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Restoration and Traditional Building

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The Wheelock Town Hall: Roof System

A Preservation Trust of Vermont

Technical Assistance Survey

The Town Hall in Wheelock, Vermont is a 32 x 50 ft. , gable front timber frame structure built around 1870. It has a 14 ft. wall height and carries a small. louvred, one stage tower at the front. The building is raised on a newer concrete basement that houses the Town Offices. The original portion, above the basement, is entirely meeting and performance space with a notable maple floor and a stage at the rear with 2 painted theater curtains and an arched opening around it. The walls are covered in white painted narrow beaded boards which, if not original, are very old. The ceiling was covered in the same material but is now both partially removed and entirely concealed by acoustic tile. The interior is a clear span of 32 ft. without posts, the ceiling and roof once supported by three kingrod trusses. For some reason, difficult to explain, the ceiling was dropped 18 inches, at some time before living memory, and in doing so the trusses were cut, their kingrods removed (they lay on the floor of the attic today) , the ceiling joists dropped to the new lower beams, and the purlin system that supported the midspan of the rafters, dismantled and rendered useless. Instead of being trussed, the 32 feet were now spanned by simple 88x8 beams, unable to reach so far without significant deflection . (see Fig. 1)

The result of the above remodeling was the visible sagging of the interior ceilings over the meeting room and stage, including the arch. Also, the small tower leans noticeably back into the Town Hall, where it depresses the roof. The destruction of the purlin system caused the 2x6 rafters to sag under snow loads. The tower and rafter problems lead to roof leakage, particularly at the back of the tower , where water is entering and staining the ceiling below.

The Original and Altered Roof Systems:

Upon entering the attic level of the Hall, you are presented with a confusing situation. The remains of 3 tie beams are cut off 4 ft. from the wall at each end, where their horizontal bracing ended, and are suspended by boards from the 5x7 inch truss rafters that were part of the kingrod trusses. (see Fig. 1) The attic is filled with loose cellulose insulation which makes it hard to examine. Lying in the insulation on the floor as soon as you enter the attic are three,long, 1 inch diameter wrought iron rods, which have led people to believe that the Hall is tied together side to side with rods, which would be a reasonable thing to do. However, these rods once hung vertically from the apex of the 5x7 truss rafters, where the hole for their passage can still be seen, and supported the midspan of the truss bottom chord, which in turn supported the ceiling. (see Fig. 2) These rods are now attached to nothing.

If you dig into the insulation below the cut off truss chords you will find 8x8 beams spanning 32 ft. of width and carrying ceiling joists, boards and plywood, and hanging the new lower ceiling. These dropped tie beams are tenoned into the 4x8 wall posts by some method that I can't see, and tension capacity is contributed by short 2x8s spiked to the sides of the posts and beams, since there is no point trying to pin a tenon into a 4 inch post. 3x8 purlin planks hang by nails from rafters they no longer support. Some have broken lengths of descending struts hanging from them. By looking at the intact gables it is possible to see the original condition: the 3x8 purlin planks perpendicular to and supporting the mid span of the rafters, held up by diagonal struts that dropped to the tie beams of the

kingrod truss. (see Fig. 2)

the rafters have few collars and there is no purlin system, but the walls don't seem to be spreading very much if at all. this can only be attributed to the nailed planks joining the ends of the dropped ties to the wall posts, and to the sagging of the ceiling, which exerts and inward pull on the ensemble.

Wheelock Town Hall: Problems at the Rear of the Tower

The front of the tower bears upon the fully studded and boarded front wall of the building. The rear of the tower is framed and supported by two 7x7 inch posts that rise from a beam built of three layers of nail laminated 2 x 10s with plywood flitches in between , spanning 32 ft. in the clear. This beam is dramatically sagging and the tower is rotating backwards and downwards. These posts originally would have sat upon sleeper timbers that spanned from the front gable plate to the first interior truss. This truss may have been stiff enough to support this small tower, but a great many churches and public buildings have gotten in trouble at just this point due to underestimated steeple loadings, and flashing and leakage problems.

Wheelock Town Hall: Solutions

Roof Trusses: The inadequate and sagging ceiling over the meeting room can be remedied by rebuilding the trusses in the attic so that they can easily span the distance. Anything done in the attic will first require that the blown-in cellulose insulation be removed so that one can see what one is doing (this was done for under $2000 at the York St. Meeting House in Lyndon Corner by a St. Johnsbury environmental contractor). The same, or another version of insulation can be put back in afterwards.

There are options for rebuilding the trusses depending upon whether the ceiling is to be left at the dropped level, or brought back to the original, 18 inches higher.

1. Truss support of the dropped ceiling: Whether the ceiling is to be left dropped or raised, the feet of the 5x7 truss rafters, and thus the walls of the building, need to be restrained by some sort of tie beam. In the dropped condition it can be groups of screw or nail laminated 2x10s spanning the distance, using as long a 2x10 plank as you can readily get, perhaps including 24 footers, to minimize joints. (While it may be possible to get a 30 or 32 ft. timber into the attic, it will be difficult to manipulate and not necessary).

Attach the 2x10s as well as the short 2x12 collars (see Fig. 3). to the rafters with gangs of structural screws such as Timberloks or GRKs. The short 2x12 collars, on both sides of each truss rafter, can carry perpendicular 4 x 6 wood blocks that support the upper ends of the king rods and their large washers.

The jacked tie beams will have to be jacked from below to an inch or so of positive camber. This can be done by spreading timbers on the maple floor that cross the locations of the walls and posts in the basement, for stiffness, and jacking from them.

Either drop new king rods, or get threading and length added to the cut off original kingrods and drill them through the middle of the dropped ties, where a large plate washer such as a 3 x 3 3/8 inch steel plate and nut will support the tie beam. You can bury some of this metal in the beam, or shim the ceiling down to cover it, or get a

decorative or an old round cast iron washer and expose it in the room. The short 3/4 inch rods nearer to the ends (see Fig. 3) will stiffen the weak connection of the dropped tie beam to the wall post.

Add 4x4 diagonal struts to pick up the purlins and thus support the midspan of the rafters. Make sure the snow load is off when you do this.

Rebuild the ceiling and reinstall some sort of insulation either fiberglass, cellulose or any of a number of other choices. Don't blow in foam that sticks to the wood members.

2. Trussing at the Original Ceiling Height: To restore the room to its original ceiling height, it will be necessary to create a bottom chord (or tie beam) at the height of the cut-off ties by laminating 2x12 plank in long pieces around and in the position of the cut-off ties. (see Fig. 4) Using 2x12s will allow getting some screws from planks into the bottoms of the 5x7 rafters. Also add some diagonal straps affixed with four 1/2 inch x 4 inch lags, or through 3/4 inch rods, to help tie the rafters to the new and old tie beam combination.

The ceiling joists from the dropped ties can be moved up to the new built up tie, cut a little shorter. I believe these are probably the original joists lowered to the dropped tie long ago. They can either bear in laps cut into the outer 2x12s or hung on joist hangers.

Restore the 4x4 struts as above, and proceed to ceil and insulate.

3. Trussing the Rear of the Tower: The rear of the tower needs to be supported by a truss across the 32 ft. span. Since it is not located in an original truss position, but sits on a (too weak) tie beam constructed under the rear tower posts, the new truss can be based upon that.

First, jack the triple 2x10 tie beam from below, under the tower posts, until it has at least 1 inch of camber and the tower is near plumb. Have the other roof truss restorations completed before this as that will make lifting the tower and the roof around it easier. Apply , and affix with screws or spikes, 2 x 12s on each side of the of the triple 2x10s. Then build the double raftered

truss off this enlarged bottom chord as shown in fig. 5. The 4x7 and 5 x7 rafters that bear against the tower posts can be held from sliding upwards by blocking lagged to the posts, since the small posts would be excessively weakened by mortise and tenon connections. The horizontal straining beams can be just tacked in place since they have little tendency to slip. A block affixed below each one will make assembly easier.

The weight of the tower will now travel down the truss rafters and bear out towards the end of the bottom chord, where the truss rafters can be blocked at their squared-off noses. The rafters can also be tied back to the chord with u-straps or through 3/4 inch rods. Bring the bottoms of the rafters as close to the wall as possible while still leaving some room to work, even closer than indicated in Fig. 5.

The rear tower posts are now queens in a queenpost truss and will suspend the span of the bottom chord by metal u-straps, rather than bearing upon it and sagging it.

It will be necessary to reflash the tower to the roof as it passes through, since this repair will disrupt the old, depressed relationship between the two.

Wheelock Town Hall: Cost Estimates

1. Repair, retaining dropped tie beam: Jacking from below, removal of insulation, removal of ceiling, assembly of 3 kingrod trusses, re-establish purlin struts.

Cost: $46,000

or

2. Repair, with restoration of the ceiling to its original height: Remove insulation, construct mostly new tie beams and support them on jacks or structural scaffolding from below. Assemble as three trusses. Dismantle ceiling, remove the dropped tie beam, bring the ceiling joists up to the new, higher, tie beam. Purlin struts.

Cost: $58,000

3. Queenpost truss incorporating the rear tower posts: Lift the rear of the tower to near plumb and level, Incorporate the rear tower posts into a double raftered queenpost truss. Reflash the tower to the roof.

Cost: $28000

4. Beaded wood ceiling: Strapped to the bottoms of the trusses and joists. Narrow beaded softwood like that covering the interior walls. Approx. 1500 sq. ft. coverage.

Cost: $6500-7500 installed

5. Attic Insulation: To cover approximately 1500 sq. ft. @ R=30. Depending upon the material chosen. Cellulose or fiberglass batts might cost $3-3500, installed. Recycled denim a bit more. Rigid foams approximately twice as much.

(Painting is not included here since it may be part of a project to paint the entire interior according to some color scheme.)

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WHEELOCK, VT

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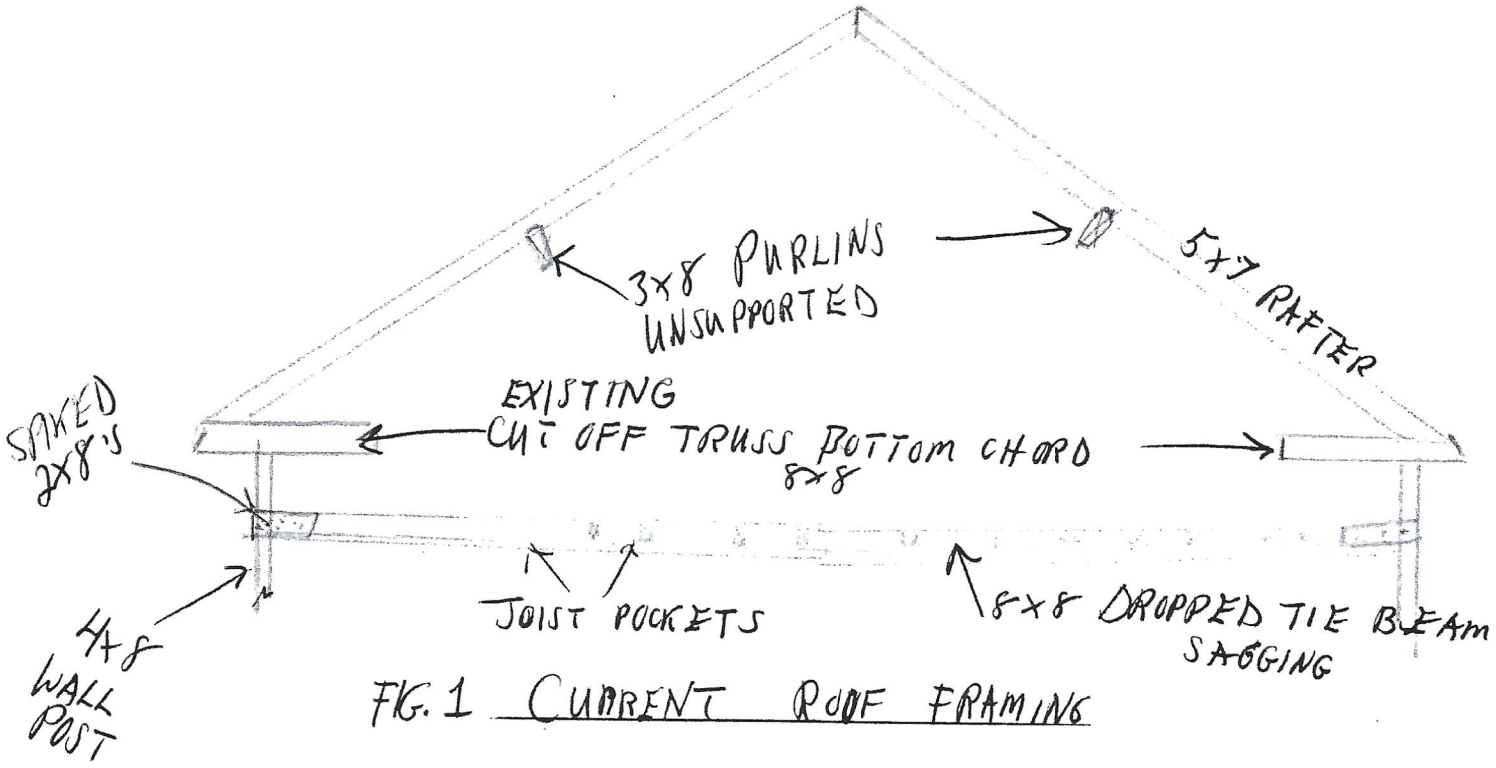

FIG. 1 CURRENT ROOF FRAMING

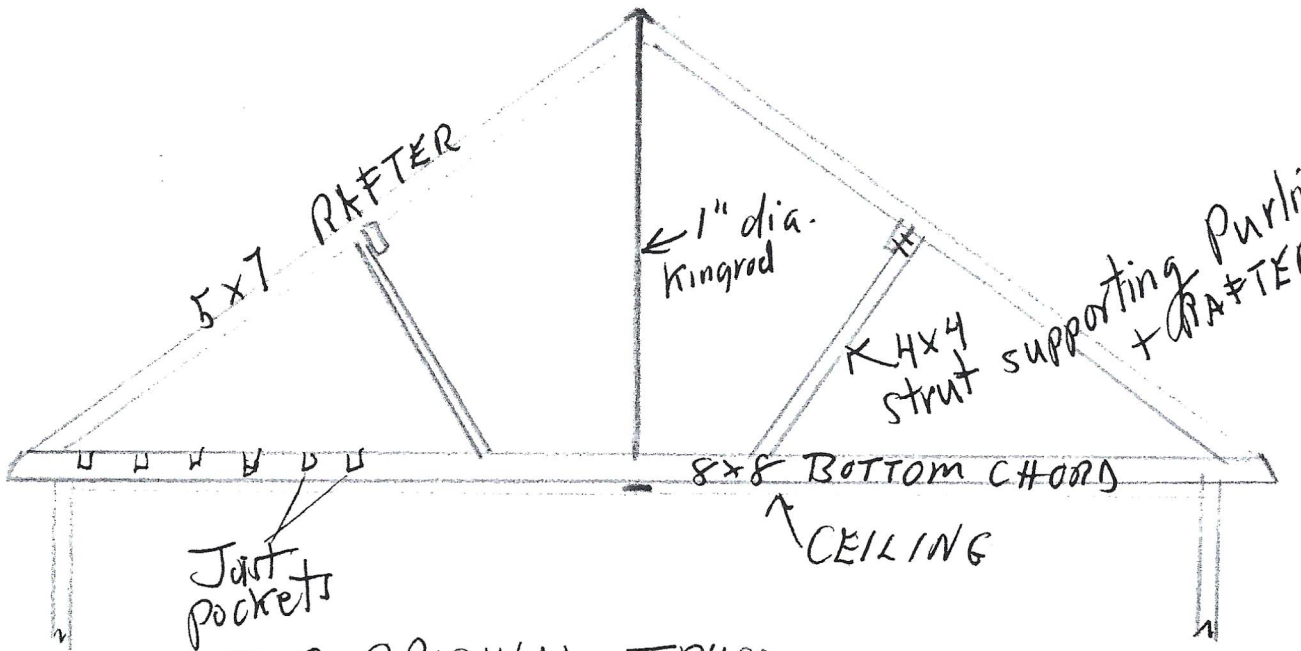

FIG. 2 ORIGINAL TRUSS

TOWN HALL, TOWN OF WHEELOCK

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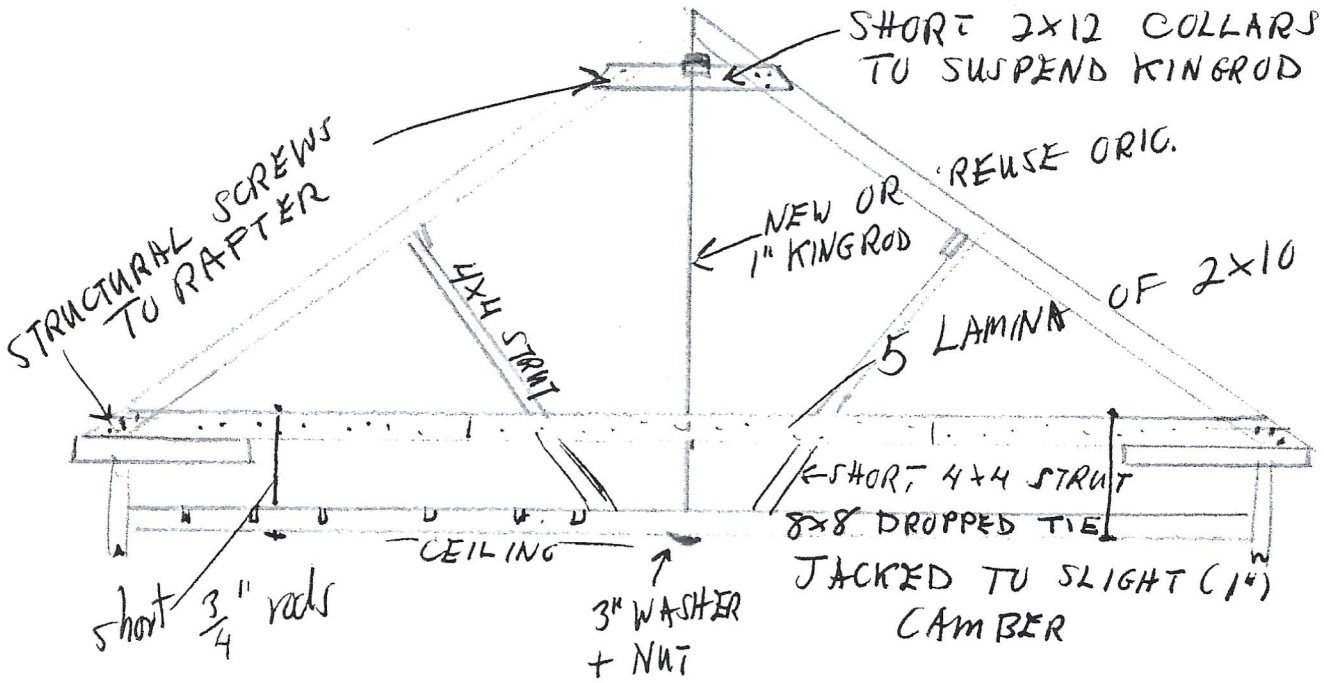

FIG. 3 REPAIR: RETAINING DROPPED TIE BEAM

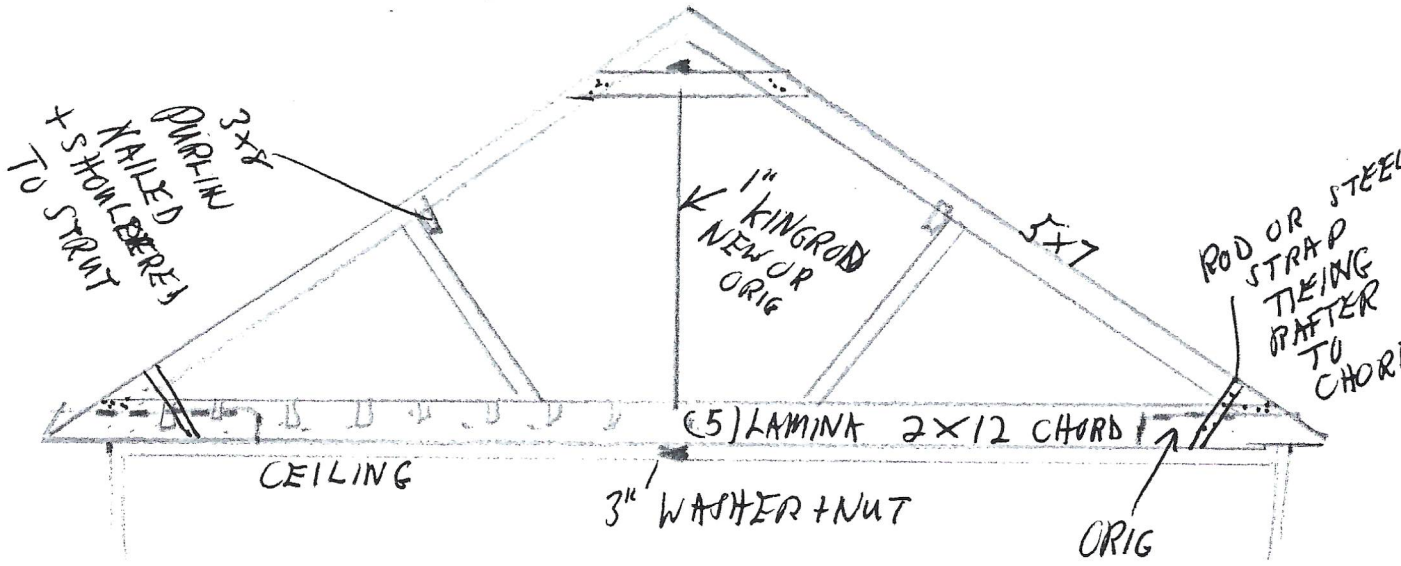

FIG. 4 CEILING AT ORIG LEVEL

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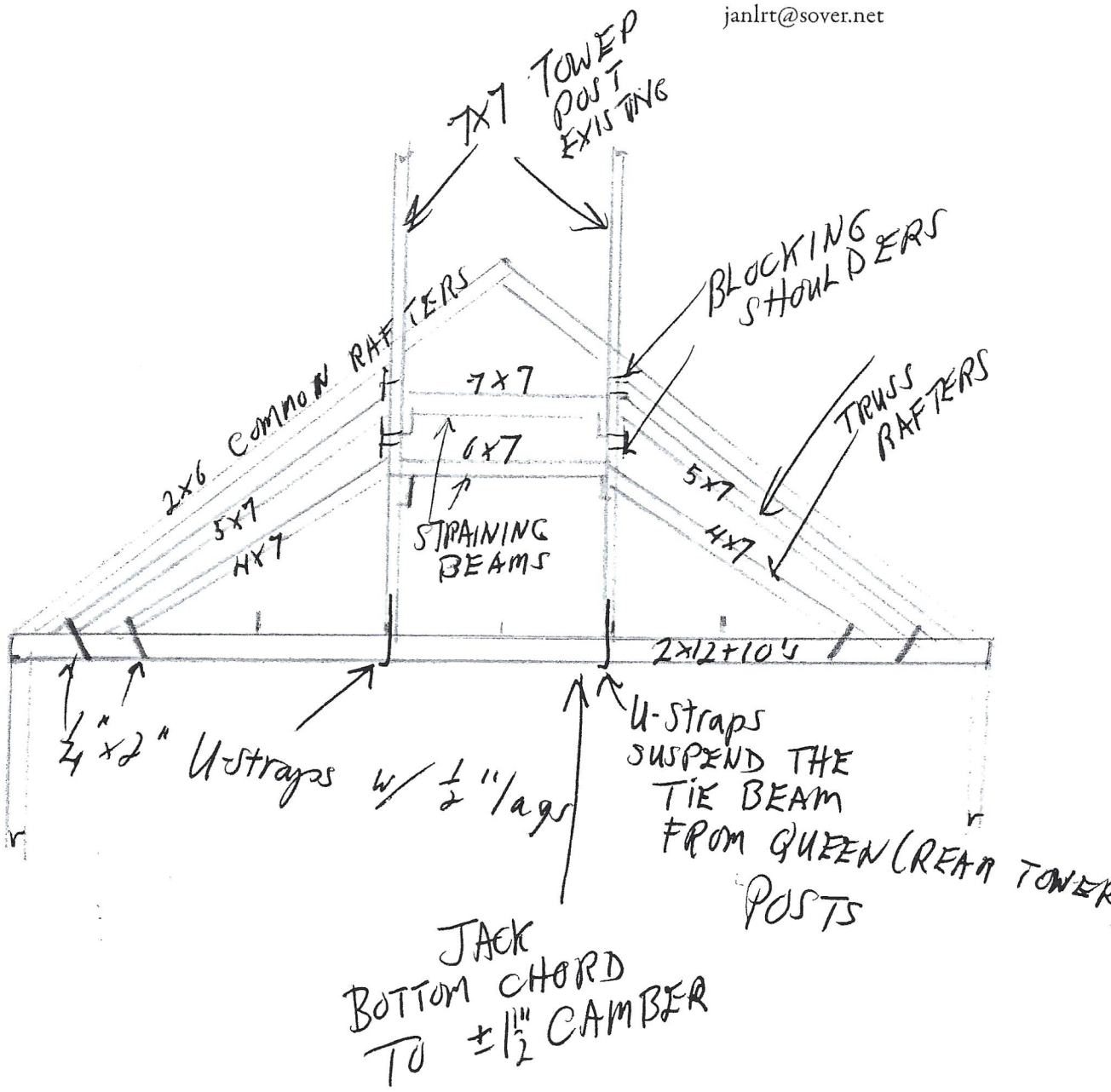

Fig 5: REAR OF TOWER BECOMES DOUBLE RAFTERED QUEENPOST TRUSS

J.L. 8/26/15