MAYO LEGION HALL

MAYO, YUKON

STRUCTURAL REVIEW

Prepared for:

NA-CHO NYAK DUN FIRST NATION

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1.0 INTRODUCTION

Following is a structural assessment of the Legion Hall in Mayo. The work was authorized by Joella Hogan, Heritage Manager for the Na-Cho Nyak Dun First Nation in Mayo. This is a follow-up from an assessment carried out by the writer in 2005 and provides documentation of changes and upgrades that have taken place since that time. It also includes structural reviews of the structural components in the building, identifies structural and code deficiencies and provides recommendations for structural upgrading.

The main purpose of the report is to provide direction for structural upgrading in order that the building can be made suitable for public use on a seasonal basis. As such, it must adhere to applicable portions of the National Building Code of Canada (NBCC), particularly relating to public safety and structural adequacy. It is understood that the building will not include any mechanical systems such as plumbing, but will have an electrical system.

The recommended upgrades are generally described in this report, but further direction and details may be required during the construction phase due to unknowns that may arise regarding existing conditions which may lead to consideration of alternative methods.

The report is based on information collected during a site visit on July 25, 2016 as well as discussions with Joella Hogan regarding future plans for the building. The 2009 report by Keay, Associate Ltd. entitled “Preservation Plan and As Found drawings” was also very helpful. A few photos and plans from the report are included in Appendix B which describe the structural components of the building. Given that such drawings had already been generated I did not feel it was necessary to re-draft them for the purposes of this report.

Included are photographs and drawings to support discussions.

2.0 BUILDING DESCRIPTION

The one and a half story log structure was built in 1936 and is approximately 7.5m x 12.7m (25’ x 42’) in size. It was constructed in the Piece en Piece or Red River Frame style where vertical logs in the corners and centre joints of the long walls have mortises with 2x4 tenons that connect with the mortises of the horizontal infill logs. During the last few years some upgrades have been carried out on the building which included adding new support beams and pad/crib systems as well as replacing logs that had deteriorated over time. Strong backs, bracing and tension cables were installed to allow the building to be moved and which remain in the building. Currently there are 4 – 3 ply 2x12 beams situated cross ways under the building that support logs that in turn support the floor. The floor support consists of 50x200mm (2x8) joists (full dimension) spaced at 600mm o/c (24” o/c) with 2 layers of 19mm (¾”) diagonal planking .

The wall system consists of vertical log columns in the four corners and at mid points in the long walls with horizontal infill logs between columns connected as described above. The original construction included lapped sill logs which supported the columns and tied the building together at the base. With the recent upgrade work, the columns are not supported on sill logs but are supported independently on cribbing. One exception is the mid wall column on the east side. The exterior log walls extend to about 3.6m (12') above the base of the building.

The roof support can be considered a rafter system with some truss-like features which add to its structural capacity. The rafters are 50x150 mm (2x6) members spaced at 600mm (24") o/c. 19x140mm (1x6) struts connect to 50x150mm (2x6) cross ties at approximately mid height. 50x150 (2x6) ceiling rafters then connect to the ends of the rafters at the eaves.

A 1,450mm (4'-9") deep truss sits below the ceiling joists and spans the full length of the building. It consists of 150x150mm (6x6) top and bottom chords with 19x150mm (1x6) webs and verticals. 50x150mm (2x6) joists connect from the bottom chord of the truss to the outer walls to function as a ceiling for the room. The shallow space above the joists may have been used for storage at one time.

See photographs in Appendix A.

3.0 STRUCTURAL ASSESSMENT AND RECOMMENDED UPGRADES

Following are assessments and comments on various structural components in the building based on information collected during the site visit and structural reviews, plus recommended structural upgrades:

3.1 FOUNDATION AND FLOOR SUPPORT

- There are a number of inadequacies with the existing foundation system which point to a requirement for reconstruction.
- The current support for the building includes pad/crib systems supporting 4 main cross beams which in turn support longitudinal logs under the floor joists. It appears that the logs are from the original construction and that the notches on the underside may have linked with cross beams. However it was difficult to confirm this from the inspection and it would be worthwhile to obtain information and/or plans of the original support structure for the building, particularly if this was to be replicated as part of foundation reconstruction work.
- The existing floor joists, spacing and cladding are considered adequate to meet NBCC design live load requirements of 4.8 kPa (100 psf) as long as the joist spans are kept to a maximum of approximately 2.4m (8 ft)

- All of the columns except for one, are independently resting on pads or cribs. From a structural standpoint it is preferred that they be supported on sill beams which should be lapped at the corners as per the original construction. See Appendix B, Figure 10 which shows an original lapped corner.
- There is no consistency with the construction of the pad/crib systems. Some of the pads may be re-used but it is recommended that the cribbing detail be revised with screw fasteners and a beam connection system as indicated on sheets 2 and 4 in Appendix C. The drawing also depicts a system in which new beams support directly to the floor joist system. With this arrangement cross ties should be installed between the main beams with connections as shown on sheet 3. Three cross ties are recommended; one at each end plus one centrally located as shown on sheet 1.
- Sheet 2 in Appendix C also shows a suggested beam connection detail which will allow for level adjustments as may be required from time to time.
- Foundation reconstruction should include re-levelling of the gravel pad prior to setting pads and cribs. It is understood that the site has been previously prepared with engineered fill. It is suggested that an additional 2"-3" layer of ¾" minus granular fill be added to the pad which will raise the pad and can be used for final levelling prior to placement of the PWF pads.
- A portion of the northwest corner column shows signs of rot and a replacement section of the log column should be extended to capture this area. See photo 10.
- Currently the floor joists are not properly supported on the perimeter of the building. See photo 15. This can be addressed during reconstruction of the foundation support system by making connection to the new sill logs. See sht. 4.
- The joists should be connected to the new support beams. It suggested that one SST A3 clip be fastened at every joist. See sht. 2
- Some joists which have been damaged will need additional support. See photo 16. This can be addressed by attaching a new joist onto the existing one.

3.2 WALL SYSTEM

- The mortise and tenon joints of the infill logs to the columns are weak and separations have occurred at the corners and mid points. See photos 21 and 22. If possible the building should be pulled together to reduce or eliminate the gaps at the corners and mid points.
- In order to help prevent further separations, steel angles can be installed on inside corners to secure the walls to the columns or outside straps can be installed. For appearance sake it may be preferred to have the connections on the inside particularly if they will be covered. A recommended connection detail is shown on sht. 6.
- For the mid points, strap ties are recommended to help secure the wall logs to the columns. See sht. 6.

- The infill logs do not appear to be connected to each other in any way. As such, the walls have weak shear capacity. One option to correct this deficiency is to fasten ½ " plywood sheathing to the inside faces of all the walls. Fasten with 64mm (2.5") nails to every log. See sht. 5 for suggested attachment details.
- It is understood that an insulated 2x4 stud wall is proposed for the inside faces of the log walls. This wall can be placed against the face of the plywood and connected to the floor through the base plate and to the ceiling joists. Further security can be provided by connecting the studs to the plywood with SST A35 clips. See sht. 5.
- Some infill logs appear to have deteriorated and should be replaced. See photo 23.
- The replacement sections of the corners and mid-wall columns should be spliced rather than butt joined as currently exists.
- It is understood that a sawdust box is desired for the building. This will cover the pad/cribs and will also provide a historical appearance. Sheet 4 shows a possible construction detail for the sawdust box.
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3.3 ROOF SUPPORT SYSTEM

- The building roof line has sagged slightly over the past 7 years as noted when comparing Keay's photo No. 7 from 2009 in Appendix B with our photo No. 3. This may have been due to some differential foundation settlement or possibly from some splaying action caused by walls separating from columns.
- The rafters, cross-ties, struts and ceiling rafters appear to remain dry and in sound condition. Analysis indicates that the existing system would probably not meet current code requirements for structural capacity. However, with metal cladding on a relatively steep roof pitch (approximately 8/12) the winter snow loading would be expected to be minimal. In any case it does not appear that snow loads over the past 80 years have created any permanent deflections or damage to the roof components. As such, I suggest that the existing system with a number of relatively minor upgrades will be adequate for years to come.
- Recommended roof upgrades include adding nails to the strut connections at both ends and improving the rafter/ceiling joist connections as required. However, I was not able inspect the condition at the rafter ends to determine the preferred connection detail. Depending on the condition, gussets or mechanical connections may be used. Improvements to the end connections of the cross ties may also be required. A detailed inspection of the attic space and all components should be carried out to properly assess the requirements.
- I suspect that the ceiling rafters are connected and possibly supported at the centre point by the underlying longitudinal truss since it is unlikely that the 50x150 ceiling joists span the entire width of the building. This should be verified. In any case, given that there is a joint at the centre, the connection may need to be upgraded. This important as the ceiling joists should be in tension and thereby adding to the strength of the roof support .

- Based on current information it is surmised that the longitudinal truss below the ceiling joists was constructed to provide some support for the ceiling joists at the centre where they join and also to provide bottom attachments for a dropped ceiling. The truss support and ceiling joists attached to the bottom chord are not adequate to support a floor for storage space in the present form. If it was desired that some storage should be made available in this ceiling space then additional columns would be required for the truss, with upgrades to the truss and joists.
- A central column support for the long truss is recommended for the long term to prevent the truss and ceiling from sagging. A minor deflection was already noted without the added load of ceiling cladding. The column would require blocking between floor joists and a direct load path to a foundation pad/crib system.
- It appears that there has been some recent upgrades made to the truss in the form of increased nailing of the webs to the bottom chords.
- Eaves troughing should be installed with down spouts directing roof runoff away from the building.
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4.0 DISCUSSION AND SUMMARY

Significant structural upgrades are required to this building in order to render it adequate for public occupancy. The work generally includes the following:

- Temporarily move the building to an adjacent location (it is suggested that the building be moved in its present form with bracing in place)
- Remove existing foundation support system, prepare and level base
- Construct new foundation support system
- Return building to new foundation system and connect to beams
- Straighten building and attempt to make log walls tight to columns
- Carry out log replacement work (some of this may be best carried out prior to returning building to the site)
- Complete internal connections, sheathing etc. and remove all temporary bracing.
- Carry out upgrades to the roof support system
- Construct sawdust box

Further details and/or clarification may be required to properly describe the upgrade work when the time comes for construction. Some unknowns at the time of construction may also lead to adjustments to the proposed upgrades or alternative methods. Any such changes should be approved by the engineer prior to construction.

It is recommended that persons with good experience with log building be contracted for the log replacement and upgrade work.