Architectural Thesis

Designs

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Texts

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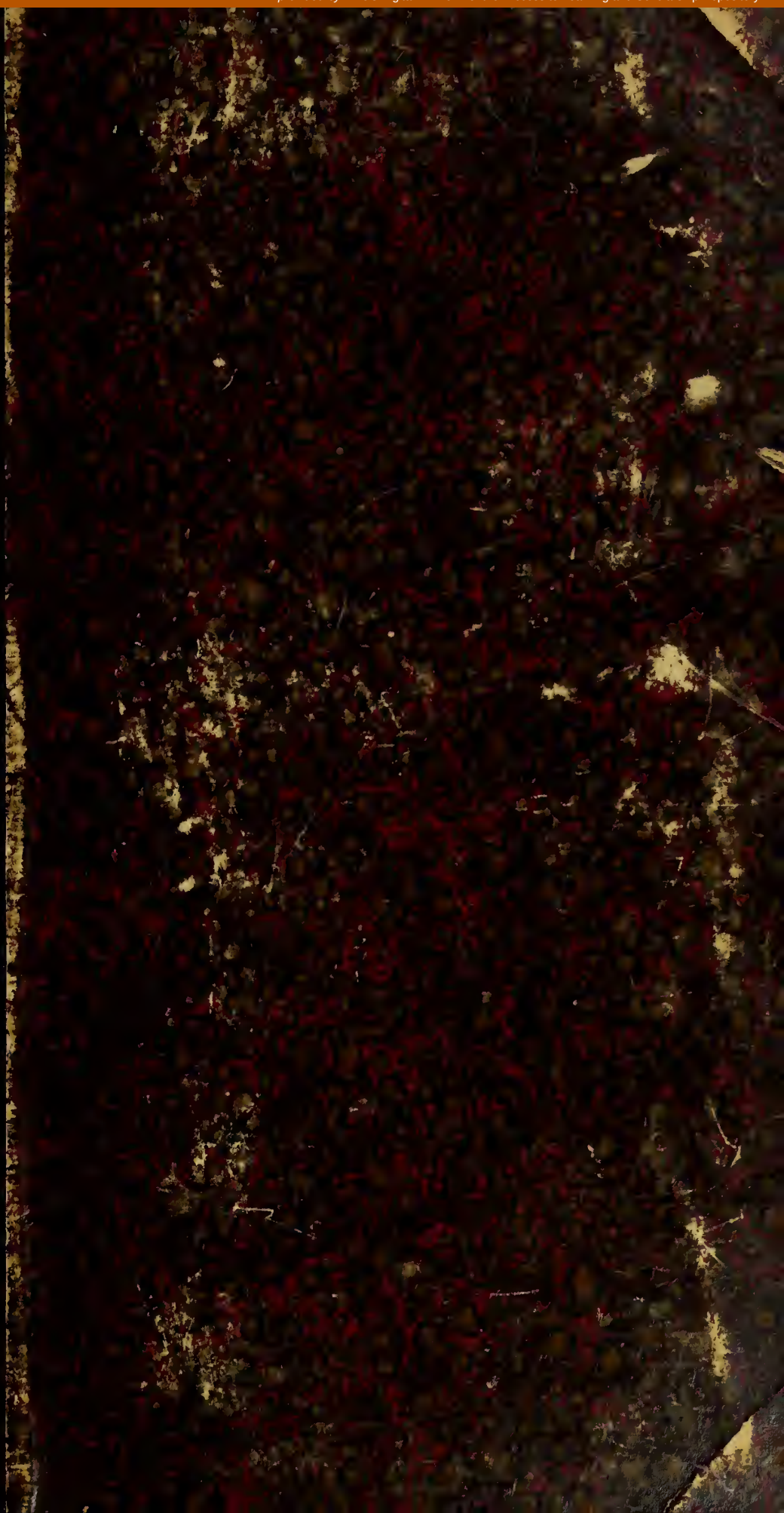


WEIGHT

OF

STEEL ROOF TRUSSES

BY

ROBERT GRANT HOLABIRD

THESIS

FOR DEGREE OF BACHELOR OF SCIENCE
IN ARCHITECTURAL ENGINEERING

COLLEGE OF ENGINEERING
UNIVERSITY OF ILLINOIS
PRESENTED JUNE 1900

UNIVERSITY OF ILLINOIS

June 1, 1900. 190

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Robert Grant Holabird

ENTITLED Weight of Steel Roof Trusses

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

OF Bachelor of Science in Architectural Engineering.

N. C. Ricker.

HEAD OF DEPARTMENT OF Architecture.

Weight of Steel Roof Trusses.

In investigating the weights of trusses for a thesis the subject has been divided into two parts, the first part being the per cent of details by weight and the weight per square foot of horizontal area covered, of trusses which have been designed and erected. The second part is devoted to a study of the Fink truss, assuming a certain load pr. sq. ft. for different spans, rise, and lower chord, with the object of finding out which form would give the most economical weight per sq. ft. of horizontal area covered.

Data for part one was obtained from the shop drawings of about a dozen trusses of different styles and spans. The roof coverings were obtained but the wind and snow loads for which they were designed were not. The weight of the truss was worked and then this result

was divided by the horizontal area covered which gave the wt. per sq. ft. of truss. The results showed that the variation between the weights was very small they were not close enough however to form any table which would be general but they showed that the designers evidently had tried to keep the weight as light as possible. The results are placed in tabular form on page 6, and drawings showing the styles on page 7.

The per cent of details by weight in terms of the main members was also obtained and showed a variation of about 10 per cent but when one remembers that different designers vary widely in their methods of obtaining details this variation does not seem so very great. From an average of the results the conclusion drawn is that 15 per cent of the wt. of the main members should be added to make up the total weight of a truss. This is a fair and average value and will hold for almost any

style of roof trusses with an average loading. The results are shown in Table I. By means of this table it enables one to quickly work out the weight and cost of a truss and thus saves many valuable moments to the designer.

In part two the analysis of the Fink type of truss was undertaken the object being to find out how the wt. per sq ft. of horizontal area carried varied with the span and spacing between centers and also to determine the relative weights of 3 different forms of the truss for equal spans and spacings. Spans of 50, 75 100, and 150 ft. were assumed with trusses spaced 16' centers, also 2 trusses of 50' and 75' spans with 18' centers, but it was found that such a small change of centre did not affect the wt. per sq. ft. One set of trusses had a rise of 1/5 the span and had a horizontal lower chord. Another set had a rise of 3' in 10' with an inclined lower chord which had a rise of 1/5 the total rise of the

truss, this same set of trusses was designed for a horizontal lower chord. The trusses were designed to carry a permanent load of 15.5 lbs per sq. ft. of roof area and a snow load of 20 lbs. per sq. ft. of horizontal projection. The wind load and truss weights were taken from tables in Ricker's Trussed Roofs. Drawings showing the trusses and the data are shown on pages 8, 9.

From the results we find that the wt. per sq. ft of horizontal area covered varies directly as the span. This is shown on page 2 when 3 lines are plotted having the span as abscissa and the wt. in lbs. as ordinates.

We also find that the truss with a rise of 3 in 10 and a horizontal lower chord gives the least wt. per sq. ft. of area covered and is therefore the most economical style of truss. A truss of the same rise with an inclined lower chord is found to be the most extravagant. Time was not long enough to work out the most economical

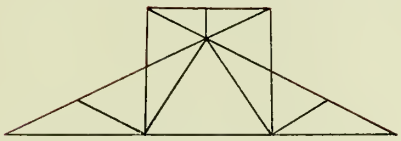
rise though it is probable that the truss assumed approximates it very closely.

From the results of this work it can be seen that the field offers chances for many valuable results and if a person had time the difference between the Fink and some other style of truss would be very interesting as would also the most economical spacing of trusses which would involve not only the weight of trusses but also the shop work and erecting.

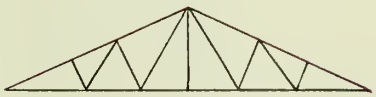
TABLE I

No. of Truss.	Span.	Rise.	Wt. of Truss per. Sq. Ft. Area Covered.	Details % of Main Members.	Roof Covering.
1.	32.	9.	2.4#	19.	Slate.
2.	44.	10.	2.5	20.	" .
3.	44.	14.	2.4	13.	" .
4.	45.	10.	2.0	15.	Tile.
5.	49.	13.	3.1	20.	Slate.
6.	49.	13.	3.0	17.	" .
7.	49.	13.	2.4	18.	" .
8.	50.	12.	2.8	16.	Tile.
9.	55.	18.	2.7	19.	Gal. Iron.
10.	59.	14.	3.1	11.	Tile.
11.	70	20.	3.0	18.	Slate.
12.	75	18	3.0	13.	Tile.
13.	110	28.	5.2	11.	Slate.

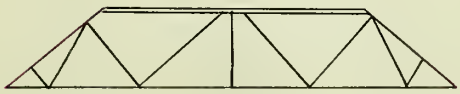
STYLE OF TRUSS FOR TABLE I.



1.



2-5-6.



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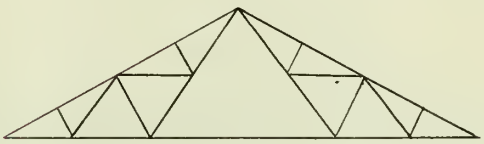
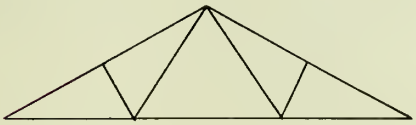


4-9.



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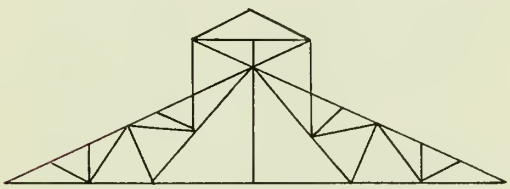

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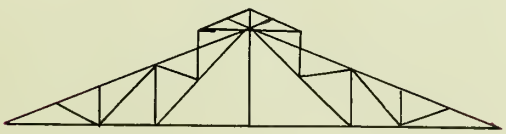

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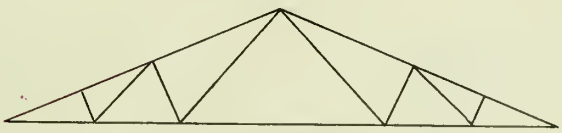

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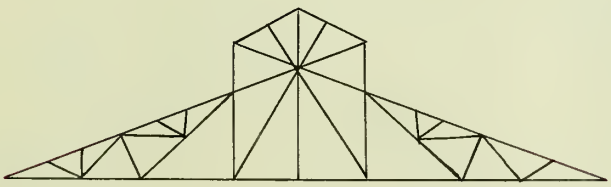

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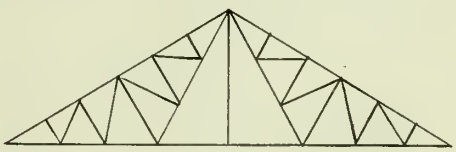
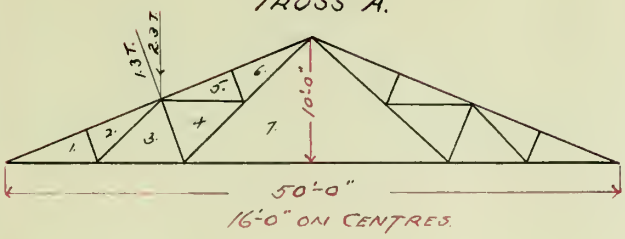


13.

TRUSS "A."

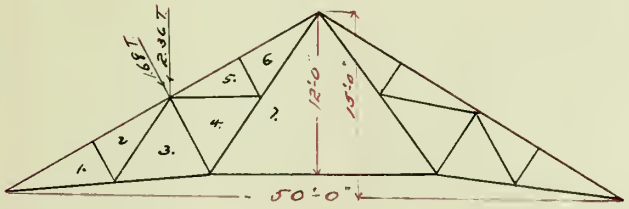


16'-0" ON CENTRES.

MEMBER.	LENGTH.	STRESS.	SECTION.	WEIGHT.
X1.	6.75	46850	4x3x11/16" ∠s	1058.0
Y1.	7.0	43900	3½x3x⅜" ∠s	437.0
Y7.	22.0	24680	3½x3x5/16" ∠s	185.0
1-2.	2.4	4600	2½x2½x¼" ∠	20.0
2-3.	7.0	6800	"	56.0
3-4.	4.8	9200	"	34.0
4-5.	7.0	6800	"	56.0
5-6.	2.4	4600	"	20.0
6-7.	7.0	20400	3x3x5/16" ∠	205.0
				2075.0
			#	310.0
				2385.0

WT. PER. SQ. FT. → 2.98 #

TRUSS "B."

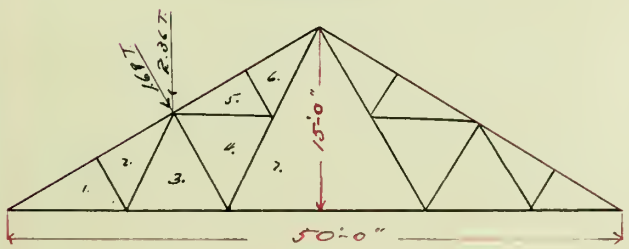


16'-0" ON CENTRES.

MEMBER.	LENGTH.	STRESS.	SECTION.	WEIGHT.
X1.	7.3	46900	4x3x½" ∠s	1300.0
Y1.	7.8	44000	3½x3x⅜ ∠s	450.0
Y7.	20.0	24700	3½x3x5/16 ∠s	240.0
1-2.	2.6	5400.	2½x2½x¼" ∠	20.0
2-3.	7.7	8000.	"	61.0
3-4.	5.2	11000.	2½x2½x⅜ ∠	60.0
4-5.	7.7	8000.	2½x2½x¼ ∠	61.0
5-6	2.6	5400.	"	20.0
6-7.	7.8	24000.	3x3x5/16"	260.0
				24720
			#	370.0
				2847.0

WT. PER. SQ. FT. 3.38 #

TRUSS "C."



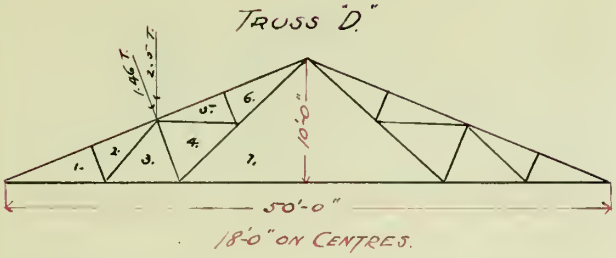
16'-0" ON CENTRES.

MEMBER	LENGTH.	STRESS	SECTION.	WEIGHT.
X1.	7.3	31400	3½x3½x5/16" ∠s	700.0
Y1.	8.5	25000	3x3x¼" ∠s	270.0
Y7.	16.0	15200	"	160.0
1-2.	4.5	5400	2½x2½x¼" ∠	36.0
2-3.	8.5	5800	"	68.0
3-4.	9.0	11000	2½x2½x⅜" ∠	104.0
4-5.	8.5	5000	2½x2½x¼" ∠	68.0
5-6.	4.5	5400	"	36.0
6-7.	8.5	16000	3x3x5/16" ∠	204.0
				1646.0
			#	246.0
				1892.0

WT. PER. SQ. FT. 2.37 #

NOTE → # 15% ADDED FOR DETAILS.

TRUSS "D."

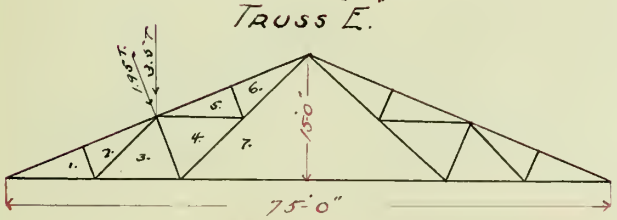


18'-0" ON CENTRES.

MEMBER.	LENGTH.	STRESS.	SECTION	WEIGHT.
X1.	6.75	50500	4x3x7/16" L	1058.0
Y1.	7.0	46700	4x3x3/8" L	476.0
Y7.	22.0	26000	4x3x5/16" L	312.0
1-2.	2.4	6000	2½x2½x¼" L	20.0
2-3.	7.0	8000	"	56.0
3-4.	4.8	12000	2½x2½x5/16" L	48.0
4-5.	7.0	8000	3½x2½x¼" L	56.0
5-6.	2.4	6000	"	20.0
6-7.	7.0	24000	3½x3½x3/8" L	235.0
				2271.0
			→ #	320.0
				2596.0

WT. PER SQ. FT. 2.9 #

TRUSS "E."

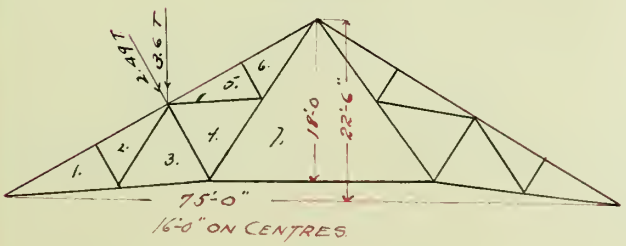


6'-0" ON CENTRES.

MEMBER.	LENGTH.	STRESS	SECTION.	WEIGHT
X1.	10.1	68000	6x3½x½" L	2473.
Y1.	11.0	62800	5x3½x3/8" L	915.
Y7.	31.0	36000	" L	645.
1-2.	4.1	8000	2½x2½x¼" L	33.
2-3.	10.5	10600	"	84.
3-4.	8.2	16000	3x3x¼" L	81.
4-5.	10.5	10600	2½x2½x¼" L	84.
5-6.	4.1	8000	"	33.
6-7.	11.0	32000	3x3x5/16" L	264.
				4612.
			# →	691.
				5303.

WT. PER. SQ. FT. 4.42 #

TRUSS "F."



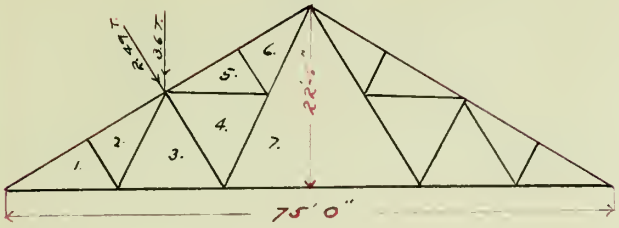
16'-0" ON CENTRES.

MEMBER	LENGTH.	STRESS.	SECTION.	WEIGHT.
X1.	11.1	70000	6x4x7/16" L	2550.
Y1.	12.0	63000	5x3½x3/8" L	1000.
Y7.	28.0	38000	"	582.
1-2.	4.5	8400	2½x2½x¼" L	36.
2-3.	12.0	11600	"	96.
3-4.	9.0	16800	3x3x¼" L	90.
4-5.	12.0	11600	2½x2½x¼" L	96.
5-6.	4.5	8400	"	36.
6-7.	24.0	33000	3x3x9/16" L	288.
				4774.0
			# →	716.0
				5490.0

WT. PER. SQ. FT. → 4.67 #

NOTE → # 15% ADDED FOR DETAILS.

TRUSS "G."

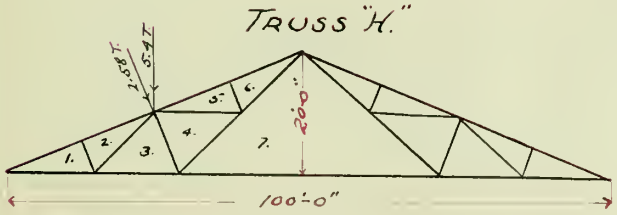


16'-0" ON CENTRES.

MEMBER.	LENGTH.	STRESS.	SECTION.	WEIGHT.
X1.	11.1	45000	5x3½x⅜" L	1850.
Y1.	13.0	37500	4x3x⅜" L	840.
Y7.	23.0	22000	"	430.
1-2.	7.0	8400	2½x2½x¼" L	56.
2-3.	13.5	8000	"	108.
3-4.	14.6	16000	3½x3½x⅜" L	274.
4-5.	13.5	8000	2½x2½x¼" L	108.
5-6.	7.0	8400	"	56.
6-7.	13.0	22500	2½x2½x 5/16" L	260.
				3982.0
				597.0
				4579.0

WT. PER SQ. FT. 3.8 #

TRUSS "H."

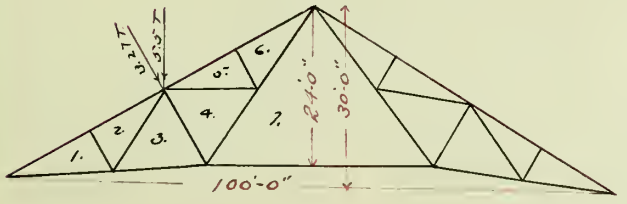


16'-0" ON CENTRES.

MEMBER.	LENGTH.	STRESS.	SECTION.	WEIGHT.
X1.	13.4	104000	6x4x⅜" L	3895.
Y1.	14.5	96000	6x4x½" L	1980.
Y7.	42.0	56000	6x4x⅜" L	1193.
1-2.	5.4	10400	2½x2½x¼" L	43.
2-3.	14.5	21000	3x3x¼" L	142.
3-4.	10.8	14000	" L	212.
4-5.	14.5	14000	" L	142.
5-6.	5.4	10400	2½x2½x¼" L	43.
6-7.	14.5	41500	3½x3½x⅜" L	713.
				8363.
		→		1254.0
				9617.0

WT. PER SQ. FT. → 6.0 #

TRUSS "I."



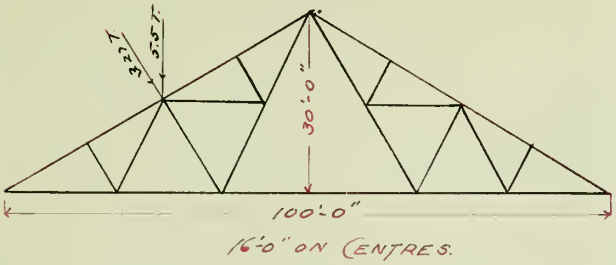
16'-0" ON CENTRES.

MEMBER	LENGTH	STRESS.	SECTION.	WEIGHT.
X1.	14.6	105000	6x6x½" L	4570.
Y1.	15.5	98000	6x4x⅜" L	1760.
Y7.	40.0	59000	" L	1130.
1-2.	5.2	11200	2½x2½x¼" L	42.
2-3.	15.4	17000	3x3x¼" L	150.
3-4.	10.4	23000	" L	203.
4-5.	15.4	17000	" L	150.
5-6.	6.2	11200	2½x2½x¼" L	42.
6-7.	15.5	51000	3x3x⅜" L	1033
				9077.0
		→		1260.0
				10337

Note # 15% ADDED FOR DETAILS.

WT. PER SQ. FT → 6.4 #

TRUSS "J."

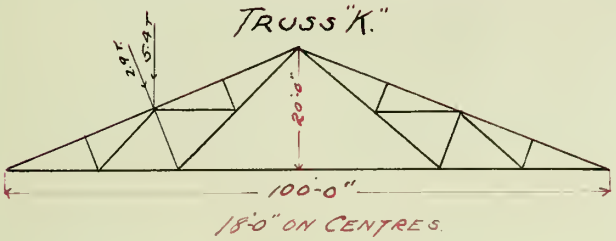


16'-0" ON CENTRES.

MEMBER.	LENGTH.	STRESS.	SECTION.	WEIGHT.
X1.	14.6	65400	6x4x½" L	3910.
X1.	17.0	51100	5x3½x⅜" L	1415.
Y7.	32.0	33000	" L	670.
1-2.	9.0	11200	3x3x¼" L	90.
2-3.	17.0	11000	" L	170.
3-4.	18.0	23000	" L	350.
4-5.	17.0	11000	" L	170.
5-6.	9.0	11200	" L	90.
6-7.	17.0	33000	3x3x⅜"	490.
				7355.0
				1102.0
				8457.0

WT. PER SQ. FT. 5.3 #

TRUSS "K."

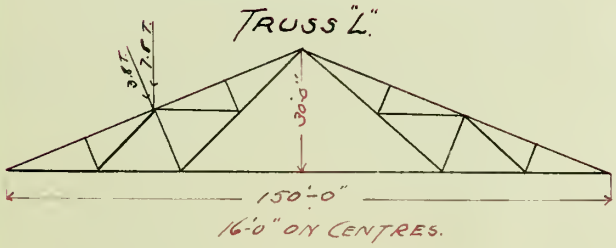


18'-0" ON CENTRES.

MEMBER.	LENGTH.	STRESS.	SECTION.	WEIGHT.
X1.	13.4	106000	6x4x11/16" L	3895.
Y1.	14.5	97500	6x4x½" L	1980.
Y7.	42.0	56000	6x4x7/16" L	1193.
1-2.	5.4	15600	3x3x5/16" L	65.
2-3.	14.5	20200	3x3x⅜" L	208.
3-4.	10.5	31000	" L	311.
4-5.	14.5	20200	" L	208.
5-6.	5.4	15600	3x3x5/16" L	65.
6-7.	14.5	63000	3½x3½x½" L	643.
				9364.0
→			#	1404.0
				10768.0

WT. PER SQ. FT. 5.98 #

TRUSS "L."



16'-0" ON CENTRES.

MEMBER.	LENGTH.	STRESS.	SECTION.	WEIGHT.
X1.	20.2	144800	6x6x7/16" L	10730.
Y1.	21.2	134000	6x4x11/16" L	3706.
Y7.	55.0	76000	6x4x⅜" L	1353.
1-2.	8.0	16000	3x3x⅜" L	115.
2-3.	22.0	21000	3x3x¼" L	431.
3-4.	16.0	32000	4x4x⅜" L	621.
4-5.	22.0	21000	3x3x¼" L	431.
5-6.	8.0	16000	3x3x⅜" L	115.
6-7.	21.2	64000	3½x3½x½" L	1887.
				19389.0
				2907.0
				22296.0

NOTE → # 15% ADDED FOR DETAILS.

WT. PER SQ. FT. 9.27 #

LINES
SHOWING
RELATIVE WEIGHT OF TRUSSES.