Toquam Magnet Elementary School

Exterior Façade Investigation

398 Glenbrook Road
Stamford, CT 06906

FINAL Report
November 12, 2019

Prepared by:
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Mr. Michael E. Handler
Director of Administration
City of Stamford
Stamford Government Center
888 Washington Boulevard, 10th Floor
PO Box 10152
Stamford, CT 06904

Re: Toquam Elementary Façade Investigation

Dear Mr. Handler:

As directed by the Stamford Mold Task Force, we present to you the results of our investigation of the current conditions and observations of the façade of Toquam Magnet Elementary School in Stamford, CT.

Objective

To investigate potential moisture infiltration locations through the façade of the building which may be contributing to mold growth within the building. Based on our observations we will make recommendation to correct observed deficiencies in the building's façade.

Description of Building

The school was original constructed in 1968. The building is three levels with the middle and lower levels stepping down the sloped site to the south. The stepping of the building allows for the taller spaces of the gym and cafeteria to be a double height space with a full, complete loop of classrooms to be located on the upper story. The lover level also contains the mechanical and custodial storage spaces.

There is an interior courtyard at the middle level with classrooms having access into the courtyard on the south and east sides. The upper portion of the gym and cafeteria create the west wall while a retaining wall creates the north side of the courtyard. The

courtyard is comprised primarily of hard scape with several elevated planters with mature trees. There are passageways from the courtyard at the north, west, and south which travel under the upper level and lead to the outside of the building. The passages to the north and west have been enclosed by roll down metal doors. The passage to the south is open and the floor of the passage creates the roof over the hallway to the gym and cafeteria, custodian room, boys and girls rest room, and grounds maintenance garage. The middle floor also houses the media center and indoor play areas. The media center is located on the outside perimeter of the building facing south. Access to the ends of the media center is from the middle level corridor. The middle of the media center steps down and has access from the lowered floor elevation to the exterior. The indoor play area is located on the outside perimeter of the east side of the building. This area is below grade with natural light being provided through skylights on the east side.

The upper floor of the building consists of a continuous loop of classrooms, main office, and other ancillary and support spaces. The three floors are connected by three stairs. There is a service elevator located on the south side of the building providing access to all primary floor levels of the building.

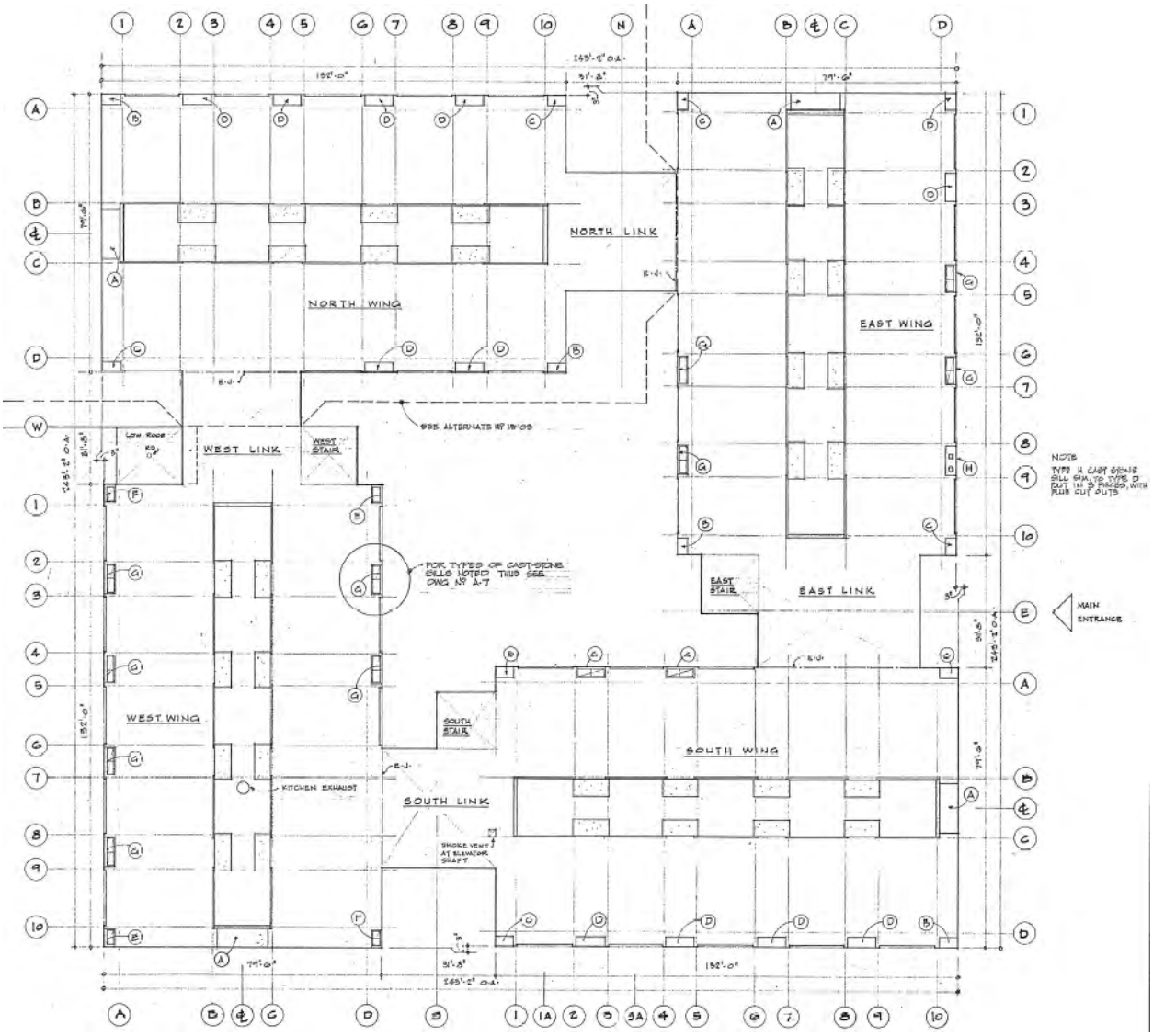
The form of each wing of the building is similar, consisting of an articulation of the exterior wall of the upper level which creates recesses for skylights to bring natural light into the story below. Where there is opportunity for typical windows at the middle level spaces, the recesses are enclosed with a precast concrete cap. The articulation of the upper floor corridor mimics the exterior wall of the upper floor. The articulation creates alcoves for the doors to the classrooms and is the location of the clearstories which bring natural light into the upper level corridor. The building has a flat roof and no parapet. The clearstories project above the roof about 3 ½ feet.

The primary load support structure of the building is a structural steel frame with acoustical metal decking for both the floor and roof. Foundations are formed, cast in place, concrete. Floors that are not elevated are cast in place concrete slab on grade. The exterior walls are a combination of block veneer with a cavity and finished interior block, or single wythe concrete block of varying thickness.

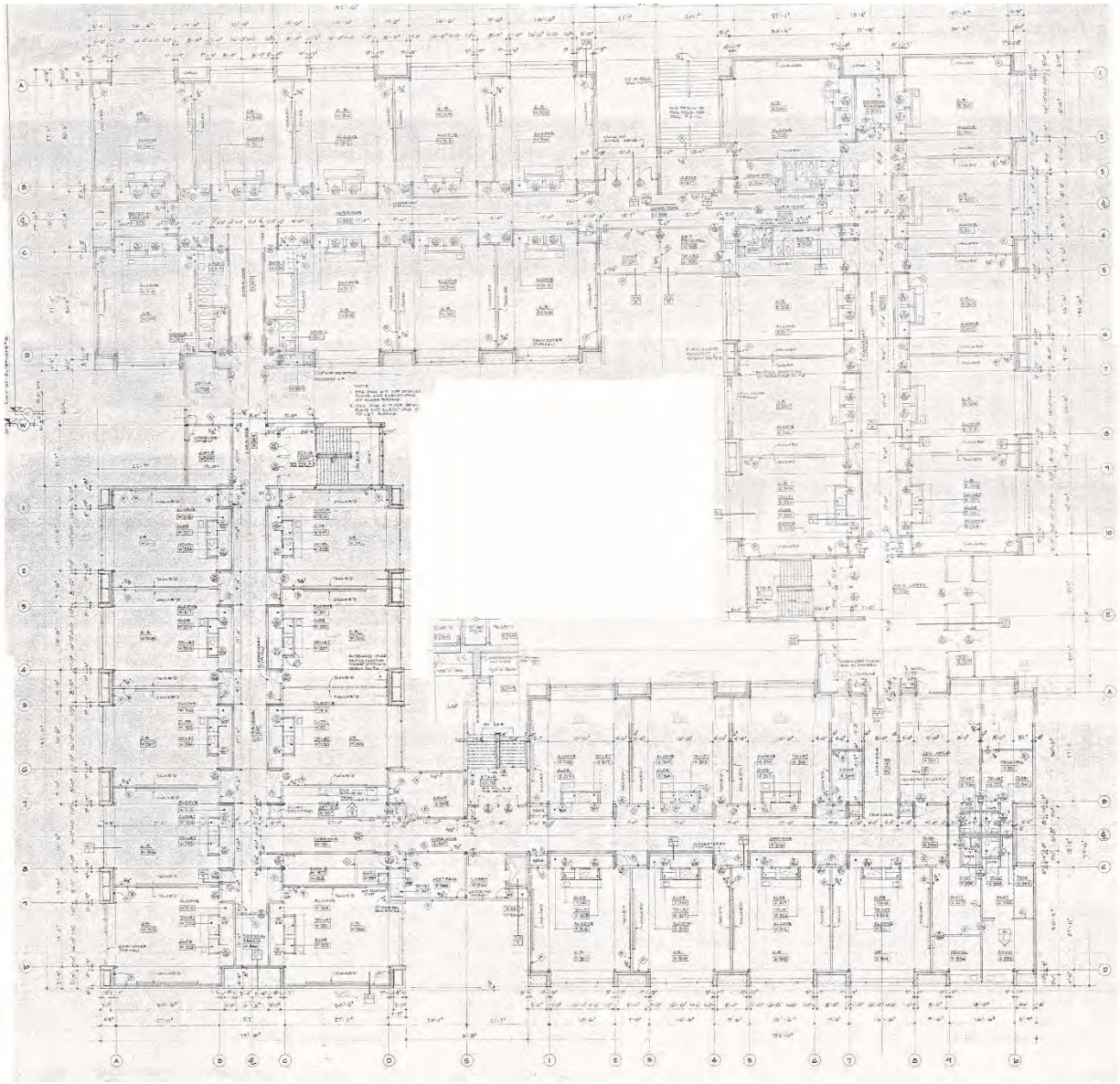
with a basement, constructed of a brick foundation and above grade walls of multi-wythe, solid brick masonry construction. The floor construction is wood joists with T&G diagonal sheathing. The roof is hipped with a 10-foot-wide flat area along the center and is constructed of wood framing. The sloped portion of the roof is constructed slat roof shingles. The roof is drained by a perimeter gutter and downspouts. The exterior walls and the corridor walls create the main load bearing elements of the building with roof and wall framing spanning from exterior wall to corridor wall.

Temporary classrooms have been added to the north of the primary building with a corridor connection back to the upper level.

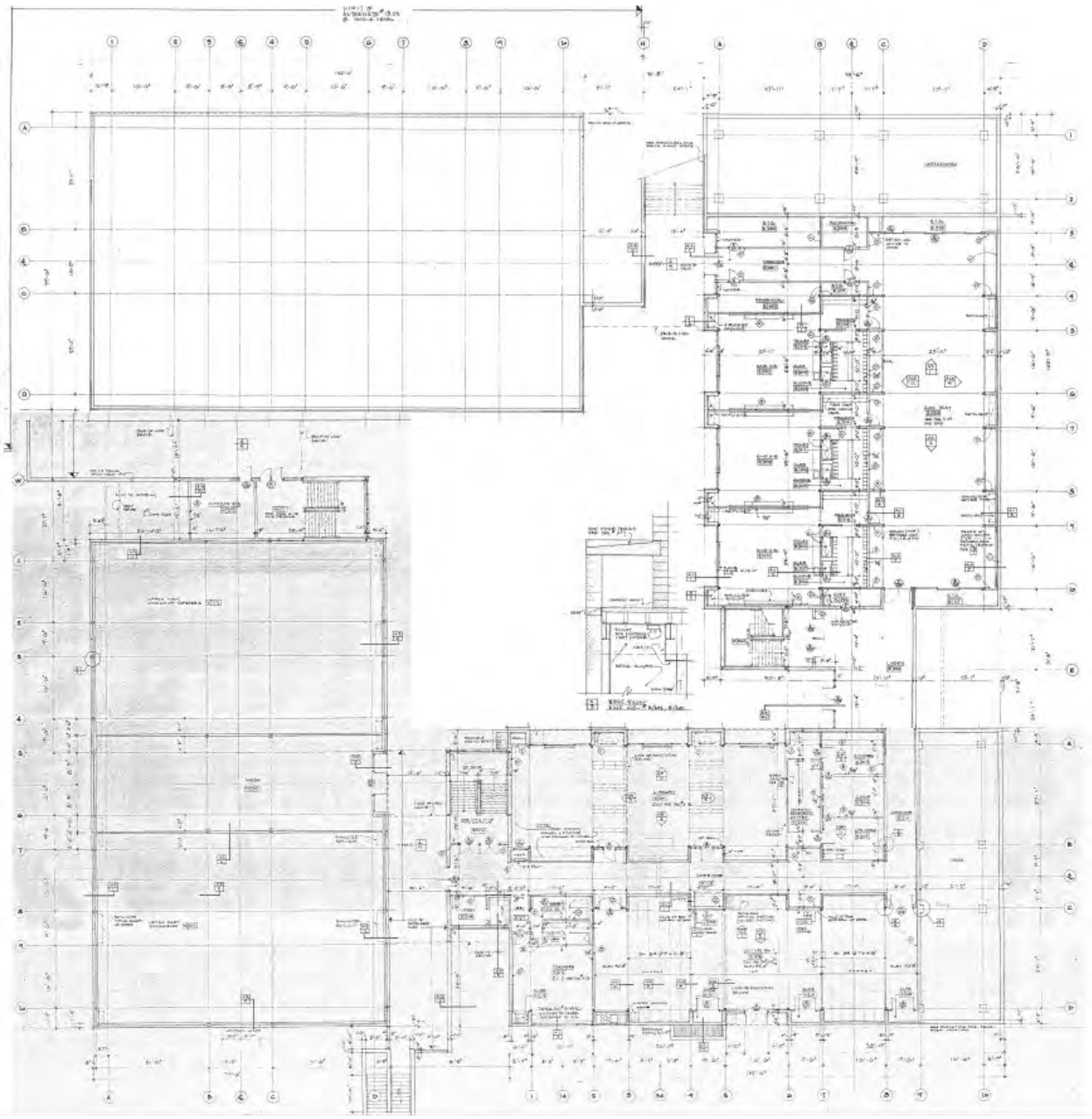
Aerial Image


NORTH LINK
NORTH WING
EAST WING
WEST LINK
WEST STAIR
WEST WING
EAST STAIR
EAST LINK
SOUTH STAIR
SOUTH WING
SOUTH LINK
KITCHEN EXHAUST
MAIN ENTRANCE

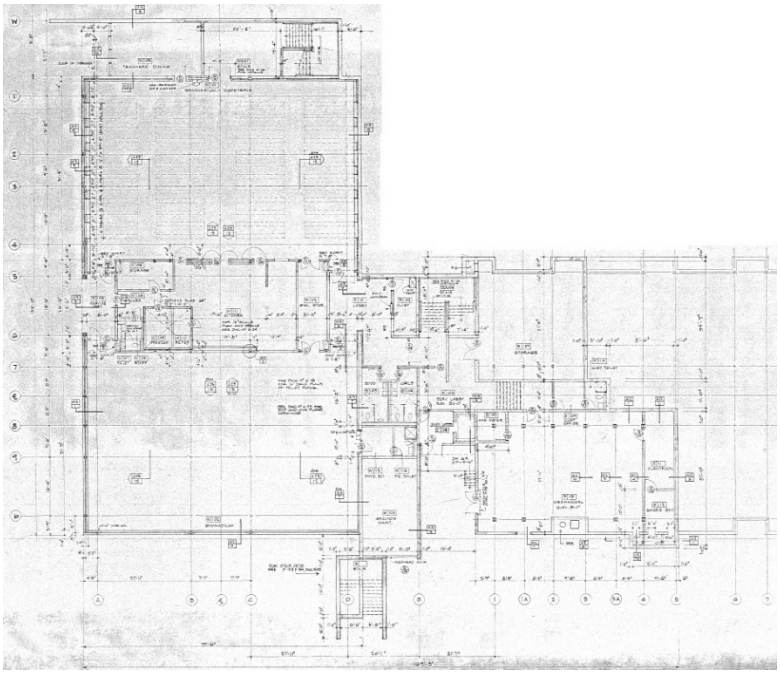
Roof Plan



Upper Level Plan



Middle Level Plan



Lower Level Plan

Field Observations

Observations are based on visible conditions at time of visit. Not all interior spaces were accessible at the time of visit. A temporary wall has been constructed about 4 feet away from the foundation wall in the Interior Kindergarten Play area. This allowed access and observations of the foundation wall at this below grade area of the building. Work was underway at the time of the visit which was removing mold impacted and/or ACM drywall from the light monitors around the building. Roof replacement was also underway during our site visit. Exterior observations were made from grade or roofs. Probe observations were made from ladders when not accessible from grade. This investigation does not include the primary roof areas or the primary roof edge flashing.

Interior Observations

1. Efflorescence is visible on the walls inside of the gym, cafeteria, and stairs where the grade outside of these spaces is elevated above the floor elevation. The location of the efflorescence coincides with the grade elevation outside.
2. Water staining and efflorescence is observed on the interior side of exterior walls of storage and similar enclosed spaces located above grade.
3. Metal building components (access panels, electrical panels, heating system piping, etc.) within enclosed spaces (closets, chases, etc.) along the exterior walls of the building are corroded.
4. Interior brick near the exterior walls or window openings are cracked.
5. Cast-in-place foundation walls at the east side of the kindergarten indoor play area were not well consolidated.
6. Cold formed galvanized metal studs along the exterior wall of the kindergarten indoor play area have minimal to sever corrosion.
7. Mold impacted drywall was observed in the kindergarten indoor play area.
8. A black sheet material was observed at the window wells of the kindergarten indoor play areas, at about grade elevation, coming through the grout joint of the exterior wall. This material would be concealed behind the metal stud and drywall finish.
9. A substantial amount of a white power substance was found on the concrete foundation wall and floor at the north end skylight window well of the kindergarten indoor play area.
10. A dehumidifier and sump pump, discharging through the foundation wall, was found in a closet at the north east corner of the kindergarten indoor play area.
11. It was reported that there is a musty/damp feel to the teachers lounge on the main floor.
12. Floor tiles are cracked within the corridor, outside of the main office.
13. Doors were removed from door frame within corridor, outside of main office.

Exterior Observations

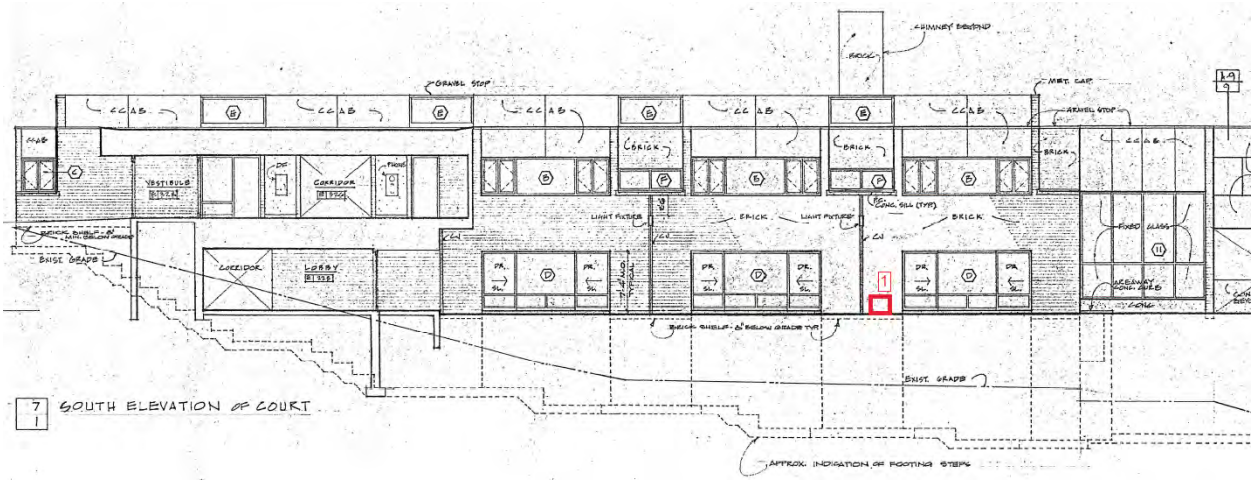
1. At each of the precast concrete caps, skylights, and standing seam metal roofs located at the façade recesses around the upper level:
    a. The water proofing finish has been worn away from the precast concrete cap.

    b. Weeps are present and appear to be open.
    c. There is heavy staining and moss growth at the mortar joints.
    d. Mortar below these areas is deteriorated.
2. Sub sills are missing at window openings of the main office and principal's office.
3. Lintels are missing at window openings of the main office and principal's office.
4. Lintels over kindergarten classrooms at interior courtyard: exposed edge of steel are rusted, delaminating and, in areas, rust has caused the welded steel plate below to deflect.
5. Sealants around window and door openings are rigid, cracking, and delaminating from adjacent materials.
6. Aluminum window frame finish is worn, exposing the bare frame material.
7. Sealants around black panels and red frames above windows is deteriorated and cracking.
8. Finish of the black panels is deteriorated.
9. Finish of the red frames around black panels is deteriorated.
10. Red frames around black panels is damages at multiple locations.
11. Seals of the glazing at typical classroom windows are cracked and missing.
12. Window systems are not thermally broken and do not use insulating glass which during cold weather may lead to excessive condensation forming on the interior of the windows, damaging interior finish material adjacent to the windows.
13. Exterior doors are in generally good condition, but lack thermal improvements typical of newer door systems.
14. It was observed in multiple location around the building that the 12" wide wing walls on either side of the upper level classroom windows:
    a. Brick at the upper portion of these walls are cracked.
    b. Brick have been pushed out of alignment with the brick below.
15. Brick and mortar joints in the major brick wall areas are in disrepair.
16. Brick and mortar joints at steal lintels around the building are in disrepair.
17. Brick lintels are in generally good shape and needing some repainting.
18. Brick walls around the grounds garage and adjacent exterior stair need extensive restoration.
19. Steel structure of exterior barrel vault skylight needs to be repaired and painted.
20. Efflorescence within stair under barrel vault skylight.
21. Masonry damage at stair under barrel vault skylight.
22. The guardrail walls adjacent to the courtyard exits and main entrance have extensive damage to both the brick and the mortar joints.
23. Hose bibs around the building need to be sealed.
24. Plywood panels outside of room W103, North of the Cafeteria, must be replaced with a proper exterior finish material.
25. Precast concrete cap between Classrooms E301 and E302: Pipe penetration through it is sealed with foil face tape.
26. Expansion joint between Classrooms N301 and N302 needs to be repaired.
27. At the recess between Classrooms E301 and E309 there is an open junction box and a junction box that needs to be sealed around.
28. Exterior stairs at the north leading to the courtyard have settled creating a 1 ½" +/- lip at the top tread.

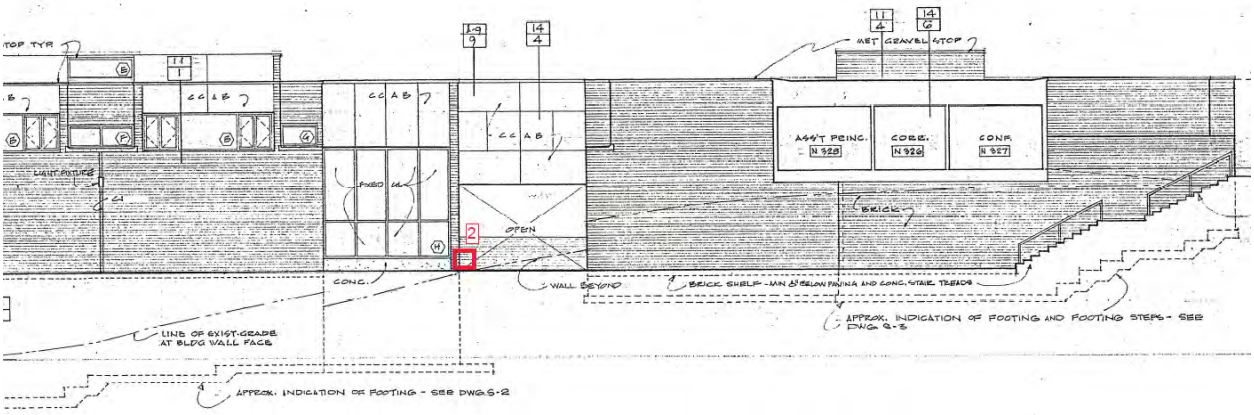
29. At the covered walkway leading from the courtyard to the north:
    a. There is a large amount of efflorescence coming through the ceiling at the wall control joint.
    b. Efflorescence is forming on the west wall under the overhang of the floor above.
    c. The bottom of the brick weeps are below the top of the concrete sidewalk.
30. At the alcove between Classrooms E301 and E302, sealants around top edge/term bar of the modified bitumen roofing are cracked and delaminating.
31. The skylight between Classrooms E302 and E303 has been repaired with flashing tape. This is a temporary fix.
32. Original skylights along the west and east sides of the West Wing, the north side of the South Wing, and the West side of the east Wing have been replaced with a red standing seam metal roof. The only skylights that have not been replaced are at the east side of the East Wing.
33. The South Courtyard exit's concrete floor surface and waterproofing traffic coating are cracked and in disrepair.
34. At the West, South and East building stairs:
    a. The parge coat at the base of the storefront windows is spalled and needs repair.
    b. Exterior metal corner guards are damaged and sealants to brick are cracked and open.
    c. Efflorescence is observed on the interior face of the exterior walls at around the ground elevation.
35. Exterior soffits are in generally good condition needing minimal scraping and repainting.
36. Grade at the east side of the building is sloped back towards the building.
37. Grade outside of room W103 is elevated preventing surface water from being able to flow away from the building.

Exterior Probes

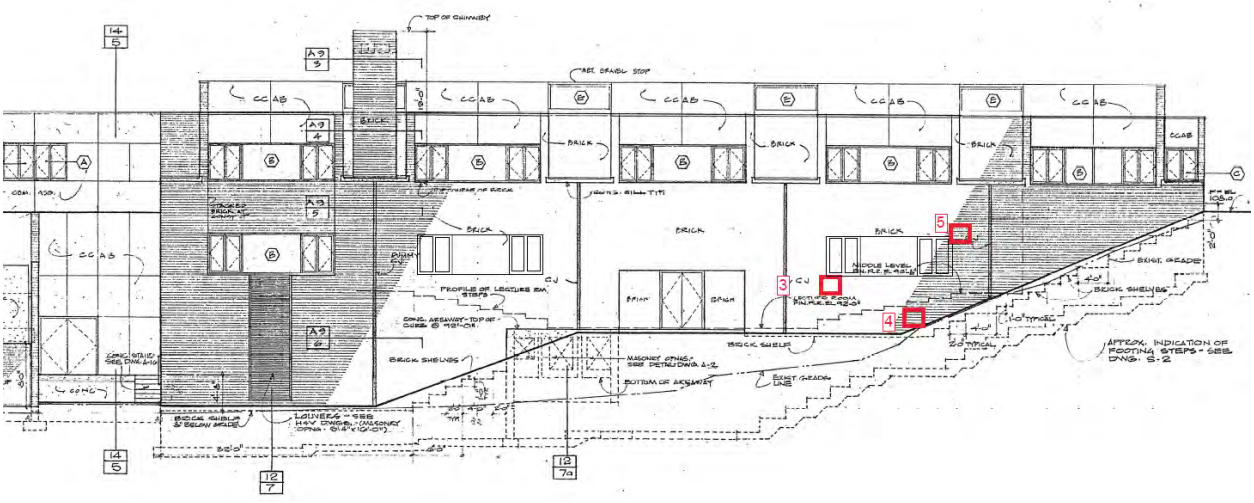
Brick was removed at various locations and conditions around the building. These conditions were reviewed for quality of work, condition of building materials and adherence to the details. Test probes were cut on or around October 10, 2019 and were observed by SP+A on October 21, 2019. The test pit on the east side of the building, down slope from the entry loop drive was dug on October 19, 2019. A representative from GeoInsight was present during the excavation. SP+A observed the test pit on October 21, 2019. There was approximately 0.40" of rain the night of October 20, 2019.



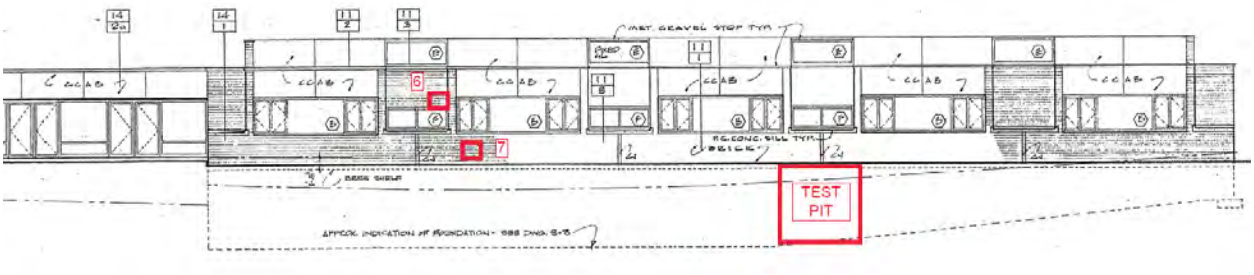
Partial South Elevation at Courtyard



Partial West Elevation at Courtyard



Partial South Elevation



Partial East Elevation

Probe 1

Brick weeps at this probe location are one course above where the through wall flashing is tucked into the mortar joint of the exterior brick. At the top of the test probe is a piece of ladder reinforcement which extends into the probe approximately 10 inches from the right and is not continuous across the probe opening. Through wall flashing is tucked into the mortar bed of the exterior wythe of brick, extends into a cavity that extends 2 courses high, runs vertically 8 inches and then into the mortar bed of the brick above. Brick at the base through wall flashing is 4 in thick. Brick above the through wall flashing is approximately 8 in thick. Through wall flashing is brittle and cracked. Mortar is generally in good condition with some small areas not adhered to the head of brick. Sand at the bottom of the brick cavity is damp. Cells of the bottom two courses of 8" thick brick, located just above the through wall flashing, have been grouted. Courses above have not been grouted.

P1-1

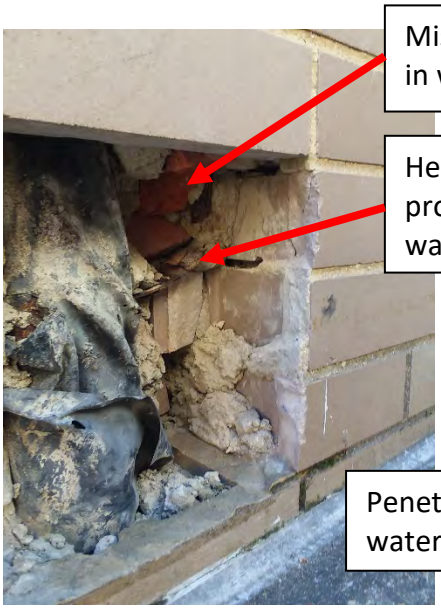
P1-2

P1-3 P1-4

Probe 2

There is a column buried within the wall about 8 inches back from the metal cover. It is wrapped in the same plastic flashing use for the through wall flashing. There are no weeps and no through wall flashing within the wall at this location. There is a stair behind this location leading to the lower level. The steel is exposed in some areas and it's starting to rust. There are brick ties attached to the steel column that are rusted and which protrude through the plastic flashing. The plastic flashing is not lapped properly to prevent water from migrating behind the flashing. The plastic flashing is rigid and brittle. The sealants at the metal cover are completely delaminated from the metal. There are small vertical fractures in the face of the brick above the test probe.

P2-1 P2-2



P2-3

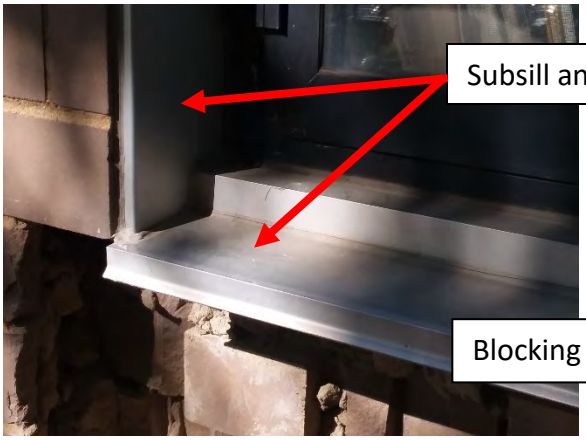
P2-4

Probe 3

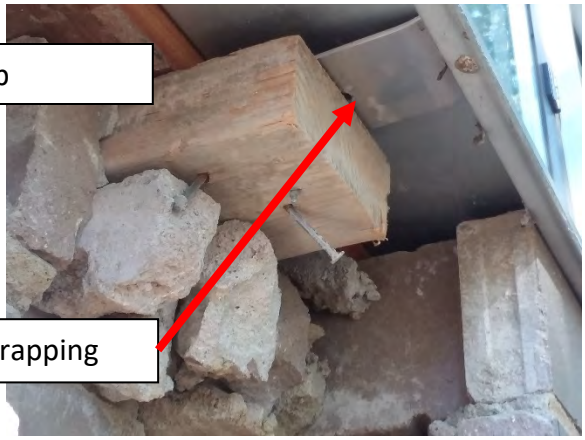
Probe is located at the bottom left corner of the east most window at the media center. This window was not included on the original drawings. There is no under sill flashing. There does not appear to be any leaking through the subsill of the window. Sealants around the subsill are still spongy and adhered to the adjacent materials. There is no water resistive barrier behind the brick. The wall is made up of both 4 inch and 8 inch thick bricks. Mortar has fallen out to the interior of the building exposing the interior of the building at this test probe. The wall is 8 inches thick below the window opening and constructed of one wythe of 8 inch thick brick.

P3-1

P3-2



P3-3



P3-4

P3-5

P3-6

P3-7

Probe 4

Probe is located at grade elevation below the window to the media center. There are no weeps at this area of the wall. Grade is sloping up from left to right across the base of the building. There is no water resistive barrier within the wall assembly. Some wire reinforcing bar was found within the grout line at the top of the probe. Cells of brick are grouted solid at grade elevation and open above grade elevation.

P4-1

P4-2

P4-3

P4-4

P4-5

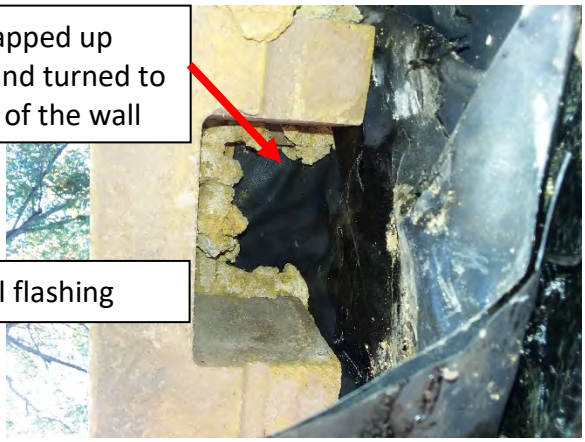
Probe 5

Probe is located at the top right-hand corner of the window to the media center. There is a large steel lintel across the top of the window. Steel lintel appears to consist of a plate with a t or angle welded to the top of it. There is a flexible through wall flashing membrane located above the lintel and turns out across the top of the lentil to the exterior. There is an end damb formed by the through wall flashing at the right side of the probe opening. The top of this flashing extends up the wall cavity two courses and then turns to the exterior at the second grout line above the window. There is a small piece of wire reinforcing located one course above the window lintel and it is not continuous across the grout line. The wire reinforcing is penetrating the flexible through wall flashing membrane. There is pea stone gravel above the window lintel. There are tube weeps a 24-inch on center across the top of the window. The exposed portion of the window lintel has minimal rust on the exposed face and little rust where it was buried into the grout line. Next to this test probe a piece of the wire reinforcing is exposed through the grout line. The through wall flashing at the steel is rigid but is still flexible about 4 in above the steel.

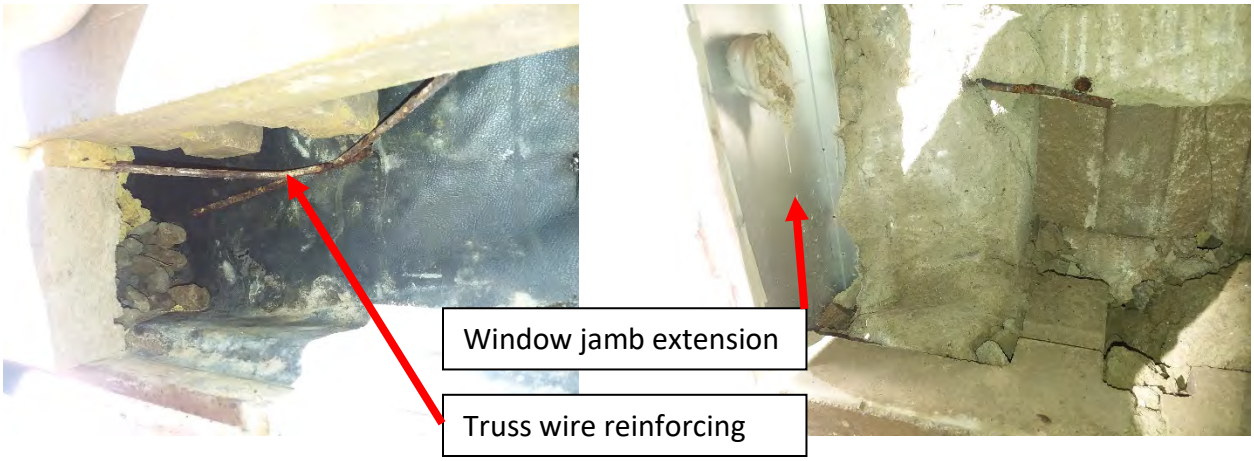
P 5-1

P 5-2

P 5-3



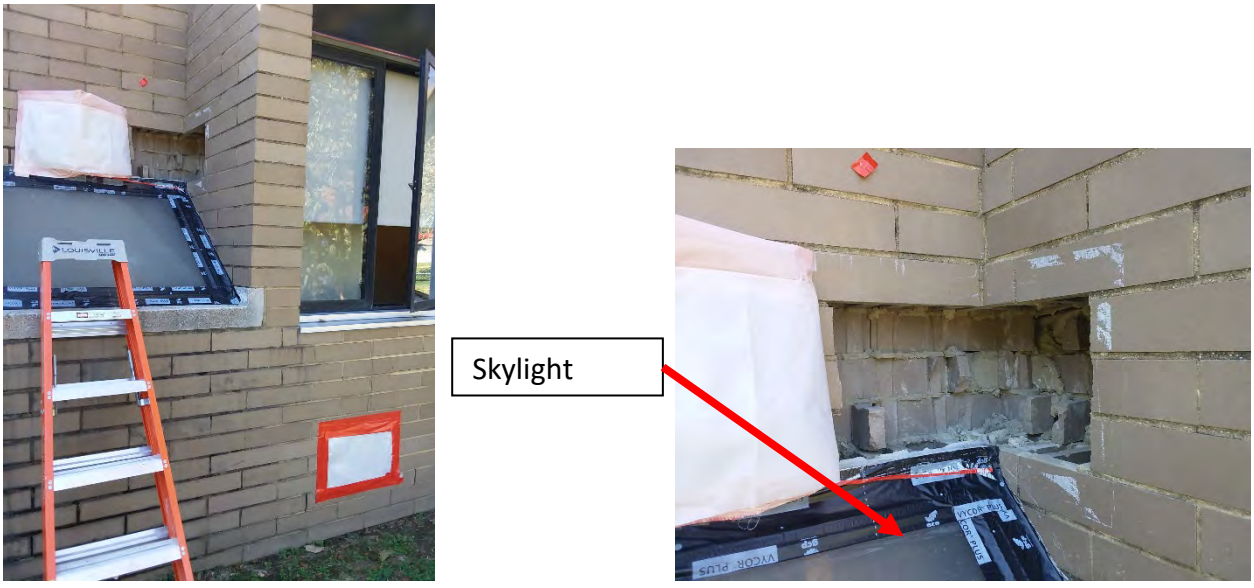
P5-4



P5-5 P5-6

Probe 6

This probe is located above a skylight, at the back corner of the recess between classrooms E304 and E305. The skylight at this location allows daylight down into the lower level kindergarten indoor play area. This area is constructed of both 4, 8 and 12 inch thick brick. When the plastic protecting the opening was peeled back there was a large amount of humid and mildew smelling air that came out of the opening. The flashing across the top of the skylight only penetrates 1/2 in into the brick veneer. There are no through wall flashing or Weeps at the top edge of the skylight. The sides of the Skylight do not have any flashing let into the brick veneer. Sealant is the only water resistive barrier at the perimeter of the skylight. The sealant is cracked along the entire length.



P 6-1 P 6-2

Skylight top edge flashing regletted into mortar joint

P 6-3

P6-4

Rusted metal Unistrut

Efflorescence in block cells

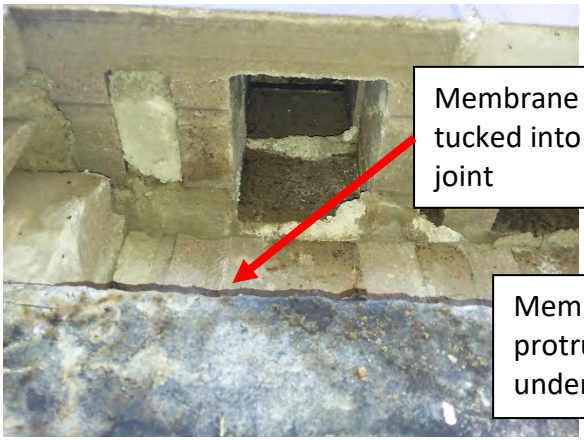
P6-5

Probe 7

Probe is located on the east elevation below the upper level classroom E304 window, to the right of the main entrance. The probe is located 1 course above the weep holes. The bottom of the flexible through wall flashing cannot be located at this area. The top of the through wall flashing is three courses above the bottom of the weep holes. The through wall flashing is between the exterior 4-inch-thick brick veneer and an inner brick. It turns into the grout line of the inner brick wythe. The flashing is visible from the interior where wall finishes have been removed from the indoor kindergarten play area. The through wall flashing is becoming rigid and there is a large tear in the membrane. There is no reinforcing visible at this area. The flexible through wall flashing has white staining on it. It also appears to be damp. The probe opening was well sealed using red duct tape and plastic sheeting. There are also a large number of small dead ants within the probe opening. There is an abundance of musty, damp air coming out of the probe opening.

P7-1

P7-2



P7-3

P7-4

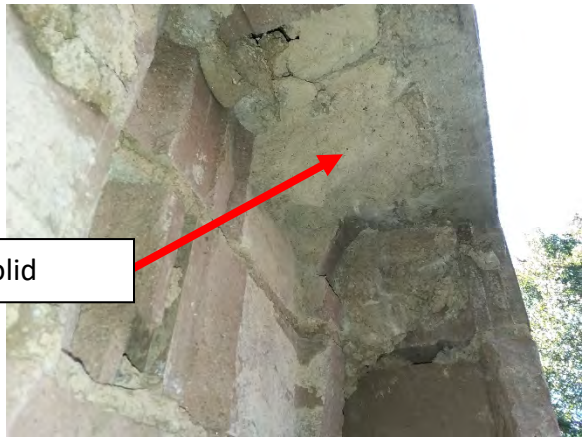
Probe 8

Probe is located above the through wall counter flashing above a roof over room W103. There are weeps at 24 inches on center above the counter flashing. The cells of the brick veneer are grouted solid for the four courses that are visible. There is a flexible through wall flashing located above the counter flashing terminating about 1/2 inch back from the face of the brick veneer. The through wall flashing turns up when it reaches the backside of the 8 inch veneer brick. The through wall flashing is not adhered to the counter flashing below it. The counter flashing seams are not sealed from one piece to another. The flexible through wall flashing is becoming rigid and brittle. There are several penetrations in the through wall flashing which may have been caused by the probe demolition. Behind the brick veneer there is pea gravel. The weeps appear to be blocked by the mortar and do not appear to be continuous all the way back to the pea gravel.

P8-1

P8-2

P8-3



P8-4

Document Review

Architectural drawings prepared by Sherwood, Mills and Smith Architects dated August 1967 were provided SP+A. Partial electrical, HVAC, and plumbing drawings prepared by John Alltieri of the same date were available for review as well.

Adherence of Construction with Design Documents

When comparing the design documents with the field observations and probes, the building façade is in general conformance with the design documentation. Outlined below are conditions that are not in conformance with the design documents.

Probe 1: There are no wall sections of this typical condition of the building. A similar condition may be found in wall section 5 on A11. This wall section is taken at the skylight over the kindergarten indoor play area. This Section shows the skylight condition and the base of wall condition at grade and transitioning to a foundation wall. It also shows a metal stud and gypsum wall board (GWB) finish on the interior below the skylight. Interior Elevations for the classroom inside of this probe location calls for a metal stud and GWB finish (10/A17). Wall Type J is indicated on A4 for the wall at this probe location. This wall type calls for ½" GWB and insulation in the stud cavity. Section 5 on A11 does not show any base through wall flashing or weeps. These are provided at this probe location, but the weeps are located above the base of the through wall flashing, which would not allow water within the cavity to escape through the weep. 5 on A11 calls for a 4" cavity with 8" exterior brick. Brick thickness found at the probe is consistent with the detail. Insulation and size of wall cavity inside of the 8" brick was not determined during our investigation. Other walls section for the building call for a clear silicone coating on the exterior face of the exterior brick. This product is intended to waterproof the exterior surface of the grout and brick, preventing water from infiltrating into the building. This product is not permanent and must be maintained to ensure water does not migrate through the brick and mortar and to the interior of the building.

Probe 2: Plan 2 on Sheet A16 – The stair plans show the location of the square column within the outside corner of the masonry wall. No wall sections or details have been found in the drawings provided to indicate the intended construction of the wall at this probe location. Stair plan seams to imply that this wall is a single, 12" thick brick. Probe appears to indicate that the wall is constructed of an 8" thick exterior brick layer and potentially a 4" thick interior brick layer. The lack of weeps at the base of the wall and from what was observable in the test probe, it is unlikely that there is a water resistive membrane within this wall assembly.

Probe 3: The plans and elevations for this area of the building did not identify a window being provided at this location. A partial Media Center Plan from Sheet A4 and Elevation from Sheet A9 indicate, in red, the location of the test probe. There are no building sections or wall types to identify how this area of the building was to be constructed. Removal of the outer face of the brick revealed that this area is a single 8" thick brick between the exterior and interior of the building. There is no insulation or additional building materials on the interior of the building. The 8" brick is exposed on the interior of the building. Some mortar was dislodged from the interior side of the brick which allowed a clear view through to the outside. There is a

windowsill detail 7 on Sheet A21 showing the window assembly and how it sits in the wall. The probe shows that the sill detail is substantially similar to the way the assembly was constructed.

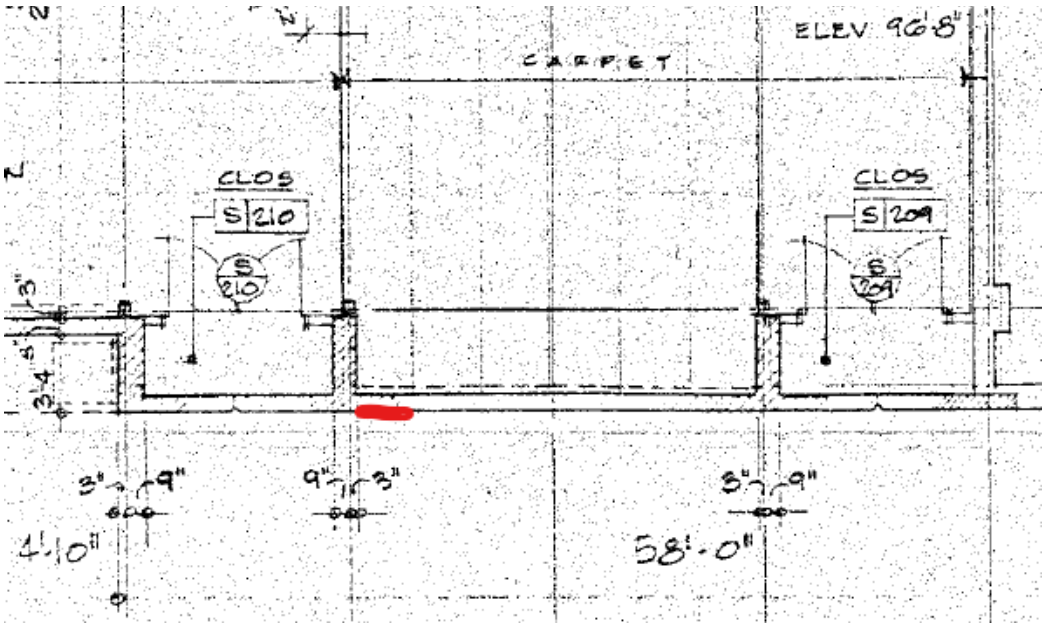
Probe 4: There are no building sections or wall types to identify how this area of the building was to be constructed. The lack of weeps at the base of the wall and from what was observable in the test probe, it is unlikely that there is a water resistive membrane within this wall assembly. Exterior Brick are 8" thick.

Probe 5: The plans and elevations for this area of the building did not identify a window being provided at this location. A partial Media Center Plan from Sheet A4 and Elevation from Sheet A9 indicate, in red, the location of the test probe. There are no building sections or wall types to identify how this area of the building was to be constructed. Window head detail 13 on Sheet A21 and window jamb detail 8 on Sheet A21 are substantially similar to what was constructed. The window jamb aluminum extends to the exterior face of brick, beyond what is shown in the detail. There is no drip bar provided at the bottom front edge of the steel window lintel. There is stone provided in the cavity behind the first course of brick above the window which is not included in the details. Window at this probe location is provided with weep tubes at 32" o.c. which is not included in the details.

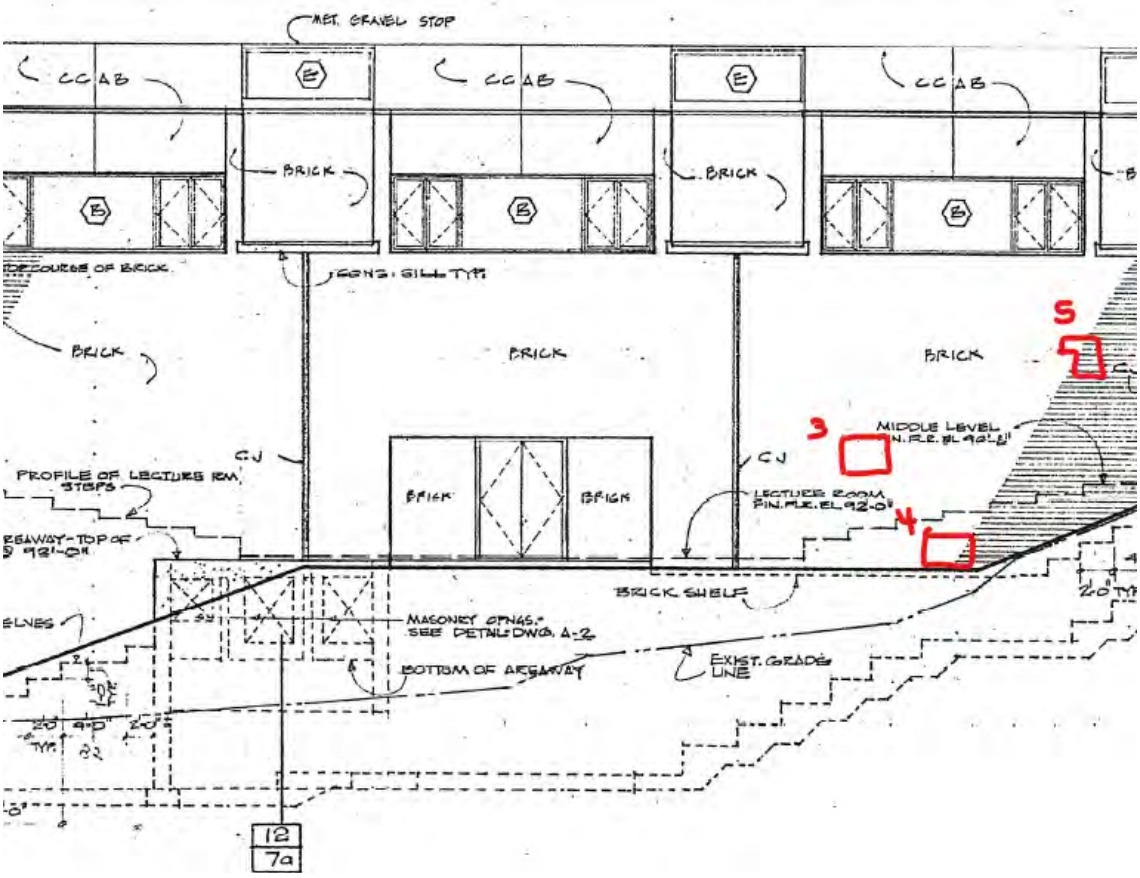
Probe 6: Wall Section 5 on A11 Skylight details 27 & 28 on A21 – Wall construction at this probe is substantially similar to the wall section and details provided for this condition. The interior wall type is identified to be F on Sheet A5. Wall Type F is identified to be ½" GWB on 3 5/8" metal studs. Side wall between classroom windows and skylight, show in elevation 2 on A17 is identified to be exposed brick on the interior of the classroom. Probe shows that this wall is constructed of 12" thick brick with no water resistive barrier within the wall.

Probe 7: There are no wall sections or details of this typical condition of the building. Exterior wall of classroom, below the classroom's windows, shows in elevation 3 on A17 that there is a radiator cover over the brick. Wall Section 1 on A11 shows a typical wall section at the upper floors classroom exterior window. That section shows an 8" thick brick below the windows at the exterior wall with no interior room finish or insulation. Wall Section 5 on Sheet A11 is adjacent to this probe location and shows the base condition above the foundation wall. This detail does not call for weep holes or flexible wall flashing which is provided at this location.

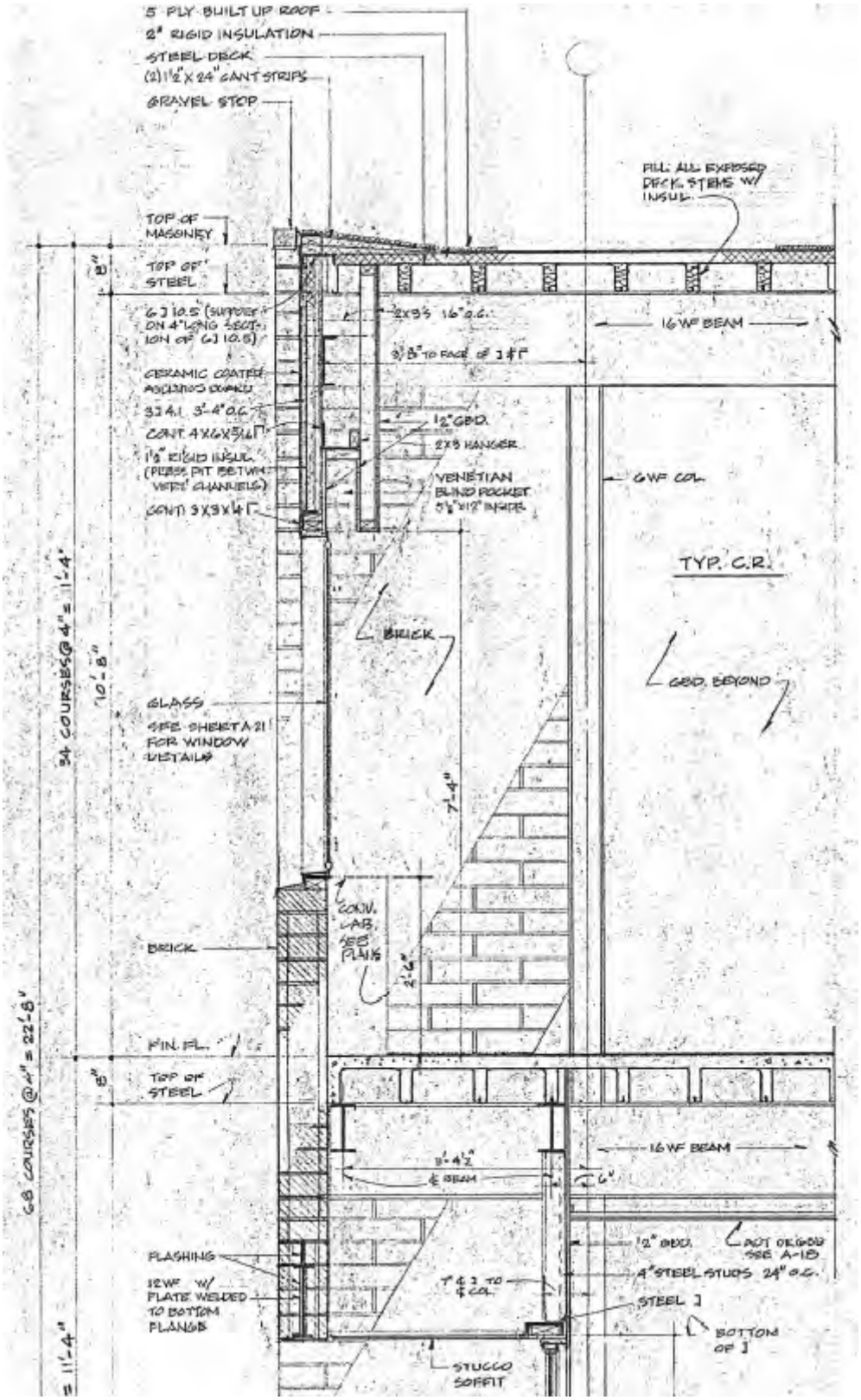
Probe 8: Wall Section 11 on Sheet A13 – Wall construction at this probe is substantially similar to the wall section. The wall section calls for loose insulation fill within the outer wythe brick cells which was not observed at the probe.



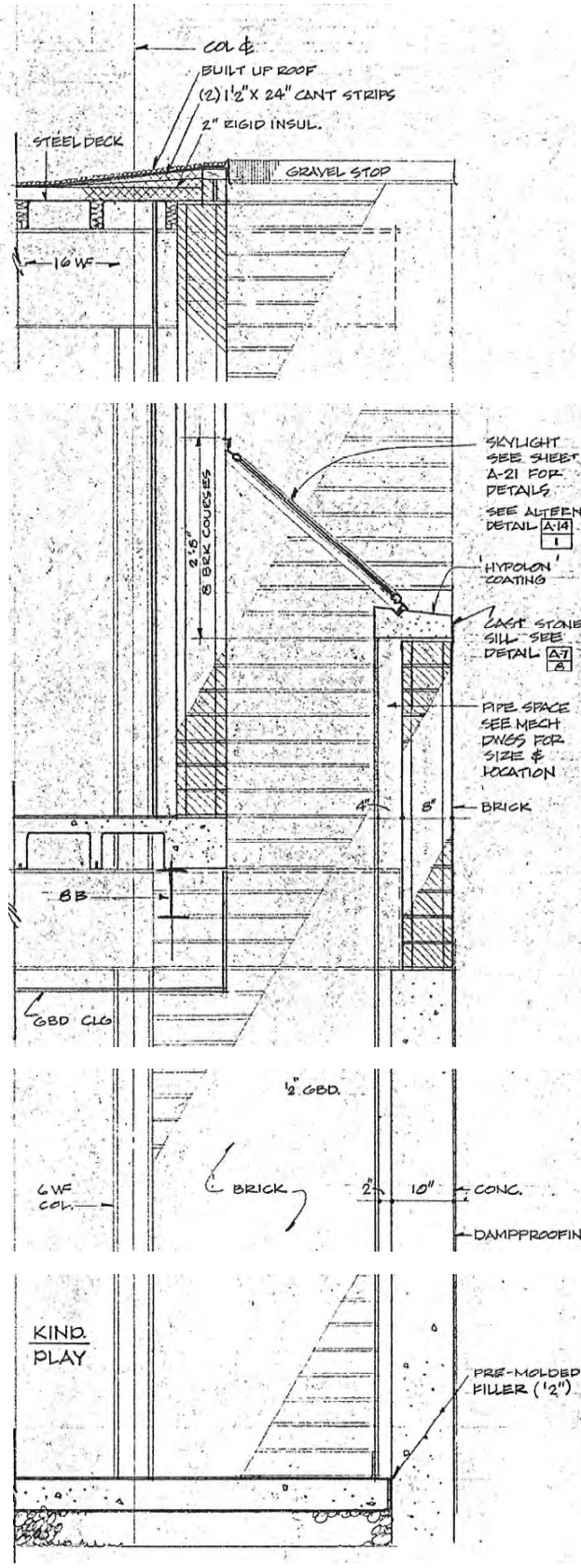
Partial Plan of Media Center from Sheet A4



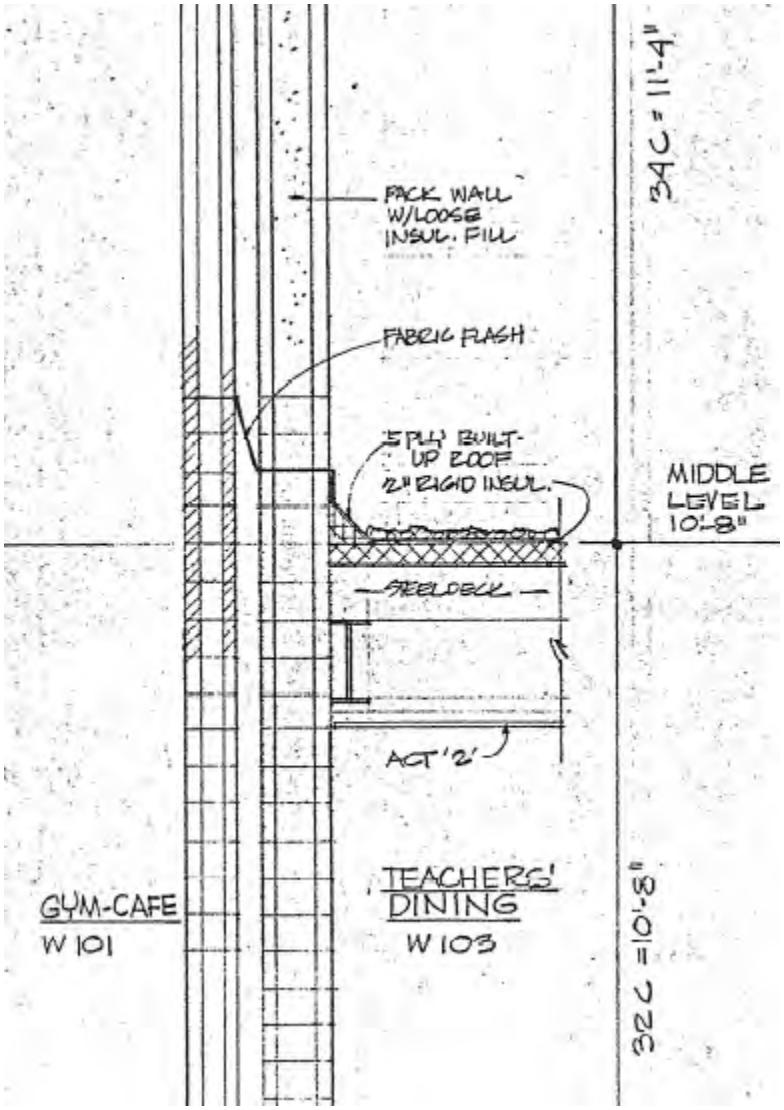
Partial South Elevation at Media Center on Sheet A9



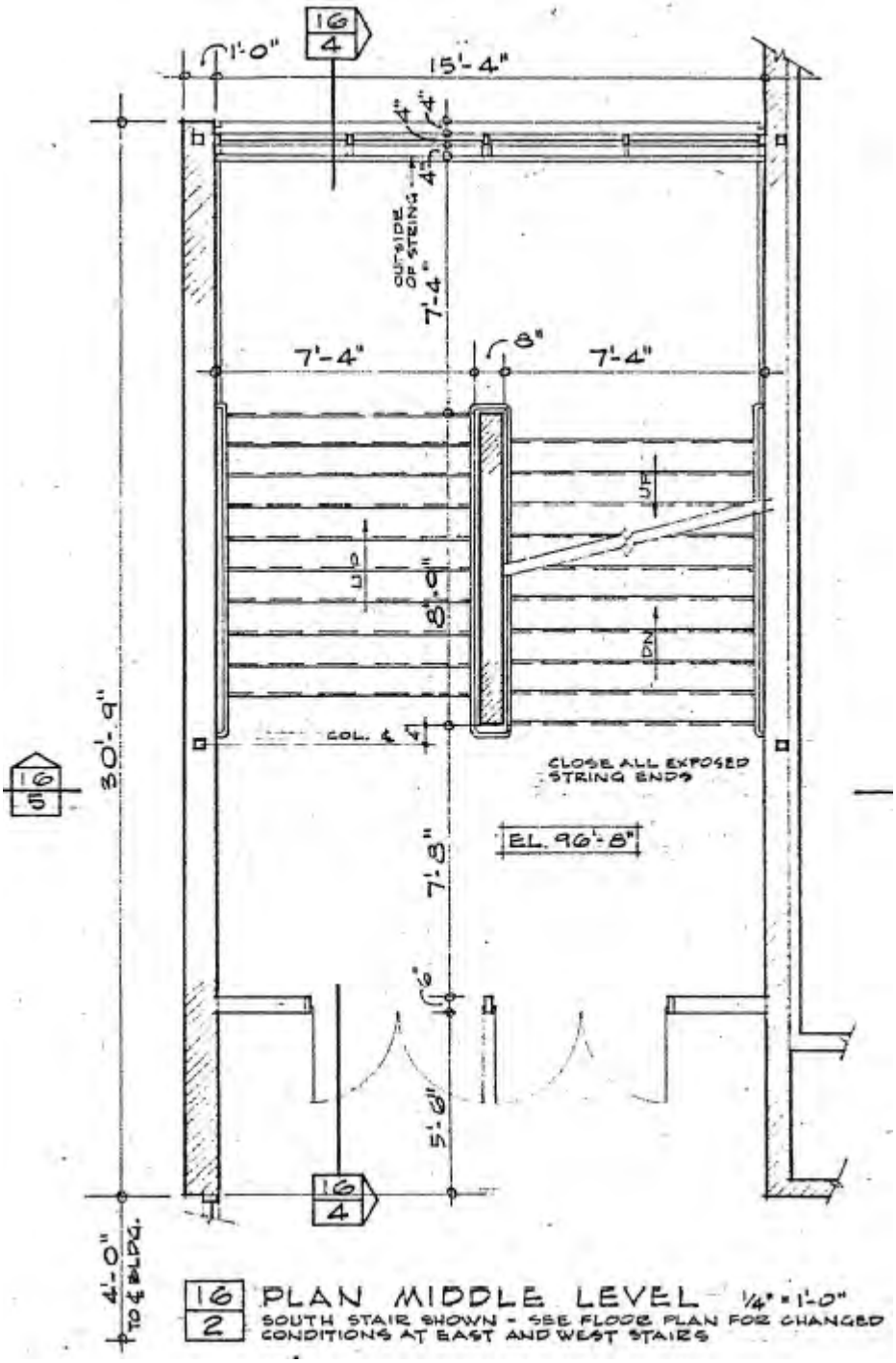
Partial wall section 1 on A11



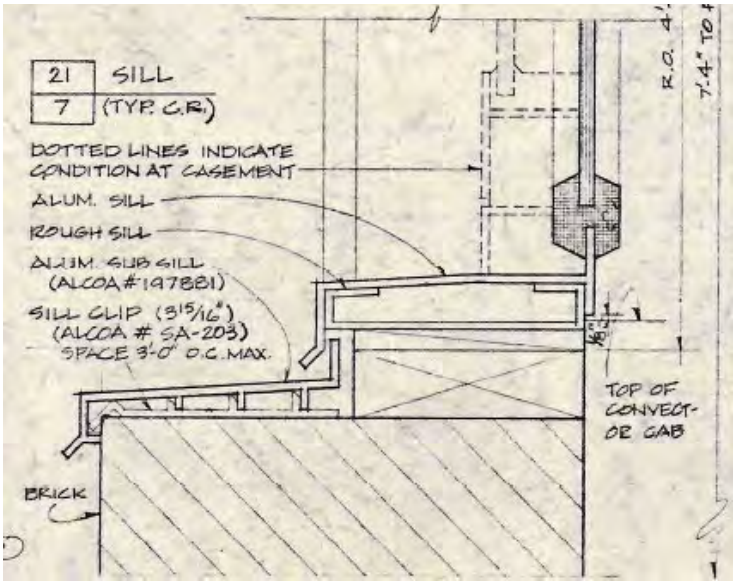
Wall Section 5 on Sheet A11



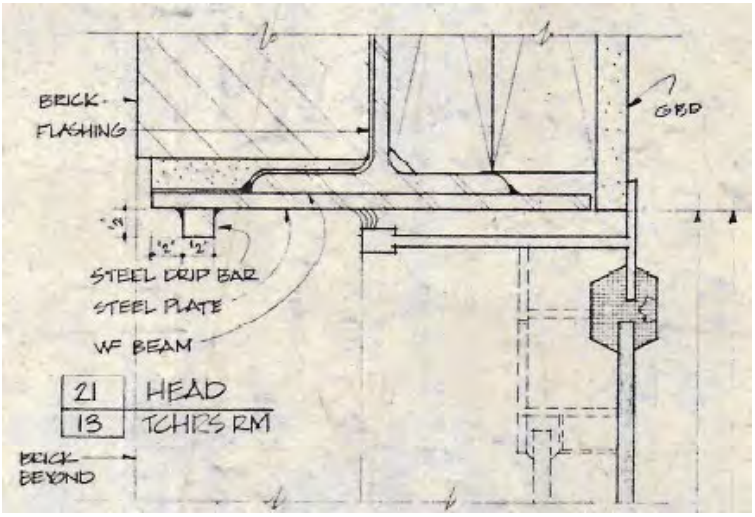
Partial Wall Section 11 on A13



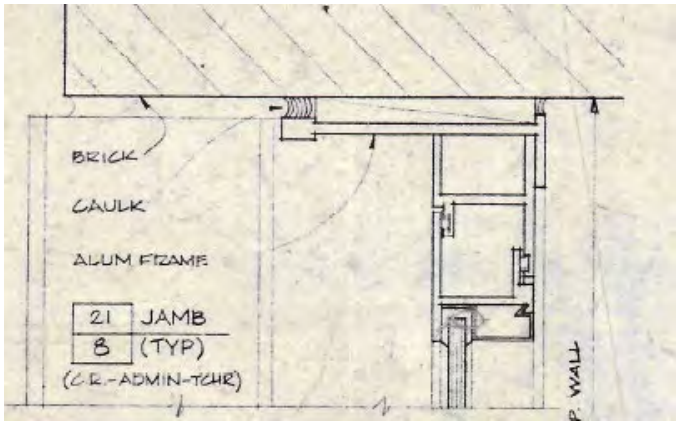
Plan 2 on Sheet A16



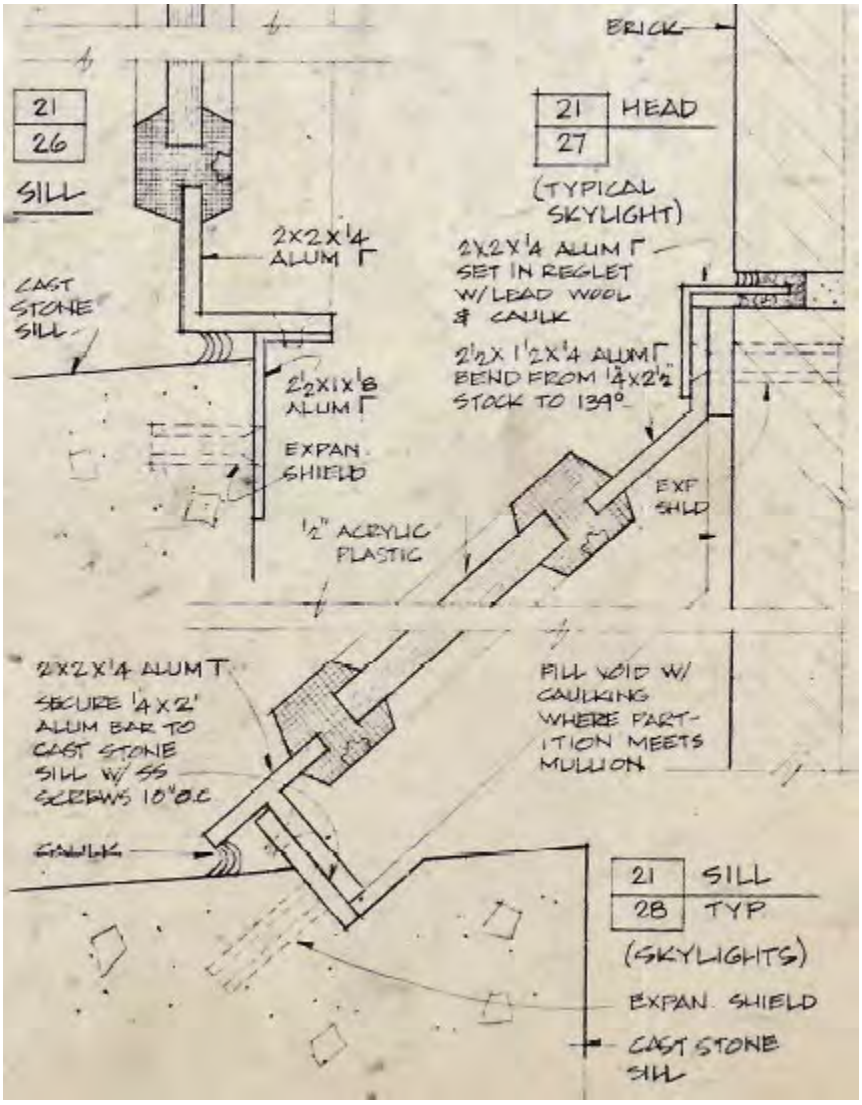
Window Type B – Detail 7 on Sheet A21

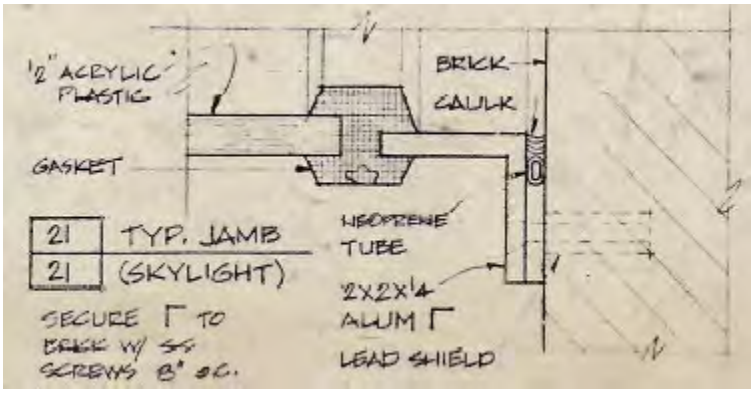


Window Type B – Detail 13 on Sheet A21



Window Type B – Detail 8 on Sheet A21





Skylight Details 21, 27 & 28 on Sheet A21

Discussion

The buildings structure is a load bearing steel frame with brick masonry infill. The brick infill is constructed in several ways ranging from a simple, single 8 to 12-inch wythe thickness to a

more robust cavity wall assembly with single 8-inch wythe veneer. In older, solid masonry buildings, the mass and thickness of the masonry facade provided infiltration protection by being solid and thick. Heat from within the building would warm the exterior walls and drive any moisture which penetrated it to the outside. In principal, portions of the Toquam school's façade is this type. The difference is that the brick of Toquam is not solid and in many areas is not as thick as these older buildings. It is similar in that there is very little insulation at some of the exterior walls which allows the interiors heat to warm the exterior brick and drive the moister within the exterior walls to the outside. A drawback to this type of action happens during the summer since the interior of Toquam is air conditioned. With the interior of the building being cool and dry, and the exterior being warm and damp, moister will be driven to the interior of the building if there is no vapor barrier in the wall assembly to stop it. It is likely that the buildings A/C will draw the moisture that enters the building in this manner out of the interiors air after it has passed through the exterior walls and condense it within the A/C unit and discharge it through the condensate drain. But if the interior elements of the building are cold and warm damp air comes in contact with them, condensation will form on those materials. Constant wetting and drying of materials such as the paper used on GWB will allow mold to grow on those surfaces.

The test probes found that in some areas a rubberized through wall flashing was used. This type of flashing was a new type of material to be employed for this type of use when the building was constructed. Historically, an asphalt impregnated felt would be used as a water resistive barrier or through wall flashing. This rubberized product, commonly referred to as "Nervastral" for the company that manufactured the product, replaced the asphalt felts. This product, during the time of Toquams construction, was not UV stable, meaning it could not be exposed to daylight or it will degrade. Also, being a rubberized material, it was susceptible to drying out and cracking. Nervastral's use in the Toquam school was used as it was intended to be, but because of the materials susceptibility to drying out, it has become brittle and tears have formed in the material.

Many of the wall sections show a cross hatching across the entire width of the brick where the brick is to be only one wythe thick. The intent of this hatching was not able to be determined. It may have implied that the wall should be grouted solid. From our test probes we know that in some areas the base of the wall was grouted solid for two to three courses but was left ungrouted above. Some wall sections show a cross hatch across the outside and inside faces of the brick, indicating where the brick is solid, and that there is a core in the middle of the brick. The core area has a stipple pattern in the core area of the brick. The stipple area is called out to be loose insulation fill. From our test probes we did not see that the cores of the brick were filled with any material. All the wall sections that are taken at the exterior wall have one or the other of these two conditions for the exterior wythe of brick.

There are areas of the building where a metal stud with GWB and insulation is placed on the interior of a single wythe thick brick exterior. Where this is shown to happen in the wall sections, it also shows loose fill insulation within the core of the brick exterior. Because we did not see loose fill insulation in our test probes, we may assume that there is none in these areas as well. If the loose fill insulation was provided it may cause the dew point to form within the core of the brick, resulting in condensation forming in the loose fill insulation. With the

insulation omitted and the assumption of insulation being placed in the stud cavity the dew point would be located in the stud cavity and condensation would form in the cavity's insulation. All of these conditions are not acceptable and introduce moisture into the exterior wall assembly without a way of channeling it back to the exterior. A vapor barrier is needed to prevent the migration of moisture into the wall assembly.

Where skylights are not provided within the recess of the upper level of the building a single piece concrete cap sill is provided. From observation we can see that there was a material that covered the surface of the concrete cap. This material has worn away over time and leaves the concrete exposed to absorb moister. Reviewing the drawings, a "hypolon coating" was called for to cover the exposed surfaces of the concrete cap.

Another design feature of the building are the clearstory and skylights. These areas are the highest point of the spaces they are connected to. This means that the warm moist air will rise up into these spaces. During cold weather the glazed area and the wall surfaces themselves may reach a temperature which would allow the warm damp air to condense on the surface of these materials. Care must be taken to insulate these spaces such that the temperature of the materials will not promote condensation formation or must be constructed of materials that are resistant to the detrimental effects of water forming on them. Neither of these considerations appear to have been employed in the design of the clearstory or skylights. There is minimal insulation at the roof and no insulation shown at the walls of the clearstory. Windows of the clearstory are a simple, solid aluminum profile with single pane glass. There are no provisions taken to prevent thermal bridging. Skylights are constructed in a similar manner.

The windows of the building are an extruded aluminum frame made of a single section. The glazing is similarly a single pane of glass. The aluminum and glass of these window assemblies are in good shape, but the sealants have deteriorated and could be allowing water through the glazing system. As discussed above, during cold weather, condensation could easily form on these materials because of there inability to resist the conductance of cold.

Throughout the façade and roofs, sealants were observed to be dried out, rigid, open and debonding. Mortar joints have cracked and fallen out joints between the masonry. These conditions increase the amount of water that can enter the wall cavity, increasing the wall's potential for leakage.

Information from Others

GeoInsight Test Pit Review

GeoInsight has provided an analysis of the soil and observations of the condition of the exterior face of the foundation wall. A test pit was dug outside of the Indoor Kindergarten Play area on the East side of the building. There findings are attached as Appendix.

EMG Report

Facilities Needs Assessment of Toquam Magnet Elementary School dated April 17, 20-21, 2009 was prepared by EMG. We have reviewed the report for façade improvements indicated to be undertaken. The one improvement we have been able to identify that have been implemented since the issuing of the report is the replacement of the buildings main roof. Improvements indicated in the report that we do not believe have been undertaken are: Epoxy injection at basement floor slab cracks; Caulking; Replacement of curtain wall system with double glazing; Point brick walls; Waterproof brick walls; Subsurface drainage improvements; Replace damaged concrete; Scrape and paint exterior metal; Remove and replace plywood siding. Many of the recommendation included within the report are still necessary as of the date of this report.

Recommendations

Brick Façade Repair Option 1

1. At cavity wall assemblies:
    a. Provide a water resistive barrier on the interior walls exterior surface.
    b. Provide insulation within cavity.
    c. Replace through wall flashing material with a more robust sheet metal through-wall flashing system.
    d. Move or provide weeps above grade plane.
    e. Ensure existing weeps are unobstructed.
2. At single wythe masonry assemblies:
    a. Repair and repoint masonry.
    b. Coat brick and mortar with a clear silicone-based sealer.
3. Replace black panel and frame system, typically located over classroom windows and upper level bridge connections between building wings.
4. Replace all sealants.
5. Provide new waterproof coating over precast concrete caps.

Advantages

The cavity wall assembly improvements will utilize contemporary materials in that type of condition which was not available or understood fully at the time the building was constructed. Adding insulation into the cavity will help move the dewpoint of any water vapor moving

through the wall assembly into the wall cavity, allowing it to drain out of the cavity weeps. New through wall flashing will replace the brittle and broken existing flashing system and provide a more durable and resilient set of materials and systems to manage any moisture which finds it way into the wall cavity.

The application of a surface treatment to the outside face of the brick and mortar will provide a water resistive coating to those materials. It will not seal any cracks in the brick or mortar so proper repair of the masonry façade must be made prior to applying the coating. This approach will have a minimal affect on the current appearance of the building.

Disadvantages

Providing a new water resistive barrier, and insulation in the cavity walls requires the complete removal and reinstallation of the exterior veneer brick, which will be costly. Demolition of the wall will be disruptive to the building operation.

The application of a surface treatment must be followed by a maintenance plan to reapply the material every several years. The treatment is known to yellow over time. The water resistive barrier of the building is not a redundant system and relies on the performance of a single material.

Brick Façade Repair Option 2

1. Repair and repoint masonry façade.
2. Replace black panel and frame system with a suitable substrate material for new exterior finish.
3. Cover all wall surfaces with an Exterior Insulation and Finish System (EIFS) like Dryvit or Sto.

Advantages

The walls will be coated with a high-quality water resistive barrier capable of bridging small cracks in the substrate. The system will add insulation to the building, helping to reduce energy costs. Does not require the disruptive removal of the exterior brick veneer. Only minimal removal of the façade materials of the building is required. This is a single source finishing system, allowing for a single warrantee for the façade. Will produce moderate levels of noise during the masonry repair but the EIFS have a relatively quiet installation process.

Disadvantages

Will alter the appearance of the building. Even with a reinforced finish, EIFS is susceptible to puncture and damaged caused by moderate impacts to the building (sports balls, lawn mowers/vehicles, etc.). The unique design of the building will require greater attention to how each condition of the building will be detailed. Roof edge flashing will need to be replaced to accommodate the increased thickness of the wall.

Brick Façade Repair Option 3

1. Replace black panel and frame system with a suitable substrate material for new water resistive barrier.
2. Provide a water restive barrier, capable of bridging small cracks, over the entire surface of the building.
3. Provide a new rainscreen system with mineral fiber insulation within systems cavity.

Advantages

A sheet applied, self-adhering, water resistive barrier will bridge most cracks in the masonry façade without the need to repair the masonry or mortar. Mineral wool insulation will not promote mold growth, is fireproof, and capable of being in a wet environment, like the cavity of a rainscreen. Will add insulation to the building, helping to reduce energy costs. The finish of the rainscreen can be composed of many different materials allowing for a variety of aesthetic choices. This could be a single source finishing system, allowing for a single warrantee for the façade. Façade materials can be more resistant to damage. Will produce moderate levels of noise during the rain screens frame installation but the rainscreen installation is a relatively quiet installation process.

Disadvantages

Will alter the appearance of the building. This could have the highest cost depending on the system and finishes selected. The unique design of the building will require greater attention to how each condition of the building will be detailed. Roof edge flashing will need to be replaced to accommodate the increased thickness of the wall.

Other Typical Building Repairs

1. Replace windows with new thermally broken, insulated glass, window system throughout building.
2. Replace windows at clearstory with windows having a high condensation resistance (CR) rating.
3. Provide insulation at clearstory.
4. Provide new skylights and proper flashing.
5. Rake out and provided provide new sealants.
6. Scraped and painted all exposed steel.
7. Repair and repaint exterior soffits.
8. Repair any cracks found in foundation.
9. Provide new foundation waterproofing system, insulation, and footing drain at all building areas that are below grade.
10. Seal all penetrations through building façade.
11. Repair exterior windowsill at the base of stair windows.

12. Remove existing exterior concrete walkways over interior spaces below. Repair roof deck surface. Provide new waterproofing over interior spaces below. Provide new concrete or paver walking surface.
13. Provide a proper exterior wall system at “Teachers Dining”, north of cafetorium.

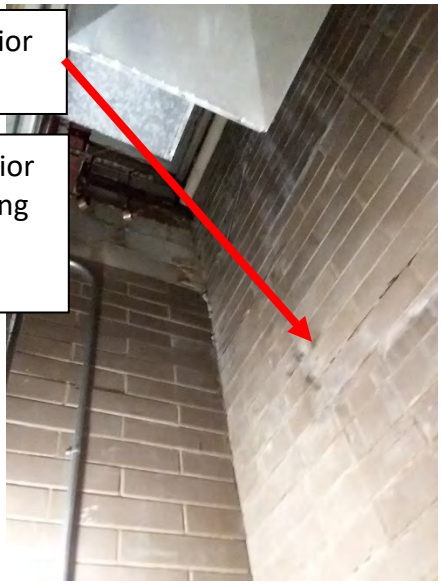
Photographs

Photograph numbers correspond to Field Observation section numbering.

Interior Observations

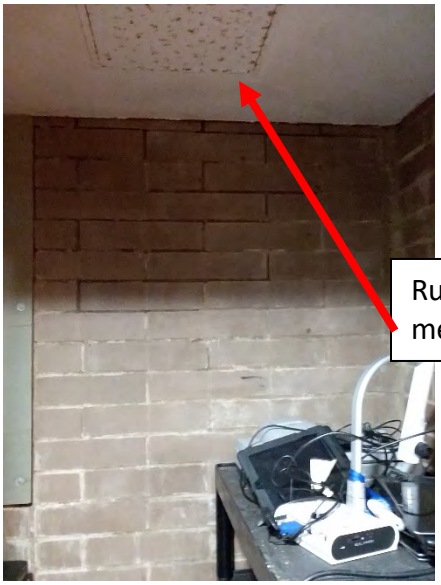
1-1

Efflorescence on interior of exterior wall.



2-1

Rust on interior metal materials



3-1

Cracked bricks

4-1


Unconsolidated concrete

5-1

6-1


Mold on back surface of GWB

7-1


Through wall flashing extending into building

8-1

9-1

10-1

Exterior Observations

1-1

1-2

1-3

1-4


Lintel not observed
No sill over brick
Rusting and delaminating steel

2-1

4-1


Cracked sealant
Cracked window gasket
Deflection of steel

4-2

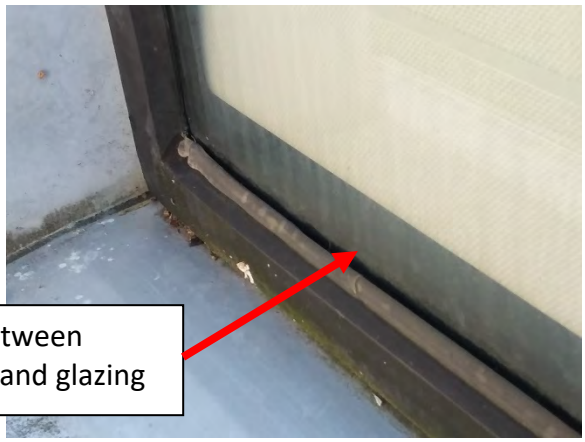
5-1

5-2

5-3

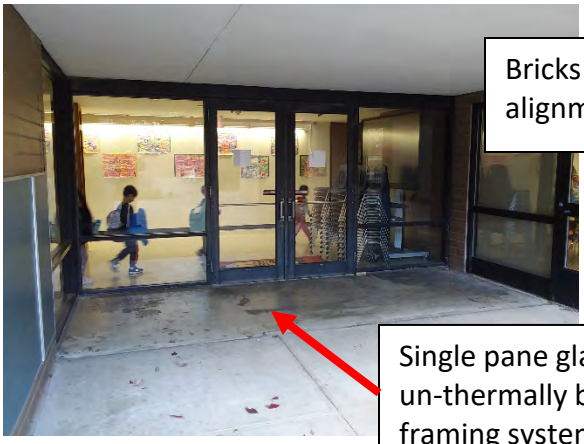
7-1

8-1



9-1

10-1



Single pane glazing and un-thermally broken framing system

12-1

Bricks out of alignment

14-1

Bricks out of alignment

14-2

Bricks cracked and out of alignment

14-3

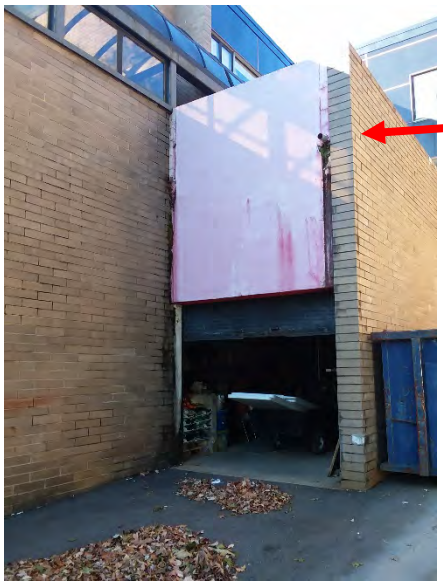
Brick and mortar in need of repair

15-1

15-2

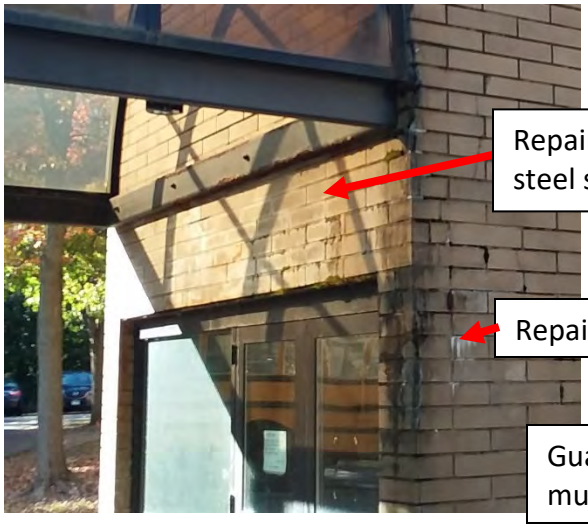
16-1

17-1



18-1

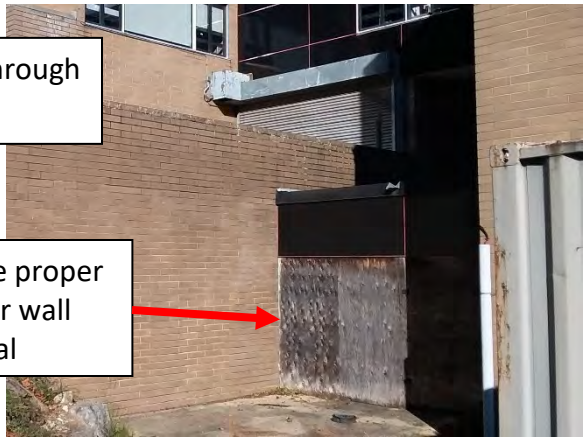
18-2



19-1

22-1

23-1



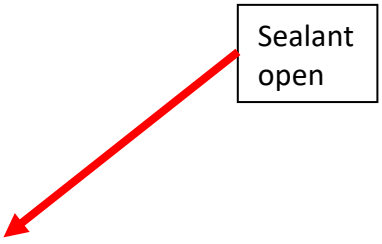
24-1

25-1

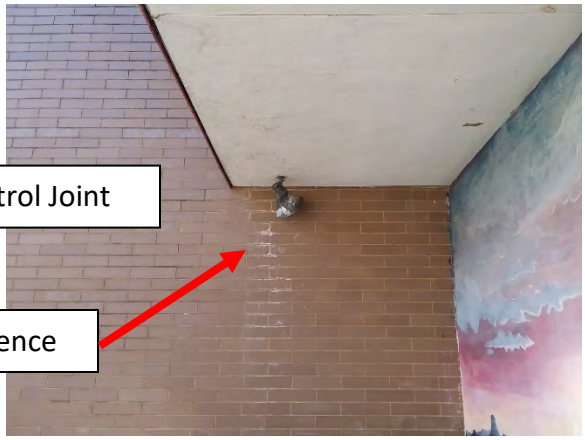
26-1

27-1

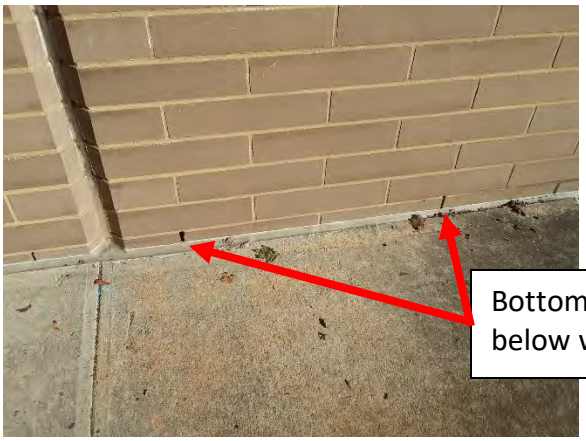
28-1



29-1

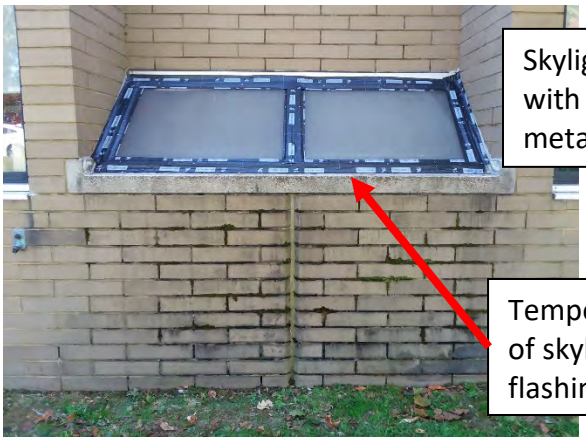


29-2

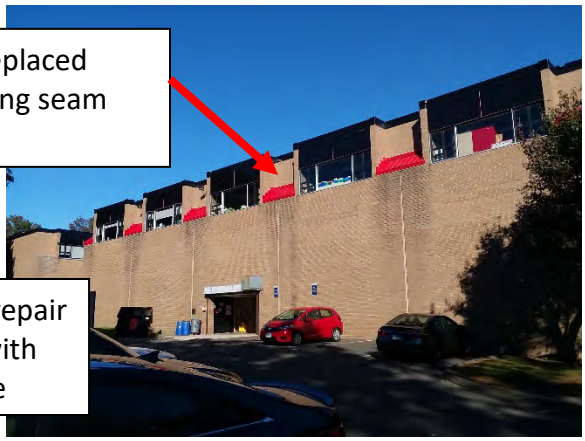


29-3

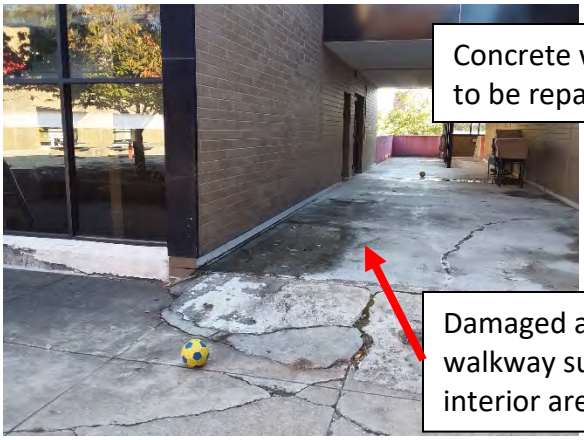
30-1



31-1



32-1



Damaged and deteriorated walkway surface over interior area below

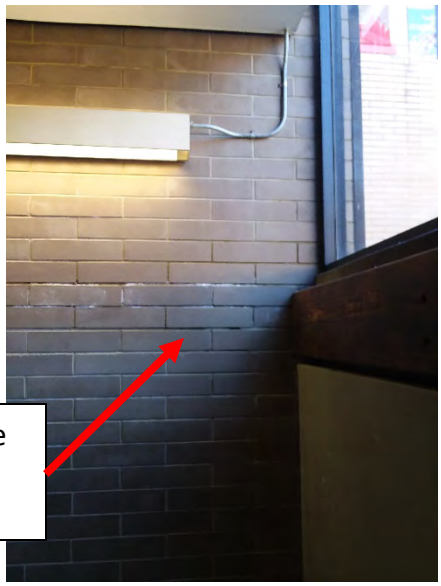
33-1

Concrete windowsill needs to be repaired

34-1

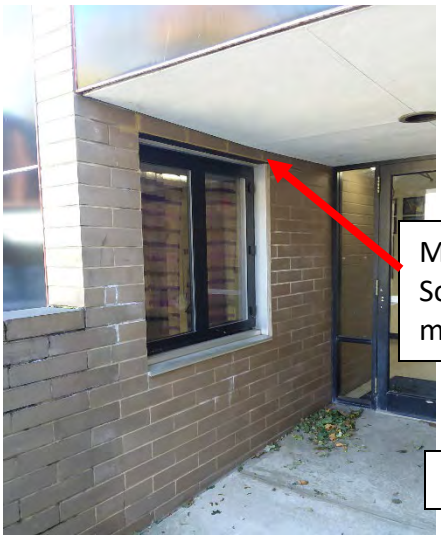
Corner guard sealant cracked

34-2



Efflorescence inside stair at exterior grade elevation

34-3



Main Entrance: Soffits deflecting at middle

35-1

Repaint Soffit

35-2


Adjacent grade pitched toward building

36-1


Grade elevated around walkway preventing proper drainage

37-1

APPENDIX A - GeoInsight Test Pit

TEST PIT LOG

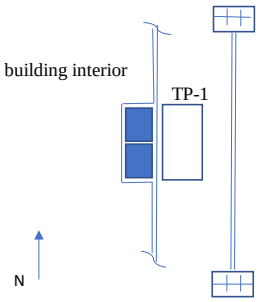
GeoInsight
Environmental Strategy & Engineering

Client: S/P&A		**Test Pit Identification:** TP-1
Project: 9514 Toquam School Water Intrusion		**Sheet:** 1 of 1
Location: 123 Ridgewood Ave, Stamford, CT		**Project Number:** 9514
Equipment:	**Date:** 10-19-19	
Reach:	**Chkd. By:**	
GeoInsight Rep.: RGS	**Weather:** 60 degrees F, Fair	
Contractor: Bismark (Mark and Eric)	**Ground Surface Elev.:**	

GROUNDWATER OBSERVATIONS	FIELD TESTING PERFORMED
Depth (ft. bgs): 9	
Stabilization (hours): approx. 2 hrs after excavation	
Est. SHWT (feet bgs): 6-8	
Description:	

DEPTH (ft)	SAMPLE INFORMATION #	Depth (ft)	Screening (ppm)	STRATUM DESCRIPTION	SAMPLE DESCRIPTION	NOTE
0					Grass and topsoil to .9 ft. Note site is graded down from parking area to east face of building as opposed to away.	
1						
2					Dark brown, coarse to fine SAND and GRAVEL, some Cobbles and Boulders, little Silt.	
3						
4						
5				**FILL**		
6						
7						
8						
9					1" to 1.25 " GRAVEL present on top of footing to approximately 9 ft bgs with preferential pathway for groundwater to drain to test pit.	
10						
11					Grey medium SAND and Gravel located along the footing.	
12						

TEST PIT ORIENTATION (sketch)



TEST PIT DETAILS (feet)

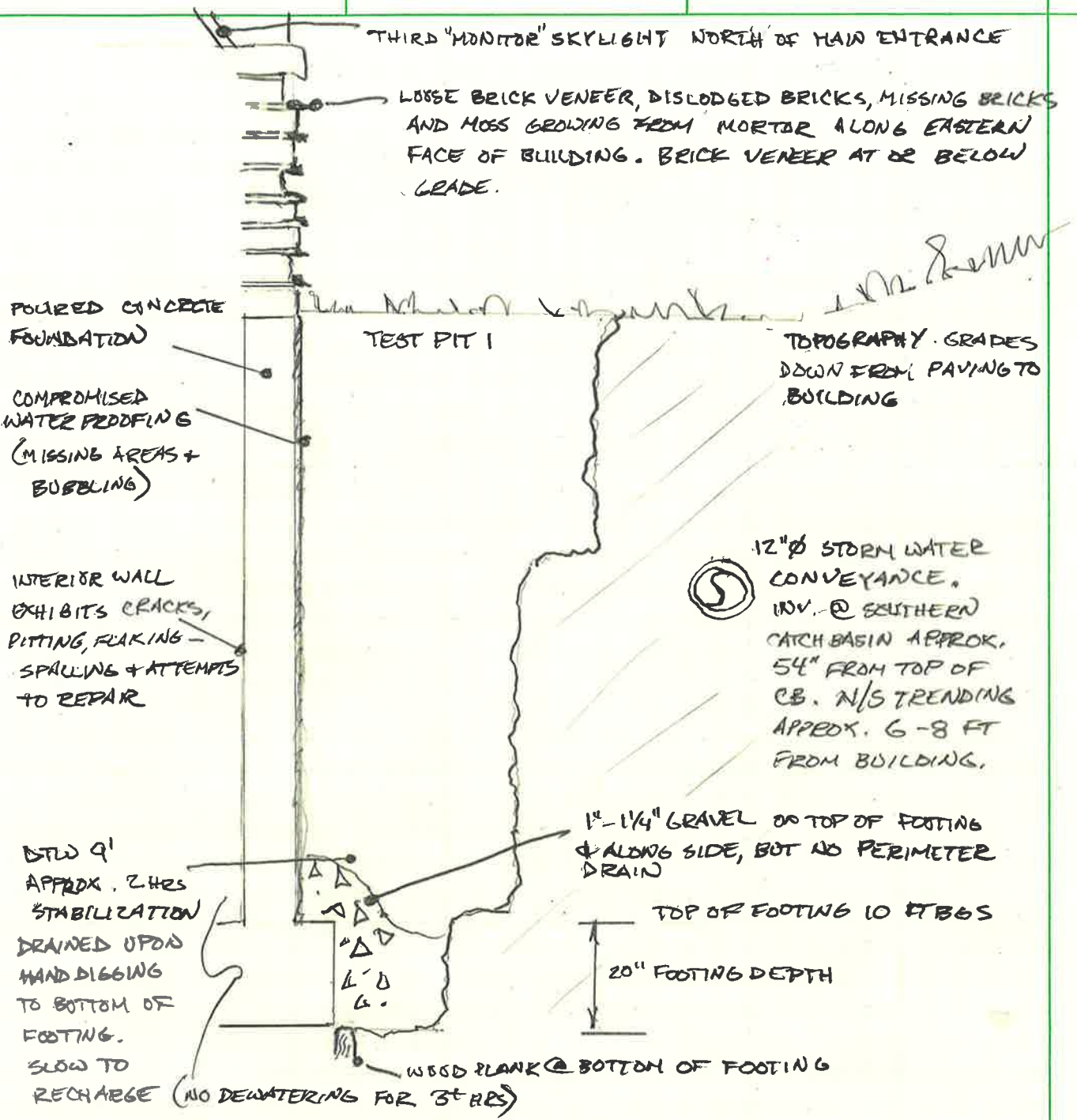
Length: approx. 10

Width: approx. 5

Depth: 11.7 to hand dug depth at southern side of test pit.

Large boulder at 10 ft along footing on northern end of test pit.

NOTES



9514 TOQUAM SCHOOL
10-A-A WATER INTRUSION TEST PIT

SITE PHOTOGRAPHS
123 RIDGEWOOD AVENUE
STAMFORD, CT
OCTOBER 19, 2019

Photo # 1: Location of test pit on eastern side of Toquam School.

Photo # 2: Moss in mortar beneath skylight over test pit.

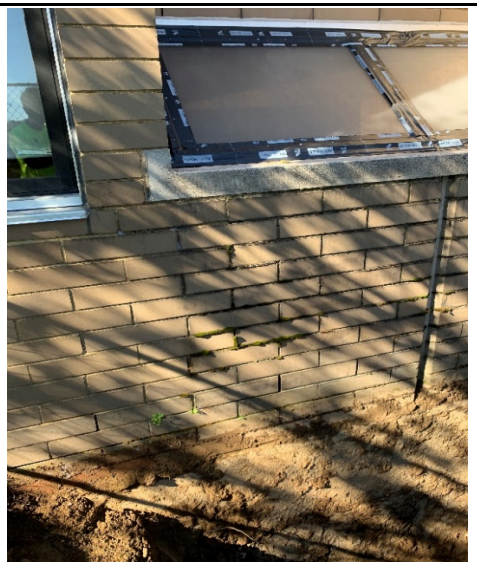


Photo # 3: Compromised water proofing and groundwater over footing.

Photo # 4: Hand dug to expose 20-inch deep footing and no perimeter drain.

SITE PHOTOGRAPHS
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Photo # 5: Loose and dislodged bricks will require re-pointing.

Photo # 6: Stockpiled spoils considered Fill (well-graded and likely till-derived).

Photo # 7: Interior of foundation wall is pitted and stained.

Photo # 8: Spalling on interior of foundastion wall.

SITE PHOTOGRAPHS
123 RIDGEWOOD AVENUE
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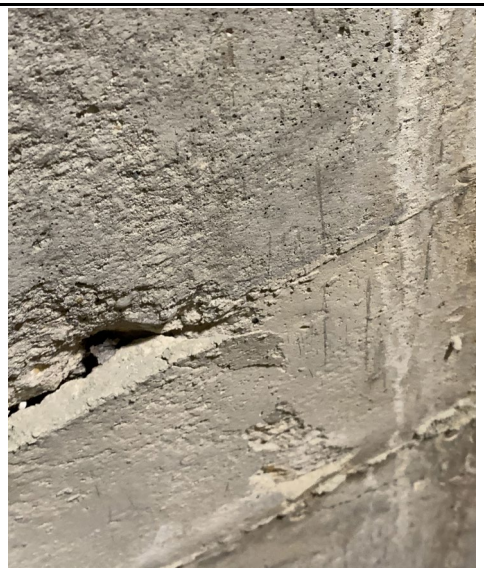

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Photo # 9: Pitting and cracking of interior foundation wall.

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Photo # 10: Bedrock outcrop with Toquam school in background.