ENGINEERING VENTURES PC

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March 1, 2019

Susan Klaiber and Megan Nedzinski
Jerusalem School House Committee
Starksboro, Vermont 05487

Re: Structural Review
Jerusalem Schoolhouse, Starksboro, Vermont EV # 18532

Dear Susan and Megan:

At your request, a site visit was made by Bob Neeld, PE of Engineering Ventures to the historic Jerusalem schoolhouse on January 16, 2019 to review the structural condition of the existing Jerusalem Schoolhouse including two additions. Committee members Megan Nedzinski and Susan Klaiber met on site to discuss their knowledge of the building and to provide some insight on potential future projects. The following is a report of our observations, assessment of the existing structure and recommendations for renovations and stabilization. This review does not include an assessment of electrical, mechanical, or fire and life-safety issues.

This study was partially funded by the Preservation Trust of Vermont.

Introduction:

The original 1874 wood-framed schoolhouse building is approximately 27' by 37' with a fieldstone & dirt crawlspace, first level for mixed public use, and attic space that is currently not being used. An approximately 15' by 25' one level wood-framed addition on block foundation abuts the schoolhouse to the north with bathroom and storage space. A 14' x 37' ~1970's shed roof addition to the east with slab on grade floor & concrete frost walls is currently being used for fire engine storage. Please refer to existing building plans with measuring date February 4, 2011, Attachment A.

Based on our conversations and review of conceptual drawings, it is understood that the Town is considering demolition of the two addition spaces and expand the original schoolhouse with updated bathrooms and kitchen to the north. A new larger freestanding fire engine garage would be built on the site to the northeast of the schoolhouse. Please refer to Combined Facilities, Concept Plan dated April 14, 2013, Attachment A. This review assumes that these improvements will be incorporated into a renovation/restoration project.

In addition to assessing the observed conditions of the building, 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:

Residential	40 Pounds per Square Foot (psf)
Public Assembly	100 psf
Roofs	60 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. Substantial structural alterations to a building will typically require upgrades.

Observations:

Site/Drainage:

The site is generally pitched from the northeast to southwest. The grade at the north and northeast corner appears to drain toward the building (although over a foot of snow cover made observations difficult). Signs of soil in the fire truck bay indicate that surface drainage is flowing through or under the foundation into the crawl space. This could be causing damage to the foundation by washing soil out from below bearing surfaces.

There is rotted siding in several areas including the east and west sides due to wood in close proximity to the ground. The north wall may also have rotted siding issues but was not observable due to several feet of snow against the wall. The tall concrete walls of the north addition keep the wood of this area from this type of deterioration.

Main Building Foundation:

The fieldstone foundation around the perimeter of the original schoolhouse is in poor condition as observed from the shallow crawlspace. The stones are loose and it appears the foundation does not extend to any depth below the surface. See Photo 2. The exterior of the west wall has been covered with a parge coat of mortar. There are cracks in this coat indicating continued movement.

Concrete steps were added at the south side of the building. These appear to stabilize or replace the original stone wall. See Photo 1. A short concrete wall has replaced the east fieldstone wall as part of the foundation for the fire engine addition. This wall does not appear

to extend below grade (if the east addition is removed, this wall would not have any frost protection) See Photo 11.

There are two rock piles in the crawlspace acting as piers to support the wood floor beams. These are shallow piers and are susceptible to frost movement. The west sill beam has been replaced and is in good shape. The north sill beam is rotting and should be replaced. The east and southern sill beams were not observed and should be inspected for signs of rot.

Main Building First Floor Framing:

The first floor of the schoolhouse is framed with 8x8 wood beams span east-west at third points of the north-south ~37' length; these beams are supported at the sill beam perimeter and at the rock-piers near mid span. Rot was observed at some ends of these beams at the sill beam support. Wood joists, 3"x8 ¼", span north-south at 2'-6" on center. The beams have a live load capacity of about 10-15 psf and the joists about 40 psf and should be reinforced to meet 100 psf requirements.

Main Building Attic & Roof Framing:

The schoolhouse attic floor joists are 2"x7 ½" at 18" on center. The rafters are 2"x5" at 18" on center with a mixed-section collar tie at slightly more than halfway up the rafter at every other rafter. The balloon framed wall studs are 2"x5" at 18" on center. The studs extend up 18" past the top of attic floor framing and support the gravity and lateral thrust reactions from the rafters. See Photo 6. The attic floor joists act as lateral ties for the wall studs. There is splitting at the top of the wall studs likely due to lateral thrust reaction from rafters. See Photo 3. The inside face of wall stud to inside face of wall stud measurement is 27'-3" at the eave level and 26'-11" at the first-floor level indicating a 4" spread from plumb at the top of wall studs. There is some water damage at the western top plate. See Photo 7. The roof is bowing inward slightly at the east side.

The attic floor has very limited capacity (even assuming support from the interior walls below). This area should not be used for storage or occupied space without substantial reinforcing.

The roof system has a capacity of about 8-10 psf and the code required snow load is 18 psf when adjusted for sliding and wind exposure.

1" flat boards span between the rafters and show some signs of water damage especially around the chimney. The roofing is standing seam metal roofing that is showing signs of deterioration and should be replaced with similar roofing that will shed snow. The flashing around the chimney is significantly damaged with daylight visible and should be replaced to prevent further water damage to the roof framing. See Photos 4 & 8. There is serious damage to rafter ends and fascia board that should be repaired.

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North Addition:

The foundation of the north addition is a mix of concrete and concrete block with significant multiple vertical cracks. See Photo 9. The first level is mostly slab on grade with some wood framing overbuild. The walls and roof here are very lightly framed with sawn wood members. The roof has about 20 psf capacity and loading can reach over 60 psf due to drifting from the main building.

East Addition/Fire Truck Bay:

The fire engine addition to the east has a slab on grade floor with shallow concrete walls around the perimeter. See Photo 10. The western foundation wall appears to have a small footing poured at grade and is therefore not frost protected which will need to be remedied for the stability of the schoolhouse if the fire addition is removed. See Photo 11.

The roof framing was not able to be observed due to the presence of ceiling finishes. However, the overhang indicates that the rafters are likely 2x4 or 2x6. Based on this the capacity is on the order of 10-20 psf. The roof loading can reach about 80 psf due to the potential for sliding snow accumulation. Additionally, the fire truck bay shed roof keeps snow from sliding off the main roof and increases the main roof snow load. There is significant damage to the wall siding. See Photo 12.

Recommendations:

Due to the condition of the north addition and the negative impact the truck bay has on the original building, we support the decision that those areas be removed.

The main/original building is in generally good condition with some deferred maintenance. A new foundation should be considered- especially if expansion plans are implemented and improvements to the floor and roof framing should be implemented.

Improvements can be phased as funds become available. Some of the deferred maintenance items should be addressed within the next 1-2 years if a more substantial project is not underway.

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The following are our recommendations to accompany a renovation/addition project:

Foundation:

We recommend that the building be shored up and at a minimum the east and west fieldstone foundation walls be replaced with full depth concrete frost walls. If possible, the full perimeter foundation walls should be replaced. There is a possibility that the south concrete steps are integral to the fieldstone wall and replacement there will be difficult. The new foundation walls may have an exterior shelf at grade to allow for fieldstone facing. There should be a continuous layer of insulation at the inside of the foundation walls.

The crawlspace should be floored with a vapor barrier, insulation and a 2" concrete floor.

The stone piers supporting first floor beams should be replaced with preservative treated (PT) posts landing on concrete spread footings either placed at frost depth or protected from frost by insulation.

First Floor Framing:

The sill beams should all be inspected for rot and replaced with new pressure treated sill beams where required. The floor beams should be reinforced with one of the following options:

1. Support by new continuous steel beams below, which would be helpful during the shoring up for pouring of new foundation walls, or
2. Replace with new PT beams with intermediate support points at new PT posts bearing on spread footings.

The floor joists should be reinforced by adding new wood joists, hung with face-mount metal joist hangers.

Attic Floor Framing:

The attic floor framing is significantly lighter than required by code. We recommend not using the attic space for even light storage.

Roof Framing:

The standing seam metal roofing should be replaced with new similar roofing that will shed snow- shingles do not allow snow to shed in a similar way and would require higher snow loads. A layer of plywood sheathing should be installed between the existing 1x flat boards and the new metal roofing. Any rotted wood should be repaired; at the chimney, rafter ends & fascia boards. New flashing should be installed at the chimney.

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The roof should be tied at the bottom of the rafters to resist spreading which is causing splitting at the top of the attic knee wall. This can be done with wood ties or cables.

The rafters should be reinforced using one of two options

1. Sister a new continuous 2x10 to each rafter, or
2. Augment the existing collar ties at approximately half the rafter height by adding new ties and cross bracing and strengthen the connections at existing collar ties.

Site:

The site grading should be reworked, especially in the north east corner, to divert water around the building.

Short Term Recommendations:

In the event that a renovation/addition project does not happen in the near future (2-4 years?) several steps should be taken to prevent further deterioration or damage to the building:

- Add vapor barrier to crawl space
- Stone foundation temporary repairs (repointing loose stones or rebuild portions)
- Roof work including removal of existing roofing, new plywood, new roofing and flashing and repair of fascia/trim
- Further investigate drainage issues
- Keep roof snow to a minimum by shoveling/raking especially at truck bay
- Avoid overloading public space. Keep occupancy to a moderate level.

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Preliminary Opinion of Construction Costs:

The following is a summary of potential construction costs for the work outlined above:

Foundation:

Shore Existing Building	$12,000 to $15,000
New Perimeter Foundation	$18,000 to $22,000
Insulation, Vapor Barrier & mud slab	$4,000 to $6,000
New interior Piers	$4,000 to $6,000

First Floor Framing:

Sill Beam replacement-	$1,000 to $3,000
Joist reinforcing	$4,000 to $6,000
Beam Reinforcing	$1,500 to $3,000

Roof Framing:

Roofing Demo, Plywood & New Standing Seam Metal Roof	$30,000 to $35,000
Sheathing and Fascia Replacement	$1,500 to $3,000
Ties at Base of Rafter	$2,000 to $4,000
Rafter reinforcing	$3,000 to $5,000
Totals	$81,000 to $108,000

Limitations:

Note that these costs are for structural stabilization only. Provisions should be made to include contractor fees, design fees, contingencies, other fit up costs including electrical, mechanical, Life Safety, & finishes and the cost of additions and site work

This report is a conditions assessment to identify the major areas of work required to stabilize the schoolhouse 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.

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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.

Please let me know if you have questions or if you need further design information. I wish you the best of luck with this very exciting project.

Respectfully Submitted,

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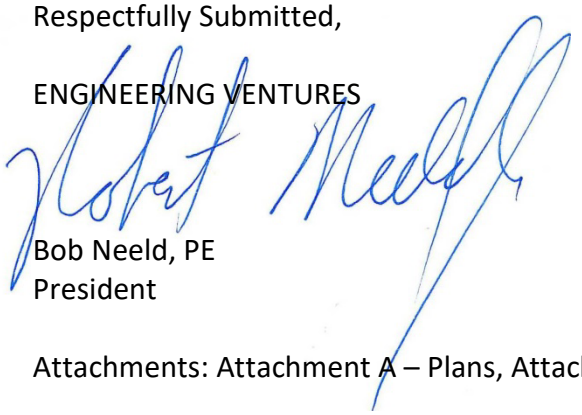

Bob Needld, PE
President

Attachments: Attachment A – Plans, Attachment B - Photos