STRUCTURAL CONDITIONS ASSESSMENT
FORMER GILFORD BUTLER SCHOOL
PROPOSED COMMUNITY CENTER & LIBRARY
SOUTH THOMASTON, MAINE

Prepared for
Town of South Thomaston

Prepared by

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Report Issue Date: October 3, 2019
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Project No. 19-180

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10/08/2019

SCOPE OF CONDITIONS ASSESSMENT

We conducted a structural site visit to observe the structure of the former Gilford Butler School located at 54 Spruce Head Road in South Thomaston, Maine on September 11, 2019. We documented visible portions of the existing structure during our visit, including the foundation and existing structural elements and layouts (member sizes, spans, etc.). We also observed the material integrity of structural framing members where exposed. This structural conditions assessment report is based on our observations of the building during this site visit. For orientation, the front of the building is considered west throughout this report (actual northwest).

BUILDING HISTORY

The existing building is a one-story masonry structure with a full basement. The structure was constructed in 1954 as the South Thomaston Consolidated School. At one point the fire department parked fire trucks in the high bay at the north end of the building. Although most structural elements do not appear to have been modified since original construction, there have been a variety of primarily non-structural modifications, including: regrading and raising of the foundation on the exterior due to poor drainage at the original overhead door elevation; construction of a platform and ramp at the interior to accommodate the higher grades at the overhead door; enclosure of the stairs toward the south end on the rear elevation; removal of historic glass block from original window openings; and installation of a dropped ceiling which covers the original sloped interior ceilings. The building is no longer occupied as a school and is currently vacant.

PROPOSED RE-PURPOSING PLAN

We understand the Gilford Butler School Futures Committee has been charged with making a recommendation to the Select Board on the future use of the former Gilford Butler School and associated site. One of the options is to repurpose the former school to be a Community Center and Library, to include a Meeting Room or Community Room with a Kitchen, Library and associated toilet facilities, Office and Entrance Vestibule. The Select Board has engaged Gartley & Dorsky Engineering & Surveying to perform a structural conditions assessment of the building as part of its due diligence in considering any proposal to repurpose the existing facility.

This report provides feedback on the existing structure as well as feasibility and/or challenges regarding the proposal to repurpose the building as a Community Center and Library. Given the nature of the request, this report does not address other possible uses.

EXECUTIVE SUMMARY

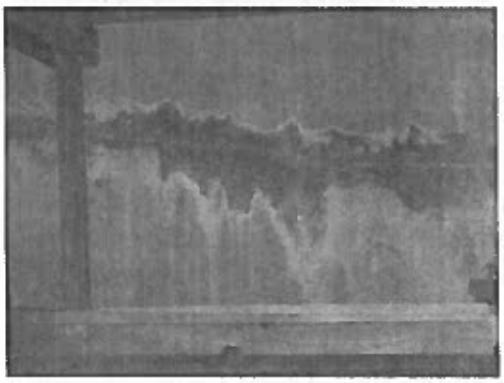
Based on our observations, assessment and review of Maine Uniform Building and Energy Code (MUBEC) existing building standard (IEBC), the existing structure appears to be structurally sound and appropriate for its previous occupancy as a school. However, the classroom floor structure on the main level, which comprises the majority of the first floor area, is not adequate for assembly (e.g. community meeting room) or library stacks and will require significant upgrade to achieve minimum standards applicable to these uses. The roof structure appears to be marginally undersized by current standards but has performed satisfactorily for many years and does not present a level of overstress that necessarily warrants mandatory upgrade. If the building's primary occupancy becomes public assembly with an occupant load of greater than 300 people, more extensive upgrades, including roof upgrades, would be required.

OBSERVATIONS

FOUNDATION

The existing foundation is a cast-in-place concrete foundation wall. The west (front) and south sides are backfilled to nearly the full height of the wall. Grades step down along the rear, exposing approximately half of the foundation wall from the southeast corner to the exterior retaining wall. Grades drop further at the overhead door and begin ascending around the northeast corner and across the north façade. The foundation is visible in the high bay at the north end of the building and in most of the cafeteria and auxiliary room spaces.

There are several vertical cracks in the south foundation wall, and similar cracks around the entry at the north wall. These appear to have been maintained and do not appear to be structurally significant at this time, although ongoing maintenance to prevent water infiltration may be required. The taller walls at the north of the building appear to have started to cure during placement which resulted in irregular cold joints in the placement (which appear as uneven horizontal seams). There is evidence that water has infiltrated through the wall at many of these cracks in the past and may still be occurring at some cracks. There is also evidence that water either infiltrates through the walls at other locations or may come up through the joint between the wall and the slab. There were a few puddles of water along the east wall in the Cafeteria space during our visit, which may have been due to water infiltrating through the foundation, although the cause was not evident.



There are localized areas of concrete damage and/or concrete degradation. Specific areas include, but are not limited to, the expansion joints near the south downspout on the east wall where a horizontal bar is exposed (painted) and at the head of the overhead door where rebar is exposed and some concrete spalling has occurred.

FIRST FLOOR FRAMING

The existing first floor framing is composed of two different systems:

Below the entry Corridor, central Corridor, Principals Office, Teachers Room, and Girls and Boys Bathrooms is a 6" thick cast-in-place suspended concrete slab.

- The suspended concrete slab below the central Corridor spans east-west approximately 8'-9" between 18" deep steel beams which run north-south under the central Corridor walls above. Based on measurements taken at two different locations, the 18" steel beams appear to be W18x50.
- The suspended concrete slab below the Principals Office and Boys Bathroom spans north-south between a concrete masonry unit (CMU) wall below (south wall of the boiler room) to a 12" deep steel beam which runs under the north wall of the Entry Corridor. Based on measurements taken the 12" steel beam appears to be W12x26.

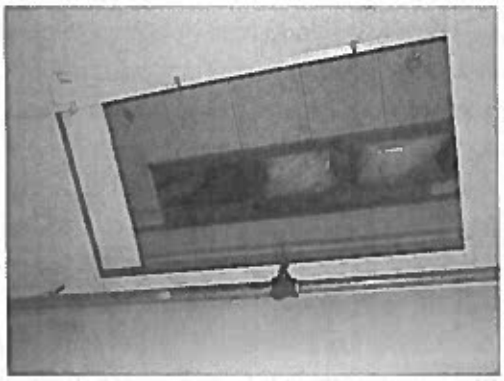
- The suspended slab below the Teacher's Room and Girls Bathroom spans north-south between a 12" deep steel beam which runs under the south wall of the Entry Corridor and a 16" deep steel beam which runs under the north wall of the southwest Classroom. Based on measurements taken the 12" steel beam appears to be W12x26 and the 16" steel beam appears to be a W16x36.

Below the Classrooms, including the Resource Room and northern extension of the Principal's Office which appear to have been partitioned out of the original northwest Classroom, are open-web steel joists spaced 24" on-center supporting a 3" to 4" thick cast-in-place suspended concrete slab. A single joist tag was found which indicates the open-web steel joists were manufactured by Bethlehem Steel Co. Based on Bethlehem's historic load tables, our measurements taken in the field and the original building specifications, the joists appear to be Bethlehem SJ-146 joists. The joists span approximately 24'-4" east-west between the exterior walls and the 18" deep steel beams which run north-south under the Corridor walls above.

Both the open-web steel joists and the steel W-beams show signs of corrosion where they intersect the concrete foundation walls. Some locations have more corrosion than others. Corrosion appeared to be mild to moderate. No severe corrosion was observed.

All documented beam-to-beam and beam-to-column connections appeared to be fully welded.

ROOF FRAMING



The existing roof framing appears to be 5 ¼" x 13 ¼" Western Fir rafters spaced approximately 7' – 4 ¾" on-center spanning approximately 24'-4" east-west between the exterior walls and the center Corridor walls. The roof framing over the Corridor was not exposed, but is assumed to be similar although it has a much smaller span. Only a small section of a few rafters was exposed, so further observation of the structural roof system was limited.

CEILING

Currently there is a level dropped ceiling in most of the interior spaces. Above the dropped ceiling is the original ceiling which slopes from the exterior walls (allow maximum daylight at the original windows) down to the center Corridor walls. The original ceiling appears to be framed with 2"x6" ceiling joists spaced approximately 24" on-center. Although not exposed, the original building specifications indicate the ceiling joists are somehow attached to the roof rafters forming a truss (although the difference in spacing is not accounted for in the written specifications). The dropped ceilings are in poor condition (non-structural). The original ceiling and associated structure were not sufficiently visible to make additional observations.

INTERIOR WALLS & COLUMNS

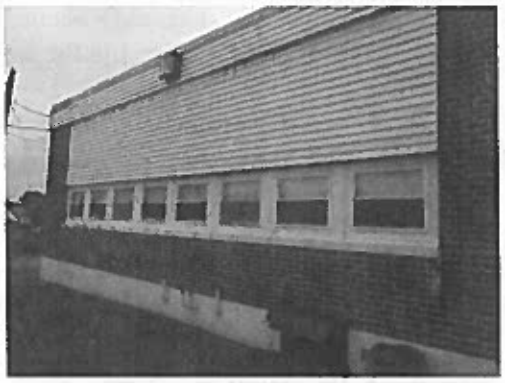
The original first floor walls appear to be CMU whether they were load bearing or not. The north-south running walls on either side of the central Corridor are load bearing as they support both ceiling and roof loads. These walls are supported on the 18" steel beams below.

The CMU walls running east-west appear to be non-load bearing, although they may act as shear walls to provide lateral stability to the structure. The CMU walls running east-west are supported by steel beams of varying size below. The CMU wall between the northeast Classroom and the central eastern Classroom, and continuing west along that same line, is supported on a CMU wall below.

CMU walls appeared to be in satisfactory condition. Other interior partition walls were considered non-structural and were therefore not assessed.

The steel beams supporting the first floor framing and the two center Corridor walls above are supported by 6" diameter steel pipe columns in the basement. These columns are spaced approximately 18'-0" on-center. Smaller 4" diameter columns are present at closer spacings to support the suspended slab around the stairs and under the entry Corridor, Principals Office, Teachers Room, and Girls and Boys Bathrooms. The columns are embedded into the slab, thus the base conditions were not observable. The top of the columns have differing column-to-beam configurations, although in almost all cases the beams run over the columns and are welded directly to the columns.

EXTERIOR WALLS



The exterior walls are composed of CMU block on the interior with a clay brick veneer on the exterior. The east and west walls have very large openings that reportedly had banks of windows and historic glass block at one time. These have since been infilled with wood-framed walls with a series of small windows near the original sill elevation and finished with drywall on the interior and vinyl siding on the exterior. There appear to be steel columns at approximately quarter points in each large opening. Where exposed, these columns appear to align with the roof rafters above. The shape of the steel columns could not be determined, although it appears likely they are a 4" wide HSS tube, or similar.

The CMU block, as exposed on the interior, appeared to be in satisfactory condition. The brick masonry façade on the exterior is generally in good condition although there are localized areas

of degradation and/or shifting. In particular, the brick near the south corner of the entrance on the west façade, above the cantilevered roof, appears to have shifted inward. Step cracks in brick masonry joints and minor shifting were observed around the north and south entries. A brick was loose and removable by hand in the second brick course directly west of the south entry. A few bricks, particularly near the entry, had surface spalling which may be associated with chloride exposure if salt was regularly spread on the adjacent stoop in winter. Some bricks were observed to be cracked through the brick itself (as opposed to in the joint) which is often due to moisture freezing in the brick material, indicating a possible moisture issue or water penetration.

ENTRY CANOPY ROOF

The entry canopy roof is cantilevered out from the building. The framing for the canopy roof was not exposed for observation.

ENTRY STOOPS

The concrete stoop and ramp at the west (front) entry is in marginal condition. The stoop appears to be a slab on grade placed on a perimeter frost wall. The stoop has several intermittent cracks running east-west which, when considering the long narrow shape of the stoop and the lack of contraction joints, are likely due to shrinkage. The stoop surface appears to be newer than the original frost wall below. The top of the frost wall appears to have substantial material degradation, which, if left unaddressed, will ultimate undermine the stoop slab and cause cracking and/or differential movement.

The stairs at the north entry appear to rest on grade and do not appear to have frost protection. Seasonal shifting of the steps may occur. Soil at the base of the steps appears to be eroding which could eventually undermine the stairs.

The stairs (1 ½ steps) at the south entry likely rest on grade and may not have frost protection. Seasonal shifting of the steps may occur.

ENCLOSED STAIR

The concrete steps at the enclosed stair at the south end of the east wall are in poor condition. Spalling and material degradation is present and is likely due to water infiltration.

EXTERIOR RETAINING WALL

The exterior retaining wall intersecting the east wall is composed of a section of cast-in-place concrete closest to the foundation wall, then transitions to a stacked stone wall beyond. The concrete retaining wall appears plumb and in good material condition. The stacked stone wall appears to be shifting/leaning inward/northward at the top.

ASSESSMENT

We have performed a preliminary analysis to determine the approximate live load capacity of the typical existing framing compared to current standards.

ESTIMATED DEAD LOADS (psf = pounds per square foot)

Estimated dead loads are as follows:

- Floor dead load at 3" – 4" thick slab with open-web steel joist framing = 55 psf
- Floor dead load at 6" slab = 80 psf
- Roof dead load = 20 psf (including suspended ceiling)
- CMU wall dead load based on 125 pcf unit density with grouting 48" on-center = 44 psf

MATERIAL PROPERTIES

Assumed material properties are as follows:

- The original specification cites Western Fir with a bending stress (Fb) of not less than 1,450 pounds per square inch (psi) in its extreme fibers for the roof rafters and for the roof decking material (2"x6" tongue and groove). Western Fir is not a contemporary wood timber specification but is anticipated to be most similar to current Douglas Fir-Larch properties. The National Design Specification for Wood Construction (NDS) gives design properties for various species and grades of wood. The lowest grade Douglas Fir-Larch Beam/Stringer Timber meeting the 1,450 psi specification is a Dense No. 1 grade with a design bending stress of 1,550 psi. As such, we have used Douglas Fir-Larch Beam/Stringer Dense No. 1 grade in our roof rafter calculations.
- Based on the year of construction (1954) the steel beams are anticipated to conform to the ASTM A7 standard which was the primary structural steel standard from 1939 to the 1960s when ASTM A36 became the predominant structural steel used for building construction. ASTM A7 had a published yield strength of 33 ksi and a tensile strength of 60-72 ksi. These values have been used in our steel beam calculations.

FLOOR FRAMING CAPACITY

The existing Bethlehem open-web steel joist framing has a live load capacity of approximately 60 – 65 psf. This live load applies to the Classrooms, including the Resource Room and northern extension of the Principal's Office which appear to have been partitioned out of the original northwest Classroom.

We cannot assess the capacity of the 6" suspended concrete slab because we do not know the reinforcement; however, based on the span and slab thickness, it is likely the slab meets or exceeds the open-web joist framing live load capacity of approximately 60 – 65 psf. In addition, considering the capacity of the beams supporting these areas, it is probable that at least the main corridors were designed for a higher live load, which would be typical both in current and historic codes (e.g. 1965 BOCA-BBC code specified 100 psf minimum uniform live load for interior corridors which matches MUBEC standards of today).

The existing steel support beams are adequate to support the calculated 60 psf floor live load in addition to the estimated dead load of the floor, dead load of the CMU walls above, and roof dead and snow loads where applicable. Based on our calculations, most of the beams have approximately 25 percent reserve capacity, indicating we may have underestimated a load or that the corridor design live loads was indeed higher than the classroom design live load, which would be typical.

ROOF FRAMING CAPACITY

Based on our analysis, the roof timbers appear to be undersized for current design snow loads, plus the dead loads applied by the roof, original ceiling and newer dropped ceiling. Calculations indicate the timbers are approximately 25 to 35 percent overstressed in bending. In addition, the stiffness of the timbers does not appear to be adequate to meet current serviceability/deflection criteria (L/360) for most directly-applied ceilings (drywall, plaster, etc.).

Based on our analysis, the roof decking (2"x6" T&G) appears to be adequate for current design snow loads plus the dead loads, although this is a markedly thinner deck profile for the span than we would typically use today.

MUBEC – IEBC REVIEW

Maine has adopted the Maine Uniform Building and Energy Code (MUBEC) which includes several national codes and standards, with amendments. MUBEC is currently mandatory in towns with over 4,000 residents (per 2010 census). Towns under this population threshold may voluntarily adopt and enforce MUBEC, or select portions of it if desired. At this time the Town of South Thomaston has not adopted MUBEC (or any portions of it) and therefore has no governing building code. However, MUBEC represents the minimum standard for professionals, regardless of whether a town has adopted it, so we present a summary and review of how MUBEC would apply to critical aspects of the proposed project below.

MUBEC incorporates several codes and standards, including the International Existing Building Code (IEBC 2015) and International Building Code (IBC 2015). If the former Gilford Butler School is renovated, the IEBC would be the appropriate reference code for the structural systems. If the building is replaced with a new building, IBC would be the appropriate reference code for the structural systems. Since this study aims to provide feedback on the existing structure as well as feasibility and/or challenges regarding the proposal to repurpose the building as a Community Center and Library, this review addresses renovation of the existing building per IEBC.

CLASSIFICATION OF WORK

The work required to renovate and repurpose the existing building into a Community Center and Library will likely fall into several IEBC work classifications, including: Repairs; Alterations – either Level 2 or Level 3 depending on the scope of renovations; and Change of Occupancy. A general overview of key points of IEBC with respect to these work classifications is below. This

list is not exhaustive but suggests the more likely constraints that could apply in general and understandable terms with respect to this building.

International Existing Building Code (IEBC) Review – Relevant Highlights
Repairs
• Repairs for less than substantial structural damage are permitted to restore the damaged element(s) to their pre-damaged condition without additional upgrade.
Alterations – Level 2:
• New structural elements shall comply with IBC standards for new construction. • Alterations shall not reduce the capacity of existing gravity load carrying elements unless the altered elements are shown to comply with IBC standards. • Existing structural elements supporting any additional gravity loads as a result of the alterations shall comply with IBC standards for new construction (unless the stress is increased by less than 5 percent). • The structure shall be shown to meet the standards of the wind and seismic provisions of IBC if an alteration increases design lateral loads or decreases the capacity of any existing lateral load-carrying structural element (with some exceptions).
Alterations – Level 3:
• All of the provisions of Alterations – Level 2 (above) apply. • An evaluation and analysis, and often upgrade, of the existing structural elements of the lateral load-resisting system is required if a substantial structural alteration is undertaken. A substantial structural alteration is when more than 30% of the total floor or roof area is modified. • For masonry buildings, wall anchors may be required at the roof line to resist seismic loads.
Change of Occupancy:
• If the new proposed occupancy results in higher minimum design live loads per IBC, then the portion of the building subjected to higher loads shall comply with IBC standards for new construction. • If the new proposed occupancy results in the building being assigned to a higher risk category based on IBC, the building shall comply with IBC standards for new construction for wind, snow and, in some cases, seismic.

Key points for this project with respect to the outlined provisions of IEBC above include:

<u>Repairs:</u>

1. We did not observe any substantial structural damage, so repairs may be made in-kind. This would apply to repairs such as repointing and localized masonry repairs.

Alterations – Level 2: Key Points for this Project:

2. Interior CMU walls are anticipated to be providing lateral load-resistance. Removal of large portions of CMU walls (in either direction) may decrease the existing lateral load-carrying capacity. Based on observation there is more than adequate lateral load capacity in the building, so we would not expect this to be problematic unless the majority of the interior CMU walls were proposed to be removed.
3. Although the existing roof rafters appear to be undersized, as long as no new additional loads are added to the roof (either directly or indirectly), the rafters can likely remain unmodified. Although not mandatory, it may be possible to reduce load on the rafters (thereby improving their situation and reducing overstress) by removing the multiple ceiling layers and installing a new, light-weight ceiling assembly.

Alterations – Level 3: Key Points for this Project:

4. We do not anticipated renovations to qualify as substantial structural alteration, unless the roof were replaced with a new roof structure of higher profile (e.g. gable trussed roof). Since the existing rafters are expected to be able to remain, the concept of installing a gable trussed roof, although feasible, adds little value and will trigger additional analysis and possibly additional upgrades.
5. Improved anchorage at the roof line may be required, but would not be hugely cumbersome to implement.

Change of Occupancy: Key Points for this Project:

6. The proposed occupancies of assembly and library have higher minimum design live loads per IBC than classrooms, thus compliance with IBC standards for new construction will be required.
7. The main floor has an existing floor live load capacity of approximately 60 psf in the classrooms. This is inadequate for assembly and library stacks, which have a minimum uniform design live load of 100 psf and 150 psf, respectively. It is adequate for library reading rooms, which have a minimum uniform design live load of 60 psf. Any classroom areas that are converted to assembly or library stack areas will require substantial upgrade.
8. The corridors may be acceptable to remain unmodified if they remain as corridors and perhaps if they were integrated into an assembly space (e.g. public meeting room). Any corridors converted to library stack space will require upgrade.
9. The slab-on-grade in the basement is acceptable for all proposed higher occupancy floor loads without modification.
10. If the building's primary occupancy is public assembly with an occupant load of greater than 300 people, upgrade of the undersized roof timbers and any other existing undersized structural components affected by wind or snow loads will become mandatory.

CONCLUSIONS

Based on our observations, assessment and review of IEBC considerations, the existing structure appears to be structurally sound in its current condition and was likely appropriate for its previous occupancy as a school.

Although the roof timbers appear to be undersized by current standards, they have performed satisfactorily for many years and do not present a level of overstress that we consider dangerous (thereby warranting mandatory upgrade). It is unlikely the roof will require mandatory upgrade unless the building's primary occupancy becomes public assembly with an occupant load of greater than 300 people.

At present, the existing classroom floor structure on the main level is only adequate for school classrooms (existing), offices, and library reading rooms; most other occupancies will require upgrade. The classroom floor structure on the main level, which comprises the majority of the first floor area, is not adequate for assembly (e.g. community meeting room) or library stack uses. The floor structure will require significant upgrade to achieve minimum standards applicable to assembly use or typical library stacks. Although we have not analyzed or designed any potential upgrades, it is probable that upgrade would require most or all of the following:

- Installation of new support beams to reduce the spans on the existing open web steel joists.
- Localized reinforcement/modification of existing open web steel joists to accommodate the new and different support conditions.
- Installation of new support columns in the lower level.
- Installation of new interior footing at each new post location in the lower level (requiring cutting of the slab, etc.).

Most other noted deficiencies are maintenance items that can be addressed with in-kind repairs.

PHOTO APPENDIX

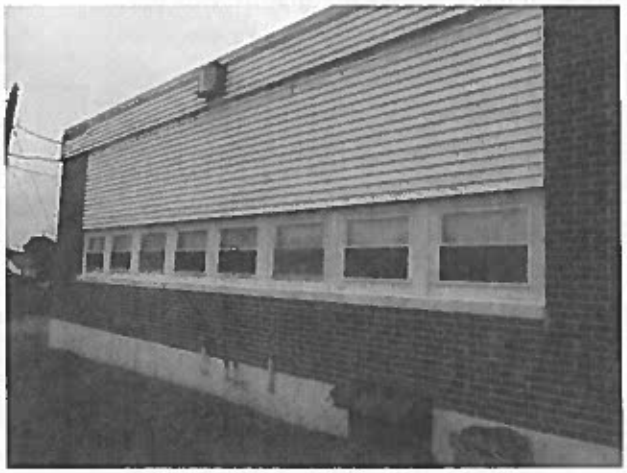
Additional photo-documentation from our site inspection is provided on the following pages for reference.

LIMITATIONS OF STUDY

This report is limited to the structure of the building and does not address life safety, energy conservation, ADA compliance, maintenance of non-structural components, or any other aspect of the building not explicitly addressed herein. This conditions assessment aims to provide a general understanding of the existing condition of the structure of the building at the time of our site visit. This report intends to assist the Town with its repurposing due diligence assessment. This report shall not be construed as a construction document. Although we make every effort to conduct a comprehensive site visit and provide accurate documentation of a building, it is possible that deficiencies may exist which are not identified in this report. It is also possible that conditions may change during the interim period between the date of the site visit and the date the report is issued. We are not responsible for either unidentified deficiencies or changes in the condition of the building any time after the date of the site visit.

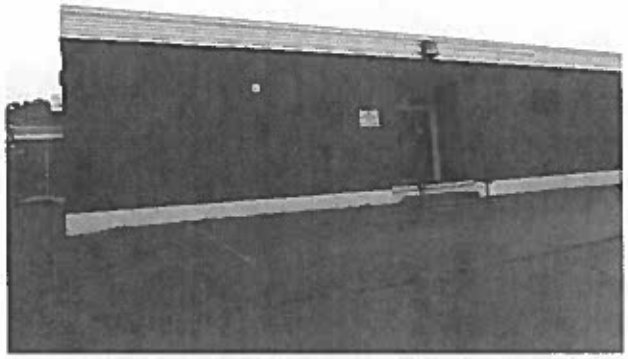
1) Exterior – West façade facing road; primary entry

2) Exterior – West façade facing road; primary entry; cantilevered roof canopy; stoop

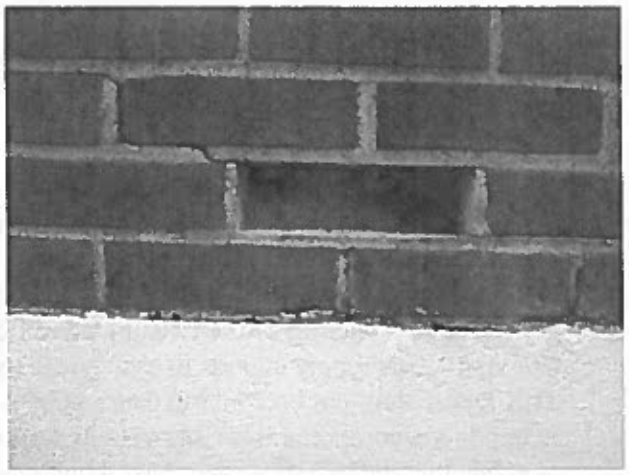


3) Exterior – Large original openings infilled with smaller windows and wood framed wall, typical on east and west sides

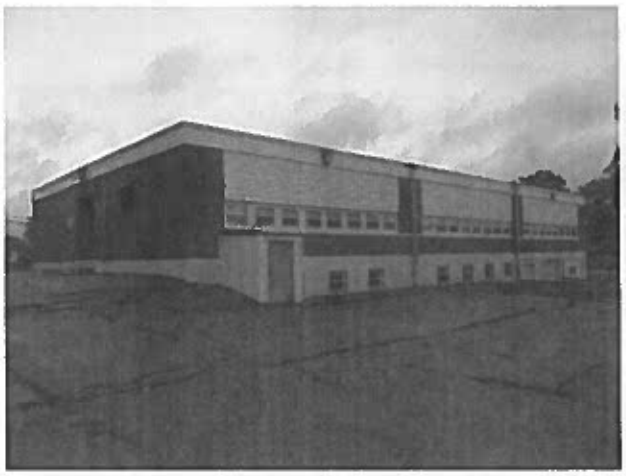
4) Exterior – Masonry degradation at south end of entry roof canopy; localized masonry repairs are required



5) Exterior – South façade



6) Exterior – Masonry degradation west of south entry; brick was loose and could be removed by hand (was replaced); step cracks in joints



7) Exterior – East façade

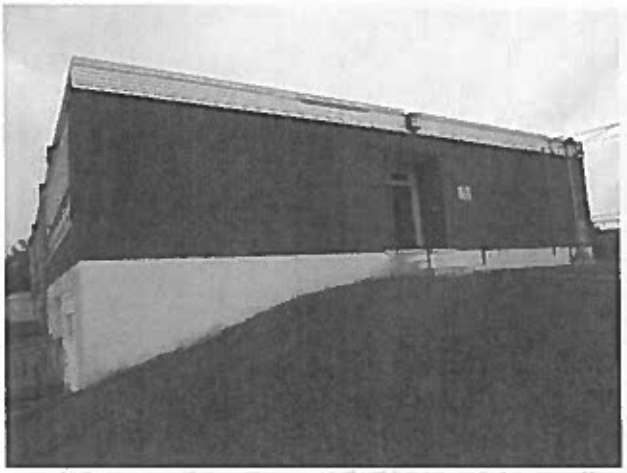
8) Exterior – East façade; foundation is partially backfilled, allowing small windows on lower level at south end

9) Exterior – East façade; retaining wall with lower grades at north end for overhead door access; interior slab is lower than exterior grades

10) Exterior – East façade; Crack at expansion joint with horizontal bar showing; paint is protecting; localized concrete repairs required

11) Exterior – East façade; Damage at overhead doors; paint is protecting; localized concrete repairs may be required

12) Exterior – Retaining wall at rear elevation change; stone wall is out of plumb and shifting; concrete wall is in good condition

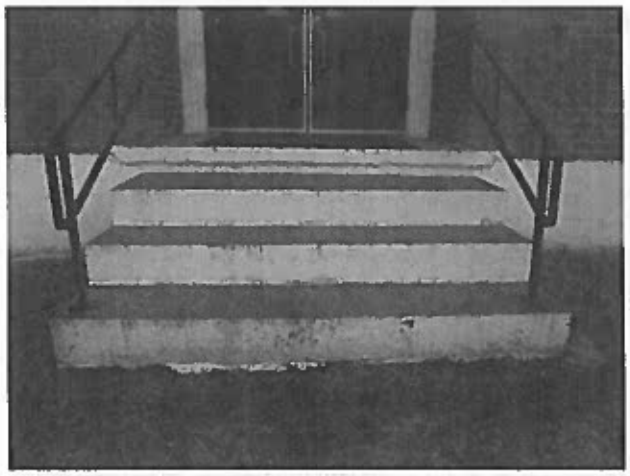


13) Exterior – North façade

14) Exterior – North entry

15) Exterior – Masonry degradation/shifting at east side of north entry opening; localized masonry repairs are required

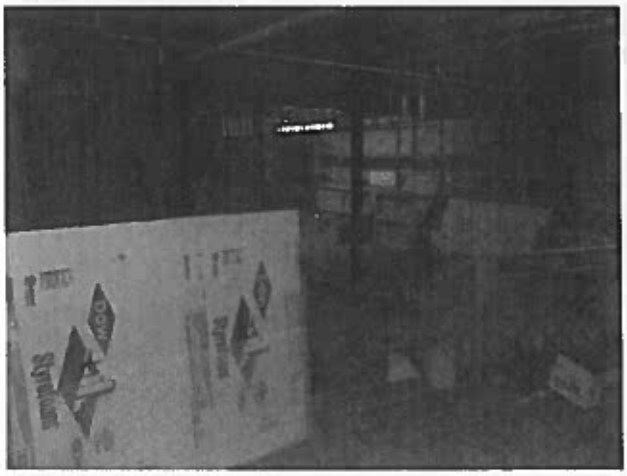
16) Exterior – Masonry degradation/shifting at west side of north entry opening; localized masonry repairs are required



17) Exterior – North entry stoop is undermined and lacks frost protection

18) Exterior – West (main) entry stoop bears on degrading frost wall below

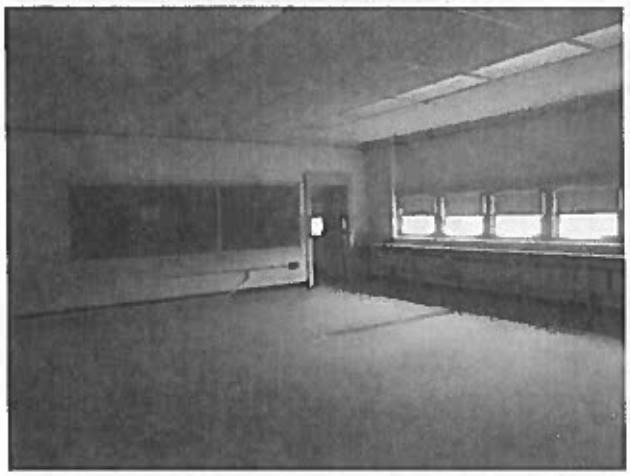
19) Interior – Lower level in cafeteria area



20) Interior – Lower level in high bay area (north end)

21) Interior – Lower level in cafeteria area; interior structural posts

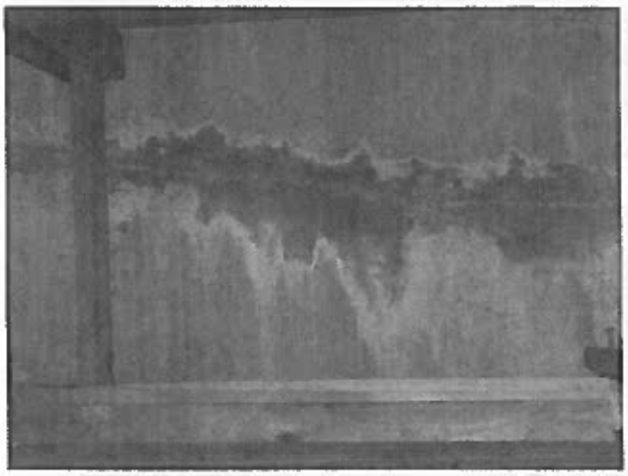
22) Interior – Main level corridors and typical CMU walls



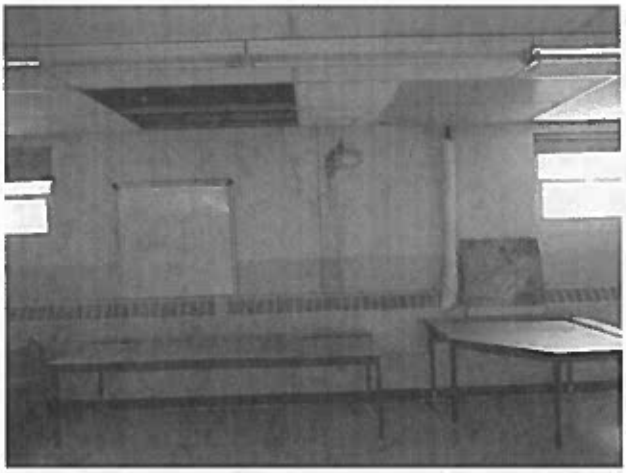
23) Interior – Main level typical classroom with dropped ceiling (original ceiling above) and infill walls where larger windows and glass block were removed

24) Interior – Main level corridors and typical CMU walls

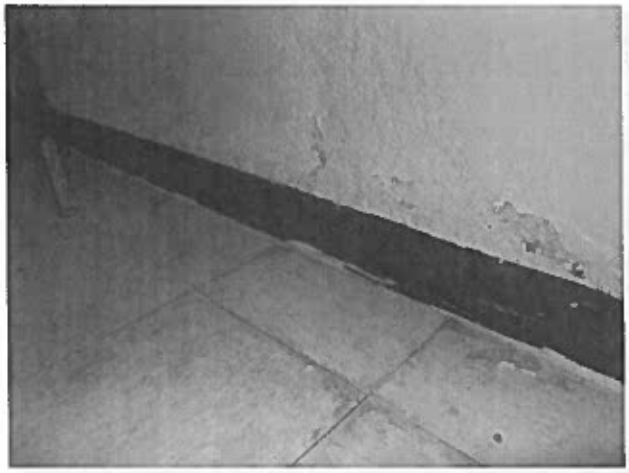
25) Interior Foundation – High bay area foundation has evidence of concrete setting during placement causing horizontal seams



26) Interior Foundation – High bay area foundation has evidence of concrete setting during placement causing horizontal seams



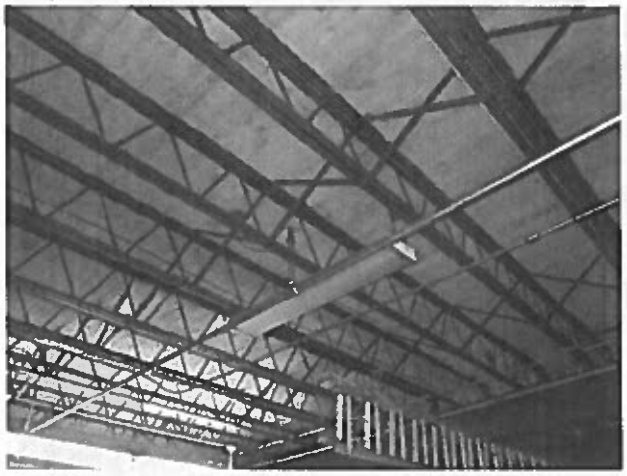
27) Interior Foundation – Cafeteria area walls are in sound condition with some vertical cracks that have been maintained; water seepage is evident



28) Interior Foundation – East cafeteria area wall has water penetration or condensation issue; puddles were evident on the floors near the wall

29) Interior Foundation – Cafeteria area walls are in sound condition with some vertical cracks that have been maintained; water seepage is evident

30) Interior Foundation – Stairs are degraded at exit stair near southeast corner of the building

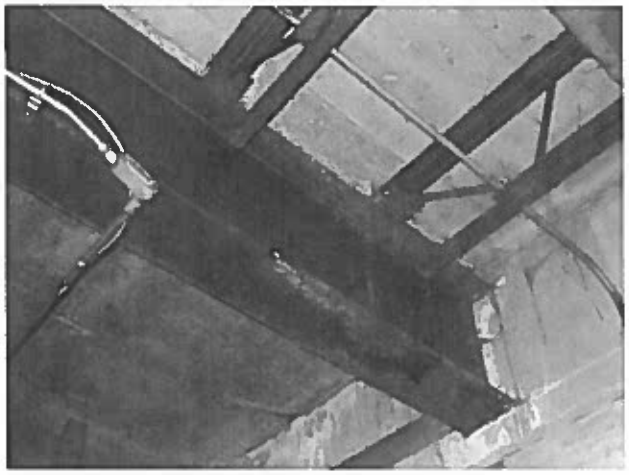


31) First floor framing – Typical open web steel joists and concrete deck at classrooms

32) First floor framing – Typical steel support beams and columns

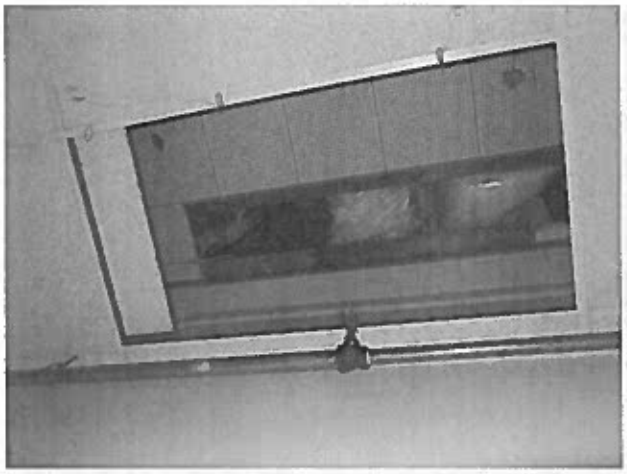
33) First floor framing – Typical open web steel joists at foundation wall

34) First floor framing – Typical suspended concrete deck at Corridors, Toilets, Principal's Office and Teacher's Room



35) First floor framing – Typical steel beam condition at foundation wall; some corrosion is present

36) First floor framing – Typical open web steel joists at foundation wall; some corrosion is present



37) Roof framing – Timber rafters were exposed in select locations; timbers match original specification

38) Roof framing – Original (sloped) ceiling is supported by rafters; newer dropped ceiling is also supported by rafters