CITY OF
VANCOUVER

CITY CLERK'S DEPARTMENT
Access to Information

File No. 04-1000-20-2016-044

February 17, 2016

s.22(1)

Dear s.22(1):

Re: **Request for Access to Records under the Freedom of Information and Protection of Privacy Act (the "Act")**

I am responding to your request of February 1, 2016 for:

> **The report prepared by Glotman-Simpson for the City of Vancouver in 2012, *Seismic Assessment and Upgrade Options in response to the Statement of Work Outlined in the Request for Proposals PS11466*.**

All responsive records are attached. Some information in the records has been severed, (blacked out), under s.13(1), s.15(1)(l), and s.17(1)(f), of the Act. You can read or download the sections here:
http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/96165_00

Under section 52 of the Act you may ask the Information & Privacy Commissioner to review any matter related to the City's response to your request. The Act allows you 30 business days from the date you receive this notice to request a review by writing to: Office of the Information & Privacy Commissioner, info@oipc.bc.ca or by phoning 250-387-5629.

Please do not hesitate to contact me if you have any questions.

Yours truly,

Barbara J. Van Fraassen, BA
Director, Access to Information
City Clerk's Department, City of Vancouver
Email: Barbara.vanfraassen@vancouver.ca

Encl.

:jb

Read Jones Christoffersen
Consulting Engineers

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1285 West Broadway
Vancouver, BC V6H 3X8
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Fax 604 738-1107
www.rjc.ca

June 21, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Atira Women's Resource Society
101 East Cordova Street, Vancouver, BC RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Atira Women's Society located at 101 East Cordova Street, in Vancouver. This evaluation included a "rapid visual seismic screening", a review of drawings, and a walk-through site inspection. The "rapid visual seismic screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
101 East Cordova	2.3	NO	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which, in this case, would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 2.3 means there is a 0.5% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be moderate to low.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available prior to our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment does not appear to be seismically restrained.

There were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening result, and assuming that this facility is NOT intended to be a post-disaster building, a detailed quantitative assessment of the seismic force resisting system elements does not appear to be required. However, we recommend a review of the non-structural elements in the building (mechanical equipment, etc.). Our budget for a detailed, non-structural study would be s.17(1)(f) +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Hanif Shariff, B.Eng., EIT
Design Engineer

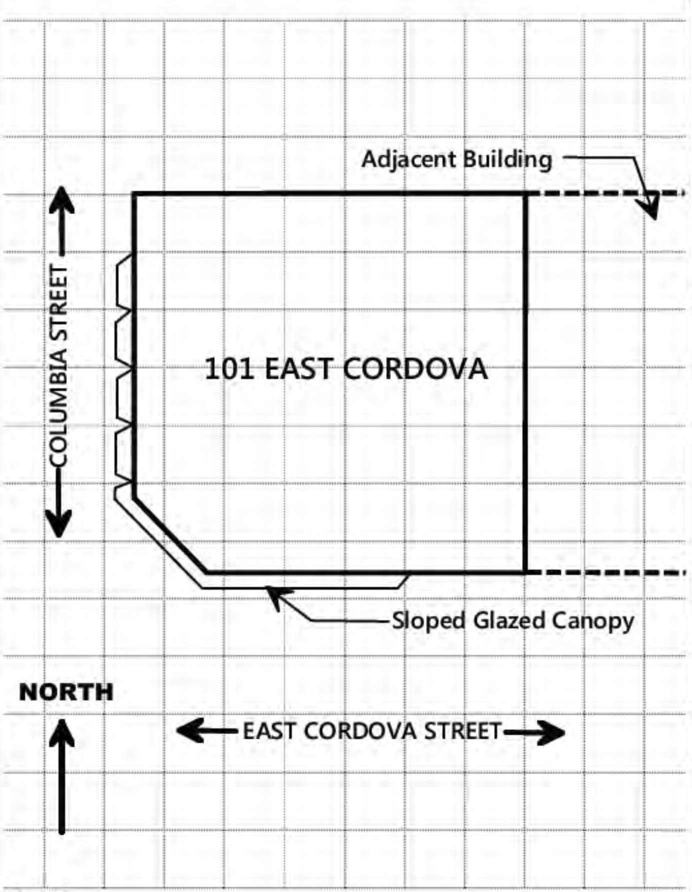
Jun 20/13
Dennis Gam, M.Eng., P.Eng.
Associate

HS/gb

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 101 East Cordova Street, Vancouver, BC

Zip V6A 1K3

Other Identifiers

No. Stories 7 **Year Built** 1979

Screener HZS **Date** April 10, 2013

Total Floor Area (sq. ft.) 133,244 SF

Building Name Atira Women's Resource Society

Use Offices and Parking Structure

OCCUPANCY			SOIL	TYPE						FALLING HAZARDS
Assembly [✓ Commercial] Emer. Services	Govt Historic Industrial	[✓ Office] Residential School	Number of Persons 0 – 10 [✓ 11 – 100] 101-1000 1000+	A Hard Rock	B Avg. Rock	[✓ C Dense Soil]	D Stiff Soil	E Soft Soil	F Poor Soil	☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☐ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	[✓ C2 (SW)]	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	[✓ 2.8]	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	[✓ +0.4]	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S									**2.3**						

COMMENTS

Drawings indicate building was designed to VBBL No. 5190;
Mechanical equipment did not appear to be restrained;
Plan irregularity, as there is only one shearwall in N-S direction.

Detailed Evaluation Required

YES [✓ NO]

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

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July 3, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for 201 Central Street
and 240 Northern Street, Vancouver, BC RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of 201 Central Street (which includes 240 Northern Street), in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
201 Central St and 240 Northern St	0	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 1.5 represents a 3% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Original structural drawings were not available.

A brief review of the building mechanical equipment indicated that equipment appears to be partially seismically restrained or unrestrained.

The chimney, stucco cladding, and north canopy structure on the building exterior represent potential fall hazards.

Pounding from the adjacent building, to the East, is a potential hazard.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Design Engineer

D. S. GAM
JUL 0 4 2013

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

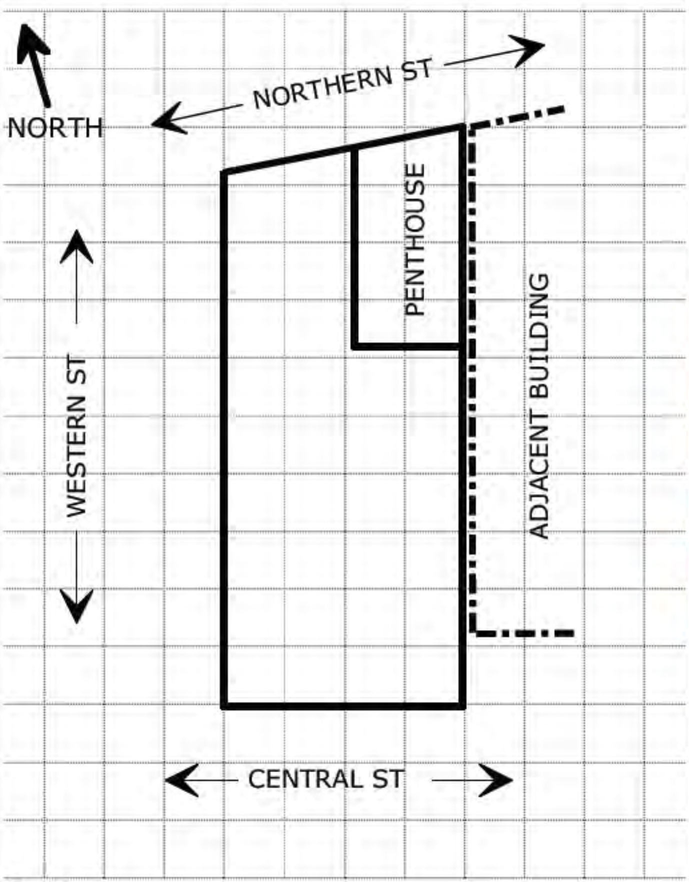
Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards
FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 201 CENTRAL ST & 240 NORTHERN ST
VANCOUVER, BC **Zip** V6A 1B6
Other Identifiers
No. Stories 2 + PENTHOUSE **Year Built** 1930?
Screener NAB **Date** JUNE 18, 2013
Total Floor Area (sq. ft.) 15, 000 SQ.FT
Building Name
Use SHELTER(FIRST FLOOR), ARTIST STUDIOS(SECOND FLOOR)


INTERIOR FRAMING

NORTH WEST ELEVATION

OCCUPANCY

Assembly Govt [✓ Office]
Commercial Historic [✓ Residential]
Emer. Services Industrial School

Number of Persons
0 – 10 [✓ 11 – 100]
101-1000 1000+

SOIL / **TYPE**

A Hard Rock
B Avg. Rock
C Dense Soil
[✓ D Stiff Soil]
[✓ E Soft Soil]
F Poor Soil

FALLING HAZARDS

☒ Unreinforced Chimneys
☐ Parapets
☒ Cladding
☒ Other: ______

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	[✓ W2]	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	[✓ 3.8]	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	[✓ -2.0]	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	[✓ -1.0]	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	[✓ -0.8]	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	[✓ -0.8]	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S		0													

COMMENTS
Drawings were not made available during the review. Structure appeared to be wood post and beam framing with wood framed exterior walls.
Exterior stucco cladding is in poor condition and represents a potential fall hazard.
Unreinforced brick chimney, and unbraced north canopy structure also represent potential fall hazards. Pounding is a potential hazard from adjacent building (on East side).

Detailed Evaluation Required
[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

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July 3, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review
for 237 and 261 Southern Street, Vancouver, BC RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of 237 and 261 Southern Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
237 & 261 Southern St.	0.6	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 0.8 represents a 15% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Original structural drawings were not available.

A brief review of the building mechanical equipment indicated that equipment appears to be partially seismically restrained or unrestrained.

The south canopy on the building exterior represents a potential fall hazard.

Pounding from the adjacent building, to the West, is a potential hazard.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] -value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Design Engineer

GAM
JUL 0 4 2013

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154)

Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
Structural Types:			
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

---

[1] No applicable material design standard with seismic provisions.
[2] Post North Ridge details in CSA S16-01
[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

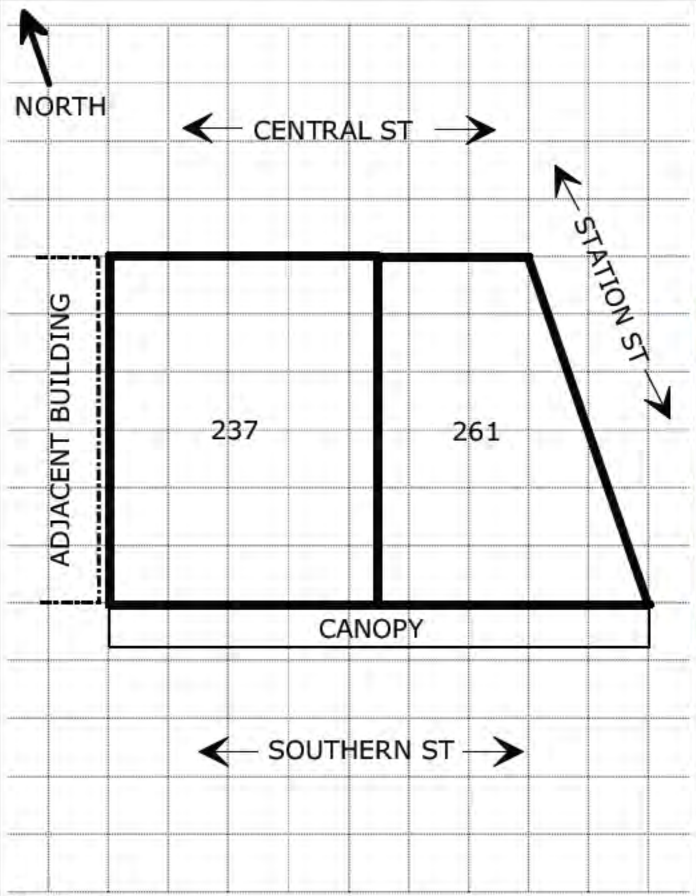
A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 237 & 261 SOUTHERN ST, VANCOUVER, BC
Zip V6A 1B6
Other Identifiers
No. Stories 1 **Year Built** 1946
Screener NAB **Date** JUNE 18, 2013
Total Floor Area (sq. ft.) 20,000 SQ.FT.
Building Name
Use WAREHOUSE

EAST ELEVATION

EAST WALL (FROM INTERIOR)

OCCUPANCY **SOIL**

Assembly, Commercial, Emer. Services, Govt, Historic, [✓ Industrial], Office, Residential, School

Number of Persons: 0 – 10, [✓ 11 – 100], 101-1000, 1000+

TYPE

A	B	C	[✓ D]	[✓ E]	F
Hard Rock	Avg. Rock	Dense Soil	Stiff Soil	Soft Soil	Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☒ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	[✓ C3 (URM INF)]	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	[✓ 1.6]	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	[✓ -0.2]	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	[✓ -0.4]	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	[✓ -0.8]	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S										0.6 TO 1					

COMMENTS

Drawings were not made available during the review. Structure appeared to be concrete frame with block infill for exterior walls, and heavy timber trusses with wood posts for interior framing, and wood roof deck.
South canopy is in poor condition and does not appear to be braced in East West direction.
Pounding is a potential hazard from adjacent building (on West side).

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know
BR = Braced frame
FD = Flexible diaphragm
LM = Light metal
MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm
SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

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1285 West Broadway
Vancouver, BC V6H 3X8
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604 738-0048
Fax 604 738-1107
www.rjc.ca

July 3, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review
for 242 Terminal Street, Vancouver, BC RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of 242 Terminal Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
242 Terminal St.	0.8	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 0.8 means there is a 15% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Original structural drawings were not available.

A brief review of the building mechanical equipment indicated that equipment appears to be partially seismically restrained or unrestrained.

The brick chimney, parapets, and concrete cornices and window sills on the building exterior represent potential fall hazards.

Pounding from the adjacent building, to the East, is a potential hazard.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Design Engineer

D. S. GAM
#27414
JUL 04 2013

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

---

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

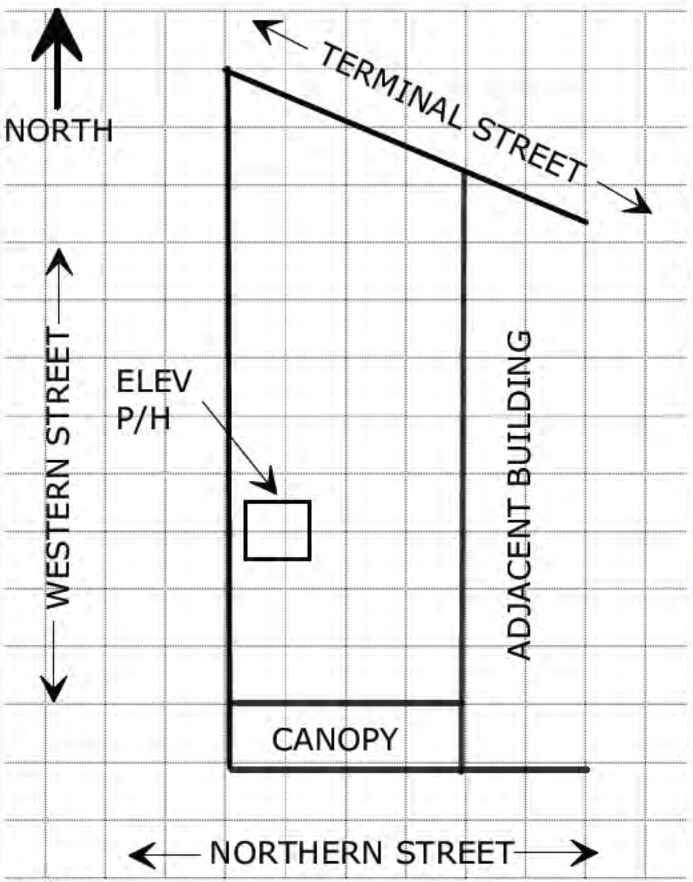
A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 242 Terminal Street, Vancouver, BC
Zip V6A 2L4
Other Identifiers
No. Stories 2 **Year Built** 1945
Screener NAB **Date** June 19, 2013
Total Floor Area (sq. ft.) 17,000 sq. ft.
Building Name
Use Storage Warehouse

NORTH ELEVATION

OCCUPANCY

Assembly | Govt | Office
[✓ Commercial] | Historic | Residential
Emer. Services | [✓ Industrial] | School

SOIL

Number of Persons
0 – 10 | [✓ 11 – 100]
101-1000 | 1000+

TYPE

A Hard Rock | B Avg. Rock | C Dense Soil | D Stiff Soil | [✓ E Soft Soil | F Poor Soil]

FALLING HAZARDS

☒ Unreinforced Chimneys | ☒ Parapets | ☒ Cladding | ☒ Other: ______

BASIC SCORE, MODIFIERS, AND FINAL SCORE, *S*

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	[✓ URM]
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	2.8	[✓ 1.8]
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	[✓ -0.2]
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	[✓ -0.6]
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	[✓ -0.8]

FINAL SCORE, *S* 0.8 to 1

COMMENTS

Drawings were not made available during the review. Structure appeared to be wood post and beam interior framing with wood decking, and unreinforced masonry block walls.
Concrete cornice and window sills are spalling and are potential fall hazards. Brick parapets and chimney are also potential fall hazards.
Pounding is a potential hazard from adjacent building (on East side).

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

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July 3, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Firehall No. 12
2460 Balaclava Street, Vancouver, BC
RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Firehall No. 12 located at 2460 Balaclava Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", a review of drawings, and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
2460 Balaclava Street	0.9	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 0.9 represents a 13% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available prior to our site visit. In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained. However, the following elements on the building exterior represent potential fall hazards: architectural metal panel on hose tower; and brick Veneer

There are many concrete masonry partition walls that appear to be part of the original construction. These walls may not be reinforced given the era of construction and do not appear to be anchored to the undersides of their respective slabs.

There were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Hardeep Gill, EIT

D. S. GAM
JUL 04 2013

Dennis Gam, M.Eng., P.Eng.
Associate

HG/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

---

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

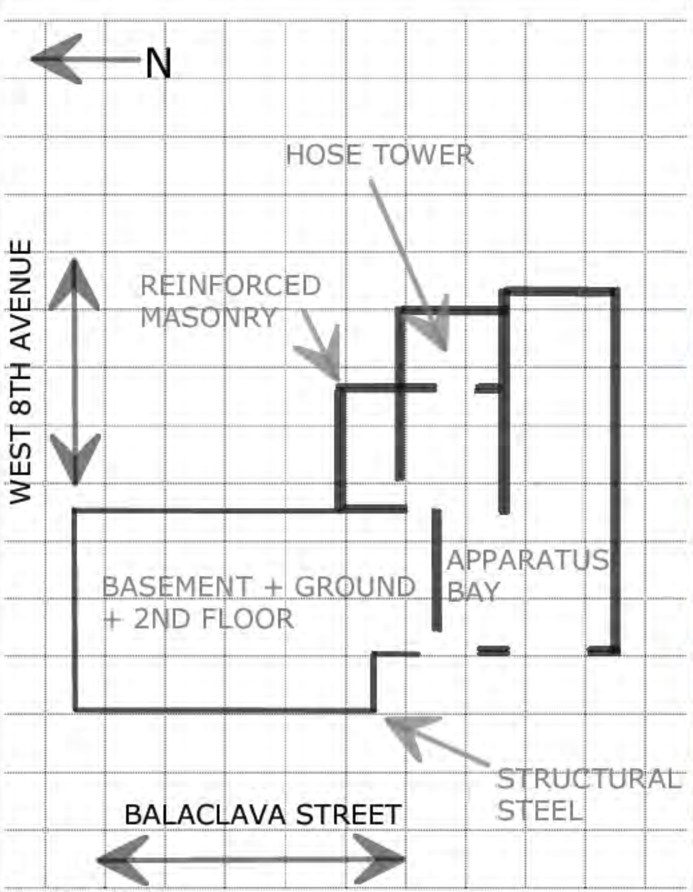
A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale: NTS

Address: 2460 BALACLAVA STREET
VANCOUVER, BC **Zip**
Other Identifiers
No. Stories 2+BASEMENT **Year Built** 1986
Screener HSG **Date** JUNE 28/2013
Total Floor Area (sq. ft.) 7,608
Building Name FIREHALL NO.12
Use FIREHALL

WEST ELEVATION

OCCUPANCY			SOIL	TYPE	FALLING HAZARDS
Assembly Commercial [✓ Emer. Services]	Govt Historic Industrial	Office Residential School	Number of Persons 0 – 10 [✓ 11 – 100] 101-1000 1000+	A Hard Rock B Avg. Rock [✓ C Dense Soil] D Stiff Soil E Soft Soil F Poor Soil	☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☐ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	[✓ 2.8]	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	[✓ -1.0]	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S													0.9		

COMMENTS

- Designed to VBBL No. 5583 and NBC 1980
- Building is primarily structural steel and reinforced masonry with OWSJ roof deck
- Mechanical equipments appear to be restrained

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

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Canada

604 738-0048
Fax 604 738-1107
www.rjc.ca

July 3, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review
for 250 Terminal Street, Vancouver, BC
RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of 250 Terminal Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
250 Terminal St.	-0.2	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 0.8 represents a 15% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Original structural drawings were not available.

A brief review of the building mechanical equipment indicated that equipment appears to be partially seismically restrained or unrestrained.

The brick chimney and parapets on the building exterior represent potential fall hazards.

Pounding from the adjacent buildings, to the East and West, is also a potential hazard.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) -value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Design Engineer

D. S. GAM
#27414
JUL 04 2013

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

---

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

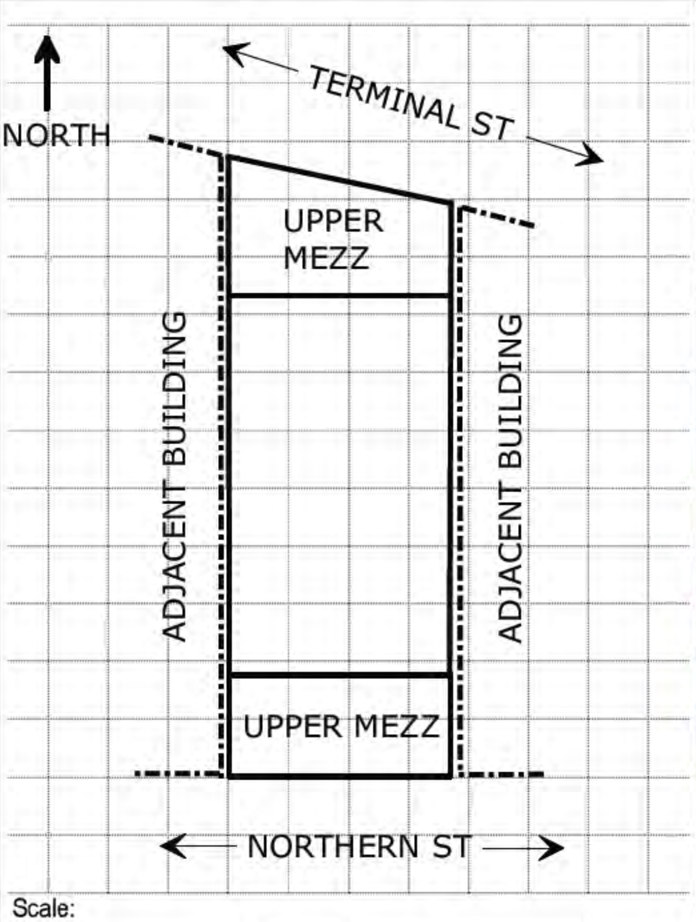
A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 250 TERMINAL ST, VANCOUVER, BC
Zip V6A 2L4
Other Identifiers
No. Stories 1 + 2 MEZZANINES **Year Built** 1924
Screener NAB **Date** JUNE 19, 2013
Total Floor Area (sq. ft.) 11,000 SQ.FT.
Building Name
Use FURNITURE WAREHOUSE

NORTH ELEVATION

SOUTH-WEST WALLS (FROM INTERIOR)

OCCUPANCY			SOIL	TYPE						FALLING HAZARDS			
Assembly	Govt	Office	Number of Persons	A	B	C	[✓ D]	[✓ E]	F	☒	☒	☐	☒
[✓ Commercial]	Historic	Residential	0 – 10 [✓ 11 – 100]	Hard Rock	Avg. Rock	Dense Soil	[✓ Stiff Soil]	[✓ Soft Soil]	Poor Soil	Unreinforced Chimneys	Parapets	Cladding	Other:
Emer. Services	[✓ Industrial]	School	101-1000 1000+										

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	[✓ URM]
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	2.8	[✓ 1.8]
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	[✓ -1.0]
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	[✓ -0.2]
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	[✓ -0.6]
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	[✓ -0.8]

FINAL SCORE, S -0.2 TO 0

COMMENTS

Drawings were not made available during the review. Structure appeared to be wood post and beam interior framing with wood decking, and unreinforced masonry block walls.
Brick parapets and chimney are potential fall hazards.
Pounding is a potential hazard from adjacent buildings (on East and West sides).

Detailed Evaluation Required

[✓ **YES**] **NO**

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

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July 3, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review
for 260 and 268 Terminal Street, Vancouver, BC — RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of 260 and 268 Terminal Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
260 & 268 Terminal St	0.8	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 0.8 means there is a 15% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Original structural drawings were not available.

A brief review of the building mechanical equipment indicated that equipment appears to be partially seismically restrained or unrestrained.

The brick parapets on the building exterior represent potential fall hazards.

Pounding from the adjacent buildings, to the East and West, is a potential hazard.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) -value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Design Engineer

D. S. GAM
#27414
JUL 0 4 2013

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154)
Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

---

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

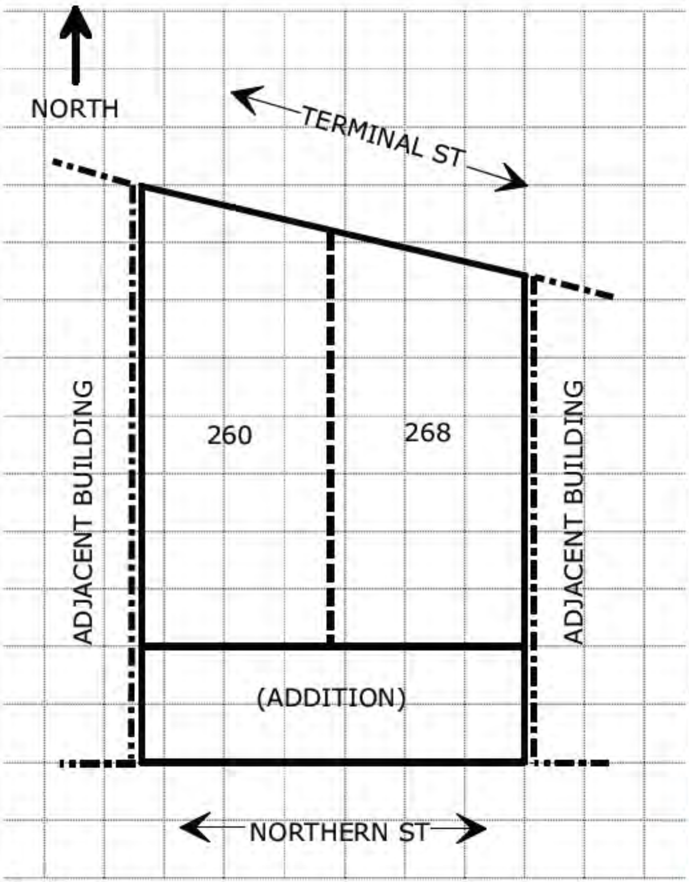
A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 260 & 268 TERMINAL ST, VANCOUVER, BC

Zip V6A 2L6

Other Identifiers

No. Stories 1 **Year Built** UNKNOWN

Screener NAB **Date** JUNE 19, 2013

Total Floor Area (sq. ft.) 14,000 SQ. FT.

Building Name

Use WAREHOUSE

INTERIOR FRAMING

NORTH ELEVATION

OCCUPANCY

Assembly Govt Office
Commercial Historic Residential
Emer. Services [✓ Industrial] School

Number of Persons
0 – 10 [✓ 11 – 100]
101-1000 1000+

SOIL

TYPE

A Hard Rock
B Avg. Rock
[✓ C Dense Soil]
[✓ D Stiff Soil]
E Soft Soil
F Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys
☒ Parapets
☐ Cladding
☒ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, *S*

BUILDING TYPE	**W1**	**W2**	**S1** (MRF)	**S2** (BR)	**S3** (LM)	**S4** (RC SW)	**S5** (URM INF)	**C1** (MRF)	**C2** (SW)	**C3** (URM INF)	**PC1** (TU)	**PC2**	**RM1** (FD)	**RM2** (RD)	[✓ **URM**]
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	2.8	[✓ 1.8]
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	[✓ -0.2]
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	[✓ -0.6]
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	[✓ -0.8]

FINAL SCORE, *S* 0.8 TO 1

COMMENTS

Drawings were not made available during the review. Structure appeared to be heavy timber trusses with wood decking spanning to unreinforced masonry exterior block walls; wood post and beam interior framing in addition area.

Brick parapets are a potential fall hazard. Pounding is a potential hazard from adjacent buildings (on East and West sides).

Detailed Evaluation Required

[✓ **YES**] **NO**

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

Suite 300
1285 West Broadway
Vancouver, BC V6H 3X8
Canada

604 738-0048
Fax 604 738-1107
www.rjc.ca

July 3, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for 261 Central Street, Vancouver, BC   RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of 261 Central Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
261 Central St.	1.2	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 1.2 means there is a 6% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Original structural drawings were not available.

A brief review of the building mechanical equipment indicated that equipment appears to be partially seismically restrained or unrestrained.

Pounding from adjacent buildings, to the East and West, is a potential hazard.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would [redacted] +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Design Engineer

D. S. GAM
#27414 JUL 0 4 2013

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

---

[1] No applicable material design standard with seismic provisions.
[2] Post North Ridge details in CSA S16-01
[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

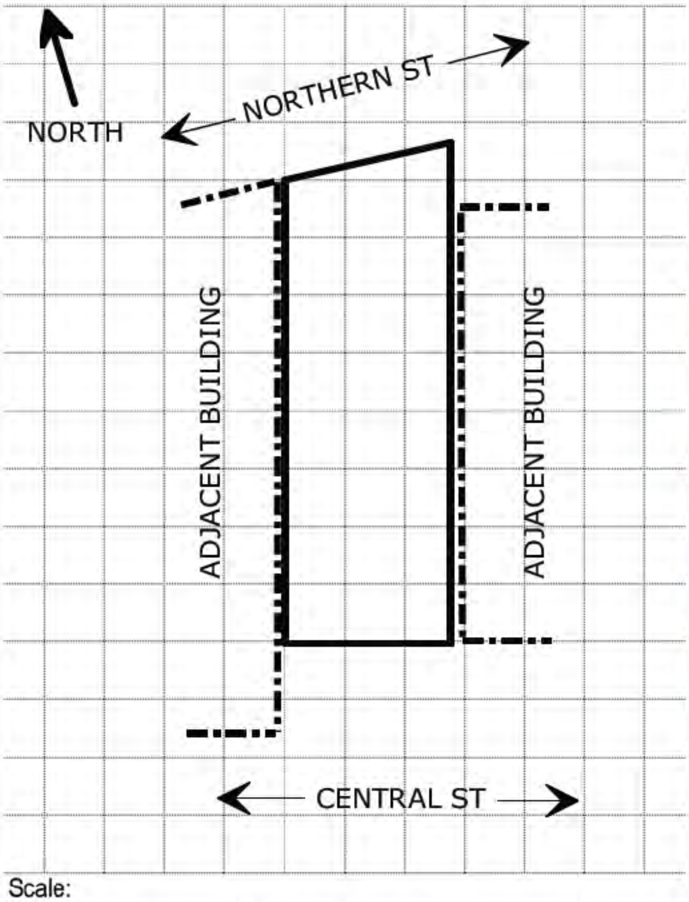
A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 261 CENTRAL ST, VANCOUVER, BC

Zip V6A 1B6

Other Identifiers

No. Stories 1 + MEZZANINE **Year Built** 1930?

Screener NAB **Date** JUNE 18, 2013

Total Floor Area (sq. ft.) 5,000 SQ.FT

Building Name

Use WORK SHOP

EAST WALL (FROM INTERIOR)

SOUTH ELEVATION

OCCUPANCY **SOIL**

Assembly Govt Office
Commercial Historic Residential
Emer. Services [✓ Industrial] School

Number of Persons
0 – 10 [✓ 11 – 100]
101-1000 1000+

TYPE

A Hard Rock
B Avg. Rock
C Dense Soil
[✓ D Stiff Soil]
[✓ E Soft Soil]
F Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☒ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, *S*

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	[✓ RM1 (FD)]	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	[✓ 2.8]	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	[✓ -1.0]	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	[✓ -0.6]	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	[✓ -0.4]	-0.6	-0.8

FINAL SCORE, *S* 1.2 TO 1.4

COMMENTS

Drawings were not made available during the review. Structure appeared to be wood post and beam interior framing with wood decking, and reinforced masonry walls. Reinforcing was observed in one of the block pilasters at a block face shell spall location.
Pounding is a potential hazard from adjacent buildings (on East and West sides).

Detailed Evaluation Required

[✓ **YES**] **NO**

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

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1285 West Broadway
Vancouver, BC V6H 3X8
Canada

604 738-0048
Fax 604 738-1107
www.rjc.ca

July 3, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review
for 270 Terminal Street, Vancouver, BC   RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of 270 Terminal Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
270 Terminal St.	0	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 0.9 represents a 13% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Original structural drawings were not available.

A brief review of the building mechanical equipment indicated that equipment appears to be partially seismically restrained or unrestrained.

The brick cladding and parapets on the building exterior represent potential fall hazards.

Pounding from the adjacent building, to the West, is a potential hazard.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Design Engineer

D. S. GAM
JUL 0 4 2013

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154)

Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:

		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
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Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
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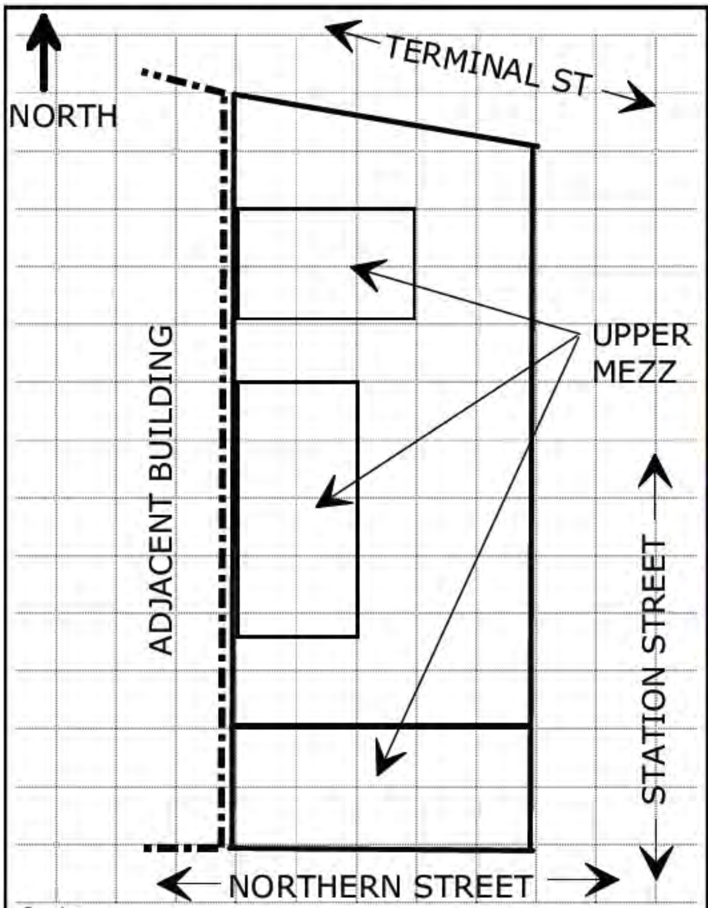
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 270 TERMINAL ST, VANCOUVER, BC
Zip V6A 2L6
Other Identifiers
No. Stories 2 **Year Built** 1947
Screener NAB **Date** June 19, 2013
Total Floor Area (sq. ft.) 13,000 SQ. FT.
Building Name
Use WAREHOUSE & SHOWROOM

WEST WALL (FROM INTERIOR)

NORTH ELEVATION

OCCUPANCY			**SOIL**		**TYPE**						**FALLING HAZARDS**			
Assembly	Govt	Office	Number of Persons		A	B	C	[✓ D]	[✓ E]	F	☐	☒	☒	☐
[✓ Commercial]	Historic	Residential	0 – 10	[✓ 11 – 100]	Hard Rock	Avg. Rock	Dense Soil	[✓ Stiff Soil]	[✓ Soft Soil]	Poor Soil	Unreinforced Chimneys	Parapets	Cladding	Other:
Emer. Services	[✓ Industrial]	School	101-1000	1000+										

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	**W1**	**W2**	**S1** (MRF)	**S2** (BR)	**S3** (LM)	**S4** (RC SW)	**S5** (URM INF)	**C1** (MRF)	[✓ **C2** (SW)]	**C3** (URM INF)	**PC1** (TU)	**PC2**	**RM1** (FD)	**RM2** (RD)	**URM**
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	[✓ 2.8]	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	[✓ -1.0]	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	[✓ -0.6]	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	[✓ -0.8]	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8

FINAL SCORE, S 0 TO 0.2

COMMENTS

Drawings were not made available during the review. Structure appeared to be steel beams spanning to concrete walls, with wood joists and roof decking; cripple walls used to slope roof. Brick cladding on North side and parapets are potential fall hazards. Pounding is a potential hazard from adjacent building (on West side).

Detailed Evaluation Required [✓ **YES**] **NO**

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

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Read Jones Christoffersen
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July 3, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for 271 Central Street, Vancouver, BC RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of 271 Central Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
271 Central St.	0.5	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 1.1 represents an 8% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Original structural drawings were not available.

A brief review of the building mechanical equipment indicated that equipment appears to be partially seismically restrained or unrestrained.

Pounding from adjacent building, to the West, is a potential hazard.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

D. S. GAM
#27414
JUL 0 4 2013

Nicole Babuik, EIT, LEED® AP
Design Engineer

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

---

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

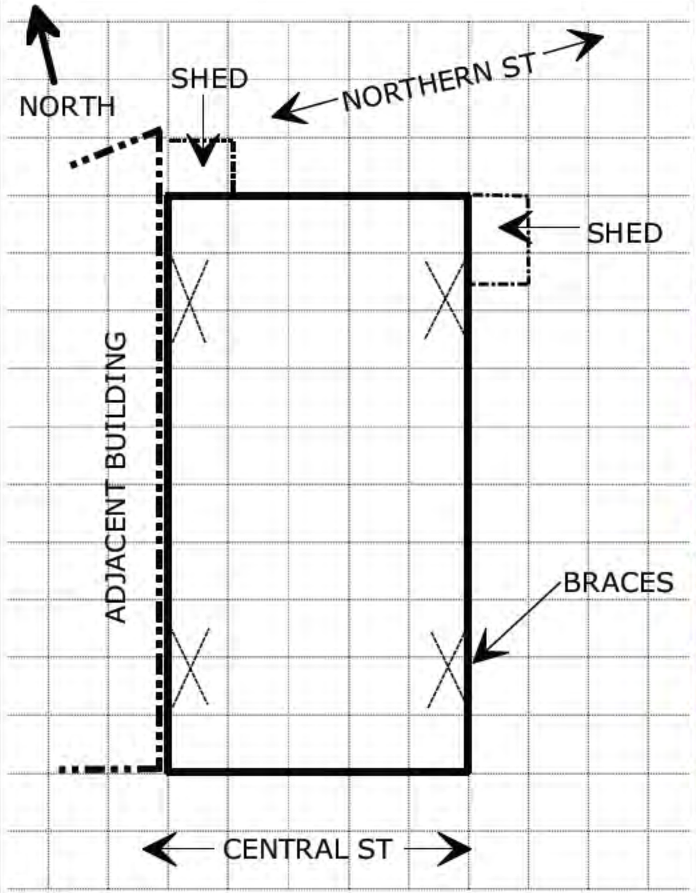
Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards
FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 271 CENTRAL STREET, VANCOUVER, BC
Zip V6A 1B6
Other Identifiers
No. Stories 1 **Year Built** 1930?
Screener NAB **Date** JUNE 18, 2013
Total Floor Area (sq. ft.) 7,000 SQ.FT.
Building Name
Use WAREHOUSE / MACHINE SHOP


EAST WALL (FROM INTERIOR)


NORTH ELEVATION

OCCUPANCY			**SOIL**							**FALLING HAZARDS**			
Assembly Commercial Emer. Services	Govt Historic [✓ Industrial]	Office Residential School	Number of Persons 0 – 10 [✓ 11 – 100] 101-1000 1000+	A Hard Rock	B Avg. Rock	C Dense Soil	[✓ D Stiff Soil]	[✓ E Soft Soil]	F Poor Soil	☐ Unreinforced Chimneys	☐ Parapets	☐ Cladding	☒ Other:

TYPE

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	**W1**	**W2**	**S1 (MRF)**	**[✓ S2 (BR)]**	**S3 (LM)**	**S4 (RC SW)**	**S5 (URM INF)**	**C1 (MRF)**	**C2 (SW)**	**C3 (URM INF)**	**PC1 (TU)**	**PC2**	**RM1 (FD)**	**RM2 (RD)**	**URM**
Basic Score	4.4	3.8	2.8	[✓ 3.0]	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	[✓ -0.8]	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	[✓ -0.6]	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	[✓ -1.2]	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8

FINAL SCORE, S 0.5 TO 1.1

COMMENTS

Drawings were not made available during the review. Structure appeared to be steel braced frames with OWSJs and steel deck roof.
Pounding is a potential hazard from adjacent building (on West side).

Detailed Evaluation Required

[✓ **YES**] **NO**

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

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July 12, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for 312 & 324 Main Street
312 & 324 Main Street, Vancouver, BC
RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of the building located at 312 & 324 Main Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", a review of architectural drawings, and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
312 & 324 Main Street	0.0	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 1.0 represents a 10% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Architectural drawings were made available after our site visit. Original structural drawings were not available.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained. However, unrestrained interior storage racks and shop equipment were observed. In addition, the following elements on the building exterior represent potential fall hazards: masonry chimney; parapet; and wall cladding panels. Pounding from the adjacent building, along the south and east side, is a potential hazard.

There are many concrete masonry partition walls that appear to be part of the original construction that may require additional restraint.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s. 17(1)(f) /alue added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Hardeep Gill, EIT
Design Engineer

D. S. GAM
July 15/13
Dennis Gam, M.Eng., P.Eng.
Associate

HG/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

[1] No applicable material design standard with seismic provisions.
[2] Post North Ridge details in CSA S16-01
[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

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Consulting Engineers

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July 03, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Firehall No. 19
4396 West 12th Avenue, Vancouver, BC RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Firehall No. 19 located at 4396 West 12th Avenue, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", a review of drawings, and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
4396 West 12th Avenue	1.4	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 1.4 means there is a 4% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be moderate to low.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available prior to our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained.

There were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Hardeep Gill, EIT
Design Engineer

Dennis Gam, M.Eng., P.Eng.
Associate

HG/gb

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be moderate to low.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available prior to our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

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There were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

for Hardeep Gill, EIT
Design Engineer

D. E. GAM
JUL 0 4 2013

Dennis Gam, M.Eng., P.Eng.
Associate

HG/gb

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
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Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
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Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
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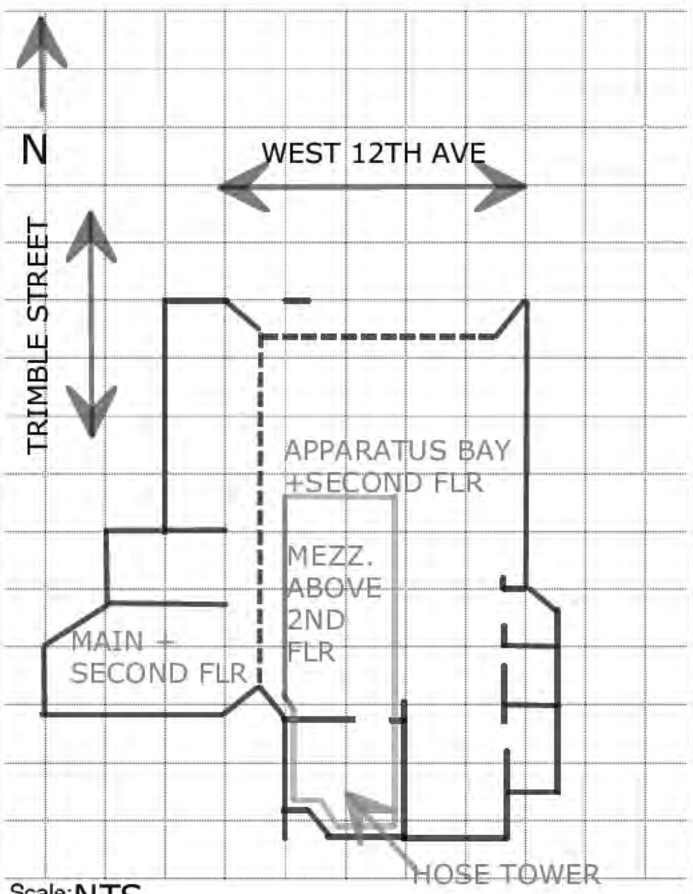
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale: NTS

Address: 4396 WEST 12TH AVENUE
VANCOUVER, BC **Zip**

Other Identifiers

No. Stories 2+MEZZ. **Year Built** 1978

Screener HSG **Date** JUNE 28/2013

Total Floor Area (sq. ft.) 6,629

Building Name FIREHALL NO.19

Use FIREHALL

NORTH ELEVATION

OCCUPANCY

Assembly | Govt | Office
Commercial | Historic | Residential
[✓ Emer. Services] | Industrial | School

SOIL

Number of Persons
0 – 10 [✓ 11 – 100]
101-1000 1000+

TYPE

A Hard Rock | B Avg. Rock | [✓ C Dense Soil] | D Stiff Soil | E Soft Soil | F Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☐ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	[✓ 2.8]	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	[✓ -1.0]	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S									1.4						

COMMENTS

- NBC 1977
- Mechanical equipments appear to be restrained

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

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June 25, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for the Aquatic Centre
1204 Beach Avenue, Vancouver, BC
RJC No.: VAN.107317.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of the Aquatic Centre located at 1204 Beach Avenue, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", a review of drawings, and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Aquatic Centre	0	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 1.0 represents a 15% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available prior to our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment does not appear to be seismically restrained.

There were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Design Engineer

D. S. GAM
JUN 25 2013

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

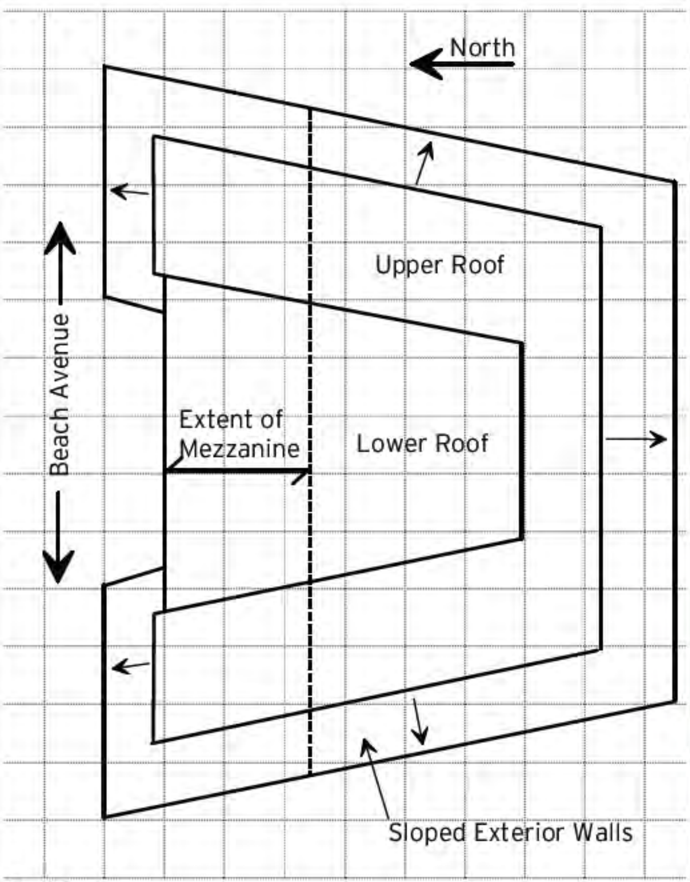
Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards
FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 1204 Beach Ave, Vancouver, BC
Zip V6E 1T7
Other Identifiers
No. Stories 1 + basement and mezzanine **Year Built** 1972
Screener NAB **Date** April 9, 2013
Total Floor Area (sq. ft.) 65,000 sq.ft.
Building Name Vancouver Aquatic Centre
Use

OCCUPANCY **SOIL**

[✓ Assembly] Govt Office
Commercial Historic Residential
Emer. Services Industrial School

Number of Persons
0 – 10 11 – 100
[✓ 101-1000] 1000+

TYPE

A Hard Rock
B Avg. Rock
C Dense Soil
[✓ D Stiff Soil]
E Soft Soil
F Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys
☐ Parapets
☐ Cladding
☐ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, *S*

BUILDING TYPE	**W1**	**W2**	**S1** (MRF)	**S2** (BR)	**S3** (LM)	**S4** (RC SW)	**S5** (URM INF)	**C1** (MRF)	**C2** (SW)	**C3** (URM INF)	**PC1** (TU)	[✓ **PC2**]	**RM1** (FD)	**RM2** (RD)	**URM**
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	[✓ 2.4]	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	[✓ -1.0]	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	[✓ -0.8]	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	[✓ -0.6]	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, *S*												0			

COMMENTS

Drawings indicate building was designed to VBBL #4193 (Effective 1965).
Inclined exterior walls are a vertical irregularity.

Detailed Evaluation Required

[✓ **YES**] **NO**

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal
MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm
SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

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1285 West Broadway
Vancouver, BC V6H 3X8
Canada

604 738-0048
Fax 604 738-1107
www.rjc.ca

June 21, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Douglas Park Community Centre
801 West 22 Ave, Vancouver, BC RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Douglas Park Community Centre located at 801 West 22 Ave, in Vancouver. This evaluation included a "rapid visual seismic screening" and a walk-through site inspection. The "rapid visual seismic screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
801 West 22 Ave	0.2	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 1.0 represents a 15% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Original structural drawings were not available. We have assumed the building seismic force resisting system primarily consists of unreinforced masonry.

A brief tour of the mechanical spaces and the roof indicated that base building equipment does not appear to be seismically restrained.

There were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Jun 20/13

Hanif Shariff, B.Eng., EIT
Design Engineer

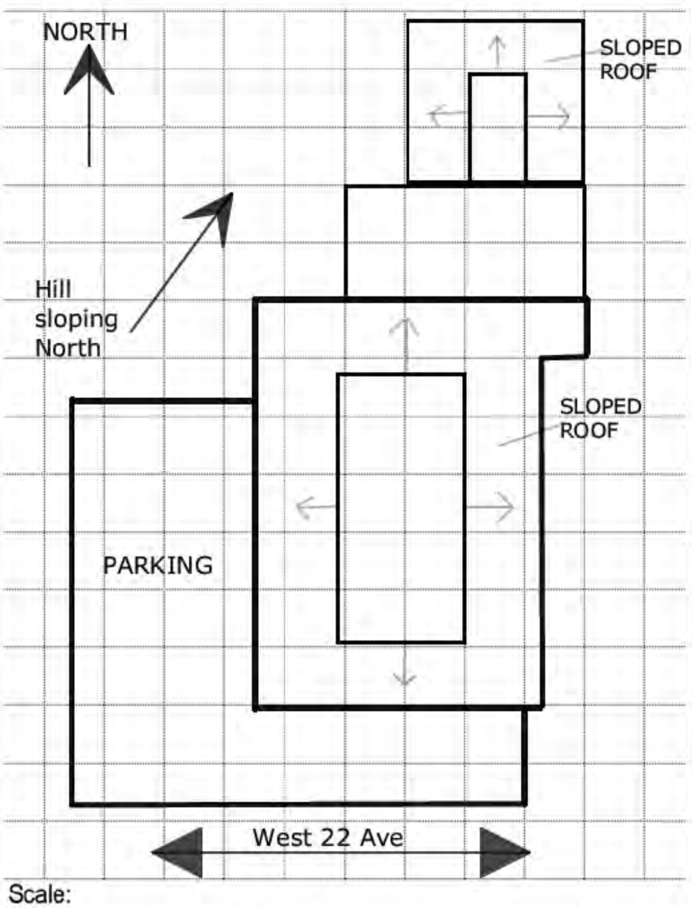
Dennis Gam, M.Eng., P.Eng.
Associate

HS/gb

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 801 W 22 Ave, Vancouver, BC

Zip V5Z 1Z8

Other Identifiers

No. Stories 2 **Year Built** 1960

Screener HZS **Date** April 12, 2013

Total Floor Area (sq. ft.) 20,837 SF

Building Name Douglas Park Community Centre

Use Mixed Use; Community Centre

OCCUPANCY

[✓ Assembly] Govt [✓ Office]

Commercial Historic Residential

Emer. Services Industrial [✓ School]

Number of Persons

0 – 10 11 – 100

[✓ 101-1000] 1000+

SOIL

A	B	C	D	E	F
Hard Rock	Avg. Rock	[✓ Dense Soil]	Stiff Soil	Soft Soil	Poor Soil

TYPE

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☐ Other: ______

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	[✓ URM]
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	2.8	[✓ 1.8]
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	[✓ -1.0]
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	[✓ -0.2]
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8

FINAL SCORE, S 0.2

COMMENTS

Drawings were not made available during review; information available indicates building was designed pre-code;
Mechanical equipment did not appear to be restrained;
Vertical irregularity, as building is on a hill.

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

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June 25, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Evelyne Saller Centre
320 Alexander Street, Vancouver, BC
RJC No.: VAN.107317.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Evelyne Saller Centre located at 320 Alexander Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Evelyne Saller Centre	1.3	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 1.3 means there is a 5% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Original structural drawings were not available. We have assumed the building seismic force resisting system primarily consists of concrete shearwalls.

A brief tour of the mechanical spaces and the second and third floor roofs indicated that base building equipment appears to be partially seismically restrained or unrestrained.

The following elements on the building exterior represent potential fall hazards:

- Parapets
- Brick veneer

Pounding from adjacent buildings, to the East and West, is a potential hazard.

There were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] -value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Design Engineer

D. S. GAM
#27414
JUN 2 5 2013

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

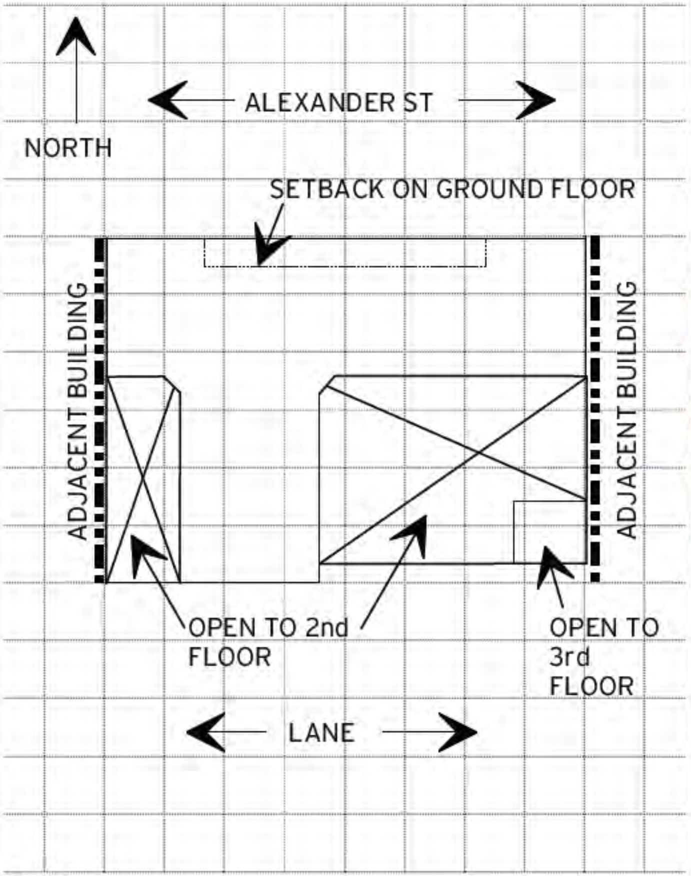
A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 320 Alexander Street, Vancouver, BC
Zip V6A 1C3
Other Identifiers
No. Stories 5 **Year Built** 1986
Screener NAB **Date** April 17, 2013
Total Floor Area (sq. ft.) 60,000 SQ FT (Approx)
Building Name Evelyne Saller Centre
Use Community Centre


NORTH ELEVATION

SOUTH ELEVATION

OCCUPANCY **SOIL**

[✓ Assembly] Govt Office
Commercial Historic [✓ Residential]
Emer. Services Industrial School

Number of Persons
0 – 10 11 – 100
[✓ 101-1000] 1000+

TYPE

A	B	C	D	E	F
Hard Rock	Avg. Rock	[✓ Dense Soil]	Stiff Soil	Soft Soil	Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys ☒ Parapets ☒ Cladding ☐ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, *S*

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	[✓ C2 (SW)]	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	[✓ 2.8]	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	[✓ +0.4]	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	[✓ -1.0]	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, *S*									**1.3**						

COMMENTS

Structural drawings were not available for review. One architectural plan was available for review on site which indicated year of construction to be 1986. Ground floor was reviewed as part of the Evelyne Saller Centre facility condition assessment; structure appeared to be concrete slab, slab band, column and wall construction. Upper floors and west half of building were not reviewed, as they are Veterans Memorial Housing.

Parapets, and brick/tile finishes present on North (front) side of building are potential fall hazards. Pounding is a potential hazard from adjacent buildings (East and West sides). Mechanical equipment observed appeared to be partially restrained.

Detailed Evaluation Required

[✓ **YES**] **NO**

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

Suite 300
1285 West Broadway
Vancouver, BC V6H 3X8
Canada

604 738-0048
Fax 604 738-1107
www.rjc.ca

June 25, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for False Creek Community Centre
1318 Cartwright Street, Vancouver, BC RJC No.: VAN.107317.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of False Creek Community Centre located at 1318 Cartwright Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
False Creek Community Centre	1.5	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 1.5 means there is a 3% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Original structural drawings were not available. We have assumed the building seismic force resisting system is governed by the majority of the building which appears to be heavy timber wood (post and beam) framing.

A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be partially seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, and the number of phases of different construction, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would be s.17(1)(f) +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Design Engineer

D. S. GAM
JUN 2 5 2013

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

---

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

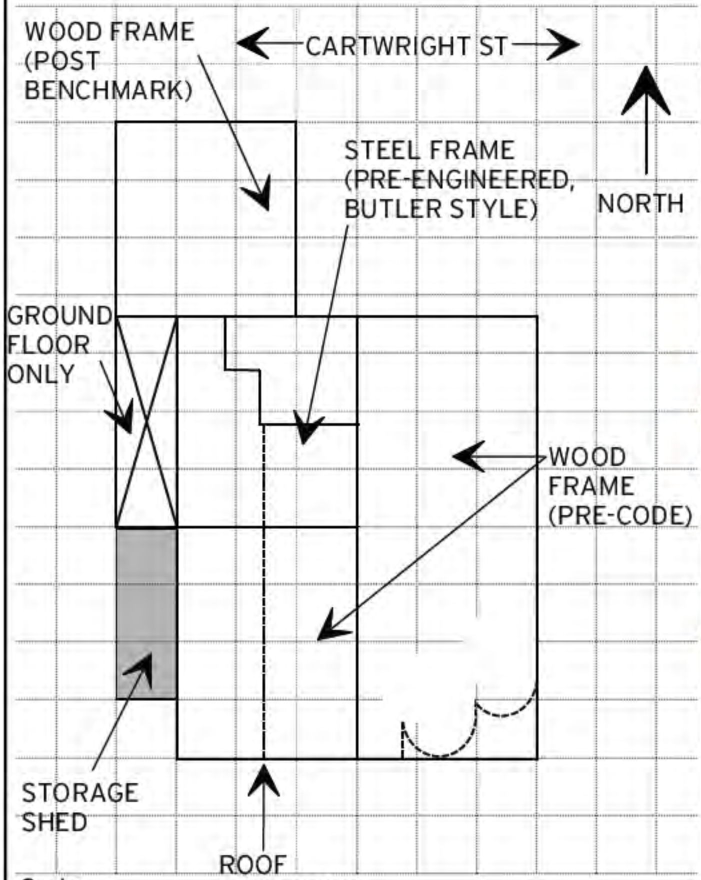
Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards
FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 1318 Cartwright Street, Vancouver, BC
Zip V6H 3R9
Other Identifiers
No. Stories 2 **Year Built** Unknown
Screener NAB **Date** May 7, 2013
Total Floor Area (sq. ft.) 25,000 SQ FT
Building Name False Creek Community Centre
Use Community Centre


WEST SIDE

WOOD FRAME (PRE-CODE)

OCCUPANCY			SOIL						FALLING HAZARDS
[✓ Assembly] Commercial Emer. Services	Govt Historic Industrial	Office Residential School	Number of Persons 0 – 10 11 – 100 [✓ 101-1000] 1000+	A Hard Rock B Avg. Rock	C Dense Soil D Stiff Soil	[✓ E Soft Soil] F Poor Soil			☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☐ Other:

TYPE: A Hard Rock, B Avg. Rock, C Dense Soil, D Stiff Soil, [✓ E Soft Soil], F Poor Soil

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	[✓ W2]	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	[✓ 3.8]	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	[✓ -0.5]	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	[✓ -1.0]	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	[✓ -0.8]	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S		1.5													

COMMENTS

Drawings were not made available during the review; majority of building appeared to be wood frame (pre-code).

Mechanical equipment observed, appeared to be restrained or partially restrained.

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

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July 3, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Firehall #14
2804 Venables Street, Vancouver, BC
RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Firehall #14 located at 2804 Venables Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", a review of drawings, and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Firehall #14	1.2	YES	NO

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 1.2 means there is a 6% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available after our site visit. In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained.

The brick cladding and parapets on the building exterior represent potential fall hazards.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

D. S. GAM
#27414

JUL 0 4 2013

Nicole Babuik, EIT, LEED® AP
Design Engineer

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

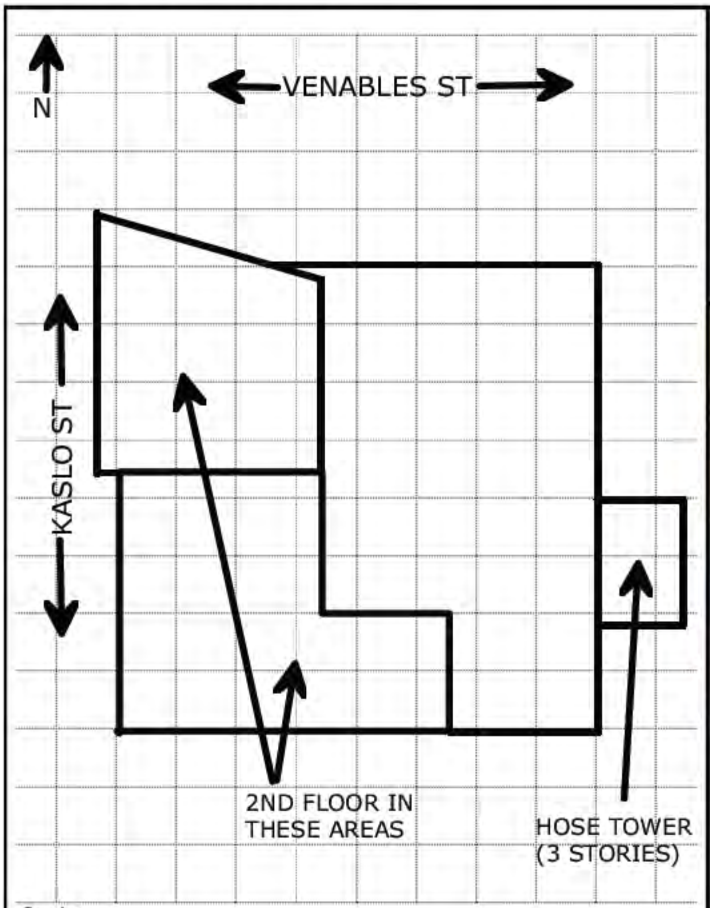
A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 2804 VENABLES STREET, VANCOUVER, BC

Zip V5K 4B6

Other Identifiers

No. Stories 2 **Year Built** 1982

Screener NAB **Date** JUNE 11, 2013

Total Floor Area (sq. ft.) 7,000 SQ.FT

Building Name FIREHALL NO.14

Use FIREHALL

EAST EXTERIOR WALL (FROM INTERIOR)

NORTH ELEVATION

OCCUPANCY

Assembly, Commercial, [✓ Emer. Services], Govt, Historic, Industrial, Office, Residential, School

Number of Persons: 0 – 10, [✓ 11 – 100], 101-1000, 1000+

SOIL / TYPE

A	B	C	D	E	F
Hard Rock	Avg. Rock	Dense Soil	[✓ Stiff Soil]	[✓ Soft Soil]	Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys ☒ Parapets ☒ Cladding ☐ Other: ____

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	[✓ RM1 (FD)]	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	[✓ 2.8]	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	[✓ -1.0]	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	[✓ -0.6]	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	[✓ -0.4]	-0.6	-0.8

FINAL SCORE, *S* 1.2 TO 1.4

COMMENTS

Drawings indicate building was designed in accordance with the 1977 National Building Code and VBBL #4702 (effective 1973).
Brick cladding and parapets are potential fall hazards.
Mechanical equipment observed appeared to typically be restrained.

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

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1285 West Broadway
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604 738-0048
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July 8, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review - Firehall #21
5425 Carnarvon Street, Vancouver, BC RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Firehall #21 located at 5425 Carnarvon Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", a review of drawings, and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Firehall #21	2.4	NO	NO

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 2.4 means there is a 0.4% (=1/(10^S) x 100%) probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be moderate to low.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available prior to our site visit. In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained.

The brick veneer cladding on the building exterior represents a potential fall hazard.

There were areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening result, and assuming that this facility is NOT intended to be a post-disaster building, a detailed quantitative assessment of the seismic force resisting system elements does not appear to be required.

Yours truly,
Read Jones Christoffersen Ltd.

Hanif Shariff, B.Eng., EIT
Design Engineer

D. S. GAM
July 8/13

Dennis Gam, M.Eng., P.Eng.
Associate

HS/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

---

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

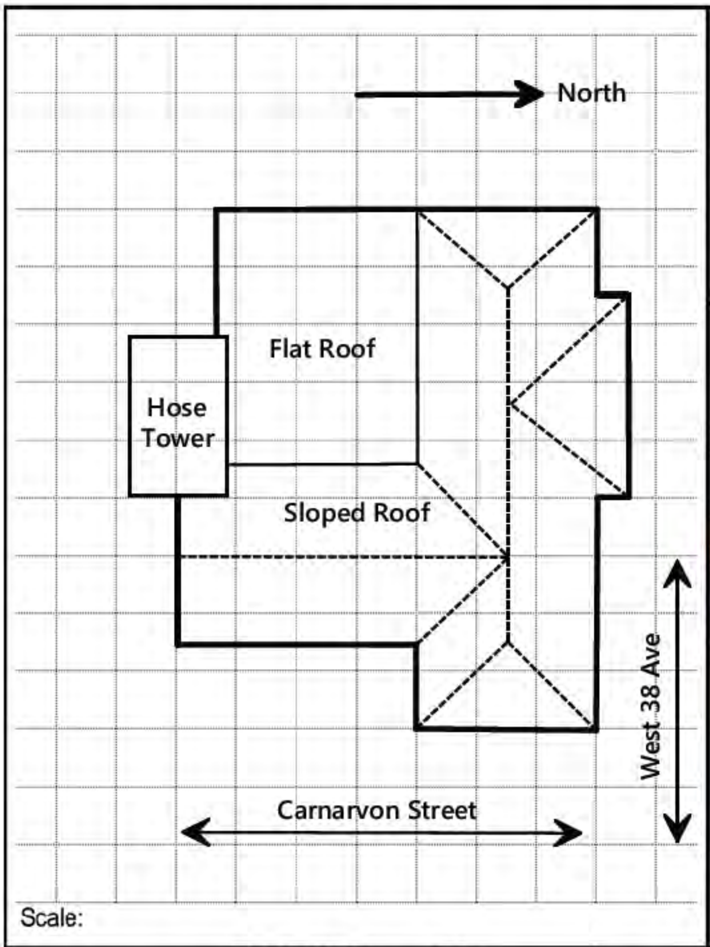
Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards
FEMA-154 Data Collection Form

HIGH Seismicity



Address: 5425 Carvarvon Street, Vancouver, BC
Zip V6N 2X4
Other Identifiers
No. Stories 2 **Year Built** 1984
Screener HS **Date** June 12, 2013
Total Floor Area (sq. ft.) 6,980 SF
Building Name Firehall #21
Use Firehall

OCCUPANCY
Assembly Govt Office
Commercial Historic Residential
[✓ Emer. Services] Industrial School

SOIL
Number of Persons
0 – 10 [✓ 11 – 100]
101-1000 1000+

TYPE
A Hard Rock
B Avg. Rock
[✓ C Dense Soil]
D Stiff Soil
E Soft Soil
F Poor Soil

FALLING HAZARDS
☐ Unreinforced Chimneys
☐ Parapets
☒ Cladding
☐ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	[✓ RM2 (RD)]	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	[✓ 2.8]	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S														**2.4**	

COMMENTS

Design Code not shown on drawings; based on Construction date, assumed to be designed VBBL No. 5190 (effective 1978);
Mechanical equipment appears to be restrained;

Detailed Evaluation Required

YES [✓ NO]

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

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1285 West Broadway
Vancouver, BC V6H 3X8
Canada

604 738-0048
Fax 604 738-1107
www.rjc.ca

July 8, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening – Firehall #22
1005 West 59 Ave, Vancouver, BC
RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Firehall #22 located at 1005 West 59 Ave, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", a review of drawings, and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Firehall #22	1.9	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 1.9 means there is a 1.3% (=1/(10^S) x 100%) probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be moderate to high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available prior to our site visit. In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained.

The brick veneer cladding on the building exterior represents a potential fall hazard.

There were areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Hanif Shariff, B.Eng., EIT
Design Engineer

July 8/13
D. S. GAM
Dennis Gam, M.Eng., P.Eng.
Associate

HS/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:

		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

---

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
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Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
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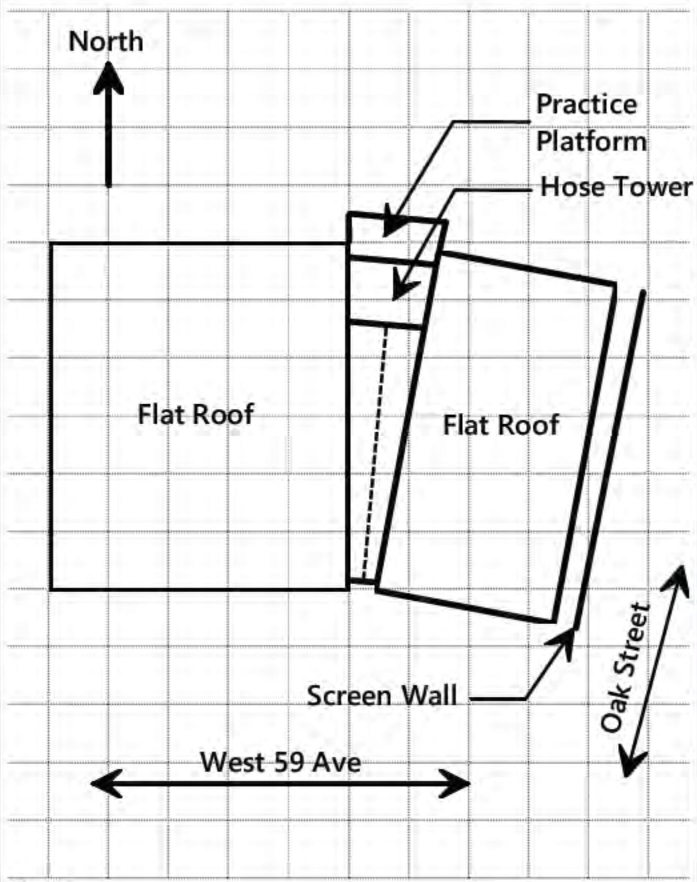
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 1005 West 59 Ave, Vancouver, BC

Zip V6P 1Y2

Other Identifiers

No. Stories 2

Year Built 1981

Screener HS

Date June 12, 2013

Total Floor Area (sq. ft.) 8,184 SF

Building Name Firehall #22

Use Firehall

OCCUPANCY **SOIL**

Assembly Govt Office
Commercial Historic Residential
[✓ Emer. Services] Industrial School

Number of Persons
0 – 10 [✓ 11 – 100]
101-1000 1000+

TYPE

A Hard Rock
B Avg. Rock
[✓ C Dense Soil]
D Stiff Soil
E Soft Soil
F Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☒ Cladding ☐ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	[✓ RM1 (FD)]	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	[✓ 2.8]	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S													1.9		

COMMENTS

Design Code not shown on drawings; based on Construction date, assumed to be designed to VBBL No. 5190 (effective 1978);
Plan irregularity due to eccentric wall layout;
Mechanical equipment appears to be restrained.

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
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URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

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1285 West Broadway
Vancouver, BC V6H 3X8
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June 25, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Firehall #7
1090 Haro Street, Vancouver, BC
RJC No.: VAN.107317.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Firehall #7 located at 1090 Haro Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", a review of drawings, and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Firehall #7	0.4	YES	NO

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 1.0 represents a 15% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available prior to our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided. A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained.

There are many concrete masonry partition walls that appear to be part of the original construction. These walls may not be reinforced given the era of construction and do not appear to be anchored to the undersides of their respective slabs.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

JUN 25 2013
D. S. GAM
#27414

Nicole Babuik, EIT, LEED® AP
Design Engineer

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
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S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

[1] No applicable material design standard with seismic provisions.
[2] Post North Ridge details in CSA S16-01
[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

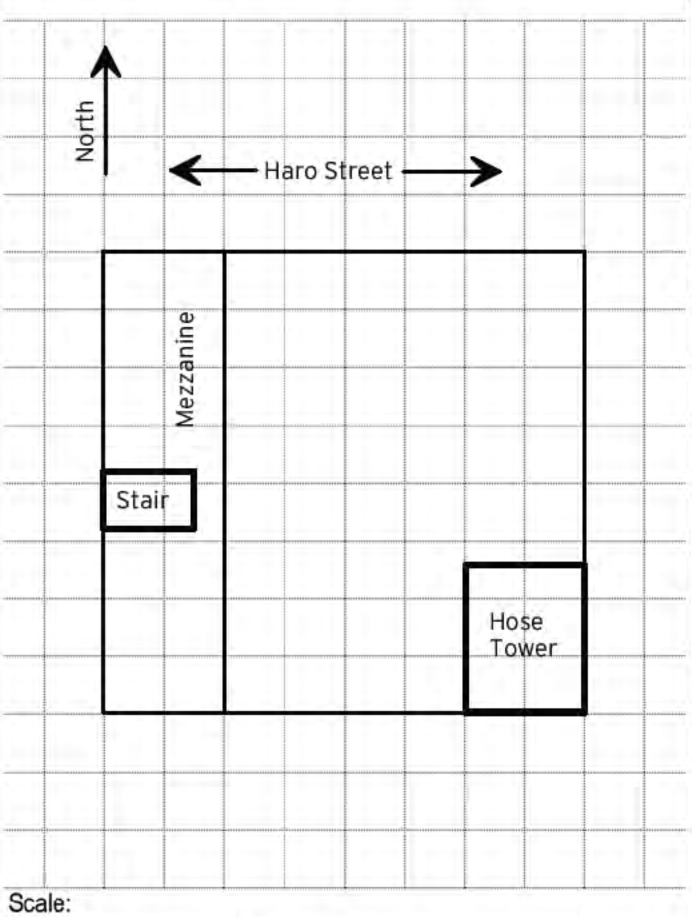
A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 1090 Haro Street, Vancouver, BC

Zip V6E 3Z8

Other Identifiers

No. Stories 2 + mezzanine **Year Built** 1973

Screener NAB **Date** April 18, 2013

Total Floor Area (sq. ft.) 9,000 sq.ft.

Building Name Firehall No.7

Use Firehall

OCCUPANCY SOIL TYPE FALLING HAZARDS

Assembly	Govt	Office	Number of Persons
Commercial	Historic	Residential	0 – 10 [✓ 11 – 100]
[✓ Emer. Services]	Industrial	School	101-1000 1000+

A	B	C	D	E	F
Hard Rock	Avg. Rock	[✓ Dense Soil]	Stiff Soil	Soft Soil	Poor Soil

☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☐ Other: ______

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	[✓ C2 (SW)]	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	**4.4**	**3.8**	**2.8**	**3.0**	**3.2**	**2.8**	**2.0**	**2.5**	**[✓ 2.8]**	**1.6**	**2.6**	**2.4**	**2.8**	**2.8**	**1.8**
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	[✓ -1.0]	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	[✓ -1.0]	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S									0.4						

COMMENTS

Drawings indicate building was designed to VBBL #4193 (Effective 1965).
Hose tower represents a vertical irregularity.
Based on a review of the drawings, hose tower has no zone steel.

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

Suite 300
1285 West Broadway
Vancouver, BC V6H 3X8
Canada

604 738-0048
Fax 604 738-1107
www.rjc.ca

June 25, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Firehall #8
895 Hamilton Street, Vancouver, BC
RJC No.: VAN.107317.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Firehall #8 located at 895 Hamilton Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", a review of drawings, and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Firehall #8	1.4	YES	NO

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 1.4 means there is a 4% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available prior to our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided. A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained.

Pounding from the adjacent building, to the North, is a potential hazard.

There are many concrete masonry partition walls that appear to be part of the original construction. These walls may not be reinforced given the era of construction and do not appear to be anchored to the undersides of their respective slabs.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Design Engineer

JUN 25 2013
D. S. GAM
#27414

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

---

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
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Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
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Construction Joints	Buildings are usually not built “in one piece”. They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
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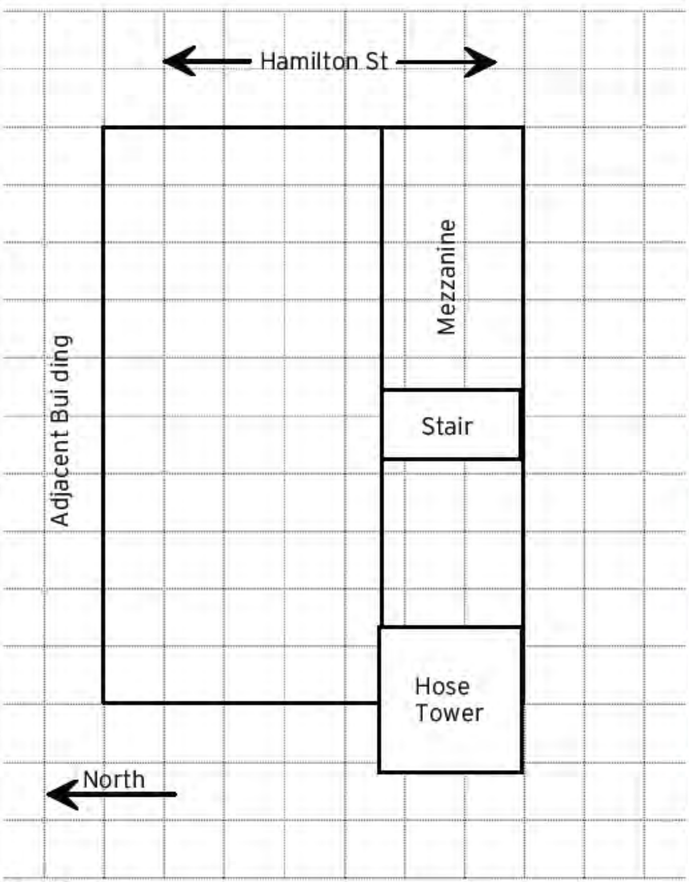
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 895 Hamilton Street, Vancouver, BC
Zip V6B 6A1
Other Identifiers
No. Stories 2 + mezzanine **Year Built** 1974
Screener NAB **Date** April 18, 2013
Total Floor Area (sq. ft.) 8,000 sq.ft.
Building Name Firehall No.8
Use Firehall

East Elevation

OCCUPANCY

Assembly Govt Office
Commercial Historic Residential
[✓ Emer. Services] Industrial School

SOIL

Number of Persons
0 – 10 [✓ 11 – 100]
101-1000 1000+

TYPE

A Hard Rock
B Avg. Rock
[✓ C Dense Soil]
D Stiff Soil
E Soft Soil
F Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☐ Other: ____

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	[✓ C2 (SW)]	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	[✓ 2.8]	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	[✓ -1.0]	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S									1.4						

COMMENTS

Drawings indicate building was designed to VBBL #4193 (Effective 1965).
Based on a review of the drawings, hose tower has no zone steel.
Hose tower does not project past height of roof parapet.

Detailed Evaluation Required

[✓ **YES**] **NO**

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

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1285 West Broadway
Vancouver, BC V6H 3X8
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July 3, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Firehall #9
1805 Victoria Drive, Vancouver, BC
RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Firehall #9 located at 1805 Victoria Drive, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Firehall #9	-0.4	YES	NO

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 0.8 represents a 15% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available after our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained.

The brick cladding on the building exterior represents a potential fall hazard.

There are many concrete masonry partition walls that appear to be part of the original construction. These walls may not be reinforced given the era of construction and do not appear to be anchored to the undersides of their respective slabs.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] -value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Design Engineer

D. S. GAM
27474
JUL 04 2013

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

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S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
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PC1	Tilt-up construction	1970	1985
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URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

---

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
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Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
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A3 Additional Definitions

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Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
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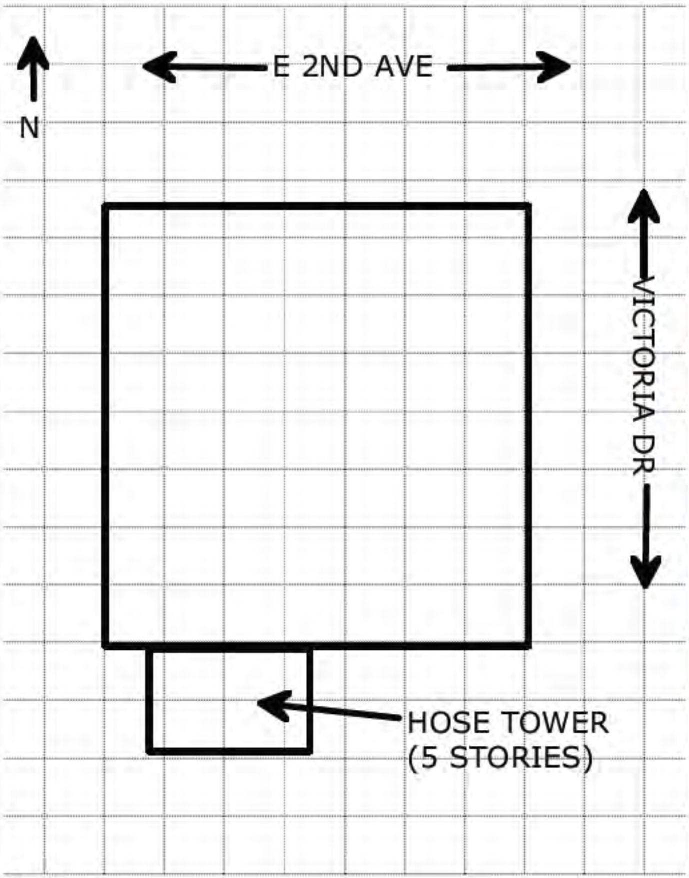
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards
FEMA-154 Data Collection Form

HIGH Seismicity

Address: 1805 VICTORIA DRIVE, VANCOUVER, BC
Zip V5N 4K2
Other Identifiers
No. Stories 2 **Year Built** 1959
Screener NAB **Date** JUNE 11, 2013
Total Floor Area (sq. ft.) 7,500 SQ.FT
Building Name FIREHALL NO.9
Use FIREHALL



Scale:

HOSE TOWER

NORTH ELEVATION

OCCUPANCY **SOIL** **TYPE**

Assembly Govt Office
Commercial Historic Residential
[✓ Emer. Services] Industrial School

Number of Persons
0 – 10 [✓ 11 – 100]
101-1000 1000+

A Hard Rock
B Avg. Rock
C Dense Soil
[✓ D Stiff Soil]
[✓ E Soft Soil]
F Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☒ Cladding ☐ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	**W1**	**W2**	**S1 (MRF)**	**S2 (BR)**	**S3 (LM)**	**S4 (RC SW)**	**S5 (URM INF)**	**C1 (MRF)**	**C2 (SW)**	[✓ **C3 (URM INF)**]	**PC1 (TU)**	**PC2**	**RM1 (FD)**	**RM2 (RD)**	**URM**
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	[✓ 1.6]	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	[✓ -1.0]	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	[✓ -0.2]	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	[✓ -0.4]	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	[✓ -0.8]	-0.4	-1.2	-0.4	-0.6	-0.8

FINAL SCORE, S -0.4 TO 0

COMMENTS

Drawings were not made available during the review. Structure (including hose tower) appeared to be concrete frame with unreinforced masonry infill.
Exterior brick cladding is a potential fall hazard.
Mechanical equipment observed appeared to be restrained.

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

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March 7, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan, Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review - Firehall No. 1
900 Heatley Avenue, Vancouver, BC
RJC No.: VAN.107371.0001

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of the building located at 900 Heatley Avenue, in Vancouver. This evaluation included a "rapid visual seismic screening", a review of drawings, and a walk-through site inspection. The "rapid visual seismic screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S"SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
900 Heatley Ave	0.6	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw, which has a probability of exceedance equal to 0.04% per annum.

For this building type, an S score of 0.9 or less means there is a 13% probability of collapse given the occurrence of the design earthquake in the current VBBL.

The S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available after our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided. A brief tour of major mechanical spaces indicated that base building equipment appears to be seismically restrained. However, unrestrained storage racks and shop equipment were observed.

There are many concrete block masonry partition walls that appear to be part of the original construction. These walls may not be reinforced given the era of construction and do not appear to be anchored to the undersides of their respective slabs.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting system elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system; and concerns related to interior masonry partition walls being fall hazards.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] -value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Building Science and Restoration

MAR 08 2013

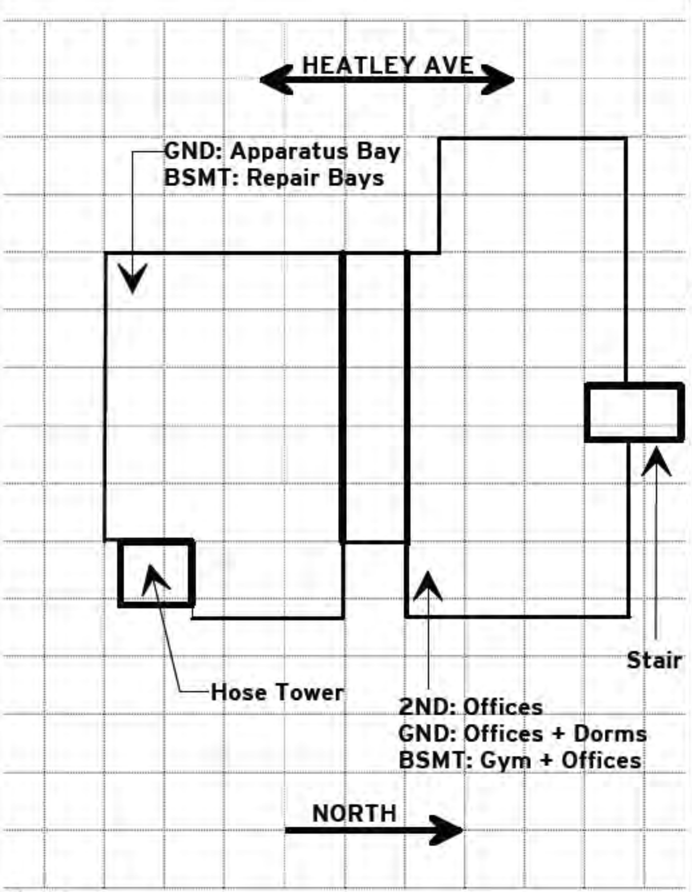
Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 900 Heatley Avenue
Vancouver, BC Zip V6A 3S7
Other Identifiers
No. Stories 2 + Basement Year Built 1973
Screener NB Date February 14, 2013
Total Floor Area (sq. ft.) 31,500 SF
Building Name Firehall No.1
Use Firehall and offices.

OCCUPANCY

Assembly Govt [✓ Office]
Commercial Historic Residential
[✓ Emer. Services] Industrial School

SOIL

Number of Persons
0 – 10 [✓ 11 – 100]
101-1000 1000+

TYPE

A	B	C	D	E	F
Hard Rock	Avg. Rock	Dense Soil	Stiff Soil	[✓ Soft Soil]	[✓ Poor Soil]

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☒ Other: SEE COMMENTS

BASIC SCORE, MODIFIERS, AND FINAL SCORE, *S*

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	[✓ S4 (RC SW)]	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	[✓ 2.8]	2.0	2.5	2.8	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	[✓ -1.0]	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	[✓ -1.2]	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, *S*						**0.6**									

COMMENTS

Post disaster building.
Pile supported foundation: may be soil type E or F. Liquefaction potential hazard.
Unreinforced masonry block wall interior partitions.
Based on review of drawings, hose tower has no zone steel.

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

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March 7, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan, Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review – Firehall No 2
199 Main Street, Vancouver, BC
RJC No.: VAN.107371.0001

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of the building located at 199 Main Street, in Vancouver. This evaluation included a "rapid visual seismic screening", a review of drawings, and a walk-through site inspection. The "rapid visual seismic screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S"SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
199 Main Street	0.9 to 0.7	YES	NO

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case, would be the design earthquake in the current Vancouver Building Bylaw.

For this building type, an S score of 0.9 or less means there is a 13% probability of collapse given the occurrence of the design earthquake in the current VBBL.

The S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available after our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided. A brief tour of major mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained.

There are many concrete block masonry partition walls that appear to be part of the original construction. These walls may not be reinforced given the era of construction and do not appear to be anchored to the undersides of their respective slabs.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting system elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system; and concerns related to interior masonry partition walls being fall hazards.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) -value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Building Science and Restoration

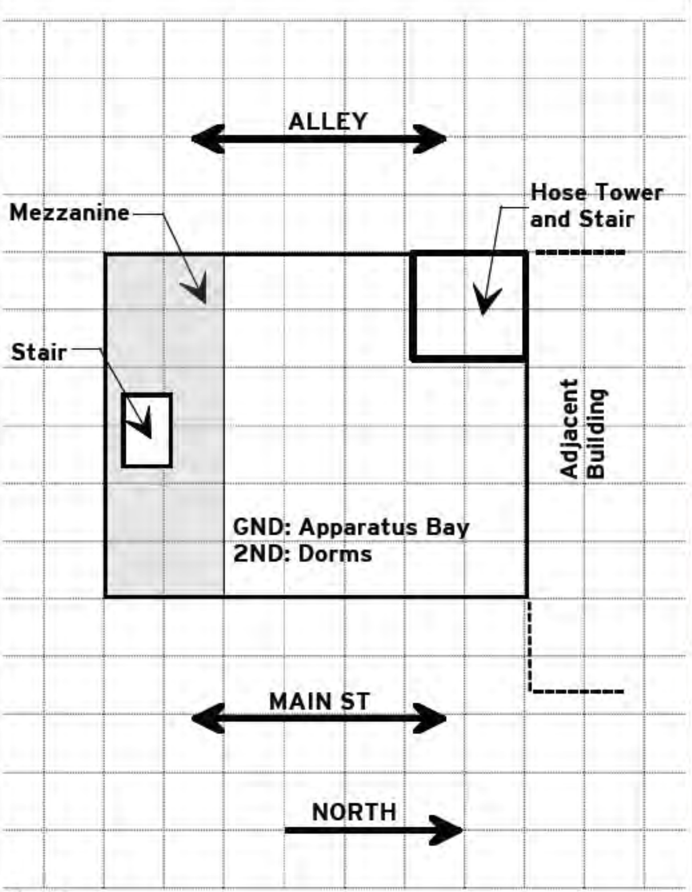
D. S. GAM
MAR 0 8 2013

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

Rapid Visual Screening of Buildings for Potential Seismic Hazards
FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 199 Main Street
Vancouver, BC Zip V6A 2S5
Other Identifiers
No. Stories 2 + Mezzanine Year Built 1975
Screener NB Date February 8, 2013
Total Floor Area (sq. ft.) 7,700 SF
Building Name Firehall No.2
Use Firehall

OCCUPANCY

Assembly Govt Office
Commercial Historic Residential
[✓ Emer. Services] Industrial School

Number of Persons
0 – 10 [✓ 11 – 100]
101-1000 1000+

SOIL / **TYPE**

A	B	C	D	E	F
Hard Rock	Avg. Rock	[✓ Dense Soil]	[✓ Stiff Soil]	Soft Soil	Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☒ Other: SEE COMMENTS

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	[✓ S4 (RC SW)]	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	[✓ 2.8]	2.0	2.5	2.8	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	[✓ -1.0]	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	[✓ -0.6]	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8

FINAL SCORE, S 0.9 to 0.7

COMMENTS
Post-disaster building.
Unreinforced masonry block wall interior partitions.
Based on review of drawings, hose tower has no zone steel.
Pounding is a potential hazard, from adjacent building (North side).

Detailed Evaluation Required
[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

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July 15, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review Frog Hollow Neighbourhood House
2131 Renfrew Street, Vancouver, BC   RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Frog Hollow Neighbourhood House located at 2131 Renfrew Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", a review of the second floor renovation drawings, and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Frog Hollow Neighbourhood House	2.9	NO	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 2.9 means there is a 0.13% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be moderate to low.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Second floor renovation drawings were made available after our site visit. Original structural drawings were not available.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment does not appear to be seismically restrained.

There were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening result, and assuming that this facility is NOT intended to be a post-disaster building, a detailed quantitative assessment of the seismic force resisting system elements does not appear to be required. However, we recommend a review of the non-structural elements in the building (mechanical equipment, etc.). Our budget for a detailed, non-structural study would be s.17(1)(f) [redacted] +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

for Hanif Shariff, B.Eng., EIT
Design Engineer

July 15/13
Dennis Gam, M.Eng., P.Eng.
Associate

HS/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154)

Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
Structural Types:			
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

---

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

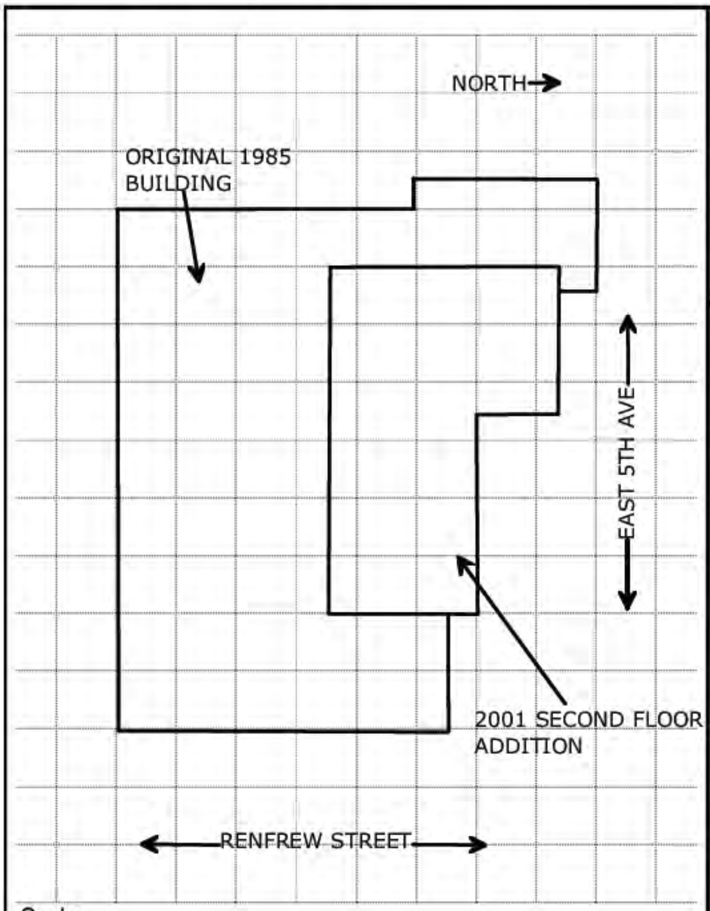
A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 2131 Renfrew Street, Vancouver, BC
Zip V5M 3J4
Other Identifiers
No. Stories 2 **Year Built** 1985/2001
Screener HZS **Date** July 3, 2013
Total Floor Area (sq. ft.) 12, 000 SQ FT
Building Name Frog Hollow Neighbourhood House
Use Mixed Use; Community Centre.

OCCUPANCY			**SOIL**		**TYPE**						**FALLING HAZARDS**
[✓ Assembly]	Govt	[✓ Office]	Number of Persons		A	B	[✓ C]	D	E	F	☐ Unreinforced Chimneys
Commercial	Historic	Residential	0 – 10	11 – 100	Hard Rock	Avg. Rock	[✓ Dense Soil]	Stiff Soil	Soft Soil	Poor Soil	☐ Parapets
Emer. Services	Industrial	[✓ School]	[✓ 101-1000]	1000+							☐ Cladding
											☐ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, *S*

BUILDING TYPE	**W1**	[✓ **W2**]	**S1** (MRF)	**S2** (BR)	**S3** (LM)	**S4** (RC SW)	**S5** (URM INF)	**C1** (MRF)	**C2** (SW)	**C3** (URM INF)	**PC1** (TU)	**PC2**	**RM1** (FD)	**RM2** (RD)	**URM**
Basic Score	4.4	[✓ 3.8]	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	[✓ -0.5]	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	[✓ -0.4]	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, *S*		2.9													

COMMENTS

Drawings for original 1985 building were not made available; based on date of construction, assumed to have been designed to VBBL No. 5583 (effective 1982);
Drawings for 2001 addition indicate this portion of the building is designed to VBBL part 4; based on date of construction, assumed to have been designed to VBBL No. 6861 (effective 1991);
Mechanical equipment does not appear to be restrained.

Detailed Evaluation Required

YES [✓ **NO**]

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

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www.rjc.ca

March 7, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan, Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review – Granville Residence
1261 Granville Street, Vancouver, BC RJC No.: VAN.107371.0001

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of the building located at 1261 Granville Street, in Vancouver. This evaluation included a "rapid visual seismic screening", a review of drawings, and a walk-through site inspection. The "rapid visual seismic screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	**FINAL "S" SCORE**	**FURTHER REVIEW RECOMMENDED**	
		STRUCTURAL	**NON-STRUCTURAL**
1261 Granville Street	-0.5	YES	NO

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case, would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 1.0 represents a 15% collapse risk given the occurrence of the design earthquake in the current VBBL.

The S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Renovation drawings were made available after our site visit. Original structural drawings were not available.

A brief tour of the mechanical spaces serving the residential occupancy noted that the equipment was relatively new and appeared to be seismically braced. Equipment in tenant spaces were not included in this review.

Two brick chimneys on the roof appeared to be original construction. These chimneys are likely unreinforced, and represent a fall hazard.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting system elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system; and concerns related to fall hazards (i.e. chimneys).

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

D. S. GAM
MAR 0 8 2013

Nicole Babuik, EIT, LEED® AP
Building Science and Restoration

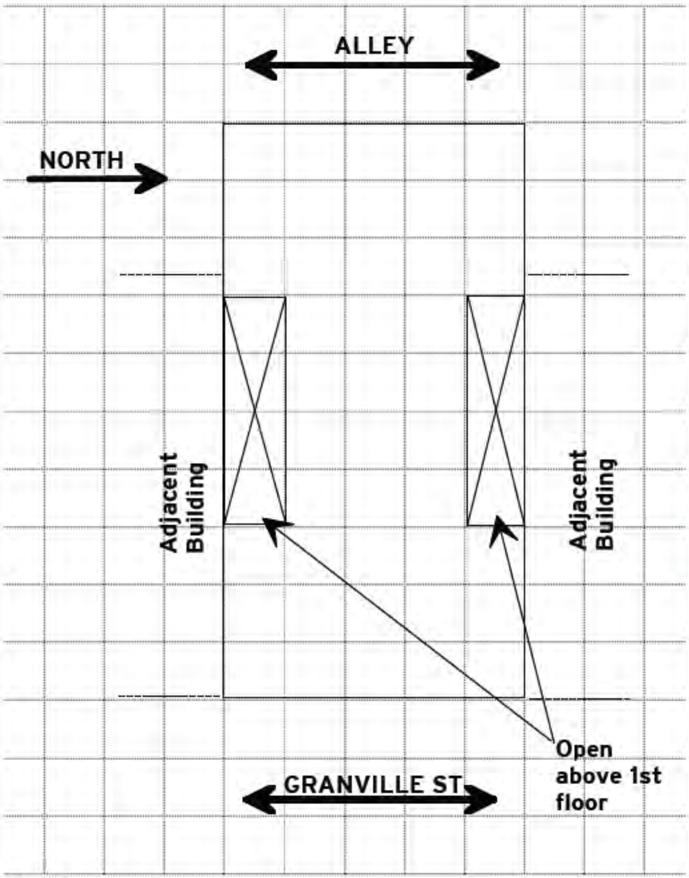
Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 1261 Granville Street
Vancouver, BC Zip V6Z 0A1
Other Identifiers
No. Stories 5 + Basement Year Built 1919
Screener NB Date February 7, 2013
Total Floor Area (sq. ft.) 32,700 SF
Building Name Granville Residence (or Granville Hotel)
Use Mixed Use: Residential, and Commercial (1st Floor only)

OCCUPANCY

Assembly Govt Office
[✓ Commercial] Historic [✓ Residential]
Emer. Services Industrial School

SOIL (Number of Persons)

0 – 10 [✓ 11 – 100]
101-1000 1000+

TYPE

A Hard Rock | B Avg. Rock | C Dense Soil | [✓ D Stiff Soil] | E Soft Soil | F Poor Soil

FALLING HAZARDS

☒ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☒ Other: SEE COMMENTS

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	[✓ URM]
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	2.8	[✓ 1.8]
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	[✓ 0.0]
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	[✓ -1.0]
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	[✓ -0.5]
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	[✓ -0.2]
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	[✓ -0.6]
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S															-0.5

COMMENTS **Exterior walls are unreinforced brick; brick appears to be in poor condition. Exterior walls inset above 1st floor appear to be wood frame.**
Soft storey on 1st floor at front (East side) and back (West side) of building.
Retrofit tie-back anchors observed on exterior at floor levels.
Unrestrained OFC's noted in commercial tenant spaces on 1st floor.
Pounding is a potential hazard, from adjacent buildings (North and South sides).

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

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June 25, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Gresham Hotel
716 Smithe Street, Vancouver, BC
RJC No.: VAN.107317.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Gresham Hotel located at 716 Smithe Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", a review of drawings, and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Gresham Hotel	0.6	YES	NO

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 1.0 represents a 15% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Renovation drawings were made available prior to our site visit. The building appears to have been partially seismically retrofitted.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided. A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained.

The sign on the North-East corner of the building exterior represents a potential fall hazard. Pounding from the adjacent building, to the South, is also a potential hazard.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Design Engineer

D. S. GAM

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

---

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

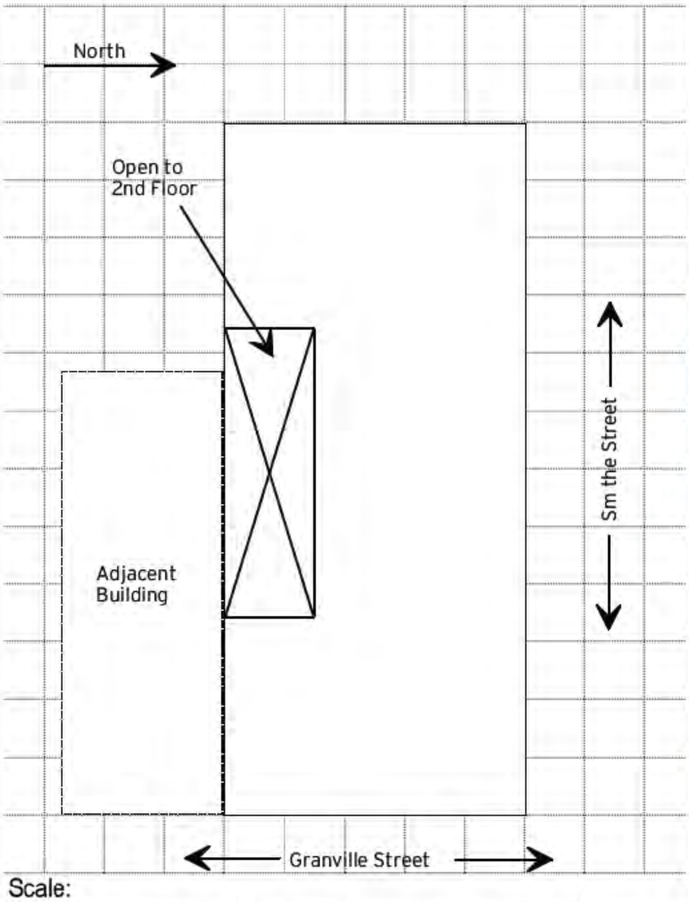
Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards
FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 716 Smithe Street, Vancouver, BC
Zip V6B 2C9
Other Identifiers
No. Stories 3 **Year Built** 1942
Screener NAB **Date** April 23, 2013
Total Floor Area (sq. ft.) 17,000 sq.ft.
Building Name Gresham Hotel
Use Residential

OCCUPANCY			SOIL						FALLING HAZARDS
Assembly Commercial Emer. Services	Govt Historic Industrial	Office [✓ Residential] School	Number of Persons 0 – 10 [✓ 11 – 100] 101-1000 1000+	A Hard Rock	B Avg. Rock	[✓ C Dense Soil]	D Stiff Soil	E Soft Soil F Poor Soil	☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☒ Other: See comments

TYPE

BASIC SCORE, MODIFIERS, AND FINAL SCORE, *S*

BUILDING TYPE	W1	W2	S1 (MRF)	[✓ S2 (BR)]	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	[✓ 3.0]	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	[✓ -1.5]	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	[✓ -0.4]	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, *S*				0.6											

COMMENTS

Renovation drawings from 1992 indicate design was in accordance with the 1990 National Building Code and VBBL No.6134. Building appears to have been partially seismically retrofitted.

Drawings indicated parapets have been braced. Sign on north-east corner of building represents a fall hazard. Pounding from adjacent building (south side) is also a potential hazard. Mechanical equipment appeared to typically be restrained.

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
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www.rjc.ca

June 25, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Hastings Community Centre
3096 East Hastings Street, Vancouver, BC – Revised RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Hastings Community Centre located at 3096 East Hastings Street, in Vancouver. This evaluation included a "rapid visual seismic screening", a review of available drawings, and a walk-through site inspection. The "rapid visual seismic screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
3096 East Hastings	-0.3	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 1.0 represents a 15% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings of the gymnasium, and North wing addition, were made available prior to our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment does not appear to be seismically restrained.

There were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously, the size of the building, and the number of phases of different construction, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would be s.17(1)(f) value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Hanif Shariff, B.Eng., EIT
Design Engineer

D. S. GAM
JUN 2 5 2013

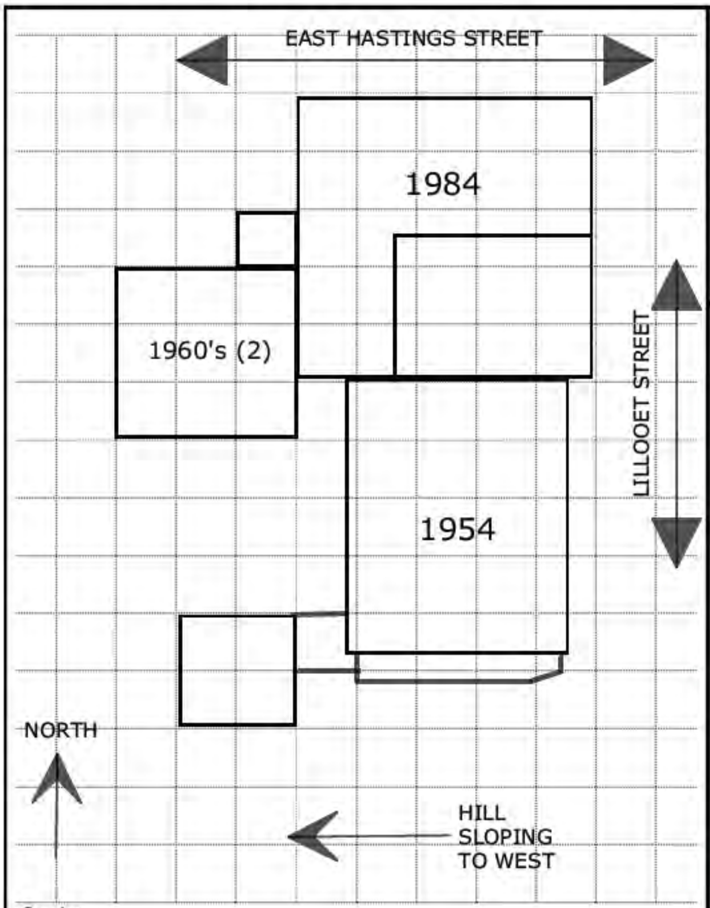
Dennis Gam, M.Eng., P.Eng.
Associate

HS/gb

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 3096 East Hastings Street
Vancouver, BC **Zip** V5K 2A3
Other Identifiers
No. Stories 2 **Year Built** 1954,1980
Screener HZS **Date** April 24, 2013
Total Floor Area (sq. ft.) 37,947 SF
Building Name Hastings Community Centre
Use Mixed Use; Community Centre

OCCUPANCY **SOIL**

[✓ Assembly] Govt [✓ Office]
Commercial Historic Residential
Emer. Services Industrial [✓ School]

Number of Persons
0 – 10 11 – 100
[✓ 101-1000] 1000+

TYPE

A	B	C	D	E	F
Hard Rock	Avg. Rock	Dense Soil	[✓ Stiff Soil]	Soft Soil	Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☐ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	[✓ C2 (SW)]	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	[✓ 2.8]	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	[✓ -1.0]	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	[✓ -1.0]	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	[✓ -0.6]	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S									- 0.3						

COMMENTS

Majority of the building is governed by the 1954 concrete shearwall structure (pre-code);
Some mechanical equipment does not appear to be restrained.

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

March 8, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review – Heritage Hall
Heritage Hall, Vancouver, BC   RJC No.: VAN.107317.0001

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of the Heritage Hall, located at 3102 Main Street, in Vancouver, BC. This evaluation included a "rapid visual seismic screening", a review of drawings, and a walk-through site inspection. The "rapid visual seismic screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	**FINAL "S"SCORE**	**FURTHER REVIEW RECOMMENDED**	
		STRUCTURAL	**NON-STRUCTURAL**
Heritage Hall	0.2 to 0.0	YES	YES

A copy of the screening form is attached for reference. The specified acceptance criteria suggested by FEMA is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case, would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 1.0 represents a 15% collapse risk given the occurrence of the design earthquake in the current VBBL.

The S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were provided prior to our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided. A brief tour of utility spaces indicated that base building equipment does not appear to be seismically restrained.

The clock tower, and rooftop chimney, are original, unreinforced masonry, construction, and represent falling hazards. The building's stone cladding and decorative copper fixtures also present falling hazards. In addition, pounding is a potential hazard, from the adjacent building on the South side.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Hanif Shariff, B.Eng., EIT
Building Science and Restoration

D. GAM
MAR 08 2013

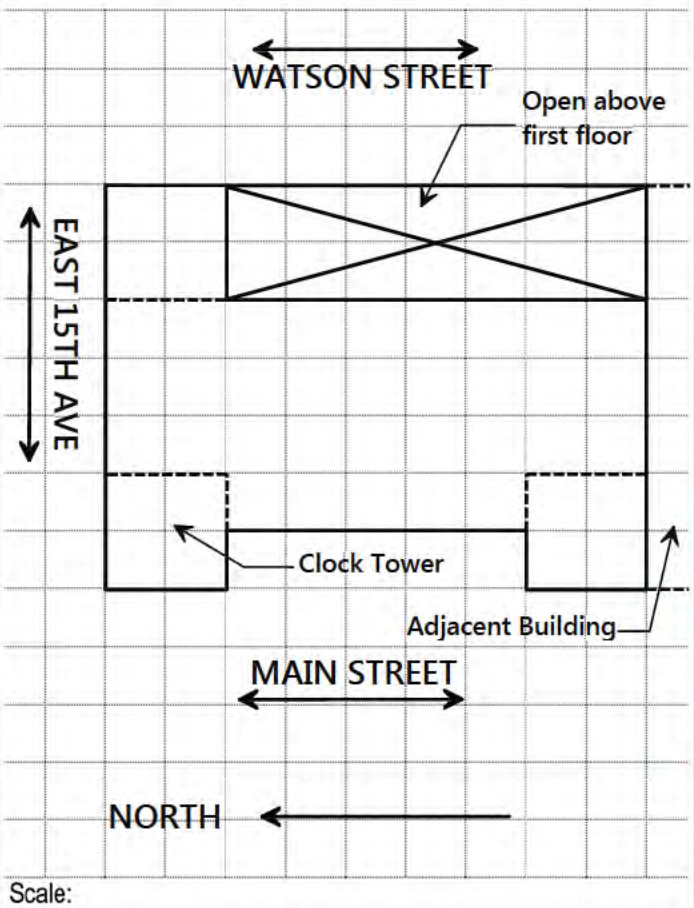
Dennis Gam, M.Eng., P.Eng.
Associate

HZS/gb

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 3102 Main Street
Vancouver, BC **Zip** V5T 3G7
Other Identifiers
No. Stories 3 + Basement **Year Built** 1914
Screener HS **Date** February 26, 2013
Total Floor Area (sq. ft.) 22,800 SF
Building Name Heritage Hall
Use Mixed Use

OCCUPANCY			SOIL	TYPE						FALLING HAZARDS			
[✓ Assembly] Commercial Emer. Services	[✓ Govt] [✓ Historic] Industrial	[✓ Office] Residential School	Number of Persons 0 – 10 11 – 100 [✓ 101-1000] 1000+	A Hard Rock	B Avg. Rock	[✓ C] Dense Soil	[✓ D] Stiff Soil	E Soft Soil	F Poor Soil	☒ Unreinforced Chimneys	☐ Parapets	☒ Cladding	☒ Other: SEE COMMENTS

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	[✓ URM]
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	2.8	[✓ 1.8]
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	[✓ -1.0]
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	[✓ -0.2]
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	[✓ -0.6]
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8

FINAL SCORE, S 0.2 to 0.0

COMMENTS Building constructed pre-code (1914); pre-seismic benchmark code. Unreinforced masonry clock tower. In addition to unreinforced masonry chimney on Southeast building corner, stone cladding and decorative copper fixtures also present Fall Hazards. Pounding is a potential hazard, from adjacent building (South side).

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

Suite 300
1285 West Broadway
Vancouver, BC V6H 3X8
Canada

604 738-0048
Fax 604 738-1107
www.rjc.ca

July 8, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

<u>Attention:</u> Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review – Kensington Community Centre
5175 Dumfries Street, Vancouver, BC RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Kensington Community Centre located at 5175 Dumfries Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", a review of drawings, and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
1978 Original Building and 1981 Gymnasium Addition	1.9	YES	NO
2000 Addition	3.8	NO	NO

The above table reflects the structural separation of the 2000 addition from the older portions of the building. Drawings confirmed that the older portions are structurally attached.

A copy of the screening form is attached for reference. The specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **<u>given</u>** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 3.8 and 1.9 means there is a 0.016% and 1.3% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be low for the newer addition, and moderate to high for the older portion.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available prior to our site visit. In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained. The cantilevered precast architectural panels on the building exterior represent a potential fall hazard. Pounding from each of the adjacent community centre buildings/addition, is a potential hazard. Unrestrained interior storage racks and shop equipment were observed.

There were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements in the older portion of the facility. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) -value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Hanif Shariff, ~~B.Eng.~~, EIT
Design Engineer

July 8/13

Dennis Gam, M.Eng., P.Eng.
Associate

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:

		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

---

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

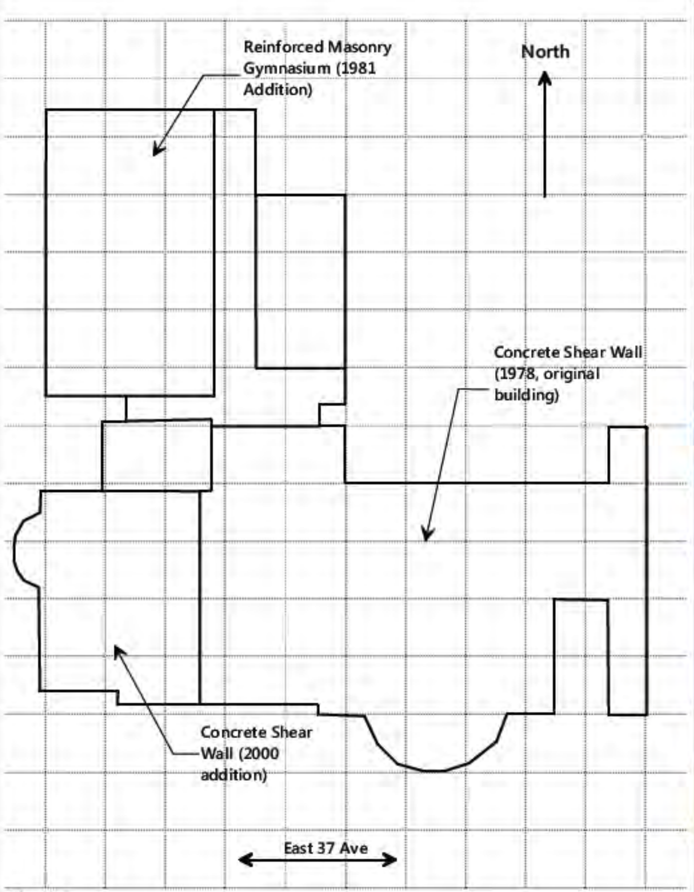
A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 5175 Dumfries Street, Vancouver, BC

Zip V5P 3A2

Other Identifiers

No. Stories 1

Year Built '78/'81'/'00

Screener HS

Date June 3, 2013

Total Floor Area (sq. ft.) 27,727 SF

Building Name Kensington Community Centre

Use Mixed Use

OCCUPANCY

[✓ Assembly] Govt [✓ Office]
Commercial Historic Residential
Emer. Services Industrial [✓ School]

Number of Persons
0 – 10 11 – 100
[✓ 101-1000] 1000+

SOIL

A	B	C	D	E	F
Hard Rock	Avg. Rock	[✓ Dense Soil]	Stiff Soil	Soft Soil	Poor Soil

TYPE

FALLING HAZARDS

☐ Unreinforced Chimneys ☒ Parapets ☐ Cladding ☐ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, *S*

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	[✓ C2 (SW)]	[✓ C2]	C3 (URM INF)	PC1 (TU)	PC2	[✓ RM1 (FD)]	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	[✓ 2.8]	[✓ 2.8]	1.6	2.6	2.4	[✓ 2.8]	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4		+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8		+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	[✓ -1.0]		-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0		-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	[✓ +2.4]		N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	[✓ -0.4]	-0.4	-0.4	-0.4	[✓ -0.4]	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6		-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8		-0.8	-0.4	-1.2	-0.4	-0.6	-0.8

FINAL SCORE, *S* 2000 addition ⟶ **3.8** **1.9** ⟵ 1978 Original Building **1.9**

COMMENTS

Drawings indicate design of 2000 addition was in accordance with the National Building Code of Canada 1995 Edition and VBBL No. 6134;
Design Code not shown on drawings for 1978 and 1981 buildings; based on Construction dates, assumed to be designed to VBBL No. 4702 (effective 1973; NBCC 1975) and VBBL No. 5190 (Effective 1978), respectively;
Vertical irregularity for 2000 addition, as it is a building on a hill;
Plan irregularity for 1978 and 1981 addition, as buildings are structurally attached;
Mechanical equipment appears to be restrained.

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

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June 25, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Kitsilano Community Centre
2690 Larch Street, Vancouver, BC — RJC No.: VAN.107317.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Kitsilano Community Centre located at 2690 Larch Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", a review of drawings, and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Kitsilano Community Centre	0.7	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 1.0 represents a 15% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Partial renovation drawings were made available prior to our site visit. We have assumed the building seismic force resisting system primarily consists of concrete shearwalls.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided. A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be partially seismically restrained or unrestrained.

The brick memorial wall on the South-West corner of site represents a potential fall hazard.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously, the size of the building, and the number of phases of different construction, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would be s.17(1)(f) +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

N Babuik

Nicole Babuik, EIT, LEED® AP
Design Engineer

Dennis Gam, M.Eng., P.Eng.
Associate

D. S. GAM
JUN 25 2013

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

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[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

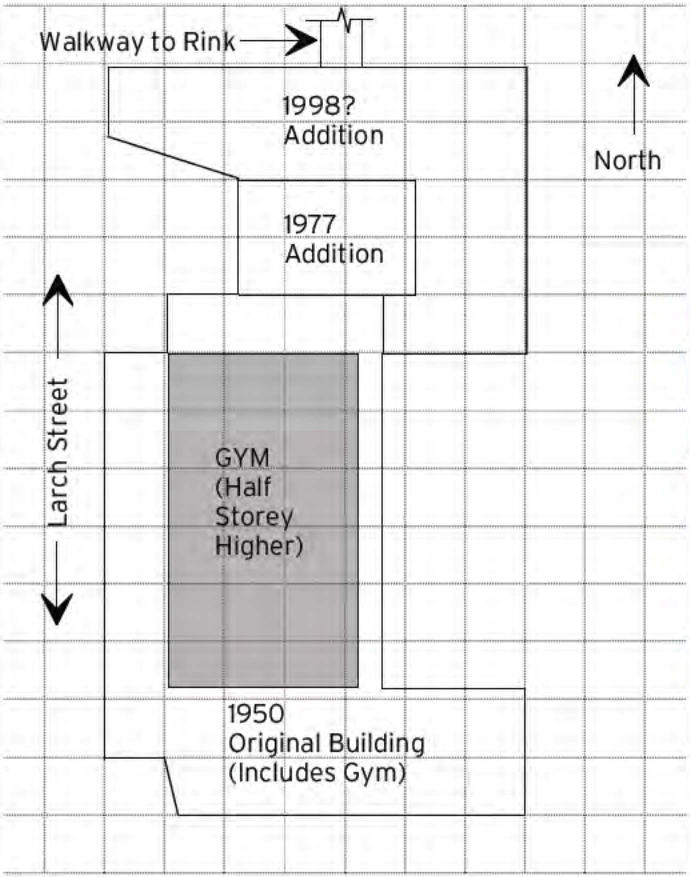
A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 2690 Larch Street, Vancouver, BC
Zip V6K 2J4
Other Identifiers
No. Stories 2 **Year Built** 1950
Screener NAB **Date** April 29, 2013
Total Floor Area (sq. ft.) 34,000 SQ FT
Building Name Kitsilano Community Centre
Use Community Centre


East side of gym.


West side of gym.

OCCUPANCY	SOIL	TYPE	FALLING HAZARDS
[✓ Assembly] Govt Office Commercial Historic Residential Emer. Services Industrial School	Number of Persons 0 – 10 11 – 100 [✓ 101-1000] 1000+	A Hard Rock B Avg. Rock C Dense Soil [✓ D Stiff Soil] E Soft Soil F Poor Soil	☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☒ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, *S*

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	[✓ C2 (SW)]	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	[✓ 2.8]	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	[✓ -1.0]	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	[✓ -0.6]	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, *S*									0.7						

COMMENTS

Majority of building is governed by 1950 concrete shearwall structure (pre-code).
Some mechanical equipment does not appear to be restrained.
Brick memorial wall on South-West corner of site is a potential fall hazard.

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

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1285 West Broadway
Vancouver, BC V6H 3X8
Canada

604 738-0048
Fax 604 738-1107
www.rjc.ca

June 25, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Kitsilano Rink
2690 Larch Street, Vancouver, BC   RJC No.: VAN.107317.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Kitsilano Rink located at 2690 Larch Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", a review of drawings, and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Kitsilano Rink	1.2	YES	NO

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 1.2 means there is a 6% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available prior to our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided. A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Design Engineer

D. S. GAM
JUN 2 5 2013

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
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S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
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[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

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A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
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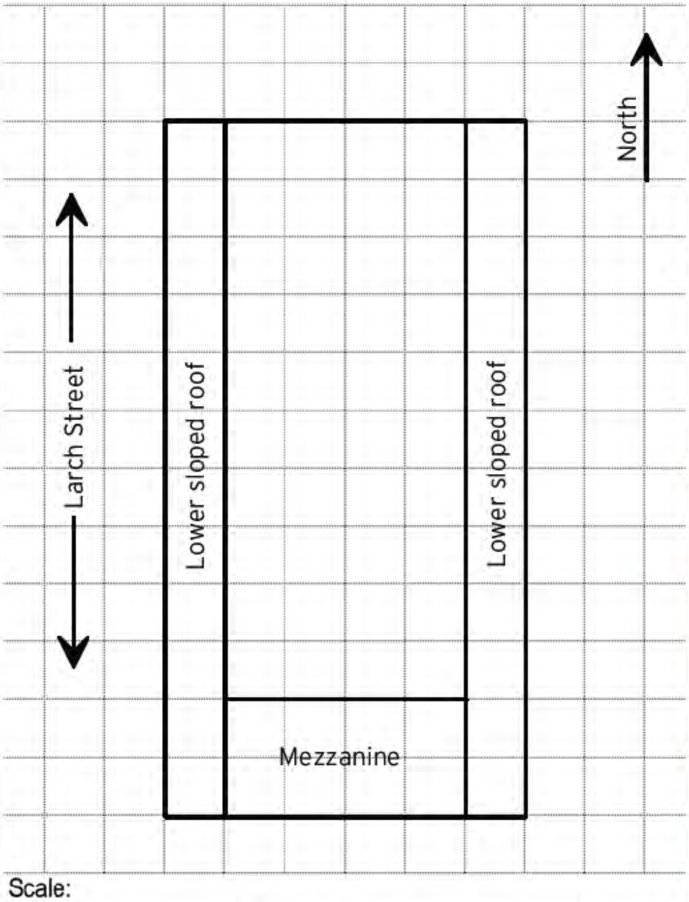
Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 2690 Larch Street, Vancouver, BC

Zip V6K 4K9

Other Identifiers

No. Stories 1 + mezzanine **Year Built** 1975

Screener NAB **Date** May 2, 2013

Total Floor Area (sq. ft.) 40,000 sq.ft.

Building Name Kitsilano Rink

Use Hockey and lacrosse rink.

OCCUPANCY			**SOIL**		**TYPE**						**FALLING HAZARDS**			
[✓ Assembly] Commercial Emer. Services	Govt Historic Industrial	Office Residential School	Number of Persons 0 – 10 [✓ 101-1000]	 11 – 100 1000+	A Hard Rock	B Avg. Rock	C Dense Soil	[✓ D Stiff Soil]	E Soft Soil	F Poor Soil	☐ Unreinforced Chimneys	☐ Parapets	☐ Cladding	☐ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	**W1**	**W2**	**S1** (MRF)	**S2** (BR)	**S3** (LM)	**S4** (RC SW)	**S5** (URM INF)	**C1** (MRF)	**C2** (SW)	**C3** (URM INF)	**PC1** (TU)	**PC2**	[✓ **RM1** (FD)]	**RM2** (RD)	**URM**
Basic Score	**4.4**	**3.8**	**2.8**	**3.0**	**3.2**	**2.8**	**2.0**	**2.5**	**2.8**	**1.6**	**2.6**	**2.4**	[✓ **2.8**]	**2.8**	**1.8**
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	[✓ -1.0]	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	[✓ -0.6]	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S													1.2		

COMMENTS

Drawings indicate building was designed in accordance with NBC 1975.
Mechanical equipment appeared to be restrained.

Detailed Evaluation Required

[✓ **YES**] **NO**

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
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URM INF = Unreinforced masonry infill

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www.rjc.ca

July 15, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review Kiwassa Neighbourhood House
2425 Oxford Street, Vancouver, BC RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Kiwassa Neighbourhood House located at 2425 Oxford Street, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Kiwassa Neighbourhood House	5.8	NO	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which, in this case, would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 5.8 means there is a 0.0002% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be moderate to low.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Original structural drawings were not available.

A brief tour of the mechanical spaces and the roof indicated that base building equipment does not appear to be seismically restrained.

Pounding from the adjacent building, 128 Nanaimo Street, is a potential hazard.

There were some areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening result, and assuming that this facility is NOT intended to be a post-disaster building, a detailed quantitative assessment of the seismic force resisting system elements does not appear to be required. However, we recommend a review of the non-structural elements in the building (mechanical equipment, etc.). Our budget for a detailed, non-structural study would be s.17(1)(f) -value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

for Hanif Shariff, B.Eng., EIT
Design Engineer

July 15/13

Dennis Gam, M.Eng., P.Eng.
Associate

HS/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

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S3	Light metal frame	1970	1985
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S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
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PC1	Tilt-up construction	1970	1985
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URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
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Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
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Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
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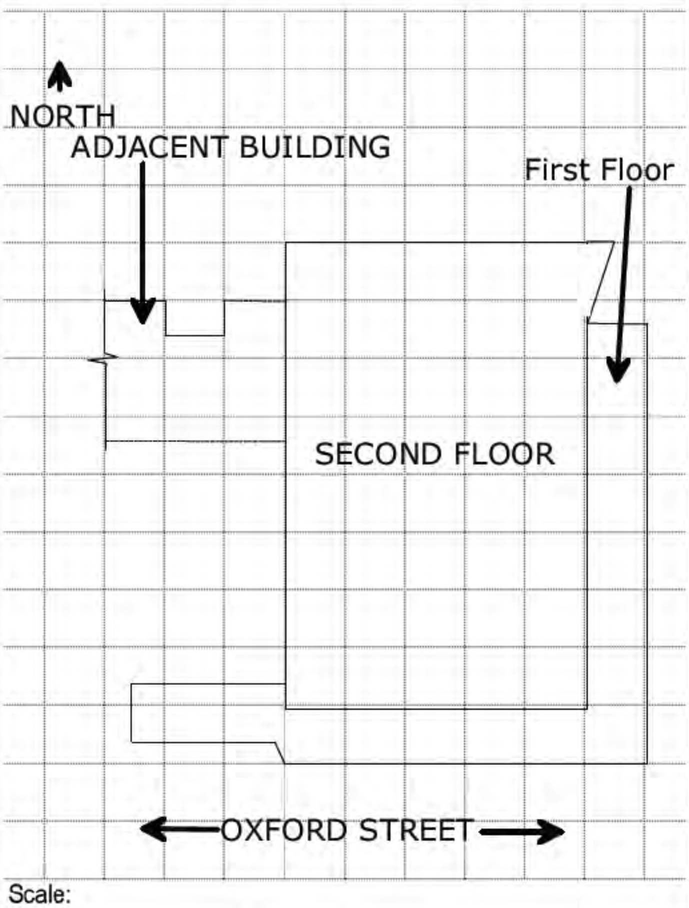
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards
FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 2425 Oxford Street, Vancouver, BC
Zip V5K 1M7
Other Identifiers
No. Stories 2 **Year Built** 1995
Screener HZS **Date** July 3, 2013
Total Floor Area (sq. ft.) 17,000 SQ FT
Building Name Kiwassa Neighbourhood House
Use Mixed Use; Community Centre

OCCUPANCY			**SOIL**
[✓ Assembly]	Govt	[✓ Office]	Number of Persons
Commercial	Historic	Residential	0 – 10 11 – 100
Emer. Services	Industrial	[✓ School]	[✓ 101-1000] 1000+

TYPE

A	B	[✓ C]	D	E	F
Hard Rock	Avg. Rock	[✓ Dense Soil]	Stiff Soil	Soft Soil	Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☐ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	**W1**	**[✓ W2]**	**S1 (MRF)**	**S2 (BR)**	**S3 (LM)**	**S4 (RC SW)**	**S5 (URM INF)**	**C1 (MRF)**	**C2 (SW)**	**C3 (URM INF)**	**PC1 (TU)**	**PC2**	**RM1 (FD)**	**RM2 (RD)**	**URM**
Basic Score	**4.4**	**[✓ 3.8]**	**2.8**	**3.0**	**3.2**	**2.8**	**2.0**	**2.5**	**2.8**	**1.6**	**2.6**	**2.4**	**2.8**	**2.8**	**1.8**
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	[✓ +2.4]	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	[✓ -0.4]	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S		5.8													

COMMENTS

Drawings were not made available; based on date of construction, assumed to be designed to VBBL No. 6861 (effective 1991);
Mechanical equipment does not appear to be restrained.

Detailed Evaluation Required

YES [✓ **NO**]

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

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1285 West Broadway
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Fax 604 738-1107
www.rjc.ca

June 25, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Meraloma Clubhouse
2390 West 10th Avenue, Vancouver, BC

RJC No.: VAN.107317.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Meraloma Clubhouse located at 2390 West 10th Avenue, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Meraloma Clubhouse	0	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 1.0 represents a 15% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Original structural drawings were not available.

A brief tour of the mechanical spaces indicated that base building equipment does not appear to be seismically restrained.

The brick chimney is likely unreinforced and represents a potential fall hazard.

There were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted]-value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Nicole Babuik, EIT, LEED® AP
Design Engineer

D. S. GAM
#27414
JUN 25 2013

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154) Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:

		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

[1] No applicable material design standard with seismic provisions.
[2] Post North Ridge details in CSA S16-01
[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

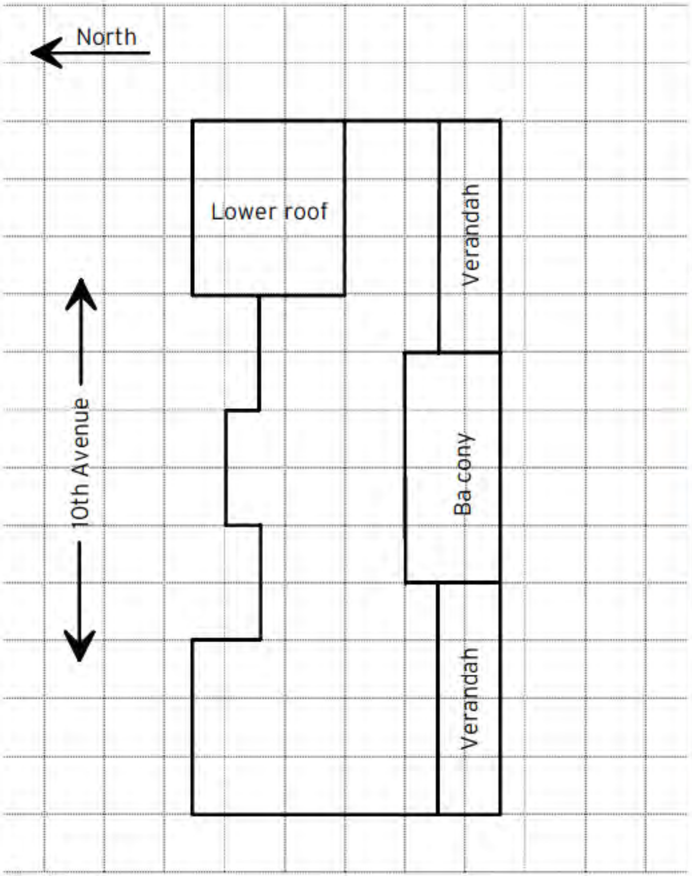
A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 2390 W 10th Ave, Vancouver, BC

Zip V6K 2J3

Other Identifiers

No. Stories 2 **Year Built** 1920

Screener NAB **Date** May 8, 2013

Total Floor Area (sq. ft.) 6,000 sq.ft.

Building Name Meraloma Clubhouse

Use Caretaker and billet suites, and rugby clubhouse.

OCCUPANCY			SOIL						TYPE	FALLING HAZARDS			
[✓ Assembly] Commercial Emer. Services	Govt Historic Industrial	Office [✓ Residential] School	Number of Persons 0 – 10 [✓ 11 – 100] 101-1000 1000+	A Hard Rock	B Avg. Rock	C Dense Soil	[✓ D Stiff Soil]	E Soft Soil	F Poor Soil	☒ Unreinforced Chimneys	☐ Parapets	☐ Cladding	☐ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	[✓ W2]	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	[✓ 3.8]	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	[✓ -2.0]	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	[✓ -1.0]	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	[✓ -0.8]	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S		0													

COMMENTS

W2 selected because building has an assembly occupancy and therefore cannot be classified as a Part 9 building according to BCBC 2012.
Brick chimney is likely unreinforced, as it appears to be original.
Boilers in mechanical room did not appear to be restrained.
Pre-National Building Code (first published in 1941).

Detailed Evaluation Required

[✓ **YES**] **NO**

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

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Vancouver, BC V6H 3X8
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Fax 604 738-1107
www.rjc.ca

June 21, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Police Headquarters 3
236 East Cordova Street, Vancouver, BC
RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Police Headquarters 3 located at 236 East Cordova Street, in Vancouver. This evaluation included a "rapid visual seismic screening", a review of drawings, and a walk-through site inspection. The "rapid visual seismic screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
236 East Cordova	2.8	NO	NO

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 2.8 means there is a 0.16% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be moderate to low.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available prior to our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained.

There were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening result, and assuming that this facility is NOT intended to be a post-disaster building, a detailed quantitative assessment of the seismic force resisting system elements does not appear to be required.

Yours truly,
Read Jones Christoffersen Ltd.

Hanif Shariff, B.Eng., EIT
Design Engineer

Jun 20/13

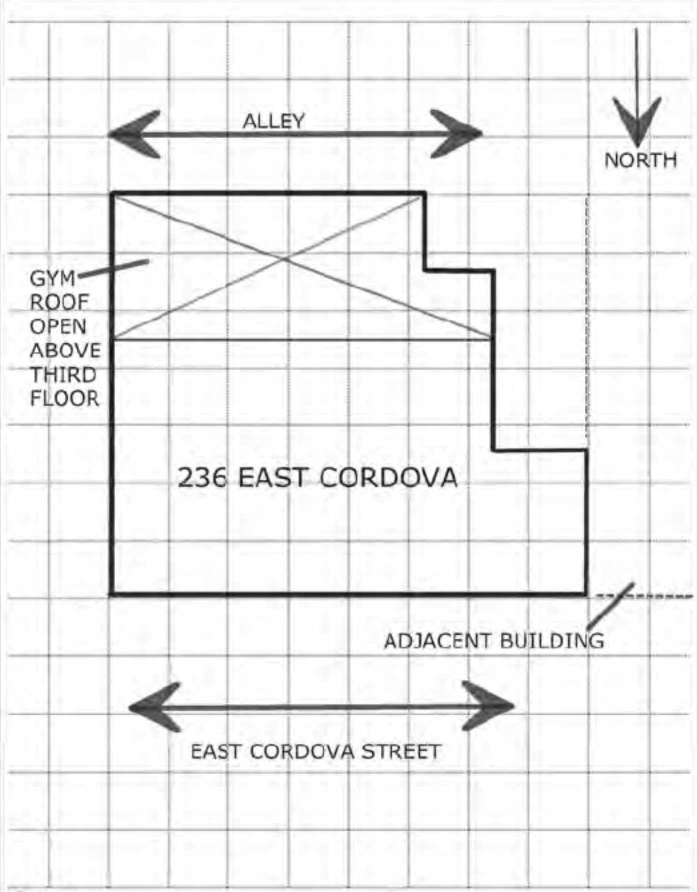
Dennis Gam, M.Eng., P.Eng.
Associate

HS/gb

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 236 EAST CORDOVA STREET
VANCOUVER, BC **Zip** V6A 2S7
Other Identifiers
No. Stories 4 **Year Built** 1976
Screener HZS **Date** MAY/2/2013
Total Floor Area (sq. ft.) 102,343 SF
Building Name POLICE HEADQUARTERS 3
Use POLICE HEADQUARTERS / OFFICE

OCCUPANCY

Assembly Govt [✓ Office]
Commercial Historic Residential
[✓ Emer. Services] Industrial School

SOIL

Number of Persons
0 – 10 11 – 100
[✓ 101-1000] 1000+

TYPE

A Hard Rock
B Avg. Rock
[✓ C Dense Soil]
D Stiff Soil
E Soft Soil
F Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys
☐ Parapets
☐ Cladding
☐ Other: ______

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	[✓ C2 (SW)]	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	[✓ 2.8]	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	[✓ +0.4]	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8

FINAL SCORE, S

COMMENTS

-DRAWINGS INDICATE BUILDING WAS DESIGNED TO VBBL NO. 4702.
-MECHANICAL EQUIPMENT APPEARED TO BE RESTRAINED.

Detailed Evaluation Required

YES [✓ **NO**]

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
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Read Jones Christoffersen
Consulting Engineers

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July 3, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Renfrew Community Centre
2929 East 22nd Avenue, Vancouver, BC   RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Renfrew Community Centre located at 2929 East 22nd Avenue, in Vancouver. This evaluation included a "Rapid Visual Seismic Screening", and a walk-through site inspection. The "Rapid Visual Seismic Screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Renfrew Community Centre	0.1	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In this case, an S score less than 0.9 represents a 13% collapse risk given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Original structural drawings were not available.

A brief tour of the mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained. However, there were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

D. R. GAM
#27414
JUL 04 2013

Nicole Babuik, EIT, LEED® AP
Design Engineer

Dennis Gam, M.Eng., P.Eng.
Associate

NB/gb

APPENDIX A - Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154)
Quick Reference Guide (for use with Data Collection Form and RVS report)

A1 Model Building Types and Critical Code Adoption and Enforcement Dates

Structural Types:

		Benchmark year for adaptation of seismic provisions in accordance with Commentary L of NBCC 2005	Benchmark year when seismic provisions improved in accordance with Commentary L of NBCC 2005 and revision to material standards
W1	Light wood frame, residential or commercial, ≤ 5000 square feet	1970	1985
W2	Wood frame buildings, > 5000 square feet.	1970	1985
S1	Steel moment-resisting frame	1970	2001[2]
S2	Steel braced frame	1970	1985
S3	Light metal frame	1970	1985
S4	Steel frame with cast-in-place concrete shear walls	1970	1985
S5	Steel frame with unreinforced masonry infill	1970	N/A[1]
C1	Concrete moment-resisting frame	1970	1995[3]
C2	Concrete shear wall	1970	1995[3]
C3	Concrete frame with unreinforced masonry infill	1970	N/A[1]
PC1	Tilt-up construction	1970	1985
PC2	Precast concrete frame	1970	1985
RM1	Reinforced masonry with flexible floor and roof diaphragms	1970	1985
RM2	Reinforced masonry with rigid diaphragms	1970	1985
URM	Unreinforced masonry bearing-wall buildings	N/A[1]	N/A[1]

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[1] No applicable material design standard with seismic provisions.

[2] Post North Ridge details in CSA S16-01

[3] Improved ductile detailing with CSA A23.3-94

A2 Score Modifier Definitions

Mid-Rise:	4 to 7 stories
High-Rise:	8 or more stories
Vertical Irregularity:	Steps in elevation view; inclined walls; building on hill; soft story (e.g. house over garage); building with short columns; unbraced cripple walls.
Plan Irregularity:	Buildings with re-entrant comers (L, T, U, E, + or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g. comer building, or wedge-shaped building, with one or two solid walls and all other walls open).
Pre-Code:	Building designed and constructed prior to the year in which seismic codes were first adopted and enforced in the jurisdiction; use years specified above in Item 1; default is 1941, except for PC1, which is 1973.
Post-Benchmark:	Building designed and constructed after significant improvements in seismic code requirements (e.g. ductile detailing) were adopted and enforced; the benchmark year when codes improved may be different for each building type and jurisdiction; use years specified above in Item 1 (see Table 2-2 of FEMA 154 *Handbook* for additional information).
Soil Type C:	Soft rock or very dense soil; S-wave velocity: 1200 - 2500 ft/s; blow count > 50; or undrained shear strength > 2000 psf.
Soil Type D:	Stiff soli; S-wave velocity: 600-1200 ft/s; blow count: 15- 50; or undrained shear strength:1000-2000 psf.
Soil Type E:	Soft soli; S-wave velocity< 600 ft/s; or more than 100ft of soil with plasticity index > 20, water content > 40%, and undrained shear strength < 500 psf.

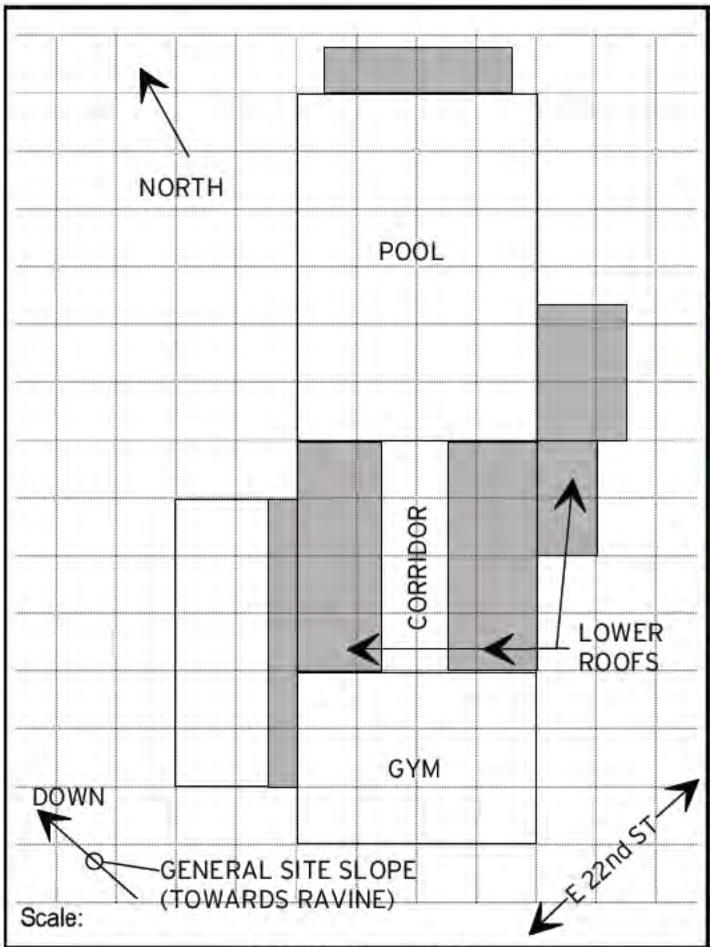
A3 Additional Definitions

Seismic Force Resisting Structure	Often abbreviated to SFRS, this is the portion of the structure which resists wind and earthquake lateral (or sideways) loads as well as vertical loads due to the weight of the building and contents (gravity loads).
Gravity Load-Resisting Structure	The portion of the structure designed to only resist the vertical loads due to the weight of the building and contents.
Non-structural Elements	Elements such as cladding, glazing, ceilings, mechanical fixtures and ducts, bookshelves etc. that are not part of the building's basic structure of beams, columns and slabs.
Construction Joints	Buildings are usually not built "in one piece". They are usually built in segments. The joint is called a construction joint if the structure is attached across the joint.
Shearwalls	Walls extending up the building from the foundations that resist the lateral (sideways) wind and earthquake loads on the building. May consist of concrete, wood, or masonry.
Braces or Braced Frames	Beam and column lateral load-resisting assemblies connected by diagonal steel "braces" extending between floors.
Moment Resisting Frames	Moment frames are a system of columns and beams solidly connected at the beam and column joint to resist lateral loads by bending. They typically consist of structural steel or concrete.
Liquefaction	When the soil is shaken by an earthquake, the loose grains tend to settle and the volume of soil becomes smaller. The water volume, however, stays the same and the result is a change from a granular soil to a fluid made thick with the suspended soil particles.
Pounding	A result of contact with the adjacent structure due to lateral movement. Pounding occurs when two structures adjacent to each other sway sideways during earthquake ground motions and collide with each other. These collisions can be quite violent and serious damage can result.

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 2929 East 22nd Avenue, Vancouver, BC
Zip V5M 2Y3
Other Identifiers
No. Stories 2 **Year Built** 1960
Screener NAB **Date** June 4, 2013
Total Floor Area (sq. ft.) 47,000 SQ FT
Building Name Renfrew Community Centre
Use Community Centre

SOUTH-WEST ELEVATION

INTERIOR OF POOL AREA (SOUTH WALL)

OCCUPANCY

[✓ Assembly] Govt Office
Commercial Historic Residential
Emer. Services Industrial School

Number of Persons
0 – 10 11 – 100
[✓ 101-1000] 1000+

SOIL

TYPE

A	B	C	D	E	F
Hard Rock	Avg. Rock	[✓ Dense Soil]	Stiff Soil	Soft Soil	Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☐ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	[✓ RM2 (RD)]	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	[✓ 2.8]	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	[✓ -1.0]	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	[✓ -0.8]	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S														0.1	

COMMENTS

Drawings were not made available during the review. Majority of the building appeared to be original; load-bearing block walls, with precast concrete single tee roof slabs for pool and gym, and cast-in-place concrete pan joist slabs typical elsewhere.
FRP appears to have been installed on some of the pool block walls.
Mechanical equipment observed appeared to be restrained.
No cladding; just painted block.

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

March 8, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review
West End Community Centre, Vancouver, BC		RJC No.: VAN.107317.0001

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of the West End Community Centre, located at 870 Denman Street, in Vancouver, BC. This evaluation included a "rapid visual seismic screening", a review of drawings, and a walk-through site inspection. The "rapid visual seismic screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S"SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
West End Community Centre	0.9	YES	NO

A copy of the screening form is attached for reference. The specified acceptance criteria suggested by FEMA is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case, would be the design earthquake in the current Vancouver Building Bylaw.

For this building type, an S score of 0.9 means there is a 13% probability of collapse given the occurrence of the design earthquake in the current VBBL.

The S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were provided prior to our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided. A brief tour of major mechanical spaces and the roof indicated that base building equipment appears to be seismically restrained. However, unrestrained storage racks and shop equipment were observed.

In addition, there is a suspended acoustical ceiling in one of the fitness rooms where the connection to base structure was not reviewable; this suspended structure may not be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Hanif Shariff, B.Eng., EIT
Building Science and Restoration

MAR. 0 8 2013

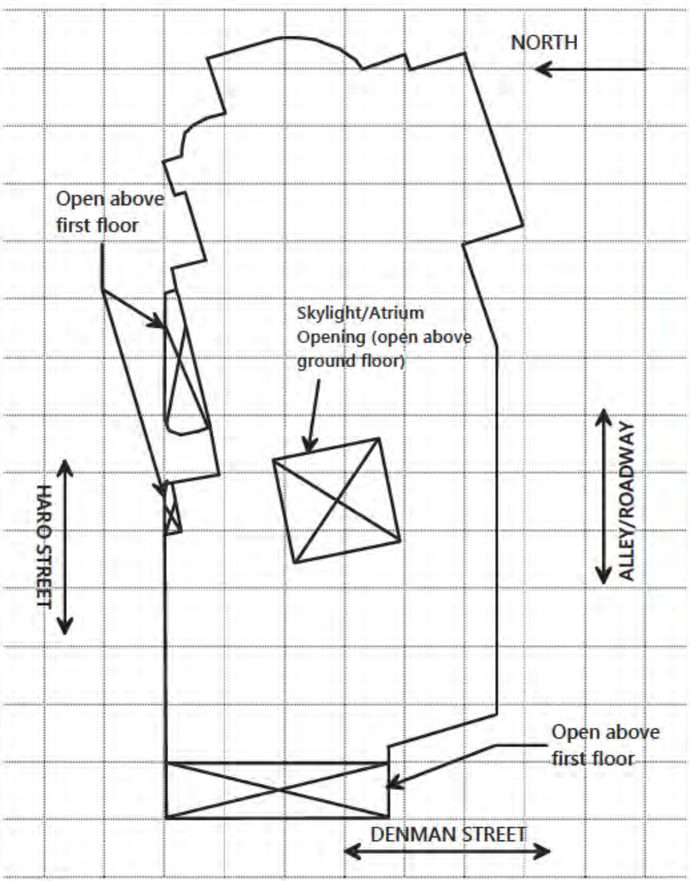
Dennis Gam, M.Eng., P.Eng.
Associate

HZS/gb

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 870 Denman Street
Vancouver, BC **Zip** V6G 2L8
Other Identifiers
No. Stories 2 + 3 Below Grade Parkade Levels **Year Built** 1973
Screener HS **Date** February 22, 2013
Total Floor Area (sq. ft.) 71,800 SF
Building Name West End Community Centre
Use Mixed Use

OCCUPANCY

[✓ Assembly] Govt [✓ Office]
Commercial Historic Residential
Emer. Services Industrial [✓ School]

Number of Persons
0 – 10 11 – 100
[✓ 101-1000] 1000+

SOIL TYPE

A Hard Rock [✓ B Avg. Rock] [✓ C Dense Soil] D Stiff Soil E Soft Soil F Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☒ Other: SEE COMMENTS

BASIC SCORE, MODIFIERS, AND FINAL SCORE, *S*

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	[✓ C2 (SW)]	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	[✓ 2.8]	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	[✓ -1.0]	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, *S*									0.9						

COMMENTS

Design Code 1970 (not pre-code).
Soft storey on first floor along alley (South) side of building (second floor overhangs the majority of the South elevation first floor).

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
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Read Jones Christoffersen
Consulting Engineers

Suite 300
1285 West Broadway
Vancouver, BC V6H 3X8
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604 738-0048
Fax 604 738-1107
www.rjc.ca

April 29, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for 1001 Kingsway
1001 Kingsway, Vancouver, BC
RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of the building located at 1001 Kingsway, in Vancouver, BC. This evaluation included a rapid visual seismic screening, a review of drawings, and a walk-through site inspection. The rapid visual seismic screening was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
1001 Kingsway	0.9	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 0.9 means there is a 13% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available after our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment does not appear to be seismically restrained.

Pounding from the adjacent building, on the East side, is a potential hazard.

There were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Hanif Shariff, B.Eng., EIT
Building Science and Restoration

April 29/13

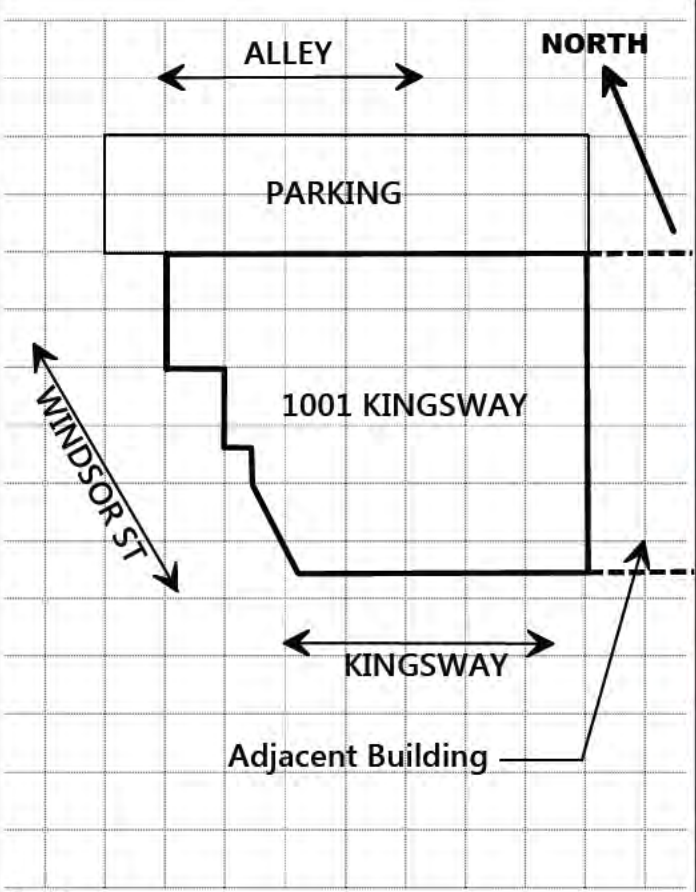
Dennis Gam, M.Eng., P.Eng.
Associate

HS/gb

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 1001 Kingsway, Vancouver, BC

Zip V5V 3C7

Other Identifiers

No. Stories 2 + Basement **Year Built** 1974

Screener HS **Date** April 19, 2013

Total Floor Area (sq. ft.) 13,800 SF

Building Name 1001 Kingsway

Use Mixed Use: Office and Commercial

OCCUPANCY			SOIL		TYPE						FALLING HAZARDS			
Assembly	Govt	[✓ Office]	Number of Persons		A	B	[✓ C]	D	E	F	☐	☐	☐	☒
[✓ Commercial]	Historic	Residential	0 – 10	11 – 100	Hard Rock	Avg. Rock	[✓ Dense Soil]	Stiff Soil	Soft Soil	Poor Soil	Unreinforced Chimneys	Parapets	Cladding	Other: SEE COMMENTS
Emer. Services	Industrial	School	[✓ 101-1000]	1000+										

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	[✓ RM2 (RD)]	URM
Basic Score	**4.4**	**3.8**	**2.8**	**3.0**	**3.2**	**2.8**	**2.0**	**2.5**	**2.8**	**1.6**	**2.6**	**2.4**	**2.8**	[✓ **2.8**]	**1.8**
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	[✓ -1.0]	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S														**0.9**	

COMMENTS Design Code 1970 (not pre-code);

Vertical irregularity: building on a hill (sloped property) and soft storey at parking at North side of the building;

Plan irregularity: greater stiffness in the North-South direction than the East-West direction.

Pounding is a potential hazard, from adjacent building (East side).

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

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Read Jones Christoffersen
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April 29, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for 1001 Kingsway
1001 Kingsway, Vancouver, BC
RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of the building located at 1001 Kingsway, in Vancouver, BC. This evaluation included a rapid visual seismic screening, a review of drawings, and a walk-through site inspection. The rapid visual seismic screening was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
1001 Kingsway	0.9	YES	YES

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

An S score of 0.9 means there is a 13% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available after our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment does not appear to be seismically restrained.

Pounding from the adjacent building, on the East side, is a potential hazard.

There were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) [redacted] -value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Hanif Shariff, B.Eng., EIT
Building Science and Restoration

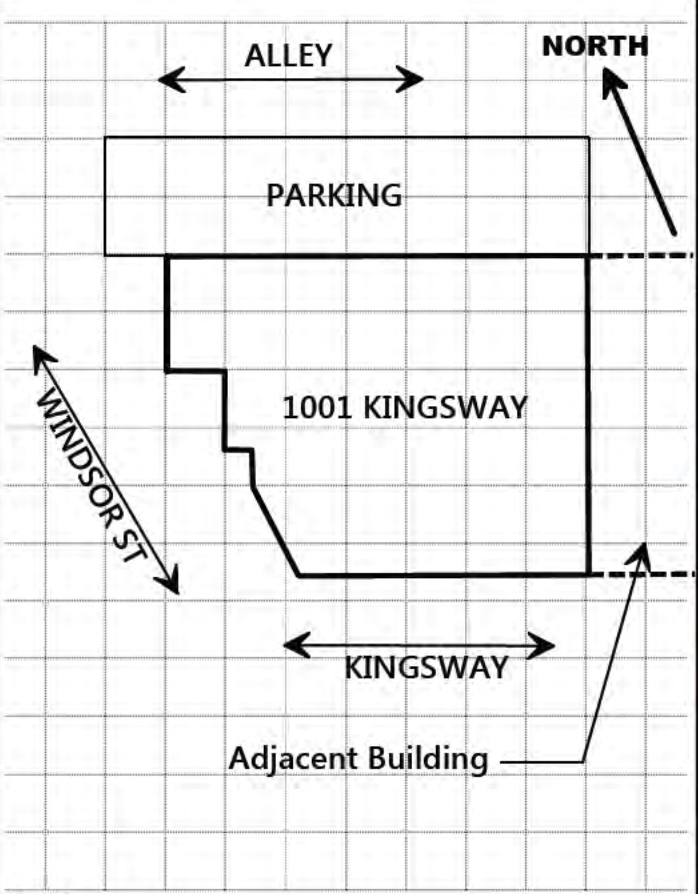
April 29/13

Dennis Gam, M.Eng., P.Eng.
Associate

HS/gb

Rapid Visual Screening of Buildings for Potential Seismic Hazards
FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 1001 Kingsway, Vancouver, BC
Zip V5V 3C7
Other Identifiers
No. Stories 2 + Basement **Year Built** 1974
Screener HS **Date** April 19, 2013
Total Floor Area (sq. ft.) 13,800 SF
Building Name 1001 Kingsway
Use Mixed Use: Office and Commercial

OCCUPANCY

Assembly	Govt	[✓ Office]
[✓ Commercial]	Historic	Residential
Emer. Services	Industrial	School

Number of Persons
0 – 10 11 – 100
[✓ 101-1000] 1000+

SOIL

A	B	[✓ C]	D	E	F
Hard Rock	Avg. Rock	[✓ Dense Soil]	Stiff Soil	Soft Soil	Poor Soil

TYPE

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☒ Other: SEE COMMENTS

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	[✓ RM2 (RD)]	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	[✓ 2.8]	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	[✓ -1.0]	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S														**0.9**	

COMMENTS Design Code 1970 (not pre-code);
Vertical irregularity: building on a hill (sloped property) and soft storey at parking at North side of the building;
Plan irregularity: greater stiffness in the North-South direction than the East-West direction.
Pounding is a potential hazard, from adjacent building (East side).

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
Consulting Engineers

Suite 300
1285 West Broadway
Vancouver, BC V6H 3X8
Canada

604 738-0048
Fax 604 738-1107
www.rjc.ca

April 16, 2013

City of Vancouver
Facilities Management
453 West 12th
Vancouver, BC V5Y 1V4

Attention: Susan Antoniali
Manager, Property Management

Dear Susan:

RE: Seismic Screening Review for Ramada Hotel
3475 East Hastings Street, Vancouver, BC

RJC No.: VAN.107371.0001

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of the Ramada Hotel located at 3475 East Hastings Street, in Vancouver. This evaluation included a rapid visual seismic screening, a review of drawings, and a walk-through site inspection. The rapid visual seismic screening was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The ground floor of the Ramada Hotel is concrete construction with reinforced masonry walls, while the second and third floors are wood frame construction. As such, separate screenings were done for the two different portions of the building.

The following chart summarizes the ratings from the seismic screening forms:

BUILDING PORTION	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
Ground Floor	1.7	YES	YES
2nd and 3rd Floors	3.0	NO	YES

Copies of the screening forms are attached for reference; attachment "A" is for the ground floor, attachment "B" is for the 2nd and 3rd floors.

The Specified acceptance criteria is an "S" score greater than 2.0. The S score represents an indication of the probability of collapse **given** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In the case of the Ramada Hotel, the ground floor S score of 1.7 governs. This S score means there is a 2% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be moderate to high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available after our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment does not appear to be seismically restrained; with the exception of new equipment being installed as part of the spring 2013 renovations.

Pounding is also a potential hazard from the adjacent building on the West side.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously and the size of the building, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would s.17(1)(f) +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

for.
Nicole Babuik, EIT, LEED® AP
Building Science and Restoration

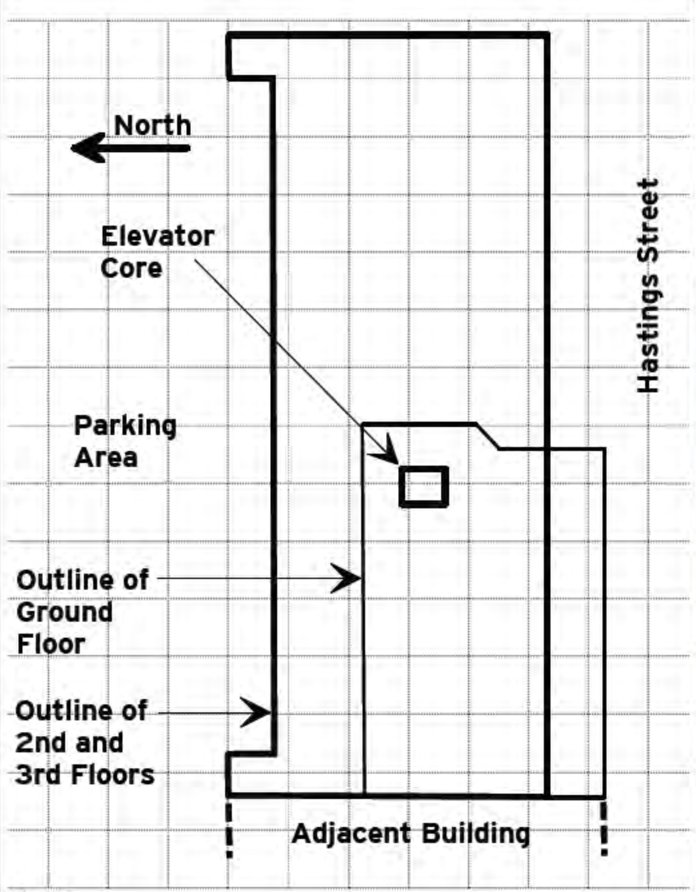
D. S. GAM
April 16/13.
Dennis Gam, M.Eng., P.Eng.
Associate

A

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 3475 East Hastings Street
Vancouver, BC **Zip** V5K 2A5
Other Identifiers
No. Stories 3 **Year Built** 1980
Screener NB **Date** April 4, 2013
Total Floor Area (sq. ft.) 30,000 sq.ft.
Building Name Ramada Hotel
Use Hotel

OCCUPANCY			SOIL
Assembly [✓ Commercial] Emer. Services	Govt Historic Industrial	Office Residential School	Number of Persons 0 – 10 [✓ 11 – 100] 101-1000 1000+

TYPE					
A Hard Rock	B Avg. Rock	C Dense Soil	[✓ D Stiff Soil]	E Soft Soil	F Poor Soil

FALLING HAZARDS			
☐ Unreinforced Chimneys	☐ Parapets	☐ Cladding	☒ Other:

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	[✓ RM2 (RD)]	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	[✓ 2.8]	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	[✓ -0.5]	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	[✓ -0.6]	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S														1.7	

COMMENTS Building is 3 stories; ground floor (and 2nd floor slab) is concrete construction with reinforced masonry walls; 2nd floor, 3rd floor, and roof are wood frame construction. RVS's for the two different construction types have been done; this RVS is for the CONCRETE CONSTRUCTION portion of the building.

Building designed to VBBL 5190.
Pounding is a potential hazard from adjacent building (West side).
Unrestrained OFC's observed in laundry/storage room (boilers) and on roof (AHU).

Detailed Evaluation Required

[✓ YES] NO

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

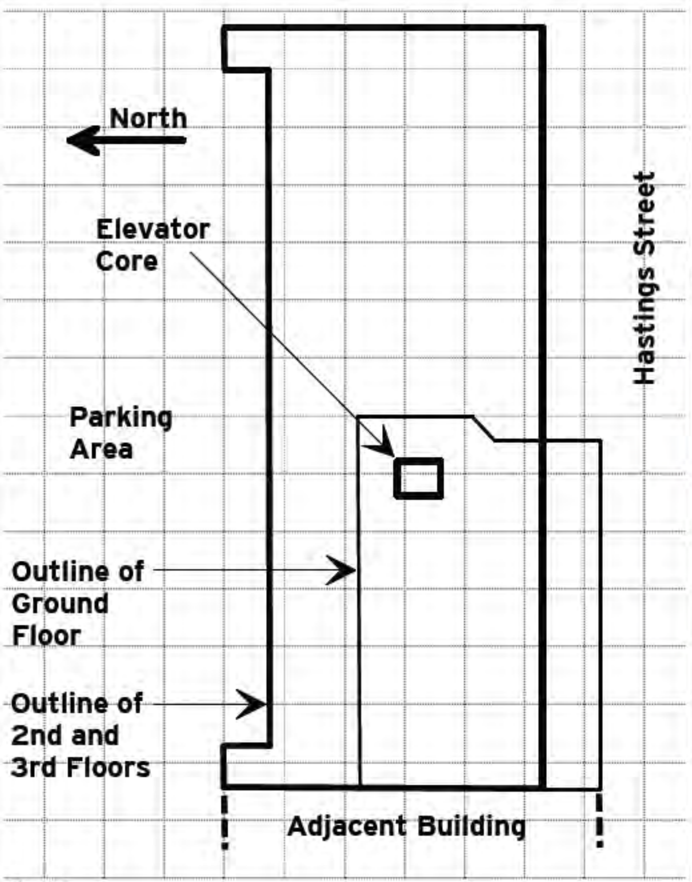
SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

B

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 3475 East Hastings Street
Vancouver, BC **Zip** V5K 2A5
Other Identifiers
No. Stories 3 **Year Built** 1980
Screener NB **Date** April 4, 2013
Total Floor Area (sq. ft.) 30,000 sq.ft.
Building Name Ramada Hotel
Use Hotel

OCCUPANCY

Assembly / [✓ Commercial] / Emer. Services
Govt / Historic / Industrial
Office / Residential / School

SOIL

Number of Persons
0 – 10 / [✓ 11 – 100]
101-1000 / 1000+

TYPE

A	B	C	D	E	F
Hard Rock	Avg. Rock	Dense Soil	[✓ Stiff Soil]	Soft Soil	Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☒ Other: ______

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	[✓ W2]	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	[✓ 3.8]	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	2.8	1.8
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	[✓ -0.8]	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8

FINAL SCORE, S 3.0

COMMENTS Building is 3 stories; ground floor (and 2nd floor slab) is concrete construction with reinforced masonry walls; 2nd floor, 3rd floor, and roof are wood frame construction. RVS's for the two different construction types have been done; this RVS is for the WOOD FRAME CONSTRUCTION portion of the building.

Building designed to VBBL 5190.
Pounding is a potential hazard from adjacent building (West side).
Unrestrained OFC's observed in laundry/storage room (boilers) and on roof (AHU).

Detailed Evaluation Required

YES [✓ NO]

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Read Jones Christoffersen
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Fax 604 738-1107
www.rjc.ca

June 25, 2013

City of Vancouver
Financial Services Group
453 West 12th
Vancouver, BC V5Y 1V4

<u>Attention:</u> Ann Duggan
Project Manager, Financial Services Group

Dear Ann:

RE: Seismic Screening Review for Dunbar Community Centre
4747 Dunbar Street, Vancouver, BC – Revised RJC No.: VAN.107371.0002

Read Jones Christoffersen Ltd. performed a seismic risk evaluation of Dunbar Community Centre located at 4747 Dunbar Street, in Vancouver. This evaluation included a "rapid visual seismic screening", a review of drawings, and a walk-through site inspection. The "rapid visual seismic screening" was based on the second edition of the FEMA 154 Handbook, "Rapid Visual Screening of Buildings for Potential Seismic Hazards".

SEISMIC SCREENING

The following chart summarizes the ratings from the seismic screening form:

BUILDING	FINAL "S" SCORE	FURTHER REVIEW RECOMMENDED	
		STRUCTURAL	NON-STRUCTURAL
4747 Dunbar Street (West Wing; 1957 Building)	1.2	YES	YES
4747 Dunbar Street (East Wing; 1984 Building)	2.4	NO	NO

A copy of the screening form is attached for reference. The Specified acceptance criteria is a "S" score greater than 2.0. The S score represents an indication of the probability of collapse **<u>given</u>** the occurrence of the Maximum Considered Event (MCE), which in this case would be the design earthquake in the current Vancouver Building Bylaw.

In the case of the Dunbar Community Centre, the West Wind building score of 1.2 governs. This S score means there is a 6% probability of collapse given the occurrence of the design earthquake in the current VBBL.

However, the S score does not provide a direct indication of the severity of damage the building would likely sustain immediately prior to collapse. Based on the definition of the S score, we believe the probability of severe damage after the design earthquake would be moderate to high.

OBSERVATIONS FROM SITE

Our site visit was of a visual nature only. Drawings were made available prior to our site visit.

In general, the building structural elements and major architectural elements appear to be consistent with the drawings provided.

A brief tour of the mechanical spaces and the roof indicated that base building equipment does not appear to be seismically restrained.

There were several areas noted with suspended acoustical tile ceilings. The connection of the ceilings to the base structure was not reviewed during our site visit; these suspended structures may not be seismically restrained.

RECOMMENDATIONS

Based on our screening we recommend a detailed, quantitative assessment of the seismic force resisting elements. The review thus far has indicated potential concerns with respect to the adequacy of the base structure seismic force resisting system.

Based on pricing submitted previously, the size of the building, and the number of phases of different construction, our budget for a detailed study, including review of building system components, and costing of repair and upgrade strategies would be s.17(1)(f) +value added taxes.

Yours truly,
Read Jones Christoffersen Ltd.

Hanif Shariff, B.Eng., EIT
Design Engineer

D. S. GAM
#27414
JUN 2 5 2013

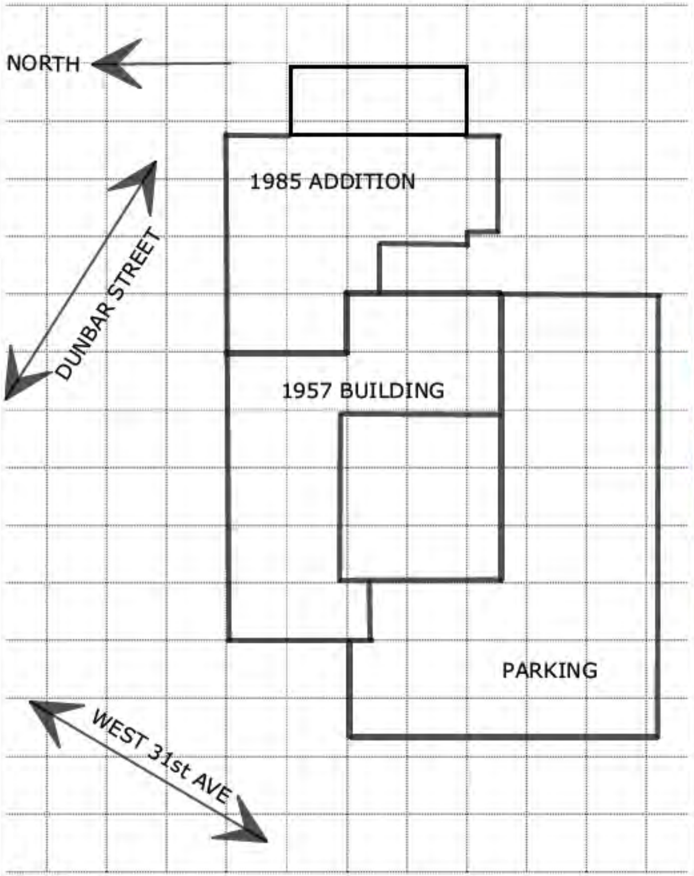
Dennis Gam, M.Eng., P.Eng.
Associate

HS/gb

Rapid Visual Screening of Buildings for Potential Seismic Hazards

FEMA-154 Data Collection Form

HIGH Seismicity



Scale:

Address: 4747 Dunbar Street, Vancouver, BC
Zip V6S 2G8
Other Identifiers
No. Stories 2 **Year Built** 1957
Screener HZS **Date** April 15, 2013
Total Floor Area (sq. ft.) 48,867 SF
Building Name Dunbar Community Centre
Use Mixed Use

OCCUPANCY

[✓ Assembly] Govt [✓ Office]
Commercial Historic Residential
Emer. Services Industrial [✓ School]

SOIL

Number of Persons
0 – 10 11 – 100
[✓ 101-1000] 1000+

TYPE

A	B	C	D	E	F
Hard Rock	Avg. Rock	[✓ Dense Soil]	Stiff Soil	Soft Soil	Poor Soil

FALLING HAZARDS

☐ Unreinforced Chimneys ☐ Parapets ☐ Cladding ☐ Other: ______

BASIC SCORE, MODIFIERS, AND FINAL SCORE, S

BUILDING TYPE	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	[✓ RM2 (RD)]	[✓ URM]
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	2.0	2.5	2.8	1.6	2.6	2.4	2.8	[✓ 2.8]	[✓ 1.8]
Mid Rise (4 to 7 stories)	N/A	N/A	+0.2	+0.4	N/A	+0.4	+0.4	+0.4	+0.4	+0.2	N/A	+0.2	+0.4	+0.4	0.0
High Rise (> 7 stories)	N/A	N/A	+0.6	+0.8	N/A	+0.8	+0.8	+0.6	+0.8	+0.3	N/A	+0.4	N/A	+0.6	N/A
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	N/A	-1.0	-1.0	-1.5	-1.0	-1.0	N/A	-1.0	-1.0	-1.0	-1.0
Plan irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	[✓ -0.2]
Post-Benchmark	+2.4	+2.4	+1.4	+1.4	N/A	+1.6	N/A	+1.4	+2.4	N/A	+2.4	N/A	+2.8	+2.6	N/A
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	[✓ -0.4]	[✓ -0.4]
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.8
FINAL SCORE, S														2.4	1.2

COMMENTS

1985 addition is reinforced masonry with rigid diaphragms;
1954 building is unreinforced masonry;
Some mechanical equipment does not appear to be restrained;
Renovation/addition drawings from 1985 indicate design was in accordance with the 1980 National Building Code and VBBL No. 5583.

Detailed Evaluation Required

[✓ **YES**] **NO**

* = Estimated, subjective, or unreliable data
DNK = Do Not Know

BR = Braced frame
FD = Flexible diaphragm
LM = Light metal

MRF = Moment-resisting frame
RC = Reinforced concrete
RD = Rigid diaphragm

SW = Shear wall
TU = Tilt up
URM INF = Unreinforced masonry infill

Glotman · Simpson
GROUP OF COMPANIES

May 7,2012 File No. 211255

City of Vancouver
555 West 12th Avenue
Vancouver, BC
V5Z 3X7

Attention: Mr. Garrick Bradshaw
Director, Facilities Design and Management

Re: Phase 1 - Seismic Performance Review and Upgrade Strategies
East Wing and West Annex – City Hall Precinct, Vancouver, British Columbia

Dear Mr. Bradshaw:

Glotman•Simpson Consulting Engineers are pleased to provide the City of Vancouver with the following Seismic Assessment and Upgrade Options in response to the Statement of Work outlined in the Request for Proposals PS11466.

This report focuses on the **Phase 1 Seismic Performance Review and Upgrading Strategies** for the two buildings identified as the East Wing and West Annex both of which are within the City Hall Precinct (453 West 12th Avenue and 515 West 10th Avenue). Later Phases would further develop the pre approved approach strategy including study of seismic risk, detailed non-linear time history analysis, upgrading details and project specifications.

We trust this report meets your needs at the moment. If you require any additional information or clarification on items presented in this report, our team would be pleased to provide additional comment.

Yours truly,
GLOTMAN•SIMPSON

P. H. ESPEZEL
PROFESSIONAL ENGINEER
1[illegible]28
DESIGNATED
STRUCTURAL ENGINEER

Philip Espezel

ASSOCIATION OF PROFESSIONAL
ENGINEERS AND GEOSCIENTISTS OF
BRITISH COLUMBIA
R. D. SIMPSON
13575
IS REGISTERED AS A
DESIGNATED
STRUCTURAL
ENGINEER
(STRUCT. ENG.)

Per: Philip Espezel, P.Eng, Struct. Eng
Project Engineer

Reviewed by: Rob Simpson, P Eng,
Struct Eng, MBA, FEC, LEED AP

Glotman · Simpson
CONSULTING ENGINEERS*

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EXECUTIVE SUMMARY

Glotman•Simpson Consulting Engineers were retained to carry out a seismic study of the existing East Wing and West Annex (VanCity) buildings on behalf of the City of Vancouver to investigate the seismic vulnerability of the two buildings for life safety and to recommend upgrading strategies.

The seismic capacity of the East Wing is very low with a number of features that are cause for a safety concern in an earthquake of any reasonable size. The capacity of the seismic load resisting structure is a small fraction of the requirements of the current Building Code. The East Wing was found to contain several features that cause extreme hazard in seismic ground shaking. A feature known as "short columns" are prone to failure because they would attract a majority of the earthquake forces and their capacity is very low. When columns fail, the structure in the area collapses downward which puts large forces on the remaining structure. The whole east side of the building has columns that could fail in a relatively small earthquake which could potentially lead to collapse of the whole building. In addition, a feature known as a 'soft story' exists in the north shearwalls where the configuration of the walls could lead to sudden instability and collapse of the walls in a moderate earthquake. Both of these features are known to have collapsed buildings in previous earthquakes and should be addressed as soon as possible.

The West Annex was also found to contain 'short columns' and potential 'soft story' effects in the parking levels. Precast construction in the parking levels is known to have caused building collapse in previous earthquakes when the precast was constructed with minimal connections as it is in this building. If the precast in the parking structure is dislodged by a moderate earthquake, then there will be a sudden loss of vertical support at the columns and all levels of the building would collapse downward suddenly into the basement. The upper storeys of the West Annex are constructed of a steel frame that has reasonable strength however it's steel connections are from a era prior to current seismic detailing practice and should be upgraded to avoid premature failure. The limited strength of the steel frame could lead to an unstable condition if overloaded by a moderate to strong earthquake, at which time the building could potentially drift sideways and collapse suddenly.

Eliminating the undesirable features noted above should be given the highest priority.

Upgrading costs for purely structural work to achieve compliance with the current Building Code are in the order of s.17(1)(f) for the East Wing and West Annex respectively. This offers good value, because the existing structure appears to be of good quality for carrying gravity loads.

In addition to purely structural costs, the following has been provided to us for use in this report

- Architectural, Mechanical, Electrical s.17(1)(f)
- Asbestos abatement allowance
- Relocation Costs
- Construction Profits and Overheads
- Consulting Fees
- Project Management
- Permits, taxes and disbursements

Totals resulting in additional costs above the structure work in the order of [redacted]

To reduce costs, a lower standard of seismic performance can be considered. Levels of seismic demand are expressed in scientific terms as the percent chance of exceedance in any 50 year period. A 2% change of exceedance is the basis for the current Building Code. A 5% chance of exceedance represents force levels approximately 70% of current Code while a 10% chance of exceedance in 50 years is approximately 50% of current Code. The 1995 Building Code used the 10% in 50 year standard for building design however the 2005 Code increased the hazard level to 2% in 50 year.

With reduced seismic demand comes the possibility of exceedance that could cause extreme damage and loss of life in an extreme seismic event. However, upgrading to a lower standard provides improved safety for smaller earthquakes that occur more frequently.

Glotman Simpson recommends that the buildings be upgraded to the current Code wherever possible. As a minimum, upgrading should target the 10% in 50 year standard with the undesirable building features of soft storey, short column and precast connections eliminated. **We also recommend that a performance based analysis be performed to help optimize the design.** The performance based analysis would employ site specific seismic parameters that better reflect the ground shaking at the site and non-linear time history analysis to better understand the building response to ground shaking. Using these advanced methods the upgrade solutions can be tailored to achieve more effective benefits with less excess money spent upon items that do not provide great value. During performance based analysis, a cost benefit evaluation can be made to determine whether upgrading to the full requirements of 2% in 50 years would provide value.

EXECUTIVE SUMMARY TABLE

EAST WING (1968)

Existing Bldg Condition – Ref 1.0	The East Wing Building appears to be in satisfactory structural condition to support gravity load in the absence of seismic conditions. There are no signs of significant deterioration in the main structural elements of the building.		
Existing Bldg Seismic Capacity – Ref 3.0	The seismic resistance of the East Wing is very low in its existing condition. The **soft story** and **short column** features pose a very significant risk of collapse under a small to moderate earthquake , therefore making it impractical to express a percentage capacity of current Code for seismic purposes. If these items are upgraded separately, then the capacity of the remaining existing system is in the order of 15% of current seismic design requirements.		
Seismic Objective and Reference – Ref 2.0	The current Vancouver Building Bylaw 2007 No. 9419 is the reference Building Code for seismic design criteria. The stated objective in the Code of life safety and collapse prevention is intended to allow occupants safe egress from the building after an earthquake of the chosen hazard level. There is no expectation that the building will be serviceable after a significant earthquake event.		
Seismic Upgrading Target Hazard **Ref 4.0 and Appendix C**	2% in 50 year 2005 Code Level	10% in 50 Year 1995 Code Level	Do Nothing Scenario
Seismic Standard of Compliance - Ref 2.0	VBBL 2007 No. 9419 100% (recommended)	Minimum suggested level of upgrade Where cost is low to increase the upgrade for a particular element, proceed to a higher level Same as for the 1995 NBC and associated VBBL 50% of current VBBL (temporary)	Glotman•Simpson strongly recommends that, at a minimum, several key features of the building that could cause sudden collapse (short columns, soft story) be considered for upgrading at the earliest possible time. 9 - 15% of current VBBL (not recommended)
Phasing Strategies – Ref 1.	Upgrading could be staged to provide improved performance of critical building elements to a lower standard of 10% in 50 years at present, and increase the seismic safety in future years as additional funds can be made available.		
Risk of Property Damage and Risk to Lives **Design level seismic event**	Slight Risk of property damage Low risk in moderate earthquakes Slight risk to life safety	Significant risk of property damage Moderate risk in moderate earthquakes Increased risk to life safety	Extreme risk of property damage Collapse likely in moderate earthquake without upgrading of key risks Extreme risk to life safety
Contingency	A contingency for unknowns is always necessary when working in existing buildings due to unknown changes in original construction and for relocating services etc.		
Operational Impacts – Ref 1, 6.0	Construction can proceed in isolated areas to progressively complete the upgrading and thereby minimize the overall impact on operations.		
Future Upgrading Considerations – Ref 0	Items that are not within this scope of work should be considered for upgrading concurrently or in the future such as ceilings and non-structural elements, mechanical systems, gas lines, automatic gas shutoff valves, etc.		
Structural Upgrading Costs* - Ref 5.0	s.17(1)(f) [redacted]	[redacted]	[redacted]
Other Construction Costs: **Arch / Mech / Elec / Envir / Contingency**	35 – 50%	35 – 50%	50%
Consultant Fees	12 – 15%	12 – 15%	20%
Operational Impact Costs / Permits / Disb.	20 – 30%	20 – 30%	30%
Total Project Cost	s.17(1)(f) [redacted]	[redacted]	[redacted]

EXECUTIVE SUMMARY TABLE

WEST ANNEX (1975)

Existing Bldg Condition – Ref 1.0	The West Annex Building appears to be in satisfactory structural condition to support gravity loading in the absence of seismic conditions. There are no signs of obvious significant deterioration in the main structural elements of the building.		
Existing Bldg Seismic Capacity – Ref 3.0	Although the members in the steel moment frame appear to have strength in the order of 50% of current seismic design requirements, steel connections are not current and the possibility of sudden instability and collapse is possible under a larger earthquake. The lower levels of the West Annex are precast that have low seismic resistance especially at connections and in the floor diaphragms.		
Seismic Objective and Reference – Ref 2.0	The current Vancouver Building Bylaw 2007 No. 9419 is the reference Building Code for seismic design criteria. The stated objective in the Code of life safety and collapse prevention is intended to allow occupants safe egress from the building after an earthquake of the chosen hazard level. There is no expectation that the building will be serviceable after a significant earthquake event.		
Seismic Upgrading Target Hazard **Ref 4.0 and Appendix C**	2% in 50 year 2005 Code level	10% in 50 Year 1995 Code Level	Do Nothing Scenario
Seismic Standard of Compliance - Ref 2.0	VBBL 2007 No. 9419 100% (recommended)	Minimum suggested level of upgrade. The cost to enhance safety of the steel frame is low, thus proceed to a higher standard such as 5% in 50 year or perhaps 2% in 50 year. Same as for the 1995 NBC and associated VBBL 50% of current VBBL (temporary)	Glotman•Simpson strongly recommends that, at a minimum, several key features of the building that could cause sudden collapse (short columns, precast connections) be considered for upgrading at the earliest possible time. 50% of current VBBL but with unsafe structural failure mechanism (not recommended) that could lead to sudden collapse.
Phasing Strategies – Ref 1.	Upgrading could be staged to provide improved performance of critical building elements to a lower standard of 10% in 50 years at present, and increase the seismic safety in future years as additional funds can be made available.		
Risk of Property Damage and Risk to Lives **Design level seismic event**	Slight Risk of property damage Low risk in moderate earthquakes Slight risk to life safety	Significant risk of property damage Moderate risk in moderate earthquakes Increased risk to life safety	Extreme risk of property damage Risk very high in moderate earthquake if not upgraded Extreme risk to life safety
Contingency	A contingency for unknowns is always necessary when working in existing buildings due to unknown changes in original construction and for relocating services etc. An example in the West Annex is a note on the existing drawings about asbestos being used as a fire stop above the top of block walls in the building.		
Operational Impacts – Ref 1, 6.0	Construction can proceed in isolated areas to progressively complete the upgrading and thereby minimize the overall impact on operations.		
Future Upgrading Considerations – Ref 0.	Items that are not within this scope of work should be considered for upgrading concurrently or in the future such as ceilings and non-structural elements, mechanical systems, gas lines, automatic gas shutoff valves, etc. Steel beam connections in the West Annex should be investigated during the course of the work		
Structural Upgrading Costs* - Ref 5.0	s.17(1)(f) [redacted]		
Other Construction Costs: **Arch / Mech / Elec / Envir / Contingency**	35 – 50%	35 – 50%	50%
Consultant Fees	12 – 20%	12 – 20%	20%
Operational Impact Costs / Permits / Disb.	20 – 30%	20 – 30%	30%
Total Project Cost	s.17(1)(f) [redacted]		

* Notes 1. Budget costs for upgrading have been considered based upon the costs of main building structural work alone, assuming normal industry costs with reasonable access and normal work schedule. Contractor s overhead and profit, permit fees, removal and replacement of finishes and other items, consulting fees, etc. are not included. See also our disclaimer for information on costing and other work. Costing of construction within existing buildings is difficult and can only be approximate when done in the absence of the assistance of a contractor who is able to invest the time to explore details of the work methods necessary to achieve the design solutions. Estimated costs do not include engineering fees or HST and are based on 2012 costs.

1. PROJECT SUMMARY

Introduction:

Glotman•Simpson Consulting Engineers were retained to carry out a seismic study of the existing East Wing and West Annex (VanCity) buildings on behalf of the City of Vancouver. The purpose of the study is to investigate the seismic resistance and vulnerability of the two buildings for life safety in a design earthquake event. In addition, a clear limitation on budget for the upgrading has been expressed, and the upgrading alternatives need to bridge any gap between the objectives of the study and the budget available to perform the work.

The East Wing is a 4 storey concrete building constructed above a 2 storey podium parking structure upon a sloping site. The building levels terrace with the site slope such that the building is buried at most by only one level at a time. Entrance to P2 is made at grade at the north end of the site and levels P1 and P2 extend just over half the depth of the building. The Ground floor projects to the south end of the site and is buried one level at the south end where Level 2 is at grade.

The structure of the East Wing is concrete shearwalls with flat concrete slabs and columns. The building was built in the late 1960's and is therefore designed to a Vancouver Building Bylaw that is well outdated to current seismic design criteria.

Originally constructed as a temporary building, the East Wing continues to serve the function it was built to serve. The structure of the building is in good shape in most areas and can be expected to have a long life from this point forward with appropriate maintenance. The most significant deficiency of the building is the seismic resistance.

The West Annex is a building previously owned by VanCity Credit Union and was purchased by the City of Vancouver. VanCity continues to occupy the building as a tenant on the ground floor while the City occupies office space in levels above.

The West Annex is a 4 storey steel frame building constructed above a 2 storey underground parking structure constructed of precast concrete. The upper levels of the building terrace outwards as the stories rise above the ground. The exterior of the building is clad with precast concrete cladding materials anchored to the steel frame of the building. Steel columns in the building rest upon precast columns at ground floor.

The West Annex seismic lateral force resisting system is a steel moment frame constructed in the early 1970's. The moment frame is fully regular and rests on ground level. The basement levels are precast concrete with concrete topping slabs. The site slopes slightly from south to north resulting in one side of the basement at grade level at P1.

Seismic Performance Objectives:

The objectives of seismic design in the National Building Code of Canada and the Vancouver Building Bylaw are to preserve life safety and prevent collapse during a design level seismic event. The design level seismic event is defined by the Code as a Uniform Hazard Spectrum that represents the earthquake risk consistent with a 2% chance of exceedance in a 50 year time period, or a return period of 2475 years. The concept of life safety and collapse prevention means that the building is expected to experience damage as a result of an earthquake of the magnitude of the design level earthquake and it may not be serviceable after the event.

Buildings that are expected to be serviceable after an earthquake are designed to a higher standard with an importance factor not normally used for the design of most buildings. The stated objective of this study is collapse prevention and life safety only, and not for immediate service.

The performance objectives to preserve life and prevent collapse can only be evaluated for a specific level of earthquake shaking. A higher level of shaking brings greater risk of collapse. The practice of reducing the seismic design forces to 75% of Code naturally results in a higher risk of collapse and loss of life.

The cost objective for the project makes it necessary to consider alternatives to the basic seismic hazard index. By increasing the hazard, the design loading is reduced making the cost and complexity of upgrading easier. However, it must be noted that the hazard increase creates a small risk that the capacity of the building could be exceeded in a earthquake event greater than the chosen hazard level. In such a case, collapse prevention might not be achieved. Still, given the poor level of seismic resistance existing in the building today, any increase in seismic resistance will make a substantial improvement to life safety especially for more frequent smaller earthquakes.

Reduced seismic performance and increased seismic hazard are expressed in the Uniform Hazard Spectrum at the increments of 5% in 50 years, 10% in 50 years and 40% in 50 years. Each design level represents a more frequent smaller event with lower shaking levels and shorter duration. Not explicitly expressed in the design information provided by the Code is the Cascadia subduction event which is expected to occur offshore sometime in the next century or more. Local earthquake shaking is expected to be approximately equivalent to the 5% in 50 years design event but with durations lasting up to 4 or 5 minutes.

While force levels of earthquakes are important, it becomes equally important to recognize that duration is a key feature of earthquakes as well. Unfortunately the science is not advanced sufficiently to specifically advise on duration. Experience indicates that 5% and 10% in 50 year earthquakes have shaking durations much less than the design level event. Therefore, when considering a design to a lesser standard, the duration of shaking under consideration can be reduced as well. This will allow some building conditions to exist that might otherwise be considered unacceptable in a long duration earthquake.

Existing Capacity:

The seismic resistance of the East Wing is very low in its existing condition. In the absence of upgrading for the soft story and short column effects noted below, the existing building is highly vulnerable to sudden collapse making it impractical to rate the existing seismic resistance as a percentage of Code. With these items excluded, the capacity of the existing system is in the order of 15% of current seismic design requirements.

The West Annex steel moment frame appears to have capacity in the order of 50% of current seismic design requirements although the mechanisms of yielding are undesirable. This analysis makes the assumption that existing connections are suitable for the loading. The lower levels of the West Annex are precast that have low seismic resistance.

Upgrade Recommendation

Glotman•Simpson recommends that the East Wing and West Annex should be upgraded to the 2% in 50 year design event as this is the modern standard of today. s.17(1)(f) [redacted] s.17(1)(f)

[redacted]

[redacted]

If budgets do not permit this level of upgrading, then alternatives should be considered. Glotman Simpson are of the opinion that the "do nothing" option should not prevail due to the potential for collapse in a moderate to strong earthquake.

Staged Upgrading

Given the limitation on project budget, a strategy must be created to provide the greatest benefit for the given budget available for improving seismic safety. By staging the upgrading it is possible to spread the project cost over an extended period to ease budget requirements and to take care of the highest priority items first. Also, by considering the staging of upgrading, it is possible to respond to changes in sentiment about the importance of seismic upgrading. As events occur worldwide or locally, people are becoming more attuned to the seismic risk here in Vancouver. Should a full upgrade be desired at a later date, it would be beneficial to be able to add to what has been provided instead of recreating work that has already been completed.

The "Do Nothing" Option and Seismic Risk

The East Wing and West Annex both have several features that make the building very risky in the event of seismic shaking. Glotman•Simpson strongly recommends that several key aspects of the building should be considered for action at the earliest possible time. Following are elements of the building that could result in extreme damage that could precipitate collapse in a seismic event considerably less than the 2% in 50 year event:

☐ Short columns on the east side of the East Wing and in the basement of the West Annex are very stiff and will attract seismic forces. The columns have low shear capacity and can shear off. In an earthquake of any significant duration, the columns could loose gravity bearing capacity.

☐ Stair walls at the ends of the East Wing are connected to the building with limited strength. In other buildings of similar construction, the stair walls have fallen away from the building in a strong earthquake. The stair wells should be tied to the main building so they remain secure in an earthquake. An option might exist to rebuild the south stairwell.

☐ A "soft storey" exists at the north end of the East Wing with shearwalls between level 2 and the roof but with no walls between ground and level 2. Similar to a short column, all seismic displacement would have to occur over this weak story, causing damage at the lowest level. This feature is known to cause collapse of buildings.

☐ Link beams between shearwalls at the north end of the building are identified weak points. By solving the soft story noted above, this problem can also be solved. Without adding redundant support, these link beams can be subject to combined gravity loading with seismic shear that could potentially fail the beams that support floors in this area.

☐ Infill openings in the south basement wall of the West Annex to improve the seismic resistance and avoid potential for a soft storey effect in this wall.

- ☐ Provide ties between precast elements in the basement parking levels of the West Annex to help minimize the chance of precast sections becoming dislodged from other sections. Poorly connected precast has been know to cause collapse of buildings.
- ☐ Improve the diaphragm of the ground level and parking level of the West Annex to sustain shaking and maintain shear distribution within the building.

Given the importance of these vulnerable features in the building, the “Do Nothing” option would perpetuate the life safety risks and potential for collapse in a moderate to strong earthquake. As a minimum, we recommend that these vulnerable features be repaired in such a way that the potential for collapse is minimized.

Alternative Upgrading Strategy:

If upgrading to the design level Uniform Hazard Spectrum of 2% in 50 years is not viable, then a reduced design level with higher hazard level can be considered.

As a minimum, Glotman•Simpson recommends upgrading to at least the level of a 10% in 50 years Uniform Hazard Spectrum, and better if possible. This reduced hazard level is consistent with design practices in the late 1980’s and 1990’s and provides a considered level of seismic safety at approximately 50% of the current design force levels. Strategies to improve seismic safety with this level of hazard have been investigated with the following specific recommendations:

- ☐ Complete the collapse prevention items noted above as a priority.
- ☐ Provide increased ductility in the East Wing shearwall building by adding concrete sections to the ends of the existing brittle concrete walls. The addition of reinforcing at the ends of the walls allows the walls to be considered as a moderately ductile wall system which leads to a reduction in seismic force levels due to the ability of the system to handle some damage without loosing strength. This approach is also consistent with the objective of life safety and collapse prevention as ductile systems are much more capable of sustaining damage beyond the anticipated design level.
- ☐ Provide carbon fibre upgrading to the shear strength of walls where necessary to achieve the collapse prevention safety.
- ☐ Consider increasing the shear strength and flexural strengths to raise the capacity of individual wall elements to the 2% in 50 years design level when the increment in cost is small, especially where the work is already being done for the chosen level of upgrading.
- ☐ Install a damping system in the West Annex to improve the ability of this building to sustain harmonic motion. While the building appears to have strength to meet the 10% in 50 year earthquake demand, the slightest overload could lead to collapse because the yield mechanism would lead to column failure. Damping can improve performance and reduce the chance of this unacceptable mode of failure.
- ☐ Increase the damping of the West Annex to achieve a 2% in 50 year design level where costs of increasing the damping performance are small.
- ☐ Provide shearwalls in the parking levels of the West Annex to improve seismic resistance of the basement and help maintain integrity of the building.
- ☐ Verify precast connections in parking levels of the West Annex and connect to maintain integrity of the primary system during ground shaking

☐ It is assumed herein that the steel moment frame connections of the West Annex are of a suitable quality. Work should be done to confirm this, and if necessary, a budget made available to upgrade the connections if necessary.

Working in Existing Buildings

Glotman Simpson recommends that a contingency be maintained for unknowns that inevitably are discovered when working in existing buildings. It is common that there are problems to be discovered when working in existing buildings. Construction of existing building is often different from what the existing drawings would indicate, and changes that may have been made during the course of original construction are often not reflected in the existing building drawings. Also, items that are not the focus of assessment at this time might come up during a renovation such as the need to move piping or electrical or to repair roofing. An example in the West Annex is a note on the drawings about asbestos being used as a fire stop above the top of block walls in the building. When work is done to laterally restrain the walls, the asbestos will be encountered. As this is not in the structural scope, we have not made an allowance for asbestos removal at this time.

Future Upgrading

Items that are not within the scope of work to be anticipated, but should be considered going forward include:

☐ Investigate the connections of the existing precast wall cladding materials on the West Annex and upgrade if necessary. It is quite possible that the connections are adequate as they exist today, however, due to the falling hazard it would be prudent to investigate the connections. If upgrading is required, the work will be somewhat difficult to accomplish but not especially expensive.

☐ Ceilings and non-structural elements should be secured to reduce seismic hazards internally.

☐ Steel beam connections in the West Annex should be investigated during the course of the work however, if the budget does not allow their upgrading at the present time, then they should be upgraded as soon as possible. This analysis can only consider that the existing connections as suitably constructed and adequately ductile.

Costing:

Budget costs for upgrading have been considered based upon the costs of structural work alone, assuming normal industry costs with reasonable access and normal work schedule. Contractor’s overhead and profit, permit fees, removal and replacement of finishes and other items, consulting fees, etc. are not included. See also our disclaimer for information on costing and other work.

Estimating the cost of construction within existing buildings is difficult and can only be approximate when done in the absence of the assistance of a contractor who is able to invest the time to explore details of the work methods necessary to achieve the design solutions.

East Wing:

Upgrading to the 10% in 50 year level is presented in sketches within the following document.

s.17(1)(f) [redacted]

West Annex:

Upgrading to the 10% in 50 year level with the introduction of dampers and steel bracing above ground floor at 8 locations within the building is estimated at s.17(1)(f) [redacted]. It is possible that this work could achieve the 2% in 50 year level when non-linear analysis is provided at a later date. Further upgrading of the ground floor and parking level diaphragm is estimated in the order of s.17(1)(f) [redacted] Shearwalls below ground level to reduce diaphragm forces and improve lateral resistance are estimated in the order of s.17(1)(f) [redacted]. Other details to achieve the project are required including masonry lateral support. We assume the precast connections and steel connections will not need upgrading. Total structural upgrading costs for the noted items are in the order o s.17(1)(f) [redacted].

Limitations:

Although there is considerable information contained in this report, the scope of work to this point has been to discover problems and consider alternatives for upgrading and improvements in safety. Design work is necessary to properly quantify the upgrading and provide sufficient information for proper costing. As a next step, a preliminary design of the chosen approach should be prepared for an updated costing by a cost consultant. If this level of design and costing provides an indication that the budget has been held, then the design should be completed and a tender could be called to verify the market price of the work.

Conclusions and Recommendations:

This study has investigated the feasibility and appropriateness of seismic upgrading for the East Wing and West Annex. It is our opinion that both buildings have many features that make them excellent candidates for long term use however both buildings have vulnerabilities that can be hazardous in a seismic event.

At the very minimum, and as a first step in improvement to building safety, several hazardous features of both buildings should be addressed to help reduce the chances of collapse in a moderate seismic event.

Glotman•Simpson recommends that upgrading to the 2% in 50 year design level will provide suitable value in the long term for these buildings. If such upgrading cannot be accommodated within the current budget then a reduced seismic performance and increased seismic hazard may be considered at the 10% in 50 year design level provided it is understood that the level of life safety and collapse prevention is reduced. 10% in 50 years is the design level used in the1980's and through to 2005, and is approximately equal to 50% of the current design force levels. Where possible, upgrading could be staged to provide improved performance to a lower standard at present, and increase the seismic safety in future years as additional funds can be made available.

With a reduced seismic demand to the 10% in 50 year hazard spectrum this seismic demand level is consistent with the design levels used in the 1995 NBC and VBBL and is approximately 50% of the 2% in 50 year hazard spectrum of the current Code. While considerably less than the full design level considered today, this is still a reasonable level of seismic performance and a significant improvement over the existing conditions.

We recommend the existing walls of the East Building be upgraded from brittle to semi-ductile with the addition of new thickenings at the ends of walls and upgrading the shear strength of the walls with either concrete or FRP. This will increase strength and the ductility to improve seismic performance. Increasing ductility has the effect of reducing the design forces while adding strength and can raise the building capacity to meet the Code demand. Our assessment has been to the 10% in 50 year with a moderately ductility demand of RdRo = 2.0 /1.4. Our analysis indicates there is sufficient capacity to meet the demand above the ground floor. Below the ground floor there is substantially more resistance in the building.

At a later stage of analysis the East Wing should be assessed for an upgrading to a ductility demand of Rd=3.5, thereby reducing the design loads much further while improving the shear strength to ensure full ductile action of the upper floor levels. This approach together with non-linear time history analysis will provide the opportunity to improve resilience of the building for overload and to prove through analysis that its ductile systems are able to sustain the ground shaking of a design level earthquake. This approach would result in a much safer building because it would also have the effect of reducing effective seismic loads on the lower levels of the building below the ground level. The challenge at this stage of analysis is the extent of work required to perform the non linear performance based analysis. We are confident that benefits will be provided however it is necessary to verify that the building displacements are not too large so that collateral elements can sustain the imposed motion of an earthquake. It may be possible to upgrade to the full 2% in 50 year through this approach for the levels above ground floor.

2.0 GENERAL INTRODUCTION

Glotman·Simpson Consulting Engineers has been retained by the City of Vancouver to prepare a Structural Seismic Performance and Upgrade Strategies report as part of an **interim** approach to seismically upgrading the two subject buildings. The terms of reference and overall seismic performance criteria are to **prevent building collapse** and to allow City staff and the public to **safely exit** the building following a seismic event.

2.1 SCOPE OF WORK AND OBJECTIVES

This Phase 1 Seismic Performance Review and Upgrade Strategies study focuses on the City of Vancouver's **East Wing Building** and **West Annex (Van City)** buildings, both facilities within the City Hall Precinct. Refer to Photograph 1 that shows the location of the buildings relative to the City Hall Main building.

The structural integrity of the buildings has been assessed in terms of their life safety performance during a seismic event. If the buildings do not meet the design requirements of the current Vancouver Building Bylaw, then upgrade options and strategies are to be presented that would improve the buildings overall performance.

Aspects of the assessment and the objectives of this review will include the following

a. Visual non destructive site reviews and visual assessments of the primary structural building components,

b. Conducting minor destructive testing if necessary in the absence of drawing information, as required and pre approved by the City,

c. Qualitative assessment of the buildings primary structural features and their likely performance in a seismic event utilizing empirical information and experience,

d. Quantitative preliminary assessment of the primary structural system of the building utilizing conventional static analysis methods and the drawing information available,

e. Provide a general assessment of the buildings existing seismic performance, indicate key weaknesses in the primary structure, consequences of these weaknesses and potential modes of failure of the buildings,

f. Based upon our expectation of the existing building performance, consider alternatives and provide specific upgrading objectives for each building to suit its unique characteristics,

g. Recommend upgrading strategies to achieve full compliance with the seismic requirements of the current Vancouver Building Bylaw,

h. Consider possible reduced levels of upgrading that will achieve a reasonable level of seismic resistance at reduced costs as an interim strategy for short term building life,

i. Recommend action to be taken to improve the life safety performance of the buildings with the objective of preventing collapse and allowing occupants to safely exit the building in the design earthquake scenario,

j. Provide preliminary order of magnitude or ballpark costing of each strategy or option,

k. Provide a statement of impact that each strategy or option will have on the City operations during construction,

l. Provide potential work phasing and priorities, if any,

m. Provide recommendations on a future course of action

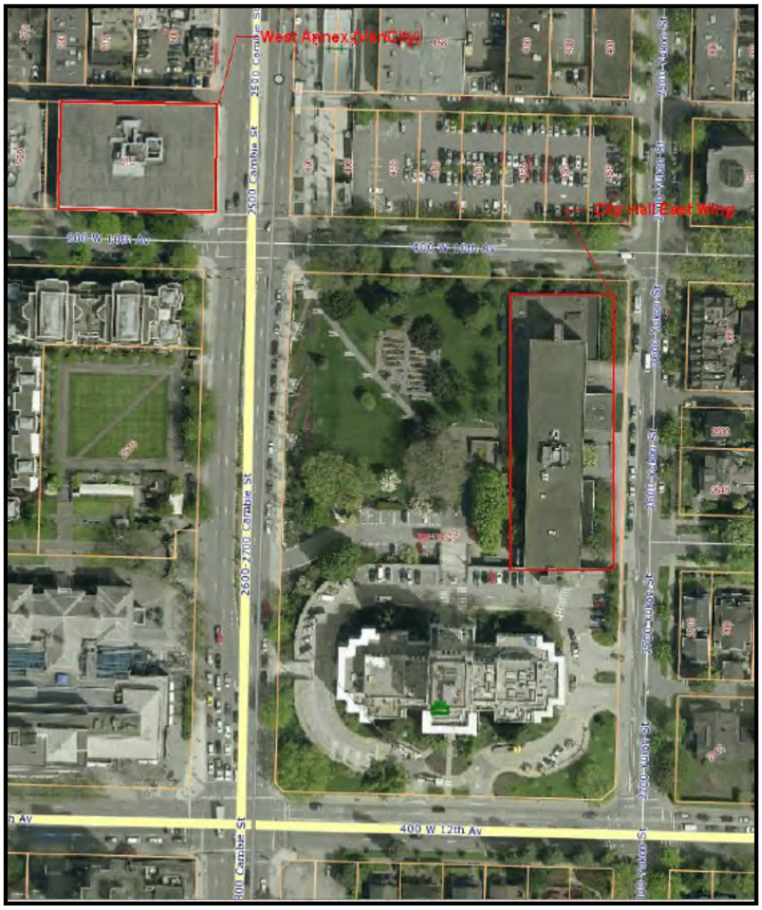
2.2 EXISTING BUILDING INFORMATION AND REFERENCE MATERIAL

A series of structural drawings were available for review as part of our structural assessment report. The drawings of the East Wing were developed by Dexter, Bush & Associates Ltd, Consulting Engineers and are dated February 1968. The West Annex was designed by David Nairne and Associates Structural Engineers and the drawings are dated September 1975. The available structural drawings are noted in Table 1.

Table 2.1 – Existing Building Drawings

East Wing (1968)	**West Annex (1975)**
P1 Site Services Plan	S1 Foundation and Parking Plan B
S1 Foundations & Sub – Basement Floor Plans	S2 Parking Plan A
S2 Mechanical Room Floor Plan	S3 Ground Floor Plan
S3 Basement Floor Plan	S4 Building Cross Sections
S4 Ground Floor Plan	S5 Foundation Details and Sections
S5 Second, Third, Fourth Floor Plans	S6 Parking Level A
S6 Connection to Existing Building	S7 Ground Floor and Plaza Sheet 1
S7 Roof Slab and Details	S8 Ground Floor and Plaza Sheet 2
S8 Typical Cross Section	S9 Ground Floor and Plaza Sheet 3
S9 Sections and Wall Details	S10 Precast Columns and Beams Loading
S10 Beam Reinforcing Details	S11 Misc Details and Masonry Notes
S11 Beam Reinforcing Details	S12 Second Floor Plan Framing
S12 Floor Slab Reinforcement	S13 Third Floor Framing
S13 Floor Slab Reinforcement	S14 Fourth Floor Framing
S14 Roof Slab Reinforcement	S15 Roof Framing Plan
S15 Column Reinforcement	S16 Structural Frame East West Wall Sections
S16 Column Reinforcement	S17 Structural Frame North South Wall Sections
S17 Stair Reinforcement and Details	S18 Steel Frame Misc Details
	S19 Anchor Bolt Plan
	S20 Stair and Elevator Shaft Section
	S21 Interior Stair Details
	S22 Penthouse Details

The following Photograph 1 is an aerial view of the subject site and identifies the relative location of the buildings on the City Hall Precinct.



Photograph 1. Aerial Photograph – City of Vancouver, City Hall East Wing and West Annex

2.3 BUILDING DESCRIPTION AND STRUCTURE

The following Photographs 2-9 provide an overview of the existing buildings and Table 2.1 summarizes the various primary existing structural systems of the buildings.

The **East Wing Building** was constructed in 1968 and the main structure of the building consists of reinforced cast in place concrete columns, walls and floor slabs and beams. The exterior finishes of the building utilizes concrete spandrels and exposed concrete. There are concrete stair wells at the north and south ends of the building with a centrally located elevator shaft and stairwell. All of the concrete in the building is cast in place concrete. The typical floor plan is approximately 260 feet long and 62 feet wide for a plan area of approximately 16,200 square feet.

Photograph 2. East Wing and East Elevation

The East Wing consists of 3 floor levels plus roof of building structure above a ground floor podium that extends beyond the footprint of the upper floors. Below the ground floor is one suspended parking level and one further parking level on grade.

The project site slopes from south to north, causing level 2 to be at grade at the south end while the lower parking level is at grade at the north end. Ground floor extends the full length of the building while the upper and lower parking levels step down toward the north.

Surrounding the lower two parking levels are cast in place concrete walls that are architectural feature walls. As a result of these walls being used as an architectural feature, the walls have two layers of reinforcing steel.

Separated from the main building toward the east are two small sections of building constructed in close proximity to the main building, utilizing the main building columns for support. Built with solid concrete perimeter walls these two separate blocks share common floor levels at ground and parking levels, but the roof of these small sections is offset from the second floor level by roughly four feet.

Stair shafts at each end of the building are separate shafts built outside the footprint of the main building immediately adjacent to the building and connected at floor slab levels.

Photograph 3. East Wing and North Elevation

Photograph 4. East Wing and South Elevation

Photograph 5. East Wing and typical parkade structure

The **West Annex Building** was constructed in 1975. Upper levels are constructed of a structural steel moment frame superstructure with concrete topping on 1 ½" steel deck on structural steel floor beams. Ground floor and parking levels are constructed with precast concrete. The precast construction of the ground and parking levels consists of 8" deep hollow core panels, precast concrete columns and 2" concrete topping. The upper floors plates are rectangular in shape measuring approximately 173 feet x 105 feet for a floor plan area of 18,000 square feet, with the upper floors larger than the lower floors.

Exterior cladding of the West Annex is architectural precast concrete supported at each floor level by the structural steel framing.

Photograph 6. West Annex South Elevation. The exterior of the building is clad with precast concrete sections.

Photograph 7. West Annex North Elevation

Photograph 8. West Annex and typical precast concrete construction of lower levels.

Photograph 9. West Annex and partial South Elevation and exterior precast concrete.

Table 2.2 – Building Description and Existing Structures

	Structural Element	East Wing	West Annex
General Information	Site	Slopes down from South to North	Slopes down from South to North
	Year Construction	1968	1975
	Parking	2 levels (partial levels with 1 suspended)	2 levels (1 suspended and one on grade)
	Suspended Levels (above parking)	5 levels (Ground floor partially on grade)	4 levels
	Area typical floor	16,200 sq.ft	18,000 sq. ft
Foundations	Foundations	Shallow column and wall concrete pad and strip footings. Shearwall footings are small strip footings.	Shallow column and wall concrete pad and strip footings
	Slab on grade	5” reinforced with WWM	5” reinforced slab with WWM
Suspended Levels	Parking Levels	Cast in place 6” concrete slab and beams	8” hollowcore precast panels with 2” of concrete topping r/w WWM, precast inverted T-beams and precast columns with corbels to receive beams. There are steps in the ground floor and parking level diaphragms.
	Ground Floor	Cast in place 6” concrete slab/beams and 1.5” topping	Similar to parking level
	Second Floor	8” flat slab and 1” topping	Steel beams, columns, 1.5” steel deck with concrete topping
	Third	Similar to second	Similar to second
	Fourth	Similar to second	Similar to second
	Roof	Similar to second	Steel beams, columns and 1.5” steel roof deck
	Roof Elements	Elevator Penthouse and cooling towers	Elevator Penthouse and cooling tower
Walls	Below Grade Walls	9”concrete cast in place sloped architectural walls	8” and 9” Reinforced concrete with openings for windows and ventilation,
	Above Grade Walls	Lightly reinforced (single layer of reinforcing) in walls above second floor. Exterior concrete spandrel beams and exposed concrete walls and columns.	Exterior architectural precast concrete cladding.
	Masonry Block Walls	4” unreinforced clay tiles at washrooms	Reinforced concrete block without lateral seismic restraint

Existing Lateral Load Resisting Elements	Lateral Load Resisting System Wind and Seismic	Concrete walls and stairwells at the north and south ends of the building and the central elevator core and stairwell above the second floor. Stairwell, central elevator and perimeter parkade walls below the second floor. Concrete perimeter walls below ground level.	Structural Steel Moment Frames and steel deck and concrete topping diaphragms on the upper floors. Perimeter concrete walls around precast levels below ground level.
	Design Code Reference	Vancouver Building ByLaw 4183 (per drawing General Notes)	NBC 1975 (per drawing General Notes)
Gravity Load Resisting		Concrete floor slabs, reinforced concrete columns, beams and footings designed in methods reasonably consistent to current design philosophy.	The gravity resisting system appears to be complete and the design superimposed live loading noted on the drawings is generally consistent with current code standards.
		The gravity load resisting system appears to be complete and of a similar configuration to current standards. Short columns are noted below level 2 on the east side of the building and at a small number of internal columns.	Precast columns in the parking levels are built tight to non-structural masonry infill.

2.4 SITE INVESTIGATION

The buildings were toured by Rob Simpson, P Eng, Struct Eng, Principal of Glotman•Simpson Consulting Engineers on January 26, 2012, February 17, 2012 and February 24, 2012. Access to various different areas of the building was provided. A representative from the City of Vancouver accompanied the tour on the first visit. An additional visit was made by Kevin Zhao on behalf of Glotman•Simpson for the purpose of photographing specific areas that were not accessible on other visits to the site.

It should be noted that this review considers only the primary structure of the building along with some other major semi-structural building components. Other non-structural elements of the building that may pose a personal safety issue such as unreinforced masonry, ceiling systems, internal fixtures, etc., are important but not a part of this review. The Primary structure consists only of the structural frame of the building and does not include architectural finishes, overlays, toppings, wall systems, ceilings, bulkheads, handrails, or decorative appurtenances whether concrete, masonry or constructed of other materials. Where finishes or architectural elements are reviewed, it is solely for the purpose of assessing the performance of the structure supporting the architecturally finished element and to ascertain whether the non structural parts and portions of the building would pose a safety issue with regards to exiting the building.

There were two methods used to carry out our visual site review.

1. Visual reviews were carried out on site at a number of locations to help provide a representative sample of the characteristics and behavior of the visible portions of the structure. The primary purpose of these reviews was to determine if there were any visually obvious inherent structural hazards such as a soft storey, weak gravity elements, lack of apparent ductility, etc. Also, during this review we consider other signs of potential for structural deterioration such as unusual cracking, excessive deflections, and indications of deterioration in the exposed structure. Possible areas requiring structural upgrade were noted as well as possible configuration and layout of new framing elements. The areas of the structures that were viewed by Glotman•Simpson Consulting Engineers were:

    - Exposed slab on grades and parking level floors;
    - Exposed exterior concrete in basement walls and in storey levels above ground
    - Inside face of exposed foundation walls in the parking areas;
    - Inside of staircases, parking areas and hallways

2. Where the structure was not directly visible, a general review was carried out to look for performance of non-structural elements that might be an indication of distress or excessive deflections in the main structure of the building. Such indications might include cracked interior or exterior finishes or excessive deflection of ceilings or floors. Typical locations where this type of inspection was carried out include:

    - Wall finishes throughout various areas of the interior of the buildings,
    - Inside face of cladding materials on exterior walls, where possible,
    - Outside face of cladding materials on exterior walls;
    - Ceiling finishes;
    - Exterior decks and rooftop;
    - Concrete topping on steel floors.

The overall condition of the East Wing and West Annex buildings appear to be satisfactory and performing well for their current intended use. With the exception of parking slabs in need of normal maintenance, no visually obvious significant deterioration was noted in the main structural elements of the buildings.

3.0 SEISMIC HAZARD AND PERFORMANCE CRITERIA

The overall seismic performance objectives of the National Building Code and the Vancouver Building Bylaw are to **prevent building collapse** and to allow safe egress from the building as a result of a design level seismic event.

3.1 UNIFORM HAZARD SPECTRUM

New buildings are designed to the requirements of the Building Code using parameters that provide a consistent level of acceptably low risk of failure of structures. The Uniform Hazard Spectra is created by geologists to represent the earthquake hazard at sites across Canada.

The design parameters embedded within the Uniform Hazard Spectra are based upon several model techniques and also upon historical earthquake information.

The design parameters used for new building design is that of a earthquake return period of 1 in 2475 years, or equivalent to a 2% chance of exceeding in any 50 year period. In Vancouver this results in a Peak Ground Acceleration (PGA) of 0.46g. Other commonly used return periods are as follows (see Appendix C) together with their percent proportional PGA, approximate Richter magnitude and approximate expected duration (based upon California research):

2% in 50 Year;	.46 PGA;	1:2475 return period	100%	M7.5	30 seconds
5% in 50 Year;	.33 PGA;	1:1000 return period	70%	M6.5	20 seconds
10% in 50 Year;	.25 PGA;	1:475 return period	50%	M6	12 seconds
40% in 50 Year;	.12 PGA;	1:100 return period	25%	M5.3	4 seconds

Additional to this is the Cascadia subduction event that is estimated at M9 with shaking levels in Vancouver consistent with a 10% in 50 year design earthquake but with duration of 3 to 5 minutes.

The earthquakes design spectrum noted above is the median spectrum. Statistical variation causes a wide scatter in response data resulting in the 84% percentile curve being roughly double the design curve. This wide scatter should clarify that real earthquakes are all very different and design procedures cannot perfectly reflect the earthquakes that we will experience.

It is worth noting that the crustal earthquake that struck Christchurch, New Zealand was approximately consistent with a 2% in 50 year event although the duration was very short. The above mentioned characteristics of earthquakes can only be a rough approximation of the anticipated events due to the wide scatter of force levels, frequency and duration of real earthquakes.

3.2 BUILDING CODE CHANGES

Building Codes have changed very substantially since the time of design and construction of the East Wing and West Annex.

Although seismic provisions existed in the 1960's and 1970's, building designers normally considered the Code requirements simply as another load case used for strength design of buildings. There was limited awareness of the value of ductility in the survival of buildings to earthquakes and no effort was made to improve building resilience beyond providing the strength required of the seismic provisions. Therefore, building designs from this era generally have features that limit the ductility of structural members that could lead to premature failure.

The science of ductility and redundancy in structures is still developing today.

In the 1960's, seismic provisions were very simplistic as noted in the following earthquake hazard map from 1953.

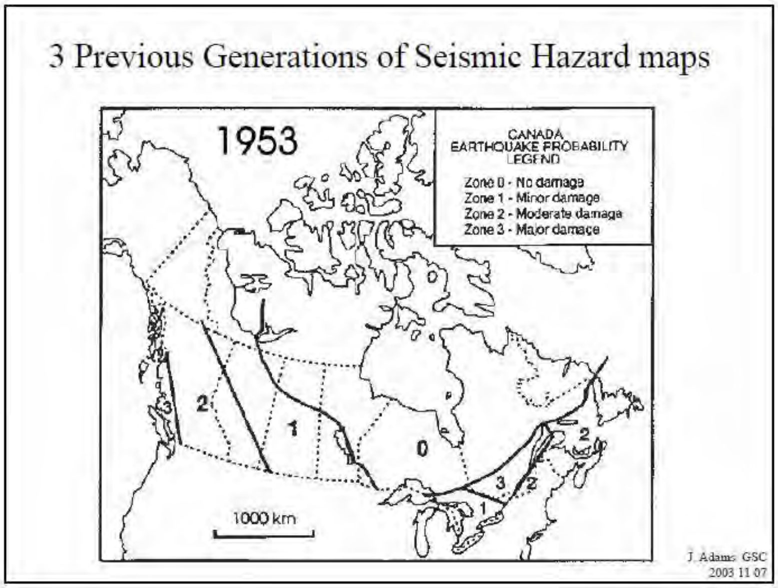


Figure 3.1 1960 Earthquake Hazard Map of Canada

In the 1970's improved seismic hazard maps allowed for improved assessment of loading for design. There was no influence of the Cascadia subduction zone earthquake hazard in the design requirements for buildings.

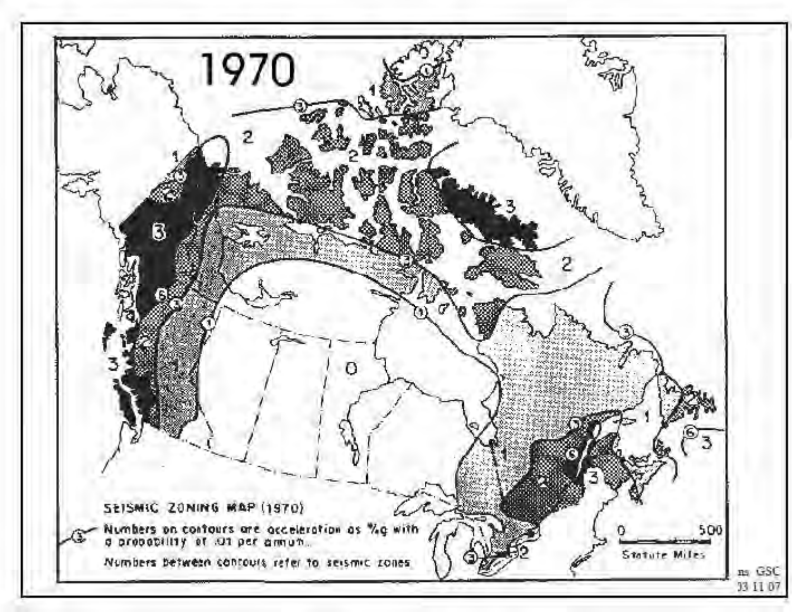


Figure 3.2 1970 Earthquake Hazard Map of Canada

In 2005 the Code was substantially updated to include effects of stronger earthquakes that were underestimated in the earlier versions of the Building Codes. At the same time, changes were made to increase loading on buildings with low ductility. The combination of these effects resulted in large increases in design forces for low ductility buildings in the Vancouver region.

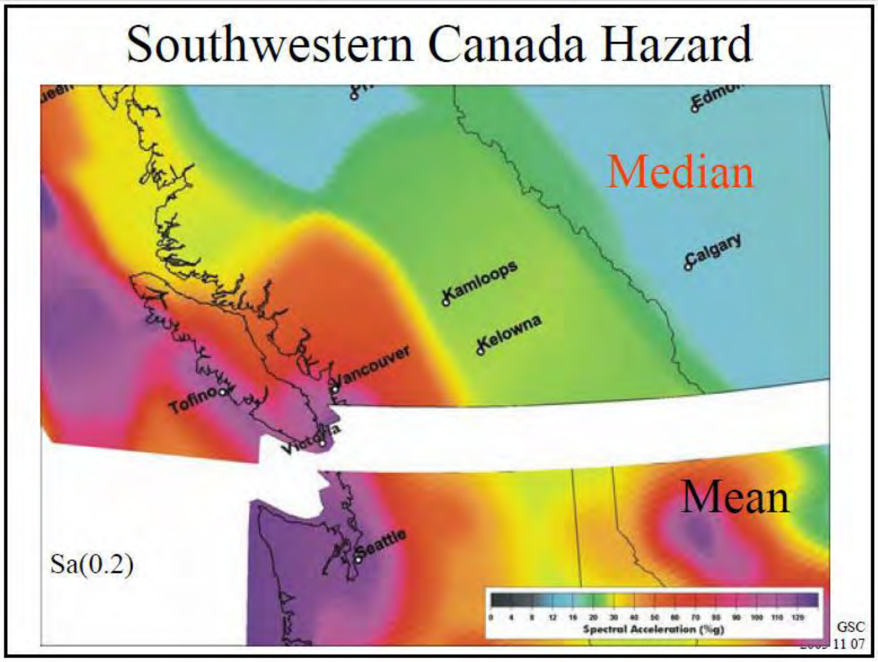


Figure 3.3 2005 Earthquake Hazard Map for Southwestern Canada

STATISTICAL VARIATION

The seismic hazard that forms the basis for design procedures for buildings is based upon statistical studies. The design standards use the median hazard values for a site location. Statistical variation provides some indication of the accuracy involved with the prediction of seismic demand. The 84th percentile uniform hazard spectrum provides seismic demand for buildings roughly double the 50th percentile that is used for design. This wide variation is instructive when considering relaxation to design requirements.

The 84th percentile Cascadia subduction event has the same demand levels as the 2% in 50 year design level earthquake, but with a much greater duration at 3 to 5 minutes. This level of shaking in Vancouver would result in an extreme damage scenario.

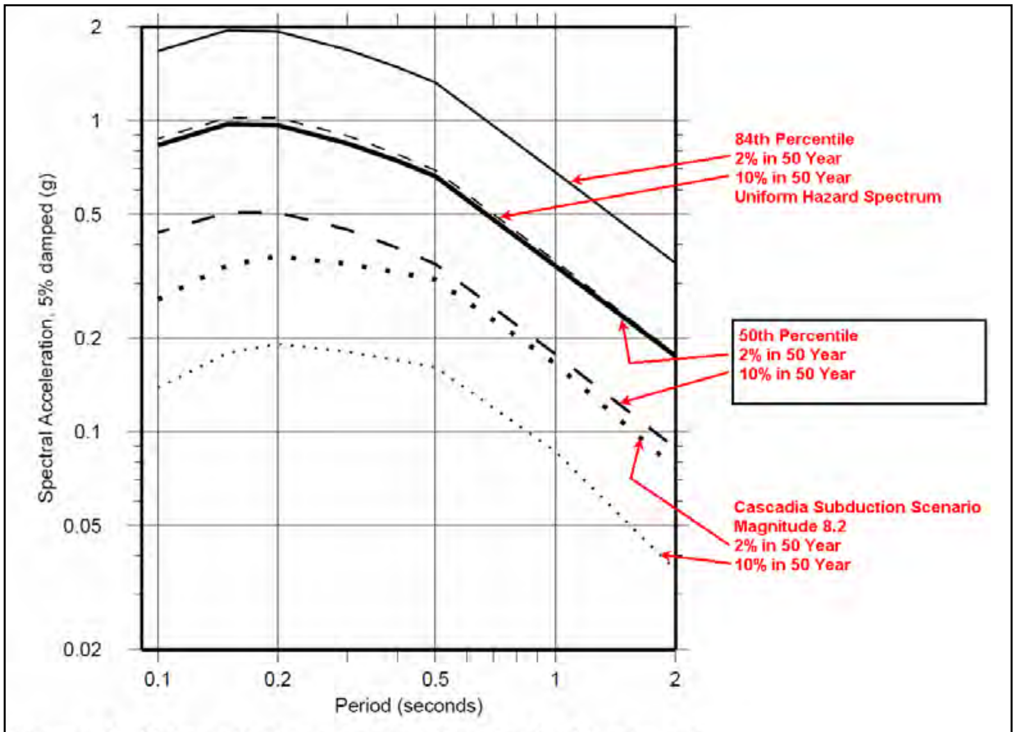


Figure 40. Robust Uniform Hazard Spectra for Vancouver

Figure 3.4 Uniform Hazard Spectra for Vancouver

3.3 LOCAL SEISMIC HAZARDS

The design spectrum is composed of an aggregate of hazards within the region created from historic data plus several analytical models. By examining the deaggregation of the data, one can see the relative distance and severity of local earthquake sources. This diagram of the Vancouver area deaggregation indicates sources very close to Vancouver with magnitudes ranging from M6 to nearly M8. The more likely scenario is a more distant and deeper earthquake of equal or less severity. Most of the hazard is composed of earthquakes in the M6 to M7 range as shown in the diagram.

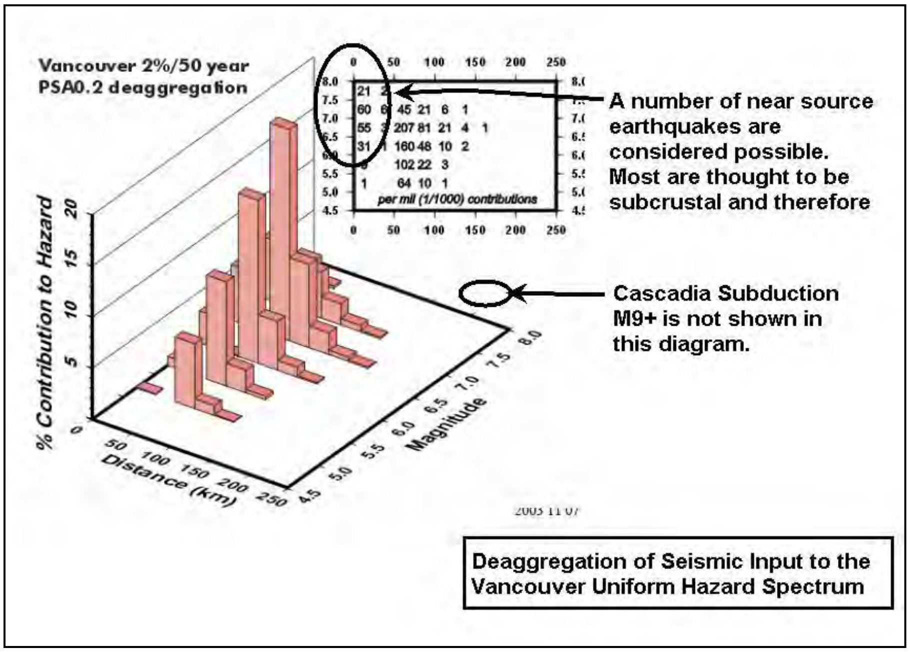


Figure 3.5 Deaggregation of Seismic Input – Vancouver Uniform Hazard Spectrum

3.4 HUMAN VERSUS GEOLOGIC TIMESCALE

The chasm between the human and geologic timescales creates is significant difficulty for humans to make well considered decisions in regard to seismic upgrading of buildings. Our personal history shows very few significant seismic events and therefore we have no experience to encourage us to be conservative in our decision making about earthquakes.

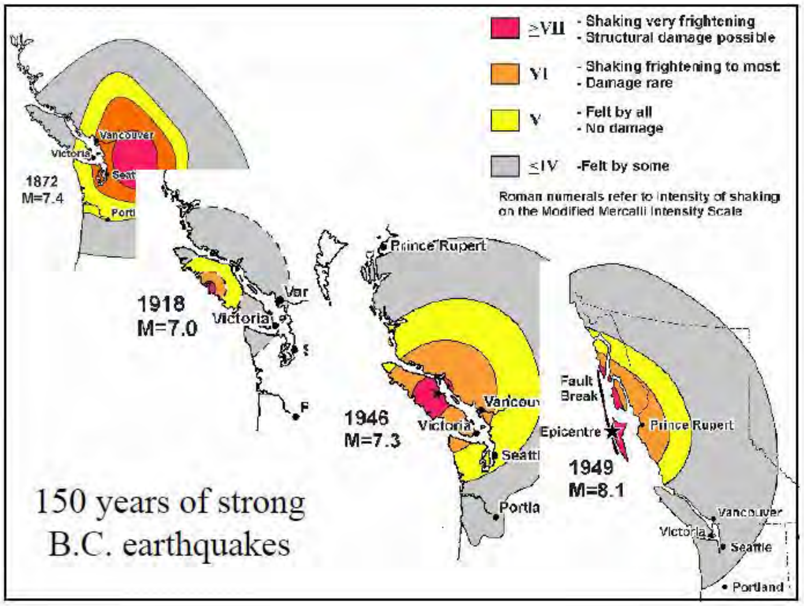


Figure 3.6 – History of Ground Shaking Intensity over past 150 years

From a geologic perspective, earthquakes occur almost continuously as the tectonic plates converge upon each other at a rate about the same as the growth of a finger nail. As humans, we can potentially live our life without ever experiencing a major earthquake in our region. The relatively quiet period over the past 70+ years leaves many people doubtful of their risk, while the risk continues to exist and grows every day. The longer we go without a significant earthquake, the more likely a major earthquake will occur in the coming years.

3.5 PERFORMANCE CRITERIA

The assessment and upgrading objective that has been expressed by the Chief Building Official is that of collapse prevention only. There is no intention that the building will be serviceable after any significant earthquake event.

3.5.1 VARIABLE DAMAGE AT DIFFERENT BUILDING SITES

It is important to note that historic evidence supported by geologic theory indicates that earthquake damage will not be uniform throughout the region, especially when the earthquake is a local crustal or subcrustal event. Damage will vary from area to area with localized pockets of damage. In some locations certain types of buildings will be damaged while other types of buildings will survive well regardless of their inherent design strength.

The possibility of reduced damage at some sites due to random selection is not a reason to reduce the standard of analysis and upgrading for the buildings.

3.5.2 EARTHQUAKE PROTECTION - UPGRADING LEVELS

Many projects in the City of Vancouver have reduced their seismic upgrading force levels based upon an argument that upgrading to the full requirements of the Code is onerous. In such cases the standard of upgrading can be reduced to 75% of current Code with the approval of the Chief Building Official. A similar standard exists in analysis of existing buildings under the Guidelines for Seismic Evaluation and Upgrading of Existing Buildings which allows a cutoff at 60% of current Code.

Glotman Simpson have discussed this theory with Dr. Ken Elwood. UBC and offer you’re your consideration a more scientifically based performance consideration. For buildings that are considered to a lesser standard from that of the Code, these buildings could be classified based upon the increased probability of exceedance used for analysis, namely the commonly used alternatives:

☐	5% in 50 year	70% of current Bylaw requirements
☐	10% in 50 year	50%
☐	40% in 50 year.	25%

It is interesting to note that the 5% in 50 year is close to the 75% standard established by the City of Vancouver in past years while the 10% in 50 years is just slightly less than the 60% standard considered by the Guidelines document. Also, the 40% in 50 year standard is similar to the trigger to require mandatory upgrading of unreinforced masonry as it exists in the Bylaw at this time, and is also similar to the trigger standards that were in place in Christchurch, New Zealand. Given the high variability in earthquakes, these relative levels are essentially the same as the noted comparisons.

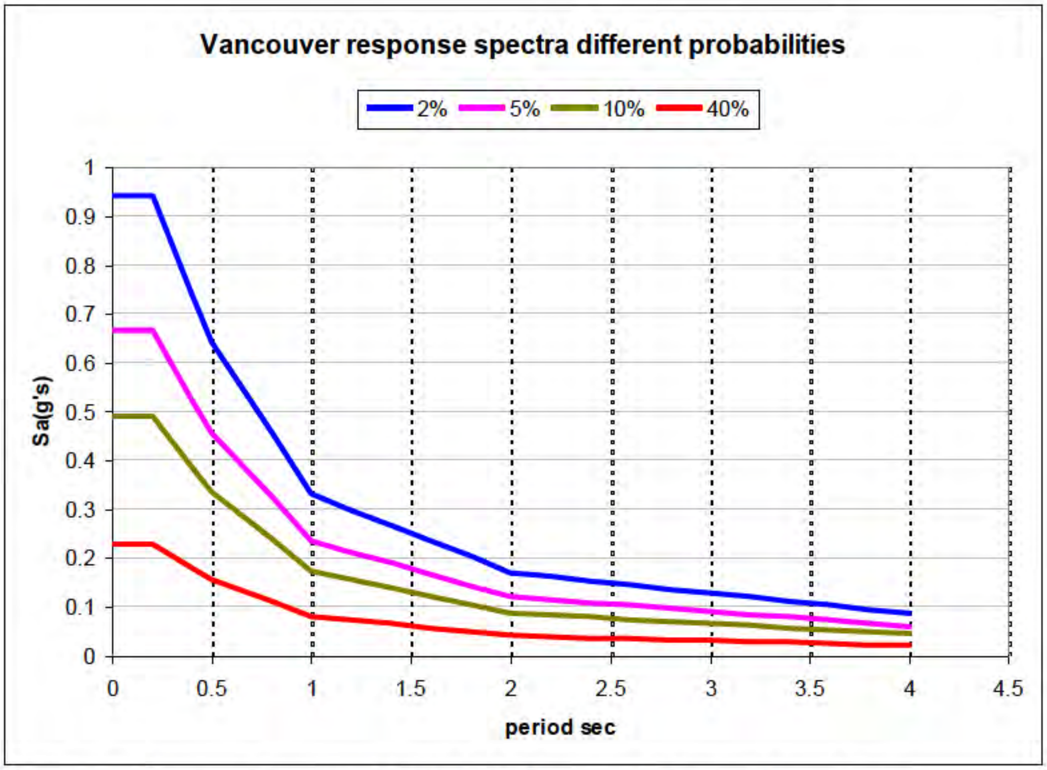


Figure 3.7 – Vancouver Response Spectra for different probabilities of exceedance

3.5.3 DURATION OF SHAKING:

Duration is an important feature of earthquake effects upon buildings and yet it is the least studied and poorest to predict of all the features related to earthquakes. Certainly a strong crustal earthquake at close range will deliver very strong motion but the duration will be short. The same earthquake at a distance could deliver lower shaking levels to the building but the duration of the shaking will be longer. Much the same as ripples in a pond, the most intense splash is where the pebble hits the water, and the waves reduce with distance away from the point of impact. At a distance for the point where the pebble hit the water, waves will continue much longer than the epicenter of the impact.

A strong burst with short duration can yield a structure that can still remain standing if there isn't a weakness that allows vertical collapse. A lower level of shaking that lasts a longer time can yield a structure and then grind it to the point of failure. These are two separate avenues to structural failure. The CTV building in Christchurch is an excellent example of an earthquake burst that failed a structure that did not have adequate collapse prevention mechanisms in place, namely strong connections to eccentric shearwalls. The failed Alto Rio building in Chile is an example of damage caused by an initial yielding followed by many cycles of shaking that eventually ground the supporting columns down enough to result in collapse.

As noted previously, the design level earthquake in Vancouver would produce perhaps 20 to 30 seconds of strong shaking for a 2% in 50 year event. Upgrading of the East Wing to this level of shaking cannot be achieved without significant improvement to the primary shearwalls in this building so that they can sustain yielding without degradation.

A reduced earthquake demand at 5% or 10% in 50 years will correlate with reduced shaking levels and reduced duration of shaking. The following graph is the El Centro earthquake in California of magnitude 7.1 with a duration of 25 seconds of shaking, and about 5 seconds of strong shaking.

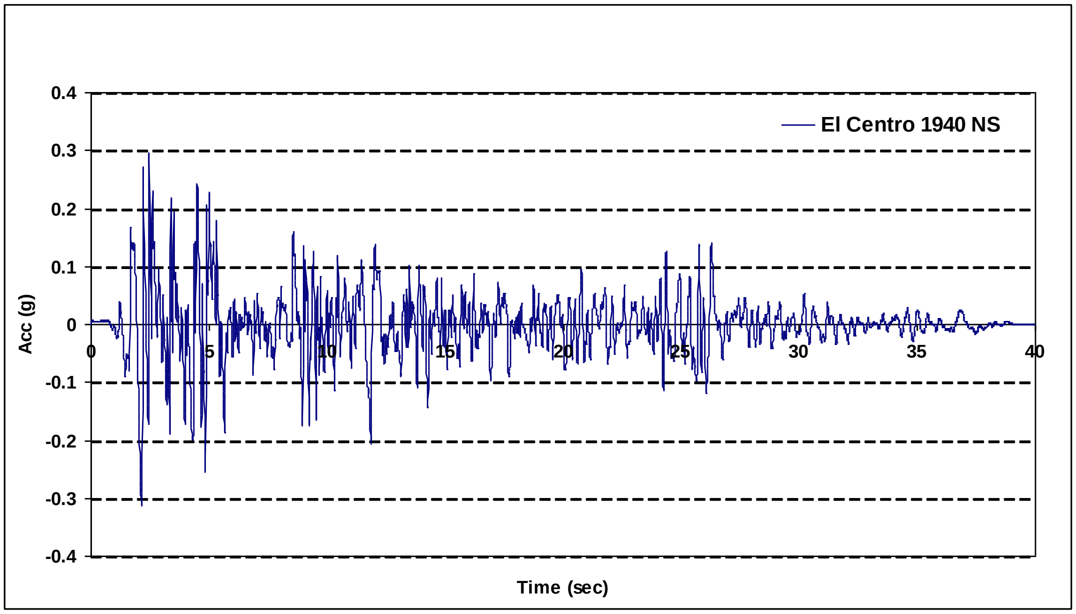


Figure 3.8 – El Centro Earthquake and duration

This earthquake might be considered a good example of our design level earthquake here in Vancouver. It becomes immediately evident how much lower the consequences of shaking will be if you imagine the 5% and 10% earthquakes at perhaps just 15 seconds and 10 seconds respectively in total duration with only a few strong cycles.

When selecting a reduced earthquake demand for upgrading purposes, it is important to realize that the consequences of a higher level earthquake will include longer duration of shaking and therefore a greater likelihood of the structure being gradually degraded with each additional yield cycle of shaking. Therefore, designing for a lower level of shaking is taking on the risk that a longer duration of more intense shaking will deliver damage beyond an acceptable level.

The following table indicates our opinion of acceptable design practices for various levels of earthquake shaking. These features are not expressed in Building Codes except for the design level 2% in 50 year design level earthquake. For designs to lesser events, it is reasonable to consider some different solutions that will result in acceptable building performance. For example, in a short duration of earthquake motion that will have only a few spikes of acceleration, then a small amount of foundations sliding may be acceptable provided the story displacements and structural systems are capable of handling the imposed distortion. While this is a subject of performance based design to resolve a final solution, it is reasonable in our opinion to allow foundation sliding for peak forces of a short duration earthquake at this stage of analysis, prior to final design.

Table 3.1 Levels of Earthquake Shaking and Design Solutions

Seismic Design Level	Characteristics of anticipated performance	Design Solutions that produce acceptable building performance
2% in 50 years 2005 National Building Code	Design Acceleration Levels 30 second duration Many yield cycles Building damage	☐ Ductile seismic systems ☐ Capacity design methods ☐ Foundations stronger than walls above ☐ Sliding of foundations is not acceptable ☐ Diaphragm strength required ☐ Drift control required ☐ Attachment of collateral elements for high forces ☐ Eliminate vulnerable features
5% in 50 years	75% of design level 20 seconds duration Several yield cycles Building damage	☐ Ductile and moderately ductile seismic systems ☐ Capacity design methods ☐ Foundations stronger than walls above ☐ Limited sliding of foundations may be acceptable ☐ Diaphragm strength required ☐ Drift control required ☐ Attachment of collateral elements for high forces ☐ Eliminate vulnerable features
10% in 50 years 1995 National Building Code	50% of design level 12 seconds duration Up to 3 or 4 yield cycles Building damage	☐ Moderately ductile seismic systems ☐ Capacity design methods ☐ Foundations can rock ☐ Foundation sliding is acceptable ☐ Diaphragm can yield ☐ Drift control required ☐ Attachment of collateral elements for high forces ☐ Eliminate vulnerable features
40% in 50 years	25% of design level 4 seconds duration Few if any yield cycles Limited building damage but may not be repairable	☐ Moderate and brittle seismic systems with adequate strength ☐ Foundations can rock ☐ Sliding acceptable ☐ Diaphragm strength required ☐ Drift control required ☐ Attachment of collateral elements for high forces ☐ Eliminate vulnerable features

3.5.4 UPGRADING METHODOLOGY:

The current Vancouver Building ByLaw 2007 No. 9419 is the reference code for the development of the proposed seismic criteria.

The proposed seismic analysis and upgrade methodology for the **East Wing** and **West Annex** consists of the following criteria and is framed after the City of Vancouver's Upgrade Trigger Model regarding upgrade levels:

a) Consider the building to 100% of the current Bylaw requirements.

b) Identify weaknesses and vulnerabilities in the building due to seismic demand consistent with 100% of the current Bylaw requirements.

c) Wherever possible, provide new construction elements to satisfy the demand of 100% of current Bylaw provided that such work does not create vulnerability due to inconsistent capacity compared to collateral elements.

d) When results of the analysis indicate that it is onerous to upgrade to 100% of the current Bylaw, consider the building to the lesser standard of the 5% in 50 year design event. When the 5% in 50 year design event is found to be onerous, then consider the building to the lesser standard of a 10% in 50 year design event.

e) Design to the objective of collapse prevention. Control damage at specific vulnerabilities and consider overall capacity of the buildings. Design to be to the chosen level noted above.

f) Provide an upgraded lateral force resisting system of the building that improves the life safety of the buildings by employing a design intended to prevent collapse and to allow occupants to safely exit for the chosen level of earthquake risk noted above. Approaches will vary depending upon the existing construction and design level chosen, however the performance result is intended to meet design objective for the chosen level of earthquake protection.

4.0 ASSESSMENT OF EXISTING STRUCTURES

The gravity framing system of the East Wing and West Annex buildings are, in the opinion of the writer, of a quality suitable for extending the service life of the building through seismic upgrading.

It should be noted that the seismic upgrade approach proposed in this report may require assessment by other members of an overall design team such as architectural, mechanical, electrical and geotechnical. Allowances should be made in budgeting of time and materials to allow for full development of the design from the basis noted herein.

4.1 GENERAL ASSESSMENT OF EXISTING SEISMIC PERFORMANCE

The following general assessment is based on a static analysis of the two buildings utilizing the 3D models identified in Figures 4.1 and 4.12.

Table 4.1 – Existing Seismic Performance, Weaknesses and Potential Modes of Failure

	East Wing (1968)	West Annex (1973)
Original Design Code	Vancouver Building ByLaw 4183 (per drawing General Notes)	National Building Code 1975 (per drawing General Notes)
% Capacity Current code	The lateral load resisting system is poor and suitable for wind loads only. The lateral system is not suitable for resisting any significant seismic loading. Structural walls are reinforced with a single layer of very light reinforcing steel which is not a ductile system. Based on our initial analysis the existing capacity is approximately 9-15% of the current Vancouver Building Bylaw.	The moment frame superstructure of the building can resist approximately 50% of the current code seismic loading with the moment frames considered pinned at the base. In this assessment we have assumed reasonable quality steel construction.
Areas of Weakness , Consequences and Potential Modes of Failure	Non ductile, very lightly reinforced wall systems (single layer of reinforcing) are used throughout the building and can be classified as "brittle" with low shear capacity and no ductility. Lightly reinforced walls or columns with widely spaced column ties provide poor concrete confinement and potential failure of the element and collapse. (**Refer Figure 4.3)**	With the moment frames considered pinned at the base the drift values above the second floor where found to be within current code limits. The greatest vulnerability exists at the ground level. (**Refer Figure 4.13**)
	Short concrete columns on the East Elevation of the building have no significant displacement capacity and will therefore attract a majority of the seismic loading. These columns do not have the capacity to resist imposed seismic forces and. (**Refer Figure 4.4)**	Panel Joint design is based on old construction and likely does not meet the current best practices for detailing of connection for moment frames. **Refer Fig 4.14** for typical beam to perimeter column connection.

	These columns are vulnerable to shearing off and will therefore fail prematurely, in our opinion, and will ultimately loose the ability to provide vertical support in a seismic event of any significant length. This loss of vertical support can cause precipitous failure of collateral building elements and overall building failure**.**	
	The shearwalls at the north and south ends of the building stop at the second floor and are connected to adjacent columns with a precarious beam frame suitable for gravity but not well suited to lateral loads. The configuration of the shearwalls creates a “**soft story**” at the lowest level, thus resulting in all seismic induced drift occurring within the single story. A soft storey is known to cause structural collapse of buildings in seismic events. With the combination of low seismic capacity, low ductility and a soft story, this building is vulnerable to collapse in a seismic event considerably less than the design event.(**Refer Figure 4.5**) Additionally, the wall configuration at the north end of the building includes two link beams between the wall assembly and the stair core. These link beams carry gravity loading of the floor slabs and will be heavily loaded in seismic loading due to lateral shaking. The link beams are not ductile and could be subject to failure thus causing vertical collapse of adjacent slab elements. **(Refer Figure 4.7)**	The **building site slopes** and therefore the ground floor is “daylighted” The ground floor and parking levels are precast construction. The precast construction creates a number of challenges and in particular interconnection between sections, inadequate floor diaphragms, brittle connections and “short columns”. (**Refer Figure 4.15)** The ground floor diaphragm appears light with only 2” of concrete topping. In addition the Parking Level P1 is a split level which creates issues with continuity of lateral load paths within the floor diaphragm. Openings in basement walls on one side of the building will cause an irregularity below ground floor level.
	Stairwell at north end is disconnected and outside of the building and connected only with a small section of slab that can only transfer a small load to the stair walls to resist lateral loads. These stairwells are essential for life safety egress from the building **.(Refer Figure 4.11)**	The **exterior precast** concrete wall panels above grade are possibly not adequately connected to the base building structure for the current “parts and portions” anchorage loading philosophy. The failure of the anchorage could create a serious falling hazard and potential blockage of emergency exit routes. **(Refer Figure 4.16).**
	The floor plate below Level 2 is irregular in comparison to the upper floors which can create differences in stiffness and behavior of the building due to eccentric loading. (**Refer Figure 4.2 and 4.6)**	The drawings note that the concrete block walls are reinforced but do not appear to be restrained at the top. **(Refer Figure 4.17)**
	Poor reinforcing details of the slab edge beams on the upper floors result in relatively brittle connections. Floors are well reinforced for gravity loading however the reinforcing is	

	not suitable for the floor to act as a diaphragm.	
	The foundations have not been designed for lateral loads. Foundations for walls are simply strip footings, which have limited gravity capacity. **(Refer Figure 4.9)**	
	Progressive collapse reinforcing at column slab interfaces is not provided in slabs. This is a design feature that came into Codes after 1994.	

East Wing – The 3D Model shown below was used to assess the existing distribution of seismic forces in the building along with an estimate of the existing seismic capacity of the building.

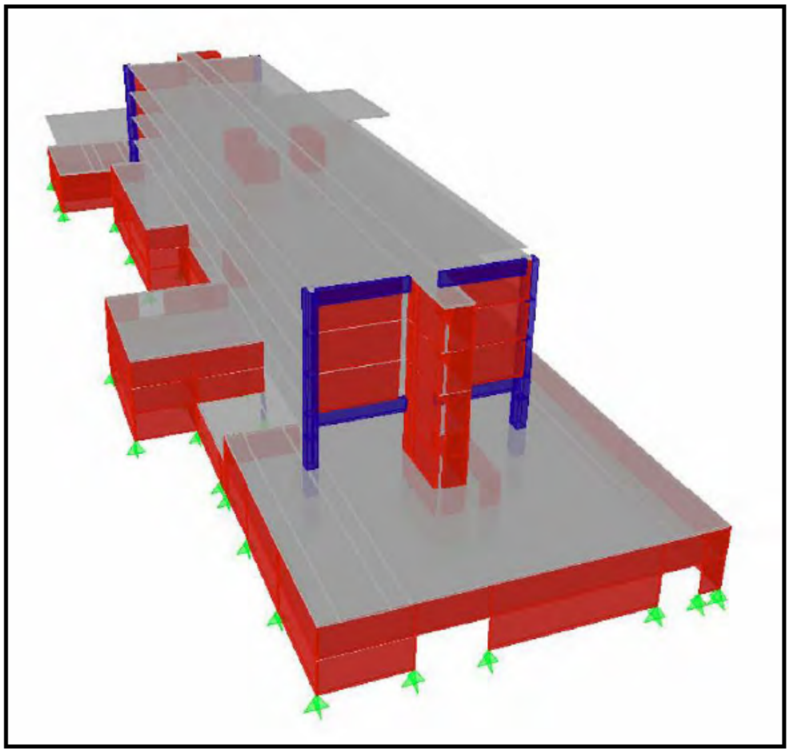


Figure 4.1 East Wing and 3D Model and Static Analysis

s.15(1)(l)

[redacted]

Figure 4.2 East Wing Floor Plan and Existing Concrete Shearwalls

Figure 4.3 Results of poorly confined concrete and widely spaced column ties, resulting in column failure in a building in Chile 2010.

s.15(1)(l)

[redacted]

[redacted]

Figure 4.4 East Wing and Short Concrete Columns on the East Elevation

s.15(1)(l)

[redacted]

Figure 4.5 East Wing and “Soft Story” on the North Elevation and North stairwell located outside the floor plate.

s.15(1)(l)

[redacted]

Figure 4.6 East Wing Floor plate and Model wall layout on the Ground Floor. The Ground floor wall layout is much more irregular than the upper 2nd, 3rd, 4th and Roof levels.

s.15(1)(l)

[redacted]

Figure 4.7 North Elevation of the East Wing indicating the short link beams that are heavily loaded with gravity loads.

s.15(1)(l)

[redacted]

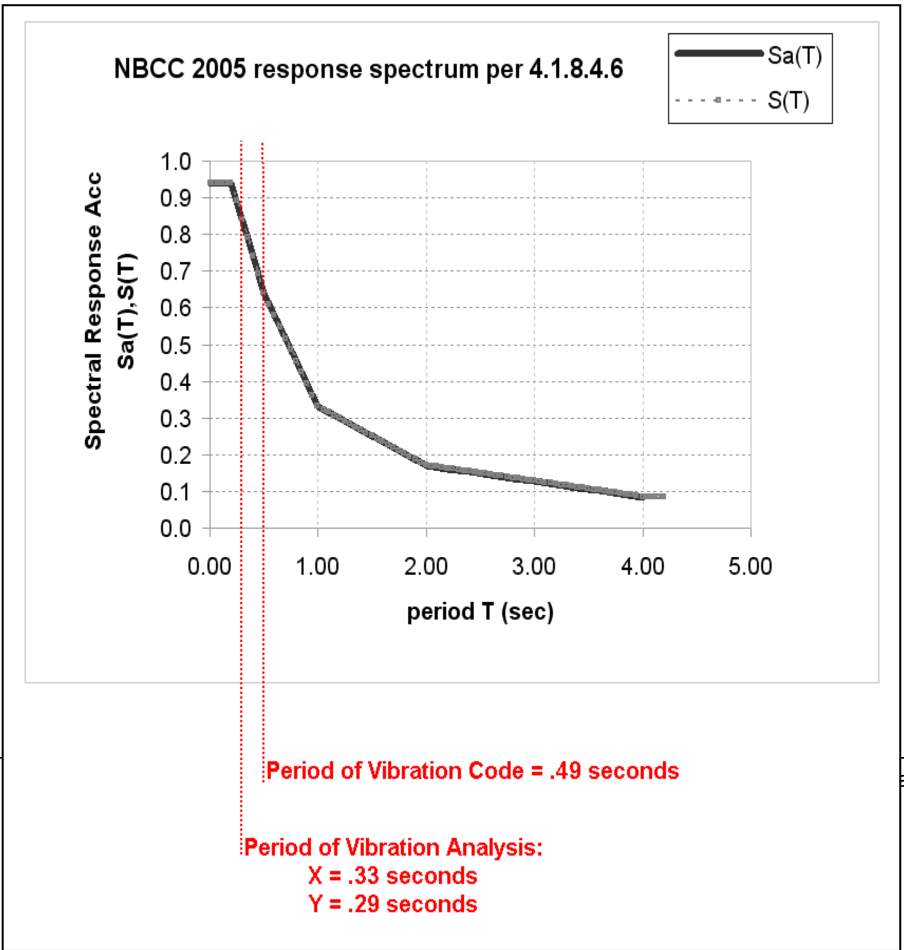
Figure 4.8 Existing openings in the basement walls

s.15(1)(l)

[redacted]

[redacted]

Figure 4.9 East Wing and foundations of the stair shafts which have not been designed for lateral seismic loading.



Period of Vibration Code = .49 seconds

Period of Vibration Analysis:
X = .33 seconds
Y = .29 seconds

Figure 4.10 East Wing analysis of natural period of vibration indicates a very stiff building which will attract high seismic forces. The Code approximation for a building of this height and size would indicate a .49 second period whereas our more detailed analysis indicates .29 and .33 seconds in the two principle axis. While both these methods are approximate, they clearly indicate a stiff building scenario.

East Wing Capacity Demand Comparison

The seismic demand is compared to the building capacity for each of the primary wall elements of the building structure. This analysis determines the load that would be attracted to the chosen seismic resisting elements under the various levels of design earthquake forces. The capacity of each element is compared to this demand to determine its relative strength.

The performance of the substructure of the East Wing is much better than the building above ground level (Level 1). Most of the major weaknesses in the building occur just above level 1 including the soft storey, vulnerable beam links at the north face, short columns and stairwell connections. The wall forces are also highest just above level 1 due to the increased number of walls below level 1. Therefore, for the purposes of the limited analysis of this report, we have focused our efforts on upgrading strategies that improve performance in the area above level 1. We anticipate that an increased seismic hazard will be considered an acceptable solution thereby reinforcing the focus upon vulnerabilities and control of collapse scenarios.

Given the short stature of the building, the seismic capacity is controlled predominantly by shear and therefore shear strength ratios are provided here for comparison purposes. Also, shear failures lead to catastrophic results whereas flexural failures can often be sustained in the short duration earthquakes under consideration. Wherever shear capacity is exceeded, flexural upgrading is likely to be required as well. Following are the relative capacities of primary building wall elements compared to various earthquake scenarios:

Values rounded to nearest 100 kips and 5% capacity and considers the building without any upgrading but without soft storey effects.

Table 4.2 – Capacity Demand Ratios of Shear Capacity for Various Seismic Demands

Seismic Demand	Base Shear Force (kips)	Overall Capacity / Demand Ratio	Weaker Primary Element Capacity / Demand Ratio
2% in 50 Year	8500	15%	10%
5% in 50 Year	6000	30%	25%
10% in 50 Year	4400	40%	35%
40% in 50 Year	2100	85%	70%

Stair Connection

Connection of the stairs at the ends of the building is essential to ensure that the stairwell remains in place during ground shaking. There are a number of examples of stairwells build exterior to buildings that have come disconnected from the building in ground shaking. A good example is the Olive View Hospital in California in the 1971 earthquake which resulted in failure of the lower floor levels and loss of the stairwells and therefore loss of means of egress from the building. A similar scenario occurred with the CTV building in Christchurch where the connection between the stair walls and the building was too minimal thereby allowing the structure to pull away from the walls that remained standing.

Strong steel strapping is proposed to connect the stairwell to the slab with Hilti anchors and nelson studs to concrete that is added to the walls for ductility. The steel strapping will have yield potential so that an event of overload can allow a slight amount of yielding without failure of the strap.

s.13(1) and s.15(1)(l)

[redacted]

[redacted]

Figure 4.11 – Proposed Remedial Connections at North and South Exit Stairwells

West Annex

Two 3D Model tests were performed on the moment frame structure of the West Annex. One test with the steel columns considered fixed at the base and one with the columns considered to be "pinned". This provides an envelope of behavior between the two base constraint conditions of the moment frame columns.

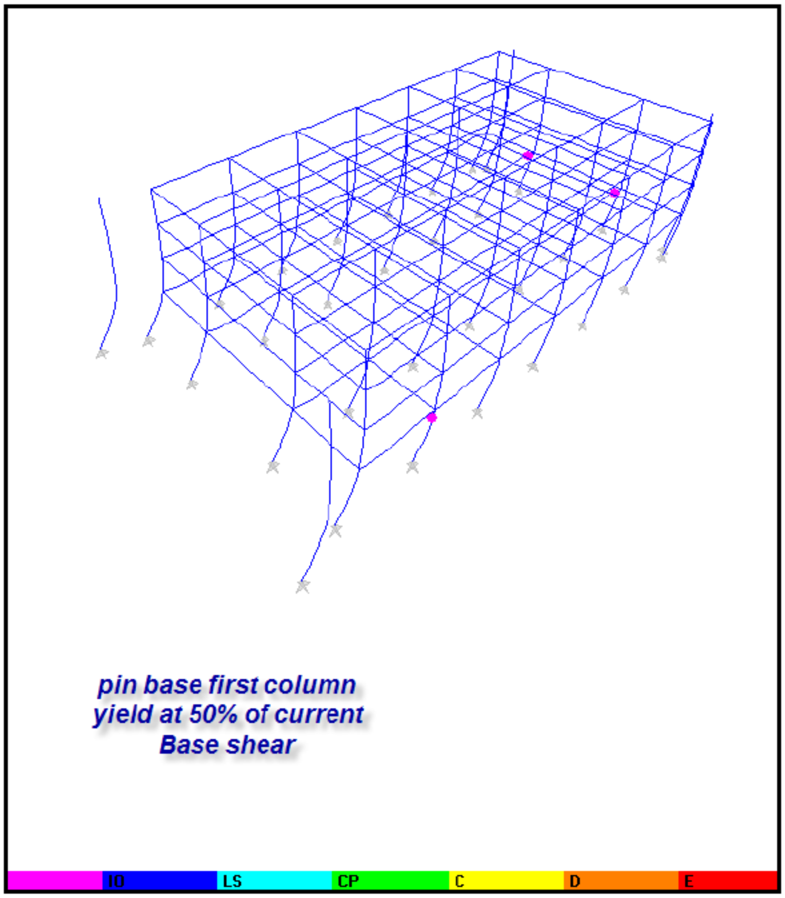


Figure 4.12 West Annex 3D Model of Steel Moment Frames – refer to Figure 4.13 for the typical steel column base plate detail to the precast concrete columns at the Ground Floor.

Precast in the ground floor and parking levels in the West Annex will require strengthening to maintain integrity during seismic shaking. Connections between beams and columns and collateral elements will be required to avoid pieces from slipping off their supports. One alternative is to remove and replace the diaphragm concrete topping with a reinforced concrete topping capable of distributing the loading to new wall elements dispersed throughout the parking areas.

Basement walls with big openings will require infill to reduce interstory drift as a result of high shear demand.

s.15(1)(l)

[redacted]

Figure 4.14 West Annex steel column to beam connection at perimeter of the building.

Figure 4.15 West Annex Precast framing and “short columns”.

Figure 4.16 West Annex Exterior Precast connected to the base building structure.

s.15(1)(l)

[redacted]

[redacted]

Figure 4.17 West Annex unrestrained concrete block walls.

5.0 SEISMIC UPGRADE ALTERNATIVES

The following seismic upgrade alternatives are considered for the two buildings:

5.1 CONVENTIONAL UPGRADE STRATEGIES

Conventional seismic upgrade strategies typically involve extensive on site works associated with the installation of new structural elements to improve the buildings performance. Elements typically include the following items:

1. Details to ensure that there is a continuous gravity and lateral load path for the inertial forces generated by the building to transmit to the foundation and into the ground.

2. Increased lateral stiffness of the Lateral Force Resisting System (LFRS) to control lateral displacements and interstorey drift of the building and floor plates. Stiffness is often increased by adding new lateral resisting elements such as concrete shear walls or steel braced frames. By limiting the lateral displacements to an acceptable level the integrity of the building systems can be maintained and the resulting damage mitigated.

3. Increasing lateral strength of stiff but weak Lateral Force Resisting Systems to control failure mechanisms in structural members. Alternatively, increased ductility may be provided to allow controlled damage of elements that are not essential for gravity load carrying.

4. Strengthening the gravity load carrying elements of the building by adding strength to those critical elements of the system and to other collateral elements that are identified as requiring strengthening due to the potential attraction of forces (for example the “short columns” noted in Section 3 – East Wing Building.

5. Addition of new foundation systems to accompany the new lateral resisting elements.

6. Upgrading floor diaphragms and drag struts to ensure the inertial floor seismic loads have an adequate load path to transfer the forces from the horizontal floor elements to the vertical lateral load resisting elements.

Steel Cross Bracing Alternative

Steel cross braced bays can be installed as shown in Figure 4.1 below. HSS diagonal sections connect to wide flange columns in a cored hole in the floor. Steel to steel connections are shop prepared and field bolted while connection to the structure is made simply by grouting around the steel sections to transfer horizontal seismic forces.

Steel columns can be installed full length through a core hole in the roof slab. HSS sections can be moved into the building by dropping them through the cored holes and storing them before the columns are dropped in.

Difficulties with this style of installation are the coring of the slabs in an operating building and the accuracy of measurement which is best done after the holes are cored. Building to site measurements will result in delays in the work process. Fabricating without site measurements can result in greater difficulties with installation, thus lengthening the process.

This system would be highly disruptive in installation since every bay or every second bay along one side of the building would require a brace in order to keep the sizes reasonable. Also, the location of the columns in the basement would eliminate a parking aisle. As a result this system is dismissed as not being feasible.

s.15(1)(l)

[redacted]

Figure 5.1 Steel Cross Bracing Alternative

Diagonal Tension-Only Steel Bracing

Braced bays at each column bay can be installed with diagonal tension rod bracing (refer to Figure 5.2). Rod sizes would vary from 2”diameter at the upper levels to 3 ½” diameter at the lower floor. Alternatively, high strength Dywidag threadbar could be used ranging from 1” diameter at the upper levels to 1 ¾” at the bottom level.

The major challenge with diagonal tension rod bracing is in connecting it to the structure. Hilti bolts placed into the slabs to drag load into the braces is feasible, but the quantity of bolts and length of installation is significant. Also, passing the column compression forces through the floors can present a challenge as there would be a tendency to shear the slab adjacent the column.

This system would be highly disruptive in installation since every bay along one side of the building would require a brace in order to keep the sizes reasonable. As a result this system is dismissed as not being feasible.

s.15(1)(l)

[redacted]

Figure 5.2 Diagonal Tension Only Steel Bracing Alternative

5.2 DAMPENED STEEL BRACED FRAMES – NEW METHODS

Dampening can be added to flexible structural systems to reduce drift demands while maintaining the low seismic forces that flexible systems attract. The introduction of dampening into a steel braced frame system can effectively decrease the force demand on the LFRS elements of the building. The inertial seismic force generated by the building is dissipated in the dampening element of the steel braced frame. As a simple analogy the damper acts as a "shock absorber" that absorbs the energy.

This type of dampened system can be effective in decreasing the need to introduce new costly foundation work to the building. Glotman•Simpson have recently successfully completed using

this type of a system on the seismic upgrade of the RCMP Building in Richmond, B.C. Refer to Figure 5.3 which shows the general arrangement of a Typical Dampened Steel Brace Bay.

The Dampened Steel Braced Frame System may include elements of the Conventional Upgrade Option including the need to upgrade the floor diaphragms and to ensure proper load paths and force distribution. Damper systems are often suitable for existing steel buildings that are relatively flexible but have sufficient strength.

s.15(1)(l)

[redacted]

Figure 5.3 Example Dampened Steel Braced Bay – from the Seismic Upgrade of the RCMP Building, Richmond, BC.

Figure 5.4 Dampers used in the braced bay noted in Figure 4.1 above.

5.3 FIBRE WRAPPED REINFORCING - FRP

The use of fibre reinforcing polymers can be an effectively and less intrusive approach to strengthening existing structural elements such as columns and walls.

FRP can be applied to strengthen the beams, columns and slabs in buildings. It is possible to increase strength of these structural members even after these have been severely damaged due to loading conditions.

Columns in building can be wrapped with FRP for achieving higher strength. This is called wrapping of columns. The technique works by restraining the lateral expansion of the column.

Figure 5.5 Examples of fibre reinforcing strengthening of columns

5.4 NON STRUCTURAL ELEMENTS – SAFETY ISSUES

The adequate restraint of non structural components of a building is an important part of the overall safety to the occupants of the building during a seismic event. Falling T-bar ceilings, light fixtures or other non structural components can create serious falling hazards as well as impediments to efficiently exiting the building. In addition, critical building services should be addressed such as automatic shut off valves on natural gas supply lines.

5.5 UPGRADING OPTIONS FOR EAST WING

5.5.1 OPTION 1: Conventional Upgrading – 2 % in 50 Years Seismic Demand

As a basis for analysis, the full force and displacement requirements of the Vancouver Building Bylaw should be used for comparison and reference purposes. Where upgrading to the full extent of the Bylaw is feasible, then no relaxation is needed to achieve all basic objectives of the work.

The development of building codes considers all aspects of risk and benefit of designing buildings to loading. While a lesser standard may be used, it is the purview of the owner to instruct any reduction from the Code and Bylaw requirements. Therefore, and for reference, Glotman Simpson recommend upgrading to the full requirements of the current Bylaw as follows:

Table 5.5.1 -East Wing Shearwall Option 1 East Sketches 1-8 (see Appendix A)

	Item	Sketch	Title	Comments
Option 1 – Concrete Shearwalls	1	1	Foundation Level Shearwall Upgrading	Shearwall layout with some walls the full height of the building with the new walls between Grids 7 and 11 only extending from the Foundation Level to either the Ground Floor or Level 2.
	2	2	P1 Level Shearwall Upgrading	Shearwall layout on the P1 Level
	3	3	Ground Level Shearwall Upgrading	Shearwall layout on the Ground Floor Level
	4	4	Level 2 Shearwall Upgrading (3,4 similar)	The shearwall layout on the 2nd, 3rd and 4th floors are contained to the North and South ends of the building. This approach is in conjunction with the floor diaphragm upgrading which will enable to the concrete floor diaphragms to span to the North and South end walls.
	5	5	Floor Diaphragm Upgrading	Angle reinforcing added to the diaphragms to act as a chord member to increase the span of the diaphragm. Reinforcing would be on both Grid A and Grid D.
	6	6	Short Column Protection Low Roof	Measures to protect the short column configuration on the East side of the building along Grid A between Grids 6-7 and 11-15.
	7	7	Short Column Protection Low Roof	Diaphragm connection to control column drift between levels.
	8	8	Wall Protection Measures	The intent of saw cutting the walls below the upper floor slabs is to reduce the potential level of seismic shear to the existing brittle walls.
	9		Fiber wrap reinforcing	Reinforcing on miscellaneous walls or columns to increase their confinement and performance under loading from a seismic event.

	10		**Non Structural Building Components** – seismic restraint.	Ceiling restraint
				Natural Gas Automatic Shutoff and other key high priority items
				Restraint of other risky elements that may impede egress in particular unrestrained concrete and clay tile walls
	11		Basement wall openings	Infill basement wall openings with structural reinforced concrete to achieve a continuous wall with increased strength to resist damage.

5.5.2 **OPTION 2:** Reduced Seismic Demand:

At the owners' option, a reduced seismic demand can be used for analysis and design. The use of reduced seismic demand will result in increased damage in any given earthquake.

Of greatest importance is the protection of key elements of the building that could result in catastrophic failure if severely damaged. Protection of key elements is easier to achieve when the earthquake duration is shorter and the inertial forces are lower. Reducing seismic demand therefore allows the designer to upgrade the building to an acceptable level, but to a lower standard.

As discussed previously, design to conventionally accepted earthquake levels of 5%, 10% and 40% probability of exceedance in 50 years can provide a stronger scientific basis for analysis than does an arbitrary threshold such as 75% of the current force levels. Therefore, Glotman Simpson considered each of these reduced seismic design levels and report relative capacities as provided in Table 4.2 above in Section 4.

Based upon instructions given, the reduced seismic demand must satisfy collapse prevention for a seismic event considered equivalent to a 10% in 50 year event, or approximately 50% of current Code levels for a brittle type building of this nature.
Upgrading to 10% in 50 year event reduces forces for analysis by roughly 50%. By further improving ductility through the use of boundary elements on shearwalls and carbon fibre to the face of shearwalls, an increase in R value could be considered from the original RdRo = 1.5 / 1.3, to a new standard of RdRo = 2.0 / 1.4. Therefore, the seismic forces for design can reduce to 70% of the analysis forces for a brittle system. For further comparison:

2% in 50 year	Rd/Ro = 1.5 / 1.3	Base Shear =	8500 kips
10% in 50 year	Rd/Ro = 1.5 / 1.3	Base Shear =	4400 kips
10% in 50 year	Rd/Ro = 2.0 / 1.4	Base Shear =	3100 kips

With loading reduced through ductility, the walls become feasible to upgrade with carbon fibre at costs ranging from s.17(1)fl) of wall area. Boundary elements can then be added to walls to provide ductility for flexural yielding. Core walls can also be strengthened with steel plate or carbon fibre plate vertically at the corners for flexural strengthening. We would also pursue an option to explore post tensioning as a means to reduce flexural strengthening required together with additional flexural reinforcing.

East Wing Upgrading to 10% in 50 Year Uniform Hazard Spectrum

Following are upgrading results of analysis to the 10% in 50 year uniform hazard spectrum. To achieve a suitable performance for this hazard, the walls must be increased in ductility to a moderately ductile structure from that of a brittle wall system. To achieve this, a tied zone section is added to the ends and corners of walls resisting seismic loading or sustaining gravity load. Refer to Figures 5.6, 5.7 and 5.8 below.

s.15(1)(l)

[redacted]

Figure 5.6 Upgrade 10% in 50 Year Uniform Hazard Spectrum – North End Wall

s.15(1)(l)

[redacted]

Figure 5.7 Upgrade 10% in 50 Year Uniform Hazard Spectrum – Central Stair/Elevator Walls

s.15(1)(l)

[redacted]

Figure 5.8 Upgrade 10% in 50 Year Uniform Hazard Spectrum – South Wall

5.6 UPGRADING OPTIONS FOR WEST ANNEX

DAMPER BRACED FRAMES AND CONVENTIONAL ELEMENTS

Upgrading the West Annex would include the introduction of dampers and steel bracing above ground floor at 8 locations within the building. It is possible that this work could achieve the 2% in 50 year level when non-linear analysis is provided at a later date. Further upgrading of the ground floor and parking level diaphragm would also be required. Shearwalls would be introduced below the ground level to reduce diaphragm forces and improve lateral resistance. Other details to achieve the project objectives are required including masonry lateral support. We assume the precast connections will not need upgrading.

Similar to the comments in Section 5.5 above, and for reference, Glotman Simpson recommend upgrading to the full requirements of the current Bylaw as follows:

Table 5.1 West Annex – West Sketches 1-3 (see Appendix B)

	Item	Sketch	Title	Comments
Option 1 - Damper Braced Frames	1	1	Steel Frame Damper Braced Bays	
	2	2	Shearwalls in Parking Levels and Foundation Anchors	
	3	3	Infill Parking Level wall openings	
	4		Ground Floor Diaphragm Upgrades	
	5		Parking Level Diaphragm Upgrades	
	7		**Non Structural Building Components** – seismic restraint. of ceilings, natural gas automatic shutoff, restraint of other risky elements that may impede egress from the building in particular unrestrained masonry block walls.	

West Annex Upgrading to 10% in 50 Year Uniform Hazard Spectrum

Upgrading to the 10% in 50 year level would include similar upgrade elements that would be introduced for the full requirements of the current ByLaw.

6.0 BUDGET COSTING – ORDER OF MAGNITUDE

Structural upgrading costing was estimated based upon historical information, cost per square foot data, cost per cubic yard data, and our understanding of the construction market today. Costing provided is for comparative purposes only and should not be used for budgeting without further review. To be used for budgeting, a preliminary design and quantity takeoff should be performed to better assess the cost components.

Table 6.1 – Estimated Upgrade Cost – East Wing Building

Item	Sketch/Fig	Description	
1	Sketch 1	Foundation Level Shearwalls and Foundations	
2	Sketch 2	P1 Level Shearwalls	
3	Sketch 3	Ground Level Shearwalls	
4	Sketch 4	Level 2,3,4 Shearwalls	
5	Sketch 5	Floor Diaphragm Upgrades 2,3,4,RF	
6	Sketch 6	Short Column Protection Low Roof	
7	Sketch 7	Short Column Protection Low Roof	
8	Sketch 8	Brittle Wall Protection Measures	
9		Non Structural Building Components	
10		Basement Wall Openings	
11	Figure 4.6	North Wall Upgrade 10% in 50 Year	
12	Figure 4.7	Centre Stairwell /Elevator Upgrade 10% in 50 Year	
13	Figure 4.8	South Wall Upgrade 10% in 50 Year	
		Estimated Probable Upgrade Cost for 2% in 50 Year Seismic Demand	**$ 4 Million**
		Estimated Probable Upgrade Cost for 10% in 50 Year Seismic Demand	**$ 1.8 - 2.1Million**

Estimated costs exclude contractors overhead and profit, HST and consulting feesand are based on 2012 costing.

An approximate costing indicates that upgrading to the 10% in 50 year level seismic demand including additions of concrete to the shearwalls to be in the order of s.17(1)(f), plus the addition of work to mitigate the high priority items noted in the order o s.17(1)(f). Foundation upgrading with ground anchors to provide nominal base resistance is estimated at approximately s.17(1)(f). Total structural upgrading costs for the noted items are in the order of s.17(1)(f).

Table 6.2 – Estimated Upgrade Cost - West Annex Damper Braced Frames

Item	Sketch/Fig	Description	
1	Sketch 1	Steel Frame Dampened Brace Bays	
2	Sketch 2	Shearwalls in Parking Level and Foundation Anchors	
3	Sketch 3	Infill Parking Level Walls	
4		Ground Floor Diaphragm Upgrades	
5		Parking Level Diaphragm Upgrades	
6		Exterior Precast Concrete Connections	
7		Non Structural Building Components	
		Estimated Probable Upgrade Cost for 2% in 50 Year Seismic Demand	s.17(1)(f)
		Estimated Probable Upgrade Cost for 10% in 50 Year Seismic Demand	s.17(1)(f)

Estimated costs exclude contractors overhead and profit, HST and consulting feesand are based on 2012 costing.

Upgrading to the 10% in 50 year level with the introduction of dampers and steel bracing above ground floor at 8 locations within the building is estimated at approximately s.17(1)(f) n. It is possible that this work could achieve the 2% in 50 year level when non-linear analysis is provided at a later date. Further upgrading of the ground floor and parking level diaphragm is estimated in the order of s.17(1)(f). Shearwalls below ground level to reduce diaphragm forces and improve lateral resistance are estimated in the order of s.17(1)(f). Other details to achieve the project are required including masonry lateral support. We assume the precast connections will not need upgrading. Total structural upgrading costs for the noted items are in the order of s.17(1)(f)

7.0 CITY OF VANCOUVER OPERATIONS IMPACT DURING CONSTRUCTION

EAST WING BUILDING

The different approaches to upgrading the East Wing building consist of strategically supplementing the existing concrete structure of the building by adding new concrete shear walls and foundations, reinforcing critical brittle wall or column elements, reducing the seismic shear demand to some lightly reinforced wall elements and adding key components to the floor diaphragms. In addition to upgrading the primary structure of the building the restraint of Non Structural Components of the building must also be addressed.

It is anticipated that the upgrade work could be done in phases with work being undertaken in certain sections of the building. For example, sections of the parkade would not be accessible during the construction of the new foundations and shearwalls on that level. The same impact would be applicable to other levels of the building. In addition, drilling of concrete in an occupied building can be very disruptive to the occupants due to the level of noise and vibration that can often occur with this type of work. It may be practical or required that certain activities would be undertaken during overnight shifts while the building is not occupied.

It can be expected that concrete deliveries to the site will be required with placement using a concrete pump and hose. Site work areas would be required to facilitate such deliveries which may disrupt some parking areas and the flow of traffic in the vicinity of the building.

WEST ANNEX

The preferred approach to upgrading the West Annex Building consists of strategically placing new structural steel braced bays with dampening. The existing steel building is a good candidate for the introduction of new steel framing elements which can take advantage of the existing steel framing. In contrast to the East Wing Building the West Annex Upgrade will not be relying on the introduction of new concrete shearwalls or the need to deliver significant quantities of concrete. However, the introduction of new steel bracing into an existing building has its own challenges from access for the delivery of long steel members to field welding and the associated fumes, fire hazards and smells.

It may be anticipated that sections or quadrants of the building where the braced bays are to be installed may need to be temporarily vacated. The noise and vibration issues with drilling into existing concrete would be present with the West Annex Upgrade as well as the challenges of field welding. It may be practical or required that field welding and insitu concrete drilling would have to be done during overnight shifts while the building is not occupied.

Diaphragm upgrade work on the ground floor and parking levels will likely require sections of the floor space to be hoarded off while work in undertaken.

8.0 MINISTRY OF EDUCATION / APEGBC – SEISMIC PERFORMANCE ANALYZER [1]

EAST WING BUILDING

The Ministry of Education, APEGBC and in collaboration with the University of British Columbia have developed a web-based software application that provides a user-friendly platform for engineers in British Columbia to access the large database of seismic risk and retrofit analysis results for Schools in British Columbia. The web based Analyzer is one of the principal end products of a multi- year applied research project undertaken at UBC. One of the main objectives of the development of the Analyzer was to implement seismic retrofits that achieve a life safety objective in a cost effective manner.

The Analyzer and the accompanying Guidelines utilize a performance- based philosophy. The key philosophy in the approach is to achieve life safety by reducing the probability of structural collapse to acceptable levels instead of concentrating on damage prevention. The Guidelines are based on a rigorous application of a non-linear performance based methodology. In brief, the purpose of the non-linear dynamic analysis is to determine the appropriate lateral strength of the structural system that will provide a high probability that the lateral deformation remains less than the specified maximum based on the non linear characteristics of the structural system or component.

The Life Safety performance objective is defined by two main criteria:

1. Probability of Drift Exceedance (PDE) of 2% in 50 years,
2. Conditional Probability of Drift Exceedance (CPDE) of 25% or less for Near Collapse Conditions at 100% of the code ground motion (2475 year return period).

Note that the performance objectives and criteria are expressed in terms of a probability of drift exceedance but reference the same return periods found in the NBC 2005. Calculating the seismic demand based on a drift limit is one on the main differences with the Seismic Retrofit Guideline and Analyzer.

The Analyzer has restriction on its use with one of the main limitations being that the programming was developed for typical school buildings ranging from 1 to 3 storeys. The analytical model assumes a two storey building while the results are utilized for one through three –story school buildings with proper adjustments. User inputs include city location, soil classification, prototype element (ie. concrete shearwall) , factored resistance of the element as a percentage of the “seismic weight - Ws” to the element, storey height and drift limit.

As a means of providing a secondary seismic assessment the Seismic Performance Analyzer has been used to provide a general review of the East Wing Building to determine the Retrofit Priority Ranking level for the building. The levels range from no retrofit to medium to three levels of high priority (H1, H2, H3) with H1 being the highest priority.

The Analyzer was used to review a typical concrete wall on the upper levels of the building. The existing concrete shearwalls are considered brittle with poor reinforcing details.

The program uses a series of prototype walls that range from a type C4 (squat shearwall with height to width ratio < 2:1) to a type C7 wall (conventional construction). In the case of the East Wing Building the brittle squat concrete walls don't fall into either of these categories and as a result the runs for the type C4 and type C7 should be viewed with caution and would likely be worse than shown. The Analyzer runs 1-4 for wall types C4 and C7 are shown in Appendix D.

From the Analyzer results the following comments can be provided:

1. Wall Type C4 Run 1 - based on a estimated current wall capacity of 3% Ws this results in a high probability of drift exceedance (PDE) and a H1 or highest priority for retrofitting,

2. Wall Type C4 Run 2 - based on an upgraded level that produces a retrofitted wall capacity of 20%Ws this decreased the PDE from 24% to 2.1% and a corresponding retrofit priority level of medium. This level of performance could possibly be achieved by upgrading to a level with a return period of 10% in 50 year earthquake uniform hazard spectrum which produces approximately 50% of the full Code capacity.

3. Wall Type C7 Run 1 and Run 2 shows that for a shearwall governed by flexure (aspect ratio >2:1) the level of retrofit required is greater. For instance the retrofit to the wall C7 would have to be to a level corresponding to 32% Ws versus the 20% for the C4 wall type to achieve the same 2% Probability of Drift Exceedance.

The results from these preliminary "Analyzer Runs" are interesting and useful as a tool to determine a level of retrofit needed to achieve an acceptable level of risk or probability of drift limit exceedance. The underlying assumption being that if the building probability of drift exceedance is limited to a predetermined maximum limit then an acceptable level of life safety against building collapse will have been achieved.

From results of the analyzer noted above in sections 2 and 3, it would appear that upgrading of the East Wing is considered a high priority and the minimum upgrading should be to a level of at least 10% in 50 years, and preferrably to 5% in 50 years.

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[1] Seismic Retrofit Guidelines, 1st Edition – for BC Low Rise Schools, September 30,2011

9.0 SUMMARY AND RECOMMENDATIONS

The East Wing and West Annex buildings located on the City of Vancouver Precinct at 453 West 12th Avenue and 515 West 10th Avenue where constructed in 1968 and 1975 respectively. The City of Vancouver has requested proposals and alternative strategies to seismically upgrade the buildings on an "interim" basis as the buildings may be scheduled for replacement in the next 12 to 15 years.

The East Wing and West Annex Buildings appear to be in satisfactory structural condition and appear to be performing well for their current intended use with no visually obvious significant deterioration in the main structural elements of the buildings.

The main gravity load supporting structure has been performing acceptably for in excess of 30 years. In accordance with Commentary L of the NBCC 2005, provided there have been no changes within the past 30 years that could significantly increase the loads on the building or affect its durability and no such changes are contemplated then no gravity load carrying upgrading is required. We are not aware of any proposed significant alterations to the loading to the existing gravity supporting systems of the building.

The East Wing and West Annex Buildings are of a quality and finish that is suitable for retrofit. Upgrading to improve safety and extend the service life of the building can provide good value.

We have structurally assessed the buildings, identified the key weaknesses in the primary structure along with consequences of those weaknesses and proposed alternatives to upgrading the lateral forces resisting systems of the buildings. Upgrading to critical gravity supporting elements, such as soft story configuration of walls and short columns that would lead to collapse in a seismic event should be addressed as soon as possible. Preliminary upgrade scheme sketches have been provided for each preferred option and can be found in the Appendices at the end of this report.

From results of the Seismic Perrformance Analyzer (refer to Section 7.0) above, it would appear that upgrading of the East Wing Building is considered a high priority and the minimum upgrading should be to a level of at least 10% in 50 years, and preferably to 5% in 50 years.

Order of magnitude budget pricing of the proposed upgrade options for each building has been included in Section 5 along with a statement of impact to the operations of the two buildings during construction and a recommended future course of action.

We recommend that a future course of action should first include a determination of the hazard level for upgrading. Given this standard, Glotman Simpson should complete a full analysis using the latest performance based methods. A cost consultant should provide guidance during the design process and tender prices should be obtained for the scope of work chosen to finally establish the budget for the work.

Due to the low seismic resistance of these buildings in their current condition, Glotman Simpson strongly recommend that at least the soft storey and short column effects in the East

Wing, and similar features in the West Annex including connections between precast elements in the parking garage should be addressed in the very near future.

10.0 LIMIT OF LIABILITY

It should be noted that this Seismic Performance and Upgrade Strategies Report is based on a visual inspection of the existing structure and building systems and a review of the available drawing information, previous reports and assessments provided as part of our review. No testing or dismantling of any architectural cladding was performed and inspections were made on a random basis with no attempt to review or inspect every element or portion of the building. The intent of the inspections was to determine areas of visually obvious deterioration and to generally determine the overall quality and sufficiency of the work, but not to ascertain the quality or sufficiency of any specific aspect of the development. Furthermore, we have carried out a preliminary review of the gravity resisting system of the building. A preliminary seismic capacity assessment of the existing structures has been done for the purposes of this Phase 1 Assessment report. Our comments are not a guarantee or warranty of any aspect of the condition of the development whatsoever.

This report was prepared by Glotman•Simpson Consulting Engineers for the account of **The City of Vancouver.** The material in it reflects the existing structural condition of the existing buildings to our best judgment in light of the information available to us at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Glotman•Simpson Consulting Engineers accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The following items were not examined by us nor were they considered as part of the structural survey of the building:

- condition of the roofing system and any leakage concerns;
- building envelope design and condition issues;
- moisture considerations at exterior walls;
- plumbing, mechanical or electrical considerations;
- fire prevention requirements or condition of existing equipment and systems; and
- presence of hazardous materials such as asbestos, PCB’s or toxic industrial waste.

APPENDIX A EAST WING SHEARWALL UPGRADE OPTION 1

Sketch	Title
1	Foundation Level Shearwall Upgrading
2	P1 Level Shearwall Upgrading
3	Ground Level Shearwall Upgrading
4	Level 2 Shearwall Upgrading (3,4 similar)
5	Floor Diaphragm Upgrading
6	Short Column Protection Low Roof
7	Short Column Protection Low Roof
8	Wall Protection Measures

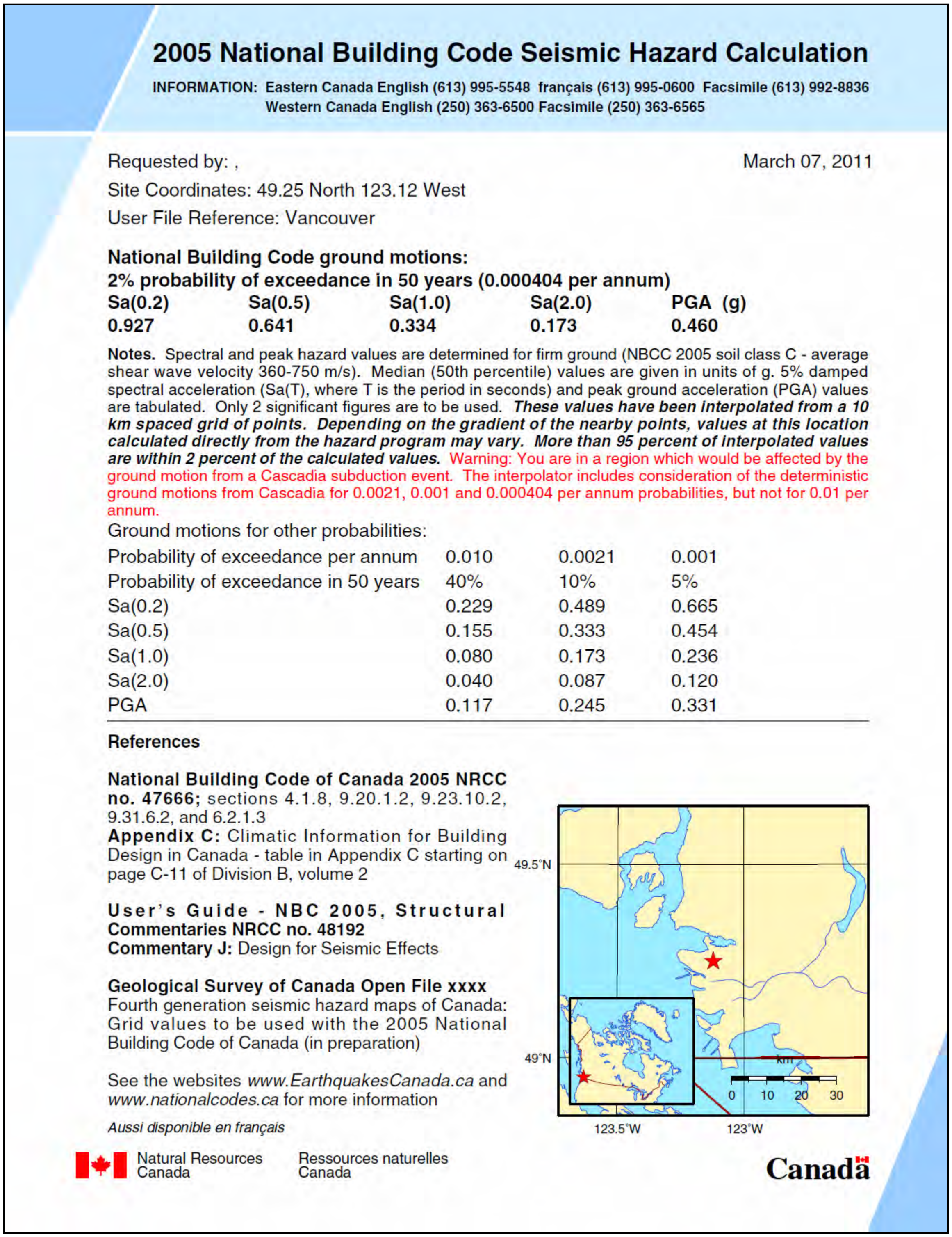
Level	East Wing Approx Suspended Floor Area sq ft.
P1	17,000
Ground	21,000
Level 2	21,000
Level 3	16,000
Level 4	16,000
Roof	16,000
Total	**107,000**

APPENDIX B WEST ANNEX DAMPER BRACED FRAMES

Sketch	Title
1	Steel Frame Damper Braced Bays
2	Shearwalls in Parking Levels and Foundation Anchors
3	Infill Parking Level wall openings

Level	West Annex Approx Suspended Floor Area sq ft.
P1	25,000
Ground	25,000
Level 2	21,500
Level 3	23,000
Level 4	23,000
Roof	23,000
Total	**140,500**

APPENDIX C: UNIFORM HAZARD SPECTRUM – VANCOUVER



2005 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

Requested by: , March 07, 2011
Site Coordinates: 49.25 North 123.12 West
User File Reference: Vancouver

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

Sa(0.2)	**Sa(0.5)**	**Sa(1.0)**	**Sa(2.0)**	**PGA (g)**
0.927	**0.641**	**0.334**	**0.173**	**0.460**

Notes. Spectral and peak hazard values are determined for firm ground (NBCC 2005 soil class C - average shear wave velocity 360-750 m/s). Median (50th percentile) values are given in units of g. 5% damped spectral acceleration (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are tabulated. 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 calculated values.*** Warning: You are in a region which would be affected by the ground motion from a Cascadia subduction event. The interpolator includes consideration of the deterministic ground motions from Cascadia for 0.0021, 0.001 and 0.000404 per annum probabilities, but not for 0.01 per annum.

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(0.2)	0.229	0.489	0.665
Sa(0.5)	0.155	0.333	0.454
Sa(1.0)	0.080	0.173	0.236
Sa(2.0)	0.040	0.087	0.120
PGA	0.117	0.245	0.331

References

National Building Code of Canada 2005 NRCC no. 47666; sections 4.1.8, 9.20.1.2, 9.23.10.2, 9.31.6.2, and 6.2.1.3
Appendix C: Climatic Information for Building Design in Canada - table in Appendix C starting on page C-11 of Division B, volume 2

User's Guide - NBC 2005, Structural Commentaries NRCC no. 48192
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File xxxx
Fourth generation seismic hazard maps of Canada: Grid values to be used with the 2005 National Building Code of Canada (in preparation)

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

Aussi disponible en français

Natural Resources Canada Ressources naturelles Canada

Canadä

APPENDIX D: ORDER OF MAGNITUDE COSTING ESTIMATE

Table 5.1A	East Wing Upgrade Option 1 – 2% in 50 Year
Table 5.2A	West Annex Upgrade – 2% in 50 Year

APPENDIX E: MOE/APEGBC/UBC - SEISMIC PERFORMANCE ANALYZER

Wall Prototype C4	Run 1 Squat Shearwall
Wall Prototype C4	Run 2 Squat Shearwall
Wall Prototype C7	Run 1 Flexure Shearwall
Wall Prototype C7	Run 2 Flexure Shearwall