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FULLER MIDDLE SCHOOL
FRAMINGHAM, MASSACHUSETTS
STRUCTURAL EXISTING CONDITIONS REPORT
NOVEMBER 1, 2017

Existing Construction

The Fuller Middle School is a one-story building built in 1958. The building is supported on cast-in-place concrete tapered piles with 65 ton capacity, located approximately 12 to 18 feet on center in each direction. The first floor is framed with a 2½" to 3½" draped mesh concrete slab and concrete joists spaced at 24" on center, spanning to reinforced concrete girders. The first floor is suspended over a 6-foot crawl space. Steel columns, which are primarily located to coincide with the corridors, rise up from the piles to support the roof framing. The roof over the classroom space is supported on 8" steel purlins bearing on 16" steel girders. The roof deck is 2" poured gypsum over 1" acoustical form boards with steel bulb tees spanning 6 feet. Over the larger volumes, such as the gymnasium and auditorium, there are 33"-36" wide flange girders to create a column-free space. In addition to the 8" steel purlins and gypsum roof at the gymnasium and auditorium, there is horizontal steel cross-bracing.

Structural Conditions Assessment

1. Roof Framing

   The steel roof framing appears to be in good condition and well maintained. There is widespread evidence of roof leaks, which causes the gypsum to be saturated with water. Prolonged exposure to entrapped water will compromise all properties of gypsum. Gypsum roof decks are a composite system that derives its strength from the sum of the parts (gypsum, wire reinforcement and steel tees), so a reduction in gypsum strength reduces the overall capacity of the roof deck system. Also, any mechanical fasteners that are screwed into the gypsum will see a reduced embedment capacity from the water-logged material.

2. First Floor Framing

   There is a significant area of the first floor that exhibits rusted and delaminated rebar on the concrete joists and girders. The worst area, under the garage space bound by grids N-T-0-5 is currently shored to grade. This should be considered a temporary fix considering no repair to the existing rebar was performed. The area of reduced structural capacity extends along the south wing (under classrooms B36-B48) in a similar fashion. The bottom rebar in the concrete joists have rusted, delaminated, and caused the concrete cover to spall and fall off. The current condition of the rebar is worse than noted in the 2013 Feasibility report since there is now rebar section loss rather than just concrete cover removal. Furthermore, it was noted from the maintenance workers that the spalled concrete damages the pipes underneath when the heavy concrete pieces fall.

3. CMU Partitions

   The existing partitions in the building are constructed from unreinforced CMU. Although customary in 1950's construction, these non-load bearing partitions are not up to current code since there is no positive attachment to the floor or roof diaphragms. Also, it is not obvious that every masonry opening has a lintel or bond beam to span over the opening. Some of the interior

CMU walls exhibit cracking, which is not necessarily a structural concern, but could be remedied by some well-placed masonry joints.

4. Exterior Envelope

   The first floor slab cantilevers over the concrete grade beam to support the exterior façade. There are some isolated areas of exposed rusted rebar and spalled concrete that can be repaired locally. The concrete exposed on the exterior is a thermal bridge to the interior conditioned space, which is a challenge to remedy if the building was renovated.

Structural Recommendations

1. Renovation Option
   a. Repair deficiencies
      i. Address roof leaks and drainage. Replace areas of gypsum roof decks that are saturated with metal roof deck.
      ii. Repair or replace damaged first floor slab. Address cause of rusted rebar, such as adding a vapor barrier and slab in the crawl space and better ventilation.
      iii. Patch exterior concrete and repair rusted rebar.
   b. Seismic Upgrade

      The original design of the building did not consider lateral loads. By default, the lateral stiffness is provided by the unreinforced CMU partitions. A renovation of the building will likely result in removed or relocated CMU partitions, and therefore a lateral design will be required based on the current code. If the CMU walls are not removed, RSE still recommends a seismic upgrade due to the significant financial investment and prolonged life expectancy of the building.
      i. Replace the entire gypsum roof deck with a metal deck that can distribute diaphragm loads. Gypsum is a brittle material that my nature does not have sufficient ductility to transfer diaphragm loads to the lateral system. Add supplemental steel framing (such as 8" steel beams) at the diaphragm edges that don't have existing steel beams. These are required because the 8" purlins sit above the girders and the load path is broken at the diaphragm edges.
      ii. Add a lateral system for the entire building, such as steel braced frames. Add grade beams or braced frames in the crawl space to transfer lateral loads to the ground. Reinforce brace frame columns as required. New piles might be required depending on location of braced frames, which will be difficult to install given the low clearance in the crawl space for the pile rig.
      iii. Brace CMU partitions to the roof diaphragm. If the gypsum roof is not replaced, supplemental steel will be required above the CMU partitions where the gypsum has been affected by roof leaks since fastening to saturated gypsum is not reliable.

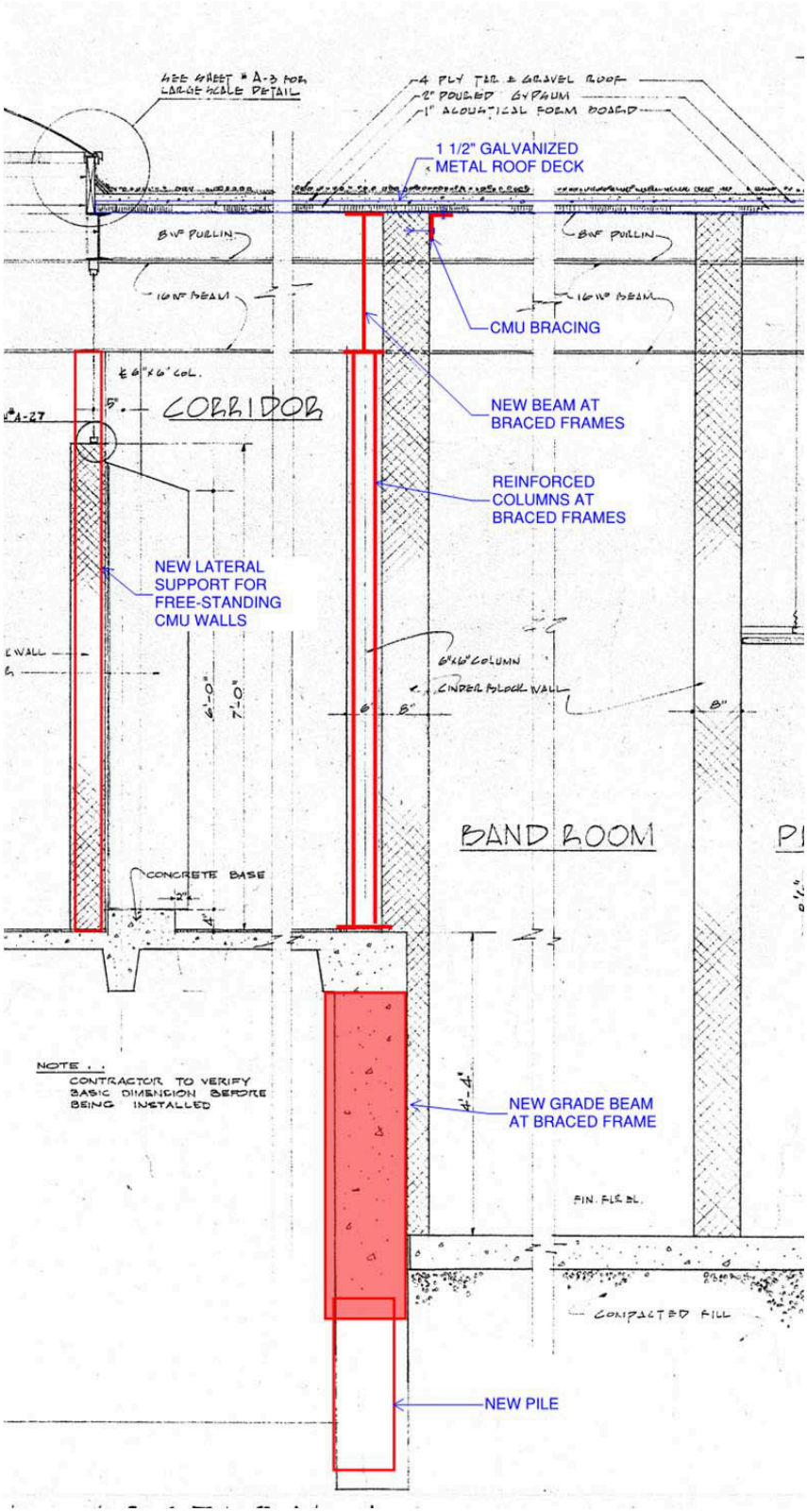
      See the Seismic Upgrade Sketch on page 3 for an illustrative clarification.

2. Renovation and Addition Option

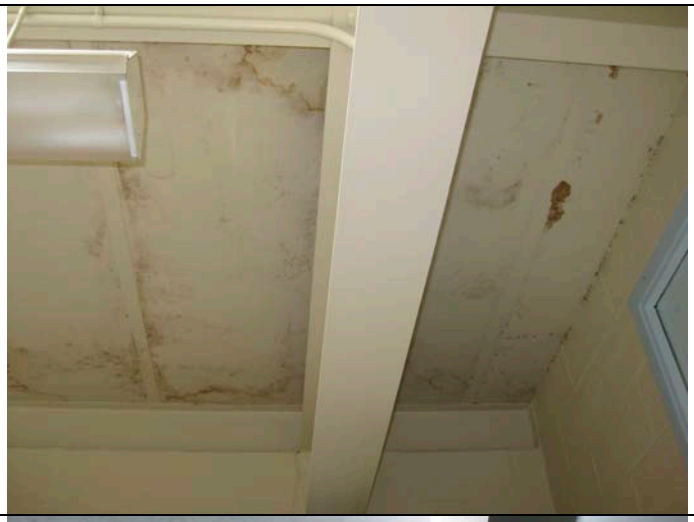
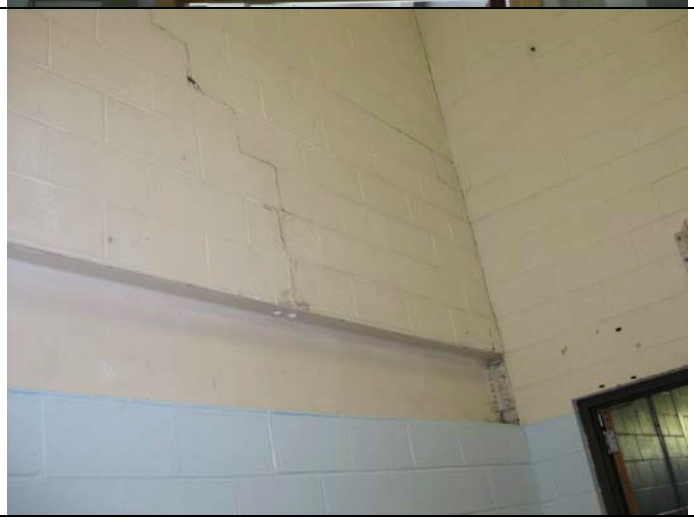
   It is structurally possible to demolish a portion of the building and renovate the remainder. The large volume spaces (such as the auditorium) lend themselves to this approach since the structure can be isolated from the rest of the building during demolition and the lateral elements can be added at the boundaries. The renovated portion would be tied to the new building and the entire building would be designed per the latest code.

3. New Construction Option
   Any new construction will be designed to the latest code and specific programming suited to the client.

Seismic Upgrade Sketch



Photos

	Roof leaks causing rusted steel tees and water-logged gypsum slab.
	No lintel observed. Top of CMU is tight up against gypsum roof deck but not positively attached.
	CMU cracking at irregularities

	Exterior concrete rebar rusted and spalling
	Temporary shores in crawl space
	Additional concrete joists with spalling concrete (unshored)