



July 8, 2020

Our Reference: 32294

City of Greenwood
City of Greenwood
Greenwood, BC

Attention: Wendy Higashi

Reference: City of Greenwood Fire Hall – Structural Review Memorandum

Thank you for your request for engineering services on the above noted project. Based on our discussions, site review and information received to date, we are pleased to submit the following report and recommendations.

Our office conducted a field review on June 11, 2020, with Richard Collumbine and Sean Annan from ISL Engineering and Land Services Ltd. (ISL) and Wendy Higashi and Randy Uyeyama from City of Greenwood (CoG) in attendance.

1.0 Scope of Work

The scope of work request by the CoG was for ISL to undertake a cursory review of the building to identify its structural condition and comment on their appropriateness for continued use and determine further investigation if warranted. No design or material testing was performed by this office.

1.1 Reference Documents

No existing documents for the were made available for review.

2.0 Site Description

The building is located at 201 S Government Street, Greenwood, BC. It is a three-story building including a partial basement. Due to the slope of the site, access to the front of the building along South Government Street (East side) is at main floor level and the rear of the building (West side) is accessed at basement level. There is a steel fire escape structure at the rear of the building allowing exit from the second floor of the building.



Photo 1: Front and rear of the building

The building is currently occupied by multiple groups including:

- Fire Department
- Ambulance Service
- Public Works

The fire department and ambulance service have a single vehicle each parked inside the building.

3.0 Post Disaster Building

The National Building Code (NBC) defines emergency response facilities, fire stations and housing for such vehicles as a post disaster building unless exempted by the authority having jurisdiction. Post disaster buildings are classified as buildings that are essential to the provision of services in the event of a disaster. They are designed to more rigorous loading criteria than a “normal” importance building and this results in higher safety factors being applied to the various loading conditions as shown below. From this definition, the Fire Hall is classified as a post disaster building.

4.0 Site Review Observations

4.1 Roof Structure

The roof structure was not reviewed during this site visit, however, a cut piece of roof truss was noted in a storage room on the main floor of the building.



Photo 2: Cut roof truss on main floor

4.2 Second Floor

The second floor is mixed use and comprises of offices, a meeting room, storage and a room currently being renovated to provide accommodation for a firefighter. It was noted that the second floor is generally uneven, with varying height gaps between the floor and doors. This unevenness was especially evident in the room being prepared for the firefighter accomodation.

A metal fire escape is present to the rear of the building and is constructed from steel HSS, channel and angle members in a series of stairs and landings. The connection of the steel structure to the building and foundation is unknown.



Photo 3: Stair access and flooring at second floor

4.3 Main Floor

The main floor houses a fire truck, an ambulance, an office area for the ambulance and storage areas. These areas are described in further detail below:

Fire Truck Area

The fire truck bears onto an assumed cast in place concrete slab bearing on grade. Randy (CoR) described that a beam had been cut in the ceiling of the firehall to allow access for the fire truck which was too tall to pass under the beam in the building. During the site visit, Randy was unable to locate the cut beam. A heavy timber post and spreader beam indicated that building modification likely occurred in this room and that the floor above was shored .

Rear Storage Areas

There are storage rooms to the rear of the building and these areas also have exposed post and beam structures installed indicated a modification and shoring at some point in the past. The storage room adjacent the fire truck had a timber post and beam installed and the ceiling deflections was evident in the ceiling tiles. The storage room behind the ambulance also had two sets of posts and beams installed to support the floor above. In all cases the posts bear onto timber lagging to spread the column point loads onto the main floor system.



Photo 4: Post and beam propping with floor deflection evident in ceiling tiles

Ambulance Service

The ambulance vehicle is parked within the building on a timber suspended floor. A hatch in the main floor allowed access to a crawlspace. The main floor under the ambulance appeared to be comprised of plywood sheathing over timber joists over timber beams and posts. It appeared that some of the posts bear directly onto rock. It is unknown if this floor is designed for the ambulance GVWR of ~5.9 Tonnes. Water staining was evident on the floor sheathing around the footprint of the ambulance likely from parking the vehicle when wet.



Photo 5: Water staining on sheathing around the ambulance

4.4 Basement and Foundations

The perimeter foundations to the building appear to be constructed of pointed stone walls. From this initial building review, there appear to be three different basement/foundation conditions:

1. The SE corner of the building housing the fire truck appears to be concrete slab on grade with no crawlspace/basement.
2. The NE corner of the building housing the ambulance is timber floor with crawlspace beneath.
3. The west side of the building has a walk-out basement.

The stone foundation wall between the west and east side of the building is a retaining wall. This wall is currently retaining the ground and the live load of the fire truck and partial ambulance loading.



Photo 6: Basement at west side

4.5 Building Elevations

The building has multiple windows on all perimeter wall elevations and two overhead doors have been installed to allow access for the fire truck and ambulance. The lateral load paths appear to be minimal without significant walls, braces or frames.

5.0 Conclusions

The building appears to have been modified from its original construction to suit the needs of the users over time. The City of Greenwood does not seem to have any drawings for the original building, nor does it have any records of structural modifications or documentation of the building for its changing use. Considering the lack of records and the current state of the building this initial review highlighted, we have the following comments:

- It appears shoring posts and beams have been introduced into the building in response to bearing walls being removed or to reduce floor sag. It is unknown if these members were designed and whether these revised load paths continue through the building to a foundation or terminated onto the main floor.
- The introduction of the fire truck and ambulance has created large live loading for the building. The ambulance currently bears onto a suspended timber floor and the fire truck bears onto a slab on grade which may apply an additional lateral pressure to the stone built retaining wall.
- There appears to be minimal load paths for lateral load in the building to resist wind/earthquake loads. There are many windows in the building and the front building elevation has two doors introduced for fire truck and ambulance access. It is assumed that there are no plywood shear walls, frames or braces within the building due to its age and lack of evidence of structural upgrading.
- The building's current occupancy classifies it as a post disaster building which subjects it to specific requirements regarding its ability to provide essential services in the event of a disaster. A post disaster building should have a designed lateral load system in accordance with the requirements of the National Building Code.

6.0 Recommendations

With the above noted concerns relating to the unknown capacity of the building's gravity and lateral systems, ISL recommends that the following action be taken immediately:

- The vehicles are removed and rehoused in code compliant buildings.
- Occupancy of the building is kept to a minimum and limited to essential staff only. The building should not be used as a place of shelter.

ISL also recommends that we are engaged to undertake a detailed analysis of the building's current structural state. This would include the following:

- A site visit to ascertain member sizes for the wall, floor and foundation as far as practical. This would require openings to be created in the walls and ceilings to allow a structural review to be undertaken.
- Analysis of the capacity of the current gravity and lateral building systems to determine their structural adequacy.
- A detailed report including analysis results and recommendations.

7.0 Report Limitations

This report is not a certification, warranty or guarantee. While this report may assist the Client in making an assessment, any decision as to whether any building considered in this report should be redeveloped, repaired and/or strengthened is solely the responsibility of the Client. Any such decisions are at the Client's own risk.

This report has been prepared on behalf of, and for the exclusive use of, ISL's Client, and is subject to, and issued in accordance with, the provisions of the contract between ISL and the Client. It is not possible to make a proper assessment of this report without a clear understanding of the terms of engagement under which it has been prepared, including the scope of the instructions and directions given to, and the assumptions made, by ISL. The report may not address issues which would need to be considered for another party if that party's particular circumstances, requirements and experience were known and, further, may make assumptions about matters of which a third party is not aware. No responsibility or liability to any third party is accepted for any loss or damage whatsoever arising out of the use of or reliance on this report by any third party.

Without limiting any of the above, in the event of any liability, ISL's liability, whether under the law of contract, tort, statute, equity or otherwise, is limited in as set out in the terms of the engagement with the Client.



Corporate Authorization

This document entitled City of Greenwood Fire Hall – Structural Review Memorandum has been prepared by ISL Engineering and Land Services Ltd. (ISL) for the use of City of Greenwood. The information and data provided herein represent ISL's professional judgement at the time of preparation. ISL denies any liability whatsoever to any other parties who may obtain this report and use it, or any of its contents, without prior written consent from ISL.

Prepared by:
ISL Engineering and Land Services Ltd.

Review by:
ISL Engineering and Land Services Ltd.

Richard Collumbine, M.Eng., P.Eng.
Project Engineer

Robin Zirnhelt, P.Eng.
Senior Engineer