THESIS FOR B. S. DEGREE FROM
* * * * * * * * * * * * * * *
WASHINGTON & LEE ---------UNIVERSITY.
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DESIGN OF 50 FT. PLATE DECK GIRDER.

RESPECTFULLY SUBMITTED BY:---
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and
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WEB ST

12" bearing plate on abuteme
atest concentrated load = 25000+

.:. 43000/17000 = 2.53 in^2 needed in
compression.

Total shear at end = 205900 lbs.
205900/15000(allow. shearing stress) = 13.72 i

1 angle 5"x 3 1/2"x 3/8" = 2.86 in^2.
.:. 6 stiffeners angles (5"x 3 1/2"x 3/8") needed to carry shear to bearing plates.
Space intermediate stiffeners 5' 0" apart.

PITCH OF RIVETS IN STIFFENERS (THEORETICAL).

Bear. value of rivets = diam. x thick of plate x allow bear. S / sq. in.

Use 7/8" rivets.

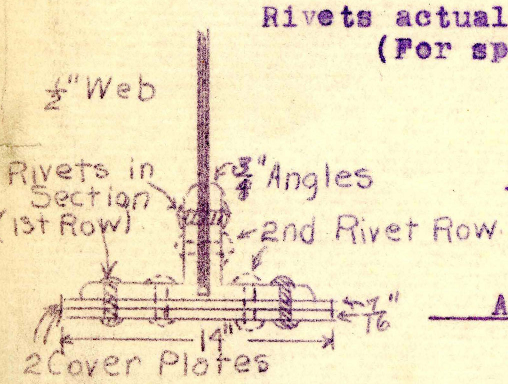
B. V. = 7/8" x 1/2 x 24000 = 10500 lb./in^2.

(at end)
NO. rivets = Max. shear at end /B. V. = 205900 / 10500 = 20 = 20.

Rivet spacing		Depth	NO. rivets		Pitch
0	section	= 65" -:-	20	=	3"
5	"	= (") -:-	16	=	4"
10	"	= (") -:-	13	=	5"
15	"	= (") -:-	11	=	6"
20	"	= (") -:-	8	=	8"
25	"	= (") -:-	6	=	10"

NO. rivets = shear. stress at sectio n/bear. value (10500) lb/in^2

Rivets actually pitched 3" in all stiffeners.
(For spacing in angles cf. Part 111 pg. 98.)



EFFECTIVE DEPTH.

(Cf. diag.)

AREAS		H. (rivets in cross-section left in)	H. (rivets dotted left in)
2 cover plates	10.50 in^2.	7/16"	7/16"
lower legs angles	7.50 "	20/16"	20/16"
(included web)	0.312 "	21/16"	21/16"
upper legs angles	6.380 "	(68/16") (subtract	(68/16") (subtract
(included web)	2.185 "	(")(2 x 90/16	(")2 x 90/16
Total	26.877 in^2.	50.7757"	50.7757"
		11.25"	11.25"
		Total Σ AH = 39.5257"	Total 44.0257" = ΣAH

M. Inertia = $\Sigma aH/\Sigma A$ (1 st. case) Σ39.5257/26.877 = 1.487 in^4. = ΣAH
= (2 nd. case) 44.0257/26.877 = 1.638 in.^{4}
Mean = 1.563 in^4.

Effective Depth =
65"-(7/16+7/16+1/8)x 2 -(2x 1.563) = 63.874"

(cf. pg. 4 for use).

#4

THEORETICAL PITCH OF RIVETSIN FLANGES.

Area 2 angles (6"x 6"x 3/8") = 13.88 in²
" 1 plate = 5.25 "
Total 19.13 "

Area web = 1/2"x 65"x=13.5 % = 4.39 in².
Bear. value 7/8" rivet = 10500 lb.
Effective depth = 63.87"
Wt. on 1 rail is destributed over 3 ties (42") = 25000lbs.
Impact = 25000 x 72.7% = 18175 "
Wt. of track on 1 girder = 205 lb./ft. x 3 1/2 = 715 "
43890 lb/42"
.:. 1045 lb./inch./girder

The moment of the flange stress/lin. inch. resisted by flange alone is

(net area 2 angles + 1 cover plate) / (13.5% gross area web + numerator) x Max shear / Effective depth --(Eq. 1)

Section	0 ft.	(19.13 / 23.52)	x (205900/63.87) =	26.30
"	5 "	(")	x (172300/63.87) =	2200
"	10 "	(")	x 140300/63.87) =	1790

Section 15 there are 2 cover plates
.:. net flange area = (19.13 + 5.25) = 24.38

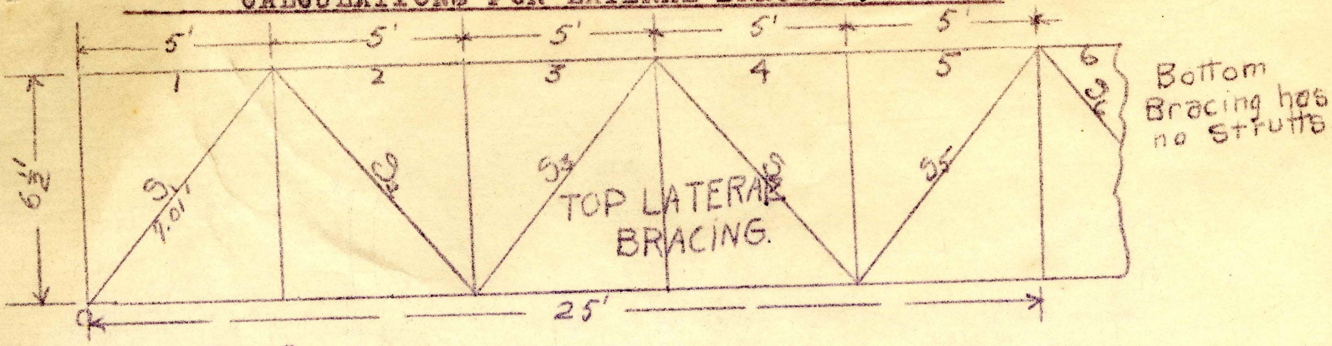
"	15 "	(24.38/28.77)	x (109900/63.87) =	1460
"	20 "	(")	x (83000/63.87) =	1100
"	25 "	(")	x (57800/63.87) =	770

Pitch in inches = Bear. value 7/8" rivet / Resultant of (Eq. 1) & Wt. lin. inch girder

Section	0 ft.	$\frac{10500 (=Z\ say.)}{\sqrt{(2630)^2 + (1045)^2}}$	= 3.72"	pitch
"	5 "	$\frac{Z}{\sqrt{(2200)^2 + (X)^2}}$ {(X) say}	= 4.31"	"
"	10 "	$\frac{Z}{\sqrt{(1790)^2 + (X)^2}}$	= 5.08"	"
"	15 "	$\frac{Z}{\sqrt{(1460)^2 + (X)^2}}$	= 5.85"	"
"	20 "	$\frac{Z}{\sqrt{(1100)^2 + (X)^2}}$	= 6.90"	"
"	25 "	$\frac{Z}{\sqrt{(770)^2 + (X)^2}}$	= 8.07"	"

Art. 62.

CALCULATIONS FOR LATERAL BRACING.



150 x 50 = 7500# .:. Effective reaction = 3750 lb.
150 x 2.5 = 3750 - 375 = 3375 lb.
For S_1 live load = 300 x 50 = 15000 "
Effective reaction = 7500- 300 x 2.5 = 6750 "
Total = 10125 lb.

.:. S_1 = 10.125 K. x sec. ~~(θ)~~ (1.441) = 14.59 Kips
P = 300 x5 = 1500

For S_2 R_1 x 8p = P(1+2+3+4+5+6)p .:. R_1 = 21 x 1500 / 8 = 3.938K

S_2 = (3.938 + 2.81 (= D.L.))1.441 = 9.72 Kips

For S_3 R_1 x 8p = P (1+2+3+4+5+)p .:. R_1 = 2.81 + 1.78(= D.L.)
= 4.59

S_3 = 4.59 x 1.441 = 6.61 Kips

For S_4 R_1 x 8 p = P(1+2+3+4)p .:. R_1 =1.875 + 0.94(=D.L.)
= 2.81 Kips.

S_4 = 2.81 x 1.441 = 4.05 Kips.

9.01 ft. = 108.12 - 24.12 = 84"
Since l/r = 120 r = 84/120 = 0.701 in.

4"x4"x3/8" angles give r = 0.79 with area = 2.86 in^2.

Column Formula (cf, Merriman's Mechanics of Materials,) gives

p =(17000/ 1 + 1/11000)x l^2/r^2

substituting p = 7360
For((1)cf. fig.) 14.59/7.36 = 1.98 in needed
.:. 4"x 4"x 3/8" angles O.K. for diag.

For strutts use 3 1/2"x 3 1/2"x 3/8" angle
Each diag. intermediate cross frame use 3 1/2"x 3 1/2"x 3/8" angles

For End Cross Frame diag. are channels (cf. drawing).
Top horizontals perpindicular girder use 3 1/2"x 3 1/2"x 3/8" angles.
Lower " " " " 3 1/2"x 31/2"x 3/8" angles.

DESIGNED BY :--

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JUNE 1, 1914.