



**STONE MASONRY WALL
STRUCTURAL REVIEW
OF
FORWARDERS' MUSEUM
PRESCOTT, ONTARIO**

REPORT PREPARED FOR
Mr. Dan Beattie
Town of Prescott
360 Dibble Street West
Prescott, Ontario
K0E 1T0

OTTAWA, ONTARIO
July 19, 2018

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Corporation of the Town of Prescott
360 Dibble Street West
Prescott, ON
K0E 1T0

Attention: Mr. Dan Beattie

**STONE MASONRY WALL STRUCTURAL REVIEW
OF FORWARDERS' MUSEUM , PRESCOTT**

Dear Sir:

On June 15, 2018, Keller Engineering was retained by the Town of Prescott to provide a second opinion on the structural reviews carried out by EVB Engineering & Architecture 49 Inc. (2017) and by Genivar (2013) regarding the stone masonry walls of the Forwarders' Museum in Prescott.

A site review was carried out on July 3, 2018. The focus of our inspection was primarily the condition of the stone masonry walls of the museum.

Background

The Forwarders' Museum was built in the 1820s and is located at 201 Water Street in Prescott, ON. The footprint of the building is approximately 7.5m x 11.2m. The property slopes toward the St. Lawrence River such that the grade at the rear is at the level of the basement floor. At the front, along 201 Water Street, the grade is approximately 1m above the first floor level. The exterior walls of the building consist of massive rubble stone masonry, approximately 24" in thickness. The floors and roof are made of timber framing.

The stone masonry walls are currently covered with stucco both on the exterior and interior. On the east side, plywood sections were installed to cover areas where stucco had been removed as part of the 2013 Genivar inspection. It is not clear at what point in time the stucco was applied to the stone masonry walls.

Site Observations

Our site inspection was purely visual and did not include any destructive testing. At the time of our inspection on July 3, 2018, several plywood panels were removed by township personnel to facilitate a limited examination of the stone masonry at the east wall. The attached photographs illustrate some of the key observations made during our inspection, including, for example, the infill wall sections at former window openings.

The only exterior sections of the stone masonry walls available for viewing were at the east wall and at the SE corner of the building. All other wall surfaces were covered with stucco. In the basement, several exposed masonry walls were visible. No stucco had been applied in these areas.

Much cracking was visible in the stucco on the east and west walls (Photo 2) of the building and there is a horizontal crack in the stucco on the south wall (Photos 13 & 14). Other more minor cracks in the stucco were present throughout (Photo 10).

The cracking pattern in the stucco would seem to indicate that some differential foundation movements are occurring between the front and the back of the building, whereas the horizontal crack on the south wall (Photo 13) would indicate bulging of this wall, although it is highly likely that only the stucco is bulging.

At the inspection opening on the east wall, we noticed that large areas of the stucco have separated from the stone masonry wall and, interestingly, we noticed the presence of two layers of stucco which had separated from each other (Photo 7).

Pertaining to the condition of the stone masonry walls, based on the exposed wall section on the east wall and the SE corner, we found that many stone units were cracked and the mortar was loose and of a sandy consistency (Photo 9). While it is not possible to judge the condition of all exterior walls based solely on these very limited viewing areas, it is nevertheless possible that all exterior wall surfaces are in a similar state of disrepair. In contrast, the exposed masonry walls in the basement are in excellent condition.

The timber framing visible within the museum is in excellent condition with one floor beam exhibiting minor surface marring due to a fire.

The wood balcony structure has been strengthened some time ago and it appears to be solid when walked on. It appears that the balcony structure is pulling away from the building which is likely caused by frost heaving of the concrete piers (Photo 15).

Previous Engineering Reports

In our opinion, the assessment reports prepared by Genivar in 2013 and EVB in 2017 were thorough, and they covered far more than the condition of the masonry walls. We concur with the essence of their conclusions, with the exception of Genivar's Option 2 to reconstruct the

building. While our inspection of the masonry walls was very limited, we are of the view that these massive masonry walls are likely structurally stable enough to warrant an effective repair/restoration project.

Both engineering firms proposed that additional investigative work be carried out and we fully agree with this proposition.

Opinion

The exterior wythe of the stone masonry walls of the Forwarders' Museum appears to be in disrepair caused primarily by freeze/thaw action in the presence of moisture. The full extent of the deterioration is not known at this time. It would appear that the stucco on the exterior was installed at a later date primarily to protect the walls against moisture penetration and general deterioration.

However, this remedial measure has likely inadvertently contributed to the accelerated deterioration of the surface of the masonry fabric due to moisture exfiltration from the interior and the trapping of moisture behind the stucco surface. The presence of moisture in the wall was confirmed in the basement outboard of the vapour barrier and insulation. It is not known whether the upper walls of the museum are also insulated. If insulated, then these stone masonry walls are now exposed to more serious freeze/thaw conditions than originally as they no longer benefit from the warm interior air keeping most of the wall section above freezing conditions. This is not typically a problem as long as the walls are kept dry.

The question now is whether these stone masonry walls can be restored at a reasonable cost.

Before this question can be answered with some degree of certainty, we recommend that the following actions be taken first:

1. Carry out a geotechnical investigation to determine the soil bearing conditions and the frost susceptibility of the soil, especially at the south end of the building. As well, determine the depth of the foundation at the south end.
2. Remove significantly more of the stucco on the other walls to confirm whether the observed masonry deterioration on the east wall is widespread or localized.
3. Make several inspection openings in the masonry walls at random locations to determine the degree of deterioration through the thickness of the walls.

Once these critical questions have been answered, a remedial work program can be put together and associated costs estimated.

An engineering review of the balcony should also be carried out to determine whether it meets OBC requirements for public access. In the interim, the balcony should be closed to the public.

Closing Comments

Based on our cursory inspection, we are of the opinion that the massive stone masonry walls of the Forwarders' Museum can be remediated with the repointing and partial reconstruction of the exterior masonry wythe. If foundation movements are occurring due to frost heaving or poor and variable soils conditions, as determined through a geotechnical investigation, these movements should be arrested first before the masonry walls are restored. The costs of these repairs can only be estimated reliably once the aforementioned key questions have been answered.

As discussed with you on site, our ballpark estimate for the masonry repairs will likely be in the range of \$250,000 - \$300,000 excluding potential underpinning, if required.

We would be pleased to assist you with any further explorations.

Trusting this meets with your present requirements. Please feel free to call me if you have any questions.

Sincerely,


Heinz Keller, P.Eng

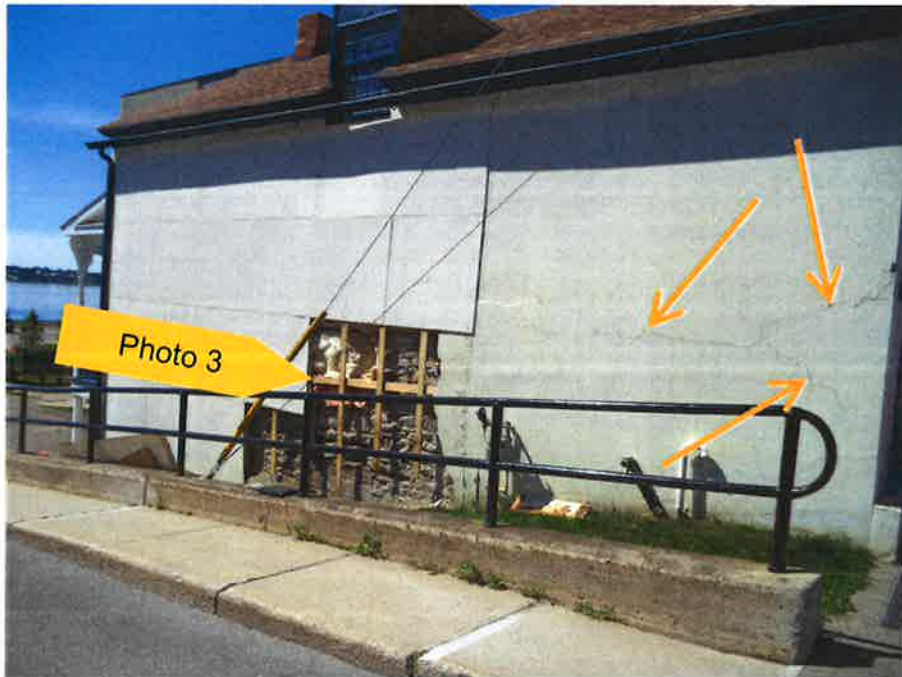


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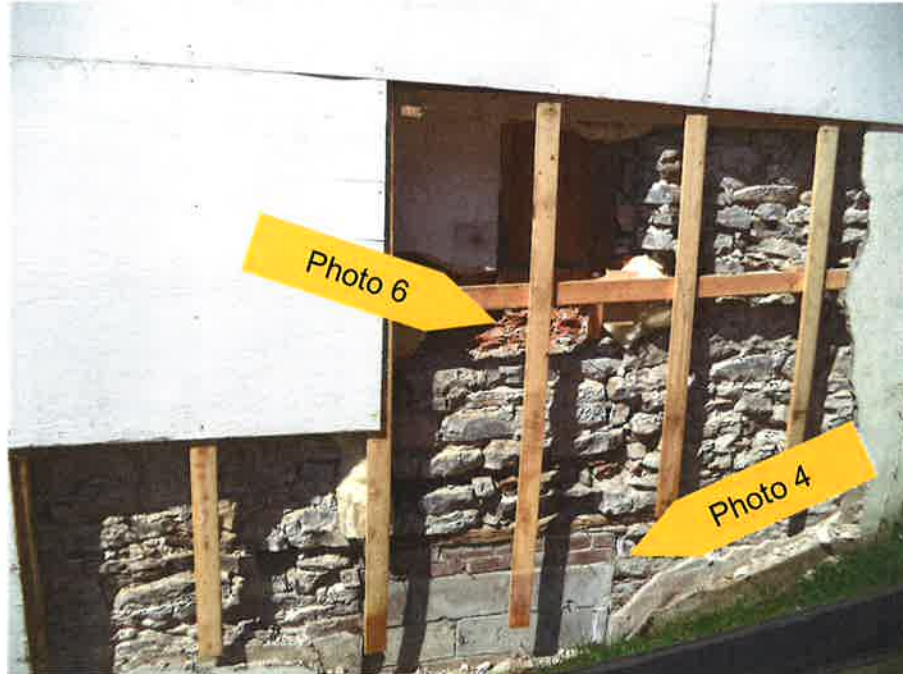
APPENDIX A
PHOTO REVIEW



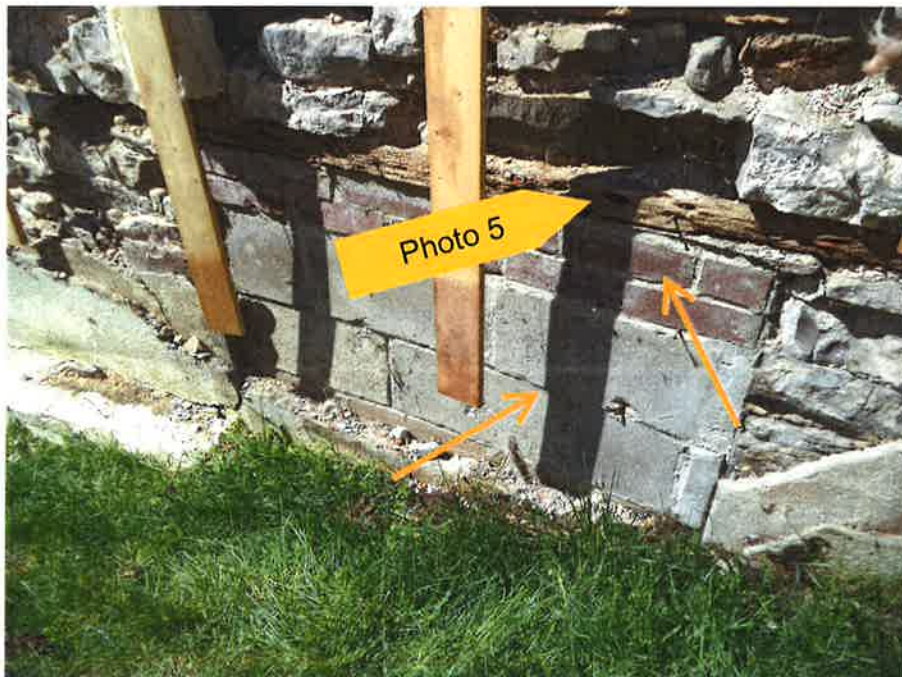
1 Front elevation of Forwarders' Museum



2 East elevation showing plywood panels installed over stucco at previous inspection openings. Note cracking in stucco.



3 Close-up view of exposed wall section



4 Note concrete block and brick infill at former basement window



5 Close-up view of decayed wood lintel



6 Close-up view of deteriorated clay brick infill below former ground floor window

A5



7 Showing presence of existing double layer of stucco on east wall

8 View of exposed masonry at SE corner





9 Close-up view showing numerous fractures in stone units and poor mortar condition



10 Showing miscellaneous cracking in stucco at NW corner

A7



11 View of concrete foundation wall strengthening measures carried out in 1977



12 Rear (South) elevation

A8

- 13 Close-up view showing horizontal crack and delamination of stucco at SW corner



- 14 View of balcony structure





15 Typical balcony post support detail