ENGINEERING VENTURES PC

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November 8, 2023

Ross Brown- Building Committee Chair
Town of South Hero
PO Box 175
South Hero, VT 05486-0175

Forestcitybuilders@gmail.com

Re: Structural Engineering Assessment
South Hero Town Office Building EV # 23523

Dear Ross:

At your request, I met with you on October 26, 2023 to review the structural condition of the existing Town Hall facility. The following is a report of our observations and recommendations and discussions.

Introduction:

The focus of this report is to document and review the structural elements and provide an overview of the structural condition of the building. A Building Inspection Report was provided by Inspection Technologies Co (ITC) in June of 2023 that addresses a broader range of topics. This report focuses only on the structural issues and is intended to augment the ITC report.

In addition to assessing the observed conditions of the building, in selected areas, the framing capacity has been evaluated for conformance with current building code requirements. The State adopted International Building Code (IBC 2015) provides loading capacities for various uses. For reference, the following are typical mandated capacities:

Offices	50 psf (Pounds per Square Foot)
Entry Lobbies and First Floor Corridors	100 psf
Public Assembly	100 psf
Roofs	40 psf ground snow load (adjusted for sliding and wind exposure)

Existing buildings that continue to be in use and do not appear unsafe are typically exempt or "grandfathered" by the building code. This allows the building to continue to be occupied even

when deficiencies are noted. Substantial structural alterations to a building or a change of use will typically require upgrades; a major renovation would likely require a full code upgrade and would be advisable based on the protection of a public investment.

Review for Life Safety, egress, electrical and other Code issues are beyond the scope of this report.

Observations & Discussion:

The building is a two-story wood frame measuring about 32'x84' in plan reportedly built in the late 1920's. The exterior walls are rusticated concrete masonry block. The roof is a gable form with a transition to a dormer at the north. The main floor houses the Town Offices on the west and a meeting room on the east with a concrete vault at the south-west. A second floor occupies the north ¼ of the building that contains light storage but is not otherwise occupied.

Roof Framing

There are three distinct roof sections:

South typical gable: The roof is framed of 2x8 rafters @ 24" spacing with a 1x ridge pole and ceiling joists that appear to be supported on the center wall in the offices below. A second ceiling has been added below the attic floor to reduce the height of the offices and allow for additional insulation.

North vaulted gable: At the north for about 8 feet along the length of the building is a section of roof that has collar ties at 8'-4 above the second floor and a 3 foot knee wall.

Dormer: A shed dormer section is located between the north and south gable sections.

The loading on the roof is determined by the State Building Code. If this was a new construction, the roof would be designed for a snow load of 40 psf (the minimum snow load for new buildings). For existing buildings, snow load reductions are allowed to take advantage of the sliding snow effects due to a slippery roof surface and relatively steep pitch and can be reduced to about 25 psf. The standard 2x8 rafter has a live load capacity of about 10 psf- much less than the standard for new construction and less than half the capacity required for the reduced load. The 10 psf equates to about 6" of wet heavy snow.

The north vaulted gable gains its stability from the collar ties but allows for a significant amount of horizontal movement outward at the eaves. Additionally, the roof capacity is further reduced by this configuration.

The dormer section is a stable configuration similar to the south section, but the shallower pitch of the roof negates the sliding snow effect, and this area would need to meet 40 psf requirements.

First Floor Framing:

The first floor framing/crawlspace is accessible from a trap door in the electrical closet at the north-east corner of the building and a small door near the south end of the building adjacent to the vault under the raised office.

The following was observed:

- The floor joists at both access locations are 2x8 joists @ 16" oc
- At the north access, a 4-2x8 beam was measured about 8 feet from the north wall. In this area, the 8 foot span joists have a reasonable capacity but the beams have about 30 psf live load capacity.
- At the south access, the joists span about 14 feet and have a capacity of about 30 psf.
- There is a pattern of sagging along the length of the meeting room that suggests beams are spaced at varying dimensions from about 10 feet to 15 feet apart with a joist capacity of about 30 to 70 psf live load. The varying floor elevations suggest deflection or deterioration of the framing, or both.
- The crawlspace is extremely damp with a soil floor less than 2 feet below the first floor. There is no vapor barrier on the crawlspace floor. This lack of moisture control has contributed to the high moisture content in the crawlspace.
- Access was limited so the condition of much of the framing could not be directly observed. However, the high moisture content and past presence of mold indicate that deterioration (rot) of portions of the framing is likely. Several access holes would need to be opened to assess more of the framing.

Foundations:

The foundations are cast in place concrete and appear in generally good condition. Exploratory test pits should be dug to determine the depth of the footings for frost protection. If there is not 5 feet of soil cover, insulation can be added below grade to provide protection.

Attic/second Floor Framing:

The attic floor supports only insulation and is supported off the rafters and by a center bearing wall between the offices and meeting room.

The occupiable second floor framing was not able to be observed due to finishes present. It is likely that the floor joists span north-south and are supported on office walls below.

Roofing:

The roofing is metal and is in fair condition. Since snow sliding off the building is important for stability under snow loads, the roofing should only be replaced with slippery surfaces and snow guards should not be used.

Exterior Masonry:

The walls are 8" concrete masonry units (CMU) with a textured surface often referred to as Rusticated Masonry. Observations include:

- There does not appear to be any reinforcing either in the horizontal masonry joints or in the vertical cores.
- The walls are about 12'-8 high. Historical code standards allow for an empirical design of unreinforced masonry allowing for a height of height: thickness ratio of 18—or 12 feet in this case. The existing masonry slightly exceeds this standard.
- There are numerous vertical cracks in the masonry. These are likely due to two causes:
    - Expansion and contraction: Walls tend to move with temperature and moisture changes. Buildings typically have vertical movement joints spaced about 15 feet apart to allow this kind of movement, but none are present here.
    - Roof forces: The roof at the north section of the building is not horizontally restrained by wood ties and a horizontal load is placed on the masonry wall. This is likely causing the cracking at the building corners.
- In addition to vertical cracking, mortar joints are in poor condition and need to be repointed. Cracks left open are susceptible to moisture intrusion and further damage due to freeze-thaw cycles.
- Several of the lintels over the windows have deteriorated. One on the south wall should be replaced.
- The existing chimney is in poor condition, and it is understood that this is no longer in use. This should be considered for removal.

Wind/Seismic Resistance:

The building stability relies on two elements for lateral load stability: the roof sheathing (diaphragm) and the outside walls (masonry shear walls). The roof diaphragm must span over 80 feet from north wall to south wall. Under code stated wind loads, the board sheathing at

the roof does not have capacity to span this distance. Additionally, the roof diaphragm is interrupted by the dormer.

The masonry walls are the shear walls. This would not meet the Building Code for new construction as unreinforced masonry is not permitted for shear walls.

Recommendations:

It is understood that the Town desires improvements to functionality and an increase in space. If this building is to be renovated, it is assumed that the investment in new mechanical, electrical, and energy efficiency would be accompanied by an upgrade to the structural systems to provide for a building to last another 50-100 years. To that end, the following should be included in the planning:

- Reinforce roof framing to meet current codes. This will likely include sistering the existing rafters and adding a ridge beam at the north section.
- Repair the exterior masonry including repointing, replacement, and repair of cracks. Consider sealing the exterior and adding vertical control joints to control future cracking.
- Reinforce the masonry walls by adding 2x8 framing on the inside. This effectively converts the masonry to a veneer rather than a structural element.
- The first floor and crawlspace should be investigated further. Due to the limited area to work, it is likely the floor sheathing will need to be removed. This will allow for:
    - Reinforcing/replacement of first floor framing
    - If the second floor is to be used, expose the framing and allow for upgrade of the capacity to meet the loading for the proposed use.
    - Adding a poly vapor barrier on the crawlspace floor.
    - Adding insulation and air sealing.
    - Waterproofing the outside walls.
    - Installation of electrical and mechanical equipment, if necessary.
- Restore all exterior wood.
- Replace existing roofing- add plywood over existing boards to reinforce the roof diaphragm. New shear walls inside the building may also be necessary.

It is further understood that the Town will continue to occupy the building for some time in its current configuration/use. To extend the life of the building, the following should be considered:

- Monitor snow load on the roof and clear the roof when there is more than 6” of heavy snow or 12” of light snow.
- Repoint the masonry joints and cracks that have developed.
- Replace the heavily deteriorated masonry lintel at the south.
- Avoid occupying the second floor.
- Conduct further evaluation of the main floor by cutting several access holes and investigating for rot or other structural damage.
- Repaint and repair all exterior woodwork.
- Follow recommendations of appropriate professionals for electrical, mechanical, life safety and air quality/mold issues. If possible, a poly vapor barrier could be added to the crawlspace floor.
- Continue with planning and implementing a deep renovation of this building or a move to a new building.

Limitations:

This report is a conditions assessment to identify the major areas of work required to stabilize the building and make steps toward financial planning, restoration, and re-use and 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 direction to contractors.

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 team. The owner is advised to employ an independent agency to test and address mold, lead, asbestos, subsurface contaminants or other hazardous materials.

Review for Life Safety, egress, electrical and other Code issues are beyond the scope of this report.

Please let me know if you have questions.

Respectfully Submitted,

ENGINEERING VENTURES

Bob Neeld, PE
President

NORTH ELEVATION

WEST ELEVATION

MASONRY CRACKING- NORTH AND WEST WALLS

MASONRY CRACKING

MASONRY CRACKING

FAILING LINTEL AT SOUTH WALL

CHIMNEY DETERIORATION

DORMER WOODWORK

SOUTH SECTION ATTIC

SOUTH SECTION CEILING ADDED BELOW ATTIC

CRAWLSPACE ACCESS AT NORTH

WATER STAINED POST IN CRAWLSPACE

SOUTH CRAWLSPACE

NORTH CRAWLSPACE