Greenwich Central Middle School Systems Evaluation

Team DTC

Submitted to:

Daniel Watson
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Greenwich Public Schools
290 Greenwich Avenue
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Submitted by:

Diversified Technology Consultants, Inc.
2321 Whitney Avenue, Suite 303
Hamden, CT 06518

DTC Project No. 17501.B07

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January 28, 2022

Mr. Daniel Watson
Director of School Facilities
Greenwich Public Schools
290 Greewich Avenue
Greewich, CT 06830

SUBJECT: GREENWICH CENTRAL MIDDLE SCHOOL SYSTEMS EVALUATION
DTC PROJECT NO. 17501

Dear Mr. Watson:

This provides you with DTC's physical condition assessment of Greenwich Central Middle School located at 8 Indian Rock Lane, Greenwich, CT, per our agreement of December 12, 2021. DTC's assessment focuses on architectural, structural, mechanical, electrical, plumbing conditions, and includes major and minor deferred maintenance activities. Our team includes Martin Benassi of Martin A. Benassi, AIA – Architect, LLC, for architectural and water proofing, and Martin Surveying Associates, LLC, for survey and monitoring of movement in existing facades.

The report is organized in (4) sections:

1. Architectural / Water Proofing
2. Structural / Wall Movement Monitoring
3. Mechanical
4. Electrical
5. Plumbing

Executive Summary

The original building is a 1 and 2 story structural steel masonry structure that was constructed in 1958. It has a partial full basement that serves for utility, emergency power, and plenum. A smaller addition was constructed sometime after 1999. Design details and as-built conditions of the original building do not take into consideration best practices making it prone to water infiltration and structural damage. Many of the MEP systems are beyond service life. Generally the facility does not conform to current CT Building Code standards.

There are significant structural concerns. By design the taller masonry walls have insufficient lateral bracing for wind and seismic loads. This results in bowing and displacement of the masonry walls and adjoining facades. Wall ties that connect façades to masonry walls are beyond service life and failing, and this poses safety concern as discussed in more detail under the structural section. The original design permits significant water infiltration into the building. We did not

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conduct destructive testing but it is possible that the extent of water damage may have results in significant deterioration in steel column bearing plates imbedded in concrete. This can be observed through significant destructive testing or inspection when repairing facades.

Thermal resistance of wall assemblies do not meet energy standards of the CT Building Code. The existing building relies heavily on varied sealants and sealing measures to keep water from infiltrating the building through walls and the roofs.

Mechanical, electrical, and plumbing, (MEP) systems are dated and do not conform to CT Building Code. Significant improvement to the facility would necessitate improving these facilities. Retrofit improvements to mechanical and electrical systems are practical and may involve structural improvements. Retrofit improvements to plumbing, particularly buried piping in slabs on grade, are more problematic.

Please call or email me if you have any questions or need additional information. My cell phone number is (603) 400-5455, and my email is cory.attra@teamdtc.com.

Sincerely,

B. Cory Attra, PE, SI, MBA, M.ASCE
Chief Engineer in Responsible Charge

DTC, INC.

Enclosure: Reports

cc: Shay Atluru, President, DTC
Graham Curtis, PE, LEED

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ARCHITECT'S FIELD REPORT X OWNER X ARCHITECT _CONTRACTOR _ FIELD

PROJECT: Facade and Roof Evaluation
Central Middle School
9 Indian Rock Lane
Greenwich, CT

PROJECT NO.: 21-23

CONTRACT: Diversified Technology Consultants
2321 Whitney Avenue, Suite 301
Hamden, CT 06518

DATE: December 28, 2021 TIME: n/a WEATHER: sunny TEMP. RANGE: 40°F

EST. % OF COMPLETION: n/a CONFORMANCE WITH SCHEDULE (±): n/a

WORK IN PROGRESS: evaluation PRESENT AT SITE: Martin A. Benassi MAB Architect
Jim Harding MAB Architect

INTRODUCTION

1. **History:**

A. We received a telephone call from Graham Curtis, P.E., of DTC on September 27th requesting a proposal to perform a facade evaluation of the Central Middle School, Greenwich, Connecticut. A proposal outlining our services dated September 28, 2021 was submitted to DTC and accepted; and an Agreement was signed on November 15, 2021.

1) A request was made to evaluate the existing roofing system, as well. A proposal for this service dated November 16, 2021 was submitted to DTC and accepted; and a Sub-Agreement was signed on January 3, 2022.

B. This was to be a visual, non-destructive type of evaluation based on our site visit. No openings were taken to examine or verify roof or exterior wall construction. Existing materials should be tested for hazardous content such as asbestos or PCB.

C. Existing construction documents were provided for our use including:

1) 830-3 Gym and Locker Room
2) 1957 Central Junior High School
3) 1958 Planting Plan
4) 1973 Upgrading of Heat Generating Plant
5) 1980 BOE Central Junior High School
6) 1986 Handicap Toilet Room
7) 1987 Subsurface Drainage System
8) 1998 Additions and Renovations to Central Middle School
9) 2006 Roof Replacement
10) 2008 Bathroom Renovations
11) Central Middle School District
12) New Boiler Room and Drains

D. A site visit was made on Tuesday, December 28th to walk the site and document existing conditions. Present at that time were Martin Benassi and Jim Harding of MAB Architect. Field measurements, photographs, and sketches were made to be used in preparation of this Field Report, some of which are attached.

2. **Building History:**

A. The building was originally constructed in 1957 and has a footprint of approximately 80,359 square feet. Numerous additions and renovations have been made to the building over the years, including the roofing system in 2006; and window and door replacement in 1980.

3. **Format:**

A. This survey is organized into sections including: Introduction, Observations and Evaluations, and Recommendations.

The *INTRODUCTION* contains a concise history of the project from commission through site visit(s) including dates, times, and personnel involved.

The *OBSERVATIONS AND EVALUATIONS* section summarizes the conditions that existed at the time of the site visit and identifies the probable causes of damage and failure. Also included are the appropriate photographs taken during the site visits, which we identify and describe in the accompanying text.

In the *RECOMMENDATIONS* section, we provide what are in our opinion the most cost-effective solutions for the problem areas found. Alternatives may also be included if there is the possibility that the main recommendations cannot be followed.

B. This Report, including all of its appendixes, is ***NOT FOR CONSTRUCTION*** and was prepared for the sole use by the Client, building Owner, and Architect.

OBSERVATIONS AND EVALUATIONS

1. **General:**

A. The original building is a low-slope roof on a steel-frame structure with masonry and curtain wall in-fill. Some of the original construction detailing is questionable by today's standards, resulting in continuous maintenance issues including:

1) The 4x6 exposed steel columns bearing plate is covered in a concrete sill which, in some locations, is close to or below grade.

2) Finish floor slab elevation and window sill are close to finish grade along some elevations.

3) Expansion joints are not continuous.

4) Building has poor thermal resistance value in both the walls and roof construction with limited insulation and lack of any thermal break between materials.

5) Initial building design relies heavily upon sealant to keep moisture out.

B. In general, the building is 65 years old and shows signs of aging in almost all elements.

2. **Masonry Wall Construction:**

A. Exterior masonry walls are of either 10" (4" CMU - 2" gap - 4" CMU) or 12" (6" CMU - 2" gap - 4" CMU) cavity wall construction with continuous standard wall ties located 16" on center vertically and a total height at some locations of over 20 feet. Deficiencies observed in the exterior walls include:

1) There are numerous cracks occurring at various locations such as the auditorium and gymnasium walls, with some previously repaired using mortar or sealant.

2) Displacement of CMU blocks, most noticeably along the roof line and corners. This is most likely due to water infiltration from roof flashing. Details indicate a lack of reinforcement anchoring the CMU back to the structure at the roof line.

3) Vertical displacement or bowing of over 5" in the exterior CMU wall at the gymnasium.

4) Staining of the CMU along the north elevation of the media/computer wing. "Special coating" was applied to the concrete sills as part of the window replacement project in 1980. The CMU may have been coated or painted with the same product.

5) Emseal® compressible seal is used to fill the vertical expansion joints. The material appears to be performing as intended. However, gaps were observed at the roof/wall transition. See comment below under roofing.

6) Twenty feet is nearing the limit for cavity wall construction without horizontal anchoring. A structural engineer should review this design.

B. There was no efflorescence observed. However, this may be due to ongoing maintenance and painting of the CMU.

1) Efflorescence is a crystalline deposit of salts observed on the surface of masonry. It occurs when water leaves behind salt deposits and is present on or in the masonry surface. Efflorescence is a sign of moisture entry into the wall. In general, masonry will not allow enough moisture through to cause extensive efflorescence to occur. Water which does penetrate the wall (through defective CMU, brick, mortar joints, hairline cracks between mortar and brick, defective roofing and flashing) will then travel through the substrate and leach out, leaving salt deposits on the face of the masonry wall.

C. Weep holes are designed for two purposes. First, it provides an opening to allow water to drain out through the bottom of the wall or above openings along the lintel / flashing. Secondly, it is intended to allow ventilating air to enter the gap within the wall to help dry the structure. A limited number of weeps were observed above the base flashing. Some may have been removed or sealed over during the roof replacement project.

3. **Sealant/Caulking**:

A. Initial building design relies heavily upon sealant to keep moisture out. This is obvious at the vertical and corner joints of the auditorium wing. A bent metal strip was surface applied in an attempt to better seal the joint.

B. Drawings indicate structural steel columns spaced at 8-foot on-center with "caulking in 1/4" x 3/4" tooled joint all around column." As the sealant dries out, cohesive failure occurs, permitting water penetration. This results in spalling of the masonry and concrete along with rusting of the steel reinforcement.

C. There are two main classifications of building joints: Static and dynamic. Static joints are those where the joint is non-moving, such as the sealing of window sills and jambs. Dynamic joints are those which experience movement through expansion or contraction.

D. Most of the sealant failure observed is cohesive. This is especially true around columns, windows, and doors.

E. The best sealant for most applications would be one with a high Class Rating to withstand the movement between the different substrates, is a single component, is non-sagging, and can adhere to as many different Use Groups as possible (such as a one-part natural silicone sealant). The life expectancy of a high grade sealant is approximately eight years.

4. **Roofing**:

A. There are three different types of roofing systems currently on the building (see attached Roof Plan and photos):

1) Liquid applied - 280 SF
2) Modified Bitumen Membrane (MBR) - 71,415 SF
3) Single-Ply Membrane (TPO) - 8,664 SF

B. MBR:

1) According to the 2006 Construction Drawings prepared by Marc Caputo Roof Consultant, the existing roofing material was removed down to the gypsum deck and the new roof assembly installed as follows:
   Gypsum decking
   Temporary roofing - nailed
   Vapor barrier
   Tapered insulation and overlay
   Two layers SBS roofing

2) Additional wood blocking and sheet metal was installed to adjust for increase thickness of insulation.

3) A copper-clad SBS membrane was used for base and edge flashing.

4) Liquid membrane was used at some of the roof drains and stack vents for flashing.

5) There were numerous blisters and ridging of the membrane observed throughout the roof area.

6) The membrane itself is showing signs of aging and alligatoring.

7) There is a pre-fabricated aluminum sheet metal cover on the expansion joints. The expansion joint does not extend continuous to the fascia.

8) A barrel roof on the northwest media center/computer wing is covered with the SBS membrane. Original material is unknown.

C. Liquid Applied Roofing:

1) A fluid applied coating was applied to the saw-tooth concrete entry canopy. Excessive debris and trash was observed at the low point. Plant growth and staining of the coating was noted.

D. TPO:

1) Thermoplastic polyolefin (TPO) is a type of single-ply roofing material that was used on the northwest media center/computer wing of the building. TPO roofing material was introduced in the 1990s as an economical alternative to the more expensive PVC roofing. The membrane is comprised of three bonded layers - a thermoplastic polyolefin base layer, a polyester-reinforced fabric center, and a thermoplastic polyolefin top layer.

2) The white membrane helps with the reflective UV and reduces heat gain in the summer months. However, the white membrane fades over time to a dirty gray. Care needs to be taken when walking on the roof as the membrane becomes very slippery when wet or icy.

E. Miscellaneous appurtenance:

1) Access onto the roof is through a roof hatch with access to the gymnasium roof via fixed aluminum ladders.

2) There are eight small pyramid skylights, various sized mechanical RTU and fans, compressors, antenna, pitch pockets for conduit/piping, stack vents, gas piping, and walkway pads. A rooftop screen hides two RTU mechanical units from view.

F. Drainage:

1) In general, the roof appears to be draining properly with only minor areas of bird-baths occurring.

2) There are 21 roof drains on the main roof. The newer media center/computer wing has 6 roof drains with 6 secondary roof drains per code.

5. **Fenestration**:

A. Original curtain wall assembly, windows, and doors were replaced in 1980 (42 years). Construction documents prepared by Maitland/Strauss/Behr, Architects PC indicate removal of the existing curtain wall assembly and installation of new aluminum thermally broken insulated units with 1-1/2" insulated panel or 1" insulated glazing. Most appear to be in good condition for their age. However, some leaks have been reported. This may be due to sealant failure and not the window itself.

B. Overall window dimensions are:

1) Typical panel: 21'-8" high x 8'-0" width, with a pair of 2'-0" x 4'-0" operable awning sashes at each floor.

2) The window frames are standard 2-1/4" thick extruded aluminum.

C. Issues were observed with exterior doors including:

1) Spalled concrete causing the aluminum threshold to lift, resulting in a tripping hazard.

2) Elevation drop due to settlement of the step/landing.

3) Possible weatherstripping issues (observed from exterior only).

4) Sandbags located around doors - possible water flooding.

D. Kalwall® translucent panels are installed on the upper portion of the gymnasium wing and "dry glazed" into the framing system. All of the panels are severely faded and are exhibiting what is called "fiber-bloom", which is when the panels deteriorate due to UV degradation, exposing the fiberglass reinforcement. The fiberglass fibers are exposed and the panels have faded to a bleached white color, reducing the amount of light transmission.

1) Use of UV inhibitors in materials to reduce impact of UV solar radiation is recommended by the manufacturer. In most installations, the Owner is not made aware of this requirement or refrains from doing the work due to cost. Our limited research indicates that applying a UV inhibitor to the panels has not proven effective in preventing fiber-bloom on products which are used in outdoor environments on a continuous basis. They also have proven to be a high cost factor.

RECOMMENDATIONS

1. The following recommendations are, in our professional opinion, the most cost-effective solutions for the problem areas found. It is important to note that the building will remain operable throughout the work. This will reflect in the selection of the materials and methods, as well as an increase in the overall cost. Test results for hazardous materials such as asbestos and PCB should be included in any bid-restoration type package so contractors can handle and dispose of the materials accordingly.

2. The following recommendations are in addition to a regularly scheduled maintenance program. We strongly recommend that you retain the services of a licensed roofing contractor to inspect and maintain the roofs and waterproofing membranes a minimum of twice a year. They need to be familiar with the various types of roofing systems on the buildings.

3. If the overall goal is to continue using the facility for its intended use, the ongoing maintenance and repair costs will be high due to age and original construction detailing.

    A. The existing roofing systems are 16 years or older and nearing the end of their useful life expectancy as earmarked by the numerous blisters and aging of the top-ply membrane. The TPO membrane has faded to a dirty gray and no longer offers the reflective UV resistance of a white membrane. Also, the reinforcement is beginning to show through the surface.

        1) We recommend complete replacement of the roofing system at all locations down to the original deck and installation of a new fully-adhered EPDM (ethylene-proplyene-diene-monomer) over a tapered rigid insulation system with all new flashing and sheet metal. We recommend the use of lead coated copper for all sheet metal, including expansion joints and fascias.

    B. Due to the aging of the Kalwall® translucent panels along the gymnasium wing, the amount of light transmission into the space is reduced and the overall appearance questionable.

        1) We recommend replacement of the panels with an aluminum energy efficient glazing system including insulated glass with solar film to reduce glare.

    C. Caulking generally lasts 3 to 5 years before experiencing some type of failure. Because the initial design detailing relies heavily on caulking to keep water out, inspection and repair will be an ongoing maintenance issue.

        1) We recommend replacement of all caulking with a one-part natural silicone sealant such as Dow 795 with a followup maintenance and inspection program approximately every 8 years.

    D. Fenestration including doors, windows, curtain walls, vents, and louvers are over 40 years old and most likely beyond any manufacturer's warranty. Leaks were reported, however the source may be related to defective sealant and not the window unit itself.

        1) Only regular maintenance and repair are recommended. Replacement of damaged or defective threshold with a more durable bronze type unit along with patching of spalled concrete as required.

    E. The observed cracking, bowing, spalling, and displacement of CMU units appear to be an ongoing issue. Studies have been done in the past regarding possible repairs.

        1) Any repair or replacement of the CMU walls should include increasing the thermal resistance by adding insulation to the wall assembly. Rigid insulation board can be installed within the cavity or surface applied to the exterior and protected with a cementitious coating.

        2) To prevent future cracking of CMU, a properly detailed control joint should be installed at not over 30 feet intervals and at penetrations.

We hope this facade and roof evaluation is as anticipated and helps in your decision-making process. Should you have any questions regarding its contents, please feel free to call us.

ATTACHMENTS:
A-1 and A-2 Roof Plan
A-3, A-4, A-5 and A-6 Elevations
Roofing Photos
Masonry Photos
Construction Details

by: Martin A. Benassi
Martin A. Benassi, AIA - Architect LLC
Two Broadway
Hamden, CT 06518

Photo 1. Auditorium roof looking north

Photo 2. Main roof looking north

Photo 3. Roof Top Unit (RTU) base flashing using SBS membrane

Photo 4. Blister and ridging of membrane - typical

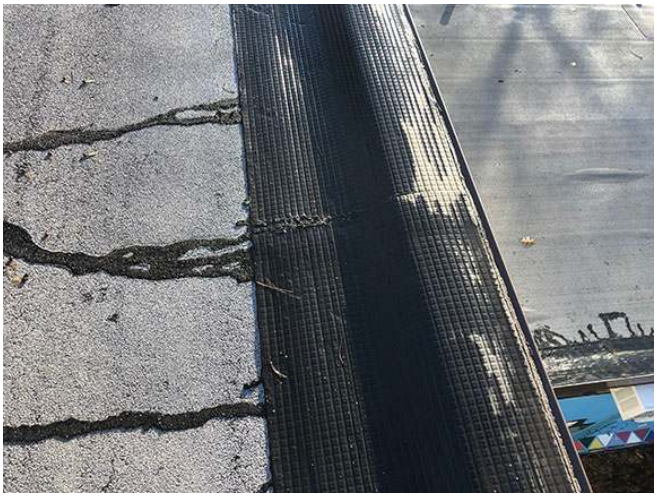


Photo 5. Typical copper clad edge flashing

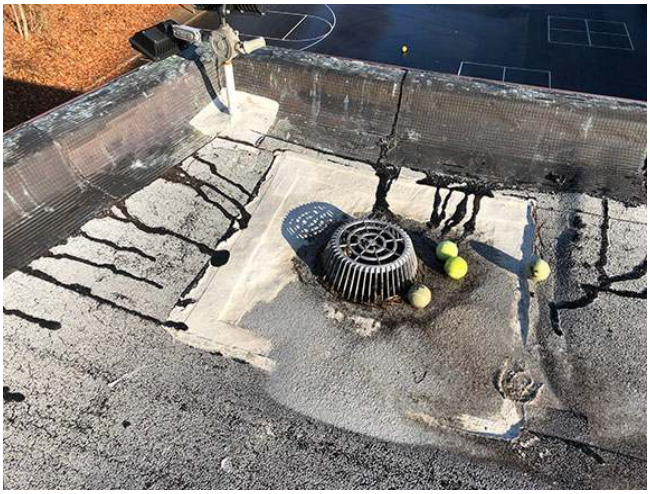


Photo 6. Typical roof drain flashed in liquid membrane

Photo 7. Expansion joint with aluminum cover - joint does not continue to roof edge

Photo 8. Sawtooth roof at entry with liquid roofing

Photo 9. Typical skylight on main roof

Photo 10. Typical pitch box and condensate unit

Photo 11. Typical rooftop fan unit and stack vent

Photo 12. Expansion joint with aluminum cover - joint does not continue to roof edge

Photo 13. Overview of main roof looking west

Photo 14. Overview of main roof looking east toward gymnasium

Photo 15. Masonry chimney

Photo 16. Connector to media/computer wing TPO membrane

Photo 17. Aluminum fascia for single-ply membrane roofing

Photo 18. Media/computer wing with TPO membrane on low-slope roof and SBS roofing on barrel area

Photo 19. Typical blister in SBS roofing membrane

Photo 20. Metal siding on barrel roof and TPO single-ply membrane on low-slope roof

Photo 21. Cracks in CMU Auditorium wall

Photo 22. Crack in CMU Auditorium wall

Photo 23. Corner detail in Auditorium wall with cover plate added

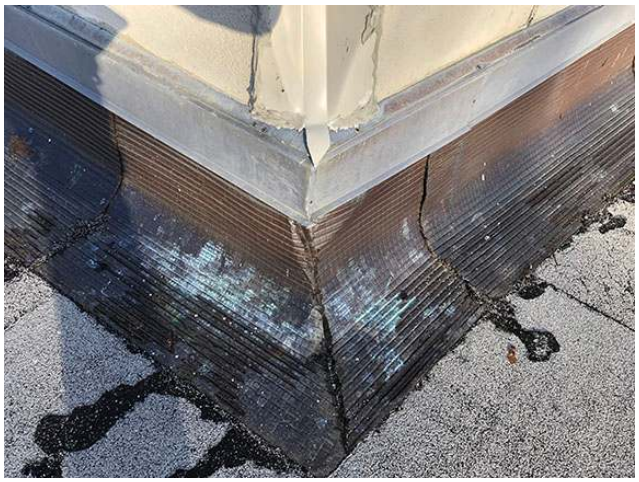


Photo 24. Base flashing detail along Auditorium wall

Photo 25. Base flashing detail along Auditorium wall with cover plate added to recess

Photo 26. Roof line showing cover plate added to recess in Auditorium wall

Photo 27. Cracked masonry along recess in Auditorium wall

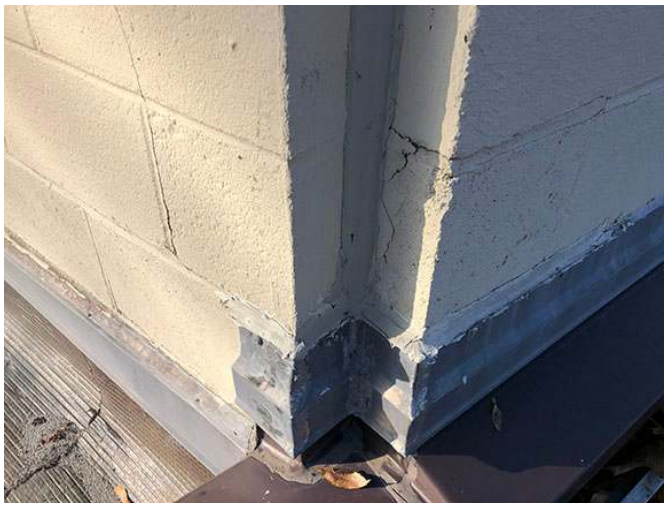
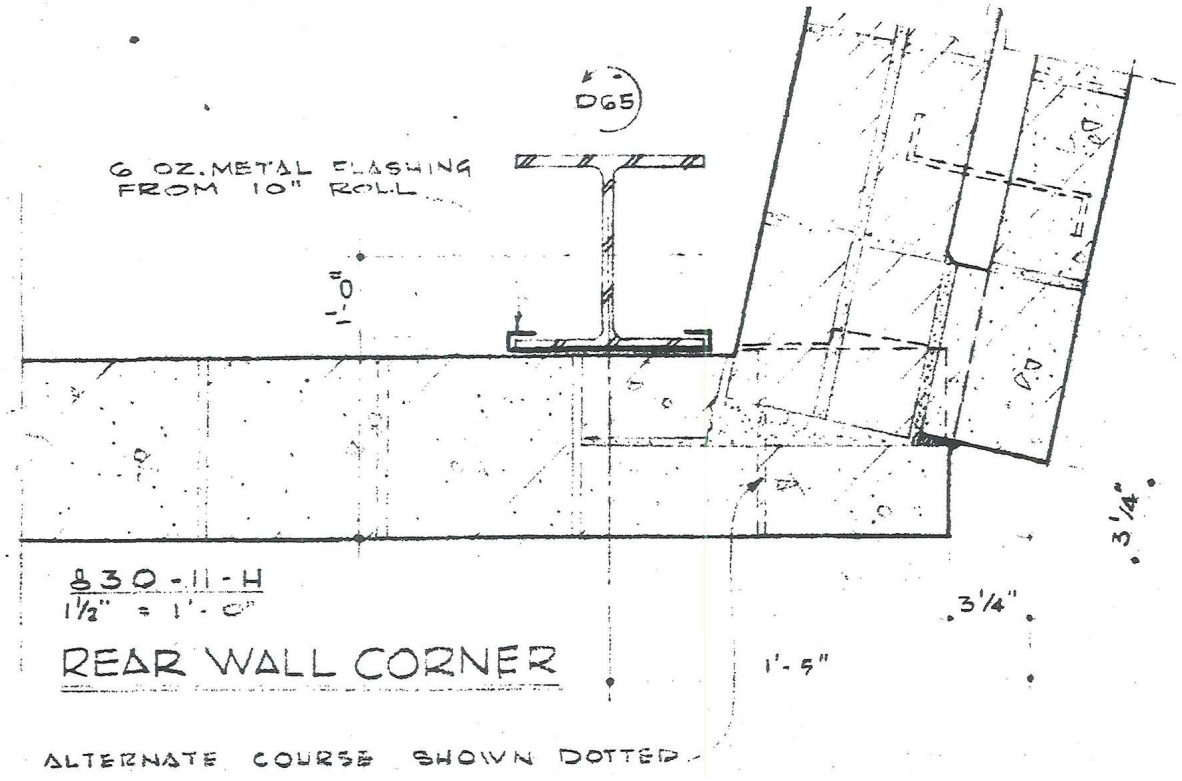


Photo 28. Spalled masonry at corner of Auditorium wall along expansion joint

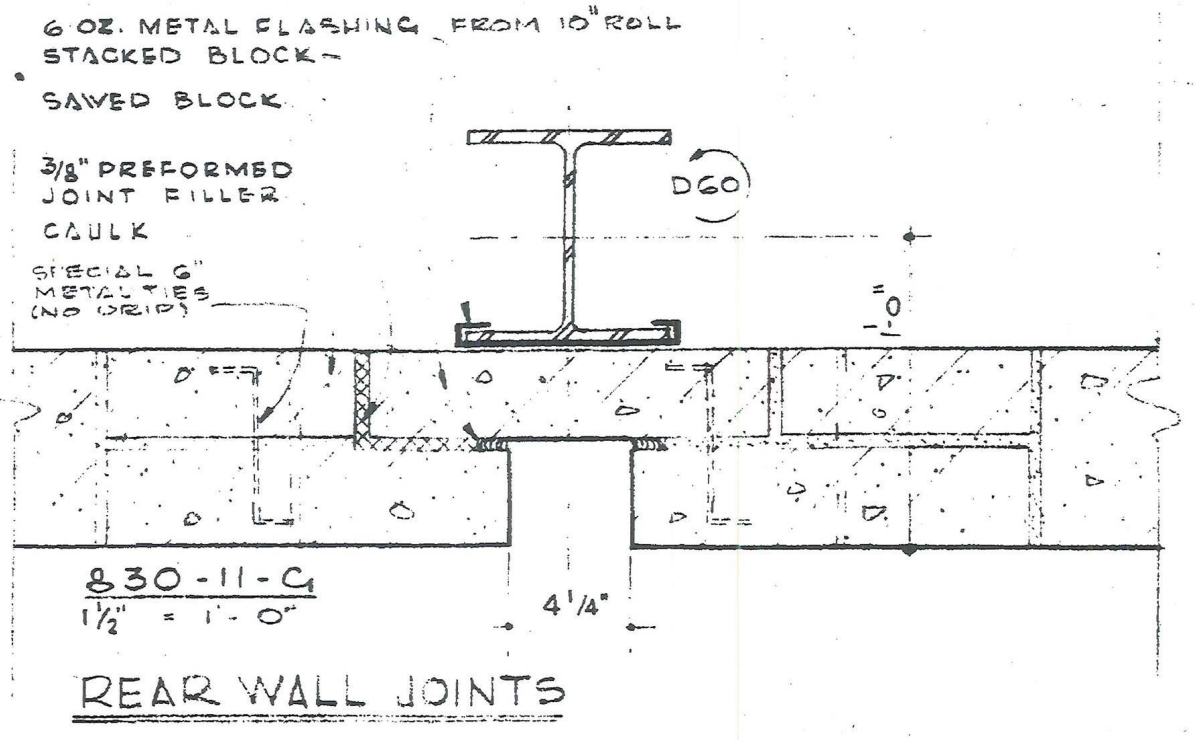
Photo 29. Crack in CMU gymnasium wall

Photo 30. Patch at corner of Gymnasium wall - markers showing bow in masonry wall

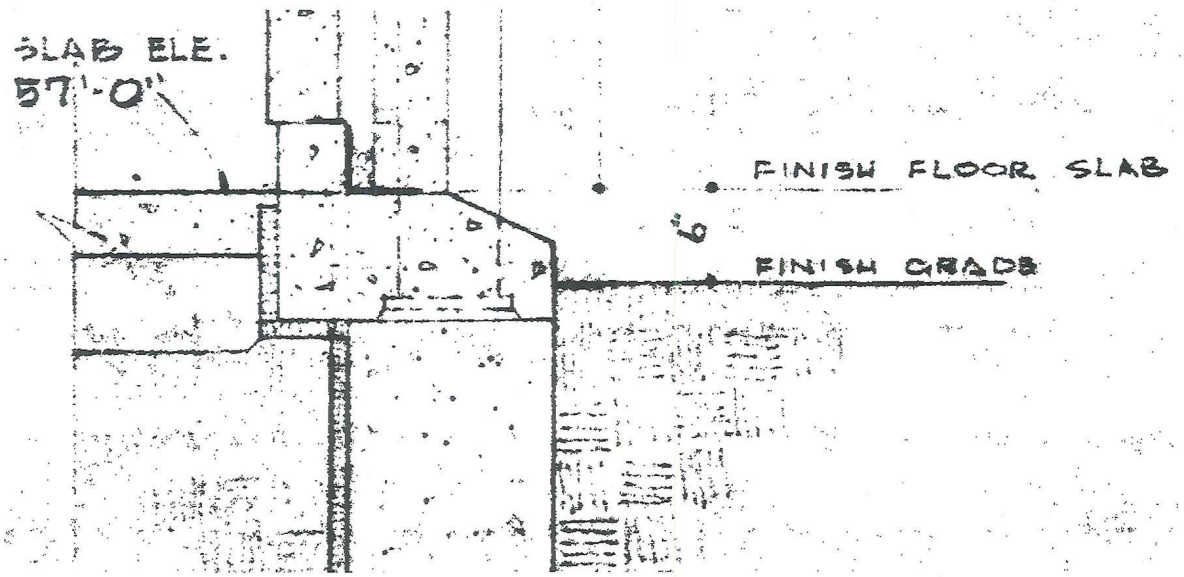
Photo 31. Translucent panels in Gymnasium wall



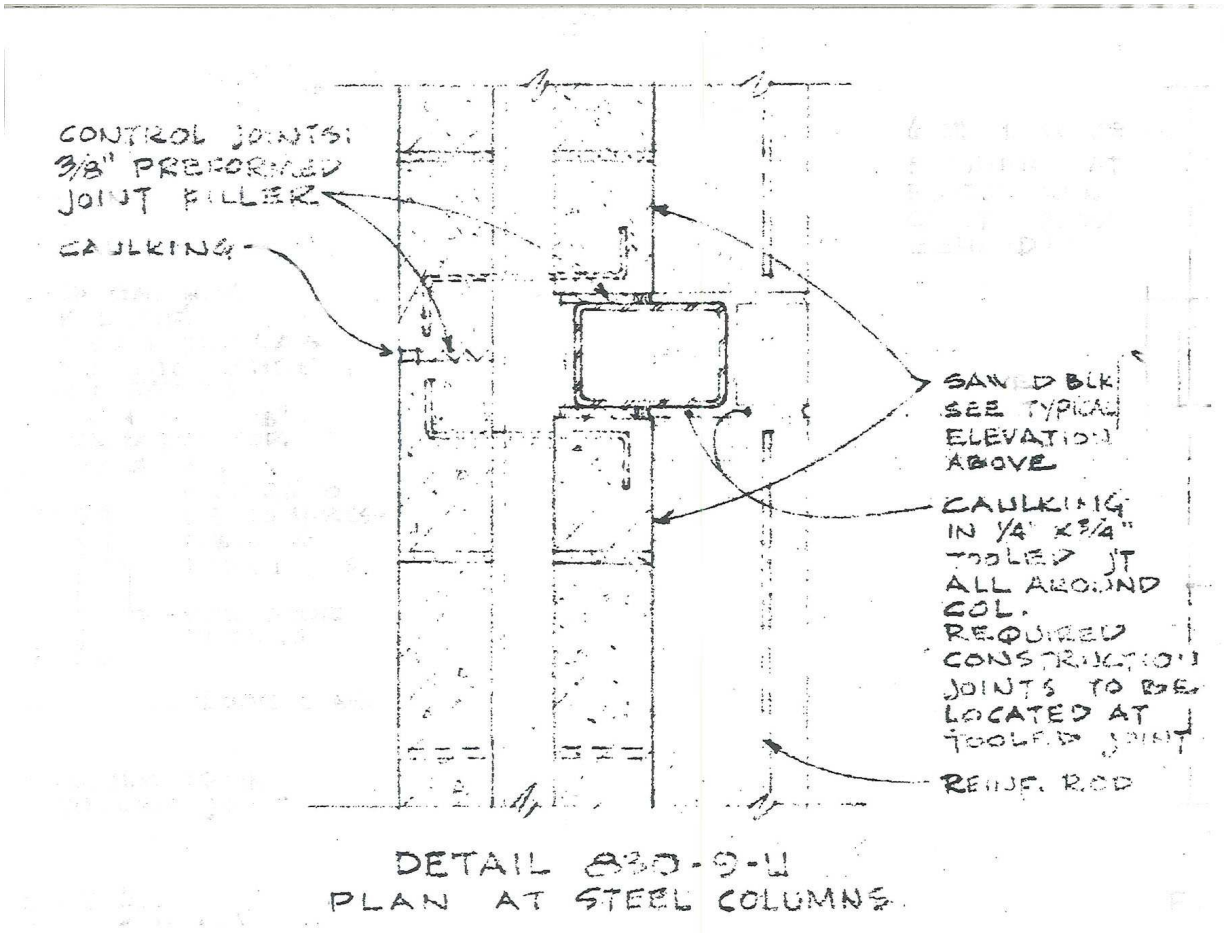
Typical detail at corner of Auditorium.



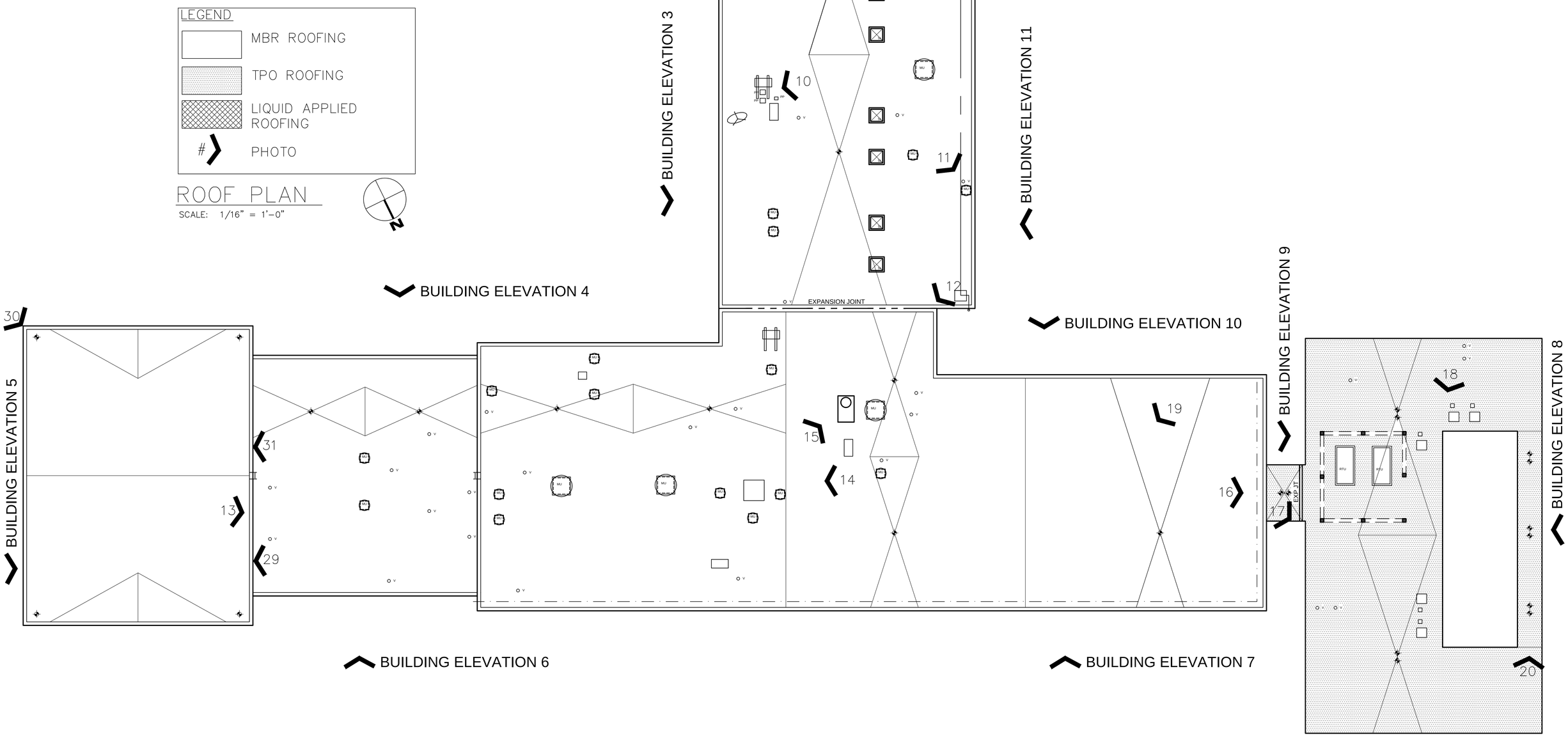
Typical detail of recess in Auditorium wall.



Typical detail at column base and concrete sill.



Typical steel column detail with caulking at perimeter.



CENTRAL MIDDLE SCHOOL ARCHITECT'S FIELD REPORT	
Drawing Prepared By Martin A. Benassi, AIA Architect, LLC TWO BROADWAY HAMDEN, CONNECTICUT 06518	Date 12/28/2021 Scale –
Project ROOF AND FACADE EVALUATION CENTRAL MIDDLE SCHOOL 9 INDIAN ROCK LANE GREENWICH, CT	Drawn By – Approved By – Drawing No. A–1
Project No. 21–23	

LEGEND

MBR ROOFING

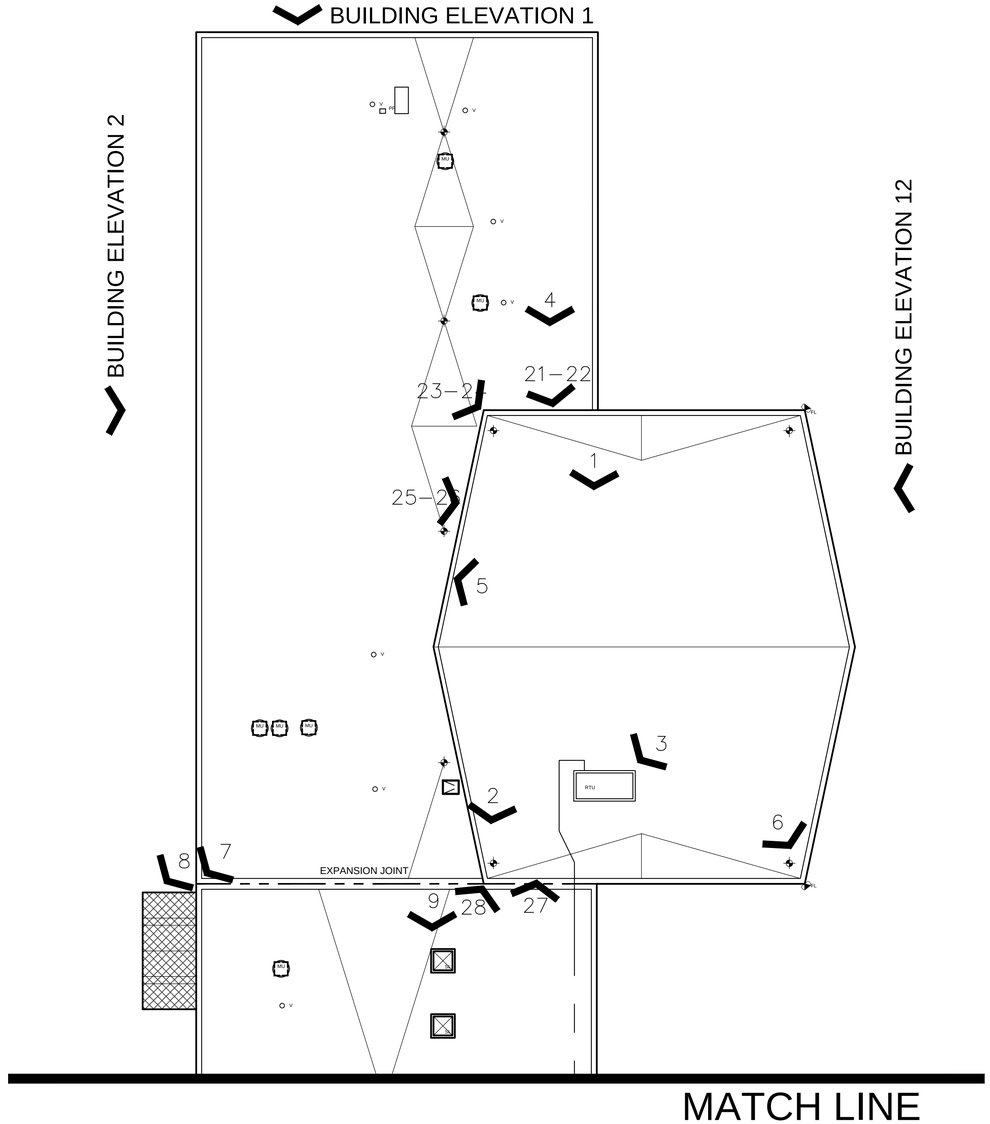
TPO ROOFING

LIQUID APPLIED ROOFING

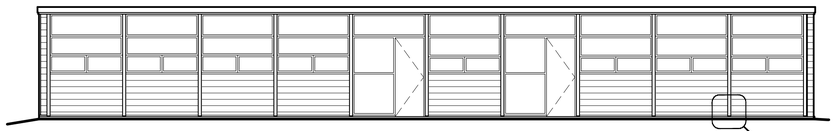
PHOTO

ROOF PLAN

SCALE: 1/16" = 1'-0"



CENTRAL MIDDLE SCHOOL ARCHITECT'S FIELD REPORT	
Drawing Prepared By Martin A. Benassi, AIA Architect, LLC TWO BROADWAY HAMDEN, CONNECTICUT 06518	Date 12/28/2021 Scale –
Project ROOF AND FACADE EVALUATION CENTRAL MIDDLE SCHOOL 9 INDIAN ROCK LANE GREENWICH, CT	Drawn By – Approved By – Drawing No. A–2
Project No. 21–23	

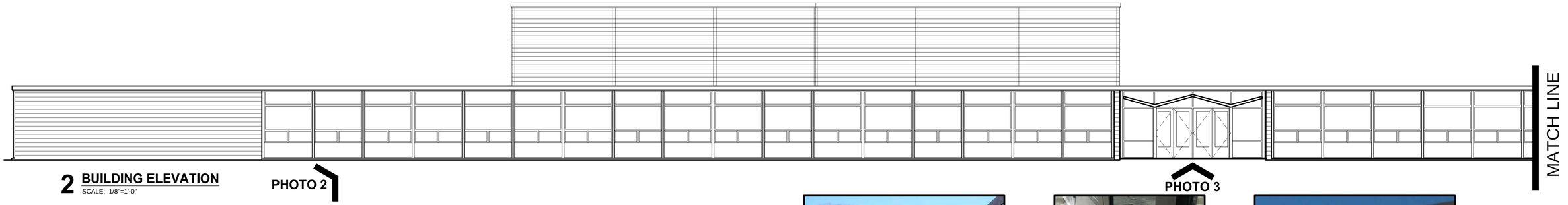


1 BUILDING ELEVATION
SCALE: 1/8"=1'-0"

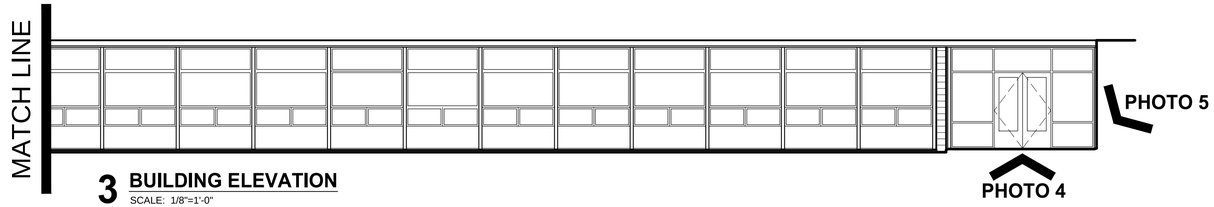
PHOTO 1: TYPICAL DETAIL AT BASE OF STEEL COLUMNS ALONG PERIMETER OF BUILDING. NOTE DETERIORATION OF CONCRETE AND REPAIRS USING SEALANT.

PHOTO 2: TYPICAL FENESTRATION SHOWING EXPOSED STEEL COLUMNS WITH INFILL OF WINDOW WALL SYSTEM AND CONCRETE MASONRY UNITS.

PHOTO 3: MAIN ENTRY CANOPY. NOTE LIQUID FLASHING MATERIAL APPLIED TO TOP SURFACE AND EVIDENCE OF WATER OVERFLOW AT EXPOSED EDGE OF CANOPY.



2 BUILDING ELEVATION
SCALE: 1/8"=1'-0"

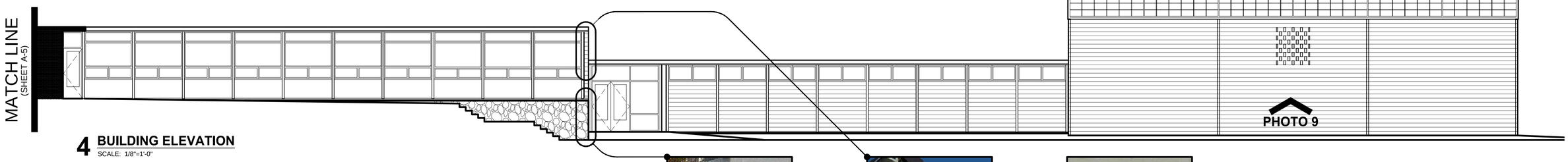


3 BUILDING ELEVATION
SCALE: 1/8"=1'-0"

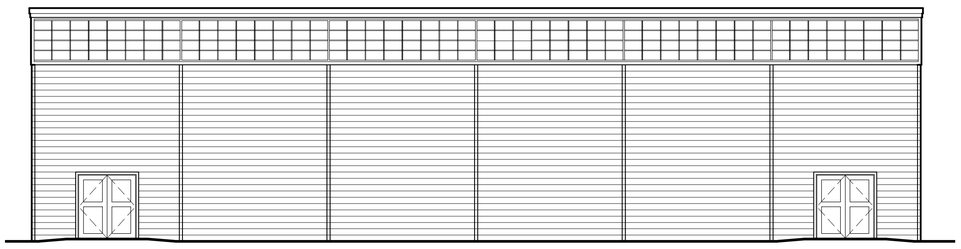
PHOTO 4: TYPICAL RECESSED SIDE ENTRY DOORS.

PHOTO 5: TYPICAL DETERIORATION AT DOOR THRESHOLDS.

PHOTO 6: EXAMPLE OF TYPICAL METAL EDGE FACIA MATERIAL IN NEED OF REPAIR.



4 BUILDING ELEVATION
SCALE: 1/8"=1'-0"



5 BUILDING ELEVATION
SCALE: 1/8"=1'-0"

PHOTO 7: TYPICAL DETERIORATION OF CONCRETE AT BASE OF PERIMETER STEEL COLUMNS ALLOWING FOR WATER INFILTRATION WHICH IN TURN PERMITS RUSTING OF STEEL COLUMN BASE PLATE AND CRACKING OF CMU.

PHOTO 8: VERTICAL CRACK IN CMU WALL. NOTE EVIDENCE OF MOISTURE PENETRATION.

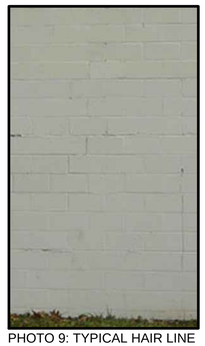


PHOTO 9: TYPICAL HAIR LINE CRACKS IN MASONRY. OBSERVATION INDICATES SEVERAL COATS OF PAINT HAVE BEEN APPLIED OVER EXISTING CRACKS.

CENTRAL MIDDLE SCHOOL ARCHITECT'S FIELD REPORT

Drawing Prepared By Martin A. Benassi, AIA Architect, LLC TWO BROADWAY HAMDEN, CONNECTICUT 06518	Date 12/28/2021
	Scale –
Project ROOF AND FACADE EVALUATION CENTRAL MIDDLE SCHOOL 9 INDIAN ROCK LANE GREENWICH, CT	Drawn By –
	Approved By –
Project No. 21–23	Drawing No. A–3

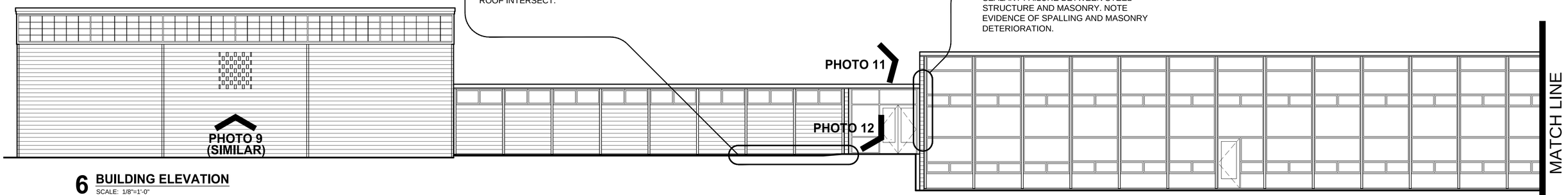
PHOTO 10: EXPOSED TYPICAL CRACK WHERE BASE OF MASONRY WALL MEETS CONCRETE FLOOR SLAB.

PHOTO 11: TYPICAL INCORRECT FLASHING DETAIL WHERE ROOF MEETS MASONRY WALL. EDGE OF FLASHING EXPOSED WITH OPEN LAPS DUE TO LACK OF TERMINATION BAR. NOTE TYPICAL CRACK AT BUILDING CORNER WHERE STEEL STRUCTURE, MASONRY AND ROOF INTERSECT.

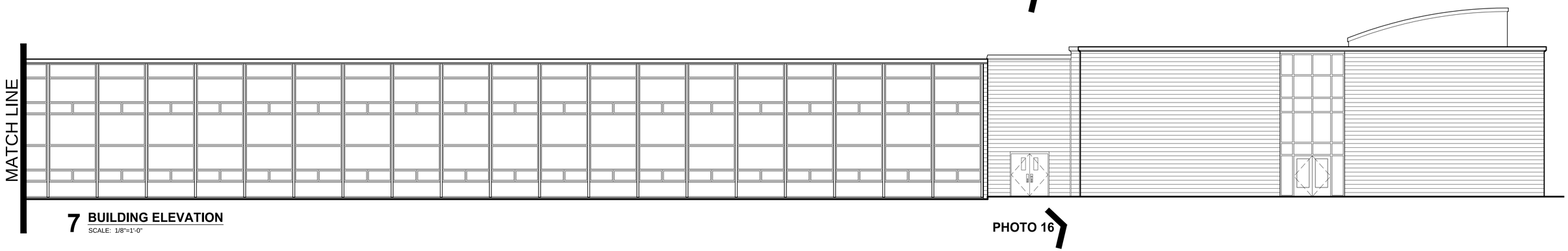
PHOTO 12: BASE OF MASONRY WALL AND ADJACENT SURFACES SHOW EVIDENCE OF SETTLEMENT OF RETAINING WALL AND LANDING.

PHOTO 13: TYPICAL EXAMPLE OF JOINT SEALANT FAILURE BETWEEN STEEL STRUCTURE AND MASONRY. NOTE EVIDENCE OF SPALLING AND MASONRY DETERIORATION.

PHOTO 14: THERE ARE LARGE AREAS OF STAINING - PARTICULARLY AT THE NORTHERN FACADES AS SHOWN IN PHOTO.



6 BUILDING ELEVATION
SCALE: 1/8"=1'-0"



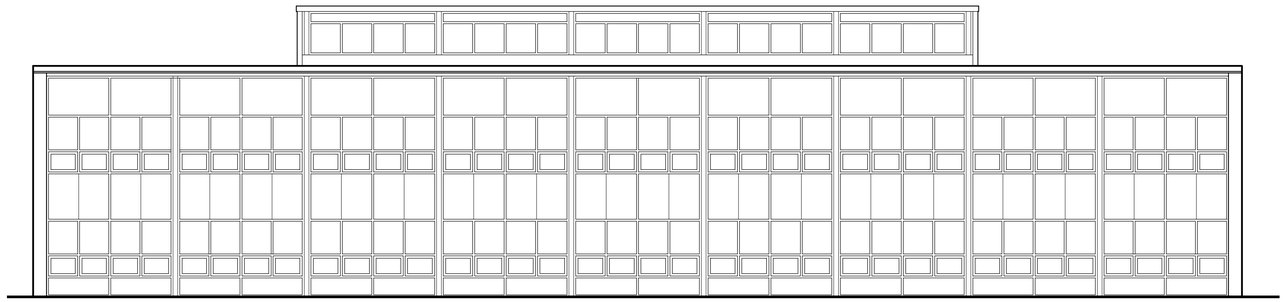
7 BUILDING ELEVATION
SCALE: 1/8"=1'-0"

PHOTO 15: NOTE INDICATION OF RUSTING AT METAL PANELS. (TYPICAL).

PHOTO 16: LARGE AREAS OF MASONRY STAINING AT MEDIA/COMPUTER WING. STAINING COULD BE EVIDENCE OF IMPROPER OR DEFECTIVE COATING.

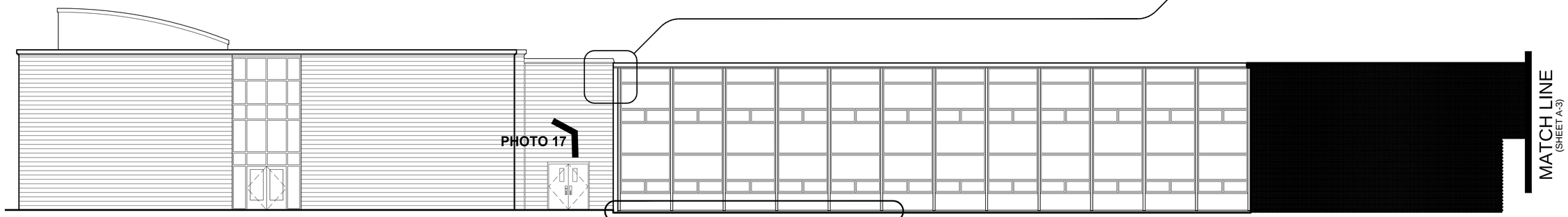
CENTRAL MIDDLE SCHOOL ARCHITECT'S FIELD REPORT

Drawing Prepared By Martin A. Benassi, AIA Architect, LLC TWO BROADWAY HAMDEN, CONNECTICUT 06518	Date 12/28/2021 Scale – Drawn By –
Project ROOF AND FACADE EVALUATION CENTRAL MIDDLE SCHOOL 9 INDIAN ROCK LANE GREENWICH, CT	Approved By – Drawing No. A–4
Project No. 21–23	



8 BUILDING ELEVATION
SCALE: 1/8"=1'-0"

9 BUILDING ELEVATION
SCALE: 1/8"=1'-0"



10 BUILDING ELEVATION
SCALE: 1/8"=1'-0"

PHOTO 17: GROUT DISPLACEMENT OVER LARGE AREAS INDICATE MOVEMENT IN MASONRY.

PHOTO 18: TYPICAL MASONRY DISPLACEMENT ALONG ROOF LINE.

PHOTO 19: EARTH SLOPES TOWARDS SIDE OF BUILDING. POSSIBLE WATER INFILTRATION.

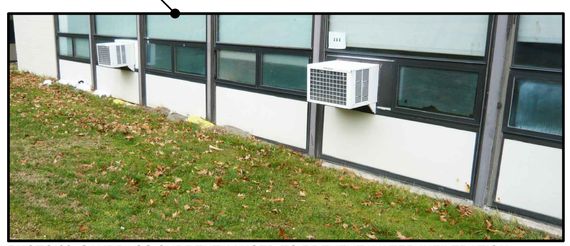
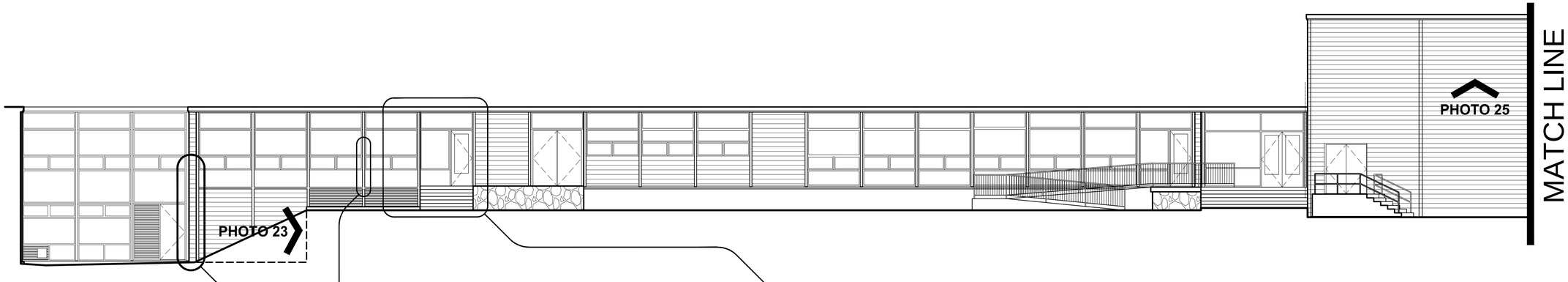


PHOTO 20: SANDBAGS CURRENTLY USED TO PREVENT WATER INFILTRATION. TYPICALLY ONLY A BEAD OF CAULK PREVENTS WATER INFILTRATION AROUND PERIMETER OF BUILDING.

CENTRAL MIDDLE SCHOOL
ARCHITECT'S FIELD REPORT

Drawing Prepared By Martin A. Benassi, AIA Architect, LLC TWO BROADWAY HAMDEN, CONNECTICUT 06518	Date 12/28/2021 Scale –
Project ROOF AND FACADE EVALUATION CENTRAL MIDDLE SCHOOL 9 INDIAN ROCK LANE GREENWICH, CT	Drawn By – Approved By –
Project No. 21–23	Drawing No. A–5



11 BUILDING ELEVATION
SCALE: 1/8"=1'-0"

PHOTO 21: TYPICAL DETERIORATION OF JOINT BETWEEN MASONRY AND STRUCTURAL STEEL.

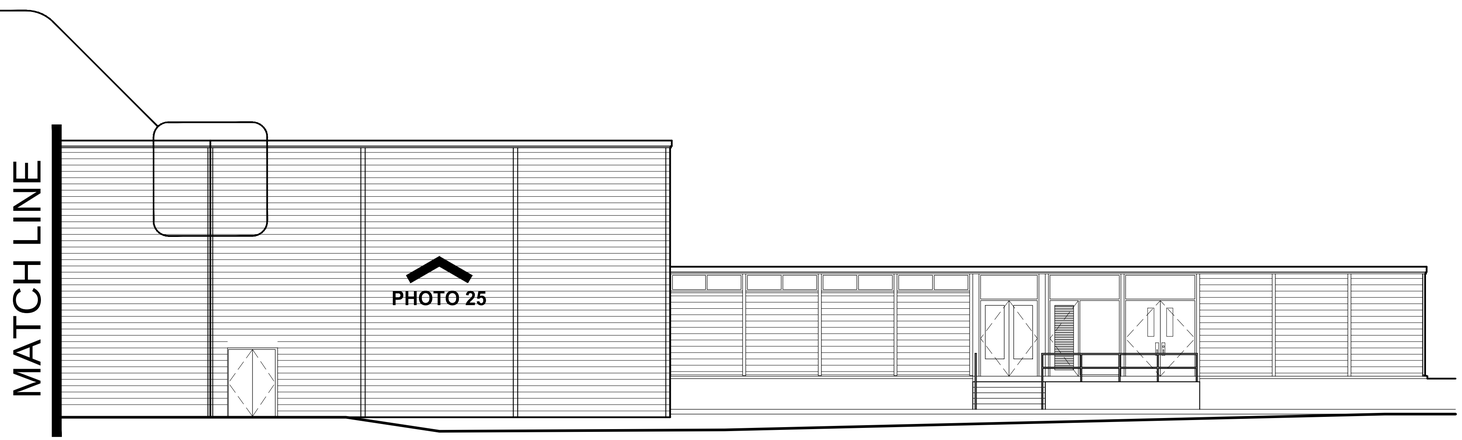
PHOTO 22: TYPICAL DETERIORATION OF JOINT BETWEEN WINDOW WALL SYSTEM AND STRUCTURAL STEEL.

PHOTO 23: WIDENING OF CONTROL JOINT INDICATES MOVEMENT AND/OR SETTLING, TYPICAL ADJACENT TO BUILDING.

PHOTO 24: DETERIORATION OF STONEWORK, CONCRETE, RAILINGS, ETC. ARE EXAMPLES OF TYPICAL CONDITIONS FOR APPURTENANCES ON STRUCTURE.

PHOTO 25: GROUT DISPLACEMENT OVER LARGE AREAS TYPICAL INDICATION OF MOVEMENT IN MASONRY.

PHOTO 26: VERTICAL CRACK TYPICAL OF ALL BUILDING CORNERS ARE A RESULT OF MOVEMENT IN MASONRY AND IS AN EXAMPLE OF POOR DETAILING OF ORIGINAL BUILDING. MANY OPEN CRACKS (AS SHOWN IN PHOTO) HAVE BEEN AND CONTINUE TO BE REPAIRED AS NEEDED.



12 BUILDING ELEVATION
SCALE: 1/8"=1'-0"

CENTRAL MIDDLE SCHOOL ARCHITECT'S FIELD REPORT

Drawing Prepared By Martin A. Benassi, AIA Architect, LLC TWO BROADWAY HAMDEN, CONNECTICUT 06518	Date 12/28/2021
	Scale –
Project ROOF AND FACADE EVALUATION CENTRAL MIDDLE SCHOOL 9 INDIAN ROCK LANE GREENWICH, CT	Drawn By –
	Approved By –
Project No. 21–23	Drawing No. A–6

Structural

We inspected Greenwich Central Middle School over the course of (3) days with our latest site inspection on Tuesday, December 28, 2021. The original building is a 1 and 2 story structure that was constructed in 1958. A smaller addition was constructed sometime after 1999[1]. The addition connects the northeast corner of the original building at a masonry sallyport and serves as a 2nd level library with 1st level classrooms.

Most of the original building and all of the addition are masonry and steel frame structures founded on shallow cast-in-place footings and frost walls. Portions of the original building have crawl space and a partial basement serving as the main boiler room, but the 1st level for most of the original building and all of the addition are cast-in-place slabs on grade.

Masonry buildings have one of three basic structures systems: 1) braced walls; 2) braced frames; or 3) a composite of braced walls and frames. Braced walls are also known as structural "cords." Structural cords transfer lateral loads to structural slabs also known as "diaphragms." Cords disperse and transfer their lateral loads to other cords by way of diaphragms which is what gives the structure strength from lateral forces such as wind and seismic energy. Braced frames can be timber, concrete or steel and where lateral loads are transferred from walls to the structural frame. The walls support their own weight vertically and are braced by the frames for lateral loads. Composite structures combine certain elements of braced walls and frames for redundancy or load path distribution or both.

Both the original building and addition are constructed with structural steel frames. The 2nd level and roofs of the original building are not designed as diaphragms and do not act to distribute lateral loads. CMU block walls carry their self-weight and are laterally supported by steel frames and the assembly at foundation walls. The 2nd level of the addition was designed as a diaphragm and acts in composite masonry walls to distribute lateral loads to steel frames.

CMU block walls are a single wythe[2] of hollow core, unreinforced concrete masonry unit (CMU) block. These are free-standing walls. Most are laterally braced with structural steel W and HSS shape columns on their sides. The bottom of CMU walls is braced with keyed foundation walls. Taller CMU walls of the gymnasium are braced with intermediary steel girts at measured 12'-0" from the bottom of the wall. These walls are braced by steel frames on all (4) sides. Constructed on top of the girts are free standing CMU walls that support clearstory window frames. These free-standing walls are braced on (3) side. Taller CMU walls in classrooms of the original building are laterally braced with a bond course of 4" hollow core block. The sallyport connector between the original building and addition was not designed to transfer 2nd floor diaphragm loads from the addition to the 2nd floor of the original building. The bond course of the original building is not

[1] Discerned from the date of as-built records that we were able to inspect.

[2] A wythe is a wall of CMU blocks that is (1) block wide in a continuous row of block. Each row of block forms a coarse. Some CMU walls have (2) wythes that are tied together with a "bond" course. Bond courses are a series of block installed 90-degrees perpendicular to (2) adjoining wythes thus forming a physical connection or bond between two wythes. The bond coarse cause the (2) wythes to act as a single wall making the wall sturdier to lateral forces such as wind and seismic. Historically there are different means and methods for constructing bond courses. The original building uses an English running bond method.

connected to the 2nd floor consequently the steel frame of the original building is the only laterally support for its CMU walls.

Most of the original building has a 4" hollow core block façade that is tied to the interior CMU wythe with randomly spaced metal wall ties. The northeast facing side of the original building is a panelized curtain wall. The addition is reinforced CMU and does not have a veneer wythe.

Neither the original building nor the addition conforms to current CT-Building Code and are not designed to contemporary safety standards for wind and seismic. Any significant work to repair, alter or improve the buildings would necessitate structural improvements for wind and seismic and these are significant cost drivers.

We observed structural concerns that necessitate major repairs to the drainage, façades, and a foundation wall. These are itemized and discussed in more detail below. These structural concerns stem from recurring water damage, exposure, and the age of key structural elements such as wall ties.

1. Concrete Foundation Wall, Northwest Corner of Original Building. The exterior wall of the northwest stairwell is settling differentially, and the wall is now leaning away from the building. Exhibit 1 are series of photos that illustrate the conditions. The cause of this condition is storm water runoff into the pocket formed by the sallyport between the original building and addition, where the storm water has no were to go but into and beneath the building. The recurring effect is removal of fine grains from the soils supporting footings causing the soil to slowly consolidate. The foundation wall require underpinning in order to arrest the condition as well as significant drainage improvements to divert recurring storm water runoff into this area.

2. Masonry Façade, Original Building. Wall ties connecting the façade to CMU are beyond service life and their evidence of systemic failure throughout the original building's façade. Exhibit 2 presents a series of photos that illustrate the condition. Additionally, DTC monitored movement of the walls during the past (6) months and although the walls are not actively moving beyond tolerances, the conditions that we inspected pose safety concerns as a result of recuring ice, wind, and exposure continue to take a toll. The most severe conditions are the gymnasium, theater, and northwest stairwell located at the sallyport connector. See "Survey Monitoring" below for additional information.

3. Water Damage. Damage to facades of the original building is exacerbated by recurring ice and water damage. Exhibit 3 are a series of photos illustrating the condition. In at least one instance, upper most course of façade blocks is being pushed away from the interior CMU wythe due to ice formation. There are (2) principal reasons for water damage: 1) design of the original building façade versus how it was constructed; and 2) design of the roof membrane and flashing details.

   Design the original building façade specifies for a 2" air gap between structural CMU walls and façade. 2" is sufficient for this purpose. Other critical design details necessary for this to air gap function correctly are: a) waterproofing membrane and flashing details that freely exhaust water vapor; b) water proofing membrane type and flashing details have sufficient flex to maintain their integrity given subtle movement at the top of free-standing CMU walls; and c) unobstructed drainage through the air gap coupled with regularly spaced weep holes that permit water to drain away from the building at the bottom of the wall.

As-built conditions differ significantly from design. Not all walls have weep holes. Some have none while others are blocked with paint and debris. We opened a corner section of one wall at the gymnasium, where we observed significant façade failure, and observed that the air gap was approximately 1" which means that excess mortar on the back side of façades is obstructing the flow of water to weep holes. 1" air gap is not sufficient for unobstructed flow of water, particularly at the gymnasium where (2) prominent architectural features introduce large openings to the air gap from the outside. These are located on the north and south walls of the gymnasium and permit significant water infiltration with wind driven rain and ice formation. These are among the walls with the most severe façade failure.

We closely inspected all roof membranes and flashing. Through interview we understand that the original building was roofed in 2006. It is approaching service life which is illustrated with a series of photos in Exhibit 4. We also observe that the waterproofing membrane and flashing details are not suitable for the design of these walls. We observe repeated efforts to repair and correct failures in the membrane, particularly at flashings with the walls, and observed various and repeated efforts to correct water intrusion into the building and walls. Structurally the membrane is not an appropriate system for the design of these walls. An appropriate membrane would include leveling of pockets in the roof structure to prevent bird baths, polyisocyanurate tapered insultation for sheet flow to interior drains, and a thermoplastic polyolefin (TPO) or siplast parapro (SPS) membrane with corresponding flashing details and assemblies that achieve full (20) commercial warrantees from manufacturers and can flex with subtle movements in the walls.

We inspected interior walls, interior of foundation walls from the boiler room, generator room, columns, column repairs, and structural slabs. We also inspected interstitial space including interior ceilings and floors, structural steel, and interface between structural diaphragms and cords. These basic structures are in serviceable condition, and we did not observe significant deferred maintenance concerns.

Monitoring of Existing Façade Movement

From August to December 2021, DTC monitored and reported the movement of existing facades on a weekly basis over. Monitoring was performed by establishing fixed survey targets on the existing facades of (20) walls labeled A to T[3]. Horizontal and vertical position and movement was measured by GPS. Temperatures and weather varied seasonally from hot and humid to cold and dry conditions. These variations were normal and there were no extreme weather events during this time.

Wall M located on the north side of the theater reported significant lateral movement[4] during the first (2) reporting periods. We inspected the target in the field, and it had been damaged[5]. The target was abandoned and new target M2 was placed at a higher elevation. Enclosed are the tabulated results from monitoring.

[3] Reference DTC façade restoration progress drawings dated June 1, 2021 for wall locations.
[4] Significant movement is 1/4th inch or greater in any axis of movement.
[5] Wall M faces a parking lot used for recess activities that include basketball and kick ball.

Our key observation of monitoring data is that the walls expanded and contracted normally during the monitoring period. Movement is the result to noise[6] inherent to contemporary survey methods, changing thermal, humidity and moisture conditions. The building was designed to respond to its environment and the mechanics of materials, structural members, and connecting assemblies permit limited degrees of movement as observed in the reports.

We also observe that the walls affixed to the façade with wall ties are not undergoing creep which is a gradual and consistent movement in the direction of one or more vertical, horizontal, and lateral axis. Creep would raise concerns such as differential settlement, quick or capillary effects, or potentially other structural concerns. We do note that there is evidence of historic differential settlement in the building. These conditions appear arrested, and the damage to facades and walls can be repaired as proposed in our earlier progress drawings.

The results of monitoring support our conclusion that structural frames and CMU[7] walls of the building are not structurally failing, and that the condition of facades is the result of water damage and deteriorating wall ties. The design of the wall tie system does not have redundancy and failure of a tie is catastrophic to the tie. Failure of a sufficient number of wall ties in a concentrated section of façade is catastrophic to the section, and the façade is expected to fail in these conditions. Consequently, our concern is that the condition of wall ties and facades remains a significant safety concern.

[6] Ambient variation in GPS survey methods that fall within measuring tolerances. Observed movement less than 1/4th inch is within tolerances.
[7] Concrete Masonry Unit.

Exhibit 1

Figure 1 - Concrete sidewalk has sunken approximately 1-3/4" throughout this area due to loss of fines which is the result of repeated flooding due to inadequacy in the storm drainage system.

Figure 2 - View of door threshold where the slab has sunken due to loss of fines.

Figure 3 - Exterior wall above the doorway in Figure 2 is leaning away from the building evidenced by the batter of the wall and opening between steel deck at stairwell.

Exhibit 2

Figure 4 - Facade leaning outward from building evidenced by the level.

Figure 5 - The base of the facade projects 4" from the CMU wall where in this location the facade is leaning out 4-3/4" from the face of the CMU block.

Figure 6 - We marked the degree of batter at the corner of the gymnasium, where the batter away from the building ranges from 4" at the base to 5-1/2" measured roughly 12' from the base of the wall.

Exhibit 3

Figure 7 - Blistering was observed throughout the building, with a significant number of bird bath puddles throughout the roof.

Figure 8 - Flashing details are not sufficiently flexible or waterproof to prevent water infiltration and ice and water damage to upper courses of the facade.

Figure 9 - A combination of design details, flashing, and water proof membrane result in water damage to architectural features. We observed repeated efforts to repair these conditions throughout the original building.

Figure 10 - Severe cracking in the facade due to water and ice damaged. We observed repeated efforts to patch repair these conditions throughout the original building.

Figure 11 - The roof membrane flashing details are not suitable for protection of the facades from ice and water damage, where this mopped down bituminous membrane and flashing systems are not sufficiently flexible for the design of exterior walls.

Exhibit 4

Figure 12 - Bid bath puddles and blister are systemic throughout the existing roof membrane protecting the original building. This indicates that the roof membrane is reaching of has pasted its service life.

Figure 13 - Panoramic view of the roof membrane over the original building. Bird path puddles and blistering are systemic throughout the roof.

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT				
MONITORING POINT INFORMATION				
POINTS	DESCRIPTION	NORTHING	EASTING	ELEVATION
A	MINI CIRCLE PRISM MOUNTED ON BUILDING	5025.596	4936.226	113.018
B	MINI CIRCLE PRISM MOUNTED ON BUILDING	5067.427	4975.347	113.715
C	MINI CIRCLE PRISM MOUNTED ON BUILDING	5120.384	4931.782	112.367
D	MINI CIRCLE PRISM MOUNTED ON BUILDING	5116.243	4903.132	116.18
E	MINI CIRCLE PRISM MOUNTED ON BUILDING	5110.406	4886.688	110.243
F	MINI CIRCLE PRISM MOUNTED ON BUILDING	5101.97	4569.048	108.578
G	MINI CIRCLE PRISM MOUNTED ON BUILDING	5046.913	4569.56	107.287
H	MINI CIRCLE PRISM MOUNTED ON BUILDING	5037.194	4575.231	106.761
I	MINI CIRCLE PRISM MOUNTED ON BUILDING	5014.168	4671.467	107.101
J	MINI CIRCLE PRISM MOUNTED ON BUILDING	5006.149	4667.238	105.048
K	MINI CIRCLE PRISM MOUNTED ON BUILDING	4969.292	4667.556	115.749
L	MINI CIRCLE PRISM MOUNTED ON BUILDING (SET ON 7-1-2021)	4928.778	4667.884	113.784
M	MINI CIRCLE PRISM MOUNTED ON BUILDING (TARGET HIT RESET 7-16-2021)(TARGET DESTROYED 8-25-2021 NEW TARGET M2 SET)	4852.743	4643.621	113.676
N	MINI CIRCLE PRISM MOUNTED ON BUILDING	4798.125	4613.728	117.82
O	MINI CIRCLE PRISM MOUNTED ON BUILDING	4754.374	4648.174	119.562
P	MINI CIRCLE PRISM MOUNTED ON BUILDING	4828.397	4697.085	129.225
Q	MINI CIRCLE PRISM MOUNTED ON BUILDING	4736.364	4667.495	113.194
R	MINI CIRCLE PRISM MOUNTED ON BUILDING	4690.308	4750.01	116.157
S	MINI CIRCLE PRISM MOUNTED ON BUILDING	5034.273	4851.896	109.339
T	MINI CIRCLE PRISM MOUNTED ON BUILDING	5031.832	4827.814	114.355
M2	MINI CIRCLE PRISM MOUNTED ON BUILDING (SET ON 8-25-2021)	4852.636	4641.892	114.019

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT						
MONITORING RESULTS	DATE: 7-1-2021			DEVIATION	DEVIATION	DEVIATION
POINTS	NORTHING	EASTING	ELEVATION	(N+/S-)	(E+/W-)	(ELEV)
A	5025.601	4936.231	113.021	0.005	0.005	0.003
B	5067.436	4975.355	113.719	0.009	0.008	0.004
C	5120.39	4931.793	112.367	0.006	0.011	0.000
D	5116.248	4903.144	116.179	0.005	0.012	-0.001
E	5110.41	4886.7	110.244	0.004	0.012	0.001
F	5101.967	4569.05	108.581	-0.003	0.002	0.003
G	5046.917	4569.558	107.289	0.004	-0.002	0.002
H	5037.199	4575.23	106.764	0.005	-0.001	0.003
I	5014.174	4671.472	107.102	0.006	0.005	0.001
J	5006.154	4667.24	105.051	0.005	0.002	0.003
K	4969.295	4667.560	115.752	0.003	0.004	0.003
L				-4928.778	-4667.884	-113.784
M	4852.757	4643.649	113.687	0.014	0.028	0.011
N	4798.134	4613.735	117.821	0.009	0.007	0.001
O	4754.374	4648.175	119.563	0.000	0.001	0.001
P	4828.407	4697.074	129.229	0.010	-0.011	0.004
Q	4736.363	4667.495	113.193	-0.001	0.000	-0.001
R	4690.31	4750.003	116.159	0.002	-0.007	0.002
S	5034.279	4851.896	109.342	0.006	0.000	0.003
T	5031.84	4827.814	114.356	0.008	0.000	0.001
M2				-4852.636	-4641.892	-114.019

Enclosure
Structural, Movement Monitoring

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT

MONITORING RESULTS		DATE: 7-16-2021		DEVIATION	DEVIATION	DEVIATION
POINTS	NORTHING	EASTING	ELEVATION	(N+/S-)	(E+/W-)	(ELEV)
A	5025.599	4936.226	113.021	0.003	0.000	0.003
B	5067.431	4975.352	113.718	0.004	0.005	0.003
C	5120.393	4931.794	112.368	0.009	0.012	0.001
D	5116.246	4903.143	116.178	0.003	0.011	-0.002
E	5110.403	4886.693	110.239	-0.003	0.005	-0.004
F	5101.966	4569.041	108.581	-0.004	-0.007	0.003
G	5046.917	4569.56	107.29	0.004	0.000	0.003
H	5037.198	4575.232	106.765	0.004	0.001	0.004
I	5014.169	4671.47	107.102	0.001	0.003	0.001
J	5006.15	4667.241	105.052	0.001	0.003	0.004
K	4969.292	4667.559	115.753	0.000	0.003	0.004
L	4928.775	4667.88	113.785	-0.003	-0.004	0.001
M	4852.751	4643.645	113.67	0.008	0.024	-0.006
N	4798.138	4613.735	117.82	0.013	0.007	0.000
O	4754.374	4648.176	119.563	0.000	0.002	0.001
P	4828.399	4697.073	129.23	0.002	-0.012	0.005
Q	4736.363	4667.495	113.192	-0.001	0.000	-0.002
R	4690.306	4750.006	116.16	-0.002	-0.004	0.003
S	5034.277	4851.896	109.34	0.004	0.000	0.001
T	5031.838	4827.807	114.355	0.006	-0.007	0.000
M2				-4852.636	-4641.892	-114.019

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT

MONITORING RESULTS		DATE: 7-30-2021		DEVIATION	DEVIATION	DEVIATION
POINTS	NORTHING	EASTING	ELEVATION	(N+/S-)	(E+/W-)	(ELEV)
A	5025.599	4936.225	113.021	0.003	-0.001	0.003
B	5067.432	4975.352	113.719	0.005	0.005	0.004
C	5120.391	4931.789	112.367	0.007	0.007	0.000
D	5116.248	4903.142	116.174	0.005	0.010	-0.006
E	5110.409	4886.697	110.241	0.003	0.009	-0.002
F	5101.969	4569.044	108.580	-0.001	-0.004	0.002
G	5046.919	4569.558	107.292	0.006	-0.002	0.005
H	5037.200	4575.231	106.767	0.006	0.000	0.006
I	5014.171	4671.471	107.103	0.003	0.004	0.002
J	5006.158	4667.243	105.052	0.009	0.005	0.004
K	4969.300	4667.564	115.754	0.008	0.008	0.005
L	4928.782	4667.888	113.789	0.004	0.004	0.005
M	4852.766	4643.638	113.685	0.023	0.017	0.009
N	4798.135	4613.736	117.820	0.010	0.008	0.000
O	4754.373	4648.176	119.563	-0.001	0.002	0.001
P	4828.401	4697.076	129.228	0.004	-0.009	0.003
Q	4736.363	4667.496	113.192	-0.001	0.001	-0.002
R	4690.306	4750.005	116.159	-0.002	-0.005	0.002
S	5034.275	4851.893	109.341	0.002	-0.003	0.002
T	5031.833	4827.812	114.355	0.001	-0.002	0.000
M2				-4852.636	-4641.892	-114.019

Enclosure
Structural, Movement Monitoring

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT							SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT						
MONITORING RESULTS		DATE: 8-11-2021		DEVIATION	DEVIATION	DEVIATION	MONITORING RESULTS		DATE: 8-25-2021		DEVIATION	DEVIATION	DEVIATION
POINTS	NORTHING	EASTING	ELEVATION	(N+/S-)	(E+/W-)	(ELEV)	POINTS	NORTHING	EASTING	ELEVATION	(N+/S-)	(E+/W-)	(ELEV)
A	5025.593	4936.226	113.023	-0.003	0.000	0.005	A	5025.596	4936.228	113.022	0.000	0.002	0.004
B	5067.426	4975.351	113.720	-0.001	0.004	0.005	B	5067.432	4975.354	113.719	0.005	0.007	0.004
C	5120.389	4931.788	112.374	0.005	0.006	0.007	C	5120.383	4931.792	112.371	-0.001	0.010	0.004
D	5116.251	4903.139	116.177	0.008	0.007	-0.003	D	5116.240	4903.138	116.183	-0.003	0.006	0.003
E	5110.410	4886.694	110.245	0.004	0.006	0.002	E	5110.401	4886.693	110.247	-0.005	0.005	0.004
F	5101.969	4569.044	108.586	-0.001	-0.004	0.008	F	5101.968	4569.050	108.582	-0.002	0.002	0.004
G	5046.916	4569.556	107.287	0.003	-0.004	0.000	G	5046.916	4569.562	107.291	0.003	0.002	0.004
H	5037.193	4575.231	106.763	-0.001	0.000	0.002	H	5037.197	4575.234	106.767	0.003	0.003	0.006
I	5014.168	4671.467	107.101	0.000	0.000	0.000	I	5014.165	4671.472	107.102	-0.003	0.005	0.001
J	5006.156	4667.236	105.048	0.007	-0.002	0.000	J	5006.147	4667.243	105.053	-0.002	0.005	0.005
K	4969.300	4667.556	115.749	0.008	0.000	0.000	K	4969.290	4667.560	115.755	-0.002	0.004	0.006
L	4928.781	4667.882	113.790	0.003	-0.002	0.006	L	4928.771	4667.883	113.787	-0.007	-0.001	0.003
M	4852.770	4643.633	113.688	0.027	0.012	0.012	M	4852.757	4643.639	113.682	0.014	0.018	0.006
N	4798.132	4613.740	117.822	0.007	0.012	0.002	N	4798.135	4613.732	117.820	0.010	0.004	0.000
O	4754.368	4648.179	119.562	-0.006	0.005	0.000	O	4754.371	4648.174	119.564	-0.003	0.000	0.002
P	4828.395	4697.079	129.230	-0.002	-0.006	0.005	P	4828.404	4697.078	129.227	0.007	-0.007	0.002
Q	4736.357	4667.497	113.192	-0.007	0.002	-0.002	Q	4736.361	4667.493	113.191	-0.003	-0.002	-0.003
R	4690.304	4750.013	116.161	-0.004	0.003	0.004	R	4690.307	4750.007	116.159	-0.001	-0.003	0.002
S	5034.272	4851.894	109.343	-0.001	-0.002	0.004	S	5034.279	4851.890	109.341	0.006	-0.006	0.002
T	5031.832	4827.812	114.359	0.000	-0.002	0.004	T	5031.838	4827.815	114.355	0.006	0.001	0.000
M2				-4852.636	-4641.892	-114.019	M2				-4852.636	-4641.892	-114.019

Enclosure
Structural, Movement Monitoring

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT				
MONITORING POINT INFORMATION				
POINTS	DESCRIPTION	NORTHING	EASTING	ELEVATION
A	MINI CIRCLE PRISM MOUNTED ON BUILDING	5025.596	4936.226	113.018
B	MINI CIRCLE PRISM MOUNTED ON BUILDING	5067.427	4975.347	113.715
C	MINI CIRCLE PRISM MOUNTED ON BUILDING	5120.384	4931.782	112.367
D	MINI CIRCLE PRISM MOUNTED ON BUILDING	5116.243	4903.132	116.18
E	MINI CIRCLE PRISM MOUNTED ON BUILDING	5110.406	4886.688	110.243
F	MINI CIRCLE PRISM MOUNTED ON BUILDING	5101.97	4569.048	108.578
G	MINI CIRCLE PRISM MOUNTED ON BUILDING	5046.913	4569.56	107.287
H	MINI CIRCLE PRISM MOUNTED ON BUILDING	5037.194	4575.231	106.761
I	MINI CIRCLE PRISM MOUNTED ON BUILDING	5014.168	4671.467	107.101
J	MINI CIRCLE PRISM MOUNTED ON BUILDING	5006.149	4667.238	105.048
K	MINI CIRCLE PRISM MOUNTED ON BUILDING	4969.292	4667.556	115.749
L	MINI CIRCLE PRISM MOUNTED ON BUILDING (SET ON 7-1-2021)	4928.778	4667.884	113.784
M	MINI CIRCLE PRISM MOUNTED ON BUILDING (TARGET HIT RESET 7-16-2021)(TARGET DESTROYED 8-25-2021 NEW TARGET M2 SET)	4852.743	4643.621	113.676
N	MINI CIRCLE PRISM MOUNTED ON BUILDING	4798.125	4613.728	117.82
O	MINI CIRCLE PRISM MOUNTED ON BUILDING	4754.374	4648.174	119.562
P	MINI CIRCLE PRISM MOUNTED ON BUILDING	4828.397	4697.085	129.225
Q	MINI CIRCLE PRISM MOUNTED ON BUILDING	4736.364	4667.495	113.194
R	MINI CIRCLE PRISM MOUNTED ON BUILDING	4690.308	4750.01	116.157
S	MINI CIRCLE PRISM MOUNTED ON BUILDING	5034.273	4851.896	109.339
T	MINI CIRCLE PRISM MOUNTED ON BUILDING	5031.832	4827.814	114.355
M2	MINI CIRCLE PRISM MOUNTED ON BUILDING (SET ON 8-25-2021)	4852.636	4641.892	114.019

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT						
MONITORING RESULTS		DATE: 9-10-2021		DEVIATION	DEVIATION	DEVIATION
POINTS	NORTHING	EASTING	ELEVATION	(N+/S-)	(E+/W-)	(ELEV)
A	5025.602	4936.233	113.019	0.006	0.007	0.001
B	5067.434	4975.356	113.716	0.007	0.009	0.001
C	5120.392	4931.793	112.364	0.008	0.011	-0.003
D	5116.248	4903.143	116.176	0.005	0.011	-0.004
E	5110.412	4886.696	110.238	0.006	0.008	-0.005
F	5101.967	4569.045	108.58	-0.003	-0.003	0.002
G	5046.916	4569.562	107.291	0.003	0.002	0.004
H	5037.199	4575.233	106.766	0.005	0.002	0.005
I	5014.169	4671.476	107.103	0.001	0.009	0.002
J	5006.149	4667.241	105.053	0.000	0.003	0.005
K	4969.291	4667.558	115.754	-0.001	0.002	0.005
L	4928.778	4667.887	113.787	0.000	0.003	0.003
M				-4852.743	-4643.621	-113.676
N	4798.134	4613.735	117.819	0.009	0.007	-0.001
O	4754.373	4648.174	119.562	-0.001	0.000	0.000
P	4828.408	4697.081	129.227	0.011	-0.004	0.002
Q	4736.361	4667.494	113.191	-0.003	-0.001	-0.003
R	4690.309	4750.005	116.158	0.001	-0.005	0.001
S	5034.282	4851.897	109.339	0.009	0.001	0.000
T	5031.841	4827.817	114.355	0.009	0.003	0.000
M2	4852.634	4641.894	114.021	-0.002	0.002	0.002

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT

MONITORING RESULTS		DATE: 9-23-2021		DEVIATION	DEVIATION	DEVIATION
POINTS	NORTHING	EASTING	ELEVATION	(N+/S-)	(E+/W-)	(ELEV)
A	5025.604	4936.232	113.018	0.008	0.006	0.000
B	5067.432	4975.356	113.715	0.005	0.009	0.000
C	5120.383	4931.791	112.372	-0.001	0.009	0.005
D	5116.239	4903.138	116.184	-0.004	0.006	0.004
E	5110.402	4886.693	110.247	-0.004	0.005	0.004
F	5101.961	4569.051	108.58	-0.009	0.003	0.002
G	5046.918	4569.561	107.29	0.005	0.001	0.003
H	5037.198	4575.233	106.765	0.004	0.002	0.004
I	5014.17	4671.474	107.103	0.002	0.007	0.002
J	5006.15	4667.241	105.052	0.001	0.003	0.004
K	4969.292	4667.562	115.754	0.000	0.006	0.005
L	4928.776	4667.885	113.785	-0.002	0.001	0.001
M				-4852.743	-4643.621	-113.676
N	4798.133	4613.735	117.819	0.008	0.007	-0.001
O	4754.371	4648.177	119.562	-0.003	0.003	0.000
P	4828.4	4697.076	129.227	0.003	-0.009	0.002
Q	4736.361	4667.495	113.191	-0.003	0.000	-0.003
R	4690.303	4750.009	116.158	-0.005	-0.001	0.001
S	5034.286	4851.898	109.339	0.013	0.002	0.000
T	5031.848	4827.814	114.353	0.016	0.000	-0.002
M2	4852.635	4641.893	114.018	-0.001	0.001	-0.001

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT

MONITORING RESULTS		DATE: 10-8-2021		DEVIATION	DEVIATION	DEVIATION
POINTS	NORTHING	EASTING	ELEVATION	(N+/S-)	(E+/W-)	(ELEV)
A	5025.605	4936.232	113.019	0.009	0.006	0.001
B	5067.433	4975.356	113.716	0.006	0.009	0.001
C	5120.388	4931.794	112.369	0.004	0.012	0.002
D	5116.238	4903.142	116.183	-0.005	0.010	0.003
E	5110.401	4886.696	110.245	-0.005	0.008	0.002
F	5101.970	4569.046	108.584	0.000	-0.002	0.006
G	5046.913	4569.560	107.290	0.000	0.000	0.003
H	5037.198	4575.232	106.765	0.004	0.001	0.004
I	5014.173	4671.473	107.102	0.005	0.006	0.001
J	5006.150	4667.243	105.051	0.001	0.005	0.003
K	4969.292	4667.566	115.753	0.000	0.010	0.004
L	4928.776	4667.887	113.785	-0.002	0.003	0.001
M				-4852.743	-4643.621	-113.676
N	4798.136	4613.734	117.820	0.011	0.006	0.000
O	4754.374	4648.175	119.563	0.000	0.001	0.001
P	4828.405	4697.076	129.225	0.008	-0.009	0.000
Q	4736.361	4667.496	113.192	-0.003	0.001	-0.002
R	4690.310	4750.003	116.159	0.002	-0.007	0.002
S	5034.289	4851.897	109.340	0.016	0.001	0.001
T	5031.848	4827.818	114.356	0.016	0.004	0.001
M2	4852.632	4641.897	114.018	-0.004	0.005	-0.001

Enclosure
Structural, Movement Monitoring

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT

MONITORING RESULTS		DATE: 10-21-2021		DEVIATION	DEVIATION	DEVIATION
POINTS	NORTHING	EASTING	ELEVATION	(N+/S-)	(E+/W-)	(ELEV)
A	5025.601	4936.233	113.022	0.005	0.007	0.004
B	5067.433	4975.353	113.718	0.006	0.006	0.003
C	5120.384	4931.793	112.363	0.000	0.011	-0.004
D	5116.246	4903.143	116.183	0.003	0.011	0.003
E	5110.405	4886.699	110.240	-0.001	0.011	-0.003
F	5101.963	4569.046	108.581	-0.007	-0.002	0.003
G	5046.922	4569.558	107.291	0.009	-0.002	0.004
H	5037.203	4575.230	106.766	0.009	-0.001	0.005
I	5014.173	4671.472	107.102	0.005	0.005	0.001
J	5006.157	4667.241	105.052	0.008	0.003	0.004
K	4969.299	4667.561	115.753	0.007	0.005	0.004
L	4928.782	4667.885	113.786	0.004	0.001	0.002
M				-4852.743	-4643.621	-113.676
N	4798.135	4613.732	117.820	0.010	0.004	0.000
O	4754.372	4648.173	119.562	-0.002	-0.001	0.000
P	4828.403	4697.078	129.226	0.006	-0.007	0.001
Q	4736.360	4667.493	113.191	-0.004	-0.002	-0.003
R	4690.310	4750.002	116.158	0.002	-0.008	0.001
S	5034.284	4851.896	109.341	0.011	0.000	0.002
T	5031.842	4827.813	114.357	0.010	-0.001	0.002
M2	4852.639	4641.893	114.018	0.003	0.001	-0.001

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT

MONITORING RESULTS		DATE: 11-4-2021		DEVIATION	DEVIATION	DEVIATION
POINTS	NORTHING	EASTING	ELEVATION	(N+/S-)	(E+/W-)	(ELEV)
A	5025.603	4936.232	113.015	0.007	0.006	-0.003
B	5067.429	4975.348	113.711	0.002	0.001	-0.004
C	5120.379	4931.785	112.367	-0.005	0.003	0.000
D	5116.242	4903.136	116.186	-0.001	0.004	0.006
E	5110.403	4886.687	110.242	-0.003	-0.001	-0.001
F	5101.971	4569.042	108.576	0.001	-0.006	-0.002
G	5046.916	4569.557	107.286	0.003	-0.003	-0.001
H	5037.199	4575.227	106.762	0.005	-0.004	0.001
I	5014.166	4671.467	107.103	-0.002	0.000	0.002
J	5006.149	4667.237	105.049	0.000	-0.001	0.001
K	4969.296	4667.557	115.751	0.004	0.001	0.002
L	4928.782	4667.882	113.783	0.004	-0.002	-0.001
M				-4852.743	-4643.621	-113.676
N	4798.128	4613.734	117.818	0.003	0.006	-0.002
O	4754.368	4648.172	119.558	-0.006	-0.002	-0.004
P	4828.398	4697.079	129.226	0.001	-0.006	0.001
Q	4736.355	4667.494	113.189	-0.009	-0.001	-0.005
R	4690.306	4750.007	116.156	-0.002	-0.003	-0.001
S	5034.281	4851.900	109.337	0.008	0.004	-0.002
T	5031.843	4827.812	114.356	0.011	-0.002	0.001
M2	4852.637	4641.891	114.017	0.001	-0.001	-0.002

Enclosure
Structural, Movement Monitoring

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT

MONITORING POINT INFORMATION				
POINTS	DESCRIPTION	NORTHING	EASTING	ELEVATION
A	MINI CIRCLE PRISM MOUNTED ON BUILDING	5025.596	4936.226	113.018
B	MINI CIRCLE PRISM MOUNTED ON BUILDING	5067.427	4975.347	113.715
C	MINI CIRCLE PRISM MOUNTED ON BUILDING	5120.384	4931.782	112.367
D	MINI CIRCLE PRISM MOUNTED ON BUILDING	5116.243	4903.132	116.18
E	MINI CIRCLE PRISM MOUNTED ON BUILDING	5110.406	4886.688	110.243
F	MINI CIRCLE PRISM MOUNTED ON BUILDING	5101.97	4569.048	108.578
G	MINI CIRCLE PRISM MOUNTED ON BUILDING	5046.913	4569.56	107.287
H	MINI CIRCLE PRISM MOUNTED ON BUILDING	5037.194	4575.231	106.761
I	MINI CIRCLE PRISM MOUNTED ON BUILDING	5014.168	4671.467	107.101
J	MINI CIRCLE PRISM MOUNTED ON BUILDING	5006.149	4667.238	105.048
K	MINI CIRCLE PRISM MOUNTED ON BUILDING	4969.292	4667.556	115.749
L	MINI CIRCLE PRISM MOUNTED ON BUILDING (SET ON 7-1-2021)	4928.778	4667.884	113.784
M	MINI CIRCLE PRISM MOUNTED ON BUILDING (TARGET HIT RESET 7-16-2021)(TARGET DESTROYED 8-25-2021 NEW TARGET M2 SET)	4852.743	4643.621	113.676
N	MINI CIRCLE PRISM MOUNTED ON BUILDING	4798.125	4613.728	117.82
O	MINI CIRCLE PRISM MOUNTED ON BUILDING	4754.374	4648.174	119.562
P	MINI CIRCLE PRISM MOUNTED ON BUILDING	4828.397	4697.085	129.225
Q	MINI CIRCLE PRISM MOUNTED ON BUILDING	4736.364	4667.495	113.194
R	MINI CIRCLE PRISM MOUNTED ON BUILDING	4690.308	4750.01	116.157
S	MINI CIRCLE PRISM MOUNTED ON BUILDING	5034.273	4851.896	109.339
T	MINI CIRCLE PRISM MOUNTED ON BUILDING	5031.832	4827.814	114.355
M2	MINI CIRCLE PRISM MOUNTED ON BUILDING (SET ON 8-25-2021)(TARGET DESTOYED 11-18-2021)	4852.636	4641.892	114.019
M2	MINI CIRCLE PRISM MOUNTED ON BUILDING (SET ON 12-2-2021)	4852.635	4641.892	114.018

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT

MONITORING RESULTS		DATE: 11-18-2021		DEVIATION	DEVIATION	DEVIATION
POINTS	NORTHING	EASTING	ELEVATION	(N+/S-)	(E+/W-)	(ELEV)
A	5025.601	4936.231	113.014	0.005	0.005	-0.004
B	5067.429	4975.348	113.711	0.002	0.001	-0.004
C	5120.379	4931.781	112.367	-0.005	-0.001	0.000
D	5116.241	4903.13	116.181	-0.002	-0.002	0.001
E	5110.405	4886.685	110.243	-0.001	-0.003	0.000
F	5101.973	4569.042	108.578	0.003	-0.006	0.000
G	5046.914	4569.559	107.287	0.001	-0.001	0.000
H	5037.197	4575.23	106.763	0.003	-0.001	0.002
I	5014.165	4671.468	107.103	-0.003	0.001	0.002
J	5006.148	4667.237	105.049	-0.001	-0.001	0.001
K	4969.291	4667.559	115.751	-0.001	0.003	0.002
L	4928.78	4667.885	113.784	0.002	0.001	0.000
M				-4852.743	-4643.621	-113.676
N	4798.13	4613.737	117.818	0.005	0.009	-0.002
O	4754.368	4648.174	119.559	-0.006	0.000	-0.003
P	4828.398	4697.081	129.227	0.001	-0.004	0.002
Q	4736.358	4667.495	113.188	-0.006	0.000	-0.006
R	4690.308	4750.007	116.156	0.000	-0.003	-0.001
S	5034.277	4851.899	109.337	0.004	0.003	-0.002
T	5031.838	4827.812	114.354	0.006	-0.002	-0.001
M2				-4852.636	-4641.892	-114.019
M3				-4852.635	-4641.892	-114.018

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT

MONITORING RESULTS		DATE: 12-2-2021		DEVIATION	DEVIATION	DEVIATION
POINTS	NORTHING	EASTING	ELEVATION	(N+/S-)	(E+/W-)	(ELEV)
A	5025.601	4936.23	113.015	0.005	0.004	-0.003
B	5067.429	4975.347	113.712	0.002	0.000	-0.003
C	5120.383	4931.78	112.368	-0.001	-0.002	0.001
D	5116.243	4903.129	116.179	0.000	-0.003	-0.001
E	5110.409	4886.685	110.243	0.003	-0.003	0.000
F	5101.974	4569.045	108.577	0.004	-0.003	-0.001
G	5046.914	4569.561	107.286	0.001	0.001	-0.001
H	5037.197	4575.232	106.762	0.003	0.001	0.001
I	5014.165	4671.467	107.103	-0.003	0.000	0.002
J	5006.149	4667.237	105.049	0.000	-0.001	0.001
K	4969.294	4667.56	115.75	0.002	0.004	0.001
L	4928.78	4667.885	113.783	0.002	0.001	-0.001
M				-4852.743	-4643.621	-113.676
N	4798.127	4613.733	117.818	0.002	0.005	-0.002
O	4754.366	4648.171	119.559	-0.008	-0.003	-0.003
P	4828.395	4697.082	129.227	-0.002	-0.003	0.002
Q	4736.356	4667.493	113.188	-0.008	-0.002	-0.006
R	4690.307	4750.008	116.155	-0.001	-0.002	-0.002
S	5034.278	4851.9	109.337	0.005	0.004	-0.002
T	5031.838	4827.813	114.355	0.006	-0.001	0.000
M2				-4852.636	-4641.892	-114.019
M3				-4852.635	-4641.892	-114.018

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT

MONITORING RESULTS		DATE: 12-17-2021		DEVIATION	DEVIATION	DEVIATION
POINTS	NORTHING	EASTING	ELEVATION	(N+/S-)	(E+/W-)	(ELEV)
A	5025.598	4936.228	113.014	0.002	0.002	-0.004
B	5067.428	4975.345	113.710	0.001	-0.002	-0.005
C	5120.381	4931.780	112.369	-0.003	-0.002	0.002
D	5116.242	4903.129	116.181	-0.001	-0.003	0.001
E	5110.406	4886.685	110.244	0.000	-0.003	0.001
F	5101.974	4569.043	108.577	0.004	-0.005	-0.001
G	5046.915	4569.561	107.286	0.002	0.001	-0.001
H	5037.195	4575.232	106.762	0.001	0.001	0.001
I	5014.165	4671.468	107.103	-0.003	0.001	0.002
J	5006.149	4667.238	105.049	0.000	0.000	0.001
K	4969.293	4667.560	115.750	0.001	0.004	0.001
L	4928.779	4667.885	113.783	0.001	0.001	-0.001
M				-4852.743	-4643.621	-113.676
N	4798.128	4613.734	117.818	0.003	0.006	-0.002
O	4754.365	4648.172	119.559	-0.009	-0.002	-0.003
P	4828.396	4697.083	129.226	-0.001	-0.002	0.001
Q	4736.356	4667.494	113.188	-0.008	-0.001	-0.006
R	4690.306	4750.006	116.155	-0.002	-0.004	-0.002
S	5034.276	4851.897	109.335	0.003	0.001	-0.004
T	5031.836	4827.811	114.352	0.004	-0.003	-0.003
M2				-4852.636	-4641.892	-114.019
M3	4852.636	4641.893	114.018	0.001	0.001	0.000

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT

MONITORING RESULTS		DATE: 10-21-2021		DEVIATION	DEVIATION	DEVIATION
POINTS	NORTHING	EASTING	ELEVATION	(N+/S-)	(E+/W-)	(ELEV)
A				-5025.596	-4936.226	-113.018
B				-5067.427	-4975.347	-113.715
C				-5120.384	-4931.782	-112.367
D				-5116.243	-4903.132	-116.180
E				-5110.406	-4886.688	-110.243
F				-5101.970	-4569.048	-108.578
G				-5046.913	-4569.560	-107.287
H				-5037.194	-4575.231	-106.761
I				-5014.168	-4671.467	-107.101
J				-5006.149	-4667.238	-105.048
K				-4969.292	-4667.556	-115.749
L				-4928.778	-4667.884	-113.784
M				-4852.743	-4643.621	-113.676
N				-4798.125	-4613.728	-117.820
O				-4754.374	-4648.174	-119.562
P				-4828.397	-4697.085	-129.225
Q				-4736.364	-4667.495	-113.194
R				-4690.308	-4750.010	-116.157
S				-5034.273	-4851.896	-109.339
T				-5031.832	-4827.814	-114.355
M2				-4852.636	-4641.892	-114.019
M3				-4852.635	-4641.892	-114.018

SETTLEMENT MONITORING PROGRAM, CENTRAL MIDDLE SCHOOL, 9 INDIAN ROCK LANE GREENWICH, CT

MONITORING RESULTS		DATE: 11-4-2021		DEVIATION	DEVIATION	DEVIATION
POINTS	NORTHING	EASTING	ELEVATION	(N+/S-)	(E+/W-)	(ELEV)
A				-5025.596	-4936.226	-113.018
B				-5067.427	-4975.347	-113.715
C				-5120.384	-4931.782	-112.367
D				-5116.243	-4903.132	-116.180
E				-5110.406	-4886.688	-110.243
F				-5101.970	-4569.048	-108.578
G				-5046.913	-4569.560	-107.287
H				-5037.194	-4575.231	-106.761
I				-5014.168	-4671.467	-107.101
J				-5006.149	-4667.238	-105.048
K				-4969.292	-4667.556	-115.749
L				-4928.778	-4667.884	-113.784
M				-4852.743	-4643.621	-113.676
N				-4798.125	-4613.728	-117.820
O				-4754.374	-4648.174	-119.562
P				-4828.397	-4697.085	-129.225
Q				-4736.364	-4667.495	-113.194
R				-4690.308	-4750.010	-116.157
S				-5034.273	-4851.896	-109.339
T				-5031.832	-4827.814	-114.355
M2				-4852.636	-4641.892	-114.019
M3				-4852.635	-4641.892	-114.018

Enclosure
Structural, Movement Monitoring

Mechanical

We visited the facility on Tuesday, December 28, 2021, over the course of (1) day to survey and assess mechanical conditions. We interviewed facilities staff, inspected physical and operating conditions, recorded maintenance tags, and inventoried existing equipment. It should be noted that facilities personnel were not able to answer most of our questions about the systems such as service schedules, trouble calls, deferred maintenance, etc.

The heating plant consists of three (3) Smith Model 28HE-10 dual-fuel cast iron steam boilers and (5) five Armstrong hot-water pumps. We do not know when they were first installed. Currently are in working condition. The boilers have been converted to natural gas fired only with each boiler having a Net IBR output capacity of 2,185 MBH. While these boilers are in good condition, due to their age and ASHRAE suggested equipment lifespan of 30 years and 20 years, respectively, the boilers and associated pumps should be replaced with like and kind. Much if not all the piping dates back to the original construction of the building in 1958 and does not appear to have any major leaks or notable operational deficiencies. The hot-water system feeds various central station air-handling unit large heating coils.

Split system air-handling units with direct-expansion cooling serve some areas of the facility, including the data closets and other ancillary rooms. Associated condensing units are located either on the roof or at grade, generally nearby to the air-handling units. This equipment does not appear to be original to the building construction.

One (1) packaged rooftop unit is brand new and was recently installed to serve the schools renovated auditorium/theater.

Through-the-wall or in-window air conditioning units serve many, if not all, of the classroom areas throughout the facility as a means of mechanical cooling.

There are four (4) central station air handling units that serve as a means of ventilation to the building, as well as a source of heat. The central station air-handlers are located in the lower-level boiler room and are ducted up through the facility to the space served.

The various HVAC system described above generally are controlled by either old pneumatic controls, or by local independent controls. A new facility-wide building management system is recommended to improve operational efficiency.

The original building is a 1 and 2 story structure that was constructed in 1958. A smaller addition was constructed sometime after 1999[8]. The addition connects the northeast corner of the original building and serves as a 2nd level library with 1st level classrooms.

Property Details

The HVAC systems at the Greenwich Central Middle School are comprised of a variety of different system types and ages, installed over the life span of the building including, rooftop packaged air-handling units, powered ventilators, and split-system air conditioning units. Much of the existing HVAC equipment appears to be original to the building or from the most recent renovation to the building, in 1999, aside from a few systems that were recently installed. The building was originally

[8] Discerned from the date of as-built records that we were able to inspect.

constructed in 1958 and is a 2-story building, constructed of concrete masonry and glass, with the previously mentioned renovation in 1999.

Scope of Work

The proposed scope of work for this Facility Condition Assessment Report is as follows:

- Meet with knowledgeable school staff for each facility to obtain from their input and to fully understand the characteristics of each school property.
- Conduct on-site inspections
- Produce a Facility Condition Assessment Analysis Report
    - In-depth assessment of the facility as it relates to any operational deficiencies
    - Recommendations required to correct the existing operational deficiencies

Existing Mechanical Systems

The heating plant consists of three (3) Smith Model 28HE-10 dual-fuel cast iron steam boilers and (5) five Armstrong hot-water pumps. We do not know when they were first installed. Currently are in working condition. The boilers have been converted to natural gas fired only with each boiler having a Net IBR output capacity of 2,185 MBH. While these boilers are in good condition, due to their age and ASHRAE suggested equipment lifespan of 30 years, the boilers and associated pumps should be replaced with like and kind. Much if not all the piping dates back to the original construction of the building in 1958 and does not appear to have any major leaks or notable operational deficiencies. The hot-water system feeds various central station air-handling unit heating coils.

Split system air-handling units with direct-expansion cooling serve some areas of the facility, including the data closets and other ancillary rooms. Associated condensing units are located either on the roof or at grade, generally nearby to the air-handling units. This equipment does not appear to be original to the building construction but based on the age and appearance of these systems, replacement is recommended.

One (1) packaged rooftop unit is brand new and was recently installed to serve the schools renovated auditorium/theater.

Through-the-wall or in-window air conditioning units serve many, if not all, of the classroom areas throughout the facility as a means of mechanical cooling.

There are four (4) central station air handling units that serve as a means of ventilation to the building, as well as a source of heat. The central station air-handlers are located in the lower-level boiler room and are ducted up through the facility to the space served.

The various HVAC system described above generally are controlled by either old pneumatic controls, or by local independent controls.

The Greenwich Central Middle School is a medium sized building that has been expanded over time, undergoing a single renovation over the life of the building. The original building is a 1 and 2 story structure that was constructed in 1958. A smaller addition was constructed sometime after 1999. The addition connects the northeast corner of the original building and serves as a 2nd level library with 1st level classrooms.

Existing Hot water Pump VFD's

Existing Hot Water Pumps

Existing Boiler Room Combustion Air Intake and ductwork from Central Station Air Handling Unit Up

Existing Central Station Air Handler Outdoor Air Intake Plenum

Gas-Fired Boiler No.1

The school has a central hot water heating plant located in the lower-level mechanical room. The heating plant consists of three large Smith cast iron boilers that are approximately 2.2 million BTUH each and all appear to be in decent condition. The median service life of typical cast-iron boiler is 30 years. The boilers have dual fuel Power Flame burners that can use either natural gas or diesel oil for combustion but have been converted to natural gas only. We assume that the boilers generate hot water at 180 degrees, the system is designed to have a 20-degree temperature difference at the hot water coils and that the third boiler is operating as stand-by. Hot water is circulated through the building by two (2) hot water base mounted pumps, each pump has a variable speed drive to control flow and pressure based on the heating demand of the building, with a third pump on the supply header of each boiler. It is assumed that the base mounted pumps are configured as primary stand-by arrangement and that each is sized for 100% of the flow and the “third” pump on the boiler supply header acts as a booster pump to accommodate for pressure losses through the boiler itself. The median service life for base mounted pumps is 20 years. There are pressure sensors located out in the piping loops that measure the system pressure and modulate the pump speeds to match the system demand. It was noted during the time of our visit that there are no terminal heating devices, baseboard, fin-tube elements, etc. along the building’s exterior walls.

Gas-Fired Boiler No.1

Gas-Fired Boiler No.2

Gas-Fired Boiler No.3

Domestic hot water is produced by one (1) AO Smith electric resistance water heater, that was recently replaced/installed on August 13th, 2020. The median service life for this type of heater is 15 years.

AO Smith Electric Domestic Hot-Water Heater

Approximately 90-95% of the building currently has air conditioning, with approximately 50% being comprised of in-window/through wall air conditioning units to be replaced. The theater/auditorium was recently provided with a brand-new Carrier RTU, the median service life of this type of equipment is 15 years.

New Auditorium Carrier RTU

Existing through wall AC Unit (typical)

The library wing has existing older Lennox packaged RTU's, as well as 1-1 split system units (Lennox as well) serving specific rooms within the library area. The median service life of this type of equipment is 15 years. The existing library rooftop equipment appeared to be extremely weather worn and had significant signs of rust.

The mini split systems consist of an indoor evaporator located in the space to be cooled and a condensing unit located on the roof. These systems provide flexible room by room cooling capability. We observed equipment by a few different manufacturers.

Mitsubishi Mr. Slim Split Systems

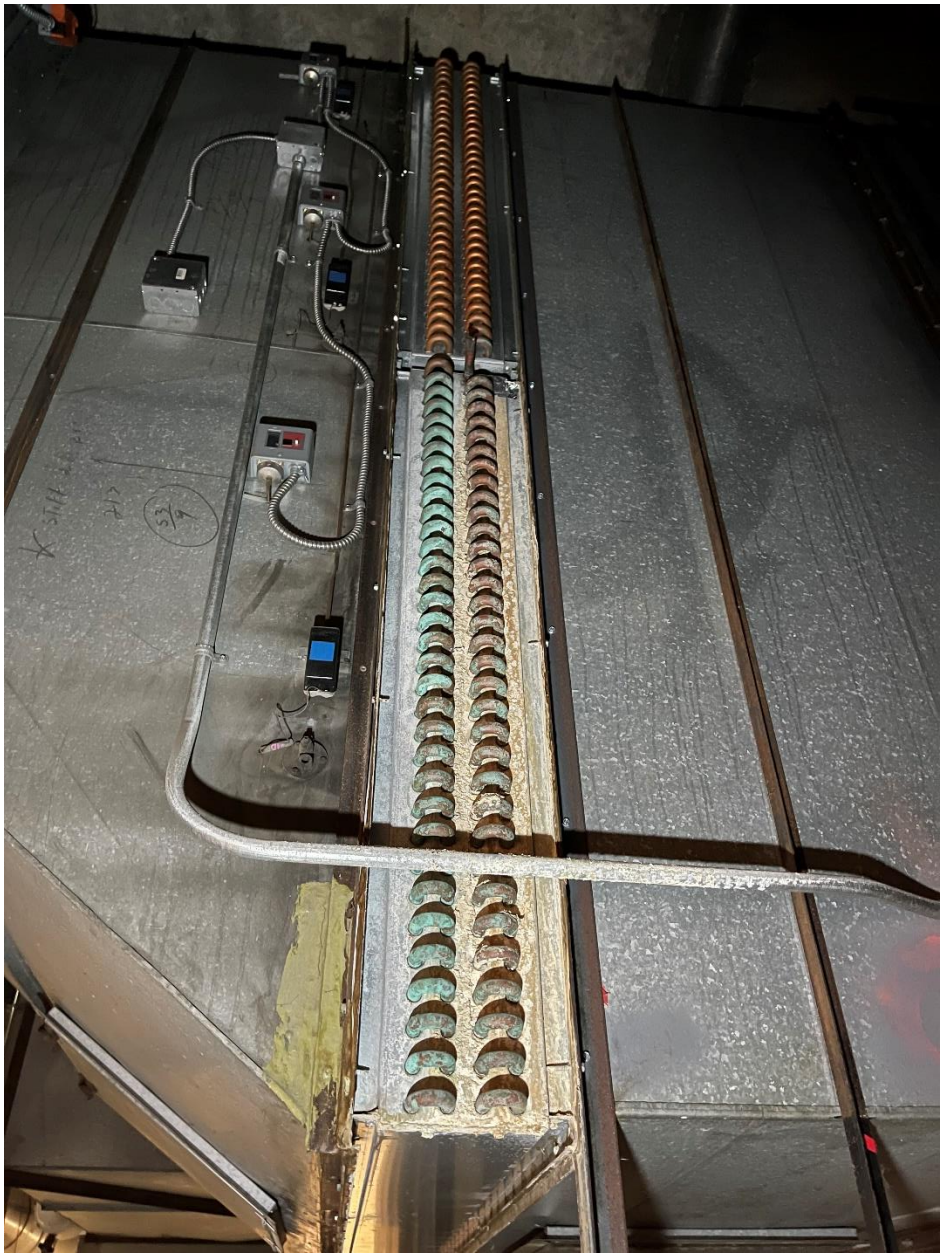
Lennox Spilt Systems

There are exhaust fans scattered throughout the building that serve toilets, MER's, science rooms, storage rooms, kitchens, and other similar spaces. Most are small mushroom style down blast type and are typical for a school application. Most appear to be quite weather worn, and replacement is suggested. The median service life of this type of equipment is 25 years.

Typical Mushroom Style Down Blast Fan

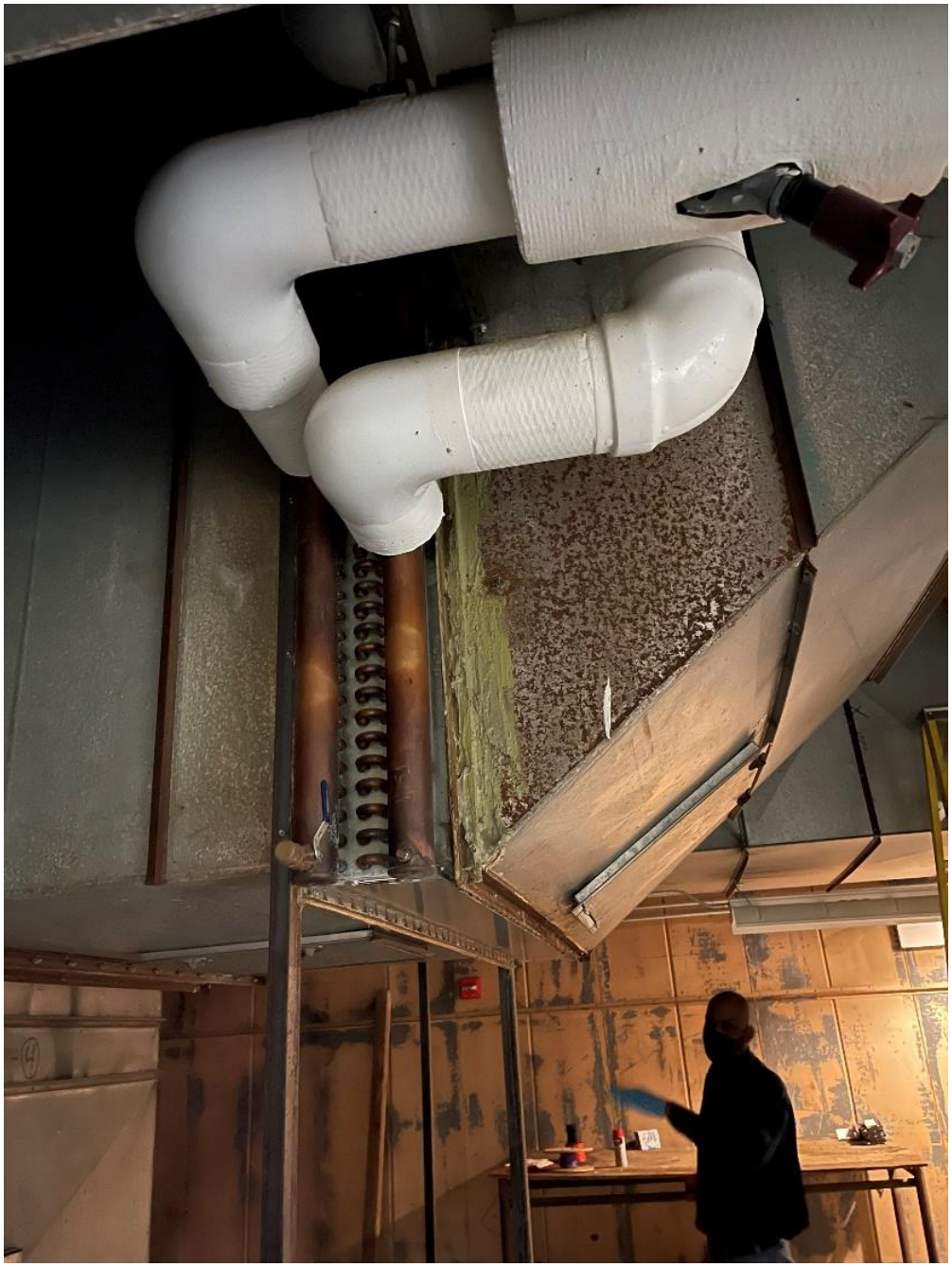
On the lower level of the building are the central station air handling units, which provide a means of ventilation air and heating to all areas of the school. There are a total of four (4) central station air handlers meaning the school is currently broken up into four (4) main heating zones. Each of the air handlers is outfitted with a large hot-water heating coil, with the hot water being supplied by the existing heating hot-water system in place. These air handlers pull fresh air into the system from a large outdoor air plenum that supplies fresh air to all four (4) air handlers. Each air handler then ducts out to individual zone ducts supplying fresh air and heat when called for to each room within the building. Every classroom is outfitted with two registers near the entrance, one for supply and one for return, refer to photos for reference. The existing outdoor air plenums need repair and some of the existing hot-water coils are in need of replacement. While on site it was noted that one coil appeared to be recently replaced. We would also advise for the replacement of the supply fans themselves due to their age and while on site we note “knocking” which is indicative of bearing failures.

Central Station Air Handler (S-1) and duct mounted smoke detector

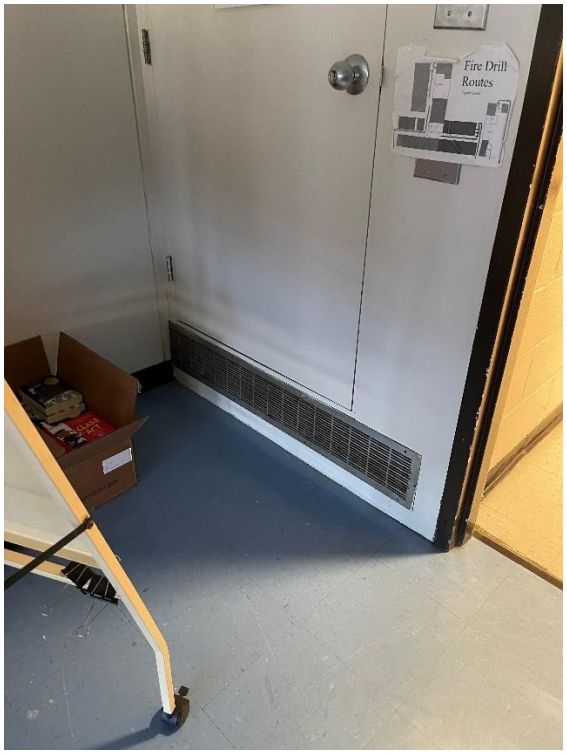


Duct mounted hot-water heating coil in need of replacement directly below recently replace coil section.

Individual uninsulated zone ductwork up from central station air handling units



Rust downstream of heating coils



Typical Air Devices at Classroom Entrances (Supply Low/Return High) & Wall mounted Thermostat

Facility Condition Assessment Analysis

Our facilities condition assessment is based on our field observations during our site visit on December 28th,2021.

Approximately 90% of the school is currently air conditioned. The majority of air conditioning equipment that serves the school installed on the roof or in the façade walls and includes in-wall AC Units, RTU's, exhaust fans and mini-split condensing units. The rooftop equipment viewed during the site visit appeared to be in average to poor condition for their age and many of the units have severe rusting.

The packaged RTU air conditioning strategy is a modular and economical (Auditorium and Library) choice because it allows the building to be easily divided into zones for heating and air conditioning. Typically, schools are divided into zones based on the space programming.

Packaged RTU's are manufactured with the fans and cooling/heating components all in one self-contained enclosure. This type of equipment typically can only provide limited additional capacity for additional outside ventilation air to the spaces they serve. This limited capability is due to the DX cooling component of the equipment. The process of conditioning outdoor air to the proper conditions requires larger DX equipment, some form of reheat and enhanced controls, this added equipment and complexity becomes very costly. One of the RTU's at the school is more custom

and is made specifically to deliver more outdoor ventilation air, this unit being the new Carrier unit serving the theater/auditorium.

The buildings air handling systems all appear to be constant volume types. The constant volume type systems are either on or off. In other words, they cycle to meet the space cooling or heating load based on temperature. The fans typically operate at one speed and the cooling/heating system turns on and off to maintain the space temperature. Constant volume systems do not maintain ventilation air to the spaces while in the off cycle. The central station air handlers also appear to be constant volume systems, that continuously supply fresh pre-heated outdoor air to the spaces.

A few of the rooms are cooled with mini-split systems. These types of air conditioning systems have an indoor evaporator and a rooftop condensing unit. It is typically challenging to control space temperature and relative humidity with mini-split air conditioners in a commercial environment. These types of systems should only be used in application that require supplemental cooling when required.

Operational Deficiencies

Building operational deficiencies is a broad term and is dependent upon many factors. Operational deficiencies may include system equipment deficiencies, repair and routine maintenance concerns, ease of use and controllability of systems to name a few.

Many operational deficiencies were identified for the school, with the main deficiencies being the lack of a BAS system, older RTU's approaching the end of their useful life (Library Units), in-wall AC units serving the majority of the classrooms, an aged central station ventilation and heating system and boilers past their effective lifespan.

The lack of a BAS system prohibits the facility from monitoring the equipment remotely or from providing optimized run times, set points, etc. through BAS tracking. All existing equipment is controlled through outdated stand-alone controllers that are in need of replacement. We would not advise to replace these like in kind and would suggest the installation of a central BAS system to allow for the above noted control capabilities.

Many older rooftop pieces of equipment were observed, mainly the library units which had significant if not complete rust coverage. These units have exceeded their effective lifetime and should be replaced with like and kind. This applies to both the packaged rooftop units serving the library and the mini-spilt AC;s serving individual rooms within the library.

The central station air handling units that provide a means of heat and ventilation to the school are quite old, as noted by their condition while on site. The existing hot water coils serving the system are rusted and one had been recently replaced. We would advise for all the hot-water coils be replaced with like and kind. The coil install also does not allow for easy maintenance of the coils for cleaning, etc.

The boiler serving the school while in decent condition on the outside are past their ASHRAE suggested equipment life span of 30 years. The boilers should be replaced with like and kind,

however, it is suggested that the piping arrangement be re-done within the boiler room, to eliminate the need for the (3) three hot-water booster pumps on each boilers supply header.

The largest operational deficiency noted on site was that a majority, if not, all of the existing classrooms are cooled by a means of an in-wall AC unit. This is an inefficient way of cooling the space they serve and does not provide a means to control the ventilation are being provided. These style units do not allow for spill air to be transferred to the outdoors and can lead to space over pressurization. Lastly, these units are controlled via on/off manual control knobs which requires the user/teacher to turn on the units when the space gets hot and tend to have a maximum of three settings. This will cause the space to either be under-cooled or over-cooled due to the factory set setpoints not matching the true demand cooling.

Electrical

The purpose of this site visit was to perform on-site observations, meet with knowledgeable school staff and to understand the current operation and maintenance of the entire school facility. The existing electrical rooms are located on First Floor and Ground Floor to provide each floor with power from the main switchgear on the first floor. Each electrical room or closet room with panelboards generally consists of 208Y/120V MLO main lug only or MCB main circuit breakers, on different sizes and manufacturers, some new panels, some close to 10 years old and some older than 40 years. There were also a few very old GE small panelboards in the corridors scattered throughout the building. The following observations may include items of work, or additional items, that are noted as not meeting the intent of this document. If no response is received, it shall be deemed that all parties receiving this report agree with the content of document.
The field investigation started from the north side of the school, designed in the 'T' Shape, at first floor, Technology Room and Woodshop room. First, I noticed that all lighting fixtures are fluorescent, no LED. First panelboard was marked 'Wood Shop Panel', 208Y/120V, GE 36ckts, no label for other information, very old panel, needs to be replaced. The outside door has Pull Station and a label 'Fire exit room', but not a horn/strobe or illuminate Exit Sign, the room has Smart Board, LCD Projector and Aruba wireless access points.

Adjacent to woodshop room is the finishing room. The entire room has all incandescent lighting fixtures.

The next room was the musical room with inside IT closet. The IT rack was fully equipped with new devices.

The next panelboard 'Panel IT-1' is a GE, 208Y/120V, 36 circuit breakers, very old, inappropriate labels and in bad condition. Additional outlets should be added to these rooms to avoid the use of surge strips and extension cords.

Next to my investigation was the Fire Alarm Control Panel. The model: MS-9600UDLS. Addressable FACP, Fire-Lite Alarms by Honeywell. Next panel 'Emergency Panel 1-D' it was new renovated, Eaton, with 12 circuit breakers for IT closet server for 20AMPS.

Stage Panel 'CMSP', 208Y/120V, Siemens 42 ckts, 250 Amps MCB, 3Ph, 4W, recently renovated and an old panelboard marked 'Stage Panel', GE, 208Y/120V, 3Ph, 4W, 200Amps, MLO, nearing the end of its useful life so needs to be replaced.

In the kitchen area there are two very old panels. Both are not CT Building Code compliant. See photos.

All emergency panels are in very poor condition and at the end of their useful life. See photos. We inspected observable conditions on all first-floor rooms without the advent of destructive inspection. Panelboard "LP-1C', GE, 30 CKTS is very old, and it was difficult to identify the amperage. I found out that Simplex Building Communication System was inoperative and appears to have been abandoned in-place.

There are branch circuit panels, low voltage 208Y/120V panels, serving classrooms, corridors, closets etc. for lighting and power. These appear functional but are old and not CT Building Code compliant.

It was observed that some electrical equipment is nearing the end of its useful life and while beyond the scope of this study, we recommend beginning a plan for a phased replacement, depending on the power requirements for the new mechanical equipment and overall other electrical devices. Some electrical devices and exterior lighting fixtures have been replaced few years back. The entire school wall speakers are very old, some of them are no longer functioning, need to replace all A/V system as well as Clock Systems as, the old one has been removed few years back.

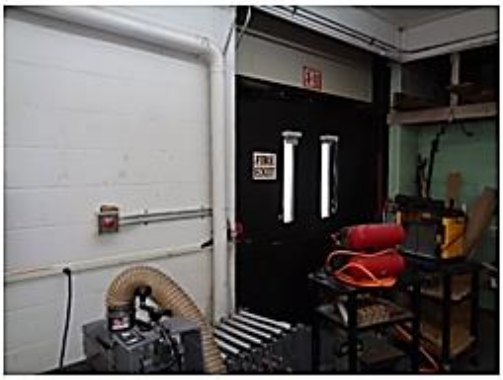
We visited (2) IT rooms, the Storage and Data closet the and 3rd room not labeled. Facilities personnel advised that both have been updated. Adjacent to the Data closet room and Room 226 is a Phone panelboard, in use.

We observed that a significant number of small electrical devices are broken and unsafe. Examples are wall occupancy sensors, motion sensor switches, outlets without covers, etc. throughout the facility.

Panelboard MLO 208Y/120V, 225AMPS, 42 ckts, 3PH, 4W located in science room 117, and the MDP panel in the electrical room, on the first floor, throughout the ground floor level entry stairs, 208Y/120V, 2,000 AMPS, 3PH, 4W, Cutler -Hammer Model: Pow-R-Line ‘C’- are in serviceable condition. Sub-panel SMDP 208Y/120V, 800AMPS 3PH, 4W, in good condition and old SDP-1 an ALT SMDP.

Kohler, Standby Generator Model “15RYG”, (13.0-15.0) KW, (13.0-18.8) KVA, Voltage 120/208, 45 AMPS, functioning in good condition.

Field Photos:



Finishing Room

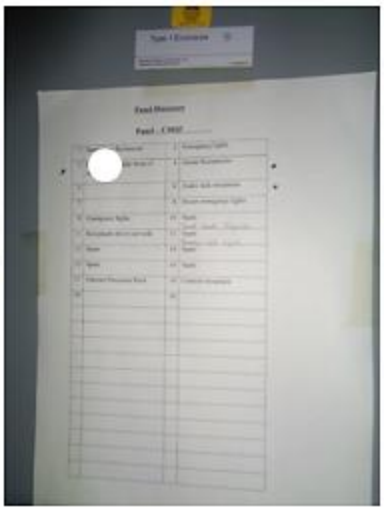
IT Room

IT Rack

FACP, Fire -Lite Alarm

FACP

Stage Panel



Stage Panel

Kitchen panels

Kitchen panels SEC 1

Kitchen panels SEC 2

Emergency panel

Emergency panel

Siemens Communication System

LP-1C Panel

Second IT room, Main Office area.

Third IT rack in Data Closet

Motion Sensor Switch

Science Room 117

Main Distribution Panel

Main Distribution Panel

SMDP sub-panel

Main Distribution Panel

School Revenue Meter

ATS – Automatic Transfer Switch

EM Generator

EM Generator

Plumbing

We visited the facility on Tuesday, December 28, 2021, over the course of (1) day to survey and assess plumbing conditions. We interviewed facilities staff, inspected physical and operating conditions, and did not perform destructive testing. It should be noted that facilities personnel were not able to answer most of our questions about domestic and sanitary waste systems such leaks, blockages, etc.

The original building was constructed in 1958 which is where we concentrated our investigations. We sample inspected and tested faucets, toilets and urinals and the systems appear to be functioning. None are CT Building Code compliant.

Generally, the age of network places the condition of pipes, manifolds, valves, regulators, fittings, and other plumbing devices beyond their service life. The original design and as-built conditions do not conform to current CT Building Code. We did not perform destructive inspection and testing methods and did not test the quality of water. We were unable to observe the condition of buried and hidden pipes and assume that domestic service and sanitary waste lines, particularly buried beneath the slabs on grade, are beyond their service and cannot be repaired in-place. We did not find records of past service and repair, and facilities personnel familiar with the plumbing network were not present at the time of the inspection.

We observed extensive ponding. Some of this is due to the age of the roof and imperfections in sloped insulation. However, we also observed a significant number of problematic roof drain penetrations and blockages due to leaves, tennis balls, kick balls, and other wind driven debris.