JIUN MASUDA
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SEIYU BLDG, TOKIO

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CALCULATIONS FOR

神戸市都市計畫課

神戸葺壱運河橋設計々算書

昭和二年三月成

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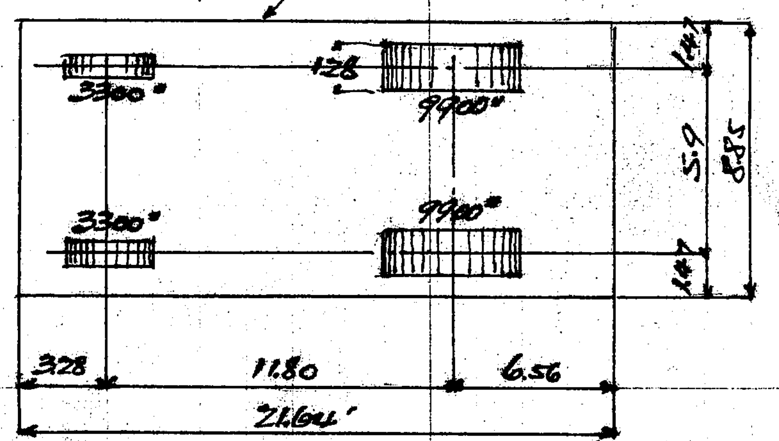
CALCULATIONS FOR

First Canal Bridge for Kobe, 60' Single Leaf Trunnion Bascule.

General Data.
Width of Roadway. 2 driveways 15.0k 18.0k for street car total width 48.0k bet. curb lines. Equivalent in ft = 47' 8¾"
Clearance from edge of plate girder to curb line 6", width of main bascule = 1'2"
Sidewalk assumed 7.0k or 6'-11½" clear
Driveway will be of timber construction with woodblock pavement 3" thick
Sidewalk slab will be of reinforced concrete construction; Double track electric car lines at ℄ bridge spaced 10'0" center to center of tracks
60'0" clear between faces of abutment and clearance above highwater Elevation 12.0
From vertical clearance line to crown of roadway limited to 4'0".

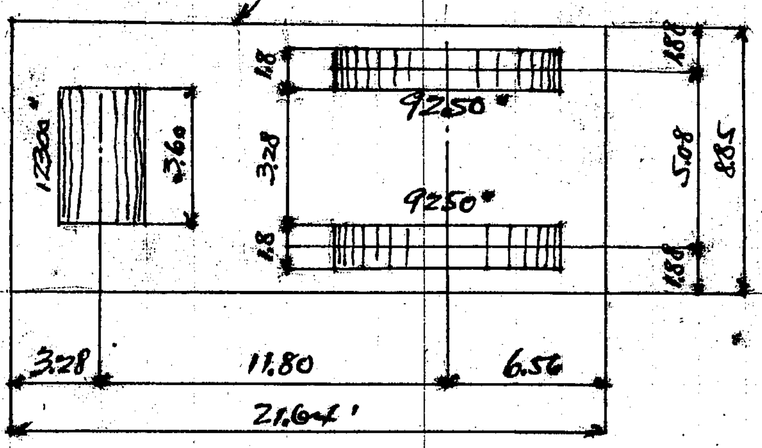
Assumed Loadings
Uniform load on roadway $w = \frac{120.000}{170+l} = 600\ kg/m^2$ or say 120 #/□'
Uniform load on sidewalk $w = \frac{100.000}{170+l} = 500\ kg/m^2$ or say 100 #/□'
where w = uniform load in kg per sq meter
l = span length in meter.

12 ton motor truck loading



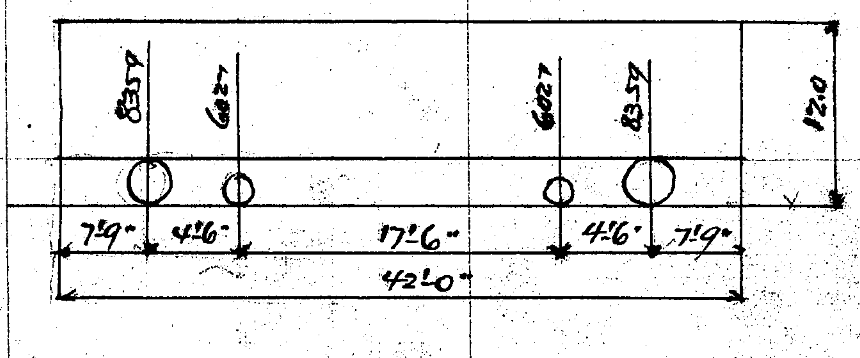
4 Rows of motor traffic on roadway with occupied width of 8.85' each
Unoccupied space of motor truck and street car loading shall be filled with the Uniform load specified above.
Impact into consideration.

14 ton Road Roller

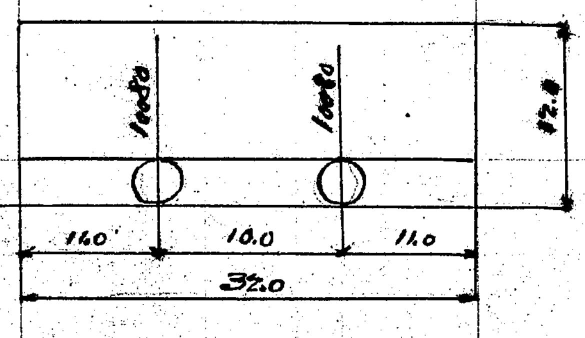


One roadroller on span without impact.
Impact for motor truck and Electric Railway car loadings
$i = \frac{20}{60+l} = 0.3$
where i = Coefficient for impact
l = loaded length of span in meter.

Electric Railway car loading
26 英呎「ボギー」車 load per rail.



18英呎電車(甲式単車) load per rail.



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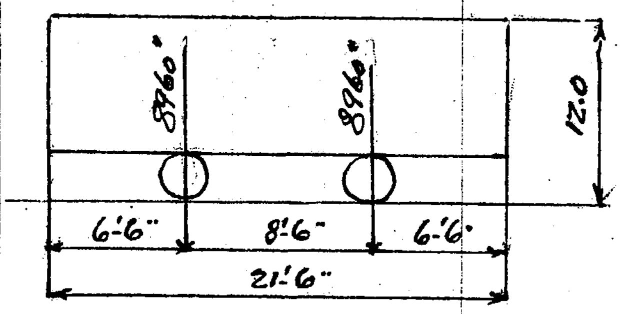
CALCULATIONS FOR

First Canal Bridge for City of Kobe. 60' single leaf trunnion bascule.

16英噸撒水車 load per rail.



Assumed width of Electric Railway Car 8'0"
Assumed wind pressure

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 inches

Compression flange of plate girder
$17000 (1 - 0.012\ l/b) \leqq 15400$ #/□.

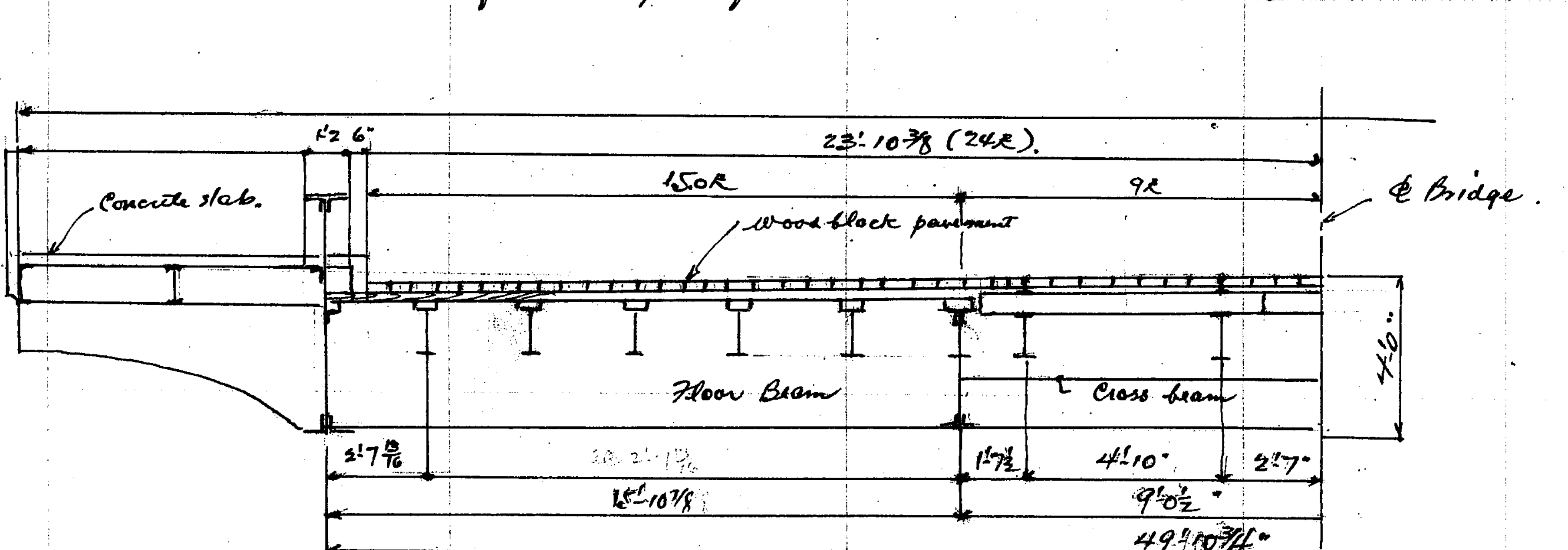
Shearing on shop driven rivets (machine)	12000 #/□"
Shearing on field driven rivets and turned bolts (machine)	10,000 "
Extreme fibre stress of pin.	24,000 "
Bearing on shop rivets	24,000 "
Bearing on field rivets and turned bolts	20,000 "
Bearing on pin	24,000 "
Bearing on masonry	640 "

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 impact stresses, the allowable working strength shall be increased 25% and proportioned the parts. In case of earthquake, the unit strength shall be increased 80% and proportion 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 City of Kobe. 60' single Leaf Trunnion Bascule.

Highway Floor span length $2'\text{-}7\frac{3}{16}" = 2.64'$

Creosoted woodblock pavement 3" thick @ 5.0" = 15.0
Asphalt felt for water proofing 0.3
3" Creosoted Planking 15.0
303# per sq. ft.

Dead Load moment $= \frac{1}{10} \cdot 30.3 \cdot 2.64^2 = 21.0$ '#
Dead Load shear $= \frac{1}{2} \cdot 30.3 \cdot 2.64 = 40.0$ #

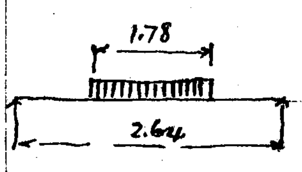
Live Load motor truck rear wheel 9900
30% impact 2970
12870#

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

Distribution of wheel concentration
Contact surface between wheel + pavement 0.66
3" wood block pavement distribution $2 @ .25 =$ 0.50
Longitudinal distribution $a =$ 1.16
Transverse distribution $b = 1.28 + 0.5 =$ 1.78'

Distribution assumed 2'0" wide

Motor truck rear wheel $= 12870 \div 2 = 6435$ # per ft strip.



moment at center $\frac{6435}{2} \cdot \frac{2.64}{2} = 4250$ '#
Less $3217 \cdot \frac{1.78}{4} = 1430$
2820 '#

For continuity of span take moment as $0.8 \cdot 2820 = 2260$
Dead Load moment 21
Total moment 2281 '#

Assume 3" planking fibre stress $= \frac{6 \cdot 2281 \cdot 12}{12 \cdot 3^2} = 1525$ # per sq inch

1270 #/□"

Floor between rails Railway ties spaced about 2.5'
Use 3" planking same as for highway floor

Cross ties under tracks and ~~and~~ between. max span length 5'2" spacing of ties 2.5'

Dead Load floor $30.3 \cdot 2.5 =$ 76.0 $m = \frac{1}{8} \cdot 102.7 \cdot 5.17^2 = 342$ '#
cross ties $8" \cdot 8"$ 26.7
102.7 shear $= \frac{1}{2} \cdot 102.7 \cdot 5.17 = 265$ #

Live Load motor truck loading Rear wheel with impact = 12870 # per wheel
Transverse distribution wheel 1.28
pavement and planking $2 @ 0.5 =$ 1.00
2.28'

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

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

$13322 \times 0.8 = 10680$

Summary for moments and shears

	moment	shear
Dead Load	342	265
Live Load	12980	10100
	13322 '#	10365 #

Using wooden sleeper! —
Fibre stress $= \frac{6 \cdot 13322 \cdot 12}{8 \cdot 8^2} = 1870$ #/□"
Shearing $= \frac{10365}{8 \cdot 8} = 162$ #/□"

Using steel stringer 10680×12 ... 8.32
$m = 13322 \times 0.8 = 10680$ '"
$6 \cdot 4\frac{1}{2} I \times 20.0\# = 11.55$
$Sm = \frac{10680 \times 12}{15400} = 8.32$
use $6" \cdot 4\frac{1}{2}" I \cdot 20.0\#$ $Sm = 11.55$

Sidewalk slab. span length say $3'\text{-}9\frac{1}{4}" = 3.77'$
3" Reinforced Concrete slab with 3/4" wearing course.
Dead Load $3\frac{3}{4}"$ concrete slab. 47#
Live Load 100
147# per sq. 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 for City of Kobe, 60' Single Leaf Trunnion Bascule.

moment $= \frac{1}{8} \cdot 147 \cdot 3.77^2 = 261.0$ ''#

Effective depth required for 17000#/□" Steel stress and 640#/□" Concrete stress.

$= \sqrt{\frac{261. \cdot 12}{12 \cdot 102}} = 1.6"$ 3/4" insulation at ~~bottom~~

make slab. 3" thick 3/4" wearing course on top.

Steel Area $= \frac{261 \cdot 12}{\frac{7}{8} \cdot 2.25 \cdot 17000} = 0.0930$□" use 3/8"ϕ bars 6" centres

Highway Stringers H.S.

span length = 15'-9" stringer spacing = 2.64'

Dead Load 30.3 · 2.64 = 80.0

stringer say 45.0

nailing piece 4"·6" = 10.0

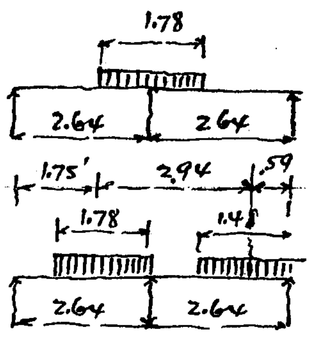
135.0# per lin. ft.

D.L. m $= \frac{1}{8} \cdot 126.5 \cdot 15.75^2 = 3920$ ''#

D.L. shear $= \frac{1}{2} \cdot 126.5 \cdot 15.75 = 1000$#

Live Load motor truck loading rear wheel concentration with impact 12870#

Transverse distribution = 1.78'



$12870 \cdot \frac{1.48}{1.78} = 10700$

Load on stringer $6435 \cdot \frac{2.19}{2.64} = 5340$

5340

10680#

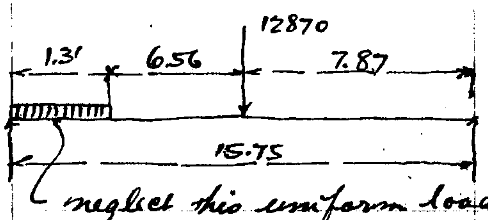
Load on stringer $12870 \cdot \frac{1.75}{2.64} = 8520$#

" " " $10700 \cdot \frac{.84}{2.64} = 3000$

11520# max.

Assume wheel load (entire) on stringer.

moment at centre of span 6435 · 7.87 = 50600 ''#



neglect this uniform load

Front wheel say 4290

Max live load shear $4290 \cdot \frac{3.95}{15.75} = 1070$#

12870

13940#

Summary for moments and shears

	moment	shear
Dead Load	3920	1000
Live Load	50600	13940
	54520 ''#	14940#

section modulus $= \frac{54520 \cdot 12}{17000} = 38.6$

use 15"⌶42.9# = Sm = 58.9

Sidewalk fascia Stringer span length 15.75'

Dead Load Concrete slab 47# · 2.15 = 101.0

Handrail assumed 40.0

141.0

Live Load assumed 1.87 · 100 187.0

Beam assumed 35.0

363.0# per lin ft.

$m = \frac{1}{8} \cdot 363 \cdot 15.75^2 = 11250$ ''#

$shear = \frac{1}{2} \cdot 363 \cdot 15.75 = 2860$#

Section modulus required $= \frac{11250 \cdot 12}{17000} = 7.95$ use 12"·3½ [@ 26.10#

Sm = 26.4

Sidewalk stringer SS2 Span length 15.75

Dead Load Concrete slab. 47# · 3.77 = 177

Live Load assumed 3.77 · 100 = 377

stringer assumed 35

589# per lin. ft.

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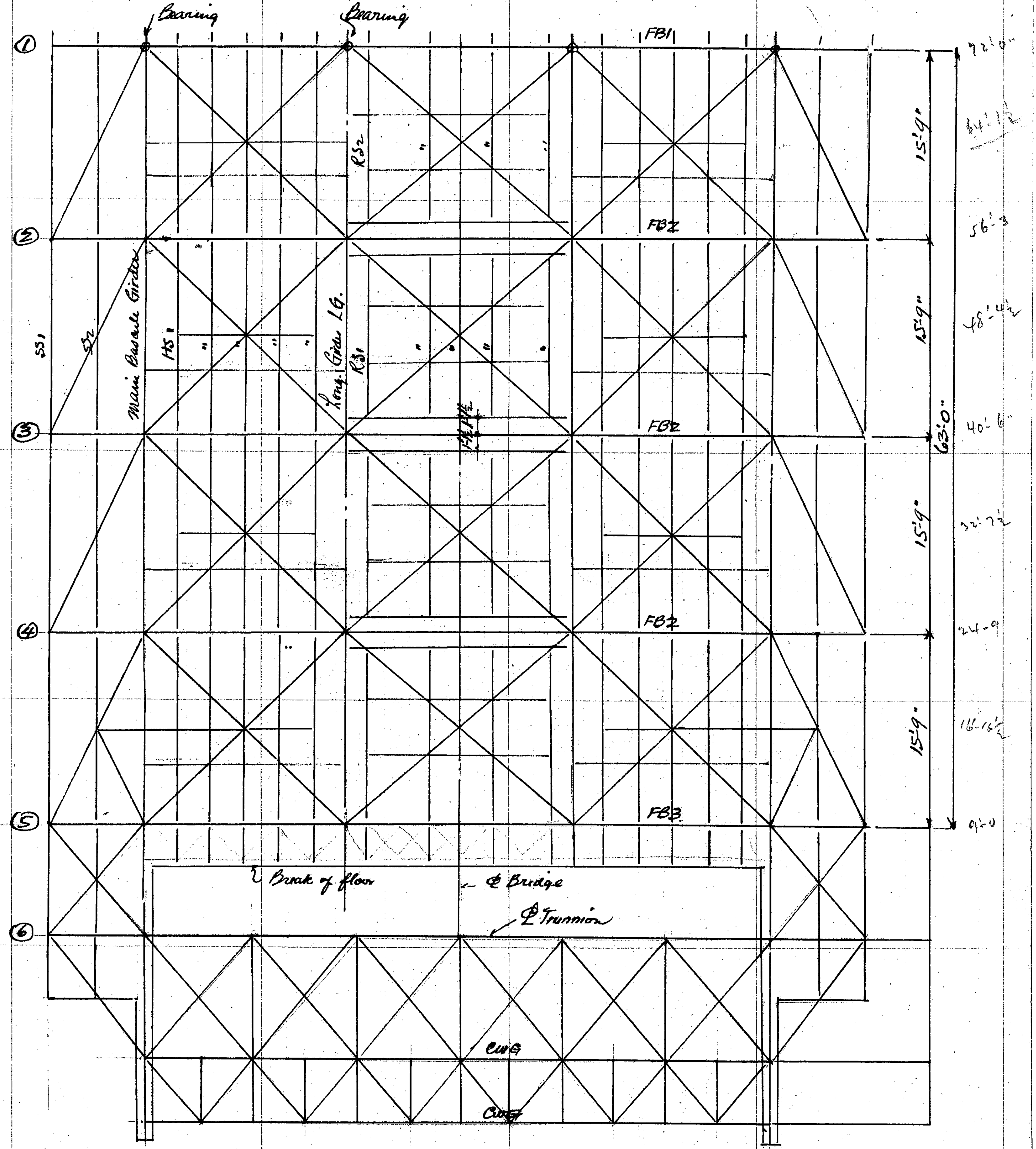
CALCULATIONS FOR

First Canal Bridge for City of Kobe, 60' Single Leaf Trunnion Bascule.
General Framing of Bascule Bridge



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CALCULATIONS FOR

First Canal Bridge for City of Kobe, 60' Single Leaf Trunnion Bascule.

Sidewalk stringer SS2 Continued

moment = $\frac{1}{8} \cdot 589 \cdot 15.75^2$ = 18300''#

shear = $\frac{1}{2} \cdot 589 \cdot 15.75$ = 4650#

Section modulus reqd = $\frac{18300 \cdot 12}{17000}$ = 12.9   Use 12" × 5" @ 31.99# Sm = 36.69

Intermediate Elec. Ry Stringer RS1   span length = 13'6"   Spacing 4'10" and 5'2"

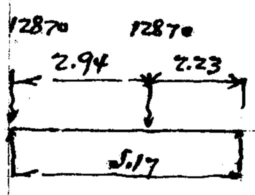
Dead Load	Flooring	30.3# · 5.0 =	151.5
	Cross beam	$\frac{8'' \cdot 8'' \cdot \cancel{6.0}\ 7.0}{2.25}$ @ 60" =	84.0
	Stringer assumed		45.0
			280.5
	Rails and accessories		42.5
			323.0#

Dead Load moment = $\frac{1}{8} \cdot 323 \cdot 13.5^2$ = 7350''#

shear = $\frac{1}{2} \cdot 323 \cdot 13.5$ = 2180#

Live Load   motor truck loading   Rear wheel cone. = 12870

max load on stringer

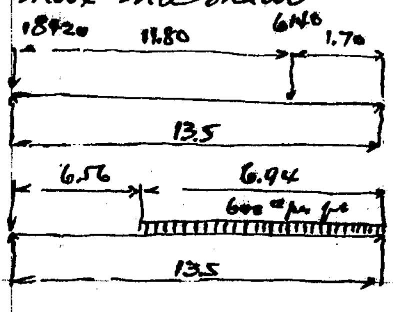


Reaction = 12870 · $\frac{2.23}{5.17}$ = 5550
12870
18420#

Load on ℄ of span neglect uniform load at rear of wheel.

moment = $\frac{18420}{2} \cdot \frac{13.5}{2}$ = 62200''#

max End Shear



Front wheel concentration $\frac{1}{3} \cdot 18420$ = 6140

Reaction = 6140 · $\frac{1.70}{13.5}$ = 772#
18420
19192#

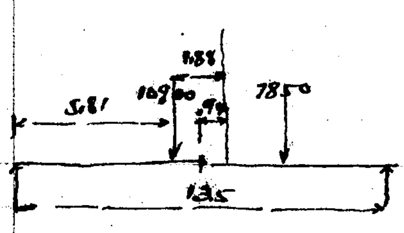
Uniform load 120 · 5. = 600# per lin ft.

End shear = $\frac{600 \cdot 6.94^2}{2 \cdot 13.5}$ = 1070

Rear wheel motor truck 18420
19490#

Electric Railway Car Loading

wheel load with impact 8359 · 1.3 = 10900
6027 · 1.3 = 7850
18750#



Center of gravity = $\frac{7850 \cdot 4.5}{18750}$ = 1.88'

moment = 18750 · $\frac{5.81^2}{13.5}$ = 46900''#

max End shear = 7850 · $\frac{9.0}{13.5}$ = 5230
10900
16130#

Summary for max moments and shears

	moment	shear
Dead Load	7350	2180
Live Load	62200	19490
	69550''#	21670#

section mod. reqd = $\frac{69550 \cdot 12}{17000}$ = 49.2

Use 15" · 42.9# I   Sm = 58.9
or 18" · 54.7# I   Sm = 88.4   same as for stringer RS2.

Electric Railway Stringer RS2 at end of span   span length 14'-7½"
spacing of stringers 4'10" and 5'2"

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CALCULATIONS FOR

First Canal Bridge for City of Kobe, 60' single leaf bascule

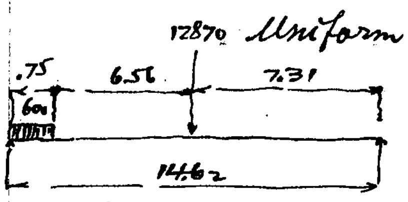
Dead Load on stringer 323.0# per lin. ft.

Dead Load moment = $\frac{1}{8} \cdot 323 \cdot 14.62^2$ = 8650'#

Dead Load shear = $\frac{1}{2} \cdot 323 \cdot 14.62$ = 2370#

Live Load motor truck loading rear wheel concentration = 12870# load on stringer = 18420

Uniform live load 120 • 5.0 = 600# per lin. ft.



moment = $\frac{18420}{2} \cdot 7.31$ = 67400'#

23 • 7.31 = 170

67570'#

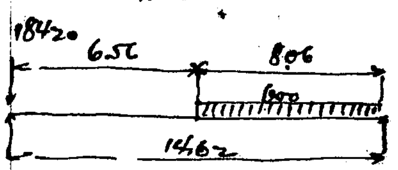
R = $\frac{600 \cdot .75^2}{14.62}$ = 23#

max End shear

Uniform load $\frac{600 \cdot 8.06^2}{2 \cdot 14.62}$ = 1330

motor truck loading 18420

19750#



Summary for max moments and shears

	moments	shear
Dead Load	8650	2370
Live Load	67570	19750
	76220'#	22120#

section modulus reqd = $\frac{76220 \cdot 12}{17000}$ = 53.8

Use 15" 42.9# I Sm = 58.9

Unit stress = $\frac{76220 \cdot 12}{58.9}$ = 15500#/□"

Try 18" • 54.7# I Sm = 88.4 width of flange = 6"

Allowable unit stress for compression flange = 17000 (1 − 0.012 l/b) =

where l = 66" b = 6" = 17000 • .868 = 14750#/□"

Unit stress = $\frac{76220 \cdot 12}{88.4}$ = 10350#/□" Ok

Railway Cross Beam under tracks. span length 18'-1".

Dead Load. Concentration A.

Flooring 30.3 • 5 = 151.5

Cross beam $\frac{8" \cdot 8" \cdot 6.5}{2.25 \cdot 2}$ @ 60# = 39.0

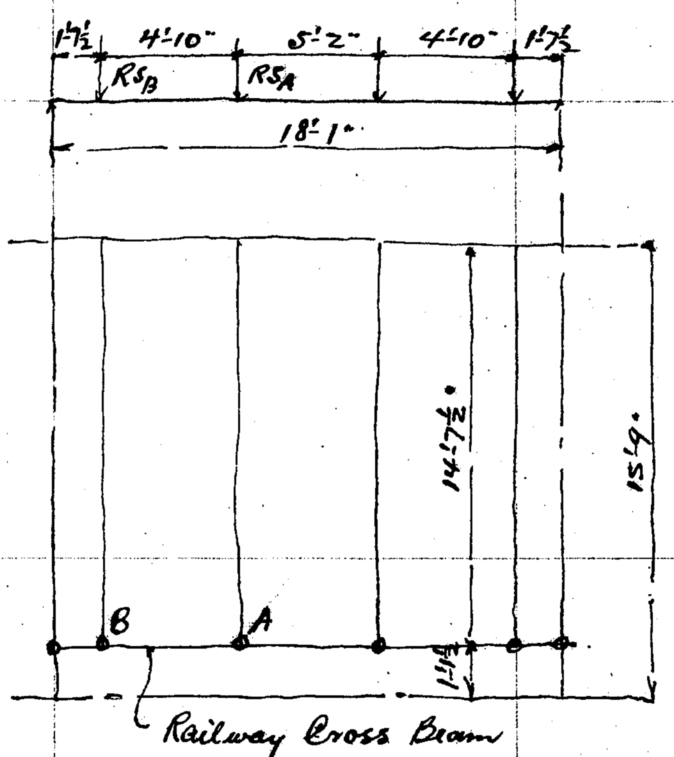
$\frac{8" \cdot 8" \cdot 6.5}{2.25 \cdot 2}$ @ 60 = 39.0

Stringer assumed 45.0

Rails and accessories 42.5

317.0#

Concentration 317 • $\frac{14.62}{2}$ = 2320#



Concentration B.

Flooring. 30.3 • 3.23 = 98.0

Cross ties. 39.0

Stringer 45.0

Rails + accessories 42.5

224.5

For misc. load say 5.5

230.0# per lin. ft.

Concentration 230 • $\frac{14.62}{2}$ = 1680#

Uniform dead Load of flooring 30.3 • 1.12 = 34#

Dead Load girder assumed 70

104# per lin. ft.

Dead Load moment at A.

4000 • 6.46 = 25900

1680 • 4.83 = −8100

17800'#

Unif. $\frac{1}{8} \cdot 104 \cdot 18.08^2$ = 4250

22050'#

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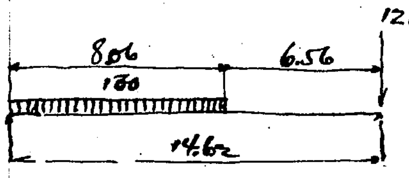
CALCULATIONS FOR

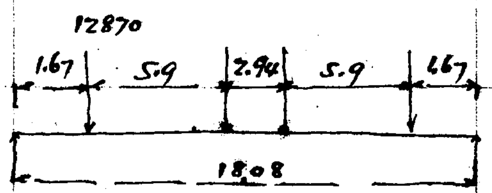
First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

max End shear. due to stringer Conc 4000
Unif. load $104 \times \frac{18.08}{2} = 940$
4940#

Live Load. motor truck loading Rear wheel Concentration = 12870#
Uniform load $120 \times \frac{8.062}{2 \times 14.62} = 266$# per lin ft.



moment due to motor truck
$2 \times 12870 \times 7.57 = 195000$
$12870 \times 5.9 = 75900$



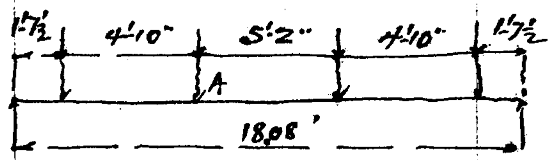
119100'#
Unif. $\frac{1}{8} \times 266 \times 18.08^2 = 10850$
129950 '#

Max End shear $4 @ 12870 \times \frac{10.71}{18.08} = 30500$#
Unif. load. $266 \times \frac{18.08}{2} = 2400$
32900#

Rear wheel $4 @ 12870 \times \frac{10.71}{18.08} = 30500$

Front wheel. $4 @ 4290 \times \frac{2.82}{14.62} \times \frac{10.71}{18.08} = 1960$
32460#

Live Load Electric Railway Car loading. 10900 + 7850 including impact
Load on floor beam
$7850 \times \frac{11.12}{14.62} = 5970$
10900
16870#



moment at A.
$2 \times 16870 \times 6.45 = 217500$
$16870 \times 4.83 = 81500$
136000'#

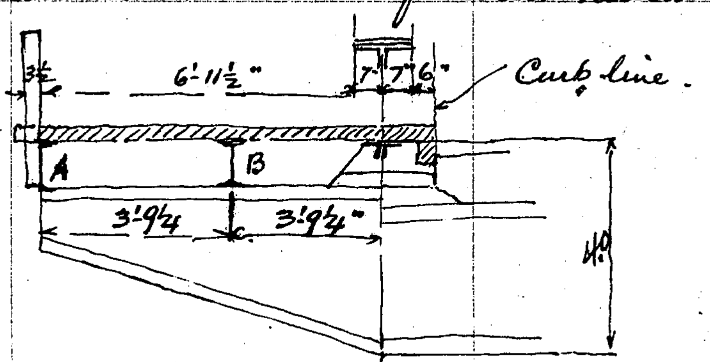
Reaction at end. 2 @ 16870 = 33740#

Summary for moments and shears ~~web assumed~~ 18 × 3/8 = 6.750"
	moments	shears
Dead Load	22050	4940
Live Load.	136000	33740
	158050'#	38680#

1/8 web = 0.840" Effective depth = 1.30
flange stress = 158050 ÷ 1.30 = 122000#
S.R. = 122000 ÷ 17000 = 7.18
Less. 0.84
6.34 □" net
Use 2 L5 × 4 × ½ = 8.50 (~~7.50~~) or ~~6.50~~ 7.50 □" net.

Deflection m. of inertia 1276 (in)⁴ or 0.0615 (ft)⁴
$158050 \times \frac{5}{48} \times \frac{18.08^2}{144 \times 30.000.000 \times 0.0615} = 0.0204'$
$d/l = 1/884$

Cantilever Bracket for intermediate panel.



Dead Load.
Concentration at A.
Concrete slab.	47# × 2.15	= 101.0
Handrail assumed		40.0
Beams &c assumed		35.0
		176.0# per ft

Concentration = 176.0 × 15.75 = 2770#

~~Concentration~~ at B
Concrete slab	47 × 3.77	= 177.
stringers &c assumed		35.
		212.# per ft

Concentration = 212.0 × 15.75 = 3340#

Dead Load Cantilever brackets assumed 100# per lin ft.

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule

Dead Load Cantilever moment about ℄ Bascule girder.

A. 2770 × 7.54 = 20850 Cant. m = 100 × $\frac{7.54^2}{2}$ = 2840
B 3340 × 3.77 = 12600
33450#
2840
36290 '#

Live Load Cantilever moment
100# per sq ft. panel Concentration. 1575# per lin ft.
moment = 1575 × $\frac{7.54^2}{2}$ = 44800 '#
DL m 36290
81090 '#

max End shear DL. 2770
3340
754
6864
Live Load 1575 × 7.54 = 11900
18764 #

Depth of Cantilever bracket 3.0' fibre stress = 81090 ÷ 3.0 = 27000 #
section required = 27000 ÷ 17000 = 1.590 □" net.
use web 5/16" thick flange angles 2Ls 3½ × 3½ × 3/8 = 4.96 □" gr or 4.21 □" net.

Cantilever Bracket for 6.0' Sidewalk. floor slab and stringers same as for 7.0' side walk.

Dead Load. Concentration at A.
Concrete slab. 47# × 1.92 = 90#
Handrail assumed 40
Beam &c 35
165 #

Concentration 165 × 15.75 = 2600 #
Concentration at B.
Concrete slab. 47# × 3.27 = 154
Stringers &c 35
189 #

Concentration 189 × 15.75 = 2980 #

Dead Load Cantilever Moment
A 2600 × 6.54 = 17000
B 2980 × 3.27 = 9750
26750
Cantilever Beam 100 × $\frac{7.54^2}{2}$ = 2840
29590 '#

Live Load 100 × 15.75 = 1575 # for 6.0 = 1575 × 6 = 9450 #
LL moment = 9450 × 3.58 = 33800
DL moment = 29590
Total moment – 63390 '#

End shear DL. 2600
2980
754
6864
Live Load – 9450
16314 #

Depth of bracket 3.0 flange stress = 63390 ÷ 3.0 = 21200 #
section required = 21200 ÷ 17000 = 1.25 □" net
use web 5/16" thick flange 2Ls 3½ × 3½ × 3/8 = 4.96 □" gr or 4.21 □" net

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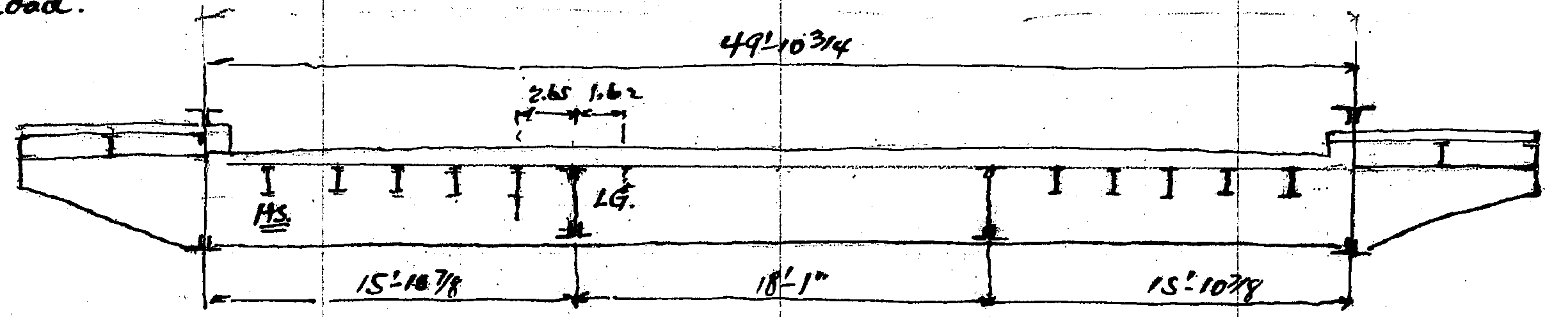
CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

Intermediate Floor Beam FB2. span length - 49'-10 3/4" (49.89').
For cross section of floor beam see page 2
Dead Load.



Concentration at LG.

Railway stringer RSA.	317 × 13.5/2	=	2140	4280
Railway stringer RSB	230 × 13.5/2	=	1550	3100
Unif. load with girder.	104 × 9.04	=	940	

4630# × 2 = 9260#

Longitudinal girder LG.

Flooring.	30.3 × 4.27/2	=	65#
nailing piece	8×4/144 @ 60	=	13#
girder assumed	80# per ft		80

158 × 15.75/2 = 1240 × 2 = 2480
5870# × 2 = 11740

Concentration at HS.
Dead Load page 4 135# × 15.75/2 × 2 = 2120 ~~1060~~# call this 2200 ~~1100~~#
moment due to concentration
Reaction 5 @ 2200 ~~1100~~ = ~~5500~~# 11000
Total ~~5870~~ 11740
~~11370~~# 22740

22740 ~~11370~~ × 15.90 = 361600 ~~180800~~
11000 ~~5500~~ × 15.9/2 = 87400 ~~43700~~
274200 ~~137100~~ #

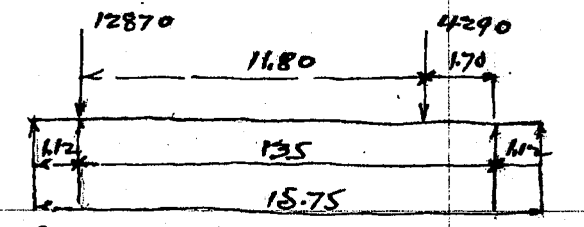
Uniform load girder assumed. 220# per ft.

Girder etc 1/8 × 220 × 49.89² = 68400
342600 ~~205500~~ #

Less cantilever moment - 29590
313010 # ~~175910~~ #

max End Shear 22740 ~~11370~~
220 × 49.89/2 = 5500
28240 ~~16870~~ #

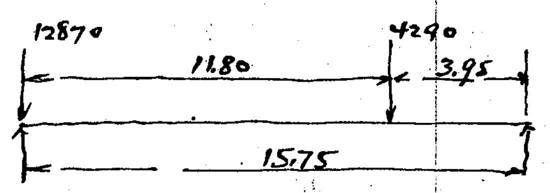
Live Load. motor truck loading



Rear wheel 12870# including impact
Front wheel 4290# " "
Reaction 4290 × 1.70/13.50 = 540#
4290 - 540 = 3750.
12870 + 540 = 13410#

For Electric Ry

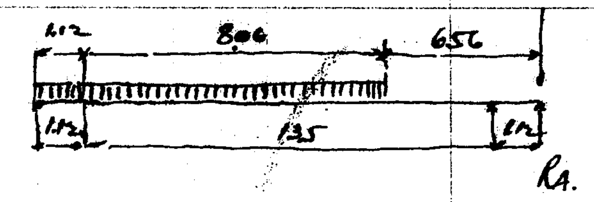
Reaction RA.
12870
540
13410 × 14.63 ÷ 15.75 = 12480
3750 × 1.12 ÷ 15.75 = 270
12750 #



Reaction RA 12870 -- 12870
4290 × 3.95 ÷ 15.75 - 1710
14580
Assume this concentration for roadway

Uniform live Load 120# per sq ft

806 × 120 = 965#



965 × 4.03 ÷ 13.5 = 288
965 - 288 = 677#
1.12 ~~8.06~~ × 120 = 135#
135 ÷ 2 = 68

} 745#

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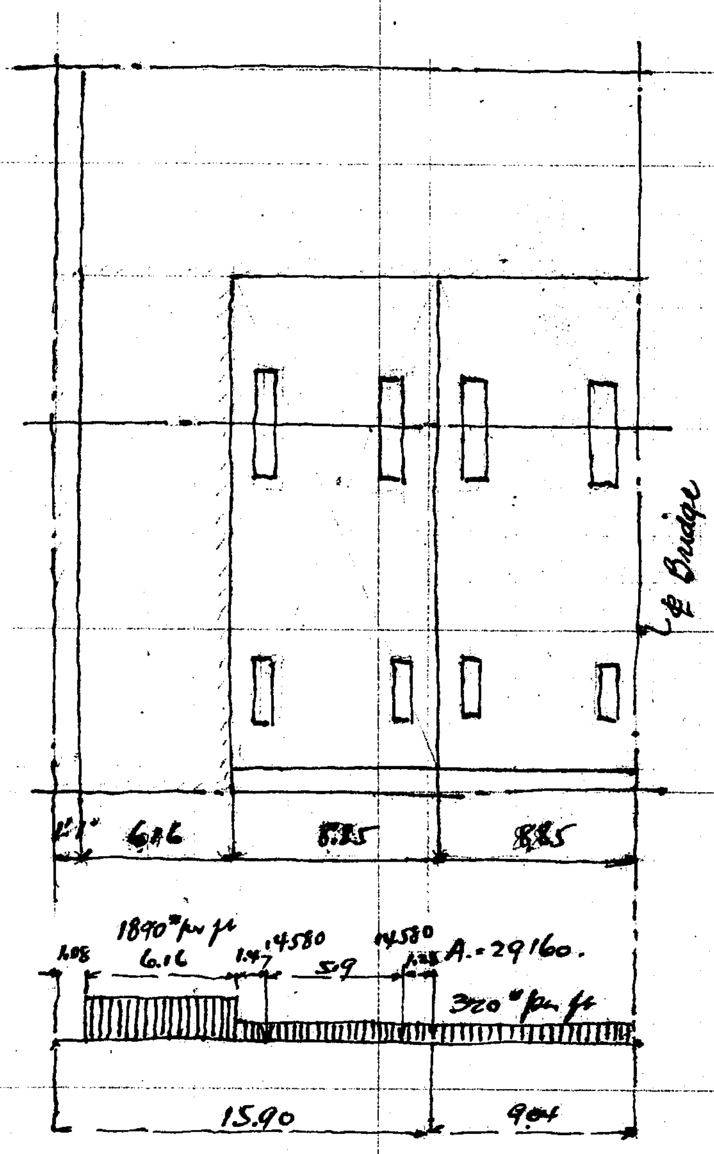
CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

Reaction 288 × 14.63 ÷ 15.75 = 268#
745 × 1.12 ÷ 15.75 = 53#
321# per ft strip. say 320#

Highway side. Unif. load 9.18 × 120 = 1100#
Reaction 1100 × 4.59 ÷ 15.75 = 320# per ft strip.



Load A. due to motor truck loading.
2 @ 14580 = 29160#
Uniform load 120 × 15.75 = 1890#

Reaction due to motor truck loading.
29160
2 @ 14580 = 29160
58320#

moment due to motor truck loading
58320 × 15.90 = 928000
29160 × 4.23 = 123200
804800#

Reaction due to unif. load
320 × 17.70 = 5660#
1890 × 6.16 = 11630
17290#

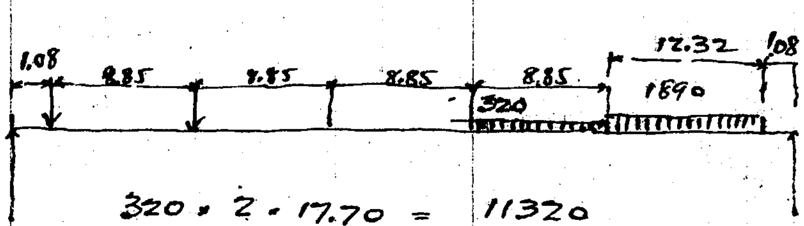
moment 17290 × 24.94 = 431.000
Less 5660 × 8.85 = 50100
11630 × 20.78 = 242000 292100
138900#
Moment due to motor truck 804800
943700#

Max End shear
motor truck ~~loading~~.

4 @ 29160 × $\frac{31.10}{49.89}$ = 72600#

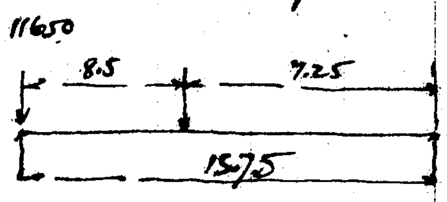
due to unif load.
11320 × $\frac{31.10}{49.89}$ = 7060

23260 × $\frac{7.24}{49.89}$ = 3380
83040#



320 × 2 × 17.70 = 11320
1890 × 12.32 = 23260

Electric Railway Car loading.



water car 8960 × 1.3 = 11650#
Reaction 11650 × $\frac{7.25}{15.75}$ = 5350
11650
17000#

2 @ 17000 = 34000# at A.

moment due to Electric Ry car loading
Reaction 34000
motor truck 29160
63160

moment 63160 × 15.90 = 1002000 1002000
29160 × ~~3.38~~ 4.23 = ~~98500~~ 123200
~~903500~~# 878800#
moment due to unif. load 138900
1017700#

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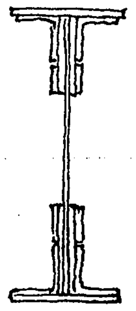
CALCULATIONS FOR

First Canal Bridge for ~~momonto~~ City of Kobe. 60' Single leaf trunnion bascule.

Summary for moments and shears.

Dead Load.	313010	28240
Live Load.	1017700	83040
	1330710 '#	111280 #

Assumed section of girder.



1 web.	36 × 1/2	=	18.00						1944
4 Ls	8 × 6 × 3/4	=	39.76	×	16.69²	+	120	=	11170
4 P/s.	9 × 3/4	=	27.00	×	13.5²	+	182	=	5100
4 P/s.	3 × 3/4	=	9.00	×	10.5²	+	6	=	998
2 P/s.	16½ × 3/4	=	24.75	×	18.62²			=	8570
			118.51□"						27782 (in)⁴ 1.34 (ft)⁴

Allowable unit stress = 17000 (1 − 0.012 l/b) = 14150 #/□"
where unsupported length = 216" b = 16.5

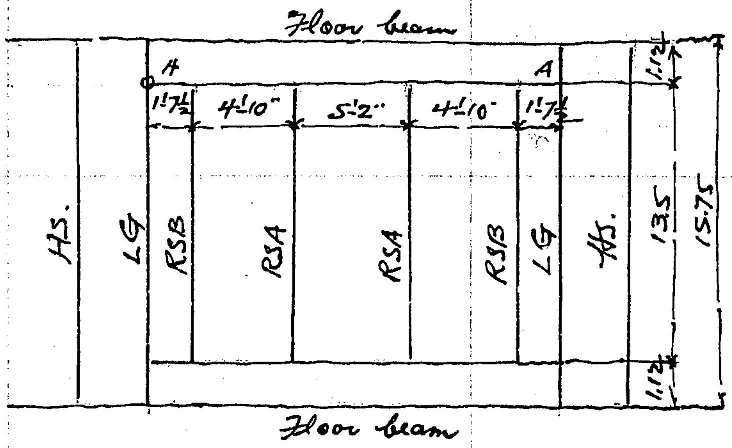
Unit stress = $\frac{1330710 \times 12 \times 19}{27782}$ = 10900 #/□"

Approximate deflection due to unif. load $\Delta = \frac{5wl^4}{384EI} = \frac{1}{8}wl^2 \times \frac{5}{48} \times \frac{l^2}{EI}$.

$\Delta = 1330710 \times \frac{5}{48} \times \frac{49.89^2}{144 \times 30.000.000 \times 1.34} = 0.0595'$ or $0.715"$

$\Delta/l = \frac{0.0595}{49.89} = \frac{1}{837}$

Design of Longitudinal girder LG1



Dead Load
Concentration at A

Railway stringer RSA	317 × 13.5/2	=	2140
Railway stringer RSB	230 × 13.5/2	=	1550
Unif. load	104 × 9.04	=	940
			4630 #

Longitudinal girder

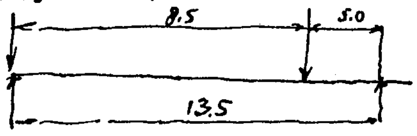
Flooring	30.3 × 4.27/2	=	65
nailing piece	8×4/144 @ 60	=	13
Girder assumed			80
			158 # call this 160 # per ft

Dead Load moment

				shear	4630
Due to Concentration at A	4630 × 1.12 =	5200		½ × 160 × 15.75 =	1260
Due to unif. load	1/8 × 160 × 15.75² =	4960			5890 #
		10160 '#			

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 ÷ 15.75 = 1040
$31920 \times \frac{14.62}{15.75}$ = 29600
30640

max live load shear due to motor truck $4290 \times \frac{3.95}{15.75}$ = 1070
12870
13940

due to electric car loading 30640
44580 #

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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	10160	5890
Live Load	85.000	44580
	95160'#	50470#

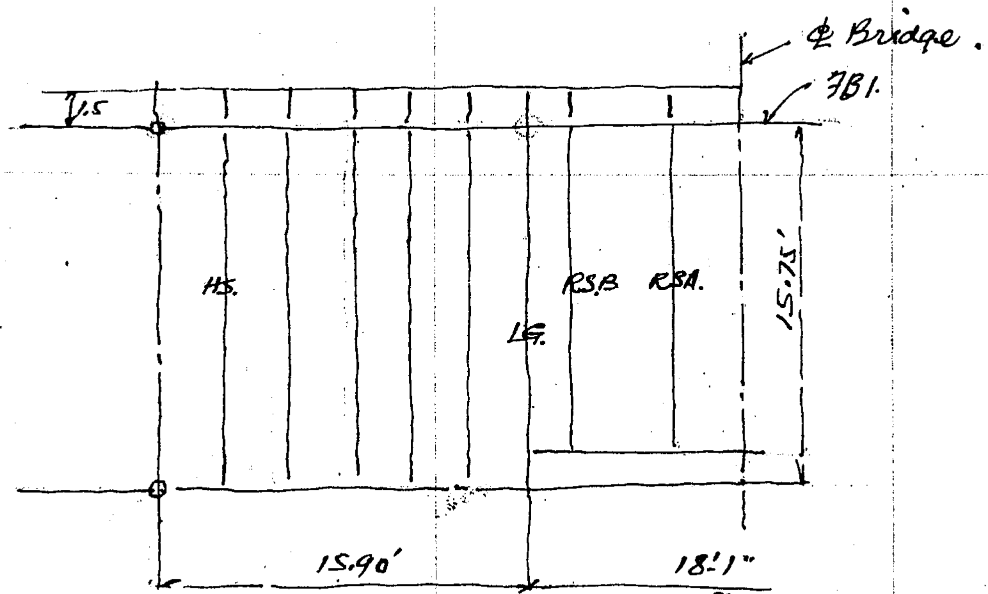
allowable unit stress in flange. 17000 × (1 − 0.012 l/b) = 12650 #/□"
where l = 15'9" = 189" b = 7 3/8

Try min. section 4Ls 3½ × 3½ × 3/8 and web 31½" 32" b to b of Ls.

			m of I
1 web. 31½ × 3/8	=	11.80	= 975
~~2~~ 4 Ls 3½ × 3½ × 3/8	=	9.92 × 14.99² + 11.0	= 2241
			3216

Fibre stress = $\frac{95160 \times 12 \times 16}{3216}$ = 5680 #/□"

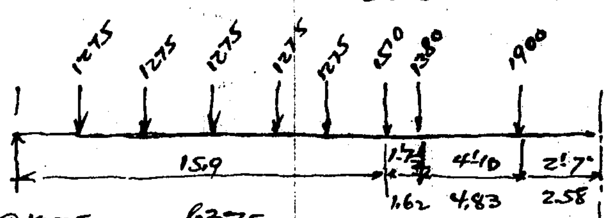
End Floor Beam FB1. span length 49' 10¾ = 49.89
Dead Load



Concentration at H.S. $135^{\#} \times \frac{17.4^2 \; 25^2}{2 \times 15.75}$ = ~~4010#÷2~~ = ~~say 2000#~~ 1275#

Concentration at LG. $160 \times \frac{17.25^2}{2 \times 15.75}$ = 1510# } Dead load of girder assumed 180# per ft. Reaction from rear end neglected

Concentration at RSA $2140 \times \frac{16.12^2}{2 \times \cancel{15.75}\ 14.62}$ = 1900#
RSB 1550 " = 1380#



R = 5@1275 = 6375
1510
1380
1900
11165#
180 × 24.94 = 4500
15665

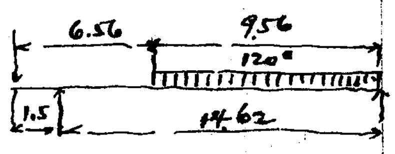
11165 × 24.94	=	278000
1900 × 2.58	=	4900
1380 × 7.41	=	10220
1510 × 9.04	=	13680
6375 × 16.99	=	108300
		−137100
		140900'#
Girder $\frac{1}{8} \times 180 \times 49.89^2$ =		55800
		196700 neglecting Cant. moment

Live Load Electric Rwy loading water car with impact 11650
max load $11650 \times \frac{16.12}{14.62}$ = 12820#.

motor truck loading $12870 \times \frac{16.12}{14.62}$ = 14200#

Uniform live load at rear of wheel

$120^{\#} \times \frac{9.56^2}{2 \times 14.62}$ = 375#



Conc. RSA 375 × 5.0 = 1880#
Conc RSB 375 × 3.22 = 1210#

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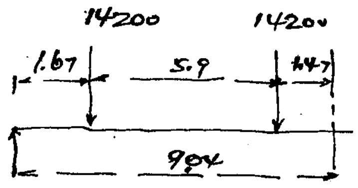
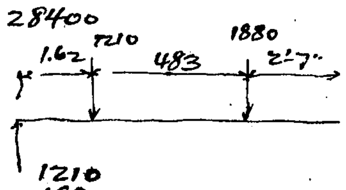
CALCULATIONS FOR

First Canal Bridge for City of Kobe ; 60' Single Leaf Trunnion Bascule.

Live Load moment





1210
1880
3090

moment 28400 · 7.57 = 215000
14200 · 5.9 = − 83700
131300 # − 131300

moment due to unif. load.
3090 · ~~7.57~~ 6.45 = 19900
1210 · 4.83 = − 5850
14050
145350 #

End shear 28400
3090
31490 #

Summary for moments and shears

	moment	shear
Dead Load	196700	15665 ?
Live Load	145350	31490
	342050 #	47155 #

Allowable unit stress = 17000 (1 − 0.012 l/b) = 13440 #/□"
where l = 216 b = 12 3/8
the case assumed is no support at intermediate point and live load carried by live load shoe when loaded.

Try web 31½ · 3/8", 32" back to back of Ls. flange Ls 6 · 3½ · ½

m of I.
1 web 31½ · 3/8 = 11.80 975
4Ls 6 · 3½ · ½ = 18.00 · 15.19² + 17 = 4177
5152

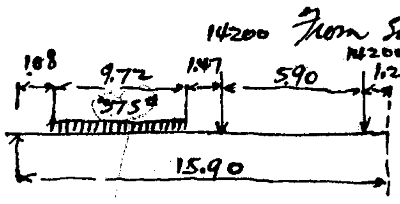
Fibre stress = $\frac{342050 \times 12 \times 16}{5152}$ = 12750 #. ok

max load on live load shoe. The case assumed is, the shoe will carry dead and live load for max load

Dead Load reaction. From center span 2280
At support 1510
From end span 2.5 × 1275 = 3190
6980 #

Live load reaction From center span 31490

From Side span



14200 × 14.63 ÷ 15.90 = 13100
14200 × 8.73 ÷ 15.90 = 7800
375 · $\frac{9.72^2 \cdot 5.94}{15.90}$ = 1360
22260
From center span 31490
53750 #
Dead Load reaction 6980
60730 #

Floor Beam FB3 span length 49.89' same as FB1 except cantilever portion which projection 4'0" about instead of 1.5' All figures referred to FB1.

Concentration HS. 135 · $\frac{19.5^2}{2 \times 15.75}$ ~~20.5²~~ = ~~1800~~ 1670 Dead load of girder and details at edge of floor break assumed 300 # per lin ft.

Concentration at LG 160 · $\frac{19.75^2}{2 \times 15.75}$ ~~20.5²~~ = ~~2140~~ 1980

Concentration at RSA 2140 · $\frac{18.62^2}{2 \times 14.62}$ ~~19.37²~~ = ~~2740~~ 2540

Concentration at RSB 1550 · " = ~~1990~~ 1840

Reaction 5 @ 1800 = 9000
2140
1990
2740
15870 #

5 @ 1670 = 8350
1980
1840
2540
14710 #

4380
2700
7080

From girder 300 · ½ · 49.89 = 7500
22210

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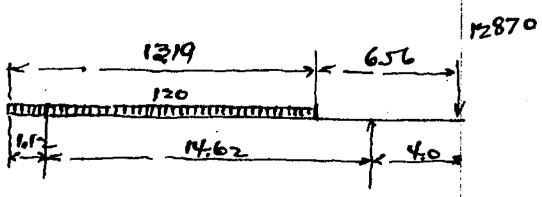
CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

Dead Load moment
14710 × 24.94 = 367000
2540 × 2.58 = 6550
1840 × 7.41 = 13620
1980 × 9.04 = 17900
8350 × 16.99 = 141800
−179870
187130
Girder $300 \times \frac{1}{8} \times 49.89^2$ = 93000
280130 '#
Less dead load cantilever moment −29590
250540 '#

Live Load moment — motor truck loading $12870 \times \frac{18.62}{14.62}$ = 16400 #



Uniform load say $\frac{120 \times 13.19^2}{2 \times 15.75}$ = 660 # per lin ft
at RSA 660 × 5.0 = 3300 #
at RSB ~~375~~ 660 × 3.22 = 2120 #
5420

Live Load moment
motor truck loading
32800 × 7.57 = 248000
16400 × 5.90 = −96700
151300
Uniform load
5420 × 6.45 = 35000
2120 × 4.83 = −10200
24800
176100 '#

End shear motor truck 32800
Unif. load 5420
38220 #

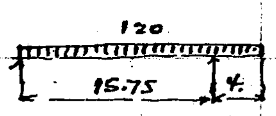
Summary for moments and shears — Try $31\frac{1}{2} \times \frac{3}{8}$ web - 32" b to b of Ls, flange assumed 4 Ls $6 \times 6 \times \frac{1}{2}$

	moment	shear
Dead Load	250540	7080
Live Load	176100	38220
	426640 '#	45300 #

1 web. $31\frac{1}{2} \times \frac{3}{8}$ = 11.80 = 975
4 Ls $6 \times 6 \times \frac{1}{2}$ = $23.00 \times 14.32^2 + 80$ = 4790
5765

Fibre stress = $\frac{426640 \times 12 \times 16}{5765}$ = 14200 #/□" for vertical load only

Max load on live load shoe.
Dead Load
From center span 7080
at support 1980
From side span 4175
" " girder 2400
15635 #



$\frac{120 \times 19.75^2}{2 \times 15.75}$ = 1485 #

Live Load From side span
16400 × 4.63 ÷ 15.90 = 15100
16400 × 8.73 ÷ 15.90 = 9000
$1485 \times 9.72 \times \frac{5.94}{15.90}$ = 5400
29500 #
From center span 38220
67720 #
Dead Load reaction 15635
Total load 83355 #

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf Trunnion Bascule.

Dead Load floor.

Sidewalk slab. 47" × 6.83" = 322" per ft strip.

Roadway planking and pavement 30.3 × $\frac{49.89}{2}$ = 755" per ft strip.

Cross ties under track $\frac{8 \times 8}{144} \times \frac{6.5}{2.25}$ @ 60 = 77"

$\frac{8 \times 8}{144} \times \frac{6.5}{2.25}$ @ 60 = 77"

misc. piece say 6

160" per ft strip. for ½ width

320" per ft strip for whole width.

Nailing piece on Highway stringers &c

say 2 × 6@ $\frac{6 \times 6}{144}$ @ 60" = 90 × 2 = 180"

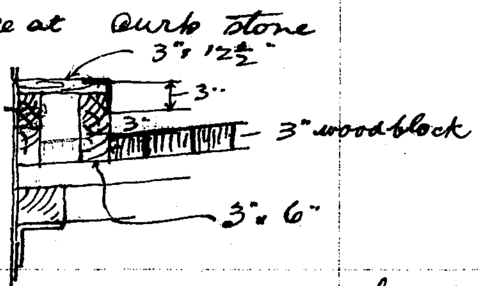
Piece at curb stone 2@ .25 × .50 = 0.25

.25 × 1.04 = 0.26.

0.51 @ 60 = 31"

Curb angle 3½ 3½ ½" = 11.1

42.1"



Summary for dead load of floor. 2@ 322 = 644

Roadway planking + pavement 755

Cross ties under tracks 320

nailing piece 180

at curb stone 2@42. 84

1983.

Adding for misc. 17.

2000" or 1000" for girder.

Dead Load stringers

Highway stringer 10 @ 42.9" = 429"

Railway stringers 4@ 54.7 = 218"

Cross beam 2 - 95" × $\frac{18.08}{15.75}$ = 218

For Highway Transverse strut 330 ÷ 15.75 = 28

For Railway stringers 600 ÷ 15.75 = 38

Connection &c say 40

Sidewalk stringers 2 @ 26.10 = 52

" " 2 @ 31.99 = 64

1087 } call this 1300" per lin ft. of span

Longitudinal girder. 2 @ 95." = 190 } 650" per girder.

1277"

Floor beam at panel point 1

FB1. approximate weight. 29.80 × 3.4 = 101"

Details say 30

131"

weight = 131 × 49.89 = 6540"

Cantilever Bracket. 4L$ 3½ × 3½ × 3/8 @ 8.5 × 6.5 = 220

1Pl. 30" av. × 3/8 @ 38.25 × 6.5 = 250

misc details. 100

570" × 2 = 1140

6540 6540

7110" 7680

For one girder 7680 ÷ 2 = 3890" call this 3900" per panel.

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(独立行政法人 土木研究所蔵)

First Canal Bridge for City of Kobe ; 60' Single leaf Trunnion Bascule

Intermediate Floor Beam FB2

Cross section 85.51 @ 3.4 = 291#
Details say 89
380# per lin ft

weight = 380 × 49.89 = 19000#
Cantilever Bracket 2@570 = 1140
20140 ÷ 2 = 10070# per girder.

End floor Beam FB3.

section 34.80 @ 34 = 153#
Hor. say 50.
details at floor break say. 100
303#

303 × 1.2 = 364# per lin ft.
weight = 364 × 49.89 = 18100#
Cantilever Bracket say 2@700 = 1400
19500 ÷ 2 = 9750# per girder

Bottom bracing.

Under sidewalk 2Ls 3½ × 3½ × 3/8 @ 8.5 × 16.0 = 272
Under Hwy 8Ls 3½ × 3½ × 3/8 @ 8.5 × 22.0 = 1500
Under tracks 8Ls do @ 8.5 × 24.0 = 1630
Gusset plates &c say 1000
4402#

main girder
depth 6'-3"
web. 75" × ½ = 37.5
4Ls 6 × 6 × 3/4 = 33.76
4Pls 14" × 5/8 = 35.00
106.26 @ 3.4 = 362#
Details say 30% say 118
480# per lin ft.

Handrails assumed 40# per lin ft. on one side.

Trolley Pole. approximate weight Cols. 4Ls 5 × 3 × 5/16 @ 8.2 = 32.8
1Pl. 15 × 5/16 = 16.5
49.3# call this 50#

2 Cols. 50 × 19 = 950
details say 350
1300#

Transverse beam 4Ls 3½ × 3½ × 3/8 @ 8.5 = 34.00
Lacing bars 20.
54 × 50 = 2700#
details say 500
3200

2 Col @ 1300 = 2600
transverse strut = 3200
5800#

On one girder 5800 ÷ 2 = 2900#

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

Panel Concentration for main girder.

at panel point 1.

Flooring	1000 ×	9.37	=	9370#
stringers &c	650 ×	9.37	=	6100
Floor Beam				3900
Bottom Bracing				2200
main girder	480 ×	9.37	=	4500
Handrail	40 ×	9.37	=	375
Trolley pl.				1450
				27895#

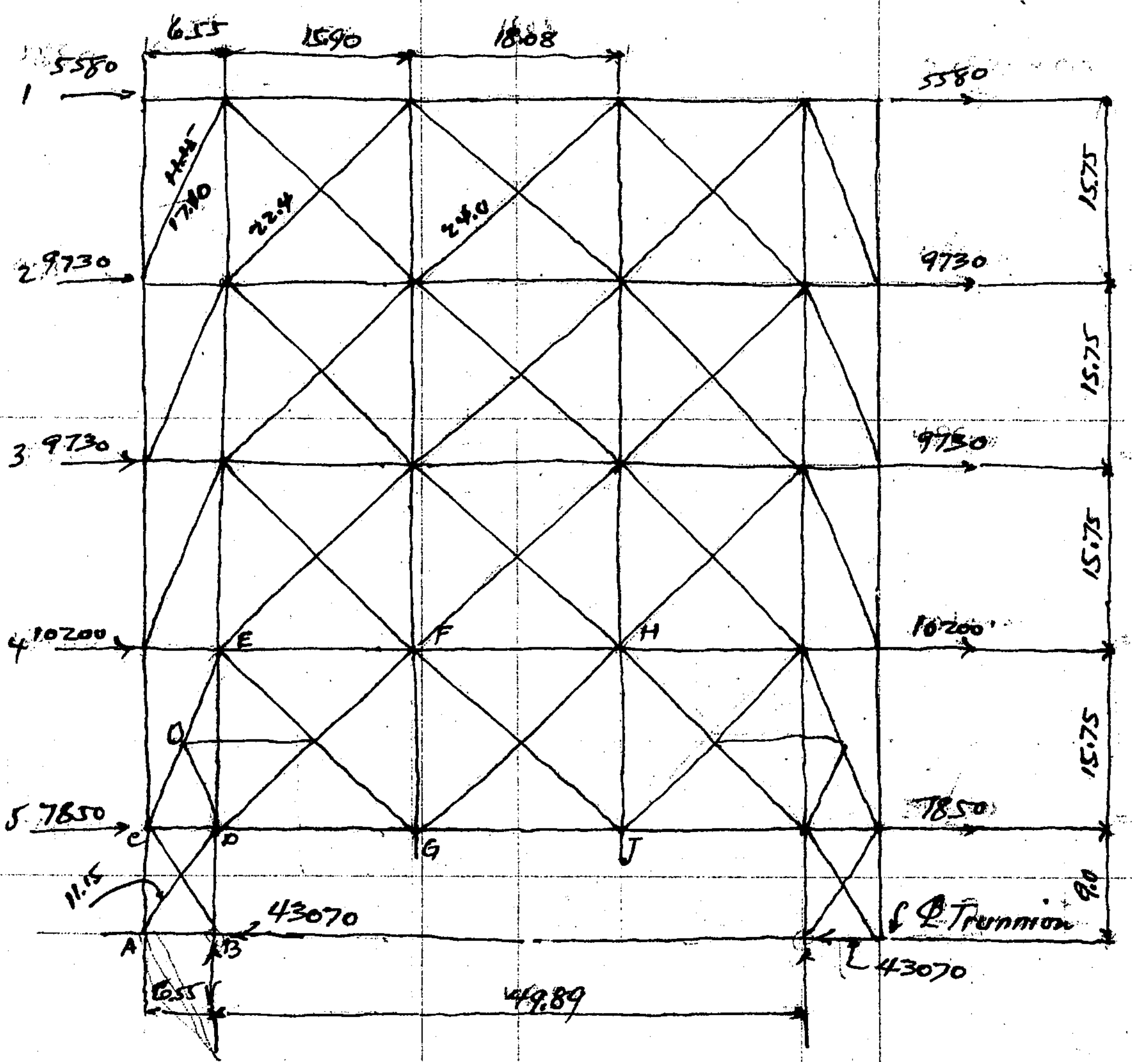
at panel point 2-3-4

Flooring	1000 × 15.75	=	15750
Stringers	650 × 15.75	=	10250
Floor Beam			10070
Bottom Bracing			4400
main girder	480 × 15.75	=	7550
Handrail	40 × 15.75	=	630
			~~1450~~
without trolley pole			48650#
with trolley pole			50100#

At panel point 5.

Flooring say	1000 × 11.87	=	11870
Stringers	650 × 11.87	=	7700
Floor beam			9750
Bottom bracing - say		=	3500
main girder say	480 × 12.37	=	5930.
Hand rail say			500
			39250#

Horizontal force assumed 0.2 of dead load.



Moment about ℄ trunnion (½)

5580	×	72.0	=	402.000
9730	×	56.25	=	546.000
9730	×	40.50	=	393.000
10200	×	24.75	=	252.000
7850	×	9.0	=	70600
				1.663.600#

2@ 1.663.600 = 3337200

Reaction on trunnion

3337200 ÷ 49.89 = 67000#

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

stress in BC 43070 × $\frac{11.15}{6.55}$ = 73600# T or C

Stress in BD 43070 × $\frac{9.0}{6.55}$ = 59300# T or C
67000
126,300#

Taking ½ reaction Stress in BC or AD = 36800# T or C
stress in AB 43070÷2 = 21535# T or C
stress in AC 21535 × $\frac{9.0}{6.55}$ = 29600#

Diagonal stress in panel 4 to 5 shear = 2 × 35240 = 70480#
This shear carried by 3 diagonals 70480 ÷ 3 = 23450
DF Diagonal stress = 23450 × $\frac{22.40}{15.90}$ = 33000# T or

GH. Diagonal stress = 23450 × $\frac{24.0}{18.08}$ = 29800# T

stress in CE moment about D. 43070 × $\frac{9.0}{6.03}$ = 64200# T or C
stress in EF
moment at G. 43070 × 9.0 = 388000
35240 × 15.75 = 555000
67000 × 15.90 = 1066000
2009000 ÷ 15.75 = 128.000#

stress in DG.
moment at E. 43070 × 24.75 = 1.070.000
7850 × 15.75 = − 124.000
946.000 ÷ 15.75 = 60.000#

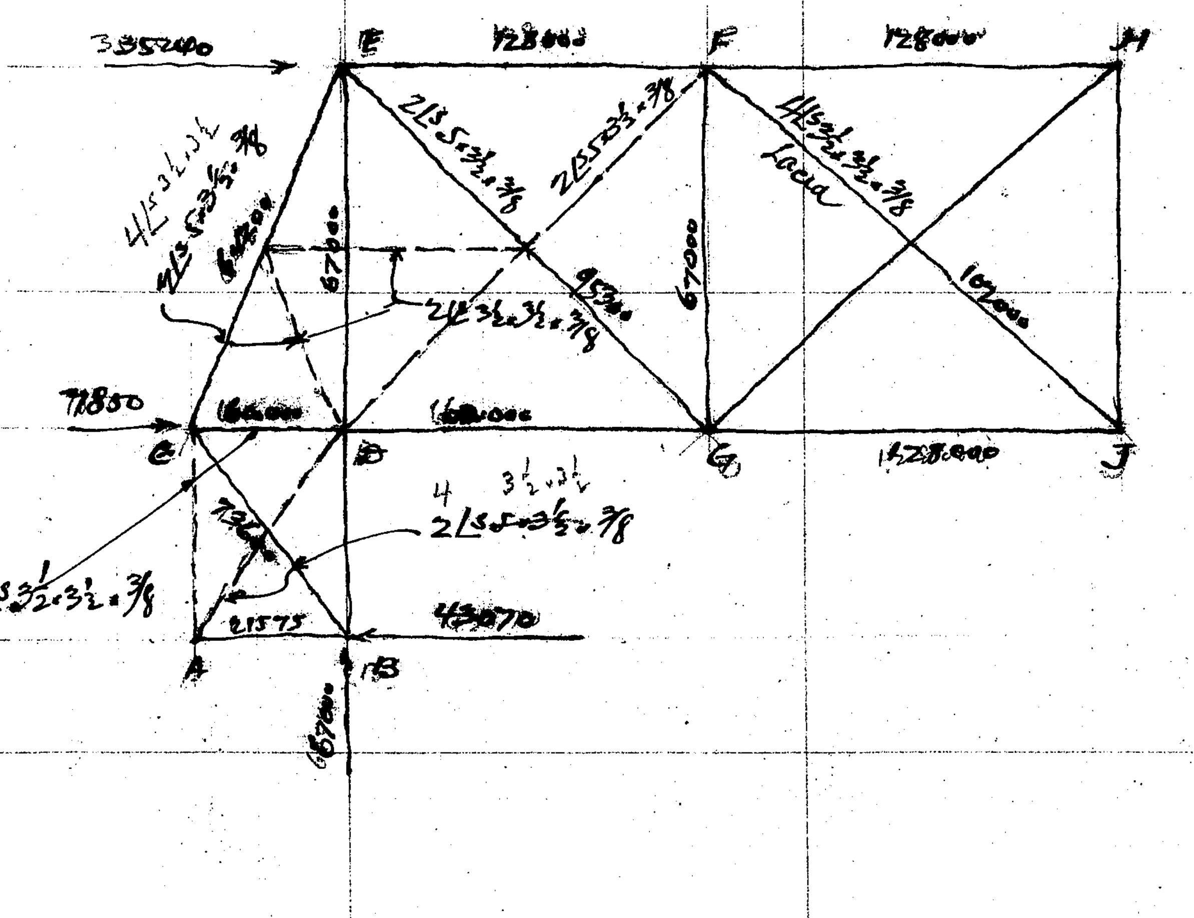
Stress in FH and GJ same as for EF.

Stress in EG. 67000 × $\frac{22.4}{15.75}$ = 95.300#

Stress in FJ 67000 × $\frac{24.0}{15.75}$ = 102.000#

G.J. 946.000
67000 × 15.9 = 1066000
2012000 ÷ 15.75
= 128.000

Stress in ED - FG 67000#



First Canal Bridge for City of Kobe ; 60' Single Leaf Trunnion Bascule.

Section of diagonal member
Stress due to Earthquake. 95300# T or C.
assume 2Ls 5×3½×3/8 = 6.10 □" or 4.60 □" net
r = 1.33 l = 134
allowable stress = 21300 (1 − 0.0055 l/r) = 9500 #/□"
for Earthquake 9500 × 1.8 = 17100 #/□"
SR = 95300 ÷ 17100 = 5.56 □" gross.
SR = 95300 ÷ 30600 = 3.12 □" net
double bracings are used, the real stress will be ½ of stress shown above.

Floor Beam under tracks. CB1.
Stresses in case of the span is raised.
Concentration at RSA. 317# × 13.5/2 = 2140#

Concentration at RSB. 230 × 13.5/2 = 1550#

Uniform load between cross beam 104# per lin ft.
Stringer RSB connected to lateral bracing and main floor beam by gusset plate.
Let us assume span length = 14'-10" instead of 18'-1".
moment due to concentration 2140 × 4.83 = 10300 '#
1/8 × 104 × 14.83² = 2860
13160 '#

Assumed section of girder 1 web. 18×3/8
4Ls 4×4×½

moment of inertia of section.
4Ls 4×4×½ = 15.0 × 1.37² + 22.4 = 50.6

Fibre stress when span up. = (13160 × 12 × 4.19)/50.6 = 13100 #/□" OK

Horizontal Girder to carry floor load when the span is up.
This girder will be combined with floor beam FB3. at floor break.
Dead Load
Intermediate Panel. Railway stringer RSA 317 × 13.5 = 4280
RSB 230 × 13.5 = 3100
CB. 2 − 104 × 9.04 = 1880
9260#
At panel points 2-3-4 3 @ 9260# = 27780#

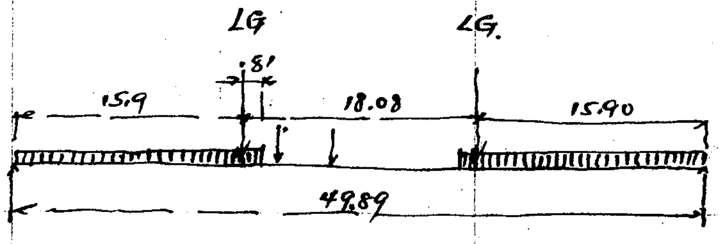
At panel point 1. RSA 317 × 9.37 = 2960
RSB 230 × 9.37 = 2150
5110.#
At panel point 5 RSA 317 × 11.87 = 3760
RSB 230 × 11.87 = 2720
6480#
Highway stringers Dead Load 135# per ft.
For one span 135 × 68.5 = 9250
or 9250 ÷ 2.65 = 3500# per lin. ft.

For longitudinal girder same uniform load as above assumed.
Floor Beam FB1. 131# per ft. For upper flange. 65.5# per ft.
Concentration at LG assumed 65.5 × 9.0 = 590#

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

Floor Beam FB2. ½ upper flange - 190# per lin ft.
Concentration at LG. assumed 190 × 9. = 1710#
3@1710 = 5130

Floor Beam FB3 and Horizontal girder
Details at floor break } assumed 600# per lin ft.



Approximate Concentration at LG.
Panel 1. 5110
Panels 2-3-4 3@9260 = 27780
Floor Beam FB1 590
Floor Beam FB2 3@1710 = 5130
38610#

Uniform load on highway side - stringers 3500
FB1. 65
FB2 3@190 570
4135# per lin ft.
4135 × 16.71 = 69000

Uniform load at panel point 5 600# per lin ft.
Concentration at " " " RSA 3760
RSB 2720

Max moment
38610 × 15.9 = 615.000
69000 × 8.35 = 576.000
⅛ × 600 × 49.89² = 186.000
6480 × 24.94 = 162.000
3760 × 2.58 = 9750
2720 × 6.42 = 17400
27150 say 27 000
135000
135.000
1512000#

Max End shear 38610
69000
600/2 × 49.89 = 15000
3760
2720
129080# - call this 130.000#

Flange assumed
1L 6 × 6 × 3/4 = 8.44 × 1.17 = 9.87
1Pl. 12½ × ½ = 6.25 × 6.12 = 38.30
1Pl 6¼ × 3/4 = 4.68 × 9.38 = 44.00
2Cov. 6 × ½ = 6.00 × 0.50 = -3.00
25.37 3.58" 89.17
2@3.58" = 7.06" or 0.59
web assumed 60 × 3/8" = 22.50" ⅛ web = 2.82 □" back to back of L^s 5.0
Effective depth = 5.00 - 0.59 = 4.41'
flange stress = 1.512.000 ÷ 4.41 = 344.000#
Section req'd = 344.000 ÷ 17.000 = 20.20 □"
2.82
17.38 □" net.

2 from angle = 1.5 4 holes. 3.0
3 from 12½ × ½ pl. = 1.5 4 holes 2.0
1 from 6¼ × 3/4 Pl. = 0.75 2 holes. 1.5
2 from 2 Pls. 6 × ½ 1.00 4 holes. 2.0
4.75 8.5

25.37 gross - 8.5 = 16.87 □" net. at splice pl.

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CALCULATIONS FOR

First Canal Bridge for City of Kobe ; 60' Single Leaf Trunnion Bascule.

Approximate weight of Horizontal girder
and details at floor break.

main section web 60 × 3/8 = 22.5
flanges 2@ 25.37 = 50.74
details at floor break say = 20.00
93.24 @ 3.4 = 320#
Details say 80
400# per lin ft.

Floor Beam FB3. 200
600# per lin ft.

weight = 600 × 49.89 = 30.000
2@ 700 = 1400
31400 ÷ 2 = 15700# at panel pt 5.

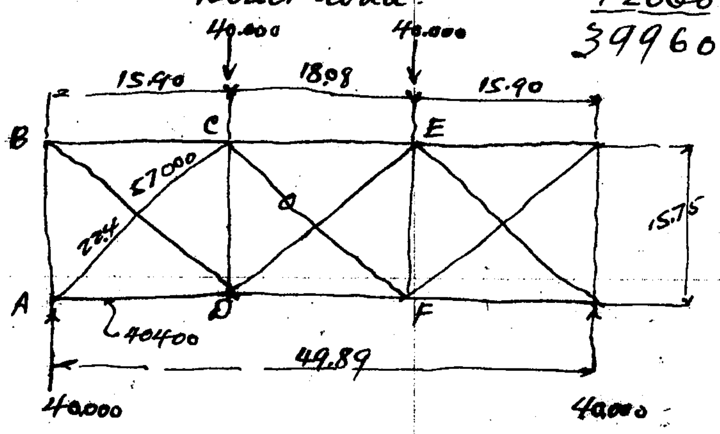
Horizontal truss at the plane of Bottom Lateral Bracing to carry dead Load when the span up.
Assumption made to carry 30% of floor load. and entire dead load of lower half.
Concentration at LG.

			Lower half.
Panel point 1		5110	
Panel points 2-3-4	3@ 9260 =	27780	
floor beam FB1		590	590
floor beams FB2	3@1710 =	5130	5130
Lateral Bracing			5440
floor beam FB3			900
RSA		3760	12060#
RSB		3720	
Highway	3500		
	131		
3@380 =	1140		
	600		

$5371 \times \frac{16.81^2}{2 \times 15.9} = 47800$

92890

92890 × 0.3 = 27900
Direct load 12060
39960 call this 40.000#



stress in AC = $40.000 \times \frac{22.4}{15.75} = 57000\#$ C

Stress in AD = $40.000 \times \frac{15.90}{15.75} = 40400\#$ T

Bending moment due to direct load on AD.
load assumed 5371 × 0.3 = 1610# per lin ft.
$m = \frac{1}{10} \times 1610 \times 15.90^2 = 40700$ ′#
m of inertia.

section assumed

18 × 3/8	= 7.50		182
2 ∟s $3\frac{1}{2} \times 3\frac{1}{2} \times \frac{3}{8}$	= 4.96	$\times 8.24^2 + 11.6 =$	349
	12.46		531

fibre stress = $\frac{40700 \times 12 \times 9.25}{531} = 8500\#$

direct 40400 ÷ 12.46 = 3240 neglecting flange angle of FB3.
11740 #/□

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

Stress in AC 57000#
95300# due to horizontal force during earthquake.
152300 ÷ 2 = 76150#
Section required 76150 ÷ 17100 = 4.45 □" gross
Use 2L$ 5×3½×3/8 = 6.10 gr or 4.600 net.
no of rivet 7/8 6010 × 1.8 = 10800# 76150 ÷ 10800 = 7 Rivets.
Use 8 Rivets for connection.

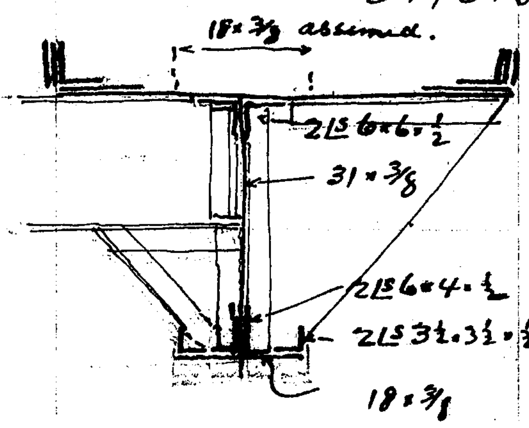
Bracing under sidewalk slab.
sidewalk slab 47 × 6.83 = 320
Stringer say 150
Lateral say 20
Concentration at edge 490 ÷ 2 = 245
Handrail 40
285#
Concentration 285 × 15.75 = 4500#
Stress in diagonal bracing = 4500 × $\frac{6.55}{6.03}$ = 4900#

Use 1L 3½×3½×3/8 3 rivets for connection.

Revised figure for Floor Beam FB3.
Dead load 600# per lin. ft instead of 300# per ft.
shear at end 14710 page 14 shear center span 4380
½ girder 600 × $\frac{50}{2}$ = 15000 5400
29710 9780#
Dead Load moment 187130 '#
Girder ⅛ × 600 × 49.89² = 186000
373130
Less cantilever moment 29590
343540 '#

Summary for moments and shears

	moment	shear
Dead Load	343540	9780
Live Load	176100	38220
	519640	48000



Center of gravity of assumed section
2 Pls. 18×3/8 = 13.50
1 Pl. 31×3/8 = 11.62
2L$ 6×6×½ = 11.50 × 13.94 = + 160.0
2L$ 6×4×½ = 9.50 × 13.63 = − 129.3
2L$ 3½×3½×½ = 6.50 × 14.56 = − 94.7
52.62 × −1.22" = − 64.0

moment of inertia of section
1 Pl. 18×3/8 = 6.75 × 17.03² = 1956
1 Pl. 18×3/8 = 6.75 × 14.59² = 1435
1 Pl. 31×3/8 = 11.62 × 1.22² + 925 = 942
2L$ 6×6×½ = 11.50 × 15.16² + 80 = 2720
2L$ 6×4×½ = 9.50 × 12.41² + 70 = 1535
2L$ 3½×3½×½ = 6.50 × 13.34² + 14 = 1174
9762

Fibre stress = $\frac{519640 \times 12 \times 17.22}{9762}$ = 11000 #/□" Top flange ok

do = $\frac{519640 \times 12 \times 14.78}{9762}$ = 9450 #/□" bottom flange ok

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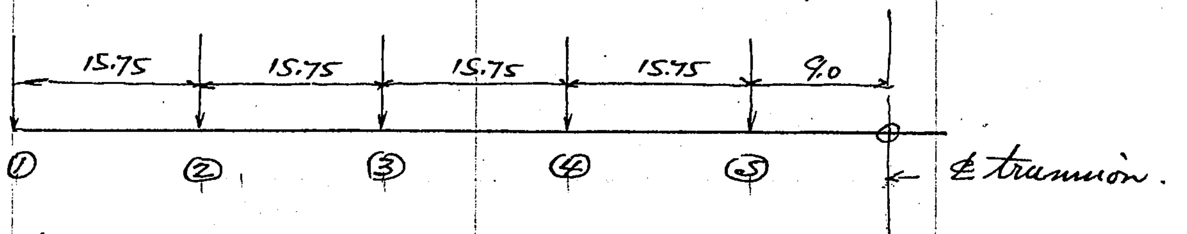
CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule.

Design of main bascule girder.

Dead Load



Panel Concentration

Sidewalk slab. Concrete. 7.01 × .31 = 2.17
filler &c .33
2.50 @ 150 = 375# per lin ft assumed.

Sidewalk plank.
weight 1¼" plank with nails 7.0# per sq ft 7 × 7.0 = 49.0
Joist $\frac{3" \times 4"}{144}$ @ 60# = 5# per ft. $\frac{5 \times 7.0}{2.0}$ = 17.5
66.5# per lin ft.

Weight of flooring between main bascule girders.
plank and pavement
3" wood block pavement @ 5.0 = 15.0
3" plank @ 5.0 = 15.0
asphalt felt .03
30.3# × 49.90 = 1510# per lin ft.

Extra plank at curb line
3" × 1.08 = 3.24
3" × 0.5 = 1.50
4.74 × 2 = 9.48 @ 5.0# = 47.5#
Curb angles 2 @ 7.2 say = 15.0
Rail 122# per yd 4 @ 40.7 = 163.0
accessories. 10% 16.3
Rail ties 6" × 4½ @ 20# I × 17'-5 = 349# ÷ 2.25 = 155.0 # per lin ft of span.
Details say 20% 30.0
nailing piece 0.25 × 12 = 3.0 cubic ft @ 60# = 180.0
0.45 × 2 = 0.9 @ 60# = 50.0
.17 × 17.5 × 0.39 = $\frac{.94}{2.25}$ @ 60 = 25.2

Drains 8.0

690#
1510
2200# ÷ 2 = 1100# per lin ft per girder.

Concentration at panel point No 1.

Trolley poles and arch per girder	5000
Railway stringers	850
strut	220
Highway stringers	1750
strut	80
Sidewalk stringers 65# × 9.37 =	610
longitudinal girder	800
floor beam	4850
Cantilever bracket	670
End lock, live load shoe, center lock, air buffer	2705
Lateral bracing under sidewalk	75
" " between girders	950
main girder assumed	4500

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CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule

Handrail		375	
Floor steel at Joint sidewalk		330	
" " " between girders		2060	
Sidewalk	66.5 × 9.37 =	623	
Driveway	1100 × 9.37 =	10300	
		36748#	call this 36900#
Concentration at panel point No 2.			
Railway stringers		1600	
Strut		440	
Highway stringers		3450	
Strut		160	
Sidewalk stringers	65# 15.75	1025	
Longitudinal girder		1600	
Cross beam under tracks		1600	
Floor beam		13700	
Cantilever bracket		750	
Lateral Bracing under sidewalk		126	
" " between girders		1900	
Main girder assumed		8500	
Handrail	40 × 15.75	630	
Sidewalk	66.5 × 15.75	1050	
Floor between girders.	1100 × 15.75 =	17320	
		53851	call this 53900#
Concentration at panel point No 3.			
Same as No 2		53900	
add for main girder		1000	
		54900	54900#
Concentration at panel point No 4.			
Railway stringers		1600	
Strut		440	
Highway stringers		3450	
Strut		160	
Sidewalk stringers		1025	
Longitudinal girder		1600	
Cross beams under tracks		1600	
Floor beam		13700	
Cantilever bracket		800	
Lateral Bracing under sidewalk	8 × 15.75 =	126	800
" between girders	100 × $\frac{15.75}{2}$ =	800	
"		2200	
Main girder assumed		11500	
Handrail	40 × 15.75	630	
trolley pole and arch		4800	
Sidewalk	66.5 × $\frac{15.75}{2}$ =	525	
"	375 × $\frac{15.75}{2}$ =	2955	
Flooring between girders	1100 × 15.75 =	17320	
		65231	call this 65300#
Concentration at panel point No 5.			
Railway stringers		850	
Strut		220	
Highway stringers		1750	
Strut		80	
Sidewalk stringers	65# × 12.37	805	

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion Bascule

longitudinal girder	800		
floor beam	17150		
Cantilever bracket	1000		
Lateral bracing under sidewalk	120		
do at bottom 100 × 12.37 =	1240		
Bottom bracing between girders	1100		
main girder assumed	13000		
Handrail say	500		
Live Load shoes & c	440		
Sidewalk slab. 375 × 12.37 =	4630		
floor between girder say 1100 × 11.87 =	13050		
End lock operating machinery & c	2265		
	59000	call this	59000 #

Concentration at panel point 6 (trunnion).

Front of trunnion only			
Sidewalk stringers 65# × 4.5 =	293		
Bracing under sidewalk 10 × 4.5 =	45		
bottom bracing do 100 × 9.25 =	925		
Strut between girders & bracings	4000		
main girder assumed front only	8000		
trunnion shaft	4900		
trunnion boss.	3350		
Sidewalk slab 375 × 9.4	3520		
	25033 #	call this	25700 #

Dead Load moment at	2.	1	36900	× 15.75 =	581.000 #
	3	1	36900	× 2 × 15.75 =	1162.000
		2	53900	× 15.75 =	850.000
			90800		2012.000 #
	4	1	36900	× 47.25 =	1744.000
		2	53900	× 31.50 =	1700.000
		3	54900	× 15.75 =	865.000
			145700		4309.000 #
	5	1	36900	× 63.00 =	2322.000
		2	53900	× 47.25 =	2550.000
		3	54900	× 31.50 =	1730.000
		4	65300	× 15.75 =	1020.000
			211,000		7622.000 #
Trunnion.	6	1	36900	× 72.00 =	2660.000
		2	53900	× 53.25 =	2870.000
		3	54900	× 40.50 =	2220.000
		4	65300	× 24.75 =	1620.000
		5	59000	× 9.00 =	531.000
			270000		9901.000 #

When the span is down the center of gravity of entire moving leaf with cwt will be at front of trunnion. The reactions at panel points 1 and 5, however, are very small & almost negligible. The adjustment will be made at panel points 1 and 5 where live load shoes are located not to take extra reaction at the said panel points. During erection without counter weight Reactions at panel point 1 and at ℄ trunnion with overhanging arm at rear.

増田淳氏関係資料
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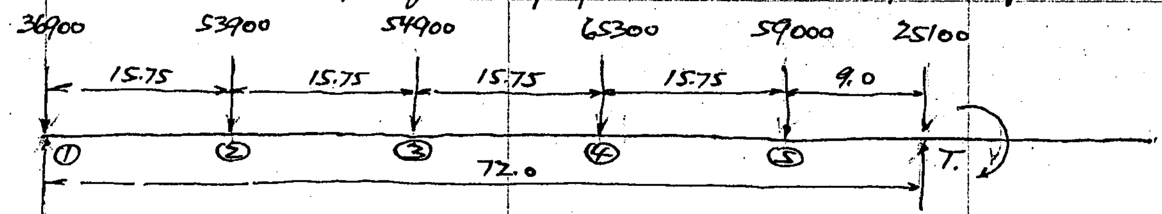
CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule



Reaction at 1 53900 × 53.25 = 2870.000
54900 × 40.50 = 2220.000
65300 × 24.75 = 1620.000
59000 × 9.00 = 531.000
233100 7241.000 ÷ 72.0 = 100500

Reaction at T 233100 − 100500 = 132600#

Overhanging moment with counter weight girders complete = 1.310.000
Reaction at 1 1.310.000 ÷ 72.0 = 18200#

Resulting reaction = 100500
− 18200
82300#

Positive moment at 2 82300 × 15.75 = 1380.000'#

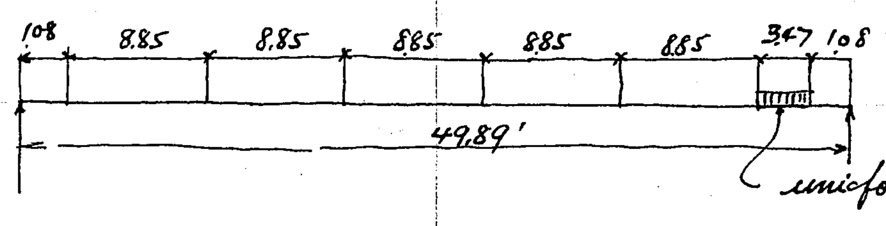
" at 3. 82300 × 31.50 = 2760.000
53900 × 15.75 = − 850.000
1.910,000'#

" at 4 82300 × 47.25 = 3900.000
54900 × 15.75 = − 865.000
53900 × 31.50 = − 1700.000
1.335.000'#

neg. m at 5 82300 × 63.00 = 5190.000
65300 × 15.75 = − 1020.000
54900 × 31.50 = − 1730.000
53900 × 47.25 = − 2550.000
− 110.000'#

Neg. moment at trunnion − 1310.000'#

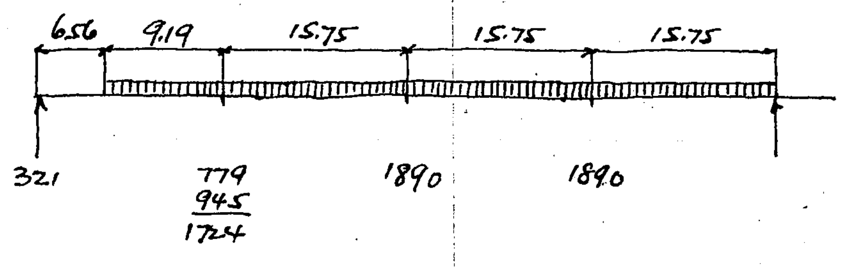
Live Load.
Max. live load at panel point no 1. motor truck loading
rear wheel concentration 12870#
front wheel concentration 4290#



uniform live load neglected.

max motor truck reaction 10 × 12870 × $\frac{26.67}{49.89}$ = 63500#

Uniform live load on Roadway 120# per Square ft.



9.19 × 120 = 1100#
1100 × $\frac{4.6}{15.75}$ = 321#
1100 − 321 = 779#
15.75 × 120 = 1890# ½ × 1890 = 945#

7650 41100 45000 45000 ← Concentration at panel point for ½ width.

Live Load on sidewalk 100# per sq ft. For 6' sidewalk 600# per ft.

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(独立行政法人 土木研究所蔵)

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MADE BY J. Masuda DATE 2-2-20 FILE NO.______
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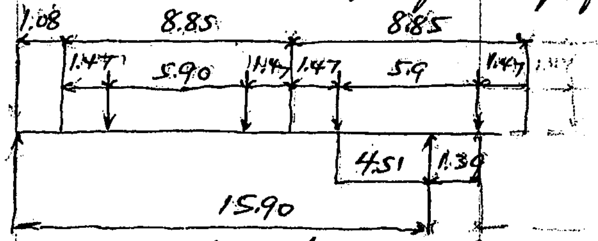
CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule.



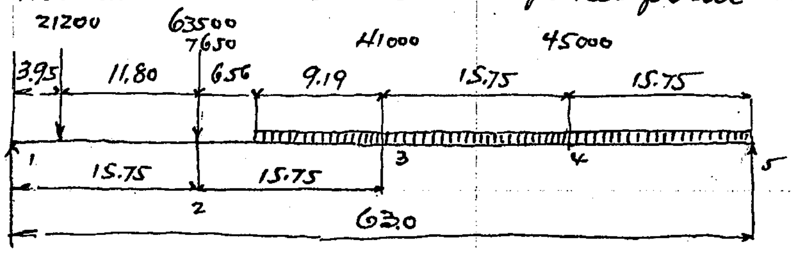
For motor truck loading $12870 \times \frac{25.31}{15.90} = 20400^{\#}$

Uniform live load on Roadway.

1890 × 1/4 = 472
1890 × 1/2 = 945
1774 × 3/4 = 1300
321
3038 × 23.86 = 72500# on shoe.

Uniform live load on sidewalk 600 × 63/2 = 18900
motor truck loading 20400
max live load on shoe – 111800#

Moment and shear at panel point no 2.



Reaction due to motor truck loadings.
panel Conc at 2 $21200 \times \frac{3.95}{15.75} = 5300$
63500
68800#

Reaction 68800 × 3/4 = 51500#
moment = 51500 × 15.75 = 811.000'#

Reaction due to unif. load on Roadway
45000 × 1/4 = 11250
41000 × 1/2 = 20550
7650 × 3/4 = 5730
37530#

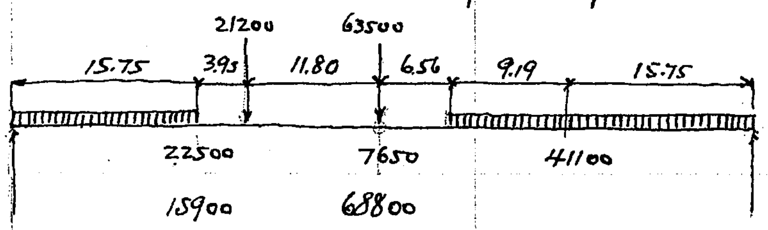
moment = 37530 × 15.75 = 591.000

Live Load on sidewalk.
panel load 600 × 15.75 = 9450
Reaction = 9450 × 1.5 = 14200#

moment = 14200 × 15.75 = 224.000
1.626.000 '#

Shear at 2. motor truck loading 68800 × 3/4 = 51500
Unif. load on Roadway 37530
Unif. load on sidewalk. 14200
103230#

moment and shear at panel point no 3.



Reaction due to motor truck loading
68800 × 1/2 = 34400
15900 × 3/4 = 11900
46300#

Moment 46300 × 31.50 = 1.460.000
–15900 × 15.75 = –250.000
30400#
1.210.000 '#

Uniform load on Roadway
Reaction 41100 × 1/4 = 10300
7650 × 1/2 = 3825
22500 × 3/4 = 16900
31025#

Moment 31025 × 31.50 = 976.000
22500 × 15.75 = 354.000
622.000 '#

$\left.\begin{array}{r}1.210.000\\622.000\\298.000\end{array}\right\}$ 2,130.000'#

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 '#

Shear due to motor truck loading 30400#
due to unif. load on Roadway 14125#
" " " " Sidewalk 9450 × .75 = 7080#
57605#

増田淳氏関係資料
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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule.

Summary for Dead and Live Load moments.

	2	3	4	5	T.
Erection stress as simple beam	+ 1380.000	+ 1910.000	+ 1335000	- 110000	- 1310.000
Dead Load Cantilever moment	- 581.000	- 2012.000	- 4309000	- 762.2000	- 9901.000
Live Load as simple beam	+ 1626.000	+ 2130.000	+ 1626000		
	+ 1045.000	+ 18000	- 2683000	- 7622.000	- 9901.000

Summary for Dead and live load shear

	1-2	2-3	3-4	4-5	5-6
Erection stress	100500	46600	8300	73600	132.600
D.L. Cantilever	36900	90800	145700	211.000	270.000
L.L. as simple beam	103230	51600	51600	103230	
	140130	142400	197300	314230	270.000

Design moment at

	2.	3	4	5	T
Dead Load m	- 581.000	- 2012.000			
Combined m	+ 1045.000	½ + 18.000			
	290500				
	+ 1335500	- 2021.000	- 4309000	- 7622.000	- 9901.000
Add 10%.	+ 133500	- 202100	- 430900	762200	990100
	+ 1469000	- 2223100	- 4739900	- 8384200	- 10891,100

Assumed section.

2
- 1Pl. 75 × ½ = 37.50 = 17600 (for 2 and 3)
- 4Ls 8 × 8 × ¾ = 45.76 × 35.47^2 + 280 = 57680 (for 2 and 3)
- 4Pls. 12 × ½ = 24.00 × 31.50^2 + 288 = 24090 (for 2 and 3)
- 2Pls. 18 × ¾ = 27.00 × 38.13^2 = 39300 for
- 134.26 — 138670

3
- 1Pl. 75 × ½ = 37.50
- 4Ls 8 × 8 × ¾ = 45.76
- 4Pls. 12 × ½ = 24.00
- 2Pls. 18 × ¾ = 27.00
- 2Pls. 18 × ¾ = 27.00 × 38.88^2 = 40800 for panel 4
- 161.26 — 179470

4
- 1Pl. 75 × ½ = 37.50
- 4Ls 8 × 8 × ¾ = 45.76
- 4Pls. 12 × ½ = 24.00
- 2Pls. 18 × ¾ = 27.00
- 2Pls. 18 × ¾ = 27.00
- 2Pls. 18 × ¾ = 27.00 × 39.63^2 = 42440
- 221910 $(in)^4$

5
- 1Pl. 80 × ½ = 40.00 × — 21350
- 4Ls 8 × 8 × ¾ = 45.76 × 37.97^2 + 280 = 66180 66180
- 4Pls. 12 × ½ = 24.00 × 34.00^2 + 288 = 28090 28090
- 6Pls. 18 × ¾ = 81.00 × 41.12^2 — 137000
- 4Pls. 4 × ¾ = 12.00 × 30.00^2 + 16 = 10816
- 4Pls. 11½ × ¾ = 34.50 × 33.75^2 + 380 = 39680
- 303116 $(in)^4$

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; 60' single leaf trunnion bascule.

2Pls.	70 × 1/2	= 70.00			= 28600
1Pl.	94 × 1/2	= 47.00			= 34600
4Ls	8×8×3/4	= 45.76	× 44.97²	+ 280	= 92780
4Pls.	12 × 1/2	= 24.00	× 41.00²	+ 288	= 40690
6Pls.	18 × 3/4	= 81.00	× 48.37²		= 189000
4Pls.	4 × 3/4	= 12.00	× 37.00²	+ 16	= 16470
4Pls.	11½ × 3/4	= 34.50	× 40.75²	+ 380	= 57680
					459820 (in)⁴

Allowable unit stress for Compression flange = 17000 (1 - 0.012 l/b) = 14850 #/□"
where l = 189" b = 18"

Unit stresses in flange

at 2. m = 1469.000 "# fibre stress = $\frac{1469000 \times 12 \times 38.50}{138670}$ = 4880 #/□"

at 3 m = 2223.100 "# fibre stress = $\frac{2223100 \times 12 \times 38.50}{138670}$ = 7400 #/□"

without cover pls. moment of inertia = 99370

fibre stress = $\frac{1469000 \times 12 \times 37.75}{99370}$ = 6700 #/□"

" = $\frac{2223100 \times 12 \times 37.75}{99370}$ = 10150 #/□"

Use for 2 & 3.

1Pl.	75 × 1/2	= 37.50
4Ls	8×8×3/4	= 45.76
4Pls.	12 × 1/2	= 24.00
		107.26 □"

At panel point no 4. m = 4739900 "#
fibre stress = $\frac{4739900 \times 12 \times 39.25}{179470}$ = 12450 #/□".

At panel point no 5 m = 8384200 "#
fibre stress = $\frac{8384200 \times 12 \times 42.5}{303.116}$ = 14100 #/□"

At trunnion. m = 10891100 "#
fibre stress = $\frac{10891100 \times 12 \times 49.50}{459820}$ = 14100 #/□"

Total load rear of trunnion without Counterweight girders + bracing.

				arm	
main girder	1800 × 18'	= 32400	×	9.0	= 292.000
	510 × 11	= 5610	×	13.5	= 75600
trunnion shaft &c		5500	×		
Rack at rear end		5000	×	15.0	= 75000
Bracing & strut at rear		10.000	×	6.7	= 67000
Tail lock		1000			15000
Air buffer		1000			15000
Concrete &c at floor buck		5000			50.000
		65510			589600 "#

Counterweight girders and framing Complete.

	For entire width	for one girder.
weight =	115.000	57500 #
m =	1660.000	830.000 "#

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule.

Load at front of trunnion			moment at front of trunnion	
①	36900		9901.000	for one girder
2	53900	variation say 2½%	248 000	
3	54900		10149 000 1#	
4	65300	Rear without cwt	− 589 600	
5	59000		9559400 1#	
6. trunnion	25100			
	295100# for one girder.			
Rear without cwt	65510			
	360610#			
For entire width	721220#		+ 19,118,800 1#	about ℄ trunnion.
			− 760.000 1#	below Crown of Roadway.

Assumed center line of gravity for counterweight. = 14.0

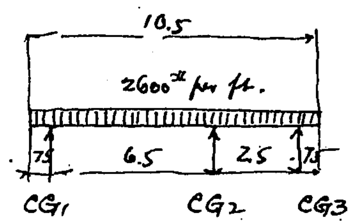
Required load for cwt. 19118800 ÷ 14.0 = 1365.000#

1365.000 ÷ 50 = 27300# per lin ft of cwt girder.

width of cwt = 10.5' or 27300 ÷ 10.5 = 2600#

Design of Counterweight girders.

Counterweight girder CG1. span length 49.89'



Max load on CG1 assumed 2600 × 4.0 = 10400#

impact assumed 10%. 1040

11440# per lin ft.

$m = \frac{1}{8} \times 11440 \times 49.89'^2 = 3570.000$ 1#

End shear = 11440 × 49.89 ÷ 2 = 285.000#

assumed section of girder			84½" btob. of Ls		m of I
1 Pl.	84 × ½	= 42.00			24700
4 Ls	6 × 6 × ¾	= 33.76	× 41.47²	+ 112	= 58010
2 Pls.	13 × ¾	= 19.50	× 42.62²		= 35500
		95.26 □"			118210 (in)⁴

$$\text{fibre stress} = \frac{3570.000 \times 12 \times 43.0}{118210} = 15600 \#/\square''$$

½" Solid plate at bottom flange is added assumed section ok

Counterweight girder CG2 span length 49.89'

max load on CG2 2600 × 10.5 = 27300#

Reaction at CG2 = 27300 × 4.5 ÷ 6.50 = 18900#

Impact 10% assumed 1890

20790# per lin ft

moment = $\frac{1}{8} \times 20790 \times 49.89^2 = 6460.000$ 1#

shear = 20790 × 49.89 ÷ 2 = 518.000#

Assumed section					m of I
1 Pl.	83¼ × 5/8	= 52.00			= 30100
4 Ls	8 × 8 × ¾	= 45.76	× 39.59²	+ 280	= 71780
4 Pls.	12 × ¾	= 36.00	× 35.62²	+ 432	= 46130
assumed 4 Pls.	18 × ¾	= 54.00	× 42.62²		= 98000
		187.76 □"			246010 (in)⁴

$$\text{fibre Stress} = \frac{6460.000 \times 12 \times 43.37}{246010} = 13700 \#/\square'' \quad ok$$

Counterweight girder CG3. span length 49.89'

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CALCULATIONS FOR

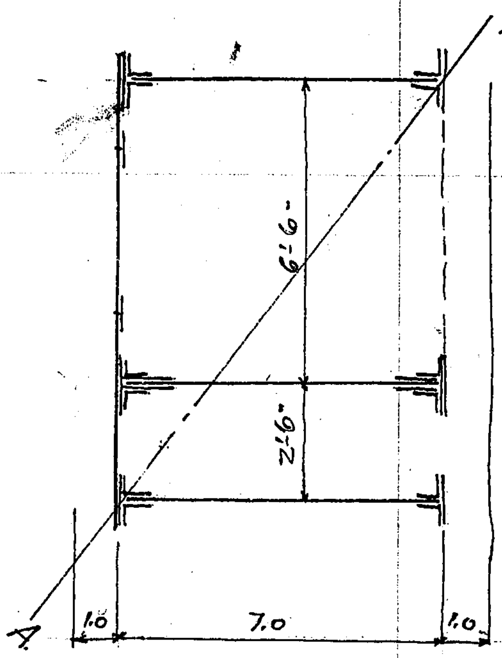
First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule.

Load on CG3. 2.0 × 2600 = 5200# per lin ft. add 10% impact Total 5720# per ft.

Try girder section

2∠s 6×6×3/4 = 16.88
1 Pl. 13×3/4 = 9.75
26.63 □"

Counterweight girder when span up. span length. 49.89'



load per girder assumed 27300 ÷ 2 = 13650# per lin ft.
impact 10%. 1365
14015

moment = 1/8 × ~~13650~~ 14015 × 49.89² = 4360,000 '#
shear = 1/2 × 14015 × 49.89 = 350.000 #

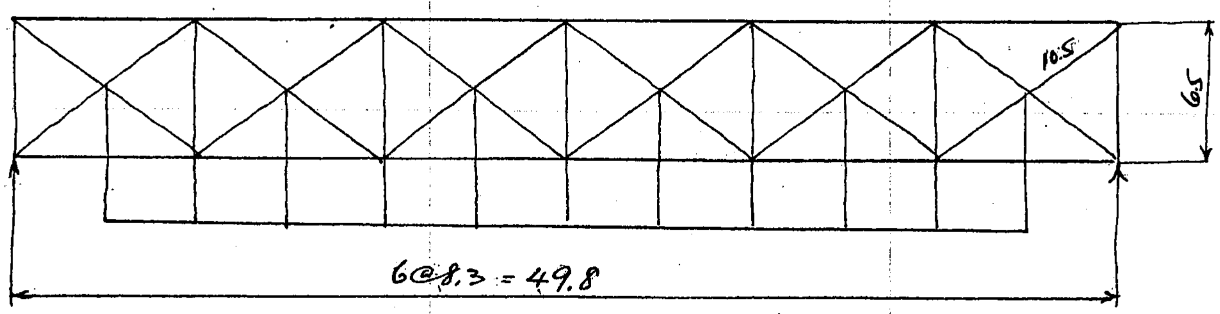
~~web assumed~~ 123 × 1/2 = 61.5 □"
1/8 web = 7.70 □"
depth of girder 9.0

flange stress = 4360.000 / 9.0 = 485.000 #

Section reqd = 485000 ÷ 17000 = 28.60
7.70
20.90 □" net

Use 2∠s 6×6×3/4 = 16.88 - 13.88
1Pl. 13×3/4 = 9.75 - 8.25
26.63 23.13 □" net ok

Top framing of Counterweight girder to carry shear



Load per lin. ft = 14015# panel concentration = 14015 × 8.3 = 116500#
End shear = 1/2 × 14015 × 49.89 = 350.000 #

shear	stress	for one diagonal	no of Rivet
291.000	470.000	235000#	32.8 shop.
175.000	282.000	141.000#	23.6 field.
58200	94.000	47.000#	7.8 field.

section for diagonal. 235000 ÷ 14200 = 16.50 □" 2∠s 6×6×3/4 = 16.88 □"
141.000 ÷ 14200 = 10.0 □" 2∠s 6×6×1/2 = 11.50 □"
47.000 2∠s 4×4×3/8 = 5.72 □"

Part of shear will be carried by concrete

Stress in hanger 116.500 ÷ 2 = 58250# Use 8 Rivets for connection.

Counterweight girders at AA position.

Total load 27300
10% impact 2730
30030# per lin ft.

moment = 1/8 × 30030 × 49.89² = 9320.000 '#

Lever arm assumed 10.0. stress in top and bottom chord 932000#

flange section reqd = 932.000 ÷ 14200 = 65.6 □" gross.

max allowable stress as flange of girder 15400 #/□"

932.000 ÷ 15400 = 60.500 □" gross.

増田淳氏関係資料
（独立行政法人 土木研究所蔵）

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MADE BY J. Masuda DATE 2-2-22 FILE NO.

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CALCULATIONS FOR

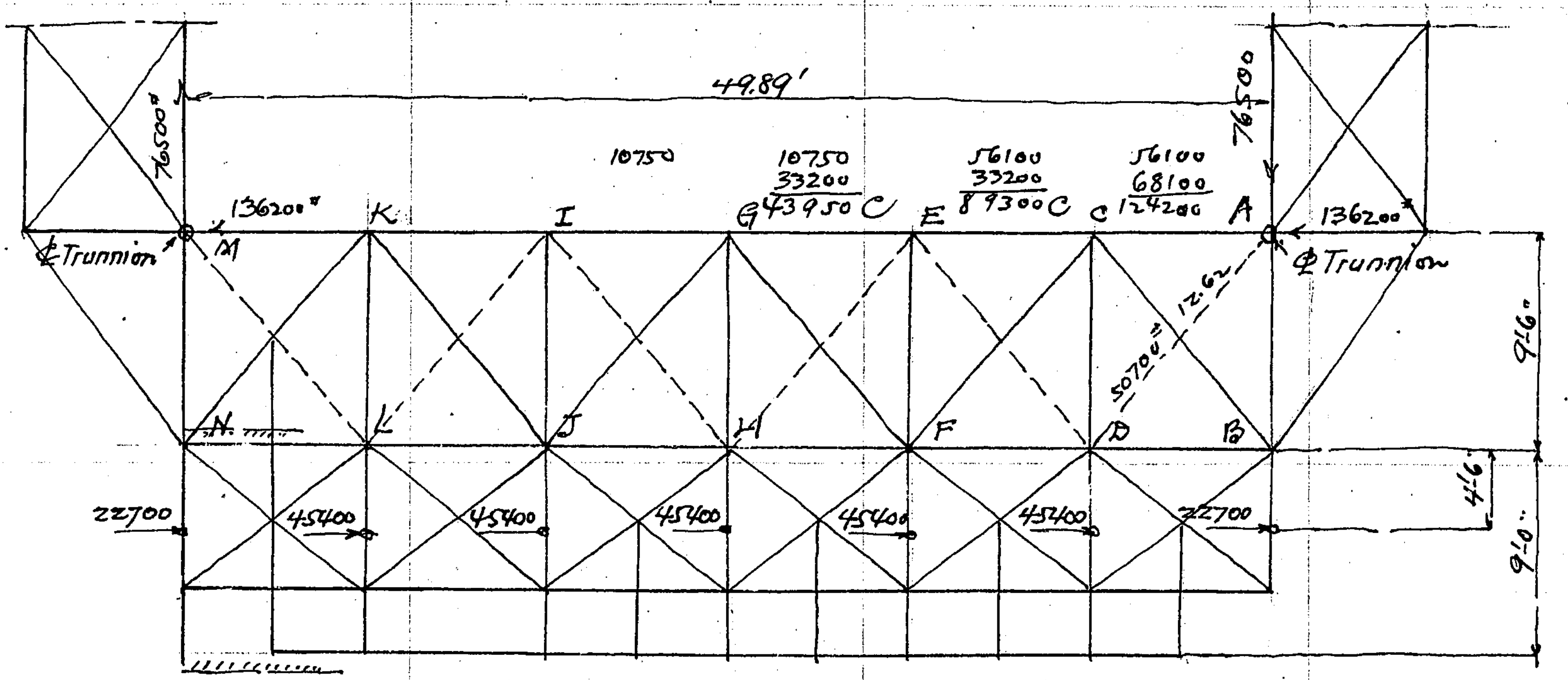
First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule.

chord section

2 cov Pls	14 × 3/4	=	21.00
2 Ls	6×6×3/4	=	16.88
2 Pls.	16 × 3/4	=	24.00
1 web say	16 × 1/2	=	8.00
			69.88 □"

Use this section for top flange of CG1 and bottom flange of CG3.

Framing at front of counterweights.



Framing figured from horizontal force of 20% of counterweight.

panel load 27300 × 8.3 = 227000

Horizontal panel load 227000 × 0.2 = 45400 for intermediate panel.
22700 for end panel

Transverse reaction at trunnion 45400 × $\frac{6.0}{2}$ = $\frac{272400}{2}$ = 136200#

Longitudinal reaction at trunnion 272400 × 14.0 ÷ 49.89 = 76500#

Stress due to loading at D H & L.

Transverse reaction = 45400 × 3 = 136200# 136200 ÷ 2 = 68100# each
Long'l reaction = 136200 × 14 ÷ 49.89 = 38200#

ACE moment at D.	+ 45400 × 4.5	=	+	204.000
	+ 68100 × 9.5	=	+	646.000
	− 38200 × 8.3	=	−	317.000
			+	533.000 ÷ 9.5 = + 56100#
DFH. moment at E.	+ 45400 × 14.0	=	+	636.000
	− 38200 × 16.6	=	−	636.000
				000
EGI moment at H	+ 45400 × 4.5	=	+	204.000
	+ 45400 × 4.5	=	+	204.000
	+ 68100 × 9.5	=	+	646.000
	− 38200 × 24.94	=	−	952.000
			+	102.000 ÷ 9.5 = + 10750#

Diagonal. shear 38200. Diagonal stress = 38200 × $\frac{12.62}{9.5}$ = 50700#

Stress due to loading at B F J N
Transverse and longitudinal reactions same as above.

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule

BDF moment C.	+ 22700	× 14.0	=	+ 318.000	
	− 38200	× 8.3	=	− 318.000	
				00	
CEG moment at F	+ 45400	× 4.5	=	+ 204.000	
	+ 22700	× 4.5	=	+ 102000	
	+ 68100	× 9.5	=	+ 646.000	
	− 38200	× 16.6	=	− 636.000	
				+ 316.000 ÷ 9.5 =	33200#

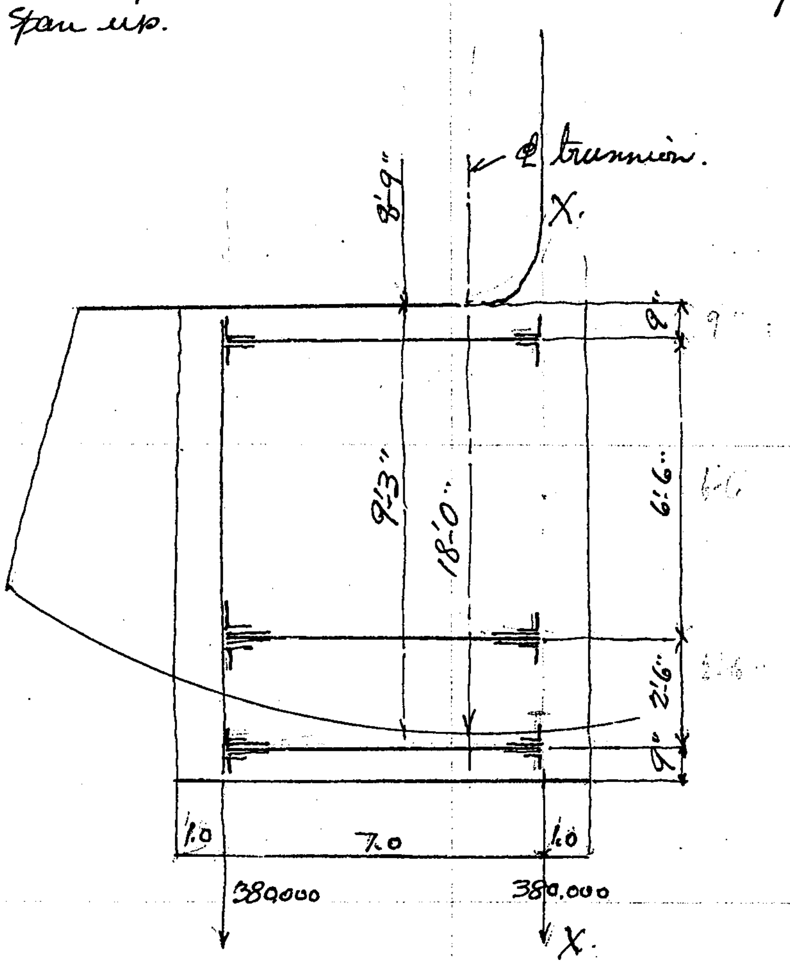
For diagonal Unit stress = 21300 (1 − 0.0055 × $\frac{151.5}{1.61}$) = 10300 #/□"

Section reqd = 50700 ÷ 10300 = 4.920"
Use 2Ls 5×3½×3/8 = 6.10 use 6-Rivets

For chord member A to M. Unit stress = 15400 #/□"
SR = 124200 ÷ 15400 = 8.07 □"
Use 4Ls 3½×3½×3/8 with 12×3/8 web.

For longitudinal beam use same section as above.

Design of main bascule girder rear of trunnion.
Span up.



Total weight of counterweight. = 1,365,000
For one girder 1365.000 ÷ 2 = 682500#
Conc. per Connection 682500 ÷ 2 = 341200
10%. impact 34120
375320#
Call this 380000#

Moment at X-X
380.000 × 7.0 = 2660.000 1#
max End shear = 2 @ 380.000 = 760.000#

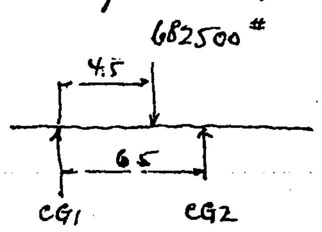
Effective depth of girder say 9.0
flange stress = 2660.000 ÷ 9.0 = 296.000#
Section required = 296.000 ÷ 14000 = 21.20 □" gross.

Use 2Ls 8×8×3/4 = 22.88
1Pl 18×3/4 = 13.50
36.38 □" used for top

2Ls 8×8×3/4 = 22.88
1Pl. 18×½ = 9.00
31.88 □" for rear

web assumed. 110 × ½ = 55 □"
at end 380.000 ÷ 55 = 6900 #/□"
at rear 760.000 ÷ (55×3) = 4600 #/□"

Stresses of main girder when span down



Counterweight = 682500# for one girder.
Reaction at Connection = 682500 × $\frac{4.5}{6.5}$ = ~~682500~~ 472500 at CG2
210.000 at CG1
682500#

moment at trunnion 472500 × 16.00 = 7564000
210.000 × 9.5 = 1995000
9559000 1#

moment at CG1 472500 × 6.5 = 3070000 1#

Dead Load moment about ℄ trunnion = + 589600
9559000
Total 10,148,600 1#

増田淳氏関係資料
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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule.

Dead Load moment at CG1 due to main girder etc (without cwt girder).

main girder	1800 × 8.5 =	15300	× 8.5/2	=	65000
		5610	× 4.0	=	22400
Rack		5000	× 5.5	=	27500
Tail lock		1000	× 5.5	=	5500
Air buffer		1000	× 5.5	=	5500
misc say		1000	say	=	1000
		28910#			126900#
	call this	29000		say	127000'#

Summary for shear and moment at CG1

Due to	moment	shear
Counterweight	3070.000	472500
structural steel etc	127.000	29000
	3.197.000'#	501500#

Starting moment due to Journal friction.
floor and structural steel 360610
cwt 682500
1043110# per girder friction = 1043110 × 0.15 = 156800#
Diameter of Journal 16½" starting force at rack circle = $156800 \times \frac{.69}{18.37} = 5900\#$

moment = 5900 × 18.37 = 108.500'#
For moment due to inertia see page followed.

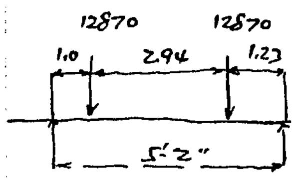
Design of fixed floor on abutment
stringer for electric Ry under the rail + Ry stringers 5'0" spacing.
Slab under Electric Ry Tracks. max span 5'2"
Dead Load. 3" wood block pavement = 15.0 DL. m = $\frac{1}{10} \times 144 \times 5.17^2 = 385$'#
4½" lean Concrete filling @12.0 = 54.0
6" Concrete slab. = 75.0 DL. shear = ½ × 144 × 5.17 = 372#
144.0

Live Load motor truck Concentration with 30% impact = 12870#
Distribution of wheel concentration for single load.
longitudinal distribution a = .66 + 1.25 = 1.91 E = ⅔(l+b)+a
transverse distribution b = 1.28 + 1.25 = 2.53 = ⅔(5.17+2.53)+1.91 = 7.04
assume distribution as 5.0'
Load per ft strip = 12870 ÷ 5.0 = 2570#

Concentrated load at center of span
m = 1285 × 2.58 = 3320
less $\frac{2.53}{4}$ × 1285 = 816
2504'#

For Continuity of slab. 0.8 × 2504 = 2000'#

Shear 12870 × $\frac{5.40}{5.17}$ = say 13500# 13500 ÷ 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

First Canal Bridge for City of Kobe; 60' Single Leaf trunnion bascule.

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 $= \frac{2385 \times 12}{17000 \times 7/8 \times 5} = .384$ use ½"# bars - 6" centers

Bond stress $= \frac{3072}{\frac{7}{8} \cdot 5} = 703$# per ft strip.

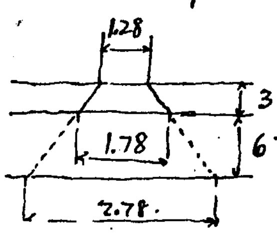
For shear use ½"# bars 3" center to carry bond stress.

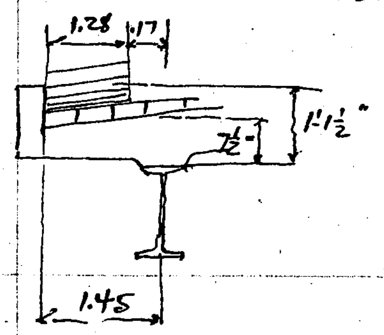
Unit bond of steel bar $= \frac{703}{6.28} = 112.0$ #/□"

Highway slab. Use 6" Reinforced Concrete slab same as for under Elec. Ry.

Overhanging Slab at Curb line of Highway.

Distribution of wheel Concentration $12870 \div 2.78 = 4630$# per lin ft assumed.





moment $= 4630 \times .81 = 3750$ "#

Dead Load = pave. 15#
slab. say 95
110#

moment say $110 \times \frac{2^2}{2} = 220$ "#
3750
3970 "#

Effective depth $= \sqrt{\frac{3970}{102}} = 6.25"$ depth over stringer 7½" Effective depth say 6.5"

Steel Area $= \frac{3970 \times 12}{\frac{7}{8} \cdot 6.5 \cdot 17000} = 0.493$ □" per ft. Use ½"# bars .590 □" per ft.

From bond stress it will be better use ½"# 3" center.

Unit shear $\frac{4850}{12 \cdot 6.5 \cdot \frac{7}{8}} = 71$ #/□" shear bars shall be used over stringer.

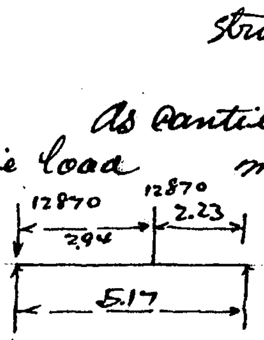
Design of longitudinal stringer Cantilever portion 4'-3"

Railway Stringer

Dead Load = 144# × 5.0 = 720#
Rails + accessories = 42#
Stringer assumed = 60
822# per lin ft.

As Cantilever $822 \times \frac{4.25^2}{2} = 7420$ '# shear = $822 \times 4.25 = 3500$#

Live load motor truck Concentration at end = 12870#



$12870 \times 2.23 \div 5.17 = 5550$
12870
18420#

moment at support $= 18420 \times 4.0 = 73600$
shear = 18420 D.m. 7420
D.L. shear 3500 81020 '#
21920#

Section modulus required $\frac{81020 \times 12}{15400} = 63.0$ 18" I @ 54.7# Sm = 88.4

approximate deflection $\frac{1}{2} \cdot wl^2 = M.$ $D = \frac{1}{2} wl^2 \cdot \frac{1}{4} \frac{l^2}{EI}$ $I = 795.^{(in)4}$

$D = \frac{81020 \times 12 \times 4.25^2 \times 12^2}{4 \times 30.000.000 \times 795} = .265"$

Use brace for Cantilever portion to reduce deflection of cantilever portion.

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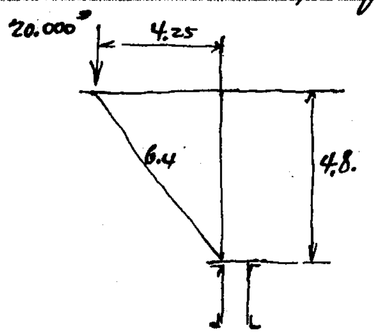
CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.



Concentration at end say 20.000#

Stress in diagonal support $= 20.000 \times \frac{6.4}{4.8} = 26700$# C.

Use 2L^s $3\frac{1}{2} \cdot 3\frac{1}{2} \cdot \frac{3}{8}$ (4.3") $= 4.960$" $r = 1.28$ $l/r = 60$

allowable unit stress $= 21300(1 - 0.0055\ l/r) = 14200$#/□"

SR $= 26700 \div 14200 = 1.880$"

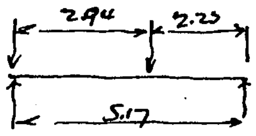
Cantilever portion of highway stringer. Use same details as for above.

Stringer S4 and S5 under Electric railway tracks span length 20'-0".

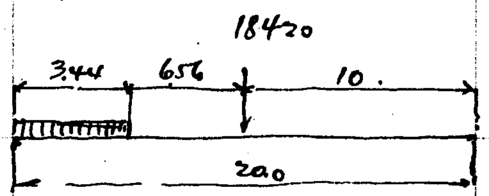
Dead Load. 822# per lin ft. $m = \frac{1}{8} \cdot 822 \cdot 20.0^2 = 41100'$#

shear $= 822 \cdot 10 = 8220$#

Live Load. motor truck loading. 12870# including impact



Reaction $= 12870 \cdot 2.23 \div 5.17 = 5550$
12870
18420#



Uniform live load. $120 \cdot 5 = 600$# per lin ft.

$600 \cdot 3.44 = 2080$#

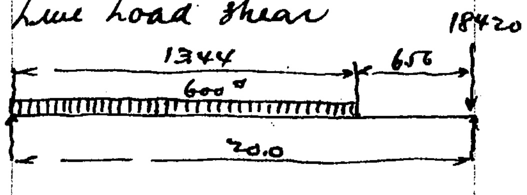
Reaction $= 2080 \cdot 1.72 \div 20 =$ say 180#

moment $= 9210 \cdot 10 = 92100$

" $= 180 \cdot 10 = 1800$

93900'#

Live Load shear



$600 \cdot \frac{13.44^2}{2 \cdot 20} = 2710$#
18420
21130#

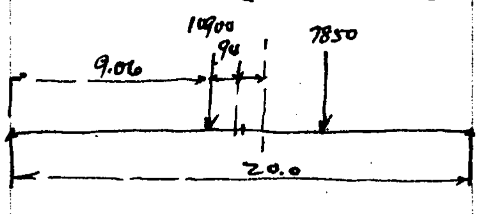
Summary for moments and shears

	moment	shear
Dead Load	41100	8220
Live Load	93900	21130
	135000	29350

$Sm = \frac{135000 \times 12}{15400} = 105.0$

18" · 7" @ 75.2#   Sm = 127.7

Live Load. Electric car loading. wheel load with impact $8359 \cdot 1.3 = 10900$
$6027 \cdot 1.3 = 7850$
18750



Center of gravity $= \frac{7850 \cdot 4.5}{18750} = 1.88$

moment $= 18750 \cdot \frac{9.06^2}{20.0} = 77000'$#

Highway Stringer S1 - S2 - S3. Use 1I 18" · 7" @ 75.2#   Sm = 127.7

Reactions due to dead load of Highway and Electric Ry stringers.

Dead Load on stringer

S1 pavement = 15
Concrete $7\frac{1}{2}$" = say 95 } $110 \cdot 1.45 = 160$#
Curb. $.33 \cdot 1.37 \cdot 150 =$ 68
228#

pavement = 15
Concrete 6" = 75
90 say 95# $\cdot 2.5 = 237$
465#

stringer assumed. 80
545# per lin ft.

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf Trunnion Bascule.

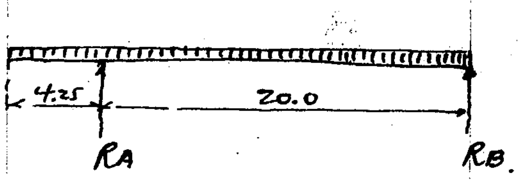
S_2. 95 × 5 = 475
stringer 80
555# per lin ft

S_3. slab between S_3 and S_4 144#
Between S_{2-3} 95 × 2.5 = 237
S_{3-4} 144 × 2.5 = 360
add 20
617
stringer say 80
697# per lin ft.

S_4. 144 × 4.92 = 708
Rail say 42
Stringer say 80
830# per lin ft

S_5 144 × 5.0 = 720
Rail 42
Stringer 80
842# per lin. ft.

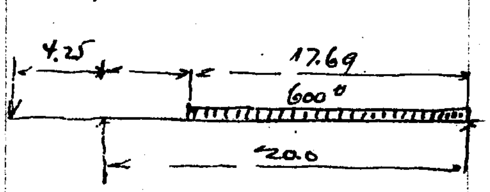
Reaction RA as Cantilever at end.



			RA.	
S_1	$545 \times \frac{24.25^2}{2 \times 20}$	=	8000	545 × 10 = 5450
S_2	555 × do	=	8150	555 × 10 = 5550
S_3	697 × do	=	10220	697 × 10 = 6970
S_4	830 × do	=	12200	830 × 10 = 8300
S_5	842 × do	=	12350#	842 × 10 = 8420

max Reaction RB. Cantilever effect neglected.

Max Live Load Reaction on Column
motor truck loading at end of cantilever. Single load at end = 18420#
Uniform load 600# per lin. ft.



$18420 \times \frac{24.25}{20}$ = 22400
$600 \times \frac{17.69^2}{2 \times 20}$ = 4680
27080#
Dead Load R = 12350
39430#

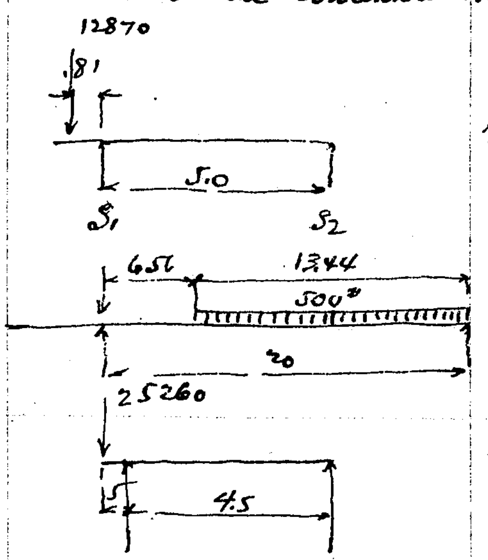
Design column for 40.000# load.

Column height = 5'9½" Try 2∠5 × 3½ × 3/8 = 6.10
Allowable unit stress = $21300\left(1 - 0.0055 \times \frac{69.5}{1.58}\right)$ = 16100#/□" use 14200#/□"

Section required = 40.000 ÷ 6.10 = 6550#/□".

For Lateral Bracing use 1∠ 3½ × 3½ × 3/8" with 3 Rivet Connection.

Max Live Load Concentration on S_1.



Load on S_1 $12870 \times \frac{5.81}{5.0}$ = say 15000#

max load on Column Uniform load. $\cancel{600}\,120 \times \frac{6.45^2}{2 \times 5.}$ = $\cancel{2500}\,500$#

Unif. $500 \times \frac{13.44^2}{2 \times 20}$ = 2260#
motor truck 15000
17260#
Dead Load say 8000
25260#

moment on Cantilever beam
25260 × 0.5 = 12600'#
Depth of beam 18" Use 18" × 75# I between S_1 and S_2.

增田淳氏関係資料
(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; 60' Single leaf trunnion bascule.

Design of trunnion girder.

Load from fixed floor

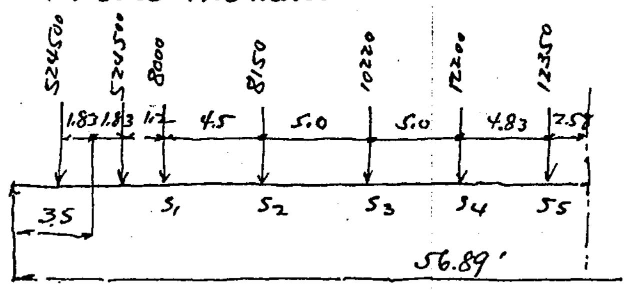
	S_1	8000
	S_2	8150
	S_3	10220
	S_4	12200
	S_5	12350
		50920

Load on trunnion and bearings.

Moving leaf without cwt	360610
Counterweight.	682500
	1043110
Due to friction at Journal.	5900
	1049010#

For each bearing 1049010 ÷ 2 = 524500#

Dead Load moment



shear 1099930
450 × 30 = 13500
1113430# say 1115000#

End Reaction = 50920
1049010
1099930#

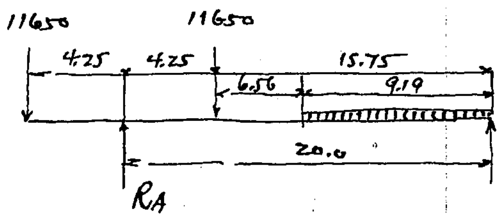
moment at center.

1099930 × 28.44	=			31,300,000 '#
12350 × 2.58	=	32.000		
12200 × 7.41	=	91.000		
10220 × 12.41	=	127.000		
8150 × 17.41	=	142.000		
8000 × 21.91	=	175.000		
1049010 × 24.94	=	26200.000		
				-26767000
				4533000

Dead Load of girder assumed 450# per lin ft. $m = \frac{1}{8} \times 450 \times 56.89^2 =$ 182.000

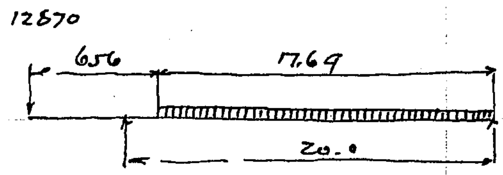
4,715,000 '#

Electric Car Loading
water car 8960 × 1.3 = 11650#

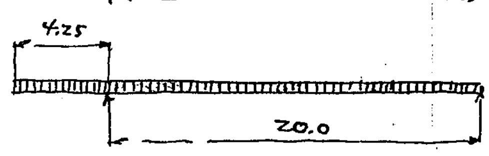


Load R_A 11650 × 24.25 = 282500
11650 × 15.75 = 184000
466500 ÷ 20 = 23300#

motor truck loading 12870
$12870 \times \frac{24.25}{20.0} =$ 15600#

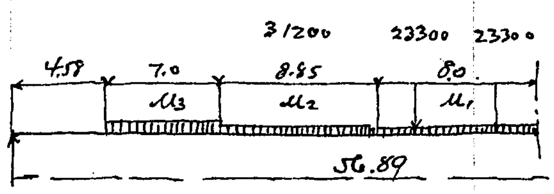


Uniform load M_1 $120 \times \frac{9.19^2}{2 \times 20} =$ 253#



M_2 $120 \times \frac{17.69^2}{2 \times 20} =$ 940#

M_3 $120 \times \frac{24.25^2}{2 \times 20} =$ 1765#



Reaction 2@23300 = 46600
motor truck 31200
77800#

moment at center 77800 × 28.44 = 2.220.000
46600 × 5.0 = 233000
31200 × 12.43 = 388.000
621.000
1599.000 '#

M_1 = 253 × 8.0 = 2020
M_2 = 940 × 8.85 = 8300
M_3 = 1765 × 7.00 = 12350
22670#

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule

Moment due to unif. load.

Moment = 22670 · 28.44 = 645.000
2020 · 4.0 = 4040
8300 · 12.43 = 103000
12350 · 20.35 = 252000

359040

Due to unif. load 285960
Due to concentrations 1599000
Total Live Load 1884960# say 1,890.000#

End shear motor truck etc 77800
Uniform 22670
100470# say 100,000#

Design trunnion girder for full dead load and live load on fixed floor.
Summary for moments and shear at center.

	moment	shear
Dead Load	4715.000	~~1175.000~~
Live Load	1890.000	100.000
	6605 000#	1275.000#

Moment at trunnion bearing.

Dead Load 1099830 · 5.33 = 5870.000
1049060 · 1.83 = 1920.000
3950.000#

Dead Load girder ½ · 450 · 5.33 · 51.56 = 62.000
4012.000# — 4012.000

Live Load moment 77800 · 5.33 = 415.000
Unif. 22670 · 5.33 = 121.000
536.000 — 536.000
4548.000#

web assumed 2 - ½" · 63" = 63.0□" ⅛ web = 7.88□"

Section assumed

2Ls 6·6·¾ = 16.88 · 1.78 = 30.00 −3.0 · 13.88
2Pls. 9·¾ = 13.50 · 4.75 = 64.10 −3.0 10.50
1Pl. 14·¾ = 10.50 · 0.37 = 3.9 −1.5 9.00
40.88 2.21" 90.2 33.38□" net.

Effective depth 5.29 − .37 = 4.92 flange stress = 6605.000 ÷ 4.92 = 1340.000#
Section required = 1340.000 ÷ 17000 = 78.80□"
7.88
70.92□" net 35.46□" for one girder.

Assumed section OK.

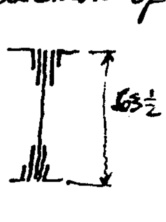
Section at trunnion support.

flange stress = 4548.000 ÷ 4.92 = 923.000#
SR = 923.000 ÷ 17000 = 54.30
7.88
46.42 ÷ 2 = 23.21□" net each girder

Use 2Ls 6·6·¾ = 16.88 −3.0 = 13.88
2Pls. 9·¾ = 13.50 −3.0 = 10.50
30.38 24.38□" net

Unit shear − 2 - 63·½ = 63.0□" 1275.000 ÷ 63 = 19300#/□"
Use Reinforcing plate both sides of web to reduce the shear.

Deflection of girder at trunnion support.



web 63 · ½ = 31.5 · 10420
4Ls 6·6·¾ = 33.76 · 31.75² + 113.0 = 34113
4Pls 9·¾ = 27.00 · 27.0² + 181.0 = 19880
64413.

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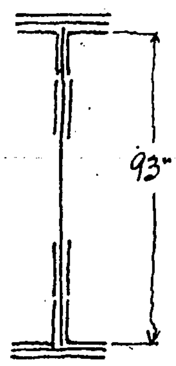
CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' Single leaf trunnion bascule

Preliminary calculation of deflection of girder give too big figure under the trunnion bearing which will cause defect of alignment of shaft after pouring concrete in counterweight. To make bascule in good working order it is required to make deflection of girder at bearing to minimum.

Let us assume the following section for trunnion girder.

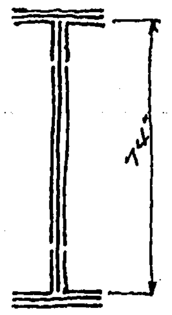
At center of span



		area ($\square$")	E^2		moment of Inertia.
cov. pls	2 Pls. $12\frac{3}{4} \times \frac{3}{4}$	= 19.125	× 47.625^2 +	0.896	= 43376
" "	2 Pls. $12\frac{3}{4} \times \frac{3}{4}$	= 19.125	× 46.875^2 +	"	= 41018
flanges	4 Ls 6.6. $\frac{3}{4}$	= 33.760	× 44.72^2 +	112.8	= 67629
web.	$92\frac{1}{2} \times \frac{3}{4}$	= 69.30			= 49465
side pls.	4 Pls $12 \times \frac{3}{4}$	= 36.00	× 34.25^2 +	432	= 42371
		177.310 $\square$"			243859

2@243859 = say 487700 $(in)^4$

~~Center of gravity of~~
Section at ℄ trunnion bearing



2 Pls. $12\frac{3}{4} \times \frac{3}{4}$	= 19.125	× 38.125^2 +	0.896	= 27865
2 Pls. $12\frac{3}{4} \times \frac{3}{4}$	= 19.125	× 37.375^2 +	"	= 26716
4 Ls 6.6. $\frac{3}{4}$	= 33.760	× 35.22^2 +	112.8	= 41990
1 Pl. $73\frac{1}{2} \times \frac{3}{4}$	= 55.12			24816
2 Pls. $61\frac{1}{2} \times \frac{3}{4}$	= 92.25			29076
	219.380 $\square$"			150463.

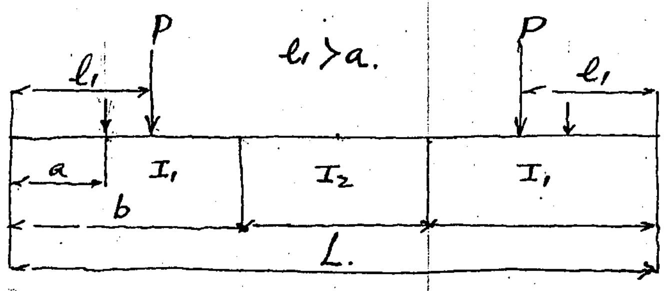
2@150463 = say, 300900 $(in)^4$.

flange stresses

at center of span $\frac{6605000 \times 12 \times 48.0}{487700}$ = 7800 #/□" gross section.

at trunnion bearing $\frac{4548000 \times 12 \times 38\frac{1}{2}}{300900}$ = 7000 #/□" gross section.

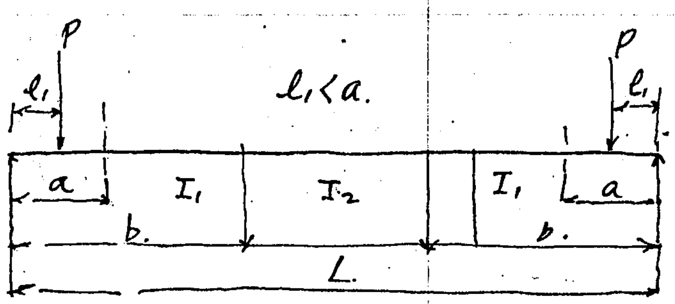
Deflection formula for given point. (a)



$$\Delta = \int_0^a \frac{Px^2dx}{EI_1} + \int_a^{l_1} \frac{Pxadx}{EI_1} + \int_{l_1}^b \frac{Pl_1adx}{EI_1} + \int_b^{\frac{L}{2}} \frac{Pl_1adx}{EI_2}$$

$$= \left[\frac{Px^3}{3EI_1}\right]_0^a + \left[\frac{Px^2a}{2EI_1}\right]_a^{l_1} + \left[\frac{Pl_1ax}{EI_1}\right]_{l_1}^b + \left[\frac{Pl_1ax}{EI_2}\right]_b^{\frac{L}{2}}$$

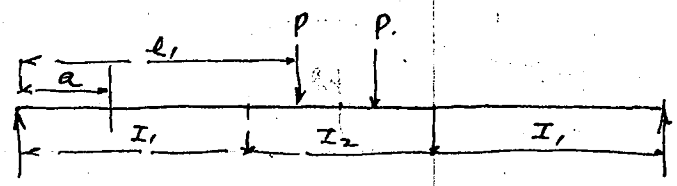
$$= \frac{Pa^3}{3EI_1} + \frac{Pa}{2EI_1}(l_1^2-a^2) + \frac{Pl_1a}{EI_1}(b-l_1) + \frac{Pl_1a}{EI_2}\left(\frac{L}{2}-b\right)$$



$$\Delta = \int_0^{l_1} \frac{Px^2dx}{EI_1} + \int_{l_1}^a \frac{Pl_1xdx}{EI_1} + \int_a^b \frac{Pl_1adx}{EI_1} + \int_b^{\frac{L}{2}} \frac{Pl_1adx}{EI_2}$$

$$= \left[\frac{Px^3}{3EI_1}\right]_0^{l_1} + \left[\frac{Pl_1x^2}{2EI_1}\right]_{l_1}^a + \left[\frac{Pl_1ax}{EI_1}\right]_a^b + \left[\frac{Pl_1ax}{EI_2}\right]_b^{\frac{L}{2}}$$

$$= \frac{Pl_1^3}{3EI_1} + \frac{Pl_1}{2EI_1}(a^2-l_1^2) + \frac{Pl_1a}{EI_1}(b-a) + \frac{Pl_1a}{EI_2}\left(\frac{L}{2}-b\right).$$



$$\Delta = \int_0^a \frac{Px^2dx}{EI_1} + \int_a^b \frac{Paxdx}{EI_1} + \int_b^{l_1} \frac{Paxdx}{EI_2} + \int_{l_1}^{\frac{L}{2}} \frac{Pl_1adx}{EI_2}$$

$$= \left[\frac{Px^3}{3EI_1}\right]_0^a + \left[\frac{Pax^2}{2EI_1}\right]_a^b + \left[\frac{Pax^2}{2EI_2}\right]_b^{l_1} + \left[\frac{Pl_1ax}{EI_2}\right]_{l_1}^{\frac{L}{2}}$$

$$= \frac{Pa^3}{3EI_1} + \frac{Pa}{2EI_1}(b^2-a^2) + \frac{Pa}{2EI_2}(l_1^2-b^2) + \frac{Pl_1a}{EI_2}\left(\frac{L}{2}-l_1\right).$$

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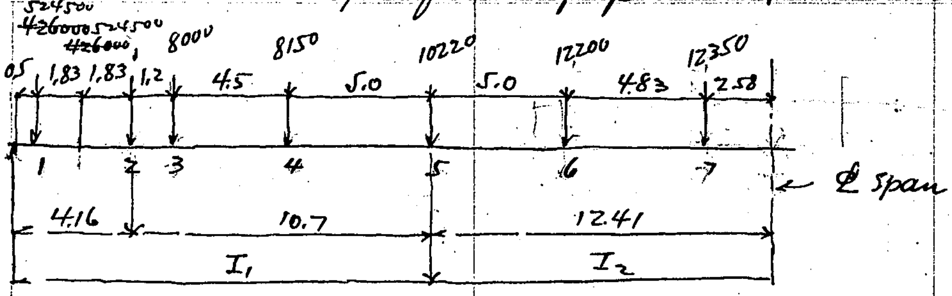
CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf trunnion bascule



Load at 1 and 2
Cwt. = 8073600 ÷ 14 = 576.000
moving leaf say 276.000
852 000 ÷ 2 = 426000 "

Dead Load deflection of girder at 2.

Load 1
$l_1 = 0.5$
$a = 4.16$
$b - a = 10.7$
$\frac{L}{2} - b = 12.41$

$+ \dfrac{\overset{524500}{\cancel{426000}} \cdot 0.5^3 \cdot 12^3}{3 \cdot 30.000.000 \cdot 300900} = 0.000034$

$+ \dfrac{\cancel{426000} \cdot 0.5 \cdot 12^3}{2 \cdot 30.000.000 \cdot 300900} \cdot (4.16^2 - 0.5^2) = 0.000340$

$+ \dfrac{\cancel{426000} \cdot 0.5 \cdot 4.16 \cdot 10.7 \cdot 12^3}{30.000.000 \cdot 300900} = 0.001820$

$+ \dfrac{\cancel{426000} \cdot 0.5 \cdot 4.16 \cdot 12.41 \cdot 12^3}{30.000.000 \cdot 487700} = 0.001290$ 0.00429 ~~0.003484~~"

Load 2
$l_1 = 4.16$
$a = 4.16$

$+ \dfrac{\cancel{426000} \cdot 4.16^3 \cdot 12^3}{3 \cdot 30.000.000 \cdot 300900} = 0.00192$

$+ \dfrac{\cancel{426000} \cdot 4.16 \cdot 4.16 \cdot 10.7 \cdot 12^3}{30.000.000 \cdot 300900} = 0.01510$

$+ \dfrac{\cancel{426000} \cdot 4.16 \cdot 4.16 \cdot 12.41 \cdot 12^3}{30.000.000 \cdot 487700} = 0.02540$ 0.0522 ~~0.04242~~"

Load 3
$l_1 = 5.36$

$+ \dfrac{8000 \cdot 4.16^3 \cdot 12^3}{3 \cdot 30.000.000 \cdot 300900} = 0.000036$

$+ \dfrac{8000 \cdot 4.16 \cdot 12^3}{2 \cdot 30.000.000 \cdot 300900} (5.36^2 - 4.16^2) = 0.000037$

$+ \dfrac{8000 \cdot 5.36 \cdot 4.16 \cdot 9.5 \cdot 12^3}{30.000.000 \cdot 300900} = 0.000320$

$+ \dfrac{8000 \cdot 5.36 \cdot 4.16 \cdot 12.4 \cdot 12^3}{30.000.000 \cdot 487700} = 0.000252$

0.000645"

Load 4
$l_1 = 9.86$
$a = 4.16$
$b - l_1 = 5.0$

$+ \dfrac{8150 \cdot 4.16^3 \cdot 12^3}{3 \cdot 30.000.000 \cdot 300900} = 0.000037$

$+ \dfrac{8150 \cdot 4.16 \cdot 12^3}{2 \cdot 30.000.000 \cdot 300900} (9.86^2 - 4.16^2) = 0.000260$

$+ \dfrac{8150 \cdot 9.86 \cdot 4.16 \cdot 5.00 \cdot 12^3}{30.000.000 \cdot 300900} = 0.000320$

$+ \dfrac{8150 \cdot 9.86 \cdot 4.16 \cdot 12.41 \cdot 12^3}{30.000.000 \cdot 487700} = 0.000490$

0.001107"

Load 5
$l_1 = 14.86$

$+ \dfrac{10220 \cdot 4.16^3 \cdot 12^3}{3 \cdot 30.000.000 \cdot 300900} = 0.000047$

$+ \dfrac{10220 \cdot 4.16 \cdot 12^3}{2 \cdot 30.000.000 \cdot 300900} \cdot (14.86^2 - 4.16^2) = 0.000830$

$+ \dfrac{10220 \cdot 14.86 \cdot 4.16 \cdot 12.41 \cdot 12^3}{30.000.000 \cdot 487700} = 0.000927$

0.001804"

Load 6.
$l_1 = 19.86$.

$+ \dfrac{12200 \cdot 4.16^3 \cdot 12^3}{3 \cdot 30.000.000 \cdot 300900} = 0.0000560$

$+ \dfrac{12200 \cdot 4.16 \cdot 12^3}{2 \cdot 30.000.000 \cdot 300900} \cdot (14.86^2 - 4.16^2) = 0.000990$

$+ \dfrac{12200 \cdot 4.16 \cdot 12^3}{2 \cdot 30.000.000 \cdot 300900} \cdot (19.86^2 - 14.86^2) = 0.000843$

$+ \dfrac{12200 \cdot 19.86 \cdot 4.16 \cdot 7.41 \cdot 12^3}{30.000.000 \cdot 487700} = 0.000725$

0.002614"

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

Load 7
$l_1 = 24.69$

$$+ \frac{12350 \cdot 4.16^3 \cdot 12^3}{3 \cdot 30.000.000 \cdot 300900} = 0.000057$$

$$+ \frac{12350 \cdot 4.16 \cdot 12^3}{2 \cdot 30.000.000 \cdot 300900} \cdot (14.86^2 - 4.16^2) = 0.001000$$

$$+ \frac{12350 \cdot 4.16 \cdot 12^3}{2 \cdot 30.000.000 \cdot 487700} \cdot (24.69^2 - 14.86^2) = 0.001180$$

$$+ \frac{12350 \cdot 24.69 \cdot 4.16 \cdot 2.58 \cdot 12^3}{30.000.000 \cdot 487700} = \underline{0.000388}$$

0.002625"

Summary for deflection at Z.

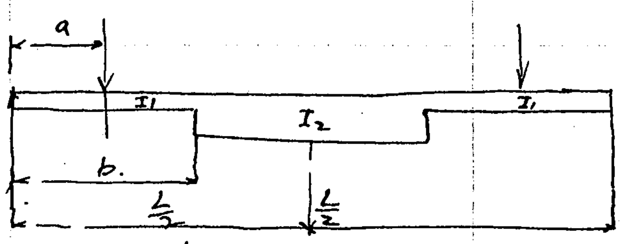
load 1	= 0.00~~3484~~ 4290
2	0.0~~42420~~ 522
3	0.000645
4	0.001107
5	0.001804
6	0.002614
7	0.002625
	~~0.054699~~"
	0.065289

Deflection due to uniform load.
at (a)

Uniform load w per lin ft.
W = total load on span

$R = \frac{1}{2}W \quad M = \frac{1}{2}Wx - \frac{wx^2}{2}$

$m = \frac{1}{2}x \cdot x 2 = x.$



$$\Delta = \int_0^{\frac{L}{2}} \frac{Mm\,dx}{EI}$$

$$\Delta = \int_0^a \frac{\frac{1}{2}Wx^2dx}{EI_1} - \frac{\frac{1}{2}wx^3dx}{EI_1} + \int_a^b \frac{\frac{1}{2}Wxa\,dx}{EI_1} - \frac{\frac{1}{2}wx^2a\,dx}{EI_1} + \int_b^{\frac{L}{2}} \frac{\frac{1}{2}Wxa\,dx}{EI_2} - \frac{\frac{1}{2}wx^2a\,dx}{EI_2}$$

$$= \left[\frac{Wx^3}{6EI_1} - \frac{wx^4}{8EI_1}\right]_0^a + \left[\frac{\frac{1}{2}Wax^2}{2EI_1} - \frac{\frac{1}{2}wx^3a}{3EI_1}\right]_a^b + \left[\frac{\frac{1}{2}Wax^2}{2EI_2} - \frac{\frac{1}{2}wx^3a}{3EI_2}\right]_b^{\frac{L}{2}}$$

$$= \left(\frac{Wa^3}{6EI_1} - \frac{wa^4}{8EI_1}\right) + \frac{Wa}{4EI_1}(b^2-a^2) - \frac{wa}{6EI_1}(b^3-a^3) + \frac{Wa}{4EI_2}\left((\tfrac{L}{2})^2-b^2\right) - \frac{wa}{6EI_2}\left((\tfrac{L}{2})^3-b^3\right)$$

$$= \frac{wa^3L}{6EI_1} - \frac{wa^4}{8EI_1} + \frac{waL}{4EI_1}(b^2-a^2) - \frac{wa}{6EI_1}(b^3-a^3) + \frac{waL}{4EI_2}\left((\tfrac{L}{2})^2-b^2\right) - \frac{wa}{6EI_2}\left((\tfrac{L}{2})^3-b^3\right)$$

Uniform load assumed 1510# per lin ft.
Deflection at $a = 4.16$

$$+ \frac{1510 \cdot 4.16^3 \cdot 5456 \cdot 12^{\cancel{4}\,3}}{6 \cdot 30.000.000 \cdot 300900} = \quad \begin{matrix} 0.00019 \\ +\,\cancel{0.00228} \end{matrix}$$

$$- \frac{1510 \cdot 4.16^4 \cdot 12^{\cancel{4}\,3}}{8 \cdot 30.000.000 \cdot 300900} = \quad \begin{matrix} 0.00001 \\ -\,\cancel{0.00013} \end{matrix} \qquad \begin{matrix} 0.00018 \\ \cancel{0.00215} \end{matrix}$$

$$+ \frac{1510 \cdot 4.16 \cdot 5456 \cdot 12^{\cancel{4}\,3}}{4 \cdot 30.000.000 \cdot 300900} \cdot (14.86^2 - 4.16^2) \quad \begin{matrix} 0.00033 \\ +\,\cancel{0.00400} \end{matrix}$$

$$- \frac{1510 \cdot 4.16 \cdot 12^{\cancel{4}\,3}}{6 \cdot 30.000.000 \cdot 300900} \cdot (14.86^3 - 4.16^3) \quad \begin{matrix} 0.00007 \\ -\,\cancel{0.00079} \end{matrix} \qquad \begin{matrix} 0.00026 \\ \cancel{0.00321} \end{matrix}$$

$$+ \frac{1510 \cdot 4.16 \cdot 5456 \cdot 12^{\cancel{4}\,3}}{4 \cdot 30.000.000 \cdot 487700} \cdot (27.28^2 - 14.86^2) \quad \begin{matrix} 0.00053 \\ +\,\cancel{0.00636} \end{matrix}$$

$$- \frac{1510 \cdot 4.16 \cdot 12^{\cancel{4}\,3}}{6 \cdot 30.000.000 \cdot 487700} \cdot (27.28^3 - 14.86^3) \quad \begin{matrix} 0.00021 \\ -\,\cancel{0.00253} \\ \cancel{.00383} \end{matrix} \; - \; \begin{matrix} 0.00032 \\ \cancel{0.00383} \end{matrix}$$

~~0.00919~~" 0.00076

Deflection due to Conc. 0.~~054699~~ 65289

~~0.063889~~"
~~0.074479~~
0.066049

増田淳氏関係資料
(独立行政法人 土木研究所蔵)

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MADE BY J. Masuda DATE 15-10-7 FILE NO.
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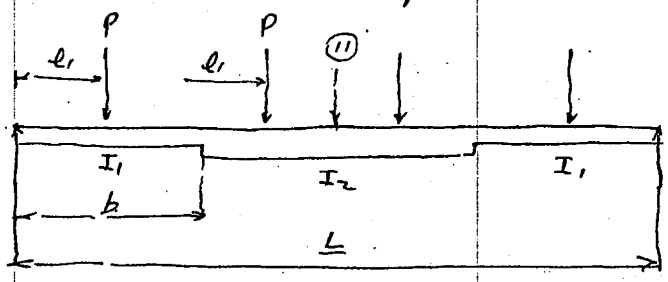
CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

Deflection at center of span



$$\Delta = \int_0^{l_1} \frac{Px^2\,dx}{EI_1} + \int_{l_1}^{b} \frac{Pl_1 x\,dx}{EI_1} + \int_b^{\frac{L}{2}} \frac{Pl_1 x\,dx}{EI_2}$$

$$= \left[\frac{Px^3}{3EI_1}\right]_0^{l_1} + \left[\frac{Pl_1 x^2}{2EI_1}\right]_{l_1}^{b} + \left[\frac{Pl_1 x^2}{2EI_2}\right]_b^{\frac{L}{2}}$$

$$= \frac{Pl_1^3}{3EI_1} + \frac{Pl_1}{2EI_1}(b^2 - l_1^2) + \frac{Pl_1}{4EI_2}\left(\left(\tfrac{L}{2}\right)^2 - b^2\right) \qquad l_1 < b.$$

$$\Delta = \int_0^{b} \frac{Px^2\,dx}{EI_1} + \int_b^{l_1} \frac{Px^2\,dx}{EI_2} + \int_{l_1}^{\frac{L}{2}} \frac{Pl_1 x\,dx}{EI_2}$$

$$= \left[\frac{Px^3}{3EI_1}\right]_0^{b} + \left[\frac{Px^3}{3EI_2}\right]_b^{l_1} + \left[\frac{Pl_1 x^2}{2EI_2}\right]_{l_1}^{\frac{L}{2}}$$

$$= \frac{Pb^3}{3EI_1} + \frac{P}{3EI_2}(l_1^3 - b^3) + \frac{Pl_1}{2EI_2}\left(\left(\tfrac{L}{2}\right)^2 - l_1^2\right) \qquad l_1 > b.$$

Deflection at center due to Concentrations.

load 1
$+\ \dfrac{\cancel{426000}^{\,524500} \cdot 0.5^3 \cdot 12^3}{3 \cdot 30.000.000 \cdot 300900} = 0.00004$

$+\ \dfrac{\cancel{426000} \cdot 0.5 \cdot 12^3}{2 \cdot 30.000.000 \cdot 300900} \cdot (14.86^2 - 0.5^2) = 0.00448$

$+\ \dfrac{\cancel{426000} \cdot 0.5 \cdot 12^3}{2 \cdot 30.000.000 \cdot \cancel{300900}\ 487{,}700} \cdot (27.28^2 - 14.86^2) = 0.00658$

0.~~0111~~ .0137"

load 2
$+\ \dfrac{\cancel{426000} \cdot 4.16^3 \cdot 12^3}{3 \cdot 30.000.000 \cdot 300900} = 0.00196$

$+\ \dfrac{\cancel{426000} \cdot 4.16 \cdot 12^3}{2 \cdot 30.000.000 \cdot 300900} \cdot (14.86^2 - 4.16^2) = 0.03440$

$+\ \dfrac{\cancel{426000} \cdot 4.16 \cdot 12^3}{2 \cdot 30.000.000 \cdot 487700} \cdot (27.28^2 - 14.86^2) = 0.05480$

0.~~0911~~ .11200"

load 3.
$+\ \dfrac{8000 \cdot 5.36^3 \cdot 12^3}{3 \cdot 30.000.000 \cdot 300900} = 0.00008$

$+\ \dfrac{8000 \cdot 5.36 \cdot 12^3}{2 \cdot 30.000.000 \cdot 300900} \cdot (14.86^2 - 5.36^2) = 0.00078$

$+\ \dfrac{8000 \cdot 5.36 \cdot 12^3}{2 \cdot 30.000.000 \cdot 487700} \cdot (27.28^2 - 14.86^2) = 0.00133$

0.00219"

load 4
$+\ \dfrac{8150 \cdot 9.86^3 \cdot 12^3}{3 \cdot 30.000.000 \cdot 300900} = 0.00050$

$+\ \dfrac{8150 \cdot 9.86 \cdot 12^3}{2 \cdot 30.000.000 \cdot 300900} \cdot (14.86^2 - 9.86^2) = 0.00094$

$+\ \dfrac{8150 \cdot 9.86 \cdot 12^3}{2 \cdot 30.000.000 \cdot 487700} \cdot (27.28^2 - 14.86^2) = 0.00250$

0.00374"

load 5
$+\ \dfrac{10220 \cdot 14.86^3 \cdot 12^3}{3 \cdot 30.000.000 \cdot 300900} \cdot (= 0.00214$

$+\ \dfrac{10220 \cdot 14.86 \cdot 12^3}{2 \cdot 30.000.000 \cdot 487700} \cdot (27.28^2 - 14.86^2) = 0.00470$

0.00648"

load 6.
$+\ \dfrac{12200 \cdot 14.86^3 \cdot 12^3}{3 \cdot 30.000.000 \cdot 300900} = 0.00256$

$+\ \dfrac{12200 \cdot 12^3}{3 \cdot 30.000.000 \cdot 487900} \cdot (19.86^3 - 14.86^3) = 0.00218$

$+\ \dfrac{12200 \cdot 19.86 \cdot 12^3}{2 \cdot 30.000.000 \cdot 487700} \cdot (27.28^2 - 19.86^2) = 0.00500$

0.00974"

load 7.
$+\ \dfrac{12350 \cdot 14.86^3 \cdot 12^3}{3 \cdot 30.000.000 \cdot 300900} = 0.00260$

$+\ \dfrac{12350 \cdot 12^3}{3 \cdot 30.000.000 \cdot 487700} \cdot (24.69^3 - 14.86^3) = 0.00286$

$+\ \dfrac{12350 \cdot 24.69 \cdot 12^3}{4 \cdot 30.000.000 \cdot 487700} \cdot (27.28^2 - 24.69^2) = 0.00240$

0.01072"

0.~~1355~~" at center.
0.1589

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MADE BY J. Masuda DATE 15-10-9 FILE NO.

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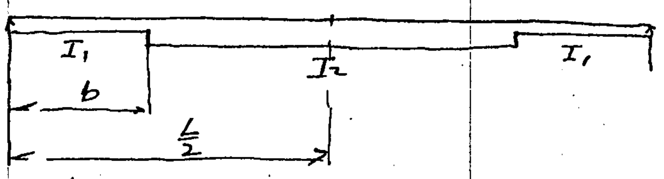
CALCULATIONS FOR

First Panal Bridge for City of Kobe : 60' Single leaf trunnion Bascule.

Deflection at Center due to uniform load
w per lin ft.
$W = wL$.



$$\Delta = \int_0^b \left(\tfrac{1}{2}Wx - \tfrac{wx^2}{2}\right)\frac{x\,dx}{EI_1} + \int_b^{\frac{L}{2}} \left(\tfrac{1}{2}Wx - \tfrac{wx^2}{2}\right)\frac{x\,dx}{EI_2}$$

$$= \frac{1}{EI_1}\left[\frac{1}{2}\frac{Wx^3}{3} - \frac{1}{2}\frac{wx^4}{4}\right]_0^b + \frac{1}{EI_2}\left[\frac{1}{2}\frac{Wx^3}{3} - \frac{1}{2}\frac{wx^4}{4}\right]_b^{\frac{L}{2}}$$

$$= \frac{1}{EI_1}\left[\frac{wLb^3}{6}\cdot^4_4 - \frac{wb^4}{8}\cdot^3_3\right] + \frac{1}{EI_2}\left[\frac{wL\{(\frac{L}{2})^3 - b^3\}}{6} - \frac{w\{(\frac{L}{2})^4 - b^4\}}{8}\right]$$

$$= \frac{wb^3}{24EI_1}(4L - 3b) + \frac{w}{24EI_2}\left\{4L\left((\tfrac{L}{2})^3 - b^3\right) - 3\left((\tfrac{L}{2})^4 - b^4\right)\right\}$$

Deflection at center. $b = 14.86 \quad \frac{L}{2} = 27.28 \quad L = 54.56'$

$$+ \frac{1510^{\#} \cdot 14.86^3 \cdot (4 \cdot 54.56 - 3 \cdot 14.86) \cdot 12^3}{24 \cdot 30.000.000 \cdot 300900} = +0.0068$$

$$+ \frac{1510 \cdot \{4 \cdot 54.56\,(27.28^3 - 14.86^3)\} \cdot 12^3}{24 \cdot 30.000.000 \cdot 487700} = +0.0276$$

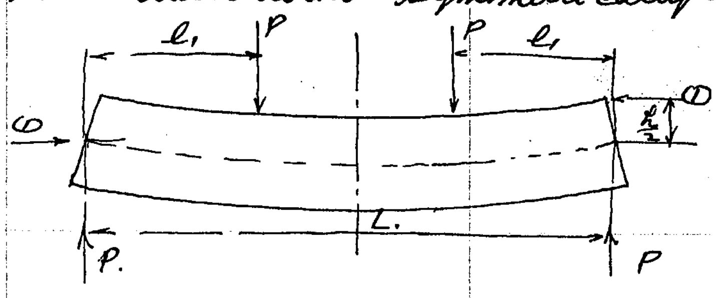
$$- \frac{1510 \cdot 3 \cdot (27.28^4 - 14.86^4) \cdot 12^3}{24 \cdot 30.000.000 \cdot 487700} = -\underline{0.0113}$$

0.0231"

0 0.0068
0.0276
0.0113

Total Deflection = due to concentration 0.1589 ~~0.1355~~
due to uniform load ~~0.0231~~
~~0.1586~~"
0.1820

Horizontal deflection of girder
Concentrated load symmetrically loaded.



$M = Px$
$m = +\frac{h}{2L}$ for left half.
$m = -\frac{h}{2L} + \frac{h}{2}$ " right half.

$$\Delta = \int \frac{Mm\,dx}{EI} = +\int_0^{l_1} \frac{Px\,h}{2L}\frac{x\,dx}{EI_1} + \int_{l_1}^{\frac{L}{2}} \frac{Pl_1 h}{2L}\frac{x\,dx}{EI}$$

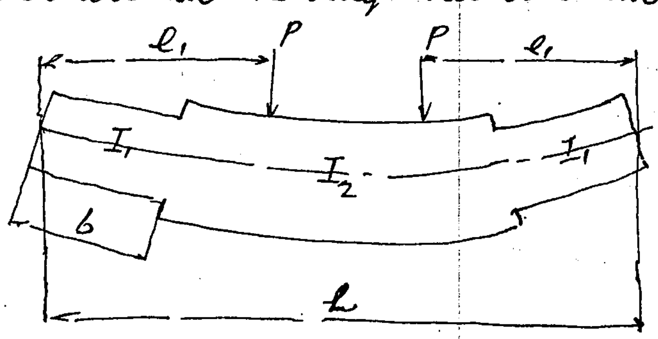
$$- \text{do} \qquad - \text{do}$$

$$+ \int_0^{l_1} Px\frac{h}{2}\frac{dx}{EI} + \int_{l_1}^{\frac{L}{2}} Pl_1\frac{h}{2}\frac{dx}{EI}$$

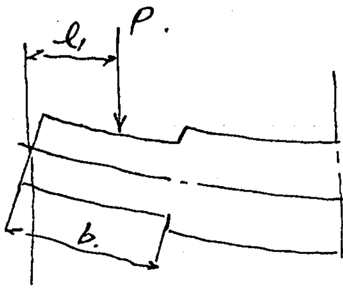
$$= +\left[\frac{Px^2h}{4EI}\right]_0^{l} + \left[\frac{Pl_1 x h}{2EI}\right]_{l_1}^{\frac{L}{2}}$$

$$= +\frac{Pl_1^2 h}{4EI} + \frac{Pl_1 h}{2EI}\left(\frac{L}{2} - l_1\right).$$

For section having variable moment of inertia.



$$\Delta = \frac{Phb^2}{4EI_1} + \frac{Ph}{4EI_2}(l_1^2 - b^2) + \frac{Pl_1 h}{2EI_2}\left(\frac{L}{2} - l_1\right)$$



$$\Delta = \frac{Pl_1^2 h}{4EI_1} + \frac{Pl_1 h}{2EI_1}(b - l_1) + \frac{Pl_1 h}{2EI_2}\left(\frac{L}{2} - b\right)$$

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MADE BY J. Masuda DATE 15-10-12 FILE NO.
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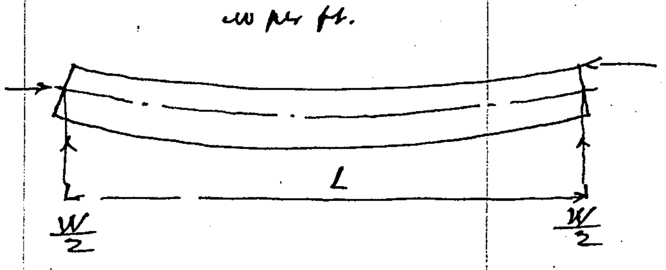
CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule.

Horizontal Deflection due to uniform load.

w per lin ft. W = wL. Total load on span.



$M = \frac{W}{2}x - \frac{wx^2}{2}$

$m = \frac{h}{2L}$ for left half

$m = -\frac{h}{2L} + \frac{h}{2}$ for right half.

$$\Delta = \int_0^L \frac{Mm\,dx}{EI} = \int_0^{\frac{L}{2}} \frac{W}{2}x\,\frac{h}{2}\frac{dx}{EI} - \frac{wx^2}{2}\frac{h}{2}\frac{dx}{EI}$$

$$= \left[\frac{Wh\,x^2}{2\cdot2\cdot2}\right]_0^{\frac{L}{2}} - \left[\frac{wh}{2\cdot2}\cdot\frac{x^3}{3}\right]_0^{\frac{L}{2}}$$

$$= \frac{Wh\left(\frac{L}{2}\right)^2}{8EI} - \frac{Wh}{4LEI}\frac{\left(\frac{L}{2}\right)^3}{3}.$$

For variable moment of inertia.

$$\Delta = \left[\frac{W}{2}\frac{h}{2}\frac{x^2}{2EI_1}\right]_0^b - \left[\frac{wh}{4}\frac{x^3}{3EI_1}\right]_0^b + \left[\frac{W}{2}\frac{h}{2}\frac{x^2}{2EI_2}\right]_b^{\frac{L}{2}} - \left[\frac{wh}{4}\frac{x^3}{3EI_2}\right]_b^{\frac{L}{2}}$$

$$= \frac{Wh}{8}\frac{b^2}{EI_1} - \frac{Wh\,b^3}{12EI_1L} + \frac{Wh}{8}\frac{\left(\left(\frac{L}{2}\right)^2 - b^2\right)}{EI_2} - \frac{Wh}{12LEI_2}\left(\left(\frac{L}{2}\right)^3 - b^3\right).$$

Horizontal Deflection of trunnion girder.

load 1.
$\frac{\cancel{426000}\ 524500 \cdot 0.5^2 \cdot 12^2 \cdot 77''}{4\cdot 30.000.000 \cdot 300900}$ = 0.000032

$\frac{\cancel{426000} \cdot 0.5 \cdot 12^2 \cdot 77}{2\cdot 30.000.000 \cdot 300900} \cdot (14.87 - 0.5)$ = 0.00190

$\frac{\cancel{426000} \cdot 0.5 \cdot 12^2 \cdot 77}{2\cdot 30.000.000 \cdot 487700} \cdot (27.28 - 14.87)$ = 0.00102

364 0.~~00295~~ 364"

load 2
$\frac{\cancel{426000} \cdot 4.16^2 \cdot 12^2 \cdot 77}{4\cdot 30.000.000 \cdot 300900}$ = 0.00226

$\frac{\cancel{426000} \cdot 4.16 \cdot 12^2 \cdot 77}{2\cdot 30.000.000 \cdot 300900} \cdot (14.87 - 4.16)$ = 0.01160

$\frac{\cancel{426000} \cdot 4.16 \cdot 12^2 \cdot 77}{2\cdot 30.000.000 \cdot 487700} \cdot (27.28 - 14.87)$ = 0.00860

275 0.~~02246~~ .02750"

load 3
$\frac{8000 \cdot 5.36^2 \cdot 12^2 \cdot 77}{4\cdot 30.000.000 \cdot 300900}$ = 0.000008

$\frac{8000 \cdot 5.36 \cdot 12^2 \cdot 77}{2\cdot 30.000.000 \cdot 300900} \cdot (14.87 - 5.36)$ = 0.000025

$\frac{8000 \cdot 5.36 \cdot 12^2 \cdot 77}{2\cdot 30.000.000 \cdot 487700} \cdot (27.28 - 14.87)$ = 0.0000208

0.0000746

load 4
$\frac{8150 \cdot 9.86^2 \cdot 12^2 \cdot 77}{4\cdot 30.000.000 \cdot 300900}$ · (0.000024

$\frac{8150 \cdot 9.86 \cdot 12^2 \cdot 77}{2\cdot 30.000.000 \cdot 300900} \cdot (14.87 - 9.86)$ = 0.000025

$\frac{8150 \cdot 9.86 \cdot 12^2 \cdot 77}{2\cdot 30.000.000 \cdot 487700} \cdot (27.28 - 14.87)$ = 0.000039

0.000088"

load 5
$\frac{10220 \cdot 14.86^2 \cdot 12^2 \cdot 77}{4\cdot 30.000.000 \cdot 300900}$ = 0.000070

$\frac{10220 \cdot 14.86 \cdot 12^2 \cdot 77}{2\cdot 30.000.000 \cdot 487700} \cdot (27.28 - 14.87)$ = 0.000074

0.
0.000144"

load 6.
$\frac{12200 \cdot 77 \cdot 14.87^2 \cdot 12^2}{4\cdot 30.000.000 \cdot 300900}$ = 0.000084

$\frac{12200 \cdot 77 \cdot 12^2}{4\cdot 30.000.000 \cdot 487700} \cdot (19.86^2 - 14.87^2)$ = 0.000040

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First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

$\frac{12200 \times 19.86 \times 77 \times 12^2}{2 \times 30.000.000 \times 487700} \times (27.28 - 19.86) = \underline{0.000070}$

0.000194"

Load 7

$\frac{12350 \times 77 \times 14.87^2 \times 12^2}{4 \times 30.000.000 \times 300900} = 0.000084$

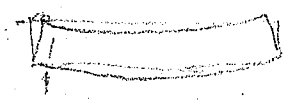
$\frac{12350 \times 77 \times 12^2}{4 \times 30.000.000 \times 300900} \times (24.69^2 - 14.87^2) = 0.000090$

$\frac{12350 \times 77 \times 24.69 \times 12^2}{2 \times 30.000.000 \times 487700} \times (27.28 - 24.69) = \underline{0.000030}$

0.000204"

Load 1	0.00 ~~295~~ 364
2	0.0 ~~2246~~ 2750
3	0.00007
4	0.00009
5	0.00014
6	0.00019
7	0.00020
	0.0 ~~2610~~ 3183 "

Horizontal Deflection of Trunnion girder due to uniform load



uniform load $w = 1510^{\#}$ per ft $W = 1510 \times 54.56 = 82500^{\#}$

$+ \frac{82500 \times 14.87^2 \times 12^2 \times 77}{8 \times 30.000.000 \times 300900} = +0.00280$

$- \frac{82500 \times 77 \times 14.87^2 \times 12^3}{12 \times 30.000.000 \times 300900 \times 54.56 \times 12} = -0.00034$

$+ \frac{82500 \times 77 \times 12^2 (27.28^2 - 14.87^2)}{8 \times 30.000.000 \times 487700} = +0.00410$

$- \frac{82500 \times 77 \times (27.28^3 - 14.87^3) \times 12^3}{12 \times 12 \times 30.000.000 \times 487700 \times 54.56} = \underline{-0.00160}$

+0.00496"

~~Due to cone.~~ 0.0 ~~2610~~ 3183

0.03679 ~~0.03106~~ "

This deformation to be measured at top corner from neutral axis. same deformation at bottom flange beyond neutral axis.

Counterweight Girder. CG1 and CG2
CG3 neglected

CG1	1 Pl. 84 × 1/2	= 42.0 □"			=	24600
	4 Ls 6×6×3/4	= 33.76	× 40.47²	+ 113	=	55110
	2 Pls. 13 × 3/4	= 19.50	× 42.63²			35400
		95.26				
						115110 (in)⁴
CG2.	1 Pl. 84 × 5/8	= 52.50				30900
	4 Ls 8×8×3/4	= 45.76	× 39.97² +	280	=	73580
	4 Pls. 12 × 3/4	= 36.00	× 36.0² +	433	=	47133
	4 Pls. 18 × 3/4	= 54.00	× 43.0²		=	99800
		188.26				
						251413
						366523

Call this 366500 (in)⁴

Max deflection at center of span
Total load on span = 1.152.000# Span length = 49.89

$\text{Max Deflection} = \frac{5}{384} \times \frac{1152.000 \times 49.89^3 \times 12^3}{30.000.000 \times 366500} = 0.294"$

Horizontal Deflection at end.

$$\Delta = \frac{Wh}{8} \cdot \frac{L^2}{4EI} - \frac{WhL^3}{12 \cdot 8 \cdot EIL} = \frac{1}{96}\frac{WhL^2}{EI}$$

$\text{Hor. Def.} = \frac{1}{96} \times \frac{1.152.000 \times 86 \times 49.89^2 \times 12^2}{30.000.000 \times 366500} = 0.0336"$ for 43"

増田淳氏関係資料 (独立行政法人 土木研究所蔵)

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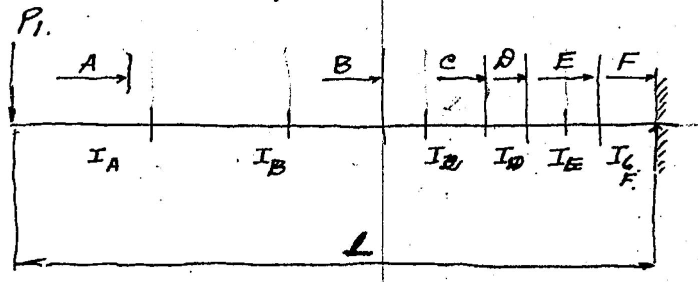
CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

Deflection at end of Cantilever Beam:



Concentrated load at end of beam

$M = P_1 x.$

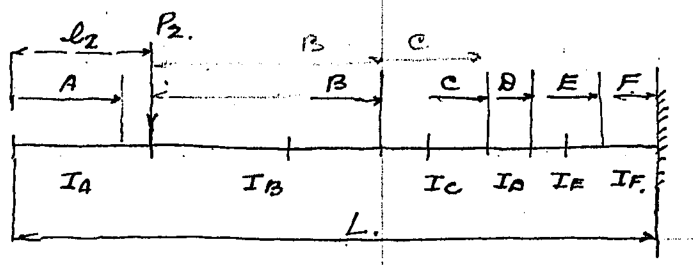
$m = x.$

$$\Delta = \int_0^L \frac{M m dx}{EI.}$$

$$\Delta = \int_0^A \frac{P_1 x^2 dx}{EI_A} + \int_A^B \frac{P_1 x^2 dx}{EI_B} + \int_B^C \frac{P_1 x^2 dx}{EI_C} + \int_C^D \frac{P_1 x^2 dx}{EI_D} + \int_D^E \frac{P_1 x^2 dx}{EI_E} + \int_E^F \frac{P_1 x^2 dx}{EI_F.}$$

$$= \left[\frac{P_1 x^3}{3EI_A}\right]_0^A + \left[\frac{P_1 x^3}{3EI_B}\right]_A^B + \left[\frac{P_1 x^3}{3EI_C}\right]_B^C + \left[\frac{P_1 x^3}{3EI_D}\right]_C^D + \left[\frac{P_1 x^3}{3EI_E}\right]_D^E + \left[\frac{P_1 x^3}{3EI_F}\right]_E^F$$

$$= \frac{P_1 A^3}{3EI_A} + \frac{P_1 (B^3 - A^3)}{3EI_B} + \frac{P_1 (C^3 - B^3)}{3EI_C} + \frac{P_1 (D^3 - C^3)}{3EI_D} + \frac{P_1 (E^3 - D^3)}{3EI_E} + \frac{P_1 (F^3 - E^3)}{3EI_F.}$$



Concentrated load P_2 at l_2

Deflection at end of beam

$M = P_2 x.$

$m = l_1 + x$

$$\Delta = \int_0^L \frac{M m dx}{EI.}$$

$$\Delta = \int_{l_2}^{L} \frac{P_2 x (l_2 + x) dx}{EI.} = \int_{l_2}^{L} \left(\frac{P_2 x^2 dx}{EI} + \frac{P_2 l_2 x dx}{EI.} \right) = \left[\frac{P_2 x^3}{3EI.}\right]_{l_2}^{L} + \left[\frac{P_2 l_2 x^2}{2EI}\right]_{l_2}^{L}$$ in general.

$$\Delta = \frac{P_2 (B^3 - \cancel{A^3})}{3EI_B} + \frac{P_2 (C^3 - B^3)}{3EI_C} + \frac{P_2 (D^3 - C^3)}{3EI_D} + \frac{P_2 (E^3 - D^3)}{3EI_E} + \frac{P_2 (F^3 - E^3)}{3EI_F.}$$

$$+ \frac{P_2 l_2 (B^2 - \cancel{A^2})}{2EI_B} + \frac{P_2 l_2 (C^2 - B^2)}{2EI_C} + \frac{P_2 l_2 (D^2 - C^2)}{2EI_D} + \frac{P_2 l_2 (E^2 - D^2)}{2EI_E} + \frac{P_2 l_2 (F^2 - E^2)}{2EI_F.}$$

Moment of inertia of Main Bascule Girder.

Section A.

1 web pl.	75 × ½	= 37.50			= 17600
4 Ls	8 . 8 . ¾	= 45.76	× 35.47²	+ 280	= 57680
4 Pls.	12 × ½	= 24.00	× 31.5²	+	= 23800
		107.26			99080

Section B.

1 web pl.	75 × ½	= 37.50		= 17600
4 Ls	8 . 8 . ¾	= 45.76	×	= 57680
4 Pls.	12 . ½	= 24.00	×	= 23800
2 Pls.	18 . ¾	= 27.00	× 38.13²	= 39300
		134.26		138380

Section C

1 web pl.	75 × ½	= 37.50		
4 Ls	8 . 8 . ¾	= 45.76		
4 Pls.	12 . ½	= 24.00		
2 Pls.	18 × ¾	= 27.00		
2 Pls	18 . ¾	= 27.00	× 38.88²	= 40800
		161.26		179180

Section D

1 web pl	75 × ½	= 37.50		
4 Ls	8 . 8 . ¾	= 45.76		
4 Pls.	12 . ½	= 24.00		
2 Pls.	18 . ¾	= 27.00		
2 Pls.	18 . ¾	= 27.00		
2 Pls.	18 . ¾	= 27.00	× 39.63²	= 42440
		188.26		221620

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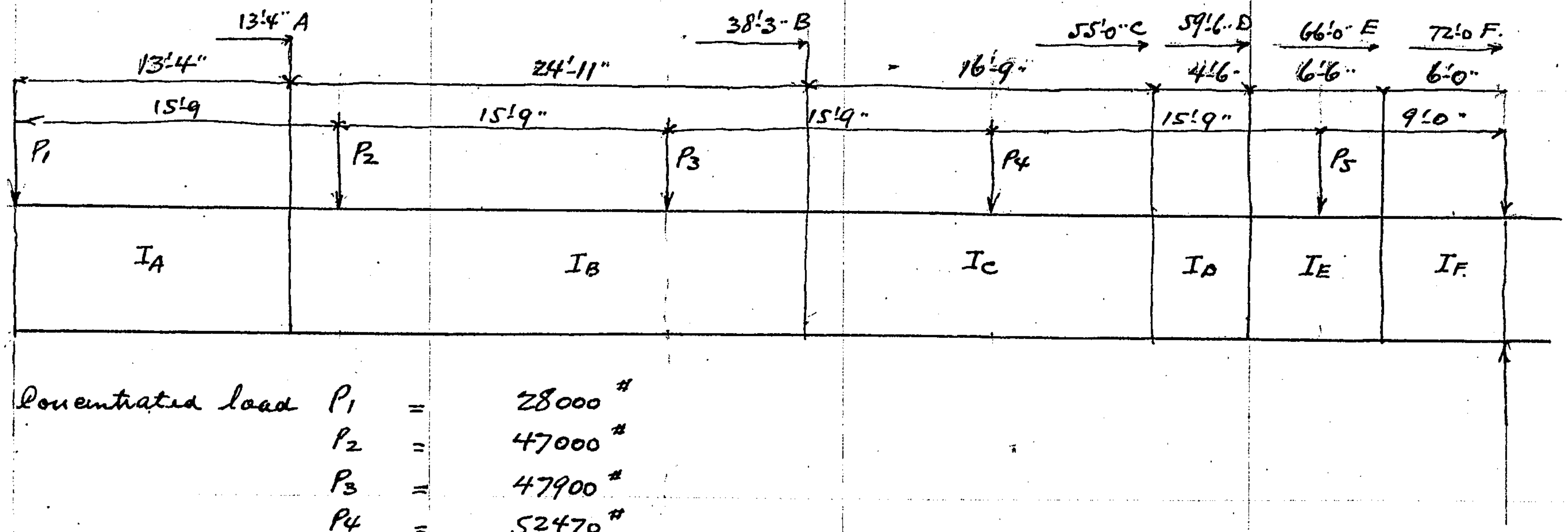
First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

Section E

1 web pl. 75 × 1/2	=	37.50			
4 Ls 8 × 8 × 3/4	=	45.76			
4 Pls. 12 × 1/2	=	24.00			
6 Pls. 18 × 3/4	=	81.00			221620
4 Pls 4 × 3/4	=	12.00	× 27.5² + 15	=	9095
4 Pls. 11½ × 3/4	=	34.50	× 31.25² + 380	=	34080
		234.76			264795

Section F.

1 web pl. 75 × 1/2	=	37.50	
4 Ls 8 × 8 × 3/4	=	45.76	
4 Pls. 12 × 1/2	=	24.00	
6 Pls. 18 × 3/4	=	81.00	
4 Pls. 4 × 3/4	=	12.00	
4 Pls. 11½ × 3/4	=	34.50	264795
2 Pls. 51 × 1/2	=	51.00	11070
		285.76	275865 (in)⁴



Concentrated load
P_1 = 28000#
P_2 = 47000#
P_3 = 47900#
P_4 = 52470#
P_5 = 49490.#

Deflection at end of girder.

load P_1.

$$\frac{28000 \times 13.33^3 \times 12^3}{3 \times 30.000.000 \times 99080} = 0.0129$$

$$\frac{28000 \times 12^3 \times (38.25^3 - 13.33^3)}{3 \times 30.000.000 \times 138380} = 0.2080$$

$$\frac{28000 \times 12^3 \times (55.0^3 - 38.25^3)}{3 \times 30.000.000 \times 179180} = 0.3320$$

$$\frac{28000 \times 12^3 \times (59.5^3 - 55.0^3)}{3 \times 30.000.000 \times 221620} = 0.1075$$

$$\frac{28000 \times 12^3 \times (66.0^3 - 59.5^3)}{3 \times 30.000.000 \times 264795} = 0.1560$$

$$\frac{28000 \times 12^3 \times (72.0^3 - 66.0^3)}{3 \times 30.000.000 \times 275865} = 0.1670$$

$$\left.\begin{matrix}0.0129\\0.2080\\0.3320\\0.1075\\0.1560\\0.1670\end{matrix}\right\} 0.9834$$

Load P_2

$$\frac{47000 \times 12^3 \times (\overset{22.50^3}{\cancel{38.25^3}} - \cancel{15.75^3})}{3 \times 30.000.000 \times 138380} = 0.074$$

$$\frac{47000 \times 12^3 \times (\overset{39.25^3 + 22.50^3}{\cancel{-38.25^3} + \cancel{55^3}})}{3 \times 30.000.000 \times 179180} = 0.247$$

$$\frac{47000 \times 12^3 \times (\overset{43.75^3 - 39.25^3}{\cancel{59.5^3} - \cancel{55.0^3}})}{3 \times 30.000.000 \times 221620} = 0.095$$

$$\frac{47000 \times 12^3 \times (\overset{50.25^3 - 43.75^3}{\cancel{66^3} - \cancel{59.5^3}})}{3 \times 30.000.000 \times 264795} = 0.147$$

$$\frac{47000 \times 12^3 \times (\overset{56.25^3 - 50.25^3}{\cancel{72^3} - \cancel{66.0^3}})}{3 \times 30.000.000 \times 275865} = 0.167$$

$$\left.\begin{matrix}0.074\\0.247\\0.095\\0.147\\0.167\end{matrix}\right\} 0.730$$

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

Load P_2.

$$\frac{47000 \cdot 12^3 \cdot 15.75 \cdot 22.50^2}{2 \cdot 30.000.000 \cdot 138380} = 0.0078$$

$$\frac{47000 \cdot 12^3 \cdot 15.75 \cdot (39.25^2 - 22.50^2)}{2 \cdot 30.000.000 \cdot 179180} = 0.0078$$

$$\frac{47000 \cdot 12^3 \cdot 15.75 \cdot (43.75^2 - 39.25^2)}{2 \cdot 30.000.000 \cdot 221620} = 0.0023$$

$$\frac{47000 \cdot 12^3 \cdot 15.75 \cdot (50.25^2 - 43.75^2)}{2 \cdot 30.000.000 \cdot 264795} = 0.0031$$

$$\frac{47000 \cdot 12^3 \cdot 15.75 \cdot (56.25^2 - 50.25^2)}{2 \cdot 30.000.000 \cdot 275865} = 0.0031$$

0.0241
0.7300
Total. 0.7541"

Load P_3. $l_3 = 31.5$

$$\frac{47900 \cdot 12^3 \cdot 6.75^3}{3 \cdot 30.000.000 \cdot 138380} = 0.0021 \qquad \frac{47900 \cdot 12^3 \cdot 31.50 \cdot 6.75^2}{2 \cdot 30.000.000 \cdot 138380} = 0.0014$$

$$\frac{47900 \cdot 12^3 \cdot (23.50^3 - 6.75^3)}{3 \cdot 30.000.000 \cdot 179180} = 0.0650 \qquad \frac{47900 \cdot 12^3 \cdot 31.50 \cdot (23.50^2 - 6.75^2)}{2 \cdot 30.000.000 \cdot 179180} = 0.0123$$

$$\frac{47900 \cdot 12^3 \cdot (28.0^3 - 23.5^3)}{3 \cdot 30.000.000 \cdot 221620} = 0.0375 \qquad \frac{47900 \cdot 12^3 \cdot 31.50 \cdot (28.0^2 - 23.5^2)}{2 \cdot 30.000.000 \cdot 221620} = 0.0046$$

$$\frac{47900 \cdot 12^3 \cdot (34.5^3 - 28.0^3)}{3 \cdot 30.000.000 \cdot 264795} = 0.0670 \qquad \frac{47900 \cdot 12^3 \cdot 31.5 \cdot (34.5^2 - 28.0^2)}{2 \cdot 30.000.000 \cdot 264795} = 0.0066$$

$$\frac{47900 \cdot 12^3 \cdot (40.5^3 - 34.5^3)}{3 \cdot 30.000.000 \cdot 275865} = 0.0845 \qquad \frac{47900 \cdot 12^3 \cdot 31.5 \cdot (40.5^2 - 34.5^2)}{2 \cdot 30.000.000 \cdot 275865} = 0.0071$$

0.2561 | 0.0320
0.2561
0.2881"

Load P_4 $l_4 = 47.25'$

$$\frac{52470 \cdot 12^3 \cdot 7.75^3}{3 \cdot 30.000.000 \cdot 179180} = 0.0026 \qquad \frac{52470 \cdot 12^3 \cdot 47.25 \cdot 7.75^2}{2 \cdot 30.000.000 \cdot 179180} = 0.0024$$

$$\frac{52470 \cdot 12^3 \cdot (12.25^3 - 7.75^3)}{3 \cdot 30.000.000 \cdot 221620} = 0.0062 \qquad \frac{52470 \cdot 12^3 \cdot 47.25 \cdot (12.25^2 - 7.75^2)}{2 \cdot 30.000.000 \cdot 221620} = 0.0029$$

$$\frac{52470 \cdot 12^3 \cdot (18.75^3 - 12.25^3)}{3 \cdot 30.000.000 \cdot 264795} = 0.0181 \qquad \frac{52470 \cdot 12^3 \cdot 47.25 \cdot (18.75^2 - 12.25^2)}{2 \cdot 30.000.000 \cdot 264795} = 0.0054$$

$$\frac{52470 \cdot 12^3 \cdot (24.75^3 - 18.75^3)}{3 \cdot 30.000.000 \cdot 275865} = 0.0314 \qquad \frac{52470 \cdot 12^3 \cdot 47.25 \cdot (24.75^2 - 18.75^2)}{2 \cdot 30.000.000 \cdot 275865} = 0.0067$$

0.0583 | 0.0174
0.0583
0.0757"

Load P_5 $l_5 = 63.0$

$$\frac{49490 \cdot 12^3 \cdot 3^3}{3 \cdot 30.000.000 \cdot 264795} = 0.0001 \qquad \frac{49490 \cdot 12^3 \cdot 63 \cdot 3^2}{2 \cdot 30.000.000 \cdot 264795} = 0.0003$$

$$\frac{49490 \cdot 12^3 \cdot (9^3 - 3^3)}{3 \cdot 30.000.000 \cdot 275865} = 0.0024 \qquad \frac{49490 \cdot 12^3 \cdot 63 \cdot (9^2 - 3^2)}{2 \cdot 30.000.000 \cdot 275865} = 0.0023$$

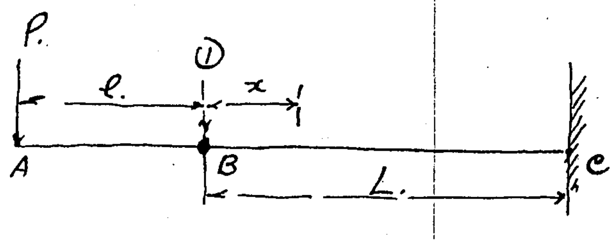
0.0025 | 0.0026
0.0025
0.0051"

Summary for deflection at end of girder

P_1	0.9834
P_2	0.7541
P_3	0.2881
P_4	0.0757
P_5	0.0051
	2.1064"

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule.

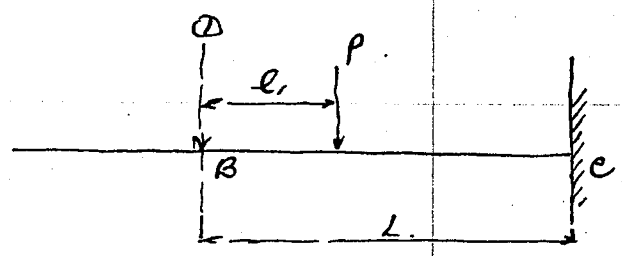
Deflection of Cantilever Girder at any point



Deflection at l.
load Between $\cancel{AB}$ $M = P(l+x)$.
$m = x$

$$\Delta = \int_0^L \frac{Mm\,dx}{EI} = \int_0^L \frac{P(l+x)x\,dx}{EI}$$

$$= \left[\frac{Plx^2}{2EI}\right]_0^L + \left[\frac{Px^3}{3EI}\right]_0^L$$



load between BC
$M = Px$ $m = l_1 + x$.

$$\Delta = \int_0^L \frac{Px(l_1+x).\,dx}{EI} = \left[\frac{Px^3}{3EI}\right]_0^L + \left[\frac{Pl_1x^2}{2EI}\right]_0^L$$

Deflection at P_3 center of span
Load P_1.

$\frac{28000 \cdot 12^3 \cdot 6.75^3}{3 \cdot 30.000.000 \cdot 138380} = 0.0012$ $\frac{28000 \cdot 12^3 \cdot 31.5 \cdot 6.75^2}{2 \cdot 30.000.000 \cdot 138380} = 0.0008$

$\frac{28000 \cdot 12^3 (23.5^3 - 6.75^3)}{3 \cdot 30.000.000 \cdot 179180} = \cancel{0.0038}$ 380 $\frac{28000 \cdot 12^3 \cdot 31.5 \cdot (23.50^2 - 6.75^2)}{2 \cdot 30.000.000 \cdot 179180} = 0.0072$

$\frac{28000 \cdot 12^3 (28.0^3 - 23.5^3)}{3 \cdot 30.000.000 \cdot 221620} = \cancel{0.0022}$ .0020 $\frac{28000 \cdot 12^3 \cdot 31.5 \cdot (28.0^2 - 23.5^2)}{2 \cdot 30.000.000 \cdot 221620} = 0.0027$

$\frac{28000 \cdot 12^3 (34.5^3 - 28.0^3)}{3 \cdot 30.000.000 \cdot 264795} = \cancel{0.0039}$ 390 $\frac{28000 \cdot 12^3 \cdot 31.5 \cdot (34.5^2 - 28.0^2)}{2 \cdot 30.000.000 \cdot 264795} = 0.0039$

$\frac{28000 \cdot 12^3 (40.5^3 - 34.5^3)}{3 \cdot 30.000.000 \cdot 275865} = \cancel{0.0049}$ 490 $\frac{28000 \cdot 12^3 \cdot 31.5 \cdot (40.5^2 - 34.5^2)}{2 \cdot 30.000.000 \cdot 275865} = 0.0041$

$\cancel{0.0160}$ 0.1492 0.0187
0.1492
0.1679

Load P_2

$\frac{47000 \cdot 12^3 \cdot 6.75^3}{3 \cdot 30.000.000 \cdot 138380} = 0.0021$ $\frac{47000 \cdot 12^3 \cdot 15.75 \cdot 6.75^2}{2 \cdot 30.000.000 \cdot 138380} = \cancel{0.0004}$ 0.0007

$\frac{47000 \cdot 12^3 \cdot (23.5^3 - 6.75^3)}{3 \cdot 30.000.000 \cdot 179180} = 0.0640$ $\frac{47000 \cdot 12^3 \cdot 15.75 \cdot (23.5^2 - 6.75^2)}{2 \cdot 30.000.000 \cdot 179180} = \cancel{0.0036}$ 0.0062

$\frac{47000 \cdot 12^3 \cdot (28.0^3 - 23.5^3)}{3 \cdot 30.000.000 \cdot 221620} = 0.0368$ $\frac{47000 \cdot 12^3 \cdot 15.75 \cdot (28.0^2 - 23.5^2)}{2 \cdot 30.000.000 \cdot 221620} = \cancel{0.00135}$ 0.0024

$\frac{47000 \cdot 12^3 \cdot (34.5^3 - 28.0^3)}{3 \cdot 30.000.000 \cdot 264795} = 0.0657$ $\frac{47000 \cdot 12^3 \cdot 15.75 \cdot (34.5^2 - 28.0^2)}{2 \cdot 30.000.000 \cdot 264795} = \cancel{0.00195}$ 0.0034

$\frac{47000 \cdot 12^3 \cdot (40.5^3 - 34.5^3)}{3 \cdot 30.000.000 \cdot 275865} = 0.0830$ $\frac{47000 \cdot 12^3 \cdot 15.75 \cdot (40.5^2 - 34.5^2)}{2 \cdot 30.000.000 \cdot 275865} = \cancel{0.00205}$ 0.0036

0.2516 0.00935 0.0163
0.2516 0.2516
0.26095 0.2679

Load P_3. see page. 50 = 0.2561

Load P_4

$\frac{52470 \cdot 12^3 \cdot 7.75^3}{3 \cdot 30.000.000 \cdot 179180} = 0.0026$ $\frac{52470 \cdot 12^3 \cdot 15.75 \cdot 7.75^2}{2 \cdot 30.000.000 \cdot 179180} = 0.0008$

$\frac{52470 \cdot 12^3 \cdot (12.25^3 - 7.75^3)}{3 \cdot 30.000.000 \cdot 221620} = 0.0062$ $\frac{52470 \cdot 12^3 \cdot 15.75 \cdot (12.25^2 - 7.75^2)}{2 \cdot 30.000.000 \cdot 221620} = 0.0010$

$\frac{52470 \cdot 12^3 \cdot (18.75^3 - 12.25^3)}{3 \cdot 30.000.000 \cdot 264795} = 0.0181$ $\frac{52470 \cdot 12^3 \cdot 15.75 \cdot (18.75^2 - 12.25^2)}{2 \cdot 30.000.000 \cdot 264795} = 0.0018$

$\frac{52470 \cdot 12^3 \cdot (24.75^3 - 18.75^3)}{3 \cdot 30.000.000 \cdot 275865} = 0.0314$ $\frac{52470 \cdot 12^3 \cdot 15.75 \cdot (24.75^2 - 18.75^2)}{2 \cdot 30.000.000 \cdot 275865} = 0.0022$

0.0583 0.0058
0.0583
0.0641"

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MADE BY J. Masuda DATE 15-10-15 FILE NO.

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule.

Load P_5

$\frac{49490 \cdot 12^3 \cdot 3^3}{3 \cdot 30.000.000 \cdot 264795} = 0.0001$ $\frac{49490 \cdot 12^3 \cdot 31.5 \cdot 3^2}{2 \cdot 30.000.000 \cdot 264795} = 0.00015$

$\frac{49490 \cdot 12^3 \cdot (9^3 - 3^3)}{3 \cdot 30.000.000 \cdot 275865} = \underline{0.0024}$ $\frac{49490 \cdot 12^2 \cdot 31.5 \cdot (9^2 - 3^2)}{2 \cdot 30.000.000 \cdot 275865} = \underline{0.00125}$

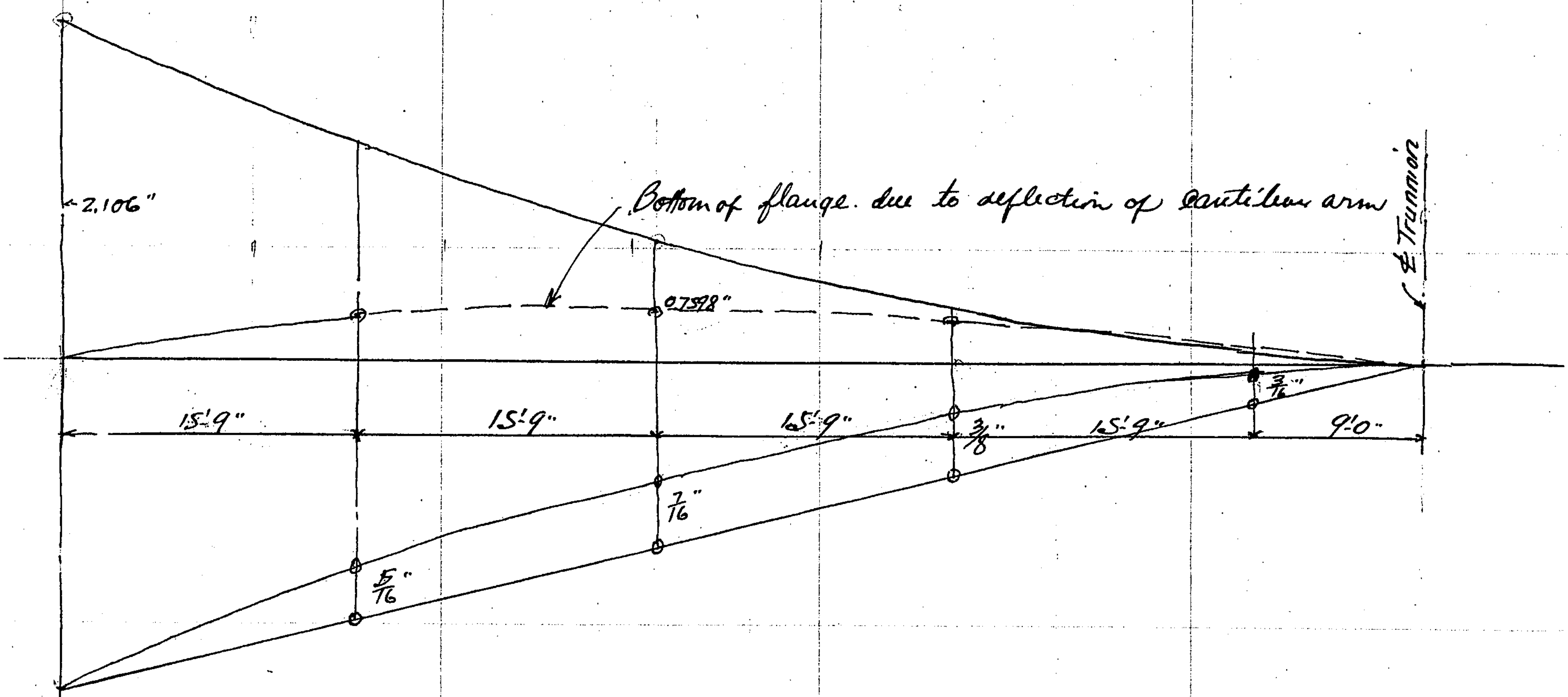
0.0025 0.00130

0.00250

0.0038 "

Summary for deflection at P_3.

P_1	0.1679
P_2	0.2679
P_3	0.2561
P_4	0.0641
P_5	0.0038
	0.7598"



Deflection of Rear Arm of Main Bascule.

Moment of inertia of rear section.

Section 1.

1 web. $77\frac{1}{2} \cdot \frac{1}{2}$							19400
2 webs $77\frac{1}{2} \cdot \frac{1}{2}$							38800
4 Ls $8 \cdot 8 \cdot \frac{3}{4}$"	=	45.76	$\cdot$	36.72^2	+ 280	=	62080
4 Pls. $4 \cdot \frac{3}{4}$	=	12.00	$\cdot$	28.75^2	+ 15	=	9915
4 Pls. $11\frac{1}{2} \cdot \frac{3}{4}$	=	34.50	$\cdot$	32.50^2	+ 380	=	36780
6 Pls. $18 \cdot \frac{3}{4}$"	=	81.00	$\cdot$	39.88^2		=	129000
							295975

Section 2.

1 web. $83\frac{1}{2} \cdot \frac{1}{2}$						=	24300
2 webs $83\frac{1}{2} \cdot \frac{1}{2}$						=	48600
4 Ls $8 \cdot 8 \cdot \frac{3}{4}$	=	45.76	$\cdot$	39.72^2	+ 280	=	72280
4 Pls. $4 \cdot \frac{3}{4}$	=	12.00	$\cdot$	31.75^2	+ 15	=	12115
4 Pls. $11\frac{1}{2} \cdot \frac{3}{4}$	=	34.50	$\cdot$	35.50^2	+ 380	=	43880
6 Pls. $18 \cdot \frac{3}{4}$	=	81.00	$\cdot$	42.88^2	+	=	149000
							350175

Section 3.

1 web. $92\frac{1}{2} \cdot \frac{1}{2}$						=	33000
2 webs. $92\frac{1}{2} \cdot \frac{1}{2}$						=	66000
4 Ls $8 \cdot 8 \cdot \frac{3}{4}$	=	45.76	$\cdot$	44.22^2	+ 280	=	89580
4 Pls. $4 \cdot \frac{3}{4}$	=	12.00	$\cdot$	36.25^2	+ 15	=	15765
4 Pls. $11\frac{1}{2} \cdot \frac{3}{4}$	=	34.50	$\cdot$	40.00^2	+ 380	=	54580
6 Pls. $18 \cdot \frac{3}{4}$	=	81.00	$\cdot$	47.38^2		=	181600
							440525

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule.

Section 4

1 web. $104\frac{1}{2} \cdot \frac{1}{2}$					=	47600
2 webs. $104\frac{1}{2} \cdot \frac{1}{2}$					=	95200
4Ls $8 \cdot 8 \cdot \frac{3}{4}$	=	45.76	$\cdot\ 50.22^2$	+ 280	=	115280
4Pls. $4 \cdot \frac{3}{4}$	=	12.00	$\cdot\ 42.25^2$	+ 15	=	21415
4Pls. $11\frac{1}{2} \cdot \frac{3}{4}$	=	34.50	$\cdot\ 46.00^2$	+ 380	=	73580
4Pls. $18 \cdot \frac{3}{4}$	=	54.00	$\cdot\ 53.25^2$		=	153000
						506075

Section 5

1 web. $122\frac{1}{2} \cdot \frac{1}{2}$	=					76700
2 webs $122\frac{1}{2} \cdot \frac{1}{2}$	=					153400
4Ls $8 \cdot 8 \cdot \frac{3}{4}$	=	45.76	$\cdot\ 59.22^2$	+ 280	=	160800
						390900

Adding 1 Cov. $18 \cdot \frac{3}{4}$ call this 506000

Section 6.

1 web. $146\frac{1}{2} \cdot \frac{1}{2}$	=					131000
2 webs. $146\frac{1}{2} \cdot \frac{1}{2}$	=					262000
4Ls $8 \cdot 8 \cdot \frac{3}{4}$	=	45.76	$\cdot\ 71.22^2$	+ 280	=	235800
						628800

Section 7

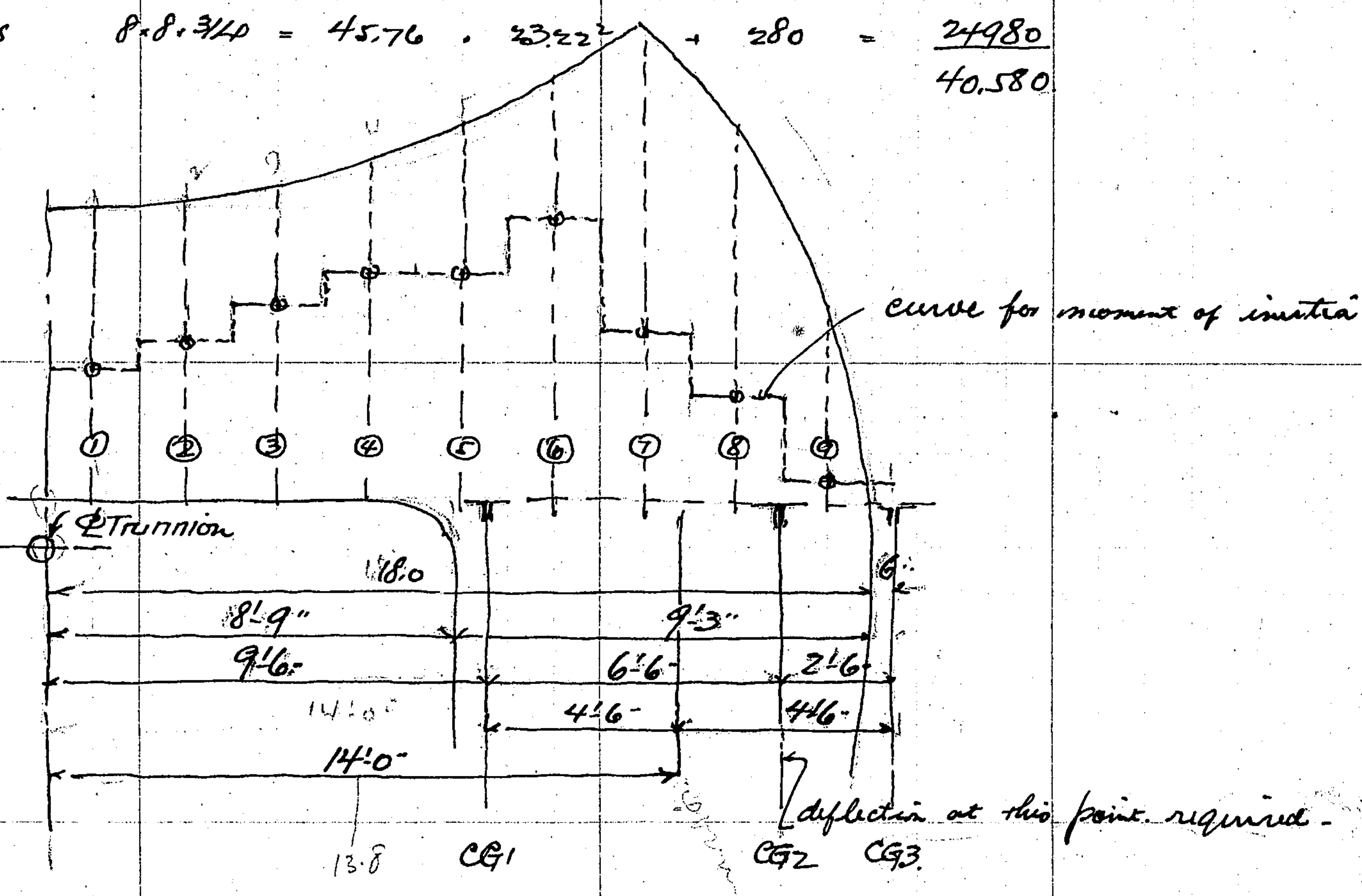
1 web. $131\frac{1}{2} \cdot \frac{1}{2}$	=					94800
2 webs. $131\frac{1}{2} \cdot \frac{1}{2}$	=					189600
4Ls $8 \cdot 8 \cdot \frac{3}{4}$	=	45.76	$\cdot\ 63.72^2$	+ 280	=	86280
						370680

Section 8

1 web. $100\frac{1}{2} \cdot \frac{1}{2}$						42300
2 webs. $100\frac{1}{2} \cdot \frac{1}{2}$						84600
4Ls $8 \cdot 8 \cdot \frac{3}{4}$	=	45.76	$\cdot\ 48.22^2$	+ 280	=	106780
						233680

Section 9

1 web. $50 \cdot \frac{1}{2}$						5200
2 webs $50 \cdot \frac{1}{2}$						10400
4Ls $8 \cdot 8 \cdot \frac{3}{4}$	=	45.76	$\cdot\ 23.22^2$	+ 280	=	24980
						40,580



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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion Bascule

Approximate load on CG1 and 2

Total weight of Cwt. = 576000 for one girder.

load on CG2 = $576000 \cdot \frac{4.5}{6.5}$ = 400.000#

Load on CG1 = 576000 − 400.000 = 176000#

neglecting load of main girder.

moment	①	176000	· 8.5	=	1.495.000				
	②	"	· 6.5	=	1145.000				
	③	"	· 4.5	=	793.000				
	④	"	· 2.5	=	440.000				
	⑤	"	· 0.5	=	88.000				
								Total M	m
moment	1	400.000	· 15	=	6.000.000	+ 1.495.000	=	7.495.000	15
	2		· 13		5200.000	+ 1.145.000	=	6.345.000	13
	3		· 11		4400.000	+ 793.000	=	5.193.000	11
	4		· 9		3600.000	+ 440.000	=	4040.000	9
	5		· 7		2800.000	+ 88.000	=	2888.000	7
	6		· 5		2000.000			2000.000	5
	7		· 3		1200.000			1200.000	3
	8		· 1		400.000			400.000	1

Deflection $\Delta = \int \frac{Mm\,dx}{EI}$ by summation

$$\frac{7495000 \cdot 15 \cdot 2 \cdot 12^3}{30.000.000 \cdot 296000} = 0.0436$$

$$\frac{6345000 \cdot 13 \cdot 2 \cdot 12^3}{30.000.000 \cdot 350.000} = 0.0270$$

$$\frac{5193000 \cdot 11 \cdot 2 \cdot 12^3}{30.000.000 \cdot 440.000} = 0.0197$$

$$\frac{4040.000 \cdot 9 \cdot 2 \cdot 12^3}{30.000.000 \cdot 506000} = 0.0126$$

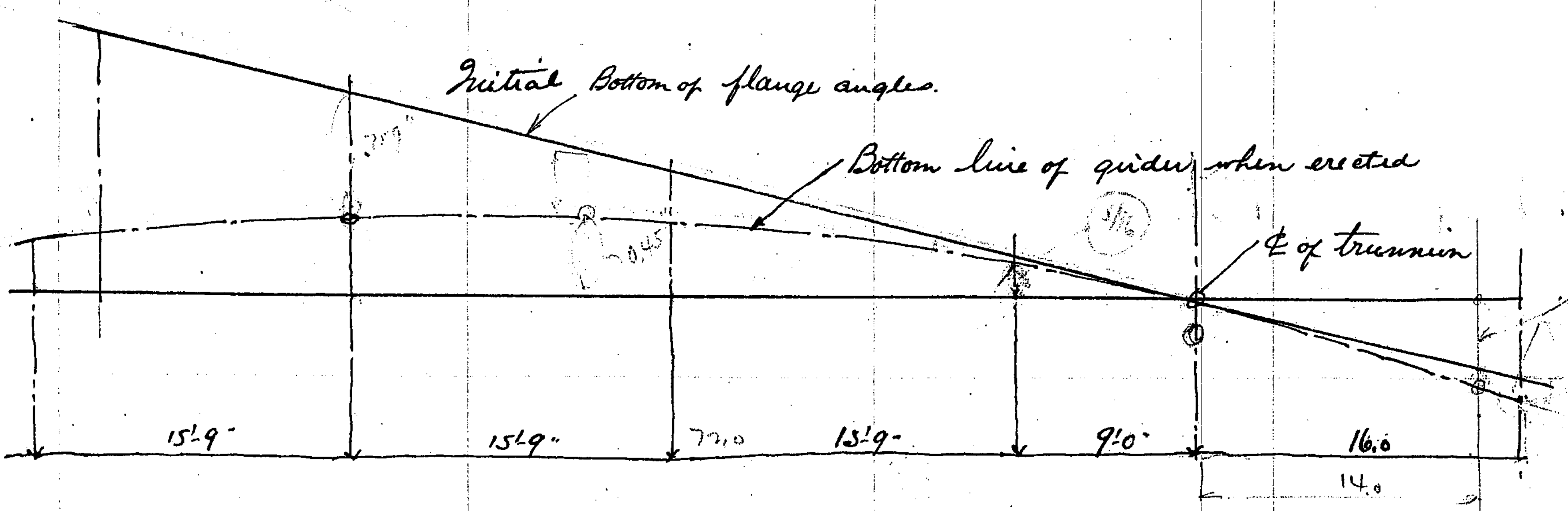
$$\frac{2888000 \cdot 7 \cdot 2 \cdot 12^3}{30.000.000 \cdot 506000} = 0.0069$$

$$\frac{2000.000 \cdot 5 \cdot 2 \cdot 12^3}{30.000.000 \cdot 628000} = 0.0018$$

$$\frac{1200.000 \cdot 3 \cdot 2 \cdot 12^3}{30.000.000 \cdot 370000} = 0.0011$$

$$\frac{400000 \cdot 1 \cdot 2 \cdot 12^3}{30.000.000 \cdot 230.000} = 0.0002$$

0.1129"



増田淳氏関係資料
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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule
Design of trunnion shaft and bearings.

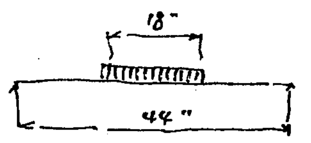
Total Dead load on one trunnion

structural steel, flooring, without cwt	360610	
Cwt.	682500	
	1043110	
10% variation	104300	
		1,147410
Assume wind load.		139.000
		1286410 #
		call this 1286.000 #

Bearing area = 19.5 × 16.5 = 322.0" 2 @ 322 = 644 □"

Unit bearing on bushing = 1286.000 ÷ 644 = 2000 #/□"

Design of trunnion shaft.
Center to center of bearings = 3'8" or 44"

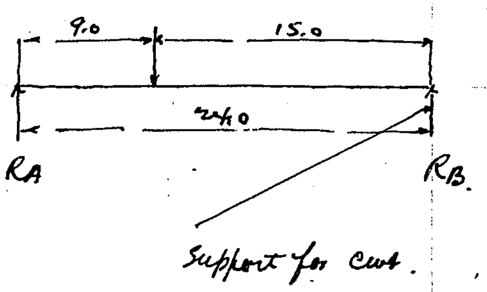


load per lin inch 1286.000 ÷ 18" = 71500 # per lin inch.
Reaction = 643.000 #
moment at center 643.000 × 22" = 14,150.000
321500 × 9" = − 2890.000
11,260,000

Diameter of shaft at center = 22"
moment of inertia = 0.049 × 22⁴ = 11500 (")⁴

Fibre stress = $\frac{11260.000 \times 11}{11500}$ = 10850 #/□"

Max Dead Load on bearing shoe under main girder



max load per girder.	1043110
10%	104300
	1147410

R_A = 1147410 × $\frac{15}{24}$ = 715000

R_B = 1147410 × $\frac{9}{24}$ = 430.000 #

Live Load shoe shall be designed for load of 715000 #

For Counterweight support 2 @ 430.000 = 860.000
or 860.000 ÷ 2240 = 384 tons

To raise Cwt and trunnion shaft.
Use 9 Jacks 384 ÷ 9 = 42.6 tons each.

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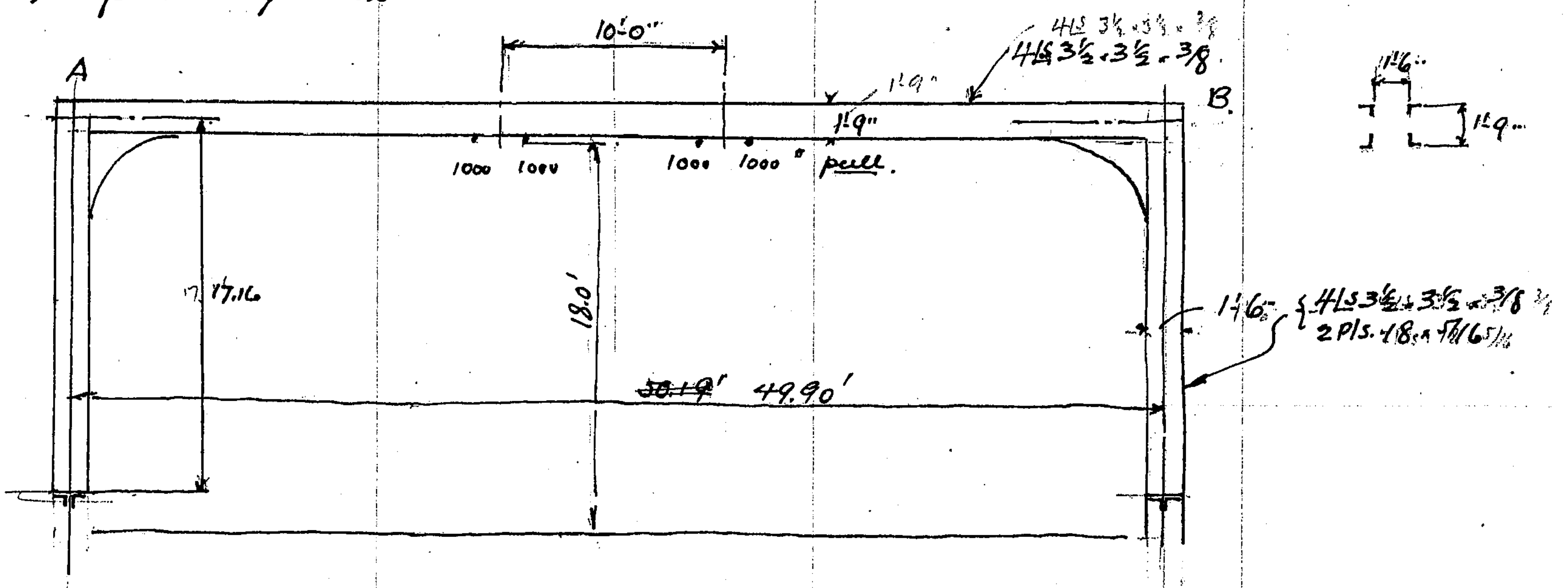
CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule.

Design of trolley arch.



Beam AB.

span raised. trolley pull working in full.

Dead weight assumed 50# per lin ft.

$M = \frac{1}{8} \cdot 50 \cdot 49.90^2 = 15600'^{\#}$

Reaction at end due to dead load. $50 \cdot 24.95$ = say $1250^{\#}$

Trolley pull $1000^{\#}$ each trolley assumed.

For reaction = $2000^{\#}$ at end.

moment = $2000 \cdot 24.95$ = 49900

$- 2 \cdot 1000 \times 5$ = -10000

39900'#

Dead Load moment 15600

Total moment. 55500'#

moment of inertia of section.

4 Ls 3½ . 3½ . 3/8

4 Ls 3½ . 3½ . 3/8 @ 2.48 = $9.92\square'' \cdot 10.01^2 + 4 \cdot 2.9 = 1004^{(")4}$

10.01 1'6"

~~out to out~~ . 25"

Fibre stress = $\frac{55500 \cdot 12 \cdot 12.5}{1004}$ = 8280 #/□"

To these stresses twisting moment from trolley pull should be added. for impact etc adding 20%. Fibre stress = $8280 \cdot 1.20$ = 9950 #/□" ok

Column when span up.

Dead Load of Column assumed 85# per lin. ft.

load at top of column. Dead Load. 1250

Trolley pull. 2000

3250#.

Dead Load moment = $\frac{1}{2} \cdot 85 \cdot 17.16^2$ = 12500'#

Reaction from arch = $3250 \cdot 17.16$ = 55700

68200'#

For impact assume 20%. 13600

81800'# —

moment of inertia ~~of section~~.

18" 18"

4 Ls 3½ . 3½ . 3/8 = $9.92 \cdot 7.99^2 + 12$ = 645

2 Pls. 18 . 5/16 = $11.24 \cdot 9.16^2$ = 943

21.16 1588 $^{(")4}$

radius of gyration $= \sqrt{\frac{1588}{21.16}} = 8.66$

Length of Col. say 201.75" $P = 21300\,(1 - 0.0055\,\frac{l}{r})$ = 18600#/□"

For max unit stress use. 14000#/□".

Fibre stress in Col = $\frac{81800 \cdot 12 \cdot 9.32}{1588}$ = 5760 #/□" ok

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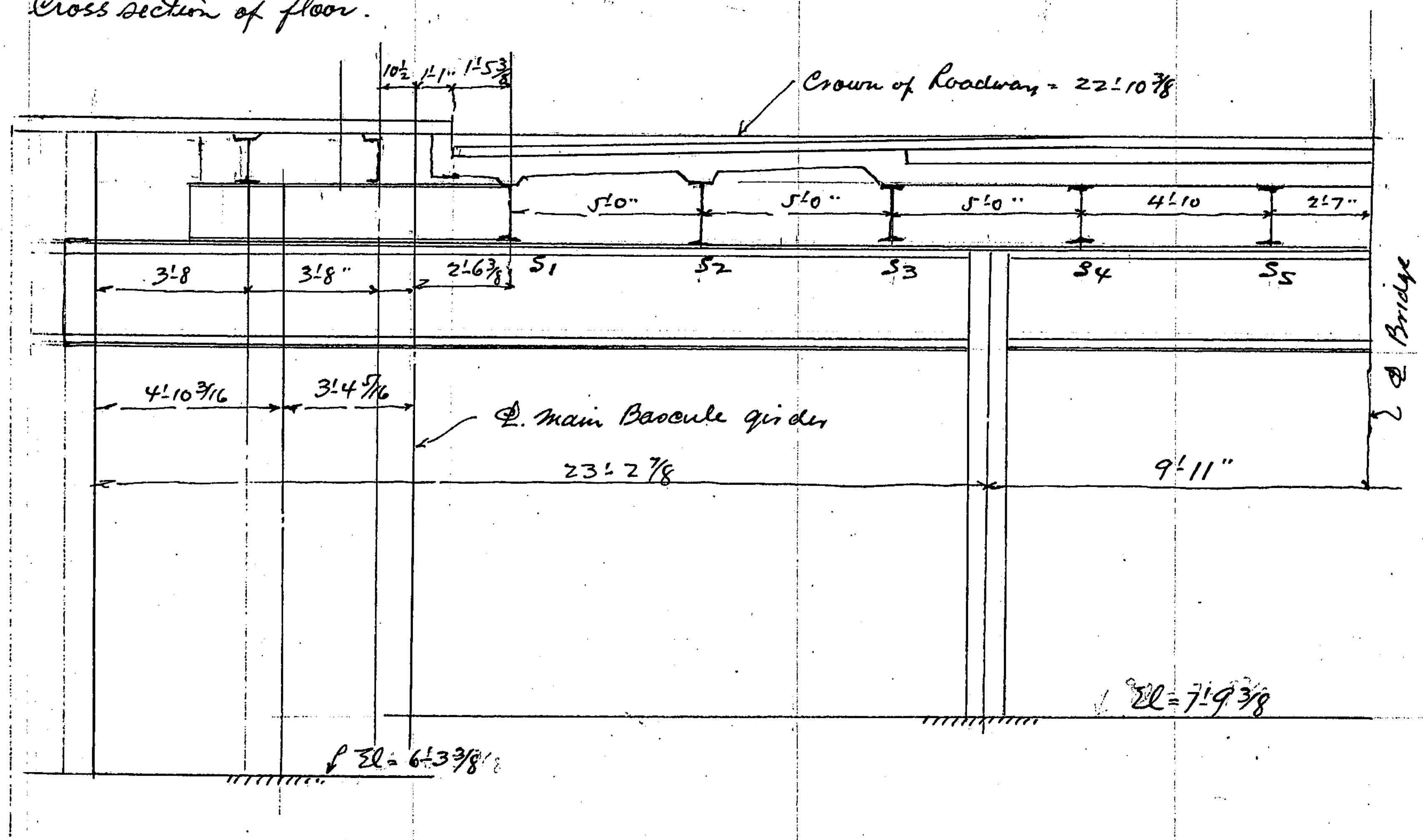
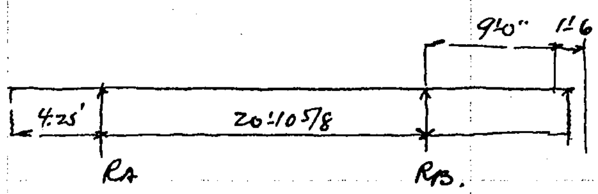
CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule.

Framing over bascule abutment.
Cross section of floor.



Railway stringers S4 and S5 refer to p 37

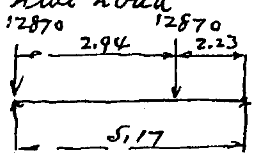


Dead Load 822# per lin ft.

D.L. moment $= \frac{1}{8} \times 822 \times 20.88^2 = 44700$ '#

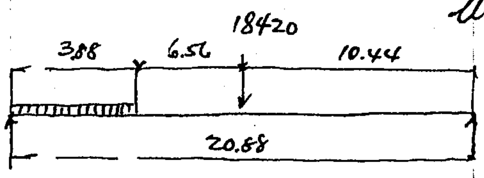
D.L. shear $= \frac{1}{2} \times 822 \times 20.88 = 8600$#

Live Load motor truck loading 12870 rear wheel with impact.



Reaction $= 12870 \times 2.23 \div 5.17 =$ 5550
12870
18420

Unif. live load $= 120 \times 5 = 600$# per lin ft of span.

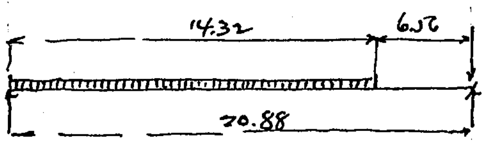


$3.88 \times 600 = 2330$#

Reaction $= 2330 \times \frac{1.94}{20.88} = 217$#

motor truck $9210 \times 10.44 = 96300$
Unif. load $217 \times 10.44 = 2265$
98565 '#

Live Load shear



Unif. load $600 \times 14.32 = 8600$
Reaction $= 8600 \times \frac{7.16}{20.88} =$ 2950
18420
21370#

Summary for moments and shears

	moments	shear
Dead Load	44700	8600
Live Load.	98565	21370
	143265 '#	29970#

Try 18" × 7" I 75.0# Sm = 127.7

Unit stress $= \frac{143265 \times 12}{127.7} = 13500$ #/□"

add 2 Cov Pls. 5 × ½" = 5.00"

Moment of inertia
1I 18" × 7" 1150
2 Pls. $5 \times \frac{1}{2} = 5.0 \times 9.25^2 =$ 428
1578 ('')^4 $\div (144)^2 = 0.076$ (')^4

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CALCULATIONS FOR

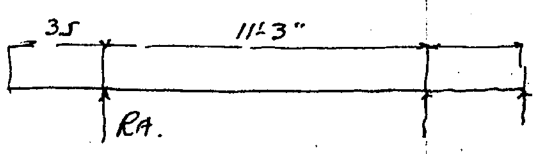
First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule.

Approximate deflection $143265 \times \frac{5}{48} \times \frac{20.88^2}{144 \times 30.000.000 \times 0.076} = 0.0198$

$d/l = \frac{0.0198}{20.88} = \frac{1}{1050}$

For Highway stringers S_1 - S_2 - and S_3 use 18 x 7" I @ 75.02# without cov. pl.

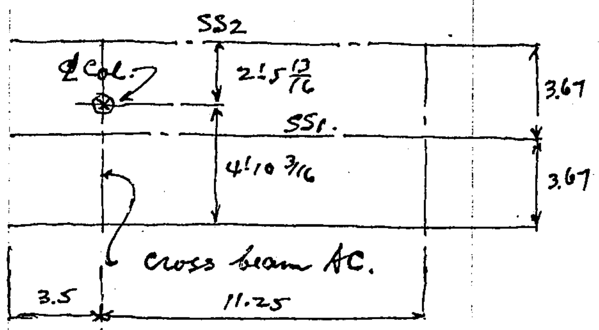
Sidewalk stringer spacing 3'-8"



Slab and wearing course 3 3/4" 47#
Live Load 100
147# per sq ft

Overhanging portion
$147 \times 3.67 = 540$#
Beam say 40
580# per lin ft.
moment $= \frac{1}{2} \times 580 \times 3.5^2 = 3570$'#

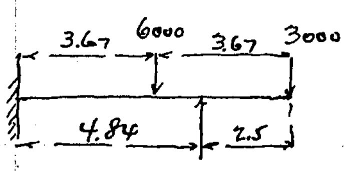
Center span span length 11.25'
moment $= \frac{1}{8} \times 580 \times 11.25^2 = 9150$'# Use 12" I x 31.99# Sm = 36.6
Unit stress $= \frac{9150 \times 12}{36.6} = 3000$ #/□" ok



Cross beam AC.
Concentration from SS2. $147 \times \frac{3.67}{2}$ = 270
stringer say 40
310#

Conc $= 310 \times \frac{14.75^2}{2 \times 11.25} = 3000$#

Concentration from SS1 say 6000#



moment $= 3000 \times 2.5 = 7500$'#
use 12" x 3/8" web
4Ls 3.3. 3/8

Load on Col. $3000 \times 7.34 = 22000$
$6000 \times 3.67 = 22000$
$44.000 \div 4.84 = 9100$
Column say 900
10.000#

Column section 4Ls $3\frac{1}{2} \times 3\frac{1}{2} \times 3/8$ = 9.92
1Pl. $10 \times 3/8$ = 3.75
13.67□"

l = ~~116~~ 174" about r = 1.5 about Unit stress $= 21300(1-0.0055 \times \frac{116}{1.5}) = 7710$ #/□"
SR $= 10.000 \div 7710 = 1.30$ □" gross.

Cross beams AB1 and AB2
Concentration.

SS1 Dead Load $47\# \times 3.67$ say = 175
Stringer say 35
$210 \times 10.12 = 2120$#

SS2 say do. 2120#

S_1 pavement $15 \times 3.95 = 59.3$
$75 \times 3.95 = 296.0$
curb say 126.0
nose 100
580 call this 600# per ft Conc $= 600 \times 15.0 = 9000$#

S_2 do. assumed 9000
S_3 $700 \times 15.0 = 10500$

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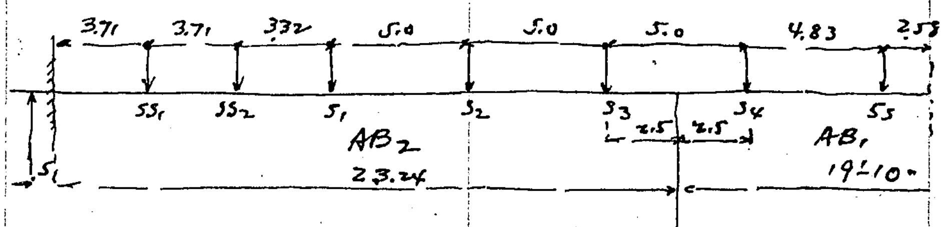
CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' Single leaf trunnion bascule.

S4 830 × 15.0 = 12450#
S5 842 × 15.0 = 12600#



AB1. Dead Load moment 25050 × 7.33 = 183500
12450 × 4.83 = -60200
123300
DL. girder 1/8 × 150 × 19.83² = 7350
130650 1#

Shear.
25050
girder 1490
26540#

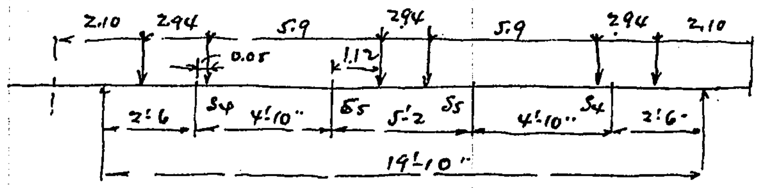
AB2
DL. Reaction 10500 × 2.5 = 26250
9000 × 7.5 = 67500
9000 × 12.5 = 112500
2120 × 15.82 = 33500
2120 × 19.53 = 41400
32740
281150 ÷ 23.74' = 11850# at left.
32740 - 11850 = 20890 at right

moment 20890 × 12.5 = 261000
9000 × 5 = 45.000
10500 × 10 = 105.000
-150.000
111 000
DL. girder 1/8 × 150 × 23.74² 10550
121550 1#

shear 11850 20890
girder 1740 1740
13590# 22630#

Live Load.

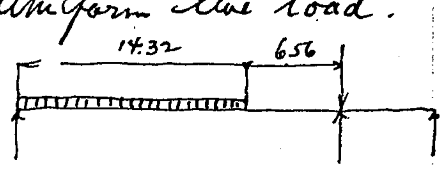
AB1. motor truck loading
12870# C.



On S4 12870 × 2.10 ÷ 5.00 = 5370
12870 × 4.95 ÷ 5.00 = 12720
18090# - 18090
On S5 150
12870
13020# - 13020
Shear 31110#

Moment 31110 × 7.33 = 228.000
18090 × 4.83 = -87300
140.700 1#

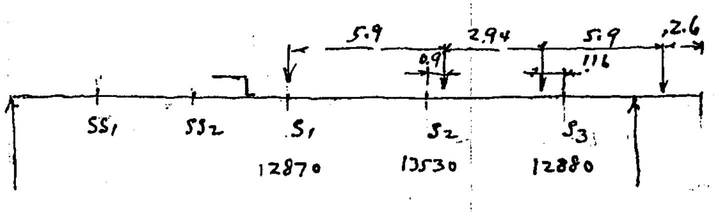
Uniform live load.



600 × 14.32 = 8600 8600 × 7.16/20.88 = 2950#

moment = 5900 × 7.33 = 43200
2950 × 4.83 = -14200
29000
motor truck m 140700
Total m 169700 1#

AB2 motor truck loading.



S1 12870#
S2 12870 × 1.16 ÷ 5.00 = 2980
12870 × 4.10 ÷ 5.00 = 10550
13530#
S3 12210
12870 × .26/5.0 = 670
12880

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MADE BY *J. Masuda* DATE *2-2-23* FILE NO.

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CALCULATIONS FOR

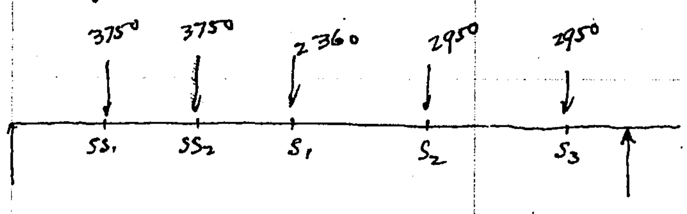
First Canal Bridge for City of Kobe: 60' Single leaf trunnion bascule.

Reaction

12880 × 2.5 = 32200
13530 × 7.5 = 101700
12870 × 12.5 = 161000
39280 — 294900'# ÷ 23.74 = 12400# left.
12400
26880 ← Right.

Moment = 12400 × 11.24 = 139,000'#

Uniform live load.



Stringer S_2 and S_3. Unif. load 600# per ft.
load 600 × 14.32 = 8600# R = 8600 × $\frac{7.16}{20.88}$ = 2950#

Stringer S_1 120 × 4.0 = 480# 480 × 14.32 = 6900#
Reaction = 6900 × $\frac{7.16}{20.88}$ = 2360# assumed.

Concentration at SS1 100 × 3.67 × 10.12 = say 3750#
SS2 assumed 3750#

Reaction

2950 × 2.5 = 7370
2950 × 7.5 = 22100
2360 × 12.5 = 29500
3750 × 15.82 = 59300
3750 × 19.53 = 73000
15760 — 191270 ÷ 23.74 = 8060# left
− 8060
7700# right.

moment 7700 × 12.5 = 96300
2950 × 5.0 = 14750
2950 × 10.0 = 29500
44250

Moment due to unif. load. 52050
" " " motor truck 139000
Total m 191,050'#

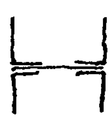
Summary for shears and moments
Girder AB1

	moment	shear	moment	shear (left)	shear (right)
Dead Load	130650	26540	121550	11850	20890
Live Load.	169700	37010	191050	20460	34580
	300350'#	63550#	312600'#	32310#	55470#

Section of girders AB1 and 2
web assumed 33" × 3/8" = 12.38□" 33½" b to b of L's 1/8 web = 1.550"
Effective depth 2.62' flange stress = 312600 ÷ 2.62 = 119,000#
section req'd = 119,000 ÷ 17000 = 7.00
− 1.55
5.45□" net.

Use 2L's 5 × 3½ × ½ = 8.00 − 6.00□" net.

Load on Col. say 63550
55470
119020#
Col. say 1500
120520# design col for 121,000#



Col. section 4L's 5 × 3½ × 3/8 = 12.20
1Pl. 12 × 3/8 = 4.50
16.70□"

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MADE BY J. Masuda DATE 2-2-23 FILE NO

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule.

Length of Col. say 149" $r = 2.3$

Unit stress $= 21300\left(1 - 0.0055\,\frac{149}{2.3}\right) = 13750$#

section req'd $= 121000 \div 13750 = 8.80$ □" gross.

Base Pl. $21\frac{1}{2} \times \frac{1}{2} \times 1'\,10\frac{1}{2}" = 483$ □"

Bearing pressure $= 121.000 \div 483 = 251$#/□" on masonry.

Reinforcement in floor for Operating House and floor for resting room.

Slab. $4\frac{1}{2}$ span length 6.12'
wearing course $\frac{13}{16}$
$5\frac{1}{4}$ @ 12.5 = 66.0# per sq ft. $M = \frac{1}{10} \times 166 \times 6.12^2 = 621.0$'#
live load 100
166.0#

Reinf. $= \frac{621 \times 12}{7/8 \times 3.5 \times 17000} = 0.140$ □" per ft

Use 3/8" bars. 6" ctrs 0.220"

main beam span length 9.5'
slab and live load $166 \times 6.12 =$ say 1020#
stem. $1.0' \times 10\frac{1}{2}"$ $.87 @ 150 =$ 130
1150# per lin ft.

moment $= \frac{1}{10} \times 1150 \times 9.5^2 = 10400$'#

Reinf. in beam $= \frac{10400 \times 12}{7/8 \times 13 \times 17000} = 0.65$ □"

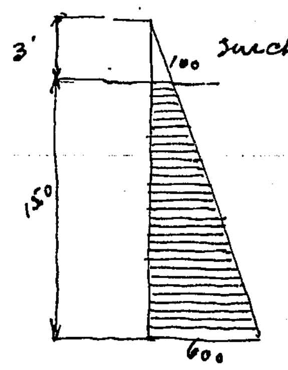
Use 3-5/8" bars @ .30 = .90 □"

End shear $1150 \times \frac{9.5}{2} = 5460$# section $10\frac{1}{2}" \times 16\frac{1}{2}"$

Unit shear $= \frac{5460}{10.5 \times 16.5 \times 7/8} = 36.0$#/□".

Reinforcement in wall of abutment.
Rear wall. Crown of Roadway 28' - 10 7/8
9' - 9 7/8
15' - 1" say 15.0'

Thickness of wall 18".



Earth pressure $= \frac{1}{3} \times 100 \times 3 = 100$#

$\frac{1}{3} \times 100 \times 18 = 600$#

moment at bottom

$15 \times 100 = 1500$# $\times 7.5 = 11250$

$15 \times \frac{500}{2} = 3750 \times 5.0 = 18750$

30000'# per ft strip

Depth req'd $= \sqrt{\frac{30.000}{102}} = 17.1"$

Reinforcing steel req'd $= \frac{30.000 \times 12}{7/8 \times 16.5 \times 17000} = 1.46$ □" per ft.

Try 2.0' wall.

Reinforcing steel req'd $= \frac{30.000 \times 12}{7/8 \times 22 \times 17000} = 1.10$ □" per ft.

7/8 bars 6" ctrs 1.20

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MADE BY J. Masuda DATE 2-2-27 FILE NO.

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CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' Single leaf trunnion bascule

Design of abutment

Volume of Concrete and weight for abutment

				Vol.		Weight	Arm	Moment
Base.	1	43.5 × 9.0 × 73.0	=	28,500	@ 140 =	4,130.000	× 21.75 =	90,000.000
	2	7.75 × 6.0 × 73.0	=	3400	@ 140 =	476.000	× 47.37 =	22,500.000
	3	7.75/2 × 3.0 × 73.0	=	848	@ 140 =	119.000	× 48.68 =	5,790.000
				32748		4725.000		118,290.000
Rear wall.	4	2 @ 13.92 × 66.31	=	1845	@ 140 =	258.000	× 1.75 =	451.000
Platform at rear	5	7.0 × 2.5 × 66.31	=	1160	@ 140 =	162.000	× 4.25 =	690.000
Int. Ribs under Platform	6	16.0 × 7.00 × 13.78	=	1540	@ 140 =	216.000	× 4.25 =	920.000
Seat for trolley pole	7	2 @ 3 × 3.5 × 5.83	=	123	@ 140 =	17.200	× 4.50 =	77.000
Sidewalls	8	2 @ 1.5 × 31.72 × 41.25	=	3920	@ 140 =	550.000	× 21.37 =	11,750.000
Block under lamp Post	9	2 @ 4.0 × 2.0 × 24.0	=	384	@ 140 =	53.700	× 2.75 =	148.000
Rear step	10	3 × 16.28 × 66.31	=	3230	@ 140 =	452.000	× 9.25 =	4180.000
Rear step	11	2.17 × 16.28 × 43.39	=	1535	@ 140 =	215.000	× 11.83 =	2550.000
machinery seat	12	2 - 2.17 × 14.98 × 8.96	=	583	@ 140 =	81.600	× 11.83 =	965.000
" "	13	2 - 4.33 × 14.98 × 9.46	=	1225	@ 140 =	171.560	× 15.00 =	2570.000
Lower step middle	14	4.33 × 11.36 × 42.39	=	2080	@ 140 =	291.000	× 15.00 =	4370.000
Along wall	15	2 - 6.5 × 16.28 × 2.5	=	528	@ 140 =	74.000	× 14.00 =	1036.000
Trunnion girder seats	16	2 - 21.0 × 13.0 abt × 7.21	=	3940	@ 140 =	551.000	× say 30.00 =	16,550.000
between	17	21.0 × 5.61 × 51.89	=	6110	@ 140 =	855.000	× 27.75 =	23,800.000
Seat for buffer block	18	2.0 × 5.25 × 51.89	=	545	@ 140 =	76300	× say 37.00 =	2820.000
Front wall. approx	19	26.11 × 4.25 × 63.71	=	7070	@ 140 =	992.000	× 40.38 =	40,000.000
				69566		9741.300#		231,167.000'#

Floor slab &c approx.

pavement	15# × 49.89	=	750
slab.	0.5 × 50. = 25.0 @ 150#	=	3750
Filling	0.42 × 25 = 10.5 @ 140	=	1470
Rail			180
Curb.			300
Sidewalk	0.31 × 2 × 9.29 = 5.75 @ 150	=	860
structural steel say			1500
			8810# per ft call this 9000# per ft

Floor slab &c	20.		9000 × 35 =	315.000	× 18.25 =	5,750.000
Earth filling	21	7.0 × 13.78 × 51.31 =	4950 @ 100 =	495000	× 4.25 =	2,100.000
" "	22	.75 × 31.5 × 73.0 =	1720 @ 100 =	172000	× .38 =	65.000
				667000		2,165.000
Operating machinery	23			50.000	× say 11.0 =	550.000

Total weight on trunnion girder 2,086.000
trunnion girder &c 150.000
2,236.000 × 31.75 = 71,000.000

Summary

	Load	moment
Concrete in abutment	9,741.300	231,167.000
floor	315.000	5,750.000
Earth fill at rear	667.000	2,165.000
Operating machinery	50.000	550.000
Total load from moving leaf	2,236.000	71,000.000
	13,009.300#	310,632.000'#

arm = 23.9

増田淳氏関係資料 (独立行政法人 土木研究所蔵)

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MADE BY J. Masuda DATE 2-2-27 FILE NO.

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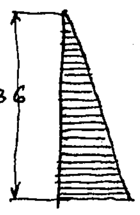
CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf trunnion bascule.

Earth pressure.

40.36



1/3 · 100 · 40.36 = 1345#

Pressure = 1345/2 · 40.36 = 27.100# per ft.

Total p = 27.100 · 73 = 1.980.000# assumed

moment = 1.980.000 × 40.36/3 = 26.600.000'#

	Load	arm	moment
abutment	13009.300	23.9	310.632.000'#
			26.600.000
		25.9'	337.232.000

Ecc = 25.9 - 25.5 = 0.4'

Toe Pressure = $\frac{13009300}{51 \cdot 73} \cdot \left(1 - \frac{6 \cdot 0.4}{51}\right)$ = 3660#/□' or 3340#/□'

Wind pressure on bascule span when the bridge raised

Total pressure = 68 · 15 · 64 = 65200#

moment about bottom of base 65200 · 74.36 = 4.850.000

337.232.000

342.082.000

Arm = 342.082.000 ÷ 13009300 = 26.2' Ecc = 26.2 - 25.5 = 0.7

Toe Pressure = $\frac{13009300}{51 \cdot 73} \left(1 \pm \frac{6 \cdot 0.7}{51}\right)$ = 3800#/□'

Center of gravity above bottom of base.

1	4,130.000	4.50	=	18.600.000
2	476.000	3.00	=	1430.000
3	119.000	7.00	=	833.000
				20 863 000
4	258.000	32.24	=	8,320.000
5	162.000	24.03	=	3890.000
6	216.000	15.89	=	3.430.000
7	17.200	28.20	=	485.000
8	550.000	24.86	=	13.700.000
9	53700	29.00	=	1.560.000
				31385 000 31385.000
10	452.000	17.14	=	7.750.000
11	215.000	17.14	=	3.690.000
12	81.600	16.48	=	1.345.000
13	171.500	16.48	=	2.820.000
14	291.000	15.18	=	4420.000
15	74.000	17.14	=	1.270.000
				21295 000
16	551.000	16.5 abt	=	9.090.000
17	855.000	11.80	=	10.100.000
18	76300	17.11	=	1305.000
19	992.000	21.55	=	21.350.000
				41845 000
20.	315.000	40.00	=	12.600.000
21	495.000	15.89	=	7.870.000
22	172.000	24.75	=	4.260.000
23	50.000	16.5 abt	=	825.000
24	2.236.000	26.61	=	59.500.000
	13009.300			200.443.000'#

Arm 15.4'

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf bascule.

Without earth pressure Hor. arm 23.9' m = 310.632.000 ''#

Toe Pressure = $\frac{13009300}{51 \times 73}\left(1 \pm \frac{6 \times 1.4}{51.0}\right)$ = 4075 #/□' at rear
2920 #/□' at toe.

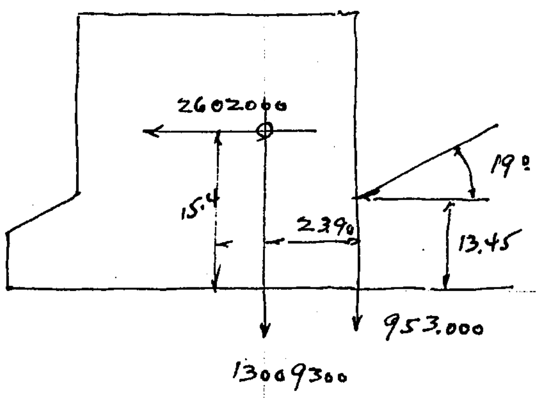
Earth quake. force assumed 0.2
13009300 × 0.2 = 260200
m = 260200 × 15.4 = 40100.000
310632.000
270532.000 ''#

Arm = 270532.000 ÷ 13009300 = 20.8'
ecc = 25.5 − 20.8 = 4.7

Toe pressure = $\frac{13009300}{51 \times 73}\left(1 \pm \frac{6 \times 4.7}{51}\right)$ = 5270 #/□' at rear
1560 #/□' at front.

Stability during Earthquake with earth pressure.
k = 0.2 k' = 0. tan β = 19°−40' sin β = 19° 40' = 0.336
P = .24 × wH² cos β = " = 0.942
height = 40.36 pressure per ft strip = 100 × 40.36² × 0.24 = 39000 #
Total = 39000 × 73 = 2.840.000 #
vertical 2.840.000 × 0.336 = 953.000 #
Horizontal 2.840.000 × 0.942 = 2.680.000 #

moment 310632.000
Earth quake 40100.000
350732 000
2.680.000 × 13.45 = 36.000.000
386.732.000 #

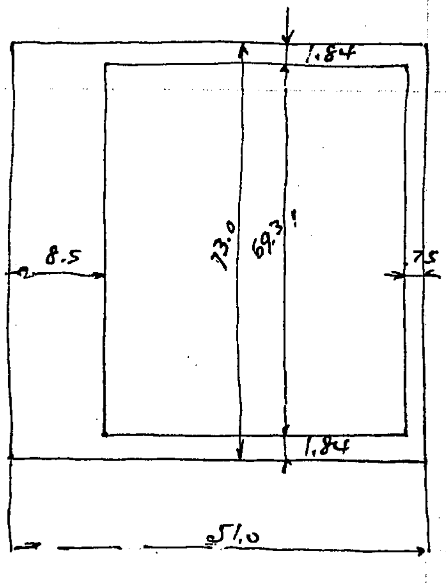


Total load 13009300
953000
13962300

arm = 386.732.000 ÷ 13.962300 = 27.6
ecc = 27.6 − 25.5 = 2.1'

Toe pressure = $\frac{13.962300}{51 \times 73}\left(1 \pm \frac{6 \times 2.1}{51}\right)$ = 4680 #/□'
2830 "

Stability of abutment considering bouyancy
height of water 24.5'
upward pressure = 24.5 × 62.5 = 1530 #/□'



Downward pressure = 3.68 × 15.5 × 62.5 = 3570 #
3570 × 51.0 = 182.000 #
15.5 × 62.5 = 970 #/□'

970 × 8.5 × 69.31	=	570.000	× 46.75	=	26600.000
970 × 0.75 × 69.31	=	50.400	× 0.38	=	19.000
		182.000	× 25.50	=	4640.000
		802400			31259 000

upward P = 1530 × 51 × 73.0 = 5.700.000

upward p.	5700.000	× 25.5	=	145.200.000
downward p.	802 400			31259.000
	~~6502400~~ 4897.600			113,941.000

arm = 113.941.000 ÷ ~~6502400~~ 4897600 = 23.2'

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule.

Dead Load Earth pressure + wind load. bouyancy

Load.	Moment
13009300	342.082.000
4897600	113.941.000
8111700	228.141.000

arm = 28.10

Ecc = 28.10 - 25.50 = 2.60

Toe Pressure = $\frac{8111700}{51 \times 73} \left(1 + \frac{6 \times 2.6}{51}\right)$ = 2840 #/□'

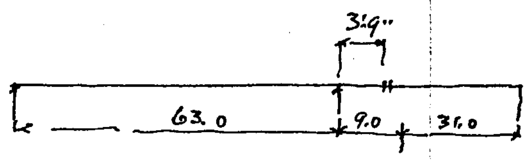
Live Load on span

full uniform load

120 × 47.73 = 5730

100 × 12.0 = 1200

6930 #. call this 7000 # per lin ft.



7000 × $\frac{66.75^2}{2}$ ÷ 63.0 = 247,000

7000 × 36.25 = 254,000

moment = 247.000 × 40.75 = 10.100.000

254.000 × 18.87 = 4800.000

501.000 14.900.000 #

with live load

	load.	moment
Dead Load.	13009300	337232.000
live load.	501000	14900.000
	13510300	352,132,000

arm = 26.0

Toe Pressure = $\frac{13510300}{51 \times 73} \left(1 \pm \frac{6 \times 0.5}{51}\right)$ = 3860 #/□'

Reinforcement in top.

upward pressure assumed 4000 #/□' uniform. upward.

projection 8.5' m = 2650 × $\frac{8.5^2}{2}$ = 95700 '# - 9 × 150 = 1350

4000
1350
2650 #

fiber stress = $\frac{6 \times 95700 \times 12}{12 \times 9^2 \times 12^2}$ = 49.3 #/□"

Use Reinf. at bottom

$\frac{95700 \times 12}{7/8 \times 96 \times 17{,}000}$ = 0.80 □" per ft

use 3/4" □ bars 6" centres.

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MADE BY Y. Hirata DATE 15-11-19 FILE NO.

CHECKED BY DATE PAGE NO 66

CALCULATIONS FOR

First Panal Bridge for City of Kobe ; 60' Single leaf trunnion bascule

2 TROLLEY POLES. TP1

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
4	Ls 3½×3½×3/8	16-8¼	@ 8.50	567.392			13493		5958	
38	Bars 2¼×5/16	1-11	@ 2.39	174.102			4140		1828	
2	Pls 26×5/16	3-10½	@ 27.63	214.132	+23-9⅜	+10-6	5092		2248	
2	Pls 17½×5/16	8-10½	@ 18.59	329.972			7847		3465	
4	Bars 2¼×5/16	1-11	@ 2.39	18.326			436		192	
2	Ls 5×3½×3/8	2-4½	@ 10.40	49.400	+24-8 5/16	+3-6½	1220		175	
2	Ls 5×3½×3/8	2-4½	@ 10.40	49.400	+22-10 7/16	+3-6½	1130		175	
2	Pls 8½×3/8	4-4½	@ 10.84	94.850	+24-7 7/16	+2-4	2333		221	
2	Ls 3½×3½×3/8	0-10½	@ 8.50	14.875	+23-9⅜	+2-7	354		38	
2	Ls 3½×3½×3/8	2-0½	@ 8.50	34.714	+24-7 11/16	+3-6¼	855		122	
4	Ls do	"		69.428	+23-9⅜	+3-6¼	1651		247	
1	Pl 17½×3/8	2-0½	@ 22.31	45.557			1083		162	
2	Ls 4×3½×3/8	1-5¼	@ 9.10	26.172	+23-9⅜	+2-7	622		68	
2	fills 3½×3/8	0-10½	@ 4.41	7.717	+23-9⅜	+2-7¾	184		20	
2	Ls 5×3½×3/8	2-0½	@ 10.40	42.473	+22-10 7/16	+3-6¼	971		150	
2	Ls 8×3½×9/16	1-7¼	@ 21.0	67.368	+22-2 1/16	+2-6¾	1494		173	
2	fills 3½×3/8	1-2½	@ 4.41	10.654	+21-11 11/16	+2-7¾	234		28	
1	Pl 19×3/8	2-0½	@ 24.23	24.478	+22-6	+3-5	551		84	
1	Pl 27×5/16	2-6	@ 28.69	71.725	+23-0¼	+18-0¾	1651		1296	
1	"	2-6	"	71.725	+24-6½	+18-0¾	1760		1296	
2	Pls 28½×5/16	2-4⅝	@ 30.28	144.436	+23-9⅜	+3-8¼	3435		533	
2	Pls 15×5/16	1-5½	@ 15.94	46.481	+ "	+18-6¾	1105		863	
2	Ls 3½×3½×3/8	8-0	@ 8.50	136.000						
1	Pl 18×5/16	3-3	@ 19.13	62.173	+23-9⅜	+15-11	5966		3992	
1	" "	2-9	"	52.608						
16	Bolt for 7/8" Bolt		@ .77	12.320	+23-9⅜	+2-5⅛	293		30	
~~400~~ 1,062	R.H. 3/4"		@Q14.25	~~57.605~~ 151.	+23-9⅜	+9-6	3748		1497	
				2597.083 — 2,590.			61648		24861	
				× 2			× 2		× 2	
				5194.166 — 5,191.			123296		49722	

2 TROLLEY POLES TP2

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
4	Ls 3½×3½×3/8	16-9⅜	@ 8.50	570.554			41563		5997	
38	Bars 2¼×5/16	1-11	@ 2.39	174.102			12661		1828	
2	Pls 26×5/16	3-10½	@ 27.63	214.132	+72-8 11/16	+10-6	15573		2248	
2	Pls 17½×5/16	9-0	@ 18.59	334.620			24335		3514	
4	Bars 2¼×5/16	1-11	@ 2.39	18.326			1333		192	
1	Pl 18×½	5-4	@ 30.60	163.190	+73-6¼	+1-9½	11998		292	
2	Ls 3½×3½×3/8	0-10½	@ 8.50	14.875	+72-8 11/16	+2-5⅞	1081		37	
4	Ls do	2-0½	@ 8.50	69.428	+72-8 11/16	+3-5⅛	5049		238	
1	Pl 17½×3/8	2-0½	@ 22.31	45.557			3313		156	
2	Ls 4×3½×3/8	1-5¼	@ 9.10	26.153	+72-8 11/16	+2-5⅞	1902		65	
2	fills 3½×3/8	0-10½	@ 4.46	7.805	+72-8 11/16	+2-6⅝	568		20	
2	Ls 5×3½×3/8	2-4⅝	@ 10.40	49.616	+71-9¾	+3-7⅛	3563		178	
2	Ls 8×3½×9/16	1-7¼	@ 21.	67.368	+71-1⅞	+2-5⅞	4791		166	
2	fills 3½×3/8	1-2½	@ 4.46	10.775	+70-11	+2-6⅝	764		27	
1	Pl 19×3/8	2-4⅝	@ 24.23	28.738	+71-4	+3-3	2054		94	
1	Pl 27×5/16	2-6	@ 28.69	71.725	+71-11½	+18-0¾	5161		1296	
1	Pl "	2-6	"	71.725	+73-5⅛	+18-0¾	5271		1296 a	
2	Ls 3½×3½×3/8	8-0	@ 8.50	136.000						
1	Pl 18×5/16	3-3	@ 19.13	62.173	+72-6 7/16	+15-11	18238		3992	
1	" "	2-9	"	52.608						

2Pls 15×5/16×1'-5
@15.94 45
× 2
90

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 Y. Hirata DATE 15-11-19 FILE NO

CHECKED BY DATE PAGE NO 67

CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule.

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
2	Pl 17½×5/16	2-4½	@ 18.59	88.303	+72-8 11/16	+3-6½	+6422		+4313	
16	Bolts for 7/8 φ		@ .77	12.320	+72-8 11/16	+2-4 5/8	+ 896		+ 29	
1066	R.H 3/4 φ		@0.1425	151.905	+72-8 11/16	+9-6	11047		1443	
				2442.048			177583		23415	
				2			2		2	
				4884.096			~~355166~~		46830	
				90.						
				4,974.						

TROLLEY ARCH TA1.

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
8	Ls 3½×3½×3/8	12-0	@ 8.50	816.000			19479		4943	
4	Ls "	27-4¾	@ "	931.464			22235		17058	
80	Bars 2¼×5/16	2-3	@ 2.39	430.200			10272		7878	
8	Ls 3½×3½×3/8	1-8	@ 8.50	113.356			2706		2076	
4	Pls 20×5/16	1-9	@ 21.25	148.750			3551		2724	
4	Pls 25 5/8×5/16	2-3	@ 27.23	245.070			5850		4488	
4	Pls 28×5/16	2-8½	@ 29.75	322.252			7692		5901	
2	Pls 15×5/16	2-1 5/8	@ 15.94	68.064			1625		1246	
2	Pls 18×5/16	2-1 5/8	@ 19.13	81.685	+23-9 3/8	+18-3¾	1950		1496	
38	Bars 2½×3/8	3-0	@ 3.19	363.660			8681		6660	
26	"	3-0	"	248.820			6940		4557	
4	Pls 12×5/16	2-1 5/8	@ 12.75	108.885			2599		1994	
4	Pls 11×1/4	2-1 5/8	@ 9.35	79.849			1906		1462	
8	Pls 14×5/16	1-9	@ 14.88	208.320			4973		3815	
4	Ls 3½×3×1/4	1-5½	@ 5.40	31.493			752		577	
8	Ls "	1-5¾	"	63.893			1525		1170	
8	Ls "	1-5½	"	62.986			1504		1153	
4	Pls 17½×5/16	1-8½	@ 18.59	127.007			3032		2326	
1200	R.H 3/4" φ		@0.1425	171.000			4082		3132	
1,500				4622.752			111354		84656	

214.

4,666.

TROLLEY ARCH TA2

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
8	Ls 3½×3½×3/8	12-0	@ 8.5	816.000			59343		14943	
4	Ls do	27-4¾	"	931.464			67740		17058	
80	Bars 2¼×5/16	2-3	@ 2.39	430.200			31286		7878	
8	Ls 3½×3½×3/8	1-8	@ 8.5	113.356			8244		2076	
4	Pls 20×5/16	1-9	@ 21.25	148.750			10818		2724	
4	Pls 25 5/8×5/16	2-3	@ 27.23	245.070			17822		4488	
4	Pls 28×5/16	2-8½	@ 29.75	322.252			23435		5901	
2	Pls 15×5/16	2-1 5/8	@ 15.94	68.064			4950		1246	
2	Pls 18×5/16	"	@ 19.13	81.685	+72-8 11/16	+18-3¾	5940		1496	
38	Bars 2½×3/8	3-0	@ 3.19	363.660			26447		6660	
26	"	3-0	"	248.820			18095		4557	
4	Pls 12×5/16	2-1 5/8	@ 12.75	108.885			7919		1994	
4	Pls 11×1/4	2-1 5/8	@ 9.35	79.849			5807		1462	
8	Pls 14×5/16	1-9	@ 14.88	208.320			15150		3815	
4	Ls 3½×3×1/4	1-5½	@ 5.40	31.493			2290		577	
8	Ls "	1-5¾	"	63.893			4647		1170	
8	Ls "	1-2	"	50.414			3666		923	
4	Pls 17½×5/16	1-8½	@ 18.59	127.007			9236		2326	
1200	R.H 3/4 φ		@0.1425	171.000			12436		3132	
1,500				4610.182			335271		84426	

214.

4,653.

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 y. Hirata DATE 15-11-20 FILE NO

CHECKED BY DATE PAGE NO 68

CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule.

2- Main Girder MBG1 L

No	Material	Length	weight per ft.	Total Weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
4	Ls 8x8x3/4	39-8	@ 38.90	6172.185						
4	Ps 12x1/2	41-0	@ 20.40	3345.600						
1	P 75x1/2	15-1	@ 37.50	565.613	+53-0	-0-9¼	585888			8523
1	P 75x1/2	25-10¾-11"	"	971.100 972.						
2	Ls 8x8x3/4	6-2	@ 38.90	479.793	+73-3 23/32	-0-9¼	35174			370
2	fills 8x3/4	4-11¼	@ 20.40	201.470	+73-2	-0-9¼	14741			155
2	fills 8x1/2	4-2¾	@ 13.60	115.028	+73-2	-0-9¼	8416			89
1	P 14x1/2	4-2¾	@ 23.80	100.650	+72-0	-0-9¼	7247 657466			78
1	P 14x3/4	2-7½	@ 35.70	93.713	+72-0	-1-11	6747			180
1	L 6x6x3/8	1-2	@ 14.90	17.388	+72-0	-0-11⅝	1252			17
1	L 6x6x1/2	3-5½	@ 19.60	67.777	+71-8⅜	+0-7	4862		40	
1	fill 6x3/4	2-4	@ 15.3	35.695	+71-7½	+0-6¼	2557		19	
~~1~~	~~L 6x4x3/8~~	~~0-5¼~~	~~@ 12.3~~	~~5.375~~	~~+71-7¼~~	~~-0-2 1/16~~	~~385~~			~~1~~
1	fill 6x1/2	4-2¾	@ 10.2	43.136	+71-7½	-0-9¼	3090			33
1	" 6x3/4	4-11¼	@ 15.3	75.536	+ "	-0-9¼	5410			58
1	L 6x6x1/2	6-2	@ 19.6	120.973	+71-8⅞	-0-9¼	8679			93
1	L 4x3½x3/8	1-6	@ 9.1	13.650	+72-9	-0-1 1/16	993			2
2	fills 3½x5/8	0-7½	@ 7.44	9.300	+72-3¾	-0-2½	673 34648			2 9468
1	L 4x3½x3/8	0-10	@ 9.1	7.580	+72-11⅞	-1-2 15/16	553			9
2	fills 3x5/8	0-3½	@ 6.38	3.726	+72-8⅜	-1-3¾	271			5
2	Ls 4x3½x3/8	3-5½	@ 9.1	62.936 65.			4136			44
2	Ls "	3-10-7"	"	69.761	+65-8⅝	-0-8 5/16	4585			48
2	Ls "	3-10	"	"			4585			48
6	Ls 6x4x1/2	6-2	@ 16.2	599.432	+63-11	-0-9¼	38314			462
6	fills 4x1/2	4-2¾	@ 6.8	172.543	+63-10		11014			133
6	" 4x3/4	4-11¼	@ 10.2	302.144			19287			233
4	Ps 9x1/2	2-1	@ 15.3	127.480	+58-4⅝	-0-9¼	7443			98
2	Ps 13x1/2	0-9" 2-8½	@ 22.1	119.694 7.			6988 97,276			92
1	L 4x3½x3/8	3-9	@ 9.1	34.125	+58-0¼	-0-1 1/16	1980			5
1	fill 3½x1/2	1-8" 0-9	@ 5.95 9.1	4.463 15	+59-4	-0-2½	265			1
~~1~~	~~" "~~ L4x3½x3/8	~~1-8~~	~~"~~	~~9.918~~	~~+56-11⅝~~	~~-0-2½~~	~~565~~			~~2~~
1	L 4x3½x3/8	3-0½	@ 9.1	27.682	+58-5¾	-1-2 15/16	1619			34
1	fill 3½x1/2	0-9	@ 5.95	4.463	+59-4	-1-3¾	265			6
1	" "	0-10	"	4.956	+57-4½	-1-3¾	284			7
1	P 15¾x1/2	4-2¾	@ 26.77	113.210	+56-3	-0-9¼	6370			87
1	P 15¾x3/4	2-9½ 2½	@ 40.15	112.099 89.	+56-3	-1-10	6308			205
1	L 6x6x1/2	3-3	@ 19.6	63.700	+55-11¾	+0-8¼	3566		44	
1	fill 6x3/4	2-2	@ 15.3	33.155	+55-10⅜	+0-7¼	1852 23,074		20	
~~1~~	~~L 6x4x3/8~~	~~0-5¼~~	~~@ 12.3~~	~~5.387~~	~~+55-10~~	~~-0-2 1/16~~	~~301~~			~~12~~
1	fill 6x1/2	4-2¾	@ 10.2	43.136	+55-10⅜	-0-9¼	2410			33
1	" 6x3/4	4-11¼	@ 15.3	75.536	+ "	- "	4220	2 Ls 4x3½x3/8x3'-7" @9.1# 66#		58
1	L 6x6x1/2	6-2	@ 19.6	120.873	+55-1¾	- "	6766			93
2	Ls 4x3½x3/8	3-4½	@ 9.1	70. 61.425	+49-11⅝	-0-8 5/16	3069			43
4 2	Ls "	3-10	"	139.521			6972			97
1	L "	3-9½-3"	"	34.507 30	+42-3½	-0-1 1/16	1459			5
1	L "	3-0½	"	27.682	+42-6	-1-2 15/16	1176			34
6	Ls 6x4x1/2	6-2	@ 16.20	599.432	+48-2	-0-9¼	28873			462
6	fills 4x1/2	4-2¾	@ 6.8	172.543	+48-1	-0-9¼	8296 63,412			133
6	" 4x3/4	4-11¼	@ 10.20	302.144			14528			233
1	P 15¾x1/2	2½ 4-2¾	@ 26.77	113.210	+40-6	-0-9¼	4585			87
1	P 15¾x3/4	2-9½	@ 40.15	112.099 89.	+40-6	-1-10	4540			205
1	L 6x6x1/2	3-3	@ 19.6	63.700	+40-2¾	+0-8¼	2563		44	
1	fill 6x3/4	2-2	@ 15.3	33.155	+40-1⅜	+0-6	1330		17	
1	L 6x4x3/8	0-5¼	@ 12.3	5.387	+40-1	-0-2 1/16	216 27,762			1 3015
				16,36,147 ✓			893,668 ✓		184 ✓	12,616 ✓

JIUN MASUDA
CONSULTING ENGINEER
MARUNOUCHI, TOKIO

MADE BY______ DATE______ FILE NO______

CHECKED BY______ DATE______ PAGE NO______

CALCULATIONS FOR

68尺 ニ入レ

Main girder.

2 P/s 63 × 1/2 × 12′-5″	@ 107.1#	= 2,660#	a4
2 〃 42 1/2 × 3/4 × 17′-7″	117.4	4,128	a5, a6
2 〃 51 × 3/4 × 17′-7″	130.1	4,574	a7, a8
2 Flg.Ls 8 × 8 × 3/4 × 45′-0″	38.9	3,540	a1. a9. a10, a11. a12, a13, a14
2 P/s 20 × 1/2 × 26′-3 3/8″	34.0	1,813	a2, a16.
1 Web Pl. 84 × 1/2 × 27′-1 7/8	142.8	3,878	a3, a15
1 〃 〃 90 × 1/2 × 23′-6	153.0	3596	a17. a18. a19.
2 Side P/s 79 × 1/2 × 10-1 1/2	134.3	2,721	a20. a21.
2 〃 〃 96 × 1/2 × 11′-9	163.2	3,835	a22. a23. a24
2 Flg.Ls 8 × 8 × 3/4 × 42-8 abt.	38.9	3,320	a1, a25. a26
1 Web Pl. 52 × 1/2 × 21′-6″	88.4	1,901	a27, a28
1 Cov. Pl. 18 × 3/4 × 21′-11″	45.9	1,006 }	a29. a30, a31, a32, a33, a34.
1 〃 〃 〃 〃 × 43′-0″	〃	1,974 }	a35, a36, a37. a38, a39
1 〃 〃 〃 〃 × 45′-9″	〃	2,100	a40. a41, a42
2 Ls 8 × 8 × 3/4 × 26′-6″	38.90	2,062	a43, a44, a45, a46, a47, a48, a49
1 Cov. Pl. 18 × 3/4 × 26′-6″	45.9	1,216	a50. a51, a52, a53, a54, a55, a56, a57
		44,324#	

增田淳氏関係資料（独立行政法人 土木研究所蔵）

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY J. Hirata DATE 15-11-20 FILE NO.

CHECKED BY DATE PAGE NO. 69

CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single Leaf Trunnion bascule

NO	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment.	-X Moment.	+Y Moment.	-Y Moment.
1	fill 6x½	4-2¾	@ 10.2	43.136	+40-1⅜	-0-9¼	1730			33
1	" 6x¾	4-11¼	@ 15.3	75.536	"	"	3030			58
1	L 6x6x½	6-2	@ 19.6	120.873	+40-2¾	"	4863			93
2	Ls 4x3½x⅜	3-4½	@ 9.1	61.425			2241			43
1	L "	3-3½ 3-0	"	29.957 27.	+36-5¾	-0-8 5/16	1093			21
1	L "	3-9	"	34.125			1245			24
4	Ls 8x8x¾	6-2	@ 38.9	959.584			31176			740
4	Ps 12x¾	2-8	@ 30.6	326.441	+32-5⅞	-0-9¼	10606			252
4	" 9x½	2-2	@ 15.3	132.620 1783.697			4309			102
2	" 14x½	2-8½	@ 23.8	128.901			4188			99
2	Ls 6x4x½	6-0½	@ 16.2	195.761	+32-5	-0-9¼	6346			151
2	fills 4x¾	4-2¾	@ 10.2	86.272	+32.4	-0-9¼	2789			67
2	" "	4-9¾	"	98.185			3175			76
~~2~~	~~Ls 4x3½x⅜~~	~~0-6½~~	~~@ 9.1~~	~~9.864~~	~~+32-6~~	~~-0-1 1/16~~	~~321~~			~~1~~
~~2~~	~~fills 3x¾~~	~~0-3½~~	~~@ 7.65~~	~~4.467~~	~~+32-0½~~	~~-0-2½~~	~~143~~			~~1~~
~~1~~	~~fill 3x½~~	~~0-3½~~	~~@ 5.1~~	~~1.489~~			~~48~~			~~0~~
1	L 4x3½x⅜	3-4	@ 9.1	30.330			796			21
1	" "	3-9	@ 9.1	34.125			896			24
1	" "	3-0	"	27.300 616.634	+26-3	-0-8 5/16	717			19
1	" "	3-9½ 3	"	34.507 30.			906			24
2	Ls "	3-6½	"	64.464			1692			45
1	L "	2-3 2½	"	20.475	+22-10	-2-7 15/16	468			55
1	P 15¾x½	4-2¾	@ 26.77	113.210	+24-9	-0-9¼	2804			87
1	P 15¾x¾	2-9½	@ 40.15	112.099 89.	"	-1-10	2777			205
1	L 6x6x½	3-3	@ 19.6	63.700	+24-5¾	+0-8¼	1559		44	
1	fill 6x¾	2-2	@ 15.3	33.155	+24-4⅜	+0-6	808		17	
1	L 6x4x⅜	0-5¼	@ 12.3	5.375	+24-4	-0-2 1/16	131			1
1	fill 6x½	4-2¾	@ 10.2	43.136	+24-4⅜	-0-9¼	1051			33
1	" 6x¾	4-11¼	@ 15.3	75.536 535.697	"	"	1840			58
1	L 6x6x½	6-2	@ 19.6	120.873	+24-5¾	-0-9⅜	2959			93
1	P 18x⅜	3-9½	@ 22.95	87.020	+71-7¼	+2-4 1/16	6231		208	
~~1~~		~~1-7½~~	~~"~~	~~37.294~~	~~+58-10½~~	~~+2-5 1/16~~	~~2196~~		~~80~~	
~~1~~	~~"~~	~~2-3~~	~~"~~	~~51.637~~	~~+57-10½~~	~~+2-5 1/16~~	~~2988~~ 5184		~~127~~	
2	Ps 18x¾	10-1	@ 45.9	994.194	+37-6⅜	-0-9¼	37313			766
2	fills "	2-8	"	244.831	+32-5⅞	"	7957			189
1	P 17x⅜	2-2	@ 21.68	46.981	+71-5½	-3-10 1/16	3357			179
1	" "	3-6½	"	76.791	+56-1¾	-3-10 1/16	4312			292
1	" "	3-6½		"	+40-7¼	-3-10 1/16	3118			"
1	P 21x⅜	3-11	@ 26.78	100.370 1743.85	+24-6	-3-10 1/16	2459			385
1	P 13½x⅜	3-8½	@ 17.21	63.815	+23-3	-3-10 1/16	1484			243
1	P 15½x⅜	2-10½	@ 19.76	47.290	+23-3	-2-9 1/16	1099			130
4	Ls 6x4x⅜	2-1	@ 12.30	102.484	+24-7¼	+1-3	2522		128	
3	Ps 8x½	2-5	@ 13.60	98.614	+40-6	-0-8	3994			66
4	Ls 6x4x½	6-2	@ 16.20	399.602	+32-4⅞	-0-9¼	12950			308
4	Ps 4x½	4-2¾	@ 6.8	115.034	+32-4⅛	-0-9¼	10236			244
4	Ps 4x¾	4-11¼	@ 10.2	201.450						
4	Ls 8x8x¾ a1	25-10	@ 38.9	4019.615			73358			3099
4	Ps 12x½ a2	27-2	@ 20.4	2216.824	+18-3	-0-9¼	40457			1709
1	P 75x½ a3	"	@ 127.5	3463.793 10728.571			63214			2671
2	Ls 6x4x½	6-3	@ 16.2	202.500			3341			148
2	fills 4x½	4-2¾	@ 6.8	57.510	+16-6	-0-8¾	949			42
2	" 4x¾	4-11½	@ 10.2	101.543			1675			74
2	Ls 6x4x½	6-2	@ 16.2	199.811			4080			154
2	fills 4x½	4-2¾	@ 6.8	57.510	+20-5	-0-9¼	1174			44
2	fills 4x¾	4-11¼	@ 10.2	100.715 358.036			2057			78
		15800.456		16162.009			384046		3994	13539

JIUN MASUDA
CONSULTING ENGINEER
MARUNOUCHI, TOKIO

MADE BY Y. Hirota DATE 15-11-20 FILE NO.
CHECKED BY DATE PAGE NO. 70

CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' Single leaf trunnion bascule.

No.	Material	Length	Weight/ft.	Total Weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
1	Fill. 15¾×½	1'-9½	@26.77	47.912	+9'-0"	+0'-5"	431		20	
2	〃 15¾×¾	2'-3	@40.15	180.670			1626		8	
2-1	Ls. 6×6×½	3'-9"	@19.60	147.000 -74.			1323		6	
2	Ls. 〃	6'-2"	〃	241.746	+9'-0"	-0'-9¼	2176			186
1	Fill. 15¾×½	4'-2¾	@26.77	113.210			1019			87
2	〃 15¾×¾	〃	@40.15	339.589			3056			262
2	Ls. 6×4×⅜	0'-5¼	@12.30	10.750	+9'-0"	-0'-1¾	97			2
2-1	Ls. 4×3½×⅜	1'-9"	@9.10	16 31.850	+10'-6	-2'-5 13/16	334			79
2-1	〃	2'-3	〃	20 40.950	+7'-3½	〃	299			102
2	〃	1'-3	〃	22.750	+12'-0	-0'-8 5/16	273			16
4	〃	3'-10	〃	139.521	+16'-5	-0'-8 5/16	2291			97
4-2	Pls. 20×½	2'-2½	@34.00	300.560 -150	+6'-3¼	-0'-9¼	1885			232
2	Ls. 6×4×½	6'-10	@16.20	221.390	+6'-1¼	-0'-5½	1351			140
2	Fills. 4×¾	4'-2¾	@10.20	86.272			527			40
2	〃 〃	11'-2½ 2'-2	〃	44.210			270			20
2	〃 4×½	4'-2¾	@6.80	57.514 -1640			351			26
1	Pl. 86×½	10'-1½	@146.20	1480.275	+1'-5	-1'-4	2098			1973
2 10	Pl. 52×½ (-760) a4	12'-5	@88.40	2195.326	-1'-4"	+1'-10		2926	4024	
2 24	Pls. 4½×¾ a5	10'-0	@11.48 -25.5	229.600 -255	+7'-4	+1'-6¼ 21091	1684		349	
2	Pls. 32×¾ a6	7'-7	@81.60 -61.2	237.546 -464	-2'-4½	+2'-2½		2939	2733	
2 18	〃 12×¾ a7	10'-0	@30.60 -45.9	612.000 -459	+7'-4	+1'-10	4484		1122	
2 34	〃 38½×¾ a8	7'-7	@98.20 -86.7	1489.301 -657	-2'-2	+2'-6		3227	3723	
2	〃 4×¾	17'-7	@10.20	358.693	+3'-9	-3'-1½	1345			1121
2	〃 11½×¾	〃	@29.33	1031.419	+3'-9	-3'-5¼	3868			3545
2	〃 91×½	12'-5	@156.40	3884.038	-0'-5	-1'-9		1620		6797
2	Ls. 6×4×½	7'-3	@16.20	235.000	+2'-8	-0'-3½	627			69
2	Fills. 4×¾	4'-2¾	@10.20	86.272	+2'-7	-0'-9¼	223			67
2	〃 〃	2'-2	〃	44.210	〃	〃	114 112			34
2	Pls. 12½×¾	11'-4	@31.90	723.045	+0'-6	+0'-9	362		542	
2	Ls. 4×3½×⅜	3'-3	@9.10	59.150	+4'-4½	-0'-1 1/16	259			8
2-4	Ls. 〃	2'-2	〃	39.440	+1'-8¼	〃	67			6
2	Ls. 6×4×⅜	0'-5¼	@12.30	10.750 -22	±0	-0'-2 1/16	0			2
2	Ls. 4×3½×⅜	2'-1	@9.10	37.910	-1'-7½	-0'-1 1/16		63		6
2	Ls. 〃	2'-5	〃	43.989	-3'-11	-0'-1 1/16		172		6
4	Ls. 〃	1'-0"	〃	36.400	-6'-3	-0'-1 1/16		228		5
2	Ls. 〃	1'-9	〃	31.850	±0	-2'-8	0			85
2	Ls. 6×3½×⅜	0'-11½	@11.70	22.417	+4'-0 1/16	-3'-4½	90			76
1	Fill. 15¾×½	1'-9½	@26.77	47.981	+9'-0	-2'-0	432			96
2	Fills. 15¾×¾	1'-9½	@40.25	144.256	+9'-0	-2'-0	1298			289
2	Ls. 6×6×½	7'-9	@19.60	303.800	±0	-0'-0¾				19
2	〃	7'-11	@ 〃	310.350						20.
2	Fills. 14×¾	3'-2½	@35.70	229.051	±0	-1'-1				248
2	〃	4'-2¾	〃	301.951						327
2	Ls. 6×4×½	8'-7½	@16.20	279.450	-2'-8½	+0'-5½		757	128	
2	Fills. 4×¾	3'-2½	@10.20	65.443	-2'-9½	-1'-1		183		71
2	〃	4'-2¾	〃	86.272	〃	〃		241		93
2	Ls. 8×8×¾ a9	2'-8	@38.90	207.493	+3'-11	+2'-11	813		606	
2	〃 a10	2'-7¾	〃	205.859	+1'-3½	+3'-5	266		704	
2	〃 a11	3'-1½	〃	243.125	-1'-4½	+4'-1		334	993	
2	〃 a12	3'-9	〃	291.750	-4'-5½	+5'-0½		1301	1471	
2	〃 a13	4'-0	〃	311.200	-7'-8½	+6'-6		2399	2023	
2	〃 a14	2'-11¼	〃	228.499	-10'-3¾	+7'-10		2357	1789	
1	Pl. 9×½×½ a15	15'-6"	@15.30	238.680	+9'-4"	+2'-6	2227		597	
2	Pls. 8×½×½ a16	15'-6"	@13.60	421.600			3934		1054	
~~2~~	~~〃 9×¾×½~~	~~6'-6~~	~~@22.95~~	~~298.350~~			~~2785~~		~~746~~	
				20,129.635			44,289	18,747	22,638	16,252

1L 6×6×½×3'-8½ @19.6# = 73#

2 Pls 11½×½×2'-2½ @19.55# = 43#

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 J. Hirata DATE 15-11-27 FILE NO ______

CHECKED BY ______ DATE ______ PAGE NO 71

CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule.

No.	Material		Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Momomet.	-Y Moment.
2	Ps 25½×½		10-4½	@ 43.85	909.890	-6-2			5611	1365	
2	fills 25½×¾		9-0½	@ 65.05	1175.280	-6-2	+1-6		7248	1763	
2	Ls 6×4×½	1½	9-10½	@ 16.20	319.950 880	-6-1			1946	480	
1	P 52×½		9-0½	@ 88.40	799.313	-4-0¾	+0-6¾		3248	449	
1	L 6×4×½		10-5	@ 16.2	168.760	-9-1			1533	309	
2	fills 4×¾		4-7	@ 10.2	85.00		+1-10		779	156	
2 1	" "		4-5	"	90.110 45	-9-2			826	165	
2	" 4×¼		1-0½	@ 3.4	7.090 174				65	13	
1	L 6×4×½		10-3 9"	@ 16.2	166.050	-9-1	+1-10		1508	304	
2	Ls 6×4×½		11-1½	"	360.450	-12-1¾			4378	849	
2	fills 4×¾		4-4	@ 10.2	88.393		+2-4¼		1081	208	
2	" "		4-9	"	96.900	-12-2¾			1185	228	
2	" 4×¼		1-0	@ 3.4	6.800				83	16	
1	P 42×½	a17	3-11	@ 71.4	279.674	-10-6	+6-3½		2937	1760	
1	P 90×½	a18	9-0	@ 153.0	1215.000	-9-9	+0-6½		11846	659	
1	P 60×½	a19	10-10	@ 102.0	1104.966	-11-1½	-9-3½		12293		1027
2	Ps 42×½	a20	4-2	@ 71.4	595.048	-10-6	+6-3½		6248	3744	
2	Ps 36×½	a21	9-4	@ 61.2	1142.359	-10-10	+3-6¼		12375	4022	
2	Ps 72×½	a22	10-2	@ 122.4	2488.882	-11-2¾	+0-10		27948	2073	
2	Ps 24×½	a23	7-8	@ 40.8	625.627	-12-5½	-4-10¼		7794		3037
2	Ps 19×½	a24	8-0	@ 32.3	490.000	-16-10¼	-2-7½		8258		1276
2	Ls 6×4×½		2-1½	@ 16.2	68.850	-12-10¾	+5-6		888	379	
2	fills 4×¾		1-0	@ 10.2	20.400	-12-10½	"		263	112	
2	Ls 6×4×½		4-2	@ 16.2	135.011	-10-7¼	+3-6½		1432	478	
2	fills 4×¾		3-9	@ 10.2	76.500	-10-7	+3-7		810	274	
2	Ls 6×4×½		2-7	@ 16.2	83.689	-8-3	+1-6½		690	129	
2	Ls "		4-1½	"	133.650	-13-1¼	+2-2¼		1860	292	
2	fills 4×¾		3-1	@ 10.2	62.893	-13-11	+2-3		875	142	
2	" "		3-2¼	"	65.443	-10-7	+0-5¾		693	31	
2	Ls 6×4×½		3-7	@ 16.2	116.089	-10-7¼	+0-4¾		1231	46	
2	Ls "		2-2	"	70.211	-8-2¼	-0-1¼		575		66
2	Ls "		5-3	"	170.100	-14-7½	-0-1¼		2488		159
2	fills 4×¾		4-3	@ 10.2	86.700	-14-7	-0-10½		1264		76
2	Ls 6×4×½		3-3	@ 16.2	105.300	-10-7	-2-2		1114		228
2	fills 4×¾		2-11	@ 10.2	59.507	-10-6½	-2-1		627		124
2	Ps 12½×½		8-7	@ 21.25	364.777	-11-6	+2-1		4195	760	
2	L 4×3½×⅜		1-9	@ 9.1	31.850	-8-1¼	-0-1 1/16		259		45
~~1~~	~~L "~~		~~1-4~~	~~"~~	~~12.130~~	~~8-1½~~	~~1-2 5/16~~		~~102~~		~~15~~
2	L "		2-3	"	40.950	-10-10⅝	-0-1 1/16		447		6
~~1~~	~~L "~~		~~3-0~~	~~"~~	~~27.300~~	~~10-6½~~	~~1-2 5/16~~		~~288~~		~~34~~
2	L "		4-3	"	77.350	-14-2½	-0-1 1/16		1099		10
~~1~~	~~L "~~		~~2-11~~	~~"~~	~~26.545~~	~~15-3½~~	~~1-2 5/16~~		~~406~~		~~33~~
1	L "		4-9	"	43.225	-9-7½	-2-11		416		127
1	L 8×8×¾		5-1	@ 38.9	197.729	-12-6	-4-1½		2472		816
1	fill 8×¾		5-1	@ 20.4	103.693	- "	-4-3		1296		441
2	Ls 8×8×¾		11-8	@ 38.9	907.693	-11-11½	-3-8		10854		3329
2	fills 8×¾		8-11	@ 20.4	363.814	-12-8¾	-3-6½		4631		1289
1	fill 9×¾		6-9	@ 22.95	154.913	-9-8¼	-7-2½		1501		1117
1	" 18½×½		8-7	@ 31.45	269.935	-13-6½	-10-3		3655		2767
1	P 6×½		8-9	@ 105.4	922.250	-14-6	-9-4		13373		8607
1	P 26×¾		6-9	@ 66.3	447.525	-16-0	-7-0		7160		3133
1	P 7½×¾		2-6	@ 19.13	47.825	-14-8½	-5-10		703		279
1	P 3×½		3-0	@ 5.1	15.300	-16-10	"		258	21206	89
1	fill 13½×½		2-8	@ 22.95	61.208	-11-4	-11-1½		694		681
1	fill 13½×¾		7-1	@ 34.4	243.655	-13-0			3168		2707

1Fill. 4×¾×4'-9 @ 10.2# = 48#

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 Y. Hirata DATE 15-11-29 FILE NO.

CHECKED BY DATE PAGE NO. 72

CALCULATIONS FOR

First Canal Bridge for City of Kobe ; 60' Single leaf trunnion Bascule.

NO	Material		Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
1	L 6×6×½		4-0	@ 19.6	78.400	-12-6½	-11-1½		983		872
1	L "		8-2	"	160.073				2008		1781
1	L 6×3½×⅜		8-6	@ 11.7	99.450	-13-6	-7-1½		1343		709
1	fill 3½×½		2-8	@ 5.95	15.867	-11-4½	-6-8½		180		106
1	" "		"	"	"	-15-8	-7-4		249		116
1	L 6×3½×⅜		1-6½	@ 11.7	18.041	-16-10½	-7-7		304		137
1	fill 3½×½		1-0	@ 5.95	5.95	-17-2	-7-6½		102		45
1	L 6×3½×⅜		7-11	@ 11.7	92.629	-12-11½	-10-2		1200		942
1	fill 3½×½		2-10	@ 5.95	16.858 503.135	-11-4	-9-5½		191		159
1	" "		1-10	"	10.908	-15-5	-10-11		168		119
2	Ls 8×8×¾	a25	14-0	@ 38.9	1089.200	-1-9	-3-9		1906		4085
2	Ls "	a26	3-6	@ 38.9	272.300	-8-9½	-4-10¼		2394		1322
1	L "		4-0	"	155.600	-8-10½	-6-7		1381		1024
1	P 7×¾		4-10	@ 17.85	86.269	-8-8¾	-6-0¾		753		523
2	Ps 17×½		7-9½	@ 28.9	450.378	-9-3½	-9-9		4185		4391
2	Ls 8×8×¾		7-5	@ 38.9	577.043	-8-10	-10-4		5097		5963
2	Ls 6×6×½		6-9	@ 19.6	264.600	-11-9¼	-14-4		3115		3793
1	fill 6×½		2-8	@ 10.2	272.034	-11-4½	-11-4½		3094		3094
1	" 6×¾		6-10	@ 15.3	104.545 3282.877	-12-8			1324		1189
1	L 6×4×½		8-2	@ 16.2	132.305	-12-8½	-11-4		1681		1499
1	P 18×½	a27	20-3½	@ 30.6	620.935	-14-4	-4-9		8900		2949
1	P 45×½	a28	9-8	@ 76.5	739.525	-16-4½	-4-7½		12110		3420
1	P 18×¾	a29	28-4⅜	@ 45.9	1301.954	+19-6¼	+2-5⅝	25415		3215	
1	" "	a30	27-1⅞	"	1246.460	+18-11	+2-4⅞	23579		2999	
1	" "	a31	12-1	"	554.610	+11-4½	+2-6⅜	6309		1404	
3	Ps "	a32	2-8	"	367.246	+4-0	+3-3	1469		1194	
3	" "	a33	2-7½	"	361.463	+1-3½	+3-9	467		1355	
3	" "	a34	3-1½	"	430.313	-1-5	+4-4½		610	1883	
1	P "	a35	1-6	"	68.850 1823.661	-3-5½	+5-0		238	344	
2	Ps "	a36	3-9	"	344.250	-4-6	+5-3		1549	1807	
1	P "	a37	2-5	"	110.940	-7-2	+6-6		795	721	
1	" "	a38	4-0	"	183.600	-7-9	+6-9		1423	1239	
1	" "	a39	2-11	"	133.890	-10-3	+8-0		1372	1071	
1	fill 15×½		9-2	@ 25.5	233.751	-16-5	-10-6		3837		2454
1	Cov P 18×¾	a40	40-0	@ 45.9	1836.000	+13-0	-3-11⅜	23868			7248
1	" "	a41	3-6	"	160.650	-8-7⅜	-6-8½		1384		1078
1	" "	a42	2-3	"	103.275	-8-2	-4-3		843		439
1	" "		23-10	"	1093.935	+4-8	-4-0⅞	5105			4456
1	" "		11-10	"	543.135	+1-9½	-4-1⅝	973			2246
1	" "		14-0	"	642.600	+1-2½	-6-4½	776			4097
1	" "		41-0	"	1881.900	+13-3½	-4-0⅛	25014			7546
2	Ls 8×8×¾	a43	3-6	@ 38.9	272.300 16,877,579						
2	" "	a44	3-8	"	285.269						
2	" "	a45	3-8	"	"						
2	" "	a46	3-8	"	"						
2	" "	a47	4-0	"	311.200						
2	" "	a48	4-0	"	"						
2	" "	a49	4-0	"	"	-16-5	-2-6		53813		8195
1	P 18×¾	a50	3-6	@ 45.9	160.650						
1	" "	a51	3-8	"	168.302 3,278,063						
1	" "	a52	3-8	"	"						
1	" "	a53	3-8	"	"						
1	" "	a54	4-0	"	183.600						
1	" "	a56	4-0	"	"						
1	" "	a57	4-0	"	"						
					~~[illegible]~~ 20155.662			112,975	118,532	17,232	75,997

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 Y. Hirota DATE 15-11-13 FILE NO.

CHECKED BY DATE PAGE NO. 73

CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule

No	Material 15½	Length	Weight/ft. 19.76	Total Weight	±X From Trunnion.	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment.
2	Pl. 15½×⅜	1'-5½	@ 19.13	47.183 58.	+16'-8½	-3'-10⅝	788			181
1	Pl. 17½×⅜	5'-8½	@ 22.31	118.000	+9'-6	- "	1121			453
1	Pl. 26½×⅜	4'-9	@ 33.79	139.000	+9'-1½	- "	1268			534
1	Pl. 19×⅜	4'-7½	@ 24.23	98.000	+9'-0	-2'-8⅞	882			269
1	Pl. 17×⅜	5'-0	@ 21.68	94.000	+0'-3	-3'-10⅝	24			361
1	Pl. 21×½	11'-10½	@ 35.70	405.000	-3'-9	" "		1519		1554
1	Pl. 6×½	8'-7½	@ 10.20	87.975	-4'-8	-3'-10⅝		411		336
1	Pl. 25×⅜	4'-0	@ 31.88	85.000	-7'-6	-3'-10⅝		638		326
1	Pl. 18×⅜	4'-3	@ 22.95	70.000	+0'-4	-2'-8⅞	23			192
1	Pl. 19×⅜	3'-8	@ 24.23	53.000	-8'-3	- "		437		145
1	Fill 6½×⅛	2'-3	@ 2.76	6.217	±0	-3'-11⅝				24
1	"	2'-4	@ "	6.446						25
6400	R.H. ⅞"φ		@ 0.2125	1360.000	+36'-0	-0'-9¼	48.960			1049
3100	120" 80		2,567	658.750	-9'-0	-0'-1¾		5929		96
1500	"		"	318.750	-13'-0	-9'-2¼		4144		2929
1	Trunnion			4876.480	±0	-5'-3			34076.	25602
2	Ls. 6×4×½	6'-4½	@ 16.20	206.550	+12'-7	-0'-8	2599			138
2	Fill. 4×½	4'-2¾	@ 6.80	57.510			724			38
2	" 4×¾	5'-1½	@ 10.20	104.550			1316			70
2	Ls. 6×4×½	6'-5½	@ 16.20	233.240	+11'-4	-0'-7½	2643			146
2	Fills. 4×½	4'-2¾	@ 6.80	57.510			652			36
2	" 4×¾	4'-2¾	@ 10.20	86.270			977			54
~~3~~	~~Pls. 11×½~~	~~6'-3~~	~~@ 18.70~~	~~350.625~~	~~+3'-0~~	~~+2'-11~~	~~1053~~		~~1023~~	
~~4~~	~~Pl. 9×¾~~	~~6'-3~~	~~@ 22.95~~	~~573.750~~	~~+3'-0~~	~~+2'-3~~	~~1721~~		~~1291~~	
2	Pls. 12×¾	5'-11	@ 30.60	362.120	+5'-5	-2'-5	1963			876
2	Fill. 12×½	2'-3	@ 20.40	91.800	+7'-3	-2'-5	666			222
~~3~~	~~Pls. 11×½~~	~~9'-6~~	~~@ 18.70~~	~~532.950~~	~~-4'-6~~	~~+5'-0~~	14314	~~2397~~ 6321	~~2664~~	1580
~~4~~	~~" 9×¾~~	~~9'-6~~	~~@ 22.95~~	~~872.100~~ 3523.975	~~-4'-6~~	~~+4'-3~~		~~3924~~	~~3706~~ 5684	
				11952.776			67.380	19399	8684	35.656
	Front of Trunnion. 115.756.098			102450.206			1.506.356	346.859	70.338	185.496
	Rear " " 89.144.314									2
				204900.412			3012.712	693.718	140.676	370.992
				Floor Beams FB1						
8	Ls. 6×3½×½	20'-5½	@ 15.30	2504.059						
4	Ls. "	8'-10	@ "	540.580						
2	Web Pl. 31½×⅜	20'-5½	@ 40.16	1643.391						
1	"	8'-10	"	354.777						
4	Ls. 6×6×½	2'-6⅞	@ 19.60	201.715						
4	Fill. 6×½	2'-0⅝	@ 10.20	83.722						
36	Ls. 5×3½×⅜	2'-6⅞	@ 10.40	963.295						
36	Fill. 3½×½	2'-0⅝	@ 5.95	439.538						
8	Ls. 6×6×½	2'-6⅞	@ 19.60	403.290						
4	Fills. 12⅞×½	2'-0⅝	@ 21.04	172.705	+72'-1	-2'-3	691.709			21591
4	Pls. 13×⅜	"	@ 16.58	136.089						
8	Pls. 3½×½	2'-1	@ 5.95	99.151						
4	Pls. 12½×½	"	@ 21.25	177.055						
16	" 14×⅜	2'-3	@ 17.85	580.600						
2	" 23×⅜	3'-1	@ 29.33	180.849						
2	" 22×⅜	2'-3	@ 28.05	126.225						
2	Ls. 4×3½×⅜	0'-9	@ 9.10	13.650						
2	"	1'-6	@ "	27.300						
32	"	1'-0	@ "	291.200						
16	Pls. 16×⅜	1'-5	@ 20.40	338.071 546						
1500	R.H. ⅞"φ		@ 0.2125	318.750 51						
700	R.H. ¾"φ		@ 0.1425	99.750	+72'-0	-1'-6	7.182			150
360	2,564			9695.762 9,874.			698.891			21741

102450.206
2,303.501 (−
100,146.705
2 (×
200,293.410 say 200,293.

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 Y. Hirata DATE 15-11-30 FILE NO.

CHECKED BY DATE PAGE NO. 74

CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule

No.	Material.	Length.	Weight.	Total Weight.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
				Floor Beams FB2, FB3 & FB4						
8	Ls. 8×6×3/4	24'-9 3/4	@ 33.80	6709.435						
2	Pls. 36×1/2	〃	@ 61.20	3037.111						
4	〃 16 1/2×3/4	〃	@ 42.10	4172.910						
8	〃 3×3/4	17'-10	@ 7.65	1091.376						
8	〃 9×3/4	15'-9 1/4	@ 22.95	2895.552						
8	〃 〃	18'-1	〃	3320.032						
8	〃 3×3/4	14'-0	@ 7.65	856.800						
8	〃 8×3/4	4'-7 1/2	@ 20.40	754.800						
4	Ls. 8×6×3/4	3'-9	@ 33.80	507.000						
4	Ls. 6×6×1/2	2'-8	@ 19.60	209.093						
4	Fills. 6×3/4	1'-2 7/8	@ 15.30	75.864						
4	〃 〃	〃	〃	〃						
4	Ls. 6×6×3/8	1'-0	@ 14.90	59.600						
4	Ls. 5×3 1/2×3/8	2'-8 1/2	@ 10.40	112.653						
4	Fills. 7×3/4	0'-9	@ 17.85	53.550						
8	〃 3 1/2×3/4	1'-3 3/8	@ 8.93	91.515						
4	Ls. 5×3 1/2×3/8	2'-9	@ 10.40	114.400						
4	Fills. 7 1/2×3/4	0'-9	@ 19.13	57.390						
8	〃 3 1/2×3/4	1'-3 7/8	@ 8.93	94.515						
4	Ls. 5×3 1/2×3/8	2'-9 1/2	@ 10.40	116.147						
4	Fills. 8×3/4	0'-9	@ 20.40	61.200						
8	〃 3 1/2×3/4	1'-4 3/8	@ 8.93	97.516						
4	Ls. 5×3 1/2×3/8	2'-10	@ 10.40	117.853						
4	Fills. 8 1/2×3/4	0'-9	@ 21.68	65.040						
8	〃 3 1/2×3/4	1'-4 7/8	@ 8.93	100.445						
4	Ls. 5×3 1/2×3/8	2'-10 1/2	@ 10.40	119.600						
4	Fills. 9×3/4	0'-9	@ 22.95	68.850						
8	〃 3 1/2×3/4	1'-5 3/8	@ 8.93	103.445						
12	〃 17 3/4×3/4	1'-7 1/4	@ 45.25	893.778						
4	Ls. 4×3 1/2×3/8	2'-2	@ 9.10	78.879						
8	Ls. 5×3 1/2×3/8	2'-11	@ 10.40	242.694						
16	Fills. 3 1/2×3/4	1'-5 7/8	@ 8.93	212.834						
4	〃 17 3/4×3/4	1'-7 1/2	@ 45.25	294.125						
2	〃 3 1/2×3/4	1'-10 3/4	@ 8.93	33.863						
2	Ls. 5×3 1/2×3/8	2'-9 1/2	@ 10.40	58.074						
2	Pls. 16 1/2×3/4	4'-4	@ 42.10	364.840						
40	Ls. 3×2 1/2×3/8	0'-6	@ 6.60	132.000						
20	Pls. 9×3/8	1'-0	@ 11.48	229.600						
4300	R.H. 7/8"		@ 0.2125	913.750						
				28,593.993						
	For FB2				+56'-3	-2'-2 7/8	1,608,412			64,051
	〃 FB3				+40'-6	〃	1,160,916			〃
	〃 FB4				+24'-9	〃	707,710			〃
	For FB2 & FB3 only.									
2	Pls. 33×3/8	3'-3	@ 42.08	273.520						
4	Pls. 22×3/8	2'-2 1/2	@ 28.05	246.018						
				519.538						
	For FB2				+56'-3	-3'-3	29,224			1,688
	〃 FB3				+40'-6	-3'-3	21,041			1,688
	For FB4 only.									
2	Pls. 22×3/8	2'-2 1/2	@ 28.05	122.149						
2	〃 41×3/8	4'-0	@ 52.28	415.240						
2	〃 26×3/8	2'-5	@ 33.15	158.507						
				695.896	+24'-4	-3'-3	16,933			2,262

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY Y. Hirata DATE 15-12-1 FILE NO.

CHECKED BY DATE PAGE NO 75

CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' Single leaf trunnion bascule

2 Longitudinal Girder LG1. R L

No	Material	Length	Weight per ft.	Total weight.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
4	Ls 3½.3½.3/8	15-0	@ 8.5	510.						
1	Pl 3½.3/8	15-5	@ 40.165	619.224						
10	Ls 3.3.3/8	2-7⅛	@ 7.2	191.232						
4	Ls 4.3½.3/8	1-9	@ 9.1	63.700	+64-0	-2-6½	203749 (8)			-8093 (8093)
2	Ls 6x6x½	2-5¾	@ 19.6	97.185						
2	fills 6x3/8	2-2⅝	@ 7.65	33.951						
360 (390)	R.H ⅞φ		@ 21.25	76.500 — 79.						
				1591.792 — 1,594.292						
				2						
				3183.584 — 3,189.						

4 Longitudinal Girder LG2

No	Material	Length	Weight per ft.	Total weight.	±X	±Y	+X Moment	-X Moment	+Y Moment	-Y Moment
2	Ls 3½.3½.3/8	14-4	@ 8.5	243.661						
2	Ls "	15-4¼	"	261.018						
1	Pl 3½.3/8	"	@ 40.165	616.693						
2	Ls 6x6x½	2-5¾	@ 19.6	97.185						
2	fills 6x3/8	2-2⅝	@ 7.65	33.951						
4	Ls 4x3½x3/8	1-9	@ 9.1	63.7						
10	Ls 3.3.3/8	2-7⅛	@ 7.2	191.232						
360 (370)	R.H ⅞φ		@ 21.25	765 — 79.						
				1583.940 — 1586.440						
				2						
				3167.880 — 3,173.						
	2- For LG2a				+32-7½	-2-6½	103352 (2)			18058 (3)
	2- For LG2b				+48-4½	"	153246 (246)			"

6 Beams RCB1

No	Material	Length	Weight per ft.	Total weight.	±X	±Y	+X Moment	-X Moment	+Y Moment	-Y Moment
2	Ls 5.4.½	17-2	@ 14.50 (14.5)	497.843						
2	Ls "	18-0¼	"	522.609						
4	Ls 5.5.½	1-2	@ 16.2	75.622						
4	fills 5.½	0-10½	@ 8.5	29.75						
6	Ls 3½.3½.3/8	1-5	@ "	72.267	+40-6	-1-11	416762			19758 (19758)
6	fills 3½.½	0-9¾	@ 5.95	29.024						
1	Web Pl 18.3/8	18-0¼	@ 22.95	413.582						
350	R.H ⅞φ		@ 21.25	74.375						
				1715.072						
				6						
				10290.432						

4 Beams RS1 & RS2

No	Material	Length	Weight per ft.	Total weight.	±X	±Y	+X Moment	-X Moment	+Y Moment	-Y Moment
4	I 18"x6"	14-6¼	@ 54.7	3083.196						
8	Ls 6x6x½	1-4	@ 19.6	209.014						
4	" "	1-0	"	78.400	+64-8⅝	-1-11	219110			6489
70 (132)	R.H ⅞φ		@ 21.25	14.875 — 28						
				3385.485 — 3,399.						

4 Beams RS3.

No	Material	Length	Weight per ft.	Total weight.	±X	±Y	+X Moment	-X Moment	+Y Moment	-Y Moment
4	I 18x6	13-4	@ 54.7	2823.26						
16	Ls 6x6x½	1-4	@ 19.6	418.029	+40-6	-1-11	131874			6241
70 (288)	R H ⅞φ		@ 21.25	14.875 — 61						
				3256.164 — 3302.						

CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule

4 - Beams RS4

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
4	[s 18x6	13-4	@ 54.7	2823.26						
16	Ls 6x6x½	1-4	@ 19.6	418.029	+40-6	-1-11	131874			6241
70	R.H ⅞ φ		@ 21.25	14.875 — 61						
288				3256.164 — 3302						

16 Struts ST2.

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
2	Ls 4x4x⅜	4-9¼	@ 9.80	93.512						
2	Ps 13x⅜	1-3	@ 16.58	41.45						
2	fills 4x⅜	0-6¾	@ 5.10	5.743						
6	Lac.bar 2¼x5/16	1-3	@ 2.39	17.925	+40-6	-1-11	141429			6693
4	Ls 4x4x⅜	1-3	@ 9.80	49.000						
50	R.H ⅞ φ		@ 21.25	10.625						
				218.255						
				x 16						
				3492.08						

Floor Beam FB5.

No	Material	Length	Weight per ft.	Total weight
4	Ls 6x6x½	24-9	@ 19.60	1940.4
4	Ls 6x3½x½	24-9	@ 15.3	1514.7
4	Ls "	2-3½	"	140.27
4	Ls 6x6x½	"	@ 19.60	179.693
4	Ls 4x4x⅜	24-9	@ 9.8	970.2
2	Ps 18x⅜	24-9	@ 22.95	1136.025
1	P 18x⅜	2-3½	"	52.601
2	Ps 4x⅜	2-0½	@ 5.10	20.828
10	Ls 3½x3½x⅜	1-6	@ 8.50	127.50
2	Ps 36x⅜	4-9½	@ 45.90	423.506
4	Ls 6x6x½	2-6½	@ 19.6	199.293
4	fills 6x½	1-7¼	@ 10.2	65.443
28	Ls 5x3½x⅜	2-6½	@ 10.4	740.23
14	fills 3½x½	0-10	@ 5.95	69.389
14	Ls 5x3½x⅜	0-11¾	@ 10.4	142.542
14	fills 6x½	0-7½	@ 10.2	89.25
14	fills 3½x½	1-1	@ 5.95	90.214
8	Ls 5x5x½	2-6½	@ 16.2	329.443
4	fills 10⅜x½	1-7¼	@ 17.64	113.178
2	Ps 31x⅜	24-9	@ 39.53	1956.735
2	Ps 12½x⅜	1-7¼	@ 15.94	50.817
14	" 9x½	0-10	@ 15.3	178.493
2	Ps 60x⅜	24-11	@ 76.5	3812.301
4	Ps 12½x½	24-11	@ 15.94	1588.708
4	Ps 6¼x¾	"	"	1588.708
2	Ps 6x½	"	@ 10.2	508.307
2	" "	23-10	"	486.193
1	P "	2-2½	"	22.522
2	Ls 6x6x¾	24-11	@ 28.7	1430.236
1	L "	4-4½	@ 28.7	125.563
1	P 6x½	4-4½	@ 10.2	44.625
1	P 12x¾	4-4½	@ 31.9	139.563
1	P 8½x⅜	1-0½	@ 10.84	11.295
1	P 12½x⅜	1-1½	@ 15.94	17.933
2	Ps 6¼x¾	2-6½	@ "	81.039
1	P 12½x⅜	2-10¾	@ "	46.162

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY Y. Hirata DATE 15-12-1 FILE NO

CHECKED BY DATE PAGE NO 77

CALCULATIONS FOR

2'-6"
0'-9"

First Canal Bridge for City of Kobe: 60' Single leaf trunnion bascule.

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
2	Ls 4×3½×3/8	3-3	@ 9.1	59.15	+					
2	Ps 27×3/8	3-0	@ 34.43	149.58						
2	Ls 6×6×½	4-10½	@ 19.6	191.10						
2	fills 6×¾	2-10¾	@ 15.3	88.611						
2	" 6×½	2-10¾	@ 10.3	59.074						
2	Ls 6×6×½	1-8	@ 19.6	65.335						
2	Ls "	2-1	"	81.665						
10	Ls 3½×3½×3/8	4-10½	@ 8.5	414.375						
20	fills 3½×5/8	2-10¾	@ 7.44	430.895						
2	Ls 6×6×¾	24-11	@ 28.7	1430.219						
1	L "	3-4½	"	96.863						
2	Ps 12×½	24-4¾	@ 20.4	995.349						
2	" 6×½	23-10	@ 10.2	486.199						
1	P 12½×¾	3-4½	@ 31.9	107.663						
2	Ls 3½×3½×3/8	0-10	@ 8.5	14.166						
2	Ls "	1-11¾	"	33.646						
2	Ps 10½×½	17-3	@ 17.85	615.825						
2	" "	4-2	"	148.751						
1	P "	4-9	@ "	84.788						
2	Ps 19½×½	17-3	@ 33.15	1143.675						
2	" "	4-2	"	276.252						
1	P "	4-9	"	157.463						
2	Ls 6×3½×½	16-6½	@ 15.3	506.176						
2	Ls 6×6×½	4-2	@ 19.6	163.335						
1	L "	4-7	@ "	89.833						
2	Ls 4×4×3/8	16-6½	@ 9.8	324.217						
2	Ls "	4-2	"	81.667						
1	Ls "	4-7	"	44.916						
1	P 11½×½	3-4½	@ 19.55	65.981						
1	P 12×½	1-2½	@ 20.4	24.649						
4	Ls 5×3½×3/8	0-8½	@ 10.4	29.465						
4	Ls "	0-9	"	31.20						
4	Ls "	0-9½	"	32.935						
4	" "	0-10	"	34.665						
4	" "	0-10½	"	36.400						
12	" "	0-11	"	114.4						
36	Ls 6×3½×3/8	0-6	@ 11.7	210.6						
36	Ls 3½×3½×3/8	0-3½	@ 8.5	89.26						
18	Ps 7×3/8	1-4	@ 8.93	214.266						
8	Ls 6×6×½	1-0	@ 19.6	156.8						
16	Ls 6×4×½	0-4 7/8	@ 16.2	105.312						
8	Ls 3×3×3/8	0-7½	@ 7.2	36.						
4	Ps 12½×3/8	1-1	@ 15.94	69.072						
32	Ls 3½×3½×3/8	2-11½	@ 8.5	804.658						
32	Ls "	2-2	"	589.342						
16	P 31×3/8	1-4	@ 39.53	843.286						
20	Ls 3×3×3/8	0-7½	@ 7.2	90.						
10	Ps 13½×3/8	1-3½	@ 17.21	222.302						
3200	R.H 7/8φ		@ 21.25	680. — 2052						
5000	R.H 7/8φ		@ "	1062.50						
9,658.				34317.786 — 34,627.	+8-5½	-1-6	290260			51477

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY Y. Hirata DATE 15-12-2 FILE NO.

CHECKED BY DATE PAGE NO. 78

CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' Single leaf trunnion bascule

16-Stringer SH11E-SH15E

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
10	I 15x5½	15-6½	@ 42.9	6560.389						
10	L 6x6x3/8	1-0½	@ 14.9	155.213						
2	L 6x6x3/8	0-10	@ 14.9	24.832						
2	" "	0-10½	"	26.075	+16-10½	-1-9½	116524		✓	12371
2	" "	0-11	"	27.318						
2	" "	0-11¾	"	29.18						
2	" "	0-9	"	22.35						
280	R.H 7/8 ϕ		@ 21.25	59.5						
				6904.857						

20- SH6E-SH10E

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
16	I 15x5½	15-6	@ 42.9	10468.20						
4	"	15-7⅜	"	2693.777						
8	L 6x6x3/8	0-10	@ 14.9	99.329						
8	"	0-10½	"	104.300	+40-6	-1-9½	556490			24621
8	"	0-11	"	109.271						
8	"	0-11¾	"	116.721						
8	"	0-9	"	89.400						
280	R.H 7/8 ϕ		@ 21.25	59.50						
				13740.498						

10- SH1E- SH5E

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
8	I 15x5½	15-6½	@ 42.9	5333.911						
2	I "	15-7¾	"	1342.410						
10	L 5x5x3/8	0-9	@ 12.3	92.25						
2	L 6x6x3/8	0-10	@ 14.9	24.832						
2	" "	0-10½	"	26.075	+64-1½	-1-9½	446171		✓	12466
2	" "	0-11	"	27.318						
2	" "	0-11¾	"	29.18						
2	" "	0-9	"	22.35						
280	R.H 7/8 ϕ		@ 21.25	59.5						
				6957.826						

32
16-Struts ST1.

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
32	L 4x4x3/8	2-7	@ 9.8	810.123						
64	L 6x4x3/8	0-6	@ 12.3	393.600	+40-6	-1-4¾	50954		✓	1756
256	R.H 7/8 ϕ		@ 21.25	54.40						
				1258.123						
				16.C 785						

4-Stringer RS5E & RS6E

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
4	I 18x6	14-6	@ 54.7	3172.600						
8	L 6x6x½	1-4	@ 19.6	209.061	+16-3¾	-1-11	56656		✓	6657
4	L 6x6x3/8	1-3	@ 14.9	74.50						
80 (248)	R.H 7/8 ϕ		@ 21.25	17.00 (53.)						
				3473.161						
				3,509.						

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY Y. Hirata DATE 15-12-2 FILE NO.

CHECKED BY DATE PAGE NO. 79

CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule

2 - Longitudinal Girders LG3

No.	Material	Length	Weight per ft	Total weight	±X from Trunnion	±Y from Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
2	Ls 3½×3½×3/8	14-4½	@ 8.5	244.375						
1	Pls 31½×3/8	15-5	@ 40.165	619.212						
10	Ls 3×3×3/8	2-7⅞	@ 7.2	191.254						
4	Ls 4×3½ 3/8	1-9	@ 9.1	63.7	+16-10½	-2-0	53365			7906
2	Ls 6×6×½	2-5¾	@ 19.6	97.185						
2	fills 6×3/8	2-2⅞	@ 7.65	33.948						
360	R.H. 7/8φ		@ 21.25	76.500						
2	Ls 3½×3½×3/8	15-5 (0")	@ 8.50	255.000 ~~373.300~~						
				1581.174×2 = 3162.348						

Stringer & Bracing.

No.	Material	Length	Weight per ft	Total weight	±X from Trunnion	±Y from Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
~~16~~	~~R.H. ¾"φ~~		~~@ 0.1425~~	~~2.285~~	~~+4-6~~	~~1-0 15/16~~	~~10~~			~~2~~
~~28~~				~~3.990~~	~~+10-4~~		~~1~~			~~4~~
2	Ls 12×3½	13-11	@ 26.1	726.467	+2-0½	-0-6¾	1483		SSA5	409
6	" "	15-9	"	2466.450	+32-7½	"	80468		SSA2~SSA4	1389
2	" "	17-3	"	900.450	+64-10½	"	58417		SSA1	507
2	Pls 11×3/8	1-8½	@ 14.03	47.926	+0-3	-1-0 15/16	12			52
2	" "	2-6	"	70.150	+9-4½	- "	658			76
6	Pls "	2-2	"	182.418	+40-9	"	7434			197
2	Pls "	1-2½	"	33.896	+72-0	"	2441			37
10	Pls 11×3/8	1-2½	"	169.482	+40-6	"	6864			183
2	" "	"	"	33.896	± 0	- "	0			37
16	Pls 6×3/8	0-8½	@ 7.65	86.659	+32-7½	-0-6¾	2827			49
2	Ls (Is) 12×5	13-11	@ 31.99	890.410	+2-0½	-0-6¾	1818		SSB5	501
6	Ls	15-9	"	3023.055	+32-7½	-0-6¾	98627		SSB2~SSB4	1702
2	"	17-3	"	1103.655	+64-10½	"	71600		SSB1	621
4	Pls 9×3/8	1-3½	@ 11.48	59.329	+4-6	-1-0 15/16	267			64
6	" 7×3/8	1-4	@ 8.93	71.422	+56-1	"	4006			77
2	Pls 9×3/8	1-9	@ 11.48	40.180	+24-5	- "	981			43
2	Pls 6×3/8	1-9	@ 7.65	26.775	+4-6	- "	120			29
2	Ls 3×3×3/8	9-0	@ 7.2	129.600	+4-6	-1-1 1/16	583		SB5	149
4	Ls "	4-3½	"	123.601	+4-6	- "	556		SB55	142
8	Ls "	15-5	"	888.019	+40-6	- "	35965		SB1~SB4	1022
~~44~~	~~R.H. ¾φ~~		~~@ 0.1425~~	~~6.270~~	~~+9-3~~	~~-1-0 15/16~~	~~58~~			~~8~~
~~34~~				~~4.845~~	~~+24-9~~		~~120~~			~~5~~
~~60~~				~~8.000~~	~~+48-3~~		~~386~~			~~8~~
~~18~~				~~3.000~~	~~+72-0~~		~~216~~			~~3~~
				11102.230 11,221			375918			7316

1032 R.H. ¾φ @ 0.1425# = 147#

2 - Canti Lever - Brackets. (A) Under side walk CB41

No.	Material	Length	Weight per ft	Total weight	±X from Trunnion	±Y from Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
2	Ls 3½×3½×3/8	6-1	@ 8.5	103.411	+72-0	-1-2⅞	7446			122
2	Ls "	6-7	"	111.911	+ "	- "	8058			132
2	Ls "	6-5	"	109.089	+ "	-2-10	7854			309
2	Ls "	6-11		117.589	+ "	- "	8466			333
4	Ls "	1-11½	"	66.572	+ "	-2-0⅛	4793			134
4	Ls "	0-11½	"	32.572	+ "	-1-6⅛	2345			48
4	Ls "	0-7½	"	21.25	+ "	-0-6¾	1530			12
4	Ls 4×3½×3/8	0-9	9.1	25.5 27	~~+ "~~	~~-0-11¾~~	~~1836~~			~~25~~
2	Pls 10×3/8	0-11	@ 12.75	23.384	+ "	-0-7½	1684			15
4	fills 3½×3/8	1-5	@ 4.46	25.279	+ "	-2-0⅛	1820			51
4	wash 3×3/8		@ 3.83	3.83	+ "	-1-7½	276			6
2	Pls 33×3/8 (-10")	6-7	@ 42.08	393.051	+ "	-2-0⅛	2830			806
380 264	Rivets head ¾φ 7/8φ		@ 14.25 0.2125	54.2 56	~~+72-0~~	~~2-0~~	~~3902~~			~~108~~
2	L 6×3½×3/8	1-1½	@ 11.7	26.325	+72-1½	-0-10¾	1899			24
2	fills 5¾×3/8	0-6	@ 7.33	7.33	+71-11½	-2-5	527			18
2	" "	2-1¾	"	31.457	"	"	2264			76
2	fills 5¾×⅝	3-2	@ 24.44	15.479		"	1114			37
				1168.229 1172			58644			2256

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY Y. Hirata DATE 15-12-2 FILE NO

CHECKED BY DATE PAGE NO 80

CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule.

2-Cantilever Brackets © Under side walk. CB4

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
2	Ls 3½×3½×3/8	6-1	@ 8.5	103.411	+24-9	-1-2⅜	2559			122
2	Ls "	6-7	"	111.916	"	"	2770			244
2	" "	6-5½	"	109.786	"	-2-10	2717			311
2	" "	6-11½	"	118.286	"	"	2928			335
4	" "	2-0	"	68	"	-2-0⅛	1683			137
4	" "	0-11½	"	32.582	"	-1-6⅛	806			49
4	" "	0-7½	"	21.25	"	-0-6¾	526			12
4	" 4×3½×3/8	0-11½ 0-9	9.1	32.582 27	~~"~~	~~-0-11¾~~	~~806~~			~~32~~
2	Pls 10×3/8	0-11	@ 12.75	23.384	"	-0-7½	579			15
4	fills 3½×3/8	1-5½	@ 4.46	26.011	"	-2-0⅛	644			52
4	wash 3×3/8		@ 3.83	3.83	"	-1-7½	95			6
2	Pls 32⅝×3/8 (-141)	6-7	@ 42.05	412.63	"	-2-0⅝	10213			846
430 256	R.H 3/4φ 7/8φ		@ 14.25 0.2125	61.275 54	~~+24-9~~	~~-2-0~~	~~1517~~			~~123~~
2	Ls 5×3½×3/8	1-0½	@ 9.8	20.423	+24-9	-0-11⅛	505			19
2	fills 5¾×9/16	2-9	@ 11.00	60.500	+24-9	-2-6	1497			151
2	fills 5¾×5/8	"	@ 12.22	67.210	"	"	1663			168
2	fills 5¾×3/8	2-1¾	@ 7.33	31.460	"	"	779			79
				1304.536 1,292			32,287			2701

4-Cantilever Brackets Ⓑ CB2 & CB3

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
4	Ls 3½×3½×3/8	6-1	@ 8.5	206.822	+48-4½	-1-2⅜	10005			243
4	"	6-7	"	223.822	"	"	10827			263
4	"	6-5	"	218.178	"	-2-10	10554			618
4	"	6-11	"	235.178	"	"	11377			666
8	"	1-11½	"	133.144	"	-2-0⅛	6441			268
8	"	0-11½	"	65.144	"	-1-6⅛	3151			98
8	"	0-7½	"	42.5	"	-0-6¾	2056			24
8	4×3½×3/8	0-9	9.1	51 55	~~"~~	~~-0-11¾~~	~~2467~~			~~50~~
4	Pls 10×3/8	0-11	@ 12.75	46.767	"	-0-7½	2262			29
8	fills 3½×3/8	1-5	@ 4.46	50.559	"	-2-0⅛	2446			102
8	wash 3×3/8		@ 3.83	7.66	"	-1-7½	371			12
4	Pls 33×3/8 7/8φ	6-7	@ 42.08	1108.051 114	"	-2-0⅝	53602			2274
860	R.H 3/4φ		@ 14.25 0.2125	122.550	~~+48-4½~~	~~-2-0~~	~~5928~~			~~245~~
4	fills 5¾×9/16	2-9	@ 11.00	121.000	+48-4½	-2-6	5853			303
4	" 5¾×5/8	"	@ 12.22	134.420	"	"	6503			336
4	" 5¾×3/8	2-1¾	@ 7.33	62.900	"	"	3043			157
536				2829.695 2,825			136,886			5,688

4-Cantilever-Brackets Ⓓ CB5 & CB6

No	Material	Length	Weight per ft.	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
8	Ls 3½×3½×3/8	6-7	@ 8.5	447.644	+4-6	-1-2⅜	2014			527
16	Ls "	6-7	"	895.288	"	-2-9 3/16	4029			2476
8	Ls "	6-7	"	596.858	"	-3-8 7/16	2685			2232 2232
16	Ls "	0-11¾	"	133.144	"	-3-2¾	599			430
16	Ls "	1-7	"	215.288	"	-1-11	969			413
16	fills 3½×3/8	1-0	@ 4.46	71.36	"	-1-11	321			137
16	" "	0-5	"	29.736	"	-3-2¾	134			96
4	" 7×3/8	3-6	@ 8.93	125.02	"	-2-9 3/16	563			346
4	Pls 19⅞×3/8	6-7	@ 25.42	669.36	"	-1-11	3012			1283

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 Y. Hirata DATE 15-12-3 FILE NO

CHECKED BY DATE PAGE NO 81

CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule

No	Material	Length	Weight per ft	Total weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
4	Pls 12½×3/8	6-7	@ 15.94	419.732	+4-6	-3-2¾	1889			1355
8	Ls 3½×3½×3/8	0-7½	@ 8.5	42.500	"	-0-6¾	191			24
8	Ls 4×3½×3/8	0-9	9.1	51.000 — 55	"	-0-11¾	230			50
4	Pls 10×3/8	0-11	@ 12.75	46.767	"	-0-7½	210			29
8	fills 5¾×3/8	1-0½	@ 7.33	61.085	+4-6	-2-4	275			143
8	fills 5¾×3/8	0-5¼	"	25.655	"	"	115			60
8	fills 5¾×1/8	2-8½	@ 2.444	52.947 164	"	"	238			124
1250 864	R.H ¾φ 7/8φ		@ 14.25 0.2125	178.125	~~+4-6~~	~~-3-2½~~	~~7927~~			~~571~~
				4061.509 4,051			25,401			10296
	Bracing at Bottom Plane of Main girder Front of Trunnion.									
4	Ls 3½×3½×3/8	9-1	@ 8.5	308.822						
4	" "	8-7½	"	293.25						
24	Bars 2¼×3/8	1-0	@ 2.87	68.88						
12	Pls 12¼×3/8	0-11¼	@ 15.62	175.819	SBB7 & SBB8					
2	Pls "	1-3	"	39.05					SBB7 & SBB8	
4	Pls 14×3/8	2-9	@ 17.85	196.35						
2	Ls 3½×3½×3/8	4-1	@ 8.5	69.411	+4-6	-3-3⅝	7318			5370
2	Ls "	3-10	"	65.161						
2	Ls "	3-7	"	60.911						
2	Ls "	3-4	"	56.661						
4	Ls "	4-2	"	141.678						
4	Ls "	4-5	0.2125	150.178 161						
650 756	R.H ¾φ 7/8φ		@ 14.25	92.625 1718.796	~~+4-6~~	~~-3-3⅝~~	~~417~~			~~306~~
2	Ls 3½×3½×3/8	10-0	@ 8.5	170.						
2	Ls "	9-8	"	164.339	SBB9				SBB9	
2	Ls "	9-1	"	154.411						
2	Ls "	8-9	"	138.975	-4-2½	-3-3⅝		3199		2510
2	Pls 12¼×3/8	1-2	@ 15.62	36.457						
2	Pls "	1-5	"	44.267						
18	Bars 2¼×3/8	1-0	@ 2.87	51.660 80						
390 376	R.H ¾φ 7/8φ		@ 14.25 0.2125	55.575 815.684	~~-4-2½~~	~~-3-3⅝~~		~~234~~		~~184~~
4	Ls 3½×3½×3/8	10-6⅜	@ 8.5	358.02						
4	Ls "	8-3	"	280.5	SBB5				SBB5	
16	Bars 2¼×3/8	1-0	@ 2.87	45.92						
2	Pls 12¼×3/8	2-4	@ 15.62	72.883	+4-6	-3-3⅝	3874			2843
2	Pls "	2-8	"	83.317						
4	fills 5¼×3/8	0-9⅛	6.69	20.338 860.978						
390 584	R.H ¾φ 7/8φ		0.2125 @ 14.25	124 55.575	~~+4-5~~	~~-3-3⅝~~	~~250~~			~~184~~
4	Ls 3½×3½×3/8	6-2½	@ 8.5	211.072						
2	Ls "	5-9	"	97.75	SBB2					
2	Ls "	5-3½	"	89.93	+13-5	-3-3⅝	6731		SBB2	1656
2	Pls 12¼×3/8	0-11½	@ 15.62	29.928						
2	Pls "	1-5	"	44.267						
10	Bars 2¼×3/8	1-0	@ 2.87	28.70						
220	R.H ¾φ 7/8φ		@ 14.25 0.2125	31.35 47.147 395.630	~~+13-5~~	~~-3-3⅝~~	~~421~~			~~104~~

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JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY Shirata DATE FILE NO.

CHECKED BY DATE PAGE NO. 82

CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule.

No.	Material	Length	Weight/ft.	Total Weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
2	Ls. 3½×3½×⅜	14'-7	@ 8.50	247.911						
2	〃 〃	14'-4	〃	243.661						
2	〃 〃	14'-1	〃	239.411					SBB1	
2	〃 〃	13'-7	〃	230.911	+16'-0½	-3'-3⅝	18,661		SBB1	3841.
4	Pls. 12×⅜	1'-3	@ 15.62	78.100						
2	〃 〃	1'-4½	〃	42.955						
28	Bars 2¼×⅜	1'-0	@ 2.87	80.360 82						
410 388	R. H. ¾"φ ⅞"φ		@ 0.1425 0.2125	58.425	~~+16'-0½~~	~~-3'-3⅝~~	~~937~~			~~193~~
4	Ls. 3½×3½×⅜	2'-0	@ 8.50	68.000	+16'-10½	-3'-8⅞	1148		SBB3	254
2	Pls. 18×⅜	1'-8½	@ 22.95	78.397	+16'-5	-3'-3⅝	1287		SBB3	259
2	〃	2'-0	〃	91.800			1507			303
4	Pls. 19½×⅜	3'-3	@ 24.86	323.180	+8'-6	-3'-3⅝	2747			1067
4	Pls. 21½×⅜	3'-7½	@ 27.41	397.445	-0'-1½	〃		50 3		1312
15	R. H. ¾"φ ⅞"φ		@ .1425 0.2125	2.138 16	~~+16'-10½~~	~~-3'-8⅞~~	~~36~~			~~8~~
76				6166.724 6381			45,334	3483		20,394

~~Front of Trunnion. 4953.595~~
~~Rear 〃 〃 1213.129~~

Lateral Bracing at rear of Trunnion on Framing on C.W.G.

No.	Material	Length	Weight/ft.	Total Weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
	STRUTS TRS									
8	Ls. 3½×3½×⅜	20'-0	@ 8.50	1360.000						
2	Web Pls. 12×⅜	20'-0	@ 15.30	612.000						
4	Fills. 5¼×⅜	0'-7⅞	@ 6.69	16.457						
2	Pls. 11½×½	2'-4	@ 19.55	91.220						
2	〃 5¼×⅜	2'-4	@ 6.69	31.216						
4	〃 11½×½	2'-4	@ 19.55	182.441						
4	Fills. 5¼×⅜	2'-4	@ 6.69	62.431	±0	-3'-3½		0		11,065.
4	Ls. 3½×3½×⅜	5'-7	@ 8.50	189.822						
4	Ls. 〃	4'-8½	〃	160.072						
2	Pls. 32×⅜ (-17")	〃	@ 40.80	214.336						
4	Pls. 8½×⅜	2'-1⅜	@ 10.84	91.706						
2	Pls. 7⅜×⅜	1'-7¾	@ 9.40	30.945						
1500	R. H. ⅞"φ		@ 21.25	318.750 3361.396						
4	Pls. 13½×⅜	1'-4⅜	@ 17.21	92.521	-0'-4	-2'-9⁹⁄₁₆		31.		255
1	〃 16⅜×⅜	1'-7⅜	@ 20.56	33.204				11.		91
3	〃 20×½	2'-5½	@ 30.60	225.644 3712.765	-0'-6	-3'-10		113.		865
	DIAGONAL CD1 ~ CD6									
~~2~~	~~Pls. 9⅜×½~~	~~9'-8½~~	~~@ 15.810~~	~~306.967~~	~~-4'-9~~	~~-3'-10~~		~~1458~~		~~1177~~
2	〃 6×½	5 6'-6	@ 10.20	132.600 111.	-4'-9	-3'-10½		630		514
2	Ls. 5×3½×⅜	10'-1⅜	@ 10.40	210.392						
2	Ls. 〃	10'-4⅜	@ 〃	215.592						
2	Ls. 〃	4'-3	@	88.400	-4'-9	-3'-8⅛		5780		4474
2	Ls. 〃	4'-0	@	83.200						
4	Ls. 〃	4'-8	@	194.147						
2000	R. H. ⅞"φ		@ 0.2125	425.000						
8	Ls. 5×3½×⅜	10'-7½	@ 10.40	884.000				4199		3250
8	〃	5'-11¾	〃	497.453	-4'-9	-3'-8⅛		2363		1829
8	〃	4'-10¾	〃	407.347				1935		1498
4	Pls. 17×½	2'-2½	〃 28.90	255.245	-4'-9	-3'-10		1212		978
4	〃 10½×⅜	1'-1	13.39	58.005				276		160
20	〃 〃	0'-10½	〃	234.325	-4'-9	-2'-9⁹⁄₁₆		1113		646
4	〃 〃	1'-2	〃	62.505				297		172

2 Pls 61×½×7'-8" @ 103.7# = 1,591# CDP1
2 Pls 56×½×7'-8" @ 95.2 = 1,460 CDP2

7767.953

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY Hirata DATE ______ FILE NO. ______

CHECKED BY ______ DATE ______ PAGE NO. 83

CALCULATIONS FOR

First Canal Bridge for City of Kobe ; 60' Single leaf trunnion bascule.

NO.	Material	Length	Weight/ft.	Total Weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
	CT52 & CT53.									
4	Ls. 10×3 1/2	8'-2 3/8	@ 23.55	772.252	118	-3'-2 1/4		7276		2462
8 10	Ls. 6×4×3/8	0'-4 1/2	@ 12.30	94.267	~~-9'-5 5/16~~	~~〃~~		~~888~~		~~301~~
8 10	〃	0'-7 1/4	@ 〃	59.434	74	~~〃~~		~~560~~		189
500	R. H.		@ 21.25	106.250		-2'-9 1/4		1001		294
				1032.203				9725		3246
	CL51 ~ CL53.									
16	Ls. 3 1/2×3 1/2×3/8	18'-5	@ 8.50	2504.712						
4	Ls. 〃	18'-4 1/2	〃	624.750						
4	Pls. 12 1/4×3/8	18'-5	@ 15.62	1150.694						
1	Pl. 12 1/4×3/8	18'-4 1/2	〃	287.018	40					
8 10	Fills. 5 1/4×3/8	0'-7 1/4	@ 6.69	323.261	-9'-3	-3'-3 1/2		48,732		17,3~~44~~
10	〃 4×3/8	0'-5 1/4	@ 5.10	22.313						
10	Ls. 4×3 1/2×3/8	0'-11 1/2	@ 9.10	87.178						
10 8	〃 6×3 1/2×3/8	0'-11 3/4	@ 11.70	114.543	92					
8	Fills. 5 1/4×3/8	0'-6	@ 6.69	26.760						
570	R.H. 7/8"φ		@ 0.2125	121.125						
2	Fills. 4 3/4×3/8	0'-6	@ 6.06	6.060						
2	Ls. 3 1/2×3 1/2×3/8	20'-10 1/2	@ 8.50	354.875	-18'-7 1/4	-2'-10 1/4	CT51	6602		1013
2	Web Pl. 17 1/2×3/8	〃	@ 15.94	665.495	-18'-6 7/16	-3'-5 1/2		12322		2191
250	R. H. 7/8		@ 0.2125	53.125	- 〃	-2'-4 1/4		984		156
1	Pl. 10×1/2	1'-9	@ 17.00	29.750	- 〃	-3'-3 1/2		552		98
1	Fill. 4 1/2×3/8	1'-9	@ 5.74	10.045	-18'-6 3/8	- 〃		186		33
4	Ls. 3 1/2×3 1/2×3/8	1'-4 1/2	@ 8.50	46.750	89.					
2	Pl. 29 3/8	2'-10	@ 36.98 357	209.529	-18'-6	-2'-7 1/2		4,977		706
60	R. H. 28"	2'-4"	@ 0.2125	12.750	202.					
	CL54 & CL55									
4	Ls. 5×3 1/2×3/8	4'-9 7/8	@ 10.40	200.637	-16'-0 3/4	-3'-8 3/4		3223		748
4	〃	5'-0 5/8	@ 〃	210.163	-15'-11 3/8	- 〃		3352		784
4	Pl. 11 1/2×1/2	1'-1	@ 19.55	84.691	-18'-1	-3'-10		1531		325
2	Pls. 18×1/2	2'-4	@ 30.60	142.780	-13'-2	-3'-10		1880		547
2	Pl. 12×1/2	1'-9	@ 20.40	71.400	-13'-3	-3'-10		946		274
5	Pl. 11 1/2×1/2	1'-1 3/8	@ 19.55	108.991	-18'-1	-3'-10 5/8		1971		419
1	Pl. 3 1/2×1/2	1'-6	@ 5.95	8.925	-18'-8	-2'-9 5/8		167		25
								13979		
	~~Belong to Maingirder~~			~~7767.943~~				119,418		26,974
	~~〃 〃 C.W.G.~~			~~8510.523~~				97,150		27,909
	Total			16278.466				116,568		54,883
				19,036.						
				18,882						

2Ls 6×3 1/2×3/8×0'-11 1/4" @ 11.7# = 22#

8Ls 6×3 1/2×3/8×0'-11 3/4" @ 11.7# = 92#

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JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY Y. Hirata DATE 15-12-4 FILE NO

CHECKED BY DATE PAGE NO 84

CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule.

Bottom Bracings.

No	Material	Length	Weight per ft.	Total Weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
2	∟s 5×3½×3/8	20-2	@ 10.40	419.467						
2	∟s "	19-11	"	413.867					LB1ᴱ	
2	∟s "	10-3¾	"	214.572					LB2ᴱ	
2	∟s "	10-0¾	"	209.300	LB1 +64-1½	-3-8¼	116,437		LB3ᴱ	6,695
4	∟s "	9-6¾	"	397.800						
2	Pls 17×3/8	2-0½	@ 21.68	88.528						
340	R.H. 7/8φ		@ 21.25	72.250 — 61.						
				1815.784 — 1,805						
288										
4	∟s 5×3½×3/8	20-2	@ 10.40	838.934						
4	" "	19-11	"	827.734					LB1ᴱ	
4	" "	10-4¾	"	432.465					LB3ᴱ	
4	" "	10-1¾	"	422.065	+40-6	-3-8¼	147,009		LB4ᴱ	13,383
8	" "	9-6¾	"	795.600						
4	Pls 17×3/8	2-0½	@ 21.68	177.056						
640	R.H. 7/8φ		@ 21.25	136.000 — 122						
				3629.854 — 3,616						
576										
2	∟s 5×3½×3/8	19-10⅝	@ 10.4	413.616						
2	" "	19-4⅝	"	403.216					LB5ᴱ	
2	" "	10-4¾	"	216.233					LB6ᴱ	
2	" "	10-1¾	"	211.033					LB7ᴱ	
4	" "	9-5⅜	"	393.033	+16-10½	-3-8¼	38,903		5884	8,500
4	" "	6-6¾	"	273.000						
2	Pls 22×3/8	4-7	@ 28.05	257.123						
650	R.H 7/8φ		@ 21.25	138.125 — 86						
				2305.379 — 2,253						
404										
128	∟s 6×3½×3/8	0-8½	@ 11.70	1060.750	+40-6	-3-5⅞	42,960			3,637
256	∟s 3×3×3/8	0-9⅝	@ 7.20	1478.431	+40-6	-2-10⅞	45,677			6,768
64	Pls 10×3/8	1-1	@ 12.75	883.973						
				3423.154						
1	∟ 3½×3½×3/8	21-8	@ 8.5	184.167						
1	∟ "	21-6	"	182.750						
2	∟s "	21-7¾	"	367.979						
2	Pls 12½×3/8	1-3	@ 15.94	39.850						
3	" 11¼×3/8	1-0½	@ 14.34	44.814					LB8	
28	bars 2½×3/8	1-1½	@ 3.19	100.485					LB9	
1	∟ 3½×3½×3/8	10-8½	@ 8.50	91.021					LB10	
1	∟ "	10-5½	@ "	88.896						
1	∟s "	10-7½	@ "	90.313						
1	∟ "	10-4½	"	88.188	+64-1½	-3-2¾	129,930			6,543
2	Pls 12½×3/8	1-3	@ 15.94	39.850						
2	" 11¼×3/8	1-0½	@ 14.34	29.876						
2	" 8½×3/8	1-0½	@ 10.84	22.584						
1	∟ 3½×3½×3/8	10-6¾	@ 8.5	89.781						
1	" "	10-2	"	86.417						
1	" "	10-7¼	"	90.136						
1	" "	10-4¼	"	88.011						
28	bars 2½×3/8	1-1½	@ 3.19	100.485						
2	Pls 14×3/8	2-2	@ 17.85	77.351						
580	R.H 7/8φ		@ 21.25	123.250 — 104						
				2026.204 — 2007						
488										

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY Y. Hirata DATE 15-12-11 FILE NO. ______
CHECKED BY ______ DATE ______ PAGE NO. 85

CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule.

No.	Material	Length	Weight/ft.	Total Weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
4	Ls. 3½×3½×⅜	21'-5½	@ 8.50	729.582						
4	"	21'-8½	"	738.082						
4	"	10'-6¾	"	359.125					LB10	
4	"	10'-2	"	345.668					LB11	
4	"	10'-7¼	"	360.543					LB12	
4	"	10'-4¼	"	352.043	+40'-6	-3'-2¾	164.051			13.079
8	Pls. 12½×⅜	1'-3	@ 15.94	159.400						
10	" 11¼×⅜	1'-0½	" 14.34	149.380						
4	" 8½×⅜	1'-0½	" 10.84	45.168						
112	bars 2½×⅜	1'-1½	" 3.19	401.940						
4	Pls. 14×⅜	2'-2	" 17.85	154.702						
1200	R. H. ⅞"φ		" 0.2125	255.000 — 206						
968				4050.633 — 4,001						

LB13, LB14 & LB15

No.	Material	Length	Weight/ft.	Total Weight	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Moment
2	Ls. 3½×3½×⅜	21'-8½	@ 8.50	369.041						
1	"	21'-7¼	@ "	183.989						
1	"	21'-4¾	" "	181.864						
2	"	10'-6¾	" "	179.563						
1	"	10'-7¼	" "	90.136						
1	"	10'-4¼	" "	88.011						
2	"	10'-4¾	" "	176.729	+16'-10½	-3'-2¾	35.332			6.761
2	"	10'-3½	" "	174.959						
4	Pls. 12½×⅜	1'-3	@ 15.94	79.700						
5	Pls. 11¼×⅜	1'-0½	@ 14.34	74.690						
2	Pls. 8½×⅜	1'-0½	@ 10.84	22.584						
56	bars 2½×⅜	1'-1½	@ 3.19	200.970						
2	Pls. 15×⅜	3'-4½	@ 19.13	129.128						
670	R. H. ⅞"φ		@ 0.2125	142.375 — 109						
512				2093.739 — 2,060						

Bottom Bracing sum. 19344.747 — 19,165 | 770.299 | 65.386

2-End Locks

No.	Material	Weight/ft.	Total Weight	±X	±Y	+X Moment	-X Moment	-Y Moment
2	@ 1.955 = 3.91 ft³	@ 490	1920.	+72'-2½	-2'-9¾	138.643		5.401
64	Bolts.	@ 0.77	49.28	"	"	3.558		139
			1969.28			142.201		5.540

2-Tail Locks

No.	Material	Weight/ft.	Total Weight	±X	±Y	+X Moment	-X Moment	-Y Moment
2	@ 1.88 = 3.76 ft³	@ 490	1842.	-16'-0	-1'-11		29.472	3.537
102	Bolts.	@ 0.77	78.54	"	"		1.257	151
			1920.54				30.729	3.688

8-Live Load Shoe

No.	Material	Weight/ft.	Total Weight	±X	±Y	+X Moment	-X Moment	-Y Moment
8	@ 0.442 = 3.540 ft³	@ 490	1735	+40'-6	-4'-4	70.268		7.518
48	Bolts.	@ 0.77	36.96	"	-4'-0	1.497		148
			1771.96			71.765		7.666

1-Center Lock.

No.	Material	Weight/ft.	Total Weight	±X	±Y	+X Moment	-X Moment	-Y Moment
1		@ 490	490	+72'-0	-4'-2	35.280		2.042
20	Bolts.	@ 0.77	15.40	"	-3'-10	1.109		59
			505.40			36.389		2.101

2-Air Buffers at rear

No.	Material	Weight/ft.	Total Weight	±X	±Y	+X Moment	-X Moment	-Y Moment
2	@ 1.5 = 3.00 ft³	@ 490	1470	-14'-0	-2'-10		20.976	4.240
28	Bolts.	@ 1.01	28.28	"	"			
			1498.28					

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SEIYU BLDG, TOKIO

MADE BY Y Hirata DATE 15-12-11 FILE NO
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CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' Single leaf trunnion bascule. 1

- 2 - Air Buffer for End

No	Material	Length	Weight per ft.	Total Weight.	±X From Trunnion	±Y From floor	+X Moment	-X Moment	+Y Moment	-Y Moment
~~2~~	3 cu.ft.		@490.	1470.						
48	Bolts 1"φ		@ 0.786	37.728						
	0.17		@450	76.50	+72-8½	-2-4	115,739			3,714
2	Bolts 1¼"		@ 2.55	5.10						
2	" ¾		@ 1.25	2.50						
				1591.828						
	4 - Guide pulleys PB2 & PB3									
4	Brackets		@ 26	104						
4	pulley		@ 5	20						
4	pins ¾φ.5"		@ 1	4	+72-0	-3-5½	9,372			450
8 16	Bolts ⅝φ		@ 0.27	2.16 — 4						
				130.16 — 132						
	2 Guide pulley PB1									
2	Bracket		@ 20	40						
2	pulley		@ 5	10						
2	pins ¾φ.5"		@ 1	2	+71-9	-3-1½	3,886			169
8	Bolts ⅝φ		@ 0.27	2.16						
				54.16						
	2 Guide pulley PB4									
2	Bracket		@ 32.	64						
2	pulley		@ 17	34						
2	pins 1.5½		@ 1.97	3.94	+71-6½	-1-7	7,448			165
8	Bolts ⅝φ		@ 0.27	2.16						
				104.10						
	2 - Counter Weight for Buffer.									
2	Counter weight		@ 82.	164.	+70-10	-2-5½	11,617			403
	4 Cast Steel Trunnion Boss and blocks.									
4	3.316 cub.ft.		@490.	6499.36	+1-7	-5-1½	10,637			34,438
218	Bolts 1"φ		@ 1.01	220.18						
				6719.54						
8	Cast steel blocks		@ 136	1088.0						
				7,808.0						
	2 - Racks									
			2@ 5000 =	10,000	-15-0	-2-6		150,000		25,000
	Operating Machinery for End Locks									
				6,000	+15-0	-3-0	90,000			15,000

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JIUN MASUDA
CONSULTING ENGINEER
MARUNOUCHI, TOKIO

MADE BY______ DATE______ FILE NO______

CHECKED BY______ DATE______ PAGE NO______

CALCULATIONS FOR

87ト Ⓐ=ハ

No.	Material	Length	Wt. per ft.	Total Wt.
	Floor break of side walk on Pier 2 Req'd.			
1	Checkered Pl 7 × 1/2	× 6'-2 3/8"	@ 11.9 =	74
2	Ls 3 1/2 × 3 1/2 × 3/8	× 6-9 5/8	8.5	116
2	Fills 3 × 3/4	× 0-3"	7.65	4
49	R.H. 3/4"φ		0.1425	7
				201 × 2 = 402
	Floor break of drive way on Pier, mark EJ3			
2	Checkered Pl/s 10 × 1/2	× 16'-0"	@ 17.0	571
2	〃 〃	3'-8 1/4"	〃	125
1	〃 〃	4-9"	〃	81
2	Ls 3 × 3 × 5/16	× 17'-2"	6.1	209
2	〃 〃	× 3-8 1/4	〃	45
1	〃 〃	× 4-9"	〃	29
2	〃 〃	× 24-9 1/4	〃	302
2	Web Pl/s 13 × 5/16	× 24-9 1/4	13.81	684
1	Pl/s 〃	× 1-5 1/2	〃	20
1	〃 3 × 5/16	× 1-8 1/2	3.19	5
597	R.H. 3/4"φ		0.1425	85
				2,156

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CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY Y. Hirata DATE 2-3-7 FILE NO.

CHECKED BY DATE PAGE NO. 87

CALCULATIONS FOR

First Panel Bridge for City of Kobe; 60' single leaf trunnion bascule.

Concrete Slab etc.

				Total Wt.	±X From Trunn.	±Y From Floor	+X Moment	−X Moment	+Y Moment	−Y Moment
	Sidewalk Conc. slab & plank floor.			26560.004	+19'-7	+0'-3	520,170		6640	
	Concrete Block	7.8 cub.ft.	140#	1092	−11'-10	+0'-2		12922	182	
	〃	41.2 〃	〃	6997.764 / 5768	−6'-5	$-0'-2\frac{3}{4}$		37013		1321
48	Bolts $\frac{3}{4}$"φ	1'-8"	2.87#	137.76	−6'-5	+0'-1		884	11	
	Asphalt filling	0.3 cub.ft.	140	42.00	+34'-4	$+0'-1\frac{5}{8}$	1442		6	
	Nail	3380'	2.5	8450.00	+40'-0	$-0'-4\frac{1}{2}$	338,000			3,169
	Bolt	3380	0.8	2704.00	+40'-0	−0'-9	108,160			2,028
2	Curb Ls. 3×3×$\frac{3}{8}$	69'-0"	7.2#	993.60	+39'-0	+0.89	38,750		884	
4	122# Rail	67'-1	@ 40.7	10921.16	$+40'-4\frac{1}{2}$	$-0'-2\frac{5}{8}$	440,943			2,392
		1.2 cub.ft.	490#	588.00	+73'-6	−0'-4	43,218	1016,258		196
		1.5	〃	735.00	+5'-10	$-0'-3\frac{7}{8}$	4,287			237
8	Drain	0.17	485	659.60	+40'-6	$-0'-8\frac{1}{2}$	26,714			467
8	〃	0.095	〃	368.60	+40'-0	$-0'-9\frac{1}{4}$	14,744			284
	For Front 52022. 〃 Rear 6997.76			59019.76			1,536,428	50,819	7,723	10,094

Down spout

					Total Wt.	±X	±Y	+X Moment	−X Moment	+Y Moment	−Y Moment
2	Pls.	18×$\frac{1}{8}$	7'-6	@ 7.65	114.75						
2	〃	8×$\frac{1}{8}$	6'-6	@ 3.40	44.20						
2	Bars	3×$\frac{1}{4}$	2'-3	@ 2.55	11.475	−4'-8	−2'-11		857		536
2	Pls.	6×$\frac{1}{2}$	0'-7	@ 10.20	11.893						
2	Bolts.	$\frac{3}{4}$"φ	$0'-2\frac{1}{2}$	@ 0.690	1.380						
					183.698						

Floor Break of Side Walk on pier

				Total Wt.	±X	±Y	+X Moment	−X Moment	+Y Moment	−Y Moment
2	Checkered Pls. 10×$\frac{1}{2}$×6'-3		@ 17.00	212.50						
2	Ls. 4×3×$\frac{3}{8}$	6'-3	@ 8.50	106.25	+73'-6	$+0'-3\frac{1}{4}$	24,251		89.	
14	Bolts. $\frac{1}{2}$"φ	1'-0	@ 0.80	11.20						
				329.95						

Floor Break of Drive Way on pier.

				Total Wt.	±X	±Y	+X Moment	−X Moment	+Y Moment	−Y Moment
2	check. Pls. 10×$\frac{1}{2}$	$16'-3\frac{1}{2}$	@ 17.00	553.928						
2	〃 〃	$4'-2\frac{3}{4}$	@ 〃	143.786						
1	〃 〃	4'-9	〃 〃	80.750	$+73'-4\frac{1}{2}$	$-0'-5\frac{1}{2}$	151,129			943
2	Pls. 13$\frac{1}{2}$×$\frac{3}{8}$	24'-11	〃 17.21	857.643						
2	Ls. 3$\frac{1}{2}$×3$\frac{1}{2}$×$\frac{3}{8}$	24'-11	〃 8.50	423.589						
				2059.696						

A

Spacer for Rail.

				Total Wt.	±X	±Y	+X Moment	−X Moment	+Y Moment	−Y Moment
120	Ls. 4×3×$\frac{3}{8}$	0'-4	@ 8.50	339.66						
30	Bars 1$\frac{1}{2}$×$\frac{3}{8}$	5'-2	@ 1.91	296.069	−32'-3	−0'-9		21005		488
120	Nut for $\frac{3}{4}$"φ Bolts.		@ 0.13	15.600						
				651.329						

Steel sleeper.

				Total Wt.	±X	±Y	+X Moment	−X Moment	+Y Moment	−Y Moment
27	Is. 6×4$\frac{1}{2}$	17'-5	@ 20.00	9405.18	$+41'-7\frac{1}{2}$	−0'-11	391,491			8,625
108	Pls. 4$\frac{1}{2}$×$\frac{1}{2}$	$0'-10\frac{1}{2}$	@ 7.65	722.925	$+41'-7\frac{1}{2}$	$-0'-7\frac{5}{8}$	44,433			678
108	Shim.pls. 4$\frac{1}{2}$×$\frac{1}{2}$	0'-5	〃 〃	344.525						
				10,472.630			435,924			9,303.

JIUN MASUDA
CONSULTING ENGINEER
SEIYU BLDG, TOKIO

MADE BY J. Hirata DATE 2-3-7 FILE NO.
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CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule.

Floor Break of Side Walk on Abutment.

							+X Moment	-X Moment	+Y Moment	-Y Moment
2	Bars 3×½	6-11½ 4¼"	@	5.1	70.972 65					
2	Ls 6×3½×⅜	6-11½	@	11.7	162.817 149					
2	" 3½×3½×⅜	6-10½	@	8.5	116.875	-4-8	+0-2¾	1695	83	
88	Rivets heads ¾φ	4¼"	@	14.25	12.540					
					364.204 343					

Horizontal spout of under Floor Break on Abutment.

2	Ps 17½×⅛	6-5½	@	7.44	96.095					
4	" 7×⅛	1-0	@	2.975	11.90					
2	" 5½×⅛	1-1	@	2.338	5.064					
2	Rods ¾φ	6-1	@	1.502	18.273					
16	Bars ⅜×¼	2-0	@	.5315	15.945					
4	" "	0-9		"	1.595	-5-0½	-1-0	994		197
4	Rods ½φ	1-9	@	.668	4.676					
8	Cast iron 4×4	0-3	@	.26	6.24					
4	Ls 5×3×⅜	0-3	@	9.8	9.8					
2	Ps 3½×⅜	0-8¼	@	4.46	6.133					
4	Ls 5×3×⅜	0-5½	@	9.8	17.954					
24	Rivets heads ¾φ		@	14.25	3.42					
					197.095					

Wooden part of Moving Span.

Wooden Block	661.6 cu.ft.	55	36388	+39-10¼	-0-2¼	1450207	6805
plank	686.0	55	37730	+39-10½	-0-5¼	1504484	1651
plank side of Rail ⓐ	99.6	70	6972	+39-10¼	-0-1½	277862	872
Do ⓑ	77.2	70	5404	+39-10¼	-0-4½	215371	2027
Filler at Rail Web ⓓ	30.8	55	1694	+39-6½	-0-4⅛	66984	583
Do ⓒ	20.0	55	1100	+39-6½	-0-3¼	43496	298
Coping	85.5	55	4702.5	+39-10½	-0-1¼	187512	489
Nailing peices at over joist	190	55	10405	+39-10½	-0-11	416694	9583
Nailing peices at over Long Girder	57	55	3135	+39-10½	-0-10	125008	2611
Nailing peices at over Floor Beam	46.8	55	2574	+40-6	-0-7½	104247	1609
Nailing peices at over sleeper	26.9	55	1480	+41-7½	-0-7	61584	863
Wooden sleeper on abutment side	22.5	55	1238	+9-1	-0-9½	11240	980
Wooden sleeper on peir side	14.9	55	819.5	+72-9½	-0-9½	59653	649
Asphalt sheet	3380 sq.ft.	0.3	1014.	+39-10¼	-0-4	40412	338
			114656.0			4564754	29358

Hand Rail

Hand Rail total Weight.	5340.00	+40-6	+2-9	216,270	14,685	

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CALCULATIONS FOR

List of materials for 60' Single leaf trunnion bascule Bridge

Description	Front	Rear	Front of trunnion +X	Rear of T. −X	above C/R +Y	below Crown of Roadway −Y
2 trolley poles TP1	5194.166		123.296		49.722	
" TP2	4884.096		355.166		46.830	
1 trolley arch TA1	4622.752		111.354		84.656	
TA2	4610.182		335.271		84.426	
2 main girders	115.756.098	89.144.314	3.012.712	693.718	140.676	370.992
Floor beam FB4	29.289.889		724.634			66.313
FB3	29113.531		1181.957			65.739
FB2	29113.531		1637.636			65.739
FB1	9695.762		698.891			21.741
Long'l girder 2-LG1	3183.584		203.749			8.093
2-LG2a	3167.880		103.352			8.053
2-LG2b	3167.880		153.246			8.053
6 beams RCB1	10.290.432		416.762			19.758
4 beams RS1 & RS2	3385.485		219.110			6.489
4- RS3	3256.164		131.874			6.241
4- RS4	3256.164		131.874			6.241
strut 16- ST2	3.492.080		141.429			6.693
Floor beam FB5	34.317.786		290.260			51.477
Stringers 10- SH11 - SH15	6904.857		116.524			12.371
Stringers 20- SH6 - SH10	13.740.498		556.490			24.621
Stringers 10- SH1 - SH5	6.957.826		446.171			12.466
Summary (1)	327.400.643	89.144.314	11.091.758	693.718	406.310	761.080
Strut 32 16- ST1	1.258.123		50.954			1.756
Stringer 4- RS5-RS6	3473.161		56.656			6.657
Long girder 2-LG3	3.162.348		53.365			7.906
Sidewalk stringers & bracketg	11.102.231		375.918			7.316
Cantilever Bracket 2- CB1	1.168.229		58.644			2.256
2- CB4	1.304.536		32.287			2.701
4- CB2-3	2.829.695		136.886			5.688
4- CB5-6	4.061.509		25.401			10.296
Bracing at bottom of main girders under sidewalk.	4.953.595	1213.129	~~44~~ 45.334	3.483		20.394
Lateral Bracing at rear	1.680.698	6087.245		19.418		26.974
Bottom bracings between girders.	19.344.747		770.299			65.386
2 End locks.	1.969.280		142.201			5.540
2 tail locks		1920.540		30.729		3.688
8 live loadshoes	1.771.960		71.765			7.666
1- center lock	505.400		36.389			2.101
2- air buffer at rear		1.498.28		20.976		4.240
2- air buffer at front	1591.828		115.739			3.714
4- guide pulley	130.160	132	9.372			450
2 " "	54.160		3.886			169
2 " "	104.100		7.448			165
2 Counterweights	164.000		11.617			403

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule.

	Front	rear	+X	−X	+Y	−Y
4 trunnion boss.	6.719.540		10.637			34.438
2 Racks.	10.000.000			150.000		25.000
End lock operating machinery &c	6.000.000		90.000			15.000
Summary 2.	73349.300	20.719.194	2.097.350	224.606		259.904
Summary 1	327.400.643	89.144.314	11.091.758	693.718	406.310	761.080
Grand Summary	400.749.943	109.863.508	13.189.108	918.324	406.310	1020.984

Weight and moments for flooring &c.

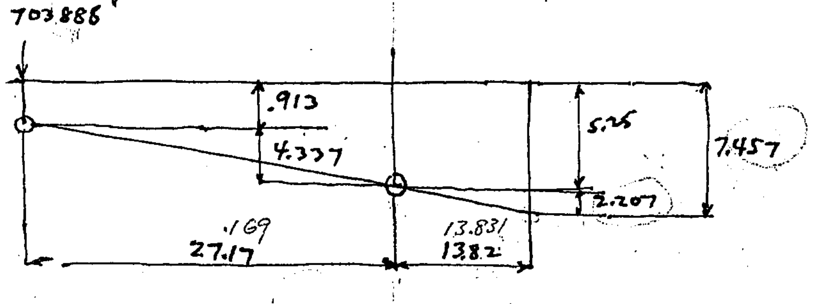
	Front	Rear	+X	−X	+Y	−Y
Sidewalk plank & Concrete	52.022.000	6997.760	1.536.428	50.819	7.723	10.094
Down spout Rail &c.		183.698		857		536
floor beam	329.950		24.251		89	
floor beam at front end	2059.696		151.129			943
Rail spacer		651.329		21.005		488
steel sleeper	10.472.630		435.924			9.303
floor beam sidewalk rear		364.204		1.695	83	
Horizontal spout		197.095		994		197
wooden part of moving leaf	114.656.000		4.564.754			29.358
Handrails	5.340.000		216.270		14.685	
	184.880.276	8394.086	6.928.756	75.370	22.580	50.919

Summary						
structure	400.749.943	109.863.508	13.189.108	918.324	406.310	1.020.984
floor.	184.880.276	8394.086	6.928.756	75.370	22.580	50.919
	585.630.219	118.257.594	20.117.864	993.694	428.890	1.071.903

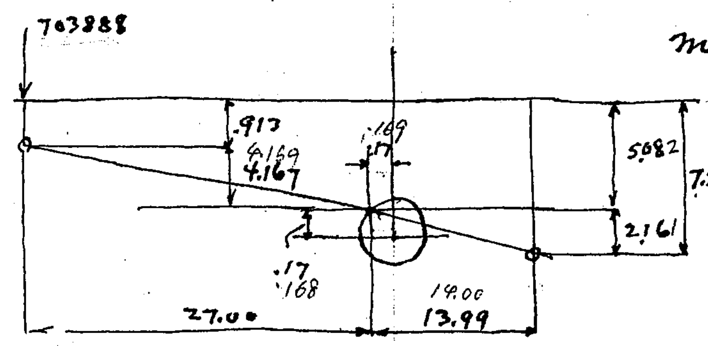
Total	load.		X moment		Y moment
Front	585.630.219	+	20.117.864	−	1071.903
rear.	118257.594	−	993.694	+	428.890
	703887.803	+	19.124.170	−	643.013

center of gravity of moving leaf without cwt girders and bracings $19.124.170 \div 703.888 = 27.17'$ (27.169)

$643.013 \div 703.888 = 0.913'$



$4.337 \times \frac{13.82}{27.17} = 2.207$
5.250
7.457



$m = 703888 \times 27.00 = 19004976.$
$19.004.976 \div 13.99 = 1357.600$ (8.670) for cwt.

$4.167 \times \frac{13.99}{27.00} = 2.16$

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule.

No.	Material	Length	Weight per ft.	Tot. Wt.	±X From Trunnion	±Y From Floor	+X Moment	-X Moment	+Y Moment	-Y Mom.
	Counter Weight girder			CG1						
4	Ls 6×6×3/4	24-9 7/8"	28.7	2849.669						
4	"	22-6	"	2583.000						
2	P/s 92 1/4×1/2	24-9 7/8	156.8	7784.461						
2	Ls 6×6×3/4	7-9 1/2	28.7	447.243						
2	"	6-2	"	353.986						
4	"	7-7 1/2	"	872.962						
4	Fills 9×3/4	5-10 1/4	22.95	537.416						
20	Ls 5×4×1/2	7-8	14.5	2223.343						
20	Fills 4×3/4	5-10 1/4	10.2	1194.257						
4	" 6×3/4	6-8 1/2	15.3	410.548						
2	P/s 19 1/2×3/4	4-7 1/2	49.7	459.725	-9'-6 1/4"	-7'-2 1/2"		320,841		242,913
2	" 12 1/2×3/4	3-5 1/2	31.9	220.639						
2	Fills 3 3/8×3/4	4-7 1/2	8.61	79.643						
2	Ls 5×3 1/2×1/2	7-8	13.6	208.534						
2	Fills 4×3/4	5-6 3/4	10.2	113.475						
2	P/s 19×3/4	5-6 1/2	48.5	537.545						
2	" 9×3/4	3-2	22.95	145.352						
1	Fill 14 1/2×3/4	4-7 1/2	37.00	171.125						
4	P/s 16×3/4	24-9 7/8	40.8	4051.097						
4	Cov.P/s 14 1/2×3/4	24-9 7/8	37.0	3673.789						
2	" 13×3/4	24-9 7/8	33.2	1648.240						
2	" 19 1/4×1/2	20-8	32.73	1352.842						
1	" "	8-3 1/2	"	271.387						
7100	Rivet Heads 7/8"		0.2125	1508.750						
				33,699.028						
	CG2	24'								
8	Ls 8×8×3/4	22-11 7/8	38.9	7154.488						
8	P/s 12×3/4	22-9 7/8	30.6	6076.~~678~~						
4	P/s 9 1/2×3/4	2-6	24.23	242.300						
4	Ls 8×8×3/4	7-7 1/4	38.9	1183.214						
4	Fills 8×3/4	6-4 1/2	20.4	520.200						
4	" 11×3/4	5-8	28.05	635.804						
20	Ls 6×4×1/2	7-8	16.2	2484.010						
20	Fills 4×3/4	5-8	10.2	1156.067						
2	P/s 92 1/4×5/8	24-9 7/8	196.025	9731.818						
4	Ls 8×8×3/4	7-8	38.9	1192.939						
2	P/s 20×3/4	4-1 3/4	51.0	422.872						
4	" 9×3/4	3-2	22.95	290.703	-16'-0"	-7'-10 1/8"		697,774		342,072
4	" 12×3/4	3-8	30.6	448.804						
2	Fills 4×3/4	5-8	10.2	115.601						
2	" "	6-4 1/4	"	129.626						
2	P/s 18×3/4	22-11 7/8	45.9	2110.445						
2	Ls 6×3 1/2×1/2	7-5 3/4	15.3	228.864						
2	P/s 18×3/4	24-9 7/8	45.9	2278.742						
2	Fills 18×3/4	3-8	"	336.603						
2	P/s "	24-9 7/8"	"	2278.742						
1	Fills 18×3/4	3-8	"	168.302						
2	P/s 27×1/2	20-8	"	1897.203						
1	" "	8-3 1/2	"	380.589						
10100	Rivet Heads 7/8"		0.2125	2146.250						
				43,610.~~818~~						

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule.

No.	Material	Length	Wt. per ft.	Tot. Wt.	±X From Trunnion	±Y From Floor	+X Mom.	−X Mom.	+Y Mom.	−Y Mom.
	CG3									
4	Ls 6×6×3/4	20-9 1/4	28.7	2384.488						
4	" "	17-7	"	2018.563						
4	P/s 16×3/4	20-9 1/4	40.8	3389.794						
4	Ls 6×6×3/4	7-8	28.7	880.137						
4	Fills 9×3/4	5-11	22.95	543.153						
4	" 6×3/4	6-9 1/4	15.3	414.373						
16	Ls 5×4×1/2	7-8"	14.5	1778.674						
16	Fills 4×1/2	5-11	10.2	965.605						
4	" "	7-2 1/2	"	294.098						
2	P/s 93×1/2	20'-9 1/4	158.1	6567.727						
2	Ls 6×6×3/4	12-2	28.7	698.368	−18'-5 3/4	−8'-9 1/2		518,652		246,755
2	P/s 16×3/4	6-4 1/2	40.8	520.200						
2	" 9×3/4	2-7 1/2	22.95	120.487						
2	" 20×3/4	5-7 1/4	51.0	571.628						
2	" 9×3/4	3-2	22.95	145.352						
2	Ls 5×3 1/2×1/2	7-6 1/2	13.6	205.134						
2	Fills 4×3/4	5-11	10.2	120.701						
2	Ls 6×6×3/4	6'-2"	28.7	353.968						
1	Pl. 14 1/2×3/4	6-4 1/2	37.0	235.875						
2	P/s 13×3/4	20-9 1/4	33.2	1379.181						
1	Pl. "	6-2	"	204.734						
2	P/s 14 1/2×3/4	20-9 1/4	37.0	1537.039						
2	" 26×1/2	16-1 1/2	44.2	1425.450						
1	" "	8-3 1/2	"	366.493						
4,450	Rivet Heads 7/8"φ		0.2125	945.625						
				28,066.847						
	Counter weight girder Top Flange Frame									
2	Fills 11×3/4	×5'-1 1/2	28.05	287.513	−12'-8 1/8	−3'-10 5/8"		3,645		1,117
2	P/s 9 1/2×3/4	3'-5"	24.23	165.573	"	−3-9 1/8		2,099		623
2	Fills 3×3/4	"	7.65 −910	52.276	"	−3-9 7/8		663		200
2	P/s 75×1/2	10'-9"	127.5 −77	1831.25	−12'-8"	−3-10		23,196		7,020
2	" 41 1/2×1/2	4'-5"	70.55 −76	546.196	−9-10 1/2	"		5,394		2,094
1	Pl. 38 1/2×1/2	6-4 1/2	65.45 −60	341.244	−9-7 1/2	− "		3,284		1,308
2	P/s 21×1/2	5-2	35.7 −55	308.902	−15'-0"	"		4,634		1,184
1	Pl. 30 1/2×1/2	8-11	51.85	407.331	−15'-9"	"		6415		1,561
2	P/s 18×3/8	2'-2"	22.95	99.452	−16'-0"	−3-9 9/16		1,591		378
4	Ls 6×6×3/4	×7-10 1/2	28.7	904.050						
4	" "	7-4 1/2	"	846.650	−15'-11	−3'-10"		57,983		13,964
8	" 6×6×1/2	8-1 5/8	19.6	1275.631						
8	" 4×4×3/8	7-10 3/8	9.8	616.585						
2	" 6×3 1/2×3/8	×17-8	11.7	413.401	−18'-8 1/4"	−3'-9 1/2"		7,725		1,567
1	L "	6-2	"	72.150	− "	−3'-8 3/4"		1,348		269
				8,168.204				117,977		31,285
	12 1/4"									
	Counter weight girder Bottom Flange Frame									
4	P/s 12 1/2×1/2	20'-1"	20.83	1673.316	−12'-7 1/2"	−11'-9"		24,884		23,159
2	" "	7-1 3/4	"	297.702						
2	" 49 1/2×1/2	20-8	84.15	3478.206	−12-7 1/2	−11'-9"		52,721		49,067
1	" "	8-3 1/2	"	697.747						
2	" 12×1/2	3-1	20.4	125.799	−12'-6 1/4"	−11'-9"		1,575		1478
2	" "	"	"	~~#~~ "	−12'-7 1/2"	−11'-9"		5005		4,658
7	" 7 3/8×1/2	"	12.54	270.652						

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CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule.

No.	Material	Length	Wt. per ft.	Tot. Wt.	±X From Trunnion	±Y From Floor	+X Mom.	-X Mom	+Y Mom.	-Y Mom.
2	Fills 6 × 3/4	3-1"	15.3	94.349	-12-6 7/8	-11'-9"		1,186		1,109
2	P/s 13 1/2 × 1/2	5-2"	22.95	237.152	-12-7 1/2	-11'-9"		2,994		2,787
2	" 28" × 1/2"	7-9 1/2	47.6	-110 631.770	-13-3	-11-10		8,371		7,476
2	" 35 × 1/2"	10'-1 3/4"	59.5	1207.350	-14-0 5/8	-11-10		16,966		14,287
2	" 13 1/2 × 1/2	1-1 1/4	22.95	50.683	-18-3 3/8	-11'-9"		927		596
				8,890.525				114,629		104,617
	Counter Weight girder Diaphragms and Cross Frames									
	D1									
2	Ls 5 × 3 1/2 × 3/8 × 1-8 1/4		10.4	35.100						
2	" "	1-6"	"	31.20						
4	" "	5-1 1/2	"	213.20	-12'-8 1/2	-8'-3 1/2		24,799		16,181
4	" 3 1/2 × 3 1/2 × 3/8	7-0"	8.5	238.00						
2	P/s 73 3/4 × 3/8	7-7 1/2	94.03	1433.957						
				1951.457						
	D2-D3									
20 (22)	Ls 5 × 3 1/2 × 3/8 × 1'-2"		10.4	242.674 (268)						
20	" "	1-1 7/8	"	229.674 (252)	-17'-3 1/2	-7'-10 1/4"		55,984		25,429
11 (22)	P/s 26 × 3/8	7-7	33.15	2765.250						
				3237.598 (3,285)						
	CF1 - CF2									
8	Ls 5 × 3 1/2 × 3/8 × 7-9 3/4		10.4	650.00						
4	P/s 3 × 3/8	0-6 1/4	3.83	7.979						
8	Ls 5 × 3 1/2 × 3/8 × 5-1 1/2		10.4	426.40						
12	Washers 3"φ × 3/8		0.75	9.00						
16	Ls 5 × 3 1/2 × 3/8	1-2	10.4	194.139						
8	P/s 15 1/4 × 3/8	1-2	19.445	181.492						
4	" 16 1/2 × 3/8	1-6	21.04	126.240						
4	" 18 × 3/8	1-8	22.95	153.003	-12'-8 1/2	-8'-4"		28,020		18,374
2	Ls 5 × 3 1/2 × 3/8	7-8 3/4	10.4	160.767						
1	Pl. 3 × 3/8	0-6 1/2	3.83	2.075						
2	Ls 5 × 3 1/2 × 3/8	5-1 1/2	10.4	106.60						
3	Washers 3"φ × 3/8		0.75	2.250						
4	Ls 5 × 3 1/2 × 3/8	1-2	10.4	48.535						
2	P/s 16 × 3/8	1-5	20.4	57.801						
1	" 18 1/2 × 3/8	1-8 1/2	23.59	40.299						
1	" 18 × 3/8	1-8	22.95	38.251						
				2,204.831						
				7,393.886				108,803		59,984
	Weight Supporting Plates along outside for Counter weight girder stiffeners.									
24	P/s 9 × 3/8	7-7 1/4	11.48	2095.109						
698	Bolts 3/4"φ	0-2"	0.63	439.74	-14'-0 1/2	-7-10"		39,037		21,777
1154	Rivet Heads 7/8"φ		0.2125	245.225						
				2,780.074						

1951
3237
2204
7392

Counter Weight girder Total = 132,609.416 → 1917713 | 1049403

132,656.

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule

No.	Material	Length	Wt. per ft.	Tot. wt.	±X From Trunnion	±Y From Floor	+X Mom.	-X Mom.	+Y Mom	-Y Mom.
	Weight Connection P/s and LS Top & Bott. Flgs. of Counter weight girder									
	CLST1									
14	LS 3½×3½×3/8×9-7½		8.5	1145.375	-14'0"	-2-7¾		16,035		3,031
14	P/s 14½×3/8	9-7½	16.58	2234.162	"	-2-2¼		31,278		4,887
600	Rivet Heads 7/8"φ		0.2125	127.50	"	-2-7		1,785		329
	CLSB1									
20	LS 5×3½×3/8 × 10-1¾		10.4	2110.326						
20	P/s 8½×3/8	10-1¾	10.84	2199.609	-14'0½"	-12'7"		64,175		55,225
440	Bolts 5/8"φ	0-1½	0.36	158.400						
480	R. Heads 7/8"φ		0.2125	102.000						
				4570.335						
	Cast steel wind bearing block Under Counter-weight girder.									
9	Cast steel block		@147#	1323.000						
72	Bolts ¾"φ ×2½"		" 0.62	45.000	-16'0"	-12'2"		22,224		17,900
36	" " ×2⅛"		" 0.58	21.000						
				1,389.000						
	Weight Connection P/s, LS & Casting, total =			9466.372				135,497		81,372
	Frames, Top of Counter weight girder.									
	CLST2									
2	LS 3½×3½×3/8 ×8-1½		8.5	152.291	-14'0"	-2-7¾		2,132		403
2	P/s 16½×3/8 ×9-3"		21.04	389.240	"	-2-2¼		5,449		852
2	LS 3½×3½×3/8	1-4½ 1'-3"	8.5	23.375 21	-9-3½	-2-2¼		217		51
130	R. Heads 7/8"φ		0.2125	27.625	-14'0"	-2'7"		387		71
	CLST3									
4	LS 3½×3½×3/8	6-7¼ 1'-3"	8.5	224.543 43.	-12-9	-2-7¾		2,863		594
4	" "	1-4½	"	46.750	-9-3½	-2-2¼		434		102
4	P/s 16½×3/8	6-10½	21.04	578.60	-12-9	"		7,377		1,266
210	R. Heads 7/8"φ		0.2125	44.625	- "	-2-7"		569		115
	CTS4									
2	LS 10×3½@23.5# × 8'0"			376.0 71.	-9'5"	-3'2¼		3,541		1,199
6	P/s 10½×3/8	1'-2 10½"	13.39	93.757	~~-9'6"~~	~~-2'9⅛~~		~~891~~		~~259~~
70	R. Heads 7/8"φ		0.2125	14.875	-9-3½	-3'0"		138		45
	CTS5									
6	LS 3½×3½×3/8 × 2-5¾ 4		8.5	126.439 119						
2	" "	1-7½ 6¼	"	27.625 26						
2	" 6×3½×3/8	2-11½	11.70	69.217	-16'-2½"	-2'8½"		9,217		1,541
2	P/s 29¾×3/8	4-1¼	37.93	311.329 293						
160	R. Heads 7/8"φ 28		0.2125 35.70	34.00						
				568.610 487						
	CTS6									
2	LS 4×3½×3/8 ×1'-2"		9.10	21.239						
2	P/s 27×3/8	2-5¾	34.43	170.704	-17'-3"	-2'8"		3,678		569
100	R. Heads 7/8"φ		0.2125	21.250						
				213.193						

2LS 6×4×3/8×1'-0" @12.3# = 25#

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CALCULATIONS FOR

First Canal Bridge for City of Kobe : 60' Single leaf trunnion bascule

No.	Material	Length	Wt. per ft.	Tot Wt.	±X From Trunnion	±Y From Floor	+X Mom.	−X Mom.	+Y Mom.	−Y Mom.
	Weir Plate between struts									
2	Pls 16½ × 3/8 (15")	× 4'-0"	21.04	168.33 (153)						
2	" "	1'-5"	" 19.13	59.627	-9'-2¼"	-2'-1"		2,505		568
2	" 6½ × 3/8	" (1'-3")	8.29	23.489 (21)						
100	R. Heads 7/8"φ		0.2125	21.25						
				272.686 (255)						
	Total =			3,026.170 (2,946)				39,398		7,635
	~~See Page No. 83~~			~~8,510.523~~ (2,923)				97,150		27,909
				~~11,536.693~~				136,548		35,544

Summary

	Wt. #	−X Mom.	−Y Mom.
	132,656.		
Counter weight girder	132,609.416	1,917,713	1,049,403
Weight Connection Pls. Ls and Castings	9,466.372	135,497	81,372
Frames, Top of counter weight girder	11,536.693	136,548	35,544
	153,612.481	2,189,758	1,166,319

2,946
2,923

145,068
145,045

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule

part	No	size	Volume (1 Section)	From Trun' ±X	From C.R.W ±Y	Total Volume	Moment of Volume ±X	±Y	Density
1	2	(3'-6 3/32")×(6'-0")×(7'-0½")	148.4	-12'-9"	-8'-0¼"	296.8	-3,782	-2,380	311.24 #/c.f (Cement mortar 51%, Scrap Steel 49%)
2	2	(3'-5 5/32")×(6'-0")×(7'-0½")	145.0	"	"	290.0	-3,700	-2,320	" "
3	4	(7'-7 1/16")×(")×(")	320.8	"	"	1,283.2	-16,360	-10,280	" "
4	10	(3'-9 27/32")×(2'-0")×(")	53.8	-17'-3"	"	538.0	-9,300	-4,320	" "
						2,408.0	-33,142	-19,300	

C.G. { X -33,142 ÷ 2,408 = -13.761 ft
C.G. { Y -19,300 ÷ 2,408 = -8.015

Weight Moment (Weight).
Total 749,465.92 -10,315,113. 6,006,932

part	No	size	Weight (For 1 Block)	From Trun' ±X	From C.R.W. ±Y	Total Weight	Moment Weight ±X	±Y	Density
SB1	32	6"×5"×3'-7 3/8"	235	-9'-0"	-8'-0 5/8"	7,520	-67,680	-60,550	315 #/c.f (about) (Cement-Mortar 50%, Scrap steel 50%)
SB2	"	"	"	-19'-0"	"	"	-142,880	"	
SB3	160	6"×5"×3'-9 7/8"	250	-9'-0"	"	40,000	-360,000	-322,080	
SB3	128	"	"	-19'-0"	"	32,000	-608,000	-257,660	
						87,040	-1,178,560	-700,840	
Bottom Block (B.B)	110	"	323	-14'-0"	-12'-2½"	35,530	-497,420	-435,000	(450 #/c.f)

part	No	size	Volume c.f.	From Trun' ±X	From C.R.W. ±Y	Total Volume c.f.	Moment of Volume ±X	±Y	Density #/c.f
M1	2	(6'-0")×(1¾")×(7'-9½")	7.3	-12'-9"	-7'-9¾"	14.6	-186.0	-114.0	140
M2	7	(6")×(8¾")×(")	34.1	"	"	238.7	-3045.0	-1,863.0	"
M3	1	(49'-7¾")×(6")×(")	193.5	-9'-6"	"	193.5	-1,838.0	-1,507.0	"
M4	1	(45'-7⅛")×(6")×(")	177.8	-16'-0"	"	177.8	-2,845.0	-1,388.0	"
M5	1	(41'-6½")×(")(")	162.0	-18'-6"	"	162.0	-3,000.0	-1,263.0	"
M6 (Front)	12	(6")×(4 3/32")×(")	1.3	-9'-0	"	15.6	-140.2	-122.0	"
M7	10	(2'-0")×(")×(")	5.2	-17'-3"	"	52.0	-898.0	-406.0	"
M6 (rear)	10	(6")×(")×(")	1.3	-19'-0"	"	13.0	-237.0	-101.0	"
M8	1	(6'-0")×(2")×(44'-3")	44.35	-12'-9"	-11'-7½"	44.35	-566.0	-516.0	"
M9	1	(")×(7")×(")	154.78	"	-4'-2½"	154.78	-1,968.0	-650.0	"
M10	1	(2'-0")×(2")×(38'-3")	12.78	-17'-3"	-11'-7½"	12.78	-220.0	-149.0	"
M11	1	(")×(7")×(")	41.20	"	-4'-2½"	41.20	-711.0	-173.0	"
M12	1	(6")×(2")×(")	3.2	-19'-0"	-11'-7½"	3.20	-60.8	-37.0	"
M13	1	(6")×(7¾")×(")	12.0	"	-4'-1"	12.00	228.0	-49.0	"
M14	1	(")×(2")×(45'-5½")	3.8	-9'-0"	-11'-7½"	3.80	-34.2	-44.0	"
M15	1	(")×(7¾")×(")	14.2	"	-4'-1"	14.20	-127.8	-58.0	"
						1,153.51	-16,105.0	-8,440.0	(Mortar and Girder)

C.G. = (X -13.96 ft.)

	Volume c.f.		Moment of Volume X	Y
Mortar and Girder	1,153.51		-16,105	-8,440
Girder only	132,609.416 / 490	= 270.6	-(-3,914)	-(-2,142)
			-12,191	-6,298

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule.

Volume of Mortar $12,191 \div 13.96 = 873^{c.f.}$
Dist of C.G $6,289 \div 873 = 7.204^{ft}$ for Y axis

	Weight	Moment (Weight) X	Y
Total	122,220	-1,706,740	-881,720

			c.f	X	Y	c.f	X	Y	Density
M16	1	(1'-1¾)×(7'-5¼)×(8'-0½)	68.5	-12'-5¾"	-3'-4⅛"	68.5	-867.5	-229	280 #/c.f
M17	1	(1'-1¾)×(10'-6)×(41'-4)	497.5	-14'-0"	"	497.5	-6975.0	-1,663	"
						566.0	-7,842.5	-1,892	(Top Frame and Mortar)

C.G. = (X - 13.86 ft).

Mortar and top Frames 566. c.f   -7,842.5   -1,892.
Frames only $\frac{11,536.93}{490} = 23.544$ -(- 278.7) -(- 72.5)
    -7,563.8   -1,819.5

Volume of Mortar $7,563.8 \div 13.86 = 546.^{c.f.}$
Dist of C.G $1,819.5 \div 546 = 3.33^{ft}$ For Y axis

	Weight.	Moment (Weight.) X	Y
Total	152,880.	-2,117,864.	-509,460.

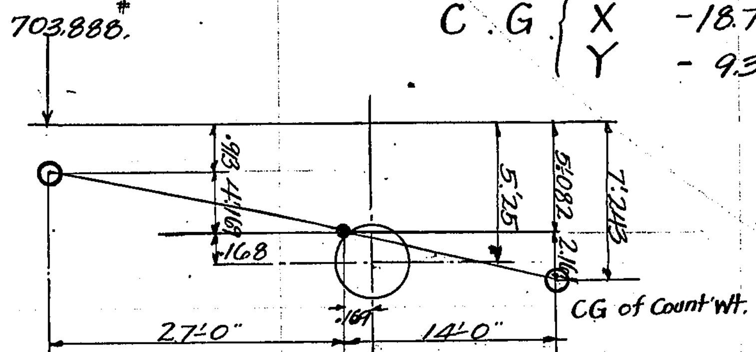
part	No	Size	Volume For (1 section).	From Trun ±X	From C.R.W. ±Y	Total Volume c.f	Moment of Volume ±X	±Y	Density
M18	7	(3'-6")×(4")×(9'-6")	11.1	-14'-0"	-2'-7¼	77.7	-1,088.	-202.0	280 #/c.f.
M19	2	(2'-11")×(1'-3¼")×(2'-3⅝)	8.6	-17'-4⅛	-2'-1⅝	17.2	-298.	-36.7	"
M20	2	(4'-1")×(")×(6'-11¾")	36.2	-12'-8½"	"	72.5	-920.	-154.8	"
M21	2	(1'-11⅜")×(")×(")	17.3.	"	"	34.6	-439.	-74.0	"
						202.0	-2,745.	-467.5	

	Weight c.f	Moment (Weight) X	Y
Total.	56,560	-768,600	-130,900

	Density	Weight.	Moment (Weight) ±X	±Y
Girder	490 #/c.f.	132,609.416	-1,917,713	-1,049,403
Top Frames	"	11,536.693	-136,548	-35,544
Longit' strut and Bearing Blocks	"	9,466.372	-135,497	-81,372
Mortar (Girder)	140	122,220.0	-1,706,740	-881,720
" (Top M16 & M17)	280	152,880.0	-2,117,864	-509,460
" (Top M18 & M21)	"	56,560.0	-768,600	-130,900
Side Block (SB)	315	87,040.0	-1,178,560	-700,840
Bottom Block (B.B)	450	35,530.	-497,420	-435,000
		607,842.481	-8,458,942.	-3,824,239.
Maine Blocks	311.24.	749,465.92	-10,315,113	-6,006,932.
		1,357,308.401	-18,774,055	-9,831,171

132,600
11,540
9,470
153,610

C.G $\begin{cases} X & -18,774,055 \div 1,357,308.4 = 13.831^{ft} \\ Y & -9,381,171 \div 1,357,308.4 = 7.243 \end{cases}$



$\frac{(7.243 - .913) \times 14}{27+14} = 2.161$

1,357,300.
153,600
1,203,700

703,900
1,357,300
2,061,200
1,030,600

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CALCULATIONS FOR

First Canal Bridge for City of Kobe ; 60' single leaf trunnion bascule.

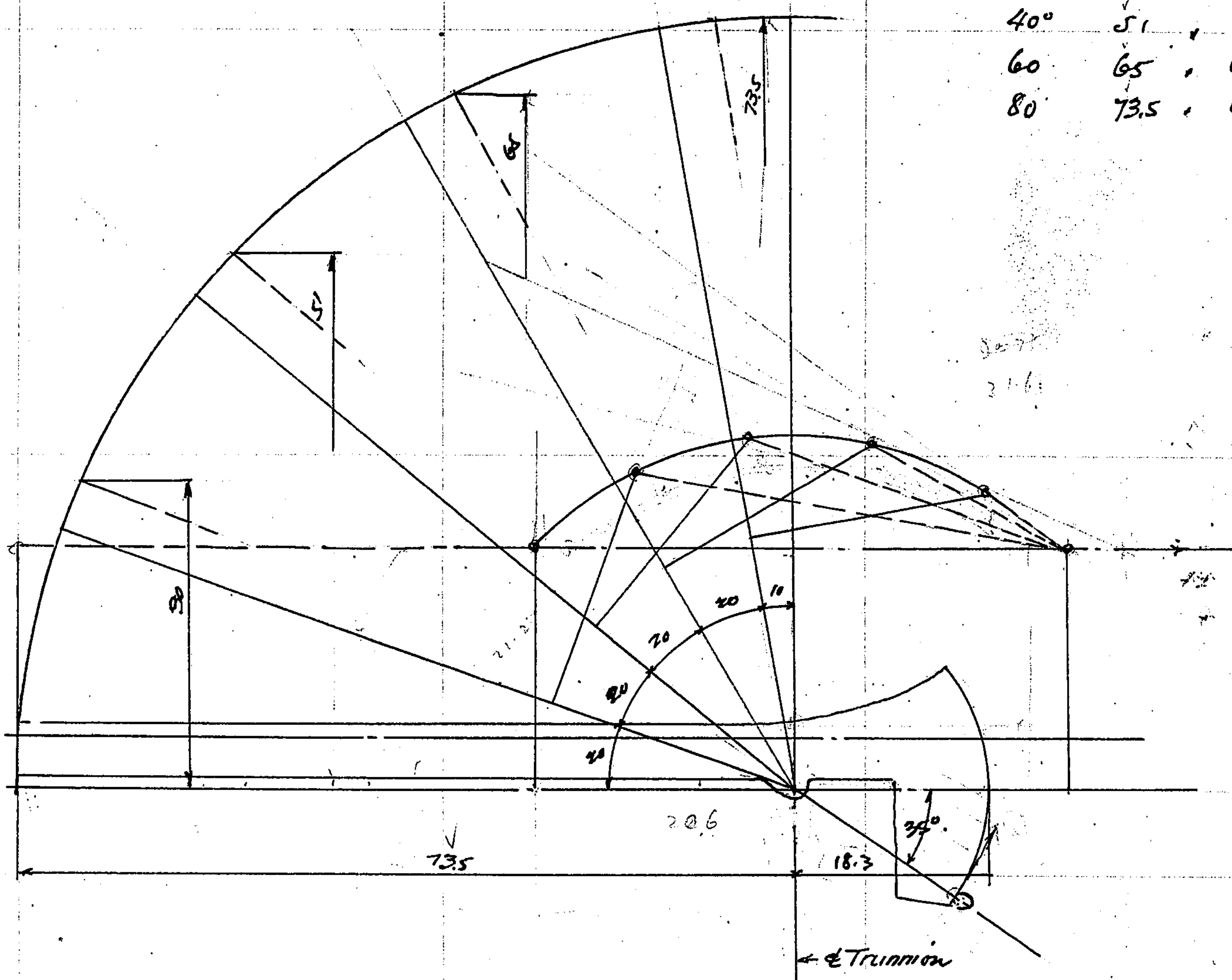
Operating Power of Bascule span.

wind load.

wind load assumed 15#/□' which is equivalent for 30 meter per second wind ~~pressure~~ velocity.

width of bridge 64' out to out
Exposed area of horizontal plane and wind pressure 15#/□'

20°	30 · 64	=	1920 □' @ 15#	=	28800
40°	51 · 64	=	3260	=	49000
60	65 · 64	=	4160	=	62500
80	73.5 · 64	=	4700	=	70500



		normal force		moment		arm		Force at rack circle
20°	28800 · 0.34	= 9800	· 36.75 =	360.000#	÷	18.3	=	19700#
40	49000 · 0.64	= 31400		1152.000		"	=	63000#
60	62500 · 0.87	= 54400		2200.000		"	=	120.000#
80	70500 · 0.98	= 69100		2540.000		"	=	139.000#

	vertical component due to rack reaction			Tangential force			vert. comp.
20°	19700 · .82	=	16200	28800 · .94	= 27100	· .34	= 9200
40	63000 · .82	=	51600	49000 · .77	= 37800	· .64	= 24200
60	120000 · .82	=	78500	62500 · .50	= 31300	· .87	= 27200
80°	139000 · .82	=	114000	70500 · .17	= 12000	· .98	= 11800

Summary for vertical component due to wind load on trunnion shaft.

	Due to rack reaction		Due to tangential force		Sum
20°	16200	+	9200	=	25400#
40	51600	+	24200	=	75800#
60	78500	+	27200	=	105700#
80	114000	+	11800	=	125800#

Total Dead Load of moving leaf. (Entire width)

moving leaf	Front of trunnion	2 @ 242000	=	484000
	Rear of trunnion	2 @ 31500	=	63000
	Cws + girder			1152000
				1699.000#

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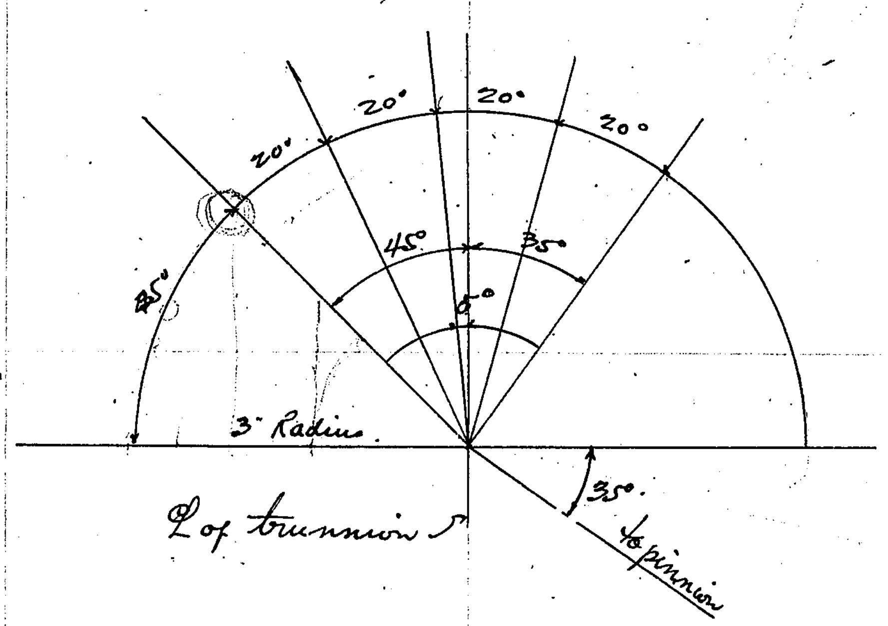
CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion Bascule. 2

Eccentricity of load on trunnion



When figuring the center of gravity of moving body including the counterweight it is better locate the same point front of the center line of trunnion when the span is down and at rear when the span up to secure the span to limiting position without using power.

Let us assume said center of gravity at 3" radius as shown on sketch

Total Dead Load assumed 1.699.000#

					arm			arm	Rack circle.
0°	For rotation	1699.000 × 0.707 =	1.200.000 ×	.25 =	~~24200~~ 300.000	÷ 18.3 =	16400"
	axial	0.707 =	1.200.000				
20°	For rotation	1699.000 × 0.422 =	715.000 ×	.25 =	179000	÷ 18.3 =	9800
	axial	× 0.906 =	1540.000				
40°	For rotation	1699.000 × 0.087 =	148.000 ×	.25 =	37000	÷ 18.3 =	2020
	axial	× 0.996 =	1690.000				
60°	For rotation	1699000 × 0.258 =	438000 ×	.25 =	109500	÷ 18.3 =	− 6000
	axial	× 0.966 =	1640.000				
80°	Rotation	1699000 × 0.570 =	970.000 ×	.25 =	242000	÷ 18.3 =	− 13200
	axial	× 0.820 =	1390.000				

Trolley pull

	0°	20°	40°	60°	80°	
For each trolley	800#	650	500	350	200	Cwt adjusted thus.
For 4 trolley wires	3200	2600	2000	1400	800#	

	Pull	arm		moment		at rack circle.
0°	3200# ×	24.0	=	76800	÷ 18.3 =	4190#
20°	2600 ×	28.0	=	72900	" =	3980
40	2000 ×	31.0	=	62000	" =	3380
60	1400 ×	33.0	=	46200	" =	2520
80°	800 ×	34.0	=	27200	" =	1485

Inertia of moving mass. $F = M\alpha$. where M = mass
α = accelleration.

$$M = \frac{Wr^2}{gr^2}$$

Mr^2	Front of trunnion =	484000 × 29.45^2	÷ 32.2 =	13.080.000	
Mr^2	rear " "	63000 × 9.27^2	÷ 32.2 =	168.600	!
Mr^2	Cwt.	1152000 × 14.0^2	÷ 32.2 =	7060.000	
				20.308400 ′#	

M at rack circle $20308400 \div 18.3^2 = 60750$

For 80° angular rotation, the length of travel along rack circle is

$$\frac{2\pi\ (18.3) \times 80^\circ}{360} = 25.5'$$

Assuming operating time as 1 min 20 second and 1st and last 20 second for accelleration
average uniform velocity $\frac{25.5}{60} = 0.425'$ per second

$$\text{accelleration} = \frac{0.425}{20} = 0.02125 \text{ ft. per second.}$$

$$F = M\alpha = 60750 \times 0.02125 = 1290^{\#}$$

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule. 3

Frictional Resistance
Frictional coefficient assumed .15 Total load = 1699.000#
at 0°. friction = 1699.000 × 0.15 = 255000#
Force at rack circle = 255000 × $\frac{8}{18.3 \times 12}$ = 9300# trunnion shaft 16" dia.

at 20°. 15# wind pressure.
load 1,699.000
wind load. 25400 vertical component only
1724400 × 0.15 = 258500 at rack circle = 258500 × $\frac{8}{18.3 \times 12}$ = 9400#

at 40° 15# wind
load 1699.000
wind. 75800
1774800 × 0.15 = 266000 at rack = 266000 × $\frac{8}{18.3 \times 12}$ = 9700#

at 60° 15# wind
load 1699.000
wind 105700
1804700 × 0.15 = 271000 at rack = 271000 × $\frac{8}{18.3 \times 12}$ = 9850#

at 80° 15# wind
load 1699.000
125800
1824800 × 0.15 = 274000 at rack = 274000 × $\frac{8}{18.3 \times 12}$ = 10.000#

Summary for required force at rack circle.
Raising the span against wind pressure.

		15#	10#	5#	0#
0°	Inertia	1290	1290	1290	1290
	wind	0	0	0	0
	friction	9300	9300	9300	9300
	Eccentric load	16400	16400	16400	16400
	Trolley pull.	−4190	−4190	−4190	−4190
		22800#	22800#	22800#	22800#
20°	Inertia	0	0	0	0
	wind	~~63000~~ 19700	~~42000~~ 13150	6570	0
	friction	9400	9360	9330	9300
	Ecc.	9800	9800	9800	9800
	Trolley pull	−3980	−3980	−3980	−3980
		34920#	28330#	21720#	15120#
40°	Inertia	0	0	0	0
	wind	63000	42000	21000	0
	friction	9700	9570	9440	9300
	Ecc	2020	2020	2020	2020
	Trolley	−3380	−3380	−3380	−3380
		71340#	50210	29080	7940
60°	Inertia	0	0	0	0
	wind	120.000	80.000	40.000	0
	friction	9850	9660	9480	9300
	Ecc	−6000	−6000	−6000	−6000
	Trolley	−2520	−2520	−2520	−2520
		121330#	81140#	40960#	880#

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule 4

		15#	10#	5#	0
80°	Inertia	– 1290	– 1290	– 1290	– 1290
	wind	139000	92500	46250	0
	friction	10000	9760	9530	9300
	Ecc	– 13200	– 13200	– 13200	– 13200
	Trolley pull	– 1485	– 1485	– 1485	– 1485
		132025#	85285#	38805#	– 7675#

Lowering ~~the span~~ against wind pressure.

		15#	10#	5#	0#
80°	Inertia	1290	1290	1290	1290
	wind	139000	92500	46250	0
	friction	10 000	10 000	10 000	10,000
	Ecc	13200	13200	13200	13200
	Trolley pull.	1485	1485	1485	1485
		164975	118235	71755	25275
60°	Inertia	0	0	0	0
	wind	120,000	80,000	40,000	0
	friction	9850	9660	9480	9300
	Ecc	6000	6000	6000	6000
	Trolley pull.	2520	2520	2520	2520
		138370	98180	58000	17820
40°	Inertia	0	0	0	0
	wind	63000	42000	21000	0
	friction	9700	9570	9440	9300
	Ecc	– 2020	– 2020	– 2020	– 2020
	Trolley pull	3380	3380	3380	3380
		74060	52930	31800	10660
20°	Inertia	0	0	0	0
	wind	19700	13150	6570	0
	friction	9400	9360	9330	9300
	Ecc	– 9800	– 9800	– 9800	– 9800
	Trolley pull.	3980	3980	3980	3980
		23280	16690	10080	2480
0°	Inertia	– 1290	– 1290	– 1290	– 1290
	wind	0	0	0	0
	friction	9300	9300	9300	9300
	Ecc.	– 16400	– 16400	– 16400	– 16400
	Trolley pull.	4190	4190	4190	4190
		– 4200	– 4200	– 4200	– 4200

Horse Power required

Operating time assumed 1 min. 20 second.

20 second acceleration.

40 " uniform speed.

20 " retardation.

average speed = 0.425' second or 25.5 ft. per min. at rack circle.

Gear efficiency assumed $(0.94)^5 = 0.73$ for 5 sets.

Horse power $= \frac{P \times 25.5}{33000 \times 0.73} = 0.00106\ P.$

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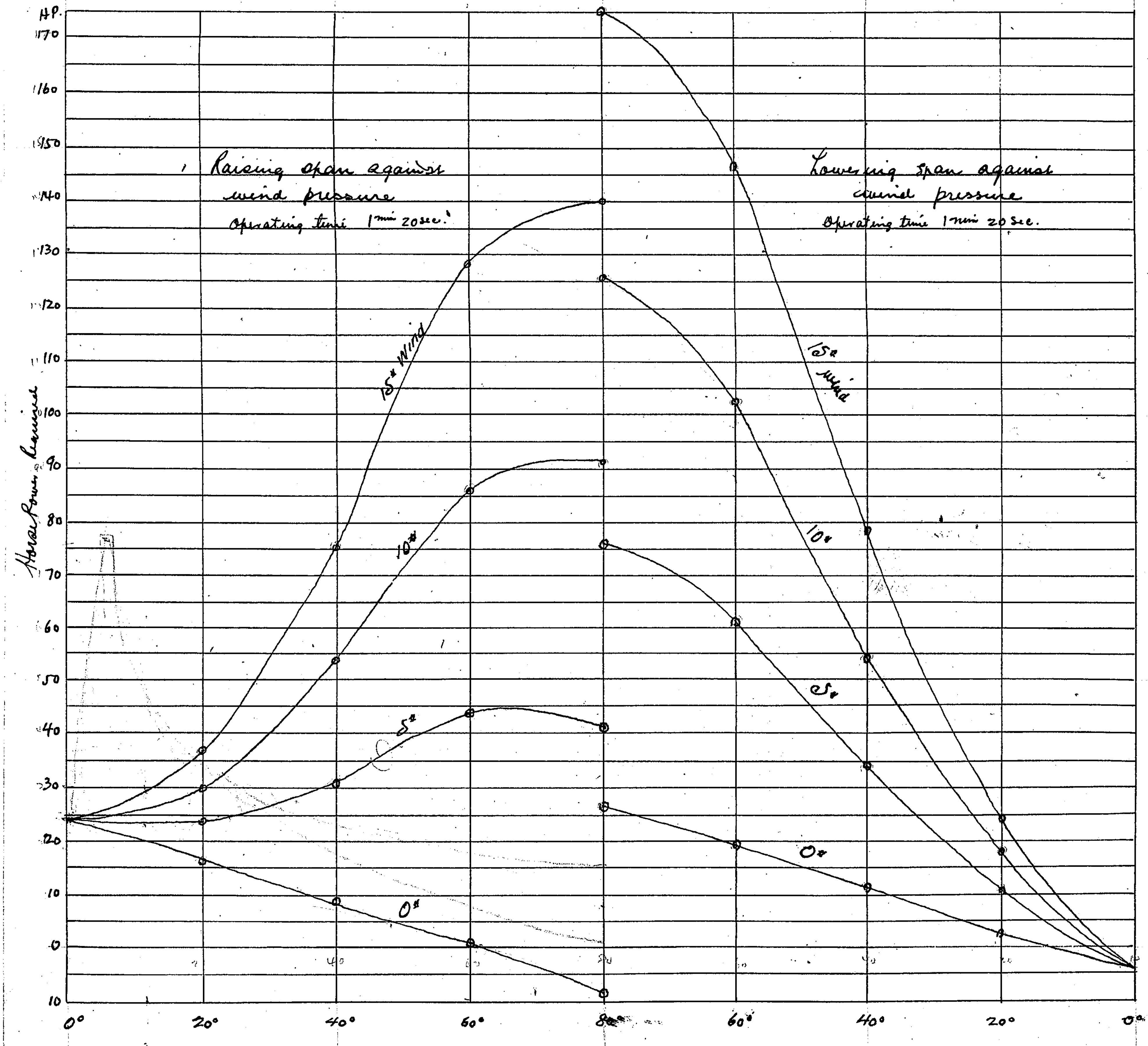
CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' Single leaf trunnion Bascule. 5

Horse Power reqd for several wind pressures

		15# force at rack	H.P.	10#		5#		0#	
Raising span against wind pressure.	0	22800	24.2	22800	24.2	22800	24.2	22800	24.2
	20	34920	37.0	28330	30.0	21720	23.0	15120	16.0
	40	71340	75.5	50210	53.2	29080	30.8	7940	8.4
	60	121330	128.5	81140	86.0	40960	43.3	880	.9
	80°	132025	140.0	85285	90.4	38805	41.1	-7675	-8.05
Lowering span against wind pressure.	80°	164975	175.0	118230	125.3	71755	76.0	25275	26.8
	60	138370	146.8	98180	104.0	58000	61.5	17820	18.9
	40	74060	78.3	52930	54.0	31800	33.7	10660	11.3
	20	23280	24.6	16690	17.7	10080	10.7	2480	2.6
	0	-4200	-4.45	-4200	-4.45	-4200	-4.45	-4200	-4.45



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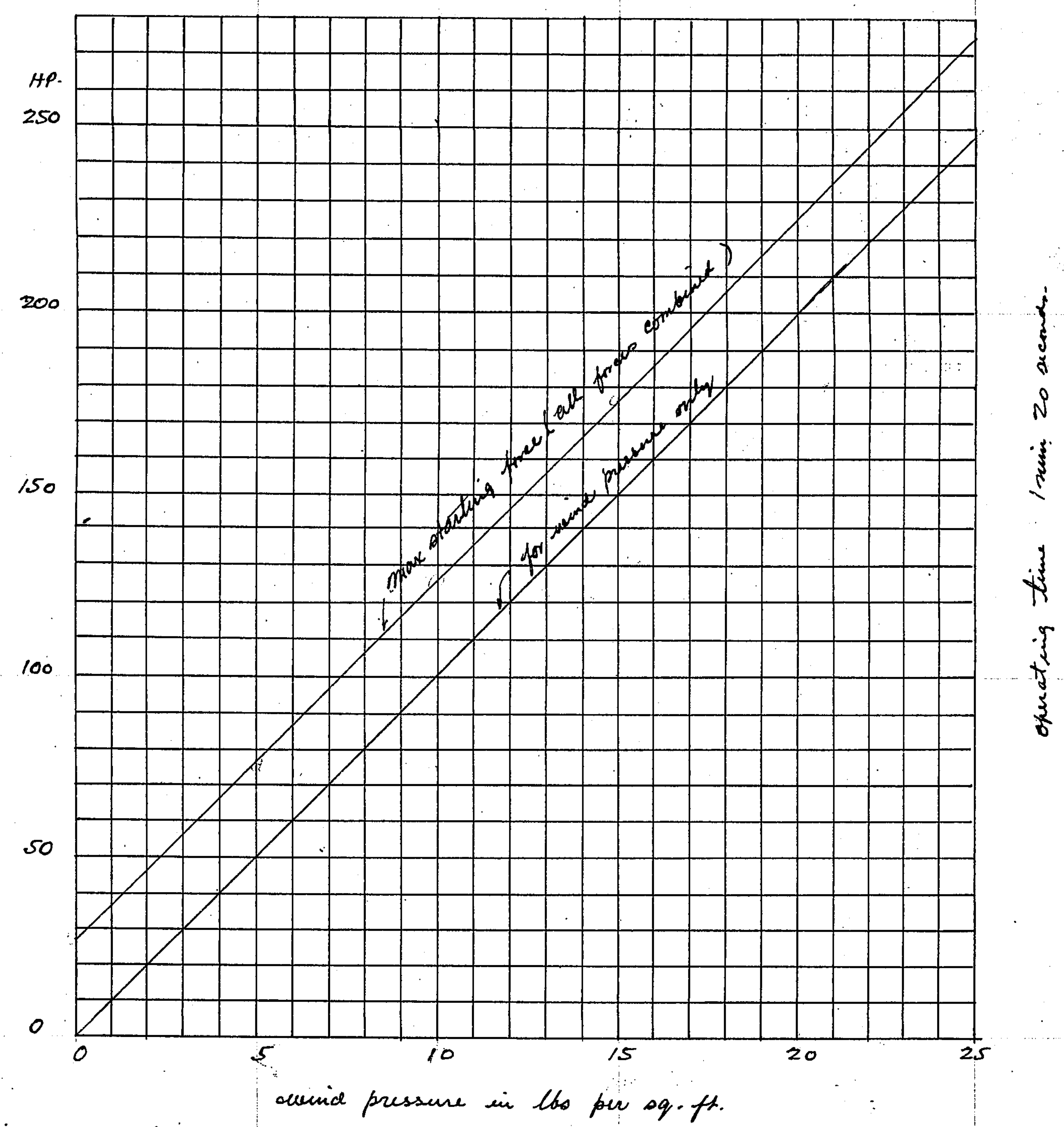
CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion Bascule. 6

Maximum starting Horse Power required.



Selection of motors.

The motors shall meet the following requirements

1. The two motors combined should operate the leaf in the required opening time against a 10#/□' wind
2. The max torque of the combined motors should be at least 50% in excess of the torque required to hold (not operate) against a 15#/□' wind.
3. Either motor alone should develope a max torque 10% in excess of torque required to operate the leaf against a 10#/□' wind

For condition 1 use 2-75HP motors which will develop power ~~to~~ resist 12.4#/□' wind pressure

For condition 2 Power required for condition 2. 150 HP
50%. 75
225 HP.

assuming the max torque of motor 2.5 times of torque of for full load.

$\frac{150}{2}$ HP = 75 HP.
75 × 2.5 = ~~169~~ 187 2@~~169~~ 187 = ~~338~~ 374 HP

For Condition 3. For 10# wind Required HP = 135 HP
10%. 13.5
148.5 HP.

Max Power of 75 HP motor = 75 × 2.5 = ~~169~~ 187 HP

For 2-75HP motors.

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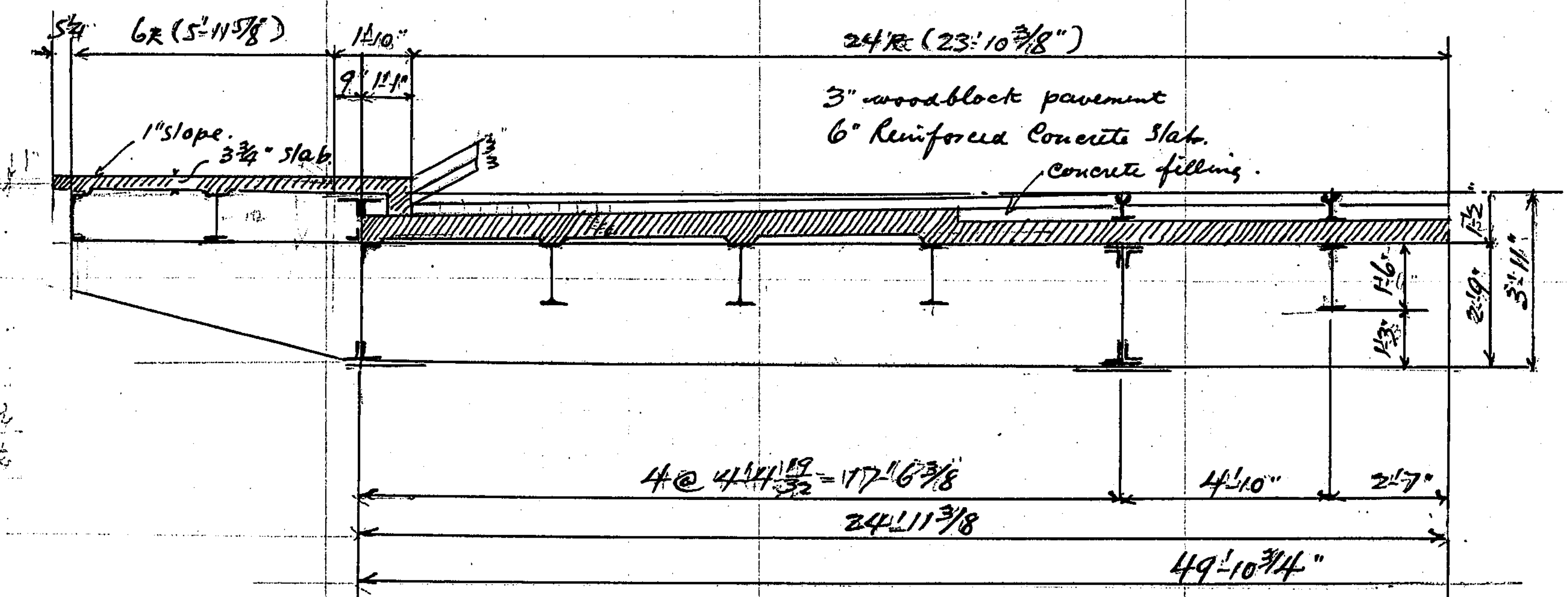
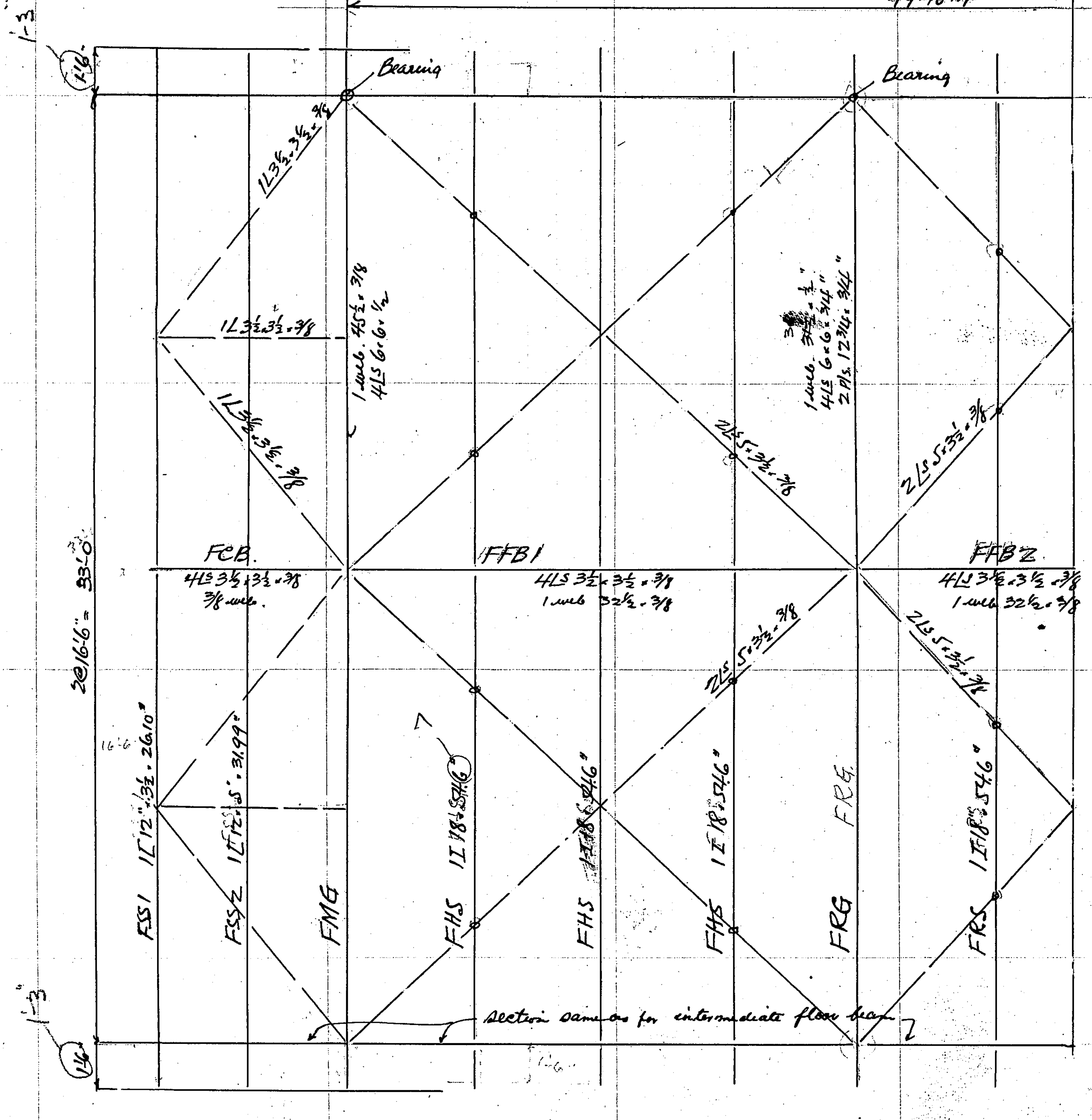
CALCULATIONS FOR

First Canal Bridge for City of Kobe: 33' fixed girder span.

Design of 33' fixed girder span.
Cross section of bridge as shown on sketch below.





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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 33' fixed girder span

Design of floor slab.
Slab under Electric Railway Tracks.

3" Woodblock pavement	=	15
4½" Lean Concrete filling	=	54
6" Concrete slab.	=	75
		144# per sq. ft.

For design of slab see page 35 slab for fixed floor on abutment

Slab for highway. span length $4'-4\frac{19}{32}"$ = 4.38'

3" woodblock pavement	=	15
6" Concrete slab.	=	75
fillet &c say		5
		95# per sq ft.

Slab for sidewalk. span length $6'9" \div 2 = 3'4\frac{1}{2}" = 3.38'$
3" reinforced Concrete slab with 3/4" wearing Course.

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

$m = \frac{1}{8} \cdot 147 \cdot 3.38^2 = 210.0'^{\#}$

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

$\doteq \sqrt{\frac{210 \cdot 12}{12 \cdot 102}} = 1.4"$ make slab 3" thick insulation at bottom 3/4" and 3/4" wearing course on top of slab.

Steel Area req'd = $\frac{210 \cdot 12}{\frac{7}{8} \cdot 2.25 \cdot 17000} = 0.075$ □" per ft.

Use 3/8"φ bars 6" centers or mesh of proper size to cover req'd steel area.

Sidewalk fascia stringer FSS1. span length - 16.5'

Dead Load	Concrete slab. 47# · 2.13	=	100#
	Handrail assumed		40
			140
	Beam assumed		35
			175#
	Live Load assumed 100 · 1.69	=	169
			344# per lin. ft.

moment = $\frac{1}{8} \cdot 344 \cdot 16.5^2 = 11700'^{\#}$

Shear = $\frac{1}{2} \cdot 344 \cdot 16.5 = 2840$

Section modulus req'd = $\frac{11700 \cdot 12}{15400} = 9.13$ Use 12"·3½ [@ 26.10#
Sm = 26.44

Sidewalk stringer FSS2 span length 16.5'

Dead Load	Concrete slab. 47 · 3.38	=	159
	stringer assumed		35
			194
Live Load	100 · 3.38	=	338
			532# per lin. ft.

moment = $\frac{1}{8} \cdot 532 \cdot 16.5^2 = 18100'^{\#}$

Shear = $\frac{1}{2} \cdot 532 \cdot 16.5 = 4390^{\#}$

Section modulus req'd = $\frac{18100 \cdot 12}{15400} = 14.1$ Use 12"·5" @ 31.99#
Sm = 36.69

Unit stress = $\frac{18100 \cdot 12}{36.69} = 5920$ #/□"

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CALCULATIONS FOR

First Panel Bridge for City of Kobe: 33' fixed girder span.

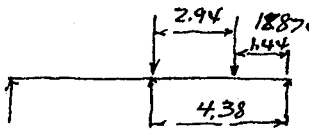
Highway stringers FHS. span length 16.5' spacing 4.38'

Highway flooring - 95 · 4.38/2 = 208
Railway flooring - 144 · 4.38/2 = 316
524# per lin ft.
stringer assumed 45
569# per lin. ft.

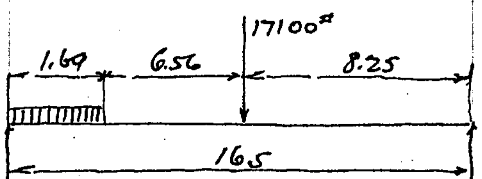
moment = 1/8 · 569 · 16.5² = 19400'#

shear = 1/2 · 569 · 16.5 = 4700#

Live Load motor truck loading rear wheel concentration with impact 12870#
Load on stringer

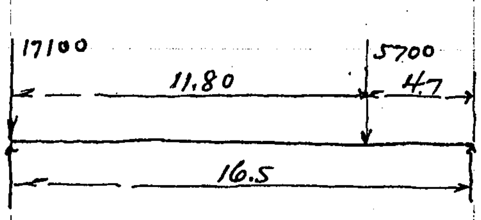


Reaction 12870 · 1.44/4.38 = 4230
12870
17100#

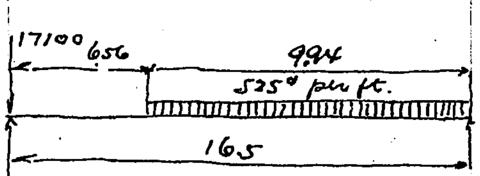


Uniform load 120 · 4.38 = 525# per lin ft.
Total load = 525 · 1.69 = 887#
Reaction = 887 · .84/16.5 = 44#

Moment due to wheel load = 8550 · 8.25 = 70500'#
moment due to unif. load = 44 · 8.25 = 360
70860'#



Max End shear. Rear wheel Conc = 17100
Front wheel Conc = 5700
shear = 5700 · 4.7/16.5 = 1630
17100
18730#



Reaction due to unif. load
525 · 9.94 · 4.97/16.5 = 1570#

Due to concentration 17100
18670#

Summary for moments and shears

	moment	shear
Dead Load	19400	4700
Live Load	70860	18730
	90260'#	23430#

Try 18"I · 54.7 Sm = 88.4

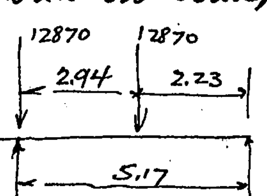
Unit stress = 90260 · 12 / 88.4 = 12240#/□" ok

Electric Railway stringers FRS span length 16.5
Dead Load.
Floor load 144 · 5.0 = 720
Rails + accessories 42
stringer assumed 80
842#

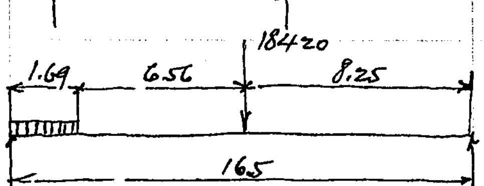
m = 1/8 · 842 · 16.5² = 28700'#

shear = 1/2 · 842 · 16.5 = 6940#

Live Load. Motor truck loading - Rear wheel with impact 12870#
Load on stringer Reaction 12870 · 2.23 ÷ 5.17 = 5550
12870
18420#



Uniform live load 120 · 5 = 600# per lin ft.
Total load 600 · 1.69 = 1010#
Reaction = 1010 · .84/16.5 = 51.#



Moment due to wheel load 9210 · 8.25 = 76000
moment due to unif. load 51 · 8.25 = 420
76420'#

増田淳氏関係資料
(独立行政法人 土木研究所蔵)

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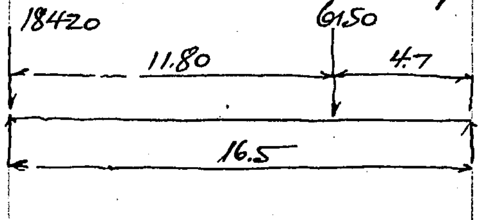
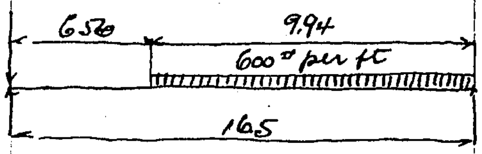
CALCULATIONS FOR

First Canal Bridge for City of Kobe: 33' Fixed Girder Span



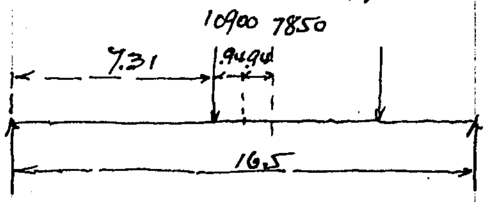
Max End shear Rear wheel conc - 18420
Front wheel conc. 6150

End shear $6150 \cdot \frac{4.7}{16.5}$ = 1755
18420
20175 #



Reaction due to unif. load $600 \cdot 9.94 \cdot \frac{4.97}{16.5}$ = 1800 #
Reaction due to conc. 18420
20220 #

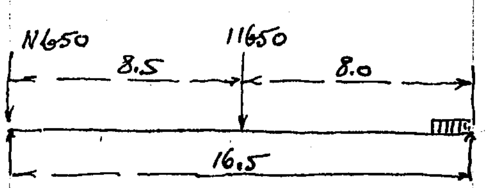
Electric Car Loading wheel load with impact $8359 \cdot 1.3$ = 10900
$6027 \cdot 1.3$ = 7850
18750 #



Center of gravity = $\frac{7850 \cdot 4.5}{18750}$ = 1.88

moment = $18750 \cdot \frac{7.31^2}{16.5}$ = 60800 '#.

End shear due to water car. Car loading with impact $8960 \cdot 1.3$ = 11650 #
$11650 \cdot \frac{8.0}{16.5}$ = 5650
11650
17300



Max moment and shear

	moment	shear
Dead Load	28700	6940
Live Load	76420	20220
	105120 '#	27160 #

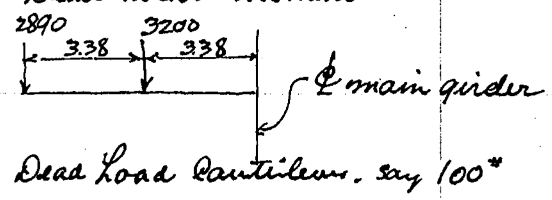
Section modulus req'd = $\frac{105120 \cdot 12}{15400}$ = 82.0
Use. 18" I. 54.7 # Sm = 88.4
Unit stress = $\frac{105120 \cdot 12}{88.4}$ = 14300 #/□"

Approximate deflection due to uniform load.

$$\Delta = \frac{5}{384}\frac{wl^4}{EI} = \frac{1}{8}wl^2 \cdot \frac{5}{48}\frac{l^2}{EI}$$

$$= 105120 \cdot \frac{5}{48} \cdot \frac{16.5^2 \cdot 12^4}{144 \cdot 30.000.000 \cdot 795} = 0.0086'$$
0.072"

Cantilever Bracket under sidewalk
Dead Load
Concentration at Fascia Stringer. $175 \cdot 16.5$ = 2890 #
Concentration at FS52 $194 \cdot 16.5$ = 3200 #
Dead Load moment m = $2890 \cdot 6.75$ = 19500
$3200 \cdot 3.38$ = 10800



30300
$100 \cdot \frac{6.75^2}{2}$ = 2280
Dead Load Cantilever. say 100 # 32580 '#

Live Load $100 \cdot 16.5$ = 1650 # for 6.75 $1650 \cdot 6.75$ = 11120 #
moment = $11120 \cdot 3.38$ = 37600
Dead Load moment 32580
70180 '#

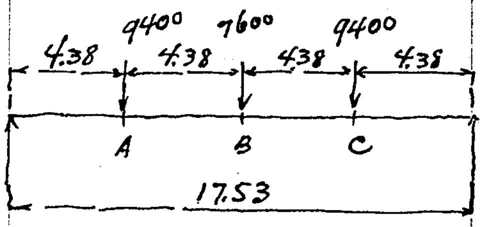
End shear 2890
3200
675
6765
Live Load. 11120
17885 #

Depth of beam say 2.7'
flange stress = 70180 ÷ 2.7 = 26000 #
section req'd = 26000 ÷ 17000 = 1.530 □" net
use 5/16" web
flange 2 L$\underline{s}$ $3\frac{1}{2} \cdot 3\frac{1}{2} \cdot \frac{3}{8}$ = 4.96 □" gr or 4.21 □" net.

First Canal Bridge for City of Kobe ; 33' fixed Girder span

Intermediate floor beam under highway. span length 17'-6 3/8 = 17.53

Dead Load



Approximate Concentration at Stringer Connection.

at C. 569" × 16.5 = 9400

at B. 95 × 4.38 = 416

stringer say 45

461" × 16.5 = 7600#

at A For safety, assume load same as for C = 9400#

End reaction = 9400 + 3800 = 13200# moment at B = 13200 × 8.76 = 115700

9400 × 4.38 = -41200

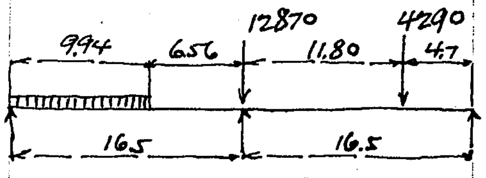
74500 1#

Less Dead Load Cant. m 32580

41920 1#

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

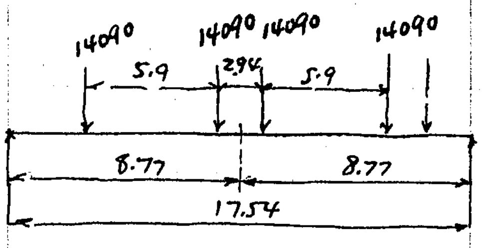
Front wheel with impact = 4290



Load on floor beam = 4290 × $\frac{4.7}{16.5}$ = 1220

12870

14090#



Uniform load 120 × 9.94 × $\frac{4.97}{16.5}$ = 359# call this 360# per ft.

Moment at center = 28180 × 8.77 = 247000

28180 × 4.42 = -124200

122800 1#

Concentration due to uniform load say 360 × 4.38 = say 1580#

moment = 1580 × 2 × 4.38 = 13800

136600 1#

End shear motor truck loading 28180 × 15.09 = 425.000

28180 × 6.24 = 175600

600600 ÷ 17.54 = 34200#

Uniform load. 1580 × 1.5 = 2370

36570

Summary for moments and shears

	moment	shear
Dead Load	41920	13200
Live Load	136600	36570
	178520 1#	49770#

Depth of girder 2'-9" b to b.

web assumed 32½" × 3/8" = 12.20"

1/8 web = 1.520" Effective depth = 2.58'

flange stress = 178520 ÷ 2.58 = 69200##

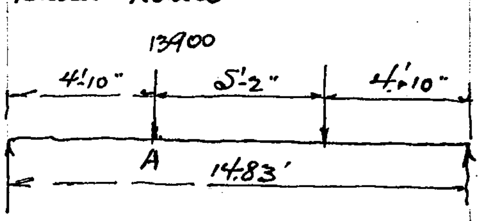
SR = 69200 ÷ 17000 = 4.07

1.52

Use 2 Ls 3½ × 3½ × 3/8" = 4.96 gr. or 4.21 ☐" net 2.55 ☐" net.

Intermediate Floor Beam under Electric Railway Tracks. span length 14'-10".

Dead Load



Concentration at A. = 842 × 16.5 = 13900#

moment at A = 13900 × 4.83 = 67000

girder say 1/8 × 100 × 14.83² = 2750

69750 1#

Dead Load girder - 740

13900

14640#

Live Load motor truck loading, rear wheel concentration with impact = 12870#

Front wheel " " " = 4290

load on floor beam = 4290 × $\frac{4.7}{16.5}$ = 1220

12870

14090#

Uniform load 360# per lin. ft of span

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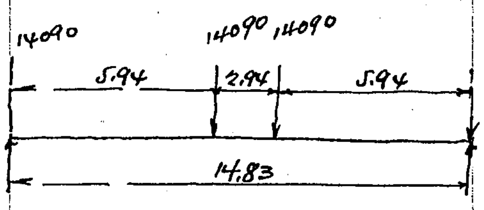
CALCULATIONS FOR

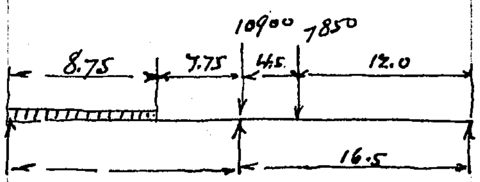
First Canal Bridge for City of Kobe ; 33' fixed girder span.

Live Load



moment due to motor truck = 14090 · 5.94 = 83500
Unif. load. 360 · 5 = 1800#
m = 1800 · 4.83 = 8700
92200 1#

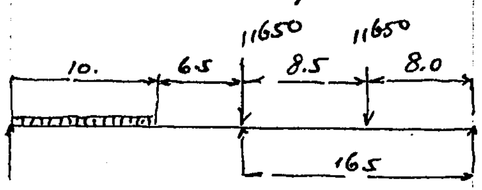
Electric Railway Car loading. Class I. Bogie Type 8359 · 1.3 = 10900
6027 · 1.3 = 7850.



$7850 \cdot \frac{12}{16.5}$ = 5680
10900
16580#

Uniform load $120 \cdot 8.75 \cdot \frac{4.38}{16.5}$ = 278# per lin ft.

Electric Railway Car loading water car with impact per rail - 8960 · 1.3 = 11650



$11650 \cdot \frac{8.0}{16.5}$ = 5650
11650
17300#

Uniform load say 360# per lin. ft.

Moment due to Concentration 17300 · 4.83 = 83500 1#
" " " Unif. load. ~~360~~ 1800 · 4.83 = 8700
92200 1#

max shear say 2@ 14090 = 28180
1800
29980 call this 30.000#.

Summary for moments and shears.

	moments	shear
Dead Load	69750	14640
Live Load	92200	30.000
	161950 1#	44640#

Depth of girder 2'-9" back to back
web assumed 32½ · ⅜ = 12.20 ⅛ web = 1.52 □"
depth = 2.58 flange stress = 161950 ÷ 2.58 = 62700
SR = 62700 ÷ 17000 = 3.70
1.52
2.18 □" net.

Use 2 L^s 3½ · 3½ · ⅜" = 4.96 □" gross or 4.21 □" net.

For End floor beams use same section as for intermediate floor beams.

Main Girder under Electric Railway track. FRG. span length 33'-0".

Dead Load. Dead Load reaction from highway side 14640
" " " " Railway side. 13200
27840#

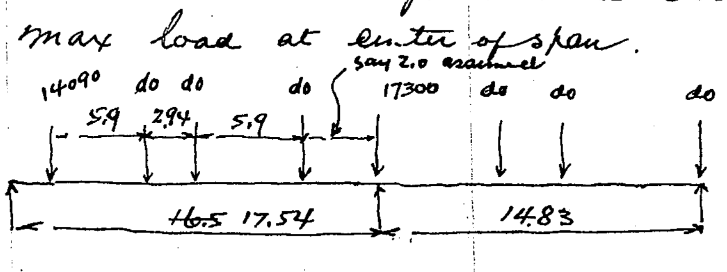
Dead Load girder assumed 250# per lin ft.

moment due to center load 13920 × 16.5 = 230.000 1#
" " " Unif. girder ⅛ · 250 × 33.0² = 34.000
264.000 1#
" " " Unif. floor ⅛ · 842 · 33.0² = 115.000
379.000 1# -

End shear. 13920. load on shoe = 2 @ 13920 = 27840
(250+842) · 16.5 = 18000 18000
31920# 45840 call this. 47500#

Live Load. { Concentration due to water car 17300#
Uniform load 360# per lin ft.
Concentration due to motor truck loading 14090# per wheel.
Uniform load 360# per lin ft.

max load at center of span.



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CALCULATIONS FOR

First Canal Bridge for City of Kobe : 33' fixed girder span.

load due to motor truck 14090 × $\frac{33.08}{17.54}$ = 26500#

Electric car loading - 2@17300 = 34600

61 100#

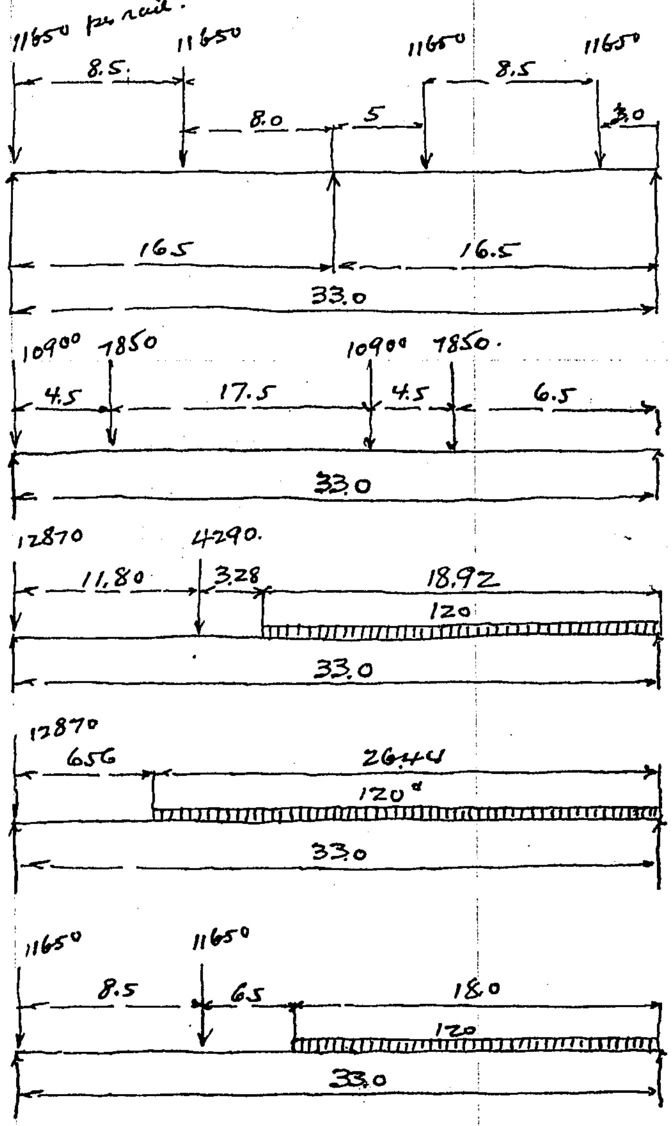
moment = $\frac{61100}{2}$ × 16.5 = 505000'#

load due to uniform load -

17.54
14.83
32.37 ÷ 2 = 16.18

360 × 16.18 = 5820
5820 ÷ 2 = 2910#
moment = 2910 × 16.5 = 48000'#
505000
Total moment 553000'#

Max End Shear



water car.

11650 × 39.0 ÷ 33.0 = 13800
11650
25450# per rail.

Bogie car 37500# per rail.
Reaction = 37500 × $\frac{19.75}{33.0}$ = 22400# per rail.

Electric
motor truck loading. 4290 × $\frac{22.20}{33.0}$ = 2880
12870
15750# per wheel.

Uniform load. 120 × 18.92 × $\frac{9.46}{33.0}$ = 650# per ft.

650 × $\frac{8.85}{2}$ = 2870#
15750
18620# per wheel.

Uniform live load 120 × 26.44 × $\frac{13.22}{33.0}$ = 1270

1270 × $\frac{8.85}{2}$ = 5600
motor truck 12870
18470# per wheel.

water car followed by uniform load. Car loading. 11650 × $\frac{14.5}{33.0}$ = 5120
11650
16770# per rail.

Uniform load. 120 × 18.0 × $\frac{9}{33}$ = 59.0#
590 × 4.5 = 2660#
Unif. load. 2660
19430#.

max live load on shoe.
water car - 2@25450 = 50900#
motor truck loading. 15750 × $\frac{33.08}{17.54}$ = 29700
Unif. load. say 650 × 8.85 about = 5750
86350#.

Summary for moments and shears

	moment	shear
Dead Load	379000	31920
Live Load	553000	86350
	932000'#	118270#

For load on shoe say 140.000#

Depth of girder 2'9" b to b of cov. pls.
assumed section.

2LS 6 × 6 × 3/4 = 16.88 × 1.78 = 30.00
1Pl. 12(1/2) × 3/4 = 9.38 × 0.38 = 3.60
3/4
26.26 1.01" 26.40

Effective depth = 2.62 − .17 = 2.45'

31 × 1/2
web assumed (31/2) × 1/2 = 15.75 1/8 web = 1.970"

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CALCULATIONS FOR

First Canal Bridge for City of Kobe. 33' fixed girder span

Stress in flange = 932000 ÷ 24.5 = 380.000
Section required = 380.000 ÷ 17000 = 22.30
1.97
20.33 □" net.

2 L^s 6×6×3/4 = 16.88 - 13.88
1 Pl. 12 3/4"×3/4 = 9.56 - 8.06
21.94 □" net. 290# per lin ft of girder

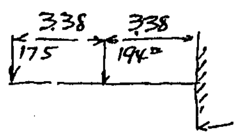
Moment of inertia of section.
1-web pl. (31 1/2)×1/2 = 15.75 1300
4 L^s 6×6×3/4 31. = 33.76 × 14.22² + 113 = 6953
2 Cov. pls. 12 3/4×3/4 = 19.12 × 16.38² = 5120
68.63 13973 in⁴.

Fibre stress = $\frac{932000 \times 12 \times 16.75}{13973}$ = 13400 #/□" ok.

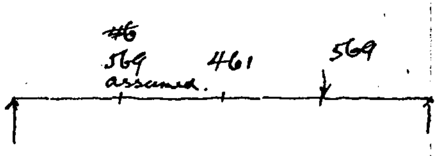
Approximate deflection = $932000 \times \frac{5}{48} \times \frac{33^2 \times 12^4}{12^2 \times 30.000.000 \times 13973}$ = 0.036'

33 : 0.036 = 916 : 1.

Main girder under sidewalk. Span length 33'-0".
Dead Load.
Cantilever action.



moment about ℄ girder 175 × 6.76 = 1180
194 × 3.38 = 655
℄ main girder 369# 1835 ÷ 17.54 = 105# extra
105
474# per lin ft. × 16.5 = 7800#



Reaction = 569
231
800# per lin ft. × 16.5 = 13200#
21000#

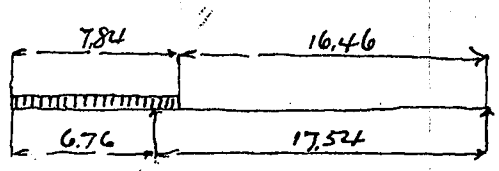
Load on girder Uniform load
Sidewalk slab. 47# × 2.76 = 130
Floor say 95# × 4.38/2 = 208
Extra load at curb line say = 75
413#
Assumed weight of girder 300
713# per lin ft.

Bending moment at center
Due to concentrated load 21000/2 × 16.5 = ~~346000~~ 173000
Due to unif. load 1/8 × 713 × 33² = ~~97000~~ 97000
~~443000~~ 1# 270000 1#

End shear 21000 ÷ 2 = 10500#
Unif. 713 × 16.5 = 11800
22300#

Load on shoe.
474
800
713
1987 × 18.0 = 35800#

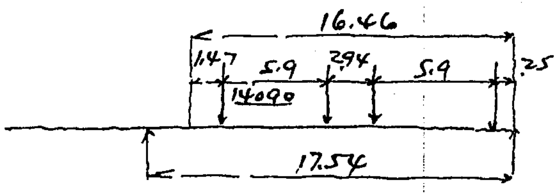
Live Load. Uniform live load on sidewalk. 100# per sq ft.
Reaction = 784" × 20.38 ÷ 17.54 = 910# per lin ft.



Uniform load on roadway 120# per sq ft.
Concentration on floor beam 360# per lin ft.
Combined with motor truck loading.
Reaction = 360 × 16.46 × $\frac{8.23}{17.54}$ = 2780# at ℄ of span

First Canal Bridge for City of Kobe. 33' fixed girder span

Live Load motor truck loading - rear wheel with impact 12870 #
Front wheel with impact 4290 #

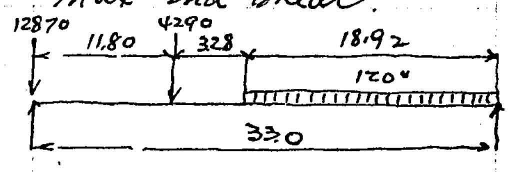


max reaction on intermediate floor beam = 14090 #

$2 \times 14090 \times \frac{15.25}{17.54} = 24400$ #
Unif. load - 2780
27180 # $\div 2 = 13090$ #

moment due to concentration $13090 \times 16.5 = 216.000$
Unif. load. $\frac{1}{8} \times 910 \times 33.0^2 = 124.000$
340.000 '#

Max End shear. motor truck loading $4290 \times \frac{22.20}{33} = 2880$
12870
15750 # per wheel.



Uniform load $120 \times 18.92 \times \frac{9.46}{33.0} = 650$ # per ft.

Reaction due to motor truck $2 @ 15750 \times \frac{15.25}{17.54} = 27400$

Unif. load on roadway $650 \times 16.46 \times \frac{8.23}{17.54} = 5030$

Unif. load on sidewalk. $910 \times 16.5 = 15000$

47430 call this max End shear.

Summary for moments and shear

	moment	shear	max load on shoe	
Dead Load	270 000	22300.	Dead load say	35800.
Live Load	340.000	say 47430	Live Load say	50000
	610.000 '#	69730 #		85800 #

Back to back of L^s assumed 3'-10" web - $45\frac{1}{2} \cdot \frac{3}{8} = 17.0$ $\frac{1}{8}$ web = 2.130"
Effective depth $3.83 - 0.29 = 3.54$ flange stress = $610.000 \div 3.54 = 172000$ #
section required = $172000 \div 17000 = 10.10$
2.13
7.97 □" net.

Use 2L^s $6 \times 6 \times \frac{1}{2}$" = 11.50 □" gross or 9.50 □" net. Ok.

Bottom Lateral Bracings
unsupported length 12'-3"
Try 2L^s $5 \times 3\frac{1}{2} \cdot \frac{3}{8}$" $r = 1.33$ $l/r = \frac{143}{1.33} = 108.$ 6 Rivets

Bracing under side walk 1L $3\frac{1}{2} \cdot 3\frac{1}{2} \cdot \frac{3}{8}$ - 3 Rivets.

Approximate weight of bracings.

8 - 2L^s $5 \times 3\frac{1}{2} \cdot \frac{3}{8}$	@ 10.4 #	× 24.0	=	2000
4 - 2L^s $5 \times 3\frac{1}{2} \cdot \frac{3}{8}$	@ 10.4	× 22.0	=	915
8 - 1L $3\frac{1}{2} \cdot 3\frac{1}{2} \times \frac{3}{8}$	@ 8.5	× 10.5	=	713
4 - 1L $3\frac{1}{2} \cdot 3\frac{1}{2} \times \frac{3}{8}$	@ 8.5	× 6.5	=	221
				3849
Gusset pls + c say				1500
				5349 # per span

weight of main girder 2250
1700
3950 @ 3.4 = 134 #
Details say 30% - 41
175 # per lin ft.
$175 \times 36.0 = 6300$ # $2 @ 6300 = 12600$ #

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First Canal Bridge for City of Kobe; 33' fixed girder span

Girder under Electric Ry tracks.

main section 68.63 @ 3.4 = 233#
Details say 25% = 58
291# per ft.

291 × 36.0 = 10500# 2@10500 = 21000#

Cross beams and Cantilever brackets.

main section of Cross beam web - 12.20
flanges 2@4.96 9.92
22.12 @ 3.4 = 75#
Details say 18
93# per lin ft.

Including Cantilever bracket total length = 63.
weight = 93 × 63 = 5850#
3 beams thus @ 5850 = 17550#.

Stringers	sidewalk.	2 @	28.0	=	56.
	"	2 @	35.0	=	70.
	Highway	6 @	58.0	=	348
	Elec. Ry	2 @	58.0	=	116
					590# per lin. ft.

weight of stringers 590 × 36. = 21200#

Summary for structural steel in Girder span

main girder under sidewalk	12600
" " " tracks	21000
Cross beams + Cantilevers	17550
Stringers	21200
Lateral Bracings.	5400
Shoes + misc	3000
	80750# or 36 tons.

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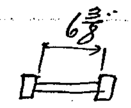
CALCULATIONS FOR

First Panal Bridge for City of Kobe: 60' Single leaf trunnion bascule. 121

No.	Material	Length	Weight per ft.	Total Weight	
	2 Trolley poles TP3				
4	Ls 3 1/2 x 3 1/2 x 3/8	19'-3 1/4	@ 8.5	655.0	
46	Lac. Bars 2 1/4 x 5/16	1-11	2.39	211.0	
2	Pls 26 x 5/16	3-10 1/2	27.63	214.0	
2	" 17 1/2 x 5/16	11-4	18.59	422.0	
4	Lac. Bars 2 1/4 x 5/16	1'-11"	2.39	18.0	
2	Pls 27 x 5/16	2'-6"	28.69	143.0	
2	Ls 3 1/2 x 3 1/2 x 3/8	8-0	8.50	136.0	
1	Pl. 18 x 5/16	3-3	19.13	62.0	
1	" "	2-9	"	53.0	
2	" 23 x 5/16	3-4	24.44	163.0	
2	" 8 1/2 x 3/8	2-1 1/2	10.84	46.	
2	Ls 4 x 3 1/2 x 3/8	2-0	9.1	36.	2 Pls. 15 x 5/16, 1'-5 1/2 @ 15.94 47#
2	" 5 x 3 1/2 x 3/8	2-4 1/2	10.4	50.	
2	" 6 x 3 1/2 x 3/8	1-7 1/4	11.7	37.	
1	Pl. 19 x 3/8	2-4 1/2	24.23	58.	
2	Fills 3 1/2 x 3/8	1'-3"	4.46	11.	
4	Ls 3 1/2 x 3 1/2 x 3/8	2'0 1/2"	8.5	69.	
2	" 6 x 3 1/2 x 3/8	1'-5"	11.7	33.	
1	Pl 17 1/2 x 3/8	2-0 1/2	22.31	46.	
2	Fills 3 1/2 x 3/8	0-10 1/2	4.46	8.	
1	L 6 x 3 1/2 x 3/8	1-5 1/2	11.7	17.	
1	Pl. 18 5/8 x 1/2	3-9"	31.71	119.	
6	Bolts 7/8"φ x 0-2 1/2		@ 1.01	6	
	Rivet Heads			158.	
				2,771 x 2 = 5,542	5,636
	~~Trolley arch 1 TA2~~			~~3,818~~	4,610
				~~10,152#~~	

No.	Material	Length	Weight per ft.	Total Weight	
	Trolley Arch TA3				
8	Ls 3 1/2 x 3 1/2 x 3/8	12'-0	@ 8.50	816.0	
4	" "	27-4 3/4	"	931.0	
80	Bars 2 1/4 x 5/16	2'-3"	2.39	430.0	
8	Ls 3 1/2 x 3 1/2 x 3/8	1'-8"	8.5	113.0	
4	Pls 20 x 5/16	1'-9"	21.25	149.0	
4	" 25 5/8 x 5/16	2-3	27.23	245.0	
4	" 28 x 5/16	2-8 1/2	29.75	322.0	
2	" 15 x 5/16	2-1 5/8	15.94	68.0	
2	" 18 x 5/16	2-1 5/8	19.13	82.0	
38	Bars 2 1/2 x 3/8	3'-0"	3.19	364.0	
26	" "	3-0	"	249.0	
4	Pls 12 x 5/16	2-1 5/8	12.75	109.0	
4	" 11 x 1/4	2-1 5/8	9.35	80.0	
8	Ls 3 x 3 x 5/16	1-8 1/4	6.1	82.0	
8	" 3 1/2 x 3 x 1/4	1-1	5.4	47.0	
4	" "	1-5 1/4	"	31.0	
4	Pls 13 x 1/4	1-5 1/4	11.05	64.0	
8	Fills 3 x 3/8	1-1 3/4	3.83	35.0	
4	Ls 6 x 4 x 3/8	2'-9"	12.3	135.0	
8	Bolts 3/4"φ	0-6 3/8	1.31	11.0	
8	" "	0-4 3/8	1.06	8.0	
8	Pls 12 x 5/16	1'-8 1/2	12.75	10.0	17.4
				4,381.0	
				4,545.0	



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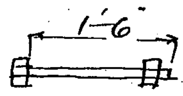
CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule. 122

No.	Material	Length	Weight per ft.	Total weight	
	2 Trolley poles TP4				
4	Ls 3½×3½×3/8	28-4½	@ 8.5	977.0	965
2	Pls 26 5/8×3/8	2-3	33.95	153.	
2	Cov.Pls 17½×5/16	20-7½	18.59	767.	
88	Lac.Bars 2¼×5/16	2-0	2.39	420.	
2	Pls 26×5/16	3-10½	27.63	214.	
2	" 27×5/16	2-6"	28.69	143.	
1	" 18×5/16	3-3	19.13	62.	
2	Ls 3½×3½×3/8	8-0	8.5	136.	
1	Pl. 18×5/16	2-9	19.13	53.	
2	Pls 15×5/16	1-5½	15.94	47.	
2	Ls 3½×3½×3/8	2-0	8.5	34.	Diaphragm.
2	" "	1-5	"	24	
1	Pl. 17½×3/8	2-0	22.31	45.	
2	Fills 3½×3/8	0-10¾	4.46	8.	
1	Base Pl. 26 5/8×¾	2-2¾	67.90	151.	Base
2	Ls 6×4×½	2-2 5/8	16.2	72.	
2	" "	1-5	"	46.	
700	Shop Rivets ¾"φ grip abt. 7/8"		0.44	308.	
25	Field " " "	" "	"	11.	
4	Anch.Bolts ¾"φ	×1'-6"	2.62	10.	
2	Washers 3"×3/8	0'-3"	3.83	8.	
				3,689. ×2 = 7,378	
					7.402



2 trolley poles TP4 2@3.689 = 7378 — 7,402
1- Trolley arch TA3 4381 — 4,545
11759# — 11,947

Summary for trolley poles and arches on fixed portion.

TP3 and arch 10152 — 10,246
TP4 and arch 11759 — 11,947
21911# — 22,193

Live load shoes 8 Required.

moving portion - 1772#

fixed portion of live load shoes.

a 2×20×21 = 840.
b 2×1.5×4×7.5 = 90
c 12×7×21 = 1765
d 2.5×5×9.5 = 119
} = 2576 cubic inch @ 0.283 = 728

8 bolts 7/8"φ × 0'.5" @ 1.64 = 13

741 × 8 = 5928#

LLS1 4- bolts. 1½"φ × 2'-0" @ 14.97 per piece 60

projection under shoe base. 1.75×1.5×22 = 58 @ 0.283 = 16

76 × 6 = 456

LLS2 4 bolts 7/8"φ × 0.3" @ 1.30 per piece. 4 = 5.0" × 2 = 10

6394

Summary moving portion = 1772
fixed portion = 6394
8166#

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CALCULATIONS FOR

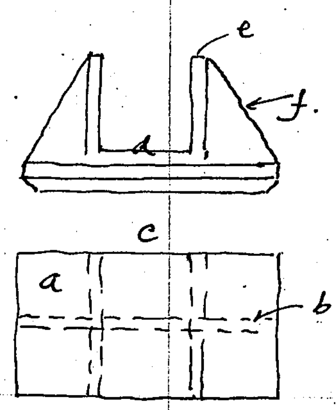
First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule. 123

Weight of Centering Castings. 1 Reqd.

moving portion 505 #

fixed portion

a	1.5 × 21.5 × 48	=	1548
b	1.5 × 1.5 × 44	=	99
c	1.5 × 1.5 × 42	=	95
d	2. × 8.5 × 13.5	=	230
e	.5 × 35 × 16 × 4	=	112
f	1.5 × 19.75 × 18 × 2	=	1068
			3152 @ 0.283 = 892 #



8 anchor bolts 1½"ᶲ × 20 @ 14.97 per piece = 120

1012

Summary moving portion 505
fixed portion 1012
1517 #

Cast steel Wind buffer blocks at rear 9 Required.

9 Cast steel blocks @ 147 # = 1323 #
72 bolts + nuts 3/4ᶲ × 2½" csk @ .62 = 45
36 bolts + nuts 3/4"ᶲ × 2⅛ csk @ .58 = 21
moving portion 1389. #

9 Cast steel wedges @ 111 = 999
9 " " pedestals @ 170 = 1530
tapped bolts and screws &c 50
fixed portion 2579

Total weight of blocks. 3968 #

Trunnion shafts and bearings.

no. Reqd.	Description		wt per piece	Total weight.	Remarks.
2	shaft ①	9.952 c/f.	5042 #	10,084 #	Hard steel.
4	bearings ②			7500 #	Cast steel
4	bearing caps ③			2336.	Cast steel
16	bolts 1½"ᶲ × 12¾" ④		9.33	149.3	M. steel
4	⑤		2.376	9.5	"
8	Keys ⑥		10.84	86.7	"
12	Collar ⑦		7.36	84.3	"
36	Screws 3/8"ᶲ × 3½" ⑧		.11	4.0	"
32	Bolts 3/4 × 2" ⑪		.63	20.7	"
4	Top bushings		308.0	1232.0	Phosphor bronze
4	Bottom		"	1232.0	"
16	Bolts 1½ ᶲ × 8¾"		7.09	113.44	m. steel
16	Bolts 1¾ × 4'-6½"		41.81	668.96	m. steel

Summary Hard steel + medium steel = 11220.4 #
Cast steel 10289.0 9836
phosphor bronze 2464.0
23973.4 # 23520.4

4 trunnion bosses around shaft. (Cast steel
Total weight 6720.0

Summary
trunnion shaft and bearings 23973
trunnion bosses 6720
30693 #

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CALCULATIONS FOR

First Panel Bridge — MATERIALS OF TRUNNION GIRDER

124

	No	Size	Length	Weight per ft.	Total Weight.		Remarks.
Web	2×2	92½"×⅜"	28'-9⅜"	235.9#	27156#		
Flg Ls	2×4	6×6×¾	28'-9⅜	28.7	6608		Bottom
"	2×4	6×6×¾	28-11½	"	6648		Top
Stiff Ls	2×24	5×4×½	6-0½	14.5	4205		
"	2×20	4×4×½	6-0½	12.8	3093		
Diaph pls	2×6	17×½	2'-4	28.9	809		
"	2×10	17×½	1'-6½	"	891		
pls	2×1	34½×¾	7-5	88.0	1305		Bottom
pls	2×4	13½×¾	3'-3	34.4	894		Splice
pls	2×4	12"×¾	2-6	30.6	612		
"	2×4	16½×¾	8'-2	42.1	2751		
"	2×4	12"×¾	2'-6	30.6	612		
"	2×4	12×¾	10'-2	"	2489		
"	2×4	12×¾	18'-0	"	4406		
Stiff. Ls	2×4	4×4×½	6-9	12.8	691		
Diaph pls	2×1	17×½	3'-0½	28.9	176		
Fills	2×4	4×¾	3'-9	10.2	306		
Stiff. Ls	2×12	4×4×½	7-7½	12.8	2342		
Diaph pls	2×3	17×½	4-0	28.9	694		
Fills	2×12	4"×¾	4'-8	10.2	1142		
Ls	8	6×6×¾	4'-2¼	28.7	961		Splice
pls	8	12×¾	2'-0½	30.6	500		
"	8	"	4-6½	"	1112		
pls	4	18½×½	4-8¼	31.45	590		
"	2×4	66"×¾	9'-9	168.30	13127		
Cov. pl.	2×2	12¾×¾	28-11½	32.55	3770	84120	
"	2×2	"	26-10¼	"	3496		
"	2×2	"	28-9⅜	"	3747		
"	2×2	"	26'-8⅛	"	3474		
Top Ls	2×1	4.4.⅜	22'-9"	9.8	446		
"	1	"	1-9	"	17		
Vertical Ls	2×2	5×3½×⅜	4-5½	10.4	185		Section. A & B.
Vertical Gusset pls	2×1	13×⅜	1-7	16.58	52		
"	2×1	14×⅜	1-3½	17.85	46		
Ls	2×1	6×6×⅜	1'-3	14.90	37		
"	2×3	6×6×⅜	0-6	"	45		
"	2×1	6×3½×⅜	0'-6	11.7	12		
"	2×1	3½×3½×⅜	4'-2	8.5	71		Diagonal.
"	2×1	"	4-5	"	75		
Fills	2×1	3½×⅜	0-6	4.46	4		
Gusset pls	2×1	13½×⅜	1-6	17.21	52		
Vertical Ls	2×2	5×3½×⅜	3-10	10.40	159		
Gusset pls	2×1	14×⅜	1-7½	17.85	58		
Ls	2×1	6×6×⅜	1-7½	14.90	48		
Gusset pls	2×1	11×½	1-0	18.70	37		Vertical.
"	2×1	13½×½	1-1½	22.95	52		"
"	2×1	9½×½	1-5	16.15	46		"
Ls	2×2	4×3×⅜	5-4	8.50	181		
"	2×2	3½×3½×⅜	4-9	"	162		
pls	2×1	7½×½	1-0½	12.75	26		Top
Top Gusset pls	2×1	12½×½	1-11	21.25	81		Section A.
pls	2×1	4"×½	2'-9	6.80	37		
Top Gusset pls	2×4	13"×½"	1'-2	22.1	206		
Vertical Gusset pls	2×3	8×½	0-11	13.60	74		Section B & C
"	2×1	13½×½	1-2	22.95	53		
"	2×1	9½×½	1-5	16.15	46	100797	
Ls	6×2	6×3½×⅜	0-8	11.70	93	101008	

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CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule 125

	No	Size	Length	Weight per ft.	Total weight	Remarks
Ls	2×2	4"×3"×3/8"	4'-0½"	8.5	137	
Ls	2×2	3½×3½×3/8	1-0½	"	34	
Top pls	2×1	12½×½	1-9	21.25	74	
Gusset pls	2×3	7"×3/8"	1-2	8.93	63	Right of section C.
Ls	2×4	5×3½×3/8	2-10½	10.40	239	
Gusset pls	2×2	9½×3/8	1-2	12.11	57	
Ls	2×2	6×6×3/8	"	14.90	69	
Ls	2×4	"	0-6	"	60	
Gusset pls	2×2	13½×½	1-3	22.95	115	
Ls	2×2×2	4×3×3/8	5-4	8.50	363	
Gusset pls	2×2	9½×½	1-5	16.15	92	
Ls	2×2.2	3½×3½×3/8	1-0½	8.5	71	
pls	2×~~2~~ 3	12½×½	1-9	21.25	~~149~~ 223	
Ls	2×2	5×3½×3/8	0-8	10.4	28	Center Top
pls	2×1	8×½	0-11½	13.6	26	
Ls	2×2	5×3½×3/8	2-9	10.4	114	
pls	2×1	13×½	1-5	22.1	63	
Ls	2×4	6×4×3/8	8-11½	12.3	881	
Gusset pls	2×1	10×½	0-10	17.0	28	
Ls	2×2	3½×3½×3/8	2-9	8.5	94	Vertical.
Gusset pls	2×1	10×½	1-0½	17.0	35	
Ls	2×2	3½×3½×3/8	"	8.5	35	
Gusset pls	2×2	13½×½	1-2½	22.95	111	
Ls	2×6	6×3½×3/8	0-9	11.70	105	
Gusset pls	2×1	15×½	1-3	25.50	64	
"	2×1	12×½	1-2½	20.40	49	
Ls	2×2	6×3½×3/8	1-0	11.70	47	
Ls	2×2	3½×3½×3/8	8-5	8.50	286	Diagonal.
Fills	2×1	3½×½	0-6	5.95	6	
Ls	2×2	4×4×3/8	8-1	9.80	317	Vertical.
Gusset pls	2×2	14½×3/8	1-8½	18.49	126	
[	2×1	12×3	7-9	25.0	387	
Ls	2×5	6×3½×3/8	0-9	11.70	88	
Fills	2×1	4×½	0-6	6.8	7	
Ls	2×4	4×4×3/8	5-0	9.8	392	Top View.
Fills	2×1	8×3/8	0-10	10.20	17	
Gusset pls	2×2	33×3/8	4-2	42.08	701	
"	2×2	29×3/8	2-9	36.98	407	
Cov. pls	2×2	12¾×¾	9-2	32.55	1194	
Fills	2×2	12¾×¾	4-2¼		545	
Web	2×1	60×½	6-3	102.0	1275	End Bracket.
Ls	2×2	6×4×½	8-1	16.2	524	
"	2×2	6×6×½	4-7	19.6	759	
"	2×2	6×4×½	2-1	16.2	535	
Fills	2×2	6"×½	1-0	10.2	41	
I	2×1	10×6	2-6	42.02	210	Grillage
"	2×3	"	3-6	"	883	
I	2×3	15×5½	5-6	45.0	1485	
"	2×3	"	9-2	"	2475	
Beam Separator	2×19	5½×½	1-3	9.35	444	
Bolts	2×6	¾"φ	2-8	4.37 per 1 Bolt	52	
"	2×4	"	1-1	1.99 "	16	
"	2×2×12	1"φ	0-5	1.97 "	95	
"	2×~~6~~ 8	1¼φ	0-9	4.00 "	~~48~~ 64	
"	2×58	7/8"φ	0-5	1.43 "	166	

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CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule. 126

Section D-D	NO	Size	Length	Weight per ft.	Total Weight	Remarks
Pls	2x4x1	12"x1/2"	3'-0 1/2"	20.40	496	projection to Wall.
Ls	4x4x2	4x3x3/8	1-0	8.5	272	
"	4x4x1	6x4x1/2	0-8	16.2	173	
Fills	4x4x1	6x1/2	0-8	10.2	109	
"	2x4x1	4x1/2	1-10	6.8	100	
"	2x4x1	"	1-1 1/2	"	61	
Gusset pls	2x1	52x3/8	7-0	66.3	928	Top.
"	2x1	27x3/8	3-10	34.43	264	Bottom.
Vertical " "	2x4	18x1/2	6-4	30.60	1550	
Ls	2x2x2	6x4x3/8	4-3	12.30	418	Top.
"	2x2x2	4x4x3/8	4-0	9.8	314	Bottom.
"	2x2x4	"	6-4	"	993	Diagonal.
Tie pls	2x2x3	9x3/8	0-9 1/2	11.48	109	
"	2x2x2	"	1-8 1/2	"	157	
Pls	2x4x1	24x1/2	2-2	40.80	707	
"	"	21x1/2	"	35.70	619	
"	2x1	15x3/8	1-8 1/2	19.13	65	
"	2x2x1	18x3/8	"	22.95	157	
Ls	2x2x2	4x4x3/8	5-6 1/2	9.8	434	
Tie pls	2x2x2	9x3/8	1-8 1/2	11.48	157	
pin	2x2x2	3"φ	1-2 1/2		232	
Pls	2x4x2	27 1/2x1/2	3-9	46.75	2805	
Ls	2x4x2	3 1/2x3 1/2x3/8	2-7	8.5	351	
pls	2x4x2	6x3/8	1-0	7.65	122	
[s	2x2x2	12[3/8	8-6	30.0	2040	Structure in Wall,
Ls	2x2x2	6x4x3/8	0-9	12.3	74	
"	2x4	6x4x1/2	5-4 1/2	16.2	697	
pls	2x2	20x1/2	"	34.0	731	
Ls	2x4	6x4x1/2	2-0	16.2	259	
Stiff Ls	2x16	4x4x1/2	1-7 1/2	12.8	666	
Diaph pls	2x2	10x1/2	"	17.0	111	
Fills	2x4	8x1/2	1-6	13.6	163	
Ls	2x1	6x4x3/8	5-4 1/2	12.3	132	Bottom.
Ls	2x10	6x4x3/8	1-8 1/2	12.3	420	
"	2x2	3x3x3/8	1-6	7.2	43	
"	2x2	"	5-10	"	168	8 Lac. bars 2 1/2x3/8, 2-3 @3.19 = 57
Washer	2x27	3"φ			48	16 " " 1-10 " = 93
R.H.	19860 20,050	7/8"φ		0.2125	4220 — 4261	8 " " 2-0 = 51
Casting	1	34x2	2-10	231.2	655	2 Req'd
	1	37 1/2x2	3-6	255	893	
	1	6 3/4x3	3-0	68.85	207	
	4	6 3/4x2	2-11	45.90	536	
	2	"	0-11	"	84	
Casting	1	34x1 1/4	2-10	144.5	3265# 409	2 Req'd.
"	1	12x2	1-3	81.6	102	2 Req'd.
	1	18 1/2x2	1-6	125.8	189	
	1	6 3/4x2	1-3	45.9	57	
	2	6 3/4x1 1/2	1-2 1/2	34.425	82	
	1	12x1 1/4	1-0	51.0	51	2 Req'd

3265
x 2
6,530
Pin. 232
6,762

~~142322# - 63.536 Tons~~

Summary
Pins and Castings 3497# 6,762
Structural steel 138825# 139,510
142322# 146,272#

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MADE BY ________ DATE 3-3-16 FILE NO ________

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CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule 127

No.	Material	Length	Weight per ft.	Total Weight	Remarks
	Cross Girder AB1				
1	WebPl. 33 × 3/8	18'-9"	42.08	789.	
4	Ls 5 × 3½ × ½	18-9	13.6	1,020.	
4	〃 6 × 4 × 3/8	2-8½	12.3	133.	
14	〃 3½ × 3½ × 3/8	2-8½	8.5	322.	
4	Fills 6 × ½	2-4¼	10.2	89.	
14	〃 3½ × ½	2-4¼	5.95	182.	
4	Pls 10½ × ½	1-2	17.85	83	
64	Rivet Heads ¾"φ		0.1425	9	
432	〃 〃 7/8"φ		0.2125	92	
				2,719	
	Cross Girder AB2 2 Req'd.				
1	WebPl. 33 × 3/8	23-6½	42.08	991.	
4	Ls 5 × 3½ × ½	23-6½	13.6	1,281.	
18	〃 3½ × 3½ × 3/8	2-8½	8.5	414.	
2	〃 6 × 4 × 3/8	〃	12.3	67	
2	Fills 7 × ½	2-2¼	11.9	52	
14	〃 3½ × ½	〃	5.95	182	
2	〃 6 × ½	〃	10.2	45	
1	Pl. 10½ × ½	0-10	17.85	15	
2	〃 〃	1-2	〃	42	
1	WebPl. 18 × 3/8	7-3½	22.95	167	
4	Ls 4 × 3½ × 3/8	6-11½	9.10	253	
6	〃 3 × 3 × 3/8	1-5¾	7.2	64	
2	Fills 6 × 3/8	0-11¼	7.65	14	
2	〃 3 × 3/8	〃	3.83	7	
2	Ls 4 × 4 × 3/8	1-1½	9.72	22	
2	Pls 8½ × ½	0-9½	14.45	23	
1	〃 〃	0-9"	〃	11	
1	〃 〃	1-6	〃	22	
1	〃 8½ × 3/8	〃	10.84	16	
4	Ls 4 × 3 × 3/8	〃	8.45	51	Grillage
1	Pl. 11½ × 3/8	〃	14.66	22	
4	Ls 3 × 3 × 3/8	0-11¼	7.2	27	
4	Fills 3 × 3/8	0-5¾	3.83	7	
2	Bolts 7/8"φ	0-2½	1.01	2	
80	Rivet Heads ¾"φ		0.1425	11	
784	〃 〃 7/8"φ		0.2125	167	
				3,975 × 2 = 7,950	
	Stringers, Lateral bracings etc.				
10	Is 18 × 7"@75.0#	25-8"		19,255.	AS1^R-5^R
10	〃 〃	10-0		7,502	AAS2^R-5^R
4	〃 〃	4-11		1,475	AST1-2
16	Conn.Ls 4 × 4 × 3/8	1-2	9.8	183	
18	Ls 3 × 3 × 3/8	4-4½	7.2	567	AST3
4	Ls 8 × 3@19.3	4-11		380	AST4
2	〃 〃	4-9		183	AST5
14— 28	Ls 4 × 4 × 3/8	0-5	9.8	114 57	
1	Ls 8 × 3@19.3#	5-1		100	AST12
4	Pls 7 × ½	23-9	11.9	1,131	AS4^R-5^R
4	〃 〃	10-10	〃	416	〃
4	〃 〃	16-3	〃	774	〃

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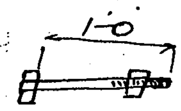
CALCULATIONS FOR

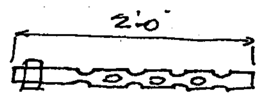
First Canal Bridge for City of Kobe. 60' single leaf trunnion bascule. 128

No.	Material	Length	Weight per ft.	Total Weight	Remarks
8	Ls 3×3×3/8	4-2½	7.2	242.	AST6
20	P/s 12×3/8	1-1½	15.3	346.	Connection Pls of stringers
10	Ls 3×3×3/8	8-6	7.2	386.	AST7
2	" "	4-0	"	58	AST8
2	" "	5-6	"	79	AST9
2	" "	4-5	"	65	AST10
4	P/s 13×3/8	2-1	16.58	138	Lateral Pls.
8	" "	1-6	"	199	
2	" 16×3/8	1-4	20.4	54	
2	" 17×3/8	1-5	21.68	62	
2	" 14×3/8	1-3	17.85	45	
2	" 11×3/8	1-3	14.03	35	
24	" 6×3/8	1-2	7.65	215	
8	" "	1-9	"	107.	
2	" 7×3/8	1-6	8.93	27	
4	" "	1-2	"	42	
2	Ls 7×3½@20.23# × 26-0			1,052	AES ℄
2	" 12×3½@32.88# × 23-10			1,567	ASS2 ℄
2	Is 12×5@31.99# × 23-10			1,525	ASS1 ℄
2	Ls 3×3×3/8	3-1½	7.2	45	AST11
4	P/s 6×3/8	0-9	7.65	23	
10	" 12×½	1-2	20.4	239	
2	" 10½×½	1-0	17.85	36	
2	" 12×½	1-0	20.4	41	
28	Anchor Bolts 7/8"φ	1-0	2.61	73	
2,752 1496	Rivet Heads 3/4"φ		0.1425	213 — 392	
12	Ls 3½×3½×3/8	1-2	8.5	120	Bracket 六箇分
12	" "	1-6	"	156	
12	" "	1-2½	"	126	
6	P/s 16×3/8	1-8½	20.4	180	
6	" 7×3/8	1-0	8.93	54	
				$\boxed{39,630}$ — 39,752	



Column AC1 2 Req'd.

No.	Material	Length	Weight per ft.	Total Weight
1	Pl. 10 3/8×½	2-9½	17.64	49.
2	Ls 6×4×3/8	0-11¾	12.3	23
2	Fills 5¼×3/8	0-6	6.69	7
4	Ls 5×3½×3/8	12-4	10.4	514
1	Pl. 12×3/8	12-4	15.3	189
2	Ls 6×6×3/8	0-11¾	14.9	29
2	Fills 5¼×3/8	0-6	6.69	7
2	P/s 15×3/8	1-9½	19.13	69
2	Ls 6×4×3/8	1-9½	12.3	44
1	Pl. 21½×½	1-10½	36.55	69
4	Swedge Anchor Bolts 1"φ × 2-0		5.6	22
372 (332)	Rivet heads 7/8"φ		0.2125	79 71
				1,101 × 2 = 2,202
				1,093 2,186



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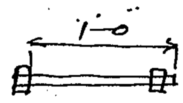
CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' Single leaf trunnion bascule.

129

No.	Material	Length	Weight per ft.	Total weight	Remarks
	Column AC2 2 Req'd.				
1	Pl. 8×½	1-6½	13.6	21.	
2	Ls 6×3½×3/8	0-9¾	11.7	19.	
2	Fills 3¼×3/8	0-6	4.14	4	
2	Ls 6×4×3/8	0-7½	12.3	16	
4	" 3½×3½×3/8	14-3½	8.5	486	
1	Pl. 10×3/8	14-3½	12.75	182	
2	Ls 6×6×3/8	0-9¾	14.9	24	
2	Fills 3¼×3/8	0-6"	4.14	4	
2	Pls 14½×3/8	1-3	18.49	46	
2	Ls 6×4×3/8	1-2½	12.3	30	
1	Pl. 14½×½	1-8	24.65	41	
4	Swedge Anchor Bolts	1"φ×2'0"	5.6	22	
286	Rivet Heads 7/8"φ		0.2125	61 - 65	
306				956 ×2 = 1,912	
				960 1920	
	Side Walk Cross Beam ACC top of Column AC2			2 Req'd.	
1	Pl. 12×3/8	8-1¾	15.3	125.	
4	Ls 3½×3½×3/8	8-1¾	8.5	277.	
10	" 3×3×3/8	0-11¾	5.9	58.	
10	Fills 3×3/8	0-5¼	3.83	17	
1	Pl. 7½×½	1-0	12.75	13	
1	" "	0-6½	"	7	
1	" 8×½	0-10"	13.6	11	
2	Anchor Bolts 7/8"φ	1'0"	2.61	5	
24	Rivet heads ¾"φ		0.1425	3	
128	" " 7/8"φ		0.2125	27	
				543 ×2 = 1,086	

Summary

Cross Girders AB1	2,719 #	
" " AB2	7,950	
Stringers. lateral bracings etc.	39,630	39,752
Columns AC1	2,202	2,186
" AC2	1,912	1,920
Side walk Cross beam ACC	1,086	
	55,499	or 24.776 Tons
	55,613	

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule. 130

		No	Size	Length	Weight per ft.	Total Weight	Remark
FMG1 R/L	Web	1	45½×⅜"	35'-6"	58.02	2060	FMG1 R/L 2 Req'd each
	Flg Ls	4	6×6×½"	35'-6"	19.60	2783	
	Stiff Ls	14	6×6×⅜"	3'-9"	14.90	782	
	"	1	"	2'-8"	"	40	
	"	12	5×3½×⅜"	3'-9"	10.40	468	
	Fills	4	6×½"	2'-9¾	10.20	115	
	"	6	12½×½	2'-9¾"	21.25	359	
	"	12	3½×½	2'-9¾	5.95	201	
	Hor. Ls	2	3½×3½×⅜	3'-6"	8.50	60	
		2	"	4'-0"	"	68	
		2	"	4'-0½	"	69	
		2	"	3-6½	"	60	
		2	"	0-8	"	11	
	Fills	2	2¾×⅜	0'-3½"	3.51	2	
	Ls	4	6×3½×⅜	1'-0"	11.70	47	
	gusset	2	23½×⅜	2-8	29.96	160	
	"	1	"	2'-9½"	"	84	
	R.H.	560	⅞ φ		0.2125	119	
		600	¾ φ		0.1425	86	
							7574×2 = 15148
FRG1	Web	1	31×½"	35'-6"	52.70	1871	FRG1 2 Req'd
	Flg Ls	4	6×6×¾	35'-6"	28.70	4075	
	Stiff Ls	24	5×3½×⅜	2'-6"	10.40	624	
	Fills	24	3½×¾	1'-7¼"	8.93	344	
	Pls	6	12½×¾	"	31.90	307	
	Cov. pls	2	12¾×¾	35'-6"	32.55	2311	
	Gusset	2	34½×⅜	3'-1½"	43.99	348	
	"	1	34½×⅜	3'-5"	"	150	
	R.H.	1500	⅞ φ		0.2125	319	
							10349×2 = 20698
FFB1-2	Web	1	32½×⅜	17'-3"	41.44	715	FFB1 ...... 4 Req'd FFB2 — 2 Req'd
	Flg Ls	4	3½×3½×⅜	16'-4"	8.5	555	
	Stiff Ls	6	"	2'-8¼"	"	137	
	Fills	6	3½×⅜	2'-1¾"	4.46	57	
	"	6	3"×⅜	1'-3"	3.83	29	
	Ls	2	6×6×⅜	2'-5¾"	14.9	74	
	R.H.	440	⅞ φ		.2125	94	
							1661×2 = 3322 ...... FFB2
	Gusset	3	11"×⅜"	2'-3"	14.03	95	
							1756×4 = 7024 ...... FFB1
FFB3-4	Web	1	32½×⅜	14'-7"	41.44	604	FFB3 — 2 Req'd FFB4 ...... 1 Req'd
	Flg Ls	4	3½×3½×⅜	13'-7½"	8.5	463	
	Stiff Ls	4	"	2'-8¼	"	91	
	Fills	4	3½×⅜	2'-1¾"	4.46	38	
	"	4	3"×⅜"	1'-3"	3.83	19	
	Ls	4	6×6×⅜	2'-5¾	14.90	148	
	R.H.	336	⅞ φ		.2125	71	
							1434×1 ------------ FFB4
	Gusset	2	11"×⅜"	2'-3"	14.03	63	
							1497×2 = 2994 ...... FFB3
FS1-2	I	1	18"×6	1'-2"	54.70	64	16 Req'd
	I	1	"	16'-4"	"	893	
	Ls	3	6×3½×⅜	1'-1"	11.7	38	
	R.H.	44	⅞ φ		.2125	9	
							1004×16 = 16064

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion girder 131

		No	Size	Length	Weight per ft.	Total Weight	Remarks.
FLB1	Ls	2	5"×3½"×⅜"	22-2¼"	10.40#	462#	FLB1 4 sets Req'd
	"	2	"	10-8	"	222	
	"	2	"	10-11	"	227	
	Gusset pls	1	17×⅜	2-2	21.68	47	
	pls	4	8½×⅜	1-1	10.84	47	
	Ls	4	4×3½×⅜	0-8½	9.1	26	
	R.H	230	⅞"φ		21.25	49	
						4@ 1080 = 4320	
FLB2	Ls	2	5×3½×⅜	20-1	10.4	419	FLB2 2 sets Req'd
	Ls	2	"	9-6½	"	198	
	Ls	2	"	9-9½	"	204	
	Gusset pl	1	17½×⅜	2-2½	22.31	49	
	pls	4	8½×⅜	1-1	10.84	47	
	Ls	4	4×3½×⅜	0-8½	9.1	26	
	R.H.	230	⅞"φ		21.25	49	
						2@ 992 = 1984	
FSS1 R/L	[	1	12×3½	17-8¾	26.10	463	FSS1 R/L 2 Req'd each
	pl	1	9×⅜	0-10½	11.48	10	
	"	1	10½×⅜	2-0	13.39	27	
	pls	2	9×⅜	1-2½	11.48	27	
	R.H	22	⅞"φ		21.25	5	
	R.H	42	¾"φ		14.25	6	
						4@ 518 = 2072	
FSS2 R/L	I	1	12×5	17-8¾	31.99	567	FSS2 R/L 2 Req'd each
	pl	1	5×⅜	0-5½	6.38	3	
	pl	1	9×⅜	1-0½	11.48	12	
	R.H.	12	⅞"φ		21.25	3	
	R.H	32	¾"φ		14.25	5	
						4@ 590 = 2360	
FCB1 R/L	Web	1	33×⅜	6-7	42.08	277	FCB1 R/L 2 Req'd each
	Flg Ls	2	3½×3½×⅜	6-1½	8.5	104	
	"	2	"	6-5	"	109	
	Stiff. Ls	2	"	1-1½	"	33	
	"	2	"	0-1½	"	16	
	Fills	2	3½×⅜	1-5	4.46	13	
	Washer	2	3"φ×⅜			1	
	Gusset pl.	1	13×⅜	1-5	16.58	24	
	"	1	12×⅜	1-1½	15.3	17	
	"	1	12½×⅜	1-1½	15.94	18	
	Ls	2	3½×3½×⅜	0-10½	8.5	15	
	Ls	2	"	0-7½	"	11	
	"	2	4×3½×⅜	0-9	9.1	14	
	pl	1	10½×⅜	1-4	13.39	18	
	"	1	10×⅜	0-11	12.75	12	
	R.H.	200	⅞"φ		21.25	43	
	R.H	24	¾"φ		14.25	3	
						4@ 728 = 2912	
FFT1-2-3 Total	I	2	9×4	4-3	28.55	242	
	I	2	"	4-8⅝	"	268	
	I	1	"	5-1	"	145	
	Ls	12 20	6×4×⅜	0-5½	12.27	72 — 113	
	R.H.	64	¾"φ		14.25	9	
						436 — 777	

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CALCULATIONS FOR

First Panal Bridge MATERIALS OF 33' FIXED GIRDER SPAN 132

		No	Size	Length	Weight per ft.	Total wt.	Remarks.
FCB2 R L	Web	1	33" × ⅜	6' 7"	42.08#	277#	FCB2 R L 1 Req'd each.
	Flg L	1	3½×3½×⅜	6-1½	8.50	52	
	"	1	"	6-7½	"	56	
	"	1	"	6-5	"	55	
	"	1	"	6-11	"	59	
	Stiff. Ls	2	3½×3½×⅜	1'-11½	8.50	33	
	"	2	"	0-11½	"	16	
	Fills	2	3½ × ⅜	1-5	4.46	13	
	Washer	2	3"φ - ⅜			1	
	Gusset pl	1	13½ × ⅜	2-2½	17.21	38	
	"	1	12 × ⅜	1-1½	15.30	17	
	"	1	12½ × ⅜	"	15.94	18	
	Ls	2	6×3½×⅜	0-10½	11.70	21	
	L	1	5×3½×⅜	"	10.40	9	
	L	1	"	1-4	10.40	14	
	Ls	2	3½×3½×⅜	0-7½	8.50	11	
	"	2	4×3½×⅜	0-9	9.10	14	
	Tension pl	1	6 × ⅜	2-11½	7.65	23	
	pl	1	10 × ⅜	0-11	12.75	12	
	Fill	1	3½ × ⅜	0-5	4.86 4.46	2	
	R.H.	222	⅞"φ		21.25	47	
		24	¾"φ		14.25	3	
					2@	791 = 1582	
FSL2	L	1	3½×3½×⅜	6-2	8.5	52	FSL2 4 Req'd.
	pl	1	14 × ⅜	1-4½	17.85	25	
	R.H	20	⅞"φ			4	
					4@	81 = 324	
FSL1	L	1	3½×3½×⅜	9-1	8.50	77	FSL1 8 Req'd.
	R.H	12	⅞"φ			3	
					8@	80 = 640	
Grillage for pier	I	4	12"×6"	4-7½	44.02	815	2 Req'd.
	"	4	18"×7"	4-6	75.02	1350	
	"	1	"	1-10	"	137	
	Bolts	36	⅞"φ	0-5	143/100	51	
						2 @ 2353 = 4,706	
FBG1 and FBG2	Cast steel	1	20×1½	1-9	102	179	FBG1 6 Req'd
		1	14×1½	1-4	71.4	95	FBG2 2 Req'd
		1	10⅜×2	0-8½	70.55	50	
		2	10⅜×1½	1-3	52.915	132	
					2@	456 = 912	...... FBG2
	2" / 1½" / 1¼"	1	1⅝ × 1½	3'-3"	8.29	27	FBG1 only
					6@	483 = 2898	
						3810	
FAB	Anchor Bolts	24	1½"φ × 2'-6"		6.08	[illegible]	

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CALCULATIONS FOR

First Canal Bridge MATERIALS OF 33' FIXED GIRDER SPAN. 133

Rail Support RS1 28 Req'd

	No	Size	Length	Weight per ft.	Total weight	Remarks.
Rail support.	1	6×3½×⅜	1-0¾	11.64 7	12	
	1	"	0-7	"	7	
	2	5×3½×⅜	0-6¼	10.37 4	10	
Rivet. R.H	24	¾ ϕ		14.25	3	
Bolt	2	¾ ϕ	0-3	75/100	2	
				28 @	34 = 952	

End Rail support RS2 28 Req'd

	No	Size	Length	Weight per ft.	Total weight
	2	6"×3½×⅜	0-7	11.64 7	14
Rivet. ~~H.H.~~ (Rivet. H 16)	8	¾" ϕ		14.25	2
Bolts	2	¾" ϕ	0-3	75/100	2
	2	5×3½×⅜	0-6¼	10.37 4	10
				28 @	28 = 784
				Rail sup.	1736

~~End Rail support of FRG1 2 Req'd~~

	No	Size	Length	Weight per ft.	Total weight	Remarks
	1	12¾×¾	1-9	32.55	57	casting
	1	11⅜×¾	1-9	29.01	51	
	1	5½×¾	1-9	14.03	25	
	3	5½×¾	0-11	14.03	39	
Bolts	28	⅞" ϕ	0-4	88/100	25	
				2@	197 = 394	

~~End Rail support of FS1-2 2 Req'd~~

	No	Size	Length	Weight per ft.	Total weight	Remarks
	1	6½×¾	1-9	16.58	29	casting
	1	11⅜×¾	1-9	29.01	51	
	1	5⅛×¾	1-9	13.07	23	
	3	5⅛×¾	0-8	"	26	
Bolts	20	⅞" ϕ	0-4	88/100	18	
				2@	147 = 294	

A

MATERIALS OF EXPANSION JOINT IN FLOOR SLAB.

		No	Size	Length	Weight per ft.	Total weight
EJ1	Pls	2	3½×½	8'-1" 2.396	5.10 5.95	82 96
	"	2	"	16-2⅞"	"	166 193
	"	2	"	3'-8¼"	"	38 44
	Pl	1	"	4'-9"	"	24 28
	Ls	2	6.3½×⅜	8'-7⅞	11.70	200
	"	"	3½.3½×⅜	7'-7"	8.50	128
	Pls	2	17"×⅜	1'-5"	21.68	61
	Ls	2	6".3½×⅜	16-6½	11.70	387
	"	2	3½.3½×⅜	24'-2"	8.50	410
	"	4	"	1'-2"	"	40
	"	8	"	0'-5⅞"	"	33
	"	2	6".3½×⅜"	3'-8¼"	11.70	86
	" Pl.	2	3½"×⅜"	4'-9"	" 4.46	17 8
	Pl	1	13"×⅜"	1'-6"	16.58	25
	Pls	2	11"×⅜"	24'-2"	14.03	678
	Bolts	14	¾" ϕ	1-0	18/100	26
	R.H.	740	¾" ϕ		14.25	105
						2608 2659

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134

First Canal Bridge for City of Kobe: 60' Single leaf trunnion bascule.

~~Material of 33' Fixed girder span~~

Material of Expansion joint in Floor slab.

		No	Size	Length	Weight per ft.	Total Weight.	Remarks
EJ2	Ls	2	6"×3½×⅜	8'-7⅞"	11.70	200	
	"	2	"	7'-7"	"	177	
	Pls	2	17"×⅜	1'-5"	21.68	62	
	Fills	2	7×⅜	0'-9"	8.93	13	
	Ls	2	6×3½×½	16'-6½	15.30	506	
	"	2	"	4'-2½ - 4¼	"	128 - 133	
	"	2	"	4-9	"	145	
	"	2	3½×3½×⅜	24'-2"	8.50	410	
	"	4	"	0'-7½	"	21	
	"	8	"	0-5⅞"	"	33	
	pl.	1	3½×⅜	1'-9"	4.46	8	
	pls	2	11"×⅜	24'-2	14.03	678	
	pl	1	13×⅜	1'-6"	16.58	25	
	Anchor Bolts	14	¾" φ	1'-0"	187/100	26	
	R.H.	636	¾" φ		0.1425	91	
						2523 - 2,528	

Summary Summary

FMG1 R L	15148	
FRG1	20698	
FFB1.	7024	
FFB2	3322	
FFB3	2994	
FFB4	1434	
FSL2	16064	
FLB1	4320	
FLB2	1984	
FSS1 R L	2072	
FSS2 R L	2360	
FFT1-2-3	736 - 777	
FCB1 R L	2912	
FCB2 R L	1582	
FSL2	324	
FSL1	640	
Grillage	2353 - 4706	
FBG1	912	casting
FBG2	2898	do.
FAB	365	
Rail support	17366	
EJ1	2608 - 2,659	
EJ2	2523 - 2,528	

Total for structural steel 93199 - 95,649
Total for Castings 3810
97009 - 99,459

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule.

135

No.	Materials	Length	Weigth per ft.	Total Weights	Remarks
		Platform (Front wall)			
4	Ls 4"×2½"×⅜"	19'-6"	@7.81	610.	
2	Ls 1½"×1½"×¼"	19'-6"	@2.34	91.	
14	Ls 〃 〃 〃	2'-4"	〃	76.	
8	[s 5"×2½"	6'-2"	10.98	542.	
16	Rivets ⅝"φ × 3/4 (grip)		0.27	4.	
42	Bolts ½"φ × ½" (〃)		0.2	8	
				1331.	
		Platform (Morter side)			
6	Is 6"×3"	4'-0"	@11.99	288.	
2	[s 6"×3"	4'-0"	@14.49	116	
1	L 5"×5"×⅜"	21'-0"	12.30	258	
14	Ls 2½"×2½"×¼"	2'-11½"	4.10	170	
4	[s 5"×2½"×	8'-5"	10.98	370	
2	Ls 1½"×1½"×¼"	8'-0"	2.34	37.	
1	L 〃 〃 〃	21'-0	〃	49.	
14	Ls 〃 〃 〃	3'-0"	〃	98	
44	Ls 〃 〃 〃	0'-5½"	〃	47	
1	che.pl. 30"×⅜"	21'-0"	38.1	802	
18	〃 〃 5½"×⅜	2'-0"	7.47	269	
14	Bolts ⅝"φ × ¾" (grip)		0.36	5	
28	Rivets 〃 × ⅝" (〃)		0.27	8	
160	〃 ½"φ × 〃 (〃)		0.15	24	
130 (170)	Bolts ½"φ × 〃 (〃)		0.20	26 — 34	
18	Ls 1½×1½×¼	2'-0"	2.34	84	
				2,651 — 2,659	
		Ladder			
2	[s 6"×3"	7'-6"	14.49	218	
1	L 1½"×1½"×¼"	7'-0	2.34	16	
3	Ls 〃 〃 〃	3'-0"	〃	21	
22	Ls 〃 〃 〃	0'-7"	〃	30	
80	Rivets ½"φ × 3/4 (grip)		0.15	12	
10	Bolts 〃 〃 (〃)		0.22	2	
9	Ls 1½"×1½"×¼	2'-0"	2.34	42	4 Anchor Bolts ½"φ × 0'-9" @ .63" = 3"
				341	
				344	
		Ladder			
4	Fls. 2½"×⅜"	10'-6"	3.19	134	L1
16	bars. ¾"φ	1'-6"	1.52	36	
4	Fls. 2½"×⅜	6'-0"	3.19	77	L2
8	bars ¾"φ	1'-6"	1.52	18	
4	Fls. 2½"×⅜"	9'-8"	3.19	123	L3
16	bars. ¾"φ	1'-6"	1.52	36	
4	Fls. 2½"×⅜	3'-6"	3.19	45	L4
6	bars. ¾"φ	1'-6"	1.52	14	
4	Fls. 2½"×⅜	8'-8"	3.19	111	L5
14	bars. ¾"φ	1'-6"	1.52	32	
4	Fls. 2½"×⅜"	10'-3"	3.19	131	L6
16	bars ¾"φ	1'-6	1.52	36	
				793	

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CALCULATIONS FOR

136

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule.

No.	Materials	Length	Weight per ft.	Total weights	Remarks
		Hand Rail	(pipe)		
2	pipes 1½"φ	42'-0"	@2.72	228	
4	" "	10'-6	"	114	
4	" "	9'-9"	"	107	
4	" "	10'-0"	"	109	
4	" "	6'-3	"	68	
44	" "	2'-8	"	319	
26	(Cross)		3.2	83	
40	(Tee)		2.4	96	
14	(Angle)		1.8	25	
44	(Flange)		4.0	176	
176	Bolts (Anch.) ½"φ	0'-8	0.55	97	
1	Chaines ¼"φ Wire	25'-0	0.43	22	
				1,444	
		Down spout			
4	Ls 5½"×3½"×⅜	5'-9"	@ 11.0	253	
2	Pls. 18"×5/16"	5'-9	19.13	220	
2	Ls 6"×3½×⅜	0'-10	11.7	20	
2	pipes 6"φ	4'-3	19.0	162	
2	pipe flange (special)		6.0	12	
2	" Covers		7.5	15	
44	Rivets ⅜φ × ⅞ (grip)		0.07	3	
8	Bolts ¾φ	1'-0	1.8	14	
				699	

Summary :—

platform (front)	1,331	1331
" (morterside)	2,651	2,659
Ladder	341	344
"	793	793
		5127
Hand Rail (pipe)	1,444	
Down Spout	699	
	7,259#	
	7,270	

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CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' Single leaf trunnion bascule

No	Material	Length	Weight per ft.	Total weight	Remarks
	Floor break for drive way (Buscule abutment)				
2	Ls 6 x 3½ x 3/8	13'-9"	11.7	326.	
2	〃 〃	4-2½	〃	99	
1	〃 〃	4-9	〃	56	
2	〃 〃	24-1	〃	564	
2	Web Pls 13 x 3/8	24-0 7/8"	16.58	798	
2	Pls 3 x ½	5-9	5.1	59	
2	〃 〃	8-1	〃	83	
2	〃 〃	4-2¼	〃	43	
2-1	〃 〃	4-9	〃	48 - 24	
1	〃 12¾ x 3/8	1-6	16.26	24	
1	Fill. 6¼ x 3/8	1-6	7.97	12	
1	Pl. 3½ x 3/8	1-9	4.46	8	
8	Ls 5 x 3½ x 3/8	0-6¼	10.4	43	
8	〃 〃	1-3	〃	104	
4	〃 3½ x 3½ x 3/8	1-3	8.5	43	
8	〃 3 x 3 x 3/8	0-6¼	7.2	30	
14	Anchor bolts 3/4"φ	1-6	2.62	55	
	Rivet heads 3/4"φ			60	
				2,485 - 2,431	
	Floor break for side walk		2 Req'd.		
1	Checkered Pl. 12" x ½	x 6-2¼	21.4	132	
1	L 6 x 3½ x 3/8	6-7 5/8	11.7	78	
1	Bent Pl. 12 x 3/8	6-7 5/8	15.3	119	
5	Anchor bolts ½"φ	0-9	0.5	3	
1	L 6 x 6 x 3/8	0-3	14.9	4	
	Rivet heads 3/4"φ			7	
				343 x 2 = 686	
	Floor break for along main buscule girder		2 Req'd.		
1	L 4½ x 4½ x 3/8	21'-6"	11.0	236	
1	Pl. 9¾ x 3/8	21-6	12.43	267	
1	L 4½ x 4½ x 3/8	11-9¾	11.0	130	
1	Pl. 9¾ x 3/8	11-9¾	12.43	147	
1	L 5½ x 3½ x 3/8	12-9	11.0	140	
1	L 2½ x 2½ x 5/16	2'-9"	5.0	14.	
1	Drain pipe 2½"φ	0-3		2	
	Rivet heads 3/4"φ			15	
				951 x 2 = 1,902	
	Floor break for along side walk		2 Req'd.		
1	Bent Pl. 11¾ x 3/8	15-4¼	14.98	230	
1	L 4 x 4 x 3/8	16-5½	9.8	162	
10	Anchor bolts ½"φ	0-9	0.63	6	
7	〃 〃 〃	0-3½	0.33	2	
				400 x 2 = 800	
	Total Weight of Floor break		5,843# 5,819	~~or 2.608~~ Tons	

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CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' Single leaf trunnion bascule. 137

Summary for structural steel.

Bascule span

① 2 trolley poles TP1 5194 — 5,191
1 trolley arch TA1 4623 — 4,666
9816 — 9,857
2 trolley poles TP2 4884 — 4,974
1 trolley arch TA2 4610 — 4,653
9494 — 9,627
19310# — 19,484

2. main bascule girders.
Front of trunnion $\cancel{115.756}$
rear of trunnion $\cancel{89.144}$
204.900° — 200,293.
Excluding trunnion shaft. 204.900 − 9752 = 195.148# — 190,541

3. Floor Beams

FB1	9695	9,874
FB2	29113	
FB3	29113	
FB4	29290	
FB5	34318	34,627
	131529#	132,017

4. Cross beam under tracks RCB. 10.290#

5 Longitudinal girder

2-LG1	3183	3,189
2-LG2	3168	3,173
2-LG2	3168	3,173
2-LG3	3163	
	12682#	12,698

6. Longitudinal stringers and struts

4- RS1-2	3385	3,399
4- RS 3	3256	3,302
4- RS 4	3256	3,302
4 - RS5-6	3473	3,509
16 struts ST2	3492	
	16862#	17,004

✓

7 Highway stringers and struts.

10 - SH11 - SH15	6905
20 - SH6 - SH10	13740
10 - SH1 - SH5	6958
32 struts ST1	1258
	28861.

8. Sidewalk stringers and bracings 11102 — 11,221
Cantilever brackets

2- CB1	1168	1,172
4- CB2-3	2830	2,825
2- CB4	1304	1,292
4- CB5-6	4061	4,051
	9363	9,340

20465# — 20,561

9 Bottom bracing between main girders 19345 — 19,165
do outside of main girders (under sidewalk). 6167 — 6,381
25512# — 25,546

10 Lateral Bracings between trunnion + cwt $\cancel{1681}$ $\cancel{6087}$ 7768# — 19,036 18882

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CALCULATIONS FOR

138

First Canal Bridge for City of Kobe: 60' Single leaf trunnion bascule.

11. Frame on top of Cwt girders 11536 — 2,946
Structural steel top and bottom 8077 excluding buffer blocks. 9466 / 1389 (- / 8077
Cwt girders complete 132609 — 132,656
152222 — 143,679

12. Misc. steel in moving span
Down spout complete moving portion only 381
Floor break at front end 2390 — 2,558
Sidewalk floor break at rear 364 — 343
Steel sleeper 10472.
~~Rail spacer~~ ~~651.~~
Curb angles. 994
14601.# — 14,748

13. Trolley arch and poles on fixed portion. 21911# — 22,193

14. Live Load shoes complete (fixed and moving) 8166#

15 Centering Castings (fixed + moving) ~~1389~~ 1517#

16 Cast steel Wind buffer blocks (fixed + moving) 3968 — 3,970

17. trunnion shafts, bearings + trunnion bosses. 30693. — 31,781

18. trunnion girder structural steel complete 138825 139,531
pins and castings 3497 — 6,762
142322# 146,293

19. Structural Framing over bascule abutment. 55.499# 55,613
~~22~~ ~~floor breaks on bascule abutment~~ 5.843 — 5,819
20. 33' fixed girder span complete structural steel 93199 95,649
Casting 3810
97007# 99,459
22
21. Misc. steel inside of bascule abutment 7259# — 7,270

Summary.

	structural steel	Cast steel etc.	Remarks.
1	19310 — 19,484		trolley poles and arches. (moving leaf)
2	195148 — 190,541		Main bascule girders
3	131529 — 132,017		Floor beams
4	10290.		Cross beams under tracks
5	12682 — 12,698		Longitudinal girders
6	16862 — 17,004		Longitudinal stringers + struts for railway
7	28861.		Highway stringers and struts
8	20465 — 20,561		Sidewalk stringers and bracings. Cantilevers
9	25512 — 25,546		Bottom bracings
10	1768 19,036 — 18,882		Lateral Bracings for Cwt
11	152222 — 143,679		Cwt girders.
12	14601 — 14,748		misc. steel in moving leaf excluding rails —
13	21911 — 22193		trolley arches + poles. (fixed portion).
14	—	8166.	Live Load shoes complete
15	—	1517	Centering Casting
16	—	3968 — 3,970	Wind buffer blocks.
17	139,531 —	30693 — 31,781.	trunnion shafts bearings and trunnion bosses. <
18	138825	3497 — 6,762	trunnion girder
19	55,613 — 55499		Framing over bascule abutment
20	95,649 — 93199	3810	33' fixed girder span
21	960,386 7259 — 7,270	56,006	misc steel in bascule abutment
22	960,276. 5.843# — 5,819	51.651# — 56004	Floor backs on bascule abutment.
	428.744 tot. 957.786#	(23.058 tons)	
	428.695 — 427.583 tons.	25.002 ✓	

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CALCULATIONS FOR

First Canal Bridg for City of Kobe.

MATERIALS OF WOODEN PART FOR MOVING FLOOR

Nailing pieces. Top of steel sleeper	54	9"×2"×1'-0½"	0.13	7.02	
	54	9×2×4'-4"	.541	29.21	
	27	9×2×4'-8"	.584	15.77	
					52.00
planks. Between Tracks at ℄ of Bridge	14	10⅞"×3"×13'-6"	3.04	42.56	
	2	10⅞"×3"×8'-4"	1.88	3.76	
	2	10⅞×3×15'-1"	3.40	6.80	
	2	"×"×11'-6"	2.58	5.16	
	2	"×"×4'-9"	1.07	2.14	
					60.42
planks, Between Rail.	20	10⅛"×3"×13'-6"	2.84	56.80	
	2	"×"×8'-4"	1.75	3.50	
	4	"×"×15'-1"	3.17	12.68	
	4	"×"×11'-6"	2.42	9.68	
	2	"×"×4'-9"	1.00	2.00	
					84.66
planks, Top of Longitudinal Beam	8	10¼"×3"×13'-6"	2.87	22.96	
	2	" "×8'-4"	1.77	3.54	
	2	" "×4'-9"	1.01	2.02	
					28.52
Wooden sleeper	2	8"×6"×17'-5"	5.83	11.66	
	3	8×6×7-6	2.51	7.53	
	1	15×7×17'-5"	12.66	12.66	
					31.85
Nailing pieces. Top of Longitudinal Beam	8	8"×8"×14'-4½"	6.37	50.96	
	2	8×8×13'-0"	5.76	11.52	
	2	8×8×5'-0"	2.22	4.44	
	2	8×8×16'-6"	7.32	14.64	
	8	6×7½×14'-4½"	4.45	35.60	
	2	"×"×13'-0"	4.03	8.06	
	2	"×"×5'-0"	1.55	3.10	
	2	"×"×16'-6"	5.11	10.22	
	8	6×7×14'-4½"	4.10	32.80	
	2	"×"×13'-0"	3.71	7.42	
	2	"×"×5'-0"	1.43	2.86	
	2	"×"×16'-6"	4.71	9.42	
	8	6×6½×14'-4½"	3.88	31.04	
	2	"×"×13'-0"	3.51	7.02	
	2	"×"×5'-0"	1.35	2.70	
	2	"×"×16'-6"	4.46	8.92	
	8	6×6×14'-4½"	3.59	28.72	
	2	"×"×13'-0"	3.25	6.50	
	2	"×"×5'-0"	1.25	2.50	
	2	"×"×16'-6"	4.13	8.26	
	8	6×5½×14'-4½"	3.32	26.56	
	2	"×"×13'-0"	3.00	6.00	
	2	"×"×5'-0"	1.15	2.30	
	2	"×"×16'-6"	3.80	7.60	
	8	4×5×14'-4½"	2.00	16.00	
	2	"×"×13'-0"	1.80	3.60	
	2	"×"×5'-0"	0.69	1.38	
	2	"×"×16'-6"	2.29	4.58	
					354.72

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CALCULATIONS FOR

First Canal Bridge for City of Kobe

Nailing pieces. Top of Intermediate Floor Beam	6	16½×4×16'-3"	7.45	44.70	
planks, sloped Drive Way	60	11½×3×15'-11"	3.82	229.20	
	36	12×3×15'-11"	3.98	143.28	
	32	12×3×15'-11"	3.98	127.36	
	2	9×3×15'-11"	2.99	5.98	
					505.82
Wooden Cushion side on Rails	4	3½×6×65'-9"	9.58	38.32	
	4	2×5¾×65'-9"	5.24	20.96	
					59.28
At Gutter	10	13×3×13'-9"	3.72	37.20	
	10	6½×3×13'-9"	1.86	18.60	
	10	7×3×13'-9"	1.96	19.60	
	10	7×3×13'-9"	1.96	19.60	
					95.00

SIDE WALK FLOOR

~~Side Walk Floor~~ Nailing piece	58	4×3×7'-0"	0.582	33.76	
planks	14	12×1¼×48'-9"	4.875	68.25	
	2	9×1¾×48'-9"	5.12	10.24	
					78.49

Total 1429.22 cub.ft
1429.22

防水用フェルト,
50'×67.25 = 3360 sq.ft
2×1'×7×48.75 = 68"
2×.75'×48.75 = 74"
3502 sq.ft

Volume of Concrete
.25×7.0×30' = 53 cub.ft
23×.33×.83 = 6
13×.33×.83 = 4
63×2 = 126 cub.ft ... 5.8 立坪

Concrete forms
6'×29.58 = 177 sq.ft
.33×32.5 = 11
.2×23.0 = 4
.2×13.0 = 3
195×2 = 390 sq.ft — 10.8 面坪

Finish of Concrete
1.03×23 = 23.6 sq.ft
1.03×13 = 13.4
7.41×29.5 = 219.0
256.0×2 = 512 sq.ft — 14.2 面坪

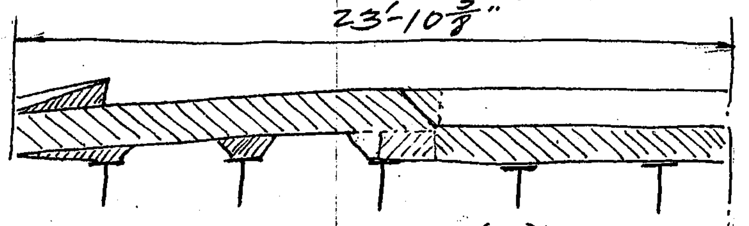
Wooden Block
39.4×67.21 = 2650 sq.ft 厚サ3"
73.5 面坪

Cast iron Drain
for Driveway 8 @ 64# = 512#
for Sidewalk 8 @ 15# = 120#

~~Handrail on moving leaf~~
2 @ 64'-6½" 41.5#/lin.ft = 5340# or 2.38 Tons

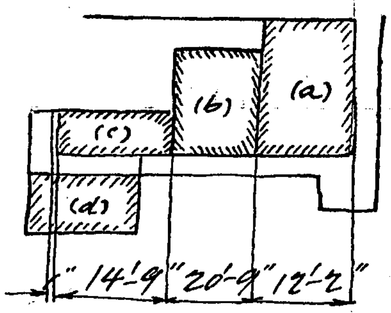
CALCULATIONS FOR

First Canal Bridge for City of Kobe
Materials for floor slab on bascule abutment
Volume of Concrete



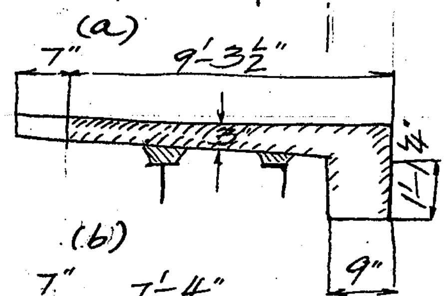
between curbline

.5 × 23.86 = 11.93 sq.ft
3 × .75 × .25 = .51
.17 × 1.0 = .17
2 × 12.61 — 25.22 sq.ft
25.22 × 35.19 = 890 cub.ft



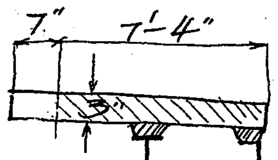
Sidewalk Plan

(a)



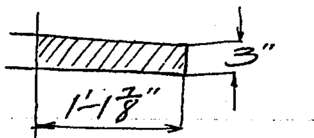
.25 × 9.29 = 2.32 sq.ft
.75 × 1.1 = .825
.83 × 0.8 = .066
2 @ 3.211 — 6.422 sq.ft
6.422 × 12.17 = 78.2 cub.ft

(b)



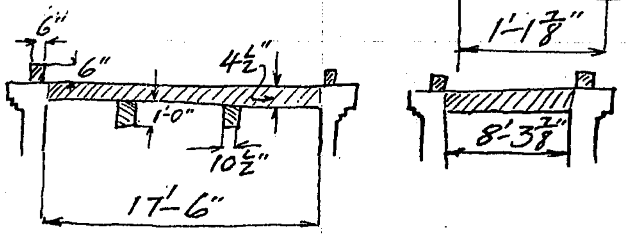
.25 × 7.33 = 1.84 sq.ft
.84 × .83 = .07
2 @ 1.91 — 3.82 sq.ft
3.82 × 20.75 = 79.0 cub.ft

(c)



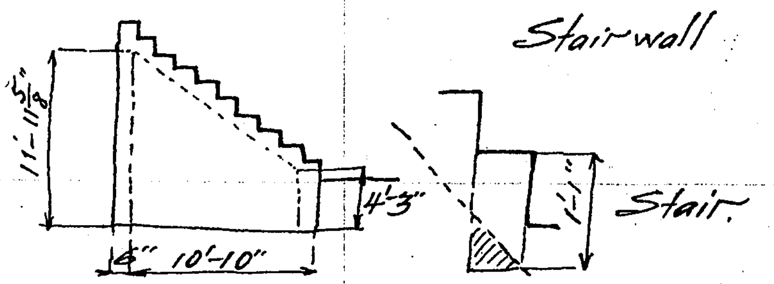
2 × .25 × 1.16 × 14.75 = 8.5 cub.ft

(d)



Slab for house 2 Req'd

.38 × 8.32 × 17.5 = 55.5 cub.ft
2 × .88 × 1. × 8.32 = 14.85 cub.ft
2 @ 70.35 — 140.7
.5 × .5 × 44.0 = 11.0
151.7 cub.ft



Stairwall

.5 × 11.97 × .75 = 4.2 cub.ft
10.83 × 11.97 × .75 = 97.10
− ½ × 10.83 × 7.72 × .75 = −31.2

Stair

1.25 × .5 × 4 = 2.5
1.08 × .83 × 4 × 13 = 46.5
.5 × .83 × .61 × 4 × 13 = −13.2

Wall and slab

.83 × 4.61 × 4 = 16.3
.75 × 4.03 × 5.58 = 16.8
3.25 × .38 × 11.33 = 14.0
3.25 × .38 × 5.58 = 7.0
160. cub.ft
1367.4 cub.ft 立坪 or 6.32

Concrete filling
2 × 11.42 × .42 × 35.19 = 337 cub.ft
1.56 立坪

Concrete forms

between curbline	50. × 35.19	= 1760. sq.ft
(a)	11.2 × 12.17	= 136.
(b)	7.42 × 20.75	= 154
(c)	2.0 × 14.75	= 29.5
(d)	2 @ 21.5 × 8.33	= 358.
	.5 × 88.0	= 44.
Stairwall	2 × .5 × 11.97	= 12
	2 × 10.83 × 4.25	= 92
	2 × .5 × 10.83 × 7.72	= 84
Stair	.75 × 11.33	= 8.5
	1.25 × .5	= .6
	1.08 × .83 × 13	= 11.7
	− .5 × .83 × .61 × 13	= −3.3
	8.6 × 4.0	= 34.4
	14. × 3.25	= 45.5

Wall & slab

.83 × 4.61 = 3.8 sq.ft
2 × 4. × 4.33 = 34.6
2 × 4.03 × 5.58 = 4.5
.83 × 4.0 = 3.3
.75 × 5.58 = 4.2
3.25 × 16.92 = 55.0

Total 2872.3 sq.ft
or 80. 坪

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First Canal Bridge for City of Kobe

Reinforcement in slab — 8029# see sheet No. 27

Reinforcement in stair and stair-wall etc..

Mark	No.	Size	U.wt	Total wt.
	2	$\frac{1}{2}$"φ x 2'-10"	.668	4 #
	2	" 4'-6"	"	6
	2	" 6'-2"	"	8
	2	" 7'-10"	"	10
	2	" 9'-6"	"	13
	2	" 11'-2"	"	15
	2	" 12'-10"	"	17
	12	" 13'-9"	"	110
	12	" 10'-10"	"	87
	4	" 16'-8"	"	45
	2x26	$\frac{3}{8}$"φ x 5'-0"	.376	98
	12	" 5'-0"	"	23
	6	$\frac{5}{8}$"φ x 5'-6"	1.043	34
	2x4	$\frac{1}{2}$"φ x 5'-3"	.668	28
	2x6	" 4'-6"	"	37

535 #

Reinforcement in restroom slab and beams

Mark	No.	Size	U.wt	Total wt.
F26	9	$\frac{3}{8}$"φ x 20'-0"	.376	68
F27	16	" 19'-0"	"	114
F24	2x19	$\frac{5}{8}$"φ 10'-0"	"	143
FB1	4	$\frac{5}{8}$" x 10'-0"	1.046	42
FB2	2	" 11'-0"	"	23
FB3	2x12	$\frac{3}{8}$"φ x 3'-6"	.376	32

442 #

8986 # or 4.012 Tons

Wooden block pavement

$2 \times 19.36 \times 35.19 = 1360$ sq.ft. or 37.8 平方坪

Granite block pavement for both sides of rails

$4 \times .63 \times .33 \times 35.19 = 29.2$ cub. ft.

Cast iron curb metal

.75" x 9.75" = 7.3 sq.in.
1.75" x .75" = 1.3 "
2.75 x .75" = 2.1

10.7 x 280.5 = 3000 cub.in.

12 @ 9" x 1.25 x .5 = 67 "

3067 x .26 #/in³ = 800 #

2 @ 800 # = 1,600 #

Area of mortar finish

In slab

(a) 2 @ 10.38 x 12.17 = 252. sq.ft.
(b) 2 @ 8.08 x 20.75 = 335.
(c) 2 @ 2.03 x 14.83 = 60.
9.0 x 5.42 = 49.

696 sq.ft.

In stair etc..

5.58 x 4 = 22.3 sq.ft.
9.19 x 4 = 36.7
12.33 x 4 = 49.3
11.33 x 5 = 56.6
3.5 x 8.33 = 29.1

194

890 sq.ft. or 24.75 平方坪

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CALCULATIONS FOR

First Canal Bridge for City of Kobe

VOLUME OF CONCRETE IN BASCULE ABUTMENT.

Base.		51.9×73.0 =	33507	32,658
	less	3×7.75×73.0 =	- 849	
Rear Wall.		2.0×13.92×66.31 =		185
Under side walks.		2.0×1.0×8.5 =		17
plat form at rear.		7.0×2.5×66.31 =		1,160
Intermediate ribs under plat form.		16×7.0×13.78 =		1,543
Seat for trolley pole.		2- 3×3.5×5.83 =		122
Side Walls.		2- 1.5×31.72×41.25 =		3,925
Coping Complete.		0.56×98 =		55
Base for lamp posts.		2- 2.0×4.0×31.72 =		508
do extra.		2.0×4.0×4.03 =		32
Rear step 1.		3.0×16.28×66.31 =		3,239
" " 2.		2.17×16.28×43.39 =		1,533
Machinery seat.		2- 2.17×14.98×8.96 =		583
"		2- 4.33×14.98×9.46 =		1,227
Lower step Middle.		4.33×11.36×42.39 =		2085
Along side Walls.		2- 6.5×16.28×2.5 =		529
Bottom layer.		21.0×4.6×66.31 =	6419	6366
	less	3.5×3.0×5.0 =	- 53	
Along Walls bottom.		2- 3.67×21.0×7.21 =		1,111
Seat for Trunnion Girder.		2- 8.44×10.0×7.21 =		1,217
Between Machinery & Trunnion		2- 4.0×8.0×11.0 =	704	672
Girder bearing.	less step	2- 1.5×8.0×2.0 =	- 32	
Tail lock seat.		2- 1.25×0.8×4.0 =		8
projection for Column Seat.		2- 2.0×2.5×1.75 =		18
Front Wall.		26.11×4.25×66.31 =	+7358	7,272
	less	$\frac{.25}{2}$× 8.35×66.31 =	- 69	
	less	2- 2×1.0×9.0 =	- 36	
At sidewalls		2- 1.5×1.15×5.60 =	+ 19	
Filler as riciss at floor.		2- 2.0×3.0×$\frac{2.08}{2}$ =		12
Wind buffer seat.		7.45□×47.89 =		357
Under operator house.	base	3.0×8.48×21.5 =		547
	Walls	1.0×36.14×31.72 =	1146	1,065
	less	1.0×8.32×9.78 =	- 81	
Seat for down spout.		2- 2.0×2.47×3.0 =		30
		2 1.5×1.17×3.0 =		11

68,087 cub ft

315.218 立坪

Concrete forms
Total 18600 sq.ft or 518 平坪

Reinforcement

	No	Size	U wt	Total wt	
Base	146	$\frac{3}{4}$"φ × 16'-0"	@1.502	3509	Hor.
	15	$\frac{1}{2}$" × 26'-6"	@0.668	266	"
	2×70	$\frac{5}{8}$ × 4'-0"	@1.043	584	Front
	2×2×27	" "	"	451	sides
	2×67	" "	"	559	Rear side
	112	" "	"	467	Rear Rib
Rear Rib	7×2×7	$\frac{1}{2}$" × 9'-9"	0.668	638	
	7×2×4	$\frac{5}{8}$" × 17'-0"	1.043	993	
	7×4	$\frac{5}{8}$" × 4'-0"	"	117	stub. bars
Rear Wall	3×12	$\frac{1}{2}$" × 25'-3"	0.668	607	
	67	$\frac{7}{8}$" × 18'-0"	2.044	2465	

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CALCULATIONS FOR

First Canal Bridge for City of Kobe

	No.	size	Utwt.	Total wt.	
	66	7/8" × 9'-0"	@2.044	1214	
	34	5/8" × 18'-0"	@1.043	638	
North wall	2×14	1/2" × 21-6"	0.668	402	Hor.
	3	" × 5'-0"	"	10	"
	14	" × 10'-0"	"	94	"
	2×14	3/4 × 19-0"	1.502	1941	"
	25	5/8 × 19-0"	1.043	495	Vert.
	25	" × 17-0"	"	443	"
	2×25	" × 15-6"	"	808	
	25	" × 4'-0"	"	104	
	3	" × 9'-0"	"	28	
South wall	2×11	1/2 × 21-6"	0.668	316	
	2×3	" × 12-0"	"	48	
	3	" × 5'-0"	"	10	
	2×7	" × 10-0"	"	94	
	2×14	3/4" × 19-0"	1.502	1941	
	29	5/8" × 19-0"	1.043	575	
	29	" × 17-0"	"	514	
	2×26	" × 15-6"	"	841	
	26	" × 4'-0"	"	108	
	2×3	" × 7'-0"	"	44	
	3	" × 9'-0"	"	28	
Front wall	3×27	3/4" × 24'-0"	1.502	2920	
	3×27	" × 25-10"	1.502	3143	
	2×32	5/8" × 19-0"	1.043	1268	
	2×32	" × 10'-0"	"	668	
	2×13	3/4" × 4'-6"	1.502	176	
	2×2×27	" × 5'-0"	"	811	
	6	5/8" × 15'-0"	1.043	94	
Rear wall hoot.	2×3×17	3/4" × 25-10"	1.502	3957	
	2×34	5/8" × 17'-0"	1.043	1206	
Machinary Platform	2×36	1/2" × 25-3"	0.668	1214	
	2×31	1/2" × 12-6"	"	518	
	2×3	" × 10-6"	"	42	
	30	7/8 × 12-0"	2.044	736	Bent. bars.
	2×4	1/2 × 2'-6"	0.668	13	
	2×4	5/8 × 6'-0"	1.043	50	
	9×3	" × 8-0"	"	225	
	9×3	1/2" × 2'-6"	0.668	45	
Lamp post pedestal	2×4	5/8" × 4'-0"	1.043	33	stub. bars
	2×4	5/8 × 19-0"	"	159	
	2×4	" × 15-6"	"	129	
	2×15	3/8 × 8'-3"	0.376	93	Hoops
South wall of house	2×14	1/2 × 19-9"	0.668	369	
	2×2	" × 13-6"	"	36	
	2×2	" × 8-6"	"	23	
	2×2	" × 2-6"		7	
	2×15	5/8 × 4'-0"	1.043	125	stub bars
	2×15	" × 19-0"	"	595	
	2×8	" × 15'-6"	"	259	
	2×7	" × 7'-0"	"	102	
	2×2	" × 10-0"	"	42	

CALCULATIONS FOR

First Canal Bridge for City of Kobe

	No	Size	Lt wt	Total wt	
East wall of house	2×5	5/8 × 4'-0"	@ 1.043	42	stub bars
	2×5	" × 7'-0"	"	73	
	2×4	1/2 × 11'-6"	0.668	61	
	2×5	5/8 × 15'-6"	1.043	162	
	2×4	" × 5'-0"	"	42	
	2×4	" × 3'-9"	"	31	
	2×5	1/2" × 11'-6"	0.668	77	
	2×3	" × 2'-3"	"	9	
West wall " "	2×5	5/8 × 4'-0"	1.043	42	stub bars
	2×5	" × 19'-0"	"	198	
	2×5	" × 7'-0"	"	73	
	2×5	" × 3'-0"	"	31	
	2×14	1/2 × 12'-6"	0.668	234	
	2×2	" × 3'-6"	"	9	
	2×2	" × 11'-0"	"	29	
	2×2	5/8 × 9'-0"	1.043	38	
Trolley pole pedestal	2×8	" × 9'-0"	"	150	
	2×4	3/8 × 9'-0"	0.376	27	Hoops.
				41738	— 18.633 Ton.

Area of Mortar finish. for machinery room 厚 3/4"

66.33 × 39.75 = 2630. sq.ft
−4.33 × 42.4 = −184.
− 2@ 10' × 2' = −40
−1.5 × 48' = −72
2334. sq.ft or 64.8 面坪

人造石洗出仕上

2 × 16.0 × 43.25 = 1380 sq.ft or 38.3 面坪

踏込石 1.0 × 1.0 × 48.73 = 48.73 cub.ft.
2 × .5 × 1.0 × 8.08 = 8.08
56.81 cub.ft.

割栗石 .5 × 74' × 52' = 1920 cub.ft
.5 × 9 × 22.5 = 101
2021 cub.ft or 9.36 立坪

土砂掘鑿

74' × 52' = 3840 sq.ft.
9 × 22.5 = 202
4042 × 24.0 = 97000 cub.ft or 450 立坪

Wind buffer block

木材 2 × 1' × .5' × 37.0 = 37 cub.ft
Anchor bolts 2 × 19 − 1"ϕ × 2'-0"
2'-0" spacing 38 × 6.19# = 235#

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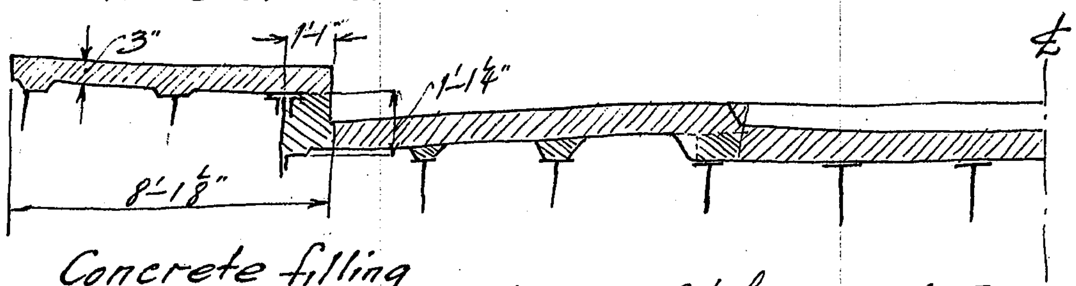
CALCULATIONS FOR

First Canal Bridge for City of Kobe
Materials for floor slab in 33' Girder span.
Volume of Concrete



.25 × 8.09 = 2.02 sq.ft
1.0 × 1.08 = 1.08
.5 × 23.86 = 11.93
3 × .58 × .25 = .44 sq.ft
2 × 15.47 = 30.94
30.94 × 35.5 = 1100 cub.ft
5.1 立坪

Concrete filling
2 × 11.42 × .42 × 35.5 = 341 cub.ft or 1.58 立坪

Concrete forms
31'-11 1/2"
4'-1"
2 × 27'-10 1/2" = 55'-9"
55.75 × 35.5 = 1980 sq.ft or 55 面坪

Reinforcement
Total 8243# or 3.68 Tons See sheet No. 20.

Wooden block pavement 厚3"
23'-10 3/8"
3'-6"
2 × 20'-4 3/8" = 40'-8 3/4
40.72 × 35.5 = 1443 sq.ft or 40 面坪

Granite block pavement for both sides of rails
4 × .63 × .33 × 35.5 = 30.0 cub.ft.

Area of mortar finish 3/4" thick
2 × 8.6 × 35.5 = 610 sq.ft or 17 面坪

Handrail on fixed span
2 @ 34'-3 1/2" 41.5#/lin.ft 2850# or 1.272 Tons

Cast iron drains 4 @ 64# — 256#

Materials for pier
Volume of Concrete

Base	7.5² × π × 4'	=	700 cub.ft
	15. × 54.08 × 4	=	3250
	5.4² × π × 2.2	=	200
	10.8 × 54.08 × 2.2	=	1280
Wall	3.11² × π × 25.92	=	785
	6.22 × 54.08 × 25.92	=	8700
	2.88² π 1'.0	=	26
	2 × 2.88 × 54.08 × 1.0	=	372
			15313 cub.ft or 71. 立坪

Concrete forms

Base	15.' π × 4.'0	=	188 sq.ft.
	2 × 54.08 × 4.'0	=	433
	10.8 π × 2.'2	=	75
	2 × 54.08 × 2.2	=	238
Wall	6.22 × π × 25.92	=	505
	2 × 2.88 π × 1'.0	=	18
	2 × 54.08 × 26.92	=	2900
			4357 sq.ft or 121 面坪

Reinforcement

	No	Size	Lt wt	Total wt
Base hor.	54	5/8"φ × 14'-8"	1.043	834#
"	24	" × 7'-0"	"	175
"	30	3/8 × 23'-6"	.376	265
"	4	5/8 × 9'-0"	1.043	38
Ver.	128	3/4 × 22'-0"	1.502	4230
"	64	" × 16'-0"	"	1538
Hor.	3×24	3/8 × 20'-6"	.376	555
	2×19	" × 12'-6"	"	179
	2×5	" × 22'-0"	"	83
	8×16	" × 7'-0"	"	337
				8234# or 3.68 Tons

割栗石
8² π × 1' = 201 cub.ft
16' × 54.08 × 1 = 865
1066 cub.ft or 4.93 立坪

土砂掘鑿
14.0' × 4.93 = 69.0 立坪

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CALCULATIONS FOR

First Canal Bridge for City of Kobe

Materials for West abutment

Volume of Concrete

base	75.' × 3.' × 20.5	= 4610 cub.ft
hooting	½ × 75. × 4.67 × 4.5	= 790
under pedestal	63.9 × 29.63 × 4.04	= 7660
	63.9 × 4.5 × 1.2	= 345
	½ × 63.9 × 1.2 × 24.11	= 925
coping	63.9 × 1. × 37	= 24
parapet wall	63.9 × 4. × 1.5	= 384
sides	2 × 4.04 × 4.7 × 34.7	= 1310
	2 × 15.83 × 4.5 × .84	= 119
	2 × 3. × 10.6 × 34.7	= 2210
coping	2 × .5 × 1.25 × 19.3	= 24
back	½ × 50.15 × 29.63 × 9.6	= 7150
	4 × ⅓ × 9.6 × 29.63 × 9.6	= 3640
		29191 cub.ft
		135.1 立坪

Concrete forms

base	3.' × 191.'	= 573 sq.ft
hoot	6.48 × 75.	= 485
sides	2 × 4.5 × 18.17	= 163
	2 × .84 × 4.5	= 8
front face	73.31 × 30.19	= 2220
sides	2 × 15.25 × 30.19	= 920
back	5.' × 88.5	= 443
	31.' × 69.33	= 2150
	2 × 6.25 × 29.63	= 370
	2 × 3' × 5.'	= 30
		7362 sq.ft
		204.5 面坪

蹴込石
跳上橋臺＝仝じ 56.8 cub.ft

割栗石
76.' × 21.5 × 1.' = 1634 7.57 立坪

土砂掘鑿
7.57 × 16.4' = 124. 立坪

Reinforcement

	No	Size	Ut.wt.	Totalwt.
parapet wall	2×10	½"φ × 7'-0"	.668#	94#
	2×33	" × 6'-0"	"	265
	3×6	" × 24'-0"	"	289
base	4×3	" × 27'-3"	"	218
	75	⅝" × 8'-0"	1.043	626
	74	" × 5.1'	"	394
				1886# … 0.842 Tons

人造石洗出仕上

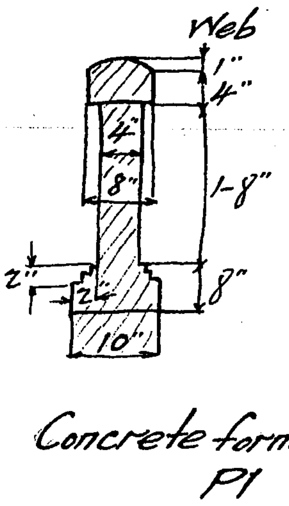
front face of lamp pedestal	2 × 4.7 × 22.0	= 270 sq.ft
sides	2 × 14.46 × 22.0	= 645
back	2 × 2' × 22.0	= 88
		1003 sq.ft … 27.9 面坪

Materials for handrails on abutments

Volume of Concrete

Post	P1 1 Req'd	1.42 × 2.66 × 3.'	= 11.3 cub.ft
	P2 1	1.42 × 2. × 3.	= 8.5
	P3 13	13 × 1. × 1. × 3.	= 39.
	P4 2	2 × 1.42 × 1.42 × 3.	= 12.

Web 8" × 4.5" = 36 sq.in.
4" × 20" = 80"
8" × 10" = 80
− 2" × 2" = −4
192 sq.in = 1.334 sq.ft



1.334 × 72.'47 = 96.6
− 87 @ 1' × .33 × .42 = −12.1
155.3 cub.ft
… .72 立坪

人造石洗出仕上

P1 8.16 × 3.' = 24.5 sq.ft
1.42 × 2.66 = 3.8
P2 6.84 × 3.' = 20.5
2. × 1.42 = 2.8
P3 4. × 3. = 12
1. × 1. = 1
13 × 13 = 169.
P4 5.67 × 3. = 17
1.42 × 1.42 = 2
2 × 19 = 38
Web 6.8 × 72.47 = 493
87 × .33 × 2.83 = 81
832.6 sq.ft
23.2 面坪

Concrete forms

P1 8.16 × 3. = 24.5 sq.ft
P2 6.83 × 3. = 20.5
P3 13 × 4. × 3. = 156.
P4 2 × 5.67 × 3. = 34.
Web 6 × 72.47 = 435.
87 × .33 × 2.83 = 81.
751. sq.ft
20.8 面坪

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CALCULATIONS FOR

First Canal Bridge for City of Kobe

Reinforcement in handrail

Post	No.	Size	Lt wt.	Total wt.	Remarks
	17×4	½"φ × 4'-7"	.668#	208	Ver. bars in P1-2-3-4
	4	⅜"φ × 8'-0"	.376	12	Hoops in P1
	4	" × 6'-10"	"	10	" P2
	13×4	" × 4'-0"	"	78	" 13-P3
	2×4	" × 5'-8"	"	17	" 2-P4
East abut.	6×4	½"φ × 10'-7"	.668	170	Hor. bars
	4	" × 7'-0"	"	19	"
	4	" × 6'-10"	"	18	"
	6×2	⅜"φ × 8'-0	.376	36	" in web
	2	" × 4'-5"	"	3	"
	12	" × 4'-2½"	"	3	"
	140	" × 1'-6½"	"	81	Ver. bars in web
West abut.	4	½"φ × 6'-11"	.668	18	Hor. bars
	4	" × 5'-2"	"	14	"
	4	" × 11'-7"	"	30	"
	2	⅜"φ × 4'-4"	.376	3	" in web
	2	" × 1'-9"	"	1	"
	2	" × 8'-7"	"	6	"
	34	" × 1'-6½"	"	20	Ver. bars in web
				747#	

0.333 Tons

Materials in foundation for weight pole WP

Volume of Concrerete 1:2:4

2 × 1.167 立坪 = 2.334 立坪

Catch basin 2 × 0.029 " = 0.058 立坪

2.392

Concrete forms

2 × 233 sq.ft = 466 sq.ft — 13 面坪

Catch basin 2 × 20.8 = 41.6 --- 1.16 面坪

14.16

Reinforcement

26	½"φ × 8'-6"	.668#	148
6	" × 6'-6"	"	26
6	" × 4'-6"	"	18

192 × 2 = 384# ... .172 Tons.

Cast iron cover 2-11" × ½" × 1'-2" 40#
2-11" × ½" × 1'-8" 57#

Gas pipes 4 - 2"φ × 20'-1" @ 3.652# 293#

Materials for handrail in outside stair of bascule abutment

Gas pipes	7-1½"φ × 1'-10"	@ 2.72#	35#
	7-1½"φ × 2'-3"	"	43
Flange	8-	@ 4.0#	32
Tee	6-	@ 2.0#	12
	1-	@ 1.5#	1.5
			123.5#

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CALCULATIONS FOR

昭和二年三月

跳上橋計算書

（機械之部）

石川島造船所起重機設計課

CALCULATIONS FOR

First Panal Bridge for City of Kobe:

Bridge Operating Mechanism.

Operating time of Bridge from 0° to 80° 1 min. 20 second.

Speed of Rack, $\frac{2\pi \times 18.3 \times 80}{360} = 25.5$ ft/m.

where, Radius of Rack $= 18.3$ ft.

Horse power $= \frac{P \times 25.5}{33000 \times .73} = .00106\,P$

where, P = Total force at pitch circle of Rack.
Gear efficiency $= (0.94)^5 = 0.73$.

Horse power at 15# wind,
$.00106\,P = .00106 \times 164.975^{\#} = 175^{H.P.}$

Horse power at 10# wind,
$.00106\,P = .00106 \times 118.235^{\#} = 126^{H.P.}$

We take 2-75 H.P. Motors, assuming $P = 142.000^{\#}$ (63 t), that is the wind of 12.4 #/□' from diagram.

Motor 75 H.P. 558 R.P.M. 220 V 60 ~ A.C.

Operating gear:—

Speed at Rack, $\frac{20.29\pi}{12} \times 558 \times \frac{15}{48} \times \frac{15}{48} \times \frac{15}{52} \times \frac{16}{52} = 25.8$ ft/m.

$$\left.\begin{array}{ll} \text{Load on teeth} \cdots\cdots & W - W_4 \\ \text{Dia. of spur gear} \cdots\cdots & D \\ \text{" " pinion} \cdots\cdots & d \\ \text{Revolution of Motor} \cdots\cdots & R. \\ \text{Gear efficiency} \cdots\cdots & 0.94 \end{array}\right\}$$

See Gear table page 3.

Load on teeth at 1st gear, $W = \frac{H.P \times 33000 \times 12}{\pi \times D \times R} = \frac{150 \times 33000 \times 12}{\pi \times 9.74 \times 558} = 3480^{\#} = 1.55^{t}$

" 2nd " $W_1 = \frac{W \times D}{d} \times .94 = \frac{3480 \times 31.2}{10.8} \times .94 = 9450^{\#} = 4.22^{t}$

" 3rd " $W_2 = \frac{W_1 \times D}{d} \times .94 \times \frac{1}{2} = \frac{9450 \times 35.1}{12.1} \times .94 \times \frac{1}{2} = 12900^{\#} = 5.75^{t}$

" 4th " $W_3 = \frac{W_2 \times D}{d} \times .94 = \frac{12900 \times 42.1}{15.5} \times .94 = 32800^{\#} = 14.7^{t}$

" Rack pinion $W_4 = \frac{W_3 \times D}{d} \times .94 = \frac{32800 \times 50.43}{20.29} \times .94 = 76700^{\#} = 34.3^{t}$

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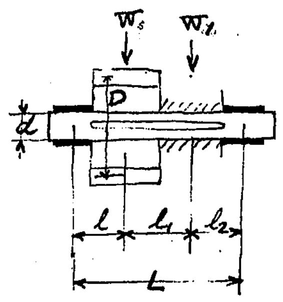
CALCULATIONS FOR

First Canal Bridge for City of Kobe

(Strength of 1st shaft.) $d = 4\frac{1}{4}"$.



when $W = 3480^{\#}$, $W_1 = 9450^{\#}$.
$l = 5\frac{7}{8}"$, $l_1 = 7"$, $l_2 = 6\frac{3}{8}"$, $L = 19\frac{1}{4}"$, $D = 31.2"$.

Max. Bending moment $= \dfrac{W_1 \times (l + l_1) + W \times l}{L} \times l_2$.

$= \dfrac{9450 \times (5.875 + 7) + 3480 \times 5.875}{19.25} \times 6.375 = 47000^{\text{in-lbs}}$ .... M_B.

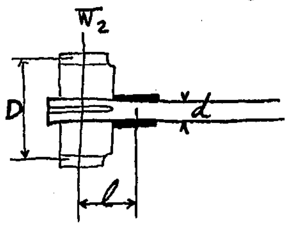
Max. Twisting moment $= W \times \dfrac{D}{2} = 3480 \times \dfrac{31.2}{2} = 54300^{\text{in-lbs}}$ .... M_T.

Equivalent Bending moment $= .35\,M_B + .65\sqrt{M_B^2 + M_T^2}$

$= .35 \times 47000 + .65\sqrt{47000^2 + 54300^2} = 62800^{\text{in-lbs}}$ .... M_e.

Max. Bending stress $= \dfrac{M_e}{Z} = \dfrac{62800}{7.536} = 8350^{\text{lb}/\square"} = 3.72^{t/\square"}$ .... f.

(Strength of 2nd shaft.) $d = 5\frac{1}{2}"$.



when $W_2 = 12900^{\text{lbs}}$, $l = 8\frac{1}{2}"$, $D = 12.1"$

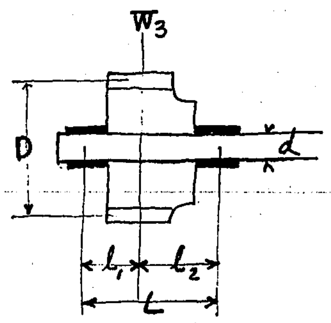
$M_B = W_2 \times l = 12900 \times 8.5 = 110000^{\text{in-lbs}}$

$M_T = W_2 \times \dfrac{D}{2} = 12900 \times \dfrac{12.1}{2} = 78000^{\text{in-lbs}}$

$M_e = .35 \times 110000 + .65\sqrt{110000^2 + 78000^2} = 126000^{\text{in-lbs}}$

$f = \dfrac{M_e}{Z} = \dfrac{126000}{16.33} = 7700^{\text{lb}/\square"} = 3.45^{t/\square"}$

(Strength of 3rd shaft) $d = 7"$



when $W_3 = 32800^{\text{lbs}}$, $l_1 = 10\frac{1}{2}"$, $l_2 = 11\frac{1}{2}"$, $L = 22"$, $D = 15\frac{1}{2}"$

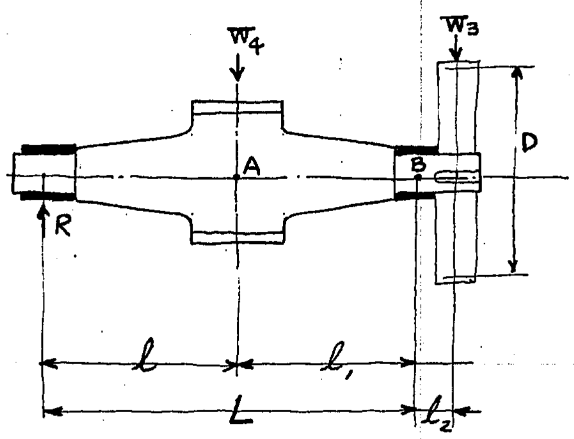
$M_B = \dfrac{W_3 \times l_2}{L} \times l_1 = \dfrac{32800 \times 11.5}{22} \times 10.5 = 180000^{\text{in-lbs}}$

$M_T = W_3 \times \dfrac{D}{2} = 32800 \times \dfrac{15.5}{2} = 254000^{\text{in-lbs}}$

$M_e = .35 \times 180000 + .65\sqrt{180000^2 + 254000^2} = 265000^{\text{in-lbs}}$

$f = \dfrac{M_e}{Z} = \dfrac{265000}{33.67} = 7850^{\text{lb}/\square"} = 3.5^{t/\square"}$

First Canal Bridge for City of Kobe
(Strength of Rack pinion shaft.)



when, $W_3 = 32800.^{lbs}$ $W_4 = 76700.^{lbs}$
$l = 24.''$ $l_1 = 27''$ $l_2 = 11\frac{1}{2}''$ $L = 51''$ $D = 50.43''$

Reaction $R = \frac{(W_4 \times l_1) - (W_3 \times l_2)}{L} = \frac{(76700 \times 27) - (32800 \times 11.5)}{51}$

$= 33400^{lbs} = 14.9^{t}$

M_B at A. $= R \times l = 33400 \times 24 = 800000.^{in\text{-}lbs}$

M_T $= W_3 \times \frac{D}{2} = 32800 \times \frac{50.43}{2} = 830000.^{in\text{-}lbs}$

M_e at A. $= .35 \times 800000 + .65\sqrt{800000^2 + 830000^2} = 1030000.^{in\text{-}lbs}$

f at A. $= \frac{M_e}{Z} = \frac{1030000}{169.6} = 6050^{lbs/\square''} = 2.7^{t/\square''}$
its $d = 12''$

M_B at B. $= W_3 \times l_2 = 32800 \times 11.5 = 378000^{in\text{-}lbs}$

M_T $= 830000.^{in\text{-}lbs}$

M_e at B. $= .35 \times 378000 + .65\sqrt{378000^2 + 830000^2} = 727000.^{in\text{-}lbs}$

f at B. $= \frac{M_e}{Z} = \frac{727000}{71.57} = 10150^{lbs/\square''} = 4.52^{t/\square''}$

its $d = 9''$

Gear table. (Gears to be cut)

Mc. module	N.	P.D. inch.	C.P. inch.	F. inch.	R/m.	Speed ft/m.	W. lbs.	Mat.	y.
16	15	9.74	2.04	7	558	1420	3480	m.s.	.091
"	48	31.2	"	$6\frac{1}{2}$	174	"	"	c.s.	.118
18	15	10.8	2.26	$7\frac{3}{4}$	174	491	9450	m.s.	.091
"	48	35.1	"	$7\frac{1}{4}$	54.5	"	"	c.s.	.118
20	15	12.1	2.53	9	54.5	173	12900	c.s.	.091
"	52	42.1	"	8	15.7	"	"	c.s.	.118
24	16	15.5	3.04	10	15.7	63.7	32800	m.s.	.092
"	52	50.43	"	$9\frac{1}{2}$	4.85	"	"	c.s.	.118
	15	20.29	4.25	$10\frac{1}{2}$	4.85	25.8	76700	m.s.	.092

Rack speed $= 25.5^{ft}/m$

Force on Rack circle from load. $= 164957^{lbs}(73.6^{t})$
for 15^{lbs} wind pressure.

" $= 118235^{lbs}(53^{t})$
for 10^{lbs} wind pressure.

First Canal Bridge for City of Kobe:

Strength of gear.

$$S = \frac{W}{p.F.y.}$$ .... Wilfred Lewis's Formula.

where S = The unit fiber stress.
p = The circuler pitch.
F = The width of the tooth face.
y = A constant depending on the number and shape of the gear teeth, and we take from Maag Gear table.
W = The total teeth pressure.

1st gear:–

pinion.

$W = 3480.^{lbs}$ $p = 2.04''$ $F = 7''$ $y = .091.$

$$S = \frac{3480}{2.04 \times 7 \times .091} = 2680^{lbs/\square''} = 1.2.^{t/\square''}$$

(allowable stress = $2.28.^{t/\square''}$)

spur wheel.

$F = 6\frac{1}{2}''$, $y = .118.$

$$S = \frac{3480}{2.04 \times 6.5 \times .118} = 2220^{lbs/\square''} = .993.^{t/\square''}$$

(allowable stress = $1.52.^{t/\square''}$)

2nd gear:–

pinion.

$W = 9450.^{lbs}$ $p = 2.26''$ $F = 7\frac{3}{4}''$, $y = .091.$

$$S = \frac{9450}{2.26 \times 7.75 \times .091} = 5930^{lbs/\square''} = 2.65.^{T/\square''}$$

(allowable stress = $4.23.^{t/\square''}$)

spur wheel.

$F = 7\frac{1}{4}''$, $y = .118.$

$$S = \frac{9450}{2.26 \times 7.25 \times .118} = 4930^{lbs/\square''} = 2.2.^{t/\square''}$$

(allowable stress = $2.82.^{t/\square''}$)

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CALCULATIONS FOR

First Canal Bridge for City of Kobe

3rd gear :—

pinion.

$W = 12900^{lbs}$ $p = 2.53$, $F = 9''$ $y = .091$.

$$S = \frac{12900}{2.53 \times 9 \times .091} = 6230^{lbs/\square''} = 2.78^{t/\square''}$$

(allowable stress = $4.^{t/\square''}$)

spur wheel.

$F = 8''$ $y = .118$.

$$S = \frac{12900}{2.53 \times 8 \times .118} = 5400^{lbs/\square''} = 2.41^{t/\square''}$$

(allowable stress = $4.^{t/\square''}$)

4th gear :—

pinion.

$W = 32800^{lbs}$ $p = 3.04''$ $F = 10''$ $y = .092$.

$$S = \frac{32800}{3.04 \times 10 \times .092} = 11700^{lbs/\square''} = 5.23^{t/\square''}$$

(allowable stress = $6.98^{t/\square''}$)

spur wheel.

$F = 9\frac{1}{2}''$ $y = .118$.

$$S = \frac{32800}{3.04 \times 9.5 \times .118} = 9640^{lbs/\square''} = 4.3^{t/\square''}$$

(allowable stress = $4.65^{t/\square''}$)

Rack gear :—

pinion.

$W = 76700^{lbs}$ $p = 4\frac{1}{4}''$ $F = 10\frac{1}{2}''$, $y = .092$.

$$S = \frac{76700}{4.25 \times 10.5 \times .092} = 18700^{lbs/\square''} = 8.35^{t/\square''}$$

(allowable stress = $8.9^{t/\square''}$)

spur wheel.

$F = 10''$ $y = .154$.

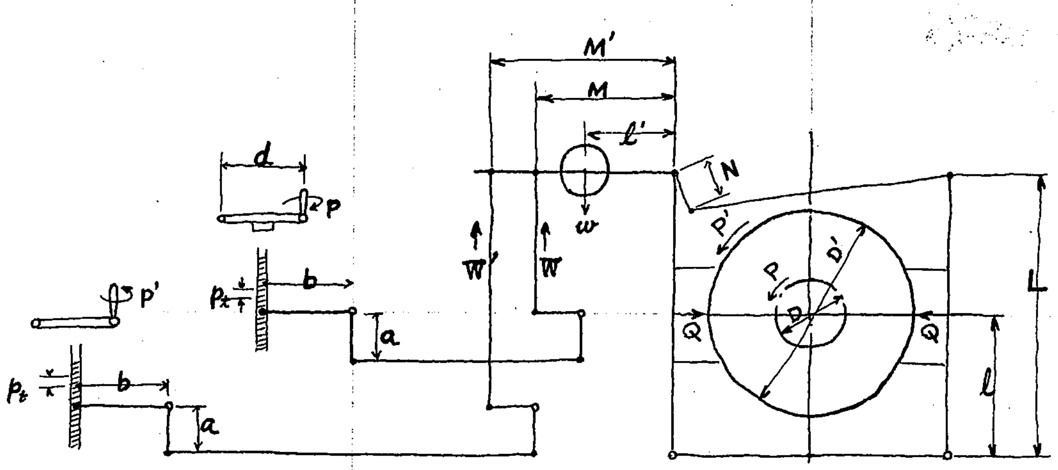
$$S = \frac{76700}{4.25 \times 10 \times .154} = 11700^{lbs/\square''} = 5.23^{t/\square''}$$

(allowable stress = $7.1^{t/\square''}$)

CALCULATIONS FOR

First Panal Bridge for City of Kobe

Hand brake.



when

$D = 9.74''$,	$D' = 24''$,
$l = 18\frac{1}{4}''$,	$L = 36\frac{1}{2}''$,
$P = 3480^{lbs}$,	$N = 4''$,
$M = 18''$,	$M' = 22''$,
$w = 60^{lbs}$	$a = 8''$,
$b = 12''$	$p_t = \frac{1}{4}''$,
$d = 14''$,	$y = .4$,
$l' = 12''$,	$\mu = .3$.

$$P' = \frac{P \times D}{D'} = \frac{3480 \times 9.74}{24} = 1410^{lbs}$$

$$Q = \frac{P'}{2} \times \frac{1}{\mu} = \frac{1410}{2} \times \frac{1}{.3} = 2350.^{lbs}$$

$$W = \frac{Ql}{L} \times \frac{N}{M} + \frac{wl'}{M} = \frac{2350 \times 18\frac{1}{4}}{36\frac{1}{2}} \times \frac{4}{18} + \frac{60 \times 12}{18} = 300.^{lbs}$$

$$W' = \frac{Ql}{L} \times \frac{N}{M'} + \frac{wl}{M'} = \frac{2350 \times 18\frac{1}{4}}{36\frac{1}{2}} \times \frac{4}{22} + \frac{60 \times 12}{22} = 246.^{lbs}$$

$$p = \frac{p_t \times W}{\pi \times d \times y} \times \frac{a}{b} = \frac{\frac{1}{4} \times 300}{\pi \times 14 \times .4} \times \frac{8}{12} = 2.84.^{lbs} \cdots\cdots$$

.... Handle in driver's house.

$$p' = \frac{p_t \times W'}{\pi \times d \times y} \times \frac{a}{b} = \frac{\frac{1}{4} \times 246}{\pi \times 14 \times .4} \times \frac{8}{12} = 2.33.^{lbs} \cdots\cdots$$

.... Handle near by Gasoline Engine.

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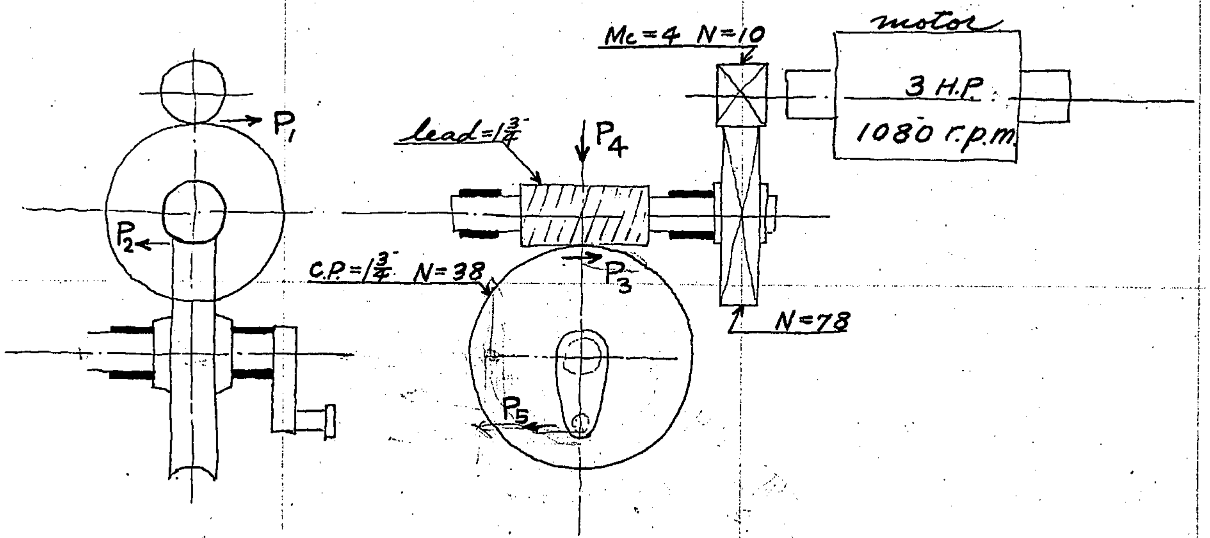
CALCULATIONS FOR

First Panel Bridge for City of Kobe

Calculations for Locking the Bridge



No. of revolutions of the motor $= 1080$ r.p.m.

" the worm $= 1080 \times \frac{10}{78} = 138.5$ r.p.m.

" the worm wheel $= 138.5 \times \frac{1}{38} = 3.65$ r.p.m.

Time required to half revolve the crank; that is time for locking.

$= \frac{60}{3.65} \times \frac{1}{2} = 8.23$ sec.

where

$H.P$ = Motor Horse power $= 3$
D_m = dia. of motor pinion $= 1.63''$
R_m = No. of revolution of the motor $= 1080$

$$P_1 = \frac{H.P \times 33000 \times 12}{\pi \times D_m \times R_m} = \frac{3 \times 33000 \times 12}{\pi \times 1.63 \times 1080} = 215^{lbs}$$

D_s = dia of spur wheel $= 12.67''$
D_w = " " worm $= 3.9''$
y_1 = 1st gear efficiency $= .94$

$$P_2 = P_1 \times \frac{D_s}{D_w} \times y_1 = 215 \times \frac{12.67}{3.9} \times .94 = 655^{lbs}$$

p = circular pitch of the worm $= 1\frac{3}{4}''$
y_2 = worm gear efficiency $= .7$

$$P_3 = P_2 \times \frac{\pi D_w}{p} \times y_2 = 655 \times \frac{\pi \times 3.9}{1\frac{3}{4}} \times .7 = 3220^{lbs}$$

β = pressure angle $= 15°$
α = angle of the helix of the worm $= 8° 6'$
$\mu' = 0.06$

$$P_4 = P_3 \left[\frac{\tan\beta}{1-\mu'\tan\alpha}\right] = 3220 \times \left[\frac{.5774}{1 - .06 \times \frac{1}{7}}\right] = 1870^{lbs}$$

D_W = dia of worm wheel $= 10.583''$
l = rad. of crank $= 4''$

$$P_5 = P_3 \times \frac{D_W}{l} = 3220 \times \frac{10.583}{4} = 7600^{lbs} = 3.5^{t}$$

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CALCULATIONS FOR

First Panal Bridge for City of Kobe:

Strength of gear:—

$$S = \frac{W}{p \cdot F \cdot y}$$ ....Wilfred Lewis's Formula.

1st gear:—

pinion. (material M.S.)

$W = 215$ lbs $\quad p = \frac{M_c \pi}{25.4} = .494'' \quad F = 2\frac{1}{4}''$

$y = .084$. (from maag gear table.)

$$S = \frac{215}{.494 \times 2\frac{1}{4} \times .084} = 2300 \text{ lbs}/\square'' = 1.01 \text{ t}/\square''$$

(allowable stress = 4.5 t/□")

spur wheel. (material C.S.)

$F = 1\frac{3}{4}'' \quad y = .123$ (from Maag gear table.)

$$S = \frac{215}{.494 \times 1\frac{3}{4} \times .123} = 2020 \text{ lbs}/\square'' = .9 \text{ t}/\square''$$

(allowable stress = 3 t/□")

worm gear:—

worm wheel (material P.B.)

$W = 3220$ lbs $\quad p = 1\frac{3}{4}'' \quad F = \frac{3.9\pi}{4} \times 2 = 6.12''$

$y = .107$

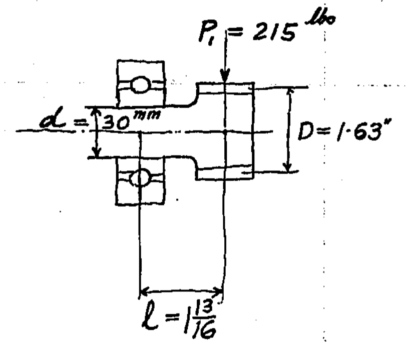
$$S = \frac{3220}{1\frac{3}{4} \times 6.12 \times .107} = 2800 \text{ lbs}/\square'' = 1.25 \text{ t}/\square''$$

(allowable stress = 3.8 t/□")

First Canal Bridge for City of Kobe

Strength of shaft:-

Motor shaft:-



Bending Moment $M_B = P_1 \times l = 215 \times 1\frac{13}{16} = 390.^{in\text{-}lbs}$

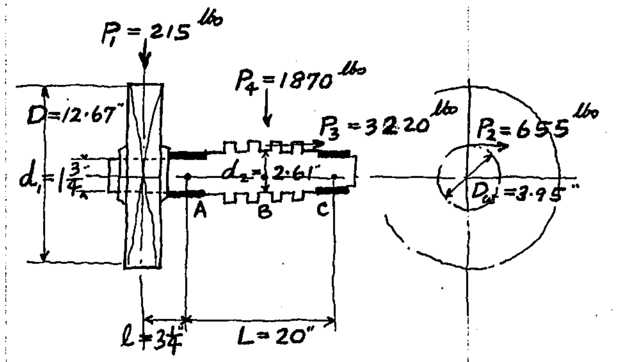
Twisting Moment $M_T = P_1 \times \frac{D}{2} = 215 \times \frac{1{\cdot}63}{2} = 175.^{in\text{-}lbs}$

Equivalent Bending Moment $M_e = {\cdot}35 M_B + {\cdot}65\sqrt{M_B^2 + M_T^2}$.

$= {\cdot}35 \times 390 + {\cdot}65\sqrt{390^2 + 175^2} = 413.^{in\text{-}lbs}$

Max. Bending stress $f = \frac{M_e}{Z} = \frac{413}{{\cdot}162} = 2550^{lbs/\square''} = 1{\cdot}5^{t/\square''}$

Worm shaft:-



M_B at A. $= P_1 \times l = 215 \times 3\frac{1}{4} = 700.^{in\text{-}lbs}$

M_T $= P_1 \times \frac{D}{2} = 215 \times \frac{12{\cdot}67}{2} = 1360.^{in\text{-}lbs}$

M_e at A. $= {\cdot}35 \times 700 + {\cdot}65\sqrt{700^2 + 1360^2} = 1235.^{in\text{-}lbs}$

$f = \frac{1235}{{\cdot}5261} = 2350^{lbs/\square''} = 1{\cdot}05.^{t/\square''}$

Reaction at C. $= \sqrt{\left(\frac{P_2}{2}\right)^2 + \left(\frac{P_4}{2} + \frac{\frac{D_w}{2} \times P_3}{L}\right)^2}$.

$= \sqrt{\left(\frac{655}{2}\right)^2 + \left(\frac{1870}{2} + \frac{\frac{3{\cdot}9}{2} \times 3220}{20}\right)^2} = 1290.^{lbs}$

M_B at B. $= 1290 \times \frac{20}{2} = 12900.^{in\text{-}lbs}$

$f = \frac{12900}{1{\cdot}74} = 7420^{lbs/\square''} = 3{\cdot}31.^{t/\square''}$

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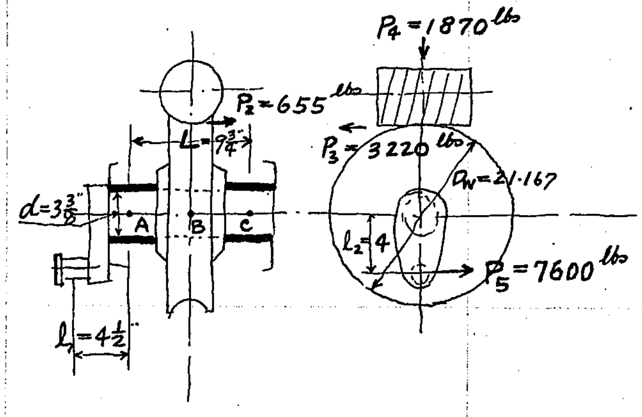
CALCULATIONS FOR

First Canal Bridge for City of Kobe

Worm wheel shaft :-



M_B at A. $= P_5 \times l_1 = 7600 \times 4\frac{1}{2} = 34200.$ in-lbs

M_T. $= P_5 \times l_2 = 7600 \times 4 = 30400.$ in-lbs

M_e at A. $= .35 \times 34200 + .65\sqrt{34200^2 + 30400^2} = 41700.$ in-lbs

$f.$ $= \frac{41700}{3.774} = 11050$ lbs/□" $= 4.94$ t/□"

Reaction at C. $= \sqrt{\left(\frac{P_3}{2}\right)^2 + \left(\frac{P_4}{2} + \frac{\frac{D_W}{2} \times P_2}{L}\right)^2}$

$= \sqrt{\left(\frac{3220}{2}\right)^2 + \left(\frac{1870}{2} + \frac{\frac{21.167}{2} \times 655}{9\frac{3}{4}}\right)^2} = 2310.$ lbs

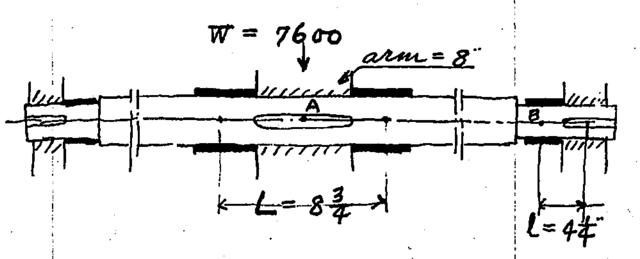
M_B at B. $= 2310 \times \frac{9\frac{3}{4}"}{2} = 11250.$ in-lbs

M_T. $= 30400$

M_e. $= .35 \times 11250 + .65\sqrt{11250^2 + 30400^2} = 25000.$ in-lbs

$f.$ $= \frac{25000}{3.774} = 6640$ lbs/□" $= 2.96.$ t/□"

Lever shaft. :-



M_B at A. $= \frac{W \times L}{4} = \frac{7600 \times 8\frac{3}{4}}{4} = 16630.$ in-lbs

M_T. $= \frac{7600}{2} \times 8 = 30400.$ in-lbs

M_e at A. $= .35 \times 16630 + .65\sqrt{16630^2 + 30400^2} = 30600.$ in-lbs

$f.$ $= \frac{30600}{5.177} = 5900$ lbs/□" $= 2.64.$ t/□"

M_B at B. $= \frac{W}{2} \times l = \frac{7600}{2} \times 4\frac{1}{4} = 16100.$ in-lbs

M_T. $= 30400$

M_e at B. $= .35 \times 16100 + .65\sqrt{16100^2 + 30400^2} = 28000.$ in-lbs

$f.$ $= \frac{28000}{3.774} = 7430$ lbs/□" $= 3.31.$ t/□"

Rod :- $d = 1\frac{3}{4}"$, $l = 6'-0"$

Safe working load $P. = \frac{16\,E}{\left(\frac{l}{r}\right)^2} \times \frac{1}{f}$ .... Euler's formula.

$P = \frac{16 \times 30\,000\,000}{\left(\frac{72}{.437}\right)^2 \times 4} = 4400.$ lbs

where
f = Safety factor. = 4
r = Radius of gyration. = .437

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CALCULATIONS FOR

First Panal Bridge for City of Kobe = 60' single leaf trunnion bascule — M1

4 Female Trolley Pans M1 (Brass Casting)

$6 \times 12 \times 0.25 = 18$
$1.4 \times 0.37 \times 12.5 \times 2 = 13$
$1.62 \times 1.25^2 \times \frac{\pi}{4} \times 3 = 6$
$0.5 \times 1 \times 10 = 5$
$0.4 \times 1.25 \times 2 = 1$
$= 43$ @ $0.3 = 13^{\#}$

2 Cap Screws $\frac{1}{2}"\phi \times 1\frac{1}{8}"$ @ $0.15 \times 2 = 0.3$
3 Taped Screws $\frac{5}{8}"\phi \times 4"$ @ $0.504 \times 3 = 1.5$
$15. \times 4 = 60^{\#}$

4 Male Trolley Pans M2

$4.75 \times 12 \times 0.25 = 14$
$1.4 \times 0.37 \times 12. \times 2 = 12$
$1.62 \times 1.25^2 \times \frac{\pi}{4} \times 3 = 6$
$0.5 \times 1 \times 10 = 5$
$0.4 \times 1.25 \times 2 = 1$
38 @ $0.3 = 11.4^{\#}$

2 Cap Screws $\frac{1}{2}"\phi$ — 0.3
3 Taped Screws $\frac{5}{8}"\phi$ — 1.5
$13.2 \times 4 = 53^{\#}$

4 Hinged Trolley Pans HP

$5.25 \times 0.3 \times 30 = 47$
$0.75 \times 1 \times 46 = 35$
$1.62 \times 1.25^2 \times \frac{\pi}{4} \times 4 = 8$
$0.25 \times 1 \times 26 \times 2 = 14$
$0.75 \times 1.75 \times 4 = 5$
$0.63 \times 1.75 \times 3 = 3$
$0.25 \times 1 \times 2 \times \frac{1}{2} \times 6 = 2$
$1.25 \times 0.4 \times 2.25 = 1$
$0.25 \times 1.4 \times 1.5 \times \frac{1}{2} \times 10 = 3$
$= 118$ cubic.in. @ $0.3 = 35.4^{\#}$

4 Cap Screws $\frac{1}{2}"\phi$ — 0.6
4 Taped Screws $\frac{5}{8}"\phi$ — 2.0
2 Pins $\frac{3}{4}"\phi \times 1\frac{3}{4}"$ — 0.3
2 Cotter Pins
$38.3 \times 4 = 153^{\#}$

4 Trolley Wire Pans M3 (Brass Casting)

$0.25 \times 6 \times 14.25 \times 2 = 43$
$0.75 \times 1.5 \times 14.25 \times 2 = 32$
$0.25 \times 3 \times 16 \times 2 = 24$
$2.25 \times .25 \times 13 = 7$
$0.7 \times 1 \times 3.2 = 22$
$0.25 \times 0.75 \times 12 = 2$
$0.25 \times 0.75 \times 4 = 1$
$1.62 \times 1.25^2 \times \frac{\pi}{4} \times 5 = 10$
$1.25 \times 0.4 \times 2 = 1$
$0.25 \times 1.25 \times 1.4 \times 10 \times \frac{1}{2} = 2$
144 @ $0.3 = 43.2^{\#}$

8 Bolts $\frac{1}{2}"\phi \times \frac{3}{4}"$ @ 0.57×8 — $4.6^{\#}$
4 Taped Screw $\frac{5}{8}"\phi \times 4"$ @ 0.504 — 2.0
1 " " $\frac{5}{8}"\phi \times 7"$ @ 0.762 — 0.8
1 Pin $1\frac{1}{4}"\phi \times 4\frac{5}{8}"$ @ — 2.2
2 Cap Screw $\frac{1}{2}"\phi \times 1\frac{1}{8}$ @ 0.15 — 0.3
53.1

1 Sheave (Steel)
$(3^2 - 1.25^2) \times 2.5 = 18.6$
$+ (10^2 - 3^2)\ 0.5 = 45.5$
$+ (10.25^2 - 9.5^2) \times 1.5 = 22.5$
$86.6 \times \frac{\pi}{4} = 68.^{\#}$ @ $.283 = 19.25^{\#}$

72.35×4
289.40

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

2
Mz

First Panel Bridge for City of Kobe; 60' single leaf trunnion bascule.

NO.	Material	Length	Weight per ft.	Total weight	Remarks
	2 Weight Poles WP				
3	Ls. $3\frac{1}{2}\times3\frac{1}{2}\times\frac{3}{8}$"	25'5"	@ 8.5	649	
1	Ls. $5"\times3\frac{1}{2}\times\frac{3}{8}$	25'5"	@ 10.4	264	
2	Pls. $23\frac{1}{2}"\times\frac{3}{8}$	25'5"	29.96	1521	
2	Ls. $3"\times3\times\frac{3}{8}$	$1'11\frac{1}{4}"$	7.2	28	
2	Fills. $3"\times\frac{3}{8}$	$1'5\frac{3}{4}"$	3.83	11	
4	Pin Pls. $17"\times\frac{1}{2}"$	1'3"	28.9	144	
1	L. $3"\times2\frac{1}{2}"\times\frac{5}{16}$	0'5"	5.6	2	
1	L. $5"\times3"\times\frac{3}{8}$	$0'7\frac{1}{2}"$	9.8	6	
2	Pls. $2\frac{1}{2}\times\frac{3}{8}"$	1'0	3.19	6	
1	Cov.Pls. $31"\times\frac{3}{8}$	22'7"	39.53	891	
4	Tees $4\frac{1}{2}"\times3\frac{1}{2}"\times$	19'3"	10.	770	
1	Pl. $31\times\frac{3}{8}$	2'7"	39.53	102	
1	Cov.Pl. "	18'1"	"	714	
1	" $14"\times\frac{3}{8}"$	2'7"	17.85	46	
1	" $9"\times\frac{3}{8}"$	2'7"	11.48	30	
2	Pls $11\frac{3}{8}"\times\frac{1}{4}"$	3'0"	10.09	61	
2	Ls $2\frac{1}{2}"\times2\frac{1}{2}\times\frac{5}{16}"$	3'2"	5.0	32	
1	Pl. $17"\times\frac{1}{4}"$	3'2"	14.45	46	
1	L $5"\times3"\times\frac{3}{8}$	3'0"	9.8	29	
1	Fill. $2\frac{1}{2}\times\frac{3}{8}"$	0'10"	3.19	3	
1	" $3"\times\frac{3}{8}"$	0'3"	3.83	1	
1	L $5"\times3"\times\frac{3}{8}$	0'6"	9.8	5	
1	L "	$14'8\frac{1}{4}"$	"	144	
2	Ls $2\frac{1}{2}\times2\frac{1}{2}\times\frac{5}{16}"$	$14'8\frac{1}{4}"$	5.0	147	
1	Pl. $8\frac{5}{8}"\times\frac{1}{4}"\times$	$10'5\frac{1}{4}"$	7.33	77	
1	Pl. "	4'3"	"	31	
1	L $4"\times4"\times\frac{3}{8}$	0'5"	9.8	4	
2	Fills $6"\times\frac{3}{8}"$	$1'4\frac{3}{4}"$	7.65	21	
1	Base Pl. $24"\times\frac{1}{2}"$	$2'8\frac{3}{4}"$	40.8	111	Base
2	Ls $6"\times4"\times\frac{1}{2}"$	$1'11\frac{1}{4}"$	16.2	63	
2	" "	1'5"	"	46	
4	Ls $4"\times3"\times\frac{3}{8}"$	3'6"	8.5	119	diaphragm
4	Ls $3"\times3"\times\frac{3}{8}$	1'5"	7.2	41.	
1	Pl. $23"\times\frac{3}{8}"$	3'6"	29.33	103	
4	Ls $4"\times3"\times\frac{3}{8}"$	1'6"	8.5	51	Top diaphragm.
1	Pl. $18"\times\frac{1}{2}"$	$1'11\frac{1}{2}"$	30.6	60	
2	Pin Pls. $15"\times\frac{1}{2}"$	1'6"	25.5	77	
1	L $3"\times3"\times\frac{3}{8}"$	0'5"	7.2	3	
4	Anch. Bolts $\frac{3}{4}"\phi$	1'0"	1.69	7	
1	Washer $3"\times\frac{3}{8}"$	0'3"	3.83	1	
750	S.R. $\frac{3}{4}"\phi$ grip $\frac{3}{4}"$		0.43	322	
20	F.R. " " "		"	9	
190	S.R. $\frac{5}{8}"\phi$ grip $\frac{5}{8}"$		0.26	49	
50	F.R. " " "		"	13	
140	Bolts $\frac{3}{4}"\phi$ grip $\frac{3}{4}"$		0.6	84	
152	" $\frac{3}{8}"\phi$ " $1\frac{1}{2}"$		0.102	16	
				6960 × 2 =	13,920#

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CALCULATIONS FOR

First Canal Bridge for City of Kobe: 66' Single leaf trunnion bascule

3

M3

NO.	Material	Length	Weight per ft.	Total weight	Remarks
	1 - Trolley arch	TA4			
8	Ls $3\frac{1}{2}"\times3\frac{1}{2}"\times\frac{3}{8}"$	11'-3"	@ 8.5	765	
4	Ls ״ ״ ״	26'-2¾"	״	892	
52	Lac. bars $2\frac{1}{2}"\times\frac{5}{16}"$	3'-4"	2.66	461	
96	״ ״ $2\frac{1}{4}"\times\frac{5}{16}"$	2'-3"	2.39	516	
4	Ls $3\frac{1}{2}"\times3\frac{1}{2}"\times\frac{3}{8}"$	1'-5¼"	8.5	49	
4	Pls. 18"×⅜"	1'-9"	22.95	161	
4	Fills. 3"×⅜"	1'-1¾"	3.83	18	
4	Ls $3\frac{1}{2}"\times3\frac{1}{2}"\times\frac{3}{8}"$	9'-9"	8.5	332	
4	Pls. 13"×⅜"	2'-0"	16.58	133	
4	Pls. 20"×⅜"	1'-9"	25.5	179	
8	Ls $3\frac{1}{2}"\times3\frac{1}{2}"\times\frac{3}{8}"$	1'-8"	8.5	113	
8	Pls. 9"×⅜"	1'-9"	11.48	161	
8	Pls. 18"×⅜"	2'-7"	22.95	474	
4	Pls. 25⅝"×⅜"	2'-7"	32.67	338	
2	Pls. 31"×⅜"	3'-9"	39.53	296	
2	Pls. 18"×⅜"	2'-7"	22.95	118	
2	Ls 6"×6"×⅜"	2'-7"	14.9	77	
16	Ls $3\frac{1}{2}"\times3\frac{1}{2}"\times\frac{3}{8}"$	1'-8¼"	8.5	229	
8	Ls ״	1'-10"	״	125	
8	Fills. 3"×⅜"	1'-1¾"	3.83	35	
2	Pls 9"×⅜"	1'-11½"	11.48	45	
2	Fills. 3"×⅜"	1'-4½"	3.83	11	
2	״ ״	0'-11"	״	7	
2	Pls. 20½"×⅜"	1'-11½"	26.14	102	
650	Shop Rivets ¾"φ grip	⅞"	0.44	286	
250	feild Rivets ״ ״	¾	0.43	108	
				6,031	

Summary

2 - Poles	13,920
	6,031
	19,951

NO.	Material	Length	Weight per ft.	Total weight	Remarks
	2 - Rack Hood				
2	Pls. 32"×$\frac{5}{16}$" (½)	6'-0"	@ 34.0	204	
2	Pls. 10½"×$\frac{5}{16}$"	5'-2"	11.16	115	
2	Ls 2½"×2½"×$\frac{5}{16}$"	3'-11"	4.5	35	
2	Pls 9"×$\frac{5}{16}$"	0'-10"	9.56	16	
2	Ls 2½"×2½"×$\frac{5}{16}$"	10'-10"	5.0	108	
1	Cov. pl. 19¾×$\frac{5}{16}$"	10'-10	20.99	228	
1	L 2½"×2½"×$\frac{5}{16}$"	2'-9"	5.0	14	
1	L 3"×2½"×$\frac{5}{16}$"	2'-9"	5.6	15	
1	L 4"×2½"×⅜"	2'-2⅛"	7.81	17	
1	L ״	1'-8½"	״	13	
210	Shop Rivets ⅝"φ	⅝"	0.26	55	
3	Anchor Bolts ½"φ	0'-5"	0.344	1	
5	Bolts ״	¾	0.22	1	
9	Taped Bolts ״	1½"	0.154	1	
9	״ ״ ״	1¾	0.164	1	

824 × 2 = 1,648#

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SEIYU BLDG, TOKIO

MADE BY Y. Hirata DATE 2-3-15 FILE NO.
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CALCULATIONS FOR

First Canal Bridge for City of Kobe: 60' single leaf trunnion bascule. M4

4 Counter weight (Cast Iron)

$3.5 \times 10.75 \times 21 \times 18$	=	14,202
$10.75 \times 22.5 \times 28$	=	6,775
$1.5 \times 3.5 \times 10.75$	=	56
		21,033
$1.75^2 \times \frac{\pi}{4} \times 3.5 \times 96$	=	808
$5 \times 10 \times 10.75$	=	538
$1.75^2 \times \frac{\pi}{4} \times 27 \times 2$	=	130
$3 \times 3.5 \times 4.0 \times 4$	=	168
		1644

Total 21.033
− 1.644
19,389 @ 0.26 = 5041.#

36 Bolts $1^{\phi} \times 10''$ @3.07 = 110.51

5151.51 × 4 = 20,606#

8-Sheaves M3 1.

Sheave (A)
$(3.75^2 - 2^2) \times \frac{\pi}{4} \times 2$ = 15.7
$1.75 \times 0.5 \times 2.25 \times 5$ = 9.85
$(12^2 - 9.25^2) \times \frac{\pi}{4} \times 1$ = 46
71.55 @ 0.283 = 20.2# × 8 = 162.# Steel casting

1-Shaft $2''^{\phi} \times 2'4''$

4-Collers	$(3\frac{1}{2}^2 - 2^2) \times \frac{\pi}{4} \times 1 \times 4$ = 26.	@ 0.283	7.4	Steel Casting
2 Brackets.	$(3.25^2 - 2^2) \times \frac{\pi}{4} \times 1.4 \times 2$ = 16	@ 0.30	4.8	Brass 〃
	$(8^2 - 2^2) \times \frac{\pi}{4} \times 0.63 \times 2$ = 59	@ 0.30	17.7	〃 〃
12- Bolts.	$\frac{3}{4}''^{\phi} \times 0'2''$	@ 0.75	9	
			65.9 × 2 = 132#.	

Total. 294#

4-Sheaves M3 2

2-Sheaves (A)		@ 20.2	40#
2 - Pin Pl.	$6 \times \frac{1}{2} \times 1'-1$	@ 10.2	22
2 L.	$4 \times 3 \times \frac{3}{8} \times 1'-1$	@ 8.5	18.4
1 Pl.	$10\frac{3}{4} \times \frac{3}{8} \times 1'-1$	@ 13.71	14.8
2 L.	$6 \times 3\frac{1}{2} \times 0'-10\frac{3}{4}$	@ 17.9	35.8
20 - Shop Rivets	$\frac{3}{4}''^{\phi}$ grip $\frac{7}{8}''$	@ 0.44	8.8
3 Bolts	$\frac{3}{4}''^{\phi} \times 2\frac{1}{4}$	@ 0.78	2.3
2 〃	$\frac{3}{4}''^{\phi} \times 4''$	@ 0.75	1.5
1 〃	$1\frac{1}{4}''^{\phi} \times 6\frac{3}{4}$	@ 4.08	4.1
			148 × 4 = 592#

Standard. Hoisting rope 6 strand 19 wire.
Improved plow steel
Proper working load 2,700#
$(117 + 121) \times 2 = 476'$ $\frac{3}{8}''^{\phi}$ @ 0.22 105#

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SEIYU BLDG, TOKIO

MADE BY y.Hirata DATE 2-3-15 FILE NO

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule. M5

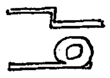
4- Sheaves M3 3 (cast iron).

1 - Sheaves (A)			20#
0.5 × 8 × 12.5	= 5		
0.5 × 9.5 × 8 × 2	= 76		
0.5 × 3 × 5 × ½	= 3.75		
0.5 × 6 × 5 × ½	= 7.5		
	92.25	@ 0.26	= 24
1- Bolt. 1¼" × 0'-5¾		@ 3.93	= 4
6- 〃 ¾" × 0'-4½		@ 0.63	= 4
			52 × 4 = 208#

160- Guide pulley for Counter weight (cast iron). M3 4

Steel pulley $1.9 \times 2.25^2 \times \frac{\pi}{4}$ = 7.55		@ 0.283	= 2.2
0.4 × 3.5 × 12.2 = 17.1		@ 0.26	= 4.45
4- Set Screw ⅜" × 1		@ 0.032	= 0.13
1- Steel Pin. ⅝" × 2⅞		@ 0.25	= 0.25
			7.03 × 160 = 1125#

Locking for Counter weight

2- Locking bars	(steel.)	@ 87.5	175#
2- Guide	(C. I.)	@ 29.2	58.4
12- Bolts. ⅝" × 1¾"			4.56
2- L	(M.S.)	@ 0.89	1.78
4- Bolts. ¾" × 2¼			0.75
2- Racks	(steel)	@	59.4
12- Bolts. ⅜" × 2½			2.3
			243.77 302.17
2- Rack pinion	(C. I.)	@ 13.0	26
4- pulley	〃	@ 18.0	72
2- 〃	〃	@ 22.4	44.8
2- 〃	〃	@ 11.0	22
16- 〃	〃	@ 2.5	40
2- Bearing Bracket (C. I.)		@ 20.0	40
2- 〃 Bushing (Brass.)			1.32
4- Bolts. ⅜" × 2⅝			0.78
12- 〃 ⅝" × 1⅞			4.68 255.58
2- Bracket	(C. I.)	@ 9.15	18.3
2- 〃 Bushing	(Brass)	@ 0.72	1.44
8- Bolts. ⅝" × 1⅞			3.12
2- Shafts 1¼" × 1'-0⅝	(steel)	@ 4.3	8.6
2- Crank levers	(W. I.)	@ 9.7	19.4
16- Guide pulley Bracket (C.I.)		@ 5.6	89.6
16 Pins ¾" × 2⅝ (M.S.)			8.0
64- Bolts. ⅝" × 3"			31.4
2- Counter wt. for locking bars (C.I.)		@ 55	110.
2- Hand levers	(W. I.)	@ 12.6	25.2
2- 	〃	@ 1	2.
2- 	〃	@ 0.45	0.9 119.08 317.96

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' Single leaf trunnion bascule. -6 M16

2-	(W. I.)	@ 0.35	0.7
2-	(H. S.)	@ 0.35	0.7
2-	(M. S.)	@ 0.59	1.18
2-	"	@ 0.22	0.44
6- Bolts. 5/16"φ × 1 5/8			0.30
4- " 1/4"φ × 1/2			0.14
4- " 1/2"φ × 1/2			0.88
2- Pins.	(steel)	@ 1.9	3.8
2- Lever Guide	(C. I.)	@ 225	450
12- Bolts. 3/4"φ × 1.0			22.5

Total { Steel & Wrought Iron 378.51; Cast Iron 971.10; Brass 2.76 }

Wire rope 1/4"φ Plow steel (175 + 225) = 400 ft. @ 0.1#/ft. 40.

2- 2"φ gas pipe @ 166.5 333.

1725.

2- Front Lock. (steel casting).

1.955 cub. ft. @ 490 960#

32 Bolts. 7/8"φ @ 0.77 24.5

1.25 × 14.5 × 24 = 435 cub. inch
1.25 × 6 × 12 × 4 = 360
1.25 × 22 × 20.5 = 564
1.25 × 14 × 20.5 × 2 = 718
1.25 × 7.5 × 14 × 2 = 262
2339 @ 0.283 662

29 Bolts. 7/8"φ × 1 5/8 @ 1.05 30

Total 1676.5 × 2 = 3,353#

2- Tail Lock. (cast steel).

1.88 cub. ft. @ 490# 921#

61- Bolts. 7/8"φ @ 0.77 39.27

1.5 × 11.5 × 25.25 = 436 cub. inch
1.25 × 7.5 × 17.65 × 2 = 331
1.5 × 7.5 × 9 = 101
1.25 × 7.5 × 4 = 38
906 @ 0.283 256

10- Bolts. 7/8"φ × 2 1/2 @ 1.22 12

1228.27 × 2 = 2,457#

2- Air Buffers at ~~rear~~

1.5 cub. ft. @ 490 735#

14 Bolts. 3/4"φ @ 1.01 14

12 × 1.5 × 24 = 432 cub. inch
9 × 2.5 × 10.75 = 242
(1 × 2.75 × 8.75 + 3/4 × 5/8 × 8.75 + 1 × 2.75 × 9) × 2 = 106
1.5 × 1.5 × 6 = 14
2 × 6.25 × 7.5 = 94
0.35 × 1.25 × 7.75 × 2 = 7
2.5 × 1.25 × 12 = 38
} 933 @ 0.283 264

5 - Roller 1 1/2"φ × 2.6 @ 3 15

4 - Bolts. 1 1/2"φ × 2.0 @ 14.97 60

4 - " 3/4" × 3" @ 0.625 3

Cast Iron piston Ring $(9.75^2 - 9.13^2) \times \frac{\pi}{4} \times 0.49 \times 6 = 25$ cub. inch @ 0.26 7

1098 × 2 = 2,196#

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CALCULATIONS FOR

First Canal Bridge for City of Kobe; 60' single leaf trunnion bascule.

M.F.

2-Air Buffer at end. (steel casting).

1.5 cub ft.	@ 490	735#	
0.085"	@ 450	38.25	
24- Bolts. 1"φ	@ 0.786	18.86	
1- " 1¼"φ	@ 2.55	2.55	
1- " ¾"φ	@ 1.25 cub inch	1.25	

Buffer block.
13 × 1.75 × 24.75 = 563
7.5 × 4.75 × 12 = 427
3 × 6 × 8 = 144
1.5 × 3 × 3.5 × ½ = 8
5 × 3 × 7 = 105
1037 @ 0.283 294

4- Bolts. 1½"φ × 2¾	@ 7.9	32
3- " 1"φ × 3⅝	@ 1.12	3
Cast Iron piston Ring $(9.75^2-9.13^2)\times\frac{\pi}{4}\times0.49\times6 = 25$	@ 0.26	7
		1131.91 × 2 = 2,264#

2- Guide Pulley PB1

2- Bracket	@ 20#	40#
2- Pulley	@ 5	10
2- pins ¾"φ × 5"	@ 1	2
8- Bolts. ⅝"φ	@ 0.27	2
		54

4- Guide pulley. PB2 & PB3.

4- Brackets.	@ 26	104#
4- Pulley	@ 5	20
4- Pins ¾"φ × 5	@ 1	4
16- Bolts. ⅝"φ	@ 0.27	4
		132

2- Guide pulley PB4.

2- Bracket	@ 32	64#
2- Pulley	@ 17	34
2- pins. 1"φ × 5½	@ 1.97	4
8- Bolts. ⅝"φ	@ 0.27	2
		104

2- Counter Weight for Buffer.

2- Counter Weight	@ 82	164#

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CALCULATIONS FOR

4

鉄部構造工事内訳書

名称	数量	単位	単価	金額	摘要
鋼材	四二七.五八三	英噸	一四〇.〇〇	五九八六一.六二	中欧鋼材料全部仕上重量
			八〇.〇〇	三四二〇六.六四	工作及ペンキ一回塗
			一五.〇〇	六四一三.七五	工場組立費一式
			五五.〇〇	二三五一七.〇七	現場指定個所迄運搬費一式、現場ステージング組立足場設ケ鋲打試験運搬手直シ一式
			一〇.〇〇	四二七五.八三	現場ペンキ塗一式 現場ペンキ二回塗
他金物類	二三.〇五八	英噸	五〇〇.〇〇	一一五二九.〇〇	スティール キャスティング 鋳鋼 鍛鋼 鋳鉄 青銅等 特ニ精密仕上ヲ要スル材料一式
			二五〇.〇〇	五七六四.五〇	製作及錆止メ一回塗 工場組立費共一式
			五〇.〇〇	一一五二.九〇	現場指定個所迄運搬費一式 取付試験手直シ一式
			一〇.〇〇	二三〇.五八	現場ペンキ塗 ペンキ二回塗一式 錆止メ塗料 運搬用手間共
		合計		一四六九五一.八九	

上部構造工事内訳書（路上個所）

名称	数量	単位	単価	金額	摘要
木材	一四二九.二二	立方呎	四.〇〇	五七一六.八八	路上個所使用床構造 コンクリート詰入材料及構造良質木材防腐剤注入仕上材料共
防水層フェルト	三五〇二.〇〇	平方呎	〇.一〇	三五〇.〇二	アスファルト フェルト 敷設及木塊舗装下ノ中間ニ敷キ亦歩道目地防水用
ボルト釘金物類一式	一七〇〇.〇〇	封度	〇.一五	二五五.〇〇	木材及床板取付用鋲 クリップ及ワッシャー等ヲ含ム
歩道コンクリート其他	〇.五八	立坪	一四〇.〇〇	八一.二〇	厚サ二吋 バスキュール床剛固個所コンクリート共
歩道鉄	〇.四〇四	英噸	一四五.〇〇	五八.五八	及鋼 軽形鋼 鋳物材料運搬仕掛組立仕上ゲ等一式
木塊舗装	一〇.八〇	面坪	八.〇〇	八六.四〇	杉板止メ仕掛面積キ手間一式
歩道仕上其他コンクリート	一四.二〇	面坪	三.五〇	四九.七〇	厚サ弐吋一二モルタル表面鏝仕上ゲ一式 材料及バスキュール床剛固個所仕上ゲ共
車道舗装	七三.五〇	面坪	三四.〇〇	二四九九.〇〇	コンクリート詰入 厚サ三吋目地アスファルト詰込 舗装材料据付手間一式
他ノ附属電気					直営工事
鉄ノ手摺両側					直営工事
伸縮継手	二.三八	英噸	二五〇.〇〇	五九五.〇〇	材料仕掛据付手間一式 現場ペンキ塗共
雨水樋	八.〇 八.〇	個	一〇.〇〇 二.五〇	八〇.〇〇 二〇.〇〇	車道用 一個六十四封度 歩道用 一個十五封度
路灯柱					直営工事
				九七九一.七八	

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CALCULATIONS FOR

B

跳上橋カウンターウエート工事

名称	数量	単位	単価	金額 円	摘要
純コンクリ	八七三.〇〇	立方呎	一一.〇〇	九六〇三.〇	一:二 配合 重量毎立方呎ニ付百四十封度
鋳鉄部分	一五.八六	英噸	七五.〇〇	一一八九.五〇	鋳鉄ヲ加工シタルモノ 但シ金物共 毎立方呎ニ付重量四百五十封度
鉄屑入コンクリ 第一種	七四八.〇〇	立方呎		四〇九三.四三	一:二:四 配合 六〇% 鉄屑四〇% 毎立方呎[illegible]封度 平均二百八十封度 [illegible] 鉄屑六五.四五英噸
第二種	三七六.三〇	立方呎		一八一三.五七	一:二:四 配合 五〇% 鉄屑五〇% 毎立方呎四百九十封度 [illegible] 一三八.二五立方呎 鉄屑三〇.三一英噸
第三種	二四〇八.〇〇	立方呎		一五五三.四五	一:二:四 配合 五一% 鉄屑四九% 鉄毎立方呎四百九十封度 [illegible] 一三二九.五五立方呎 鉄屑二五七.八英噸
					材料損料等ト同一式
	計			二三五八八.二五 円	

跳上橋木造基床工事内訳書

名称	数量	単位	単価	金額 円	摘要
床コンクリート	六.三二	立坪	一四〇.〇〇	八八四.八〇	一:二:四 配合
中埋コンクリート	一.五六	立坪	一〇五.〇〇	一六三.八〇	一:四:八 配合
防腐材料	八〇.〇〇	面坪	八.〇〇	六四〇.〇〇	松板ニテ仕舞 [illegible] ト同一式
鉄金物	四.〇一三	英噸	一四五.〇〇	五八一.七四	仕上鋼鉄及形鉄金物材料 運搬仕舞 但シ 仕上ゲ費ト同一式
側車道金物両	一六〇〇.〇〇	封度	〇.一五	二四〇.〇〇	鋳鉄材料石附ケ同一式
車道舗装(木塊)	三七八.〇	面坪	三四.〇〇	一二八五二.〇	コンクリート [illegible] 材料損料ト同一式 [illegible]
舗装用両側	三九.三〇	立方呎	三.五〇	一〇三.二〇	[illegible]
縦隔高欄					直営工事 [illegible]
歩道防[illegible]	二四.七五	面坪	三.五〇	八六.六三	[illegible] 一:三 [illegible] 仕上ケ費ト同一式
				三九八四.三七	

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CALCULATIONS FOR

バスキュール橋基礎構体工事内訳

名称	数量	単位	単価	金額	摘要
コンクリート	三一五.二二	立坪	一四〇.〇〇	四四一三〇.八〇	配合一二六
鉄筋	一八.六三三	英噸	一四五.〇〇	二七〇一.七九	丸鋼及形鋼切断材料運搬仕掛組立仕上迄一切
擁壁型枠	五一八.〇〇	面坪	八.〇〇	四一四四.〇〇	材料足場仕掛取外し迄一切
人造石	三八.三〇	面坪	二〇.〇〇	七六六.〇〇	外部欄干両側壁地覆下一尺仕上[illegible]
内室部床板仕上	六四.八〇	面坪	三.五〇	二二六.八〇	一二モルタル仕上[illegible]
防水	五六.八〇	平方呎	三.五〇	一九八.八〇	材料持運仕上迄一切 表面二回塗[illegible]
杉丸太杭	二四四.〇〇	本	一五.〇〇	三六六〇.〇〇	末口六寸長十五尺 材料打込迄一切
割栗石	一九.三六	立坪	五〇.〇〇	四六八.〇〇	
盛土砂搗	四五〇.〇〇	立坪	一〇.〇〇	四五〇〇.〇〇	[illegible]
仮締切工事一切				八五〇〇.〇〇	水替共他一切
[illegible]	三七.〇〇	平方呎		一八三.〇〇	[illegible]
			六九四七九.一九		

三十三呎プレートガーダー床工事内訳

名称	数量	単位	単価	金額	摘要
コンクリート	五.一〇	立坪	一四〇.〇〇	七一四.〇〇	配合一二四
中埋コンクリート	一.五八	立坪	一〇五.〇〇	一六五.九〇	配合一[illegible]
擁壁型枠	五五.〇〇	面坪	八.〇〇	四四〇.〇〇	材料足場仕掛取外し迄一切
鉄筋	三.六八	英噸	一四五.〇〇	五三三.六〇	丸鋼及形鋼切断材料運搬仕掛組立仕上迄一切
[illegible]	四〇.〇〇	面坪	三四.〇〇	一三六〇.〇〇	[illegible]
[illegible]	三〇.〇〇	平方呎	三.五〇	一〇五.〇〇	[illegible]
[illegible]					左官工事
両側歩道仕上	一七.〇〇	面坪	三.五〇	五九.五〇	[illegible]
[illegible]	一.二七	英噸	二五〇.〇〇	三一七.五〇	
両水吐	四.	個	一〇.〇〇	四〇.〇〇	一個 [illegible]
			三七三五.五〇		

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CALCULATIONS FOR

D

橋脚工事内訳

名称	数量	単位	単価	金額	摘要
コンクリート	七一・〇〇	立坪	一四〇・〇〇	九九四〇・〇〇	配合一：三：六
鉄筋	三・六八	英噸	一四五・〇〇	五三三・六〇	軟鋼丸形鉄筋材料運搬仕拵組立代共
捨型枠	一二一・〇〇	面坪	八・〇〇	九六八・〇〇	杉板正寸仕拵取附ケ一式
杉丸太杭	一一一・〇〇	本	一五・〇〇	一六六五・〇〇	末口六寸長サ十五尺材料打込ミ共一式
割栗石	四・九三	立坪	五〇・〇〇	二四六・五〇	~~根堀基礎~~
盤土砂掘	六九・〇〇	立坪	一〇・〇〇	六九〇・〇〇	根堀基礎築島両作業ニ要スル手数一式
締切工事一式				三五〇〇・〇〇	水替費ヲ含ム一式
			一七五四三・一〇		

両岸橋台工事費内訳

名称	数量	単位	単価	金額	摘要
コンクリート	一三五・一〇	立坪	一四〇・〇〇	一八九一四・〇〇	配合一：三：六
鉄筋	〇・八四二	英噸	一四五・〇〇	一二二・〇九	軟鋼丸形鉄筋材料運搬仕拵組立代共一式
捨型枠	二〇四・五〇	面坪	八・〇〇	一六三六・〇〇	杉板正寸仕拵取附ケ一式
人造石	二七・九〇	面坪	二〇・〇〇	五五八・〇〇	[illegible]
蛇籠	五六・八〇	[illegible]	三・五〇	一九八・八〇	[illegible]
杉丸太杭	二〇〇・〇〇	本	二〇・〇〇	四〇〇〇・〇〇	末口七寸長サ二十尺材料打込ミ共一式
割栗石	七・五七	立坪	五〇・〇〇	三七八・五〇	
盤土砂掘	一二四・〇〇	立坪	一〇・〇〇	一二四〇・〇〇	根堀基礎築島両作業ニ要スル手数一式
締切工事一式				四〇〇〇・〇〇	水替費ヲ含ム一式
			三一〇四七・三九		

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

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雑工事

名称	数量	単位	単価	金額	摘要
運轉室		一		一二五〇.〇〇	図面及示方書参照
見張所		一		四五〇.〇〇	仝上
休憩室				六〇〇.〇〇	仝上 尚機械室ノ戸ヲ含ム建具押入畳共一式
コンクリート高欄				七八〇.〇〇	コンクリート 二〇.七二立坪 型枠 二〇.八面坪 人造仕上 三三.二 〃 鉄筋 〇.三三三噸 仕様一式
親柱		四	五〇〇.〇〇	一〇〇〇.〇〇	図面仕様書参照 矢燈基坐柱名板並工 月日板其他一式
ポートホール基礎				五三五.〇〇	コンクリート 一.三九二立坪 型枠 一四.一六面坪 金物 三九〇.〇〇ポンド 鉄筋 〇.一七二噸 仕様一式
階段手摺				一八.五〇	橋台外側階段手摺 瓦斯パイプ其他 一二三.五封度 仕様一式
				四六三三.五〇	

鉄部構造工事	一四六九五一、八九
上部構造工事	九七九一、七八
跳上橋カウンターウエート工事	二三五八八、二五
跳上橋橋臺床工事	三九八四、三七
バスキュール橋橋臺橋体工事	六九四七九、一九
三十三呎プレートガーダー床工事	三七三五、五〇
橋脚工事	一七五四三、一〇
西岸橋臺工事	三一〇四七、三九
雑工事	四六三三、五〇
	三一〇七五四、九七

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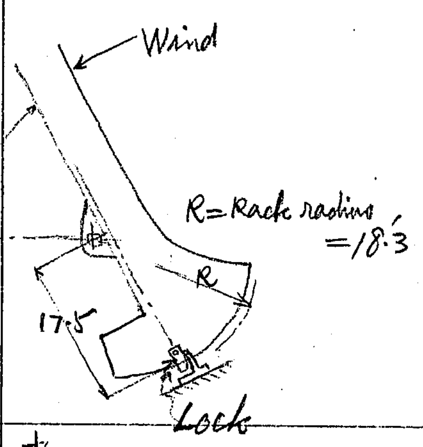
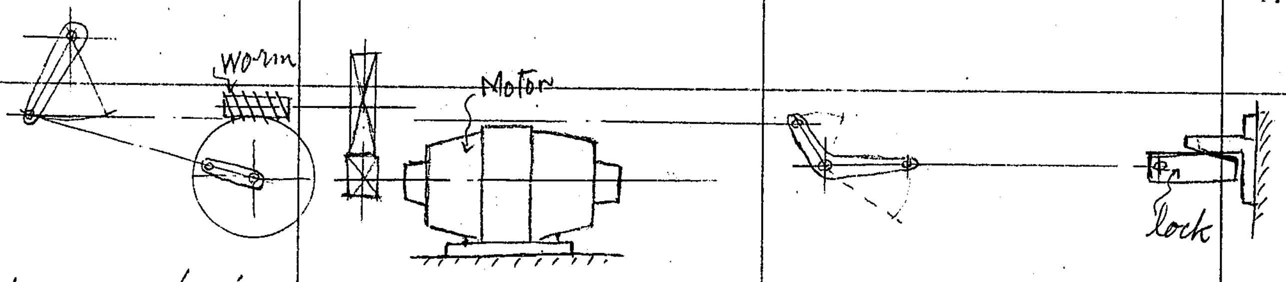
CALCULATIONS FOR

Frist Canal Bridge for city of Kobe (60 ft single leaf)

Calculation for Locking power

Power ヲ計算スルニ先ヅ Front lock ト Rear lock ト何レガ大ナル power ヲ操作ニ要スルカヲ比較スルニ、front locking ニアリテハ Trunnion ヲ中心トスル橋体ノ balancing ノ Eccentricity ニヨル friction ヲ主トスルノデアルガ、Rear locking ニアリテハ橋面ノ風圧 15#/□' ノ総荷重ニヨル friction ヲ基礎トシタルモノデ、前者ニ比シテ後者ハ遥ニ大ナル数字デアル。従ッテ以下 Rear lock ニ付キ計算スル

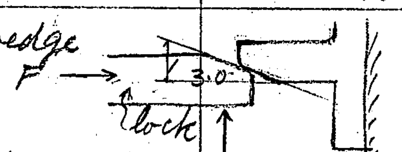




Load on Rear lock

Wind (15#/□')	$139{,}000 \times \frac{18.3}{17.5}$	=	145,300#
Ecc.	$-\ 13{,}200 \times$ 〃	=	− 13,800
Trolley pull	$-\ 1{,}485 \times$ 〃	=	− 1,500
Friction of Trunnion	$-\ 10{,}000 \times$ 〃		10,500
			119,500

Force required to lift the wedge



$$F = \frac{119500 \times 1}{3} = 39{,}700^{\#}$$

Locking force.

Coefficient of sliding friction 0.18 say

force reqd $119{,}500 \times 0.18 + 39{,}700 = 21{,}500 + 39{,}700 = 61200^{\#}$

friction ハ材料ノ性質、硬軟及ビ摩擦面ノ状態、乾湿等ニヨリテ著シク異ルモノニテ、適確ナル係数ハ実験ノ他ニハ得ラレナイノデアルガ、上記ノ数字 0.18 ハ次ノ如キ根拠カラ考案シテ決定シタルモノデアル。

普通乾イタ鉄ト鉄トノ摩擦係数ハ 0.15〜0.2 位デ、摩擦面ガ滑ラカニシテ且ツ Greas ヲ給スルモノニアリテハ 0.07〜0.08 位ヒトセラレテイル。本 lock ハ、鋼ト鋼ニテ面ハ中仕上、折々 Greas ヲ給スル事ニナッテ居ルモ、長期間ニハ錆及ビ塵埃等ガ附着ナスモノト見テ此係数ヲ 0.18 ト決定シタ。

Lock travel 8" abt

efficiency

1. Worm gear

pitch of worm thread. (lead) $= 1\frac{3}{4}''$

pitch dia. of worm $= 3.9''$

angle of inclination of worm thread (2)

$$\tan 2 = \frac{1.75}{\pi \times 3.9} = .143 \quad \therefore 2 = 8^\circ\text{-}10'$$

efficiency – – – – – – – = 70% – – – – E_1

2. spur gear. eff. – – – – = 94% – – – – E_2

3. link motion

arm of link = 8" mean

radius of pin = 1.5 〃

coeff of friction = .12

$$\text{eff.} = 1 - \frac{.12 \times 1.5}{8} = .975 \text{ – – – – – } E_3$$

此摩擦係数 0.12 ハ稍大ナル様ナルモ本装置ハ手入及給油

ニ不便ナ箇所デ且ツ乾燥不足デ塵埃ノ附着スル外気ニ曝サレテイル故デアル。但シ常ニ手入レノ行届ク箇所ハ 0.10 位 e. 尚精巧ナル製作物ニアリテハ 0.05~0.08 位 e ニ採リテ可ト思ワレル。

4. twist and guide rollers
eff. - - - - - - - = 80% say - - - E_4

Total eff $= E_1 \times E_2 \times E_3^6 \times E_4$
$= .70 \times .94 \times .975^6 \times .80 = .45$

operating time - - - - - - - - - 12. sec.

Required H.P $= \dfrac{61{,}200 \times 8 \times 60}{33{,}000 \times 12 \times 15^{sec}} \times \dfrac{1}{.45} = 11.0$ H.P

以上ハ風圧 15#/□' ノ時ノ計算デアル。然ルニ其ノ時ハ運転セヌ故、従ッテ lock ヲ挿入スル場合ハ有リ得ナイ。依ッテ運転ニ対スル風圧ノ最大限度デアル 10#/□' ニヨリテ計算シ使用馬力ヲ決定スレバ下ノ如クナル。

wind (10#/□')	$92{,}500 \times \dfrac{18.3}{17.5}$	$= 96{,}700$#
ecc.		$= -13{,}800$
Trolly pull		$= -1{,}500$
Friction of Trunnion		$= -10{,}500$
		$70{,}900$#

Force req'd to lift the wedge $= \dfrac{70{,}900 \times 1}{3} = 23{,}600$#

Total locking force $= 70{,}900 \times 0.18 + 23{,}600 = 12{,}800 + 23{,}600 = 36{,}400$#

$H.P = \dfrac{36{,}400 \times 8 \times 60}{33{,}000 \times 12 \times 15} \times \dfrac{1}{.45} = 6.52$ H.P

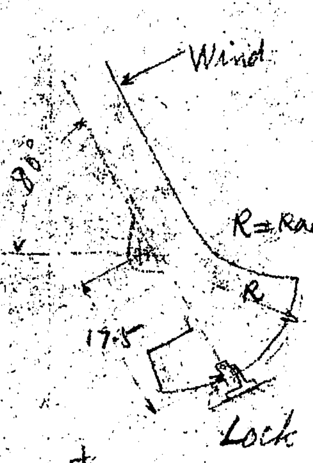
Motor $6.52 \times \dfrac{1}{1.4} = 4.65$ H.P
use 5H.P motor.

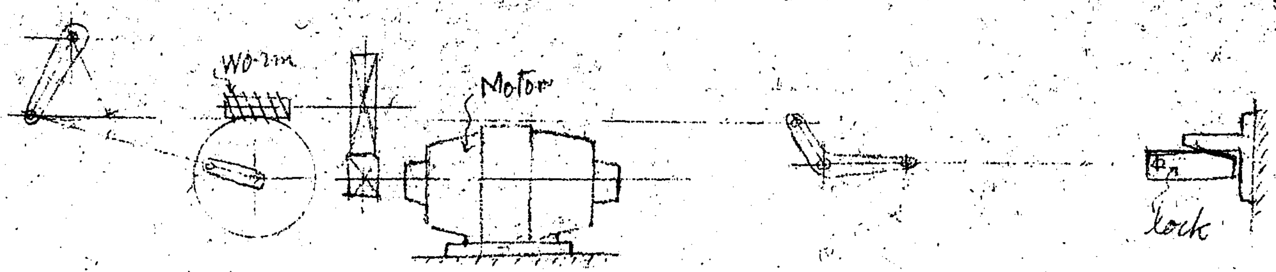
但シ使用電動機ハ起重用トシテ設計セラレタル密閉型誘導電動機ニテ連続3分間40%過負荷ニ対シ毫モ損傷ヲ来サザルモノデアル。

First Canal Bridge for City of Kobe (60 ft single leaf)

Calculation for Locking power

Power ヲ計算スルニ先ヅ Front lock ト Rear lock ト何レガ大ナル power ヲ操作ニ要スルヤヲ比較スルニ、front locking ニアリテハ Trunnion ヲ中心トスル桁体ノ balancing ノ Eccentricity ニ対スル friction ヲ主トスルノデアルガ Rear locking ニアリテハ橋面ノ風圧 15#/□' ノ総荷重ニ対スル friction ヲ基礎トシタルモノニテ 前者ニ比シテ後者ハ遥ニ大ナル数字デアル。依ッテ以下 Rear lock ニ付キテ計算ス

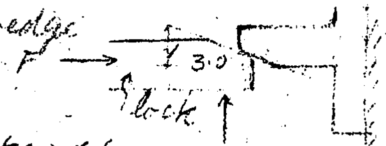




Load on Rear lock

Wind (15#/□')	$139{,}000 \times \frac{12.3}{17.5}$	=	145,300#
Ecc.	− 73,200 × 〃	=	− 13,800
Tailing pull	− 1,485 × 〃	=	− 1,500
Friction of Trunnion	− 10,000 × 〃		10,500
			119,500

Force required to lift the wedge



$$F = \frac{119500 \times 1}{3} = 39{,}700^{\#}$$

Locking force

Coefficient of sliding friction 0.18 ~ 0.2

force reqd. $119{,}500 \times 0.18 + 39{,}700 = 21{,}500 + 39{,}700 = 61{,}200^{\#}$

friction ハ材料ノ性質、硬軟及ビ摩擦面ノ状態、乾湿等ニヨリテ著シク異ルモノニテ、正確ナル係数ハ実験ニ拠ルノ外得ラレナイノデアルガ 上記ノ数字 0.18 ハ次ノ如キ根拠カラ考察シテ決定シタルモノデアル。

普通乾燥鉄ト鉄トノ摩擦係数ハ 0.15～0.2 ナルモ、摩擦面ガ滑ラカニシテ且ツ Grease ヲ塗ルモノニアリテハ 0.07～0.08 位ヒトセラレテイル。

本 lock ハ鋼ト鋼トノ面ハ中仕上、尚ホ Grease ヲ塗ル事ニナッテ居ルモ、長期間ニハ錆及ビ塵埃等ガ附着スルモノト見テ此係数ヲ 0.18 ト決定シタ。

Lock Travel .... 8" abt

efficiency

1. Worm gear
   - pitch of worm thread (lead) $= 1\frac{3}{4}"$
   - pitch dia. of worm $= 3.9"$
   - angle of inclination of worm thread (α).
     $\tan\alpha = \frac{1.75}{\pi \times 3.9} = .143 \quad \therefore \alpha = 8°-10'$
   - efficiency .... = 70 % .... ε_1

2. spur gear eff. .... = 94 % .... ε_2

3. link motion
   - arm of link = 8" mean
   - radius of pin = 1.5 〃
   - coeff of friction = .12
   - eff. $= 1 - \frac{.12 \times 1.5}{8} = .975$ .... ε_3

此ノ摩擦係数 0.12 ハ[illegible]本装置ハ手入及注油

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CALCULATIONS FOR

ニ不便ナ箇所デ且ツ乾燥不良デ塵埃ノ附着スル外気ニ曝サレテ居ル故デアル。但シ常ニ手入レノ行届ク箇所ハ0.10位モ。尚精巧ナル製作ニアリテハ0.05～0.08位モニ採リテ可ト思ワレル。

4. twist and guide rollers
eff. - - = 80% say - - - E4

Total eff $= E_1 \times E_2 \times E_3^6 \times E_4$
$= .70 \times .94 \times .975^6 \times .80 = .45$

[illegible] Time = 12 sec.

Required H.P $= \frac{61,200 \times 8 \times 60}{33,000 \times 12 \times 15} \times \frac{1}{.45} = 11.0$ H.P

17上ハ風圧15#/□'ノ時ノ計算デアル。然ルニ其ノ時ハ運転セヌ故、従ッテlockヲ挿入スル場合ハ有リ得ナイ。依ッテ運転ニ対スル風圧ノ最大限度デアル10#/□'ニ取ッテ計算シ使用馬力ヲ決定スレバヨクナル。

wind (10#/□')	[illegible]500 × [illegible]	= 96700#
ecc		= -13700
Trolly [illegible]		= -1500
Factor of Tension		= -14000
		70900#

[illegible] to lift the edge = $70900 \times$ [illegible] = [illegible]#

Total [illegible] force = $70900 \times .12 +$ [illegible] = [illegible] + [illegible] = [illegible]400#

H.P $= \frac{[illegible]400 \times 8 \times 60}{33,000 \times 12 \times [illegible]} \times \frac{1}{.45} = 6.52$ H.P

motor $6.52 \times \frac{1}{1.4} = 4.65$ H.P
use 5H.P motor.

但シ使用電動機ハ起重用トシテ設計セラレタル密閉型誘導電動機ニシテ連続3合[illegible]40%過負荷ニ対シ些モ損傷ヲ来サヌモノデアル。