



CONSULTING STRUCTURAL ENGINEER, INC.

336 Baker Avenue
Concord, MA 01742

978-461-6100
www.cse-ma.com

December 12, 2019

First Parish Unitarian Church
Concord, MA

c/o: Roselyn Romberg, Trustee

Email: roselyn.romberg@gmail.com

RE: Structural Investigation and Evaluation
The Wright Tavern
6 Lexington Road
Concord, MA

CSE 05319

Dear Roselyn:

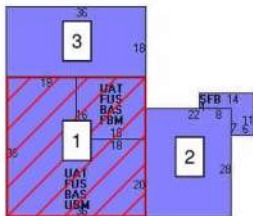
Consulting Structural Engineer, Inc. (CSE) is pleased to provide you with the following structural investigation and evaluation for The Wright Tavern located at 6 Lexington Road in Concord Massachusetts. On November 19, 2019 CSE conducted a site investigation and general visual observation in and around the accessible areas of the interior and exterior of the building for the purpose of preparing this report. The building is open and operating as leased commercial office space at the time of observation.

In addition, we witnessed the structural concerns identified for further evaluation in a building inspection report prepared by Paul Cornell and Associates dated July 19, 2019. The following items related to structure were reviewed from the referenced report:

- Item 1.5 – deflection of roof framing
- Item 3.3 – foundation cracking
- Item 3.8 – side wall uneven settlement and distortion
- Item 6.1 – loose and spalling foundation material
- Item 6.5 – general condition of first floor framing and support in the basement
- Item 6.7 – lally column connection in crawl space
- Item 12.0 – possible framing failure at interior spaces
- Item 12.9 – selective demolition for assessment of third floor space.
- Item 14.1 – broken framing and connection failure.

BACKGROUND

The building is an historic wood frame structure over full basement that was constructed in 1747 according to available public records. See footprint sketch of the building floor plan and recent photo of the subject property below:



Footprint Sketch



Exterior Photo

For the purposes of this report, North is to the right of the footprint sketch and the area marked "2" represents the north end of the building.

We understand that this structural evaluation is commissioned to assess the building's current condition, identify structural concerns and make recommendations for structural repair as necessary. There are no proposed improvement or alteration plans considered in this evaluation.

EXISTING STRUCTURE

The building can be separated into three (3) structurally distinct areas based on the observed construction type and as keyed on the footprint sketch as follows:

- Area 1: Original 1747 core of the building measuring 36-feet by 36-feet on two floors with accessible attic over full basement. Framed of hand-hewn lumber at the time of original construction. The foundation consists of clay brick masonry on field stone.
- Area 2: Area 2 is two floors over full basement and appears to be an addition made subsequent to the original construction. The approximately 30-foot long by 24-foot wide area is framed of dimensional rough sawn lumber and the foundation consists of clay brick masonry on field stone.
- Area 3: Single story addition over crawl space framed of more modern, dressed conventional lumber and supported by a stone and concrete masonry unit foundation. Flat/low slope roof construction.

Several modifications and reinforcements are evident within areas 1 and 2 as damage was addressed and alterations made over time.

FINDINGS

The following observations were made during the site investigation:

- A. Area 1 roof framing:
- The general configuration of the roof is hip framed to a low-pitch/flat center area. There exists a center king post (see photo #3 and #5) and four (4) hip posts (see photo #4 and #6), see general arrangement below:



- Significant sagging of roof framing members is observed in the sloped/hip roof framed areas. (See photo #9)
 - Sagging down towards each hip post from the center post is evident. (See photo #10)
 - Past damage due to snow load and deterioration as well as miscellaneous repairs are evident within the roof framing. (See photo #4)
- B. Area 1 third/attic floor framing:
- The third/attic floor framing is completely concealed with some areas expressed through finishes. The framing consists of approximately 9x9 timber girders

spanning 18-feet, spaced at 9-feet on center, supporting unknown smaller timber joists between them. The girders are generally sagging along their span and out of level. (See photos #8 and #14)

- b. A continuation of the center roof post exists through this level within the center wall. A noticeable high point in the floor occurs immediately adjacent to and around the center post, the floor slopes down in all directions from the center. (See photo #7)
 - c. There is no continuation below each of the four (4) hip posts. The timber girders aligned under these posts are sagging significantly under the weight of the roof. (See photo #8)
 - d. A crack monitor is present on the interior finishes at the location of the timber girder as it ties into the mid-point of the east wall.
 - i. Original photographic documentation of the crack monitor at time of installation in approximately 2014 was reviewed while on site. (See photo #11)
 - ii. A new photograph of the crack monitor position was recorded as part of this report. (See photo #12)
 - iii. The difference between the original installed position of the monitor and the observed current position is approximately 1 millimeter more separated as read from the monitor markings. The movement of the crack indicates separation of the timber girder from the east wall.
 - e. Cracking and separation of the timber girder from the west wall adjacent to the northwest chimney of the second floor is observed. (See photo #13)
- C. Area 1 second floor framing:
- a. The second floor framing is completely concealed with some areas expressed through finishes. The framing is similar in configuration, span and size to the third/attic floor framing above. (See photos #15 and #16)
 - b. A continuation of the center roof post exists through the first floor level within the center wall in the area of the bathroom/corridor wall. (See photo #17)
 - c. Based on the more segmented floor plan layout of the first floor, there are more incidental opportunities available for support of the second floor framing by interior walls separating halls/office units/bathrooms, etc.
- D. Area 2 roof framing:
- a. The ridge line of area 2 has a visible sag along its length. The ridge board is not visible from the inside.
 - b. Roof rafters are 3x5 timbers at 32-inches on center, supported by balloon framed walls that extend approximately 32-inches above the second floor level. (See photo #19)
- E. Area 2 second floor framing is not visible due to interior finishes.
- F. Area 1 and 2 first floor framing:
- a. The first floor framing is a mix of original timber framing and more modern reinforcements to address damage and alterations made over time. (See photos #20 and #25)
 - b. Framing reinforcements in many instances are done poorly with inadequate support. (See photo #24)
 - c. A masonry wall is present under the center post location. (See photo #23)
 - d. Interior supports consist of concrete filled lally columns located along timber girders and at other locations that appear to have been installed more recently. (See photos #20 and #25)

G. Area 3 framing:

- a. The roof framing is generally low-slope/flat and not visible due to interior finishes. (See photo #18)
- b. The framed first floor consists of 2x8 joists, spanning 8-feet, spaced at 16-inches on center and supported by a 6x10 centerline beam. Lally columns spaced at approximately 9-feet on center support the center line beam to interior isolated footings. (See photo #26)
- c. The lally columns supporting the centerline beam are generally deteriorated due to moisture exposure in the crawl space. Some lally columns are no longer in contact with/supporting the centerline beam.

H. The following is noted regarding foundations in general for all areas:

- a. Overall the foundations appear free of obvious and significant settlement concerns. Some minor settlement or movement in the past has resulted in various cracking noted in a few areas, mainly at building corners. (See photos #21, #27, #28 and #29)
- b. A more modern interior poured concrete foundation is present along the east wall of area 1 adjacent to the internal basement stair. The base of this wall has significant spalling due to moisture exposure and steel reinforcement deterioration. The purpose of this interior foundation is not fully understood, but it does support timber floor framing above it. (See photo #22)
- c. In many locations the interior brick masonry walls are eroding. (See photo #21)

STRUCTURAL CODE EVALUATION

This report assumes that the building will continue to be used as commercial office building with no change of use or alterations proposed. The building is designated as an historic building and repairs to the structure are to be evaluated in accordance with the requirements of the International Existing Building Code, 2015 (IEBC) as amended by the Massachusetts State Building Code, 9th ed. (MSBC).

The work area compliance method of Chapter 5 in the IEBC is used as the basis for this structural evaluation and a summary of MSBC requirements applicable structural repair/restoration is provided below:

IEBC Code Section	Code text / <i>Comments</i>
104.2.2.1 Building investigation and evaluation. <i>MA Amendment</i>	<i>This report summarizes the <u>structural</u> investigation and evaluation as directed by this section.</i>
301.1 General	<i>The work area compliance method per Section 301.1.2 is utilized in this evaluation.</i>
202 General Definitions.	DANGEROUS. Any building, structure or portion thereof that meets any of the conditions described below shall be deemed dangerous: <ol style="list-style-type: none"> 1. The building or structure has collapsed, has partially collapsed, has moved off its foundation, or lacks the necessary support of the ground. 2. There exists a significant risk of collapse, detachment or dislodgement, of any portion, member, appurtenance or ornamentation of the building or structure under service loads.

	<p>HISTORIC BUILDING. Any building or structure that is one or more of the following:</p> <ol style="list-style-type: none"> 1. Listed or certified as eligible for listing by the State Historic Preservation Officer, or the Keeper of the National Register of Historic Places, in the National Register of Historic Places. 2. Designated as historic under applicable state or local law. 3. Certified as a contributing resource within a National Register, state designated or locally designated historic district. <p>REPAIR. The reconstruction or renewal of any part of an existing building for the purpose of maintenance or to correct damage.</p>
508.1 Scope <i>Historic Buildings</i>	Historic building provisions shall apply to buildings classified as historic as defined in Chapter 2 .
508.2 Application <i>Historic Buildings</i>	Except as specifically provided for in Chapter 12 , historic buildings shall comply with the applicable provisions of this code for the type of work being performed.
1202.1 General <i>Repairs - Historic Buildings</i>	Repairs to any portion of an historic building or structure shall be permitted with original or like materials and original methods of construction, subject to the provisions of this chapter. Hazardous materials, such as asbestos and lead-based paint, shall not be used where the code for new construction would not permit their use in buildings of similar occupancy, purpose and location.
1202.2 Unsafe Conditions <i>Repairs - Historic Buildings</i>	Conditions determined by the code official to be unsafe shall be remedied. No work shall be required beyond what is required to remedy the unsafe conditions.
1206.1 General <i>Structural - Historic Buildings</i>	Historic buildings shall comply with the applicable structural provisions for the work as classified in Chapter 5 . Exception: The code official shall be authorized to accept existing floors and approve operational controls that limit the live load on any such floor.
1206.2 Dangerous Conditions <i>Structural - Historic Buildings</i>	Conditions determined by the code official to be dangerous shall be remedied. No work shall be required beyond what is required to remedy the dangerous condition.

PROFESSIONAL OPINION AND RECOMMENDATIONS

Based on our visual observation and the findings of the investigation outlined in this report, we offer the following professional opinions and recommendations:

1. The roof framing within the original 1747 core (Area 1) of the building requires reinforcement to support snow loads. The observed local sagging of sloping rafters is the result of snow load overwhelming the existing framing.
 - a. We recommend reinforcement of all rafters within the roof.
2. The third/attic floor framing above the second floor of the original 1747 core (Area 1) requires reinforcement to support the roof loads imposed by the four (4) hip posts. The

excessive span of 9x9 timbers under the hip posts and lack of suitable supports aligned below these posts has resulted in the apparent sagging in the ceiling of the second floor. In addition, the transient nature of the snow load on the roof results in cyclical loading that is contributing to the horizontal separation over time between girder and wall observed on both the east and west walls of the second floor. The high point of second and third floors around the center post location is evidence that the center post is suitably supported and the inadequate framing under the hip posts is the primary cause of the observed concerns.

- a. We recommend removing all the finishes in the third floor/attic space as well as the second floor ceiling in order to properly assess and re-frame the third/attic floor to provide suitable support of the roof. This repair and reinforcement should be considered a priority item.
3. The observed framing of the first floor in areas 1 and 2 is the result of original undersized framing, past alterations and damage repair made by poorly done reinforcements.
 - a. We recommend correction of the first floor reinforcements and addition of more suitable supports in the basement where warranted. This work may include one or more of the following types of work:
 - i. Installation of additional beam lines with lally columns adjacent to foundation walls where joist ends are not properly supported.
 - ii. Installation of additional lally columns under existing girders.
 - iii. Installation of suitable joist hangers on joist ends framing into timber girders.
 - iv. Sistering of original joist framing and/or removal and reinstallation of existing joist sisters with properly installed joist sisters.
4. The observed ridge line sagging of the roof at area 2 is due to the existing rafter framing supported on a stud wall plate that is 32-inches above the floor level. The lack of ceiling ties at the rafter bearing plate allows the rafters to push out on the wall and results in the sagging rafter.
 - a. We recommend the installation of a ridge beam under the existing ridge to stabilize the condition.
5. The observed deterioration of lally columns in the crawl space of area 3 is the result of exposure to excessive moisture in the space.
 - a. We recommend that the moisture is controlled in the area by installation of a moisture barrier and concrete slab-on-grade.
 - b. We recommend all lally columns are replaced with new lally columns. Expose footings as part of the work to determine the footing size/suitability, replace if warranted.
6. The observed interior brick wall deterioration within area 1 and 2 is the result of soft clay brick eroding over time.
 - a. We recommend these walls are removed/replaced in locations where the interior brick walls provide necessary support of the framing above. This may be accomplished by masonry in-kind or replacement with lally columns and beams in the basement as necessary.
7. The observed cracking in perimeter brick masonry and stone foundation walls is the result of past minor movement, thermal movements or minor localized settlement.
 - a. We recommend that these walls are repointed and sealed at the crack locations.
8. The spalling of the interior poured concrete foundation in area 1 is due to inadequate concrete cover on reinforcing and exposure to moisture over time.
 - a. We recommend that the loose and unsound concrete and deteriorated reinforcing be removed, and the wall repaired with a suitable repair mortar.

9. In general, the overall unlevel and sloping nature of the floors in areas 1 and 2 is the result of undersized framing and long spans, common in the time period of construction. While the ceiling of the first floor is entirely finished, there were not obvious and visible concerns noted at the second floor framing level. The observed concerns of the third/attic floor and first floor framing levels are noted in this report.
10. As an historic building, the applicable sections of the building code for structural repair are geared towards general safety and removing dangerous conditions. The code will not trigger code upgrades related to damage requiring repair beyond the requirement to remedy a dangerous condition. In our professional opinion of the third/attic floor framing as it supports the roof hip posts (item 2 above) is an observed condition that warrants repair/reinforcement under this provision.

CONCLUSION

This structural evaluation is prepared to assess the building's current condition, identify structural concerns and make recommendations for repair. The building's current condition is consistent with its construction type, age and various repairs/alterations made over the years. Existing structural conditions are identified that will require attention. We specifically identified the reinforcement of the third/attic floor supporting the roof at hip posts (item #2) as a priority item for reinforcement. It would be prudent to address item #1 at the same time as item #2 and would represent a significant reinforcement effort related to the roof. The next level of priority should consider items #3 through #6, followed by items #7 and #8 as lower priorities.

The observations, evaluations and recommendations made in this report are based on one walk-through, visual observation of readily accessible areas within and around the existing building. The work performed to date and the information presented in this report is representative of only the areas witnessed during the investigation. As a result, it cannot be assumed that this report identifies all structural deficiencies or that this report conveys an assessment of the structure in its entirety, specifically those areas not witnessed during the observation.

Thank you for the opportunity to support you with this project. If you would like to discuss this project further or have any questions, please feel free to contact the undersigned.

Sincerely,



Brian A. Walsh, P.E., SECB
CONSULTING STRUCTURAL ENGINEER, INC.
BAWalsh@cse-ma.com
(978) 866-8354

Attachments: Photographs taken November 19, 2019



1) North west elevation, area 2 to left, area 3 to right and area 1 center.



2) South west elevation, area 3 single story area in foreground.



3) Center post in attic above ceiling.



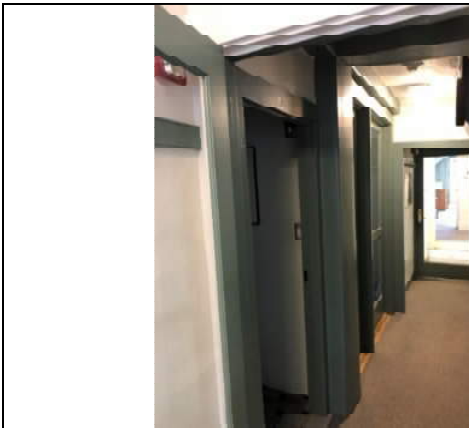
4) Typical hip post in attic above ceiling, typical of 4 locations.



5) Continuation of center post through third/attic level.



6) Continuation of hip post through third/attic level.



7) Continuation of center post through second floor level. See photo #17 for continuation through first floor.



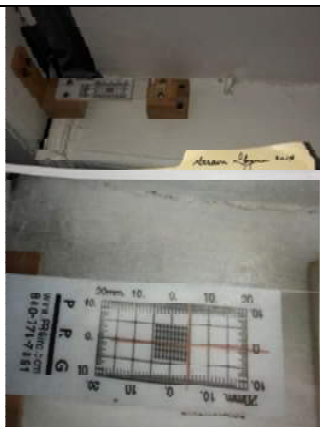
8) Timber girder in third/attic framing supporting hip post above, span approximately 18-feet.



9) Sagging rafters on west facing hip roof of the original 1747 construction in area 1.



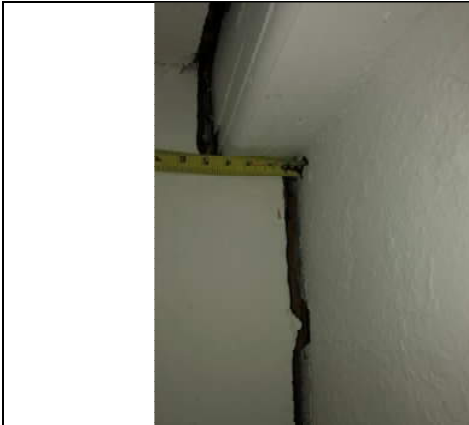
10) Sagging end of center girder at interface of hip roof at west side.



11) Existing crack monitor on east wall at interface with center girder (top) and documented measurement from 2014.



12) Current reading of crack monitor during observation.



13) Crack in closet of second floor office on west wall at chimney.



14) Sagging condition of timber girders typical throughout second floor ceiling.



15) Exposed second floor timber beams in ceiling of first floor.



16) Exposed second floor timber beams in ceiling of first floor.



17) Continuation of center post through first floor level adjacent to bathroom door.



18) Interior of the single story area 3 under roof.



19) Area 2 roof rafter bearing on wall plate above floor level.



20) General first floor framing in area 2.



21) General condition of field stone wall and interior brick masonry walls.



22) Spalling of interior concrete foundation at base in area 1.



23) Concrete masonry wall along center line in area 1 and beneath center post to roof.



24) Sample floor joist sisters in area 1 with inadequate support at foundation wall.



25) General first floor framing of area 1.



26) General first floor framing within area 3 and dirt floor crawl space, deteriorated lally columns.



27) Interior side of wall at photo 28, no crack visible.



28) Exterior side of wall at photo 27, crack present.



29) Exterior foundation of area 3 with visible crack.



30) North east corner.