OLD TROLLEY BARN
BUILDING STUDY
Town of Rye, NH

Final Report
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ROBERT E DOYLE PE RA

Architecture • Engineering • Project Management
22 West Concord Street, Dover NH 03820
603•738•2872 rdoylepera@gmail.com

The Old Trolley Barn Building Study

The Old Trolley Barn building was built by the Boston & Maine Railroad as a shelter for a storage battery for the electric railway that ran between Portsmouth and Rye, North Hampton and Hampton, NH. The building was constructed approximately in year 1898. The railway was abandoned in 1925. The Town has used the building for multiple uses since, including the Department of Public Works and the Police Department. The building has been unoccupied since 2008. In recent years the building has been used for storage; items stored include bicycles, furniture, green head fly traps, and miscellaneous smaller items.

A soil vapor and indoor air monitoring was performed by Exeter Environmental Associates in February 1997 at the building because of a report of a gasoline vapor smell. The monitoring confirmed that there were gasoline vapors at the southwest rear corner of the building but at very low levels. After reviewing the monitoring information, in June of 1997, the New Hampshire Department of Environmental Services stated that "all sources of groundwater contamination at the subject site discovered during the site investigation have been eliminated and require no additional investigation, remedial measures, or groundwater monitoring."

A. Building Existing Conditions

Structural System

The building is a symmetrical gable, timber framed structure with a 2:12 roof pitch. The structure of the building is a timber frame with 8"x10" exterior posts and 8"x10"roof beams at 10 feet on center connected to a row of 8"x8" center posts. There are 8"x8" ridge beam and eave plates and 8"x8" tie beams at the gable ends. There are 4"x5" knee braces connecting all the posts, to the roof beams and eave plates.

The exterior wall is framed with 2"x6" studs that extend full height to the 8"x8" eave plate. The original wall sheathing is 1" thick boarding. The roof sheathing is a double layer of 1 ½" and 1" decking. The foundation is brick masonry on top of granite block. The floor is a concrete slab on grade.

A framed attic floor was added to the building at a later date. The attic floor was framed with 2x8 joists at 16" on center. A portion of the west half of the building was sheathed to provide for light weight storage. The 2x8 attic floor joists below this storage area are supported at near mid-span by an interior post and beam system. The attic framing in the East bay was not sheathed and only supports the ceiling system below. Access to the attic is by a pull down stair.

At a later date, a small addition was added to the building, at the East elevation. The addition floor is approximately 4 inches above the slab on grade of the main building. The addition is wood framed with a high slope roof.

The building structure is generally in good condition, showing little sign of sag, deflection or being out of plumb. There have been minor repairs to two of the knee braces and a portion of the eave plate in the Southeast corner of the building shows signs of decay from possible water damage.

Insulation, Moisture Control and Finishes

The building exterior walls and roof were insulated with a 2 inch thick honeycomb paper insulation panel. The insulation panels were placed between the wall and roof framing and attached to the backside of the exterior wall and roof sheathing. At a later date, unfaced and paper faced fiberglass batt insulation were added to the exterior walls and ceiling of the building. 3 ½" (R-11) fiberglass batt insulation was added to the exterior walls over the insulation panel. 3 ½" fiberglass batt (R-11) in two layers, was added to the attic floor between the attic framing.

The interior wall and ceiling finish is gypsum wallboard painted. A portion of the northwest corner of the building is unfinished and open to the roof structure above. There is no evidence of a vapor barrier on the warm side of the insulation at either the walls or the attic floor framing. The floor finishes are a mix of carpeting and resilient flooring.

The building is vinyl sided. The vinyl siding has reached the end of its service life. The vinyl is brittle and has numerous locations of cracking and splitting. An air barrier was observed below the siding and was probably installed at the time the vinyl siding was installed. The building was reroofed recently with an EPDM roof. An investigation of the roof was not included in this study.

Electrical System

The building has a 200 Amp service with manually resettable circuit breakers. The service panel was installed in June 1993. The wiring that is visible in the building is a mix of Romex cable and MC cable.

Heating System

The existing system is a hot air furnace. All main spaces in the building are supplied by a ductwork system. There are two return air vents, one located at the front of the building and one centrally located on the West side of the building, ducted back to the furnace. The heating system has been inoperable for most of the period that the building was vacant.

B. Structural Analysis

JSN Associates of Portsmouth, NH made a site visit on May 30, 2013 to review the existing conditions of the building and take measurements in order to analyze the structural integrity of the building. See Appendix A for a copy of their analysis. The following is a summary of their findings:

- The perimeter foundation system appears to be generally of brick and in good condition.
- The only major visible defect in the structural system was noted around the chimney where the stud wall's top plate appears to have disintegrated due to an extended period of exposure to weather.
- In general, the building appears in good condition and of adequate structural integrity to be utilized for future use. Minor repairs will most likely be necessary as structural items are exposed during renovations.
- If re-use of the building requires removal of some of the attic floor, this modification will not adversely affect the structural integrity of the building as long as the exposed studs are found to be continuous from floor to the eave.

- The renovation of the building may require removal of the existing posts and beams supporting mid-span of the attic floor joists on the West half of the building. In my opinion, this modification will not adversely affect the building's structural integrity as long as the attic space is not used for any function including storage.
- The attic flooring is suitable for attic access purposes only. Any future use of the building should not include storage in the attic.

C. Environmental Analysis

RPF Environmental (RPF) of Northwood, NH conducted a site visit on June 3, 2013. They provided observance and testing for mold, lead paint and asbestos contamination. See Appendix B. for a copy of their report. The following is the scope of work provided:

Mold and Moisture

- RPF made visual observations of accessible interior building materials and accessible portions of ventilation equipment at the site for indicators of mold contamination. RPF measured moisture content (%) of accessible representative interior building material surfaces.
- Two indoor area air samples, one outdoor (control) air, and one required analytical field blank sample for comparative purposes for a total of four area air samples was performed to quantify airborne fungi spore and particulate analysis utilizing the Air-O-Cell spore trap cassette method to identify and count airborne particulates such as fungal spores and mycelial fragments (parts of fungi).

Lead Paint Screening

- RPF conducted limited spot sampling of representative surfaces utilizing a portable x-ray fluorescence detector (XRF) to determine lead content.

Asbestos Survey Service

- RPF collected 24 samples of onsite materials. The samples were analyzed for asbestos content using polarized light microscopy (PLM).

Summary

The following is a summary of RPF Environmental's observances, testing results and recommendations:

- Based on the testing performed by RPF asbestos was not detected in the materials sampled.
- RPF conducted limited spot testing of paint and trace amounts to no lead concentrations were detected on the interior and exterior building components.
- RPF observed apparent fungal growth on walls throughout the building as well as on several chairs in the south center room of the building.
- High moisture levels were detected in various interior building components throughout the building. Elevated concentrations of airborne fungal spores were detected in the air samples collected inside the building. The concentrations of Aspergillus/Penicillium spores were elevated well above the concentration of Aspergillus/Penicillium spores

detected in the outside control sample. Aspergillus/Penicillium is commonly associated with damp and/or water damaged building materials. Given the moisture content of the interior building materials and the visual observations of suspected fungal growth on interior materials, the source of the airborne fungal spores is likely inside the building.

- RPF recommends that porous interior building materials such as carpeting, ceiling tiles, sheetrock and other wall coverings allowed to sit wet for more than 48 to 72 hours should be discarded and replaced, as applicable. Regardless of the level of effort expended to remediate fungal growth, the potential for fungal growth to return exists if the building materials were to become wet again, or be subject to elevated humidity levels.

D. Septic System Analysis

Ambit Engineering of Portsmouth, NH provided septic system evaluation and preliminary design for a potential septic system for the building. See Appendix C for a copy of their report. Ambit conducted a field test on June 30, 2013. Due to required setbacks from property lines the front yard of the building was the only area suitable for a below ground septic system. The soil tested in this area was a sandy loam with a percolation rate of 2 minutes per inch. The groundwater table at the test location was 94 inches below grade. The soils tested are adequate for septic disposal system. A preliminary design has been provided showing the extent of the proposed system.

E. Architectural Analysis

Robert E. Doyle PE RA made multiple site visits to review the architectural elements of the building including: integrity of framing and sheathing; extent of air and vapor barriers; condition of finishes; condition of doors and windows; condition of building systems and general spatial layout of existing partitions.

The following are the primary findings of the review:

- There was no sign of a vapor barrier on the warm side of the insulation at the exterior walls or ceiling. Additionally, due to the age of the concrete slab on grade there is probably no vapor barrier under the slab.
- Windows and Doors are older construction and have limited reuse in a full renovation.
- Vinyl siding shows signs of deterioration and has reached the end of its service life.
- The visible portions of the structural frame and sheathing seem to be solid and in good condition and should require only minor repairs for continued use..
- The concrete slab is generally flat with one section in the southwest corner that pitches 1 ½ inches in 12 feet.

F. Renovation Recommendations

The primary renovation issue with the building is the levels of moisture and mold found in the building. Because the building has been vacant for a period of time without an operable heating system this has probably been a long term issue. Because of the mold and moisture findings, this study recommends removing all organic and porous building materials from the building. This would include all flooring finishes, all gypsum wallboard ceilings and walls, and all faced

and unfaced insulation. We would also recommend the removal of all interior non structural framing due to high moisture contents at these locations. After demolition, we would recommend a cleaning of the structural frame and concrete slab.

Because of the likely possibility of no vapor barrier under the concrete slab on grade and the high moisture levels of the building, we would recommend all renovation options include an epoxy vapor barrier floor coating. This would mitigate some of the moisture entering the building by diffusion through the slab.

A vapor barrier should be installed on the warm side of the insulation at the exterior walls and at either the attic framing or roof framing. For all renovation options the building should be resided with a moisture resistant air barrier and appropriate flashing at all building doors and windows.

Additionally to control moisture further we would recommend the installation of gutters at the building eaves and the connection of downspouts to the storm water system. We would recommend a masonry sealer be applied to the brick foundation prior to residing the building.

The building should be insulated with appropriate levels of insulation. For cost estimating we have proposed R-38 fiberglass batt at the attic/roof and R-19 fiberglass batt plus 1 inch of rigid continuous insulation at the exterior walls.

For cost estimating purposes we have proposed all new electrical, plumbing, HVAC, and fire alarm systems for the building.

For all renovation options, we would recommend removing the Easterly addition to the building and replacing the doors and windows on the front façade with more historically accurate units. This would restore some of the buildings historic character and give it a more positive appearance in the Town center.

G. Renovation Approaches

This study proposes three levels of renovation for the building. The three levels of renovation will give a range of improvements from a minimal renovation to a more complete renovation of the building. The minimal renovation will be for a storage use only. The storage use will have no building occupants and will not require plumbing improvements or a septic system.

The midlevel renovation approach will be 50% storage use and 50% office use. For the office use half of the building will be renovated to the level of a typical office space. There will be improved finishes and a HVAC system.

The office/program renovation approach would improve the entire building to the level of a typical office space, while providing some larger spaces for larger group activities. These program spaces could have higher cathedral ceilings with the timber frame exposed.

The following are the specific improvements of each renovation approach:

Storage Use Renovation

The storage use would include all improvements to the building needed to provide for a storage use for the Town. This renovation approach would provide a heating and ventilation system but would not provide archival quality storage. This renovation option would not provide for future occupants of the building. The storage use renovation would include:

- Demolition of easterly addition, and infill of exterior wall.
- Demolition of all interior finishes and interior non-structural partitions, including; flooring, gypsum wall board interior walls and ceilings, doors, plumbing fixtures, insulation, plumbing fixtures and heating system.
- Demolition of windows and doors at front elevation
- Minor structural repairs to existing timber frame.
- Epoxy vapor barrier floor coating.
- Roof and wall insulation (R-19 and R-38)
- Vapor barrier at wall and ceiling.
- Limited gypsum wallboard partitions
- Gypsum wallboard ceilings.
- Limited new windows at front facade
- New Overhead door at side of building
- New vinyl siding
- Heating and ventilation system
- Electrical and fire alarm systems

Mixed Use Storage/Office Renovation

The mixed use storage and town offices renovation would include all improvements for half the building to be used as a storage use and provide offices for approximately 4 to 6 occupants for the other half of the building. Parking for this use would be limited to the amount of spaces that could fit in the parking lot, approximately 10 spaces including 2 ADA spaces. Depending on the amount of occupants of the building, there could be some minimal visitor parking provided.

This use would require installation of a septic system and repaving of the parking area. The mixed use storage/office renovation would include the requirements of the storage use renovation and the following:

- Demolition of all exterior window and doors
- Septic system and repaving of parking area
- Infill of exterior wall at window removal locations
- Energy efficient windows to match historic period of building on office side
- Concrete slab leveling as required.
- Additional gypsum wallboard partitions.
- Additional interior doors
- Acoustical tile ceilings.
- Resilient and carpet flooring
- Casework cabinets and counters.

- Plumbing fixtures.
- HVAC system.

Town Office and Program Space Renovation

The town office and program space renovation would include all improvements to provide offices for approximately 4 to 6 occupants and to provide program space for group activities. Onsite parking for this use would still be limited to the amount of spaces that could fit in the parking lot (approximately 10 spaces including 2 ADA spaces). For this use to be functional, additional parking would need to be provided close to the site. A potential location for parking would be for cars to park along the interior access road to the Town Cemetery across the street. Access from the parking would require construction of a pathway across the parade lawn area to Central Road, a portion of stone wall would need to be removed to make this connection.

The town office/program space renovation would include the requirements of the mixed use renovation and the following:

- Demolition of portions of the ceiling framing as required to accommodate new program spaces.
- Additional quantity of windows, doors, flooring, act ceilings, partitions, plumbing fixtures and hvac system.
- 140 foot paver walkway from proposed parking along the cemetery road.
- Removal of 10 feet of stone wall.

See Figures 1 through 3 for conceptual plans of the renovation options. A conceptual building elevation has been provided for the office/program space use (See Figure 4)

H. Cost Estimates

The following are preliminary budget cost estimates based on the renovation approaches discussed above. The costs provided are 2013 construction costs and do not include inflation. The construction costs include demolition, building construction and site improvements. The costs do not include A/E design fees, permit fees, or Owner soft costs. Selective building demolition costs are the same for all renovation approaches and include material demolition and removal; and building clean up and estimated abatement. A building and site demolition cost has been provided that would include: building, foundation and pavement demolition; and hydroseeding of the site. All costs include a 10% contingency. The estimated costs are based on the exterior area of the building of 2,650 square feet. See Appendix D for detailed cost estimate spreadsheets.

Cost Estimates

The following is a cost for selective demolition of the existing building which would include such items as: East addition, gypsum wallboard walls and ceilings, interior nonstructural framing, flooring, fiberglass and board insulation, hvac system, electrical system, plumbing fixtures and front elevation window and doors.

Selective Demolition Costs		
(Add to all renovation options for total cost)	**$45,000**	**$17/sq. ft.**
Storage Renovation	**$147,000**	**$56/ sq. ft.**
Storage/Office Renovation	**$277,000**	**$105/ sq. ft.**
Office/Program Use Renovation	**$377,000**	**$143/ sq. ft.**
Building and Site Demolition Cost		
For complete building demolition including foundation, pavement removal and hydroseeding of disturbed areas.	**$45,000**	

I. SUMMARY

The building investigation showed that the structural system of the building and the septic capacity of the site soils are adequate for future use of the building. The mechanical and electrical systems are either inoperable or of limited reuse value and should be replaced as part of any renovation option.

Due to high levels of mold and moisture found in the building, all interior finishes, insulation and interior nonstructural framing should be removed as part of any renovation option. After demolition the building slab and exposed structure should be cleaned by trained personnel using proper equipment and controls.

The existing exterior building finishes, doors and windows are at the end of their service life or are not adequate for future use and should be replaced as part of any renovation option. Replacement of the doors, windows, siding and trim with traditional units and detailing would allow the building; to replicate it's historic period of construction and provide a better appearance in the Town center.

A storage use renovation could be completed relatively inexpensively because the amounts of improvements are limited and no site improvements or septic system are required. The total construction costs for this option would be $73 per square foot, which would be well below new construction costs. The midlevel mixed use renovation would add improvements beyond the storage use including: septic system and repaving the parking area: increase in finishes, doors, windows, hvac system, and electrical system. The midlevel renovation total construction costs would be $122/square foot which would again be well below costs for new construction.

The full office/program use renovation would add an increased amount of finishes, doors, windows, plumbing, hvac system, and electrical system. The full office/program renovation total construction costs would be $160/square foot which would be 10 to 20 percent below costs for new construction. The additional issue and cost with the full office/program use renovation would be the need for additional offsite parking close enough to the site to meet the program needs.