

D-18
Marsh-Billings

STRUCTURAL REPORT
FOR THE
BILLINGS CARRIAGE BARN
WOODSTOCK, VERMONT

MARCH 30, 1988

SCANNED

1/8/2002

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Lawes Consulting Engineers, Inc.

P.O. BOX 554

WILLISTON, VERMONT 05495

802-878-8697

March 30, 1988

Mr. Stephen H. Smith
Northern Architects, Inc.
115 College Street
Burlington, Vermont 05401

Billings Carriage Barn
Woodstock, Vermont
Project #8806

Dear Steve:

This is a report summarizing our findings and recommendations concerning the structural integrity of the Billings Carriage Barn. We have based our recommendations on observations made at the site on March 17, 1988, Drawings prepared by Rossiter and Wright - Architects outlining the original design, Drawings X1 through X8 prepared by your office outlining existing conditions and our subsequent evaluation.

The wood frame structure was built around 1895 and measures approximately 66'x66' in plan. There is a full lower level that is accessible at grade from the north side and a first floor level that is accessible from the south side. A large loft area exists beneath the higher roof sections. The structural system is wood rafters and joists which bear on wood beams, trusses and walls which are supported by brick walls and piers. Refer to the attached Sheets 1 through 4 for Plans and a Section.

The quality of construction is generally very good and the building has been well maintained. There are however, several structural concerns. Most of these concerns are a result of the original design which was inadequate and a few others are a result of modifications and deterioration. The concerns that we observed are as follows:

1. Main Roof - The original design made no provision for the horizontal thrust at the lower end of the four valley beams. This thrust has resulted in a very noticeable (up to 3") outward movement where these valleys are supported at Grids C2, E2, C6 and E6. This problem is compounded by the fact that the loft level knee walls are also not restricted from outward movement as they support the sloped roof rafters.

A set of four skewed 6x6 wood struts and two horizontal tie rods were added in an attempt to stabilize the roof. These added members may have helped but unfortunately this work placed unacceptable loads on the Queen Post Truss on the 4 line (discussed later in this report).

We recommend that the roof be properly stabilized. The solution is not simple. A detailed study will be required that considers proposed future use as well as proper structural design. Conceptually, the corrective work could involve more or larger horizontal rods, reinforced knee walls, reinforced valley beams or even a new line of support that could be established by extending the 10x10 wood columns at C4 and E4 up to the roof. Acceptable structural solutions will be restricted by the proposed final use of this level.

2. Lower Flatter Roofs - These sections are not capable of safely supporting the anticipated drifting and sliding snow from the main roof. These roof sections (refer to Sheet #3 for location) are a good example of how wood has an ability to re-distribute loads when overloaded. The presence of wood blocking (presumably installed after the original construction) transfers some roof loads down to the first floor ceiling joists. This improves the roof's capacity but, since the blocking appears random the condition still requires improvement.

We recommend these sections be strengthened. The work might involve removal of the roofing and wood deck due to restricted work space or perhaps could be done from underneath if carefully thought out. This work should be coordinated with the knee wall stabilization work mentioned in Item 1.

3. Chimney - There is a brick chimney in the southwest section of lower roof that is susceptible to damage from sliding snow and ice. Although the masonry chimney is braced to the roof, we recommend a proper sized cricket be constructed to minimize the possibility of damage.
4. Loft - As noted in Item 1, the Queen Post Truss on the 4 line is overstressed by the 4 skewed 6x6 struts that support the valleys of the roof. Even without the loads from the struts (as on the 2 line) the Queen Post Truss has a relative low (35 psf) Live Load Capacity.

We recommend that the 4 line truss be strengthened if any loft level live loads are added and that the 2 line truss be strengthened if the loft level is used for more than attic type loading. The strengthening would involve replacement of the vertical rods with steel of higher strength and better bracing of the top chords. We were not able to observe the bearing conditions of these trusses. They should be exposed to verify their capacity.

5. First Floor- This level has several concerns that are as follows:

- A. 8x10 Wood Beam - The 8x10 between D1 and D2 spans twice as far as the typical 8x10 and consequently has a much lower Live Load Capacity.

We recommend this be strengthened by either increasing its size or adding a support near centerspan.

- B. 12x12 Brick Piers - Two of the brick piers (Grids D6 and E4) are overstressed. E4 was undersized in the original design and the condition at D6 became a concern when the two adjacent brick piers were removed during past renovations (when the W12x40 steel beam was installed).

Our recommendation is to replace all of the brick piers (7 locations). Two are overloaded, the one at F2 is cracked at the top and there is some evidence of "dead" mortar and soft brick throughout this level. With temporary shoring, the replacement should be straightforward and considering the importance of these piers, should be done.

- C. Mortar - As previously mentioned, there are areas of "dead" mortar and soft brick. These areas should be rebuilt as required.

- D. Floor Beneath Stalls - This section of floor is the northern most 10'± of the building between A and D. There is some evidence of rot and, considering its use, it is not surprising.

We recommend this floor be exposed prior to any major renovation to verify the condition of the floor framing beneath the floor boards.

6. Wall Construction - There is a noticeable (3"±) vertical deflection in the exterior clapboard siding at grid C7 (Refer to Sheet #1) and some distress noted at Grid C6 (Refer to Sheet #2). We were not able to remove wall finishes to observe the framing in the walls but this distress is probably related to the concentrated loads at the bearing of the loft level wall trusses.

The walls at C6, C7, E6 and E7 should be opened to expose the existing construction and reinforced if necessary.

7. Ground and Surface Water - The site slopes down from west to east. A gravel drive exists on the west side. Previous water problems have led to the site being regraded to slope away from the building. A concrete facing was added along the A line and a section of the 1 line wall between A and C was reconstructed. The concrete facing was presumably to help waterproof the wall and the 1 line wall may have needed repairs due to damage from water and soil pressures. The condition appears stable now but existing grades should be maintained to divert surface water.

We understand that proposals are being considered that involve renovating the building into a museum that is accessible to the public. A detailed study of the areas not exposed during our site visit should be undertaken and a complete set of detailed drawings prepared that outline the needed structural work. If the decision is made not to renovate soon, we recommend that, as a minimum, the lower flatter roof sections be carefully monitored and all snow accumulations above 30 psf be promptly removed and that the loft level not be used until the Queen Post Truss on 4 line is reinforced.

In summary, there is a significant amount of structural work needed to bring this building into compliance with present Code requirements. We would enjoy working with you on this project when the decision is made to proceed. Please call if you have any questions or comments. Thank you for the opportunity to provide a Structural Engineering Service.

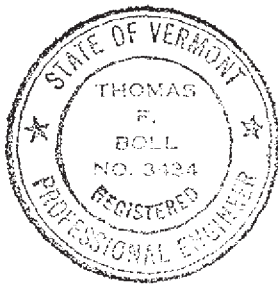
Very truly yours,

LAWES CONSULTING ENGINEERS, INC.

Thomas F. Boll

Thomas F. Boll, P.E.
Vice President

TFB/jl





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BOX 554

WILLISTON, VERMONT 05495

802-878-8697

PROJECT: BILLINGS CARRIAGE BARN

LOCATION: WOODSTOCK, VERMONT

PROJ. NO. 8806

DRAWN TFB

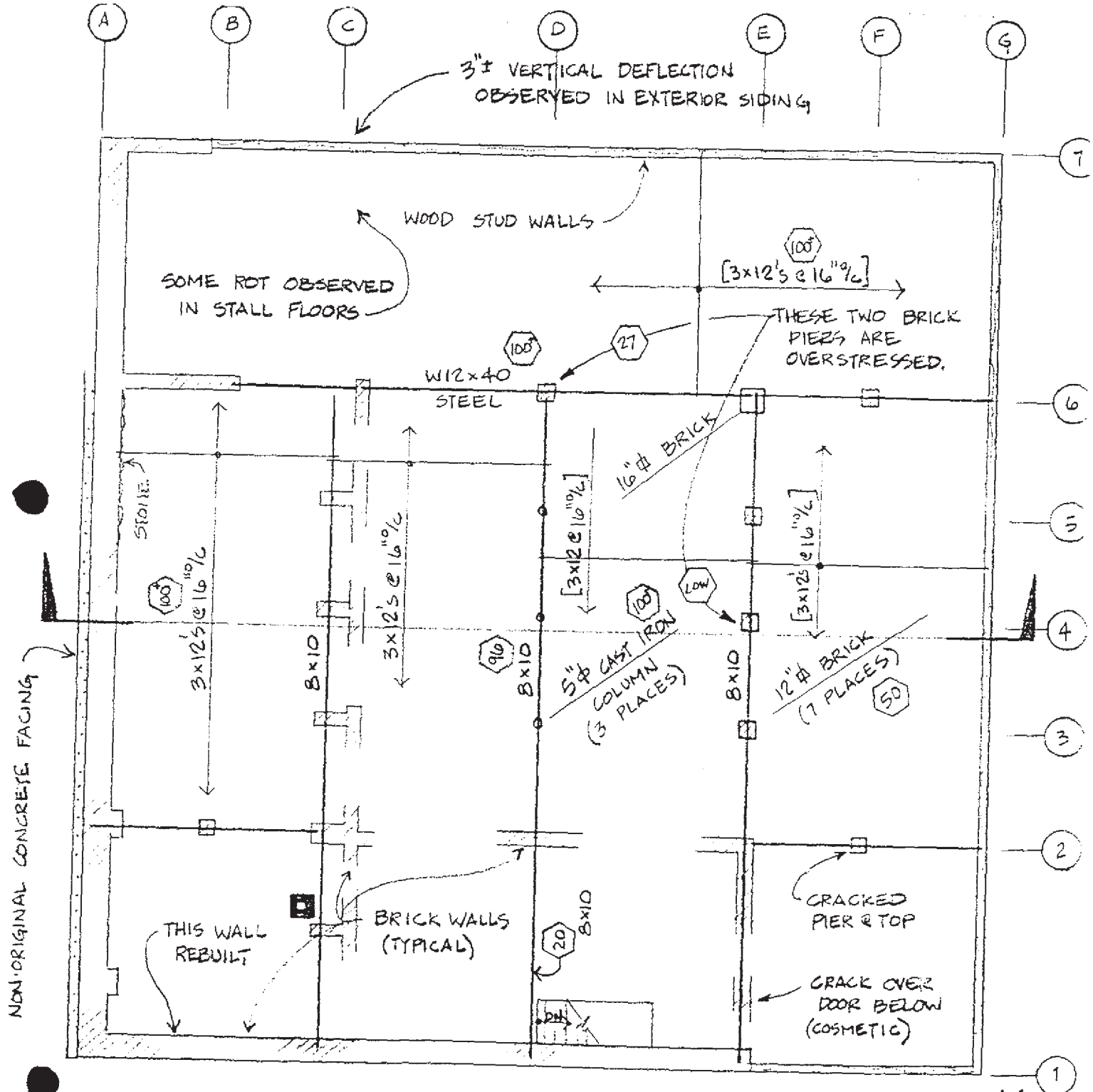
CHKD. CWL

SHEET 1

DATE 3.30.88

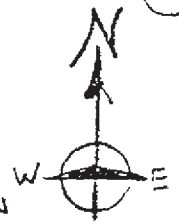
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OF 4



FIRST FLOOR FRAMING PLAN - SCALE 1"=10'±

1. ○ = INDICATES LIVE LOAD CAPACITY IN PSF.
2. ALL FRAMING IS WOOD UNLESS NOTED.
3. SIZES NOTED IN [---] WERE NOT OBSERVED, THEY ARE TAKEN FROM ORIGINAL PLANS AND ASS.





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BOX 554

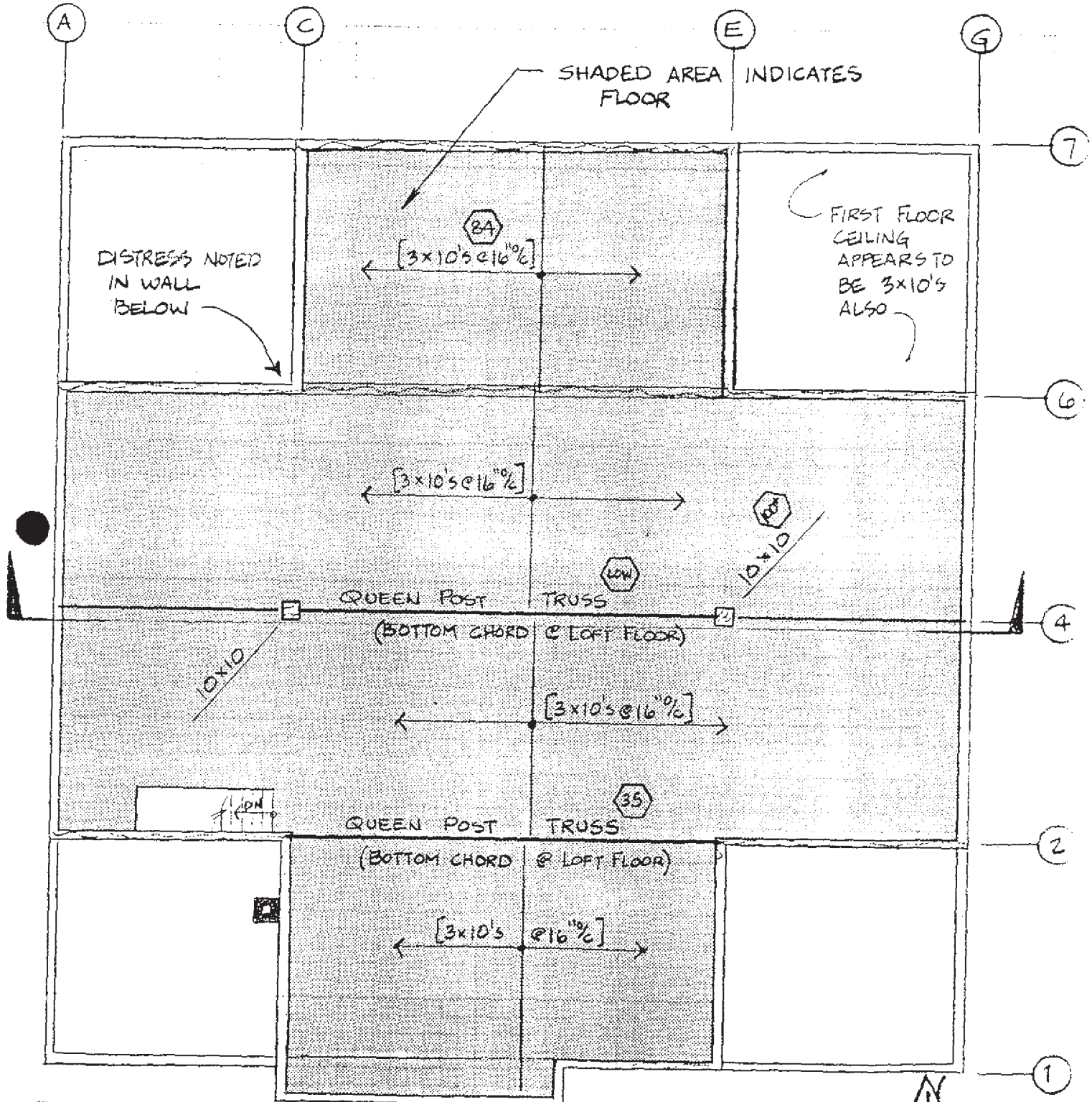
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PROJECT BILLINGS CARRIAGE BARN
LOCATION WOODSTOCK, VERMONT
PROJ. NO. 8806

DRAWN TFB
CHKD. lwl
SHEET 2

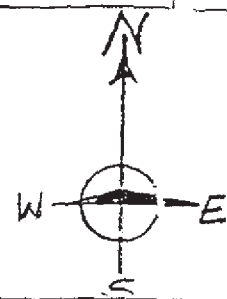
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OF 4



LOFT FRAMING PLAN

SCALE 1" = 10' ±

1. SEE NOTES ON SHEET 1 OF 4.





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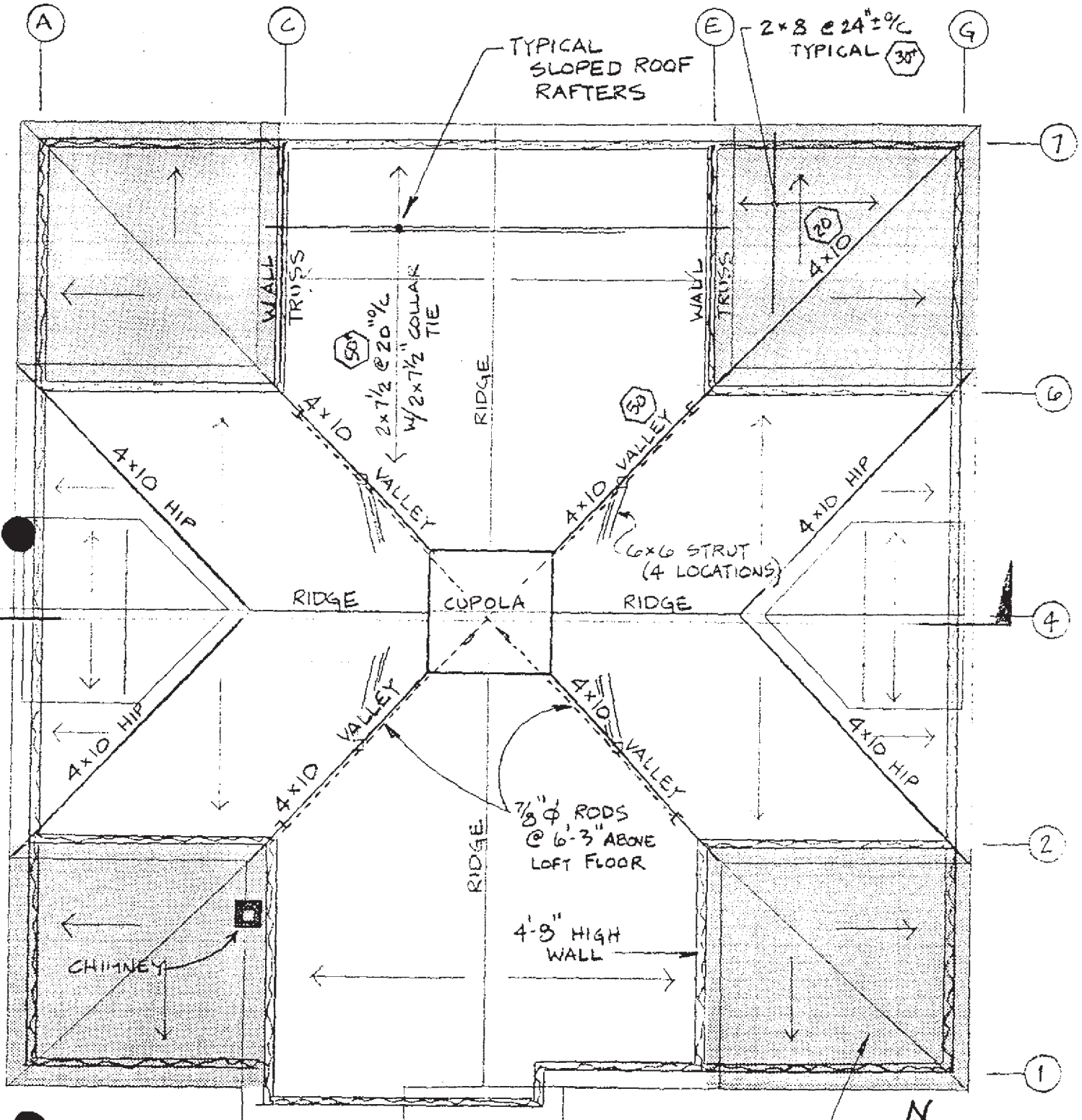
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PROJECT BILLINGS CARRIAGE BARN
LOCATION WOODSTOCK, VERMONT
PROJ. NO. 8806

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SHEET 3

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DATE 3.30.88
OF 4

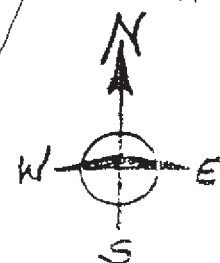


ROOF FRAMING PLAN

SCALE 1" = 10'±

1. SEE NOTES ON SHEET 1 OF 4.

SHADED AREAS
INDICATE LOWER
FLATTER ROOF
SECTIONS





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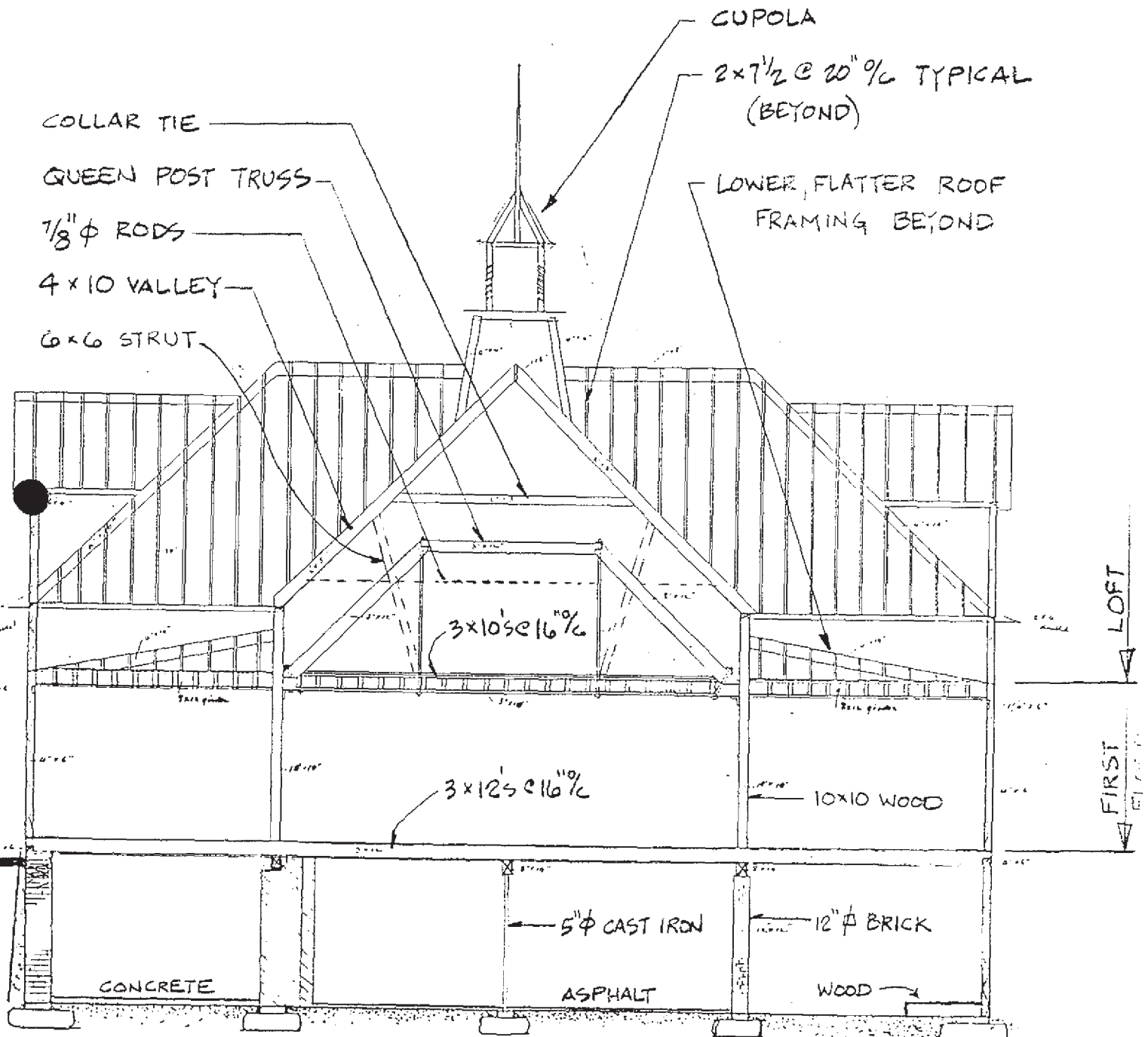
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LOCATION WOODSTOCK, VERMONT
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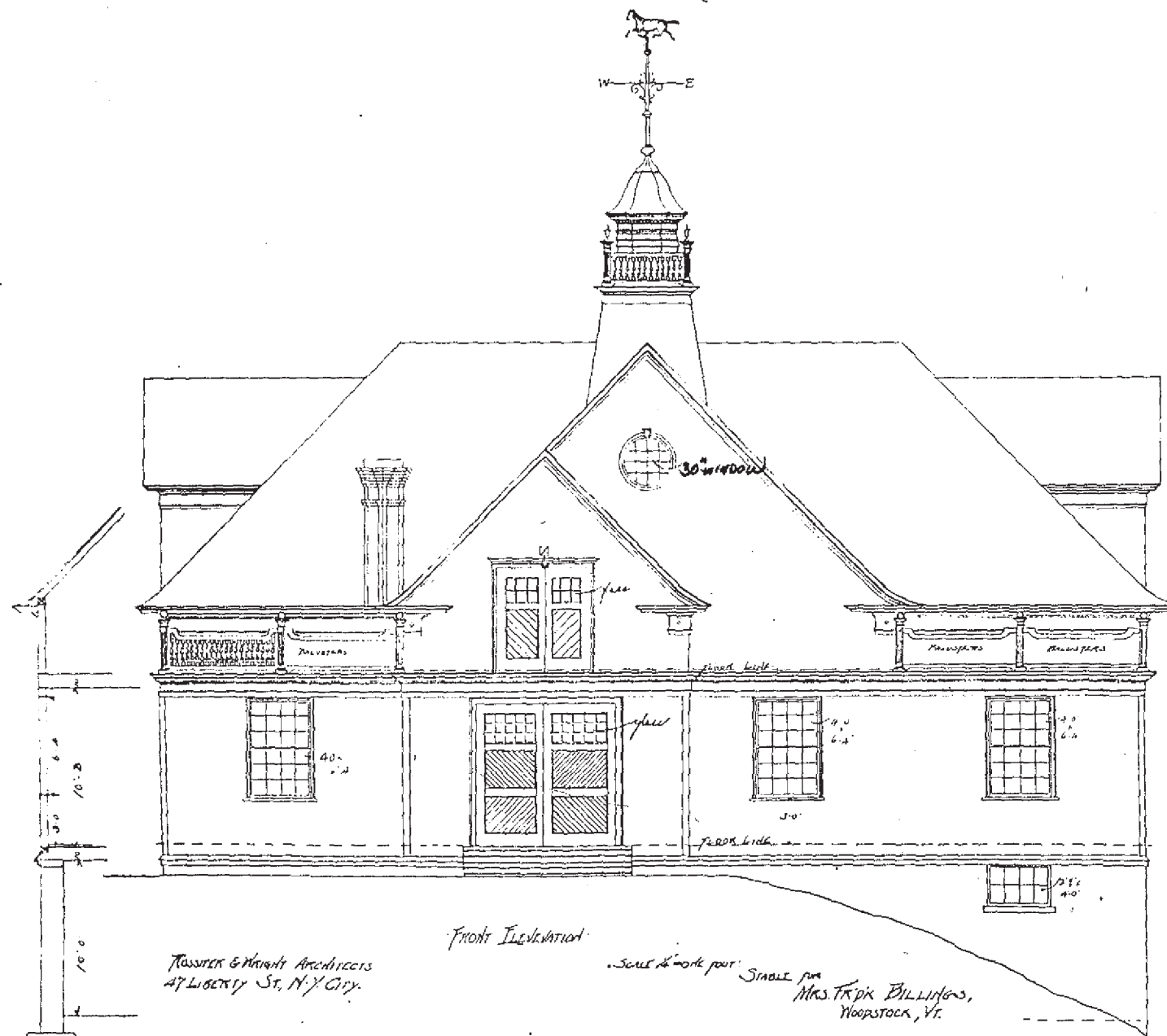
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CHKD. Cwl
SHEET 4

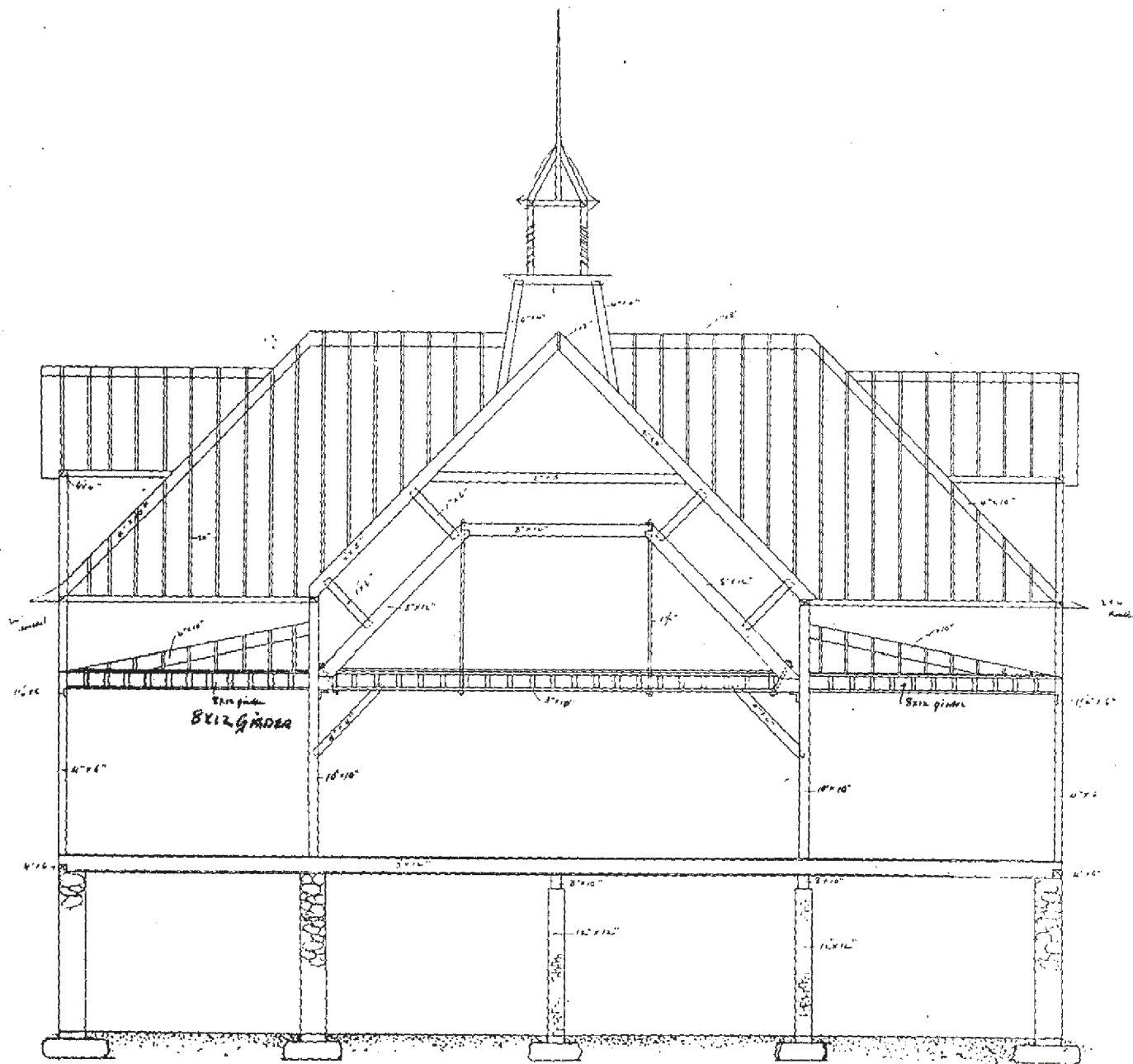
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OF 4



SECTION

SCALE 1" = 10' ±



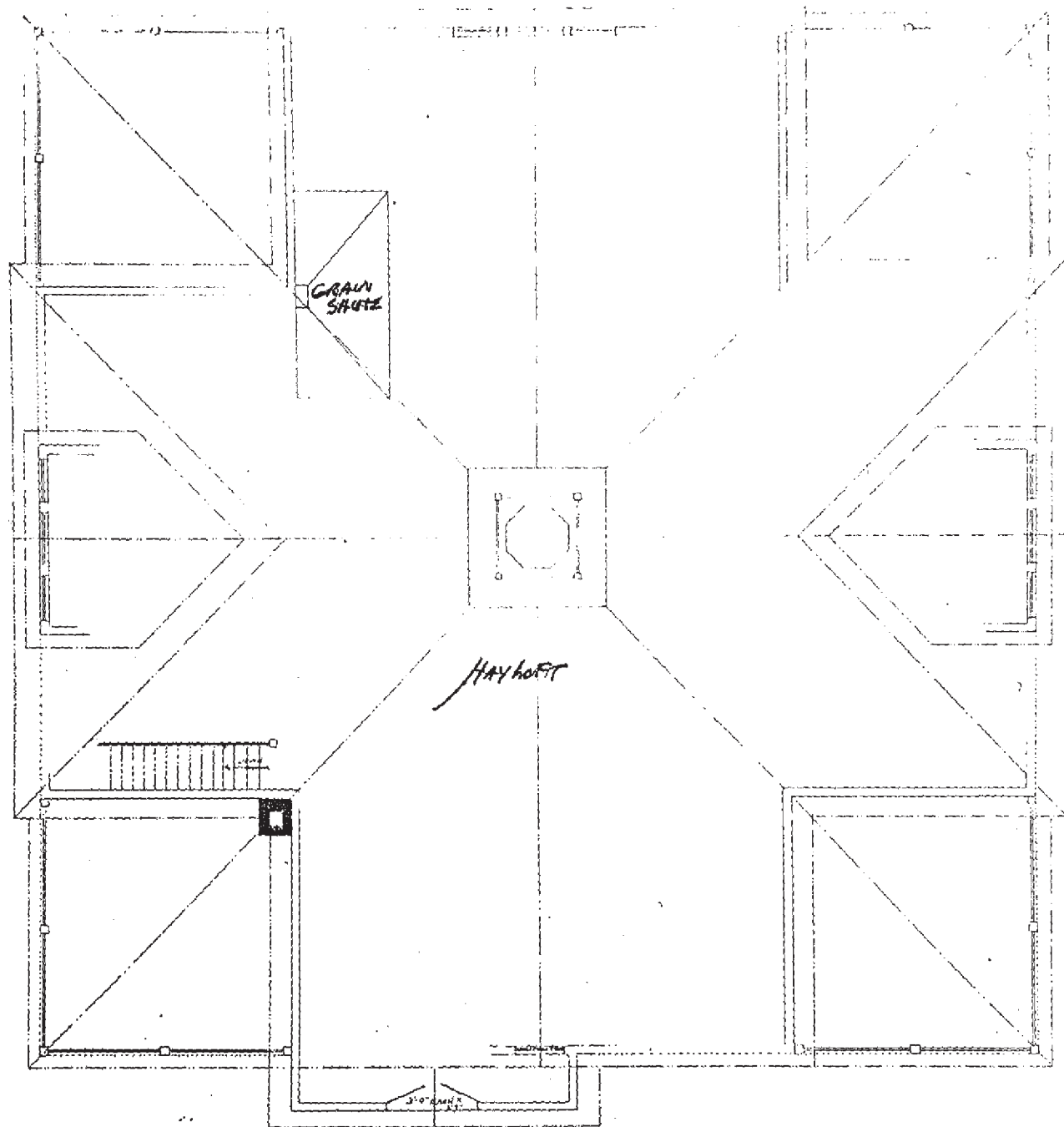


CROSS SECTION

Steeple Truss, Post, & C.

SCALE 1/4" = 1'-0"

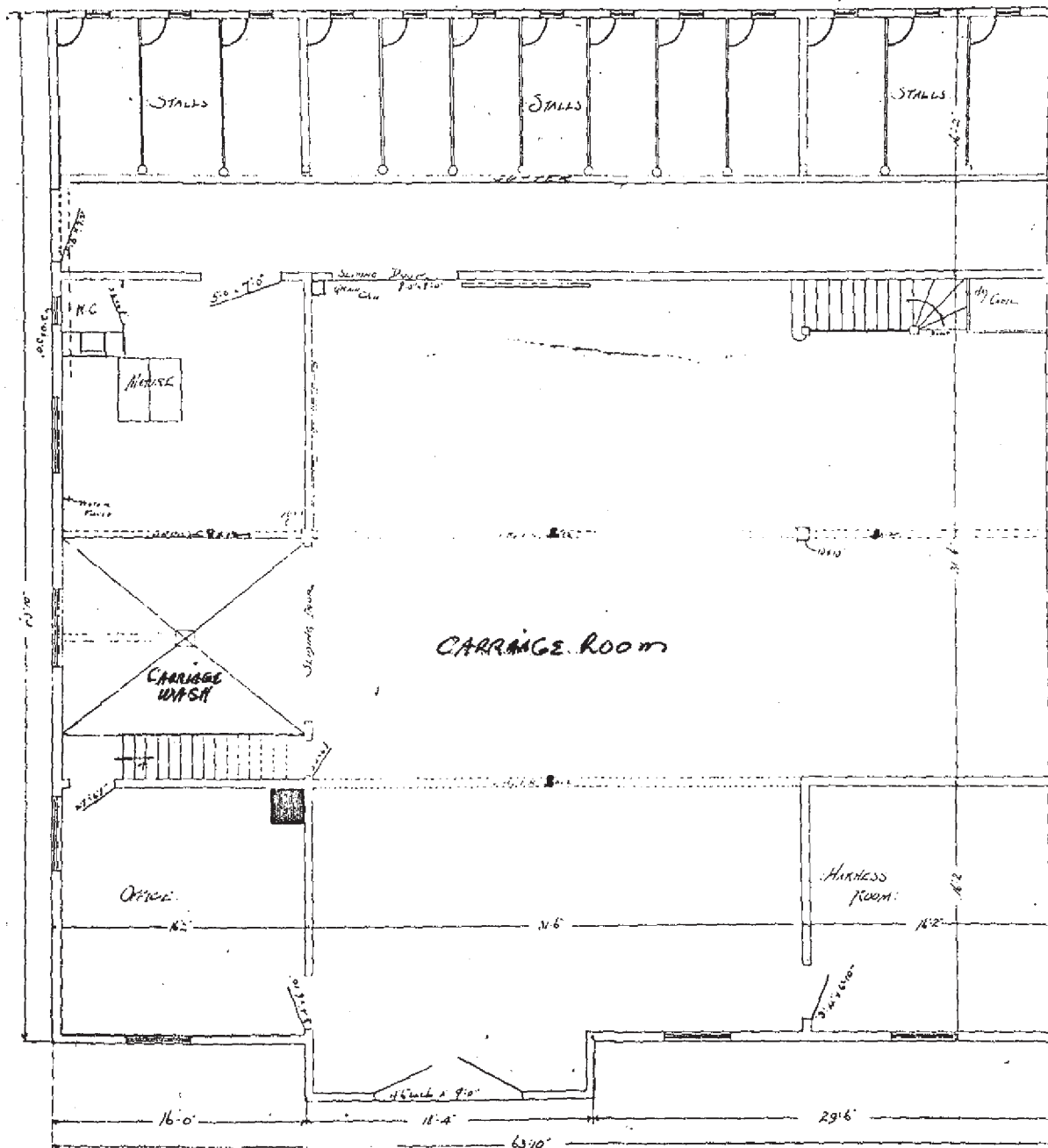
1
2
3
4
5



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LOT PLAN

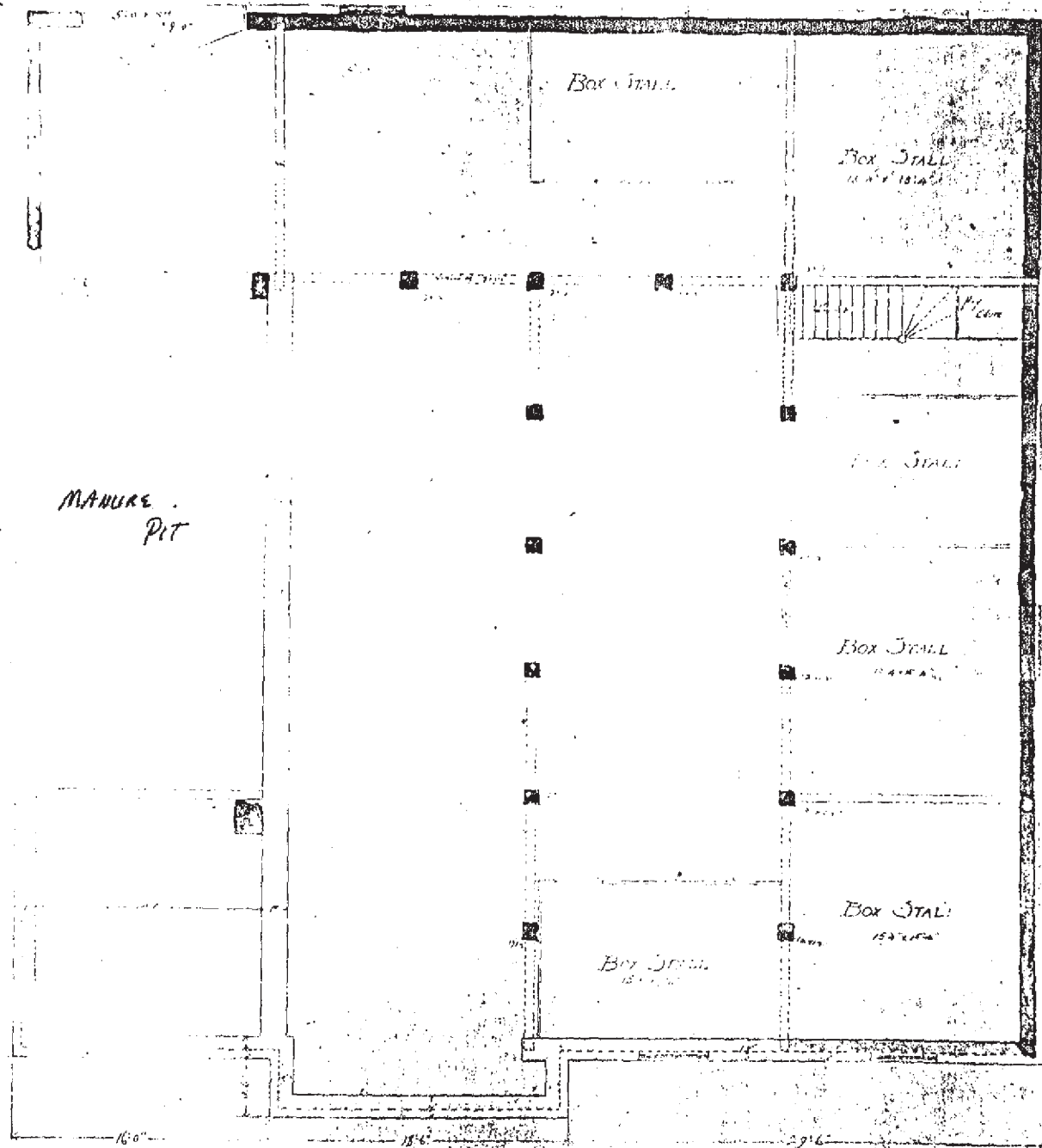
SCALE 1/4" = ONE FOOT



GROUND FLOOR PLAN

STABLE FOR
MRS. FRANK DILLINGHAM,
Woods Rock, VT.

Plan
47
1/4" = 1'-0"



CENTRAL PLAN

THROAT