Design of 108A Bridge for City of Tokyo

After surveying of bridge site, the center line of bridge has been changed. Exact dimension and angles shall be figured Later. Let us assume the length of bridge 114.8' out to out on? 11 panels @ 10.3' = 113.3' center to center of end bearings.

1.5

114.8 out to out of structure

With skew of 3° (2°) to center line of canal.

The bridge is divided in to the following span (This type has been approved by City Bridge Engineer Mr. Koike)

Anchor span	3@10.3' = 30.9' on both side
Cantilever arm	1 panel 10.3 - 1.12 = 9.18' to CL hinge.
Suspended span	3@10.3 = 30.9
Panel point to pin	2@1.12 = 2.25
	33.15

Roadway 6 meters = 19.685' = 19'-8 $\frac{1}{4}$" 19' 8 $\frac{1}{4}$

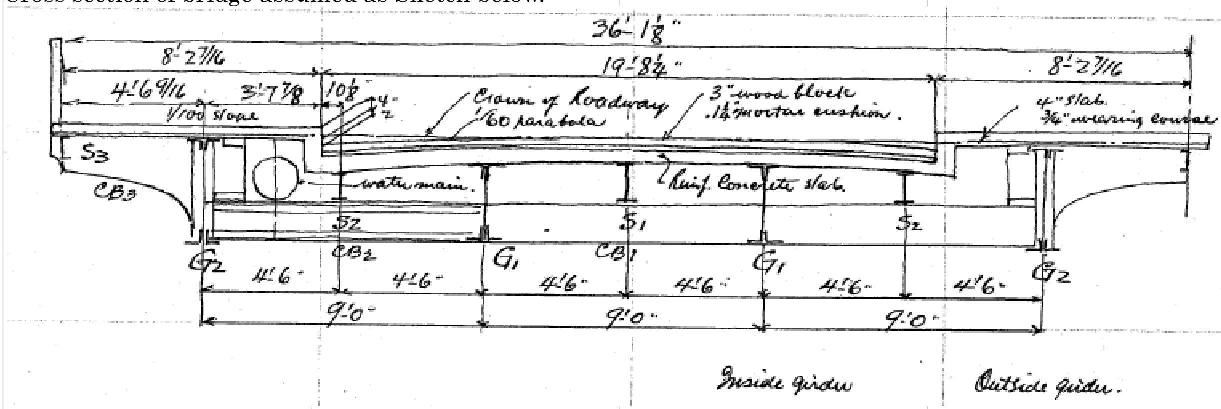
Sidewalks 2-2.5 meter = 8.202 = 8'-2 $\frac{7}{16}$" = 2@8'-2 $\frac{7}{16}$" = 16 - 4 $\frac{7}{8}$

Total effective width = 36'-1 $\frac{1}{8}$" ins to ins of handrails

inside to inside

Loading as for specification

Cross section of bridge assumed as Sketch below.



Design of Floor slab span length 4'-6"

Dead Load 3 wood block pavement @ $\frac{60}{12}$# = 15.0

$1\frac{1}{4}$" mortar cushion @ 110#/12 = 11.5

floor slab assumed 75.0

allowance 3.50

105.0# per of ft.

Dead Load moment = $\frac{1}{10}\times105\times4.5^2$ = 212.0'#

〃 〃 shear == $\frac{1}{2}\times105\times4.5$ = 237#

Live Load motor truck loading rear wheel concentration = 9920

30% impact 2980

12900#

Front wheel concentration say 12900 ÷ 3 = 4300#

Distribution of wheel concentration on floor slab.

Longitudinal distribution = 2 @ 4 $\frac{1}{4}$" = .70

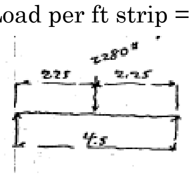
20cm = .66

a = 1.36'

Transverse distribution = b = 1.28 + .70 = 1.98'

Effective width = $\frac{2}{3}(4.50+1.98)+1.36$ = 5.67' ??????? 2 eters

Load per ft strip = 12900 ÷ 5.67 = 2280#



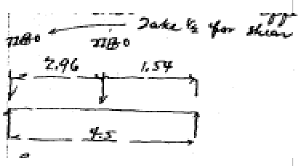
moment = 1140 × 2.25 = 2560'#

For continuity of slab reduce the moment to

0.8 × 2560 = 2050'#

Design of 108A Bridge for City of Tokyo

End shear Effective width assumed same as for moment



$1140\times\frac{1.54}{4.50}$ = 390

1140

1530#×2 = 3060# shear = $2280\times\frac{4.04}{4.50}$ = 2080#

1140
1920

Sum many for moment and shear

	moment	shear
Dead Load	212	237
Love Load	2050	2080
	2262'#	~~3297#~~
		2317#

Effective depth of slab for 17000# steel stress and 640#/□" Concrete stress n=15

$d=\sqrt{\frac{2262}{102}}$ = 4.72"

Use 6" slab with 1" insulation at bottom

必要鋼（公）面積

Steel area required = $\frac{2262\times12}{7/8\times5\times17000}$ = 0.365□" per ft strips.

1/2"ϕ bars 6" centers = 0.39 □" per ft strip

End shear $\frac{2319\times12}{7/8\times5\times12}$ = 44#/□"

perimeter = 2-1/2"Φ = 3.14
= 2-3/8"Φ = 1.41
4.55"

Bond stress = $\frac{2317\times12}{7/8\times5\times4.55}$ = 117#/□" ＜ 130#/□" OK

Use 2-3/8" bars at support in addition to 2-1/2"Φ bars per ft. strip for bond stress.

Sidewalk slab span length 4.54'

Dead Load

3/4" wearing course (mortar)	7"
4" concrete slab	50
misc assumed	3
	60# per sq ft

Dead Load moment = = 123'#
〃 〃 shear = =136#

Live Load 100# per sq ft
Live Load moment = = 206'#
shear = =227#

Sum many for moment and shear

	Moment	shear
Dead Load	123	136
Live Load	206	227
	329'#	363#

Effective depth =

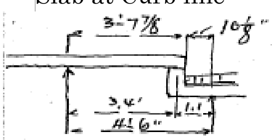
use 4" slab with 1" insulation at bottom

Steel area = = 0.088□" per ft strips
Use 3/8" ϕ bars 6" centers = 0.22□"
This should be bent up at support to total each of

負曲げより、反対側に配置 ベントアップ
現在では、L/6の示方書規定

negative moment

Slab at Curb line Construction assumed as sketch



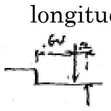
sidewalk slab same as for outside of main girder
1.1' cantilever portion shall be figured.
Dead Load sidewalk slab 60*3.4/2 = 102#
Curd assumed 75
177#

Moment = = 63
= 195
258'#

Live Load 100 × 3.4/2 = 170
At3"edge = 25
195# per lin ft

liner？

Motor truck loading rear wheel concentration with impact = 12900#
longitudinal distribution assumed arbitrarily 2' wide 12900#÷2 = 6450#



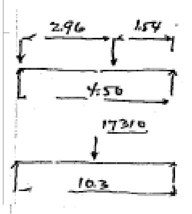
Moment = 6450 × 0.2 = 1290
195 × 1.1 = 241
1504'#

slab6" reinf. 2-1/2" ϕ
2-3/8" ϕ } bars

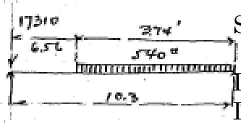
Design of 108A Bridge for City of Tokyo

Longitudinal stringer for roadway S1 span length 10.3’
Dade Load
Slab and pavement 105 × 4.5 = 472#
Stringer assumed 48
520# per lim ft.
Dead Load moment = = 6900’#
Shear = =2680#
Live Load motor track rear wheel with impact = 12900#
Load on stringer

$12900 \times \frac{1.54}{4.50} = 4410$



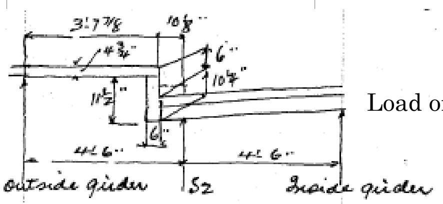
Load on stringer 17310#
Moment at center =
End shear uniform live load 120#/□' × 4. = 540# per lin ft of span
Reaction =



Sum many for moment and shear

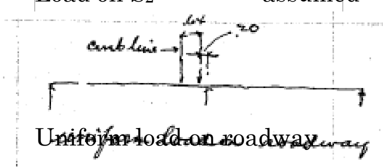
	Moment	shear
Dead Load	6900	2680
Live Load	44700	17677
	51600’□	20357#

Section modulus rigid Use
Unit stress = 51600 × 12/62.946 = 9860#/□"
Longitudinal stringer S2 span length 10.3'
Dead Load sidewalk slab



Load on S_2

Load on outside girder
Load on S_2
Weight of stringer
Dead Load moment
shear
Live Load
Uniform live load
load on S_2
motor truck loading rear wheel with impact
Load on S_2 assumed

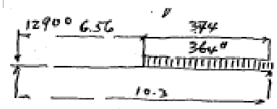


Moment uniform load
Moment motor truck
Uniform load on roadway
per lin ft

Design of 108A Bridge for City of Tokyo

End shear for live load

Uniform load on sidewalk



Motor truck

Fibre?
Fibre stress
軸方向（応力度）

same？
単位当りの面積の合計か

Sum many for moment and shear

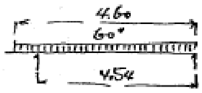
	moment	shear
Dead Load		
Live Load		

Use 12" × 5" I @ 31.99#   sm? = 36.69

Fibre stress

Sidewalk stringer S_3

Dead Load



Handrail assumed

Stringer assumed

per lim ft.

DL. moment

Shear

Live Load   per lim ft.

LL moment

Shear

required
約して、req'd

Sum many for moment and shear

	moment	shear
Dead Load	3120	1210
Live Load	3010	1170
	6130'#	2380'#

Section modulus reqid

Use   per ft.   sm = 10.273

Unit stress

Cantilever Bracket on side walk spacing 10.3'

Dead Load   Concentration at S_3

Moment

Shear

2420

2647#

Live Load 227 × 10.3 = 2340# at S_3

Moment = 2340 × 4.54 = 10600

Shear = 2340

Sum many for moment and shear

	Moment	shear
Dead Load	12030	2647
Live Load	10600	2340
	22630#	4987#

Depth of beam at connection assumed 24" about.

Flange section   web   thick

Effective depth for tension plate 24"

stress =

Section required?

SR = 11315 ÷ 17000 = .66□" net

Assumed section OK

Cross beam between main inside girder   span length 9'-0"   3° skew neglected

Dead Load

Concentration at center from S_1 S20# × 10.3 = 5350#

Moment =

DL. beam =

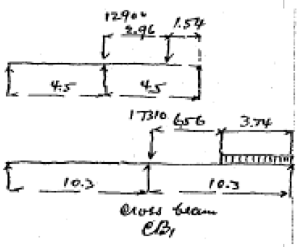
End shear = 5350 ÷ 2 = 2675

Cross beam   360

3035#   at end

Design of 108A Bridge for City of Tokyo

Live Load motor truck loading rear wheel with impact = 12900#



$12900\times\frac{1.54}{4.50}$ = 4410
12900
17310#

Unif. load 120×4.50= 540

Load on cross beam = $540\times3.74\times\frac{1.87}{10.3}$ = 367
17310
17677#

Moment = $\frac{17677}{2}\times4.5$ = 44300'#

Shear = 17677÷2 = 8839#

Sum many for moment and shear

	Moment	shear
Dead Load	12860	3035
Live Load	44300	8839
	57160'#	11874#

Depth $12\frac{5}{8}$" web= $12\frac{1}{4}\times\frac{3}{8}$" = 4.6□"

$\frac{1}{8}$ web = 0.57□"

Effective depth 12.62
2.02
10.60"

Flange stress $\frac{57160\times12}{10.60}$ = 64600#

Section Reg'd $\frac{64600}{17069}$ = 3.79□" net
.57
3.22□" net

reqd

Unit flange stress compression side= 17067(k 0.012 $\frac{l}{b}$) = 15600#/○

l = 54" b = 7.37 $17067(1-0.012\times\frac{54}{7.37})$ = 15600#/○

Try

Unit flange stress

Weight of cross beam

Web

Details say 25% 13
63# per lim ft.

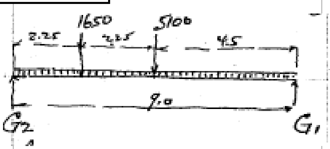
Cross beam CB2. span length 9.0'

Dead Load. Stringer concentration S2 495# × 10.3 = 5100#

Dead load water main.

12" main water contents = 0.78 @ 62 = 48
pipe with details say 60#
Protection assumed 52
160# per lim ft.

付属物付のパイプ。



Concentration on CB = 160 × 10.3 = 1650#

Dead Load moment = 3790 × 4.5 = 17050
1650 × 2.25 = 3710
13340'#
beam = 810
14150'#

R =1650×6.75÷9.0 = 1240
2550
3790#
beam 360
4150# End shear G_2

Concentration?

Dead Load cantilever moment should be reduced from the above

Cantilever moment 12030 ÷ 2 = 6015'#
at center of span
On safe side this moment neglected.

1650 – 1240 = 410
cone. 2550
beam 360
3320# End shear G_1

Live Load. see page 4. 2 @ 758 = 1516 on sidewalk
13147
14663# motor truck and unif. on Roadway

Uniform load ?

Design of 108A Bridge for City of Tokyo

Moment =

Shear =

Sum many for moment and shear

	Moment	$shearG_2$	$shearG_1$
Dead Load	14150	4150	3320
Live Load	33.000	7330	7330
	47150#	11480#	10350#

Depth web
web
Effective depth = 10.60”

Flange stress =

Section req’d =

Use

Unit flange stress =

Approximate weight of Cross beam and Cantilever Brackets.
Cross beam CB_1

Rivet heads mise say

Per lin ft

Cantilever Bracket CB3 and bracket at rear.

Miscellaneous：雑多

Misc details say

Say：だいたい、アバウト、まぁ

Total weight of cross beam and cantilever
3 cross beams @ 502 = 1506
2 cantilever @ 400 = 800
2306# ÷ 36.1 = 64# per lin ft.

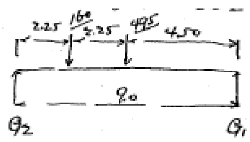
Suspended span span length 33.15'
Design of main girder G1 (Inside girder)
Dead Load
Uniform 105 × 4.5 = 473#
Girder assumed 167
640# per lin ft

Panel concentration from floor beam for intermediate point.
End shear CB_1 3035
〃 〃 CB_2 3320
6355#

Panel concentration from End floor beam length 5.15+1.12 = 6.27
From CB_1 520 × 6.27 = 3260 3260 ÷ 2 = 1630
End floor beam 360
1900#

Design of 108A Bridge for City of Tokyo

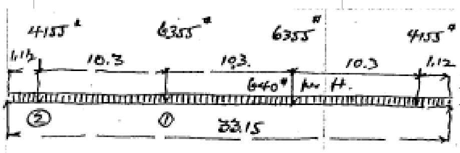
From CB_2



288 × 6.27 = 1805
Cross beam 360
From cross beam CB_2 2165#
〃 〃 〃 CB_1 1990
4155#

Dead Load moment

Reaction = 6355
4155
10510#



moment due to concentration.
Moment ① 10510 × 1142 = 120000
4155 × 1030 = -42800
77200'#

Moment ② 10510 × 1.12 = 11800'#

Moment due to uniform load
at center = 88000'#
at ① = 79500
at ② = 11500

End shear
Concentration = 10510
Unif. = 10600
21110#

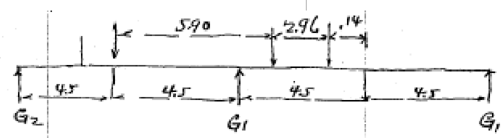
Sum many for moments

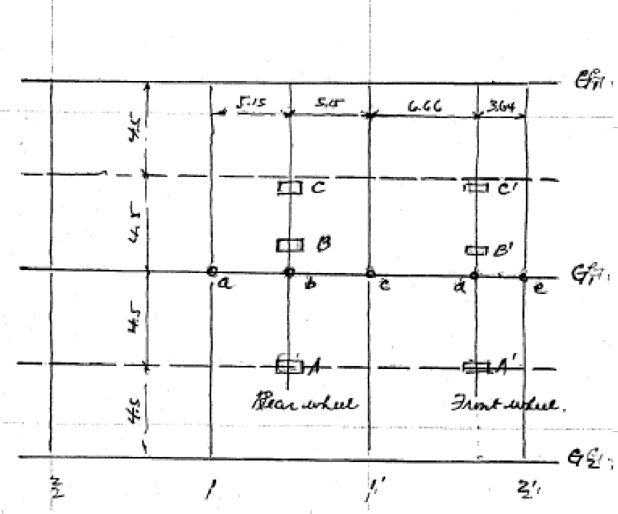
	1 at 1	2	center
Concentration	11800	77200	77200
Uniform	11500	79500	88000
	23300'#	156700'#	165200'#

Girder section will be determined at Center of span and the same section will be used throughout. Let us figure the live load moment at center of span only.

Live Load motor truck loading impact = = 28.5%

Rear wheel concentration 9920#
Impact 28.5% 2820
12740#





Front wheel with impact
12740 ÷ 3 = 4250#
Rear wheel 12740#
A. 12740 ÷ 4 = 3185 a and c

B+C 12740-396= 12344
12740-8780= 3960
16304
Direct on girder b. on stringer
9170－
16304 ÷ 4 = 4076# on a ? c

Front wheel 4250#
A'

B'+C'

a	b	c	d	e
3158	3185			
4076	9176	4076		
		750	3059	1375
		960		1760
7261	9176	8971	3059	3135

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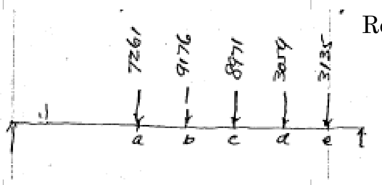
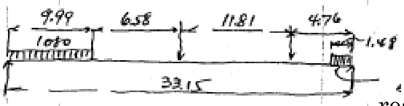


Reaction 3125 × 1.12 ÷ 33.15 = 106
3059 × 4.79 ÷ 33.15 = 439
8971 × 11.42 ÷ 33.15 =3100
9176 ÷ 2 =4588
7261 × 21.72 ÷ 33.15 =<u>4750</u>
12983#

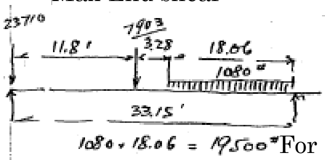
Moment = 12983 ×16.57 = 215000
7261 × 5.15 = <u>−37400</u>
177600'#

Uniform live load at rear of motor truck
Rear wheel Front wheel On safe side 120 × 9.0 = 1080# assumed



Uniform load on sides of motor truck neglected.
Uniform loading assumed as Sketch
~~neglected~~
reaction = 10800 × 5.0 ÷ 33.15 =16300
1600 ×32.41 ÷ 33.15 = 1570
Due to Uniform load 27600'#
〃 〃 motor truck 177600
205200'#

Max End shear
motor truck rear wheel

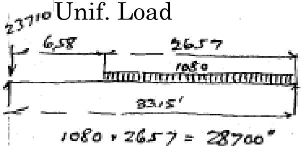


A 12740 ÷ 2 = 6370
B 12740 × 7.60 ÷ 9.0 = 10780
C 12740 × 4.64 ÷ 9.0 = <u>6560</u>
23710#

For Front wheel 23710 ÷ 3 = 7903#
Uniform load at rear or front of motor truck assumed 1080# per ft.

Motor truck 7903 × 21,34 ÷ 33.15 = 5090
<u>23710</u>
28800#
19500 × 9.03 ÷ 33.15 = <u>5320</u>
34120#

Unif. Load



Unif.
Motor truck
max

Sum many for moment and shear

	Moment	shera
Dead Load	165200	21110
Live Load	<u>205200</u>	<u>35210</u>
	370400'#	56320#

b to b of web

Effective depth = 2.01
Flange stress = 370400 ÷ 2.01 = 184000#
SR = 184000 ÷ 17067 = 10.80
<u>1.27</u>
9.53□" net

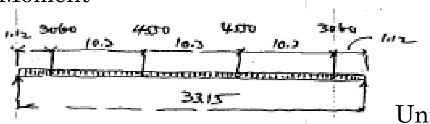
net：正味、物だけの（質量、重さ）
net area:断面積とは、綴釘孔に失はる可き断面を減じたるなり

Try net
Reduction of hole

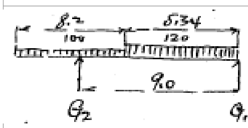
Unit flange stress =
Compression side =
Unit shear =

Design of 108A Bridge for City of Tokyo

Outside girder G2
Dead Load
Uniform load see page4 60 × 4.60 = 276 × 2.30 = 635
Handrail 75 × 4.54 = 341
Stringer assumed 20 × 4.54 = 91
371 1067
Extra reaction 1067 ÷ 9.0 = 120
491# per lin ft. From Cantilever side.
Direct load Outside girder page3 156
647#
Girder assumed 123
770#
Load on stringer S_2. see page 3 495# per lin ft. including weight of stringer.
Water main 160# per lin ft.
Reaction on outside girder through cross beam
495 ÷ 2 = 248
= 120
368# per lin ft. see page 7.
Panel Concentration 368 × 10.30 = 3800#
Cross beam ~~368 × 6.27~~ say 750
4500
Panel Concentration 368 × 6.27 = 2310
Cross beam + cantilever say 750
3060#
Moment



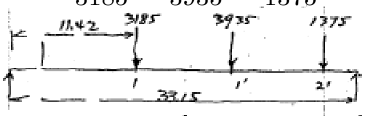
4550 M = 7610 × 11.42 = 87000
3060 3060 × 10.3 = −31500
55500
Uniform load = 105500
161000'#
End shear due to concentration 7610
Unif. 12750
20360#
Live Load. Uniform live load. on sidewalk. 8.2 × 100 = 820# per lin ft.



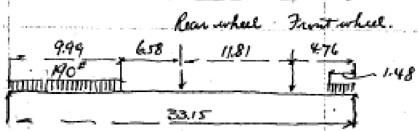
Max load on G_2 = 860# per lin ft.
Uniform live load on roadway 120 × 5.34 = 640#
load on G_2 = = 190# per lin ft.
These uniform load assumed act direct on girder.
Motor truck loading rear wheel Concentration with impact 12740# see page 7
Front wheel 4250# 〃 〃 〃
Loading as skewn on page7" Panel Concentration from wheel load A + A'

1	1'	2'
3185	3185	
	750	1375
3185	3935	1375

Reaction 3185 × 21.72 ÷ 33.15 =2100
3935 ÷ 2 =1968
1375 × 1.12 ÷ 33.15 = 46
4114#



Moment = 4114 × 11.42 = 47000'# at1
4114 × 21.72 = 89300'#
3185 × 10.3 = −32800
56500'# at1'

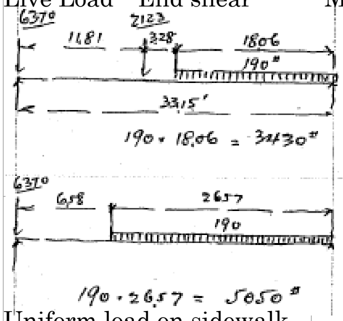


Reaction 1900 × 5 ÷ 33.15 = 286.0
280 × 32.41 ÷ 33.15 = 274.0
560#
190 × 9.99 = 1900#
190 × 1.48 = 280
M = 560 × 16.57 = 9300
280 × 15.83 = −4400
4860'#
56500
Live Load on ??? = 61360'#

Design of 108A Bridge for City of Tokyo

Uniform load on sidewalk = = 118000'#
Due to load on roadway 61360
179360'#

Live Load End shear Motor truck loading



Rear wheel 12740 ÷ 2 = 6370# direct
Front wheel 6370 ÷ 3 = 2123
Motor truck = 1365
6390
7735#

Uniform load

Unif. Load

Uniform load on sidewalk.
load on roadway max

Sum many for moment and shear G_2
moment shear
Dead Load
Live Load

Net section

Net

Web assumed
Effect depth

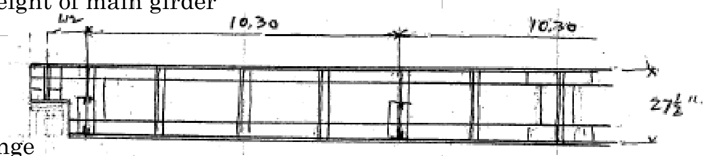
Flange stress
SR

Net

Unit flange stress (tension)
Compression

net section

Approximate weight of main girder
Inside girder



Flange

Stiffs int.?
Stiff Panel
filler
stiffs
fillers
bedplate
splice
〃

Rivet heads + mise say 5%

On account of curve ture（又は、curve line,curvet use） for bottom add

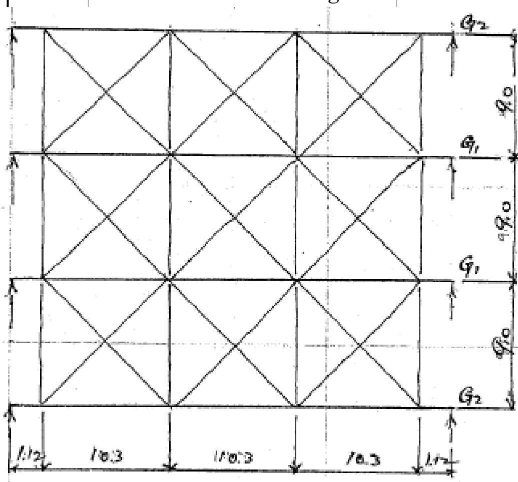
Design of 108A Bridge for City of Tokyo

Out side girder
Flange
Stiffs
Stiffs
filler
stiffs
fillers
bedplate
splice
〃
at bearing

Rivet heads + C

For Curve line of bottom flange add ← 加える？

Bottom lateral bracing" 3° skew. For design sany the structure as sruare.



diagonal length
sec θ
Inside girder.

Outside girder

for intermediate panel

for End panel

for intermediate point

for End panel point

For intermediate panel point

Horizontal → Hor. force for Earthquake

For End panel point

Hor. force for Earthquake

End reaction

End shear for diagonal
for one diagonal
stress in diagonal
section required net.

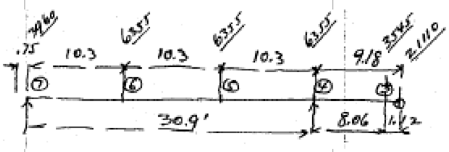
Use net
??? Use Rivets
Approximate weight.

Center connection
end connection

Design of 108A Bridge for City of Tokyo

Approximate weight of suspended span
Stringers
Floor beams
Inside girders
Outside girders
Lateral Bracing

Design of Anchor span
Inside girder G1 span length 30.9' Cantilever arm 9.18'



Concentration ⑤－⑥ see page6
Concentration at ③
From CB_1
Cross beam

From CB_2
cross beam

cross beams
→ OK ←

Concentration at ④length 9.18'
For extra strut a cross the shoe and deeper girder assumed the panel load some as for ⑤
Concentration at ⑦ length 5.9
Panel load
Cross beam

Concentration at hinge. Dead Load reaction from suspended span 21110# see p8
Moment at various points
3. neq? frequency
4.

Neq
moment at 5 moment at 6

Uniform dead load on girder 640# per lin ft.
at 3. m
at 4. m
at 5. m

at 6. m

Sum many for moment

	3	4	5	6	7
Due to concentration					
Due to uniform					

End shear and reaction.:－
Cantilever arm at hinge
Panel concentration
Uniform load

Design of 108A Bridge for City of Tokyo

Shear between 4 and 5
Shear as simple beam
From cantilever effect

Uniform

Total.

Shear between 6 and 7
Load on ⑦ as simple beam

Uniform
Projection

From cantilever

Pas? Load on shoe

As shear

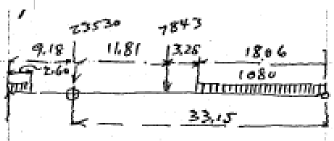
Load on pier ④
due to concentration. Cantilever arm
cantilever effect
As simple beam
direct load
due to unif. ~~with cantilever effect~~

Live Load
Cantilever moment and max negative at panel point of simple span.
Motor truck loading
Span length
Cantilever
suspended
for full loading
for cantilever arm

impact for cantilever arm

impact for simple span

for full loading



motor truck rear wheel

see page 8

Load on girder loading some(some?) as for suspended span see page 7
A
B
C

Front wheel
Reaction at hinge.

Unif. load

neg moment at ③

moment at pier

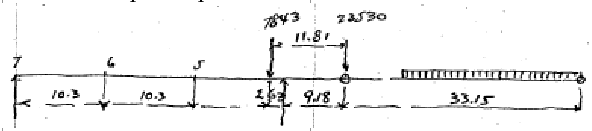
neg moment at ③

max shear
Rear wheel at hinge, uniform load at rear see p8
inform load
motor truck

moment at pier max
End shear

Design of 108A Bridge for City of Tokyo

moment at panel points 5 and 6



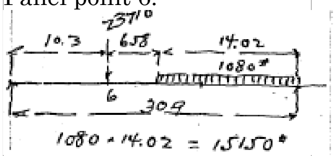
Reaction
moment at 6

moment at 5

Rear wheel at hinge and unif load at rear and front.
Moment at 6
At 5
} max negative
Max negative section at 7 max

Load on shoe (abutment)
~~Max~~ Dead Load

Positive reaction.
Live load on simple span for postive moments
Motor truck loading impact taken some(down?) as for suspended span
Panel point 6.

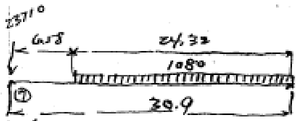


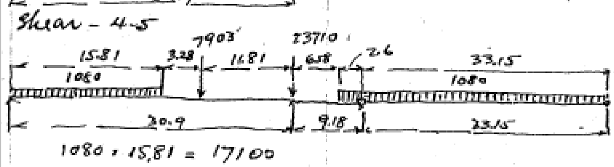
Reaction

Moment

Panel point 5. same bending moment assumed
Max End shear at 7 uniform load

Reaction





Positive shear for simple span

Unif.

Extra shear due to cantilever moment

Extra reaction

End reaction at hinge
Moment

Shear at 4-5

Load on 4 (pier) positive shear shear 4-5
Unif.
〃

Motor truck on suspended span shear
Extra load on pier

Unif. Load on simple span

Max load on pier

Design of 108A Bridge for City of Tol LL

Sum many for moments

	7	6	5	4	3
Dead Load					
Live Load					

Dead Load and negative moment

postive

Dead Load and pos. LL. moment

	7	6	5	4
Dead Load				
Live Load				

Sum many for Inside girder G_1

	7-6	5-4	4-3	Load on 7 max	Load on 7 min	Load on pier
Dead Load						
Live Load						

Section of Inside girder. G_1
Cantilever portion max moment
Depth b to b of angles. web
Effective depth of girder 4.27' flange stress
Section req'd net

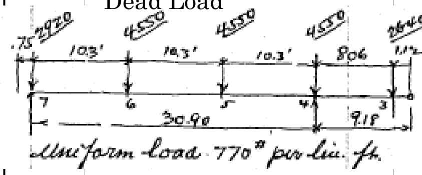
net
Use net

Unit flange stress for tension tension
Unit flange stress for compression comp.
At panel point 5 Tension in for Reversal
Tension on top.
Depth of girder at 5 assumed b to b of angles wed
Effective depth
Flange stress
Section req'd

net
Use net
Unit flange stress for tension
Unit flange stress for compression

Design of 108A Bridge for City of Tokyo

Design of Anchor span
Outside girder G2 span length 30.9' Cantilever arm 9.18'
Dead Load



Concentration at 5 and 6
Concentration at 4 assumed some(same)
Concentration at 3

cross beam + cantilever

concentration at 7
concentration at hinge p10
cross beam and cantilever

Moments at various Points
moment ??? to panel concentration. Moment due to uniform load
Panel pt 3 m ③ m

Panel pt 4 m load
④ m

Panel pt 5 m ⑤ m

Panel pt 6 m ⑥ m

Sum many for moments

	3	4	5	6	7
Due to concentration					
Due to uniform load					

Concentration ?

End shears and reactions
Shear for cantilever arm
Conc at hinge
Concentration
Uniform load

Shear between 4 and 5
Shear as simple beam
Unif.
Cantilever effect
Due to concentration

Shear between 6 and 7
Shear simple beam
Unif.
Cantilever effect
Due to concentration

Load on shoe
Concentration
Unif.

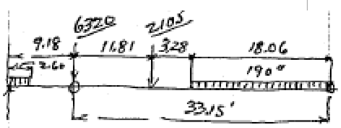
Load on pier due to concentration Cantilever arm
Cantilever effect
Concentration
Uniform load

Design of 108A Bridge for City of Tokyo

Live load
Cantilever moments and max negative moments at panel pts(パイント？) of simple span.
Motor truck loading rear wheel
27.5% impact

Front wheel
load on girder Rear wheel
Front wheel
Uniform live load at rear or front of motor truck
〃 〃 〃 on side walk (see page 9)

Cantilever portion



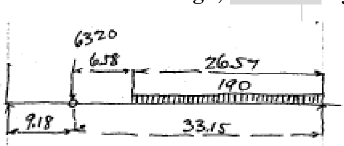
190 × 18.06 = 3430.
190 × 2.60 = 493
½ span 860 × 33.15/2 = 14250
860 × 9.18 = 7900

Reaction at hinge

Unif.
〃
Neg moment at ③
Moment at pier.

Max
Shear max

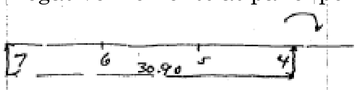
Rear wheel at hinge, followed by uniform load.



190 × 26.57 = 4850

load at hinge
Motor truck
Moment at pier

Negative moments at panel points 5 and 6



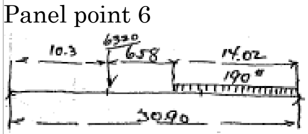
Neg m at 5
Neg m at 6

Negative=neg
Moment=m

Negative reaction at 7.

Load on shoe (min) Dead load
Live Load
on abutment

Live load on simple span for positive moments
Panel point 6



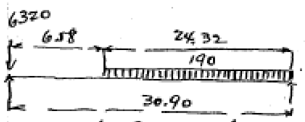
Reaction

Moment

Unif. per lin. Ft.

Panel point 5. Some bending moment assumed

Max End shear at 7



unif. 860# per lin ft.

Unif.

Unif. load
Reaction
Unif. load
Motor truck

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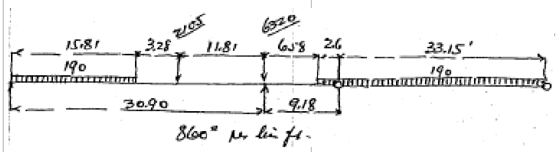
Design of 108A Bridge for City of Tokyo

Shear 4-5



Reaction

Uniform load
Direct shear

Extra shear due to Cantilever moment.
Reaction at hinge

Moment at pier.

Extra shear
Direct shear
Max shear

Load on pier

cantilever

Shear 4-5
Load on cant. arm

Motor truck on suspended span
Shear
see page 17
Extra reaction

Unif. load on simple span

Max. load on pier.

Sum many for moments

	7	6	5	4	3
Dead Load					
Live Load (neg)					

Positive

Dead Load
Live Load (pos)

Sum meny for shears and loads

	7-6	5-4	4-3	Load on 7 max,	load on 7 min	Load on pier
Dead Load						
Live Load						

Section of Outside girder G_2
Cantilever portion max moment
Depth of girder
Effective depth flange stress
Section req'd

Use

Not Counting web for flange section Unit stress tension
〃 〃 comp

compression

Design of 108A Bridge for City of Tokyo

Panel point No5. moment section on top flange.
Reversal

Web assumed effective depth
Flange stress
Sectionreq'd

Net
Use
Not counting 1/8 web for flange sections
Unit stress (tension)
〃 〃 (conp)
Approximate weight of main girder (anchor span)
Insid girder
Flange
〃
Web
〃
〃
〃
Int stiff

intermediate stiffener

Fillers
Web stiffs
Fillers
Web splice
〃
Flange sp.
〃
Fillers

Bed plate
〃

Variation

Outside girder
Flange
〃
Web
〃
〃
〃
Int. stiffs
〃
Fillers
End stiff
Fillers
Web splice
〃

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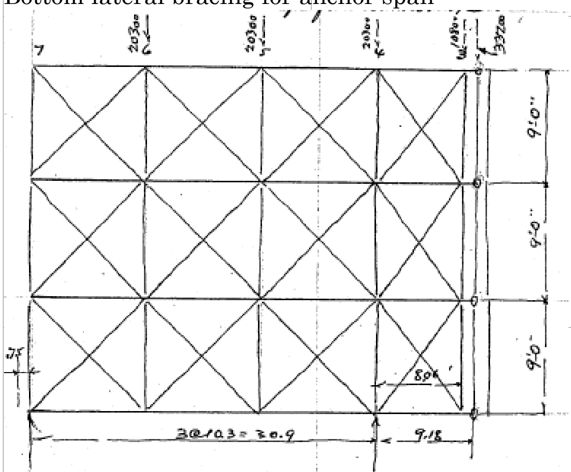
Flange sp.
〃
Fillers

Bed pl.
〃

3% variation

Bottom lateral bracing for anchor span



Sum many for panel load at 3.
Inside girder
Outside girder
Hor. Force due to Earth quake

Shear for panel 3-4 33200
10800
44000#

Shear panel 4-5 20300 from simple span
Extra shear due to cantilever moment
m

shear panel 5-6 stress
shear panel 6-7 stress

Max Reaction at panel point 4 (Horizontal)
Shear at 4 from cantilever
〃 〃 simple beam
Panel load
Extra load due to cantilever

Max horizontal load at 7.
Inside girder
Outside girder

Load Inside girder 20300
Outside gorder 12200
32500# Max Hor. load

Design the Lateral bracing as square.
diagonal length
sec θ
for 8.06' panel.
Diagonal length
sec θ

Load at hinge see p11
Inside girder
Outside girder

Horizontal force

Panel load at 3. inside girder.
Unif.
Conc

Panel load at 3outside girder
Unif.
Concentration

Diagonal stress

diagonal stress

Design of 108A Bridge for City of Tokyo

Section of lateral 3-4

Use net Use rivets for connection.
panel 4-7 use same section
Approximate weight of lateral bracing (see page 11)

Street at
Extra details at hinge say Extra. details at hinge say

Sum many weight of anchor span
stringers
floor beams
Inside girders
Outside girder
Lateral Bracings

Anchor span For 2 spans
Suspended span
shoes and misc details

Shoes on pier
Inside girder DL.
LL.

For shoe

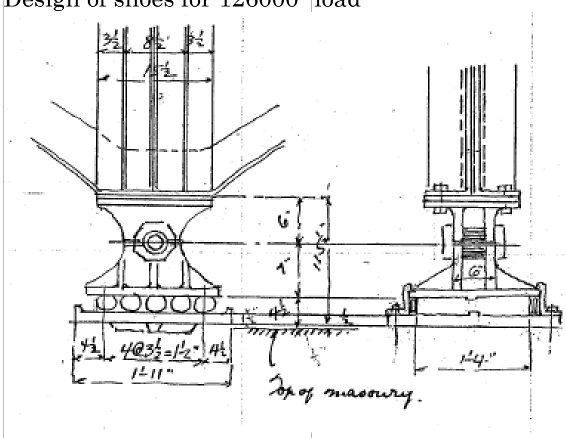
Call this 126000

Outside girder DL.

For shoe

Call this 116000#

Design of shoes for 126000# load



diameter of pin assumed 3"
bearing and

Roller 3" per lin inch
Length of roller
for 5 rollers each

Roller out to out

guard
transverse
Longitudinal

allowance

Base area on masonry
Fixed shoe use similar base
shoes on abutment
Inside girder DL.
LL

??? shoe

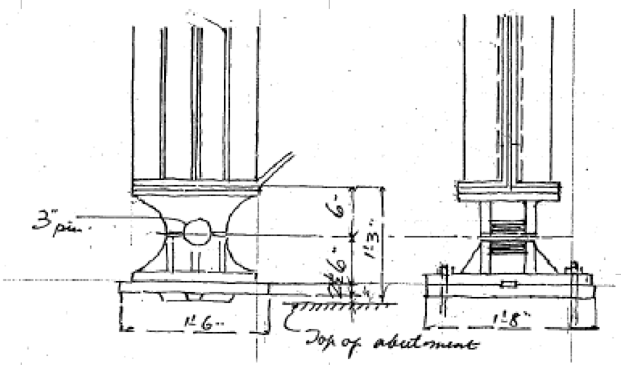
Design shoes for 48000# load.

Outside girder DL.
LL

For shoe

Design of 108A Bridg diameter kyo

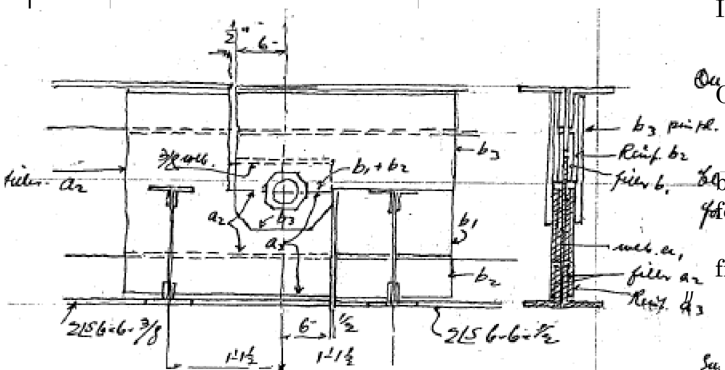
Sketch of shoe on abutment



Pin 3" dia same as for on pier.
sliding shoe.
Bearing area

Unit bearing
on masonry

Details of hinge for suspended span



Inside girder DL
LL

Outside girder DL

bearing area
for anchor span

fillers

Suspended span
fillers
Reinf.pls.
pin pls.

Reinforcement plate? Reinf. Pls.

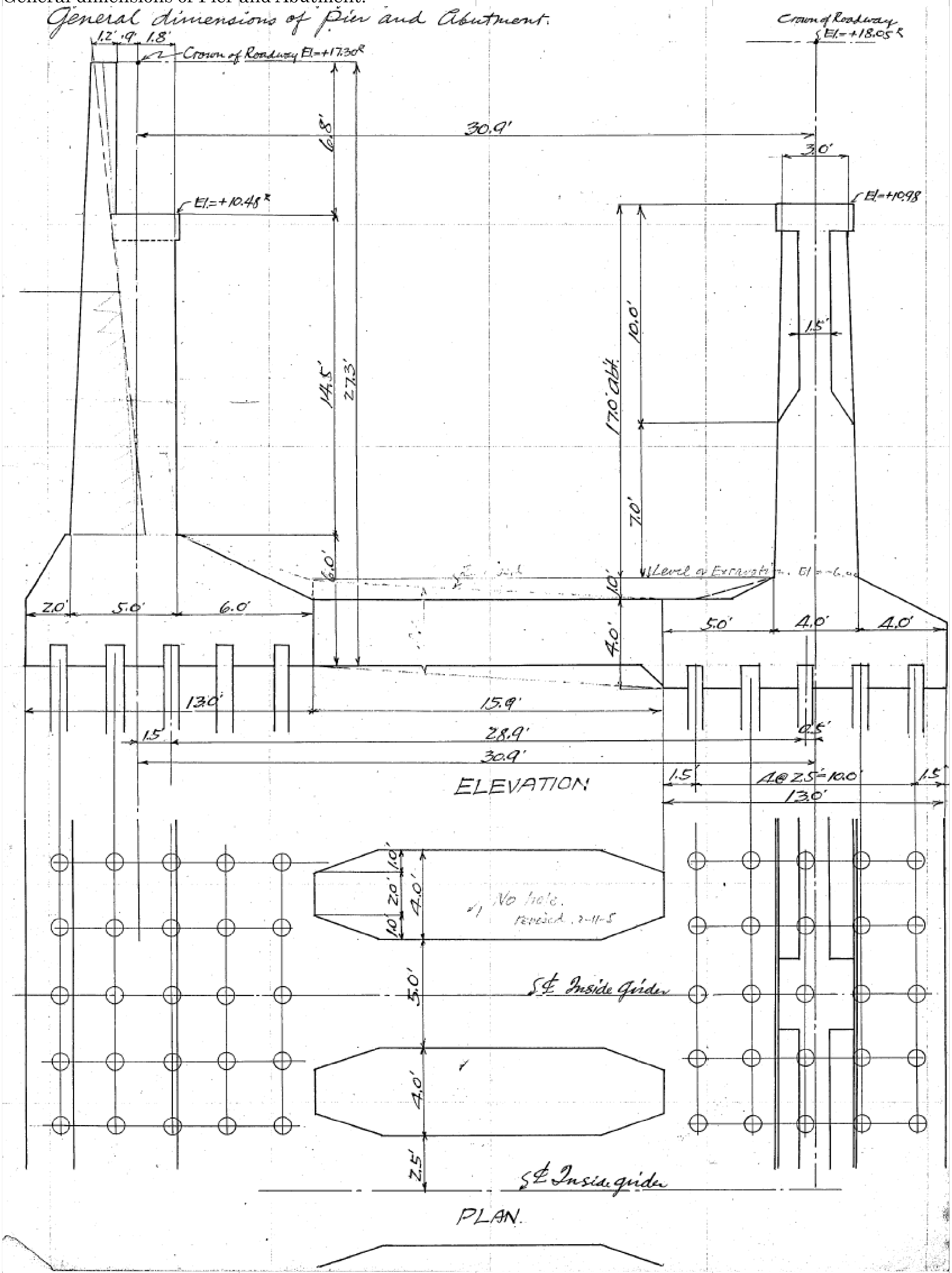
Bending

fibre stress

Pin assumed
bearing area
Unit bearing
Beading?(bearing)
fibre stress about OK

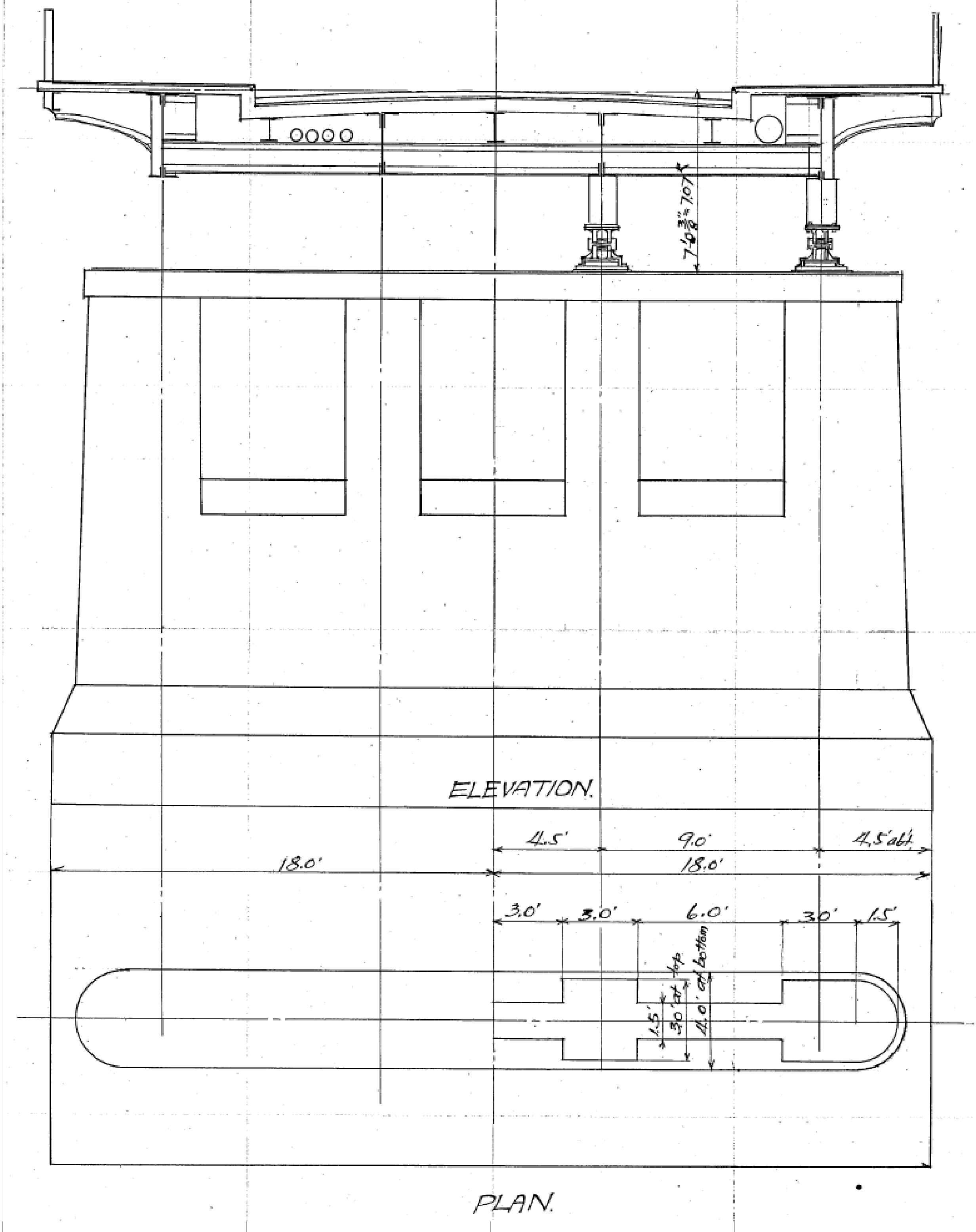
Design of 108A Bridge for City of Tokyo

General dimensions of Pier and Abutment.



Design of 108A Bridge for City of Tokyo

General sketch of Pier.



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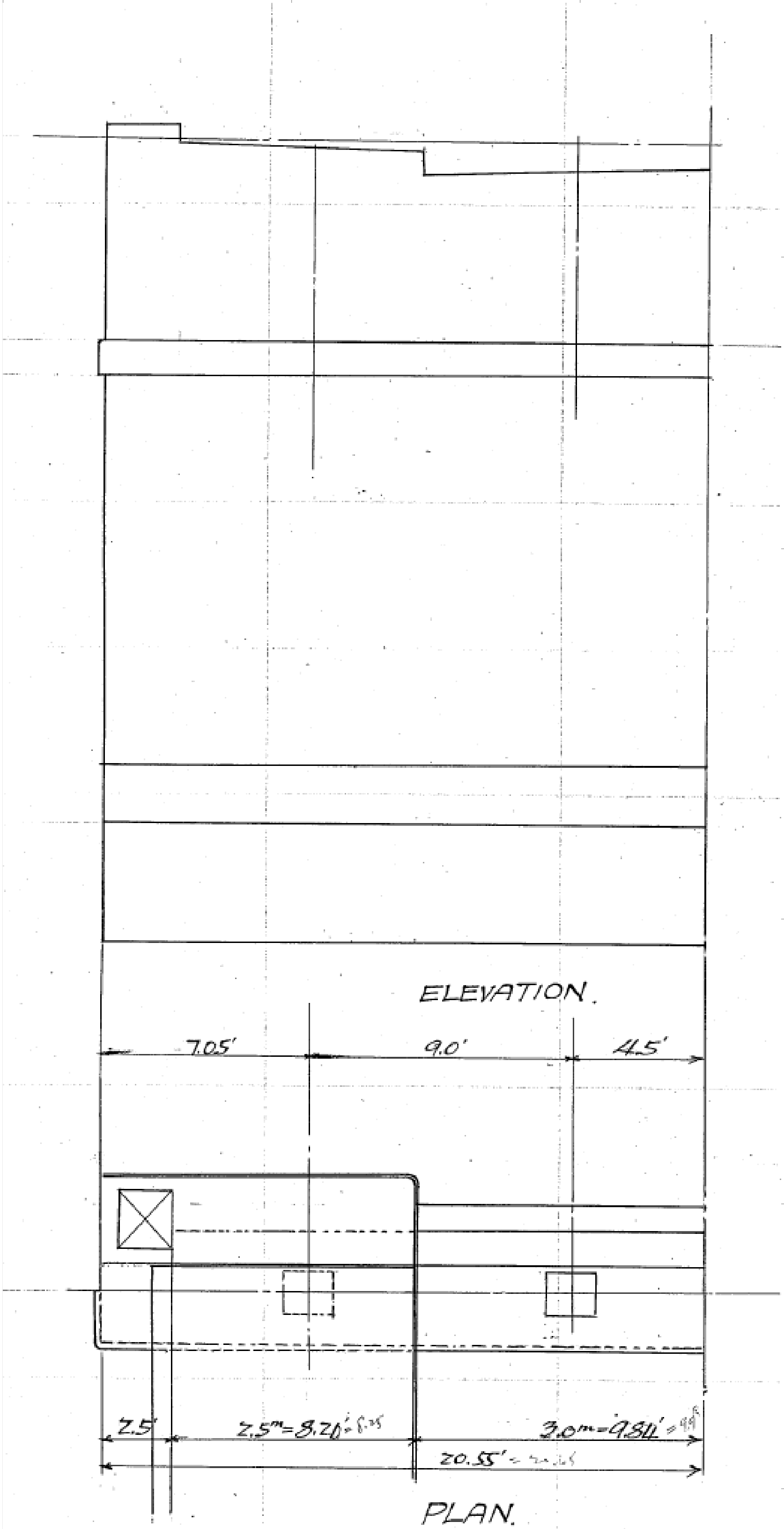
General sketch of Abutment.



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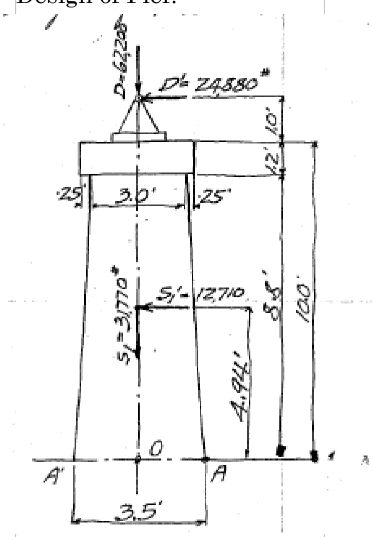
Design of Pier.



Suspended imposed load.

Dead Load
Weight of shoe
Live Load

Call this for one girder.

Case A.

Stability of Pier shaft during earthquake. k=0.4

Center of gravity of shaft above section AA'

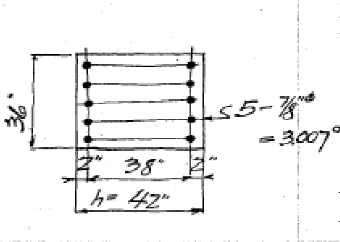
names	Dimensions	weight	lever arm	moment
coping				
shaft				
curtain wall				
chamfer				

Vertical distance of c,g of shaft from O.

seismic force

Seismic moment about O.

Vert load	seismic forces	lever arm	moment
D			
S			



Eccentricity

K= L= j=
fc= OK
fs= OK<30700
Unit shear v= OK
Unit load u= OK

Case B.

Stability of Pier shaft for full load at normal state.

Superimposed load

No bending moment occurs in the shaft.

Unit compressions on concrete OK

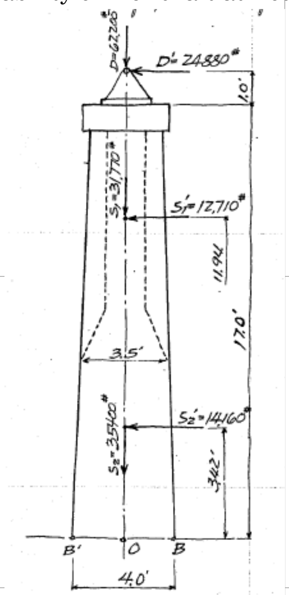
〃 〃 〃 steel OK

Load on shaft

superimposed load	=	126000#
shaft	=	31770
		15770

Design of 108A Bridge for City of Tokyo

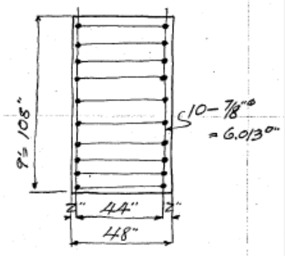
Stability of Pier shaft at Bottom.



Case A. Stability during earthquake
Center of gravity of shaft of lower 7ft.
X_1 above 0.
weight
seismic force
seismic moment about 0.
Loads seismic forces arm moment
D D'
S_1 S_1'
S_2 S_2'

Eccentricity E=

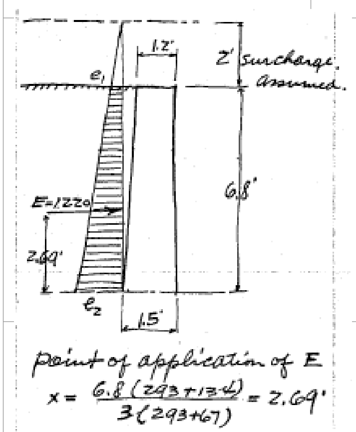
k= j= L=
f_C= OK
f_S= OK
Unit shear v= OK
Unit load u= OK



CaseB
Stability for full load or normal state
superimposed loa
shaft
〃

No bending moment occurs in the shaft
Direct compression on concrete OK
fs= OK

Design of Abutment
Parapet wall
Case A Under full load or normal state/



2ft. surcharge for live load assumed.
Earth pressure e_1= e_2=
Total earth pressure on parapet wall
Moment at bottom
Steel required
Use per ft. strip.
p= j= k=
fs= OK
fc= OK
v= OK
u= OK

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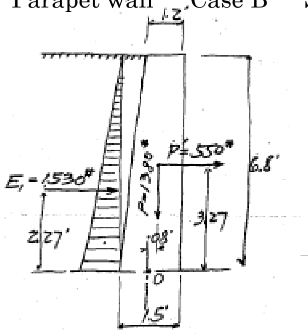
Design of abutment continued

Parapet wall Case B Stability during earthquake/

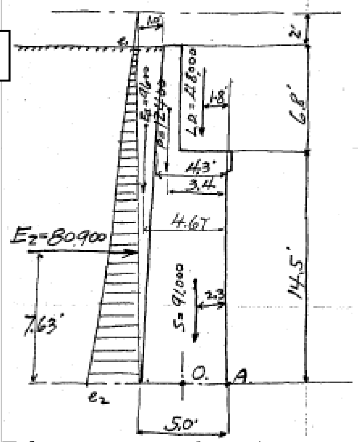


Coefficient of earth pressure for

Earth pressure
Weight of parapet wall
Moment due to
earth pressure
seismic force
wt. of wall
steel req'd per ft. strip.
Previous assumed section OK.

Stability of abutment shaft
Shaft under inside girder
Case A Stability under full load or normal state

weight



Super imposed loads/
Dad load
Wt. of shoe
Call this
Live load 〃 〃
Call this 48000#
Let us figure for shaft 9' wide under inside girder.
Weight of shaft
Weight of parapet wall
Earth pressure
〃 〃
E_2
Wt. of earth behind
Ea

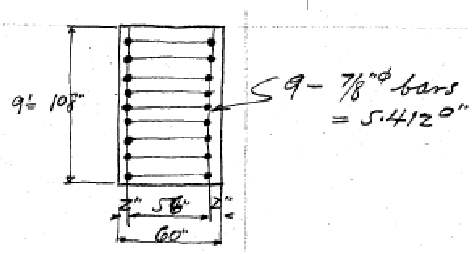
Taking moment about A

Loads	Hor forces	vert force	lever arm	moment
Super posed load				
Parapet wall				
shaft				
Earth behind				
Earth pressure				

Eccentricity E
Moment about 0
Assumed section.

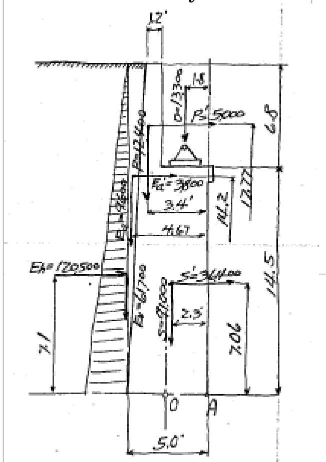
steel ratio

k= j= L=
fc= OK
fs= OK
unit shear OK
〃 load OK



Design of 108A Bridge for City of Tokyo

Case B Stability of shaft during earthquake for seismic forces acting forward river side

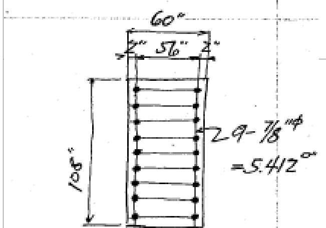


Earth pressure during earthquake
Hor. component of earth pressure
Vent. 〃 〃 〃 〃
Taking moment about A.

Loads	Hor. forces	vent. forces	lever arm	moment
D				
P				
P’				
S				
S’				
Ea				
Ea’				
Ev				
Eh				

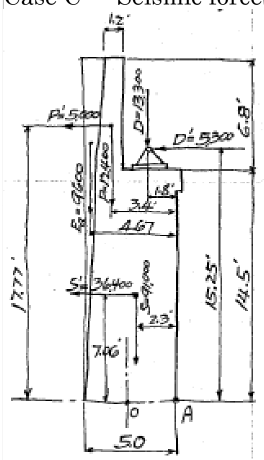
Eccentricity E=
Moment about 0.

Po
From prepared diagrams, we have



k= j= L=
fc OK
fs= OK
shear stress v=
bond stress u= OK

Case C Seismic forces reversal to case B



Taking moment about A.

Loads	Hor. forces	vent forces	moment
D			
D’			
P			
P’			
S			
S’			
Ea			

Eccentricity E=
Moment about 0

Since → Since all loads of moments smaller than for case B, it is unnecessary to investigate stresses.

unnessary

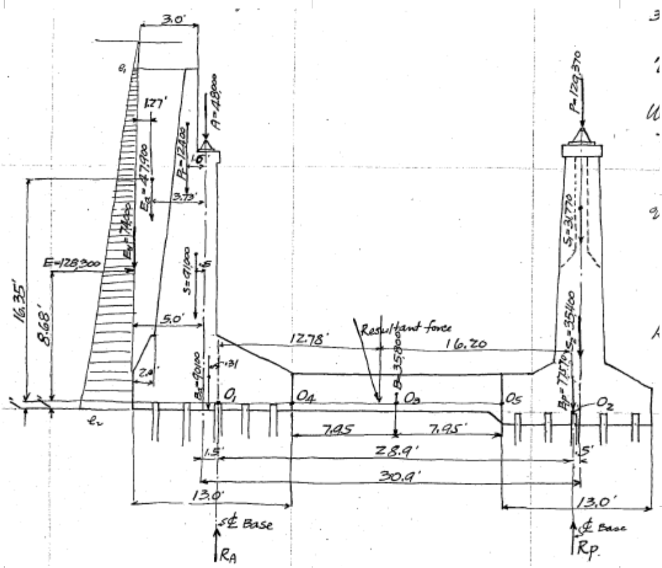
Shaft under outside girder.

Dead Load
Weight of shoe
Call this
Live Load
〃
Total

Use similar details as for shaft under insides girder.

Design of 108A Bridge for City of Tokyo

Design of combined base for Abutment and Piers
Base under inside girder 9' wide
Case A Case of full loads at moment state.



Taking moments of several forces about 01

Loads Hor. Forces Vent. Force Lever arm moments

A
Pr
S
Ba
Ea
Ev
E

P
S_1
S_2
Bp

B

Total.
Reaction for Pier R_p

Reaction for abutment R_A

Weight of pier base.

Vert.: vertical
Dist.:distance

Vent. Dist. c.q from bott
Weight of abutment base

Vent. Dist. of c.q. from bottom

heel:かかと

Hor. Dist. of c.q from heel
or rear side of ・ base.
Weight of Beam between pier and abutment
Assumed the section be

Weight of earth behind of abutment

Earth pressure
e_1
e_2

Earth pressure on abutment
E_h
E_v

Point of application of Resultant force
Distance from 0_1

Load on one pile
for pier tons on one pile.
for abutment tons on one pile.

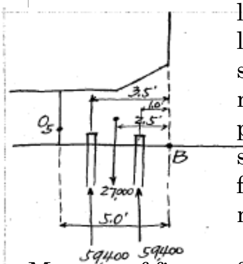
Design of 108A Bridge for City of Tokyo

Moment at center of beam 03
Loadlever arm moment

Assume 3' settlement of earth after completion
Assume weight of earth in water
Moment at center of span span being assumed 20'

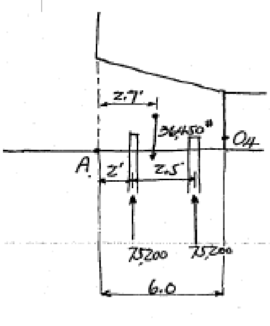
For continuity of Beam m=
Total moment at 0_3

Moment at fixture of abutment base for Case A



load on one pile
load for 3 piles
shear at 0_5
moment at fixture B.
piles
shear
footing
moment at 0_5

Moment of fixture for abutment footing in Case A



load on one pile
load for 3 piles
moment at A.
moment at 0_4
shear at 0_4
pile
footing
shear at A
shear at 0_4
footing
piles

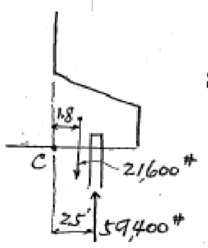
Moment at toe of abutment 04
Moment at 0_3

Shear at end of abutment base on beam (0_4)

Shear at end of Pier base on beam. (0_5)

Moment at toe of pier 05
moment at 0_3

Moment at C



Shear on C

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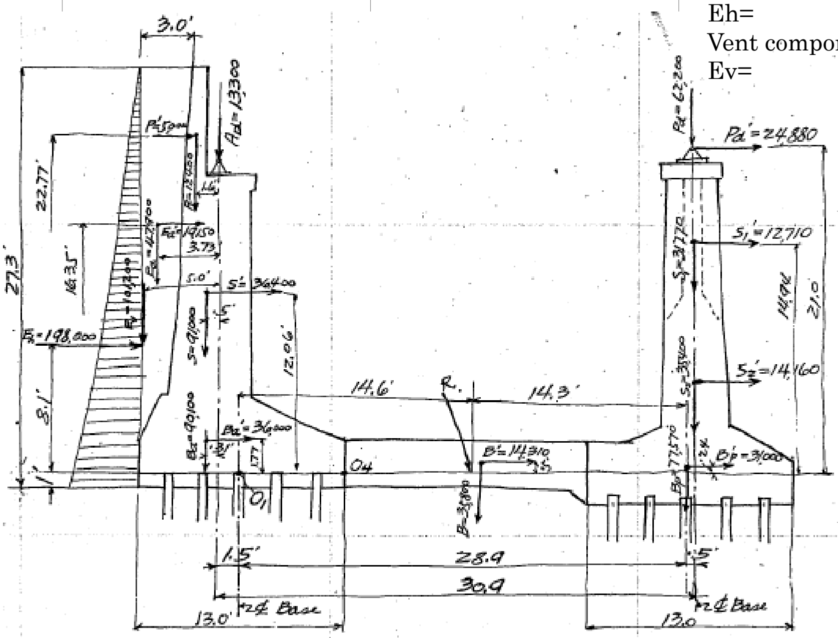
Case B Stability during earthquake for seismic forces acting toward river side

Earth pressure during earthquake.
How component
Eh=
Vent component
Ev=



Taking moments about 01

Loads Hor. force Vent. force lever arm moment
Ad
Pr
Pr'
S
S'
Ba
Ba'
Ea
Ea'
Ev
Eh

Pd
Pd'
S_1
S_1'
S_2
Bp

B
B'

Total ΣH

Reaction for Pier
Rp=
Reaction for abutment
R_A=
Load on one Pile for Pier
〃 〃 〃 〃 〃 abutment
Position of Resultant force
Hor. dist. from 0_1

Moment at 0_3 on beam
Load Hor. force Vent. force lever arm moment
Rp
Pd
Pd'
S_1
S_1'
S_2
S_2'
Bp
Bp'
B
B

moment due to 3' settlement of earth

shaer at 0_3

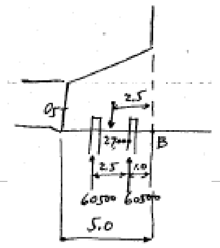
Design of 108A Bridge for City of Tokyo

Moment at 0_4 on beam
moment at 0_3

shear at 0_4
Moment at 0_5 on beam
moment 0_3
shear
beam

shear at 0_5

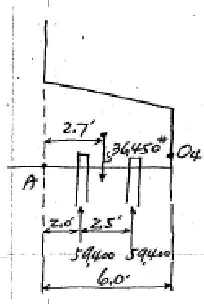
Moment at Pier footing at B for case B.



load on pile   tons per pile
for 3 piles
moment at B.
moment at 0_5
shear 〃 〃
piles
footing

Shear at B
shear at 0_5
footing
piles

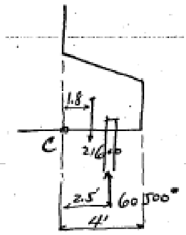
Moment of fixture of footing for abutment (point A)



weight of footing
upward pressure due to Piles

moment at 0_4
shear
pile
wt. of footing

Shear at A
shear at 0_4
pile
wt. of footing
Moment at Pier footing at C for Case B
piles
footing



Shear at C
pile
footing

Case C   Case of seismic forces reversed to Case B
Reffering to the figure for Case B
Taking moment about 0_1

Loads	Hor. force	Vent. force	lever arm	moment
Ad				
Ad'				
Pr				
Pr'				
S				
S'				
Ba				
Ba'				
Ea				
Pd				
Pd'				
S_1				
S_1'				
S_2				
S_2'				
Bp				
Bp'				
B				
B'				

Reaction for Pier
Rp
Reaction for abutment
Ra
Loads on Piles
For Piers
For abutment
Point of application of Result force
from 0_1

Design of 108A Bridge for City of Tokyo

Moment at 0_3 on beam

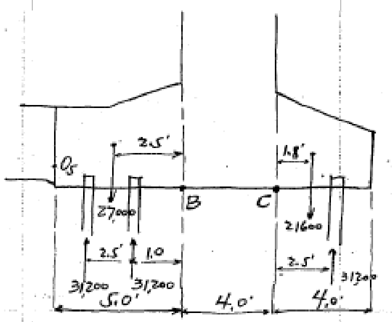
Loads	Hor. force moment	Vent. force	lever	arm
Rp				
Pd				
Pd'				
S_1				
S_1'				
S_2				
S_2'				
Bp				
Bp'				

shear at 0_3

Moment at 0_4 on beam
moment at 0_3
shear
beam
Shear at 0_4

Shear at 0_5
moment at 0_5
moment at 0_3
shear
beam

Moment of fixture for Pier footings



Moment at B
wt. of footing
moment at 0_5
shear
piles
footing

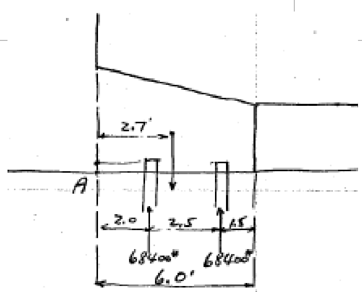
shear at B
sheear at 0_5
piles
footing

Moment at C
wt. of footing

moment at C
piles
footing

shear

Moment of fixture for abutment footing (at point A)

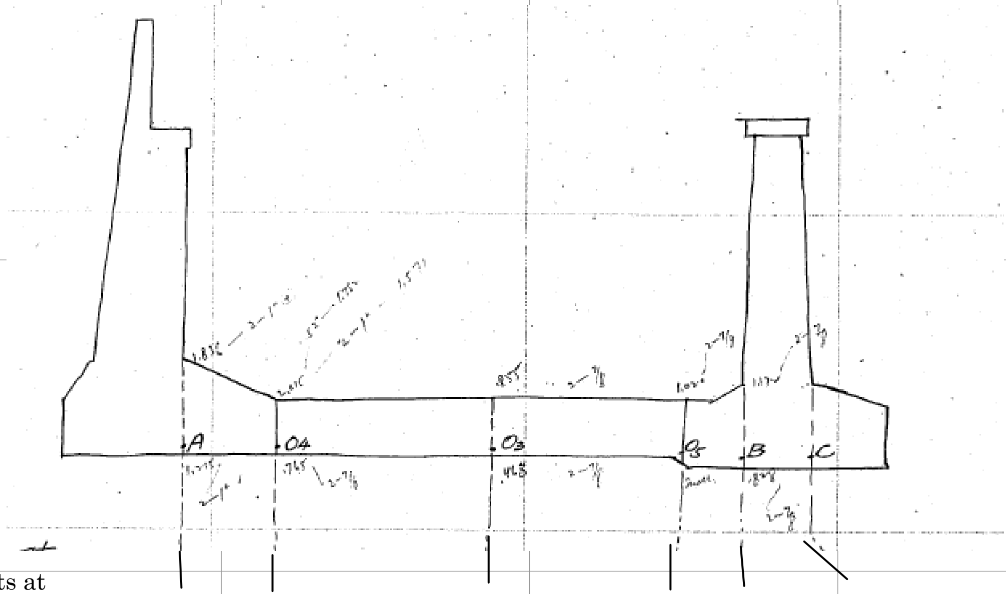


Load on one pile
〃 〃 3 〃
Moment at A
shear 〃 〃
piles
footing

Shear at A
shear at 0_4
footing
piles

Design of 108A Bridge for City of Tokyo

Moments and Shears for several cases at several points in the combined footing

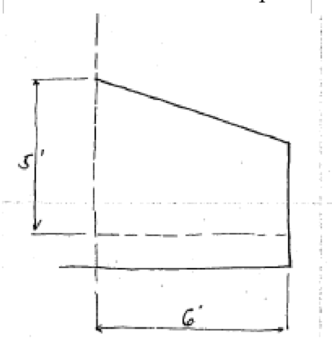


Moments at
Normal, case A
Earthquake 〃 B
〃 〃 C

Shear at
Normal case A
Earthquake 〃 B
〃 〃 C

Load on Piles at Abutment
Normal case A
Earthquake 〃 B
〃 〃 C

Design of Footing and Beams
Footing for abutment (all figures are for footing 9' wide)
Max moment during earthquake Case B
〃 〃 〃 C
Max shear for full loads at normal case.
Reinforcement req'd



Use P
k j
fs OK
fc Ok
steel for neg. moment

Use 9'-1"
shear stress OK
load stress OK

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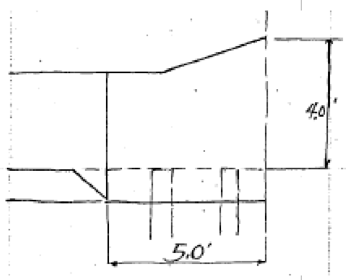
Footing for Pier (Side span side)
Max moment during earthquake, Case C
〃 〃 〃 B
Max shear for full load Case A

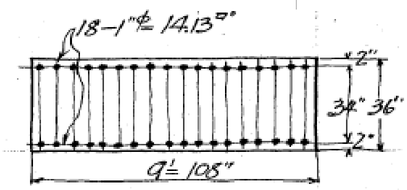


steel required
Use
p k j
fs OK
fc Ok
shear stress OK
bond stress OK
Steel for neg. moment

Use

Footing for Pier (Center span side)
Max moment
Max shear
Steel required
Use
Shear OK

Design of Beam between Abutment and pier
Section at 0_4



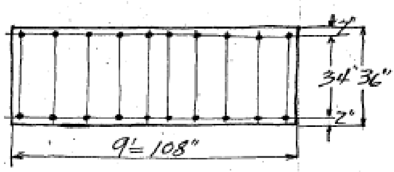
Max moment

revise:訂正する？

Max shear
Assumed section 9' wide 3' thick (assumption of width at start 7' being reviced to 9')
Steel required for siugb reinforcement
Use on Top a Bottom.
From the prepared diagram, we have,
k j
fs OK
fc OK
v OK
u OK

Design of 108A Bridge for City of Tokyo

Section at 03 (Center of span Beam)



Max moment for full load at normal case A.
during earthquake case B
Max shear
Assumed section 9' wide 3 thick (Revised from 6' to 9')
Steel required for ??? reinforcement
Use on Top and Bott.

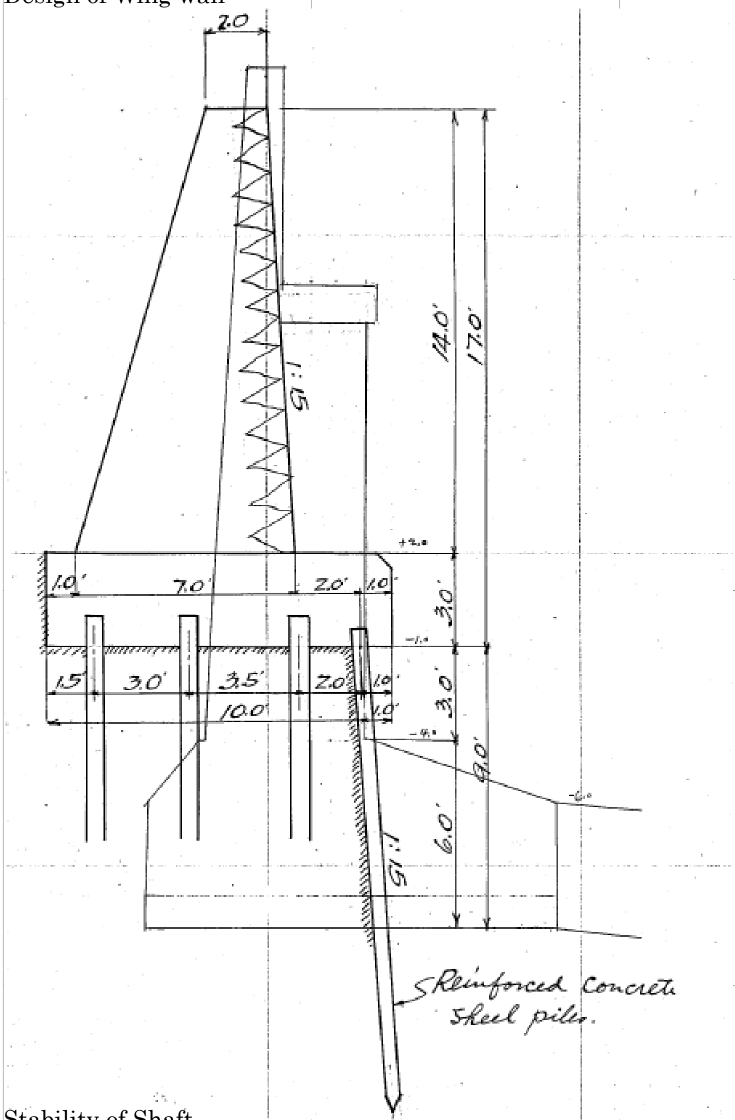
k j
fs OK
fc OK
v OK
u OK

Section at 05 (near pier)

Max moment for full load at normal case A
during earthquake case B
Max shear 〃 〃 〃 B
Use the same reinforcement as for section at 0_3
shear v OK
bond u OK

Design of 108A Bridge for City of Tokyo

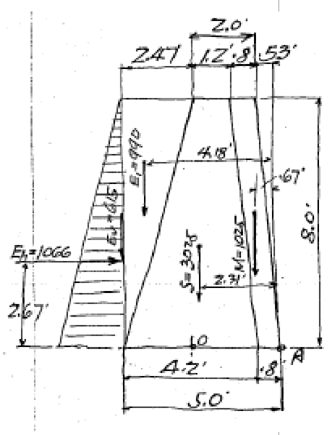
Design of Wing wall



Stability of Shaft

Section at 8 ft below top of wall

Case A at normal case



weight of masonry M

〃 〃 concrete S

〃 〃 earth behind E_1

Earth pressure E

Friction of earth on wall

Taking moments about A

Loads	Hor. force	Vert. force	lever arm	moment
M				
S				
E_1				
Ev				
Eh				

Eccentricity E

Resultant force cut base between middle third points. OK

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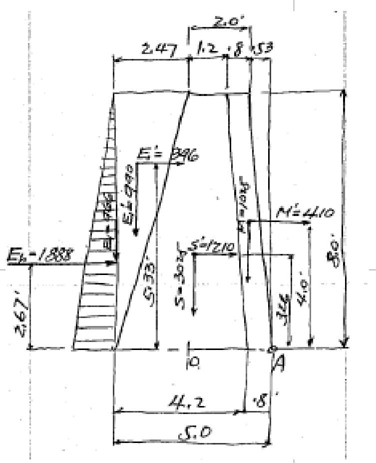
Case B Stability during earthquake for seismic forces acting forward river side



Earth pressure during earthquake
Hor. component of earth pressure = Eh =
Vert. 〃 〃 〃 〃 = Ev =
Taking moment about A

Loads Hor. force Vert. force lever arm moments
M
M'
S
S'
E_1
E_1'
Ev
Eh

Eccentricity E=
moment ab't. o
Extreme fibre stress
compression OK
or Tension OK

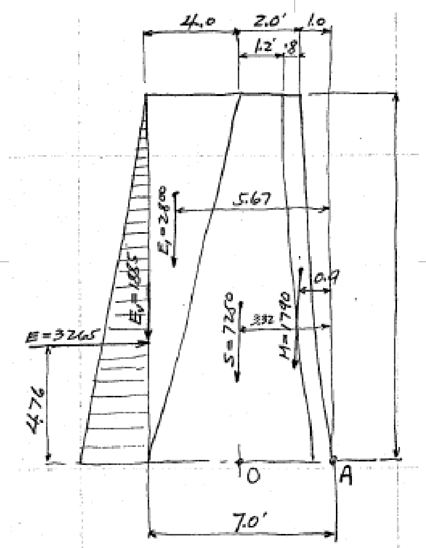
Section modulus bed area

Case C Stability druing earthquake for seismic forces reversed case B.
Reffering to figure for case B moment about A

Loads Hor. force Vert. force lever arm moments
M
M'
S
S'
E_1

Eccentricity E =
Resultant forces cut base between middle 3rd points.
OK

Stability of Bottom of shaft.
Case A at normal state.



Weight masonry
〃 〃 concrete
Earth behind
Earth pressure
fiction on wall
Takingh moment about A.

Loads Hor. force Vert. force lever arm moments
M
S
E_1
Ev
E

Eccentricity E =
Resultant force cut base between middle 3rd points.

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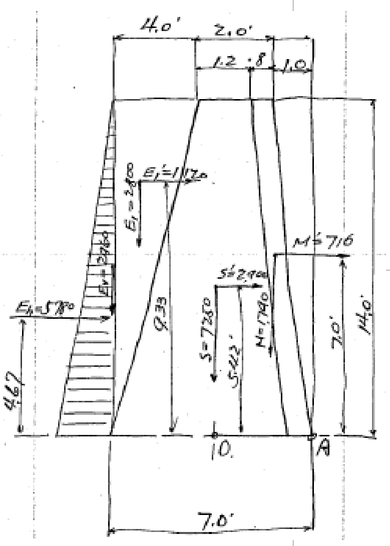
Case B. Stability during earthquake for seismic forces acting forward river.



Earth pressure
Hor. component Eh
Vert. 〃 Ev

Loads Hor. forces Vert. force lever arm moments
M
M'
S
S'
E_1
E_1'
Ev
Eh

Eccentricity E
moment about 0.
Use reinforcement on back side.
Steel area req'd per ft strip of wall.
Use
Pevised to

Case C. Stability during Earthquake for seismic forces reversed to case B.
Reffer to the figure for case B.

section area of bottom area

section modulus of bottom area

Loads Hor force Vert. force lever arm moments ab't A/
M
M'
S
S'
E_1

Eccentricity E
moment about o
Extreme fibre stress

comp. OK
Tens. OK

Stability at bottom of base.
Case A Under full loads at normal state.

Weight of earth behind Ei
earth pressure E
Friction of earth on wall Ev
Weight of base B
Taking moment about A.

Loads Hor. force Vert. force lever arm moment
M
S
E_1
E_2
B
Ev
E

Eccentricity E
moment about 0

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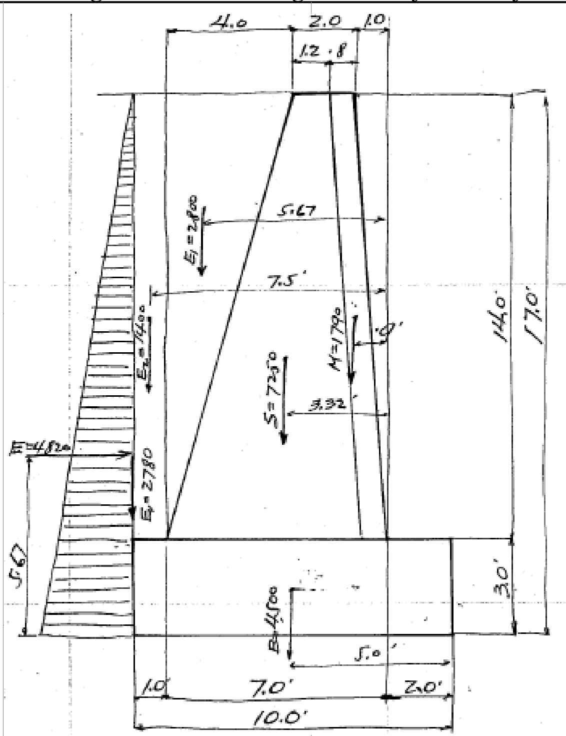
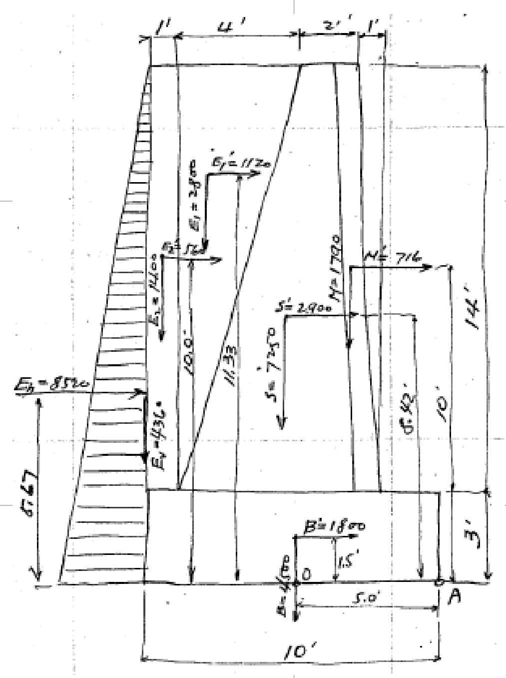


section modulus of bed area per ft. of wall
Max toe pressure
comp
〃 〃
Max load on one pile.
On steel piles
projection of footing

On a pile nearest to the toe

on a pile at heel

Case B. Stability during earthquake for seismic forces acting forward river side.



Earth pressure
Eh
Ev

Loads	Hor. force	Vert. force	lever arm	moments
M				
M'				
S				
S'				
E_1				
E_1'				
E_2				
E_2'				
Ev				
Eh				
B				
B'				

Eccentricity E
Moment at 0.

Max . toe pressure

Negative tension
Max toe pressure

Load on sheet pile
〃 〃 a pile nearest to toe

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Case C Stability during earthquake for seismic force reversed to case B.

Reffer to the figure of case B.

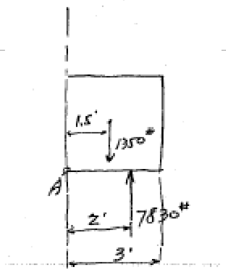
Loads	Hor. force	Vert. force	lever arm	moment
M_1		1790	− 2.9	− 5190
M_1'	716		−10.0	− 7100
S		7250	− 5.32	− 38600
S'	2900		− 8.42	− 24420
E_1		2800	− 7.67	− 21480
E_2		1400	− 9.50	− 13300
B		4500	−5.00	− 22500
B'	1800		− 1.50	− 2700
	5416	17740		−135290

Eccentricity E

Neglecting tension, max toe pressure

Load on one pile at heel

Footing at toe.



weight of footing= $3 \times 3 @ 150 = 1350^{\#}$

upward pressure of sheet pile= $3.5 \times 2240 = 7830^{\#}$

moment at A

due to sheet pile $7830 \times 2 = +15660'^{\#}$

〃 〃 wt. of footing $1350 \times 1.5 = 7830^{\#}$

End shear = $7830 - 1350 = 6480^{\#}$

steel req'd for moment = $\dfrac{13630 \times 12}{30700 \times \frac{7}{8} \times 24} = 0.25$ per ft. strip

Use bars at 1790

bond stress OK

Use 26" effective depth if possible bond stress