EFFECT OF THE MANNER OF SUPPORT, ETC. ON THE SECONDARY STRESSES IN A ROOF TRUSS

A THESIS

THE EFFECT OF THE MANNER OF SUPPORT AND OF CERTAIN DETAILS OF CONSTRUCTION ON THE SECONDARY STRESSES IN A ROOF TRUSS.

Submitted to

The Faculty of Graduate Studies and Research
McGill University

As Part Requirement for the Degree of
Master of Science

BY

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INDEX

ILLUSTRATIONS

The writer wishes to acknowledge his indebtedness to Dean H. M. Mackay, of McGill University for his valuable instruction and advice; and also to Mr. S. D. Macnab of the McGill University Testing Laboratory for his assistance throughout the experimental work.

Definition of Secondary Stress:

Consider any member in a structure. This member, when loaded, carries a certain total stress, which, if divided by the cross-sectional area of the member, will give an average unit stress commonly called the primary stress. This assumes a uniform distribution of stress which rarely, if ever, exists. If it were possible to determine the actual stress existing in any particular fibre, by measuring the strain in that fibre, it would, in general, differ from the rrimary Stress. Secondary Stress, as considered in this paper, is defined as the difference between the rrimary Stress in any fibre and the stress actually existing in that fibre.

General Remarks:

Only in comparatively recent years have structual engineers recognized, to any great extent, the importance of Secondary Stresses. In analysing the stresses in the various members of a structure, certain assumptions are made which reduce the determination of stresses to a comparatively simple problem. The stresses found in this way are only an approximation to those actually existing and, in some cases, not a very close approximation.

Since the latter part of the nineteenth century, considerable work has been done by engineers in striving for a more accurate and a more thorough method for the determination of the stresses actually existing in a structure. The engineering profession owes much to the early German investigators for their valuable contributions. In 1877 the Technical

University of Munich offered a prize for the best solution of the problem - "What Stresses arise in the members of a bridge truss owing to the fact that the angles of the triangles of the truss suffer no change?" The prize was awarded in 1879 to H. Manderla, an assistant in the Technical University of Munich, who submitted a very excellent solution. The method of Secondary Stress determination most commonly used at the present time is, with a few slight modifications, the method as developed by Manderla in this solution.

In September, 1922, Cecil Vivian Von Abo presented to the Committee on Graduate Studies of McGill University a thesis "Secondary Stresses in Bridges", for the degree of Doctor of Philosophy. This paper was presented to the American Society of Civil Engineers at the meeting of November 5th, 1924, and was reprinted from the Transactions of the A.S.C.E. Vol. 89, p.1 (1926). It presents all the known methods of Secondary Stress determination, demonstrating them with the solution of a problem by all the methods. This paper, as reprinted from the Transactions, includes a discussion by many of the leading Bridge Engineers of this continent and is, in the opinion of the writer, the best treatment of the subject available in the English language.

As well as the purely theoretical treatments of the problem, there has been considerable work done which was of a practical nature. Manderla's experiments on the Waltenhofen Bridge were among, if not, the first. Engineers appreciated the importance of the problem and since the time when Manderla

conducted his early experiments there has been much valuable information obtained from experiments in Europe and America.

Of special significance to this particular investigation is the work of Alexander Campbell, M.Sc., which was carried on at McGill University 1925-26. Campbell submitted to the Committee on Graduate Studies of McGill University, a Thesis "Secondary Stresses in a Roof Truss having Unsymmetrical Members". The author, in his investigation, obtained much valuable information and arrived at some important conclusions.

Object of the Investigation:

The object of this investigation was to obtain further information concerning the stress distribution in a certain roof truss, to study the effect of varying the conditions of support, and to study the effect of certain minor changes in detail which, it was hoped, would give a more desirable distribution of stress in the members. The truss to be used was the same as had been used by Campbell in 1925-26.

Campbell concluded from his test results that the forces in members meeting at a joint acted along the centres of gravity of the members rather than along the rivet lines, as was generally considered. It was the intention of the writer to verify this conclusion by further extensometer measurements.

In order to get some test results where the conditions of test more nearly approximated the conditions actually

met with in practice, it was proposed that tests be carried on with the truss carried by flat supports. Wood blocks and concrete blocks were to be used. These flat supports would give a more or less fixed condition of support, rather than having the joint free to rotate, as it is when supported at a point. The fixity would not be absolute due to the elasticity of the supports; any slight rotation of the joint was to be measured by sensitive levels.

When a double angle member is riveted to a gusset plate between the angles, the two angles are eccentrically loaded. They are not absolutely fixed in a plane normal to the plane of the gusset plate, and consequently there is bending in this plane which causes an uneven distribution of stress over the cross-section of the member. It was hoped that by introducing one additional stitch rivet near the edge of the gusset plate, the fixity of the angles would be increased, consequently, the bending would be reduced and a more desirable distribution of stress would result. It was proposed that tests be carried on with, and without, the additional rivet to determine its effectiveness in reducing the Secondary Stresses in the member.

Some welded connections were used and it was hoped that some information would be obtained concerning the relative values of riveted and welded joints.

THEORY OF SECONDARY STRESSES

The methods of analysis used in determining the so-called "primary stresses" are based on several assumptions, viz:-

1. That the members are connected at the joints by frictionless pins; thus no resistance is offered to a change of angle between any two members meeting at a joint.

2. That the gravity axes of all members meeting at a joint meet at one point - the centre of the pin.

3. That loads are applied to the structure only at the joints.

4. That all members are straight.

The primary stress in any member will, determined in this way, be pure tension or compression. There will be a uniform distribution of stress over the entire cross-section of the member.

In practice these ideal conditions are not realized. When the members at a joint are connected by gusset plates, as they quite often are, these members are not free to rotate about the joint but are held rigidly by the gusset plates and the angles between them remain constant. Even where provided, pin-joints are not frictionless, as assumed, but offer resistance to any change of angle between the members. To facilitate fabrication it is often desirable not to have the gravity axes, of all the members meeting at a joint, meeting at one point. Members, other than vertical ones, must always act as beams in supporting their own weight and, quite

often, loads are applied to members between the joints. Members are seldom, if ever, perfectly straight. Owing to the actual conditions differing from the assumed conditions, there will be additional stresses induced in the members. These additional stresses are known as "Secondary Stresses".

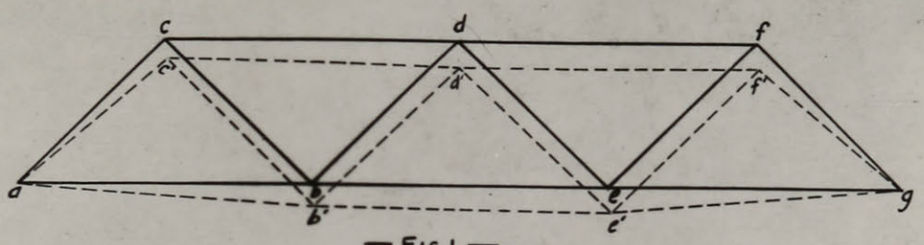
Professor Turneaure states that, "It is generally possible and sufficient to so design a structure as to keep these stresses within low limits, and then to neglect them in the calculations, but in many special cases, and in large and important structures, they will require calculation".

The chief causes of secondary stresses are,- rigidity of joints, eccentric joint details, and beam action of the members in carrying their own weight or loads applied between joints. The stresses caused by the beam action of the members can be readily determined from the recognized formulae for moments and shears in beams with fixed ends, whereas the problem of calculating the stresses caused by rigidity of joints and eccentric joint details is more troublesome.

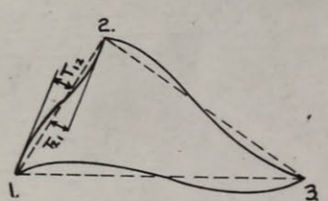
Method of Determining Secondary Stresses:

There have been several methods developed for the determination of secondary stresses. A paper "Secondary Stresses in Bridges" by Cecil Vivian Von Abo, with discussion by many of the leading engineers on this continent, was reprinted from the transactions of the American Society of Civil Engineers, Vol. 89, p.1 (1926). This paper presents, in excellent form, all the known methods of secondary stress determination.

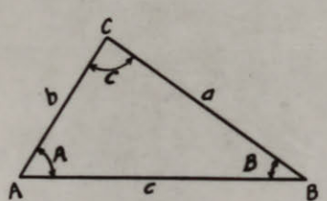
PLATE-6



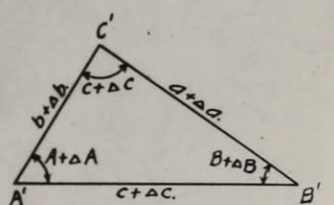
—FIG 1.—



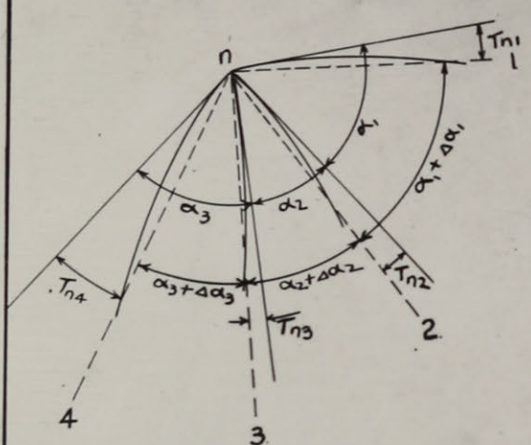
—FIG. 5.—



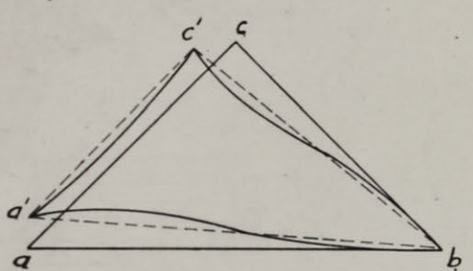
—FIG 3—



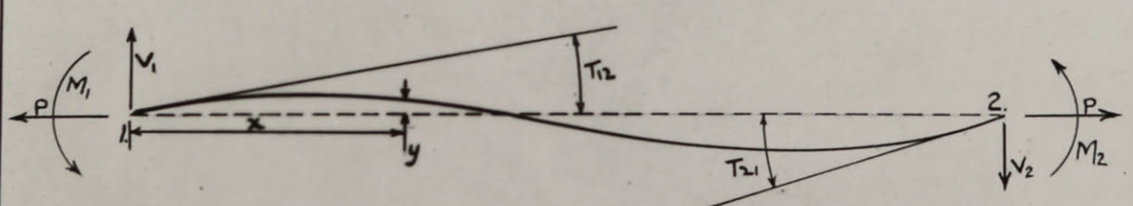
—FIG. 4.—



—FIG. 6.—



—FIG. 2.—



—FIG. 7.—

DIAGRAMS USED IN DEVELOPMENT OF
THEORY of SECONDARY STRESSES
in connection with
EXPERIMENTAL TRUSS
—McGILL UNIVERSITY—
C.F. Morrison. March 1927.

Judging from the discussion the Manderla-Winkler method and Mohr's method are the most commonly used. The former is a purely analytical solution, while the latter is semi-graphical.

The method of Secondary Stress calculation, which will be presented here is that of Manderla with modifications by Winkler. With a few departures, this is the solution as given in Volume II of "Modern Framed Structures" by Johnson, Bryan and Turneaure.

Secondary Stresses Due to Rigidity of Joints:

When the members of a truss are subjected to axial stresses there will be deformations produced in these members. If the members were free to turn at the joints these deformations would, in general, cause changes in the angles between the members at the joints. Consider the truss ag in Fig. I, Plate 6, suppose the nature of the stresses to be as indicated by the signs. The full lines show the position of the unloaded truss: after loading, the truss will deflect to the position as shown by the dotted lines. The deformations are, of course, shown greatly exaggerated. In the triangle abc, the member a c will be shortened and the members a b and b c will be lengthened. This will cause a decrease in the angle at b and an increase or decrease in the angles at a and c, depending upon the relative changes in length of a b and b c. If the changes in lengths of these members are known, it is possible to calculate what the changes in the several angles will be. Similarly for the other angles, it is evident that if the changes in lengths of all the members

are known, the changes in all the angles can be determined.

Consider the conditions when the members are rigidly connected at the joints by means of gusset plates and the angles between them remain constant. The lengths of the members will be changed as before, by the axial stresses, and their ends (the vertices of the triangles) will move as before. This movement will now force the members to bend, as represented diagramatically in Fig. 2, Plate 6, producing bending moments in the members. These moments will be a maximum near the joints.

In Fig. 2, let A, B and C represent the original positions of the three joints, and A^1, B^1, and C^1, the positions after the members are stressed. Let A, B, and C represent the original angles $\angle A$, $\angle B$, and $\angle C$ represent the changes that would take place in these angles if the members were free to turn at the joints. The angles between the dotted straight lines joining A^1, B^1 and C^1, will then be equal to $A + \angle A$, $B + \angle B$, and $C + \angle C$, respectively. In proceeding with a solution of the problem, the changes of angle $\angle A$, $\angle B$ and $\angle C$ are first found from the known changes in lengths of the sides of the triangle due to the axial stresses. From these changes in angle the bending moments in the members are then calculated. The process requires the simultaneous consideration of all the members and angles of the truss. It is, therefore, somewhat tedious, although simple in application if careful attention is paid to signs and the work is well systematized.

Calculation of the △ Angles.

Calculation of the changes in angle in any triangular element of a truss in terms of the changes in the lengths of the members:

Let ABC shown in Fig.3, Plate 6, be the original form of any triangular element of a truss, and let A^1 B^1 C^1, Fig. 4, represent the form of the same truss after the changes in lengths of the members. Designate the members as a, b, and c and the angles as A, B, and C as shown and let -

s_1, s_2 and s_3 = stress intensity in each member
a, b and c = length of each member
E = modulus of elasticity.

After deformation the lengths of the members with bc, a + △a, b + △b, and c + △c, respectively, where △a, △b, and △c are the changes in lengths of the members. The change in length of any member is readily determined from the stress intensity, length, and modulus of elasticity.

$$\triangle a = \frac{s_1 a}{E}$$

The changes in angle △A, △B and △C, can be determined from their geometric relations to the original angles, the original length of the members, and the changes in lengths of the members.

Consider the triangle of ABC:

$$\frac{a}{b} = \frac{\sin A}{\sin B} \qquad a = \frac{b \sin A}{\sin B} \qquad \sin B = \frac{b \sin A}{a}$$

Consider the triangle $A^1 B^1 C^1$.

$$\frac{a + \Delta a}{b + \Delta b} = \frac{\sin (A + \Delta A)}{\sin (B + \Delta B)} = \frac{\sin A \cos \Delta A + \cos A \sin \Delta A}{\sin B \cos \Delta B + \cos B \sin \Delta B}$$

For angles as small as ΔA and ΔB, there is no appreciable error in considering the sine of the angle equal to the angle and the cosine of the angle equal to unity, hence

$$\frac{a + \Delta a}{b + \Delta b} = \frac{\sin A + \Delta A \cos A}{\sin B + \Delta B \cos B}$$

Cross-multiplying and omitting terms containing the product of two of ΔA, ΔB, Δa, Δb, since these are so small in comparison with the other quantities:-

$$a \sin B + a \Delta B \cos B + \Delta a \sin B = b \sin A + b \Delta A \cos A + b \sin A \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (A)$$

Substitute $a = \frac{b \sin A}{\sin B}$ and $\sin B = \frac{b \sin A}{a}$ in (A)

$$b \Delta B \cot B \sin A + \frac{\Delta a}{a} b \sin A = b \Delta A \cos A + \Delta b \sin A$$

Divide by $b \sin A$:

$$\Delta B \cot B + \frac{\Delta a}{a} = \Delta A \cot A + \frac{\Delta b}{b}$$

$$\Delta A \cot A = \frac{\Delta a}{a} - \frac{\Delta b}{b} + \Delta B \cot B \quad \ldots\ldots\ldots\ldots\ldots (1)$$

Similarly:

$$\Delta C \cot C = \frac{\Delta c}{c} - \frac{\Delta b}{b} + \Delta B \cot B \quad \ldots\ldots\ldots\ldots\ldots (2)$$

$$\Delta A + \Delta B + \Delta C = 0 \; : \; \Delta B = -(\Delta A + \Delta C)$$

Substitute $\Delta B = -(\Delta A + \Delta C)$ in (1) and (2)

$$\Delta A \cot A = \frac{\Delta a}{a} - \frac{\Delta b}{b} - \Delta A \cot B - \Delta C \cot B$$

$$\Delta C \cot C = \frac{\Delta c}{c} - \frac{\Delta b}{b} - \Delta A \cot B - \Delta C \cot B$$

$$\Delta A (\cot A + \cot B) + \Delta C \cot B = \frac{\Delta a}{a} - \frac{\Delta b}{b} \quad \ldots\ldots\ldots\ldots\ldots (1)^1$$

$$\Delta C (\cot C + \cot B) + \Delta A \cot B = \frac{\Delta c}{c} - \frac{\Delta b}{b} \quad \ldots\ldots\ldots\ldots\ldots (2)^1$$

E eliminating ΔC.

$(1)^1 \times (\cot C + \cot B)$

$$\Delta_A(\cot A + \cot B)(\cot C + \cot B) + \Delta C \cot B (\cot C + \cot B) = \left(\frac{\Delta a}{a} - \frac{\Delta b}{b}\right)(\cot C + \cot B)$$

$(2)^1 \times \cot B$

$$\Delta_A \cot B + \Delta C \cot B (\cot C + \cot B) = \left(\frac{\Delta c}{c} - \frac{\Delta b}{b}\right)\cot B.$$

Subtracting:

$$\Delta_A \left[\cot A \cot C + \cot B \cot C + \cot A \cot B\right] = \cot C\left(\frac{\Delta a}{a} - \frac{\Delta b}{b}\right) + \cot B\left(\frac{\Delta a}{a} - \frac{\Delta c}{c}\right) \quad \ldots\ldots\ldots (3)$$

Since when $(A + B + C) = 180^\circ$ the expression $\cot A \cot C + \cot B \cot C + \cot A \cot B$ equals unity, equation (3) reduces to:

$$A = \cot C\left(\frac{\Delta a}{a} - \frac{\Delta b}{b}\right) + \cot B\left(\frac{\Delta a}{a} - \frac{\Delta c}{c}\right)$$

$$\Delta a = \frac{s_1 a}{E} \quad , \quad \frac{\Delta a}{a} = \frac{s_1}{E}$$

$$E \Delta_A = \cot C(s_1 - s_2) + \cot B (s_1 - s_2) \quad \ldots\ldots\ldots (4)$$

Similarly:

$$E \Delta B = \cot C(s_2 - s_1) + \cot A (s_2 - s_3) \quad \ldots\ldots\ldots (5)$$

$$E \Delta C = \cot A(s_3 - s_2) + \cot B (s_3 - s_1) \quad \ldots\ldots\ldots (6)$$

<u>Deflection Angle (T) at an end of a Member</u>:

The deflection angle at the end of a member is the angle between the position of the member and the position it would occupy if not restrained at the end, but free to turn. It is necessary to have a convention as to the sign of the moments in the members. Consider the (T) angles

shown in Fig. 5, Plate 6, as positive and the moments caused by them as positive.

When the members at a joint are rigidly connected, the angles between them must remain unchanged and it is possible to express the (T) angle of any member in terms of the (T) angle of any selected member and the ($\triangle$) angles at the joint. Consider the (T) angle of the member first encountered in proceeding around the joint in a clockwise direction, starting on the outside of the truss, as the (T) angle of the joint. It is then possible to express the T angle of any member at the point in terms of the T angle of the joint, and the $\triangle$ angles at the joint. Fig. 6 shows the relation between these angles:

$$Tnm = Tn1 + \sum_{1}^{m}$$

Moment in a Member in terms of the Deflection Angles:

Consider any member subject to direct stress and to bending at the ends, as shown in Fig. 7.

$$V_1 = V_2 = \frac{M_1 + M_2}{\ell}$$

$$M(x) = M_1 - V_1 x + Ty$$

The term Ty may be omitted since the deflection y is small. Exact solutions, including the Ty term, have been derived, but are not generally used.

$$M_{(x)} = -EI \frac{d_2 y}{dx^2} = M_1 - V_1 x$$

$$-EI \frac{dy}{dx} = M_1 x - \frac{V_1 x^2}{2} + C_1$$

$$-EI\ y = M_1 \frac{x^2}{2} - \frac{V_1 x^3}{6} + C_1 x + [C_2 = 0]$$

When x=0, y=0

when $x = \ell$ $y = 0$ $\quad 0 = \frac{M_1 \ell^2}{2} - \frac{V_1 \ell^3}{6} + C_1 \ell$

$$C_1 = \frac{V_1 \ell^2}{6} - \frac{M_1 \ell}{2}$$

When $x = 0$, $\frac{dy}{dx} = \frac{-1}{EI} \cdot C_1 = T_{12}$

$$T_{12} = \frac{1}{EI}\left[\frac{M_1 \ell}{2} - \frac{V_1 \ell^2}{6}\right] = \frac{1}{EI}\left[\frac{M_1 \ell}{2} - \frac{(M_1 + M_2)\ell}{6}\right]$$

$$T_{12} = \frac{\ell}{6.EI}\left[2M_1 - M_2\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Similarly

$$T_{21} = \frac{\ell}{6\ EI}\left[2M_2 - M_1\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

$$(1) \times 2 \cdots\cdots 2T_{12} = \frac{\ell}{6\ EI}\left[4M_1 - 2M_2\right]$$

Adding,—

$$2T_{12} + T_{21} = \frac{\ell}{6.EI}\ (3M_1)$$

$$M_1 = \frac{2EI}{\ell}\left[2T_{12} + T_{21}\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Equation (3) expresses the moment in a member at a joint in terms of the T angles of the member. At any joint the summation of moments must equal zero if the gravity axes of all the members meet at one point, or must equal the summation of the axial stresses times their eccentricities if there are eccentric connections. An equation can be formed for each joint, having as the unknown quantities the T angles of the members meeting at the joint. Since all the T angles of the members can be expressed in terms of the T angles of the joints and the △ angles of the truss(the △ angles may be computed from equations (4), (5) and (6)), the number of

unknowns will be equal to the number of joints of the truss. That is, the number of unknowns will be equal to the number of equations, and the problem may be solved. The solution involves the simultaneous solution of as many equations as there are joints of the truss.

Formulation of Equations:

It is first necessary to compute and tabulate the angles for the entire truss. With the aid of this table the T angles of all the members are expressed in terms of the T angles of the joints.

Equation at any joint (n)

Moment applied to the joint by any member:

$$M = \frac{2EI}{\ell}\left[2T_{nm} + T_{mn}\right]$$

Total moment applied to joint by members:

$$M\ (\text{members}) = \sum \frac{2EI}{\ell}\left[2T_{nm} + T_{mn}\right]$$

The total moment applied by the members must equal minus the externally applied moment. For a joint without eccentric connections, this external moment will equal zero. For a joint having eccentric connections its value can be determined from the forces and their eccentricities.

For convenience the quantity $\frac{I}{\ell}$ is represented by K and the equation for any joint takes the form:-

$$\sum_{o}^{m} 2KE\left[2T_{nm} + T_{mn}\right] = -M_e$$

After the equations have been solved giving the T angles for the joints, the T angles for all members are determined

from the equation $T_{nm} = T_{nl} + \sum_{1}^{m} \Delta\alpha$. Having the values of T for all members the moment at either end of any member can be computed by means of the equation -

$$M_{nm} = 2EK \left[2T_{nm} + T_{mn} \right]$$

From the Moment in the member the fibre stress is determined by means of the equation $f = \frac{My}{I}$ where:-

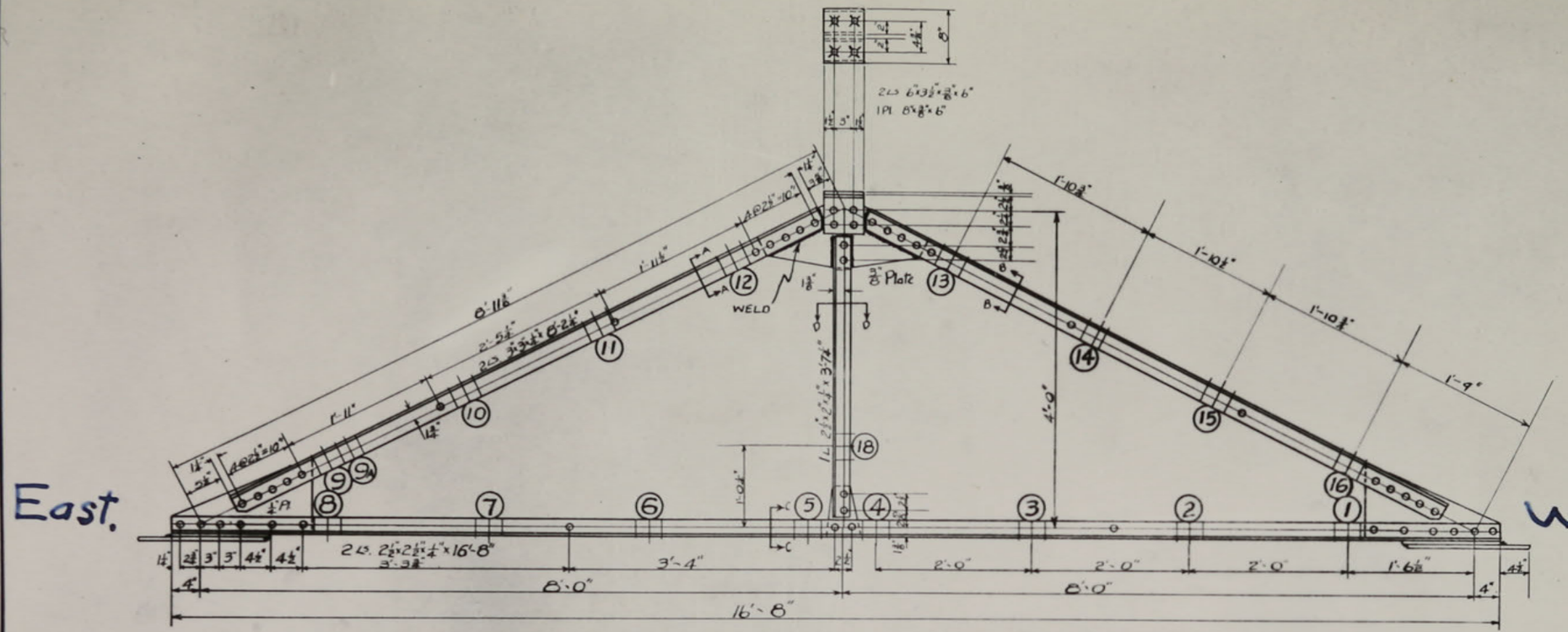
f = fibre stress in lbs/in.^{2}

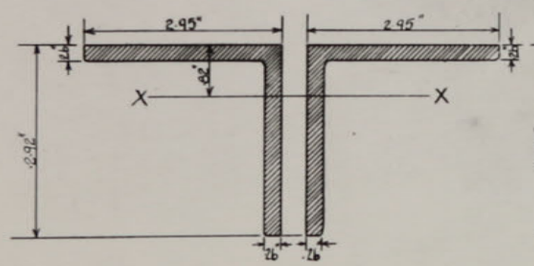
M = Moment at section in inch-lbs.

y = Distance in inches from neutral axis to fibre considered.

I= Moment of inertia of section in in.^{4}

Having determined the Secondary Stress at any point the combined or total stress is determined by adding algebraically the primary and secondary stresses.

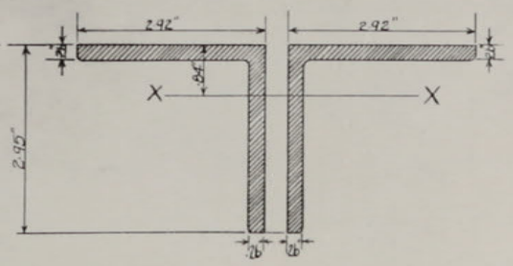




SECTION AA.

Area of two angles = 2·92 in²

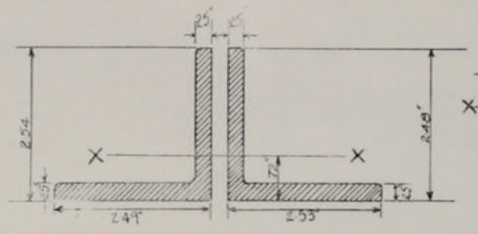
Moment of Inertia I_{xx} = 2·374 in⁴



SECTION BB

Area of two angles = 2·92 in²

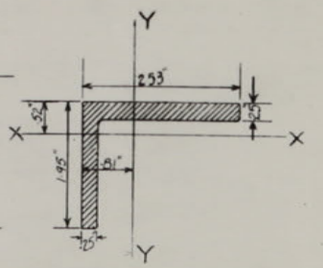
Moment of Inertia I_{xx} = 2·416 in⁴



SECTION CC

Area of two angles = 2·35 in²

Moment of Inertia I_{xx} = 1·432 in⁴



SECTION DD

Area = 1·06 in²

Moment of Inertia I_{YY} = 0·67 in⁴

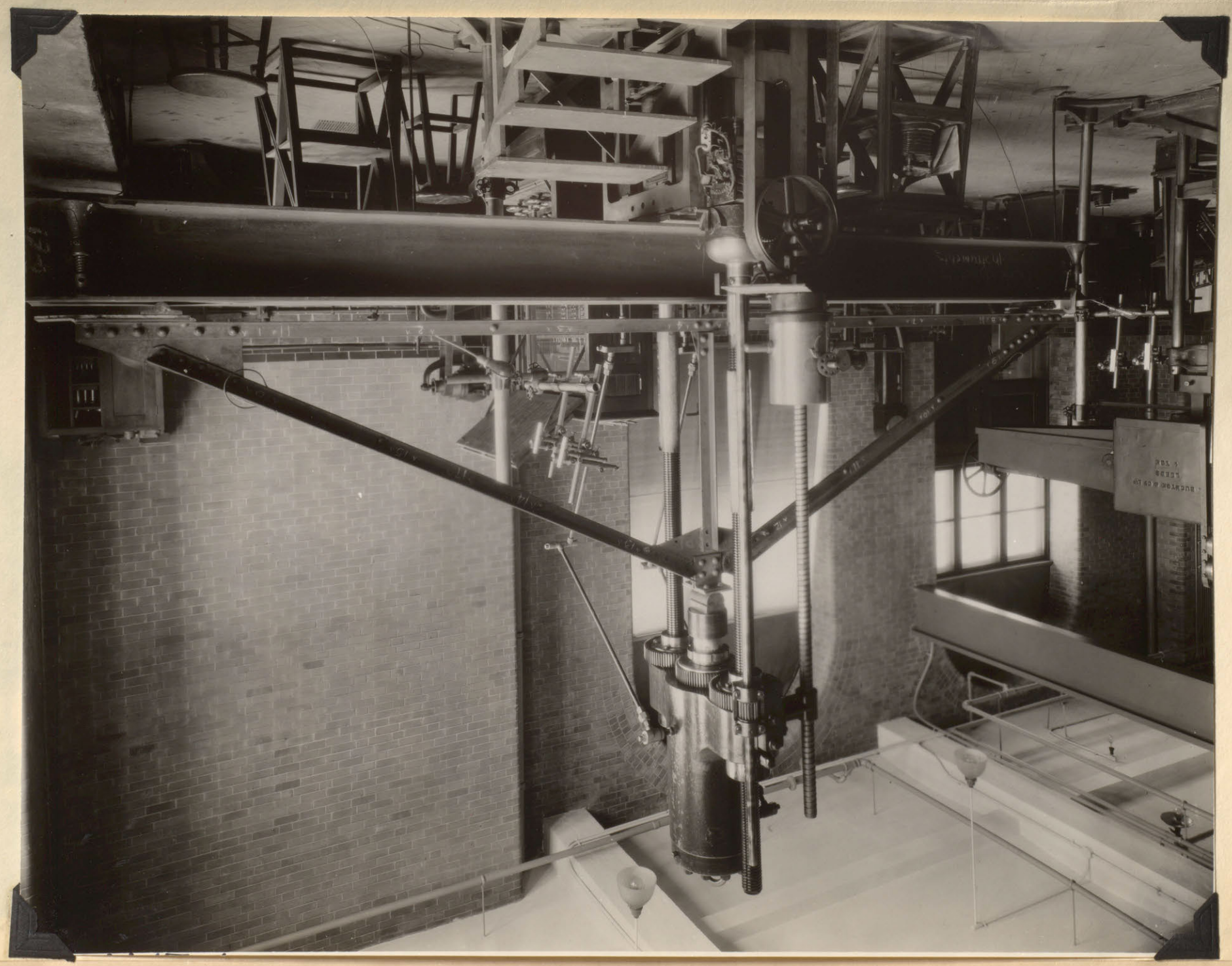
EXPERIMENTAL TRUSS

McGILL UNIVERSITY

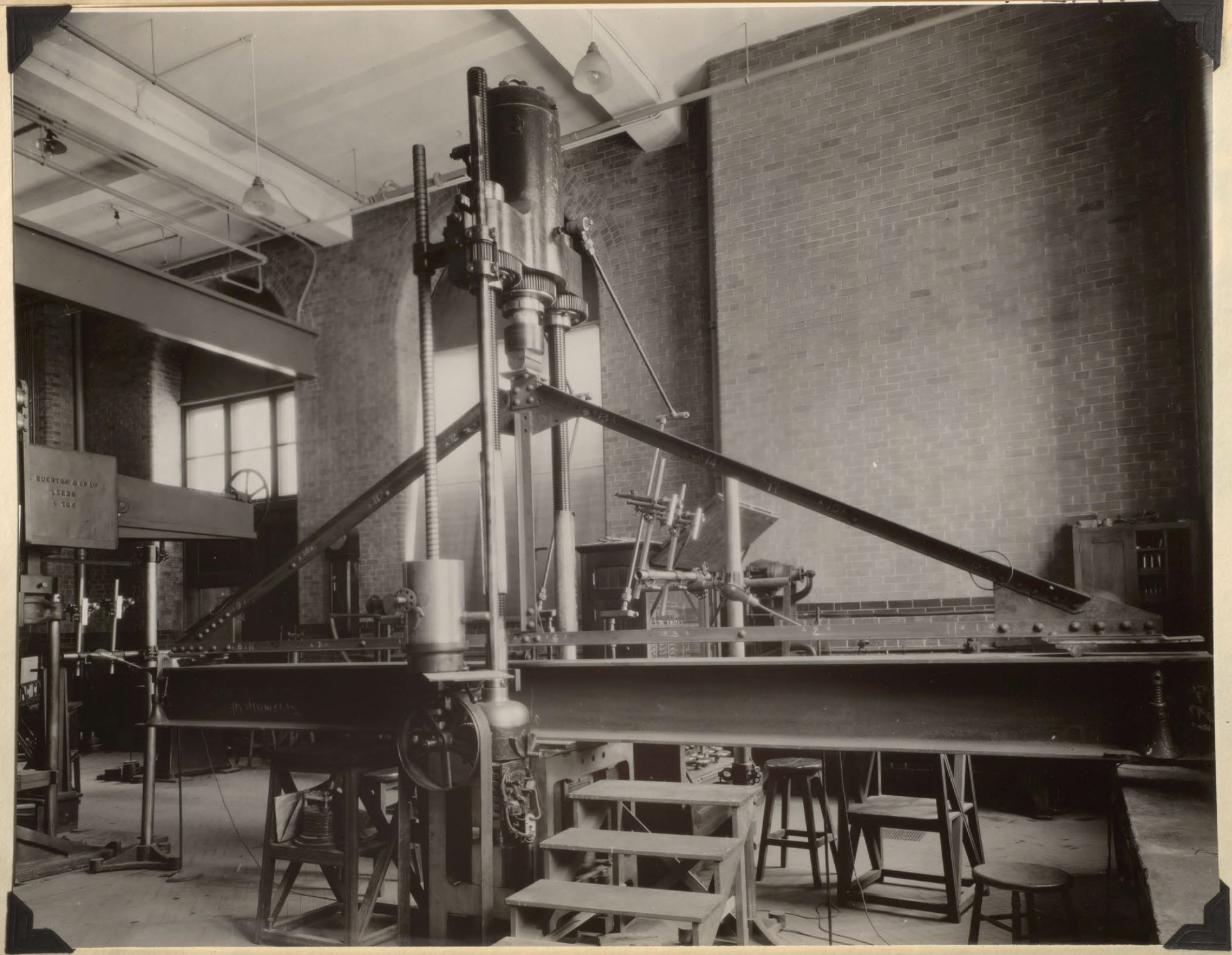
C.F. Morrison. March 1927.

PLATE 5.

PLATE 1.



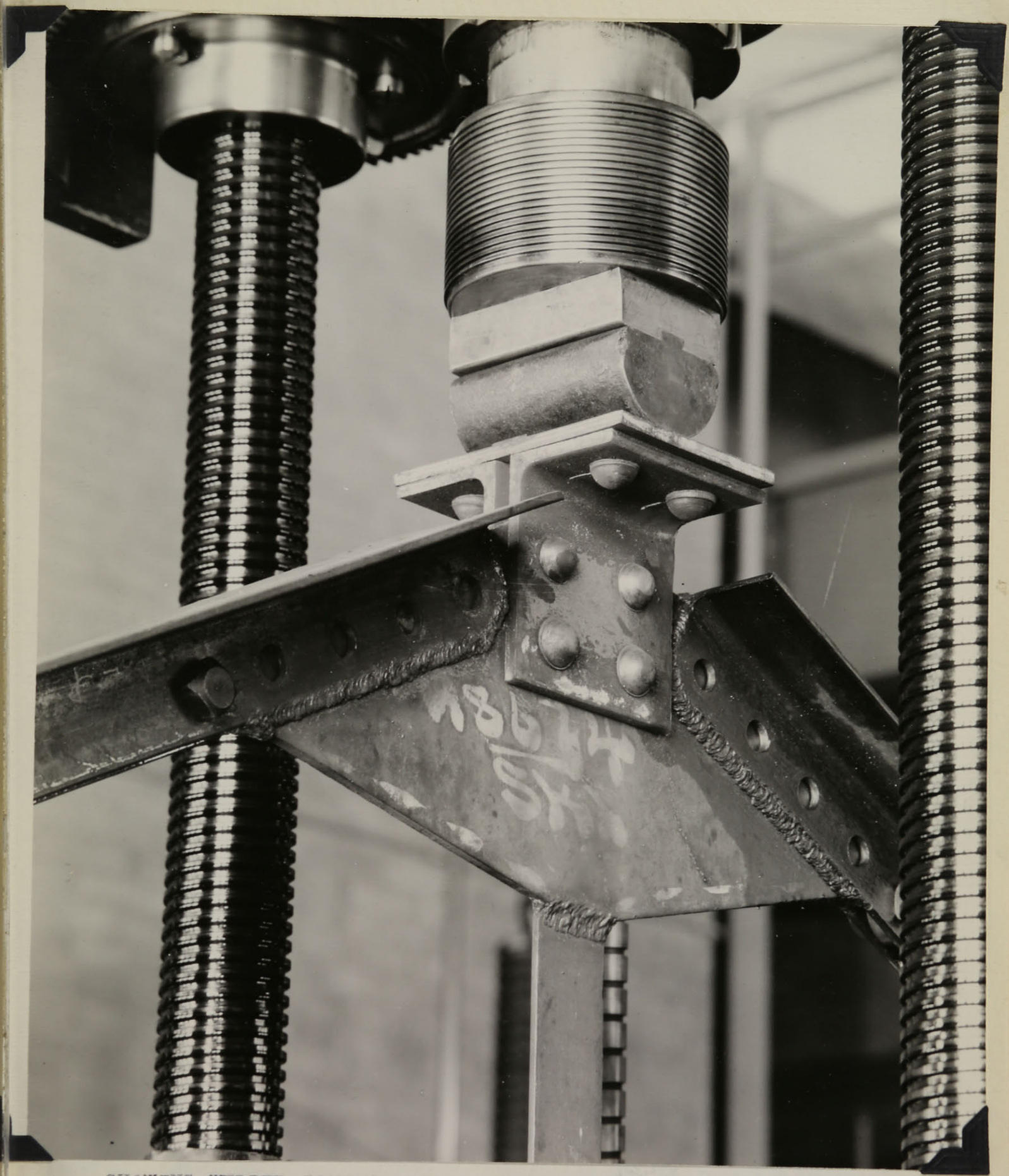
SHOWING TRUSS SET UP IN EMERY TESTING MACHINE. NOTE EXTENSOMETERS CLAMPED IN POSITION AT LOCATION 9, ALSO ARRANGEMENT OF TELESCOPES AND SCALES.



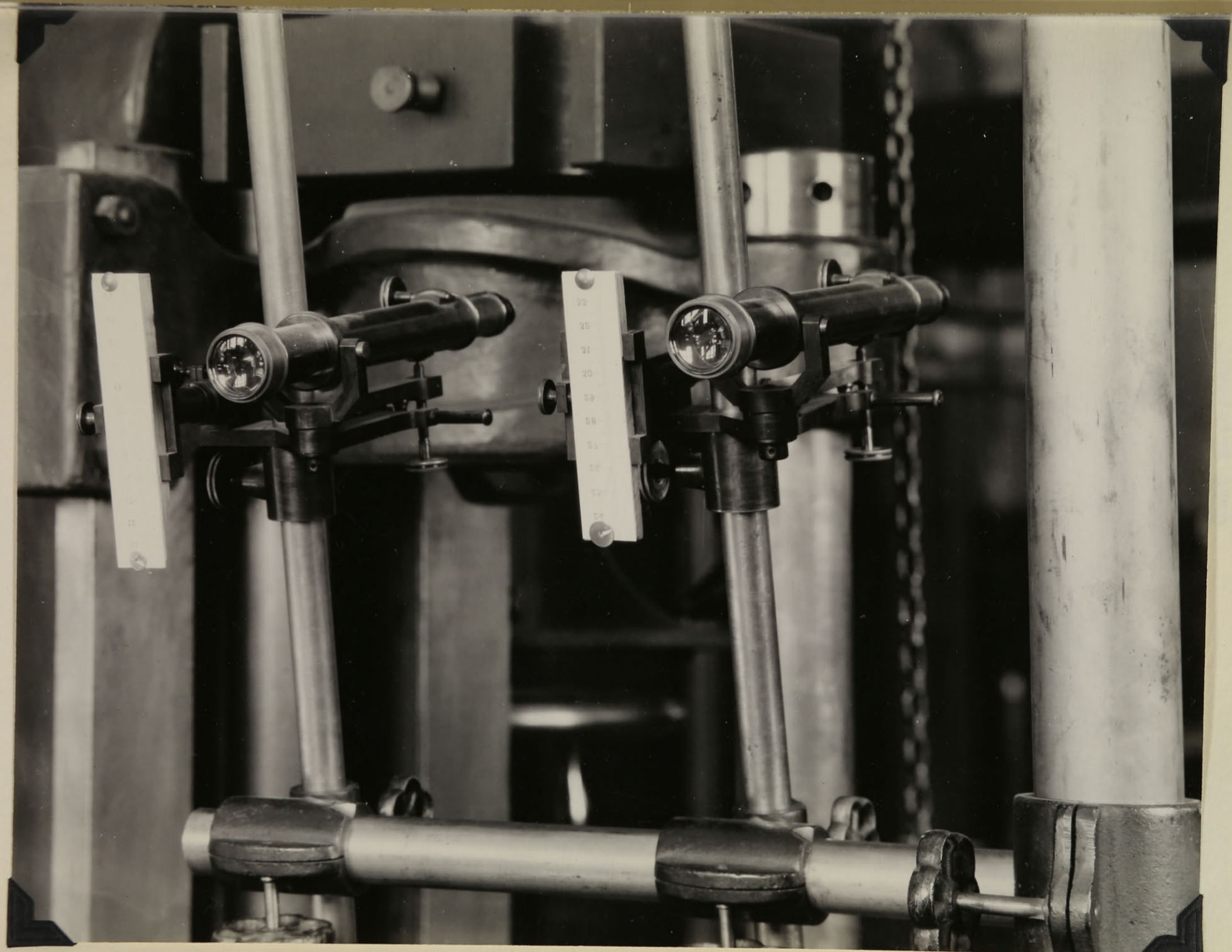
SHOWING TRUSS SET UP IN EMERY TESTING MACHINE. NOTE EXTENSOMETERS CLAMPED IN POSITION AT LOCATION 9, ALSO ARRANGEMENT OF TELESCOPES AND SCALES.

PLATE 1.

PLATE 2.



SHOWING WELDED CONNECTIONS TO TOP GUSSET PLATE AND METHOD OF LOADING



SHOWING TELESCOPES AND SCALES USED WITH EXTENSOMETERS.

PLATE 4.

APPARATUS USED

The Truss

The roof truss used in this investigation is shown in detail in Plate 5. This truss was donated to McGill University, for experimental purposes, by the Dominion Bridge Company of Lachine, and was used by Campbell in his work during 1925 and 1926. A few slight changes, however, were made for this investigation.

When the cast iron rockers, which were used in supporting the truss, were placed under the intersections of the gravity axes, it was found that they protuded somewhat beyond the sole plates. Therefore, in order that the truss might be supported at these points it was necessary to extend the sole plates. Two plates were obtained and welded to the original sole plates, as shown in Plate 3, extending $4\frac{1}{2}$ inches beyond their ends.

The top gusset plate failed in one of the earlier tests and was replaced by a slightly heavier plate. It was felt that some information could be obtained as to the effect of welded connections on secondary stresses, and consequently, the top chords and the vertical member were connected to the new gusset plate by welding rather than by riveting. Plate 2 shows clearly these welded connections.

At the upper end of the top chords, five rivet holes were punched, whereas only four were required. The extra hole was beyond the gusset plate and was used in determining the effect on stress distribution of a stitch rivet close to the gusset plate.

The Extensometers

The extensometers used were of the reflecting mirror type, a modification of the Martens extensometer. These were designed and constructed at McGill University. Plate 3 shows an extensometer assembled and clamped in position on the test specimen, while Plate 4 shows the telescopes and scales which are used in connection with the extensometers. The telescope and scale are so placed, relative to the mirror, that an image of the scale appears in the telescope. The cross-hair in the telescope is read on the scale; any change in length of the test specimen causes a rotation of the mirror and a corresponding change in the reading on the scale. This change in reading is a measure of the strain in the test specimen. By varying the distance from the scale to the back of the mirror, the change in reading caused by a certain strain in the specimen will vary.

In this work the distance was chosen such that a strain of .001 inch caused a change in reading of $\frac{1}{2}$ inch. This $\frac{1}{2}$ inch on the scale is divided into ten divisions and in reading the cross-hair tenths of these smaller divisions can be easily estimated. The strain is thus measured to .00001 inch. With a 4 inch distance piece, which was the length used in these tests, the unit strain is thus measured to .0000025. Considering the modulus of elasticity of steel = 30,000,000 a unit strain of .0000025 represents a stress of 75 lbs./in^2. That is, with these instruments, provided that certain precautions are taken in their use the stress in a specimen is measured to within 75 lbs./in.^{2}.

To ensure this accuracy it is necessary that certain precautions be taken in the use of the instruments.

Any change in position of the telescope and scale between readings would cause a change in reading on the scale which would be incorrectly considered as affected by a rotation of the mirror. For this reason the telescopes and scales should be mounted on solid stands quite separate from the machine and test specimen, and should not be moved while a test is being made. They would then remain fixed in position and thus one possibility of error would be eliminated.

When the telescope and scale are correctly placed with respect to the extensometer, the following conditions exist:

The line of sight of the telescope is normal to the plane of the mirror.

The plane of the scale is parallel to the plane of the mirror.

An image of the scale appears in the telescope.

The distance from the scale to the back of the mirror is equal to the calibration distance of the extensometer.

In this work, as in most of the work which has been done with these extensometers, the calibration distance was chosen so that a change in length of the test specimen of .001 inch caused a change in reading on the scale of $\frac{1}{2}$". This calibration was obtained by setting up an extensometer in the Whitworth measuring machine and changing the length of the test specimen by .001". The distance from the back

of the mirror to the scale was then varied till this .001" strain caused the desired $\frac{1}{2}$" change in reading on the scale.

Since the dimensions of these extensometers are not exactly the same, their calibration distances will also differ somewhat and it is necessary to calibrate every extensometer.

Care should be taken in clamping the extensometer on to the test specimen. The surface should be even to ensure a good bearing of the diamond-piece. The diamond-piece should be clamped firmly in position with its long axis normal to the distance-piece.

The V-grooves which are cut in the distance pieces must be wide enough to allow the knife-edge of the diamond-piece to bear on the bottom of the groove rather than on the shoulders. When these grooves are narrow and the diamond-piece does bear on the shoulders, its effective depth is reduced and correct results are not obtained.

Any rotation of the test specimen as a whole, such as occurs in members of a built-up structure, will cause an error in the strain measurement. To eliminate this error the extensometer must also be placed in the reversed position on the specimen and the average of the two differences in readings taken as a true measure of the strain. In this way the error, due to the rotation of the specimen, appears twice and with opposite algebraic signs, and hence is eliminated.

The Loading Machine

The Emery testing machine in the McGill University Testing Laboratory was used for loading the truss. This machine is very suitable for work of this nature as the load is applied by hydraulic pressure and the vibration reduced to a minimum.

Measurement of Stresses

The location and magnitude of all observed stresses are shown in Plate 8.

All tests were conducted with the truss set up in the Emery testing machine, as illustrated in Plate 1. The method of support at the heel of the truss was not, however, the same for all tests.

A complete extensometer survey was made of the stress distribution in the members with the truss supported by cast-iron rockers placed under the intersections of the gravity axes of the top and bottom chords. With this type of support the joints at the heel of the truss were not restrained in any way, but were free to rotate. By considering the forces in the members as acting along the gravity axes it is seen that there was no eccentricity of forces at the heel of the truss.

Further stress determinations were made with the truss supported by these same rockers placed with spans of 15' and 16'. Using these methods of support, there was no restraint at the joint but there was an eccentricity of reaction. These same determinations had been made previously

by Campbell, but were repeated as a check to see whether or not the action of the truss was the same after the slight changes had been made in it. The stresses were found to agree quite well with those determined by Campbell under similar conditions.

Other types of supports used were flat supports; wood and concrete blocks. For the wood supports, 3" x 8" x 1'-6", white pine blocks were used. For the concrete supports 3" x 8" x 1'-6", concrete blocks were placed on the supporting beam and covered with a cement grout in which the sole plates were allowed to set. With these flat supports there was an eccentricity of reaction and also a fixed condition of the joint at the heel of the truss. The restraint was not absolute but the joint underwent a slight rotation due to the deformation of the material in the support. This rotation was measured with levels. These were quite sensitive and a measure of the rotation was obtained which was accurate to within 10" of arc.

For the purpose of measuring the deflection of the truss, small holes were drilled in rivets in the bottom chord directly over the supports. Nails were driven into these holes and a very fine wire stretched over them. A scale was clamped at the centre of the bottom chord, just behind the wire, and the deflection determined by reading the wire on this scale. A fine scale was used and the readings were taken with a telescope giving the deflection to ten-thousandths of an inch.

Tests were made at locations 12 and 13 to determine the effect of a stitch rivet close to the gusset plate on the stress distribution in the members. The extra rivet holes, which were punched in the top chord, were used for this purpose. Fillers were driven between the angles in the top chords opposite these holes and turned bolts and nuts were used to hold the angles together.

Owing to the lack of facilities for riveting, the desired stitch rivets were not put in, but bolts and fillers at locations 12 and 13, a filler and clamp at 9A, and fillers at locations 1 and 8,were substituted. It was assumed that they would give conditions analagous to those obtained by the use of stitch rivets.

In double angle compression members the angles tend to spread; the bolts and clamp would prevent this spreading as would stitch rivets. In tension members the tendency of the two angles is to pull together; the fillers at locations 1 and 8 would prevent this in much the same way as would the fillers used with stitch rivets.

Conclusions were arrived at, as to the effect of stitch rivets, based on the results produced by the substitutes used since their effects were considered as analagous.

The stresses were measured at location 9A with, and without, the top chord clamped close to the gusset plate. These determinations were made under various

conditions of support:

1. With C.I. rockers at the intersection of the gravity lines.
2. With C.I. rockers with a 15' span.
3. With wood block supports.

The purpose of these tests was to determine the effect of a stitch rivet close to the gusset plate. It was assumed that the effect of the filler and clamp in restraining the member would be equivalent to that of a stitch rivet.

The clamp was attached to the top chord at $2\frac{1}{2}$" (the rivet pitch used in the gusset plate) from the last rivet in the plate. A filler was planed to a snug driving fit and driven betwwen the angles at this point. Washers of the same diameter as the head of a rivet were stuck to the outside of the vertical legs of the angles and the clamp was tightened on these washers.

At locations 1 and 8 in the bottom chord tests were made for the purpose, as in the tests at locations 9A, 12 and 13, of determining the effect of a stitch rivet near the gusset plate.

At these locations, since the tendency of the angles in a tension member is to draw together, it was only necessary to drive a filler between the vertical legs of the angles. No clamp was used. These fillers were placed $4\frac{1}{2}$" (the rivet pitch in the gusset plate) from the last rivet in the plate.

Arrangement of Extensometers

In measuring the stresses, four extensometers were used. Some tests were made with the four extensometers at one section, but later they were arranged at two sections, these sections being chosen at opposite ends of the truss. With the extensometers arranged in this way, more time was required in taking the readings since it was necessary for the observer to walk between the two sets of telescopes for each reading, but much time was saved in setting up the extensometers and telescopes. It was felt that the stress measurements could be obtained more efficiently with the latter arrangement and consequently, in subsequent tests, the extensometers were arranged two at a section.

With each loading of the truss the extensometers were set up in position and before any readings were taken the load was run up to 12000 lbs. and then removed rather rapidly. The purpose of applying this preliminary load was to eliminate slight irregularities in the action of the instruments. Experience had shown that better and more accurate results were obtained by so doing. Readings were then taken at loads of 3000 lbs, 7000 lbs, 11000 lbs. and 15000 lbs. and again at 11000 lbs., 7000 lbs. and 3000 lbs. as the load was removed.

Hooke's law states that $\frac{\text{Stress}}{\text{Strain}}$ = constant.

If the material followed this law, as would be expected, the strain, and hence the change in reading caused by an increment of load of 4000 lbs., would be the same for all increments of 4000 lbs. whether it be from 3000 lbs. to 7000 lbs. or from 15000 lbs. to 11000 lbs. The 3000 lbs. readings would also be the same before and after the load was applied.

When several tests were made it was seen that the material was behaving in the expected manner, the strains were practically the same for all 4000 lbs. intervals. After this was determined the intermediate readings served no useful purpose and were omitted in subsequent tests.

To eliminate any error due to a rotation or bending of the specimen, the extensometers were also set up in the reversed positions. The average of the differences in readings caused by the 12000 lbs. increment of load (3000 lbs. to 15000 lbs.) with the extensometers in each of these positions was taken as a true measure of the strain.

By taking the mean of the averages for the increasing and decreasing 12000 lbs. increments, it was thought that a still more accurate measure was obtained.

All the measured stresses were deduced for a load of 15000 lbs. as follows:-

Total differences ÷ 4 = mean average change in reading caused by an increment of load of 12000 lbs.

Strain of 4" test specimen due to a load of 15000 lbs. = $\frac{15}{12} \times \frac{1}{4}$ x Total Differences x .00001".

Unit Strain = $\frac{15}{12} \times \frac{1}{4} \times \frac{1}{4}$ x Total Differences x .00001.

Stress in lbs./in.^{2} = 30,000,000 x $\frac{15}{12} \times \frac{1}{4} \times \frac{1}{4}$ x .00001 x Total Differences

= 23.44 x Total Differences.

It is doubtful whether the mean of the differences in readings caused by the increasing and decreasing 12000 lbs. increments of loads gives a more accurate measure of the strain than is given by the former alone. In almost every instance the latter increment was smaller than the former. This was quite probably due to a slight temporary set in the test specimen, a lag in returning to its original form. The actual strain measurement would therefore be the former increment rather than the mean of the two. For this reason, in most of the tests the second 3000 lbs. reading was recorded as equal to the first. Using the latter difference in readings when it did not agree with the former, would give incorrect rather than more accurate results. Nevertheless, the second reading at 3000 lbs. was always taken as a check against any slipping of the instrument, or any error in taking the first. If this did not check within .00003" with the first reading the test was repeated.

In computing the stresses the constant 23.44 was used and the answer read on a slide rule to within 10 lbs. Such precision is not warranted. The stresses for a load of

12000 lbs. would be accurate to within 75 lbs. and as determined for the load of 15000 lbs. would be accurate to within $\frac{15}{12} \times 75 = 100$ lbs. (approx.). The stresses recorded in the tables of results are therefore reliable only to the nearest 100 lbs.

The calibration distances for the extensometers were determined by the Whitworth measuring machine before commencing the tests. These calibration distances were again determined after the completion of the tests and were found to check with those previously obtained.

Mention has previously been made of the failure of the gusset plate at the top of the truss. This failure occurred during the first test attempted by the writer.

The truss was set up in the loading machine with the extensometers, telescopes and scales in position. Readings were taken at loads of 3000 lbs., 7000 lbs. and 11000 lbs. but the load of 15000 lbs. was not reached as the top gusset plate buckled with the machine, registering a load of 13600 lbs. This failure was very unexpected as the truss had been designed for a load of 20000 lbs.

Fortunately, none of the other members were destroyed and it was possible to repair the truss by removing the plate, replacing it by a slightly heavier one. As previously stated the connections to this new plate were welded. This work was done by the Welding Engineers Ltd., of Montreal.

After this failure the loading machine was calibrated and was found to be registering the load incorrectly. The load at which failure occurred was not 13600 lbs. as indicated by the machine, but approximately 35000 lbs.

Before further tests were made the machine was adjusted till the error in registering the load was shown by calibration to be less than 1%. Another calibration was made after the completion of the writer's tests which again showed the error to be less than 1%.

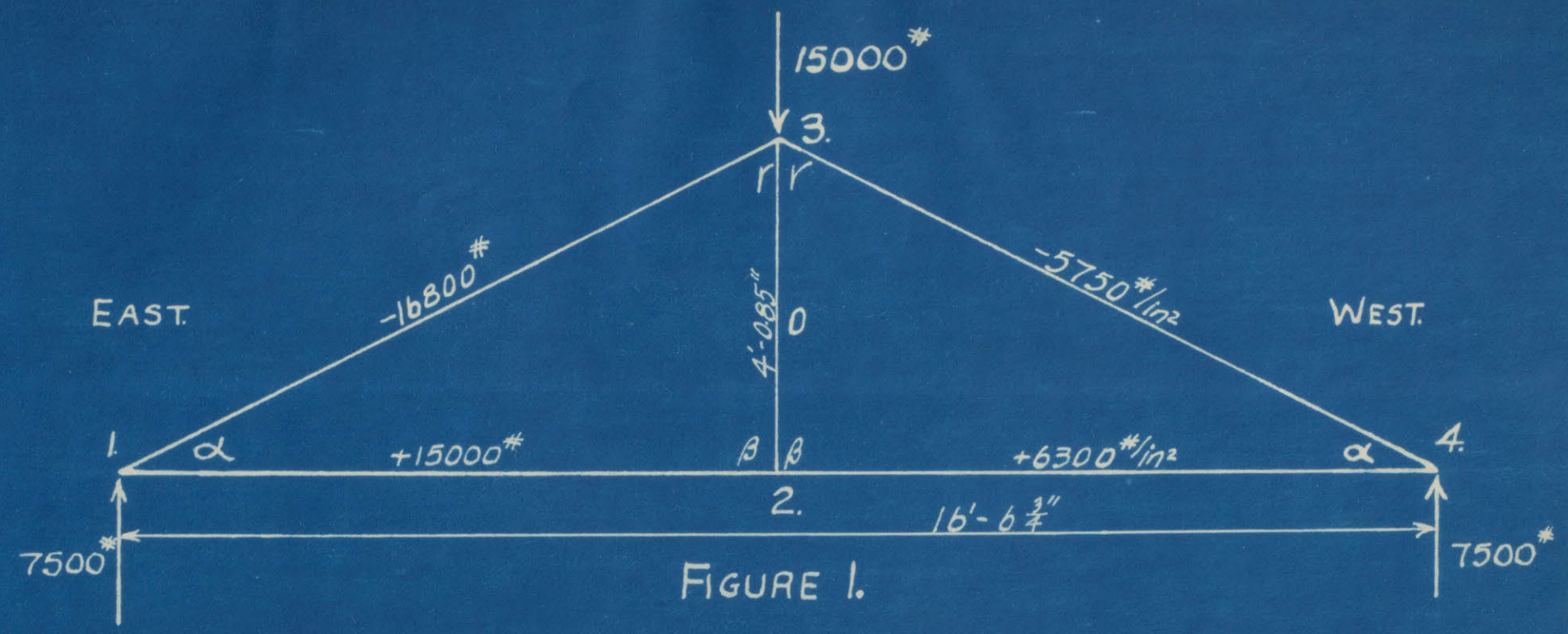


FIGURE 1.

TABLE 1.

Member	Section	Area in in.²	Length in in.	I in in⁴	K = I/L	x–x: Y₁	x–x: Y₂
13	2 L's ~ 3" x 3" x ¼"	2.92	111.1	2.374	.0214	0.82	2.10
34	2 L's ~ 3" x 3" x ¼"	2.92	111.1	2.416	.0216	0.84	2.11
12	2 L's ~ 2½" x 2½" x ¼"	2.38	99.4	1.432	.0144	0.72	1.82
24	2 L's ~ 2½" x 2½" x ¼"	2.38	99.4	1.432	.0144	0.72	1.82
23	1 L ~ 2" x 2½" x ¼"	1.06	49.7	0.670	.0135	0.81	1.72

TABLE 2. ~ Δ ANGLES

cot. α = 2.00 cot. β = 0 cot. r = .50

$E\Delta\alpha = (0+5750)\times.50 + (0-6300)\times.0 = +2875.$

$E\Delta\beta = (-5750-6300)\times2.0 + (-5750-0)\times.50 = -26975.$

$E\Delta r = (6300+5750)\times2.0 + (6300-0)\times0 = +24100.$

TABLE 3.

Joint	Member	K	L	EΔL	EΣΔL	E·KΣΔL
1	13	.0214				
	12	.0144	312	+2875	+2875	+41.4
		.0358				+41.4
2	21	.0144				
	23	.0135	123	-26975	-26975	-3642
	24	.0144	324	-26975	-53950	-776.9
		.0423				-1141.1
3	34	.0216				
	32	.0135	432	+24100	+24100	+325.4

FIGURE
CALCULATION
EXPERIM
McGI
C.F. Morrison

PL

Calculation of Secondary Stresses.

The secondary stresses in the experimental truss, for a load of 15000 lbs. are calculated by the Manderla-Winkler method which is described under "Theory of Secondary Stresses". The stresses caused by the weights of the members are not considered since they are negligible in comparison with those caused by the rigidity of the joints and by the eccentric forces at the joints.

Table I, Plate 7, gives all the required information concerning the primary stresses in the members of the truss and the dimensions and make-up of these members.

Table II gives the computation of the Δ angles.

Table III is an arrangement of the above data which is used in writing the equations for the T angles.

1. Truss supported by C.I. rockers under the intersection of the Gravity Axes.

Formation of equations from Table III, Plate 7.

External moments at joints 1 and 4 = 0. Equation at joint 1

$$\left.\begin{array}{l} .0716T_1 + 82.8 \\ .0214T_3 + 1031.4 \\ .0144T_2 \end{array}\right| = 0$$

1) $.0716T_1 + .0144T_2 + .0214T_3 = -1114.2$

2) $.0144T_1 + .0846T_2 + .0135T_3 + .0144T_4 = +1915.4$

3) $.0214T_1 + .0135T_2 + .0216T_3 + .0216T_4 = -2411.5$

4) $.0144T_2 + .0216T_3 + .0720T_4 = +652.7$

SOLUTION OF EQUATIONS

Equation	T_1	T_2	T_3	T_4	Absolute Term	Check
1	7.16	1.44	2.14		- 111.42	- 100.68
2 x $\frac{716}{144}$ ....2'	7.16	42.06	6.71	7.16	+952.05	+1015.14
3 x $\frac{716}{214}$ ....3'	7.16	-4.52	37.81	7.23	-807.00	- 750.28
2' - 1 I		40.62	4.57	7.16	+1063.47	+1115.82
3' - 2' ...II		-37.54	31.10	.07	-1759.05	-1765.42
I x $\frac{3754}{4062}$....I'		37.54	4.22	6.62	+ 982.50	+1030.88
4 x $\frac{3754}{144}$....4'		-37.54	-56.31	-187.80	-1702.00	-1983.65
II + I' ...III			35.32	6.69	- 776.55	- 734.54
I' + 4' IV			-52.09	-181.18	- 719.50	- 952.77
III x $\frac{5209}{3532}$..III'			52.09	9.87	-1145.50	-1083.54
IV + III'....V				-171.31	-1865.00	-2036.31
Values of T	T_1 -13,890		T_2 +27000	T_3 -24000	T_4 +10900	

Since the truss is symmetrical about the centre line, the stresses at one end only need be calculated.

$T_{23} = T_{32} = 0$ (From symmetry)

$T_{13} = -13,800$

$\Delta\alpha = +2,875$

$T_{12} = -10,925$

$T_{21} = 27,000$

$T_{31} = T_{34} + 2\Delta r = 24,000$

The secondary stresses are determined from the T angles and certain geometric properties of the members. In this solution the T angles will first be found for the various conditions

of support and the secondary stresses will then all be calculated at once thus minimizing the work involved in the computations.

2. Truss supported by C.I. rockers, 16' span.

Distance from intersection to intersection of gravity axes = 16'-6$\frac{3}{4}$".

Eccentricity of reaction at heel = 3.375"

External moments at joings 1 and 4 = 7500 x 3.375

= 25300 in.-lbs.

The absolute terms in the equations for joints 1 and 4 are modified by this external moment.

When the external moment M is in a counterclockwise direction the term to be added to the right side of the equation is $+\frac{M}{2E}$; or, when E has been omitted in the calculations $+\frac{M}{2}$. In this problem the term to be added to the right side of the equation is $+\frac{25300}{2} = 12650$.

(1) $.0716T_1 + .0144T_2 + .0214T_3 = -1114.2 + 12650$

Considering the truss as symmetrical about the vertical member

$T_{23} = T_{32} = 0$

$T_3 + \Delta\gamma = T_{32} = 0, T_3 = -24,100$

$T_2 + \Delta\beta = T_{23} = 0, T_2 = +27,000$

(1) $.0716T_1 + .0144x27000 - .0214 \times 24100 = +11536$

$T_1 = +163,00.$

T_{13} = +163,000

$\Delta\alpha$ = + 2,875

T_{12} = +165,900

T_{21} = + 27,000

T_{31} = + 24,100

Owing to the simplicity of the truss this abbreviated solution for determining the T angles is possible. In the average problem it would, however, be necessary to solve simultaneously as many equations as there were joints of the truss.

3. Truss supported by C.I. rockers, 15' span.

Eccentricity of reaction = 9.375"

Moment at joint 1. = 9.375 x 7500 = 70300 inch-lbs.

(1) $.0716T_1 + .0144T_2 + .0214T_3 = -1114.2 + 35,150$

T_2 = +27,000

T_3 = -24,100

From (1) T_1 = +477,000

T_{13} = +477,000

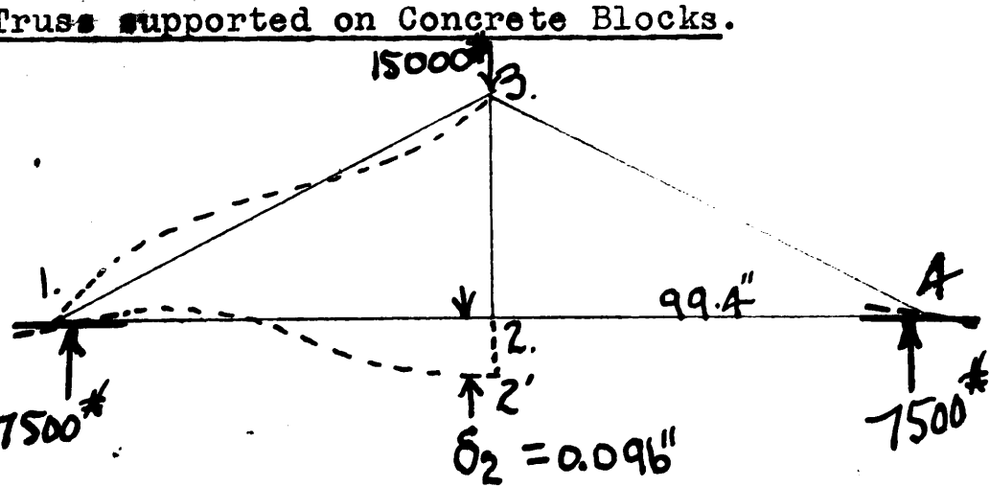
$\Delta\alpha$ = + 2,875

T_{12} = +479,900

T_{21} = + 27,000

T_{31} = + 24,100

4. Truss supported on Concrete Blocks.



T_{12} caused by $\delta_2 = \frac{.096}{99.4} = .00968$ radians.

Rotation of 12 at joint 1 = .003185 radians

Rotation of 13 at joint 1 = .003665 radians

Change of angle 213 = +.000480 radians

In order to express these angles in the same units as have been used in the previous computations, they are multiplied by 30,000,000.

T_{12}= +29040 + 95550 = +124,600

T_{13}= +124,600 + 14,450 - ($\Delta\alpha$ = +2875) = +136,200

T_{21}= +27,000

T_{31}= +24,100

The following Table gives a summary of the T angles at both ends of members 1-2 and 1-3 with the various methods of support.

	CONDITION OF SUPPORT			
T	C.I.rockers C.G. Lines	C.I.rockers 16' span	C.I.rockers 15' span	Concrete Blocks
1-2	-10,925	+165,900	+479,900	+124,600
2-1	+27,000	+27,000	+27,000	+ 27,000
1-3	-13,800	+163,000	+477,000	+136,200
3-1	+24,000	+ 24,100	+ 24,100	+ 24,100

Having the T angles for the members the secondary stresses are calculated by the equation $f_{ab} = \frac{2c}{\ell}\left[2T_{ab} + T_{ba}\right]$

Where f_{ab} = the secondary stress in member a b at joint a.

c = the distance from the neutral axis of the section to the fibre considered.

ℓ = distance from joint a to joint b.

Secondary stresses in member 1-3 at joint 1. (concrete block supports).

$$f_{13} = \frac{2c}{\ell} \left[2T_{13} + T_{31} \right]$$

$\left[(t) \frac{2c}{\ell}\right] = .0148$, $\left[(b) \frac{2c}{\ell}\right] = .0378$ where (t) designates the value for the top fibre of the section and (b) the value for the bottom fibre.

T_{13} = +136,200

T_{31} = + 24,100

$2T_{13} + T_{31}$ = 296,500

$f_{13(t)}$ = +4,400 (At Location 9 measured stress = +5000)

$f_{13(b)}$ = -11,200 (At Location 9 measured stress = -11000)

The direction of the stress, tension or compression, is determined by a consideration of the convention as to the sign of the moments.

Table "S" gives the secondary stresses in the top and bottom fibre at both ends of members 1-2 and 1-3 under the various conditions of support. The principles of statics show that a straight line relation exists between the stresses at various points along a member. With the stresses at the ends of the members known it is therefore possible to determine the stresses at intermediate points by this relation.

TABLE "S"

MEMBER		CONDITION OF SUPPORT			
		C.G.Lines	16' Span	15' Span	Concrete Blocks
1-2	(t)	+190	+13100	+36150	+10100
	(b)	-75	-5200	+14300	+4000
2-1	(t)	-1575	-8050	-19550	-6550
	(b)	+625	+3200	+7750	+2600
1-3	(t)	-50	+5200	+14500	+4400
	(b)	+140	-13200	-37000	-11200
3-1	(t)	-500	-3150	-7775	-2750
	(b)	+1300	+8000	+19850	+6970

(t) designates the stress in the top fibre of the section.

(b) designates the stress in the bottom fibre of the section.

\+ = tension

\- = compression

The total stress at any point is found by adding algebraically the primary stress and the secondary stress at that point.

LOCATION
9A

With and Without
Clamp and Filler.

	Without.	With.	Without.	With	Without.	With.
South.	-4880 -4650	-5250 -4970	-520 +2340	+560 +3520	-3700 -2820	-3850 -3000
	-6900 -5540	-6750 -5110	-27200 +4920	-26600 +4080	-11900 -2860	-11150 -3150
	-7080 -5450	-7040 -5160	-27800 +4830	-27100 +4000	-12050 -2900	-11600 -3100
North	-4700 -4450	-5150 -4880	-520 +2100	+330 +2630	-3700 -2900	-4120 -3380

C.G. LINES — 15' SPAN — WOOD BLOCKS

Concrete Blocks
-2750 -1120
-16800 -17100 -510 -470
-3000 -1120
-3800 -2630
-13000 -13000 -2630 -2720
-3560 -2530
-240 +3140
-30000 -30150 +6000 +6000
-890 +2770
-4720 -4530
South. -7150 -7400 -5550 -5460
North. -4220 -3900
15' Span
C.G. Lines

C.G. Lines With Bolt and Filler.
-4840 -4920
-4880 -5300 -6050 -5950
-6140 -6460
-4500 -4750
-5430 -4950
-5850 -5410 -5550 -5490
-6500 -6450
-5400 -5540 -6100 -6050
-6520 -6700
-5770 -5720
-6120 -6170 -4920 -5400
-5770 -5450

C.G. Lines With Bolt and Filler
-6130 -5850
-6240 -6370 -4220 -3940
-5800 -5530
-5400 -5860
-6210 -6830 -3940 -3540
-6320 -5740
-5960 -5580
-6300 -6370 -4090 -4170
-5920 -5870
-5200 -5530
-5750 -4910 -6500 -6850
-5720 -5960

Concrete Blocks
-1000 -3720
-1040 -1100 -16000 -16000
-1520 -4050
-2380 -3660
-2850 -2850 -12200 -11900
-3100 -2850
+3000 -570
+6520 +6410 -31600 -31600
+3290 -240
-3800 -4470
-4430 -5640 South. -8000 -8060
-4400 -4540 North.
15' Span
C.G. Lines.

Wood Blocks

-115 +360
-420 -470

Gravity Axis of Member.

(12) (11) (10) (9) (9A) (13) (14) (15) (16) (18)

(8) (7) (6) (5) (4) (3) (2) (1)

Gravity Axis of Member.

TYPE of SUPPORT

C.G. Lines

+6570 +6050
South. +7930 +8400 +5460 +5120
North. +5570 +4860

+6140 +6330
+6420 +6620 +6250 +5770
+5200 +5160

+6670 +6940
+4470 +4920 +6600 +6370
+5550 +5900

+7120 +7360 +6650 +6870
+3570 +3130 +7120 +3590 +6830 +7050 +3870 +6830
+5950 +6000 +5200 +6070

+6470 +6320
+4830 +4950 +6400 +6670
+5620 +5720

+6140 +6150
+6450 +6180 +5850 +6040
+5720 +5580

+5500 +5100
+6240 +6020 +5450 +5200
+5770 +3600
+4380 +2670

C.I. Rockers at intersection of C.G. Lines.

16' Span

+14600 +14850 +2430 +1960
+5220 +3520
+4380 +3000

C.I. Rockers, 16' Span.

+15000 +14400 +2180 +2090
+4550 +3310
+4170 +3240

Wood Blocks

+12500 +12900 +2370 +2090
+4320 +3240

Wood Blocks

+10900 +10960 +3050 +2970
+4480 +3870

C.G. Lines (With Fillers)

+6700 +6330
+7920 +7920 +5350 +4830
+5480 +4730

+5350 +4820
+8700 +8350 +5020 +4950
+5580 +5420

C.G. Lines. (With Fillers)

+3400 +1200
+20300 +20700 +150 -400
(8)
+3900 +1400

Concrete Block Supports.

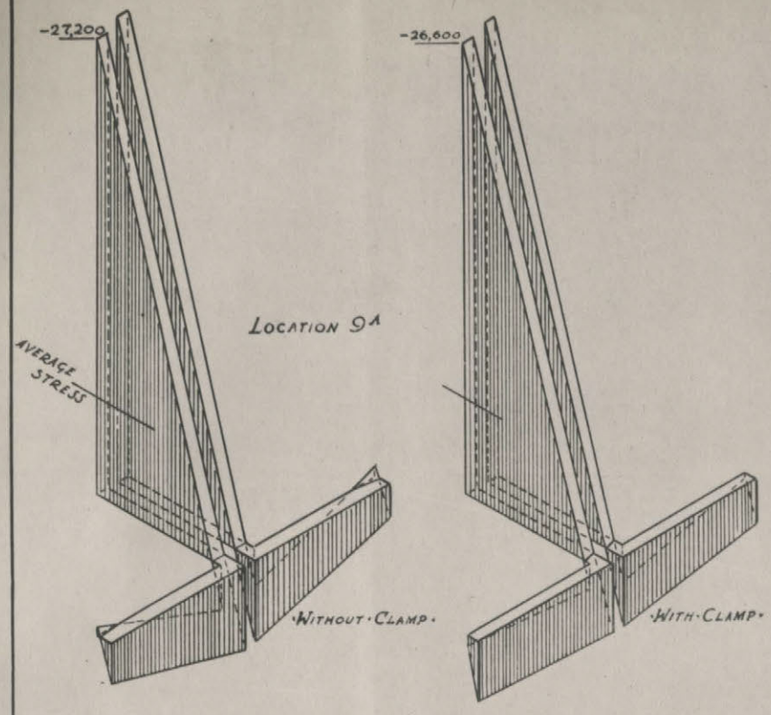
·SHOWING·MAGNITUDE·AND·LOCATION·OF·
ALL·MEASURED·STRESSES·

\+ = TENSION
− = COMPRESSION
All stresses shown are for load of 15000 lbs.

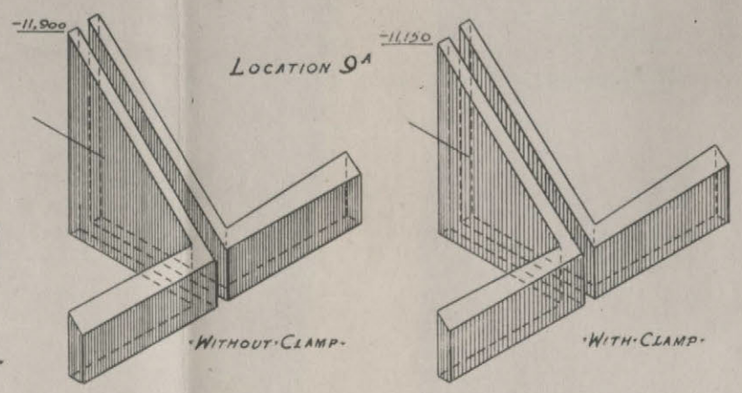
·STRESSES·
·IN·
·EXPERIMENTAL·TRUSS·
·McGILL·UNIVERSITY·

·C·F·MORRISON· ·APRIL·1927·

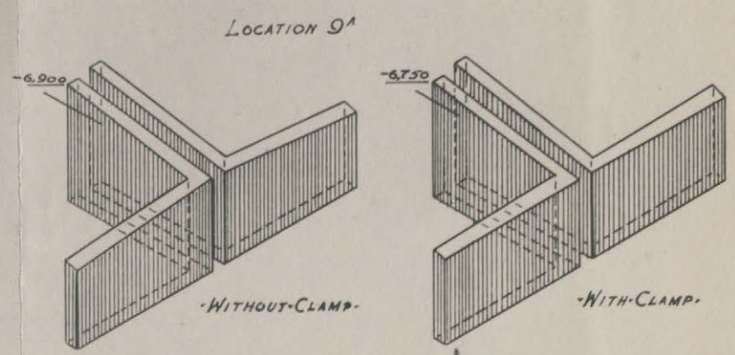
SHOWING STRESS DISTRIBUTION
AT VARIOUS LOCATIONS UNDER
VARIOUS CONDITIONS OF SUPPORT
AND ILLUSTRATING EFFECT OF STITCH RIVETS



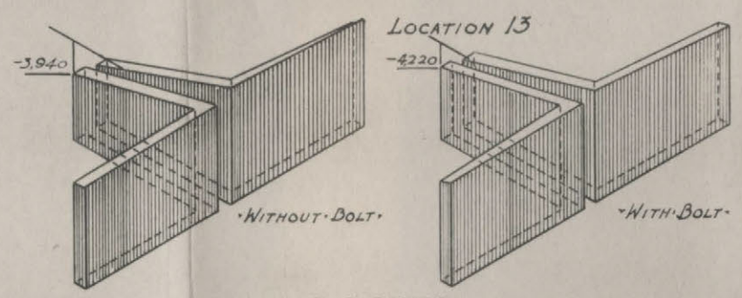
15 FT. SPAN



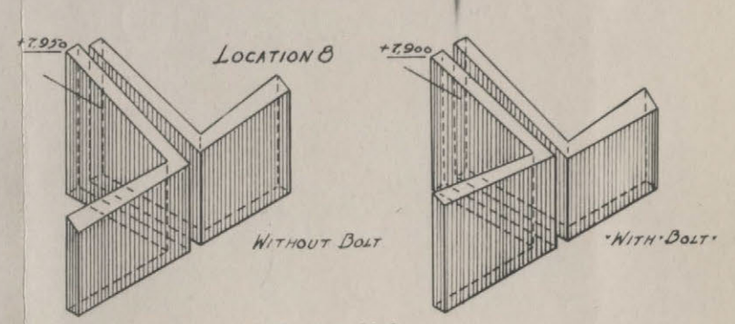
WOOD BLOCKS



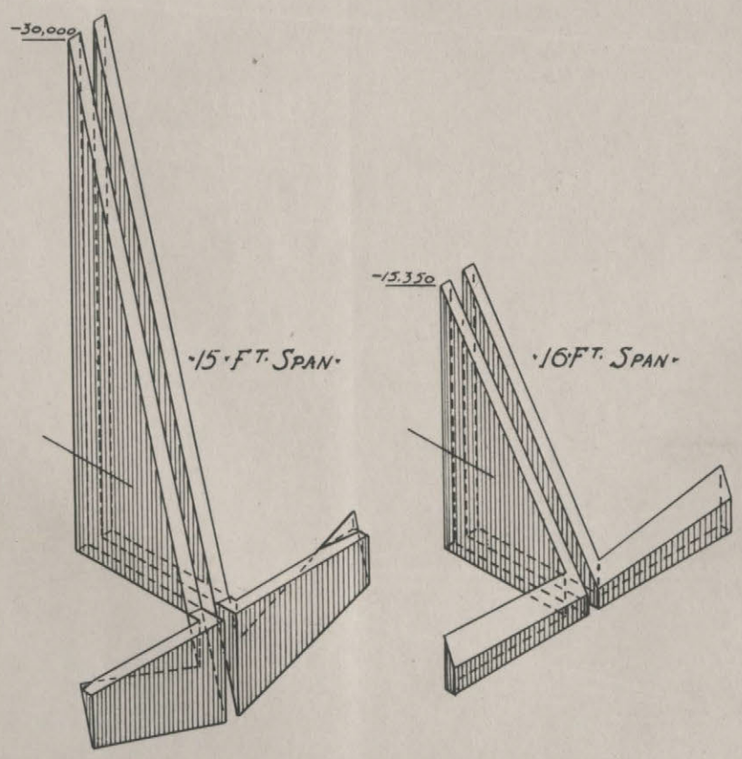
C.G. LINES

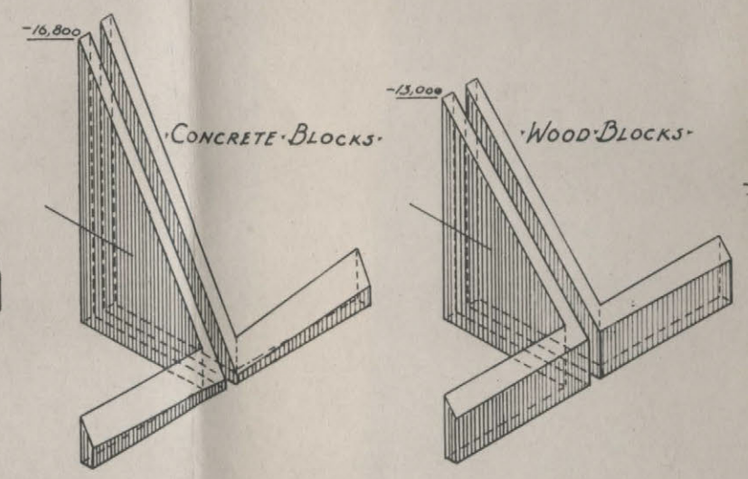


C.G. LINES

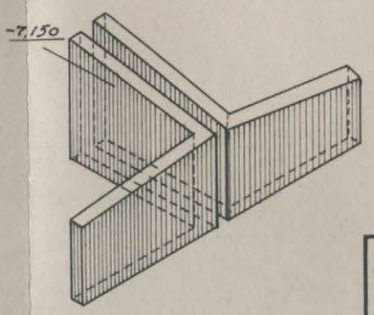


C.G. LINES





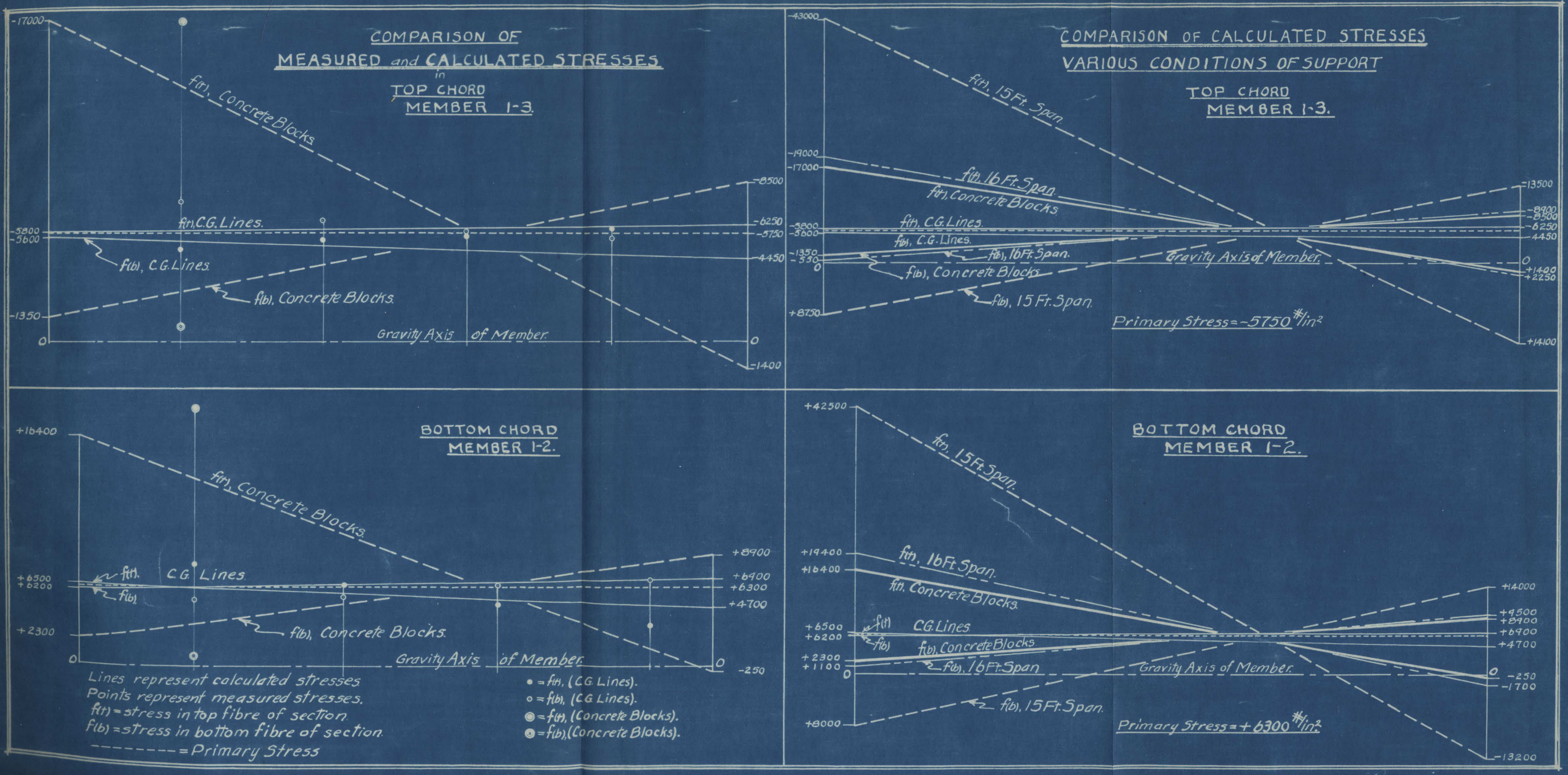
+ Tension
- Compression



LOCATION 9

STRESS DISTRIBUTION
at various locations on
Experimental Truss
McGILL UNIVERSITY
C.F. Morrison April 1927

-PLATE-10.-



C. H. Morrison May 1927.

Discussion of Results:

In general the stresses computed by the Manderla-Winkler method of secondary stress analysis are in agreement with the stresses actually existing, as determined by extensometer strain measurements. An exact check is practically impossible owing to the errors in the assumptions made in the theoretical method and the unavoidable errors in obtaining the extensometer measurements. The discrepancies are, however, within the allowable range for work of this nature.

Campbell's Results:

Campbell's measurements, with the truss supported by C.I. rockers at 15' span and 16' span, were shown by him to give stresses which agreed quite well with those calculated by the above mentioned theory.

Results of this Investigation:

Plate 10 represents a comparison of the measured and calculated stresses for two conditions of support, - C.I. rockers at the intersection of the gravity axes (16'-6¾" span), and concrete block supports (15'-7" c. to c.). There is seen to be a straight line relation between the stresses at various points along a member; this is in agreement with the theory regarding the stress relations and indicates a consistency in the extensometer measurements. The total stress in a member at any section may be determined

definitely from the conditions of loading and the relations which, according to the principles of statics, must exist. At every section where extensometer measurements were taken the total stress in the member, indicated by these measurements, was computed and found to agree quite well with the total computed stress at the section. Thus a check on both the consistency and absolute accuracy of the extensometer measurements was obtained.

An analysis of the stresses in the top and bottom chords meeting at the East heel indicated that there was a slight external moment at that point when the truss was supported by rockers placed with a span of 16'-6¾". The moment was approximately 3500 in.-lbs. which would be caused by an eccentricity of reaction of $\frac{3500}{7500}$ -- = 0.47"

A change in these stresses, affected by eliminating this external moment, would give a much closer check with those calculated by the theoretical method.

It is difficult to determine the exact position of the gravity lines owing to slight irregularities in the shapes of the members. With such an acute angle of intersection a small error in the position of the lines would cause considerable error in the location of their intersection, hence, this eccentricity of 0.47" can hardly be considered as excessive.

These results indicate, ad did Campbell's, that the forces in the members act along the gravity axes rather than

along the rivet lines where they have generally been considered to act.

Plate 9. illustrates the stress distribution at location 9 in the top chord under various conditions of support. The measured stresses are plotted on the cross-section of the member as a base plane, and the resulting solid is shown in isometric projection. From the illustration it is evident that by reducing the eccentricity of the reaction at the heel the secondary stresses are reduced. The most nearly uniform distribution of stress is obtained with the truss supported by rockers under the intersection of the C.G. lines. This type of support, however, is seldom, if ever, used in practice. In construction the more common type of support is the flat support such as the wood and concrete blocks used in this investigation.

Considering the stresses at a location near the heel of the truss, where the effect of the support is most noticeable, it is seen that, - supported by rockers (16' span) the maximum secondary stress is 167% of the primary stress while with the concrete block supports, it is 192% and with the wood blocks 126%. These stresses with the flat supports are not what would result from an absolutely fixed condition of support, but the rotation of the joint, due to the elastic deformation of the material in the support, relieves the secondary stresses somewhat. Since the modulus

of elasticity of white pine is less than that of concrete the deformation of the wood blocks is greater than that of the concrete blocks and consequently the secondary stresses are less.

A study of the moments indicated by the measured stresses in the members meeting at the heel of the truss shows an eccentricity of reaction of 1.87" with the wood block supports, and 3.20" with the concrete supports. These supports were centered with a span of 15'-7", that is, 6.4" inside the intersection of the gravity lines; but with the application of the load and deformation of the support, the reaction moved out towards the point of intersection of the forces in the members, thus reducing the eccentricity of reaction and the external moment.

The extensometer measurements indicate that the stresses with the truss supported on wood blocks are much the same as when concrete blocks are used. For this reason a further study of the stress relations was made using only the one type of flat support, namely, the concrete block.

The two methods of stress determination used for the condition of flat supports both involve experimental measurements. The stresses in the members are dependent upon the rotation of the joint at the support which was determined experimentally. Any purely theoretical method of computing this rotation would be complicated and not reliable, owing to lack of knowledge of the exact physical properties of the

Showing Arrangement of Levels for Measuring Rotation of Members at Joint I.

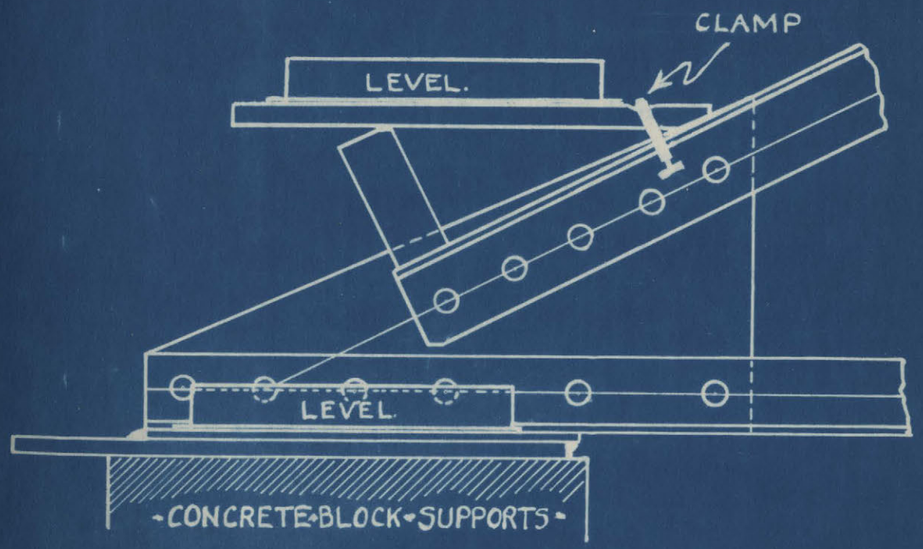


Figure 1.

Recommended Detail for Joint at Support.

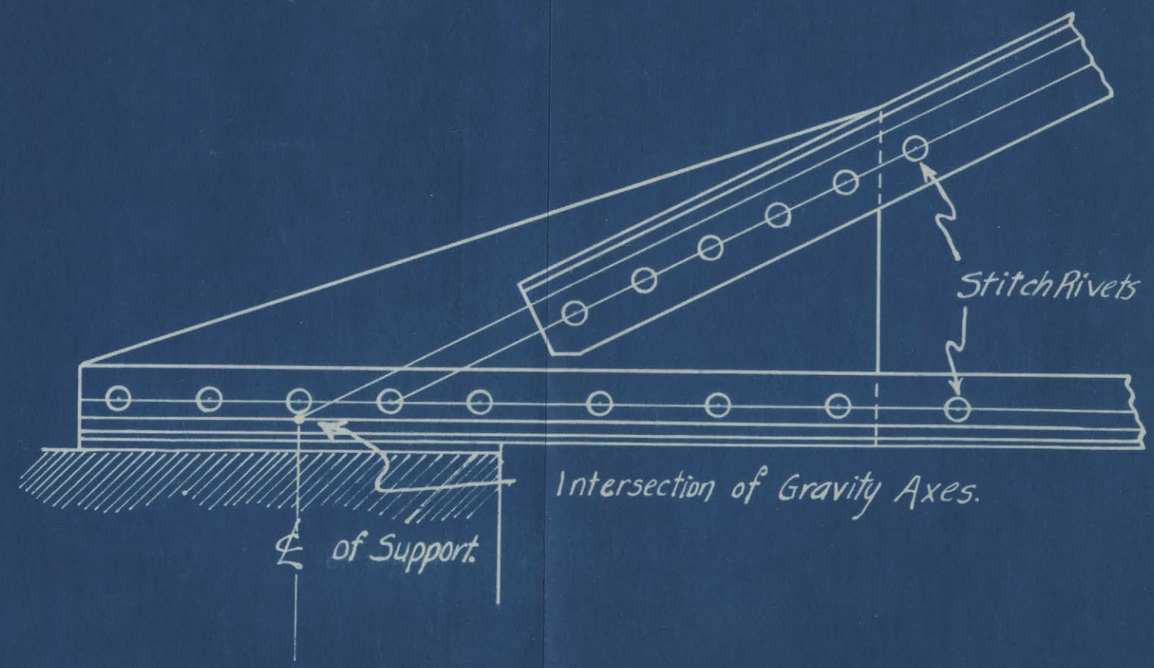


Figure 2.

B.B. Morrison May. 1927.

material of the supports and the consequent difficulty in making assumptions as to the interaction of the supports and the structure. The check in stresses for flat supports is, therefore, only a check on stresses measured in two different ways since there is no purely analytical method for determining them. With the truss supported on concrete blocks the rotations of the top and bottom chords where they were attached to the gusset plate at the East heel, were measured with levels. The bottom chord is horizontal and the level was placed directly on it, but since the top chord was inclined, it was necessary to clamp a bracket to it in such a way as to obtain a horizontal surface on which to place the level. This bracket was firmly clamped in position, hence, any rotation of the chord would produce an equal rotation of the level. Fig. 1 Plate II shows the arrangement of levels for measuring these rotations.

In the Manderla-Winkler analysis the angle between the members meeting at a joint is assumed to remain constant. The measurements described above show that this is not so. The angle did not remain constant, but suffered a change of + .000480 radians. Although disagreeing with the assumption in the theory, this change of angle was not unexpected. No matter how rigid the restraint at the joint, the angle must change somewhat when the members are subjected to a bending moment, due to the elastic deformation of the rivets and gusset plate.

Since any relation for computing this change in angle

would necessarily involve an enormous amount of work and give results of doubtful dependability, its inclusion in the method of secondary stress determination is undesirable.

This method of stress determination gives results which are, at best, only approximations to the true stresses, but since experimental results have shown the approximation to be much closer than when the secondary stresses are neglected in the computations, the error in this assumption does not materially reduce its superiority over the more commonly used methods which neglect the secondary stresses.

Effect of Stitch Rivets:

As previously stated, stress measurements were taken with the hope of obtaining information as to the effect of a stitch rivet near the end of a member on the stress distribution over the section of the member. Rivets were not used but certain substitutes were used which, it was assumed, would have equivalent effects. In the following discussion, for the purpose of simplicity and clearness, these substitutes will be spoken of as stitch rivets.

Plates 9 illustrates the stress distribution at locations 8, 9A, and 13, with and without these stitch rivets. It is seen that in every case the addition of the stitch rivet has reduced the lateral bending, that is, bending in a plane normal to the plane of the gusset plate, and as a result has reduced the secondary stresses in the member.

With the supports under the intersection of the gravity lines the lateral bending in the members was very slight and although the effect of the rivet was to reduce this bending, it was not noticeable to any marked degree. With the more common method of supporting the truss, involving an eccentricity of reaction, the lateral bending is more pronounced, and hence the effect of the stitch rivet in reducing it is more apparent.

Stress Distribution in an Eccentrically loaded Member:

Considering the distribution of stress over a section as conforming to a linear law, the following equation expresses the stress at any point of the section in terms of the coordinates of that point, the coordinates of the point of action of the resultant force N, and certain constants of the section.

$$f = \frac{N}{A} + \frac{Nx(I_x X_1 - KY_1)}{I_x I_y - K^2} + \frac{Ny(I_y Y_1 - KX_1)}{I_x I_y - K^2} \quad 1.$$

where

f = stress at any point on the section; the coordinates of the point are x and y, referred to any pair of rectangular axes passing through the center of gravity of the section.

N = The resultant force acting on the section at a point whose coordinates are X_1 and Y_1.

A = the area of the section.

I_x and I_y = "moments of inertia" of the section about the axes X-X and Y-Y respectively.

(1. Swain Strength of Materials Pge. 157, Equation (8).

$K = \iint xy\, dx\, dy$ = the "product of inertia" of the section for these axes.

By choosing the parameters (X_1 and Y_1) in this equation such that the stresses given by the equation agree at various points on the section with the stresses existing at those points, the coordinates of the point of action of the normal force N are obtained.

It was impossible to choose these parameters and locate the position of N so that the equation would give stresses agreeing absolutely with the measured stresses for the entire cross-section. In investigating the restraint against lateral bending, the resultant normal force (N) was located so that the stresses given by the equation agreed with the measured stresses in the outstanding leg of the angle. This failure of the equation to represent the actual conditions indicates that the stress distribution departs somewhat from the linear law. This may, perhaps, be explained by considering the member as made up of a number of small strips each of which tends to bend in its own way imperfectly restrained by the adjoining strips. That is, the material at the edge of an outstanding leg of an angle may be subjected not only to the primary stress in the member, but to a stress due to bending in the member, and also, if a compression member, to stresses due to that strip of material acting as an imperfectly restrained column. The first two would combine to give a linear distribution,

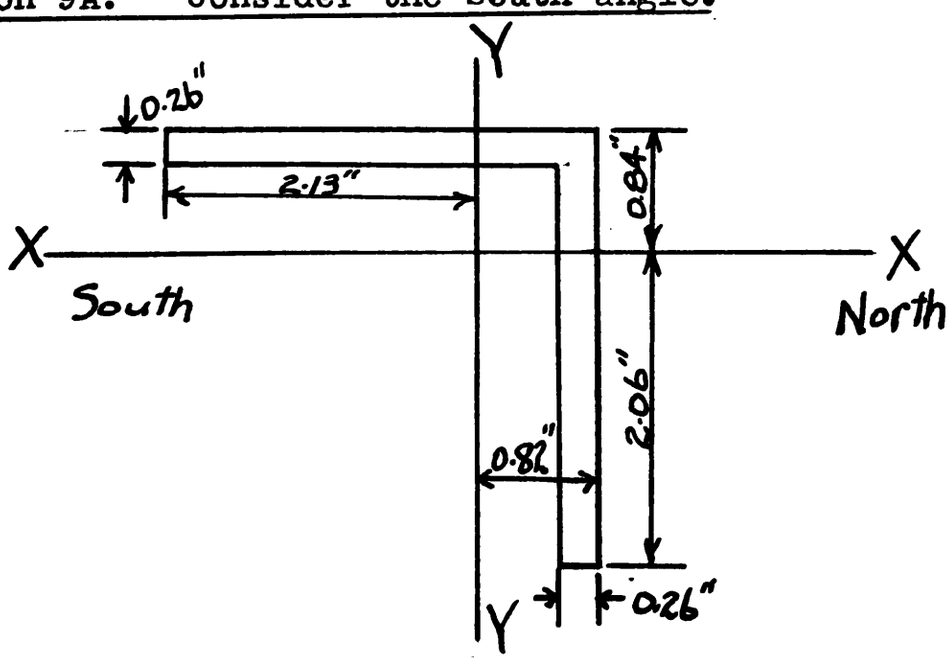
while the effect of the last bending would be to cause the actual stress distribution to depart from the linear law.

Lateral Bending and Restraining Action of the Connection

When stress is developed in an angle by a riveted connection to a gusset plate the problem of calculating the exact point of application of the force is very complicated and, in fact, is almost indeterminate. Experimental results, however, show that the error in considering the load as applied at the back of the angle is quite small. In the following calculations the load will be considered as applied at the back of the angle.

The position of N was obtained at various locations under various conditions of support, with and without the stitch rivets, and thus a measure was obta ined of the restraint of the connection and of the additional restraint caused by the introduction of the rivet.

Location 9A. Consider the South angle.



Total stress in top chord = -16800 lbs.

Stress in one angle, N = -8,400 lbs.

$I_x = 1.187 \text{ in.}^4$

$I_y = 1.208 \text{ in.}^4$

$K = -.715 \text{ in.}^2$

$A = 1.46 \text{ in.}^2$

$$f = \frac{8400}{1.46} - \frac{8400X(1.187X_1 + .715Y_1)}{1.187 \times 1.208 + .715^2} - \frac{8400y(1.208Y_1 + .715X_1)}{1.187 \times 1.208 + .715^2}$$

$$= -5750 + 9120\,X_1(1.187X_1 + .715Y_1) + 9120y(1.208Y_1 + .715X_1).$$

X_1 and Y_1 are chosen such that the stress given by the equation agrees with the measured stress at that point.

For complete restraint against lateral bending, the point of action of the resultant force N will be such that the stresses in all points having the same value of y are the same regardless of the value of x. The restraint of the connection transfers the action of the force N from x = .820" (The back of the angle where the load is applied) to $x = X_1$. If this restraint were complete the force N would be transferred from x = .820" to $x = \overline{X}_1$, the value of $\overline{X}_1$ being such that all points having the same y would be subjected to equal stresses. The value of the restraint of the connection is rated as a percentage of absolute or complete fixity. The percentage is calculated as the ratio of the distance the resultant force N is transferred to the distance it would have to be transferred to give a condition of complete fixity.

That is $\frac{0.820 - X_1}{0.820 - \bar{X}_1}$

$X_1 = 0$ when $Y_1 = 0$, but when the member is subjected to a vertical bending, that is, $Y_1 \neq 0$, X_1 will have some value other than zero.

Table "T" gives the percentage restraints, against lateral bending, of the connections to the top chord, with and without the additonal stitch rivets, as indicated by the measured stresses at locations 9A and 13.

DISTRIBUTION OF STRESS AT LOCATION 9A (Riveted Connection)						
Method of Support	With or Without stitch rivet	Applied Load (X)	X_1	$\bar{X}_1$	Lateral Restraint %	Secondary Stress % of Primary
C.G.Lines	Without	.820	.089	.061	96.4	374
C.G.Lines	With	.820	.075	.071	99.4	362
Wood Blocks	Without	.820	.293	.285	98.4	107
wood Blocks	with	.820	.276	.271	99.2	94
15' Span	Without	.820	.884	.963	44.7	20.0
15' Span	With	.820	.950	.963	91.0	17.4
	LOCATION 13. (Welded Connection)					
C.G. Lines	Without	.820	-.068	-.084	98.3	37.6
C.G. Lines	With	.820	-.023	-.048	97.3	31.4

At the top end of the top chord (location 13) the computations show a restraint of 97.3% with the stitch rivet while without the rivet the restraint is 98.3%. This indicates an error in the stress measurements as it would be impossible to reduce the restraint by the introduction of an additional rivet. The other figures all show an increase in the lateral restraint of the joint with the introduction of the stitch rivet. When the truss is supported by eccentric reactions (15' span), which is quite common in practice, the value of the rivet is quite marked, increasing the restraint of the joint from 45% to 91%. Bending in a vertical plane contributes the large portion of the total secondary stresses and hence the additional rivet is not so effective in reducing these total stresses as in reducing lateral bending.

Column 7 of Table "T" gives the maximum secondary stress at the section as a percentage of the primary stress. It is seen that the rivet is most effective with the wood block supports, reducing secondary stress from 107% to 95%.

Since the cost of the additional rivet would be infinitisimal, its effect in reducing lateral bending and secondary stresses certainly warrants its adoption.

Plate 11, Fig.2, shows a recommended detail for the joint at the support. Note the additional stitch rivets and the position of the center line of the support.

Location 13 is close to the upper end of the top chord where the connection to the gusset plate is welded. The

stresses at that section were studied with a view to discovering the restraining action of the welded connection. Since the truss was not loaded to destruction, no data was obtained as to the ultimate strength of the weld. It, however, showed no signs of failure under the loads used in the tests.

The position of N, the resultant normal force on the section, was determined by the method previously explained. A comparison of the percentage fixities shows that the action of the welded connection is much the same as that of the riveted connection. The lateral restraints of the connections are, welded 98.3%, riveted 96.4%.

These figures would indicate that the welded connection is slightly superior to the riveted. A strong point in favour of the riveted connection is its dependability. Since the weld is dependent, for its strength, upon the quality of workmanship it is looked upon with distrust by the more conservative designers.

This investigation leads to the following conclusions:-

1. That the Manderla-Winkler method of secondary stress determination gives results which are a very good approximation to the true conditions.

2. That the forces in double angle members do not act along the rivet lines, but along their gravity axes.

3. That in structures of this type, for the purpose of reducing the secondary stresses to a minimum, the eccentricity of reaction should be eliminated (See Plate 11, Fig.2).

4. That with flat supports, the line of action of the resultant reaction is not necessarily at the center of the support, but that with the application of the load and deformation of the support this reaction moves towards the point of intersection of the forces in the members meeting at the joint. As a result of this movement of the reaction the external moment at the joint is reduced and the secondary stresses are, in general, thereby reduced.

5. That these tests tend to substantiate the theory that double angle members do not act as a single piece bending as a beam but that each angle bends separately, restrained somewhat by the action of the other.

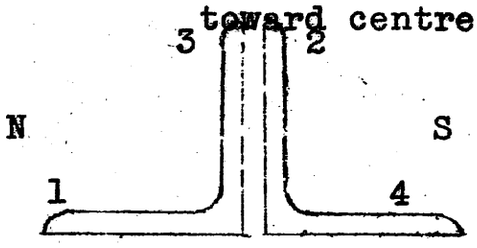
6. That the stress distribution near the ends of the members does not conform to a linear law.

7. That an additional stitch rivet near the end of a double angle member (as shown in Plate 11, Fig.2,) is effective in increasing the restraint of the connection, thereby reducing the lateral bending and secondary stresses.

8. That the restraint of a welded connection is slightly greater than that of a riveted connection. No information was obtained as to the ultimate strength of a welded connection.

16' Span

Table Direct when mirror end of Distance piece is toward centre.



LOCATION NO. 1

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	7.00	+	3.00	+	+
		20		12	
7	7.20		2.88		
		20		12	
11	7.40		2.76		
		20		12	
15	7.60		2.64		
		19		13	
11	7.41		2.77		
		21		13	
7	7.20		2.90		
		20		12	
3	7.00		3.02		
Total		120		74	194
Stress 23.44 x 194 = +4550					
Remarks					

Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	34.50	+	31.00	+	+
		57		48	
7	35.07		30.52		
		56		46	
11	35.63		30.06		
		60		50	
15	36.23		29.56		
		58		51	
11	35.65		30.05		
		54		48	
7	35.11		30.53		
		58		53	
3	34.53		31.00		
Total		343		288	431
Stress 23.44 x 431 = +15000					
Remarks					

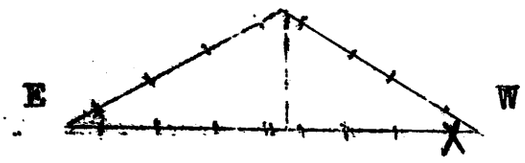
Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	7.00	+	2.00	+	+
		54		44	
7	7.54		1.56		
		57		49	
11	8.11		1.09		
		57		49	
15	8.68		0.60		
		58		47	
11	8.10		1.07		
		52		46	
7	7.58		1.53		
		57		47	
3	7.01		2.00		
Total		335		280	615
Stress 23.44 x 615 = +14,400					
Remarks					

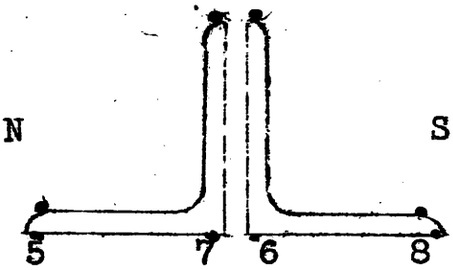
Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	32.00	+	29.00	+	+
		20		13	
7	32.20		28.87		
		20		10	
11	32.40		28.77		
		20		09	
15	32.60		28.68		
		20		10	
11	32.40		28.78		
		20		10	
7	32=20		28.88		
		23		12	
3	31.97		29.00		
Total		123		64	187
Stress 23.44 x 187 = +4380					
Remarks					

N.B. Stress given is for load of 15000#

16' Span

Table





LOCATION NO. 1

Load in 1000#	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	3.00	+	5.00	+	+
		.07		.16	
7	2.93		5.16		
		.09		.17	
11	2.84		5.33		
		.07		.14	
15	2.77		5.47		
		.08		.15	
11	2.85		5.32		
		.10		.16	
7	2.95		5.16		
		.07		.15	
3	3.02		5.01		
Total		48		93	141
Stress 23.44 x 141 = +3310					
Remarks					

Load in 1000#	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	32.00	+	33.00	+	+
		.03		.12	
7	31.97		33.12		
		.04		.12	
11	31.93		33.24		
		.03		.12	
15	31.90		33.36		
		.03		.11	
11	31.93		33.25		
		.05		.13	
7	31.98		33.12		
		.03		.12	
3	32.01		33.00		
Total		21		72	93
Stress 23.44 x 93 = +2180					
Remarks					

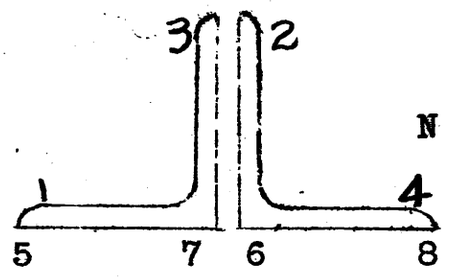
Load in 1000#	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	7.00	+	7.00	+	+
		.04		.12	
7	6.96		7.12		
		.04		.13	
11	6.92		7.25		
		.01		.11	
15	6.91		7.36		
		.02		.11	
11	6.93		7.25		
		.04		.13	
7	6.97		7.12		
		.03		.11	
3	7.00		7.01		
Total		18		71	89
Stress 23.44 x 89 = +2090					
Remarks					

Load in 1000#	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	32.00	+	30.00	+	+
		.06		.15	
7	31.94		30.15		
		.04		.15	
11	31.90		30.30		
		.04		.12	
15	31.86		30.42		
		.04		.14	
11	31.90		30.28		
		.04		.15	
7	31.94		30.13		
		.07		14	
3	32.01		29.99		
Total		29		85	114
Stress 23.44 x 114 = +2670					
Remarks Total stress = +14,260 llb.					

N.B. Stress given is for load of 15000#

16' SPAN

Table



LOCATION NO. 8

Load in #/1000	1 Direct Read.	Direct Inc.	reversed Read.	reversed Inc.	Total
3	30.00	+	30.00	+	+
		.18		.13	
7	29.82		30.13		
		.18		.14	
11	29.64		30.27		
		.17		.12	
15	29.47		30.39		
		.16		.11	
11	29.63		30.28		
		.16		.12	
7	29.79		30.16		
		.18		.13	
3	29.97		30.03		
Total		103		75	178
Stress 23.44 x 178 = +4170					
Remarks					

Load in #/1000	2 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	15.00	+	19.00	+	+
		.52		.48	
7	14.48		19.48		
		.58		.50	
11	13.90		19.98		
		.57		.52	
15	13.33		20.50		
		.57		.50	
11	13.90		20.00		
		.55		.49	
7	14.45		19.51		
		.55		.50	
3	15.00		19.01		
Total		334		299	633
Stress 23.44 x 633 = +14850					
Remarks					

Load in #/1000	3 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	28.00	+	29.00	+	+
		.53		.50	
7	27.47		29.50		
		.57		.49	
11	26.90		29.99		
		.57		.49	
15	26.33		30.48		
		.57		.48	
11	26.90		30.00		
		.50		.50	
7	27.40		29.50		
		.55		.48	
3	27.95		29.02		
Total		329		294	623
Stress 23.44 x 623 = +14600					
Remarks					

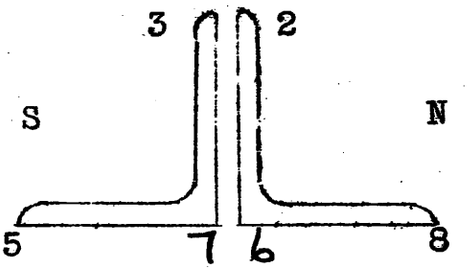
Load in #/1000	4 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	20.00	+	20.00	+	+
		.22		.14	
7	19.78		20.14		
		.21		.14	
11	19.57		20.28		
		.23		.12	
15	19.34		20.40		
		.24		.13	
11	19.58		20.27		
		.23		.18	
7	19.81		20.09		
		.25		.14	
3	20.06		19.95		
Total		132		85	217
Stress 23.44 x 217 = +5220					
Remarks					

N.B. Stress given is for load of 15000#

16' SPAN

LOCATION NO. 8

Table



Load in 1000#	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	27.00	+	30.00	+	+
		.09		.13	
7	27.09		29.87		
		.08		.13	
11	27.17		29.74		
		.08		.12	
15	27.25		29.62		
		.06		.11	
11	27.19		29.73		
		.09		.12	
7	27.10		29.85		
		.10		.12	
3	27.00		29.97		
Total		50		73	123
Stress	23.44 x 123 = +2880				
Remarks					

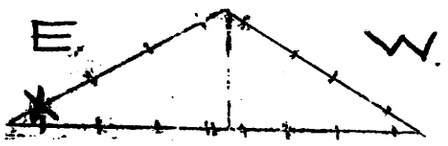
Load in 1000#	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	19.00	+	20.00	+	+
		.06		.11	
7	19.06		19.89		
		.03		.11	
11	19.09		19.78		
		.01		.09	
15	19.10		19.69		
		.02		.09	
11	19.08		19.78		
		.05		.12	
7	19.03		19.90		
		.05		.10	
3	18.98		20.00		
Total		22		62	84
Stress	23.44 x 84 = +1960				
Remarks					

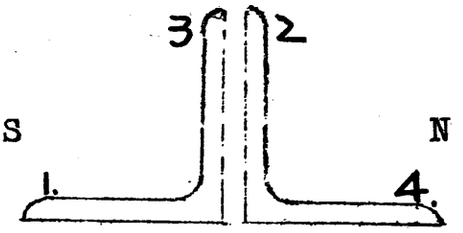
Load in 1000#	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	27.00	+	31.00	+	+
		.08		.12	
7	27.08		30.88		
		.07		.11	
11	27.15		30.77		
		.03		.11	
15	27.18		30.66		
		.03		.11	
11	27.15		30.77		
		.08		.11	
7	27.07		30.88		
		.07		.12	
3	27.00		31.00		
Total		36		68	104
Stress	23.44 x 104 = +2430				
Remarks					

Load in 1000#	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	26.00	+	20.00	+	+
		.07		.16	
7	26.07		19.84		
		.08		.15	
11	26.15		19.69		
		.05		.16	
15	26.20		19.53		
		.10		.18	
11	26.10		19.71		
		.10		.18	
7	26.00		19.89		
		.09		.18	
3	25.91		20.07		
Total		49		101	150
Stress	23.44 x 150 = +3520				
Remarks	Total stress = +14500 lbs.				

5. Stress given is for load of 15000#

15' Span Table





LOCATION NO. 9

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	29.00	-	30.00	+	-
7					
11					
		51		46	
15	28.49		29.54		
11					
7					
		51		46	
3	29.00		30.00		
Total		102		92	10
Stress 23.44 x 10 = -240					
Remarks					

Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	16.00	-	20.00	-	-
7					
11					
		373		270	
15	12.27		22.70		
11					
7					
		373		270	
3	16.00		20.00		
Total		746		540	1286
Stress 23.44 x 1286 = -30150					
Remarks					

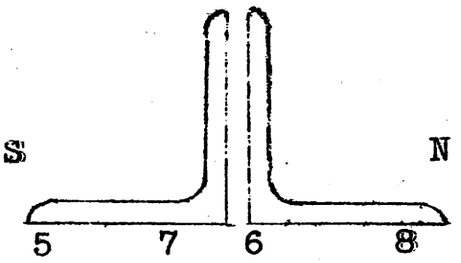
Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	30.00	-	28.00	-	-
7					
11					
		370		270	
15	26.30		30.70		
11					
7					
		370		270	
3	30.00		28.00		
Total		740		540	1280
Stress 23.44 x 1280 = -30000					
Remarks					

Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	17.00	-	18.00	+	-
7					
11					
		58		39	
15	16.42		17.61		
11					
7					
		58		39	
3	17.00		18.00		
Total		116		78	38
Stress 23.44 x 38 = -890					
Remarks					

N.B. Stress given is for load of 15000#

Table

15' Span



LOCATION NO. 9

Load in 1000 #.	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	29.00	+	30.00	-	+
7					
11					
		83		16	
15	28.17		29.84		
11					
7					
		83		16	
3	29.00		30.00		
Total		166		32	134
Stress	2 3.44 x 134 = +3140				
Remarks					

Load in 1000 #.	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	17.00	+	15.00	+	+
7					
11					
		115		13	
15	15.85		15.13		
11					
7					
		115		13	
3	17.00		15.00		
Total		230		26	256
Stress	2 3,44 x 256 = +6000				
Remarks					

Load in 1000 #.	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	30.00	+	29.00	+	+
7					
11					
		114		14	
15	28.86		29.14		
11					
7					
		114		14	
3	30.00		29.00		
Total		228		28	256
Stress	2 3.44 x 256 = +6000				
Remarks					

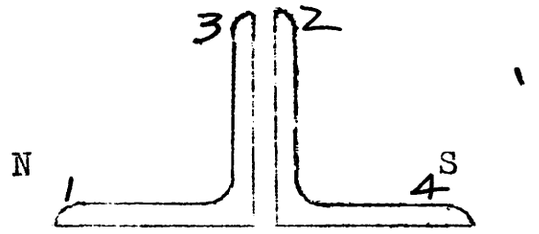
Load in 1000 #.	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	18.00	+	16.00	-	+
7					
11					
		79		20	
15	17.21		15.80		
11					
7					
		79		20	
3	18.00		16.00		
Total		158		40	118
Stress	2 3.44 x 118 = +2770				
Remarks	Total stress = -14600 lbs.				

N.B. Stress given is for load of 15000 #.

15' SPAN

LOCATION NO. 16

Table



Load in #/1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	6.00	-	6.00	+	-
7					
11					
		60		55	
15	6.60		6.55		
11					
7					
		60		55	
3	6.00		6.00		
Total		120		110	10
Stress 23.44 x 10 = -240					
Remarks					

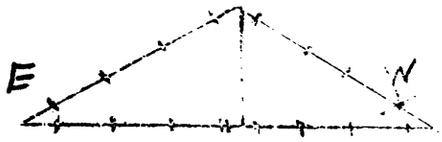
Load in #/1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	30.00	-	32.00	-	-
7					
11					
		3.93		2.80	
15	33.93		29.20		
11					
7					
		3.93		2.80	
3	30.00		32.00		
Total		786		560	1346
Stress 23.44 x 1346 = -31600					
Remarks					

Load in #/1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	6.00	-	6.00	-	-
7					
11					
		3.93		2.80	
15	9.93		3.20		
11					
7					
		3.93		2.80	
3	6.00		6.00		
Total		786		560	1346
Stress 23.44 x 1346 = -31600					
Remarks					

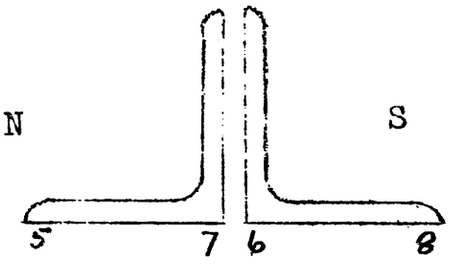
Load in #/1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	33.00	-	32.00	+	-
7					
11					
		62		50	
15	33.62		32.50		
11					
7					
		62		50	
3	33.00		32.00		
Total		124		100	24
Stress 23.44 x 24 = -570					
Remarks					

N.B. Stress given is for load of 15000#

15' Span



Cable



Location No. 16

Load in #/1000	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	7.00	+	5.00	-	+
7					
11					
		92		22	
15	7.92		5.22		
11					
7					
		92		22	
3	7.00		5.00		
Total		184		44	140
Stress 23.44 x 140 = +3290					
Remarks					

Load in #/1000	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	35.00	+	29.00	+	+
7					
11					
		128		11	
15	36.28		28.89		
11					
7					
		128		11	
3	35.00		29.00		
Total		256		22	278
Stress 23.44 x 278 = +6520					
Remarks					

Load in #/1000	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	5.00	+	5.00	+	+
7					
11					
		126		11	
15	6.26		4.89		
11					
7					
		126		11	
3	5.00		5.00		
Total		252		22	274
Stress 23.44 x 274 = +6410					
Remarks					

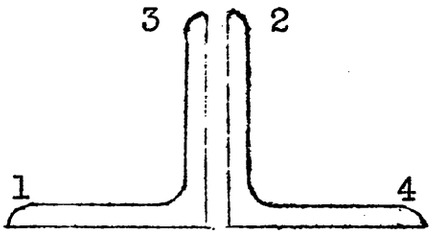
Load in #/1000	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	33.00	+	32.00	-	+
7					
11					
		92		28	
15	33.92		32.28		
11					
7					
		92		28	
3	33.00		32.00		
Total		184		56	128
Stress 23.44 x 128 = +3000					
Remarks Total stress = -1500 lbs.					

N.B. Stress given is for load of 15000#.

Table

C. G. LINES

LOCATION NO. 1



Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	5.00	+	3.00	+	+
		17		23	
7	5.17		2.77		
		18		24	
11	5.35		2.53		
		17		23	
15	5.52		2.30		
		18		23	
11	5.34		2.53		
		20		25	
7	5.14		2.78		
		16		22	
3	4.98		3.00		
Total		106		140	246
Stress 23.44 x 246 = +5770					
Remarks					

Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	33.00	+	30.00	+	+
		27		32	
7	33.27		29.68		
		27		31	
11	33.54		29.37		
		26		32	
15	33.80		29.05		
		28		33	
11	33.52		29.38		
		25		31	
7	33.27		29.69		
		27		32	
3	33.00		30.01		
Total		160		191	351
Stress 23.44 x 351 = +8240					
Remarks					

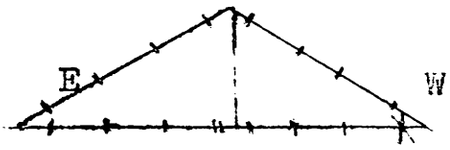
Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	6.00	+	5.00	+	+
		26		31	
7	6.26		4.69		
		26		31	
11	6.52		4.38		
		27		31	
15	6.79		4.07		
		26		31	
11	6.53		4.38		
		25		32	
7	6.28		4.70		
		26		30	
3	6.02		5.00		
Total		156		186	342
Stress 23.44 x 342 = +8020					
Remarks					

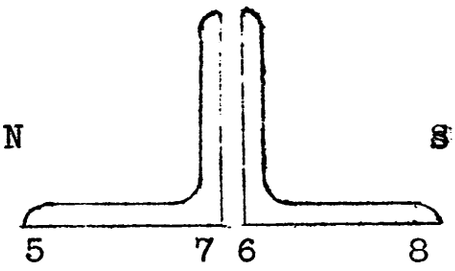
Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	29.00	+	30.00	+	+
		17		22	
7	29.17		29.78		
		20		22	
11	29.37		29.56		
		20		23	
15	29.57		29.33		
		15		20	
11	29.42		29.53		
		15		20	
7	29.27		29.73		
		17		24	
3	29.10		29.97		
Total		104		131	235
Stress 23.44 x 235 = +5500					
Remarks					

N.B. Stress given is for load of 15000#.

Table

C. G. LINES





LOCATION NO. 1

Load in #/1000	5 Direct Read.	Direct Inc.	reversed Read.	reversed Inc.	Total
3	4.00	+	3.00	+	+
		22		17	
7	3.78		3.17		
		24		17	
11	3.54		3.34		
		23		16	
15	3.31		3.50		
		23		17	
11	3.54		3.33		
		24		17	
7	3.78		3.16		
		23		16	
3	4.01		3.00		
Total		139		100	239
Stress 23.44 x 239 = +5600					
Remarks					

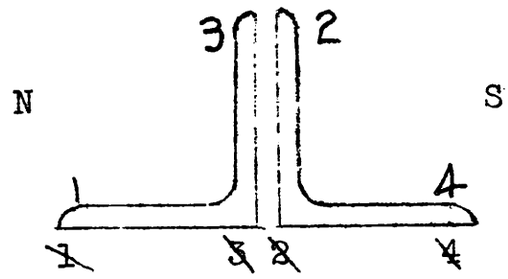
Load in #/1000	6 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	30.00	+	34.00	+	+
		23		17	
7	29.77		34.17		
		24		16	
11	29.53		34.33		
		21		17	
15	29.32		34.50		
		18		14	
11	29.50		34.36		
		23		18	
7	29.73		34.18		
		25		16	
3	29.98		34.02		
Total		134		98	232
Stress 23.44 x 232 = +5450					
Remarks					

Load in #/1000	7 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	6.00	+	6.00	+	+
		21		16	
7	5.79		6.16		
		22		16	
11	5.57		6.32		
		20		16	
15	5=37		6.48		
		19		15	
11	5.56		6.33		
		24		16	
7	5.80		6.17		
		20		17	
3	6.00		6.00		
Total		126		96	222
Stress 23.44 x 222 = +5200					
Remarks					

Load in #/1000	8 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	33.00	+	30.00	+	+
		20		17	
7	32.80		30.17		
		20		16	
11	32.60		30.33		
		20		17	
15	32.40		30.50		
		17		14	
11	32.57		30.36		
		21		16	
7	32.78		30.20		
		21		18	
3	32.99		30.02		
Total		119		98	217
Stress 23.44 x 217 = +5100					
Remarks Total stress = +14,700 lbs					

N.B. Stress given is for load of 15000#.

Table



LOCATION NO. 2

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	30.00	+	34.00	+	+
		16		27	
7	29.84		34.27		
		14		26	
11	29.70		34.53		
		13		27	
15	29.57		34.80		
		13		27	
11	29.70		34.53		
		13		26	
7	29.83		34.27		
		15		27	
3	29.98		34.00		
Total		84		160	244
Stress 23.44 x 244 = +5720					
Remarks					

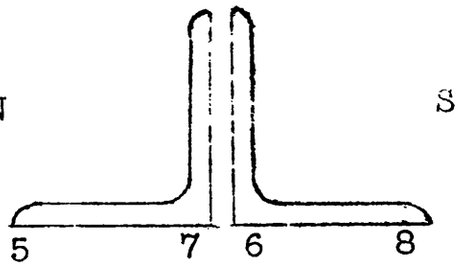
Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	6.00	+	7.00	+	+
		18		28	
7	5.82		7.28		
		15		29	
11	5.67		7.57		
		19		29	
15	5.48		7.86		
		16		30	
11	5.64		7.56		
		17		28	
7	5.81		7.28		
		18		28	
3	5.99		7.00		
Total		103		172	275
Stress 23.44 x 272 = +6450					
Remarks					

Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	33.00	+	32.00	+	+
		17		29	
7	32.83		32.29		
		14		28	
11	32.69		32.57		
		17		28	
15	32.52		32.85		
		18		28	
11	32.70		32.57		
		14		28	
7	32.84		32.29		
		16		27	
3	33.00		32.02		
Total		96		168	264
Stress 23.44 x 264 = +6180					
Remarks					

Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	7.00	+	7.00	+	+
		18		28	
7	6.82		7.28		
		16		27	
11	6.66		7.55		
		16		27	
15	6.50		7.82		
		13		24	
11	6.63		7.58		
		17		27	
7	6.80		7.31		
		20		29	
3	7.00		7.02		
Total		100		162	262
Stress 23.44 x 262 = +6140					
Remarks					

N.B. Stress given is for load of 15000#.

Table



LOCATION NO. 2

Load in 1000#	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	33.00		34.00		
		26		13	
7	33.26		33.87		
		26		13	
11	33.52		33.74		
		28		13	
15	33.80		33.61		
		27		12	
11	33.53		33.73		
		26		15	
7	33.27		33.88		
		27		12	
3	33.00		34.00		
Total		160		78	238
Stress 23.44 x 238 = +5580					
Remarks					

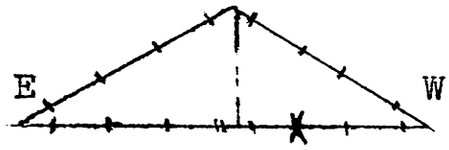
Load in 1000#	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	8.00	+	4.00	+	+
		26		16	
7	8.26		3.84		
		26		14	
11	8.52		3.70		
		27		17	
15	8.79		3.53		
		26		16	
11	8.53		3.69		
		24		14	
7	8.29		3.83		
		28		15	
3	8.01		3.98		
Total		157		92	249
Stress 23.44 x 249 = +5850					
Remarks					

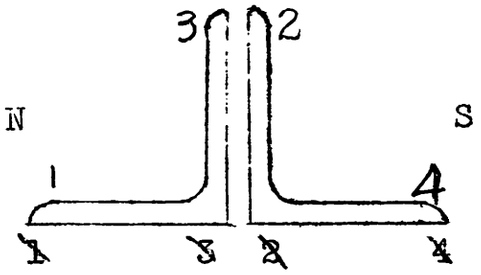
Load in 1000#	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	34.00	+	34.00	+	+
		28		15	
7	34.28		33.85		
		29		17	
11	34.57		33.68		
		26		15	
15	34.83		33.53		
		26		16	
11	34.57		33.55		
		28		17	
7	34.29		33.83		
		29		17	
3	34.00		34.00		
Total		166		94	260
Stress 23.44 x 260 = +6090					
Remarks					

Load in 1000#	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	4.00	+	7.00	+	+
		28		17	
7	4.28		6.83		
		29		16	
11	4.57		6.67		
		25		17	
15	4.82		6.50		
		25		13	
11	4.57		6.63		
		27		17	
7	4.30		6.80		
		29		19	
3	4.01		6.99		
Total		163		99	262
Stress 23.44 x 262 = +6150					
Remarks Total stress = +14,400 lbs.					

N.B. Stress given is for load of 15000#.

Table





LOCATION NO. 3

Load in #/1000#	1 Direct Read.	Inc.	reversed Read.	Inc.	Total
3	34.00	+	32.00	+	+
		13		25	
7	33.87		32.25		
		17		25	
11	33.70		32.50		
		14		26	
15	33.56		32.76		
		13		26	
11	33.69		32.50		
		15		25	
7	33.84		32.25		
		16		25	
3	34.00		32.00		
Total		88		152	240
Stress 23.44 x 240 = +5620					
Remarks					

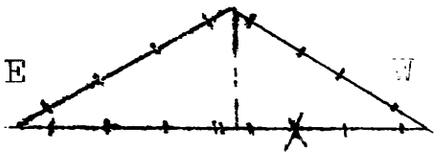
Load in #/1000#	2 Direct Read.	Inc.	Reversed Read.	Inc.	
3	6.00	+	8.00	+	+
		13		21	
7	5.87		8.21		
		14		21	
11	6.73		8.42		
		13		21	
15	5.60		8.63		
		10		21	
11	5.70		8.42		
		14		21	
7	5.84		8.21		
		16		21	
3	6.00		8.00		
Total		80		126	206
Stress 23.44 x 206 = +4830					
Remarks					

Load in #/1000#	3 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	33.00	+	31.00	+	+
		12		20	
7	32.88		31.20		
		11		21	
11	32.77		31.41		
		12		22	
15	32.65		31.63		
		7		22	
11	32.72		31.41		
		12		20	
7	32.84		31.21		
		14		21	
3	32.98		31.00		
Total		68		126	194
Stress 23.44 x 194 = +4550					
Remarks					

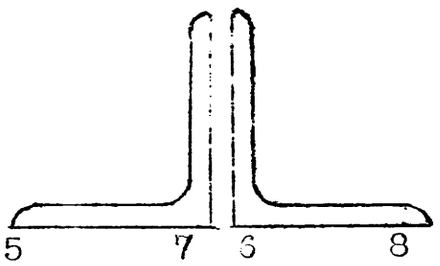
Load in #/1000#	4 Direct Read.	Inc.	Reversed Read.	Inc.	
3	4.00	+	8.00	+	+
		20		28	
7	3.80		8.28		
		20		25	
11	3.60		8.53		
		20		27	
15	3.40		8.80		
		16		26	
11	3.56		8.54		
		19		25	
7	3.75		8.29		
		23		27	
3	3.98		8.02		
Total		118		158	276
Stress 23.44 x 276 = +6470					
Remarks					

N.B. Stress given is for load of 15000#

Table



LOCATION NO. 3



Load in 1000#	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	32.00	+	34.00	+	+
		27		13	
7	32.27		33.87		
		24		16	
11	32.51		33.71		
		29		14	
15	32.80		33.57		
		27		13	
11	32.53		33.70		
		26		13	
7	32.27		33.83		
		25		17	
3	32.02		34.00		
Total		158		86	244
Stress	23.44 x 244 =				+5720
Remarks					

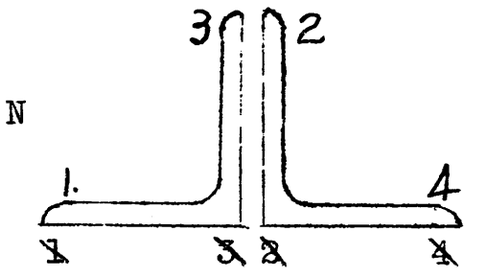
Load in 1000#	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	7.00	+	6.00	+	+
		28		19	
7	7.28		5.81		
		27		20	
11	7.55		5.61		
		27		17	
15	7.82		5.44		
		26		16	
11	7.56		5.60		
		26		18	
7	7.30		5.78		
		29		20	
3	7.01		5.98		
Total		163		110	273
Stress	23.44 x 273 =				+6400
Remarks					

Load in 1000#	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	32.00	+	32.00	+	+
		30		20	
7	32.30		31.80		
		29		19	
11	32.59		31.61		
		29		18	
15	32.88		31.43		
		28		15	
11	32.60		31.58		
		30		19	
7	32.30		31.77		
		28		20	
3	32.02		31.97		
Total		174		111	285
Stress	23.44 x 285 =				+6670
Remarks					

Load in 1000#	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	7.00	+	4.00	+	+
		30		21	
7	7.30		3.79		
		27		20	
11	7.57		3.59		
		25		19	
15	7.82		3.40		
		25		16	
11	7.57		3.56		
		27		18	
7	7.30		3.74		
		27		23	
3	7.03		3.97		
Total		161		117	278
Stress	23.44 x278 =				+6520
Remarks	Total Stress =				+14,100 lbs.

N.B. Stress given is for load of 15000#

Table



LOCATION NO. 4

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	32.00	+	32.00	+	+
		18		22	
7	31.82		32.22		
		20		22	
11	31.62		32.45		
		20		24	
15	31.42		32.69		
		18		23	
11	31.60		32.46		
		20		23	
7	31.80		32.23		
		20		23	
3	32.00		32.00		
Total		84		138	222
Stress 23.44 x 222 = +5200					
Remarks					

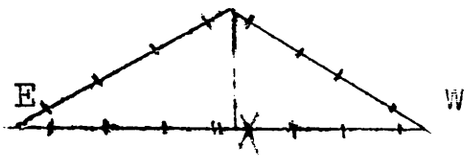
Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	6.00	+	6.00	+	+
		12		13	
7	5.88		6.13		
		13		14	
11	5.75		6.27		
		12		14	
15	5.63		6.41		
		13		11	
11	5.70		6.30		
		11		13	
7	5.81		6.17		
		16		16	
3	5.97		6.01		
Total		71		82	153
Stress 23.44 x 153 = +3590					
Remarks					

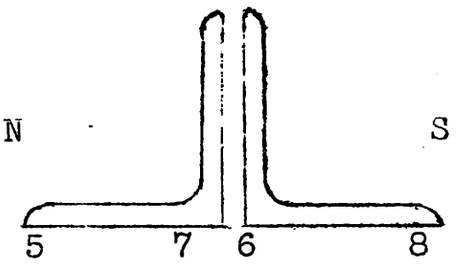
Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	33.00	+	31.00	+	+
		12		17	
7	32.88		31.17		
		13		15	
11	32.75		31.32		
		11		16	
15	32.64		31.48		
		9		12	
11	32.73		31.36		
		13		15	
7	32.86		31.21		
		14		18	
3	33.00		31.03		
Total		72		93	165
Stress 23.44 x 165 = +3870					
Remarks					

Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	6.00	+	5.00	+	+
		25		26	
7	5.75		5.26		
		24		24	
11	5.51		5.50		
		21		23	
15	5.30		5.73		
		20		23	
11	5.50		5.50		
		23		24	
7	5.73		5.26		
		26		25	
3	5.99		5.01		
Total		139		145	284
Stress 23.44 x 284 = +6650					
Remarks					

N.B. Stress given is for load of 15000#

Table





LOCATION NO. 4

Load in 1000#	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	33.00	+	34.00	+	+
		23		19	
7	33.23		33.81		
		23		21	
11	33.46		33.60		
		24		20	
15	33.70		33.40		
		24		19	
11	33.46		33.59		
		23		20	
7	33.23		33.79		
		23		20	
3	33.00		33.99		
Total		140		119	259
Stress 23.44 x 259 = +6070					
Remarks					

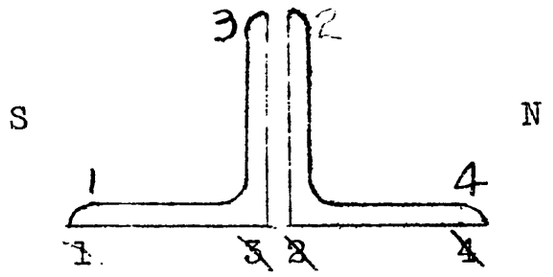
Load in 1000#	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	3.00	+	6.00	+	+
		26		23	
7	3.26		5.77		
		24		25	
11	3.50		5.52		
		26		22	
15	3.76		5.30		
		24		20	
11	3.51		5.50		
		25		23	
7	3.26		5.73		
		26		26	
3	3.00		5.99		
Total		152		139	291
Stress 23.44 x 291 = +6830					
Remarks					

Load in 1000#	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	33.00	+	32.00	+	+
		26		22	
7	33.26		31.78		
		25		24	
11	33.51		31.54		
		27		23	
15	33.78		31.31		
		26		21	
11	33.52		31.52		
		25		23	
7	33.27		31.75		
		26		23	
3	33.01		31.98		
Total		155		136	291
Stress 23.44 x 291 = +6830					
Remarks					

Load in 1000#	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	6.00	+	7.00	+	+
		26		26	
7	6.26		6.74		
		25		24	
11	6.51		6.50		
		25		22	
15	6.76		6.28		
		25		21	
11	6.51		6.49		
		24		23	
7	6.27		6.72		
				26	
3	6.01		6.98		
Total		151		142	293
Stress 23.44 x 293 = +6870					
Remarks Total stress = +13,900 lbs.					

N.B. Stress given is for load of 15000#

Table



LOCATION NO. 5

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	13.00	+	17.00	+	+
		24		29	
7	12.76		17.29		
		24		29	
11	12.52		17.58		
		21		26	
15	12.31		17.84		
		20		26	
11	12.51		17.58		
		23		28	
7	12.74		17.30		
		25		29	
3	12.99		17.01		
Total		137		167	304
Stress 23.44 x 304 = +7120					
Remarks					

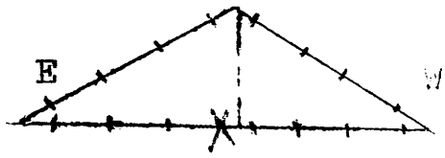
Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	28.00	+	29.00	+	+
		10		11	
7	27.90		29.11		
		10		13	
11	27.80		29.24		
		10		14	
15	27.70		29.38		
		6		8	
11	27.76		29.30		
		7		13	
7	27.83		29.17		
		14		17	
3	27.97		29.00		
Total		57		76	133
Stress 23.44 x 133 = +3130					
Remarks					

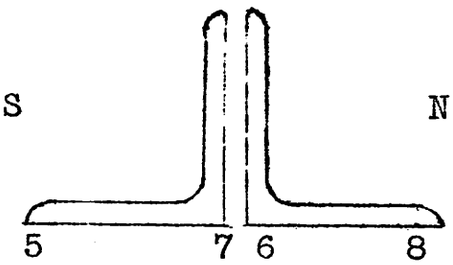
Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	19.00	+	20.00	+	+
		11		15	
7	18.89		20.15		
		11		15	
11	18.78		20.30		
		9		14	
15	18.69		20.44		
		4		8	
11	18.73		20.36		
		11		17	
7	18.84		20.19		
		14		15	
3	18.98		20.04		
Total		60		84	144
Stress 23.44 x 144 = +3370					
Remarks					

Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	27.00	+	27.00	+	+
		18		22	
7	26.82		27.22		
		20		23	
11	26.62		27.45		
		20		24	
15	26.42		27.69		
		18		23	
11	26.60		27.46		
		20		23	
7	26.80		27.23		
		20		23	
3	27.00		27.00		
Total		116		138	254
Stress 23.44 x 254 = +5950					
Remarks					

N.B. Stress given is for load of 15000#

Table





LOCATION NO. 5

Load in #/1000#	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	13.00	+	16.00	+	+
		30		25	
7	13.30		15.75		
		29		24	
11	13.59		15.51		
		27		21	
15	13.86		15.30		
		26		20	
11	13.60		15.50		
		30		23	
7	13.30		15.73		
		30		27	
3	13.00		16.00		
Total		172		140	312
Stress 23.44 x 312 = +7360					
Remarks					

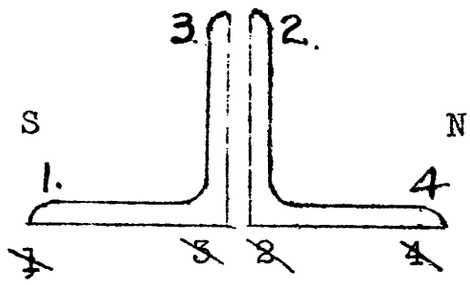
Load in #/1000#	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	27.00	+	27.00	+	+
		27		24	
7	27.27		26.76		
		26		25	
11	27.53		26.51		
		27		21	
15	27.80		26.30		
		27		20	
11	27.53		26.50		
		25		23	
7	27.28		26.73		
		28		27	
3	27.00		27.00		
Total		160		140	300
Stress 23.44 x 300 = +7050					
Remarks					

Load in #/1000#	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	17.00	+	20.00	+	+
		29		23	
7	17.29		19.77		
		27		25	
11	17.56		19.52		
		24		22	
15	17.82		19.30		
		25		22	
11	17.57		19.52		
		28		23	
7	17.29		19.75		
		29		25	
3	17.00		20.00		
Total		164		140	304
Stress 23.44 x 304 = +7120					
Remarks					

Load in #/1000#	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	28.00	+	27.00	+	+
		22		20	
7	28=22		26.80		
		23		20	
11	28.45		26.60		
		23		20	
15	28.68		26.40		
		22		20	
11	28.46		26.60		
		24		20	
7	28.22		26.80		
		22		20	
3	28.00		27.00		
Total		136		120	256
Stress 23.44 x 254 = +6000					
Remarks Total stress = +14,100 lbs.					

N.B. Stress given is for load of 15000#

Table



LOCATION NO. 6

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	14.00	+	18.00	+	+
		19		32	
7	13.81		18.32		
		16		30	
11	13.65		18.62		
		16		30	
15	13.49		18.92		
		13		30	
11	13.62		18.62		
		18		31	
7	13.80		18.31		
		19		31	
3	13.99		18.00		
Total		101		184	285
Stress 23.44 x 285 = +6670					
Remarks					

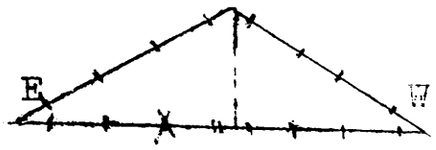
Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	31.00	+	28.00	+	+
		11		21	
7	30.89		28.21		
		13		24	
11	30.76		28.45		
		13		23	
15	30.63		28.68		
		10		21	
11	30.73		28.47		
		13		24	
7	30.86		28.23		
		14		23	
3	31.00		28.00		
Total		74		136	210
Stress 23.44 x 210 = +4920					
Remarks					

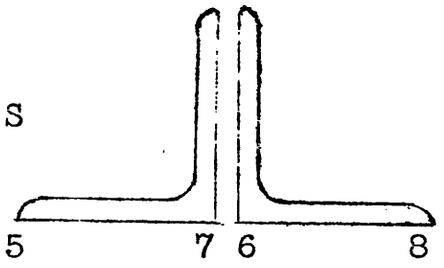
Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	18.00	+	19.00	+	+
		12		24	
7	17.88		19.24		
		11		25	
11	17.77		19.49		
		12		23	
15	17.65		19.72		
		7		22	
11	17.72		19.50		
		13		24	
7	17.85		19.26		
		14		25	
3	17.99		19.01		
Total		69		143	212
Stress 23.44 x 212 = +4970					
Remarks					

Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	32.00	+	29.00	+	+
		13		22	
7	31.87		29.22		
		17		26	
11	31.70		29.48		
		17		24	
15	31.53		29.72		
		14		22	
11	31.67		29.50		
		14		23	
7	31.81		29.27		
		18		27	
3	31.99		29.00		
Total		93		144	237
Stress 23.44 x 237 = +5550					
Remarks					

N.B. Stress given is for load of 15000#

Table





LOCATION NO.6

Load in ″ 1000	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	17.00	+	15.00	+	+
		33		20	
7	17.33		14.80		
		32		17	
11	17.65		14.63		
		31		16	
15	17.96		14.47		
		31		13	
11	17.65		14.60		
		31		19	
7	17.34		14.79		
		32		21	
3	17.02		15.00		
Total		190		106	296
Stress 23.44 x 296 = +6940					
Remarks					

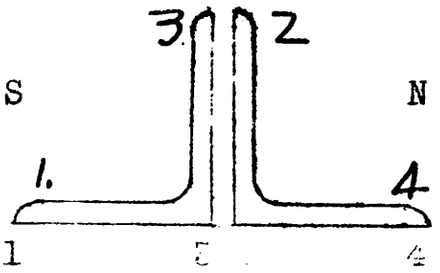
Load in ″ 1000	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	27.00	+	7.00	+	+
		28		17	
7	27.28		6.83		
		29		16	
11	27.57		6.66		
		27		18	
15	27.84		6.48		
		27		14	
11	27.57		6.62		
		27		18	
7	27.30		6.80		
		30		20	
3	27.00		7.00		
Total		168		104	272
Stress 23.44 x 272 = +6370					
Remarks					

Load in ″ 1000	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	20.00	+	17.00	+	+
		30		17	
7	20.30		16.83		
		30		17	
11	20.60		16.66		
		30		17	
15	20.90		16.49		
		29		13	
11	20.61		16.62		
		29		18	
7	20.32		16.80		
		32		19	
3	20.00		16.99		
Total		180		101	281
Stress 23.44 x 281 = +6600					
Remarks					

Load in ″ 1000	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	31.00	+	26.00	+	+
		23		14	
7	31.23		25.68		
		27		17	
11	31.50		25.69		
		27		18	
15	31.77		25.51		
		27		15	
11	31.50		25.66		
		24		16	
7	31.26		25.82		
		26		18	
3	31.00		26.00		
Total		154		98	252
Stress 23.44 x 252 = +5900					
Remarks Total stress = +14320 lbs.					

N.B. Stress given is for load of 15000″

Table



LOCATION # 7

Load in 1000#	1 Direct Read.	Inc.	reversed Read.	Inc.	Total
3	20.00	+	16.00	+	+
		13		20	
7	19.87		16.30		
		15		19	
11	19.72		16.59		
		15		29	
15	19.57		16.88		
		14		29	
11	19.71		16.59		
		15		29	
7	19.86		16.30		
		14		30	
3	20.00		16.00		
Total		86		176	262
Stress 23.44 x 262 = +6140					
Remarks					

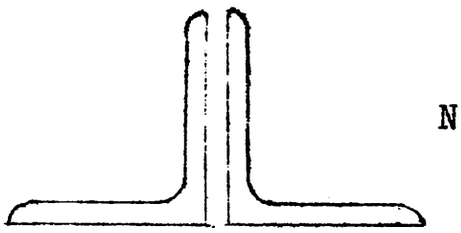
Load in 1000#	2 Direct Read.	Inc.	Reversed Read.	Inc.	
3	29.00	+	28.00	+	+
		15		30	
7	28.85		28.30		
		18		29	
11	28.67		28.59		
		19		30	
15	28.48		28.89		
		18		30	
11	28.66		28.59		
		17		29	
7	28.83		28.30		
		17		30	
3	29.00		28.00		
Total		104		178	282
Stress 23.44 x 282 = +6620					
Remarks					

Load in 1000#	3 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	19.00	+	20.00	+	+
		15		30	
7	18.85		20.30		
		16		30	
11	18.69		20.60		
		16		30	
15	18.53		20.90		
		17		30	
11	18.70		20.60		
		16		30	
7	18.86		20.30		
		15		29	
3	19.01		20.01		
Total		95		179	274
Stress 23.44 x 274 = +6420					
Remarks					

Load in 1000#	4 Direct Read.	Inc.	Reversed Read.	Inc.	
3	31.00	+	32.00	+	+
		11		23	
7	30.89		32.23		
		13		25	
11	30.76		32.48		
		15		24	
15	30.61		32.72		
		11		21	
11	30.72		32.51		
		17		24	
7	30.89		32.27		
		13		25	
3	31.02		32.02		
Total		80		142	222
Stress 23.44 x 222 = +5200					
Remarks					

N.B. Stress given is for load of 15000#

Table



LOCATION #7

Load in 1000#	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	21.00	+	20.00	+	+
		31		18	
7	21.31		19.82		
		31		14	
11	21.62		19.68		
		28		15	
15	21.90		19.53		
		29		15	
11	21.61		19.68		
		29		14	
7	21.32		19.82		
		30		16	
3	21.02		19.98		
Total		178		92	270
Stress	23.44 x 270 =		+6330		
Remarks					

Load in 1000#	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	28.00	+	30.00	+	+
		28		16	
7	28.28		29.84		
		27		14	
11	28.55		29.70		
		26		14	
15	28.81		29.56		
		24		14	
11	28.57		29.70		
		27		13	
7	28.30		29.83		
		28		15	
3	28.02		29.98		
Total		160		86	246
Stress	23.44 x 246 =		+5770		
Remarks					

Load in 1000#	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	20.00	+	15.00	+	+
		30		13	
7	20.30		14.87		
		30		17	
11	20.60		14.70		
		29		15	
15	20.89		14.55		
		29		14	
11	20.60		14.69		
		29		16	
7	20.31		14.85		
		30		15	
3	20.01		15.00		
Total		177		90	267
Stress	23.44 x 267 =		+6250		
Remarks					

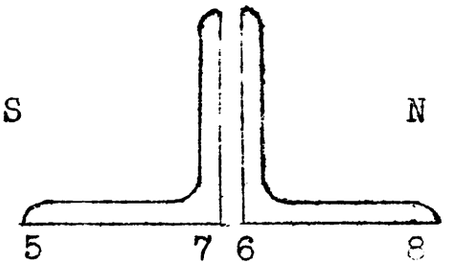
Load in 1000#	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	30.00	+	30.00	+	+
		23		11	
7	30.23		29.89		
		25		14	
11	30.48		29.75		
		23		14	
15	30.71		29.61		
		21		10	
11	30.50		29.71		
		24		15	
7	30.26		29.86		
		25		14	
3	30.01		30.00		
Total		154		78	135
Stress	23.44 x ~~135~~ 219 =		~~+3160~~ +5140		
Remarks	Total stress =		+14150 lbs.		

N.B. Stress given is for load of 15000#.

C.G. LINES

LOCATION # 8

Table



Load in #/1000#	6				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	31.00	+	26.00	+	+
		27		17	
7	31.27		25.83		
		25		16	
11	31.52		25.67		
		27		18	
15	31.79		25.49		
		26		22	
11	31.53		25.67		
		24		16	
7	31.29		25.83		
		27		17	
3	31.02		26.00		
Total		156		102	258
Stress 23.44 x 258 = +6050					
Remarks					

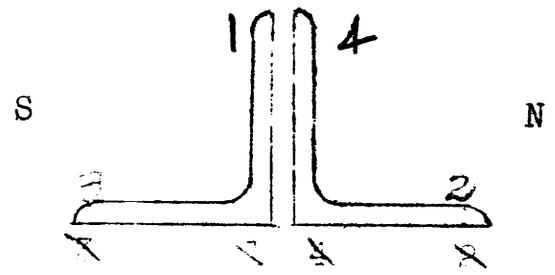
Load in #/1000#	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	20.00	+	20.00	+	+
		22		14	
7	20.22		19.86		
		22		16	
11	20.44		19.70		
		22		14	
15	20.66		19.56		
		19		14	
11	20.47		19.70		
		24		14	
7	20.23		19.84		
		22		15	
3	20.01		19.99		
Total		131		87	218
Stress 23.44 x 218 = +5120					
Remarks					

Load in #/1000#	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	29.00	+	31.00	+	+
		24		14	
7	29.24		30.86		
		23		16	
11	29.47		30.70		
		22		17	
15	29.69		30.53		
		19		16	
11	29.50		30.69		
		26		16	
7	29.24		30.85		
		24		16	
3	29.00		31.01		
Total		138		95	233
Stress 23.44 x 233 = +5460					
Remarks					

Load in #/1000#	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	19.00	+	19.00	+	+
		20		14	
7	19.20		18.86		
		20		16	
11	19.40		18.70		
		19		14	
15	19.59		18.56		
		16		12	
11	19.43		18.68		
		23		17	
7	19.20		18.85		
		21		15	
3	18.99		19.00		
Total		119		88	207
Stress 23.44 x 207 = +4860					
Remarks Total stress = +14770 lbs.					

N.B. Stress given is for load of 15000#.

Table



LOCATION # 8

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	31.00	±	31.00	+	+
		23		32	
7	30.77		31.32		
		26		32	
11	30.51		31.64		
		23		33	
15	30.28		31.97		
		24		33	
11	30.52		31.64		
		25		32	
7	30.77		31.32		
		23		32	
3	31.00		31.00		
Total		144		194	338
Stress	23.44 x 338 = +7930				
Remarks					

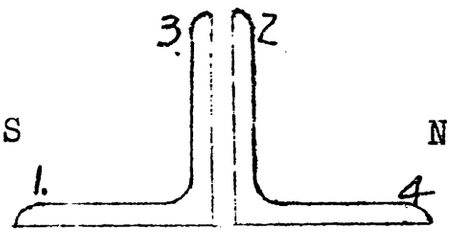
Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	20.00	+	16.00	+	+
		17		22	
7	19.83		16.22		
		17		22	
11	19.66		16.44		
		18		23	
15	19.48		16.67		
		15		24	
11	19.63		16.43		
		19		18	
7	19.82		16.25		
		18		24	
3	20.00		18.01		
Total		104		133	237
Stress	23.44 x 237 = +5570				
Remarks					

Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	29.00	+	28.00	+	+
		19		28	
7	28.81		28.28		
		20		27	
11	28.61		28.55		
		20		26	
15	28.41		28.81		
		21		25	
11	28.62		28.56		
		18		26	
7	28.80		28.30		
		20		30	
3	29.00		28.00		
Total		118		162	280
Stress	23.44 x 280 = +6570				
Remarks					

Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	16.00	+	20.00	+	+
		25		31	
7	15.75		20.31		
		26		36	
11	15.49		20.67		
		28		34	
15	15.21		21.01		
		29		33	
11	15.50		20.68		
		26		32	
7	15.76		20.36		
		24		34	
3	16.00		20.02		
Total		158		200	358
Stress	23.44 x 358 = +8400				
Remarks					

N.B. Stress given is for load of 15000#

Table



1 3 2 4

LOCATION # 9

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	28.00	-	20.00	-	-
		16		18	
7	27.84		20.13		
		15		19	
11	27.69		20.37		
		17		20	
15	27.52		20.57		
		18		19	
11	27.70		20.38		
		17		20	
7	27.87		20.18		
		14		19	
3	28.01		19.99		
Total		97		115	212
Stress 23.44 x 212 = -4720					
Remarks					

Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	14.00	-	28.00	-	-
		23		28	
7	13.77		28.28		
		25		29	
11	13.52		28.57		
		23		27	
15	13.29		28.84		
		30		32	
11	13.59		28.52		
		23		28	
7	13.82		28.24		
		21		27	
3	14.03		27.91		
Total		145		171	316
Stress 23.44 x 316 = -7400					
Remarks					

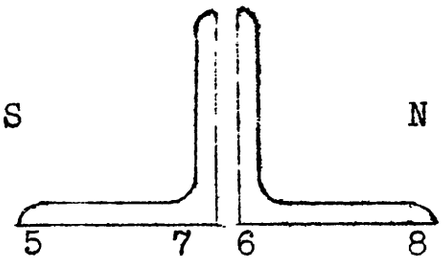
Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	30.00	-	20.00	-	-
7					
11					
		70		80	
15	29.30		20.80		
11					
7					
		72		83	
3	30.02		19.97		
Total		142		163	305
Stress 23.44 x 305 = -7150					
Remarks					

Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	14.00	-	30.00	-	-
		12		17	
7	13.88		30.17		
		15		15	
11	13.73		30.32		
		15		16	
15	13.58		30.48		
		16		16	
11	13.74		30.32		
		14		16	
7	13.88		30.16		
		12		16	
3	14.00		30.00		
Total		84		96	180
Stress 23.44 x 180 = -4220					
Remarks					

N.B. Stress given is for load of 15000#

Table

C. G. Lines



LOCATION # 9

Load in #/1000	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	28.00	-	16.00	-	-
		17		13	
7	28.17		15.87		
		17		16	
11	28.34		15.71		
		18		15	
15	28.52		15.56		
		16		15	
11	28.36		15.71		
		18		16	
7	28.18		15.87		
		18		14	
3	28.00		16.01		
Total		104		89	193
Stress 23.44 x 193 = -4530					
Remarks					

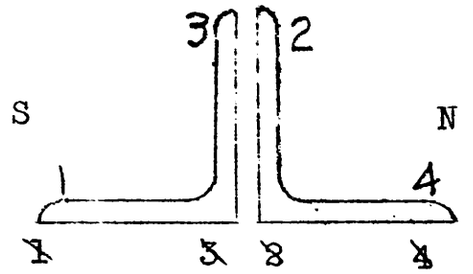
Load in #/1000	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	19.00	-	31.00	-	-
		23		17	
7	19.23		30.83		
		22		16	
11	19.45		30.67		
		22		17	
15	19.67		30.50		
		19		17	
11	19.48		30.67		
		23		16	
7	19.25		30.83		
		24		17	
3	19.01		31.00		
Total		133		100	233
Stress 23.44 x 233 = -5460					
Remarks					

Load in #/1000	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	28.00	-	16.00	-	-
		23		17	
7	28.23		15.83		
		23		16	
11	28.46		15.66		
		21		17	
15	28.67		15.49		
		19		17	
11	28.48		15.66		
		25		16	
7	28.25		15.83		
		25		18	
3	28.00		16.01		
Total		134		103	237
Stress 23.44 x 237 = -5550					
Remarks					

Load in #/1000	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	19.00	-	29.00	-	-
		17		10	
7	19.17		28.90		
		15		12	
11	19.32		28.78		
		15		13	
15	19.47		28.65		
		14		14	
11	19.33		28.79		
		16		11	
7	19.17		28.90		
		17		12	
3	19.00		29.02		
Total		94		72	166
Stress 23.44 x 166 = -3900					
Remarks Total stress = -1661[illegible] lbs.					

N.B. Stress given is for load of 15000#

Table



LOCATION NO. 10

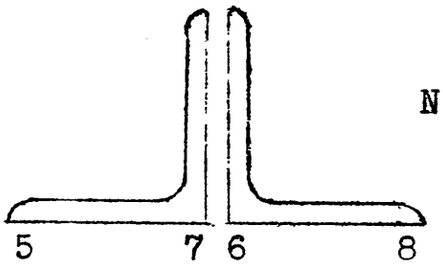
Load in #/1000"	1 Direct Read.	Inc.	reversed Read.	Inc.	Total
3	20.00	-	15.00	-	-
		16		24	
7	19.84		15.24		
		16		25	
11	19.68		15.49		
		17		25	
15	19.51		15.74		
		16		24	
11	19.67		15.50		
		17		26	
7	19.84		15.24		
		16		24	
3	20.00		15.00		
Total		98		148	246
Stress	23.44 x 246 =				-5770
Remarks					

Load in #/1000"	2 Direct Read.	Inc.	Reversed Read.	Inc.	
3	27.00	-	29.00	-	-
		20		29	
7	26.80		29.29		
		20		27	
11	26.60		29.56		
		20		28	
15	26.40		29.84		
		22		31	
11	26.62		29.53		
		20		27	
7	26.82		29.26		
		18		27	
3	27.00		28.99		
Total		120		169	289
Stress	23.44 x 289 =				-6770
Remarks					

Load in #/1000"	3 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	19.00	-	16.00	-	-
		18		26	
7	18.82		16.26		
		15		26	
11	18.67		16.52		
		17		27	
15	18.50		16.79		
		18		28	
11	18.68		16.51		
		18		27	
7	18.86		16.24		
		15		26	
3	19.01		15.98		
Total		101		160	261
Stress	23.44 x 261 =				-6120
Remarks					

Load in #/1000"	4 Direct Read.	Inc.	Reversed Read.	Inc.	
3	31.00	-	31.00	-	-
		18		24	
7	30.82		31.24		
		17		24	
11	30.65		31.48		
		17		23	
15	30.48		31.71		
		16		22	
11	30.64		31.49		
		18		25	
7	30.82		31.24		
		18		24	
3	31.00		31.00		
Total		104		142	246
Stress	23.44 x 246 =				-5770
Remarks					

N.B. Stress given is for load of 15000#



LOCATION #10

Load in 1000#	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	18.00	-	17.00	-	-
		24		16	
7	18.24		16.84		
		25		17	
11	18.49		16.67		
		24		16	
15	18.73		16.51		
		23		16	
11	18.50		16.67		
		26		16	
7	18.24		16.83		
		24		17	
3	18.00		17.00		
Total		146		98	244
Stress 23.44 x 244 = -5720					
Remarks					

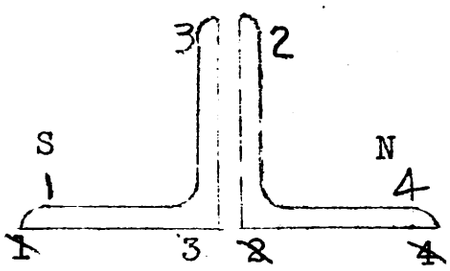
Load in 1000#	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	27.00	-	27.00	-	-
		23		15	
7	27.23		26.85		
		25		15	
11	27.48		26.70		
		23		14	
15	27.71		26.56		
		23		14	
11	27.48		26.70		
		25		15	
7	27.23		26.85		
		23		15	
3	27.00		27.00		
Total		142		88	230
Stress 23.44 x 230 = -5400					
Remarks					

Load in 1000#	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	20.00	-	19.00	-	-
		22		12	
7	20.22		18.88		
		23		13	
11	20.45		18.75		
		22		13	
15	20.67		16.82		
		21		12	
11	20.46		18.74		
		24		13	
7	20.22		18.87		
		22			
3	20.00		19.00		
Total		134		76	210
Stress 23.44 x 210 = -4920					
Remarks					

Load in 1000#	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	29.00	-	31.00	-	-
		23		17	
7	29.23		30.83		
		24		15	
11	29.47		30.68		
		21		15	
15	29.68		30.53		
		21		15	
11	29.47		30.68		
		24		15	
7	29.23		30.83		
		23			
3	29.00		31.00		
Total		138		94	232
Stress 23.44 x 232 = -5450					
Remarks Total stress = -16,480 lbs.					

N.B. Stress given is for load of 15000#.

Table



LOCATION NO. 11

Load in 1000#	1 Direct Read.	Inc.	reversed Read.	Inc.	Total
3	14.00	-	18.00	-	-
		12		24	
7	13.88		18.24		
		14		26	
11	13.74		18.50		
		14		26	
15	13.60		18.76		
		13		26	
11	13.73		18.50		
		14		26	
7	13.87		18.24		
		13		24	
3	14.00		18.00		
Total		80		152	232
Stress 23.44 x 232 = -5430					
Remarks					

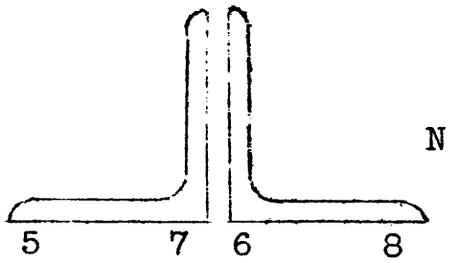
Load in 1000#	2 Direct Read.	Inc.	Reversed Read.	Inc.	
3	28.00	-	31.00	-	-
		16		26	
7	27.84		31.26		
		16		24	
11	27.68		31.50		
		17		27	
15	27.51		31.77		
		16		27	
11	27.67		31.50		
		16		25	
7	27.83		31.25		
		17		26	
3	28.00		31.00		
Total		98		154	252
Stress 23.44 x 252 = -5910					
Remarks					

Load in 1000#	3 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	17.00	-	18.00	-	-
		16		26	
7	16.84		18.26		
		16		25	
11	16.68		18.57		
		16		24	
15	16.52		18.75		
		17		26	
11	16.69		18.49		
		16		25	
7	16.85		18.24		
		16		26	
3	17.01		17.98		
Total		97		152	249
Stress 23.44 x 249 = -5850					
Remarks					

Load in 1000#	4 Direct Read.	Inc.	Reversed Read.	Inc.	
3	30.00	-	31.00	-	-
		19		30	
7	29.81		31.30		
		17		29	
11	29.64		31.59		
		17		26	
15	29.47		31.85		
		17		29	
11	29.64		31.56		
		18		28	
7	29.82		31.28		
		18		29	
3	30.00		30.99		
Total		106		171	277
Stress 23.44 x 277 = -6500					
Remarks					

N.B. Stress given is for load of 15000#

Table



LOCATION NO. 11

Load in 1000#	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	20.00	-	18.00	-	-
		23		10	
7	20.23		17.90		
		24		12	
11	20.47		17.78		
		23		13	
15	20.70		17.65		
		23		12	
11	20.47		17.77		
		24		13	
7	20.23		17.90		
		23		11	
3	20.00		18.01		
Total		140		71	211
Stress 23.44 x 211 = -4950					
Remarks					

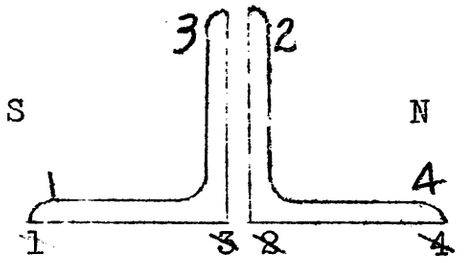
Load in 1000#	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	26.00	-	27.00	-	-
		24		14	
7	26.24		26.86		
		25		16	
11	26.49		26.70		
		24		13	
15	26.73		26.57		
		24		13	
11	26.49		26.70		
		25		16	
7	26.24		26.86		
		24		14	
3	26.00		27.00		
Total		146		86	232
Stress 23.44 x 232 = -5450					
Remarks					

Load in 1000#	7				
	Direct		Reversed		
	Read.	Inc	Read.	Inc.	Total
3	20.00	-	16.00	-	-
		25		14	
7	20.25		15.86		
		25		17	
11	20.50		15.69		
		24		13	
15	20.74		15.56		
		25		14	
11	20.49		15.70		
		25		16	
7	20.24		15.86		
		25		14	
3	19.99		16.00		
Total		129		88	237
Stress 23.44 x 237 = -5550					
Remarks					

Load in 1000#	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	30.00	-	26.00	-	-
		28		19	
7	30.28		25.81		
		28		18	
11	30.56		25.63		
		28		16	
15	30.84		25.47		
		30		17	
11	30.54		26.64		
		27		18	
7	30.27		25.82		
		28		18	
3	29.99		26.00		
Total		169		106	275
Stress 23.44 x 275 = -6450					
Remarks Total stress = -16,560 lbs.					

N.B. Stress given is for load of 15000#.

Table



LOCATION NO. 12

Load in ″ 1000	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	16.00	-	17.00	-	-
		11		20	
7	15.89		17.20		
		11		20	
11	15.78		17.40		
		13		21	
15	15.65		17.61		
		13		21	
11	15.78		17.40		
		11		21	
7	15.89		17.19		
		11		19	
3	16.00		17.00		
Total		70		122	192
Stress 23.44 x 192 = -4500					
Remarks					

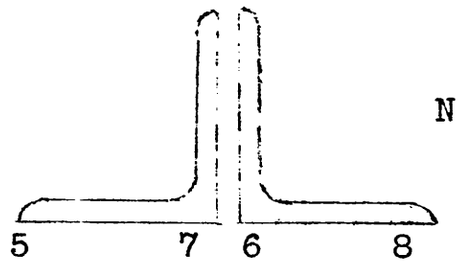
Load in ″ 1000	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	31.00	-	29.00	-	-
		13		25	
7	30.87		29.25		
		17		25	
11	30.70		29.50		
		14		24	
15	30.56		29.74		
		14		24	
11	30.70		29.50		
		14		23	
7	30.84		29.27		
		16		27	
3	31.00		29.00		
Total		88		148	236
Stress 23.44 x 236 = -5540					
Remarks					

Load in ″ 1000	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	17.00	-	19.00	-	-
		14		24	
7	16.86		19.24		
		16		24	
11	16.70		19.48		
		14		23	
15	16.56		19.71		
		12		21	
11	16.68		19.50		
		15		25	
7	16.83		19.25		
		17		25	
3	17.00		19.00		
Total		88		142	230
Stress 23.44 x 230 = -5400					
Remarks					

Load in ″ 1000	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	27.00	-	28.00	-	-
		20		28	
7	26.80		28.28		
		20		27	
11	26.60		28.55		
		18		26	
15	26.42		28.81		
		19		28	
11	26.61		28.53		
		19		26	
7	26.80		28.27		
		20		27	
3	27.00		28.00		
Total		116		162	278
Stress 23.44 x 278 = -6520					
Remarks					

N.B. Stress given is for load of 15000″.

Table



LOCATION NO. 12

Load in #/1000"	5 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	17.00	-	18.00	-	-
		20		11	
7	17.20		17.89		
		21		13	
11	17.41		17.76		
		23		13	
15	17.64		17.63		
		23		14	
11	17.41		17.77		
		21		12	
7	17.20		17.89		
		21		11	
3	16.99		18.00		
Total		129		74	203
Stress 23.44 x 203 = -4750					
Remarks					

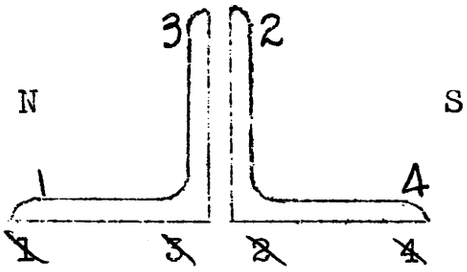
Load in #/1000"	6 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	26.00	-	31.00	-	-
		28		17	
"	26.28		30.83		
		24		16	
11	26.52		30.67		
		27		17	
15	26.79		30.50		
		26		17	
11	26.51		30.67		
		26		17	
7	26.25		30.84		
		25		16	
"	26.00		31.00		
Total		158		100	258
Stress 23.44 x = -6050					
Remarks					

Load in #/1000"	7 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	30.00	-	17.00	-	-
		27		17	
7	20.27		16.83		
		25		16	
11	20.52		16.67		
		28		17	
15	20.80		16.50		
		29		17	
11	20.51		16.67		
		24		17	
7	20.27		16.84		
		27		16	
3	20.00		17.00		
Total		160		100	260
Stress 23.44 x 260 = -6100					
Remarks					

Load in #/1000"	8 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	28.00	-	28.00	-	-
		29		20	
7	28.29		27.80		
		27		19	
11	28.56		27.61		
		28		20	
15	28.84		27.41		
		28		20	
11	28.56		27.61		
		27		19	
7	28.29		27.80		
		29		20	
3	28.00		28.00		
Total		168		118	286
Stress 23.44 x 286 = -6700					
Remarks Total stress = -16900 lbs.					

N.B. Stress given is for load of 15000#

Table



LOCATION NO. 13

Load in # 1000	1 Direct Read.	Direct Inc.	reversed Read.	reversed Inc.	Total
3	33.00	-	29.00	-	-
		20		23	
7	32.80		29.23		
		18		23	
11	32.62		29.46		
		16		22	
15	32.46		29.68		
		17		24	
11	32.63		29.44		
		17		23	
7	32.80		29.21		
		17		22	
3	33.00		28.99		
Total		108		137	245
Stress 23.44 x 245 = -5740					
Remarks					

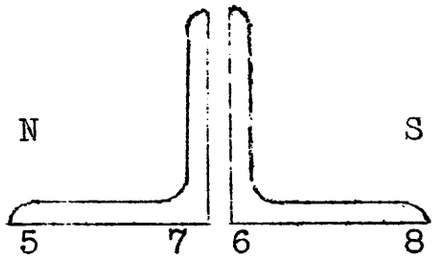
Load in # 1000	2 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	8.00	-	4.00	-	-
		12		17	
7	7.88		4.17		
		12		15	
11	7.76		4.32		
		12		16	
15	7.64		4.48		
		12		14	
11	7.76		4.34		
		12		16	
7	7.88		4.18		
		12		18	
3	8.00		4.00		
Total		72		96	168
Stress 23.44 x 168 = -3940					
Remarks					

Load in # 1000	3 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	32.00	-	30.00	-	-
		11		14	
7	31.89		30.14		
		11		14	
11	31.78		30.28		
		12		14	
15	31.66		30.42		
		8		13	
11	31.74		30.29		
		13		15	
7	31.87		30.14		
				15	
3	32.00		29.99		
Total		68		85	153
Stress 23.44 x 153 = -3590					
Remarks					

Load in # 1000	4 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	7.00	-	7.00	-	-
		19		21	
7	6.81		7.21		
		19		22	
11	6.62		7.43		
		19		24	
15	6.43		7.67		
		20		25	
11	6.63		7.42		
		18		23	
7	6.81		7.19		
				21	
3	7.00		6.98		
Total		114		136	250
Stress 23.44 x 250 = -5860					
Remarks					

N.B. Stress given is for load of 15000#

Table



LOCATION NO. 13

Load in 1000#	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	29.00	-	32.00	-	-
		27		20	
7	29.27		31.80		
		23		20	
11	29.50		31.60		
		24		20	
15	29.74		31.40		
		24		20	
11	29.50		31.60		
		26		20	
7	29.24		31.80		
		24		21	
3	29.00		32.01		
Total		148		121	269
Stress 23.44 x 269 = -6320					
Remarks					

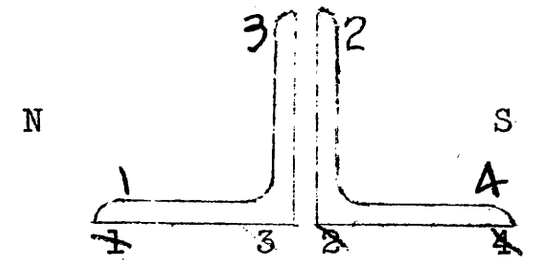
Load in 1000#	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	7.00	-	6.00	-	-
		25		21	
7	7.25		5.79		
		23		20	
11	7.48		5.59		
		24		20	
15	7.72		5.39		
		24		21	
11	7.48		5.60		
		25		20	
7	7.23		5.80		
		23			
3	7.00		6.01		
Total		144		121	265
Stress 23.44 x 265 = -6210					
Remarks					

Load in 1000#	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	30.00	-	30.00	-	-
		27		22	
7	30.27		29.78		
		25		22	
11	30.52		29.56		
		28		22	
15	30.80		29.34		
		29		23	
11	30.51		29.57		
		25		22	
7	30.26		29.79		
		26		21	
3	30.00		30.00		
Total		160		132	292
Stress 23.44 x 292 = -6850					
Remarks					

Load in 1000#	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	6.00	-	4.00	-	-
		22		19	
7	6.22		3.81		
		23		19	
11	6.45		3.62		
		24		19	
15	6.69		3.43		
		24		19	
11	6.45		3.62		
		24		19	
7	6.21		3.81		
		21		19	
3	6.00		4.00		
Total		138		114	252
Stress 23.44 x 252 = -5900					
Remarks Total stress = -16,430 lbs.					

N.B. Stress given is for load of 15000#

Table



LOCATION NO. 14

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	32.00	-	32.00	-	-
7	31.86		32.29		
		16		25	
11	31.70		32.54		
		13		28	
15	31.57		32.82		
		13		27	
11	31.70		32.55		
		15		27	
7	31.85		32.28		
		15		28	
3	32.00		32.00		
Total		86		164	250
Stress 23.44 x 250 = -5870					
Remarks					

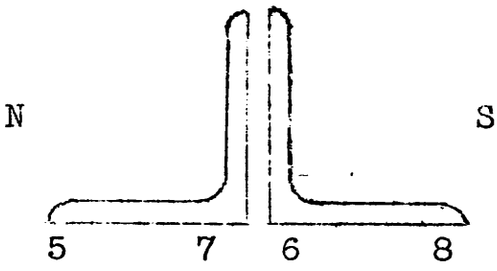
Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	6.00	-	4.00	-	-
		10		19	
7	5.90		4.19		
		10		19	
11	5.80		4.38		
		9		20	
15	5.71		4.58		
		9		20	
11	5.80		4.38		
		10		20	
7	5.90		4.18		
		10		18	
3	6.00		4.00		
Total		58		116	174
Stress 23.44 x 174 = -4080					
Remarks					

Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	30.00	-	33.00	-	-
		10		20	
7	29.90		32.20		
		11		20	
11	29.79		33.40		
		9		19	
15	29.70		33.59		
		9		21	
11	29.79		33.38		
		11		19	
7	29.90		33.19		
		10		19	
3	30.00		33.00		
Total		60		118	178
Stress 23.44 x 178 = -4170					
Remarks					

Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	8.00	-	4.00	-	-
		14		25	
7	7.86		4.25		
		16		25	
11	7.70		4.50		
		14		25	
15	7.56		4.75		
		14		27	
11	7.70		4.48		
		15		25	
7	7.85		4.23		
		15		23	
3	8.00		4.00		
Total		88		150	238
Stress 23.44 x 238 = -5580					
Remarks					

N.B. Stress given is for load of 15000#

Table



LOCATION NO. 14

Load in 1000#	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	31.00	-	31.00	-	-
		29		14	
7	31.29		30.86		
		27		16	
11	31.56		30.70		
		28		12	
15	31.84		30.58		
		28		12	
11	31.56		30.70		
		28		13	
7	31.28		30.83		
		28		17	
3	31.00		31.00		
Total		168		84	252
Stress	23.44 x 252 = -5920				
Remarks					

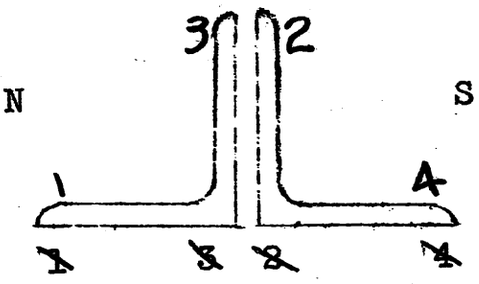
Load in 1000#	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	4.00	-	8.00	-	-
		28		18	
7	4.28		7.82		
		27		19	
11	4.55		7.63		
		28		15	
15	4.83		7.48		
		28		16	
11	4.55		7.62		
		28		19	
7	4.27		7.81		
		27		18	
3	4.00		7.99		
Total		166		103	269
Stress	23.44 x 269 = -6300				
Remarks					

Load in 1000#	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	33.00	-	34.00	-	-
		27		19	
7	33.27		33.81		
		27		19	
11	33.54		33.62		
		28		16	
15	33.82		33.46		
		29		17	
11	33.53		33.63		
		26		17	
7	33.27		33.80		
		27		20	
3	33.00		34.00		
Total		164		108	272
Stress	23.44 x 272 = -6370				
Remarks					

Load in 1000#	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	6.00	-	7.00	-	-
		26		16	
7	6.26		6.84		
		26		16	
11	6.52		6.68		
		27		16	
15	6.79		6.52		
		25		16	
11	6.50		6.68		
		25		15	
7	6.25		6.83		
		25		17	
3	6.00		7.00		
Total		158		96	254
Stress	23.44 x 254 = -5960				
Remarks	Total stress = -16400 lb				

N.B. Stress given is for load of 15000#

Table



LOCATION NO. 15

Load in #/1000"	1 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	31.00	-	34.00	-	-
		16		28	
7	30.84		34.28		
		15		27	
11	30.69		34.55		
		16		25	
15	30.53		34.80		
		15		26	
11	30.68		34.54		
		15		26	
7	30.83		34.28		
		17		28	
3	31.00		34.00		
Total		94		160	254
Stress	23.44 x 254 = -5960				
Remarks					

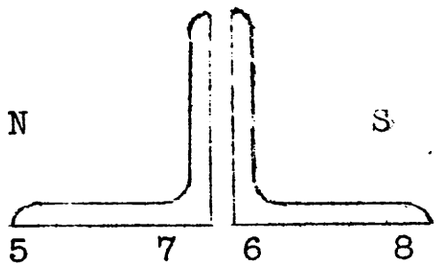
Load in #/1000"	2 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	5.00	-	6.00	-	-
		18		28	
7	4.82		6.28		
		19		28	
11	4.63		6.56		
		16		29	
15	4.47		6.85		
		18		29	
11	4.65		6.56		
		18		29	
7	4.83		6.27		
		17		28	
3	5.00		5.99		
Total		106		171	277
Stress	23.44 x 277 = -6500				
Remarks					

Load in #/1000"	3 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	33.00	-	31.00	-	-
		19		30	
7	32.81		31.30		
		19		28	
11	32.62		31.58		
		19		30	
15	32.43		31.88		
		20		32	
11	32.63		31.56		
		22		29	
7	32.81		31.27		
		19		29	
3	33.00		30.98		
Total		114		178	292
Stress	23.44 x 292 = -6850				
Remarks					

Load in #/1000"	4 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	5.00	-	5.00	-	-
		16		23	
7	4.84		5.23		
		16		24	
11	4.68		5.47		
		16		23	
15	4.52		5.70		
		15		23	
11	4.67		5.47		
		16		24	
7	4.83		5.23		
		17		23	
3	5.00		5.00		
Total		96		140	236
Stress	23.44 x 236 = -5530				
Remarks					

N.B. Stress given is for load of 15000#.

Table



LOCATION NO. 15

Load in #/1000"	5 Direct Read.	Inc.	reversed Read.	Inc.	Total
3	33.00	-	29.00	-	-
		27		15	
7	33.27		28.85		
		25		15	
11	33.52		28.70		
		26		14	
15	33.78		28.56		
		26		12	
11	33.52		28.68		
		26		16	
7	33.26		28.84		
		26		16	
3	33.00		29.00		
Total		156		88	244
Stress	23.44 x 244 =				-5720
Remarks					

Load in #/1000"	6 Direct Read.	Inc.	Reversed Read.	Inc.	
3	7.00	-	3.00	-	-
		23		14	
7	7.23		2.86		
		25		14	
11	7.48		2.72		
		22		12	
15	7.70		2.60		
		22		11	
11	7.48		2.71		
		25		15	
7	7.23		2.86		
		23		14	
3	7.00		3.00		
Total		140		80	220
Stress	23.44 x 220 =				-5150
Remarks					

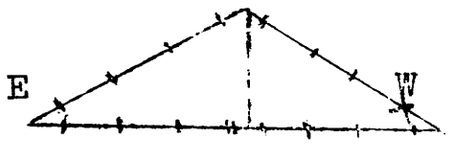
Load in #/1000"	7 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	33.00	-	32.00	-	-
		22		12	
7	33.22		31.88		
		24		13	
11	33.46		31.75		
		23		12	
15	33.69		31.63		
		22		12	
11	33.47		31.75		
		25		13	
7	33.22		31.88		
		22		12	
3	33.00		32.00		
Total		138		74	212
Stress	23.44 x 212 =				-4970
Remarks					

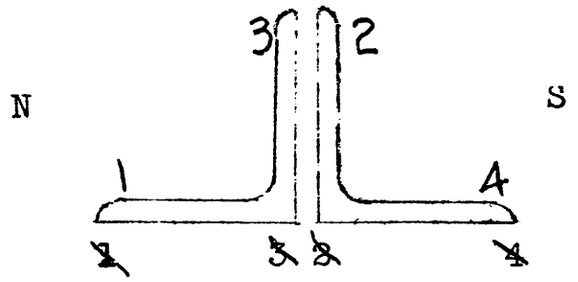
Load in #/1000"	8 Direct Read.	Inc.	Reversed Read.	Inc.	
3	8.00	-	3.00	-	-
		22		14	
7	8.22		2.86		
		23		16	
11	8.45		2.70		
		23		13	
15	8.68		2.57		
		23		13	
11	8.45		2.70		
		23		15	
7	8.22		2.85		
		22		15	
3	8.00		3.00		
Total		136		86	222
Stress	23.44 x 222 =				-5200
Remarks	Total stress =				-16440 lbs.

N.B. Stress given is for load of 15000#

Table

C. G. LINES





Location 16.

Load in #/1000"	1 Direct Read.	Inc.	reversed Read.	Inc.	Total
3	4.00	-	7.00	-	-
		13		18	
7	4.13		6.82		
		15		19	
11	4.28		6.63		
		14		16	
15	4.42		6.47		
		15		16	
11	4.27		6.63		
		15		19	
7	4.12		6.82		
		14		19	
3	3.98		7.01		
Total		86		107	193
Stress	23.44 x 193 = -4540				
Remarks					

Load in #/1000"	2 Direct Read.	Inc.	Reversed Read.	Inc.	
3	33.00	-	31.00	-	-
		27		30	
7	33.27		30.70		
		26		30	
11	33.53		30.40		
		25		30	
15	33.78		30.10		
		31		33	
11	33.47		30.73		
		26		30	
7	33.21		30.73		
		24		29	
3	32.97		31.02		
Total		159		182	341
Stress	23.44 x 341 = -8000				
Remarks					

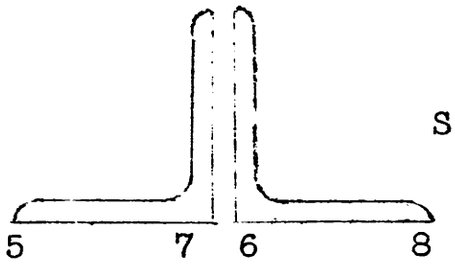
Load in #/1000"	3 Direct Read.	Inc	Reversed Read.	Inc.	Total
3	7.00	-	5.00	-	-
				30	
7			4.70		
				30	
11			4.40		
		84		31	
15	7.84		4.09		
				34	
11			4.43		
				29	
7			4.72		
		77		30	
3	7.07		5.02		
Total		161		184	345
Stress	23.44 x 345 = -8060				
Remarks					

Load in #/1000"	4 Direct Read.	Inc.	Reversed Read.	Inc.	
3	33.00	-	29.00	-	-
		19		16	
7	33.19		28.84		
		15		14	
11	33.34		28.70		
		16		16	
15	33.50		28.54		
		17		16	
11	33.33		28.70		
		14		15	
7	33.19		28.85		
		18		15	
3	33.01		29.00		
Total		99		92	191
Stress	23.44 x 191 = -4470				
Remarks					

N.B. Stress given is for load of 15000#

Table

C. G. LINES



LOCATION NO. 16

Load in 1000#	5 Direct Read.	Inc.	reversed Read.	Inc.	Total
3	4.00	-	4.00	-	-
		18		12	
7	3.82		4.12		
		17		14	
11	3.65		4.26		
		18		14	
15	3.47		4.40		
		16		14	
11	3.63		4.26		
		19		15	
7	3.82		4.11		
		18		12	
3	4.00		3.99		
Total		106		81	187
Stress 23.44 x 187 = -4400					
Remarks					

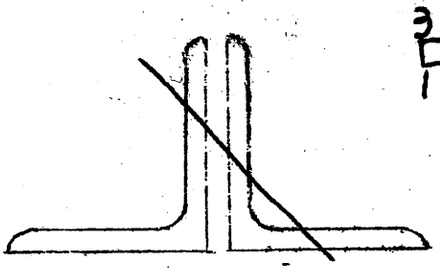
Load in 1000#	6 Direct Read.	Inc.	Reversed Read.	Inc.	
3	32.00	-	34.00	-	-
		20		16	
7	31.80		34.16		
		18		15	
11	31.62		34.31		
		19		16	
15	31.43		34.47		
		17		16	
11	31.60		34.31		
		21		15	
7	31.81		34.16		
		20		17	
3	32.01		33.99		
Total		115		95	210
Stress 23.44 x 210 = -4930					
Remarks					

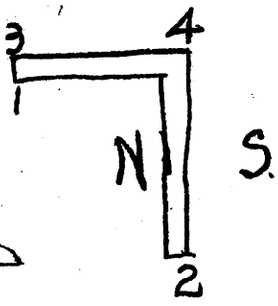
Load in 1000#	7 Direct Read.	Inc	Reversed Read.	Inc.	Total
3	4.00	-	5.00	-	-
		22		.16	
7	3.78		5.16		
		21		.16	
11	3.57		5.32		
		19		.15	
15	3.38		5.47		
		17		15	
11	3.55		5.32		
		22		15	
7	3.77		5.17		
		20		17	
3	3.97		5.00		
Total		121		94	215
Stress 23.44 x 215 = -5040					
Remarks					

Load in 1000#	8 Direct Read.	Inc.	Reversed Read.	Inc.	
3	33.00	-	32.00	-	-
		.14		.14	
7	32.86		32.14		
		.12		15	
11	32.74		32.29		
		.14		12	
15	32.60		32.41		
		12		13	
11	32.72		32.28		
		14		15	
7	32.86		32.13		
		13		14	
3	32.99		31.99		
Total		79		83	162
Stress 23.44 x 162 = -3800					
Remarks Total stress = -16450 lbs.					

N.B. Stress given is for load of 15000#

Table





LOCATION NO. 18

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	34.00	-	34.00	-	-
		4		1	
7	34.04		33.99		
		3		0	
11	34.07		33.99		
		2		0	
15	34.09		33.99		
		2		0	
11	34.07		33.99		
		3		1	
7	34.04		34.00		
		4		0	
3	34.00		34.00		
Total		18		2	20
Stress	23.44 x 20 =		-470		
Remarks					

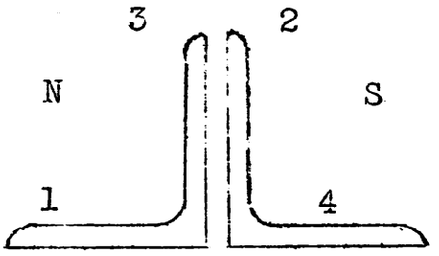
Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	3.00	+	5.00	+	+
		1		3	
7	2.99		5.03		
		1		3	
11	2.98		5.06		
		1		3	
15	2.97		5.09		
		1		3	
11	2.98		5.06		
		1		3	
7	2.99		5.03		
		1		3	
3	3.00		5.00		
Total		6		18	24
Stress	23.44 x 24 =		+560		
Remarks					

Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	32.00	-	33.00	-	-
		0		3	
7	32.00		33.03		
		1		3	
11	31.99		33.06		
		0		2	
15	31.99		33.08		
		0		2	
11	31.99		33.06		
		1		2	
7	32.00		33.03		
		0		3	
3	32.00		33.00		
Total		2		16	18
Stress	23.44 x 18 =		-420		
Remarks					

Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	7.00	+	8.00	-	-
		1		1	
7	7.01		8.01		
		0		1	
11	7.01		8.02		
		1		2	
15	7.02		8.04		
		0		2	
11	7.02		8.02		
		1		2	
7	701		8.00		
		1		1	
3	7.00		7.99		
Total		4		9	5
Stress	23.44 x 5 =		-115		
Remarks					

N.B. Stress given is for load of 15000#

Table I.



LOCATION No. I.

With Filler

Load in ″ 1000	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	5.00	+	5.00	+	+
7					
11					
		53		66	
15	5.53		4.34		
11					
7					
		53		66	
3	5.00		5.00		
Total		106		132	238
Stress $3.44 X 238 =+5580					
Remarks					

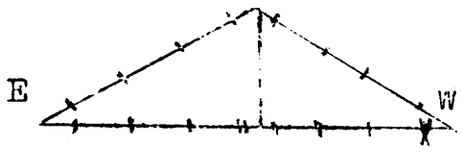
Load in ″ 1000	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	32.00	+	34.00	+	+
7					
11					
		87		98	
15	32.87		33.02		
11					
7					
		87		98	
3	32.00		34.00		
Total		174		196	370
Stress $3.44 X 370 =+8700					
Remarks					

Load in ″ 1000	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	4.00	+	4.00	+	+
7					
11					
		82		95	
15	4.82		3.05		
11					
7					
		84		95	
3	3.98		4.00		
Total		166		190	356
Stress $3.44 X 356 =+8350					
Remarks					

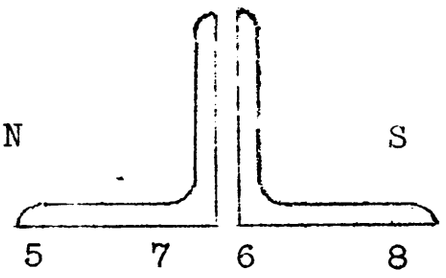
Load in ″ 1000	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	30.00	+	34.00	+	+
7					
11					
		56		58	
15	30.56		33.40		
11					
7					
		54		58	
3	30.02		33.98		
Total		110		118	228
Stress $3.44 X 228 =+5350					
Remarks					

N.B. Stress given is for load of 15000″

Table I



Location No. I with Filler



Load in #	5				
	Direct		reversed		
1000#	Read.	Inc.	Read.	Inc.	Total
3	7.00	+	7.00	+	+
7					
11					
		66		50	
15	6.34		7.50		
11					
7					
		65		50	
3	6.99		7.00		
Total		131		100	231
Stress	$3.44^2 \times 231 = +5420$				
Remarks					

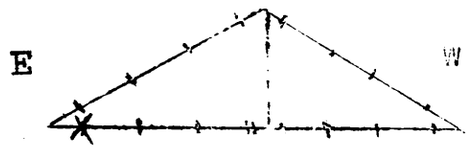
Load in #	6				
	Direct		Reversed		
1000#	Read.	Inc.	Read.	Inc.	
3	34.00	+	32.00	+	+
7					
11					
		60		48	
15	33.40		32.48		
11					
7					
		58		48	
3	33.98		32.00		
Total		118		96	214
Stress	$3.44^2 \times 214 = +5020$				
Remarks					

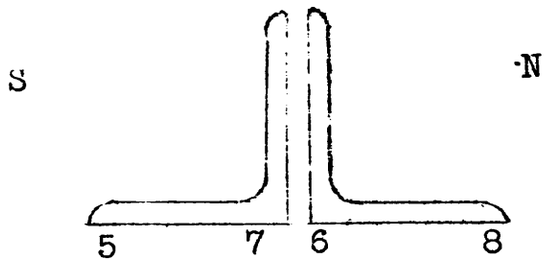
Load in #	7				
	Direct		Reversed		
1000#	Read.	Inc.	Read.	Inc.	Total
3	6.00	+	6.00	+	+
7					
11					
		58		50	
15	5.42		6.50		
11					
7					
		56		47	
3	5.98		6.03		
Total		114		97	211
Stress	$3.44^2 \times 211 = +4950$				
Remarks					

Load in #	8				
	Direct		Reversed		
1000#	Read.	Inc.	Read.	Inc.	
3	30.00	+	32.00	+	+
7					
11					
		57		49	
15	29.43		32.49		
11					
7					
		54		46	
3	2997		32.03		
Total		110		95	205
Stress	$3.44^2 \times 205 = +4820$				
Remarks	Total Stress = +14330 lbs.				

N.B. Stress given is for load of 15000#.

Table





Location No. 8 with Filler

Load in #/1000	5 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	29.00	+	30.00	+	+
7					
11					
		80		56	
15	29.80		29.44		
11					
7					
		78		56	
3	29.02		30.00		
Total		158		112	270
Stress	$3.44 \times 270 = +6330$				
Remarks					

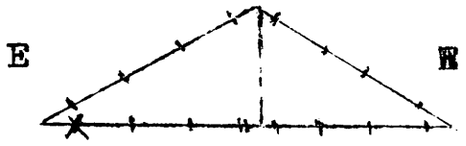
Load in #/1000	6 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	16.00	+	20.00	+	+
7					
11					
		62		42	
15	16.62		19.58		
11					
7					
		60		42	
3	16.02		20.00		
Total		122		84	206
Stress	$3.44 \times 206 = +4830$				
Remarks					

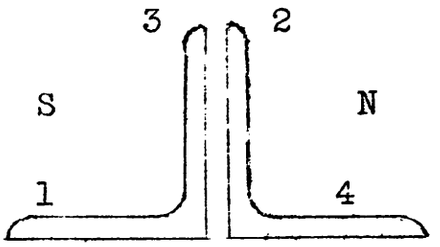
Load in #/1000	7 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	30.00	+	28.00	+	+
7					
11					
		68		48	
15	30.68		27.52		
11					
7					
		66		46	
3	30.02		27.98		
Total		134		94	228
Stress	$3.44 \times 228 = +5350$				
Remarks					

Load in #/1000	8 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	18.00	+	20.00	+	+
7					
11					
		58		45	
15	18.58		19.55		
11					
7					
		56		43	
3	18.02		19.98		
Total		114		88	202
Stress	$3.44 \times 202 = +4730$				
Remarks	Total stress = +14350lbs.				

N.B. Stress given is for load of 15000#.

Table





Location No. 8 with Filler

Load in #/1000"	1 Direct Read.	Direct Inc.	reversed Read.	reversed Inc.	Total
3	27.00	+	27.00	+	+
7					
11					
		60		84	
15	26.40		27.84		
11					
7					
		60		82	
3	27.00		27.02		
Total		120		166	286
Stress	$3.44 \times 286 = +6700$				
Remarks					

Load in #/1000"	2 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	17.00	+	15.00	+	+
7					
11					
		72		97	
15	16.28		15.97		
11					
7					
		72		97	
3	17.00		15.00		
Total		144		194	338
Stress	$3.44 \times 338 = +7920$				
Remarks					

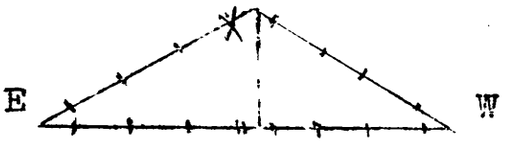
Load in #/1000"	3 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	27.00	+	28.00	+	+
7					
11					
		71		97	
15	26.29		29.97		
11					
7					
		73		97	
3	27.02		28.00		
Total		114		194	338
Stress	$3.44 \times 338 = +7920$				
Remarks					

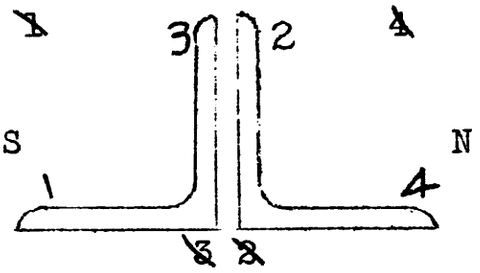
Load in #/1000"	4 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	19.00	+	15.00	+	+
7					
11					
		51		68	
15	18.49		15.68		
11					
7					
		50		65	
3	18.99		15.03		
Total		101		133	234
Stress	$3.44 \times 234 = +5480$				
Remarks					

N.B. Stress given is for load of 15000#

Table

BOLTS AND FILLERS





LOCATION NO. 12

Load in ″ 1000	1 Direct Read.	Direct Inc.	reversed Read.	reversed Inc.	Total
3	20.00	-	30.00	-	-
7					
11					
		37		62	
15	19.63		30.62		
11					
7					
		37		62	
3	20.00		30.00		
Total		74		124	198
Stress 23.44 x 198 = -4640					
Remarks					

Load in ″ 1000	2 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	30.00	-	20.00	-	-
7					
11					
		43		70	
15	29.57		20.70		
11					
7					
		43		70	
3	30.00		20.00		
Total		86		140	226
Stress 23.44 x 226 = -5300					
Remarks					

Load in ″ 1000	3 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	17.00	-	16.00	-	-
7					
11					
		42		62	
15	16.58		16.62		
11					
7					
		42		62	
3	17.00		16.00		
Total		84		124	208
Stress 23.44 x 208 = -4880					
Remarks					

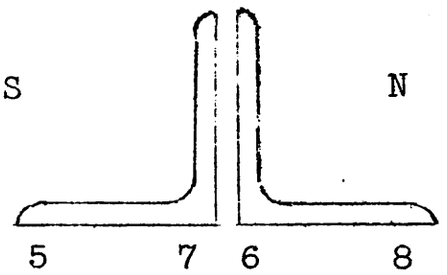
Load in ″ 1000	4 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	30.50	-	29.00	-	-
7					
11					
		53		78	
15	29.97		29.78		
11					
7					
		53		78	
3	30.50		29.00		
Total		106		156	262
Stress 23.44 x 262 = -6140					
Remarks					

N.B. Stress given is for load of 15000″.

BOLTS AND FILLERS

Table

LOCATION NO. 12



Load in #	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	15.00	-	28.00	-	-
7					
11					
		67		38	
15	15.67		27.62		
11					
7					
		67		38	
3	15.00		28.00		
Total		134		76	210
Stress	23.44 x 210 =				-4920
Remarks					

Load in #	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	31.00	-	16.00	-	-
7					
11					
		73		54	
15	31.73		15.46		
11					
7					
		73		54	
3	31.00		16.00		
Total		146		108	254
Stress	23.44 x 254 =				-5950
Remarks					

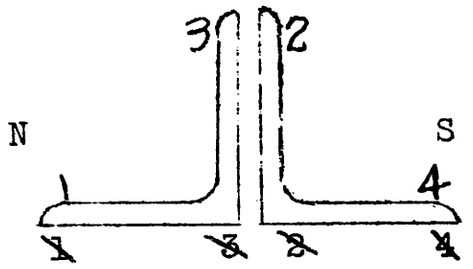
Load in #	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	20.00	-	27.00	-	-
7					
11					
		78		51	
15	20.78		26.49		
11					
7					
		78		51	
3	20.00		27.00		
Total		156		102	258
Stress	23.44 x 258 =				-6050
Remarks					

Load in #	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	29.00	-	15.00	-	-
7					
11					
		80		58	
15	29.80		14.42		
11					
7					
		80		58	
3	29.00		15.00		
Total		160		116	276
Stress	23.44 x 276 =				-6460
Remarks	Total stress =				-16450

N.B. Stress given is for load of 15000#

Table

WITH BOLTS & FILLERS



LOCATION NO. 13

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	31.00	-	33.00	-	-
7					
11					
		50		68	
15	30.50		33.68		
11					
7					
		50		68	
3	31.00		33.00		
Total		100		136	236
Stress 23.44 x 235 = -5530					
Remarks					

Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	7.00	-	3.00	-	-
7					
11					
		38		52	
15	6.62		3.52		
11					
7					
		38		52	
3	7.00		3.00		
Total		76		104	180
Stress 23.44 x 180 = -4220					
Remarks					

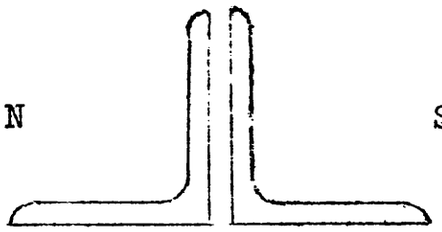
Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	32.00	-	30.00	-	-
7					
11					
		34		50	
15	31.66		30.50		
11					
7					
		34		50	
3	32.00		30.00		
Total		68		100	168
Stress 23.44 x 168 = -3940					
Remarks					

Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	6.00	-	6.00	-	-
7					
11					
		55		70	
15	5.45		6.70		
11					
7					
		55		70	
3	6.00		6.00		
Total		110		140	250
Stress 23.44 x 250 = -5850					
Remarks					

N.B. Stress given is for load of 15000#

Table

WITH BOLTS AND FILLERS



LOCATION NO. 13

Load in #/1000"	5 Direct Read.	Direct Inc.	reversed Read.	reversed Inc.	Total
3	34.00	-	30.00	-	-
7					
11					
		71		53	
15	34.71		29.47		
11					
7					
		71		53	
3	34.00		30.00		
Total		142		106	248
Stress	23.44 x 248 = -5800				
Remarks					

Load in #/1000"	6 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	6.00	-	5.00	-	-
7					
11					
		74		59	
15	6.74		4.41		
11					
7					
		74		59	
3	6.00		5.00		
Total		148		118	266
Stress	23.44 x 266 = -6240				
Remarks					

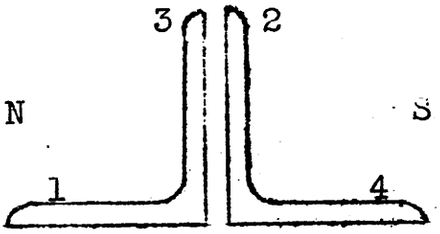
Load in #/1000"	7 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	34.00	-	33.00	-	-
7					
11					
		78		62	
15	34.78		32.28		
11					
7					
		78		62	
3	34.00		33.00		
Total		156		124	280
Stress	23.44 x 280 = -6570				
Remarks					

Load in #/1000"	8 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	4.00	-	5.00	-	-
7					
11					
		73		58	
15	4.73		4.42		
11					
7					
		73		58	
3	4.00		5.00		
Total		146		116	
Stress	23.44 x 116 = -6130				
Remarks	Total stress = -16430 lbs.				

N.B. Stress given is for load of 15000#.

Table

WOOD BLOCKS



LOCATION NO. I

Load in # 1000#	1 Direct Read.	Direct Inc.	reversed Read.	reversed Inc.	Total
3	7.00	+	6.00	+	+
7					
11					
		50		47	
15	7.50		5.53		
11					
7					
		47		47	
3	7.03		6.00		
Total		97		94	191
Stress	33.44 x 191 = +4480				
Remarks					

Load in # 1000#	2 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	32.00		32.00	+	+
7					
11					
		120		113	
15	33.20		30.87		
11					
7					
		119		113	
3	32.01		32.00		
Total		239		226	465
Stress	33.44 x 465 = +10900				
Remarks					

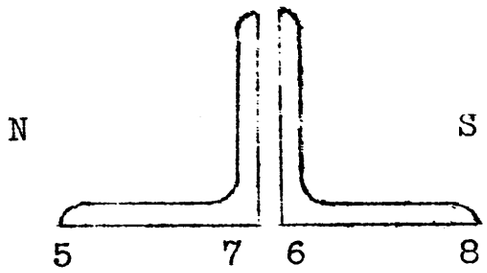
Load in # 1000#	3 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	6.00	+	4.00	+	+
7					
11					
		121		114	
15	7.21		2.86		
11					
7					
		119		113	
3	6.02		4.00		
Total		240		227	467
Stress	33.44 x 467 = +10960				
Remarks					

Load in # 1000#	4 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	33.00	+	31.00	+	+
7					
11					
		50		38	
15	33.50		30.62		
11					
7					
		50		40	
3	33.00		31.02		
Total		100		78	178
Stress	33.44 x 178 = +4170				
Remarks					

N.B. Stress given is for load of 15000#

Table

WOOD BLOCKS



Location No. 1

Load in #/1000"	5 Direct Read.	Direct Inc.	reversed Read.	reversed Inc.	Total
3	4.00	+	7.00	+	+
7					
11					
		43		41	
15	3.57		7.41		
11					
7					
		41		40	
3	30.98		7.01		
Total		84		81	165
Stress	$3.44 \times 165 = +3870$				
Remarks					

Load in #/1000"	6 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	31.00	+	30.00	+	+
7					
11					
		32		33	
15	30.68		30.33		
11					
7					
		32		33	
3	31.00		30.00		
Total		64		66	130
Stress	$3.44 \times 130 = +3050$				
Remarks					

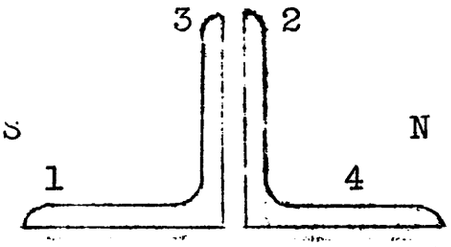
Load in #/1000"	7 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	6.00	+	6.00	+	+
7					
11					
		28		38	
15	3.72		6.38		
11					
7					
		25		36	
3	3.97		6.02		
Total		53		74	127
Stress	$3.44 \times 127 = +2970$				
Remarks					

Load in #/1000"	8 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	34.00	+	32.00	+	+
7					
11					
		30		40	
15	33.70		32.40		
11					
7					
		28		40	
3	33.98		32.00		
Total		58		80	138
Stress	$3.44 \times 138 = +3240$				
Remarks	Total stress = +12900 lbs.				

N.B. Stress given is for load of 15000#.

Table

WOOD BLOCKS



Location No. 8

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
2	30.00	+	27.00	+	+
7					
11					
		55		39	
15	29.45		27.39		
11					
7					
		54		39	
3	29.99		27.00		
Total		109		78	187
Stress 23.44 x 187 = +4380					
Remarks					

Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	14.00	+	18.00	+	+
7					
11					
		145		130	
15	12.55		19.30		
11					
7					
		145		130	
3	14.00		18.00		
Total		290		260	550
Stress 23.44 x 550 = +12900					
Remarks					

Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	28.00	+	31.00	+	+
7					
11					
		143		124	
15	26.57		32.24		
11					
7					
		143		124	
3	28.00		31.00		
Total		286		248	534
Stress 23.44 x 534 = +12500					
Remarks					

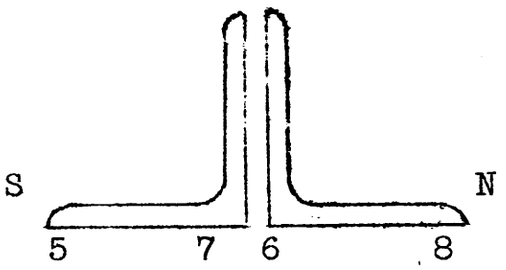
Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	18.00	+	16.00	+	+
7					
11					
		53		40	
15	17.47		16.40		
11					
7					
		53		38	
3	18.00		16.02		
Total		106		78	184
Stress 23.44 x 184 = +4320					
Remarks					

N.B. Stress given is for load of 15000#

wood Blocks

Table

LOCATION NO. 8



Load in # 1000#	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	29.00	+	29.00	+	+
7					
11					
		26		40	
15	29.26		28.60		
11					
7					
		24		38	
3	29.02		28.98		
Total		50		78	128
Stress	23.44 x 128 = +3000				
Remarks					

Load in # 1000#	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	15.00	+	19.00	+	+
7					
11					
		16		30	
15	15.16		18.70		
11					
7					
		15		28	
3	15.01		18.98		
Total		31		58	89
Stress	23.44 x 89 = +2090				
Remarks					

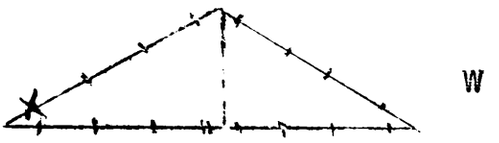
Load in # 1000#	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	30.00	+	31.00	+	+
7					
11					
		19		33	
15	30.19		30.67		
11					
7					
		17		32	
3	30.02		30.99		
Total		36		65	101
Stress	23.44 x 101 = +2370				
Remarks					

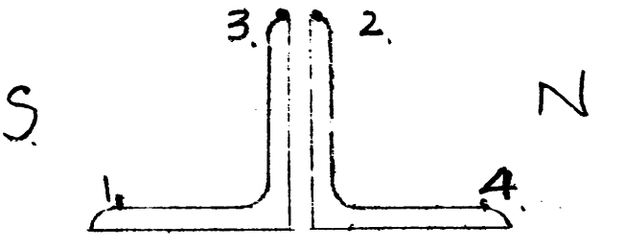
Load in # 1000#	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	19.00	+	14.00	+	+
7					
11					
		26		43	
15	19.26		13.57		
11					
7					
		26		43	
3	19.00		14.00		
Total		52		86	138
Stress	23.44 x 138 = +3240				
Remarks	Total stress = +13200 lbs.				

N.B. Stress given is for load of 15000#

Table

WOOD BLOCKS





Location No. 9

Load in #/1000	1 Direct Read.	Direct Inc.	reversed Read.	reversed Inc.	Total
3	28.00	→	30.00	-	-
7					
11					
		53		28	
15	27.47		30.28		
11					
7					
		53		28	
3	28.00		30.00		
Total		106		56	162
Stress	$\frac{2}{3}$3.44 x 162 = -3800				
Remarks					

Load in #/1000	2 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	15.00	-	18.00	-	-
7					
11					
		149		129	
15	13.51		19.29		
11					
7					
		129		129	
3	15.00		18.00		
Total		298		258	556
Stress	$\frac{2}{3}$3.44 x 556 = -13000				
Remarks					

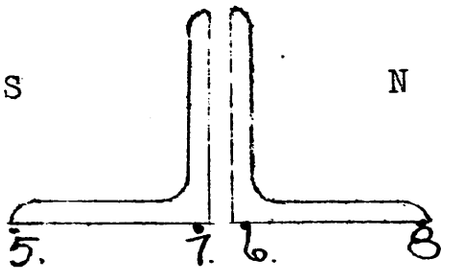
Load in #/1000	3 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	28.00	-	31.00	-	-
7					
11					
		150		128	
15	26.50		32.28		
11					
7					
		150		128	
3	28.00		31.00		
Total		300		256	556
Stress	$\frac{2}{3}$3.44 x 556 = -13000				
Remarks					

Load in #/1000	4 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	18.00	-	18.00	-	-
7					
11					
		50		26	
15	17.50		18.26		
11					
7					
		50		26	
3	18.00		18.00		
Total		100		52	152
Stress	$\frac{2}{3}$3.44 x 152 = -3560				
Remarks					

N.B. Stress given is for load of 15000#

WOOD BLOCKS

Table



Location No. 9

Load in #/1000	5 Direct Read.	Direct Inc.	reversed Read.	reversed Inc.	Total
3	29.00	-	26.00	-	-
7					
11					
		16		40	
15	29.16		25.60		
11					
7					
		16		40	
3	29.00		26.00		
Total		32		80	112
Stress	$S = 33.44 \times 112 = -2630$				
Remarks					

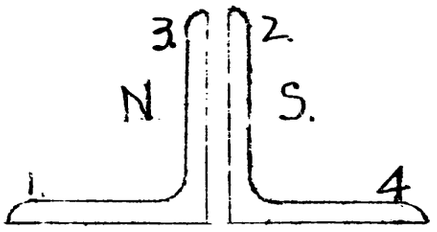
Load in #/1000	6 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	20.00	-	16.00	-	-
7					
11					
		20		38	
15	20.20		15.62		
11					
7					
		20		38	
3	20.00		16.00		
Total		40		76	116
Stress	$S = 33.44 \times 116 = -2720$				
Remarks					

Load in #/1000	7 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	32.00	-	28.00	-	-
7					
11					
		19		37	
15	32.19		27.63		
11					
7					
		19		37	
3	32.00		28.00		
Total		38		74	112
Stress	$S = 33.44 \times 112 = -2630$				
Remarks					

Load in #/1000	8 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	13.00	-	19.00	-	-
7					
11					
		16		38	
15	13.16		18.62		
11					
7					
		16		38	
3	13.00		19.00		
Total		32		76	108
Stress	$S = 33.44 \times 108 = -2530$				
Remarks	Total stress = -16350 lbs.				

N.B. Stress given is for load of 15000#.

WOOD BLOCKS Table



Location No. 16

Load in #/1000	1 Direct Read.	Direct Inc.	reversed Read.	reversed Inc.	Total
3	4.00	-	6.00	-	-
7					
11					
		47		35	
15	4.47		5.65		
11					
7					
		47		35	
3	4.00		6.00		
Total		94		70	164
Stress	$3.44^2 \times 164 = -3850$				
Remarks					

Load in #/1000	2 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	33.00	-	34.00	-	-
7					
11					
		136		125	
15	34.36		32.75		
11					
7					
		136		125	
3	33.00		34.00		
Total		272		250	522
Stress	$3.44^2 \times 522 = -12200$				
Remarks					

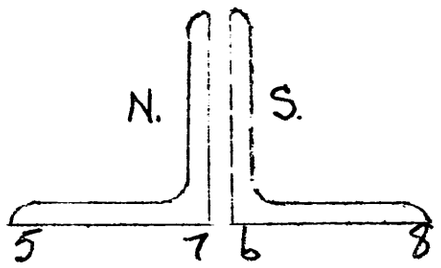
Load in #/1000	3 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	6.00	-	7.00	-	-
7					
11					
		132		122	
15	7.32		5.78		
11					
7					
		132		122	
3	6.00		7.00		
Total		264		244	508
Stress	$3.44^2 \times 508 = -11900$				
Remarks					

Load in #/1000	4 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	32.00	-	32.00	-	-
7					
11					
		50		28	
15	32.50		31.72		
11					
7					
		50		28	
3	32.00		32.00		
Total		100		56	156
Stress	$3.44^2 \times 156 = -3660$				
Remarks					

N.B. Stress given is for load of 15000#.

Table

WOOD BLOCKS



Location No. 16

Load in 1000#	5 Direct Read.	Direct Inc.	reversed Read.	reversed Inc.	Total
3	7.00	-	6.00	-	-
7					
11					
		27		39	
15	6.73		6.39		
11					
7					
		27		39	
3	7.00		6.00		
Total		54		78	132
Stress	$3.44 x 132 = -3100				
Remarks					

Load in 1000#	6 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	32.00	-	31.00	-	-
7					
11					
		23		38	
15	31.77		31.38		
11					
7					
		23		38	
3	32.00		31.00		
Total		46		76	122
Stress	2 $3.44 x 122 = -2850				
Remarks					

Load in 1000#	7 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	4.00	-	4.00	-	-
7					
11					
		24		39	
15	3.76		4.39		
11					
7					
		24		39	
3	4.00		4.00		
Total		48		78	122
Stress	2 $3.44 x 122 = -2850				
Remarks					

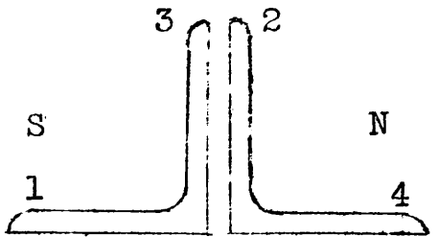
Load in 1000#	8 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	34.00	-	33.00	-	-
7					
11					
		14		37	
15	33.86		33.37		
11					
7					
		14		37	
3	34.00		33.00		
Total		28		74	102
Stress	2 $3.44 x 102 = -2380				
Remarks	Total stress = -15,900 lbs.				

N.B. Stress given is for load of 15000#.

Table

CEMENT BLOCKS

LOCATION NO. 8



Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	18.00	+	20.00	+	+
7					
11					
		65		8	
15	17.35		20.08		
11					
7					
		65		8	
3	18.00		20.00		
Total		130		16	146
Stress	23.44 x 146 = +3400				
Remarks					

Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	31.00	+	31.00	+	+
7					
11					
		253		187	
15	28.47		32.87		
11					
7					
		253		187	
3	31.00		31.00		
Total		506		374	880
Stress	23.44 x 880 = +20700				
Remarks					

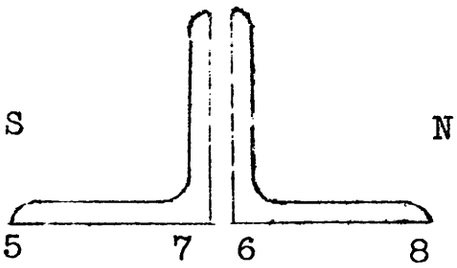
Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	18.00	+	19.00	+	+
7					
11					
		250		182	
15	15.50		20.82		
11					
7					
		250		182	
3	18.00		19.00		
Total		500		364	864
Stress	23.44 x 864 = +20,300				
Remarks					

Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	30.00	+	29.00	+	+
7					
11					
		77		6	
15	29.23		29.06		
11					
7					
		77		6	
3	30.00		29.00		
Total		154		12	166
Stress	23.44 x 166 = +3900				
Remarks					

N.B. Stress given is for load of 15000#

CEMENT BLOCKS

Table



LOCATION NO. 8

Load in #/1000	5 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	20.00	-	19.00	+	+
7					
11					
		18		44	
15	19.82		18.56		
11					
7					
		18		44	
3	20.00		19.00		
Total		36		88	52
Stress 23.44 x 52 = +1200					
Remarks					

Load in #/1000	6 Direct Read.	Inc.	Reversed Read.	Inc.	
3	30.00	-	28.00	+	-
7					
11					
		37		28	
15	29.63		27.72		
11					
7					
		37		28	
3	30.00		28.00		
Total		74		56	18
Stress 23.44 x 18 = -400					
Remarks					

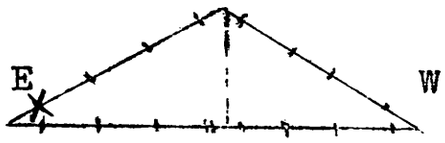
Load in #/1000	7 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	18.00	-	17.00	+	+
7					
11					
		30		33	
15	17.70		16.67		
11					
7					
		30		33	
3	18.00		17.00		
Total		60		66	6
Stress 23.44 x 6 = +150					
Remarks					

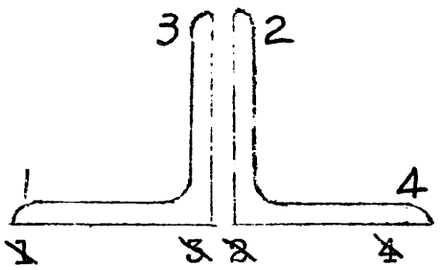
Load in #/1000	8 Direct Read.	Inc.	Reversed Read.	Inc.	
3	26.00	-	28.00	+	+
7					
11					
		20		49	
15	25.80		27.49		
11					
7					
		20		49	
3	26.00		28.00		
Total		40		98	58
Stress 23.44 x 58 = +1400					
Remarks Total stress = +13,600 lbs.					

N.B. Stress given is for load of 15000#.

Table

CEMENT BLOCKS





LOCATION NO. 9

Load in 1000#	1 Direct Read.	Direct Inc.	reversed Read.	reversed Inc.	Total
3	29.00	-	31.00	-	-
7					
11					
		49		10	
15	28.51		31.10		
11					
7					
		49		10	
3	29.00		31.00		
Total		98		20	118
Stress 23.44 x 118 = -2750					
Remarks					

Load in 1000#	2 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	16.00	-	15.00	-	-
7					
11					
		200		166	
15	14.00		16.66		
11					
7					
		200		166	
3	16.00		15.00		
Total		400		332	732
Stress 23.44 x 732 = -17100					
Remarks					

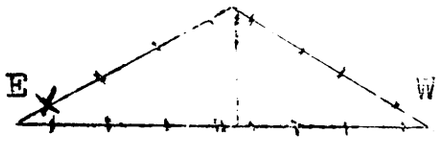
Load in 1000#	3 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	30.00	-	29.00	-	-
7					
11					
		198		162	
15	28.02		30.62		
11					
7					
		198		162	
3	30.00		29.00		
Total		396		324	720
Stress 23.44 x 720 = -16800					
Remarks					

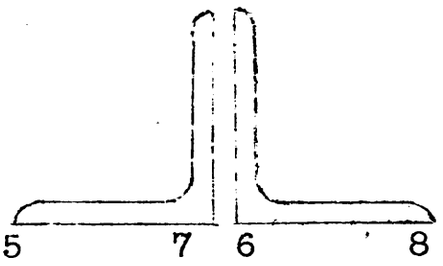
Load in 1000#	4 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	15.00	-	18.00	-	-
7					
11					
		50		14	
15	14.50		18.14		
11					
7					
		50		14	
3	15.00		18.00		
Total		100		28	128
Stress 23.44 x 128 = -3000					
Remarks					

N.B. Stress given is for load of 15000#.

Table

CEMENT BLOCKS





LOCATION NO. 9

Load in #/1000#	5 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	30.00	+	27.00	-	-
7					
11					
		7		31	
15	29.93		26.69		
11					
7					
		7		31	
3	30.00		27.00		
Total		14		62	48
Stress 23.44 x 48 = -1120					
Remarks					

Load in #/1000#	6 Direct Read.	Inc.	Reversed Read.	Inc.	
3	19.00	+	19.00	-	-
7					
11					
		11		21	
15	18.89		18.79		
11					
7					
		11		21	
3	19.00		19.00		
Total		22		42	20
Stress 23.44 x 20 = -470					
Remarks					

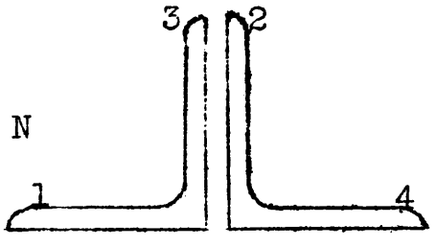
Load in #/1000#	7 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	29.00	+	28.00	-	-
7					
11					
		11		22	
15	28.89		27.78		
11					
7					
		11		22	
3	29.00		28.00		
Total		22		44	22
Stress 23.44 x 22 = -510					
Remarks					

Load in #/1000#	8 Direct Read.	Inc.	Reversed Read.	Inc.	
3	19.00	+	19.00	-	-
7					
11					
		6		30	
15	18.94		18.70		
11					
7					
		6		30	
3	19.00		19.00		
Total		12		60	48
Stress 23.44 x 48 = -1120					
Remarks Total stress = -15650 lbs.					

N.B. Stress given is for load of 15000#.

CEMENT BLOCKS

Table



LOCATION NO. 16

Load in # 1000	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	18.00	-	18.00	-	-
7					
11					
		70		16	
15	17.30		18.16		
11					
7					
		70		16	
3	18.00		18.00		
Total		140		32	172
Stress 23.44 x 172 = -4050					
Remarks					

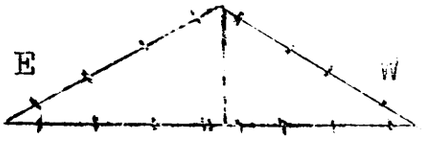
Load in # 1000	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	28.00	-	29.00	-	-
7					
11					
		180		161	
15	26.20		30.61		
11					
7					
		180		161	
3	28.00		29.00		
Total		360		322	682
Stress 23.44 x 682 = -16000					
Remarks					

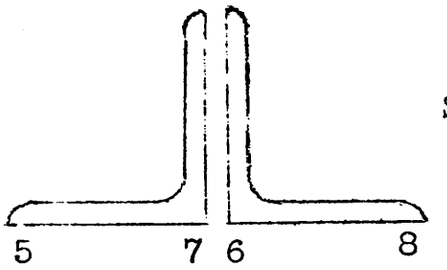
Load in # 1000	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	19.00	-	17.00	-	-
7					
11					
		186		155	
15	17.14		18.55		
11					
7					
		186		155	
3	19.00		17.00		
Total		372		310	682
Stress 23.44 x 682 = -16000					
Remarks					

Load in # 1000	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	27.00	-	28.00	-	-
7					
11					
		60		19	
15	26.40		28.19		
11					
7					
		60		19	
3	27.00		28.00		
Total		120		38	158
Stress 23.44 x 158 = -3720					
Remarks					

N.B. Stress given is for load of 15000#.

CEMENT BLOCKS





LOCATION NO. 16

Load in #/1000"	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	18.00	+	19.00	-	-
7					
11					
		9		41	
15	17.91		19.41		
11					
7					
		9		41	
3	18.00		19.00		
Total		18		82	64
Stress	23.44 x 64 =		-1520		
Remarks					

Load in #/1000"	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	29.00	+	30.00	-	-
7					
11					
		7		29	
15	28.93		30.29		
11					
7					
		7		29	
3	29.00		30.00		
Total		14		58	44
Stress	23.44 x 44 =		-1040		
Remarks					

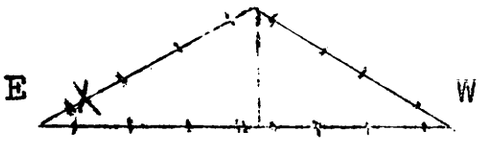
Load in #/1000"	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	19.00	+	19.00	-	-
7					
11					
		6		30	
15	18.94		18.70		
11					
7					
		6		30	
3	19.00		19.00		
Total		12		60	48
Stress	23.44 x 48 =		-1100		
Remarks					

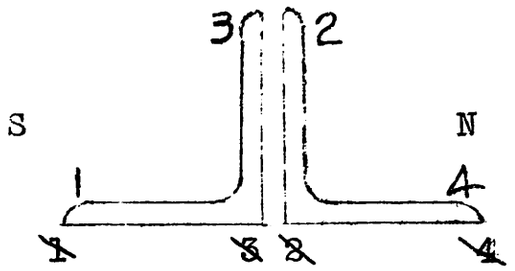
Load in #/1000"	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	28.00	+	27.00	-	-
7					
11					
		6		27	
15	27.94		27.27		
11					
7					
		6		27	
3	28.00		27.00		
Total		12		54	42
Stress	23.44 x 42 =		-1000		
Remarks	Total Stress = 15700				

N.B. Stress given is for load of 15000#

Table

C. G. LINES





LOCATION NO. 9-A

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	27.00	-	27.00	-	-
7					
11					
		42		62	
15	26.58		27.62		
11					
7					
		42		62	
3	27.00		27.00		
Total		84		124	208
Stress	23.44 x 208 = -4880				
Remarks					

Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	18.00	-	19.00	-	-
7					
11					
		63		88	
15	17.37		19.88		
11					
7					
		63		88	
3	18.00		19.00		
Total		126		176	302
Stress	23.44 x 302 = -7080				
Remarks					

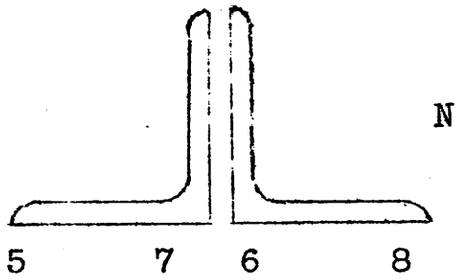
Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc	Read.	Inc.	Total
3	29.00	-	29.00	-	-
7					
11					
		63		84	
15	28.37		29.84		
11					
7					
		63		84	
3	29.00		29.00		
Total		126		168	294
Stress	23.44 x 294 = -6900				
Remarks					

Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	16.00	-	17.00	-	-
7					
11					
		39		61	
15	15.61		17.61		
11					
7					
		39		61	
3	16.00		17.00		
Total		78		122	200
Stress	23.44 x 200 = -4700				
Remarks					

N.B. Stress given is for load of 15000#

Table

C.G. LINES.



LOCATION NO. 9-A

Load in # 1000#	5 Direct Read.	Inc.	reversed Read.	Inc.	Total
3	28.00	-	28.00	-	-
7					
11					
		60		39	
15	28.60		27.61		
11					
7					
		60		39	
3	28.00		28.00		
Total		120		78	198
Stress	23.44 x 198 = -4650				
Remarks					

Load in # 1000#	6 Direct Read.	Inc.	Reversed Read.	Inc.	
3	15.00	-	15.00	-	-
7					
11					
		70		46	
15	15.70		14.54		
11					
7					
		70		46	
3	15.00		15.00		
Total		140		92	232
Stress	23.44 x 232 = -5450				
Remarks					

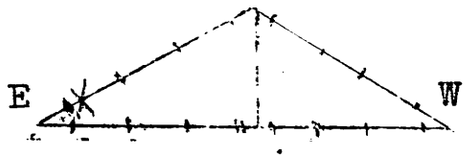
Load in # 1000#	7 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	31.00	-	28.00	-	-
7					
11					
		70		46	
15	31.70		27.62		
11					
7					
		70		48	
3	31.00		28.00		
Total		140		96	236
Stress	23.44 x 236 = -5540				
Remarks					

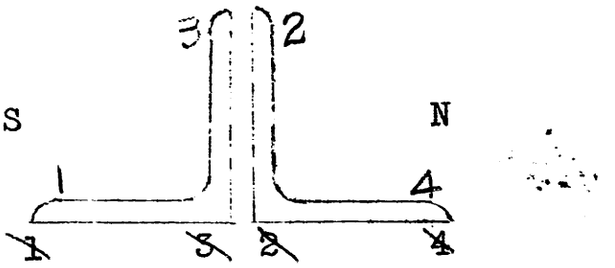
Load in # 1000#	8 Direct Read.	Inc.	Reversed Read.	Inc.	
3	15.00	-	19.00	-	-
7					
11					
		59		36	
15	15.59		18.64		
11					
7					
		59		36	
3	15.00		19.00		
Total		118		77	190
Stress	23.44 x 190 = -4450				
Remarks	Total stress = 16600 lbs.				

N.B. Stress given is for load of 15000#

Table

C.G.LINES FILLER & CLAMP





LOCATION NO. 9a

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	29.00	-	28.00	-	-
7					
11					
		46		66	
15	28.54		28.66		
11					
7					
		46		66	
3	29.00		28.00		
Total		92		132	224
Stress 23.44 x 224 = -5250					
Remarks					

Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	18.00	-	18.00	-	-
7					
11					
		62		88	
15	17.38		18.88		
11					
7					
		62		88	
3	18.00		18.00		
Total		124		176	300
Stress 23.44 x 300 = -7040					
Remarks					

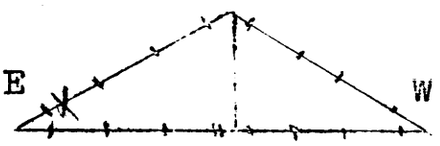
Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	28.00	-	27.00	-	-
7					
11					
		60		84	
15	27.40		27.84		
11					
7					
		60		84	
3	28.00		27.00		
Total		120		168	288
Stress 23.44 x 288 = -6750					
Remarks					

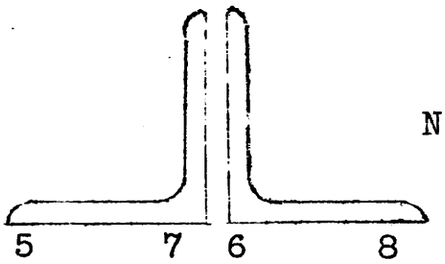
Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	19.00	-	19.00	-	-
7					
11					
		44		66	
15	18.56		19.66		
11					
7					
		44		66	
3	19.00		19.00		
Total		88		132	220
Stress 23.44 x 220 = -5150					
Remarks					

N.B. Stress given is for load of 15000#

C.G. LINES FILLER AND CLAMP

Table





LOCATION NO. 9-A

Load in # 1000#	5 Direct Read.	Inc.	reversed Read.	Inc.	Total
3	28.00	-	28.00	-	-
7					
11					
		62		44	
15	28.62		27.56		
11					
7					
		62		44	
3	28.00		28.00		
Total		124		88	212
Stress	23.44 x 212 = -4970				
Remarks					

Load in # 1000#	6 Direct Read.	Inc.	Reversed Read.	Inc.	
3	20.00	-	16.00	-	-
7					
11					
		69		41	
15	20.69		15.59		
11					
7					
		69		41	
3	20.00		16.00		
Total		138		82	220
Stress	23.44 x 220 = -5160				
Remarks					

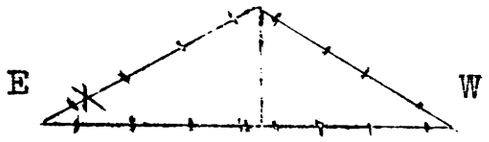
Load in # 1000#	7 Direct Read.	Inc	Reversed Read.	Inc.	Total
3	28.00	-	31.00	-	-
7					
11					
		67		42	
15	28.67		30.58		
11					
7					
		67		42	
3	28.00		31.00		
Total		134		84	218
Stress	23.44 x 218 = -5110				
Remarks					

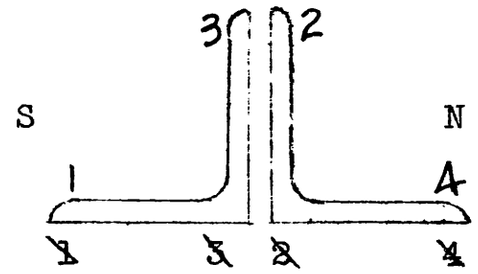
Load in # 1000#	8 Direct Read.	Inc.	Reversed Read.	Inc.	
3	20.00	-	17.00	-	-
7					
11					
		64		40	
15	20.64		16.60		
11					
7					
		64		40	
3	20.00		17.00		
Total		128		80	208
Stress	23.44 x 208 = -4880				
Remarks	Total stress = -16350 lbs.				

N.B. Stress given is for load of 15000#

Table

15' Span





LOCATION NO. 9-A

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	27.00	-	28.00	+	-
7					
11					
		30		19	
15	26.70		27.81		
11					
7					
		30		19	
3	27.00		28.00		
Total		60		38	22
Stress	23.44 x 22 = -520				
Remarks					

Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	18.00	-	17.00	-	-
7					
11					
		325		267	
15	14.75		19.67		
11					
7					
		325		267	
3	18.00		17.00		
Total		650		534	1184
Stress	23.44 x 1184 = -27800				
Remarks					

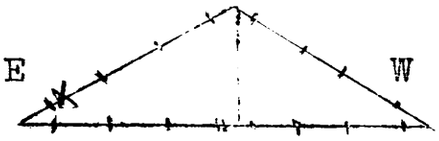
Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	30.00	-	28.00	-	-
7					
11					
		316		263	
15	26.84		30.63		
11					
7					
		316		263	
3	30.00		28.00		
Total		632		526	1158
Stress	23.44 x 1158 = -27200				
Remarks					

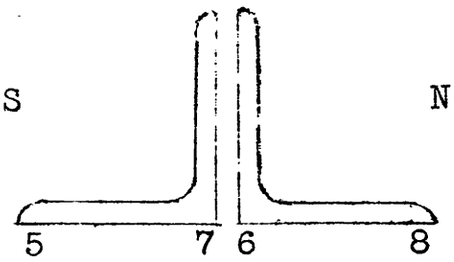
Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	18.00	-	17.00	+	-
7					
11					
		30		19	
15	17.70		16.81		
11					
7					
		30		19	
3	18.00		17.00		
Total		60		38	22
Stress	23.44 x 22 = -520				
Remarks					

N.B. Stress given is for load of 15000#.

15' Span

Table





LOCATION NO. 9-A

Load in #/1000#	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	29.00	+	26.00	+	+
7					
11					
		50			
15	28.50		26.00		
11					
7					
		50			
3	29.00		26.00		
Total		100		0	100
Stress	23.44 x 100 = +2340				
Remarks					

Load in #/1000#	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	17.00	+	17.00	+	+
7					
11					
		78		25	
15	16.22		17.25		
11					
7					
		78		25	
3	17.00		17.00		
Total		156		50	206
Stress	23.44 x 206 = +4830				
Remarks					

Load in #/1000#	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	28.00	+	29.00	+	+
7					
11					
		78		27	
15	27.22		29.27		
11					
7					
		78		27	
3	28.00		29.00		
Total		156		54	210
Stress	23.44 x 210 = +4920				
Remarks					

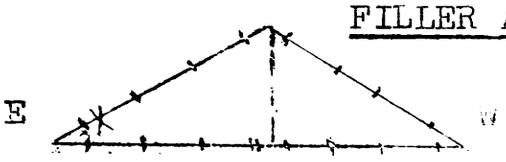
Load in #/1000#	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	19.00	+	13.00	-	+
7					
11					
		47		2	
15	18.53		12.98		
11					
7					
		47		2	
3	19.00		13.00		
Total		94		4	90
Stress	23.44 x 90 = +2100				
Remarks	Total stress = -14500 lbs.				

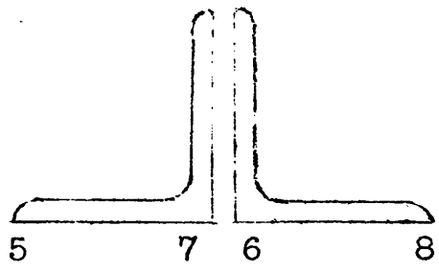
N.B. Stress given is for load of 15000#

Table

C. I. ROCKER 15' SPAN

FILLER AND CLAMP





LOCATION NO. 9-A

Load in #/1000"	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	31.00	+	29.00	+	+
7					
11					
		62		8	
15	30.38		29.08		
11					
7					
		62		8	
3	31.00		29.00		
Total		134		16	150
Stress	23.44 x 150 =				+3520
Remarks					

Load in #/1000"	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	20.00	+	20.00	+	+
7					
11					
		70		15	
15	19.30		20.15		
11					
7					
		70		15	
3	20.00		20.00		
Total		140		30	170
Stress	23.44 x 170 =				+4000
Remarks					

Load in #/1000"	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	29.00	+	30.00	+	+
7					
11					
		70		16	
15	28.30		30.16		
11					
7					
		70		16	
3	29.00		30.00		
Total		140		32	172
Stress	23.44 x 172 =				+4030
Remarks					

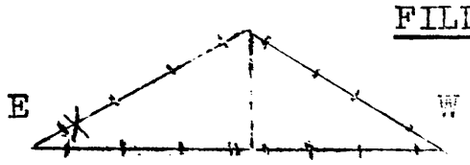
Load in #/1000"	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	17.00	+	20.00	+	+
7					
11					
		54		2	
15	16.46		20.02		
11					
7					
		54		2	
3	17.00		20.00		
Total		108		4	112
Stress	23.44 x 112 =				+2630
Remarks	Total stress =				-14350 lbs.

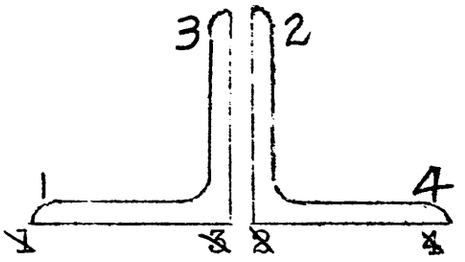
N.B. Stress given is for load of 15000#.

Table

C.I. ROCKER 15' Span

FILLER & CLAMP





LOCATION NO. 9-A

Load in # 1000#	1 Direct Read.	Inc.	reversed Read.	Inc.	Total
3	29.00	-	30.00	+	+
7					
11					
		21		33	
15	28.79		29.67		
11					
7					
		21		33	
3	29.00		30.00		
Total		42		66	24
Stress	23.44 x 24 = +560				
Remarks					

Load in # 1000#	2 Direct Read.	Inc.	Reversed Read.	Inc.	
3	17.00	-	18.00	-	-
7					
11					
		318		260	
15	13.82		20.60		
11					
7					
		318		260	
3	17.00		18.00		
Total		636		520	1156
Stress	23.44 x 1156 = -27100				
Remarks					

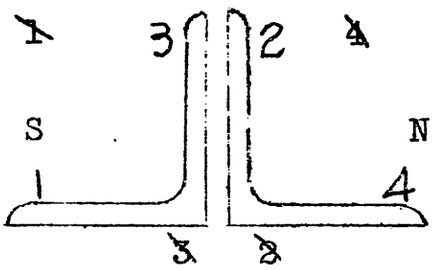
Load in # 1000#	3 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	30.00	-	29.00	-	-
7					
11					
		311		256	
15	26.89		31.56		
11					
7					
		311		256	
3	30.00		29.00		
Total		622		512	1134
Stress	23.44 x 1134 = -26600				
Remarks					

Load in # 1000#	4 Direct Read.	Inc.	Reversed Read.	Inc.	
3	16.00	-	17.00	+	+
7					
11					
		23		30	
15	15.77		16.70		
11					
7					
		23		30	
3	16.00		17.00		
Total		46		60	14
Stress	23.44 x 14 = +330				
Remarks					

N.B. Stress given is for load of 15000#

WOOD BLOCKS

Table



LOCATION NO. 9-A

Load in 1000#	1				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	29.00	-	29.00	-	-
7					
11					
		40		39	
15	28.60		29.39		
11					
7					
		40		39	
3	29.00		29.00		
Total		80		78	158
Stress	23.44 x 158 = -3700				
Remarks					

Load in 1000#	2				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	17.00	-	17.00	-	-
7					
11					
		127		130	
15	15.73		18.30		
11					
7					
		127		130	
3	17.00		17.00		
Total		254		260	514
Stress	23.44 x 514 = -12050				
Remarks					

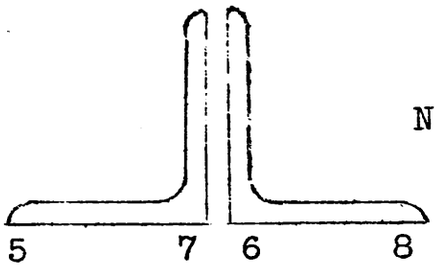
Load in 1000#	3				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	29.00	-	28.00	-	-
7					
11					
		126		128	
15	27.74		29.28		
11					
7					
		126		128	
3	29.00		28.00		
Total		252		256	508
Stress	23.44 x 508 = -11900				
Remarks					

Load in 1000#	4				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	18.00	-	14.00	-	-
7					
11					
		39		40	
15	17.61		14.40		
11					
7					
		39		40	
3	18.00		14.00		
Total		78		80	158
Stress	23.44 x 158 = -3700				
Remarks					

N.B. Stress given is for load of 15000#.

Table

WOOD BLOCKS



LOCATION NO. 9-A

Load in ″ 1000	5				
	Direct		reversed		
	Read.	Inc.	Read.	Inc.	Total
3	30.00	-	30.00	-	-
7					
11					
		29		31	
15	30.29		29.69		
11					
7					
		29		31	
3	30.00		30.00		
Total		58		62	120
Stress 23.44 x 120 = -2820					
Remarks					

Load in ″ 1000	6				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	16.00	-	17.00	-	-
7					
11					
		32		30	
15	16.32		16.70		
11					
7					
		32		30	
3	16.00		17.00		
Total		64		60	124
Stress 23.44 x 124 = -2900					
Remarks					

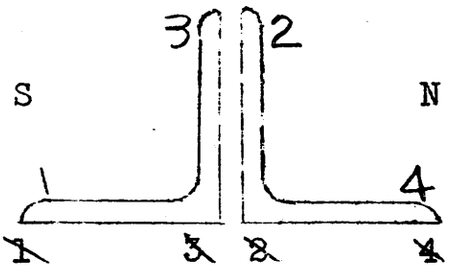
Load in ″ 1000	7				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	Total
3	30.00	-	28.00	-	-
7					
11					
		31		30	
15	30.31		27.70		
11					
7					
		31		30	
3	30.00		28.00		
Total		62		60	122
Stress 23.44 x 122 = -2860					
Remarks					

Load in ″ 1000	8				
	Direct		Reversed		
	Read.	Inc.	Read.	Inc.	
3	16.00	-	16.00	-	-
7					
11					
		32		30	
15	16.32		15.70		
11					
7					
		32		30	
3	16.00		16.00		
Total		64		60	124
Stress 23.44 x 124 = -2900					
Remarks Total stress = -15850 lbs.					

N.B. Stress given is for load of 15000″.

Table

WOOD BLOCKS FILLER & CLAMP



LOCATION NO. 9-A

Load in #/1000	1 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	26.00	-	28.00	-	-
7					
11					
		47		35	
15	25.53		28.35		
11					
7					
		47		35	
3	26.00		28.00		
Total		94		70	164
Stress	23.44 x 164 = -3850				
Remarks					

Load in #/1000	2 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	16.00	-	18.00	-	-
7					
11					
		128		120	
15	14.72		19.20		
11					
7					
		128		120	
3	16.00		18.00		
Total		256		240	496
Stress	23.44 x 496 = -11600				
Remarks					

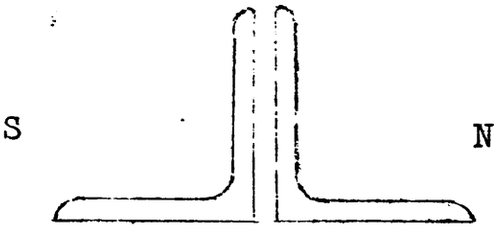
Load in #/1000	3 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	Total
3	31.00	-	29.00	-	-
7					
11					
		120		118	
15	29.80		30.18		
11					
7					
		120		118	
3	31.00		29.00		
Total		240		236	476
Stress	23.44 x 476 = -11150				
Remarks					

Load in #/1000	4 Direct Read.	Direct Inc.	Reversed Read.	Reversed Inc.	
3	19.00	-	20.00	-	-
7					
11					
		46		42	
15	18.54		20.42		
11					
7					
		46		42	
3	19.00		20.00		
Total		92		82	176
Stress	23.44 x 176 = -4120				
Remarks					

N.B. Stress given is for load of 15000#

Table

WOOD BLOCKS CLAMP & FILLER



LOCATION NO. 9-a

Load in #/1000"	5 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	31.00	-	31.00	-	-
7					
11					
		26		38	
15	31.21		30.62		
11					
7					
		26		38	
3	31.00		31.00		
Total		52		76	128
Stress	23.44 x 128 = -3000				
Remarks					

Load in #/1000"	6 Direct Read.	Inc.	Reversed Read.	Inc.	
3	15.00	-	16.00	-	-
7					
11					
		29		37	
15	15.29		15.63		
11					
7					
		29		37	
3	15.00		16.00		
Total		58		74	132
Stress	23.44 x 132 = -3100				
Remarks					

Load in #/1000"	7 Direct Read.	Inc.	Reversed Read.	Inc.	Total
3	29.00	-	27.00	-	-
7					
11					
		31		36	
15	29.31		26.64		
11					
7					
		31		36	
3	29.00		27.00		
Total		62		72	134
Stress	23.44 x 134 = -3150				
Remarks					

Load in #/1000"	8 Direct Read.	Inc.	Reversed Read.	Inc.	
3	18.00	-	17.00	-	-
7					
11					
		35		37	
15	18.35		16.63		
11					
7					
		35		37	
3	18.00		17.00		
Total		70		74	144
Stress	23.44 x 144 = -3380				
Remarks	Total stress = -15940 lbs.				

N.B. Stress given is for load of 15000#.