SKYLINE
ENGINEERING

METCHOSIN FIRE HALL

STRUCTURAL ENGINEERING SERVICES

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District of Metchosin

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INTRODUCTION

Skyline Engineering Ltd. visited the truck bay building of the Metchosin Fire Hall located at 4440 Happy Valley Road in the spring of 2022, to review the existing structure and available historical documents in order to provide a preliminary structural review of the building and comment on its existing seismic capacity. Our results were provided in our report dated May 24, 2022, and one is referred to that report for a more complete description of the structure and discussion on our findings.

Since the time of our initial review, the District of Metchosin has engaged Johnston Davidson Architecture (JDa) to provide a program study of current and future needs for the Metchosin Fire Hall, and JDa has presented several options ranging from full replacement of facilities on the adjacent site, along with several plans that involve retaining the existing apparatus bay. In those plans, the apparatus bay is either retained and continues to operate as a truck bay, or is repurposed to provide two levels of administration, ancillary space and sleeping quarters.

Skyline Engineering has been engaged to review the various plans and provide high level feedback on the structural implications of each, including a discussion on the seismic upgrade requirements of the existing structure.

STRUCTURE DESCRIPTION

The existing truck bay building is a single storey building with a training "hose tower" located in the southeast corner. The roof consists of engineered wood trusses sheathed with ½" plywood roof with OSB sheathing along the bottom chords (the ceiling of the truck bay).

The walls are of concrete "tilt-up" construction, with 8" wall panels approximately 17' high. The side walls do not have any openings through the walls, but the front and back walls of the truck bay have multiple overhead doors and convenience doors, with minimal wall sections.

There is a wood frame mezzanine structure along the east side of the building with ancillary rooms supporting the truck bay operations.

DISCUSSION

Our review in 2022 compared the existing structure to the British Columbia Building Code (BCBC) in effect at the time of our report, which was the 2018 BCBC. The truck bay building was originally constructed in 1996 and would have been designed to meet the requirements of the Building Code in effect at that time (the 1992 BC Building Code, which was based on the 1990 National Building Code of Canada). Seismic design requirements have increased significantly since the time of original construction, and design forces for this region have increased again since our 2022 review. The current design forces for this building are much higher than at the time of original design, and the building does not currently have the capacity to resist these current Code level design forces.

Our previous review identified and discussed the structural elements that were seismically deficient and would require upgrading to meet current Code requirements for a post-disaster facility. These include the concrete tilt-up wall panels and the roof diaphragm and connections to the concrete walls of the building. Our previous review determined that design seismic forces on the building had increased by approximately 70% - these design forces have since increased another 40% with the 2024 BC Building Code, and the original design forces are now approximately 43% of current Code level design.

The north and south elevations of the building have minimal walls available to resist seismic forces due to the overhead doors and other access doors that are required for the truck bay to operate and are the weakest portion of the main building. The roof diaphragm and connections to the concrete walls of the building are particularly deficient, however. The capacity of the connections between the roof and ceiling to the walls is now estimated to be in the order of 10% of current Code requirements.

Diaphragm design forces are sufficiently high that horizontal steel cross bracing is likely required to meet those forces. Similarly, the concrete tilt-up walls require upgrades, which may include increased connections between concrete panels and supplemental seismic reinforcing of the building in the east-west direction, possibly with new external cast-in-place concrete walls at one or both sides of the building. Upgrades to concrete foundations will also most likely be required. The wood roof trusses are required to resist higher snow loads as a designated post-disaster facility, and their existing capacity to resist these higher loads is doubtful. It is likely that any re-use of the building will require a new roof designed to meet increased snow loads as well as higher seismic forces on the diaphragm and connections.

The two JDa options that re-use the existing apparatus bay as part of the new complex (options 2 and 3.1) place new drive through apparatus bays immediately adjacent. As there will be openings for overhead doors required at both ends of the new building, it is unlikely that the new building will have the ability to accommodate additional seismic loads from the existing apparatus bay. This scenario should include a seismic gap between the old and new structures, and the existing building will have to be upgraded separately, most likely with four external concrete buttress walls along the opposite wall. The impact of these new buttress walls on the overall site should be taken into account (area use and proximity to property lines for example). As noted, the roof structure would also need to be upgraded – most likely consisting of new structural steel trusses with horizontal bracing provided at the tops of the concrete walls.

JDa program layout options 4, 5 and 6 include re-purposing the existing apparatus bay as a two-storey building to provide administration, ancillary space and sleeping quarters. In these options, new apparatus bays would be constructed along the west side of the existing building. It is likely that sufficient new walls (and supplemental foundations) may be added on the north and south elevations of the existing building to provide the required seismic resistance, as the existing drive through doors would be eliminated. The current building is not tall enough to provide two levels of occupiable space however, so the existing concrete tilt-up walls would require the addition of new concrete elements along the top. As noted above, the roof structure will require upgrades (designed for higher forces due to the additional height of the building and the introduction of the second floor within the space). This second floor will require all new structure and interior foundations and is likely to consist of structural steel beams and joists that support metal deck and concrete topping, with interior steel columns and the exterior concrete walls providing vertical support. Alternately, the second floor could be constructed from wood framing, with consideration given to providing a seismic gap between the new wood framing and the existing concrete walls. This would allow the wood framing to be designed for reduced forces, and upgrades to the existing concrete walls would not have to consider added seismic loads from the interior second floor. As with options 2 and 3.1, there should be a seismic gap provided between the new and the existing building.

JDa has also provided program options that include building an entire new facility on the adjacent site or demolishing the existing buildings and constructing a new facility on the existing property.

SUMMARY

The District of Metchosin is considering several options for modernizing the existing Fire Hall to meet new standards. In some of the options, re-using the original apparatus bay building is included in the plans. These options will require significant upgrades for the existing building to meet current Code level seismic design forces at a post-disaster level. The various options provided by Johnston Davidson Architecture that include keeping the existing apparatus bay building have pros and cons associated with this choice, including the structural implications discussed above, as well as other non-structural implications (such as the need for building envelope, mechanical and electrical upgrades). The cost for all upgrades as well as the impact on the existing services provided by the operating fire hall during construction need to be considered in conjunction with the potential benefits of retaining the existing structure in the overall design.

The extent of structural upgrades to keep the existing apparatus bay as part of the redeveloped Fire Hall will be extensive due to the increased seismic requirements under the current 2024 BC Building Code. The cost of these upgrades is anticipated to be significant and could very well approach the cost of a new (replacement) building serving the same purpose. We note that one JDa option includes maintaining the existing facility in operation while a new Fire Hall is constructed on the adjacent property. This may prove to be the most economical solution, in addition to providing seamless services to the community during construction of the new facility.

You may wish to have a more detailed schematic seismic upgrade plan prepared with sufficient detail such that a qualified general contractor or a quantity surveyor could provide order-of-magnitude costs, to help better inform a decision on how best to proceed with the existing apparatus building, in consideration of the overall fire hall replacement project.

We trust the above information is satisfactory. We remain available to assist with developing a schematic seismic upgrade plan for the truck bay building, if desired. If you have any questions or would like to discuss our findings in more detail, please contact the undersigned.

Yours truly,

Skyline Engineering Ltd.

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Principal

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