June 6, 2019

Chmiel Architects Inc.
Attention Richard Chmiel
200-109 Bank Street
Ottawa, Ontario, K1P 5N5

Re: OTT-000252850-A0 DRAFT
Somerset House – 352 Somerset Street, Ottawa, Ontario
Brick Masonry Review and Testing

Dear Mr. Chmiel:

The property located at the corner of Somerset and Bank Streets, also known as Somerset House, contains a three (3) storey, heritage building with 3-wythe solid masonry exterior walls (Photograph 1). For the purposes of this letter, the exterior wall facing Somerset Street is the North elevation.

It was reported that the east end of the building suffered a partial collapse in 2007 during a foundation repair attempt. The building was originally constructed in 1906. Several structural repairs and some temporary measures have been completed over the years in an attempt to stabilize the building and the exterior wall components. EXP was not retained to comment or review the structural adequacy of the building, any modifications or repairs performed. The purpose of this letter is to provided information regarding the exterior brick masonry only. Some photographs have been attached to the end of this letter for reference.

There are some concerns regarding the adequacy of the exterior masonry. EXP Services Inc. (EXP) was retained to perform some preliminary testing of the brick masonry in accordance with CSA standard A82-14 Fired Masonry Brick Made From Clay or Shale. The standard applies to brick made from fired clay or shale that are intended for use as structural and/or facing components in masonry. Although the standard was published long after the Somerset House was constructed, it is to be used as a reference to determine if the existing (original) bricks can continue to perform in a new construction application.

EXP visited the Somerset House building on April 17. 2019, to collect brick samples from the exterior wall for testing purposes. A qualified mason and a structural engineer from Art Engineering were also present and assisted with the brick collection. EXP worked with the structural engineer to determine suitable locations for brick removals and the mason performed the extractions.

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Brick Sampling and Testing:

Brick samples were taken from four (4) separate areas/locations within the exterior wall assembly in order to get an indication of the current performance criteria, with respect to absorption and compressive strength, for each of the wythes and at different elevations. A total of five (5) bricks were taken at each location and tested.

The best condition bricks from each opening were selected as samples in order to perform the testing. Bond course bricks were not sampled. It should be noted that it was difficult to extract whole and intact bricks from each area. Some of the surrounding bricks broke or spalled when slightly disturbed. Bricks were removed from locations under limited stress so not to compromise the loadbearing capacity of the wall.

At the time of the brick extractions, bricks were not able to be removed from the west elevation (facing Bank Street) as adequate overhead protection along the sidewalk was not in place. There were also some past wall stabilization measures taken on the west elevation and it was not clear if some brick removal was possible.

The following locations were sampled:

- The interior wythe of the second floor, north elevation (Photograph 2),
- The Exterior wythe of the ground floor, north elevation (Photograph 3),
- The Exterior wythe of the third floor, south elevation (Photograph 4), and
- The middle wythe of the second floor, north elevation (Photograph 5).

Absorption and Freeze-Thaw Durability

The CSA A82-14 standard outlines the absorption and freeze-thaw durability requirements for exterior grade and structural bricks.

CSA 82-2014, clause 7.2.2 Absorption Testing indicates that each specimen shall have:

a. 5 h boiling water absorption of not greater that 17.0%; and
b. Either a 24 h cold water absorption not greater than 8.0% or a saturation coefficient not greater than 0.078.

It was decided to perform a 24-hour cold water absorption test and then proceed depending on the results. If the absorption criteria is met, than the freeze-thaw testing would not be required.

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The following are the results of the 24-hour cold water absorption testing performed:

24-Hour Cold Water ABSORPTION (%)				
Sample No.	**2nd floor, north Interior Wythe**	**1st floor, north Exterior Wythe**	**3rd floor, south Exterior Wythe**	**2nd floor, north Middle Wythe**
A	16.1	16.2	16.7	14.2
B	14.6	15.8	17.4	16.1
C	15.5	16.4	16.6	12.1
D	8.2	16.3	17.3	16.1
E	17.0	16.2	17.4	16.9
Average	14.3	16.2	17.1	15.1

In summary, all test samples absorption percentages are greater than the allowed 8.0% and therefore failed the 24-hour cold water absorption test. Therefore, freeze-thaw testing is required to determine if the bricks can meet the freeze-thaw durability requirements for exterior grade and structural bricks outlined in the CSA A82-14 standard.

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Compressive Strength

CSA 82-14 outlines the requirements for exterior grade bricks with regards to compressive strength. The standard indicates that bricks tested in compression shall have a minimum compressive strength of 20.7 MPa for the average of the test and a minimum compressive strength of 17.2 MPa for each individual test.

The following are the results of the compressive strength testing performed The numbers in red do not meet the standard:

Compressive Strength (MPa) - 2nd floor, North Elevation Interior Wythe					
Sample No.	**Length (mm)**	**Width (mm)**	**Height (mm)**	**Load (kN)**	**Compressive Strength (MPa)**
A	99.0	103.0	65.0	297.74	**29.2**
B	102.0	102.0	66.0	170.56	**16.5**
C	98.0	104.0	65.0	217.11	**21.4**
D	98.0	101.0	65.0	224.43	**22.8**
E	107.0	102.0	66.0	127.01	**11.6**
				Average:	**20.3**

Compressive Strength (MPa) - 1st floor, North Elevation Exterior Wythe					
Sample No.	**Length (mm)**	**Width (mm)**	**Height (mm)**	**Load (kN)**	**Compressive Strength (MPa)**
A	102.0	100.0	65.0	319.22	**31.6**
B	106.0	101.0	66.0	302.95	**28.6**
C	105.0	102.0	65.0	250.77	**23.5**
D	105.0	99.0	65.0	339.26	**32.8**
E	106.0	101.0	65.0	298.83	**28.2**
				Average:	**28.9**

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Compressive Strength (MPa) - 3rd floor, South Elevation Exterior Wythe					
Sample No.	**Length (mm)**	**Width (mm)**	**Height (mm)**	**Load (kN)**	**Compressive Strength (MPa)**
A	105.0	103.0	65.0	109.48	**10.1**
B	107.0	102.0	66.0	153.76	**14.1**
C	108.0	103.0	66.0	136.28	**12.3**
D	106.0	103.0	65.0	141.23	**13.0**
E	105.0	103.0	65.0	118.61	**11.0**
				Average:	**12.1**

Compressive Strength (MPa) - 2nd floor, North Elevation Middle Wythe					
Sample No.	**Length (mm)**	**Width (mm)**	**Height (mm)**	**Load (kN)**	**Compressive Strength (MPa)**
A	103.0	101.0	65.0	317.60	**30.7**
B	104.0	100.0	66.0	365.80	**34.5**
C	97.0	99.0	65.0	388.59	**41.3**
D	109.0	100.0	66.0	322.78	**29.7**
E	116.0	101.0	67.0	337.04	**29.0**
				Average:	**33.0**

In summary, two (2) of the four (4) test locations failed the compressive strength testing performed; the interior wythe of the second floor north wall and the exterior wythe of the third floor south wall. Two (2) of the individual test results and the average of all five (5) test brick samples were below the allowable values of 20.7Mpa and 20.7MPa respectively at the interior wythe of the second floor from the north wall. All five of the brick samples as well as the average measured compressive strength was well below the allowable values set out in the CSA A82-14 standard at the third floor exterior wythe of the south wall.

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General Observations:

At the time of brick collection and extraction EXP made the following general observations:

- The exterior masonry walls are load bearing, solid, three (3) wythe masonry construction.
- The east end of the building has collapse and is partially open to the elements. The open wall space was in the process of being temporarily sealed with wood framing and fiberglass insulation. Tarps are acting as the temporary weather barrier (Photograph 6).
- Some previous window openings have been in-filled solid with brick masonry (Photograph 7).
- Various brick vintages, colors, and sizes were noted at the remaining exterior portions of the exterior walls along the ground floor and within past window openings (Photograph 7).
- Bond course bricks were not noted on the exterior wythe on the north elevation.
- Significant masonry deterioration was noted at the base of the wall (just above top of the stone foundation wall) on the interior side of the south wall, east end (Photograph 8).
- Several areas of brick cracking was noted throughout. Art Engineering indicated that the cracks were being monitored.
- Areas of brick damage and deterioration were noted throughout the interior wythe, particularly on the north wall (Photographs 9 and 10).
- In locations where the middle wythe was exposed at masonry opening locations, the mortar at the middle wythe was noted in poor condition and dusted/crumbled when touched. Some locations no longer had mortar (Photographs 11 and 12).
- Some cracks bricks were also noted within the middle wythe (Photographs 11 and 12).
- The bricks located in the middle wythe were severely cracked and crushed within the opening made from the exterior on the north elevation (ground floor) (Photographs 13 and 14).

Summary:

Brick sampling was performed in four separate locations where the bricks were not under significant loads or stress so as not to compromise the loadbearing capacity of the masonry walls. Obtaining whole and undamaged bricks was difficult as many of the surround bricks were cracked or broken. In some cases the brick broke while conducting the removals.

The results of the absorption testing performed on the bricks revealed, that as per CSA A82-14, the masonry at 352 Somerset Street is not likely suited for exterior grade masonry however, this would be need to be confirmed with freeze thaw testing. Freeze-thaw testing can take approximately 12 weeks to perform. Based on the vintage of the bricks, the high level and extent of failure, the bricks are not likely to pass the freeze thaw testing.

The test results also revealed that fifty (50%) percent of the test areas failed in compression indicating there are inadequacies with the masonry strength. This is concerning given the wall is a loadbearing solid masonry wall.

At the four (4) masonry opening locations, the middle wythe was exposed and the condition of the middle wythe (bricks and mortar) was poor. Mortar was severely deteriorated and crumbled and dusted when touched. In some cases the mortar within the middle wythe was absent. Brick cracking

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and crushed bricks were noted on the north elevation of the middle wythe. Conventional repairs to the middle wythe are not possible.

Opinion:

We are of the opinion the exterior walls of the Somerset House have been compromised based on the following:

- Collapse of the east end of the building occurred during previous repair attempts,
- Past stabilization concerns are evident because of temporary rigging and added structural features have been added on the interior,
- The exterior and interior brick masonry surfaces were observed with several deficiencies and the bricks were noted with some cracking and spalling,
- The very poor condition of the middle wythe bricks and mortar cannot be restored by conventional means,
- Failed and unfavorable absorption test results indicating the bricks are likely not suitable for an exterior grade application, and
- Most significantly, some failed compression test results indicating there are inadequacies with the masonry strength,

Should you have any questions or require additional information regarding this report, please do not hesitate to contact the undersigned. We thank you for the opportunity to be of service.

Sincerely,
EXP Services Inc.

Karen McKenzie, B.Arch.Sc.
Project Manager
Building Engineering Services

Chantal Wegner, M.A.Sc., P.Eng.
Manager
Building Engineering Services

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Photograph 1: View of the Somerset House, corner of Bank Street and Somerset Street.

Photograph 2: Test sample extraction from the interior wythe of the second-floor north wall.

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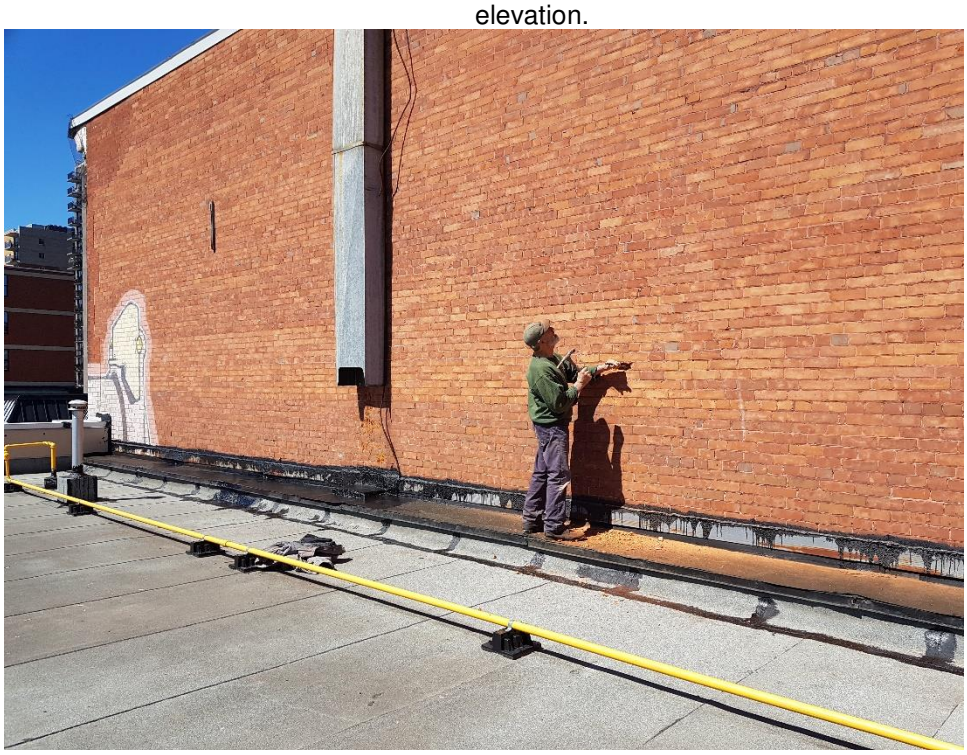
Photograph 3: Test sample extraction area of the exterior wythe on the ground floor of the north elevation.



Photograph 4: Test sample extraction of the exterior wythe on the third floor of the south elevation.

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Photograph 5: Test sample extraction area (below window) of the middle wythe on the second floor of the north elevation.

Photograph 6: View of the east elevation. Area is fenced off with restricted access.

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Photograph 7: Example of various brick vintages and in-filled openings.

Photograph 8: Area of severe brick deterioration on the south wall (above foundation wall).

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Photograph 9: Area of noted brick deterioration on the interior wythe of second floor, north wall.

Photograph 10: Area of noted brick deterioration on the interior wythe of second floor, north wall.

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Photograph 11: View of the middle wythe condition. Mortar in poor condition and some cracked bricks. Opening on south wall, third floor.

Photograph 12: View of the middle wythe condition. Mortar in poor condition and some cracked bricks. Opening on north wall, second floor (below window to extract middle wythe).

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Photograph 13: View of the middle wythe condition. Mortar deteriorated, crack and crushed bricks. Opening on the exterior, ground floor of the north elevation.

Photograph 14: Close-up view of the middle wythe condition. Mortar deteriorated, crack and crushed bricks. Opening on the exterior, ground floor of the north elevation.

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