SEADROME DESIGN

THESIS FOR THE DEGREE OF B. S.

Glenn C. Dailey

1932

THESIS

Airports
Tide

SUPPLEMENTARY
MATERIAL
IN BACK OF BOOK

[illegible] DESIGN

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Glenn C Dailey

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THESIS

PREFACE

In an authoritative statement made recently by the Secretary of Commerce, it was estimated that approximately $[illegible] had been invested in aviation, or had been made available for that purpose. Such a tremendous sum of money but voices the conviction of American business men that the rapid transportation of mail, express and passengers will soon be over the air routes of the country.

Equivalent air development is part of the program of the other world powers, airplanes are covering the earth with gigantic strides, crisscrossing it in every direction. Aerial routes totaling [illegible] miles are reaching out over Europe, Asia, Africa, Australia, North and South America, so that crossing a continent will soon be a matter of a few hours as compared with the weeks or months required before the coming of the air lane.

From a world point of view the establishment of airways over the ocean is of still more economic importance, and will have greater effect on international trade and the comity of nations than will the millions now being expended in establishing and extending continental airways. Foremost among possible ocean airway routes the economic need for trans-Atlantic airplane service is becoming more imperative as the people of this and other commercial concerns increasingly air-minded and recognize more and more the saving of time and money that is possible by this new means of transportation.

However, ocean flying to be popular and useful must be safe and profitable. It is not so today. Flying over the ocean is not in itself dangerous. The danger is inherent because of the distance that must be traveled without refueling, motor inspection, weather reports or any of the other services that have made land flying commonplace and reliable. It is obvious and axiomatic that ocean airways to be successful must pay. To be profitable the transportation service they must offer must be at rates that will attract traffic. In any type plane, now developed or proposed, equipped for ocean flying, the economic flight range will not much exceed five hundred miles and it will require almost an engineering miracle to extend this practical range to a thousand miles. The barrier limiting the air lanes to overland airways is very real. Fundamentals of design and performance fix very definite limits to economic flight distance ----distances that fall very far short of spanning either the Atlantic or Pacific. Successful continental and inter-continental airways now in operation, ranging in length from

7,000 to 10,000 miles, are possible and successful only in that their flight distance, without refueling, rarely exceed 400 miles.

The fuel load required on long flights is an insuperable bar to payload, and without payload no commercial airway can be successful. Improvements in motors such as reduction in weight, increased power, reduced fuel consumption, more efficient propellers, wings of less resistance ---all possibly within [illegible] --- will not yet yield [illegible] airplanes or extend their possible flight distance much beyond the above noted. There is, therefore, nothing in sight to justify the frequently expressed opinion of both the layman and technician that we will shortly have ocean airways connecting the continents operating with a frequency and reliability commensurate with the land lines now developed. Obviously, to establish a safe and economic airway operation between Europe and America the obstacle of distance must be eliminated.

Since distance is the chief difficulty, the problem in establishing ocean airlines is to shorten the distance, to break it up into intervals, comparable with those distances found to be commercial and practical for overland routes. This is the purpose for which the seadrome is designed. A series of eight of these structures, anchored to the bottom of the Atlantic, at intervals of approximately [illegible] miles, will remove the hazard from ocean flying and permit a paying operation daily, at rates little or any in excess of those now charged by the high-speed steamship lines.

The seadrome is a floating landing deck high above the waves, moored at one end so as to trail into the wind, and long enough and wide enough to permit the landing and take-off of the largest planes; the whole supported by a number of columns so arranged and of such a shape that passing waves will go through the assembly without being broken up. Buoyancy tanks, below the columns supporting the deck truss and floor system, are located so as to be in the relatively undisturbed water under the waves.

Still farther down, ballast tanks give the whole structure adequate stability, the latter being obtained by having the center of gravity below the center of buoyancy. These ballast tanks are extended in circular form to act as damping discs to prevent any oscillation.

Ten years of progress in airplane design and operation have not reduced the hazard of ocean flying appreciably; it is still a devil-defying stunt and without the aid of seadromes will long continue to be extremely hazardous, with no prospect of ever being a safe and dependable commercial operation. In addition, it seems to appear very definitely that, other than the seadrome proposal there is no project for an ocean airway between the United States and Europe, and it does not appear that a sound, commercial venture reliable and safe in operation is possible now, or can be forecasted as being possible, at any reasonable, definite time in the future. It further has been definitely established that "if and when and as" such services are in operation they could not compete with the seadrome system, using the same advanced equipment that now appears necessary to make any other project possible.

DESIGN

The weights on the floor of a Seadrome are very difficult to conceive due to the fact that there is available little or no information upon the subject. A assumed weight of 125 pounds per square foot has been found sufficient to cover all of the cases. In some instances the weight over a small portion will undoubtably exceed this but at this time the greater portion of the floor will be without load so the stress will be less than 125 pounds per square foot over the entire floor.

THICKNESS OF FLOOR

From formula $S = \frac{Mc}{I}$ the thickness is 3/8 inches

deflection is equal to $5/384 \frac{Wl^4}{EI}$

deflection equals $5/384 \frac{x\ 125 \times 36 \times 36 \times 36 \times 36 \times 12}{30{,}000{,}000 \times 12 \times 0.375^3}$

equals 3.36 inches--To much def.

Try 0.5" plate

deflection $= \frac{5}{\ } \times \frac{125 \times 36 \times 36 \times 36 \times 36^3 \times 12}{30{,}000{,}000 \times 12 \times 0.375^3}$

$= 0.75"$

In view of the fact that the plates are welded at the ends and also that the live weight is an emergency weight only this will be O. K.

COMPUTATION OF REACTIONS

Uniform load	=	125 #/ft
Plate load	=	20.4 #/ft
Total weight		145.4 #/ft

Weight per 3 ft span	436.2 #/ft
Assumed weight of girder	49.8 #/ft
Total weight	486.0 #

$$M_1 \quad 4M_2 \quad M_3 \qquad = -\tfrac{1}{2}wl^2$$
$$M_2 \quad 4M_3 \quad M_4 \qquad = -\tfrac{1}{2}wl^2$$

$M_1 = M_4 = 30 \times 486 \times 15 = 219{,}000$ ft #

$-\tfrac{1}{2}wl^2 = \tfrac{1}{2} \times 486 \times 100 \times 100 = 2{,}430{,}000$ ft #

Solving M_2 equals M_3 equals 530,000 ft#

$$530{,}000 = 100R_1 - (486 \times 100 \times 50)$$
$$R_1 = 46{,}350 \text{ \#}$$

$$530{,}000 = (46{,}350 \times 200) - (215 \times 30 \times 486) - (100 \times 486 \times 150) - (100 \times 486 \times 50) \quad 100R_2$$
$$R_2 = 41{,}000\text{\#}$$

An attempt was make to use built up sections and also rolled sections for the cross-supports of the floor but due to the excess weight this was discarded and a truss selected.

A sketch for computation purposes is found in the pocket in the back of this thesis.

STRESS IN MEMBERS

DIAGONAL MEMBERS

$L_1 U_2$ --- 2,750

$L_2 U_3$ --- 5,500

$L_3 U_4$ --- 8,200

$L_4 U_5$ --- 10,900

$L_5 U_6$ --- 13,700

$L_6 U_7$ --- 16,450

$L_7 U_A$ --- 19,200

$L_8 U_A$ --- 43,700

$L_9 U_8$ ---42,000

$L_{10}U_9$ --- 38,400

$L_{11}U_{10}$ --- 35,400

$L_{12}U_{11}$--- 32,900

$L_{13}U_{12}$ --- 30,000

$L_{14}U_{13}$ --- 27,300

$L_{15}U_{14}$ --- 24,500

$L_{16}U_{15}$ --- 21,800

$L_{17}U_{16}$ --- 19,100

$L_{18}U_{17}$ --- 16,300

$L_{19}U_{18}$ --- 13,500

$L_{20}U_{19}$ --- 10,800

$L_{21}U_{20}$ --- 8,100

$L_{22}U_{21}$ --- 5,350

$L_{23}U_{22}$ --- 2,600

$L_{23}U_{24}$ --- 2330

$L_{24}U_{25}$ --- 5,070

$L_{25}U_{26}$ --- 7,800

$L_{26}U_{27}$ --- 10,520

$L_{27}U_{28}$ --- 13,300

$L_{28}U_{29}$ --- 16,000

$L_{29}U_{30}$ --- 18,900

$L_{30}U_{31}$ ---	21,600	$L_{39}U_{38}$ ---	16,300
$L_{31}U_{32}$ ---	24,400	$L_{40}U_{39}$ ---	13,500
$L_{33}U_{32}$ ---	32,800	$L_{41}U_{40}$ ---	10,750
$L_{34}U_{33}$ ---	30,000	$L_{42}U_{41}$ ---	8,000
$L_{35}U_{34}$ ---	27,300	$L_{43}U_{42}$ ---	5,300
$L_{36}U_{35}$ ---	24,500	$L_{44}U_{43}$ ---	2,560
$L_{37}U_{36}$ ---	21,900	$L_{45}U_{44}$ ---	000
$L_{38}U_{37}$ ---	19,000		

All of the above diagonals are stressed in tension.

VERTICAL MEMBERS

$L_1\ U_1$ ---	1944	$L_{13}U_{13}$ ---	21, 278
$L_2\ U_2$ ---	3,888	$L_{14}U_{14}$ ---	19,334
$L_3\ U_3$ ---	5,832	$L_{15}U_{15}$ ---	17,390
$L_4\ U_4$ ---	7,776	$L_{16}U_{16}$ ---	15.446
$L_5\ U_5$ ---	9,720	$L_{17}U_{17}$ ---	13,502
$L_6\ U_6$ ---	11,664	$L_{18}U_{18}$ ---	11,558
$L_7\ U_7$ ---	13,508	$L_{19}U_{19}$ ---	9,624
$L_8\ U_8$ ---	46,350	$L_{20}U_{20}$ ---	7,680
$L_9\ U_9$ ---	30,998	$L_{21}U_{21}$ ---	5,736
$L_{10}U_{10}$ ---	29,054	$L_{22}U_{22}$ ---	3,790
$L_{11}U_{11}$ ---	27,110	$L_{23}U_{23}$ ---	1,944
$L_{12}U_{12}$ ---	25,166	$L_{24}U_{24}$ ---	3,592

$L_{25}U_{25}$ --- 5,536

$L_{26}U_{26}$ --- 7,480

$L_{27}U_{27}$ --- 9,424

$L_{28}U_{28}$ --- 11,368

$L_{29}U_{29}$ --- 13,312

$L_{30}U_{30}$ --- 15,256

$L_{31}U_{31}$ --- 17,200

$L_{32}U_{32}$ --- 41,000

$L_{33}U_{33}$ --- 23,198

$L_{34}U_{34}$ --- 21,254

$L_{35}U_{35}$ --- 19,310

$L_{36}U_{36}$ --- 17,366

$L_{37}U_{37}$ --- 15,422

$L_{38}U_{38}$ --- 13,478

$L_{39}U_{39}$ --- 11,534

$L_{40}U_{40}$ --- 9,590

$L_{41}U_{41}$ --- 7,646

$L_{42}U_{42}$ --- 5,702

$L_{43}U_{43}$ --- 3,758

$L_{44}U_{44}$ --- 1,944

$L_{45}U_{45}$ --- 1,944

All vertical members are stressed in compression.

UPPER CHORD MEMBERS

U_1 U_2 --- 000

U_2 U_3 --- 1,944

U_3 U_4 --- 5,832

U_4 U_5 --- 11,664

U_5 U_6 --- 19,440

U_6 U_7 --- 29,160

U_7 U_A --- 40,824

U_A U_8 --- 231,730

U_8 U_9 --- 202,676

U_9 U_{10} --- 175,556

U10U11 --- 150.400

$U_{11}U_{12}$ --- 127,178

$U_{12}U_{13}$ --- 105,900

$U_{13}U_{14}$ ~~-86~~ 86,556

$U_{14}U_{15}$ --- 69,176

$U_{15}U_{16}$ --- 53,730

$U_{16}U_{17}$ --- 40,228

$U_{17}U_{18}$ --- 28,670

$U_{18}U_{19}$ --- 19,056

$U_{19}U_{20}$ --- 11,376

$U_{20}U_{21}$ --- 5,640

$U_{21}U_{22}$ --- 1848

$U_{22}U_{23}$ --- 0000

$U_{23}U_{24}$ --- 0000

$U_{24}U_{25}$ --- 1,645

$U_{25}U_{26}$ --- 5,240

$U_{26}U_{27}$ --- 10,776

$U_{27}U_{28}$ --- 18,256

$U_{28}U_{29}$ --- 27,680

$U_{29}U_{30}$ --- 39,048

$U_{30}U_{31}$ --- 52,360

$U_{31}U_{32}$ --- 67,616

$U_{32}U_{33}$ --- 126,874

$U_{33}U_{34}$ --- 105,620

$U_{34}U_{35}$ --- 86,210

$U_{35}U_{36}$ --- 68,944

$U_{36}U_{37}$ --- 53,522

$U_{37}U_{38}$ --- 40,044

$U_{38}U_{39}$ --- 28,510

$U_{39}U_{40}$ --- 18,920

$U_{41}U_{42}$ --- 11,274

$U_{42}U_{43}$ --- 5,572

$U_{43}U_{44}$ --- 1814

$U_{44}U_{45}$ --- 000

$U_{45}U_{46}$ --- 000

All upper chord members are stressed in tension

<u>LOWER CHORD MEMBERS</u>

$L_1 L_2$ --- 1,944

$L_2 L_3$ --- 5,832

$L_3 L_4$ --- 11,664

$L_4 L_5$ --- 19,440

$L_5 L_6$ --- 29,160

$L_6 L_7$ --- 40,824

$L_7 L_A$ --- 54,442

$L_A L_8$ --- 262,728

$L_8 L_9$ --- 231,730

$L_9 L_{10}$ --- 202,676

$L_{10}L_{11}$ --- 175,566

$L_{11}L_{12}$ --- 150,400

$L_{12}L_{13}$	---	127,178
$L_{13}L_{14}$	---	105,900
$L_{14}L_{15}$	---	86,566
$L_{15}L_{16}$	---	69,176
$L_{16}L_{17}$	---	53,730
$L_{17}L_{18}$	---	40,228
$L_{18}L_{19}$	---	28,670
$L_{19}L_{20}$	---	19,056
$L_{20}L_{21}$	---	11,376
$L_{21}L_{22}$	---	5,640
$L_{22}L_{23}$	---	1848
$L_{23}L_{24}$	---	1,848
$L_{24}L_{25}$	---	5,240
$L_{25}L_{26}$	---	11,776
$L_{26}L_{27}$	---	19,256
$L_{27}L_{28}$	---	28,680
$L_{28}L_{29}$	---	40,048
$L_{29}L_{30}$	---	53,360
$L_{30}L_{31}$	---	68,616
$L_{31}L_{32}$	---	85,816
$L_{32}L_{33}$	---	126,874
$L_{33}L_{34}$	---	105,620
$L_{34}L_{35}$	---	86,310
$L_{35}L_{36}$	---	68,944
$L_{36}L_{37}$	---	53,522
$L_{37}L_{38}$	---	40,044
$L_{38}L_{39}$	---	28,510
$L_{39}L_{40}$	---	18,920
$L_{40}L_{41}$	---	11,274
$L_{41}L_{42}$	---	5,572
$L_{42}L_{43}$	---	1814
$L_{43}L_{44}$	---	000

All lower members are in compression.

DESIGN OF MEMBERS

Stress limits used are 16,000 pounds per sq. inch for members in tension and the column formula of the Joint Committee of the A. R. E. A. and the A. S. C. E. was used. ($P/A = 15,000 - 50 \times l/r$

DESIGN OF DIAGONAL MEMBERS

L_1U_2 --- stress 2,750#

2,750 ÷ 2 = 1,375#, stress in one member

1,375 ÷ 16,000 = 0.085 sq in area reqd.

A 1/8 inch bar was selected

Weld required was one inch at each end.

Weight is 5.65 x .053 = 0.78 pounds

In form similar to the above computation the following table was computed.

Member	Stress	Size	Weld	Weight
L_1U_2	2,750	1/8 x 1/8	1"	.78
L_2U_3	5,500	7/16 x 7/16	1"	7.4
L_3U_4	8,200	1/2 x 1/2	1"	9.6
L_4U_5	10,900	5/8 x 5/8	1"	15.0
L_5U_6	13,700	3/4 x 3/4	½"	21.6
L_6U_7	16,450	3/4 x 3/4	½"	21.6
L_7U_A	19,200	1/2 x 2 1/4	1"	23.0
L_8U_A	43,700	1/2 x 2 3/4	1½"	53.0
L_9U_8	42,000	1/2 x 2 5/8	1½"	50.0
$L_{10}U_9$	38,400	1/2 x 2 5/16	1½"	44.0
$L_{11}U_{10}$	35,400	1/2 x 2 1/4	1½"	42.0
$L_{12}U_{11}$	32,900	1/2 x 2	1"	39.0
$L_{13}U_{12}$	30,000	1/2 x 2	1"	39.0
$L_{14}U_{13}$	27,300	1/2 x 1 7/8	1"	35.5

Member	Stress	Size	Weld	Weight
$L_{15}U_{14}$	19,334	1/2 x 1 1/2	1"	29.0
$L_{16}U_{15}$	17,390	1/2 x 1 1/2	1"	29.0
$L_{17}U_{16}$	15,446	1/2 x 1 1/4	1"	25.4
$L_{18}U_{17}$	13,502	1/2 x 1	1"	19.5
$L_{19}U_{18}$	11,558	1/2 x 1	1"	19.5
$L_{20}U_{19}$	9,624	1/2 x 3/4	1"	13.0
$L^{21}_{21}U_{20}$	7,680	1/2 x 1/2	1"	9.6
$L_{22}U_{21}$	5,736	7/16 x 7/16	1"	7.4
$L_{23}U_{22}$	3,790	3/16 x 3/16	1"	1.34
$L_{23}U_{24}$	1,944	3/16 x 3/16	1"	1.34
$L_{24}U_{25}$	5,070	7/16 x 7/16	1"	7.4
$L_{25}U_{26}$	7,800	1/2 x 1/2	1"	9.6
$L_{26}U_{27}$	10,520	5/8 x 5/8	1"	15.0
$L_{27}U_{28}$	13,300 13,300	1/2 x 1	1"	19.5
$L_{28}U_{29}$	16,000	1/2 x 1	1"	19.5
$L_{29}U_{30}$	18,900	1/2 x 1 1/4	1"	25.4
$L_{30}U_{31}$	21,600	1/2 x 1 1/2	1"	29.0
$L_{31}U_{32}$	24,400	1/2 x 1 1/2	1"	29.0
$L_{33}U_{32}$	32,800	1/2 x 2	$1\frac{1}{4}$"	38.1
$L_{34}U_{33}$	30,000	1/2 x 2	$1\frac{1}{4}$"	38.1
$L_{35}U_{34}$	27,300	1/2 x 1 3/4	1"	31.8
$L_{36}U_{35}$	24,500	1/2 x 1 1/2	1"	29.0

Member	Stress	Size	Weld	Weight
$L_{37}U_{36}$	21,9000	1/2 x 1 1/2	1"	25.6
$L_{38}U_{37}$	19,000	1/2 x 1 1/4	1"	22.2
$L_{39}U_{38}$	16,300	1/2 x 1	1"	18.8
$L_{40}U_{39}$	13,500	1/2 x 7/8	1"	18.8
$L_{41}U_{40}$	10,750	1/2 x 3/4	1"	12.3
$L_{42}U_{41}$	8,000	1/2 x 1/2	1"	9.6
$L_{43}U_{42}$	5,300	7/16 x 7/16	1"	7.4
$L_{44}U_{43}$	2,560	5/16 x 5/16	1"	3.6
$L_{45}U_{44}$	000	5/16 x 5/16	1"	3.6

Total weight of the diagonals is 917,24 pounds

DESIGN OF LOWER MEMBERS

The lower members are of channels and, where needed, plates. At the points at which plates are not needed the channels are held apart by steel strips 1/4"x 1"x 14" placed in a zig-zag manner and welded to the channels. Although it is not necessary to have strips of this weight along the entire channel length the cost of having varying strips prohibits their use.

The width of channel used through out is 8"

I

It will be noted that the weight of channel is designed only for a span of two members. The cost of welding at the end of each pannel is far in excess of the cost of the extra weight of channel used so this method was adopted.

L_1 to L_3 ---Maximum stress 5832 #

5832 ÷ 13,500 =.43 square inches

Use 2-11.5# 8" channel with

45 degree lateral bracing

Weight 92# per pannel

Above is sampel of computations from which the following table was computed

Member	Max. Stress	Wt 8" Channel	Plates	Wt. per pan.
L_3 to L_5	19,440	11.5	------	92
L_5 to L_7	40,834	11.5	------	92
L_7 to L_A	54,422	11.5	--------	92
L_A to L_9	202,728	21.23	2- 3/8"x 10"	292
L_9 to L_{11}	202,676	21.25	1- 1/4"x 10"	225
L_{11} to L_{13}	150,400	18.75	-----------	150
L_{13} to L_{15}	105,900	13.75	-----------	110
L_{15} to L_{17}	69,176	11.5	--------	92
L_{17} to L_{32}	85,818	11.5	-------	92
L_{32} to L_{34}	126,874	21.25	-------	170
L_{34} to $_1L_{44}$	86,310	11.5	-------	92

Total weight of lower members is 5,114#

DESIGN OF UPPER MEMBERS

It was found that the best method of constructing the member was to use a built up "I" beam. Minimun plate depth used was $9\frac{1}{2}$" and the minimum angel used was $2\frac{1}{2}$" x $2\frac{1}{2}$". The limiting feature was the stress of 231,730 pounds being member U_A to U_9. It will be noted that, as in the case of the lower members, the design was made for a span of two pannels.

Minimum plate $\frac{1}{4}$" x $9\frac{1}{2}$" == 2.38 sq. in.

Minimum angles 3/16" = 3.60 sq. in.

Stress is possible of 5.98 x 16,000

or 95,500 pounds

The following table was computed.

Member	Stress	Angle thickness	Plate thickness
U_1 to U_A	40,824	3/16"	1/4"
U_A to U_9	231,730	1/2"	9/16"
U_9 to U_{11}	175,566	3/8"	1/2"
U_{11} to U_{13}	127,178	1/4"	3/8"
U_{13} to U_{32}	67,616	3/16"	1/4"
U_{32} to U_{34}	126,874	1/4"	3/8"
U_{34} to U_{45}	86,000	3/16"	1/4"

Total weight of upper chord members is 4,300#

DESIGN OF VERTICAL MEMBERS

D Design of the vertical members is by means of the column formula of the Joint Committee of the A. R. E. A. and the A. S. C. E. (P/A = 15,000 - 50 l/r)

1 x 1 x 1/4 was the minimun angle used for any member.

Angle size 1 x 1 x 1/4

r = 0.29   A = 0.44

P/0.44 = 15,000 - 50 x 5 x 12 ÷ 0.29

Stress allowable is 5,550

Above is a sample of the computations from which the following table was computed.

Member	Stress	Size angle	Weight	Weld
$L_1 U_1$	1,944	1 x 1 x 1/4	12.70	1"
$L_2 U_2$	3,888	1 x 1 x 1/4	12.70	1"
$L_3 U_3$	5,832	1 x 1 x 1/4	12.70	1"
$L_4 U_4$	7,776	1 x 1 x 1/4	12.70	1"
$L_5 U_5$	9,720	1 x1 x 1/4	12.70	1"
$L_6 U_6$	11,664	$1\frac{1}{4}$ x $1\frac{1}{4}$ x $\frac{1}{4}$	19.20	$1\frac{1}{4}$"
$L_7 U_7$	13,508	$1\frac{1}{4}$ x $1\frac{1}{4}$ x $\frac{1}{2}$	19.20	$1\frac{1}{4}$"
$L_8 U_8$	30,998	2 x 2 x 5/16	39.2	$1\frac{1}{4}$"
$L_9 U_9$	29,054	2 x 2 x 5/16	39x2	$1\frac{1}{4}$"
$L_{10} U_{10}$	27.110	$1\frac{3}{4}$ x $1\frac{3}{4}$ x 5/16	33.9	$1\frac{1}{4}$"
$L_{11} U_{11}$	25,166	$1\frac{3}{4}$ x $1\frac{3}{4}$ x 5/16	33.9	$1\frac{1}{4}$"
$L_{12} U_{12}$	23,222	$1\frac{3}{4}$ x $1\frac{3}{4}$ x 1/4	27.9	1"
$L_{13} U_{13}$	21,278	$1\frac{3}{4}$ x $1\frac{3}{4}$ x 1/4	27.9	1"
L14U14	19334	$1\frac{1}{2}$ x $1\frac{1}{2}$ x 1/4	23.4	1"

Member	Stress	Size angle	Weight	Weld
$L_{15}U_{15}$	17,390	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$	23.4	1"
$L_{16}U_{16}$	15,446	$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{1}{4}$	19.4	1"
$L_{17}U_{17}$	13,502	$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{1}{4}$	19.4	1"
$L_{18}U_{18}$	11,558	$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{1}{4}$	19.4	1"
$L_{19}U_{19}$	9,624	$1 \times 1 \times \frac{1}{4}$	14.9	1"
$L_{20}U_{20}$	7,680	$1 \times 1 \times \frac{1}{4}$	14.9	1"
$L_{21}U_{21}$	5.736	$1 \times 1 \times \frac{1}{4}$	14.9	1"
$L_{22}U_{22}$	3,790	$1 \times 1 \times \frac{1}{4}$	14.9	1"
$L_{23}U_{23}$	1,944	$1 \times 1 \times \frac{1}{4}$	14.9	1"
$L_{24}U_{24}$	3,592	$1 \times 1 \times \frac{1}{4}$	14.9	1"
$L_{25}U_{25}$	5,536	$1 \times 1 \times \frac{1}{4}$	14.9	1"
$L_{26}U_{26}$	7,480	$1 \times 1 \times \frac{1}{4}$	14.9	1"
$L_{27}U_{27}$	9,424	$1 \times 1 \times \frac{1}{4}$	14.9	1"
$L_{28}U_{28}$	11,368	$1 \times 1 \times \frac{1}{4}$	14.9	1"
$L_{29}U_{29}$	13,312	$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{1}{4}$	19.2	1"
$L_{30}U_{30}$	15,256	$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{1}{4}$	19.2	1"
$L_{31}U_{31}$	17,200	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$	23.4	1"
$L_{32}U_{32}$	41,000	$2 \times 2 \times 3/8$	47.0	2"
$L_{33}U_{33}$	23,198	$1\frac{1}{2} \times 1\frac{1}{2} \times 5/16$	28.6	$1\frac{1}{2}$"
$L_{34}U_{34}$	21,254	$1\frac{1}{2} \times 1\frac{1}{2} \times 5/16$	28.6	$1\frac{1}{4}$"
$L_{35}U_{35}$	19,310	$1\frac{1}{2} \times 1\frac{1}{2} \times 1/4$	23.4	1"
$L_{36}U_{36}$	17,366	$1\frac{1}{2} \times 1\frac{1}{2} \times 1/4$	23.4	1"
$L_{37}U_{37}$	15,422	$1\frac{1}{4} \times 1\frac{1}{4} \times 1/4$	19.4	1"
All other members		$1\frac{1}{4} \times 1\frac{1}{4} \times 1/4$	19.4	1"

Weight of vertical members is 976.40

The total weight of the truss is 89,892 pounds

The weight acting on R_1 is 46,631
Assumed weight acting on R_1 is 46,350
This is close enough to be O. K.

The weight acting on R_2 is 43,261
The assumed weight is 41,000
This is close enough to be O. K.

DESIGN OF SUPPORT TRUSS

, DUE to the fact that the truss supporting the floor acts with the action of a continious beam it is necessary to design the two support trusses with different loadings. Allowing a load of 250 pounds per foot for the truss, the load was 15.7 kip per foot. It will be noted that this load is taken as a uniform load instead of a series of concentrated loads at three foot intervals.

STRESS IN MEMBERS (DIAGONAL) All loads in kips

Member	Stress in truss A	Stress in truss B
L_1U_2	110	104
L_2U_3	298	298.3
L_3U_4	502	502
L_5U_4	550	520
L_6U_5	332	312
L_7U_6	112	105
L_7U_8	110	103
L_8U_9	329	312
$L_{10}U_9$	362	338
$L_{11}U_{10}$	142	132
$L_{11}U_{12}$	80.5	78
$L_{12}U_{13}$	302	286
$L_{13}U_{14}$	525	493

Member	Stress im truss A	Stress in truss B
$L_{15}U_{14}$	398	388
$L_{16}U_{15}$	175	181
$L_{16}U_{17}$	46.5	27
$L_{17}U_{18}$	270	235
$L_{18}U_{19}$	490	443
$L_{20}U_{19}$	425	415
$L_{21}U_{20}$	202	206
$L_{21}U_{22}$	19.8 242	1.4
$L_{22}U_{23}$	242	206
$L_{23}U_{24}$	463	415
$L_{25}U_{24}$	507	466
$L_{26}U_{25}$	284	259
$L_{27}U_{26}$	60.5	51
$L_{27}U_{28}$	161	157
$L_{28}U_{29}$	384	365
$L_{30}U_{29}$	273	242
$L_{31}U_{30}$	51	34
$L_{31}U_{32}$	171	174
$L_{32}U_{33}$	392	381
$L_{33}U_{34}$	615	590
$L_{35}U_{34}$	520	490
$L_{36}U_{35}$	300	281
$L_{37}U_{36}$	765	734
$L_{37}U_{38}$	146	135
$L_{38}U_{39}$	367	343
$L_{40}U_{39}$	477	570

Member	Stress in truss A	Stress in truss B
$L_{41}U_{40}$	257	273
$L_{42}U_{41}$	34	165
$L_{42}U_{43}$	188	42.5
$L_{43}U_{44}$	410	250
$L_{45}U_{44}$	353	457
$L_{46}U_{45}$	131	250
$L_{47}U_{46}$		41
$L_{46}U_{47}$	90.5	
$L_{47}U_{48}$	312	165
$L_{48}U_{49}$	535	373
$L_{50}U_{49}$	465	550
$L_{51}U_{50}$	245	342
$L_{52}U_{51}$	22.4	134
$L_{52}U_{53}$	200	342
$L_{53}U_{54}$	421	550
$L_{55}U_{54}$	523	605
$L_{56}U_{55}$	300	400
$L_{57}U_{56}$	790	191
$L_{57}U_{58}$	143	17
$L_{58}U_{59}$	365	225
$L_{60}U_{59}$	680	650
$L_{61}U_{60}$	463	443
$L_{62}U_{61}$	240	236
$L_{63}U_{62}$	32.5	28.3
$L_{63}U_{64}$	246	236

As the truss chosen was 10 feet high and the pannels 10 feet long the stress in the diagonals was computed by deviding the shear by 0.707. See computation sketch in the back of this thesis for location of the members.

DESIGN OF DIAGONALS

The design was chosen to be of built up "I" beam type the "I" being composed of 4 angles and a single web plate. A tensile stress of 16,000 pounds per square inch was allowed. It will be noted that all web plates are 15" wide. This is necessary due to the fact that the lower chord is of this width and in order to secure aducate fastening at the joints it is essential that the "I" beam be of this width also.

The process of design is as follows;--

Stress $\div$ 16,000 = Sq. in. of steel required.

By means of a steel handbook suitable sections were chosen.

	Truss A		Truss B	
Member	Angles	Plate	Angles	Plate
$L_1 U_2$	3 $3 \times 2\frac{1}{2} \times \frac{1}{4}$	$\frac{1}{4}$	$3 \times 2\frac{1}{2} \times \frac{1}{4}$	$\frac{1}{4}$
$L_2 U_3$	$3\frac{1}{2} \times 3\frac{1}{2} \times 3/8$	$\frac{1}{2}$	$3\frac{1}{2} \times 3\frac{1}{2} \times 3/8$	3/8
$L_3 U_4$	$4 \times 4 \times 5/8$	3/4	$4 \times 4 \times 5/8$	3/4
$L_5 U_4$	$4 \times 4 \times 5/8$	3/4	$4 \times 4 \times 5/8$	3/4
$L_6 U_5$	$3 \times 2\frac{1}{2} \times 5/8$	$\frac{1}{4}$	$3 \times 2\frac{1}{2} \times 3/8$	1/4
$L_7 U_6$	$3 \times 2\frac{1}{2} \times \frac{1}{4}$	$\frac{1}{4}$	$3 \times 2\frac{1}{2} \times \frac{1}{4}$	$\frac{1}{4}$
$L_7 U_8$	$3 \times 2\frac{1}{2} \times 3/8$	$\frac{1}{4}$	$3 \times 2\frac{1}{2} \times 3/8$	$\frac{1}{4}$
$L_8 U_9$	$3 \times 2\frac{1}{2} \times 3/8$	$\frac{1}{4}$	$3 \times 2\frac{1}{2} \times 3/8$	$\frac{1}{4}$
$L_{10} U_9$	$4 \times 3 \times 5/8$	3/8	$4 \times 3 \times 5/8$	3/8
$L_{11} U_{10}$	$3 \times 2\frac{1}{2} \times \frac{1}{4}$	$\frac{1}{4}$	$3 \times 2\frac{1}{2} \times \frac{1}{4}$	$\frac{1}{4}$
$L_{11} U_{12}$	$3 \times 2\frac{1}{2} \times \frac{1}{4}$	$\frac{1}{4}$	$3 \times 2\frac{1}{2} \times \frac{1}{4}$	$\frac{1}{4}$
$L_{12} U_{13}$	$4 \times 3 \times 3/8$	$\frac{1}{2}$	$3 \times 2\frac{1}{2} \times \frac{1}{4}$	$\frac{1}{2}$

Member	Truss A Angles	Truss A Plate	Truss B Angles	Truss B Plate
$L_{13}U_{14}$	4 x 4 x ½	1	4 x 4 x ½	1
$L_{15}U_{14}$	4 x 3 x ½	3/4	4 x 3 x ½	3/4
$L_{16}U_{15}$	3 x 2½ x 3/8	¼	3 x 2½ x 3/8	¼
$L_{16}U_{17}$	3 x 2½ x ¼	¼	3 x 2½ x ¼	¼
$L_{17}U_{18}$	3 x 2½ x ½	½	3 x 2½ x 3/8	½
$L_{18}U_{19}$	4 x 4 x ½	1	4 x 4 x 3/8	1
$L_{20}U_{19}$	4 x 4 x 3/8	7/8	4 x 4 x 3/8	7/8
$L_{21}U_{20}$	3 x 2½ x 3/8	3/8	3 x 2½ x 3/8	3/8
$L_{21}U_{22}$	3 x 2½ x ¼	¼	3 x 2½ x ¼	¼
$L_{22}U_{23}$	3 x 2½ x ½	3/8	3 x 2½ x 3/8	3/8
$L_{23}U_{24}$	4 x 4 x ½	1	4 x 3 x 5/8	5/8
$L_{25}U_{24}$	4 x 3 x 5/8	1	4 x 3 x 5/8	1
$L_{26}U_{25}$	3 x 2½ x ½	½	3 x 2½ x ½	½
$L_{27}U_{26}$	3 x 2½ x ¼	¼	3 x 2½ x ¼	¼
$L_{27}U_{28}$	3 x 2½ x ¼	3/8	3 x 2½ x ¼	3/8
$L_{28}U_{29}$	3½ x 3½ x 3/8	7/8	3½ x 3½ x 3/8	7/8
$L_{30}U_{29}$	3 x 2½ x ½	½	3 x 2½ x ½	3/8
$L_{31}U_{30}$	3 x 2½ x ¼	¼	3 x 2½ x ¼	¼
$L_{31}U_{32}$	3 x 2½ x ¼	3/8	3 x 2½ x ¼	3/8
$L_{32}U_{33}$	3½ x 3½ x 3/8	7/8	3½ x 3½ x 3/8	7/8
$L_{33}U_{34}$	4 x 4 x 5/8	3/4	4 x 4 x 5/8	3/4
$L_{35}U_{34}$	4 x 4 x 5/8	1	4 x 4 x ½	1
$L_{36}U_{35}$	4 x 3 x 3/8	5/8	4 x 3 x 3/8	5/8
$L_{37}U_{36}$	6 x 4 x 3/4	1 3/8	6 x 4 x 3/4	1 3/8
$L_{37}U_{38}$	3 x 2½ x ¼	¼	3 x 2½ x ¼	¼
$L_{38}U_{39}$	3½ x 3½ x 3/8	7/8	3½ x 3½ x 3/8	3/4

Member	Truss A Angles	Truss A Plate	Truss B Angles	Truss B Plate
$L_{40}U_{39}$	4 x 4 x ½	1	6 x 4 x 5/8	1
$L_{41}U_{40}$	3 x 2½ x ½	3/8	3 x 2½ x ½	3/8
$L_{42}U_{41}$	3 x 2½ x ¼	¼	3 x 2½ x ¼	3/8
$L_{42}U_{43}$	3 x 2½ x ¼	3/8	3 x 2½ x ¼	¼
$L_{43}U_{44}$	3 x 2½ x ½	1	3 x 2½ x 3/8	½
$L_{45}U_{44}$	4 x 3 x ½	5/8	4 x 4 x ½	1
$L_{46}U_{45}$	3 x 2½ x ¼	¼	3 x 2½ x ½	3/8
$L_{47}U_{46}$			3 x 2½ x ¼	¼
$L_{46}U_{47}$	3 x 2½ x ¼	¼		
$L_{47}U_{48}$	3 x 2½ x ½	5/8	3 x 2½ x ¼	3/8
$L_{48}U_{49}$	4 x 4 x 5/8	1	3 x 2½ x 3/8	½
$L_{50}U_{49}$	4 x 4 x ½	1	4 x 4 x 5/8	1
$L_{51}U_{50}$	3 x 2½ x ½	3/8	3 x 2½ x ½	3/4
$L_{52}U_{51}$	3 x 2½ x ¼	¼	3 x 2½ x ¼	¼
$L_{52}U_{53}$	3 x 2½ x 3/8	3/8	4x 4 x 3/8	5/8
$L_{53}U_{54}$	5 x 3½ x ½	3/4	6 x 4 x ½	1
$L_{55}U_{54}$	4 x 4 x 5/8	1	6 x 4 x 5/8	1
$L_{56}U_{55}$	3 x 2½ x ¼	5/8	3 x 2½ x ½	1
$L_{57}U_{56}$	6 x 4 x 3/4	1 3/8	3 x 2½ x ¼	3/8
$L_{57}U_{58}$	3 x 2½ x ¼	¼	3 x 2½ x ¼	¼
$L_{58}U_{59}$	4 x 3 x ½	5/8	3 x 2½ x ½	3/8
$L_{60}U_{59}$	6 x 4 x 5/8	1 3/8	6 x 4 x 3/4	1
$L_{61}U_{60}$	6 x 4 x ½	5/8	6 x 4 x ½	5/8
$L_{62}U_{61}$	3 x 2½ x ½	3/8	3 x 2½ x ½	3/8
$L_{63}U_{62}$	3 x 2½ x ¼	¼	3 x 2½ x ¼	¼
$L_{63}U_{64}$	3 x 2½ x ½	3/8	3 x 2½ x ½	3/8

STRESS AND DESIGN OF THE VERTICAL MEMBERS

The vertical members are stressed in compression so they are therefore designed as columns. The best section to use was found to be a column built up of two plates and four angles. The angles were turned in to give aditional bearing area for the column to rest on. The column is held apart and braced by lattice work at 45 degree pitch. In the design of the columns the formula $\frac{P}{A} = 16{,}000 - 50\ l/r$ was used. The following table was compiled from the computations.

Member	Stress of truss A	Stress of truss B	Truss A Angles	Truss A Plate	Truss B Angles	Truss B Plate
$L_1 U_1$	78.5	73.5	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$	$10 \times \frac{1}{4}$	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$	$10 \times \frac{1}{4}$
$L_2 U_2$	235.5	120.5	$2\frac{1}{2} \times 2\frac{1}{2} \times 3/8$	$10 \times \frac{1}{2}$	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$	$10 \times \frac{1}{4}$
$L_3 U_3$	628.0	330	$6 \times 6 \times 3/8$	$16 \times 7/8$	$3 \times 3 \times 3/8$	$12 \times 5/$
$L_4 U_4$	942	882	$6 \times 6 \times 3/4$	$18 \times 7/8$	$6 \times 6 \times 3/4$	$18 \times 7/8$
$L_5 U_5$	383	383	$3\frac{1}{2} \times 3\frac{1}{2} \times 5/8$	$12 \times \frac{1}{2}$	$3\frac{1}{2} \times 3\frac{1}{2} \times 5/8$	$12 \times \frac{1}{2}$
$L_6 U_6$	232	221	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$	$10 \times 3/8$	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$	$10 \times 3/8$
$L_7 U_7$	157	147	$2\frac{1}{2} \times 2\frac{1}{2} \times 3/8$	$10 \times \frac{1}{4}$	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$	$10 \times \frac{1}{4}$
$L_8 U_8$	235	143	$3 \times 3 \times \frac{1}{2}$	$10 \times 3/8$	$2\frac{1}{2} \times 2\frac{1}{2} \times 3/8$	$10 \times \frac{1}{4}$
$L_9 U_9$	646	606	$6 \times 6 \times \frac{1}{2}$	$16 \times 3/4$	$6 \times 6 \times \frac{1}{2}$	$16 \times 5/8$
$L_{10} U_{10}$	257	239	$3 \times 3 \times \frac{1}{2}/3$	$12 \times 3/8$	$3 \times 3 \times 3/8$	$12 \times 3/8$
$L_{11} U_{11}$	157	147	$2\frac{1}{2} \times 2\frac{1}{2} \times 3/8$	$10 \times \frac{1}{4}$	$2\frac{1}{2} \times 2\frac{1}{2} \times 3/8$	$10 \times \frac{1}{4}$

Member	Stress truss A	Stress truss B	Truss A Angles	Truss A Plate	Truss B Angles	Truss B Plate
$L_{12}U_{12}$	214	202	3 x 3 x ½	12 x ¼	3 x 3 x 3/8	12 x ¼
$L_{13}U_{13}$	371	349	3½ x 3½ x 5/8	12 x ½	3½ x 3½ x 5/8	12 x ½
$L_{14}U_{14}$	809	771	6 x 6 x 3/4	16 x 3/4	6 x 6 x 3/4	16 x 3/4
$L_{15}U_{15}$	281	275	3½ x 3½ x ½	10 x 3/8	3½ x 3½ x ½	10 x 3/8
$L_{16}U_{16}$	157	147	2½ x 2½ x 3/8	10 x ¼	2½ x 2½ x 3/8	10 x ¼
$L_{17}U_{17}$	190	166	2½ x 2½ x ¼	12 x 3/8	2½ x 2½ x 3/8	12 x 3/8
$L_{18}U_{18}$	347	313	3½ x 3½ x ½	12 x 1/2	3 x 3 x 3/8	12 x 5/8
$L_{19}U_{19}$	804	753	6 x 6 x 3/4	16 x 7/8	6 x 6 x 3/4	16 x 3/4
$L_{20}U_{20}$	300	293	3½ x 3½ x 3/8	12 x ½	3½ x 3½ x 3/8	12 x ½
$L_{21}U_{21}$	157	147	2½ x 2½ x 3/8	10 x ¼	2½ x 2½ x 3/8	10 x ¼
$L_{22}U_{22}$	171	148	2½ x 2½ x ¼	10 x 3/8	2½ x 2½ x 3/8	10 x ¼
$L_{23}U_{23}$	328	293	3½ x 3½ x 5/8	10 x 5/8	3 x 3 x ½	10 x ½
$L_{24}U_{24}$	842	770	6 x 6 x 3/4	16 x 7/8	6 x 6 x 5/8	16 x 7/8
$L_{25}U_{25}$	357	330	3 x 3 x ½	12 x 5/8	3 x 3 x 3/8	12 x 5/8
$L_{26}U_{26}$	200	183	2½ x 2½ x 3/8	10 x 3/8	2½ x 2½ x ¼	10 x ¼
$L_{27}U_{27}$	157 147	147	2½ x 2½ x 3/8	10 x ¼	2½ x 2½ x 3/8	10 x ¼
$L_{28}U_{28}$	271	258	3½ x 3½ x 3/8	10 x ½	3 x 3 x 3/8	10 x ½
$L_{29}U_{29}$	621	705	6 x 6 x 5/8	16 x ½	6 x 6 x 5/8	16 x 3/4
$L_{30}U_{30}$	193	181	3 x 3 x ½	10xx ¼	3 x 3 x ½	10 x ¼
$L_{31}U_{31}$	157	147	2½ x 2½ x 3/8	10 x ¼	2½ x 2½ x 3/8	10 x ¼
$L_{32}U_{32}$	278	270	3 x 3 x ½	12 x 3/8	3 x 3 x ½	12 x 3/8
$L_{33}U_{33}$	435	417	4 x 4 x 5/8	12 x 5/8	4 x 4 x 5/8	12 x ½
$L_{34}U_{34}$	860	810	6 x 6 x 3/4	16 x 7/8	6 x 6 x 3/4	16 x 3/4
$L_{35}U_{35}$	368	346	4 x 4 x 3/8	12 x 5/8	4 x 4 x 3/8	12 x 5/8

Membef	Srwess truss A	Stress truss B	Truss A Angles	Plate	Truss B Angles	Plate
$L_{36}U_{36}$ L	211	199	3 x 3 x ¼	10 x ½	3 x 3 x ½	10 x ¼
$L_{37}U_{37}$	157	147	2½ x 2½ x 3/8	10 x ¼	2½ x 2½ x¼	10 x ¼
$L_{38}U_{38}$	260	242	2½ x 2½ x 3/8	12 x ½	2½ x 2½ x ½	12 x 3/8
$L_{39}U_{39}$	755	700	6 x 6 x 5/8	16 x 7/8	6 x 6 x ½	16 x 7/8
$L_{40}U_{40}$	338	411	3½ x 3½ x 3/8	12 x 5/8	4 x 4 x 5/8	14 x 3/4
$L_{41}U_{41}$	181	264	2½ x 2½ x ¼	10 x 3/8	3 x 3 x ½	10 x ½
$L_{42}U_{42}$	157	147	2½ x 2½ x 3/8	10 x ¼	2½ x 2½ x 3/8	10 x ¼
$L_{43}U_{43}$	290	177	4 x 4 x 3/8	12 x 3/8	3 x 3 x 3/8	10 x ¼
$L_{44}U_{44}$	690	647	6 x 6 x ½	16 x 7/8	6 x 6 x ½	16 x 3/4
$L_{45}U_{45}$	250	223	3 x 3 x ¼	10 x 5/8	3 x 3 x 3/8	10 x 3/8
$L_{46}U_{46}$	157	169	2½ x 2½ x 3/8	10 x ¼	2½ x 2½ x 3/8	10 x ¼
$L_{47}U_{47}$	221	147	3 x 3 x 3/8	10 x 3/8	2½ x 2½ x 3/8	10 x ¼
$L_{48}U_{48}$	378	264	3½ x 3½ x 5/8	12 x ½	4 x 4 x 3/8	12 x 3/8
$L_{49}U_{49}$	865	810	6 x 6 x 3/4	16 x 7/8	6 x 6 x 3/4	16 x 3/4
$L_{50}U_{50}$	330	389	3 x 3 x ½	12 x ½	3½ x 3½ x 5/8	12 x ½
$L_{51}U_{51}$	173	242	2½ x 2½ x 3/8	12 x ¼	2½ x 2½ x ¼	10 x 5/8
$L_{52}U_{52}$	157	147	2½ x 2½ x 3/8	10 x ¼	2½ x 2½ x 3/8	10 x ¼
$L_{53}U_{53}$	298	389	3 x 3 x ½	10 x ½	3½ x 3½ x 5/8	10 x 5/8
$L_{54}U_{54}$	925	865	6 x 6 x 7/8	18 x 7/8	6 x 6 x 7/8	18 x 3/4
$L_{55}U_{55}$	370	429	3½ x 3½ x 5/8	12 x ½	3½ x 3½ x 5/8	12 x 5/8
$L_{56}U_{56}$	157	147	2½ x 2½ x 3/8	10 x ¼	2½ x 2½ x 3/8	10 x ¼
$L_{57}U_{57}$	258	169	3 x 3 x 3/8	10 x ½	2½ x 2½ x 3/8	10 x ¼

Member	Stress truss A	Stress truss B	Truss A Angles	Truss A Plate	Truss B Angles	Truss B Plate
$L_{59}U_{59}$	899	767	6 x 6 x 7/8	18 x 3/4	6 x 6 x 5/8	18 x 3/4
$L_{60}U_{60}$	484	461	$3\frac{1}{2}$ x $3\frac{1}{2}$ x $\frac{1}{2}$	14 x 3/4	$3\frac{1}{2}$ x $3\frac{1}{2}$ x $\frac{1}{2}$	14 x 3/4
$L_{61}U_{61}$	320	314	$3\frac{1}{2}$ x $3\frac{1}{2}$ x $\frac{1}{2}$	10 x $\frac{1}{2}$	$3\frac{1}{2}$ x $3\frac{1}{2}$ x $\frac{1}{2}$	10 x $\frac{1}{2}$
$L_{62}U_{62}$	180	167	$2\frac{1}{2}$ x $2\frac{1}{2}$ x $\frac{1}{4}$	10 x 3/8	$2\frac{1}{2}$ x $2\frac{1}{2}$ x $\frac{1}{4}$	10 x 3/8
$L_{63}U_{63}$	157	147	$2\frac{1}{2}$ x $2\frac{1}{2}$ x 3/8	10 x $\frac{1}{4}$	$2\frac{1}{2}$ x $2\frac{1}{2}$ x 3/8	10 x $\frac{1}{4}$
$L_{64}U_{64}$	625	590	4 x 4 x 5/8	16 x 7/8	4 x 4 x 5/8	16 x 3/4

The above listed stresses are in kips.

STRESSES IN THE UPPER CHORD MEMBERS

The upper chord members are stressed in tension throughout the entire truss. The stress was computed by the method of joints. The following table gives the stresses in all upper chord members.

Member	Stress in truss A in kips	Stress in truss B in kips
$U_1\ U_2$	0	0
$U_2\ U_3$	78.5	73.5
$U_3\ U_4$	313	284
$U_4\ U_5$	315	295
$U_5\ U_6$	79	74
$U_6\ U_7$	0	0
$U_7\ U_8$	0	0
$U_8\ U_9$	78	73
$U_9\ U_{10}$	100	92
$U_{10}U_{11}$	0	0
$U_{11}U_{12}$	0	0
$U_{12}U_{13}$	57	55
$U_{13}U_{14}$	271	257

Member	Stress in truss A in kips	Stress in truss B in kips
$U_{14}U_{15}$	124	128
$U_{15}U_{16}$	0	0
$U_{16}U_{17}$	0	0
$U_{17}U_{18}$	33	19
$U_{18}U_{19}$	223	185
$U_{19}U_{20}$	243	146
$U_{20}U_{21}$	0	0
$U_{21}U_{22}$	0	0
$U_{22}U_{23}$	14	1
$U_{23}U_{24}$	185	147
$U_{24}U_{25}$	243	219
$U_{25}U_{26}$	43	36
$U_{26}U_{27}$	0	0
$U_{27}U_{28}$	0	0
$U_{28}U_{29}$	114	111
$U_{29}U_{30}$	36	24
$U_{30}U_{31}$	0	0
$U_{31}U_{32}$	0	0
$U_{32}U_{33}$	121	123
$U_{33}U_{34}$	399	393
$U_{34}U_{35}$	265	251
$U_{35}U_{36}$	54	52
$U_{36}U_{37}$	0	0
$U_{37}U_{38}$	0	0
$U_{38}U_{39}$	103	95

Member	Stress in truss A in kips	Stress in truss B in kips
$U_{39}U_{40}$	205	381
$U_{40}U_{41}$	24	117
$U_{41}U_{42}$	0	0
$U_{42}U_{43}$	0	0
$U_{43}U_{44}$	133	30
$U_{44}U_{45}$	93	205
$U_{45}U_{46}$	0	29
$U_{46}U_{47}$	0	0
$U_{47}U_{48}$	64	0
$U_{48}U_{49}$	285	117
$U_{49}U_{50}$	209	197
$U_{50}U_{51}$	66	56
$U_{51}U_{52}$	0	0
$U_{52}U_{53}$	0	0
$U_{53}U_{54}$	141	242
$U_{54}U_{55}$	269	417
$U_{55}U_{56}$	56	135
$U_{56}U_{57}$	0	0
$U_{57}U_{58}$	0	0
$U_{58}U_{59}$	101	12
$U_{59}U_{60}$	520	501
$U_{60}U_{61}$	193	187
$U_{61}U_{62}$	23	20
$U_{62}U_{63}$	0	0
$U_{63}U_{64}$	0	0

DESIGN OF THE UPPER CHORD MEMBERS

In the design of the upper chord members it was necessary to take the fact that they are to provide bearing surface for the floor support trusses into account. For this reason they designed of a single web plate and 4 angles. In order to have a uniform depth upper chord the minimun and maximum depth of angle were required to be the same, the only variation being in the thickness of the angle. It will be noted that the members are designed from support to support instead of for each pannel. The design is for the maximum stress occuring in that span and is so designed because of the expense of welding at each pannel point.

Span	Thickness of angle in truss A	Thickness of angle in truss B	Plate A	Plate B
$U_1 U_4$	3/8"	3/8"	5/8"	1/2"
$U_4 U_9$	3/8"	3/8"	5/8"	5/8"
$U_9 U_{14}$	1/2"	1/2"	3/8"	3/8"
$U_{14} U_{19}$	3/8"	3/8"	3/8"	3/8"
$U_{19} U_{24}$	3/8"	3/8"	3/8"	3/8"
$U_{24} U_{29}$	1/2"	3/8"	3/8"	3/8"
$U_{29} U_{34}$	5/8"	5/8"	5/8"	5/8"
$U_{34} U_{39}$	3/8"	3/8"	1/2"	1/2"
$U_{39} U_{44}$	3/8"	5/8"	3/8"	5/8"
$U_{44} U_{49}$	3/8"	3/8"	1/2"	3/8"
$U_{49} U_{54}$	3/8"	3/8"	3/8"	3/8"
$U_{54} U_{59}$	3/8"	5/8"	1/2"	5/8"
$U_{59} U_{64}$	5/8"	5/8"	5/8"	5/8"

All angles are $3\frac{1}{2} \times 3\frac{1}{2}$

All plates are $15\frac{1}{4}$" wide.

STRESSES IN THE LOWER CHORD MEMBERS

Member	Stress in truss A in kips	Stress in truss B in kips
$L_1 L_2$	78.5	73.5
$L_2 L_3$	313	283
$L_3 L_4$	705	640
$L_4 L_5$	708	663
$L_5 L_6$	315	295
$L_6 L_7$	79	74
$L_7 L_8$	78	73
$L_8 L_9$	310	293
$L_9 L_{10}$	357	331
$L_{10} L_{11}$	100	92
$L_{11} L_{12}$	57	55
$L_{12} L_{13}$	271	257
$L_{13} L_{14}$	342	606
$L_{14} L_{15}$	405	403
$L_{15} L_{16}$	124	128
$L_{16} L_{17}$	33	19
$L_{17} L_{18}$	220	185
$L_{18} L_{19}$	567	498
$L_{19} L_{20}$	443	439
$L_{20} L_{21}$	143	146
$L_{21} L_{22}$	14	1
$L_{22} L_{23}$	185	147
$L_{23} L_{24}$	513	440

Member	Stress in truss A in kips	Stress in truss B in kips
$L_{24}L_{25}$	600	549
$L_{25}L_{26}$	243	219
$L_{26}L_{27}$	43	36
$L_{27}L_{28}$	114	111
$L_{28}L_{29}$	385	369
$L_{29}L_{30}$	229	195
$L_{30}L_{31}$	36	24
$L_{31}L_{32}$	121	123
$L_{32}L_{33}$	399	393
$L_{33}L_{34}$	834	810
$L_{34}L_{35}$	633	597
$L_{35}L_{36}$	265	251
$L_{36}L_{37}$	54	52
$L_{37}L_{38}$	103	95
$L_{38}L_{39}$	363	337
$L_{39}L_{40}$	543	782
$L_{40}L_{41}$	205	381
$L_{41}L_{42}$	24	117
$L_{42}L_{43}$	133	30
$L_{43}L_{44}$	423	207
$L_{44}L_{45}$	343	528
$L_{45}L_{46}$	93	205
$L_{46}L_{47}$	64	29
$L_{47}L_{48}$	285	117
$L_{48}L_{49}$	663	381
$L_{49}L_{50}$	519	721

Member	Stress in truss A in kips	Stress in truss B in kips
$L_{50}L_{51}$	189	337
$L_{51}L_{52}$	16	95
$L_{52}L_{53}$	141	242
$L_{53}L_{54}$	439	631
$L_{54}L_{55}$	639	846
$L_{55}L_{56}$	269	417
$L_{56}L_{57}$	56	135
$L_{57}L_{58}$	101	12
$L_{58}L_{59}$	359	171
$L_{59}L_{60}$	520	501
$L_{60}L_{61}$	193	187
$L_{61}L_{62}$	23	20
$L_{62}L_{63}$	174	167

DESIGN OF THE LOWER CHORD MEMBERS

The lower chord members are all in compression. It is essential that they all have the same depth in order that a even bearing area is furnished for the floats. A depth of 23 inches was found to be the best suited for this truss. The angles used were 4" x 4" varying in thickness only. All members were designed using the formula

$$\frac{P}{A} = 16{,}000 - 50\ l/r$$

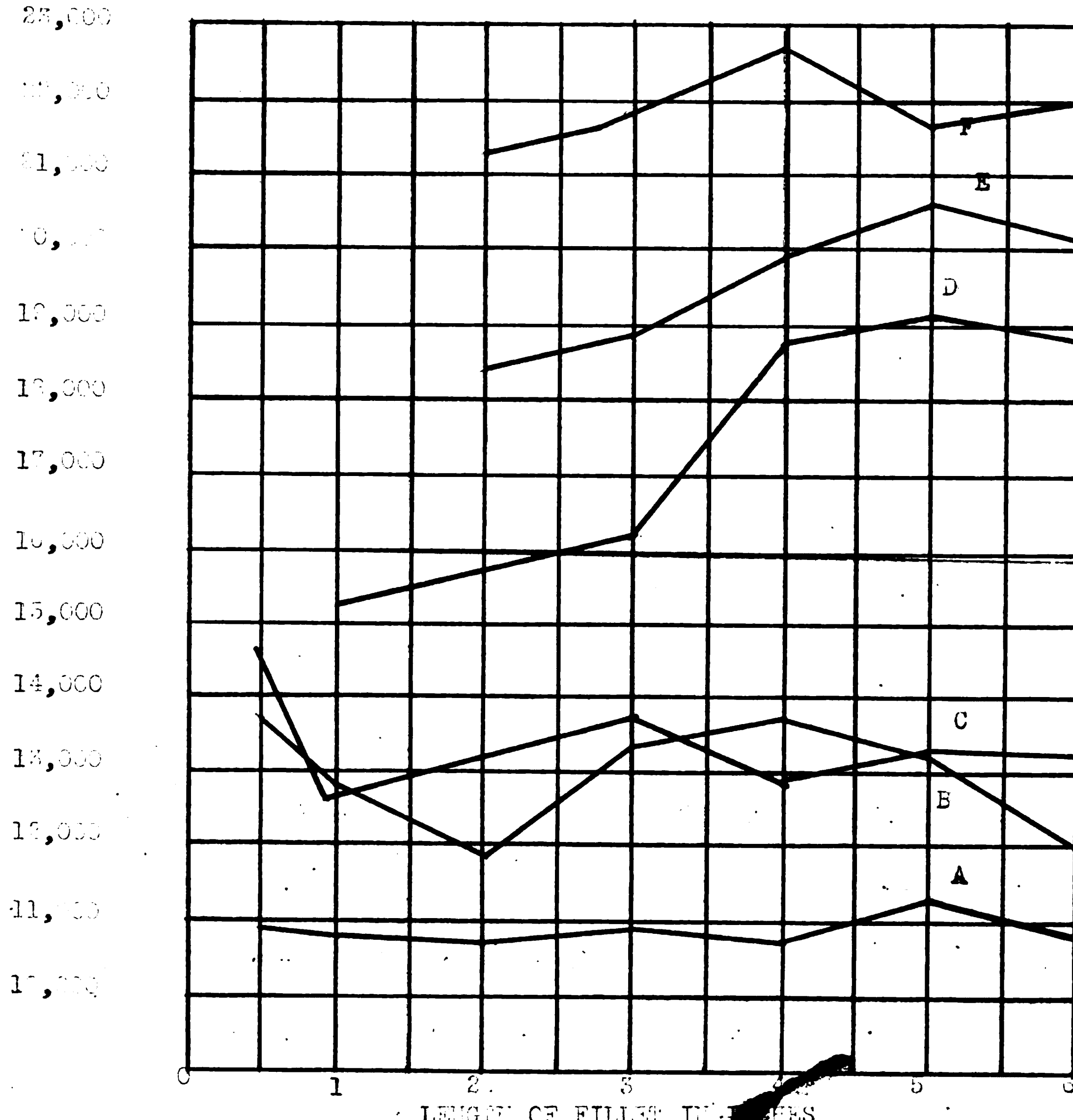
The design is for spans of more than one pannel due to the high cost of welding at each pannel point. In each case the member is designed for the maximum stress in the span.

The following table was made of the results of the design

Member	Angle thickness truss A	Plate thickness truss A	Angle thickness truss B	Plate thickness truss B
$L_1\ L_7$	3/8"	7/8"	5/8 "	5/8"
$L_7\ L_{11}$	3/8"	5/8"	3/8"	5/8"
$L_{11}L_{16}$	1/2"	5/8"	1/2"	5/8"
$L_{16}L_{21}$	1/2"	5/8"	3/8"	5/8"
$L_{21}L_{27}$	1/2"	5/8"	3/8"	5/8"
$L_{27}L_{31}$	3/8"	5/8"	3/8"	5/8"
$L_{31}L_{37}$	5/8"	1	1/2"	1"
$L_{37}L_{42}$	3/8"	1"	3/8"	5/8"
$L_{42}L_{46}$	3/8"	5/8"	3/8"	5/8"
$L_{46}L_{52}$	1/2"	3/4"	3/8"	5/8"
$L_{52}L_{57}$	1/2"	3/4"	1/2"	3/4"
$L_{57}L_{64}$	5/8"	5/8"	5/8"	5/8"

The members are designed a columns with the angles turned in in order that welding surface may be provided for the gusset plates. Lattice work bracing is used it being at a 45 degree pitch.

These members rest upon shoes that are welded to the top of the float assembly. No bracing is required between the lower chords of the different trusses as they are rigidly braced at the top and the floats are also rigidly braced at the bottom.



A - 1/4" - 1 LAYER

B - 5/16" - 1 LAYER

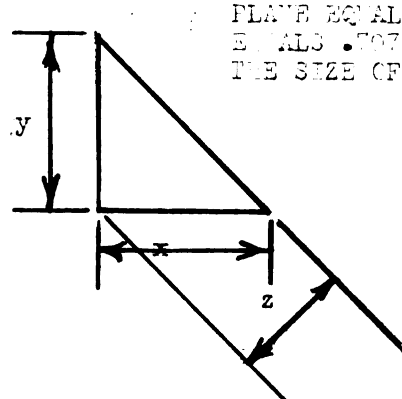
C - 3/8" - 1 LAYER

D - 1/2" - 1 LAYER

E - 5/8" - L LAYER

F - 3/4" - 1 LAYER

x & y EQUAL SIZE
OF FILLET. SHEAR
PLANE EQUALS z
EQUALS .707 TIMES
THE SIZE OF THE FILLET



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Pocket has:
3 Suppl.