



Engineers

July 21, 2023

Allan Wasal,
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Dear Allan Wasal,

RE: Balcony Investigation

RJC No. VAN.103256.0015

Bellevue Tower West

195 21st Street, West Vancouver, BC V7V 4A4

As requested by Hollyburn Properties Ltd., Read Jones Christoffersen Ltd. (RJC) has prepared this Structural Condition Assessment of the concrete balcony guards for the above-noted building.

1.0 Introduction

The existing concrete upstand walls/guards at the balconies on the building are showing signs of deterioration, especially at the upstand-to-slab connection. RJC was engaged to conduct a comprehensive survey and a limited scope structural condition assessment of the balcony upstands to inform future repairs or replacements.

A Limited Scope Assessment is typically conducted for a specific area of a building when there is a known structural concern as outlined in the Engineers and Geoscientists British Columbia Practice Guideline for "Structural Condition Assessment of Existing Buildings" RJC's scope of Limited assessment included the following:

- Review of record documents.
- Balcony Upstand Connection Review:
 - Visually review signs of structural damage, deterioration, distress or deformations at the balcony upstand-to-slab connection.
- Concrete Deterioration Survey:
 - Perform a visual review and hammer sounding at balconies surfaces to measure and map concrete deterioration.

2.0 Building and Structural Description

The building is located at 195 21st St in West Vancouver, BC. It is bound to the north by Bellevue Avenue, to the east by 21st street, to the south by Argyle Avenue, and to the west by a back alley. See Figure 1.



Figure 1: Aerial view of the building site (Google 2023)

The building is a 16-storey residential building with two levels of underground parking. The structure was constructed of reinforced concrete slabs, walls and columns circa 1970. Except for the first level, which has six balconies, the building has eight balconies per level for a total of 126 balconies.

The balconies' guards are constructed on two sides with independent precast upstand concrete walls connected to the slab. The third side of each balcony is constrained by a full-height concrete divider wall. The approximate plan dimensions of the cantilevered balcony slab are 5'-0" x 19'-0". The precast upstand walls are 4 in +/- thick and 32 in +/- tall. An aluminum railing connected to the upper portion of the upstand forms the remaining height of the guard. Refer to Figure 2 for an overview of the balcony dimensions.

As noted in the base building structural drawings by Read Jones Christoffersen, dated 1970, and issued for construction, the second-floor balconies are supposed to be constructed of a cast-in-place slab and upstand wall. No balcony detail is shown for the typical floor layout. The balconies' connection shop drawings were not

available to RJC for review. The connections are observed to be constructed of embedded steel plates and angles connected through welds. See Figure 3.



Figure 2: Overview of balcony dimensions

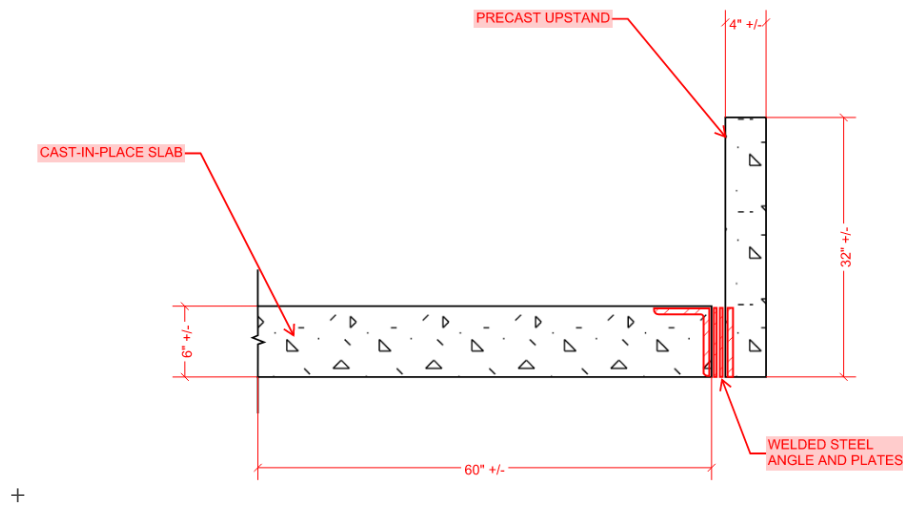




Figure 3: Observed upstand/slab connection detail



3.0 Observations

RJC attended the site on May 23 and 24, 2023 with the client’s representatives who provided access to all units in the building. The observations have been compiled into separate sections below to summarize the typical signs of deterioration noted during our review. For a condition summary and inventory of upstand wall/slab connection see Section 5. A summary of our observations are as follows:



3.1 Top Surface Connection Deterioration

Table 1: Top Surface Connection Deterioration	
Observations	Photograph
<p>At localized connections, the topping has spalled partially or completely as noted in Photos 1 and 2, respectively. Where this condition was noted, the steel connection plates presented significant surface rust and potential cross-section loss, see Photo 2.</p> <p>Many locations were observed to have previous topping repairs at the upstand walls/slab.</p> <p>During our review we noted a consistent hollow sound around the connections indicating either a poor topping repair application or steel plate deterioration.</p>	 <p>Photo 1: Spalled concrete at upstand wall/slab connection</p>  <p>Photo 2: Exposed steel plate connection with visible signs of major surface rust and cross-section loss</p>

3.2 Soffit Connection Deterioration

Table 2: Soffit Connection Deterioration	
Observations	Photograph
<p>Concrete spalling was observed at the soffit of concrete slabs and underneath the embedded steel connections. In general, the majority of steel plates and observed welds presented significant surface rust.</p> <p>At localized connections, the large extent of rebar and steel plate connection deterioration has resulted in a significant loss of concrete leading to a poor embedment of the steel plate connections, see Photo 3. The welds connecting the steel plates presented visible signs of cross-section loss.</p>	 <p>Photo 3: Spalled concrete at upstand wall/slab connection. Slab soffit presents reinforcement with visible cross-section loss</p>  <p>Photo 4: Poor steel plate embedment due to major spalled concrete</p>

3.3 Balcony Slabs and Walls Concrete Survey

Table 3: Slabs And Walls Concrete Deterioration Observations	
Description	Photograph
<p>Localized top surface delamination was observed during our hammer sounding review. Spalled concrete due to rebar corrosion was observed as noted in Photo 5.</p> <p>The concrete survey at the precast upstand walls showed that the walls are generally in good condition with only minor vertical concrete delaminations.</p>	 <p>Photo 5: Spalled concrete at balcony top surface</p>  <p>Photo 6: Minor vertical delamination at upstand wall</p>



4.0 Remediation Options

We understand Hollyburn would like to pursue balcony remediation due to the poor condition of the precast upstand walls and their connection to the slab. RJC and Hollyburn discussed the feasibility of two different options: a) repair the existing upstand walls, slabs and connections, and b) install new aluminum and glass guardrails. The following is a summary of each option.

4.1 Option A: Repair Existing Conditions

This option includes connection repairs ranging from minor repairs to major repairs and full connection replacement, where required, due to the extent of the deterioration. This option would also include localized structural concrete repairs at balconies slabs and upstand walls.

A typical minor repair would include a concrete repair around the connection: chipping the loose concrete around the connections, wire brushing and cleaning the steel plates and welds to remove surface rust, and patching with new concrete. This is for connections where the plates and welds present minor or negligible surface rust only and minor concrete deterioration.

When the concrete deterioration is more significant and the weld at the connection plates has been compromised, a major repair would be necessary. In addition to the minor repair requirements, a major connection repair would include new welding between the embedded steel plates to retrofit the connection and a greater extent of concrete repair.

When the connection is observed to have significant cross-section loss in the embedded plates, and reduction in the structural capacity of the existing welds, a full connection replacement would be warranted. In this condition, the connection plates and welds would be replaced and reinstalled and a significant area of concrete repairs would be carried out.

It is important to note that Option A will require ongoing maintenance and possible future connection repairs as the current inadequate waterproofing will likely continue to lead to deterioration of the connections.

4.2 Option B: Install New Guardrails

An alternative to the repair strategy discussed above is to demolish the existing precast upstand walls and install new aluminum and glass guardrails. This option would include localized structural concrete repairs at balconies slabs and the installation of a new railing system connected to the slab.



5.0 Discussion, Recommendations and Opinions of Probable Cost

Overall, the connections of the precast upstand walls appear to be generally in fair-poor condition with consistent observations of spalled concrete and steel corrosion. If left without repair, continued deterioration will result in further steel plate cross-section and embedment loss compromising the structural integrity of the balcony guards. For a condition summary and inventory of upstand wall/slab connection, see Section 5.1

Based on our observations, the balconies do not have a separate drainage system, and therefore direct any water to the edge of the slab where it meets the upstand wall. Without an adequate waterproofing system, the welded connections were continually exposed to water which has led to the deterioration observed on site.

The concrete repairs survey was performed by hammer sounding the precast walls and cast-in-place slabs of each balcony. When debonded concrete is encountered, the pitch of the sound changes and a 'hollow' sound is heard. Our survey noted that the top surface, soffit, and inner face upstand walls are generally in good condition with minor areas of localized concrete delamination. The results of the concrete survey are presented in Section 5.2. Based on our experience in the repair and rehabilitation of deteriorated concrete structures, the actual repair areas will be slightly larger than what was identified in the survey. In order to account for corrosion of embedded reinforcing steel extending into otherwise undamaged adjacent concrete, a "growth" is accounted for in the development of our opinion of probable costs of Section 5.3 to undertake repairs.

5.1 Connection Visual Review Summary

The visual connection review included a total of 882 connections to observe evidence of deterioration including cross-section loss at steel plates, loss-of-weld capacity, and deteriorated and spalled concrete. 39 connections were not accessible for review due to concealed conditions and finishes observed at the balconies. A summary of the visual observations and photographs are included in Table 1 and 2. Table 4 is a connection condition summary.

Table 4: Connection Condition Summary					
Not Accessible	Good	Minor Repair	Major Repair	Replacement Required	Total
39	87	528	158	70	882



5.2 Concrete Deterioration Survey

The concrete deterioration survey included slab-top surface, soffits, and inner face of upstand walls. Table 5 shows a summary of the as measured and “growth” areas.

Table 5: Concrete Deterioration Survey Summary			
Concrete Repair	Suites with Visible Deterioration	As Measured Area (sq.ft.)	Growth Repair Area (sq.ft.)
Top Surface	30	200	300
Soffit	6	15	30
Walls	54	100	200

5.3 Recommendations

Based on the above, we recommend the following:

- Complete localized concrete repairs to the balcony slabs.
- All concrete upstand walls and slab soffits should be scaled to remove any loose or spalled concrete.
- Undertake a repair project to the existing upstands and their connections or replace the existing upstand walls with new guardrails. **We recommend that this work be commenced within the next year.** If new guardrails are selected as the option to move forward, this work may require a development permit and the involvement of an architect.
- Tenants should be advised that heavy objects should not lean or rest on the precast concrete upstand walls.
- Consider restricting the number of people who can be on the balcony at any time.

5.4 Opinion of Probable Costs

The following Opinion of Probable Costs for repairs should be treated as “order of magnitude” estimates based on conceptual designs derived from the limited information obtained during this condition assessment. The costs are based on the present extent of deterioration and bulk unit rates for similar work completed within the last five years and are intended for planning purposes. Item S1.6 and S1.7 are separate items, not required for the structural repairs/replacement, but strongly suggested to extend the service life of either Option A or B. A value of 15% of the construction cost is included to cover general requirements such as permits, engineering fees, testing etc. GST is not included in the values provided. RJC recommends including a 30% contingency which is included in table.

RJC’s Opinion of Probable Costs are presented in Table 6 below.



Table 6: Remediation Options					
	Lump Sum Price Items			Repairs	New Guardrails
1.2	Scaffolding and Site Access			\$ 470,000	\$ 310,000
1.3	Selective Demolition of Existing Balcony Parapets, Brick walls, etc.			\$ -	\$ 170,000
1.4	Shoring			\$ 60,000	\$ -
1.5	Balcony Railings			\$ -	\$ 660,000
S1.6	Balcony/Pedestrian Deck Coating			\$ 600,000	\$ 600,000
S1.7	Painting (including misc. flashing, balcony slab painting etc. as required)			\$ 90,000	\$ 60,000
	Lump Items Net Subtotal (No GST)			\$ 1,220,000	\$1,800,000
	Unit Price Items	Estimated Quantity	Unit Rate		
2.1	Minor Connection Repair (ea)	528	\$ 680	\$ 360,000	\$ -
2.2	Major Connection Repair (ea)	158	\$ 1,330	\$ 210,000	\$ -
2.3	Connection Replacement (ea)	70	\$ 1,780	\$ 120,000	\$ -
2.4	Top Surface Concrete Repairs (sq.ft)	197	\$ 90	\$ -	\$ 20,000
2.5	Top Surface and Vertical Concrete Repairs	360	\$ 90	\$ 30,000	\$ -
	Unit Items Net Subtotal (No GST)			\$ 720,000	\$ 20,000
T.1	Total (1.2 to 2.5)			\$ 1,940,000	\$ 1,820,000
1.1	15% for General Requirements			\$ 290,000	\$ 270,000
T.2	Net Total			\$ 2,230,000	\$ 2,090,000
T.3	Net Total +30% Contingency			\$ 2,900,000	\$ 2,700,000
	Estimated Construction Duration			1 year	8 months

RJC has not performed a code compliance review for the building or reviewed the connections for gravity and seismic design consideration as it was beyond the scope of this assessment. Given the age of the building and connections, it is reasonable to assume that this building will have significant shortcomings with respect to the current building code requirements for seismic design.



6.0 Limits of Commission

Our opinion cannot be extended to portions of the site that were not reviewed or situations reasonably beyond the control of RJC. If unexpected conditions are encountered at the site, RJC must be notified in order that we may determine if modifications to the conclusions presented here are necessary. Any conclusions or recommendations presented in this report were determined from the limited information available.

This report has been prepared in accordance with generally accepted engineering practices. No other warranties, expressed or implied, are made as to the professional services provided under the terms of our contract and included in this report. A detailed review of the structural system, including seismic restraint, was not included in the scope of work.

Hollyburn Properties Ltd. recognizes that special risks occur whenever engineering or related disciplines are applied to identify hidden elements or portions of a building. Even a comprehensive sampling and testing program, implemented with the appropriate equipment and experienced personnel, under the direction of a trained professional who functions in accordance with a professional standard of practice, may fail to detect certain conditions. This is because these conditions are hidden and therefore cannot be considered in the development recommendation. For similar reasons, actual conditions that the design professional properly inferred to exist between examined conditions may differ significantly from those that actually exist.

RJC prepared this report for the use of Hollyburn Properties Ltd.. The material in it reflects RJC's judgement in light of information available to RJC at the time of preparation. Any use that a third party makes of this report, or any reliance or decisions to be based on it, is the responsibility of such third parties. RJC accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.



7.0 Closing

We trust this meets your requirements at this time. If you wish to discuss any of the above, please call the undersigned.

Yours truly,

READ JONES CHRISTOFFERSEN LTD.
EGBC Permit to Practice No. 1002503

Reviewed by:

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