FIRST CANAL BRIDGE

DOUBLE LEAF BASCULE

FOR

CITY OF KOBE.

DESIGNED BY J. MASUDA.

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MADE BY J. Masuda DATE 15-4-3 FILE NO.
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CALCULATIONS FOR

First Canal Bridge

Wind pressure. 30 meters per second.

$P = 0.0032\,V^2$ where P = Pressure in lbs per sq ft
V = velocity in miles per hour

30.0 meters per second.

30. × 3.28 = 98.3' per second 98.3 × 3600.. = 354.000' or 67 miles per hour

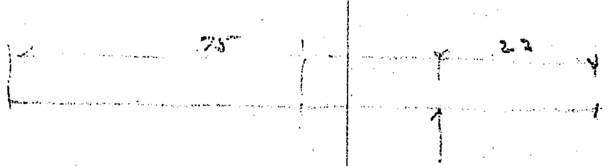
Wind pressure $P = 0.0032 \times 67^2$ = 14.35# per sq ft. or say 15# per sq ft.

15% friction on trunnion load.

Approximate weight of moving mass.

Span length beyond trunnion 75.0

Span length at rear to end of counter weight. = 23.0



Dead weight assume flooring. 60# per sq ft.

Dead weight of steel =

stringers = 12 @ 35 = 420
floor beams 350
laterals. 100
girders. 300 × 4 = 1200
2070# / 50 = 41.5

101.5# per sq ft
call this 100# per sq ft.

49
23
26

75 × 2
23
98 × 100 × = 9800# × 50 = 490,000 moment about trunnion =
= 490.000 × 26 = 12,750.000 '#

Counter weight required = 12.750.000 / 20.0 = 637.000 ~~795.000~~ #

75
23
52
26

volume of counter weight = 637.000 ~~795.000~~ / 145 = 4400 ~~5500~~ cubic ft.

width 8 × 12 = 96 4400 / 96 = ~~57.5~~ 46.0

75
26
49

Total weight on trunnion
490.000
637.000
1,127,000

98
46
52

Counter weight & moment.
directly — on trunnion. 5000 × 46 = 230.000# this is ballanced on ℄ trunnion
5000 × 52 ~~49~~ = 260.000 ~~245.000~~ #

75
25
50.5

moment = 260.000 ~~245.000~~ × 50.5 = 13,130,000

Total weight on trunnion = 1.127.000#
15% friction = 1.127.000 × .15 = 169,000#

Inertia of moving mass. $M = \frac{Wc^2}{32.2\,r^2}$ or $Mr^2 = \frac{Wc^2}{32.2}$

Live arm 75 × 5000 = 3,750,00 × 37.5^2 ÷ 32.2 = 16,24 00,0 00
Rear arm 25 × 5000 115,000 × 11.5^2 ÷ 32.2 = 472,000
Rear Concrete 637,000 × 20.0^2 ÷ 32.2 = 7900,000
Mr^2 total 24,772,000
r^2 = 10.0^2 M = 247,720.

CALCULATIONS FOR

First Canal Bascule Bridge -

80°. travel $2\pi\ 10 \cdot \frac{80}{360} = \underline{6.975'} \times 2 = 14.0'$

For 1 min opening -

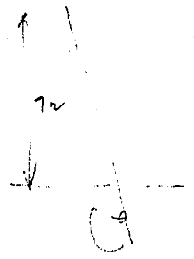
Giving the total time of 1 min. first 15 sec on acceleration - 3.
last 15 " on retardation -

$$\frac{14.0}{\left(\frac{15}{2}+30+\frac{15}{2}\right)} = \frac{14}{45} = \underline{.311}' \text{ per second.}$$

The acceleration is therefore. $\frac{0.311}{15} = 0.0207$ ft per second^2 ✓

And $F = Ma = 247.720 \times 0.0207 = 5130$ #

Wind resistance



$51 \times 15 = 765$ # per ft.

$72 \times 765 \times \frac{36}{10} = 198,500$ #

49,000

Frictional Resistance.

Load on trunnion - 1,127.000

Wind load pinion reaction - 198500

1,325,500 # ÷ 2 = 662,750 # per trunnion -

$\frac{662.750}{1,750} = \frac{379.0''}{4} = \boxed{9.5}$. $\frac{95''}{10} = 9.5''$

frictional force reduced ~~to~~ the perimeter of ~~the~~ rack circle, is therefore

$\frac{1,325,500}{120} \times 5 \times 0.15 = 8300$ #

Inertial - 5130.
Wind 198500
frictional - 8300
211,930 #

Pitch radius of the main drive pinion = 8.912

max torque = 211.930 × 8.912 = 1,880.000 # or 157,000 #

Max linear velocity of the rack .311' per second or 18.65' per min

circumference of ~~the~~ drive pinion is $\frac{2\pi(8.912)}{12} = 4.66'$ at the pitch circle.

the rpm of ~~the~~ pinion $\frac{18.65}{4.66} = 4.0$.

The power required ~~to~~ operate pinions:

$\frac{2\pi\,(157.000) \cdot 4.0}{33000} = \underline{120}$. 2 - 60 <u>HP</u>.

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CALCULATIONS FOR

Preliminary Calculation for 1st Canal Bascule Bridge for Kobe-City Planning Commission

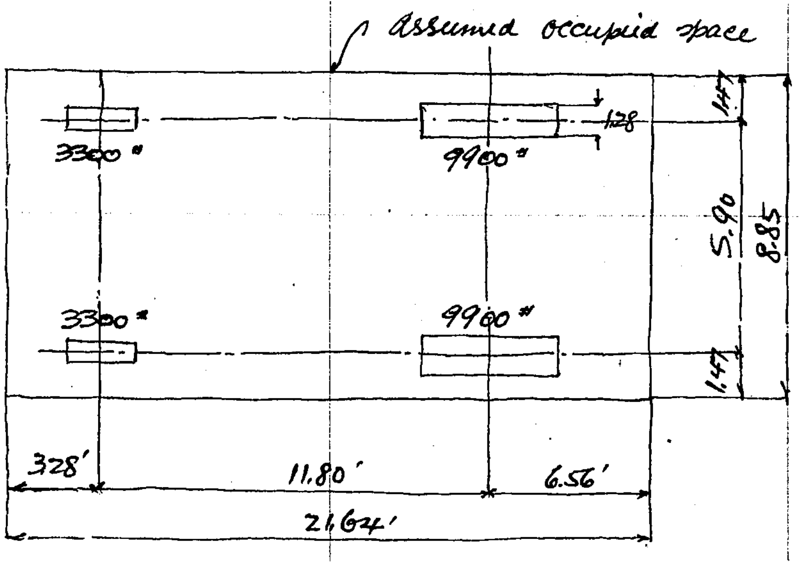
Clear span length between faces of abutments
Total width of roadway 51.0 ft between insides of Handrails
2 side walks 6.6 ft each on both ends leaving clear roadway of 37.8 ft
or 2 Sidewalks @ 6'-6¾ and clear roadway of 37'-7" Total width = 50'-8½"
Clearance above highwater Elevation 14.0 ft for 30' at center 10.0 ft about at faces of abutments
Loadings on Bridge -
Uniform load on roadway.

For roadway $w = \dfrac{120.000}{170+l} \fallingdotseq 600\ ^{kg}/_{m^2}$ or say $120\ ^{\#}/_{\square'}$

For sidewalks $w = \dfrac{100.000}{170+l} \fallingdotseq 500\ ^{kg}/_{m^2}$ or say $100\ ^{\#}/_{\square'}$

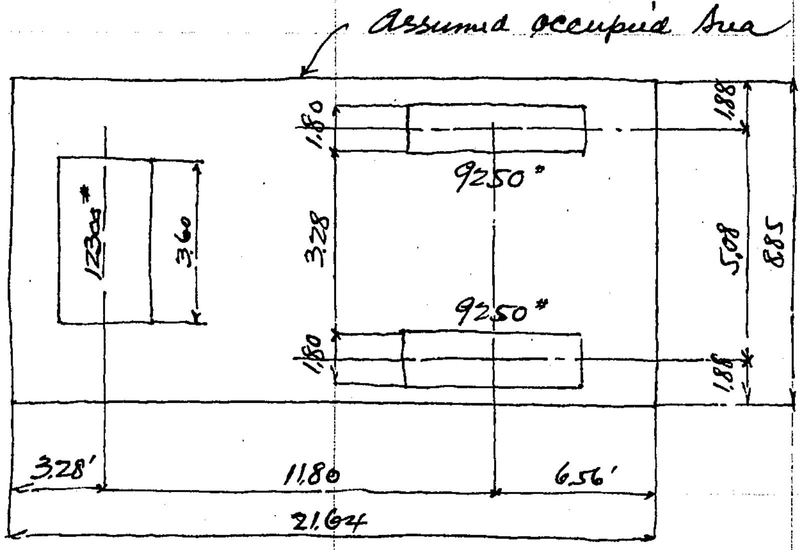
where w = uniform load in kg per sqare meter
l = loaded length of span in metre.

Motor truck loading (12 tons)



2 rows of motor traffic on roadway with occupied space of 8.85' each. Impact into consideration.
Unoccupied space of motor car and Street Electric Ry shall be filled with said uniform live load.

Road roller (14 tons)



One road roller on span without impact

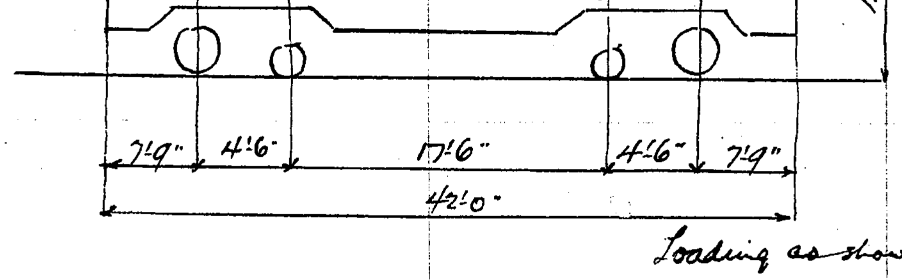
Impact for motor truck and Electric Railway Car Loadings.

$i = \dfrac{20}{60+l} \fallingdotseq 0.3$

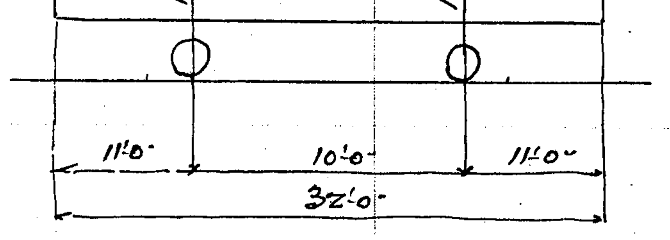
where i = coefficient for impact
l = loaded length of span in metre.

Electric Railway Traffic. The following 3 types of Car assumed.

Class I 26 ton Car 26 gross tons



Class II. 18 ton Car

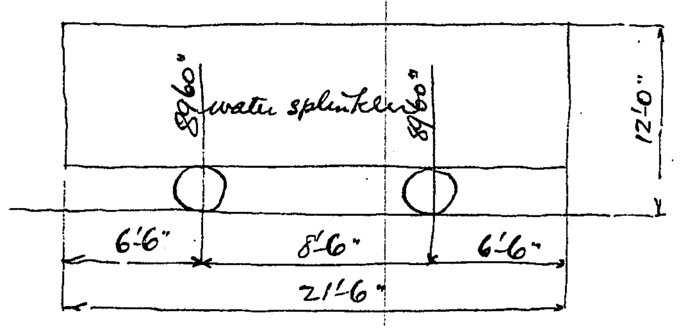


Loading as shown per rail.

Preliminary Calculation for 1st Canal Bascule Bridge.

Class III. 16 tons

width of street car - 7'-6".



Assumed wind pressure.

Span closed 30#/□' on projected area
Span up. 15#/□' on projected area
wind velocity 69 miles per hour or
30 meter per second nearly.

Allowable working strength
Structural Steel or Reinforcing bars.

Tension	17000 #/□"
Extreme fibre stress	17000 #/□"
Shear of web gross section.	12800 #/□"
Compression member	21300 (1- 0.0055 l/r) or not more than 14000 #/□"

where l = length of member in inches
r = least radius of gyration in (inch)²

Compression flange of plate girder
17000 (1- 0.012 l/b) ≤ 15400 #/□"

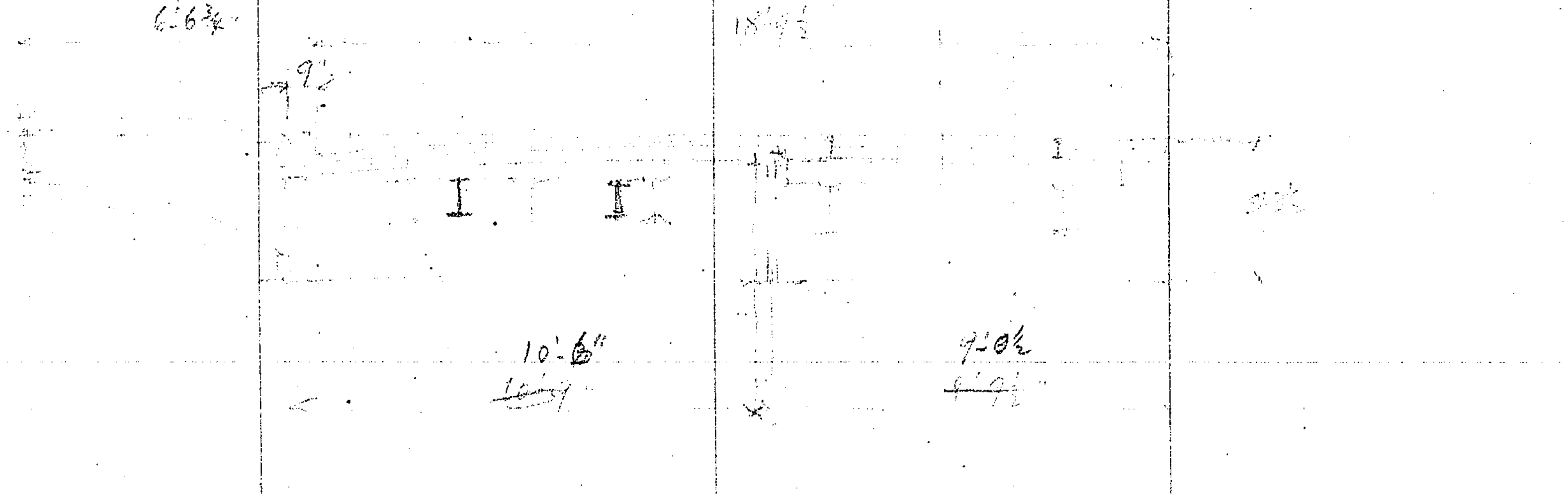
Shearing on shop driven rivets (machine driven)	12.000 #/□"
Shearing on field driven rivets and turned bolts (machine driven)	10.000 #/□"
Extreme fibre stress of pin.	24.000 "
Bearing on shop rivets	24.000 "
Bearing on field rivets and turned bolts	20.000 "
Bearing on pin.	24.000 "
Bearing on masonry	640 #/□"

Strength of Concrete 1:2:4 mixture

Compression fibre stress	640 #/□"
Shear for plain Concrete	58 "
Punching shear	128 "
Bond stress of plain bars	85 "
Bond stress of deformed bars	130 "
Shear for reinforced Concrete	128 "

Considering wind, traction and temperature stresses in addition to dead live and impact stresses, the allowable working strength shall be increased 25% and proportioned the parts in case of earthquake the unit stresses shall be increased 80%.

Assumed cross section of moving leaf as shown on sketch below.



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CALCULATIONS FOR

Preliminary Design of 1st Canal Bascule Bridge.

Roadway floor.

span length = 2'-8¼" = 2.69'

3" Creosoted woodblock pavement @ .5# = 15 $m = \frac{1}{10} \cdot 30.5 \cdot 2.69^2 = 22.0'^{\#}$

asphalt felt for water proofing 0.5

3" Creosoted planking = $\underline{15.0}$

30.5# per sq ft.

Distribution of wheel Concentration.

Contact space between wheel and pavement 0.66

woodblock 2 @ .25 $\underline{0.50}$

Longitudinal distribution a = 1.16

Transverse distribution b = 1.28 + 0.5 = 1.78

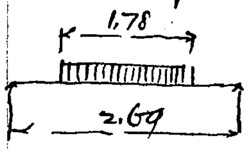
Effective width $E = \frac{2}{3}(l + b) + a$ where l = span length

$= \frac{2}{3}(2.69 + 1.78) + 1.16 = 4.14'$ call this. 3.0

Rear wheel Concentration = 9900 $\frac{12870}{3.0} = 4290^{\#}$ per ft strip

30% impact = $\underline{2970}$

12870#



moment at center $\frac{4290}{2} \cdot \frac{2.69}{2} = 2890'^{\#}$

$2145 \cdot \frac{1.78}{4} = \underline{953}$

1937

For Continuity of span $1937 \cdot 0.8 =$ say 1550.'#

Planking assumed 3"

fibre stress $= \frac{6 \cdot 1550 \cdot 12}{12 \cdot 3^2} = 1030 \#/\square''$ ok.

Flooring between track and rails. 3" woodblock pavement and 3" Creosoted planking on wooden cross beam.

Cross Beam between tracks span length 5'-2"

spacing of Cross beam assumed 2.5' centers

Dead Load. $30.5^{\#} \cdot 2.5 = 76.2^{\#}$ $m = \frac{1}{8} \cdot 86.2 \cdot 5.17^2 = 288'^{\#}$

Cross beam say 6"·8" $\underline{10.0}$

86.2# per lin ft

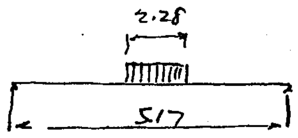
Live Load motortruck loading Concentration rear wheel with impact = 12870#

transverse distribution say 1.28

2 @ .5 = $\underline{1.00}$ moment $= 6435 \cdot 2.59 = 16650$

2.28 $6435 \cdot \frac{2.28}{4} = \underline{3670}$

12980'#



Fibre stress $= \frac{6 \cdot (12980 + 288) \cdot 12}{8 \cdot 6^2} = 3310 \#/\square''$ too high stress

try 8"·8" cross beam Fibre stress $= \frac{6 \cdot \text{say } 13300 \cdot 12}{8 \cdot 8^2} = 1870 \#/\square''$ ok

Sidewalk slab.

Span length 5.75' 3" slab with ¾" wearing course 47# per sq ft

Live Load $\underline{100}$

147# per sq ft

$m = \frac{1}{8} \cdot 147 \cdot 5.75^2 = 606'^{\#}$

Effective depth req'd $= \sqrt{\frac{606}{102}} = 2.4"$ use 3" Concrete slab.

Reinforcing steel $= \frac{606 \cdot 12}{\frac{7}{8} \cdot 2.5 \cdot 17000} = .196$ use ⅜"φ bars. 6" centers 0.220□" per ft.

Stringers span length 10'-2" stringer Spacing 2'-8¼"

Dead Load. $30.5 \cdot 2.69 = 82^{\#}$ per lin ft. moment $= \frac{1}{8} \cdot 117 \cdot 10.17^2 = 1510'^{\#}$

Stringer say. $\underline{35}$

117#

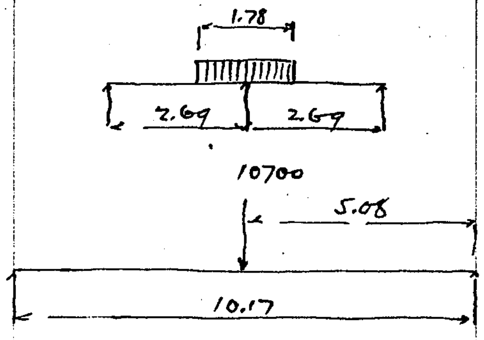
CALCULATIONS FOR

Preliminary Design of 1st Canal Bascule Bridge.

Stringers

Live Load motor truck loading rear wheel conc. with impact 12870#

transverse distribution. 1.78'



$$6435 \times \frac{2.24}{2.69} = 5350$$

$\times 2$

$10700^{\#}$

moment = $5350 \times 5.08 = 27200^{\#}$

Dead Load moment 1510

$28710^{\prime\#}$

section modulus required $= \frac{28710 \times 12}{17000} = 20.3$

Use $10" \times 5" I$ 29.99# or Sm = 29.14

Railway stringers. See revised figures on p5

Dead Load on stringers. Flooring 3" wood block + 3" planking = 30.5# sq ft × 5.0 = 152.5#

Cross beam $8" \times 8" \times 8.0$ = 214# or $214 \div 2.5$ = 85.5# per lin ft. 85.5

238.0#

Stringers assumed. 45.0

283.0#

Dead Load moment $= \frac{1}{8} \times 283.0 \times 10.17^2 = 3660^{\prime\#}$ Add weight of rail.

Live Load motor truck loading. one rear wheel conc at center = 12870#

L Load moment $= \frac{12870}{2} \times 5.08 = 32700^{\prime\#}$

Dead Load Moment 3660

$36360^{\prime\#}$

section modulus req'd $= \frac{36360 \times 12}{17000} = 25.60$

Use $10" \times 5" I$ 29.99# or Sm = 29.14

Sidewalk fascia stringer

Reinforced Concrete Slab. $47.^{\#} \times 2.90$ = 136.0# $m = \frac{1}{8} \times \overset{+30}{\underset{506}{476}} \times 10.17^2 = 6530^{\prime\#}$

Handrail assumed 50.0

186.0# per lin ft. $Sm = \frac{6530 \times 12}{17000} = 4.60$

Live Load 100×2.90 = 290.0

476.0# per lin ft. Use $8" \times 2\frac{1}{2}$ [15.12# Sm = 10.27

beam assumed 30.0

506.0

Summary for weight of stringer

Railway stringer 4 @ 32.0 = including details. = 128.

Highway stringers 6 @ 32.0 " = 192

fascia stringers 2 @ 17.0 " = 34

354# per lin ft. of span.

See revised figure.

Try highway stringer spacing. 3'7"

Planking + pavement 30.5#/□ $Dl.\ m = \frac{1}{10} \times 30.5 \times 3.58^2 = 39^{\prime\#}$

Live Load motor truck 12870# including impact distribution assumed 3.0

$12870 \div 3.0 = 4290^{\#}$ per ft strip.

moment at center $\frac{4290}{2} \times \frac{3.58}{2} = 3840^{\prime\#}$

For less m 953

, continuity $2887^{\prime\#} \times 0.8 = 2310$

Dl. moment = 39

$2349^{\prime\#}$

Fibre stress $= \frac{6 \times 2349 \times 12}{12 \times 3^2} = 1570^{\#}/□"$ make stringer spacing. 3'7".

Revised weight of stringers Railway stringers 128

Highway stringers 128

Fascia stringers 34

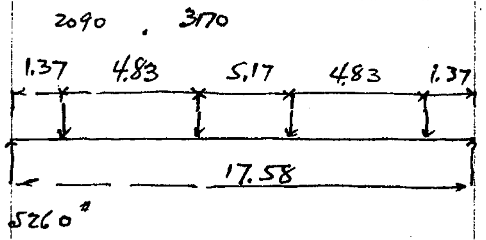
290# per lin ft of span

Preliminary Design of 1st Canal Bascule Bridge.

Design of Cross beam under street railway tracks. span length. 17'-7". spacing = 10'-2".

Dead Load flooring - say - 238.# per lin ft.
stringer say. 32#
Rail $\frac{122}{3}$ = 40.6 say 42
312# per lin ft. inside rails.

Outside rails. Flooring - 30.5 × 3.10 = 94.5#
8"×8"×3.5 wt $\frac{932}{2.5}$ = 37.0
131.5#
Stringer 32.0
Rail. 42.
205.5# per lin ft.



Concentration 312 × 10.17 = 3170#
" 205.5 × 10.17 = 2090#

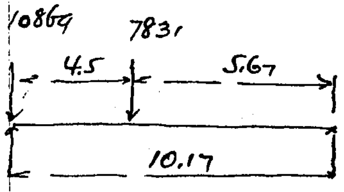
moment = 5260 × 6.20 = 32600
~~3170~~ 2090 × 4.83 = 10100
22500'#

Dead Load beam $\frac{1}{8}$ × 80 × 17.58^2 = 3090
25590'#

Live Load. street car loading. Bogie.

	8359	6021
30% impact	2510	1810
	10869#	7831#

Reaction.



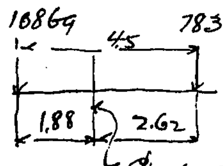
7831 × $\frac{5.67}{10.17}$ = 4370#
10869
15239 say 15240# per rail.

Live Load moment = 15240 × 12.4
15240 × 4.83
7.57 = 115400'#
Dead Load m = 25590
140990'#

Girder. 2'-5¾" back to back of Ls.
web. 29" × 5/16 = 9.05 o" $\frac{1}{8}$ web = 1.13 o" Effective depth say 2.34'
Stress in flange 140990 ÷ 2.34 = 60200# SR = 3.54
1.13
2.41 o" net.
2L^s 3. 3. 3/8 = 4.22 o
1.32
2.90 o" net.

Revised figure for Electric Ry stringers
D.L: 312# per lin ft. m = $\frac{1}{8}$ × 312 × 10.17^2 = 4030'#

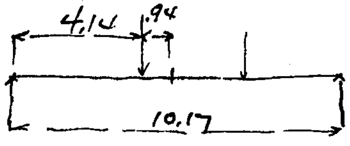
Live Load Street Car.



center of gravity 10869 × 4.5 = 49000 ÷ 18700 = 2.62
7831
18700

4.50
2.62
1.88

moment 18700 × $\frac{4.14^2}{10.17}$ = 31500'#



Class II. 18 ton car. 10080 moment = $\frac{13080}{2}$ × 5.08 = 33200'#
30%. 3000 D.L. m = 4030
13080# 37230

Section modulus reqd = $\frac{37230 \times 12}{17000}$ = 26.2 Use 10"×5" I @ 29.99#
Sm = 29.14

CALCULATIONS FOR

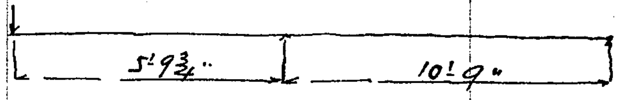
Preliminary Design of 1st Canal Bascule Bridge.

Cantilever Bracket and Floor Beam

Sidewalk Cantilever.

spacing - 10'-2"

Dead Load Floor + Handrail		186.0
Dead Load beam		17.0
		203.0# × 10.17 = 2065#
D.L. moment =	2065 × 5.81 =	12000 ″#
L.L moment =	2950 × 5.81 =	17100
Total moment		29100 ″#



L.L. cone = 100 × 2.90 = 290

290 × 10.17 = 2950#

Depth at connection say 3'-1½" = 3.12' stress = $\frac{29100}{3.12}$ = 9320.#

Minimum section 3.3.3/8 Ls for flange.

Cross beam under roadway. span length 10'-9"

Use 2Ls 3.3.3/8 for flanges.

Approximate weight of floor beam

web.	1Pl.	29 × 5/16	@ 30.81	= 30.81
	4Ls	3.3.3/8	@ 7.2	= 28.80
				59.61#
Details say 25%.				15.00
				74.61# call this 70# per lin ft for whole width

Total weight 70 × 51 = 3570# per floor beams and two Cantilever Brackets.

Main Longitudinal Girders.

Dead Load reaction - on girders.

sidewalk slab. 47# × 6.56 = 309# Flooring. 30.5# × 19.54 = 595#

Handrail 50#

at curb. timber block. $\frac{5" \times 6"}{144}$ × 60# = 12.5# per lin ft.

structural metal at curb. 8" × 3/8 = 10.20

22.70#

nailing piece on stringer and shelf angle. average $\frac{5" \times 4"}{144}$ × 60 = 8.5# per lin ft.

Timber Cross beam under track $\frac{8 \times 8}{144}$ × 7.0 × 60# = 187# per piece

187 ÷ 2.5 = 74.8# or say 75# per lin ft.

Dead Load distribution on girders.

Electric Railway girder. G_2				Highway. girder G_1.			
Floor and pavement	30.5# × 14.17	=	432#	Flooring.	30.5 × 5.37	=	164.0
Cross beam	7.5 × 1.5	=	112.5	nailing piece	2 @ 8.5	=	17.0
Stringers	3 @ 32#	=	96.0	Stringer	1 @ 32	=	32.0
Floor beam	$\frac{70}{10.17}$ × 14.17	=	97.5	load at curb.	curb timber	=	12.5
					curb bar	=	10.2
nailing piece			8.5	Sidewalk slab.	47 × 3.65	=	171.0
			746.5#	Floor beam	$\frac{70}{10.17}$ × 5.37	=	37.0
							443.7#

Reaction due to Cantilever.

Dead Load floor and Handrail	= 186.0			
" " beam	17.0			
	203.0#	× 5.81	=	1180
Floor beam $\frac{70}{10.17}$ = 6.9 × 5.8	40.0	× say 2.00	=	80
	243.0#			1260

negative reaction on G_2 = 1260 ÷ 10.75 = 117.0# per lin ft.

reaction on G_1 = 243.0 + 117.0 = 360.0# per lin ft.

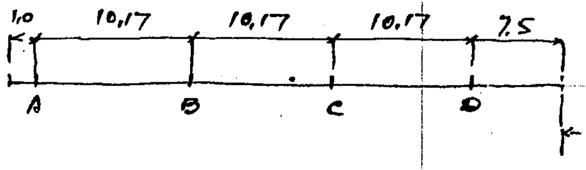
Preliminary Design of 1st Canal Bascule Bridge.

Summary load on G_1 and G_2

On G_1 443.7
360.0
803.7# per lin. ft.

On G_2 746.5#
117.0
629.5# per lin ft.

Dead Load moment G_1 due to uniform floor load of 810# per lin ft.
assumed girder & lateral 3 say 300
1210# per lin. ft.



← ℄ trunnion

moment at B. $1210 \cdot \frac{11.17^2}{2} =$ 75500#

moment at C $1210 \cdot \frac{21.34^2}{2} =$ 275.000#

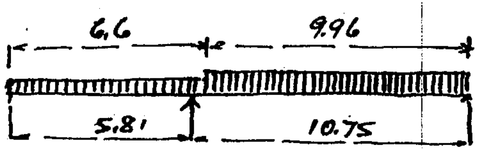
moment at D $1210 \cdot \frac{31.51^2}{2} =$ 600.000#

moment at T. $1210 \cdot \frac{39.01^2}{2} =$ 920.000#

The moments as figured should be increased for trolley poles and center lock mechanisms.

Live Load moments.

Uniform live load on side walk. 100# per sq ft.
Uniform live load on Roadway 120# per sq ft.
At end of span motor truck loading
load on sidewalk. $660^{\#} \cdot \frac{13.26}{10.75} = 813.0^{\#}$ per lin ft.

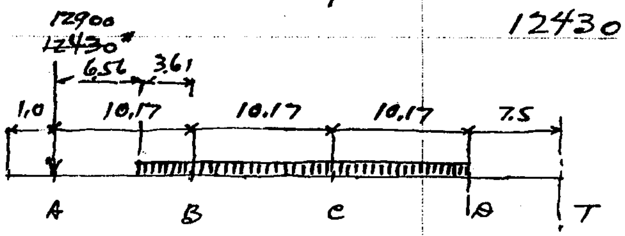


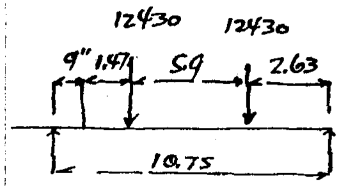
$120 \cdot 9.96 = 1195^{\#} \cdot \frac{4.98}{10.75} = 554^{\#}$ per lin. ft.

motor truck loading. Impact $= \frac{20}{60 + \frac{60.}{3.28}} = 25.6\%$.

Rear wheel concentration = 9900
Impact 25.6% = 2530
12430#

Front wheel conc $= 12430 \cdot \frac{1}{3} = 4110^{\#}$





max reaction on girder G_1
$12430 \cdot 2 \cdot \frac{5.58}{10.75} = 12900^{\#}$

Front wheel $12900 \div 3 = 4300^{\#}$

moment at B = $\overset{12900}{\cancel{12430}} \cdot 10.17 =$ 131100#
Sidewalk. $813 \cdot \frac{11.17^2}{2} =$ 50700
Roadway $554 \cdot \frac{3.61^2}{2} =$ 3600
185400#

moment at C
motor truck $12900 \cdot 20.34 =$ 262500
Sidewalk $813 \cdot \frac{21.34^2}{2} =$ 185.000
Roadway $554 \cdot \frac{13.78^2}{2} =$ 52500
500,000#

moment at D
motor truck $12900 \cdot 30.51 =$ 394000
Sidewalk $813 \cdot \frac{31.51^2}{2} =$ 403.000
Roadway $554 \cdot \frac{23.95^2}{2} =$ 159.000
956000#

Summary for dead and live load moments.

	B	C	D
Dead Load moment	75500	275000	600.000
Live Load moment	185400	500.000	956.000
	260900#	775.000	1556.000#

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CALCULATIONS FOR

Preliminary Design of 1st Canal Bascule Bridge.

Girder Section.

At B moment = 260900 web assumed 39" × 3/8 = 14.60□" 1/8 web = 1.83□"
Effective depth say 3.15 flange stress = 260900 ÷ 3.15 = 82900#
section required = 82900 ÷ 17000 = 4.87
1.83
3.04 □"

Revised

At C moment = 775000'# web assumed 48" × 3/8 = 18.0□" 1/8 web = 2.25□"
Effective depth say = 3.84 flange stress = 775.000 ÷ 3.84 = 202.000#
section required = 202.000 ÷ 17000 = 11.90
2.25
9.65□" net 2L^s 6×6×1/2" = 11.50 or 10.50□" net.

Section at D moment = 1556000'# web assumed 60 × 3/8 = 22.5□" 1/8 web = 2.82□"
Effective depth say = 4.84 flange stress = 1556000'# ÷ 4.84 = 322.000#
Section required = 322.000 ÷ 17000 = 18.9 2L^s 6×6×1/2 = 11.50 or 9.50
2.82 1Pl. 13 × 5/8 = 8.12 or 6.88
16.08 □" net 19.62 16.38 □" net.

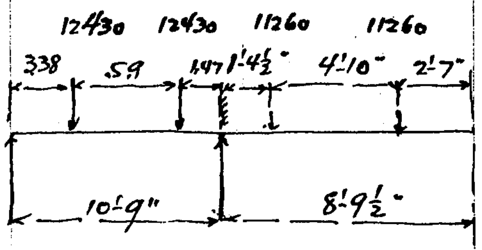
Girder G2

Dead Load moment

Uniform floor load 630#
Girders + bracing say 300
930# per lin ft.

Moment at B 930 × $\frac{11.17^2}{2}$ = 58000'#
moment at C 930 × $\frac{21.34^2}{2}$ = 211000 "
moment at D 930 × $\frac{31.51^2}{2}$ = 464000 "

Live Load.



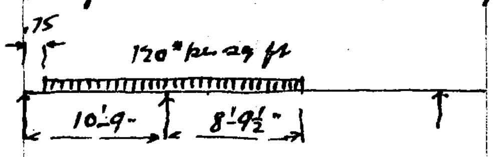
water sprinkler. concentration per rail 8960
Impact 25.6% - 2300
11260#

Reaction motor truck loading. 2 × 12430 × $\frac{6.33}{10.75}$ = 14650#

14650#
24860
39510

Reaction motor truck loading ~~14650~~
29300#

Uniform load on roadway and tracks



120 × 10 = 1200# × $\frac{5.75}{10.75}$ = 642#
75# × $\frac{.38}{10.75}$ = 3
645#
120 × 8.81 = 1060
1705# call this 1700#

Moment at B.
motor trucks ~~29300~~ 39510 × 10.17 = ~~298000~~ 402,000
Unif. 1700 × $\frac{3.61^2}{2}$ = 11100
~~309100~~ 413100'#

Moment at C
motor trucks ~~29300~~ 39510 × 20.34 = ~~596000~~ 802000
Uniform load 1700 × $\frac{13.78^2}{2}$ = 161500
~~757500~~ 963500'#

Moment at D
motor trucks ~~29300~~ 39510 × 30.51 = ~~895000~~ 1206000
Uniform load 1700 × $\frac{23.95^2}{2}$ = 487000
~~1382000~~ 1693000'#

Summary for dead + Live Load moments

	B	C	D
Dead Load moments	58000	211.000	464000
Live Load moment	309100 413100	757500 963500	1382000 1693000
	~~367100~~ 471100	968500 1174500	1846000'# 2,157,000

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CALCULATIONS FOR

Preliminary Design of 1st Canal Bascule Bridge.

Girder section.

Section at B. m = 367100 '# web assumed 32″ × 3/8 = 12.00″ ⅛ web = 1.50″
Effective depth say 2.57′ flange stress = 367100 ÷ 2.57 = 143000 #
Section required = 143000 ÷ 17000 = 8.40 ☐″
1.50
6.90 ☐″ net

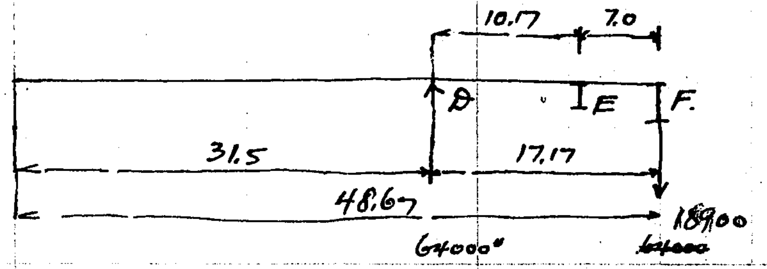
Section at C m = 968500 '# web assumed 41″ × 3/8 = 15.40 ☐″ ⅛ web = 1.92 ☐″
Effective depth say 3.3′ flange stress = 968500 ÷ 3.3 = 293000 #
Section required = 293000 ÷ 17000 = 17.20 2∟s 6×6×½ = 11.50 or 9.50
1.92 1 Pl 13×½ = 6.50 5.50
15.28 ☐″ net 18.00 ☐″ 15.00 ☐″ net

Section at D m = 1846000 '# web assumed 53″ × 3/8 = 19.90 ☐″ ⅛ web = 2.49 ☐″
Effective depth say 4.3′ flange stress = 1846000 ÷ 4.3 = 430.000 #
Section required = 430.000 ÷ 17000 = 25.30 ☐″ 2∟s 6×6×½ = 11.50 or 9.50
2.49 1 Pl. 13×½ = 6.50 5.50
22.81 ☐″ net. 1 Pl. 13×5/8 = 8.12 6.88
26.12 21.88

Try 2∟s 6×6×½ = 11.50 or 9.50
1 Pl. 13×5/8 = 8.12 6.88
1 Pl. 13×5/8 = 8.12 6.88
27.74 ☐″ 23.26 ☐″ net.

Anchor Arm for Electric Ry Girder. G₂

Dead Load.



Dead Load 930# per lin. ft.
Reaction 930 × 48.67 = 45200 #
Reaction 45200 × 24.33/17.17 = 64000 #

moment at E. ~~64000~~ 18900 × 7.0 = ~~448.000~~ '# 132200 '#
930 × 7.0²/2 = 22800
155,000 '#

64000 − 45200 = 18800 #

moment at E.
930 × 41.67²/2 = 806.000
64000 × 10.17 = 650.000
156,000 '#

Live Load motor truck loading at end uniform load at rear.
Total moment at D 1382,000 '# reaction at rear (F) 1382.000 ÷ 17.17 = 80.500 #
L.L. moment at E = 80500 × 7.0 = 564000 '#
D.L. moment 156.000
720,000 '#

Section at E web assumed 53″ × 3/8 = 19.9 ⅛ web = 2.49 ☐″
Effective depth 4.3 flange stress = 720.000 ÷ 4.3 = 167000 #
Section required 167000 ÷ 17000 = 9.82 ☐″
2.49 2∟s 6×6×½″ = 11.50 or 9.50 ☐″ net.
7.33 ☐″

max shear at D.
Dead Load 930 × 31.5 = 29300 #
Live Load motor truck 29.300
Unif. load
1700 × 23.95 = 40.700
99.300 #

Section required for shear
99.300 ÷ 12800 = 7.75 ☐″ gross.
For 3/8″ web. 7.75/.375 = 20.7″ required.

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CALCULATIONS FOR

Preliminary Design of 1st Canal Bascule Bridge.

Cross beam at face of abutment.
To carry dead Load only. max reaction G_2 64000#
moment = 64000 · 10.75 = 688.000
$\frac{1}{8}$ · 300 · 39.08^2 = 57400
745400 1#

Depth of web. say 30 · 3/8 = 11.25 □" $\frac{1}{8}$ web = 1.41
Effective depth say 2.4 745400 ÷ 2.4 = 310,000# SR = 310.000 ÷ 17000 = 18.25
1.41
16.84 □" net.

$2L^s$ 6·6·½ = 10.5 - 9.5
1 Pl. 13 · 5/8 = 8.12 - 6.88
18.62 □" 16.38 □"

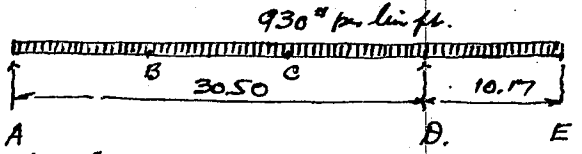
Cross beam at center of span
Dead Load assumed ~~to~~ carry railway girder
Dead Load G_2 930# per lin ft. conc. = 930 · 16.25 = 15100#
moment = 15100 · 10.75 = 162.200 1#
beam say - $\frac{1}{8}$ · 300 · 39.08^2 = 57400
219,600 1#

Live Load - motor truck 29300# m = 29300 · 10.75 = 315.000
Unif. load - 1700 · $\frac{23.95^2}{2}$ ÷ 30.51 = 16000 · 10.75 = 172.000
487,000
D.L. m say 220.000
707,000 1#

Depth of web say 30 · 3/8 = 11.25 □" $\frac{1}{8}$ web = 1.41 □" Effective depth say 2.4
flange stress = 707000 ÷ 2.4 = 294000 SK = 294000 ÷ 17000 = 17.30
1.41
15.89 □"

$2L^s$ 6·6·½ = 10.5 - 9.5
1 Pl. 13 · 5/8 = 8.12 - 6.88
18.62 □" 16.38 □" net

Revised Design of main girder. span length 30.50' cantilever projection at rear 10.17'
Dead Load 930# per lin ft including wt of main girder and lateral Bracings.



A: 14200# - 1575 = 12625#
D: 14200 + 9450 = 23650 + 1575 = 25225#

moment at D = 930 · $\frac{10.17^2}{2}$ = 48,000 1# neg.
48 000 ÷ 30.50 = 1575#
moment at B or C 12625 · 10.17 = 128400 1#
930 · $\frac{10.17^2}{2}$ = 48 000
80,400 1#

Live Load moment section at D. motor truck loading at E. Concentration = 39510#
Uniform live load 1700# per lin ft of girder.
negative moment at D. motor truck 39510 · 10.17 = 402000
Unif. load. 1700 · $\frac{3.61^2}{2}$ = 11100
413,100 1#

Positive moment at B or C. motor truck loading at B or C.
Reaction 39510 · $\frac{2}{3}$ = 26300# moment = 26300 · 10.17 = 267000
Unif. load - 1700 · $\frac{13.78^2}{2 \cdot 30.50}$ = 5290# 5290 · 10.17 = 53800
320800 1#

Summary for moments.

	B or C	D.
Dead Load moments	80400	48 000
Live Load moments	320800	413.100
	401,200 1#	461.100 1#

web assumed 24 · 3/8 = 9.00 □" 461.000 ÷ 2.0 = 230500# SR = 13.60 □" $2L^s$ 6·6·¾ = 16.88 - 13.88 net
2.5 = 184500 Sk = 10.85 $2L^s$ 6·6·$\frac{9}{16}$ = 12.86 - 10.61 net

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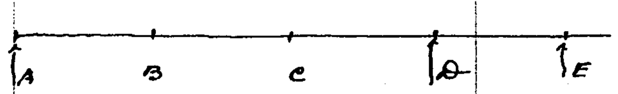
CALCULATIONS FOR

Preliminary Design of 1st Canal Bascule Bridge

Cross beam at ℄ of span.
Dead Load reaction from main girder G_2 -
Cantilever portion neglected. Uniform load on Cross beam $30.5^{\#} \cdot \frac{10.17}{2} = 155^{\#}$ per lin ft.
Girder assumed 200
$355^{\#}$ per lin ft.

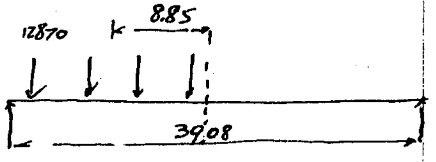


Concentration $30.5^{\#}$

approximate load from G_2 $12625^{\#}$

Dead Load moment say $12625 \cdot 10.75 = 136{,}000^{1\#}$
beam $\frac{1}{8} \cdot 300 \cdot 39.08^2 = 57{,}400$
$193{,}400^{1\#}$

Live Load. motor truck. $12870 \cdot 4 = 51500^{\#}$



moment at Center $51500 \cdot 19.54 = 1{,}008{,}000$
$51500 \cdot 8.85 = 455{,}000$
$553000^{1\#}$
Dead Load moment 193400
$743400^{1\#}$

Depth of web $30 \cdot 3/8 = 11.25\,\square''$ $\frac{1}{8}$ web $= 1.41\,\square''$ Effective depth say 2.4
flange stress $= 743400 \div 2.4 =$ ~~186000~~ $310{,}000$ $SR = 310{,}000 \div 17{,}000 = 18.25$
2Ls $6 \cdot 6 \cdot 5/8 = 14.22$ 11.72 1.41
1 Cov. Pl. $13 \cdot \frac{1}{2} = 6.50$ 5.5 $16.84\,\square''$ net.
20.72 $17.22\,\square''$

Cross beam at rear (Live Load shoe).
Dead Load. $25225 \cdot 10.75 = 271{,}000$
$\frac{1}{8} \cdot 300 \cdot 39.08^2 = 57{,}400$
$328{,}400^{1\#}$

Live Load ~~motor truck~~ loading.
$12870 \cdot \frac{4}{3} = 17150^{\#}$ $17150 \times 4 = 68500^{\#}$
Live Load moment $68500 \cdot 19.54$
$68500 \cdot 8.85$
$10.69 = 731000^{1\#}$
Dead Load m $= 328400$
$1{,}059{,}400^{1\#}$

Depth $54\frac{3}{4}'' \cdot 3/8 = 19.90\,\square''$ $\frac{1}{8}$ web $= 2.49$ depth say 4.3' flange stress $= 247{,}000^{\#}$
section required $= 247{,}000 \div 17000 = 14.5$
2.49
$12.01\,\square''$
2Ls $6 \cdot 6 \cdot \frac{1}{2} = 11.50$ 9.5
1Pl. $13 \cdot \frac{1}{2} = 6.50$ 5.5
18.00 $15.0\,\square''$ net.
2Ls $6 \cdot 6 \cdot 3/4 = 16.88$ — $13.88\,\square''$ net.

main girder G_1.
Dead Load see p6. 746.5 call this $2000^{\#}$ per lin ft.
443.7
243.0 Reaction from Cross beam at center. $12625^{\#}$
$1433.2^{\#}$ girder say - $200 \cdot 19.5 = 3900$
Dl. girder $\overset{2@300}{\text{assumed}}$ 600.0 $16525^{\#}$ call this $16500^{\#}$
$2033.2^{\#}$ Reaction from rear cross beam at live load shoe.
25225
beam say 3900
$29{,}125$ call this $29000^{\#}$

Dead Load moment

		B	C	D	T	
at B.	$16500 \cdot 10.17 =$	168000	336000	495000	643,000	see p7
	$1210 \cdot \frac{11.17^2}{2} =$	75500	275.000	600.000	217.000	
					920.000	
		243500"	511.000	1,095,000	1,780,000	

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CALCULATIONS FOR

Preliminary Design of 1st Canal Bascule Bridge

Live Load moment.

One motor truck at center of span - Concentration. - 12430 × 2 = 24860#
Unif. load. $\frac{1700 \times 23952}{2 \times 3050}$ = 16000
40860#

	B	C	D.
40860 × 10.17 =	415000	830.000	1245.000
	185400	500.000	956.000 ← see p7
Live load	600,400	1330.000	2201,000 '#
Dead Load.	243500	511.000	1095.000
	843900	1,841,000	3296,000 '#

Section of girder

At B m = ~~260~~ 843900# ~~web assumed~~ 39 × 3/8 = 14.6 ⅛ web = 1.83 □"
Effective depth say 3.15 . flange stress = 268000# SR = 268000 ÷ 17000 = 15.8 □"
1.83
13.97 □" net

Use 2Ls 6×6×3/4" = 16.88 □" gr or 15.38 □" net. (210)

14.6
33.76
48.36
(405#)

At C. m = 1.841.000 ~~web assumed~~ 48 × 3/8" = 18.0 □" ⅛ web = 2.25 □"
Effective depth say 3.84 flange stress = 480000# SR = 28.2
2.25
24.95 □" net

18.0
62
80.0 @ 3.4 × 1.45

Use 2Ls 6×6×3/4 = 16.88 13.88 □" net
1Pl. 14×½ = 7.00 6.00
1Pl. 14×½ = 7.00 6.00
30.88 □" gr 25.88 □" net

(350#)

At D m = 3296,000 '# ~~web assumed~~ 60 × 3/8 = 22.5 ⅛ web = 2.82
Effective depth say 4.84 flange stress = 682.000# SR = 40.0
2.82
37.18 □"

11.25 @ 3.4 × 1.25

2Ls 6×6×3/4 = 16.88 13.88 net
2Pls. 14×½ = 14.00 12.00
2Pls. 14×½ = 14.00 12.00
44.88 □" 37.88 □" net

(480)

Approximate metal in moving leaf. (½ span ~~½ width~~).

Stringers 4@ 32# = 128# per lin ft. 128 × 40.67 = 5210# 2@5210 = 10420#
Cross beam A. Fascia. 17 × 2 × 40.67 = = 1380

web + 20.72
flanges 20.72
11.25
52.69# @ 3.4 = 179#
20%. 21
200#

200 × 39. = 7800#
2- 70 × 5.5 = 770
8570#

Cross beam B + C + E. 70 × 51 = 3570#

Cross beam D web - 19.90
2@16.88 = 33.76
53.66 @ 3.4 = 182
20% details - 35
217#

217 × 39 = 8460
2-70 × 5.5 = 770
9230#

Girder G_2 web - 9.00
flanges. 25.72
34.72 @ 3.4 = 118.0
20% details = 24.0
142.0#

2- 142.0 × 40.67 = 11550#

Bracings. 100# per lin ft. × 41.7 = 4170#

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CALCULATIONS FOR

Preliminary Design of 1st Canal Bascule Bridge.

weight of main girder G1

average. flanges. 62.0
web. 18.0
80.0 @ 3.4 = 272#
20%. details. 55
327#

654 × 57.5 = 37600#
654 × 39.0 = 25500
654 × 18.5 = 12100

Cross beam for Cwt frames. 2-500 × 39 = 39000#

Flooring – 30.5 × 39.08 × 41.7 = 49700#
nailing piece and curb angles &c 3 @ 8.5 = 25.5# × 41.7 = 1060 × 2 = 2120#
Curb angles + Timber 22.7 × 41.7 = 945 × 2 = 1890#
sidewalk slab. 47 × 6.6 × 2 = 620# per ft 620 × 41.7 = 25900#
Track tie 225# × 41.7 = 9400#
Handrail. 100 × 41.7 = 4170#
rails. 4-43# × 41.7 = 7160#

Trolley poles 4000#
Center lock mechanisms. say 1200# including motor.
mechanisms around trunnion. say 4000#

Center of gravity moment about ℄ of trunnion.

wt	weight	arm	moment	arm	moment
stringers	10420	1.58	16500	17.65	184000
"	1380	0.50	690	17.65	24400
Beam A	8570	2.00	17140	38.00	326.000
B	3570	2.00	7140	27.83	99200
C	3570	2.00	7140	17.66	63000
D	9230	3.00	27700	7.50	69200
E	3570	2.00	7140	- 2.67	- 9500
Girder G2	11550	2.00	23100	17.65	204000
girder G1	37600	3.50	131500	7.00	263000
bracings	4170	3.00	12410	17.65	73600
Cross beam cwt	39000	3.00	117000	- 13.50	- 527000
Flooring.	49700	0.33	16400	18.15	902.000
nailing piece	2120	0.70	1480	18.15	38500
track ties	9400	0.83	7800	18.15	170500
rails	7160	0.30	2150	18.15	130000
Curb Ls&c	1890	0.00	—	18.15	34300
Sidewalks	25900	-0.12	- 3100	18.15	470000
Handrails	4170	-1.50	- 6250	18.15	75700
Trolley poles	4000	-16.00	- 64000	38.00	192000
Center lock	1200	+2.00	2400	39.00	46800
About trunnion	4000	3.00	12000	0.00	—
	242170	1.39	336340	11.68	2829700

25500
12100

14.0
18.0
8.0

38200
497000
97000

360000
97000
260000

54670
197500
from crown of Roadway.

466690
73350
336,340
1.39'

From ℄ trunnion
3366200
536500
2829700
11.68

536500
97000
633500

3366200
97000
3463200

2.55

12100
3570
39000
54670

54670 -- 11.6 633500 —
197500 -- 17.50 3463700 —

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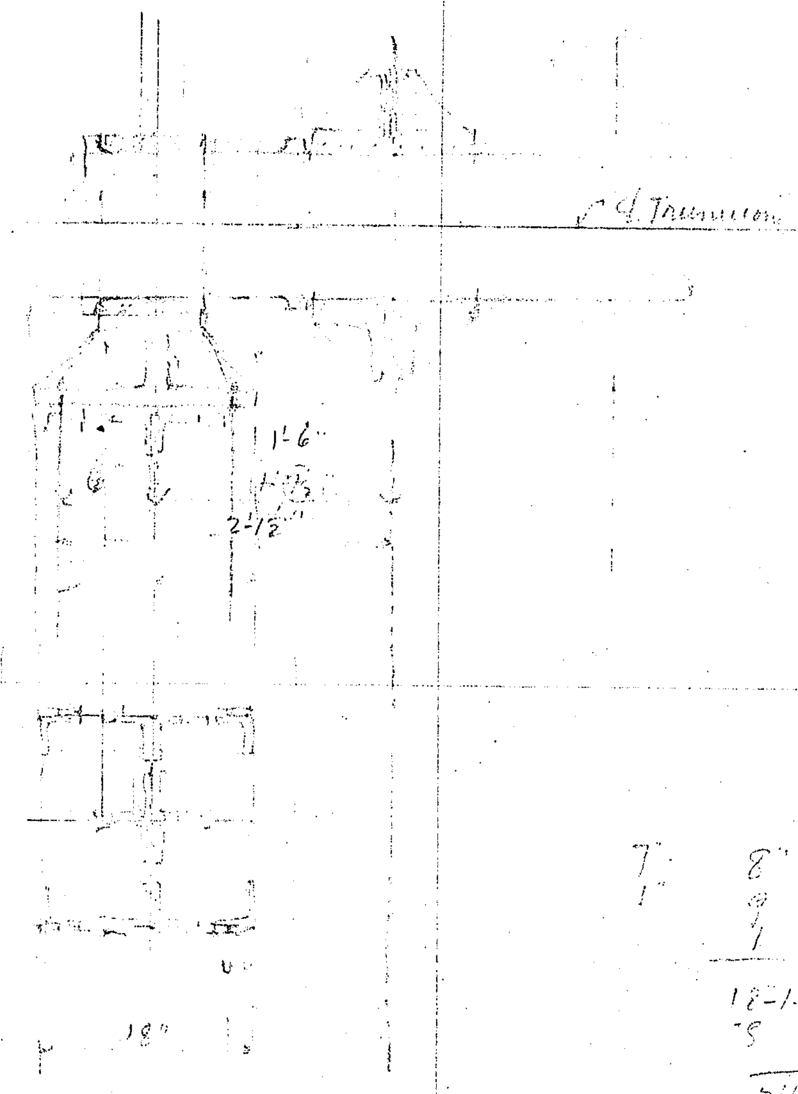
CALCULATIONS FOR

Preliminary Design of 1st Canal Bascule Bridge.

Counterweight. arm = 14.5
moment about ℄ trunnion = 2829700# Wt reqd for Cwt = 2829700 ÷ 14.5 = 195000#
Concrete required = 195000 ÷ 145 = 1345 cubic ft.
length of Concrete Cwt 35.0 $\frac{1345}{35 \times 6} = 6.4'$ $\frac{1345}{35 \times 5.5} = 7.0$

Use Cwt = 35 × 5.5 × 7.0 = 1345 cubic ft.
Total load on trunnion
moving leaf. = say 242000
Counterweight = 195,000
437.000# ÷ 2 = 218500# per girder.
trunnion bearing 218500 ÷ 1600 = 136.5 □"
trunnion assumed 12" dia. length required = $11\frac{1}{2}$"

Bearing on trunnion support 2-10" $\frac{136.5}{20}$ = 6.825" about.



strength of trunnion
span length 3'-3". load = 218500#
moment at center. = $\frac{218500}{2} \times 1.62$ = 176500'#
or 2120.000"#
moment of inertia = 0.049 × 12^4 = 1016. (11#)
$fs = \frac{2120.000 \times 6}{1016} = 12500$#/□"

Load on one trunnion post. = say 110.000#
Section for trunnion post.
110.000 ÷ 11000 = 10.□"
2[s 12 × 25# = 14.64

Transverse moment load 110.000 × 0.2 = 22.000#
moment = 22.000 × 7 = 154.000'#
fibre stress = $\frac{154.000 \times 12 \times 6}{\text{say } 300}$ = 37000 #/□".
Try 18" plate and angle section.
or 18" I beams. moment of inertia = say 2200.

7" 8"
1" 9
1

fibre stress = $\frac{154.000 \times 12 \times 9}{2200}$ = 3440 #/□"

18-1'6
-8 9
1
2'4"

Approximate weight of trunnion post.

2- 400 × 15.0 = 12000#

2Pls 18 × 1/2 = 61.2
4Ls 4 × 4 × 1/2 = 51.2
1Pl. 18 × 3/8 = 22.95
4Ls 3½ × 3½ × 3/8 = 34.0
169.35#
Details say 30.65
200.00# per lin ft.
2@200 × 8.0 = 3200#
base. 2@600 = 1200
braces. 800
diaphragms. 500
5700 call this 6000#

Preliminary Design of 1st Canal Bascule Bridge.

weight of trunnion 1 ⌀ 385# × 4.0 = 1540#
Bearings. 2-700 1400
2940# call this 3000#

2 @ 5700 = 11400
2 @ 3000 = 6000
17400#

Max Starting force at the rack circle.
Inertia of the moving Mass. F = Ma.
where M = ~~the~~ Equivalent mass at the rack circle
a = acceleration in ft per second.
If a given weight W has its gravity center a distance e from the center of rotation, the equivalent mass reduced to a rack of radius r may be had from the formula

$$M = \frac{We^2}{32.2 r^2} \quad \text{or} \quad Mr^2 = \frac{We^2}{32.2}$$

For approximate only
Lever Arm Mr^2 = $197500 \times 17.50^2 \div 32.2$ = 1880000
rear arm Mr^2 = $54670 \times 11.60^2 \div 32.2$ = 228,000
" " Concrete Mr^2 = $195000 \times 14.5^2 \div 32.2$ = 1272.000
3,380,000

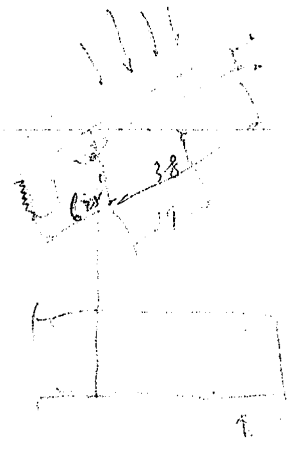
r = radius of rack = 6'3". Then M = 86500 ft-lbs.
Length of travel on rack circle $2\pi \times \frac{6.25 \times 72}{360} = 7.84'$

time for operation 1 min $\frac{7.84}{\frac{15}{2}+30+\frac{15}{2}} = \frac{7.84}{45} = .174'$ per second.

Acceleration for 15 second $\frac{0.174}{15} = 0.0116$ ft per second

F = Ma = 86500 × 0.0116 = 1000 lbs for both racks.

Wind resistance
Flooring 51.5 × 15# = 772# per lin ft.
Tangential force at rack circle = $\frac{772 \times 38 \times 19}{6.25}$ = 89000#



Frictional resistance Load on trunnion (dead Load) 242170
Counterweight 195000
437170#
Wind load pinion reaction 89000
526170#

Journal assumed 8" × 10" bearing = $\frac{526170}{4 \times 8 \times 10}$ = 1645#/□" ok Trunnion assumed 10" dia.

Frictional coefficient assumed 0.15
$0.15 \times \frac{526170 \times 5}{75}$ = 35200# × .15 = 5280#

The total tangential force at Rack circle

Inertial		1000	Inertial	1000		1000
Wind	15#	89000	Wind 10#	59300	5#	29700
Frictional		3520 5280	Frictional	3500 5280		3500 5280
		93520#		63800#		34200#
		47000		32000		17100

Main drive pinion
16 teeth 3½" pitch circle. tooth face 10" Total force for one rack. 47000#
$S = \frac{47000}{3\frac{1}{2} \times 10 \times 0.094} = 14200$#/□"

assuming tooth face 9" $S = \frac{47000}{3.5 \times 9 \times 0.094} = 15800$#/□" ok

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CALCULATIONS FOR

Preliminary design of 1st Panal Bascule Bridge.

Pinion radius $3.5 \times 16 \div 2\pi = 8.912$ inches.

max torque on the drive pinion

15# wind $93520 \times 8.912 = 832000$ ''# or 69300 '#

10# wind $63800 \times 8.912 = 568000$ 47300 "

5# wind $34200 \times 8.912 = 305000$ 25400 "

0# wind $4500 \times 8.912 = 40000$ 3340 "

Circumference of the drive pinion $\frac{2\pi(8.912)}{12} = 4.66$ ft

max linear velocity of rack 0.174' per second or 10.42' per min.

revolution per min of the pinion $\frac{10.42}{4.66} = 2.24$ rev. pm.

The power required to operate each pinion

$$HP = \frac{2\pi(\text{torque})\,RPM.}{33000} = \frac{2\pi(69300) \times 2.24}{2 \times 33000} = 14.8 \text{ or}$$

For both sides $14.8 \times 2 = 29.6$ HP.

Average gear efficiency each set say 0.93 For 4 sets $0.93^4 = 0.747$

15# $29.6 \div 0.747 = 39.7$ HP. — 92700 '#

For 10# wind 33.9 " 63200

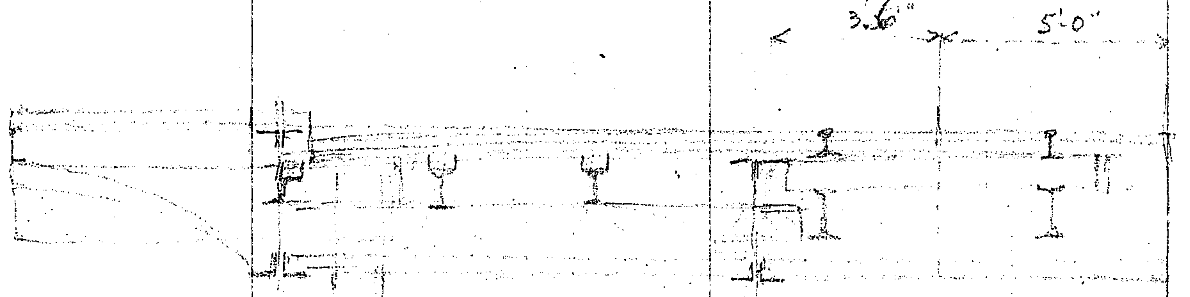
" 5# wind 18.2 " 34000

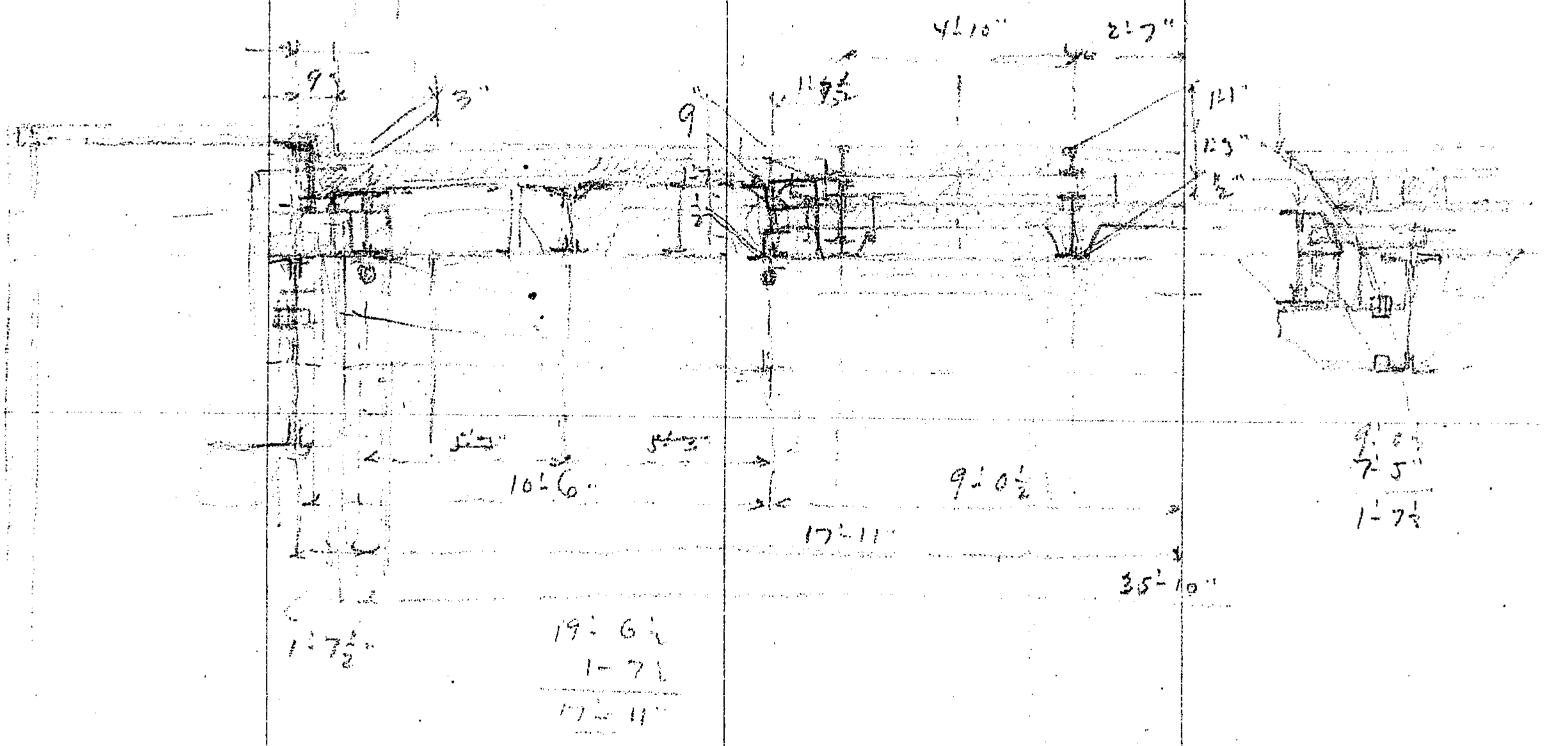
" 0# wind 7.39 " 4460

holding against 15# wind. $\frac{87000}{93520} = 0.93$ 46.2 " 86200

$\frac{2.0}{2.0}$

⑤





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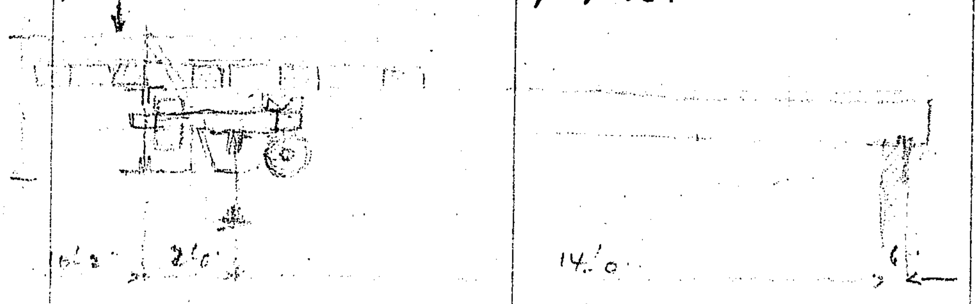
CALCULATIONS FOR

Preliminary design of 1st Panel Bascule Bridge

Flooring on pier.
General sketch shown on page 16.



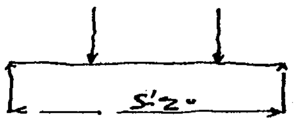
Railway Stringer.
Concrete slab under Electric Tracks and Highway –
max span length 5'-2" under Elec. Ry track.

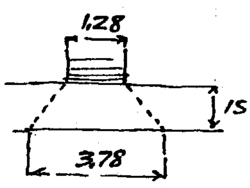
Height of Rail 7" Railway tie 6" high. 3" under track or 2" 7"+8" = 15"
Pavement 3", 12" cinder Concrete or gravel filling 120#/cubic ft.
Dead Load
3" pavement = 15#
12" concrete = 120#
6" concrete slab. 75
210# per lin ft.

$m = \frac{1}{8} \cdot 210 \times 5.\frac{25}{17}{}^2 = 704$#
Shear $= \frac{210}{2} \cdot 5.17 = 543$#

Live Load Concentration rear wheel motor truck 9900
Impact 30% 2970
12870#

15
7
6
28 – 2.4





distribution of wheel concentration for single load.
1.28 + 2.5 = 3.78' transverse. b.
.66 + 2.5 = 3.16' longitudinal a

$E = \frac{2}{3}(l+b)+a$
$= \frac{2}{3}(5.17+3.78)+3.16 = 9.11'$

Assume distribution 5.0 12870 ÷ 5.0 = 2570
Concentration at center of span $m = 1285 \cdot 2.58 = 3320$#
Less. $\frac{3.78}{4} \times \frac{2570}{2} = 1215$
2105#
Dead Load moment 704
2809#

Effective depth required for concrete slab $= \sqrt{\frac{2809}{102}} = 5.25"$ insulation say 3/4"

Total depth of slab say 6"

Slab under highway. transverse dist b = 1.28 + 1.0 = 2.28
longitudinal dist a = .66 + 1.0 = 1.66
Effective width $E = \frac{2}{3}(5.17+2.28)+1.66 = 6.69$ Effective width assumed 5.0.

Dead Load moment
Dead Load pavement 15 $m = \frac{1}{10} \cdot 90 \cdot 5.25^2 = 248$#
slab say 75
90#

Live Load moment Concentration rear wheel motor truck 12870#
12870 ÷ 5.0 = 2570#
Concentration at center of span $m = 1285 \cdot 2.\overset{62}{\cancel{58}} =$ ~~3320~~ 3360
$\frac{2.28}{4} \times \frac{2570}{2} =$ 730
2630 · 0.8 = 2100
Dead Load moment 248
2348#

Effective depth req'd $= \sqrt{\frac{2348}{102}} = 4.8"$ use 6" Slab over all

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CALCULATIONS FOR

Preliminary design of 1st Panal Bascule Bridge.

Electric Railway Stringer

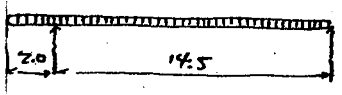
span length 14.5 over hang 2.0

Dead Load 210# · 5.0 = 1050# per lin ft.

Rail. $\frac{122}{3}$ say = 41

stringer say = 40

1131# per lin ft.



1131 · 16.5 = 18700#

Reaction = $18700 \cdot \frac{8.25}{14.5}$ = 10670

8030 ÷ 1131 = 7.1

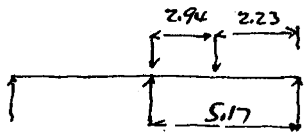
18700 - 10670 = 8030#

max. positive moment = 8030 · 7.1 = 57000 '#

8030 · 3.55 = -28500

28500 '#

Live Load moment motor truck loading



$12870 \cdot \frac{2.33}{5.17}$ = 5800

12870

17670#

moment at center of span

$\frac{17670}{2} \cdot 7.25$ = 64000 '#

Dl. moment = 28500

92500 '#

section modulus req'd = $\frac{92500 \cdot 12}{17000}$ = 65.2

Use 15" beam 60.8# section modulus = 81.2

Highway stringers

Dead Load 90# · 5.25 = 472#

stringer say 40

512#

m = ~~4820~~ ·3630 · 7.1 = 25800

$\frac{3630}{2} \cdot 7.10$ = -13900

13900 '#

512 ·(14.5 + 2.0) = 8450# R = $8450 \cdot \frac{8.25}{14.5}$ = ~~2480~~ 4820

8450 - 4820 = 3630 3630 ÷ 512 = 7.1

Live Load Rear wheel motor truck 12870# moment at center $\frac{12870}{2} \cdot 7.25$ = 46600

Dead Load moment 13900

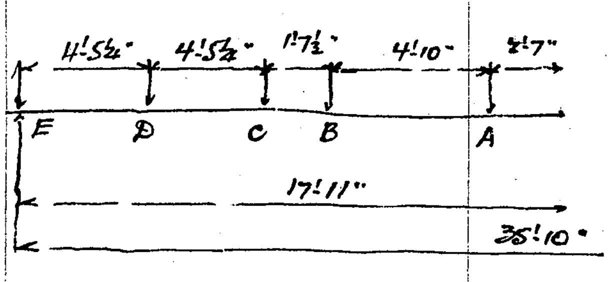
60500 '#

Section modulus req'd = $\frac{60500 \cdot 12}{17000}$ = 42.7

Use 15" · 42.9 I. Sm = 58.9

Cross beam under Electric Ry and Highway slab. span length 35'-10"

Dead Load. approximate only.



A = 1130# per lin ft Reaction = 10670#

B = 210 · 3.23 = 678.

Rail + stringer say 82

760 · 16.5 = 12550#

~~760~~ $12550 \cdot \frac{8.25}{14.5}$ = 7150#

C. 210 · 0.81 = 170#

90 · 2.22 = 200

stringer say 45

415

$R = \frac{415 \cdot \overset{16.5^2}{\cancel{14.5}^2}}{2 \cdot 14.5}$ = 3900#

D 90 · 4.44 = 400

~~stringer~~ say 45

445

$R = \frac{445 \cdot 16.5^2}{2 \cdot 14.5}$ = 4170

A 10670
B 7150
C 3900
D 4170
25890#

moment at A 25890 · 15.33 = 397000 '#

7150 · 4.83 = 34500

3900 · 6.45 = 25200

4170 · 10.89 = 45400

105100

291,900 '#

Live Load moment Electric loading on tracks and motor truck loading on both sides.

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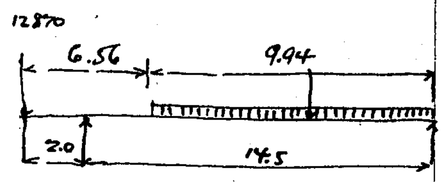
CALCULATIONS FOR

Preliminary Design of 1st Canal Bascule Bridge.

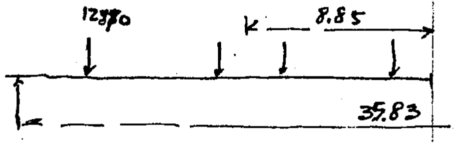
Live Load max loading will be 4 motor truck at the end of cantilever bracket



uniform load 120# per sq ft.

$R = \frac{120 \cdot 9.94^2}{2 \cdot 14.5} = 408$# per lin ft.

motor truck loading



moment at center 4 · 12870 · 17.92 =
4 · 12870 · 8.85
9.07 = 468000

$\frac{1}{8} \cdot 408 \cdot 35.83^2$ = 65700

533700

Dead Load moment = 291900

825600 #

Depth of web say 33" · 3/8 = 12.38 ☐" 1/8 web = 1.550 ☐" Effective depth say 2.65'

flange stress = 825600 ÷ 2.65 = 312000 SR = 18.35
1.55
16.80 ☐"

2Ls 6×6 · 5/8 = 14.22 - 11.72
1 Cov.pl. 13 · 1/2 = 6.50 5.50
20.72 ☐" 17.22 ☐" net.

Approximate column load.

Dead Load say	say	30.000	Use 4Ls 6×4 · 1/2 =	19.00	3/8" metal.	14.44
Live Load.	4 × 12870 =	51500	1 web. 12 · 1/2 =	6.00		4.50
unif.	410 · 17.92 =	7300		25.00		18.94 ☐"
beam say		4200			Use this section.	
		93000 #				

Approximate structural steel in span moving leaf.

stringers		10420 #
" sidewalk.		1380
Cross beams	A	8570
	B	3570
	C	3570
	D	9230
	E	3570
Girder G2		11550
Girder G1		37600
Bracings -		4170
Cross beam Cwt		39000
Curb Ls &c		1890
Trolley poles. say		4000
		138520 #

Around trunnion and trunnion supports. = 17400 # for one leaf.

Summary for structural steel

2 moving leaves	2 @ 138520 =	277040 #
2 trunnions + supports	@ 17400 =	34800 #
2 Flooring + misc.	@ 27550 =	55100
Total -		366940 #

or 164 tons of structural steel.

Flooring on abutment (fixed Floor).

Stringers 4 @ 60 # = 240 # · 17.0 = 4080 #
6 @ 42.8 = 257. · 17.0 = 4370 #

Cross beam 20.72 × 2 = 41.44
web 12.38
53.82

53.82 · 1.25 · 3.4 # = 227 # · 37.0 = 8400

Columns 2 @ 90 # · 15.0 = 2700

Reaction Column for tail end say = 3000

Trolley poles say fixed end 4000

Trolley side poles for cwt 1000

27550 #

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CALCULATIONS FOR

Preliminary design of 1st Canal Bascule Bridge

Mechanism at Center lock 1 Required.
" " tail lock 2 Required.
Operating mechanism c 2 Required

Operating machineries

Gears and Pinions	4 sets	@ 2500#	=	10.000	
Shafting & Couplings	4 sets	@ 2000	=	8000	
Machinery frames	4 @	3000	=	12000	
Racks	4 @	1600	=	6400	
					36400#
Center Locking machinery - say -					7000
tail Locking machinery say -		2 @ 4000 -			8000
Brakes indicators etc.					3000
					54400# — call this 55000#

Estimate of abutment.
Concrete in the base. $32.0 \times 60.0 \times \frac{6.0}{216.0} = 5320$ 立坪
Outside walls.
$164.0 \times 3.0 \times \frac{29.0}{216} = 66.0$ 立坪

Inside concrete filling - $24.0 \times 51.0 \times \frac{6.5}{216} = 36.8$ 立坪

Machinery flooring and Column support say 10.0 立坪

Reinforcing bars in concrete walls and floor and column support 15 tons.

Estimate of Cost.

Concrete in base.	5320 立坪	@ $140.^{00}$	=	7450 yen
walls.	66.0	@ 140^{00}	=	9250 "
Inside concrete filling.	36.8	@ 100^{00}	=	3680 "
Machinery flooring &c	10.0	@ 140^{00}	=	1400^{00}
forms for concrete. say				4500^{00}
Reinforcing bars	10 tons	@ 160^{00}	=	1600^{00}
Excavation.	50.0 立坪	@ 50^{00}	=	2500^{00}
Coffer dam sheet piling	30 ken	@ 150^{00}	=	4500^{00}
				34880^{00} call this 35000^{00}

$2 @ 35000^{00} = 70.000^{00}$

Operating House. $2.5 \times 2.0 = 5.0$ 坪
$5 @ 250^{00} = 1250^{00}$
2 houses @ 1250 = 2500^{00} yen.
House Equipment switch board &c. 2000
4500

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CALCULATIONS FOR

Preliminary design of 1st Canal Basoule Bridge.

Estimate of Cost.

Flooring on moving leaf. $\frac{37.8 \times 41.5}{36} = 43.5$ 面坪

Flooring on moving leaf. Sidewalk. $13.2 \times \frac{41.5}{36.} = 15.2$ 面坪

Flooring on fixed portion. $37.8 \times \frac{18}{36} = 18.4$ 面坪

Sidewalks. $13.2 \times \frac{18}{36} = 6.6$ 面坪

Estimate of Cost for flooring. 2@ 70 × 43.5 = 6090.00
sidewalk. 2@ 25 × 15.2 = 760.00
under track. 2@ 35 × 30.0 = 2100.00
8950.00

Fixed portion. 2@ 75 × 18.4 = 2760
2@ 35 × 6.6 = 460
3220.00
¥ 12170.00

Electric Ry tracks over bridge proper only.
$\frac{4}{3}$-122# = 163#
misc metal say 27.
190# per lin ft. × 120' = 22800# or 10.2 tons.

Rail + Rail laying bonding &c 10.2 tons @ 180.00 = ¥ 1835.00

Structural steel in spans. 164 tons @ 260.00 = 42600.00 164 @ 280.00 = 46000.00
Operating machinery 55000# @ 60 sen = 33.000.00 55000 @ 75c = 41200.00

Electrical Equipment motors 4@ 2200 = 8800.
3 @ 800 = 2400
10200
wiring etc. 3000
13200.00

Trolley wire equipment say 1000.00
gates 2@ 250.00 500
1500.00 × 2 = 3000.00

Concrete in counter weight. 2@ $\frac{1345}{216}$ = 12.45 立坪

12.45 @ 180.00 = 2240.00

Summary for cost

Flooring	12170.00	
Ry tracks. rails only	1835.00	
structural steel	~~42600.00~~	46000.00
Operating machinery	~~33000.00~~	41200.00
Electrical Equipment	13200.00	
Trolley wires + gates	3000.00	
Concrete Cwt	2240.00	
		119.645.00
Handrails. 2@ 120' × 12.00		2880
		122525.00
2 abutments		70.000.00
Operating House + Equipment		4500.00
		197025.00
misc expense. say		20000
		217025.00

41200
13000
54200 × $\frac{28}{80}$

17500

増田淳氏関係資料
（独立行政法人 土木研究所蔵）

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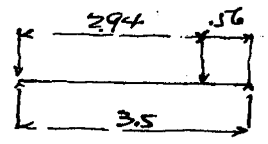
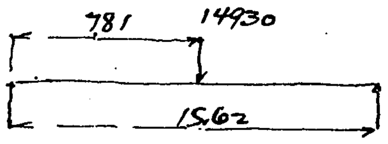
CALCULATIONS FOR

Preliminary design of 1st Canal Bascule Bridge 60' single leaf. trunnion Bascule.

General cross section of bridge same as for 30' double leaves.
Loading etc see sheets nos 1 and 2
Timber Flooring same.
Stringers span length 15'-7½" stringer spacing 3'-6". for Highway stringers
Dead Load. 30.5 × 3.5 = 106.8#
stringer say 35.2
142.0# per lin ft.
Dead Load moment = $\frac{1}{8}$ × 142.0 × 15.62² = 4320'#
Live Load motor truck loading rear wheel concentration with impact 12870#



12870 × $\frac{.56}{3.5}$ = 2060#
12870
14930#



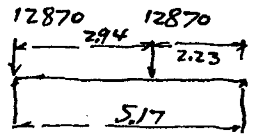
wheel concentration at ℄ of span
moment = $\frac{14930}{2}$ × 7.81 = 58400
Dead Load moment = 4320
62720'#
section modulus required = $\frac{62720 × 12}{17000}$ = 44.2

Use 12" × 6" I × 44.02# Sm = 52.57

Electric Ry stringers Dead Load 312# per lin ft.
moment = $\frac{1}{8}$ × 312 × 15.62² = 9530'#

Live Load Street Ry Car.
18 ton car conc 10080
30% 3000
13080
m = $\frac{13080}{2}$ × 7.81 = 51100
DL.m 9530
60630'#

motor truck loading -

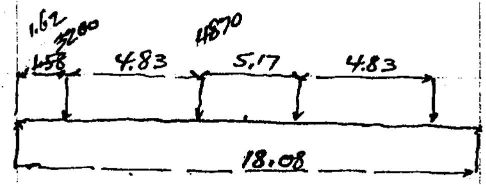


12870 × $\frac{2.23}{5.17}$ = 5550
12870
18420#
m = $\frac{18420}{2}$ × 7.81 = 72000
DL. moment 9530
81530'#
section modulus reqd = $\frac{81530 × 12}{17000}$ = 57.5

Use 12" × 6" @ 53.99# Sm = 62.6#

Approximate weight of stringers -
2 @ 12" [s @ 26.1# = 52.2
4 @ 12" × 6" I @ 44.02 = 176.0
4 @ 12" × 6" I @ 54.00 = 216.0
444.2# per lin ft.
444.2# × 78.2 = 34700# for moving leaf.

Design of floor Beam at end of span
make this floor beam continuous between main outside girders to carry load from longitudinal Electric Railway girders.
Intermediate floor beam spacing 15'-7½" span length 18'-1" for Electric Railway tracks
Dead Load Flooring Inside Rail 312# × 15.62 = 4870#
outside rail 205.5 × 15.62 = 3200
Dead Load moment Reaction 4870
3200
8070
m = 8070 × 6.45 = 52000
3200 × 4.83 = 15450
36550'#



Girder = $\frac{1}{8}$ × 80 × 18.08² = 3260
39810'#

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CALCULATIONS FOR

Preliminary design of 1st canal Bascule Bridge - 60' single leaf trunnion Bascule.

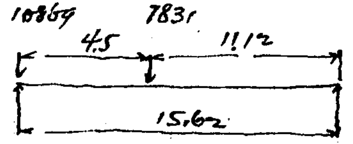
Live Load.

Street car loading - 8359 6021 $7831 \times \frac{11.12}{15.62}$ = 5570#

30% 2510 1810 10869

10869 7831. 16439 call this 16500#

Reaction on floor beam



Live Load moment 16500 · 2 · 6.45 =

16500 · 4.83 =

16500 · 8.07 = 133,000'#

DL moment = 39810

172810'#

Girder 2'-6½" back to back of Ls

web 30 · 5/16 = 9.37 □" ⅛ web = 1.18 stress in flange 172810 ÷ 2.40 = 72000#

Section required 72000 ÷ 17000 = 4.23

1.18

3.05 □" Use 2Ls 3½ · 3½ · 3/8 = 4.96

\- 1.32

3.64 □" net.

For highway Floor beam and cantilever bracket under sidewalk use same section as per above floor beam

Approximate weight of intermediate floor beam.

main section 4.96 × 2 = 9.92

web. 9.37

19.29 @ 3.4 = 65.5

details say 20% 13.0

78.5 call this 80# per lin ft.

Total weight 80 · 51 = 4080 or say 4000# per piece.

Longitudinal Electric Ry Girder. G2. Highway main girder G1

Dead Load flooring etc 746.5# per lin ft. DL etc 443.7# per lin ft.

sidewalks. 243.0# per sidewalk. moment about G1 = 1260'#

negative reaction on G2 = 1260 ÷ 10.5 = 120#

Reaction on G1 = 243.0 + 120 = 363#

Summary reaction. G1 443.7 G2 746.5

363.0 120.0

806.7# per lin ft. 626.5# per lin ft.

Not counting cantilever effect

G1 443.7 G2 746.5# per lin. ft.

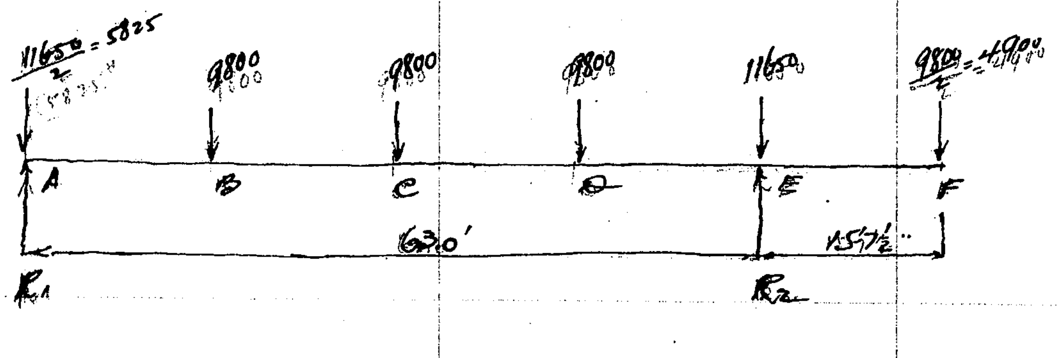
243.0

686.7# per lin ft.

Concentration on G1 806.7 · 15.62 = 12600 on G2 626.5 · 15.62 = 9800#

or 686.7 · 15.62 = 10700 746.5 · 15.62 = 11650#

Dead load stress. G2



moment at E due to cantilever effect.

4900# · 15.62 = 76500'#

negative reaction = 76500 ÷ 63 = 1218#

Summary reaction R1

9800 · 1.5 = 14700#

1218

13482#

14700
11650
4900
31250
-1220
30030 call this 30,000#

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CALCULATIONS FOR

Preliminary design of 1st Canal Bascule Bridge 60' single leaf trunnion Bascule.

Dead Load positive moment at C.

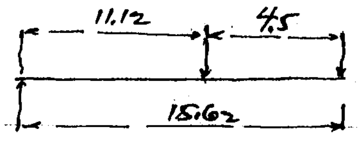
m = 13482 · 2 · 15.62 = 421.000
9800 · 15.62 = 153.000

268.000 1# ← add DL m of girder itself.

Live Load

negative moment at E Electric car loading.

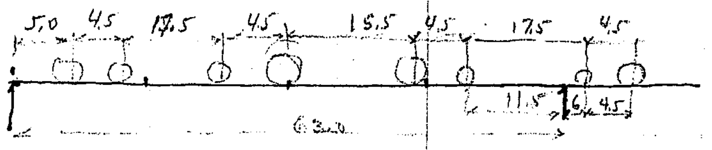
7831# · 2 10869# · 2 moment 10869 · 15.62 = 170.000
7831 · 11.12 = 87.200



259,200 # × 2 = 518,400
Unif. load. $\frac{9850}{2}$ · 15.62 = ~~76900~~ 76900
~~336100~~ 1# 595,300 1#

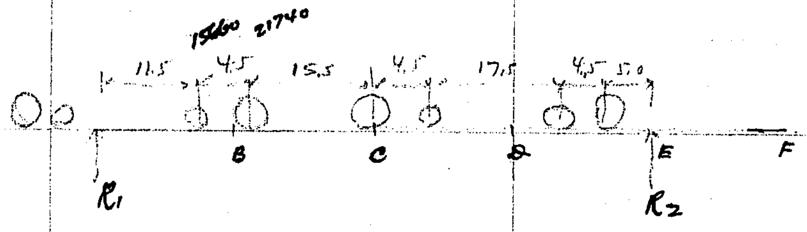
Uniform load $\frac{10.5}{2}$ · 120 = 630#
Concentration 630 · 15.62 = 9850#

Positive moment at C



Reaction R1 = 21740 · 83.5 = 1815.000
15660 · 87.5 = 1370.000
3,185.000 1#

R1 = 3185.000 ÷ 63.0 = 50,500#



moment at C 50500 · 31.5 = 1590000
21740 · 15.5 = 337000
15660 · 20.0 = 313000

- 650.000
940.000 1#

Uniform live load - Conc. 9850 moment 9850 · 2 · 15.62 = 308.000
1,248.000 1#

Live Load moment 1,248.000
Dead Load moment 268.000
1,516.000 1#

~~web assumed~~ 48" · 3/8" = 18.0 □" $\frac{1}{8}$ web = 2.25 flange stress = 1,516.000 ÷ 39 = 389,000#

Section required 389.000 ÷ 17000 = 22.90
2.25
20.65 □" net

2Ls 6 · 6 · ½ = 11.50 9.50
1Pl 13 · ½ = 6.50 5.50
1Pl 13 · ½ = 6.50 5.50
24.50 □" 20.500 □" net

2 · 24.5 = 49.0
web = 18.0
67.0 □" · 3.4 = 228.0
20% 45.
273#

Approximate weight of one girder.
call this 280# per lin ft.

280 · 78.6 = 22000#
For two girder 2 @ 2200 = 44000# for one span.

End Floor Beam span length 39'-1"

Dead Load Concentration from Ry Girder G2.

13482
5825
19307# neglecting negative reaction concentration say 20.000#

Dead Load moment

moment = 20.000 · 10.5 = 210.000 1#
Girder $\frac{1}{8}$ · 300 · 39.08² = 57.200
267.200 1#

Max Reaction due to live load.

moment 21740 · 118.0 = 2,570.000
15660 · 122.0 = 1910.000
4,480,000 ÷ 63.0 = 71,100#

Use live Load shoes under G2.

From uniform load 630 · 31.5 = say 20.000
91.100#

Preliminary design of 1st Canal Bridge 60' Single leaf Bascule

max load on live load shoe

Live Load		91.100
Dead Load	20.000	
girder	6000	
		26.000
		117.100 # per girder.

Max Live Load moment span length 18'-1" 133000 '# see page 23
Dead Load moment 267.200
400.200 '#

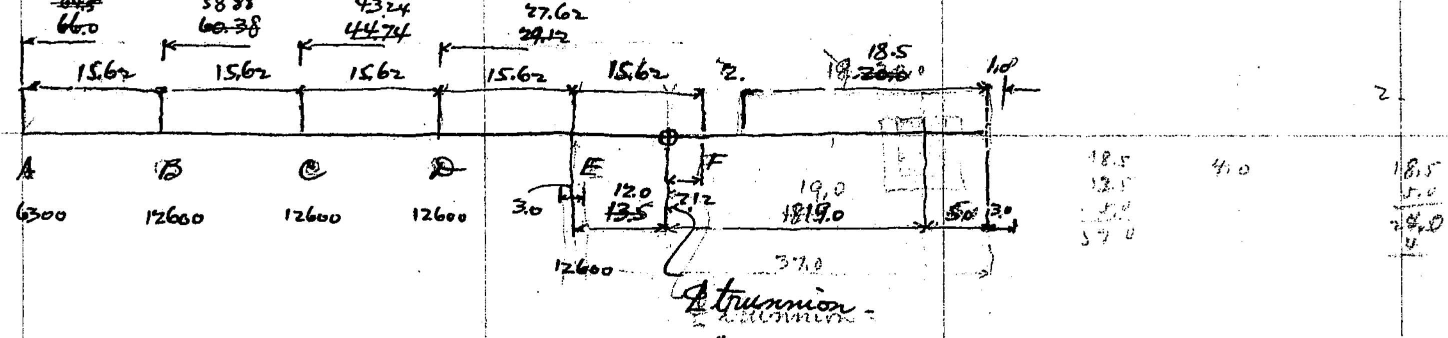
Depth of girder 54" × 3/8" = 20.25 □" of web = Effective depth say 4.4 about
flange stress = 400.200 ÷ 4.4 = 91.000 # SK = 91000 ÷ 17000 = 5.35 □" net.
use 2Ls 5 × 3½ × 3/8 = 6.10 or 5.35 □" net.

approximate weight of end Floor Beam
2 × 6.10 = 12.20
web - 20.25
32.45 @ 3.4 = 110.4 #
20% 22.0
132.4 call this 135 # per lin ft.

Total weight. Between main girders. 135 × 39 = 5260 #
2 cantilever Brackets - say 1000
6260 #

End Floor Beam over live load shoes at main abutment.
Using live load shoe. approximate weight say 8000 #

Outside main girder G1.
Dead Load. say 810 # per lin ft. Concentration say 12600 #



moment at B 6300 · 15.62 = 98500 '#
C 6300 × 2 · 15.62 + 12600 × 15.62 = 419,000 '#
D 6300 · 3 · 15.62 + 12600 × 3 × 15.62 = 885.000 '#
E 6300 · 4 · 15.62 + 12600 · 6 × 15.62 = 1575.000 '#
T. 1,575.000 + 4.5 × 12600 · 12 = 2255.000 '#

Dead from girder G2

at A.	13500	at E	30000
300 · 31.5 =	9400	300 × 3 · 15.62 =	14.000
Floor beam Extra	1000		1500
	23900 #		45,500 #

Moment at B 23900 · 15.62 = 374.000
C do · 2 = 7~~6~~48.000
D do · 3 = 1,122.000
E do · ~~4~~ = 1.495.000
T. 23900 ~~do~~ 74.5 ~~64.5~~ = 1.780.000 + 45.500 · 12 = 2320.000 '#

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CALCULATIONS FOR

Preliminary design of 1st Canal Bridge 60' Single leaf Bascule

Dead Load girder assumed 550# per lin ft.

moment at B $550 \times \frac{15.62^2}{2} =$ 67,000 1#

$550 \times \frac{4 \times 15.62^2}{2} =$ 268.000

$9 \times 550 \times \frac{15.62^2}{2} =$ 603.000

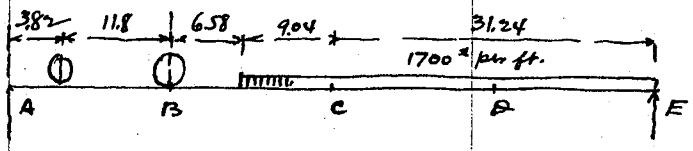
$16 \times 550 \times \frac{15.62^2}{2} =$ 1070.000

$550 \times \frac{74.5^2}{2} =$ 1525.000

Summary for dead Load moments

	B	C	D	E	T
Dead Load Floor	98500	419.000	885 000	1575.000	2.255.000
From girder g2	374.000	748.000	1122 000	1495000	2320.000
Dead Load girder	67.000	268.000	603000	1070.000	1525.000
	539,500	1,435.000	2,610.000	4,140.000	6,100.000 1#

Live Load moment motor truck loading. Rear wheel · 24800# Front wheel 1/3 × 24800 = 8260#



$R = \frac{1700 \times 40.28^2}{2 \times 63} = 21900$ #

motor truck $24800 \times \frac{3}{4} =$ 18600#

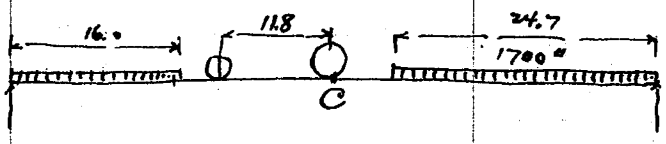
" " $8260 \times \frac{59.2}{63} =$ 7760

21900
18600#
7760
48260#

moment at B = 48260 × 15.62 = 755000

8260 × 11.80 = − 97500

657,500 1#



Reaction $\frac{1700 \times 24.7^2}{2 \times 63} =$ 8220#

$1700 \times 16. \times \frac{55}{63} =$ 23800

32020#
5660
12400
50080#

motor truck 12400# $8260 \times \frac{43.2}{63} = 5660$#

moment at C 50080 × 31.5 = 1,578,000

8260 × 11.8 = 97500

1700 × 16 × 23.5 = 640000

637 500

940,500 1#

Summary for dead and live load moments

	B	C	D	E	T
dead Load	539500	1.435.000	2610.000	4140.000	6.100.000
Live Load	657500	940.500	657500	—	—
	1197000	2,375,500	3,267,500	4.140.000	6.100.000 1#

Section of girder

at B 60" × 3/8 = 22.5 □" 1/8 web = 2.82 □" d = 4.9 Stress = 1,197.000 ÷ 4.9 = 244.000#

SR = 244000 ÷ 17000 = 14.35

2.82

11.53 □" net 2Ls 6×6 × 3/4 = 16.88 or 13.88 □" net.

at D. 2610.000 S = 2610.000 ÷ 4.9 = 533 000# SR = 533 000 ÷ 17000 = 31.40 □"

2.82

28.58 □"

2Ls 6×6 × 3/4 = 16.88 13.88

2Pls. 14 × 5/8 = 17.50 15.00

34.38 □" 28.88 □" net.

at E depth 7.0 84 × 3/8" = 31.50" 1/8 web = 3.94 □" d = 6.8 S = 4,140.000 ÷ 6.8 = 610.000#

SR = 610.000 ÷ 17000 = 35.90

3.94

31.96 □"

2Ls 6 × 6 × 3/4 = 16.88 13.88

2Pls × 14 × 5/8 = 17.50 15.00

1Pl. 14 × 3/8 = 5.25 4.50

39.63 33.38 □" net

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CALCULATIONS FOR

Preliminary design of 1st Canal Bridge 60' single leaf Bascule

at trunnion depth = 12.5 S = 6100.000 ÷ 12.5 = 488.000 SR = 28.70 –
use same section as for section Σ.
approximate weight of girder –
2@40 = 80.0
web – 31.5
121.5 × 3.4 = 413#
20% 82
495#

495# × 98 = 48500#
2@ 48500 = 97000# –

Counter weight girder – say 50.000#

Summary of structural steel in moving leaf.

Stringers		34700#
Floor beam	4@4000 =	16000
" "		6260
" "		8000
G2		44000.
G1		97000
Laterals –	100 × 79 – say	7900
Trolley poles	2@4000	8000
Curb L's &c.		3500
in Cwt.		50.000
		275360

Flooring on moving leaf. 30.5 × 39.08 × 80.0 = 95300
nailing piece and curb angles &c 3@8.5 = 25.5 × 80 = 2040 × 2 = 4080#
curb angles & timber 22.7 × 80 = 1820 × 2 = 3640#
sidewalk slab. 47 × 6.6 × 2 = 620 620 × 80 = = 49600#
Handrails. 100 100 × 80 = 8000
Track ties 225# × 80 = 18100
rails – 4@43 × 80 = 13750
Trolley poles. 2@ 4000 = 8000#
around trunnion – 4000 –

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CALCULATIONS FOR

Preliminary design of 1st Canal Bridge 60' single leaf Bascule.

Center of gravity ~~moment about~~ ℄ of trunnion.

wt.	weight.	arm	moment	arm	moment
Stringers	34700.	1.66		36.12	1,257,000
Beam A	6260	25		75.0	470,000
" B	4000	2.0		59.25	237,000
" C	4000	2.0		43.50	174,000
" D	4000	2.0		27.75	111,000
" E	8000	3.0		12.00	96,000
" F	4000	2.0		− 15.75	− 63,000
Girder G_2	44000			36.12	1,590,000
Girder G_1	97000			23.00	2,230,000
bracings.	7900			36.12	285,000
Cwt beams	50,000			− 19.0	− 950,000
Flooring.	95300			36.12	3,440,000
nailing piece	4080			36.12	147,000
track ties	3640			36.12	131,000
rails.	13750			36.12	496,000
Curb Ls &c	3500			36.12	126,000
Sidewalks.	49600			36.12	1,790,000
HR.	8000			36.12	289,000
Trolley Poles.	8000			51.00	408,000
around trunnion	4000			0.00	———
	452730				+ 13,272,000
				27.0	− 1,013,000
					12,259,000

33.2
(18.7) 27.7

Counterweight.
moment about trunnion 12.259.000'# wt required for cwt 12.259.000 ÷ 19.0 = 645,000#
Arm assumed 19.0 Concrete required = $\frac{645.000}{145}$ = 4450

arm

length 35.0 d = 8 b = $\frac{4450}{35 \times 8}$ = 15.9

Arm assumed 22 Cwt required = 12.259.000 ÷ 22 = 557,000#
Concrete vol. = $\frac{557.000}{145}$ = 3850
35 × 10 d = $\frac{3850}{3500}$ = 11.0

Max starting force at rack circle.
Inertia of moving mass.

River arm or moving leaf.	$4\overset{00}{\cancel{54}}000$	×	$\overset{33.2^2}{\cancel{27.0}^2}$	÷ 32.2	=	13.700.000
rear	54000	×	21.7^2	÷ 32.2	=	790.000
Concrete	557000	×	22.0^2	÷ 32.2	=	8370.000
						22,860,000

radius of rack 10.0 M = 2286.000
length of travel on rack circle $2\pi \times 10.0 \times \frac{76^\circ}{360^\circ}$ = 13.26'

time of operation 1 min. $\frac{13.26}{\frac{15}{2}+30+\frac{15}{2}} = \frac{13.26}{45}$ = 0.294' per second.

Acceleration for 15 seconds. $\frac{0.294}{15}$ = 0.0196 ft per second.

F = Ma = 228600 × 0.0196 = 4480# for both racks.

Wind resistance
On floor 51.5 × 15# = 772# per lin ft.
Tangential force at rack circle = $772 \times 76 \times \frac{38}{10}$ = 223000#

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CALCULATIONS FOR

Preliminary design of 1st Canal Bridge 60' single leaf trunnion bascule.

Frictional Resistance

Dead Load on trunnions. moving leaf. 454 000
Counterweight 557 000
1,011,000
wind load pinion reaction 223,000
1,234,000 #

Bearing required for Journal $\frac{1.234.000}{1650} = 749$

~~12"×8"~~ 4 - 15" × 12.5" trunnion assumed 15" dia.

Frictional coefficient 0.15 assumed

Friction $= 0.5 \times \frac{1.234.000 \times 7.5}{120} = 77200\# \times .15 = 11600\#$

The total tangential force at Rack circle.

	15"	10"	5"	0"
Inertial	4480	4480	4480	4480
15# wind	223000	148600	74300	—
Frictional	11600	11600	11600	11600
	239080 #	164680 #	90380 #	16080 #

Main drive pinion Total force for one rack 239000# ÷ 2 = 120,000#

16 teeth 3½" pitch 13"

$$S = \frac{120.000}{3.5 \times 13 \times 0.094} = 28{,}000 \ \#/\square''$$

Assuming a unit working strength of 20.000 #/□".

Required width of teeth $= b = \frac{120.000}{3.5 \times 0.094 \times 20.000} = 18.2''$

Pinion radius $3.5 \times 16 \div 2\pi = 8.912$ inches.

max torque on the drive pinion

15# wind $239080 \times \frac{8.912}{12} = 178{,}000$ ′#
10 " 164680 " $= 122500$ ′#
5 " 90380 " $= 67200$ ′#
0 " 16080 " $= 12000$ ′#

Circumference of the drive pinion $\frac{2\pi(8.912)}{12} = 4.66'$

max lin. velocity of rack 0.294' per second or 17.6' per min.

RPM pinion $\frac{17.6}{4.66} = 3.78$ Rev. per min.

Power required to operate each pinion.

$$HP = \frac{2\pi \times 178.000 \times 3.78}{12 \times 33000} = 64.0$$

For both girder $2 \times 64 = 128.$ HP

Average gear efficiency each set say 0.93 For 4 sets $0.93^4 = 0.747$

			torque.
For 15# wind.	$128 \div 0.747 =$	171.0 HP	238 000 #
10 "		118.0 "	$\overset{164}{158}$ 000 "
5 "		64.5 "	90.000 "
0 "		11.5 "	16100 "

Holding against the 15# wind $\frac{223000}{239080} = 0.93$ 159.0 HP.

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CALCULATIONS FOR

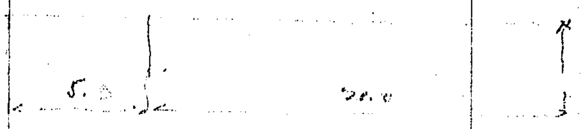
Preliminary design of 1st Canal Bridge, 60' single Leaf Trunnion Bascule.

Fixed Floor over abutment

Design of floor slab same as for double leaf trunnion bascule

Electric Ry stringers

Dead Load 1131# per lin ft.



D.L. moment Cantilever $1131 \cdot \frac{5^2}{2} = 14150$ 1#

D.L. moment at center line of span

$1131 \cdot 25 = 28300$ # $R_1 = \frac{28300 \cdot 12.5}{20} = 17700$ #

$R_2 \quad 28300 - 17700 = 10600$ #

$10600 \div 1131 = 9.35'$

moment at 9.35 $10600 \cdot 9.35 = 99000$ 1#

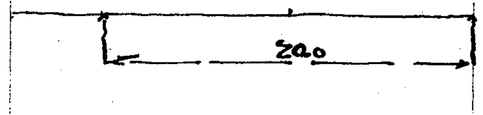
$1131 \cdot \frac{9.35^2}{2} = \underline{49500}$

49500 1#

Live Load moment

motor truck loading. Concentration = 17670#

moment = $\frac{17670}{2} \cdot 10 = 88350$ #



For unif. load say $\underline{1650}$

90,000 1#

Dead load m $\underline{49500}$

139500 1#

section modulus reqd = $\frac{139500 \cdot 12}{17000} = 98.5$ +

Use 18" @ 75.6# I Sm = 126.9

Highway stringers

Dead Load 512# per lin ft   approximate moment say $\frac{1}{8} \cdot 512 \times 20^2 = 25600$ 1#

Live Load Rear wheel concentration 12870

moment at center $\frac{12870}{2} \times 10 = 64350$

For unif. load say $\underline{1000}$

65350 1#

D.L. $\underline{25600}$

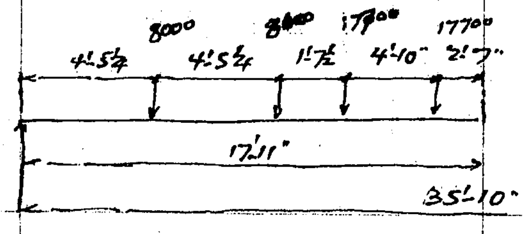
90950 1#

Section modulus reqd = $\frac{90950 \times 12}{17000} = 64.1$

Use 18" · 54.7# I Sm = 88.4

Floor Beam under fixed Floor.

Dead Load approximate only



Railway stringers. $1130 \cdot \frac{25^2}{2 \cdot 20} = 17700$ # $\div 5 = 3540$ # per ft.
$\underline{300}$
3840

Highway stringers $512 \cdot \frac{25^2}{2 \cdot 20} = 8000$ # $\div 3.5 = 2300$ #
$\underline{300}$
2600# "

$2 @ 17700 = 35400$
$2 @ 8000 = \underline{16000}$
51400#

moment = $51400 \cdot 17.92 = 922000$

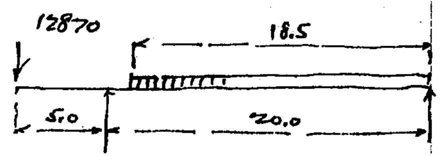
$17700 \cdot 10.0 = 177000$

$8000 \cdot 22.5 = \underline{180000}$

357000

D.L. beam say $\frac{1}{8} \cdot 300 \cdot 35.83^2 =$ 565000 1#
$\underline{48000}$
613,000 1#

Live Load 4 motor trucks at the end of Cantilever brackets.



Uniform load 120# per sq ft.

motor truck $12870 \cdot \frac{25}{20} = 16100$ #

Unif. load $\frac{120 \cdot 18.5^2}{2 \cdot 20} = 1030$ # per lin ft.

moment at center $4 \cdot 16100 \cdot 9.07 = 584000$

Unif. load $\frac{1}{8} \cdot 1030 \cdot 35.83^2 = \underline{165000}$

749000 1#

D.L. $\underline{613000}$

Total load m. 1362000 1#

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CALCULATIONS FOR

Preliminary design of 1st Panal Bridge, 60' single leaf Trunnion Bascule.

Depth of girder 3.0 web 36 × 3/8 = 13.50□" 1/8 web = 1.68 Effective depth = 2.9
Flange stress = 1362.000 ÷ 2.9 = 470000# SR = 27.60
1.68
25.92□" net

Try 42" × 3/8 = 15.70" 1/8 web = 196 Effective depth = 3.4
flange stress = 1362.000 ÷ 3.4 = 400.000# SR = 2360
1.96
21.64□" net

2 Ls 6×6×3/4 = 16.88□" 13.88 net
2 Pls. 14 × 1/2 = 14.00 12.00
30.88 25.88

2 @ 27.38 = 54.76
web. 15.70.
70.46 □" × 3.4 = 240
20% - details 48
288#

2 Ls 6×6×3/4 = 16.88 — 13.88□" net
1 Pl. 14 × 3/4 = 10.50 - 9.00
27.38□" 22.88□" net

approximate weight of girder 288# × 37.0 = 10700#

approximate Column load.
DL. say 65000
LL. 4×16100 = 64500
ULL. 1000 × 50/2 = 25000
Column say 2000
156500#

Unit stress say 9000#/□" including bending.
SR = 156500 ÷ 9000 = 17.35 □"
Use 2 Ls 6×6×3/8 = 14.44
web 12 × 3/8 = 4.50
18.94 □" @ 3.4 = say 650#

Approx. weight 65 × 15 = 975#
Shoes &c. 30%. 295
1270 say 1300#

2 @ 1300# = 2600# call this 3000#

approximate metal in stringers -
4 @ 75 × 26.0 = 7800#
4 @ 55 × 26.0 = 5720
2 @ 42 × 26.0 = 2180
15700#
misc details say 2300
18000#

Summary for structural steel in fixed floor.

stringers	18000
F.B.	10700
Cols.	3000
Trolley poles 2@4000	8000
Trolley side pole cut.	2000
	41700#

around trunnion and trunnion supports 25000#

Summary for structural steel.

moving leaf. say	280.000
trunnion supports &c	25000
Fixed floor	42.000
	347000# or 155 tons.
Live Load shoes say	3
	158 tons.

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CALCULATIONS FOR

Preliminary design of 1st Canal Bridge 60' trunnion Bascule.

Operating machinery
gears and pinion. 2 @ 4000 = 8000 #
Shafting + couplings 2 @ 2000 = 4000
Machinery frames 2 @ 4000 = 8000
Racks. 2 @ 3000 = 6000
26000 #
End Locking - 2 @ 2000 4000
Brakes + indicators and other misc. 3000
33000 # call this 40.000 #

Estimate of abutments.
Abutment for moving leaf.
Base. $46 \cdot 60 \cdot \frac{6.0}{216}$ = 76.6 立坪

Outside walls. $200 \cdot 3.0 \cdot \frac{35}{216}$ = 94.5 立坪
Inside concrete filling. say = 20.0 立坪
machinery flooring + col supports say = 15.0 立坪

Reinforcing bars in concrete walls, floors + col. supports. 20 tons.
Excavation say $12 \cdot 46 \cdot \frac{60}{216}$ = 1530 立坪

Abutment for fixed End.
Concrete in base. $16 \cdot 60 \cdot \frac{5.0}{216}$ = 22.2 立坪

Excavation - say 50.0 立坪
Shaft. say - $60 \cdot 5.0 \cdot \frac{35}{216}$ = 47.5 立坪

Reinforcing bars. 5.0 tons.

Estimate of cost for abutments
Abutment for moving leaf
Concrete in base 76.6 立坪 @ 140^{00} = 107000^{00}
walls 94.5 " " @ 140^{00} = 132000^{00}
filling 20.0 " " @ 100^{00} = 2000^{00}
flooring 15.0 " " @ 140^{00} = 2100^{00}
Reinforcing bars 20.0 tons @ 160^{00} = 3200^{00}
Excavation. 153.0 @ 40^{00} = 6120^{00}
Coffer dam sheet piling. 5000^{00}
forms. say 5500^{00}
~~26~~ ~~2920~~
47820

Abutment for fixed End.
concrete in base 22.2 @ 140^{00} = 3110^{00}
Shaft 47.5 @ 140^{00} = 6650
forms say 2500
Reinforcing bars 5.0 @ 160^{00} 800
Excavation. 50.0 @ 40^{00} 2000
Cofferdam + sheet piling. 2000
17060
~~4980~~
64880^{00}

Operating house and fixture 3000^{00}

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CALCULATIONS FOR

Preliminary design of 1st Canal Bridge 60' Trunnion Bascule.

Estimate of Cost.

Flooring on moving leaf. $378 \times \frac{80}{36} = 84.0$ 平方坪

Flooring on moving leaf. side walk $13.2 \cdot \frac{80}{36} = 29.4$ 平方坪

Flooring on fixed portion $378 \times \frac{27}{360} = 28.4.0$ 平方坪

Sidewalks. $13.2 \cdot \frac{27}{360} = 10.0$ 平方坪

Estimate of cost for flooring.

84.0 @ 70 = 5880
25 @ 29.4 735
90 @ 28.4 2550
35 @ 10.0 = 350
9515.00

Electric Railway tracks say 1700.00
structural steel in span 158 tons. @ 280.00 = 44,200.00
Operating machinery 40,000.00 @ 75c = 30.000.00

Electric Equipment motors 4 @ 2300.00 = 9200.00 4-40 HP-motors
misc motors 1500.00
10700.00
Electrical Equipment say 3000.00
13700.00

Trolley wire Equipment + gates say 2500.00

Concrete in Cwt $\frac{3850}{21.6} = 178$ 立坪 @180.00 = 3220.00

Summary for cost.

Flooring.	9515.00	
Ry tracks and rails.	1700.00	
structural steel.	44200.00	
Operating machinery.	30000.00 ✓	
Electrical Equipment	13700.00 ✓	
Trolley wires &c	2500.00 ✓	
Concrete Cwt	3220.00	
Handrails say	2800.00	
		107635.00
Abutments		64880.00
Operating house + Equipment say		3000.00
		175515.00
Misc Expense.		20000.00
		195515.00

Double leaf trunnion Bascule.	217025.00
Single leaf trunnion design	195515.00
	21510.00

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CALCULATIONS FOR

First Canal Bridge, double leaf trunnion bascule

After preliminary design we decided to use double leaf trunnion bascule 30'-0" each instead of 60' single leaf bascule.

General data.

width of Roadway 37.8 R 2 sidewalks 6.6' each. Total width 51.0 R
37.8 R = 37.58' or 37'-7" 6.6 R = 6.56 or 6'-6¾"

Roadway will be of timber construction with wood block pavement 3" thick. Sidewalk slab. will be of reinforced concrete to make rigid ~~the~~ edges of bridge double track electric car lines at ℄ bridge spacing C to C 10'-0". Clearance above highwater Elevation 12.0 R for 30'-0" at middle, 10.0 R about at faces of abutments.

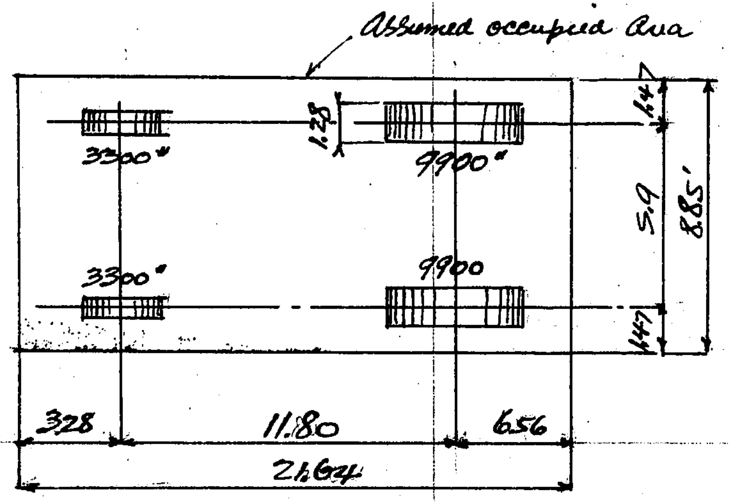
Assumed Loading

Uniform load on roadway $w = \frac{120.000}{170+l} \fallingdotseq 600$ kg/m² or say 120 #/□'.

Uniform load on sidewalk $w = \frac{100.000}{170+l} \fallingdotseq 500$ kg/m² or say 100 #/□'.

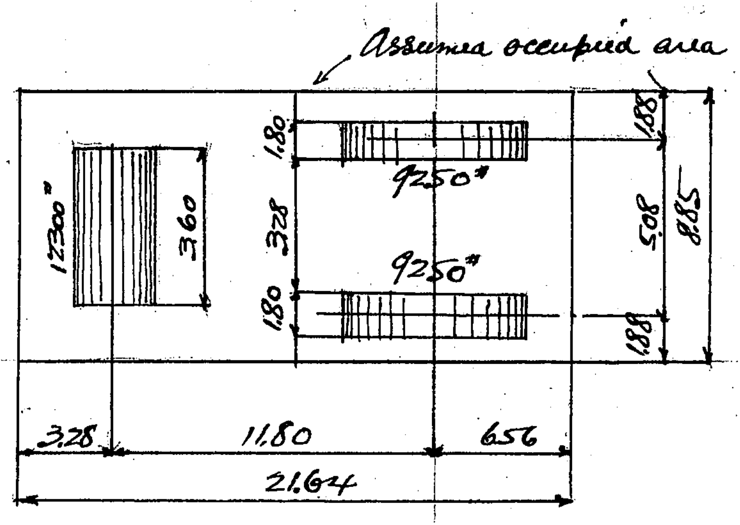
where w = uniform load in kg per sq meter
l = span length in meter.

motor truck loading (12 tons)



4 ~~②~~ Rows of motor traffic on roadway with occupied space of 8.85' each
Impact into consideration.
Unoccupied space of motor truck and Street car shall be filled with the uniform live load mentioned above.

Road roller (14 tons).



One roadroller on span without impact

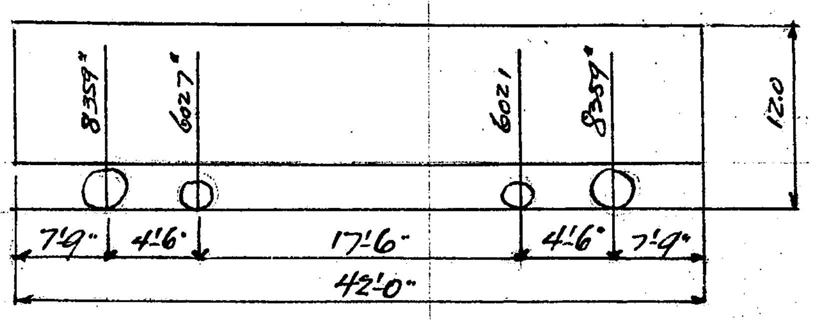
Impact for motor truck and Electric Rwy Car loadings.

$i = \frac{20}{60+l} \fallingdotseq 0.3$

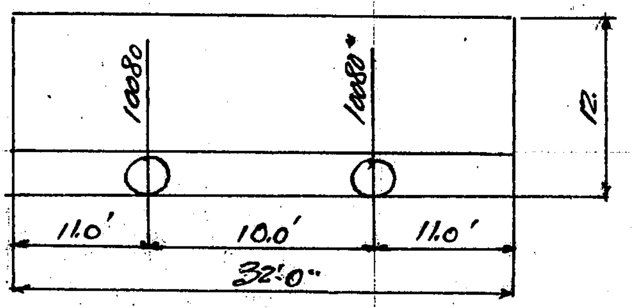
where i = coefficient for impact
l = loaded length of span in meter.

Electric Railway Car loading.

26英噸「ボギー」車輛 load per rail



18英噸電車（甲式單車）. load per rail.



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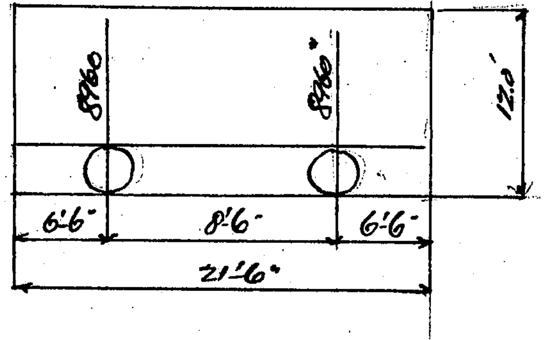
CALCULATIONS FOR

First Canal Bridge for Municipality of Kobe.

16英噸撒水電車 load per rail.



width of Electric Railway Car 7'-6"

Assumed wind pressure.
span closed 30#/□' on projected area
span up 15#/□' on projected area
wind velocity assumed 30 meters per second
during operation of bridge

Allowable working strength
Structural Steel or Reinforcing bars.

Tension	17000#/□"
Extreme fibre stress	17000
Shearing on web gross section	12800
Compression member 21300 (1 - 0.0055 l/r) or not more than	14000#/□"

where l = length of member in inches
r = least radius of gyration in inches²

Compression flange of plate girder
17000 (1 - 0.012 l/b) ≒ 15400#/□"

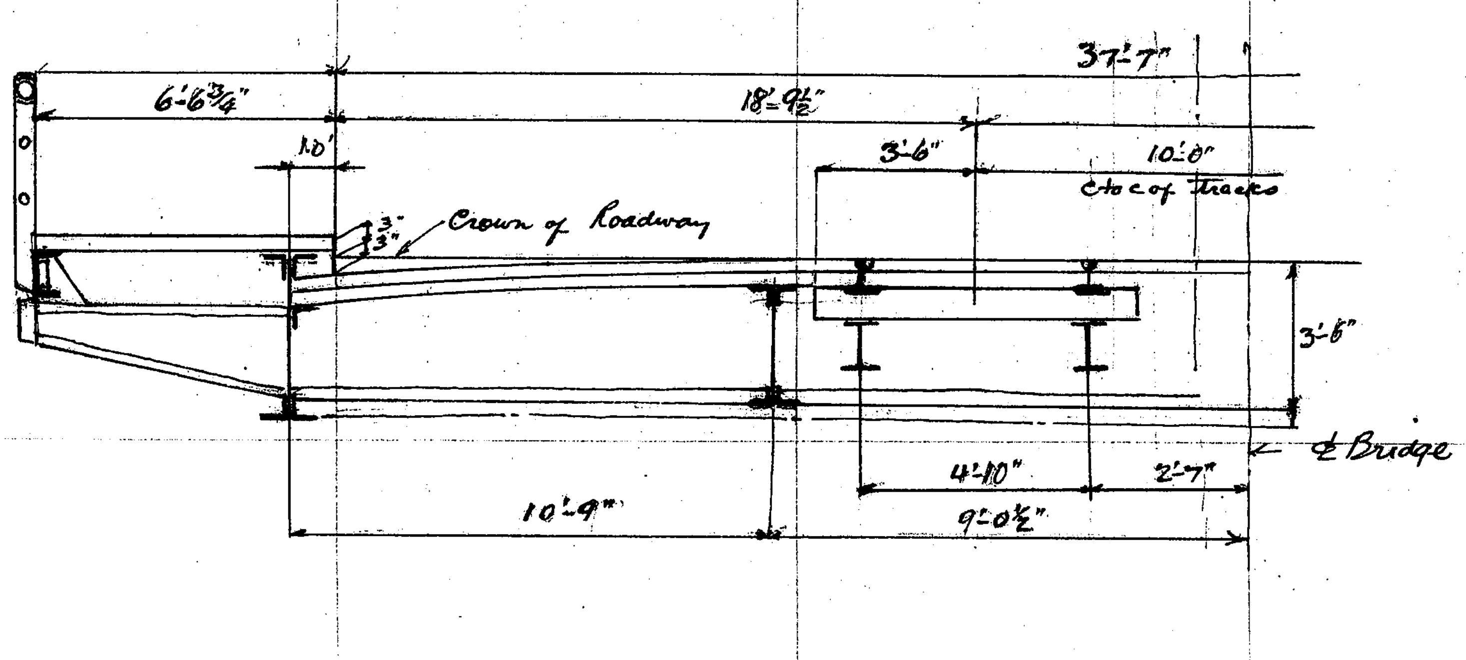
Shearing on shop driven rivets (machine)	12000#/□"
Shearing on field driven rivets and turned bolts (machine).	10.000 "
Extreme fibre stress of pin.	24.000 "
Bearing on shop rivets	24.000 "
Bearing on field rivets and turned bolts	20.000 "
Bearing on pin.	24.000 "
Bearing on masonry 640#/□"	

Strength of Concrete 1:2:4 mixture

Compression fibre stress	640#/□"
Shear for plain concrete	58 "
Punching shear	128 "
Bond stress of plain bar	85 "
Bond stress of deformed bar	130 "
Shear for reinforced Concrete	128 "

Considering wind, traction and temperature stresses in addition to dead, live and ~~wind~~ impact stresses. the allowable working strength shall be increased 25% and proportioned the parts. Incase of earthquake the unit strength shall be increased 80% and proportioned the parts of members.

Assumed Cross section of moving leaf as shown on sketch below.



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CALCULATIONS FOR

First Canal Bridge for Kobe.

Highway floor span length 2'-8¼" = 2.69'

Creosoted woodblock pavement 3" thick @50.# = 15.0
Asphalt felt for water proofing 0.3
3" Creosoted Planking 15.0
30.3# per sq ft.

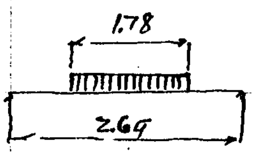
Dead Load moment = $\frac{1}{10} \cdot 30.3 \cdot 2.69^2 = 22.0^{\#}$
Dead Load shear = $\frac{1}{2} \cdot 30.3 \cdot 2.69 = 41.0^{\#}$

Live Load motor truck rear wheel 9900#
30% impact 2970
12870#

Front wheel $\frac{1}{3} \cdot 12870 = 4290^{\#}$

Distribution of wheel concentration
Contact face between wheel and pavement 0.66
3" woodblock pavement dist $2 \cdot .25$ = 0.50
Longitudinal distribution a = 1.16'
Transverse distribution b = 1.28 + 0.5 = 1.78'

For planking assume 2' wide using 1.0' plank
Distribution of wheel load = 12870 ÷ 2 = 6435# per ft. strip



moment at center $\frac{6435}{2} \cdot \frac{2.69}{2} = 4330$
$3217 \cdot \frac{1.78}{4} = 1430$
2900'#

For continuity of span take moment = $0.8 \cdot 2900 = 2320^{\#}$
22 Dead Load moment
2342

Assume 3" plank fibre stress = $\frac{6 \cdot 23\overset{42}{\cancel{20}} \cdot 12}{12 \cdot 3^2} = 1560^{\#}/\square''$ ok.

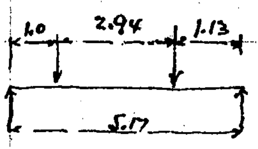
Flooring between rails. Railway ties spaced about 2.5' centers
Use 3" plank same as for highway flooring.

Cross Beam under tracks max span length 5'-2" spacing of ties = 2.5' centers about.
Dead Load $30.3 \cdot 2.5$ = 76.0 $m = \frac{1}{8} \cdot 102.7 \cdot 5.17^2 = 342'^{\#}$
Cross beam 8"·8" 26.7
102.7 Shear = $\frac{1}{2} \cdot 102.7 \cdot 5.17 = 265^{\#}$

Live Load motor truck loading Rear wheel 12870#
Transverse distribution wheel 1.28
Pavement + planking 2 @ 0.5 = 1.00
2.28'

One wheel at center moment = $6435 \cdot 2.59 = 16650$
Less $6435 \cdot \frac{2.28}{4} = 3670$
~~203200~~ 12980'#

max End shear say $12870 \cdot \frac{4.07}{5.17} = 10100^{\#}$



Summary for moments and shears

	moment	shear
Dead Loads	342	265
Live load	12980	10100
	13322	10365

Fibre stress = $\frac{6 \cdot 13322 \cdot 12}{8 \cdot 8^2} = 1870^{\#}/\square''$ ok.

Shearing = $\frac{10365}{8 \cdot 8} = 162^{\#}/\square''$ ok

Sidewalk slab. span length say 5'-5" ℄ bearings.
3" slab with ¾" wearing course

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CALCULATIONS FOR

First Canal Bridge double leaf Bascule.

Dead Load 3¾" Concrete 47# per sq ft.
Live Load 100
147#

moment $= \frac{1}{8} \cdot 147 \cdot 5.42^2 = 540.0'\#$

Effective depth required for 17000#/□" steel stress and 640#/□" concrete stress.

$= \sqrt{\frac{540.0}{102}} = 2.3"$ insulation say ¾" at bottom make slab 3" thick ¾" wearing course on top.

Steel area $= \frac{540 \times 12}{\frac{7}{8} \times 2.25 \times 17000} = 0.194\square"$ per ft.
⅜"□ - 6" centres.

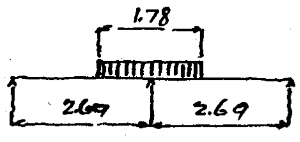
Highway stringers.
span length 10'-2" stringer spacing 2'-8¼"

Dead Load 30.3 × 2.69 = 81.5#
stringer say 35.0
nailing piece 4×6" = 10.0
126.5#

DL moment $= \frac{1}{8} \cdot 126.5 \cdot 10.17^2 = 1632'\#$

shear $= \frac{1}{2} \cdot 126.5 \cdot 10.17 = 645\#$

Live Load motor truck loading rear wheel conc. with impact 12870#



Transverse distribution = 1.78'
Load on stringer $6435 \cdot \frac{2.24}{2.69} =$ 5350
5350
10700#

Moment at center of span 5035.0 · 5.08 = 27200'#
max live load shear = 10700#

Summary for moments and shears

	moment	shear
Dead Load	1632	645
Live Load	27200	10700
	28832	11345

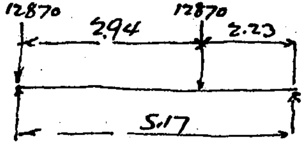
Section modulus reqd $= \frac{28832 \times 12}{17000} = 20.4$
Use 12"×5" @ 31.99# Sm = 36.64
machinery will be framed to these stringers use heavier section as shown

Railway stringers spacing 4'-10" and 5'-2" span length 10'-2"

Dead Load Flooring 30.3 × 5.0 = 151.5
Cross beam $\frac{8" \times 8" \times 6.0}{2.5}$ @ 60 = 64.0
215.5#
stringer assumed 35.0
250.5#
Rails + accessory 42.5
293.0

Dead Load moment $= \frac{1}{8} \cdot 293 \cdot 10.17^2 = 3780.0'\#$
Dead Load shear $= \frac{1}{2} \cdot 293 \cdot 10.17 = 1490\#$

Live Load motor truck loading rear wheel conc. = 12870#
max load on stringer Reaction $= 12870 \cdot \frac{2.23}{5.17} =$ 5550
12870
18420#



moment at center of span $= 9210 \cdot \frac{10.17}{2} = 46800'\#$
max end shear say 18420#

Summary for moments and shears

	moment	shear
Dead Load	3780.0	1490
Live Load	46800.0	18420
	50580.0'#	19910#

Section modulus reqd $= \frac{50580 \times 12}{17000} = 35.7$
Use 12"×5" @ 31.99# Sm = 36.64

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CALCULATIONS FOR

First Canal Bridge double leaf bascule.

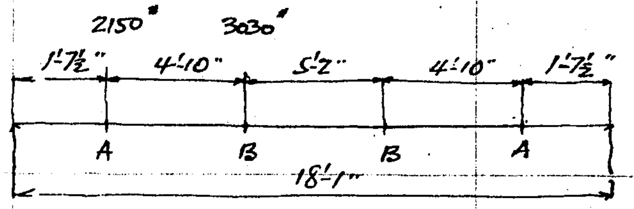
Sidewalk fascia stringer span length 10.17'

Dead Load Concrete slab. 47# · 2.95 = 139.0
Handrail assumed 40# = 40.0
179.0
Live Load assumed 2.7 · 100 = 270.0
449.0#
Beam assumed 30.
479.0#

moment = $\frac{1}{8}\cdot 479.0 \cdot 10.17^2$ = 6180 '#
shear = $\frac{1}{2}\cdot 479 \cdot 10.17$ = 2430#

section modulus req'd = $\frac{6180 \times 12}{17000}$ = 4.35 Use 8·2½ @ 15.12# Sm = 10.27

Intermediate Floor Beam between long'l Electric Ry girders (Panel points 2 and 3)
span length 18.08' spacing 10'-2".
Dead Load.



Dead Load concentration on A
Flooring. 30.3 · 3.22 = 97.5
Cross ties $\frac{8" \cdot 8" \cdot 3.42}{144 \cdot 2.5}$ @ 60# = 36.5
stringer assumed 35.0
Rails and accessories 42.5
211.5# per lin ft.

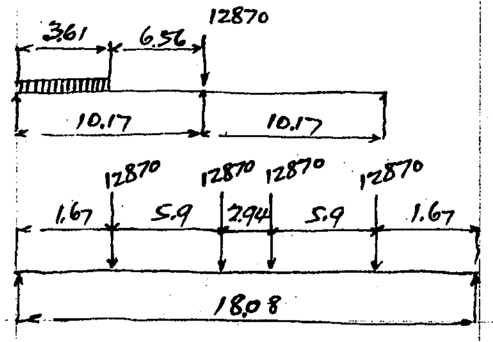
R = 5180#

Concentration A = 211.5 · 10.17 = 2150#
Concentration B = 298. · 10.17 = 3030#

Dead Load moment = 5180 · 6.45 = 33400 '#
2150 · 4.83 = − 10400
23000 '#
Beam $\frac{1}{8}\cdot 80 \cdot 18.08^2$ = 3260
26260 '#

Dead Load shear = 5180
$\frac{80}{2}\cdot 18.08$ = 720
5900#

Live Load motor car loading concentration 12870# for rear wheel.
Uniform load $\frac{120\# \cdot 3.61^2}{2 \cdot 10.17}$ = 77# per lin ft on floor beam



Concentration at stringer connections.
at B 77 · 5.0 = 385#
at A 77 · 3.42 = 263#
moment due to motor truck 2 · 12870 · 7.57 = 195000
12870 · 5.9 = 76000
119000 '#
moment due to unif. live load 648 · 6.45 = 4180
~~385~~ 263 · 4.83 = 1270
2910 '#

Live Load moment for motor truck and unif. load = 119000
2910
121910 '#

max End shear motor truck loading 4 × 12870 · $\frac{10.71}{18.08}$ = 30500#
Uniform load 650#
31150#

Summary for moments and shears

	moment	shear
Dead Load	26260	5900
Live Load	121910	31150
	148170 '#	37050#

Depth of girder ~~2'-1½"~~ 1'-9⅞" web ~~25"~~ 21½ · 3/8 = ~~9.370~~ 8.08
Effective depth = ~~1.98~~ 1.68 ⅛ web = ~~1.170~~ 1.00
flange stress = 148170 ÷ ~~1.98~~ 1.68 = ~~75100~~# 88300
5.72 SR = ~~75100~~ 88300 ÷ 17000 = ~~4.42□"~~ 5.20 − ~~1.17~~ 1.00 = ~~3.25□"~~ 4.20 net
2L 5×3 ~~3½·3½~~ · 3/8 = 4.96□" 1.52 = ~~3.44□"~~ 4.20 net

Rivet pitch $\frac{0560 \cdot 178.7}{37050}$ = 3.16"

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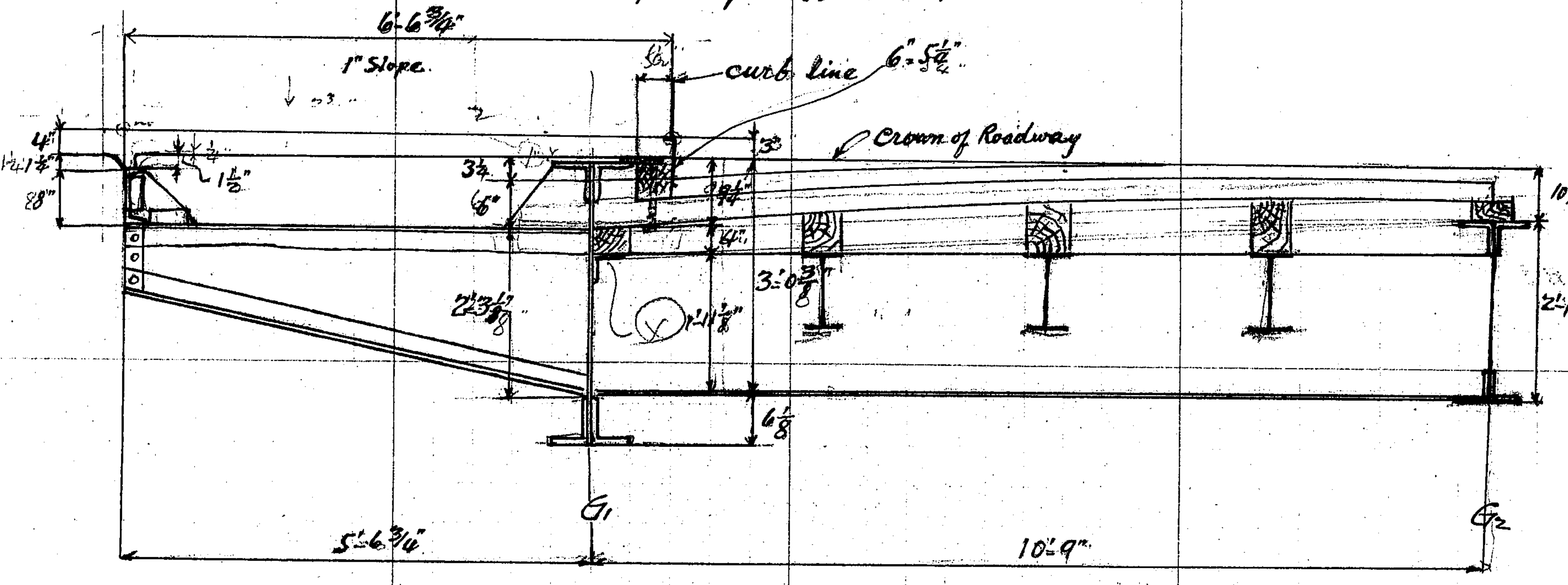
CALCULATIONS FOR

First Canal Bridge double leaf bascule.

Intermediate Cantilever Bracket and Highway Floor Beams.



Spacing of Cantilever bracket 10'-2"

Dead Load

Sidewalk slab. 47# · 5.81 = 273# R = 273 · $\frac{2.91}{5.56}$ = 143
Handrail 40
Stringers say 18
201# call this 200# per ft

moment at G1 200 · ~~5.81~~ 5.56 = ~~1162~~ 1120 '# · 10.17 = 11400 '#
Cantilever bracket 80# · 5.56 = 445# 445 · 2.0 = 890
12290 '#

Live Load 100 · 2.78 = 278# per lin ft. Concentration 278 · 10.17 = 2830#
Live Load moment = 2830 · 5.56 = 15750 '#

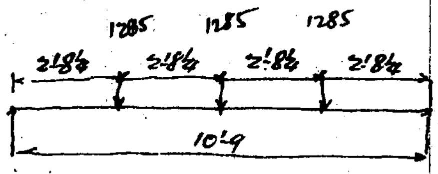
Dead Load moment = 12290
Live Load moment = 15750
28040 '#

shear D.L. 200 · 10.17 = 2034#
DL cantilever 445
2479 say 2480#
Shear Live load 2830
Total 5310#

Section of Cantilever Bracket at Connection.
depth 2'-3 1/8 web say 27" · 3/8" · 5/16. Effective depth required for tension pl. say 2.2
tension in plate = 28040 ÷ 2.2 = 12800# section required = 12800 ÷ 17000 = 0.750 □" net.
Use 3" · 3/8" = 1.1250 □" or 0.800 □" net.
For flange Ls use 3.3. 3/8 as min. section.

Intermediate Highway Floor Beam span length 10'-9" spacing 10'-2"

Dead Load



Shear = 1285 × 1.5 = say 2000
beam $\frac{80}{2}$ · 10.75 = 430
2430#

Concentration at Highway stringer connection
126.5 · 10.17 = 1285#

Dead Load moment due to Flooring.
moment at center 1285 × 1.5 · 2 · 2.69 = 10390
1285 · 2.69 = 3460
6930 '#

Dead Load moment beam = $\frac{1}{8}$ · 80 · 10.75² = 1160
8090 '#

Counting off 2/3 negative moment due to cantilever − 12290 · 2/3 − 8200
− 110 '#

call this 000 moment

Counting full negative moment summary moment − 4200 '#

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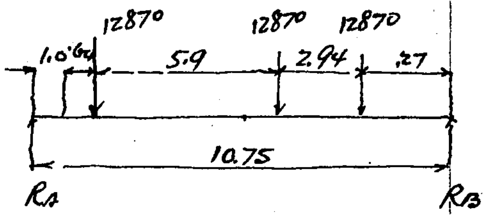
CALCULATIONS FOR

First Canal Bridge double leaf bascule.

Live Load. see p5 for loading.

motor truck loading. Concentration 12870# Uniform live load 77# per lin ft.



$R_B = 12870 \cdot \frac{19.66}{10.75} = 23500$#

moment = 23500 · 3.21 = 75500
12870 · 2.94 = 37900
37600#

Uniform load Concentration say 77 · 2.69 = 207#
moment at center say 207 · 2 · 2.69 = 1110
sum 38710#

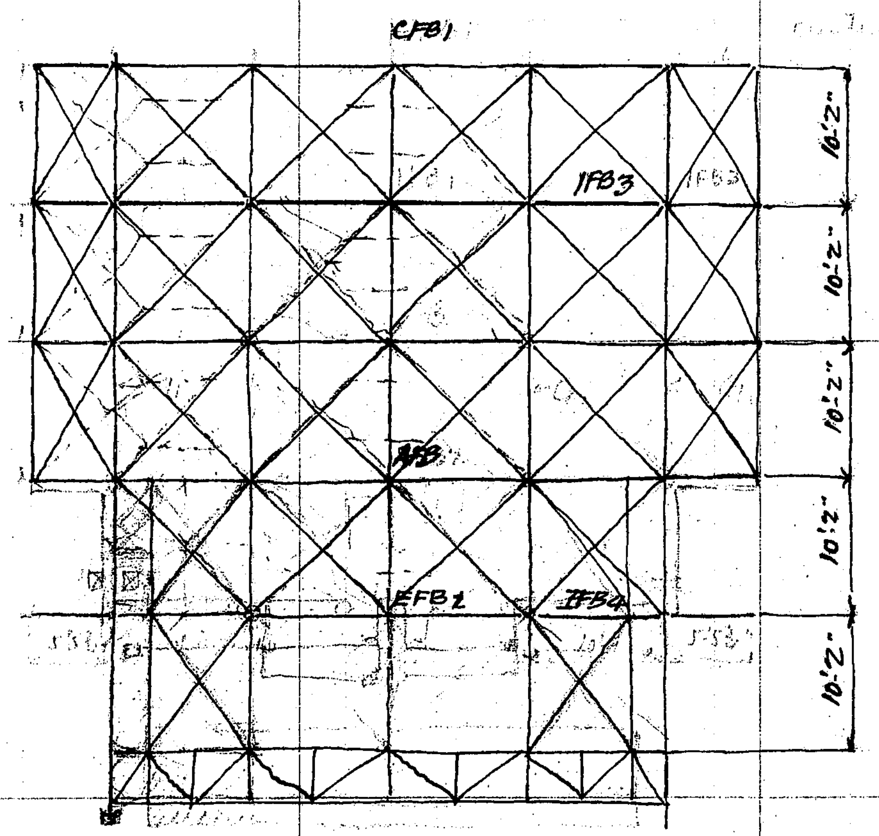
One rear wheel at center moment = $\frac{12870}{2} \cdot 5.38 = 34600$# this moment is less than figured above.

Max End shear say 23500 motor trucks
207 · 1.5 = 310 Unif. load.
23810

Summary for moments and shears

	moment	shear
Dead Load	say 0	2430
Live Load	38710	23810
	38710#	26240#

Depth of girder at center say ~~2'-0½"~~ 1'-9⅞
web assumed ~~24 × 7/16~~ = 7.5□" ⅛ web = 0.940□
Effective depth say 1.88
flange stress = 38710 ÷ 1.88 = 20600#
SR = 20600 ÷ 17000 = 1.210□ − 0.94 = .270□ net
Use min angle 2Ls 3 · 3 · ⅜"



Longitudinal girder G2 to carry Electric Ry Tracks.

Dead Load Dead Load reaction from IFB1 5180#
Beam say 720
5900#

Dead Load reaction due to cantilever effect
p6. 12290 ÷ 10.75 = −1140# −1140
Dead Load reaction from IFB2 = 2430#
Sum 7190# at intermediate panel point.

Dead Load reaction from EFB1 5180 ÷ 2 = 2590
720
3310#

Dead Load reaction due to cantilever $\frac{11400}{2} \div 10.75 = -530$
$890 \div 10.75 = -83$
−613

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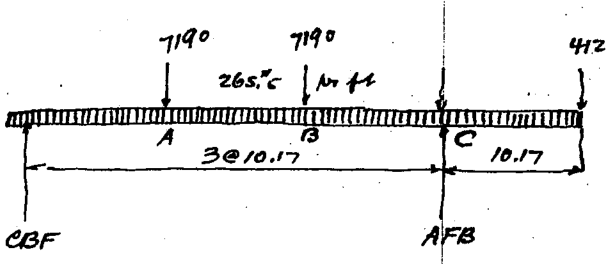
CALCULATIONS FOR

First Canal Bridge double leaf bascule

Dead Load reaction from EFB4 Floor 2000 ÷ 2 = 1000
Floor beam 430
1430#

Summary for 2nd floor beam
+3310
−613
1430
4127#

Uniform floor load $\frac{2.69+1.62}{2}$ = 2.16 @ 30.3 = 65.5# per lin ft.
Dead Load girder assumed 100.0
Dead Load lateral Bracing say 100.0
265.5# per lin ft.



Dead Load Cantilever moment $4127 \cdot 10.17$ = 42000'#
Unif. load $265.5 \cdot \frac{10.17^2}{2}$ = 13800
55800'#

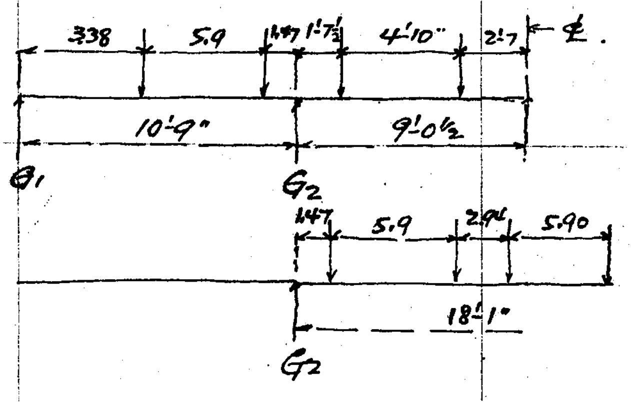
Dead Load moment at A or B. $7190 \cdot 10.17$ = 73.000
$\frac{1}{8} \cdot 265.5 \cdot 30.51^2$ = 30800
103800
Less Cantilever moment − 55800
48000'#

max shear at AFB.
Cantilever effect 55800 ÷ 30.51 = 1830
Concentration 7190
Unif. $266.5 \cdot \frac{30.51}{2}$ = 4050
13070#

max shear at CFB
7190
4050
11240
− 1830
9490#

Live Load

Impact $i = \frac{20}{60+l} = \frac{20.}{60+\frac{305}{3.28}}$ = 28.8%



撒水車 Concentration per rail 8960
Impact 28.8% 2580
11540#

Reaction on G2 = 2 · 11540 = 23080#
motor truck loading on center floor beam
Concentration at rear wheel 9900
Impact 28.8% 2850
12750#

Reaction on G2 = $4 \cdot 12750 \cdot \frac{9.23}{18.08}$ = 26000#
motor truck loading on side floor beam
Reaction on G2 = $2 \cdot 12750 \cdot \frac{6.33}{10.75}$ = 15000#

Assuming impact 30% instead of 28.8%.

撒水車. Concentration per rail 8960
30% 2690
11650#

motor truck loading 9900
30% 2970
12870#

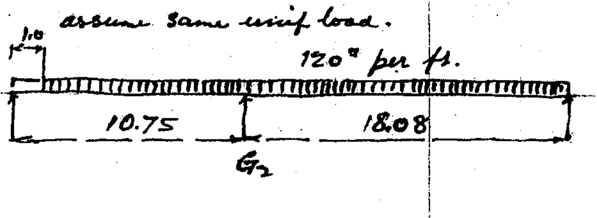
2@ 11650 = 23300#

$R_1 = 4 \cdot 12870 \cdot \frac{9.23}{18.08}$ = 26250

$R_2 = 2 \cdot 12870 \cdot \frac{6.33}{10.75}$ = 15200#

Uniform live load. 120# per sq ft.

Reaction on G2 = $120 \cdot \frac{10.75+18.08}{2}$ = 1730# per lin ft.



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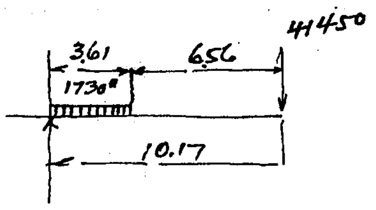
CALCULATIONS FOR

First Canal Bridge double leaf bascule.

moment cantilever arm

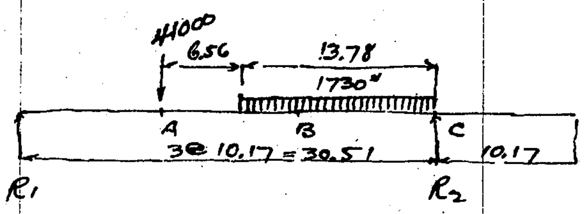


max motor truck reaction 30% impact 26250
15200
41450#

moment due to motor truck 41450 · 10.17 = 421000
$1730 \cdot \frac{3.61^2}{2}$ = 11300
432300'#

max shear 1730 · 3.61 = 6250
motor truck = 41450
47700#

Live Load positive moment at A. motor truck wheel concentration - 28.8% impact 26000
15000
41000



Uniform load 1730 · 13.78 = 23800#
Reaction motor truck $41000 \cdot \frac{2}{3}$ = 27400#
Reaction unif. load $23800 \cdot \frac{6.89}{30.51}$ = 5370#

moment 24700 · 10.17 = 251000
5370 · 10.17 = 54500
305500'#

Max End shear at R1 Uniform load $\frac{1730 \cdot 23.95^2}{2 \cdot 30.51}$ = 16250#
motor truck loading 41000
57250#

Max End shear at R2 One of max shears = 57250# same as above

Summary for moments and shears.

	Cantilever Portion		Between Supports		
	moment	shear	moment	shear R2	shear R1
Dead Load	55800	~~13070~~ 11240	48000	13070	9410
Live Load	432300	47700#	305500'#	57250#	57250
	- 488100'#	58940#	+353500'#	70320#	66660#

Depth of girder (2'-1½") 2'-8" Effective depth say (2.00) 2.67 Stress in tension pl = 488100 ÷ (2.0) 2.67 = ~~244050~~# 183000
section required for tension plate = ~~244050~~ 183000 ÷ 17000 = (1435□") 10.75□"
Use 2. ~~(14)~~ 13 · (5/8)" 1/16 = (17.5□") 13.0 gross or (15.00□") 11.00 net.
For compression side use same compression plates. 11.72
For flange Ls Use 2Ls. 6·6·(3/4) 5/8 = (16.88□") 14.22 or (13.88□") net ok

web assumed 25" · 3/8 = 9.38□" 1/8 web = 1.17□" Effective depth = 1.98
Stress in flange = 353500 ÷ 1.98 = 178000 SR = 178000 ÷ 17000 = 10.50
2Ls 6·6· 5/8" = 14.22 - 2.5 = 11.72 1.17
Use -- 2Ls 6·6· 9/16 = 12.86 - 2.25 = 10.61 9.33□" net.

If make tail locks for live load., then the overhanging arm will become simple beam
Use section 2Ls 6·6· 3/8

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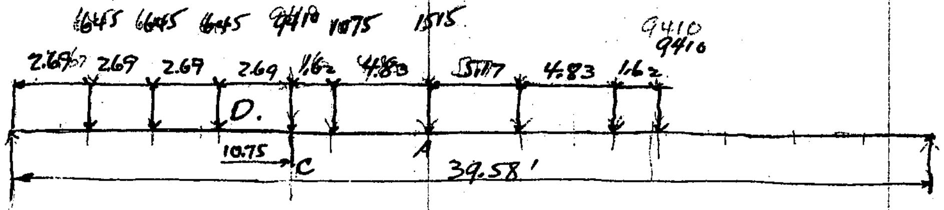
CALCULATIONS FOR

First Canal Bridge double leaf bascule.

Center Floor Beam span length 39'-7"
Dead Load

3 @ 645 = 1935
9410
1075
1515
Reaction. 13935 #

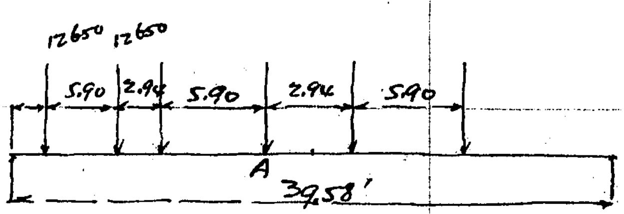


moment at A. 13935 · 17.21 = 240,000
1075 · 4.83 = 5200
9410 · 6.45 = 60700
645 · 9.14 = 5890
645 · 11.83 = 7640
645 · 14.52 = 9380
88810

summary 240.000
88810
151190 '#
Dead Load beam say 220 #
$m = \frac{1}{8} \cdot 220 \cdot 39.58^2 =$ 43000
194190 '#

Live Load. motor truck loading. impact $i = \frac{20}{60 + \frac{39.58}{3.28}} = 27.8\%$

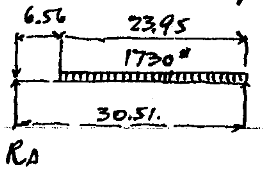
motor truck rear wheel 9900
Impact 27.8% 2750
12650 #



Reaction = 4 @ 12650 = 50600 #

moment at Center of span 50600 · 19.79 =
50600 · 8.85 =
10.94 = 553,000 '#

Live Load uniform. $R_A = \frac{1730 \cdot 23.95^2}{2 \cdot 30.51} = 16250$ #



moment = 16250 · 10.75 = 174800 '#
motor truck 553000
727800 '#

moment due to center lock mechanism &c assume 2000 # concentration at C.
moment = 2000 · 10.75 = 21500 '#

Summary moments
DL. 194190
DL. 21500 } 215690
LL 727800
943490 '#

Depth of girder at center 2'-10½" web 34 · 3/8" = 12.750 □" 1/8 web = 1.59 □"
Effective depth say 2.73 flange stress = 943490 ÷ 2.73 = 346000 #
section required = 346000 ÷ 17000 = 20.40
1.59
18.81 □" net

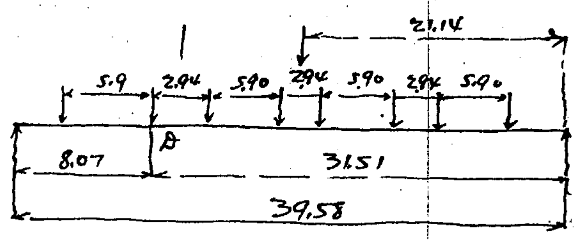
2∠s 6·6·5/8 = 14.22 or 11.72
1 Cov. Pl. 14·5/8 = 8.75 7.50
22.97 gr. 19.22 □" net.

max moment at D.
Dead Load. Reaction 13935 m = 13935 · 8.07 = 112500
645 · 2.69 = 1735
645 · 5.38 = 3470
-5205
107295 '#
Dead Load beam $\frac{220}{2} \cdot 8.07 \cdot 31.51 =$ 29990
135195 '#

CALCULATIONS FOR

First Canal Bridge double leaf bascule

Center Floor beam continued
Live Load.



$8 @ 12650 \cdot \frac{21.14}{39.58} = 54000^{\#}$

moment = 54000 · 8.07 = 436.000 ''#
Unif. LL m = 16250 · 8.07 = 131.000
machinery say 2000 · 8.07 = 16100
D.L. m
583100
135200
718300

depth of girder say 2'-9½" web say 33 · 3/8 = 12.4 ⅛ web = 15.5 □"
Effective depth assumed 2.65 flange stress = ~~583.100~~ 718300 ÷ 2.65 = ~~220.000~~ 271.000
Section required = ~~220.000~~ 271000 ÷ 17000 = ~~12.92~~ 15.95

$\frac{1.55}{~~11.370~~ 14.40}$ □" net. Use 2L^s 6·6·5/8 and 1 Cov. Plate 14 · 5/8 here.
extend cover plate beyond this point.

Max End Shear due to live load.
motor truck load - same as above 54000
Unif. load 16250
70250 #

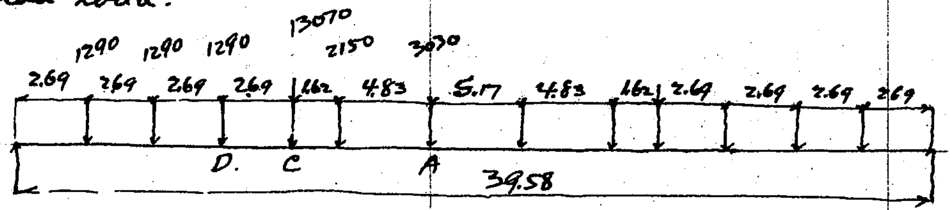
Dead Load shear 13935
Girder ½ · 220 · 39.58 = 4350
machinery &c say 2000
20285 #

D.L. shear. 20285
Tot. 90535 #

no of Rivet for End connection. 15 - 7/8"φ

Depth of girder at connection 30" about 30 · 3/8 = 11.25 □" Unit shearing $\frac{90535}{11.25}$ = 8050 #/□"
Rivet pitch at end. 7/8" bearing on 3/8" pl 7880 #
Rivet pitch = $\frac{7880 \cdot 26}{90535}$ = 2.26" at end.

Floor Beam at abutment
Dead Load.



Reaction
3 @ 1290 = 3870 #
13070
2150
3030
22120 #

moment at A. 22120 · 17.21 = 382000
2150 · 4.83 = 10400
13070 · 9.14 = 119300
1290 · 35.49 = 45700
175400
206600 ''#
m = ⅛ · 300 · 39.58² = 58500
265100 ''#

D.L. beam assumed 300# per lin ft.

End reaction 22120
½ · 300 · 39.58 = 5940
28060 #

Cantilever effect neglected.

Live Load motor truck loading Reaction 50600 #
moment 553000 ''#
Unif. load Reaction 16250
moment 174800
66850 # 727800 ''#

Summary moment Dead Load & 265100 ''#
992900 ''#

Live Load motor truck loading at end of cantilever bracket.
motor truck loading. Rear wheel Concentration say 12650 #
Reaction at floor beam 12650 · ⅓ = 4220
12650
16870 · 4 = 67400 #
moment = 67400 · 10.94 = 737000 ''#

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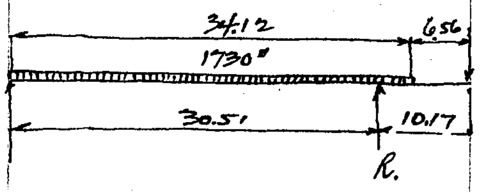
CALCULATIONS FOR

First Canal Bridge double leaf bascule

Floor beam at abutment continued.
Uniform live load.



Reaction R = $\frac{1730 \cdot 34.12^2}{2 \cdot 30.51}$ = 33000#

moment = 33000 · 10.75 = 355000'#

Summary for live load moment

motor trucks	737000
Unif. load	355000
	1092000'#
Dead Load moment	265100
	1357100'#

Depth of girder 4'8½ web say 55"·3/8" = 20.65□" ⅛ web = 2.58□" Effective depth say 4.45
flange stress 1357100 ÷ 4.45 = 305000# Section reqd = 305000 ÷ 17000 = 17.94□"
2.58
15.36□" net

2Ls 6·6·5/8 = 14.22 or 11.72
1P 14·3/8 = 5.25 or 4.50
19.47□" 16.22□" net

Max moment at D. see page 11
Dead Load reaction 22120 m = 22120 · 8.07 = 178500
1290 · 8.07 = −10400
168100
Dead Load beam $\frac{300}{2}$ · 8.07 · 3151 = 38200
206300'#

Live Load see p 11. Reaction 8@16870 · $\frac{21.14}{39.58}$ = 72000

moment 72000 · 8.07 = 581,000
Unif. LL. 33000 · 8.07 = 266.000
847.000'#
Dead Load moment 206300
1053300'#

Depth of girder 4' 6½" about web say 54"·3/8 = 20.25 ⅛ web = 2.53□"
Effective depth say 4.37 flange stress = 1053300 ÷ 4.37 = 241.000#
Section required 241.000 ÷ 17000 = 14.18
2.53
11.65□" 2Ls 6·6·5/8 = 14.22 or 11.72□" ok

Cut cover plate here.

Max End shear due to live load.
motor truck load same as above 72000
Uniform load 33000
105.000#
Dead Load shear 28060
133060#

Depth of girder at connection say 52 · 3/8 = 19.5
Unit shearing 133060 ÷ 19.5 = 6840#/□" No of rivets 133060 ÷ 6010 = 22.- 7/8"
Rivet pitch at end 7/8"⌀ Rivet bearing on 3/8" pl = 7880#

Rivet pitch = $\frac{7880 \cdot 45}{133060}$ = 2.66"

CALCULATIONS FOR

First Canal Bridge double leaf bascule.

Main Girder G1

Dead Load

Trolley pole approximate weight. ~~Cols~~ 4 Ls 5·3·5/16 @ 8.2 = 32.8
1 Pl. 15·5/16 = 16.5
49.3 call this 50# per ft.

2 Cols 50 · 21 = 2100#
Bed pls &c say. 300
2400

Transverse beam 4 Ls 3½ · 3½ · 3/8 @ 8.5 = 34.00
Lacing bars 20.00
54.00 · 41. = 2220
Gusset pls ties &c 480
2700#

2 Cols. 2400
transverse strut 2700
5100#

On one girder 5100 ÷ 2 = 2550#

Dead Load Floor.

Intermediate Floor Beam

Sidewalk slab. 47# · 5.81 = 273.

Reaction at fascia stringer 273 · $\frac{2.91}{5.56}$ = 143.0 130.0# on G1
Handrail 40.0
Stringer say 18.0
201.0 call this 200# per lin ft.

Concentration at panel point 200 · 10.17 = 2034# see p 6
Cantilever bracket say 445# see p.6

moment about G1

2034 · 5.56 = 11400
445 · 2.00 = 890
2479 12290#

Positive reaction on G1 12290 ÷ 10.75 = 1320.0#

Reaction from Floor beam between G1 and G2. including floor beam = 2430#

Direct load on G1

Sidewalk slab. 47# · 1.0 = 47.0
Curb bars. 9"·3/8 C = 11.48
Curb timber $\frac{6 \cdot 5\frac{1}{4}"}{144}$ @ 60# = 13.10
Flooring. 30.3 · $\frac{2.69}{2}$ = = 40.80
nailing piece $\frac{6 \cdot 4\frac{3}{4}}{144}$ @ 60 = 11.90
124.28#

From sidewalk slab. 130.00
254.28 call this 255# per lin ft.

Dead Load girder. Concentration at panel point.

center - 1 200 · 6.08 = 1260#
2 240 · 10.17 = 2440
3 350 · 10.17 = 3560
at abut. 4 480 · 8.83 = 3360
at trunnion 600 · $\frac{7.5}{2}$ = 2250 at front of trunnion.

End floor beam at center. No cantilever effect. both cantilevers will cancel. reactions.

End Floor Beam at Abutment Same as above

metal in lateral Bracing. 106# per lin. ft.

増田淳氏関係資料
（独立行政法人 土木研究所蔵）

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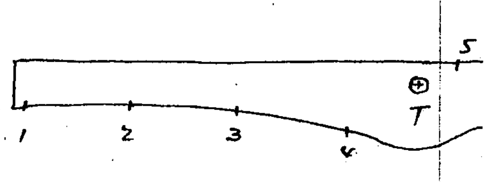
CALCULATIONS FOR

First Canal Bridge double leaf bascule.

Panel Concentration for lateral bracing.

106 · 10.17 = 1080 at intermediate panel point and abutment
½ · 1080 = 540# at end panel point.

Summary for Concentration



	1	2	3	4	Trunnion
Cantilever	1216	2479	2479	1200	
floor beam	20285	2430	2430	2860	
Cantilever effect	—	1320	1320	—	
Girder	1210	2440	3560	3360	2250
bracing	540	1080	1080	1080 ~~540~~	
Trolley pole	2550	—	—	—	
floor load unif.	1550	2600	2600	say 2250	960
	27351#	12349	13469	950 ~~35410~~ 35950	3210

Dead Load moment

at 2 27351 · 10.17 = 278000'#

at 3 27351 · 2 · 10.17 = 556000
12349 · 10.17 = 126000
682000'#

at 4 27351 · 3 · 10.17 = 835,000
12349 · 2 · 10.17 = 252000
13469 · 1 · 10.17 = 137,000
1,224,000'#

at trunnion
27351 · 38.01 = 1,036,000
12349 · 27.84 = 344,000
13469 · 17.67 = 238,000
35950
~~35410~~ · 7.50 = 266,000
1,884,000'#

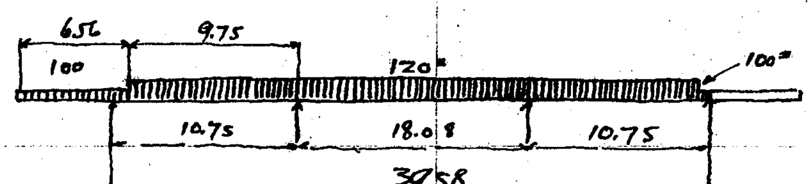
Concentration at 5 Beyond this panel point not counted.

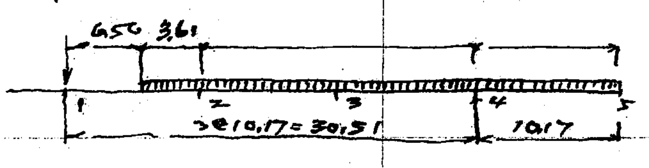
stringer —
Floor beam 1215
Girder say $\frac{600}{2} \cdot 2.67$ = 800 800 at trunnion
Bracing 540
floor load unif. $\frac{255}{2} \cdot 2.67$ = 340 340 at trunnion
2895# 1140

Dead load moment about trunnion 2895 · 2.67 = 7750'#

Live Load. motor truck loading rear wheel at panel point 1.
wheel concentration say 12650#
max Reaction = 8@12650 · $\frac{21.14}{39.58}$ = 54000#

Uniform live load. 100#/□' on sidewalk.
120#/□' on Roadway.





~~530~~ 795	640 −139 1085 1586#	640 5 1085 1730	530 95 625#

6.56 · 100 = 656#

9.75 · 120 = 1170 · $\frac{4.88}{10.75}$ = 530 1170 − 530 = 640.0

18.08 · 120 = 2170 ÷ 2 = 1085

100 · $\frac{10.25}{10.75}$ = 95

Cantilever effect 656 · $\frac{13.03}{10.75}$ = 795# 795 − 656 = −139.0

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CALCULATIONS FOR

First Canal Bridge double leaf bascule.

Live Load unif. concentration.

Sidewalk 1 795 · 6.08 = 4830
2 795 · 10.17 = 8100
3 795 · 10.17 = 8100
4 795 · 6.00 = 4770

Between main girders 1 530 · 3.61 = 1910 1910 · $\frac{3.61}{2 \cdot 10.17}$ = 340
2 1910 - 340 = 1570 + 2700 = 4270
3 5400
4 5400

Reaction longitudinal girder. 1586 · 23.95 = 38000#
at 1 38000 · $\frac{11.98}{30.51}$ = 14900

38000 - 14900 = 23100

Concentration Uniform load

	1	2	3	4
Sidewalk	4830	8100	8100	4770
Between girders	340	4270	5400	5400
From cross beam at end	14900	――	――	23100
	20070	12370	13500	33270#

Live Load moment

motor truck loading.

at 2. 54000 · 10.17 = 549000'#
at 3 54000 · 2 · 10.17 = 1098000'#
at 4 54000 · 3 · 10.17 = 1647000'#

Uniform live load

at 2 20070 · 10.17 = 204000'#

at 3 20070 · 2 · 10.17 = 408000
12370 · 10.17 = 125600
533600'#

at 4 20070 · 3 · 10.17 = 612000
12370 · 2 · 10.17 = 251000
13500 · 1 · 10.17 = 137000
1006000'#

Summary for live load moments

	2	3	4
motor truck loading	549000	1098.000	1647.000
Unif. live load	204000	533600	1000.000
	753000	1631600	2647.000
Dead Load moment	278000	682000	1224.000
Total moment	1031000	2313600	3871000'#

Section of girder

at 2. M = 1031000'# depth of girder. 3'-6 5/16 web 42" · 3/8 = 15.750□"
Effective depth say 3.28 flange stress = 1031000 ÷ 3.28 = 315.000
section required = 315.000 ÷ 17000 = 18.54
1/8 web = 1.97
16.57□" net

Use 2Ls 6.6.3/4 = 16.88 or 15.38□" net.
add 1 cover plate

at 3 M = 2313600'# depth of girder 4'-1 5/8" web. 49 · 3/8" = 18.38□"
Effective depth say. 3.99' flange stress = 2313600 ÷ 3.99 = 578000
Section required 578000 ÷ 17000 = 34.00
1/8 web 2.30
31.70□"

2Ls 6.6.3/4 16.88 13.88□" net.
2 Pls 14 · 3/4 21.00 18.00
37.88□" 31.88□" net.

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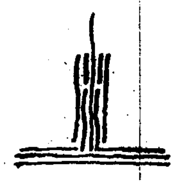
CALCULATIONS FOR

First Canal Bridge double leaf bascule.

at 4 live load bearing. m = 3871000 depth of girder 5'-10" 67½ · 3/8" = 25.30·
assumed section

2 Pls. 14 · 3/4 = 21.00 · 0.75 = − 15.75
2 L^s 6·6·3/4 = 16.88 · 1.78 = 30.00
2 Pls. 3 · 3/4" = 4.50 · 7.25 = 34.90
2 Pls. 8¼ · 3/8 = 6.18 · 5.12 = 31.60
48.56 1.66" 80.75



Effective depth 5.83 − 0.28 = 5.55'
flange stress = 3871000 ÷ 5.55 = 696000 SR = 696000 ÷ 17000 = 41.00
⅛ web. 3.16
37.84 □" net.

Use 2 P/s 14 · 3/4 = 21.00 − 18.00
2 L^s 6 · 6 · 3/4 = 16.88 − 13.88
2 P/s 3 · 3/4 = 4.50 − 3.00
2 P/s. 8¼ · 3/8 = 6.18 − 4.69
48.56 □" 39.57 □" net.

18.00
13.88
9.00
40.88

Load on Live Load bearing

D Load see p14		Live Load
at 1	27351	20070
2	12349	12370
3	13469	13500
4	35950	33270
	89119# +	79210# = 168329#

Add wt of shoe. 671
169000# on live load bearing.

Bearing area req'd on concrete 169000 ÷ 450 = 375"
use 18" · 21" = 378 □"
Allowable unit bearing 640#/□" by specification.

Dead Load moment about trunnion.
Load front of trunnion only. 1.884.000'#

Concentration at panel point 5 see p 14 2895# call this 3000#
weight of main girder rear of panel point 5. 500# per lin ft.
" " bracing assumed 120# per lin. ft.
girder. 500 · 15.58 = 7780
Bracing 120 · 15.58 = 1870
9550 · 10.17 = 97000
at 5 2895 · 2.67 = 7730
104730'# Say 105.000

Summary moment about trunnion
at front 1884.000
− 105000
1779.000'#

weight required for Cwt and Cwt frames. (one side only).

Revised.

Arm = 14'-7½" = 14.62'
weight req'd = $\frac{1779.000}{14.62}$ = 121,400#

Approximate volume of Cwt = 7.0 · 5.0 · 17'-1¼" = 5990.
at end. = 3.5 · 3.5 · 2.69 = 33
6023 cubic ft.

121,400 ÷ 250# = 4860 cubic
33
4827 = 5,63
17.1·5

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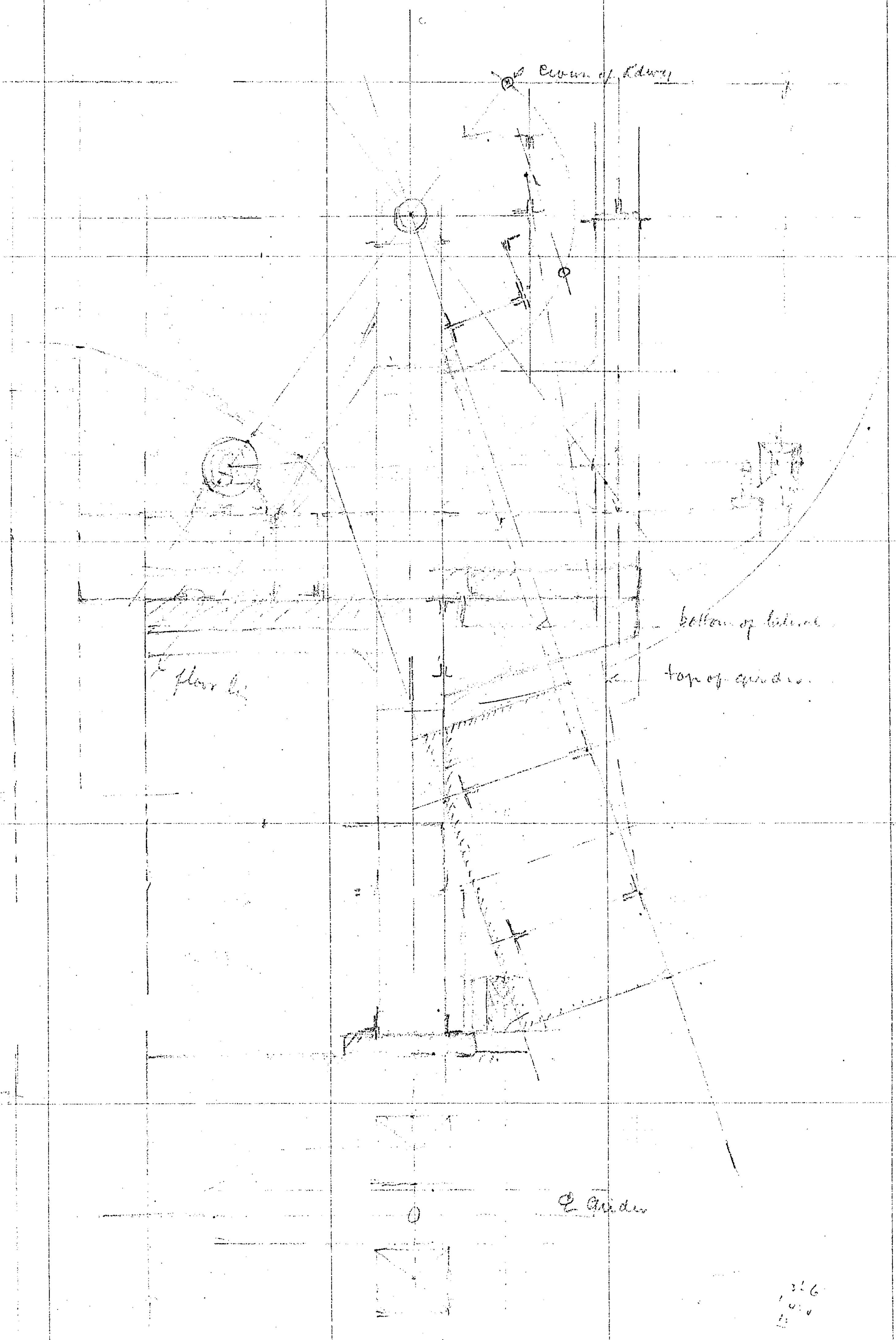
CALCULATIONS FOR

First Canal Bridge double leaf bascule.



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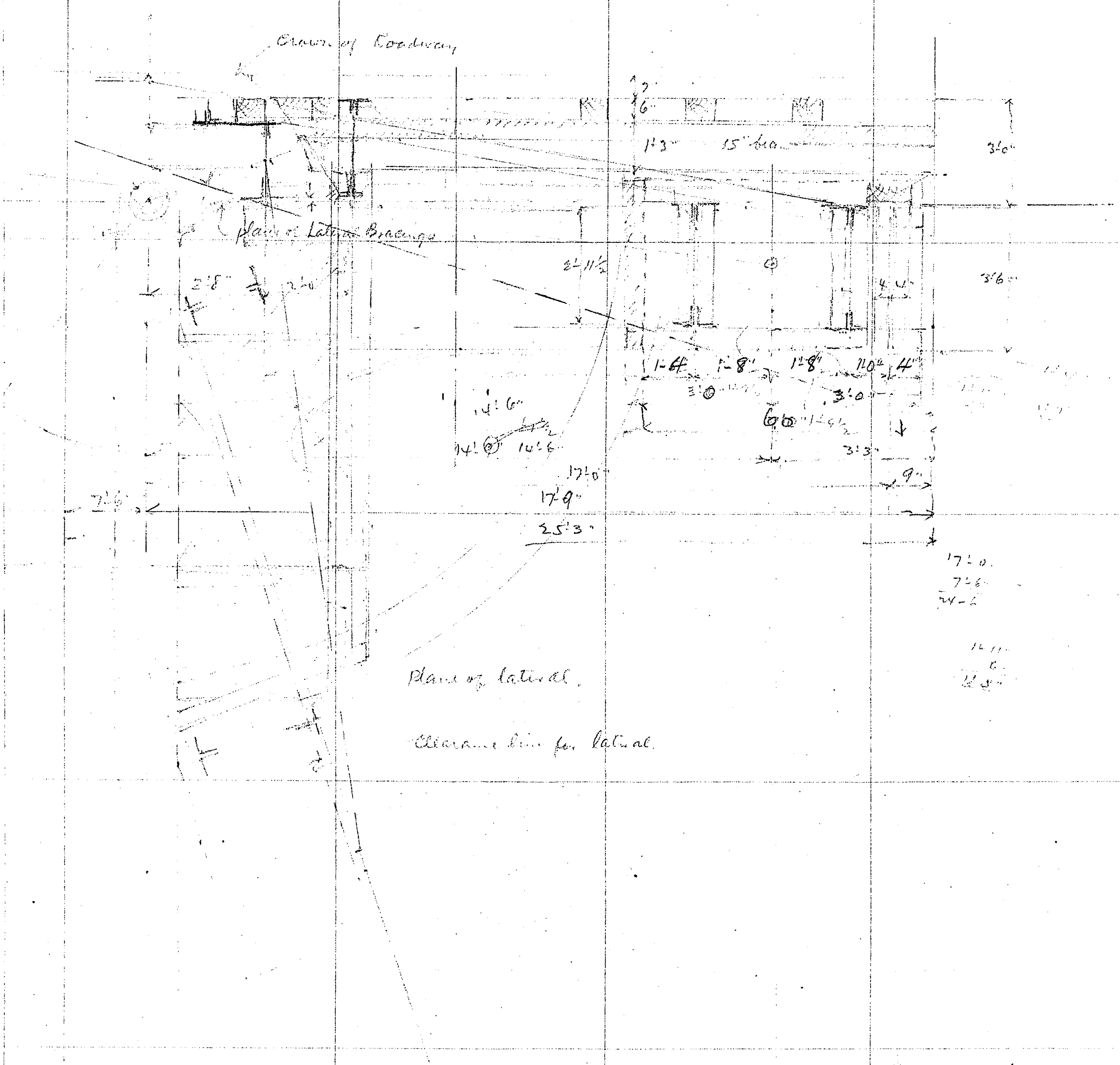
CALCULATIONS FOR

First Canal Bridge Double leaf bascule.



増田淳氏関係資料
（独立行政法人 土木研究所蔵）

CALCULATIONS FOR

First Canal Bridge Double leaf bascule.

Revised figure for counterweight. and Frames.

Arm = 14'-6.

weight required = $\frac{1779.000}{14.50}$ = 122,600 #

Approximate volume of Cwt = 6 · 5 · 17.10 = 5125
3.5 · 3.33 · 2.69 = 31
5156 cubic ft.

Unit weight = 122.600 ÷ 5156 = 238# per cubic ft.

Rear End of main girder G1
Dead Load moment at rear of live load bearing
Load on trunnion girder and floor front of T ~~3210~~ 2250
" " " rear of T 1140
Trunnion say 2000
94
6350
~~5390~~ #

Moment

trunnion	6350 ~~5390~~	· 7.5	=	40400
panel point 5	2895	· 10.17	=	29400
Rear of panel point 5	9550	· say 17.58 ~~16.83~~	=	167800
Cwt and frames	122600	· 22.0	=	2700000
				2,937,600 '#

Total moment at panel Point 4
live load m 2647.000
DL. moment 1224.000
3871 000
2937.600
933400 '#

negative Reaction at tail End Arm = 24.5'
933400 ÷ 24.5 = 38100 #

Dead Load balanced at ℄ trunnion.
max neg reaction at tail for live load only,
2647.000 ÷ 24.5 = 108 000 #

Volume of Concrete required for weight 108000 ÷ 140 = 770 cubic ft.
3 · 3 · 8.55 = 770
net section required 108000 ÷ 17000 = 6.36 □" net.
No of rivet 108.000 ÷ 6010 = 18 - 7/8"φ field.

Use 2[s 12 · 3½" @ 26.10 # = 15.34 □" gross. 11.820 □" net.
→ 2[s 10 · 3½ @ 23.55 = 13.85 □" gross 10.330 □" net.

Moment at trunnion DL. moment = 1,884.000 '#
Due to live load. 108000 · 17.17 = 1,855,000
3,739,000 '#

at panel point no 5.
DL. moment 9550 · 7.44 = 71000
122600 · 11.83 = 1450.000
1,521,000
L.L. Moment 108000 · 14.33 = 1550.000
3,071,000 '#

at 7'-3" rear of trunnion
DL. moment 620 · $\frac{10.25^2}{2}$ = 32600
122600 · 7.25 = 888 000
920600
Live Load moment 108000 · 9.92 = 1070 000
1990600 '#

CALCULATIONS FOR

First Canal Bridge Double leaf bascule

At Front End of Cwt Frame.

DL.m. girder + floor 620 · 4.67²/2 = 6750

Cwt 122600/2 · 3.33 = 204000

210750

Live Load moment 108000 · 4.33 = 467000

677.750 '#

At rear end of Cwt frame

DL. moment say 0.000

Live load moment 108000 · 1.0 = 108.000 '#

Section of girder

at trunnion. m = 3739.000 '# Depth of beam 8'-10" web say 96 + 7½ = 103½

103 · 3/8 = 38.60 □" ⅛ web = 4.83 Effective depth say 8.30

flange stress 3739.000 ÷ 8.30 = 450.000 #

Area required 450.000 ÷ 17000 = 26.45 □"

4.83

21.62 □"

Use ~~same~~ section as for panel point 4

2Pls. 14 · 3/4 = 21.00 - 18.00

2Ls 6·6·3/4 = 16.88 13.88

2Pls. 3 · 3/4 = 4.50 3.00 31.88

2Pls. 8¼ · 3/8 = 6.18 4.69

~~48.56~~ 39.57 □" net.

At panel point 5 m = 3071000 '# Depth of girder say 7'-9"

web say 90 · 3/8 = 33.70 □" ⅛ web = 4.21 □" Effective depth 7.25'

flange stress = 3071000 ÷ 7.25 = 423000 #

Area required 423000 ÷ 17000 = 24.90 □"

4.21

20.69 □" net.

2Ls 6·6·3/4" 16.88 - 13.88 □"

1Pl. 14 · 3/4 10.50 - 9.00

27.38 □" 22.88 □" net

At 7'-3" rear of trunnion. m = 1990600 '# Depth of girder 4'-10"

web say 56 · 3/8 = 21.0 □" ⅛ web = 2.62 □" Effective depth say - 4.5 about

flange stress = 1990600 ÷ 4.5 = 442000 '# SR = 26.00

2.62

23.38 □" -

Use 2Ls 6·6·3/4 = 16.88 - 13.88

1Pl. 14 · 3/4 = 10.50 - 9.00

27.38 □" 22.88 □" net.

At front End of Cwt Frame. m = 677750 '# depth 4.0' web say 47 · 3/8 = 17.6

⅛ web = 2.20 □" Effective depth say 3.85

flange stress 677750 ÷ 3.85 = 176.000 # SR = 10.35 □"

2.20

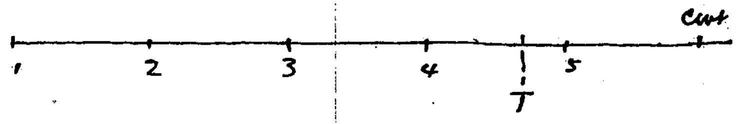
8.15 □" net

Use 2Ls 6·6·3/4" = 16.88 - 13.88 □" net.

CALCULATIONS FOR

First Canal Bridge Double leaf bascule.

Dead Load shear of main girder



at 1. 27351#
12349

at 2 49700#
13469

at 3 63169#
35950

at 4 89119#
call this 89100#

Rear. cwt 122600
at 5 9550
132150#
at trunnion 2895
135045#

Total load on trunnion
Front 89100
Rear 135045
at 6350
230495# call this 230500#

Live Load shear of main girder

at 1 20070
12370
2 32440
13500
3 45940
33270
4 79210

Rear 108000 req

Summary for shears.

1	1	2	3	4	5
Dead Load	27350	39700	SB170	89120	132150
Live Load	20070	32440	45940	79210	108000
	47420#	72140	99110	168330	240150#

Load on Trunnion.
Dead Load only. 230500#
Trunnion dia assumed 12" dia. Bearing req'd $= \frac{230500}{1600} = 144.00$□"
Bearing length requires 12" or 2 @ 6" each on each col.
Strength of trunnion. span length = 3'-0" load 230500
moment at center $= \frac{230500}{2} \cdot 1.50 = 172{,}500$ '#
or 2,070,000 "#

moment of inertia $0.049 \cdot 12^4 = 1016.$

$$f_s = \frac{2070.000 \cdot 6}{1016} = 12\overset{240}{\cancel{500}}\ \#/\square"$$

Assuming c to c of bearings 3'-3" $m = \frac{230500}{2} \cdot 1.62 = \cancel{243}\ 187{,}000$ '#
or 2240,000 "#

$$f_s = \frac{2240.000 \cdot 6}{1016} = 13200\ \#/\square"$$ ok

Trunnion Col. load on trunnion col. $\frac{230500}{2} = 115250$#
seismic horizontal force $= 115250 \cdot 0.2 = 23050$#
Section of col. assumed 2[15" × 4" @ 41.94 = 24.66
p.web. $16 \cdot \frac{3}{8}$ = 6.00
4Ls $3\frac{1}{2} \times 3\frac{1}{2} \times \frac{3}{8}$ = 9.92
40.58 □"

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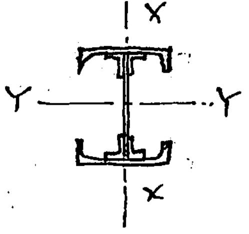
CALCULATIONS FOR

First Canal Bridge Double leaf bascule.

Moment of Inertia X-X



web. $16 \cdot 3/8'' = 6.00$
$4 L^s\ 3\frac{1}{2} \cdot 3\frac{1}{2} \cdot 3/8 = 9.92 \cdot 1.20^2 + 11.6 = 23.50$
$2 [^s\ 15'' @ 41.94^{\#} = \underline{24.66} \qquad = \underline{754.00}$
$40.58 \qquad 777.5$

$r = \sqrt{\frac{777.5}{40.58}} = 4.38$

Moment of Inertia YY.

web. $16 \cdot 3/8 = 6.00 \qquad 128.0$
$4 L^s\ 3\frac{1}{2} \cdot 3\frac{1}{2} \cdot 3/8 = 9.92 \times 7.11^2 + 11.6 = 513.6$
$2 [^s\ 15'' @ 41.94^{\#} = 24.66 \cdot 7.57^2 + 29.1 = \underline{1410.0}$
$2051.6^{(in)^4}$

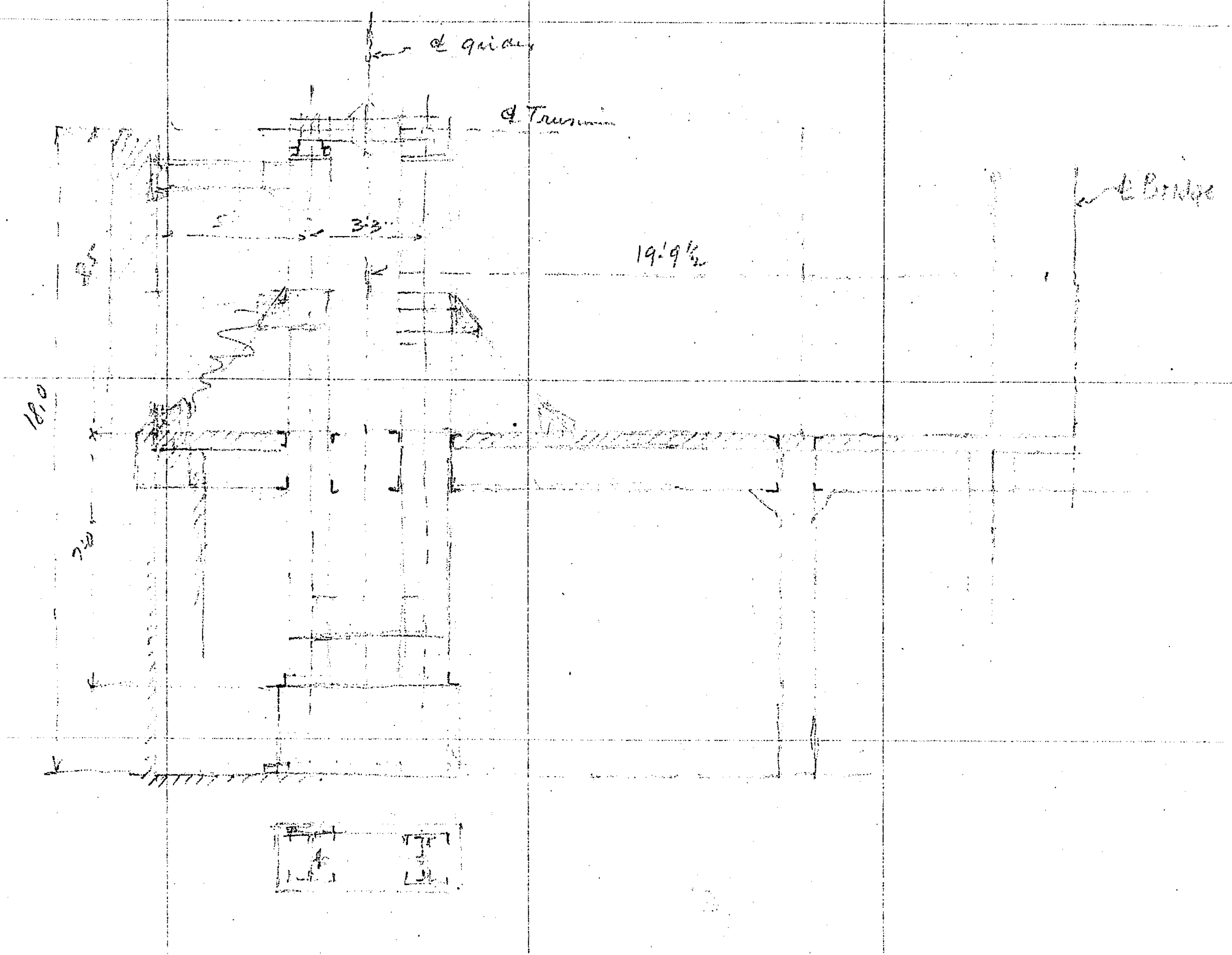
$r = \sqrt{\frac{2051.6}{4058}} = 7.09$

Seismic force. moment about XX axis. $= 23050 \cdot 5 = 115.000^{\#}$
Unsupported length say 5.0 $\quad l/r = \frac{60}{4.38} = 13.7$
Unit stress $= 14000^{\#}/\square''$
For seismic force $\quad 14000 \times 1.8 = 25200^{\#}/\square''$
Bending stress $= \frac{115.000 \cdot 12 \cdot 7.5}{777.5} = 13320^{\#}/\square''$

Unit stress for D load $\quad \frac{115250}{40.58} = \underline{2840}$
$16160^{\#}/\square''$

Seismic moment about YY axis $= 7.5 \cdot 23050 = 173.000^{\prime\#}$
Unsupported length 90" Unit stress $= 14000$
For seismic m $\quad 14000 \cdot 1.8 = 25200^{\#}/\square''$
Bending stress $= \frac{173.000 \cdot 12 \cdot 8.5}{2051.6} = 8580$

Unit stress for Direct load $\quad \frac{115250}{40.58} = \underline{2840}$
$11420^{\#}/\square''$ ok



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MADE BY J. Masuda DATE 15-5-4 FILE NO 4

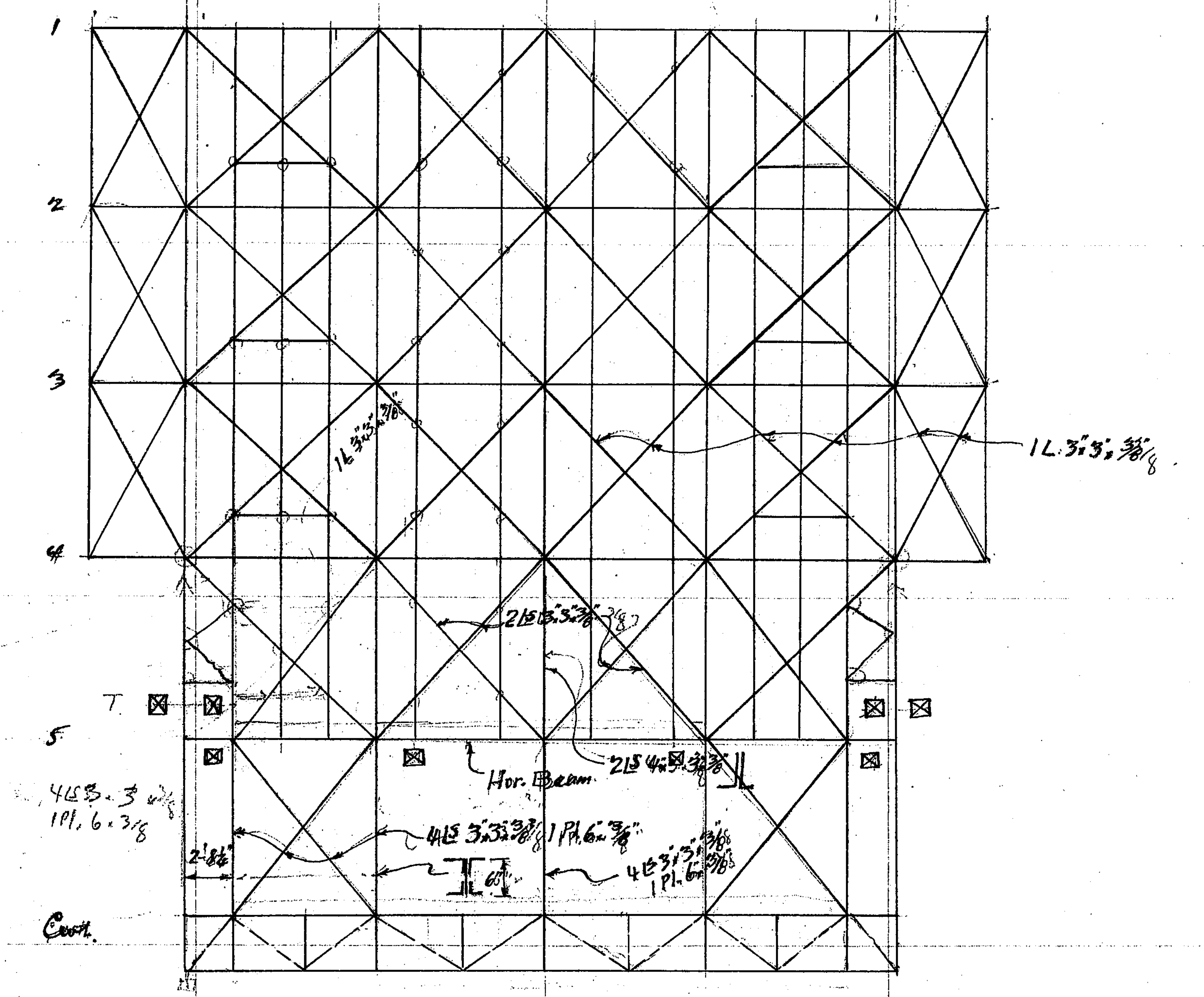
CHECKED BY ______ DATE ______ PAGE NO 23

CALCULATIONS FOR

Tiros Canal Bridge Double leaf bascule.

Lateral Bracing.

Exposed area   Static wind pressure 6.0 · 30" = 180" per lin ft.
moving wind pressure 12.0 · 30 = 360" " " "



Panel Conc. 1 540 · 6.08 = 3300
2 · 10.17 = 5500
3 · 10.17 = 5500
4 · 10.17 = 5500

Shear at 4 14300# assume this wind pressure resisted by 2 sets of bracings.
Shear by 1 set = 14300 ÷ 2 = 7150#
Stress in diagonal 7150 · 1.38 = 9900#
SR = 9900 ÷ 17000 = 0.580" net.
Use 1L 3 · 3 · 3/8 = 2.110" Use 3-7/8" Rivets.

Seismic stress. Shear at trunnion Front of trunnion 89120#
Horizontal force 89120 · 0.2 = 17800#
stress in diagonal. 17800 · 1.38 = 24600 ÷ 30600 = 0.800" net
17800 · 1.62 = 28800 ÷ 30600 = 0.940" net.

Rear of trunnion. D.L. shear = 132150#. Hor. F = 132150 · 0.2 = 26430
Stress in diagonal 26430 · 1.62 = 42800 for tension only
Compression member acting. 21400# T or C.
Section required 21400 ÷ 30600 = 0.700" net for tension
21400 ÷ 25200 = 0.850" gr.
Use 4Ls 3 · 3 · 3/8 with 1 web pl. rigid strut.

Chord stress. moment due to wind load Hor. F = 26430#
moment at 4 = 26430 · 22 = 580.000'#
stress in strut = 580.000 ÷ 8.06 = 72000#
SR for comp = 72000 ÷ 25200 = 2860"

4Ls 3.3.3/8 = ~~4.22~~ 8.44
1 web. 6.3/8 = 2.25
~~6.47~~ 0" 10.69

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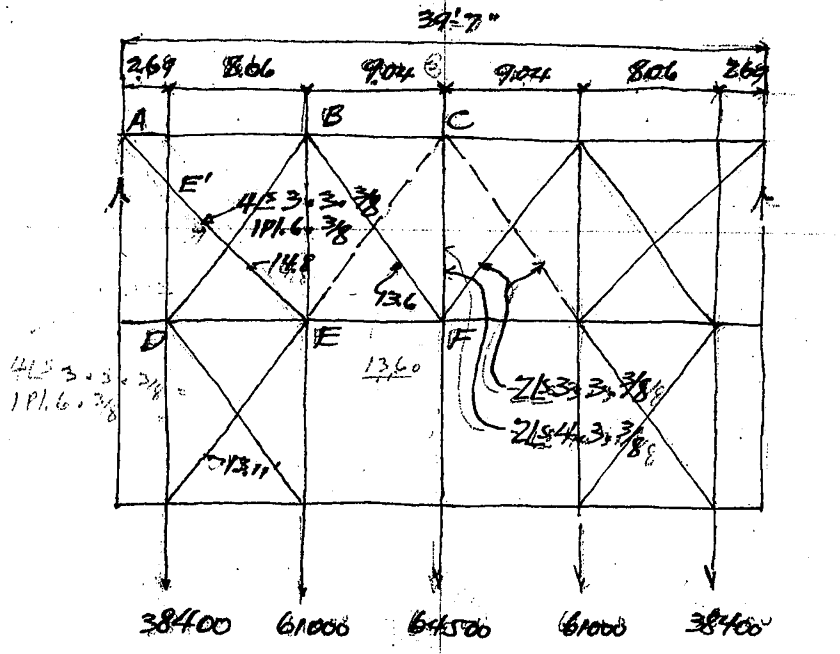
CALCULATIONS FOR

First Canal Bridge Double leaf bascule.

Lateral Bracing Continued.

Hanger for cwt. cwt = 5·6 @ 238# = 7140# per lin ft.

panel Concentration 7140 · 9.04 = 64500
7140 · ~~9.90~~ 8.55 = 61000
7140 · 5.38 = 38400



Reaction 38400
61000
32250
131650#

stress in AE' 131650 · $\frac{14.8}{10.17}$ = 191.600#

SR = 191.600 ÷ 17000 = 11.30 □" net.

Use 4Ls 3.3.3/8 = 8.44 - 5.40
1Pl. 6.3/8 = 2.25 - 1.50
2Pls. 8.3/8 = 6.00 - 4.50
16.69 □" - 11.40 □" net.

stresses in E'-E and BD. shear = 93150

EE' 46575 × 1.45 = 67500# 67500 ÷ 17000 = 3.97 □" net
BD 46575 · 1.29 = 60000# 60.000 ÷ 14000 = 4.29 □" gr.

Use 4Ls 3.3.3/8 = 8.44 - 5.40
1Pl 6.3/8 = 2.25 - 1.50
10.69 □" 6.90 □" net.

Stress in BF. 32250 · $\frac{13.6}{9.04}$ = 48500 48500 ÷ 17000 = 2.85 □" net.

Use 2Ls 3.3.3/8 = 4.22 - 0.75 = 3.47 □" net.
also use counter bracing.

Stress in EF

moment at center of span 131650 · 19.79 = 2600.000
61000 · 9.04 = 551.000
38400 · 17.10 = 656.000
1207.000
1,393,000 "#

Stress in chord = 1393.000 ÷ 10.17 = 137.000#
net section required = 137.000 ÷ 17000 = 8.06 □" net.

Section required for BC = 137000 ÷ 14000 = 9.80 □" gr.

Stress in AB approximate only.

moment at E 131650 · 10.75 = 1415.000#
38400 · 8.06 = 310.000
1105.000

stress = 1105000 ÷ 10.17 = 109.000# T SR = 7.8 □" gross.

For EF. 4Ls 3½.3½.3/8 = 9.92 - 7.28 or combined with girder
1Pl. 6.3/8 = 2.25 1.50 above use 4Ls 3½.3.3/8"
12.17 □" 8.78 □" net

For ABC Use 4Ls 3.3.3/8 = 8.44 □" to be riveted to web of main floor beam

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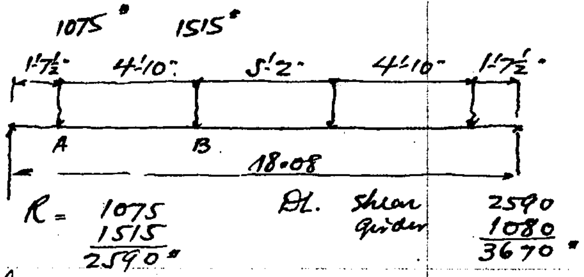
CALCULATIONS FOR

First Canal Bridge Double leaf bascule.

Floor Beam at Panel Point no 5. see page 5
Intermediate Floor Beam between longitudinal Electric Railway girders.
Span length 18.08'
Dead Load   Floor load will be half of intermediate



Dead Load moment $2590 \cdot 6.45 =$ 16700
$1075 \cdot 4.83 =$ 5200
11500"#
Beam say $\frac{1}{8} \cdot 120 \cdot 18.08^2 =$ 4900
16400"#

Live Load Same as for intermediate floor beam 121910
Total m 138310"#

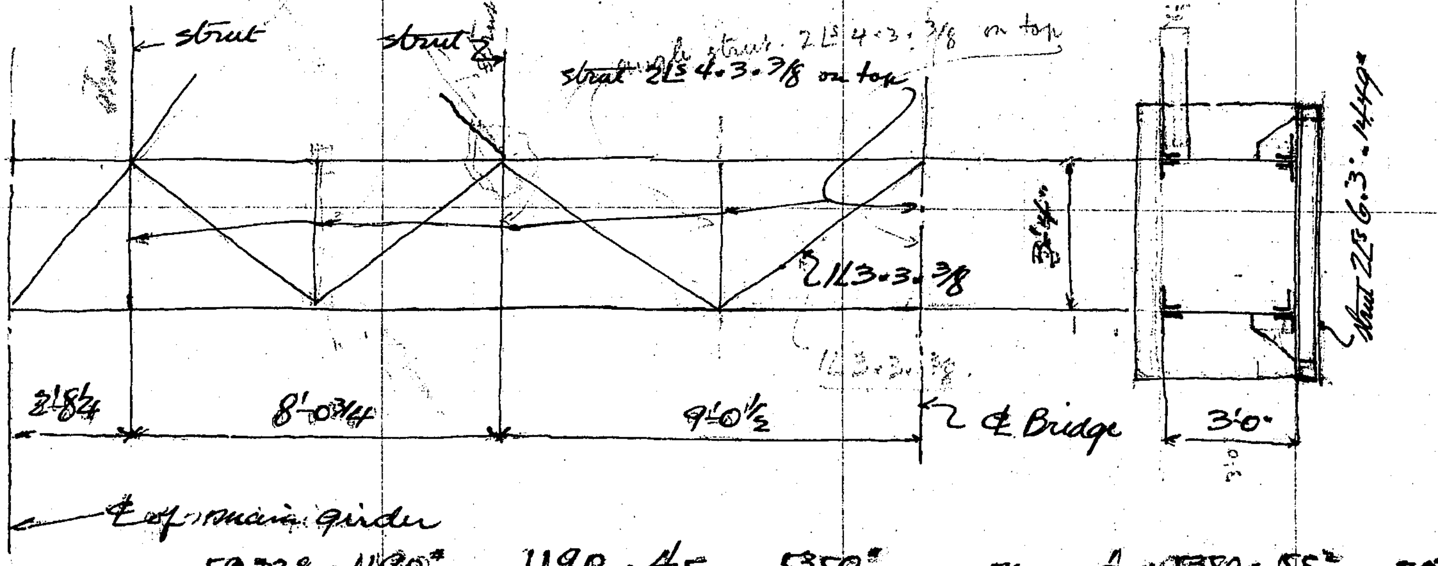
Summary for moments and shears

	Moment	Shear
Dead Load	16400	3670
Live Load	121910	31150
	138310"#	34820#

depth of girder 2'4¼" web say $28 \cdot \frac{3}{8}" = 10.5$
$\frac{1}{8}$ web = 1.32 □" Effective depth say 2.2'
flange stress = $138310 \div 2.2 = 62800$#
SR = $62800 \div 17000 = 3.70$ □" net.
Use 2Ls $3 \cdot 3 \cdot \frac{3}{8}$ = 4.22 − 1.48 = 2.74 □" 1.32 + 2.38 □" net. ok

Use same section 2Ls $3 \cdot 3 \cdot \frac{3}{8}"$ = 4.22 for highway floor beam.

Counterweight Frame
Counterweight girder span length 39'7".
Load. $30 \cdot 238" = 7140$# For one girder 3570# per lin. ft.
moment = $\frac{1}{8} \cdot 3570 \cdot 39.58^2 = 698000$"#
Depth of girder. 3'0" about web $36 \cdot \frac{3}{8} = 13.50$ □" $\frac{1}{8}$ web = 1.69 □"
Effective depth. say 2.72' flange stress = $698.000 \div 2.72 = 257.000$#
Section required $257.000 \div 17000 =$ 15.15
less 1.69
13.46 □" net
Use 2Ls $6 \cdot 6 \cdot \frac{3}{4}$ = 16.88 − 13.88 □" net 2 holes out each angle.
End shear $3570 \cdot \frac{39.58}{2} = 70700$#
Rivet pitch at end $= \frac{28.75 \cdot 7880}{70700} = 3.2"$ no of rivet for end connection
$70700 \div 6010 = 12$ − ⅞" Rivets.



5@238 = 1190# $1190 \cdot 4.5 = 5350$# m = $\frac{1}{8} \cdot 5350 \cdot 5.5^2 = 20200$"#
Sm = $\frac{20200 \cdot 12}{17000}$ = 14.25
Shear $5350 \cdot 3.0 = 16100$#
required 4-¾" rivets Use 2Ls 6·3" @ 14.49# = 8.52 □" Sm = 16.66 □"

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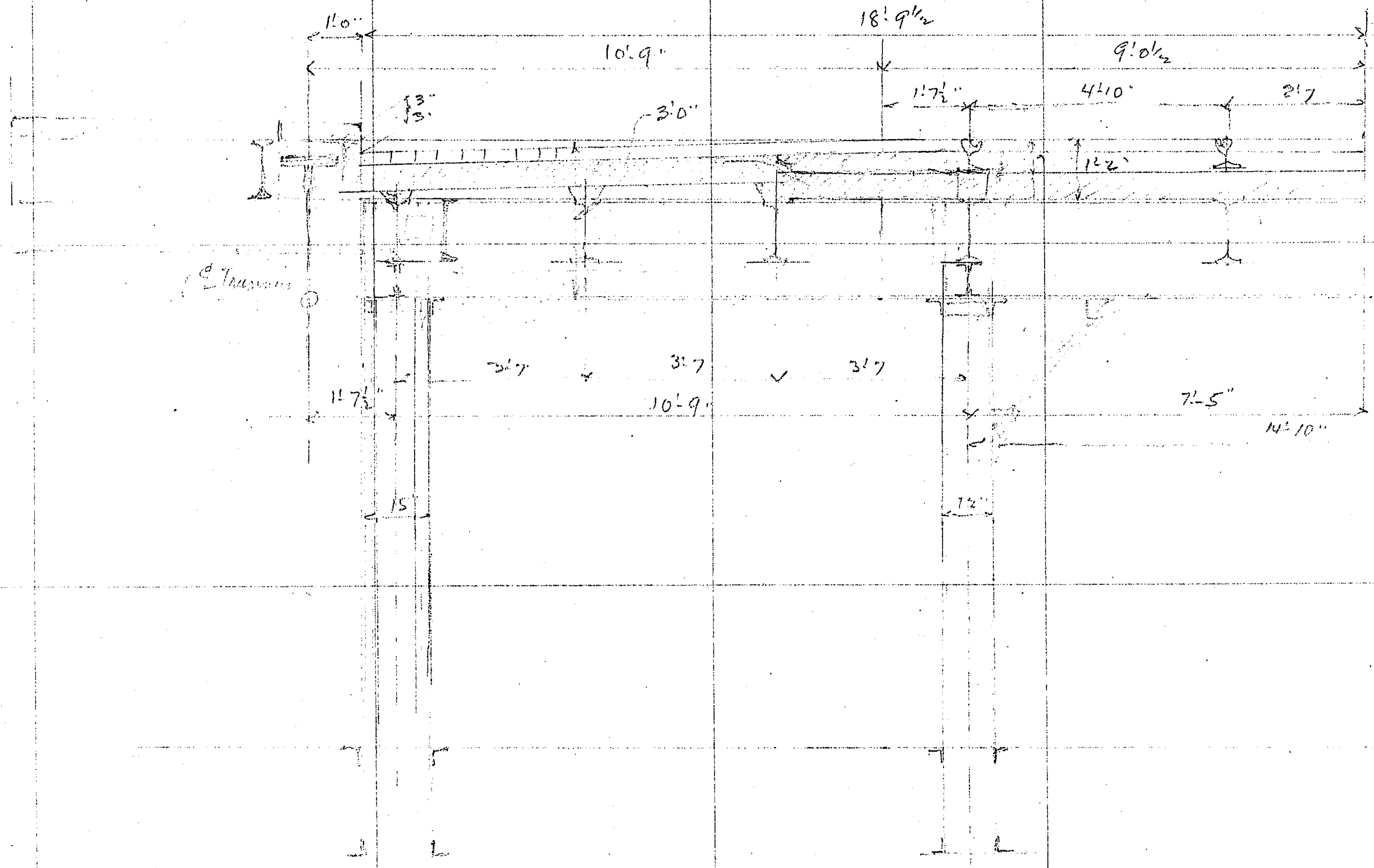
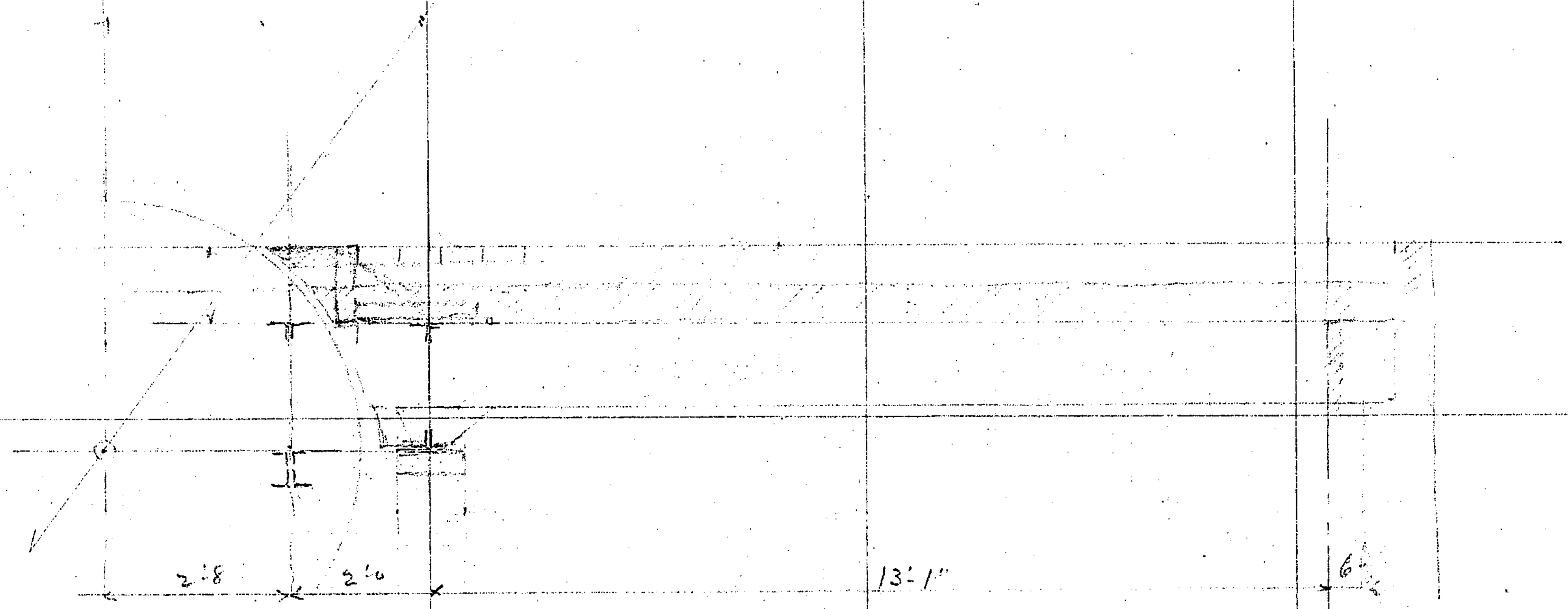
CALCULATIONS FOR

Tiroi Canal Bridge for Kobe double leaf bascule.

Design of Fixed Floor on Abutment.
Cross sections of floor.





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CALCULATIONS FOR

First Canal Bridge for Kobe double leaf bascule

Slab under Electric Ry tracks   max span length 5'-2"
Rails will be carried by steel chair of 3" wide about
Slab assumed 6"   Rail height 7" ½" clear under the base to top of slab.

Dead Load

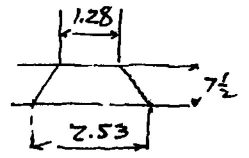
3" pavement		15
4½" Lean Concrete filling @12#	=	54#
6" Concrete slab		75
		144#

$DL.m = \frac{1}{10} \cdot 144 \cdot 5.17^2 =$ ~~482~~'# 385'#

$DL.\ Shear = \frac{1}{2} \cdot 144 \cdot 5.17 = 372$#

Live Load   motor truck Concentration rear wheel   9900
Impact 30%   2970
12870#

Distribution of wheel Concentration for single load



longitudinal distribution a   .66 + 1.25 = 1.91'
Transverse distribution b   1.28 + 1.25 = 2.53
$E = \frac{2}{3}(l+b) + a = \frac{2}{3}(5.17 + 2.53) + 1.91 = 7.04$
assume distribution 5.0' and take effective width as 5.0

Load per ft strip   12870 ÷ 5.0 = 2570# per ft.

Concentrated load at center of span

$m = 1285 \cdot 2.58 = 3320$
$Less.\ \frac{2.53}{4} \cdot 1285 = 816$
2504'#

For Continuity of Slab $0.8 \cdot 2504 = 2000$'#

Live load shear say 12870#

Summary for moments and shears.

	moment	shear	
Dead Load	~~3~~85	~~372~~	372
Live load	2000	~~12870~~	2570
	2385	13242	2842

Effective depth of slab for 640# Concrete stress and 17000# Steel Stress
$d = \sqrt{\frac{2385}{102}} = 4.83$"

Use 6". Slab with 1" insulation at bottom

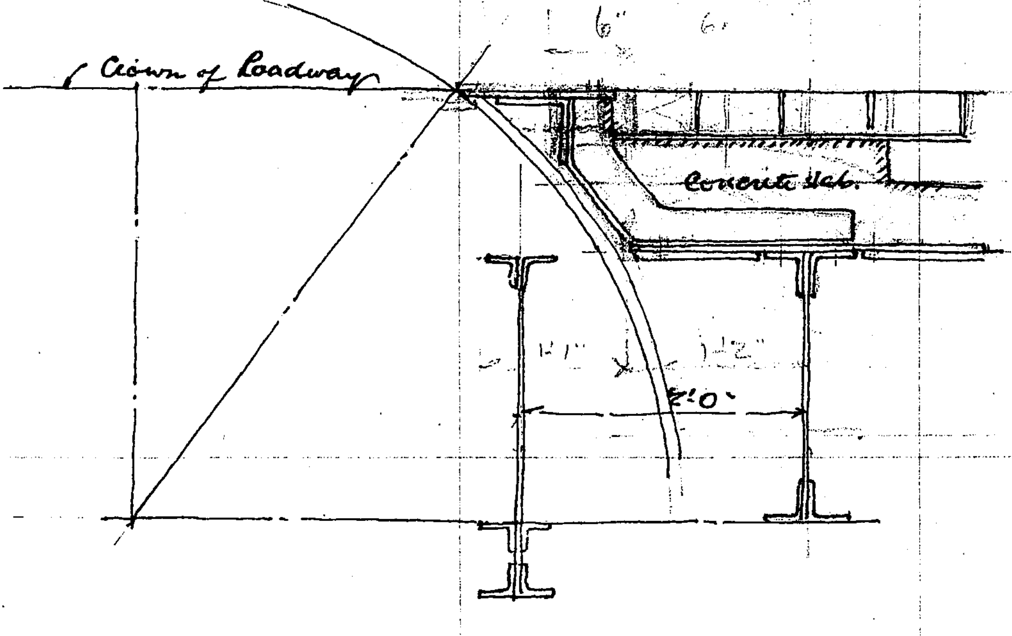
Steel Area required $= \frac{2385 \cdot 12}{17000 \cdot 7/8 \cdot 5} = .384$ use ½"ϕ bars 6" centers

Bondstress $\frac{\overset{2842}{\cancel{13242}}}{7/8 \cdot 5.5} = \overset{649}{\cancel{3030}}$ per ft strip

For shear use ½"ϕ bars 3" center to carry bond stress
Unit bond of steel bar $= \frac{649}{6.28} = 103.4$#/□" ok

Highway slab.   Use 6" slab same as for Electric Railway slab.

Electric Railway stringers   ~~span~~ length 13'-7" = 13.58
Overhang 2.0



motor truck rear wheel Conc. = 12870#
distribution assumed 2.0
12870 ÷ 2 = 6435# per ft.
moment = 6435 · 0.5 = 3218'#
fibre stress $= \frac{3218 \cdot 12 \cdot 6}{12 \cdot .375^2} = 137500$#/□"

Stresses are too high   use cover plate and take stress by tension.
Effective depth assumed 9"
stress in flange $= \frac{3218}{.75} = 4290$# per ft.
tensile stress ok
Use stays 2'-0" centers about

CALCULATIONS FOR

First Canal Bridge for Kobe double leaf bascule.

Cantilever Bracket over hang assumed 2.0

Dead Load.

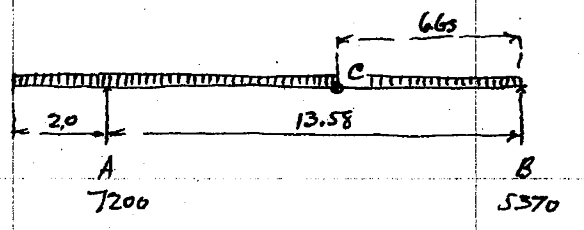
Floor 144 · 5.0 = 720

Rail say $\frac{122}{3}$ say = 41

stringer say $\underline{45}$

806# per lin ft.

moment = $806 \cdot \frac{2^2}{2} = 1612$'# at A.



Reaction at A $\frac{806 \cdot 15.58^2}{2 \cdot 13.58} = 7200$

806 · 15.58 = 12570 12570 - 7200 = 5370#

5370 ÷ 806 = 6.65' moment at C = 5370 · 6.65 = 35700.

$\frac{806 \cdot 6.65^2}{2} = \underline{17800}$

17900'#

max shear 7200 - 2 · 806 = 5590#

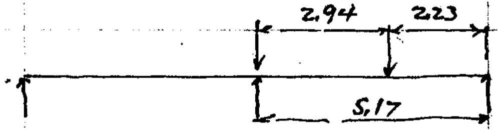
Live Load motor truck rear wheel 12870#

Cantilever moment = 12870 · 2.0 = 25740'# for single load

trucks side by side max load = $12870 \cdot \frac{2.23}{5.17} = 5800$

$\underline{12870}$

17670#

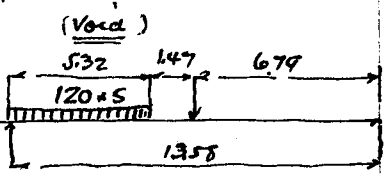


moment for Cantilever = 17670 · 2 = 35340'#

max positive moment at center = $\frac{17670}{2} \cdot 6.79 = \frac{120000}{2}$'# = 60.000

$625 \cdot 6.79 = \frac{}{4}$ $\underline{4250}$

64250'#



no. uniform load.

For motor truck load only m = 60.000'#

120 · 5 = 600# per lin ft.

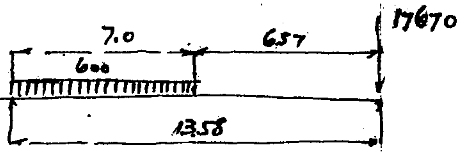
Reaction = $\frac{600 \cdot 5.32^2}{2 \cdot 13.58} = 625$#

max shear

unif load $\frac{600 \cdot 7^2}{2 \cdot 13.58} = 1080$

motor truck loading $\underline{17670}$

18750#



Summary for moment and shear.

	Cantilever Portion		Beam Portion	
	moment	shear	moment	shear
Dead Load	1612	1612	17900	5590
Live Load	35340	17670	60.000	18750
	36952'#	19282#	77900'#	24340#

stress in tension plate 36952 ÷ 1.25 = 29500# SR = 29500 ÷ 17000 = 1.73 □"

use 6½" · 3/8 = 2.34 - 1.78 net use 3/4"φ rivet 7.0

Beam portion section modulus reqd $\frac{77900 \cdot 12}{17000} = 55.0$

Use 15" · 42.9# I Sm = 58.9

For Highway stringer use same section as for above.

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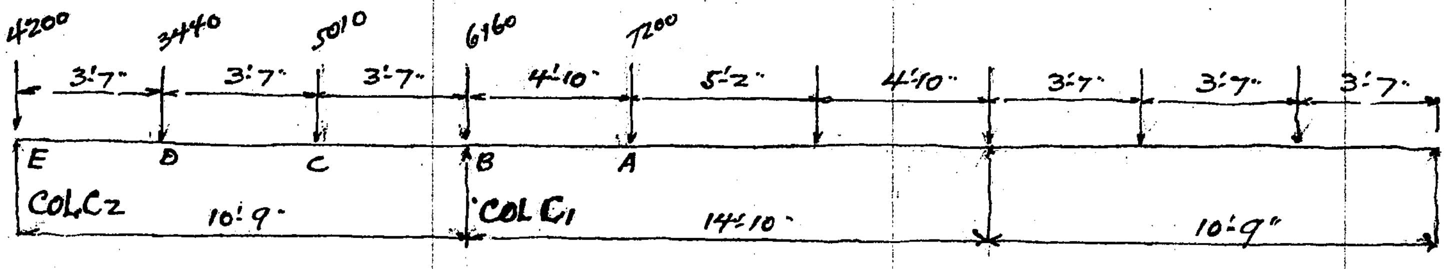
CALCULATIONS FOR

First Canal Bridge for Kobe, double leaf bascule.

Cross beams under Electric Railway and Highway slab.



Dead Load.

Concentration at A.

Floor	$144 \cdot 5.0$	=	720	$806 \cdot 15.58 = 12570^{\#}$
Railway	$\frac{122}{3}$	=	41	$R = \frac{806 \cdot 15.58^2}{2 \cdot 13.58} = 7200$
Stringer say			45	$12570 - 7200 = 5370$
			806.	

Concentration at B

4'10
3'7"
8'-5"

Floor	$144 \cdot 4.2$	=	605	$691 \cdot 15.58 = 10750$
Rail.	$122 \div 3$	=	41	$R = \frac{691 \cdot 15.58^2}{2 \cdot 13.58} = 6160^{\#}$
Stringer			45	$10750 - 6160 = 4590$
			691	

Concentration at C

Floor	$144 \cdot 2.4$	=	346	$561 \cdot 15.58 = 8730$
"	$95 \cdot 1.79$	=	170	$R = \frac{561 \cdot 15.58^2}{2 \cdot 13.58} = 5010$
stringer say			45	$8730 - 5010 = 3720$
			$561^{\#}$	

Concentration at D

Floor	$95 \cdot 3.58$	=	340	$385 \cdot 15.58 = 6000$
Stringer say			45	$R = \frac{385 \cdot 15.58^2}{2 \cdot 13.58} = 3440$
			385	$6000 - 3440 = 2560$

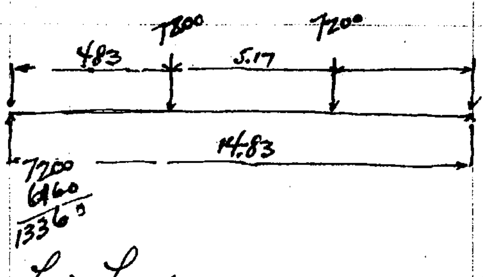
Concentration at E from rear end only.

Floor	$95 \cdot 2.41$	=	229	$469 \cdot 15.58 = 7300$
Curb.	$42^{\#}$ per ft.	=	42	$R = \frac{469 \cdot 15.58^2}{2 \cdot 13.58} = 4200^{\#}$
Sidewalk	$47 \cdot 3.25$	=	153	$7300 - 4200 = 3100^{\#}$
Stringer say			45	
			469	

Load from front say. $47^{\#} \cdot 3.25 = 153.$
$153^{\#} \cdot 5 =$ say $800^{\#}$

Dead Load moment center floor beam

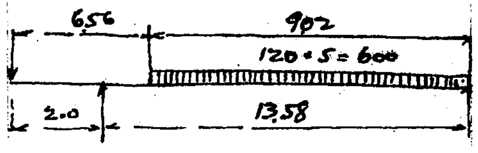
moment $= 7200 \cdot 4.83 = 34800$
$\frac{1}{8} \cdot 100 \cdot 14.83^2 = 2750$
$37550^{1\#}$



Shear $=$ 7200
$\frac{100}{2} \cdot 14.83 =$ 740
$7940^{\#}$

Live Load motor car loading concentration rear wheel $12870^{\#}$

$12870 \cdot \frac{15.58}{13.58} = 14750^{\#}$



Uniform load $\frac{600 \cdot 9.02^2}{2 \cdot 13.58} = 1800^{\#}$

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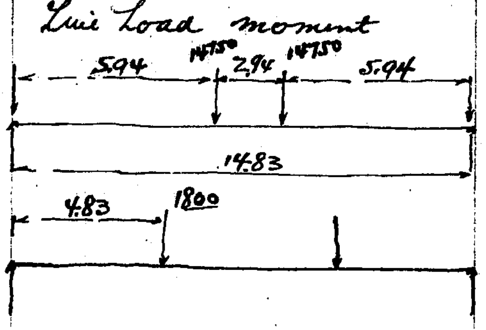
CALCULATIONS FOR

First Canal Bridge for City of Kobe double leaf bascule.

Center Floor beam Continued.

Live Load moment



motor truck loading 14750 · 5.94 = 87500

Uniform loading 1800 · 4.83 = 8700

96200 ″#

End shear = 2 @ 14750 = 29500 #

Say 1800

31300 # -

Summary for moments and shears

	moment	shear
Dead Load	37550	7940
Live Load	96200	31300
	133750 ′#	39240 #

Depth of girder. 1′-10″ web assumed 22 · 3/8 = 8.25 □″

1/8 web = 1.03 □″

Effective depth re = 1.69

flange stress 133750 ÷ 1.69 = 79100 #

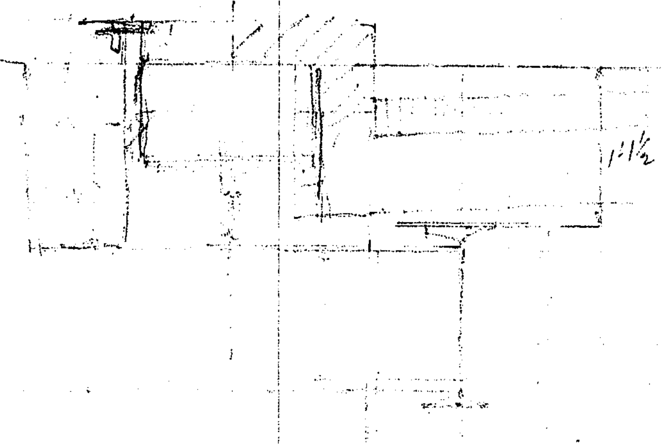
Section required = 79100 ÷ 17000 = 4.65

1.03

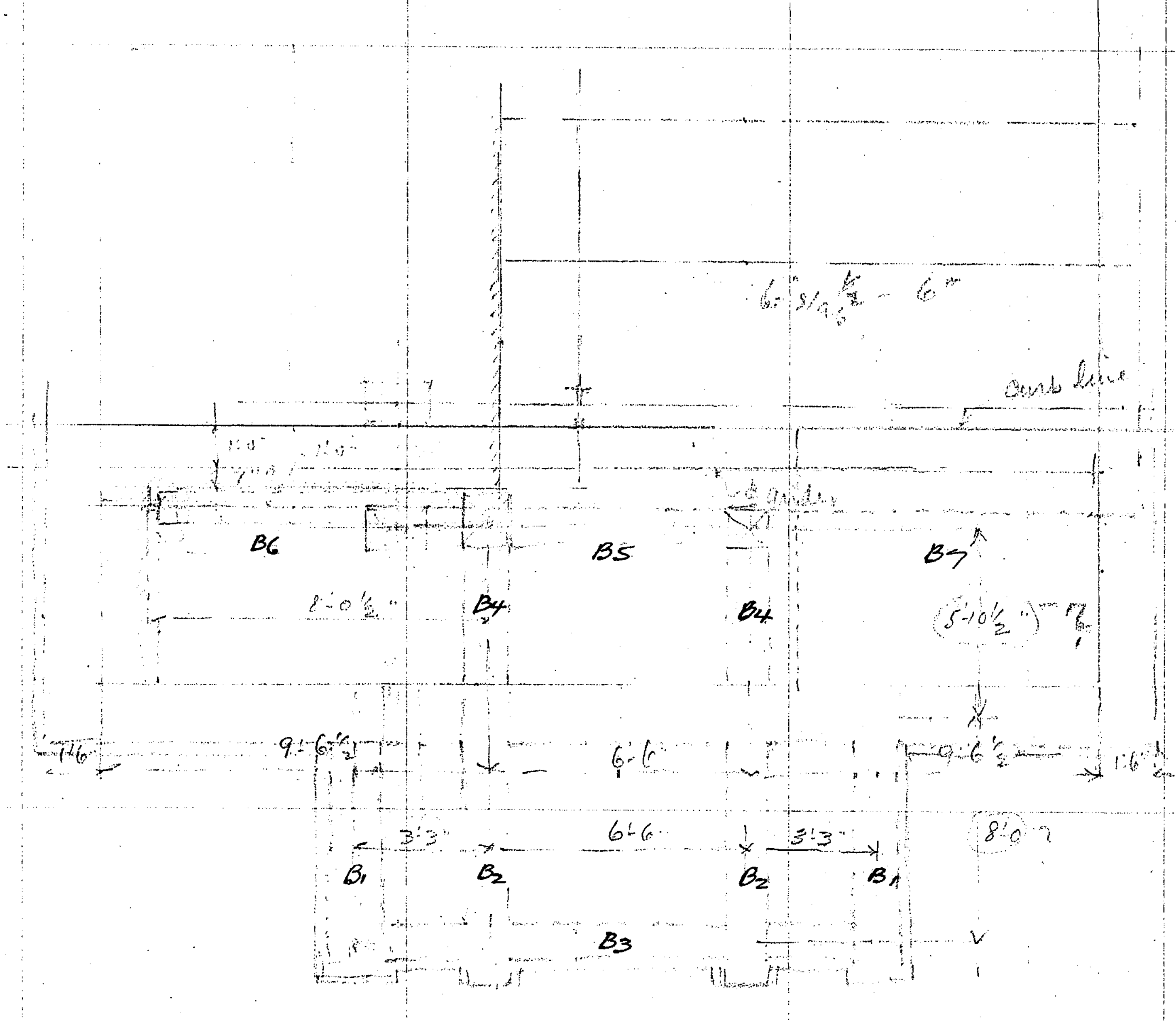
3.62 □″ net.

Use 2L^s 3½ · 3½ · 3/8 = 4.96 □″ gross or 4.21 □″ net.

Use same section for side floor beams.



General sketch of fixed sidewalk floor.



CALCULATIONS FOR

First Canal Bridge for City of Kobe, double leaf bascule.

Columns carrying Floor beams under fixed floor. see page 29 for column marks.

Column C1.

Dead Load from center floor beam

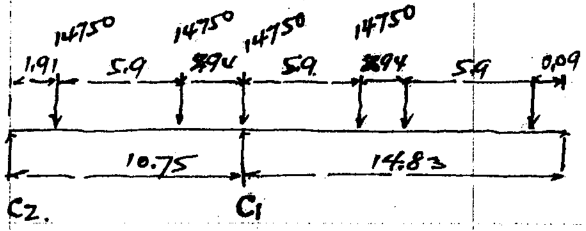
	Concentration	A	7200
		B	6160
from side	$5010 \cdot \frac{2}{3}$	C	3340
" "	$3440 \cdot \frac{1}{3}$	D	1150
			17850 #

Column C2

Dead Load	$5010 \cdot \frac{1}{3}$	C	1670
	$3440 \cdot \frac{2}{3}$	D	2300
		E	4200
			8170 #

Live Load on Columns.

max on Col C1.



motor truck reaction on floor beam 14750

Uniform live load. $\frac{120 \cdot 9.02^2}{2 \cdot 13.58} = 360$ # per lin ft.

motor truck loading $2 @ 14750 = 29500$

$29500 \cdot \frac{4.86}{10.75} = 13350$

42850 #

Uniform load $360 \cdot 12.79 = 4600$

Tot load 47450 #

max load on Col. C2.

wheel load on C2. motor truck loading - $14750 \cdot \frac{4.85}{10.75} = 6650$ #

14750

21400 #

Uniform load $360 \times \left(\frac{10.75}{2} + .62\right) = 2160$

23560 #

From sidewalk say 1000

Total load 24560 #

Summary for load on Columns

	Col. 1	Col 2
Dead Load	17850	8170
Live Load	47450	24560
	65300 #	32730 #

Unsupported length $8.5 \times 12 = 102"$

$r = 3.85 \quad l/r = 102 \div 3.85 = 26.5$

$p = 21300\,(1 - 0.0055 \cdot 26.5) = 18250$

say 14000 #/□"

Earthquake moment

Horizontal force Col. C1 $17850 \cdot 0.2 = 3570$ # $m = 3570 \cdot 11.0 = 39300$ '#

Col C2 $8170 \cdot 0.2 = 1630$ $m = 1630 \cdot 11.0 = 17900$ '#

Try 10" 3½" @ 23.55 # = 13.85 □"

fibre stress $= \frac{39300 \cdot 12 \cdot 5.0}{204.0} = 11550$ #

Direct stress $= \frac{65300}{13.85} = 4720$

16270 # allowable stress $14000 \cdot 1.8 = 25200$ #/□"

Use same section for C2 as C1. 2[10" · 3½ @ 23.55 # = 13.85 □"

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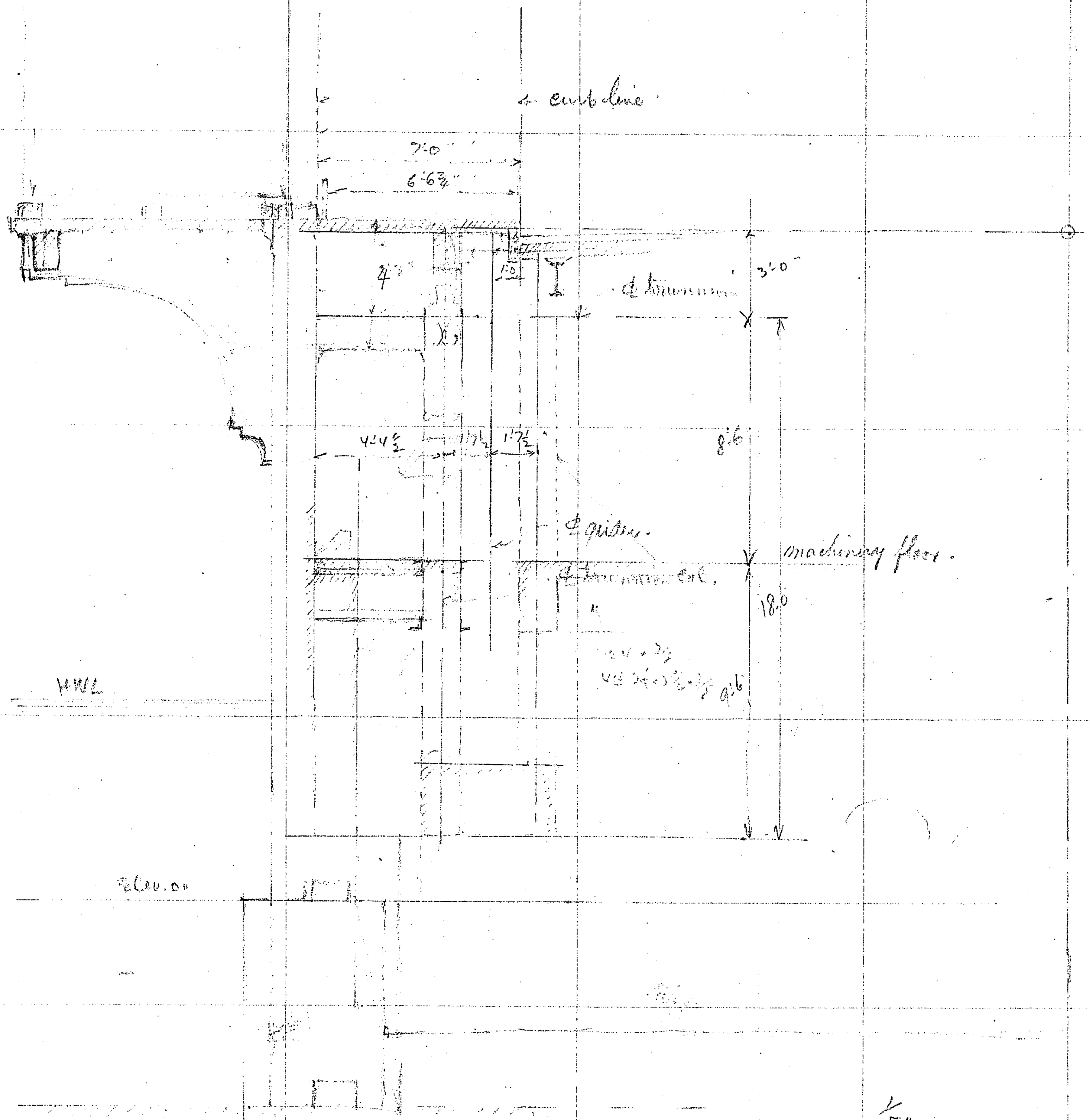
CALCULATIONS FOR

First Canal Bridge for City of Kobe, double leaf bascule.



増田淳氏関係資料
（独立行政法人 土木研究所蔵）

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CALCULATIONS FOR

First Canal Bridge for City of Kobe, double leaf bascule

Operating House and sidewalk slab + beams.

Floor slab. span length 6'-6"

Concrete slab. 5" thick 62.5 #
4" cinder - 32.0
2" floor - 10.0
104.5 call this 105# per sq ft.
Live Load say 100
205#

moment = $\frac{1}{10} \cdot 205 \cdot 6.5^2 = 865'^{\#}$ Effective depth req'd $\sqrt{\frac{865}{102}} = 2.92"$ for 640# concrete stress and 17000#/□" steel stress

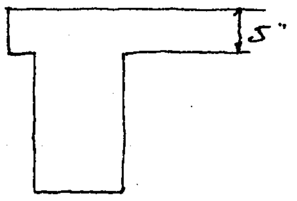
Steel Area req'd = $\frac{865 \times 12}{\frac{7}{8} \cdot 4" \cdot 17000} = .175□"$ per ft strip

Use 3/8"φ bars 6" centers = .220□" per ft strip.

Beam B_1

Dead Load per ft run of wall.

wall 50# · 10 = 500
roof 50# · 9 = 450
Live load say 20 · 9 = 180
1130#
Slab and beam 700
1830# per lin ft.



span length say 8.0'

$m = \frac{1}{10} \cdot 1830^{\#} \cdot 8.0^2 = 11,700'^{\#}$

End shear = $\frac{1}{2} \cdot 1830 \cdot 8. = 7320^{\#}$

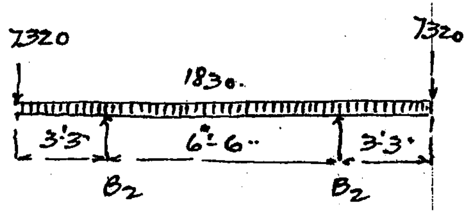
As ~~simple~~ square beam Effective depth = $\sqrt{\frac{7320}{102}} = 8.5"$

For main reinf. use 2-3/4"φ bars. at top and bottom of beam and ~~provide~~ enough web reinforcement. similar to ~~B2~~

Beam B_3 Facia Beam at End of B_1 and B_2

Concentration at end of beam 7320

Dead Load from wall. 1830# per lin ft.



max moment at B_2
Uniform load $1830 \cdot \frac{3.25^2}{2} = 9650'^{\#}$
Concentration $7320 \cdot 3.25 = 23800$
33450'#

Reaction $1830 \cdot 6.5 = 11900$
7320
19220#

max positive moment $\frac{1}{8} \cdot 1830 \times 6.5^2 = +9660'^{\#}$
−33450
Summary moment −23790'#

Effective depth = $\sqrt{\frac{33450}{102}} = 18.1"$

Depth say 2.5' at B_2 Connection Steel Area required $\frac{33450 \times 12}{\frac{7}{8} \cdot 28" \cdot 17000} = 0.96□"$

Use 4-3/4"φ bars = 1.76□" allowing for Earthquake.

Depth say 1.5' at center of beam

Steel Area required = $\frac{23790 \cdot 12}{\frac{7}{8} \cdot 16 \cdot 17000} = 1.20□"$

Beam B_2. Load at end = 19220#

direct load on beam + beam itself. $205 \cdot 4.87 = 1000$
beam say 750
1750#

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CALCULATIONS FOR

First Canal Bridge for City of Kobe, double leaf bascule.

Cantilever moment Uniform load $1750 \times \frac{8^2}{2} = 56000$
$19220 \times 8.0 = 153800$
209800 '#

Effective depth required $= \sqrt{\frac{209800}{102}} = 46.5$" Effective depth 46.5" make depth 4'-3"

Steel Area required $= \frac{209800 \times 12}{\frac{7}{8} \times 48 \times 17000} = 3.53$ □" use 8- 7/8"□ bars 4.80□" in double rows on top single row at bottom of beam

max shearing Concentration at end 19220
Uniform $1750 \times 4 = 7000$
26220 #

Unit shearing stress $= \frac{26220}{12 \times \frac{7}{8} \times 48} = 52$ #/□"

At end of beam 19220# depth say 3.0
Unit shearing stress $= \frac{19220}{12 \times \frac{7}{8} \times 34} = 54$ #/□".

Beam B4 span length 5'-10½"
weight of beam and 1.0' slab on both sides.
beam say - 600
slab. $47 \times 3.0 =$ 141 741
Live load 300
1041# per ft.

DL. moment $\frac{1}{8} \times 741 \times 5.87^2 = 2330.0$
LL. moment $\frac{1}{8} \times 300 \times 5.87^2 = 1290.0$
3620.0 '#

max negative reaction due to cantilever moment
$= 209800 \div 5.87 = 35800$#
Dead Load 2330
33470 #

make depth of beam 4'-3" use same reinforcement as for B2.

Slab on sidewalk. span length 5'-10½"
slab 4¼" slab. @12.5 = 53
3/4" wearing course = 10
63# per sq ft.
Live load say 100
163#

moment $= \frac{1}{10} \times 163 \times 5.87^2 = 562$ '#
Effective depth $= \sqrt{\frac{562}{102}} = 2.34$ slab say 4½"
Steel Area $= \frac{562 \times 12}{\frac{7}{8} \times 3.75 \times 17000} = .121$
use 3/8"□ bars 6" centres.
Every other bars to be bent up at support.

Beams B5-6-7. max span length say 10.0'
Dead Load. say 63#
Live Load 100
163×4.5 about $= 733$#
Dead Load beam say.

DL. only - 283
200
483#
Live Load - 450
933#

$m = \frac{1}{10} \times 933 \times 10^2 = 9330$ '#

Effective depth say $\sqrt{\frac{9330}{102}} = 9.5$" beam assumed 1.5 from top.

Steel area required $= \frac{9330 \times 12}{\frac{7}{8} \times 16 \times 17000} = .47$ use 3- 5/8"□ bars - .90□"
on top and bottom.

Load on col. max negative reaction 33470#
$483 \times 5 =$ less 2420
31050# upward.

make col. 15"×15" and solid wall below machinery floor
Concrete required for weight $= 31050 \div 140 = 222$ cubic ft.

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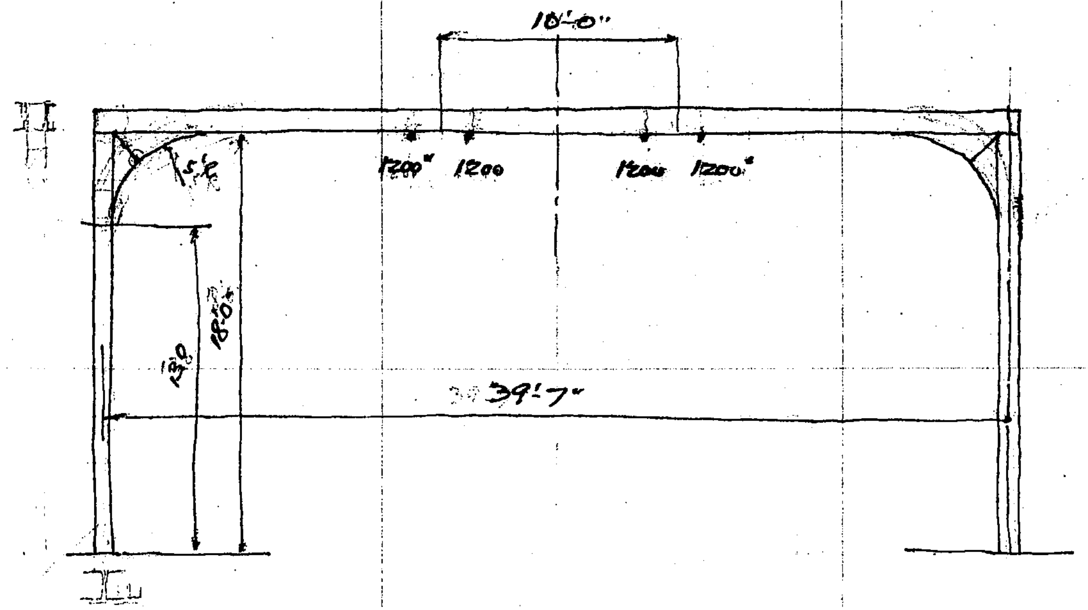
CALCULATIONS FOR

First Canal Bridge for City of Kobe, double leaf bascule.

Design of trolley pole.



Trolley wire 000 0.41" dia cross sectional area = 0.132 weight = 0.132 · 3.86 = 0.51# per ft
span length 58'-0"

moment = $\frac{1}{8}$ · 0.51 · 58² = 215'#
Sag assumed 0.2 215 ÷ 0.2 = 1075# horizontal pull assumed 1200# each wire.

vertical load · trolley pan and connection and detail 2 @ 400 = 800# per track
assumed main section 4 Ls 3½ · 3½ · 3/8 @ 8.5 = 34.0
lacing bars. 25.0
" " 30.0
Tie Plates + other misc details 31.0
120.0 per lin ft.

moment due to vertical load $\frac{1}{8}$ · 120 · 39.58² = 23400
concentration 800 · 14.79 = 11800
35200'#

Moment due to horizontal pull. 2400 · 14.79 = 35450'#

Stress due to vertical load Stress = 35200 ÷ 1.58 = 22300#
section assumed 2 Ls 3½ · 3½ · 3/8 = 4.96□" Unit stress = 22300 ÷ 4.96 = 4500#/□"
back to back of Ls assumed 1'-9".
stress due to horizontal pull 35450 ÷ 1.33 = 26600#
Unit stress = 26600 ÷ 4.96 = 5360
Combined stress. 9860#/□"

Direct load on Col. 120 · 19.79 = 2370
800
3170#

col say 1000
beam 3170
4170

Lateral Bending due to wind pressure
wind pressure assumed 1800# point of contraflexure = 6.5'
moment 1800 · 6.5 = 11.700'# Section assumed 4 Ls 5 × 3½ · 3/8 = 12.2
r = 2.39 m of I = 69.6

Fibre stress = $\frac{11700 \cdot 12 \cdot 5.19}{69.6}$ = 10450

Stress due to direct load 4170 ÷ 12.2 = 340
10790#/□"

Longitudinal Bending concentration at end 3170 assume this 3500# neglecting weight of Col.
Concentration due to horizontal pull. = 2400
5900# at end
assumed

Tirol Canal Bridge for City of Kobe, double leaf bascule.

Longitudinal bending 5900 × 19.0 = 112.000 ″# 56000

4 Ls 5 × 3½ × 3/8 = 12.20 moment of inertia back to back of Ls 22½″ = 1330 $r=\sqrt{\frac{1330}{12.2}}=10.44$

Unsupported length = 19 × 12 = 228″

$p = 21300 \times (1 - 0.0055\ \frac{l}{r}) = 21{,}100\ \#/\square''$ Use 14000 #/□″.

Fibre stress $= \frac{112.000 \times 12 \times 11.25}{1330} = 11400\#$

In case of 18½″ back to back m of inertia = 872

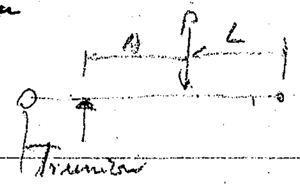
Fibre stress $= \frac{112.000 \times 12 \times 9.25}{872} = 14250\ \#/\square''$ use this section.

○ Shear at center lock.

The value of the stress transferred from one leaf to the other by the shear lock at center of span determined by the following emperical formula;

$$S = \frac{P}{4}\left(\frac{A}{L}\right)^2\left(3-\frac{A}{L}\right)$$

where S = shear at center lock for a given load P on the span
A = distance from live load support to the given load P.
L = distance from the support to the center lock.



L = 31′6″

Panel Point	A	$\frac{A}{L}$	$\frac{1}{4}$	$(\frac{A}{L})^2$	$(3-\frac{A}{L})$		P
1	30′6″	.967	″	.935	× 2.033	= 0.475	
2	20′4″	.645	×	.416	× 2.355	= 0.245	
3	10′2″	.323	″	.104	× 2.677	= 0.069	

Shear due to dead Load Concentration

	Load	Coef	Shear
1	27351	× 0.475	= 13000
2	12349	× 0.245	= 3020
3	13469	× 0.069	= 930
			16950#

Shear due to live load Concentration.

	Load	Coef	
1	54000 + 20070 = 74070	× 0.475	= 35200
2	12370	× 0.245	= 3030
3	13500	× 0.069	= 930
			39160

Summary of shear

Dead Load	16950
Live Load	39160
	56110#

design center shear lock for 60.000# shear.

Tail lock. to carry dead and live loads.

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CALCULATIONS FOR

List of Drawings for First Canal Bridge for Kobe

Double leaf Trunnion Bascule.

1. General map of bridge site
2. General layout of bridge and approaches.
3. marking diagram and general details of bridge.
4 Details of floor on moving leaf
5 ~~Details of Handrails and Track rails on bridge~~
6 5 Details of trolley arches and wt pole
7 6 Details of main girder MG1 and Cantilever Brackets CB1-2-3.
8 7 Details of floor beams ~~FB1-2-2A-2B and 3~~ and stringer
9 8 Details of longitudinal girders LG1 + 2 and Floor beam FB4
10 9 Details of ~~stringers and~~ Bottom Lateral Bracings.
11 ✓ Details of Counter weight Frame.
12 ✓ Details of Trunnion Columns and Anchor Cols + Bumper Block
13 ✓ Details of fixed floor on abutment ~~and Handrails~~ machinery Floor.
14 ~~Details of stringers, Floor beams : supporting cols~~ + Floor Break
~~15~~ ~~Details of machinery floor and structural framing~~
15 ⑯ Operating House
16 ~~17~~ Detail of Abutment

Details of Curb

{ structural steel framings for fixed + machinery floors

Handrails

M1 Details of trolley pans and moving mechanism
M2 Details of ~~tail~~ Center lock Castings
M3 Details of tail lock, trunnion shaft and bearings
M4 Operating machinery of Center and tail locks and limit Switch
M5 General layout of Operating machinery
M6 Details of gears &c
M7 do
M8 do
M9 Span limit switch and gate operating mechanism
M10 General wiring diagram

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CALCULATIONS FOR

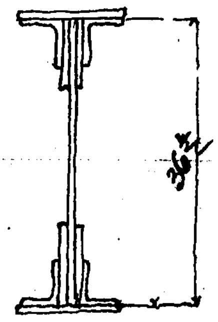
First Canal Bridge for City of Kobe ; 60' Single Leaf Trunnion Bascule.

Summary for moments and shears

	moment	shear
Dead Load	175910	16870
Live Load	1017700	83040
	1193610	99910 #

Design girder for 1,200,000 '# moment.

Assumed section of girder



							M of inertia
1 web.	36 × ½	=	18.00			=	1944
4Ls 6×6×¾		=	33.76	× 16.47²	+ 113	=	8703
4Pls. 9×⅜		=	13.50	× 13.5²	+ 91	=	2550
2Pls. 13½×¾		=	20.25	× 18.62²		=	7020
			85.51				20214 in⁴ = 0.975 (1)⁴

Allowable unit stress = 17000 × (1 − 0.012 $\frac{l}{b}$). = 13740 #/□"
unsupported length = 216 b = 13.5

Unit stress in flange = $\frac{1200.000 \times 12 \times 19}{20214}$ = 13520 #/□"

Unit-stress dead load only = $\frac{175900 \times 12 \times 19}{20214}$ = 1980 #/□" Revised

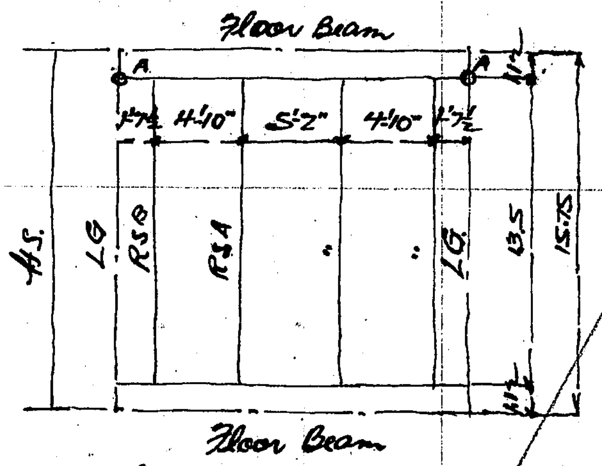
Approximate deflection due to uniform load Void

$$\Delta = \frac{5wl^4}{384EI} = \frac{1}{8}wl^2 \times \frac{5}{48}\frac{l^2}{EI}.$$ .065

$$= 1{,}200.000 \times \frac{5}{48} \times \frac{49.89^2}{144 \times 30000.000 \times .975} = 0.074'$$

or say 1.0"

Design of Longitudinal Girder LG.



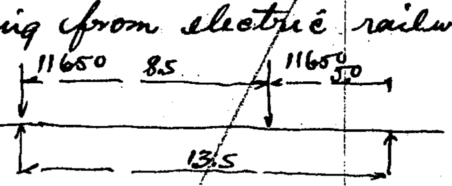
Dead Load
Concentration at A.
Railway stringer RSA 317 × $\frac{13.5}{2}$ = 2140
Railway stringer RSB 230 × $\frac{13.5}{2}$ = 1550
Unif. load 104 × 9.04 = 940
4630 #

Longitudinal girder
Flooring 30.3 × $\frac{4.27}{2}$ = 65
nailing piece $\frac{8 \times 4}{144}$ @ 60 = 13
Girder assumed 80
158 # call this 160 # p.f.

Dead Load moment
Due to concentration at A. 4630 × 1.12 = 5200
Due to uniform load $\frac{1}{8}$ × 160 × 15.75² = 4960
10160 '#

shear — 4630
½ × 160 × 15.75 = 1260
5890 #

Live Load motor truck loading Rear wheel 12870 #
Loading from electric railway loading. water car wheel load 11650 #



Reaction 11650 × 5.0 ÷ 13.5 = 4310 #
11650
15960 × 2 = 31920
11650 − 4310 = 7340 # × 2 = 14680
46600

Live Load moment due to motor truck loading
$\frac{12870}{2} \times \frac{15.75}{2}$ = 50600 '#
30640 × 1.12 = 34400
85,000 '#

Reaction
14680 × 1.12 = 16400 ÷ 15.75 = 1040
31920 × $\frac{14.63}{15.75}$ = 29600
1040
30640

Max live load shear due to motor truck 4290 × $\frac{3.95}{15.75}$ = 1070
12870
13940
due to Elec. loading 30640
44580 #

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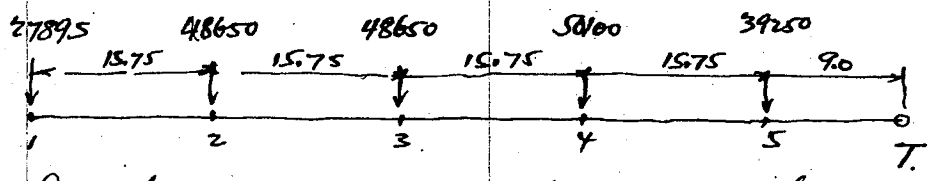
CALCULATIONS FOR

First Canal Bridge for City of Kobe ; 60' single leaf trunnion bascule.

Main Bascule girder
Dead Load Concentration as shown



stresses span raised

Dead load moment and shear about trunnion.
27895 × 72.0 = 2010.000
48650 × 56.25 = 2740.000
48650 × 40.50 = 1970.000
50100 × 24.75 = 1240.000
39250 × 9.00 = 353.000
214545# 8.313.000'#

DL. moment and shear about 5
27895 × 63.00 = 1760.000
48650 × 47.25 = 2300.000
48650 × 31.50 = 1530.000
50100 × 15.75 = 790.000
175295# 6,380,000'#

Dead Load moment and shear about 4
27895 × 47.25 = 1320.000
48650 × 31.50 = 1530.000
48650 × 15.75 = 765.000
125195 3,615.000

DL moment and shear about 3
27895 × 31.50 = 880.000
48650 × 15.75 = 766.000
76545 1,646,000'#

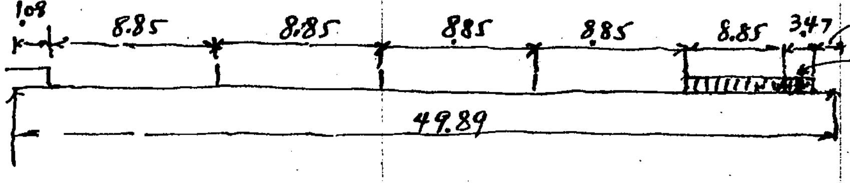
Dead Load moment and shear about 2
27895 × 15.75 = 440.000'#

Dead Load Stresses when the span down as simple girder. ~~of 63'~~ in span
shear at panel point ① 6380.000 ÷ 63 = 101000
− 27900
73100#

moment and shear at panel 2
73100 × 15.75 = 1.150.000'#
moment and shear at panel point 3.
73100 × 15.75 × 2 = 2300.000
48650 × 15.75 = − 765.000
24450# 1,535,000'#
moment and shear at panel ~~point~~ 4
73100 × 15.75 × 3 = ~~4~~3.450.000
48650 × 15.75 × 3 = − 2295.000
1~~2~~155000'#

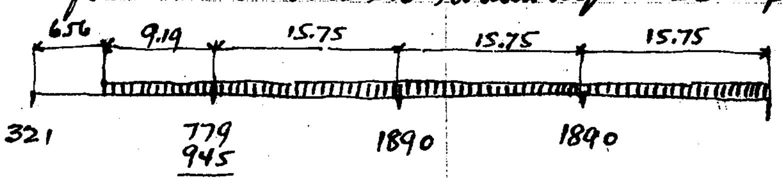
when the ~~span~~ is down the center of gravity of moving portion will be at front of trunnion and will take some reaction at panel point 5; however will take no reaction at panel point 1 Adjustment of live load shoe at panel point 1 shall be made not to take extra reaction from dead load during erection.

Live Load.
Max live load at panel point 1. motor truck loading rear wheel. 12870#
Front wheel 4290#



max motor truck reaction $10 \times 12870 \times \frac{26.67}{49.89} = 63500$

Uniform live load on roadway 120# per square ft.



321	779 945 1724	1890	1890
7650	41100	45000	45000 for ½ width

9.19 × 120 = 1100#
$1100 \times \frac{4.6}{15.75} = 321$# 1100 − 321 = 779#
15.75 × 120 = 1890 ½ × 1890 = 945#

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule.

load on panel point 1.

$1890 \cdot \frac{1}{4} = 472$

$1890 \cdot \frac{1}{2} = 945$

$1724 \cdot \frac{3}{4} = 1300$

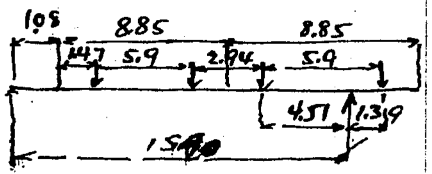
$\underline{321}$

$3038^{\#} \cdot 23.86 = 72500^{\#}$ on shoe.

Live Load on side walk. $100^{\#}/\square'$

$100 \cdot 6 \cdot \frac{63}{2} = 18900^{\#}$

For motor truck loading



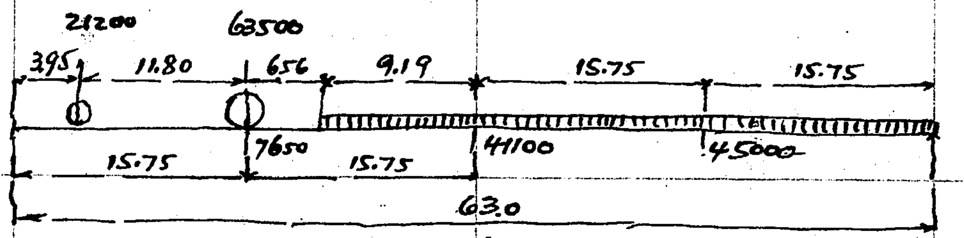
$12870 \cdot \frac{25.31}{15.90} = 20400^{\#}$

Unif. load on Ry 72500

" " on sidewalk $\underline{18900}$

$111800^{\#}$ max live load on shoe.

Live Load moment at panel point 2.



moment due to motor truck

$R = 63500$

$21200 \cdot \frac{3.95}{15.75} = \underline{5300}$

68800 Reaction $68800 \cdot \frac{3}{4} = 51500^{\#}$ $m = 51500 \cdot 15.75 = 811{,}000'^{\#}$

moment due to uniform load on roadway.

$R = 45000 \cdot \frac{1}{4} = 11250$

$41100 \cdot \frac{1}{2} = 20550$

$7650 \cdot \frac{3}{4} = \underline{5730}$

$37530^{\#}$ moment $= 37530 \cdot 15.75 = 591{,}000$

moment due to uniform load on sidewalk.

moment ~~18900 · 15.75 = 298,000~~

~~600 · 15.75² / 2~~ =

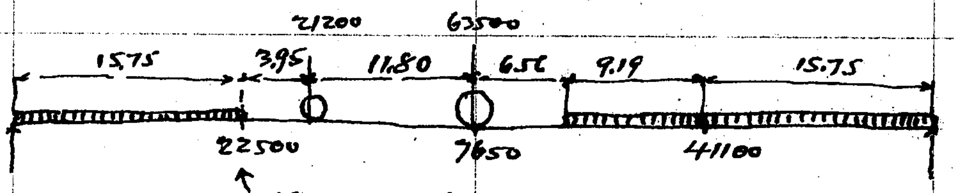
Panel load $600 \cdot 15.75 = 9450^{\#}$ $R = 9450 \cdot 1.5$

$= 14200^{\#}$

moment $= 14200 \cdot 15.75 = \underline{224{,}000}$

$1626{,}000'^{\#}$

Live Load moment at panel point 3.



$\underline{15900}$ 63500

$21200 \cdot \frac{3.95}{15.75} = \underline{5300}$

68800

moment due to motor truck loading.

Reaction $68800 \div 2 = 34400$

$15900 \cdot \frac{3}{4} = \underline{11900}$

$46300 \cdot 31.50 = 1460{,}000$

$15900 \cdot 15.75 = \underline{250{,}000}$

$1{,}210{,}000$

Uniform live load on Roadway.

$R \quad 41100 \cdot \frac{1}{4} = 10300$ moment $31025 \cdot 31.50 = 976000$

$7650 \cdot \frac{1}{2} = 3825$ $22500 \cdot 15.75 = \underline{354000}$

$22500 \cdot \frac{3}{4} = \underline{16900}$ 622,000

31025

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CALCULATIONS FOR

First Canal Bridge for City of Kobe : 60' Single Leaf Trunnion Bascule.

Uniform load on sidewalk 600# per lin. ft. panel load = 600 × 15.75 = 9450#

Reaction 9450 × 1.5 = 14200#

moment = 14200 × 31.50 = 447.000

9450 × 15.75 = 149.000

298.000 ''#

Summary for moments

motor truck	1.210.000
Uniform load on Roadway	622.000
Uniform load on sidewalk	298.000
	2.130.000 ''#

Summary for Dead and Live Load moments.

	2	3	4	5	Trunnion
Dead Load Cantilever	440.000	1646.000	3615000	6380.000	8313000
Live Load Simple beam	1626.000	2130.000	1626000	—	—
Dead Load Simple beam	1150.000	1535 ~~1646~~.000	1155000	—	—
Bottom flange.	2776.000 T 440.000 C	3665000 T 1646.000 C	3615000 C 2781.000 T	6380.000 C	8313.000 C

Approximate section of main bascule girder.

① 2 P/s. 12 × ½ = 12.0 × 6.25 = 75.0 Effective depth 6.29
2 L^s 8 × 8 × ¾ = 22.88 × 2.28 = 50.8 .60
34.88 3.6" 125.8 5.69'

2 2 P/s 12 × ½ = 12.00 × 6.25 = 75.0 Effective depth 6.29
2 L^s 8 × 8 × ¾ = 22.88 × 2.28 = 50.8 .42
1 Pl. 18 × ¾ = 13.50 × 0.37 = − 5.06 5.87
48.38 2.5" 120.74

3 2 P/s 12 × ½ = 12.00 × 6.25 = 75.0 Effective depth 6.29
2 L^s 8 × 8 × ¾ = 22.88 × 2.28 = 50.8 .18
3 P/s. 18 × ¾ = 40.50 × 1.12 = − 45.4 6.11
75.38 1.07" 80.4

4 2 P/s. 12 × ½ = 12.0 × 6.25 = 75.00 Effective depth 6.29
2 L^s 8 × 8 × ¾ = 22.88 × 2.28 = 50.80 .44
3 P/s. 18 × ¾ = 40.50 × 1.12 = − 45.40 5.85
2 P/s. 4¼ × ¾ = 6.37 × 10.12 = 64.60
2 P/s. 11 × ¾ = 16.50 × 6.75 = 111.40
97.75 2.63" 256.40

Allowable unit stress for compression flange = 17000 (1 − 0.012 l/b). = 14850#/□"
where l = 189" b = 18"

	stress m	depth	flange stress		SR
2	2776.000 ✓	5.69	488.000#	÷ 14850 =	32.80□"
3	3665.000	5.87	625.000	=	42.10□"
4	3615.000	5.87	615.000	=	41.40□"
5	6380.000	6.11	1044.000	=	70.20□"
T.	8313.000	5.85	1420.000	=	95.50□"

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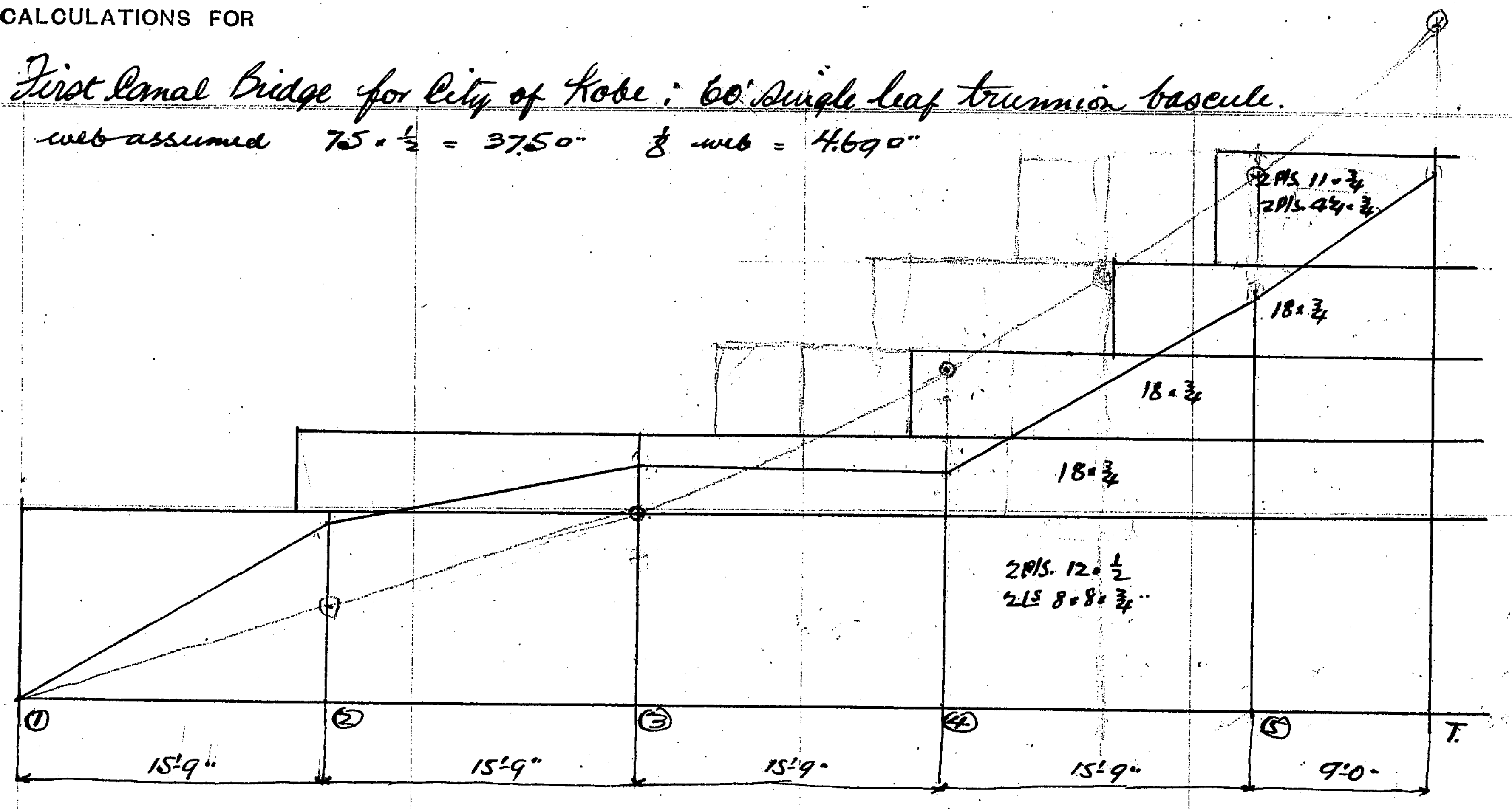
CALCULATIONS FOR

First Canal Bridge for City of Kobe : 60' single leaf trunnion bascule.

web assumed 75 × ½ = 37.50" ⅛ web = 4.690"



approximate panel load of main bascule girder.

at panel point 1.
34.88
34.88
37.50
107.26 @ 3.4# = 365#
Detail say 25% 91
456# per ft.
Conc. 456 × 9.37 = 4270#

at panel point 2.
48.38
48.38
37.50
134.26 @ 3.4 = 456.
25%. 114
570#
Conc. 456 × $\frac{15.75}{2}$ = 3600
570 × do = 4500
8100#

at panel point 3 570 × 15.75 = 9000#

at panel point 4
2@70.20 = 140.4
37.5
177.9 @ 3.4 = 605
30%. say 180
785#
Conc. 575 × $\frac{15.75}{2}$ = 4500
785 × do = 6170
10670#

at panel point 5
2@97.75 = 195.5
37.5
233.0 @ 3.4 = 792
50% say 398
1190#
Conc. 785 × $\frac{15.75}{2}$ = 6170
1190 × 4.5 = 5350
11520#

Revised Concentration on Main girder

At panel point 1.

Flooring -	1000 × 9.37	=	9370
Stringers &c	650 × 9.37	=	6100
Floor beam			3900
Bottom bracing			1100 ~~2200~~
main girder			4270
Handrail -			375
Trolley Pole			2900
			~~29115~~
			28015

At panel point 2

Flooring	1000 × 15.75	=	15750
Stringers &c	650 × 15.75	=	10250
Floor beam			10070
Bottom bracing			2200
main girder			8100
Handrail	40 × 15.75	=	630
			47000#

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule

At panel point 3

Flooring	$1000 \cdot 15.75$	=	15750
Stringers &c	$650 \cdot 15.75$	=	10250
Floor beam		=	10070
Bottom bracing		=	2200
main girder		=	9000
Handrail		=	630
			47900#

At panel point 4

Flooring		15750
stringers &c		10250
Floor beam	do	10070
Bottom bracings		2200
main girder	——	10670
Handrail	47900	630
Trolley poles.	2900	2900
	~~50800~~#	52470#

At panel point 5

Flooring say	$1000 \cdot 11.87$	=	11870
Stringers &c	$650 \cdot 11.87$	=	7700
Floor beam	$600 \cdot 25$	=	15000
Cantilever say			700
Bottom bracing say			2200
main girder			11520
Handrail. say			500
			49490#

At trunnion.

Sidewalk.	$322 \cdot 9.0$	=	2900
stringers &c			600
bracing say			3000
main girder say at front only			6000
			12500#
Trunnion and details say			10.000
			22500#

Dead load moment about trunnion (dead load front of trunnion only)

1	28015	72.0	=	2020.000
2	47000	56.25	=	2645.000
3	47900	40.50	=	1940.000
4	52470	24.75	=	1300.000
5	49490	9.00	=	445.000
	224875			8,350.000 '#

Dead Load moment at rear of trunnion due to main bascule girder.
approximate only.
Dead load of girder assumed 1500# per lin ft. 17'
Connection for Cwt frame say 6000#

moment = $1500 \cdot \frac{17^2}{2}$ = 217000
$6000 \cdot 12.5$ = 75000
292000 '#

Net dead Load moment 8350.000
292.000
8058.000 '#

Arm for Cwt. = 12.5 Cwt reqd = $\frac{8058.000}{12.5}$ = 645.000 #

Approximate volume of Concrete in Counterweight. = $9 \cdot 8 \cdot 50$ = 3600 cubic ft.
weight per cubic ft = 645.000 ÷ 3600 = 179# per cubic ft.
weight per lin ft = 645000 ÷ 50 = 12900# per lin ft.
For one girder 6450# per lin ft.

Design of Counterweight frame.
moment = $\frac{1}{8} \cdot 6450 \cdot 49.89^2$ = 2,000.000 '#

End shear = $\frac{1}{2} \cdot 6450 \cdot 49.89$ = 161.000 #

Revised

Add about 25% for impact m = 2,500.000 '#
shear = 201.000#

Before figuring too further about Counterweight let us figure approximate center of gravity of moving parts.

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule.

Approximate center of gravity of moving leaf. 25800

		load	arm	moment	load	vetarm	moment
✓ Sidewalk slab.	322 × 77.5 =	25000 ~~25700~~	34.75	669 894.000	25700	0.1	2570 ~~8500~~ –
plank & pavement	755/2 × 68.5 =	25.800	39.25	1012.000	25.800	0.33	8500
Cross ties	160 × 68.5 =	10.300	39.25	404.000	10300	0.83	8550
nailing piece	90 × 68.5 =	6160	39.25	242.000	6160	0.90	5540
curb	42 × 68.5 =	2880	39.25	113.000	2880	0.12	350 –
Highway stringer	215 × 68.5 =	14700	39.25	577.000	14700	1.79	26300
Railway stringer	109 × 68.5 =	7470	39.25	293.000	7470	1.92	14350
Cross beam	3@ 1720 =	5160	40.50	209.000	5160	1.92	9900
Hy transv. strut	4@ 330 =	1320	40.50	53.000	1320	1.25	1650
Ry transv strut	4@ 600 =	2400	40.50	97.000	2400	1.92	4600
Connection	20 × 68.5 =	1370	39.25	54.000	1370	1.92	2630
Sidewalk stringer	58 × 77.5 =	4500	34.75	156.000	4500	0.58	2600
Long. girder	95 × 68.5 =	6500	39.25	255.000	6500	2.50	5 16200
Floor beam ①		3900	72.00	281.000	3900	2.50	9750
" " 2 3 4	3 @ 10070 =	30210	40.50	1223.000	30210	2.25	68.000 ~~68.200~~
" " 5 H	350 × 25 =	8750	8.5	4 74.500	8750	1.00	8750
do	250 × 25 =	6250	9.0	56.000	6250	2.75	17200
bracing	4 × 2200 =	8800	40.50	357.000	8800	3.83	33700
main girder 1		4270	72.00	307.000	4270	0.83	3540
" 2		10070	56.25	566.000	10070	0.83	8350
" 3		10070	40.50	407.000	10070	0.83	8350
" 4		10070	24.75	249.000	10070	0.83	8350
" 5		11520	9.0	6 103.500	11520	0.83	6 9570
Handrail	40 × 63 =	2520	40.50	102.000	2520	1.60	4040 –
Trolley pole		2900	72.00	209.000	2900	18.00	2 52100 –
do		2900	24.75	8 71.600	2900	18.00	2 52100 –
main girder front of trunnion		6000	0	——	6000	0.83	8 4990
at trunnion		10000	0	——	10000	5.20	52000
summary		~~244380~~ 242870# 25 247,000		~~8365.600~~ – 8340.600 7000 9350.000			+ 222410 ✓ 8500 230970
Rear of trunnion							
main girder &c	1500 × 17 =	25500	17/2	217.000	25500	0.	——
at cwt connection		6000	12.5	75000	6000	6.0	~~36000~~
		31500 ~~244380~~ 241870		– 292000 8365600 8340.600			222410 258410
Resultant moment & load		~~275880~~ 273300 273370 25		8073600 8048600			270970 284970

Horizontal arm front of trunnion = 8048600 / ~~8073600~~ over ~~275880~~ 273370 = ~~29.25'~~ 29.45

Arm below of crown of roadway = 258410 / 275880 273370 = 0.945

Arm for Counterweight = 12.0 (Void)

Counterweight req'd = 8073600 / 12 = 673000#

Size of Counter weight = 7 × 7 = 49   length 49.89

673000 ÷ 49.89 = 13500# per lin ft. or 6750# per girder.

Design of Counterweight frame

moment = 1/8 × 6750 × 49.89² = 2090000"#

Impact say 20% = 418.000

2508,000"#

Shear = 1/2 × 6750 × 49.89 = 168.000

20% 33600

201600#

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule

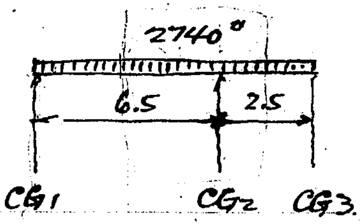
Arm for Cwt = 130

Cwt required = $\frac{8073600}{\cancel{13}\ 14}$ = ~~622000~~ 576000# for one girder

~~1244000~~ 1152000# for one span

$\frac{1244000}{50}$ = 24600# per lin. ft of Counterweight.

24600 ÷ 9 = 2740# per ft. $\frac{2740}{9}$ = 305# per cubic ft of Cwt.



Load on CG2 = $\frac{24600 \cdot 4.5}{6.5\ \ 9}$ = ~~18300~~ 12300 ~~17000~~

Load on CG1 = 24600 - 18300 = 6300#

main Cwt girder CG1   span length 49.89'

assumed load.   ½ · 6.5 · 2740 = 8900#   for max load. assumed.

m = ⅛ · 8900 · 49.89² = 2770.000 '#
20% impact = 554.000
3324.000 '#

End shear = 8900 · 25 = 222000
20% impact 44400
266400#

web assumed ~~96~~ 84 · ½ = ~~48~~ 42 □"   Unit shear = $\frac{266400}{\cancel{48}\ 42}$ = ~~5540~~ 6330 #/□"

Effective depth = 7.92' about

flange stress = $\frac{3324.000}{\cancel{7.92}\ 6.92}$ = ~~420.000~~ 480.000#

Section required = $\frac{\cancel{420.000}\ 480}{17.000}$ = ~~24.70~~ 28.20 -

⅛ web = ~~6.00~~ 5.25
~~18.70~~ 22.95 □" net

2Ls 6·6·¾ = 16.88 - 13.88
1Pl. 13·¾ = 9.75 - 8.25
26.63   22.13 □" net

6.57
7.5
~~9~~ 7 × ½ × 2740 =

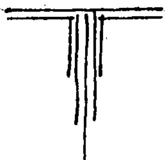
main Cwt Girder CG2   span length 49.89'   max load say 18300# per ft.

m = ⅛ · 18300 · 49.89² = 5580.000
20% impact 1116.000
6696.000 '#

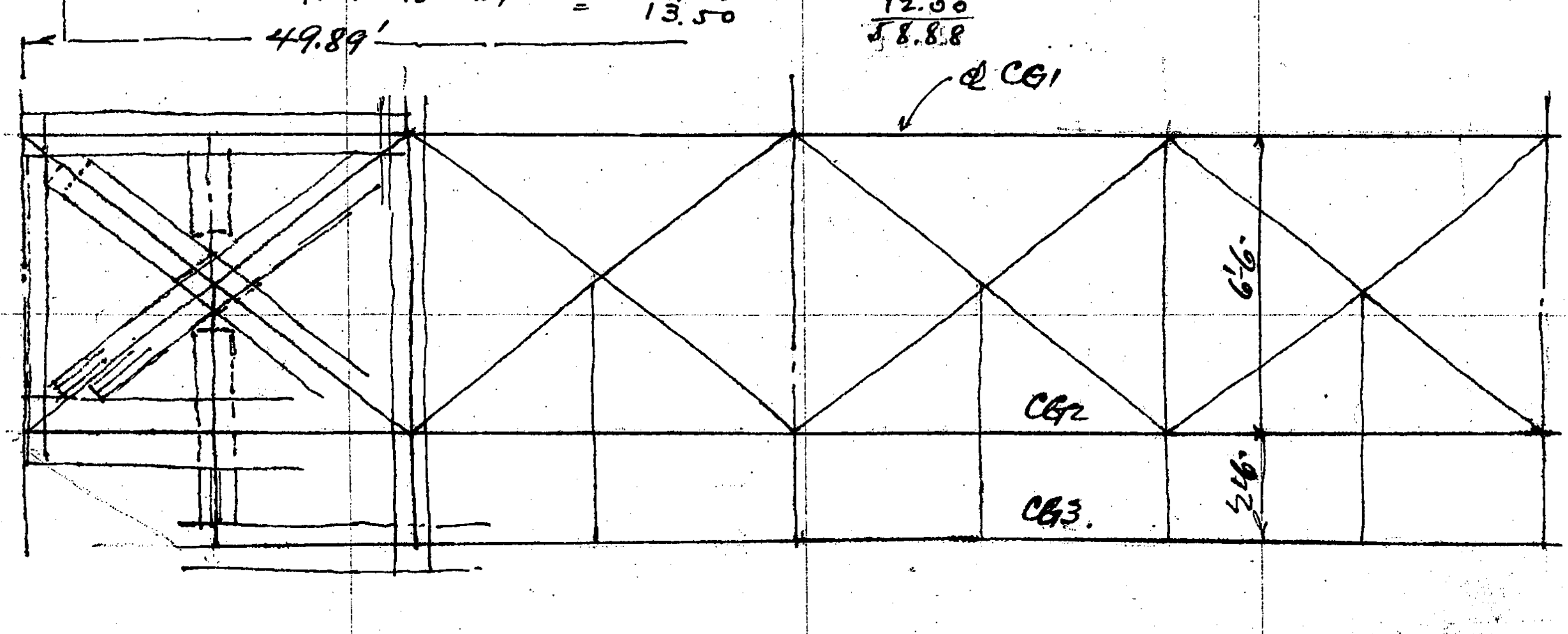
Shear ½ · 18300 · 49.89 = 456.000   12300
20% impact = 92.000
548.000#

web assumed ~~96~~ 84 · 5/8 = ~~60~~ 52.5 □"   ⅛ web = ~~7.5~~ 6.58   Effective depth ~~7.62~~ 6.62

flange stress = $\frac{6696.000}{\cancel{7.62}\ 6.62}$ = ~~880.000~~ 1012.000#   SR = $\frac{\cancel{880.000}\ 1012.000}{17000}$ = ~~51.8~~ 59.5
7.5   6.62
~~44.3~~ □" net   52.88



2Ls 8·8·¾ = 22.88 -3.0- 19.88
2Pls. 12·¾ = 18.00 -3.0 15.00
1Pl. 18·¾ = 13.50 1.5 12.00
1Pl. 18·¾ = 54.38□" 4688 □" net
13.50   12.00
58.88



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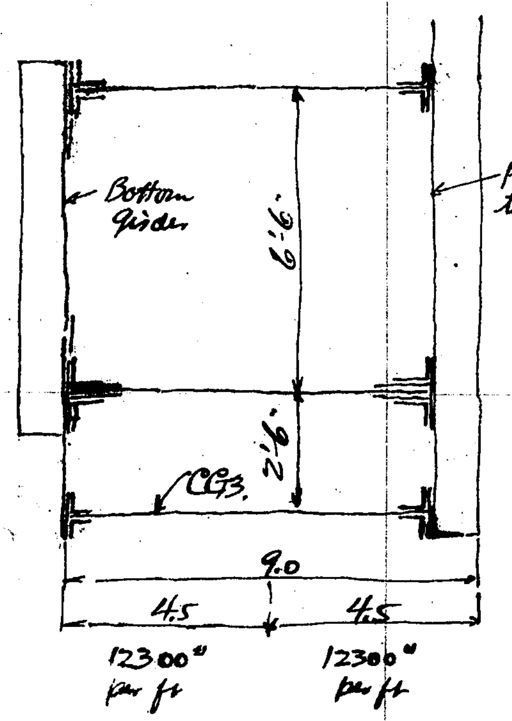
CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf trunnion bascule.

Counterweight frame span up.



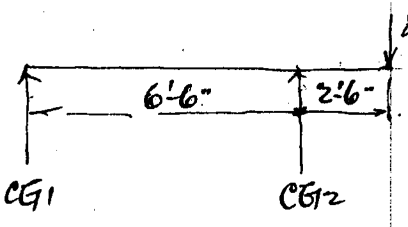
Bottom Girder span length 49.89'
Uniform load 12300# per lin ft of girder
$m = \frac{1}{8} \cdot 12300 \cdot 49.89^2 = 3.820.000$

$Shear = \frac{1}{2} \cdot 1230 \cdot 49.89 = 307.000\#$
web assumed $123" \cdot \frac{1}{2} = 61.5\square"$
$\frac{1}{8}$ web $= 7.70\square"$
depth $= 9.0$
flange stress $= \frac{3820.000}{9} = 425000\#$

$SR = 425000 \div 17000 = 25.00$
$\underline{7.70}$
$17.30\square"$ net.

Use. 2Ls 6 × 6 × 3/4	= 16.88	13.88	
1Pl. 13 × 3/4	= 9.75	8.25	
	26.63□"	23.13□"	net

Flange in CG3. use 2Ls 6 × 6 × 3/4 and 1Pl 13" × 3/4"
approximate ~~to car~~ load to be carried by CG3. = 2740 × 1.25 = 3420# per ft.
End reaction = $3420 \cdot \frac{50}{2} = 85500\#$

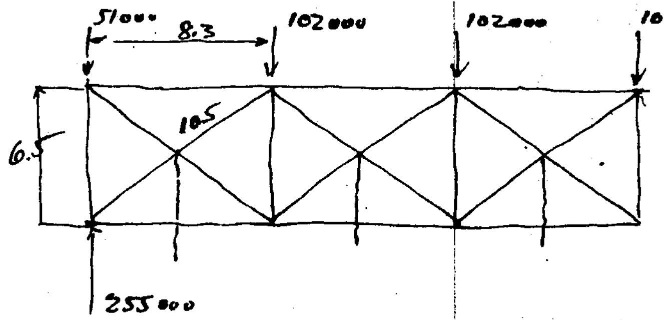


Reaction at CG1 $= 85500 \cdot \frac{2.5}{6.5} = 32800\#$

Reaction at CG2 $= 85500 \cdot \frac{9.0}{6.5} = 119.000\#$ on Bearing.

Top Framing - load to be carried 12300# per lin ft.
Concentration say 12300 × 8.3 = 102000# per panel.

Reaction = 102000 × 2.5 = 255.000#



Shear	z	Stress	For one diagonal.	no of Rivet	
255000	$\cdot \frac{10.5}{6.5}$	= 412000	206000	28.6	shop
153000	"	248000	124000	21.0	field.
51000	"	82000	41000	6.8	field.

Section for diagonal
$206000 \div 14200 = 14.5\square"$ 2Ls 6 × 6 × 3/4 = 16.88
$124000 \div 14200 = 8.74$ 2Ls 6 × 6 × 1/2 = 11.50
41000 2Ls 4 × 4 × 3/8 = 5.72

stress in hanger say 102000 ÷ 2 = 51000# use 8 Rivets for Connection.

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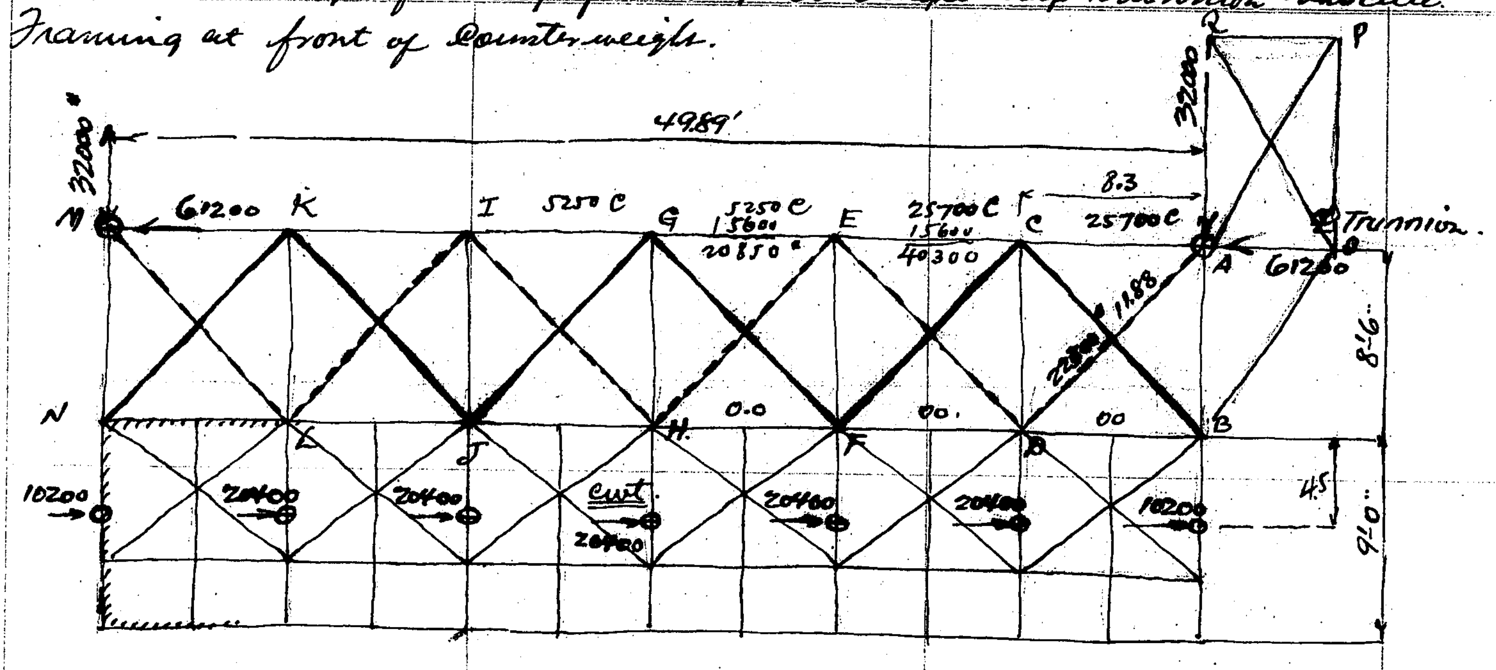
CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule.

Framing at front of Counterweight.



Framing figured from horizontal force of 20% of counterweight.
End panel 51000 × 0.2 = 10200#
Int. panel 102000 · 0.2 = 20400#

Horizontal Reaction at trunnion 20400 · 6 = 122400#.
Reaction at trunnion = 122400 · 13 ÷ 49.89 = 32000#

Stress due to loading at D + H + L.
Horizontal Reaction = 20400 × 3 = 61200# for one side 30600#
Vertical Reaction = 61200 · 13 ÷ 49.89 = 160.00#

ACE moment at D.
+ 20400 · 4.5 = + 91800
+ 30600 · 8.5 = + 260000
− 16000 · 8.3 = − 133000
+ 218800 ÷ 8.5 = 25700# C

DFH. moment at E
+ 20400 · 13.0 = + 265000
− 16000 · 16.6 = − 265000
0

EGI. moment at H.
+ 20400 · 4.5 = + 91800
+ 20400 · 4.5 = + 91800
+ 30600 · 8.5 = + 260000
− 16000 · 24.94 = − 399000
44600 ÷ 8.5 = 5250# C

Diagonal shear = 16000 Stress = 16000 · $\frac{11.88}{8.5}$ = 22300# T

Stress due to loadings at B + F. J + N.

BDF moment at C
+ 10200 · $\overset{13.0}{\cancel{4.5}}$ = 132500
− 16000 × 8.3 = 133000
00.

CEG moment at F.
+ 20400 × 4.5 = + 91800
+ 10200 · 4.5 = + 45900
− 16000 × 16.6 = − 265000
− 127300
+ 30600 × 8.5 + 260000
+ 132700 ÷ 8.5 = 15600#

Diagonal same as for above = 22300# T

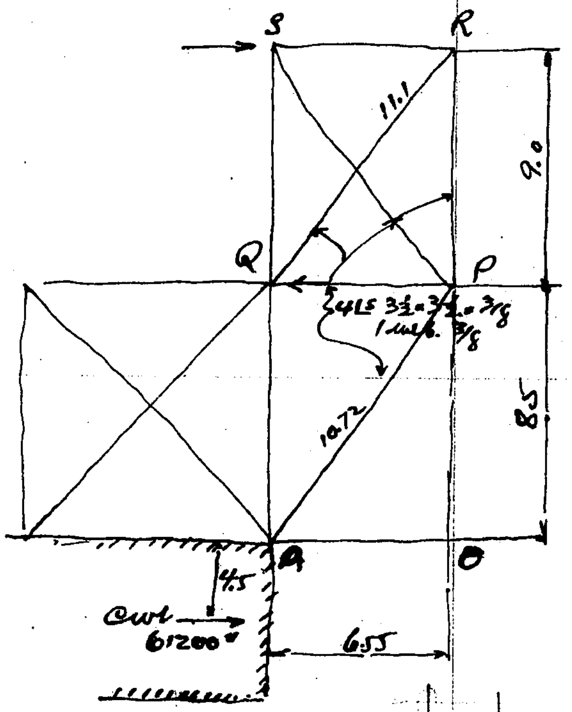
For diagonal Unit stress = 21300 (1 − 0.0055 · $\frac{142.5}{1.61}$) = 10950#/□"
AR = 22300 ÷ 10950 = 2.04 □"
Use 2∠s 5 × 3½ · 3/8" = 6.10 □" Use 6 Rivets

For chord member A to M. Use 4∠s 3½ · 3½ · 3/8 3/8 web.
vertical. CD − EF. Use. do.

CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

Framing at both ends of Counter weight.



20% of Cwt = 61200#

Reaction at Q & S. as Cantilever.

at R = $6200 \cdot \frac{22.0}{9.0}$ = 150.000 #

at S = $61200 \cdot \frac{13}{9.0}$ = 88500 #

stress in AP = $61200 \cdot \frac{10.72}{6.55}$ = 156,000 # C

stress in PS = $88500 \cdot \frac{11.1}{6.55}$ = 150,000 C

stress in RR = 150.000

stress in PR = moment at Q

$61200 \cdot \frac{13}{6.55}$ = 121,500 #

Use 4Ls 3½ · 3½ · 3/8 = 9.92 □"

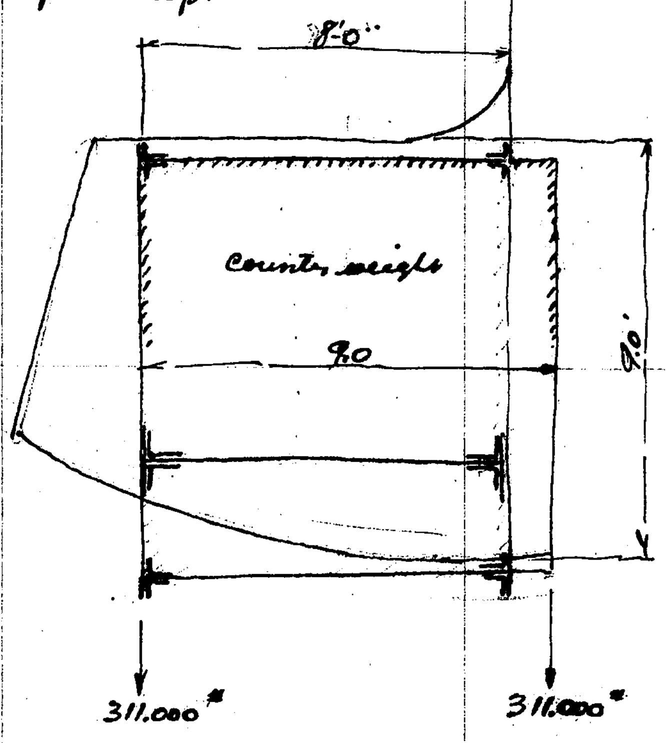
1 web. 12 · 3/8 = 4.50

14.42 □"

Allowable unit stress = $21300 \cdot (1 - 0.0055 \cdot \frac{129}{159})$ = 11800 #/□"

SR = 156000 ÷ 11800 = 1320 □" ok

Design of main girder rear of trunnion.
main girder for Counter weight Connection.
span up.



Moment as concentration.

m = 311.000 · 8 = 2480.000 '#

as uniform load 311.000 ÷ 4.5 = 69000# per lin. ft.

m = $69000 \cdot \frac{8^2}{2}$ = 2,210.000 '#

max shear say 622,000 #
Girder 6000
628.000 #

flange stress = 2480.000 ÷ 9.0 = 276.000 #

SR = $\frac{276000}{14850}$ = 18.60 □"

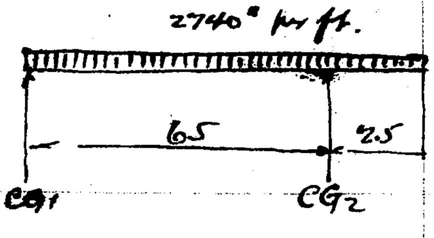
Use 2Ls 8 · 8 · 3/4" = 22.880 □" front or top.
Use 2Ls 6 · 6 · 3/4 = 16.88 □" Rear or bottom

web pl. 108 · ½ = 540 □"

Unit shear = $\frac{628,000}{54}$ = 11650 #/□" Reinforce web or splice ½ web with ½ plates on both sides. 4.5' about.

Design of main girder. span down.
Load on Counter weight girder. CG1 and 2.

2740 · 9 = 24600 #



Load on CG2 = $\frac{24600 \cdot 4.5}{6.5}$ = 18300 #

Conc = 18300 · 25 = 457,000 #

Load on CG1 24600 − 18300 = 6300 #

Conc = 6300 · 25 = 157.000 #

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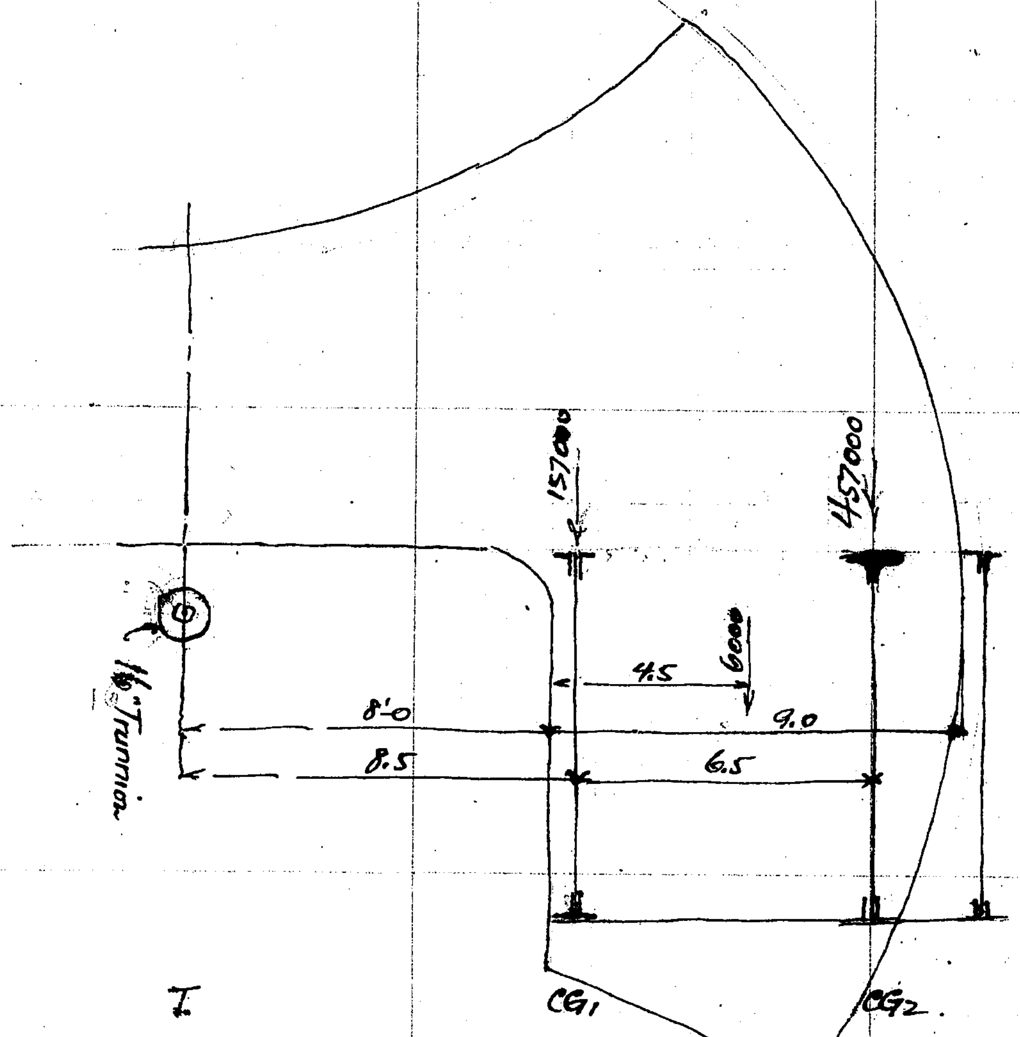
CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' Single Leaf Trunnion Bascule



Dead Load girder 1500# per lin ft. length 17.0 assumed.

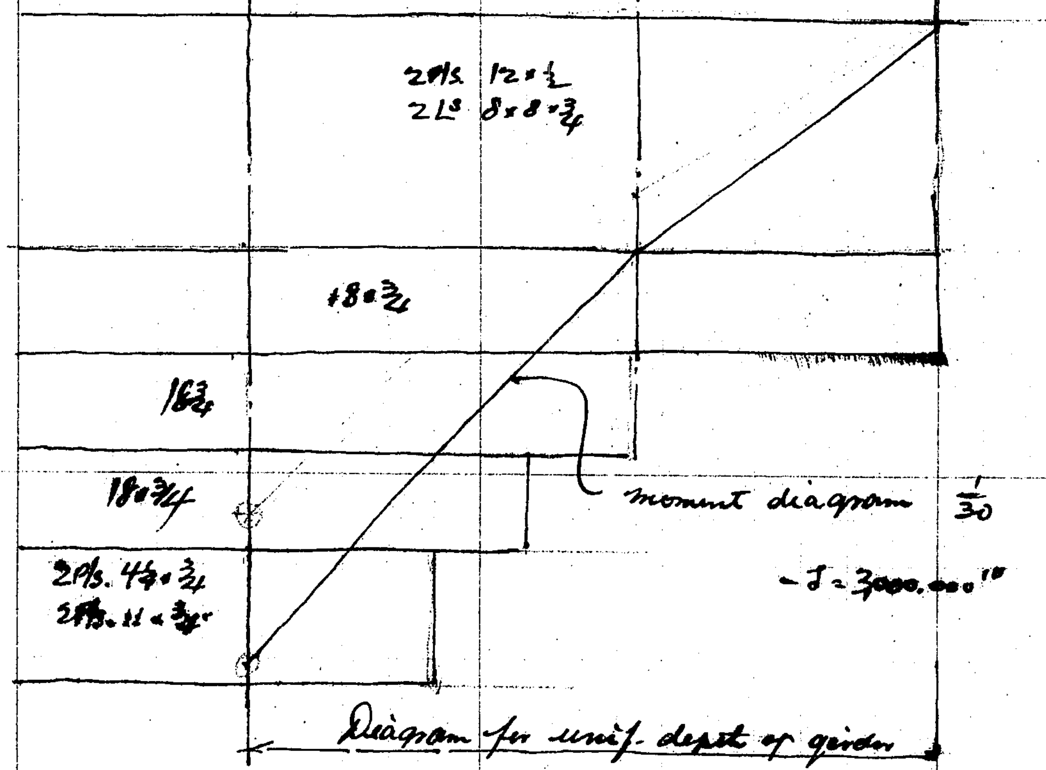


Diagram for unif. depth of girder assumed.

moment about trunnion.
457000 × 15 = 6850.000
157000 × 8.5 = 1335.000
6000 × 12.5 = 75.000
8260.000'#

moment due to dead load of girder = 1500 × $\frac{17^2}{2}$ = 217.000#
8260.000
8477,000

moment about CG1.
457000 × 6.5 = 2.970.000
6000 × 4.0 = 24,000
2,994,000'#
Girder 1500 × $\frac{7.5^2}{2}$ = 42.000
3,036,000

Starting moment due to Journal friction.
Total load on Journal per girder
DL. 276.000
Cwt 622.000
898 000 call this 900.000#
Journal friction assumed 15%
900.000 × .15 = 135 000#
dia of Journal assumed 16"

Starting Force = 135000 × $\frac{.67}{17.3}$ = 5230# at rack circle.
moment = 5230 × 17.3 = 90.000'#
Summary for moment
8.477.000
90.000
8,567,000'#

Effective depth say 5.85

8.567.000 ÷ 5.85 = 1465,000#

SR = 1465.000 ÷ 14850 = 98.80□

For section of girder see page 36.

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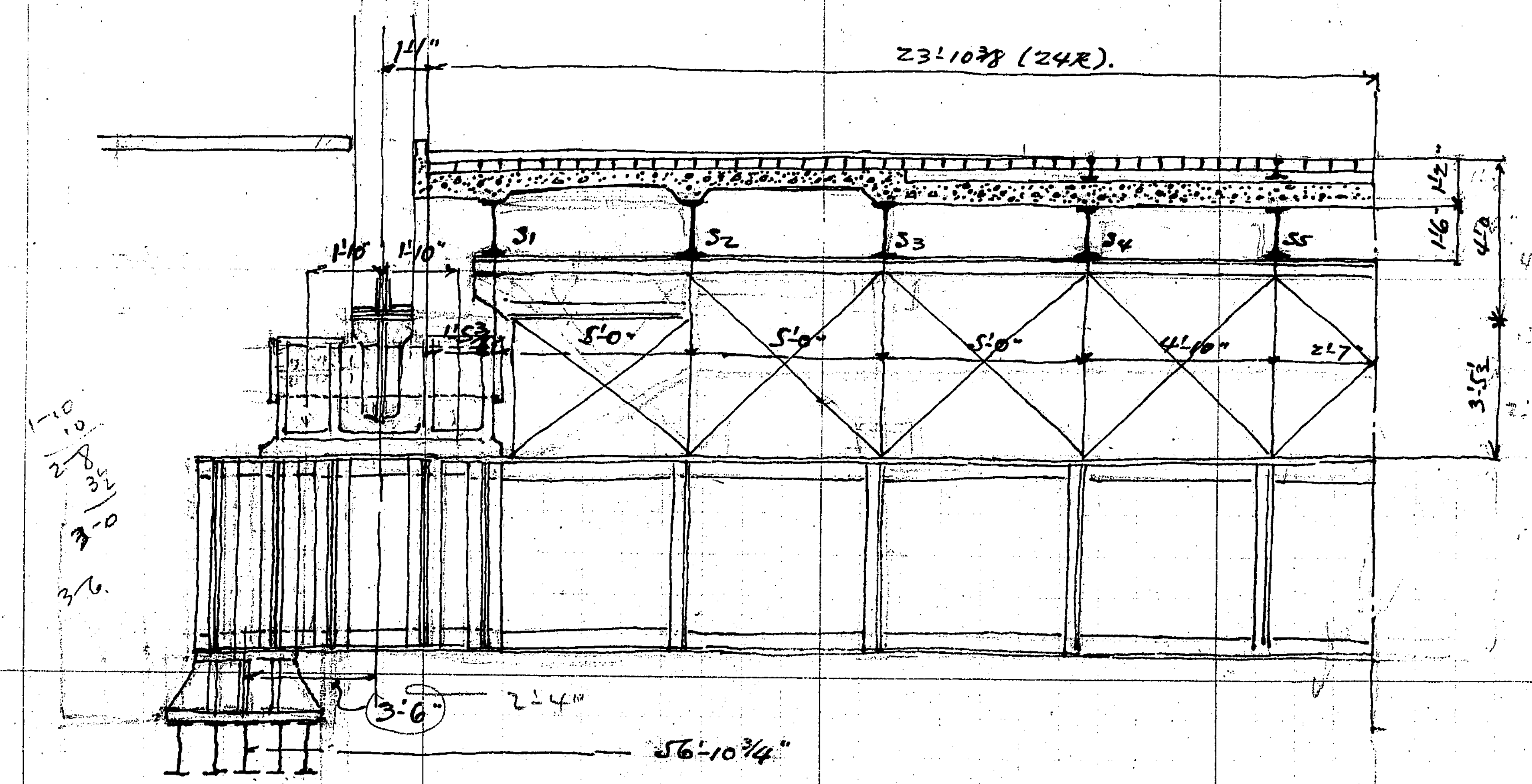
CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule.

Design of Fixed Floor on Abutment

Cross section of floor.



Slab under Electric Ry Tracks. max span 5'-2"

Rails will be carried by steel chairs of 3" wide about.

Dead Load

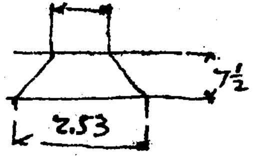
3" woodblock pavement	=	15	$DL\ m = \frac{1}{10} \times 144 \times 5.17^2 = 385^{\#}$
4½" lean concrete filling. @ 12.0"	=	54	
6" concrete slab.	=	75	$DL\ shear = \frac{1}{2} \times 144 \times 5.17 = 372^{\#}$
		144#	

Live Load motor truck concentration rear wheel 9900

Impact 30% 2970

12870

Distribution of wheel concentration for single load.



longitudinal distribution $a = .66 + 1.25 = 1.91$

Transverse distribution $b = 1.28 + 1.25 = 2.53$

$E = \frac{2}{3}(l+b) + a = \frac{2}{3}(5.17 + 2.53) + 1.91 = 704$

~~Assume~~ distribution 5.0'

Load per ft strip = $12870 \div 5.0 = 2570^{\#}$ per ft.

Concentrated load at center of span

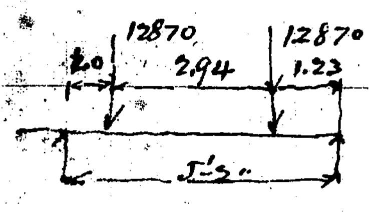
$m = 1285 \times 2.58 = 3320$

less. $\frac{2.53}{4} \times 1285 = 816$

$2504'^{\#}$

For Continuity of slab. $0.8 \times 2504 = 2000'^{\#}$

Shear



$12870 \times \frac{5.40}{5.17} =$ say $13500^{\#}$ $13500 \div 5.0 = 2700^{\#}$

Summary for moments and shears

	moment	shear
Dead Load	385	372
Live Load	2000	2700
	2385'#	3072#

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CALCULATIONS FOR

昭和三年六月

神戸運河第壱橋

完成圖ニ依ル

可動部重心計算書

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MADE BY M.K DATE 2-11-4 FILE NO

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

MAIN GIRDER G1 R/L 2 Req'd

Mark	No.	Materials	Length	wt/ft.	Total wt.	±X from trunnion	±Y from floor	+X Moment	-X Moment	+Y Moment	-Y Moment
170 172 }	4	Ls 8"x8"x¾"	39'-8"	38.90#	6,172	+ 53'-8"	- 0'-9¼"	331.251			4.752
171 173 }	4	Pls 12x½	41'-0"	20.40	3.346	+ 53-0	"	177.338			2.576
169	1	Pl 75x"	15-1¼	127.50	1.925	+ 65-11¼	"	126.935			1.482
40	1	"	25-10¾	"	3.302	+ 45-5¼	"	150.043			2.543
152	2	Ls 8x8x¾	6-3½	38.90	489	+ 73-3¾	"	35.849			377
153	2	Fills 8x½	4-2¾	13.60	115	+ 73'-2"	"	8.415			89
157	1	L 6x6x½	3-5¾	19.60	68	+ 71-9 11/16	+0'-8"	4.883		46	
158	1	L " x⅜	1-1⅞	14.90	17	+ 72'-0"	-1-0⅜	1.224			18
159	1	Fill 13⅞x½	2-2¾	23.59	53	"	-1-9⅞	3.816			96
160	1	" " x¾	2-7"	35.43	91	"	-1-11½	6.552			178
161	1	" 6x½	1-11½	10.20	20	+ 71-8 5/16	+0-4½	1.434		8	
162	1	" 6x¾	2-3¾	15.30	35	"	+0-6⅛	2.509		18	
163	1	L 6x6x½	6'-2	19.60	121	+ 71-9 11/16	-0-9¼	8.689			93
164	1	Fill 6"x½	4-2¾	10.20	43	+ 71-8 5/16	"	3.083			33
165	1	" 6x¾	4-11¼	15.30	76	"	"	5.448			59
154	1	L 3½x3½x⅜	0-6	8.50	4	+ 73-1½	-0-3¼	293			1
155	1	" "	0'-7⅜	"	5	+ 72-3 3/16	"	361			1
156	1	" 4x3½x⅜	0'-9½	9.10	7	+ 72-11¾	-1-1⅜	511			8
	1	Wash 3"φx½		0.96	1	+ 72-8½	-1-0⅛	73			1
	1	" " x¾		1.44	1	"	"	73			1
166	6	Ls 6"x4"x⅜	6-3½	12.30	464	+ 63-9 13/16	-0'-9¼"	29.612			357
167	6	Fills 4"x½	4-2¾	6.80	173	+ 63-8¾	"	11.025			133
166	6	Ls 6"x4"x⅜	6-3½	12.30	464	+ 48-0 3/16	"	22.304			357
167	6	Fills 4x½	4-2¾	6.80	173	+ 47-11¾	"	8.301			133
166	2	Ls 6x4x⅜	6-3½	12.30	155	+ 36'-4 3/16	"	5.634			119
167	2	Fills 4x½	4-2¾	6.80	58	+ 36'-3⅛	"	2.103			45
168	2	Pls 13"x⅜	4-2¾	16.58	140	+ 58-4⅝	"	8.175			108
174	1	L 4x3½x⅜	3-0¼	9.10	27	"	-1-3"	1.577			34
175	1	Fill 3½x⅜	0-8½	4.46	3	+ 59-3⅝	- 1-3¾	178			4
176	1	" "	0-10¾	"	4	+ 57-4½	"	230			5
177	2	Ls 6x6x½	3-1⅝	19.60	123	+ 48'-1⅛	+ 0-9"	5.915		92	
178	2	Fills 6x½	2-1⅞	10.20	44	+ 47-11¾	+ 0-3 1/16	2.111		11	
179	2	" 6x¾	2-6⅛	15.30	77	"	+ 0-5 3/16	3.694		33	
180	2	" 15¾x½	1-10⅞	26.78	102	+ 48'-4½	- 1-11 1/16	4.935			196
181	2	" " x¾	2'-3⅜	40.15	181	"	- 2-1 3/16	8.757			380
163	2	Ls 6x6x½	6'-2"	19.60	242	+ 48-1⅛	-0'-9¼	11.638			186
164	2	Fills 6x½	4-2¾	10.20	86	+ 47-11¾	"	4.126			66
165	2	" 6x¾	4-11¼	15.30	151	"	"	7.245			116
189	1	L 4x3½x⅜	3-7⅛	9.10	33	+ 69'-7⅛	-1'-3"	2.296			41
190	2	Ls "	3-9¾	"	69	+ 63-8¼	"	4.395			86
191	1	L "	3-6¼	"	32	+ 53-9¾	"	1.722			40
209	2	Ls "	3-9¾	"	69	+ 48'-0"	"	3.312			86
192	1	L "	3'-0"	"	27	+ 42-8"	"	1.152			34
193	1	L "	3-4½	"	31	+ 38-1⅝	"	1.182			39
194	1	L "	3-3¼	"	30	+ 34-7¾	"	1.040			38
206	4	Ls 3½x3½x⅜	0'-6"	8.50	17	+ 67-10½	-0'-3¼	1.154			5
"	1	L "	"	"	4	+ 61-9"	"	247			1
"	2	Ls "	"	"	9	+ 59-8 13/16	"	538			2
"	1	L "	"	"	4	+ 57-6⅞	"	230			1
"	1	L "	"	"	4	+ 56-7½	"	227			1
"	4	Ls "	"	"	17	+ 52-1½	"	886			5
"	2	Ls "	"	"	9	+ 45-3⅛	"	407			2
"	1	L "	"	"	4	+ 42-6"	"	170			1

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

Mark	No.	Material	Length	Wt./ft	Total Wt.	±X from Trunnion	±Y from Floor	+X Moment	−X Moment	+Y Moment	−Y Moment
206	1	L 3½x3½x⅜	0'-6"	8.5	4	+40-10½	−0'-3¼	164			1
"	4	Ls "	"	"	17	+36-4½	"	618			5
207	1	L "	0'-6¼"	"	4	+63-6⅝	"	254			1
"	1	" "	"	"	"	+47-9⅝	"	191			1
208	1	Fill 3"φx⅞"		@ 1.75	2	+ 63-5	−0-4¼	127			1
"	1	" "		"	"	+ 47-8	"	95			1
231	2	" 6x¾	0-7½	15.30	19	+ 73-1½	−2-10	1389			54
232	1	" 8½x½	1-0⅝	14.45	15	+ 72-5⅞	−2-4 7/16	1087			36
233	1	" " x¾	1-3⅞	21.68	29	"	−2-6 5/16	2102			73
234	1	" 15x"	1-10½	38.30	71	+ 72'-9"	−2-8	5.165			190
212	4	Ps 11½x½	2-1¾	19.55	168	+ 45-6⅞	−0-9¼	7656			129
213	4	Fills 4x¾	"	10.20	88	"	"	4010			68
199	1	P 16¾x⅜	2-2½	21.36	47	+ 71-5 3/16	−3-10 1/16	3.357			181
200	1	" 19"x"	3-5¾	24.23 $^{-5}$	79	+ 56-3½	"	4447			303
201	1	" "	3-5¼	" $^{-5}$	78	+ 40-6	"	3.159			300
235	1	L 4x3x½	1-5½	11.10	16	+ 73-8	+0-3⅜	1.179		4	
210	2	Ps 8x½	2-3¼	13.60 $^{-8}$	54	+ 48-4½	−0-7½	2.613			34
217	2	Fills 6x¾	0-8½	15.30	22	+ 48-3⅜	−0-6	1.062			11
218	2	Cov P. 18x¾	10-0⅜	45.90	946	+37-6⅝	−0-9¼	35484			728
182	2	Fills "	2-8	"	245	+32-5⅞	"	7.960			189
183	4	sp.Ps 12x¾	"	30.60	327	"	"	10.624			252
184	4	" Ls 8x7¼x¾	6-2"	36.40	898	"	"	29.176			691
185	4	" Ps 9x⅜	2-2"	11.48	100	"	"	3.249			77
186	2	" " 14x"	2-8½	17.85	97	"	"	3.152			75
187	2	Fill 4x⅞	4-2¾	11.90	101	"	"	3.281			78
188	2	" 4x¾	4-9¾	10.20	98	"	"	3.184			75
189	2	Ls 6x4x⅜	6-0½	12.30	149	"	"	4.841			115
214	1	Fill 9½x½	1-5"	16.15	23	+ 66-8½	−2-6"	1.534			58
215	1	" 13½x¾	"	34.40	49	"	−2-8"	3.269			131
2120		R.H. ⅞"φ		@ 0.2125	451	+ 51-7¼	−0-9⅞	2.327			370
					23.120			1,172,054		212	19,157
					x2						
					46,240			2.344.108		424	38.314

MAIN GIRDER GZ^{R}_{L} 2 Req'd

Mark	No.	Material	Length	Wt./ft	Total Wt.	±X from Trunnion	±Y from Floor	+X Moment	−X Moment	+Y Moment	−Y Moment
236{	1	Web.P. 75"x½"	27'-1¾"	127.5	3,462	+ 18'-11"	− 0'-9¼	65501			2.666
	1	" 84¼x"	(14'-8")½	14.03	103	+ 10'-2¾	+ 2-7¼	1.054		268	
5{	1	" 84¾x"	7'-2¼	144.08	1,036	+ 1-8⅞	− 0-4⅜"	1.803			373
	1	" 14½x"	(")½	24.65	88	+ 0-6⅜	+ 3'-7"	47		315	
	1	" 34½x"	"	58.65 $^{-185}$	237	+ 1-4½	− 4'-11"	327			1.166
41{	1	" 100x"	4'-4¾	170.0	748	− 4-0¾	+ 0'-3		3.036	187	
	1	" 19x"	(")½	32.3	71	− 4-9⅜	+ 4-11¼		339	381	
222	1	Cov.pl. 18x¾	13-3¾	45.9	611	+ 27-0½	+ 2-5⅝	16,521		1,509	
223	1	"	16-7¾	"	764	+ 24-2"	+ 2-4⅞	18.466		1,841	
219	1	"	15-5"	"	708	+24-9⅜	− 3-11⅜	17.544			2,797
220	1	"	11-2¾	"	575	+28-1"	− 4-0⅛	14.461			2.065
221	1	Pl. "	6-10½	"	316	+ 22-8⅞	− 4-0⅞	7.186			1.286
202	1	" 13½x⅜	3-7¼	17.21	62	+ 23-3 1/16	− 3-10 1/16	1.442			238
205	1	" 27½x"	4-1½	35.07 $^{-33}$	112	+24'-2"	"	2.707			430
203	1	" 15½x"	2-6"	19.76	49	+23-4¾	− 2-9 3/16	1.147			136
204	1	L 4x3½x⅜	1-11	9.1 $^{-7}$	10	+23-1⅜	− 2-8"	231			27
195	1	" "	3-3	"	30	+30-3⅜	− 1-3"	908			38
196	1	" "	3-1½	"	28	+27-0⅞	"	758			35
197	1	" "	3-6¼	"	32	+22-3¾	"	714			40
206	1	" 3½x3½x⅜	0'-6"	8.5	4	+31-7⅝	− 0-3¼	127			1

MADE BY M.K DATE 2-11-7 FILE NO.

CHECKED BY DATE PAGE NO. 3

CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

Mark	No.	Material	Length	Wt./ft.	Total wt.	±X From Trunnion	±Y From floor	+X Moment	−X Moment	+Y Moment	−Y Moment
206	2	Ls 3½x3½x⅜	0'-6"	8.5	9	+29-6⅞	−0-3¼	266			2
224	1	L 4x3½x⅜	3-4¾	9.1	31	+26-7	−0-1¾	824			5
225	1	" "	3-6¼	"	32	+22-3¾	"	714			5
166	2	Ls 6x4x⅜	6-3½	12.3	155	+28-6⅜	−0-9¼	4.422			119
167	2	Fills 4x½	4-2¾	6.8	58	+28-5⅜	"	1,650			45
177	1	L 6x6x½	3-1⅝	19.6	62	+24-5⅝	+0-9"	1,517		47	
178	1	Fill 6x "	2-1⅞	10.2	22	+24-4¼	+0-3 1/16	536		6	
179	1	" 6x¾	2-6⅛	15.3	38	"	+0-5 3/16	925		16	
180	1	" 15¾x½	1-10⅞	26.78	51	+24-9	−1-11 1/16	1.262			98
181	1	" " x¾	2-3⅛	40.15	91	"	−2-1 3/16	2,252			191
163	1	L 6x6x½	6-2"	19.6	121	+24-5⅝	−0-9¼	2,961			93
164	1	Fill 6x½"	4-2¾	10.2	43	+24-4¼	"	1.047			33
165	1	" 6x¾	4-11¼	15.3	76	"	"	1.851			59
210	1	Pl. 8x½	2-3¼	13.6^{-4}	27	+24-9"	−0-7½	668			17
217	1	Fill 6x¾	0-8½	15.3	11	+24-7⅝	−0-6	271			6
211	4	Ls 6x4x⅜	2-1½	12.3	105	+22-9¾	+1-2¼	2.395		125	
1	2	Ls 8x8x¾	10-10	38.9	843	+25-8⅞	+2-2¼	21.699		1846	
	2	" "	11-4½	"	885	+14-7⅞	+2-4	12.974		2.062	
	2	" "	6-5	"	499	+5-9 13/16	+2-11¼	2.904		1467	
	2	" "	5-10	"	454	−0-1⅛	+3-10⅝		41	1766	
	2	" "	5-1½	"	399	−5-3⅛	+5-5¼		2.099	2170	
3	2	" "	38-5½	"	2,992	+11-11⅛	+3-8¾	35,695		11.160	
2	2	Pls 12x½	26-4	20.4	1.074	+19-3⅝	+1-10½	20.728		2.019	
	2	" 8x½	(14-2)½	13.6	193	+10-4	+2-7	1.994		498	
4	2	" 12x½	26-4	20.4	1074	+19-3⅝	−3-5	20.728			3,673
67	2	" 21½x"	2-1½	36.55^{-4}	152	+6-1⅜	+2-2½	929		336	
12	2	" 55½x"	12-5	94.35	2.344	−0-0⅝	−1-7¼		117		3.750
	2	" 34½x"	7-2¼	58.65^{-370}	473	+1-4½	−4-11	653			2.327
11	2	" 27½x"	12-5	46.75	1.161	−0-0⅝	+1-11½		58	2,276	
	2	" 10x"	(6-1⅞)½	17.0	105	+2-0⅝	+3-4¾	215		357	
	2	" 22x"	(6-3⅛)½	37.4	234	−4-2	+4-8¼		976	1,097	
	2	" 11⅜x"	6-3⅛	29.01	364	−3-1 9/16	+3-7⅛		1139	1.307	
10	2	" 12½x¾	11-4¼	31.9	724	+0-5¾	+0-9¾	348		586	
6	2	" 14¼x"	17-7	36.35	1.278	+3-7⅛	+1-11⅜	4588		2.492	
	2	" 5½x"	(6-2¾)½	14.03	87	+8-2¾	+2-8⅝	716		237	
	2	" 6x"	11-4¼	15.3	347	+0-5¾	+2-9¾	167		976	
	2	" 10x"	(6-1⅞)½	25.5	157	+2-0⅝	+3-4	322		523	
	2	" 11⅜x"	5-2⅜	29.01	302	−2-7 3/16	+3-6 7/16		785	1,069	
	2	" 17¾x"	(")½	45.25	235	−3-5⅝	+4-6		815	1.058	
7	2	Fills 6¾x"	17-7"	17.21	605	+3-7⅛	+1-7⅝	2.172		992	
	2	" 5½x"	(6-2¾)½	14.03	87	+8-2¾	+2-1⅛	716		182	
	2	" 6x"	11-4¼	15.3	347	+0-5¾	+2-2¼	167		760	
	2	" 10x"	(6-1⅞)½	25.5	157	+2-0⅝	+2-8½	322		425	
	2	" 11⅜x¾	5-2⅜	29.01	302	−2-7 3/16	+2-10 15/16		785	879	
	2	" 17¾x"	(")½	45.25	235	−3-5⅝	+3-10½		815	912	
8	2	Pls 11½x"	17'-7"	29.33	1031	+3-7⅛	−3-4½	3.701			3485
9	2	Fills 4x"	"	10.20	359	"	−3-0¾	1289			1099
45	2	Ls 6x4x½	6-3½	16.20	204	+20'-5⅜	−0-9¼	4172			157
46	6	Fills 4x½	4-2¾	6.8	173	+16-5⅝	"	2849			133
47	2	Ls 6x4x½	6-4½	16.2	207	+16-6⅝	−0-8¾	3426			151
48	4	" 4x3½x⅜	3-9½	9.1	138	+16-5⅛	−0-8⅜	2267			97
49	2	" 6x4x½	6-5	16.2	208	+12-7⅞	−0-7¾	2633			135
50	2	Fills 4x¾	5-2	10.2	105	+12-6⅞	"	1320			68
51	2	Ls 6x4x½	6-6	16.2	211	+11-5⅝	−0-7¼	2420			127
52	4	Fills 4x¾"	4-2¾	10.2	173	+11-6⅝	−0-9¼	1998			133

JIUN MASUDA
CONSULTING ENGINEER
SEIYU-BLDG, TOKIO

MADE BY M. K. DATE 2-11-8 FILE NO
CHECKED BY DATE PAGE NO 4

CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

Mark	No.	Materials	Length	wt./ft.	Total wt.	±X from Trunnion	±Y from Floor	+X Moment	−X Moment	+Y Moment	−Y Moment
46	2	Fills 4x½"	4-2¾	6.8	58	+ 11-6⅝	− 0-9¼	670			45
53	1	L 6x6x½	6'-8"	19.6	131	+ 9-2 5/16	− 0-6¼	1205			68
54	1	L "	6-8½	"	132	+ 8-9 11/16	− 0-6	1163			66
55	1	Fill 14x½	4-2¾	23.8	101	+ 9'-0"	− 0-9¼	909			78
56	2	" 14x¾	"	35.7	302	"	"	2718			233
63	2	Ls 5x3½x⅜	0-5½	10.4	10	"	− 0-2¾	90			2
64	2	Ls 4x"x"	1-3"	9.8	25	+ 12-0¾	− 0-8⅜	302			18
65	1	L "	1-9"	"	17	+ 10-5¾	− 0-1¾	178			3
66	1	" "	2-2⅛	"	21	+ 7-3 1/16	"	154			3
57	1	" 6x6x½	3-9½	19.6	74	+ 9-2 5/16	+ 0-10¾	680		67	
58	1	" "	3-10¼	"	75	+ 8-9 11/16	− 0-11	661			69
59	1	Fill 14x½	1-9¾	23.8	43	+ 9-0	+ 0-5⅛	387		18	
60	2	Fills 14x¾	2-4½	35.7	170	"	+ 0-1⅜	1530		19	
61	1	Fill "x½	1-8"	23.8	40	"	− 2-0½	360			82
62	2	Fills "x¾	"	35.7	119	"	"	1071			243
70	2	" 12x½	2-2	20.4	89	+ 7-3⅜	− 2-4½	648			212
71	2	Pls "x¾	5-10¼	30.6	358	+ 5-5¼	"	1948			852
72	2	" 11½x½	2-4½	19.55	93	+ 6-0⅝	− 3-4½	563			314
73	2	Ls 6x3½x⅜	0-1½	11.70	22	+ 4-1⅛	"	90			74
216	1	Fill 6x¾	1'-0"	15.30	15	+ 5-7⅜	− 2-4½	84			36
237	1	" 6x½	"	10.2	10	"	"	56			24
46	2	Fills 4x"	4-2¾	6.8	58	+ 6-0⅜	− 0-9¼	350			45
68	2	Ls 6x4x½	6-11"	16.2	224	+ 6-1⅜	− 0-4¾	1.369			90
69	2	Fills 4x¾	2-1¼	10.2	43	+ 6-0⅜	− 0-9⅜	259			34
52	2	" "	4-2¾	"	86	"	− 0-9¼	519			66
"	2	" "	"	"	"	+ 2-8⅛	"	230			66
69	2	" "	2-1¼"	"	43	"	− 0-9⅜	115			34
74	2	Ls 6x4x½	7-4	16.2	237	+ 2-9⅛	0-2¼	654			45
75	2	" 6x6x½	7-10	19.6	307	+ 0-2¼	+ 0-0¾	58		18	
76	2	" "	8-0"	"	314	− 0-2¼	+ 0-1¾		60	47	
77	2	Fills 13¾x¾	3-1½	35.05	219	0'-0"	− 1-3¾				287
78	2	" "	4-2¾	"	297	"	− 0-9¼				229
63	4	Ls 5x3½x⅜	0-5½	10.4	19	"	− 0-2¾				4
79a	1	L 4x"x"	3'-0"	9.1	27	+ 4'-4"	− 0-1¾	117			4
79b	1	" "	1-11½	"	18	+ 3-10⅛	"	69			3
80	2	Ls "	2-2¼	"	40	+ 1-8½	"	68			6
83	2	" "	2-0"	"	36	− 1-6⅞	"		57		5
84	2	" "	2-6¼	"	46	− 3-11¼	"		181		7
85	2	" "	1-0¼	"	19	− 5-8⅜	"		108		3
22	2	Ls 6x4x½	9'-10"	16.2	318	− 6-2⅝	+ 1-0¾		1.978	337	
23	2	Fills 25x¾	9-0½	63.8 -58	1096	− 6-3¼	+ 1-1"		6.872	1184	
24	2	Pls "x½	10-4½	42.5 -39	843	"	"		5.286	910	
81	2	Ls 6x4x½	8-8	16.2	281	− 2-8⅜	+ 0'-5¾		759	135	
82	2	Fills 4x¾	3-1½	10.2	64	− 2-9⅜	− 1-3¾		178		84
52	2	" "	4-2¾	"	86	"	− 0-9¼		239		66
148	1	spl.pl. 18x¾	4-9¾	45.9	221	+ 15-11½	+ 2-8"	3.527		590	
	1	Cov.pl 18x¾	2-10	"	130	+ 21-6⅞	+ 2-6⅜	2.804		329	
	1	" "	7-9½	"	358	+ 16-5⅛	+ 2-7¼	5.882		931	
151	1	" "	6-6¾	"	301	+ 9-3⅛	+ 2-1⅞	2.787		900	
	1	" "	6-1"	"	279	+ 3-0	+ 3-7⅜	837		.1007	
	1	" "	4-2¾	"	194	− 2-1⅜	+ 4-9½		409	929	
	1	" "	7-11¾	"	366	+ 16'-7	+ 2-6½	6068		930	
	1	" "	6-1½	"	304	+ 9-3⅛	+ 2-11	2815		888	
150	1	" "	6-2"	"	283	+ 3-0"	+ 3-6½	849		1002	
	1	" "	6-5¼	"	296	− 3-0⅝	+ 5-1		903	1504	
	1	" "	2-5½	"	113	− 7-2⅜	+ 6-8		814	754	

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY M.K. DATE 2-11-10 FILE NO

CHECKED BY DATE PAGE NO 5

CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

Mark	No.	Materials	Length	Wt/ft.	Total wt.	±X From Trunnion	±Y From Floor	+X Moment	−X Moment	+Y Moment	−Y Moment.
149	1	Cov. Pl. 18×¾"	3'-4"	45.9	153	+14-2¼	+2-6⅞	2.171		393	
	1	" "	6-7½	"	304	+9-3⅛	+2-10¼	2815		866	
	1	" "	6-2¼	"	284	+3-0	+3-5¾	852		988	
	1	" "	6-5¼	"	296	−3-0⅝	+5-0¼		903	1486	
	1	" "	5-9	"	264	−8-8⅜	+7-4½		2297	1948	
145	1	" "	4-3	"	195	−8-0⅝	−6-3		1700		1219
	1	" "	25-5¾	" $^{-37}$	1133	+4-4"	−3-1⅜	4906			4475
146	1	" "	29-9¼	" $^{-37}$	1329	+7-7	−4-0⅛	10.074			5.329
147	1	" "	25-7"	" $^{-37}$	1137	+6-6⅞	−4-0⅞	7.470			4,628
143	1	" "	11-7½	" $^{-37}$	497	+1-10⅜	−4-1⅝	924			2058
144	1	" "	1-11½	"	90	+6-8½	−4-2⅜	604			378
	1	" "	6-5"	"	295	+2-10⅜	−5-8	844			1673
	1	" "	3-9"	"	172	−1-3	−6-0		215		1032
	1	" "	1-11½	"	90	−2-11⅝	−4-2⅜		267		378
226	2	Pls 15"×⅜"	2-1¾	19.13 $^{-28}$	54	+16-10½	−3-10 1/16	912			207
129	1	Pl. 16¾×"	5-6	21.36 $^{-17}$	100	+9-3"	− "	925			384
130	1	" 28¼×"	4-9¾	36.02 $^{-30}$	143	"	− "	1323			549
135	1	" 17½×"	5-1	22.31 $^{-17}$	96	+0-2	−3-9 15/16	16			368
136	1	Fill 6½"×⅛"	2-6	2.76	7	−1-4¼	−3-10 3/16		9		27
132	1	" "	2-4¾	"	7	+1-3⅝	− "	9			27
137	1	Pl 19½×½	2-2½	33.15 $^{-24}$	49	+1-3	−3-10	61			188
	1	" "	9-9	" $^{-3}$	320	−4-5	− "		1414		1226
138	1	" 6¼×½	9-2¼	10.63	98	−4-3⅜	−3'-10½		419		380
126	1	L 4×3½×⅜	1-9	9.1	16	+10-6⅛	−2-8	168			43
128	1	" "	2-2	"	20	+7-3⅜	− "	146			53
127	1	Pl 18½×⅜	4-5¼	23.59 $^{-28}$	77	+9-1	−2-9 3/16	699			213
133	1	" 18×⅜	4-4	22.95 $^{-34}$	65	+0-3	− "	16			180
131	1	L 4×3½×⅜	1-10½	9.1	17	+1-6⅝	−2-8	26			45
134	1	" "	1-9½	"	16	−1-5⅞	− "		24		43
	2	Ls 6×4×½	2-3	16.2	73	+22-9	−1-2¼	1661			87
	2	Fills 4×½	1-3¼	6.8	17	+22-8	−0-8¾	385			12
	2	" 4×¾	1-7½	10.2	33	"	−0-10⅝	748			29
	2,500	⅞"φ R.H.		@0.2125	531	+18-8	−0-8	9914			356
	1.200	"		"	255	+1-7¼	−0-10¾	408			230
	1.000	"		"	213	−4-1½	+0-⅞		880	141	
	38	1¼"φ Boltheads		@2.27	86	+1-8¼	−4-0⅜	145			347
					48.935			421.683	36977	62,438	56970
					×2						
					97,870			843.366	73.954	124,876	113940

MAIN GIRDER G3$^{R}_{L}$ 2 Reqd.

Mark	No.	Materials	Length	Wt/ft.	Total wt.	±X From Trunnion	±Y From Floor	+X Moment	−X Moment	+Y Moment	−Y Moment.
15	1	Web Pl. 30×½	(7-6)½	51.0	191	−10-6	+6-11		2.005	1322	
	1	" 90×"	10'-0"	153.0 $^{+7}$	160	−10-0	+1-1		1.600	173	
	1	" 60×"	"	102.0	102	−11-3	−8-11		1,148		910
	1	" 10½×"	(5'-0)½	17.85	45	−12-1	−14-2½		544		639
17	1	" 30×"	(4-0)½	51.0	102	−14-7⅛	+3-8½		1488	378	
	1	" 41½×"	6-3½	70.55	444	−15-6	−1-0½		6882		462
	1	" 48½×"	5-0	82.45	412	−15-9¼	−6-4		6497		2,608
	1	" 32¼×"	6-0	54.83	329	−15-2½	−11-5½		5.004		3770
13	2	Pls 30×½	(7-6)½	51.0	383	−10-6	+6-11		4.022	2,650	
	2	" 47¾×"	7-6	81.19	1218	−10-0	+4-1⅜		12,180	5006	
	2	" 31×"	(4-3)½	52.70	224	−14-7½	+3-6½		3,277	793	
14	2	" 12×¾	8-7	30.6 $^{-8}$	518	−11-5⅞	+2-1½		5.952	1,103	
	2	" 72½"×½"	7'-6	123.25	1,849	−10-0	−0-10¾		18490		1,664
	2	" 41¾×"	6'-0½	70.98	858	−15'-6½	−1'-1½		13,333		970
	2	" 23½×"	9'-0	39.95 $^{+8}$	727	−13'-4	−4-10¾		9,691		3,562

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY ________ DATE ________ FILE NO ________

CHECKED BY ________ DATE ________ PAGE NO 6

CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

Mark	No	Materials	Length	wt/ft	Total wt	±X From Trunnion	±Y From Floor	+X Moment	−X Moment	+Y Moment	−Y Moment.
18	1	Pl. 20½ × ½	8'-7	34.85 -6	293	-13-9¼	-10-2		4,035		2,980
19	1	〃 36¼ × 〃	4-9¾	61.63	296	-15-4	-7-4¾		4,538		2,190
	1	〃 43¾ × 〃	5-6	74.38	409	-14'-9½	-11-4¼		6,049		4,642
25	2	Fills 6¼ × ¾	2-3½	15.94	73	-14-10⅞	-5-9		1,088		420
26	1	〃 3 × 〃	2-10¼	7.65	22	-16-11½	-5-8⅝		373		126
38	1	Pl 24 × 〃	5-1	61.20	311	-16-2¼	-6-3		5,035		1,944
	1	〃 13½ × 〃	3-5	34.40 -3	118	-15-10	-10-3¾		1,868		1,217
36	2	〃 16 × ½	7-9¼	27.20	420	-9-5¼	-9-9		3,965		4,095
37	1	〃 8 × ¾	8-6	20.40	173	-9-9¼	-8-1		1,690		1,398
35	2	∟s 8×8 × ¾	8-9	38.90	681	-8-11¼	-9-6½		6,088		6,497
	2	〃 〃	2-9	〃	214	-8-3½	-4-2½		1,774		901
20	〃	〃 〃	3-9	〃	292	-12-4⅜	+7-5½		3,609	2,178	
	〃	〃 〃	3-6	〃	272	-14-7	+4-9½		3,966	1,303	
	〃	〃 〃	3-9	〃	292	-16-3¾	+1-8		4763	488	
	〃	〃 〃	4-0	〃	311	-17-4½	-2-0		5405		622
	〃	〃 〃	3-6	〃	272	-17-8	-5-7½		4806		1,531
	〃	〃 〃	4-0	〃	311	-17-2½	-9-3¼		5,352		2,883
	〃	〃 〃	4-4	〃	337	-15-9½	-13-1½		5321		4,425
21	1	Coupl. 8 × ½	3-6¾	13.60	48	-12-7	+7-8		604	368	
	1	〃 〃	3-6	〃	〃	-14-9¾	+4-11½		711	238	
	1	〃 〃	3-9	〃	51	-16-6¾	+1-9½		845	91	
	1	〃 〃	4-0	〃	54	-17-8	-1-11¼		954		105
	1	〃 〃	3-6	〃	48	-17-11½	-5-8		862		272
	1	〃 〃	4-1	〃	55	-17-5½	-9-4		960		513
	1	〃 〃	4-3	〃	58	-16-1	-13-2¾		933		767
113	2	Fills 11½ × ¾	1-7	29.33	93	-14-0	-2-7¾		1,302		246
114	2	∟s 8×8 × ¾	11-6½	38.90 -5	898	-12-0⅞	-3-7½		10,839		3260
115	2	Fills 8 × ¾	8-10¾	20.40	358	-12-11½	-3-5¾		4,640		1246
116	1	∠ 8×8 × ¾	5-0½	38.90	196	-12-6⅜	-2-1¼		2,464		804
117	1	Fill 8 × ¾	〃	20.40	103	- 〃	-4-3		1,295		438
27	1	〃 14 × ¾	〃	35.70	180	- 〃	-11-9		2,263		2,115
28	1	〃 〃 × ½	2-9	23.80	65	-11-6	- 〃		748		764
29	1	∠ 6×6 × ½	5-0½	19.60 -2	99	-12-7¾	-11-7⅛		1252		1,147
30	2	〃 〃	7'-10¼	〃 -1	306	-12-8⅞	-11-10⅞		3898		3,644
31	1	Fill 6 × ½	2-9	10.20	28	-11-6	-12-1¼		322		339
32	1	〃 〃	1-4	〃	14	-15-3	- 〃		214		169
33	1	〃 6 × ¾	6-6½	153	100	-12-8½	-14-4½		1,271		1,210
34	2	∟s 6×6 × ½	6-7½	19.6	260	-11-10	-8-6¾		3,076		3739
39	1	Fill 8 × ½	5-6	13.6	75	-17-3	-12-11½		1,294		642
	1	〃 〃	3-8	〃	50	-15-11	+2-2½		796		648
88	1	∠ 6 × 4 × ½	10-9	16.2	174	-9-1⅝			1,590	385	
89	1	〃 〃	10-3½	〃	167	〃	+2-5¼		1,526	407	
90	2	Fills 4 × ¾	4-3	10.2	87	-9-2⅝	+4'-8¾		802	412	
91	1	Fill. 〃	4-9	〃	48	〃	-0-9		443		36
92	1	〃 〃	4-4	〃	44	〃	-0-6½		406		24
93	2	∟s 6 × 4 × ½	11-1	16.2	359	-12-2⅝	+2-4½		4,387	854	
94	2	Fills 4 × ¾	4-5	10.2	90	-12-3⅝	+4'-9¾		1,107	433	
95	2	〃 〃	4-9	〃	97	〃	-0-9		1,193		73
86	〃	∟s 4 × 3½ × ⅜	1-0	9.1	18	-6-9⅝	-0-1¾		122		3
87	〃	〃 〃	1-7½	〃	30	-8-0⅞	〃		242		5
111	〃	〃 〃	2-4	〃 -4	42	-10-11⅝	〃		461		6
112	〃	〃 〃	3-8½	〃	64	-14-2⅞	〃		911		10
96	〃	〃 6 × 4 × ½	2-2	162	70	-12-11	+5-7		904	391	
97	〃	Pls 4 × ¾	1-2	10.2	24	-12-10	+5-6		308	132	
98	〃	∟s 6 × 4 × ½	4-3	16.2	138	-10-7¼	+3-8¼		1,463	509	

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY________ DATE________ FILE NO.________

CHECKED BY________ DATE________ PAGE NO 7

CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

Mark	No	Materials	Length	wt/ft	Total wt	±X From Trunnion	±Y From Floor	+X Moment	−X Moment	+Y Moment	−Y Moment
99	2	pls 4 × $\frac{3}{4}$	3-7$\frac{1}{2}$	10.2	74	-10-9	+3-9$\frac{1}{4}$		796	279	
100	〃	∠s. 6×4×$\frac{1}{2}$	2-7	16.2	84	-8-2$\frac{1}{2}$	+1-8		690	140	
101	〃	pls 4 × $\frac{3}{4}$	1-6	10.2	31	-7-9$\frac{1}{4}$	+1-2$\frac{1}{2}$		241	38	
102	〃	∠s 6×4×$\frac{1}{2}$	2-2$\frac{1}{2}$	16.2	72	-8-2$\frac{1}{4}$	-0-8$\frac{1}{2}$		590		51
103	〃	〃 〃	3-7$\frac{1}{2}$	〃	118	-10-7$\frac{1}{4}$	+0-8$\frac{1}{4}$		1,251	81	
104	〃	Fills 4 × $\frac{3}{4}$	3-3$\frac{1}{2}$	10.2	67	-10-9$\frac{1}{4}$	+0-7$\frac{1}{4}$		722	40	
105	〃	∠s 6×4×$\frac{1}{2}$	4-1$\frac{1}{2}$	16.2	134	-13-10$\frac{3}{4}$	+2-5$\frac{1}{2}$		1863	330	
106	〃	Fills 4 × $\frac{3}{4}$	1-2	10.2	24	-14-8	+2-11$\frac{1}{2}$		352	71	
107	1	∠ 6×4×$\frac{1}{2}$	3-3$\frac{1}{2}$	16.2	53	-10-6	-1-11		557		102
108	〃	Fills 4 × $\frac{3}{4}$	2-11$\frac{1}{2}$	10.2	30	-10-8	〃		320		58
109	2	∠s 6×4×$\frac{1}{2}$	5-3	16.2	170	-14-7	-0-8$\frac{3}{4}$		2,479		124
110	〃	Fills 4 × $\frac{3}{4}$	4-4	10.2	88	-14-6	-0-10		1,276		73
118	1	∠ 6×3$\frac{1}{2}$×$\frac{3}{8}$	8-4$\frac{1}{2}$	11.7	98	-13-7	-6-11$\frac{1}{2}$		1,331		682
119	〃	Fill. 3$\frac{1}{2}$ × $\frac{1}{2}$	2-8$\frac{1}{2}$	5.95	16	-11-5	-6-7$\frac{1}{2}$		183		106
120	〃	〃 〃	2-6$\frac{1}{2}$	〃	15	-15-11	-7-2		239		108
121	〃	∠ 6×3$\frac{1}{2}$×$\frac{3}{8}$	1-7	11.7	18	-16-11$\frac{1}{2}$	-7-3$\frac{1}{2}$		305		131
122	〃	Fill. 3$\frac{1}{2}$ × $\frac{3}{4}$	0-11$\frac{1}{2}$	8.93	9	-16-8	-7-3		150		65
123	〃	∠ 6×3$\frac{1}{2}$×$\frac{3}{8}$	7-11	11.7	93	-13-2$\frac{1}{2}$	-9-11$\frac{1}{2}$		1,229		926
124	〃	Fill. 3$\frac{1}{2}$ × $\frac{1}{2}$	2-11	5.95	17	-11-6$\frac{5}{8}$	-9-4$\frac{1}{4}$		196		159
125	〃	〃 〃	1-9	〃	10	-15-5$\frac{1}{4}$	-10-9		154		108
139	〃	pl. 18 × $\frac{3}{8}$	3-7$\frac{3}{4}$	22.95^{-35}	49	-8-7	-2-9$\frac{3}{16}$		420		136
140	〃	∠ 4×3$\frac{1}{2}$×$\frac{3}{8}$	4-9$\frac{3}{4}$	9.1	44	-9-8$\frac{3}{4}$	-2-10$\frac{3}{8}$		428		126
141	〃	pl. 20 × $\frac{3}{8}$	4-1"	25.5^{-30}	74	-8-0	-3-9$\frac{15}{16}$		592		283
142	〃	Fill 6$\frac{1}{2}$ × $\frac{1}{2}$	〃	2.76	11	-8-4	-3-10$\frac{3}{16}$		92		42
227	〃	∠ 4$\frac{1}{2}$×3×$\frac{5}{16}$	11-3$\frac{1}{2}$	7.70	87	-11-7	+0-1$\frac{1}{8}$		1,007	8	
228	〃	pl. 7$\frac{1}{2}$ × $\frac{3}{8}$	11-1$\frac{1}{4}$	9.56^{-5}	101	-11-8$\frac{1}{2}$	-0-0$\frac{9}{16}$		1,183		5
229	〃	∠ 4$\frac{1}{2}$×3×$\frac{5}{16}$	21-11	7.70	169	-6-2$\frac{1}{2}$	+0-1$\frac{1}{8}$		1,049	15	
230	〃	pl. 7$\frac{1}{2}$ × $\frac{3}{8}$	22-0	9.56^{-9}	201.	-6-2	-0-0$\frac{9}{16}$		1,240		10
2800 $\frac{7}{8}$"φ R.H				@ .2125	595	-12-0$\frac{7}{8}$	-2-9$\frac{3}{8}$		7,182		1,654
124 $\frac{3}{4}$"φ 〃				@ .1425	18	-8-6	-0-0$\frac{5}{16}$		153		1
57 〃 Bolt heads				@ .500	29	〃	〃		247		1
					19,897				247,763	20,616	77,632
					× 2				×		2
					39,794				495,526	41,232	155,264
Maingirder summary											
G1$^{R}_{L}$					46,240			2344108		424	38,314
G2$^{R}_{L}$					97,870			843,366	73,952	124,876	113,940
G3$^{R}_{L}$					39,794				495,526	41,232	155,264
					183,904			3,187,474	569.480	166,532	307,518

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY M. K DATE 2-11-16 FILE NO

CHECKED BY DATE PAGE NO 8

CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

FLOOR BEAM FB1. 1 Req'd.

No.	Material	Length.	Wt per ft.	Total Wt.	±x From Trunnion	±Y From Floor	+x Moment	−x Moment	+Y Moment	−Y Moment
2	Web Pls 31½ × ⅜	20'4¾	40.17	1,639						
1	" " "	8'10	"	355						
8	∠s 6 × 3½ × ½	20'4¾	15.3	2,497						
4	" "	8'10	"	540						
4	" 6 × 6 × ½	2'6⅞	19.6	201						
4	Fills 6 × ½	2'0⅝	10.2	84						
36	∠s 5 × 3½ × ⅜	2'6⅞	10.4	962	+72'0	− 2'5$\frac{5}{16}$	553,248			1,9.133
36	Fills 3½ × ½	2'0⅝	5.95	439						
8	∠s 6 × 6 × ½	2'6⅞	19.6	403						
4	Fills 12½ × ½	2'0⅝	21.25	174						
8	Pls 3½ × ½	2'0	5.95	95						
4	" 12 × ⅜	2'0⅝	15.3	125						
4	" 12½ × ½	2'0	21.25	170						
10	" 13 × ⅜	2'1	16.58^{-43}	302	+ 72'0	− 1'1$\frac{13}{16}$	21,744.			347
2	" "	2'2	" $^{-8}$	64	"	"	4,608			74
4	" 13¼ × ⅜	2'4¾	16.90^{-20}	142	+ 71'11	"	10,213			163
2	∠s 4 × 3½ × ⅜	0'9¼	9.1	14	+ 71'4$\frac{9}{16}$	− 2'9⅜	1,006			39
2	" "	1'6	"	27	"	"	1,941			75
2	Pls 22⅜ × $\frac{5}{16}$	2'3¾	23.78^{-17}	93	+ 70'11	− 2'8¼	6,596			250
2	" 22½ × $\frac{5}{16}$	3'1½	23.91^{-2}	148	+ 71'7	− 3'10	10,594			567
{8	∠s 4 × 3½ × ⅜	0'11½	9.1	70	+ 73'0¼	− 1'3¼	5,111			89
4	Pls 15½ × ⅜	1'6	19.76^{-40}	79	+ 72'8	− 1'9	5,741			138
{20	∠s 4 × 3½ × ⅜	0'11½	9.1	175	+ 73'0¼	− 1'3¼	12,779			222
10	Pls 15½ × ⅜	1'5	19.76^{-44}	187	+ 72'8	− 1'9	13,589			327
{4	∠s 4 × 3½ × ⅜	0'11	9.1	33	+ 73'0½	− 1'3¼	2,410			42
2	Pls 14 × ⅜	1'4½	17.85^{-18}	31	+ 72'8¼	− 1'9	2,254			54
2400	Rivets Heads ¾		@ 0.2125	510	+ 72'0	− 2'4½	36,720			1,214
				9,559			688,554			22,734

FLOOR BEAM FB2. FB3. & FB4

8	∠s 8 × 6 × ¾	24'9¾	33.8	6,709
2	Pls 36 × ½	24'9¾	61.2	3,037
4	Pls 18 × ¾	19'11¼	45.9	3,661
1	Pl. "	4'8	" $^{-5}$	209
1	" "	5'6	"	252
8	Pls 9 × ¾	15'9¼	22.95	2,895
4	" "	18'1	"	1,660
8	" 3 × ¾	17'11	7.65	1,097
4	" "	13'9½	"	422
8	" 8 × ¾	4'9⅝	20.4	777
4	" 8 × 6 × ¾	3'9	33.8	507
12	Fills 17¾ × ¾	1'8	45.25	907
4	∠s 8 × 6 × ¾	0'11	33.8^{-3}	121
2	Fills 18 × ¾	1'4	45.9	122
2	" "	2'0½	"	187
4	∠s 6 × 6 × ½	2'8	19.6	209
8	Fills 6 × ¾	1'2¾	15.3	151
4	∠s 5 × 3½ × ⅜	2'8½	10.4	113

増田淳氏関係資料
（独立行政法人 土木研究所蔵）

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY M. K. DATE 2-11-16 FILE NO

CHECKED BY DATE PAGE NO 9

CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

NO.	Material.	Length.	Wt. per ft.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	−X Moment	+Y Moment	−Y Moment.
8	Fills. 3½ × ¾	1'3¼	8.93	91.						
8	〃 6¾ × ¾	0'9	17.21	103						
4	∠ 5 × 3½ × ⅜	2'9	10.40	114						
8	Fills 3½ × ¾	1'3¾	8.93	94						
8	〃 7¾ × ¾	0'9	19.76	119						
4	∠ 5 × 3½ × ⅜	2'9½	10.40	116						
8	Fills 3½ × ¾	1'4¼	8.93	96						
8	〃 7¾ × ¾	0'9	19.76	119						
4	∠ 5 × 3½ × ⅜	2'10	10.40	118						
8	Fills 3½ × ¾	1'4¾	8.93	100						
8	〃 8¼ × ¾	0'9	21.04	126						
4	∠ 5 × 3½ × ⅜	2'10½	10.40	120						
8	Fills 3½ × ¾	1'5¼	8.93	103						
8	〃 8¾ × ¾	0'9	22.31	134						
8	∠ 5 × 3½ × ⅜	2'11	10.40	243						
16	Fills 3½ × ¾	1'5¾	8.93	211						
2	∠ 5 × 3½ × ⅜	2'9½	10.40	58						
4	Pl/s 17¾ × ¾	1'7	45.25	286						
2	Fills 3½ × ¾	1'10¾	8.93	34						
3650	R. H. ⅞φ		@ 0.2125	776						
				26,197						
	For FB2			26.197	+56'3	−2'5	1,473,581			63,397
	〃 FB3			〃	+40'6	〃	1,060,979			〃
	〃 FB4			〃	+24'9	〃	648,376			〃
				78,591			3,182,936			190,191
	For FB2 only.									
2	Pl/s 37 × 5/16	3'8¾	39.31^{-4}	289	+56'3	−3'10	48,825			1,107
4	〃 23½ × 5/16	2'3½	24.97^{-25}	204		−2'8¼				549
4	∠ 4 × 3½ × ⅜	2'3	9.1^{-5}	.77		−2'9⅜				214
40	∠ 3" × 2½ × ⅜	0'6	6.6	132		−2'6				330
20	Pl/s 9 × ⅜	0'10¾	11.48^{-41}	166		−2'8½				450
				868			48,825			2,650
	For FB3 only (Wt. and Y axis arm equal to FB2)									
				868	+40'6		35,154			2,650
	For FB4 only									
2	Pl/s. 46 × 5/16	5'0¾	48.88^{-41}	454	+24'4	−3'10	11,046			1,739
2	〃 23½ × 5/16	2'3½	24.97^{-12}	102	+24'6	−2'8¼	5,709			627
2	〃 26½ × 5/16	2'6½	28.16^{-12}	131						
40	∠ 3" × 2½ × ⅜	0'6	6.6	132	+24'9	−2'6	7,376			330
20	Pl/s 9 × ⅜	0'10¾	11.48^{-41}	166		−2'8½				450
4	∠ 4 × 3½ × ⅜	2'3	9.1^{-5}	77	〃	−2'9⅜	1,906			214
				1062			26,037			3,360
	FB2, FB3 & FB4 Summary			81,389			3,292,952			198,851

MADE BY M. K DATE 2-10-3 FILE NO

CHECKED BY DATE PAGE NO 10

CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

FLOOR BEAM FB5

No.	Material.	Length.	Wt. per ft.	Total Wt.	±x From Trunnion	±Y From Floor	+x Moment	-x Moment	+Y Moment	-Y moment.
2	Pls 60 × 3/8	24'-11	76.5	3,813		-1'-1 13/16				4,385
4	〃 12½ × ½	〃	21.25	2.118		-1'-1 3/8				2.351
4	〃 6¼ × 3/4	〃	15.94	1.589		-1'-0¾				1,684
2	〃 〃	2'-6½	〃	81		-1'-0				81
1	Pl. 12½ × 3/8	2'-10½	15.94	46		-1'-1 7/16				52
4	∟s 6 × 6 × 3/4	24'-11	28.70	2,861		-0'-11½				2.747
1	Pl. 8 × 3/8	1'-0½	10.2	11		-1'-2 3/16				13
1	〃 12½ × 3/8	1'-1 1/8	15.94	17		〃				20
1	〃 12½ × 3/4	4'-4½	31.9	140		-1'-2 3/8				168
1	∟ 6 × 6 × 3/4	〃	28.70	126	+8'-9½	-0'-10 5/8	120.836			112
1	〃 〃	3'-4½	〃	97		〃				86
1	Pls 12½ × 3/4	〃	31.9	108		-1'-2 3/8				130
2	∟s 6 × 6 × ½	4'-10½	19.6	191		-0'-10¾				172
2	〃 〃	2'-0¾	〃	81		-1'-3 5/8				105
2	〃 〃	1'-8	〃	65		〃				85
2	Fills 6 × 3/4	2'-10¾	15.3	89		-1'-0¾				94
2	〃 6 × ½	〃	10.2	59		-1'-1 3/8				65
10	∟s 3½ × 3½ × 3/8	4'-10½	8.5	415		-0'-11 3/8				394
20	Fills 3½ × 5/8	2'-10¾	7.44	432		-1'-1				467
4	Pls. 6 × ½	24'-11	10.2	1,017		-0'-10 1/8				854
1840	R.H. 7/8"		@ 0.2125	391		-1'-1 5/8				446
2	Pls 6 × ½	23'-9¾	10.2	486	+11'-4¼	-0'-10 1/8	5,516			408
1	Pl. 〃	4'-4½	〃	45	+11'-4¾	〃	513			38
1	〃 〃	2'-2½	〃	23	+11'-4¼	〃	261			19
2	Pls 12 × ½	24'-3¾	20.4	992	+6'-3¼	-0'-7 1/8	6,220			585
450	R.H. 7/8"		@ 0.2125	96	+11'-3¾	-0'-9½	1.086			76
2	∟s 6 × 3½ × ½	16'-5 7/8	15.3	505	+6'-1	-0'-3 3/8	3,070			141
2	〃 4 × 4 × 3/8	〃	9.8	323	+6'-4 5/8	-0'-3¼	2,064			87
2	〃 〃	4'-2	〃	82	〃	-0'-1 5/8	524			11
2	〃 6 × 6 × ½	〃	19.6	163	+6'-1 3/8	-0'-2 5/8	996			36
1	∟ 〃	4'-9½	〃	94	〃	〃	574			21
1	〃 4 × 4 × 3/8	〃	9.8	47	+6'-4 5/8	-0'-1 5/8	300			7
4	∟s 5 × 3½ × 3/8	0'-8½	10.4 -5	25						
4	〃 〃	0'-9	〃 -5	26						
4	〃 〃	0'-9½	〃 -5	28	+6'-0 7/8	-0'-8	1056			117
4	〃 〃	0'-10	〃 -5	30						
4	〃 〃	0'-10½	〃 -5	32						
4	〃 〃	0'-11	〃 -5 -10	33						
8	〃 〃	〃	〃	67	+6'-0 7/8	-0'-7	407			39
2	Fills 2½ × ½	0'-7½	4.25	5	+6'-2¾	-0'-4¾	31			2
2	Washs. 3¼ × ½		@ 0.96	2	〃	〃	12			1
8	∟s 5 × 5 × ½	1'-0	16.2	130	+6'-3 3/8	-0'-8½	814			92
16	〃 6 × 4 × ½	0'-4 3/8	16.2	106	〃	-0'-10	664			88
1	Pl. 11½ × ½	3'-4½	19.55	66	+6'-2¼	-0'-7	409			38
1	Fill. 12 × ½	1'-2½	20.40	25	+6'-3¼	〃	1.57			15
950	R.H. 7/8"		@ 0.2125	202	〃	-0'-7¾	1.267			131
2	Pls 10½ × ½	17'-3¾	17.85	618						
2	〃 〃	4'-2	〃	149	+5'-10	-0'-0¾	4.979			51
1	〃 〃	4'-10½	〃	87						
2	Check. Pls 19½ × ½	17'-3½	34.88	1,206		-0'-1¾	9.835			181
2	〃 〃 〃	4'-2	〃	291	+5'-10¾	-0'-0¼				6
1	〃 〃 〃	4'-10½	〃	170		〃				3

増田淳氏関係資料
（独立行政法人 土木研究所蔵）

MADE BY M. K DATE 2-10-3 FILE NO

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

No.	Material	Length.	Wt. per ft.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	−X Moment	+Y Moment	−Y Moment.
2	Ls 3×3×⅜	1'-11½	7.2	28	+5'-7¾	-0'-2⅛	158			5
2	, 6×3½×⅜	0'-9¾	11.7	190	+5'-4⅞	-0'-2	1,028			32
380	R. H. ⅞φ		@0.2125	81	+5'-11	-0'-2	480			14
2	Pls. 31 × ⅜	24'-9	39.53	1,957						
4	Ls 6×6×½	"	19.6	1,940						
4	" 6×3½×½	"	11.7	1,158						
2	, 6×6×½	2'-3½	19.6	90						
2	, 6×3½×½	2'-3½	11.7	54						
4	, 6×6×½	2'-6½	19.6	199						
4	Fills 6 × ½	1'-7¼	10.2	65						
28	Ls 5×3½×⅜	2'-6½	10.4	740						
14	" "	0'-11¾	"	143						
14	Fills. 3½ × ½	0'-10	5.95	69						
14	, " "	1'-1	"	90	+9'-0	-2'-9⅛	95,067			29,154
14	, 6⅛ × ½	0'-7⅜	10.42	89						
8	Ls 6×5×½	2'-6½	17.9	364						
4	Fills. 12⅜ × ½	1'-7¼	21.04	135						
14	Pls. 9 × ½	0'-10	15.30	178						
2	, 12½ × ⅜	1'-7¼	15.94	51						
4	Ls 4×4×⅜	24'-9	9.8	970						
2	Pls 18 × ⅜	,	22.95	1.136						
10	Ls 3½×3½×⅜	1'-6	8.5	128						
1	Pl. 18 × ⅜	2'-3½	22.95	53						
2	Pls 4 × ⅜	2'-0½	5.10	21						
2	Ls 4×3½×⅜	2'-6	9.10	46						
2	, ,	0'-9	,	14						
4,110	R. H. ⅞φ		@0.2125	873						
{ 2	Pls. 36 × 5/16	4'-9½	38.25 -18	348	+9'-8	-3'-10	3,365			1,333
2	" 28 × 5/16	3'-0	29.75	127	+10'-0	-2'-8 3/16	1,270			340
32	Ls 3½×3½×⅜	2'-2	8.5	590	+7'-4½	-1'-3	4,354			738
32	, ,	2'-11½	, -640	805	,	-2'-5½	5,941			1,980
16	Pls. 31⅜ × ⅜	2'-6¼	40.01	973	+8'-0½	-2'-1	7.823			2,024
20	Ls 3×3×⅜	0'-7½	7.2 -50	91	+9'-9¾	-2'-5⅜	893			227
10	Pls. 12¼ × ⅜	1'-3½	15.62	151	+9'-6	-2'-11	1,435			441
8	Ls 3×3×⅜	0'-7½	7.2	37	+9'-10	-2'-8⅜	364			101
4	Pls. 12½ × ⅜	1'-0½	15.94	66	+9'-5½	-3'-1	624			203
36	Ls 6×3½×⅜	0'-6¼	11.7	219	+7'-0⅜	-0'-10⅜	1,548			188
36	" 3½×3½×⅜	0'-3½	8.5 -90	89	+6'-4⅜	-0'-2¾	570			20
18	Pls. 8 × ⅜	1'-3½	10.20	147	+6'-9½	-0'-7⅝	998			94
256	R. H. ⅞φ		@0.2125	54	+7'-4½	-1'-4¼	399			73
288	" " "		"	61	"	-2'-5½	450			150
424	, , ,		,	90	+7'-5¼	-1'-1¾	670			104
				34.611			289,028			53.925

LONGITUDINAl GIRDERS LG1&2 2 Reqd.

2	Ls 3½×3½×⅜	14'-11	8.5	254						
2	,	14'-4¾	,	245						
1	Pl. 31½ × ⅜	15'-4½	40.17	618						
10	Ls 3"×3×⅜	2'-7⅞	7.2	191						
2	" 4×3½×⅜	1'-10	9.1	33						
2	, ,	1'-9	,	32						
2	, 6×5×½	2'-5½	17.9	88						
2	Fills. 5 × ⅜	2'-2¼	6.38	28						
388	R. H. ⅞φ		@0.2125	82						
				1571						
				× 2						
				3,142	+64'-0	-2'-6	201.088			7.855

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY M. K DATE 2-10-3 FILE NO
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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

No.	Material.	Length.	Wt. per ft.	Total. Wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y. Moment.
	LG2			4 Req'd.						
2	∠s 3½×3½×⅜	15'3½	8.5	260						
2	〃 〃	14'2½	〃	242						
1	Pl. 31½ × ⅜	15'3½	40.17	614						
10	∠s 3×3×⅜	2'7⅞	7.2	192						
4	〃 4×3½×⅜	1'9	9.1	64						
4	〃 6×5×½	2'5½	17.9	176						
4	Fills. 5×⅜	2'2¼	6.38	56						
470	R. H. ⅞"φ		@0.2125	100						
				1,704						
				× 4						
				6816	+40'6	-2'6	276,048			17,040
	LG3 R/L			2 Req'd.						
2	∠s 3½×3½×⅜	15'0	8.5	255						
2	〃 〃	14'2¼	〃	241						
1	Pl. 31½ × ⅜	15'5	40.17	619						
10	∠s 3×3×⅜	2'7⅞	7.2	192						
2	〃 4×3½×⅜	1'10¼	9.1	34						
2	〃 〃	1'9	〃	32						
2	〃 6×5×½	2'5½	17.9	88						
2	Fills. 5×⅜	2'2¼	6.38	28						
428	R. H. ⅞"φ		@0.2125	91						
				1,580						
				× 2						
				3,160	+16'10½	-2'6	53,341			7,900
	FLOOR BEAM RCB1			6 Req'd.						
2	∠s 5×4×½	17'2	14.5	498						
2	〃 〃	18'0¼	〃	523						
1	Pl. 17½ × ⅜	〃	22.31	402						
4	∠s 5×5×½	1'1¾	16.2	75						
6	〃 3½×3½×⅜	1'5	8.5	72						
4	Fills. 5×½	0'10⅛	8.5	29						
6	〃 3½×½	0'9¾	5.95	29						
4	〃 9¾×½	1'4	16.58	88						
306	R. H. ⅞"φ		@0.2125	65						
				1,781						
				× 6						
				10,686	+40'6	-1'11	432,783			20,517
	RS1 R/L and RS2 R/L			4 Req'd.						
1	I 18×6	14'6	54.7	793						
2	∠s 6×6×½	1'4	19.6	52						
1	∠ 〃	1'0¾	〃	21						
74	R. H. ⅞"φ		@0.2125	16						
				882						
				× 4						
				3,528	+64'8⅝	-1'11	228,332			6,774
	RS3 and RS4			8 Req'd.						
1	I 18×6	13'4	54.7	729						
4	∠s 6×6×½	1'4	19.6	104						
92	R. H. ⅞"φ		@0.2125	20						
				853						
				× 8						
				6,824	+40'6	-1'11	276,372			13,102

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MADE BY M. K. DATE 2-10-3 FILE NO

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

No.	Material.	Length.	Wt per ft.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment.	−X Moment.	+Y Moment	−Y Moment.
	RS5^R_L and RS6^R_L 4 Req'd.									
1	I 18 × 6	14'-5½	54.7	791						
2	Ls 6 × 6 × ½	1'-4	19.6	52						
1	L 6 × 6 × ⅜	1'-3	14.9	19						
74	R. H. ⅞ϕ		@0.2125	16						
				878						
				× 4						
				3,512	+16'-3¾	−1'-11	57,281			6,743
	STRUT ST2 16 Req'd.									
2	Ls 4 × 4 × ⅜	4'-9¼	9.8	93						
4	〃 〃	1'-2¼	〃	47						
2	Pls. 12¾ × ⅜	1'-2½	16.26	39						
2	Fills. 4 × ⅜	0'-6¾	5.1	6						
6	Lac. bars 2¼ × 5/16	1'-2⅜	2.39	17						
80	R. H. ¾ϕ		@0.1425	12						
				214						
				× 16						
				3,424	+40'-6	−1'-11	138,672			6,574
	10-STRINGERS SH1^R_L to SH5^R_L									
10	Is 15 × 5½	15'-6½	42.9	6.667						
10	Ls 6 × 6 × ⅜	0'-10	14.9	123						
2	〃 6" × 5 × ⅜	0'-11	13.6	25						
2	〃 〃	0'-11½	〃	26						
6	〃 〃	1'-0¼	〃	83						
420	R. H. ⅞ϕ		@0.2125	89						
				7,013	+64'-1½	−1'-9½	449,744			12,553
	20-STRINGERS SH6^R_L to SH10^R_L									
20	Is 15 × 5	15'-5	42.9	13,230						
8	Ls 6 × 5 × ⅜	0'-11	13.6	100						
8	〃 〃	0'-11½	〃	104						
24	〃 〃	1'-0¼	〃	333						
880	R. H. ⅞ϕ		@0.2125	187						
				13,954	+40'-6	−1'-9½	565,137			24,978
	10 STRINGERS SH11^R_L SH15^R_L									
10	Is 15 × 5½	15'-6	42.9	6,650						
10	Ls 6 × 6 × ⅜	1'-0¾	14.9	158						
2	〃 〃	0'-11	〃	27						
2	〃 〃	0'-11½	〃	29						
6	〃 〃	1'-0¼	〃	91						
420	R. H. ⅞ϕ		@0.2125	89						
				7,044	+16'-10½	−1'-9½	118,903			12.609
	Strut ST1 32 Req'd									
1	L 4 × 4 × ⅜	2'-7	9.8	25						
2	Ls 6 × 4 × ⅜	0'-6	12.3	12						
24	R. H. ⅞ϕ		@0.2125	5						
				42						
				× 32						
				1,344	+40'-6	−1'-4¾	54,432			1,882

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SEIYU BLDG, TOKIO

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

No.	Material.	Length	Wt. per ft.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment.	−X Moment.	+Y Moment.	−Y Moment.
		SIDE	WALK BRACKETS	CB1^R_L 2-Req'd.						
2	Ls. 3½×3½×⅜	6'-6¾	8.50	112	+72'-0"	−1'-2⅛	8,064			132
2	〃	6'-10⅜	〃	117		−2'-10	8424			331
2	〃	1'-11½	〃	33		−2'-1	2,376			69
2	〃	0'-11½	〃	16		−1'-6¼	1,152			24
2	Fills. 3½×⅜	1'-5	4.46	13		−2'-1	936			27
2	〃	0'-5	〃	4		−1'-6¼	288			6
1	Pls. 32⅝×⅜	6'-6¾	41.60 $^{-87}$	186		−2'-0½	13,392			379
1	Fills. 5¾×⅛	3'-3⅝	2.44	9	+71'-11½	−2'-2½	648			20
1	〃 〃×⅜	2'-1⅞	7.33	16	〃	−2'-5½	1,151			39
1	〃 5⅜×⅜	0'-6	6.85	3	〃	−0'-9¾	216			2
1	L. 6×3½×⅜	1'-1	11.64	13	+72'-0	−0'-11	936			12
2	Ls. 3½×3½×⅜	0'-7	8.50	10	〃	−0'-11¾	720			10
2	Ls. 4×3½×⅜	0'-9½	9.10 $_{-3}$	14	〃	−0'-6⅛	1,008			7
1	Pl. 10×⅜	0'-11	12.75 $_{-6}$	9	〃	−0'-7½	649			6
1	Fill. 20¼×⅜	1'-8¼	25.82	38	+72'-0⅜	−2'-9½	2,737			106
123	Rivts. Head ⅞"d		@ 0.2125	26	+72'-0	−2'-0½	1,872			53
10	〃 〃 ¾"d		@ 0.1425	1	〃	−0'-7½	72			1
				620			44,641			1224
				× 2			× 2			× 2
				1,240			89,282			2,448
				CB2^R_L 4-Req'd.						
2	Ls. 3½×3½×⅜	6'-6¾	8.50	112	+48'-4½	−1'-2⅛	5,419			132
2	〃	6'-10⅜	〃	117		−2'-10	5,660			331
2	〃	1'-11½	〃	33		−2'-1	1,597			69
2	〃	0'-11½	〃	16		−1'-6¼	774			24
2	Fills. 3½×⅜	1'-5	4.46	13		−2'-1	629			27
2	〃	0'-5	〃	4		−1'-6¼	194			6
1	Pl. 32⅝×⅜	6'-6¾	41.60 $^{-83}$	190		−2'-0½	9,192			388
1	Fill. 5¾×9/16	3'-5⅝	11.00	38	+48'-4	−2'-1½	1,837			81
1	〃 〃×⅝	〃	12.22	42	〃	〃	2,030			89
1	〃×⅜	2'-1⅞	7.33	16	〃	−2'-5½	773			39
1	L. 5×3½×⅜	1'-1	10.40	11	+48'-4½	−0'-11	532			10
1	Fill. 5¾×5/16	0'-8½	6.11	4	〃	−0'-8	194			3
2	Ls. 3½×3½×⅜	0'-7	8.50	10	〃	−0'-11¾	484			10
2	〃 4×3½×⅜	0'-9½	9.10 $_{-3}$	14	〃	−0'-6⅛	677			7
1	Pl. 10×⅜	0'-11	12.75	9	〃	−0'-7½	435			6
138	R. H. ⅞"d		@ 0.2125	29	〃	−2'-0½	1,403			59
10	〃 ¾"d		@ 0.1425	1	〃	−0'-7½	48			1
				659			31,878			1,282
				× 4			× 4			× 4
				2,636			127,512			5,128
				CB3^R_L 2-Req'd.						
2	Ls. 3½×3½×⅜	6'-6¾	8.50	112	+24'-9	−1'-2⅛	2,772			132
2	〃 〃	6'-10⅜	〃	117	〃	−2'-10	2,896			331
2	〃 〃	2'-1	〃	35	〃	−2'-1½	866			75
2	〃 〃	0'-11½	〃	16	〃	−1'-6¼	396			24
2	Fills. 3½×⅜	1'-6⅜	4.46	14	〃	−2'-1½	347			30
2	〃 〃	0'-5	4.46	4	+ 〃	−1'-6¼	99			6
1	Pl. 32¼×⅜	6'-6¾	41.12 $^{-71}$	199	〃	−2'-1½	4,925			424
1	Fill 5¾×9/16	3'-5¼	11.00	38	+24'-8½	−2'-1½	939			81
1	〃 〃×⅝	3'-5¼	12.22	42	〃	〃	1,038			89
1	〃 〃×⅜	2'-1½	7.33	16	〃	−2'-5½	395			39
1	L. 5×3½×⅜	1'-1	10.40	11	+24'-9	−0'-11	272			10

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

No.	Material	Length	Wt. per ft.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	−X Moment	+Y Moment	−Y Moment
1	Fill. 5¾×5/16	0'-8½	6.11	4	+24'-9	−0'-8	99			3
2	Ls. 3½×3½×3/8	0'-7	8.50	10	〃	−0'-11¾	248			10
2	Ls. 4×3½×3/8	0'-9½	9.10 −3	14	〃	−0'-6⅛	347			7
1	Pl. 10×3/8	0'-11	12.75	9	〃	−0'-7½	223			6
154	R.H. 7/8"φ		@ 0.2125	33	〃	−2'-1½	817			70
10	〃 3/4"φ		@ 0.1425	1	〃	−0'-7½	25			1
1	L. 4×3½×3/8	0'-8½	9.10	6	〃	−2'-8	149			16
				681			16,853			1,354
				× 2			× 2			× 2
				1,362			33,706			2,708

CB4^R_L & CB5^R_L 4-Reqd.

2	Ls. 3½×3½×3/8	6'-6	8.50	111	+4'-6	−1'-2⅛				131
4	〃 〃	〃	〃	221	〃	−2'-9¼				612
2	〃 〃	〃	〃	111	〃	−3'-8⅞				415
1	Fill. 7⅜×3/8	3'-6	9.40	33	〃	−2'-9¼				91
2	Ls. 3½×3½×3/8	0'-11¾	8.50	17	〃	−3'-3⅝				56
4	〃	1'-7⅛	〃	54	〃	−1'-11				104
2	Ls. 4×3½×3/8	0'-11¾	9.10	18	〃	−3'-3⅝				59
1	Pl. 19½×3/8	6'-6	24.86	162	〃	−1'-11				311
1	Pl. 12×3/8	〃	15.30	99	〃	−3'-3⅝				327
2	Fills. 3½×3/8	0'-5¼	4.46	4	〃	〃				13
2	〃 4×3/8	〃	5.10	4	〃	〃				〃
4	〃 3½×3/8	1'-0⅝	4.46	19	〃	−1'-11				36
2	〃 5¾×〃	0'-5¼	7.33	6	〃	−3'-3⅝				20
1	〃 〃×⅛	1'-0	2.44	2	〃	〃				7
2	〃 〃×3/8	1'-0½	7.33	15	〃	−1'-11				29
1	〃 〃×⅛	1'-7½	2.44	4	〃	〃				8
2	Ls. 3½×3½×3/8	0'-7	8.50	10	〃	−0'-11¾				10
2	〃 4×3½×3/8	0'-9½	9.10 −3	14	〃	−0'-6⅛				7
1	Pl. 10×3/8	0'-11	12.75	9	〃	−0'-7½				6
296	R.H. 7/8"φ		@ 0.2125	63	〃	−2'-8				168
10	〃 3/4"φ		@ 0.1425	1	〃	−0'-7½				1
				977			4,397			2,424
				× 4			4			× 4
				3,908			17,588			9,696

STRINGERS AND BRACINGS (SSA1~SSA4, SSB1~SSB3 & SB1~SB4)

2	[s. 12×3½	17'-3	26.10	900	+64'-10½	−0'-6¾	58,392			505
2	Is. 12×5	〃	31.99	1,104	〃	〃	71,628			618
6	[s. 12×3½	15'-8¾	26.10	2,463	+32'-7½	〃	80,368			1,379
6	Is. 12×5	〃	31.99	3,019	〃	〃	98,510			1,691
2	[s. 12×3½	13'-10¾	26.10	726	+2'-0⅝	〃	1,488			407
2	Is. 12×5	〃	31.99	889	〃	〃	1,822			498
8	Ls. 3×3×3/8	15'-7⅛	7.20	898	+40'-6	−1'-2	36,369			1,051
2	〃	9'-8⅜	〃	140	+4'-6	〃	630			164
4	〃	4'-7/16	〃	132	〃	〃	594			154
2	Pls. 12×3/8	1'-0⅞	15.30 −5	28	+72'-0	−1'-1	2,016			30
6	〃	2'-1⅞	〃 −38	160	+40'-9	〃	6,520			173
2	〃	2'-10	〃 −5	82	+9'-5	〃	772			89
2	〃	1'-9⅛	〃 −5	49	+0'-2	〃	8			53
10	Pls. 11×3/8	1'-0⅞	14.03 −20	130	+40'-6	〃	5,265			140
2	〃	〃	〃 −4	26	0	〃	0			28
16	Pls. 6×3/8	0'-8½	7.65 −14	87	+32'-7½	−0'-6¾	2,839			49
6	〃 6¾×3/8	1'-4½	8.61 −10	57	+56'-0	−1'-1	3,192			62
2	〃 9¼×〃	1'-9½	11.79	32	+24'-6	〃	784			35

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

NO.	Material	Length.	Wt. per ft.	Total Wt.	±X From Trunnion.	+/−Y From Floor.	+X Moment.	−X Moment.	+X Moment	−X Moment.
4	Ps. 9¼ × ⅜	1'-3¾	11.79^{-13}_{-8}	49.	+ 4'-6	− 1'-1	221			53
2	〃 6¾ × ⅜	1'-10½	8.61	24	〃	〃	108			26
8	Fills. 3½ × ⅜	0'-6	4.46	18	+ 48'-6½	〃	874			19
4	Ls. 5 . 3 . ⅜	0'-5½	9.80_{-3}	18	− 4'-11	− 0'-4¾		89.		.7
2	Ps. 5½ × ½	0'-7¾	9.35	9	− 4'-8¼	− 1'-0¾		42		10
184	R. H. ⅞"d		@ 0.2125	39	+ 32'-7	− 〃	1,271			41
808	〃 ¾"d		@ 0.1425	115	〃	− 1'-1	3,747			124
				11,194			3:77,418	131		7,406
			SBB1 ~ SBB8 2-Req'd.							
1	L. 3½ . 3½ . ⅜	14'-9 3/16	8.50	126						
1	〃	14'-6 7/16	〃	123						
1	〃	13'-10 3/16	〃	118						
1	〃	14'-3 1/16	〃	122						
1	Pl. 11 × ⅜	1'-4¼	14.03^{-1}	18	(SBB1)					
1	〃	1'-4½	〃	19	+ 16'-0½	− 3'-3⅝	10,955.			2,254
1	〃	0'-10¾	〃	13						
14	Lac. bars. 2¼ . ⅜	1'-0¾	2.87_{-2}	42						
1	Pl. 17½ . ⅜	1'-10¼	22.31_{-6}	39						
1	〃 16¼ . ⅜	1'-7	20.72	27						
92	R. H. ⅞"d		@ 0.2125	20						
112	〃 ¾"d		@ 0.1425	16						
2	Ls. 3½ . 3½ . ⅜	6'-3¼	8.50	107						
1	〃	5'-9¾	〃	49						
1	〃	5'-4¼	〃	45	(SBB2)					
1	Pl. 10¾ . ⅜	0'-11	13.71_{-1}	13	+ 13'-6	− 3'-3⅝	3,524			861
1	11 . ⅜	1'-4¼	14.03	18						
4	Lac. bars 2¼ . ⅜	1'-0¾	2.87	12						
48	R. H. ⅞"d		@ 0.2125	10						
52	〃 ¾"d		@ 0.1425	7	(SBB3)					
2	Ls. 3½ . 3½ . ⅜	2'-1⅝	8.50	36	+ 16'-10½	− 3'-8⅞	726			161
32	R. H. ⅞"d		@ 0.2125	7						
2	Ls. 3½ . 3½ . ⅜	10'-7⅜	8.50	180						
2	〃	8'-2⅝	〃	140						
2	Ps. 19 × ⅜	3'-2	24.23^{-24}	130	(SBB4)					
2	Ps. 21½ × ⅜	3'-6¾	27.41^{-35}	160	+ 4'-6	− 3'-3⅝	3,249			2,383
2	〃 11 × ⅜	2'-1⅜	14.03	59						
8	Lac. bars 2¼ . ⅜	1'-0¾	2.87	24						
96.	R. H. ⅞"d		@ 0.2125	20						
64	〃 ¾"d		@ 0.1425	9						
2	Ls. 3½ . 3½ . ⅜	9'-3¼	@ 8.50	158						
2	〃	8'-9¾	〃	150						
1	Pl. 10¾ × ⅜	0'-11	13.71_{-2}	13						
1	〃 11 × ⅜	1'-1½	14.03	14						
2	Ps. 13¾ × ⅜	2'-9	17.53^{-17}	79						
1	Pl. 11 × ⅜	1'-0½	14.03	15						
7	bars 2¼ × ⅜	1'-0¾	2.87	21						
88	R. H. ⅞"d		@ 0.2125	19						
76	〃 ¾"d		@ 0.1425	11	(SBB5 ~ SBB7)					
1	L. 3½ × 3½ × ⅜	4'-2	8.50	35	+ 4'-6	− 3'-3⅝	3,893			2,855
1	〃	3'-11¼	〃	33						
1	〃	3'-8½	〃	32						
1	〃	3'-5¾	〃	30						
1	Pl. 11 × ⅜	1'-1½	14.03^{-2}	14						
1	〃 10¾ × ⅜	0'-11	13.71	13						
2	Lac. bars 2¼ × ⅜	1'-0¾	2.87	6						

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

No.	Material	Length	Wt. per ft.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	−X Moment	+Y Moment	−Y Moment.
2	Ls. 3½×3½×⅜	4'-5½	8.50	76						
2	〃	4'-2¾	〃	72						
2	Pls. 10¾×⅜	0'-11	13.71	25						
3	Lac. bars 2¼×⅜	1'-0¾	2.87	9						
128	R. H. ⅞"φ		@ 0.2125	27						
88	R.H. ¾"φ		@ 0.1425	13						
1	L. 3½×3½×⅜	10'-2⅜	8.50	87						
1	〃	9'-10¼	〃	84						
1	〃	9'-6¾	〃	81						
1	〃	9'-2⅝	〃	78	(5888)					
1	Pl. 11×⅜	1'-4¼	14.03 -3	19	−4'-6	−3'-3⅝		1,944		1,426
1	〃	1'-9½	〃	22						
9	Lac. bars. 2¼×⅜	1'-0¾	2.87	27						
104	R. H. ⅞"φ		@ 0.2125	22						
84	〃 ¾"φ		@ 0.1425	12						
				3006			22,347.	1,944		9,940
				× 2			×			2
				6,012			44,694	3,888		19,880
			LATERAL BRACINGS							
32	Ls. 6×3½×5/16	0'-8¼	9.80	216		−3'-5⅜				745
2	Ls. 5×3½×⅜	19'-10¾	10.40	414						
2	〃 〃	19'-8	〃	409						
2	〃 〃	10'-0½	〃	209					LB1$^{R}_{L}$	
2	〃 〃	9'-9¾	〃	200	+64'-1½	−3'-8¼	127,875.		LB2$^{R}_{L}$	6,561
4	〃 〃	9'-5⅝	〃	394					LB3$^{R}_{L}$	
2	Pls. 17×⅜	2'-0½	21.68 -15	73						
144	R. H. ⅞"φ		@ 0.2125	31						
336	〃 ¾"φ		@ 0.1425	48						
8	Ls. 5×3½×⅜	9'-5⅝	10.40	788						
4	〃	19'-6⅞	〃	814						
4	〃	19'-9⅝	〃	824						
4	〃	9'-5¾	〃	394					LB3$^{R}_{L}$	
4	〃	9'-8¼	〃	403	+40'-6	−3'-8¼	160,340		LB4$^{R}_{L}$	13,015
4	Pls. 17×⅜	2'-0½	21.68 -30	147					LB5$^{R}_{L}$	
672	R. H. ¾"φ		@ 0.1425	96						
288	〃 ⅞"φ		@ 0.2125	61						
64	Ls. 6×3½×5/16	0'-8¼	9.80	432		−3'-5⅜				1,490
2	Ls. 5×3½×⅜	19'-9⅝	10.40	412						
2	〃	19'-6½	〃	406						
2	〃	9'-8½	〃	202						
2	〃	9'-5¾	〃	197					LB6$^{R}_{L}$	
4	〃	9'-5⅝	〃	394	+16'-10½	−3'-8¼	40,850		LB7$^{R}_{L}$	8,133
4	〃	6'-5⅝	〃	270					LB8$^{R}_{L}$	
2	Pls. 22⅜×⅜	4'-4	28.53 -80	164					LB9$^{R}_{L}$	
432	R. H. ⅞"φ		@ 0.2125	92						
468	〃 ¾"φ		@ 0.1425	67						
32	Ls. 6×3½×5/16	0'-8¼	@ 9.80	216		−3'-5⅜				745
1	L. 3½×3½×5/16	21'-10⅜	7.20	157						
1	〃	21'-8¼	〃	156						
2	〃	21'-5½	〃	309						
1	〃	10'-8½	〃	77						
1	〃	10'-5½	〃	75						
1	〃	10'-7 13/16	〃	77						
1	〃	10'-5 1/16	〃	75						
1	〃	10'-7⅞	〃	77						

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

No.	Material	Length.	Wt. per ft.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	−X Moment.	+Y Moment	−Y Moment.
1	L. 3 1/2 × 3 1/2 × 5/16	10'-2 3/4	7.20	74.						
1	"	10'-3 7/16	"	74					LB10 R/L	
1	"	10'-0 11/16	"	72	+64'-1 1/2	−3'-2 3/4	103,955		LB11 R/L	5,236
2	Pls. 14 7/8 × 3/8	2'-2	18.97^{-14}	68					LB12 R/L	
2	Pls. 12 × 5/16	1'-2 1/2	12.75	31						
3	Pls. 10 3/4 × 5/16	1'-0	11.42	34						
2	Pls. 12 × 5/16	1'-1 3/4	12.75	29						
36	bars. 2 1/2 × 5/16	1'-1 3/8	2.66	106						
2	Pls. 8 × "	1'-0	8.50	17						
2	" 10 3/4 × "	"	11.42	23						
192	R.H. 7/8"φ		@ 0.2125	41						
344	" 3/4"φ		@ 0.1425	49						
4	Ls. 3 1/2 × 3 1/2 × 5/16	10'-7 7/8	7.20	307						
4	"	10'-2 3/4	"	295						
4	"	10'-3 7/16	"	296						
4	"	10'-0 11/16	"	290						
4	"	21'-7 1/2	"	623						
4	"	21'-1 1/8	"	607					LB12	
4	Pls. 14 7/8 × 3/8	2'-2	18.97^{-14}	151	+40'-6	−3'-2 3/4	129,722		LB13	10,346
4	Pls. 8 × 5/16	1'-0	8.50	34						
4	" 10 3/4 × 5/16	"	11.42	46						
8	" 12 × "	1'-1 3/4	12.75	117						
6	" 10 3/4 × "	1'-0	11.42	69						
68	bars 2 1/2 × "	1'-1 3/8	2.66	201						
348	R.H. 7/8"φ		@ 0.2125	74						
656	" 3/4"φ		@ 0.1425	93						
2	L. 3 1/2 × 3 1/2 × 5/16	22'-0 3/4	7.20	318						
2	"	21'-1 1/8	"	304						
2	"	10'-7 9/16	"	153						
1	"	10'-3 7/16	"	74						
1	"	10'-0 11/16	"	72						
2	"	10'-8	"	154						
1	"	10'-3 7/16	"	74						
1	"	10'-0 11/16	"	72	+16'-10 1/2	−3'-2 3/4	27,920			5,342
2	Pls. 12 × 5/16	1'-4 1/2	12.75^{-3}	32						
7	" 10 3/4 × "	1'-0	11.42$_{-7}$	69						
2	" 12 × 5/16	1'-2 3/4	12.75	24						
36	Lac. bars. 2 1/2 × 5/16	1'-1 3/8	2.66$_{-28}$	106						
2	Pls. 14 3/4 × 3/8	3'-1	18.81	88						
294	R. H. 7/8"φ		@ 0.2125	64						
350	" 3/4"φ		@ 0.1425	50						
64	Ls. 4 × 3 × 5/16	0'-8 3/4	7.20	336						
16	Pls. 9 1/2 × "	1'-0 1/4	10.09	165	+64'-1 1/2	−2'-10 3/8	36,811			1,641
512	R. H. 3/4"φ		@ 0.1425	73						
128	Ls. 4 × 3 × 5/16	0'-8 3/4	7.20	672						
32	Pls. 9 1/2 × 5/16	1'-0 1/4	10.09	330	+40'-6	−2'-10 3/8	46,494			3,283
1024	R. H. 3/4"φ		@ 0.1425	146						
64	Ls. 4 × 3 × 5/16	0'-8 3/4	7.20	336						
16	Pls. 9 1/2 × 5/16	1'-0 1/4	10.09	165	+16'-10 1/2	−2'-10 3/8	9,689			1,641
512	R.H. 3/4"φ		@ 0.1425	73						
				17,147			683,656			58,178

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

TROLLEY ARCH (Common part).

No.	Material	Length.	Wt. per ft.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment.	+Y Moment	-Y Moment
4	Ls. 3 × 3 × 5/16	12'-0	6.10	293		+19'-4 3/8			5,672	
2	〃 〃	27'-4 3/4	〃	334		〃			6,466	
4	〃 3 1/2 × 3 1/2 × 3/8	12'-0	8.50	408		+17'-9 1/4			7,250	
2	〃 〃	27'-4 3/4	〃	466		+ 〃			8,281	
4	〃 3 × 3 × 3/8	1'-8	〃	57		+17'-9 1/2			1,014	
4	〃 2 3/4 × 2 3/4 × 5/16	〃	5.60	37		+19'-4			715	
2	Pls. 18 × 5/16	2'-0 5/8	19.13	78		+19'-5 3/8			1,517	
4	〃 20 × 〃	2'-11 1/2	21.25	252		+18'-6 3/4			4,677	
4	〃 6 × 〃	(1'-7) × 1/2	6.38	20		+17'-6 1/4			350	
4	〃 20 × 〃	1'-8 1/2	21.25	145		+18'-6 3/4			2,691	
2	〃 14 1/2 × 〃	2'-1 5/8	15.41	66		+17'-8 1/8			1,167	
2	〃 24 1/2 × 〃	2'-0 5/8	26.03	107		+19'-5 3/8			2,081	
2	〃 〃	2'-1 5/8	〃	111		+17'-8 1/8			1,962	
8	〃 14 × 5/16	1'-8 1/2	14.88	204		+18'-6 3/4			3,786	
20	Lac. bars. 2 1/2 × 3/8	2'-9 13/16	3.19	180		+19'-5 5/8			3,504	
12	〃	2'-10 7/8	〃	111		〃			2,161	
6	〃	2'-11 1/4	〃	56		〃			1,090	
20	〃	〃	〃	188		+17'-7 7/8			3,320	
6	〃	2'-11 5/8	〃	57		〃			1,007	
32	〃 2 1/4 × 3/8	2'-2 1/8	2.87	200		+18'-6 3/4			3,712	
48	〃	2'-2 7/8	〃	309		〃			5,735	
1,424	R. H. 3/4″d		@ 0.1425	203		〃			3,768	
				(3,882)					(71,926)	

TROLLEY ARCH TA1 1 Req'd.

No.	Material	Length.	Wt. per ft.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment.	+Y Moment	-Y Moment
	Common part.			3882	+22'-0 1/8		85,443		71,926	
4	Pls. 11 1/2 × 5/16	2'-0 5/8	12.22	100		+19'-5 3/8			1,945	
4	〃 11 × 1/4	2'-1 5/8	9.35	80		+17'-8 1/8			1,414	
Diag. 4	Ls. 3 1/2 × 3 × 1/4	1'-5 1/2	5.40	32		+19'-4 3/8			620	
8	〃	〃	〃	64	+22'-0 1/8	+17'-9 1/4	10,939		1,239	
8	〃	〃	〃	〃		+18'-8 3/4			1,199	
4	Pls. 17 1/2 × 5/16	1'-8 1/2	18.59	127		+18'-6 3/4			2,357	
210	R. H. 3/4″d		@ 0.1425	30		〃			557	
				4,379			96,382		81,257	

TROLLEY ARCH TA2 (wt. same as TA1) 1-Req'd.

No.	Material	Length.	Wt. per ft.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment.	+Y Moment	-Y Moment
				4,379	+72'-8 1/16		318,441		81,257	

TROLLEY POLE TP2 2-Req'd.

No.	Material	Length.	Wt. per ft.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment.	+Y Moment	-Y Moment
4	Ls. 3 × 3 × 5/16	17'-0 3/4	6.10	416		+10'-10 7/8			4539	
2	Pls. 17 1/2 × 5/16	9'-5 7/8	18.59	353		+ 7'-1 7/16			2,513	
2	〃 〃	3'-6	〃	130		+13'-7 3/4			1,775	
2	〃 6 3/4 × 5/16	(2'-1) × 1/2	7.17 -8	15		+14'-7 3/4			220	
2	〃 26 1/2 × 〃	2'-5 1/4	28.16	129		+18'-3 1/4			2,357	
2	〃 12 1/2 × 〃	1'-5 1/2	13.28	39		+18'-11			738	
4	bars 2 1/4 × 5/16	1'-11 1/2	2.39	19		+16'-1 7/8			307	
2	Ls. 3 × 3 × 5/16	7'-0	6.10	85		+16'-3			1,381	
1	Pl. 18 × 〃	2'-9	19.13	53		+17'-6 1/4			929	
1	Pl. 〃	3'-2 1/2	〃	61	+72'-8 1/16	+13'-4 3/4	126,678		817	
36	bars 2 1/4 × 5/16	1'-10 7/16	2.39	161		+12'-6 1/4			2,016	
8	〃 〃	〃	〃	36		+5'-9 1/4			208	
2	Pls. 17 1/2 × 5/16	2'-4 1/2	18.59 -6	82		+3'-6 3/4			292	
4	Ls. 3 1/2 × 3 1/2 × 3/8	2'-1 1/4	8.50	71		+3'-5 1/8			244	
1	Pl. 17 1/2 × 3/8	2'-1	22.31	46		+3'-5			157	

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

No.	Material	Length.	Wt. per ft.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	−X Moment	+Y Moment	−Y Moment.
2	Ls. 4×3½×⅜	1'-3½	9.10	23.		+ 2'-5½			57.	
2	Fills. 3½×⅜	0'-10½	4.46	8		+ 2'-6¼			20	
2	Ls. 3½×3½×⅜	"	8.50	15		+ 2'-5½			37	
2	" 8×3½×9/16	1'-7¾	21.00	69	+71'-1	+ 2'-5¼	4,905.		168	
2	" 5×3½×⅜	2'-4½	10.40	50	+71'-9¾	+ 3'-6½	3,591		177	
1	Pl. 19¾×⅜	"	25.18^{-23}	37	+71'-3¼	+ 3'-1¾	2,637		117	
2	Fill 3½×⅜	1'-3	4.46	11	+70'-10⅝	+ 2'-6¼	780		28	
1	Pl. 18×½	4'-3¼	30.60	131	+73'-6¼	+ 2'-4⅛	9,631		307	
896	R. H. ¾"φ		@ 0.1425	128	+72'-8 11/16	+ 9'-9⅝	9,308		1,254	
24	" ⅞"φ		@ 0.2125	5	+71'-0⅝	+ 2'-4⅜	355		12	
48	" "		"	10	+73'-5⅞	+ 1'-4⅜	735		14	
16	Bolts Heads		@ 0.76	12	+72'-8 11/16	+ 2'-4⅜	873		28	
				2,195			159,493		20,712	
				× 2			× 2		× 2	
				4,390			318,986		41,424	

TROLLEY POLE TP1 2-Req'd.

No.	Material	Length.	Wt. per ft.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	−X Moment	+Y Moment	−Y Moment.
4	Ls. 3×3×5/16	16'-10½	6.10	412.	+	+ 11'-0			4,532	
2	Pls. 17½×"	9'-3⅝	18.59	346		+ 7'-2 9/16			2,495	
2	" "	3'-6	"	130		+ 13'-7¾			1,775	
2	" 6¾×"	(2'-1)×½	7.17_{-8}	15		+ 14'-7¾			220	
2	" 26½×"	2'-5¼	28.16	129		+ 18'-3¼			2,357	
2	" 12½×"	1'-5½	13.28	39		+ 18'-11			738	
4	Bars 2¼×"	1'-11½	2.39	19		+ 16'-1⅞			307	
2	Ls. 3×3×5/16	7'-0	6.10	85	+22'-0⅛	+ 16'-3	38,033		1,381	
1	Pl. 18×"	2'-9	19.13	53		+ 17'-6¼			929	
1	" "	3'-2½	"	61		+ 13'-4¾			817	
36	Bars. 2¼×5/16	1'-10 7/16	2.39	161		+ 12'-6¼			2,016	
8	" "	"	"	36		+ 5'-9¼			208	
2	Ls. 5×3½×⅜	2'-1½	10.40	44		+ 3'-7¼			158	
2	" "	2'-2¼	"	46		+ 3'-7½			167	
2	Pls. 28⅝×⅜	2'-2¼	36.50^{-8}	152		+ 3'-7½			552	
6	Ls. 3½×3½×⅜	2'-0½	8.50	104		+ 3'-7			372.	
1	Pl. 17×⅜	2'-0½	21.68	44		"			158	
2	Ls. 4×3½×⅜	1'-4	9.10	24	+22'-0⅛	+ 2'-7¾	4,248.		64	
2	Fills. 3½×⅜	0'-10½	4.46	8		+ 2'-8½			22	
2	Ls. 3½×3½×⅜	0'-9½	8.50	13		+ 2'-7¾			34	
2	Ls. 8×3½×9/16	1'-7½	21.00	68	+20'-4	+ 2'-7½	1,382		179	
2	" 5×3½×⅜	2'-0½	10.40	42	+21'-1 3/16	+ 3'-6¾	886		150	
1	Pl. 19⅞×⅜	"	25.35^{-20}	32	+20'-6¾	+ 3'-4	658		107	
2	Fills. 3½×"	1'-2⅞	4.46	11	+20'-2 5/16	+ 2'-8½	222		30	
980	R. H. ¾"φ		@ 0.1425	140	+22'-0⅛	+ 9'-10½	3,081		1,383	
64	" ⅞"φ		@ 0.2125	14	+22'-9⅞	+ 1'-3	319		18	
36	" "		"	8	+20'-4⅝	+ 2'-6	163		20	
16	Bolt Heads ⅞"φ		@ 0.76	12	+22'-0⅛	"	264		30	
2	Pls. 8½×⅜	4'-3¼	10.84	93	+22'-10⅛	+ 2'-3⅛	2,124		210	
				2,341			51,380		21,429	
				× 2			× 2		× 2	
				4,682			102,760		42,858	

CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

Mark	NO.	Material	Length	Wt. per ft.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	−X Moment	+Y Moment	−Y Moment
		CAST STEEL BRACKET OF MAIN GIRDER G2^R_L 2-Req'd.									
㊸	2	Bracket		@ 150	300	+1'-3$\frac{3}{4}$	−3'-6$\frac{3}{4}$	393			1,068
㊹	2	〃		@ 155	310	−1'-4$\frac{6}{8}$	〃		415		1,104
					610			393	415		2,172
					× 2			×			2
					1,220			786	830		4,344
		CAST STEEL TRUNNION BOSS (Cast steel)									
	4	Boss		@ 1,702	6,808						
	116	Bolt Head. 1"φ		@ 1.20	139						
	102	〃		@ 〃	122						
					7,069	+1'-4	−4'-11	9,402			34,779
		STEEL TRUNN. SHAFT. (Half hard steel)									
	2	Shaft.		@ 5,040	10,080						
	12	Collar		@ 7.40	89						
	8	Key		@ 10.80	86						
					10,255	±0	−5'-3				53,839
		CENTERING CASTING CC1 (Cast steel).									
	1	Casting		@ 400	400						
	20	Bolt Head. 7/8"φ		@ 0.76	15						
					415	+72'-0	−4'-1	29,880			1,693
		LIVE LOAD SHOE (Cast steel)									
(X1)x(X2)	4	Shoe		@ 158	632	+72'-0	−4'-0	45,504			2,528
	24	Bolt head 7/8"φ		@ 0.76	18	〃	−3'-11	1,296			71
(X3)x(X4)	4	shoe		@ 158	632	+9'-0	−4'-1	5,688			2,579
	24	B. H. 7/8"φ		@ 0.76	18	〃	−3'-11$\frac{1}{4}$	162			71
					1,300			52,650			5,249

CALCULATIONS FOR

Fist Canal Bridge for city of kobe 60' single leaf Trunnion bascule.

No	Material	Unit wt.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
			Creosoted Wooden Block pavement (目地ナモ含ム)						
2,657 sq.ft.		13.3#/sq.ft.	35,338	+39'-10⅜"	-0'-2¼"	1,407,866			6,714
			Asphalt felt.						
3300 sq.ft.	driveway	0.3#/sq.ft.	990	+39'-10⅜	-0'-4"	39,442			327
140 sq.ft.	side walk	"	44	+50'-11⅜	+0'-3½"	2,243		13	
			1,034			41,685		13	327
			Rail Web fillers (檜材) WF1 R L 4 Req'd						
1	6¼"×3"×16'-4"	5.2	85						
2	6¼×3"×15'-9"	"	164						
1	6¼"×3"×17'-11"	"	93						
1	5⅝×1⅜×1'-2½"	2.8	3						
11	" ×4'-5½"	"	137						
4	" × 2'-2½"	"	25						
1	" × 5'-9"	"	16						
			523						
			× 4						
			2,092	+39'-8"	-0'-4"	82,990.			690
			Creosoted Hard wood pavement along about Rails (檜材) 4 Req'd						
1	9×2½"×22'-5"	6.3	141						
1	" ×22'-6"	"	142						
1	" ×21'-5¾"	"	135						
1	" ×13'-5"	"	85						
1	" ×24'-9"	"	156						
1	" ×18'-0"		113						
1	" ×10'-2¾"		64						
			836						
			4						
			3,344	+39'-10⅜"	-0'-¼"	133,255			334
			Coping (檜材) Creosoted (40#/cub.ft.) 2 req'd						
1	13×3×7'-6"	10.8	81						
2	" ×15'-0"	"	324						
2	" ×16'-0"	"	346						
			751						
			2						
			1,502	+38'-8½"	+0'-2"	58,142		255	
			Creosoted Wooden plank (檜材) 2 Req'd						
1	11⅜×3½×11'-6¼"	10.8	124						
1	" ×20'-6¼"	"	222						
5	" × 15'-9"	"	851						
1	" × 8'-4"	"	90						
1	" ×15'-1"	"	163						
2	7¼×3½×11'-6¼"	7.0	161						
2	" ×20'-6¼"	"	287						
10	" ×15'-9"		1,103						
2	" × 8'-4"		117						
2	" × 15'-1"		211						
2	12×3½×11'-6¼"	11.6	267						
1	" ×20'-6¼"	"	238						
8	" ×15'-9"		1,461						
2	" × 8'-4"		193						

CALCULATIONS FOR

First Canal Bridge for Kobe 60' single leaf trunnion bascule.

NO	Material	Unit Wt.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
1	12 × 3½ × 15'-1"	11.6	175						
1	10¾ × 3½ × 20'-6¼	10.4	213	+39'-7⅞"	-0'-5¼	711,288			7,758
2	" × 15'-9"	"	328						
1	" × 15'-1"	"	157						
2	8⅜ × 3½ × 15'-11"	8.1	258						
57	12 × 3½ × "	11.6	10,526						
4	7½ × 3½ × "	7.3	421						
1	9¼ × 3½ × "	8.9	142						
6	10 × 3½ × 2'-7½	9.6	151						
2	5¾ × 3 × 15'-0"	4.8	144						
2	" × 15'-6"	"	149						
1	" × 7'-7"		36						
1	6¾ × 2½ × 1'-5½	4.7	7						
1	" × 4'-1¼	"	19						
9	" × 3'-10"	"	162						
1	" × 3'-10½	"	18						
1	" × 3'-11½	"	19						
1	" × 4'-0½	"	19						
2	" × 3'-10¼"	"	36						
1	" × 1'-3¼	"	6	+38'-10¼"	-0'-3"	38,967			251
1	" × 2'-3½	"	11						
1	" × 2'-2"	"	10						
1	" × 2'-8½	"	13						
1	6¼ × 3 × 1'-5½"	5.2	8						
1	" × 4'-1¼"	"	21						
9	" × 3'-10"		179						
1	" × 3'-10½		20						
1	" × 3'-11½		21						
1	" × 4'-0½		21						
2	" × 3'-10¼		40						
1	" × 1'-3¼		7						
1	" × 2'-3½		12						
1	" × 2'-2"		11						
1	" × 2'-8½"		14						
			18,862			750,255			8,009
			× 2						
			37,724			1500510			16018

Creosoted Sleeper (栗材)

NO	Material	Unit Wt.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
2	14" × 7" × 8'-8½"	36.0	626	+72'-9¾	-0'-10½"	45,579			551
1	11" × 6⅜ × 8'-6"	25.8	219	+10'-8"	-0'-10¼"	2,337			186
2	8 × 7⅝ × 8'-3"	22.7	374	+9'-10½	-0'-10⅜	3,695			340
2	" × 8'-8½	"	395	+7'-8"	"	3,030			359
2	11¾ × 6⅜ × 1'-9"	27.5	96						
2	" × 2'-6"	"	138	+6'-10½"	-0'-10¼"	2,759			341
2	" × 3'-0½"		167						
			2,015			57,400			1,777

Nailing strips (檜材) Creosoted

NO	Material	Unit Wt.	Total Wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
21	9" × 2" × 4'-10"	5.1	517						
6	7½" × 2" × "	4.3	125						
42	9" × 2" × 4'-4"	5.1	927						
12	7½" × 2" × "	4.3	223	+41'-7½"	-0'-7"	89,713			1,250
42	9" × 2" × 1'-1½"	5.1	242						
12	7½" × 2 × 1'-1½"	4.3	58						
1	11 × 6 × 3'-5	18.4	63						

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CALCULATIONS FOR

First Canal Bridge for city of kobe 60' single leaf trunnion bascule.

No.	Material.	Unit wt.	Total wt	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
2	8"×8×17'-1¾	18.0	617						
4	" ×15'-9"	"	1,134	+42'-3¾"	-0'-10"	94,478			1,853
2	" ×13'-4½"	"	482						
2	8×7⅝×16'-4¾"	17.2	564						
4	" ×14'-3"	"	980	+42'-3¾	-0'-10¼"	83,689			1,681
2	" ×12'-7½"	"	434						
2	8×7⅛×16'-4¾	15.8	518						
4	" ×14'-3"	"	901	+ "	-0'-10½"	76,920			1,600
2	" ×12'-7½"	"	399						
2	8×6½×16'-4¾	14.5	476						
4	" ×14'-3"	"	827	+ "	-0'-10¾"	70,615			1,502
2	" ×12'-7½	"	366						
2	8×6×16'-4¾	13.4	440						
4	" ×14'-3"	"	764	+ "	-0'-11"	65,242			1,419
2	" ×12'-7½"		338						
2	8"×5½"×16'-4¾"	12.3	403						
4	" ×14'-3"	"	701	+ "	-0'-11¼"	59,953			1,332
2	" ×12'-7½	"	313						
2	8×7⅝×4'-10"	17.2	166		-0'-9⅝"				133
2	8×7¼ ×4'-10"	16.1	156		-0'-10"				129
2	8×6⅞× "	15.3	148	+9'-0"	-0'-10⅜"	7,587			127
2	8×6¼× "	13.9	134		-0'-10⅝"				119
2	8×5¾"×4'-10"	12.9	125		-0'-10⅞				114
2	8×5¼× "	11.8	114		-0'-11⅛"				106
2	12"×5"×4'-10½	16.8	164	+9'-0"	-0'-11¼"	1,476			154
6	18×5⅜×15'-11"	27.0	2,579	+40'-6"	-0'-6¾"	104,450			1,444
2	12"×5"×1'-11"	16.8	65	+72'-3	-0'-11½	4,696			62
2	5×4×3'-9"	5.5	41						
10	" ×3'-10"	"	193						
8	" ×3'-1½"	"	138						
2	" ×3'-10½"	"	43	+42'-3¾"	-0'-11½"	26,528			602
2	" ×3'-3"		36						
2	" ×3'-4"		77						
4	" ×3'-10¼"		85						
2	" ×1'-3¾"		14						
			17,090			685,347			13,627
			Side walk Creosoted pavement plank (檜材) 2 Req'd						
1	9×1¾×14'-11"	4.5	67	+50'-1¾	+0'-4"	10,247		66	
2	" ×14'-10½	"	134						
1	12×1¼×10'-0"	4.0	40						
3	" ×9'-8½	"	117						
3	" ×4'-5½"	"	54						
3	" ×14'-0"	"	168	+50'-11¾"	+0'-2¾	63,672		287	
7	" ×15'-9"	"	441						
4	" ×15'-11⅜"	"	256						
3	" ×10'-2⅞"	"	123						
4	" ×3'-0"	"	48						
			1,448			73,919		353	
			×2						
			2,896			147,838		706	

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

SIDEWALK NAILLING STRIPS (檜 材) Creosoted. 2 Reqd.

No	Material	Unit wt	Total wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
1	3"×2⅝"×7'-0"	1.8	13	+73'-1"	+0'-1⅛"	950		1	
27	4"×3"×〃	3.3	624	+50'-6⅞"	±0	31,556		0	
			637			32,506		1	
			×2						
			1,274			65,012		2	

RAILS, RAIL BRACKETS, FILLER, CONNECTION BOLTS. 4 Reqd.

Mark	No	Material	Unit wt	Total wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
	1	93# Rail × 67'-1"	@31.00#	2,079	+40'-4½"	-0'-3"	83,950			520
⑤	16 16	Brackets 9"×½"×0'-10½" ∠s 2½"×2½"×⅜"×0'-4¾"	13.46	215						
①	16	Washers 2"φ × ½"	0.334 ~~1.01~~	5						
②	16	Bolts ⅞"φ × 0'-2½"	1.01	16						
⑥	32	〃 ¾"φ × 0'-3¾"	0.85	27						
⑧	16	〃 〃 × 0'-3"	0.75	12						
⑦	80	Washers 1⅞"×⅝"×0'-2"	0.40	32	+41'-7½"	-0'-6½"	21,981			285
㉘	16	Bolts ¾"φ × 0'-3⅝"	0.84	13						
③	15	Shim pls 4½"×½"×0'-7¾"	4.97	75						
④	1	〃 〃 × 0'-7¾"	4.97	~~14~~ 5						
⑥	22	Bolts ¾"φ × 0'-3¾"	0.85	19						
⑦	44	Washers 1⅞"×⅝"×0'-2"	0.40	18						
⑨	11	Shim pls 4½"×½"×0'-5"	3.21	35						
⑩	34	Bolts ⅞"φ × 0'-5¼"	1.47	50						
㊳	4	Gas Pipes 1"φ × 0'-5"	0.75	3						
㊴	4	Lag screws ¾"φ × 〃	0.70	3						
				2,607			105,931			805
				×4						
				10,428			423,724			3,220

BOLTS.

Mark	No	Material	Unit wt	Total wt.
㊵	30	Bolts ¾"φ × 0'-7¾"	@1.34#	40
⑬	513	〃 〃 × 0'-3¼"	0.78	400
⑦	〃	Washers 1⅞"×⅝"× 0'-2"	0.40	205
㊶	72	Bolts ⅞"φ × 0'-8½"	2.02	145
㉔	118	〃 ¾"φ × 0'-8¾"	1.46	172
㉓	〃	〃 〃 × 0'-8½"	1.43	169
㉒	〃	〃 〃 × 0'-8¼"	1.40	165
㉑	〃	〃 〃 × 0'-7½"	1.31	155
⑳	〃	〃 〃 × 0'-7"	1.25	148
⑲	〃	〃 〃 × 0'-6¾"	1.22	144
⑱	122	〃 〃 × 0'-5½"	1.06	129
⑦	580	Washers 1⅞"×⅝"× 0'-2"	0.40	232
㊷	8	Bolts ⅞"φ × 0'-9"	2.10	17
㊸	8	〃 〃 × 0'-8½"	2.02	16
㊹	8	〃 〃 × 0'-8¼"	2.06	16
㊺	8	〃 〃 × 0'-7½"	1.85	15
㊻	8	〃 〃 × 0'-7"	1.77	14
㊼	8	〃 〃 × 0'-6¾"	1.73	14
㊽	12	〃 〃 × 0'-6¼"	1.64	20
⑫	708	〃 ½"φ × 0'-5¾"	0.45	319
⑭	224	〃 ⅜"φ × 0'-4¼"	0.20	45
⑮	48	Lag screws ¾"φ× 0'-3"	0.11	53

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

(Mark)	No	Material	Unit wt.	Total wt	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
⑪	424	Bolts, ¾"φ × 0'-8¼"	@ 1.30	551						
㊾	64	Lag screws 〃 × 0'-11"	1.38	88						
⑯	96	〃 ⅜"φ × 0'-4	0.346	33						
⑰	144	Bolts ⅞"φ × 0'-7¼"	1.81	261						
㉕	112	〃 ½"φ × 0'-4¾"	0.39	44						
㉖	56	〃 〃 × 0'-4¼	0.37	21						
⑦	168	Washers, 1⅞" × ⅝" × 0'-2	0.40	67						
				3,698	+39'-10⅛"	-0'-8"	147,328			2,478
		NAILS. (Drive way)								
	3,400	× 0'-6"	@ .05	170						
	290	× 0'-5½"	.042	12						
	34,320	× 0'-4½"	.025	858						
				1,040	+39'-10⅛"	-0'-4½	41,434			395
		NAILS. (Side walk)								
	1030	× 0'-3½"	@ .017	18						
	180	× 0'-5"	.033	6						
				24	+50'-11¾"	+0'-2"	1,223		4	
		CURB ANGLES.								
	6 ∠s 3"×3"×⅜"	× 17'-2"	@ 7.2	742						
	2 〃 〃	× 17'-1½"	〃	247						
				989	+38'-8¾	+0'-2⅝"	38304		178	
		GAGE ANGLS.								
	17 ∠ 1½"×1½"×⅛"	× 3'-4½"	1.23	71						
	34 〃 〃	× 2'-8"	〃	112						
	34 〃 〃	× 15'-6½"	〃	650						
				833	+41'-8"	-0'-4"	34,771			275
		COCRETE SLAB OF SIDE WALK 2 Req'd								
	73 c.f		150#/c.f	10,950.	+11'-11½"	+0'-1½"	130,962		1424.	
	2.6		〃	390	〃	+0'-3¾"	4,664		121	
	6.8		140#	952	-7'-7"	+0'-1¾		7216	143	
				12,292			135,625	7,216	1,668	
				× 2			×		2	
				24,584			271,252.	14,432	3,376	
		HANDRAILS. 2 Req'd								
	11.	2"φ Gas Pipes × 5'-2½"	@ 19	209		}+3'-1"			718.	
	1	〃 〃 × 6'-8½"	24	24						
	22	1¼"φ 〃 × 5'-2½"	12	264		}+1'-7¼"			470	
	2	〃 〃 × 6'-8½"	15	30						
	13	Cast Iron Posts	60	780		+1'-1"			842	
	1	〃 〃	20	20		+1'-11"			38	
	12	〃 Panels	82	984		}+1'-7½			1,638	
	1	〃 〃	21	21						
				2,332	+41'-3"		96,195		3,7,06	
				× 2			×		2	
				4,664			192,390		7,412	

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

No	Material	Unit wt	Total wt	±X From Trunnion	±Y From Floor	+X Moment	-x Moment	+Y Moment	-Y Moment
	CAST IRON DRAIN								
8.	Drain for driv way	@ 70	560	+40'-6 1/2"	-0'-5 1/2"	27,243			258
8	〃 〃 sid walk	@ 14	112		+0'-1 3/4"			17	
			672			27,243		17	258
	SAND AND WATER								
	Drive way 3,169 S.F	3#/sq.ft	9,507	+39'-10 1/8"	-0'-1"	378,759			761
	Side walk 719	〃	2,157	+50'-11 7/8"	+0'-3 1/4"	110,007		582	
			11,664			488,766		582	761

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SEIYU BLDG, TOKIO

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

No.	Material.	Length	Wt per ft.	Total wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment.
				STEEL SLEEPERS						
1	I 6"×4 1/2	17'-5"	20.00#	348	+70'-10 1/2"	-0'-11"	24,666			320.
26	Is "	"	"	9058	+40'-6"	-0'-11"	366,849			8,333
4	pls 4 1/2×1/2	0'-5 1/2	7.65	14	+68-7 1/2	-0'-7 3/4	961			9
40	" "	"	"	141	+40'-6	"	5,711			92
48	c.i. crips 3"×3/4	0'-4	2.34	112	"	-1-1/2"	4536			127
48	bolt heads 3/4"φ		0.5	24	"	-1'-0"	972			24
16	rivet heads 3/4"φ		@ 0.1425	2	+70'-10 1/2	-1'-2"	142			2
416	" " "		@ "	59	+40'-6"	-1'-2"	2,390			69
88	" " "		@ "	13	"	-0'-8"	527			9
				9,771			406,754			8,985
				EXPANSION JOINT EJ3						
2	Ls 3×3×5/16	17'-2 3/4	6.10	210	+73'-3 3/8	-0'-3"	15,397.			53
2	" "	4'-2	"	51	"	-0'-1 3/8	3,739			6
1	L "	4'-10 1/2	"	30	"	"	2,200			3
2	Ls "	24'-8 5/8	"	302	"	-1'-1/8	22,143			33
2	Web pls 13×5/16	"	13.81 -76	607	+73'-4 7/8	-0'-8 1/4	44,560			419
1	pl. 13×5/16	1'-5 1/2	"	20	+73'-5 1/4	-0'-7 1/4	1,469			12
1	" 3"×5/16	1'-8 1/2	3.19	5	+73-3 1/4	-1'-2 1/8	366			6
2	ch. pls 10×1/2	17'-2 1/4	17.00	584	+73-5 1/2	-0'-1 1/4	42,901			88
2	" "	4'-2"	"	142	"	-0'-0 1/4	10,431			3
1	" "	4'-10 1/2	"	83	"	"	6,097			2
685	Rivet heads 3/4"φ		@ 0.1425	98	+73'-4 1/2	-0'-9"	7,191			74
14	Bolt heads 3/4"φ		@ 0.5	7	+73'-3"	-1'-2"	513			8
				2,139			157,007			707
				EXPANSION JOINT EJ5 R/L 2 req'd.						
2	Ls 3 1/2×3 1/2×3/8	6'-9 5/8	8.5	116	+73'-3"	+0'-1"	8,497		9	
1	chpl. 8×1/2	6'-3 3/8	13.6	85	+73'-7 1/2	+0'-3 1/4	6,259		23	
2	Fills 3 1/2×3/4	0'-5	8.93	8	+73'-1	-0'-1 1/2	585			1
50	Rivet heads 3/4"φ		@ 0.1425	7	+73'-3 1/2	-0'-2"	513			1
				216			15,854		32	2
				× 2						
				432			31,708		64	4
				SIDE WALK FLOOR BREAK with DOWN SPOUT FSW2 R/L 2 req'd						
1	L 3 1/2×3 1/2×3/8	6'-10 1/4	8.5	58	-4'-6 1/4	+0'-0 1/4		262	1	
1	L 6×3 1/2×3/8	6'-4 1/4	11.7	74	-4'-9 1/4	+0'-2"		353	13	
1	pl. 3×1/2	"	5.1	32	-4'-8 3/4	+0'-3 1/4		151	9	
2	Ls 5×3×3/8	0'-3"	9.8	5	-4'-11 3/4	+0'-0 3/4		25	0	
1	pl. 4×3/8	0'-8 1/2	5.1	4	-5'-0"	-0'-1 1/4		20		1
1	" 18 1/2×1/8	6'-4 3/4	7.86 -1	49	-5'-0 1/2	-0'-8 3/4		247		36
2	pls 6"×1/8	1'-5"	2.55	7	"	"		35		5
8	bars 1/2"×1/4	1'-11"	0.43	7	"	"		35		5
2	" 3/4×3/8	1'-3 1/2"	0.96	2	"	"		10		1
1	rod 3/4"φ	6'-4 1/2	@ 1.50	10	"	-0'-3 3/4		50		3
2	bolts 1/2"φ	1'-9"	@ 1.30	3	"	-1'-0"		15		3
4	c.i. wt 5×5×3		@19.50	78	"	-1'-6 3/4		393		122
				329				1,596	23	176
				× 2						
				658				3,192	46	352

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CALCULATIONS FOR

First Canal Bridge for City of kobe 60' Single leaf trunnion bascule.

No	Material	Length	Wt per ft.	Total wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment.
				DOWN SPOUT For SIDE WALK 2 req'd.						
1	Pl 18½ × ⅛	× 5'-1½"	7.86	40	-4'-8"	-1'-3¾"				
1	" 8 × ⅛	× 5'-11"	3.40	20						
1	" 8 × ⅛	× 0'-4½	"	1						
1	" 26 × "	× 1'-3¾	11.05	14						
1	" 3 × ¼	× 4'-6"	2.55	11						
				86						
				× 2						
				172				803		225

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

C-23364 （石川島造船所設計 機械装置）

Mark	Description	NO	Weight	±X From Trunnion	±Y From Floor	Moment: +X	Moment: −X	Moment: +Y	Moment: −Y
			#	ft.	ft.	ft-lbs.			ft-lbs.
1	カップリング	1	5.0	11.125	− 2.50	56			13
2	〃	1	9.5	11.250	〃	107			24
3	$\frac{9}{16}$" リーマー ボールト	4	.4	11.19	〃	4			1
5	モーター直結軸及ピニオン	1	4.6	11.58	〃	53			12
6	歯車	1	20.0	11.90	− 1.89	238			38
8	ウオーム	1	39.9	12.71	〃	507			75
9	ウオーム ホヰール	1	214.3	12.88	− 2.95	2,760			632
10	ウォーム ホヰールセンター	1							
11	$\frac{9}{16}$ リーマー ボールト	6							
12	ウォームギヤーケーシング	2	295.9	12.75	− 2.615	3,773			774
13	$\frac{9}{16}$" リーマー ボールト	4							
14	$\frac{5}{8}$" ボールト	7							
15	ブッシュ	2	9.6	12.88	− 2.95	124			28
16	〃	2	.8	13.50	− 1.89	11			2
17	〃	2	.6	12.25	〃	7			1
18	グリースカップ	4	3.6	12.88	− 2.00	46			7
19	ボールベアリング	2	4.5	〃	− 1.89	58			9
20	〃	2	1.1	11.67	− 2.50	13			3
21	$\frac{13}{16}$" リーマー ボールト	8	8.0	12.88	− 3.24	103			26
22	視孔蓋	1	1.0	〃	− 3.05	13			3
23	クランクシャフト	1	554	〃	− 2.95	714			163
24	クランクピン	1							
25	$\frac{1}{2}$" ナット	1							
26	キー	1							
27	〃	1							
28	モーター台	1	18.6	11.48	− 3.94	214			72
29	$\frac{1}{2}$" ボールト	4							
30	ハンドル	1	8.5	8.50	− 2.50	72			21
31	ガスカン	1							
32	レバー Wind lock	2	121.0	66.88	− 2.98	8,092			361
〃	〃	2	121.0	−10.58	− 2.08		1,280		252
33	ピン	4	6.1	12.17	− 2.04	74			18
〃	〃	4	6.1	−10.83	− 2.21		66		13
〃	〃	4	6.1	15.50	− 1.92	95			12
34	レバー	2	118.0	〃	〃	1,829			227
35	〃	2	42.0	24.40	− 1.90	102			80
36	ピン	2							
37	レバー	1	63.1	15.33	− 2.13	967			134
38	ピン	1							
39	ピン	2	61.3	24.30	− 1.57	1,490			96
40	ピン受	2							
41	$\frac{1}{4}$" ナット	2							
42	$\frac{13}{16}$" リーマー ボールト	4							
43	軸受	2	58.3	15.50	− 1.92	904			112
44	ブッシュ	2							
45	$\frac{3}{8}$" ボールト	6							
46	軸受	2	349.0	15.50	− 1.92	5,410			670
47	ブッシュ	2							
48	$\frac{15}{16}$" リーマー ボールト	16							
49	ピン	2	378.3	66.71	− 2.81	25,236			1,063
50	ピン受 (L=$12\frac{1}{2}$")	2							
51	2" ナット	2							
52	$\frac{15}{16}$ リーマー ボールト	16							

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60′ Single leaf trunnion bascule.

Mark	Description	NO	Weight	±X	±Y	+X	-X	+Y	-Y
52	15/16″ リーマーボールト(L=1 3/4″)	16	359.9	10.42	-1.92	3,750			691
53	軸受	2	137.1	15.50	-2.00	2,125			274
54	キャップ	2							
55	ブッシュ	4							
56	ボールト	4							
57	1/16 リーマーボールト	4							
58	ノック	2							
59	カップリング	2	346.6	15.50	-1.92	5,372			665
60	〃	2							
61	7/8 ボールト	12							
62	フォーク エンド	2	29.5	24.10	-2.10	711			62
63	1 3/4 ナット	2							
64	ターンバックル	2	71.4	63.96	-2.19	4,567			156
65	1 3/4″ ナット	4							
〃	〃 〃	〃	〃	47.75	〃	3,409			156
〃	〃 〃	〃	〃	27.58	〃	1,969			156
〃	〃 〃	〃	〃	18.92	-1.63	1,351			116
〃	〃 〃	〃	〃	12.08	-2.49	563			178
〃	〃 〃	〃	〃	2.21	〃	158			178
〃	〃 〃	〃	〃	-7.67	〃		548		178
66	ロッド	1	25.1	13.79	-2.78	346			70
67	〃	2	74.0	69.52	-3.10	5,144			229
〃	〃	2	74.0	-13.06	-2.21		966		164
68	〃	2	52.9	65.50	-2.19	3,465			116
〃	〃	2	〃	26.04	〃	1,378			116
〃	〃	2	〃	17.38	-1.46	919			77
〃	〃	2	〃	13.63	-2.49	721			132
〃	〃	2	〃	-9.21	〃		487		132
69	〃	2	89.4	21.73	-1.90	1,943			170
70	〃	2	160.0	7.15	-2.49	1,144			398
〃	〃	2	〃	-2.73	〃		437		398
71	〃	2	261.0	55.85	-2.19	14,577			572
72	〃	2	327.0	37.67	〃	12,318			716
73	ガイドローラー	4	78.2	60.67	-2.19	4,744			171
74	ピン	4							
75	全上取付用プレート	2							
76	〃	2							
77	5/8″ ボールト	8							
78	3/4″ ボールト	8							
〃	〃	〃	〃	52.70	〃	4,121			171
〃	〃	〃	〃	44.89	〃	3,510			171

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60′ Single leaf trunnion bascule

Mark	Description	No	Weight	±X	±Y	+X	−X	+Y	−Y
78	寻゛ボールト	8	78.2	37.09	〃	2,900			171
〃	〃	〃	〃	29.28	〃	2.290			171
〃	〃	〃	78.0	5.66	- 2.49	441			194
〃	〃	〃	〃	-3.16	〃		246		194
79	シャフト	2							
80	〃	1							
81	キー BSK-5	2	1995.5	15.50	- 1.92	30,930			3,831
82	〃 -6	4							
83	〃 -6	1							
	モーター	1	143.0	10.48	- 2.52	1,499			360
C- 23384									
	モーター用軸	1	5.84	9.25	- 2.50	54			15
C- 23349									
1	サイドクリップ	2							
2	〃	2	16.5	11.31	- 2.70	1,354			45
16,17,18	ピン	4							
21	ボールト	6							
24	ブレーキシュー	2	4.9	重量合計 119.6	- 2.50				12
3	テンションバー	2							
14	クロッスベッド	1	6.5		- 2.00				13
15	〃	1							
4	コンプレッションロッド	1	.75		- 2.04				2
5	テンションロッド	1	.9		- 2.37				2
6	アヂャスチングロッド	1							
10	スプリング	1	4.43		- 2.75				12
11	スプリング受	2							
16	ピン	1							
7	レバー	2							
20	ピン	2	8.65		- 2.96				25
22	ボールト	2							
26	ピン	1							
8	リンク	1	2.35		- 3.04				7
19	ピン	1							
9	錘	1	20.30		- 2.88				58
12	ロッドガイド	2	2.85		- 2.50				7
23	ボールト	3							
13	マグネット取付板	1							
27	ボールト	4							
28	〃	4	16.10		- 2.58				42
29	〃	4							
	マグネット	1	35.30		- 2.42				85

Locking & magnetic brake

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SEIYU BLDG, TOKIO

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

Mark	Description	No	Weight	±X	±Y	+X	−X	+Y	−Y
	C-23394								
1	[7×3½×.4"×5'2"	1	104.6	13.92	-3.53	1,456.			369.
〃	〃 〃	1	104.6	9.94	- 〃	1,040			369
2	〃 5'1½"	2	207.6	15.60	-1.96	3,239			407
3	〃 4'9"	2	192.4	12.06	-3.53	2,320			681
4	〃 4'1¾"	2	168.0	11.93	〃	2,004			595
5	[5"×2½×5/16×4'4"	1	47.6	11.25	-1.90	536			90
6	L3½×3½×3/8×23½"	2	28.2	15.60	-2.32	440			65
7	〃 21"	2	25.2	20.88	-1.29	526			33
8	〃 12"	2	14.4	〃	-2.05	311			30
9	〃 10½"	4	25.2	15.50	-2.10	391			53
10	〃 7"	4	16.8	〃	-1.96	260			33
〃	〃 〃	4	16.8	11.93	-3.53	200			59
11	〃 5"	4	12.0	〃	〃	143			42
12	pl ½"	2	51.6	14.21	-3.84	733			198
13	pl 3/8"	1	57.7	20.88	-1.20	1,205			69
14	〃	2	78.0	〃	-1.71	1,629			133
15	〃	1	22.1	10.48	-3.22	232			71
16	〃	2	21.0	14.38	-3.80	302			80.
17	〃	2	9.0	14.58	-3.49	131			31
18	FB 3/8"×3½"	1	12.2	10.04	-2.00	122			24
19	〃	2	2.3	14.67	-3.29	34			8
20	座金	6	15.0	9.80	-3.57	147			54
21	3/4" 皿頭ボールト	4	1.9	11.27	-3.24	214			62
22	3/4" ボールト	6	5.1	9.79	-3.57	50			18
23	〃	2	1.6	14.67	-3.61	23			6
24	〃	2	1.5	〃	-3.37	22			5
〃	〃	20	14.7	14.25	-3.80	209			56
25	〃	2	1.4	11.27	-3.24	16			5
〃	〃	8	5.6	15.50	-1.96	87			11
〃	〃	8	5.6	20.88	-2.05	117			11
26	〃	2	1.4	9.00	-2.00	13			3
〃	〃	4	2.8	14.42	-3.49	40			10
	C-23388								
1	目盛板	1	.61	8.44	-2.96	5			2
2	針	1	18.50	21.59	-2.50	399			46
3	レバー	1							
4	アーム	1	6.22	15.37	-2.04	96			13
5	アーム止板	1							
8	ピン	1							
13	ボールト	2							
6	アングル	1	2.17	8.92	-2.81	19			6
7,9,10, 11,12.	其他								
	C-23371								
1	前部ロックピン受	2	1,792.8	72.52	-2.73	130,014			4,894.
7	5/8"×7½" ボールト	16							
8	〃×7" 〃	18							
11	〃×4½" 〃	10							

side locking frame

JIUN MASUDA
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SEIYU BLDG, TOKIO

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60′ Single leaf trunnion bascule.

Mark	Description	No	Weight	±X	±Y	+X	-X	+Y	-Y
13	3/8"×4" ボールト	4							
14	〃 ×3 5/8	22							
2	後部ロックピン受	2	1348.40	-16.13	- 2.00		21,750		2,697
12	3/8"×4 1/4" ボールト	86							
C - 23376									
1	前部ロックピン	2	243.10	72.52	- 2.81	17,634			683
3	ピン	2							
2	後部ロックピン	2	161.10	-16.19	- 1.92		2,608		309
3	ピン	2							
C - 23368									
1	シリンダー	2	920.0	72.77	-2.19	66,948			2,015
4	シュー	2	50.0	72.71	-4.15	3,635			407
5	ガイド	4	34.8	〃	- 2.04	2,530			71
6	仝上-アーム	2	35.2	〃	- 2.33	2,559			82
7	〃 ピース	2	8.4	〃	- 1.44	610			12
8	ピストンロッド	2	168.0	〃	- 2.98	12,215			501
9	ピストン	2	210.9	〃	- 1.76	15,334			371
10	仝上リング	6							
11	ガイドプーリー	2	32.5	71.13	- 1.50	2,311			49
12	〃	2	10.0	72.56	- 3.39	726			34
〃	〃	2	10.0	71.57	- 3.54	716			35
〃	〃	2	10.0	71.42	- 3.39	714			34
13	ピストンロッドガイド	2	108.2	72.71	- 3.18	7,967			345
14	ブッシュ	2							
15	プーリーブラケット	2	64.4	71.75	- 1.56	4,621			100
16	〃	2	49.4	71.77	- 3.56	3,545			176
17	〃	2	33.8	72.27	- 3.44	2,443			116
18	〃	2	31.0	71.79	-3.50	2,225			109
19	1" 頭付ピン	2	1.9	71.13	- 1.50	135			3
20	3/4 〃	2	1.0	72.56	- 3.39	73			3
〃	〃 〃	2	1.0	71.57	- 3.54	72			4
〃	〃 〃	2	1.0	71.42	- 3.39	71			3
21	1/4" ボールト	2	9.1	72.71	- 3.86	662			35
22	1" 〃	8	24.8	73.13	- 2.81	1,814			70
23	1" 〃	8	22.0	73.13	- 1.48	1,609			33
24	1" 〃	8	17.4	72.05	- 2.15	1,254			38
26	5/8" 〃	8	6.2	72.00	- 3.48	446			22
27	〃 〃	8	4.4	71.98	- 1.67	317			7
〃	〃 〃	8	4.4	〃	- 3.27	317			14
29	1/2 タップボールト	12	2.8	72.71	- 2.04	204			6
30	ウェイト	8	160.0	70.77	- 1.21	11,323			194
31	3/4 アイボールト	2	3.3	〃	〃	234			4
	1/6" 亜鉛鍍ワイヤロープ	1	3.0	71.63	- 2.33	215			7
C- 23367									
1	シリンダー	2	977.0	-14.00	- 2.93		13,678		2,863
7	ピストン	2	210.9	-14.05	- 3.50		2,963		738
8	仝上リング	6							

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CALCULATIONS FOR

First Canal Bridge for City of kobe 60' Single leaf trunnion bascule.

Mark	Description	No	Weight	±X	±Y	+X	−X	+Y	−Y
9	全上ロッド	2	58.8	-14.10	-4.16		829		245
10	〃 ガイド	2	108.2	-14.06	-3.78		1,521		409
11	ブッシュ	2							
12	1" ボールト	16	44.8	-14.00	-2.58		627		115
13	〃 〃	12	29.5	〃	-3.44		413		101
14	3/4 〃	8	6.7	-14.07	-3.79		94		25
C-23390									
	ニードルバルブ	4	63.5	73.04	- 1.44	464			9
	〃	4	〃	-14.00	- 2.36		89		15
√ C-23346									
1	ラック	2	2,320.0	-13.82	+ 7.41		32,062.	17,191.	
2	リーマーボールト	32							
〃	〃	〃	〃	-17.04	+ 1.75		39,533	4060	
〃	〃	〃	〃	-18.04	-4.70		41,853		10,904
〃	〃	〃	〃	-16.67	-11.05		38,674		25,636
C-23385									
1	ベルクランク	1	13.20	-10.58	- 3.34	140.			44
3	プレート	1							
13	ピン	1							
25	ローラー	1							
2	ベルクランク	1	13.20	-11.52	- 3.59		152		47
2.13.25	プレート, ピンローラー	1							
4	レバー	1	10.30	10.77	-3.68	111			38
27	重錘	1	67.80	10.52	-4.60	714			312
23	5/8 x 6¼ ボールト	1							
9.11.12	ターンバックル, フォークエンド, ピン		46.90	- 0.27	- 2.41		13		113
5. 6.	ロッド	1							
18	ブラケット	2	77.00	9.85	-3.34	758			257
22	5/8" x 2" ボールト	12							
26	軸受	2							
20	ブラケット	1	25.70	11.83	-3.85		302		99
16	ボールト	1							
22	5/8 x 2" ボールト	4							
8	シャフト (キー附)	1	6.7	10.85	-3.51	73			24
7	ロッド	2	5.10	10.24	- 2.41	52			12
10,14,15	ターンバックル、ピン								
	リミットスヰッチ	1	49.6	7.71	- 2.67	383			132

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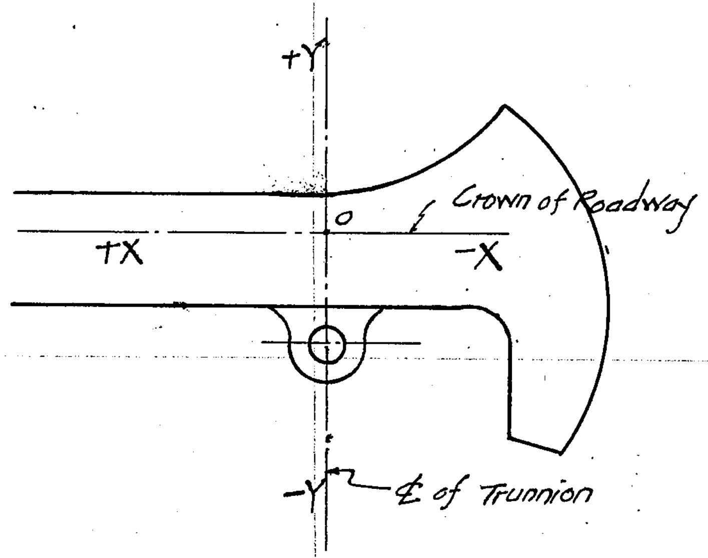
CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule.

Mark	Description	No	Weight	±X	±Y	+X	-X	+Y	-Y
	C- 23383								
1	アングル	2	59.10	8.82	-3.90	521.			231.
2	プレート	1	55.40	7.79	-3.80	431			210
3	ボールト座金		15.10	〃	-3.82	118			58
	C- 23387.								
1	シーブ(押板押ネヂ付	1	20.10	12.88	-2.95	259			59.
13	5/16 亜鉛鍍ワイヤロフプ	1							
2	1/4 角棒(押ネヂ付)	1	39.70	16.18	-2.50	643			99
3	ローラーガイド	1	3.50	19.83	-2.50	69			9
10	ボールト	2							
4	ローラー	1	0.70	19.86	-2.50	14			2
5	ボールト(座金付)	1							
	リミットスヰッチ	1	49.60	20.88	-2.17	1,035			108

TOTAL OF MACHINE PART

	Weight	±X From Trunnion	±Y From Floor	+X	-X	+Y	-Y
ロッキング装置	12497.14			336,685	28,388		29,065
バッファ 〃	3487.50			148,309	20,214		9420
リミットスヰッチ 装置	558.70			5,321	467		1,854
ラック	9200.00				152,112	21,251	36,540
合計	25743.34			490,315	201,181	21,251	76,879
可動機械部重量 重心及モーメント	25743.34 lbs	+ 11.23 ft.	- 2.16 ft.	+289,134 ft-lbs.		-55,628 ft-lbs.	



注意

Xハ Center of Trunnion ヨリ
Yハ Crown of Roadway ヨリ計ル

Trolley wire 及 Trolley pan ハ含マズ

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

	Description		Total wt.	+X Moment	-X Moment	+Y Moment	-Y Moment.
2	Main girders		183,904	3,187,474	569,480	166,532	307,518
1	Floor Beam	FB1	9,557	688,554			22,734
3	〃	FB2, FB3 & FB4	81,389	3,292,952			198,851
1	〃	FB5	34,611	289,028			53,925
2	Longitudinal girders	LG1^R_L	3,142	201,088			7,855
4	〃	LG2	6,816	276,048			17,040
2		LG3^R_L	3,160	53,341			7,900
6	Beams	RCB1	10,686	432,783			20,517
4	〃	RS1^R_L & RS2^R_L	3,528	228,332			6,774
8	〃	RS3 & RS4	6,824	276,372			13,102
4	〃	RS5^R_L & RS6^R_L	3,512	57,281			6,743
16	Struts	ST2	3,424	138,672			6,574
10	Stringers	SH1^R_L to SH5^R_L	7,013	449,744			12,553
20	〃	SH6^R_L to SH10^R_L	13,954	565,137			24,978
10	〃	SH11^R_L to SH15^R_L	7,044	118,903			12,609
32	Struts	ST1	1,344	54,432			1,882
2	Side walk brackets	CB1^R_L	1,240	89,282			2,448
4	〃 〃 〃	CB2^R_L	2,636	127,512			5,128
2	〃 〃 〃	CB3^R_L	1,362	33,706			2,708
4	〃 〃 〃	CB4^R_L & CB5^R_L	3,908	17,588			9,696
	Side wark stringers and bracings		11,194	377,418	131		7,406
	Bracing at bottom of Main girders under side walk	SBB1 to CBB8	6,012	44,694	3,888		19,880
	Lateral bracings		17,147	683,656			58,178
1	Trolly arch	TA1	4,379	96,382		81,257.	
1	〃 〃	TA2	4,379	318,441		81,257	
2	Trolly poles	TP2	4,390	318,986		41,424	
2	〃 〃	TP1	4,682	102,760		42,858	
		Summary ①	441,237	12,520,566	573,499	413,328	826,999
	Machine part (石川島造船所)		25,743	490,315.	201,181	21,251	76,879
4	Trunnion boss		7,069	9,402			34,779
2	〃 Shafts.		× 10,255	0			53,839
	Cast steel brackets of Main girders		1,220	786	830		4,344
	Centering castings	(CC1)	415	29,880			1,693
	Live load shoes		1,300	52,650			5,249
		Summary ②	46,002	583,033	202,011	21,251	176,783
		Summary ①	441,237	12,520,566	573,499	413,328	826,999
		Grand summary	△ 487,239	13,103,599	775,510	434,579	1,003,782

Weight and Moment of Floor.

Wooden block pavement	35,338	1407,866		6,714
Asphalt felt.	1,034	41,685	13	327
Rail web fillers.	2,092	82,990		690
Wood pavement along about Rails	3,344	133,255		334
Wood Coping	1,502	58,142	255	
Wood plank	37,724	1,500,510		16,018
Wood sleepers	2,015	57,400		1,777
Nailing strips	17,090	685,347		13,627
Side walk plank	2,896	147,838	706	
Side walk Nailing strips	1,274	65,012	2	
Rails, Rail brackets, fillers, bolts etc.	10,428	423,724		3,220

CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' single leaf trunnion bascule

Bolts		3.698 ✓	147.328 ✓			2,478 ✓
Nails		1,064 ✓	42,657 ✓		4 ✓	395 ✓
Curb angles		989 ✓	38304 ✓		178 ✓	
Gage angles		833 ✓	34711 ✓			275 ✓
Side walk concrete slabs		24.584 ✓	271,252 ✓	14432 ✓	3.376 ✓	
Sand and water		11.664 ✓	488.766 ✓		582 ✓	761 ✓
Hand Rails		4664 ✓	192390 ✓		7412 ✓	
Cast iron drains		672 ✓	27,243 ✓		17 ✓	258 ✓
Steel sleepers		9.771 ✓	406,754 ✓			8.985 ✓
Expansion joint	EJ3	2.139 ✓	157.007 ✓			707 ✓
" "	EJ5	432 ✓	31,708 ✓		64 ✓	4 ✓
Side walk Floor breaks and down spouts		830 ✓	~~3995~~	3,995	46 ✓	577 ✓
		176,077 ✓	6441.889	18427	12,655 ✓	57,147 ✓

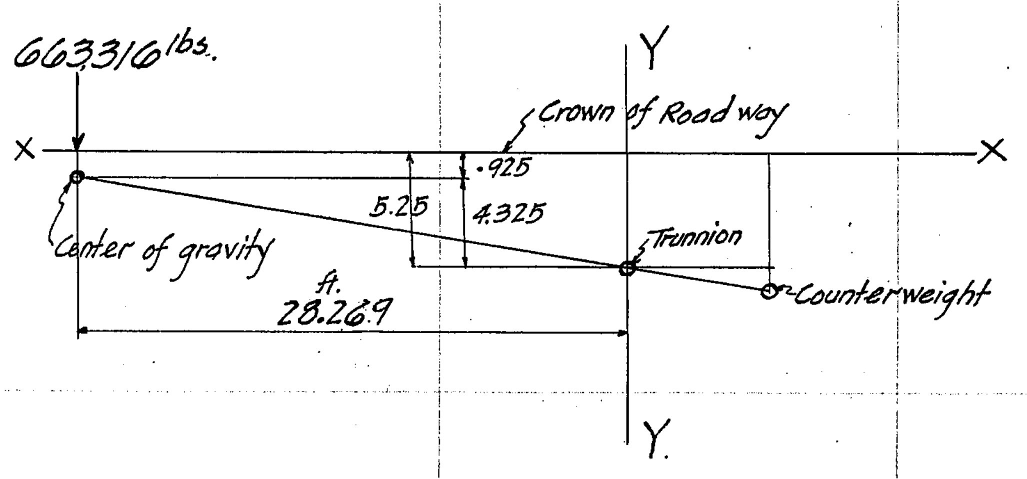
Summary

Structure	487.239 ✓	13,103,599 ✓	775510	434.579 ✓	1,003782 ✓
Floor	176.077 ✓	6441.889	18427	12.655 ✓	57.147 ✓
	663316 ✓	19,545488	793937	447.234 ✓	1,060,929 ✓

Total	Load	X Moment	Y Moment
	663316 ✓	+19,545488	-1060,929 ✓
		- 793937	447.234 ✓
	663316 ✓	+18,751,551	-613,695 ✓

Center of Gravity of Moving Leaf
Without Counter weight girder and bracings

1875,1551 ~~18,75~~ ÷ ✓ 663316 = 28.269 ft.
✓ 613,695 ÷ 663316 = .925



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CALCULATIONS FOR

First Canel Bridge for City of Kobe 60' Single leaf trunnion bascule.

NO	Material	Length.	Wt per ft.	Total wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment.	+Y Moment.	-Y Moment.
				COUNTER WEIGHT GIRDER CG1.						
4	∠s 6×6×¾	24'-9⅞"	28.70	2,850						
4	"	22'-6	"	2,583						
2	pls 92¼×½	24'-9⅞	156.80	7,784						
2	∠s 6×6×¾	7'-10½	28.70	452						
2	"	6'-2½	"	356						
4	"	7'-7¼"	"	873						
4	Fills 9×¾	5'-10¼	22.95	537						
20	∠s 5×4×½	7'-8	14.50	2,223						
20	Fills 4×¾	5'-10¼	10.20	1,194						
2	pls 19½×¾	4'-7¾	49.70	462						
2	" 13½×¾	3'-5½	34.40	238						
2	Fills 3⅜×¾	4'-7½	8.61	80						
2	∠s 5×3½×½	7'-6½	13.60	205						
2	pls 20½×¾	4'-9¼	52.30	499						
2	" 9×¾	3'-2½	22.95	147						
2	Fills 3½×¾	5'-6¾	8.93	99						
1	" 14½×¾	4'-7¾	37.00	172						
4	pls 16×¾	24'-9⅞	40.80	4,051						
4	Cover pls 14½×¾	"	37.00	3,674						
2	" " 13×¾	"	33.20	1,648						
2	" " 19¼×½	20'-8	32.73	1,353						
1	" pl 19¼×½	8'-3½	"	271						
7,413	Rivet heads ⅞φ		@ 0.2125	1,575.						
				33,326	-9'-6"	-7'-4¾"		-316,597		246,612
					CG2					
8	∠s 8×8×¾	22'-11⅞	38.90	7,154						
8	pls 12×¾	24'-9⅞	30.60	6,077						
4	" 9¾×¾	2'-3½	24.86	228						
4	∠s 8×8×¾	7'-7¼	38.90	1,183						
4	Fills 8×¾	6'-4½	20.40	520						
4	" 11×"	5'-8"	28.05	636						
20	∠s 6×4×½	7'-8	16.20	2.484						
20	Fills 4×¾	5'-8"	10.20	1.156						
2	pls 92¼×⅝	24'-9⅞	196.03	9,732						
4	∠s 8×8×¾	7'-8¼	38.90	1.196						
2	pls 19×¾	4'-1½	48.50	400						
4	" 9×¾	3'-1	22.95	283						
4	" 12×¾	3'-8	30.60	449						
2	Fills 3½×¾	5'-8	8.93	101						
2	" "	6'-3"	"	112						
2	∠s 6×3½×½	7'-5¾	15.30	229						
2	pls 18×¾	22'-11⅞	45.90	2.110						
2	" "	24'-9⅞	"	2.279						
2	Fills 7½×½	1'-2⅝	12.75	31						
2	" "	1'-10"	"	47						
2	Fills 18×¾	3'-8	45.90	337						
2	pls "	24'-9⅞	"	2279						
1	pl. "	3'-8	"	168						
2	Fills 7½×½	1'-3¼	12.75	32						
2	Fills 7½×½	0'-8	"	17						
8,800	Rivet heads ⅞φ		@ 0.2125	1,870						
				41,1.10	-16'-0"	7'-6⅝"		-657,760		310,381

CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

No.	Material	Length	Wt. per ft.	Total wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
					CG3					
4	∟s 6×6×¾	20'-9¼	28.70	2,384						
4	" "	17'-7	"	2,019						
4	pls 16×¾	20'-9¼	40.80	3,390						
4	∟s 6×6×¾	7'-8	28.70	880						
4	Fills 9×¾	5'-11"	22.95	543						
4	" 6×¾	7'-2½	15.30	441						
16	∟s 5×4×½	7'-8¾	14.50	1,792						
16	Fills 4×¾	5'-11"	10.20	966						
4	" "	7'-2½	"	294						
2	pls 93×½	20'-9¼	158.10	6,568						
2	∟s 6×6×¾	12'-2¾	28.70	702						
2	" "	6'-1⅜	"	351						
2	pls 16×¾	6'-4½	40.80	521						
2	" 10×¾	3'-7	25.50	183						
2	" 19×¾	5'-1½	48.50	498						
2	" 9×¾	3'-1"	22.95	141						
2	∟s 5×3½×½	7'-6½	13.60	205						
2	Fills 3½×¾	5'-11	8.93	106						
1	" 14½×¾	6'-4½	37.00	236						
2	pls 14½×¾	20'-9¼	"	1,537						
2	" 13×¾	"	33.20	1,379						
1	" "	6'-2	"	205						
4,760	Rivet heads ⅞ϕ		@ 0.2125	1,011						
				26,352	-18'-6"	-8'-5½		487,512		222,938
	COUNTER WEIGHT GIRDER TOP FLANG · FRAME									
2	Fills 11"×¾"	5'-1¼	28.05	286	-12'-9½	-3'-10⅝		3,658		1,113.
2	pls 9¾×"	3'-3¾	24.86	165	"	-4'-0⅛		2.110		662
2	Fills 3×¾	"	7.65	51	"	-3'-11⅜		652		201
2	pls 75×½	10'-11"	127.50 -786	1,999	-12'-9	-3'-10		25,487		7,656
2	" 40½×½	4'-7½	68.85 -78	559	-9'-8½	"		5,428		2,141
1	pl 40½×"	6'-3"	" -77	353	-9'-6	"		3,354		1,352
2	pls 21½×"	5'-1½	36.55 -28	347	-15'-0"	"		5,205		1,329
1	pl 32¾×"	8'-11"	55.68 -60	437	-15'-8	"		6,848		1,674
1	" 18×⅜	2'-0½	22.95	47	-16'-0"	-3'-9 13/16		752		180
1	" "	2'-0⅜	"	47	"	"		752		180
2	∟s 6×6×¾	7'-10"	28.70	449						
2	" "	7'-4"	"	421						
2	" "	7'-9⅝	"	448						
2	" "	7'-3⅝	"	419						
8	∟s 6×6×½	7'-9"	19.60	1,215	-12'-7⅜	-3'-10"		44,841		13619.
8	" 4×4×⅜	7'-8⅜	9.80	604						
1	∟ 6×3½×⅜	6'-1⅜	11.70	71	-18'-8¼	-3'-8¾		1,327		265
2	∟s 6×3½×⅜	17'-8¾	"	415	"	-3'-9½		7,756		1,573
				8,333				108,170		31,945
	COUNTER WEIGHT GIRDER BOTTOM FLANGE FRAME									
4	pls 12¼×½	20'-0"	20.83	1,666	-12'-7¾	-11'-9"		24,769		23,007
2	" "	7'-0¼	"	292						
2	" 49½×½	20'-8	84.15	3,478	-12'-7¾	-11'-9½		52,826		49,235
1	" "	8'-3½"	"	698						
4	" 11¼×½	3'-1"	19.13	236	-12'-7¾	-11'-8⅜		2,985		2,761
2	" 6×¾	"	15.30	94	"	-11'-8⅞		1,189		1,104
7	" 7⅜×½	"	12.54	271	"	-11'-9		3,428		3,184
2	" 15×½	5'-2"	25.50	264	"	"		3,340		3,102

JIUN MASUDA
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SEIYU BLDG, TOKIO

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

No	Material	Length	Wt.per ft.	Total/Wt	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
2	pls 27×½	7'-9½	45.90 -110	715	-12'-10⅜	-11'-10"		9,195		8,458
2	" 33×½	10'-1¾	56.10	1,139	-14'-0⅝	-11'-10"		16,003		13,474
2	" 13½×½	1'-2⅞	22.95	57	-17'-4	-11'-9"		988		670
2	" 53×½	20'-8	90.10	3,725	-16'-10¼	-11'-9½		62,766		43,918
1	pl "	8'-3½	"	747	-16'-10¼	"		12,587		8,807
				13,382				190,076		157,720
	D1. COUNTER WEIGHT GIRDER DIAPHRAGMS and CROSS FRAMES									
2	∟s 5×3½×⅜	1'-7⅞	10.40	35						
2	" "	1'-7"	,	33						
4	" "	5'-2"	"	215						
8	" 3½×3½×⅜	7'-0"	8.50	476						
2	pls 74½×⅜	7'-7½	95.00	1450						
				2,209	-12'-8½"	-8'-0¾"		28,076		17,805
	D2 to D4									
4	∟s 5×3½×⅜	1'-1½"	10.40	47	-17'-4"	-7'-9¾		815		367.
2	pls 39¼×⅜	7'-7"	50.05	759.	-17'-10	-7'-10		13,533		5,943
16	∟s 5×3½×⅜	1'-1½	10.40	188						
16	" "	1'-1⅛	"	193						
8	pls 26½×⅜	7'-7"	33.79	2,049	-17'-3½	-7'-10¼		46,804		21,250
2	∟s 5×3½×⅜	1'-0"	10.40	21						
2	" "	1'-0¾	"	22						
1	pl 24¼×⅜	7'-7"	30.92	234						
				3,513				61,152		27,560.
	CF1-CF2									
8	∟s 5×3½×⅜	7'-10"	10.40	651						
4	pls 3×⅜	0'-6½	3.83	8						
8	∟s 5×3½×⅜	5'-1¼	10.40	424						
12	Washers 3"ϕ×⅜		@ 0.75	9						
16	∟s 5×3½×⅜	1'-1½	10.40	188						
4	pls 15×⅜	1'-6¾	19.13	119						
4	" 15½×⅜	"	19.76	123						
4	" 19½× "	1'-9½	24.86	178						
4	" 20×⅜	"	25.50	183						
2	∟s 5×3½×⅜	7'-8½	10.40	160						
4	" "	1'-4½	"	47						
2	" "	4'-1⅜	"	104						
1	pl 20×⅜	1'-10"	25.50	47						
1	" 17½×⅜	1'-10"	22.31	41						
1	" 16×⅜	1'-6¾	20.40	32						
1	" 15×⅜	1'-6¾	19.13	30						
3	Washers 3"ϕ×⅜		@ 0.75	2						
1	Fill 3×⅜	0'-6½	3.83	2						
				2,348	-12-8½	-8'-4"		29,843		19,559
	WEIGHT SUPPORTING PLATES ALONG OUT SIDE OF COUNTER WEIGHT GIRDER STIFFENERS.									
16	pls 9¾×⅜	7'-7¼	12.43	1,511						
1	pl 9×⅜	"	11.48	87	-14'-0"	-7'-10"		23,576		13,186.
1	" "	7'-5¾	"	86						
2	pls 9¾×⅜	7'-7¼	12.43	189	-8'-11¼"	-7'-10"		1,690		1,480
				1,873				25,266		14,666
	Counter weight girder total			132,446 ✓				1,904,452 ✓		1,049,186 ✓

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

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CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

WEIGHT CONNECTING FRAMES

No	Material	Length	Wt. per ft.	Total wt.	±X From Trunnion	±Y From Floor	+X Moment	−X Moment.	+Y Moment	−Y Moment.
	CLST1									
14	∟s 3½×3½×⅜ ×	9'-7½"	8.50	1,146	-14'-0"	-2'-7¾		16,044		3037
14	pls 14½×⅜ ×	9'-7½	18.49	2,493	"	-2'-1¼		34,902		5,235
560	Rivet heads ⅞"ϕ		@ 0.2125	119	"	-2'-7"		1,666		307
				3,758				52,612		8,579
	CLSB1 - CLSB2									
20	∟s 5×3½×⅜	10'-1¾	10.40	2,111	-14'-0⅜	-11'-11½		60,483		25,248
20	pls 8½ × ⅜	10'-1¾	10.84	2,200		-12'-3¼				26,994
				4,311				60,483		52,242
	CLST2									
2	∟s 3½×3½×⅜	8'-10¾	8.50	151	-13'-9"	-2-7¾		2,076		400
2	pls 14½ × ⅜	9'-2¾	18.49	341	-14'-0"	-2'-1¼		4,774		716
2	∟s 3½×3½×⅜	1'-3"	8.50	21	-9'-3½	"		195		441
2	∟s "	2'-4	"	40	-18'-5	-2'-8		737		107
116	Rivet heads ⅞"ϕ		@ 0.2125	25	-14'-0"	-2'-6"		350		63
				578				8,132		1,727
	CLST3									
4	∟s 3½×3½×⅜	6'-7"	8.50	224	-12'-6¾	-2'-7¾		2,813		594
4	" "	1'-3"	"	43	-9'-3½	-2'-1¼		399		90
4	" "	2'-4	"	79	-16'-1"	-2'-8"		1,270		211
4	pls 14½ × ⅜	6'-11"	18.49	512	-12'-7¾	-2'-1¼		6,477		1,075
184	Rivets heads ⅞"ϕ		@ 0.2125	39	"	-2'-6"		493		98
				897				11,452		2,068
	CTS1									
2	pls 11¾×⅜	17'-10⅝	14.98	535	-18'-6"	-3'-3⅝		9,898		1,766
2	∟s 3½×3½×⅜	20'-9¼	8.50	353	-18'-7¼	-2'-10¼"		6,566		1,006
2	" "	2'-4"	"	40	-18'-4¾	-2'-8		736		107
2	pls. 28 × ⅜	2'-10	35.70	202	-18-6	"		3,737		539
1	pl. 11⅜ × ½	1'-8⅝	19.34	33	-18'-7"	-3'-3⅝		613		109
1	" 11¾ × ½	"	19.98	34	-18-5½	"		628		112
1	Fill 4½ ×⅜	1'-8⅝	5.74 -2	10	-18-6⅜	-3'-3⅛		185		33
2	pls 10 × ⅜	0'-11"	12.75 -15	21	-18-5	-2'-9"		387		58
10	" "	0'-10½	"	97	-18'-5½	"		1,791		267
2	" "	0'-11"	"	23	-18'-4¼	"		422		63
1	pl 3½ × ½	1'-6"	5.95	9	-18-8	-2'-9"		168		25
480	Rivet heads ⅞"ϕ		@ 0.2125	102	-18'-6½	-2'-11"		1,891		298
				1,459				27,022		4383
	CTS2									
2	[s 10×3½	8'-2⅜	23.55	386	-9'-5	-3'-2¼		3,636		1,231
8	∟s 6×4×⅜	0'-7¾	12.30 -5	64	-9'-5¾	"		607		204
2	pls 10 × ⅜	1'-2"	12.75 -10	25	-9'-7"	-2'-9"		240		69
4	" "	0'-10½	"	35	"	"		335		96
120	Rivet heads ⅞"ϕ		@ 0.2125	26	-9'-5½	-2'-11¼		246		76
				536				5,064		1,676
	CTS3									
2	[s 10 × 3½	8'-2⅜	23.55	386	-9'-5"	-3'-2¼		3,636		1,231
8	∟s 6×4×⅜	0'-7¾	12.30	64	-9'-5¾	"		607		204
2	pls 10 × ⅜	0'-11"	12.75 -15	23	-9'-7½	-2'-9"		221		63
6	" "	0'-10½	"	52	-9'-7"	"		498		143

JIUN MASUDA
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CALCULATIONS FOR

First Canal Bridge for City of Kobe. 60' single leaf trunnion bascule.

No	Material	Length	Wt. per ft.	Total Weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
132	Rivet heads ⅞"φ		@ 0.2125	28	-9'-5½"	-2'-11¼"		265		82
				553				5,227		1,723
	CTS4									
2	Ls 10"x3½	8'-1"	23.55	380	-9'-5"	-3'-2¼		3,580		1,212
2	pls 14½x⅜	4'-0"	18.49	148	-9'-2¼	-2-1¼		1,360		311
2	" "	1'-5"	"	53	"	"		487		111
2	" 6¼x⅜	1'-2½	7.97 -12.5	19	-9'-2¾	"		175		40
6	pls 9"x⅜	0'-10"	11.48	45	-9'-7"	-2'-9		431		124
4	Ls 6x4x⅜	0'-7¾	12.30	32	-9'-5¾	-3'-2¼		303		102
232	Rivet heads ⅞"φ		@ 0.2125	49	-9'-4½	-2'-8		460		131
				756				6,796		2,039
	CLS1~CLS3									
16	Ls 3½x3½x⅜	18'-5"	8.50	2,505						
4	" "	18'-4½	"	625						
4	pls 12¼x⅜	18'-5	15.62	1,151						
1	pl. "	18'-4½	"	287						
10	Fills 3"x⅜	0'-5¾	3.83	18						
10	" "	0'-11⅜	"	36						
10	Ls 4"x3½x⅜	0'-11½	9.10	87						
8	" 6x3½x⅜	0'-11¾	11.70	92						
2	" "	0'-11½	"	22						
10	Washers 3"φx⅜		@ 0.72	7						
5	pls 11½x½	1'-1⅜	19.55 -10	99						
1,030	Rivet heads ⅞"φ		@ 0.2125	219						
				5,148	-9'-3¼"	-3'-3½"		47,722		16937.
	CLS4~CLS5									
4	Ls 5"x3½x⅜	4'-9"	10.40	198	-16'-1"	-3'-8⅛		3,184		729
4	" "	4'-11"	"	205	-16'-0"	"		3,280		754
4	pls 11½x½	1'-1"	19.55 -8	76	-18'-0"	-3'-10"		1,368		291
2	" 18½x"	2'-4	31.45 -30	117	-13'-3	"		1,550		448
2	" 12x½	1'-9¾	20.40 -7	67	-13'-2	"		882		257
8	Ls 6x3½x⅜	0'-1⅝	11.70 -4	78	-18'-3¾	-3'-4½		1,428		264
4	Wash's 3"φ¾		@ 1.44	6	-18-4	-3'-3		110		20
130	Rivet heads ⅞"φ		@ 0.2125	28	-16-1	-3'-8		450		103
				776				12,252		2,866

LATERAL BRACING at REAR of TRUNNION

No	Material	Length	Wt. per ft.	Total Weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
	STRUTS TRS									
8	Ls 3½x3½x⅜	20'-0"	8.50	1,360						
2	pls 12x⅜	"	15.30	612						
2	Fills 5¼x"	1'-4	6.69	18						
2	" "	1'-4⅛	"	18	0'-0"	-3'-3½"				7,087
2	pls 11½x½	2'-9⅝	19.55	109						
2	Fills 5¼x⅜	"	6.69	37						
4	Ls 3½x3½x⅜	4'-8½	8.50	160	0'-0"	-3'-8¾				597
4	" "	5'-7"	"	190	"	-2'-6"				475
2	pls 32x⅜	4'-8½	40.80 -183	201	"	-2'-10⅞				585
4	" 11½x½	2'-6	19.55	196	"	-3'-3½	0.			645
4	Fills 5¼x⅜	"	6.69	67	"	"				220
2	pls 7⅜x"	1'-8	9.40 -40	31	"	-2'-9				85
4	Fills 8½x⅜	2'-1⅜	10.84	87	"	-2'-5½				214
4	pls 13½x⅜	1'-4⅝	17.21 -11	85	-0'-4"	-2'-9		28		234
1	pl. 16⅝x"	1'-7⅞	21.20 -6	28	"	"		9		77

CALCULATIONS FOR

First Canal Bridge for City of Kobe 60' Single leaf trunnion bascule.

NO	Material	Length	Wt.per ft.	Total wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment.
3	pls 19⅝×½	2'-5⅞	33.36 -12	237	-0'-6"	-3'-10"		1 19		908
1,380	Rivet heads ⅞φ	@	0.2125	293	0'-0	-3'-3½		0		964
				3,729				156		12,091

DIAGONALS CDP1. CDP2. and CD1~CD6.

2	Ls 5×3½×⅜	10'-5⅝	10.40	217						
2	Ls 5×3½×⅜	10'-2⅞	〃	212 92						
2	〃 〃	4'-5	〃	87						
2	〃 〃	4'-2								
4	〃 〃	4'-7¾	〃	193	-4'-9"	-3'-8⅞"		11,975		9,277
8	〃 〃	10'-8½	〃	891						
8	〃 〃	5'-0¼	〃	418						
8	〃 〃	4'-11¼	〃	411						
2	pls 60¾×½	7'-8⅝	103.28 -140	1,455	-2'-2	-3'-10"		3,157		5,572
2	〃 55×½	7'-10¾	93.50 -155	1,322	-7'-1	〃		9,360		5,063
2	〃 6×½	6'-6¼	10.20 -50	133	-4'-9	-3'-10½		632		516
4	〃 17×½	2'-3"	28.90	210	〃	-3'-10		998		804
1,570	Rivet heads ⅞φ	@	0.2125	334	〃	-3'-9"		1,587		1,253
				5,975				27,709		22,485

CTS5 & CTS6

2	Ls 3½×3½×⅜	2'-4	8.50	40	-16'-3¼	-2'-8"		651		107
2	〃 6×3½×⅜	2'-11¾	11.70	70	-16'-4¼	-3'-9½		1,145		265
2	pls 28×⅜	4'-0"	35.70	286	-16'-2⅞	-2'-7½"		4,627		752
2	〃 26×⅜	2'-4	33.15	154	-17'-4	-2-8"		2,669		411
2	Ls 3½×3½×⅜	1'-1½	8.50	19	-17'-4	-3'-9¼		329		72
180	R.H. ⅞φ		@ 0.2125	38	-16'-2⅞"	-2'-9"		615		105
90	〃 〃 〃		〃	19	-17'-4	〃		329		52
				626				10,365		1,764

Summaly

Lateral Bracing at rear of Trunnion and Frames on Counter Weight Girder

				29,102 √				274,992 √		130,580 √

WIND LOAD BEARING BLOCKS (Cast steel).

7	A1		@ 148	1,036						
2	A4		@ 〃	288						
108	⅝-φ Bolt heads	@	0.3	32						
				1,356	-16'-0"	-12'-1¾		21,696		16,475

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CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY R.I & M.K. DATE ____ FILE NO ____
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CALCULATIONS FOR

Part	NO.	Size	Volume or Wt.	±X From Trun.	±Y From Floor	Total Vol. or Wt.	±X M't.	±Y M't.	Density
		鋼屑混凝土							
①	2	3'6 3/32" × 6'0" × 7'0 1/2"	148.4 c.f.	-12'9"	-8'0 1/4	296.8 c.f.	-3782	-2,380	
②	2	3'5 5/32" × 〃 × 〃	145.0	〃	〃	290.0	-3700	-2,320	
③	4	7'7 1/16" × 〃 × 〃	320.8	〃	〃	1,283.2	-16,360	-10,280	
					(Vol.)	1,870.0	-23,842	-14,980	270#/c.f.
					(Wt.)	504,900#	-6437,340'#	-4044,600'#	
		再製ズクブロック及ポンチ屑混凝土							
④	180	(再製ズクブロック)	480#	-17'3	-10'0	86,400#	-1,490,400	-864,000	450#/c.f.
	30	〃	480	-17'9 1/2"	-7'11	14,400	-256,205	-114,005	〃
	10	鋼屑混凝土 31. or	8370#	-17.19	-6.76	83,700	-1,438,800	-565,810	270#/c.f.
						184,500#	-3185,405	-1543,815	
		填充混凝土（配合1:2:4 正4分目篩砂利ヲ使用）							
C1	2	6'0" × 1 3/4" × 7'9 1/2"	7.0 c.f.	-12'9	-7'9 3/4"	14.0 c.f.	-179	-109	
C2	7	〃 × 8 3/4 × 〃	34.1	〃	〃	238.9	-3,046	-1867	
C3	1	49'7 3/4 × 3" × 〃	96.7	-9'7 1/2"	〃	96.7	-919	-756	
C4	1	45'7 3/8 × 6" × 〃	177.8	-16'0"	〃	177.8	-2845	-1,388	
C5	1	41'6 1/2" × 3" × 〃	81.0	-18'4 1/2"	〃	81.0	-1,488	-633	
C6	10	2'0" × 4" × 〃	5.2	-17'3	〃	52.0	-897	-406	
C7	1	6'0" × 2" × 44'3"	44.4	-12'9	-11'7 1/2"	44.4	-566	-516	
C8	1	〃 × 7" × 〃	154.8	〃	-4'2 1/2"	154.8	-1974	-651	
C9	1	2'0" × 2" × 38'3"	12.8	-17'3	-11'7 1/2"	12.8	-221	-149	
C10	1	〃 × 7" × 〃	44.5	〃	-4'2 1/2"	44.5	-768	-187	
C11	1	9" × 2" × 〃	4.8	-18'10 1/2"	-11'7 1/2"	4.8	-91	-56	
C12	1	9" × 7 3/4" × 〃	18.5	〃	-4'2 7/8"	18.5	-349	-78	
C13	1	9 × 2" × 〃	4.8	-9'1/2"	-11'7 1/2"	4.8	-44	-56	
C14	1	9 × 7 3/4" × 〃	18.5	-9'1/2"	4'2 7/8"	18.5	-169	-78	
		Concrete and Girders				963.5 c.f.	-13,568	-6930	
		Girders only	132,446# ÷ 490 =			270.0 c.f.	-3,887	-2,141	
		〃				-(36.7	- 507	- 297	
		Girder only				233.3	3380	-1,844	
		Concrete only			(Vol.)	730.2 c.f.	-10,188	-5,086	140#/c.f.
		〃			(Wt.)	102,228#	-1,426320'#	-712,040'#	
		ポンチ屑混凝土打込ミ							
⑥	2	1'1 3/4 × 3'11 × 7'4 5/8	33.3 c.f.	-12'5 1/2"	-3'4	66.6 c.f.	-830	-222	
⑦	1	〃 × 10'4" × 41'0"	487.2	-14'0	〃	487.2	-6,821	-1,622	
⑪	5	1'3" × 3'6 × 9'7"	41.9	〃	-2'1 5/8	209.5	-2,933	-448	
⑨	2	2'10 × 1'3 × 2'3 1/2	8.1	-17'4	〃	16.2	-281	-35	
⑩	2	4'1 × 1'3 × 6'11 1/2	35.5	-12'8 1/2	〃	71.0	-902	-152	
⑧	2	1'11 × 〃 × 〃	16.7	〃	〃	33.4	-425	-71	
					Vol.	883.9 c.f.	-12,192	-2550	270#/c.f.
					Wt.	238,653#	-3291,840#	-688,500#	

両側鉄鈑取付ポンチ屑混凝土打込ミ

						c.f.			
⑤	1	9"×6'11⅜×41'6⅜	217.54	-9'4½	-8'0⅝	217.54	-1985	-1,752	
(5A)	1	〃	217.54	-18'4½	〃	217.54	-4106	-1,752	
			Girder ＆ scrap Concrete			435.08	-6091	-3,504	
			Girder only	-14.38	-8.10	-(32.50	-467	-263)	
			Scrap Concrete only (Vol.)			402.58 c.f.	-5,624	-3,241	250#/c.f.
			〃 (Wt.)			100,645#	1,406,000#	-810,250#	

底部取付銑鉄ブロック

BB	114	@ 323#	-13'8⅞	-12'2¼	36,822#	-503,725#	-448,860#	450#/c.f.
		Summary			1,167,748#	-16,250,630#	-8,248,065#	

Total of Counter Weight

Count. wt. girders	132,446	-1,904,452	-1,049,186
Rear lateral bracing	29,102	-274,992	-130,580
Wind load bearing blocks	1,356	-21,696	-16,475
Count. wt.	1,167,748	-16,250,630	-8,248,065
Ground Summary	1,330,652	-18,451,770	-9,444,306

arm of Count. wt. { X axis - 18,451,770 ÷ 1,300,652 = -13.867
{ Y axis - 9,444,306 ÷ 〃 = -7.098

Center of gravity of morving leaf.

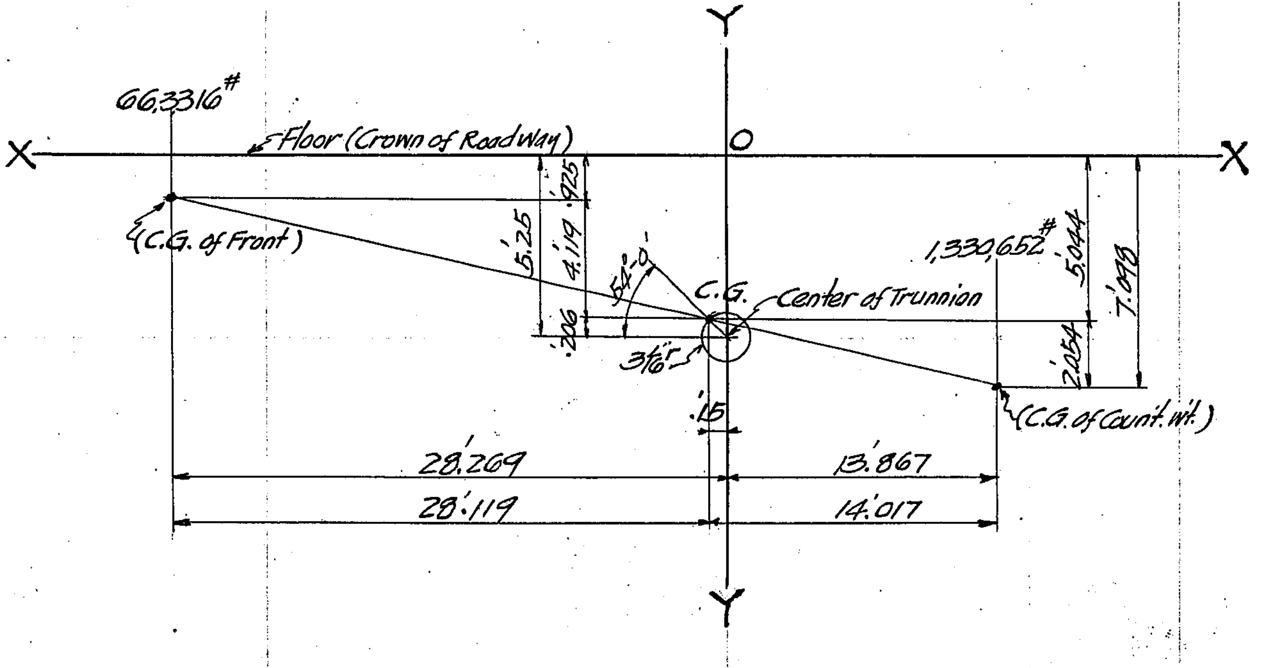
Front	663,316	+18,751,551	-613,695
Count. wt.	1,330,652	-18,451,770	-9,444,306
	1,993,968	299,781	-10,058,001

Center of gravity { ± X 299,781 ÷ 1,993,968 = +0.150
{ ± Y -10,058,001 ÷ 〃 = -5.044

-5.25-(-5.044) = 0.206

$\tan\theta = \frac{.206}{.150} = 1.37333$ ∴ $\theta = 54°-0'$

$r = .150 \times \sec\theta = .150 \times 1.701 = .255$ ft. $= 3\frac{1}{16}$"



Pig Iron	$312^{\#} \times 114$	$= 35{,}568^{\#}$	or 15.879 Tons.	$450^{\#}$/c.f.
再製ブックブロック	$480^{\#} \times 210$	$= 100{,}800^{\#}$	or 45.000 Tons.	$450^{\#}$/c.f.

For $270^{\#}$/c.f. Scrap steel Concrete

$$490x + 120(1-x) = 270^{\#}$$

$$\therefore x = \frac{270-120}{490-120} = 0.4054^{\text{c.f.}}$$

$$\text{Scrap steel} = 490 \times 0.4054 = 198.65^{\#} \text{ per c.f. of Scrap Concrete}$$

For $250^{\#}$/c.f. Scrap steel Concrete

$$490x + 120(1-x) = 250^{\#}$$

$$\therefore x = \frac{250-120}{490-120} = 0.3514^{\text{c.f}}$$

$$\text{Scrap steel} = 490 \times 0.3514 = 172.19^{\#} \text{ per c.f. of Scrap Concrete}$$

Scrap Steel

	c.f				
①	296.8	×	$198.65^{\#}$	$58{,}960^{\#}$	$270^{\#}$/c.f.
②	290.0	×	〃	57,610	〃
③	1,283.2	×	〃	254,910	〃
④	310.0	×	〃	61,580	〃
⑤ヲ(5A)	402.58	×	$172.19^{\#}$	69,320	$250^{\#}$/c.f.
⑥	66.6	×	$198.65^{\#}$	13.230	$270^{\#}$/c.f.
⑦	487.2	×	〃	96.780	〃
⑧	33.4	×	〃	6.630	〃
⑨	16.2	×	〃	3.220	〃
⑩	71.0	×	〃	14,100	〃
⑪	209.5	×	〃	41,620	〃
				677.960	or 302.661 Tons

（以上ハ計算上ノ数字ヲ示シタルモノニテ実際ハ設明書ニ記載セルガ如ク規定単量（$270^{\#}$/c.f.及$250^{\#}$/c.f.）ヲ得ベキ試験塊ヲ作製シテ之ニヨリ鋼屑及モルタルノ実際割合ヲ検定シ標準トナスベキモノトス）

Mortar (1:2)

①	296.8 c.f.	×	0.5946	176 c.f.	$120^{\#}$/c.f.
②	290.0	×	〃	172	〃
③	1,283.2	×	〃	763	〃
④	310.0	×	〃	184	〃
⑤ヲ(5A)	402.58	×	0.6486	261	〃
⑥	66.6	×	0.5946	40	〃
⑦	487.2	×	〃	290	〃
⑧	33.4	×	〃	20	〃
⑨	16.2	×	〃	10	〃
⑩	71.0	×	〃	42	〃
⑪	209.5	×	〃	125	〃
				2,083 c.f.	= 9.814 立坪

塡充混凝土（正四分目篩通シ砂利）

C1~C14 730 c.f. = 3.439 立坪 $140^{\#}$/c.f.

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

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CALCULATIONS FOR

（参考 1）

⑤A ヨリ差引クベキ鉄部 (CG3)

		sqin ft.		
Web pl.	6′11¾″ × ¼″ × 20′9$\frac{11}{32}$″	20.93 × 20.781	434.946	
Side pl. (Bottom)	14¼″ × ¾ × 20′9$\frac{11}{32}$	10.69 × 20.781	222.149	
Fill (end)	9¼″ × ¾″ × 5′9½″	6.938 × 5.792	40.185	
〃 (in)	4″ × ¾ × 5′9½″ × 4	3.0 × 5.792 × 4	69.504	
〃 (end)	6″ × ¾ × 6′7¾″	4.5 × 6.646	29.907	
Flg ∟ (Bottom)	4″ × ¾ × 17′7″	3.0 × 17.583	52.749	
Stif. (end)	6″ × 6″ × ¾ × 6′11¾″	8.44 × 6.979	58.903	
〃 (in)	5″ × 4″ × ½ × 7′0½ × 4	4.25 × 7.042 × 4	119.714	
Fill (〃)	4″ × ¾ × 6′7¾	3.0 × 6.646	19.938	
Spl. ∟ (Bottom)	4″ × ¾ × 6′1⅜″	3.0 × 6.115	18.345	
Sidepl. spl. pl.	10″ × ¾ × 1′9½″	7.5 × 1.792	13.440	
pl.	7½″ × ⅜ × 6′11¾″ × 4	2.813 × 6.979 × 4	78.528	
Rivet heads	⅞ϕ × 545	0.062 × 545	33.790	
			1192.098 × 2	= 2,384.196 (A)

		sqin ft.		
Web spl. pl.	19″ × ¾″ × 5′2″	14.25 × 5.167	73.630	
Spl. pl (Top)	7½″ × ¾ × 3′1″	5.625 × 3.083	17.342	
∟	5 × 3½ × ½ × 7′0½″	4.0 × 7.042	28.168	
Fill	3½ × ¾ × 5′9½″	2.625 × 5.792	15.204	
pl.	7½ × ⅜ × 6′11¾″	2.813 × 6.979	19.632	
			153.976	(B)

(A)-- 2,384.196
(B)-- + 153.976
2538.172 ÷ 144 = 17.626 c.f.

⑤ ヨリ差引クベキ鉄部 (CGT)

		sq.in ft.		
Web pl.	6′11¾″ × ¼″ × 20′9$\frac{11}{32}$″	20.93 × 20.781	434.946	
Side pl. (Top)	9¼″ × ¾″ × 20′9$\frac{11}{32}$″	6.938 × 20.781	144.179	
Flg ∟ (Bottom)	4″ × ¾ × 20′9$\frac{11}{32}$″	3.0 × 20.781	62.343	
Stiff. ∟ (in)	5″ × 4″ × ½ × 6′11¾ × 4	4.25 × 6.979 × 4	118.643	
Fill.	4″ × ¾ × 5′10½ × 4	3.0 × 5.875 × 4	70.500	
pl.	7½ × ⅜ × 6′11¾ × 4	2.813 × 6.979 × 4	78.528	
Rivet heads	⅞ϕ 437	0.062 × 437	27.094	
			936.233 × 2	= 1,872.466 (A)

		Sq. in ft.		
Spl. ∟ (Bottom)	4¾″ × ¾ × 6′2½″	3.563 × 6.208	22.119	
pl.	9″ × ¾ × 3′2½	6.75 × 3.208	21.654	
〃	[illegible]½″ × ¾ × 4′9¾	15.38 × 4.813	74.024	
Fill.	3½ × ¾ × 5′6¾	2.625 × 5.563	14.603	
Stiff. ∟	5″ × 3½ × ½ × 6′11¾″	4.0 × 6.979	27.916	
Side pl. spl.	12¾ × ¾ × 4′7¾	9.563 × 4.646	44.430	
Fill.	3⅜ × ¾ × 4′7½	2.532 × 4.625	11.711	
pl.	12¾ × ¾ × 3′5½″	9.563 × 3.458	33.069	
pl.	7½ × ⅜ × 6′11¾	2.813 × 6.979	19.632	
			269.158	(B)

(A)-- 1,872.466
(B)-- + 269.158
2141.624 ÷ 144 = 14.872 c.f.

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

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CALCULATIONS FOR

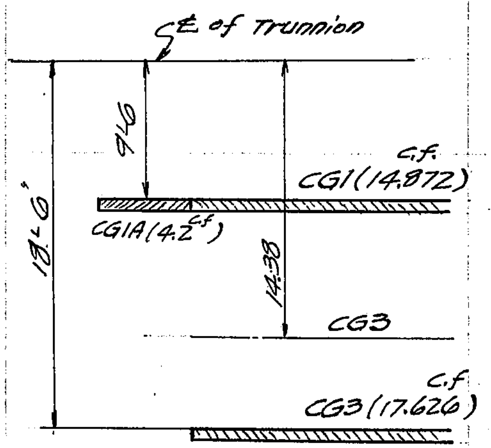
（参考 2）

C3 ヨリ差引クベキ鉄部 (CG1A)

		sq.in ft.	
Web pl.	6'11¾" × ¼" × 4'0 17/32	20.93 × 4.047	84.704
Side pl.	9¼ × ¾ × 4'0 17/32"	6.938 × 4.047	28.078
Flg Ls (Bottom)	4" × ¾ × 4'0 17/32"	3.0 × 4.047	12.141
Fill (end)	9" × ¾ × 5'10½"	6.75 × 5.875	39.656
〃 (in)	4" × ¾ × 5'10½"	3.0 × 5.875	17.625
L stiff.	6 × 6 × ¾ × 6'11¾"	8.44 × 6.979	58.903
〃 〃	5" × 4 × ½ × 6'11¾"	4.25 × 6.979	29.661
pl.	7½" × ⅜ × 6'11¾"	2.813 × 6.979	19.632
Rivet heads	7/8" 168	0.062 × 168	10.416

300.816 × 2 = 601.632 ÷ 144

= 4.2 c.f.



Vol.		mt.
14.872 × 9'6"	=	141.284
17.626 × 18'6	=	326.081
32.5		467.365

arm 467.365 ÷ 32.5 = 14.38 ft. for X axis

	Vol. c.f.	arm X	Y	X mt.	Y mt.
CG1&CG3	32.5	-14.38	-8.10	-467.	-263
CG1A	4.2	-9.5	-8.10	-40	-34
	36.7			-507	-297

		c.f
⑤	Concrete & scrap steel	217.54
	Scrap steel only	-(14.87)
	Concrete only	202.67

		c.f.
(5A)	Concrete & scrap steel	217.54
	Scrap steel only	-(17.63)
	Concrete only	199.91

増田淳氏関係資料
（独立行政法人 土木研究所蔵）

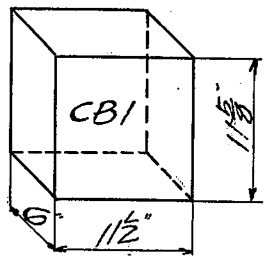
CALCULATIONS FOR

（参考3）

Punch scrap Concrete Blocks ($288^{\#}$/c.f.)

$490x + 120(1-x) = 288^{\#}$ $\therefore x = \frac{288-120}{490-120} = 0.454$

Scrap steel $490^{\#} \times 0.454 = 222^{\#}$ per c.f. of punch scrap Concrete

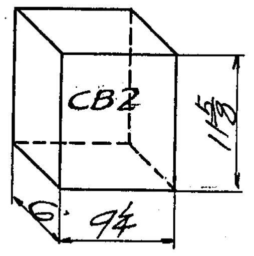


CB1 — 896 Reqd.

Vol. $11\frac{1}{2}'' \times 11\frac{5}{8} \times 6'' = 0.464$ c.f.

Wt. $288 \times .464 = 134^{\#}$

(Scrap steel $222 \times 0.464 = 103^{\#}$ abt.)

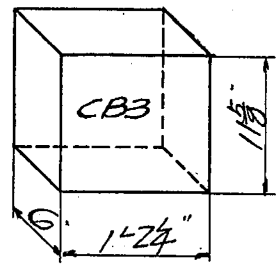


CB2 — 168 Reqd.

Vol. $9\frac{1}{4}'' \times 11\frac{5}{8} \times 6'' = 0.374$ c.f.

Wt. $288 \times .374 = 108^{\#}$

(Scrap steel $222 \times .374 = 83^{\#}$ abt.)

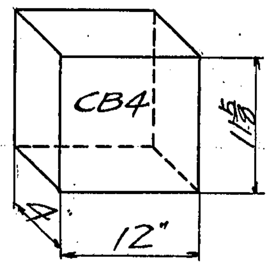


CB3 — 122 Reqd.

Vol. $1'2\frac{1}{4}'' \times 11\frac{5}{8} \times 6'' = 0.576$ c.f.

Wt. $288 \times .576 = 166^{\#}$

(Scrap steel $222 \times .576 = 128^{\#}$ abt.)

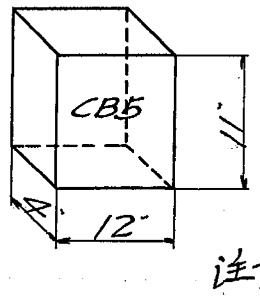


CB4 — 300 Reqd.

Vol. $12'' \times 11\frac{5}{8} \times 4'' = 0.323$ c.f.

Wt. $288 \times 0.323 = 93^{\#}$

(Scrap steel $222 \times .323 = 72^{\#}$ abt.)



CB5 — 50 Reqd.

Vol. $12'' \times 11'' \times 4 = 0.305$ c.f.

Wt. $288 \times 0.305 = 88^{\#}$

(Scrap steel $222 \times .305 = 68^{\#}$ abt.)

注意（以上括弧中ノScrap steelノ重量ハ計算上ノ数字ニテ実際ハ試作Blockニヨリテ割出スベシ）

場所打鋼屑混凝土 ($270^{\#}$/c.f.)

$490x + 120(1-x) = 270$ $\therefore x = \frac{270-120}{490-120} = .4054$ c.f.

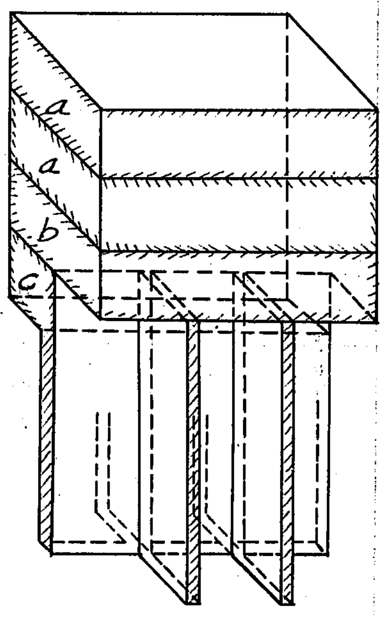
Scrap steel. $490^{\#} \times .4054 = 198.65^{\#}$ per c.f. of scrap Concrete

①	上一段	$2'6\frac{3}{32}'' \times 5'0'' \times 1'0\frac{1}{2}''$	$= 13.12$ c.f.	$270^{\#} \times 13.12 = 3,542^{\#}$	scrap steel $= 198.65 \times 13.12 = 2,605^{\#}$
	下六段各	〃 〃 $\times 1'0''$	$= 12.59$ c.f	$270 \times 12.59 = 3,399^{\#}$	〃 = 〃 $\times 12.59 = 2,500^{\#}$
②	上一段	$2'5\frac{5}{32}'' \times 5'0''$ ~~×1'~~ $0\frac{1}{2}''$	$= 12.66$ c.f.	$270 \times 12.66 = 3,418^{\#}$	〃 = 〃 $\times 12.66 = 2,515^{\#}$
	下六段	〃 〃 $\times 1'0''$	$= 12.15$ c.f.	$270 \times 12.15 = 3,281^{\#}$	〃 = 〃 $\times 12.15 = 2,415^{\#}$
③	上一段	$6'7\frac{1}{16}'' \times 5'0 \times 1'0\frac{1}{2}''$	$= 34.33$ c.f.	$270 \times 34.33 = 9,269^{\#}$	〃 = 〃 $\times 34.33 = 6,820^{\#}$
	下六段各	〃 〃 $\times 1'0''$	$= 32.95$ c.f.	$270 \times 32.95 = 8,897^{\#}$	〃 = 〃 $\times 32.95 = 6,545^{\#}$

CALCULATIONS FOR

（参考４）

④

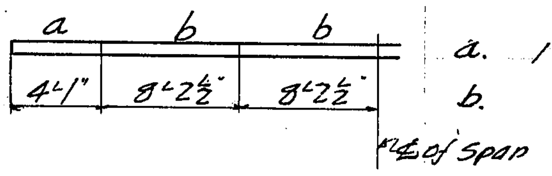


a. 1'4" × 3'1 $\frac{29}{32}$" × 1'0" = 4.21 c.f. 270# × 4.21 = 1,137# Scrapsteel = 198.65 × 4.21 = 835#
b. 〃 〃 × 0'11" = 3.86 c.f. 〃 × 3.86 = 1,042# 〃 = 〃 × 3.86 = 765#

c. 9" × 1'0 $\frac{1}{2}$" × 3'1 $\frac{7}{8}$" = 2.46
2" × 3'1" × 3'9 $\frac{7}{8}$" = 2.00
3 $\frac{7}{8}$ × 3'1" × 1'10" = 1.80
〃 × 1'0 $\frac{1}{2}$ × 0'11" = .31
} + 6.57 c.f. 270 × 6.57 = 1,774# 〃 = 〃 × 6.57 = 1,305#

⑥ 33.3 c.f. 270 × 33.3 = 8,991# Scrap steel 198.65 × 33.3 = 6,615#

⑦



a. 1'1 $\frac{3}{4}$" × 10'4" × 4'1" = 48.5 c.f. 270 × 48.5 = 13,095# Scrapsteel - 198.65 × 48.5 = 9,635#
b. 〃 〃 × 8'2 $\frac{1}{2}$ = 97.55 〃 × 97.55 = 26,339# 〃 = 〃 × 97.55 = 19,380#

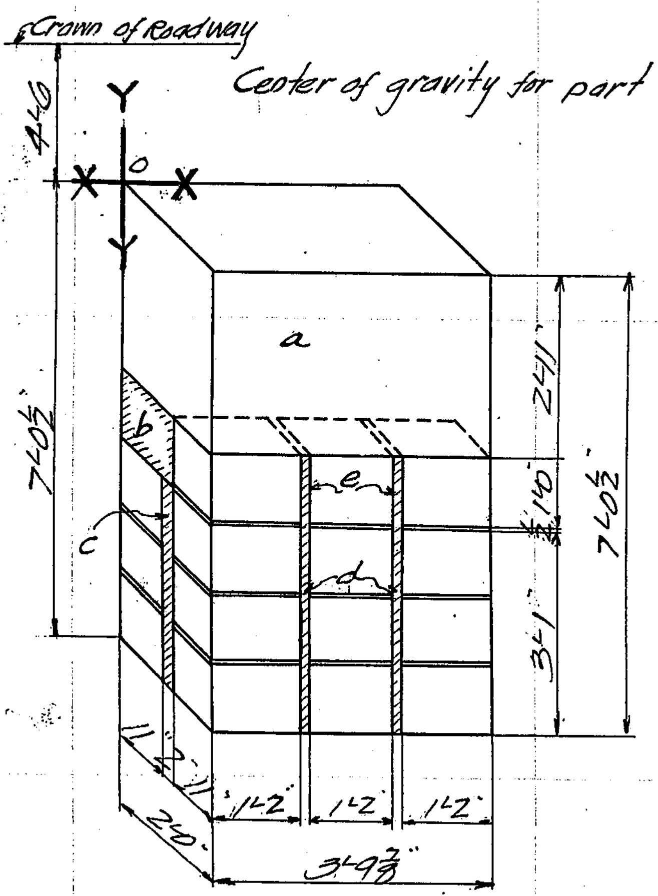
⑧ 16.7 c.f. 270 × 16.7 = 4,509# Scrap steel. 198.65 × 16.7 = 3,315#

⑨ 2'11" × 1'3 × 2'3 $\frac{1}{2}$ = 8.1 c.f. 270 × 8.1 = 2,187# 〃 〃 〃 × 8.1 = 1,610#

⑩ 4'1" × 1'3" × 6'11 $\frac{1}{2}$" = 35.5 c.f. 270 × 35.5 = 9,585# 〃 〃 〃 × 35.5 = 7,050#

⑪ 41.9 c.f. 270 × 41.9 = 11,313# 〃 〃 〃 × 41.9 = 8,325#

Center of gravity for part ④



Vol.
a. 3'9 $\frac{7}{8}$ × 2'0" × 2'11" = 22.31 c.f.
b. 1'1" × 1'0 $\frac{1}{2}$ × 3'9 $\frac{7}{8}$" = 4.29
c. 2" × 3'1" × 〃 = 2.00
d. 3 $\frac{7}{8}$ × 〃 × 1'40" = 1.80
e. 〃 × 1'0 $\frac{1}{2}$ × 11" = 0.31
} + = 30.71 c.f.

Center of gravity

For X axis

	c.f.		mt.
a.	22.31 × 1'	=	22.31
b.	4.29 × .54	=	2.32
c.	2.00 × 1.	=	2.00
d.	1.80 × 1.	=	1.80
e.	.31 × 1.54	=	.48
	30.71		28.91

arm for X --- 28.91 ÷ 30.71 = .941'

From Trunn. 17'3" + .941 = 17.19 ft.

For Y axis.

	c.f.	
a	22.31 × 1.46'	= 32.57
b	4.29 × 3.44	= 14.76
c	2.00 × 5.50	= 11.00
d	1.80 × 5.50	= 9.90
e	.31 × 3.42	= 1.06
	30.71	69.29

arm for Y = 69.29 ÷ 30.71 = 2.256'

From floor 4.5 + 2.256 = 6.76 ft.

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CALCULATIONS FOR

（参 考 5）

⑤	上一段	$20.27 \times \frac{11\frac{1}{2}''}{6'11\frac{1}{2}''} = 2.84^{c.f.}$	$250^{\#} \times 2.84 = 710^{\#}$	Scrapsteel $172.19 \times 2.84 = 490^{\#}$	$(250^{\#}/c.f.)$
	下六段各	$20.27 \times \frac{1'0''}{6'11\frac{1}{2}''} = 2.90$	$250 \times 2.90 = 725$	〃 〃 $\times 2.90 = 500$	(〃)
(5A)	上一段	$19.99 \times \frac{11\frac{1}{2}''}{6'11\frac{1}{2}''} = 2.80$	$250^{\#} \times 2.80 = 700$	Scrap steel $172.19 \times 2.80 = 480$	(〃)
	下六段各	〃 $\times \frac{1'0''}{6'11\frac{1}{2}''} = 2.86$	$250 \times 2.86 = 715$	〃 〃 $\times 2.86 = 495$	(〃)

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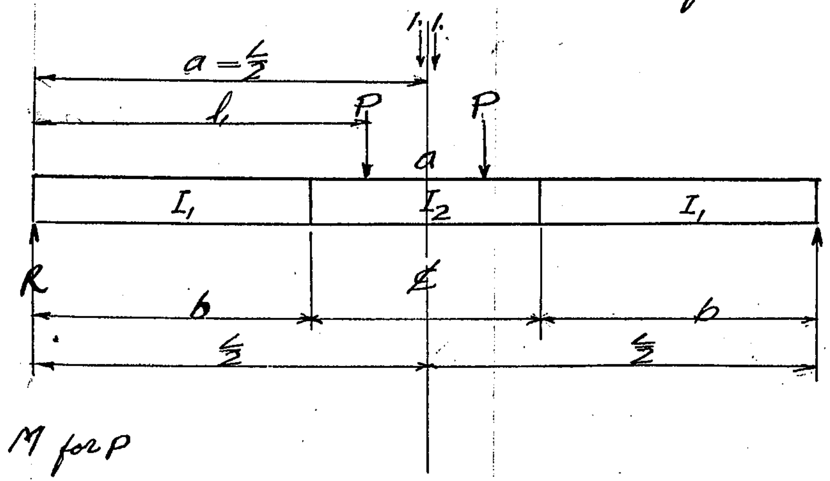
CALCULATIONS FOR

（参考 6）

Deflection of Trunnion Girder.

Deflection at a.



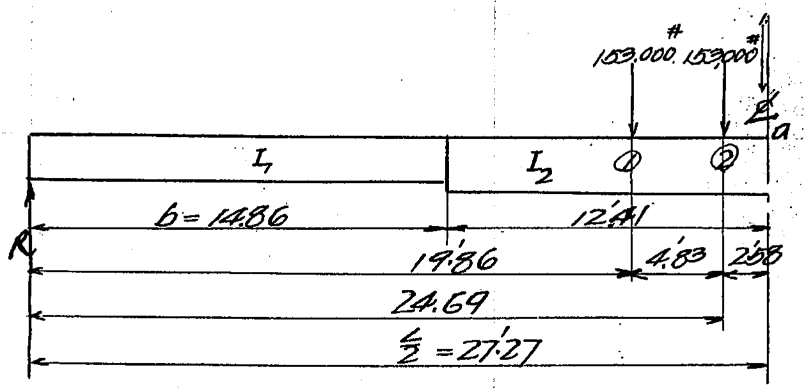
M for P
m for 1.

$$\Delta = \int \frac{Mm\,dx}{EI}$$

$$\Delta = \int_0^b \overset{\substack{M=Px\\m=x}}{\frac{Px^2dx}{EI_1}} + \int_b^{l_1} \overset{\substack{M=Px\\m=x}}{\frac{Px^2dx}{EI_2}} + \int_{l_1}^{\frac{L}{2}} \overset{\substack{M=Pl_1\\m=x}}{\frac{Pl_1x\,dx}{EI_2}}$$

$$= \left[\frac{Px^3}{3EI_1}\right]_0^b + \left[\frac{Px^3}{3EI_2}\right]_b^{l_1} + \left[\frac{Pl_1x^2}{2EI_2}\right]_{l_1}^{\frac{L}{2}}$$

$$= \frac{Pb^3}{3EI_1} + \frac{P}{3EI_2}(l_1^3-b^3) + \frac{Pl_1}{2EI_2}\left(\left(\frac{L}{2}\right)^2-l_1\right)$$



Load 1

$l_1 = 19'86$

$I_1 = 309900^{('')4}$

$I_2 = 487,700^{('')4}$

$E = 30,000,000.$

$$\frac{153,000 \times 14.86^3 \times 12^3}{3 \times 30,000,000 \times 300,900} = 0.03204$$

$$\frac{153,000 \times 12^3}{3 \times 30,000,000 \times 487,700} \times (19.86^3 - 14.86^3) = 0.027355$$

$$\frac{153,000 \times 19.86 \times 12^3}{2 \times 30,000,000 \times 487,700} \times (27.27^2 - 19.86^2) = \underline{0.061884}$$

0.121279"

Load 2

$l_1 = 24'69$

$$\frac{153,000 \times 14.86^3 \times 12^3}{3 \times 30,000,000 \times 300,900} = 0.03204$$

$$\frac{153,000 \times 12^3}{3 \times 30,000,000 \times 487,700} \times (24.69^3 - 14.86^3) = 0.070888$$

$$\frac{153,000 \times 2469 \times 12^3}{2 \times 30,000,000 \times 487,700} \times (27.27^2 - 24.69^2) = \underline{0.029532}$$

0.13246"

Total 0.25374"

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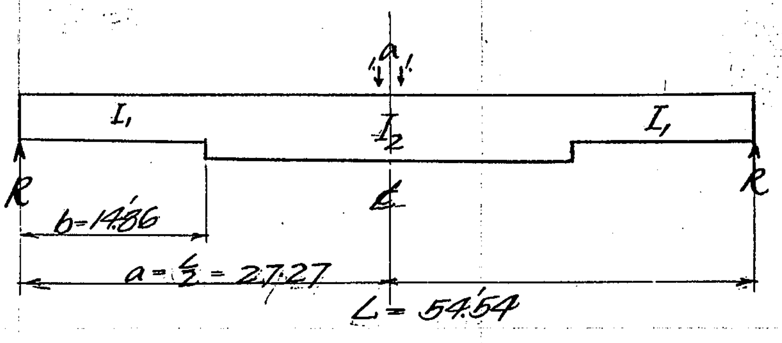
CALCULATIONS FOR

（参考７）



Deflection at a. (Uniform load)

$R=\frac{1}{2}W \quad M=\frac{1}{2}Wx-\frac{wx^2}{2}$ where w = load per line ft
$m=x$ W = Total load on span.

$$\Delta=\int_0^{\frac{L}{2}}\frac{Mm\,dx}{EI}$$

$$\Delta=\int_0^{b}\frac{\frac{1}{2}Wx^2dx}{EI_1}-\frac{\frac{1}{2}wx^3dx}{EI_1}+\int_b^{\frac{L}{2}}\frac{\frac{1}{2}Wx^2dx}{EI_2}-\frac{\frac{1}{2}wx^3dx}{EI_2}$$

$$=\left[\frac{Wx^3}{6EI_1}-\frac{wx^4}{8EI_1}\right]_0^b+\left[\frac{Wx^3}{6EI_2}-\frac{wx^4}{8EI_2}\right]_b^{\frac{L}{2}}$$

$$=\left(\frac{Wb^3}{6EI_1}-\frac{wb^4}{8EI_1}\right)+\frac{W}{6EI_2}\left(\left(\frac{L}{2}\right)^3-b^3\right)-\frac{w}{8EI_2}\left(\left(\frac{L}{2}\right)^4-b^4\right)$$

Uniform load assumed 1,510# per lin ft, (=w)
Deflection at a = 27.27′ W=wL

$$+\ \frac{1510\times54.54\times14.86^3\times12^3}{6\times30{,}000{,}000\times300{,}900} = +0.008622''$$

$$-\ \frac{1510\times14.86^4\times12^3}{8\times30{,}000{,}000\times300{,}900} = -0.001762''$$

$$+\ \frac{1510\times54.54\times12^3}{6\times30{,}000{,}000\times487{,}700}\times(27.27^3-14.86^3) = +0.027554''$$

$$-\ \frac{1510\times12^3}{8\times30{,}000{,}000\times487{,}700}\times(27.27^4-14.86^4) = \underline{-0.011235''}$$

+0.023179″

Total deflection – due to Concentration. 0.25374
due to uniform load. <u>0.023179</u>
0.276919″

神戸運河第一橋「カウンターウエート」構造及施工法説明書

第一章　設計及施行概要

一、「カウンターウエートガーダー」組立取付終了後　各区劃ノ底部 C13 C7 C9 C11ノ個所ニ図面指示ノ二吋ダケ混凝土ヲ敷キナラシノ事　但シ配合一・二・四砂利混凝土トス

二、区劃①②③ノ部分ハCB記号ノ鋼屑混凝土塊ヲ周囲ニ積並ベガーダー及「ブレーシング」取付個所ノ空隙C1 C2 C3 C4ハ前記配合一・二・四砂利混凝土ニテ填充スルノ事。但シ単位重量一立方呎ニ付キ百四十封度トス。区劃④ノ個所ハ断面AAニ示セル如ク下部三段半ハSB記号ノ再製鉄塊ヲ敷キ並ベ其ノ上部ハCB記号ノ鋼屑混凝土塊ヲ積ミ並ベ周囲ノ空隙ハ前項同様配合一・二・四砂利混凝土ニテ填充スルノ事。鋼屑混凝土塊ノ一立方呎ノ単位重量ハ二百八十八封度トス　但シ目地ヲ含ミ平均二百七十封度ノ事

三、以上前後両区劃ヘノ積込ヲ全部鋼屑混凝土平均一立方呎ニ付キ二百七十封度ノモノヲ場所詰トスル事

四、ガーダーCG1及CG3ノ外側区劃⑤⑤Aノ個所ハ鉄型鈑取付ノ上前三項同様鋼屑混凝土平均一立方呎ニ付キ二百五十封度ノモノヲ場所詰トスル事

五、前記各項作リ上ゲ後（断面A-A参照）C8 C10ノ個所ハ厚サ七吋　C14 C12ノ個所ハ七吋四分ノ三・配合一・二・四砂利混凝土ヲ敷キナラス　但シ外側ハ図示ノ如ク鉄筋挿入ノ事

六、区劃⑥及⑦ノ個所ハ鋼屑混凝土（単位重量二百七十封度）場所打ノ事

七、区劃⑧⑨⑩⑪ハ前項同様ノ「ボールト」挿入ノ上鋼屑コンクリート場所打ノ事

八、カウンターウエート底部ハ図面指示ノ如ク銑鉄塊単位重量一立方呎ニ四百五十封度ノモノヲ取付クノ事

九、以上打込ミハ凡テ水平位置ニテ上方床空隙ヨリ作業ヲナスモノトス

第二章　砂利混凝土

一、混凝土ニ使用スル砂利材料ハ其ノ質堅硬ニシテ土其他不純物ヲ附着セズ且ツ大キサハ

正四分目篩通

トシ細粗混交セルモノタルベシ

二、混凝土配合ハ凡テ一・二・四ヲ以テ標準トスベシ

三、混凝土単位重量ハ一立方呎ニ付キ百四十封度トス　務メテ試作ニ依リ規定重量塊ヲ作ルコト可能ナラシムル様係員ノ指揮ニ従ヒ材料及配合ヲ調節スベシ

四、混凝土ノ填充作業ハ鋼屑混凝土塊積込ト併行シテ之ヲ行フモノニシテ塊一段積重毎ニ填充ヲ行フモノトス

五、混凝土ハ練合セ後迅速ニ打込ミ気孔不陸其他欠陥ナキ様専属人夫ヲシテ搗固メシメ間隙ノ填充ヲ充分ニ行渡ラシムヘシ

第三章　場所打鋼屑混凝土

一、鋼屑ハポンチ屑ヲ主トシタル適当ノ大サヲ有スル清浄ナルモノニシテ屈曲シタル鋼鈑鋼棒並ニ不正形材料及形大ニ失スルモノ等ヲ混入スヘカラス
鋼屑ハ豫メ係員ノ指揮ニ従ヒテ種類ニヨリ區分、精選シ検査ニ合格シタルモノニ非レハ使用スルコトヲ得ス

二、練合セ膠泥ノ配合ハセメント一、細砂二、出来上リ重量一立方呎ニ付キ百二十封度トス

三、鋼屑混凝土ノ單位重量ハ

甲	二七〇　封度
乙	二五〇　封度

ノ二種トシ其ノ配合ハ計算上一立方呎ニ付キ

甲、	鋼屑	一九九封度	〇、四〇五　立方呎	毎立方呎ニ付キ	四九〇封度
	膠泥	七一　封度	〇、五九五　立方呎	仝	一二〇封度
乙、	鋼屑	一七二封度	〇、三五　立方呎	仝	四九〇封度
	膠泥	七八封度	〇、六五　立方呎	仝	一二〇封度

トス、豫メ係員立會ノ上鋼屑ノ種類毎ニ各試験塊ヲ作製シ規定重量ヲ得ヘキ鋼屑及膠泥ノ重量割合ヲ検定シ之ヲ配合ノ標準トスヘシ

四、鋼屑混凝土打込量ハ図面記載ノ寸法（深サニ於テ約一尺以外）ヲ以テ其ノ區劃ニ於ケル一日分ノ打込量トナシ之ヲ超ルコトヲ得ス

五、打込ミハ凡テ係員立會ノモトニナシ打込區劃ノ容積ヲ其都度精測計算シテ之ニ対スル所要ノ鋼屑ヲ検量シタル後ニ非レハ打込作業ニ着手スルヲ得ス

六、鋼屑混凝土ハ凡テ配合正シク「ミキンサー」ニヨリ充分混合ノ後所定ノ個所ニ運搬打込ムモノトス

七、打込ノ際ハ其都度區劃内部ヲ清浄ニシテ撒水濕潤ナラシムヘシ

八、區劃④⑤⑤A（図面参照）ニ打込ム鋼屑混凝土ノ鋼屑ハ特ニポンチ屑以外ノモノヲ使用スヘカラス

九、區劃⑤⑤Aハ鉄型板ニ段或ハ三段ヲ取付ケ図面記載ノ深サヲ以テ一日分ノ打込量トナスヘシ 但シ鉄型板取付ト打込作業トハ併行シテナスヘキモノトス

第四章　鋼屑混凝土塊

一、鋼屑混凝土塊ハ図面記載ノ寸法ニヨリ形状正確ニシテ隅角縁端共ニ填充シ有害ト認ムヘキ疵、空窩等アルヘカラス

二、鋼屑混凝土塊ノ計算重量及計算上配合量ハ左ノ如シ

單位重量	毎立方呎ニ付キ　二八八封度			
鋼屑	二二二封度	〇、四五四立方呎	毎立方呎ニ付キ	四九〇封度
膠泥	六六封度	〇、五四六立方呎	仝	一二〇封度

三、鋼管混凝土塊ハ係員立會ノモトニ各塊ニツキ体積及重量ヲ検査シ記入スベシ

四、鋼管混凝土塊積込ノ作業ハセメント膠泥目地トナシ一段毎ニ外部間隙（図面参照）ニ砂利混凝土ヲ填充シタル後ニ非レバ次ノ段ヲ積込ムヲ得ス

第五章　銑鉄塊「B」及再製銑鉄塊「B」

一、銑鉄材料ノ重量ハ

銑鉄　　毎立方呎ニ付　　四五〇封度
再製銑鉄　　仝　　四五〇封度　トス

二、銑鉄塊及再製銑鉄塊共ニ其質緻密ニシテ一樣ナル組織ヲ有シ表面平滑ニシテ隅角及縁端共ニ鋭利ニシテ有害ト認ムベキ龜裂、空隙等アルベカラズ

三、カウンターウェート底部取付ノ銑鉄塊「B」ハ所定ノ形状寸法ヲ鋳込ミタルモノニシテ其強度ハ商工省ノ標準規格ニ準ズルモノトス但シ図面記載ノ重量ヲ以テ標準トスベシ

四、銑鉄塊及再製銑鉄塊ハ係員立會ノモトニ重量検査ヲナシ各塊ニツキ体積及重量ヲ記入スベシ

跳上橋新舊材料比較表

舊設計（舊設計書ニ依ル）

カウンターウェート
- 銑鉄 15.86 tons
- 鋼屑 353.46 369.32 tons
- モルタル及混凝土 2689.5 cf or 12.671 立坪

「カウンターウェート總重量」 1,203,696.# or 537.369 tons

構造鉄總重量（舊設計書参照） 427.583 tons（内 可動部 296.529 tons）

新設計（新材料表ニ依ル）

カウンターウェート
- 銑鉄 15.879 tons
- 再製銑鉄 45.000
- 鋼屑 302.661 363.540 tons
- モルタル及混凝土 13.253 立坪

「カウンターウェート總重量」 1,167,748.# or 521.316 tons

構造鉄總重量 416.718 tons（内 可動部 285.664 tons）

新舊比較表

	銑鉄	再製銑鉄	鋼屑	銑、再製銑、鋼屑計	モルタル及混凝土	カウンターウェート總重	構造鉄總重
舊設計	tons 15.86	tons 0.0	tons 353.46	tons 369.32	立坪 12.671	tons 537.369	tons 427.583
新設計	15.879	45.000	302.661	363.54	13.253	521.316	416.718
差引	0.019(増)	45.000(増)	50.799(減)	5.78(減)	0.582(増)	16.053(減)	10.865(減)

舊設計ニ対スル別設計ノ材料比較表

	銑鉄	再製銑鉄	鋼屑	銑及鋼屑計	モルタル及混凝土	カウンターウェート總重	構造鉄總重
舊設計	tons 15.86	tons 0.0	tons 353.46	tons 369.32	立坪 12.671	tons 537.369	427.583
別設計	15.879	0.0	350.43	366.309	12.565	523.136	416.718
差引	0.019(増)	0.0	3.03(減)	3.011(減)	0.106(減)	14.233(減)	10.865(減)

（但シ別設計ノ材料ハ「別設計図」ヨリ算出ス）

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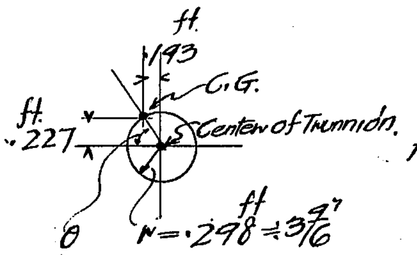
CALCULATIONS FOR

「カウンターウェート」別設計 材料計算書

Part	No	Size	Vol. or wt.	±X arm.	±Y arm.	total vol. or wt.	±X Mt.	±Y Mt.	Density
			c.f			c.f			
周囲ブロック積 ①	2	17'-0½"×6"×7'-0½"	59.98	-12'-9"	-8'-0¼	119.96	-1,530	-964	270#/c.f
②	2	16'-10¼"×〃×〃	59.31	〃	〃	118.62	-1,512	-954	〃
③	4	25'-2"×〃×〃	88.60	〃	〃	354.42	-4,518	-2,850	〃
④	10	10'-3¾×4"×〃	24.17	-17'-3"	〃	241.70	-4169	-1943	〃
				Vol.		834.70 c.f	-11,729	-6,711	
				wt.		225369.#	-3,166,830.'#	-1,811,970.'#	
G~G4.(Concrete only)						102,228.#	-1,426,320.'#	-712,040'#	140#/c.f
⑥~⑪						238,653.	-3,291,840'#	-688,500'#	270#/c.f
⑤&⑤A						115,943.#	-1,619,712'#	-933,408'#	288#/c.f
BB.	114.					36,822#	-503,725'#	-448,860'#	450#/c.f
				Total		719,015.	-10,008,427.	-4594,778.	
			c.f			c.f			
内部打込 ①	2	5'-0"×2'-6¼×7'-0½	88.70	-12'-9"	-8'-0¼	177.40	-2262.	-1,423.	
②	2	〃×2'-5⅛×〃	85.54	〃	〃	171.08	-2181.	-1,372	
③	4	〃×6'-7⅟₁₆×〃	231.97	〃	〃	927.88	-1,1830.	-7,442	
④	10	1'-4"×3'-1⅞×〃	29.59	-17'-3"	〃	295.90	-5104	-2373	
				Vol.		1572.26 c.f	-21,377.	-12,610	
				wt.		452,810.#	-6156577'#	-3,631,681.'#	288#/c.f
				Summary ①		1,171,825.#	-16,165,004.'#	-8,226,459.	
Count. wt Girders.						132,446	-1,904,452	-1,049,186.	
Rear lateral bracings.						29,102	-274,992	-130,580	
Wind load bearing Blocks.						1,356	-21,696	-16,475	
				Summary ②		162,904#	-2201,640'#	-1,196,241#	
				Summary ①+②		1,334,729.#	-18,366,644.#	-9,422,700.'#	
Front.						663,316#	+18,751,551'#	-613,695'#	
Count. wt.						1,334,729	-18,366,644	-9,422,700	
						1,998,045	+384,907	-10,036,395	



Center of gravity { X + 384,907 ÷ 1,998,045 = +0.193 ft
Y -10036395 ÷ 〃 = -5.023

5.25 - 5,023 = 0.227 ft.

$\tan\theta = \frac{.227}{.193} = 1.176166 \therefore \theta = 49°-40'$

$r = .193 \times \sec\theta = .193 \times 1.545 = .298 \text{ ft} \doteqdot 3\tfrac{9}{16}''$