THE CORPORATION OF THE

CITY OF WHITE ROCK

CORPORATE REPORT

DATE: **January 13, 2020**

TO: **Mayor and Council**

FROM: **Jim Gordon, P.Eng., Director of Engineering and Municipal Operations**

SUBJECT: **City Hall – Seismic Report - 2020**

RECOMMENDATIONS

THAT Council:

1. Receive for information the corporate report dated January 13, 2020 from the Director of Engineering and Municipal Operations titled “City Hall – Seismic Report - 2020”;
2. Endorse the retention of a consultant to evaluate options for the future of White Rock City Hall; and
3. Endorse the development of a 5-year implementation plan for the future of White Rock City Hall as well as the civic precinct.

INTRODUCTION

White Rock City Hall was originally constructed in 1962. The building was not designed to withstand a 100-year return period earthquake. The City retained Bush, Bohlman & Partners LLP (BBP) to conduct a seismic assessment, a cost estimate for retrofit, and a retrofit report for White Rock City Hall. The report is attached as Appendix A. The purpose of this corporate report is to summarize BBP’s findings and present options for the future of White Rock City Hall.

PAST PRACTICE / POLICY / LEGISLATION

In British Columbia, new buildings are designed to the 2018 BC Building Code to withstand ground motion with a 2,475-year return period.

ANALYSIS

BBP reviewed the building’s existing structural systems, and assessed the building using the Seismic Retrofit Guidelines Third Edition (SRG3) and the BC Building Code 2018. BBP’s assessment did not include a geotechnical subsurface investigation or a non-structural seismic assessment.

White Rock City Hall is an 11,908-sq.ft building, separated into three areas:

- West Wing - the seismic system for the West Wing consists of unreinforced masonry walls on three sides, and nonductile concrete columns on the west side.

- East Wing - at the East Wing, the seismic systems include unreinforced masonry walls on three sides and nonductile concrete columns on the south side.
- Lobby - the lobby does not have a seismic system; it shares the systems with the two adjacent wings.

BBP's seismic assessment found seismic deficiencies in the following locations:

1. South and west lateral systems are very weak and nonductile, posing a high risk of major damage in a moderate earthquake
2. The masonry walls are unreinforced and risk collapse out of plane.
3. The east wing roof diaphragm is very weak and is not able to properly transfer seismic demands to the lateral system
4. The lobby roof is not connected to a lateral system in the east-west direction, potentially causing failure to the masonry walls
5. The basement is not designed to resist dynamic soil pressures

The consultant found the Probability of Drift Exceedance (PDE) for the concrete frame was 20% in 50 years. Based on the Seismic Retrofit Guidelines, White Rock City Hall is a High Risk (High 1) building. Furthermore, the building only meets 20% of the required lateral capacity of the latest building code (2018 BCBC). Unlike new buildings which are designed to withstand ground motion for a 2,475-year return period earthquake, the White Rock City Hall building could fail from the ground motion predicted for a 100-year return period earthquake.

In addition to seismic deficiencies, the City Hall building does not meet the growing needs of the residents and staff. The building does not have an elevator. A person with mobility challenges needs to walk around the exterior of the building to access another floor. The building also does not house all City staff; Human Resources, Information Technology, Bylaws, Parking and Engineering staff are in a separate buildings. Visitors seeking to do business with other City departments may need commute to a separate building. As the demand for City services increases, the number of City staff will increase. The building does not have space to accommodate additional office space to house new staff.

In a 2010-2011 space planning analysis by MKT Development Group consultants estimated that 26,592-sq.ft of office space is required for accommodating Corporate Administration, Council, Information Technology, Human Resources, Planning and Development Services, and Financial Services staff. Unfortunately, the analysis failed to consider that Senior Engineering staff and Engineering development staff currently at the Operations Yard should be relocated to City Hall requiring an additional 5,475-sq.ft of office space. Therefore, a minimum combined total of 32,000-sq.ft of office space is necessary.

RISK MANAGEMENT

SRG3 is used by the Ministry of Education to determine seismic risk and retrofit requirements. For comparison, the public school system in BC currently has 27% of its schools in high seismic zones rated at the High 1 Risk level. All of these, and any other schools with a PDE rating of 5% in 50 years or greater, will eventually be retrofitted or replaced, but not all at once. The School Seismic Program has been going on for 15 years and will still take many years to complete.

The City Hall building is rated as High 1. If the building is not seismically retrofitted, the building could fail in a 100-year return period earthquake. There are also financial risks to seismically retrofitting City Hall because additional space would be necessary to accommodate accessibility requirements and office space for staff.

OPTIONS

Given the growing needs of the City, seismically retrofitting City Hall may not offer the best value. Staff have considered several options for the future of City Hall. These options are listed as follows:

1) Seismic retrofit of City Hall to less than 2% PDE per SRG3
2) Partial seismic retrofit of City Hall to High 2 (7% to 10% PDE) per SRG3
3) Rent office space and relocate City Hall to a commercial building
4) Partnerships with other institutions to develop a new City Hall
5) Relocate staff to other City-owned buildings (ie: Evergreen Daycare)
6) Construct a new City Hall

Option 1 – Seismic Retrofit
A retrofit is estimated to cost $1.8M and at least 9 months to complete, if the building is unoccupied during renovation. This retrofit will address life safety issues in the event of a major earthquake; but the building could be extensively damaged beyond repair. This retrofit could potentially protect the building against less severe earthquakes. The cost estimate for a retrofit excludes staff relocation and office space rental. If the building is to remain occupied during retrofit, additional budget and time would be necessary.

Option 2 – Partial Seismic Retrofit
Costs for an interim partial retrofit to a lower standard (High 2) are not currently available.

Option 3 – Rent Commercial Office Space
Commercial office space vacancy is low in White Rock. The estimated commercial rental rate for the South Surrey and White Rock area is between $14/sq.ft and $30/sq.ft per annum. The challenge is finding a location that provides 32,000-sq.ft. of office space to house all City staff.

Assuming a 32,000-sq.ft facility is available, the present value (PV) of this option is determined using the growing annuity formula as shown in Appendix B. At a 50 year term (based on the typical design useful life of a civic building), the present value of this option is $24.9M at rents of $14/sq.ft and $124.7M at rents of $30/sq.ft. These costs do not include the fitting of the rental space with offices, IT, etc..

Option 4 – Partnerships with Other Institutions to Develop a New City Hall
This option involves working with a developer to incorporate commercial space within a multi-use building. Similar to the White Rock Community Centre, the commercial space would be in a separate commercial strata. The City would purchase the commercial strata at market value less the value of development's Community Amenity Contribution (CAC). For example, if the market value of the commercial strata is $25M and the development site's CAC is $5M, the City's cost would be $20M.

Option 5 – Relocate Staff to Other City-Owned Buildings
This option involves relocating some City staff to other City-owned buildings in the Civic Block (ie: Library or Evergreen Daycare). The costs of this option is currently not available as seismic assessments would be required for the Library or the Evergreen Daycare building. This option would displace the current users of these civic buildings.

Option 6 – Construct a New City Hall
A very rough estimate for the construction of a new City Hall is approximately $25 M. This cost estimate is for a basic office building, excluding the premium furnishings of typical civic buildings (ie: atrium, art, or Council chambers).

BUDGET IMPLICATIONS

There is currently $50,000 in the Financial Plan to develop options that could be used for detailed feasibility investigations. The 2020 to 2024 Financial Plan, subject to Council approval, includes $1.5M in each of the next two years for a "City Hall Project".

RECOMMENDATION

Staff recommends that a consultant be retained to develop, evaluate and assess the feasibility of the options for the future of City Hall, including the options listed above. Furthermore, Staff recommends that Council endorse the development of a 5 year implementation plan for the future of City Hall as well as the civic precinct.

CONCLUSION

The City retained Bush, Bohlman & Partners LLP (BBP) to conduct a seismic assessment, a cost estimate for retrofit, and a retrofit report. New buildings are designed to the 2018 BC Building Code to withstand a ground motion with a 2,475-year return period.

Based on the Seismic Retrofit Guidelines, White Rock City Hall is a High Risk (High 1) building and only meets 20% of the required lateral capacity of the latest building code (2018 BCBC). The building could fail from the ground motion predicted for a 100-year return period earthquake. A seismic retrofit is estimated to cost $1.8M and at least 9 months to complete if the building is unoccupied. This retrofit does not address the accessibility issues of the building nor the need for more office space to house City staff.

Given the growing needs of the City, seismically retrofitting City Hall may not offer the best value. It is recommended that a consultant be retained to develop options and provide a feasibility study for the future of City Hall and a 5-year implementation plan that would include the civic precinct.

Respectfully submitted,

Jim Gordon, P.Eng.
Director of Engineering and Municipal Operations

Comments from the Chief Administrative Officer:

I concur with the recommendations of this corporate report.

Dan Bottrill
Chief Administrative Officer

Appendix A: DRAFT Bush, Bohlman & Partners LLP report titled "White Rock City Hall Seismic Assessment and Retrofit Report"

Appendix B: Present Value of Renting Commercial Office Space

December 6, 2019

White Rock City Hall

Seismic Assessment and Retrofit Report

BUSH, BOHLMAN & PARTNERS LLP

Draft

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EXECUTIVE SUMMARY

Structural engineering assessment results indicate that the White Rock City Hall building has an overall rating of High 1 Risk, per Seismic Retrofit Guidelines Third Edition (SRG3) and only meets 20% of the lateral strength requirements of the 2018 British Columbia Building Code (BCBC).

A seismic retrofit scheme has been devised to achieve the Life-Safety Performance Objective of SRG3. This can be achieved by adding new exterior concrete buttress walls, reinforcement of existing unreinforced masonry walls, roof diaphragm upgrades, and improvements to the basement walls. The retrofit would take nine months if the building was unoccupied. The cost for this retrofit is approximately $1.8 million excluding office rental and moving costs.

To move forward with the retrofit we recommend completing a more detailed cost estimate, a geotechnical sub-surface investigation, and a hazardous materials assessment of the affected parts of the building. Following that, a full consultant team should be engaged to develop design drawings and a phasing plan if the building is to remain occupied during the retrofit.

INTRODUCTION

Bush Bohlman and Partners, LLP (BBP), performed a structural seismic assessment of White Rock City Hall at 15322 Buena Vista Avenue in White Rock, BC. The purpose of this assessment was to update a previous seismic study by BBP, which was completed in August 2013. Specifically, the update was intended to address changes in the seismic provisions of the recent 2018 British Columbia Building Code (BCBC), and provide context on the level of risk to the existing building.

This report includes an evaluation of the seismic load resisting systems of the building and a proposed seismic retrofit scheme with cost estimate. The opinions and recommendation are based on a review of existing drawings, a site visit, and calculations using SRG3, BCBC, and applicable material standards. Our scope of services did not a geotechnical subsurface investigation or a non-structural seismic assessment.

We visited the facility on October 18, 2019. Our objective was to confirm relevance of available drawings and reports, and to review the condition of the building structure. During our visit we were able to observe representative areas of the building interior and exterior. This review was of a visual nature only and did not include any destructive investigation or x-ray scanning to determine existence or quantity of reinforcement in concrete and masonry elements.

This report includes a description of the existing structural systems, a seismic assessment, a retrofit concept, and a preliminary cost estimate.

DESCRIPTION OF BUILDING

White Rock City Hall was originally constructed in 1962. It is a two-storey structure with flat roofs. The lower level has a basement wall on the north side but exits at grade on the south elevation. Figure 1 below includes a photograph of the main entry area on the north side of the building.

Figure 1: North Elevation of White Rock City Hall

The building can be separated into three distinct portions or "blocks". Figure 2 provides a key plan of the blocks. These are the West Wing which houses the Council Chambers on the upper level, the East Wing, and the lobby. All three blocks have the same floor elevations at both the lower and upper levels. The West Wing has a higher roof elevation than the East Wing, and the lobby has a lower roof elevation than both East and West Wings.

During our previous study we were provided with copies of the original architectural and structural drawings of the building. The architectural set was prepared by Carlberg Jackson Associates Architects and dated September 1962. This set included drawings A1 through A6. Structural drawings were prepared by C.F. Moore Structural Engineer and also dated September 1962. That set included drawings S1 through S4.

Our site walkthrough on October 18, 2019, confirmed that the main structure had not been significantly altered since original construction. There have been a number of interior renovations, but nothing to the extent that would influence the seismic behaviour of the building.

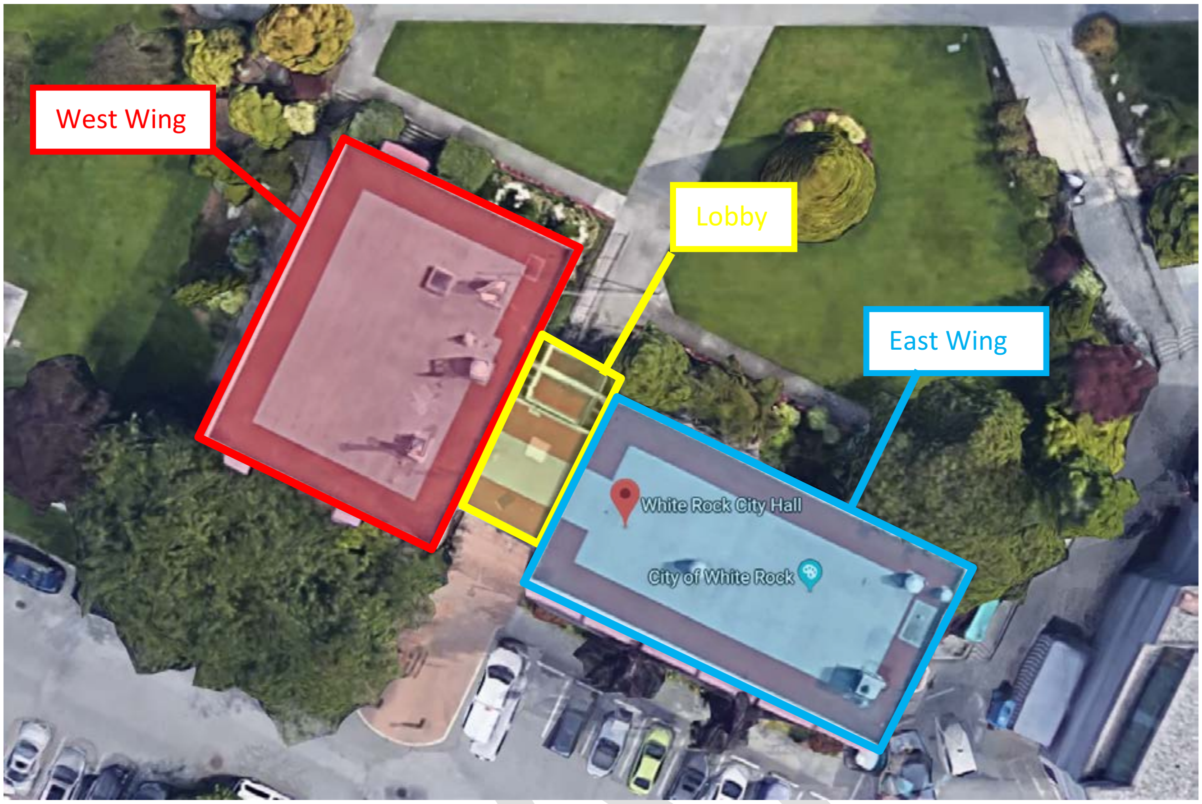


Figure 2: Key Plan of White Rock City Hall

West Wing

The West Wing roof structure consists of 64mm tongue and groove (T&G) timber decking supported by glulam beams at the interior and masonry walls at the exterior. The glulam beams are supported by a combination of steel posts, concrete columns (west elevation), and masonry walls. The suspended floor is plywood and shiplap over timber joists spanning to glulam beams at the interior. On the north side the joists are supported by a concrete basement wall. On the south side they are supported by masonry walls. The glulams, like the upper floor, are supported by a combination of steel posts, concrete columns (west elevation), and masonry walls. The ground floor is slab on grade. The foundation consists of conventional strip and pad footings. Interior partition walls are wood stud, except in the vault (see below) where they are unreinforced masonry.

On the lower level there is a vault in the northeast corner of the west wing. This area has a concrete suspended slab over top (instead of a timber floor) and is supported by masonry walls on the interior sides and concrete walls on the exterior sides. Also, on the lower level, the north walls and northern part of the east exterior walls are concrete basement walls.

The seismic system for the west block consists of unreinforced masonry walls on three sides, and nonductile concrete columns on the west elevation.

East Wing

The east wing roof consists of shiplap on timber joists spanning to glulam beams. Glulam beams are supported by steel posts at the interior and concrete columns at the exterior. At the east and west ends of the east wing, the glulam beams bear on unreinforced masonry walls. The suspended floor is a cast-in-place concrete slab. The slab is supported by concrete beams and columns. The ground floor is slab on grade. Foundations are conventional strip and pad footings. Interior partition walls are mostly wood stud, however there are a number of unreinforced masonry demising walls on the east half of the block. There partial- and full-height concrete basement walls on the north and east exterior elevations.

On the upper floor there is an existing vault room with masonry walls and a concrete slab ceiling which is separate from the main roof framing.

The seismic systems for the east wing are unreinforced masonry walls on three sides and nonductile concrete columns on the south elevation. The roof diaphragm is timber and the suspended floor diaphragm is cast-in-place concrete.

Lobby

The lobby has a T&G roof deck supported by glulam beams. The beams bear on masonry walls on both sides, which are shared with the two wings. The suspended floor is a cast-in-place slab which spans across the width of the block and bears on the two shared masonry walls. Ground floor is slab on grade. There are two sets of stairs, both of which are of suspended concrete construction. Footings are conventional strip and pad footings. Demising walls in this block are either glazing or timber stud walls.

The lobby does not have a seismic system of its own, but shares the systems with the two wings. In the north-south direction it shares the masonry walls of those blocks. In the east-west direction it relies on its connection to the east wing via its floor slab.

There is no seismic gap between the lobby and the two adjacent wings.

Masonry Walls

White Rock City Hall has what looks like clay brick walls on many exterior faces and in portions of the interior. Typical clay brick units have approximate dimensions of 64mm high, 100mm wide, and 200mm long. Walls of this type are present as a load-bearing medium only in pre-WW2 buildings. Contemporary buildings only use bricks as a non-load bearing veneer. The brick at White Rock City Hall is referred to as “Giant Brick” and is actually a form of load-bearing masonry (i.e., from a structural engineering perspective, we treat it as concrete masonry, not as clay brick). These brick units have dimensions of 64mm high, 200mm wide, and 300mm long. For the most part this masonry is unreinforced, however there are portions supporting beams that have vertical reinforcing added to enhance their load-bearing capacity.

GEOTECHNICAL INVESTIGATION

There were no recent geotechnical reports available to assist in our review. Original structural drawings have indicated that the soil has an allowable bearing pressure of 8000psf (385kPa). Based on our experience with the White Rock area, we have assumed this to be founded on Site Class C materials for the purposes of seismic evaluation.

REVIEW OF PREVIOUS SEISMIC ASSESSMENT

Our previous seismic report of White Rock City Hall was completed in August 2013. The report identified the building as “High” risk and provided capacity-demand ratios based on 2012 BCBC code requirements. A conceptual retrofit scheme was proposed with an order of magnitude costing of $850,000.

SEISMIC ASSESSMENT

Methodology

BBP performed structural engineering evaluation based on the Seismic Retrofit Guidelines. These are technical procedures developed by The Association of Professional Engineers and Geoscientists of British Columbia (now EGBC) and the University of British Columbia (UBC) for use in the British Columbia Ministry of Education School Seismic Upgrade Program. The guidelines aim to provide a uniform approach for providing life-safety seismic performance of low-rise buildings in a cost-effective manner. The original Seismic Retrofit Guidelines (SRG1) were published in 2011. These were updated and improved in 2013 (SRG2) and again in 2017 (SRG3). Our evaluation is based on SRG3.

Structural elements are evaluated for their ability to continue supporting gravity loads while undergoing horizontal displacements under seismic loading. The guidelines have identified a number of common structural prototypes used within school buildings in British Columbia. For each prototype researchers have established the maximum drift, which is the ratio of an element’s displacement to its height, it can experience without losing load-carrying capacity. The SRG3 evaluates the probability that this drift will be exceeded in a fifty-year period for all types of earthquakes and levels of shaking at a given geographic location. The probability of drift exceedance (PDE) value is used as a measure of risk to the life safety of the building occupants. Relative values of PDE allow the risk to be prioritized. A summary of PDE versus risk ranking is presented below.

0 ≤ PDE ≤ 2.0%	No retrofit required
2.0% < PDE ≤ 5.0%	Medium
5.0% < PDE ≤ 7.0%	High 3
7.0% < PDE ≤ 10.0%	High 2
10% < PDE	High 1

Seismic Assessment Parameters

Below were the governing parameters for the Seismic Retrofit Guidelines (SRG3) assessment:

(SRG3)	
Site class:	C
Municipality:	White Rock
LDRS prototypes:	Unreinforced masonry (M-2)
	Nonductile concrete frame (C-3)
Governing drift limit:	1.25%
Governing LDRS capacity (R_e):	M-2 (27%W)
	C-3 (6.5%W)
VLS drift capacity:	1.25%
Diaphragm prototype:	Unblocked plywood (D-2)
	Horizontal boards (D-3)
Diaphragm span:	18.5m and 22.2m
Diaphragm capacity:	9%W_d and 4.5%W_d

In addition to SRG3 analysis, BBP also evaluated the building using the building code. Demands for earthquake loads were determined based on the British Columbia Building Code (BCBC), 2018 edition.

(2018 BCBC)	
Site class:	C
SFRS system (R_dR_o):	Conventional Construction (1.5, 1.3)
Importance factor:	1.0
Building period:	0.2 seconds
Spectra accelerations:	0.871g
Base shear demand:	39%W

Seismic Assessment Results

The lateral systems for City Hall are a combination of unreinforced masonry walls and nonductile concrete moment frames. The masonry walls (acting in plane) are long with a relatively small proportion of openings. Thus their capacity is quite reasonable, ranging from 25%W to 45%W based on location and level. The weakest of the group had a PDE=3.0% which is at the low end of Medium. The concrete moment frames are much weaker. Resistance ranged from 6%W to 8%W. PDE was over 20%, which makes these risk level High 1, which is the worst rating under SRG3. From a code perspective the masonry walls are not permitted in high seismic regions, so we are not able to compare them to code. The concrete moment frames only meet about 20% code requirements. An earthquake with a return period of 100 years has seismic demands of only 24% of the full code design requirements. As such the concrete moment frames would not be expected to be able to resist an earthquake with a 100-year return period.

The timber roof diaphragms have capacity ranging from 4.5%W to 9%W. The lower capacities are High risk, while the higher capacities are Medium risk. This represents a range between 30% and 60% of resistance to BCBC force demands. We have assumed that the T&G decking in the lobby roof and west wing roof are "side-spiked" based on the thickness of the T&G decking. This may need to be verified by pacometer scanning depending on future seismic retrofit plans. The floor diaphragms have much lower seismic demands and higher capacities. The flexible timber floor diaphragm in the West Wing is low risk and 100% code compliant, as are the rigid concrete diaphragms in the lobby and East Wing.

The masonry walls were assessed for their out-of-plane stability. Lower floor walls with lowest demand and highest surcharge had a PDE of 5.1%, which is a risk of High 3. Upper level walls had a PDE of 9.2%, or High 2.

Seismic Deficiencies

The seismic deficiencies for the building are summarized on the next page.

See Appendix A for a plan illustrating the deficiencies.

SEISMIC RETROFIT SCHEME

Given the extensive list of seismic deficiencies for White Rock City Hall, we recommend a seismic retrofit. Given the vintage of the building, in our experience it is not economically feasible to upgrade to be in compliance with the seismic provisions of the building code. We would recommend upgrading using the BC Seismic Retrofit Guidelines for Schools, Third Edition (SRG3). SRG3 was specifically developed to upgrade school buildings, many of which are of similar vintage and construction type to White Rock City Hall.

The level of upgrade we recommend in SRG3 is called the Life-Safety Performance Objective. This level of upgrade has been specifically designed to allow the occupants of the building to exit safely after a large earthquake with a return period of 2,475 years. This is the same seismic hazard as used by the BCBC. After such an event the building would not be repairable, but the Life-Safety upgrade would either mitigate or eliminate damage resulting from lesser earthquakes.

The actual design forces for the new buttress shear walls (based on SRG3) are approximately equal to 65% of the design forces that would be required for a new building by 2018 BCBC.

Table 1: Seismic Deficiencies

Ref #	Element	Description
1	South and west nonductile columns lateral system	The south and west lateral systems are very weak and nonductile. They pose a very high risk of major damage in even a moderate earthquake. We estimate that a 1-in-100-year event could cause this lateral system to fail.
2	Masonry walls	The masonry walls are unreinforced and pose a risk to collapse out of plane. The risk of this is higher on the upper level. The masonry walls also provide lateral resistance for most of the building. In this regard they have reasonable capacity, but are not permitted in new construction and thus are not code compliant. All unreinforced masonry walls in the building are susceptible to out-of-plane failure.
3	Wing roof diaphragms	The East Wing roof diaphragm is very weak and is not able to properly transfer seismic demands to the lateral system, nor adequately restrain the top of the masonry walls. The West Wing roof diaphragm may or may not be High risk. If the T&G decking is "side spiked" then it will be only Medium risk.
4	Lobby roof diaphragm	The lobby roof diaphragm is not connected to a lateral system in the east-west direction and could "pound" into the wings and potentially fail the masonry walls.
5	Basement walls	The basement retains soil on the north side but not the south. The basement is required to resist dynamic soil pressures for which it has not been designed.

SRG3 allows for lower forces levels than the code, as it specifically controls the amount of movement of the seismic elements, and allows them to move as far as possible without degrading dangerously. The code is specifically developed for the design of new buildings, and does not get into much detail on the nonlinear behaviour of different types of seismic systems. The purpose of the code is to provide a robust infrastructure of buildings. SRG was developed to provide affordable yet safe retrofits to existing buildings.

The seismic retrofit scheme with typical details is provided in Appendix B. Table 3 below provides a further description with quantities.

Table 2: Seismic Retrofit Recommendations

Ref #	Element	Description	Quantities
CSW#5	Exterior concrete buttress walls	Provide new external concrete shear walls with soil anchors and steel drag struts.	(2) walls 350mm thick x 1800mm long. West wall is 6.85m tall. East wall is 6.25m tall. Both pile caps 3m x 1.5m x 900mm deep. Each pile cap comes with (4) #14 Dywidag soil anchor.
MW#1	Masonry walls (reinforce at 1200mm o.c.)	Add vertical reinforcing to existing masonry walls. Provide troweled finish with mortar joints. Provide connections to roof and floor diaphragms. Paint entire wall.	3.2m high x 60m 3.0m high x 37.8m 3.65m high x 38.5m
MW#1 Alt	Masonry walls (reinforce at 600 o.c.)	Add vertical reinforcing to existing masonry walls. Provide troweled finish with mortar joints. Provide connections to roof and floor diaphragms. Paint entire wall.	3.2m high x 9m 3.0m high x 6.1m 3.65m high x 4.9m
WD#1	Roof diaphragm upgrades	Remove roofing and resheathe existing deck with new 12.7mm plywood. Provide sheet metal straps around. Reroof.	$564m^2$
	Steel drag struts	Provide steel drag struts on top of roof or on underside of suspended floors.	Roof: PL102 x 6.4mm x 60m Ceiling: L102x102x6.4 x 60m
SSK#1	Basement wall upgrades	Excavate adjacent to basement wall. Provide horizontal exterior grade beam and vertical piers with footings. Backfill.	Grade beam: 50m long Piers & footing: 4 of each

Operational Disruptions

Construction is extensive and while much of the work can be completed from the outside, a significant portion would have to be completed on the inside. These include:

- Adding vertical reinforcing to masonry walls (not all but a large portion)
- Connections between masonry walls and roofs and floors
- Drag struts attached to the underside of floors

The exterior upgrades do not directly impact the interior space, but will impact building exits and can be very loud.

Our estimate for the duration of construction is nine months, assuming the building is unoccupied. If the building must remain at least partially occupied, a phasing plan will have to be developed in conjunction with an architect.

Cost Estimate

The Ministry of Education has developed unit rate costs for the retrofit of schools based on past projects. The White Rock City Hall is not unlike a small school building. Based on type of construction and location, we estimate the construction cost for the retrofit to be approximately $1.8 million excluding office rental and moving costs.

A more detailed cost estimate is currently being developed by our Quantity Surveyor, LEC. We will forward their report as soon as it is available.

Seismic Retrofit Discussion

Many building owners are faced with the dilemma as to what is an acceptable level of earthquake risk. We recommend reducing the risk of structural failure down to 2% in 50 years. This is achievable by the life-safety retrofit performance objective in SRG3, and reflected in the retrofit scheme presented in this report. However we recognize that costs to retrofit some buildings are prohibitive, and it often makes sense to relocate or rebuild.

For comparison, the public school system in BC currently has 27% of its schools in high seismic zones rated at the High 1 Risk level. All of these, and any other schools with a PDE rating of 5% in 50 years or greater, will eventually be retrofitted or replaced, but not all at once. The School Seismic Program has been going on for 15 years and will still take many years to complete.

A compromise solution can be to replace the building (often required for reasons not purely seismic) in the future, but in the meantime perform a partial seismic upgrade to significantly reduce the risk without bringing the risk down all the way to 2% in 50 years.

CONCLUSIONS AND RECOMMENDATIONS

The White Rock City Hall is a High Risk (High 1) building as defined by the Seismic Retrofit Guidelines Third Edition (SRG3). Compared to the latest building code (2018 BCBC) it only meets 20% of the required lateral capacity. The predicted level of ground shaking for a 100-year-return-period earthquake could fail the building's seismic-force-resisting system. New buildings are designed to withstand a ground motion with a 2,475-year return period. We highly recommend this building be seismically retrofitted.

The major seismic deficiencies include: a weak and brittle concrete-frame lateral system on the west side of the West Wing and south side of the East Wing, unreinforced masonry "Giant-Brick" walls throughout, weak roof diaphragms, and unbalanced dynamic earth pressures against the existing basement walls.

Our recommended seismic retrofit would achieve the Life-Safety Performance Objective of SRG3 and includes: new buttress shear walls, reinforcement of existing masonry, roof diaphragm upgrades, and retrofitting of the basement walls. Approximate cost of retrofit is $1.8 million (excluding office rental and moving costs). A more detailed costing is being prepared by LEC.

If there is a desire to rebuilt or relocate City Hall, a lesser level upgrade can be developed to provide a reduced risk until such time.

Next steps include: developing a more detailed cost estimate, geotechnical site investigation, hazardous materials investigation, and testing the existing roof decking for side-spiking. These will help further define scope of work. Beyond this, a full consultant team would need to be retained to develop design drawings.

If you have any comments or questions, please contact the undersigned.

Yours truly, Reviewed by,

Tim White, Ph.D., P.Eng.,
Partner

Charlene Hails, P.Eng.
Project Engineer

APPENDIX A
SEISMIC DEFICIENCIES

- SEISMIC DEFICIENCIES PLAN

#1 - Non-ductile moment frames are very weak and brittle
#4 - Lobby roof diaphragm can "pound" into adjacent masonry walls
#2 - Unreinforced masonry walls. All susceptible to out-of-plane failure
#3 - Weak timber roof diaphragms
#5 - Basement walls must be improved to resist dynamic soil forces
MAIN FLOOR PLAN
SCALE : 1/4" = 1'-0"
White Rock City Hall
Seismic Deficiencies Diagram
Bush, Bohlman & Partners LLP
November 10, 2019
CARLBERG JACKSON ASSOCIATES
ARCHITECTS
NEW WESTMINSTER, B.C.
Filename: HALL03
WHITE ROCK CITY HALL
WHITE ROCK B.C.

APPENDIX B
SEISMIC RETROFIT

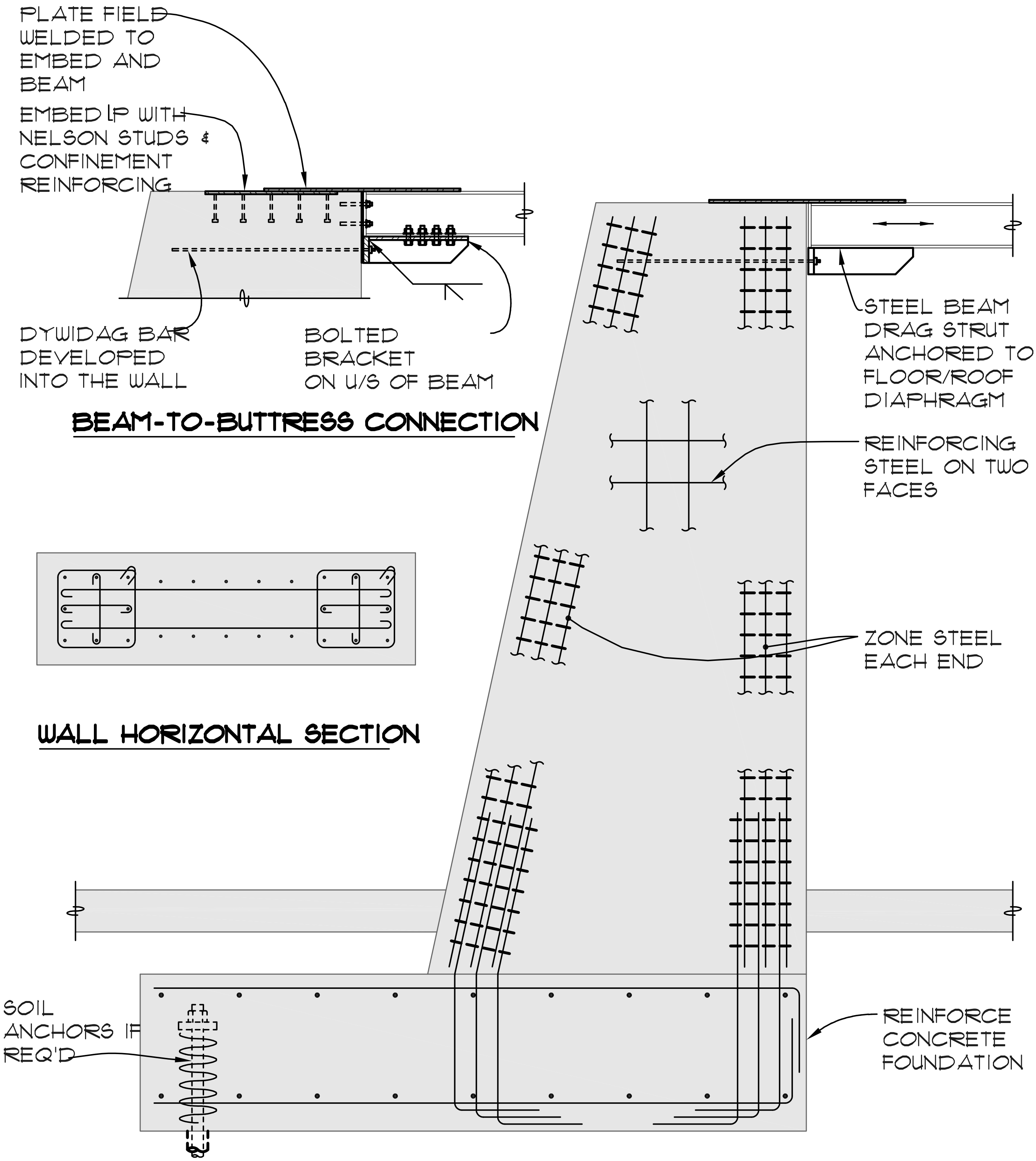
- SEISMIC RETROFIT SCHEME
- TYPICAL SEISMIC RETROFIT DETAILS

DRAFT

White Rock City Hall Seismic Retrofit Scheme

Bush, Bohlman & Partners LLP

November 20, 2019

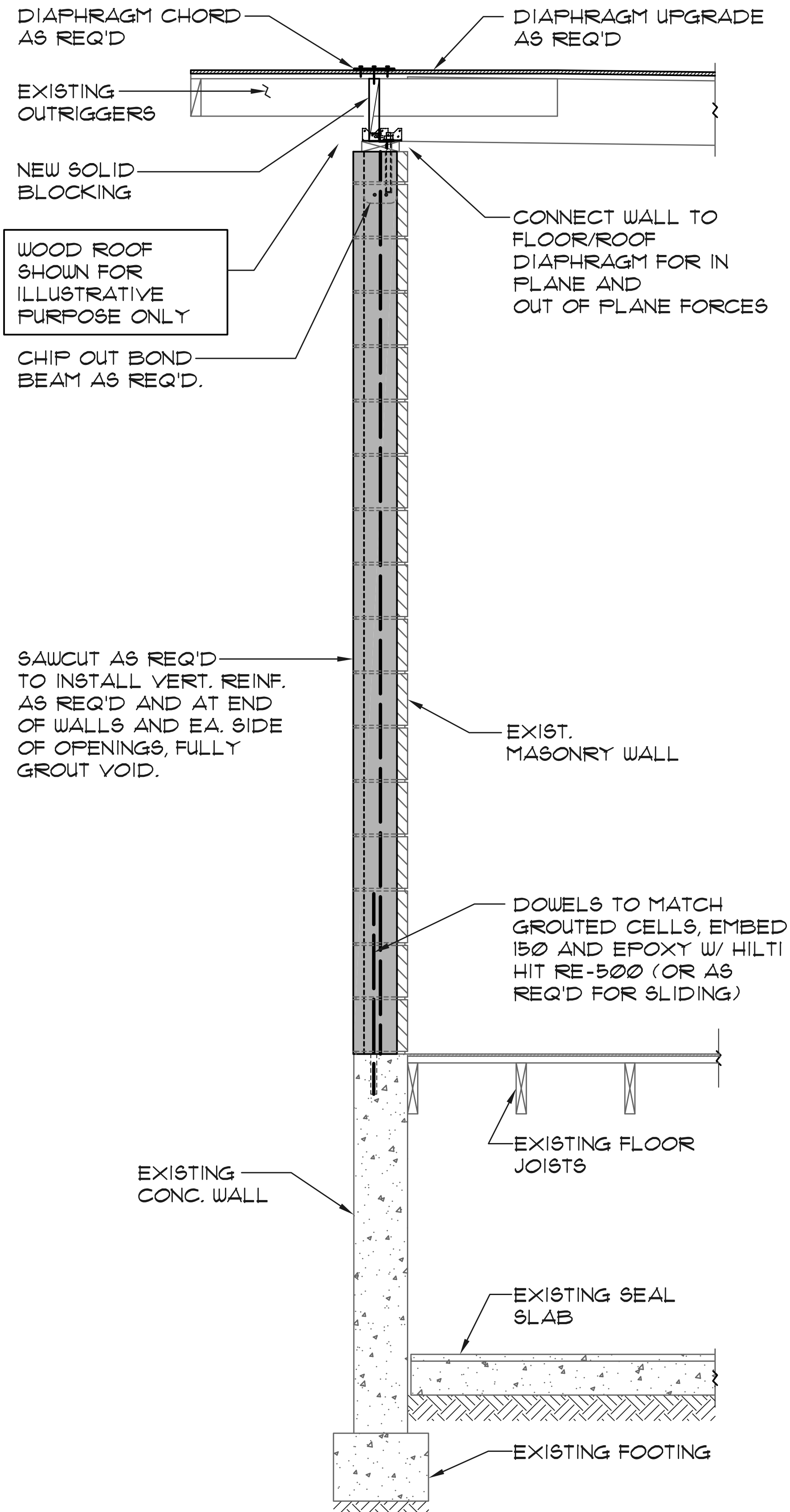


BEAM-TO-BUTTRESS CONNECTION

WALL HORIZONTAL SECTION

EXTERIOR REINFORCED CONCRETE BUTTRESS

SEISMIC RETROFIT GUIDELINES THIRD EDITION LIBRARY OF RETROFIT DETAILS SEPTEMBER, 2016	CONCRETE SHEARWALL #5 EXTERIOR BUTTRESS WALL	SCALE 1:20 SHEET No. CSW #5

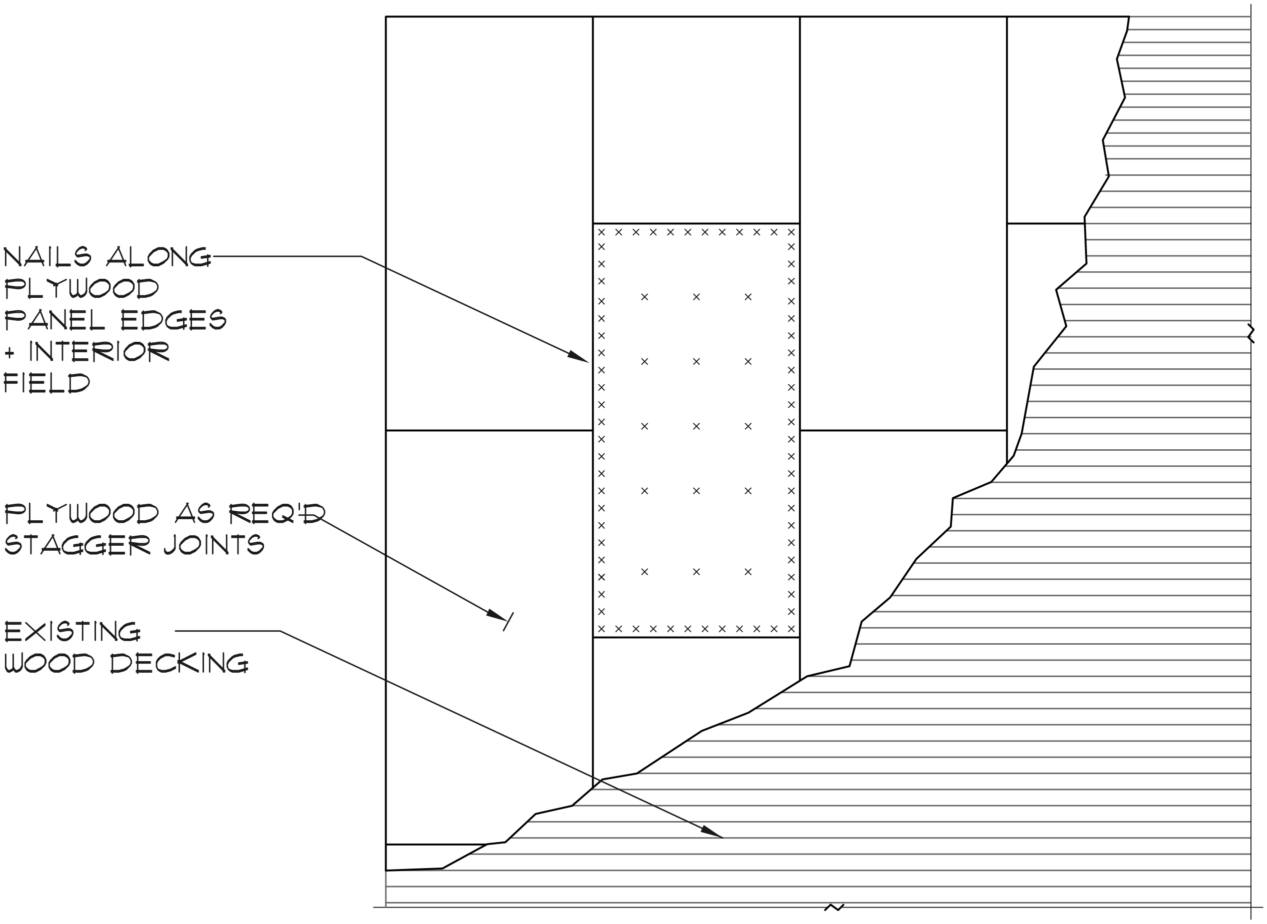


SEISMIC RETROFIT GUIDELINES
THIRD EDITION
LIBRARY OF RETROFIT DETAILS
SEPTEMBER, 2016

MASONRY WALLS #1
ADD VERTICAL REINFORCING TO EXISTING MASONRY

SCALE 1:25

SHEET No. MW #1



NOTES

1. ROOF SHEATHING TO BE NAILED WITH 6d NAILS (3.3mm?). DO NOT USE THIN GAUGE GUN NAILING STAPLES OR NAILS. NOTCHED HEAD NAILS ARE NOT ACCEPTABLE.
2. DO NOT NAIL THROUGH EXISTING JOINTS IN TONGUE AND GROOVE DECKING.
3. STAGGER JOINTS AND ORIENT PLYWOOD PANELS PERPENDICULAR TO DIRECTION OF TONGUE AND GROOVE DECKING.
4. NAIL TO CHORDS, DRAG STRUTS AND SHEAR WALLS

SEISMIC RETROFIT GUIDELINES THIRD EDITION LIBRARY OF RETROFIT DETAILS SEPTEMBER, 2016	WOOD DIAPHRAGM #1 SHEATH EXISTING ROOF WITH NEW PLY AND ADD SHEET METAL STRAPS	SCALE N.T.S SHEET No. WD #1 (1/3)

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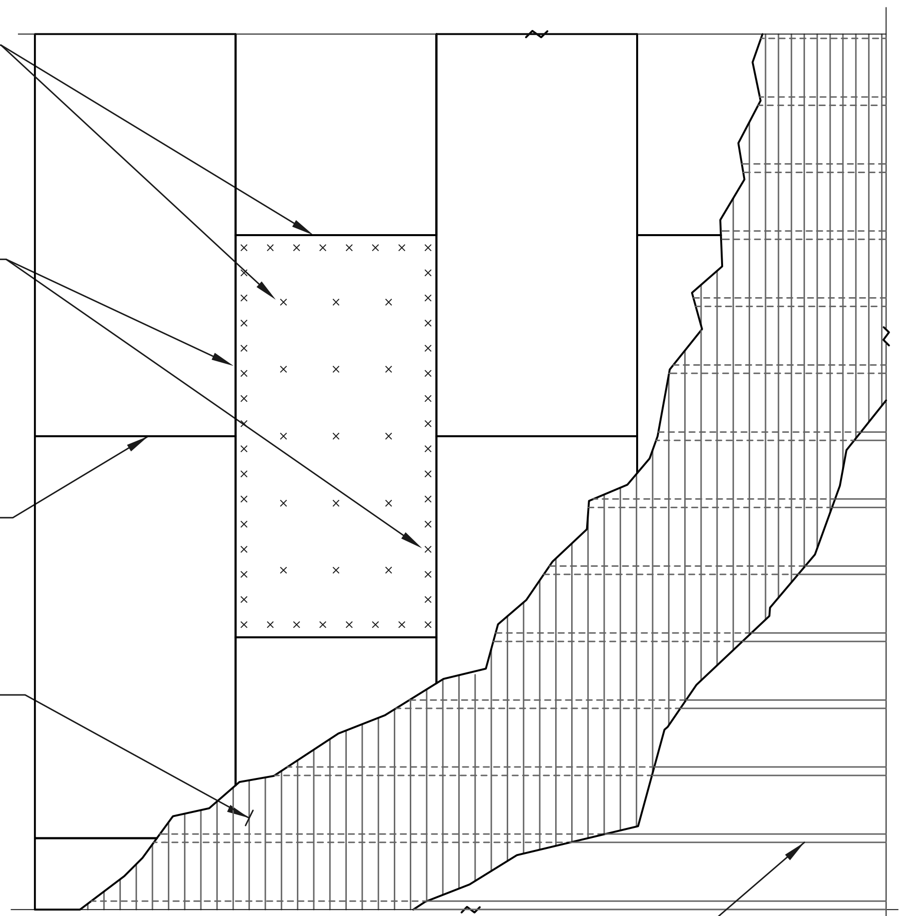
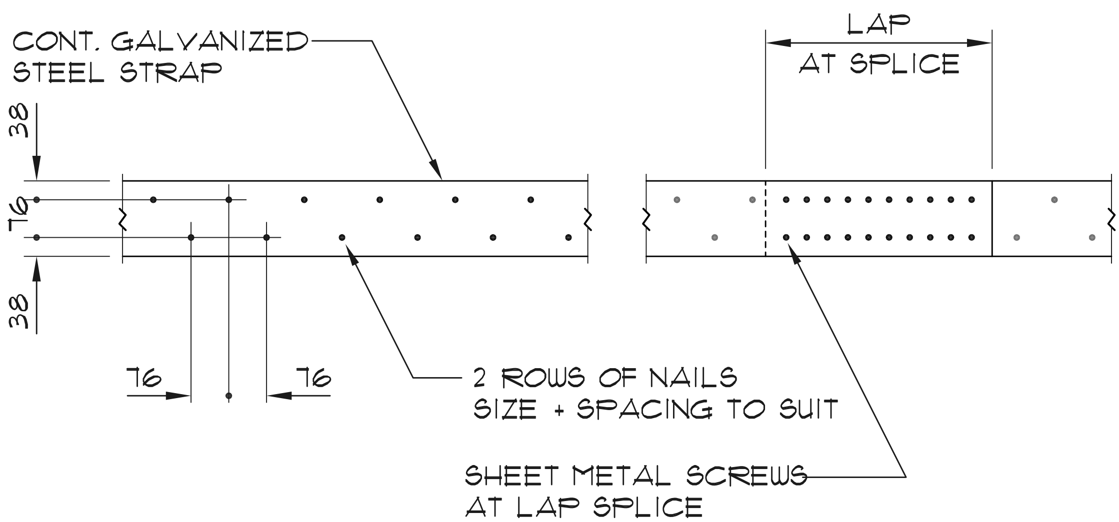


NOTE:

NAILING FOR ILLUSTRATION ONLY, DESIGN TO SUIT SPECIFIC REQMT'S

SEE SHT 1/3 FOR ADDITIONAL NOTES

SEISMIC RETROFIT GUIDELINES THIRD EDITION LIBRARY OF RETROFIT DETAILS SEPTEMBER, 2016	WOOD DIAPHRAGM #1 SHEATH EXISTING ROOF WITH NEW PLY AND ADD SHEET METAL STRAPS	SCALE N.T.S SHEET No. WD #1 (2/3)



NOTES

1. CONTINUOUS GAUGE STEEL STRAP TO BE CENTRED OVER WALLS OR BLOCKI
2. FASTEN TO PLYWOOD SHEATHING WITH 2 ROWS OF NAILS AND SPLICE AS PER DETAILS.

SEISMIC RETROFIT GUIDELINES THIRD EDITION LIBRARY OF RETROFIT DETAILS SEPTEMBER, 2016	WOOD DIAPHRAGM #1 SHEATH EXISTING ROOF WITH NEW PLY AND ADD SHEET METAL STRAPS	SCALE N.T.S SHEET No. WD #1 (3/3)

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DESIGNER TW

CHECKED BY

BUSH, BOHLMAN & PARTNERS LLP
CONSULTING ENGINEERS

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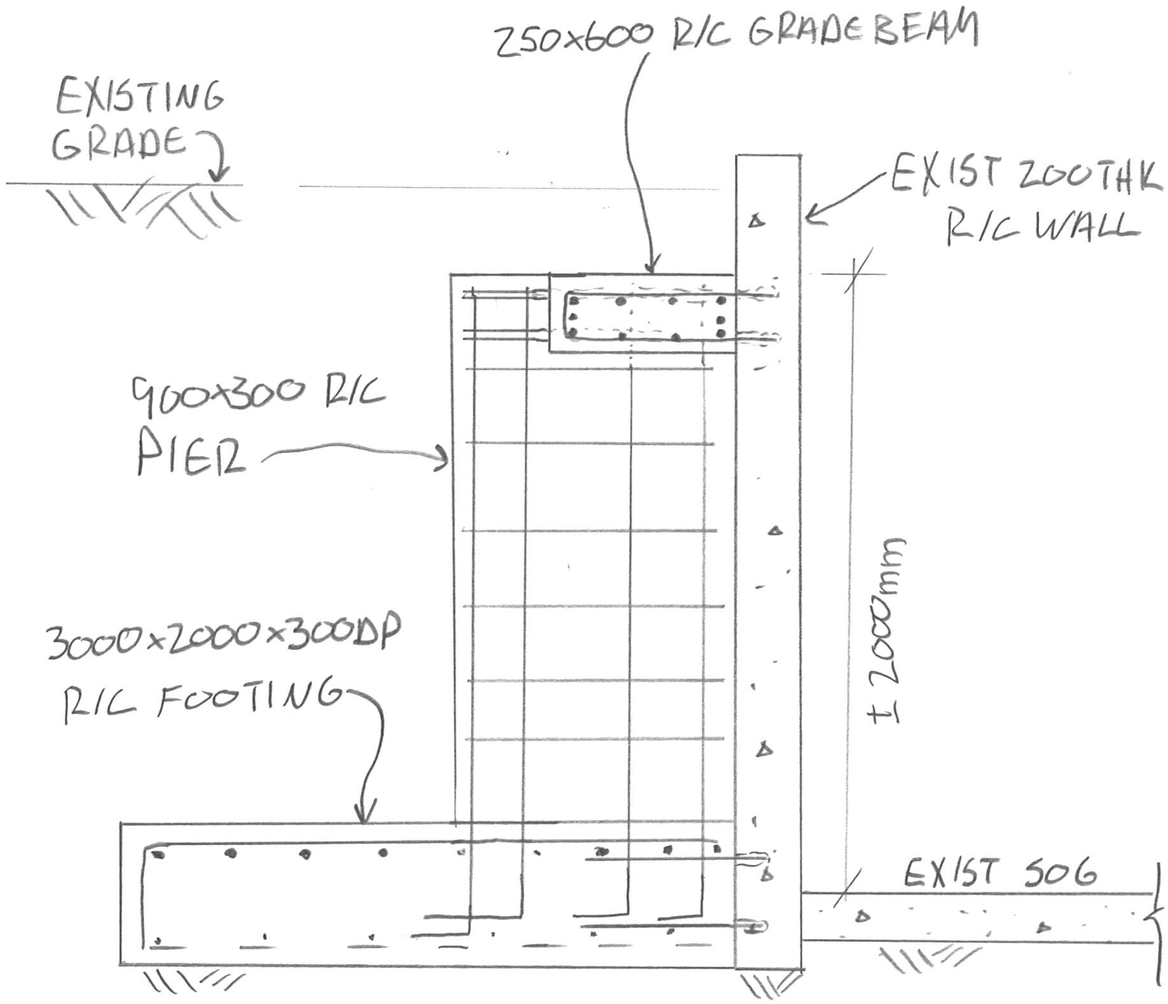
DATE Nov 20, 2019

PROJECT NO. 7756



WHITE ROCK CITY HALL - SEISMIC STUDY

BASEMENT WALL UPGRADES NTS

SSK-1

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Appendix B – Present Value of Renting Commercial Office Space

The growing annuity formula as follows:

$$PV = C \times \frac{1 - \left(\frac{1+g}{1+r}\right)^n}{r-g}$$

Where PV = Present Value, C = annual rent, g = % of annual rent increase, r = the discount value, and n = the term of the rental.

The term of the rental, n, is 50 years because the design useful life of a typical civic building is 50 years, without major renovation. The discount value, r, is provided as a range between 0.5% and 2.0%, based on the City's investment rate of return and the City's interest rate for loans. The annual rent increase is provided as a range between 2.5% and 4.0%. The Province of BC does not regulate commercial rental increases. These rates are determined at the time of the agreement.

The following figures show the present value of renting 32,067 sq.ft of commercial space relative to rent, growth rate of rent, and interest rate.

Figure 1: Present Value of Commercial Property at $14/sq.ft

Rent	$ 14.00	per sq.ft		
Area	32067	sq.ft		
C	$ 448,938			
n	50	years		

r	g			
	2.5%	3.0%	3.5%	4.0%
0.5%	$ 37,676,918	$ 43,391,059	$ 50,165,166	$ 58,209,805
1.0%	$ 32,619,702	$ 37,387,221	$ 43,023,567	$ 49,699,523
1.5%	$ 28,401,736	$ 32,394,644	$ 37,101,727	$ 42,661,821
2.0%	$ 24,869,524	$ 28,226,677	$ 32,172,575	$ 36,820,346

Figure 2: Present Value of Commercial Property at $30/sq.ft

Rent	$ 30.00	per sq.ft		
Area	32067	sq.ft		
C	$ 962,010			
n	50	years		

r	g			
	2.5%	3.0%	3.5%	4.0%
0.5%	$ 80,736,253	$ 92,980,840	$ 107,496,783	$ 124,735,297
1.0%	$ 69,899,361	$ 80,115,474	$ 92,193,357	$ 106,498,977
1.5%	$ 60,860,863	$ 69,417,094	$ 79,503,700	$ 91,418,188
2.0%	$ 53,291,838	$ 60,485,736	$ 68,941,231	$ 78,900,742