1952

ROOF TRUSS DESIGNS

FOR STANDARD AND SPECIAL CONDITIONS

ENGINEERED DESIGNS FOR
KING POST AND "W" TRUSSES

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R O O F T R U S S D E S I G N S

FOR STANDARD AND SPECIAL CONDITIONS

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DESIGN OF ROOF TRUSSES

Willard J. Worth
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Economy is one of the most important things in building today. That much I think we all agree on. That may well be the last thing we'll agree on. With each of you operating in different communities and each having local problems, it would be foolish to lay down a series of absolute statements. The best we can do is to tell you what we do know about trusses--you can judge for yourselves how important it is to you in your own set-up.

Truss Economy

Trusses for small homes are not new, and a good many people besides ourselves have been and still are interested in them. It is important to remember that economies are gained both in the savings of trusses over rafters and in the elimination of bearing partitions and their supporting constructions. It is probable that any other system of "clear span" framing would give equal savings. Right now, the best way we know to get "clear span" framing is through the use of trusses.

The Design of Trusses

The use of trusses brings up an important matter. Someone has to design them. Perhaps a few words about how the engineer operates might help. The engineer, in small house construction, is essentially a shortcut substitute for several years of costly trial-and-error on any new type of construction. His function is to predict the forces present in any system and the behavior of members under those forces. He accomplishes this through the use of standard engineering procedures. His value, to the builder, lies in his ability to design structural systems that will carry the imposed loads without waste of materials or labor--in other words, economical structures.

The trusses presented on the sheets which have been distributed to you are in two series. Each series consists of designs for spans from 16' to 32'. The first series has been designed for use where no attic storage is possible, while the second series has been designed to carry an attic storage load, including any necessary flooring, of 20 p.s.f.

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*Contributing personnel: J. T. Lendrum, I. T. Carrithers, P. Fung, F. Masek, C. McClain, J. Schwaiger and F. Creager.

1. Slide: KING POST TRUSS
This is the recommended truss for spans from 16' to 20'.

2. Slide: "W" TRUSS
This is the "W" truss which you will see constructed at full scale tomorrow afternoon. It is unique in several respects. Each of the three main members contains one lap splice. This allows the use of ring connectors at the three major joints without the close tolerances that would ordinarily be required. It also allows the truss to be adjusted in span and to be laid up without splice plates, gussets or filler blocks. In addition, it may be sub-assembled and stored or transported in a minimum space. The final assembly may be completed quickly on the job site. A full description and all the information needed to build this truss at any span from 20' to 32' is included in the material you have received.

Both series of trusses have also been designed for the dead loads (weight of the structure itself) and live loads (snow and wind) that appear on the stress diagrams included.

3. Slide: STRESS DIAGRAMS
This is a stress diagram for the "W" truss; the design conditions are listed here.

4. Slide: STRESS DIAGRAM
In areas where greater loads are possible, the trusses must be redesigned. The loads, as given, are substantially correct for the State of Illinois.* The wind loads used are the result of the most recent research into the action of winds on houses. It is important to note that, for this slope, the wind exerts a considerable force tending to lift the roof from the building.

5. Slide: WIND DESTROYED STRUCTURE
To the engineer, the value in tension of toe-nailing is so unpredictable as to make it valueless. For this reason, these trusses have been designed to be fastened to the wall plates with light metal framing anchors which make toe-nailing unnecessary and load the nails in shear rather than tension. All of the trusses have been designed for a slope of 5 in 12 and are to be spaced 24" on center. Where the trusses are to be used for slopes other than 5 in 12 they must be redesigned.

*H.H.F.A. Performance Standards (1947)

6. Slide: STRESS GRADE MARKINGS
This is a stress grade marking. The wood must be of 1100 p.s.i. stress grade or better. This is equivalent to Coastal Region Douglas Fir #2 and is one of the lowest grades obtainable.

One of the most critical factors in the design of wood trusses is the design of the connections. Like a chain, a truss is only as strong as its weakest link. Too often in wood construction, it is the connection that proves to be the weakest link. It is useless to use a member size that will sustain the necessary load if the connection will fail at one-half of that load.

7. Slide: DETAIL NAILED JOINT (Lap or Splice)
One of the main problems in truss design is the uncertain value of nailing, which in turn is reflected by a large factor of safety in the nail value. This causes the number of nails in the critical joints to become quite large. It is important that the proper number of nails be used. A badly split member must be replaced. It is this uncertainty about nailing that makes the use of ring connectors necessary where stresses are very high.

8. Slide: CUTAWAY RING-CONNECTOR
This is a ring connected joint before assembly. Any variation in the location of the connectors will create a tendency for the joint to rotate and the resulting stresses have not been taken into account in these designs. Therefore, we strongly advise that the connectors be located exactly as shown.

9. Slide: UNSATISFACTORY PIECE OF 1" MATERIAL
You may have noticed that several of these trusses use 1-inch members, and at the same time it is impossible to buy 1-inch material that is stress graded. The Forest Products Laboratory at Madison, Wisconsin, has informed us that rules for the stress grading of 1-inch boards will be published in their revised Wood Handbook. In the meantime, the builder's judgment will be perfectly adequate for the choice of the pieces. Checks, shakes, and splits are unimportant--any piece without an excess of knots will be satisfactory. The slide illustrates an unsatisfactory 1-inch board.

10. Slide: WRONG OVERHANG
Overhangs are very important both as a means of increasing sales appeal and as a practical means of minimizing the exposure of window frames to rain and snow. There are two ways of providing trusses with overhangs. The first way is to move the bearing walls inside of the heel joints. This method is illustrated in the slide. It causes extreme bending in the lower chord and must not be used unless the truss is redesigned.

11. Slide: CORRECT OVERHANG

The easiest method of providing an overhang is to extend the top chord. This method is illustrated in this slide. The stresses caused by this detail are not large and horizontal overhangs of up to 30" may be obtained with a 2" x 4" top chord.

Briefly, the important things are these: Trusses are economical. They can be engineered more accurately than corresponding rafter and ceiling joist designs.

Uplift on the roof due to the wind is a major problem. Toe-nailing is undependable in tension and should not be relied upon. Light, inexpensive, metal framing anchors should be used to connect trusses to the wall plates. To derive the full benefits of engineering, the designs must be followed closely and used only for the design conditions. Overhangs of reasonable dimensions can best be achieved by extending the top chord.

Mr. Harrell will continue this discussion of trusses with more detailed remarks on economy and on assembly procedures.

COST AND CONSTRUCTION PROBLEMS

Raymon H. Harrell
Research Associate, Small Homes Council

My discussion will deal primarily with the "W" truss that Mr. Worth has mentioned to you. Recently in one of the laboratories on campus, we constructed two of these expandable trusses to see what problems or what qualities this designed truss has over other trusses that have been used during the past years. When the two pilot models were completed, we were very pleased with the results, for in this truss several problems have been eliminated.

As you see on the model, there are only five different lengths of material and all of that material is of one dimension; namely, two by fours. As far as lengths of material needed is concerned, standard lengths of 10', 12', and 14' will cut out for a lineal footage of waste approximately 4' long consisting of two pieces 12" long, two pieces 8" long, and two pieces 4" long.

In designing this truss, the amount of cutting was taken into consideration and held to a minimum in order to help reduce the over-all time required in the precutting operation. Even with this minimum cutting it is not necessary to be exact for the lap joint in all of the main members will allow for any small deviations or variations that might occur in lengths.

As the most efficient means of carrying out such an operation, we have left two small angle cuts--one on each bottom chord at the heel joint and one on each of the two long diagonals--as hatchet cuts to be made when the truss is removed from the jig or after it has been put in place prior to the sheathing operation.

This lap joint also takes care of the old problem of fastening continuous members at both ends with ring connector. With three rings in this truss--one at each heel joint and one at the peak between the two top chords--the possibility of any racking is eliminated.

Following the instructions that you have been given, two carpenters should, within an hour, lay out this truss and cut a pattern model using either a skill saw or a radial arm saw. One carpenter and one laborer should then, within one working day, precut, bore, and preassemble the subassembly which you see on the model for a rectangular-shaped house of approximately 1,000 square feet. One other thing that you have probably noticed is that within this truss there are no left or right members.

This holds true even to the boring for the ring connectors. The only necessary or reasonable care that must be exercised during the subassembly concerns the peak joint. This assembly must be put together in all cases in one definite manner so that when preparing to nail the truss together the two top members, namely, the top chord and the long diagonal, can be moved to the left with the two corresponding members moved to the right. If this is followed, there is no difficulty in getting all of the members in their respective planes.

Since there must be some starting point in the assembly of the truss, we recommend in the printed matter that you start this procedure by laying out the lower right subassembly with the top chord resting on the subfloor. For the next step, the corresponding assembly is placed on the left with the top chord in a reversed position. With these two members in place it is then possible to put down the necessary blocking to fit the notches in the heel joints in order to give the over-all desired length. By using a steel square at the heel joint and the top chord, the desired pitch that you have decided upon is given to the truss. When this has been ascertained, chalk lines are snapped to the peak joint, thus giving you an over-all layout of the truss. The next step is to place the peak joint, swinging the top two members to the left, the bottom two to the right, and placing these members so that they rest within their particular plane. From this point on, it is a matter of nailing the proper members including the short diagonals in their respective places. Caution, however, should be exercised in that the nailed joints on the bottom chord should always be nailed from the top leaving a minimum of nailing to be finished once the truss is brought to the upright position. (Approximately four nails.)

Another feature of a truss of this nature is the minimum amount of storage space required for the subassemblies prior to the actual time of assembly and erection. If this is done in a mill away from the construction site, it lessens trucking problems in that the longest member of any subassembly is 14 feet. This means that an ordinary 1½-ton truck is ample for any transportation problems that might arise and no special or large equipment will be needed. It is possible in areas where large volume is needed that subassemblies may be stocked in standard spans by contractors, builders, and maybe even some local lumber yards.

In the printed matter that you have, this truss is carried one step further and its main members used as outlining members for the gable ends with two minor changes. The lap joints become butt joints, and fillers are put in to bring all members on the top side into the same plane.

The finish material that is to be applied to the gable end will determine what type of vertical or horizontal supporting and nailing members are to be applied in place of the web members.

The economy that is achieved by using the truss is not by any means centered on the comparison between the truss and standard rafter and joist construction as such. There are other things to be considered, but in passing these are the dollar costs of materials. For the truss you see here, the cost is $8.00 for a clear span of 25 feet. A rafter and joist of the same length and placed 2-feet on center, but with a load-bearing partition, have a material cost of $11.40.

Other economies that result from using the truss and add up to considerable savings in construction cost are:

1. Trusses can be erected very rapidly which puts the job under cover. This helps to eliminate delays due to weather conditions and makes complicated scaffolding or bracing unnecessary.

2. Side-wall and ceiling finish-material can be applied in one continuous operation. Sheet materials can be used with a minimum of waste.

3. The finish floor material can be put down over the entire house with a minimum of cutting and fitting. This results in savings in both labor and material.

4. Light non-load-bearing partitions can be constructed on the floor and tipped into place. This allows 100 per cent flexibility in the design and spacing of the house interior and eliminates extra supporting floor joist members.

5. Non-load-bearing closet partitions are also possible. This results in cost reduction in installation time and material, and at the same time provides a greater amount of storage space in the house.

6. Outside finish material can be applied to the gable trusses while they are still on the subfloor, thus saving many hours of labor. A study conducted by the Small Homes Council in 1950 revealed that twelve man-hours were saved in following this procedure as opposed to the method of two carpenters working from ladders and scaffolding which was used on another house of identical size and design.

THE KING POST TRUSS

SPANS*: 16'-8" to 20'-8"

LOADING - The following king post truss has been designed to carry loads as listed in Figure 1.

SLOPE - 5 in 12

SPACING - 24" on center

MATERIAL - Material must be 1100 p.s.i. stress grade or better. (Equivalent to Coastal Region Douglas Fir #2)

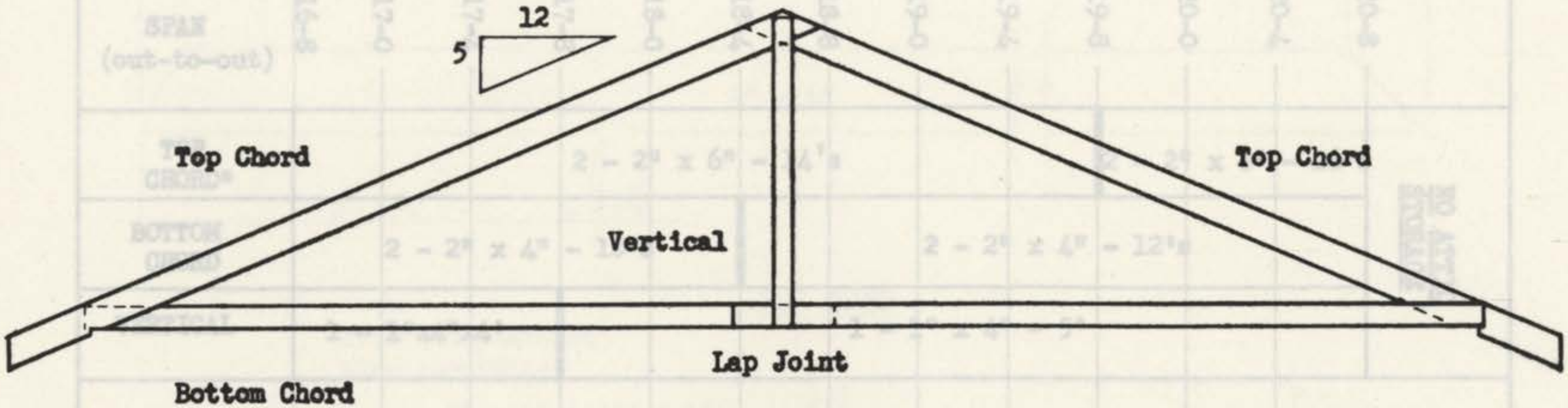
ASSEMBLY PROCEDURE

1. Compute out-to-out dimension of exterior wall plates.
2. Locate this dimension in Table I and read down--the individual member sizes and the total lumber for one truss may be taken from this table. Where your span falls on the dividing line between member sizes, use the member size to the left.
3. Cut members for one truss according to cutting diagrams in Figure 2. The lengths of the members have been omitted from these diagrams. It is felt that the assembly is similar enough to rafter construction so that the calculation of these lengths for a particular span is no problem to the builder.
4. Lay out necessary chalk lines and out-to-out dimensions of plates to align bottom chord notches. NOTE: If building truss with no attic load, consult heel joint detail in Figure 4.
5. Assemble truss as illustrated in the three steps of Figure 3.
6. Check the accuracy of all cuts.
7. Disassemble; using members as a pattern, cut remainder of trusses.
8. Assemble; nail each member as it is laid according to details and nailing schedule shown in Figure 4.
9. In nailing trusses to exterior wall plates, use metal framing anchors.

Overhangs - Overhangs should be achieved by extending the top chord. The maximum allowable overhang for the 2" x 6" top chord is 44", measured horizontally.

Intersections - Modify truss as shown in Figures 19 and 20.

*NOTE: In the following discussions, tables and drawings, the term "span" refers to the out-to-out dimension of the exterior wall plates.



KING POST TRUSS

LOADING

SPACING - 24" on center

Series A

No Attic Storage
Roofing- 2.5 psf
Sheathing- 2.5 psf
Truss- 2.5 psf
Snow- 20.0 psf
Wind- 23.0 psf (uplift)

Series B

Attic Storage- 20.0 psf
(includes necessary flooring)
Roofing- 2.5 psf
Sheathing- 2.5 psf
Truss- 2.5 psf
Snow- 20.0 psf
Wind- 23.0 psf (uplift)

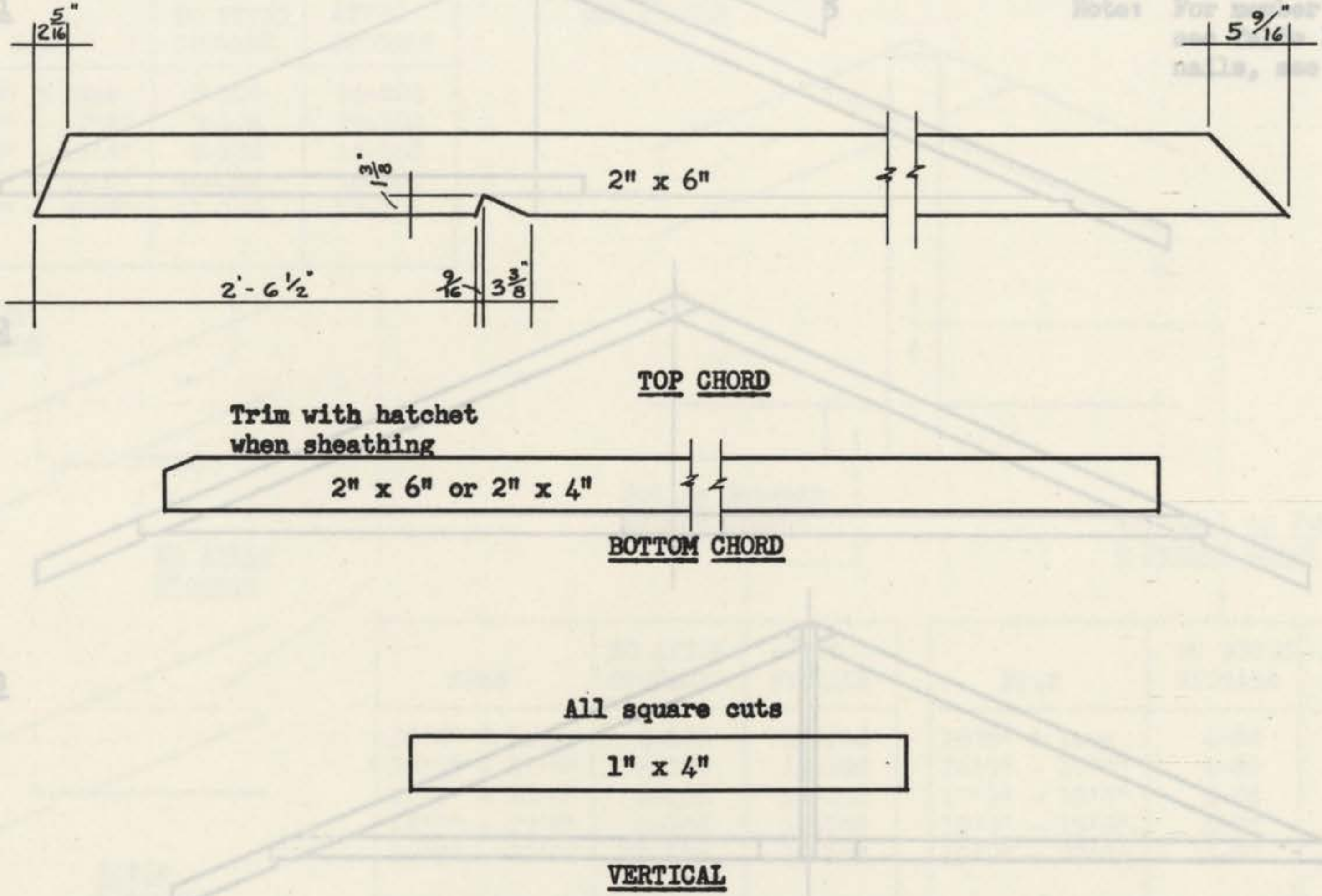
Figure 1

SPAN (out-to-out)	16-8	17-0	17-4	17-8	18-0	18-4	18-8	19-0	19-4	19-8	20-0	20-4	20-8	
TOP CHORD*	2 - 2" x 6" - 14's									2 - 2" x 6" - 16's				NO ATTIC STORAGE
BOTTOM CHORD	2 - 2" x 4" - 10's					2 - 2" x 4" - 12's								
VERTICAL	1 - 1"x4"x4'			1 - 1" x 4" - 5'										
TOP CHORD*	2 - 2" x 6" - 14's									2 - 2" x 6" - 16's				ATTIC STORAGE
BOTTOM CHORD	2 - 2" x 6" - 10's					2 - 2" x 6" - 12's								
VERTICAL	1 - 1" x 4" - 5"													

*Member lengths shown here are sufficient for a 30" horizontal overhang. Revise if another overhang is desired.

MEMBER SIZES - KING POST TRUSS

Table I



CUTTING DIAGRAMS - KING POST TRUSS

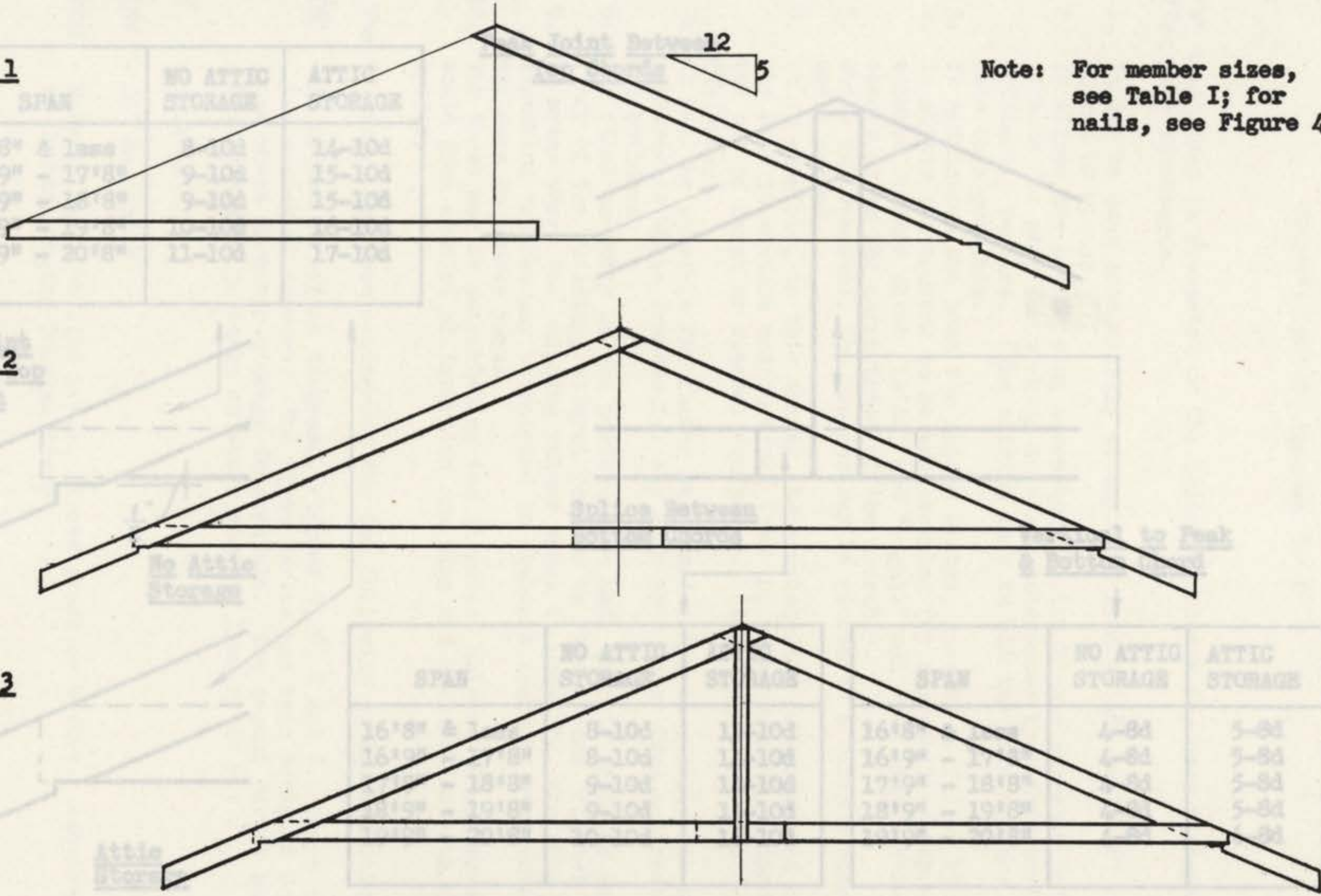
Figure 2

Note: For member sizes, see Table I; for nails, see Figure 4.

Step 1

Step 2

Step 3

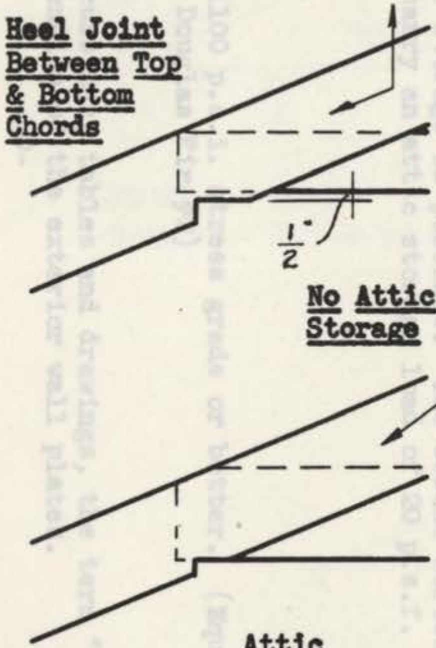


ORDER OF ASSEMBLY - KING POST TRUSS

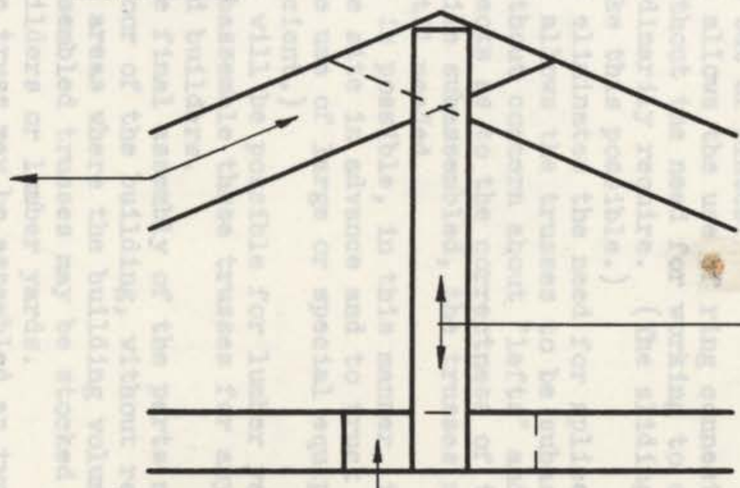
Figure 3

SPAN	NO ATTIC STORAGE	ATTIC STORAGE
16'8" & less	8-10d	14-10d
16'9" - 17'8"	9-10d	15-10d
17'9" - 18'8"	9-10d	15-10d
18'9" - 19'8"	10-10d	16-10d
19'9" - 20'8"	11-10d	17-10d

Heel Joint Between Top & Bottom Chords



Peak Joint Between Top Chords



Splice Between Bottom Chords

Vertical to Peak & Bottom Chord

SPAN	NO ATTIC STORAGE	ATTIC STORAGE
16'8" & less	8-10d	13-10d
16'9" - 17'8"	8-10d	14-10d
17'9" - 18'8"	9-10d	14-10d
18'9" - 19'8"	9-10d	15-10d
19'9" - 20'8"	10-10d	16-10d

SPAN	NO ATTIC STORAGE	ATTIC STORAGE
16'8" & less	4-8d	5-8d
16'9" - 17'8"	4-8d	5-8d
17'9" - 18'8"	4-8d	5-8d
18'9" - 19'8"	4-8d	5-8d
19'9" - 20'8"	4-8d	6-8d

NAILING SCHEDULE - KING POST TRUSS

Figure 4

THE "W" TRUSS

SPANS*: 20'-8" through 32'-8"

The "W" truss that is presented on the following sheets has been designed to offer many advantages:

1. It may be used economically at any span from 20'-8" to 32'-8" out to out of plates.
2. It allows the use of ring connectors at the highly stressed joints without the need for working to close tolerances that this would ordinarily require. (The sliding laps in all the main members make this possible.)
3. It eliminates the need for splice plates, gussets or filler blocks.
4. It allows the trusses to be subassembled (by semi-skilled labor) without concern about "lefts" and "rights" and with simple visual checks as to the correctness of the assembly.
5. While subassembled, the trusses may be stored in a minimum space until needed.
6. It is possible, in this manner, to complete the subassemblies off the site in advance and to truck them in, when required, without the use of large or special equipment. (A pickup truck is sufficient.)
7. It will be possible for lumber yards and mills to quickly cut and subassemble these trusses for any span upon order from contractors and builders.
8. The final assembly of the parts may be made quickly upon the subfloor of the building, without regards to "lefts" and "rights".
9. In areas where the building volume makes it possible, the subassembled trusses may be stocked in standard spans by contractors, builders or lumber yards.
10. The truss may be assembled as two identical halves. Final assembly would then consist of inserting one ring and bolt and nailing one splice.

The "W" truss has been engineered for the following design conditions:

LOADING - As listed on stress diagrams, Figures 5, 6, 7 and 8. There are two series of trusses. The first series has been designed for use where no attic storage is possible. The second series has been designed to carry an attic storage load of 20 p.s.f.

SLOPE - 5 in 12

SPACING - 24" on center

MATERIAL - Material must be 1100 p.s.i. stress grade or better. (Equivalent to Coastal Region Douglas Fir #2)

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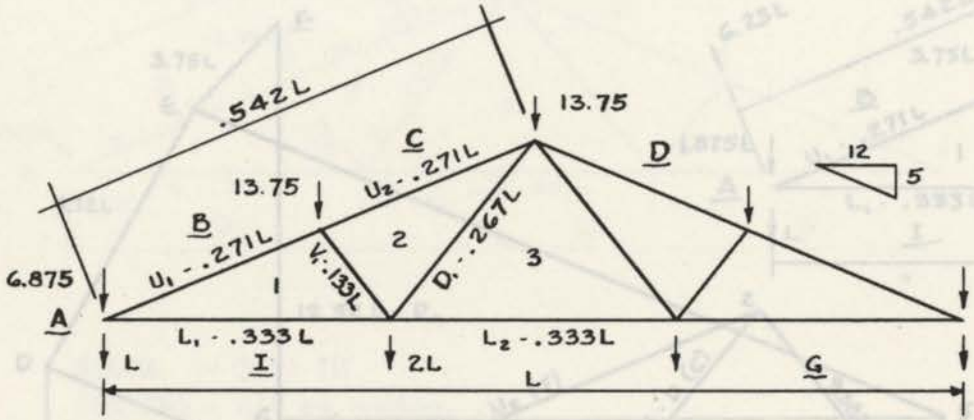
*NOTE: In the following discussions, tables and drawings, the term "span" refers to the out-to-out dimension of the exterior wall plates.

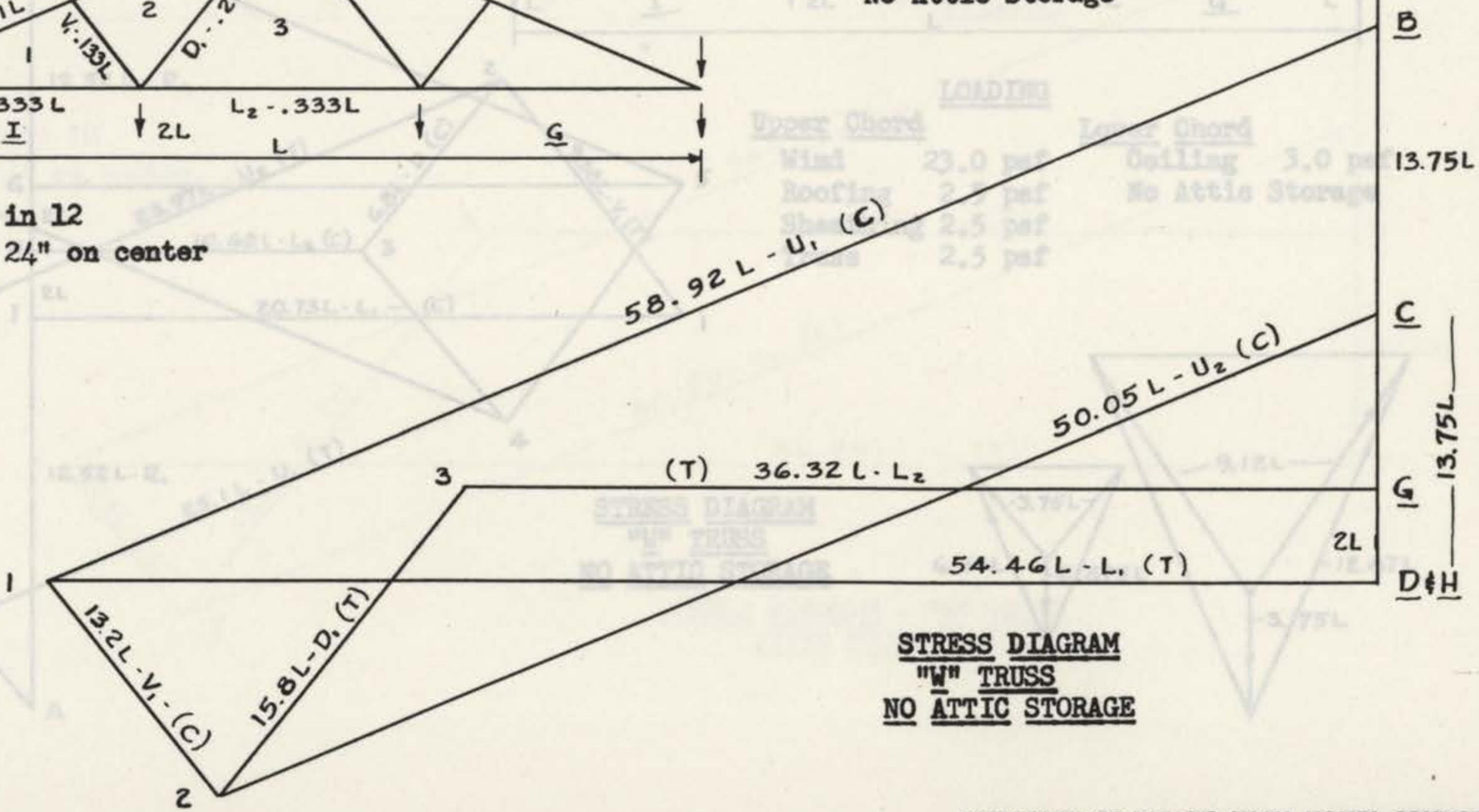


SLOPE - 5 in 12

SPACING - 24" on center

LOADING

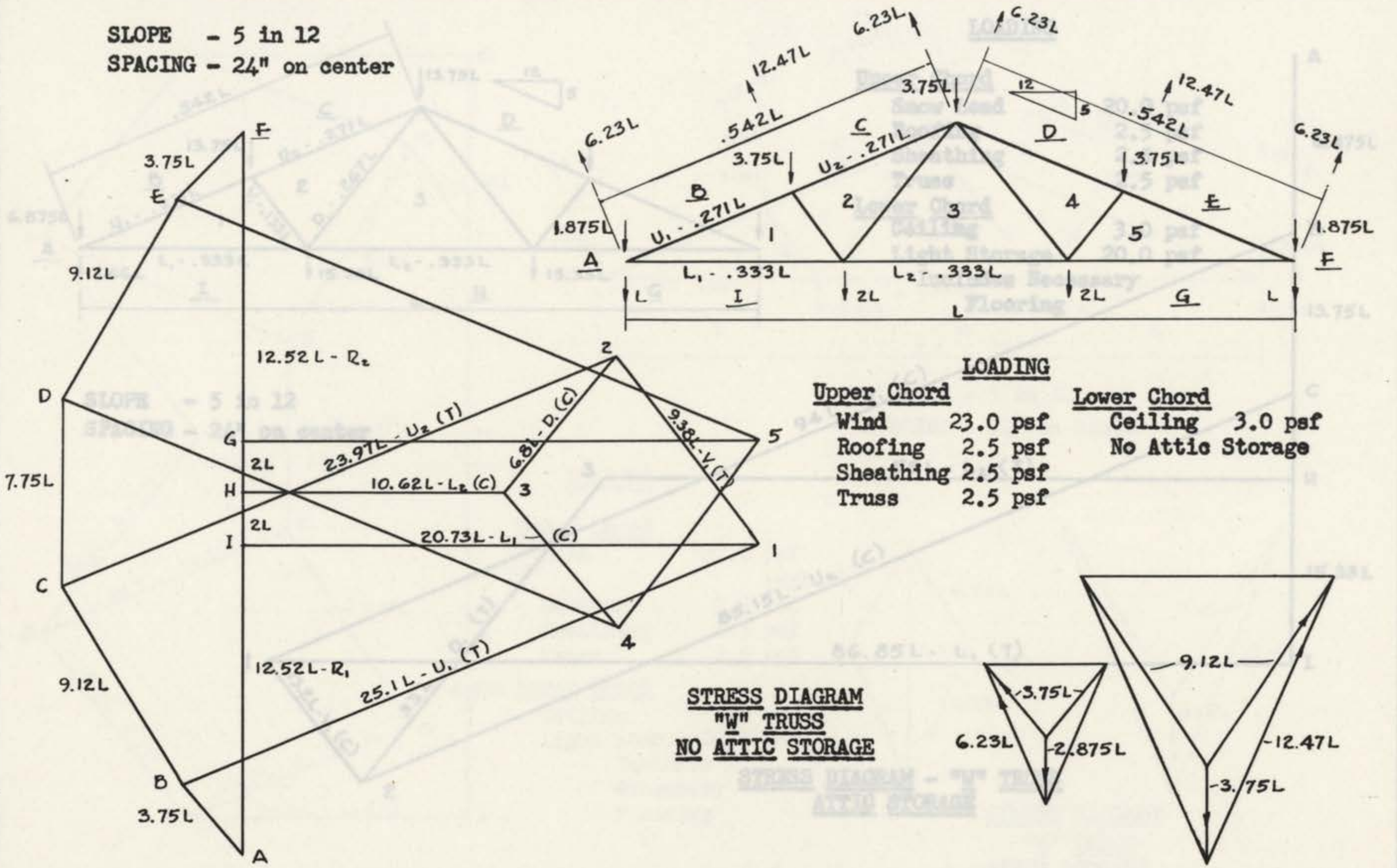
Upper Chord	
Snow Load	20.0 psf
Roofing	2.5 psf
Sheathing	2.5 psf
Truss	2.5 psf
Lower Chord	
Ceiling	3.0 psf
No Attic Storage	



STRESS DIAGRAM
"W" TRUSS
NO ATTIC STORAGE

Figure 5

SLOPE - 5 in 12
SPACING - 24" on center

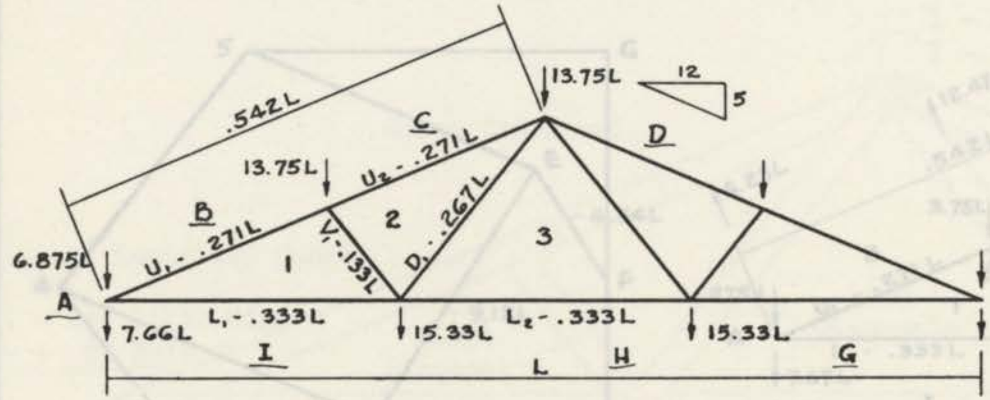


LOADING

Upper Chord		Lower Chord	
Wind	23.0 psf	Ceiling	3.0 psf
Roofing	2.5 psf	No Attic Storage	
Sheathing	2.5 psf		
Truss	2.5 psf		

STRESS DIAGRAM
"W" TRUSS
NO ATTIC STORAGE

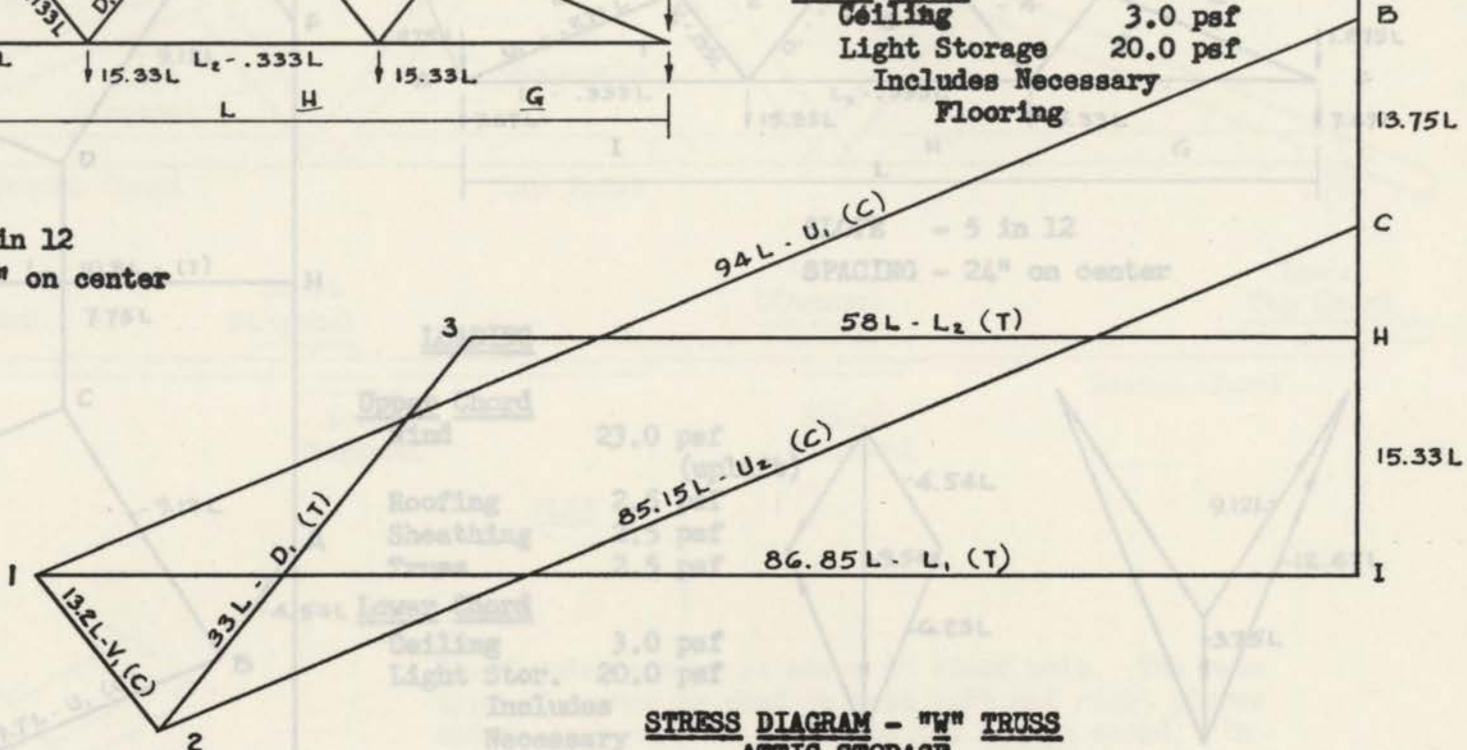
Figure 6



LOADING

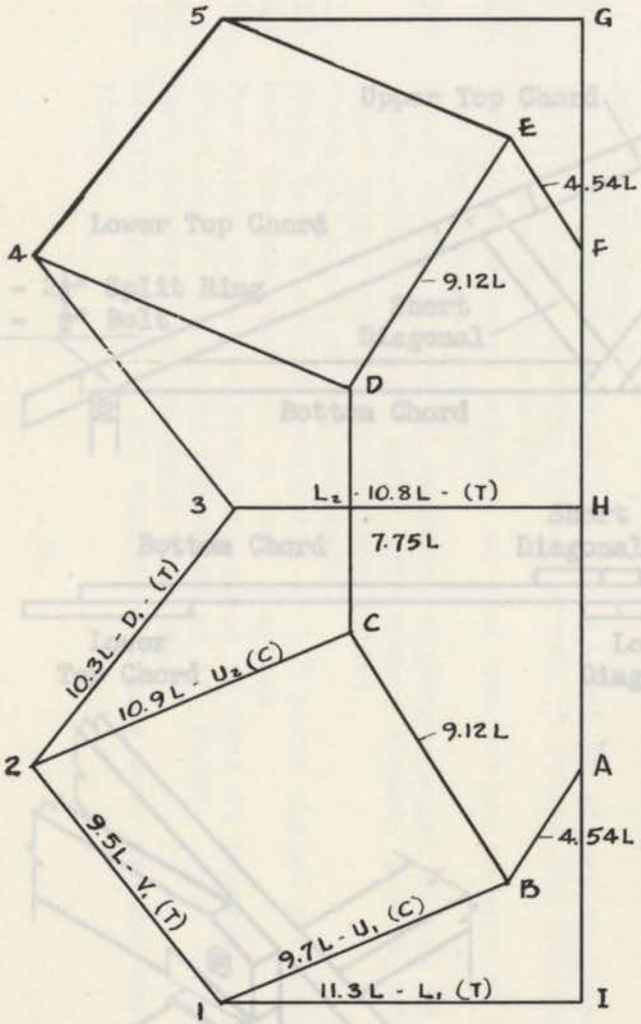
Upper Chord	
Snow Load	20.0 psf
Roofing	2.5 psf
Sheathing	2.5 psf
Truss	2.5 psf
Lower Chord	
Ceiling	3.0 psf
Light Storage	20.0 psf
Includes Necessary Flooring	

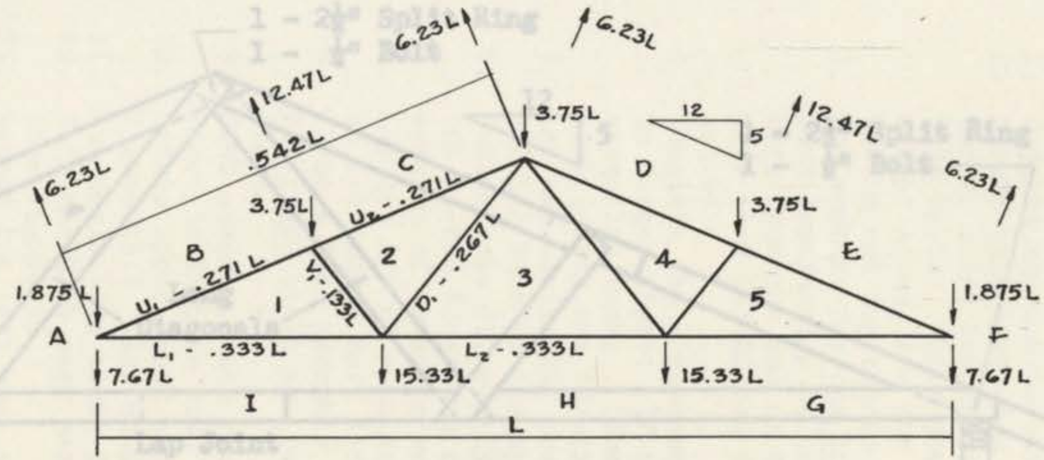
SLOPE - 5 in 12
SPACING - 24" on center



STRESS DIAGRAM - "W" TRUSS ATTIC STORAGE

Figure 7



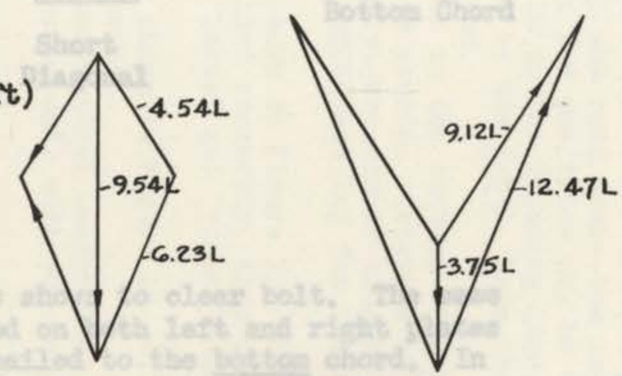


SLOPE - 5 in 12

SPACING - 24" on center

LOADING

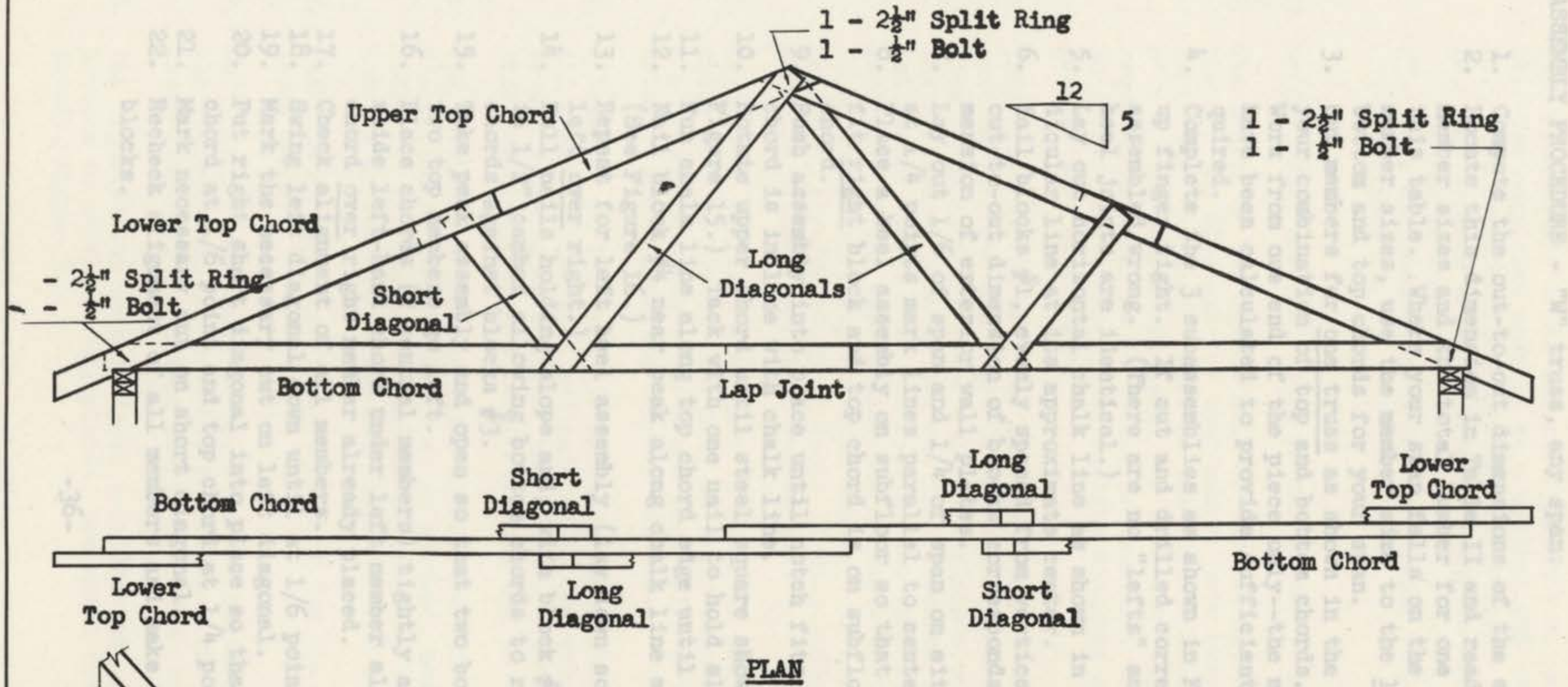
Upper Chord	
Wind	23.0 psf (uplift)
Roofing	2.5 psf
Sheathing	2.5 psf
Truss	2.5 psf
Lower Chord	
Ceiling	3.0 psf
Light Stor. Includes Necessary Flooring	20.0 psf

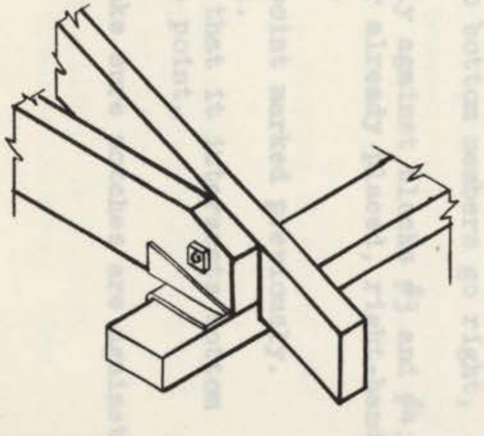


STRESS DIAGRAM
"W" TRUSS
ATTIC STORAGE

Figure 8

UNIVERSITY OF ILLINOIS SMALL HOMES COUNCIL





Use framing anchor as shown to clear bolt. The same type of anchor is used on both left and right plates and in each case is nailed to the bottom chord. In spacing the trusses, the measured distance to the triangular flange of the anchor is the same for both left and right plates.

Figure 9

ASSEMBLY PROCEDURE - "W" truss, any span:

1. Compute the out-to-out dimensions of the exterior wall plates.
2. Locate this dimension in Table II and read down--the individual member sizes and the total lumber for one truss may be taken from this table. Where your span falls on the dividing line between member sizes, use the member size to the left. Note the size of bottom and top chords for your span.
3. Cut members for one truss as shown in the cutting diagram for your combination of top and bottom chords. (Figures 10 and 11.) Work from one end of the piece only--the member lengths given have been calculated to provide sufficient lap for the nails required.
4. Complete the 3 subassemblies as shown in Figure 13. Bring bolts up finger tight. If cut and drilled correctly, they cannot be assembled wrong. (There are no "lefts" and "rights"--the two heel joints are identical.)
5. Lay out horizontal chalk line as shown in Figure 14, with perpendicular line at its approximate center.
6. Nail blocks #1, evenly spaced from vertical center line, so that out-to-out dimension of blocks corresponds with out-to-out dimension of exterior wall plates.
7. Lay out 1/6 of span and 1/4 of span on either side of center line; at 1/4 points mark lines parallel to center line.
8. Place a heel assembly on subfloor so that notch is in position to fit right block and top chord is on subfloor, bottom chord on top chord.
9. Push assembly into place until notch fits block tightly and bottom chord is in line with chalk line.
10. Rotate upper chord until steel square shows a slope of 5/12. (See Figure 15.) Tack with one nail to hold slope.
11. Run chalk line along top chord edge until it intersects center line.
12. Nail block #4 near peak along chalk line and block #3 near heel. (See Figure 16.)
13. Repeat for left heel assembly (lay down so bottom chords lap--left over right.)
14. Pull nails holding slope and, with block #2 at center line, put in 1/2" camber allowing bottom chords to rotate and holding top chords against blocks #3.
15. Take peak assembly and open so that two bottom members go right, two top members go left.
16. Place chords (2 central members) tightly against blocks #3 and #4; slide left-hand chord under left member already placed, right-hand chord over right member already placed.
17. Check alignment of all members.
18. Swing left diagonal down until at 1/6 point marked previously.
19. Mark the necessary cut on left diagonal.
20. Put right short diagonal into place so that it intersects bottom chord at 1/6 point and top chord at 1/4 point.
21. Mark necessary cut on short diagonal.
22. Recheck alignment of all members and make sure notches are against blocks.

23. Disassemble truss and cut diagonals slightly short of mark.
24. Use completed members as a pattern and cut remainder of trusses.
25. Bolt subassemblies together and stack.
26. Lay up each truss in steps similar to original, using original blocks as a jig.
27. Nail each member as placed according to nailing schedule presented in Figure 12.

In the following designs, these points should be noted:

1. The length of the bottom half of the top chord has been computed and the cutting diagrams for that member have been drawn for a 30-inch horizontal overhang. This is the maximum allowable overhang for a 2" x 4" top chord. However, for a 2" x 6" top chord, a horizontal overhang as large as 44 inches is possible. If an overhang other than 30 inches is preferred, the cutting diagrams and lower top chord member lengths must be changed.

2. This truss may be used for any span from 20'-8" to 32'-8" if the cutting diagrams and member sizes are followed. However, there are some spans at which there will be a minimum of unnecessary lap when the individual members are cut from standard lumber lengths. For an individual member size and length, the span corresponding to the right-hand edge of the appropriate box in Table II is the span at which there is no unnecessary lap for that member. If a free choice of span is possible, careful study of Table II will indicate the span that will give the minimum amount of wasted lap.

3. Certain of the long diagonals in Table II are marked with an asterisk. These must be braced laterally at their center point either by running a 1" member between trusses and edge nailing it to the diagonal or by using 2" solid blocking between trusses.

4. A "camber" of 1/2 inch is shown at the center of the bottom chord for all spans. This is an estimate as to the amount this point will drop as the truss adjusts itself under load. Putting this camber in will help preserve a smooth horizontal ceiling in the finished structure.

5. The height to which the guide blocks are built up has been left to the discretion of the builder. It is advised, however, that those blocks which fit the top chord notches be built up sufficiently to keep the notches in contact during all phases of the assembly.

6. There is no need for filler blocks or for the warping of any of the truss members.

7. Sufficient time should be spent on the pattern truss to familiarize the workmen with the assembly procedure. The remaining cutting and assembling will go rapidly and without fear of error.

8. The trusses have been designed to withstand uplift. In nailing trusses to exterior wall plates, use metal framing anchors. (See detail, Figure 9.)

SPAN (out-to-out)	20-8	21-0	22-0	23-0	24-0	25-0	26-0	27-0	28-0	29-0	30-0	31-0	32-0	32-8	
UPPER TOP CHORD	1 - 2" x 4" 14'			1 - 2" x 4" x 16'			1 - 2" x 6" x 18'				2 - 2" x 6" 10's		2 2" x 6" 12's		NO ATTIC STORAGE
LOWER TOP CHORD*	2 - 2" x 4" - 10's					2 2" x 4" 12's	2 - 2" x 6" - 12's					2 - 2" x 6" 14's			
BOTTOM CHORD	2 - 2" x 4" 12's			2 - 2" x 4" - 14's				2 - 2" x 4" x 16's				2 - 2" x 4" 18's			
SHORT DIAGONAL	1 - 1" x 4" x 8'					1 - 2" x 4" x 8'			1 - 2" x 4" x 10'						
LONG DIAGONAL	1 - 1" x 4" x 14' **					1 2x4 14'	1 - 2" x 4" x 16' **			1 - 2" x 4" x 18' **					

*The length of these members has been computed to provide a 30" horizontal overhang. If a different overhang is desired, revise these lengths and the cutting diagrams.

**Laterally brace long diagonal at center.

"W" TRUSS MEMBER SIZES

(Continued on the next sheet)

Table II

SPAN (out-to-out)	20-8	21-0	22-0	23-0	24-0	25-0	26-0	27-0	28-0	29-0	30-0	31-0	32-0	32-8
UPPER TOP CHORD	1 - 2" x 4" 14'			1 - 2" x 6" x 16'			1 - 2" x 6" x 18'			2 - 2" x 6" - 10's				ATTIC STORAGE
LOWER TOP CHORD*	1 - 2" x 4" 18'			2 - 2" x 6" - 12's								2 - 2" x 6" 14's		
BOTTOM CHORD	2 2" x 4" 12'		2 2" x 6" 12'	2 - 2" x 6" - 14's				2 - 2" x 6" - 16's				2 - 2" x 6" 18's		
SHORT DIAGONAL	1 - 1" x 4" x 8'				1 - 2" x 4" x 8'			1 - 2" x 4" x 10'						
LONG DIAGONAL	1 - 1" x 6" x 14'				1 2" x 4" 14'	1 - 2" x 4" x 16'				1 - 2" x 4" x 18'				

*The length of these members has been computed to provide a 30" horizontal overhang. If a different overhang is desired, revise these lengths and the cutting diagrams.

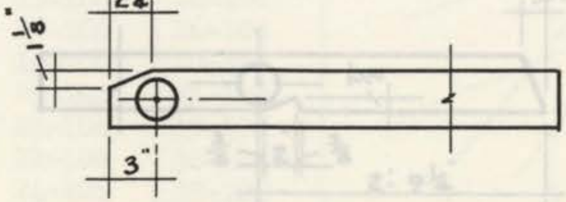
"W" TRUSS MEMBER SIZES

Table II, Continued

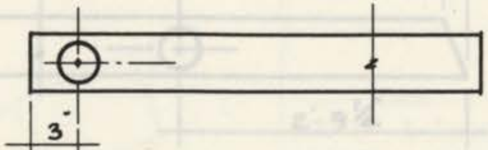
CUTTING DIAGRAMS - "W" TRUSS
5/12 SLOPE

BOTTOM CHORD - Drill for 2 1/2" Ring as Shown

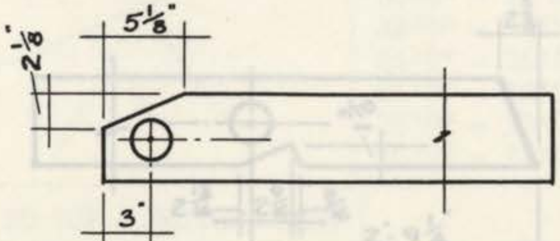
2"x 4" Use With 2"x 4" Top Chord



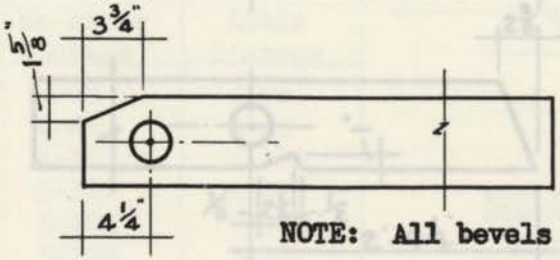
2"x 4" Use With 2" x 6" Top Chord



2"x 6" Use With 2"x 4" Top Chord

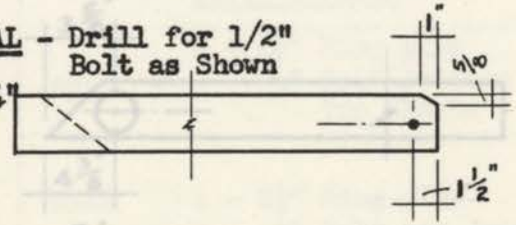


2"x 6" Use With 2"x 6" Top Chord

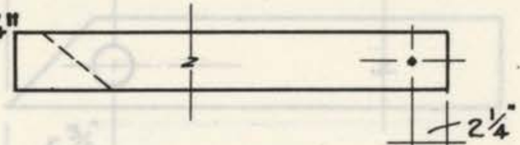


LONG DIAGONAL - Drill for 1/2" Bolt as Shown

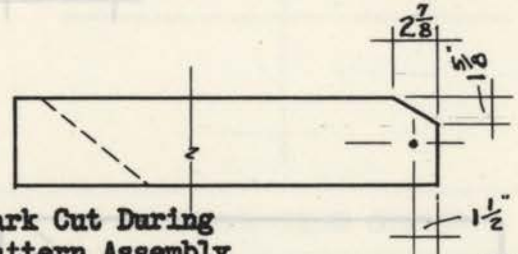
1"x 4" or 2"x4" Use With 2" x 4" Top Chord



1"x 4" or 2"x4" Use With 2" x 6" Top Chord

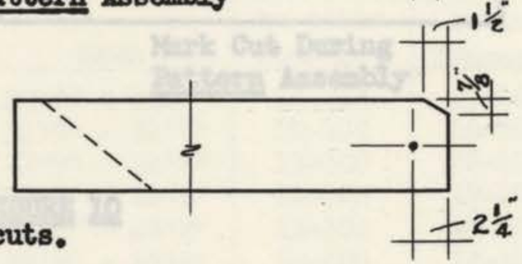


1"x 6"



Mark Cut During Pattern Assembly

1" x 6"



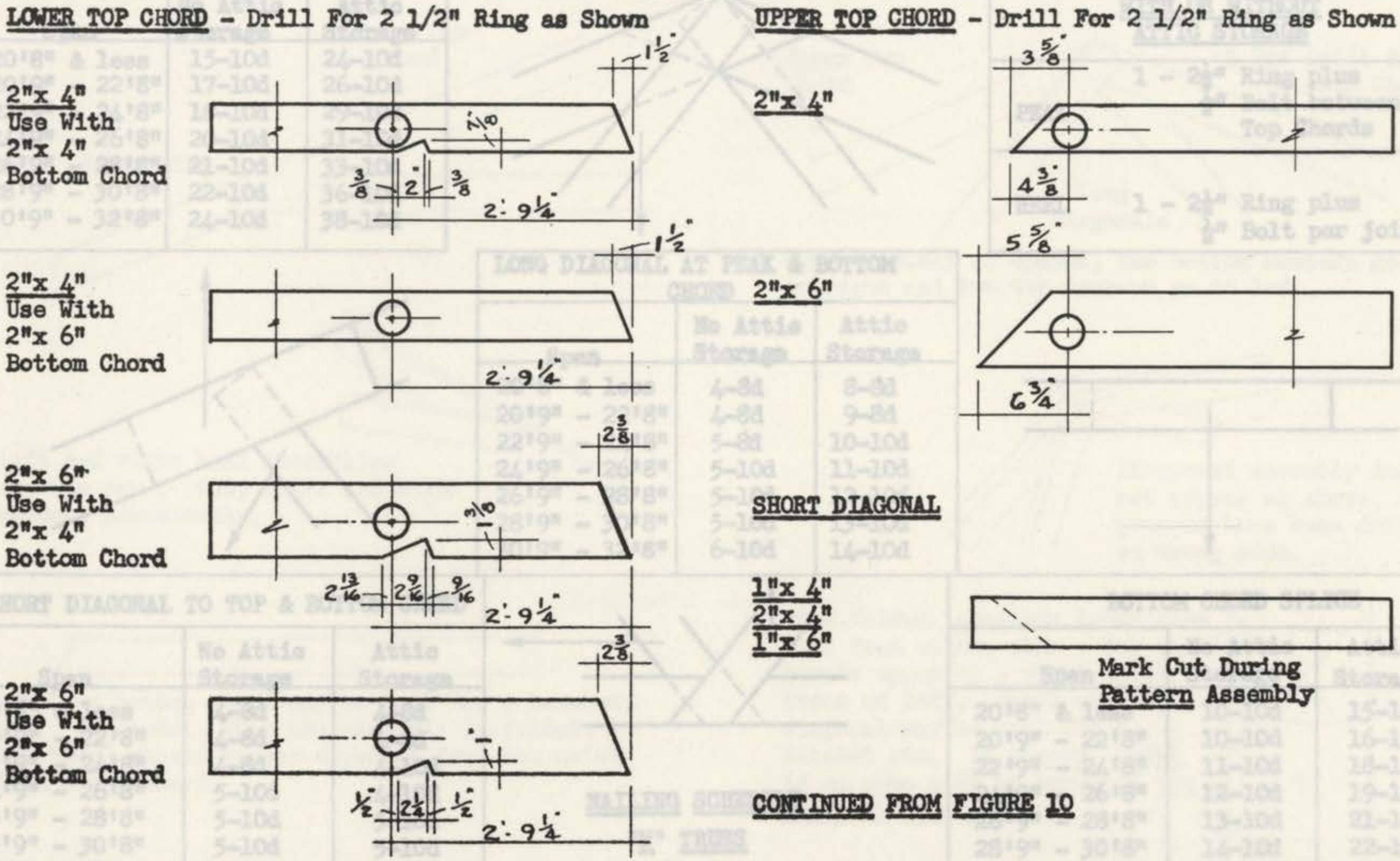
NOTE: All bevels may be left as hatchet cuts.

CONTINUED ON FIGURE 11

Figure 10

CUTTING DIAGRAMS - "W" TRUSS

5/12 SLOPE

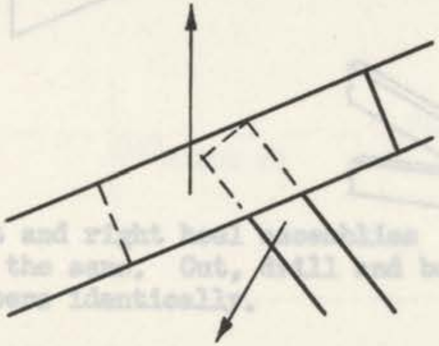


CONTINUED FROM FIGURE 10

Figure 11

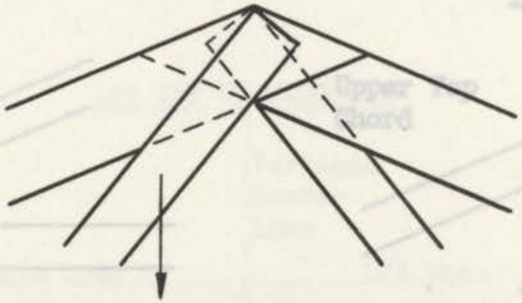
TOP CHORD SPLICE

Span	No Attic Storage	Attic Storage
20'8" & less	15-10d	24-10d
20'9" - 22'8"	17-10d	26-10d
22'9" - 24'8"	18-10d	29-10d
24'9" - 26'8"	20-10d	31-10d
26'9" - 28'8"	21-10d	33-10d
28'9" - 30'8"	22-10d	36-10d
30'9" - 32'8"	24-10d	38-10d



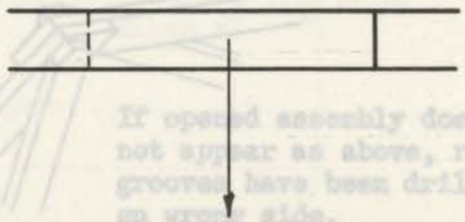
SPLIT RINGS
SPANS: 20'-8" to 32'-8"
WITH OR WITHOUT ATTIC STORAGE

PEAK	1 - 2½" Ring plus ½" Bolt between Top Chords
HEEL	1 - 2½" Ring plus ½" Bolt per joint



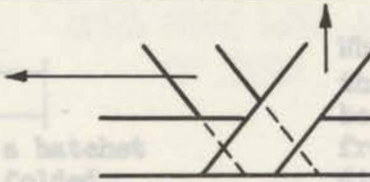
LONG DIAGONAL AT PEAK & BOTTOM CHORD

Span	No Attic Storage	Attic Storage
20'8" & less	4-8d	8-8d
20'9" - 22'8"	4-8d	9-8d
22'9" - 24'8"	5-8d	10-10d
24'9" - 26'8"	5-10d	11-10d
26'9" - 28'8"	5-10d	12-10d
28'9" - 30'8"	5-10d	13-10d
30'9" - 32'8"	6-10d	14-10d



SHORT DIAGONAL TO TOP & BOTTOM CHORD

Span	No Attic Storage	Attic Storage
20'8" & less	4-8d	4-8d
20'9" - 22'8"	4-8d	4-8d
22'9" - 24'8"	4-8d	4-10d
24'9" - 26'8"	5-10d	4-10d
26'9" - 28'8"	5-10d	5-10d
28'9" - 30'8"	5-10d	5-10d
30'9" - 32'8"	6-10d	5-10d



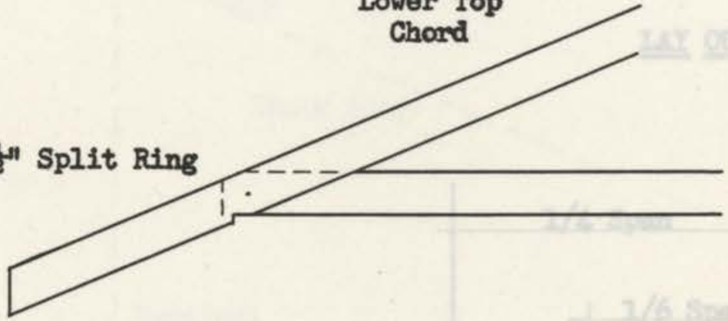
NAILING SCHEDULE
"W" TRUSS

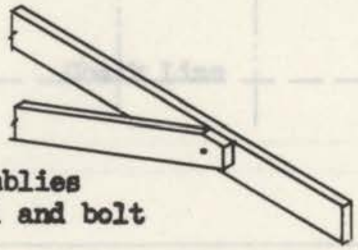
BOTTOM CHORD SPLICE

Span	No Attic Storage	Attic Storage
20'8" & less	10-10d	15-10d
20'9" - 22'8"	10-10d	16-10d
22'9" - 24'8"	11-10d	18-10d
24'9" - 26'8"	12-10d	19-10d
26'9" - 28'8"	13-10d	21-10d
28'9" - 30'8"	14-10d	22-10d
30'9" - 32'8"	15-10d	24-10d

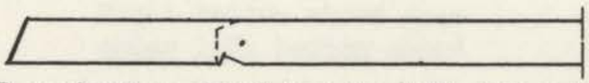
Figure 12

HEEL JOINT SUBASSEMBLY



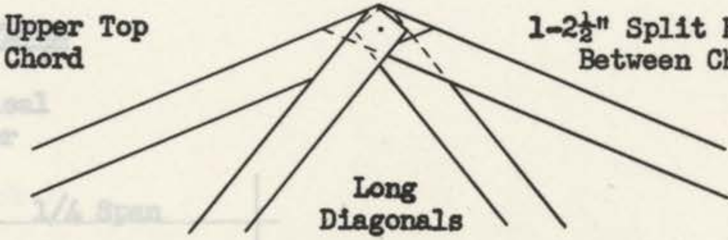


Left and right heel assemblies are the same. Cut, drill and bolt members identically.

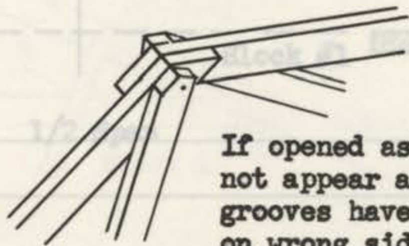


Bevel on bottom chord may be left for a hatchet cut. If precut, when the assembly is folded, the bevel should appear opposite from the notch in the top chord.

PEAK JOINT SUBASSEMBLY



When assembly is opened, two bottom members go to right and two top members go to left.



If opened assembly does not appear as above, ring grooves have been drilled on wrong side.

When folded, assembly looks like this from either side - top chord bevels opposite - right bevel in front of left. Bevel on long diagonal may be left for a hatchet cut. <u>If precut, bevel is on same side as bevel of top chord it adjoins.</u>

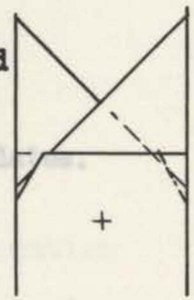
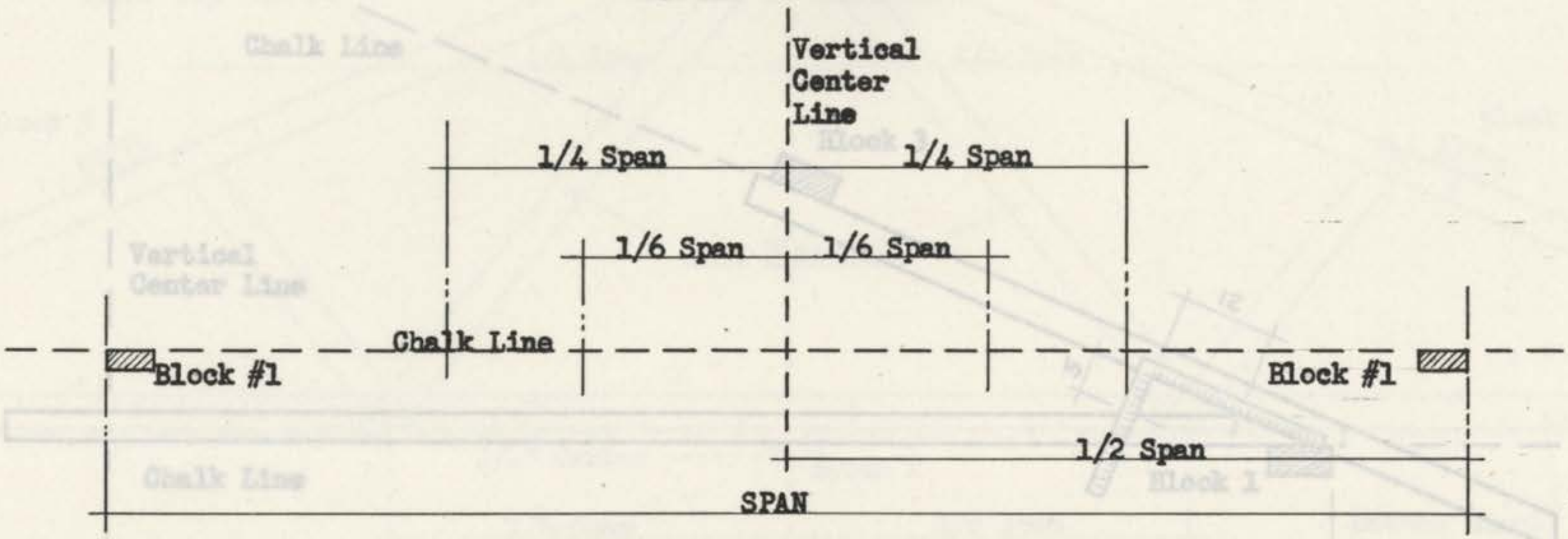


Figure 13

LAY OUT ON SUBFLOOR

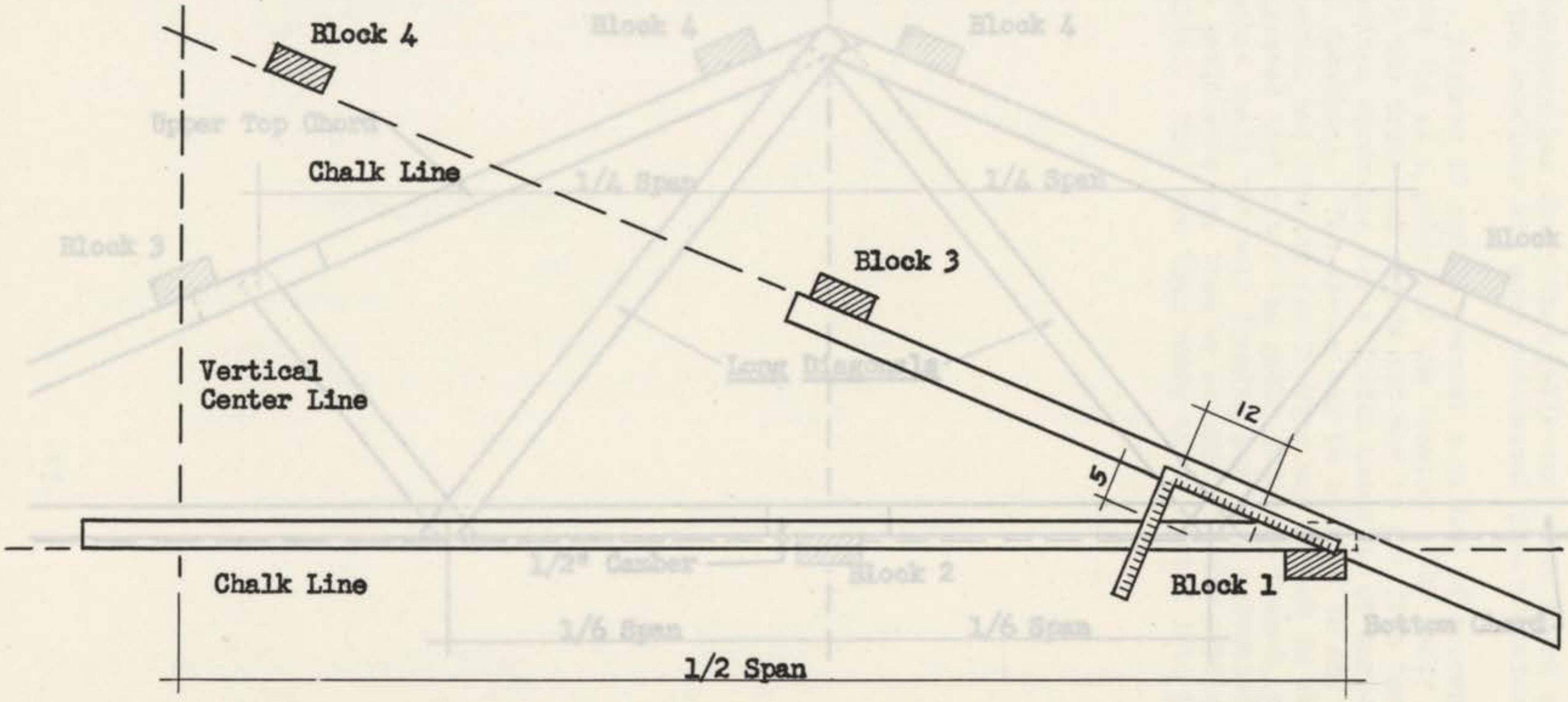


BASIC CHALK LINE LAYOUT

"W" TRUSS

NOTE: The term "span" refers to the out-to-out dimensions of the exterior wall plates.

Figure 14

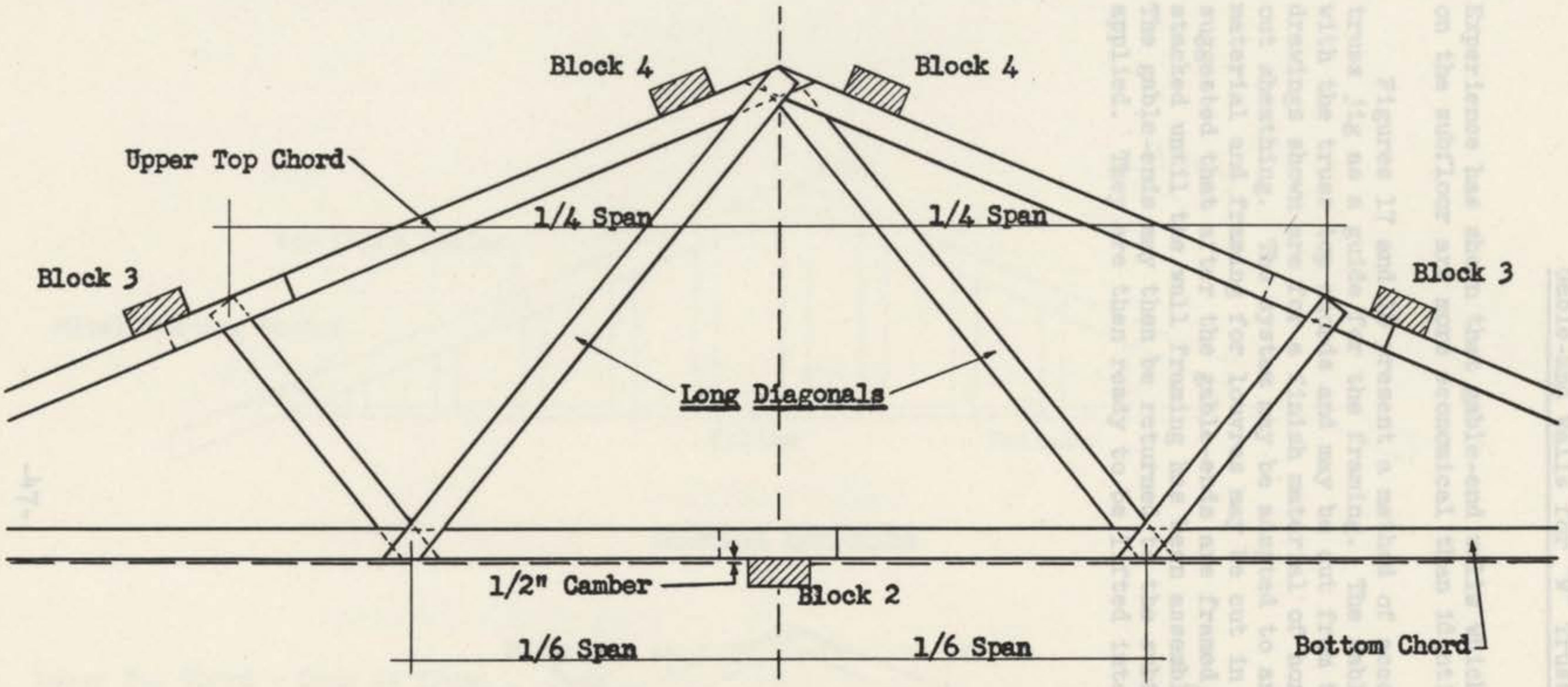


Right bottom chord goes <u>under left bottom chord</u>

SLOPE LAYOUT

NOTE: The height to which the guide blocks are built up has been left to the discretion of the builder. See discussion in text.

Figure 15



PLACEMENT OF GUIDE BLOCKS
"W" TRUSS

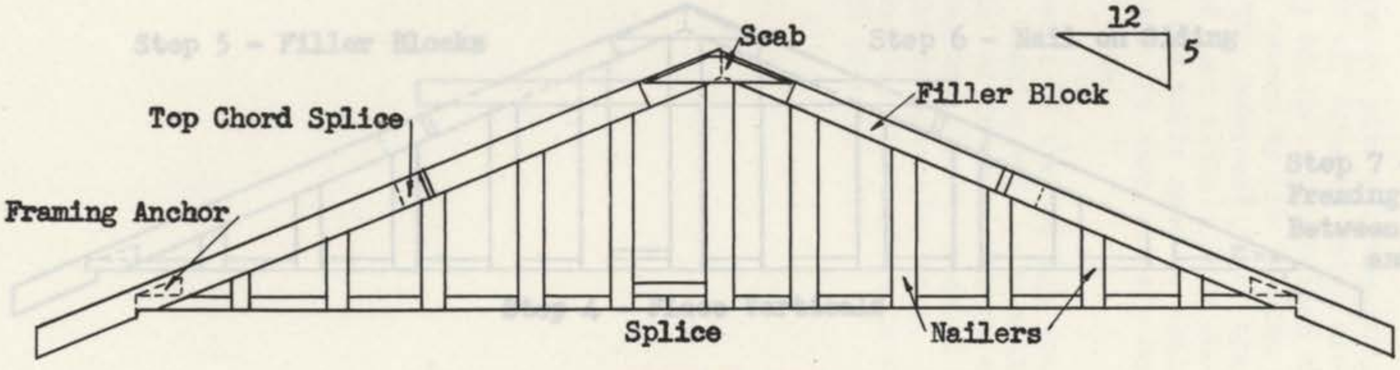
NOTE: 1/2" camber measured above horizontal chalk line at centerline.

Figure 16

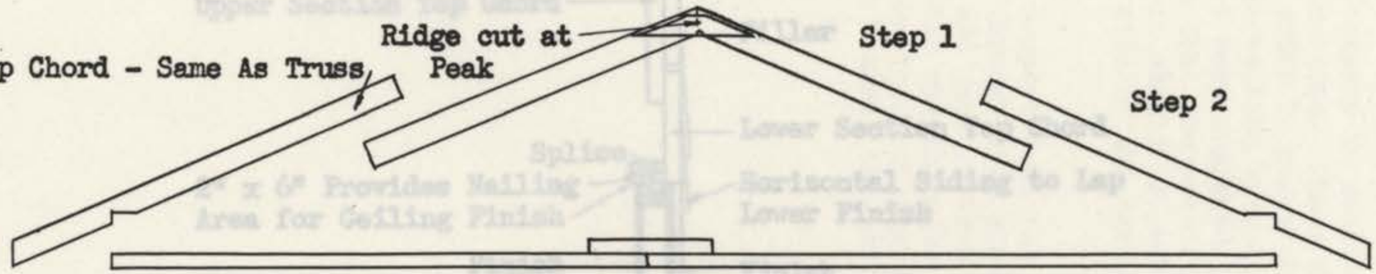
Gable-End Walls for "W" Trusses

Experience has shown that gable-end walls which are framed and finished on the subfloor are more economical than identical walls built in place.

Figures 17 and 18 present a method of accomplishing this, using the truss jig as a guide for the framing. The gable rafters are identical with the truss top chords and may be cut from the same diagrams. The drawings shown are for a finish material of horizontal siding applied without sheathing. The system may be adapted to any other type of finish material and framing for louvres may be cut in where desired. It is suggested that after the gable-ends are framed, they be taken out and stacked until the wall framing has been assembled and tipped into place. The gable-ends may then be returned to the subfloor and the finish material applied. They are then ready to be lifted into place.



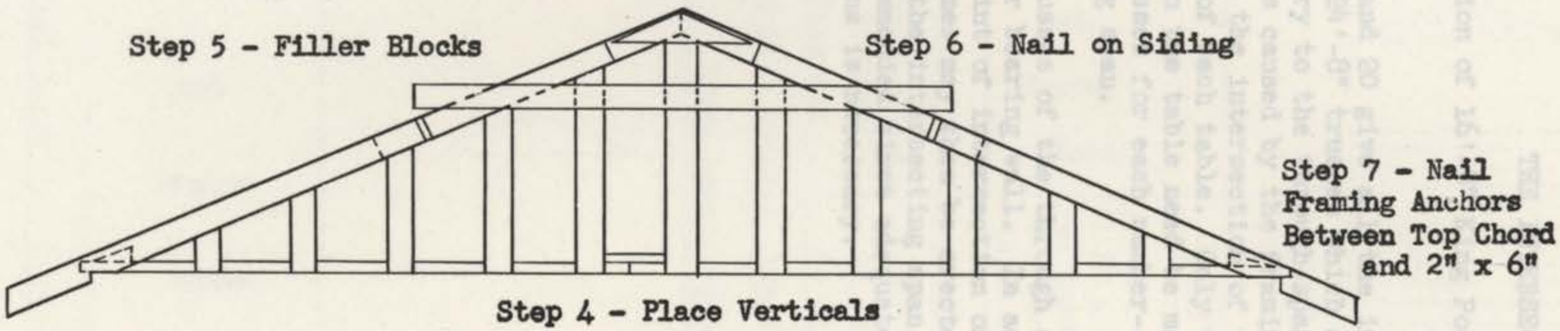
ASSEMBLY PROCEDURE



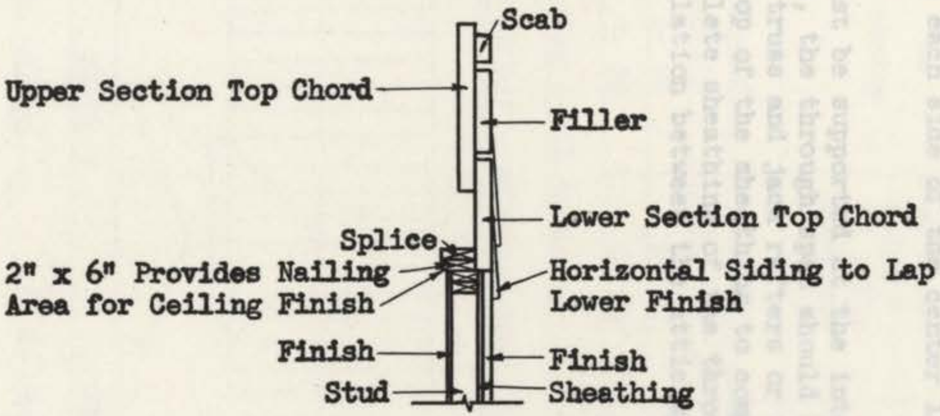
TYPICAL GABLE-END WALL
(Horizontal Siding)

Figure 17

ASSEMBLY PROCEDURE
(Continued from Figure 17)



SCHEMATIC SECTION



TYPICAL GABLE-END WALL
(Horizontal Siding)

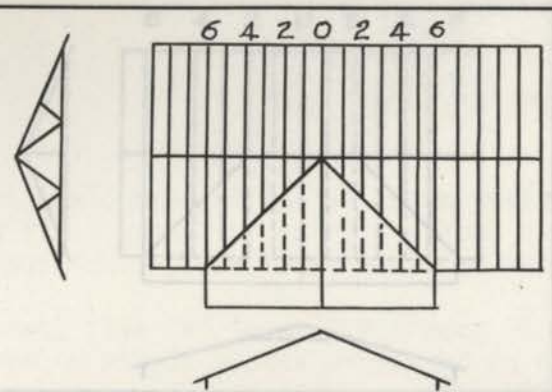
Figure 18

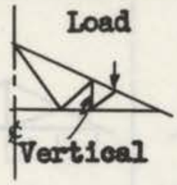
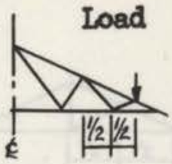
THE INTERSECTION OF TRUSSES

Intersection of 16'-8" King Post Trusses and 24'-8" "W" Trusses

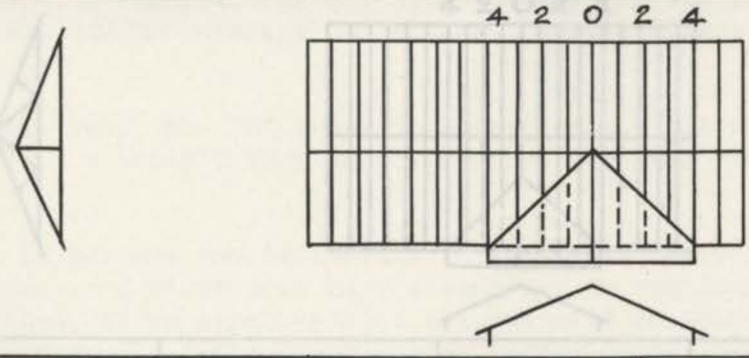
Figures 19 and 20 give all the information necessary to modify regular 16'-8" and 24'-8" trusses which are at intersections. These modifications are necessary to the through-span trusses in order to carry the concentrated loads caused by the framing of the intersecting span. The trusses involved in the intersection of the spans have been numbered in the drawings at the top of each table. Only those trusses that are specifically mentioned in the table need be modified, but it should be noted that there are two trusses for each number--one on each side of the center line of the intersecting span.

The trusses of the through span must be supported at the intersection by a beam or bearing wall. In addition, the through span should be sheathed past the point of intersection on each truss and jack rafters or small trussed frames may then be erected on top of the sheathing to complete the framing of the intersecting span. Complete sheathing of the through span is not recommended since adequate ventilation between the attic spaces of the two spans is necessary.



Modifications to Pattern and Member Sizes	TRUSS 2	TRUSS 3	TRUSS 4	TRUSS 5
				
	Add 1-2" x 4" to upper top chord (SCAB ON)	No change	Change all web members to 1" x 6" Add 2 1" x 6" as shown using 6 8d nails each end	Change all web members to 1" x 6" Add 2 1" x 6" as shown using 10 8d nails each end
Connections				
Btm. Chord Splice	11-10d	12-10d	13-10d	13-10d
Top Chord Splice	17-10d	22-10d	24-10d	26-10d
Short Diagonal	5- 8d	6- 8d	7- 8d	7- 8d
Long Diagonal	5- 8d	7- 8d	8- 8d	8- 8d
Peak & Heel Joints: 1-2½" split ring - all trusses				

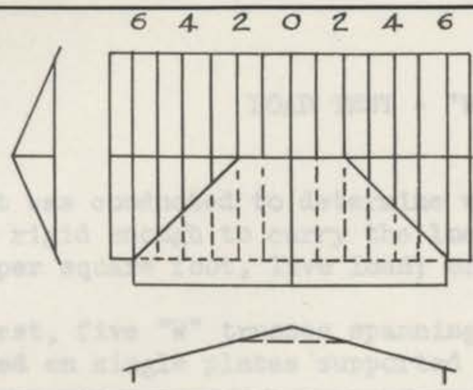
TRUSS INTERSECTION - 24' ON 24' - NO ATTIC LOAD

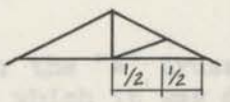
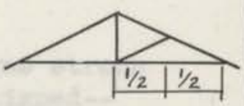


Modifications to Pattern and Member Sizes	TRUSS 2	TRUSS 3
	No change	No change
Connections		
Heel Joint	10-10d	10-10d
Peak Joint	10-10d	10-10d
King Post	4- 8d	4- 8d
Bottom Chord Splice	10-10d	10-10d

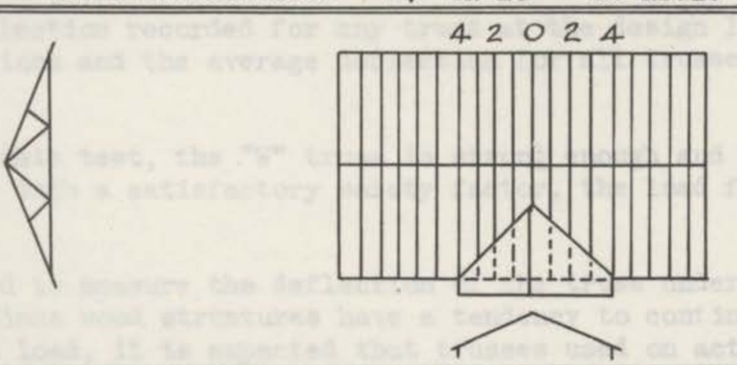
TRUSS INTERSECTION - 16' ON 16' - NO ATTIC LOAD

Figure 19



	TRUSS 3	TRUSS 4	TRUSS 5
		 Add 1 - 2" x 4" diagonal as shown	 Add 1 - 2" x 4" diagonal as shown
Modifications to Pattern and Member Sizes	No change	Change bottom chord to a 2" x 6" for nailing area	Change bottom chord to a 2" x 6" for nailing area
Connections Heel Joint	10-10d	20-10d	15-10d
Peak Joint	10-10d	11-10d	10-10d
King Post	1- 8d	5- 8d	4- 8d
Btm. Chord Splice	9-10d	22-10d	17-10d
Added Member	--	9-10d	4-10d

TRUSS INTERSECTION - 24' ON 16' - NO ATTIC LOAD



	TRUSS 1	TRUSS 2	TRUSS 3
Modifications to Pattern and Member Sizes	No change	Add 1 - 2"x4" to lower top chord (SCAB ON)	Add 1 - 2"x4" to lower top chord (SCAB ON)
Connections Btm. Chord Splice	11-10d	12-10d	12-10d
Top Chord Splice	18-10d	20-10d	21-10d
Short Diagonal	5- 8d	5- 8d	7- 8d
Long Diagonal	5- 8d	6- 8d	7- 8d
Peak & Heel Joints	1 - 2½"	split ring	ALL TRUSSES

TRUSS INTERSECTION - 16' ON 24' - NO ATTIC LOAD

Figure 20

LOAD TEST - "W" TRUSS

A load test was conducted to determine whether the "W" truss was strong enough and rigid enough to carry the load for which it was designed-- 20 pounds per square foot, live load; or 30.5 p.s.f., total load.

For this test, five "W" trusses spanning 25'-8", out to out of the plates, were erected on single plates supported on concrete foundation walls.

The trusses were of No. 2 grade, or better, lumber. No special care was taken during fabrication. Trusses built on an actual job could be expected to be of equal or better strength.

The trusses, which were not braced in any manner during the testing, were sheathed with square-edged boards. Concrete blocks were placed on the sheathing, the trusses being loaded uniformly at approximately 20 p.s.f. for each increment of loading.

Deflection of the bottom chord was recorded for each loading.

The trusses collapsed due to failure of the top chords in the upper panels at a total imposed load of 128 p.s.f. This represents a factor of safety of 4.36 based on total loads. This is a satisfactory margin of safety since a 4.00 factor of safety is considered usual for wood.

The greatest deflection recorded for any truss at the design load of 20 p.s.f. was 5/16 inch and the average deflection for all trusses was approximately 1/8 inch.

On the basis of this test, the "W" truss is strong enough and rigid enough to carry, with a satisfactory safety factor, the load for which it was designed.

Tests are planned to measure the deflection of the truss under a long-term loading. Since wood structures have a tendency to continue deflecting under a constant load, it is expected that trusses used on actual constructions would eventually deflect more under design loads than the value given above. This tendency, of course, is equally true of any other method of roof construction.