A Preliminary Report on the

Shepherd Barn

Historic Northampton

66 Bridge Street, Northampton, MA

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By

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Introduction

This report will provide information on the construction and carpentry of the Shepherd barn focusing on evidence of its original purpose and use and how it has been modified to its current form. A better understanding of the structure will both aid in its interpretation and serve as a guide to its future re-use as part of the museum.

The Building

The Shepherd barn complex includes the main building that measures 28 x 38 that has been dendro-dated to 1805-6, and a smaller ell roughly 14 x 20 that is attached at the Southeast corner. The main building is of timber frame construction, where the superstructure is composed of both large and small timber components fastened with wooden joinery (mostly mortise and tenon) and braced to prevent racking with diagonal members (wind braces) framed between members. The construction of the ell is not visible at present but likely post-dates the barn.

The Timber Frame

The building is a three-bay, four-bent structure with bays measuring roughly twelve and a half feet, thirteen feet, and twelve and a half feet. These are measured to the *face side* of the bents and not to the centers of posts. Unusually, the face sides of the two interior bents are to the exterior and not towards each other as would be typical of a three bay English type barn. More on face framing later. The size of the bays is also not typical of a barn which of this size might measure 10, 12, & 16 feet. The timber frame as originally constructed was not for a barn (or perhaps any agricultural purpose) as its present use would suggest! Further evidence presented will support this conclusion.

The roof structure is a common rafter roof with inclined (canted) purlin plates supporting the rafters at mid span. At the peak, the rafters are tenoned into a ridge beam hewn to a five-sided shape. The ridge is made in two sections and the two pieces appear to just butt each other though there could be a concealed tenon to align them. In barns, the ridge would either be full length or joined with a scarf (splice). In houses, the middle of the ridge would be cut out for the central chimney so two ridge lengths would suffice. At each end of the ridge, on the South slope, a diagonal brace stiffens the roof. The rafters are small, measuring 3” x 3-1/2” and spaced at about 30” on center. At some later point, probably when the heavier slate roof was added, additional 2x4 rafters were inserted between each of the original ones. At their lower end, the rafters bear on the plate or are tenoned into the tie beams. The two 6x6 purlin plates run the full length of the roof (38’), are in the plane of the roof, and are supported by purlin posts perpendicular to the slope. These posts are braced both down to the tie beam and up to the purlin plate. Inclined purlin plates are commonly found in Federal period houses but not typically in barns until the mid-nineteenth century and later.

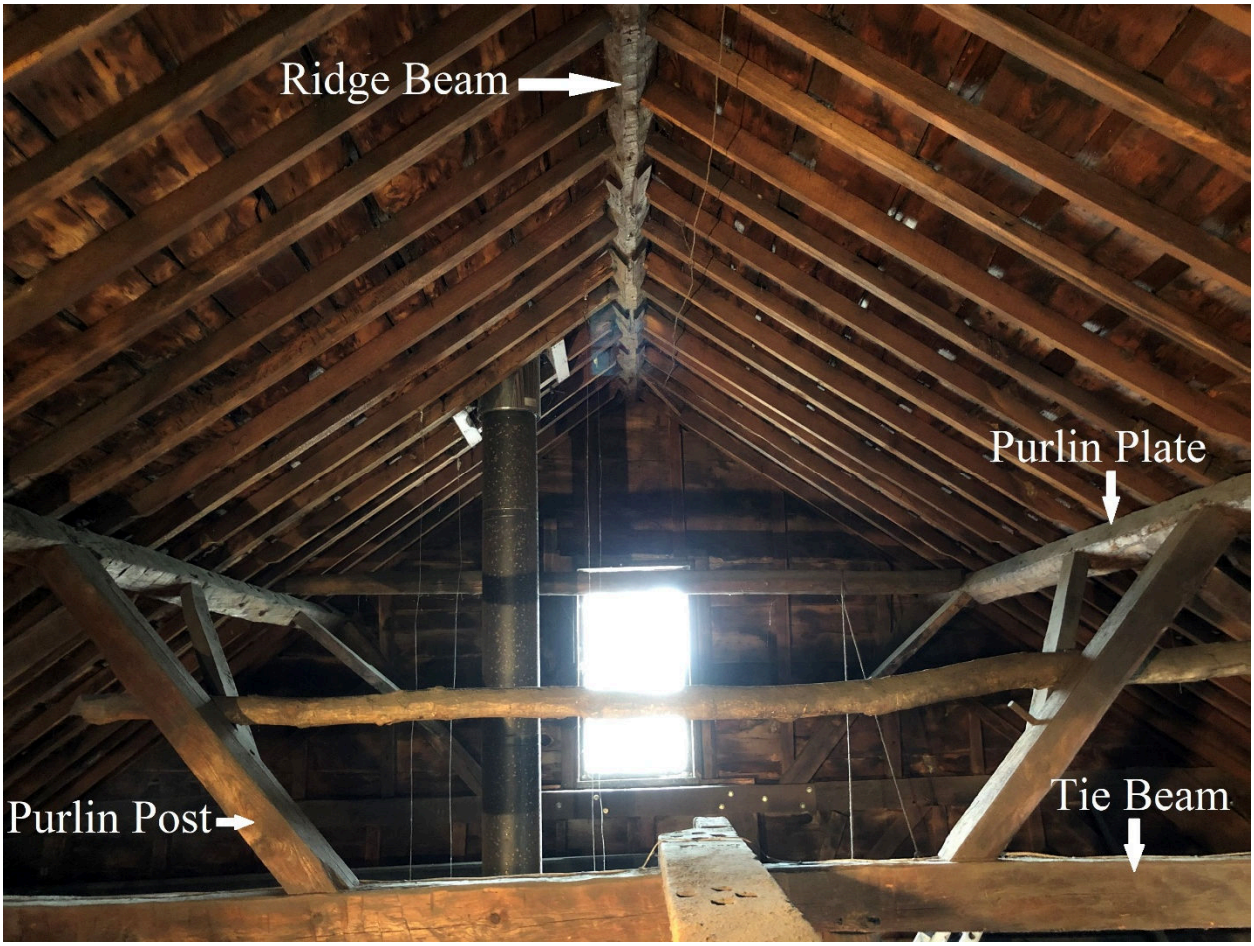


Fig. 1

Looking East above the tie beams, one can see the ridge beam at the peak and the purlin plates supporting the rafters at their mid-span. The braces from the inclined purlin posts up to the purlin plate are only in the end bays. The purpose of the poles laid across is unknown at this point.

The roof pitch is a rise of 9 inches in 12 inches of run (9/12) as roofs are considered in modern times. This also the famous 3-4-5 proportion, a perfect square triangle. However, in the period that the building was framed, pitch was considered differently than today. Pitch was the in-slope run of the rafters to the overall width of the building, so in this case 5/8. So, for every 8" of building width, there would be 5" of rafter length. Of course, the roof is still the 3-4-5 triangle.

This building utilizes the English tying joint, a joint developed in England around the 13th century and used here up to about the first quarter of the 19th century. It features the joining of post, plate, tie beam, and rafter in an ingenious manner. The post top is flared to accommodate two tenons, one into the plate and one into the tie beam. The tie beam also laps into the top of the plate with a half dovetail and the rafter tenons into the top of the tie beam. There are eight of these joints in the building.

Fig. 2

The English tying joint occurs at the top of each wall post (8) and cleverly joins the post-tie beam-plate-rafter. Seasoning and shrinkage have partially revealed the lap half dovetail joint where the bottom two inches of the tie beam laps over the plate. The 8x8 post flares out at its upper end to 10-1/2", providing room for two tenons: one into the plate and a higher one into the tie beam.

Flared posts are also referred to as *jowled posts* or *gunstock posts.*

While once typical of houses and barns prior to about 1815, English tying joints are rarely seen today. They are usually concealed in house framing and 18th century barns are rare in the area. Here are examples that can be seen by the public up close and should be taken advantage of. Perhaps a graphic poster with an exploded view would help point it out to the public.

The walls of this building are framed with timber studs about 3" x 3-1/2" at about 28 inches on center. These studs supported 15-18" wide, one inch thick, bevel edged weatherboarding. This was probably the original exterior siding that was later clapboarded over. It mostly survives on the North wall. It would be interesting to expose some of this weatherboarding and determine if it is actually weathered or was ever painted.

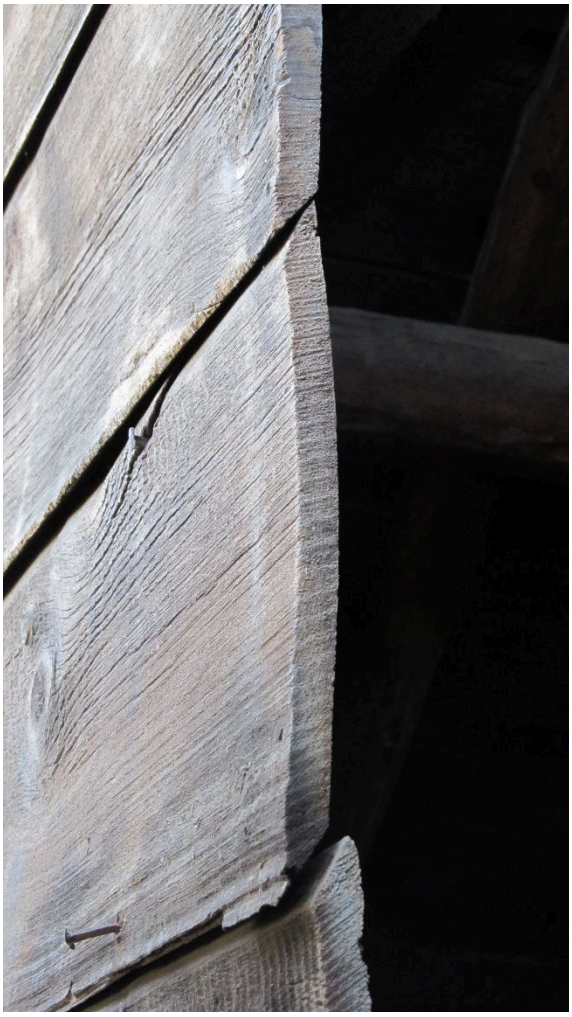


Fig. 3,4 Bevel Edge Weatherboarding

At left, a steel rule inserted in the siding lap illustrates the bevel angle. At right, similar bevel edged weatherboarding on a 1791 barn in Whately, Massachusetts.

As originally framed, the building featured a split-level loft. Along the South wall, a twelve-foot wide loft ran the full length of the structure. Its floor level was a mere seven feet above the main floor. When entering the present large doors on the South, notches for the original longitudinal loft joists can readily be seen on the beam to the left. Obviously, there was no large doorway here originally. Girt and brace mortises on the posts and stud mortises in the underside of the plate indicate a sheathed wall where the doorway is currently. The loft floor still survives in the end bays.

Along the North wall, a sixteen-foot wide loft, three feet higher up, survives in the Westernmost bay and likely also ran the full length of the building. Here the transverse loft joists were not notched in but rested on top of the longitudinal girts. Some original loft joists remain and can be seen in the space between the lower ceiling and the upper loft. Unfortunately, the carpenter that installed the dropped ceiling, made saw cuts in the top side of the old joists. It was probably to take out the sag in them and jack them up straight.

Fig. 5 Upper Loft Joist Notching

This sixteen-foot long hewn loft joist has been cut on its top edge near mid-span so it could be jacked up, creating a more level floor. The joist is supported with a stud.

Since the upper loft is four feet wider than the lower, the dividing line is not centered on the building's width. A partition originally ran the building's length along this line. Some of the studs remain while in other areas, only the stud mortises survive. The current large doorway on the North wall is also not original as empty stud and brace mortises will attest. Nowhere else in the building is there visible evidence for large wagon type doors. The only possible locations for large openings are in the East and West ends under the higher loft. Much of the East end original studding is missing but there are empty brace mortises. At the West end, one brace and some studs still remain. If there was a large opening, it would have had its upper corners clipped for the braces, precluding hinged doors. A wide, tall longitudinal bay, open to the elements at one or both ends would justify a studded partition dividing this open bay from the other side of the barn. The floor in this bay might have been earthen, adding to the usable height under the high loft. Being open to the weather might explain why there is so much new studding at the East end

where this opening would have been. At this time, there is no evidence for any original doorways or windows, though person sized doorways and small windows could have been almost anywhere. The other puzzling evidence is the building's height. In the majority of barns in this period, the ratio between the width of the barn and the height of the peak is 1 to $\sqrt{3}/2$ (1 to .866) which is based on an equilateral triangle inscribed within its cross section. In this building's cross section, the width equals the height (a square inscribed instead)!

So, the preceding evidence begs the question: What was this building built for? Was it built on this site, or moved here later? When this frame was cut in 1805-6, Northampton was well settled and there were likely many businesses and cottage industries in addition to farming. What business would require two longitudinal lofts at different widths and different heights? Buildings were frequently moved intact, or dismantled and moved, and modified for another use. These questions may be answered as portions of the building are stripped for making repairs.

The Scribe Rule

The timber-framed components for this building were laid out and cut according to the "Scribe Rule" system. This system was brought here from Europe by the carpenters and was the standard way to frame a timber frame in this area until about 1812 (Goshen, MA). It was at this time that the "Square rule", an American innovation, was introduced and it quickly replaced the older, more labor-intensive "Scribe Rule', which was also referred to as "Cut and Try, or Try Rule" system. This building predates this 1812 changeover.

The scribe rule was a fabrication process that involved setting out the components for two-dimensional assemblies (floor frame, wall frame, cross frame, or roof frame) horizontally, level and square, and custom mating each piece to fit. There is little interchangeability of parts and each is numbered as a key to its placement. When one assembly is finished and numbered, it is dis-assembled and the next one set up, many components are scribed in more than one assembly. The jowled posts for instance, are first scribed in the longitudinal wall, then in the cross wall. Though it is a time consuming, labor intensive process, it allowed the use of crooked, twisted, out of square, and tapered members that were a typical product of England's forests and the colonists continued the technique here.

The surface that is up when the setting out and scribing is done is referred to as the *upper face, fair face, layout face, or best face*. It is the surface that receives the roofing, siding, or flooring so all the joinery is flush on this face. Variations will occur on the non-face side. The face side of interior cross frames is chosen by the carpenter but typically faces the threshing floor in barns or the chimney bay in houses. In this building, as noted earlier, the faces are all towards the exterior, another anomaly. Since the face is up as the bent is framed, it also receives the numbering marks for re-assembly. Individual carpenters made use of different tools and different numbering sequences but most utilized Roman numerals. This particular builder used a tool called a *race knife* or *timber scribe* to number components. It is a hooked knife that is dragged across the surface removing a strip of wood like a gouge. A compass point enables it to cut circles as well.

Fig. 6

This purlin plate brace and its corresponding purlin post is marked #3 with a race knife. When the purlin plate assembly was set out flat for framing, it was numbered from left to right.

Fig. 7

This post to tie beam brace is number 2 but with a circle added using the compass point on the race knife. In this building it appears that the circles were used in cross framing and non-circles in longitudinal framing. Since most of the marks are on faces concealed by sheathing, it is difficult to understand the carpenter's exact system. Interestingly, there is a mistake in the carpentry shown here. The peg hole for the brace was first bored at the wrong end of the mortice. Peg hole diameter is 15/16" to 1"

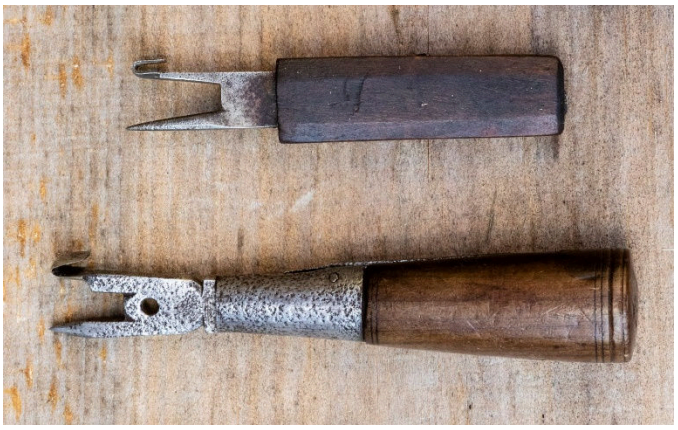


Fig. 8

Race Knife

Period race knives or timber scribes used by carpenters to number their timber components.

The Timber

The timber components in this frame include both mill sawn and hand hewn. The mill sawn pieces include rafters, braces, joists, studs, girts, and posts. These were sawn locally on a water powered up-and-down type mill that could handle up to at least 18' long logs. Those pieces too long for the sawmill; plates, purlin plates, ridge, tie beams, and sills were squared up with axes (hand hewn). The jowled or flared posts utilized both methods of conversion. They were first sawn on three sides completely and then the fourth side up to the beginning of the jowl. Utilizing the natural flair of the log, the last bit was hewn with an axe to follow the flair.

Fig. 9

On this post, the sawing stopped just above where the brace would enter. The tapered portion above is hand hewn.

The flooring, siding, roof sheathing, window and door framing of the original building period would all have been sawn on a water powered up-and-down sawmill leaving characteristic straight saw marks roughly perpendicular to the edge. By the 1860's and 70's (depending on when the first circular sawmill operated in the area), the much faster steam or turbine powered circular sawmill becomes predominant. It of course leaves telltale circular marks. This distinction helps us separate original portions of the building from later ones. For example, the large South wagon doors which are *framed doors*, were constructed after circular sawing became the norm. Framed doors are ones where there is a structure of mortise and tenoned scantlings (small timbers) that the boarding is attached to. Framed doors are superior to batten doors which utilize only boards.

When this building was framed in 1805-6, the original old growth forest in the area had long been cleared. What was left was either smallish, less than perfect remnants, or forests that had grown back (second growth) since the original clearing. Thus, the timbers are on the small size and quite waney but none the less typical of the period. Wane is the bark edge resulting from using undersized logs. For species, the building has a mix of oak, white pine, and pitch pine. Most of the studs, rafters, and braces are red oak (and perhaps white), while larger members as well as siding are of the pines. There are likely to be additional species found if one examines every piece. Pitch pine, *Pinus rigida*, is one of the Southern yellow hard pines group. Though it survives today in a much more limited area, dry, sandy, or rocky uplands, and mostly coastal New England, it once grew in fine stands along the Connecticut and Housatonic basins and is often found in 18th century buildings.

Changes over Time

At this point, it is not clear if the structure was moved here from elsewhere, but the possible presence of openings at the gables rather than the sides where the present large doorways are located, would suggest that. An opening in the East wall would be on the property line! It is clear however that the structure was heavily modified sometime after the Civil war to be used as a horse and carriage barn. The center bay became a drive through for carriages or wagons and horses (or other animals) were stalled to the left and possibly a tack room area located to the immediate right. There were likely 5 animal stalls with one (most northern) considerably wider than the others. There are faint animal names still visible above the sliding stall windows.

In each gable, near eave height, are holes indicating the former presence of *dovecotes* (for the keeping of pigeons). Though they are now clapboarded over on the outside, the holes are still visible from the lofts. Dovecotes were a common feature in English barns both in England and here so their presence could even date to the original build. Since the shape of those on the West gable are rounded on the top and those at the East are pointed, they are likely from different periods.

Fig. 10 & 11

Dovecote openings in the West gable just below the tie beam (photo above) and those in the East gable just above the tie (below).

There is also evidence that the structure underwent some restoration work early on, perhaps prior to moving it. Some stud bottoms visible behind the stairs have had their bottoms repaired with a nailed-on section that is probably tenoned in to the sill. This type of repair suggests decayed stud bottom tenons and a replaced sill beam. If the building was to be moved

by rolling or dragging and the sills were decayed, they would need to be repaired prior to the move.

Fig. 12

Stud Bottom Repair

The replacement piece on the right, which is likely tenoned into the sill, is tapered to permit nailing into the existing stud.

The Future of the Shepherd Barn

As with all older buildings, the Shepherd barn has undergone adaptive reuse and has been repaired and modified substantially over its lifetime. The present exterior would probably not be recognizable to the original owner. Some of this work was done well (as in fig. 12 above), in other places, not so well. There is also work that yet needs to be done. Even a cursory inspection of those areas readily visible indicates there are decaying areas that need to be

addressed. A thorough cleaning out of the building and some good lighting will reveal more. The worst areas are likely to be the timberwork under the floor; the sills and joists, which are nearly on the ground. Little of this can be seen at present. For safety of the occupants in any future use, the flooring should be lifted up and this area examined. When originally constructed, the building's sill beams would have sat on a stone foundation wall along its perimeter and under interior posts, the sills would have borne on stone piers. Over the building's lifetime, these stones have sunken into the earth and the exterior ground has also risen so now the building appears to sit right on the ground. Wood, even preservative treated wood, does not last when on the ground.

Fig. 13

Southwest corner horse stall doorway illustrates the at-grade condition of the barn. Note that much of this framing has already been replaced and some of it recently.

For permanence, wood needs to be elevated above the ground. Per the building code, untreated wood sills must be a minimum of 8" above grade, floor joists must be 18" above earth, and floor timbers 12" above earth. Preservative treated members can be used, but their life expectancy is only 20 or 30 years longer than untreated if exposed to ground and dampness. That is too short a time frame for such an important component to last before replacing. Thus, there are two basic options for this barn:

1. Repair or replace the floor structure as necessary, elevate the building at least the minimum to meet the building code. Since we don't want a crawlspace under the barn that is even with or below the outside grade so as to collect water, that would mean raising the finish barn floor a minimum of 28" above the highest existing grade (the Southeast corner?). A new perimeter foundation would be installed with footings below the frost line (four feet) and interior pier type footings under posts and girders. The foundation would be concrete but it could be faced with stone or brick, or entirely masonry above the ground for appearance sake. The advantage of this option is that it retains the original timbered floor design.

2. Remove the wood floor structure entirely and replace with a concrete foundation and concrete floor slab. The concrete perimeter walls could extend a few inches up the walls to provide the required separation distance to grade. The finish floor could be concrete, stone, or tile, or a wood floor (using original planks) built on top of the slab. As with option 1, the concrete wall could be faced with stone or brick on the outside (and inside) if desired. The advantage to this option is that it retains the original floor height near grade. It would also permit increasing the clear ceiling height under the loft to 7'- 6" to meet the code.

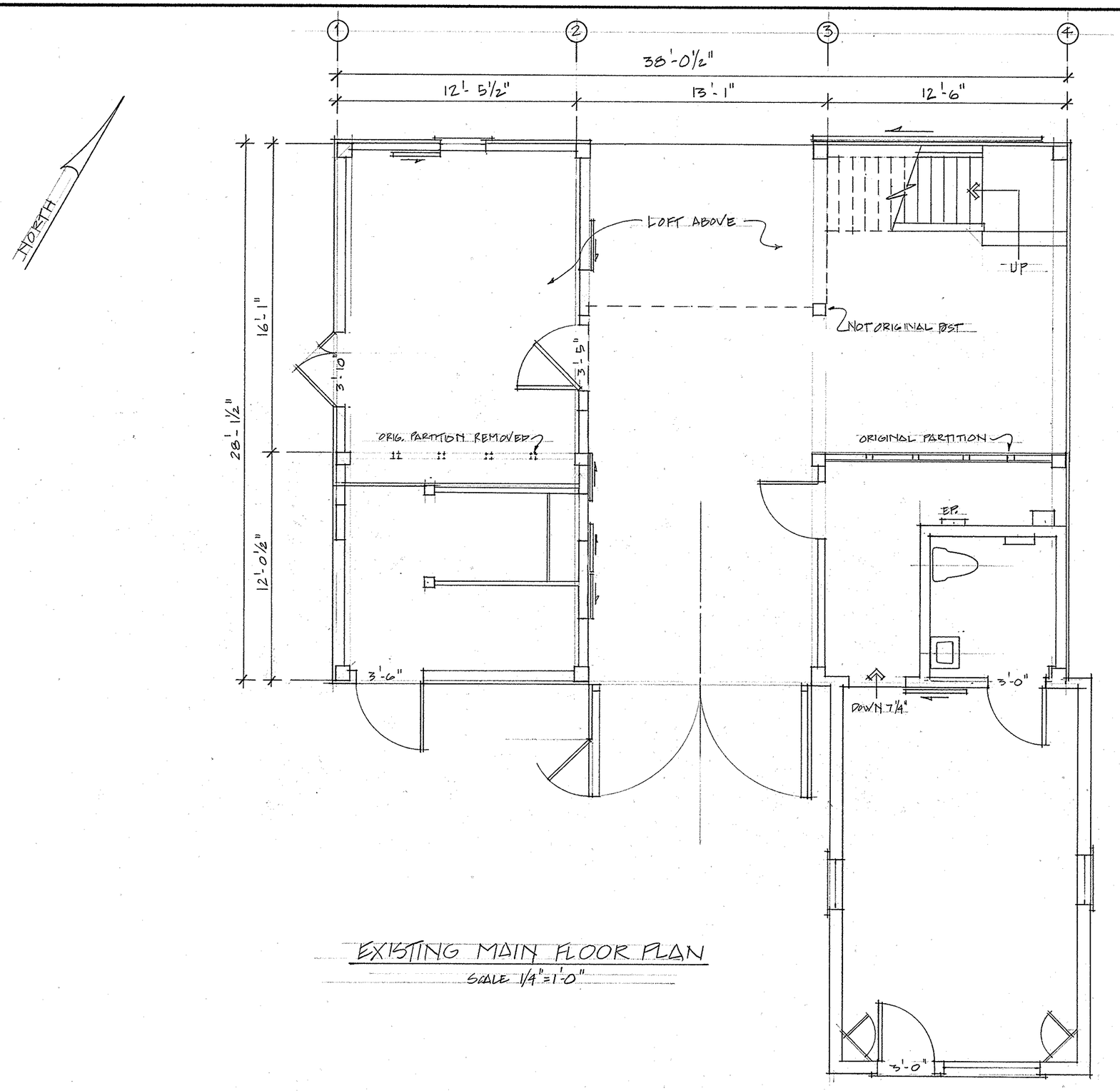
An important consideration for the building's future use is accessibility. Ideally, all floors shall be on the same level (no changes between the main barn and ell) and near as practical to the exterior grade so extensive ramps and stairs are not detracting from the exterior appearance. The maximum ramp slope for accessibility is 1 in 12. A finish floor height 28 inches above grade requires a ramp 28 feet long! This favors option 2.

How the building will be used also affects the repair scheme chosen. Using the building for exhibit space only is different from using it for performance space (public assembly) and those requirements are based on how large the space is. Accessibility of the lofts is another issue. Being a historical structure, there may be some leeway on using the lofts. As is, the present loft stairs are not code compliant. Structurally, the lofts are probably not rated high enough for public use. This will require structural analysis.

Before any decisions on the use of the buildings are formalized, the following steps should be undertaken:

1. Empty the structure and clean the interior. Remove metal chimney and patch roof. Provide temporary lighting sufficient to examine the visible areas requiring work. Photograph completely.
2. Number existing main level flooring for re-use and remove and stack in container.
3. Rough clean the underfloor area, screening for artifacts.
4. Examine existing floor structural system, sills, joists, foundation. Photograph and add to drawings. Examine for evidence of previous use.
5. Provide shoring and bracing if necessary.
6. Do some archaeology work in the under-floor space.
7. Strip siding (number pieces and save in container) where necessary for sill, post, and stud repairs.
8. Do a building code compliance analysis based on a range of potential uses including mixed use.

The information provided by these steps will be essential in determining how the space can be used.



EXISTING MAIN FLOOR PLAN

SCALE 1/4"=1'-0"

HISTORIC NORTHAMPTON

THE SHEPHERD BARN

66 BRIDGE ST.
NORTHAMPTON, MA.
5/1/20

JACK A. SOBON: ARCHITECT
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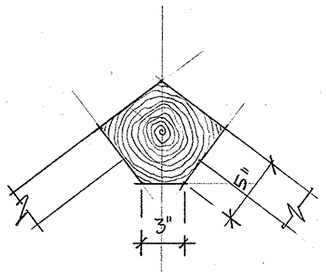

RIDGE SECTION
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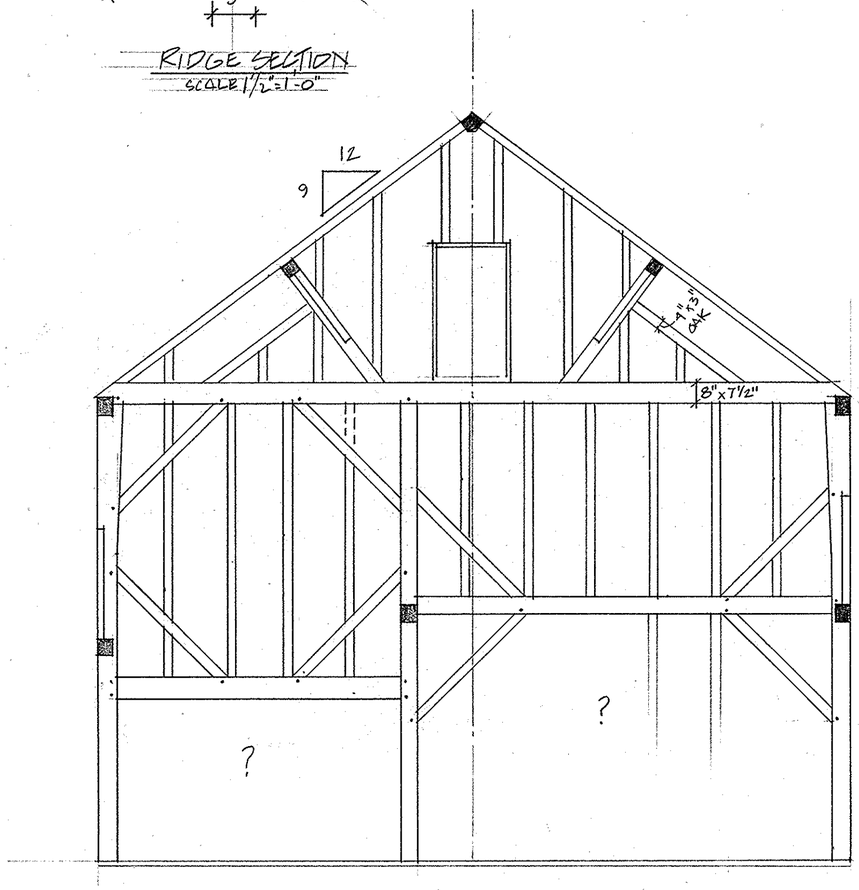

SECTION # 1
LOOKING WEST
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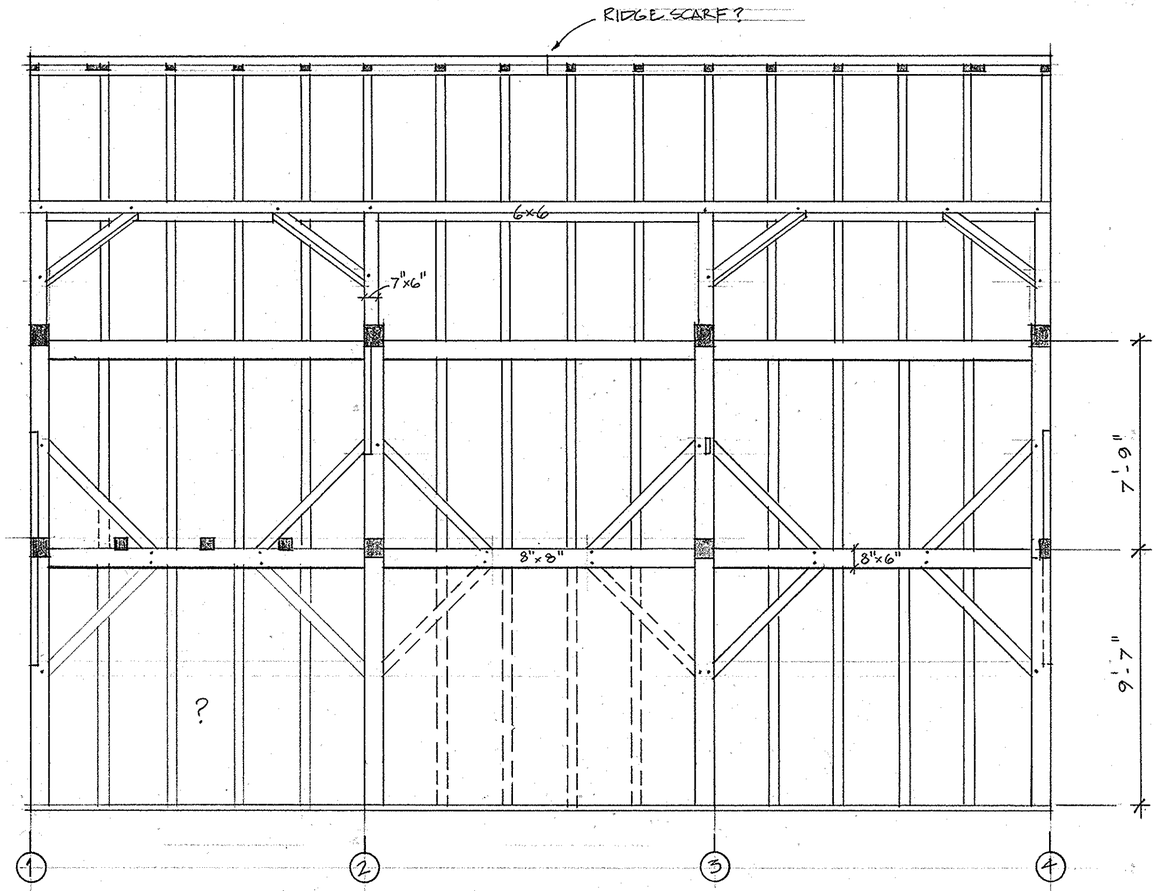

LONGITUDINAL SECTION
LOOKING NORTH
SCALE 1/4"=1'-0"

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THE SHEPHERD BARN
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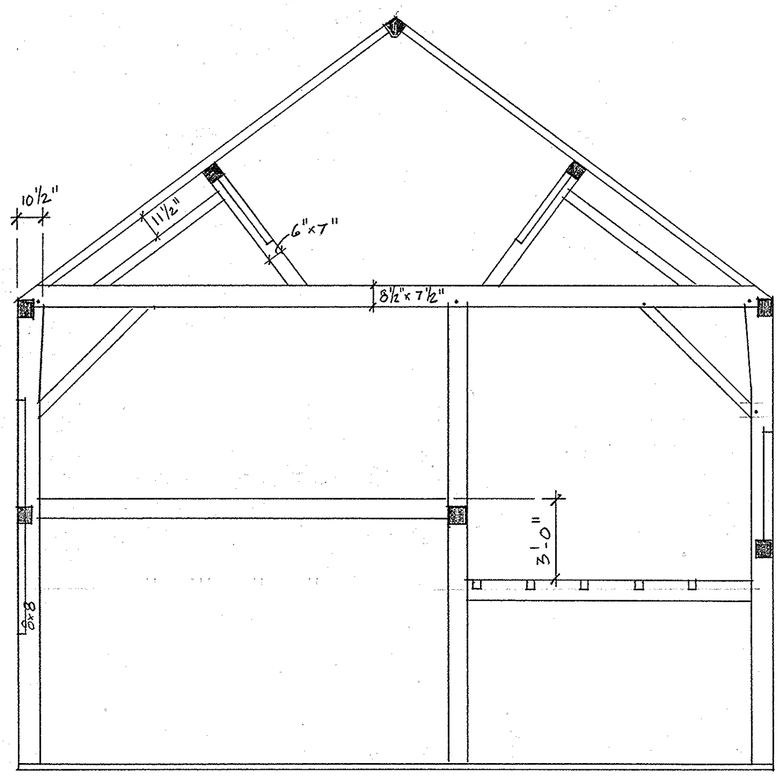
2



SECTION #2

LOOKING EAST
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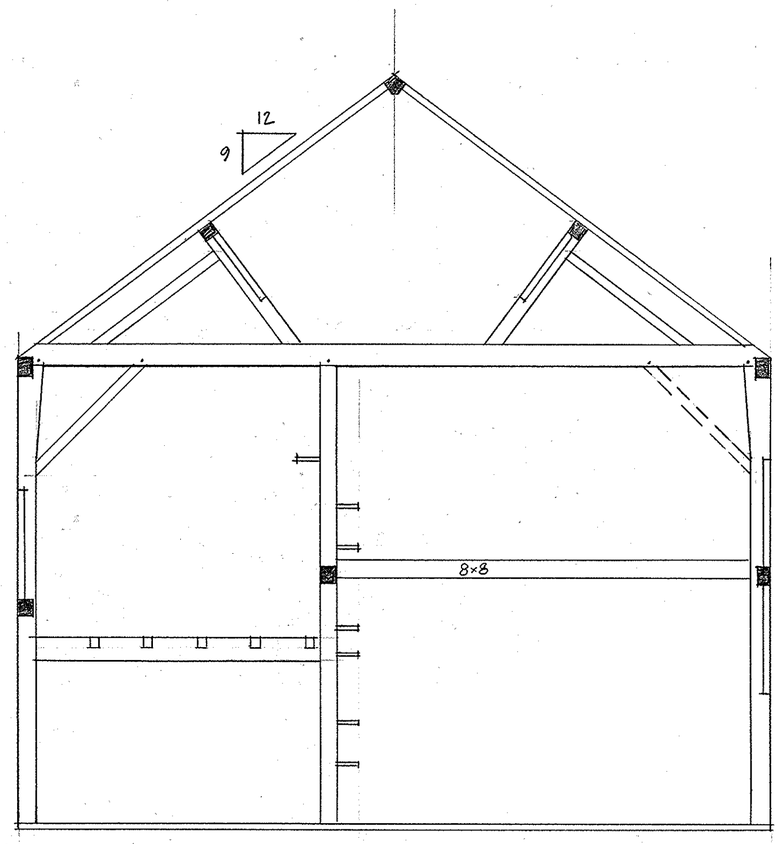

SECTION #3

LOOKING WEST
SCALE 1/4"=1'-0"

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THE SHEPHERD BARN
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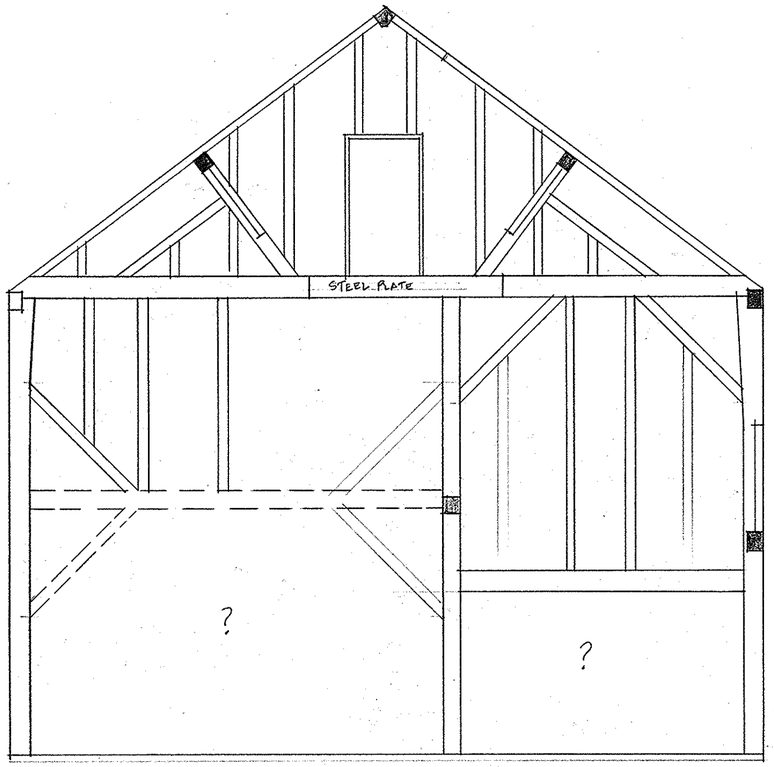

SECTION #4
LOOKING EAST
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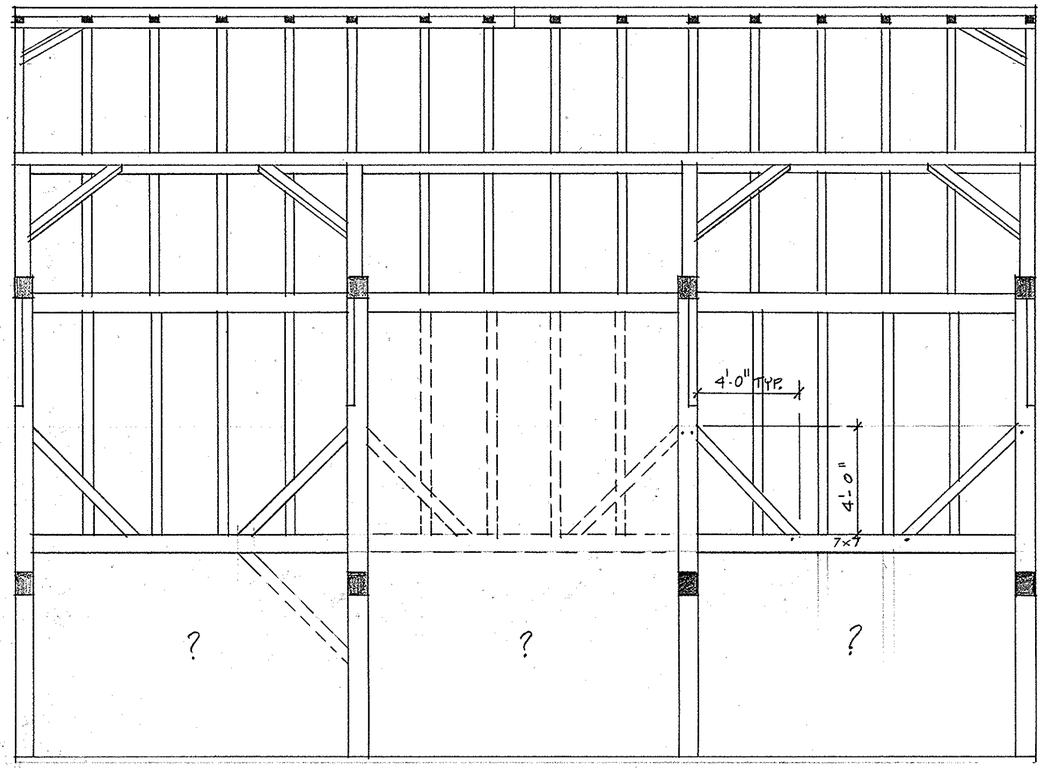

LONGITUDINAL SECTION
LOOKING SOUTH
SCALE 1/4"=1'-0"

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4