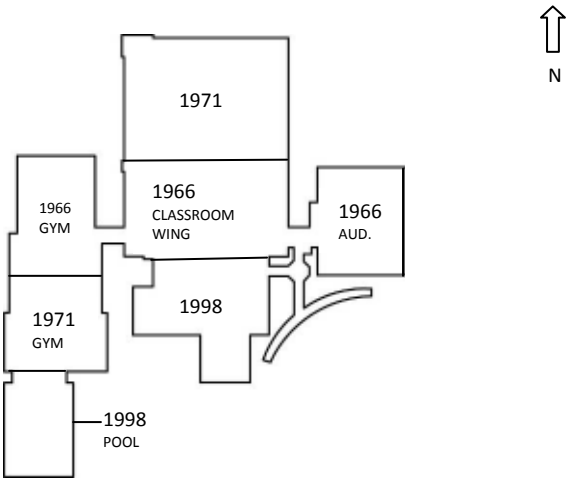
Overview:



EAST LYME HIGH SCHOOL

Original 1966 Building:

The original East Lyme High School was constructed in 1966 and was composed of the main building with a two story classroom wing including the Cafeteria on the Main Level. The Gymnasium on the west side and the Auditorium on the east side were attached to the main building by way of single story connectors. The structure of the main building consists of reinforced concrete waffle slabs at the Upper Level, Mechanical Room and roof that are supported by interior and exterior reinforced concrete beams and columns. The exterior columns and spandrel beams are exposed on the exterior and continue into the finished spaces which subject the concrete to considerable temperature differential movement. The foundations which support the structure are constructed of reinforced concrete walls, piers and footings.

The exterior masonry cavity walls frame horizontally between columns and vertically between floor or roof beams. The walls are constructed with 4" brick, 2" rigid insulation and 8" concrete block. According to the Contract Documents the brick is tied to the concrete brick with U shaped steel anchors that are placed in the concrete block mortar joints with eyes that extend into the cavity. Steel U shaped pintels are attached to the eyes and are set in the brick mortar joints. The anchors are spaced at 16" on center horizontally and vertically. The drawings do not specify if the pintel or anchor are hot dipped galvanized.

The Connectors consists of reinforced concrete waffle slabs and spandrel beams that are supported on reinforced concrete columns. Reinforced concrete walls, buttresses, piers and footings carry the vertical loads from the columns and walls.

The Auditorium which is attached to the east connector is constructed wide flange steel columns that support wide flange floor beams and slabs at the Mechanical Mezzanines and the roof structure. Wide flange roof beams span between columns and support long span steel joists and 18 gage metal roof deck at the high roof above the Auditorium. The structure for the adjoining music rooms is similar to the Auditorium with wide flange columns and beams with long span joists spanning between the beams. The exterior walls are 1'-2" deep with 4" brick, 2" rigid insulation and 8" concrete block. The superstructure and walls are supported by reinforced concrete foundation walls piers, buttresses and footings.

The Gymnasium wing consists of a two story space with Locker Rooms on the Main Level and a Mechanical Mezzanine above Locker Rooms. The Mezzanine Level floor is a reinforced concrete waffle slab that is supported by reinforced concrete beams and columns. The roof structure is composed of wide flange columns and beams that provide support for steel joists and metal roof deck.

The Gymnasium structure is constructed with wide flange columns on the exterior walls that support spandrel wide flange beams. Steel joists which span the Gymnasium floor bear on the spandrel beams and carry the metal roof deck. The foundation for this wing is similar to the Auditorium wing.

1971 Additions:

The 1971 additions consisted of a two story C – shaped classroom wing attached to the north side of the original building and a new Gymnasium attached to the south side of the original locker rooms and gymnasium.

The classroom addition was constructed with reinforced concrete beams and columns that support a reinforced 2 way concrete slab for the 2nd floor and the roof deck. The perimeter beams carried the exterior concrete block and cavity walls. Reinforced concrete foundation walls, buttresses, piers and footings provided the bearing capacity for the concrete framed building.

The South Gymnasium addition was constructed adjacent to the south wall of the original building Locker Rooms. The structure of the South Gymnasium is constructed of structural steel columns and perimeter beams with long span joists spanning the gymnasium floor. The columns and exterior masonry walls are supported by the reinforced concrete walls, buttresses and footings.

1998 Additions:

The structure for the two story classroom addition includes steel tube columns supporting wide flange floor and roof beams. Metal floor and roof deck span between and are attached to the wide flange beams. The floors slab is 3¼"lightweight concrete over 2", 20 gauge galvanized metal floor deck. The slab is reinforced with welded wire fabric. The roof deck is 1½" 20 gauge Type "B" metal roof deck. The canopy that ties the new addition to the original school building is constructed of steel framed tube trusses supported by steel columns. Wide flange beams installed perpendicular to the trusses is purlins with tension rods. The purlins are attached to the top chord of the trusses and support the glass skylight system and metal roof deck.

The pool addition to the south side of the South Gymnasium is constructed with steel rigid frames and steel beam purlins that span between the rigid frames. Metal roof deck spans perpendicular to the purlins and is attached to the top flange of the purlins. An Upper Level Mezzanine is located on the north side of the pool building. The Mezzanine structure consists of wide flange columns and beams which support an 8" precast hollow core plank system. The steel beams bear on an interior reinforced concrete block wall that separates the pool from the changing rooms. The foundation walls, buttresses, piers tie beams and footings along with the slab on grade are constructed with reinforced concrete.

Existing Conditions Assessment:

Original 1966 Building:

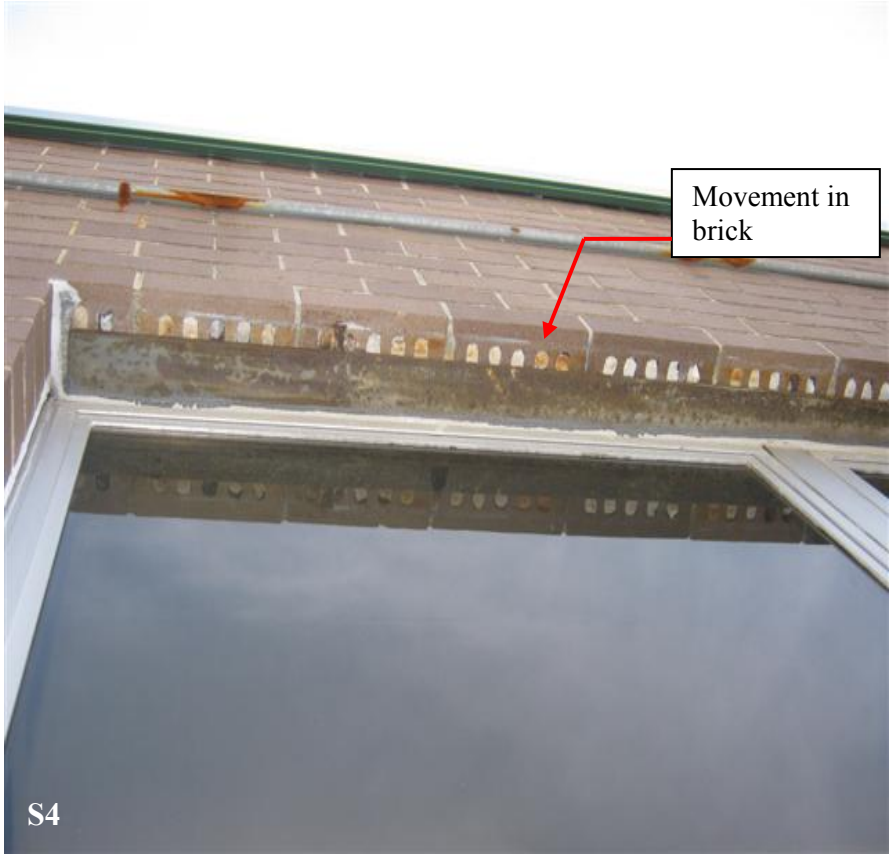
The overall condition of the 1966 building appears to be structurally sound. However, there are concerns with the exterior masonry in particular locations. The location where movement was observed is noted below.

Movement has been observed in the exterior brick on the north side of the Music Rooms adjacent to the Auditorium and above the mechanical louver on the south side of the north Gymnasium as well as above the three window openings on the north side of the same Gymnasium. The exterior brick wythe is moving outward away from the face of the building. The movement is greatest directly below the roof's gravel stop and ends approximately half the distance down the window height. The cause of the movement is not known at this time and additional exploration of the wall will be required.

North Wall of the Music Suite Adjacent to the Auditorium

Close up of Movement in the Exterior Brick Wall at the Music Suite

Outward Displacement of the Exterior Brick

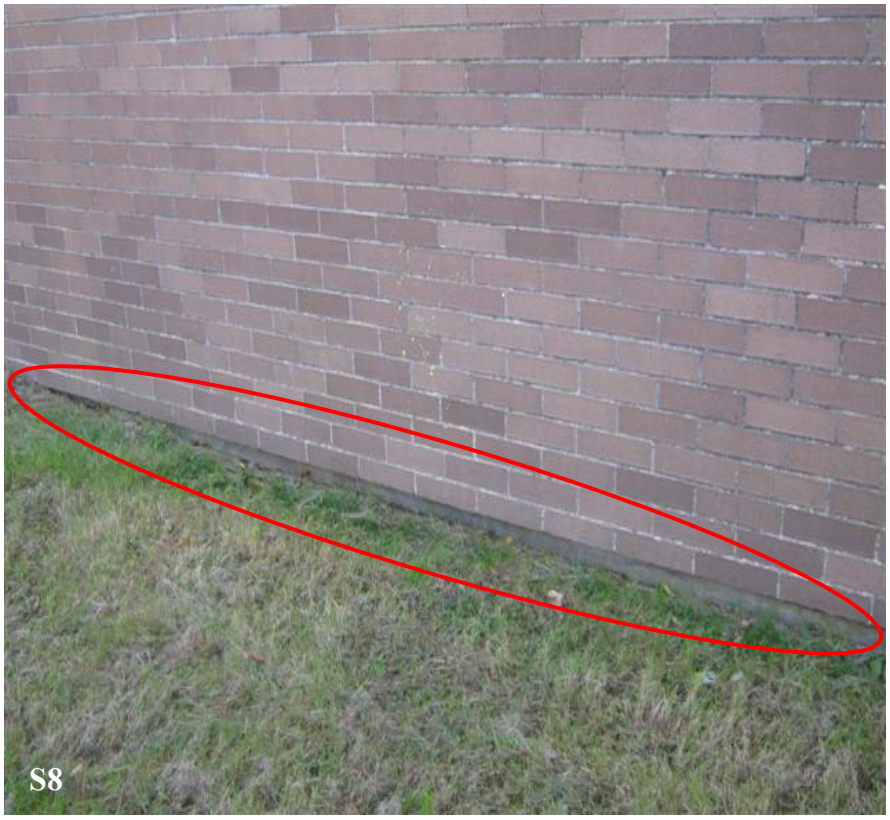


Looking Upward at the Brick Displacement

Diagonal Cracking and Movement in the Exterior Brick

Brick Shifting Outward above Window Opening

Movement in the Exterior Brick at Northwest Corner of Music Suite



Omitted Weep Holes at Base of Exterior Brick at Music Suite

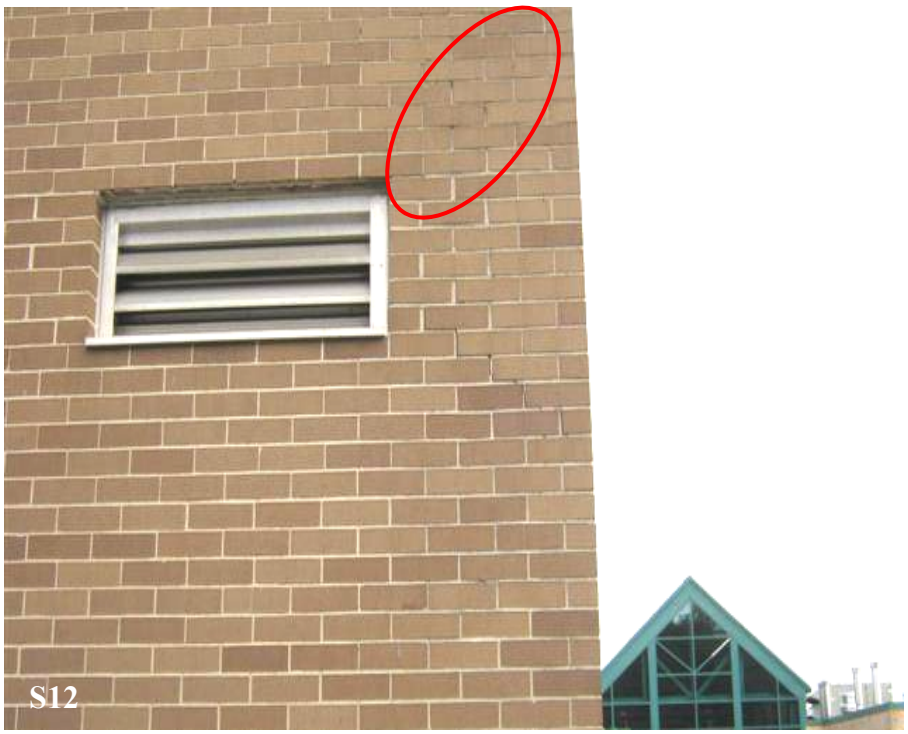
The brick supported by the steel angle lintel that spans the large louver opening on the south wall of the north Gymnasium has shifted outward ¾" minimum. Approximately 2" of the 3 5/8" width is suspended beyond the support of the angle. Water is able to enter into the enlarged cavity caused by the movement. Any water trapped in the wall may cause mold to grow in the wall undetected. The wet condition will also create the proper atmosphere for corrosion to the steel angle and possible freeze / thaw damage. A similar condition is beginning to occur to brick above the window openings on the north wall of the north Gymnasium. The movement is not as extensive at this time but the brick will continue to shift until it fails.

Outward Movement in Exterior Brick above Lintel at North Gym Mechanical Room

View Looking Upward at the Brick Displacement

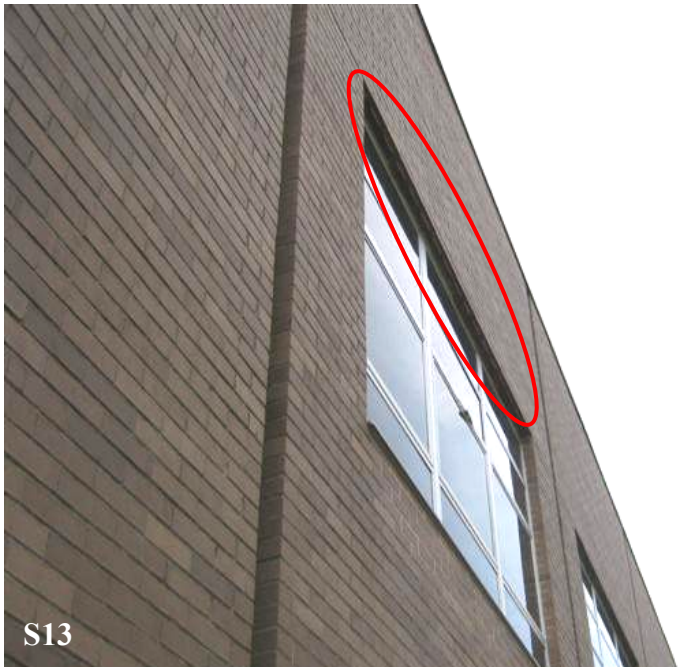
Movement in the Brick at West Pilaster of Louver Opening in South Face of North Gym

Movement in the exterior brick is visible at the southwest corner of the Mechanical Mezzanine above the Locker Rooms that are attached to the north Gymnasium. The crack begins at the corner of a louver which is cut into the west wall and continues diagonally toward the corner of the building. Differential movement is not noticeable on the corner of the building.



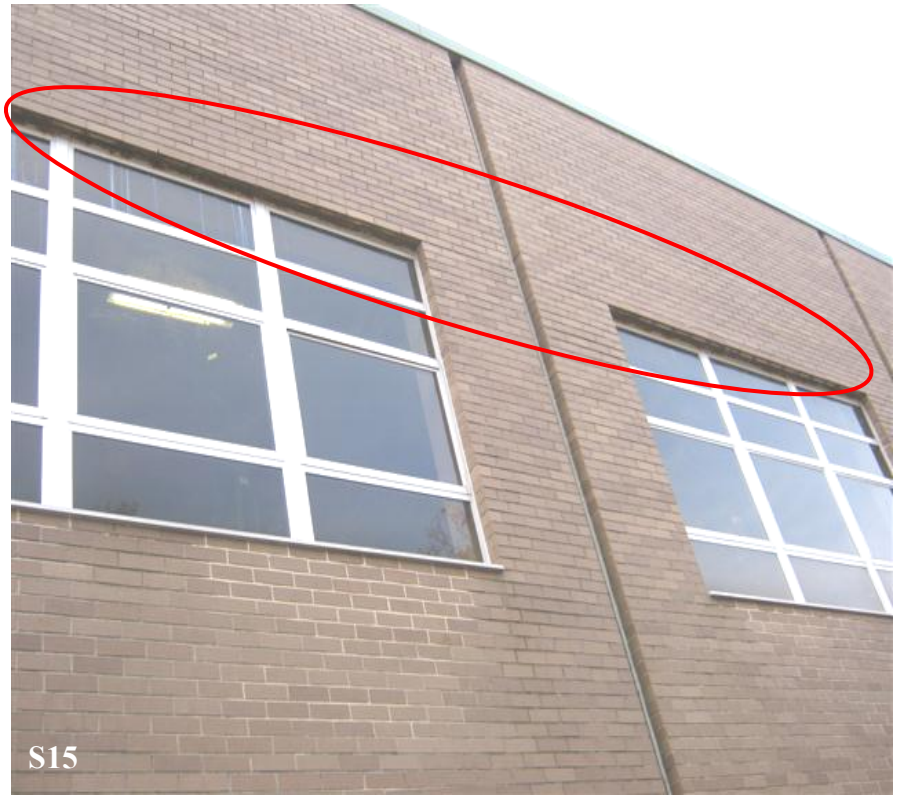
Cracking and Spalling in South Wall of North Gym Mechanical Room

A similar condition is beginning to occur to brick above the window openings on the north wall of the north Gymnasium. The movement is not as extensive at this time but the brick will continue to shift until it fails.



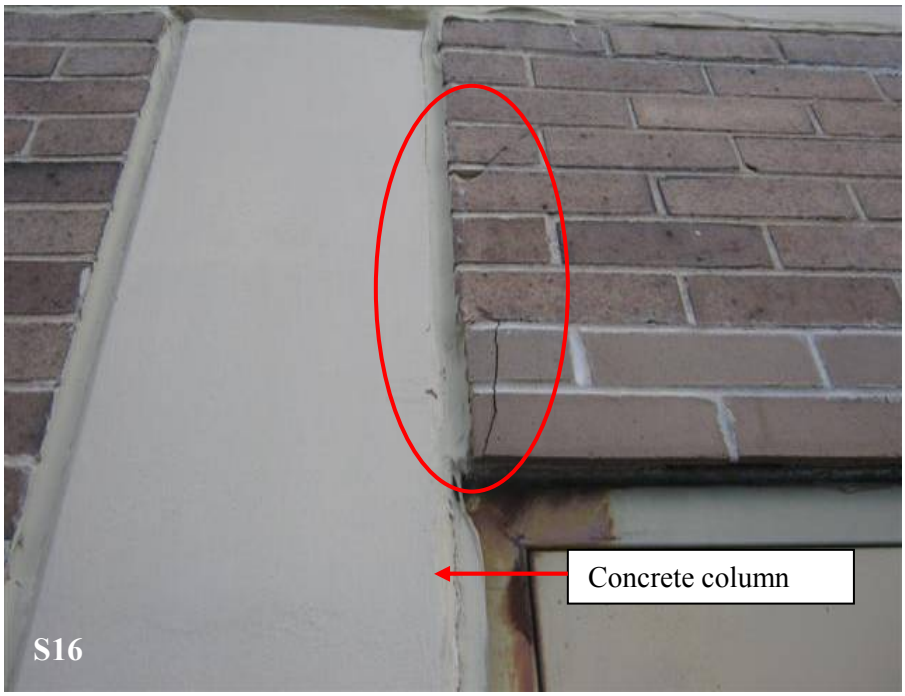
Outward Movement in Exterior Brick above Window Openings in North Wall of North Gym

Movement in Brick above Center Window of North Gym



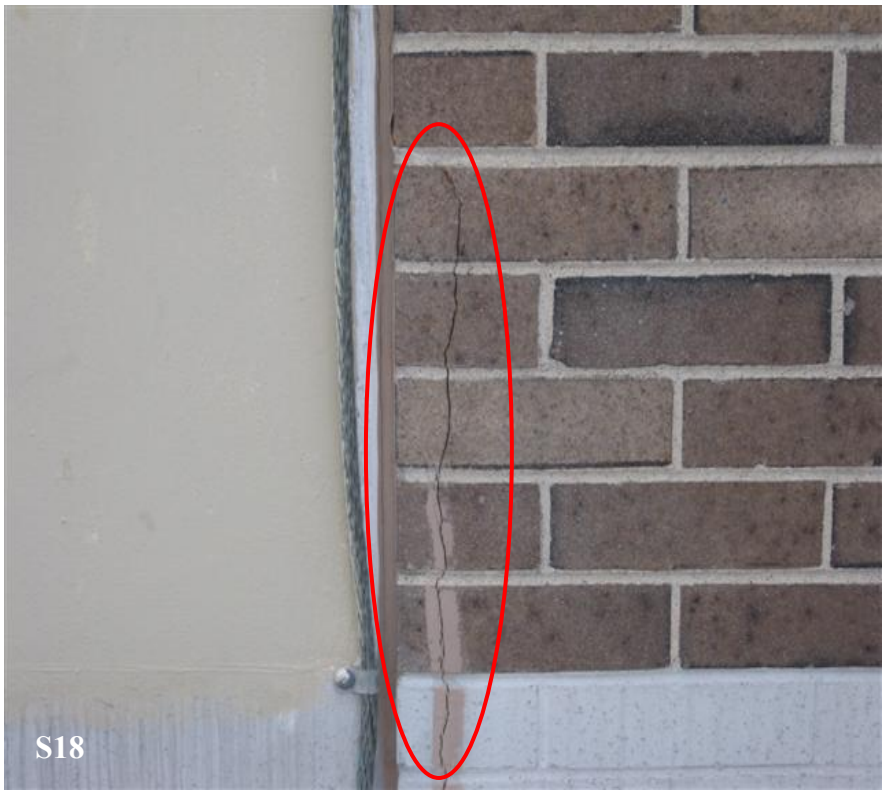
Movement in Brick above the Center and West Window Openings in North Gym

Vertical cracks were observed in the exterior bricks at various locations throughout the exterior of the building. Some of the cracks were due to natural movement due to the omission of brick expansion joints. At other locations, the reason for the movement is not apparent.



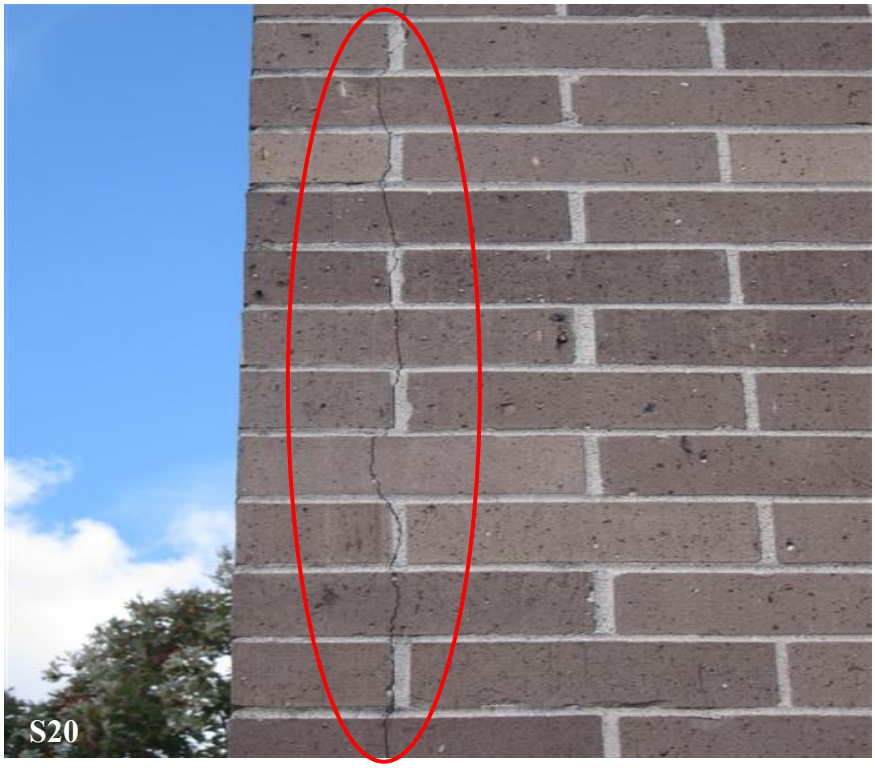
Cracking in Exterior Brick Adjacent to Concrete Column on West Face

Cracking in Exterior Brick adjacent to Concrete Column above low Roof at Mechanical Room



Close up of Vertical Crack.

Vertical Crack in Exterior Wall above Low Roof



Vertical Crack at Southeast Corner of the Auditorium above Low Roof

Movement in Exterior Brick at Steel Lintel for Door Opening

Along the south and west sides of the original school building the grade is such that the weep holes located at the base of the masonry walls was buried below the grade. This has and will continue to trap water behind the brick and allow freeze / thaw damage to occur over a period of time. At other walls there are no weep holes present on the exterior face of the brick walls

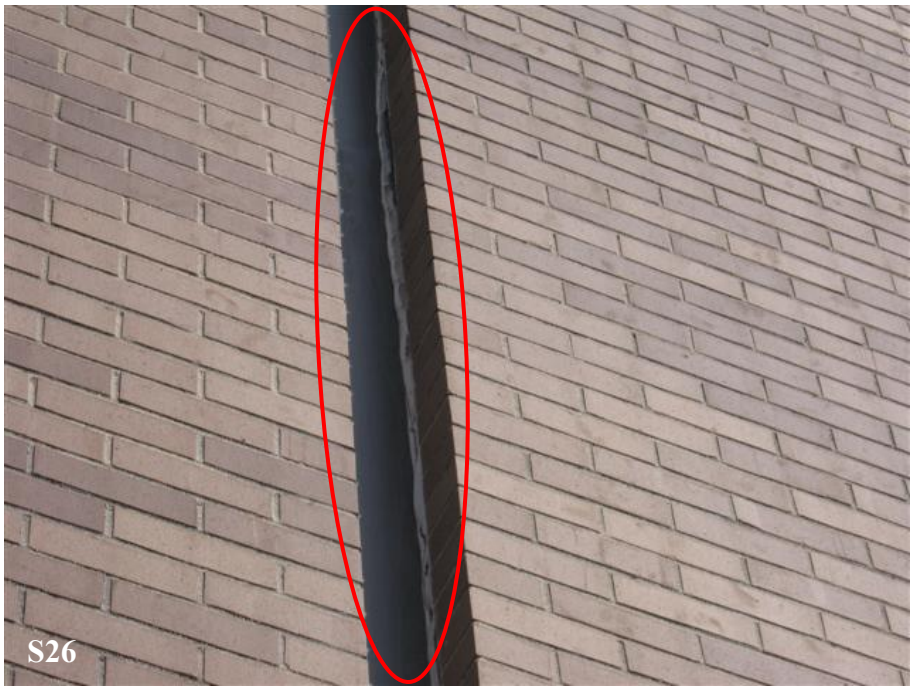
Weep Holes below Grade

Partially Concealed Weep Holes at Sidewalk

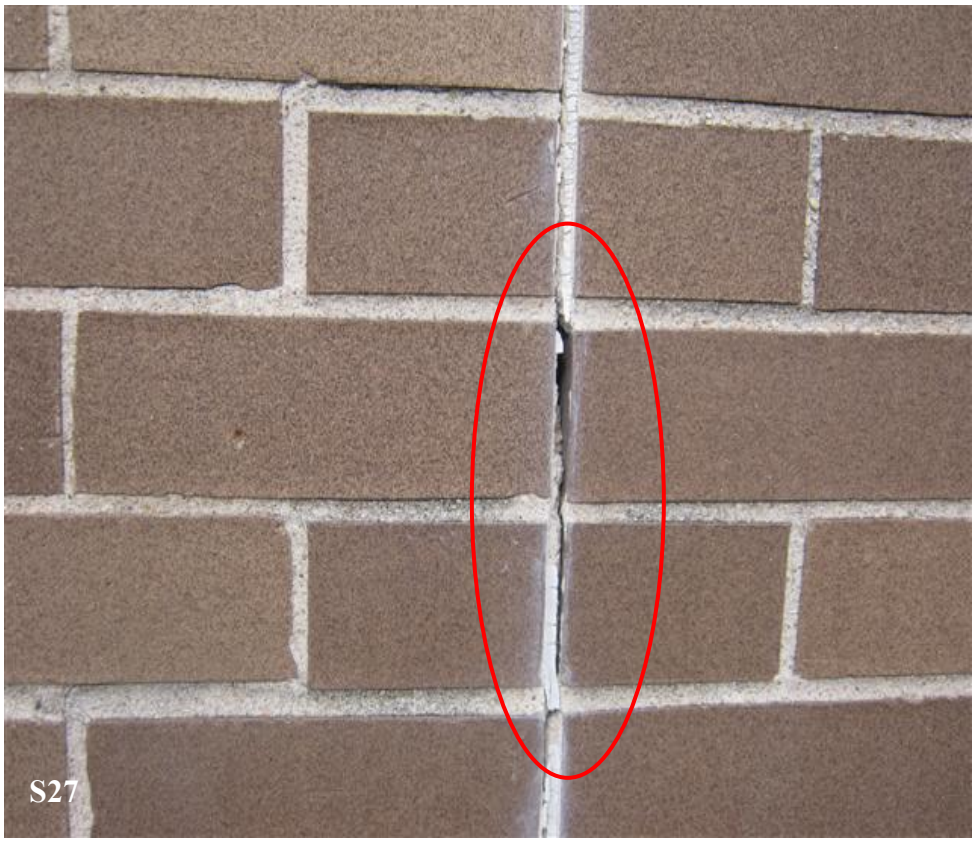
Concealed Weep Holes below Mulch

Concealed Weep Holes below Grade

Several of the caulk joints at the brick expansion joints and column covers are failing. The failed caulking is dry and brittle and cracking open which may allow water into the cavity behind the brick or into the building.



Brittle and Open Caulk Joint at Column Cover

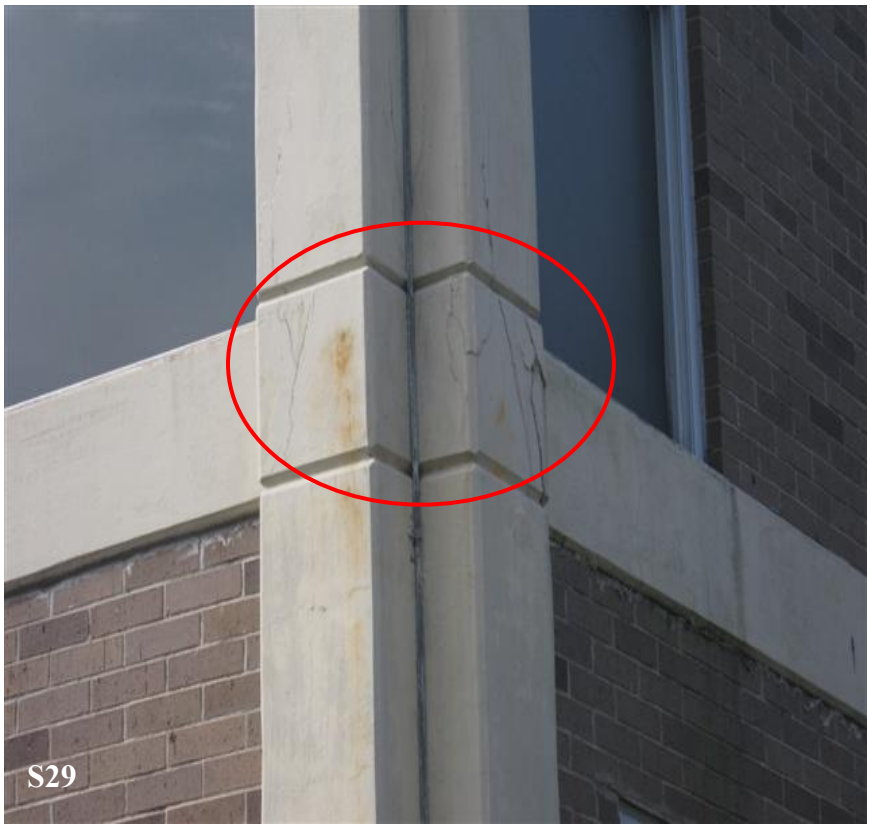


Dried and Spalled Caulking at Vertical Joint in Brick

1971 Additions:

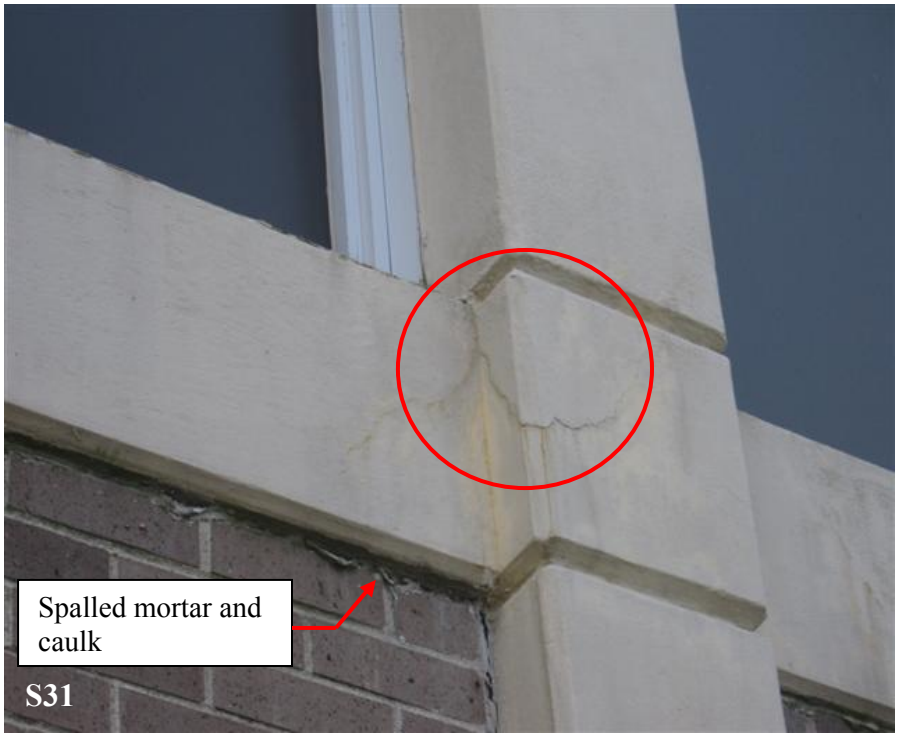
The two story classroom addition to the north side of the original building exhibited issues involving the movement and spalling of the exterior concrete spandrel beams especially on the north and east faces of the addition and the east, south and west faces in the courtyard. The damage varied from hairline cracks (typically vertical) to major spalling of the face of the concrete beams and columns. The most extensive movement is visible on the northeast corner of the building where chunks of the concrete are in various stages of spalling. The reinforcing steel in these areas is beginning to be exposed as the concrete breaks off the beams and column. Spalling is also present in the concrete spandrel beams that support the roof deck on the south face of the addition in the courtyard. Spalling is also present on the face of the roof spandrel beams on the west side of the addition.

Spalling Concrete and Rust Stains at Concrete Column

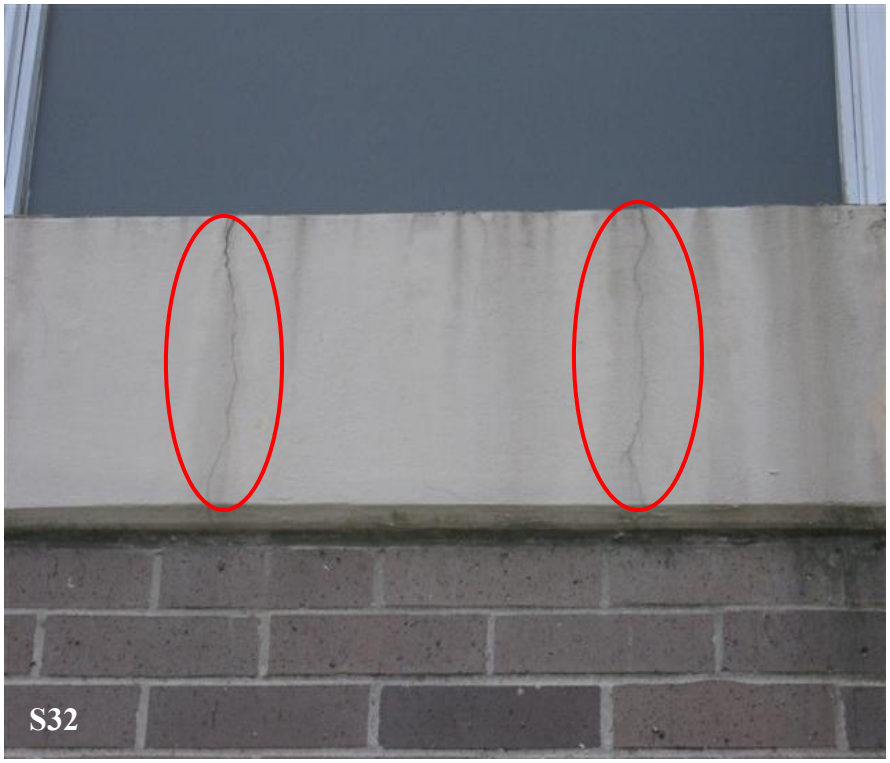


Spalling Concrete and Rust Stains at Concrete Column looking Southwest

Close up of Spalled Concrete Beam and Column



Cracks and Spalling beginning in Concrete Column and Beam



Cracks in Concrete Spandrel Beam at Upper Level floor

Crack and Spalling in Face of Concrete Spandrel Beam

Close up of Spalling and Cracking in Beam

Spalling Concrete at Beam Stirrups

Spalled Concrete at Reinforcing Steel

Movement is occurring in the exterior brick wall panels constructed between the concrete columns and beams as observed and documented on the north side of the addition. The movement which is occurring around the edges includes cracked and spalled mortar joints and brick and spalled caulking.

Spalled Caulk at Joint between Brick and Spandrel Beam

Spalled Caulk at Brick / Column Interface

Close up of Open Joint Allowing Water Infiltration into the Building

Spalled Mortar, Brick and Caulking at Brick and Concrete Beam Interface at Underside of Upper Level Spandrel Floor Beam

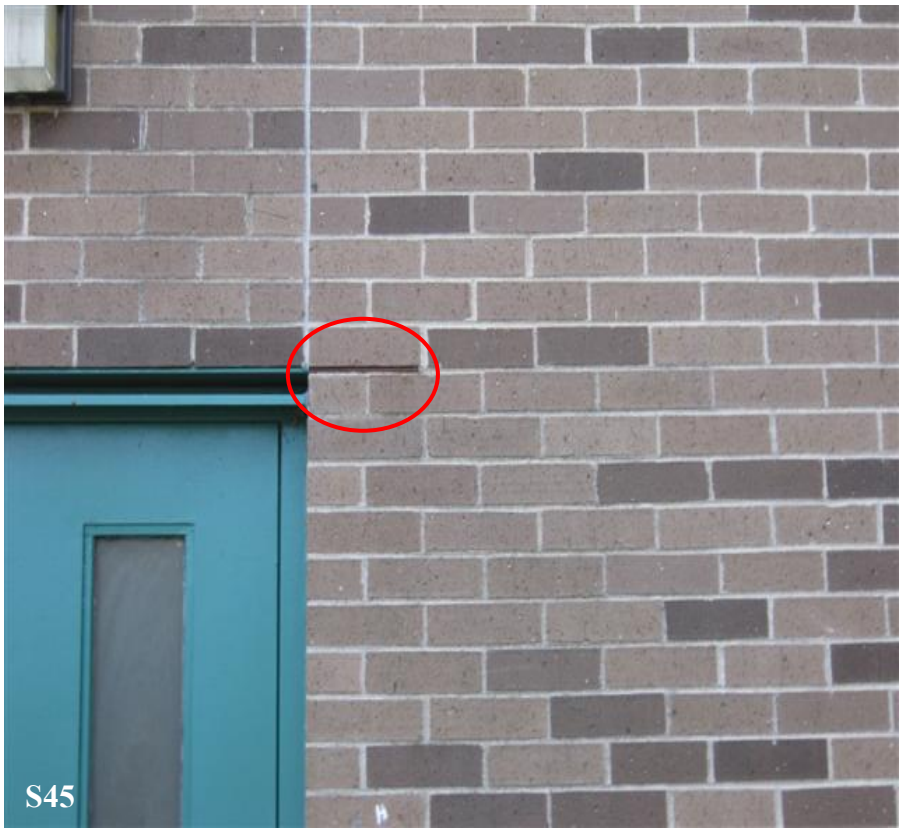
Spalled Mortar and Caulk looking down at Upper Level Spandrel Floor Beam on South Wall of Courtyard

Spalled Mortar and Caulk looking down at Upper Level Spandrel Floor Beam on South Wall of Courtyard

Throughout the addition there were other conditions observed which allows water infiltration and will promote freeze / thaw damage.

Open Expansion Joint between Original Building and 1971 Addition

Partially Open Expansion Joint between Original Building and 1971 Addition

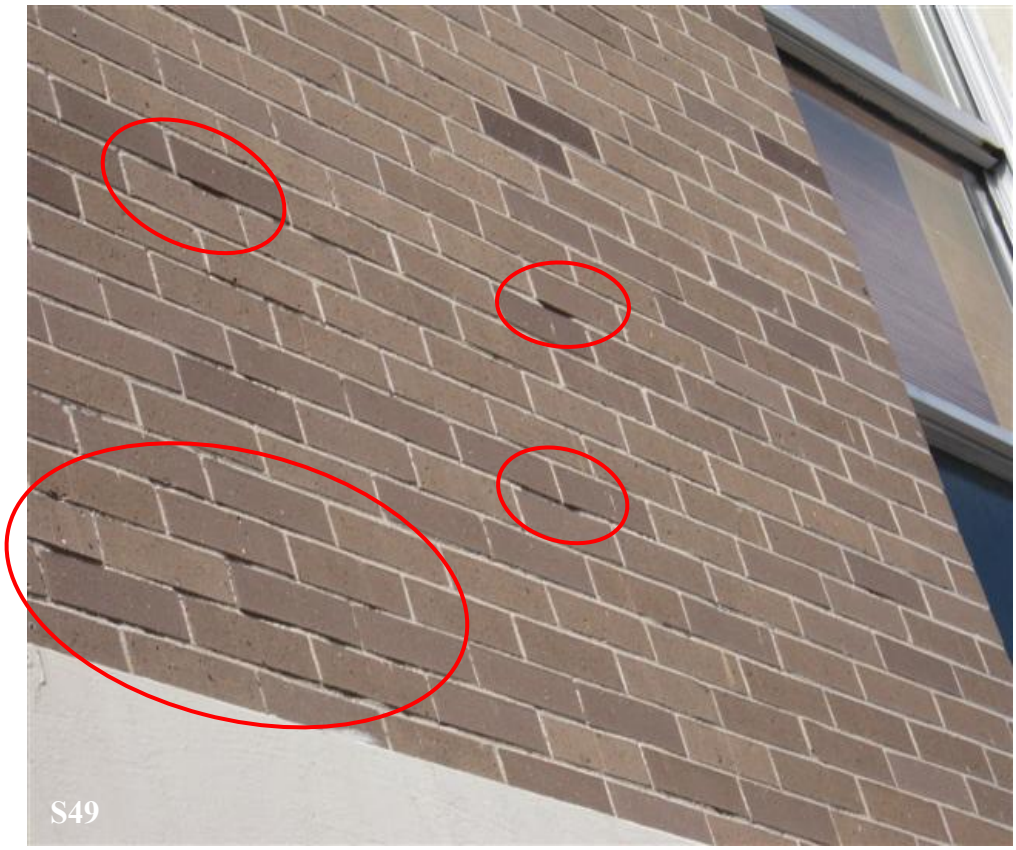


Spalled Mortar at Door Opening Lintel

Mortar Joints Requiring Re-pointing

Spalled Mortar at Exhaust Duct Penetration

Spalled mortar at door opening lintel



Spalling Mortar Joints Require Re-pointing

1998 Additions:

The 1998 two story classrooms, single story entrance and Multi Purpose Room addition to the south side of the original building appears to structurally sound with no outstanding issues observed during the onsite evaluation. Similarly, there are no issues involving the pool addition to the south face of the 1971 South Gymnasium.

Recommendations:

Original 1966 Building:

The cause of the movement in the north exterior wall of the Music Suite is not known. We would recommend that the Owner hire a mason to remove small areas of the brick in a number of locations so that a further investigation of the type, condition and spacing of the masonry anchors can be documented. At this time, our recommendation for permanent repairs would be to remove all of the brick and anchors projecting from the inner wythe concrete block down to the top of the foundation wall. An air and vapor barrier should be applied to the exterior surface of the concrete block, new expansion anchors installed along with insulation, flashing and weep holes as part of rebuilding the brick wythe. The rebuilt wall would continue to new vertical expansion joints constructed where the new wall meets the remaining existing wall. The additional investigation will confirm our preliminary findings prior to preparing construction documents.

At the louver and windows in the exterior walls of the North Gymnasium, a similar investigation should be performed to confirm that the movement at these locations is caused by the same issue as the wall at the Music Suite.

Locations where vertical cracks have occurred in the exterior brick should be repaired to prevent water damage. The damaged bricks will be removed and replaced and anchored to the inner wythe concrete block. Flashing, backer rods and caulking would also be installed locally at the area to be repaired.

At door, louver or window openings where the steel angle lintels are in various degrees of corrosion that is causing the mortar and brick to crack and spall, Owner's mason should remove a few bricks at these locations so that we can evaluate the extent of the corrosion occurring to the steel lintels. Recommendations for repairing the condition will be developed based on the information gathered.

Where weep holes are concealed below grade, the ground must be regarded such that the weeps are exposed. Any debris clogging the weep holes must be removed to create positive drainage.

Caulk must be removed from all caulk joints and reinstalled with the proper backer rods and caulking.

1971 Additions:

A further investigation of the damage occurring at the concrete columns and beams is required. The investigation would include the Owner's mason removing small areas of the loose concrete so that we can evaluate the depth of the cracks and the condition of the concrete and reinforcing steel. We would also model the structure of the building to determine the possible drift of the building. The drift is a critical issue because of the cracking in concrete and also the spalling of the mortar, caulk and masonry in the brick panels which were constructed between the concrete columns and beams. We will provide recommendations based on the analysis of the building and investigation of the concrete and reinforcing.

The large expansion joints between the original building and the 1971 addition should be evaluated. One of the joints is completely open and other has caulking on the vertical surface but the horizontal return is

open. New joint covers should be installed to protect the building from the elements and also allow for differential movement between the buildings.

At door, louver or window openings where the steel angle lintels are in various degrees of corrosion that is causing the mortar and brick to crack and spall, Owner's mason should remove a few bricks at these locations so that we can evaluate the extent of the corrosion occurring to the steel lintels. Recommendations for repairing the condition will be developed based on the information gathered.

Re-pointing of the mortar joints is recommended for areas where the mortar has spalled allowing water easier infiltration in the joints.

Summary:

The above recommendations would address the known areas of visible deterioration to the masonry and the concrete frame. The additional investigations recommended will assist us in identifying the actual cause of the movement so that proper repairs can be developed. The items noting spalling joints should be repaired to prevent water infiltration into the cavity which will increase the freeze / thaw damage. Our structural review of the building is based only on the areas which were not concealed by exterior grades, slabs, finishes or other obstructions. Recommended repairs and maintenance procedures should be implemented to eliminate possible future damage to the structure.