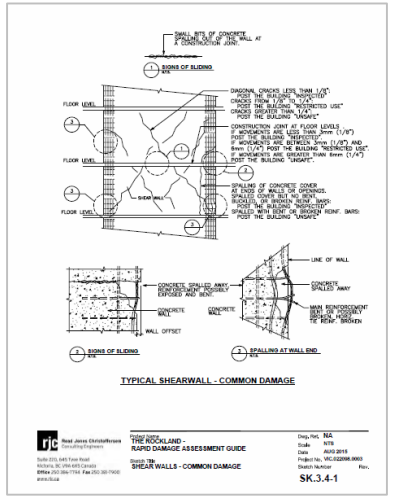
Using the RDA for engineering evaluation?

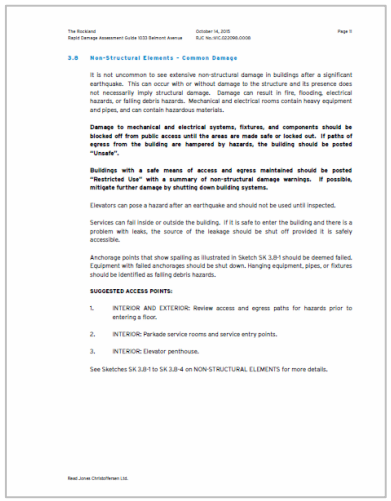


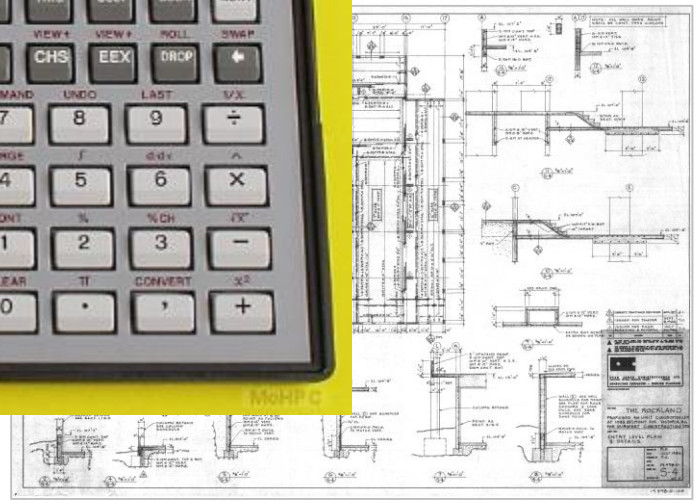












Creative Thinking **Practical Results**

Summary / Takeaways

- Assess
- Plan & Prepare
- Practice

Summary / Takeaways

Assessment
+
Planning &
Preparation
+
Practice
=