



November 8, 2019

Mr. Harold LeBlanc
Property Maintenance Committee
St. Theresa's Church
6351 North Street
Halifax, NS B3L 1P7

Dear Mr. LeBlanc:

RE: *Structural Review of St. Theresa's Church Block Walls*

Campbell Comeau Engineering Limited has carried out a structural review of the exterior masonry walls of Saint Theresa's Church. The review focused upon the condition of the concrete block walls and the connection of the walls to the concrete frame at the exterior of the church. This report provides the findings of our on-site investigation which involved making 16 openings in the exterior walls.

EXECUTIVE SUMMARY

This structural review focused upon the connection of the exterior block walls to the concrete frame of the church. Openings to observe these connections, the "dovetail ties", were made at 16 locations. Ties were found at only four of these locations. The ties observed were rusted with the galvanized coating depleted. Based upon our findings, we recommend that restoration of the exterior walls will require refastening of the exterior block walls to the concrete frame of the church.

CHURCH CONSTRUCTION

Saint Theresa's Church was constructed in two phases. The initial phase was the construction of the lower level, below the main floor of the church. This was carried out in the 1930s timeframe. In the 1950s the superstructure of the church was placed over the initial 1930s construction. The church was designed by Mr. Franco Consiglio, Architect, of Montreal. The architectural drawings are dated 1956.

The superstructure of the church is a reinforced concrete frame. Concrete columns and beams support the exterior masonry walls. Concrete arches, visible within the church, support areas of the exterior masonry walls as well as the roof.

The exterior block walls of the church details are shown on the original architectural drawings shown in Drawing SW-3 attached herewith. The drawings indicate that there is an exterior 4” stone facing which is in direct contact with 8” concrete block. There is then an interior 1” air space between the interior face of the concrete block and a 3” masonry clay lining (commonly referred to as “speed-tile”). The interior plaster is applied to this clay lining. The concrete block walls are surrounded by the reinforced concrete frame of the building. This consists of concrete columns, piers and arches and these elements form the major structural frame for the building above the main floor. Some of the 8” concrete block is load bearing as is the case in the north end of the church at the area of the Chapel and the Sanctuary.

TEMPORARY WALL STABILIZATION

In the Fall of 2018 Campbell Comeau Engineering provided a structural review of the building to Capital Management Engineering Limited. At that time Capital Management Engineering Limited provided an overall condition review of the church. Cracking and bulging of the exterior stone facing was then observed at a number of locations. Some areas were unstable and temporary support of the stone facing was required to provide safe access at the church perimeter. In the early part of 2019 a number of steel plates were installed at strategic locations on the exterior masonry to stabilize the masonry where cracking and open areas of the wall were present.

BLOCK WALL INVESTIGATION

During the 2018 structural review we observed the interior block wall behind the stone facing at two locations. Following from this, we recommended that a review of the **connection** of the 8” concrete block walls to the concrete frame be carried out.

The reason for this is that the exterior stone facing relies upon the 8” concrete wall for structural support. Wind and other forces applied to the exterior wall are transferred to the major concrete frame members by the 8” concrete block wall.

The concrete block walls are connected to the columns of the building by steel straps embedded in the mortar joints at the wall to column junction. The straps are known as “dovetail ties”. The block wall study was carried out to observe the ties and the frequency of the installation of the ties. Ties found in the study can be seen in Photo No. 44.



To carry out the block wall investigation work a drawing was prepared indicating where openings were to be made in the exterior stone facing. This drawing, SW-1, is provided with this report. In total, 16 openings were made through the 4" stone facing. Additional probing was carried out at the interface of the concrete block to concrete column junction to determine the presence and spacing of dovetail ties.

The Wall Section and Plan Detail in the upper right hand corner of Drawing SW-1 indicates the anticipated layout of the dovetail ties and the positioning of them. During the construction of the formwork for the concrete columns a dovetail shaped slot is installed into the formwork. The slot is revealed when the formwork is removed and the dovetail anchors are installed as the concrete block wall is constructed. Ties are also placed in the concrete block to connect the 4" stone facing to the concrete block. These ties are different from the dovetail anchor ties. A number of these ties, known as "corrugated strip ties", were observed in the openings made through the wall. Photo No. 33 shows a close view of the corrugated strip ties.

During the planning of the investigation a provision was made to provide two openings within the church. They are shown on the Key Plan on Drawing SW-1 and identified as "Note 1". During the investigation of the walls from the exterior it was determined that sufficient information was obtained from the exterior study and the decision was taken to not make openings within the interior of the church.

The result of the investigation through the 4" stone facing is summarized in the attached table, Table 1. In the 16 openings made, dovetail ties were only found in four of the openings. In one of these, Opening 11, the dovetail tie was not in a slot but placed in a chamfer between the concrete column and a wythe of concrete block, Photo No. 32. In only one of the openings where a dovetail tie was found were we able to observe a second tie, Opening 1. The reason we wished to view a second tie where a "first" one was found was to determine the vertical spacing of the dovetail ties. Normally these would be provided at every 16 or 24 inches on centre, corresponding to the concrete block wall coursing. Where investigation openings were made they were biased in the vertical direction in an attempt to observe one or more ties within a two to three block coursing.

SITE OBSERVATIONS

Photograph Nos. 1 to 7 show the various elevations of the church for reference. Photographs Nos. 8 through 33 illustrate the condition of the back-up wall and any concrete columns present within the 16 observation openings. Photograph No. 44 shows three of the dovetail anchors found during the investigation. It can be noted that surface corrosion is present on all three of these anchors



indicating that the protective galvanized coating has been essentially consumed. Going forward, corrosion of the anchors will continue and this will take place at an increasing rate.

At all of the opening locations we observed that there was a gap or cavity present between the 4" stone facing and the 8" concrete block. This cavity varied from ½" up to 3 ½ - 4" as noted in Table 1. In each case where the cavity was found it had been filled during construction with mortar and occasionally with pieces of concrete block. The original architectural drawings show no cavity present between the 4" stone facing and the 8" concrete block. This would be difficult to achieve as the alignment of the structure may not have coincided with the desired vertical alignment of the 4" stone facing. Adjustments would have to be made within the width of the cavity. Typically in current masonry wall construction the cavity is left open. (Although there may be unintentional mortar droppings present from the construction process.) We believe that the cavities at Saint Theresa's Church were filled as part of the work to achieve a solid wall as opposed to leaving a cavity void.

Weathering and time have taken a toll on the walls. There are many open gaps present at corners and cracking of the masonry throughout. There are also areas where repairs and repointing of the masonry joints has taken place over the years. A number of the repaired corner areas display open joints again.

In a modern exterior masonry wall provision is made in the outer layer for movement to take place as temperature fluctuations occur. Vertical movement joints are typically provided on a 20 to 30 foot horizontal spacing. They are also strategically placed at window and door openings. These joints are called control joints. They are provided to control cracking in the outside wythe of the masonry.

Our observations of the openings we made indicated that there would have originally been good bonding of the outer stone wythe to the inner block wythe. With temperature fluctuations the outer wythe would undergo dimensional changes following the exterior seasonal temperature fluctuation while the concrete block of the inner wythe would remain at a relatively stable dimension. This variance would set up internal forces between the outer and inner wythes. This would cause cracking at corners of the building. This can be readily observed and the corners are the primary locations where the temporary pinning has taken place.



BLOCK WALL STUDY FINDINGS

1. The field study indicates that the connection of the 8” concrete block walls to the concrete frame is not as frequent as would have been expected. Additionally, the dovetail ties which were found are in a corroded state.
2. The connection of the concrete block walls to the concrete frame of the building is deficient with respect to current requirements. Any restoration of the exterior walls will require providing additional connection of the masonry block walls to the concrete frame.
3. The exterior stone facing is connected to the concrete block walls with corrugated strip ties. At many locations these ties were found to be corroded and their useful life has been consumed.
4. There is a gap in the exterior wall between the stone facing and the concrete block walls. This gap was found to be filled with mortar and sometimes block pieces.
5. Overtime, separation of the mortar infill in the wall gap and the stone has taken place due to water ingress and freeze-thaw and temperature fluctuations. This separation will compromise the corrugated tie connections of the stone to the block walls.
6. Overall, we find that the exterior walls are in poor condition. The exterior stone displays cracking and bulging at numerous locations. The ties which fasten the exterior stone to the interior block were observed to be corroded and in some cases corroded completely so that an interconnection between the outer masonry and the inner block was non-existent. The dovetail ties in the block walls are not present to the extent expected. Deterioration of the precast concrete window surrounds is taking place. Some of the precast is now in poor condition.
7. The concrete columns within the exterior walls were found to be in good condition.

DISCUSSION / RECOMMENDATIONS

One of the purposes of providing a cavity within a modern masonry wall is so that water which penetrates the outer layer of masonry does not travel further than the cavity. The design is such that the water is to remain on the interior face of the masonry inside the cavity and then drip down to the bottom of the cavity where it can be directed to the exterior face of the wall by a base flashing and weep opening system. In the case of the church walls, water which penetrates the outer masonry



layer can find its way into the mortar filled cavity and into the block back-up. Water within the cavity can freeze and cause expansion in winter. This expansion can result in cracking and bulging of the outer stone facing layer. The bulging can dislodge the ties which connect the outer layer to the inner layer.

Older masonry walls, pre 1900, were thick and multi-wythed. Commonly 12 to 16” or more thick, they were also made of one material. Water would be absorbed into the wall thickness and the depth of absorption would vary seasonally. In summer the wall could dry out. In a well heated building, prior to the increase in fuel cost in the 1970s, the depth of frost penetration into the uninsulated walls was less than it would be today. Today the opposite effect occurs with the church interiors being kept at lower temperatures though the winter season. This currently causes masonry walls to deteriorate due to weather at a faster rate.

The work required to provide durable lasting exterior walls on the church will depend on the wall system chosen. We do not believe that the current stone facing can be left in place and function as a weather barrier because of the cracking and stone movement which has taken place.

Options would include removal of the masonry exterior stone layer and provision of a different wall type which would include provision for a rain screen system or a face sealed system to prevent the ingress of water into the walls. A masonry solution option can be considered where the exterior stone would be removed from the face of the building and an insulated cavity system developed. This will thicken the exterior wall and create the need for support of the new outer masonry layer on the face of the foundation wall. This would include design considerations around the window openings.

The windows of the church feature precast concrete jambs, sill and arch sections. These pieces of precast extend from the exterior through to the interior of the wall. Deterioration of a number of these elements has taken place. The most extensive example of the deterioration is on the front entrance east side door. This existing detail will be a consideration in any wall renewal planning.



Mr. LeBlanc
Page 7
November 8, 2019

We look forward to continuing our work on this building project with you. Please let me know if there is any additional information that we can provide.

Yours very truly,

CAMPBELL COMEAU ENGINEERING LIMITED



Michel P. Comeau, P.Eng.

MPC/mpg
cc. Mr. Torquil Duncan, CMEL
Ms. Kyla Simpson, CMEL
Enclosures
28118



PHOTOGRAPHS





Photo No. 1 – Front, south, elevation.



Photo No. 2 – East elevation (south).





Photo No. 3 – East elevation (north).



Photo No. 4 – North and east elevation.





Photo No. 5 – North elevation.



Photo No. 6 – West elevation (north).





Photo No. 7 – West elevation (south).





Photo No. 8 – Opening 1 – Concrete column and dovetail slot and anchor visible.



Photo No. 9 – Opening 1 – Tail of dovetail tie corroded and partially cut away.



Photo No. 10 – Opening 1 – Column and mortar filled cavity.



Photo No. 11 – Opening 1 – view of dovetail anchor in slot. Surface corrosion on anchor projection. Greater corrosion on tail of anchor.





Photo No. 12 – Opening 2 – Masonry wall observed at bell tower base. Concrete column not located. Mortar filled cavity.



Photo No. 13– Opening 3 – Area of opening at east entry. Note displaced precast at base of opening. Temporary flashing in place. Note deteriorated precast at entrance arch.



Photo No. 14 – Opening 3 – Block masonry infill in place behind precast. Mortar filled cavity.



Photo No. 15 – Opening 3 – Displaced precast with open joint. No precast ties to back up observed.



Photo No. 16 – Opening 4 – Opening at inside corner at rear of Church. Block wall observed.



Photo No. 17 – Opening 4 – Block wall with corroded strip tie visible. Concrete column not observed. Through-wall flashing in place.



Photo No. 18 – Opening 5 – Concrete column at corner. Dovetail slot in place.

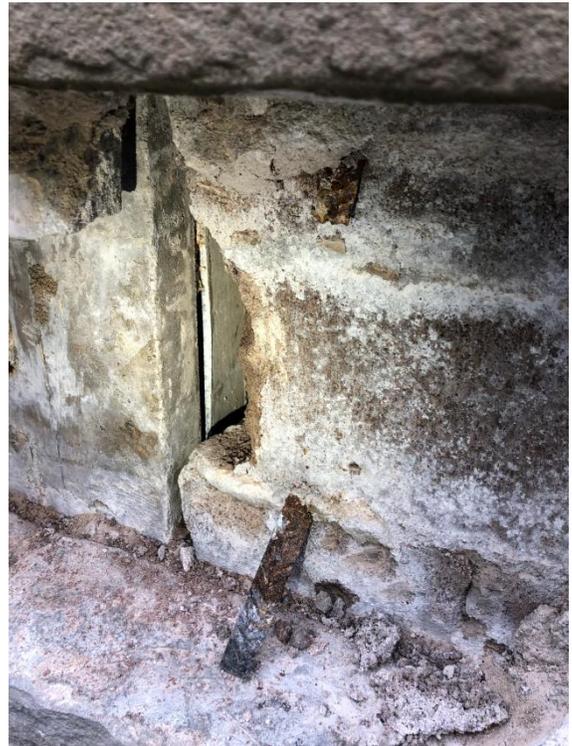


Photo No. 19 – Opening 5 – Mortar filled cavity. Corroded strip tie visible. Dovetail slot in column face.





Photo No. 20 – Opening 6 – Opening above east Elevation window. Corroded strip ties observed. Clay “speed tile” in interior wall observed.



Photo No. 21 – Opening 6 – Block wall with strip tie. Mortar filled cavity.



Photo No. 22 – Opening 7 – Block bearing wall in place with no concrete corner column.

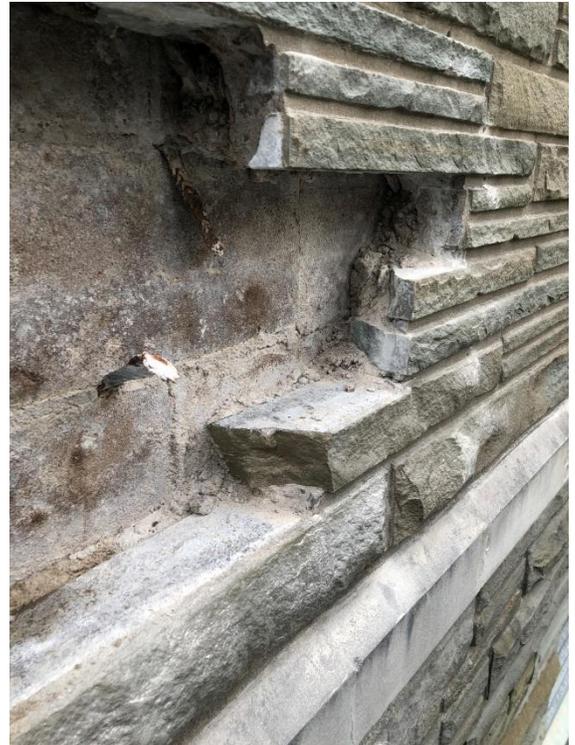


Photo No. 23 – Opening 7 – Mortar filled cavity and corroded strip ties.





Photo No. 24 - Opening 8 – Block bearing wall in place. No concrete column. Corroded strip tie in masonry filled cavity.



Photo No. 25 - Opening 9 – Dovetail slot on face of column not on side facing block wall. Surface corrosion on anchors. Corroded strip tie at face of brick.



Photo No. 26 - Opening 9 – View of column and cavity is filled with mortar.



Photo No. 27 - Opening 9 – View of cavity with mortar fill.





Photo No. 28 - Opening 10 - View of concrete column, block wall and filled cavity (note sloping “bricks”).



Photo No. 29 - Opening 10 - Block wall to concrete column junction. No dovetail slot or block anchors observed.



Photo No. 30 - Opening 10 – Concrete beam at base of opening.



Photo No. 31 - Opening 11 – Corner area. Corner column visible. No dovetail slots. Strip ties to veneer visible.



Photo No. 32 - Opening 11 – Dovetail tie at column chamfer. Corroded tail section.



Photo No. 33 - Opening 11 – Strip ties in cavity. Corrosion of the surfaces. Mortar filled cavity.



Photo No. 34 - Opening 11 – Column chamfer used as tie "slot".



Photo No. 35 - Opening 12 – Above west entrance. Block bearing wall. No column present.





Photo No. 36 - Opening 12- Filled cavity at opening, "rubble masonry".



Photo No. 37 - Opening 13 – Anchor in block wall. No mortar present in cavity.



Photo No. 38 - Opening 13 – Anchor in cavity. Block wall to column interface.



Photo No. 39 - Opening 14 – At precast window jamb. Corroded strip ties observed. Dovetail slot present in concrete column. No dovetail ties in place. Concrete column chipped away on right side to provide clearance for precast at window jamb.





Photo No. 40 - Opening 14 – Exposed concrete column mortar filled cavity.



Photo No. 41 - Opening 15 – Column at corner of wall. Corroded strip ties observed.



Photo No. 42 - Opening 15 – Dovetail slot present in column face at brick wall.

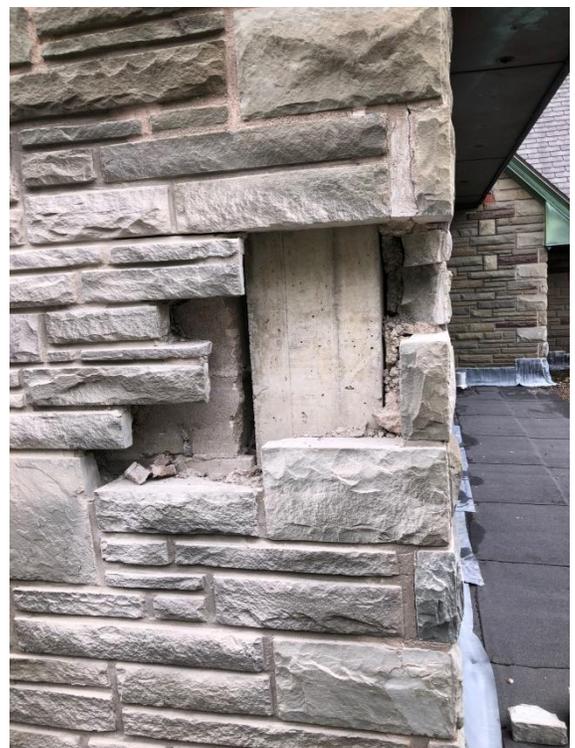


Photo No. 43 - Opening 16 – Column at corner of wall. Dovetail slot present on block wall face of column. No dovetail ties observed.





Photo No. 44 – Photograph of three dovetail anchors with opening number indicated.



TABLE



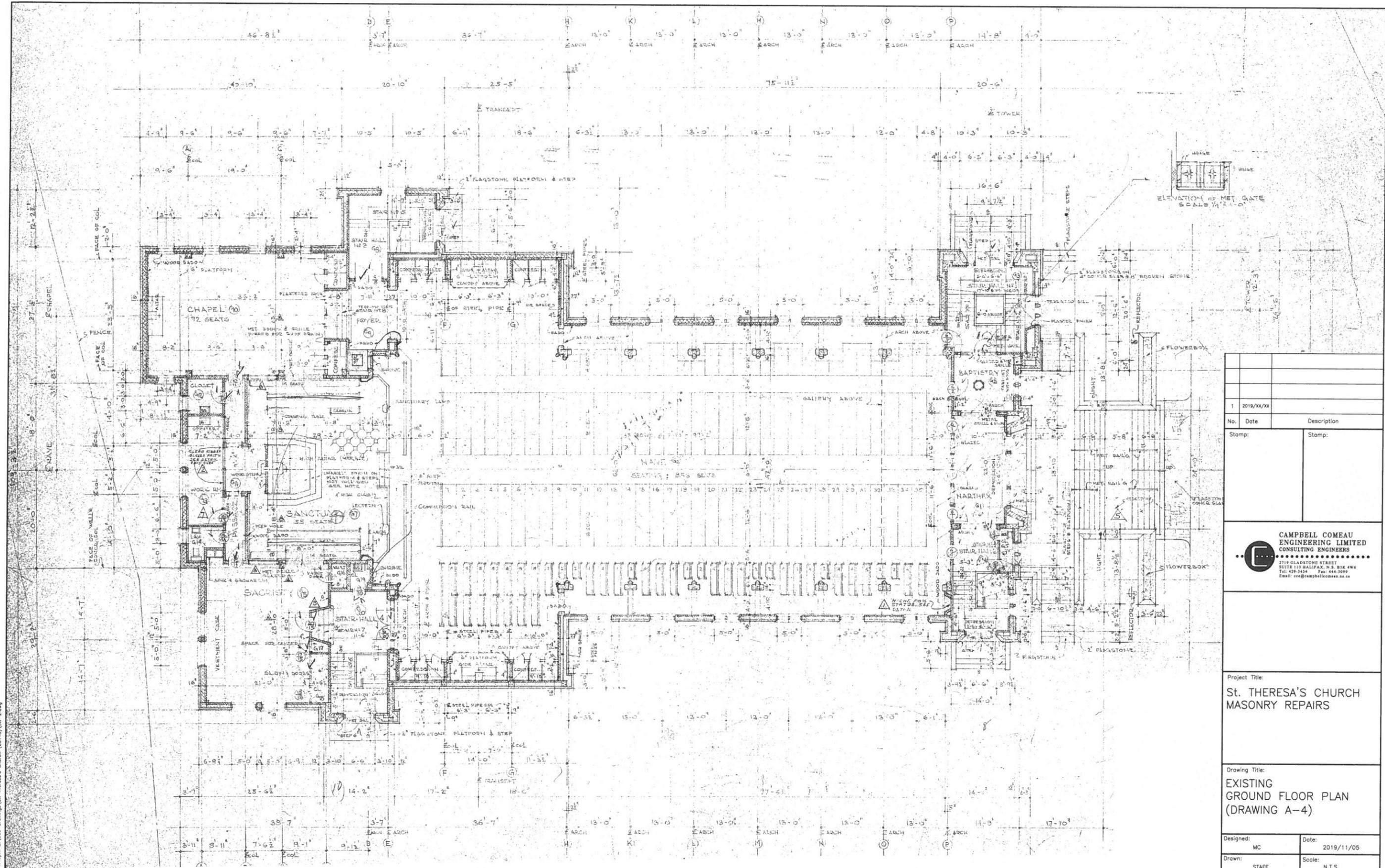
<i>Opening</i>	<i>Photo Numbers</i>	<i>Column Found</i>	<i>Dovetail Slot Found</i>	<i>Dovetail Tie Found</i>	<i>Next Dovetail Tie Spacing</i>	<i>Wall Cavity Dimension</i>	<i>Tie Condition/Comments</i>
1	8 – 11	✓	✓	✓	28"	2 ¼"	Dovetail tie corroded in cavity – galvanizing consumed. Part of dovetail cut away.
2	12	Bell Tower corner column not observed.				3"	Solid filled cavity with 8" block backup.
3	13 – 15	No column at this elevation.				½"	5" thick precast section, mortar and block behind precast. ½" gap behind precast. Precast is loose, no precast ties observed.
4	16 – 17	Upper corner east side.				½"	Column not observed. Concrete block is 5" in from exterior stone face.
5	18 – 19	12" wide	✓			¾"	Corroded strip ties to block. No dovetail anchors found. Corroded reinforcing steel tie at horizontal concrete (beam) observed.
6	20 – 21					3 ¼"	Corroded strip ties to block, clay tile inside wall.
7	22 – 23					1 ¼"	Block bearing wall – no column.
8	24					2"	Block bearing wall – no column.
9	25 – 27	✓ 12" x 12"	✓ On veneer face	✓		2 ½"	Dovetail slots on veneer face – not on block wall face. Dovetail ties to veneer, not block wall.
10	28 – 30	12" wide				2 ½"	Adjacent to buttress. No dovetail slot or ties found. 31" high opening.
11	31 – 34	✓ Corner observed		✓ Not in slot		1"	Dovetail tie place in column chamfer.
12	35 – 36						Block bearing wall – no column.
13	37 – 38	✓	✓	✓		3 ½"-4"	Single dovetail tie observed in 32" high opening. Surface rust present.
14	39 – 40	✓	✓				No dovetail anchors present. Corner of concrete columns chipped away to clear precast at window.
15	41 – 42	12" x 12"	✓				No dovetail anchors present.
16	43	12" x 12"	✓				No dovetail anchors present.

TABLE 1 – ST. THERESA CHURCH MASONRY WALL INVESTIGATION

DRAWINGS



User: Nov 06, 2019 1:48pm Z:\Cad-Drawings\St. Theresa's Church (28118)\SW-2.dwg



No.	Date	Description
1	2019/xx/xx	
Stamp:		Stamp:

**CAMPBELL COMEAU
ENGINEERING LIMITED
CONSULTING ENGINEERS**

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Project Title:
**St. THERESA'S CHURCH
MASONRY REPAIRS**

Drawing Title:
**EXISTING
GROUND FLOOR PLAN
(DRAWING A-4)**

Designed: MC	Date: 2019/11/05
Drawn: STAFF	Scale: N.T.S.
Checked: MC	Job No.: 28118

Drawing No.:
SW-2

