

3 December 2020

Joseph F. Powers
Interim Town Administrator
Town of Harwich
732 Main Street
Harwich, MA 02645

Reference: Brooks Academy Museum
Structural Conditions Assessment Report

Dear Mr. Powers:

On Thursday 17 September I visited the Brooks Academy Museum to perform a structural inspection of the property in accordance with our September 14 proposal. The following is a summary of my findings and recommendations:

GENERAL DESCRIPTION

The Brooks Academy Museum is housed within the former Brooks Academy, built in three phases during 1844, 1909, and 1924.

1844 and 1909 Sections

The combined 1844 and 1909 structures have two floors and a crawlspace under a gabled roof with a low attic and ridge running in the north-south direction. The majority of the first floor consists of a large exhibit space with an entry hall to the north and offices to the south.

The combined second floor has collections storage at its southern end and a large exhibit space and then a stair hall and gift shop to the north. There is an open colonnade at the extreme north end of the structure, which sits under a pediment formed by the extended roof gable, with a tower-like cupola over the looming above.

The combined 1844 and 1909 structures are a combination of wood timber and sawn lumber framing, with a rafter-framed tied gable roof. The first floor of the 1844 portion is constructed with east-west running timber girts with north-south running sawn lumber joists spanning between them. The first floor of the 1909 portion is constructed in similar fashion, but with girts running in the north-south direction and joists running east-west. Walls are constructed of board-sheathed wood studding.



The first floor joists have been reinforced (sistered) with modern pressure treated lumber and the girts have been sistered with modern manufactured lumber and re-supported on modern pressure treated wood posts that land on cast-in-place concrete footings.

The perimeter foundations are constructed of dry-laid field stone below grade and wet-laid multi-wythe brick above grade, supporting a timber sill. The stone foundations appear only to run a foot or two below the exterior grade level, and are relatively loosely placed fieldstones, based upon test pits dug during our investigation. There is a dug out trench leading to a full-depth mechanical space near the approximate point where the 1844 and 1909 portions of the building meet. The earth floor of the crawlspace is retained by partial height concrete block walls along the trench and full height walls within the mechanical area that appear to be contemporaneous with the block foundations of the 1924 section.

The second floor structure is hidden by floor finishes and a plaster ceiling, so the actual configuration of framing members could not be determined. One would assume the framing to be similar in nature to the first floor, but without the reinforcing and with the members' arrangements unknown.

The cupola over the front of the 1844 section has been extensively rebuilt with modern dimensional lumber and steel framing and external replicated fiberglass elements.

1924 Section

The 1924 portion of the building is markedly more "modern" than the older portions, even though less than two decades apart in age. This section has two floors and a low attic, with a full basement below.

The roof is constructed with dimensional lumber rafters as a tied gable, with the ridge running in the east-west direction.

Floors and walls are believed to be of modern dimensional lumber "stick frame" construction, however the framing sizes and configurations were obscured by floor, ceiling and wall finishes.

The foundation is constructed of wet-laid concrete block below the exterior grade, and wet-laid multi-wythe brick above. The basement floor is a cast-in-place concrete slab on grade.

NOTED CONDITIONS AND RECOMMENDATIONS-

We noted the following for which we have the following *recommendations*.

Exterior

1844 Section-

- The flat wooden column bases at the front colonnade are collecting water and causing the bottoms of the fluted columns to begin to rot.

The bases should be replaced with new ones that are slightly pitched to shed water and the bottoms of the columns should be repaired with fitted wood dutchmen.



- The 1844 section's foundations are in poor condition:

- The exposed brickwork on the northern end of the west foundation is unraveling, with bricks that are loose, debonded and displaced.
- The remainder of the west foundation brickwork has eroded mortar joints and debonded bricks (that move when lightly tapped on with a hammer).



- The east foundation also has eroded mortar joints and debonded brickwork.
- The east foundation appears to have settled in several places as the brick coursing is not level.

Because of these extremely poor conditions we recommend that the east and west foundations be replaced. This would involve temporarily supporting the building structure, removing the brick above grade and stone below grade, and additionally excavating to a depth of at least four feet and constructing a new concrete footing and foundation wall on which a new masonry above-grade wall would be built. The above grade masonry would consist of grouted concrete block with an external bonded brick veneer that would incorporate as many of the original bricks as possible.

With the effort involved in replacing the foundations, we have recommended that the additional measures of excavating the crawlspace to create an expanded basement be considered. Pursuant to this suggestion and at the Museum's request, we submitted a schematic design study outlining this work dated 27 October 2020.

The north foundation has already been replaced and would remain whether the basement is expanded or not.

- The wood-sheathed east wall slopes toward the north and south ends in reaction to the foundation settlements that have occurred. *No attempt need be made to re-level the wall during foundation replacement as this would cause damage to interior and exterior finishes.*
- The roof ridge dips in the center however I saw no apparent damage in the attic that might have caused this condition, other than perhaps cross-grain shrinkage of the wood framing.
- The cornice molding at the base of the front pediment sags in the center. This is likely due to slippage of the wood furring that supports the cornice *and should be monitored.*



1909 Section-

- As with the 1844 section, the 1909 section's foundations are also in poor condition:
 - The exposed brickwork dips between the northeast and southeast corners and the deeper underpinning foundation of the dug-out mechanical area, which provides a hard point of support.
 - The brickwork at the southeast corner is rotated the eastward direction.
 - The south and east walls have eroded mortar joints and debonded brick units.



- According to two test pits, the stone foundations below the brickwork consist of loose, rounded fieldstone that are dry laid in soil to a depth of only a few feet below the ground surface.

Because of their extremely poor conditions we recommend that the south and east foundations be replaced. This would be done in the same manner as described for the 1844 section.



Our 27 October schematic design study also addresses the potential creation of basement space within the 1909 section.

- As at the 1844 section, the supported building walls above the foundation follow the same undulating settlement patterns as the foundation.
- The wood siding on the east wall bulges outward above the mechanical areaway. This bulge could be indicative of compression in the wood framing behind the siding. Such compression could either come from rotting studs or wall plates, or localized overload as would occur if the foundations to each side of the compressed area settled downward, which they have, but the center did not. *This condition should be investigated.*
- The lower clapboards and watertable of the south wall are rotted and bulged out. The bulge might be attributable to compression in the wall's sill. *The rotted wood should be removed and replaced, and the sill investigated and repaired if needed.*
- The upper half of the south wall appears to sweep backward above the second floor, however there are no signs of movement or cracking at the interior. This may be an historical condition that has since stabilized *but should be monitored for change going forward.*



1924 Section-

- The concrete block window wells at the west wall are in poor condition and have settled away from the main building foundation. *These should eventually be replaced.*

- There is a disused stairway to the basement in an areaway that is covered with a rickety plywood shield. *Since this is the only secondary egress from the basement, we recommend that the access be restored.*
- The roof-edge fascia atop the north wall appears to dip in two places. *These localized deflections should be investigated and monitored.*



Interior/ Basement and CrawlSpace

1844 & 1909 Sections-

- All of the first floor framing has been extensively reinforced through sistering and posting in what is clearly an engineered solution to earlier deficiencies.
- It is not clear whether the partial height concrete block walls along the trench that leads to the mechanical space are designed as cantilever retaining walls to hold back the higher grade of the crawlspace, however no lateral movement was observed.
- The concrete footings that run along the sides of the trench rest on both the tops of the concrete block walls and the retained soil behind them, creating a condition that is prone to settlement and lateral movement of the walls. Fortunately, no such settlements or movements were observed.



1924 Section-

The 1924 section has no notable defects.

Interior/ First Floor

1844 & 1909 Sections-

- The first floor surfaces are somewhat irregular with scattered ridges and valleys that are moderately noticeable underfoot. The elevated portions of the floor correspond to supporting girt and wall alignments within the basement with the floor joists sagging between them. *Because the joists and girts have been so extensively reinforced, other than for the specific conditions noted below one would assume that the reinforcement was done in response to the deflections and done in accordance with proper engineering practice.*
- The floor of 1844 section sags in the vicinity of the wall that divides the main Exhibit Hall from the Gift Shop. This wall supports the second floor, where there is a high point noted above it. *The sag is likely caused by the stacked second floor loads coming down on the first and should be investigated and reinforced if needed.*
- The floor of 1844 section also sags in the vicinity of the two columns toward the main Exhibit Hall's south end, along with the ceiling there. The column also support the second floor, and a high point is noted above them. *Again, the sag is likely caused by the stacked second floor loads coming down on the first framing and should be investigated and reinforced if needed.*
- There is a heavy concentration of file cabinets against the west wall of the Marketing and Research room that has caused the floor to dip and the wall to crack, and appears to be beyond the intended capacity of the reinforcement below it. *The files should be relocated to the basement slab or the floor construction should be analyzed and additionally reinforced as needed.*
- There is some disturbance in the wall and ceiling finishes around the mechanical chase against the east exterior wall. *This may relate to rot or other damage within the chase and should be investigated.*



- The ceiling of the Meeting and Research room sags in the southwest corner, where a piece of plywood appears to have been added. *The ceiling attachment to the second floor should be reviewed and reinforced as needed.*
- The ceiling of the Meeting and Research room also sags along the west edge where it has been dragged down with the west wall.



1924 Section-

- The first floor surfaces have detectable ridges and valleys that correspond to the supporting walls within the basement below, and the likely joist spans between them. As the floor structure was constructed during a time when structures were routinely engineered, it was likely designed and constructed appropriately for the loads that are placed on it and the sagging is just normal creep and shrinkage in the wood.

Interior/ Second Floor

All Sections-

- Like the first floor, the second floor has localized dips and ridges that generally correspond to supporting walls below. The deflections are within a normal ranges for the construction type.
- There is water related plaster damage on the south wall of the 1909 section *that should be investigated as to its source.*



Interior/ Attic

All Sections-

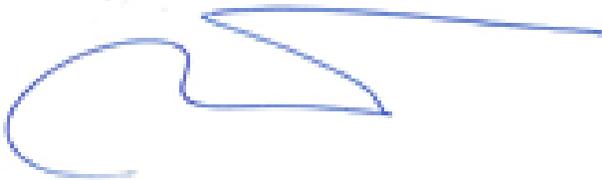
The exposed framing within the attic spaces all appeared to be in generally good condition other than for the specific items noted below.

- The rafter pair at the intersection of the 1844 and 1909 sections is discolored at the ridgeline, possibly by fungus, *and should be checked for rot.*
- The wooden posts that frame the cupola land on the sloping roof covering of the belfry with 90-degree cut ends and not hold-down connections. This puts undue stress on the roofing system and will eventually cause it to tear, and the lack of restraint diminishes the resistance of cupola structure to wind loads. *Properly seated and anchored post-base connections should be installed.*



Thank you for the opportunity to explore this interesting and significant structure. Please contact me if you have any questions or comments.

Respectfully Yours,



John M. Wathne, PE, President
Structures North Consulting Engineers, Inc.