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STRUCTURAL ENGINEERING SOLUTIONS

November 14, 2019 19-527

District of Lantzville
7192 Lantzville Road
Lantzville, BC V0R 2H0

Attn: Ronald Campbell

Re: Lantzville Heritage Church, 7244 Lantzville Road – Code Compliance Review

Preamble

Sorensen Trilogy Engineering has been requested to review the condition of Lantzville Heritage Church and to provide a general assessment of the building, including a seismic review. The assessment is based on a walk-through review of the structure. No destructive testing or investigative techniques were employed. The reference code is the 2018 British Columbia Building Code. The original report on this building was done in 2013 and this report encompasses that report and has been updated to reflect the new Building Code now in effect.

Building Description

The building is about 90 years old. The building is on a sloping site with main entry at the upper level. The building has a footprint that is roughly 24' x 35', with a 10'x24' single storey addition at the back. The building is oriented with the long axis running north-south.

The building is a wood frame structure with concrete walls and foundations. The main building roof has a scissor construction with the roof pitch steeper than the ceiling joists. There is a center drop beam running along the east-west axis. The beams are 8x8 sawn timbers supported on 8x8 posts. The beam line is divided into three spans (12'-4", 12'-3", 9'-9" respectively starting at the east end). The west end span is offset about 24" to the north. Floor joists run from the exterior walls to the center beam. The floor joists are 2x8 @ 24". Given the age of the structure and typical construction methods in place at the time the building was built, the concrete foundations are assumed to be unreinforced.

Gravity Load Resisting System

The upper level of the church is considered an Assembly Occupancy. This means that the live load requirements are 100 psf. The joists are currently overstressed by about 100% in bending for this load requirement. The joists can meet code strength requirements for a live load of 40 psf. Deflection and vibration criteria are not meet at this load level. To meet all of the Building Code requirements, the joist spacing would have to be decreased to 12" o/c.

The 8x8 beams are overstressed by more than 300% in bending for the longer spans and 180% in bending for the shorter span. The finding of code compliance of the beams and joists must be balanced with the fact that the structure is more than 80 years old and has performed adequately in that time. To be code compliant, the beams need to be replaced with 4 ply 1.75"x11.25" 2.0E SCL.

The roof framing is undetermined, but likely is comprised of roof rafter and separate ceiling joists. The two elements are probably tied together in some fashion, but they will not act as a truss in the modern sense of the term. However, like the floor system, the roof has performed adequately since the date of construction. No upgrade can be determined without more fully understanding how the roof is constructed. As noted above, the roof has served well for many years and with continued maintenance is expected to continue to do so.

Lateral Load Resisting System

In the previous report, the governing code was the 2012 BCBC. The seismic design forces in the new 2018 BCBC have increased by about 30%. This will have an impact on the structure, but any seismic upgrade scenario will be aiming for 60-75% of full code compliance in accordance with National Research Council "Guidelines for Seismic Evaluation of Existing Buildings" recommendations for existing buildings. The current capacity of the building to resist lateral loads is estimated at about 30%. Levels below 40% are considered to have significant life-safety issues and upgrades are recommended.

The lateral load resisting system for this building is nominally wood shear walls. Given the age of the structure, the walls are probably covered with 1x6 shiplap. The shiplap was sometimes installed diagonally which does increase the lateral load carrying capacity. The upper level has horizontal wood siding and the lower level has shingles.

The upper storey of the building has relatively small windows and there are significant solid wall portions for all walls except, the front wall. However, even the front wall has a relatively low window to wall ratio. The nominal capacity of a wall with shiplap construction can be considered to be about 130 lbs/ft. The lateral load demand on the front wall is about 610 lbs/ft. The side and rear walls will see a lateral load demand of about 230 lbs/ft.

The lower level walls will see higher loads as they must carry the loads from the roof and then pick up the lateral loads associated with the floor. The nominal capacity of the lower walls is similar to the upper level walls at 100 lb/ft. The east-west running walls have a lateral load demand of 330 lb/ft. The front wall at the lower level has no openings and the lateral load demand is about 130 lb/ft. The rear wall at the lower level (below the upper rear wall) has numerous openings including three doorways and two large openings for ductwork. The lateral load demand for this wall is about 780 lb/ft. The lower level single storey addition walls are not considered to have significant lateral load issues, because of the small size of the structure and small number of openings in the walls.

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The attachment between the walls and the concrete foundation walls could not be determined without cutting holes in the interior finishes. Without adequate connection the walls can slide off the foundation walls during an earthquake.

Seismic Upgrade Scenario

The seismic upgrade for this building consists of installing wood panel shear walls, likely to the inside of the walls. The wood code allows the new plywood sheathing to be installed over the existing walls coverings. However, there is a requirement to access the floor space between floors and the stud space at the footing level, so it is probable that the interior finishes will have to be removed to complete the work. Straps between floors at the ends of the new shear wall elements must be installed. Anchors between the framing and the concrete foundations must be installed. Hold down rod elements will be required to be epoxy grouted into the existing concrete foundations to resist uplift forces. At the back wall of the church, a new footing is expected to be required, because the existing footing will likely be too small for the new imposed loads. A detailed upgrade scenario is appended to this report.

Conclusion

The structure has supported the imposed gravity loads since it was constructed. To this extent the building would be considered to be "existing non-conforming". If the intended use and occupancy are expected to change, where the expected live load will more likely to approach code levels, consideration should be given to upgrading the floor system (as noted above). The roof structure is expected to continue to perform adequately with ongoing maintenance.

The building is seismically deficient for current Building Code lateral load requirements. The most critical walls are the upper level front wall and the lower level rear wall. These two walls are more than four times weaker than the Building Code requires. The lower wall is of particular concern, because the wall is the weakest link in the entire structure at six times understrength. If a seismic upgrade is considered, details may have to be revised once the finishes are opened and actual conditions are verifiable.

A seismic upgrade will require further study to determine the specific requirements of the upgrade. More invasive investigation will be required to provide the required information. In addition, the extent of upgrade must be determined. As a minimum, it is recommended that the lower rear wall be upgraded, so that the lateral loads from the upper building can be transferred down to the foundations. At that time, the connection between the walls and foundations should be assessed and upgraded if required.

Yours truly,

Sorensen TRILOGY Engineering Ltd

Brian McClure, P.Eng. Struct.Eng.
Principal / Senior Engineer

bmc
Enclosure: Seismic Upgrade Scenario

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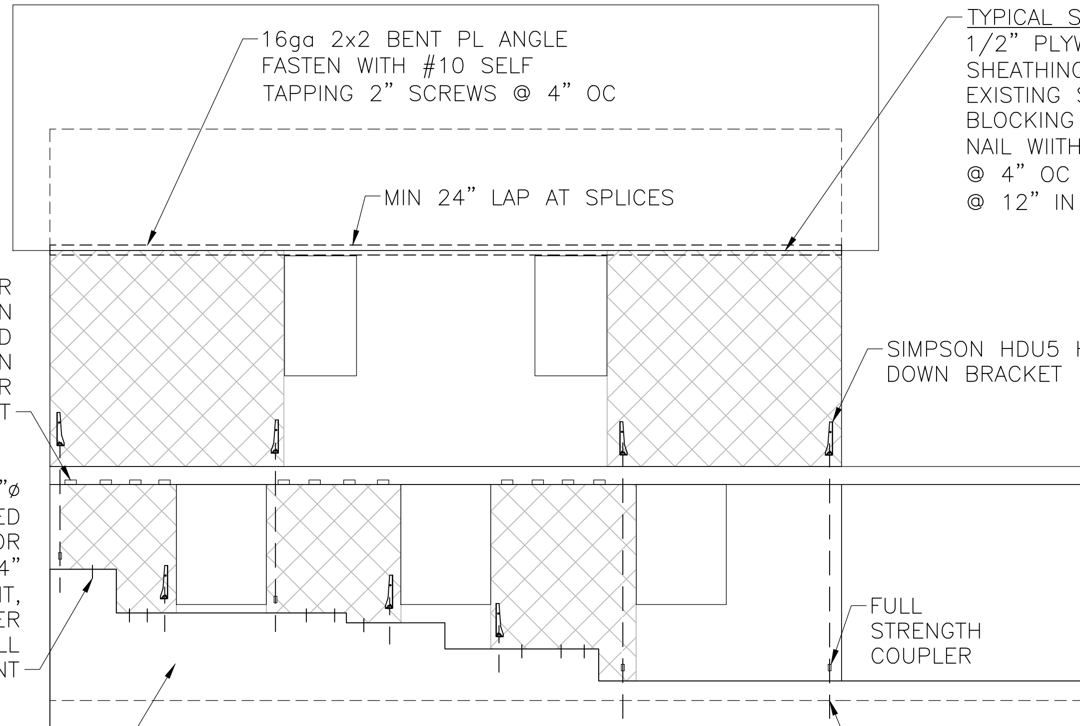
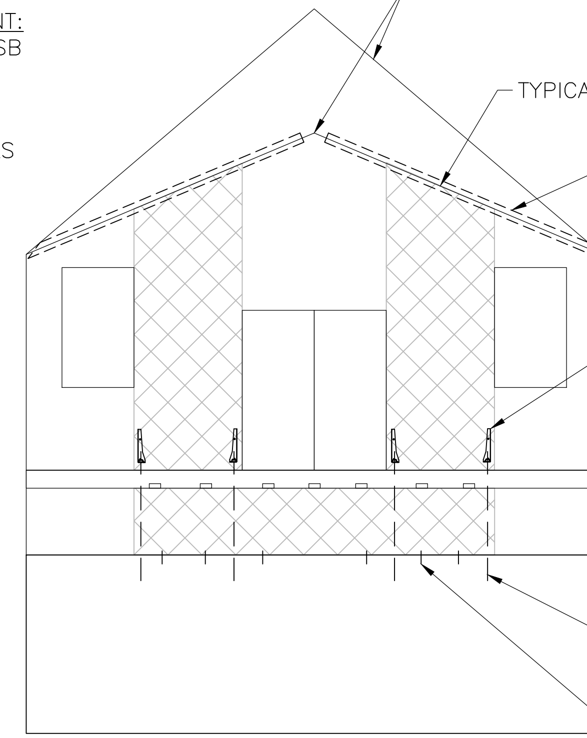
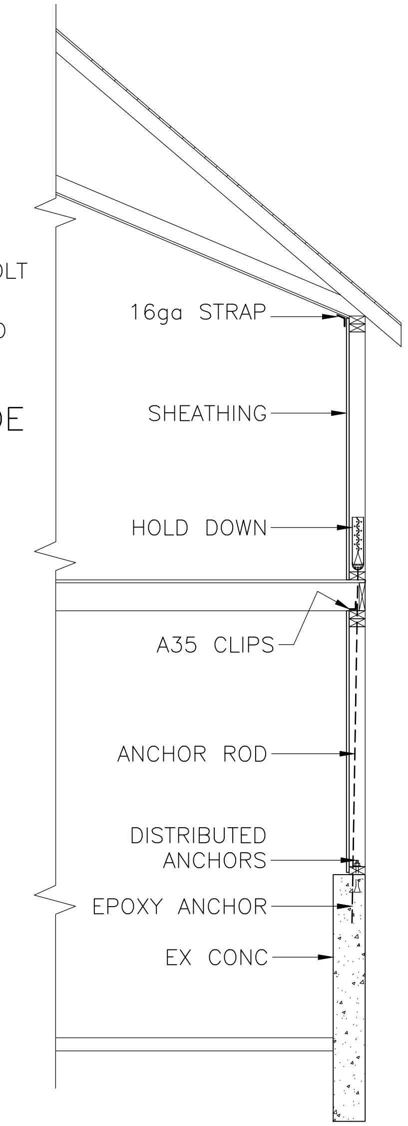


1 / —
INTERIOR UPGRADE SOUTH WALL
1/8" = 1'-0"

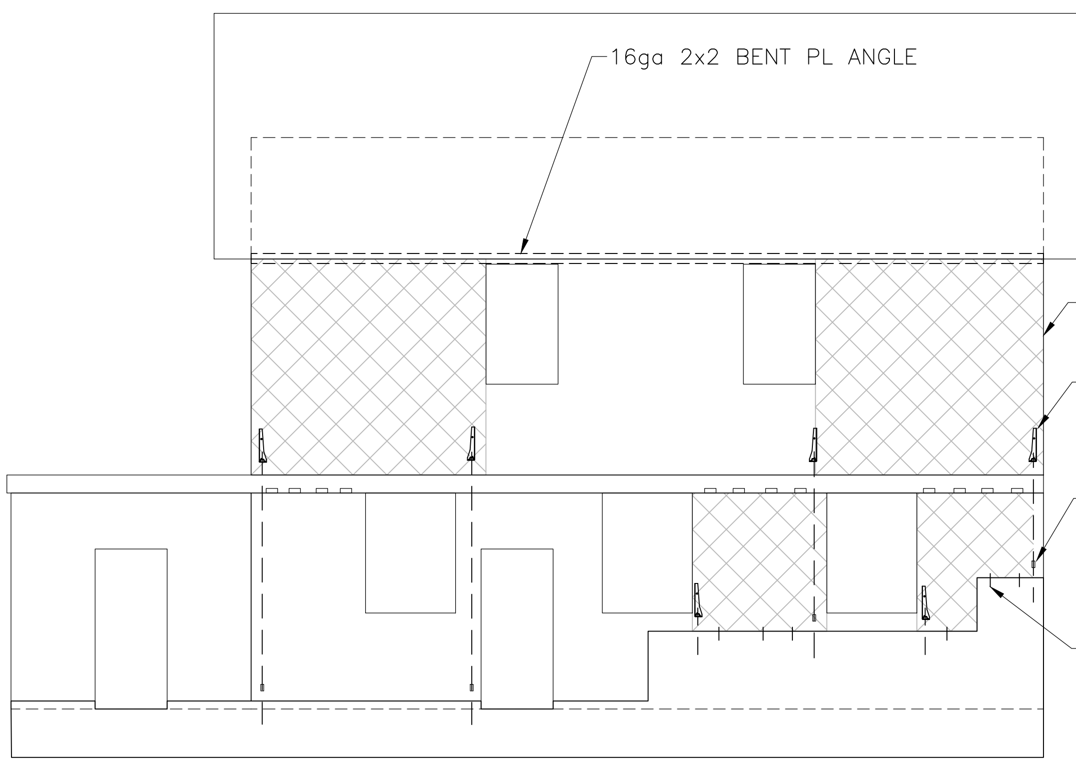


3 / —
INTERIOR UPGRADE WEST WALL
1/8" = 1'-0"

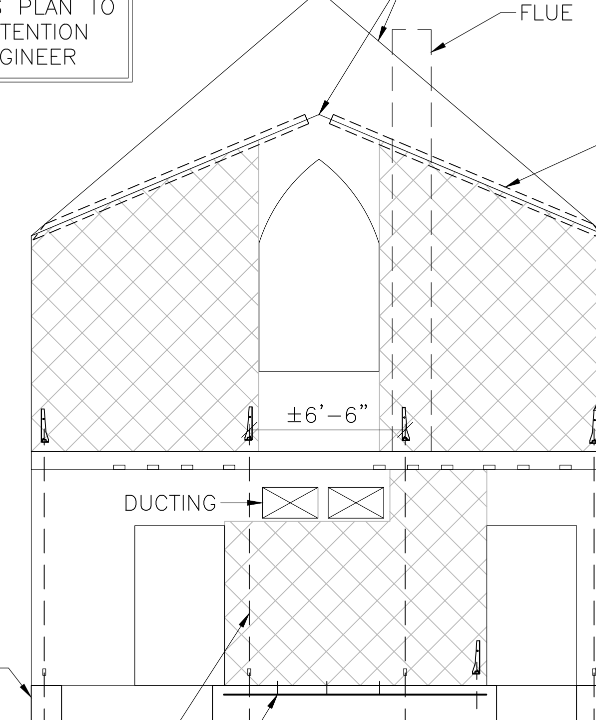


A / —
SECTION
1/4" = 1'-0"

SITE CONDITIONS THAT VARY FROM DETAILS SHOWN ON THIS PLAN TO BE BROUGHT TO THE ATTENTION OF THE STRUCTURAL ENGINEER



2 / —
INTERIOR UPGRADE NORTH WALL
1/8" = 1'-0"



4 / —
INTERIOR UPGRADE EAST WALL
1/8" = 1'-0"

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NO.	DATE:	REVISION:

LANTZVILLE HERITAGE CHURCH
SEISMIC UPGRADE

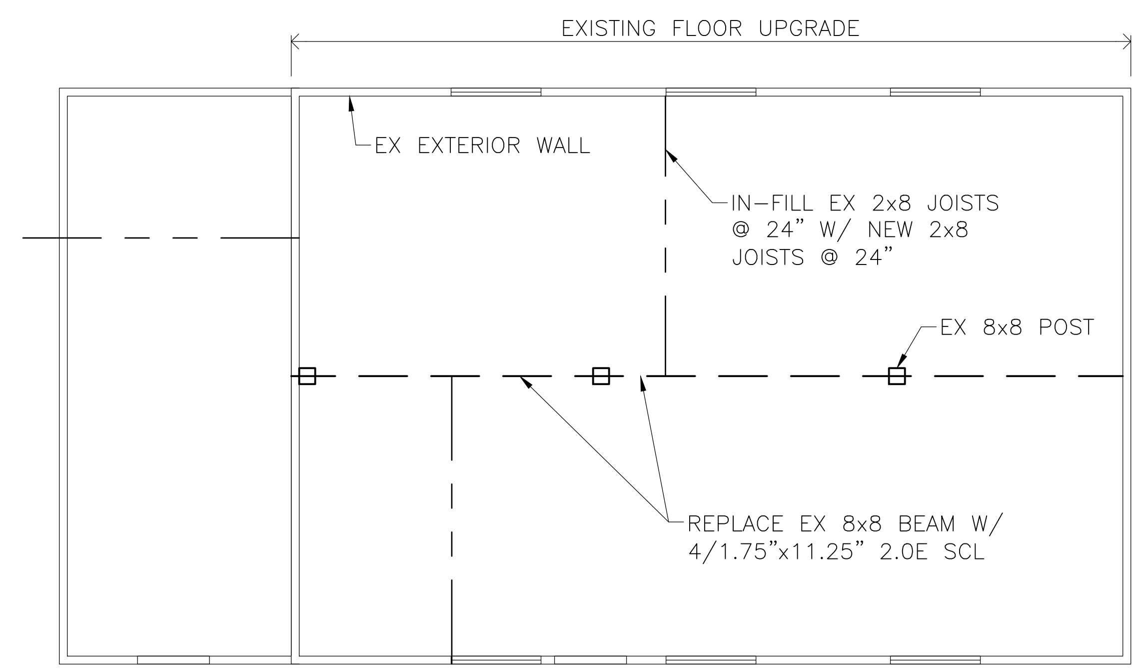
7244 Lantzville Road
District of Lantzville

SEISMIC UPGRADE BUILDING ELEVATIONS

DATE: 14NOV19
DESIGNED BY: BMc
REVIEWED BY:
DRAWN BY:
CHECKED BY:
SCALE: AS SHOWN

S01

19-527
SHT. NO.: 1 OF 2
REV #



A
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INTERIOR UPGRADE
MAIN FLOOR
1/8" = 1'-0"

DEAD LOAD = 20 psf
LIVE LOAD = 100 psf

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NO.	DATE:	REVISION:

LANTZVILLE HERITAGE CHURCH
GRAVITY UPGRADE

7244 Lantzville Road
District of Lantzville

FLOOR PLAN

DATE: 14NOV19
DESIGNED BY: BMc
REVIEWED BY:
DRAWN BY:
CHECKED BY:
SCALE: AS SHOWN

S02

19-527

SHT. NO.: 2 OF 2
REV #