

Daventry

Page

Building Plans 1

Vault 5

Columns 20 8

Grillage Calculations 28

13 March 1936

Steelworks

design 28

217

NOTE

Concrete Roof substituted

For Timber Roof on

13 March, 1936.

For Calculations on

this see p. 33 et seq.

C.P.C.

13 3/31

Empire Hotel
Daventry
Extension
Calculations

INDEX.

Page.

Ceiling Beams	<u>CEILING.</u>	1
Vault	Effort and span	5
Columns		20 8
Ceiling Beams (continued)		11
Grillage Foundation		28
<u>1st</u> = <u>Act</u> <u>vent</u> <u>Calculations</u>		17

= 53.9 inch units.

Dist. $\sqrt{13 \times 12}$

= $\frac{26}{20} \times \frac{25 \times 12}{100}$

= 2.3 inch units.

10% of 240

[2.352]

* $\Sigma Z = 53.9 + 2.3 = 56.2$ inch units.

which may be accepted.

$$\text{Equal reaction} = \frac{26}{40 \times 80} \left[\frac{9527}{40} \right] = \frac{26 \times 992}{40 \times 80}$$

Re-calculate using 5 C.P.W's. getting 11.
 his design altered. See NEW Drawing

Side Beams for ceiling...

Beams A.H. type. effective span = 14'

$$w = 9 \times 68 = 612 \text{ lb. per ft. run.}$$

$$Z' = \frac{w l^2}{64} = \frac{612 \times 14^2 \times 12}{64} = 10.04 \text{ inch}^3 \text{ units.}$$

13" x 5" x 35
 $[Z = 43.6]$

Select NBSB-7

8" x 6" x 18
 $[Z = 13.9]$

and $\Sigma Z'' = \frac{w l^2}{64} = \frac{18 \times 14^2 \times 12}{64} = 0.30$

Equal parts = $\frac{0.30}{2} = 0.15$

+ $\Sigma Z = 10.04 + 0.30 = 10.34 \text{ inch}^3 \text{ units}$

Safe.

Equal reactions = $\frac{14}{4480} \left[\frac{612}{18} \right] = \frac{14 \times 630}{4480} = 1.97 \text{ tons.}$

and total load = $L = 3.94 \text{ tons.}$

Circle Beams type 13 B.

Effective span = 21.5'

$Cwt = 68 \times 14 \quad W = 4.74 \text{ tons}$

distributed = 952 lbs. per ft. run.

= 612 lbs per ft. run.

$Z' = \frac{wb^2}{64} = \frac{952 \times 21.5^2 \times 12}{64 \times 2240}$
= 36.83 inch³ units.

Select NB 5B - 11

13" x 5" x 35"

$Z'' = \frac{w'b'^2}{64} = \frac{35 \times 21.5^2 \times 12}{64 \times 2240}$
= 1.36 inch³ units.

$[Z = 43.6]$

and $\Sigma Z = 36.83 + 1.36 = 38.19 \text{ inch}^3 \text{ units}$
 $[Z = \text{Safe}]$

Equal reactions = $\frac{21.5}{4480} [952] = \frac{21.5 \times 987}{4480}$

and $\Sigma Z = 987 \therefore R = 4.74 \text{ tons}$

and total load = $L = 9.48 \text{ tons}$

Equal reactions = $\frac{21.5}{4480} [612]$

$= 2.37 + 26.5 \times 677$
 $= 2.37 + 4.31$

Ceiling beams type C.C.D.

Effective span = 28.5'

Central load $W = 4.74$ tons

Distributed load $w = 68 \times 9 = 612$ lb. per ft. run.

$M = \frac{wl^2}{8} + \frac{wl^2}{8}$

$\therefore Z' = \frac{Wl}{32} + \frac{wl^2}{64}$

$= \frac{4.74 \times 28.5 \times 12}{32} + \frac{612 \times 28.5^2 \times 12}{64 \times 2240}$

$= 50.66 + 41.61 = 92.27$ inch³ units.

Steel - NR 503-16

20" x 6 1/2" x 65 [Z = 122.6]

Corrected $Z = \frac{wl^2}{64} = \frac{65 \times 28.5^2 \times 12}{64 \times 2240} = 4.42$ inch³ units.

and $\Sigma Z = 92.27 + 4.42 = 96.69$ inch³ units. Safe.

Equal Reactions = $2.37 + \frac{28.5}{4480} [612 \times 65]$

$= 2.37 + 28.5 \times 677$

Load on foundation = $2.37 + 4.31$

$= 6.68$ tons.

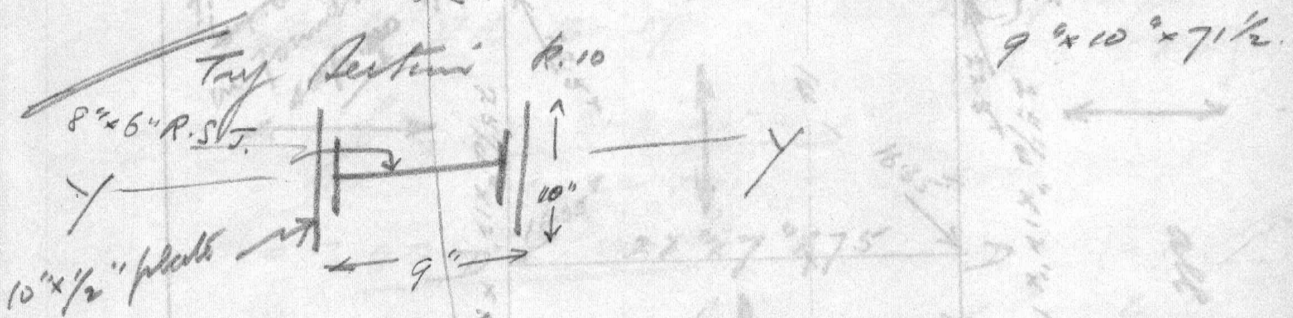
Columns Type ①.

Height = 26'

Load on top = 13.36 + 4.74
= 18.10 tons.

Load cannot be eccentric on X-axis.
allow for 1" eccentricity on Y-axis.

Required minimum $K = \frac{26 \times 12}{140} = 2.23''$



Eccentricity on Y-axis.

$\frac{e}{R} = \frac{26 \times 12}{2.25} = 138.7$ Safe stress = 2 tons per ins.

1" eccentricity coefficient = 1.99
 Equivalent to Centric load = $1.99 \times 18.1 = 36.02$ tons.
 weight of column = $\frac{26 \times 71.5}{2240} = 0.83$ "

and Safe load = $2 \times 20.2 = 40.4$ tons Safe.

Load on foundation = 18.1 + 0.83
= 18.93 tons.

Plan Vault

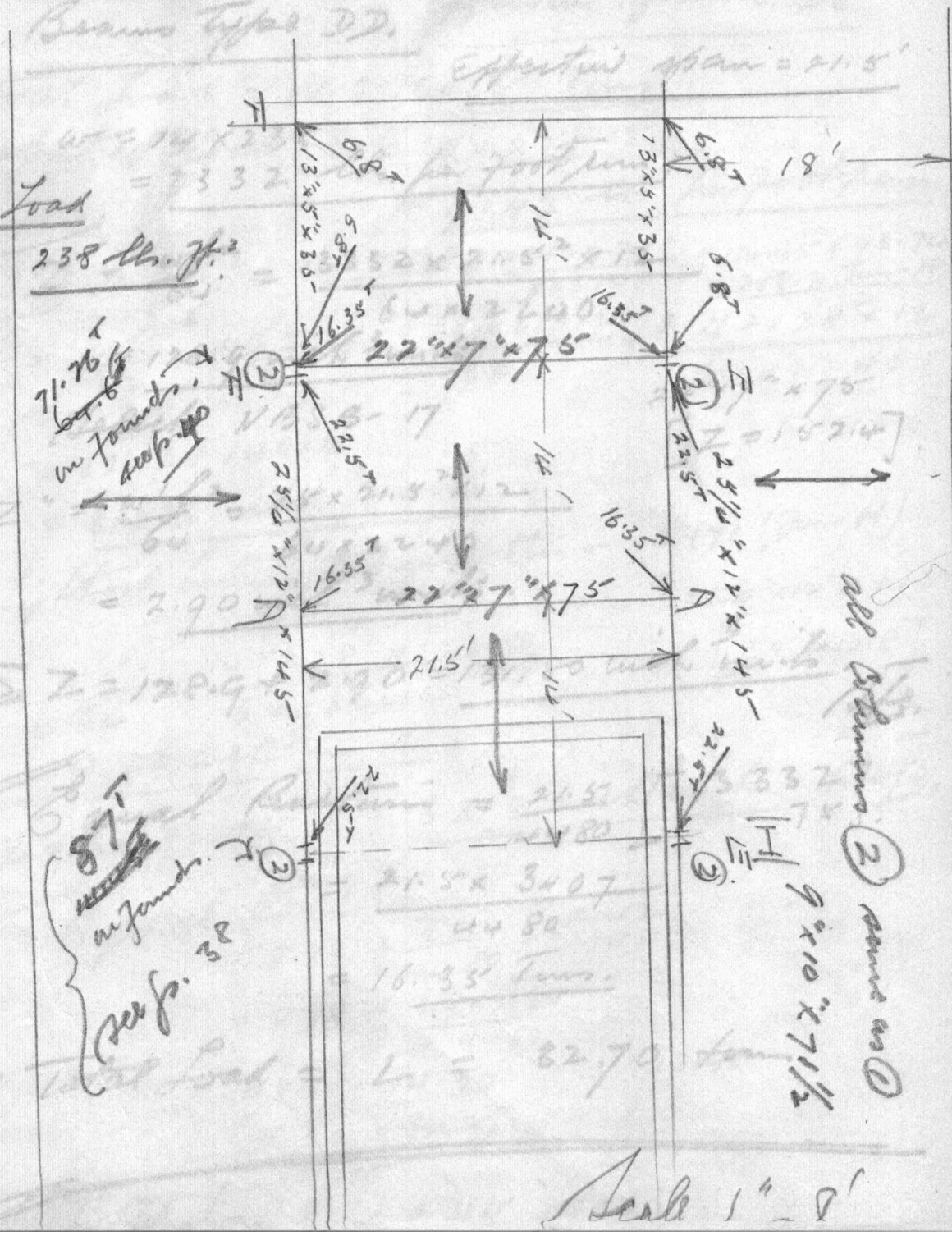
Beams type 32

Effective span = 21.5'

Floor Load

238 lb. ft.²

71.76
6 ft. 6 in.
w/ founds
off door



87
w/ founds
see p. 38

All Columns (2) same as (1)
9' x 10' x 7 1/2'

Scale 1" = 8'

Beams VAULT.

Beams Type DD.

Effective span = 28'

Effective span = 21.5'

Central load = W = 16.

$w = 14 \times 238$

$= 3332$ lbs. per foot run.

$Z' = \frac{wl^2}{64} = \frac{3332 \times 21.5^2 \times 12}{64 \times 2240} = 128.9$

$Z' = 128.9$ with 3 units

Select NBSB-17

$22'' \times 7'' \times 75$
[Z = 152.4]

$Z'' = \frac{w'l^2}{64} = \frac{75 \times 21.5^2 \times 12}{64 \times 2240}$

The lightest beam = 2.90 with 3 units.

and $\Sigma Z = 128.9 + 2.90 = 131.80$ with 3 units.

Equal Pasture = $\frac{21.5}{4480} [3 \times 3332]$

$= \frac{21.5 \times 3407}{4480}$
 $= 16.35$ tons.

and Total Load = $L_4 = 32.70$ tons.

Beams type EE.

23

Effective Span = 28'

Central Load = $W = 16.35$ Tons.

Distributed load = $w = 9 \times 238$

$2142 \text{ lb. per foot run.}$

$$M = \frac{WL}{4} + \frac{wL^2}{8} = \frac{16.35 \times 28}{4} + \frac{2142 \times 28^2}{8 \times 2240} = 114.45 + 93.74 = 208.2 \text{ Ton-ft.}$$

$$\therefore Z' = \frac{WL}{32} + \frac{wL^2}{64} = \frac{16.35 \times 28 \times 12}{32} + \frac{2142 \times 28^2 \times 12}{64 \times 2240}$$

$$Z' = 171.7 + 140.6$$

$$= 312.3 \text{ inch}^3 \text{ units.}$$

The lightest beam to carry this is a.171 (from M)

$$Z'' = \frac{wL^2}{64} = \frac{145 \times 28^2 \times 12}{64 \times 2240}$$

$$= 9.52 \text{ inch}^3 \text{ units}$$

$$[Z = 340.8]$$

$$\therefore \Sigma Z = 312.3 + 9.5 = 321.8 \text{ inch}^3 \text{ units. (Safe)}$$

Equal Reactions

$$= 8.18 + \frac{28}{4480} \left[\begin{matrix} 2142 \\ 145 \end{matrix} \right]$$

$$= 8.18 + \frac{28 \times 2287}{4480}$$

$$\text{and total load} = 8.18 + 14.30 = 22.48$$

$$= 22.5 \text{ tons.}$$

Total load = 1044 tons.

Beams type FF. (2)

24

Effective span = 14'

Load = $w = 9 \times 238$
 $= 2142$ lbs. per ft. run.

$$Z' = \frac{wl^2}{64} = \frac{2142 \times 14^2 \times 12}{64 \times 2240}$$

$$= 35.14 \text{ inch}^3 \text{ units.}$$

Select NBS 13 - 11

13" x 5" x 35

$$Z'' = \frac{w'l^2}{64} = \frac{35 \times 14^2 \times 12}{64 \times 2240}$$

$$= 0.58 \text{ inch}^3 \text{ units.}$$

$$[Z = 43.6]$$

and $\Sigma Z = 35.14 + 0.58 = 35.72 \text{ inch}^3 \text{ units.}$

There must be any eccentricity in the base.
Equal Reaction

$$= \frac{14}{4480} [2142]$$

$$(6.8 + 18.93 + 16.35 + 22.5)(p+d) = 6.8p + (18.93 + 16.35)(p+d) + 22.5(p+d)$$

$$64.58p + 64.58d = 4480$$

$$= 6.8 \text{ four} + 22.5p + 22.5d$$

$$64.58d = (17.64 + 22.5)d$$

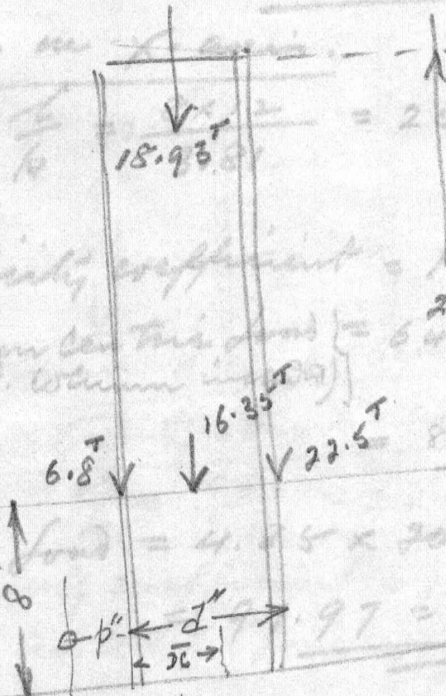
and total load = $L = 13.6 \text{ four}$
 $= \frac{40.14}{64.58} d = 0.6215 d$

~~$L = (0.6215 - 15)d$~~

Columns Type (2)

Then Case I. Height = 8' 9" = 1.0936 m.
= 1.1 m.

Eccentricity on X-axis.



Safe stress = 4.85 tons per sq. in.

1.1 eccentricity coefficient = $1 + .31 \times 1.1 = 1 + .34 = 1.34$
Equivalent eccentricity = $64.58 \times 1.34 = 86.54$ tons.

and safe load = 4.85×2012

There cannot be any eccentricity on the Y-axis.

To find the eccentricity on the X-axis.

$$(6.8 + 18.93 + 16.35 + 22.5)(p + \bar{x}) = 6.8p + (18.93 + 16.35)(p + \frac{d}{2}) + 22.5(p + d)$$

$$64.58p + 64.58\bar{x} = 6.8p + 35.28p + \frac{35.28 \times d}{2} + 22.5p + 22.5d$$

$$64.58\bar{x} = (17.64 + 22.5)d$$

$$\therefore \bar{x} = \frac{40.14}{64.58} d = 0.6215 d$$

and eccentricity = $(.6215 - .5)d$
= $.1215 d$ inches.

Try Section K. 10 as before.

9" x 10" x 7 1/2"

Then eccentricity = .1215 x 9 = 1.0935
= 1.1 inches.

Eccentricity on X-axis.

$\frac{e}{r} = \frac{8 \times 12}{3.81} = 25.2$

Safe stress = 4.85 tons per in².

1.1" eccentricity coefficient = 1 + .31 x 1.1 = 1 + .34 = 1.34

Equivalent eccentric load (Wt. column included) = 64.58 x 1.34 = 86.54 tons.

and safe load = 4.85 x 20.2 = 97.97 = 98 tons.

Equivalent eccentric load = 64.6 tons.

and safe load = 20.2 x 4.85 = 97.97 = 98 tons.

Safe

Load on foundation = 64.6 tons.

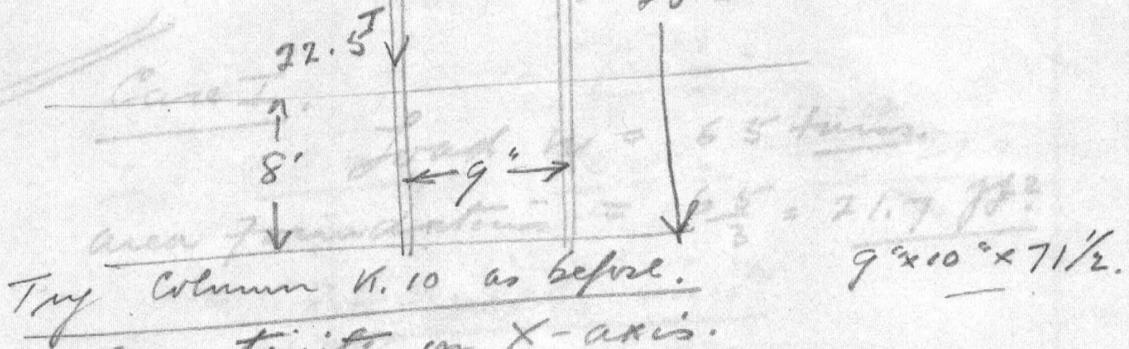
and safe load = 20.2 x 4.85 = 97.97 = 98 tons.

Safe

Case II. Grillage foundation

There are 18.93 tons on column (including wt. Column).

Steel stress on grillage beams = 12 tons per in².



Try Column No. 10 as before.

Eccentricity on X-axis.

$$\frac{e}{r} = \frac{9.6}{3.81} = 25.2 \quad \text{Safe stress} = 4.85 \text{ tons/in}^2$$

4 1/2" eccentricity coefficient = $1 + 0.31 \times 4.5 = 1 + 1.4 = 2.4$

Equivalent ten centric load = $2.4 \times 18.93 = 45.43$ tons.

Superimposed load in cladding wt. of column = 18.93 tons.

and Safe load = $20.2 \times 4.85 = 97.97 = 98$ tons.

* Load on foundation = $18.93 + 22.5 = 41.43$ tons.

Gridage foundation

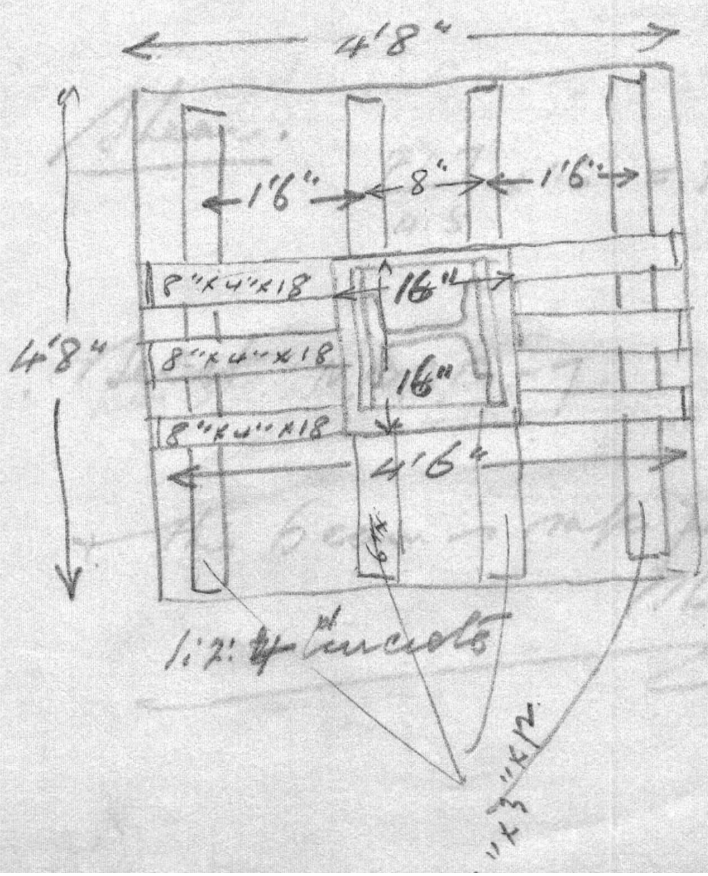
Steel in Rebar soil = 3^T per ft.²

Steel in gridage beams } = 12^T per in.²

Case I.

Load $W = 65$ tons.

Area foundations = $\frac{65}{3} = 21.7$ ft.²
 = 8.68 inch units



NOT safe.
NOTE: all steel
 to have a minimum cover of concrete of 3" +
 horizontal section
 of found. to be
 constant throughout
 its depth.

10/2/21 See R.B. p. 430 for formulas.

Load per beam = $\frac{6.5}{2} = 21.7$ tons

$L = 4.5'$

$P = 1.6'$ per unit

$f = 12^T$ per in²

$Z = \frac{3 P L W}{12} = \frac{P L W}{4} = \frac{1.6 \times 21.7}{4} = 8.68$ inch³ units

Select N.B.S.B.-6 $7'' \times 3\frac{1}{2}'' \times 15''$
[Z = 10.2]

Shear.

$\frac{21.7}{4.5} \times 1.6 = 7.7$ tons

NOT SAFE
[Z = 6.9]

Select N.B.S.B.-7

$8'' \times 4'' \times 18''$

[Z = 13.9]

+ this beam is safe for Shear.

Bottom tier.

30.

$$\text{Load per beam} = \frac{63}{4} = 16 \text{ tons}$$

$$L = 4.5'$$

$$P = 1.6'$$

$$f = 12^T \text{ per in}^2$$

$$\therefore I = \frac{3 P \times W}{12} = \frac{P \times W}{4} = \frac{1.6 \times 16}{4} \\ = 6.4 \text{ inch}^3 \text{ units.}$$

$$\text{Stress} = \frac{16}{4.5} \times 1.6 = 5.7 \text{ tons}$$

Select N.B.S. B. - 3'

6" x 3" x 12

$$[I = 6.9]$$

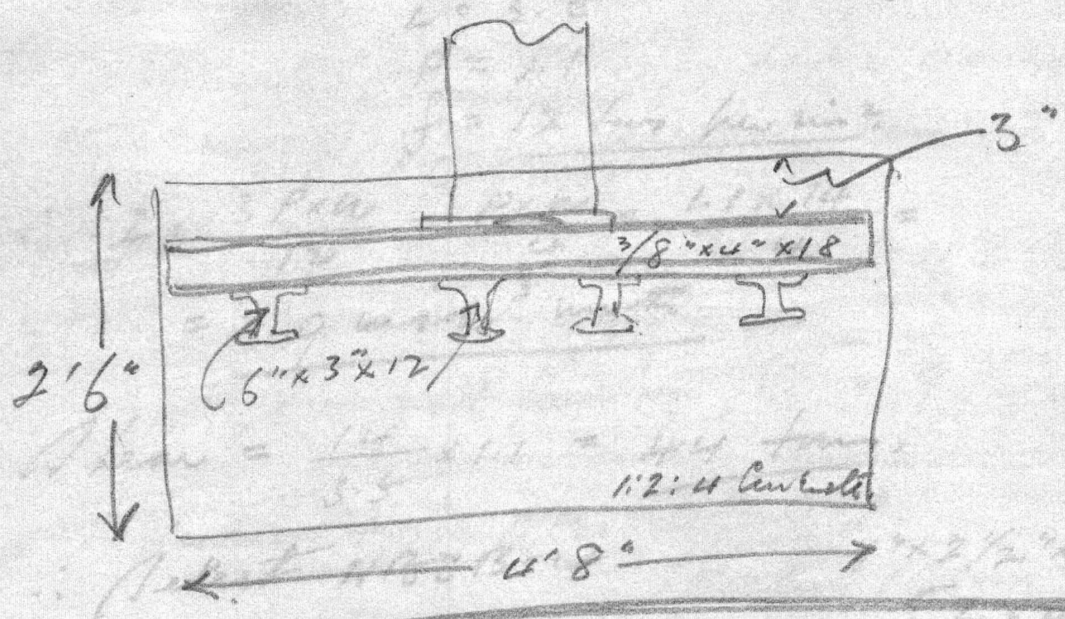
$$\text{Stress} = 5.3^T$$

Spec. 296

R.B.

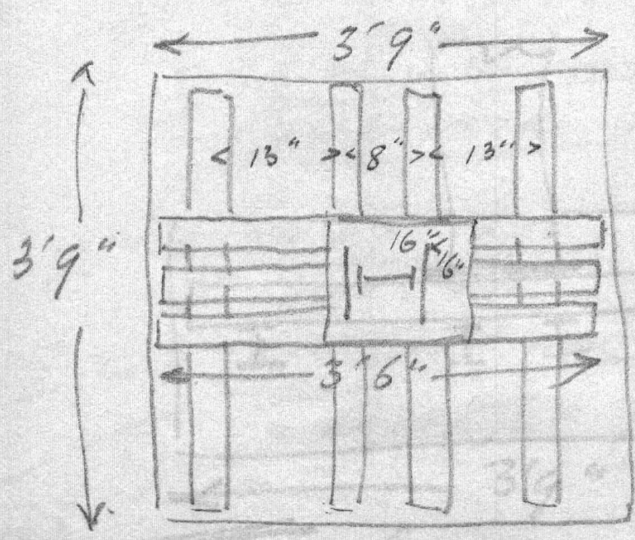
This value may be accepted.

Top beam is 6" x 12" beam
 and per beam = $\frac{42}{3} = 14$ tons



Case II. Load = 42 tons.

This area founds = $\frac{42}{3} = 14$ ft²



all R.S.I.s. 5" x 2 1/2" sq.

1:2:4 concrete.