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CALCULATIONS FOR

昭和五年八月

國道第壹號線

愛知縣木曾川橋上部工事

設計々算書並材料調書

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MADE BY K. Inaba. DATE 3-2-26 FILE NO AF

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken.

The proposed new bridge is located at 162 meters (90 ken) down stream and parallel to the present railway bridge. The total length of the new bridge is 878.8 meters (483 ken) between faces of parapet walls of both abutments. Said total length is divided into 14 spans in which the first span on west side is 40.77 meters (134' about) between end bearings and the rest consists of 13 equal spans of 63.43 meters (208' about) between end bearings, using same numbers of piers as for railway bridge just above with proportional span length to give free flow during flood time.

The total width of roadway is 7.5 meters wide between curb lines, paved with asphaltic block on reinforced concrete slab.

The handrails throughout the bridge are made of cast iron and the pedestals and handrails at entrance over both abutments are of cut stone and ornamental design.

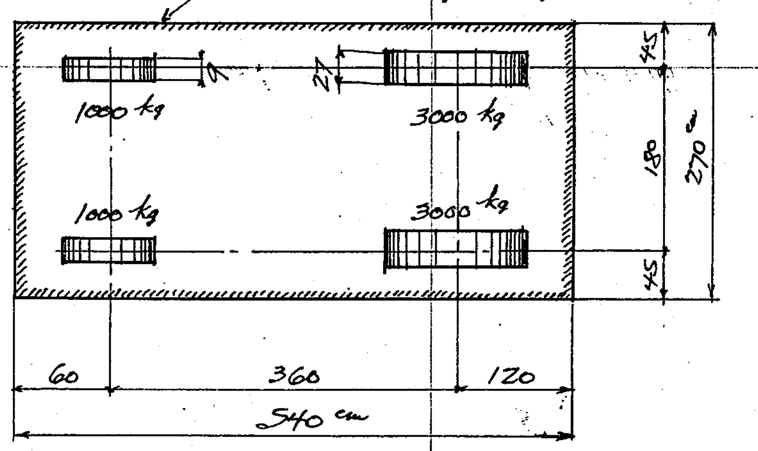
The findings of borings at the bridge site show the layer of fine sand at top and then clay soil of low bearing power until the firm sand is reached at the depth of 48 meters below ground line. It is impossible to sink the piers such a depth with the present practice of caisson method. Most practical method, therefore, in this case is to use pneumatic process and carry the piers enough depth to get side friction and spread the base to get required base area to secure designed safety.

Assumed Loadings.

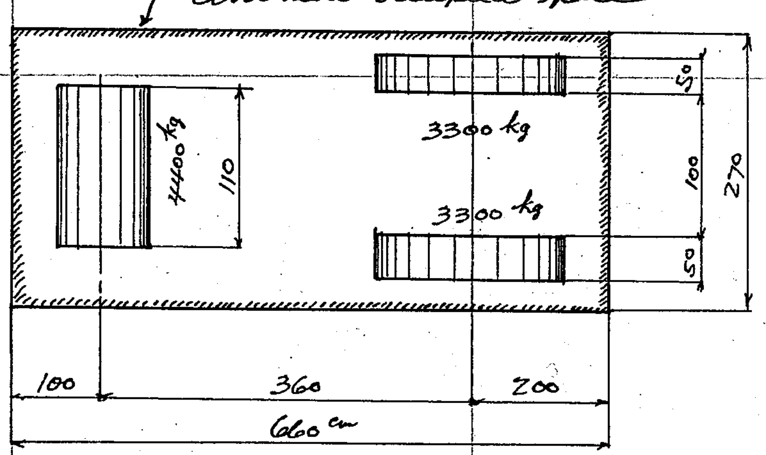
Uniform load on Roadway $w = \frac{100000}{170+l} \leq 500$ kg/m²

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

8 ton motor truck loading



11 ton Road Roller loading



2 rows of motor traffic on roadway with occupied width of 270 cm each; unoccupied space around the motor truck shall be filled with uniform load specified above.

One Road roller on one span

Impact for motor truck loading. Coef. $= \frac{20}{60+l}$ where l = loaded length in meters
max. impact 30%.

No impact considered for road roller and uniform live load.

Allowable working Strength.

Concrete 1:2:4 mixture

Direct compression	35	kg/cm²
Fibre stress due to bending	45	"
Combined stresses due to direct and bending, compression member	35	"
Arch ring	45	"
Punching shear of Concrete	9	"
Shear of plain concrete	4	"
Bearing value	45	"

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-ken.

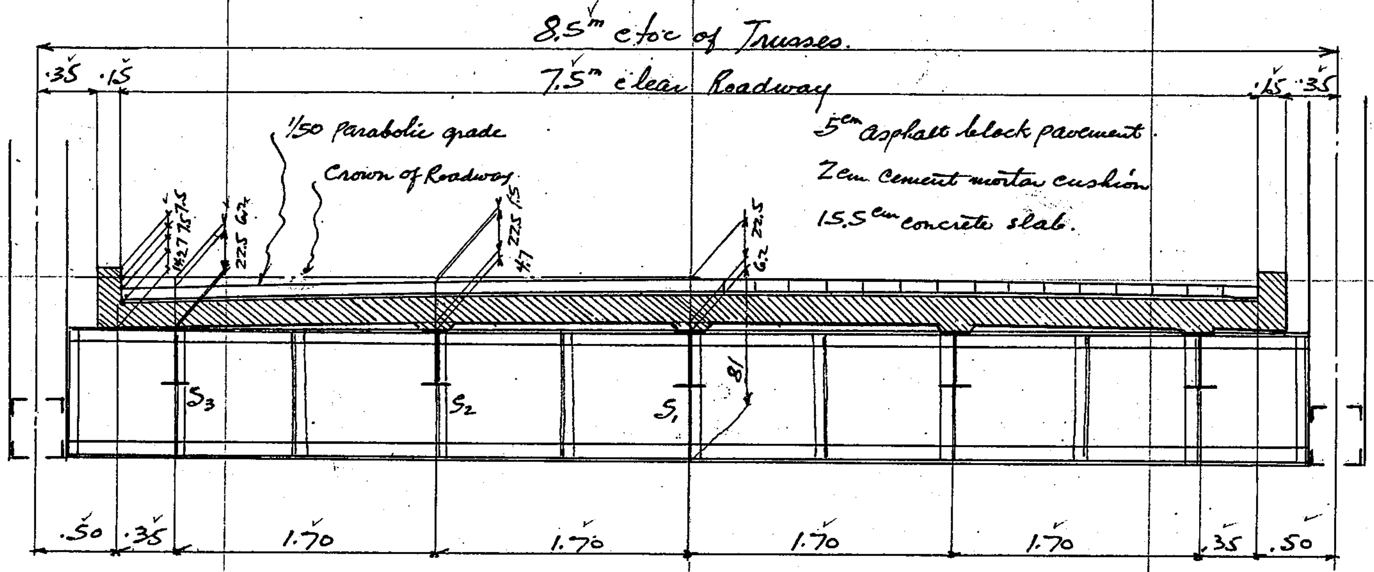
Bond stress for plain bars	6	kg/cm²
〃 〃 〃 deformed bars	9	〃
Reinforcing bars		
Tension or Compression	1200	〃
Shearing strength	900	〃
Structural steel		
Tension net.	1,200	kg/cm²
Extreme fibre stress, net	1,200	〃
Shear of web, gross section	900	〃
Compression member		
1,500 (1 − 0.0055 l/r) not over	1,000	〃
where l = length of member in cm; r = least radius of gyration in cm		
Compression flange of girder		
1200 (1 − 0.012 l/b) not over	1,100	〃
where l = Unsupported length of flange in cm.; b = width of flange in cm.		
Shear on shop driven rivets (machine driven)	850	〃
〃 field 〃 and turned bolts (machine driven)	750	〃
Shear on pin	900	〃
Bearing on shop driven rivets (machine driven)	1,700	〃
〃 〃 field 〃	1,500	〃
〃 〃 pin	1,800	〃

Roller (steel) 45 d kg/cm where d = diameter of roller in cm.

Considering wind or temperature stress in addition to dead, live and impact stresses the allowable working strength shall be increased 25 %; in case of earthquake increase working strength 60 %

Seismic acceleration 3000 mm/sec² or k = 0.30

Cross section of Bridge assumed as shown on sketch below.



scale 1:50

Floor slab Span length 1.70 meters.

Dead Load.

5cm	asphalt block pavement	@ 21 kg	= 105
2cm	cement ~~motor~~ mortar cushion	@ 17 〃	= 34
15.5cm	concrete slab	@ 24 〃	= 372
	miscellaneous concrete. say		9
			520 kg/m²

Dead Load moment $= \frac{1}{10} \times 520 \times 1.7^2 = 150$ kgm

Dead Load shear $= \frac{1}{2} \times 520 \times 1.7 = 442$ kg

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken.

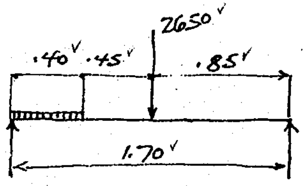
Live Load Motor truck rear wheel concentration 3000 kg
30 % impact 900
3900 kg

Distribution of wheel concentration on slab.
Longitudinal distribution a = Contact between wheel and pavement 20 cm
Distribution 2×7 = 14
34 cm

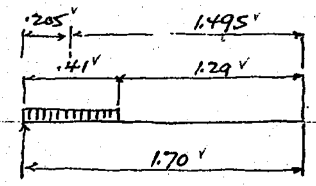
Transverse distribution b = 27 + 2×7 = 41 cm

Effective width E = ⅔ l + a = ⅔ × 1.70 + .34 = 1.47 metres

Load per meter strip 3900 ÷ 1.47 = 2650 kg
Uniform live load 500 kg per square meter.



Motor truck loading $\frac{2650}{2} \times .85 = 1125$
Uniform load $\frac{500 \times .4^2}{1.7 \times 2} = 23.5 \times .85 = 20$
1145



For continuity of slab, moment = 1145 × .8 = 915 kgm

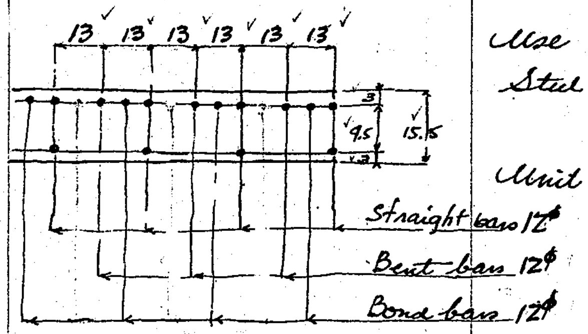
End shear = $2650 \times \frac{1.495}{1.7}$ = 2330 kg

Summary of moments and shears.

	moments	End shears
Dead Load	150	442
Live Load	915	2330
	1065 kgm	2772 kg

Effective depth required = $\sqrt{\frac{1065 \times 100}{100 \times 7.18}} = 12.2$ cm

Use effective depth of 12.5 cm with 3 cm insulation on tension side, total depth = 15.5 cm
Steel area required = $\frac{1065 \times 100}{1200 \times \frac{7}{8} \times 12.5} = 8.12$ cm² per meter strip of slab.



Use 12mmφ bars at 13 cm c to c = 8.70 cm²
Steel ratio = $\frac{8.70}{100 \times 12.5}$ = .00071 k = .367, j = .878

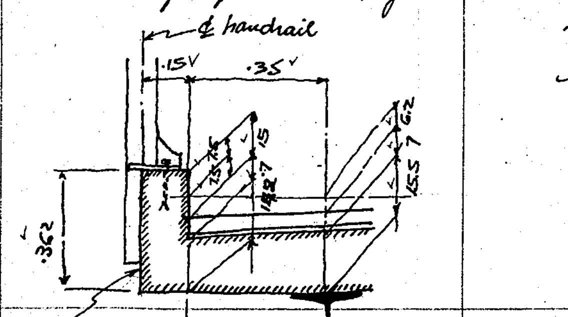
Unit shear = $\frac{2772}{100 \times .878 \times 12.5}$ = 2.53 kg/cm² ok.

Total perimeter of bars for bond.
main reinforcements 7.70 × 3.77 = 29.0
bond bars 3.85 × 3.77 = 14.5
43.5 cm

If deformed bars be used no bond bars is required. spacing of main bars 14 cm unit bond 8.7 kg/cm² (for 13φ bars)

Unit bond = $\frac{2772}{43.5 \times .878 \times 12.5}$ = 5.8 kg/cm² ok.

Overhanging Slab beyond end stringer.

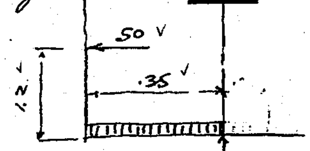


In final this coping changed to 20 cm wide

Dead Load

Coping concrete	.15 × .362	× 2400 = 130	× .425 =	55.2
Slab and pavement	0.35	× 520 = 182	× .175 =	31.8
Handrail say	1.0	× 80 = 80	× .50 =	40.0
misc. say		8	× .45 =	3.6
		400 kg		130.6	call this 130 kgm.

Live Load
Uniform load moment = $\frac{500 \times .35^2}{2}$ = 31
hor. thrust on handrail top 50 × 1.2 = 60
91 kgm.



End shear 500 × .35 = 175 kg.

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-ken.

Summary for moments and shears.

	moments	End shears.
Dead Load	130	400
Live Load	91	175
	221 kgm	575 kg

Steel area required $= \frac{221 \times 100}{1200 \times \frac{7}{8} \times 12.5} = 1.69$ cm² per meter strip of slab.

Use 12φ bars at 13 cm c.to c. = 8.70 cm²

unit shear $= \frac{575}{100 \times .878 \times 12.5} = 0.52$ kg/cm² ok.

Total perimeter of bars for bond.

main reinforcements $6.67 \times 3.77 = 25.2$

unit bond $= \frac{575}{25.2 \times .878 \times 12.5} = 2.1$ kg/cm² ok.

Design of Stringers S_1 and S_2. Span length 4.53 meters, spacing 1.7 meters.

Dead Load

floor slab and pavement $520 \times 1.7 = 885$

beam assumed 75

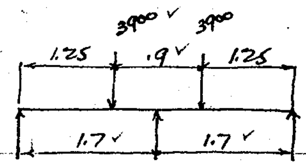
960 kg per lin meter.

Dead Load moment $= \frac{1}{8} \times 960 \times 4.53^2 = 2460$ kgm

End shear $= \frac{1}{2} \times 960 \times 4.53 = 2175$ kg

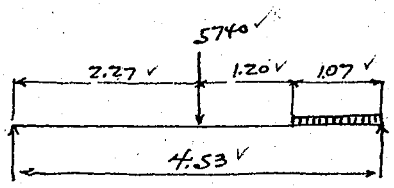
Live Load

motor truck loading rear wheel $2 \times 3900 \times \frac{1.25}{1.7} = 5740$ kg



Uniform live load $= 500 \times 1.7 = 850$ kg per lin meter

motor truck rear wheel $5740 \div 2 = 2870$



unif. load $\frac{850 \times 1.07^2}{2} \div 4.53 = 107$

2977 kg

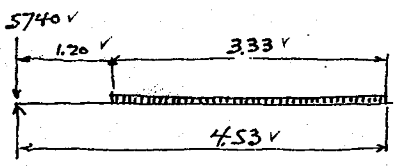
moment $2977 \times 2.27 = 6760$ kgm.

End shear

unif load $\frac{850 \times 3.33^2}{2 \times 4.53} = 1040$

rear wheel 5740

6780 kg



Summary of moment and shears.

	moments	End shears
Dead Load	2460	2175
Live Load	6760	6780
	9220 kgm	8955 kg

Section modulus required $= \frac{9220 \times 100}{1100} = 838$ cm³

use 1 I beam 350 × 150 × 9 @ 58.54 kg

Section modulus = 870.6 ok.

Design of End Stringer S3. span length 4.53 meters, spacing 1.7 meters.

Dead Load

Floor and pavement between $S_3 + S_2$ $520 \times .85 = 442$

Overhanging slab pav. coping + handrail 400

beam assumed 73 } 915

extra load due to overhanging moment $= 130 \div 1.7 = 77$

992 kg per lin meter

Dead Load moment $= \frac{1}{8} \times 992 \times 4.53^2 = 2545$ kgm

Dead Load shear $= \frac{1}{2} \times 992 \times 4.53 = 2245$ kg

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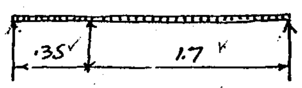
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-ken.

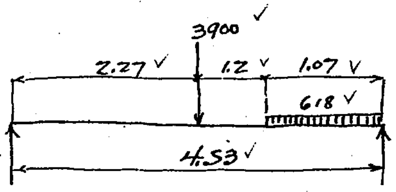
Live Load: One rear wheel directly on stringer assumed

Uniform live load

$\frac{500 \times 2.05^2}{2 \times 1.7} = 618$ kg per lin meter.



uniform load $\frac{618 \times 1.07^2}{2 \times 4.53} = 78$

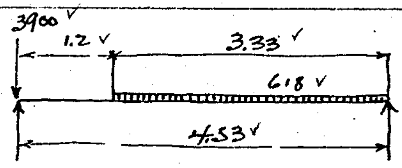


rear wheel $3900 \div 2 = \underline{1950}$

2028 kg

Moment $= 2028 \times 2.27 = 4,600$ kgm.

End shear



uniform load $\frac{618 \times 3.33^2}{2 \times 4.53} = 756$

rear wheel $= \underline{3900}$

4656 kg

Summary of moments and shears.

	moments	end shears
Dead Load	2545	2245
Live Load	4600	4656
	7145 kgm	6901 kg

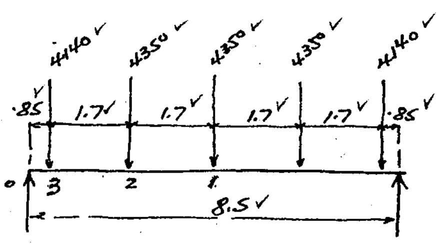
Section modulus required $= \frac{7145 \times 100}{1100} = 650$ cm³

Use 1 I-beam 350×150 @ 58.54 kg S.m. = 870.6 cm³

Unit shear $= \frac{6901}{.90 \times 35} = 219$ kg/cm² ok.

Design of Intermediate Floor Beams. Span length = 8.50 meters, spacing 4.53 meters.

Dead Load:— Stringer concentrations on floor beam.



Due to stringer S_1 or S_2 $2 \times 2175 = 4350$ kg

" " S_3 without cantilever effect $2 \times 2070 = 4140$ kg $\frac{915 \times 4.53}{2} = 2070$, p4.

Reaction or End shear

$4350 \times 1.5 = 6520$
$\underline{4140}$
10660 kg = End shear

moment at center, point 1.

$10660 \times 4.25 = 45300$
$4350 \times 1.70 = -7390$
$4140 \times 3.40 = -\underline{14060}$
23850 kgm.

moment at point 2.

$10660 \times 2.55 = 27200$
$4140 \times 1.70 = -\underline{7040}$
$20,160$ kgm.

Shear at point 2.

$4350 \times 1.5 = 6520$ kg

Shear at center $4350 \times .5 = 2175$ kg

Weight of Floor beam assumed 195 kg per lin meter.

moment at center, point 1 $= \frac{1}{8} \times 195 \times 8.5^2 = 1760$ kgm

End shear $= \frac{1}{2} \times 195 \times 8.5 = 830$ kg

moment at point 2

$830 \times 2.55 = 2118$
$\frac{195 \times 2.55^2}{2} = -\underline{634}$
1484 kgm

moment at point 3
$10660 \times .85 = 9060$ kgm
$830 \times .85 = 705$
$\frac{195 \times .85^2}{2} = -\underline{70}$
635
9695 kgm

Shear at point 2 Reaction 830
$195 \times 2.55 = -\underline{497}$
333 kg

Summary of Dead Load moments and Shears

	moments at End	point 2	point 1	Shears at End	point 2	point 1	moment at point 3
Stringer concentration	0	20160	23850	10660	6520	2175	9060
weight of floor beam	0	1484	1760	830	333	0	635
	0	21644 kgm	25610 kgm	11490 kg	6853 kg	2175 kg	9695 kgm

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CALCULATIONS FOR

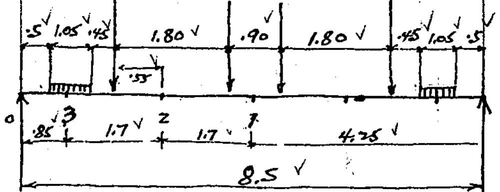
Design of Kiso-gawa Bashi for Aichi-ken.

Live load :— motor truck loading rear wheel concentration 3000 kg

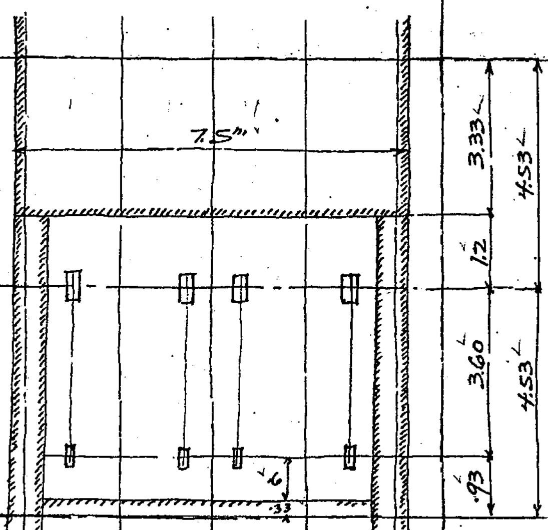
Impact $\frac{20}{60+8.5}$ = 29.2% say 880 → 3880 kg

Front wheel concentration with impact say 3880 ÷ 3 = 1290 kg

Uniform live load 500 kg per square meter.



Rear wheels directly on floor beam.
Front wheels of motor truck and uniform load through stringers concentrated to floor beam assumed.



Reaction on stringer due to front wheels of motor truck :

On stringer 1. $1290 \times \frac{1.25}{1.7} \times 2$ = 1900 kg

on stringer 2. $1290 \times \frac{.45}{1.7}$ = 330
$1290 \times \frac{1.15}{1.7}$ = 870
1200 kg

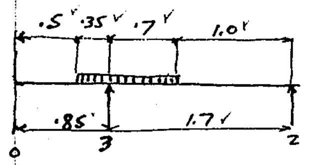
On stringer 3. $1290 \times \frac{.55}{1.7}$ = 420 kg

Uniform live load on side of motor truck

load on stringer 3 500 × .35 = 175

$\frac{500 \times .7 \times 1.35}{1.7}$ = 278

453 kg per lin meter

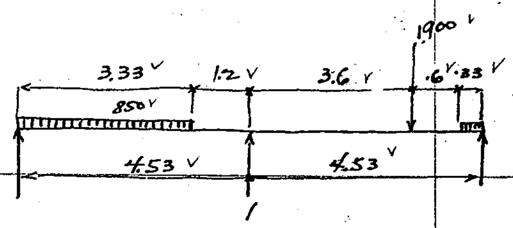


load on stringer 2. $\frac{500 \times .7^2}{2 \times 1.7}$ = 72 kg " "

Uniform load on front and rear of motor truck

load on stringer 2 + 1 500 × 1.7 = 850 kg " " 850 − 72 = 778

" " " 3 500 × 1.2 = 600 kg " " 600 − 453 = 147



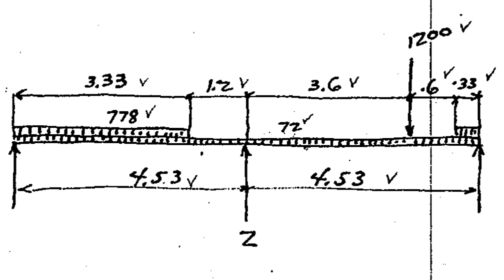
Stringer concentration on floor beam at 1.

front wheel $\frac{1900 \times .93}{4.53}$ = 390

Unif. load $\frac{850 \times .33^2}{2 \times 4.53}$ = 10

" $\frac{850 \times 3.33^2}{2 \times 4.53}$ = 1040

1440 kg at 1.



Stringer concentration on floor beam at 2.

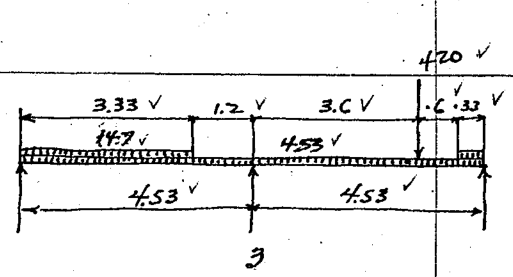
front wheel $\frac{1200 \times .93}{4.53}$ = 246

unif. load. $\frac{778 \times .33^2}{2 \times 4.53}$ = 9

" $\frac{778 \times 3.33^2}{2 \times 4.53}$ = 955

" 72 × 4.53 = 325

1535 kg at 2.



Stringer concentration on floor beam at 3

front wheel $\frac{420 \times .93}{4.53}$ = 86

unif load $\frac{147 \times .33^2}{2 \times 4.53}$ = 2

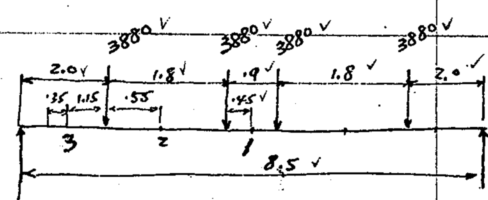
" $\frac{147 \times 3.33^2}{2 \times 4.53}$ = 184

" 453 × 4.53 = 2054

2326 kg at 3

Moments and shears due to Rear wheels.

Reaction = 3880 × 2 = 7760 kg



moment at center, point 1

7760 × 4.25 = 33,000

3880 × .45 = − 1,745

3880 × 2.25 = − 8,730

22,525 kgm.

End shear

Shift all concentrations by 1.05 m to leftward.

End shear = 4 × 3880 ÷ 2 = 7760

$\frac{4 \times 3880 \times 1.05}{8.5}$ = 1920

9680 kg

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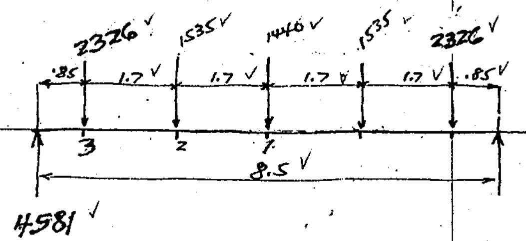
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-ken.

moment at point 2:
7760 × 2.55 = 19780
3880 × .55 = − 2135
17645 kgm

moment at point 3
7760 × .85 = 6600 kgm

Moments and Shears due to Front wheel and uniform load.



Reaction = 4581 kg

moment at center, point 1
4581 × 4.25 = 19470
1535 × 1.70 = − 2610
2326 × 3.40 = − 7910
8950 kgm at 1.

End shear Shift all concentration (approx) by 1.05 m leftward

4581
2 × 4581 × 1.05 ÷ 8.5 = 1132
End shear = 5713 kg

Moment at point 2.
4581 × 2.55 = 11690
2326 × 1.70 = − 3950
7740 kgm at 2

moment at point 3.
4581 × .85 = 3890 kgm

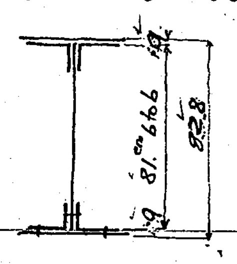
Summary of Live Load moments and shears.

	moments at End	point 2	point 1	point 3	End shear
Rear wheel concentrations	0	17645	22525	6600	9680
Front wheel + unif. load	0	7740	8950	3890	5713
	0	25385 kgm	31475 kgm	10490 kgm	15393 kg

Summary of Dead Load and Live Load moments and shears.

	moments at End	point 2	point 1	point 3	End shear
Dead Load	0	21644	25610	9695	11490
Live Load	0	25385	31475	10490	15393
Total in round numbers	0	47029 kgm	57085 kgm	20185 kgm	26883 kg

Assumed section



Try web plate 800 × 9, 1/8 web area = 9.0 cm², back to back of Ls = 81.0 cm

flange stress = 57085 / .786 = 72700 kg

flange area required = 72700 / 1200 = 60.5 cm² net
1/8 web area = − 9.0
51.5 cm² net.

Use.
2Ls 125 × 90 × 10 = 41.0 − 8.8 = 32.2
1Pl. 280 × 9 = 25.2 − 4.0 = 21.2
66.2 cm² gr. 53.4 cm² net.

19φ rivets 4 rivets
2 rivets

41.0 × 3.12 = 128.0
25.2 × .45 = 11.4
66.2 × 2.1 = 139.4

eff. depth = 82.8 − 4.2 = 78.6 cm

Unit shear = 26883 / 72 = 373 kg/cm² ok.

Top flange area req'd = 72700 / 1100 = 66.1
− 9.0
57.1 cm² gr. ok.

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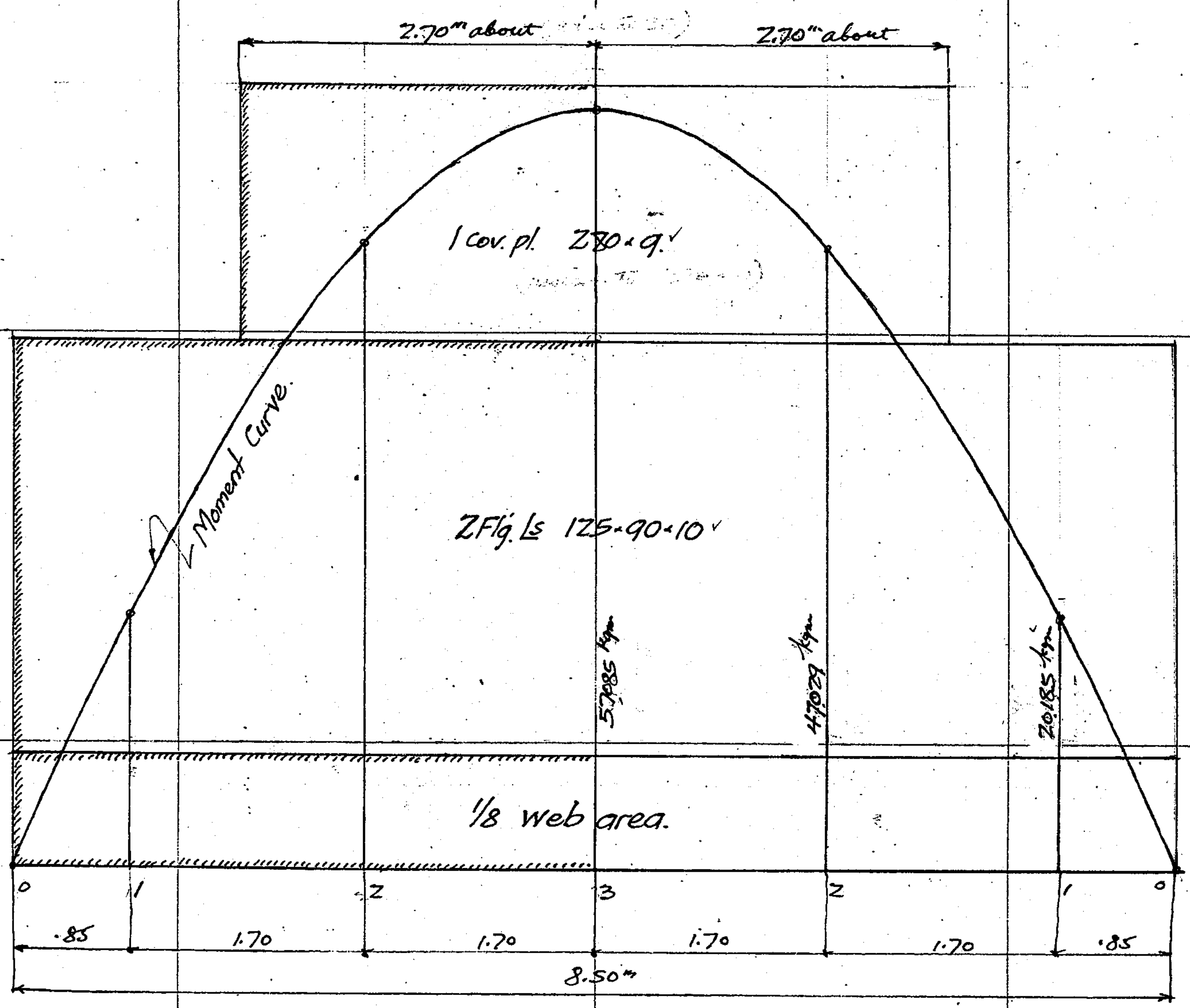
CALCULATIONS FOR

Design of Kiso-Gawa Bashi for Aichi-Ken.

Bending Moment diagram of Intermediate floor beam.



Scale of space 1:50
Scale of moment $\frac{1}{50}$ meter = 10,000 kgm.

Approximate weight of Intermediate floor beam.

1 web pl.	1 Pl.	800×9	@ 56.52 kg	× 8.07 m	=	456.
Flange	4 Ls	125×90×10	@ 16.09	× 8.07	=	519.
〃	2 Pls.	280×9	@ 19.78	× 5.43	=	214
End stiffs.	4 Ls	150×100×9	@ 17.02	× 0.80	=	55
fills	4 Pls	220×10	@ 17.27	× 0.625	=	43
Stringer conn.	10 Ls	100×75×10	@ 12.95	× 0.79	=	102
fills	10 Pls	75×10	@ 5.89	× 0.626	=	37
Int. stiffs.	8 Ls	75×75×9	@ 9.96	× 0.81	=	64
						1490

Rivet heads and variations say 3½ % — 55

1,545 kg

weight per lin meter of beam = 1545 ÷ 8.1 = 191 kg/m.

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CALCULATIONS FOR

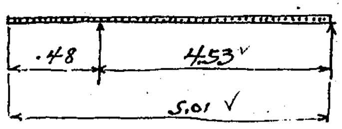
Design of Kiso-gawa Bashi for Aichi-ken.

Design of End floor Beam   Span length 8.50 meters. spacing 4.53 meters.

Dead Load :- Stringer concentration on floor beam.

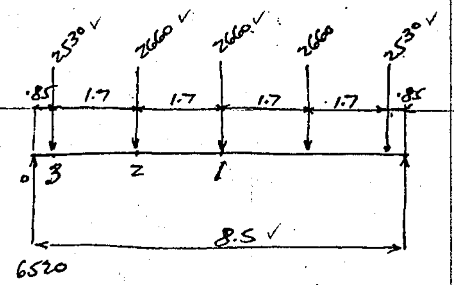
S_1 and S_2. Dead Load on Stringer = 960 kg per lin meter including wt. of beam.

$\frac{960 \times 5.01^2}{2 \times 4.53} = 2660$ kg.



S_3. Dead load on stringer = 915 kg

$\frac{915 \times 5.01^2}{2 \times 4.53} = 2530$ kg   overhanging effect neglected.



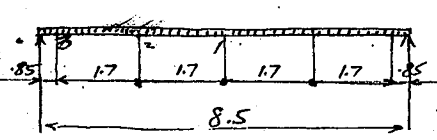
Reaction   2660 × 1.5 = 3990
2530
6520 kg = End shear.

moment and shear at point 3
moment. 6520 × .85 = 5540 kgm at 3
Shear = 6520 kg

Moment and Shear at point 2.
moment 6520 × 2.55 = 16620
2530 × 1.7 = −4300
3990
12320 kgm. at 2
Shear = 3990 kg

moment and shear at point 1 or center.
moment 6520 × 4.25 = 27700
2530 × 3.40 = −8600
2660 × 1.70 = −4520
14580 kgm at 1.
Shear = 1,330 kg

Moments & shears due to weight of floor beam. wt. = 175 kg/m assumed.
End shear = 175 × 4.25 = 744 kg
moment at point 3



$\frac{175}{2} \times .85 \times 7.65 = 570$ kgm at 3.
Shear 175 × 3.4 = 595 kg

moment and shear at point 2.
moment $\frac{175}{2} \times 2.55 \times 5.95 = 1330$ kgm at 2
Shear 175 × 1.7 = 300 kg

moments and shear at center point 3
moment $175 \times \frac{8.5^2}{8} = 1580$ kgm at 1
Shear = 0 kg

Summary for Moments and shears due to Dead Load.

	Moments at End	point 1	point 2	point 3	Shears at End	point 1	point 2	point 3
Stringer concentration	0	5540	12320	14580	6520	6520	3990	1330
weight of floor beam	0	570	1330	1580	744	595	300	0
	0	6110 kgm	13650 kgm	16160 kgm	7264 kg	7115 kg	4290 kg	1330 kg

Live Load :- motor truck rear wheel concentration with impact = 3880 kg
" " front " " " = 1290 kg

Uniform live load 500 kg per square meter.

Rear wheels of motor truck and uniform load through stringers concentrates to floor beam assumed.

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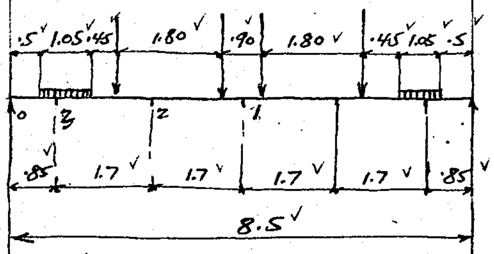
CALCULATIONS FOR

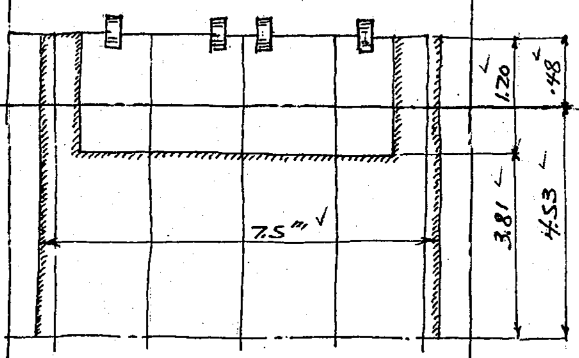
Design of Kiso-gawa Bashi for Aichi-ken.



Stringer concentrations on floor beam.
Reaction on stringers due to rear wheel of motor truck

On stringer at 1	1900 × 3 =	5700 kg	page 6.
on " 2	1200 × 3 =	3600 "	
on " 3	420 × 3 =	1260 kg	

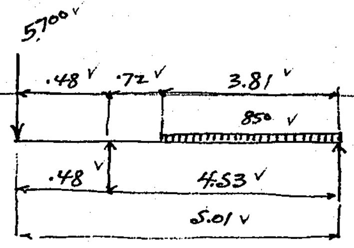
For uniform live load same as for intermediate floor beam.



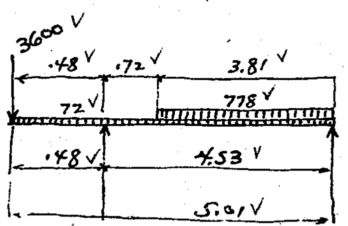
Load on stringer at point 3.
Side of motor truck 453 kg/lin m diff. = 147 kg/lin m.
front + rear " 600 "

Load on stringer at point 2.
Side of motor truck 72 kg/lin m diff. = 778 kg/lin m
front and rear " 850

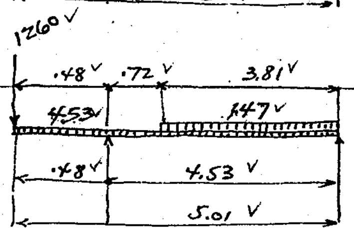
Load on stringer at center
Side of motor truck 0
front + rear " 850 kg/lin m



Stringer concentration on floor-beam at point 1.
Rear wheel $5700 \times \frac{5.01}{4.53} =$ 6300 kg
Unif. load. $\frac{850 \times 3.81^2}{2 \times 4.53} =$ 1360
7,660 kg at 1.

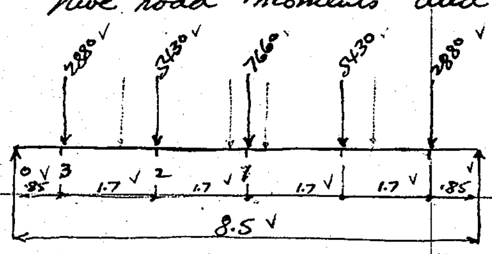


Stringer concentration on floor beam at point 2.
Rear wheel $3600 \times \frac{5.01}{4.53} =$ 3980
Unif load $\frac{778 \times 3.81^2}{2 \times 4.53} =$ 1,250
" $\frac{72 \times 5.01^2}{2 \times 4.53} =$ 200
5,430 kg at 2.



Stringer concentration on floor-beam at point 3
Rear wheel $1260 \times \frac{5.01}{4.53} =$ 1395
Unif load. $\frac{147 \times 3.81^2}{2 \times 4.53} =$ 235
" $\frac{453 \times 5.01^2}{2 \times 4.53} =$ 1250
2,880 kg. at 3

Live Load moments and shears. Reaction 7660 ÷ 2 = 3830
5430
2880
12,140 kg.



12140

End shear.
Shift all concentration by 1.05m leftward
12140
$12140 \times 2 \times 1.65 \div 8.8 =$ 3000
15140 kg

moment at point 3 12140 × .85 = 10,310 kgm at 3.
Shear " 12140 kg

moment at point 2. 12140 × 2.55 = 30950
2880 × 1.70 = − 4890
26060 kgm at 2
Shear " 12140 − 2880 = 9260 kg "

moment at center 12140 × 4.25 = 51550
2880 × 3.40 = − 9790
5430 × 1.70 = − 9230
32,530 kgm at 1.
Shear " 7660 ÷ 2 = 3830 kg

Summary of Dead Load and Live Load moments and shears.

	Moments at Point 0	Point 3	Point 2	Center	Shears at End	Point 1	Point 2	Center
Dead Load	0	6,110	13650	16160	7264	7115	~~4290~~	1330
Live Load	0	10310	26060	32,530	15,140	12140	9260	3830
Total in round no.	0	16,420 kgm	39,710 kgm	48,690 kgm	22,400 kg	19,260 kg	13,550 kg	5160 kg

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CALCULATIONS FOR

Design of Kisogawa Bashi for Aichi-ken.

36.0 × 3.36 = 121.0
21.6 × 4.5 = 9.7
57.6 × 2.3 = 130.7
eff. depth = 82.8 − 4.6 = 78.2 cm

Try web plate 800 × 9, 1/8 web area = 9.0 cm², back to back of Ls = 81.0 cm

flange stress = 48690 / .782 = 62300 kg

Flange area required = 62300 / 1200 = 51.9

1/8 web area = −9.0

42.9 cm² net.

Use 2Ls 100 × 90 × 10 = 36.0 − 8.8 = 27.2

1Pl. 240 × 9 = 21.6 − 4.0 = 17.6

57.6 cm² gr. 44.8 cm² net.

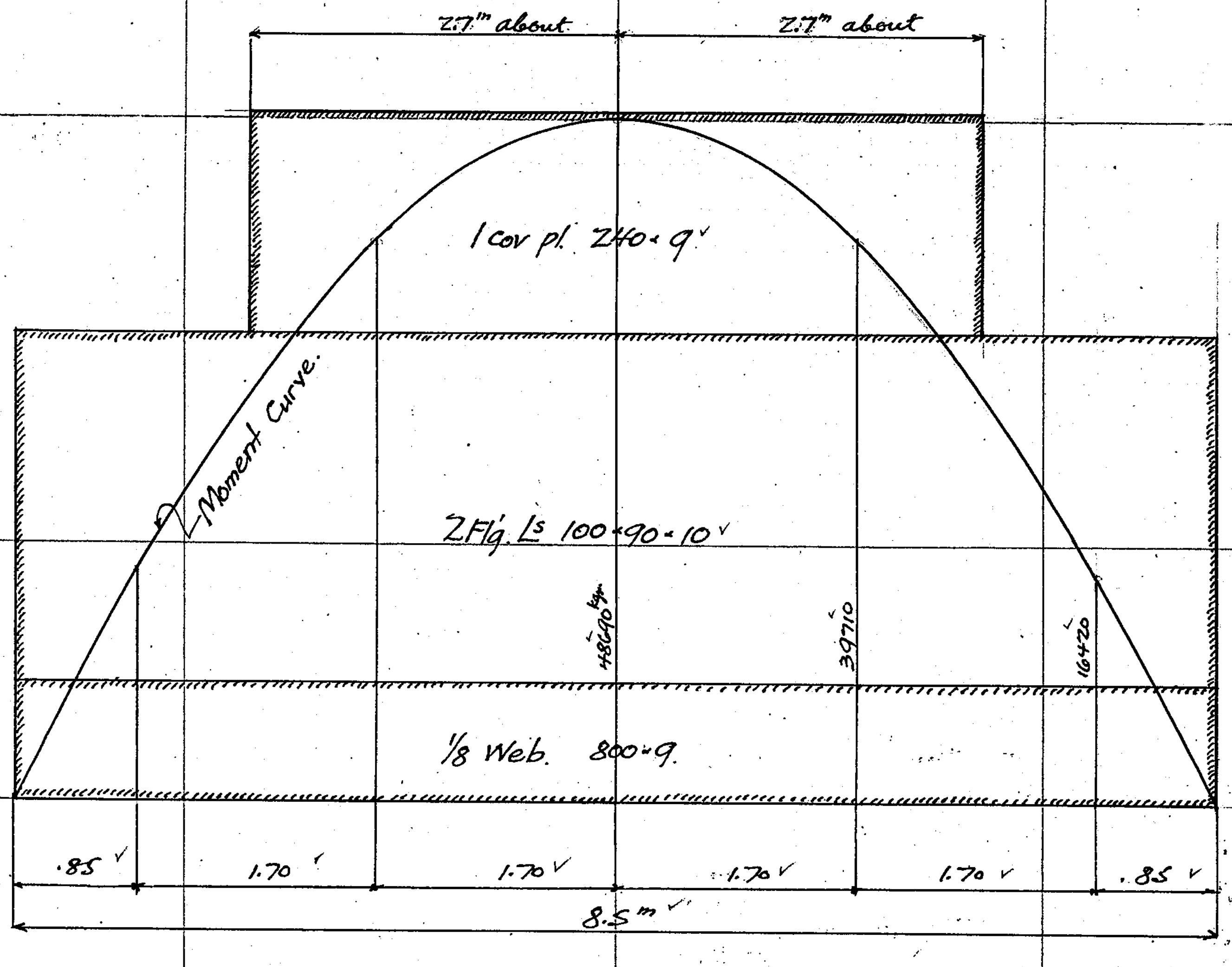
Allowable stress for top flange
= 1200 (1 − .012 × 1.7/.24)
= 1100

Gross area required = 62300 / 1100 = 56.6

1/8 web area = −9.0

47.6 cm² gross. ok.

Unit shear = 22400 / 72 = 310 kg/cm² ok.



Approximate weight of End Floor Beam.

1 web pl.	1Pl. 800 × 9	@ 56.52 kg	× 8.10 m	=	458
flange	4Ls 100 × 90 × 10	@ 14.13	× 8.10	=	458
"	2Pls 240 × 9	@ 16.96	× 5.40	=	183
End stiffs.	4Ls 150 × 100 × 9	@ 17.02	× 0.79	=	54
fills	4Pls 220 × 10	@ 17.27	× 0.625	=	43
String conn.	10Ls 100 × 75 × 10	@ 12.95	× 0.79	=	102
fills	10Pls 75 × 10	@ 5.89	× 0.625	=	37
int. stiffs.	16Ls 75 × 75 × 9	@ 9.96	× 0.81	=	129
					1464

Rivets heads and variations say 3½ % = 51

1515 kg

weight per lin. meter of beam = 1515 ÷ 8.1 = 187 kg/m.

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CALCULATIONS FOR

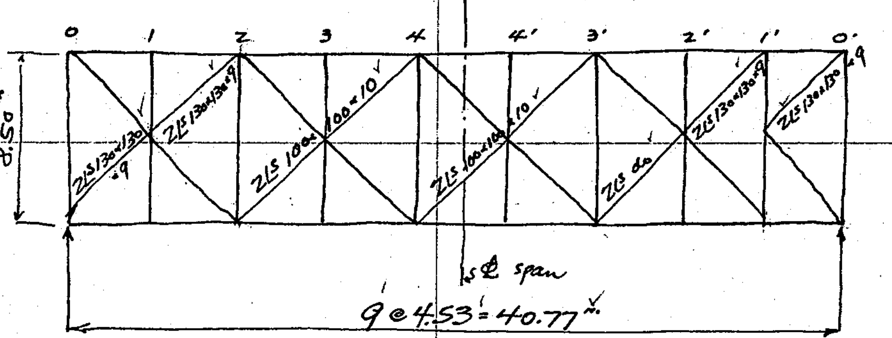
Design of Kiso-gawa Bashi for Aichi-Ken.

Design of Bottom Lateral Bracings. Seismic force assumed k = 0.3
Dead Load. metal assumed

Stringers	5 @ 62 =	310		
Floor beams	1545 ÷ 4.53 =	341		
lateral bracing say		100		
truss assumed	2 @ 920 =	1840		
			2591	
Floor load	520 × 7.5 =	3900		
Copings	2 @ 173 =	346		width of coping revised to 20 cm, wt = 173 kg/m
Handrails	2 @ 80 =	160		
			4406	
			6997 kg per lin m. of span	

Call this 7,000

Panel concentration = 7000 × 4.53 = 31700 kg
Seismic force on panel pt. = 31700 × .3 = 9500 kg



Diagonal length
$4.53^2 = 20.52$
$4.25^2 = 18.06$
38.58

$\sqrt{38.58} = 6.21$ m

Coefficient $= \frac{6.21}{4.25} = 1.46$

unit stress for tension 1200 × 1.6 = 1920 kg/cm²
field rivets 22 mmφ 2851 × 1.6 = 4560 single shear.

For tension only

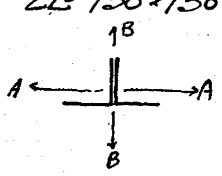
		coeff.	stress	Section required		Rivet reqd.	
0–1	38,000 ×	1.46 =	55500 ÷ 1920 =	28.9 cm² net	2 L's 130×130×9 = 45.18 − 9.0 = 36.18	12.1	14
1–2	28,500		41600	21.7	2 L's do	9.1	10
2–3	19,000		27750	14.45	2 L's 100×100×10 = 38.00 − 10.0 = 28.00	6.1	8
3–4	9,500		13870	7.2	2 L's do	3.0	6
4–4'	0		0	0	2 L's do	0	6

For tension and Compression

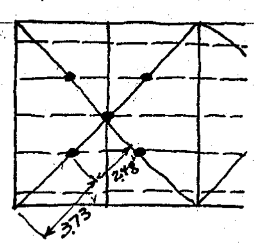
				section required				use
0–1	27750	T or C	÷ 822 =	33.7 cm² gross	< 45.18	} assumed section ok.	6.1	10
1–2	20,800		822 =	25.3	< "		4.6	10
2–3	13880		416 =	33.4	< 38.0		3.0	6
3–4	6940		416 =	16.7	< "		1.5	6
4–4'	0		416 =	0	< "		0	6

Section for lower lateral bracings.

2 L's 130 × 130 × 9 = 45.18 cm²



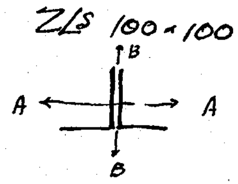
A–A axis Radius of gyration r = 3.96 cm, l = 3.73 m
B–B axis Radius of gyration r =
2 L's 130×130×9 = 45.18 × 3.51^2 + 710 = 1266
$r = \sqrt{\frac{1266}{45.18}} = 5.20$ l = 6.21 m



A-A axis allowable unit compression = $1500\left(1 - 0.0055 \times \frac{373}{3.96}\right) = 723$ kg/cm²
BB axis allowable unit compression = $1500\left(1 - 0.0055 \times \frac{621}{5.2}\right) = 514$ kg/cm²

Allowable seismic unit compression = 514 × 1.6 = 822 kg/cm²

2 L's 100 × 100 × 10 = 38.00 cm²



A-A axis Radius of gyration r = 3.03, l = 3.73 m
B-B axis
2 L's 100 × 100 × 10 = 38.0 × 2.81^2 + 349 = 649
$r = \sqrt{\frac{649}{38}} = 4.13$ cm l = 6.21 m

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-ken.

A-A axis Allowable unit compression = $1500(1-0.0055 \cdot \frac{373}{303})$ = 483 kg/cm²
B-B axis Allowable unit compression = $1500(1-0.0055 \cdot \frac{621}{4.13})$ = 260 kg/cm²

For seismic unit compression = 260 × 1.6 = 416. kg/cm²

Wind Stresses on Lower Lateral Bracings.
wind load 45#/sq. ft or 220 kg/m² assumed.

Exposed area Lower Deck
bottom to crown of roadway = 1.10
Curb and handrail assumed = .50
verticals, diagonals = .40
2.00
Leeward exposed area assumed 1.00
3.00

Upper chord. = .50
verticals & diagonals = .40
0.90
Leeward exposed area assumed 0.90
1.80

total = 4.80 sq. meter
wind load = 4.80 @ 220 = 1055 kg per lin m
panel concentration = 1055 × 4.53 = 4780 kg moving load assumed
unit stress 1200 kg/cm² 22 mm φ field rivets 2851 kg/single shear.

	Shear		Stress	Section reqd.		No. of Rivets	use
0-1	19100	× 1.46 =	27,880 ÷ 1200 =	23.2 cm² net	2Ls 130×130×9 = 36.18 cm² net.	9.8	10
1-2	14,870		21,700	18.1	do	7.6	10
2-3	11,150		16,280	13.6	2Ls 100×100×10 = 28.00 net	5.7	6
3-4	7,970		11,640	9.7	do	4.1	6
4-4'	5,310		7,750	6.5	do.	2.7	6

	Tension and Compression				Gross section used.	
0-1	13,940	÷	514	27.1 cm² gross	45.18 cm²	ok.
1-2	10,850		514	21.1	45.18	"
2-3	8,140		260	31.3	38.00	"
3-4	5,820		260	22.4	38.00	"
4-4'	3,875		260	14.9	38.00	"

Chord stress due to seismic forces.
moment at panel pt. 4.
38000 × 18.12 = 689000
9500 × 4.53 × 6 = 258000
431,000 kgm.
stress 4-3-2 = $\frac{431000}{8.5}$ = 50700 kg T or C

Chord stress due to wind load, moving load.
4780 × 4 = 19120 kg reaction
moment at panel pt. 4.
19120 × 18.12 = 346,000
4780 × 4.53 × 6 = 130,000
216,000 kgm
stress 4-3-2 = $\frac{216000}{8.5}$ = 25400 kg T or C

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken.

Approximate weight of Lateral Bracings.

16 L's	130×130×9 @	17.73 × 5.66 =	1,589	
20 L's	100×100×10 @	14.91 × 5.60 =	1,670	note:-
~~16 L's~~	~~100×7~~	~~14.1~~ × ~~5.8~~	~~1,310~~	Conn. plates to chord not included.
Center connections say	5 @ 85	=	420	← hangers included.
Rivet heads &c say			41	
			3720 kg	

wt. per lin meter of span = 3720 ÷ 40.77 = 91 kg/m

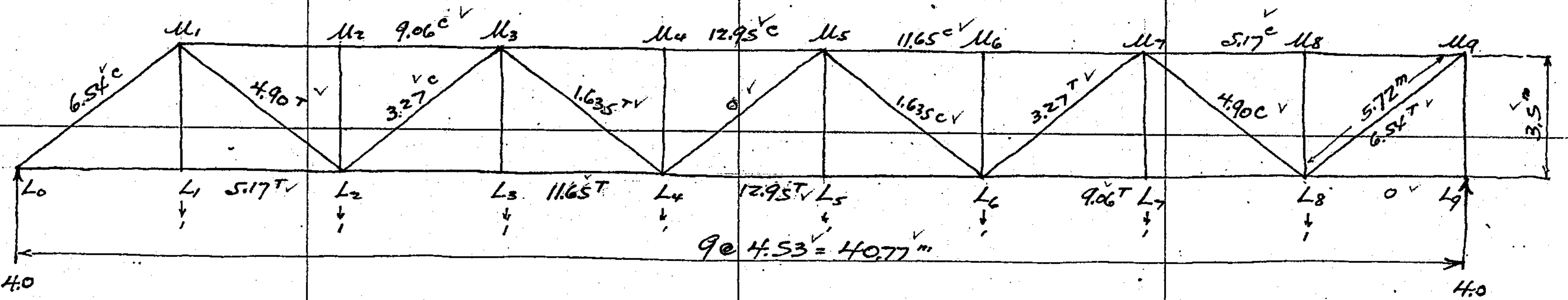
Design of Truss.

Dead load on Truss

Stringers	5 @ 62 =	310
Floor beam	1545 ÷ 4.53 =	341
Lateral bracings		91
truss assumed	2 @ 940 =	1880 (changing assumption of wt.)
		2622
Floor load	520 × 7.5 =	3900
Copings	2 @ 173 =	346
Handrails	2 @ 80 =	160
		4406
		7028 kg per meter of span

Dead load concentration on panel = $\frac{7028}{2} \times 4.53 = 15900$ kg.

General dimensions of truss is as shown on sketch below.



Diagonal length

$4.53^2 = 20.51$
$3.50^2 = 12.25$
32.76, $\sqrt{32.76} = 5.72^m$

$\frac{5.72}{3.5} = 1.635$ — coefficient.

Dead load stresses.

members.	stress due to unity	panel load	D.L. stress.
U1 – U3	9.06 c	× 15900	= 144,000 kg c
U3 – U5	12.95 c	"	= 206,000 c
U5 – U7	11.65 c	"	= 185,200 c
U7 – U9	5.17 c	"	= 82,200 c
L0 – L2	5.17 T	× 15900	= 82,200 T
L2 – L4	11.65 T	"	= 185,200 T
L4 – L6	12.95 T	"	= 206,000 T
L6 – L8	9.06 T	"	= 144,000 T
L8 – L9	0	"	= 0
L0 – U1	6.54 c	× 15900	= 104,000 c
U1 – L2	4.90 T	"	= 77,900 T
L2 – U3	3.27 c	"	= 52,000 c
U3 – L4	1.635 T	"	= 26,000 T
L4 – U5	0	"	= 0 c
U5 – L6	1.635 c	"	= 26,000 c
L6 – U7	3.27 T	"	= 52,000 T
U7 – L8	4.90 c	"	= 77,900 c
L8 – U9	6.54 T	"	= 104,000 T

Vertical stresses.

U1 – L1	1.0 × 15900	=	15900 kg T
U3 – L3		=	15900 "
U5 – L5		=	15900 "
U7 – L7		=	15900 "
U2 – L2	1.0 × 2010	=	2010 kg C
U4 – L4		=	2,010 "
U6 – L6		=	2,010 "
U8 – L8		=	2,010 "

$\frac{885}{2} \times 4.53 = 2010$ panel load on U2, U4 &c

U9 – L9 4.0 × 15900 = 63600
2010
65,610 kg C

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CALCULATIONS FOR

Design of Kisogawa Bashi for Aichi-Ken.

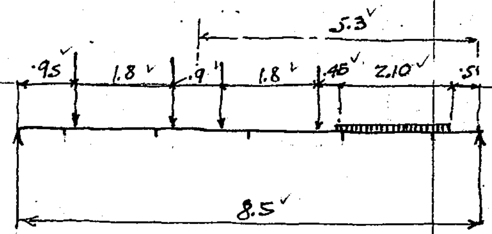
Live Load Stresses of truss.

Uniform live load w = 100,000 / (170+40.77) = 475 kg/m²

motor truck rear wheel concentration = 3000
impact = 20 / (60+40.77) = 19.85% 595
3595 kg

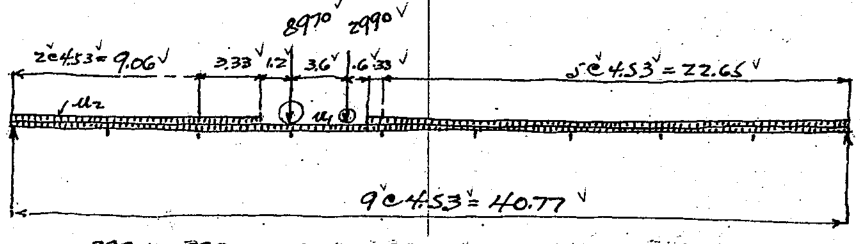
front wheel = 3595 ÷ 3 = 1200 kg

max. reaction on truss



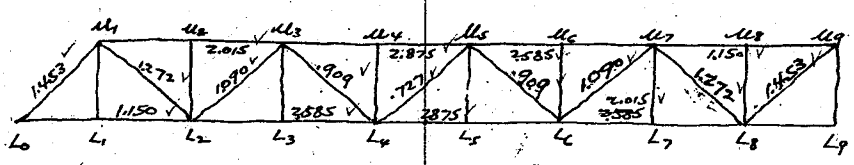
motor truck rear wheel. 3595 × 4 × 5.3 ÷ 8.5 = 8970 kg
" " front " 8970 ÷ 3 = 2990 kg

Uniform load.
Side of motor truck 475 × 2.10 × 1.55 ÷ 8.5 = 182 kg/lin meter = u_1
front and rear " 475 × 7.5 ÷ 2 = 1780 "
diff. 1780 − 182 = 1598 = u_2



u_1	823	823	823	823	823	823	823	823
u_2	7240	6980	1960		7240	7240	7240	7240
"			19	4128				
front wheel.			614	2376				
rear wheel			8970					
	8063	7803	12386	7327	8063	8063	8063	8063
assumed loading	8060	8060	8060 say 4300	8060	8060	8060	8060	8060

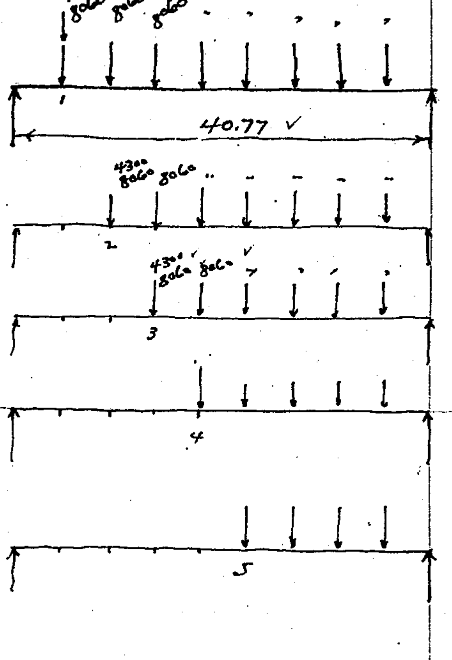
max. stresses due to single unit load.



Chord stresses due to Live Load.

members	stress due to unity	panel load	stresses	single load 4300	Total stresses
U_1-U_3	9.06 C	× 8060	= 73000	8660	81,660 kg C
U_3-U_5	12.95 C		= 104400	12350	116750 C
U_5-U_7	11.65 C		= 93800	11120	104920 C
U_7-U_9	5.17 C		= 41700	4950	46650 C
L_0-L_2	5.17 T	× 8060	= 41700	4950	46650 T
L_2-L_4	11.65 T		= 93800	11120	104920 T
L_4-L_6	12.95 T		= 104400	12350	116750 T
L_6-L_8	9.06 T		= 73000	8660	81660 T
L_8-L_9	0		= 0	0	0

Diagonal stresses



L_0-U_1 Reaction 8060 × 4 = 32240
4300 × 8/9 = 3825
36065 kg × 1.635 = 58900 kg C

U_1-L_2 Reaction 8060 × 28/9 = 25060
4300 × 7/9 = 3345
28405 × 1.635 = 46450 kg T

L_8-U_9 = 58900 kg T

L_8-U_7 = 46450 kg C

L_2-U_3 8060 × 21/9 = 18800
4300 × 6/9 = 2865
21665 × 1.636 = 35400 kg C

L_6-U_7 = 35400 kg T

U_3-L_4 8060 × 15/9 = 13445
4300 × 5/9 = 2390
15835 × 1.635 = 25900 kg T

U_5-L_6 = 25900 kg C

L_4-U_5 8060 × 10/9 = 8950
4300 × 4/9 = 1910
10860 × 1.635 = 17750 kg C or T

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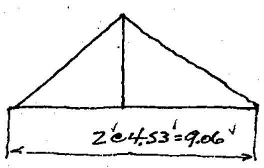
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken.

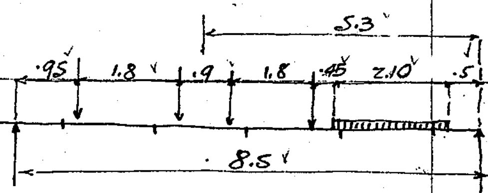
Live Load stress on hanger. Uniform load = $\frac{100000}{170+9.06}$ = 559 kg/m² use 500 kg/m²



motor truck rear wheel concentration = 3000
Impact $\frac{20}{60+9.06}$ = 29.0% 870
3870 kg

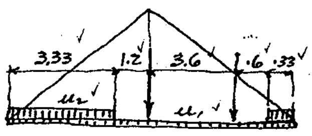
front wheel concentration with impact $\frac{3870}{3}$ = 1290 kg

Max. reaction on panel point.



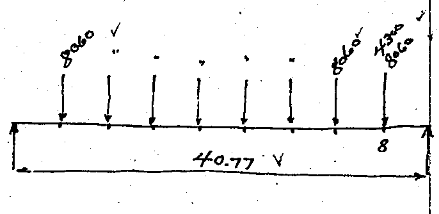
motor truck rear wheel 3870 × 4 × 5.3 ÷ 8.5 = 9650 kg
" " front 9650 ÷ 3 = 3215

Uniform load.
Side of truck 500 × 2.10 × 1.55 ÷ 8.5 = 190 = u_1
front and rear of truck 500 × 7.5 ÷ 2 = 1875
1685 = u_2



Panel load.
unif. load u_1 190 × 4.53 = 860
" " u_2 $\frac{1685 \times 3.33^2}{2 \times 4.53}$ = 2060
" " " $\frac{1685 \times .33^2}{2 \times 4.53}$ = 20
front wheel 3215 × $\frac{.93}{4.53}$ = 660
rear wheel = 9650
13250 kg T

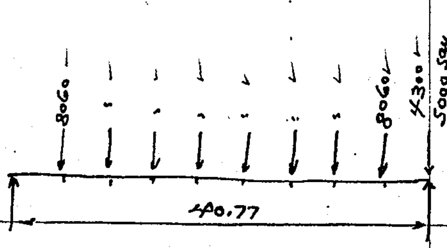
Live Load stress on Vertical U_9-L_9.



8060 × 4 = 32240
4300 × $\frac{8}{9}$ = 3820
36060 kg C

Max. Load on shoe.
Dead Load 4.5 @ 15900 = 71500 kg
Shoes etc say 1000
72500 kg

Live Load



40 @ 8060 = 32240
4300
5000
41540
call this 41500
Total Load on shoe = 114000 kg on one shoe.

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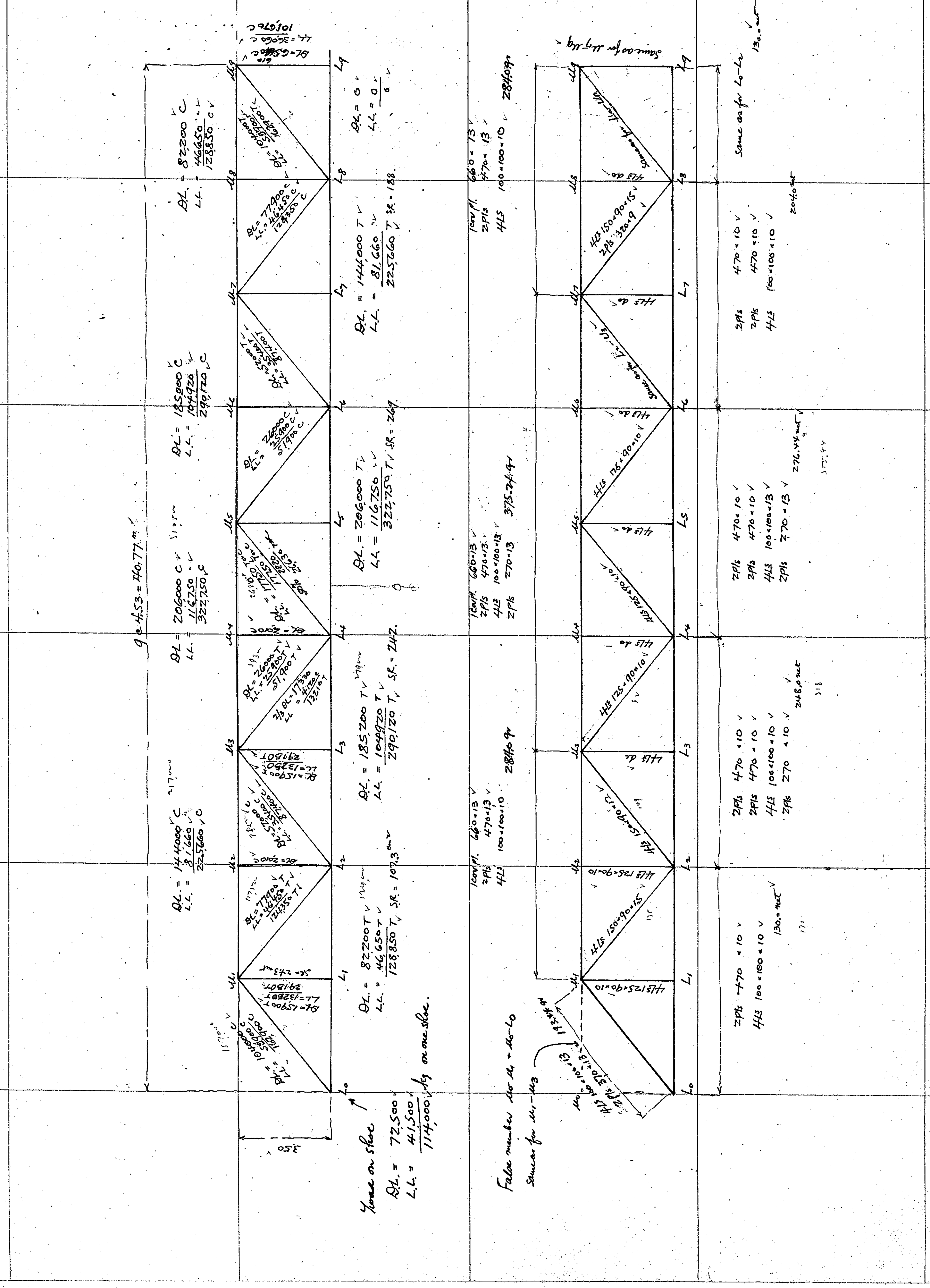
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken.
Stress Diagrams.



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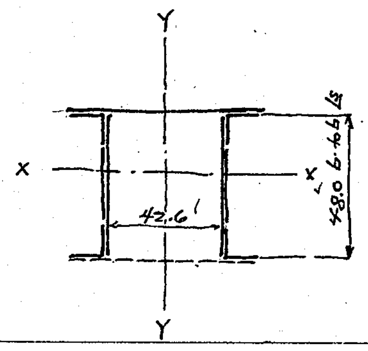
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi Ken.

Sections of Truss members.

Chord members. $U_3 - U_5$ Stress = 322,750 kg C S.R. = 322.75 cm² gross.

1 cov. pl.	660 × 13	=	85.8
2 Pls	470 × 13	=	122.2
4 Ls	100 × 100 × 13	=	97.24
2 Pls	270 × 13	=	70.2
			375.44 cm² gross.



moment of inertia about Y-Y axis.

1 cov. pl.	$66^3 \times 1.3 \div 12$	=	31,150
2 Pls	122.2×21.95^2	=	58800
2 Pls	70.2×23.25^2	=	37,850
4 Ls	$221 \times 4 + 97.24 \times 25.52^2$	=	64,180
			191,980 cm⁴

Radius of gyration

$r_y = \sqrt{\frac{191,980}{375.44}} = 22.6$ cm

$\frac{l}{r} = \frac{906}{22.6} = 40.1$

allowable unit compression = $1500(1 - .0055 \times 40.1) = 1170$ kg/cm² use 1000 kg/cm²

$U_5 - U_7$ Stress 290,120 kg C S.R. = 290.12 cm² gross.
use same section as for $U_3 - U_5$.

$U_1 - U_3$ Stress 225,660 kg C S.R. = 225.66 cm² gross.

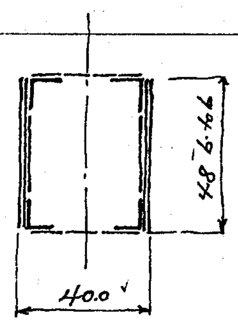
1 cov. pl	660 × 13	=	85.8
2 Pls	470 × 13	=	122.2
4 Ls	100 × 100 × 10	=	76.0
			284.0 cm² gross.

$U_7 - U_9$ Stress = 128,850 kg C S.R. = 128.850 cm² gross.
use same section as for $U_1 - U_3$.

Bottom chord members.

$L_4 - L_6$ Stress = 322,750 kg T. S.R. = 269 cm² net.

2 Pls	470 × 10	= 94.0	− 20.0	= 74.0
2 Pls	470 × 10	= 94.0	− 20.0	= 74.0
4 Ls	100 × 100 × 13	= 97.24	− 26.0	= 71.24
2 Pls	270 × 13	= 70.20	− 13.0	= 57.20
		355.44 cm² gr		276.44 cm² net.



$L_2 - L_4$ Stress = 290,120 kg T. S.R. = 242 cm² net

2 Pls	470 × 10	= 94.0	− 20.0	= 74.0
2 Pls	470 × 10	= 94.0	− 20.0	= 74.0
4 Ls	100 × 100 × 10	= 76.0	− 20.0	= 56.0
2 Pls	270 × 10	= 54.0	− 10.0	= 44.0
		318.0 cm² gr		248.0 cm² net

$L_6 - L_8$ Stress = 225,660 kg T S.R. = 188 cm² net

2 Pls	470 × 10	= 94.0	− 20	= 74.0
2 Pls	470 × 10	= 94.0	− 20	= 74.0
4 Ls	100 × 100 × 10	= 76.0	− 20	= 56.0
		264.0 cm² gr		204.0 cm² net

$L_0 - L_2$ Stress = 128,850 kg T S.R. = 107.3 cm² net

2 Pls	470 × 10	= 94.0	− 20	= 74.0
4 Ls	100 × 100 × 10	= 76.0	− 20	= 56.0
		170.0 cm² gr		130.0 cm² net

$L_8 - L_9$ Stress none
use same section as for $L_0 - L_2$.

$L_0 - U_1$ Stress = 162,900 kg C S.R. = 162.9 cm² gr.

4 Ls	100 × 100 × 13	= 97.24	− 26.0	= 71.24
2 Pls	370 × 13	= 96.2	− 26.0	= 70.20
		193.44 cm² gr		141.44 cm² net

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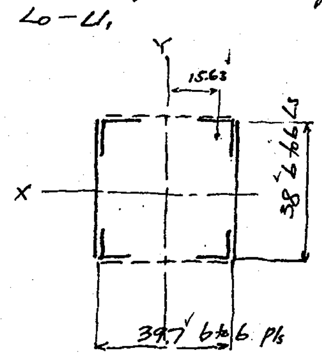
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi Ken.

$L_0 - U_1$



moment of inertia about Y-Y axis.

4Ls 100 × 100 × 13 = 97.24 × 15.63² + 221 × 4 = 24,660
2Pls 370 × 13 = 96.2 × 19.2² = 35,450
193.44 cm² gr 60,110 cm⁴

moment of inertia about X-X axis.

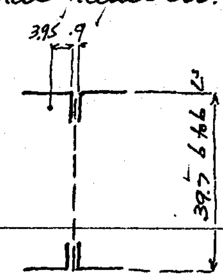
4Ls 97.24 × 16.08² + 221 × 4 = 26,040
2Pls 13 × 37³ ÷ 12 × 2 = 10,990
37,030 cm⁴

Least radius of gyration $r_x = \sqrt{\frac{37030}{193.44}} = 13.85$ cm

Unsupported length = 572 cm $l/r = \frac{572}{13.85} = 41.3$

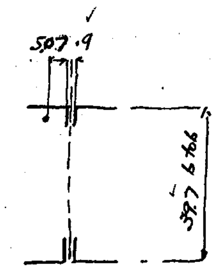
Allowable unit compression = 1500(1-0.0055 × 41.3) = 1160 use 1000 kg/cm²

Diagonal members.



$M_3 - L_4$, $L_4 - M_5$, $M_5 - L_6$ max stress 51900 kg T or C
4Ls 125 × 90 × 10 = 82.0 gr − 20.0 = 62.0 cm² net
for tension member 62.0 × 1200 = 74400 kg T ok.
82.0 × 4.42² + 1270 = 2860
$r = \sqrt{\frac{2860}{82}} = 5.90$ cm $l/r = \frac{572}{5.9} = 97$

$P = 1500(1-0.0055 \times 97) = 702$ kg/cm²
for Compression members 82.0 × 702 = 57,500 kg C ok.

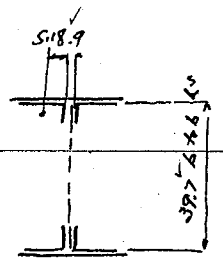


$L_2 - M_3$ + $L_6 - M_7$ 87400 kg T or C
4Ls 150 × 90 × 12 = 109.44 − 24 = 85.44 cm² net
for tension members 85.44 × 1200 = 102,500 kg T ok.

109.44 × 5.52² + 618 × 4 = 5800
$r = \sqrt{\frac{5800}{109.44}} = 7.3$ cm $l/r = \frac{572}{7.3} = 78.4$

$P = 1500(1-0.0055 \times 78.4) = 854$ kg/cm² C
for Compression members 109.44 × 854 = 93,500 kgC ok

$M_1 - L_2$ Stress = 124,350 kg T
4Ls 150 × 90 × 15 = 135.0 − 30.0 = 105.0 cm² net
for tension members 105 × 1200 = 126,000 kg T ok



$M_7 - L_8$ stress = 124,350 kg C
4Ls 150 × 90 × 15 = 135.0
2Pls 320 × 9 = 57.6
192.6 cm² gr

135.0 × 5.63² + 302 × 4 = 7300
1.8 × 32³ ÷ 12 = 4920
I = 12,220 cm⁴

$r = \sqrt{\frac{12220}{192.6}} = 7.96$ cm

$P = 1500(1-.0055 \times \frac{572}{7.96}) = 909$ kg/cm² C
for compression member. 192.6 × 909 = 175,200 kg C ok.

$L_8 - M_9$ stress = 162900 kg T S.R. = 135.9 cm² net
use same section as for $L_0 - U_1$ net section = 141.44 cm².

Vertical members

$M_9 - L_9$ use same section as for top chord $M_7 - M_9$

all other vertical members use same section as for $M_3 - L_4$
4Ls 125 × 90 × 10 = 82.0 − 20.0 = 62.0 cm² net.

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi Ken.

Approximate weight of truss.

Top chord	284.0 cm²	@ .785 kg	× 22.65 m	=	5,050
End posts	284.0	@ .785	× 7.00	=	1,560
Top chords	375.24	@ "	× 18.12	=	5340
Bottom chord	170.0	@ "	× 13.59	=	1813
"	264.0	@ "	× 9.06	=	1876
"	318.0	@ "	× 9.06	=	2260
"	355.44	@ "	× 9.06	=	2528
Diagonals	3- 82.0	@ "	× 5.72	=	1105
"	2-109.44	@ "	× 5.72	=	981
"	135.0	@ "	× 5.72	=	605
"	192.6	@ "	× 5.72	=	863
"	2- 193.44	@ "	× 5.72	=	1735
Verticals	8- 82.0	@ "	× 3.50	=	1802
					27,518
Details say 40 %				=	11,022
					38,540 kg

38540 ÷ 40.77 = 945 kg per lin m

weight of 2 trusses 2 @ 38,540 = 77,080 kg

Approximate weight of steel in One span.

Stringers	5 @ 62 = 310 × 41.50	=	12,850
floor-beams	8 @ 1,545	=	12,360
" "	2 @ 1,515	=	3030
lateral bracings			3,720
trusses	2 @ 38540	=	77,080
shoes say	4 @ 700	=	2,800
Expansion joints and misc. metals say		=	1000
			112,840 kg

Call this 113.0 kg tons for one span.

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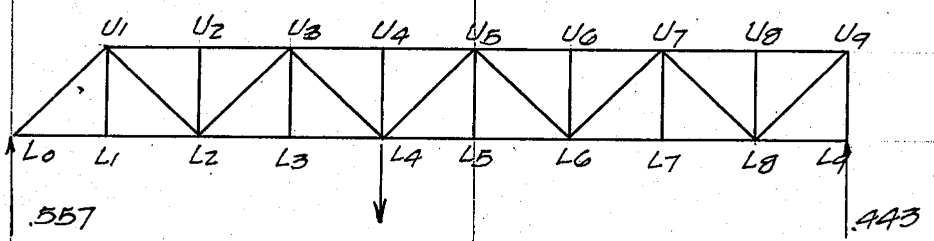
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken

Deflection of truss



Diagonals U1-L2, L2-U3, U3-L4, L4-U5, U5-L6, L6-U7
U7-L8, L8-U9 = 0.818

Verticals U1-L1, U2-L2, U3-L3, U4-L4, U5-L5, U6-L6
U7-L7, U8-L8 = 0.
U9-L9 = 0.443

Deflection $= \Sigma \frac{SUl}{EA}$

Coef. of diagonal 1.635
ratio $\frac{4.53}{3.50} = 1.295$

Stress U of member due to unity at L4

L0-U1	.557 ×	1.635		= .911
L0-L2	.557 ×	1.295		= .721
U1-U3	.557 ×	1.295 ×	2	= 1.442
L2-L4	.557 ×	1.295 ×	3	= 2.163
U3-U5	.557 ×	1.295 ×	4	= 2.885
L4-L6	.443 ×	1.295 ×	4	= 2.293
U5-U7	.443 ×	1.295 ×	3	= 1.721
L6-L8	.443 ×	1.295 ×	2	= 1.147
U7-U9	.443 ×	1.295		= .574
L8-L9	[illegible] ×	[illegible]		= 0

Live Load stresses due to full load and a single concentration of 4,300 kg at L4

Members	Stresses due to full unit load	Panel loads	Stresses	Stresses due to single unit load at L4	Single load	Stresses	Total stresses
L0-U1	-6.54 ×	8,060 =	-52,700	-.911	4,300 =	-3,920	-56,620
U1-U3	-9.06 ×	8,060 =	-73,000	-1.442	" =	-6,200	-79,200
U3-U5	-12.95		-104,400	-2.885	" =	-12,400	-116,800
U5-U7	-11.65		-93,900	-1.721	" =	-7,400	-101,200
U7-U9	-5.17		-41,700	-.574	" =	-2,468	-44,168
L0-L2	+5.17 ×	8,060 =	+41,700	+.721	4,300 =	+3,100	+44,800
L2-L4	+11.65		+93,800	+2.163	" =	+9,300	+103,100
L4-L6	+12.95		+104,400	+2.293	" =	+9,860	+114,260
L6-L8	+9.06		+73,000	+1.147	" =	+4,932	+77,932
L8-L9	+0.00		0	0	" =	+ 0	0
U1-L2	+4.90 ×	8,060 =	+39,500	+.818	4,300 =	+3,515	+43,015
L2-U3	-3.27		-26,350	-.818	" =	-3,515	-29,865
U3-L4	+1.635		+13,180	+.818	" =	+3,515	+16,695
L4-U5	+0.00		0	+.818	" =	+3,515	+3,515
U5-L6	-1.635		-13,180	-.818	" =	-3,515	-16,695
L6-U7	+3.27		+26,350	+.818	" =	+3,515	+29,865
U7-L8	-4.90		-39,500	-.818	" =	-3,515	-43,015
L8-U9	+6.54		+52,700	+.818	" =	+3,515	+56,215
U9-L9	-4.00 ×	8,060 =	-32,240	-.443	4,300 =	-1,904	-34,144

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CALLCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken

Deflection at L_4 $E = 2,100,000\ kg/cm^2$

Members	length L (cm)	gross area A (cm²)	$\frac{l}{EA}$	D.L. S S_1 Kg	L.L. S. S_2 Kg	Stress due to unity at L_4	$\frac{S_1 l U}{EA}$	$\frac{S_2 l U}{EA}$
L_0-U_1	572.0	193.44	1.409 ÷ 1,000,000	−104,000	−56,620	−.911	.1335	.0728
U_1-U_3	906.0	284.00	1.519	−144,000	−79,200	−1.442	.3152	.1735
U_3-U_5	906.0	375.44	1.150	−206,000	−116,800	−2.885	.6832	.3875
U_5-U_7	906.0	375.44	1.150	−185,200	−101,200	−1.721	.3665	.2002
U_7-U_9	906.0	384.00	1.519	−82,200	−44,168	−.574	.0717	.0385
L_0-L_2	906.0	170.00	2.540	+82,200	+44,800	+.721	.1505	.0820
L_2-L_4	906.0	318.00	1.357	+185,200	+103,100	+2.163	.5433	.3028
L_4-L_6	906.0	355.44	1.214	+206,000	+114,260	+2.293	.5736	.3181
L_6-L_8	906.0	264.00	1.635	+144,000	+77,932	+1.147	.2700	.1460
L_8-L_9	453.0	170.00	1.270	0	0	0	0	0
U_1-L_2	572.0	135.00	2.018	+77,900	+43,015	+.818	.1285	.0710
L_2-U_3	572.0	109.44	2.495	−52,000	−29,865	−.818	.1061	.0609
U_3-L_4	572.0	82.00	3.325	+26,000	+16,695	+.818	.0707	.0459
L_4-U_5	572.0	82.00	3.325	0	+3,515	+.818	0	.0096
U_5-L_6	572.0	82.00	3.325	−26,000	−16,695	−.818	.0707	.0454
L_6-U_7	572.0	109.44	2.495	+52,000	+29,865	+.818	.1060	.0609
U_7-L_8	572.0	192.60	1.414	−77,900	−43,015	−.818	.0901	.0497
L_8-U_9	572.0	193.44	1.408	+104,000	+56,215	+.818	.1196	.0648
U_9-L_9	350.0	284.00	0.587	−65,610	−34,144	−.443	.0171	.0089
					Summary		3.8163	2.1380

Dead load deflection at L_4 = 3.8163
Live load 〃 〃 〃 = 2.1380
5.9543 cm

$\frac{4077}{5.95} = 695$ nearly $\frac{1}{700}$ of Span

a camber of 4.20 cm about shall be given to truss.

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 K. Inaba DATE 5-7-22 FILE NO A.F.
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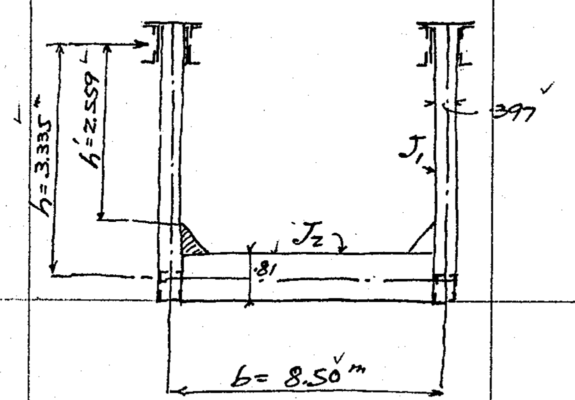
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-ken

Lateral stiffness of Truss.

以下計算ニ用ヒタル公式ハ次ノ書籍ヲ参照セリ
1. Der Brückenbau nach Vorträgen von Dr. Ing. e. h. Joseph Melan Band III. 2 page 277–278
2. Taschenbuch für Bauingenieure von M. Foerster Band II Page 397~398.

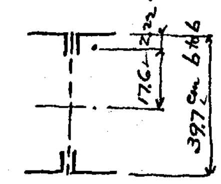


Sections
verticals. 4Ls 125 × 90 × 10
floor beam 4Ls 125 × 90 × 10
1Pl. 800 × 9
2Pls 280 × 9

$$\frac{1}{K} = \frac{h'^3}{3EJ_1} + \frac{h^2 b}{2EJ_2}$$

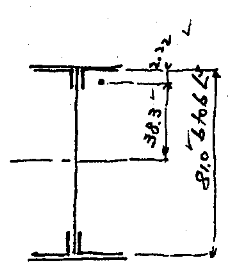
where $h = 3.335^m$, $h' = 2.559^m$, $b = 8.50^m$
J_1 + J_2 moments of inertia of vertical member and floor beam respectively.

Moment of inertia of vertical member. J_1



4Ls 125 × 90 × 10 = 82.0
4 × 138 = 550
82 × 17.6² = 25400
25950 cm⁴ = J_1.

Moment of inertia of floor beam J_2



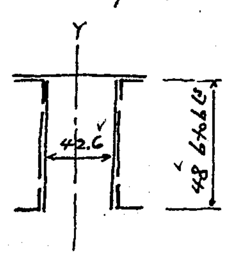
4Ls	125 × 90 × 10 =	82.0	4 × 138 + 82.0 × 38.3²	=	120850
2Pls	280 × 9 =	50.4	50.4 × 40.95²	=	84500
1Pl.	800 × 9 =	72.0	9 × 80³ ÷ 12	=	38400
					243750 cm4 = J_2

$$\frac{1}{K} = \frac{255.9^3}{3 \times 2{,}100{,}000 \times 25950} + \frac{333.5^2 \times 850}{2 \times 2{,}100{,}000 \times 243750} = 0.000103 + 0.000092$$

$$= 0.000195 = \frac{1}{5130}$$

or $K = 5130$

Moment of inertia of chord ab't Y-Y axis.



1 Cov.pl.	660 × 13 =	85.8	66³ × 1.3 ÷ 12	=	31150
2Pls	470 × 13 =	122.2	122.2 × 21.95²	=	58800
4Ls	100 × 100 × 13 =	97.24	221.4 + 97.24 × 25.52	=	64180
2Pls	270 × 13 =	70.20	70.2 × 23.25²	=	37850
		375.44 cm² gr			191980 cm4 = J

$r = \sqrt{\frac{191980}{375.44}} = 22.6^{cm}$

$$l^2 = \pi^2 \sqrt{\frac{EJa}{K}}$$

where l = unsupported length of chord member
a = panel length = 453 cm

$$= 3.1416^2 \sqrt{\frac{2{,}100{,}000 \times 191980 \times 453}{5130}} = 9.88 \times 188600 = 1{,}864{,}000$$

$$l = \sqrt{1{,}864{,}000} = 1365 \text{ meters}$$

1365 ÷ 453 = 3.0 panels

allowable unit compression on top chord member

$$= 1500\left(1 - 0.0053 \cdot \frac{1365}{22.6}\right) = 1002 \text{ kg/cm}^2 \quad \text{ok.}$$

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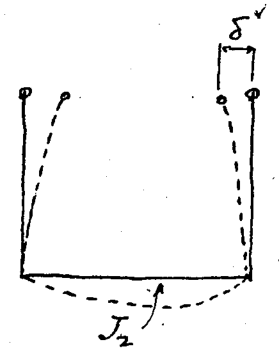
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken

Lateral Bending Stress of Top chord member.



$$\delta = \frac{M\,b\,h}{3E\,J_2}$$

where M = max live load moment on floor beam = 31,475 kgm
b = distance c to c of trusses 850 cm
h = height of truss 333.5 cm
J_2 = moment of inertia of floor beam = 243,750 cm^4

$$\delta = \frac{31475 \times 100 \times 850 \times 333.5}{3 \times 2{,}100{,}000 \times 243{,}750} = 0.581\ cm$$

Deflection formula $\delta = \frac{5Wl^3}{384EI} = 0.581$

$$W = \frac{384EI \times 0.581}{5l^3} = \frac{384 \times 2{,}100{,}000 \times 191{,}980}{5 \times 1365^3} \times .581 = 7080\ kg$$

Equivalent uniform load $w = \frac{7080}{13.65} = 520$ kg/lin meter

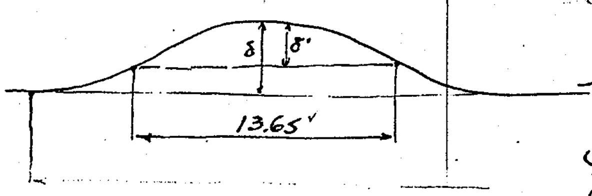
moment $= \frac{1}{8} \times 520 \times 13.65^2 = 12{,}110$ kgm

fibre stress $f = \frac{12110 \times 33.0 \times 100}{191{,}980} = \underline{208}$ kg/cm²

δ' assumed $\frac{\delta}{2} = \frac{.581}{2} = .29$ cm

Equivalent uniform load = 520 kg/lin m. for .581 cm deflection

[illegible] $= 520 \times \frac{.29}{.581} = 259$ kg/m for .29 cm "



lateral moment $= \frac{259 \times 13.65^2}{8} = 6000$ kgm

fibre stress $f = \frac{6000 \times 100 \times 33.0}{191980} = \underline{103}$ kg/cm²

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken.

Design of Top Lateral Bracings

Dead Load:

Truss say $\frac{1}{3} \times 126{,}000 \div 63.42 = .663$

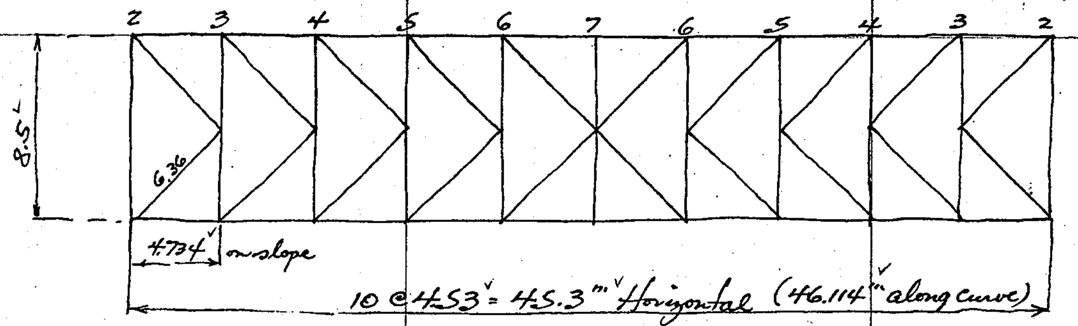
top lateral $26000 \div 45.3 = .577$

$1{,}240$ kg per lin meter.

Panel concentration $= 1240 \times 4.53 = 5600$ kg

Seismic panel load $= 5600 \times .30 = 1680$ kg Call this 1,700 kg

Reaction $4.5 @ 1{,}700 = 7650$ kg



Diagonal length

$4.25^2 = 18.0625$

$4.734^2 = 22.4108$

40.4733

$\therefore \sqrt{40.4733} = 6.36$ m

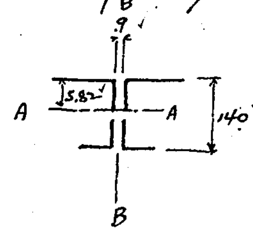
Coefficient $= \frac{6.36}{4.25} = 1.497$ at end panel.

End shear $= 7650$ kg Diagonal stress 2-3 $= 7650 \times 1.497 = 11{,}450$ kg tension only.

Tension and compression $11450 \div 2 = 5725$ kg for one diagonal.

19 mm φ rivet value for single shear $= 2126 \times 1.6 = 3400$ kg.

Section of diagonal bracing



Center of gravity of section

2Ls $100 \times 75 \times 10 = 33.00 \times 1.94 = 64.0$

2Ls $60 \times 60 \times 9 = 19.98 \times 12.21 = 244.0$

52.98 5.82 cm 308.0

moment of inertia about A-A axis.

2Ls $100 \times 75 \times 10 = 33.00 \times 3.88^2 + 152. = 649$

2Ls $60 \times 60 \times 9 = 19.98 \times 6.39^2 + 64 = 880$

1529 cm⁴

Radius of gyration $r_A = \sqrt{\frac{1529}{52.98}} = 5.37$ cm

moment of inertia about B-B axis.

2Ls $100 \times 75 \times 10 = 33.00 \times 3.62^2 + 318 = 751$

2Ls $60 \times 60 \times 9 = 19.98 \times 2.24^2 + 64 = 164$

52.98 915 cm⁴

Radius of gyration $r_B = \sqrt{\frac{915}{52.98}} = 4.16$ cm

Unsupported length $6.36 - 0.30 = 6.06$ m, $\therefore l/r = 606 \div 4.16 = 146$ ok

Allowable unit stress $= 1500 (1 - 0.0055 \times 146) = 295$ kg/cm²

For seismic stress $f = 295 \times 1.6 = 472$ kg/cm²

Gross section required $= 5725 \div 472 = 12.13$ cm² ok.

Rivet no. required $= 5725 \div 3400 = 1.69$ use 6 - 19φ rivets.

Use the same section for all members.

Wind Pressure 45 #/□′ or 220 kg/m² (四日市港附近ニ於ケル実測記録ニヨル)

Exposed area assumed chord + verticals 1.00

Leeward assume $.80$

On horizontal projection $1.80 @ 220 = 396$ kg per lin meter

Panel concentration $396 \times 4.53 = 1795$ kg Call this 1800 kg

End shear $= 4.5 @ 1800 = 8100$

Stress $= 8100 \times 1.497 = 12{,}120$ kg, for one member $= \frac{12120}{2} = 6060$ kg T or C

Gross section required $= \frac{6060}{295} = 20.55$ cm² ok

19φ rivet no. required $= \frac{6060}{2126} = 2.85 < 6.0$ ok.

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken.

Wind Stress on Top chord
moment at point 7. $8100 \times 22.65 = 183{,}500$
$1800 \times 4.53 \times 10 = 81{,}500$
$102{,}000$ kgm. $\div 8.5 = 12{,}000$ kg T or C

Seismic stress on top chord is smaller than above.

Design of Bottom Lateral Bracings.
Dead Load:

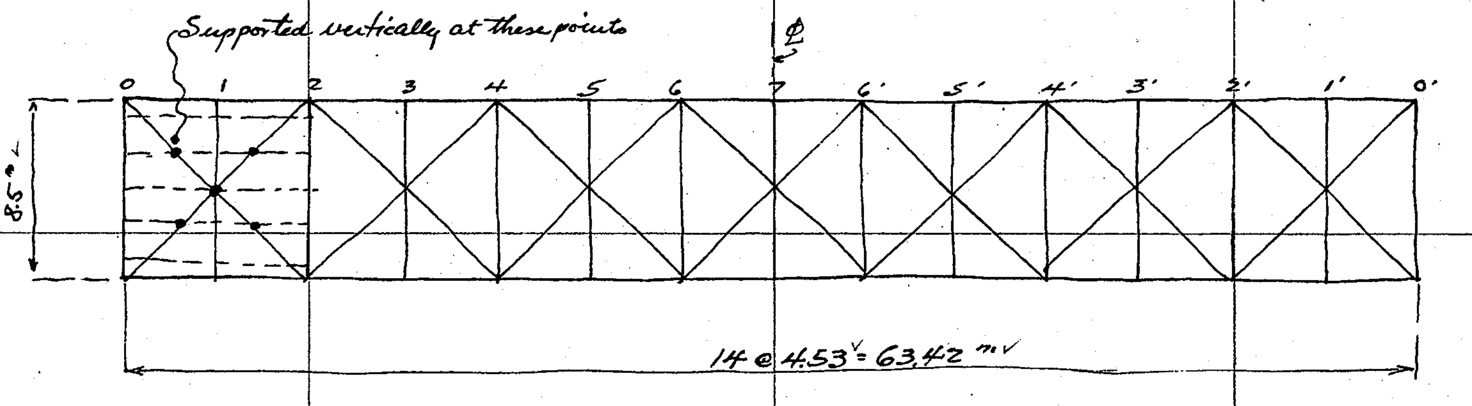
metal assumed

Stringers	5 @ 62.0	=	310
Floor beam	545 ÷ 4.53	=	341
Bottom lateral bracing say		=	120
Truss assumed	2/3 × 126,000 ÷ 63.42	=	1325
			2096

Floor load.

Slab and pavement	520 × 7.5 =	3900
Copings	2 @ 173 =	346
Handrails	2 @ 80 =	160
Misc say		100
		4506
		6602 kg per lin meter of span

Panel concentration = 6602 × 4.53 = 29900 call this 30,000 kg
Seismic panel concentration = 30000 × .30 = 9000 kg, Reaction 6.5 × 9000 = 58,500 kg



Diagonal length. $4.53^2 = 20.52$
$4.25^2 = 18.06$
38.58 $\sqrt{38.58} = 6.21$ m Coefficient $= \frac{6.21}{4.25} = 1.46$

Stresses on diagonals 0-1 & 1-2 due to thrusts transmitted from top chor lateral through portal.
Reaction on point 2 = 1700 × 5 = 8500 kg
Stress in 0-1 & 1-2 8500 × 1.46 = 12400 kg

Diagonal stresses due to seismic forces of lower deck. unit stress for tension = 1200 × 1.6 = 1920 kg/cm²
For tension only field rivet value 22φ = 2851 × 1.6 = 4560 / single shear

	Shear	coeff	stress	due to top lateral thrust	total	S.R.		Rivet req'd	
0-1	58500 ×	1.46 =	85400 +	12400 =	97800	50.90 cm² net	2Ls 150×150×11 = 63.58 − 11 = 52.58	21.5	22
1-2	49,500		72300 +	12,400 =	84,700	44.10	〃	18.6	20
2-3	40,500		59,100		59,100	30.80	〃	13.0	18
3-4	31,500		46,000		46,000	23.90	2Ls 130×130×9 = 45.18 − 9 = 36.18	10.1	12
4-5	22,500		32,800		32,800	17.10	〃	7.2	10
5-6	13,500		19,700		19,700	10.30	2Ls 100×100×10 = 38.0 − 10 = 28.00	4.3	6
6-7	4,500		6,570		6,570	3.40	〃	1.5	6

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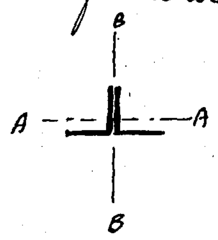
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken

For tension and compression

				Gross section reqd			22φ rivet no. reqd.	Use
0–1	48,900	÷	1060	= 46.10 cm^2 gross	< 63.58		10.7	20
1–2	42,350		1060	40.00	〃		9.3	18
2–3	29,550		1060	27.90	〃	assumed section ok.	6.5	18
3–4	23,000		856	26.90	< 45.18		5.1	10
4–5	16,400		856	19.20	〃		3.6	10
5–6	9,850		421	23.40	< 38.00		2.2	6
6–7	3,285		421	7.80	〃		0.7	6

Section for Lower Lateral Bracings.

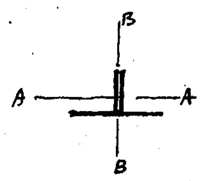


2Ls 150×150×11 = 63.58 cm^2 gr.
Radius of gyration about A–A axis r_A = 4.57 cm, l = 3.72 m (2.55×1.46)
axis B–B.
63.58 × 4.07² + 1327 = 2382
$r_B = \sqrt{\frac{2382}{63.58}} = 6.12$ l = 6.21 meters

A–A axis allowable unit compression = $1500(1-0.0055 \times \frac{372}{4.57}) = 830$ kg/cm² (81.4)

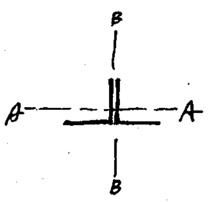
B–B axis 〃 〃 〃 = $1500(1-0.0055 \times \frac{621}{6.12}) = 663$ 〃 (101.5)

For seismic stress = 663 × 1.6 = 1060 kg/cm² C



2Ls 130×130×9 = 45.18 cm² gross.
A-A axis radius of gyration r_A = 3.96 cm l = 3.72 m l/r = 94.
B-B axis
45.18 × 3.51² + 710 = 1266
$r_B = \sqrt{\frac{1266}{45.18}} = 5.30$, l = 6.21 meters l/r = 117

A–A axis allowable unit stress = 1500(1–0.0055 × 94) = 725 kg/cm² C
B–B 〃 〃 〃 = 1500(1–0.0055 × 117) = 535 〃 C
For seismic stress = 535 × 1.60 = 856 kg/cm² C.



2Ls 100×100×10 = 38.00 cm² gross.
A-A axis radius of gyration r_A = 3.03 cm l = 3.72 m l/r = 122.8 ok
B-B axis   38.00 × 2.81² + 349 = 649
$r_B = \sqrt{\frac{649}{38.0}} = 4.13$ cm l = 6.21 meters l/r = 150 ok.

A–A axis allowable unit stress = 1500(1–0.0055 × 122.8) = 486 kg/cm² C
B-B axis 〃 〃 〃 = 1500(1–0.0055 × 150) = 263 〃 C
For seismic stress = 263 × 1.6 = 421 kg/cm² C.

Chord stresses due to seismic forces.
moment at 7.   58,500 × 31.71 = 1,845,000
9000 × 4.53 × 21 = 855,000
990000

due to top lateral   8,500 × 31.71 = 269,500
8,500 × 4.53 × 5 = 192,500
77,000
1,067,000 kgm ÷ 8.5 = 125,500 kg T or C
This stress less than 80% of D.L.+L.L. stress (257,880 kg) ok.

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi Ken.

Wind Stresses on Lateral bracing (Bottom lateral).

Wind Load on Lower Deck — wind load assumed 45 #/□' or 220 kg/m²

Exposed area
- Bottom to crown of roadway = 1.10
- Curb and handrail assumed = 0.50
- middle chord verticals & diagonals = .90
- 2.50
- Leeward exposed area 1.25
- 3.75 × 220 = 825 kg/lin m

Panel concentration 825 × 4.53 = 3740 kg

Tension only — Unit stress = 1200 kg/cm² — 22ᵠ field rivet 2851 kg / single shear

	Shear	from top lateral	total	stress	S.R.			no of rivet	use
0-1	24300 +	9000 =	33300 × 1.46 =	48600	40.50 net	2L^s 150×150×11 = 63.58 − 11 =	52.58 net	17.0	20
1-2	20750 +	9000 =	29750	43400	36.20	〃	〃	15.2	18
2-3	17650		17650	25760	21.48	〃	〃	9.0	18
3-4	14700		14700	21460	17.90	2L^s 130×130×9 = 45.18 − 9 =	36.18 net	7.5	10
4-5	12030		12030	17580 (14950)	14.65		〃	6.2	10
5-6	9620		9620	14040	11.70	2L^s 100×100×10 = 38.0 − 10 =	28.00 net	4.9	6
6-7	7490		7490	10930	9.12	〃	〃	3.8	6

Tension and Compression.

					Gross section used		Use
0-1	stress =	24300	÷ 663 =	36.7 cm² gr	63.58	8.5	20
1-2		21700	〃 =	32.8	〃	7.6	18
2-3		12880	〃 =	19.4	〃	4.5	18
3-4		10730	535 =	20.1	45.18	3.8	10
4-5		8790	〃 =	16.4		3.1	10
5-6		7020	263 =	26.7	38.00	2.5	6
6-7		5465	〃 =	20.8	〃	1.9	6

Chord stress due to wind load.

moment at point 7.
- 24300 × 31.71 = 771000
- 3740 × 4.53 × 21 = 356000
- 415000

from top lateral
- 9000 × 31.71 = 285500
- 9000 × 4.53 × 5 = 204000
- 81500

496500 kgm. ÷ 8.5 = 58400 kg T or C

max. L.L. + D.L. chord stress L_6-L_7 = 257880 kg T

257880 × 0.25 = 64500 kg > 58400 see stress sheet OK.

Approximate weight of Lateral bracings.

Bottom Lateral bracings.

24L^s 150×150×11	@ 24.95 × 5.60	=	3350
16L^s 130×130×9	@ 17.73 × 5.60	=	1590
16L^s 100×100×10	@ 14.91 × 5.60	=	1337
Center connection	2 @ 90	=	180
	2 @ 60	=	120
	3 @ 55	=	165
Hangers.	28 @ 10	=	280
Rivet heads and variation	3½%	=	248
			7270 kg

Call this 7300 kg

7300 ÷ 63.42 = 115 kg / lin m of span.

Top Lateral Bracings

for one panel.

4L^s 100×75×10 @ 12.95 × 5.80	=	300
4L^s 60×60×9 @ 7.84 × 5.80	=	182
Tie plates 4 @ 3	=	12
do 10 @ 2	=	20
Connection at sway bracing say	=	20
Rivet heads & variations say	=	20
		554 kg

for 10 panels @ 554 = 5540 kg

for average for span length,

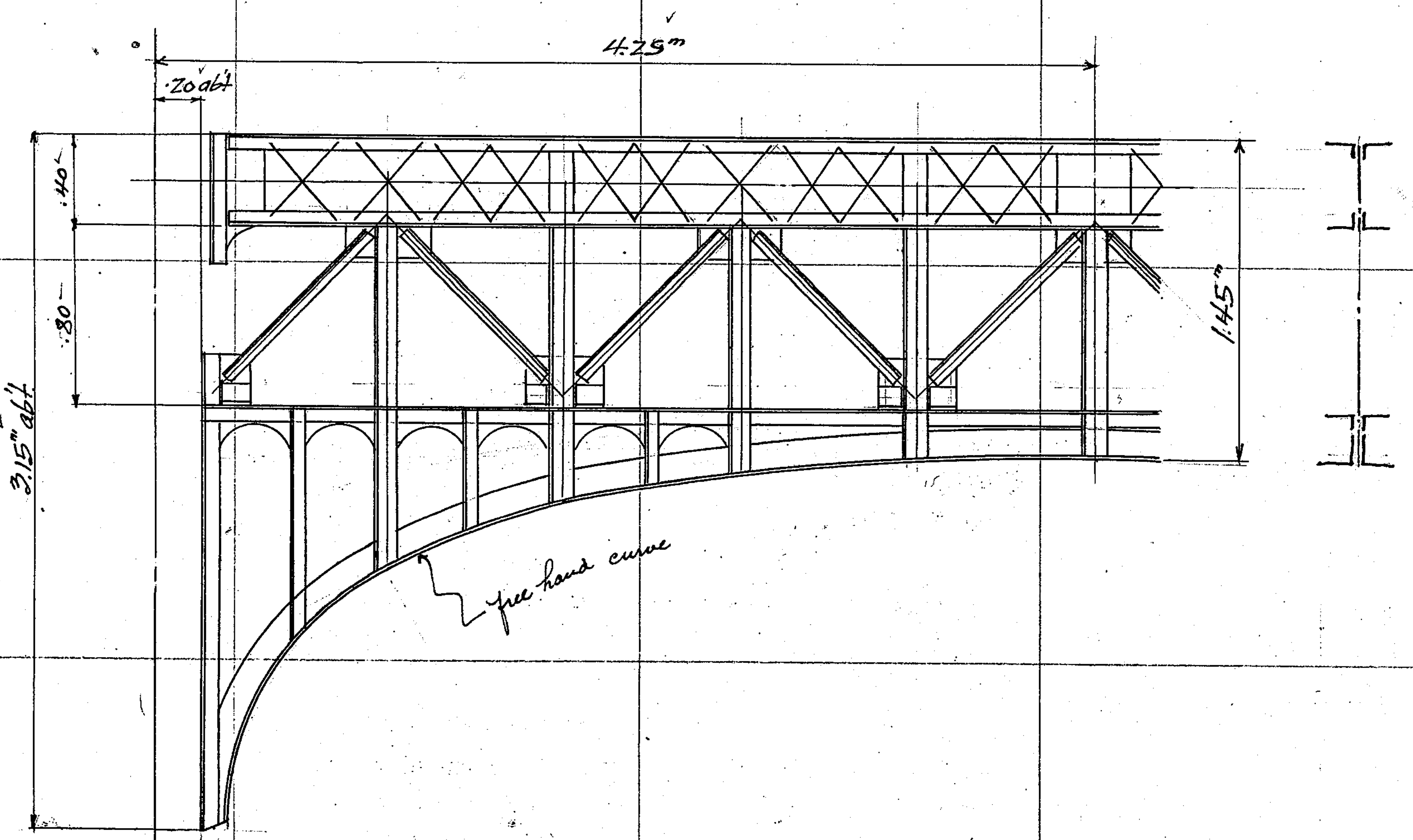
5540 ÷ 63.42 = 87 kg / lin meter.

ZZL

Design of Kisogawa Bashi for Aichi Ken

Sway Bracings:

General dimensions are as shown on sketch below.



Approximate weight of Sway Bracings. 9 Bracings required for one span.

Top strut	4 Ls	100 × 75 × 10	@	12.95 ×	7.90	=	409
middle tie	2 Ls	100 × 75 × 10	@	" ×	8.10	=	210
Diagonals	20 Ls	75 × 75 × 9	@	9.96 ×	.92	=	183
Verticals	2 Ls	75 × 75 × 9	@	" ×	15.20	=	303
Conn. Ls	2 Ls	100 × 75 × 10	@	12.95 ×	5.40	=	140
Lag Ls	20 Ls	100 × 100 × 10	@	14.91 ×	.13	=	39
Lacing	44 bars	60 × 9	@	4.24 ×	.53	=	99
web, bottom	1 Pl.	370 × 9	@	26.14 ×	4.70	=	123
"	2 Pls	200 × 9	@	14.13 ×	3.40	=	96
Bottom chord	2 Ls	130 × 130 × 9	@	17.73 ×	10.00	=	356
Fillers	1 Pl	75 × 9	@	5.30 ×	3.00	=	16
		Rivet heads and variation say 3½%				=	66
							2040 kg.

For one span 9 @ 2040 = 18.360 ~~kg~~ tons

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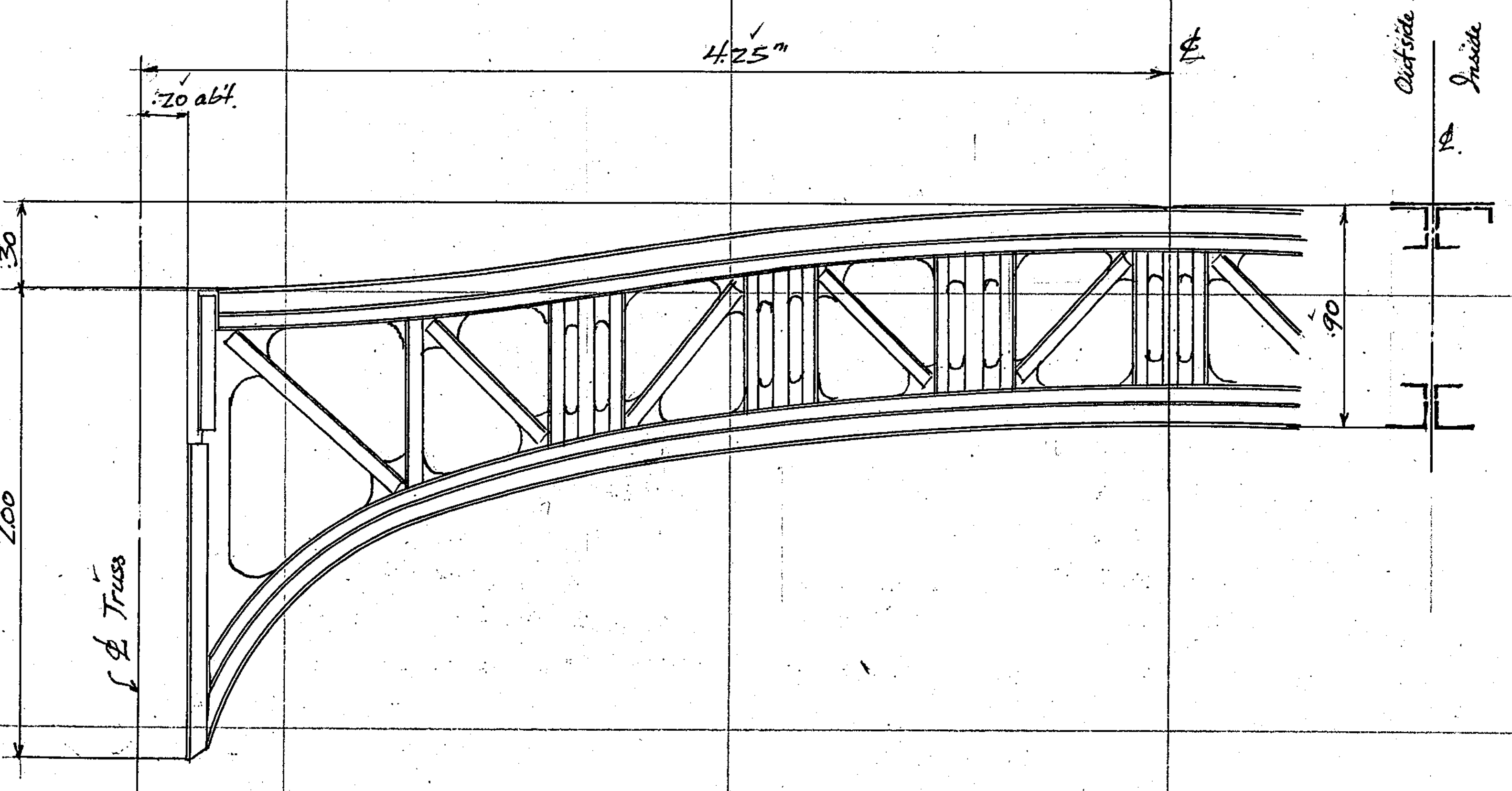
CALCULATIONS FOR

Design of Kisogawa Bashi for Aichi-Ken.

Portal Bracings.

Assumed portal Bracing is as shown on sketch below.



Approximate weight of Portal Bracing. 2 Bracings req'd. for 1 span.

Cover plate	1Pl.	370 · 9	@ 26.14	· 8.00	=	209.
Top chord	2Ls	150 · 90 · 9	@ 16.32	· 8.00	=	261
"	1L	60 · 60 · 9	@ 7.84	· 8.00	=	63
Top & Bott chords	2Ls	90 · 60 · 9	@ 9.96	· 17.50	=	348
Bottom chord	2Ls	150 · 90 · 9	@ 16.32	· 9.50	=	310
Verticals	2Ls	60 · 60 · 7	@ 6.20	· 11.70	=	145
Diagonals	2Ls	90 · 90 · 10	@ 13.34	· 8.50	=	227
Connection	2Ls	100 · 75 · 10	@ 12.95	· 4.00	=	104
web + gusset	1Pl	300 · 9	@ 21.20	· 17.00	=	360
		Rivet heads and variation say		3½%	=	73
						2100 kgs.

2 Bracings @ 2100 = 4.200 kg tons for one span.

Approximate weight of Top Lateral Bracing Sway and portal bracings.

Top Lateral bracings				7700
Sway Bracings	9 @	2040	=	18,360 ← (½ = Sway 4ケ所 Strut 5ケ所ニ [illegible] Safe side [illegible])
Portal Bracings	2 @	2100	=	4200
				30,260 kg

30260 ÷ 45.3 = 669. kg per lin m Call this 670

Panel Load on Top Chord

Top Lateral Bracings		670
Truss	say ⅓ · 126000 ÷ 63.42 =	663
		1333 kg per lin meter.

Panel concentration = 1333 · 4.53 = 6040

Call this 6,100 kg

Seismic panel Load = 6100 · .3 = 1830 kg   Reaction = 1830 · 5.0 = 9150 kg

Seismic panel Concentratn 200 · 4.53 = 910 kg   910 · 5.0 = 4550 kg.

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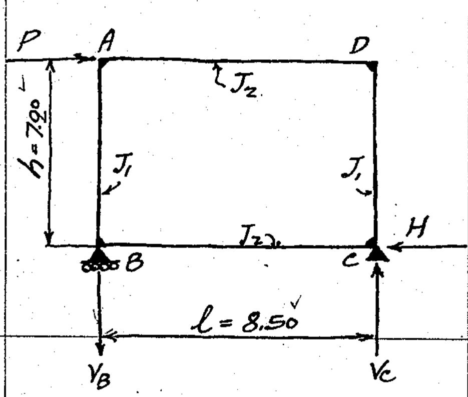
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken.

Let us design the portal bracing as a Rahmen constructed by portal bracing, verticals, and floor beam.

Formulas for moments and reactions. (Refer to Kleinlogel's Rahmenformeln P. 288)



Moments.

$M_A = M_C = Ph\left[\frac{3k+1}{4(3k+1)}\right] = \frac{Ph}{4}$ where $k = \frac{J_2}{J_1} \cdot \frac{h}{l}$

$M_B = M_D = -Ph\left[\frac{3k+1}{4(3k+1)}\right] = -\frac{Ph}{4}$

J_2 = moment of inertias of portal bracing and floor beam.

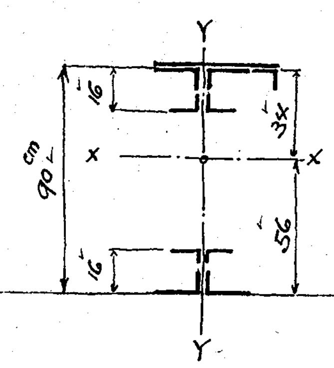
J_1 = do. of vertical member.

Reactions $V_B = V_C = \frac{Ph}{l}$,

$H = P$.

h assumed 7.20 meters

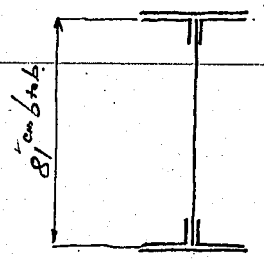
Moment of inertia of Portal bracing.



1Pl.	370×9 =	33.3	× 90.45 =	3010
4Ls	150×90×9 =	83.2	× 45.00 =	3740
4Ls	90×60×9 =	50.8	× 45.00 =	2285
1L	60×60×9 =	10.0	× 88.20 =	882
		177.3 cm²	× 56.0 cm =	9917

1Pl.	370×9		33.3	× 34.45²	=	39,500
2Ls	150×90×9	258 +	41.6	× 32.02²	=	43,000
2Ls	"	258 +	41.6	× 54.02²	=	121,800
2Ls	90×60×9	72 +	25.4	× 19.50²	=	9,700
2Ls	"	72 +	25.4	× 41.50²	=	43,800
1L	60×60×9	32 +	10.0	× 32.21²	=	10,400
						268,200 cm⁴

Moment of inertia of Floor Beam (Floor beam [illegible] section [illegible])

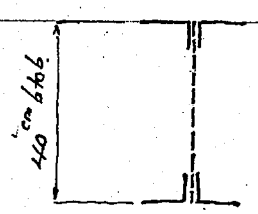


2Pls.	280×10 = 56.0		56.0 × 41.0²	=	94,200
4Ls	125×90×10 = 82.0	552 +	82.0 × 38.28²	=	120,700
1Pl.	800×9 =		0.9×80³ ÷ 12	=	38,400
					253300 cm⁴

moment of inertia J_2
268,200
253300
Above 2 moment of inertias are very near. 521500 ÷ 2 = 260750 cm⁴ = J_2

Moment of inertia of Vertical member J_1.
Assumed section.

4Ls 125×75×13 = 97.24   408 + 97.24 × 18.15² = 32400 cm⁴ = J_1



$k = \frac{J_2}{J_1} \cdot \frac{h}{l} = \frac{260750}{32400} \times \frac{7.20}{8.50} = 6.82$

$3k+1 = 21.45$ $\frac{3k+1}{4(3k+1)} = \frac{21.45}{4 \times 21.45} = .25$

Moments and Reactions

$M_A = M_C = \frac{Ph}{4}$, $M_B = M_D = -\frac{Ph}{4}$, $V_B = V_C = \frac{Ph}{l} = \frac{P \times 7.20}{8.50} = .847P$.

Earthquake stresses. $M_A = M_C = \frac{9150 \times 7.2}{4} = 16,480$ kgm $M_B = M_D = -16480$ kgm.

$V_B = V_C = .847 \times 9150 = 7,750$ kg $H = 9150$ kg

Wind stresses $M_A = M_C = \frac{9000 \times 7.2}{4} = 16200$ kgm, $M_B = M_D = -16200$ kgm.

$V_B = V_C = .847 \times 9000 = 7030$ kg, $H = 9,000$ kg.

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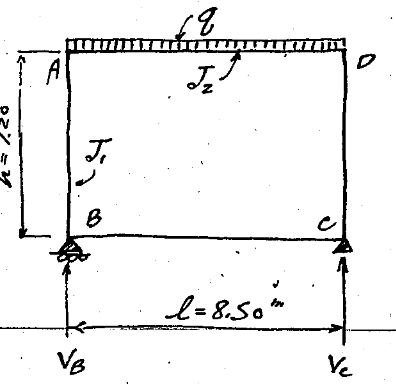
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi Ken

Moment and reaction due to own weight of Portal bracing.

$V_B = V_C = \frac{ql}{2}$, $k = \frac{J_2}{J_1} \cdot \frac{h}{l} = 6.82$



$2k+3 = 16.64$ $\quad$ $\frac{2k+3}{k^2+4k+3} = \frac{16.64}{76.90} = .215$

$k^2+4k+3 = 76.90$

$M_A = M_D = -\frac{ql^2(2k+3)}{12(k^2+4k+3)} = -0.0179 \cdot ql^2$

$M_B = M_C = +$ " $= +0.0179 \cdot ql^2$

weight of portal bracings = 2100 kg

$2100 \div 8.5 = 247$ kg/lin m call this $q = 250$ kg/lin m.

$M_A = M_D = -0.0179 \times 250 \times 8.5^2 = -320$ kgm

$M_B = M_C = +$ " " $= +320$ "

$V_B = V_C = 250 \times 8.5 \div 2 = 1060$ kg

Summary of moments and reactions.

	moments $M_A = M_C$	moments $M_B = M_D$	Reactions V_B	Reactions V_C	H	Shear
Dead Load	± 320	± 320	+ 1,060	+ 1060	0	+ 1,060
Seismic force	± 16480	∓ 16480	∓ 7750	± 7750	9150	± 3875
Wind force	± 16200	∓ 16200	∓ 7630	± 7630	9000	± 4800
Summary for Dead Load + seismic force	− 16,800 kgm	+ 16,800 kgm	+ 8,810 kg	+ 8,810 kg	9150 kg	+ 4,935 kg
Dead Load + wind force	− 16,520	+ 16,520	+ 8,690	+ 8690 (or − 6570)	9000	+ 5,560

Direct compression on portal bracing Seismic force $9150 \div 2$ on one chord
wind force $9000 \div 2$ "

Wind force stress governs the sections.

Checking the assumed section

End of portal bracing moment ± 16520 kgm shear 5560 kg

Total depth assumed 1.00 m at end Eff. depth say 90 cm

Flange stress $= \frac{16520 \times 100}{90} = 18350$ kg T or C

Sectional area required for tension $= \frac{18350}{1200 \times 1.25} = 12.23$

Direct tension $\frac{9000}{2 \times 1200 \times 1.25} = 3.00$

15.23 cm² net

Sectional area required for compression $= \frac{18350}{1000 \times 1.25} = 14.68$

Direct compression $\frac{9000}{2 \times 1250} = 3.60$

18.28 cm² gross.

For bottom chord

2Ls $150 \times 90 \times 9 = 41.58 - 4.5 = 37.08$

2Ls $90 \times 60 \times 9 = 25.38 - 4.5 = 20.88$

66.96 cm² gr $\quad$ 57.96 cm² net ok.

Diagonal member Coefficient 1.50 about

$5560 \times 1.5 = 8340$ kg T S.R. reqd $= \frac{8340}{1200 \times 1.25} = 5.57$ cm² net for tension

$= \frac{8340}{922 \times 1.25} = 7.23$ cm² gr for compression

2Ls $90 \times 90 \times 10 = 34.0 - 5.0 = 29.00$ cm² net

$\frac{l}{r} = \frac{190}{2.71} = 70$ $\quad$ $f = 1500(1 - .0055 \times 70) = 922$

For wind stress + DL stress $f = 922 \times 1.25 = 1152$ kg/cm²

Assumed portal bracing is ample.

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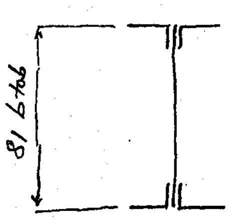
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi Ken.

At End of Floor Beam



moment = ± 16,520 kgm   Shear = 5,560 kg

Total depth 81 cm, Effective depth = 81 − 4.4 = 76.6 cm

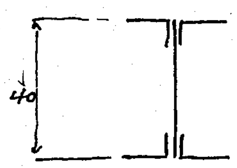
Flange stress = 16520 × 100 / 76.6 = 21580 kg T or C

Flange area required = 21580 / 1,500 = 14.37

Direct tension 9000 / 2×1500 ÷ 2 = 1.50
15.87

1/8 web area 72/8 = − 9.00
6.87 cm² net ok.

Vertical member   moment = ± 16520 kgm. Shear = 4500 kg



Total depth = 40.0 Effective depth = 40.0 − 3.48 = 36.52 cm
Flange stress due to moment = 16520 / .3652 = 45,200 kg T or C

Direct stresses.
wind Vc 8690/2 = 4345 C   6570/2 = 3285 T
D.L. plane concentration 15000/2 = 7500 T   7500 T
3,155 T   10,785 T

Assumed section
4Ls 125 × 75 × 10 = 76.0 − 2 × 8.80 = 58.40
1 Pl. 400 × 9 = 36.0 − 3.96 = 32.04
112.0 gr   90.44 cm² net

For 1 flange area
2Ls 125 × 75 × 10 = 38.0 − 8.8 = 29.20
1/8 web area 36/8 = 4.5   4.50
47.5 gr   33.70 net

Bending stress 45,200 ÷ 33.70 = 1,340 kg/cm² T
45,200 ÷ 42.5 = 1065 " C
Direct stress
10,785 ÷ 90.44 = 119 kg/cm² T
3,155 ÷ 112.0 = 28 " T

Summary for unit stresses	Tension	Compression
Bending	1340	1065
Direct	119	− 28
	1,459 kg/cm² T	1,037 kg/cm² C ok.

2Ls 125 × 75 × 10 = 38.0 × 4.67² + 594 = 1424 cm⁴
$r = \sqrt{\frac{1424}{38.0}} = 6.12$ cm $l = 3.8$ m $l/r = \frac{380}{6.12} = 62$

Allowable unit stress = 1500(1 − 0.0055 × 62) = 988 kg/cm² C
for Dead + wind combined f = 988 × 1.25 = 1233 kg/cm² C ok.

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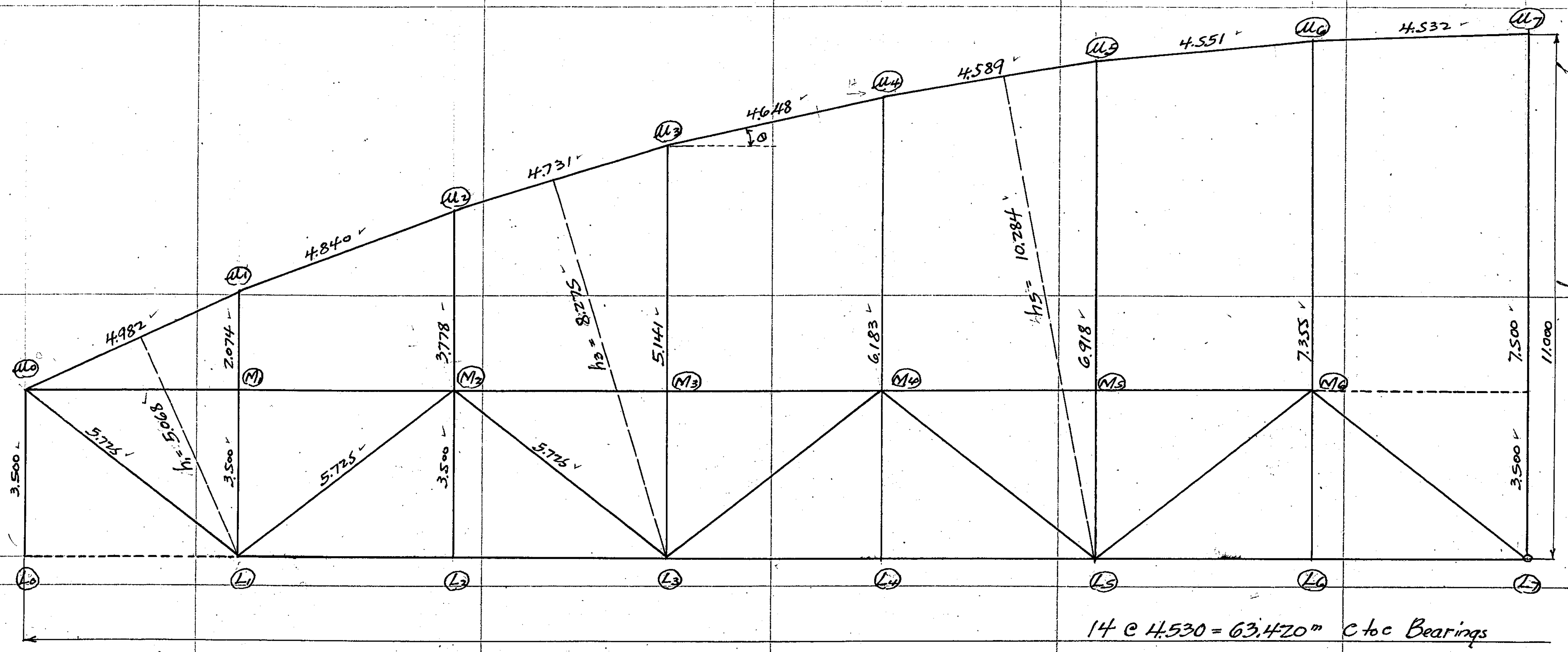
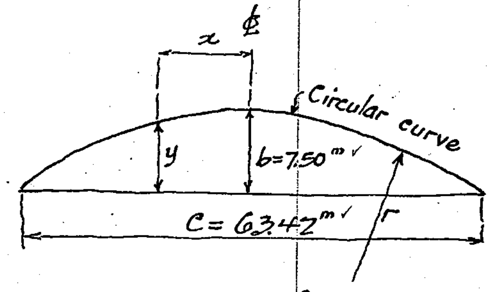
CALCULATIONS FOR

Design of Kisogawa Bashi for Aichi-ken.
Design of truss.
General dimension of truss is as shown on sketch below.





Curve for Top chord. a circular curve.

$$r = \frac{4b^2+C^2}{8b} = \frac{4 \cdot 7.5^2+63.42^2}{8 \cdot 7.5} = 70.785^m$$

$$y = b - r + \sqrt{r^2 - x^2} = 7.5 - 70.785 + \sqrt{70.785^2 - x^2}$$
$$= -63.285 + \sqrt{5010.5162 - x^2}$$

Length of vertical members.

panel pt.	y.
0	0.000
1	2.074
2	3.778
3	5.141
4	6.183
5	6.918
6	7.355
7	7.500

Length of Top chord members.

members	Length	tanθ	Secθ
$U_0 - U_1$	4.982	0.4578	1.0998
$U_1 - U_2$	4.840	0.3762	1.0684
$U_2 - U_3$	4.731	0.3009	1.0443
$U_3 - U_4$	4.648	0.2300	1.0261
$U_4 - U_5$	4.589	0.1623	1.0131
$U_5 - U_6$	4.551	0.0965	1.0046
$U_6 - U_7$	4.532	0.0320	1.0005

Length of diagonal members.

$3.50^2 + 4.530^2 = 32.7709$

$\sqrt{32.7709} = 5.725$

Coefficient $= \frac{5.725}{3.50} = 1.636$

Lever arms of top chord members from bottom panel pt.

members	h_m =
$U_0 - U_1$	h_1 = 5.068
$U_2 - U_3$	h_3 = 8.275
$U_4 - U_5$	h_5 = 10.284

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-ken.

Influence Surfaces of Stresses for truss members.

Influence Surface of Horizontal Thrust H and Vertical Reaction R.

Load on	Reaction R	Moment at center hinge				Hor. Thrust H	
0	1.000	31.710	− 31.710	= 0.000	÷ 11.000 =	0.000	0
1	0.929	29.459	− 27.180	2.279		0.207	1
2	0.857	27.157	− 22.650	4.507		0.410	2
3	0.786	24.924	− 18.120	6.804		0.619	3
4	0.714	22.650	− 13.590	9.060		0.824	4
5	0.643	20.390	− 9.060	11.330		1.030	5
6	0.571	18.106	− 4.530	13.576		1.234	6
7	0.500	15.855	− 0.000	15.855		1.441	7
6'	0.429					1.234	6'
5'	0.357					1.030	5'
4'	0.286					.824	4'
3'	0.214					.619	3'
2'	0.143					.410	2'
1'	0.071					.207	1'
0'	0.000					.000	0'
Summary	7.500				Summary	10.089	

Influence Surface of Top Chord members. (All Compression)

Load on	H.		M_0-M_1	M_1-M_2	M_2-M_3	M_3-M_4	M_4-M_5	M_5-M_6	M_6-M_7
		Sec θ =	1.0998	1.0684	1.0443	1.0261	1.0131	1.0046	1.0005
1	.207		.228	.221	.216	.212	.210	.208	.207
2	.410		.451	.438	.428	.421	.415	.412	.410
3	.619		.681	.661	.646	.635	.627	.622	.619
4	.824		.906	.880	.861	.846	.835	.828	.824
5	1.030		1.133	1.100	1.076	1.075	1.043	1.035	1.031
6	1.234		1.357	1.318	1.289	1.266	1.250	1.240	1.235
7	1.441		1.585	1.540	1.505	1.479	1.460	1.448	1.442
Summary for whole span			11.097	10.776	10.537	10.389	10.220	10.138	10.094

Vertical Component of Top Chord Stresses.

Load on	H	M_0-M_1	M_1-M_2	M_2-M_3	M_3-M_4	M_4-M_5	M_5-M_6	M_6-M_7
1	.207	.095	.078	.062	.048	.034	.020	.007
2	.410	.188	.154	.123	.094	.067	.040	.013
3	.619	.283	.233	.186	.142	.100	.060	.020
4	.824	.377	.310	.248	.190	.134	.080	.026
5	1.030	.472	.387	.310	.237	.167	.099	.033
6	1.234	.565	.464	.371	.284	.200	.119	.039
7	1.441	.660	.542	.434	.331	.234	.139	.046

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-ken.

Influence Surface of Hangers. (all tension)

Load on panel point	U_1-M_1	U_2-M_2	U_3-M_3	U_4-M_4	U_5-M_5	U_6-M_6	U_7-M_7
1	.017	.016	.014	.014	.014	.013	.013
2	.034	.031	.029	.027	.027	.027	.026
3	.050	.047	.044	.042	.040	.040	.040
4	.067	.062	.058	.056	.054	.054	.052
5	.085	.077	.073	.070	.068	.066	.066
6	.101	.093	.087	.084	.081	.080	.078
7	.118 ✓	.108 ✓	.103 ✓	.097 ✓	.095 ✓	.093 ✓	.092 ✓
Summary for the whole span	.826 ✓	.760 ✓	.713 ✓	.683 ✓	.663 ✓	.653 ✓	.642 ✓

Influence Surface of Middle Chord members. (+ Sign tension, and − Sign Compression.)

Load on panel points	U_0-M_2	M_2-M_4	M_4-M_6	
1	− .872 ✓	− .506	− .216	1
2	− .457	− 1.021	− .444	2
3	− .031	− 1.523 ✓	− .653	3
4	+ .388	− .739	− .876	4
5	+ .808	+ .047	− 1.094 ✓	5
6	+ 1.225	+ .828	− .025	6
7	+ 1.648 ✓	+ 1.616 ✓	+ 1.053 ✓	7
6'	+ 1.411	+ 1.383	+ .900	6'
5'	+ 1.178	+ 1.156	+ .755	5'
4'	+ .943	+ .925	+ .604	4'
3'	+ .708	+ .692	+ .456	3'
2'	+ .468	+ .458	+ .296	2'
1'	+ .237	+ .234	+ .154	1'
	− 1.360 ✓	− 3.789 ✓	− 3.308 ✓	
	+ 9.014 ✓	+ 7.339 ✓	+ 4.218 ✓	
Summary	+ 7.654 ✓	+ 3.550 ✓	+ 0.910 ✓	

Influence Surface of Bottom Chord members. (+ Sign tension, and − Sign Compression)

Load on panel points	L_1-L_3	L_3-L_5	L_5-L_7	
1	+ .887	+ .561	+ .308	1
2	+ 1.776 ✓	+ 1.124	+ .616	2
3	+ 1.366	+ 1.681	+ .920	3
4	+ .959	+ 2.241 ✓	+ 1.225	4
5	+ .553	+ 1.509	+ 1.535	5
6	+ .146	+ .776	+ 1.841 ✓	6
7	− .261 ✓	+ .043 ✓	+ .855 ✓	7
6'	− .221	+ .041	+ .738	6'
5'	− .188	+ .029	+ .608	5'
4'	− .149	+ .025	+ .489	4'
3'	− .114	+ .015	+ .361	3'
2'	− .069	+ .015	+ .249	2'
1'	− .040	+ .002	+ .117	1'
	+ 5.687 ✓	+ 8.062 ✓	+ 9.862 ✓	
	− 1.042 ✓			
Summary	+ 4.645			

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi Ken.

Influence Surfaces of Diagonal Members. (+Sign Tension, and −Sign Compression)

Load on panel points	M_0-L_1	L_1-M_2	M_2-L_3	L_3-M_4	M_4-L_5	L_5-M_6	M_6-L_7
1	+ 1.364 ✓	+ .244	− .218	+ .195	− .172	+ .149	− .128
2	+ 1.094	− 1.150 ✓	− .435	+ .388	− .344	+ .299	− .255
3	+ .823	− .905 ✓	+ .982 ✓	+ .582	− .514	+ .448	− .383
4	+ .551	− .661	+ .762 ✓	− .857 ✓	− .687	+ .599	− .510
5	+ .280	− .419	+ .545	− .664 ✓	+ .779 ✓	+ .746	− .638
6	+ .010	− .175	+ .327	− .470	+ .607 ✓	− .739 ✓	− .767 ✓
7	− .262 ✓	+ .069 ✓	+ .108 ✓	− .276 ✓	+ .435 ✓	− .591 ✓	+ .746 ✓
6'	− .222	+ .057	+ .095	− .237	+ .375	− .507 ✓	+ .638
5'	− .188	+ .049	+ .077	− .196	+ .311	− .422	+ .530
4'	− .149	+ .039	+ .062	− .157	+ .249	− .337	+ .426
3'	− .113	+ .031	+ .046	− .118	+ .187	− .252	+ .317
2'	− .074	+ .018	+ .036	− .080	+ .124	− .169	+ .213
1'	− .039	+ .011	+ .015	− .038	+ .061	− .083	+ .105
	+ 4.122 ✓	+ .518 ✓	+ 3.055 ✓	+ 1.165 ✓	+ 3.128 ✓	+ 2.241 ✓	+ 2.974 ✓
	− 1.047 ✓	− 3.310 ✓	− .653 ✓	− 3.093 ✓	− 1.717 ✓	− 3.100 ✓	− 2.681 ✓
Summary	+ 3.075 ✓	− 2.792 ✓	+ 2.402 ✓	− 1.928 ✓	+ 1.411 ✓	− .859 ✓	+ .293 ✓

Influence Lines of End post M_0-L_0 Compression

Load on panel points	M_0-L_0
1	− .929 ✓
2	− .857 ✓
3	− .786 ✓
4	− .714 ✓
5	− .643 ✓
6	− .571 ✓
7	− .500 ✓
6'	− .429 ✓
5'	− .357 ✓
4'	− .286 ✓
3'	− .214 ✓
2'	− .143 ✓
1'	− .071 ✓
Summary	− 6.500 ✓

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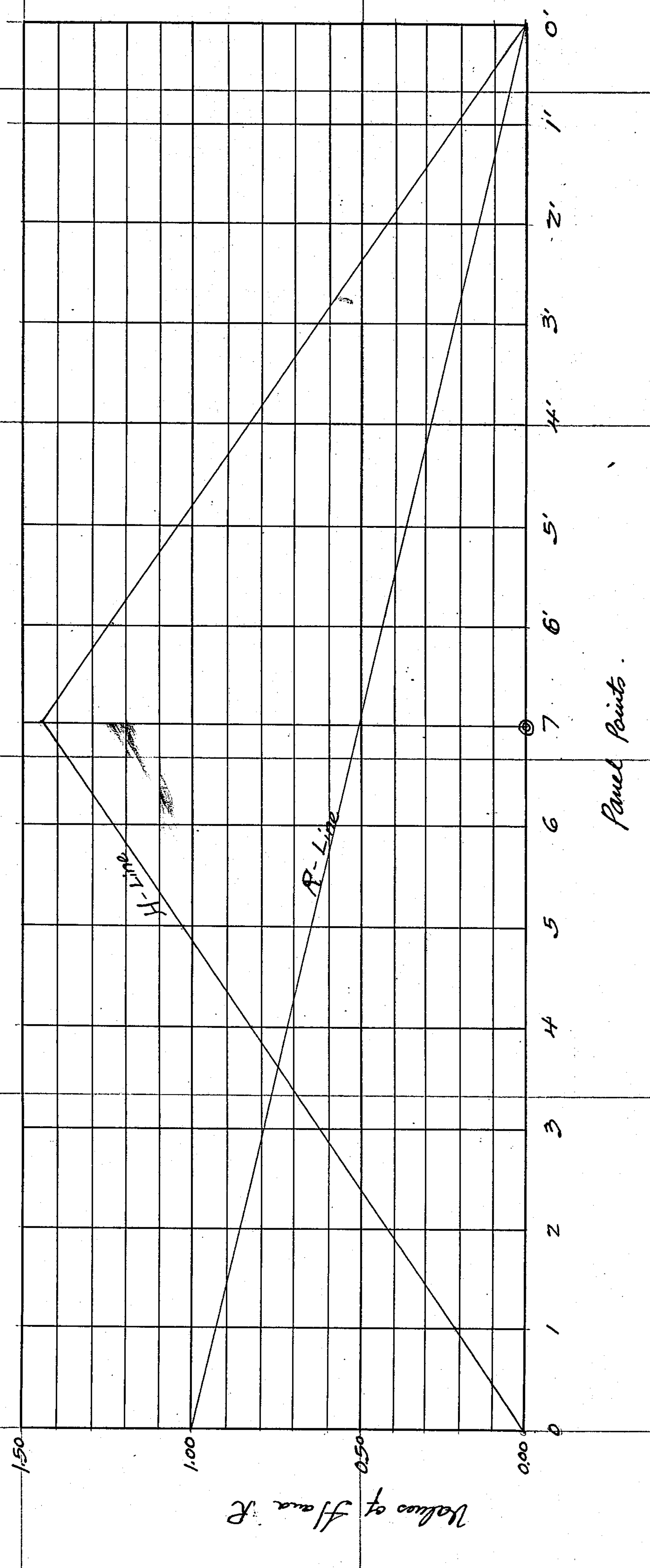
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi Ken.

Influence Lines of Horizontal Thrust H and Vertical End Reaction R.



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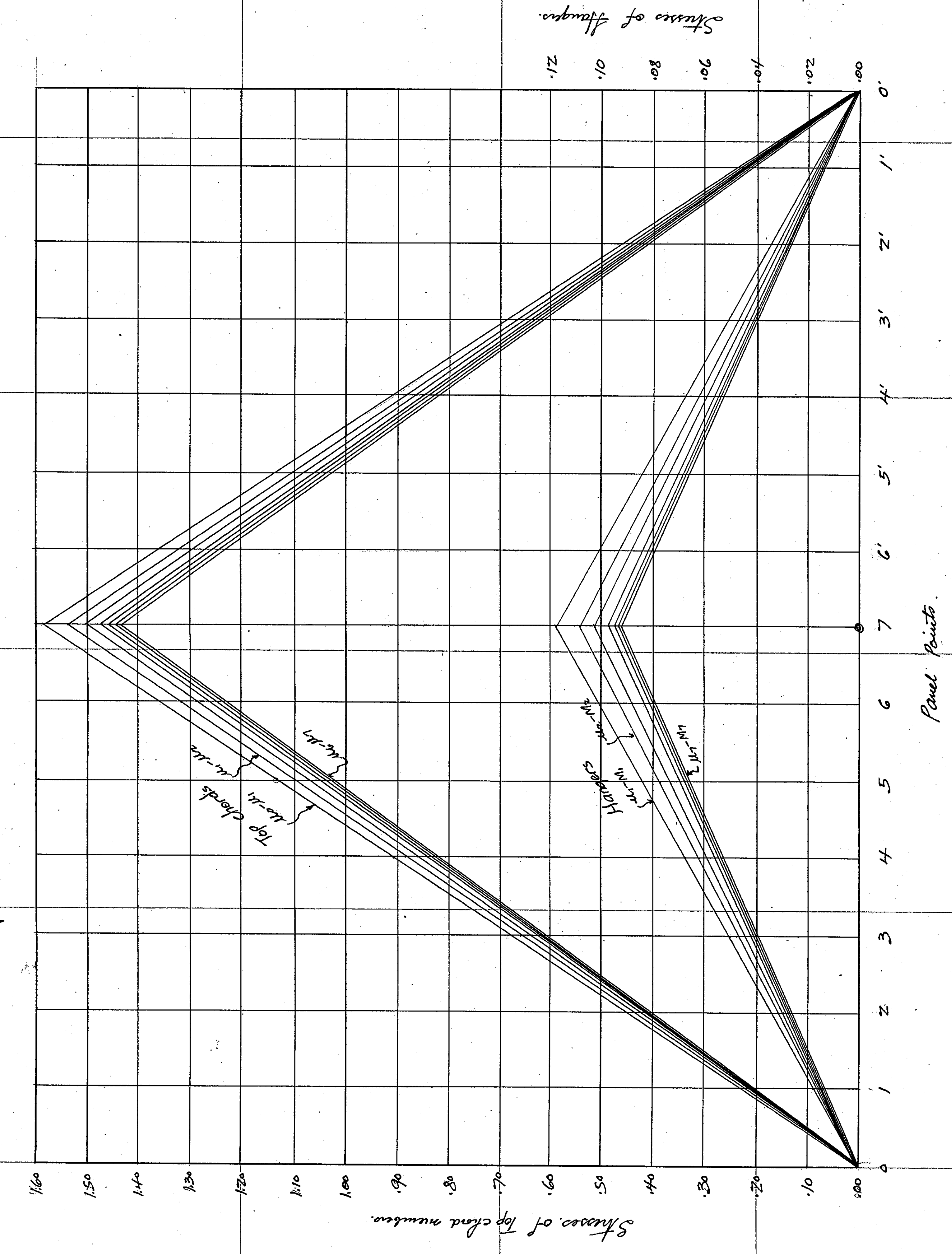
CALCULATIONS FOR

Design of Kisogawa Bashi for Aichi-ken

Influence Lines for Top chord and Hanger stresses.



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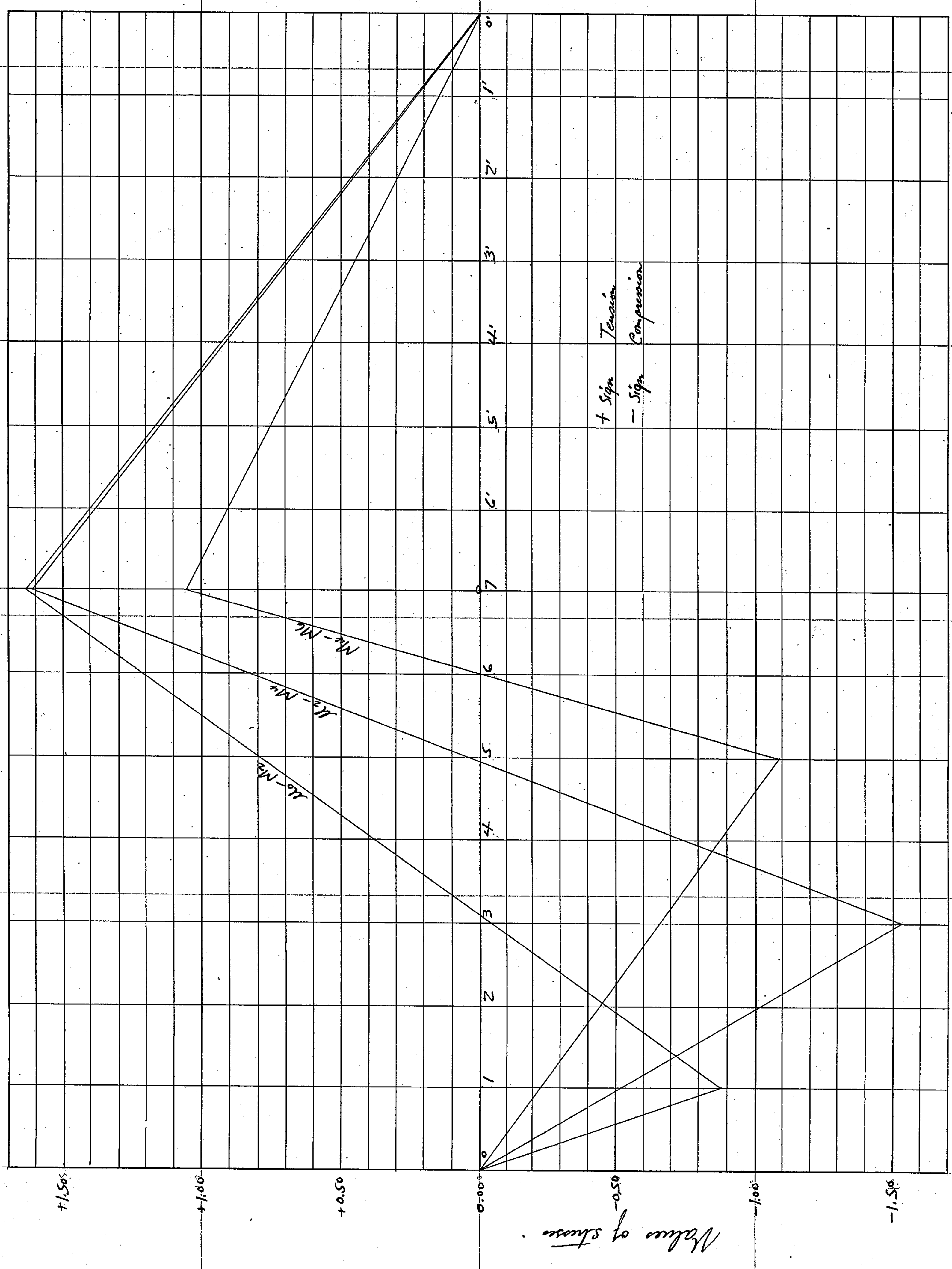
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-ken.
Influence Lines for middle chord stresses.



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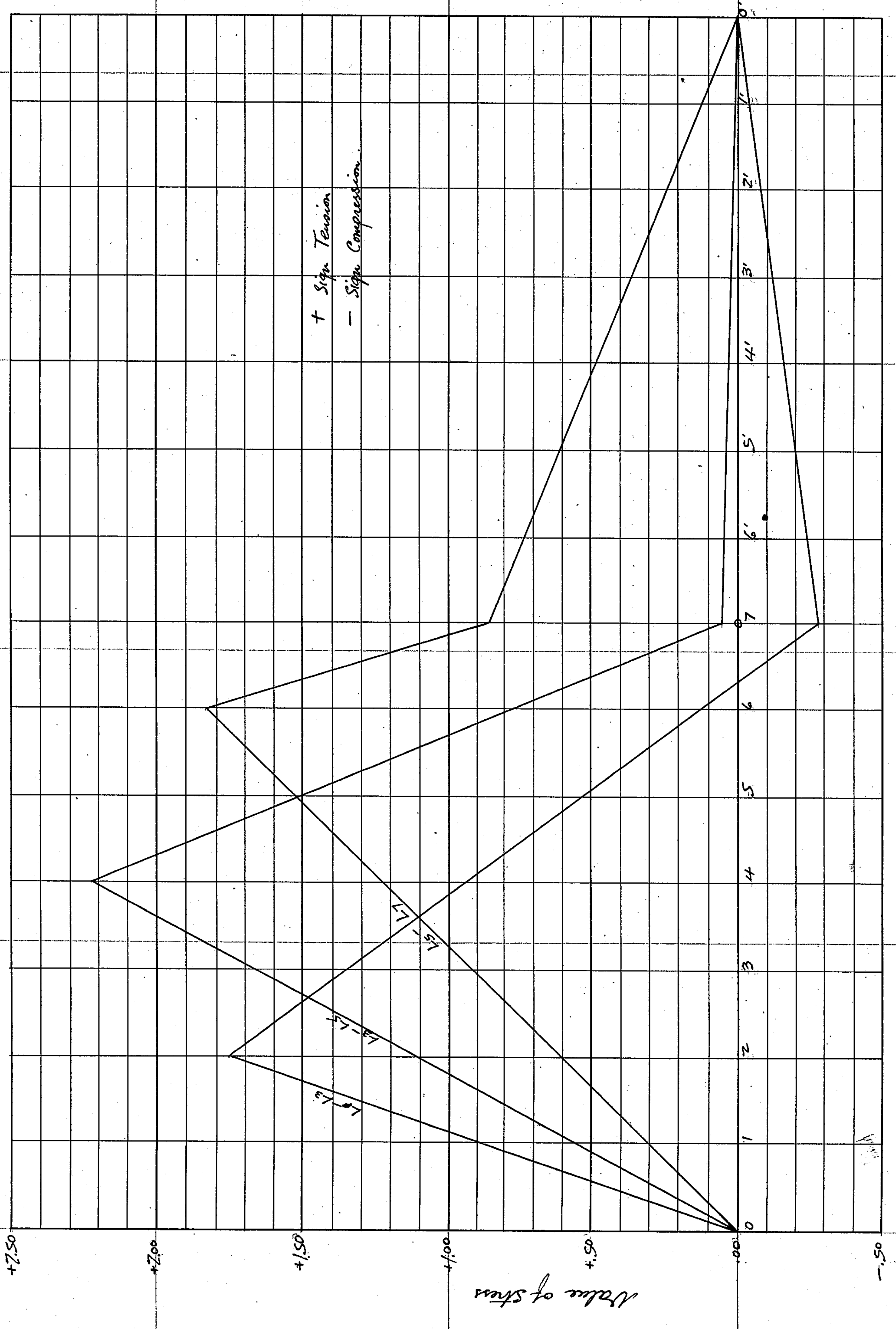
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken.

Influence Lines for Bottom Chord Stresses.



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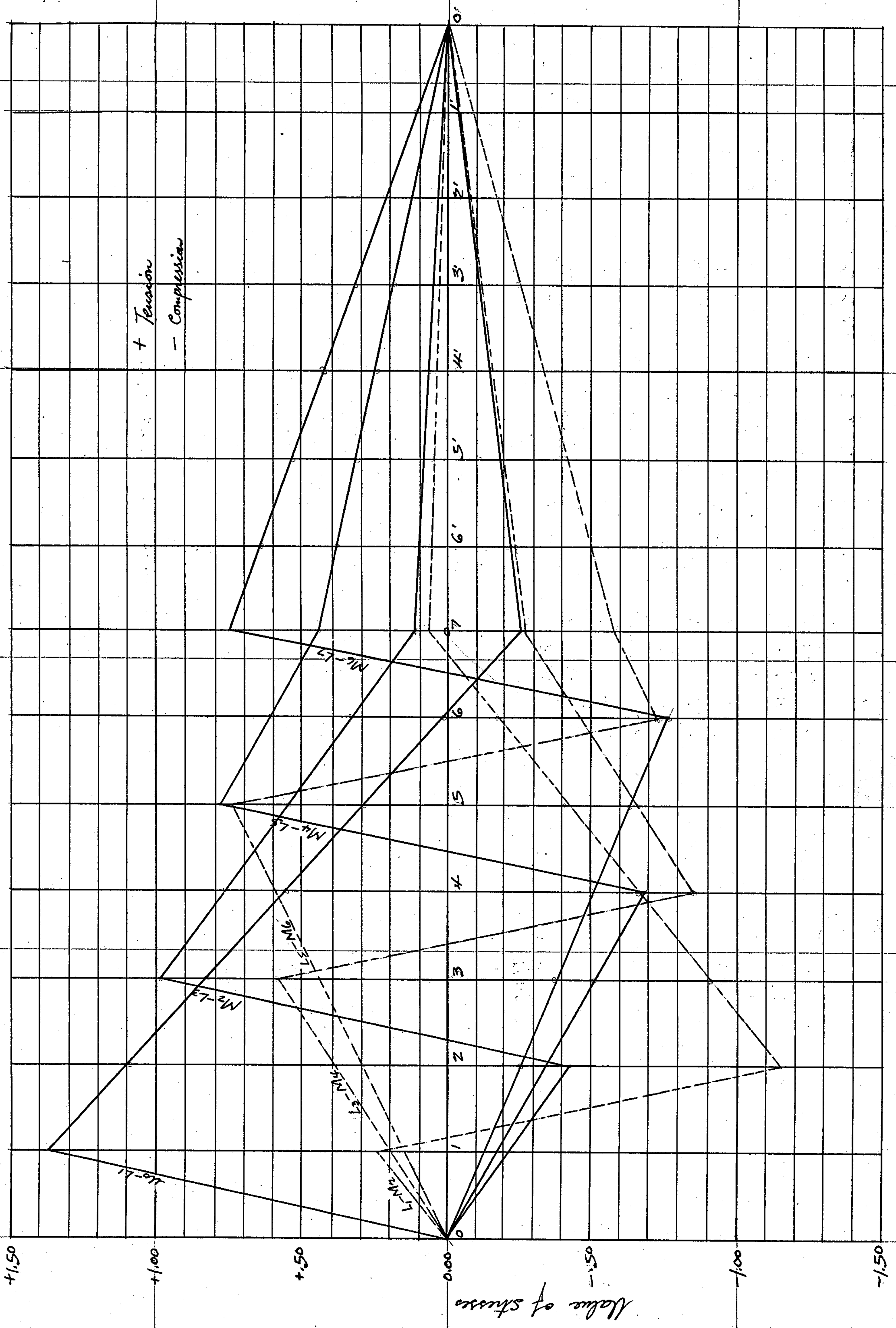
CALCULATIONS FOR

Design of Kisogawa-Bashi for Aichi-Ken.
Influence Lines for Diagonal stresses.



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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken.

Design of Truss.

Dead Load on Truss.

Stringers 5 @ 75.0 = 375
Floor beams 13 @ 1600 = 20800
do 2 @ 1500 = 3000
23800 ÷ 63.42 = 375
Bottom lateral bracing 120
Truss say 2/3 × 126000 ÷ 63.42 = 1325
2195

Floor Load
Slab and pavement 520 × 7.5 = 3900
Copings 2 @ 130 = 260
Handrails 2 @ 80 = 160
misc. pipes and others 115
4435

for 2 trusses ... 6630 kg per lin m of span

Bottom panel load = 6630/2 × 4.53 = 15000 kg.

Top Lateral Bracing sways + portals = 670
Truss say 1/3 × 126000 ÷ 63.42 = 663
for 2 trusses 1333 kg per lin meter of span

Top panel load = 1333/2 × 4.53 = 3020 call this 3000 kg

Total panel load on one truss = 15000 + 3000 = 18000 kg.

Dead Load Stresses on Truss.

Horizontal Thrust H and Vertical Reaction R.

R = 7.0 × 18,000 = 126,000 kg
Shoes etc say = 2000 (overhanging of floor included)
128000 kg Dead Load on shoe.

H = 10.089 × 18,000 181,500 kg Dead Load thrust on center hinge.

Top chords		Hangers		Middle chords		Bottom chords		Diagonals	
M_0-M_1	-199,700	M_1-M_1	+12,870	M_0-M_2	+137,800	L_1-L_3	+83,600	M_0-L_1	+55,300
M_1-M_2	-194,000	M_2-M_2	+10,680	M_2-M_4	+63900	L_3-L_5	+145,700	L_1-M_2	-50,200
M_2-M_3	-189,600	M_3-M_3	+9650	M_4-M_6	+16,380	L_5-L_7	+177,500	M_2-L_3	+43,700
M_3-M_4	-187,000	M_4-M_4	+9,300					L_3-M_4	-34,700
M_4-M_5	-184,000	M_5-M_5	+8930					M_4-L_5	+25,400
M_5-M_6	-182,500	M_6-M_6	+8,750					L_5-M_6	-15,450
M_6-M_7	-181,600	M_7-M_7	+8,550					M_6-L_7	+5,270

Top panel load 3000 kg is reduced for all hangers.

Stress on hangers M_2-L_2, M_4-L_4 and M_6-L_6 = +15,000 kg.
Stress on end post M_0-L_0 = 18000 × 7.0 = -126,000 kg
overhanging floor say 1000
-127,000

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken.

Live Load Stresses on truss members.

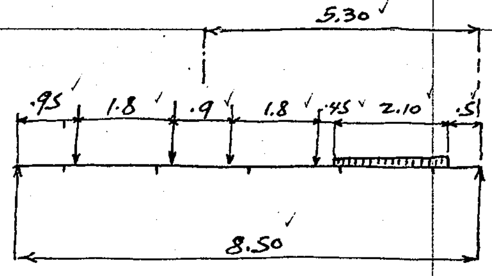
Uniform load $w = \frac{100,000}{170+6342} = 429$ kg/m² call this 430

Motor truck rear wheel concentration = 3,000
Impact allowance = $\frac{20}{60+6342}$ = 16.2 % = 486
3486 kg call this 3,500 kg

Motor truck front wheel concentration with imp. say 3500 ÷ 3 = 1,170 kg

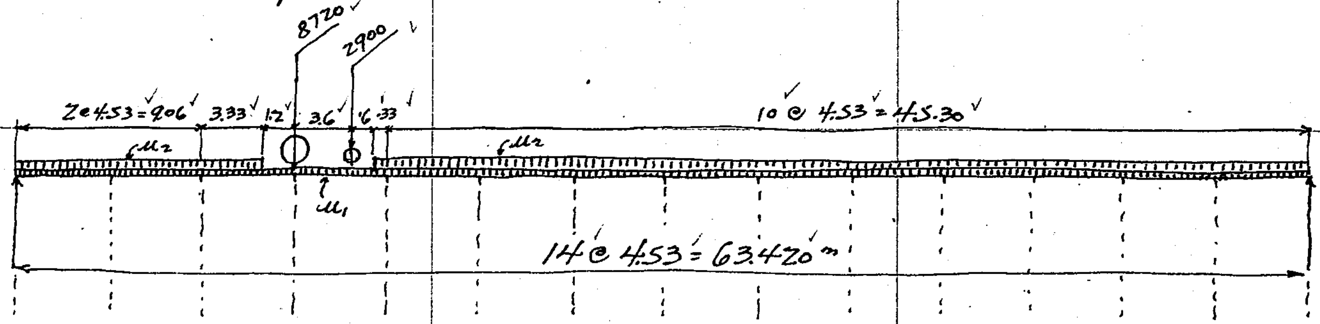
max. reaction on truss

motor truck rear wheel 3500 × 4 × 5.3 ÷ 8.5 = 8720 kg
" front wheel 8720 ÷ 3 = 2900 kg



Uniform load.
Side of motor truck 430 × 2.1 × 1.55 ÷ 8.5 = 165 kg/lin m = u_1
front and rear " 430 × 7.5 ÷ 2 = 1615 "
difference 1615 − 165 = 1,450 " = u_2

Live Load panel concentrations.



u_1	747	747	747	747	747	747	747	747	747	747	747	747	747
u_2	6563	3282	17	461	6563	6563	6563	6563	6563	6563	6563	6563	6563
u_2		3050	1775	3282									
front wheel			595	2305									
rear wheel			8720										
	7310	7079	11854	6795	7310	7310	7310	"	"	"	"	"	7310
Assumed Loading	7310	7310	7310 / 4500 (Single concentration.)	7310	7310	7310	7310	"	"	"	"	"	7310

Horizontal Thrust H and Vertical Reaction R.

Full load. R = 7.0 × 7310 = 51,700 kg.
Concentration at 0. 1.00 × 4500 = 4,500
55,700 kg — Live load on shoe.
effect of overhanging floor say 1,300
57,000

Full load H = 10.089 × 7310 = 73,800
Concentration at 7. 1.441 × 4500 = 6,500
80,300 kg Live load thrust on center hinge.

Top chords.	Panel loads 7310	4500	Total stress.
u_0-u_1	80,200	7,130	−87,330
u_1-u_2	78,700	6930	−85,630
u_2-u_3	77,000	6770	−83,770
u_3-u_4	75,900	6650	−82,550
u_4-u_5	74,700	6570	−81,270
u_5-u_6	74,100	6520	−80,620
u_6-u_7	73,800	6480	−80,280

Hangers	Panel load 7310	4500	Total stress.
u_1-M_1	6040	530	+6,570
u_2-M_2	5,550	490	+6,040
u_3-M_3	5210	460	+5,670
u_4-M_4	4,990	440	+5,430
u_5-M_5	4,850	430	+5,280
u_6-M_6	4,770	420	+5,190
u_7-M_7	4,690	410	+5,100

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-ken.

Middle chord stresses

members	Panel load 7,310	Sum of influence ordinates	Stress	Single concentration 4,500	Influence ordinate	Stress	Total stress
M_0-M_2	7,310 ×	+9.014 =	+65,900	4,500 ×	+1.648 =	+7,420	+73,320
		−1.360	−9,950		−.872	−3,920	−13,870
M_2-M_4		+7.339	+53,620		+1.616	+7,270	+60,890
		−3.789	−27,680		−1.523	−6,850	−34,530
M_4-M_6		+4.218	+30,830		+1.053	+4,740	+35,570
		−3.308	−24,180		−1.094	−4,920	−29,100

Bottom chord stresses.

members	Panel load	Sum of influence ordinates	Stress	Single concentration 4,500	Influence ordinate	Stress	Total stress.
L_1-L_3	7,310 ×	+5.687 =	+41,600	4,500 ×	+1.776 =	+7,990	+49,590
		−1.042	−7,600		−.261	−1180	−8,780
L_3-L_5		+8.062	+58,920		+2.241	+1,010	+59,930
L_5-L_7		+9.862	+72,100		+1.841	+8,280	+80,380

Diagonal stresses.

members	Panel load	Sum of influence ordinates	Stress	Single concentration	Influence ordinate	Stress	Total stresses.
M_0-L_1	7,310 ×	+4.122 =	+30,120	4,500 ×	+1.364 =	+6,140	+36,260
		−1.047	−7,650		−.262 =	−1,180	−8,830
L_1-M_2		+.518	+3,790		+.244	+1,100	+4,890
		−3.310	−24,180		−1.150	−5,170	−29,350
M_2-L_3		+3.055	+22,310		+.982	+4,420	+26,730
		−.653	−4,770		−.435	−1,960	−6,730
L_3-M_4		+1.165	+8,520		+.582	+2,620	+11,140
		−3.093	−22,600		−.857	−3,860	−26,460
M_4-L_5		+3.128	+22,850		+.779	+3,500	+26,350
		−1.717	−12,540		−.687	−3,090	−15,630
L_5-M_6		+2.241	+16,380		+.746	+3,360	+19,740
		−3.100	−22,650		−.739	−3,330	−25,980
M_6-L_7		+2.974	+21,720		+.746	+3,360	+25,080
		−2.681	−19,600		−.767	−3,450	−23,050

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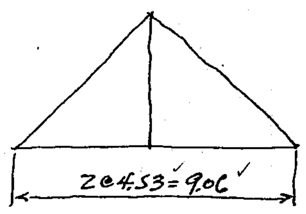
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken.

Live Load Stress on hangers M_2-L_2, M_4-L_4, and M_6-L_6.



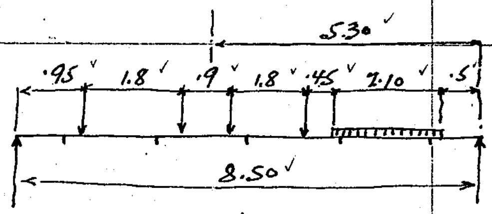
Uniform load = $\frac{100000}{170+9.06}$ = 559 kg/m² use 500

Motor truck rear wheel concentration = 3,000

Impact allowance = $\frac{20}{60+9.06}$ = 29% = 870

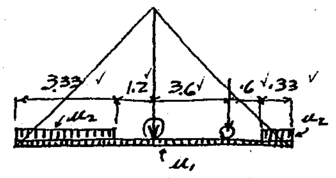
3870 kg

front wheel concentration with impact say 3870÷3 = 1,290 kg



Max. reaction on panel point

motor truck rear wheels	3870×4×5.3÷8.5	=	9,650 kg
" " front wheels	9650÷3	=	3,215
Uniform load			
Side of truck	500×2.1×1.55÷8.5	=	190 = u_1
front and rear of truck	500×7.5÷2	=	1875
difference			1685 = u_2



Panel Load.

Uniform load u_1	190×4.53 =		860
" " u_2	$\frac{1685×3.33^2}{2×4.53}$ =		2060
" " "	$\frac{1685×.33^2}{2×4.53}$ =		20
front wheel	3215×$\frac{.93}{4.53}$ =		660
rear wheel		=	9650
max. hanger stress		=	+13,250 kg

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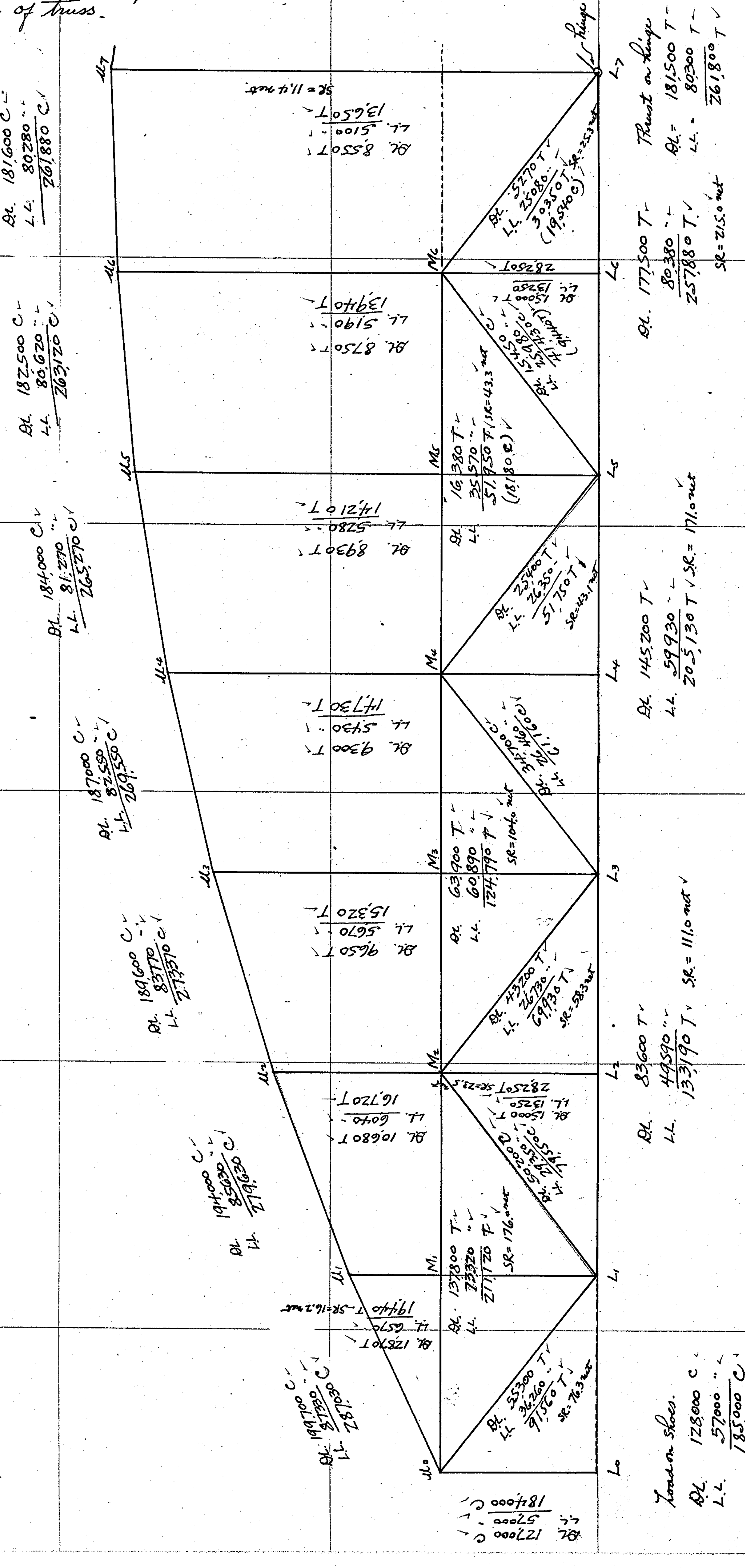
(33)

CALCULATIONS FOR

Design of Kisogawa-Bashi for Aichi-Ken

Stress diagram of truss.



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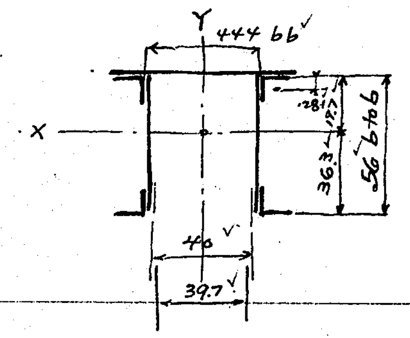
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi Ken.

Sections of Truss Members.

Top chord members. max stress = 287,030 kg C (u_0-u_1)

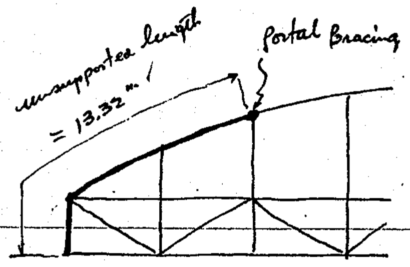


1 Cov. Pl.	650×13	= 84.50	×	56.65 =	4785
4 Ls	100×100×10	= 76.00	×	28.00 =	2128
2 Pls	550×12	= 132.00	×	28.00 =	3695
		292.50 cm² gross.		36.3 cm	10,608

Moment of inertia X-axis.

1 cov. pl.		84.50 × 20.35² =	35,000
2 Ls	349 + 38.00 × 16.89² =		11,180
2 Ls	349 + 38.00 × 33.49² =		42,950
2 Pls	2.4 × 55³ ÷ 12 =		33,270
			122,400 cm⁴

Radius of gyration $R_x = \sqrt{\frac{122400}{292.50}} = 20.46$ cm $\frac{l}{r} = \frac{498.2}{20.46} = 24.3$



Moment of inertia Y-axis.

1 cov. pl.	1.3 × 65³ ÷ 12 =	29,750
4 Ls	698 + 76.0 × 25.01² =	48,300
2 pls	132.0 × 21.6² =	61,550
		139,600

Radius of gyration $R_y = \sqrt{\frac{139600}{292.50}} = 21.80$ cm $\frac{l}{r} = \frac{1332}{21.80} = 61.2$

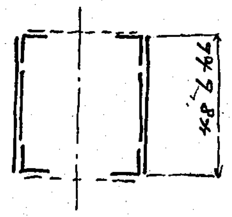
Allowable unit compression = 1500(1−0.0055×61.2) = 993 kg/cm²

Unit stress = $\frac{287030}{292.50}$ = 982 kg/cm² ok.

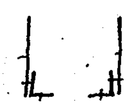
Bottom chord members. Sectional area required for

L_1-L_3 = 111.0 cm² net
L_3-L_5 = 171.0 "
L_5-L_7 = 215.0 "

for L_1-L_3.

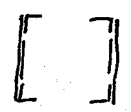


2 Pls	470×10 =	94.0 − 10 =	84.00
2 Ls	100×100×10 =	38.0 − 10 =	28.00 cm
		132.00 gr	112.00 net



L_3-L_5

2 Pls	470×10 =	94.00 − 20.0 =	84.00
4 Ls	100×100×10 =	76.00 − 20.0 =	56.00
2 Pls	270×10 =	54.00 − 10.0 =	44.00
		224.00 gr	174.00 net.



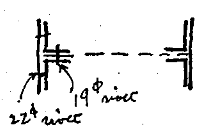
L_5-L_7

2 Pls	470×16 =	150.40 − 32.0 =	118.40
4 Ls	100×100×10 =	76.00 − 20.0 =	56.00
2 Pls	270×10 =	54.00 − 10.0 =	44.00
		280.40 gr	218.40 net.

do.

Middle chord members. Sectional area required for

M_0-M_2 = 176.0 cm² net
M_2-M_4 = 104.0 "
M_4-M_6 = 43.3 "

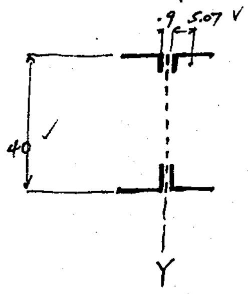


M_0-M_2	4 Ls	150×90×15 =	135.00 − 28.2 =	106.8
	2 Pls	320×13 =	83.20 − 13.0 =	70.2
			218.20 gr	177.0 cm² net
M_2-M_4	4 Ls	150×90×15 =	135.00 − 28.2 =	106.80 net
M_4-M_6	4 Ls	150×90×9 =	83.16 − 18.0 =	65.16 net

Design of Kiso-gawa Bashi for Aichi Ken.

Diagonals

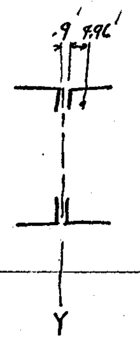
M_0-L_1 stress $= 91{,}560$ kg T Section reqd $= 76.3$ cm² net
L_1-M_2 $= 79{,}550$ C



4L^s 150×90×12 = 109.44 − 24.0 = 85.44 cm² net
moment of inertia Y-axis:
109.44 × 5.52² + 2465 = 5800
radius of gyration Y axis $r_y = \sqrt{\frac{5800}{109.44}} = 7.28$ cm $\frac{l}{r} = \frac{5.725}{.0728} = 78.6$
Allowable unit comp. $f = 1500(1-0.0055 \times 78.6) = 852$ kg/cm²

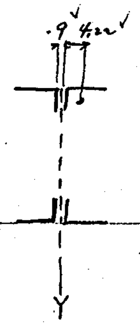
unit comp. on L_1-M_2 = $\frac{79550}{109.44} = 727$ kg/cm² C ok

M_2-L_3 stress 69930 kg T S.R. = 58.3 cm² net
L_3-M_4 61160 C



4L^s 150×90×9 = 83.16 − 18.0 = 65.16 cm² net

moment of inertia Y-axis
83.16 × 5.41² + 1873 = 4305 cm⁴
radius of gyration Y axis $= \sqrt{\frac{4305}{83.16}} = 7.20$ cm $\frac{l}{r} = \frac{572.5}{7.2} = 79.5$
Allowable unit comp. $= 1500(1-0.0055 \times 79.5) = 844$ kg/cm²
Unit comp. on L_3-M_4 = $\frac{61160}{83.16} = 736$ kg/cm² ok.



M_4-L_5 51,750 kg T S.R. = 43.1 cm² net
L_5-M_6 41430 kg C
M_6-L_7 30,350 kg T S.R. = 25.3 "

4L^s 125×75×10 = 76.00 − 20.0 = 56.0 cm² net

moment of inertia Y axis.
76.00 × 4.67² + 1190 = 2860 cm⁴
radius of gyration Y axis $r_y = \sqrt{\frac{2860}{76.0}} = 6.13$ cm $\frac{l}{r} = \frac{572.5}{6.13} = 93.4$
Allowable unit comp. $f = 1500(1-0.0055 \times 93.4) = 730$ kg/cm² C
Unit comp on L_5-M_6 = $\frac{41430}{76.0} = 545$ kg/cm² ok.

Hangers. 4L^s 125×75×10 = 76.0 − 20.0 = 56.0 cm² net. ok

Hanger $U_2-M_2-L_2$
4L^s 125×75×10 = 76.0 − ~~20.0~~ 18.8 = ~~56.0~~ 57.2
1Pl. 395×9 = 35.6 − 3.96 = 31.64
111.6 gr. 88.84 net

End post. U_0-L_0 stress 184000 kg C

Use same section as for top chord.

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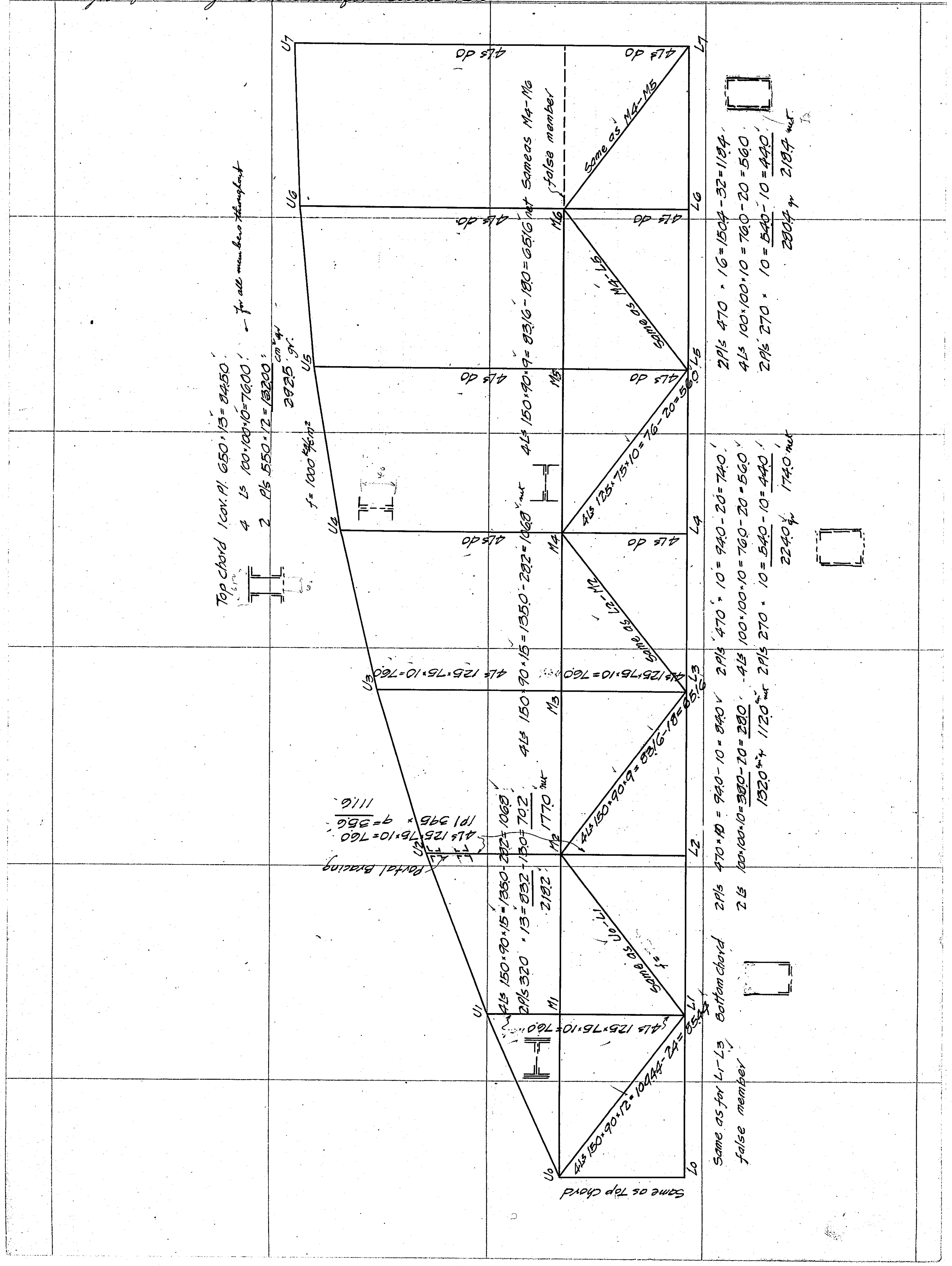
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken



増田淳氏関係資料
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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi Ken.

Approximate weight of Truss

Top chord	292.50	@	.785	×	32.873	=	7550
bottom chord	280.40	@	"	×	9.06	=	1993
"	224.00	@	"	×	9.06	=	1593
"	132.00	@	"	×	13.59	=	1407
middle chord	218.20	@	"	×	9.06	=	1552
"	135.00	@	"	×	9.06	=	960
"	83.16	@	"	×	13.59	=	886
verticals	76.00	@	"	×	50.671	=	3020
" u_2-L_2	111.60	@	"	×	7.278	=	637
" End post	292.50	@	"	×	3.50	=	803
Diagonals	109.44	@	"	×	11.45	=	983
"	83.16	@	"	×	11.45	=	747
"	76.00	@	"	×	17.175	=	1024
							23155 × 2 = 46310 kg
					Details say 42%	=	19480
							65790 kg

For 2 trusses 2 @ 65790 = 131,580 kg

Call this 132.0 kg tons.

Approximate weight of structural steel in one span.

Stringers	310 @	64.3	=	19950
intermediate floor beams	13 @	1545	=	20100
end floor beams	2 @	1515	=	3030
bottom lateral bracing			=	7300
top lateral bracing			=	5540
sway bracing	4 @	2040	=	8160
" struts	5 @	800	=	4000
Portal bracing	2 @	2100	=	4200
trusses	2 @	66,000	=	132,000
shoes			=	3900
expansion joints to say			=	1,000
				209,180 kg

Call this 210.0 kg tons

For 13 spans @ 210 = 2,730. kg tons.

Summary of steel for whole bridge

13 - Arch spans	2730.
1 - simple span	113
	2843 kg tons

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CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi Ken.

Deflection of Truss at each panel point for full live load and a concentration at center of span
Live Load stress due to full load and single concentration at center of span.

Top chord	stress	Hangers	stress	middle chord	stress	Bottom chord	stress
U_0-U_1	− 87,330	$U_1-M_1-L_1$	+ 6,570	U_0-M_2	+ 63,370	L_1-L_3	+ 32,820
U_1-U_2	− 85,630	U_2-M_2	+ 6,040				
U_2-U_3	− 83,770	$U_3-M_3-L_3$	+ 5,670	U_2-M_4	+ 33,210	L_3-L_5	+ 59,110
U_3-U_4	− 82,550	U_4-M_4	+ 5,430				
U_4-U_5	− 81,270	$U_5-M_5-L_5$	+ 5,280	U_4-M_6	+ 11,390	L_5-L_7	+ 75,950
U_5-U_6	− 80,620	U_6-M_6	+ 5,190				
U_6-U_7	− 80,280	$U_7-M_7-L_7$	+ 5,100				

Diagonals	stress	Hangers	stress	End post	stress
U_0-L_1	+ 21,290	M_2-L_2	+ 7,310	U_0-L_0	− 49,750
L_1-M_2	− 20,080	M_4-L_4	+ 7,310		
M_2-L_3	+ 18,030	M_6-L_6	+ 7,310		
L_3-M_4	− 15,320				
M_4-L_5	+ 12,270				
L_5-M_6	− 8,930				
M_6-L_7	+ 5,480				

$E = 2{,}100{,}000$ kg/cm²

members	Length l cm	Gross area A cm²	$\frac{l}{EA}$	D.L. stress S_1 kg	L.L. stress S_2 kg	$\frac{S_1 l}{EA}$	$\frac{S_2 l}{EA}$
U_0-U_1	498.2	292.5	0.812 ÷ 1,000,000	− 199,700	− 87,330	− 0.1621	− 0.0708
U_1-U_2	484.0	"	0.788	− 194,000	− 85,630	− 0.1530	− 0.0675
U_2-U_3	473.1	"	0.770	− 189,600	− 83,770	− 0.1496	− 0.0662
U_3-U_4	464.8	"	0.755	− 187,000	− 82,550	− 0.1412	− 0.0623
U_4-U_5	458.9	"	0.747	− 184,000	− 81,270	− 0.1373	− 0.0606
U_5-U_6	455.1	"	0.742	− 182,500	− 80,620	− 0.1353	− 0.0598
U_6-U_7	453.2	"	0.738	− 181,600	− 80,280	− 0.1341	− 0.0592
U_1-L_1	557.4	76.0	3.494	+ 12,870	+ 6,570	+ 0.0449	+ 0.0230
U_2-M_2	377.8	111.6	1.612	+ 10,680	+ 6,040	+ 0.0172	+ 0.0097
U_3-L_3	864.1	76.0	5.410	+ 9,650	+ 5,670	+ 0.0522	+ 0.0307
U_4-M_4	618.3	"	3.875	+ 9,300	+ 5,430	+ 0.0360	+ 0.0211
U_5-L_5	1,041.8	"	6.522	+ 8,930	+ 5,280	+ 0.0582	+ 0.0344
U_6-M_6	735.5	"	4.605	+ 8,750	+ 5,190	+ 0.0403	+ 0.0239
U_7-L_7	1,100.0	"	6.890	+ ½ · 8,550	+ ½ · 5,100	+ 0.0295	+ 0.0176
U_0-M_2	906.0	218.2	1.973	+ 137,800	+ 63,370	+ 0.2719	+ 0.1250
M_2-M_4	906.0	135.0	3.200	+ 63,900	+ 33,210	+ 0.2041	+ 0.1063
M_4-M_6	906.0	83.16	5.190	+ 16,380	+ 11,390	+ 0.0850	+ 0.0591
L_1-L_3	906.0	132.0	3.270	+ 83,600	+ 32,820	+ 0.2735	+ 0.1074
L_3-L_5	906.0	224.0	1.928	+ 145,200	+ 59,110	+ 0.2800	+ 0.1141
L_5-L_7	906.0	280.4	1.540	+ 177,500	+ 75,950	+ 0.2730	+ 0.1165
U_0-L_1	572.5	109.44	2.498	+ 55,300	+ 21,290	+ 0.1380	+ 0.0531
L_1-M_2	572.5	"	2.498	− 50,200	− 20,080	− 0.1252	− 0.0502
M_2-L_3	572.5	83.16	3.280	+ 43,200	+ 18,030	+ 0.1418	+ 0.0592
L_3-M_4	572.5	"	3.280	− 34,700	− 15,320	− 0.1138	− 0.0502
M_4-L_5	572.5	76.00	3.588	+ 25,400	+ 12,270	+ 0.0911	+ 0.0440
L_5-M_6	572.5	"	3.588	− 15,450	− 8,930	− 0.0554	− 0.0320
M_6-L_7	572.5	"	3.588	+ 5,270	+ 5,480	+ 0.0189	+ 0.0198
M_2-L_2	350.0	111.6	1.495	+ 15,000	+ 7,310	+ 0.0224	+ 0.0109
M_4-L_4	350.0	76.00	2.194	+ 15,000	+ 7,310	+ 0.0329	+ 0.0160
M_6-L_6	350.0	"	2.194	+ 15,000	+ 7,310	+ 0.0329	+ 0.0160
U_0-L_0	350.0	292.50	0.570	− 127,000	− 49,750	− 0.0724	− 0.0284

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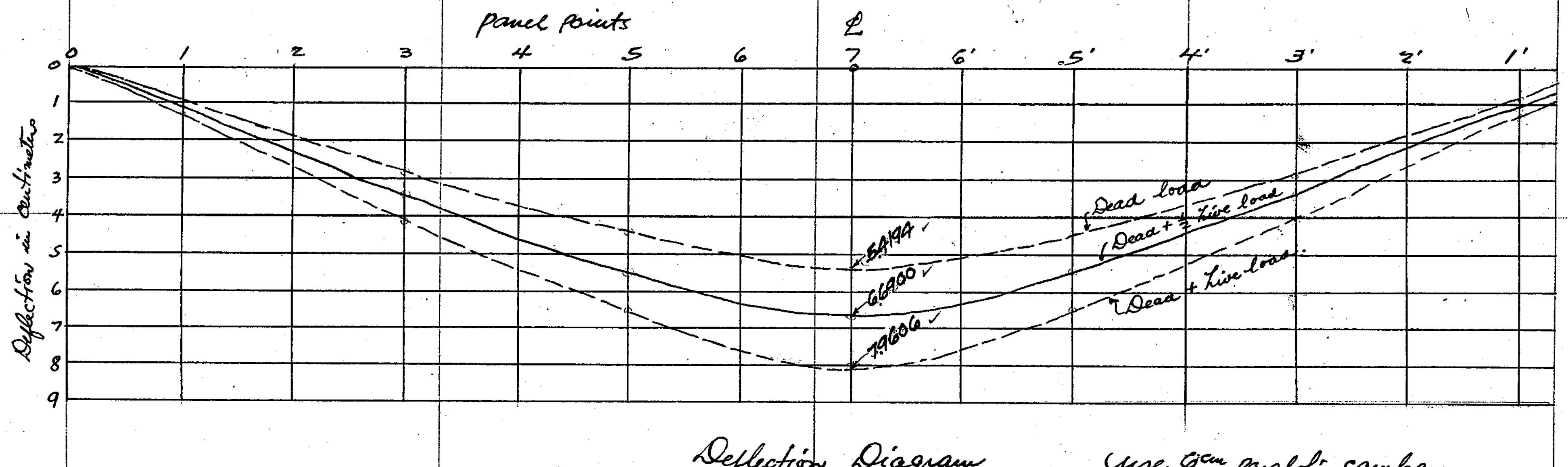
CALCULATIONS FOR

Design of Kiso-gawa Bashi for Aichi-Ken.

Deflection of Truss at panel points.

members	D.L.	L.L.	Vertical Deflection												Hor. Deflection		
			Panel pt. 1			Panel pt. 3			Panel pt. 5			Panel pt. 7			Panel pt. 0' (end)		
	$\frac{S_1 l}{EA}$	$\frac{S_2 l}{EA}$	u_1	$\frac{S_1 l u_1}{EA}$	$\frac{S_2 l u_1}{EA}$	u_3	$\frac{S_1 l u_3}{EA}$	$\frac{S_2 l u_3}{EA}$	u_5	$\frac{S_1 l u_5}{EA}$	$\frac{S_2 l u_5}{EA}$	u_7	$\frac{S_1 l u_7}{EA}$	$\frac{S_2 l u_7}{EA}$	u_h	$\frac{S_1 l u_h}{EA}$	$\frac{S_2 l u_h}{EA}$
U0-U1	-.1621	-.0708	-.228	.0370	.0161	-.681	.1105	.0482	-1.133	.1838	.0802	-1.585	.2568	.1122			
U1-U2	-.1530	-.0675	-.221	.0338	.0149	-.661	.1011	.0446	-1.100	.1682	.0742	-1.540	.2358	.1038			
U2-U3	-.1496	-.0662	-.216	.0323	.0143	-.646	.0986	.0428	-1.076	.1610	.0711	-1.505	.2250	.0995			
U3-U4	-.1412	-.0623	-.212	.0300	.0132	-.635	.0896	.0396	-1.075	.1520	.0670	-1.479	.2089	.0921			
U4-U5	-.1373	-.0606	-.210	.0288	.0127	-.627	.0861	.0379	-1.043	.1435	.0632	-1.460	.2002	.0885			
U5-U6	-.1353	-.0598	-.208	.0282	.0125	-.622	.0842	.0372	-1.035	.1402	.0619	-1.448	.1959	.0866			
U6-U7	-.1341	-.0592	-.207	.0278	.0123	-.619	.0830	.0366	-1.031	.1382	.0610	-1.442	.1935	.0854			
U1-L1	+.0449	+.0230	+.017	.0008	.0004	+.050	.0022	.0012	+.085	.0038	.0020	+.118	.0053	.0027			
U2-M2	+.0172	+.0097	+.016	.0003	.0002	+.047	.0008	.0005	+.077	.0013	.0007	+.108	.0019	.0010			
U3-L3	+.0522	+.0307	+.014	.0007	.0004	+.044	.0023	.0014	+.073	.0038	.0022	+.103	.0053	.0032			
U4-M4	+.0360	+.0211	+.014	.0005	.0003	+.042	.0015	.0009	+.070	.0025	.0015	+.097	.0035	.0020			
U5-L5	+.0582	+.0344	+.014	.0008	.0005	+.040	.0023	.0014	+.068	.0040	.0023	+.095	.0055	.0038			
U6-M6	+.0403	+.0239	+.013	.0005	.0003	+.040	.0016	.0009	+.066	.0027	.0016	+.093	.0037	.0022			
U7-L7	+.0295	+.0176	+.013	.0004	.0002	+.040	.0012	.0007	+.066	.0020	.0012	+.092	.0027	.0016			
U0-M2	+.2719	+.1250	-.318	-.0864	-.0398	+.339	.0921	.0424	+.993	.2697	.1240	+1.648	.4475	.2060			
U2-M4	+.2041	+.1063	-.136	-.0278	-.0145	-.416	-.0850	-.0443	+.602	.1227	.0640	+1.616	.3300	.1715			
M4-M6	+.0850	+.0591	-.031	-.0026	-.0018	-.099	-.0084	-.0059	-.170	-.0145	-.0105	+1.053	.0896	.0623			
L1-L3	+.2735	+.1074	+.424	.1160	.0456	+.626	.1712	.0673	+.183	.0500	.0197	-.261	-.0713	-.0280	+1.000	.2735	.1074
L3-L5	+.2800	+.1141	+.282	.0790	.0322	+.848	.2375	.0968	+.769	.2160	.0878	+.043	.0120	.0049	+1.000	.2800	.1141
L5-L7	+.2730	+.1165	+.213	.0582	.0248	+.641	.1751	.0780	+1.072	.2920	.1248	+.855	.2335	.0996	+1.000	.2730	.1165
U0-L1	+.1380	+.0531	+.663	.0913	.0352	+.355	.0490	.0189	+.046	.0064	.0024	-.262	.0363	-.0139			
L1-M2	-.1252	-.0502	+.128	-.0160	-.0064	-.437	.0546	.0219	-.185	.0232	.0093	+.069	-.0087	-.0035			
M2-L3	+.1418	+.0592	-.102	-.0144	-.0060	+.514	.0728	.0304	+.311	.0441	.0184	+.108	.0153	.0064			
L3-M4	-.1138	-.0502	+.079	-.0090	-.0040	+.232	-.0264	-.0117	-.430	.0489	.0216	-.276	.0314	.0139			
M4-L5	+.0911	+.0440	-.056	-.0051	-.0025	-.164	-.0149	-.0072	+.545	.0496	.0240	+.435	.0396	.0191			
L5-M6	-.0554	-.0320	+.033	-.0018	-.0011	+.098	-.0054	-.0031	+.162	-.0090	-.0052	-.591	.0328	.0189			
M6-L7	+.0189	+.0198	-.012	-.0002	-.0002	-.033	-.0006	-.0007	-.054	-.0010	-.0011	+.746	.0141	.0148			
M2-L2	+.0224	+.0109	.000	.0000	.0000	.000	.0000	.0000	.000	.0000	.0000	.000	.0000	.0000			
M4-L4	+.0329	+.0160	.000	.0000	.0000	.000	.0000	.0000	.000	.0000	.0000	.000	.0000	.0000			
M6-L6	+.0329	+.0160	.000	.0000	.0000	.000	.0000	.0000	.000	.0000	.0000	.000	.0000	.0000			
U0-L0	-.0724	-.0284	-.500	.0362	.0145	-.500	.0362	.0145	-.500	.0362	+.0145	-.500	.0362	.0145			
Summary for one-half of span				+.6028	+.2506		+1.5515	+.6641		+2.2658	+1.0006		+2.826	+1.3110			
				-.1633	-.0753		-.1407	-.0729		-.0245	-.0168		-.01163	-.0404			
				.4395	.1753		1.4108	.5912		2.2413	0.9838		2.7097	1.2706			
Summary for one span				.8790	.3506		2.8216	1.1824		4.4826	1.9676		5.4194	2.5412		+.8265	+.3380
Total for D.L.+L.L.				+1.2296 cm			+4.0040 cm			+6.4502 cm			+7.9606 cm			1.6530	.6760
" " D.L.+ ½ L.L.				+1.0543			+3.4128			+5.4664			+6.6900			+2.3290 cm	
																+1.9910	



Deflection Diagram   Use 9cm parabolic camber.

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CALCULATIONS FOR

Material list for Kisogawa-Bashi Aichiken (Simple span)

No.	Description.	Section in Mm.	Length in Mm.	Wt. of One Meter.	Wt. of Main Section in kgs.	Wt. of Details in kgs.	Total wts.	Remarks.
			END POST	Lo-Uo	kgs. 2 Req'd.			
2	Ls	100x100x10	4,500	14.91	134.2			
2	〃	〃	3,290	〃	98.1			
2	Pls	470 x 13	2,140	47.964	205.3			
2	〃	650 x 13	1,170	66.333	155.2			
1	Cov Pl.	660 x 13	3,570	67.353	240.5			
1	〃	〃	990	〃	66.7			
2	Pls	160 x 10	470	12.560		kgs. 11.8		
2	〃	〃	275	〃		6.9		
1	Pl.	320 x 10	660	25.120		16.6		
4	Ls	90x90x10	320	13.34		17.1		
2	Pls	160 x 10	470	12.560		11.8		
2	〃	275 x 10	320	21.588		13.8		
1	Bent Pl	660 x 10	680	51.810		35.2		
2	Ls	100x100x10	780	14.91		23.3		
1	Tie Pl.	305 x 10	660	23.943		15.8		
6	Lac Bars.	70 x 13	875	7.144		37.5		
2	Washers.	70φ x 13		@ 0.393		0.8		
					900.0 +	190.6 =	kgs. 1,090.6	
							x 2	
							2,181.2	
		TOP	CHORD	Uo-U1	2 Req'd.			
4	Ls	100x100x10	2,994	14.91	178.6			
2	Pls	470 x 13	2,994	47.964	287.3			
1	Cov Pl.	660 x 13	2,994	67.353	201.7			
1	Pl.	320 x 10	660	25.120		16.6		
4	Ls	90x90x10	320	13.34		17.1		
2	Pls	275 x 10	320	21.588		13.8		
1	Tie Pl.	380 x 10	660	29.830		19.7		
8	Lac Bars.	70 x 13	875	7.144		50.0		
2	Washers.	70φ x 13		@ 0.393		0.8		
2	Pls.	95 x 10	320	7.458		4.8		
					667.6 +	122.8 =	790.4	
							x 2	
							1,580.8	
		TOP	CHORD	U1-U3	2 Req'd.			
1	Cov Pl.	660 x 13	9,918	67.353	668.1			
4	Ls.	100x100x10	9,918	14.91	591.6			
2	Pls.	470 x 13	9,918	47.964	951.6			
2	〃	900 x 13	1,930	91.845		354.5		
2	〃	800 x 13	1,630	81.640		266.1		
1	Pl.	660 x 13	790	67.353		53.2		
4	Ls.	90x90x13	640	13.34		34.2		
4	Fills	170 x 3	320	4.004		5.1		
2	Pls	270 x 10	340	21.195		14.4		
2	Fills.	270 x 13	245	27.554		13.5		
2	Pls.	95 x 10	340	7.458		5.1		
2	〃	430 x 13	470	43.882		41.2		
2	Tie Pls.	605 x 10	660	47.493		62.6		
1	〃	455 x 10	660	35.718		23.6		
1	〃	380 x 10	660	29.830		19.7		
16	Lac Bars.	70 x 13	890	7.144		101.7		

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CALCULATIONS FOR

Material list for Kisogawa-Bashi Aichiken (Simple span)

4	Washers	70φ × 13		@ 0.393		1.6
					2,211.3 + 996.5 =	3,207.8
					×	2
						6,415.6
		TOP	CHORD	U_3-U_5	Σ Req'd.	
1	Cov Pl.	660 × 13	9.068	67.353	610.9	
4	Ls	100.100 × 13	9.068	19.08	692.2	
2	Pls	470 × 13	9.068	47.964	870.1	
2	"	270 × 13	9.068	27.554	499.8	
2	"	800 × 13	1.540	81.640		251.5
1	Pl.	660 × 13	790	67.353		53.2
4	Ls	90.90 × 13	640	17.04		43.6
2	Pls	270 × 13	640	27.554		35.3
2	"	430 × 13	470	43.882		41.2
2	Tie Pls	605 × 10	660	47.493		62.7
2	"	455 × 10	660	35.718		47.1
16	Lac Bars	70 × 13	890	7.144		101.7
4	Washers	70φ × 13		@ 0.393		1.6
2	Pls	95 × 10	340	7.458		5.1
					2,673.0 + 643.0 =	3,316.0
					×	2
						6,632.0
		TOP	CHORD	U_5-U_7	Σ Req'd.	
1	Cov Pl.	660 × 13	9.068	67.353	610.9	
4	Ls	100.100 × 13	9.068	19.08	692.2	
2	Pls	470 × 13	9.068	47.964	870.1	
2	"	270 × 13	9.068	27.554	499.8	
2	Tie Pls	605 × 10	660	47.493		62.7
2	"	455 × 10	660	35.718		47.1
8	Lac Bars	70 × 13	890	7.144		50.9
8	"	"	875	"		50.0
4	Washers	70φ × 13		@ 0.393		1.0
2	Pls	430 × 13	470	43.882		41.2
					2,673.0 + 253.5 =	2,926.5
					×	2
						5,853.0
		TOP	CHORD	U_7-U_9	Σ Req'd.	
1	Cov Pl.	660 × 13	8.873	67.353	597.8	
4	Ls	100.100 × 10	8.873	14.91	529.3	
2	Pls	470 × 13	8.263	47.964	792.8	
2	"	900 × 13	1.920	91.845		352.7
2	"	430 × 13	470	43.882		41.2
2	Tie Pls	605 × 10	660	47.493		62.7
2	"	380 × 10	660	29.830		39.4
8	Lac Bars	70 × 13	875	7.144		50.0
8	"	"	860	"		49.2
4	Washers	70φ × 13		@ 0.393		1.6
1	Pl.	660 × 13	790	67.353		53.2
4	Ls	90.90 × 13	640	17.04		43.6
4	Fills	170 × 3	320	4.004		5.1
2	Pls	270 × 10	340	21.195		14.4
2	Fills	270 × 13	245	27.554		13.5

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CALCULATIONS FOR

Material list for Kisogawa-Bashi, Aichiken (Simple span)

2	Pls.	95 x 10	340	7.458		5.1
					1,919.9 + 731.7 =	2,651.6
						x 2
						5,303.2
		END	POST	L9-U9		2 Req'd.
2	Ls	100x100x10	3.030	14.91	90.4	
2	"	"	4.220	"	125.8	
2	Pls	470 x 13	2.025	47.964	194.3	
1	Cov Pl	660 x 13	3.285	67.353	221.3	
1	"	"	990	"	66.7	
2	Pls	830 x 13	980	84.702		166.0
2	"	985 x 13	1.285	100.510		258.3
2	"	275 x 10	460	21.588		19.9
2	Ls	100x100x10	100	14.91		3.0
2	"	100x90x10	1.075	14.13		30.4
1	Pl.	320 x 10	660	25.120		16.6
2	Ls	100x100x10	780	14.91		23.3
2	Pls	275 x 10	310	21.588		13.4
2	"	"	620	"		26.8
2	Tie Pls.	530 x 10	660	41.605		54.9
4	Lac. Bars.	70 x 13	820	7.144		23.4
2	Washers.	70φ x 13		@ 0.393		0.8
					698.5 + 636.8 =	1,335.3
						x 2
						2,670.6
		Summary of	Top chords		30,636.4 Kgs.	
		BOTTOM	CHORD	L0-L2		2 Req'd.
2	Pls.	470 x 10	7.250	36.895	535.0	
4	Ls.	100x100x10	7.635	14.91	455.4	
2	Pls	1,300 x 13	1.445	132.665		383.4
2	"	990 x 13	1.145	101.030		231.4
2	"	755 x 10	1.120	59.268		132.8
1	Pl	590 x 13	1.060	60.210		63.8
1	"	"	795	"		47.9
2	Fills	270 x 10	440	21.195		18.7
2	Pls	470 x 10	615	36.895		45.4
2	Fills	270 x 10	385	21.195		16.3
4	"	85 x 10	385	6.673		10.3
2	Pls	270 x 10	315	21.195		13.4
4	"	85 x 12	465	8.007		14.9
1	Tie Pl.	370 x 9	455	26.141		11.9
1	"	"	380	"		9.9
13	Tie Pls	230 x 9	370	16.250		78.2
1	Pl	335 x 9	790	23.608		18.7
1	L.	100x75x10	540	12.95		7.0
1	Pl.	510 x 9	665	36.032		24.0
2	Pls.	360 x 9	535	25.434		27.2
					990.4 + 1,155.2 =	2,145.6
						x 2
						4,291.2

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Material list for Kisogawa-Bashi Jaichiken (Simple span)

BOTTOM CHORD L_2-L_4 2 Req'd.

4	Ls.	100.100.10	8.895	14.19	530.5	
2	Pls	470 x 10	8.895	36.895	656.4	
2	〃	〃	8.585	〃	633.5	
2	〃	270 x 10	7.910	21.195	335.3	
2	〃	470 x 10	1.235	36.895		91.1
2	〃	〃	615	〃		45.4
2	〃	450 x 12	785	42.390		66.6
2	〃	350 x 9	535	24.728		26.5
2	Fills	390 x 3	450	9.185		8.3
2	Pls	980 x 13	1.790	100.009		358.0
1	Pl.	590 x 13	1.060	60.210		63.8
1	〃	〃	795	〃		47.9
1	〃	655 x 9	1.115	46.276		51.6
1	〃	510 x 9	655	36.032		23.6
12	Tie Pls.	230 x 9	350	16.250		68.3

2,155.7 + 851.1 = 3,006.8
× 2
6,013.6

BOTTOM CHORD L_4-L_5 2 Req'd.

4	Ls.	100.100.13	6.885	19.08	525.5	
2	Pls	470 x 10	6.885	36.895	508.0	
2	〃	〃	6.265	〃	462.3	
2	〃	270 x 13	6.885	27.554	379.4	
2	〃	470 x 10	1.235	36.895		91.1
2	〃	〃	615	〃		45.4
2	〃	445 x 14	935	48.906		91.5
2	〃	810 x 13	1.640	82.661		271.1
1	Pl.	590 x 13	1.060	60.210		63.8
1	〃	〃	795	〃		47.9
1	〃	655 x 9	1.110	46.276		51.4
1	〃	510 x 9	655	36.032		23.6
7	Tie Pls.	230 x 9	350	16.250		39.8
2	Pls.	350 x 9	535	24.728		26.5

1,875.2 + 752.1 = 2,627.3
× 2
5,254.6

BOTTOM CHORD L_5-L_6 2 Req'd.

4	Ls.	100.100.13	5.125	19.08	391.1	
2	Pls.	470 x 10	5.125	36.895	378.2	
2	〃	〃	4.505	〃	332.4	
2	〃	270 x 13	5.125	27.554	282.4	
2	〃	470 x 10	1.235	36.895		91.1
2	〃	〃	615	〃		45.4
4	〃	85 x 12	465	8.007		14.9
2	〃	350 x 9	535	24.728		26.5
2	Fills	85 x 3	230	2.002		0.9
2	Pls	915 x 13	1.715	93.376		320.3
1	〃	655 x 9	1.110	46.276		51.4
4	Tie Pls.	230 x 9	350	16.250		22.8

1,384.1 + 573.3 = 1,957.4
× 2
3,914.8

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CALCULATIONS FOR

Material list for Kisogawa-Bashi, Aichiken, (Simple span)

BOTTOM CHORD L6-L8 — 2 Req'd.

4	Ls.	100x100x10	8.285	14.91	494.1	
2	Pls.	470 x 10	8.285	36.895	611.4	
2	〃	〃	7.975	〃	588.5	
1	Pl.	590 x 13	795	60.210		47.9
1	〃	〃	1.060	〃		63.8
2	Pls.	1,060 x 13	2.030	108.173		439.2
4	Fills.	270 x 10	440	21.195		37.3
1	Pl.	510 x 9	655	36.032		23.6
1	〃	655 x 9	815	46.276		37.7
1	〃	310 x 9	360	21.902		7.9
12	Tie Pls.	230 x 9	350	16.250		68.3

1,694.0 + 725.7 = 2419.7
× 2
4,839.4

BOTTOM CHORD L8-L9 — 2 Req'd.

4	Ls.	100,100x10	3.640	14.91	217.1	
2	Pls.	470 x 10	3.405	36.895	251.3	
2	〃	605 x 10	1.120	47.493		106.4
2	〃	850 x 13	1.590	86.743		275.8
2	〃	690 x 13	1.215	70.415		171.1
1	Fill	75 x 13	155	7.654		1.2
1	Pl	335 x 9	790	23.668		18.7
1	L	100x75x10	475	12.95		6.2
5	Tie Pls.	230 x 9	370	16.250		30.1
1	〃	370 x 9	375	26.141		9.8
1	〃	〃	400	〃		10.5

468.4 + 629.8 = 1,098.2
× 2
2,196.4

DIAPHRAGM AT L0 & L9 — 4 Req'd.

4	Ls	125x90x10	885	16.09	57.0
1	Pl	370 x 9	885	26.141	23.1
4	Ls	100x100x10	360	14.910	21.5
4	Fills.	100 x 10	195	7.850	6.1

107.7
× 4
430.8

DIAPHRAGM DM1 — 2 Req'd.

4	Ls	125x90x10	440	16.09	28.3
1	Pl	350 x 9	440	24.728	10.9
2	Ls	100x100x10	150	14.910	4.5

43.7
× 2
87.4

DIAPHRAGM DM2 — 8 Req'd.

4	Ls	125x90x10	440	16.09	28.3
1	Pl	330 x 9	440	23.315	10.3
2	Ls	100x100x10	150	14.910	4.5

43.1
× 8
344.8

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			DIAPHRAGM	DM3	6 Req'd.	
4	L	125 x 90 x 10	440	16.09	28.3	
1	Pl.	330 x 9	440	23.315	10.3	
2	L	100 x 100 x 10	150	14.910	4.5	
						43.1
						x 6
						258.6
			FILLER (Under Floor beams)			
16	Fills	260 x 10	260	20.410	84.9	
4	"	210 x 10	335	16.485	22.1	
						107.0
			Summary of Bottom-chords	27.738.6 Kgs.		

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CALCULATIONS FOR

Material list for Kisogawa-Bashi, Aichiken (Simple span)

DIAGONAL L0-U1 2 Req'd.

2	Ls	100.100.13	4825	19.08	184.1	
2	〃	〃	4675	〃	178.4	
2	Pls	370 × 13	4825	37.759	364.4	
4	〃	360 × 9	390	25.434		39.7
2	Ls	100.100.13	155	19.08		5.9
4	〃	〃	230	〃		17.6
2	〃	〃	305	〃		11.6
39	Lac. Bars.	70 × 9	370	4.946		71.4
1	Washer	70φ × 9		0.272		0.3

726.9 + 146.5 = 873.4
× 2
1,746.8

DIAGONAL U1-L2 2 Req'd.

2	Ls	150.90.15	4960	26.49	262.8	
2	〃	〃	4790	〃	253.8	
2	Pls.	385 × 9	390	27.200		21.2
15	Lac. Bars.	70 × 9	410	4.946		30.4

516.6 + 51.6 = 568.2
× 2
1,136.4

DIAGONAL L2-U3 2 Req'd.

2	Ls	150.90.12	4810	21.47	206.5	
2	〃	〃	4730	〃	203.1	
15	Lac. Bars.	70 × 9	410	4.946		30.4
2	Pls.	385 × 9	390	27.200		21.2

409.6 + 51.6 = 461.2
× 2
922.4

DIAGONAL U3-L4, L4-U5, & U5-L6 6 Req'd.

2	Ls	125.90.10	4890	16.09	157.4	
2	〃	〃	4770	〃	153.5	
2	Pls	385 × 9	390	27.200		21.2
15	Lac. Bars.	70 × 9	410	4.946		30.4

310.9 + 51.6 = 362.5
× 6
2,175.0

DIAGONAL L6-U7 2 Req'd.

2	Ls	150.90.12	4870	21.47	209.1	
2	〃	〃	4670	〃	200.5	
2	Pls.	385 × 9	390	27.200		21.2
15	Lac. Bars.	70 × 9	410	4.946		30.4

409.6 + 51.6 = 461.2
× 2
922.4

DIAGONAL U7-L8 2 Req'd.

2	Ls	150.90.15	4850	26.49	257.0	
2	〃	〃	4730	〃	250.6	
2	Pls	320 × 9	4850	22.608	219.3	
2	〃	370 × 9	470	26.141		24.6

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CALCULATIONS FOR

Material list for Kisogawa-Bashi, Aichiken (Simple span)

14	Lac. Bars	70 x 9	390	4.946		27.0
					726.9 +	51.0 = 778.5
						x 2
						1,557.0
	DIAGONAL			L8-U9	2 Req'd.	
2	Ls	100x100x13	4650	19.08	177.4	
2	"	"	4500	"	171.7	
2	Pls.	370 x 13	4800	37.759	362.5	
3	"	360 x 9	390	25.434		29.8
1	Pl.	"	370	"		9.4
4	Ls	100x100x13	230	19.08		17.6
2	"	"	155	"		5.9
41	Lac. Bars	70 x 9	370	4.946		75.0
1	Washer	70ϕ x 9		@ 0.272		0.3
					711.6 +	138.0 = 849.6
						x 2
						1,699.2
	Summary of Diagonals			10,159.2 Kgs.		
	VERTICALS	L1-U1, L3-U3, L5-U5, & L7-U7			8 Req'd.	
4	Ls	125x90x10	3405	16.09	219.1	
1	Pl.	385 x 9	870	27.200		23.7
1	"	"	470	"		12.8
8	Lac. Bars	70 x 9	410	4.946		16.2
					219.1 +	52.7 = 271.8
						x 8
						2,174.4
	VERTICALS	L2-U2, & L8-U8			4 Req'd.	
4	Ls	125x90x10	3405	16.09	219.1	
1	Fill.	155 x 13	260	15.818		4.1
	Same as L1-U1 details					52.7
					219.1 +	56.8 = 275.9
						x 4
						1,103.6
	VERTICALS	L4-U4 & L6-U6			2 Req'd.	
8	Ls	125x90x10	3405	16.09	438.3	
1	Fill	235 x 13	260	23.982		6.2
1	"	260 x 13	405	26.533		10.7
	Same as L1-U1 details				52.7 x 2 =	105.4
					438.3 +	122.3 = 560.6
						x 2
						1,121.2
	Summary of Verticals			4399.2 Kgs.		

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CALCULATIONS FOR

Material list for Kisogawa-Bashi. Aichi-Ken (Simple span)

			END FLOOR BEAMS	FB1 R/L	2 Req'd.		
4	Ls	100×90×10	8,040	14.13	454.4		
1	Web Pl.	800 × 9	8,040	56.52	454.4		
2	Cov. Pls.	240 × 9	5,420	16.956	183.8		
4	Ls	150×100×9	790	17.02		53.8	
16	"	75×75×9	810	9.96		129.1	
10	"	100×75×10	790	12.95		102.3	
4	Fills.	220 × 10	625	17.27		43.2	
10	"	75 × 10	625	5.888		36.8	
5	"	100 × 10	300	7.85		11.8	
					1092.6 +	377.0 =	1469.6
							× 2
							2,939.2
			INTERMEDIATE FLOOR BEAMS	FB2. & FB3		8 Req'd.	
4	Ls	125×90×10	8,060	16.090	518.7		
1	Web.Pl.	800 × 9	8,060	56.520	455.6		
2	Cov. Pls	280 × 9	5,420	19.782	214.4		
4	Ls	150×100×9	1,045	17.020		71.1	
10	"	100×75×10	790	12.950		102.3	
8	"	75×75×9	810	9.960		64.5	
4	Fillers	145 × 10	240	11.383		10.9	
2	"	145 × 9	240	10.244		4.9	
4	"	220 × 10	625	17.270		43.2	
10	"	75 × 10	625	5.888		36.8	
10	"	100 × 10	300	7.850		23.6	
					1,188.7 +	357.3 =	1,546.0
							× 8
							12,368.0
			BRACKETS	R1 R/L	10 Req'd.		
2	Ls	75×75×9	295	9.96		5.9	
1	Pl.	315 × 9	400	22.255		8.9	
							14.8
							× 10
							148.0
			GUSSET PLATES		1 Req'd.		
1	(P1)	870 × 9	930	61.466		57.2	
2	(P2)	760 × 9	930	53.694		99.9	
1	(P3)	815 × 9	930	57.580		53.5	
1	(P4)	575 × 9	930	40.624		37.8	
							248.4
			Summary of Floor beams		15,703.6 kgs.		
			STRINGERS	S1 & S2 R/L	45 Req'd.		
1	I	350×150 @58.54	4,490		262.8		
2	Ls	100×100×10	305	14.910		9.1	
					262.8 +	9.1 =	271.9
							× 45
							12,235.5
			Summary of Stringers		12,235.5 kgs.		

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CALCULATIONS FOR

Material list for Kisogawa-Bashi Aichiken (Simple Span)

BOTTOM LATERALS — 1 Req'd.

4	Ls	130x130x9	5505	17.73	390.4	
4	〃	〃	5355	〃	379.8	
4	〃	〃	5525	〃	391.8	
4	〃	〃	5675	〃	402.5	
10	〃	100x100x10	5490	14.91	818.6	
10	〃	〃	5640	〃	840.9	
18	〃	150x100x9	205	17.02		62.8
18	〃	75x75x9	435	9.96		78.0
8	Pls	170 x 11	170	14.680		20.0
10	〃	150 x 10	170	11.775		20.0
					3,224.0 +	180.8 = 3,404.8

Summary of Bottom laterals 3,404.8 Kgs

ROLLER SHOE RS1 — 2 Req'd.

1	Cast steel shoe RS1.	@ 170.0		170.0
1	〃 〃 Sole pl. SP1.	@ 155.0		155.0
2	〃 〃 Dust guard DG2	@ 19.0		38.0
4	Tapped bolts 12φ x 40	@ 0.07		0.3
2	Pl (dust guard) 132 x 8 x 760		8.29	12.6
10	Tapped bolts 6φ x 25	@ 0.01		0.1
4	Bolts 22φ x 45	@ 0.28		1.1
4	Rollers 100φ x 750		61.65	185.0
2	Pls 80x13x410		8.164	6.7
4	Pins 22φ x 50	@ 0.13		0.5
4	〃 22φ x 50	@ 0.15		0.6
4	Anchor bolts 40φ x 950	@ 9.8		39.2
1	Pin & Nuts 120φ x 601	@ 57.0		57.0
				666.1
				x 2
				1,332.2

FIXED SHOE FS1 — 2 Req'd.

1	Cast steel shoe FS1	@ 270.0	270.0
4	Anchor bolts 40φ x 950	@ 9.8	39.2
1	Pin & Nuts 120 x 601	@ 57.0	57.0
			366.2
			x 2
			732.4

BED PLATES BP1 & BP2 — 1 Req'd.

2	Cast steel pls BP1.	@ 167.0	334.0
2	〃 〃 〃 BP2.	@ 117.0	234.0
			568.0

Summary of Shoes 2,632.6 Kgs.

RIVET HEADS

29,820	Shop rivet heads for 22φ	@ 0.0964	2,874.6
14,090	Field 〃 〃 〃 〃	@ 〃	1,358.3
15,100	Shop 〃 〃 for 19φ	@ 0.0646	975.5
830	Field 〃 〃 〃 〃	〃	53.6
			5,262.0

Summary of Rivet heads 5,262.0 Kgs.

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CALCULATIONS FOR

Material list for Kisogawa-Bashi Aichi-Ken (Simple Span) 5-7-31

Total Summary for Simple Span.

Summary of	Kgs	Kgs
Top chords.	30,636.4	72,933.4
Bottom chords.	27,738.6	
Diagonals.	10,159.2	
Verticals.	4,399.2	
Floor beams.	15,703.6	
Stringers	12,235.5	
Bottom laterals	3,404.8	
Expansion on abutment. (see page no. M27)	866.7	
	105,144.0	
Rivet heads.	5,262.0	
	110,406.0	
Shoes.	2,632.6	Kgtons.
	113,038.6 or	113.039

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CALCULATIONS FOR

Material list for Kisogawa-Bashi, Aichiken (arch span)

No.	Description.	Section in Mm.	Length in Mm.	Wt. of One Meter.	Wt. of Main Section in Kgs.	Wt. of Details in Kgs.	Total wts.	Remarks.
		END	POST Lo-Uo		4 Req'd (for 1 span)			
1	Cov Pl.	650 × 13	2900	66.333	192.4			
2	∟s	100×100×10	3845	14.91	114.7			
2	〃		3080	〃	91.8			
2	Pls.	550 × 12	2080	51.810	215.5			
1	Cov Pl.	650 × 13	950	66.333	63.0			
2	∟s	100×100×10	780	14.910		23.3		
2	Pls.	310 × 10	455	24.335		22.1		
2	〃	455 × 10	460	35.718		32.9		
2	〃	355 × 10	725	27.868		40.4		
2	〃	1,170 × 10	2,060	91.845		378.4		
2	〃	930 × 12	1,400	87.606		245.3		
2	∟s	100×90×10	790	14.130		22.3		
1	Pl.	650 × 13	660	66.333		43.8		
1	Tie Pl.	615 × 10	650	48.278		31.4		
1	〃	605 × 10	650	47.493		30.9		
2	Pls.	95 × 10	200	7.458		3.0		
2	Lac bars.	70 × 13	880	7.144		12.6		
2	Washers.	70φ × 13		@ 0.393		0.8		
					677.4 +	887.2 =	1,564.6	
							× 4	
							6,258.4	
		TOP	CHORD Uo-U1		4 Req'd.			
1	Cov Pl.	650 × 13	5,130	66.333	340.3			
2	∟s	100×100×10	5,120	14.91	152.7			
2	〃	〃	4815	〃	143.6			
2	Pls.	550 × 12	4020	51.810	416.6			
2	∟s	90×90×13	720	17.04		24.5		
2	〃	〃	675	〃		23.0		
2	Pls.	95 × 9	360	6.712		4.8		
1	Pl.	650 × 13	830	66.333		55.1		
2	Pls.	560 × 10	750	43.906		65.9		
2	〃	360 × 10	450	28.260		25.4		
2	Tie Pls.	605 × 10	650	47.493		61.7		
2	∟s	100×90×10	845	14.130		23.9		
6	Lac bars.	70 × 13	880	7.144		37.7		
2	Washers.	70φ × 13		@ 0.393		0.8		
					1,053.2 +	322.8 =	1,376.0	
							× 4	
							5,504.0	
		TOP	CHORD U1-U2		4 Req'd.			
1	Cov Pl.	650 × 13	4855	66.333	322.0			
2	∟s	100×100×10	4850	14.910	144.6			
2	〃	〃	4825	〃	143.9			
2	Pls.	550 × 12	4850	51.810	502.6			
1	Pl.	565 × 9	1,085	39.917		43.3		
1	〃	545 × 13	860	55.617		47.8		
2	∟s	90×90×13	710	17.04		24.2		
2	〃	〃	670	〃		22.8		
2	Pls.	560 × 10	785	43.906		68.9		
2	〃	360 × 10	480	28.260		27.1		
2	〃	95 × 9	345	6.712		4.6		
2	Tie Pls.	605 × 10	650	47.493		61.7		

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Material list for Kisogawa-Bashi, Aichiken (arch span)

10	Lac Bars	70 x 13	880	7.144		62.9
2	Washers	70φ x 13		@ 0.393		0.8

1,113.1 + 364.1 = 1,477.2
× 4
5,9088

TOP CHORD U2-U3 4 Req'd.

1	Cov Pl	650 x 13	4750	66.333	315.1	
2	Ls	100x100x10	4745	14.910	141.5	
2	"		4720	"	140.8	
2	Pls	550 x 12	4745	51.810	491.7	
2	Ls	90x90x13	740	17.04		25.2
2	Pls	95 x 9	335	6.712		4.5
1	Pl	565 x 13	850	57.658		49.0
2	Ls	90x90x13	700	17.04		23.9
1	Pl	410 x 9	925	28.967		26.8
2	Pls	560 x 10	775	43.906		68.0
2	"	360 x 10	465	28.260		26.3
2	Tie Pls	605 x 10	650	47.493		61.7
10	Lac Bars	70 x 13	880	7.144		62.9
2	Washers	70φ x 13		@ 0.393		0.8

1,089.1 + 349.1 = 1,438.2
× 4
5,7528

TOP CHORD U3-U4 4 Req'd.

1	Cov Pl	650 x 13	4665	66.333	309.4	
2	Ls	100x100x10	4660	14.91	139.0	
2	"	"	4630	"	138.1	
2	Pls	550 x 12	4660	51.810	482.9	
2	Ls	90x90x13	700	17.04		23.9
2	Pls	95 x 9	325	6.712		4.4
1	Pl	565 x 13	810	57.658		46.7
2	Ls	90x90x13	660	17.04		22.5
1	Pl	410 x 9	885	28.967		25.6
2	Pls	560 x 10	735	43.906		64.5
2	"	360 x 10	425	28.260		24.0
2	Tie Pls	605 x 10	650	47.493		61.7
10	Lac Bars	70 x 13	880	7.144		62.9
2	Washers	70φ x 13		@ 0.393		0.8

1,069.4 + 337.0 = 1,406.4
× 4
5,625.6

TOP CHORD U4-U5 4 Req'd.

1	Cov Pl	650 x 13	4605	66.333	305.5	
2	Ls	100x100x10	4605	14.91	137.3	
2	"	"	4570	"	136.3	
2	Pls	550 x 12	4605	51.810	477.2	
2	Ls	90x90x13	715	17.04		24.4
2	Pls	95 x 9	345	6.712		4.6
1	Pl	565 x 13	825	57.658		47.6
2	Ls	90x90x13	675	17.04		23.0
1	Pl	410 x 9	900	28.967		26.1
2	Pls	560 x 10	750	43.906		65.9
2	"	360 x 10	440	28.260		24.9

CALCULATIONS FOR

Material list for Kisogawa-Bashi, Aichiken (arch span)

2	Tie Pls.	605 x 10	650	47.493		61.7
10	Lac Bars.	70 x 13	880	7.144		62.9
2	Washers.	70φ x 13		@ 0.393		0.8
					1,056.3 +	341.9 = 1,398.2
						× 4
						5,592.8
		TOP	CHORD	U5-U6		4 Req'd.
1	Cov Pl.	650 x 13	4565	66.333	302.8	
2	Ls.	100x100x10	4565	14.91	136.1	
2	〃	〃	4530	〃	135.1	
2	Pls.	550 x 12	4565	51.80	472.9	
2	Ls.	90x90x13	650	17.04		22.2
2	Pls.	95 x 9	330	6.712		4.4
1	Pl.	565 x 13	835	57.658		48.1
2	Ls.	90x90x13	685	17.04		23.3
2	Pls.	560 x 10	760	43.906		66.7
2	〃	360 x 10	455	28.260		25.7
1	Pl	410 x 9	910	28.967		26.4
1	Tie Pl.	605 x 10	650	47.493		30.9
1	〃	530 x 10	650	41.605		27.0
10	Lac Bars.	70 x 13	880	7.144		62.9
2	Washers.	70φ x 13		@ 0.393		0.8
					1,046.9 +	338.4 = 1,385.3
						× 4
						5,541.2
		TOP	CHORD	U6-U7		4 Req'd.
1	Cov Pl.	650 x 13	4550	66.333	301.8	
2	Ls.	100x100x10	4550	14.91	135.7	
2	〃	〃	4510	〃	134.5	
2	Pls.	550 x 12	4550	51.80	471.4	
2	Tie Pls	530 x 10	650	41.605		54.1
10	Lac Bars.	70 x 13	880	7.144		62.9
2	Washers.	70φ x 13		@ 0.393		0.8
					1,043.4 +	117.8 = 1,161.2
						× 4
						4,644.8
		SPLICE OF	TOP CHORD	AT U7		2 Req'd.
2	Ls	90x90x13	760	17.04		25.9
2	Pls	95 x 9	405	6.712		5.4
1	Pl.	565 x 13	795	57.658		45.8
2	Ls.	90x90x13	645	17.04		22.0
1	Pl.	410 x 9	795	28.967		23.0
2	Pls	560 x 10	795	43.906		69.8
2	〃	360 x 10	485	28.260		27.4
						219.3
						× 2
						438.6

Summary of Top chords. 45,267.0 Kgs

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Material list for Kisogawa-Bashi, Aichiken (arch span)

MIDDLE CHORD $M_0 - M_2$ — 4 Req'd.

4	Ls	150x90x15	8.515	26.49	902.2	
2	Pls	320 x 13	7.950	32.656	519.2	
1	Pl.	360 x 9	520	25.434		13.2
1	"	"	370	"		9.4
1	"	"	550	"		14.0
2	Pls	320 x 22	1.500	55.264		165.8
2	"	730 x 12	1.440	68.766		198.0
2	Fills	320 x 12	520	30.144		31.3
29	Lac Bars	60 x 9	375	4.239		46.1

1,421.4 + 477.8 = 1,899.2
× 4
7,596.8

MIDDLE CHORD $M_2 - M_3$ — 4 Req'd.

4	Ls	150x90x15	4.260	26.49	451.4	
2	Pls	310 x 22	1.310	53.537		140.3
2	"	310 x 9	390	21.902		17.1
14	Lac Bars	60 x 9	400	4.239		23.7

451.4 + 181.1 = 632.5
× 4
2,530.0

MIDDLE CHORD $M_3 - M_4$ — 4 Req'd.

4	Ls	150x90x15	4.260	26.49	451.4	
2	Pls.	655 x 10	1.325	51.418		136.3
2	"	310 x 9	390	21.902		17.1
14	Lac Bars.	60 x 9	400	4.239		23.7

451.4 + 177.1 = 628.5
× 4
2,514.0

MIDDLE CHORD $M_4 - M_5$ — 4 Req'd.

4	Ls	150x90x9	4.260	16.32	278.1	
2	Pls.	310 x 13	1.010	31.636		63.9
2	"	310 x 9	390	21.902		17.1
14	Lac Bars.	60 x 9	400	4.239		23.7

278.1 + 104.7 = 382.8
× 4
1,531.2

MIDDLE CHORD $M_5 - M_6$ — 4 Req'd.

4	Ls	150x90x9	4.260	16.32	278.1	
2	Pls	720 x 10	1.250	56.520		141.3
2	"	310 x 9	390	21.902		17.1
14	Lac Bars.	60 x 9	400	4.239		23.7

278.1 + 182.1 = 460.2
× 4
1,840.8

MIDDLE CHORD $M_6 - M_7$ — 2 Req'd.

4	Ls	150x90x9	4.260	16.32	278.1	
2	Pls	310 x 10	730	24.335		35.5
2	"	310 x 9	390	21.902		17.1
14	Lac Bars.	60 x 9	400	4.239		23.7

278.1 + 76.3 = 354.4
× 2
708.8

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		MIDDLE CHORD		M7 - M6	2 Req'd.		
4	∟s	150 × 90 × 9	4.215	16.32	275.2		
1	Pl.	295 × 9	390	20.842		8.1	
1	"	310 × 9	390	21.902		8.5	
14	Lac. bars	60 × 9	400	4.239		23.7	
					275.2 +	40.3 =	315.5
							× 2
							631.0

Summary of Middle chords 17,352.6

		BOTTOM CHORD		L_0 - L_1	4 Req'd.		
2	∟s	100 × 100 × 10	3.705	14.91	110.5		
2	Pls	470 × 10	3.470	36.895	256.1		
2	"	455 × 13	1.125	46.433		104.5	
2	"	690 × 10	1.125	54.165		121.9	
2	"	925 × 10	1.520	72.613		220.7	
2	"	925 × 12	1.215	87.135		211.7	
1	Fill.	75 × 10	230	5.888		1.4	
1	"	75 × 12	230	7.065		1.6	
1	Pl.	370 × 9	700	26.141		18.3	
1	L	100 × 75 × 10	785	12.95		10.2	
1	"	"	550	"		7.1	
1	Pl.	565 × 9	1.030	39.917		41.1	
3	Tie Pls	230 × 9	370	16.250		18.0	
					366.6 +	756.5 =	1,123.1
							× 4
							4,492.4

		BOTTOM CHORD		L_1 - L_3	4 Req'd.		
2	∟s	100 × 100 × 10	8,445	14.91	251.8		
2	Pls	470 × 10	8,445	36.895	623.2		
2	∟s	100 × 100 × 10	8,850	14.91	263.9		
2	Pls.	900 × 10	1,675	70.650		236.7	
1	Pl.	590 × 10	1,060	46.315		49.0	
1	"	"	795	"		36.8	
4	Fills.	~ 270 × 10	440	21.195		37.3	
1	Pl.	370 × 9	400	26.141		10.5	
1	"	315 × 9	370	22.255		8.2	
1	"	890 × 9	1,035	62.879		65.1	
1	"	510 × 9	665	36.032		24.0	
12	Tie Pls.	230 × 9	370	16.250		72.2	
					1,138.9	539.8	1,678.7
							× 4
							6,714.8

		BOTTOM CHORD		L_3-L_5	4 Req'd.		
2	∟s	100 × 100 × 10	9,975	14.91	297.5		
2	"	"	9,205	"	274.5		
2	Pls.	470 × 10	9,205	36.895	679.2		
2	"	270 × 10	8,370	21.195	354.8		
2	"	470 × 10	765	36.895		56.4	
2	"	270 × 10	315	21.195		13.4	
4	"	85 × 12	465	8.007		14.9	
2	"	820 × 10	1,040	64.370		211.1	

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Material list for Kisogawa-Bashi. Aichiken (arch span)

1	Pl.	590 x 10	1.060	46.315		49.1
1	〃	〃	795	〃		36.8
2	Pls.	470 x 10	615	36.895		45.4
2	〃	270 x 10	785	21.195		33.3
4	〃	85 x 12	465	8.007		14.9
4	Fills.	85 x 6	390	4.004		6.2
2	〃	270 x 6	540	12.717		13.7
1	Pl.	745 x 9	1.260	52.634		66.3
1	〃	510 x 9	665	36.032		24.0
2	Pls.	365 x 9	535	25.787		27.6
13	Tie Pls.	230 x 9	370	16.250		78.2
2	Pls.	370 x 9	535	26.141		28.0

1,606.0 + 719.3 = 2,325.3
× 4
9,301.2

BOTTOM CHORD L5-L6 4 Req'd.

4	Ls	100x100x10	6.340	14.91	378.1	
2	Pls	470 x 16	6.340	59.032	748.5	
2	〃	270 x 10	6.340	21.195	268.8	
2	〃	820 x 10	1.490	64.370		191.8
1	Pl	590 x 10	1.060	46.315		49.1
1	〃	〃	795	〃		36.8
2	Pls	470 x 18	915	66.411		121.5
2	〃	450 x 12	615	42.390		52.1
2	〃	360 x 9	535	25.434		27.2
1	Pl	660 x 9	1.110	46.629		51.8
1	〃	510 x 9	660	36.032		23.8
8	Tie Pls	230 x 9	360	16.250		46.8

1,395.4 + 600.9 = 1,996.3
× 4
7,985.2

BOTTOM CHORD L6-L6' 2 Req'd.

4	Ls	100x100x10	7.540	14.91	449.7	
2	Pls	470 x 16	7.540	59.032	890.2	
2	〃	270 x 10	7.540	21.195	319.6	
2	〃	795 x 10	1.490	62.408		186.0
1	Pl.	660 x 9	1.110	46.629		51.8
10	Tie Pls	230 x 9	360	16.250		58.5

1,659.5 + 296.3 = 1,955.8
× 2
3,911.6

DIAPHRAGM AT L0 4 Req'd.

4	Ls	125x90x10	885	16.09	57.0
1	Pl	345 x 9	885	24.374	21.6
4	Ls	100x100x10	334	14.91	19.9
4	Fills.	100 x 10	170	7.850	5.3

103.8 × 4 = 415.2

DIAPHRAGM DM1 16 Req'd.

4	Ls	125x90x10	440	16.09	28.3
2	〃	100x100x10	150	14.91	4.5
1	Pl.	350 x 9	440	24.728	10.9

43.7 × 16 = 699.2

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Material list for Kisogawa-Bashi Aichi-Ken (arch span)

DIAPHRAGM DM2 10 Req'd.

4	Ls	125×90×10	440	16.09		28.3
1	Pl.	340 × 9	440	24.021		10.6
2	Ls	100×100×10	150	14.91		4.5
						43.4 × 10 = 434.0

FILLER (Under floor beams) 1 Req'd.

4	Fills	210 × 10	565	16.485		37.3
4	"	260 × 10	340	20.410		27.8
18	"	"	265	"		97.4
4	"	"	490	"		40.0
						202.5 × 1 = 202.5

summary for Bottom chords 34,156.1

DIAGONAL U0-L1 4 Req'd.

2	Ls	150×90×12	4,850	21.47	208.3	
2	"	"	4,610	"	198.0	
2	Pls	385 × 9	390	27.20		21.2
14	Lac. bars	70 × 9	410	4.946		28.4
					406.3 +	49.6 = 455.9
						× 4
						1,823.6

DIAGONAL L1-M2 4 Req'd.

2	Ls	150×90×12	4,910	21.47	210.8	
2	"	"	4,870	"	209.1	
2	Pls	385 × 9	390	27.20		21.2
15	Lac. bars.	70 × 9	410	4.946		30.4
					419.9 +	51.6 = 471.5
						× 4
						1,886.0

DIAGONAL M2-L3 4 Req'd.

2	Ls	150×90×9	4,845	16.32	158.1	
2	"	"	4,865	"	158.8	
2	Pls.	385 × 9	390	27.20		21.2
15	Lac bars	70 × 9	410	4.946		30.4
					316.9 +	51.6 = 368.5
						× 4
						1,474.0

DIAGONAL L3-M4 4 Req'd.

4	Ls	150,90,9	4,890	16.32	319.2	
2	Pls.	385 × 9	390	27.200		21.2
15	Lac. bars	70 × 9	410	4.946		30.4
					319.2 +	51.6 = 370.8
						× 4
						1,483.2

DIAGONALS M4-L5, L5-M6 & M6-L7 12 Req'd.

4	Ls	125,75×10	4,940	14.91	294.6	
2	Pls	340 × 9	385	24.021		18.5
15	Lac. bars	70 × 9	430	4.946		31.9
					294.6 +	50.4 = 345.0
						× 12
						4,140.0

Summary of Diagonals 10,806.8

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CALCULATIONS FOR

Material list for Kisogawa-Bashi, Aichi-Ken (Arch span).

VERTICAL L1-M1 4 Req'd.

4	Ls.	125x75x10	3,080	14.91	183.7	
1	Pl.	385 x 9	870	27.200		23.7
1	"	310 x 9	385	21.902		8.4
1	Fill.	260 x 10	235	20.410		4.8
7	Lac Bars.	70 x 9	430	4.946		14.9
					183.7	51.8 = 235.5 × 4 = 942.0

VERTICAL L2-M2 4 Req'd.

4	Ls	125x75x10	3,730	14.91	222.5	
1	Web Pl.	395 x 9	3,730	27.907	104.1	
2	Pls	260 x 13	645	20.533		34.2
2	"	240 x 9	645	16.956		21.9
					326.6 +	56.1 = 382.7 × 4 = 1,530.8

VERTICALS L3-M3, L4-M4, L5-M5, L6-M6 & L7-M7 18 Req'd.

4	Ls	125x75x10	3,725	14.91	222.2	
1	Pl.	385 x 9	870	27.200		23.7
1	"	"	960	"		26.1
2	Pls.	260 x 13	645	20.533		34.2
8	Lac bars.	70 x 9	430	4.946		17.0
					222.2 +	101.0 = 323.2 × 18 = 5,817.6

FILLER FOR L3-M3, L5-M5, & L7-M7 10 Req'd.

1.	Fill	260x10	395	20.410	8.1 × 10 = 81.0

Summary of Verticals 8,371.4

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CALCULATIONS FOR

Material list for Kisogawa-Bashi, Aichiken (arch span)

HANGER U1 M1 — 4 Req'd.

2	Ls	125x75x10	2.030	14.91	60.5	
2	〃	〃	1.980	〃	59.0	
1	Pl.	385 x 9	390	27.200		10.6
1	〃	〃	470	〃		12.8
4	Lac Bars	70 x 9	430	4.946		8.5
2	Pls.	260 x 13	970	26.533		51.5

119.5 + 88.4 = 202.9
× 4
811.6

U2 M2 R/L — 4 Req'd.

2	Ls	125x75x10	3.365	14.91	100.3
2	〃	〃	3.400	〃	101.4
1	Web Pl.	395 x 9	3.330	27.907	92.9

294.6 × 4 = 1,178.4

U3 M3 R/L — 4 Req'd.

2	Ls	125x75x10	4.740	14.91	141.3	
2	〃	〃	4.765	〃	142.1	
1	Pl	370 x 9	385	26.141		10.1
1	〃	385 x 9	390	27.200		10.6
14	Lac Bars.	70 x 9	430	4.946		29.8

283.4 + 50.5 = 333.9
× 4
1,335.6

U4 M4 R/L — 4 Req'd.

2	Ls	125x75x10	5.785	14.91	172.5	
2	〃	〃	5.805	〃	173.1	
1	Pl	385 x 9	670	27.200		18.2
1	〃	370 x 9	385	26.141		10.1
1	〃	385 x 9	390	27.200		10.6
15	Lac Bars.	70 x 9	430	4.946		31.9

345.6 + 70.8 = 416.4
× 4
1,665.6

U5 M5 R/L — 4 Req'd.

2	Ls	125x75x10	6.520	14.91	194.4	
2	〃	〃	6.535	〃	194.9	
1	Pl.	370 x 9	385	26.141		10.1
1	〃	385 x 9	390	27.200		10.6
21	Lac Bars.	70 x 9	430	4.946		44.7

389.3 + 65.4 = 454.7
× 4
1,818.8

U6 M6 R/L — 4 Req'd.

4	Ls	125x75x10	6.970	14.91	415.7	
1	Pl.	385 x 9	670	27.200		18.2
1	〃	370 x 9	385	26.141		10.1
1	〃	385 x 9	390	27.200		10.6
20	Lac Bars.	70 x 9	430	4.946		42.5

415.7 + 81.4 = 497.1
× 4
1,988.4

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CALCULATIONS FOR

Material list for Kisogawa-Bashi, Aichiken (arch span)

			U7 M7		2 Req'd.	
4	Ls	125x75x10	7.110	14.91	424.0	
1	Pl.	370 x 9	385	26.141		10.1
1	"	385 x 9	390	27.200		10.6
23	Lac Bars.	70 x 9	430	4.946		48.9

424.0 + 69.6 = 493.6
× 2
987.2

Summary of Hangers 9,785.6 Kgs.

PORTAL BRACING PB1 — 2 Req'd.

2	Ls	150x90x9	7.900	16.32	257.9
2	"	90x60x9	7.900	9.96	157.4
2	"	"	8.700	"	173.3
2	"	150x90x9	9.300	16.32	303.6
1	Cov Pl.	375 x 9	7.900	26.494	209.3
1	L	60x60x9	7.900	7.84	61.9
4	Ls	90x90x10	830	13.34	44.3
4	"	75x75x9	620	9.96	24.7
4	"	"	720	"	28.7
4	"	"	650	"	25.9
4	"	"	700	"	27.9
4	"	90x90x10	660	13.34	35.2
8	"	60x60x9	550	7.84	34.5
4	"	"	570	"	17.9
4	"	"	580	"	18.2
12	"	"	590	"	55.5
4	Bars	60 x 9	550	4.239	9.3
4	"	"	570	"	9.7
6	"	"	590	"	15.0
2	Ls	125x90x10	395	16.09	12.7
2	"	"	420	"	13.5
4	"	100x100x10	750	14.91	44.7
2	Pls	320 x 9	480	22.608	21.7
2	"	240 x 9	330	16.956	11.2
2	"	300 x 9	360	21.195	15.3
2	"	"	600	"	25.4
2	"	"	310	"	13.1
1	Pl.	310 x 9	570	21.902	12.5
2	Fills.	160 x 9	490	11.304	11.1
2	"	165 x 9	420	11.657	9.8
2	"	150 x 9	420	10.598	8.9
4	"	"	400	"	17.0
2	Pls	350 x 9	750	24.728	37.1
2	"	240 x 9	420	16.956	14.2
2	"	320 x 9	640	22.608	28.9
2	"	300 x 9	340	21.195	14.4
2	"	310 x 9	600	21.902	26.3
1	Pl.	290 x 9	300	20.489	6.1

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CALCULATIONS FOR

Material list for Kisogawa-Bashi Aichiken (arch span)

2	Fills	180 × 9	590	12.717	15.0
2	〃	165 × 9	460	11.657	10.7
2	〃	155 × 9	400	10.951	8.8
4	〃	〃	380	〃	16.6
					1,905.2
					× 2
					3,810.4

SWAY BRACINGS SB1 & SB2 (共通部分) 4 Req'd.

4	Ls	100.75.10	7,830	12.95	405.6
2	Pls	410 × 9	465	28.967	26.9
5	〃	370 × 9	530	26.141	69.3
10	Bars	60 × 9	390	4.239	16.5
16	Lac Bars	60 × 9	515	〃	34.9
4	Bars	90 × 9	530	6.359	13.5
20	Ls	60.60.7	935	6.20	115.9
18	〃	90.60.9	810	9.96	145.2
2	Pls	220 × 9	240	15.543	7.5
5	〃	155 × 9	240	10.951	13.1
10	Ls	100.75.10	230	12.95	29.8
4	Pls	225 × 9	370	15.896	23.5
8	Ls	100.75.10	370	12.95	38.3
2	〃	〃	8,100	〃	209.8
2	〃	130.130.9	9,800	17.73	347.5
4	〃	100.75.10	2,135	12.95	110.6
2	Fills	70 × 9	1,010	4.946	10.0
4	Ls	100.75.10	1,160	12.95	60.1
4	〃	〃	780	〃	40.4
4	〃	〃	590	〃	30.6
4	〃	〃	460	〃	23.8
4	〃	〃	370	〃	19.2
4	〃	〃	220	〃	11.4
2	〃	〃	190	〃	4.9
6	Washers	70φ × 9		@ 0.272	1.6
2	Pls	240 × 9	1,820	16.956	61.7
2	〃	310 × 9	1,550	21.902	67.9
1	Pl	230 × 9	1,350	16.250	21.9
2	Pls	310 × 9	840	21.902	36.8
2	Fills	180 × 9	800	12.717	20.3
2	〃	150 × 9	880	10.598	18.7
2	〃	140 × 9	730	9.891	14.4
4	Ls	100.75.10	310	12.95	16.1
4	〃	〃	140	〃	7.3
					2,075.0
					× 4
					8,300.0

SWAY BRACING SB1 2 Req'd.

2	Ls	125.90.10	370	16.09	11.9
2	〃	〃	385	〃	12.4
					24.3 × 2 = 48.6

SWAY BRACING SB2 2 Req'd.

2	Ls	125.90.10	360	16.09	11.6
2	〃	〃	350	〃	11.3
					22.9 × 2 = 45.8

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CALCULATIONS FOR

Material list for Kisogawa-Bashi, Aichiken (arch span)

TOP LATERAL STRUTS TS1, TS2, & TS3 (共通部分) 5 Req'd.

4	Ls	100x75x10	7.830	12.95	405.6	
2	Pls.	410 x 9	465	28.967	26.9	
20	Bars	60 x 9	390	4.239	33.1	
16	Lac Bars	"	515	"	34.9	
2	Pls.	370 x 9	520	26.141	27.2	
1	"	"	390	"	10.2	
4	Ls	100x100x10	1.710	14.91	102.0	
4	Washers	70φ x 9		0.272	1.1	
2	Fills	100 x 9	295	7.065	4.2	
						645.2
						× 5
						3,226.0

TOP LATERAL STRUT TS1 2 Req'd.

2	Ls	125x90x10	380	16.09	12.2	
2	"	"	400	"	12.9	
						25.1
						× 2
						50.2

TS2 2 Req'd

2	Ls	125x90x10	360	16.09	11.6	
2	"	"	375	"	12.1	
						23.7
						× 2
						47.4

TS3 1 Req'd.

4	Ls	125x90x10	355	16.09	22.8	

TOP LATERAL BRACINGS TB1^R_L, TB2^R_L, TB3^R_L, TB4^R_L, & TB5^R_L 4 Req'd.

2	Ls	100x75x10	5.610	12.95	145.3	
2	"	"	5.720	"	148.1	
2	"	"	5.690	"	147.4	
2	"	"	5.650	"	146.3	
2	"	"	5.630	"	145.8	
2	"	60x60x9	5.610	7.84	88.0	
2	"	"	5.720	"	89.7	
2	"	"	5.690	"	89.2	
2	"	"	5.650	"	88.6	
2	"	"	5.630	"	88.3	
10	Pls	130 x 9	280	9.185	25.7	
25	"	"	140	"	32.1	
						1,234.5
						× 4
						4938.0

TOP LATERAL PLATES LP1, 2, 3, 4 & 5 1 Req'd.

2	Pls	470 x 9	670	33.206	44.5	
2	"	450 x 9	670	31.793	42.6	
4	"	440 x 9	670	31.086	83.3	
1	Pl	660 x 9	690	46.629	32.2	
						202.6

Summary for Top lateral bracings 20691.8

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Revised 5-7-10

CALCULATIONS FOR

Material list for Kisogawa-Bashi. Aichi-Ken (arch span)

		FLOOR	BEAM	FB1 R/L		2 Reqd.	
2	Cov. Pls.	240 × 9	5,420	16.956	183.8		
4	Ls	100, 90 × 10	8,050	14.13	455.0		
1	pl.	800 × 9	8,050	56.520	455.0		
4	Ls	150 × 100 × 9	790	17.02		53.8	
4	Fills	220 × 10	625	17.27		43.2	
16	Ls	75 × 75 × 9	810	9.96		129.1	
10	"	100 × 75 × 10	790	12.95		102.3	
10	Fills	75 × 10	625	5.888		36.8	
5	"	100 × 10	300	7.85		11.8	
					1,093.8	377.0	1470.8
							× 2
							2941.6

		FLOOR BEAMS	FB2, FB3, FB4 & FB5			13 Reqd.	
2	Cov Pls.	280 × 9	5,420	19.782	214.4		
4	Ls	125 × 90 × 10	8,070	16.09	519.4		
1	pl.	800 × 9	8,070	56.52	456.1		
4	Ls	150 × 100 × 9	1,045	17.02		71.1	
4	Fills	220 × 10	625	17.27		43.2	
4	"	145 × 10	240	11.383		10.9	
2	"	145 × 9	240	10.244		4.9	
10	Ls	100 × 75 × 10	790	12.95		102.3	
10	Fills.	75 × 10	625	5.888		36.8	
8	Ls	75 × 75 × 9	810	9.96		64.5	
10	Fills	100 × 10	300	7.85		23.6	
					1,189.9	357.3	1,547.2
							× 13
							20,113.6

Summary for Floor beams 23,055.2

		STRINGER	BRACKET	R1 R/L	10 Reqd.	
2	Ls	75 × 75 × 9	295	9.96	5.8	
1	pl.	315 × 9	400	22.255	8.9	
					14.7 × 10 =	147.0

		STRINGERS		S1 & S2 R/L	70 Reqd.	
1	I	350 × 150 @ 58.54 kgs	4,490		262.8	
2	Ls	100 × 100 × 10	305	14.91	9.1	
						271.9
						× 70
						19,033.0

Summary for stringers 19,180.0

		BOTTOM LATERAL PLATES		LP1, 2, 3 & LP4	2 Reqd.	
1	pl.	755 × 9	1,320	53.341	70.4	
1	"	1,100 × 9	1,200	77.715	93.3	
1	"	870 × 9	930	61.466	57.2	
1	"	760 × 9	930	53.694	49.9	
						270.8
						× 2
						541.6

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Reviced 5-7-10

CALCULATIONS FOR

Material list for Kisogawa-Oashi, Aichiken (arch span)

BOTTOM LATERAL BRACING BL 1 R/L — 4 Req'd.

1	L	150x150x11	5515	24.95	137.6
1	〃	〃	5315	〃	132.6
1	〃	150x100x9	205	17.02	3.5
1	〃	75x75x9	435	9.96	4.3
1	Pl	170 x 9	200	12.011	2.4
					280.4
					× 4
					1,121.6

BL 2 R/L & BL 3 R/L — 8 Req'd.

1	L	150x150x11	5465	24.95	136.4
1	〃	〃	5665	〃	141.3
1	〃	150x100x9	205	17.02	3.5
1	〃	75x75x9	435	9.96	4.3
1	Pl.	170 x 9	200	12.011	2.4
					287.9
					× 8
					2,303.2

BL 4 R/L — 8 Req'd.

1	L	130x130x9	5525	17.73	98.0
1	〃	〃	5675	〃	100.6
1	〃	150x100x9	205	17.02	3.5
1	〃	75x75x9	435	9.96	4.3
1	Pl.	170 x 11	170	14.680	2.5
					208.9
					× 8
					1,671.2

BL 5 R/L — 8 Req'd.

1	L	100x100x10	5490	14.91	81.9
1	〃	〃	5640	〃	84.1
1	〃	150x100x9	205	17.02	3.5
1	〃	75x75x9	435	9.96	4.3
1	Pl	150 x 10	170	11.775	2.0
					175.8
					× 8
					1,406.4

Summary for Bottom lateral bracings 7,044.0

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Revised 5-7-10

CALCULATIONS FOR

Material list for Kisogawa-Bashi, Aichiken (arch span)

ROLLER SHOE RS2 — 2 Req'd.

1	Cast steel shoe RS2		@ 296.0	296.0
1	〃 〃 Sole Pl. SP2		@ 227.0	227.0
2	〃 〃 dust guard DG4		@ 27.0	54.0
4	Topped bolts 12$^\phi$ x 40		@ 0.07	0.3
2	Pl.(dust guard) 132 x 8	760	8.29	12.6
10	Topped bolts 6$^\phi$ x 25		@ 0.01	0.1
6	Bolts 22$^\phi$ x 45		@ 0.28	1.7
6	Rollers 100$^\phi$ x 750		61.65	277.4
2	Pls 80 x 13	630	8.164	10.3
8	Pins 22$^\phi$ x 50		@ 0.13	1.0
4	〃 〃		@ 0.15	0.6
4	Anchor bolts 40$^\phi$ x 950		@ 9.8	39.2
1	Pin & Nuts 130 x 601		@ 68.0	68.0

988.2
x 2
1,976.4

FIXED SHOE FS2 — 2 Req'd.

1	Cast steel shoe FS2	@ 435.0	435.0
4	Anchor blts 40$^\phi$ x 950	@ 9.8	39.2
1	Pin & Nuts 130$^\phi$ x 601	@ 68.0	68.0

542.2
x 2
1,084.4

BED PLATE BP3 & BP4 — 1 Req'd.

2	Cast steel Pls BP3	@ 230.0	460.0
2	〃 〃 〃 BP4	@ 163.0	326.0

786.0

Summary of Shoes. 3,846.8

RIVET HEADS.

38,580	Shop rivet heads	22$^\phi$	@ .0964	3,719.1
30,480	Field 〃 〃	〃	@ .0964	2,938.3
38,320	Shop 〃 〃	19$^\phi$	@ .0646	2,475.5
2,840	Field 〃 〃	〃	@ .0646	183.5

9,316.4

Summary of Rivet heads 9,316.4

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CALCULATIONS FOR

Material list for Kisogawa-Bashi, Aichiken (Arch span)

		EXPANSION JOINT	EJ1 (on west abutment)		1 Req'd.
1	L	100x75x10	8210	12.95	106.3
1	Pl	275 x 9	7275	19.429	141.3
1	L	75x75x9	7890	9.96	78.6
2	Pls	310 x 9	350	21.902	15.3
2	Ls	75x75x9	320	9.96	6.5
2	Fills	75 x 10	190	5.888	2.2
2	Ls	75x75x9	190	9.96	3.8
2	"	"	210	"	4.2
2	"	"	225	"	4.5
2	"	"	240	"	4.8
2	"	"	245	"	4.9
2	"	"	250	"	5.0
10	Washers	70φ x 10		@ 0.302	3.0
5	Pls	75 x 9 Kgs.	290	5.299	7.7
5	Is	150.125@30.22	300		54.3
4	Anchor bolts	12φ	310	@ 0.305	1.5
4	Washers	70 x 3	70	1.049	0.5
10	Bolts	12φ	50	@ 0.108	1.1
					445.5

		EXPANSION JOINT	EJ2 (or EJ2A)		1 Req'd.
1	Checkered Pl	255 x 9	8210	20.296	166.6
1	L	75x75x9	8210	9.96	81.8
1	Pl	270 x 9	7030	19.076	134.1
2	Pls	340 x 9	420	24.021	20.2
2	Ls	75x75x9	595	9.96	11.9
3	"	"	220	"	6.6
					421.2

		EXPANSION JOINT	EJ3		1 Req'd.
1	Bars	50 x 10	8210	3.925	32.2
1	L	150.90x9	8210	16.32	134.0
1	Pl	270 x 9	7030	19.076	134.1
2	Pls	340 x 9	420	24.021	20.2
2	Ls	75x75x9	595	9.96	11.9
3	"	"	220	"	6.6
					339.0

Summary of Expansion joint

on west abutment 445.5 + 421.2 = 866.7 (see page no. M11.)

on piers 421.2 + 339.0 = 760.2

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CALCULATIONS FOR

Material list for Kisogawa-Bashi, Aichiken (arch span)

Total summary for Arch span (one span)

	kgs.	
Top chords.	45,267.0	
Middle chords.	17,352.6	
Bottom chords.	34,150.1	
Diagonals.	10,806.8	125,739.5 kgs.
Verticals.	8,371.4	
Hangers.	9,785.6	
Top laterals.	20,691.8	
Floor beams	23,055.2	
Stringers	19,180.0	
Bottom laterals	7,044.0	
Expansion joints on pier.	760.2	
	196,470.7	
Rivets heads.	9,316.4	
	205,787.1	
Shoes.	3,846.8	kgtons.
	209,633.9 or	209.634

Grand summary for steel

Simple span	113.039 × 1	= 113.039
Arch span	209.634 × 13	= 2,725.242
		2,838.281 kg tons

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 M. Juida DATE 5-5-8 FILE NO
CHECKED BY M. Kojima DATE 5-5-10 PAGE NO M.29

CALCULATIONS FOR

Materials of Kisogawa-Bashi for Aichi-Prefecture

Material List for Floor slab
Concrete (1:2:4 mixture)
Sectional area

Slab	.155	×	7.50	=	1.162
Coping	2 × .17	×	.342	=	.116
Fillet	.062	×	.212	=	.013
〃	2 × .047	×	.197	=	.019
					1.310 sq. meters

Length of Floor Slab for Span no. 1 = 41.59 m

Floor 1.310 × 41.59 m = 54.48
Fillet 8@ .035 × .315 × 6.20 = .55 on intermediate floor beam
〃 2@ .035 × .275 × 6.20 = .12 on end 〃 〃
55.15 cub. meters

Length of Floor slab for Span no. 2 ~ no. 13 (12 × 64.22 m)

Floor 1.310 × 64.22 = 84.13
Fillet 13@ .035 × .315 × 6.20 = .89 on intermediate floor beam
〃 2@ .035 × .275 × 6.20 = .12 〃 end 〃 〃
85.14 c.m.
× 12
1,021.68 cub. m.

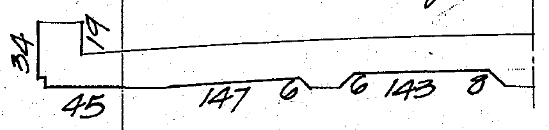
Length of Floor Slab for Span no. 14 = 64.44 m

Floor 1.310 × 64.44 = 84.42
Fillet 13@ .035 × .315 × 6.20 = .89 on intermediate floor beam
〃 2@ .035 × .275 × 6.20 = .12 〃 end 〃 〃
85.43 cub. m.

Concrete for Span no. 2 ~ no. 14 1,107.11 cub. m.

Total concrete for floor Slab
Span no. 1 = 55.15
Span no. 2 ~ 14 = 1,107.11
Summary of Concrete for the whole Bridge 1,162.26 cub. m. drain hole neglected

Forms



width = 8.16 meters net
Span no. 1 8.16 × 41.59 = 339.4
less 8@ .25 × 7.15 = (−) 14.3 on intermediate floor beam
〃 2@ .21 × 7.15 = (−) 3.0 〃 end 〃 〃
322.1 sq. m.

Span no. 2 ~ 13 12 - Required
8.16 × 64.22 = 524.0
less 13@ .25 × 7.15 = (−) 23.2 on intermediate floor beam
〃 2@ .21 × 7.15 = (−) 3.0 〃 end 〃 〃
497.8
× 12
5,973.6 sq. m.

Span no. 14 1 - Required
8.16 × 64.35 = 525.1
less 13@ .25 × 7.15 = (−) 23.2 on intermediate floor beam
〃 2@ .21 × 7.15 = (−) 3.0 〃 end 〃 〃
498.9 sq. m.

Forms for Span no. 2 ~ no. 14 = 6472.5 sq. m.

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MADE BY M. Imida DATE 5-5-8 FILE NO

CHECKED BY M. Kajima DATE 5-5-10 PAGE NO M30

CALCULATIONS FOR

Materials of Kisogawa-Bashi for Aichi-Prefecture

√Total Forms of Floor Slab
√Span no. 1 = √322.1
√Span no. 2 ~ no. 14 = √6472.5
6,794.6 sq. m.

√Reinforcements √Plain bars
√Span no. 1 1 @ 6,293.0 = 6,293.0
√Span no. 2 ~ no. 13 12 @ 9,663.2 = 115,958.4 } 125,658.0
√Span no. 14 1 @ 9,699.6 = 9,699.6 }
131,951 kg. tons

√Pavements (asphalt block)
√width = 7.50 meters Drain hole neglected
√Span no. 1 7.50 × 41.59 = 311.9 × 1 = 311.9
√Span no. 2 ~ no. 13 7.50 × 64.22 = 481.7 × 12 = 5,780.4 } 6,263.7 for Span no. 2 ~ 14
Span no. 14 7.50 × 64.44 = 483.3 × 1 = 483.3 }
√6,575.6 sq. m.

√Expansion joints 14ヶ所

√Construction joints (3/8" thick carey elastite 挿入)
√Span no. 1 1 @ 2 = 2
√Span no. 2 ~ no. 13 4 @ 12 = 48
√Span no. 14 1 @ 5 = 5
√55ヶ所

√Drains (cast iron)
√Span no. 1 1 @ 12 = 12
√Span no. 2 ~ no. 14 13 @ 16 = 208
√220ヶ required weight 30 kgs

√人造洗出仕上
√Span no. 1 2 × .83 × 41.59 69.0
√Span no. 2 ~ no. 13 24 × .83 × 64.22 = 1,279.3 } 1,386.3
√Span no. 14 2 × .83 × 64.44 = 107.0 }
1,455.3 sq. m.

√Tar paper on east abutment only 一ヶ所

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JIJI BLDG, TOKYO

MADE BY M. Kojima DATE 5-6-7 FILE NO ______

CHECKED BY M. Iwida DATE 5-6-9 PAGE NO M.31

CALCULATIONS FOR

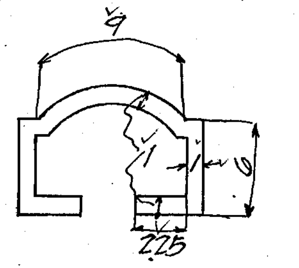
Materials of Kisogawa-Bashi for Aichi-ken

Materials of Handrails

Top Rail (cast iron)

Sectional area = 1 × (9 + 6 × 2 + 2.25 × 2) = 25.5 sqcm

Volume of rib = 8 × 1 × 5 = 40 cub.cm



Top Rail for H1 volume = (25.5 × 146) + 2 × 40 = 3,803 cub.cm

Weight = .00725 × 3,803 = 27.57 kgs

For H2 volume = (25.5 × 91) + 2 × 40 = 2,401 cub.cm

Weight = .00725 × 2,401 = 17.41 kgs

For H3 volume = (25.5 × 48) + 40 = 1,264 cub.cm

Weight = .00725 × 1,264 = 9.16 kgs

Grate for H1

a (3 × 3 × 75.5) × 2 = 1,359.0

b (2.5 × 3 × 138) × 2 = 2,070.0

c (2.5 × 4 × 138) × 1 = 1,380.0

d (1.7 × 3 × 56) × 9 = 2,570.4 (上，飾り，両側)

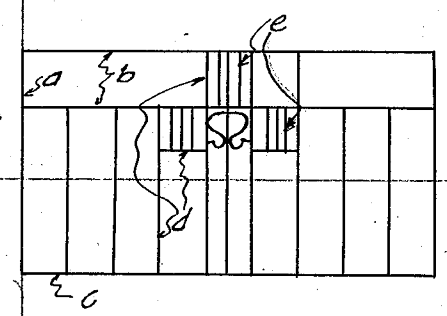
〃 (1.7 × 3 × 12) × 2 = 122.4 (〃 〃)

〃 (1.7 × 3 × 14) × 2 = 142.8 (中，飾り，下縁)

e (1.3 × 2 × 12) × 9 = 280.8 (飾り，中條)

〃 (1.3 × 2 × 25) × 2 = 130.0 (〃 〃)

8,055.4 × .00725 = 58.4 kgs



Grate for H2

a ------------ = 1,359.0

b (2.5 × 3 × 83) × 2 = 1,245.0

c (2.5 × 4 × 83) × 1 = 830.0

d (1.7 × 3 × 56) × 5 = 1,428.0

d ------------ = 122.4

〃 (1.7 × 3 × 15) × 2 = 153.0

e ------------ = 280.8

〃 ------------ = 130.0

5,548.2 × .00725 = 40.2 kgs

Grate for H3

a ------------ = 1,359.0

b (2.5 × 3 × 29) × 2 = 435.0

c (2.5 × 4 × 29) × 1 = 290.0

d (1.7 × 3 × 56) × 1 = 285.6

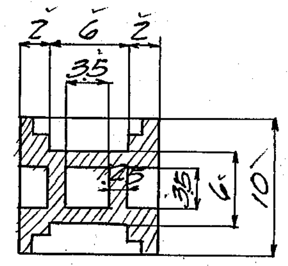
2,369.6 × .00725 = 17.2 kgs

Post P1

at middle 6 × 10 − 3.5 × 7.5 = 33.75

2 × 2 × 3/4 × 4 = 12.00

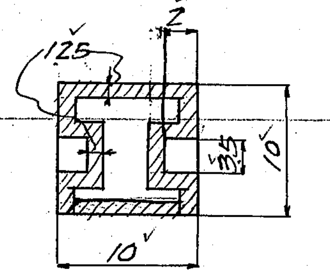
45.75 × 58 = 2,654 cub.cm.



Top and bottom

1.25 × (10 + 7.5 + 2 + 2) × 2 = 53.75 sqcm

Volume 53.75 × 26 = 1,398 cub.cm



Bed 21 × 2 × 16 = 672

less 7.5 × 2 × 7.5 = −113

= 559 cub.cm.

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CALCULATIONS FOR

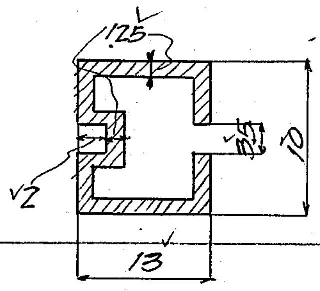
Materials of Kisogawa-Bashi for Aichi-Prefecture

Weight of P1
(2,654 + 1,398 + 559) × .00725 = 33.4 kgs

Cover pl. for joint of top rail
for P1 — 10 × 1.0 × 320 = 7.85 × 320 = 2.51 kgs × 13/10 = 3.26 kgs for P2
Filler — 16 × 9 × 21 = 11.304 × 21 = 2.37 kgs
Anchor Bolt — 1.2ϕ × 24 cm @ 0.28 kgs
" " — 1.2ϕ × 55 @ 0.1 kgs
Washer — 5.0 × 9 × 13.0 = 3.533 × 13 = @ 0.46 kgs

Post P2
at middle — 6 × 13 − 3.5 × 11 = 39.50
2 × 2 × 3/4 × 4 = 12.00
51.50 × 58 = 2,987 cub. cm

Top and bottom
1.25 × (13 × 2 + 7.5 + 2 × 2 + 4) = 51.88
Volume 51.88 × 26 + 3.5 × 9.5 = 1,382 cub. cm



Bed — 24 × 2 × 16 = 768
less — 7.5 × 2 × 10.5 = −158
= 610 cub. cm.

Weight of P2 (2,987 + 1,382 + 610) × .00725 = 36.1 kgs

Weight of handrails (Both Sides)

	Mark	Req'd no.	Piece wt.	Total weight	Remarks
Cast iron	H1	1,146	27.57	31,595.2	Top rail
	H2	26	17.41	452.7	Top rail
	H3	4	9.16	36.6	"
	H1	1,146	58.4	66,926.4	Grate
	H2	26	40.2	1,045.2	"
	H3	4	17.2	68.8	"
	P1	1,152	33.4	38,476.8	Post
	P2	26	36.1	938.6	"
			Total	139,540.3 kgs	
Structural steel	Cov. Pl.	1,152	2.51	2,891.5	
	"	26	3.26	84.8	
	Anchor bolt (24 cm)	4,708	0.28	1,318.2	
	" (55 cm)	4	0.1	0.4	
	Washer	2,354	.46	1,082.8	
	Fill	2	2.37	4.7	
			Total	5,382.4 kgs	

Total wt. of handrails 144,922.7 kgs

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MADE BY M. Jinda DATE 5-6-12 FILE NO

CHECKED BY M.K & R.I DATE 5-6-13 PAGE NO M.33

CALCULATIONS FOR

Materials of Kisogawa-Bashi for Aichi-Prefecture

Materials of granite

親柱石材（一基分）

Reqd no.	Dimension	Piece Volume	Total Volume	Remarks
4	55×20×60	.066	.264	1st course from lower
2	55×20×80	.088	.176	
4	50×20×60	.060	.240	
2	50×20×80	.080	.160	
2	45×20×90	.081	.162	2nd course
2	45×20×50	.045	.090	
2	30×175×70	.037	.074	3rd course
2	30×175×35	.018	.036	
14	30×15×65	.029	.406	column
14	30×15×35	.016	.224	
1	65×15×65	.063	.063	cap
			1.895 cub.m.	

小柱石材（一基分）

2	55×15×70	.058	.116	下部
2	55×15×60	.050	.100	〃
2	325×65×90	.190	.380	上部
			0.596 cub.m	

袖高欄石材（一ヶ所分）

1	25×15×125	.047	.047
1	25×15×70	.026	.026
1	25×18×125	.056	.056
1	25×18×70	.032	.032
1	25×25×96	.060	.060
2	15×25×96	.036	.072
1	15×63×125	.118	.118
1	15×63×70	.066	.066
			0.477 cub.m

親柱用（一基分）

Concrete 1:2:4 mixture

.35×.35×2.40 = .294
.50×.50×.45 = .113
.80×.80×1.05 = .672

1.079 cub.m.

Reinforcements, plain bars = 61.2 kgs

Gas pipes

1 - 2"φ gas pipe 3.90^m long
4 - 1"φ gas pipe 0.30^m long

Bronze lamps 4 set @ 20 kgs for one pedestal

Milk white glass 5^mm thick

Bronze name plate

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MADE BY M. Inida DATE 5-7-23 FILE NO
CHECKED BY M.K. R.I. DATE 5-7-24 PAGE NO M.34

CALCULATIONS FOR

Materials of Kisogawa-Bashi for Aichi-Ken

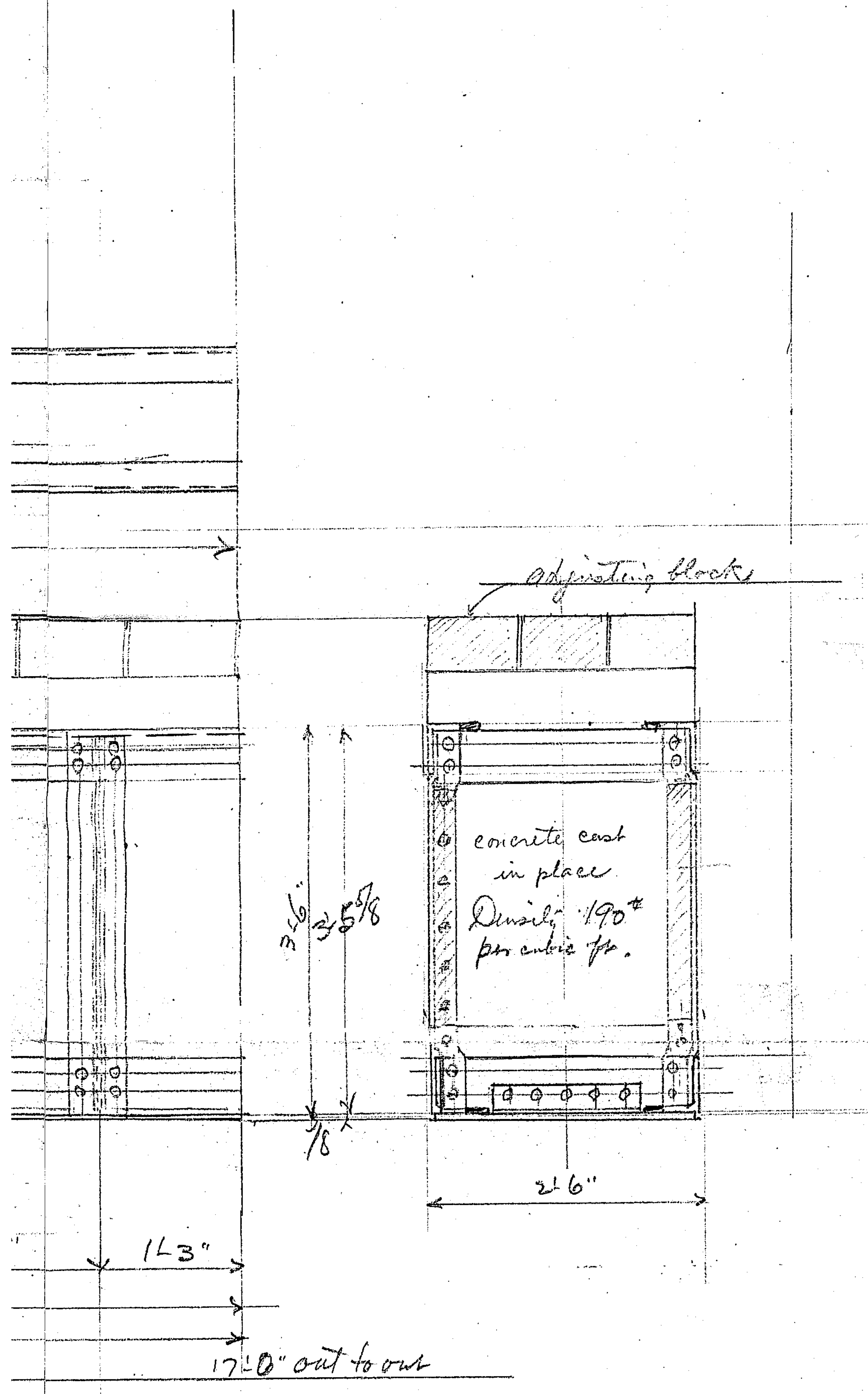
袖小柱用 (一基分)

concrete 1:2:4 mixture
.35^m × .60 × .55 = .116 cub m.

Bracket for lamp (82-Required)
Castings 26.7 Kgs
gas pipe 1"$^\phi$ gas pipe .56^m long
Bolt or screw 4-12$^\phi$ × 55^{cm} 4 @ 0.7 = 2.8 Kgs

Bronze fixture 30 Kgs
milk white glove 1-30^{cm} dia 5^{mm} thick

Lamp post (on simple span only)
Casting 180 Kgs
Bolts { 2-22$^\phi$ × 105^{cm} .59 × 2 = 1.18
{ 2-22$^\phi$ × 80^{cm} .52 × 2 = 1.04
222 Kgs



Pull in cable — $\frac{15.75 \text{ tons}}{2} = 7.875$

Try — 2 3/4 . .875φ — 26.82 tons breaking strength

$\frac{26.82}{7.875} = 3.4$

bar φ = 7.875 × 2240 = 17,650#

section req'd = $\frac{17650}{16000}$ = 1.10 net

dia of rod.

15-0"
2-6
17.5

3'6

3.5 × 17.5 × 2?0 = 1530
1.0 × 14 × 2.5 = 35
188

$\frac{35300}{188}$ = 187.5#/sq ft

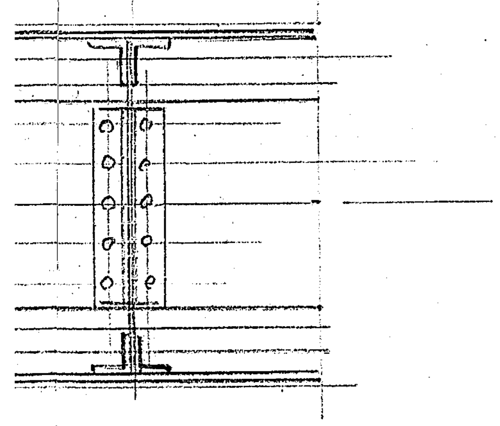
35300
23100
12200

2'-0"

12'-6"

15 tons

31.5
15.75

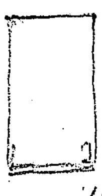


Uniform load 2.5 × 4.5 × 200 = 2250#/per lin ft. 25.0' @ 200

5000

m = 1/8 × 2250 × 15² = 63,500#

$\frac{35300\#}{5000}$ = 706



Effective depth 4.0 × 7/8 = 3.50

2.5 × 15.0 = 37.5 @ 220 =

stress = $\frac{63500}{3.5}$ = 18150

SR = 18150

6600 × 825
3 35
33300
198
23100

289/2

11.33/2
22.66 @ 220 = 5000

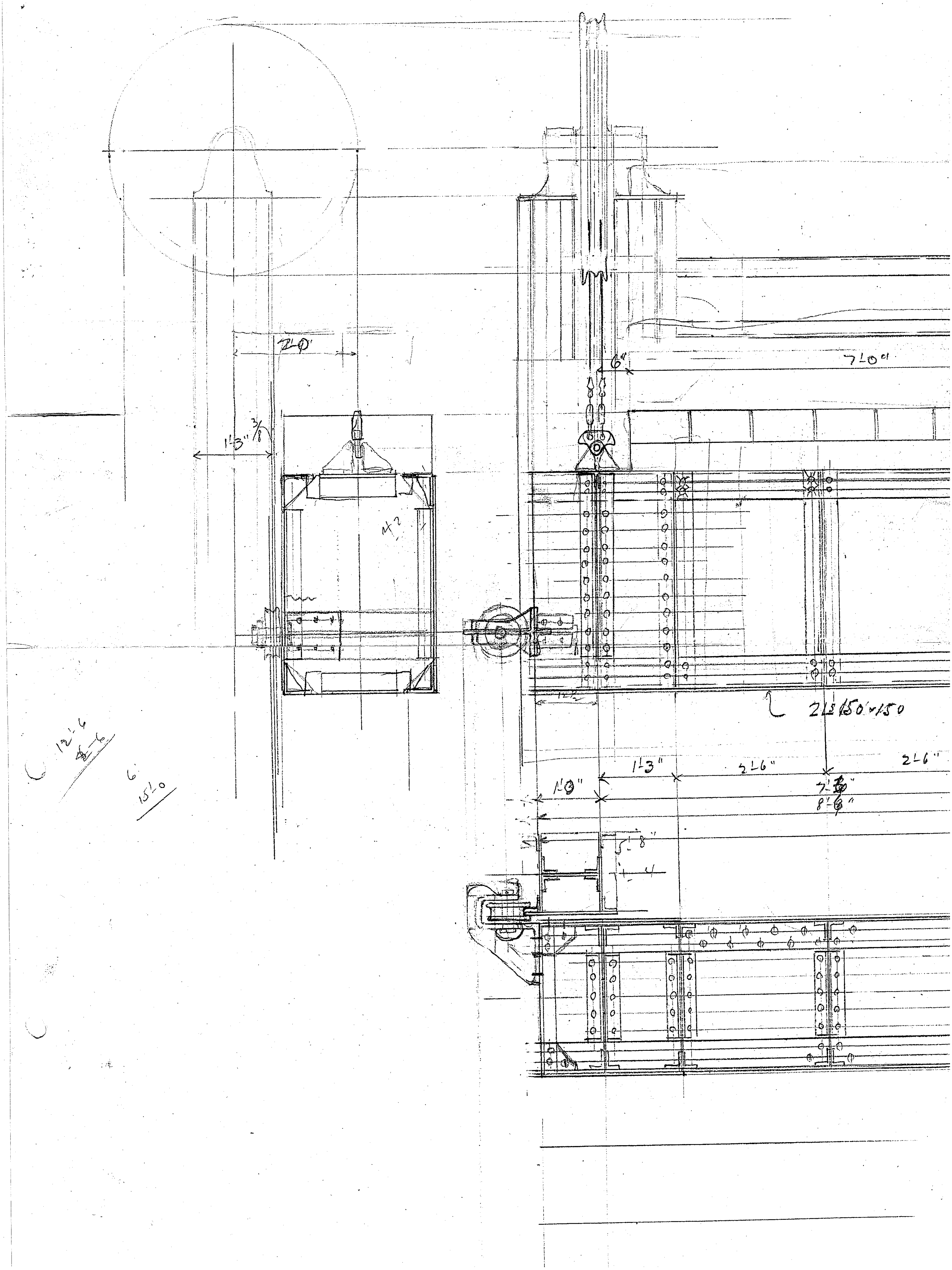
11.33

2.

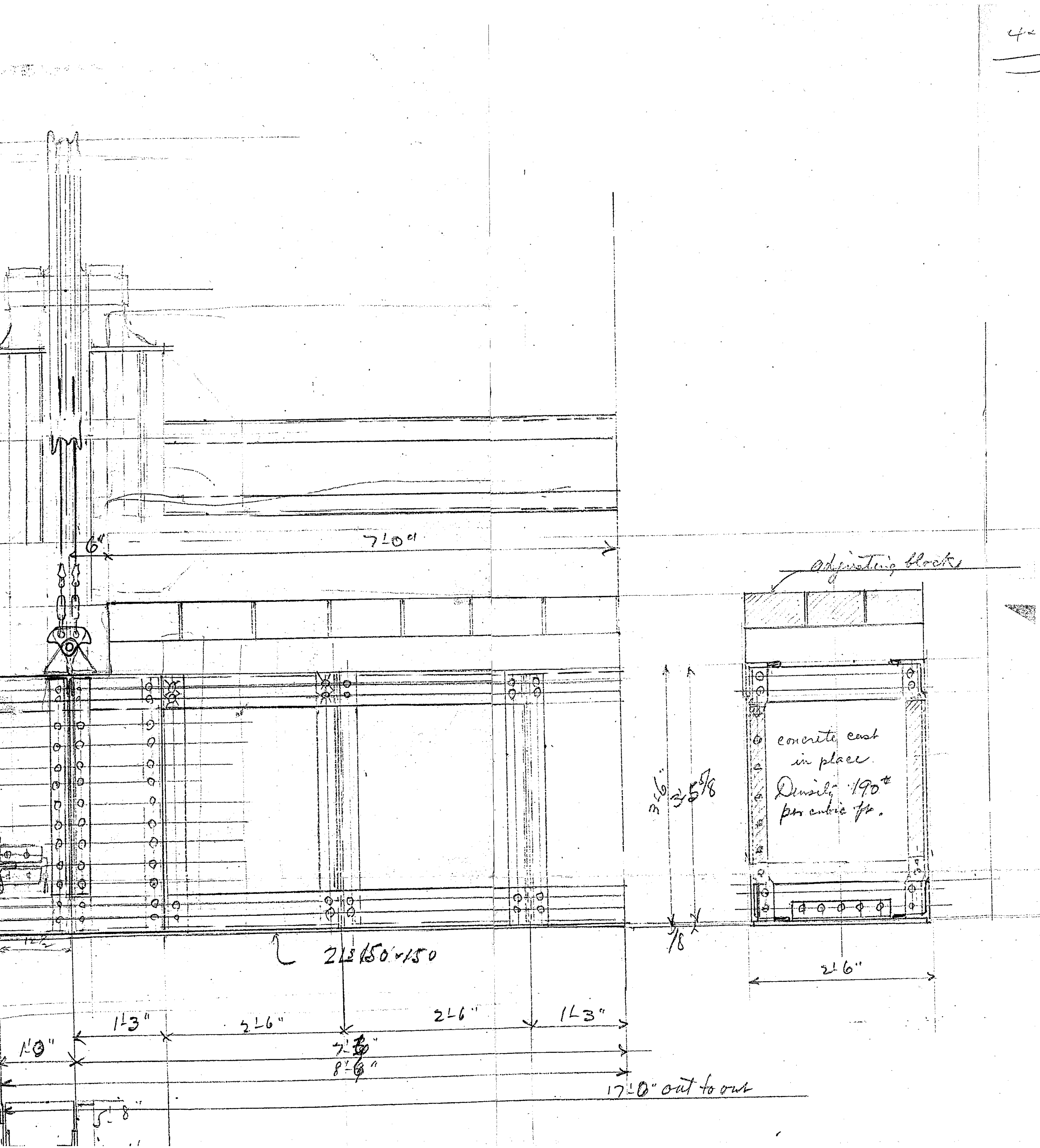
35300
2890
6400

7'-6
1-3
6-3

12'-6 15
10 2'6
2'6"
30



2'-0"
1'-3" 3/8
6"
7'-0"
2L 150×150
1'-3"
2'-6"
2'-6"
1'-0"
8'-6"
1'-8"
12'-6
6'
15'-0



2'-2 3/8
5/16

Pull in cable — $\frac{15.75 \text{ tons}}{2}$ = 7.875

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1.0 × 14. × 2.5 = 35.0
188

$\frac{35300}{188}$ = 187.5#/sq ft

35300
23100
12200

2'-0"

15 tons