ENGINEERING VENTURES PC

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May 31, 2017

Jeff Nick
Nick and Morrissey Development, LLC
29 Church Street
Burlington, VT 05401

Re: Memorial Auditorium- Preliminary Structural Review EV # 17404

Dear Jeff:

At your request, a preliminary structural review of the Memorial Auditorium facility in downtown Burlington has been completed. It is understood that you have an interest in redeveloping the property for retail occupancy.

This review is based on the following:

- A site visit on May 10 where I met with you, Martha Keenan from the City of Burlington Public Works, and Doug Young from Wright and Morrissey Construction to walk-through the existing facility.
- A follow up visit on May 18 where I was able to measure the main floor framing.
- Available original drawings from 1926 of the roof, balcony, and foundation.
- Reports of previous investigative and repair work including:
    - Facility Condition Assessment by EMG- October 2014
    - Masonry Wall Deterioration Report by Stantec- October 2015
    - Facilities Assessment Report by Stantec- April 2009
    - Masonry Restoration Report by Liszt- January 2008

OBSERVATIONS & COMMENTS

Roof Framing:

- The roof framing consists of exposed steel trusses bearing on steel columns embedded in the masonry walls and wood purlins and wood decking.
- The original design drawings show forces in the trusses that appear to be consistent with current load requirements for new construction.

- The roof beams and decking appear to be sized reasonably for current codes for snow. However, several beams are cracked and split. Engineering Ventures provided a design for repair of these in December of 2015. This upgrade work has not been implemented.

Walls:

- The brick walls are load bearing at the east and west ends and are non-load bearing in the main hall where there are steel columns embedded in the masonry that support roof and floor beams.
- As discussed, and as noted in several reports, moisture has entered the walls through roof and parapet leaks, condensation, and infiltration. This moisture has created a condition where columns, window lintels, and tie beams have rusted. The brick pilasters surrounding the steel columns have begun to crack due the expansion of the steel during the corrosion process exerting pressure on the brick causing cracks that are visible on most pilasters. An area at the west end of the north face was repaired in 2008.
- Based on the photos and report from 2008 partial renovation, the columns do not appear to be structurally compromised yet. This should be confirmed by additional brick removal and observation of the steel conditions.
- The window lintels above the balcony and the tie beams buried in the brick between columns appear to be compromised. All conditions should be observed and deteriorated conditions repaired or replaced.
- The cast stone detail near the top of the wall is in poor condition and much of this should be replaced.
- Based on reports, photos of remedial work, and site visits, I agree that the steel framing should be exposed and treated by cleaning and coating with a waterproofing system or paint. I have not reviewed/confirmed the budget put forth, however, the order of magnitude seems reasonable and a contingency should be held to address unforeseen conditions.
- Since this work has a potentially significant impact on the construction budget, I suggest a Phase 2 evaluation that would consist of further testing. This would include removing bricks at different locations to observe the condition of embedded steel. This can help quantify the amount of work needed and inform the next phase of remedial construction.
- It is likely that a renovation will include the addition of insulation to the inside of the building. This can lead to changes in the moisture and temperature within the brick

walls. I recommend an analysis by a building scientist experienced with Hygrothermal modeling (WUFI analysis) to determine save levels and configuration of insulation. It is possible that limiting the amount of insulation will be necessary to avoid moisture and freeze-thaw issues within the brick.

Main Floor Framing:

- Retail loading requires a 125 pounds per square foot (PSF) live load. The existing use as an auditorium requires 100 PSF. Therefore, a change of use will require an evaluation and potential upgrade for retail use.
- The drawings do not show any information about the main floor, so I measured the framing. The main floor framing steel beams have over 125 PSF live load capacity and the wood joists are at about 100 PSF live load and have some issues of cracking and splitting. Some with issues have been reinforced with additional wood joists. At this point I would plan to reinforce about 2/3 of the timbers.
- The concrete sections over the boiler room and east corridor appear to have adequate capacity for 125 PSF live load. This should be confirmed with additional field measuring and review.

Infill Second Floor:

- It was discussed that a second floor for retail space is desired. The configuration would include removal of the sloped seating balcony and replacing it with a slightly larger flat space to be used for retail. This area would require 125 PSF live load.
- I suggest that the new floor be constructed of steel and possibly wood timber joists to mimic the existing framing systems. Instead of hanging all of the load from the roof, the floor should be supported on new posts that continue to the basement with new footings. It is possible some of the load may be supported on the existing first floor steel beams.

Foundation:

- The foundation generally appears in good condition. Details shown on the drawings indicate a robust foundation for this time period.
- The west end of the building was constructed close to the Burlington Ravine- notorious for poor fill and settling buildings. The foundation does not show signs of

significant settlement or cracking that would indicate problems often encountered with the Ravine. It was noted that a portion of the concrete floor slab slopes toward the north-west. This is possibly due to settling or could have been constructed to slope to the trench drain located along the north wall. If there is movement, it does not appear to be recent.

- It is understood that the south exterior concrete stair is in poor condition- although this was not confirmed. If the stair is removed, it will allow for waterproofing the foundation at the south face. Replacement will depend on needs of the tenant and on historic considerations
- Portions of the concrete wall at the west end of the building have spalled and cracked. These areas are not in danger of collapse, but repairs should be made to contain the deterioration.
- Sections of wall at the east and south-east corner at the lower level appear to have water infiltration and brick damage. Waterproofing from the exterior is recommended where access can be gained.

Wind/Seismic Loading:

- The building frame is structural steel with unreinforced masonry infill acting as shear walls. This system is not permitted by the current building code for new construction, but is permitted to remain as a "grandfathered" building. The change of use from public assembly to retail does not trigger a seismic upgrade.
- Any new construction (increased second floor) should be light-weight to avoid triggering a seismic upgrade. When the building's seismic weight is increased by 10% or more, an upgrade is required.
- In the event of a seismic event, the building's weight is supported by the structural steel columns. While the more brittle brick would likely fail during seismic movement, the likelihood of a structural collapse is much less than the brick bearing wall buildings commonly seen in Vermont downtowns.

Conclusions/Recommendations:

Roof Framing:

- The roof purlin reinforcing design provided in the fall of 2016 should be implemented.

- New loads for a renovated and expanded second floor should not be supported exclusively off the roof.

Walls:

- If preliminary budgeting concludes that a renovation project is financially feasible, a thorough review of existing conditions should be made to determine with more certainty the level of steel deterioration and the amount of brick replacement required. This would include construction personnel to provide lift operation and brick removal/replacement and engineering staff to document existing conditions.
- In the interim, the budget of about $1 million presented by Stantec in the 2015 appears appropriate for evaluating the project.
- A Building Science analysis by a building scientist experienced with Hygrothermal modeling should be employed to determine safe levels and configuration of insulation and other moisture mitigation work.

Main Floor Framing:

- Floor joists that have not been previously reinforced should be reinforced with new 3x12 each side. At this point I would plan to reinforce about 2/3 of the timbers.
- The concrete sections over the boiler room and at the east end should be measured and confirmed for 125 PSF capacity.

Infill Second Floor Potential:

- A design of a new floor should be developed to include light-weight construction similar to the existing. The floor should be supported on new posts that continue to the basement with new footings. A portion of the load may be able to be supported from the roof trusses and/or the first floor beams.

Foundation:

- The south exterior stair should be documented further and likely removed.
- Spalled concrete at the west end should be repaired.

Memorial Auditorium

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Wind/Seismic Loading:

- Any new construction should be light-weight and designed so that it does not trigger a seismic upgrade.

Based on this limited review, it appears that the most significant and unknown work to stabilize the building is the exterior columns and brick work. The roof and floor structures can reasonably be reinforced to stabilize them and increase the capacity to meet the needs of a retail tenant.

Please let me know if you have further questions or if you would like us to look further into the structural issues on the building.

Respectfully,

Bob Needld, PE – President
Engineering Ventures, PC