ENGINEERING VENTURES PC

208 Flynn Avenue, Suite 2A, Burlington, VT 05401 · Tel: 802-863-6225
85 Mechanic Street, Suite E2-3, Lebanon, NH 03766 · Tel: 603-442-9333
414 Union Street, Schenectady, NY 12305 · Tel: 518-205-9141

January 15, 2021

Larry Gubb
Shane O'Keefe
Town of Londonderry, Vermont
100 Old School Street
South Londonderry, VT 05155

Re: Londonderry Old Town Hall Structural Review EV# 20236

Dear Larry:

At your request, a structural review of the Londonderry Old Town Hall has been completed. It is understood that this effort is part of a feasibility study to renovate and restore the building to be used as year-round public space.

This evaluation is based on the following:

- Observations from a site visit on October 30th 2020 by Matt Ernst, PE of Engineering Ventures.
- Existing condition drawings of the basement plan and first floor plan dated 4/7/1980 prior to renovations completed at some time after that date.

INTRODUCTION:

The building is a two-story wood-framed structure located at 139 Middletown Rd in Londonderry VT. The original structure was built in 1860 and served as the town hall. Both front and rear additions have been added and renovated over the years to create additional lobby/entry/ticket office space in the front and stage and meeting space in the rear. The building was listed on the National Register of Historic Places in 1983. For the purposes of this report, the side of the building facing the road will be referred to as the "front", the middle original portion of the building will be referred to as the "center", and the side farthest from the road the "rear".

OBSERVATIONS & GENERAL RECOMMENDATIONS:

The following are observations made during the site visit. Recommended work items are in bold. A summary of work items is also included in the Opinion of Probable Cost section of this report.

Foundations:

The perimeter foundation walls of the original building are loose laid stone walls, which have since had a concrete wall poured on the exterior of the stones. The concrete looks to be in fairly good condition. The walls create about a 4' high crawlspace below the Level 1 framing. **Some zones of the loose laid**

stonework have lost contact with the ground. Such areas should be infilled with grouted stones to stabilize the walls. Stones supporting the perimeter Level 1 wood framing posts should be grouted solid or replaced with concrete piers to create a more stable bearing condition.
Water was noted on the gravel floor of the crawlspace and dampness on the interior of the walls. In particular, the access hatch to the exterior on the north side was visibly leaking snow melt at the time of the visit. **The hatch should be replaced, repaired, or removed to stop the water intrusion.**
Concrete piers in the interior of the space supporting wood posts were of more recent construction and appeared in good condition.

The front addition foundation walls are concrete and appeared in fair condition.

The rear addition foundation is concrete walls which create a partial basement. These walls appear in fair condition. Moisture in the space is apparent from pealing paint on the inside face of the concrete walls and surface rust on sheetrock metal corner beads. The slab on grade appeared in good condition.

It is recommended that site drainage be improved to mitigate moisture in the crawlspaces and basement. The following are items should be considered:

- **Excavate perimeter foundation walls around the building, install perforated PVC foundation drain pipes, backfill with crushed stone and re-establish grades that slope away from the building.**
- **Install roof gutters with downspouts that tie into the perimeter foundation system.**
- **Install a vapor barrier in the crawl spaces.**
- **Install waterproofing on outside of concrete fnd walls**
- **Passive or active ventilation of crawl spaces**
- **Include moisture management in the HVAC planning for the basement space**
- **Keep snow piles away from building.**

Floor Framing:

The Level 1 main floor framing and elevated stage floor framing consist of wood joists supported by wood beams. The framing that could be observed was analyzed and the results are summarized in Table 1 below.

Table 1: Floor Framing Capacity Summary

Location	Framing	In-Situ Capacity	Code Recommended Capacity (Minimum)*
Level 1 Front	3”x6” joists at 16”oc	100psf	100psf
Level 1 Center	2x10 nominal joists at 12”oc	100psf	100psf
Level 1 Center	(5)2x12 nominal beams at 12’oc	100psf	100psf
Level 1 Rear (Stage)	2”x8” joists at 16”oc	120psf	150psf
Level 1 Rear (Stage)	(1)8”x8” beams at 10’oc	40psf	150psf
Level 1 Rear (Stage)	(2)8”x8” beams at 10’oc	80psf	150psf
Level 2 Front	TBD	TBD	100psf
Level 2 Center	TBD	TBD	60psf/100psf**

*Per State adopted International Building Code (IBC 2015).
**Code recommended live load with fixed seats is 60psf, without fixed seats is 100psf.

At the original center portion of the building, the floor framing has been entirely replaced relatively recently (since 1980) with modern preservative treated lumber joists, beams, and posts.

Though not of immediate concern, the metal joist hangers and nails which connect the Level 1 Center joists to the beams show signs of corrosion. Wood rot was noted at the hatch opening on the north side of the building. **Hatch should be replaced, repaired, or removed and rotted wood repaired. Condition of crawlspaces should be monitored to watch for worsening corrosion and rot in wood members. Moisture should be mitigated as discussed in the Foundations section above.**

The connection of the Level 1 Front joists to the interior beam was suspect but difficult to observe. **It is recommended that A34 Simpson angles be placed each side of these joists to reinforce this connection.**

The stage floor joists have a capacity of about 120psf, which is substantial, but falls short of the code recommendation of 150psf for stage floors. The ends of the joists appeared to have a half notch bearing into the 8x8 beams, which significantly weakens the shear strength of the joist**. It is recommended that the existing joists are sistered with 2x8's and metal joist hangers used to support both the existing and new joist together at the existing beam.**
The rear zone of the building has undergone renovations and it appeared that some of the 8x8 beams, but not all, had been reinforced with additional 8x8 beams directly below in a stacked configuration. The single and double 8x8 beams have a 40psf and 80psf capacities, respectively. **It is recommended that these beams be reinforced to increase their capacities to 150psf, likely with LVL or steel material below or on the sides of the 8x8 beams.** Further demo of sheetrock ceiling would be required to view the conditions in order to determine a suitable reinforcement scheme

The Level 2 floor framing at the front and balcony over the center portions were not observed. **It is recommended that a small amount of flooring be removed to determine the size and spacing of the framing for analysis.** The floor boards around an old chimney a corner closet were significantly rotted and did not appear safe to walk on. **Flooring should be replaced and framing below should be investigated for rot and replaced as needed.**
The beam that supports the edge of the balcony was observed to be at least (4)2x8, but may be deeper or more plys. **Demo of the floor boards adjacent to this beam is recommended to view the depth of this beam and to see how the joists connect to it.** This beam is currently being supported by iron rods hanging from the roof structure above – this will be discussed in the roof framing section below. The balcony area is stepped with fixed theater-style seating screwed to the floor. If the space remains with fixed seats, then the recommended code live load is 60psf. If the space is to be changed such that the seats are removed and the floor is made flat, then the code live load is 100psf. It is assumed that the framing is flat at the ceiling level and the steps are made using overbuild framing. More information on the framing would be needed in order to assess the feasibility of flattening the floor and increasing the live load from its previous use. Note that this would also create a step in elevation between the front floor zone and the balcony floor zone.

<u>Roof Framing:</u>

Front Roof:
The front roof is a hip roof configuration with 2"x6" rafters and 2"x8" hips. These are a little under capacity to meet the balanced snow load plus some drifting from the main high roof, however, the

framing appeared in sound condition, and reinforcement is not required unless weight is added to the roof in excess of a lightweight ceiling and insulation as discussed below in the building code review section. **It is recommended that the top ends of the rafter connections to the wall be augmented with face-mount sloped hangers or framing angles on each side.**

The front entry canopy roof appeared in stable condition.

Center Roof:
The center roof of the original building was framed with rafters supported on beams which are supported by large timber frame trusses at about 12'oc. The truss bottom chords are supported by timber columns at the exterior walls. Diagonal knee braces also are present from column to underside of truss bottom chord in space above the curved ceiling. The 4"x5" rafters and the 8"x8" purlins have adequate capacity for the roof dead and snow loads. Based on a 9.5 on 12 roof pitch and an unobstructed slippery roofing surface the balanced snow load is 34psf. Dead load at the roof surface is estimated to be 15psf. Dead load at the ceiling surface, which loads the bottom chords of the trusses is estimated to be 7psf. The timber trusses have a code capacity in the range of 35psf total.

The first interior truss towards the front of the building supports some additional dead loading of the cupola above, along with balcony below by way of (3) iron rods going down through the ceiling to Level 2. This truss is more heavily loaded than the others and it appears that the additional load has caused enough deflection to push down and out on the knee braces and columns below, evidenced by visible bowing of the exterior walls at each side of the building at this truss. At some point in time, a horizontal iron rod was installed through the building along the top of the balcony railing presumably to keep the walls from bowing out further. Metal channels on the exterior of the building hold the rod in place. **Given the amount of deformation observed in the truss/column structure here, and the fact that the truss is under code capacity, measures should be taken to remedy the deficiency. Measures could include adding posts under the balcony down to the foundation to unload the balcony weight from the roof truss and/or reinforcing the roof truss system. Roof truss reinforcements would likely include adding diagonal timbers, sistering existing members, and reinforcing timber to timber connections with wood or steel plates.**

With the exception of the timber truss supporting the cupula and balcony, significant signs of distress or deformation were not observed in the roof structure. Therefore, reinforcements to increase the capacity of the trusses would not be mandatory by the existing building code (refer to code review section below). Voluntary upgrades to improve the safety would be to replace the slate roofing with metal roofing to reduce the dead loads and/or reinforce the trusses. Roof truss reinforcements would likely include adding diagonal timbers, sistering existing members, and reinforcing timber to timber connections with wood or steel plates. Another option would be to implement a snow removal plan to remove snow from the roof when snow loads are over a certain threshold.

The ceiling/attic floor over the center portion of the building is framed with 2"x8" spanning to the bottom of the timber frame truss. With the exception of the lightweight insulation, no weight should be added to the ceiling or roof structure. Access to the attic space should remain very limited, as it is now, and care should be taken during any construction activities to limit the amount of load in the attic to 10psf in a given area. Do not store or stack any materials in the attic space.

Rear Roof:
The rear roof was originally framed with full-size 2x framing and has since been reinforced with modern 2x lumber in a truss configuration. The exact configuration and connections were not able to be measured and analyzed, but the framing is presumed to be sufficient for the roof loads. Further investigation is not warranted unless signs of distress or deterioration is observed, or additional weight is added to the roof (including ceiling) in excess of lightweight insulation as discussed below in the building code review section.

The small canopy roof over the rear door near the parking lot was observed to have significant rot at the junction of the knee brace to the wall. **This should be investigated further to determine extent of rot at this canopy and wall. Repair, replace, or remove the canopy as needed.**

Roof General:
The roof eves in general are fairly short. Dripping rain and snow melt appears to be splashing against the walls after hitting the ground. Roof gutters could be considered to mitigate this issue and decrease the frequency of façade maintenance. The gutters would need to be installed far enough below the drip edge to not interfere with snow sliding off the roof. Downspouts could tie directly into the foundation drains.

Walls:

Walls are framed with wood studs. Most walls were concealed by finishes and were not observed. Some zones of the exterior siding appeared to be deteriorating due to moisture, particularly at the rear addition of the building. The base of these walls should be investigated to see if rot is present in the wood wall. As noted above, the wall at the junction of the knee braces at the rear entry canopy showed significant signs of rot and should be investigated and repaired. Façade maintenance should be done to keep the structure dry. As noted above, the base of the wall at the access hatch on the north side of the building is rotting and needs to be repaired with the replacement or elimination of the hatch.

BUILDING CODE REVIEW OF RENOVATION ITEMS:

The renovation of this structure would be governed by the 2015 International Existing Building Code (IEBC). The work would be classified as an *Alteration*. EV understands that the following items are the significant items being considered for the renovation project that may have structural implications:

- Insulating the wall, floor and ceiling framing cavities and heating the building for year-round use.
- Reroofing
- ADA Upgrades
- Façade maintenance
- Site drainage

In general, if the alterations do not increase the loading on the building elements by more than 5%, and the structure is not showing signs of distress, and there is no change in use of the spaces that increases live loads, then structural work is not required by the IEBC.

The added insulation would not increase the snow load in this case because the existing conditions are unheated, cold roofs. Adding heat to the building with or without insulation would result in either the same or lower thermal factor for snow loads in accordance with ASCE 7-10. It is assumed that the added insulation would be lightweight and weigh less than or equal to 2 pounds per square foot to stay under the 5% threshold noted above.

If reroofing is completed, it should be done with materials that weigh the same or less than the existing materials (slate), and old materials must be removed prior to new installation to not add weight. In addition, in order to not increase roof snow loads, new roofing should be a slippery and unobstructed surface, such as slate or metal roofing, with no snow guards that would keep the snow from shedding off of the roof. Using asphalt roofing and/or adding snow guards would increase the snow load on the roof and trigger required reinforcements to the structure.

It is understood that ADA upgrades are being considered, such as a new exterior entry ramp and an interior accessibility lift. It is not expected that the new ramp would have a significant influence on the main building structure. The lift would be in the front addition area from the first floor up to the second floor. It is recommended that the lift be located to the right as you enter the building. Installing the lift to the left near the existing stair would be significantly more complicated in terms of working around the existing framing of the stairs, and therefore is not recommended.

Façade maintenance such as painting and siding work does not have a structural code implication, however, it is needed to keep the structure from deteriorating due to moisture. Specific items are discussed in the observations and recommendations section of this report.

Site drainage work does not have structural code implications; however, it is recommended as discussed in the observations and recommendations section of this report.

Please note that this code review is for structural items only. Additional modifications for Life Safety, egress, electrical and other Code issues are beyond the scope of this report.

OPINION OF PROBABLE COST OF RECOMMENDED STRUCTURAL ITEMS:

Foundations:

- Some zones of the loose laid stonework foundation have lost contact with the ground. Such areas should be infilled with grouted stones to stabilize the walls. Stones supporting the perimeter Level 1 wood framing posts should be grouted solid or replaced with concrete piers to create a more stable bearing condition….$8,000
- The leaking exterior hatch access to the crawl space at the north side of the building should be replaced, repaired, or removed, and wood rot at base of wall repaired….$2,000 to $4,000
- New foundations for access lift….$3,000
- Moisture mitigation for basement/crawlspaces:
    - Excavate perimeter foundation walls around the building, install perforated PVC foundation drain pipes, backfill with crushed stone and re-establish grades that slope away from the building….$12,000
    - Install a vapor barrier in the crawl spaces….$2,000

- Install waterproofing on outside of concrete fnd walls…$6,000
- Passive or active ventilation of crawl spaces….consult MEP professional and/or contractor
- Include moisture management in the HVAC planning for the basement space….consult MEP professional and/or contractor
- Keep snow piles away from building.

Floor Framing:

- Condition of crawlspaces should be monitored to watch for worsening corrosion of metal hangers and fasteners and rot in wood members.
- A34 Simpson angles placed each side of these Level 1 Front joists to beam connection….$250
- Sister existing stage floor joists with 2x8's and install metal joist hangers to support both the existing and new joist together at the existing beam….$3,000
- Reinforce stage floor beams, likely with LVL or steel material below the original 8x8 beams….$5,000
- Potential Level 2 Front and Balcony framing reinforcement, if necessary, pending further investigation….TBD.
- Added posts and foundations to support Level 2 balcony with rods above removed….$4,000.
- Replace/repair rotted floor framing and floor boards at Level 2 Front around old chimney….$800
- Frame out openings in Level 1 and Level 2 Front floors for access lift….$2,000

Roofs:

- Front roof rafter conn hangers….$250
- Center roof timber frame truss reinforcements (1 truss required, 3 optional)….$8,000 to $12,000 per truss.
- Remove iron rods supporting balcony….$500
- Repair or replace rear canopy over door….$1,000 to $2,000
- Gutters and downspouts….$3,000

<u>Limitations of this report</u>:

This investigation was not intended to be an exhaustive search to find all issues that may be present, but rather to identify the major areas of structural work and facilitate steps toward financial planning for restoration. This report is not intended to be used as a construction document for implementation of specific work. Additional design, drawings, specifications and integration of project steps will be required to finalize recommendations and provide more direction to contractors. Not all the of the structure was able to be observed. If renovation work goes forward, it should be anticipated that issues will be uncovered along the way that may require repair.

Opinions of Construction Cost provided herein are to be considered preliminary for planning purposes only. Since a final design has not been developed and we have no control over the costs or price of

labor, equipment or materials, or over the selected contractor's method of pricing, it is understood that the opinions of cost provided are made based on experience and may differ from bid or actual costs.

No attempt has been made to identify hazardous materials as this is beyond the scope of this report and outside of the expertise of the EV team. The owner is advised to employ an independent agency to test and address lead, asbestos, subsurface contaminants or other hazardous materials.

Please let us know if there are further questions or if you would like us to assist in planning & implementation of the next steps.

We are pleased to be of service.

Best Regards,

Bob Neeld, PE – President
Engineering Ventures, PC

Matthew Ernst, PE – Project Engineer, Principal
Engineering Ventures, PC