Appendix

M

5-year Professional Engineer report

All indicated corrections have been regarding life and safety have been addressed.

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Report on the:

Structural Evaluation

At the:

Westmoreland County Community College PSTC Class A Live Fire Training Structure ("Burn Building")

EL&M No.: 23012

Prepared for:

Westmoreland County Community College

Prepared by:

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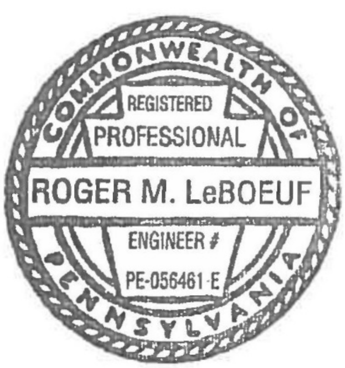
Roger M. LeBoeuf, P.E.
President

Date:

July 18, 2023



This report has been electronically signed and sealed by Roger M. LeBoeuf, P.E. on July 18, 2023 using a Digital Signature.

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Table of Contents - Appendices

1. Introduction

1.1 Purpose of Structural Evaluation

The "burn building" at the Westmoreland County Community College Public Safety Training Center is a live fire training structure located at 65 Public Safety Drive, Smithton, PA 15479. It is used for training firefighters in live fire training evolutions.

During conversations before the structural evaluation, the Client's representatives stated that there is evidence of structural damage due to repetitive fire exposure during training evolutions. The purpose of this structural evaluation is to determine the extent of any structural damage and to make recommendations. Accomplishing this purpose will keep the Owner in conformance with NFPA's requirements for structural evaluations of the burn building for a maximum of 5 years, depending on the additional requirements of the Authority Having Jurisdiction, though EL&M recommends evaluating the structure at least every other year. This structural evaluation and report fulfill the requirements of NFPA 1402 and 1403 for periodic structural evaluations of live fire training structures.

1.2 Description of Survey at this Burn Building

To accomplish the purpose, Mr. Jeremy Jones, of Elliott, LeBoeuf & McElwain (EL&M), traveled to the site on March 28, 2023 to conduct a visual structural survey. Upon arriving at the burn building for the field survey, Mr. Jones met Ms. Shelley Shaffer, Director of Westmoreland County Community College Facilities Management & Construction, and Mr. Marc Jackson, Director of the Westmoreland County Community College Public Safety Training Center. The meeting included a walk-through of the burn building. During the walkthrough, Mr. Jackson pointed out damage and enumerated specific concerns about the burn building. Prior to the walkthrough, Mr. Jones provided a questionnaire to Mr. Jackson, to obtain information about the burn building history, condition, and use. Following the survey, Mr. Jackson emailed the completed questionnaire to Mr. Jones. The questionnaire responses are included in the table in Section 2.3 of this report.

After the walkthrough, Mr. Jones conducted a non-destructive, visual structural survey of the burn building. Visual observations were made of exposed surfaces in every accessible room for the purpose of evaluating the general condition of the existing structural systems. Furthermore, exposed top and bottom surfaces of the concrete roof and elevated floor slabs were sounded in an attempt to locate delaminations. The exterior was observed from the ground and accessible roof and stair locations. Fire bricks at the floor of Room 201 were temporarily removed by the Owner to expose the hidden structural concrete slab below the fire brick. HTL inspection tiles at ceilings were not removed to expose the hidden structural concrete slabs behind the tiles. Although the burn building was generally clean during the survey, soot, straw, pallets, burn racks, barrels, and other debris existed on many surfaces which impaired the ability to observe every surface clearly.

Following the survey, ECS Ltd., of Pittsburgh, PA traveled to the site on June 16, 2023 and removed four (4) cores from the second floor slab in Room 201 in order to look for hidden delaminations, or splits, within the slab and to provide samples for compression testing. Room 201 was selected for the coring because the room appeared to have been exposed to the hottest and/or most frequent fires and due to concerns expressed by the Owner prior to the survey. This is described in more detail in Section 3.2 of this report. Following removal of the cores from the slab, ECS patched the holes with non-shrink grout and performed concrete compression tests on the cores in their lab in Cranberry Township, PA. ECS's test report is included in Appendix 3.

The survey did not include soils testing, evaluation of structural load capacity or building stability, or evaluation of non-structural items, such as smoke exhaust system, temperature monitoring system, lights, electrical wiring, or any items beyond the exterior walls of the burn building. The only non-structural items included in the survey were doors, window shutters, guardrails, thermal linings, non-structural masonry partitions, and any other items indicated in the report. The assessment of non-structural items was limited to a visual assessment of their general condition. Testing and inspections were not performed on the non-structural items. For example, door and shutter hinges were not inspected or tested for wear or risk of failure, but visible corrosion and warping on doors and shutters would have been noted. Thermal linings were not inspected for hairline cracking, anchor loosening, moisture content in the insulation behind the tiles, or ice damage, but missing tiles, broken tiles, missing anchors, and missing clay plugs over anchor heads would have been noted.

Evaluation of code compliance and other safety issues was not included in the scope of work. Code compliance issues, such as door and window dimensions, egress requirements, and guardrail heights, were not included.

The scope of the evaluation was limited to an evaluation of the visible condition of structural elements. Therefore, evaluations of fuel loads, training temperatures, training procedures, and other operational items were not performed. Only rooms with two doors or one door plus one window to a tenable location should be used as burn rooms, as required by NFPA 1402.

The original architectural and structural drawings were available for review during the survey. These drawings were prepared by L. Robert Kimball & Associates of Ebensburg, PA and Atlantic Engineering Services of Pittsburgh, PA and dated May 2, 2007. The drawings were spot-checked in the field and were found to be a generally accurate representation of the exposed conditions. We have assumed that the drawings accurately reflect the as-built conditions of the existing structure, including the hidden conditions such as slab reinforcing.

The visual survey is a useful method for determining the general structural condition of the burn building. Materials testing enhances the visual survey by providing limited insight about the structural materials and some hidden conditions. However, without exposing every hidden condition and without testing all of the structural materials for deterioration, the survey is not exhaustive. It is possible for damaged structural elements to appear undamaged at the exposed surface. There may be damage that was not detected during this survey, and future damage can occur due to continued live fire training evolutions. Therefore, while it is believed that the survey provides a good general assessment of the building condition, the results of this survey cannot be considered a warranty of the structural condition of the burn building. Furthermore, the survey results cannot be used, in themselves, as contract documents for repairs.

2. Burn Building Description

See Appendix 1 for approximate floor plans. For a glossary of all terms typed in *italics*, see Appendix 2.

The burn building is a two-story structure measuring approximately 1,880 square feet. There are currently 5 burn rooms (rooms used for live fire training). The burn building is approximately 16 years old (constructed in 2007).

AB Perspective

CD Perspective

2.1 Structural Systems

This description is based on the original drawings and observed conditions. The foundation was not excavated for observation. The burn building structure consists of *poured-in-place reinforced concrete* slabs supported by *poured-in-place reinforced concrete* columns. The columns are supported on concrete *spread footings*. The masonry walls consist of reinforced *CMU* and are non-structural (neither load-bearing walls nor shear walls). Interior stairs are *poured-in-place reinforced concrete* supported by *poured-in-place reinforced concrete* walls supported on concrete *spread footings*. The ground floor consists of a concrete *slab-on-grade* with turn-downs at the perimeter of the structure.

2.2 Non-Structural Features

The non-structural features are described in the table below.

Element	Description
Doors	Combination of steel plate and core-filled hollow metal doors.
Windows	Steel plate shutters (double swing).
Roof Guardrails	Steel pipe guardrails at 2 1/2 sides, CMU parapets at 1 1/2 sides.
Roof Hatches	CMU "chimney" with removable cover at top of fireplace, hinged steel cover plates over ventilation opening, removable cover over chopout opening.
Thermal Lining	High Temperature Linings System 203 on ceilings of all rooms. Brick pavers pushed tight together, with no mortar or setting bed, on floors of all rooms. Calcium silicate insulation boards with 4" solid CMU at interior concrete columns.

2.3 Use of Facility, Based on Interview with Facility Personnel

The following table describes the general use of this burn building, as provided by personnel from the facility. The information provided in this table gives an indication of the general care and condition of the burn building. Typically, one can expect to observe more damage in the building if there are one or more of the following: higher temperatures, frequent training evolutions, misuse, no thermal protection, and no routine maintenance.

Item	Information Provided by Marc Jackson
Personnel that use the burn building	All fire departments in the regional area, including beyond the county (approx. 150 departments total), and 5 industrial emergency response teams.
Degree of supervision	All burns are overseen by WCCC staff, who are all state certified instructors, but it wasn't always that way in the past.
Number of live fire training days (days during which at least one fire was set) per year in this burn building	Approximately 50 days per year.
Temperature range during training	Hot, easily 1,600˚ F to 2,000˚ F, measured with thermal imaging cameras.
Typical fuel used for one evolution	Start with 3 wood pallets with a heavy hay load for PSFA burns and 5 wood pallets with a heavy hay load for non-PSFA burns, and re-load pallets as fire dies down.
Damage to the structure that has either changed training routine or raised concerns about safety	Room 201 has been temporarily taken out of service due to concerns about possible water penetration into the concrete floor slab. Try to rotate room use to minimize wall damage.
Past repairs and renovations	Have replaced some masonry walls several times in the past. Removed the door into the closet in Room 203 and blocked up the door opening.
Maintenance history	HTL installed inspection tiles at ceilings in several burn rooms in 2021. Have plugged thermal lining tile bolt holes and re-welded a few door hinges. Add refractory cement to interior wall surfaces prior to burns.
Planned changes for the future	Need to meet the new NFPA 1402 requirements and want to improve the layout for fire dynamics.
Other information	Typically block the ventilation opening within the chimney with a plate to cut off flow to the rooftop exhaust fan, which doesn't work. The temperature monitoring system (TMS) doesn't work.

3. Structural Observations and Recommended Actions

3.1 Structural Issues - Visual Survey

The following structural defects were observed. Recommended actions for repairing the defects are provided in the following tables.

Item	Observations and Recommended Actions
Elevated Floor and Roof Slabs (Items 6, 14, 16, 19, and 22 in Appendix 1)	Observations: There are several hairline/minor *cracks* at the vertical edges of the second floor and roof slabs, including within the interior stairwell, in the top surface of the second floor slab, where the fire brick was removed from the floor in Room 203 during the 2021 survey, and at the bottom surface of elevated second floor and roof slabs, at locations where inspection tiles were removed for observation during the 2021 survey in Rooms 100, 101, 201, and 203. The cracks are likely due to shrinkage after initial curing, temperature related movements, and weathering. There are severe *cracks, spalls*, and *delaminations* in the vertical slab edges within the ventilation chopout opening at the ceiling of Room 201, which is not protected with thermal linings. This damage is noticeably worse than during our 2021 evaluation. There are minor *cracks*, shallow *spalls*, and *delaminations* in the top surface of the second floor slab, where the fire brick was removed from the floor in Room 201. This damage was likely caused by heat passing through the fire brick to the top of the slab during repetitive live fire training evolutions. There is a moderate *crack* in the vertical face of the second floor slab at the interior corner of the interior stairwell. This crack was visible in the 2021 evaluation and has worsened since. It is now wider and there appears to be a slight vertical offset along the crack, with the slab to the left of the crack slightly lower than the slab to the right. This requires additional investigation, per recommended actions below. There are minor (shallow) *spalls* at the top surface of the roof slab, adjacent to the roof ventilation and chopout openings. This damage was likely caused by excessive heat passing through the openings to the top of the slab.

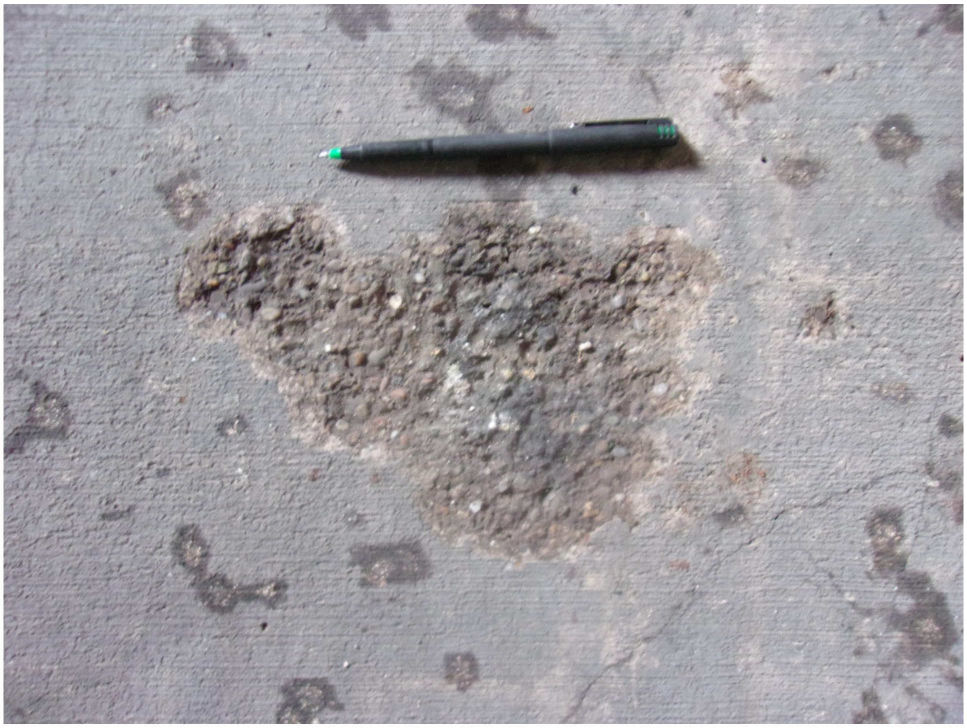
Item	Observations and Recommended Actions
Elevated Floor and Roof Slabs (cont.)	Recommended Actions: After immediately removing the steel frame at the chopout opening at the ceiling of Room 201, saw cut around the perimeter of the damaged concrete and remove all delaminated (loose) concrete, including around exposed reinforcing bars. Remove corrosion from exposed reinforcing and apply an anti-corrosion bonding agent to the exposed reinforcing and the existing concrete surfaces. Patch the concrete with a high strength (bond and compressive strengths), non-shrink, cementitious repair material, such as SikaTop 123 Plus or SikaTop 111 Plus, or other equivalent repair materials from other manufacturers that is suitable for exterior vertical / overhead applications, to restore the slab to its original conditions. Provide proper cover over slab reinforcing. Follow the manufacturer's instructions for preparing slab surfaces and mixing/ placing/curing the patch material. After patching and curing the concrete, provide thermal linings within the opening to protect the concrete in the future. Remove remaining fire brick at the floor in Room 201 to expose the remainder of the top of the slab. Rout and seal all cracks wider than 1/32" in the top surface of the second floor slab in Room 201. Seal cracks with a flexible, exterior-quality sealant such as Sikaflex 1a. Another option is to pressure inject the cracks with an epoxy adhesive such as Sikadur 52. After repairing cracks, apply a coat of MasterProtect H 1000, by BASF, or an equivalent concrete sealer by Euclid Chemical Company or Sika USA, to the entire top surface of the floor slab in Room 201. Prepare the concrete surface and apply the sealer in accordance with the requirements of the manufacturer. Reinstall the fire brick on the floor after applying and properly curing the concrete sealer. At the crack in the second floor slab, near the corner of the interior stairwell, more investigation is required. Remove the fire brick from the top of the second floor slab in the Closet adjacent to Room 203 for a distance of at least 3'-0" from Column C3 in both directions, or farther if required to reveal the full length of the slab crack that is visible at the slab edge in the stairwell. Remove the 4" CMU wrap around all four sides of Column C3 below the second floor slab and look for

	cracks in the faces of Column C3. Once the fire brick is removed from the second floor slab and masonry wrap removed from Column C3, notify EL&M so that EL&M can send an engineer to evaluate the conditions. The minor cracks in the slabs, the minor delaminations and spalls at the top of the second floor slab in Room 201, and the minor spalls at the top of the roof slab do not require repair at this time. To reduce damage to the structural slabs, place fuels in burn racks that keep burning materials, embers, and coals off the fire brick at the floors, to reduce how much heat can soak through the fire brick into the structural slab below. See sample burn rack detail in Appendix 4.

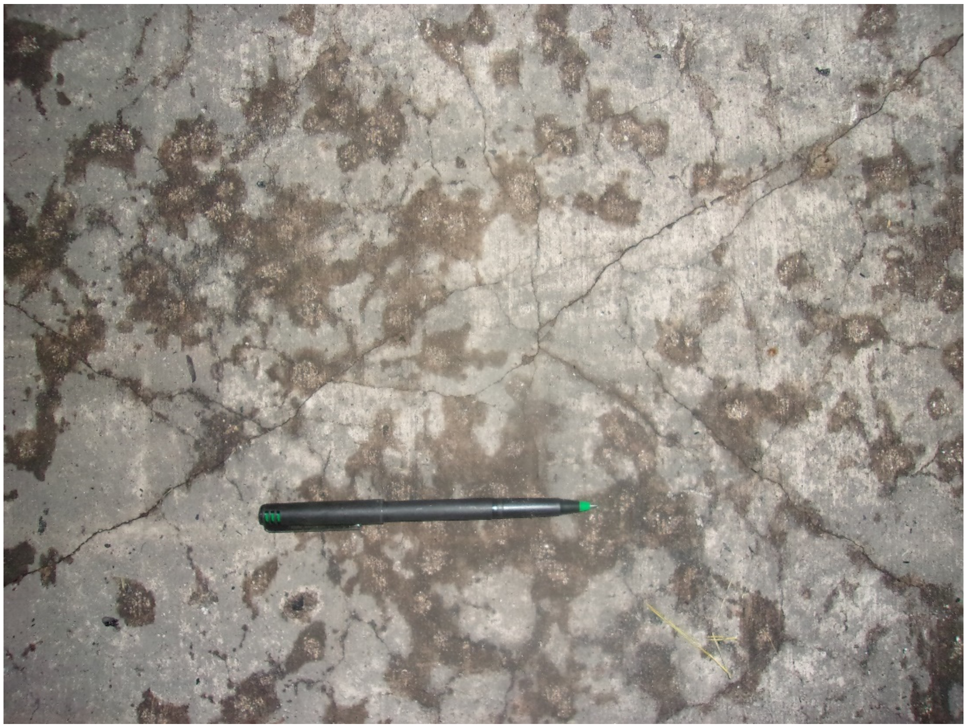
See photos of these conditions on the following pages.

Severely spalled concrete with exposed reinforcing within chopout opening at ceiling in Room 201 (above and below)

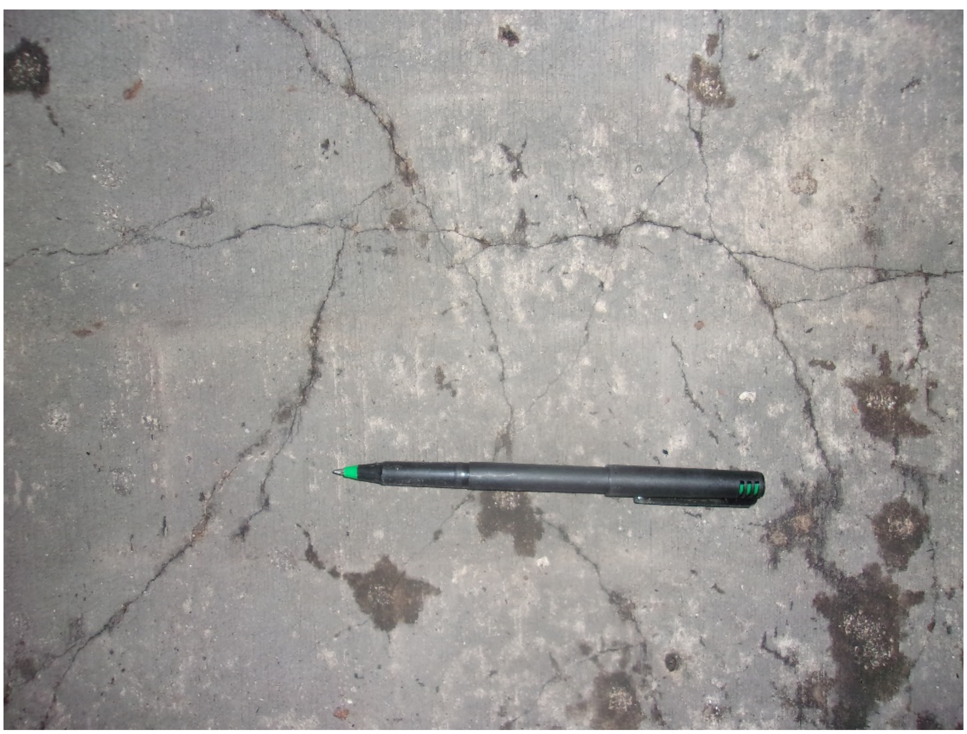
Cracked, delaminated and spalled concrete within chopout opening at ceiling in Room 201 (above and below)



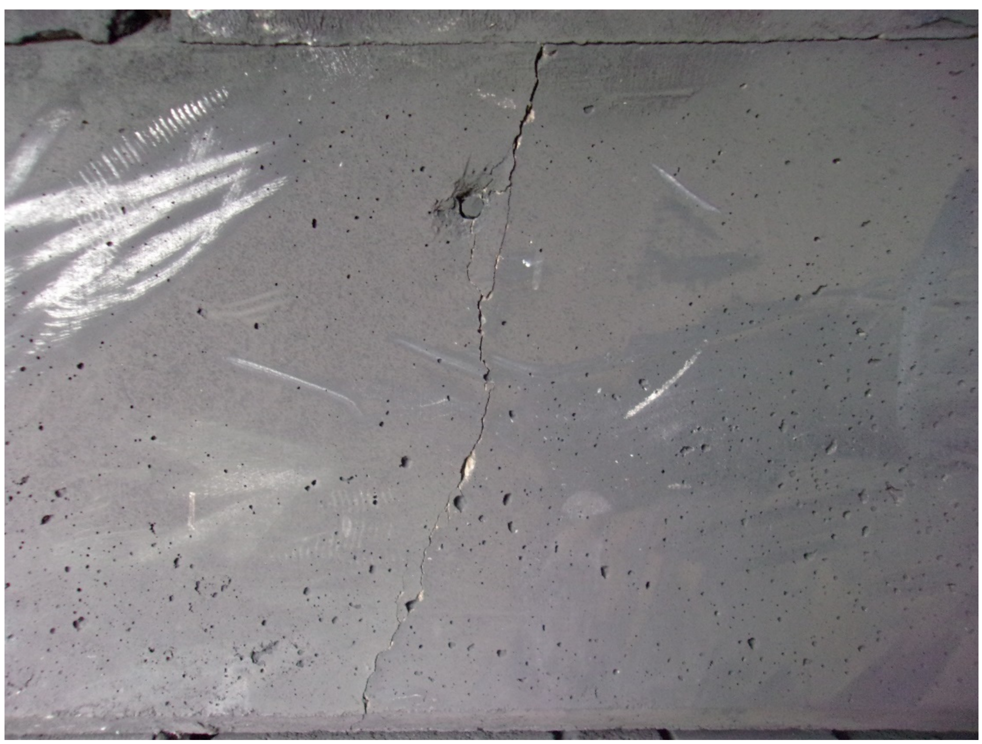
Minor (shallow) spalls in top of slab where fire brick was removed at floor of Room 201 (above and below)



Typical cracks and chips in top of slab where fire brick was removed at floor of Room 201 (above and below)



Moderate crack at vertical edge of second floor slab at interior stairwell



Same crack at vertical edge of second floor slab at interior stairwell during 2021 evaluation

Typical minor cracks in vertical exterior edges of elevated slabs

Minor spalls at top of roof slab adjacent to chopout opening

Minor spalls at top of roof slab adjacent to ventilation opening

Item	Observations and Recommended Actions
Interior and Exterior Concrete Stairs (Items 12 and 26 in Appendix 1)	Observations: There are minor chips in many of the stair nosings at the interior and exterior concrete stairs. There is grout missing from the cores at the base of several of the embedded guardrail posts at the exterior concrete stairs. There are cracks at several of the embedded guardrail posts at exterior stair treads, however none of the posts are loose, but the cracks could worsen and cause the guardrails to become loose and unstable in the future. Recommended Actions: No repair required at this time for the chipped stair nosings. Fill the cores at the base of the embedded guardrail posts at the exterior concrete stairs with a non-shrink grout to prevent standing water in the cores, which could freeze and damage the treads further and possibly cause the guardrails to become loose and unstable. Epoxy inject the cracks in the steps adjacent to the guardrail posts. See the guardrails section of this report for additional information.

Typical minor chips in concrete stair nosings at interior and exterior concrete stairs and typical grout missing from core at base of embedded guardrail posts

Typical cracks at embedded guardrail posts at exterior concrete stairs (above and below)

3.2 Structural Issues - Materials Testing

Four concrete cores were removed by ECS from the concrete floor slab in Room 201 (core diameters of approximately 4″) on June 16, 2023. See ECS's report in Appendix 3 for approximate core locations.

Room 201 was selected for the coring because the room appeared to have been exposed to the hottest and/or most frequent fires and due to concerns about possible water penetration into the concrete slab that were expressed by the Owner prior to the survey. Room 201 appeared to be the most likely location for concrete degradation. The floor in Room 201 was first sounded by Mr. Jones during the field survey on March 28, 2023, and only small areas of minor *delaminations* were detected during the sounding. At each location, the core was drilled to an approximate depth between 5″ and 8″ from the top of the slab, not completely through the slab, in order to not damage the slab reinforcing or the thermal lining system at the ceiling below.

There were two primary purposes for removing the cores. First, coring the slab uncovers hidden *delaminations* that may not be visible at the surface or audible when sounding the surface (and verifies *delaminations* found during sounding). Although coring can uncover hidden delaminations only at the core locations, spot-checking four locations helps validate the visual findings and sounding results.

Second, the cores were used for *compression tests*. These tests indicate the remaining concrete strength at the isolated core locations. Since exposure to repetitive fire can cause concrete to lose a portion of its strength, determining the current concrete strength makes analysis of capacity of the structural elements more accurate.

Test Results:

Since the coring was completed at a later date than the field survey, Mr. Jones was not able to observe the cores and the holes in the slabs after the cores were removed by ECS. Based on the photos included in ECS's report, it does not appear that any signs of delaminations were visible in the cores or core holes.

After allowing the cores to dry cure in the lab, ECS Ltd. performed *compression tests* on the four cores. The test results concluded that the concrete compressive strengths at the four core locations are 4,430 pounds per square inch (psi), 5,270 psi, 5,210 psi, and 8,020 psi. From these results, we believe it is reasonable to assume that all of the concrete slabs in the building have a minimum compressive strength of 4,000 psi, which is an appropriate value for burn building slabs.

The tests quantify compressive strength and determine if the slabs are delaminated only at the test locations. The test results were used as a tool to help make conclusions about the structural conditions in the untested portions of the building, based on visual observations of exposed conditions. See Appendix 3 for a copy of ECS's testing report.

4. Non-Structural Observations and Recommended Actions

The following non-structural defects were observed. Recommended actions for repairing the defects are provided in the following tables.

Item	Observations and Recommended Actions
Masonry Walls (Items 4, 5, 7, 8, 13, 20, 21, and 29 in Appendix 1)	<u>Observations:</u> There are numerous defects in the interior and exterior *CMU* (non-structural) walls, including minor, moderate, and severe *cracks*, missing mortar at joints, moderate to severe *cement matrix deterioration*, loose *CMU* at tops and ends of walls, bowing and displacement of blocks and *lintels*, and minor and moderate to severe cracks in *lintels* at door and window openings. These defects appear to have been caused by heat, expansion/contraction, and thermal shock due to repetitive live fire training, likely with some large/hot training fires, as well as walls that were not built with expansion detailing the last time they were replaced. <u>Recommended Actions:</u> Given the current condition of the CMU walls and the need to meet the current NFPA 1402 requirement of two doors or one door plus one window to a tenable location in burn rooms, we recommend that a majority of the masonry walls be removed and re-built in their entirety using proper detailing for reinforcing and expansion. At the Owner's option, and if structural calculations (not included in the scope of this evaluation) confirm that the structure can support additional weight, thermal linings could be added to non-bearing masonry walls at several locations, if it is desired to eliminate future damage and maintenance to the walls at those locations. We typically do not recommend lining non-structural CMU walls but, if the intensity of the training fires is not going to be diminished in the future to reduce risks to personnel and reduce wear-and-tear of the building, then adding linings at some burn corners could extend the life of the masonry at the highest-use burn areas. Note that adding thermal linings to the walls could increase the heat levels in the burn rooms even if the same fuel packages from the past are used in the future. Follow NFPA 1402 and 1403 for maintaining safe temperatures for personnel and the structure.

	For any walls that are not removed and re-built, repoint all cracks that are wider than 3/16″ or where mortar is missing from joints. Cracks narrower than 3/16″ do not require repair at this time. Continue to monitor the condition of existing cracks and the potential addition of new cracks in the future.

Typical minor crack at exterior surface of exterior walls around interior stairwell

Moderate cracks at exterior surface of first floor wall at B Elevation

Blocked up door opening at first floor wall at C Elevation

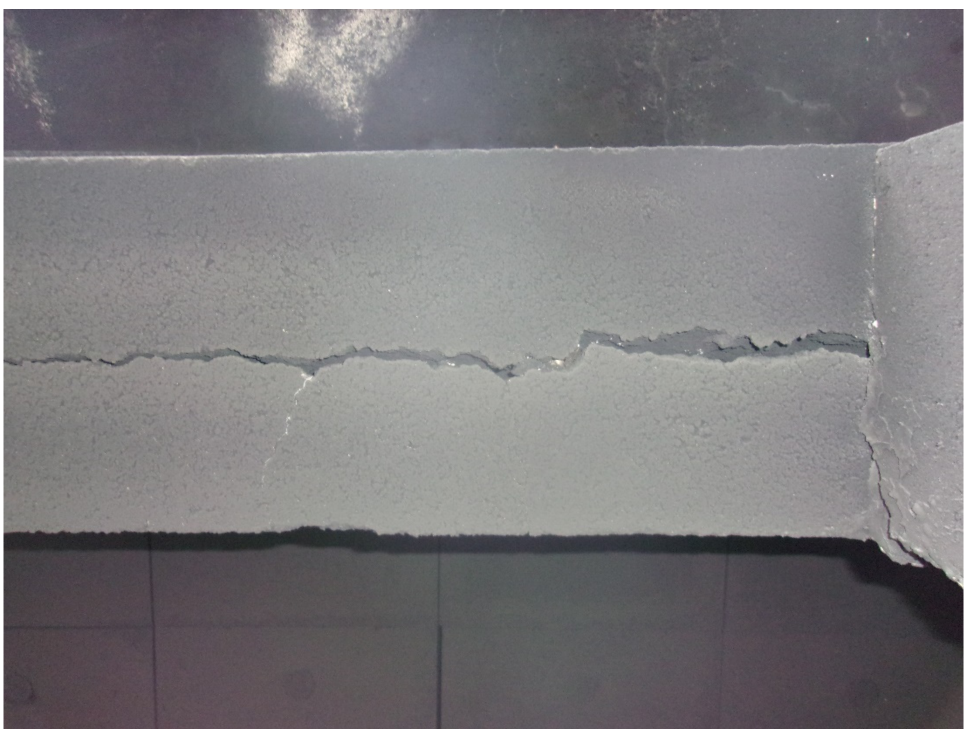
Moderate to severe cracks at exterior surface of second floor wall at C Elevation

Moderate to severe cracks at exterior surface of second floor wall at C Elevation at CD corner (above and below)

Severe crack at jamb of first floor window opening at D Elevation

General deterioration at exterior surface of first floor wall at D Elevation

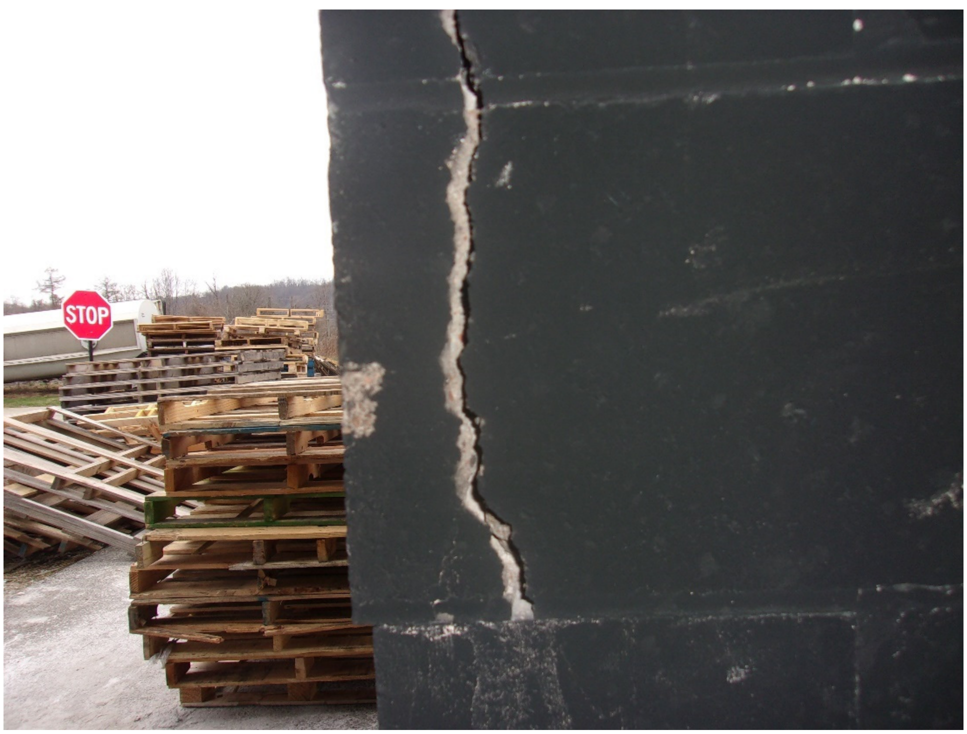
General deterioration at exterior surface of first floor wall at A Elevation



Severe crack in bottom face of lintel at double door opening in Room 100

Severe cracks at south jamb of double door opening in Room 100 (exterior face above and interior face below)

**Severe cracks at north jamb of double door opening in Room 100
(exterior face above and interior face below)**



General deterioration at interior surface of south wall in Room 100

General deterioration at east wall in Room 100 (backside of Room 101)

Severely deteriorated west wall in Room 101

Deterioration at interior surface of east exterior wall in Room 101

Deterioration at interior surface of south exterior wall in Room 101

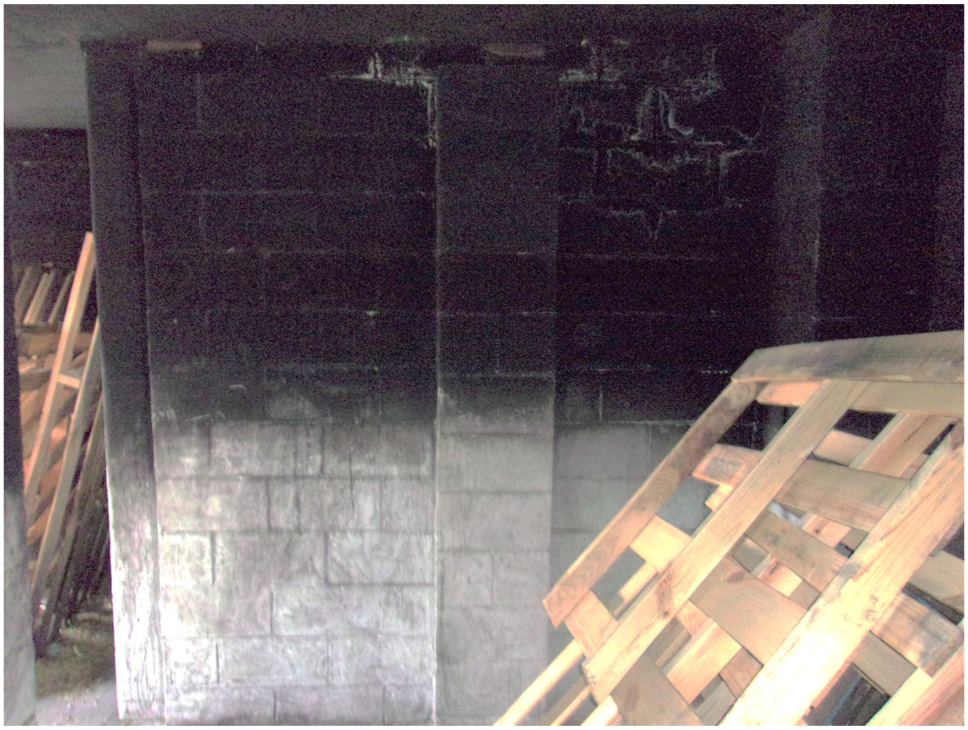
Severely damaged CMU at jamb of window opening in south wall in Room 101

Severely damaged (unreinforced) north wall in Room 101 (front side above and back side below)

Severely damaged (unreinforced) partial height east wall in Room 101 (front side above and back side below)

General deterioration at interior surface of east exterior wall in Room 102

General deterioration at surface of south wall in Room 102 (backside of Room 100)



Unreinforced CMU walls constructed in front of damaged west wall (above) and unstable north wall at stairwell (below) in Room 102

Loose CMU wrap at column at SE corner of interior stairwell (above and below)

Room 200 walls prepped with refractory cement prior to upcoming burns

Severely damaged north wall in Room 201

Severe damage at west (above) and east (below) ends of north wall in Room 201

Severely damaged east wall in Room 201 (above and below)

Severely damaged south wall in Room 201

Spalled CMU at east end of south wall in Room 201

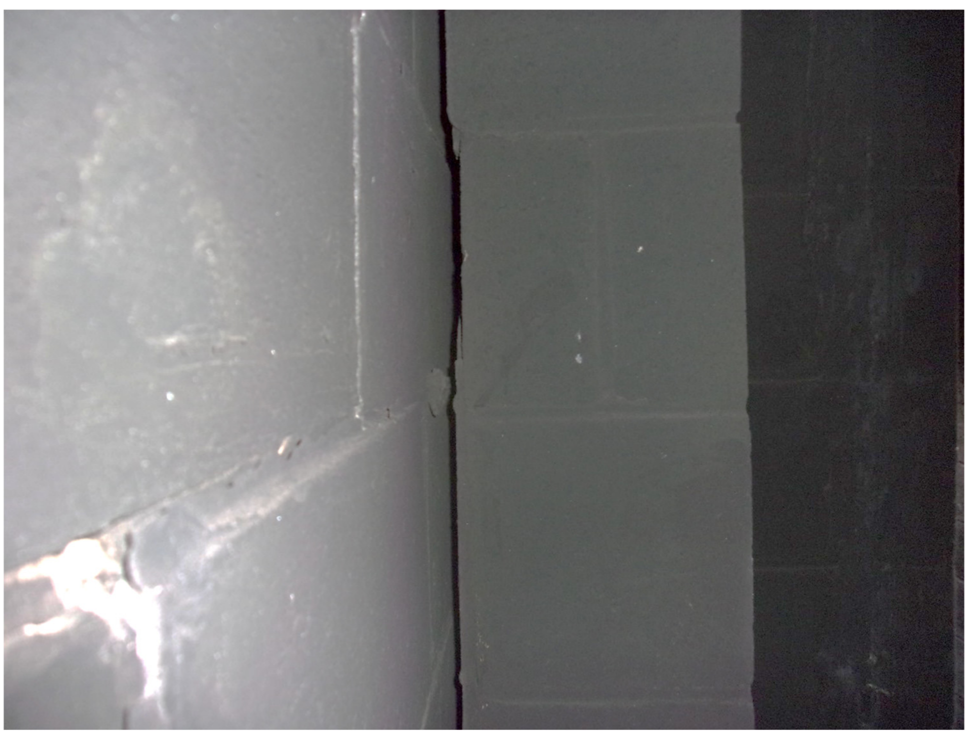
Bowing CMU at east end of south wall in Room 201

Displacement at east end of lintel at window opening in south wall in Room 201

Spalled CMU at east jamb of window opening in south wall in Room 201

Severely damaged CMU at east end of south wall in Hallway 202

Severe cracks and bowing at west end of north wall in Hallway 202



Loose CMU (not tied back to adjacent walls) at chase at north side of Hallway 202

Room 203 walls prepped with refractory cement prior to upcoming burns and new unreinforced wall constructed in front of heavily damaged west wall (below)

Bowing at top west jamb at doorway in south wall in Room 203

Severely damaged lintel with exposed reinforcing at window opening in north wall of Room 203

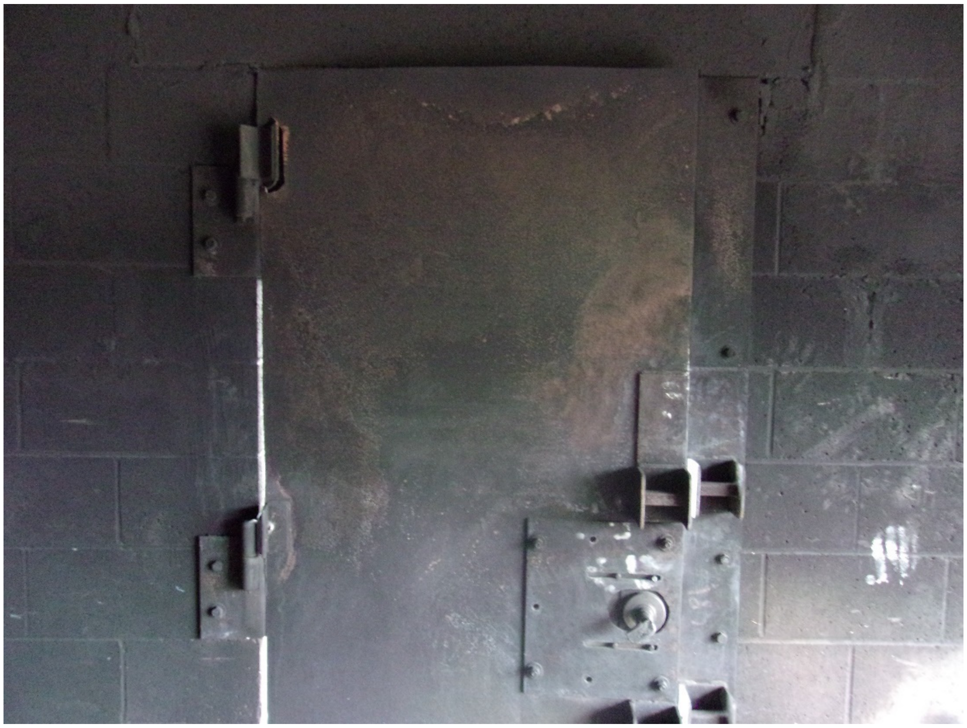
Item	Observations and Recommended Actions
Masonry Parapets at Roof (Item 24 in Appendix 1)	Observations: There are minor *cracks* at several locations at the *CMU* parapets, including at the concrete cap, at the roof. Recommended Actions: The cracks in the parapet are minor and do not require repair at this time.

Typical minor cracks in CMU parapets and concrete caps (above and below)

Item	Observations and Recommended Actions
Doors and Window Shutters (Items 2, 3, 17, 30, and 31 in Appendix 1)	Observations: There is minor to moderate corrosion, sagging, and warping at numerous steel plate doors and shutters. The latch bars are bent at several doors and shutters, so those doors and shutters cannot be latched properly. The top hinge is broken at the exterior door at the south side of Room 100, and the bottom hinge is broken at the interior door between Rooms 100 and 101. There are stiff hinges at several doors, so the doors are left in the open position and cannot be closed. There is a loose hinge (hinge bolts are loose and pulling out) at the east shutter at the window in Room 203.There is a missing hinge and loose anchors at another hinge at the double doors at the exterior of Room 100. The latch bar sticks in the latch catch at the exterior door between the exterior steel stairs and Hallway 202, and the latch is difficult to open. Recommended Actions: Immediately repair or replace the loose bolts/hinge at the shutter in Room 203 so that the shutter does not fall to the ground. Another option is to remove the shutters. Remove and replace all the doors and windows and associated hardware, with the possible exception of the door between the interior and exterior concrete stairs (if the exterior walls around the stairwell are not replaced).

Corroded, warped and sagging double doors at exterior of Room 100

No bottom hinge at north door leaf (above) and loose anchors at bottom hinge at south door leaf (below) at double doors at exterior of Room 100



Corroded and warped exterior door at Room 100 (above) - top hinge broken (below) and door cannot be latched.

Corroded, warped, and sagging doors between Rooms 100 and 101

Bent latch bar and no means of latching interior door between Rooms 100 and 101

Broken bottom hinge at door between Rooms 100 and 101

Corroded and binding top hinge at door between Rooms 100 and 101

Corroded sliding doors at closet in Room 201 are inoperable.

Corroded, warped and sagging shutters at Room 203 cannot be latched.

Loose bottom hinge at east shutter leaf at window in Room 203

Warped shutters at Room 102 cannot be latched.

Warped and corroded shutters at Room 101 (above and below) with bent latch bar cannot be latched.

Corroded, warped and sagging shutters at Room 200 (above) and at Room 201 (below) cannot be latched.

Item	Observations and Recommended Actions
Guardrails at Roof, Exterior Steel Stairs and Exterior Concrete Stairs (Items 25 and 27 in Appendix 1)	Observations: There is minor corrosion on guardrails at several locations at the roof and at the exterior steel and concrete stairs. There are several missing bolts at the guardrails at the north side of the second floor deck at the exterior steel stairs. As previously indicated at the embedded guardrail posts at the exterior concrete stairs, there is grout missing from the cores at the base of the embedded guardrail posts at the roof. There are galvanizing ventilation holes in guardrails at the roof and at the exterior steel and concrete stairs. It is possible for water to enter the guardrails through the galvanizing vent holes, filling up the posts and corroding the posts from the inside or freezing, expanding and cracking or spalling the surrounding concrete. This condition, although not severe, has occurred at several other burn buildings. Recommended Actions: Provide galvanized bolts where they are missing at the guardrails at the north side of the exterior steel stairs. Fill the cores at the base of the embedded guardrail posts at the roof with a non-shrink grout to prevent standing water in the cores, which could freeze and damage the surrounding concrete and possibly cause the guardrails to become loose and unstable. Plug any galvanizing vent holes in the guardrails to help prevent moisture and/or insects from getting inside the railing pipes. Holes can be plugged in several ways. One way is to hammer in a zinc galvanizing vent hole plug by Bruce Reichelt Enterprises (503-879-9085), grind it smooth, and touch up with galvanizing repair paint. A second option is to plug the holes with a black nylon bumper panel retainer by Au-ve-co Products (Part number 10831) and supplied by Fastenal (Fastenal part number 0162595 at www.fastenal.com). Provide a different size plug if galvanizing vent holes are a different size than the specified plug. A third way, although more time consuming and costly, is to plug weld the vent holes, grind the welds smooth, and touch up with galvanizing repair paint. If desired, remove corrosion from guardrails and touch up with two coats of galvanizing repair paint.

See photos of these conditions on the following pages.

Typical minor corrosion on hinges at guardrail gates at roof

Typical missing grout in core at base of embedded guardrail posts at roof

Typical galvanizing vent holes in guardrails at roof

Missing bolts at guardrails at north side of exterior steel stairs

Item	Observations and Recommended Actions
Handrails at Interior Stairwell (Item 15 in Appendix 1)	Observations: There are loose anchors at several handrail brackets in the interior stairwell. Recommended Actions: Tighten or replace loose anchors at handrail brackets at the interior stairwell.

Loose anchor at handrail bracket at interior stairwell

Item	Observations and Recommended Actions
Miscellaneous Steel Items (Items 18 and 23 in Appendix 1)	Observations: There is moderate corrosion and warping on steel items at the chopout opening at the ceiling of Room 201, including the pulldown frame at the bottom of the opening and the joist hangers within the opening. Anchors are failing and pulling out of the concrete at the pulldown frame, which is sagging and holding chunks of concrete that have spalled at the opening. There is moderate corrosion on the steel cover plates at the ventilation opening at the roof (ceiling of the Room 203 closet that has been blocked in from below). Recommended Actions: Immediately remove the pulldown frame and the joist hangers at the chopout opening at the ceiling of Room 201. Make concrete repairs as described on Page 8 of this report. If desired, remove corrosion from the cover plates at the ventilation opening at the ceiling of the Room 203 closet and apply two coats of exterior quality paint. Another option is to remove the existing cover plates and replace with a new refractory concrete curb at the roof slab around the opening and new steel cover plates over the opening.

Corroded cover plates and no concrete curb at Room 203 ventilation opening

Corroded, warped and sagging pulldown frame and corroded joist hangers at chopout opening at ceiling of Room 201 (above and below)

Anchors pulling out at pulldown frame, which is holding spalled concrete, at chopout opening at ceiling in Room 201 (above and below)

<table>
<tr><th>Item</th><th>Observations and Recommended Actions</th></tr>
<tr><td>Thermal Lining System on Ceilings and Fire Brick on Floors (Items 1, 9, 10, 11, and 28 in Appendix 1)</td><td> <u>Observations:</u> There are numerous exposed bolt heads in the HTL System 203 tiles at ceilings and walls, where the fire clay plug covering the bolt has fallen out. There is efflorescence on the surface of lining tiles at the southeast corner of Room 101. There is no thermal lining above the tops of interior walls. This is not easy to observe at the full-height walls, however it is evident when observing the partial-height wall in Room 101, which was originally a full-height wall when the burn building was constructed. The insulation boards and refractory cement that has been used to cover the concrete ceiling above the partial-height wall are cracked and delaminated. The refractory packing at the end of the thermal lining system on the face of the second floor slab is damaged at the north exterior wall. In Rooms 100 and 101, there are several missing brick pavers on the floor at the south side of the rooms. There is also a small area of refractory cement at the floor, at the south end of the partial height wall, that is cracked and delaminated. <u>Recommended Actions:</u> Where thermal lining system bolt heads are exposed, tighten the bolt, if necessary, to a snug tight condition. Clean the holes and patch the fire clay plugs over the bolt heads in accordance with the manufacturer's recommendations. When the interior walls are removed, also remove all bracing angles at the tops of the walls. Remove the insulation boards and refractory cement from the ceiling above the partial-height wall in Room 101. Provide thermal linings at the ceiling at these locations. Then construct the new CMU walls and provide stainless steel bracing assemblies at the tops of the interior walls, to brace the tops of the walls. Where refractory packing at the end of thermal lining tiles is damaged or missing, patch the packing in accordance with the manufacturer's recommendations. Replace the missing fire bricks on the floors in Rooms 100 and 101. Remove the damaged refractory cement infill at the south end of the partial height wall in Room 101 and provide new fire brick at the floor instead. </td></tr>
</table>

See photos of these conditions on the following pages.

Clay plugs falling out at thermal lining system tiles

Efflorescence on thermal lining system tiles at southeast corner of Room 101

Insulation boards and refractory cement at ceiling above interior partial-height walls in Room 101

Damaged refractory packing at end of thermal lining system on face of concrete slab at north side of interior stairwell

Missing fire brick at floor in Room 101

Cracked and delaminated refractory cement infill at floor at south end of interior partial-height wall in Room 101

Note that the recommended actions for structural and non-structural defects are intended to restore visibly deteriorated areas to good condition in order to prolong the life of the burn building. This does not guarantee the burn building will remain in good condition for any particular period of time. Repetitive live fire training will continue to deteriorate the burn building after the following recommendations are implemented. Nevertheless, repairs and maintenance for structural elements, non-structural features, and thermal linings can be expected in the future and should be included in budget planning.

5. Summary and Conclusions

In general, the burn building is in good structural condition but requires many repairs and a significant amount of maintenance. At this time, the most significant needs for the structure are:

- Immediately remove the steel frame at the chopout opening at the ceiling of Room 201, remove all delaminated concrete, and patch the concrete as indicated in the table on Page 8 of this report. After patching and curing the concrete, provide thermal linings within the opening to protect the concrete in the future.
- Remove remaining fire brick at the floor in Room 201 to expose the remainder of the top of the slab. Rout and seal all cracks wider than 1/32″ in the top surface of the slab as indicated in the table on Page 8 of this report.
- At the crack in the second floor slab, near the corner of the interior stairwell, more investigation is required. Remove the fire brick from the top of the second floor slab in the Closet adjacent to Room 203 for a distance of at least 3′-0″ from Column C3 in both directions, or farther if required to reveal the full length of the slab crack that is visible at the slab edge in the stairwell. Remove the 4″ CMU wrap around all four sides of Column C3 below the second floor slab and look for cracks in the faces of Column C3. Once the fire brick is removed from the second floor slab and masonry wrap removed from Column C3, notify EL&M so that EL&M can send an engineer to evaluate the conditions.
- Fill the cores at the base of the embedded guardrail posts at the exterior concrete stairs with a non-shrink grout to prevent standing water in the cores, which could freeze and damage the treads further and possibly cause the guardrails to become loose and unstable. Epoxy inject the cracks in the steps adjacent to the guardrail posts.
- Given the current condition of the CMU walls and the need to meet the current NFPA 1402 requirement of two doors or one door plus one window to a tenable location in burn rooms, we recommend that a majority of the masonry walls be removed and re-built in their entirety using proper detailing for reinforcing and expansion.
- For any walls that are not removed and re-built, repoint all cracks that are wider than 3/16″ or where mortar is missing from joints. Cracks narrower than 3/16″ do

not require repair at this time. Continue to monitor the condition of existing cracks and the potential addition of new cracks in the future.

- Immediately repair or replace the loose bolts/hinge at the shutter in Room 203 so that the shutter does not fall to the ground. Another option is to remove the shutters.
- Remove and replace all the doors and windows and associated hardware, with the possible exception of the door between the interior and exterior concrete stairs (if the exterior walls around the stairwell are not replaced).
- Provide galvanized bolts where they are missing at the guardrails at the north side of the exterior steel stairs.
- Fill the cores at the base of the embedded guardrail posts at the roof with a non-shrink grout to prevent standing water in the cores, which could freeze and damage the surrounding concrete and possibly cause the guardrails to become loose and unstable.
- Plug galvanizing vent holes in all guardrails as indicated in the Guardrails table of this report.
- Tighten or replace loose anchors at handrail brackets at the interior stairwell.
- Immediately remove the pulldown frame and the joist hangers at the chopout opening at the ceiling of Room 201.
- Where thermal lining system bolt heads are exposed, tighten the bolt, if necessary, to a snug tight condition. Clean the holes and patch the fire clay plugs over the bolt heads in accordance with the manufacturer's recommendations.
- When the interior walls are removed, also remove all bracing angles at the tops of the walls. Remove the insulation boards and refractory cement from the ceiling above the partial-height wall in Room 101. Provide thermal linings at the ceiling at these locations. Then construct the new CMU walls and provide stainless steel bracing assemblies at the tops of the interior walls, to brace the tops of the walls.
- Where refractory packing at the end of thermal lining tiles is damaged or missing, patch the packing in accordance with the manufacturer's recommendations.
- Replace the missing fire bricks on the floors in Rooms 100 and 101. Remove the damaged refractory cement infill at the south end of the partial height wall in Room 101 and provide new fire brick at the floor instead.
- We observe that the training in this burn building is much hotter than at the other 200+ burn buildings we have evaluated, based on the reported training temperatures and the observed damage. For a burn building that is only 16 years old, it shows significant damage, including noticeable worsening in just the past two years. It stands out that the fuel loads used when non-state fire academy training is conducted are 66.7% larger than those used when state fire academy training is conducted, especially knowing that the state fire academy strengthened its safety requirements after a fatal training accident at the State Fire Academy in

Lewistown in 2005. Evaluating operational procedures is outside the scope of this evaluation and beyond EL&M's expertise as structural engineers. We recommend having independent, qualified personnel evaluate the fuel loads and training procedures at this burn building and make recommendations to the College for how to modify training so that personnel safety is maximized and damage to the burn building is minimized.

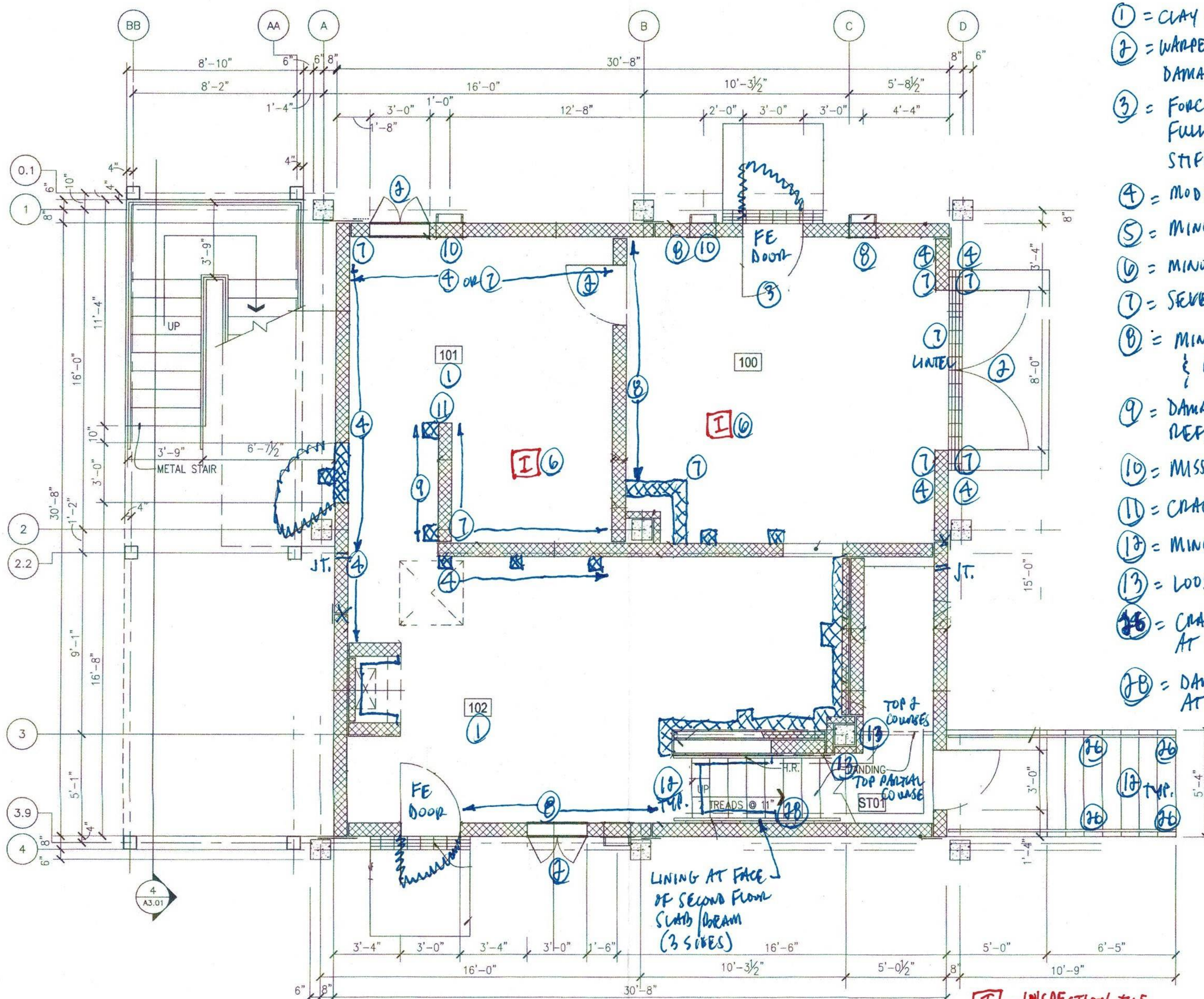
- To reduce damage to the structural slabs, place fuels in burn racks that keep burning materials, embers, and coals off the fire brick at the floors, to reduce how much heat can soak through the fire brick into the structural slab below. See sample burn rack detail in Appendix 4.

In addition, the following optional items could be performed but are not required:

- At the Owner's option, and if structural calculations (not included in the scope of this evaluation) confirm that the structure can support additional weight, thermal linings could be added to non-bearing masonry walls at several locations, if it is desired to eliminate future damage and maintenance to the walls at those locations.
- If desired, remove corrosion from guardrails and touch up with two coats of galvanizing repair paint.
- If desired, remove corrosion from the cover plates at the ventilation opening at the ceiling of the Room 203 closet and apply two coats of exterior quality paint. Another option is to remove the existing cover plates and replace with a new refractory concrete curb at the roof slab around the opening and new steel cover plates over the opening.

Note that this survey provides a general assessment of the condition of the burn building on the date of the survey. Live fire training and continued exposure to the elements will further degrade the burn building and its components. The condition of the burn building will change with the first live fire training evolution conducted after the survey. Therefore, there is no guarantee that the burn building will remain in its current condition for any length of time. If live fire training evolutions are conducted in the burn building before the recommended repairs, renovations and maintenance are performed, or if a year elapses with no live fire training in the burn building before the recommended repairs, renovations and maintenance are performed, then the findings of this report may become invalid and may require additional survey work.

Appendix 1
Approximate Floor Plans and Field Notes



FIRST FLOOR PLAN

1 = CLAY PLUGS MISSING AT LINING TILES

2 = WARPED/SAGGING DOORS/SHUTTERS w/ DAMAGED OR MISSING HARDWARE

3 = FORCIBLE-ENTRY DOOR CANNOT BE FULLY CLOSED. WARPED/CORRODED, STIFF HINGES, TOP HINGE BROKEN

4 = MODERATELY DAMAGED CMU WALL

5 = MINOR/MODERATE WALL CRACKS

6 = MINOR CRACK AT CONC. CEILING/FLOOR

7 = SEVERELY DAMAGED WALL

8 = MINOR/MODERATE WALL DETERIORATION & MINOR CRACKING

9 = DAMAGED INSULATION BOARD & REFRACTORY CEMENT AT CEILING

10 = MISSING FIRE BRICK AT FLOOR

11 = CRACKED REFRACTORY INFILL AT FLOOR

12 = MINOR CHIPS IN CONC. STAIR TREADS

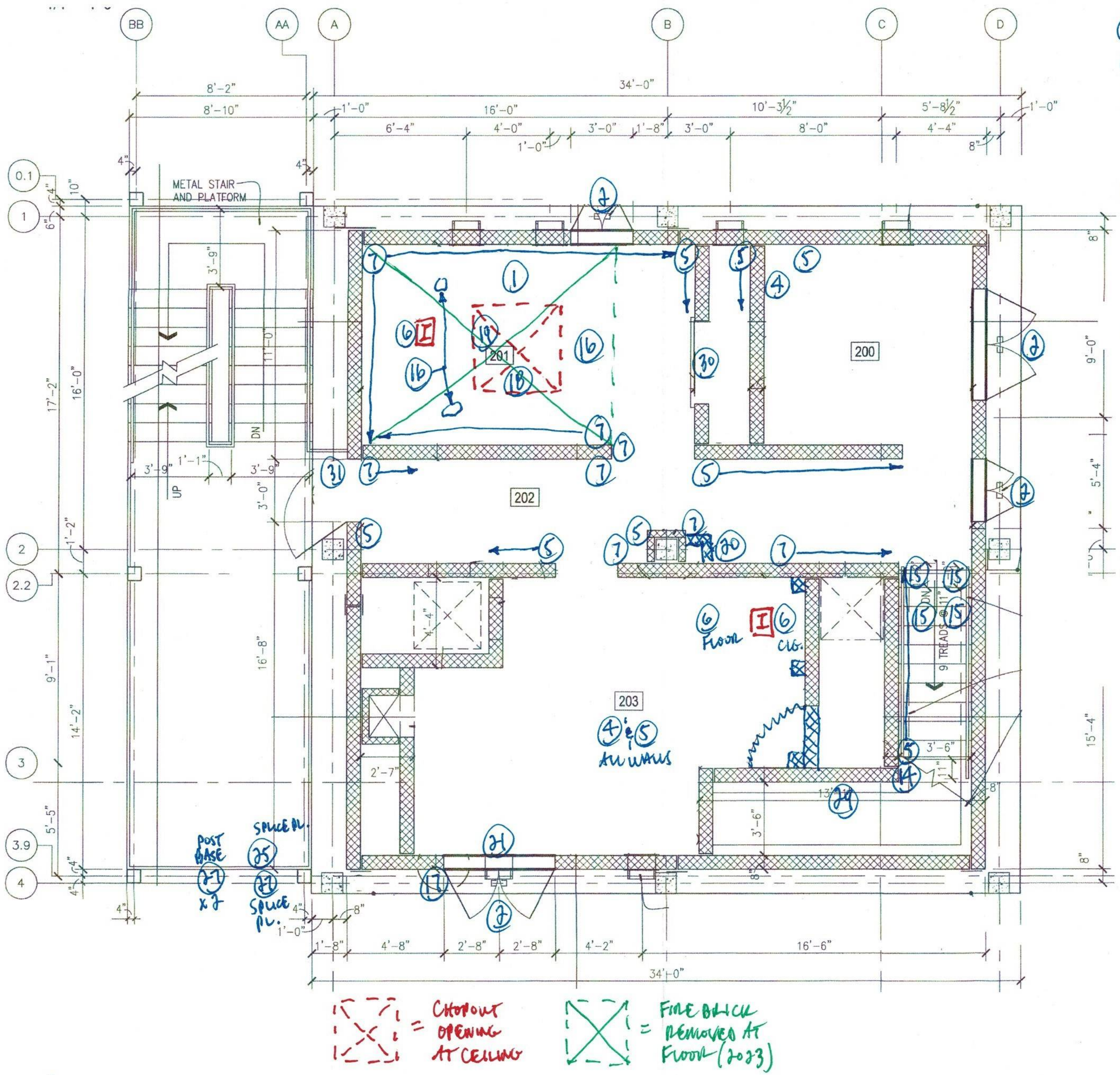
13 = LOOSE CMU AT TOP OF WALL

26 = CRACKS IN CONC. STAIR TREADS AT EMBEDDED GUARDRAIL POST

28 = DAMAGED REFRACTORY PACKING AT END OF THERMAL LINING

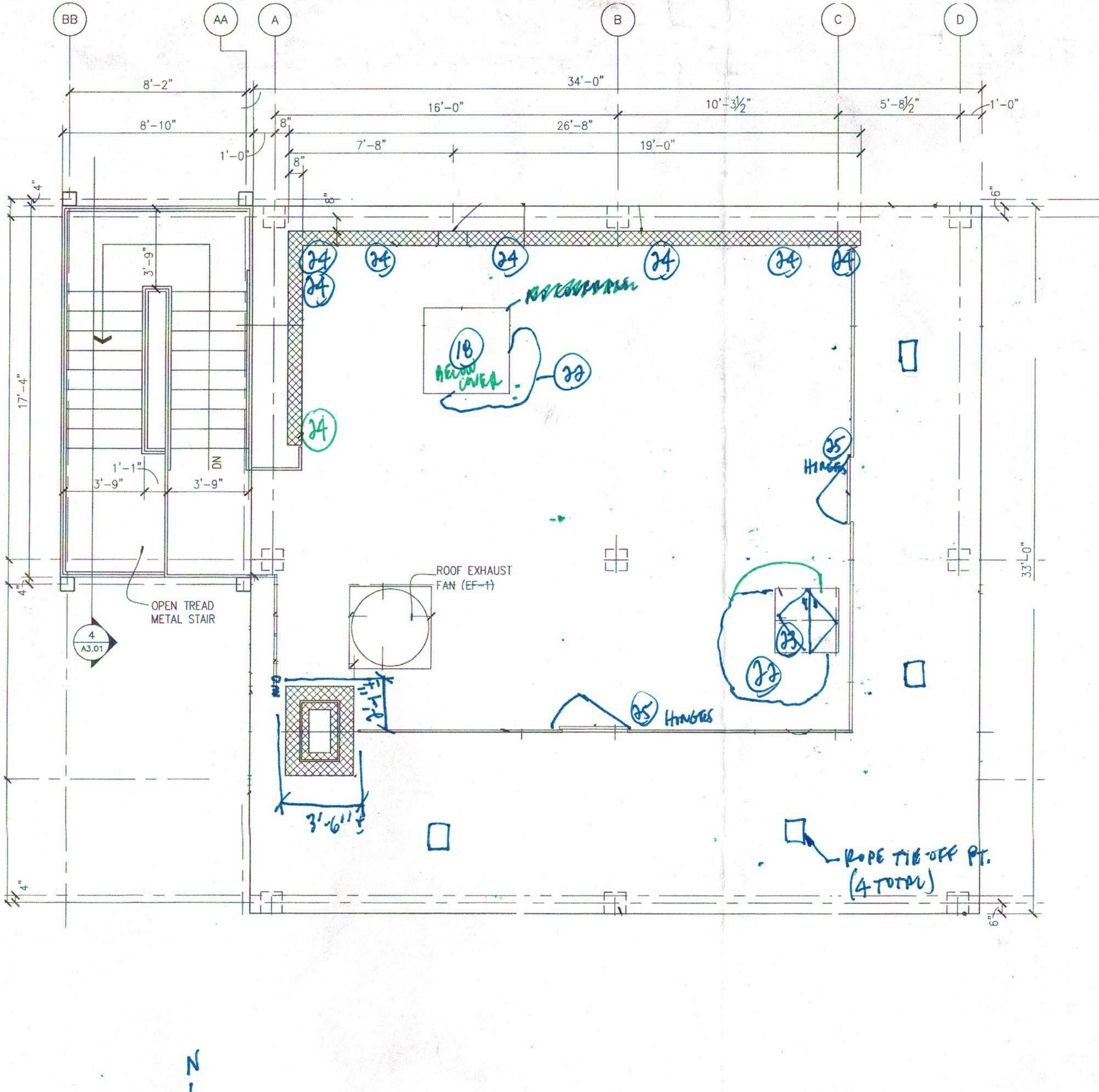
I = INSPECTION TILE AT CEILING

- (14) = Moderate crack in face of conc. slab
- (15) = Loose anchor at handrail bracket
- (16) = Minor cracks/spalls/delaminations in top of conc. slab where fire brick was removed at floor
- (17) = Thru-bolts at shutter hinge loose & pulling out. Bolt slides within bolt hole.
- (18) = Warped/corroded steel frame & anchors pulling out at chopout opng.
- (19) = Severely spalled/delam./cracked concrete within chopout opening (all 4 sides)
- (20) = Loose CMU, not mortared tight & could easily be pulled down
- (21) = Spalled lintel w/exposed reinf.
- (22) = Bolts missing at guardrail
- (29) = Displaced CMU near top of wall
- (30) = Corroded sliding doors/frame - inoperable
- (31) = Door latch sticks in catch - very hard to open if latched

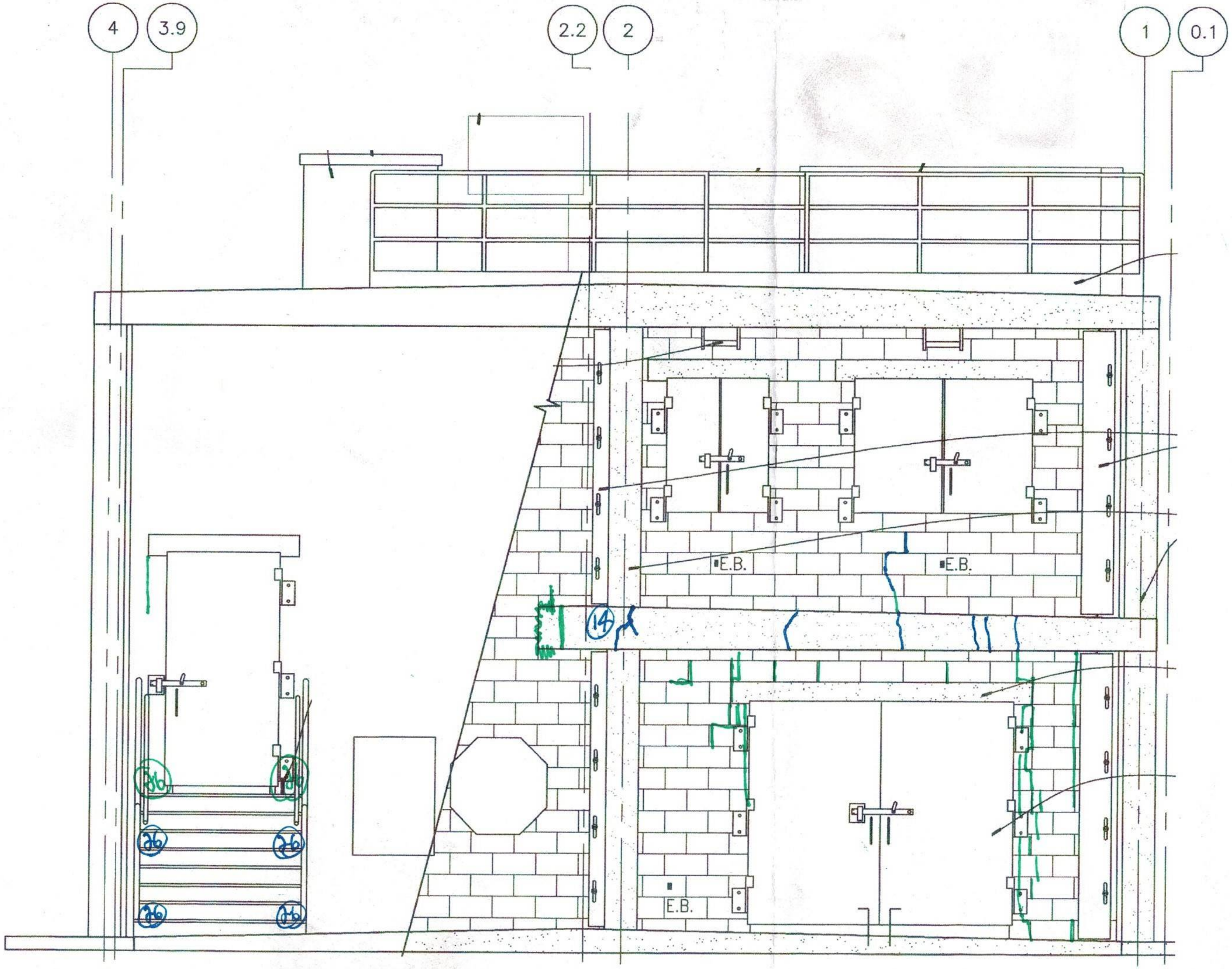


SECOND FLOOR PLAN

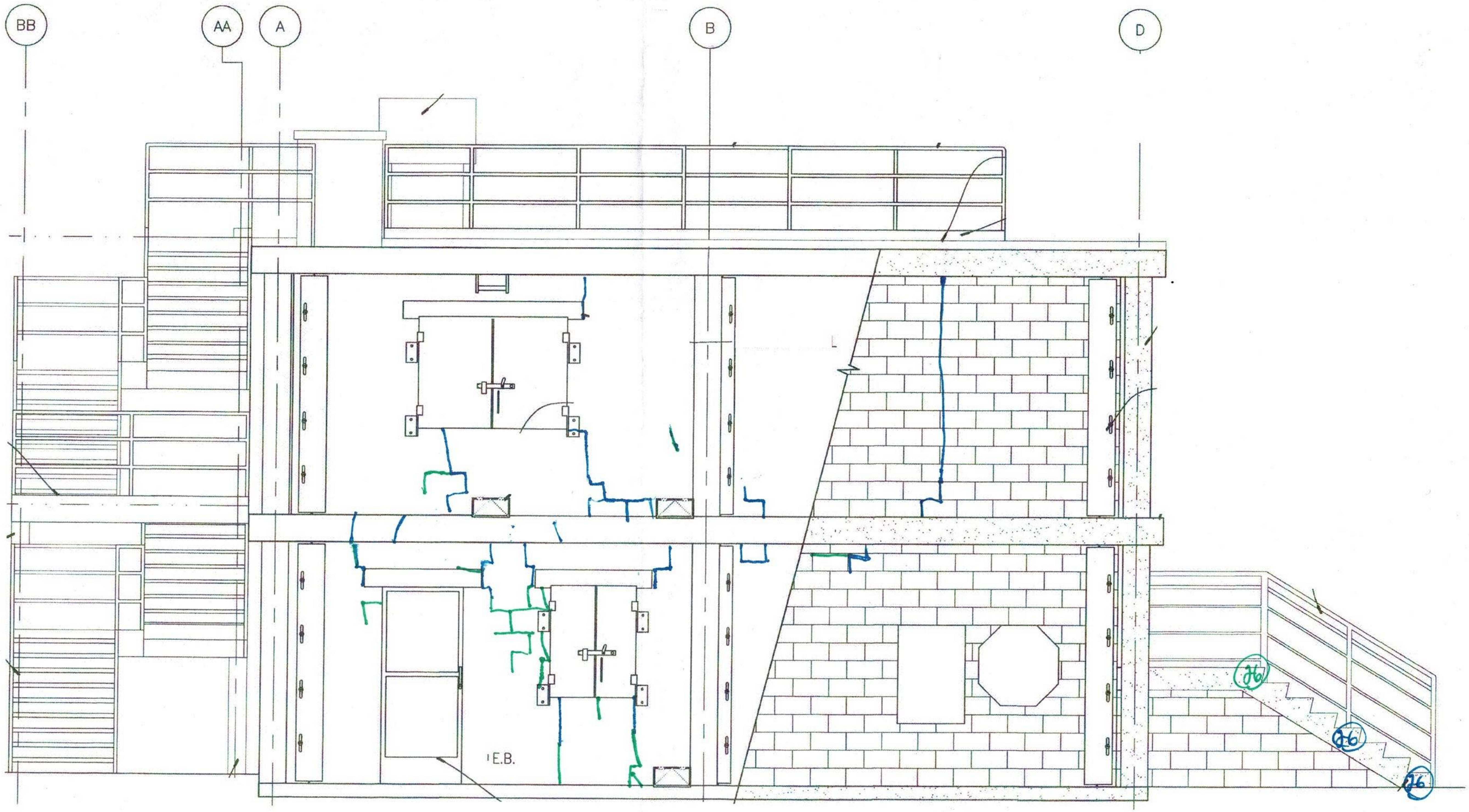
(22) = MINOR (SHALLOW) SPALLS IN TOP OF CONC. ROOF SLAB
(23) = MODERATE CORROSION AT VENT. OPNG. COVER PLS.
(24) = MINOR CRACK IN CMU PARAPET &/OR CONC. CAP
(25) = MINOR CORROSION AT GUARDRAILS



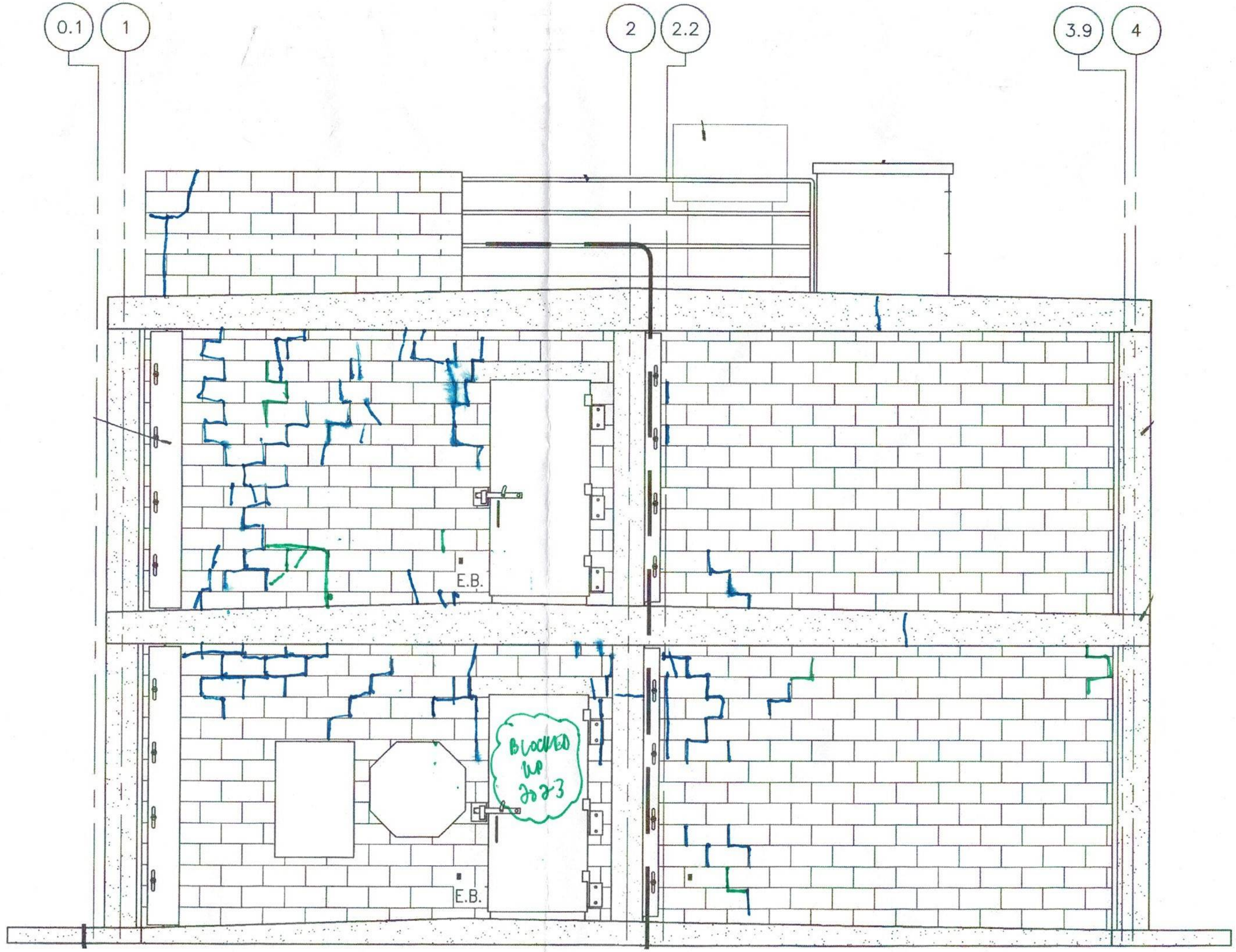
ROOF PLAN



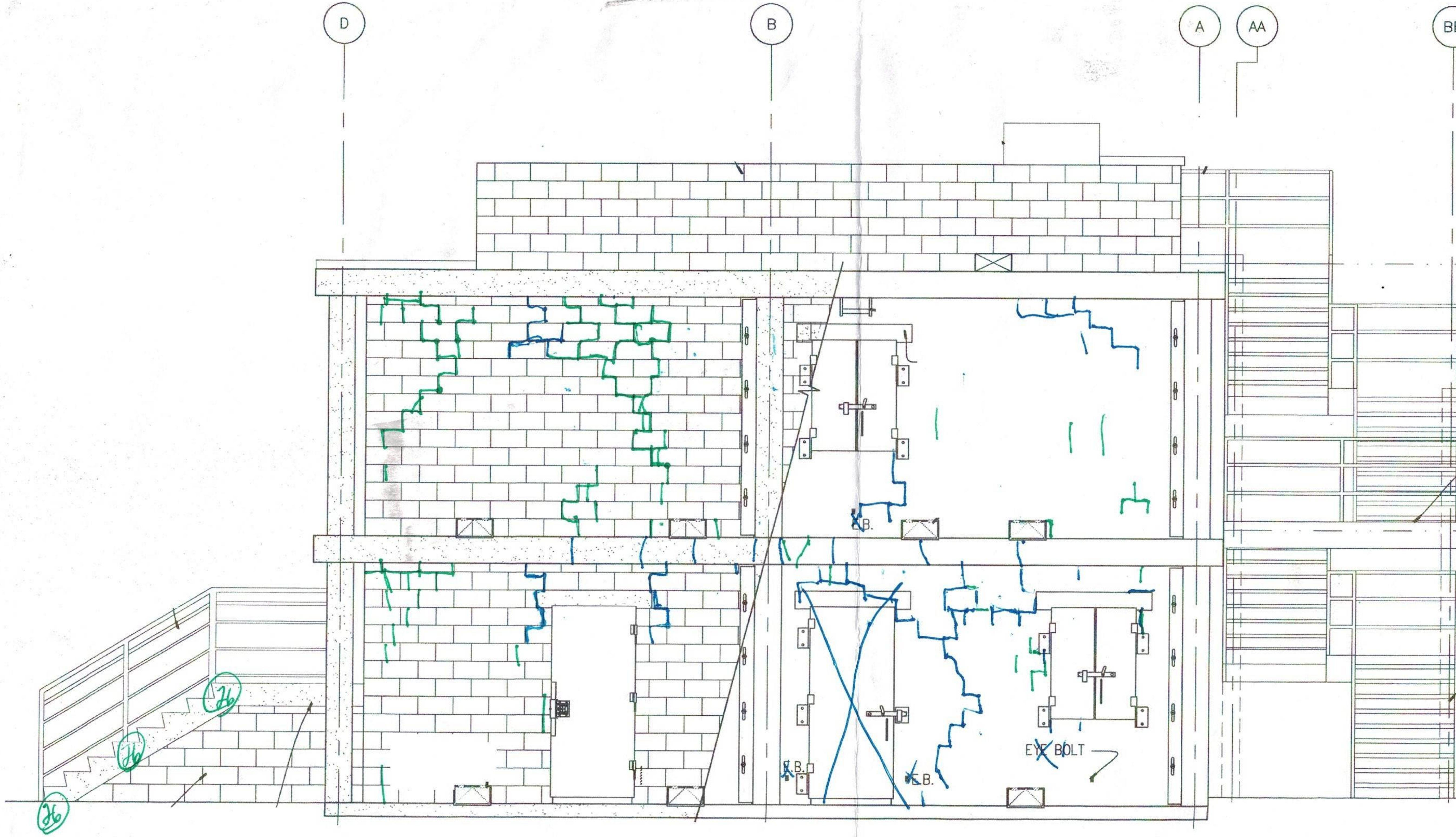
~~EAST~~ WEST ELEVATION A



NORTH
~~SOUTH~~ ELEVATION B



EAST ~~WEST~~ ELEVATION C



~~NORTH~~ SOUTH ELEVATION D

Appendix 2
Glossary of Structural Terms

Glossary of Terms

Term	Definition
ACI 318	"Building Code Requirements for Reinforced Concrete", published by the American Concrete Institute (ACI). This concrete code is referenced by the Building Code and provides design standards for reinforced concrete construction.
ASTM	American Society for Testing and Materials. The standards written by ASTM are widely used in the construction and building design industry, and are referenced by the Building Codes.
Bearing wall	A structural wall which supports the roof and elevated floor structures.
Bond beam	A continuous horizontal masonry course, usually at or near a roof or floor elevation, that ties the building together around its perimeter. It can also serve to support roof or floor loads over *non-bearing walls* or wall openings. A *CMU* bond beam is typically constructed of U-shape block filled with *grout*, with continuous *reinforcing bars* running parallel to the course.
Calcium Aluminate Concrete	A special concrete product produced using calcium aluminate cement instead of standard portland cement. The aggregate can be either normal weight, lightweight, or calcium aluminate aggregates. The chemical composition of calcium aluminate concrete makes it more resistant to high temperatures and thermal shocks. It is less likely to spall or delaminate when first exposed to fires, compared to regular concrete made with portland cement. However, many older burn buildings with structural, reinforced, cast-in-place, calcium aluminate concrete slabs, beams, columns, and walls have large delaminations that are significant safety concerns. Calcium aluminate concrete is also known as "refractory concrete."

Cement Matrix Deterioration	Chemical breakdown of the cement paste in concrete or *CMU* due to high temperatures and flame impingement. This deterioration manifests itself as pitting, dusting, or eroding of the exposed concrete or CMU surface.
CMU	Concrete Masonry Unit, also referred to as concrete block, cinder block, or block. These blocks are made of concrete, are typically hollow but can be solid, and are typically 16″ long x 8″ high x a thickness of 6″, 8″, or 12″ (nominal dimensions). CMU is typically defined by *ASTM* C-90.
Compression test (concrete)	Removing a cylindrical sample of existing, in-place concrete with a core drill, compressing the concrete sample in a machine until failure, and calculating the compressive strength of the sample from the measured test results. This test is significant because compressive strength is an important concrete quality. Test is defined by *ASTM* C-42.
Concrete fill	Non-structural, low-grade concrete placed on top of a structural element such as a structural concrete slab or *steel deck*. Typical uses for concrete fill include insulation, achieving roof slope, providing a smooth finish, and moisture protection for steel deck.
Concrete topping	Structural or non-structural concrete poured on top of a structural element, such as composite *steel deck* or *precast prestressed hollow core plank*, to provide a smooth finish and/or additional structural capacity.
Crack	An unintentional break in a building material, such as concrete or *CMU*, that can be through a partial depth or the entire depth of the material. In a burn building, there can be several causes of cracks, but the most common ones are (1) expansion and contraction of the concrete or CMU during heating and cooling causing excessive stress within the material, (2) shrinkage of the concrete during the original curing process (not related to fire training evolutions).
Crazing	Narrow, shallow surface cracks in concrete that separate the surface into small, irregularly shaped, contiguous areas.
Delamination	A separation along a plane, generally parallel to the concrete surface, causing the surface to become loose though still in place. In a wall, the separation is vertical. In a slab, the

	separation is horizontal. If the separation falls out or disintegrates, the area becomes a *spall*. In a burn building, delaminations usually occur because (1) moisture within the concrete changes to steam when exposed to high temperatures, and the steam pressure separates the concrete, or (2) fuel used to ignite the fires soaks into the concrete and burns when exposed to high temperatures, increasing internal pressure.
Discoloration	Concrete exposed to high temperatures changes from its typical gray color to a pinkish, salmon color (above 600° F), a white color (above 1,100° F), or a tan, or buff color (above 1,700° F).
Efflorescence	Deposits of salts that form on the surface of concrete, *CMU*, or brick as a result of evaporation of the water in which the salts were dissolved. Usually an indication that moisture is passing through the structural material.
Expansion joint	Intentional gap through the entire thickness of a building element, such as a wall or a slab, to allow for expansion and contraction of the element when it is exposed to temperature changes. Expansion joints can be built into the element during original construction, or can be cut into the element at a later time. In a burn building, expansion joints are most commonly found in walls, especially near the corners of exterior walls and at the intersection of an interior and exterior wall.
Fire brick	Masonry brick, usually made of *fire clay*, especially made to withstand the effects of high heat without fusion or softening.
Fire clay	A natural clay which does not fuse or soften when subjected to high temperature. Fire clay typically contains fewer metallic oxides than other natural clays.
Grout	For application in filling hollow cells of *CMU* walls: a fluid concrete mix that will flow freely into masonry joints and cells within a wall to fill all voids solid. For application in filling a crack in a masonry wall or a gap between two elements: a stiff concrete mix that resembles masonry mortar and is troweled into a crack or gap to seal the void.

Hollow core plank	*Precast concrete* structural slab element reinforced with prestressed steel cables. Typical plank size is 2′-0″ wide x 6″ or 8″ thick x required length up to approximately 35′-0″. Circular voids, approximately 4″ to 5″ in diameter, run the entire length of the plank to reduce the weight of the slab. After curing, planks are transported, lifted into place, and anchored to supporting beams or walls. A structural *concrete topping* is often placed on top of the planks after erection.
Lightgage metal joist	A horizontal structural framing element (joist) made of thin steel material, typically 12 gage or thinner. Most common cross section is C-shaped.
Lightgage metal stud	A vertical structural framing element (stud) made of thin steel material, typically 12 gage or thinner. Most common cross section is C-shaped.
Lintel	A horizontal beam placed across the top of a door or window opening to support the wall immediately above the opening. Lintels in a burn building are typically fabricated out of *precast concrete* or a reinforced masonry course. Lintels can also be fabricated out of steel angles, steel wide flange section (I-beam), stone, or wood.
Non-bearing wall	A non-structural wall, also called a partition, that divides the space into rooms but does not support floor or roof structures, or any other ceiling loads.
Petrographic analysis (concrete)	Removing a cylindrical sample of existing, in-place concrete with a core drill, slicing the core vertically and horizontally, and analyzing the core along the sliced faces. This test determines, among other properties, the physical composition, degree of cracking, and degree of cement paste degradation within the sampled core. Test is defined by *ASTM* C-856.
Pilaster	A rectangular column attached to a wall, so that the face of the column projects out from the face of the wall.
Poured-in-place reinforced concrete	Concrete reinforced with steel bars that is poured into forms and cured at its final location. Once the wet concrete cures, the forms are removed but the concrete is not relocated.

Pre-engineered metal building	A building constructed of standardized steel roof and wall assemblies, that is engineered by the manufacturer for typical column bay dimensions.
Pre-engineered wood truss	Truss element, typically fabricated out of conventional 2x lumber and steel nail plates, that is engineered by the manufacturer for given spans, configurations, and load requirements.
Precast concrete	Concrete reinforced with steel bars that is poured into forms and cured at a location other than its final location. Once the wet concrete cures, the forms are removed and the concrete element is transported, lifted, and anchored into its final location.
Precast prestressed hollow core concrete plank	See *hollow core plank*.
Pressure injection (for *crack* repair)	A concrete *crack* repair method usually made with epoxy. The typical repair sequence is to seal the exposed faces of the crack(s) with epoxy, drill small holes into the concrete at the cracks, and inject epoxy under pressure to completely fill the crack. If the shiny epoxy appearance at the face of the crack is undesirable, the epoxy that was applied to initially seal the exposed crack faces can be ground away to bare concrete.
Prestressed concrete	Concrete element reinforced with steel cable that is mechanically tensioned.
Prestressed concrete double tee	*Precast concrete* structural slab element, reinforced with prestressed steel cables, with a cross-section in the shape of a double tee (TT). After curing, the sections are transported, lifted into place, and anchored to supporting beams or walls.
Prism test (masonry)	Removal of a piece of masonry (CMU) wall at the mortar joints, typically 2′-0″ height x 1′-6″ length x wall thickness, compressing the sample in a machine until failure, and calculating the compressive strength of the sample from the measured test results. This test is significant because compressive strength of the masonry wall assembly (f′m) is an important masonry quality. Test is defined by *ASTM* E-447.

Refractory concrete	A special concrete product produced using calcium aluminate cement instead of standard portland cement. The aggregate can be either normal weight, lightweight, or calcium aluminate aggregates. The chemical composition of refractory concrete makes it more resistant to high temperatures and thermal shocks. It is less likely to spall or delaminate when first exposed to fires, compared to regular concrete made with portland cement. However, many older burn buildings with structural, reinforced, cast-in-place, refractory concrete slabs, beams, columns, and walls have large delaminations that are significant safety concerns. Refractory concrete is also known as "calcium aluminate concrete."
Reinforcing bar	A round, steel bar used to reinforce concrete or *CMU*. Typical bar diameters range between 3/8" and 2-1/4". Reinforcing bars are typically defined by *ASTM* A-615.
Repoint	To remove and replace mortar in the joints of a masonry wall.
Scaling	Small, shallow pits in a concrete surface, usually grouped in a small area. Scaling does not expose reinforcing and is smaller and shallower than a *spall*.
Slab-on-grade	A concrete slab element poured on, and permanently supported by, the ground.
Spall	An area in a concrete surface in which the outer surface has separated from the base concrete element and disintegrated, leaving a shallow crater in the surface. Spalls can occur on a vertical wall surface, a horizontal floor slab surface, or an overhead ceiling slab surface. In a burn building, spalls usually occur because (1) moisture within the concrete changes to steam when exposed to high temperatures, and the steam pressure separates the concrete, or (2) fuel used to ignite the fires soaks into the concrete and burns when exposed to high temperatures, increasing internal pressure.
Spread footing	A concrete foundation for a wall or column. The dimensions of a spread footing are larger than those of the supported element, so as to distribute the load across a larger area of supporting soil and reduce settlement. Also called a "footing" or a "footer".

Steel deck	Corrugated sheets fabricated from thin steel, typically 16 gage or thinner, that can be used in floor and roof construction. Steel deck is typically used in one of three ways: (1) as a structural support for a non-structural *concrete fill*; (2) as a non-structural element used only as a form for a structural concrete slab; (3) as a structural element that acts compositely with a structural *concrete topping*.
Steel joist	A horizontal structural framing element (joist) made of *structural steel* material that is a parallel-chord truss. Typically, the top and bottom chords of the joists are steel angles or bars, and the webs are steel bars.
Structural steel	Steel elements fabricated in shapes, such as wide flanges (I-beams), channels, angles, pipes, tubes, bars, and plates. These can be used as structural or non-structural elements.
Tensile test (reinforcing)	Removing a length of steel *reinforcing bar* from an existing, in-place concrete element, pulling the reinforcing sample in a machine until failure, and calculating the tensile strength of the sample from the measured test results. This test is significant because tensile strength is an important reinforcing quality. Test is defined by *ASTM* A-370.
Tensile test (structural steel)	Removing a length of existing *structural steel*, pulling the reinforcing sample in a machine until failure, and calculating the tensile strength of the sample from the measured test results. This test is significant because tensile strength is an important quality in structural steel. Test is defined by *ASTM* A-370.
Welded wire fabric	Reinforcing mesh fabricated from two layers of thin steel wires welded together, with the top layer perpendicular to the bottom layer. Wire spacing in each layer is typically 4″ or 6″.

Appendix 3
Materials Testing Report by ECS, Ltd.

STRUCTURAL SLAB CORING

WESTMORELAND COUNTY COMMUNITY COLLEGE BURN BUILDING

65 PUBLIC SAFETY DRIVE
SMITHTON, PENNSYLVANIA 15479

ECS PROJECT NO. 46:9434

FOR

WESTMORELAND COUNTY COMMUNITY COLLEGE

JUNE 26, 2023

June 26, 2023

Ms. Shelley Shaffer
Westmoreland County Community College
65 Public Safety Drive
Smithton, Pennsylvania 15479

ECS Project No. 46:9434

Reference: Report of Structural Slab Coring, Westmoreland County Community College Burn Building, 65 Public Safety Drive, Smithton, Pennsylvania

Dear Ms. Shaffer:

ECS Mid-Atlantic, LLC (ECS) is pleased to provide the results of the Structural Slab Coring for the Westmoreland County Community College Burn Building. ECS services were provided in general accordance with ECS Proposal No. 46:12562-AP authorized on June 13, 2023.

We are pleased to have this opportunity to provide consulting services for this project. If you have any questions or comments concerning this report, please do not hesitate to contact us.

ECS Mid-Atlantic, LLC

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Principal
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TABLE OF APPENDICES

1.0 INTRODUCTION

1.1 Project Information

1.2 Scope of Services

ECS Mid-Atlantic, LLC (ECS) is pleased to provide you with the results of our Structural Slab Coring for the Westmoreland County Community College Burn Building project. ECS services were provided in general accordance with ECS Proposal No. 46:12562-AP authorized on June 13, 2023.

1.3 Limitations

Our observations of the buildings were limited to readily accessible areas only. Exterior areas obscured by vegetation, debris, equipment, etc. are not considered readily accessible areas. Interior areas such as crawl spaces or areas obscured by stored items, furniture, equipment, etc. are not considered readily accessible.

2.0 CONCRETE CORE SAMPLING

Four (4), 4-inch diameter concrete core samples were obtained from the floor slab within the structure. Coring locations were selected by the client. Cores were extracted from Room 201 of the structure.

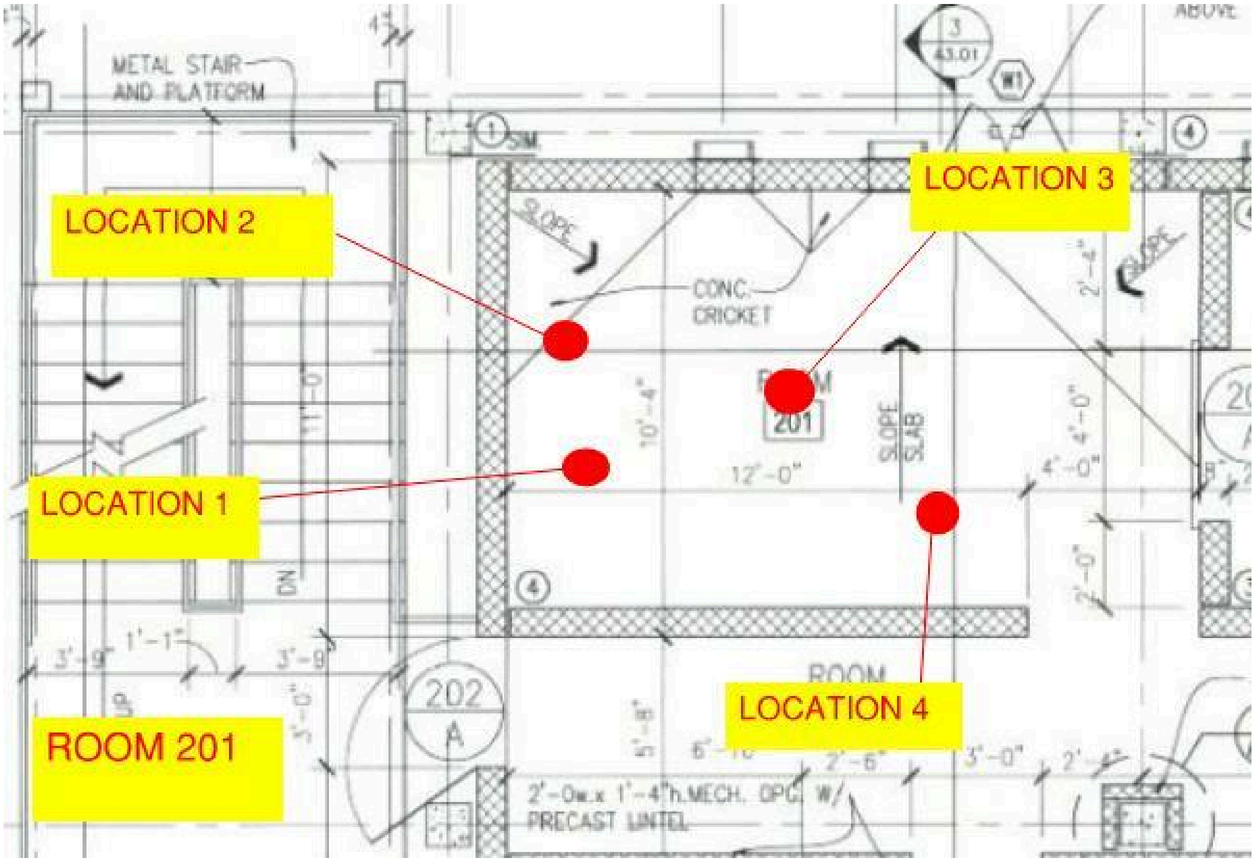
Cores were drilled to approximately 10-inches in depth where applicable. A reduction in depth was necessary on cores No. 1 and No, 4 due to the presence of reinforcing steel at the bottom of the slab.

Core samples were returned to the ECS laboratory in Cranberry Township, Pennsylvania for laboratory compressive strength testing, where they were conditioned for 5 days and tested in general accordance with ASTM C39.

Prior to coring operations ECS utilized a GSSI StructureScan Mini HR GPR system with a 2,600 MHz antenna. ECS performed scanning of the floor slab for the purpose of locating reinforcing steel and embedded objects within the concrete structures.

Laboratory test results can be found in the Appendices of this report.

3.0 CONCRETE AND STEEL SAMPLING LOCATIONS



4.0 LABORATORY TEST RESULTS OF CONCRETE CORES

COMPRESSIVE STRENGTH TEST RESULTS
FOR CORES - ASTM C42-04

100 East Kensinger Drive, Suite 300
Cranberry Township, PA 16066
Office (412) 206-1470
Fax (412) 927-1273

PROJECT: WCCC PTSC Burn Building Structural Evaluation **JOB#:** 46.9434

CLIENT: **DATE:** 6/21/2023

CORE NO.	SAMP NO.	DATE PLACED	DATE OBTAINED	TEST DATE	AGE OF CONCRETE (days)	DIAMETER (in)	WEIGHT OF UNCAPPED CORE (lbs)	LENGTH UNCAPPED (in)	LENGTH CAPPED (in)	AREA (sq in)	LOAD (lbs)	DRY UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	LENGTH TO DIAMETER RATIO	CORRECTION FACTOR *	CORRECTED COMPRESSIVE STRENGTH (psi)	AVERAGE (psi)
1	1	Unknown	6/16/2023	6/21/2023	N/A	3.96	4.52	4.63	4.85	12.32	59050	137.0	4794	1.22	0.925	4430	**4970**
2	2	Unknown	6/16/2023	6/21/2023	N/A	3.95	7.84	7.99	8.15	12.25	64560	138.4	5268	2.06	1	5270	
3	3	Unknown	6/16/2023	6/21/2023	N/A	3.95	7.64	7.72	7.94	12.25	63880	139.6	5213	2.01	1	5210	
4	4	Unknown	6/16/2023	6/21/2023	N/A	3.96	4.86	4.84	5.00	12.32	106050	140.9	8611	1.26	0.931	8020	

A. TYPE OF CURING 5 Day Bags
B. MOISTURE CONDITION SSD
C. NOMINAL MAX. SIZE AGGREGATE 0.75
D. DIRECTION OF LOAD APPLICATION Perpendicular
TO THE HORIZONTAL PLANE OF CONCRETE AS PLACED.
* CORRECTION FACTOR APPLIED AS REQUIRED BY AASHTO T 24

REMARKS:

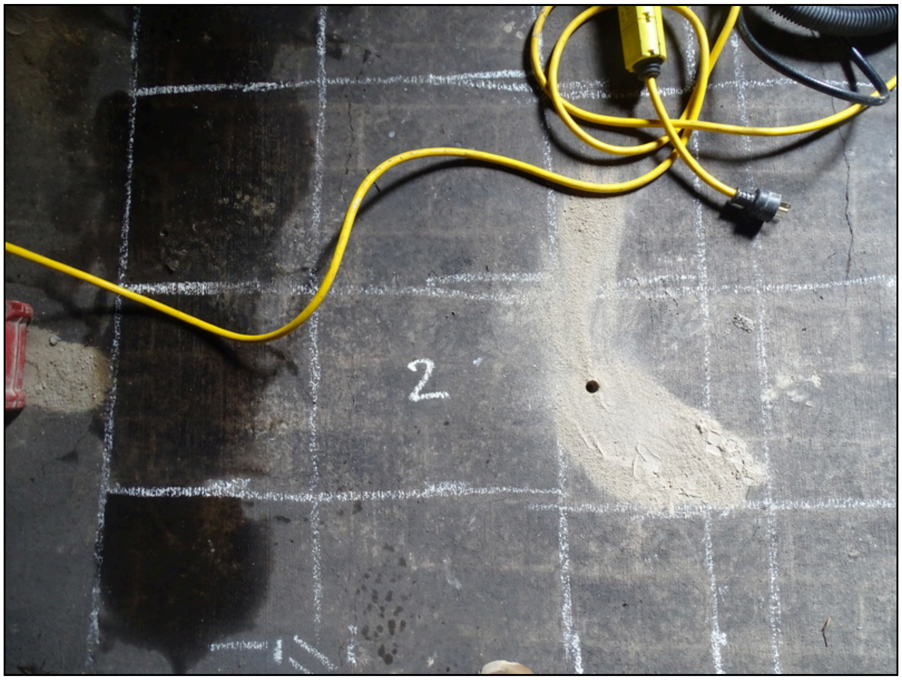
Ratio of Length of Cylinder to Diameter	Strength Correction Form*
1.75	0.98
1.50	0.96
1.25	0.93
1.00	0.87

* These correction factors apply to lightweight concrete weighting between 100 and 120 lb/cf" (1600 and 1420 kg/cm') and to normal weight concrete. They are applicable to concrete dry or soaked at the time of loading. Values not given in the table shall be determined by interpolation. The correction factors are applicable for nominal concrete strengths from 2000 to 6000 psi (13.8 to 41.4 Mpa). (Correction factors depend on various conditions such as strength and classic moduli. Average values are given in the table.)

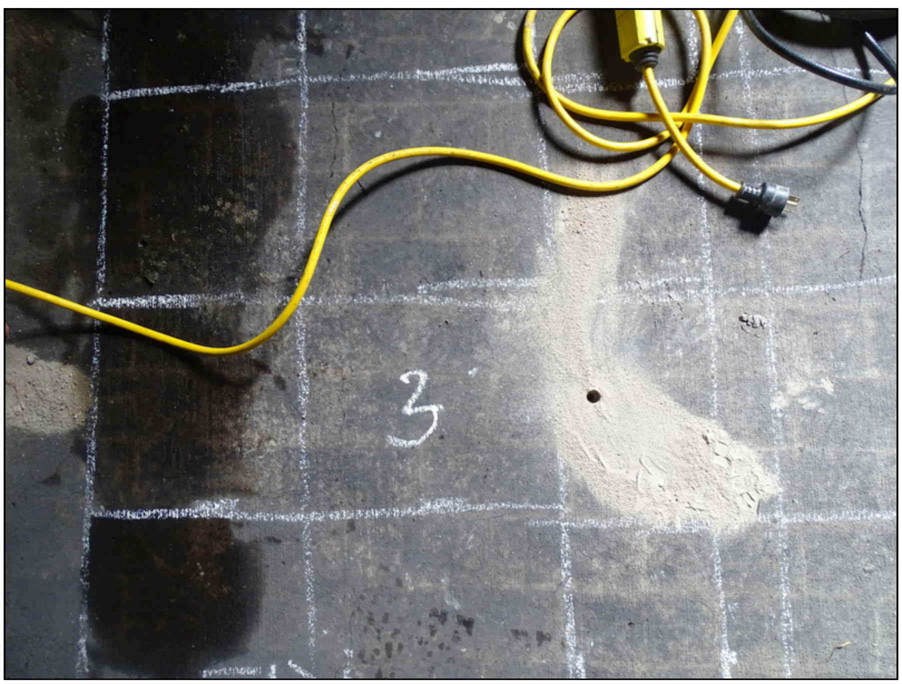
Appendix I: Photographs

Photograph 1: Coring operations overview

Photograph 2: Coring setup at location #1

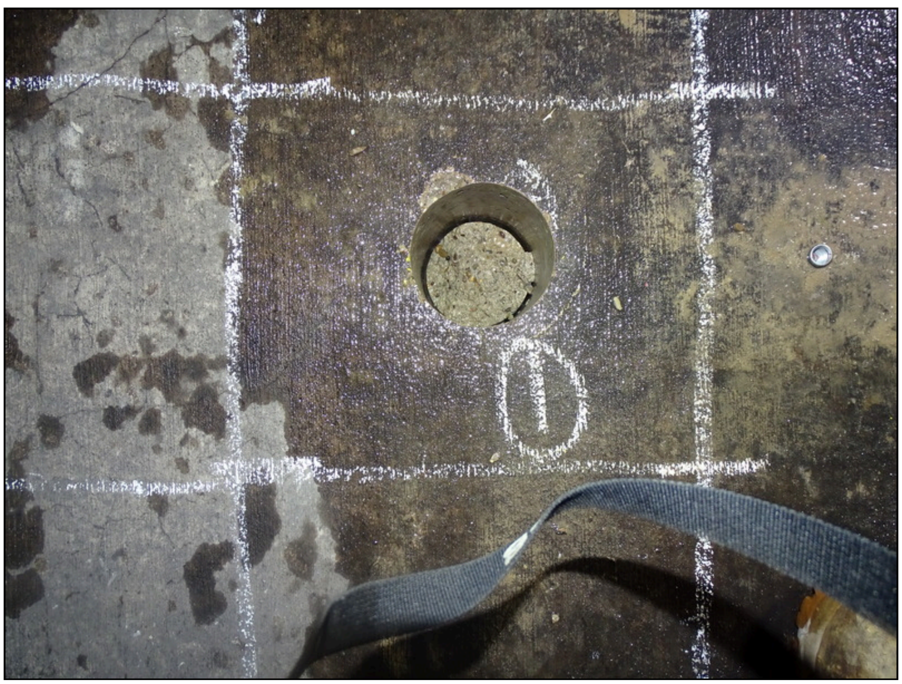


Photograph 3: Core location #2 prior to drilling



Photograph 4: Core location #3 prior to drilling

Photograph 5: Core location #4 prior to drilling



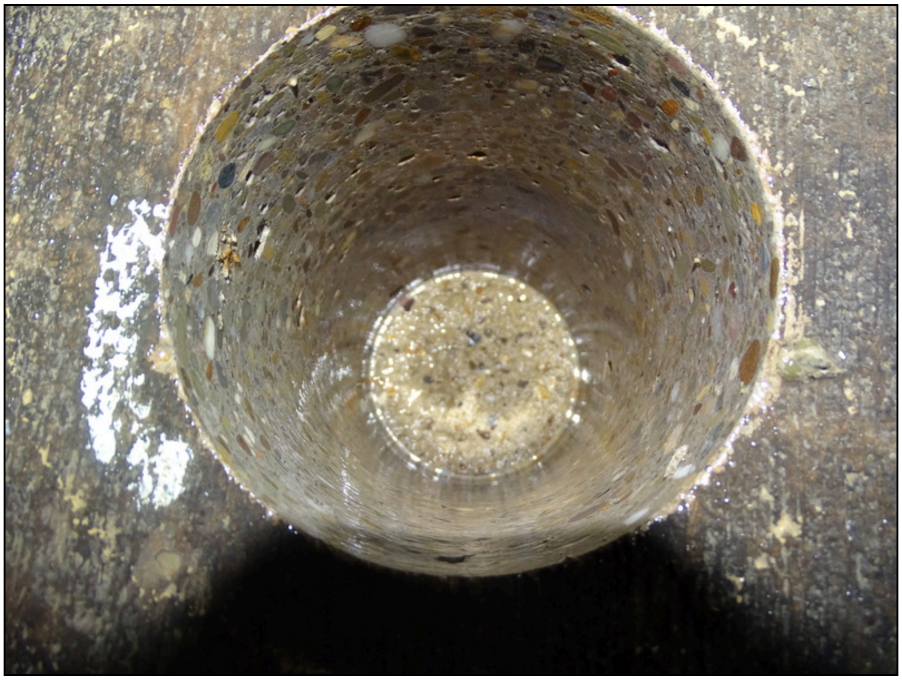
Photograph 6: Location #1 after core extraction

Photograph 7: Location #1 after core extraction

Photograph 8: Location #2 after core extraction

Photograph 9: Location #2 after core extraction

Photograph 10: Location #3 after core extraction



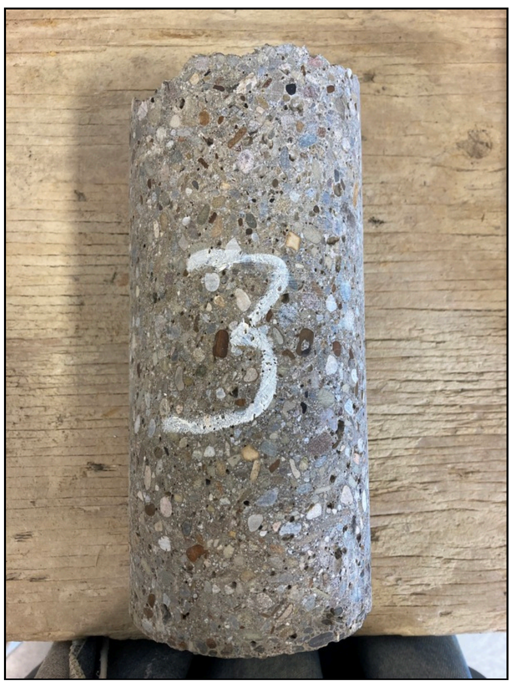
Photograph 11: Location #3 after core extraction

Photograph 12: Location #4 after core extraction

Photograph 13: Location #4 after core extraction

Photograph 14: Laboratory photo of extracted core #1

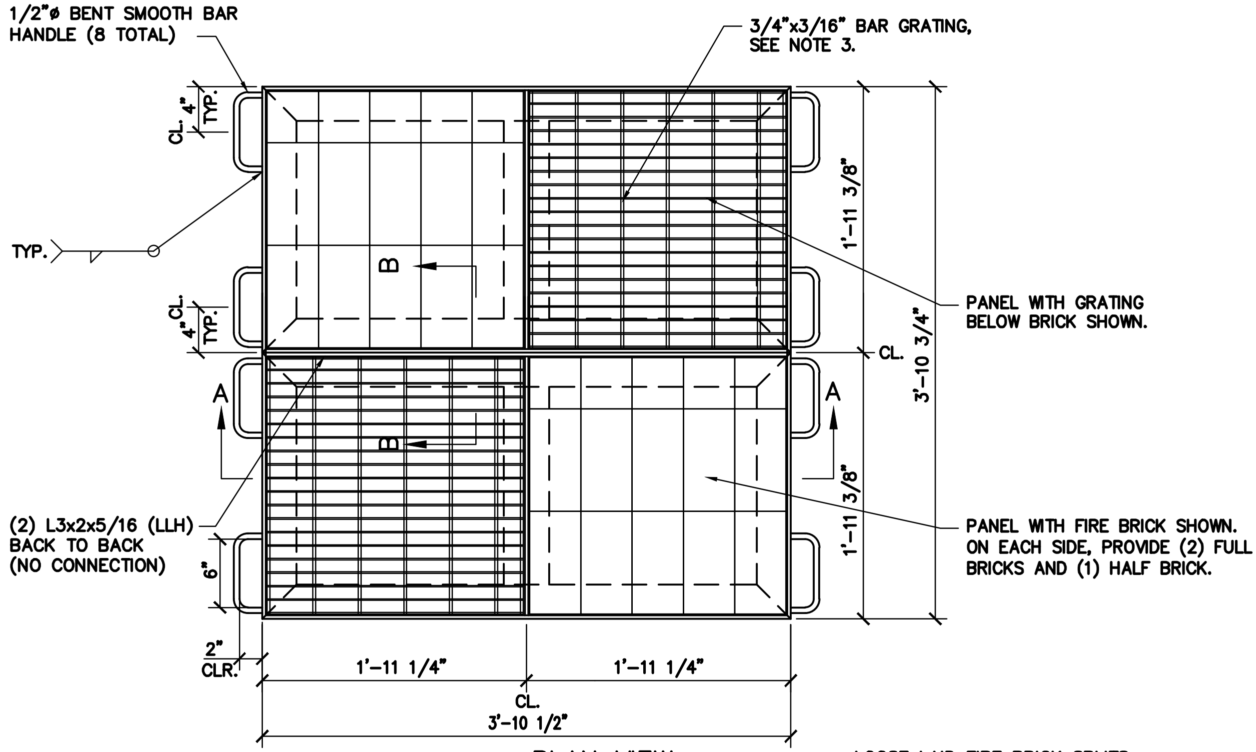
Photograph 15: Laboratory photo of extracted core #2



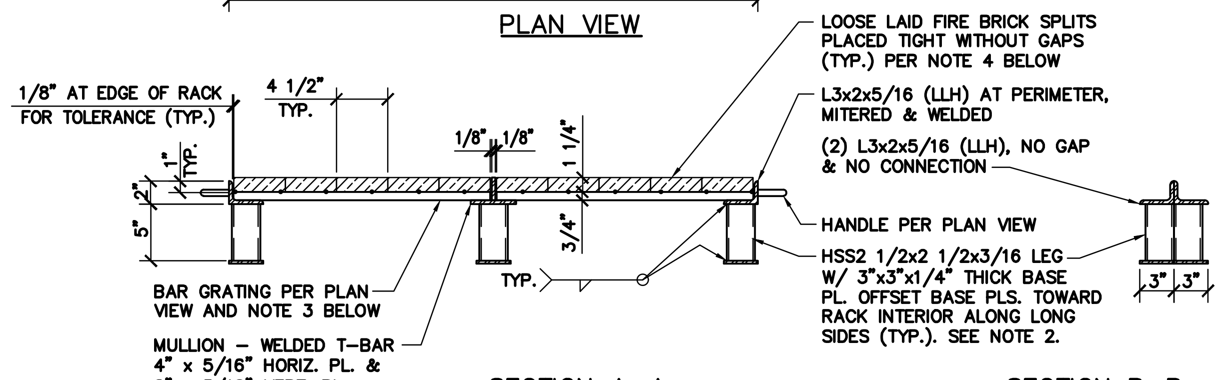
Photograph 16: Laboratory photo of extracted core #3

Photograph 17: Laboratory photo of extracted core #4

Appendix 4
Burn Rack Details



PLAN VIEW



SECTION A–A

SECTION B–B

NOTES:

1. PROVIDE GALV. STEEL FOR ALL BURN RACK PIECES AND COMPONENTS.

2. PROVIDE VERTICAL LEG AT EACH CORNER AND AT CENTER OF EACH LONG SIDE (12 TOTAL LOCATIONS). PROVIDE A 1/4"ø HOLE IN ONE SIDE OF EACH TUBE LEG, JUST ABOVE THE BASE PL.

3. PROVIDE ITEM NO. GW-75A (SMOOTH, GALV. FINISH), BY McNICHOLS CO. OR APPROVED EQUAL (1'-10 1/4" ⟷ x 1'-10" ↕). SUPPORTED LOOSE ON PERIMETER ANGLES AND MULLIONS (NO CONNECTION) TYP. AT ALL FOUR PANELS.

4. PLACE FIRE BRICK SPLITS (ASTM C-27, CLASSIFICATION: MEDIUM-DUTY) LOOSE LAID OVER BAR GRATING, TYP. AT ALL FOUR PANELS. TYPICAL BRICK SIZE IS 9" x 4 1/2" x 1 1/4".

1 BURN RACK DETAILS

SK-1 | SK-1 NOT TO SCALE

PROJECT: 2023 WESTMORELAND CO. CC PSTC BURN BUILDING STRUCTURAL EVALUATION	
DRAWING TITLE: BURN RACK DETAILS	EL&M NO.: 23012
Elliott, LeBoeuf & McElwain 8001 Forbes Place, Suite 201 Springfield, VA 22151 Phone (703) 321-2100 Fax (703) 321-2112	DATE: JULY 2023 REF. DWG.: N/A DRAWING NO.: SK-1