art engineering inc.
171 Walgreen Road • Carp • Ontario • K0A 1L0 • Canada
(613) 836-0632 • Fax: (613) 836-1226
www.artengineering.ca

Project No: 0653

Recommended Investigation & Testing Report

Date: **August 25, 2022**
Client: **TKS Holdings Inc.**
Project: **352 Somerset Street West, Ottawa, Ontario**
Subject: **Recommended Investigation & Testing**

1.0 Introduction:

The intent of this report is to outline the methodology for further building investigations and material testing of the exterior masonry walls. This report shall be read in conjunction with the Stabilization and Remediation drawings, nos. SR-1 to SR-5, prepared by ART Engineering Inc. (AEI), dated August 3, 2022, and Progress Report #2, prepared by AEI, dated August 15, 2022.

The purpose of the recommended investigations and material testing is to obtain the information required for structural analytical modeling, for seismic upgrade design as well as to identify any potential risks which require repair or remediation.

2.0 Preliminary Investigations and Testing Completed (Conducted June 2019):

Previous preliminary brick wall investigations, sampling and testing was conducted in June, 2019 by EXP Services Inc. in coordination with AEI. Five (5) brick samples were taken within four (4) separate areas of the exterior brick walls and tested for absorption and compressive strength (note that only single brick units were tested, not full brick-mortar test prisms). The following was noted as a result of the investigation and testing at the time:

- Bricks easily broke or spalled when slightly disturbed;
- Several areas of brick cracking were noted, especially at the middle (bond) wythe where severe cracking and crushed bricks were noted;
- Mortar at the middle (bond) wythe was noted to be lacking in areas and in poor condition with dusted and crumbled mortar in other areas;
- Bond courses were not identified for the exterior wythe on the north elevation;
- Significant masonry deterioration was noted at the base of the wall at the east end;
- The results of the water absorption test indicate that the bricks do not meet CSA A82-14 requirements for absorption and likely doesn't meet freeze-thaw durability requirements;
- The results of the CSA A82-14 compressive strength tests indicate that the average compressive strength of all brick unit samples was 23.6 MPa and the minimum average of 5 samples within a single opening was 12.1 MPa;

The preliminary testing provided some indication of the quality and variability of the single unit brick samples taken, however does not provide useful material property information for the existing mortar-brick wall composition for the purposes of structural analysis. Therefore, there is a need to conduct further investigations and material testing to obtain the necessary properties for structural analysis.

3.0 Proposed Openings for Visual Condition Assessment:

Given the limited as-built documents available for 352 Somerset Street West, the age of the building, and the proposed building re-development, AEI recommends that a comprehensive visual condition assessments be conducted.

The 2015 NBCC Structural Commentary 'L' and SEI/ASCE 41-06/ FEMA 356 "Seismic Evaluation of Existing Buildings" technical documents were used as a guideline in preparing these recommendations.

3.1 Test Pits in Masonry Required for Visual Condition Assessment

The following test pits shall be made in the **exterior brick walls** to gather the necessary information as part of the comprehensive visual condition assessment:

1. Prepare a 200x200 mm test pit (minimum), extending 1 wythe deep into the north wall (interior, at ground floor, in masonry pier at GL 'A-2a');
2. Prepare a 200x200 mm test pit (minimum), extending 1 wythe deep into the west wall (interior, at second floor, between bay windows);
3. Prepare a 200x200 mm test pit (minimum), extending 1 wythe deep into the south wall (interior, at ground floor, below stairs, between GLs '4' & '5');
4. Prepare a 200x200 mm test pit (minimum), extending 1 wythe deep into the west wall (exterior, at third floor, between GLs 'B' & 'Ba');
5. Prepare a 200x200 mm test pit (minimum), extending 1 wythe deep into the north wall (exterior, at second floor, at exposed end, near GL '5'.
6. Prepare a 200x200 mm test pit (minimum), extending 1 wythe deep into the south wall (exterior, at third floor, between GLs '1' & '2'.

Exact test pit locations shall be determined by a representative of AEI on site. It is recommended that AEI be present on site during the brick removals.

The following test pits shall be made in the **masonry foundation walls** to gather the necessary information as part of the comprehensive visual condition assessment:

1. Prepare a 300x300 mm (minimum) test pit extending into the core and into the north foundation wall (interior, between GLs '1' & '2');
2. Prepare a 300x300 mm (minimum) test pit extending into the core and into the west foundation wall (interior, between GLs 'A' & 'B');

3. Prepare a 300x300 mm (minimum) test pit extending into the core and into the south foundation wall (interior, between GLs '2' & '4');
4. Prepare a 300x300 mm (minimum) test pit extending into the core and into the north foundation wall (exterior, at GL '1');
5. Prepare a 300x300 mm (minimum) test pit extending 1 wythe deep at GL 'B-1' masonry pier (interior, south face of pier).

Exact test pit locations shall be determined by a representative of AEI on site, in coordination with the contractor. It is recommended that AEI be present on site during the stone masonry removals.

Once all test pits are made, contact AEI to conduct the visual condition assessment. The visual condition assessment will evaluate the wall consolidation, mortar quality and presence, masonry unit quality, masonry bond (interlock) type and condition, and identify the presence of any veneer and backing wythes. A visual condition assessment report will be prepared by AEI for both the exterior multi-wythe brick walls and the stone masonry foundations walls.

3.2 Site Access Required for Visual Condition Assessment of Other Elements

The following site access shall be made available to AEI for the visual condition assessment of structural elements other than the masonry walls and foundations:

1. Provide site access to the underside of the roof trusses. Full measurements of structural elements and visual review are anticipated;
2. Provide site access to the rooftop. Visual review of roof framing and anchorage of existing roof appendages is anticipated. Visual review of skyward facing masonry joints, roofing, parapets, flashing, roof penetrations is anticipated. Provide suitable temporary fixed anchor tie-off point for fall-arrest support, in accordance with CSA Z259.16;
3. Provide site access to the north and west building exterior. Visual review of exterior test pits, anchorage of wall appendages and review of exterior condition of bay window and turret is anticipated;

Once site access for each element is made available, contact AEI to conduct the visual condition assessment. Visual condition assessment reports will be prepared by AEI for the above-noted elements.

3.3 Exterior Wall Site Survey:

It is understood that a site survey of the exterior masonry walls was conducted. The site survey shall be submitted to AEI for review in order to assess the plumbness and overall geometry of the masonry walls.

If no survey is available, the owner shall retain a surveyor to complete a full exterior survey of the brick walls. The survey shall be provided to AEI for review.

3.4 Review of Neighbouring Foundation:

It is recommended that the founding conditions of the neighbouring foundation (297 Bank Street) to the south is reviewed by AEI once the south masonry foundation wall between gridlines 5 & 9 is removed.

3.5 Investigation into Existing Concrete Underpinning:

Three (3) 3" diameter concrete cores have been previously taken below the north and west foundations walls in the existing concrete underpinning. The results of visual assessment of these cores were that the concrete consistency was found to be solid, and the depth of the underpinning does extend to the full width of the masonry foundation wall above.

Refer to Section 4.3 for recommended compressive strength testing of concrete cores taken.

3.6 Investigation into Gridline 'A-1' Ground Floor Column:

It is recommended that the bearing conditions of the existing wrought-iron column located at the northwest corner of the building be exposed by locally removing the infill bricks at the top and bottom. Care shall be taken so as not to disturb the support of adjacent structural elements. Once the bearing conditions (top and bottom) of the column are visible and accessible, contact AEI for an inspection.

4.0 Proposed Testing:

The rehabilitation and planned seismic upgrade of 352 Somerset Street West requires structural material properties for structural analytical modeling and seismic upgrade design. Since there is limited as-built documentation available and based to the age, condition, and configuration of building, these properties cannot be accurately estimated.

The exterior masonry walls consist of a 3-wythe unreinforced brick wall, laid with a common running bond with headers every 6 to 7 courses (except at the north wall, where no header courses are observed on the exterior wythe).

The following testing program is recommended to measure the compressive strength, elastic modulus, and shear strength properties of the exterior masonry brick walls.

4.1 Recommended Brick Masonry Tests:

Refer to Table 1 for the recommended in-situ brick masonry tests for the exterior walls.

Table 1: Recommending Brick Masonry Tests

Test	Material Property	Overview of Test
ASTM C1196 & ASTM C1197	F_{me} (Compressive Strength) E_{me} (Elastic Modulus)	In-situ flat-jack test to determine compressive strength & deformability of masonry wall.
ASTM C1531 (Method 'A')	V_{me} (Joint Shear Strength)	In-situ horizontal hydraulic jack push test in face wythe to determine joint shear strength of masonry wall.

The bond wrench test method, as described in ASTM C1072, to determine out-of-plane flexural properties is not recommended, as the flexural tensile strength of older brick walls constructed with lime mortar are not expected to be substantial and the test is costly and disruptive.

Expected material properties shall be based on the mean values from the test data. Lower bound material properties shall be based on the mean values from the test data, subtracting one standard deviation, as recommended by SEI/ASCE 41-06.

4.2 Quantity & Location of Tests:

The following locations are specified for the above-noted brick masonry tests:

1. Interior wythe of north wall, at ground floor, in masonry pier at GL 'A-3a' – ASTM C1196 & ASTM C1197;
2. Interior wythe of west wall, at second floor, between bay windows – ASTM C1196, ASTM C1197 & ASTM C1531;
3. Interior wythe of south wall, at third floor, between GLs '3' & '4' – ASTM C1196, ASTM C1197 & ASTM C1531;

Additional testing may be requested by AEI, pending the results from the initial tests. If the coefficient of variation in the test measurements exceeds 25%, additional testing shall be performed as directed by AEI.

4.3 Testing of Concrete Cores:

Three 3" diameter concrete cores were taken below the north and west foundation walls, in the existing concrete underpinning present. It is understood that this section of underpinning was constructed before current ownership and no as-built documentation is available. It is recommended that all three core samples be retained and tested for compressive strength in accordance with CSA A23.2-14C. Test Results shall be submitted to AEI for review.

4.4 Testing During Construction:

Additional testing may be recommended during construction, such as GPR scanning of masonry walls to determine the extent of discontinuities/ voids located within the wall, additional surveys, and/or thermal imaging of the exterior walls.

art engineering inc.
171 Walgreen Road • Carp • Ontario • K0A 1L0 • Canada
(613) 836-0632 • Fax: (613) 836-1226
www.artengineering.ca

5.0 Summary:

In summary, test pit openings and site access are requested to conduct a comprehensive visual condition assessment of the building. Additionally, ASTM in-situ testing is requested to attain the material properties required for structural analytical modeling, seismic upgrade design as well as to identify any potential risks which require repair or remediation. In-situ testing shall be conducted by a testing company experienced with the tests outlined in this report and in coordination with AEI.

We trust that the above satisfies your requirements. Should you have any further questions, please do not hesitate to call our office at (613) 836-0632.

Hussein Makke, M.Eng., P.Eng.

Timothy Berg, P.Eng.