

**Seismic Risk Assessment**

**REPORT NO. SRA-61-03**

**for**

**BLOCK #60-3 (SOUTH CLASSROOM WING)**

**RICHMOND ELEMENTARY SCHOOL**

**2780 Richmond Road  
Victoria, BC  
V8R 4T4**

**Facility No: 6161060**

**School District No. 61  
Greater Victoria School District**

**Structural Engineering Guidelines for the  
Performance-based Seismic Assessment and Retrofit of  
Low-rise British Columbia School**

This Seismic Risk Assessment (SRA) report is the report that documents the seismic risk posed by a potentially high risk school block.

The Ministry of Education requires that a School District submit a SRA for any school block as the first due diligence step in support of the District's request that the given block be added to the list of high risk school blocks in the province.

The Engineers and Geoscientists British Columbia (EGBC) was requested by the Ministry of Education to develop the format and technical requirements for the SRA.

From a structural engineering perspective, the SRA for a high risk block is the first step toward starting a Seismic Project Identification Report (SPIR) that will document seismic retrofit options for the seismically deficient school block.

On-going feedback from engineering practitioners is encouraged to advance future enhancements of the SRA document.

<b>Table 1.1: Seismic Risk Assessment Summary</b>		
<b>No.</b>	<b>Technical Topic</b>	<b>Summary</b>
1	School Name and School District	<ul style="list-style-type: none"> <li>Richmond Elementary</li> <li>Greater Victoria School District (SD #61)</li> </ul>
2	Block No. / Name	<ul style="list-style-type: none"> <li>Block #60-3</li> <li>South Classroom Wing</li> </ul>
3	Engineer-of-Record Structural Firm	<ul style="list-style-type: none"> <li>Graham Taylor</li> <li>TBG Seismic Consultants</li> </ul>
4	Technical Reference	<ul style="list-style-type: none"> <li>Seismic Retrofit Guidelines 3<sup>rd</sup> Edition (June, 2017)</li> </ul>
5	Year Built, Number of Storeys, Clear Storey Height, Floor Area	<ul style="list-style-type: none"> <li>1971</li> <li>1 Storey</li> <li>3770 mm</li> <li>540 m<sup>2</sup></li> </ul>
6	Type of Construction	<ul style="list-style-type: none"> <li>#33 (lightly reinforced masonry with wood roof)</li> </ul>
7	Soil Type	<ul style="list-style-type: none"> <li>Site Class E</li> </ul>
8	Previous Seismic Upgrade	<ul style="list-style-type: none"> <li>None</li> </ul>
9	Liquefaction Potential	<ul style="list-style-type: none"> <li>Low risk</li> </ul>
10	Post-earthquake Maximum Sa(1.0)	<ul style="list-style-type: none"> <li>10 %g (subduction)</li> </ul>
11	PPR Thresholds (subduction)	<ul style="list-style-type: none"> <li>14 %g (green / yellow)</li> <li>42 %g (yellow / red)</li> </ul>
12	Risk	<ul style="list-style-type: none"> <li>H1 (High Level 1)</li> </ul>

(Professional Seal and Signature)  
Date



**Figure 2.1: East Elevation  
Block #60-3  
South Classroom Wing  
Richmond Elementary School**

## INTRODUCTION

This chapter details the engineering analysis that generated the seismic risk classification (H1) given on the summary page (page 1-1).

## BLOCK DESCRIPTION

A typical cross-section for the South Classroom Wing (Block #60-3) is given in Figure 3.1. A description of the significant structural elements of this block is as follows:

**Type of Construction:** Block #60-3 is comprised primarily of reinforced concrete masonry walls.

**Year of Construction:** This block was constructed in 1971.

**Storey Height:** The vertical height from the top of the floor to the top of the roof is 3770 mm.

**VLS:** The VLS is comprised on reinforced concrete masonry exterior walls and steel stud walls along the main corridor.

**Partition Walls:** In several non-classroom rooms, the partition walls are constructed of unreinforced concrete masonry walls 140 mm thick.

**Lateral System:** The primary lateral deformation resisting system in the north / south direction is comprised of the reinforced concrete masonry walls. For east / west shaking, the north end of Block #60-3 is connected to Block #60-1 (Central Classrooms).

**Roof Diaphragm:** The roof diaphragm is comprised of steel metal deck. The steel deck is considered a non-governing element in the analysis of this block.

## CONNECTION TO BLOCK #60-1 – GOVERNING ELEMENT

The north end of Block #60-3 has no east / west lateral system. East / west resistance at the north end is provided by connections to Block #60-1 as illustrated in Figure 3.2.

Block #60-1 has been assigned a “H1 – High Level 1” Retrofit Priority Ranking. Given that the north end of Block #60-3 is totally dependent on Block #60-1, Block #60-3 has been assigned the same “H1 – High Level 1” ranking.

## REINFORCED MASONRY – NORTH / SOUTH SHAKING

The exterior reinforced concrete masonry walls act as rocking elements between windows for north / south shaking. These walls were analyzed using the data given in Table 3.1. Using Analyzer Version 3.0, the Retrofit Priority Ranking for the in-plane behaviour of the reinforced masonry walls was determined to be “Medium”. The post-earthquake evaluation data for the in-plane behaviour of the reinforced masonry walls is given in Table 3.2.

## SOILS

Block #60-3 is founded on Site Class E soils (soft soils). The soil type is a crucial consideration in the overall assessment of the life safety risk posed by this block.

**POST-EARTHQUAKE EVALUATION**

The ground motion rating results for use in the post-earthquake evaluation of Block #60-3 are given in Table 3.2. Some comments on the values in Table 3.2 are as follows:

**Governing Hazard Type:** The subduction hazard is the governing earthquake hazard type for this block. The maximum ground motion for this block is lowest for the subduction hazard. The subduction hazard has the largest numerical value for the deaggregated ground motion that has a 2% probability of exceedance in 50 years.

**Sa(1.0):** All numerical values given in Table 3.2 are deaggregated spectral acceleration Sa(1.0) values (%g units) for the subduction hazard.

**PPR Thresholds:** The green / yellow PPR threshold value in Table 3.2 is for a drift limit of 1% and CPDE  $\leq$  50%. The yellow / red PPR threshold in Table 3.2 is for a drift limit of 5% and CPDE  $\leq$  50%.

**RISK SUMMARY**

The risk ranking for the South Classroom Wing (Block #60-3) is summarized as follows:

**Risk:** Block #60-3 has been assigned a “H1 – High Level 1” Priority Retrofit Ranking because the north end of this block is dependent on the performance of Block #60-1 (also as H1 high risk block).

**Exterior Masonry Walls:** The exterior reinforced concrete masonry walls have been assigned a Medium risk.

**Soils:** The soft soils exacerbate the shortcomings of the deficient block elements.

<b>Table 3.1: Analysis Data for In-Plane Rocking of Exterior Reinforced Concrete Masonry Walls</b>		
<b>No.</b>	<b>Data Description</b>	<b>Value</b>
1	SRG3 prototype	R-1
2	$R_m$	30 % $W_s$
3	Wall height	3770 mm
4	Drift limit	5 %

<b>Table 3.2: Post-earthquake Evaluation Data for In-Plane Behaviour of Reinforced Concrete Masonry</b>	
<b>Data Description</b>	<b>Maximum <math>S_a(1.0)</math> Value</b>
Post-earthquake Engineering Assessment	10 %g
PPR Green / Yellow Threshold	14 %g
PPR Yellow / Red Threshold	42 %g

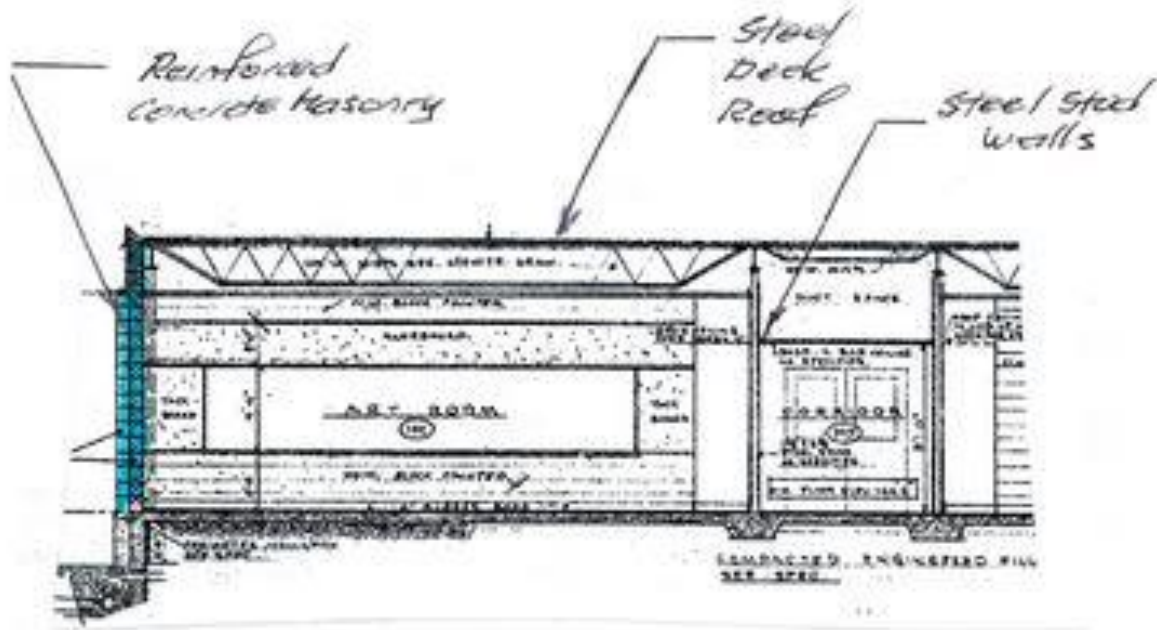


Figure 3.1: Typical Section  
Block #60-3  
South Classroom Wing  
Richmond Elementary School



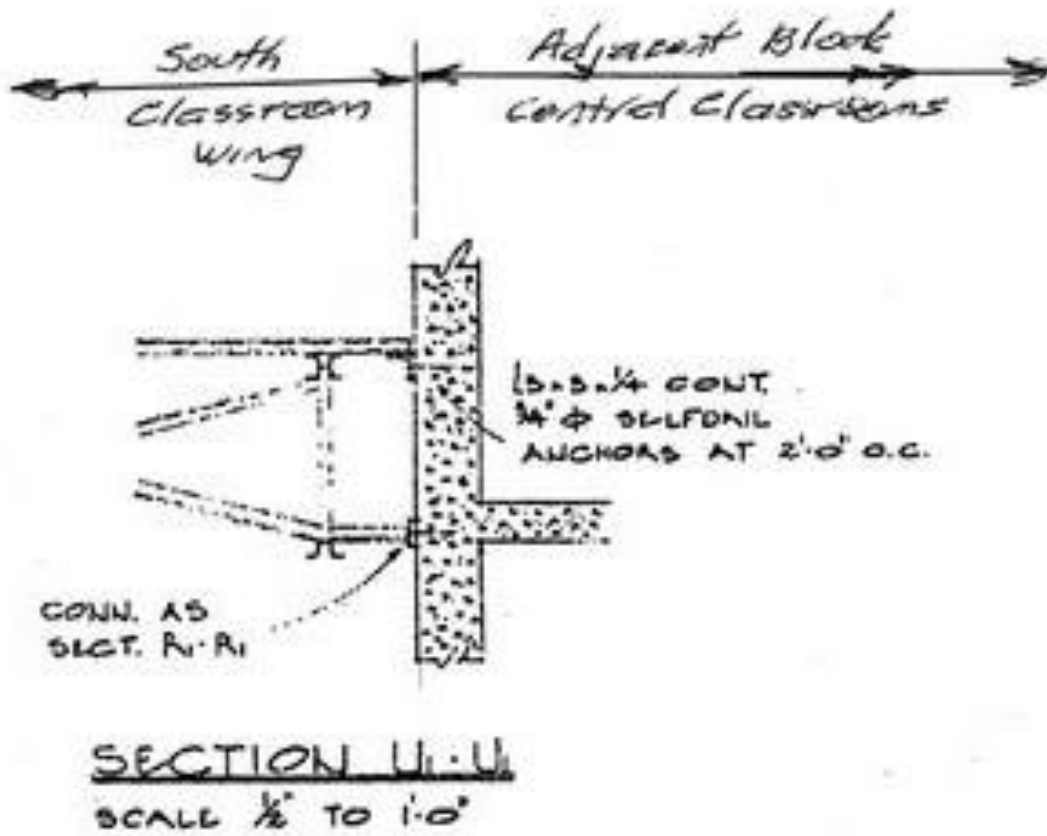


Figure 3.2 Roof Connection to Adjacent Block  
Block #60-3  
South Classroom Wing  
Richmond Elementary School