

MacLeod Consulting, Inc.

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Belmont, MA 02478
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May 13, 2008

Mr. Maximilian Ferro
Preservation Partnership
8 West Seminary Street,
Brandon, VT 05733

Re: Structural Condition Survey
Mendon Town Hall Roof

Dear Max:

At your request I, surveyed the condition of the Mendon Town Hall Roof for the purpose of determining the need for long-term structural repairs carried out as a historic preservation project.

BACKGROUND

The Mendon Town Hall is a wood framed building c.1840. This is a two-story structure with a gable roof supported on a foundation enclosing the basement. An addition c.1900's extended the rear of the building. Another addition c.2000 further extended the rear of the building. The exterior is finished with painted wood clapboard siding and a combination of board and shaped trim. The roof is finished with asphalt shingles.

The town is resubmitting a MPPF grant application with this structural report replacing a previously submitted report. Supplemental to the application, the previous AE team carried out and assisted construction efforts emergency stabilization repairs to correct failed structural framing.

The purpose of my participation is to provide alternative long-term repair concepts to meet the service needs of the structure as economically as possible. Included with this report are five drawing sheets illustrating existing conditions and proposed repairs. I have also prepared a construction budget for structural repairs to which you should add costs for architectural work. Six pages showing 12 photographs are attached to the end of the report.

SURVEY

On May 5, 2008, I met with Dale Pleau, the Mendon Town Coordinator, to review the history of the building and MPPF grant application. I spent the day surveying the roof structure from the ground on the exterior and from within the attic. Later in the day I met with John Trainor from the Mendon Historical Commission to review my findings and preliminary recommendations.

Exterior Observations

Viewed from the ground, sags between trusses are evident in the c.1840 construction. The c.1900 and c.2000 roofs are not sagging. One large sag at the truss immediately east of the west chimney is readily apparent. See photos 1 and 2.

Interior Observations

Meeting Hall Ceiling. The ceiling in the second floor Meeting Hall at the northwest corner is displaced several inches. This is directly under the large sag in the roof next to the west chimney. See photos 3 and 4.

Trusses. Trusses in the c.1900 construction are in good condition. See photos 5, 6, and 7. They show no signs of distress. One tie rod fastener in the westernmost c.1900 trusses is loose on the south end. At the truss immediately east of the west chimney on the north end, a crack is evident in the shear key of the bottom chord. The stair provides a good viewing angle of this condition.

The c.1840 trusses have varied construction. One is a gable truss at the west end of the attic. The remaining five are scissor trusses so as to vault over the Meeting Hall. Within each of these five trusses the member layout varies. Some elements are incomplete. Some are heavily cracked. Some components have been removed and replaced with temporary stabilization repairs. See photos 8, 9, and 10.

Purlins. Purlins in the c.1900 construction are adequately sized and fastened. In the c.1840 construction most of the purlins are oriented with the wide face upward, the weak direction. Those purlins in the weak orientation are sagging several inches. See photos 11 and 12.

Rafters. The rafters appear in good condition. In the c.1840 construction, 3 by 4 rafters run continuously over the purlins.

Ceiling. The Meeting Hall ceiling is covered with insulation and partly concealed by catwalks recently installed. Some hangers attached to rafters appear to support ceiling joists. The ceiling has some odd headers at the corners of the Meeting Hall room which appear to carry larger areas of the ceiling than those areas supported on hangers attached to the rafters.

Roofing. The roof shingles are heavily worn. Granules in the asphalt have completely worn off large areas of the south slope.

Venting. The roof is serviced with one passive louver at the east gable end wall. The air is stagnant and hot.

EVALUATION

Trusses. The shear key in the truss heels are traditional joinery. These are undersized in the c.1840 construction. The joinery for the c.1840 trusses are highly stressed. Analysis indicates they need to be strengthened. Supplementing the members by sistering LVL's will provide the needed strength. Attached to the end of this report is an analysis sheet illustrating a summary of stress index values for the typical strengthened scissor truss. Any value one or less means the member or component is within acceptable stresses at full loading.

Purlins. Orienting the purlins in their weak direction has cut their strength in half and their stiffness by six. Rotating the purlins 90 degrees will allow them to adequately carry the roof.

Rafters. The rafters are adequately sized.

Ceiling. The ceilings need resupport possibly hanging directly from the purlins, reconnecting the headers, and checking framing under the catwalks.

Roofing

The roofing needs to be stripped and replaced with a new complete roofing system which includes replacing decayed board sheathing, plywood sheathing recovery, ice and water membrane, underlayment felts, and shingles. Include chimney flashing.

Venting. Add an air intake at the west end of the building to ensure cross ventilation and an exhaust fan at the east end to ensure movement.

General Assessment

The truss framing in the c.1840 construction does not meet the strength required by the Massachusetts State Building Code, 6th edition. Neither do the purlins installed in the weak orientation. In particular the code requires structural components that have deteriorated or were designed less than 85 percent of the strength required by the prevailing code (the current if none apply) to be strengthened. This c.1840 construction requires strengthening. Completely replace the roofing.

RECOMMENDATIONS

The schematic design drawings illustrate needed repairs. The structural repairs are needed for safety. The reroofing is needed to protect the building from weather damage.

CONSTRUCTION

Employ only contractors certified by DCAM qualified in historic framing and restoration and demonstrating recent experience working in municipal buildings.

Mr. Maximilian Ferro
Structural Condition Survey, Mendon Town Hall Roof

May 13, 2008

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BUDGET

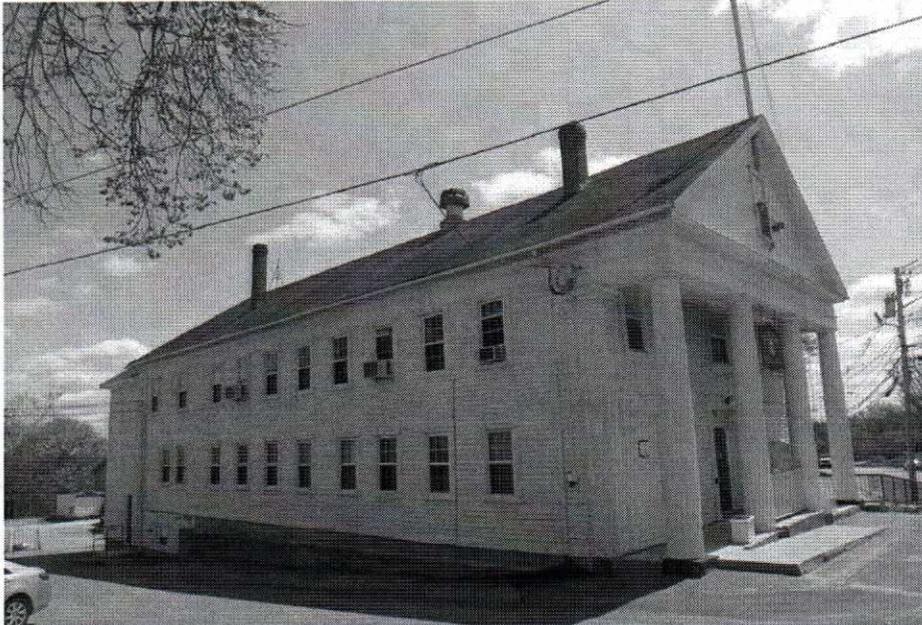
The attached budget is for the work described in this report. You should add costs for additional work and owner administrative costs. I estimate the project costs, construction and AEC design, and design contingency at \$185,000. I recommend planning for contingencies in the order of \$10,000) for conditions uncovered during construction. Once a program is approved, the project costs may be adjusted and final design fees negotiated.

Sincerely,

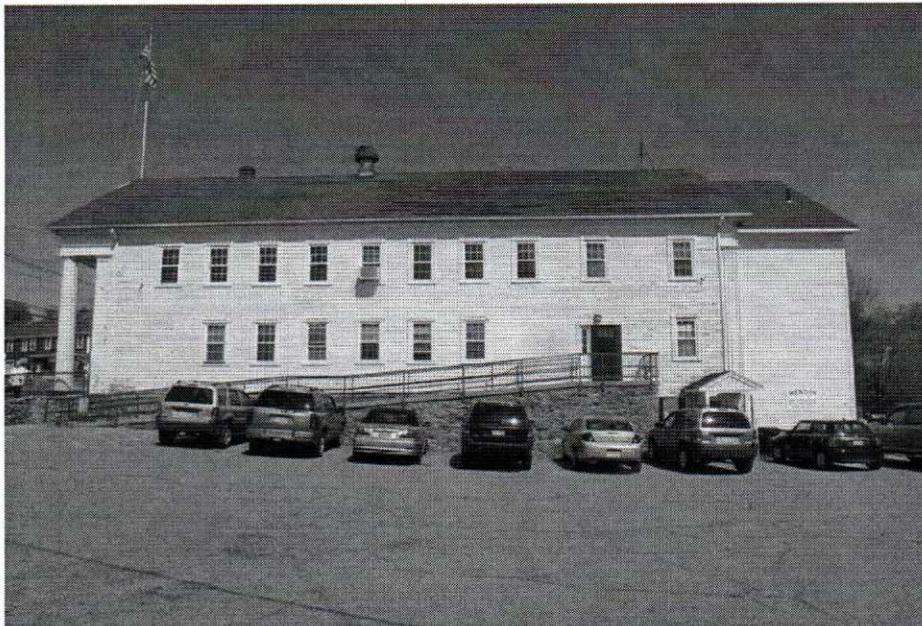
A handwritten signature in black ink, appearing to read 'Arthur H. MacLeod', written in a cursive style.

Arthur H. MacLeod, P.E., Principal
MacLeod Consulting, Inc.

Attachments: Captioned Photographs, Budget Calculations, Truss Analysis, and Schematic Design Drawings



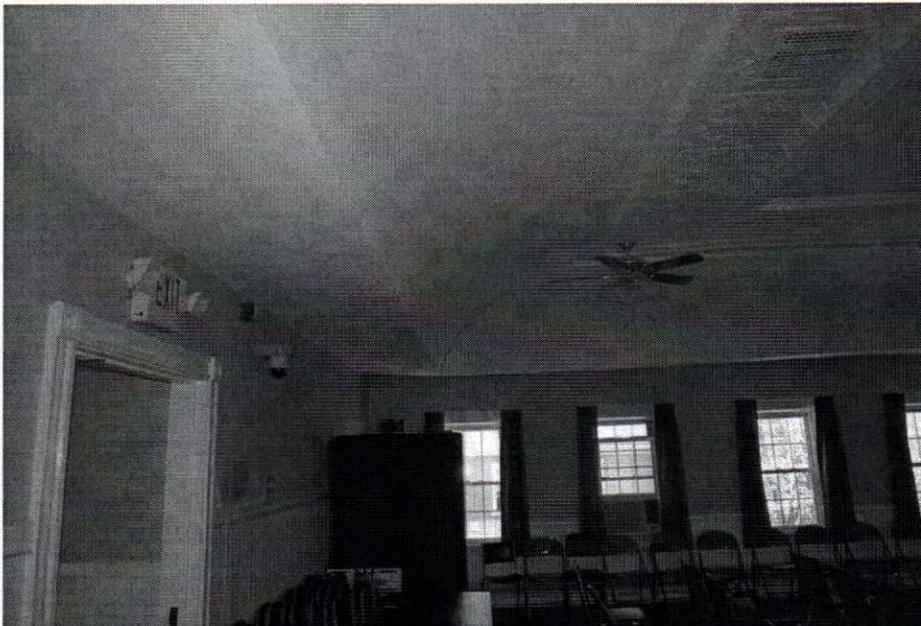
1. Mendon Town Hall viewed from the northwest. The 20th Century ventilator is abandoned. Sags from trusses and purlin displacements create shadows in the roof.



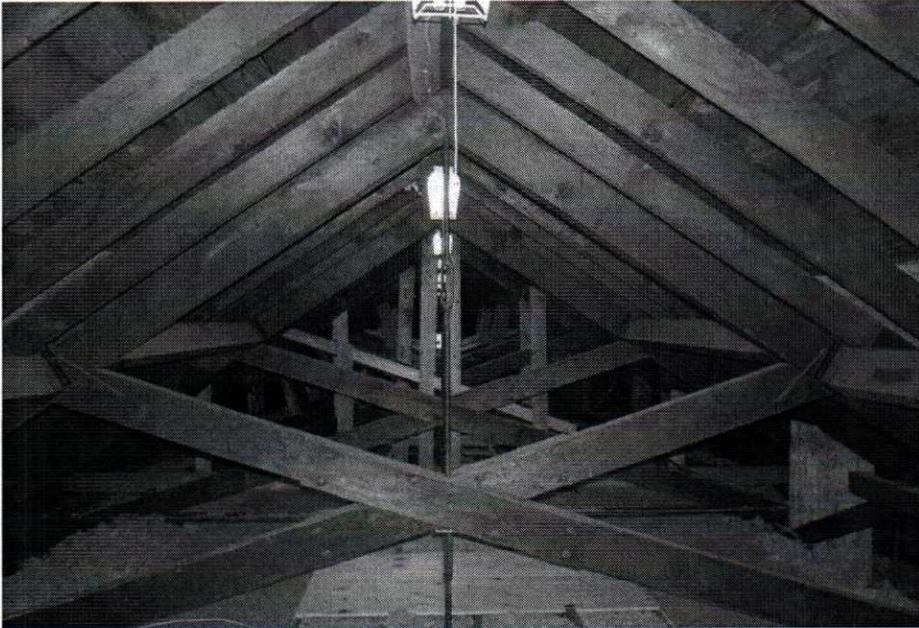
2. Mendon Town Hall viewed from the south. Sags are evident in roof. Shingles are worn beyond service.



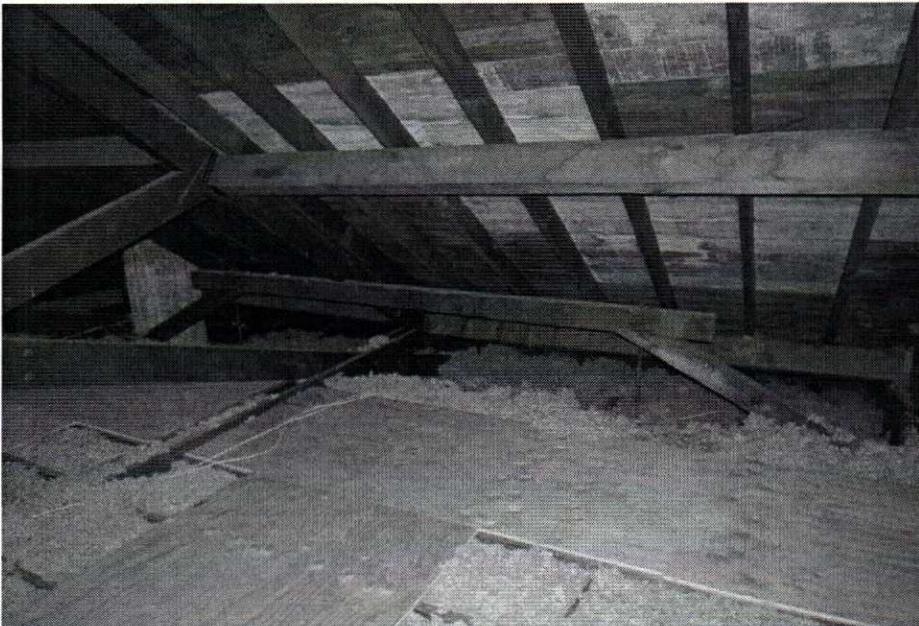
3. Second floor Meeting Hall viewed from west (entry). The proscenium marks the joint between the c.1840 and c.1900 construction.



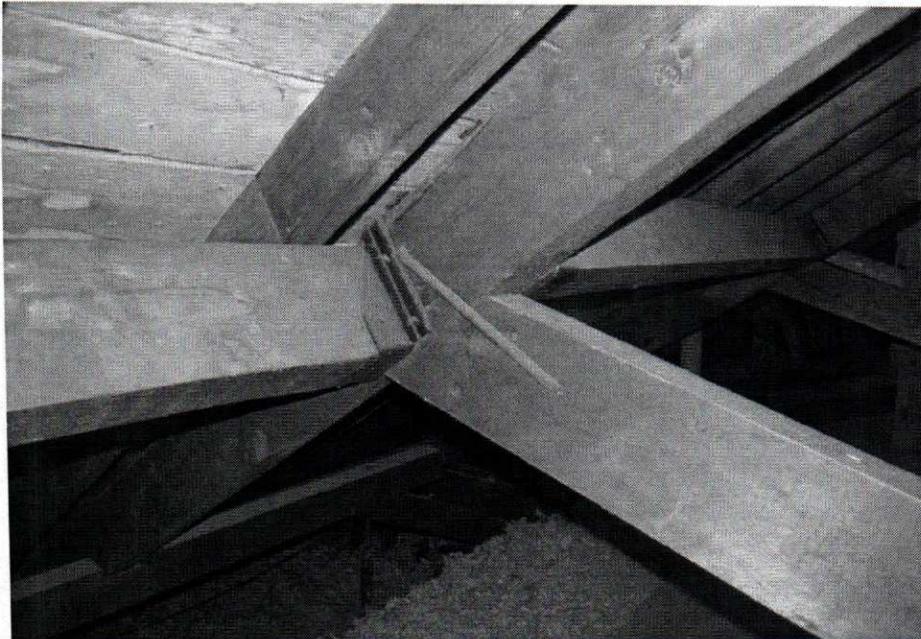
4. The northwest corner of the Meeting Hall viewed from the south. Note the displaced soffit, which is under a failed truss.



5. Roof trusses viewed from the east end of the attic at the wall separating the c.1900 from the c.2000 construction. The two trusses, purlins, and rafters in the foreground c.1900 are in good condition.



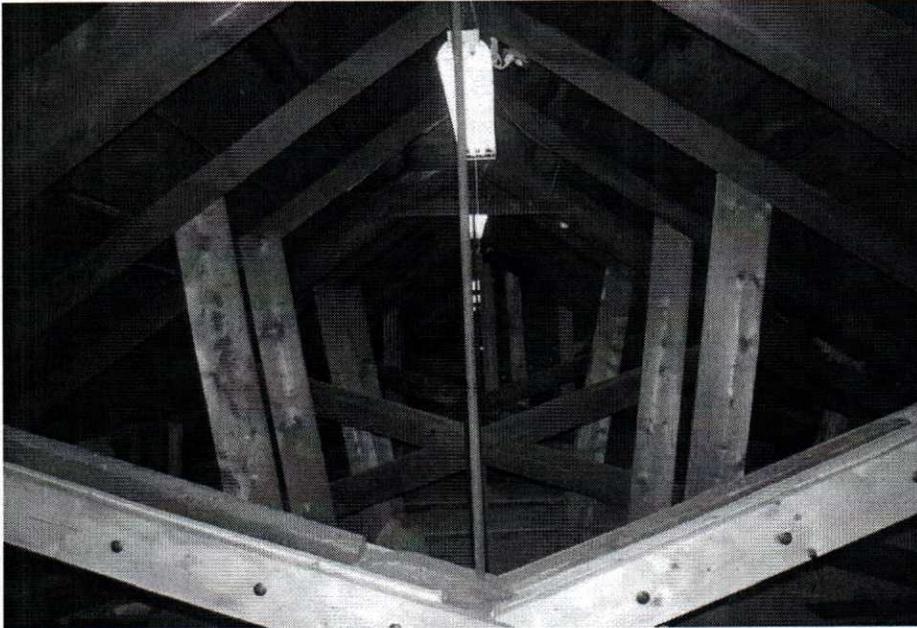
6. Purlin in the c.1900 construction is well supported on steel stirrups. It is oriented in the strong direction. A ceiling truss several feet from the outside wall is on each side of the c.1900 stage. Recent renovations below conceal the purpose of these trusses.



7. Close-up view of c.1900 truss joint showing steel hardware. Joint is tight and shows no signs of distress.



8. Circa 1840 trusses at the west end of the attic viewed from the east on the north side. The new wood members are recent repairs made to stabilize the framing.



9. Center area of c.1840 trusses viewed from the west. Board hangers fastened to rafters support the Meeting Hall ceiling.



10. Close-up view of c.1840 truss joint showing traditional joinery where treenails fasten tenons to mortises.

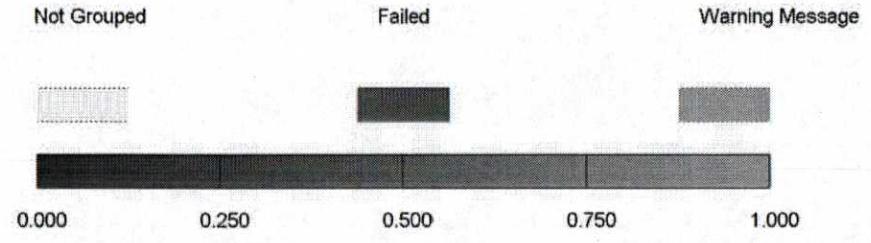
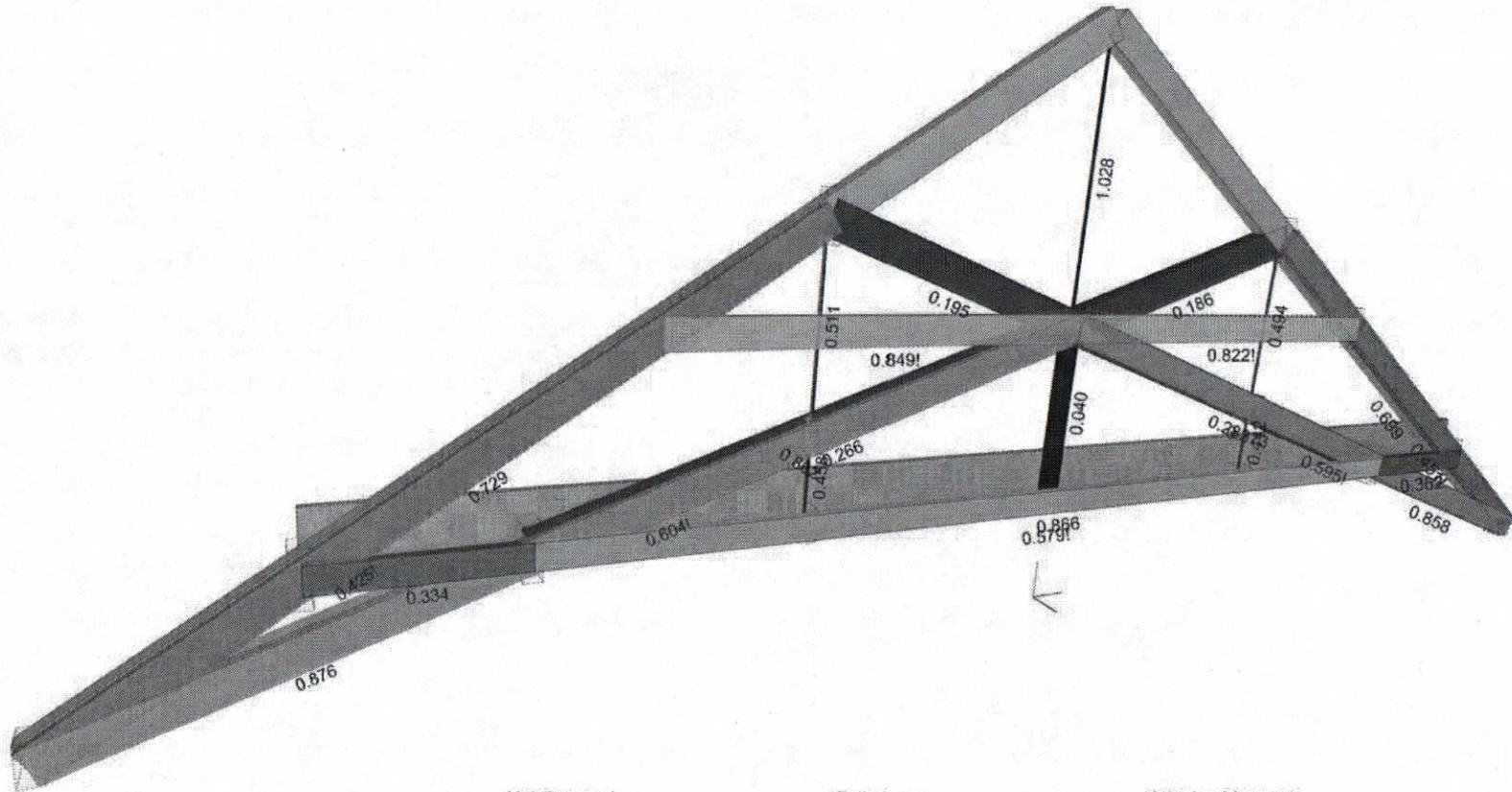


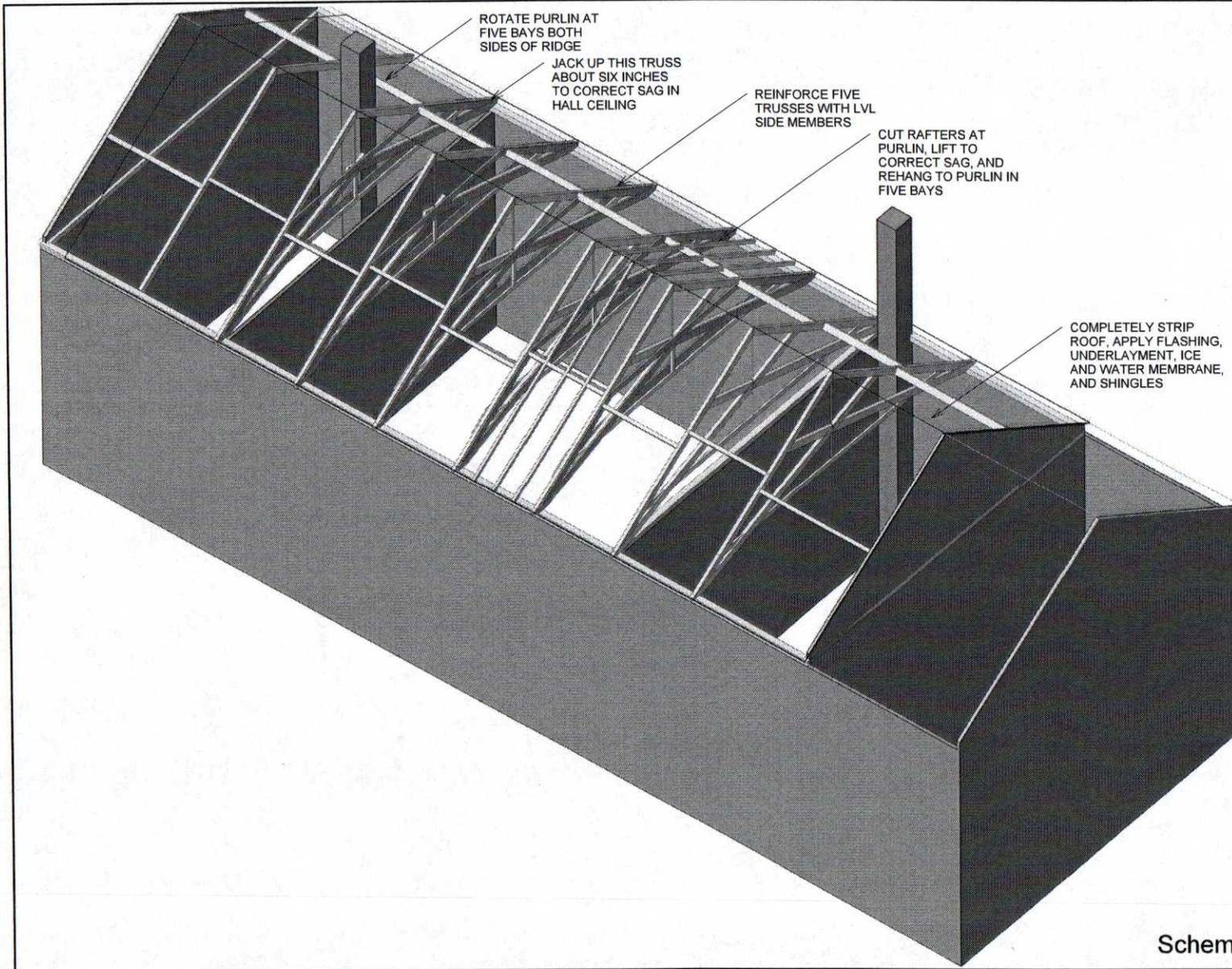
11. Rafters and purlins in c.1840 construction viewed from the north. Purlins are oriented in weak direction. Note they are displaced several inches.



12. Closer view of purlin in c.1840 construction. Two purlins in background replaced a broken purlin.

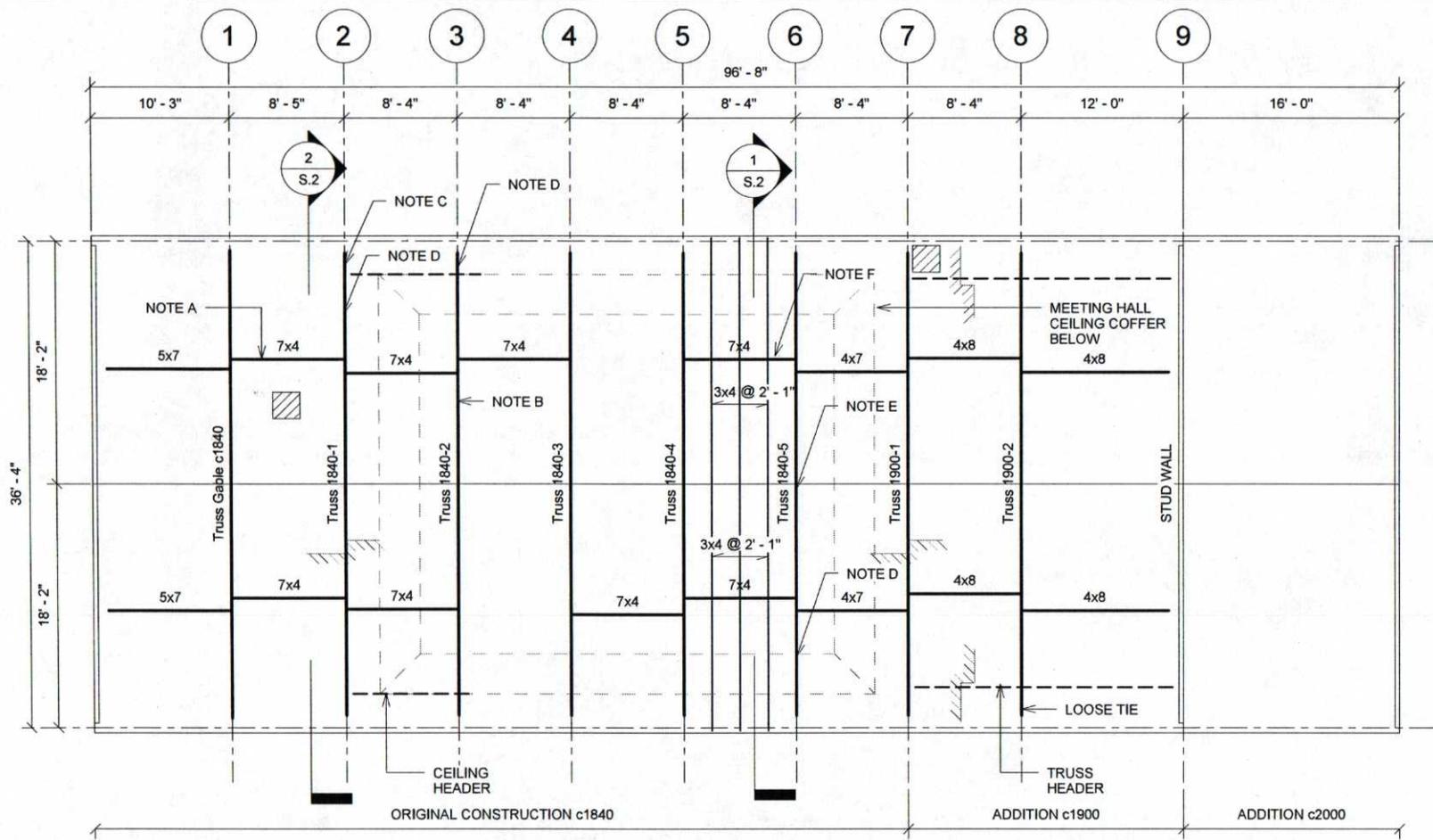
Mendon Scissor Truss.vap
MacLeod Consulting, Inc., Arthur H. MacLeod
May 12, 2008; 02:58 PM
Design View
IES VisualAnalysis 6.00.0102





Schematic Design

SHEET TITLE Structural Roof Repairs	PROJECT Mendon Town Hall Roof 20 Main Street Mendon, Massachusetts 01756	CLIENT Preservation Partners 8 West Seminary Street Brandon, VT 05733	DRAWING S.0
MacLeod Consulting, Inc. 29 Woods Road Belmont, MA 02478 (617) 484-4733 <i>structural engineering</i>			



NOTE A: PURLINS NOTED 7x4 INDICATE WIDE FACE UP, WEAK POSITION.

NOTE B: TRUSSES ON LINES 2, 3, 4, 5, AND 6 ARE UNDERSIZED AND DO NOT MEET MSBC, 780 CMR CHAPTER 34 REQUIREMENTS FOR SAFE USE.

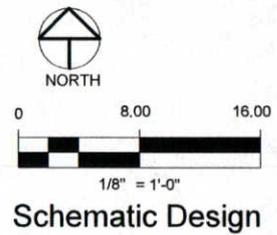
NOTE C: TRUSS ON 2 LINE HAS DISPLACED ABOUT SIX INCHES DOWN. SETTling IS LIKELY ACTIVE AS CEILING DIRECTLY BELOW IS DISPLACED SEVERAL INCHES.

NOTE D: BROKEN TRUSS CHORD

NOTE E: TRUSS CHORDS ARE SPLIT ALONG THEIR LENGTHS.

NOTE F: RAFTERS SUPPORTED ON WEAK PURLINS (SEE NOTE A) HAVE DISPLACED SEVERAL INCHES. WHERE PURLINS ARE NARROW FACE UP NO SAG IS PRESENT.

① **Roof Plan Existing Conditions**
1/8" = 1'-0"



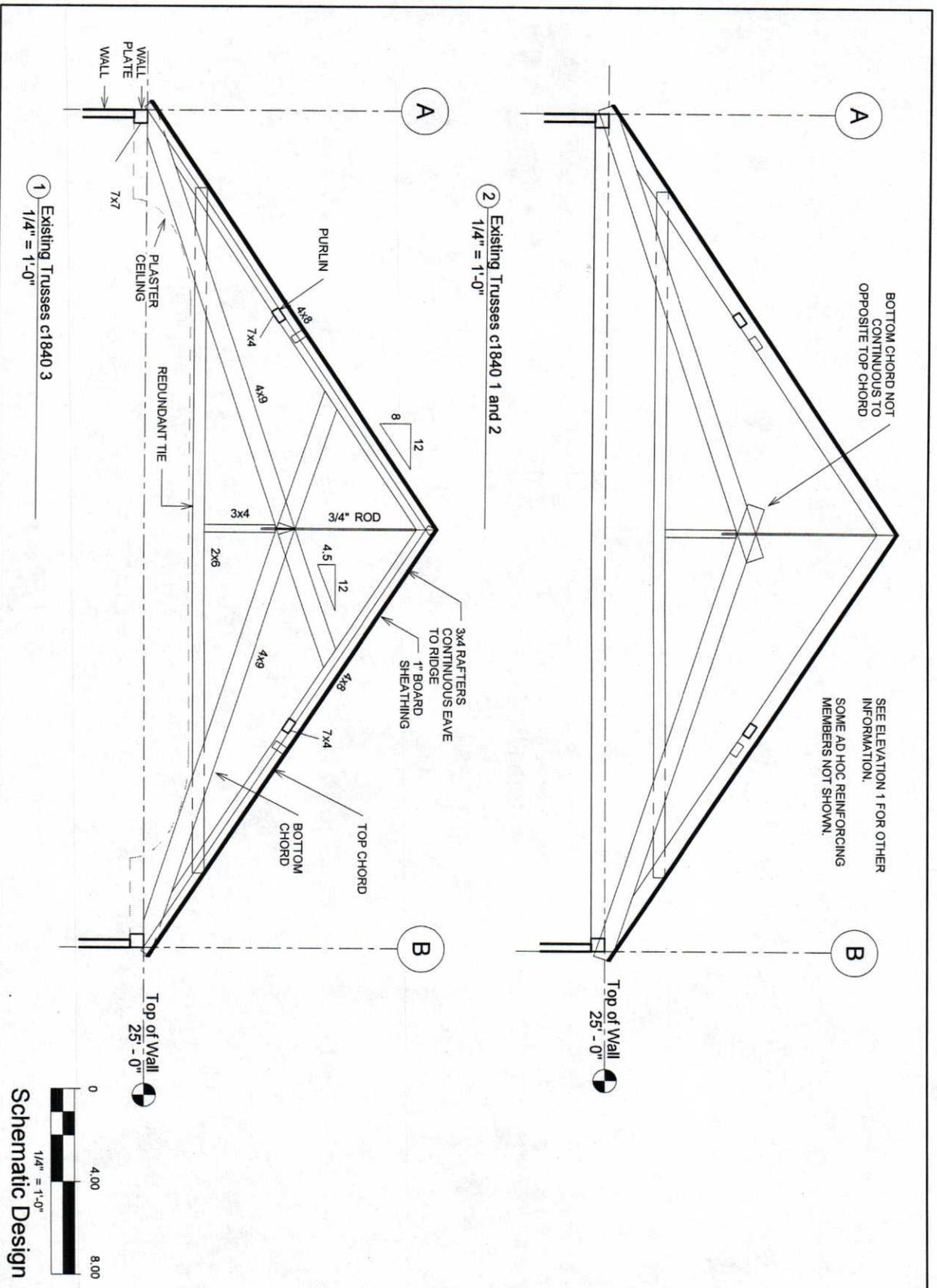
SHEET TITLE
Roof Framing Plan Existing Condition

PROJECT
Mendon Town Hall Roof
20 Main Street
Mendon, Massachusetts 01756

CLIENT
Preservation Partnership
8 West Seminary Street
Brandon, VT 05733

MacLeod Consulting, Inc.
29 Woods Road
Belmont, MA 02478
(617) 484-4733
structural engineering

PROJECT NO: 2008.09
DATE: 13 May 08
FILE:
DRAWN BY: AHM
DES'D BY: AHM



1 Existing Trusses c1840 3
1/4" = 1'-0"

2 Existing Trusses c1840 1 and 2
1/4" = 1'-0"



<p>MacLeod Consulting, Inc. 29 Woods Road Belmont, MA 02478 (617) 484-4733 structural engineering</p>	<p>CLIENT Preservation Partnership 8 West Seminary Street Brandon, VT 05733</p>	<p>SHEET TITLE Elevations Existing Trusses</p>
	<p>PROJECT Mendon Town Hall Roof 20 Main Street Mendon, Massachusetts 01756</p>	<p>PROJECT Mendon Town Hall Roof 20 Main Street Mendon, Massachusetts 01756</p>
<p>PROJECT NO: 2008.09 DATE: 13 May 08 FILE: DRAWN BY: Author DES'D BY: Designer</p>		<p>DRAWING S.2</p>

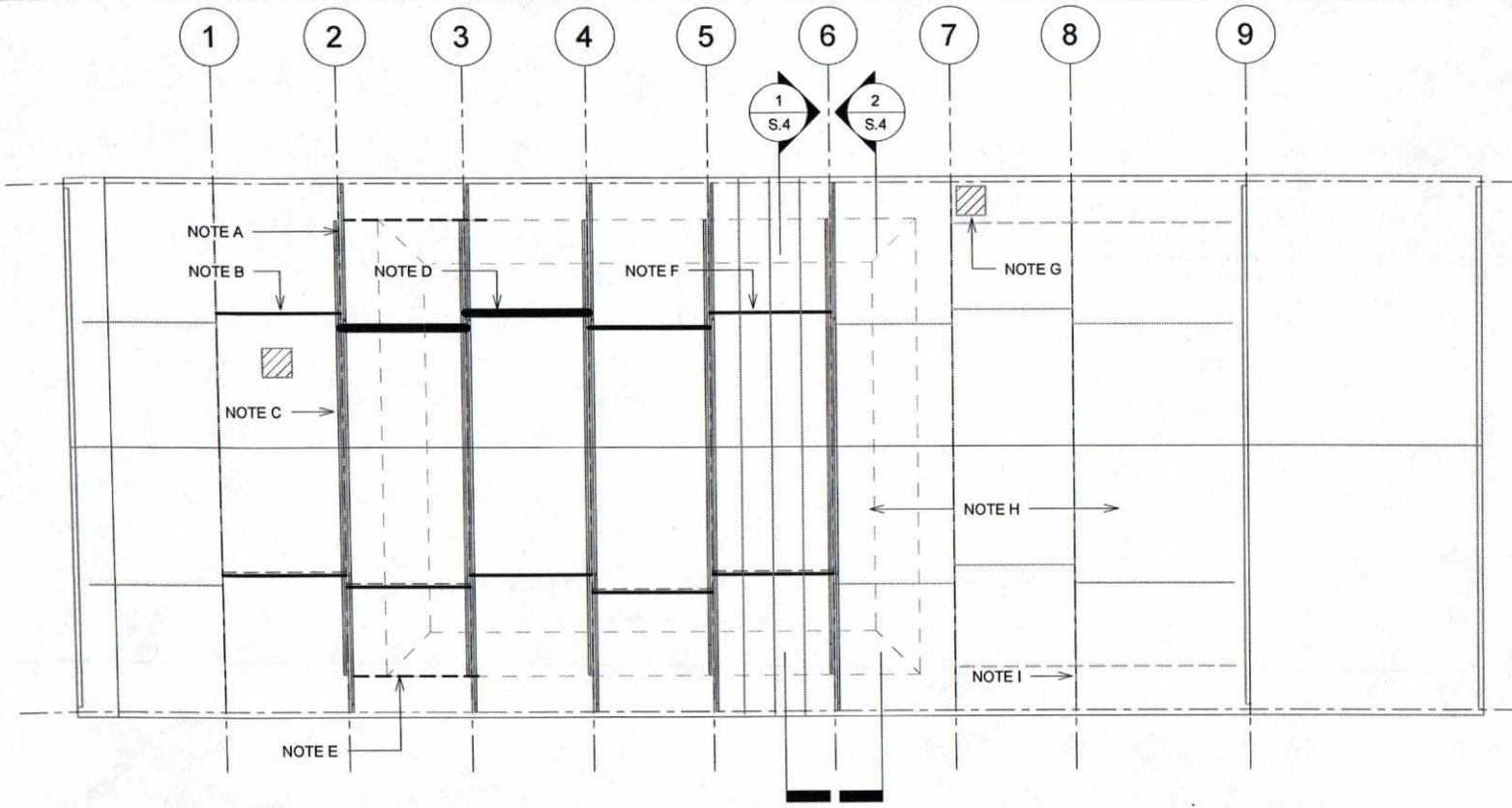
SHEET TITLE
Roof Framing Plan Proposed Repairs

PROJECT
Mendon Town Hall Roof
20 Main Street
Mendon, Massachusetts 01756

CLIENT
Preservation
Partnership
8 West Seminary Street
Brandon, VT 05733

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29 Woods Road
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PROJECT NO: 2008.09
DATE: 13 May 08
FILE:
DRAWN BY: Author
DES'D BY: Designer



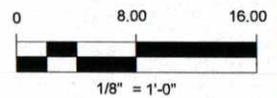
① Roof Plan Proposed Repairs
1/8" = 1'-0"

SUMMARY OF REPAIRS

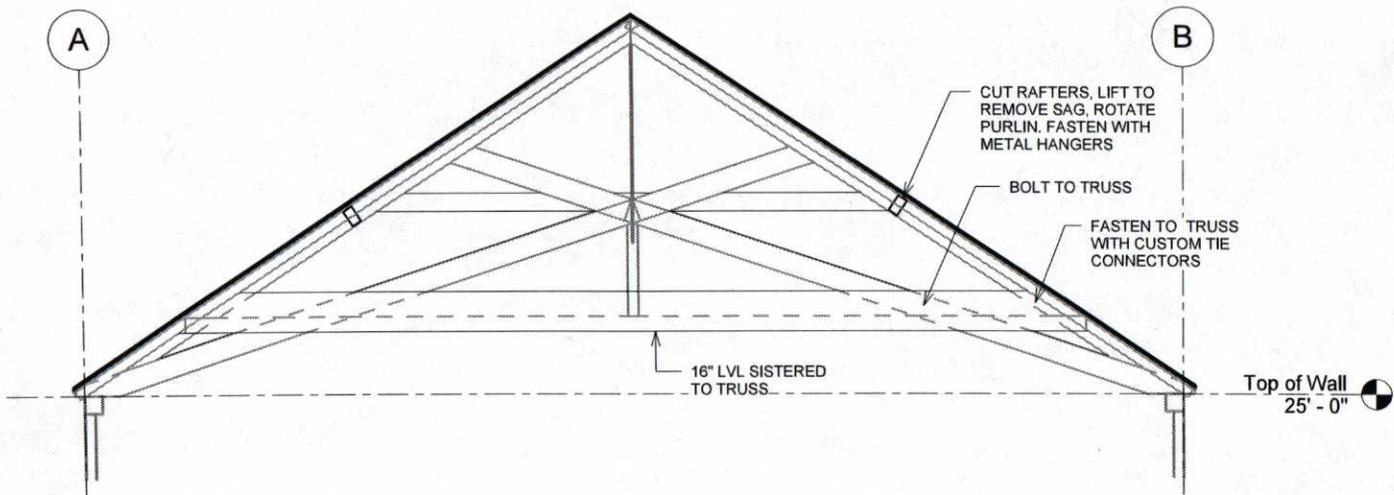
NOTE A: JACK DISPLACED TRUSS UP TO REMOVE SAG. 1 INSTANCE.
NOTE B: ROTATE MIS-ORIENTED PURLINS. 8 INSTANCES.
NOTE C: REINFORCE TRUSSES. 5 INSTANCES.
NOTE D: PROVIDE REPLACEMENT PURLINS. 2 INSTANCES.

NOTE E: RESUPPORT CEILING HEADER. 2 INSTANCES.
NOTE F: CUT RAFTERS. LIFT TO CORRECT SAG. FASTEN WITH METAL HANGERS. 30 INSTANCES.
NOTE H: STRIP ROOF. PATCH DECAYED SHEATHING. RECOVER WITH PLYWOOD. ADD ICE AND WATER SHIELD AND UNDERLAYMENT, ADD SHINGLES. 4,310 SF

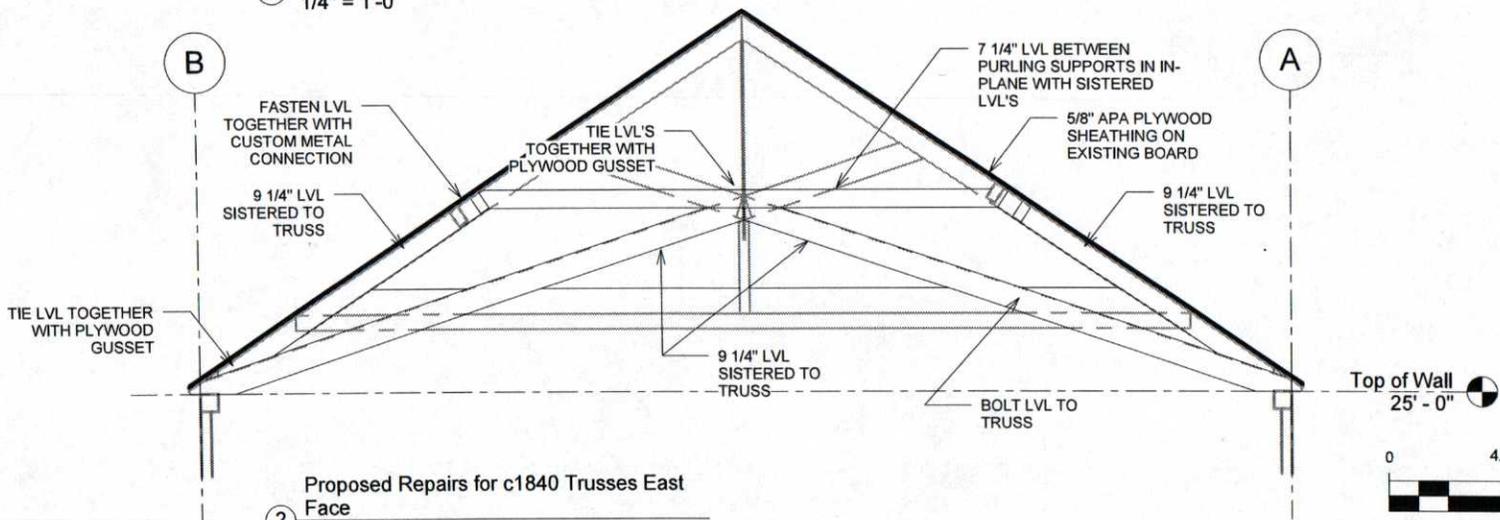
NOTE I: RECONNECT LOOSE TIE BAR. 1 INSTANCE.



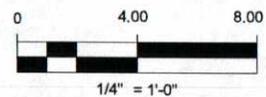
Schematic Design



1 Proposed Repairs for c1840 Trusses West Face
1/4" = 1'-0"



2 Proposed Repairs for c1840 Trusses East Face
1/4" = 1'-0"



Schematic Design

SHEET TITLE	Elevation Proposed Truss Repairs		
	PROJECT		
CLIENT	Mendon Town Hall Roof 20 Main Street Mendon, Massachusetts 01756		
	PROJECT		
CLIENT	Preservation Partnership 8 West Seminary Street Brandon, VT 05733		
	PROJECT		
CLIENT	MacLeod Consulting, Inc. 29 Woods Road Belmont, MA 02478 (617) 484-4733 structural engineering		
	PROJECT		
PROJECT NO.	2008.09	DATE:	13 May 08
FILE:		DRAWN BY:	Author
DESIGNED BY:	Designer		