ARCHITECTURAL CONSERVATION ASSESSMENT

August 1, 2011

1790 WESTFORD ACADEMY

TOWN OF WESTFORD & WESTFORD HISTORIC SOCIETY

WESTFORD, MASSACHUSETTS

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INTRODUCTION

This architectural Assessment has been prepared William B. Finch of Finch&Rose to provide the architectural component of the Conservation Assessment Program Survey (CAP) for the 1794 Westford Academy and adjacent cottage which are owned by the Town of Westford and operated by the Westford Historical Society (WHS) as a museum of the Town's history. The subject structure is located at 2 Boston Street in Westford, Massachusetts.

The assessment is based on site visits made on June 26 and 28 of 2011. The Survey is being funded by Heritage Preservation, of Washington, D.C. A concurrent Collections Assessment has been conducted by Marc Williams of XXXX, CN. The June 28 visit was made in coordination with the CAP Collections assessor, Marc Williams. Substantial help and background information was provided during the site visits by Penny Lacroix, Museum Director, Newell Tillman, day-to-day facilities manager. We also met with John MangiarattiJohn Mangiaratti, Asst. Town Manager, Beth Shaw, WHS board president, Sally Benedic, treasurer of the WHC, Patti Mason, WHS board member to review their concerns regarding the museum buildings.

The Westford Academy was originally constructed on the Westford Common in 1794 based on records of the Academy. The acadamy stopped using the building in 1897 after constructing a new academy building. In about 1916 the building was moved from the common to its current site and renovated for use a the Westford Fire House. Further changes were made later in the twentieth century to upgrade its usage as the fire house. A new fire house was constructed in the 1970s and building was then restored for its current used as a town museum. The restoration was carried out over a period of about 3 years starting in 1980 by students from the vocational high school under the Direction of Robert Adam and others This restoration is referred to in this report as the "c. 1980 restoration". The cupola was struck by lightning in 1982 which resulted in additional repairs to it and a small fire in the cellar.

Despite the changes made for the fire station usage, the exterior retains an extensive amount of original fabric including clapboards and trim, most window frames, and the cupola. The interior was reconstructed following evidence for its original plan with period typical detailing, as there was no remaining evidence for the interior finishes. The plan is an entry vestibule with two staircases across the west end of the building, with the rest of each floor being a single large open room. The interior finishes at the start of the c. 1980 restoration dated to the late 19th and early 20th centuries. Currently the first floor is used for museum exhibits and a meeting room, and the second has additional exhibits.

The cottage was constructed c. 1870 as a residence. It was later used by the Fire Department until c. 1983 when it began its current usage as offices of the WHS and to house their archives of historical materials including numerous photographs and paper records.

The primary goals of this Architectural Assessment are to identify conditions of the buildings that may impact their preservation as well as the preservation of the collection items within them, recommend appropriate options to remedy the identified conditions, and to review the operation of the property in relation to environmental, safety, access, and security issues. The assessment is confined to readily visible architectural and mechanical systems components of the buildings and is not intended to evaluate building code compliance, hazardous materials, and structural capacities or other structural issues that are normally within the purview of a structural and/or mechanical engineer.

The buildings were recently the subject of structural engineering reports by Ipswich River Engineering, Inc., of North Reading MA. These reports were reviewed by this assessor as part of the background for this assessment and are referred to in the report text by the initials "IRE".

The text of the architectural assessment is organized by building systems, dealing first with the Westford Academy building. Exterior elements are discussed first starting with the roof. 68 photographs and three drawings of the cupola framing illustrating the text are attached at the end of the report text on the Academy Building. The photographs and drawings are by William B. Finch unless otherwise noted in the captions. Recommendations are provided at the end of each section in indented italic type. The relative priority of recommendations is indicated by asterisks, three being high priority, two being medium, and one being low. A summary of all the recommendations is attached at the end of the Acadamy Building report text. Also attached are graphs of the temperature and relative humidity readings from the the two data logs that were run during the site visit (note; copies of the graphs are not included in the PDF file of the report). The results of these two data loggers along with others compiled by the WHS are discussed the collections assessment report.

EXECUTIVE SUMMARY

This architectural Assessment has been prepared William B. Finch of Finch&Rose to provide the architectural component of the Conservation Assessment Program Survey (CAP) for the 1794 Westford Academy and adjacent cottage which are owned by the Town of Westford and operated by the Westford Historical Society (WHS) as a museum of the Town's history. The subject structure is located at 2 Boston Street in Westford, Massachusetts.

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The most pressing needs of the Academy building are to replace the deteriorated wood shingle roof and its flashings, replace the composition roofing and flashing of the bell deck that has had a history of leaking, replace the cupola balustrade and repair other deteriorated cupola trim, and to retain a professional with wide experienced in the evaluation of eighteenth and early nineteenth century timber frame construction involving steeples and cupolas to carry out a detailed evaluation of the cupola and bell deck framing.

Other significant issues needing treatment include the following:

- Most of the window sash need to be reglazed and painted and incorrectly oriented ones reinstalled
- The first floor front corner quoins need to replaced to better match the historic quoins.
- The southerly corner board and the southeast rear corner needs to be removed and reset.

(More items to be added to this list)

MAIN ROOF (Photos 7-9)

Description
The original roof was undoubtably hand split wood shingles installed over the original wide pine roof sheathing boards that remain in place. The sheathing boards are oriented vertically up the pitch of the roof. The original shingles would likely have been Eastern red or white cedar, or possibly eastern white pine. They would have been hand split with a smooth shaved surface, and were otherwise very similar in dimension and thickness to modern sawn cedar shingles.

The current roof is red cedar wood shingles installed in 1992. According to a letter documenting the completion of the job by the project architect, Robert Jefferies, the shingles are "red label" grade with a preservative treatment. They are fastened with copper plated steel staples. They are laid directly on felt roofing paper over the plywood deck that was added in the c. 1980 work. An additional layer of felt roofing paper that was installed between the original roof sheathing boards and the new plywood deck in the c. 1980 restoration. According to the Jefferies letter, the wood shingles installed in c. 1980 were in poor condition in 1992.

Condition
The roof shingles are currently at the end of their useful service life and in very poor condition. A number of individual shingles have recently slipped out of place and been replaced with new shingles, presumably due to their fasteners corroding. Many of the shingles are curling badly. Based on several samples in the museum office, their exposed surface has become deeply eroded from ultra-violet sunlight. "Red Label" shingles are the #2 shingles in the four tier grading system of the shingle industry. They are permitted to have some knots in the upper portion of the shingles along with a limited amount of sapwood and/or flat sawn wood. The shingles in the office were vertically grained heartwood without knots, and would conform #1 "blue label" standards. "Blue label" shingles are the standard product used on roofs in quality work.

The installation of the shingles has a number of problems. In addition to the poor choice of fasteners, the staples were placed an inch or two higher up on the shingles than the normal placement, which contributes to the curling problem. The shingles are also spaced about 1/2" apart, which is wider than normal. Installing the shingles directly over felt paper without any provisions for air circulation beneath them to dry out moisture often causes premature deterioration from the underside of the shingles. The plywood deck further aggravates this problem.

The normal service life for red cedar wood shingle roofs is 20-25 years when installed properly. Given the problems of the 1992 installation, the shingles have performed reasonably well. Most of the recent leaking that has affected the second floor ceiling is due to flashing problems at the chimney and the cupola.

Treatment Recommendations
*Replace the roof within the next year using "blue label" #1 "perfection" (i.e., 18" long) red cedar shingles incorporating provisions for ventilation under the shingles and with proper nailing. ****

We like to install them at 5" to the weather rather than the minimum of 5 1/2". Options for ventilation include "Cedar Breather" type plastic mesh, or spaced boarding composed of 1"x3" furring strips spaced horizontally to match the exposure of the shingles. 3" wide strips of 3/8" plywood can be placed vertically 16" on center under the furring to further promote ventilation. The crown molding around the edge of the roof would need to be raised to hide

the boarding while providing a space to let air in. Alternatively, the boarding can be stopped about 2' above the roof edge with reversed shingles used as shims to taper the surface of the new shingles down to the current position of the crown molding. Felt paper underlayment is acceptable but not necessary as long as it is under the cedar breather or furring strips. Removal of the plywood would improve ventilation under the shingles but may get into issues of the condition of the original sheathing. In that case using spaced boarding can get around issues of how well the original sheathing can hold nails. A band of self adhering "Ice and Water Shield" type membrane should be installed at the eaves, hips, and other flashing locations, but should not be installed over the entire roof surface.

The shingles should be hand nailed with good quality hot dipped galvanized shingle nails or box nails. Some contractors use ring-shanked stainless nails, but that will create problems for the eventual replacement of the shingles due to the strong holding power of the ring shanks. # 316 alloy stainless nails without ring shanks are an option provided they have a wide enough head, but they may not have the holding power of hot dipped galvanized nails. The use of nail guns can cause problems by over or under driving nail heads in relation to the surface of the shingles, but can be used if the applicator demonstrates that the gun is consistently driving the nails correctly.

16 oz. Lead-coated copper flashings should be used if they can be obtained. 16 oz red copper is also acceptable, but there is some concern that the tannic acid in the shingles will corrode the copper. Our experience has been that the shingles fail before the copper does.

Alaskan Yellow Cedar shingles are a viable option to red cedar. They weather to a silver grey whereas red cedar weathers to a dark brown. We do not recommend using white cedar shingles.

In general, details should be based on the recommendations of Cedar and Shingle Bureau "Roofing Manual" and various other publications of that organization including their PDF documents on historical applications (available online at http://www.cedarbureau.org/installation-and-maintenance/roof-manual) as well as Preservation Brief #19: The Repair and Replacement of Historic Wooden Shingle Roofs by the National Park Service (available online at http://www.nps.gov/history/hps/tps/briefs. As some of these recommendations can be confusing and/or not appropriate for the Westford Academy application (much of the literature is meant for new construction) the town should retain a professional preservation consultant or architect to guide them through the options and prepare formal specifications for the roofing project. The consultant should have substantial experience in the installation of wood shingle roofs on historic buildings. The specifications should include a contractor qualifications section that requires 5 years experience installing wood shingle roofs on buildings of similar age including buildings listed on the National Register of Historic Places and buildings used as museums.

CUPOLA BELL DECK AND ROOF (Photos 12, 13, 16-18)

Description
The original materials used on these surfaces is not known, but the late 19th century photograph suggests that flat seamed sheet metal was used at that time on the cupola.

The cupola is currently finished with soldered flat seamed copper sheets and is painted a dark iron oxide red. In appearance and detailing it is nearly identical to the roof in the late 19th century photograph, except that the current sheets are wider and therefore fewer sheets have been used. The metal roof is topped with a wood cap. The cap may have a sheet metal covering.

The cupola is topped with a ball and weathervane.

The bell deck is currently covered with asphalt composition roll roofing that was installed in 1982. The penetrations eight cupola posts through the deck appear to be "flashed" with roll roofing that is now covered with roofing tar.

Condition
The sheet metal cupola roof appears to remain in serviceable condition. It was not examined "hands on", but there was no evidence of current leaking from the roofing or the cupola shaft on the ceiling boards of the cupola. The painted surface of the metal roofing exhibits some wear with its primer showing through in some places. It was not clear if the roof cap is clad with sheet metal over wood, or is painted wood without a cover. It shows some wear and likely needs substantial repair or replacement, but its condition needs to be more fully assessed next time the cupola roof is painted.

The bell deck roof is extremely worn and many years past its useful service life. Past leaking is evidenced by water stains on the ceiling of the second floor and extensive patching of its surface with roofing tar. According to staff, the most recent repairs (presumably with tar) have stopped the leaking (at least to the extent that water has not penetrated to the second floor plaster ceiling. The cupola posts have in the past been the source of chronic leaks that ran down the posts in the attic and generated rot and insect damage in the transfer beams supporting the posts. Much of this probably occurred many years ago, but some lessor leaking may still be occurring that reaches the transfer beams. The tar "flashing" is not an adequate way to prevent water penetration at the posts. The wood sheathing under the roll roofing was installed in 1982, and appears to remain serviceable.

The weathervane and its penetration through the cupola roof appears to remain sound, as there is no side of leaking on the cupola ceiling boards.

Treatment Recommendations
*The cupola roof should be repainted within the next 1-3 years, at which time the condition of the cap below the weathervane should be checked. Ideally this should be done in conjunction with repairs to the cupola wood trim.***

*The bell deck roofing should be replaced within the next 1-2 years. ****

The ideal, most historically appropriate, and long lasting material would be lead-coated copper or copper with flat soldered seams. Alternatively, fully adhered EPDM membrane roofing could be used provided that the perimeter edges can be detailed to not obscure the cornice with an excessive drip edge or visible membrane. The service life of EPDM roofing is about 20

years, whereas copper should last at least 50 years if properly installed.

The roofing should include metal flashings that form watertight collars around the penetrations of the cupola posts, and bases to receive the posts of a new balustrade.

The bell deck work should be coordinated with other work at the cupola including a new balustrade, trim repairs, and any frame repairs.

MAIN ROOF FLASHINGS (Photos 10-11)

Description
Lead flashings exist where the rear chimney penetrates the roof and around the base of the cupola. The chimney flashings appear to be lead. The flashing material at the cupola base is not known, but is probably lead. There do not appear to be any flashings in conjunction with the roof hips or at the eaves of the roof (i.e., a metal drip edge).

Condition
There are currently active leaks at the second floor ceiling at the rear chimney due to defective flashings. The cap flashings at the rear chimney are not properly dressed down tight to the chimney (they are literally flapping in the breeze), and allow wind driven rain to run over the tops of the base flashing. Whether there are other problems with the flashings is not known (i.e., wear) as they were not examined hands-on. According to staff they are to be repaired in the near future to stop the leaks. This repair will probably involve dressing down and/or replacing some of the cap flashings, but will not completely replace the flashings.

The flashings at the base of the cupola show a few sharp buckles which may indicate fatigue cracks, assuming they are lead, but otherwise appeared sound. They were not examined hands-on.

Treatment Recommendations
*Chimney Flashings: Replace the both cap and base flashings in conjunction with the replacement the wood shingle roof. The base flashings should be 16 oz. lead coated or red copper. The cap flashings can be 4lb. lead ,or 16 oz. lead coated, or red copper. ****

*Cupola Base Flashings: Replace all existing flashings in conjunction with the replacement the wood shingle roof using 4lb. lead. Note that 2 1/2 lb lead should not be used as it is prone to fatigue failure when long pieces are installed. Copper could also be used, but is more difficult to dress down tightly over the shingles. ****

CHIMNEY (Photo 8)

Description
There is a small brick chimney at the rear of the building that probably dates to the twentieth century.

Condition
The top courses of brick are loose. As previously noted its flashing is defective.

Treatment Recommendations
*Rebuild the top courses of the chimney and install new flashings in conjunction with installing a new roof. ****

ROOF DRAINAGE (Photos 1-2, 31)

Description
There are no gutters at the both the roof and cupola bell deck eaves. The main roof has a considerable overhang that results in the roof drainage hitting the ground about 12" -18" from the foundation. There are no special provisions at grade to absorb or channel the runnoff, except along the front facade where there is an 18" wide bed of gravel. The grade around the foundation is flat. Historic photographs indicate the building never had gutters.

Condition
There are no obvious conditions of deterioration on the sidewalls of the building resulting from roof drainage blowing back against the building. However, there has been a chronic issue of seepage through the foundation walls below grade into the basement. Also, the recent replacement of the sill on the north side of the building may in part have been generated by rot to the sill from splashback at the foundation. The placement of the handicapped ramp tightly against the north wall clapboards may also have been a factor.

Treatment Recommendations
The building should continue to be maintained without gutters, but measures should be taken around the foundation to better control the roof runoff at grade:

- *Install a perimeter drain around the building.****

  The drain should consist of a trench about 2' deep by 3' wide with perforated drain pipe at its bottom and filled with gravel. Plastic sheeting (or rubber roofing material) should be placed against the face of the foundation from about an inch below grade to the bottom of the trench. The bottom of the trench should be pitched to drain away from the foundation, and the plastic sheet should extend over the bottom a least 1' to direct any water at the base of the trench away from the foundation. The trench would also be lined with "geo-fabric" to prevent silt from the adjacent soil from filtering into the gravel. The trenches and their pipes should be pitched towards the rear of the building where the pipes can probably be extended to drain at grade where the site drops off. If this is not possible they would need to be run into a drywell. The portion of the trench along the drip line from the roof should be finished with gravel. The rest of the trench can be finished either with grave or sod. In general the detailing and materials of the trench should be conform to standard practices for this type of drainage.

- *Move the existing handicapped ramp at least 12" from the side of the building to prevent snow and splashback from roof runoff from hitting the clapboards. ***

  This will require adding a railing on the building side of the ramp. As the drainage trench should extend under the ramp, the ramp will have to be temporarily removed to install the trench.

- *When the new roof is installed be sure to extend the shingles about 2" beyond the outer edge of the crown molding at the eaves.****

MAIN CORNICE (Photos 1, 2, 7)

Description
The classically detailed main cornice overhangs the sidewalls of the building by about 18". It consists of a large crown molding at its top planted on a fascia board, a soffit below the fascia with large molded modillion blocks, and a large bed molding below modillions on a frieze board set several inches proud of the clapboards. The current crown molding is a replacement installed during the c. 1980 restoration. The rest of the cornice woodwork is largely original.

Condition
Most of the cornice woodwork remains in sound, serviceable condition. A short section of the crown molding on the rear facade exhibits some visible rot along its top edge. Removal of the shingles may reveal some additional sections of rot along the top edge. Some of the modillion blocks may be found to be loose or cracked when being prepared for repainting, but most appear to sound. The protected portions of the cornice have a substantial build-up of firmly adhered paint on them making them a good site for paint analysis to determine the original color of the trim.

Treatment Recommendations
*Replace the rotted section of crown molding on the rear facade to match the existing crown molding and check for deterioration in other sections in conjunction with installing a new wood shingle roof. ****

*Carry out minor repairs to re-secure any loose modillion blocks and other defects in conjunction with painting or re-roofing work. As a major original element of the facade, it is important to retain and preserve as much of the original components as possible. ***

CUPOLA WOODWORK (Photos 12-20)

Description
The cupola woodwork includes formal cornices below the bell deck and below the cupola roof, a balustrade around the bell deck, and molded trim on the eight cupola posts with the skirt boards between them forming arched openings. Other than its crown molding which was replaced c. 1980, the bell deck cornice is largely original with detailing similar to the main cornice but slightly smaller in scale. The current bell deck balustrade was installed in 1982 and does not match the detailing of the original balustrade that is visible in the historic photographs. The trim at the cupola posts along with the arched skirt boards is largely original, but was partially stripped of paint and underwent some repairs c. 1982 when the cupola top was rebuilt due to a lightning strike. The cupola cornice was rebuilt in 1982 and lacks the modillion and related details that are visible in the historic photographs. The eight cupola posts appear to be original. The current cupola ceiling boards were installed in 1982. They were purposely spaced about 1/2" apart to facilitate ventilation to the cupola roof framing above them.

Condition
The bell deck cornice appears to be in generally sound condition, but a few of the modillion blocks exhibit cracking due to weathering and loss of some material, and some may be loose.

The balustrade is in extremely poor condition with individual balusters delaminating and falling apart due. These were inexpensive stock lumber yard elements fabricated with finger jointing and inferior glue. There is some risk that individual pieces that are delaminating could fall off, posing a risk to persons walking around the perimeter of the building. The posts and rails of the balustrade are not detailed to match the

originals as visible in the late 19th century photograph.

The skirt boards and molded trim at the tops of the cupola posts exhibit a range of deterioration. Some are cracking badly while others remain sound or only slightly cracked. A few molded pieces that were replaced in 1982 do not match the profiles of the originals.

The cupola cornice appears to remain sound, although some of its detailing does not match the original as visible in the historic photographs, as discussed in the description section above.

Treatment Recommendations

*Balustrade: Completely replace matching the detailing and number of balusters visible in the historic photographs (13 balusters per side instead of the current 11 per side). ****

Do this in conjunction with the replacement of the bell deck roof to incorporate sound bases for the balustrade posts. As a temporary safety measure, consider putting a band of nylon strapping around each baluster to secure the laminations in place, or else completely removing the balustrade. The new balustrade should be constructed of rot resistant wood such as mahogany, Spanish cedar, or possibly western red cedar using solid stock for the balusters. The bottom rail should be detailed to avoid holding pockets of water. As the bell deck is readily accessible from the attic, keeping a new wood balustrade painted should not be difficult. Custom molded fiberglass is another option, but would require considerable care in detailing and finish.

*Bell Deck Cornice: Repair substantial cracks in modilion blocks using epoxy consolidation and filling procedures, and reconstruct broken out sections using epoxy and/or wood Dutchman inserts. ***

We use the West System epoxies and fillers for this type of repair, but there are also other similar products. The work can best be done on a bench with the modillions removed from the building. The work should be done when there is access in place for other adjacent work.

*Cupola Skirt Boards and Trim: Replace severely defective pieces to match existing elements. Use rot resistant wood species for replacement elements rather than pine. ****

*Original moldings that are split but otherwise sound can be retained and restored by removing them to a bench, and using epoxy conservation techniques to glue them back together. This type of work requires a contractor experienced in historic conservation woodwork, as most conventional contractors will simply want to replace the split pieces.****

*Cupola Cornice: Re-work the cornice to include reproductions of the original modillion blocks and related moldings based on historic photographs.**

This will require removal of the current bed moldings above the course of small dentils. It will also require measuring the existing cornice detailing and working out the new detailing on paper before executing the work. As the existing woodwork is sound and period appropriate in character, this work would be done only to improve the accuracy of the restoration at a fairly subtle level and is therefore of low priority.

CORNER BOARDS (Photos 21-23)

Description
The corners are finished with rusticated corner boards that are intended to simulate the appearance of dressed stone. At the front corners, both the front and side boards are rusticated. At the rear corners, only the side boards are rusticated, the rear boards being flat. All the corner boards are original except the first story portions of the front corners where the boards are reproductions form the c. 1980 restoration work. The original boards are unusual in that 1" thick beveled rusticated pieces are not applied to a background board. Rather, they are worked out of the 2" thick corner boards, making the entire piece a single board.

Condition
The c. 1980 reproduction portion of the southwest (front) corner has substantial vertical cracking and separations. It is made up of glued up elements, and the cracks are mostly separations along the glue lines. The original section remaining at the second floor level remains sound. The c. 1980 portions of the northwest corner boards are holding up better. At the southeast (rear) corner, the lower two-thirds of the side (i.e., south) corner board has pulled out from the building leaving a considerable (1/4" -1/2" wide) gap open to water penetration between the board edge and the clapboards. The upper third is a separate board and remains tight to the building. In other respects the board remains sound. The northeast corner board has not pulled out and remains sound.

Treatment Recommendations
*Southwest Front Corner: The c. 1980 portion of the southwest corner board should be replaced with new corner boards matching the original section above without using glued up pieces. Ideally it should be worked from 2" thick boards like the originals, but applying the rusticated pieces to a 1" thick background board would be acceptable. ***

*Southeast Rear Corner: Remove and reset lower section of the south side corner board that has pulled away. This will require cutting the original nails between it and rear corner board, and must be done with extreme care to avoid splitting the boards. The original thin wood flashing strip between the clapboards and the corner boards should be preserved in situ where remains in place. New metal flashings could be slipped under the adjacent clapboards and corner board (over the original wood flashing) to provide better water protection. The removal of the board may reveal other unknown problems at the corner that caused the separation to occur. ****

WINDOW FRAMES (Photos 24-26)

Description
The original window frames remain in place at most window openings. Exceptions are the two front facing first floor windows which were installed c. 1980 following the removal of the firehouse doors, and the center first floor window on the north side which appears to be an original frame that was moved to fill in a firehouse entry door in this location. The frames are thick (2" or more) "plank frames" characteristic of Middlesex County 18th century window construction. On the first floor they are finished at the top with a crown molding and hip shaped solid wood cap. All have ogee band moldings on the jambs. They are installed over the wood sheathing boards with their jambs being nailed through the sheathing into studs. They have had sub-sills and jamb shims installed within them to fit the c. 1980 reproduction windows.

Condition
The caps and crown moldings on the two c. 1980 window frames are severely deteriorated. The caps were

fabricated with laminated stock that is now separating at the glue joints. The crown moldings have severe rot. There is also more limited rot occurring at the junctions of the jambs to the horns of the sills. This has recently been repaired with a "Bondo" type filler that is now failing. These frames lack the ogee band molding on their jambs that is present on the historic window frames.

The remaining original frames are in very good condition for their age. To the extent we could see them the sills appeared sound, although the storm windows obscured (and now protect) most of their top surfaces. The caps on several of the first floor south facade windows were spot checked. They have some moderate weather checking but remain solid except for a small pocket of rot that found on one of them. They were originally fabricated with side extensions that extended behind the clapboards and provided a way to nail them in place without exposing the nail heads top the weather. One cap had been cut into at its end to install a tie rod during the fire station period.

The two middle window frames have been pushed outwards at their sills by whatever is causing the bulge in the clapboards between them. This has generated some gaps between the side jambs, sill ends and the clapboards.

Treatment Recommendations
*The two first floor front window frames should, at the least, have their caps and crown moldings replaced, and the rot to the sill horns at the base of the jambs more carefully repaired with epoxy consolidation and filling. New ogee band moldings matching the originals on other frames should be installed on their jambs. Assuming that the wood in the jambs and sill is not very rot resistant, completely replacing the frames to match the other original frames is an option. ****

*The weather checking in the historic caps is problematic as to the best treatment. Epoxy consolidation and filling is an option, but if not well done and maintained with paint can generate rot below the epoxy. Leaving the checks as is provided they are kept well painted and the wood remains firm without rot in the checks is also an option. Filling them with modern caulking is not recommended. There current condition suggests the wood is quite rot resistant. We did observe a small pocket of rot in the south facade cap closest to the rear corner that warrants treating with epoxy or a small wood Dutchman. If the clapboards directly over the caps are removed for repairs, deterioration at the top lip of the caps may be found that needs epoxy conservation work. Installing metal flashing under the clapboard and extending about 1/2" down over the exposed face of the caps is an option. We do not recommend completely covering the caps with metal. ***

The caps are currently painted to match the clapboards rather than the window frames. Normally they are painted to match the frames.

WINDOW SASH (Photos 27-28)

Description
The windows are fitted with 12 light over 12 light single hung sash installed during the c. 1980 work to restore the appearance of the original sash. They replaced the 6/6 light sash that had replaced the original sash in the mid-nineteenth century. The upper sash is fixed in place. The lower sash opens, but requires a stick to hold it up as the windows are not fitted with pulleys and weight balances. The 12/12 configuration was determined during the 1980 restoration from the historic record of the number of panes of glass ordered in the original construction of the building (850 panes divided by 34 or 35 window openings).

The sash were fabricated to a standard modern layout pattern and using modern muntin profile rather than exactly following late 18th century practices. As a result, the sash were a slightly smaller in height and width than the originals, and original frames had to have a sub-sill and extension jambs added to fit them. The sash are glazed with modern glass. The windows are fitted with modern triple track exterior aluminum storm installed c. 1980. There is no UV protection on the windows.

Condition
The wood of the sash remains in sound, serviceable condition, but the glazing compound is failing on most of the sash with extensive cracking and some putty lifting or missing. The exterior paint is also worn and flaking on the lower portions and the sub-sills. Several sash were observed to be installed with their interior side facing the exterior. The aluminum storm windows are serviceable, but probably loose fitting and less efficient than good quality new ones would be.

Treatment Recommendations
*All the window sash need to be repainted along with reglazing of defective putty. ****

They need to be systematically examined in more detail to determine if they need partial reglazing which can be done in place, or if the failure is so widespread that they need to removed to carry out 100% replacement of all the exterior glazing putty on a bench. All the frame elements inside the storm windows also need to be repainted.

*Replacing the storm windows with new, high quality aluminum storms such as the Harvey "Tru-Channel" is an optional treatment that would probably improve the energy performance of the windows. **

Refer to the collections assessment for a discussion of treatments to provide UV glazing.

FRONT ENTRY PORCH (Photos 29-30)

Description
The front entry porch is a c. 1980 approximate reconstruction of the original front porch based on period photographs. It consists of a nearly flat projecting roof over a classical entablature and cornice with modillion blocks supported on two classical stock wood columns with "composition" caps in the Corinthian order ("composition" is a compound of cementitious materials instead of wood). The door is a stock wood "colonial" 6 panel door having a 5 light transom over it. Flat pilasters with minimal detail flank the door.

Condition
All the elements of the entry porch are in sound, serviceable condition. The interior side of the door is unfinished and has some water staining at its bottom due to water seeping in at the threshold.

Due to the constraints of its limited budget, the c. 1980 restoration of the porch has some substantially inaccurate detailing. Plain round columns and bases were used instead of the fluted columns with classical bases shown in the historic photograph, and the Corinthian capitols sit awkwardly on the columns. The entablature portion of the porch roof is substantially higher (i.e., thicker) than the entablature in the historic photograph. The entry door and transom in the historic photograph rises to the porch ceiling and is clearly a Victorian replacement of the original. The flanking pilasters are simply plane boards of unknown date. The current door is a conjectural restoration of the original door that seems awkward due to the use of watered down classical moldings on the flanking pilasters.

Treatment Recommendations
*Consider replacing the existing columns with fluted columns and bases matching the columns and bases in the historic photograph. ***

The existing capitols can be reused on the new columns if the fit is correct. If not, new capitols will be needed with the columns. Replacing the pilasters flanking the door with plain boards would improve the appearance of the entry. Restoring the Victorian door and transom is another option to consider, but would be a little incongruous with the 12/1/2 windows. Reworking the entablature to be closer to its appearance in the historic photograph would require major reworking of the roof and would probably be too subtle a change to warrant the effort and expense.

SIDE AND REAR EGRESS DOORS (Photos 3, 31-32)

Description
The side door is a modern wood "colonial" 6 panel door with a 4 light transom over it set in a frame that is detailed to be similar to the window frames. It was installed c. 1980, at which time the original window in this location was removed and reinstalled at the center of this facade where the side door of the fire station had previously been located. The rear egress door is a modern flush door set in a plain frame installed along with the existing steel stair to provide a second egress for the second floor.

Condition
Both doors are in sound, serviceable condition. The interior face of the side door is unfinished and has water staining at its bottom due to water seeping in at the threshold. The base of the frame casing on the right side is checked from water seepage and may be starting to rot. The landing of the handicapped ramp causes both rain splash back and snow accumulation at the base of the door that is causing moisture problems for the entry. There is a weather sweep on the base of the door that looks to be relatively new and may have reduced to water penetration at the base of the door.

Treatment Recommendations
*Monitor the condition of the bottom of the side door and exterior casings for rot, and repair with epoxy consolidation and/or wood Dutchman if rot is found. ****

CLAPBOARDS (Photos 33-38)

Description
The original clapboards remain in place on most of the building. Exceptions are the first floor of the front facade where new clapboards replaced the area of the firehouse garage doors in the c. 1980 restoration, the lower few feet of the other facades where clapboards have been replaced in conjunction with repairs to the sills, and the first floor center of the north facade where the side firehouse door was removed c. 1980. The original clapboards are riven pine (or possibly eastern cedar -we did not verify their species) in approximately 4'6" lengths. Their ends are lapped and skived (i.e., joined with long bevels), and they are nailed with hand wrought nails having faceted rose or butterfly heads. The c. 1980 replacement clapboards are mostly Phillippine mahogany, as there was a major shortage of western red cedar clapboards at that time. They are installed in longer lengths than the originals with square cut butted end joints. There are also a few small scattered areas of modern replacement clapboards where very poor quality flat sawn pine clapboards were used.

Condition

The original clapboards are in fair condition compared to modern clapboards, but are fairly good considering their age. Many have become thin due to erosion of their surface from weathering when the building was not kept well painted, there are a number in random locations with varying degrees of cracking, and a few are loose. Their original nails remain in place. Past paint preparation using circular grinders has put circular gouges in the surface of some clapboards as well as smoothing the facets on their nail heads. The extent of the damage on the building varies depending on the skill of the various workers on the painting crew.

The various modern replacement clapboards are in sound condition. The flat sawn ones may become problematic in the future, as this type of clapboard tends to warp causing their nails to pull out. Their rough surface texture is also visually very different from the rest of the clapboards.

Treatment recommendations

*It is important to preserve as many of the original clapboards in place as possible including their hand wrought nails. Their short lengths with lapped and skived ends along with their rose head nails give the building a distinctive appearance that is characteristic of eighteenth century construction. Treatment of cracked clapboards is problematic, as efforts to remove individual clapboards invariably lead to cracking adjacent clapboards. Therefore, only the most severely cracked clapboards should be replaced. The replacements should match the length of each clapboard being removed, and should have lapped ends that have been skived with hand tools to match the original bevels (typically about 2" long - the bevels are cut with a draw knife with the clapboard held in a shave horse). Cutting the bevels on a table saw usually results in short, steep bevels that are not acceptable. Ideally, nailing should be with hand-headed cut nails, but modern galvanized box nails are also acceptable. ****

*The small areas of modern flat sawn clapboards should be replaced with good quality vertical grained clapboards, as the flat sawn ones are likely to cause future problems. ***

Ideally, replacement clapboards should be vertically grained (i.e., radially sawn) pine with all heartwood. Richmond Clapboards in Richmond, NH, 603-239-4514 (wakefieldtavern@ne.rr.com) his a good source for this type of clapboard. Modern top grade western red cedar with vertical grain is also acceptable provided their exposed surface is hand planed or sanded to remove the modern"mill" finish. They may be somewhat more difficult skive the ends.

EXTERIOR PAINT (Photos 33, 39)

Description

The building was last painted about two years ago using a greyish green acrylic latex paint on the clapboards and off-white on the trim. Variations of this color treatment have been used since the c. 1980 restoration. The use of green is based on the eighteenth century academy records where it was directed that the building be painted a green tone similar to the Chelmsford Academy. However, it is not known if that directive was actually carried out. A very brief examination of an area of relatively intact paint buildup on the rear facade clapboards with a scalpel and 10x magnifier revealed multiple layers of grey before the modern greens, and a few fragments of multiple layers of off-whites before the greys. The layers observed certainly suggest the building was painted off-white during much of the nineteenth century, but it is unlikely that any of the layers observed dated back to the original construction.

Condition
Much of the paint remains sound, but there are some random patches where paint is peeling in small sheets. Much of the past buildup on the clapboards has been removed by past overly aggressive paint preparation. Areas of firmly adhered alligatored paint buildup remain on the trim and most of the cornice. As discussed above under window sash, the paint on surfaces covered by the storm windows and on the sash is peeling, as these surfaces were not painted during the last exterior paint job.

Treatment Recommendations
*Areas of peeling paint should be scraped and touched to match up the existing paint in order to get the maximum life out of the existing paint job. Repainting of the top surfaces of the window caps would also be desirable, as the paint on these upward facing surfaces usually weathers faster than other locations. ***

*Areas covered by the storm windows should be prepared and repainted in conjunction with reglazing the window sash. This will require the temporary removal of the storm windows. ***

*When the next complete repainting is done (probably in 2-4 years), care should be taken in preparation to not do damage to the clapboards and their nails from grinding or power sanding. If power washing is done care should be taken to not direct the water spray upwards and under the clapboards. However, we prefer to not power wash a building like this with early clapboards, as excessive amounts of water are likely to be driven up under the clapboards and saturate the sheathing. The undersides of the clapboards should not be caulked, as this will only trap the water that inevitably gets behind the clapboards. Where there is a firmly adhered buildup of paint on the trim and cornice, it should be left in place, as excessive scraping to remove it s likely to gouge the molded surfaces. ****

*The hip shaped window caps have been painted the clapboard color. It is conventional to paint them the trim color. ***

*Professional paint analysis should be considered to determine both the original and early 19th century color treatments of the building. ***

Locating original paint is often difficult on a building of this age and usually requires taking multiple samples from relatively protected locations and the preparation of cross sections for examination under a microscope. The presence of a written record regarding the initial paint treatment makes this an especially interesting case for analysis.

FIRST AND SECOND FLOOR INTERIORS (Photos 40-43)

Description
All the finish woodwork, plaster, and stairs in the interior dates to the c. 1980 restoration at which time the existing plaster was and woodwork was removed back to the wall studs. Based on photographs, the plaster and woodwork that was removed dated to the conversion of the building to a fire station c. 1916 or in some cases the second half of the nineteenth century.

All the walls are finished with a horizontal square edged pine board wainscot up to just above the window sills, with plaster (actually plaster board) above that. The ceilings are also modern plaster board. The floors are random width pine in varying lengths. Where the framing protrudes through the wall or ceiling fin-

ishes it is cased with wood boards. At the first floor there are four square solid wood columns supporting the two principal beams that carry the second floor. Although there was no clear evidence for the original woodwork in the building, the c. 1980 work is intended to reproduce the finishes typically used in the original construction of buildings of this type. Physical evidence was reportedly found for the placement of the stairs and the wall between the entry vestibule and the main rooms.

Condition
Except for the water damage at the second floor ceiling under the cupola and around the rear chimney, the plaster finishes are in sound, serviceable condition. All the woodwork is unpainted with some of the wainscoting disfigured by substantial past water stains. The cause of the stains is not known, but there are no current leaks affecting it. The wood floors appear to have been finished with a medium brown stain (or perhaps a polyurethane) after they were installed. The finish has now worn off in many random areas (usually areas of higher traffic) leaving the floors with a mottled appearance.

Treatment Recommendations
The woodwork in a building of this period would likely have been painted originally, or at least by the early years of the nineteenth century. The unpainted woodwork conveys an inaccurate picture to the public of the likely early appearance of the building. The extensive water stains make the natural woodwork unsightly.

*It is recommended that all the wood wall wainscots, window trim and framing casings be painted a period appropriate color all the wood wall wainscots, window trim and framing casings be painted a period appropriate color (probably off-whites or light beiges or greys). The different spaces could be different colors. ***

*Floors in buildings of this type were usually either left unfinished and periodically scrubbed with lye or soap and water, or they were painted. One treatment would be to leave the floors as is and allow the finish to continue to wear off. The downside to this is that the unfinished floor may eventually wear excessively in areas of heavy traffic. As the traffic in the building is probably fairly light, this may not be a significant problem. The other option is to paint the floors a period appropriate color. This will protect the wood from wear, but will require periodic repainting. ***

Other than repairing the water damage under the cupola and at the rear chimney no remedial work is needed for the plaster finishes.

CELLAR (Photos 44-46)

Description
The building has a full cellar that was initially constructed when the building was moved to its current site c. 1916. The mortared fieldstone foundation forms the walls, which are finished with cement plaster parging for the lower 3/4 of their height. The parging may have once extended to the top of the masonry, but has spalled off from dampness. The floor is concrete. The ceiling is unfinished with the underside of the first floor boards and framing being fully exposed. The first floor structure was completely redone in the mid-twentieth century with very heavy joists and beams supported by numerous steel posts on raised concrete footings in order to carry the weight of the fire engines. The only partition is at the rear corner to form an enclosed space for the furnace. Their is a shallow well in the floor near the southeast corner that is fitted with a sump pump. A commercial grade dehumidifier is positioned nearby with a hose into the sump pump well to dispose of accumulated condensate automatically.

Condition
There has been a chronic problem of water seeping through the masonry walls. As a result, some of the parging has lost its bond to the masonry, and the uppermost sections of parging may have fallen off. The Ipswich River engineering report noted a limited area of slightly bulging masonry at the west end of the north wall that also could be the result of chronic water seepage. As discussed on the section above on roof drainage, the likely cause of the seepage is roof runnoff saturating the soil adjacent to the foundation along with the site grading being dead flat on all sides of the building except the rear. There is a limited area of fire damage (i.e., charred surfaces) to the framing at the east end near the northeast corner that was caused by a lightning strike in 1982. One joist bears on a thick plank with char that spans the opening for a cellar window. As there is no visible distress or deflection in the plank and the area of the first floor that is carried at that end of the joist is small, this situation appears to be benign. As noted above a sump pump is present in a shallow well near the southeast corner to collect and dispose of seepage from the floor and condensate from the nearby dehumidifier.

A data logger that we placed in the cellar about 4' above the floor for three days during our site visits (there was no rain during this period) showed a quite constant relative humidity level of 68-70%. Although high for store collections materials, this is acceptable and probably normal for a cellar of this type in the summer.

Treatment Recommendations
*Install perimeter drains around the entire foundation as discussed in the section above on Gutters and Site Drainage. ****

*At the charred plank over the east cellar window, consider removing a patch of char down to sound wood to determine the remaining sound thickness of the plank and its ability to carry the joist that bears on it. **

ROOF FRAMING (Photos 47-54)

Description
The roof framing consists of two pairs of principal rafters with tie girts at the attic floor level and a king post at their peak. A heavy ridge beam between them is framed into the top of the king posts, as are the major hip rafters. A third pair of principal rafters frame into the ridge beam midway between the king posts with a tie girt at the floor level. A pair of iron tie rods run from ridge beam down to the tie girt. Diagonal struts run from the various principal rafters down to their tie girts. These struts, which are sawn oak, are part of the original construction as they are framed into the rafters, and not a later repair to correct problems with rafters as suggested in the IRE Report. However, the original struts at each of the hip rafters have been removed and replaced by heavy planks nailed to the sides of the rafters or adjacent purlins. The principal rafters and tie girts are hewn pine or possibly hemlock. Common sawn oak purlins span between the various rafters to carry the roof sheathing boards which run up the roof pitch from eaves to peak. This is all fairly standard framing for eighteenth century hip roofs.

Condition
The roof framing is in remarkably good condition for its age and type. We did not notice any obvious substantial sagging in the principal rafters and purlins, although we did not observe each member at close range. Wen viewed from the exterior, we did not see any substantial sagging in the roof surface marking the positions of the principal rafters. The bowing strut photographed in the Ipswich River Report has a substantial amount of insect damage on one side and a large knot near its top. Whether these defects and/

or loading from the rafter are factors causing its bowed condition, or whether it is simply warped as a result of its grain structure is not clear (although we suspect the large knot is the cause). All the other struts appeared to remain straight with no obvious signs of distress.

Other than at the cupola framing (discussed in a separate section below) signs of insect infestations appeared to be limited to areas along the waney edges, primarily the small exist holes of Powder Post Beetles (*Anobium*). However, we could not see the surfaces of the tie girts and other framing in the attic floor due to insulation, nor the joints at the eaves between the rafters and the tie girts (insect damage often occurs at the eaves due to roof leaks, and can substantially weaken the joints between the rafters and the tie girts). We also did not systematically carry out a close up inspection of all the rafters and purlins.

Safe access for close up examination of the attic framing was limited to the central area adjacent to the cupola and the path from the hatch over the stairs. It would be prudent to install a network of boarding to provide access paths around the entire attic perimeter so that the framing could be routinely examined for insect activity and deterioration. A path about 2' wide would be adequate.

The IRE Report notes that although the roof has withstood major recent snow loading, it does not meet the load capacity requirements of modern building codes. We do not doubt that analysis, as the framing of virtually every eighteenth and early nineteenth century roof would also not meet modern code requirements if rigorously analyzed. Serious undersizing of members usually manifests itself in obviously sagging rafters and/or purlins. Failures also sometimes occur as a result of substantial insect and/or water damage, usually at critical joints. We did not observe either of these conditions in the roof framing that was readily visible from the attic access boarding (exclusive of the cupola).

> ***Treatment Recommendations***
> *Carry out a systematic survey of all the roof framing for insect activity and deterioration, including the ends of the rafters at the tie beam joint. ***
>
> *We often lift roof sheathing boards over the bottoms of the rafters when replacing roof shingles, as this provides the clearest view of the rafter/tie beam joint. The presence of plywood over the original sheathing on this roof makes that much more difficult for this building.*
>
> *Install a network of boarding to provide access paths around the entire attic perimeter so that the framing can safely be routinely inspected. ***
>
> *Examine the bowed strut noted in the IRE Report to determine if it has been weakened to the extent that a sister strut should be added next to it. ***

CUPOLA FRAMING (Photos 55-66)

Drawings A1, A2, and A3 provide schematic plans and an elevation of the cupola framing and should be referenced along with photographs #55-66 to clarify the following description and condition discussions.

Description
The square bell deck frame consists of four perimeter beams (one on each side), and center beam running front to back that is crowned to pitch the deck surface towards the outer edges, and four joists that run from the outer corners of the perimeter beams to the middle of the center beam. Substantial posts under each of the four corners of the frame (i.e., four posts total - labeled A, B, C, & D on the drawings and photos) extend down onto two heavy beams (transfer beams) at the attic floor that transfer the loads

from the posts to the bottom chords of the two main roof trusses and the attic tie beam under the center of the frame. Four beams located at about seven feet above the attic are framed into the posts to form a lower perimeter ring (referred to as "perimeter beams" or "PB"). The posts are further braced by oak diagonal members running between the posts forming "X" braces.

The octagonal cupola above the bell deck is carried on eight posts (one at each vertex of the octagon - labeled C1 - C8 on the drawings and photos) that penetrate through the bell deck and run down inside the bell deck frame to bear on a crib of four transfer beams that in turn transmit the cupola loads to the lower ring of perimeter beams between the bell deck posts, which in turn transfer the loads to the bell deck posts. The cupola transfer beams are positioned at 45 degrees in relation to the lower perimeter ring beams. Like the bell deck posts, diagonal members between the pairs of cupola posts form a series of "X" braces.

The installation of the ridge beam between the king posts and the placement of the cupola transfer beams both appear to have been a changes from the original design of the frame made during the initial installation of the frame, as the system of "X" braces between cupola posts is interrupted by the ridge beam and between bell deck posts the at the level of the cupola transfer beams at the front and rear pairs of posts (C1 & C2, and C5 & C6). The evidence for this is unused mortises in the affected cupola posts, and the ends of the braces between the front and rear pairs of bell deck posts being cut off just above the cupola transfer beams with the mortises intended to house them in the lower bell deck perimeter beam being empty. The north and south pairs of cupola posts were not affected by this change and retain their full system of diagonal braces, but the north and south side braces for the bell deck posts have been cut just above the cupola transfer beams.

Condition

The IRE Report describes a number of condition issues which we also observed, although in some cases our opinions as to the cause and implications differ. We do feel that some of the conditions of deterioration are significant, and that the complexity of the frame complicates their evaluation. It would therefore be prudent to obtain a second opinion from another professional with wide experienced in the evaluation of eighteenth and early nineteenth century timber frame construction involving steeples and cupolas.

As described in the IRE report, The west transfer beam below bell deck posts C and D does have a series of diagonal checks in its easterly face, and others on its top face. The interior surface of the checks in the easterly face are quite dark both from accumulated dirt and oxidation of the surface. This indicates they have been present for a substantial time in their current condition. In our opinion they are probably shrinkage cracks that occurred shortly after the building was constructed due to the drying out of the green timber. In this case the beam appears to have spiral grain rather than straight grain which causes the cracks to run diagonally rather than horizontally. The east transfer beam also has shrinkage checks in its west side, but in that case they are horizontal because the wood is straight grained. The lower portion of bell deck post C also exhibits similar shrinkage cracks.

The base of bell deck post C exhibits some exit holes from wood boring insects. The holes are oval in shape, have pellets of frass in them, and are much larger than the exit holes from powder post beetles (*anobium*) that are the most common insect pest in old timber framed buildings in New England. The "Old House Borer", a type of long horned beetle, appears to be the most likely insect. Another possibility is the "Death Watch Beetle". Although common in England, it is rare in New England and usually only attacks oak, whereas the bell deck post is pine or hemlock. Using a long 3/16" bit on a power drill as a resistance drill indicated the post was still solid. It was not clear from this examination whether the insects are currently active. Similar exit holes are present in other timbers at the easterly side of the frame, as discussed below, and may be active.

The lower perimeter beam between posts B and C Exhibits similar insect exit holes over its length, and a large patch of whitish fungus on its westerly face under the cupola transfer beam at cupola post C6. The interior of the beam behind the fungus was severely rotted at least into at least the first inch or two with more signs of insect activity. Drilling the beam near the insect holes that were closer to post B indicated the insect damage in this area was more than superficial, although we did not drill deep enough to fully assess its extent. The wood in the exit holes looked fresh enough (i.e., not yet oxidized) to suggest the insect activity may be fairly recent or active.

The end of the transfer beam at cupola post C6 was hollowed out in its center from water damage. The dark color of the damaged wood suggests this damage has been present for a long time. Similar damage is present in the end of the transfer beam under cupola post C2 at the westerly side of the frame. In that case only a thin outer shell of the beam remains relatively solid where it bears on the perimeter beam. Given the load that one would expect C2 to place on the transfer beam, it is surprising that the crushing of the timber is not much greater than the small amount that is visible. We suspect the answer is that most of the loads on the westerly and easterly pairs of cupola posts (C1 & C2, and C5 & C6) are transferred over to the ridge beam by the short beams passing over the ridge beam that are framed into the pairs of cupola posts. The ridge beam in turn transfers the loads to the king posts of the main roof trusses. The validity of this theory should be assessed by a structural engineer experienced in evaluating similar timber framed systems. In contrast, the loads on the north and south pairs of cupola posts do go down to the ends of the transfer beams directly below them. As the transfer beams appear to remain relatively solid at these locations, there are no visible signs of major distress.

The major cause of the damage below cupola posts C2 and C6 has been water running down the posts from defective roofing and flashing where the posts penetrate the bell deck. While leaks at these points are reportedly not now active, leaking must have gone on for years in the past to generate the extent of rot and fungus growth that is now present. The damage occurs primarily on the horizontal beams rather than on the posts, because that is where the water sits after it runs down the posts. Small amounts of water may still be running down the posts during heavy rain to provide a damp enough environment for the growth of fungus and wood boring insects without saturating the attic insulation and showing up on the ceiling below.

The above discussion is based on a relatively brief and incomplete review of the framing that did not examine the condition of every timber and joint. Further systematic examination may reveal additional areas of deterioration. As we are not structural engineers the above observations and comments are intended only to identify and describe the observed areas of deterioration, and should not be considered a formal structural analysis.

Treatment Recommendations

*Retain a professional with wide experienced in the evaluation of eighteenth and early nineteenth century timber frame construction involving steeples and cupolas to carry out an in depth systematic analysis of the cupola and bell deck frames, and to recommend appropriate repairs and methodology to carry out the repairs. ****

One firm that we have had experience with that carries out this type of work is Preservation Timber Framing of Eliot, Maine. The contact person is Arron Sturgis; Arron@Preservation-TimberFraming.com
Preservation Timber Framing, Inc.; P.O. Box 28 Berwick, ME 03901; 603 – 781 – 5725.

*Assuming the repair work will be funded by the Town and require bidding under Chapter 149, a design professional will have to be retained to produce plans and specifications for the repairs. ****

As the repair of the defective framing may require access through the bell deck floor to deliver materials, etc., the replacement of the bell deck roofing and flashing should be coordinated with the further evaluation and repair of the frame.

Any repairs should preserve as much of the historic frame as possible, and where replacement is necessary, the new members should duplicate the originals to the greatest extent feasible.

*Take immediate steps to kill the fungus and any active insect infestation. The first step would be a topical application of borates to the frame. However, the literature on the Old House Borer indicates that successful eradication takes a number of years of treatment. ****

OTHER ISSUES - BULGE IN EXTERIOR WALL AT SOUTH FACADE (Photo 67)

Description
There is a pronounced bulge in the center of the south exterior wall between the two middle first floor windows. The bulge is most extreme at the level of the window sills, and is not apparent at the window heads. The ends of these two sills are skewed outwards as a result of the bulge.

Condition
The cause of this bulge is not apparent from an examination of the surface. It also does not show up on the interior wall of the building. It is visible in a photograph in the archives that was taken a number of years ago, suggesting it is has been present fro some time. Moderate bulges are often present in the clapboards of 200 year old buildings and are often due to twisted or warped framing members and/or loose or warped sheathing boards rather than major structural problems.

Treatment recommendation
*The most prudent route to investigate this issue would be to remove the modern wallboard finishes at the interior side of the affected area. **

This will reveal the condition of the framing and sheathing without damaging the early exterior fabric at this location. As the sheathing boards extend under the window frames, removing them to examine the framing would also require removal of the two window frames or cutting the sheathing where it is not supported by a stud. If the investigation indicates that repair is warranted, the window frames will probably have to be removed to carry out the repairs. Care should be taken in removing the original clapboards in this area so that they can be reinstalled on completion of the repair.

MECHANICAL AND ELECTRICAL SYSTEMS (Photo 68)
Description
The building is heated by an oil fired furnace supplying hot water to modern baseboard units on the perimeter walls. The system has two zones, one for each floor. The furnace, which was installed sometime between 2000 and 2006, is vented through the rear chimney. It is located in a small room in the northeast corner of the cellar that has been partitioned off from the rest of the cellar.

Summer cooling is provided by window air conditioners on each floor.

The current electrical service panel with circuit breakers was installed during the c. 1980 restoration work. Most of the wiring is modern romex cable also installed c. 1980.

Condition
No condition issues were noted for the mechanical systems.

Heating is reportedly lowered to about 55 degrees for the first floor during the winter, and lower for the second floor. The heat is turned up when events are held in the winter.

The functionality of the window air conditioners and winter heating practices is discussed in the Collections Assessment by Marc Williams.

> ***Treatment Recommendations***
> *Refer to the Collections Assessment by Marc Williams for recommendations as to the operation of the heating system and window air conditioning units.*

UNIVERSAL ACCESS (Photos 2, 31)

Description
A ramp along the north facade provides access through the side door at the end of the ramp to the first floor of the museum building including its meeting space.

There is a bathroom in the front entry vestibule of that building located under the northerly stair. It lacks support bars, its entry door is not wide enough, and is too small in its internal dimensions for turning a wheel chair.

The only access to the second floor is by stairs.

Condition
The access ramp is in sound, functional condition. The threshold under the side door rises straight up about 3/4" above the ramp surface. We believe the standard maximum rise is 1/2". However, a lower rise would likely exacerbate the current problem of water seeping under the door.

Within the building, the bathroom does not come close access standards, and there is way to access the second floor exhibits. There is not enough space within the entry vestibule to alter the existing bathroom to meet standards. The only way to do this would be to partition off a corner of main first floor room.

The only way to provide access to the second floor would be to install an elevator in the main room, or in place of one of the entry vestibule stairs, or in a new addition to the rear of the building. Given the budget of the museum and its relatively small size, these options are probably not viable from a cost perspective, and would also require penetrating the historic roof (unless an addition was constructed to the rear)

An option that is frequently considered acceptable when full access is not feasible would be to provide "programmatic Access" on the first floor in the form of a video display showing the exhibits on the second as well as some of the highlights of the archives in the Cottage building.

Treatment Recommendations
*Add a sloped piece to the front of the threshold to reduce its abrupt rise. ***

*Consider partitioning off a corner of main first floor room to provide an accessible bathroom. The easiest location for that would the corner next to the existing bathroom. ***

*Provide programmatic access to the second floor and the cottage building by Producing and installing a video display on the first floor showing the exhibits on the second as well as some of the highlights of the archives in the Cottage building. ***

FIRE AND BUGLAR ALARMS SYSTEMS

The building has hard wired motion detectors and smoke detectors on both floors that are connected to an alarm service and monitored 24/7. We did not observe any issues with this system.

INSULATION (Photos 7, 50, 52)

There is 6"-8" of loose cellulose insulation in the attic floor. As noted in the IRE Report, there are cardboard collars around the light fixtures for the second floor intended to keep the insulation away from the fixtures, although in each case there is still a couple of inches of insulation around the base of the fixtures. These may have been installed to facilitate access to the fixture wiring and reduce overheating of the fixtures rather than for fire protection, as the cellulose likely has a fire retardant in it. In any case resulting gap in the insulation does provide a short circuit for heat to escape to the attic.

The walls insulated with fiberglass batts of unknown thickness that were installed during the c. 1980 restoration.

2" diameter circular ventilators are present in the main cornice soffit that are intended to provide cold air to the attic space in order to reduce the likelihood of ice dams at the eaves. The space above them is not covered by the attic insulation (it stops at the roof plate), but their functionality may have reduced y paint buildup. There are no other provisions to ventilate the attic. Given the minimal ventilation, the likely buildup of excess heat during the summer makes cooling the second floor more difficult despite the attic floor insulation.

As discussed in the section on windows, the existing aluminum storm windows are thirty years old *Consider partitioning off a corner of main first floor room to provide an accessible bathroom. The easiest location for that would the corner next to the existing bathroom.* and may have lost some of their effectiveness.

Treatment Recommendations
*Consult with a qualified electrician and the fire department as to the need and fire risk associated with the collars and cellulose insulation. Consider removing the cellulose from within the collars and replacing it with fiberglass batts that could easily be lifted for access, assuming that overheating the fixtures is not an issue. **

*Consider installing a large capacity ventilation fan with a thermostatic control in the top of rear pitch of the roof or in the bell deck of the cupola to reduce summer heat. ****

*Clean excess paint form the soffit ventilators next time the building is painted, or consider replacing them with new ones of the same size is that is cheaper. ***

SUMMARY OF TREATMENT RECOMMENDATION - ACADEMY BUILDING

MAIN ROOF

*Replace the roof within the next year using "blue label" #1 "perfection" (i.e., 18" long) red cedar shingles incorporating provisions for ventilation under the shingles and with proper nailing.****

CUPOLA BELL DECK AND ROOF

*he cupola roof should be repainted within the next 1-3 years, at which time the condition of the cap below the weathervane should be checked.***

*he bell deck roofing should be replaced within the next 1-2 years.****

MAIN ROOF FLASHINGS

*Chimney Flashings: Replace the both cap and base flashings in conjunction with the replacement the wood shingle roof using lead or lead coated copper.****

*Cupola Base Flashings: Replace all existing flashings in conjunction with the replacement the wood shingle roof using 4lb. lead. ****

CHIMNEY

*Rebuild the top courses of the chimney and install new flashings in conjunction with installing a new roof. ****

ROOF DRAINAGE

The building should continue to be maintained without gutters, but measures should be taken around the foundation to better control the roof runoff at grade:

- *Install a perimeter drain around the building.****
- *Move the existing handicapped ramp at least 12" from the side of the building to prevent snow and splashback from roof runoff from hitting the clapboards.***
- *When the new roof is installed be sure to extend the shingles about 2" beyond the outer edge of the crown molding at the eaves.****

MAIN CORNICE

*Replace the rotted section of crown molding on the rear facade to match the existing crown molding and check for deterioration in other sections in conjunction with installing a new wood shingle roof. ****

*Carry out minor repairs to re-secure any loose modillion blocks and other defects in conjunction with painting or re-roofing work. ***

CUPOLA WOODWORK

*Balustrade: Completely replace matching the detailing and number of balusters visible in the historic photographs (13 balusters per side instead of the current 11 per side). ****

*Bell Deck Cornice: Repair substantial cracks in modilion blocks using epoxy consolidation and filling procedures, and reconstruct broken out sections using epoxy and/or wood Dutchman inserts. ***

*Cupola Skirt Boards and Trim: Replace severely defective pieces to match existing elements. Original moldings that are split but otherwise sound can be retained and restored by removing them to a bench, and using epoxy conservation techniques to glue them back together. ****

*Cupola Cornice: Re-work the cornice to include reproductions of the original modillion blocks and related moldings based on historic photographs. **

CORNER BOARDS

*Southwest Front Corner: The c. 1980 portion of the southwest corner board should be replaced with new corner boards matching the original section above without using glued up pieces. ***

*Southeast Rear Corner: Remove and reset lower section of the south side corner board that has pulled away. ****

WINDOW FRAMES

*The two first floor front window frames should, at the least, have their caps and crown moldings replaced, and the rot to the sill horns at the base of the jambs more carefully repaired with epoxy consolidation and filling. New ogee band moldings matching the originals on other frames should be installed on their jambs. ****

*The weather checking in the historic caps: Epoxy consolidation and filling is an option, but if not well done and maintained with paint can generate rot below the epoxy. Leaving the checks as is provided they are kept well painted and the wood remains firm without rot in the checks is also an option. ***

WINDOW SASH

*All the window sash should be be repainted along with reglazing of defective putty.****

*All the frame elements inside the storm windows also need to be repainted. ***

*Replacing the storm windows with new, high quality aluminum storms such as the Harvey "Tru-Channel" is an optional treatment that would probably improve the energy performance of the windows. **

FRONT ENTRY PORCH

*Consider replacing the existing columns with fluted columns and bases matching the columns and bases in the historic phot**O**graph. ***

SIDE AND REAR EGRESS DOORS

*Monitor the condition of the bottom of the side door and exterior casings for rot, and repair with epoxy con**S**olidation and/or wood Dutchman if rot is found. ****

CLAPBOARDS

*Preserve as many of the original clapboards in pla**C**e as possible including their hand wrought nails. Only the most severely cracked clapboards should be replaced. ****

*The small areas of modern flat sawn clapboards should be replaced with good quality vertical grained clapboards, matching the detailing of the original clapboards. ***

EXTERIOR PAINT

*Areas of peeling paint should be scraped and touched to match up the existing paint in order to get the maximum life out of the existing paint job. The top surfaces of the window caps should also be repainted, this time matching the trim color. ***

*When the next complete repainting is done (probably in 2-4 years), care should be taken in preparation to not do damage to the clapboards and their nails from grinding or power sanding. ****

*Professional paint analysis should be considered to determine both the original and early 19th century color treatments of the building. **

FIRST AND SECOND FLOOR INTERIORS

*Consider painting all **T**he wood wall wainscots, window trim and framing casings a period appropriate color(s). ***

*Consider painting all floors a period appropriate color(s) or maintaining them as completely unfini**S**hed floors. ***

CELLAR

*Install perimeter drains around the entire foundation as discussed in the section above on Gutters and Site Drainage. ****

ROOF FRAMING

*Carry out a systematic survey of all the roof framing for insect activity and deterioration, including the ends of the rafters at the tie beam joint. ***

*Install a network of boarding to provide access paths around the entire attic perimeter so that the framing can safely be routinely inspected. ***

*Examine the bowed strut noted in the IRE Report to determine if it has been weakened to t***H***e extent that a sister strut should be added next to it. ***

CUPOLA FRAMING

*Retain a professional with wide experienced in the evaluation of eighteenth and early nineteenth century timber frame construction involving steeples and cupolas to carry out an in depth systematic analysis of the cupola and bell deck frames, and to recommend appropriate repairs and methodology to carry out the repairs.****

*Assuming the repair work will be funded by the Town and require bidding under Chapter 149, a design professional will have to be retained to produce plans and specifications for the repairs. Any repairs should preserve as much of the historic frame as possible, and where replacement is necessary, the new members should duplicate the originals to the greatest extent feasible. ****

*Take immediate steps to kill the fungus and any active insect infestation. The first step would be a topical application of borates to the frame. ****

OTHER ISSUES - BULGE IN EXTERIOR WALL AT SOUTH FACADE

*Remove the modern wallboard finishes at the interior side of the affected area to investigate the cause of the bulge and determine appropriate repairs. **

MECHANICAL AND ELECTRICAL SYSTEMS

Refer to the Collections Assessment by Marc Williams for recommendations as to the operation of the heating system and window air conditioning units.

UNIVERSAL ACCESS

*Add a sloped piece to the front of the threshold at the side door to reduce its abrupt rise. ***

*Consider partitioning off a corner of main first floor room to provide an accessible bathroom. The easiest location for that would the corner next to the existing bathroom. ***

*Provide programmatic access to the second floor and the cottage building by Producing and installing a video display on the first floor showing the exhibits on the second as well as some of the highlights of the archives in the Cottage building. ***

INSULATION

*Consult with a qualified electrician and the fire department as to the need and fire risk associated with the collars and cellulose insulation. Consider removing the cellulose from within the collars and replacing it with fiberglass batts that could easily be lifted for access, assuming that overheating the fixtures is not an issue. **

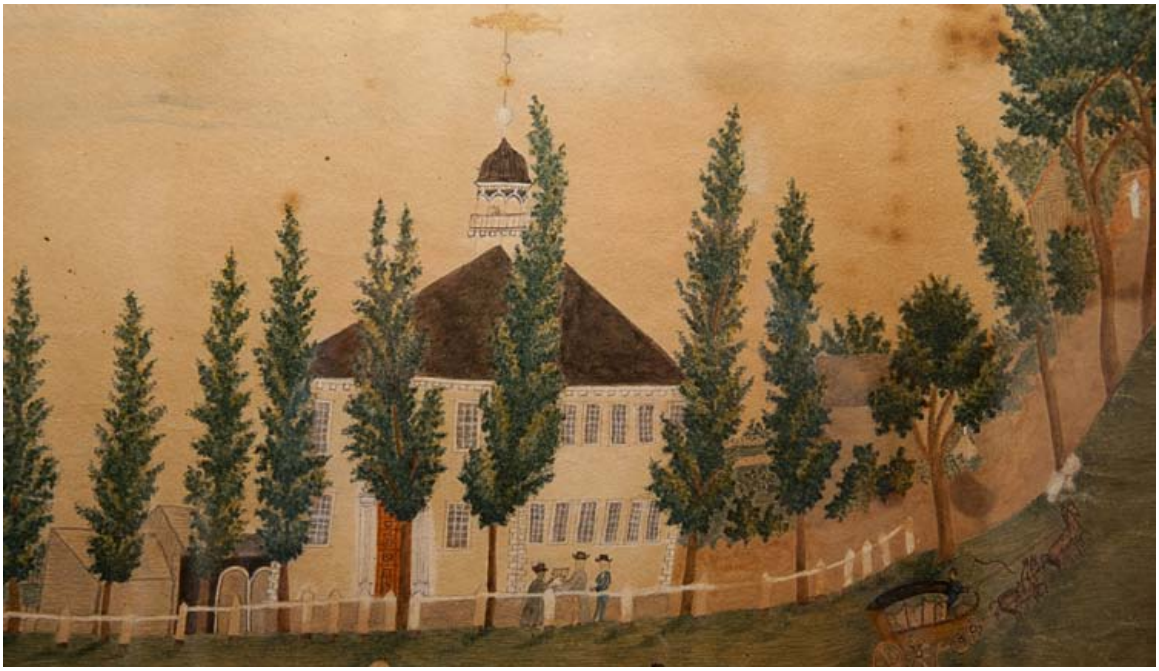
*Consider installing a large capacity ventilation fan with a thermostatic control in the top of rear pitch of the roof or in the bell deck of the cupola to reduce summer heat. ****

*Clean excess paint form the soffit ventilators next time the building is painted, or consider replacing them with new ones of the same size is that is cheaper. ***

1: Front (west) and south side facades of the 1794 Westford Academy Building.

2: North side of Westford Academy showing universal access ramp.

3: Rear (east) side of Westford with egress stair from second floor meeting room.



4: Early 19th century watercolor painting of the Westford Academy.

5: Front facade of the Westford Academy showing the entry porch installed c. 1980.

6: Late 19th century photogrph of the Westford Academy. The 6/6 window sash, the entry door, and transom are chamges that probably date to the mid-19th century.

7: Wood shingles installed in 1992 show excessive curling and area of missing shingles at eaves. The crown molding (A) was installed c. 1980 to reproduce the original. The rest of the cornice elements are original and in good condition.

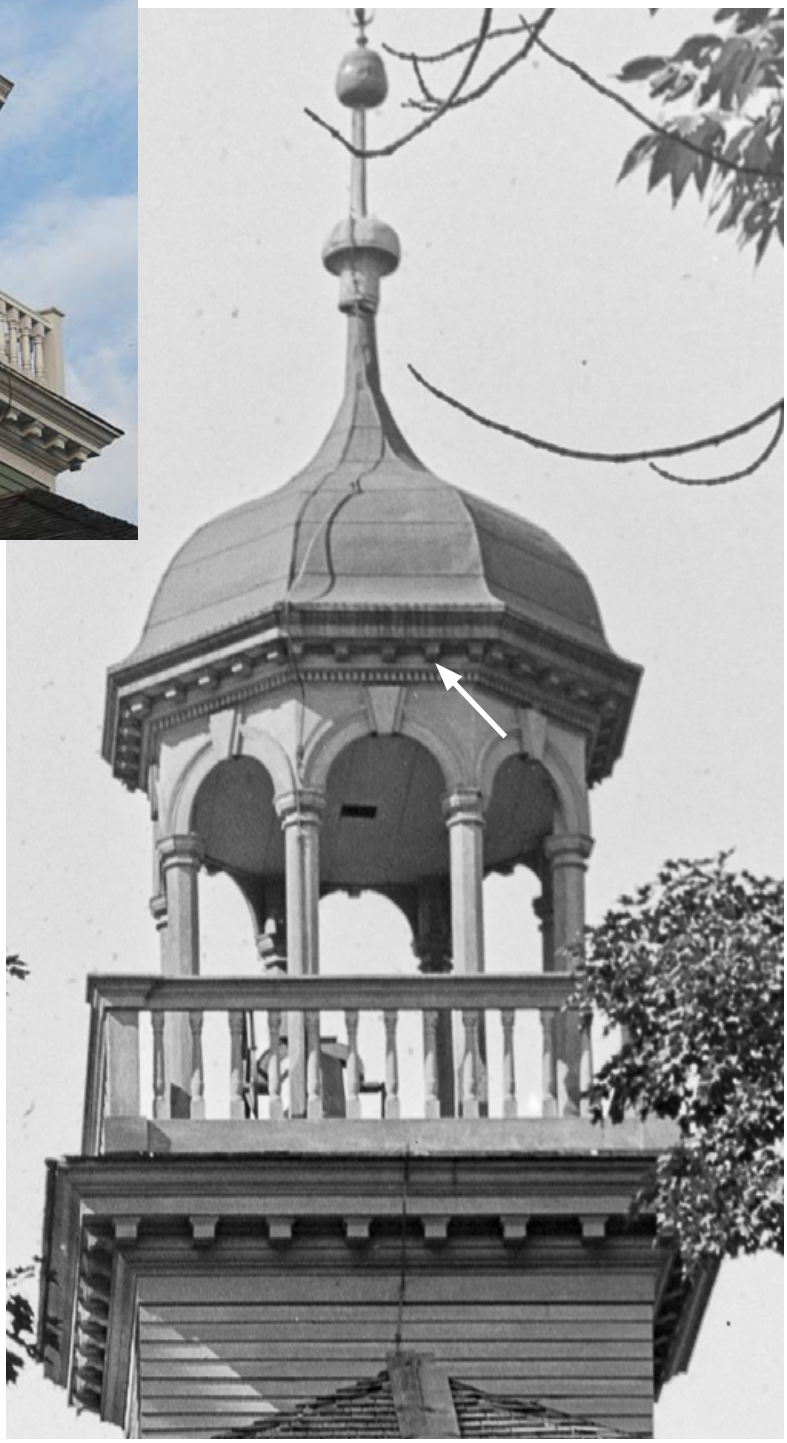
8: Wood shingles installed in 1992are in poor condition. The top of the chimney is missing a brick and thge top 4-5 courses need to be rebuilt. The flashing and detailing of the cricket at the back of the chimney may be a problem.

9: Front face of wood shingle from the roof showing its exposed heavily eroded from UV exposure to become very thin. This shingle is clear and straight grained red cedar, although the "Red Label" grade used on this roof would allow some defects in the top portion of the shingle and some shingles with flat sawn grain.

10: Cap flashings at rear chimney are not tightly dressed down over the base flashings. Arrow points to the upstand of a sheet of base flashings where wind driven rain could blow under the cap flashing and run down behind the base flashing. The mortar pointing looks to be tight and sound in this area.

11: Water stains around chimney at second floor from active leaks at chimney flashing.

12: Current appearance of cupola as repaired c. 1980. Note paint on metal roofing has areas of wear as does the cap at its top (arrow).



13: Detail of cupola from Photo 6 showing original detailing. Note that the modillion blocks (arrow) were not reproduced in the c. 1982 restoration work.

14: Current view of cupola balustrade and cornice showing that the balusters, railing, and posts do not match the ones in the late 19th century photo below. Also note the balusters are splitting apart, and the top of the crown molding (which was installed in 1982) is rotting (arrow). The fascia, modillion blocks, and bed molding below the c rown molding are original to 1794. The ends of the modillion blocks on the cornice show weather checking.

15: Detail from the late 19th century photograph showing what are likely the original balusters, railing, and posts. There are 13 balusters on a side whereas the current balustrade has only 11. The current balusters are also heavier than the ones in this photo.

16: Section of bell deck roof showing roll composition roofing installed in 1982 that is severely deteriorated with numerous roofing tar patches. This material normally has only a 15 year service life. Replacement with flat seam soldered copper is recommended.

17: Detail of delaminating balusters. Pieces splitting off are a potential hazard in that they may fall off the edge of the main roof.

18: Stains on second floor ceiling from past leaks at the cupola. Less heavy leaks could still be occurring without showing up on the ceiling, and could continue to provide moisture for fungus and insect activity in the cupola framing.

19: The worst case example of deteriorated trim on the cupola columns. Much of this trim is original and was stripped of paint in the 1982 restoration of the cupola.

20: Original arched boards and moldings show separations and splits. These conditions warrant conservation treatments.

21: The quoins installed in the first floor front corners after the fire house doors were removed have splits and separations due to their construction detailing. These sections of the corner boards should be redone more accurately detailing the construction detailing of the originals.

22: A portion of the original corner board at the southeast corner has pulled away from the building leaving a large gap for water penetration. The board should be taken off and rest tight to the sheathing.

23: Detail of the top of the loose board with a clapboard removed showing the strip of original wood flashing under the junction between the corner board and the clapboards. The original flashing should be preserved, but may be covered over with a strip of aluminum or copper flashings to better protect the joint.

24: One of the two window frames installed c. 1980 after the fire house doors were removed. The cap is made of laminated stock and is coming a coming apart. The crown molding under it is rotting. An ogee band molding matching the moldings on the original frames was never installed. The window needs a new cap made of a single piece of rot resistant wood matching the detailing of the original caps.

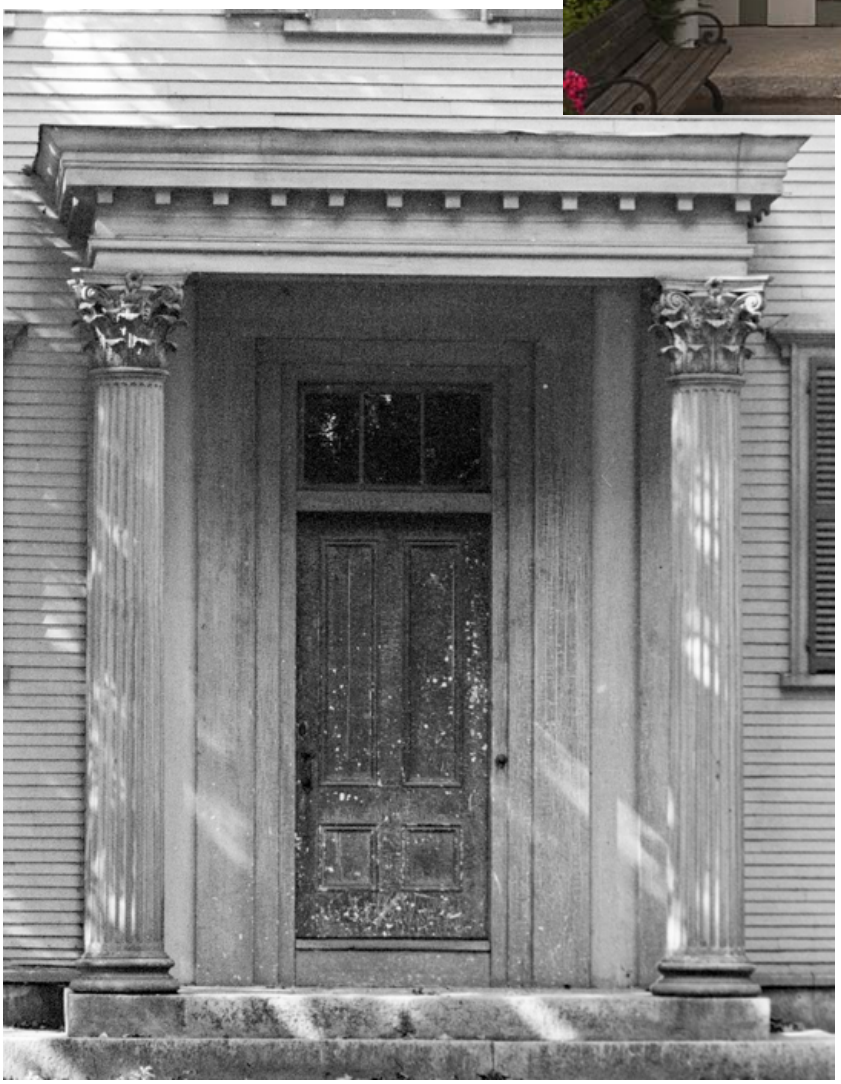
25: Lower corner of one of the two window frames installed c. 1980 after the fire house doors were removed showing rot that has been repaired with some type of wood filler that is now failing. The repair needs to be redone using epoxy conservation and/or a wood Dutchman.

26: Original window cap on the south facade showing typical moderate weather checks. The awl is in a small area of rot that should be repaired with epoxy and/or a wood Dutchman. The wood in the other checks seemed to be solid.

27: Typical window sash installed in the c. 1980 restoration. The lower sash has been turned around and installed with its interior side facing outwards. The upper sash is facing the right way, but is glazing putty is failing.

28: Detail of a typical window sash showing extensive area of missing or loose glazing putty. All the windows need to be reglazed.

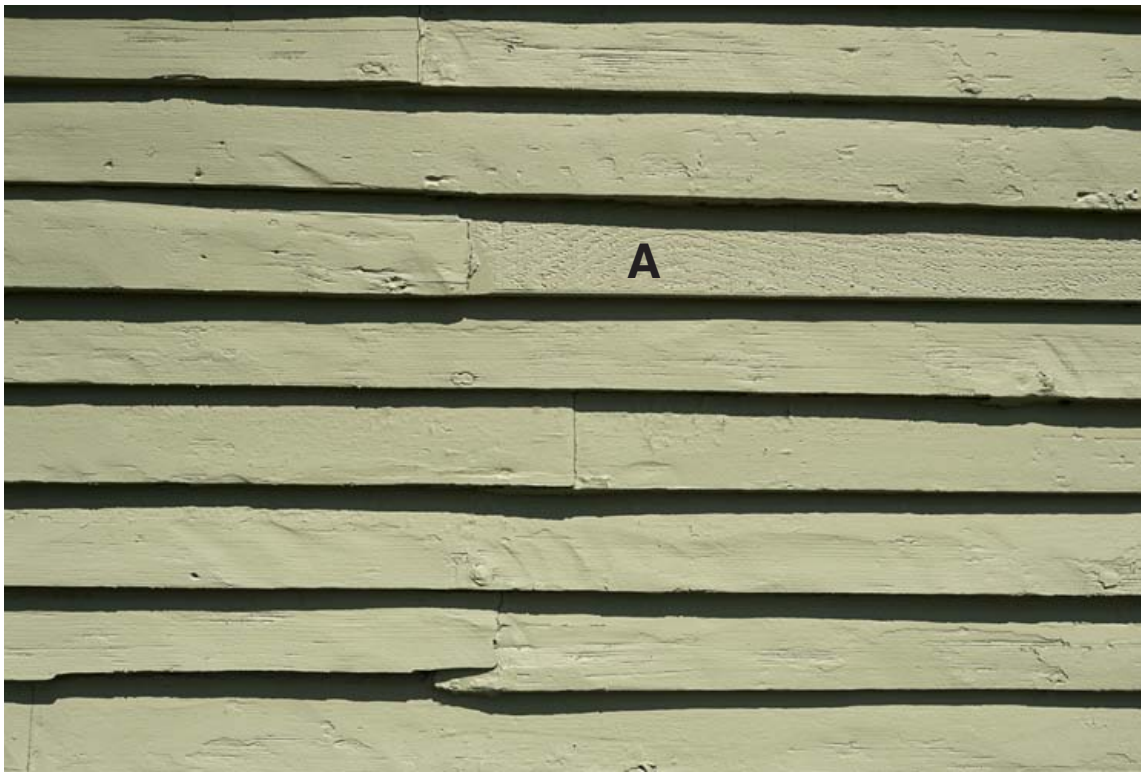
29: Front entry and porch as reconstructed in the c. 1980 restoration. Due to budget constraints round rather than fluted columns were used.



30: Detail of late 19th century photograph showing original fluted columns with fully developed classical bases, and mid-19th century door and transom light. There is also a difference in the height of the entablature and cornice of the porch from the current porch. It would be desirable to redo the columns to better match the originals.

31: Handicapped access ramp and door on the north side facade. The door casing on the right side (arrow) is starting to rot at its base. Having the full length of the ramp tight against the clapboards will eventually rot the clapboards and framing beneath themdue to snow piling up against the wall and rain splashing back.

32: Interior side of the handicapped entrance door is damp-stained from water leaking under the door and at the joints of the panels to the rails.



33: Area of original clapboards that have been gouged and disfigured by inept preparation with a circular grinder to remove paint. "A" marks a poor quality replacement clapboard that is flat-sawn. It and opthers like it should be replaced with vertically grained clapboards.

34: Detail of original clapboards showing their original butterfly headed hand wrought nails. One of the nail heads (arrow) has been flattened by the use of a paint grinder. Care should be taken during paint preparation to not damage the original nail heads.

35: Back side of an original clapboards showing its hand riven surface. They were split out a a log and then shaved smooth their surface.

36: Detail of the clapboard showing its original surface texture on the back side.

37: The front of an original clapboard showing the long bevel that has been shaved to make a watertight lapped joint with the end of the adjacent clapboard. This joint is made with a draw knife and cannot be properly cut on a table saw.

38: The back corner of this window head was cut away in the early 20th century to install a steel tie rod at the ceiling of the first floor, probably so that a columns could be removed to make space for the fire trucks. The rough textured clapboards to right are poor quality modern replacements.

39: Typical small area of paint failure. To maximize the life of the current paint job, such areas should scrapped to remove the loose paint and touched up to match the adjacent sound paint.

40: Typical detailing of the second floor exhibit space. The board wainscot is intended as a period typical wall treatment. It would better approximate a period appearance if the woodwork is painted using a period appropriate color.

41: Typical detailing of the first floor exhibit and meeting space. The wood columns ar placed to support the floor beams that align with the two major roof trusses.

42: Unpainted woodwork in the entry vestibule is severely stained from past water leaks of unknown source. Paiinting would improve its appearance.

43: The floors received a finish in the 1980 restoration that is now wearing away to bare wood in areas of heavy traffic. A period typical treatment would be either all bare wood without a finish, or paint.

44: Cellar showing the posts and framing for the first floor installed in the mid-20th century to support the fire engines. This framing is in good condition and obviously extremely strong.

45: Cellar wall on the north side showing the cement plaster parging over the fieldstone foundation wall. As noted in the IRE report, the parging has lost its bond to the stone in places, and the upper section has apparently fallen off, all due to water seeping in through the foundation. Installation of a subsurface drain around the exterior perimeter of the foundation is recommended to reduce the seepage through the foundation. The ends of the beams appear to be incased with masonry without provisions for ventilation. This can lead to premature rot in the beam ends. The beam ends should be checked every two years for signs of any rot.

46: Char on the framing near the northeast corner is from a fire in 1982 that was started by a lightning strike on the cupola. The floor joist bears on charred lintel over the window opening. The lintel does not show any visible deflection or other visible signs of being over-stressed. To confirm the remaining sound thickness of the lintel, the char can be scrapped off a section of so it can be measured

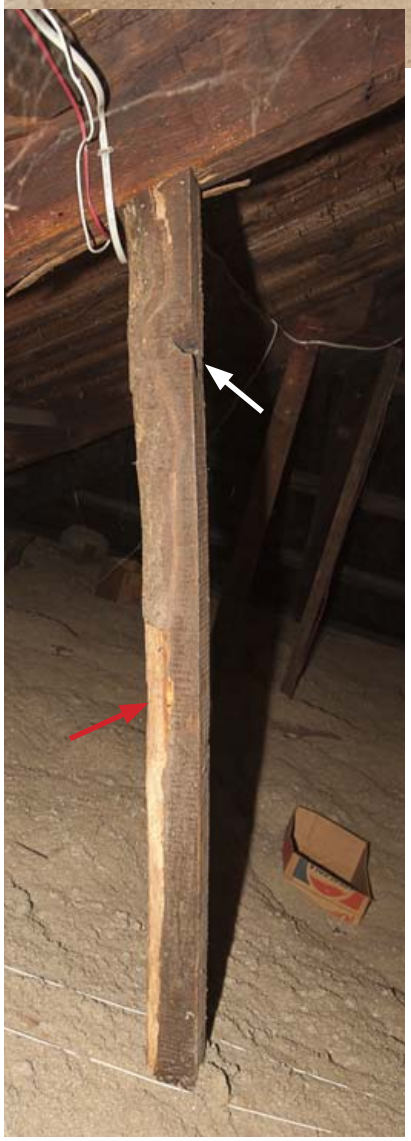
47: Existing access hatch to the attic with a ladder set up to enter the attic. The access is somewhat awkward and discourages regular checking of the attic. Re-positioning it and making it a little larger is recommended. We understand it is too high for a stock folding attic stair ladder, but perhaps a custom installation could be fabricated to eliminate the need to haul a ladder up the stairs.

48: North pitch of roof in attic looking towards the rear. Purlins and rafters are straight without visible deflection or other signs of distress. The struts between the rafters and the tie beams in the attic floor are also straight. The original strut under the hip rafter in the rear of the photo has been replaced by two thick boards. This has been done at all four hip rafters.

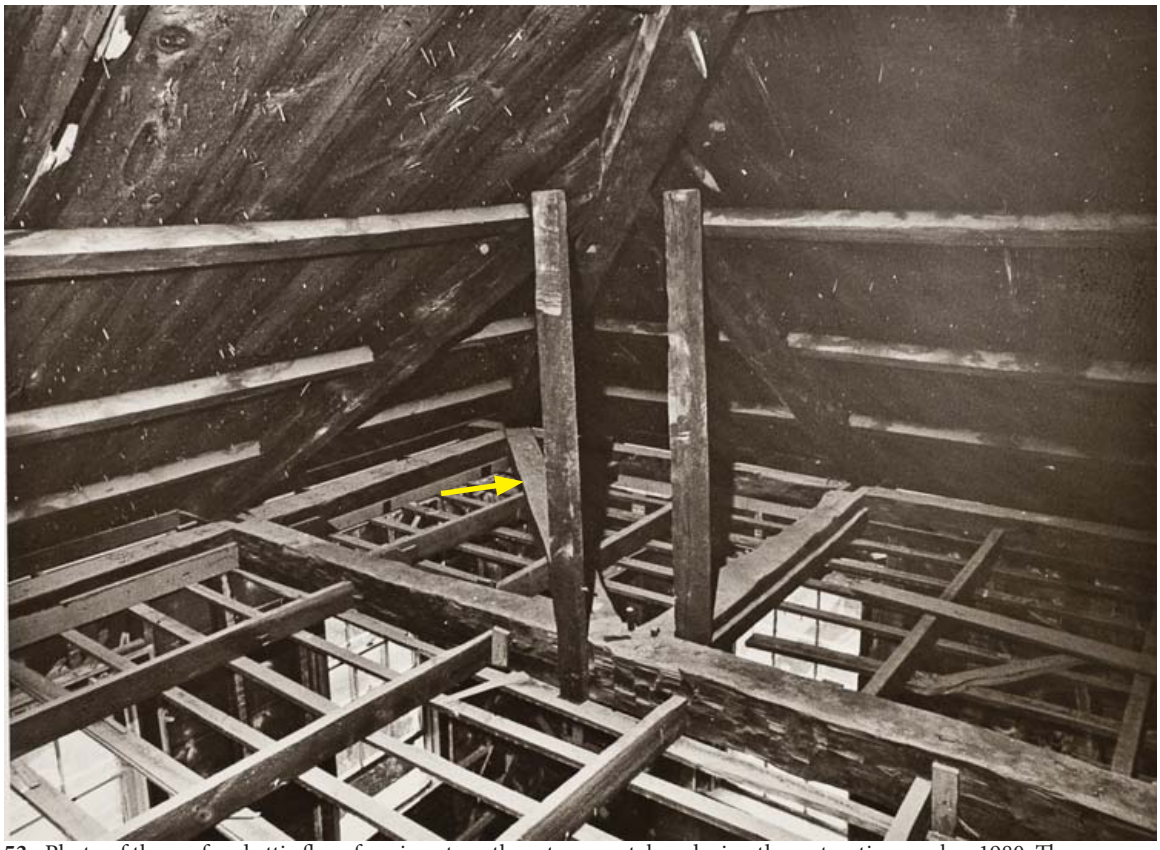
49: Junction of the hip rafters to the rafter pair and king post of the westerly main roof truss. A portion of the cupola support frame is in the lower center behind the king post.

50: Typical roof purlin showing its joint with the rafter (arrow). The purlin is sawn oak with no sign of deflection or cracking where it has been cut to form the tenon that sits in the open mortise in the top of the rafter. This construction is typical of 18th and early 19th century roof framing. These purlins are more substantial and uniformly cut than one frequently finds in this type of framing.

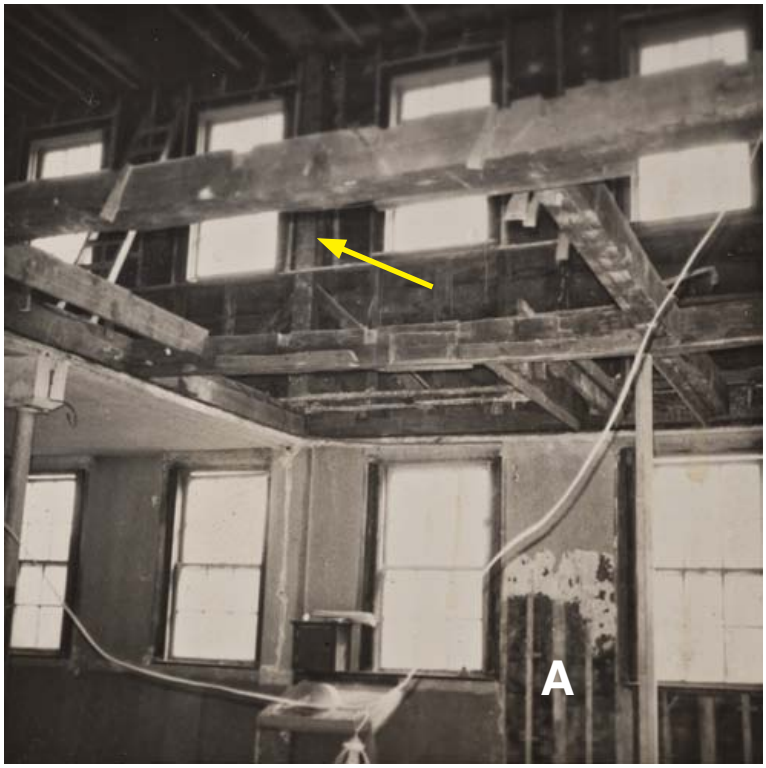
51: Detail showing the top of an oak strut with its tenon set in a mortise in the bottom of the rafter. This joinery indicates the strut is part of the original construction and not later measure to support sagging rafters.



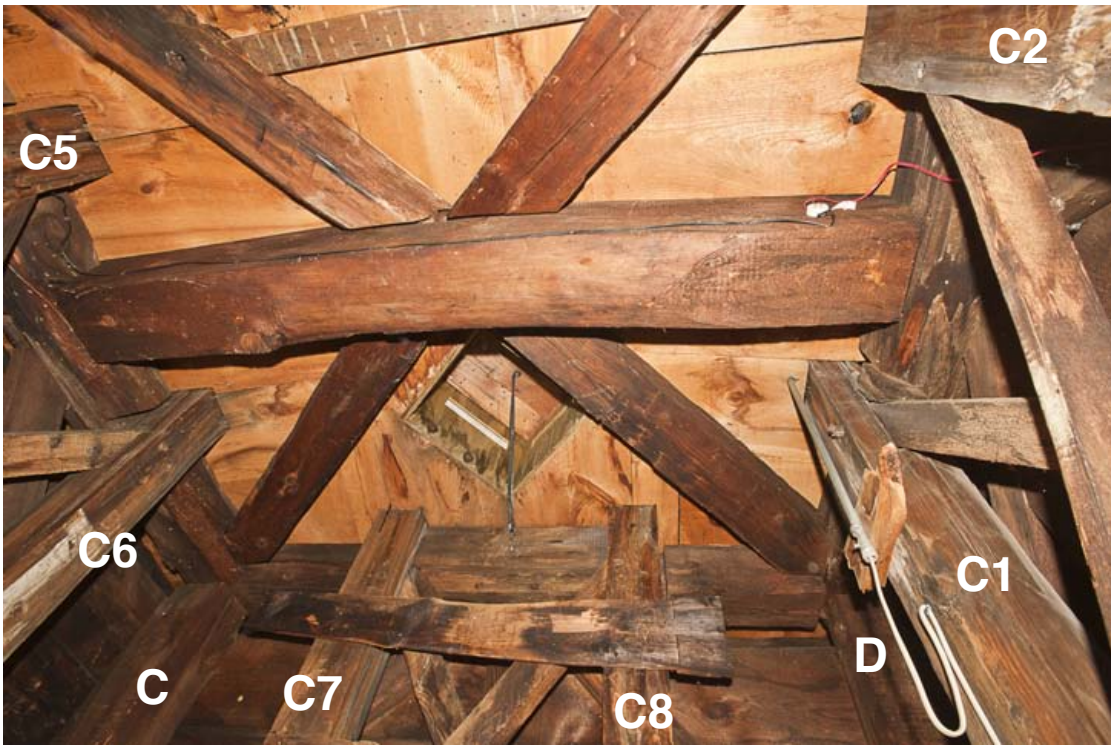
52: Photo of the strut illustrated in the IRE report suggesting the struts are deforming due to excessive compressive loads. This is the only strut we observed to be "bending". It has a large knot (white arrow) that both weakens it and disrupts its grain pattern in a manner that may have caued ti to warp to its current shape. There is also has substantial insect damage along its rear corner (red arrow) that also may be weakening the strut if the damage extends into its center.



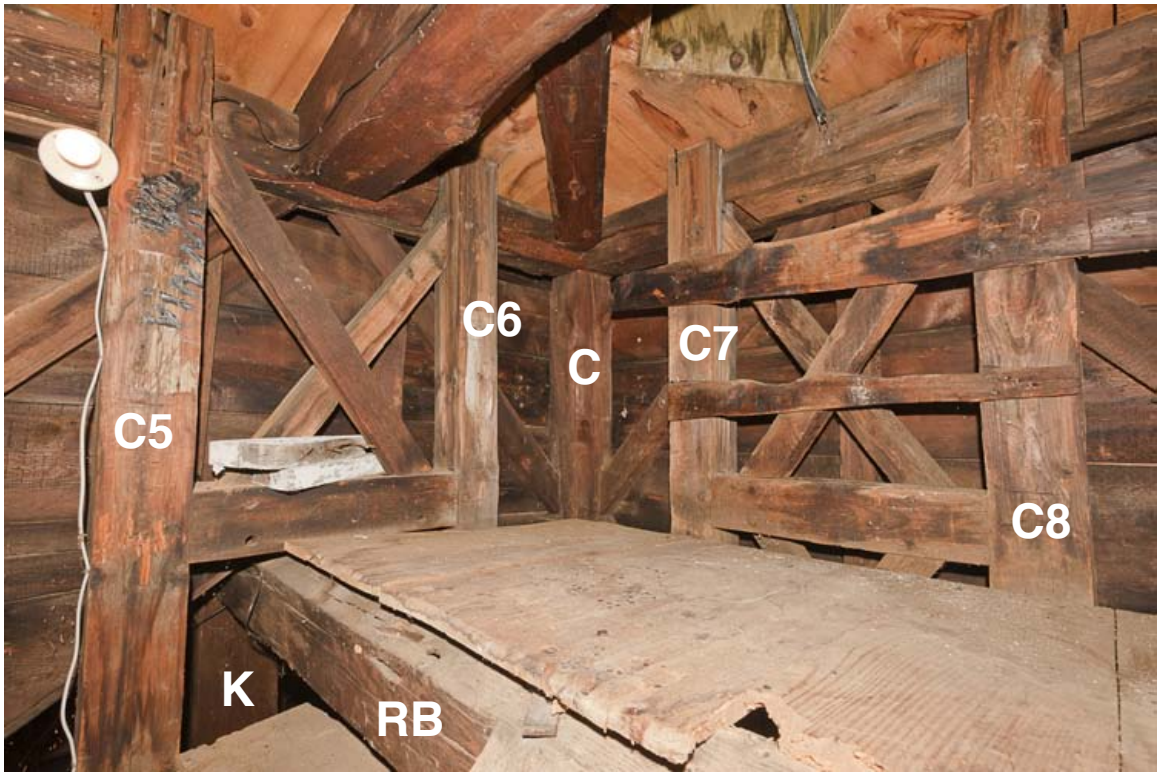
53: Photo of the roof and attic floor framing at southwest corner taken during the restoration work c. 1980. The arrow points to the "dragon beam" that is typical of hip roof framing of this period. The two vertical members replaced the original rafter strut at the hip rafter long before this photo was taken. *Photo by Robert Adam from the Westford Historical Society Archives.*



54: Photo of the attic floor and south wall framing taken during the restoration work c. 1980. The arrow points to the wall post under the easterly main roof truss. "A" marks the area of the south wall shat current shaos a bulge on the exterior. It is not clear why or when the floor njoists were removed in this area. *Photo by Robert Adam from the Westford Historical Society Archives.*



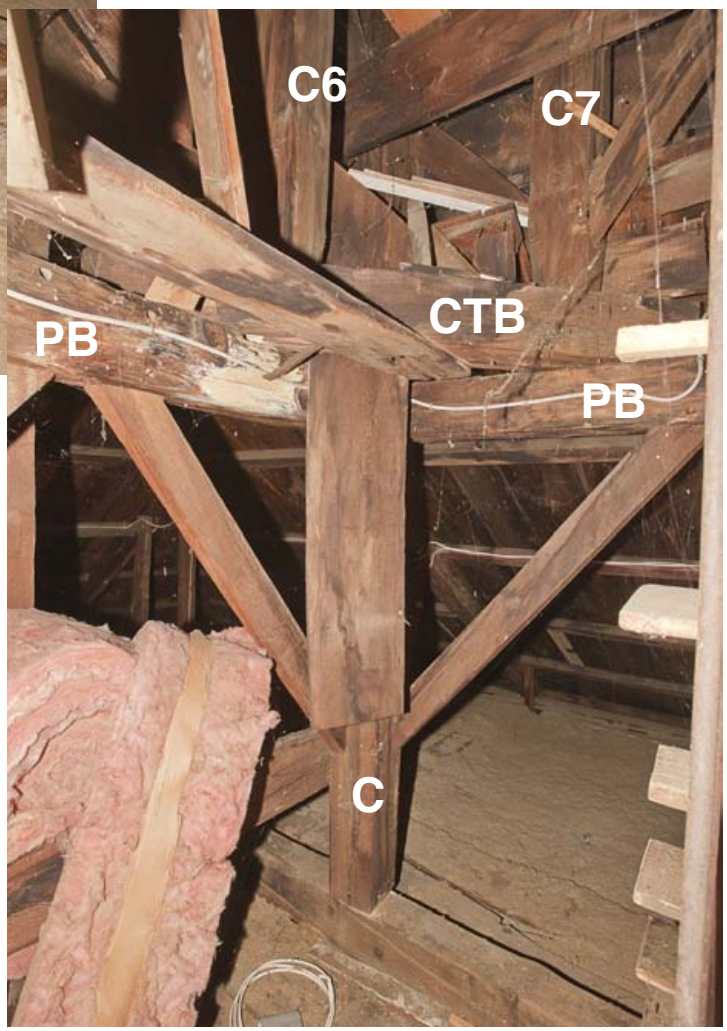
55: Looking up at the underside of the bell deck floor showing its framing. The deck sheathing boards probably date to c. 1980. Six of the eight cupola posts are visible and are marked C1, C2, etc., to correspond to the post numbers on the cupola framing Plan A2. The two visible bell deck posts are marked "C" and "D" as on Plan A2.



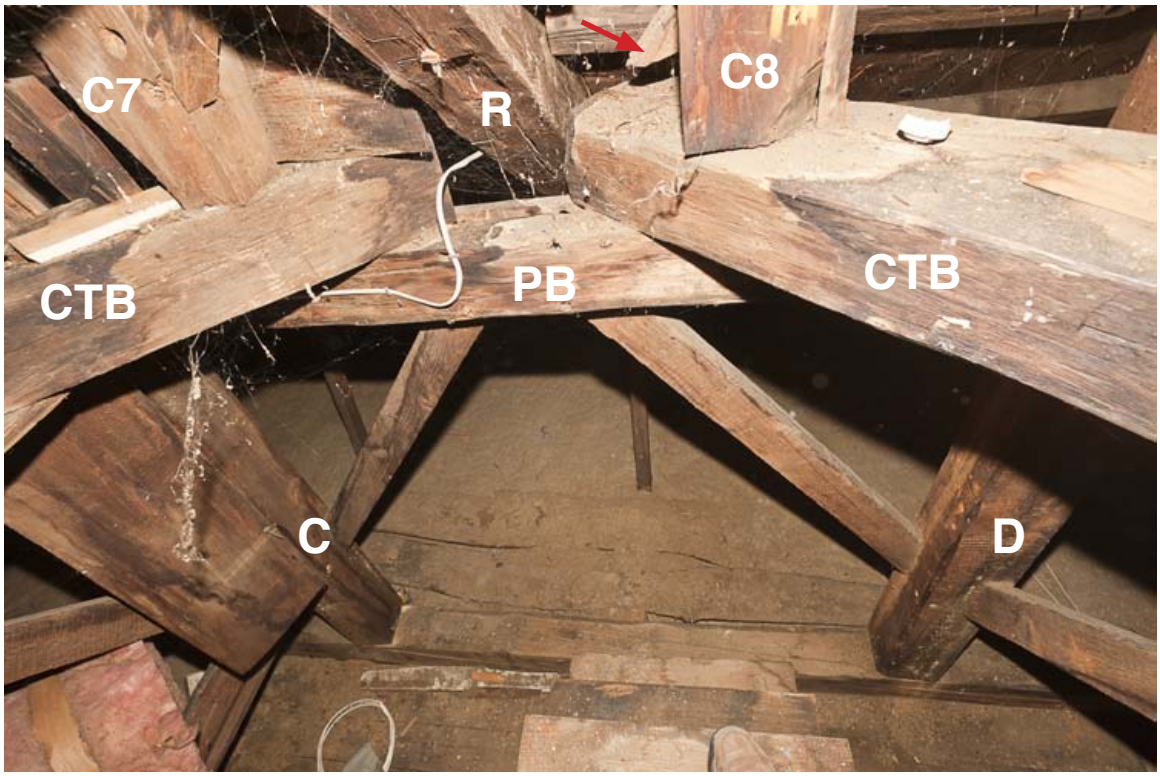
56: Looking up at southeast corner the cupola framing showing the diagonal bracing intended to stiffen both the cupola post frame and the bell deck frame. The ridge beam spanning between the king posts is marked "RB", and the king post is marked "K". The short beam between posts C5 & C6 sits on top of the ridge beam and may be transferring most of the loads from the two posts to the ridge beam. The beam between posts C7 & C8 serves only to stiffen the frame and receive the lower set of diagonal braces.

57: Looking at the southerly king post (marked "K") with the lower portion of the bell deck frame beyond (its northwest post is marked "A". The white arrow points to the lower perimeter beam between bell deck posts A and D (Post D is not visible). The white circle marks the severely deteriorated transfer beam end under cupola post C2 that is shown in more detail in photo 61. The yellow arrow points to the ridge beam that is framed into both the north and south king posts. It is shown in more detail in photos 59 and 60.

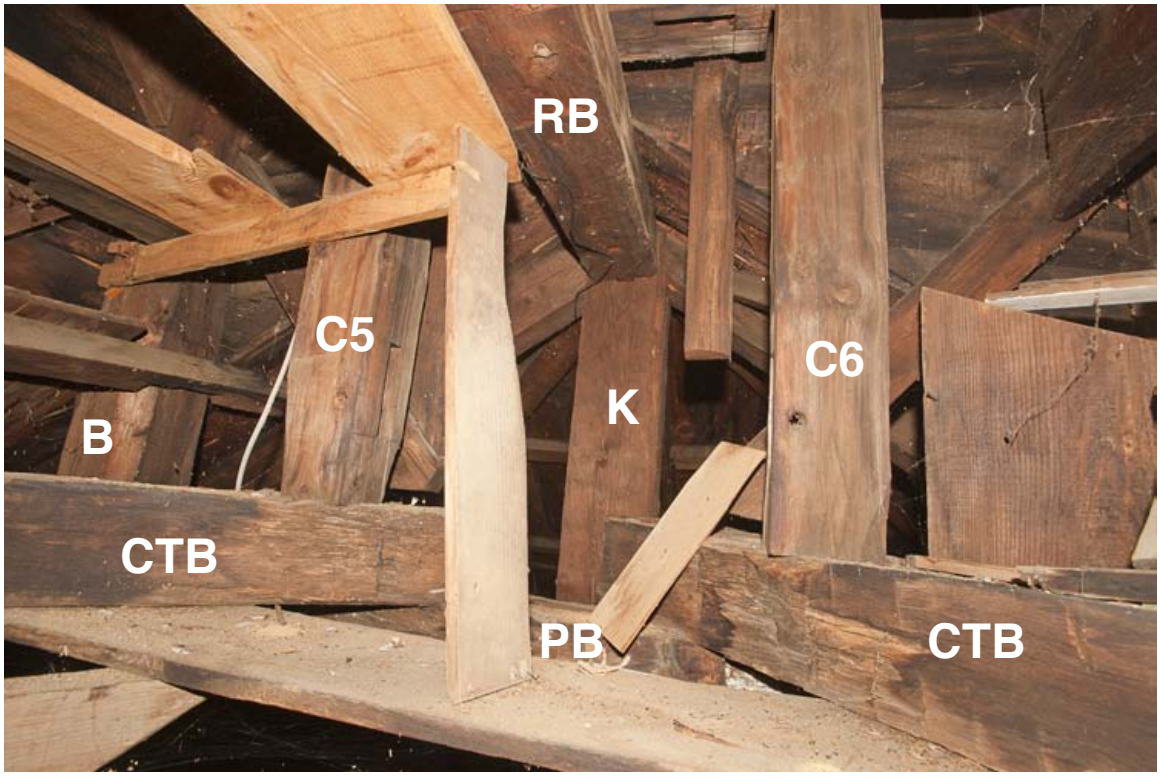
Plan and Elevation Drawings A1, A2, and A3 should be reviewed with these photographs to better understand the framing nomenclature and the locations of the photographs.



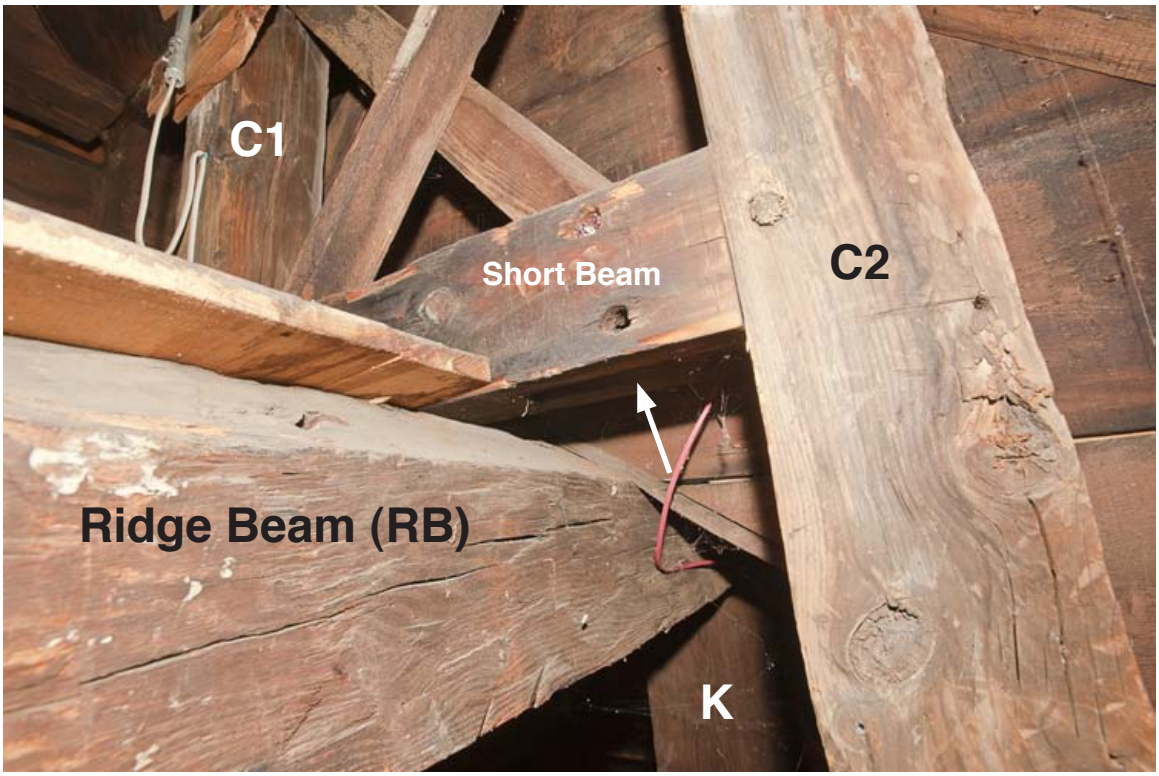
58: Looking up at the southeast bell deck post "C" sitting on the main transfer beam at the attic floor level. The lower perimeter beams between the bell deck posts are marked "PB". The cupola post transfer beam (CTB) spans over the two perimeter beams and in theory transfers the loads from posts C6 and C7 to the perimeter beams, which in turn transfer the loads to bell deck post "C". The whitish patch (arrow) on the perimeter beam is fungus with rot and insect damage behind it and on the portion of the cupola transfer beam above it. This is shown in more detail in photos 63 and 64. We suspect that much of the loading from C6 has been transferred above this area to the ridge beam as shown in photo 56. The end of the cupola transfer beam under C7 appears to remain sound.



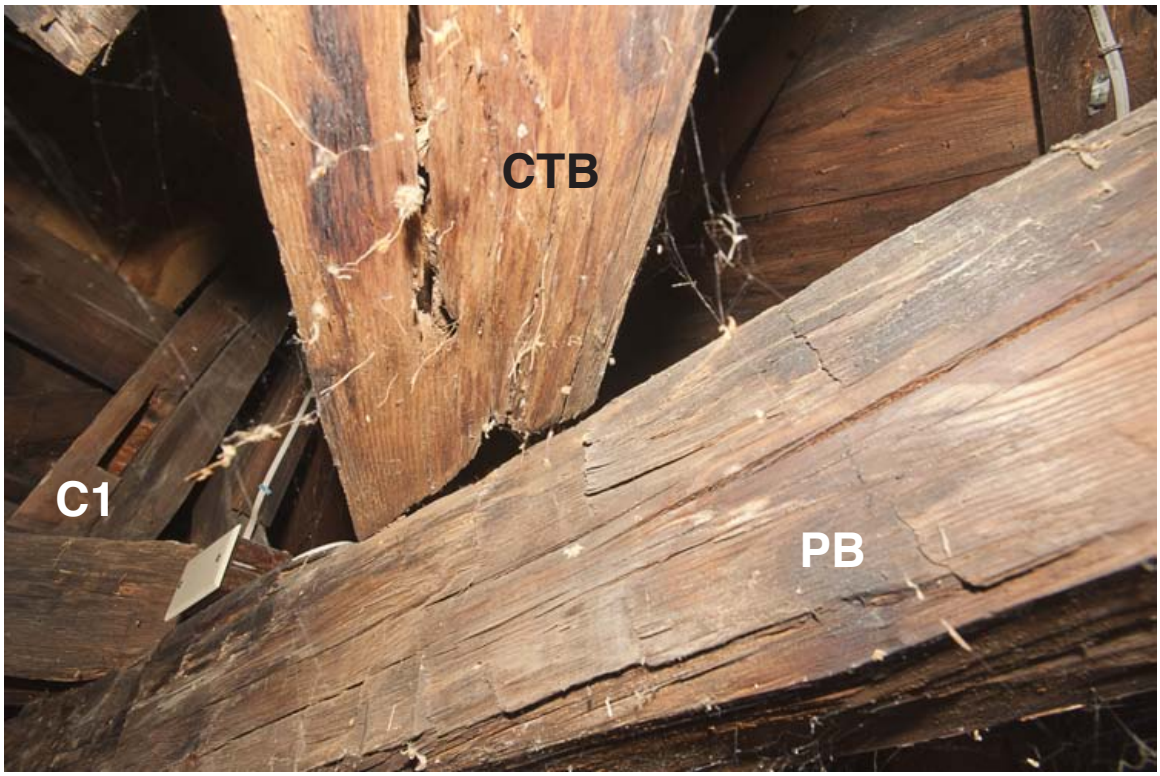
58: South side of the bell deck frame & cupola frame where the cupola transfer beams and perimeter beams appear to be sound. Arrow points to where the bottom of the bell deck post diagonal brace was been cut off to fit in the cupola transfer beam. The empty mortise that was cut to receive it is visible on the top of the perimeter beam.



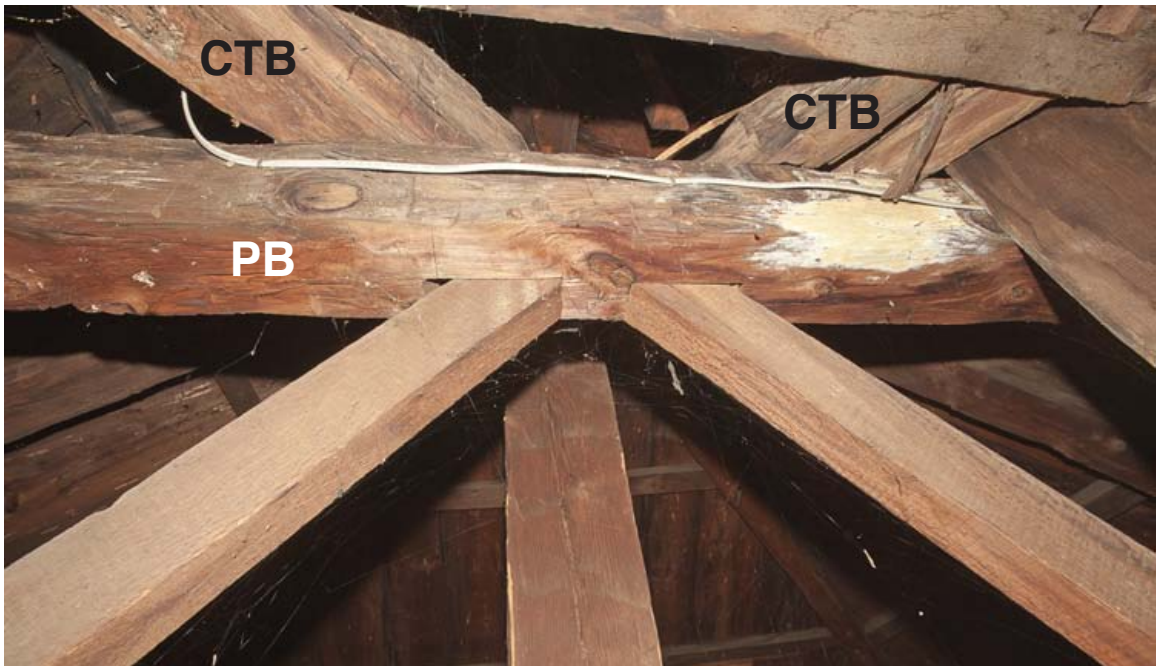
59: East side of the bell deck frame & cupola frame where the cupola transfer beams and perimeter beams appear to be sound. Arrow points to the fungus on the perimeter beam that is under the cupola transfer beam. The ridge beam (RB) may be carrying most of the loads on C5 and C6.



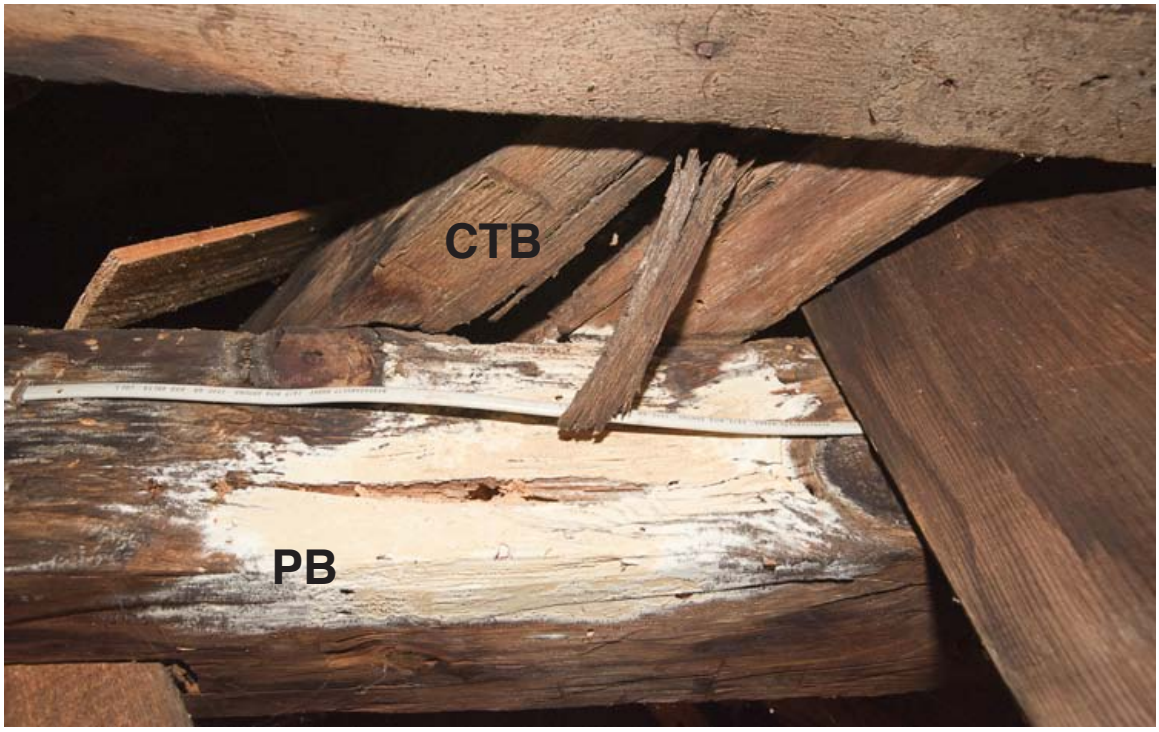
60: West side of cupola frame showing the short beam between C1 and C2 sitting on the top of the ridge beam. The arrow points to the empty mortise and empty pin hole in the short beam that was cut to receive the top of the lower diagonal brace that was never installed because the ridge beam was in the way.



61: West side of cupola frame showing the underside of the cupola transfer beam under cupola post C2. This end of the beam is completely rotted out except for a thin shell where it bears on the perimeter beam below it.



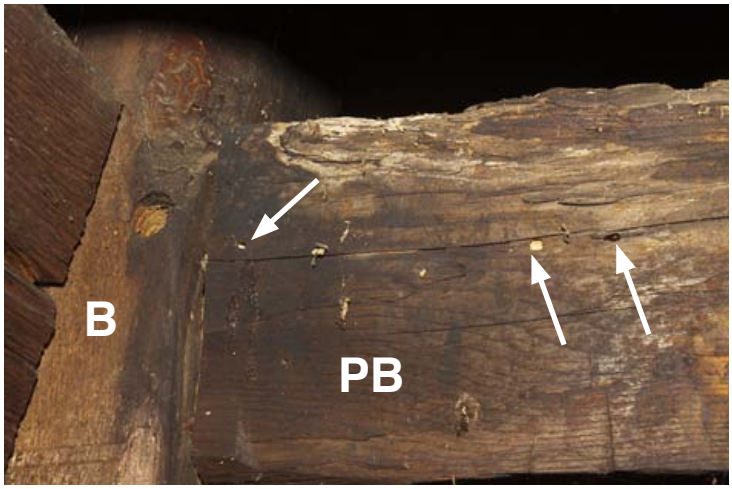
62: East side of frame showing the underside of the perimeter beam (PB) between bell deck posts B and C, and the undersides of the cupola transfer beams under cupola posts C5 (left) and C6 (right). This end of beam CBT has substantial center rot under post C6 and where it bears on the perimeter beam. The white area on the perimeter beam is a fungus with rot and insect damage beneath it. Exit holes for the Old House Borer are scattered along this perimeter beam. We suspect the loads intended for this perimeter beam are actually on the ridge beam above this area.



63: Detail of the area of fungus on the perimeter beam in photo 62. A sliver of the outer surface of the wood has been pried away to reveal insect damage behind it (arrow). Although we did not observe the specific cracks shown in Figures 7 & 8 of in the IRE report, we wonder if they are the peeling of the outer skin of the beams over insect damage rather than stress failure cracks. There are a number of insect exit holes visible in Figure 7.

64: Detail of diagonal crack shown in Figures 5 & 6 of in the IRE report in the side of the southerly main transfer under bell deck post C. The surface of the wood in the cracks is dark with oxidation and dirt indicating they have been present a long time and are likely shrinkage cracks rather than stress failure cracks. They are diagonal because this particular beam appears to contain spiral growth wood.

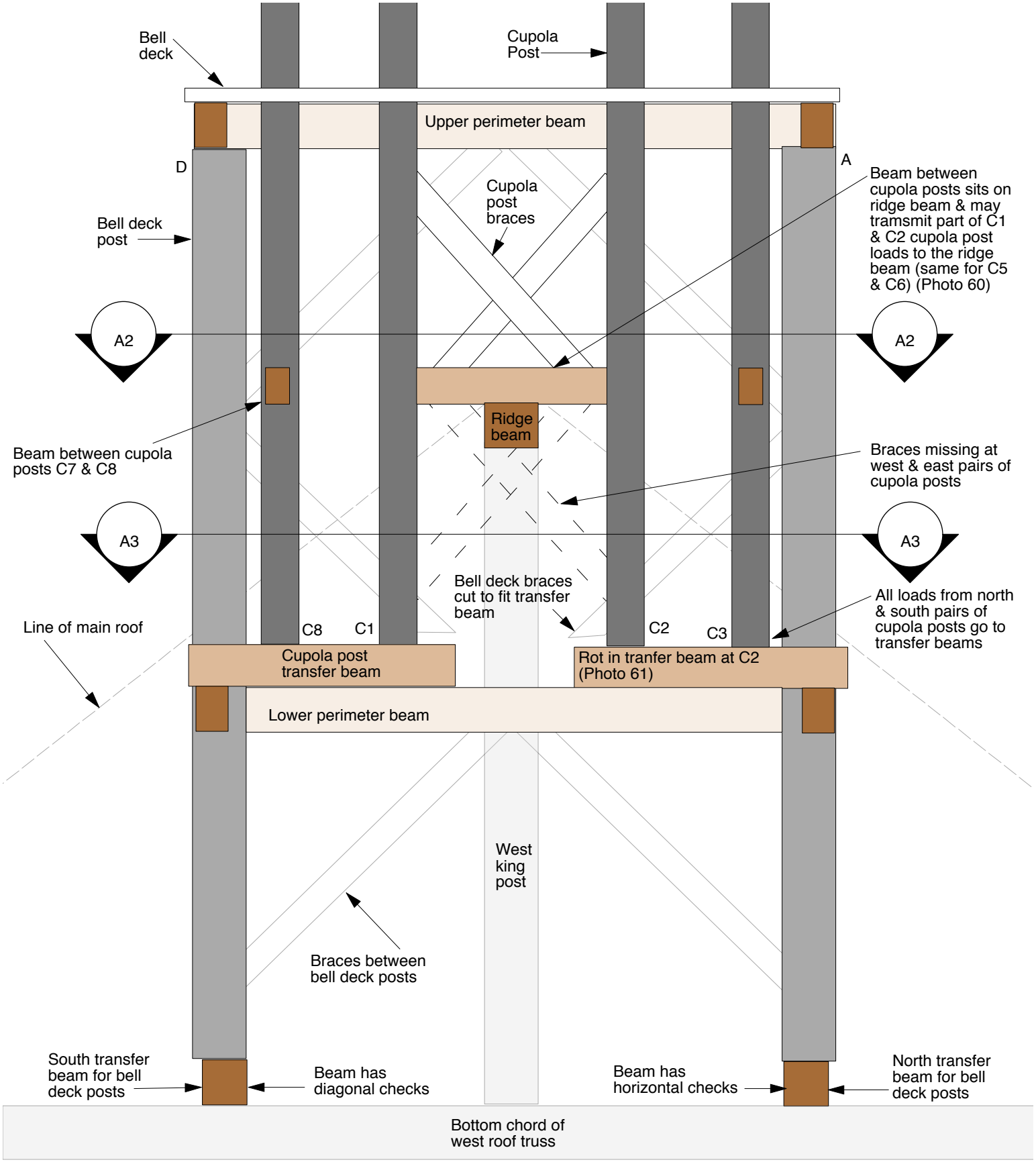
65: Top surface of the main transfer beam also shows diagonal cracks that are likely normal shrinkage cracks. The side of bell deck post C also shows similar shrinkage cracks. It also shows several insect exit holes (arrow) from old house borers. The wood was found to be solid when we test drilled near the exit holes.



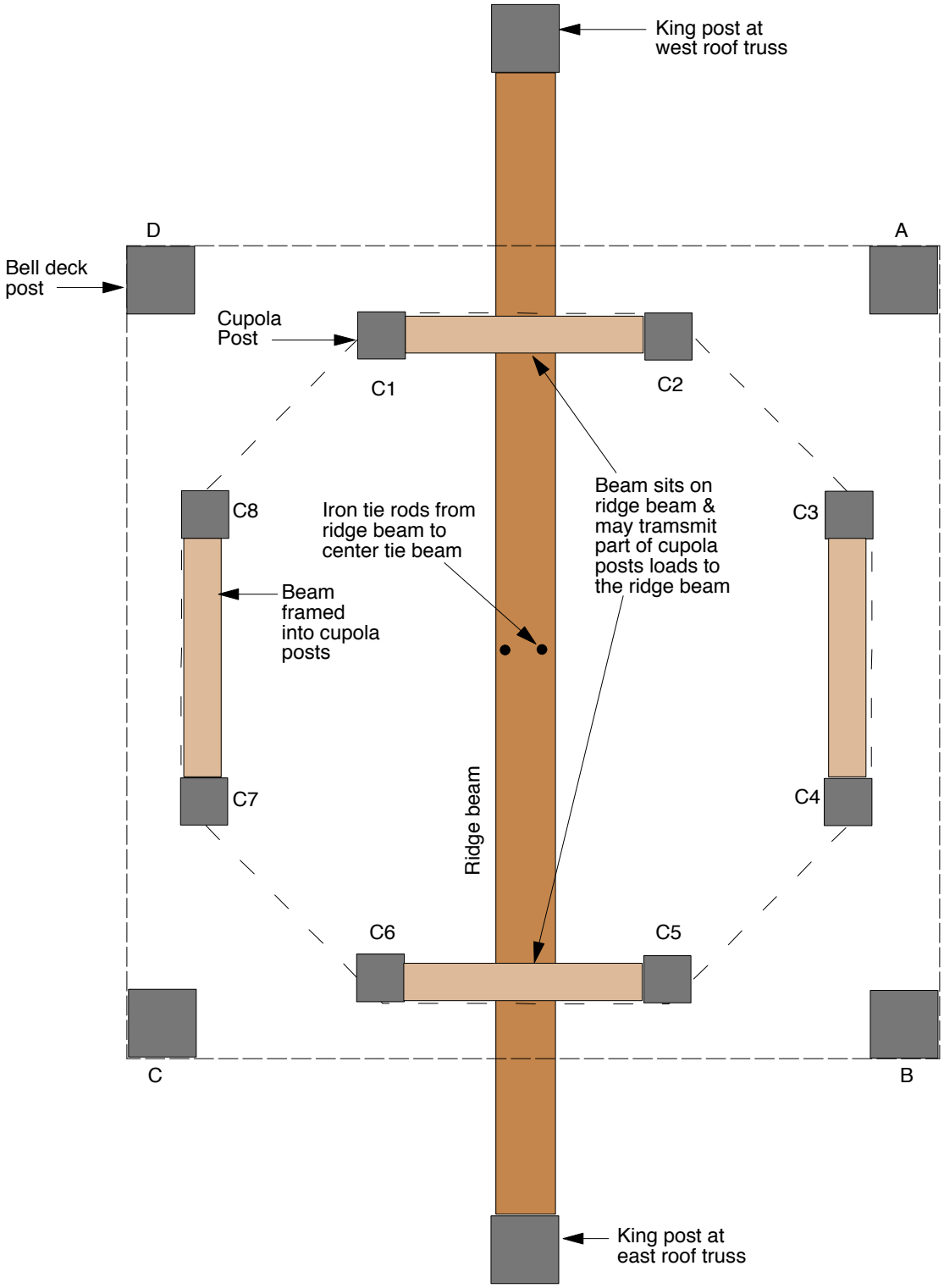
66: Detail of the north perimeter beam at bell deck post B showing several insect exit holes (arrows) from old house borers. These holes are much larger and more oval shaped than the exit holes of powder post beetles (*anobium*). Test drilling a few inches deep near these holes found some wood to be soft, although the actual extent of the damage is not known. More systematic drilling with a resistance drill is needed to determine if the damage is significant.

67: Area of bulge in center of south facade clapboards with that has also caused the ends of the two window sills to sit askew. The cause of this would best be investigated by removing the modern finishes on the interior side of this area.

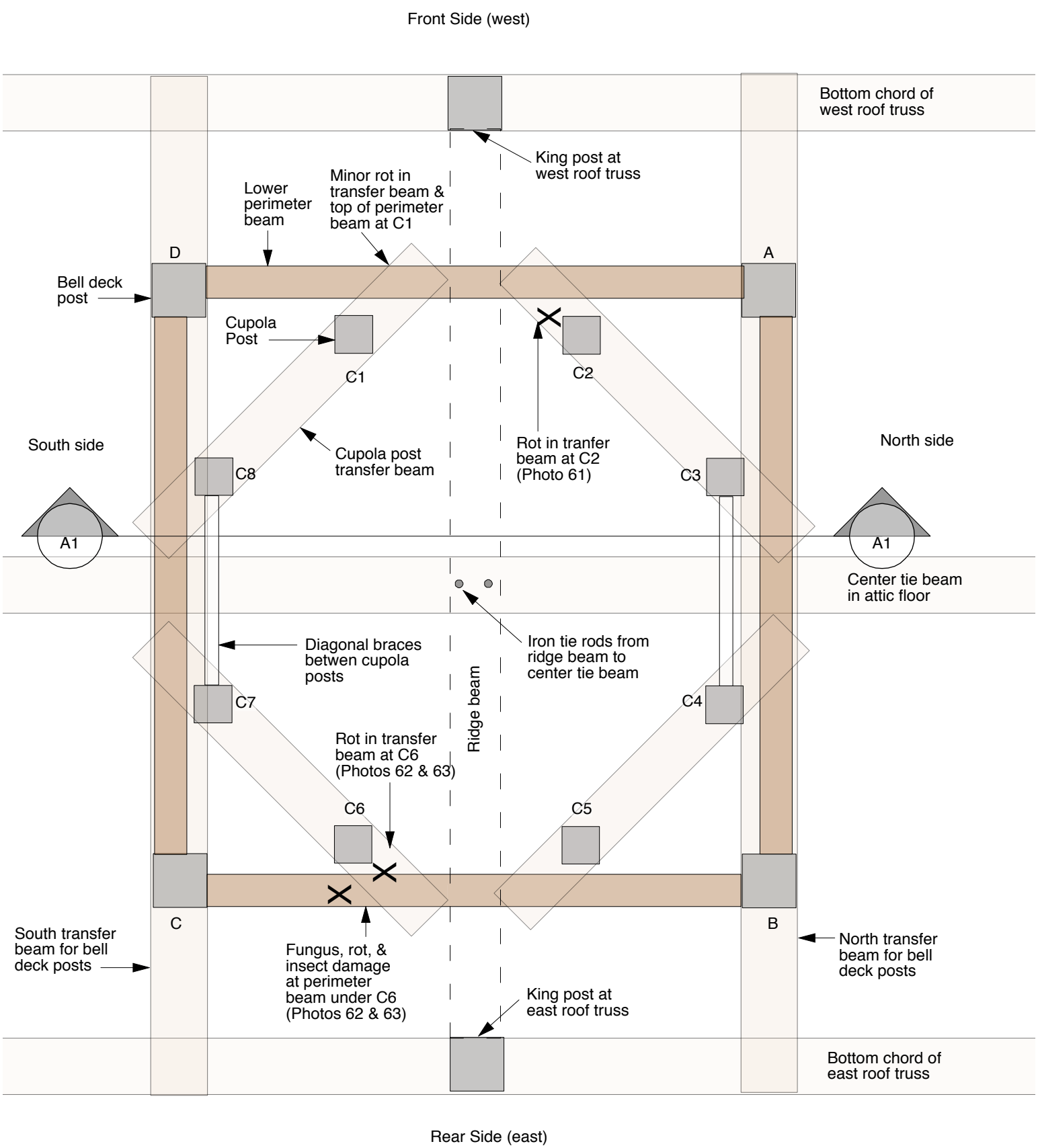
68: Electric panel in the cellar showing the building was updated with modern wiring and circuit breaker when the building was restored c. 1980.



DRAWING A1
SECTION THRU BELL DECK FRAME
LOOKING WEST
Westford Acadamy CAP Assessment
Not to Scale
Some details omitted for clarity



DRAWING A2
PLAN OF BELL DECK FRAME 2' BELOW BELL DECK
Westford Acadamy CAP Assessment
Not to Scale
Some details omitted for clarity



DRAWING A3
PLAN OF BELL DECK FRAME AT BASE OF CUPOLA POSTS
Westford Acadamy CAP Assessment
Not to Scale
Some details omitted for clarity