JIUN MASUDA
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JIJI BLDG, TOKYO

CALCULATIONS FOR

MADE BY _____ DATE _____ FILE NO _____

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昭和六年六月

富山縣電氣局

小見支水路

常願寺川水路橋設計々算書

及材料予算書

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MADE BY J. Masuda DATE 6-5-20 FILE NO ____
CHECKED BY ____ DATE ____ PAGE NO 1

CALCULATIONS FOR

富山縣電気局常願寺川水路橋

This bridge shall be built over Jioganji Gawa on main line of Omi water channel for Toyama-ken Hydro-Electric-Works. This will carry water main on lower deck and construction engine and footway on upper deck. Type of bridge selected for this site is half through arch bridge on rock foundations which is preferred to suspension type considering rigidity and permanency of structure.

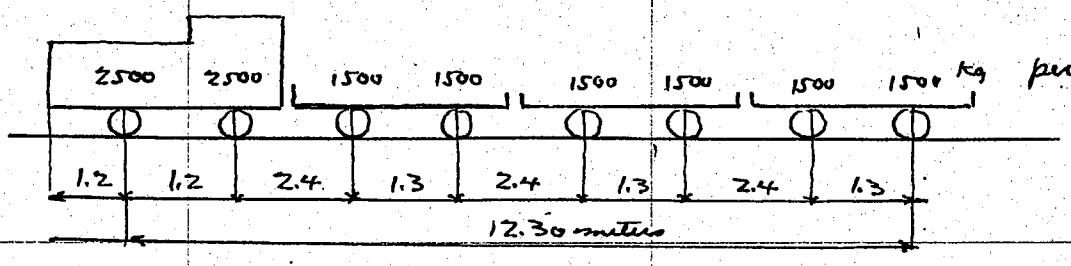
Total span length 88.0 meters between end hinges which is divided into 22 panels of 4.0 meters each and 6.0 meters apart of trusses. Present foot path is 3.0 meter wide between handrails and .762 meter gage track line on center line of bridge. Diameter of water pipe on lower deck will be 1.2 meters in diameter.

For future construction, the track will be removed after completion of entire water power works and the above will be remodeled as highway bridge; Clear roadway of 5.0 meters between handrails and wooden flooring to carry 6ton motor trucks and uniform live load as prefectural highway bridge

Loading

As waterway bridge.

water main 1.2 meter dia Stiel riveted pipe or welded pipe.
traction engine. diagram as shown below.
Wind load 150 kg per sq meter on windward
75 " " " " leeward



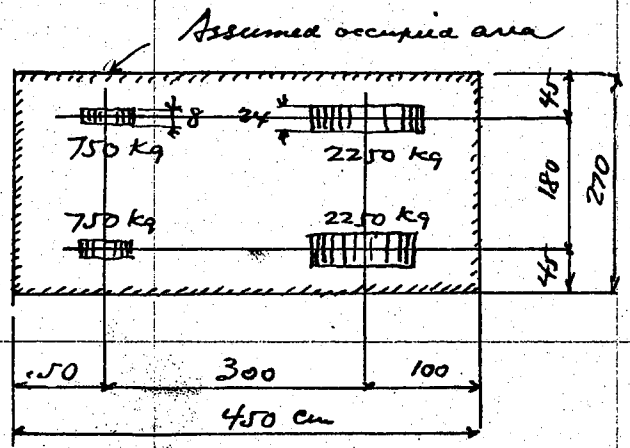
The above wheel load including impact.
Snow load combined to engine load, = 150 kg per lin meter of span assuming roadway 3.0 meter wide.

As highway bridge

Uniform live load $w = \frac{100.000}{170+l} \leq 500$ kg/m²

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

Motor truck loading 6ton gross weight.



One motor truck on bridge with occupied space of 270 × 450 cm and un occupied space around motor truck filled with uniform live load specified above.

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CHECKED BY DATE PAGE NO 2

CALCULATIONS FOR

富山縣電気局常願寺川水路橋

Impact for motor truck loading

$$\text{Coef} = \frac{20}{60+l}$$

where l = loaded length in meter
max impact 30%.

No impact for uniform live load.

Wind load ; Same as above 150 kg per sq meter of exposed area on windward
75 " " " " leeward.

Snow load, neglected, this shall be included into uniform live load.

Allowable Working Strength.

Structural Steel or Reinforcing Bars

Tension net	1200	kg/cm²
Extreme fibre stress net	1200	"
Shear of rivet gross section	900	"
Compression member $1500\left(1 - 0.0055\frac{l}{r}\right)$ not over	1000	"

where l = length of member in cm
r = least radius of gyration in cm

Compression flange of girder $1200\left(1 - 0.012\frac{l}{b}\right)$ not over	1100	"

where l = Unsupported length of flange in cm
b = width of flange in cm.

Shear on shop driven rivets (machine driven)	850	"
" " field " " & turned bolts (machine driven)	750	"
Shear on pin.	900	"
Bearing on shop driven rivets (machine driven).	1700	"
" " field	1500	"
" " pin	1800	"

Rollers $45d$ kg where d = diameter of roller in cm

Concrete 1:2:4 mixture

Direct compression	35	kg/cm²
Fibre stress due to bending	45	"
Combined stress direct and bending	35	"
Punching shear of Concrete	9	"
Shear of plain concrete	4	"
Bond stress	6	"
Bearing on Concrete	45	"

Timber 栗材 fibre stress 65 "
杉材 " " 60 "

Considering wind, temperature stresses in addition to dead live and impact stresses allowable working strength increased 25%. In case of earth quake the unit strength increased 60%.
Seismic acceleration assumed 1500 mm/sec² or 15% of weight.

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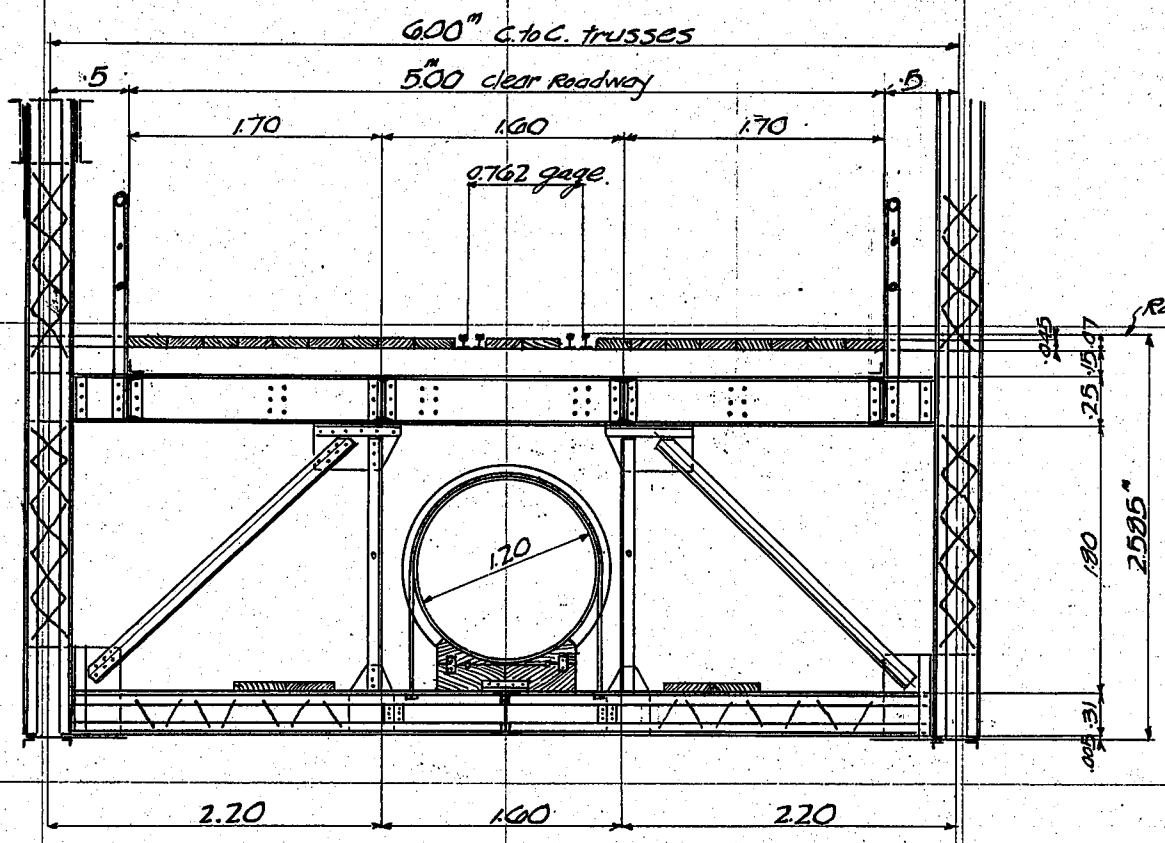
CHECKED BY ____ DATE ____ PAGE NO 3

CALCULATIONS FOR

小見支水路常願寺川水路橋

Design of Floor system for Future Construction
Cross section of Bridge assumed as shown on sketch below.



Scale 1:50

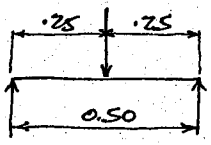
Planking Span length assumed 0.50 meter.

Dead load	wearing surface	4.0 cm	@ 6.50 =	26.0
	planking	7.5 "	@ 6.50 =	49.0
				75.0 kg per sq. meter.

Dead load moment = 1/10 × 75 × 0.50² = 2 kgm
Dead load shear = 1/2 × 75 × 0.50 = 19 kg.

Live load 6.0 ton motor truck load, Rear wheel concentration = 2,250
30 % impact 675
2,925 kg

2925 ÷ 65 = 4500



Longitudinal distribution of concentration a = 0.20 + 0.04 × 2 = 0.28 m
Transverse " b = 0.24 + 0.04 × 2 = 0.32 m
Effective width E = 2/3 × 0.5 + 0.32 = 0.65 m

Load per meter strip = 2925/.65 = 4500 kg

Moment per meter strip = 4500 × 0.50 ÷ 4 = 562
for continuity of planking, moment = 562 × 8/10 = 450 kgm.
Shear = 4500 ÷ 2 = 2,250 kg

Summary for moments and End shears.

	Moment	End Shear.
Dead Load	2	19
Live Load	450	2250
	452 kgm.	2,269 kg

Section modulus required = 452 × 100/60 = 754 cm³
Use 7.5 cm planking S_m = 100 × 7.5²/6 = 938 "
Fibre stress = 452 × 100/938 = 48.2 kg/cm²
Unit shear = 2269/100 × 7.5 × 3/2 = 4.5 "

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MADE BY K. Inaba DATE 6-5-19 FILE NO
CHECKED BY DATE PAGE NO 4

CALCULATIONS FOR

常願寺川水路橋

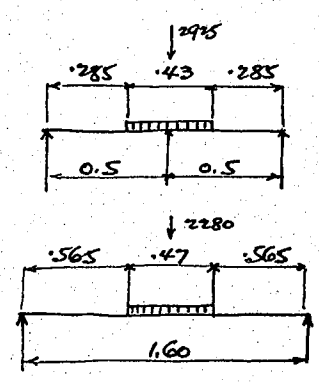
Design of Sleepers. Span length 1.60 meters, Spacing 0.50 meter.

Dead load.

planking	0.50 @ 75	=	37.5
Sleeper assumed	.15×.18 @ 650	=	17.5
rails with accessories	say	=	19.0
Miscellaneous details	"	=	1.0
			75.0 kg per lin meter.

Dead load moment = 1/10 × 75 × 1.6² = 19 kgm
Dead load shear = 1/2 × 75 × 1.6 = 60 kg

Live load 6.0 ton motor truck load. Rear wheel concentration with impact = 2925 kg

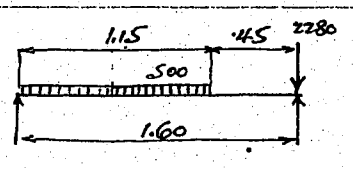


Longitudinal distribution a = 0.20 + .115×2 = 0.43 m
Transverse " b = 0.24 + .115×2 = 0.47 m
load on one sleeper. = 2925 × .39/.50 = 2280 kg

2280 ÷ 0.47 = 4850 kg/m.

moment 1140 × 0.80 = 912
4850 × .235² ÷ 2 = −134
778

For continuity of sleeper, moment = 778 × 8/10 = 622 kgm.



End shear $\frac{500 \times 1.15^2}{2 \times 1.60}$ = 207
2280
2487 kg.

Summary for moments and end shears

	moments	End shears.
Dead load	19	60
Live load	622	2487
	641 kgm	2547 kg

Section modulus required = 641×100/65 = 986 cm³

use 15×20 timber. Sm = 15×20²/6 = 1000 cm³.

unit shear = 2547/(15×20) × 3/2 = 12.7 kg/cm²

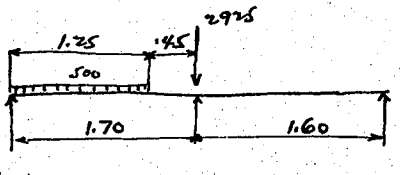
Design of Inside Stringers. Span length 4.00 meters, spacing 1.60 meters + 1.70 meters.

Dead load

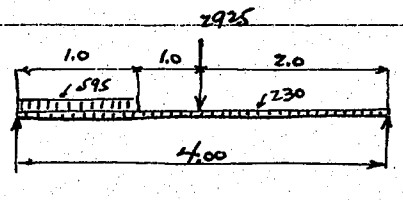
Floor planking	1.65 @ 75	=	124
sleepers	19.5×1.65 +	0.5	= 64
rails &c say	2 @ 12.5	=	25
Stringers assumed		=	42
			255 kg per lin. meter

Dead load moment = 1/8 × 255 × 4.0² = 510 kgm
Dead load shear = 1/2 × 255 × 4.0 = 510 kg

Live load 6.0 ton motor truck rear wheel concentration with impact = 2925 kg
" " " front " " " = 975 "



Uniform load on side of truck = 500×1.25²/2×1.70 = 230 kg/m
" " " front + rear " = 500×1.65 = 825 "
diff. = 595 "



Reaction $\frac{595 \times 1.0^2}{2 \times 4}$ = 75
230 × 2.0 = 460
2925 ÷ 2 = 1463
1998
2668 kg

moment 2668×2.0 = 3996
230×2.0²/2 = 460
3536 kgm

Shear.
595×3.0²/2×4.0 = 670
260×2 = 460
2925
4055 kg.

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CHECKED BY DATE PAGE NO 5

CALCULATIONS FOR

常願寺川水路橋

Snow load — max snow load assumed 150 kg/m²
load on stringer = 150 × 1.65 = 248 kg/lin meter
moment = 1/8 × 248 · 4.0² = 496 kgm.
Shear = 1/2 × 248 × 4.0 = 496 kgs

Summary for moments and end shears.

	moment	end shear
Dead load	510	510
Live load.	3536	4055
Snow load	496	496
	4542 kgm	5061 kg.

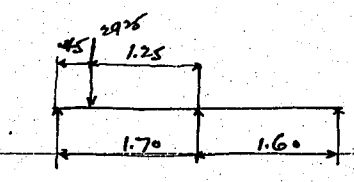
Section modulus required = $\frac{4542 \times 100}{1100}$ = 413 cm³
use I beam 250×125 @ 38.3 Sm = 414.9 cm²
fibre stress = $\frac{4542 \times 100}{414.9}$ = 1095 kg/cm²
unit shear = $\frac{5061}{0.75 \times 25}$ = 270 "

Design of Outside Stringers. Span length 4.00 meters.
Dead load.

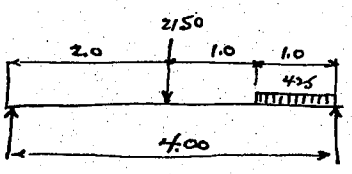
Floor planking	.85 @ 75	= 64
Sleepers	19.5 × 1.08 ÷ .5	= 42
Stringer assumed		37
handrail "		50
		193 kg/m.

Dead load moment = 1/8 × 193 × 4.0² = 386 kgm.
Dead load shear = 1/2 × 193 × 4.0 = 386 kg.

Live load. load on stringer = $\frac{2925 \times 1.25}{1.70}$ = 2150 kg/m.



uniform load. 500 × 0.85 = 425 kg/m.



Reaction $\frac{425 \times 1.0^2}{2 \times 4.0}$ = 53
2150 ÷ 2 = 1075
1128

Moment = 1128 × 2.0 = 2256 kgm

Shear $\frac{425 \times 3.0^2}{2 \times 4}$ = 478
2150
2628 kg.

Snow load.

load on stringer = 150 × 0.85 = 128 kg/m
moment = 1/8 × 128 × 4.0² = 256 kgm
Shear = 1/2 × 128 × 4.0 = 256 kg.

Summary for moments and shears.

	moments	end shears.
Dead Load	386	386
Live Load	2256	2628
Snow load.	256	256
	2898 kgm	3270 kg

Section modulus required = $\frac{2898 \times 100}{1100}$ = 263.5 cm³
Use I 250 · 90 @ 34.6 kg Sm = 334.5 cm³
fibre stress = $\frac{2898 \times 100}{334.5}$ = 867 kg/cm²
unit shear = $\frac{3270}{0.9 \times 25}$ = 145 "

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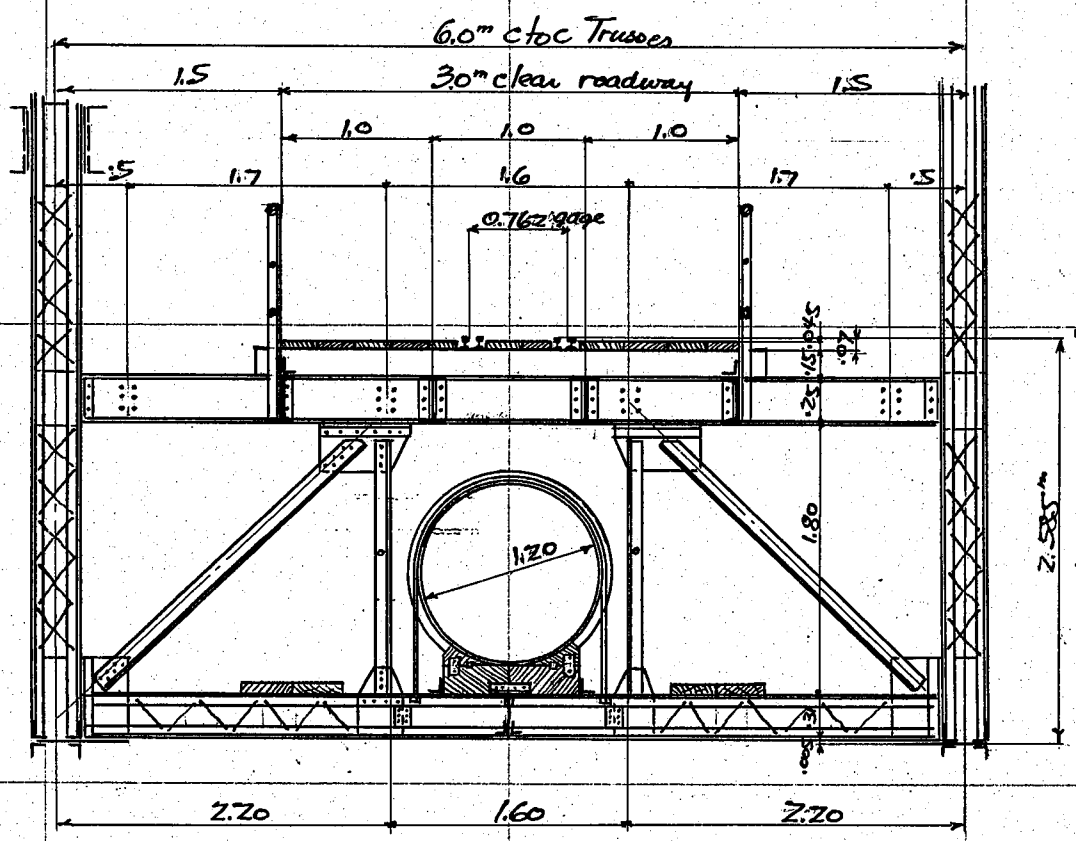
CHECKED BY DATE PAGE NO 6

CALCULATIONS FOR

常願寺川水路橋

Design of Floor System for present Construction.
Cross section of Bridge assumed as shown on sketch below.



Scale 1:50

Planking. Span length 1.0 meter side spans and 0.5 meter for center span.

Dead load Side span.

Planking 4.5 cm @ 650 = 29.

Dead load moment = 1/10 × 29 × 1.0² = 3 kgm.
Dead load shear = 1/2 × 29 × 1.0 = 15 kg.

Live load. Uniform load = 500 kg/m²
Live load moment = 1/10 × 500 × 1.0² = 50 kgm
Live load shear = 1/2 × 500 × 1.0 = 250 kg.

Snow load 150 kg/m²
Snow load moment = 1/10 × 150 × 1.0² = 15 kgm.
Snow load shear = 1/2 × 150 × 1.0 = 75 kg.

Summary for moments & shears.

	moments	shears.
Dead load	3	15
Live load	50	250
Snow load	15	75
	68 kgm	340 kg.

Section modulus required = $\frac{68 \times 100}{60}$ = 113 cm³

Use 4.5 cm planking

Sm. = $\frac{100 \times 4.5^2}{6}$ = 338 cm²

Use same planking for center span.

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CHECKED BY DATE PAGE NO 7

CALCULATIONS FOR

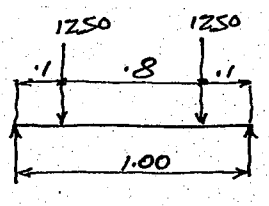
常願寺川水路橋

Design of Sleepers. 栗材 Span length 1.0 meter each for center and side spans.
Center span. Spacing 0.50 m c to c.
Dead load.

Planking	0.50 @ 29	=	15
Sleeper	.15 × .18 @ 650	=	18
rails with accessories say		=	19
miscellaneous details say		=	1/53 kg per lin meter of span.

Dead load moment = 1/10 × 53 × 1.0² = 5 kgm.
Dead load shear = 1/2 × 53 × 1.0 = 27 kg.

Live load. Engine load wheel concentration with 50% impact = 2500 kg



Above concentration assumed to be carried by two sleepers.
Concentration for one sleeper = 2500 ÷ 2 = 1250 kg
moment on sleeper = 1250 × 0.1 = 125 kgm
Shear " " = 1250 kg

for 25% impact
moment = 125 × 1.25/1.50 = 104 kgm
Shear = 1250 × " = 1040 kg

Snow load 150 kg/m² or 75 kg per lin meter on sleeper.
Snow load moment = 1/10 × 75 × 1.0² = 8 kgm
Snow load shear = 1/2 × 75 × 1.0 = 38 kg

Summary for moments and shears.

	moments	end shears
Dead load	5	27
Engine load 50% imp	125	1250
	130 kgm	1277 kg

	moments	2nd shears.
Dead load	5	27
Engine load 25% imp.	104	1040
Snow Load	8	38
	117 kgm	1105 kg

Section modulus required = 130 × 100/65 = 186 cm³
use 15 cm × 18 cm chestnut timber Sm. = 18 × 15²/6 = 675 cm³
fibre stress = 130 × 100/675 = 19.3 kg/cm²
unit shear = 1277/15 × 18 × 3/2 = 7.1 "

Side span. Spacing 1.0 meter c to c.
Dead load planking 1.0 @ 29 = 29.
Sleeper = 18
misc. say 3/50 kg per lin meter of span length.
Dead load moment = 1/10 × 50 × 1.0² = 5 kgm.
Dead load shear = 1/2 × 50 × 1.0 = 25 kg.
Live load + Snow load = 500 + 150 = 650 kg/m² load on sleeper = 650 kg/lin m.
moment = 1/10 × 650 × 1.0² = 65 kgm
shear = 1/2 × 650 × 1.0 = 325 kg.

Summary for moments and shears.

	moment	2nd shear.
Dead load	5	25
Live + Snow load	65	325
	70 kgm	350 kg.

Use same sleeper as for Center span

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CHECKED BY DATE PAGE NO 8

CALCULATIONS FOR

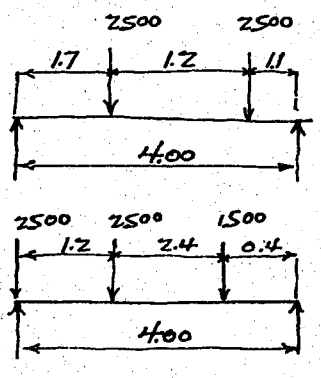
常願寺川水路橋

Design of Inside Stringers. Span length = 4.00 meters, spacing = 1.00 meter c to c.
Dead load.

Floor planking	1.0 @ 29	=	29.
sleepers	18×1.0 ÷ .75	=	24
rails and accessories say	2 @ 12.5	=	25
Stringers assumed			42
			120 kg per lin meter.

Dead load moment = 1/8 × 120 × 4.00² = 240 kgm.
Dead load shear = 1/2 × 120 × 4.00 = 240 kg.

Live load



Engine load, wheel concentration with 50% imp = 2500 kg
following car load " " " " = 1500 "

moment. 2500 × 1.10 = 2750
2500 × 2.30 = 5750
8500 ÷ 4.0 = 2125 kg
2125 × 1.70 = 3610 kgm for 25% imp 3610 × 1.25/1.5 = 3010 kgm

Shear
2500 × 2.80 ÷ 4.0 = 1750
2500
1500 × 0.40 ÷ 4.0 = 150
4400 kg " 4400 × " = 3670 kg.

Snow load
150 × 1.00 = 150 kg per lin meter.
Snow load moment = 1/8 × 150 × 4.0² = 300 kgm.
" " shear = 1/2 × 150 × 4.0 = 300 kg

Summary for moments and shears.

	moments	shears.
Dead load	240	240
Engine load 50% imp	3610	4400
	3850 kgm	4640 kg

	moments	shears
Dead load	240	240
Engine load 25% imp.	3010	3670
Snow load	300	300
	3550 kgm	4210 kg.

Section modulus required = 3850 × 100 / 1100 = 350 cm³
Use 1 I beam 250 × 125 @ 38.3 kg. Sm = 414.9 cm³
fibre stress = 3850 × 100 / 414.9 = 929 kg/cm²
Unit shear = 4640 / 0.75 × 25 = 248 "

Design of Outside stringer. Span length 4.00 meters. Spacing 1.00 meter c to c.
Dead load.

Floor planking	0.50 × 29	=	15
sleepers	18 × .7 × 1.0	=	13
handrail say			50
Stringer assumed			37
			115 kg per lin meter.

Dead load moment = 1/8 × 115 × 4.0² = 230 kgm.
Dead load shear = 1/2 × 115 × 4.0 = 230 kg

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MADE BY K. Inaba DATE 6-5-20 FILE NO
CHECKED BY DATE PAGE NO 9

CALCULATIONS FOR

常願寺川水路橋

Live load 500 × 0.5 = 250 kg per lin meter.
Live load moment = 1/8 × 250 × 4.0² = 500 kgm
Live load shear = 1/2 × 250 × 4.0 = 500 kg.

Snow load 150 × 0.7 = 105 kg per lin meter.
Snow load moment = 1/8 × 105 × 4.0² = 210 kgm
Snow load shear = 1/2 × 105 × 4.0 = 210 kg.

Summary for moments and shears.

	moments	shears.
Dead Load	230	230
Live Load	500	500
Snow Load	210/940 kgm	210/940 kg

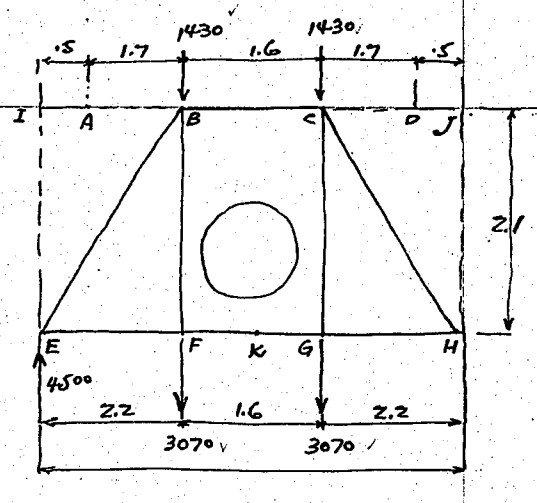
Section modulus required = 940×100/1100 = 86 cm³

use IL 250×90 @ 34.6 Sx = 414.9 cm³.

Design of Floor Beam for future Construction

Dead load.

Stringer concentrations on floor beam.
Inside stringers 2@510 = 1020 kg on B+C
Outside " 2@386 = 772 " on A+D.



Panel load		B+C	F+G
Stringer concentration		1020	
" "	772 × .5/2.2 =	175	
Top beam with details	60 × 1.9 =	115	
bottom " "	70 × 1.9 =		135
vertical "		50	35
diagonal "		70	
pipe line with water	1400/2 × 4 =		2,800
Chair, band, + strut etc say			100
		1430 kg	3070 kg

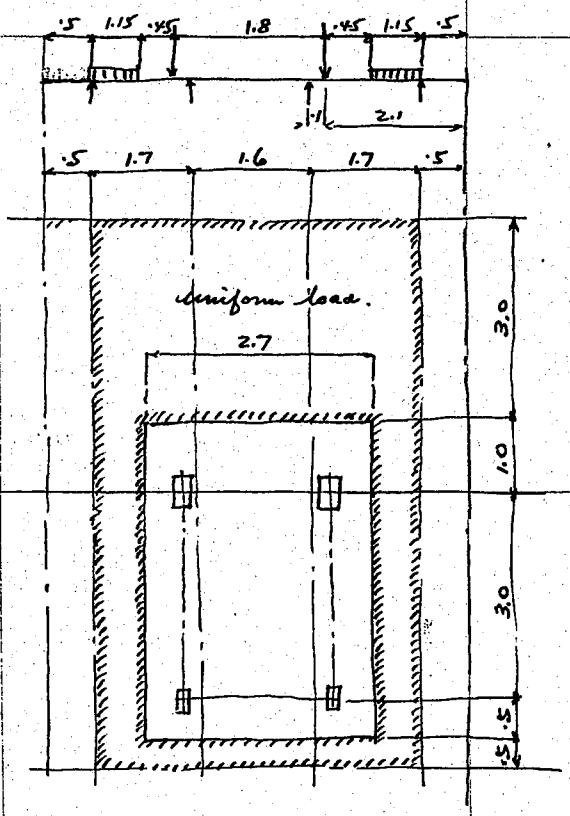
Dead load Stresses on members.

member			
BC.	4500 × 2.2 ÷ 2.1 =	4,710 kg	C
EFGH	" =	4,710 "	T
EB	4500 × 2.2 ÷ 1.5 =	6600 "	C
BF		3,070 "	T
moment at D = 597 × 0.5 =		300 kgm	
moment at K = 5800 × 1.6/4 =		2,320 "	

772 − 175 = 597

(2800+100) × 2 = 5800 kg

Live load.



6.0 ton motor truck rear wheel concentration with impact = 2925 kg
" front " " " = 975 "

Uniform load 500 kg per sq. meter.

Wheel concentration on floor beam
Rear wheel 2925
front " 975 × 1.0 ÷ 4.0 = 245
3170 kg

Load on panel pt. B+C 3170 × 2.1/2.2 = 3030 kg
" " " I+J 3170 × 0.1/2.2 140 kg.

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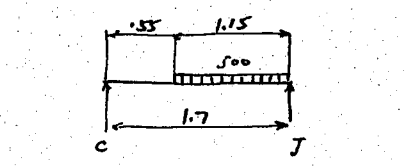
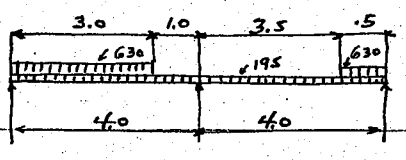
MADE BY K. Inaba DATE 6-5-20 FILE NO
CHECKED BY DATE PAGE NO 10

CALCULATIONS FOR

常願寺川水路橋





Uniform load stringer concentrations.

Stringers at B+C.

Unif. load on front + rear of truck 1.65 @ 500 = 825 kg/lin m.

" " Side " $\frac{500 \times 1.15^2}{2 \times 1.7}$ = 195 "

diff = 630 "

Concentration on B+C stringers

195×4.0	=	780
$\frac{630 \times 3.0^2}{2 \times 4.0}$	=	710
$\frac{630 \times .5^2}{2 \times 4.0}$	=	20
		1510 kg

Stringers at A+D.

Unif. load on front + rear of truck 0.85 @ 500 = 425 kg/lin m

" " Side " 575-195 = 380 "

diff. = 45 "

Concentration on A+D stringers

380×4.0	=	1520
$\frac{45 \times 3.0^2}{2 \times 4.0}$	=	50
$\frac{45 \times .5^2}{2 \times 4.0}$	=	—
		1570 kg.

Concentrations on panel points B+C.

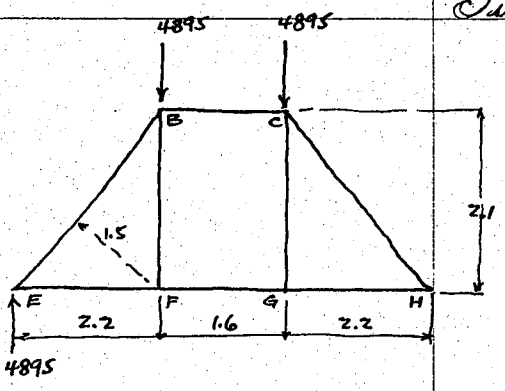
Stringers B+C 1510

" A+D $1570 \times \frac{.5}{2.2}$ = 355

1865 kg.

Concentration on panel points I+J

$1570 \times \frac{1.7}{2.2}$ = 1215 kg.



Summary for panel loads.

panel points	B+C	I+J
wheel load.	3030	140
unif. load	1865	1215
	4895 kg	1355 kg.

Stresses on members.

BC	$4895 \times 2.2 \div 2.1$	= 5130 kg	C
FG	"	= 5130 "	T
EF	"	= 5130 "	T
EB	$4895 \times 2.2 \div 1.5$	= 7180 "	C
BF		0	

Moment at D = 1355×0.5 = 680 kgm.

Snow load.

Stringer concentration

B+C	$1.65 \times 150 \times 4.0$ =	990 kg.	
A+D	$1.0 \times 150 \times 4.0$ =	600 kg	$600 \times \frac{0.5}{2.2}$ = 140 kg

Panel load.

B+C	I+J
990	
140	460
1130	460

Stresses on members.

BC	$1130 \times 2.2 \div 2.1$	= 1190 kg	C
FG = EF	"	1190 "	T
EB	$1130 \times 2.2 \div 1.5$	= 1660 "	C
BF		0	

Moment at A+D = 460×0.5 = 230 kgm

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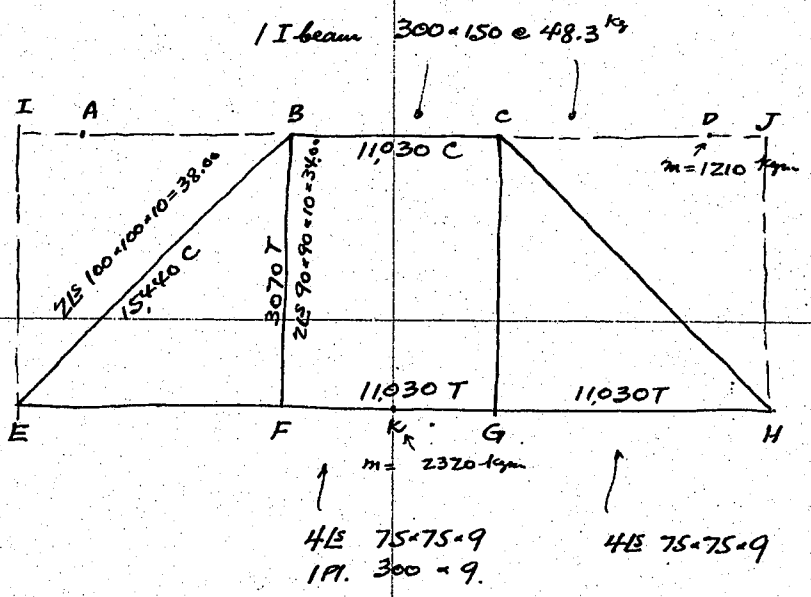
CHECKED BY DATE PAGE NO 11

CALCULATIONS FOR

常願寺川水路橋



Summary of stresses for members.

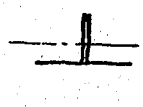
Members	D.L.	L.L.	S.L.	Total
BC	4710 C	5130 C	1190 C	11,030 kg C
EFGH	4710 T	5130 T	1190 T	11,030 T
EB	6600 C	7180 C	1660 C	15,440 C
BF	3070 T	0 T	0 T	3070 T
Moment at A+D	300 kgm	680	230	1,210 kgm
" K	2320	0	0	2320 "

Sections of members.

BE. Stress = 15440 kg C.

ZLS 100×100×10 = 38.00 cm² gr.

radius of gyration r = 3.03 cm



l = 300 cm

$\frac{l}{r} = \frac{300}{3.03} = 99.$

allowable unit compression

$f = 1500\left(1-0.0055\frac{l}{r}\right)$

$= 1500(1-0.0055\times 99)$

$= 683$ kg/cm² C

Section required $= \frac{15440}{683} = 22.60$ cm² gr

alternate section ZLS 125×75×9 = 34.38 cm² gr

BC Stress 11030 kg C

SR = 11.03 cm² gr

use I I beam 250×125 @ 38.3 kg.

area = 48.79 cm²

BF Stress 3070 kg T

$SR = \frac{3070}{1200} = 2.56$ cm² net

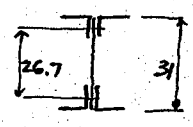
use ZLS 90×90×10 = 34.0 − 4.00 = 30.00 cm² net

alternate section

ZLS 125×75×9 = 34.38 − 3.96 = 30.42 cm² net

EFGH Stress = 11030 kg T moment = 2320 kgm

$SR = \frac{11030}{1200} = 9.20$ cm² net



web assumed 300×9 = 27.0 1/8 web = 3.37 cm²

Try ZLS 75×75×9 = 25.38 − 7.92 = 17.46

1/8 web area 3.37

20.83 net

Bending stress on flange.

$= \frac{2320\times 100}{26.7} = 8700$ kg

unit bending stress $= \frac{8700}{2083} = 4180$

direct stress $= \frac{11030}{6983} = 158.0$ kg/cm² T

25.38
17.46
27.00
69.83 cm²

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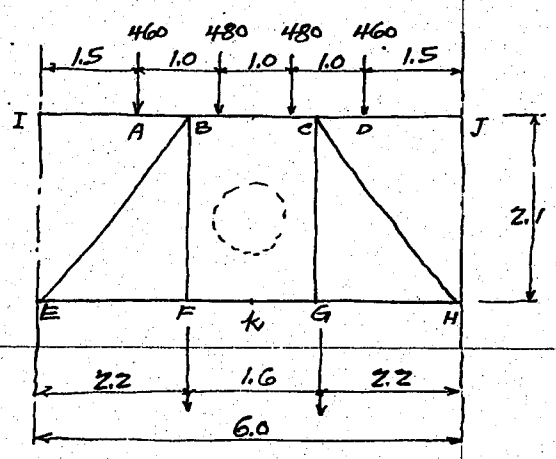
CHECKED BY DATE PAGE NO 12

CALCULATIONS FOR

常願寺川水路橋

Design of Floor Beam for Present Construction.

Dead Load.

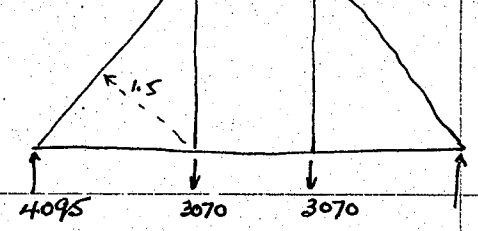


Stringer Concentrations on floor beam.
Inside stringers 2 @ 240 = 480 kg on B and C
Outside stringers 2 @ 230 = 460 " " A + D.

Panel loads.	B+C	F+G	I+J.
Stringer	480		
" 460 × 1.5/2.2 =	310		150
Top beam	115		
Bottom beam		135	
Vertical	50	35	
Diagonal	70		
Pipe with water		2800	
Chair band strut say	___	100	___
	1025	3070	150

Moment at D = 150 × 1.5 = 225 kgm
" " K = 5800 × 1.6/4 = 2320 "

(2800+100) × 2 = 5800

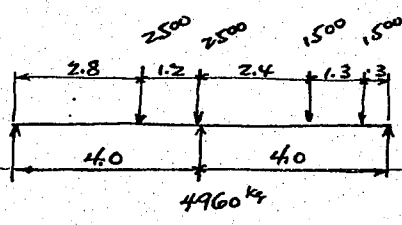


Dead load stresses for members

member			
BC	4095 × 2.2 ÷ 2.1	=	4290 kg C
FFGH	"	=	4290 " T
BE	4095 × 2.2 ÷ 1.5/2.1	=	6000 " C
BF	"	=	3070 " T

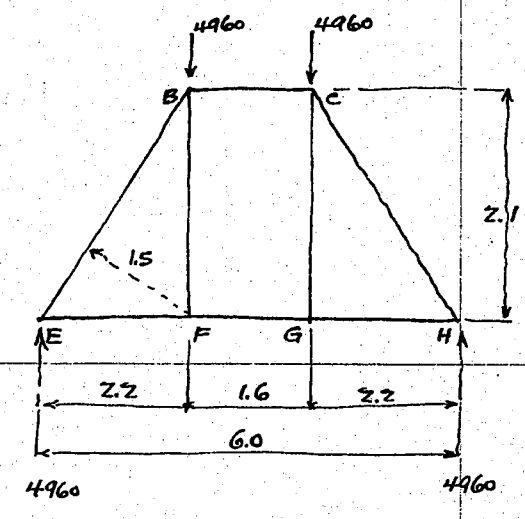
Live load

Engine load wheel concentration with 50% impact = 2500 kg
following cars. " = 1500 "



Concentration on panel pts. B+C.

2500 × 2.8 ÷ 4.00	=	1750
		2500
1500 × 1.60 ÷ 4.00	=	600
1500 × 0.30 ÷ 4.00	=	110
		4960 kg.



Live load stresses of members.

member.			50% imp		25% imp
BC	4960 × 2.2 ÷ 2.1	=	5200 kg C	× 1.25/1.50	4330 kg C
EFGH	"	=	5200 " T		4330 " T
EB	4960 × 2.2 ÷ 1.5	=	7260 " C		6050 " C
BF			0		0

Snow Load

Stringer Concentration

		Panel load.	
B+C	1.0 × 150 × 4.0 = 600 kg	600 + (420 × 1.5/2.2) =	890 kg on B+C
A+D	0.7 × 150 × 4.0 = 420 "		130 " on I+J

Snow load stresses on member.

BC	890 × 2.2 ÷ 2.1	=	930 kg C
EFGH	"	=	930 " T
EB	890 × 2.2 ÷ 1.5	=	1310 " C
BF		=	0
moment at D	130 × 1.5 "	=	195 kgm.

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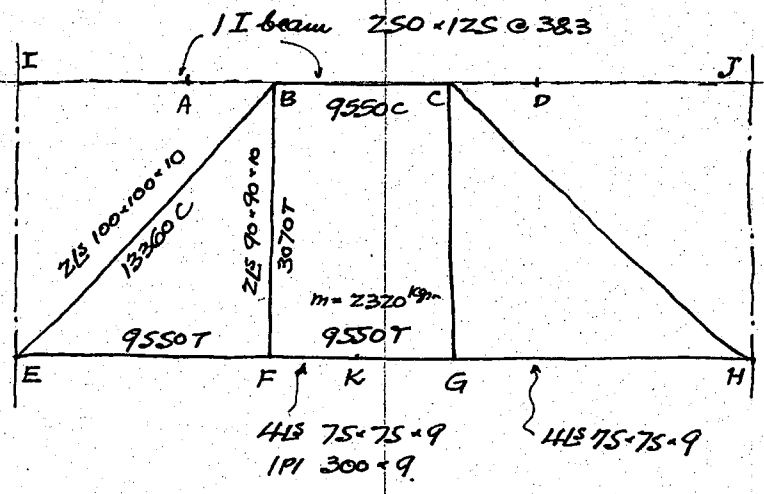
CHECKED BY DATE PAGE NO 13

CALCULATIONS FOR

常願寺川水路橋

Summary of Stresses for members.

members.	D.L.	L.L. 50%	Total. kg	D.L.	L.L. 25%	S.L.	Total
BC	42.90 C	52.00 C	94.90 C	42.90 C	43.30 C	9.30 C	95.50 C
EFGH	42.90 T	52.00 T	94.90 T	42.90 T	43.30 T	9.30 T	95.50 T
EB	60.00 C	72.60 C	132.60 C	60.00 C	60.50 C	13.10 C	133.60 C
BF	30.70 T	0	30.70 T	30.70 T	0	0	30.70 T
moment k.	23.20 kgm		23.20 kgm	23.20 kgm			23.20 kgm.



Sections of members.

BE Stress = 133.60 kg C

2L 100×100×10 = 38.00 cm² gr.

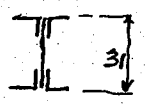
allowable compression = 683 kg/cm²

Actual stress = 13360/38 = 352 kg/cm²

alternate section.

2L 125×75×9 = 34.38 cm²

EFGH Stress 95.50 kg T. moment = 23.20 kgm



4L 75×75×9
1P1 300×9.

Bending stress on flange = 87.00

Unit bending stress = 8700/20.83 = 418

direct stress = 9.550/69.83 = 137/555 kg/cm² T

BC. Stress = 95.50 kg C

Use I I Beam 250×125@38.3

Sectional area = 48.79 cm²

BF stress = 30.70 kg T

use 2L 90×90×10 = 34.00 − 3.96 = 30.04 cm² net

alternate section

2L 125×90×9 = 34.38 − 3.96 = 30.42 cm² net.

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CHECKED BY DATE PAGE NO 14

CALCULATIONS FOR

常願寺川水路橋

Design of wind bracings.

assumed wind pressure 150 kg per square metre on windward
75 " " " " " leeward
225

Exposed area for truss members

Top chord				.42
middle chord				.41
Verticals	average height say 5.0 m	.25 ·	$\frac{5.0}{4.0}$	= .31
Diagonals	" length say 4.5 m	.25 ·	$\frac{4.5}{4.0}$	= .28
miscellaneous area say				.18

1.60 sq. metre per metre

For top lateral above floor level or bottom lateral for truss members below floor level the following pressure is assumed

Wind Pressure 1.60 · 225 = 360 kg per lin. metre
Panel concentration say 360 · 4.0 = 1440 kg

Exposed area of floor and conduit

handrail say as net area	.50
floor construction	.30
Siphon	1.20
longitudinal strut and chord members	.60
	2.60 square metre per metre

Wind pressure 2.60 · 225 = 585 kg per lin. metre
Panel concentration say 585 · 4 = 2340 kg

Summary wind pressure for truss 1440
for floor etc 2340
3780 kg.

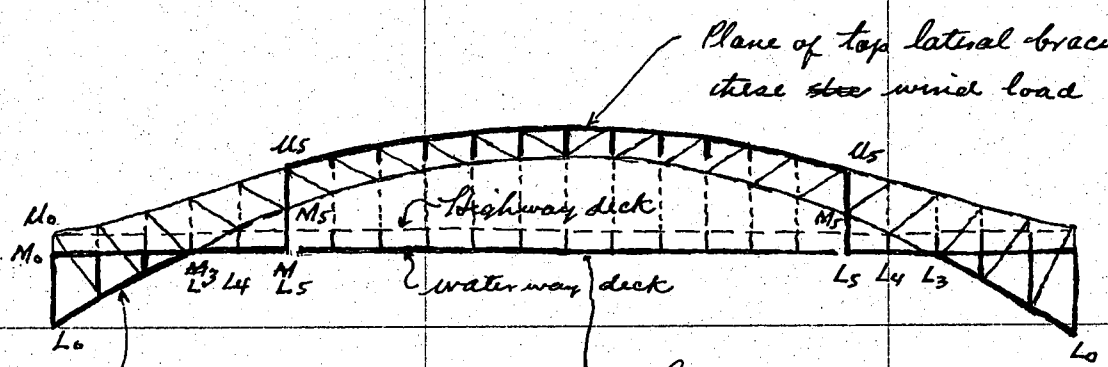
Wind load as highway bridge by specification

for loaded chord as span length 90 meter 400
4.0 × 15 = 60
460 kg per lin. metre of span

for unloaded chord 200
60
260 kg per lin. metre

Let us assume the wind load 225 kg per square metre for exposed area of truss and floor construction complete which will give severer stresses in lateral bracings than the assumed wind load by specification issued by Engineering Department of Home Affairs

General arrangement of wind bracings are as follows.



Plane of top lateral bracing with sways at top between U5-U5 these shall wind load assumed carried down to L5 of lower chord through panel point M5 of middle chord.

Lower lateral bracings load shall be carried through outside with hinged joint at L5

Wind load at U5 and L5 to be carried horizontally from L5 to the panel point L3 and then to L0 and the wind load between U0 and U5 shall be carried down to chord members below the each panel point.

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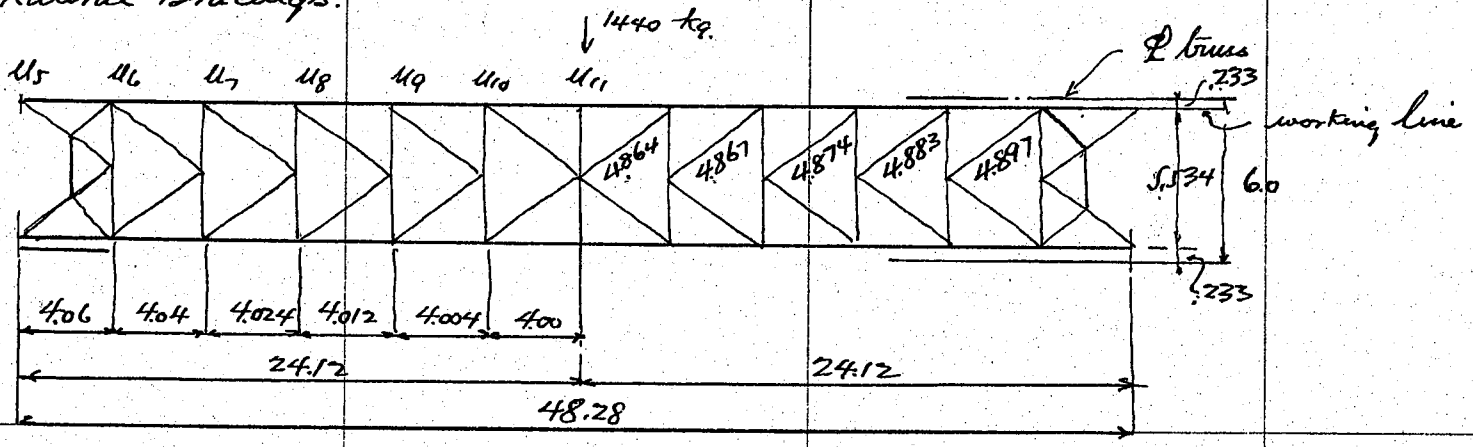
CHECKED BY DATE PAGE NO 15

CALCULATIONS FOR

常願寺川水路橋

Top Lateral Bracings.



Panel	max shear	Coef		Stress for one member		Coeff.
6-7	6600	× 1.63	=	10760 ÷ 2 = 5380	$\sec\theta = \frac{4.897}{3.00}$	= 1.63
7-8	5400	× 1.63	=	8800 ÷ 2 = 4400	$\sec\theta = \frac{4.883}{3.000}$	= 1.63
8-9	4320	× 1.62	=	7000 ÷ 2 = 3500	$\sec\theta = \frac{4.874}{3.000}$	= 1.62
9-10	3360	× "	=	5440 ÷ 2 = 2720	$\sec\theta = \frac{4.867}{3.000}$	= 1.62
10-11	2520	× "	=	4080 ÷ 2 = 2040	$\sec\theta = \frac{4.864}{3.000}$	= 1.62

For upper lateral bracing the span length assumed as shown in sketch above taking 12 panels and the shears required as simple span of 12 panels; for beams fixed at ends will give inflection point at ¼ point of span, that is, between panel points U5 and U6. Let us assume 48.28 meter as span length of truss in figuring lateral stresses.

As K truss section used for U6-U7 which will max stress.

assumed section 2L 125 × 90 × 9 = 37.08

least radius of gyration XX Axis = 3.39 unsupported length = 4.897

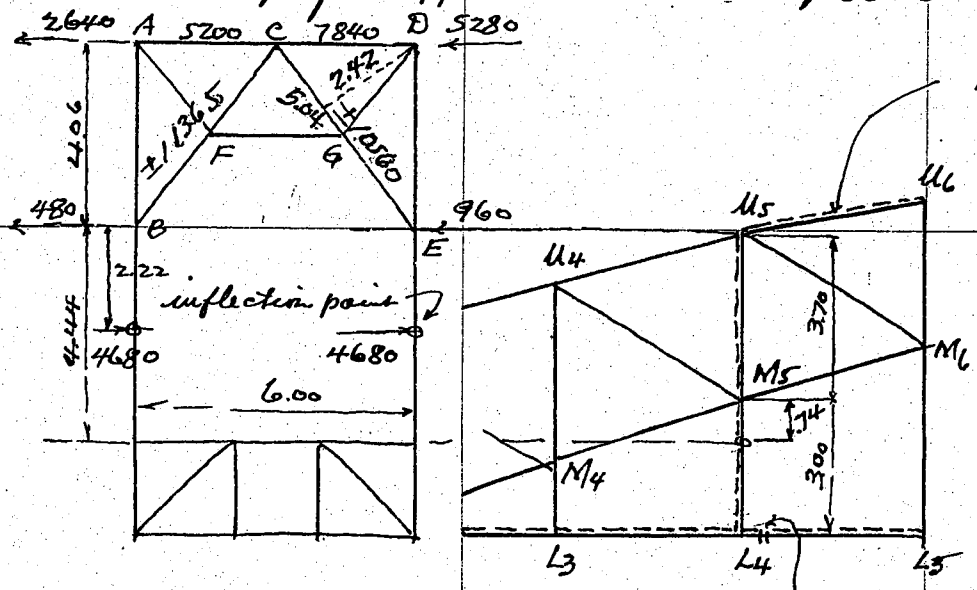
$L_a = 145$ about

unit stress $P = 1500 (1 - 0.0055 \times 145) = 300$ kg/cm²

This section good for stress of $37.08 \times 300 = 11100$ kg.

For all diagonals use 2L 125×90×9 riveted back to back long legs vertical.

Portal Bracing for upper chord to carry down wind load to bottom laterals.



Wind load on upper chord $1440 \times 5.5 = 7920$

windward	$7920 \times \frac{2}{3}$	=	5280 kg	$1440 \times \frac{2}{3}$	=	960 kg
leeward	$7920 \times \frac{1}{3}$	=	2640 kg.	$1440 \times \frac{1}{3}$	=	480 kg.

Horizontal reaction $H = \frac{7920 + 1440}{2} = 4680$ kg

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CHECKED BY DATE PAGE NO 16

CALCULATIONS FOR

常願寺川水路橋

Stress in Knee Brace CE $\frac{4680 \times 6.28}{2.42} = 12170$

$\frac{960 \times 4.06}{2.42} = -1610$

10560 kg

Knee Brace CB $12170 - 805 = 11365$ kg.

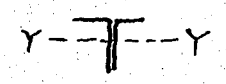
Top Strut CD $\frac{4680 \times 2.22}{4.06} = 2560$

5280

7840 kg

AC $2560 + 2640 = 5200$ kg.

Section for Knee Brace



2L⁵ 125 × 90 × 9 = 37.08 cm²

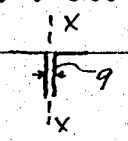
Least radius of gyration YY axis = 3.94

Unsupported length 504 cm

$P = 1500 \left(1 - 0.0055 \times \frac{504}{3.94} \right) = 447$ kg/cm²

Assumed section good for 37.08 × 447 = 16600 kg.

Transverse strut



2L⁵ 125 × 90 × 9 = 37.08 for top flange.

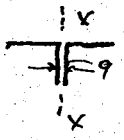
Least radius of gyration XX axis 9 mm apart 3.70

Unsupported length = 300

$P = 1500 \left(1 - 0.0055 \times \frac{300}{3.70} \right) = 830$

Assumed section good for 37.08 × 830 = 30800 kg.

Inv 2L⁵ 130×130 × 9 = 45.18 cm² for bottom flange



Least radius of gyration XX axis 9 mm apart 5.60

Unsupported length = 600 $l/r = \frac{600}{5.60} = 107.0$

$P = 1500 \left(1 - 0.0055 \times \frac{600}{5.6} \right) = 615$ kg/cm²

Bending moment at B or C due to horizontal reaction at inflection point.

inflection point assumed $\frac{444}{2} = 2.22$ meters

$m = 4680 \times 2.22 = 10400$ kg meters

Vertical reaction at panel point $U_5 M_5 L_5$

Assuming the transverse steel at panel point U_5 of top chord the vertical reaction at floor say

Total wind load = $6.5 \times 1440 = 9360$ kg

Reaction = $\frac{9360 \times 4.44}{6.0} = 6940$ kg

The wind load will be carried down by several truss members besides of vertical U_5-M_5. However the distribution of load can not be figured analytically; let us assume 100% of wind load carried by the said vertical one safe side of design.

Chord stresses due to wind load Span length assumed 48.24 meter 12 panels.

U_5-U_6 $\frac{9360 \times 4.06}{6.0} = 6340$ kg.

U_6-U_7 $9360 \times 8.10 = 75700$

$1440 \times 4.04 = -5820$

$69880 \div 6 = 11600$ kg

U_7-U_8 $9360 \times 12.124 = 113600$

$1440 \times 12.088 = -17400$

$96200 \div 6 = 16050$ kg

U_8-U_9 $9360 \times 16.136 = 151000$

$1440 \times 24.124 = -34700$

$116300 \div 6 = 19400$

U_9-U_{10} $9360 \times 20.14 = 188500$

$1440 \times 40.14 = -57800$

$130700 \div 6 = 21200$

U_{10}-U_{11} $9360 \times 24.14 = 226000$

$1440 \times 60.14 = -86600$

$149400 \div 6 = 24900$

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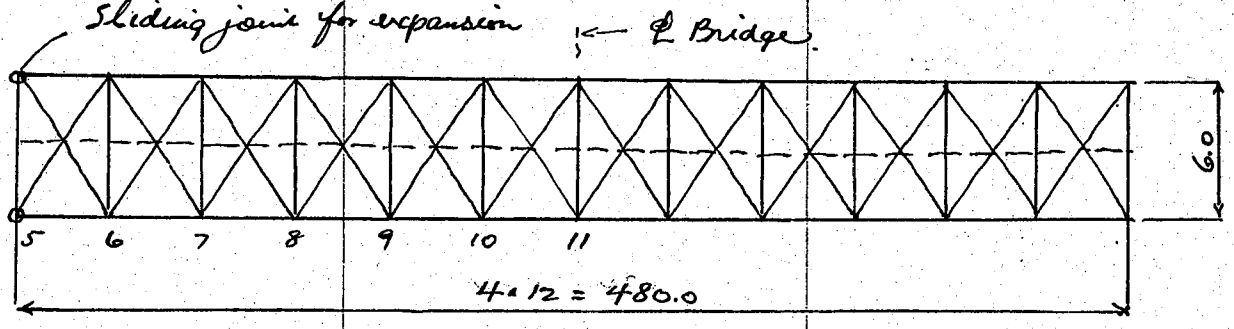
CALCULATIONS FOR

常願寺川水路橋

Bottom Lateral Bracings on waterway deck



Diagonal length $6^2 = 36$ $\sec\theta = \frac{7.2}{6.0} = 1.20$

$4^2 = 16$

$7.2^2 = 52$ $\tan\theta = \frac{4}{6} = .67$

Wind load panel concentration 2340 kg in which 2/3 on windward and 1/3 on leeward } assumed.

Diagonals Panel Point		max shear as moving load		stress	22φ Rivets	
5-6	5.5	12870	× 1.2 =	15480	5.4	2L 125×75×9 = 34.38 − 4.5 = 29.88 net
6-7	5.5/12	10710		12850	4.5	1L 125×75×9 = 17.19 − 2.25 = 14.94 net
7-8	4.5/12	8770		10500	3.6	〃
8-9	3.5/12	7020		8420	2.9	〃
9-10	2.5/12	5450		6540	2.3	〃
10-11	1.5/12	4100		4920	1.7	〃

Section required for diagonal 5-6 $15420 \div 1200 = 12.85$ cm² net

6-7 $12850 \div 1200 = 10.70$ net

Diagonal Stresses due to Pipe sliding on saddle block.

Total weight of pipe 270 kg.

Saddle and misc. 30

300

water content 1145

Panel concentration $1445 \times 4.0 = 5780$ kg.

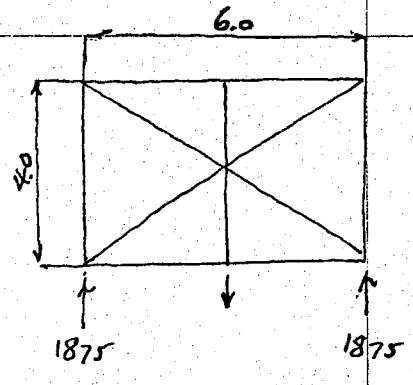
Frictional coefficient between steel and hardwood dry 60%.

" " wet 65%

when greased this coefficient sometimes reduced to 11%

when laying saddle block must grease to make sliding as free as possible.

Horizontal force $= 5780 \times 0.65 = 3750$ kg.



Diagonal length $= 3^2 = 9$

$2^2 = 4$

$3.6 \quad 13.$

Diagonal stress $= 1875 \times \frac{3.6}{2.0} = 3360$ kg.

No of rivet req'd 22φ $= \frac{3360}{2851} = 1.12$

when detailing connection No of rivet to be increased as 1.12 to the ordinary wind load stresses.

Use longitudinal strut at ℄ of bridge to carry sliding stresses to diagonal riveting strut at intersection of diagonals.

When the diagonals act as for both compression and tension the stress will be reduced to one-half figured above.

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MADE BY J. Masuda DATE 6-5-25 FILE NO
CHECKED BY DATE PAGE NO 18

CALCULATIONS FOR

常願寺川水路橋

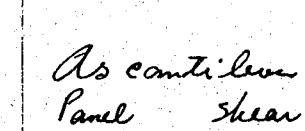
Chord stresses of lower laterals.

Panel				Stress			Section req'd		
5-6	2340 ×	5.5	× 2/3 =	8600 kg	÷ 975	=	8.8	use 2∠ 125×75×9 = 68.76 cm²	
6-7		10.0		15600		=	16.1	"	
7-8		13.5		21100		=	21.7	"	
8-9		16.0		25000		=	25.7	"	
9-10		17.5		27400		=	28.2	"	
10-11		18.0		28200		=	29.0	"	

Section assumed 4∠ 125×75×9 9mm apart

4∠ 125×75×9 = 68.76 cm²
radius of gyration 6.10

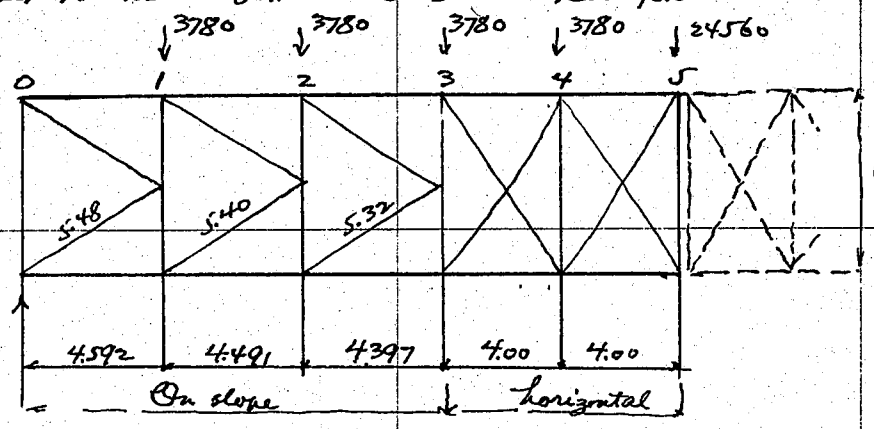
$P = 1500 \left(1 - 0.0055 \times \frac{400}{6.10}\right) = 975$ kg/cm²



Stress in transverse strut ; compression in diagonal neglected

member	Stress	22φ Rivt
5-5	12870	4.5
6-6	10710	3.7
7-7	8770	3.1
8-8	7020	2.5
9-9	5450	1.9
10-10	4100	1.5
11-11	2930	1.0

Lower laterals between 0-5



Diagonal stresses

Load at 5

From lower chord	12870	
	2340	15210
From top lateral	1440 × 6.5 =	9350
		24560

For ordinary panel point

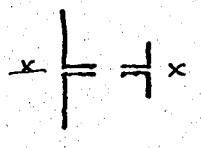
From deck floor	2340
" truss	1440
	3780 assumed

$\sec\theta = \frac{5.48}{3.00} = 1.825$ $\sec\theta = \frac{5.40}{3} = 1.80$ $\sec\theta = \frac{5.32}{3} = 1.77$

As cantilever truss

Panel	Shear		for one member		Stress.		Section req'd			Rivets
0-1	39680	÷ 2 =	18840	× 1.825 =	34400 T or C	÷ 619	= 55.6 cm²	2∠ 125×75×9 + 2∠ 75×75×9 = 59.76		12.0
1-2	35900		17950	× 1.800 =	32300 T or C	÷ 631	= 51.2 "			11.4
2-3	32120		16060	× 1.77 =	28400 T or C	÷ 645	= 44.0 "			10.0
3-4	28340		14170	× 1.20 =	17000 T or C			2∠ 125×90×9 = 37.08		6.0
4-5	24560		12280	× 1.20 =	14700 T or C					5.2

Sectioning of members 0-1, 1-2, and 2-3.



2∠ 125×75×9	= 34.38	× 4.64²	+ 538.2	= 1278
2∠ 75×75×9	= 25.38	× 2.60²	+ 128.8	= 300
	59.76			1578

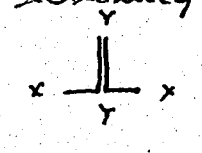
$r = \sqrt{\frac{1578}{59.76}} = 5.14$

$P = 1500 \left(1 - 0.0055 \times \frac{548}{5.14}\right) = 619$ kg/cm²

$P = 1500 \left(1 - 0.0055 \times \frac{540}{5.14}\right) = 631$ "

$P = 1500 \left(1 - 0.0055 \times \frac{532}{5.14}\right) = 645$ "

Sectioning of members 3-4 and 4-5



2∠ 125×90×9 = 37.08
Radius of gyration xx 3.94
YY 3.39

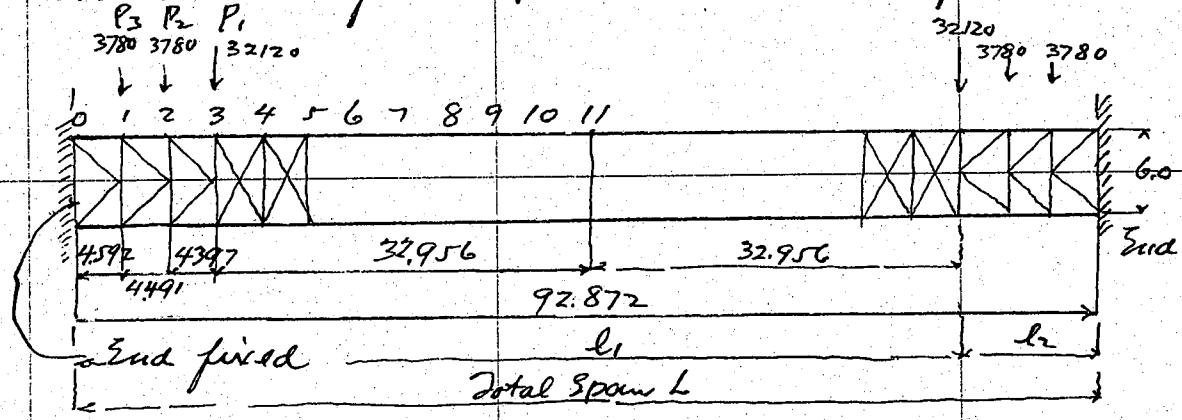
$P = 1500\left(1 - 0.0055 \times \frac{360}{3.39}\right) = 622$ kg/cm²

Section good for $622 \times 37.08 = 23100$ kg C

Chord stress as Cantilever truss.
Wind load at panel point 1 and 2 will be carried by horizontal bracing to end post and partly carried down sway bracing. however the main system in floor will carry the most of wind stress. Neglect this wind load when figuring chord stress

		stress
Panel 4-5	$24560 \times \frac{4}{6}$ =	162400 kg.
Panel 3-4	24560×8 =	196300
	3780×4 =	15100
		211400 ÷ 6 = 35200 kg. T or C
Panel 2-3	24560×12.379 =	304000
	3780×12.794 =	48300
		352300 ÷ 6 = 58700 kg T or C
Panel 1-2	24560×16.888 =	414000
	3780×21.776 =	82000
		496000 ÷ 6 = 82800 kg T or C
Panel 0-1	24560×2148 =	526.000
	3780×30.96 =	116.000
		642.000 ÷ 6 = 107.000 kg T or C

If we consider the whole truss as both ends fixed and the central portion between panel point 3-3 strong enough to carry the shear throughout, and the loading assumed as follows, then the stresses of chord members are,



Formula for negative moment at end due to symmetrical loadings.

$$M = -P\left(\frac{l_1 l_2^2 + l_2 l_1^2}{L^2}\right)$$

where P = panel load

moment due to P_1	$M = -32120\left(\frac{13.48 \times 79.392^2 + 79.392 \times 13.48^2}{92.872^2}\right)$	=	− 368.000 kgm
P_2	$M = -3780\left(\frac{9.083 \times 83.789^2 + 9.083^2 \times 83789}{92.872^2}\right)$	=	− 30.900
P_3	$M = -3780\left(\frac{4.592 \times 88.28^2 + 4.592^2 \times 88.28}{92.872^2}\right)$	=	− 16500
			415400 kgm

Positive moment at L_1	39680×4.592	=	+ 192.000
L_2	39680×9.083	=	+ 360.000
	3780×4.491	=	− 17.000
			+ 343000
L_3	39680×13.48	=	+ 534000
	3780×13.285	=	− 50.000
			+ 484.000

Cantilever moment at 3 due to wind load concentration at 4 and 5 = -211400 kgm

Summary moments and chord stresses

	0	1	2	3	4
	− 415400	− 415400	− 415400		
	− 211400	− 214400	− 211400	− 211400	− 98000
	+ 192000	+ 343000	+ 484000	+ [illegible]	
moment	434800	− 283800	− 142800	− 211400	− 98000
chord stress	− 72.300 kg	− 47200	− 23800	− 35200	− 16400 kg.

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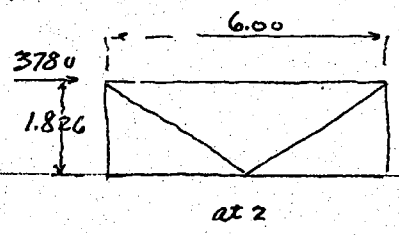
MADE BY J. Masuda DATE 6-5-25 FILE NO
CHECKED BY DATE PAGE NO 20

CALCULATIONS FOR

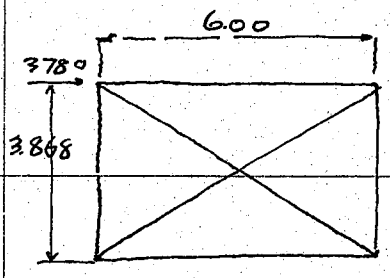
常願寺川水路橋

Final figures calculated above assumption give less wind stress than the figures calculated as cantilever truss; for safe side in sectioning of chord members let us use figures calculated cantilever assumptions.

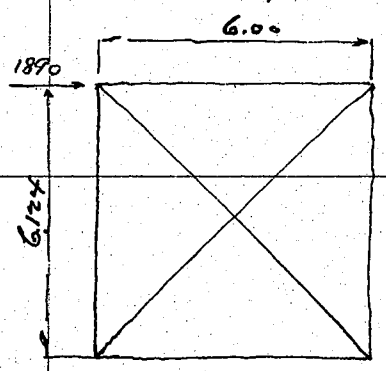
Sway Bracings under floor line at panel point 0 1 and 2
panel concentration assumed 3780 kg at 1 and 2, and at 0 1890 kg.



at 2



at 1



at 0

Diagonal length

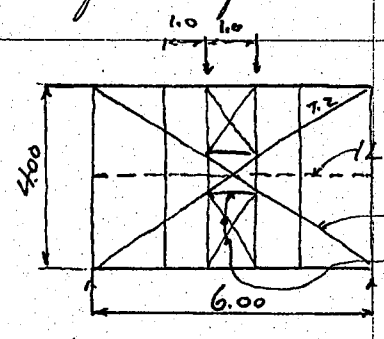
1.826^2	= 3.33	3.868^2	= 14.92	6.124^2	= 37.50
3.0^2	= 9.00	6.00^2	= 36.00	6.00^2	= 36.00
3.5^2	12.33	7.13^2	50.92	8.57^2	73.50

Diagonal stress

$3780 \cdot \frac{3.50}{3.00} = 4410$	$3780 \cdot \frac{7.13}{6.00} = 4500$	$1890 \cdot \frac{8.57}{6.00} = 2700$ kg.
Use 1L 130×130×9	Use 1L 130×130×9	Use 1L 130×130×9

1L 130×130×9 = 2.259 - 2.25 = 20.34 net
This angle good for stress of $1200 \cdot 20.34 = 24400$ kg in tension.

Thrust frame for Railway Deck.



divided into two.

Total live load 28000 kg.
for one rail 14000
Horizontal traction $14000 \cdot .2 = 2800$ kg.
diagonal stress $= 2800 \cdot \frac{7.2}{4.0} = 5040$ kg.
stress in tie $= 2800 \cdot \frac{6.0}{4.0} = 4200$ kg.
when the stress carried by 2 diagonals above stresses shall be
Use 1L 90×90×10 = 17.00 cm² for diagonal
least radius of gyration = 1.71
Unsupported length 1.80 meter $l/r = 105.5$
section good for both tension and compression.

Portal bracing and sway for upper lateral
Vertical sways to be provided at panel points U6 to U6'

top strut	2L 125×90×9	} to be used with diagonals
bottom strut	2L 130×130×9	of 75×75×9 angles and 75×9 bars.
knee brace	2L 130×130×9	

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CHECKED BY DATE PAGE NO 21

CALCULATIONS FOR

常願寺川水路橋

Estimate of Dead Load on Main Truss. (for future construction).

Wood flooring

Wearing surface	0.014 × 5.00	@ 650	=	130
Planking	0.075 × 5.00	@ 650	=	244
Sleepers	.15 × .20 × 5.6 ÷ .5	@ 650	=	219
rails with accessories	4	@ 15	=	60
platform for pipe line	.05 × 1.0	@ 650	=	30
miscellaneous bolts &c say				17
				700 kg per lin. m.

Structural steel

Handrails. say	2	@ 35	=	70
Stringers	2	@ 43	=	86
"	2	@ 38 "	=	76
floor beam with frames	22,000	÷ 88	=	250
bottom lateral bracings complete			=	347
top lateral bracings complete			=	158
trusses assumed	160,000	÷ 88	=	1820
				2807 kg per lin. m.
Pipe line with flanges + bolts &c say				270
Saddles bands &c say				23
				293 "

Summary for Dead Load → = 3800 "

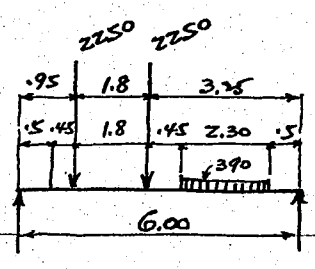
Dead load for one truss = 3800 ÷ 2 = 1,900 kg per lin. meter.
panel load = 1900 × 4 = 7,600 kg

Water load 1.207² × 0.7854 × 1000 kg = 1,145 kg per lin. meter.
panel load = 1145/2 × 4.00 = 2290 kg
call this 2300 kg
Total Dead panel load = 7600 + 2300 = 9,900 kg.

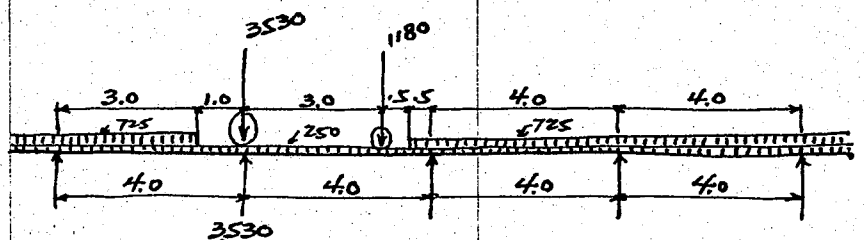
Live load on Main Truss. (for future construction).

Uniform load. $w = \frac{100000}{170+88} = 388$ call this 390 kg/m²

Motor truck load 6.0 ton motor truck rear wheel concentration = 2250
Impact coeff. = 20/(60+88) = 13.5% ∴ 300 kg
2550 kg
Front wheel with impact. say 2550 ÷ 3 = 850 "



Rear wheel concentration on truss
2550 × 3.25 = 8290
2550 × 5.05 = 12900 } 21190 ÷ 6.0 = 3530 kg
Front wheel " " 3530 ÷ 3 = 1180 "
Uniform load on front + rear of truck = 390 × 2.5 = 975 kg/m } diff. 725 kg/m
" " Sides of truck = 390 × 2.3 × 1.65/6 = 250 "

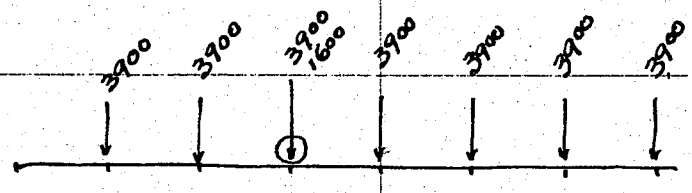


	3530		1180		
	295		885		
1000	1000		1000	1000	1000
1450			1450	2900	2900
1360	815				
	75		340		
3810	5665		3675	3900	3900

Assume this loading as follows.

3900	3900	3900	3900	3900
	1600 ← extra single concentration			

Assumed loading



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CHECKED BY DATE PAGE NO 22

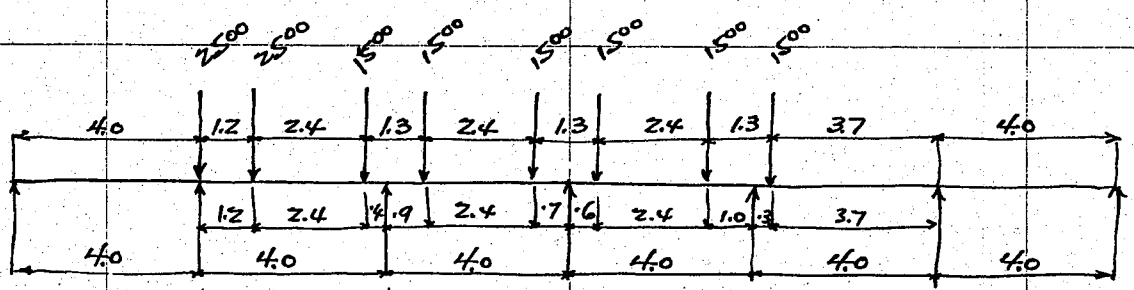
CALCULATIONS FOR

常願寺川水路橋

Train load

Engine wheel concentration with 50% impact = 2,500 kg
following car wheel .. .. = 1,500 ..

Snow load 150 × 1.65 = 250 kg/m
Panel load 250 × 4.0 = 1000 kg throughout bridge.



2500				
1750	750			
150	1350			
	1160	340		
	260	1240		
		1275	225	
		375	1125	
			1390	110
4400	3520	3230	2740	110

For simplicity sake, let us assume as follows.

4400 kg	3500	3200	2800	100

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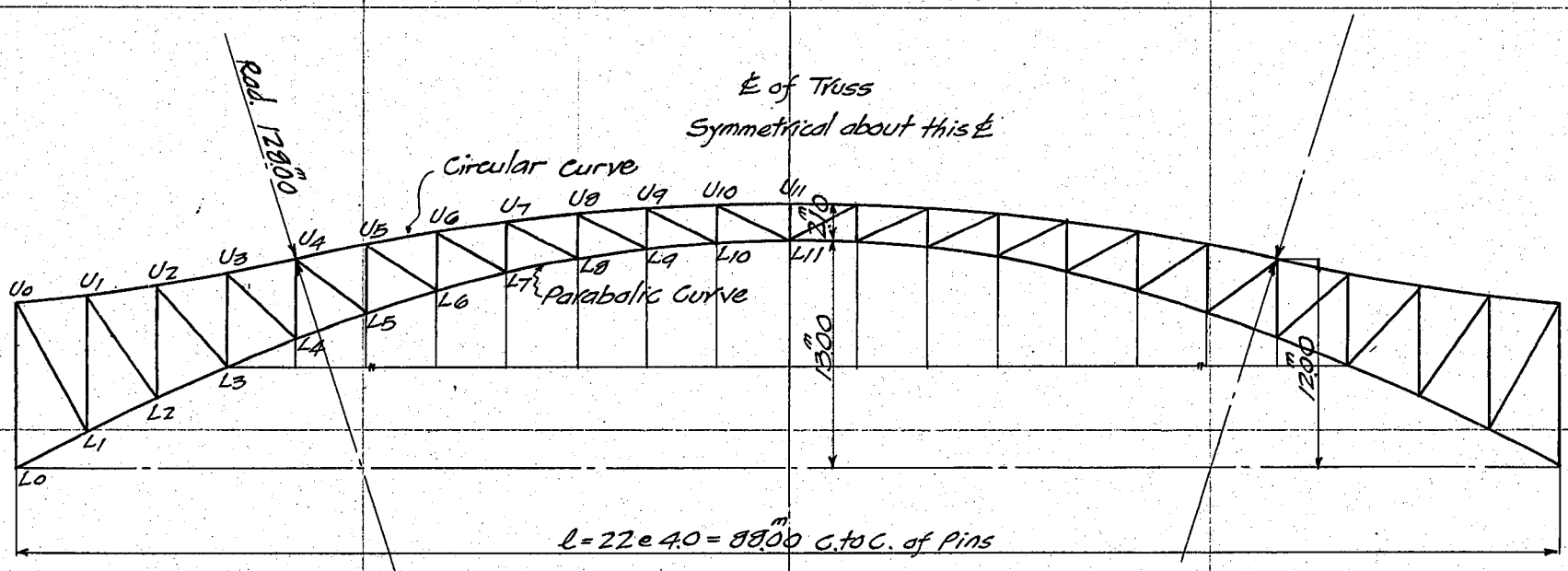
MADE BY K. Inaba DATE 6-5-15 FILE NO
CHECKED BY M. Jinda DATE 6-5-16 PAGE NO 23

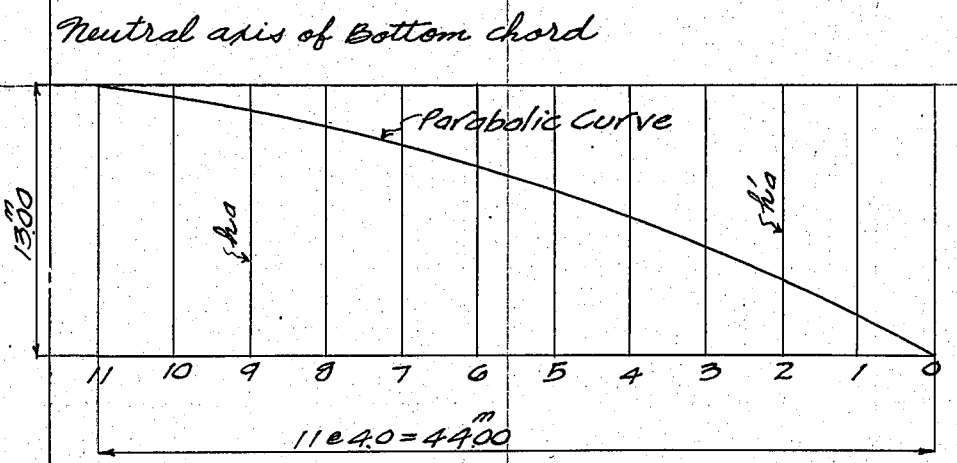
CALCULATIONS FOR

常願寺川水路橋

Necessary dimensions of truss

Let us use a parabolic curve for the neutral axis of Bottom chord and a reversed circular curve for that of Top chord, the radii of circles being equal.





Radius 12900"

$$\frac{130}{11^2} = \frac{130}{121} = 0.107438$$

No.			h'o	ha
11	0^2 =	0	0.000	13.000
10	1^2	1	0.107	12.893
9	2^2	4	0.430	12.570
8	3^2	9	0.967	12.033
7	4^2	16	1.719	11.281
6	5^2	25	2.686	10.314
5	6^2	36	3.868	9.132
4	7^2	49	5.264	7.736
3	8^2	64	6.876	6.124
2	9^2	81	8.702	4.298
1	10^2	100	10.744	2.256
0	11^2	121	13.000	0.000

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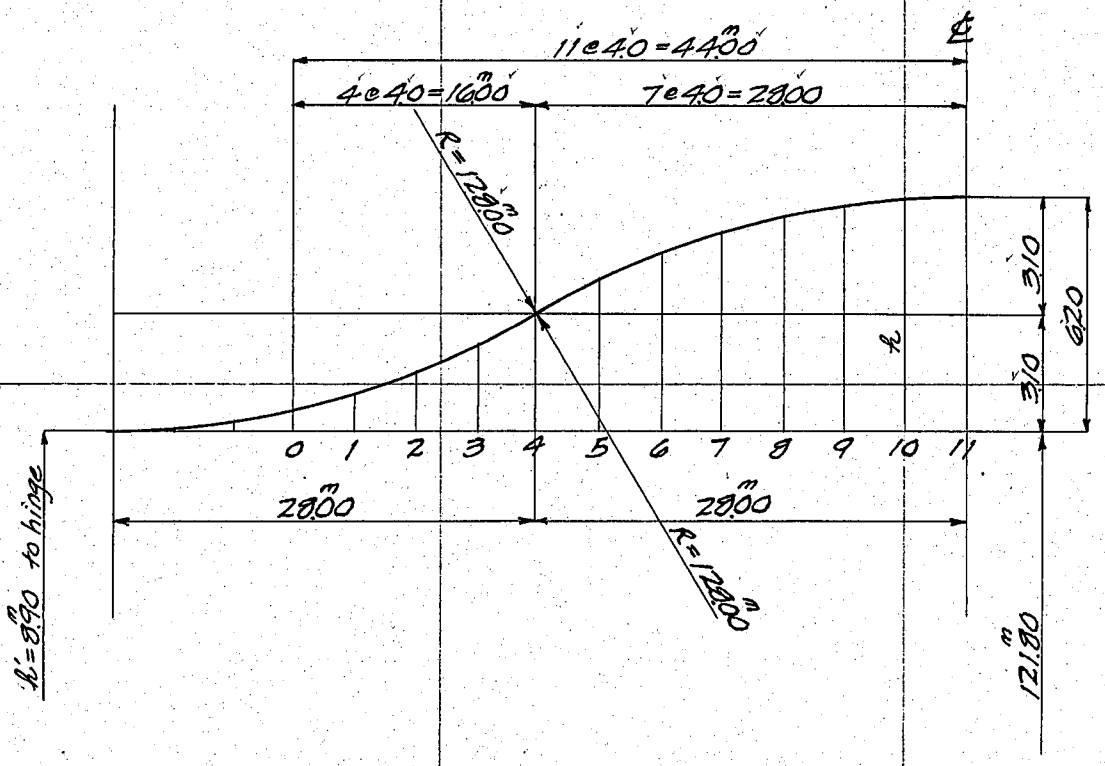
CHECKED BY M. Jinda DATE 6-5-16 PAGE NO 24

CALCULATIONS FOR

常願寺川水路橋

Neutral axis of upper chord



$x^2+y^2=R^2$
for $x=28.00$ $y=R-3.10$
$28.0^2+R^2-6.20R+3.10^2=R^2$
$6.2R=784+9.61=793.61$
$R=\frac{793.61}{6.2}=128.00^m$

Equation to this circle
$x^2+y^2=16,384$.

Length of members
Equation to neutral axis of upper chord
$x^2+y^2=16,384^m$ or $y^2=16,384-x^2$ $y=\sqrt{16,384-x^2}$

No.	x	x^2	$16,384-x^2$	y	h	h' above hinge			Length of verticals
11	0.00	0.00	16,384	128.000	6.200	+ 8.900	15.100	-13.000	2.100
10	4.00	16.00	16,368	127.937	6.137	"	15.037	12.893	2.144
9	8.00	64.00	16,320	127.750	5.950	"	14.850	12.570	2.280
8	12.00	144.00	16,240	127.436	5.636	"	14.536	12.033	2.503
7	16.00	256.00	16,128	126.996	5.196	"	14.096	11.281	2.815
6	20.00	400.00	15,984	126.428	4.628	"	13.528	10.314	3.214
5	24.00	576.00	15,808	125.730	3.930	"	12.830	9.132	3.698
4	28.00	784.00	15,600	124.900	3.100	"	12.000	7.736	4.264
3		128.00		-125.730	= 2.270	"	11.170	6.124	5.046
2		"		-126.428	= 1.572	"	10.472	4.298	6.174
1		"		-126.996	= 1.004	"	9.904	2.256	7.648
0		"		-127.436	= 0.564	"	9.464	0.000	9.464

Length of upper chords

Panel pts.	x	x^2	y	y^2	x^2+y^2	$\sqrt{x^2+y^2}$ = Length of upper chords
11	4.00	16.00	.063	0.003969		
10	"	"	.187	0.034969	16.003969	4.000
9	"	"	.314	0.098596	16.034969	4.004
8	"	"	.440	0.193600	16.098596	4.012
7	"	"	.568	0.322624	16.193600	4.024
6	"	"	.698	0.487204	16.322624	4.040
5	"	"	.830	0.688900	16.487204	4.060
4	"	"	.830	0.688900	16.688900	4.085
3	"	"	.698	0.487204	16.688900	4.085
2	"	"	.568	0.322624	16.487204	4.060
1	"	"	.440	0.193600	16.322624	4.040
0	"	"			16.193600	4.024

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MADE BY K. Inaba DATE 6-5-15 FILE NO
CHECKED BY M. Jinda DATE 6-5-16 PAGE NO 25

CALCULATIONS FOR

常願寺川水路橋

Length of Lower chords

Panel pt.	x	x^2	y	y^2	x^2+y^2	$\sqrt{x^2+y^2}$
11						
10	4.0	16.00	0.107	0.011449	16.011449	4.001
9	〃	〃	0.323	0.104329	16.104329	4.013
8	〃	〃	0.537	0.288369	16.288369	4.036
7	〃	〃	0.752	0.565504	16.565504	4.070
6	〃	〃	0.967	0.935089	16.935089	4.115
5	〃	〃	1.182	1.397124	17.397124	4.171
4	〃	〃	1.396	1.948816	17.948816	4.237
3	〃	〃	1.612	2.598544	18.598544	4.313
2	〃	〃	1.826	3.334276	19.334276	4.397
1	〃	〃	2.042	4.169764	20.169764	4.491
0	〃	〃	2.256	5.089536	21.089536	4.592

Length of Diagonals

Panel pt.	x	x^2	y	y^2	x^2+y^2	$\sqrt{x^2+y^2}$
11						
10	4.0	16.00	2.037	4.149369	20.149369	4.489
9	〃	〃	1.957	3.829849	19.829849	4.453
8	〃	〃	1.966	3.865156	19.865156	4.457
7	〃	〃	2.063	4.255969	20.255969	4.501
6	〃	〃	2.247	5.049009	21.049009	4.588
5	〃	〃	2.516	6.330256	22.330256	4.725
4	〃	〃	2.868	8.225424	24.225424	4.922
3	〃	〃	3.434	11.792356	27.792356	5.272
2	〃	〃	4.348	18.905104	34.905104	5.908
1	〃	〃	5.606	31.427236	47.427236	6.887
0	〃	〃	7.208	51.955264	67.955264	8.243

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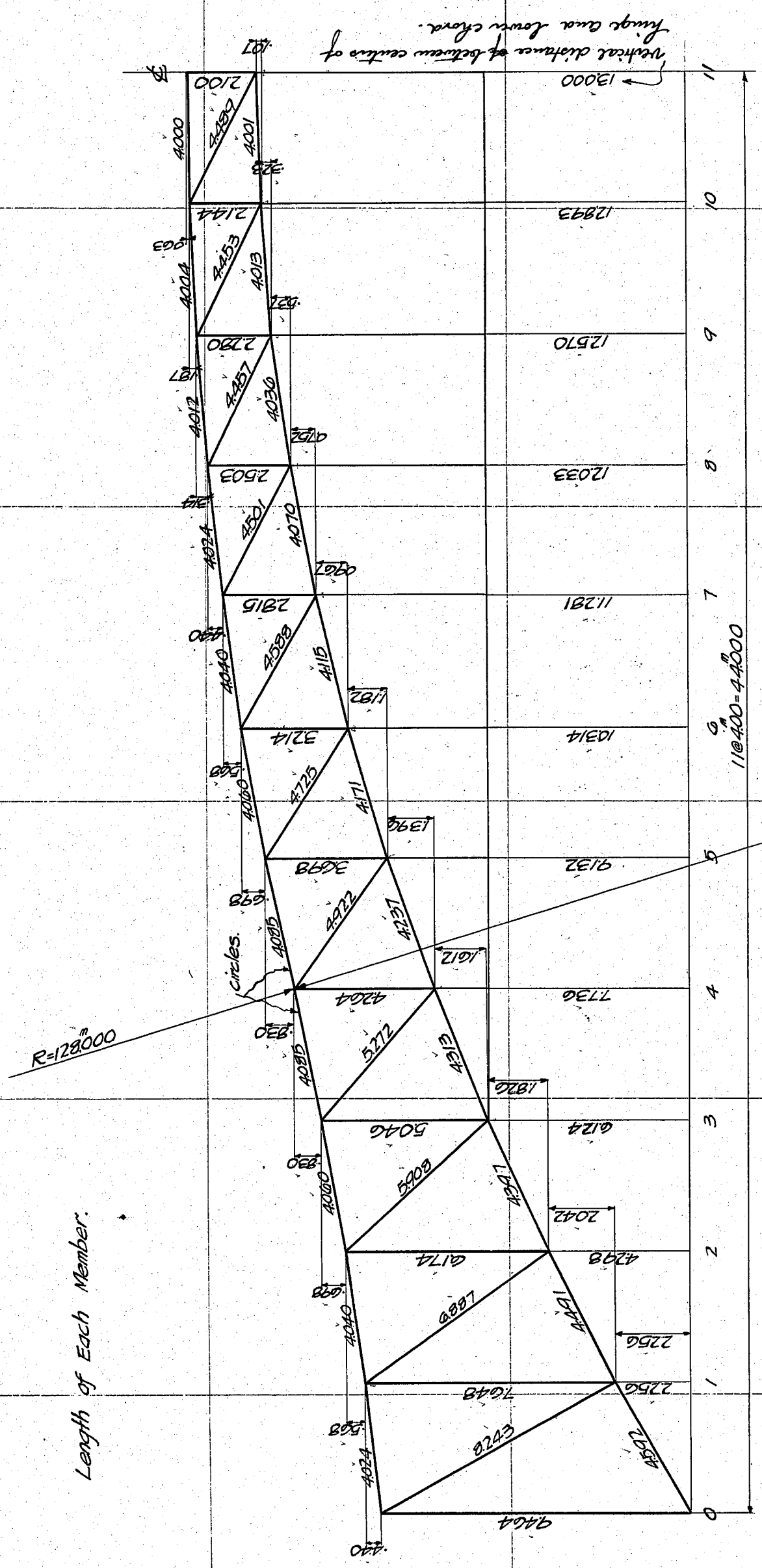
MADE BY K. Inaba DATE 6-5-15 FILE NO
CHECKED BY M. Jinda DATE 6-5-16 PAGE NO 26

CALCULATIONS FOR

常願寺川水路橋

Nominal Dimensions of Truss.



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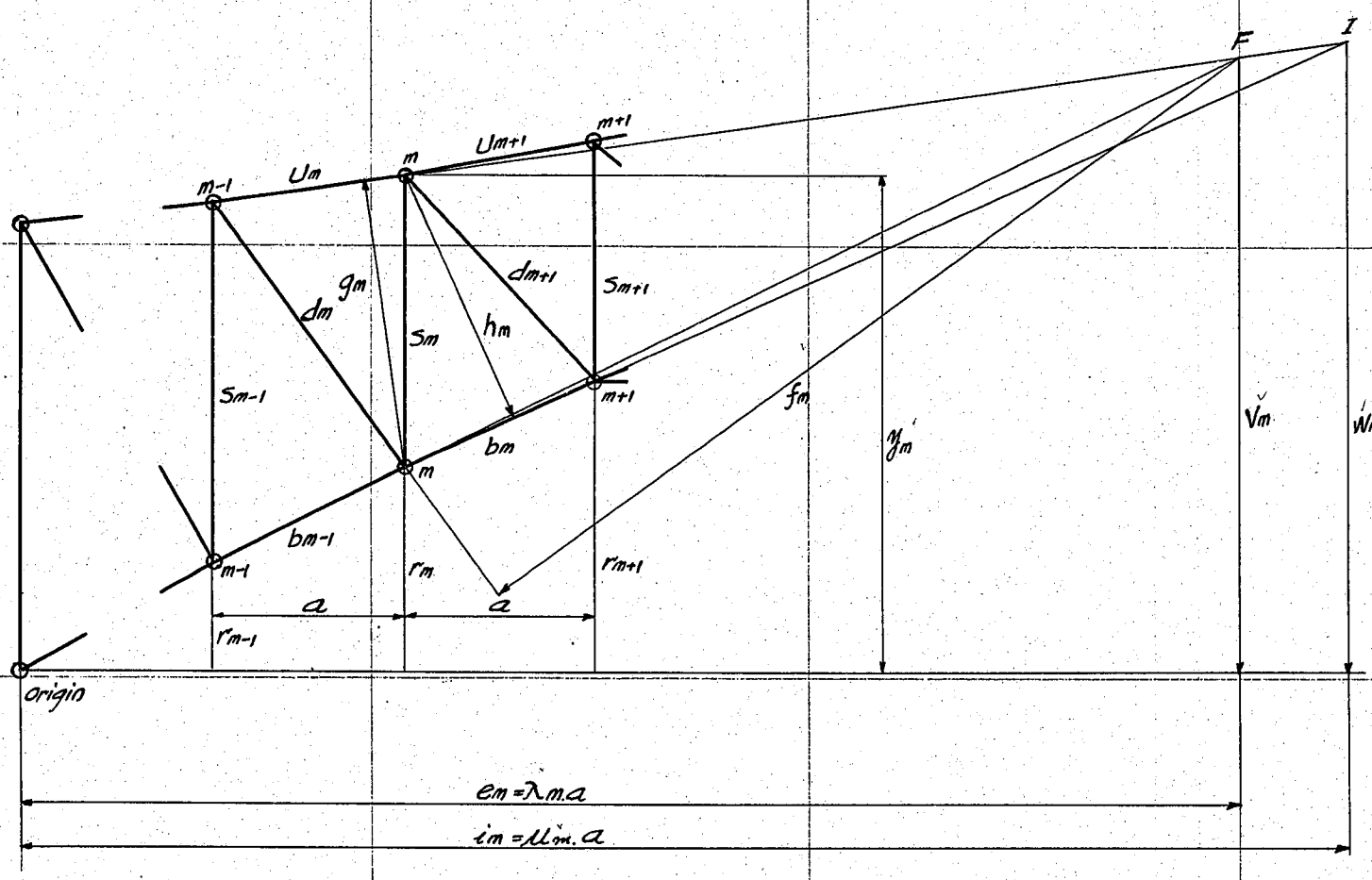
CHECKED BY DATE PAGE NO 27

CALCULATIONS FOR

常願寺川水路橋

Lever arms for moment



Notations

S_m = length of verticals
d_m = " diagonals
U_m = " upper chords
b_m = " lower chords
V_m = ordinates of lower panels
a = panel length
g_m = perpendicular distance from lower panel pt. m to upper chord U_m
h_m = perpendicular distance from upper panel pt. m to lower chord b_m.
v_m = vertical distance from intersection pt. (F) of chord U_m and chord b_{m-1}.
f_m = perpendicular distance from (F) to diagonals d_m.
w_m = vertical distance from intersection pt. (I) of chords U_m and b_m to left support.
e_m = horizontal distance from intersection pt. (F) to left support = $\lambda_m a$
i_m = horizontal distance from intersection pt. (I) to left support = $\mu_m a$

Then in general

$$g_m = \frac{a}{U_m} S_m$$

$$h_m = \frac{a}{b_m} S_m$$

$$v_m = \frac{S_{m-1}}{S_{m-1}-S_m}(r_m - r_{m-1}) + r_{m-1}$$

$$f_m = \frac{S_{m-1}}{S_{m-1}-S_m}\frac{a}{d_m} S_m$$

$$e_m = \frac{S_{m-1}}{S_{m-1}-S_m} a + (m-1)a = \lambda_m a$$

$$i_m = \frac{S_m}{(r_{m+1}-r_m)-(y_m-y_{m-1})} a + ma = \mu_m a$$

$$w_m = \frac{S_m}{(r_{m+1}-r_m)-(y_m-y_{m-1})}(r_{m+1}-r_m) + r_m$$

where $y_m = r_{m+1} + S_m$

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CHECKED BY DATE PAGE NO 28

CALCULATIONS FOR

常願寺川水路橋

$gm = \frac{a}{Um} Sm$

panel point	a	Sm	a.Sm	Um	gm.
0	4.0				
1	〃	7.648	30.592	4.024	7.602
2	〃	6.174	24.696	4.040	6.113
3	〃	5.046	20.184	4.060	4.971
4	〃	4.264	17.056	4.085	4.175
5	〃	3.698	14.792	4.085	3.621
6	〃	3.214	12.856	4.060	3.167
7	〃	2.815	11.260	4.040	2.787
8	〃	2.503	10.012	4.024	2.488
9	〃	2.280	9.120	4.012	2.273
10	〃	2.144	8.576	4.004	2.142
11	〃	2.100	8.400	4.000	2.100

$hm = \frac{a}{bm} Sm.$

panel point	a	Sm.	a.Sm.	bm.	hm.
0	4.0	9.464	37.856	4.592	8.244
1	〃	7.648	30.592	4.491	6.812
2	〃	6.174	24.696	4.397	5.617
3	〃	5.046	20.184	4.313	4.680
4	〃	4.264	17.056	4.237	4.025
5	〃	3.698	14.792	4.171	3.546
6	〃	3.214	12.856	4.115	3.124
7	〃	2.815	11.260	4.070	2.767
8	〃	2.503	10.012	4.036	2.481
9	〃	2.280	9.120	4.013	2.273
10	〃	2.144	8.576	4.001	2.143
11	〃				—

$fm = \frac{Sm-1}{Sm-1 - Sm} \frac{a}{dm} \cdot Sm.$

panel point	Sm-1	Sm-1 − Sm	a	Sm-1 × a	Sm-1 × a × Sm	dm	(Sm-1 − Sm) × dm	fm.
0								
1	9.464	1.816	4.0	37.856	289.522688	8.243	14.969288	19.341
2	7.648	1.474	〃	30.592	188.875008	6.887	10.151438	18.606
3	6.174	1.128	〃	24.696	124.6160016	5.908	6.664224	18.699
4	5.046	0.782	〃	20.184	86.064576	5.272	4.122704	20.876
5	4.264	0.566	〃	17.056	63.073088	4.922	2.785852	22.641
6	3.698	0.484	〃	14.792	47.541488	4.725	2.286900	20.789
7	3.214	0.399	〃	12.856	36.189640	4.588	1.830612	19.769
8	2.815	0.312	〃	11.260	28.183780	4.501	1.404312	20.069
9	2.503	0.223	〃	10.012	22.827360	4.457	.993911	22.967
10	2.280	0.136	〃	9.120	19.553280	4.453	.605608	32.287
11	2.144	0.044	〃	8.576	18.009600	4.489	.197516	91.180

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MADE BY M. Jinda DATE 6-5-10 FILE NO ____
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CALCULATIONS FOR

常願寺川水路橋

$$e_m = \frac{S_{m-1}}{S_{m-1} - S_m} \times a + (m-1)a$$

panel point	$S_{m-1} \times a$	$S_{m-1} - S_m$	$\frac{S_{m-1}}{S_{m-1}-S_m} a$	$(m-1)$	$(m-1) \times a$	e_m
0						
1	37.856	1.816	20.846	—	—	20.846
2	30.592	1.474	20.754	1	4.00	24.754
3	24.696	1.128	21.894	2	8.00	29.894
4	20.184	.782	25.811	3	12.00	37.811
5	17.056	.566	30.134	4	16.00	46.134
6	14.792	.484	30.562	5	20.00	50.562
7	12.856	.399	32.221	6	24.00	56.221
8	11.260	.312	36.090	7	28.00	64.090
9	10.012	.223	44.897	8	32.00	76.897
10	9.120	.136	67.059	9	36.00	103.059
11	8.576	.044	194.909	10	40.00	234.909

$$i_m = \frac{S_m}{(r_{m+1} - r_m) - (y_m - y_{m-1})} a + ma$$

panel point	$S_m a$	$(r_{m+1} - r_m) - (y_m - y_{m-1})$	$\frac{S_m}{(r_{m+1}-r_m)-(y_m-y_{m-1})} \times a$	ma	i_m
0					
1	30.592	1.602	19.096	4.0	23.096
2	24.696	1.258	19.631	8.0	27.631
3	20.184	.914	22.083	12.0	34.083
4	17.056	.566	30.134	16.0	46.134
5	14.792	.352	42.023	20.0	62.023
6	12.856	.269	47.792	24.0	71.792
7	11.260	.184	61.196	28.0	89.196
8	10.012	.097	103.216	32.0	135.216
9	9.120	.009	1.013.333	36.0	1049.333
10	8.576	-.080	-107.200	40.0	-67.200
11	8.400	—	—	—	—

$$v_m = \frac{S_{m-1}}{S_{m-1} - S_m} (r_m - r_{m-1}) + (r_{m-1})$$

panel point	S_{m-1}	$S_{m-1} - S_m$	r_m	r_{m-1}	$r_m - r_{m-1}$	$(S_{m-1}) \times (r_m - r_{m-1})$	$\frac{(S_{m-1}) \times (r_m - r_{m-1})}{S_{m-1} - S_m}$	v_m
0								
1	9.464	1816	2.256	0	2.256	21.350784	11.757	11.757
2	7.648	1474	4.298	2.256	2.042	15.617216	10.595	12.851
3	6.174	1.128	6.124	4.298	1.826	11.273724	9.994	14.292
4	5.046	0.782	7.736	6.124	1.612	8.134152	10.402	16.526
5	4.264	0.566	9.132	7.736	1.396	5.952544	10.517	18.253
6	3.698	0.484	10.314	9.132	1.182	4.371036	9.031	18.163
7	3.214	0.399	11.281	10.314	.967	3.107938	7.789	18.103
8	2.815	0.312	12.033	11.281	.752	2.116880	6.785	18.066
9	2.503	0.223	12.570	12.033	.537	1.344111	6.027	18.060
10	2.280	0.136	12.893	12.570	.323	.736440	5.415	17.985
11	2.144	0044	13.000	12893	.107	.229408	5214	18.107

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CHECKED BY DATE PAGE NO 30

CALCULATIONS FOR

常願寺川水路橋

$$W_m = \frac{S_m}{(r_{m+1}-r_m)\sim(y_m-y_{m-1})}(r_{m+1}-r_m)+r_m.$$

panel point	S_m	r_{m+1}	r_m	$(r_{m+1}-r_m)$	$S_m\times(r_{m+1}-r_m)$	y_m	y_{m-1}	y_m-y_{m-1}	$(r_{m+1}-r_m)-(y_m-y_{m-1})$	$\frac{S_m\times(r_{m+1}-r_m)}{(r_{m+1}-r_m)-(y_m-y_{m-1})}$	W_m
0	—										
1	7.648	4.298	2.256	2.042	15.617216	9.904	9.464	0.440	1.602	9.749	12.005
2	6.174	6.124	4.298	1.826	11.273724	10.472	9.904	0.568	1.258	8.962	13.260
3	5.046	7.736	6.124	1.612	8.134152	11.170	10.472	.698	.914	8.900	15.024
4	4.264	9.132	7.736	1.396	5.952544	12.000	11.170	.830	.566	10.517	18.253
5	3.698	10.314	9.132	1.182	4.371036	12.830	12.000	.830	.352	12.418	21.550
6	3.214	11.281	10.314	.967	3.107938	13.528	12.830	.698	.269	11.554	21.868
7	2.815	12.033	11.281	.752	2.116880	14.096	13.528	.568	.184	11.505	22.786
8	2.503	12.570	12.033	.537	1.344111	14.536	14.096	.440	.097	13.857	25.890
9	2.280	12.893	12.570	.323	.736440	14.850	14.536	.314	.009	81.827	94.397
10	2.144	13.000	12.893	.107	.229408	15.037	14.850	.187	−.080	−2.868	10.025
11	2.100	—	13.000								

Data finding the stresses of each members

panel pt.	U_m	b_m	S_m	d_m	r_m	g_m	h_m	f_m	e_m	i_m	v_m	w_m	$e_m-\overline{m-1}.a$	i_m-ma
0	—	4.592	9.464	—	—	—	8.244	—	—	—	—	—	—	—
1	4.024	4.491	7.648	8.243	2.256	7.602	6.812	19.341	20.846	23.096	11.757	12.005	20.846	19.096
2	4.040	4.347	6.174	6.887	4.298	6.113	5.617	18.606	24.754	27.631	12.851	13.260	20.754	19.631
3	4.060	4.313	5.046	5.908	6.124	4.971	4.680	18.699	29.894	34.083	14.292	15.024	21.894	22.083
4	4.085	4.237	4.264	5.272	7.736	4.175	4.025	20.876	37.811	46.134	16.526	18.253	25.811	30.134
5	4.085	4.171	3.698	4.922	9.132	3.621	3.546	22.641	46.134	62.023	18.253	21.550	30.134	42.023
6	4.060	4.115	3.214	4.725	10.314	3.167	3.124	20.789	50.562	71.792	18.163	21.868	30.562	47.792
7	4.040	4.070	2.815	4.588	11.281	2.787	2.767	19.769	56.221	89.196	18.103	22.786	32.221	61.196
8	4.024	4.036	2.503	4.501	12.033	2.488	2.481	20.069	64.090	135.216	18.060	25.890	36.090	103.216
9	4.012	4.013	2.280	4.457	12.570	2.273	2.273	22.967	76.897	1.049.333	18.060	94.397	44.897	1013.333
10	4.004	4.001	2.144	4.453	12.893	2.142	2.143	32.287	103.059	−67.200	17.985	10.025	67.059	−107.200
11	4.000	—	2.100	4.489	13.000	2.100	—	91.180	234.909	—	18.107	—	194.909	—

General Equation finding H Surface

$$H = \frac{\Sigma y_o y_a f + \Sigma e_o y_a l}{\Sigma y_a^2 f}$$

or $H = \frac{\Sigma y_o y_a f}{\Sigma y_a^2 f}$ neglecting temperature effect

where $f = \frac{l}{AE}$

y_o – Stresses of each members redundancy removed and unit load applied.
y_a – " " " " due to redeundancy. $H = -1$ applied.

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CALCULATIONS FOR

常願寺川水路橋

Upper chord stresses So redundancy removed and Unit load applied

	Load on									
member	1	2	3	4	5	6	7	8	9	10	11
1	-0.024	-0.048	-0.072	-0.096	-0.120	-0.144	-0.167	-0.191	-0.215	-0.239	-0.263
2	-0.059	-0.119	-0.178	-0.238	-0.297	-0.357	-0.416	-0.476	-0.535	-0.595	-0.654
3	-0.110	-0.219	-0.329	-0.439	-0.549	-0.658	-0.768	-0.878	-0.988	-1.097	-1.207
4	-0.174	-0.348	-0.523	-0.697	-0.871	-1.045	-1.219	-1.394	-1.568	-1.742	-1.916
5	-0.251	-0.502	-0.753	-1.004	-1.255	-1.506	-1.757	-2.008	-2.260	-2.511	-2.762
6	-0.344	-0.689	-1.033	-1.378	-1.722	-2.067	-2.411	-2.756	-3.100	-3.445	-3.789
7	-0.457	-0.913	-1.370	-1.827	-2.283	-2.740	-3.197	-3.653	-4.110	-4.567	-5.023
8	-0.585	-1.169	-1.754	-2.338	-2.923	-3.508	-4.092	-4.677	-5.262	-5.846	-6.431
9	-0.720	-1.440	-2.160	-2.880	-3.600	-4.319	-5.039	-5.759	-6.479	-7.199	-7.919
10	-0.849	-1.698	-2.546	-3.395	-4.244	-5.093	-5.942	-6.791	-7.639	-8.488	-9.337
11	-0.952	-1.905	-2.857	-3.810	-4.762	-5.714	-6.667	-7.619	-8.571	-9.524	-10.476
11'	-0.952	-1.905	-2.857	-3.810	-4.762	-5.714	-6.667	-7.619	-8.571	-9.524	-10.476
10'	-1.018	-2.037	-3.056	-4.075	-5.093	-6.111	-7.130	-8.149	-9.168	-10.186	-9.337
9'	-1.040	-2.079	-3.119	-4.159	-5.200	-6.240	-7.279	-8.319	-9.359	-8.639	-7.919
8'	-1.023	-2.046	-3.069	-4.092	-5.116	-6.139	-7.161	-8.185	-7.600	-7.015	-6.431
7'	-0.979	-1.957	-2.936	-3.914	-4.893	-5.872	-6.850	-6.393	-5.937	-5.480	-5.023
6'	-0.919	-1.837	-2.756	-3.674	-4.593	-5.511	-5.167	-4.822	-4.478	-4.134	-3.789
5'	-0.853	-1.707	-2.561	-3.414	-4.268	-4.017	-3.766	-3.515	-3.264	-3.013	-2.762
4'	-0.784	-1.568	-2.352	-3.136	-2.901	-2.787	-2.613	-2.439	-2.265	-2.090	-1.916
3'	-0.695	-1.390	-2.085	-1.975	-1.865	-1.756	-1.646	-1.536	-1.426	-1.317	-1.207
2'	-0.595	-1.190	-1.130	-1.071	-1.011	-0.952	-0.892	-0.833	-0.773	-0.714	-0.654
1'	-0.502	-0.478	-0.454	-0.431	-0.407	-0.383	-0.359	-0.335	-0.311	-0.287	-0.263

Lower chord stresses So redundancy removed and Unit load Applied

	Load on.									
member	1	2	3	4	5	6	7	8	9	10	11.
0	0	0	0	0	0	0	0	0	0	0	0
1	0.027	0.053	0.080	0.107	0.133	0.160	0.187	0.214	0.240	0.267	0.294
2	0.065	0.129	0.194	0.259	0.324	0.388	0.453	0.518	0.583	0.647	0.712
3	0.117	0.233	0.350	0.466	0.583	0.699	0.816	0.932	1.049	1.166	1.282
4	0.181	0.361	0.542	0.723	0.903	1.084	1.265	1.446	1.626	1.807	1.988
5	0.256	0.513	0.769	1.025	1.282	1.538	1.795	2.051	2.307	2.564	2.820
6	0.349	0.698	1.048	1.397	1.746	2.095	2.444	2.794	3.143	3.492	3.841
7	0.460	0.920	1.380	1.840	2.300	2.760	3.220	3.680	4.140	4.600	5.060
8	0.586	1.173	1.759	2.345	2.931	3.518	4.104	4.690	5.276	5.863	6.449
9	0.720	1.440	2.160	2.880	3.600	4.319	5.039	5.759	6.479	7.199	7.919
10	0.848	1.697	2.545	3.394	4.242	5.091	5.939	6.787	7.636	8.484	9.333
10'	1.018	2.037	3.054	4.073	5.090	6.109	7.126	8.145	9.163	10.181	9.333
9'	1.040	2.079	3.119	4.159	5.200	6.240	7.279	8.319	9.359	8.639	7.919
8'	1.026	2.051	3.078	4.104	5.130	6.155	7.182	8.208	7.622	7.035	6.449
7'	0.985	1.971	2.957	3.942	4.928	5.913	6.899	6.440	5.980	5.520	5.060
6'	0.931	1.862	2.794	3.725	4.656	5.587	5.238	4.889	4.540	4.190	3.841
5'	0.872	1.743	2.615	3.487	4.358	4.102	3.846	3.589	3.333	3.076	2.820
4'	0.813	1.626	2.439	3.252	3.072	2.891	2.710	2.530	2.349	2.168	1.988
3'	0.739	1.476	2.214	2.098	1.981	1.865	1.748	1.632	1.515	1.399	1.282
2'	0.648	1.295	1.230	1.165	1.101	1.036	0.971	0.906	.842	0.777	0.712
1'	0.561	0.534	0.507	0.480	0.454	0.427	0.400	0.374	.347	0.320	0.294
0'	0	0	0	0	0	0	0	0	0	0	0

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MADE BY M. Jiuda DATE 6-5-20 FILE NO
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CALCULATIONS FOR

常願寺川水路橋

Stresses of Diagonals To redundancy removed and Unit load applied.

	Load on										
member	1	2	3	4	5	6	7	8	9	10	11
1	0.049	0.098	0.147	0.196	0.245	0.294	0.343	0.392	0.441	0.490	0.539
2	0.060	0.121	0.181	0.242	0.302	0.363	0.423	0.484	0.544	0.605	0.665
3	0.073	0.145	0.218	0.291	0.363	0.436	0.509	0.581	0.654	0.727	0.799
4	0.082	0.165	0.247	0.329	0.412	0.494	0.576	0.659	0.741	0.823	0.906
5	0.093	0.185	0.278	0.370	0.463	0.556	0.648	0.741	0.834	0.926	1.019
6	0.111	0.221	0.332	0.442	0.553	0.663	0.774	0.884	0.995	1.106	1.216
7	0.129	0.259	0.388	0.517	0.646	0.776	0.905	1.034	1.163	1.293	1.422
8	0.145	0.290	0.435	0.581	0.726	0.871	1.016	1.161	1.306	1.452	1.597
9	0.152	0.304	0.457	0.609	0.761	0.913	1.065	1.218	1.370	1.522	1.674
10	0.145	0.290	0.435	0.580	0.725	0.871	1.016	1.161	1.306	1.451	1.596
11	0.117	0.234	0.351	0.468	0.586	0.703	0.820	0.937	1.054	1.171	1.288
11'	-0.073	-0.147	-0.220	-0.293	-0.366	-0.439	-0.512	-0.586	-0.660	-0.733	1.288
10'	-0.021	-0.042	-0.064	-0.085	-0.106	-0.127	-0.148	-0.170	-0.191	1.741	1.596
9'	0.022	0.044	0.066	0.088	0.110	0.132	0.154	0.176	1.978	1.826	1.674
8'	0.054	0.108	0.162	0.217	0.271	0.325	0.379	2.032	1.887	1.742	1.597
7'	0.073	0.146	0.219	0.292	0.365	0.438	1.939	1.810	1.680	1.551	1.422
6'	0.082	0.164	0.246	0.327	0.409	1.769	1.658	1.548	1.437	1.327	1.216
5'	0.084	0.168	0.252	0.336	1.575	1.482	1.389	1.297	1.204	1.111	1.019
4'	0.109	0.219	0.328	1.482	1.400	1.317	1.235	1.153	1.070	0.988	0.906
3'	0.141	0.282	1.381	1.308	1.235	1.163	1.090	1.017	0.945	0.872	0.799
2'	0.155	1.209	1.149	1.089	1.028	0.968	0.907	0.847	0.786	0.726	0.665
1'	1.029	0.980	0.931	0.882	0.833	0.784	0.735	0.686	0.637	0.588	0.539

Stresses of Verticals To redundancy removed and Unit load applied

	Load on										
Member	1	2	3	4	5	6	7	8	9	10	11.
0	-0.045	-0.091	-0.136	-0.182	-0.227	-0.273	-0.318	-0.364	-0.409	-0.455	-0.500
1	-0.055	-0.110	-0.165	-0.220	-0.275	-0.330	-0.385	-0.440	-0.495	-0.550	-0.605
2	-0.064	-0.128	-0.192	-0.256	-0.320	-0.384	-0.448	-0.512	-0.576	-0.640	-0.704
3	-0.070	-0.140	-0.210	-0.281	-0.351	-0.421	-0.491	-0.561	-0.631	-0.702	-0.772
4	-0.070	-0.139	-0.209	-0.278	-0.348	-0.418	-0.487	-0.557	-0.626	-0.696	-0.765
5	-0.067	-0.134	-0.201	-0.268	-0.335	-0.403	-0.470	-0.537	-0.604	-0.671	-0.738
6	-0.068	-0.137	-0.205	-0.273	-0.341	-0.410	-0.478	-0.546	-0.615	-0.683	-0.751
7	-0.066	-0.133	-0.199	-0.265	-0.331	-0.398	-0.464	-0.530	-0.596	-0.663	-0.729
8	-0.060	-0.119	-0.179	-0.238	-0.298	-0.357	-0.417	-0.476	-0.536	-0.595	-0.655
9	-0.047	-0.094	-0.141	-0.188	-0.235	-0.282	-0.329	-0.377	-0.424	-0.471	-0.518
10	-0.028	-0.057	-0.085	-0.114	-0.142	-0.171	-0.199	-0.228	-0.256	-0.285	-0.313
10'	0.066	0.132	0.197	0.263	0.329	0.395	0.461	0.526	0.592	-0.342	-0.313
9'	0.044	0.087	0.130	0.173	0.216	0.259	0.302	0.345	-0.612	-0.565	-0.518
8'	0.021	0.042	0.063	0.083	0.104	0.125	0.146	-0.834	-0.774	-0.715	-0.655
7'	0.001	0.002	0.002	0.003	0.005	0.005	-0.994	-0.928	-0.861	-0.795	-0.729
6'	-0.015	-0.031	-0.046	-0.062	-0.077	1.092	-1.024	-0.956	-0.888	-0.819	-0.751
5'	-0.028	-0.056	-0.085	-0.113	-1.140	-1.073	-1.006	-0.939	-0.872	-0.805	-0.738
4'	-0.063	-0.127	-0.189	1.253	-1.183	-1.113	-1.044	-0.974	-0.905	-0.835	-0.765
3'	-0.111	-0.222	1.333	-1.263	-1.193	-1.122	-1.052	-0.982	-0.912	-0.842	-0.772
2'	-0.140	1.280	-1.216	-1.152	-1.088	-1.024	-0.960	-0.896	-0.832	-0.768	-0.704
1'	-1.154	-1.100	-1.045	-0.990	-0.935	-0.880	-0.825	-0.770	-0.715	-0.660	-0.605
0'	-0.955	-0.909	-0.864	-0.818	-0.773	-0.727	-0.682	-0.636	-0.591	-0.545	-0.500
11	0.015	0.030	0.045	0.060	0.075	0.090	0.105	0.120	0.135	0.150	0.165
11'	0.015	0.030	0.045	0.060	0.075	0.090	0.105	0.120	0.135	0.150	0.165

JIUN MASUDA
CONSULTING ENGINEER
JIJI BLDG, TOKYO

MADE BY M. Jinda DATE 6-5-21 FILE NO
CHECKED BY DATE PAGE NO 33

CALCULATIONS FOR

常願寺川水路橋

Upper chord stresses Sa H=-1 applied.

$Um \times gm + 1 \times Ym = 0 \quad Um = \frac{-Ym}{gm}$

merber	Ym	gm	Sa
1	2.256	7.602	-0.2968
2	4.298	6.113	-0.7031
3	6.124	4.971	-1.2319
4	7.736	4.175	-1.8529
5	9.132	3.621	-2.5220
6	10.314	3.167	-3.2567
7	11.281	2.787	-4.0477
8	12.033	2.488	-4.8364
9	12.570	2.273	-5.5301
10	12.893	2.142	-6.0191
11	13.000	2.100	-6.1905

Lower chords stresses Sa H=-1 applied.

$-bm \times hm + ym = 0 \quad \therefore bm = \frac{ym}{hm}$

member	ym	hm	Sa
0	9.464	8.244	1.1480
1	9.904	6.812	1.4539
2	10.472	5.617	1.8643
3	11.170	4.680	2.3868
4	12.000	4.025	2.9814
5	12.830	3.546	3.6182
6	13.528	3.124	4.3303
7	14.096	2.767	5.0943
8	14.536	2.481	5.8589
9	14.850	2.273	6.5332
10	15.037	2.143	7.0168

Diagonals stresses Sa H=-1 applied.

$-dm \cdot fm + Vm = 0 \quad \therefore dm = \frac{Vm}{fm}$

member	Vm	fm	Sa
1	11.757	19.341	0.6079
2	12.851	18.606	0.6907
3	14.292	18.699	0.7643
4	16.526	20.876	0.7916
5	18.253	22.641	0.8062
6	18.163	20.789	0.8737
7	18.103	19.769	0.9157
8	18.066	20.069	0.9002
9	18.060	22.967	0.7863
10	17.985	32.287	0.5576
11	18.107	91.180	0.1986

Vertical stresses Sa H=-1 applied

$Sm \times (im - ma) + wm = 0 \quad Sm = -\frac{wm}{im - ma}$

member	wm	im-ma	Sa
0	—	—	-0.5640
1	12.005	19.096	-0.6287
2	13.260	19.631	-0.6755
3	15.024	22.083	-0.6803
4	18.253	30.134	-0.6057
5	21.550	42.023	-0.5128
6	21.868	47.792	-0.4576
7	22.786	61.196	-0.3723
8	25.890	103.216	-0.2506
9	94.397	1013.333	-0.0932
10	-10.025	107.200	+0.0935
11	—	—	+0.0975

JIUN MASUDA
CONSULTING ENGINEER
JIJI BLDG, TOKYO

MADE BY M. Jinda DATE 6-5-22 FILE NO
CHECKED BY DATE PAGE NO 34

CALCULATIONS FOR

常願寺川水路橋

Values of $\ell = \frac{l}{EA}$ for each member $E = 2{,}100{,}000\ kgs/cm^2$

Upper chord members

mark	member	l	A	$\ell/EA \times 1{,}000{,}000$
A	1	402.4	190	1.0085
B	2	404.0	〃	1.0125
C	3	400.0	〃	1.0175
D	4	408.5	〃	1.0238
E	5	408.5	〃	1.0238
F	6	400.0	〃	1.0175
G	7	404.0	〃	1.0125
H	8	402.4	〃	1.0085
I	9	401.2	〃	1.0055
J	10	400.4	230	0.8290
K	11	400.0	〃	0.8282
L	—	—	—	—
M	—	—	—	—
N	11'	400.0	230	0.8282
O	10'	400.4	〃	0.8290
P	9'	401.2	190	1.0055
Q	8'	402.4	〃	1.0085
R	7'	404.0	〃	1.0125
S	6'	406.0	〃	1.0175
T	5'	408.5	〃	1.0238
U	4'	408.5	〃	1.0238
V	3'	406.0	〃	1.0175
W	2'	404.0	〃	1.0125
X	1'	402.4	〃	1.0085

Lower chord members

mark	member	l	A	$\ell/EA \times 1{,}000{,}000$
A	0	459.2	380	0.5754
B	1	449.1	315	0.6789
C	2	439.7	〃	0.6647
D	3	431.3	〃	0.6520
E	4	423.7	〃	0.6405
F	5	417.1	220	0.9028
G	6	411.5	〃	0.8907
H	7	407.0	〃	0.8810
I	8	403.6	190	1.0115
J	9	401.3	〃	1.0058
K	10	400.1	150	1.2702
L	—	—	—	—
M	—	—	—	—
N	10'	400.1	150	1.2702
O	9'	401.3	190	1.0058
P	8'	403.6	〃	1.0115
Q	7'	407.0	220	0.8810
R	6'	411.5	〃	0.8907
S	5'	417.1	〃	0.9028
T	4'	423.7	315	0.6405
U	3'	431.3	〃	0.6520
V	2'	439.7	〃	0.6647
W	1'	449.1	〃	0.6789
X	0'	459.2	380	0.5754

Diagonal members

mark	member	l	A	$\ell/EA \times 1{,}000{,}000$
A	1	824.3	70	5.6075
B	2	688.7	〃	4.6850
C	3	590.8	〃	4.0190
D	4	527.2	〃	3.5864
E	5	492.2	〃	3.3483
F	6	472.5	〃	3.2143
G	7	458.8	〃	3.1211
H	8	450.1	〃	3.0619
I	9	445.7	〃	3.0320
J	10	445.3	〃	3.0293
K	11	448.9	〃	3.0537
L	—	—	—	—
M	—	—	—	—
N	11'	448.9	70	3.0537
O	10'	445.3	〃	3.0293
P	9'	445.7	〃	3.0320
Q	8'	450.1	〃	3.0619
R	7'	458.8	〃	3.1211
S	6'	472.5	〃	3.2143
T	5'	492.2	〃	3.3483
U	4'	527.2	〃	3.5864
V	3'	590.8	〃	4.0190
W	2'	688.7	〃	4.6850
X	1'	824.3	〃	5.6075

Vertical members

mark	member	l	A	$\ell/EA \times 1{,}000{,}000$
A	0	946.4	70	6.4381
B	1	764.8	〃	5.2027
C	2	617.4	〃	4.2000
D	3	504.6	〃	3.4327
E	4	426.4	〃	2.9007
F	5	369.8	〃	2.5156
G	6	321.4	〃	2.1864
H	7	281.5	〃	1.9150
I	8	250.3	〃	1.7027
J	9	228.0	〃	1.5510
K	10	214.4	〃	1.4585
L	11	210.0	〃	1.4286
M	11'	210.0	〃	1.4286
N	10'	214.4	〃	1.4585
O	9'	228.0	〃	1.5510
P	8'	250.3	〃	1.7027
Q	7'	281.5	〃	1.9150
R	6'	321.4	〃	2.1864
S	5'	369.8	〃	2.5156
T	4'	426.4	〃	2.9007
U	3'	504.6	〃	3.4327
V	2'	617.4	〃	4.2000
W	1'	764.8	〃	5.2027
X	0'	946.4	〃	6.4381

JIUN MASUDA
CONSULTING ENGINEER
JIJI BLDG, TOKYO

MADE BY M. Jinda DATE 6-5-22 FILE NO ____
CHECKED BY ____ DATE ____ PAGE NO 35

CALCULATIONS FOR

常願寺川水路橋

Find H-Surfaces.

Upper chord members

mark	member	δ_{01}	δ_a	$\gamma \times 1{,}000{,}000$	$\delta_{01}\delta_a$	δ_a^2	$\delta_{01}\delta_a\gamma \times 1{,}000{,}000$	$\delta_a^2\gamma \times 1{,}000{,}000$
A	1	-0.024	-0.2968	1.0085	0.0071	0.0811	0.0072	0.0818
B	2	-0.059	-0.7031	1.0125	0.0415	0.4943	0.0420	0.5005
C	3	-0.110	-1.2319	1.0175	0.1355	1.5176	0.1379	1.5442
D	4	-0.174	-1.8529	1.0238	0.3224	3.4332	0.3301	3.5149
E	5	-0.251	-2.5220	1.0238	0.6330	6.3605	0.6481	6.5119
F	6	-0.344	-3.2567	1.0175	1.1204	10.6061	1.1400	10.7917
G	7	-0.457	-4.0477	1.0125	1.8498	16.3839	1.8729	16.5887
H	8	-0.585	-4.8364	1.0085	2.8293	23.3908	2.8533	23.5896
I	9	-0.720	-5.5301	1.0055	3.9817	30.5820	4.0036	30.7502
J	10	-0.849	-6.0191	0.8290	5.1102	36.2296	4.2364	30.0343
K	11	-0.952	-6.1905	0.8282	5.8934	38.3223	4.8809	31.7385
L	—	—	—	—	—	—	—	—
M	—	—	—	—	—	—	—	—
N	11'	-0.952	-6.1905	0.8282	5.8934	38.3223	4.8809	31.7385
O	10'	-1.018	-6.0191	0.8290	6.1274	36.2296	5.0796	30.0343
P	9'	-1.040	-5.5301	1.0055	5.7513	30.5820	5.7829	30.7502
Q	8'	-1.023	-4.8364	1.0085	4.9476	23.3908	4.9897	23.5896
R	7'	-0.979	-4.0477	1.0125	3.9627	16.3839	4.0122	16.5887
S	6'	-0.919	-3.2567	1.0175	2.9929	10.6061	3.0453	10.7917
T	5'	-0.853	-2.5220	1.0238	2.1513	6.3605	2.2025	6.5119
U	4'	-0.784	-1.8529	1.0238	1.4527	3.4332	1.4873	3.5149
V	3'	-0.695	-1.2319	1.0175	0.8562	1.5176	0.8712	1.5442
W	2'	-0.595	-0.7031	1.0125	0.4183	0.4943	0.4235	0.5005
X	1'	-0.502	-0.2968	1.0085	0.1490	0.0811	0.1503	0.0818

$1{,}000{,}000\Sigma\delta_a^2\gamma = 31{,}2926$

Lower chord members

mark	member	δ_{01}	δ_a	$\gamma \cdot 1{,}000{,}000$	$\delta_{01}\cdot\delta_a$	δ_a^2	$\delta_{01}\delta_a\gamma \cdot 1{,}000{,}000$	$\delta_a^2\gamma \cdot 1{,}000{,}000$
A	0	0	1.1840	0.5754	0	1.4019	0.0000	0.8067
B	1	0.027	1.4539	0.6789	0.0392	2.1130	0.0266	1.4345
C	2	0.065	1.8643	0.6647	0.1212	3.4756	0.0806	2.3102
D	3	0.117	2.3868	0.6520	0.2793	5.6968	0.1821	3.7143
E	4	0.181	2.9814	0.6405	0.5396	8.8887	0.3496	5.6932
F	5	0.256	3.6182	0.9028	0.9263	13.0914	0.8363	11.8189
G	6	0.349	4.3303	0.8907	1.5113	18.7515	1.3461	16.7020
H	7	0.460	5.0943	0.8810	2.3434	25.9519	2.0645	22.8636
I	8	0.586	5.8589	1.0115	3.4333	34.3267	3.4728	34.7215
J	9	0.720	6.5332	1.0058	4.7039	42.6827	4.7312	42.9303
K	10	0.848	7.0168	1.2702	5.9502	49.2355	7.5579	62.5389
L	—	—	—	—	—		—	
M	—	—	—	—	—		—	
N	10'	1,018	7.0168	1.2702	7.1431		9.0732	
O	9'	1,040	6.5332	1.0058	6.7945		6.8339	
P	8'	1,026	5.8589	1.0115	6.0112		6.0803	
Q	7'	0.985	5.0943	0.8810	5.0179		4.4208	
R	6'	0.931	4.3303	0.8907	4.0315		3.5909	
S	5'	0.872	3.6182	0.9028	3.1551		2.8484	
T	4'	0.813	2.9814	0.6405	2.4239		1.5525	
U	3'	0.739	2.3868	0.6520	1.7638		1.1500	
V	2'	0.648	1.8643	0.6647	1.2081		0.8030	
W	1'	0.561	1.4536	0.6789	0.8155		0.5536	
X	0'	0	1.1480	0.5754	0.0000		0.0000	

$1{,}000{,}000\Sigma\delta_a^2\gamma = 411.0682$

JIUN MASUDA
CONSULTING ENGINEER
JIJI BLDG, TOKYO

MADE BY M. Jinda DATE 6-5-22 FILE NO
CHECKED BY DATE PAGE NO 36

CALCULATIONS FOR

常願寺川水路橋

Diagonal members

mark	member	$\Sigma\varphi_1$	Σa	$\Sigma\varphi_1 \times 1{,}000{,}000$	$\Sigma\varphi_1 \Sigma a$	Σa^2	$\Sigma\varphi_1 \Sigma a \times 1{,}000{,}000$	$\Sigma a^2 \times 1{,}000{,}000$
A	1	0.049	0.6079	5.6075	0.0298	0.3695	0.1671	2.0720
B	2	0.060	0.6907	4.6850	0.0414	0.4771	0.1940	2.2352
C	3	0.073	0.7643	4.0190	0.0558	0.5842	0.2243	2.3479
D	4	0.082	0.7916	3.5864	0.0649	0.6266	0.2328	2.2472
E	5	0.093	0.8062	3.3483	0.0750	0.6500	0.2511	2.1764
F	6	0.111	0.8737	3.2143	0.0970	0.7634	0.3118	2.4538
G	7	0.129	0.9157	3.1211	0.1181	0.8385	0.3686	2.6170
H	8	0.145	0.9002	3.0619	0.1305	0.8104	0.3996	2.4814
I	9	0.152	0.7863	3.0320	0.1195	0.6183	0.3623	1.8747
J	10	0.145	0.5570	3.0293	0.0808	0.3102	0.2448	0.9397
K	11	0.117	0.1986	3.0537	0.0232	0.3944	0.0708	1.2044
L	—	—	—	—	—		—	
M	—	—	—	—	—		—	
N	11′	-0.073	0.1986	3.0537	-0.0145		-0.0443	
O	10′	-0.021	0.5570	3.0293	-0.0117		-0.0354	
P	9′	0.022	0.7863	3.0320	0.0173		0.0523	
Q	8′	0.054	0.9002	3.0619	0.0486		0.1488	
R	7′	0.073	0.9157	3.1211	0.0668		0.2085	
S	6′	0.082	0.8737	3.2143	0.0716		0.2301	
T	5′	0.084	0.8062	3.3483	0.0677		0.2267	
U	4′	0.109	0.7916	3.5864	0.0863		0.3095	
V	3′	0.141	0.7643	4.0190	0.1078		0.4332	
W	2′	0.155	0.6907	4.6850	0.1071		0.5017	
X	1′	1.029	0.6079	5.6075	0.6255		3.5075	

$1{,}000{,}000 \Sigma\varphi_a^2 f = 452994$

vertical members

mark	member	$\Sigma\varphi_1$	Σa	$\Sigma\varphi_1 \times 1{,}000{,}000$	$\Sigma\varphi_1 \Sigma a$	Σa^2	$\Sigma\varphi_1 \Sigma a \times 1{,}000{,}000$	$\Sigma a^2 \times 1{,}000{,}000$
A	0	0.045	0.5640	6.4381	0.0254	0.3181	0.1635	2.0480
B	1	0.055	0.6287	5.2027	0.0346	0.3953	0.1800	2.0566
C	2	0.064	0.6755	4.2000	0.0432	0.4563	0.1814	1.9165
D	3	0.070	0.6803	3.4327	0.0476	0.4628	0.1634	1.5887
E	4	0.070	0.6057	2.9007	0.0424	0.3669	0.1230	1.0643
F	5	0.067	0.5128	2.5156	0.0344	0.2630	0.0865	0.6616
G	6	0.068	0.4576	2.1864	0.0311	0.2094	0.0680	0.4578
H	7	0.066	0.3723	1.9150	0.0246	0.1386	0.0471	0.2564
I	8	0.060	0.2506	1.7027	0.0150	0.0628	0.0255	0.1069
J	9	0.047	0.0932	1.5510	0.0044	0.0087	0.0068	0.0135
K	10	0.028	0.0935	1.4585	0.0026	0.0087	0.0038	0.0127
L	11	0.015	0.0975	1.4286	0.0015	0.0095	0.0021	0.0136
M	11′	0.015	0.0975	1.4286	0.0015		0.0021	
N	10′	0.066	0.0935	1.4585	0.0062		0.0090	
O	9′	0.044	0.0932	1.5510	0.0041		0.0064	
P	8′	0.021	0.2506	1.7027	0.0053		0.0090	
Q	7′	0.001	0.3723	1.9150	0.0004		0.0008	
R	6′	0.015	0.4576	2.1864	0.0069		0.0151	
S	5′	0.028	0.5128	2.5156	0.0144		0.0362	
T	4′	0.063	0.6057	2.9007	0.0382		0.1108	
U	3′	0.111	0.6803	3.4327	0.0755		0.2592	
V	2′	0.140	0.6755	4.2000	0.0946		0.3973	
W	1′	1.154	0.6287	5.2027	0.7255		3.7746	
X	0′	0.955	0.5640	6.4381	0.5386		3.4676	

$1{,}000{,}000 \Sigma\varphi_a^2 f = 203932$

$\Sigma\varphi_a^2 f \times 1{,}000{,}000 = 311.2926 + 411.0682 + 452.994 + 203.932 = 788.0534$

JIUN MASUDA
CONSULTING ENGINEER
JIJI BLDG, TOKYO

MADE BY M. Jinda DATE 6-5-22 FILE NO
CHECKED BY DATE PAGE NO 37

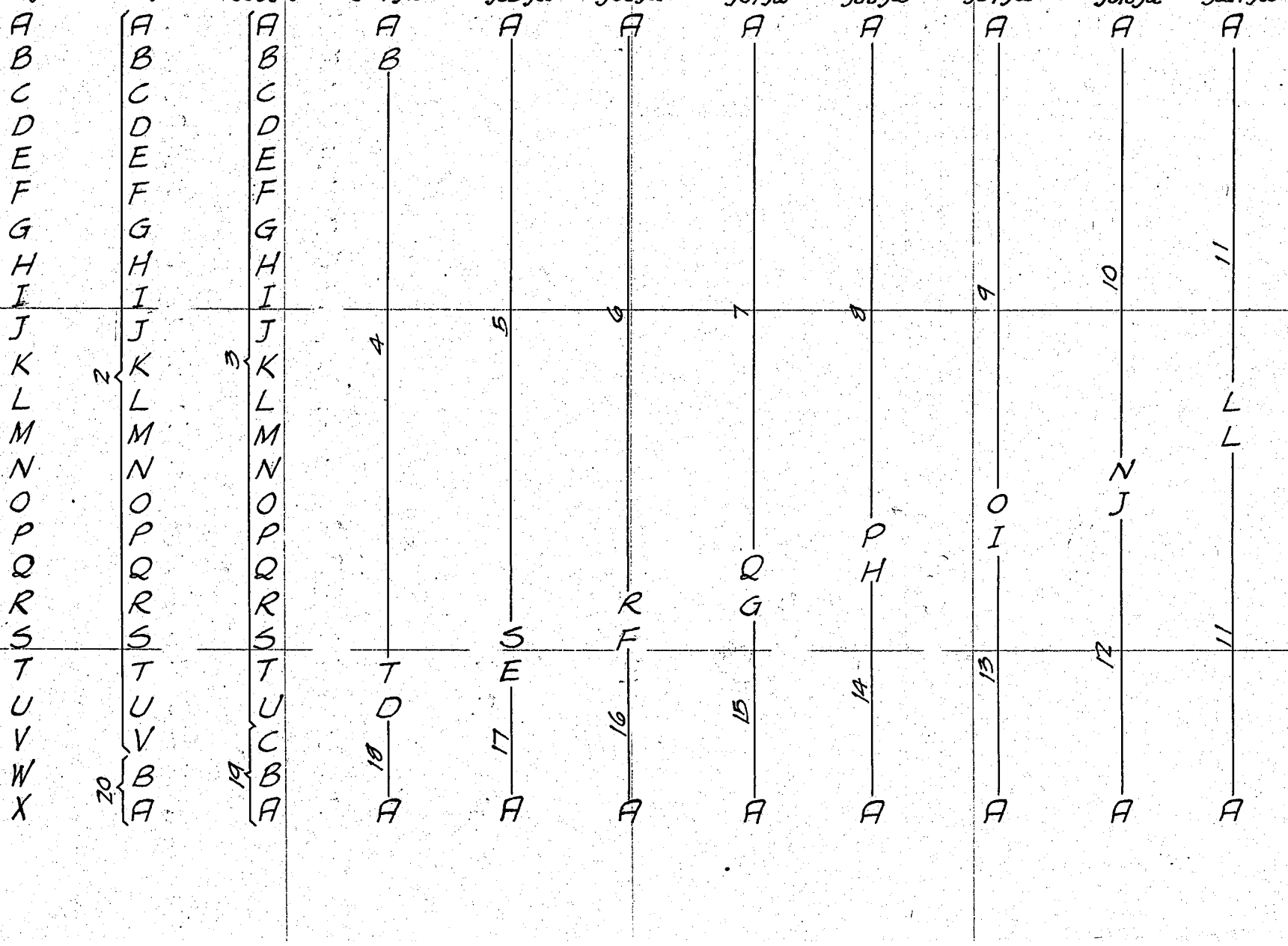
CALCULATIONS FOR

常願寺川水路橋

$\Sigma S_{01} S_a$ 1,000,000

mark	upper chords	Lower chords	Diagonals	verticals	Summary	Summary	Remarks
A	0.0072	0.	0.1671	0.1635	0.3378	0.3378	A
B	0.0420	0.0266	0.1940	0.1800	0.4426	0.7804	A—B
C	0.1379	0.0806	0.2243	0.1814	0.6242	1.4046	A—C
D	0.3301	0.1821	0.2328	0.1634	0.9084	2.3130	A—D
E	0.6481	0.3496	0.2511	0.1230	1.3718	3.6848	A—E
F	1.1400	0.8363	0.3118	0.0865	2.3746	6.0594	A—F
G	1.8729	1.3461	0.3686	0.0680	3.6556	9.7150	A—G
H	2.8533	2.0645	0.3996	0.0471	5.3645	15.0795	A—H
I	4.0036	3.4728	0.3673	0.0255	7.8642	22.9437	A—I
J	4.2364	4.7312	0.2448	0.0068	9.2192	32.1629	A—J
K	4.8809	7.5579	0.0708	0.0038	12.5058	44.6687	A—K
L	———	———	———	0.0021	0.0021	44.6708	A—L
M	———	———	———	0.0021	0.0021	44.6729	A—M
N	4.8809	9.0732	0.0443	0.0090	13.9188	58.5917	A—N
O	5.0796	6.8339	0.0354	0.0064	11.8717	70.4634	A—O
P	5.7829	6.0803	0.0523	0.0090	11.9065	82.3699	A—P
Q	4.9897	4.4208	0.1488	0.0008	9.5585	91.9284	A—Q
R	4.0122	3.5909	0.2085	0.0151	7.8267	99.7551	A—R
S	3.0453	2.8484	0.2301	0.0362	6.1600	105.9151	A—S
T	2.2025	1.5525	0.2267	0.1108	4.0925	110.0076	A—T
U	1.4873	1.1500	0.3095	0.2592	3.2060	113.2136	A—U
V	0.8712	0.8030	0.4332	0.3973	2.5047	115.7183	A—V
W	0.4235	0.5536	0.5017	3.7746	5.2534	120.9717	A—W
X	0.1503	0.0000	3.5075	3.4676	7.1254	128.0971	A—X

1,000,000 f



JIUN MASUDA
CONSULTING ENGINEER
JIJI BLDG, TOKYO

MADE BY M. Juda DATE 6-5-23 FILE NO
CHECKED BY DATE PAGE NO 39

CALCULATIONS FOR

常願寺川水路橋

panel pt. $1{,}000{,}000\Sigma J_0 J_a J \div 1{,}000{,}000\Sigma J_a J = H$

1 $1{,}000{,}000\Sigma J_0 J_a J = 128.0971 \times 1 + 0.0000$ $= 128.0971 \div 788.0534 = 0.162$

2 〃 $\Sigma J_0 2 J_a J = 115.7183 \times 2 + 0.7804 \times 20 = 231.4366 + 15.6080 = 247.0446 \div$ 〃 $= 0.313$

3 〃 $\Sigma J_0 3 J_a J = 113.2136 \times 3 + 1.4046 \times 19 = 339.6408 + 26.6874 = 366.3282 \div$ 〃 $= 0.465$

4 〃 $\Sigma J_0 4 J_a J = 110.0076 \times 4 + 2.3130 \times 18 = 440.0304 + 41.6340 = 481.6644 \div$ 〃 $= 0.611$

5 〃 $\Sigma J_0 5 J_a J = 105.9151 \times 5 + 3.6848 \times 17 = 529.5755 + 62.6416 = 592.2171 \div$ 〃 $= 0.751$

6 〃 $\Sigma J_0 6 J_a J = 99.7551 \times 6 + 6.0594 \times 16 = 598.5306 + 96.9504 = 695.4810 \div$ 〃 $= 0.882$

7 〃 $\Sigma J_0 7 J_a J = 91.9284 \times 7 + 9.7150 \times 15 = 643.4988 + 145.7250 = 789.2238 \div$ 〃 $= 1.001$

8 〃 $\Sigma J_0 8 J_a J = 82.3699 \times 8 + 15.0795 \times 14 = 658.9592 + 211.1130 = 870.0722 \div$ 〃 $= 1.104$

9 〃 $\Sigma J_0 9 J_a J = 70.4634 \times 9 + 22.9437 \times 13 = 634.1706 + 298.2681 = 932.4387 \div$ 〃 $= 1.183$

10 〃 $\Sigma J_0 10 J_a J = 58.5917 \times 10 + 32.1629 \times 12 = 585.9170 + 385.9548 = 971.8718 \div$ 〃 $= 1.233$

11 〃 $\Sigma J_0 11 J_a J = 44.6708 \times 11 + 44.6708 \times 11 = 491.3788 + 491.3788 = 982.7576 \div$ 〃 $= 1.247$

Summary for one span H $= 16.657$

Find $J_a H$.

for upper chord members — Load on.

member	$-J_a$ \ H	1	2	3	4	5	6	7	8	9	10	11
		0.162	0.313	0.465	0.611	0.751	0.882	1.001	1.104	1.183	1.233	1.247
1	0.297	0.048	0.093	0.138	0.181	0.223	0.262	0.297	0.328	0.351	0.366	0.370
2	0.703	0.114	0.220	0.327	0.430	0.528	0.620	0.704	0.776	0.832	0.867	0.877
3	1.232	0.200	0.386	0.573	0.753	0.925	1.087	1.233	1.360	1.457	1.519	1.536
4	1.853	0.300	0.580	0.862	1.132	1.392	1.634	1.855	2.046	2.192	2.285	2.311
5	2.522	0.409	0.789	1.173	1.541	1.894	2.224	2.525	2.784	2.984	3.110	3.145
6	3.257	0.528	1.019	1.515	1.990	2.446	2.873	3.260	3.596	3.853	4.016	4.061
7	4.048	0.656	1.267	1.882	2.473	3.040	3.570	4.052	4.469	4.789	4.991	5.048
8	4.836	0.783	1.514	2.249	2.955	3.632	4.265	4.841	5.339	5.721	5.963	6.030
9	5.530	0.896	1.731	2.571	3.379	4.153	4.877	5.536	6.105	6.542	6.818	6.896
10	6.019	0.975	1.884	2.799	3.678	4.520	5.309	6.025	6.645	7.120	7.421	7.506
11	6.191	1.003	1.938	2.879	3.783	4.649	5.460	6.197	6.835	7.324	7.634	7.720

for Lower chord members — Load on.

member	$-J_a$	1	2	3	4	5	6	7	8	9	10	11
0	-1.148	-0.186	-0.359	-0.534	-0.701	-0.862	-1.013	-1.149	-1.267	-1.358	-1.415	-1.432
1	-1.454	-0.236	-0.455	-0.676	-0.888	-1.092	-1.282	-1.455	-1.605	-1.720	-1.793	-1.813
2	-1.864	-0.302	-0.583	-0.867	-1.139	-1.400	-1.644	-1.866	-2.058	-2.205	-2.298	-2.324
3	-2.387	-0.387	-0.747	-1.110	-1.458	-1.793	-2.105	-2.389	-2.635	-2.824	-2.943	-2.977
4	-2.981	-0.483	-0.933	-1.386	-1.821	-2.239	-2.629	-2.984	-3.291	-3.527	-3.676	-3.717
5	-3.618	-0.586	-1.132	-1.682	-2.211	-2.717	-3.191	-3.622	-3.994	-4.280	-4.461	-4.512
6	-4.330	-0.701	-1.355	-2.013	-2.646	-3.252	-3.819	-4.334	-4.780	-5.122	-5.339	-5.400
7	-5.094	-0.825	-1.594	-2.369	-3.112	-3.826	-4.493	-5.099	-5.624	-6.026	-6.281	-6.352
8	-5.859	-0.949	-1.834	-2.724	-3.580	-4.400	-5.168	-5.865	-6.468	-6.931	-7.224	-7.306
9	-6.533	-1.058	-2.045	-3.038	-3.992	-4.906	-5.762	-6.540	-7.212	-7.729	-8.055	-8.147
10	-7.017	-1.137	-2.196	-3.263	-4.287	-5.270	-6.189	-7.024	-7.747	-8.301	-8.652	-8.750

JIUN MASUDA
CONSULTING ENGINEER
JIJI BLDG, TOKYO

MADE BY M. Juida DATE 6-5-23 FILE NO
CHECKED BY DATE PAGE NO 39

CALCULATIONS FOR

常願寺川水路橋

for Diagonal members

member	-Sa	1	2	3	4	5	6	7	8	9	10	11
1	-0.608	-0.098	-0.190	-0.283	-0.371	-0.457	-0.536	-0.609	-0.671	-0.719	-0.750	-0.758
2	-0.691	-0.112	-0.216	-0.321	-0.422	-0.519	-0.609	-0.692	-0.763	-0.817	-0.852	-0.862
3	-0.764	-0.124	-0.239	-0.355	-0.467	-0.574	-0.674	-0.765	-0.843	-0.904	-0.942	-0.953
4	-0.792	-0.128	-0.248	-0.368	-0.484	-0.595	-0.699	-0.793	-0.874	-0.937	-0.977	-0.988
5	-0.806	-0.131	-0.252	-0.375	-0.492	-0.605	-0.711	-0.807	-0.890	-0.953	-0.994	-1.005
6	-0.874	-0.142	-0.274	-0.406	-0.534	-0.656	-0.771	-0.875	-0.965	-1.034	-1.078	-1.090
7	-0.916	-0.148	-0.287	-0.426	-0.560	-0.688	-0.808	-0.917	-1.011	-1.084	-1.129	-1.142
8	-0.900	-0.146	-0.282	-0.419	-0.550	-0.676	-0.794	-0.901	-0.994	-1.065	-1.110	-1.122
9	-0.786	-0.127	-0.246	-0.365	-0.480	-0.590	-0.693	-0.787	-0.868	-0.930	-0.969	-0.980
10	-0.557	-0.090	-0.174	-0.259	-0.340	-0.418	-0.491	-0.558	-0.615	-0.659	-0.687	-0.695
11	-0.199	-0.032	-0.062	-0.093	-0.122	-0.149	-0.176	-0.199	-0.220	-0.235	-0.245	-0.248

for vertical members

member	-Sa	1	2	3	4	5	6	7	8	9	10	11
0	0.564	0.091	0.177	0.262	0.345	0.424	0.497	0.565	0.623	0.667	0.695	0.703
1	0.629	0.102	0.197	0.292	0.384	0.472	0.555	0.630	0.694	0.744	0.776	0.784
2	0.676	0.110	0.212	0.314	0.413	0.508	0.596	0.677	0.746	0.800	0.834	0.843
3	0.690	0.110	0.213	0.316	0.415	0.511	0.600	0.681	0.751	0.804	0.838	0.848
4	0.606	0.098	0.190	0.282	0.370	0.455	0.534	0.607	0.669	0.717	0.747	0.756
5	0.513	0.083	0.161	0.239	0.313	0.385	0.452	0.514	0.566	0.607	0.633	0.640
6	0.458	0.074	0.143	0.213	0.280	0.344	0.404	0.458	0.506	0.542	0.565	0.571
7	0.372	0.060	0.116	0.173	0.227	0.279	0.328	0.372	0.411	0.440	0.459	0.464
8	0.251	0.041	0.079	0.117	0.153	0.189	0.221	0.251	0.277	0.297	0.309	0.313
9	0.093	0.015	0.029	0.043	0.057	0.070	0.082	0.093	0.103	0.110	0.115	0.116
10	-0.094	-0.015	-0.029	-0.044	-0.057	-0.071	-0.083	-0.094	-0.104	-0.111	-0.116	-0.117

Influence surfaces for upper chord members.

member	1	2	3	4	5	6	7	8	9	10	11
1	0.024	0.045	0.066	0.085	0.103	0.118	0.130	0.137	0.136	0.127	0.107
2	0.055	0.101	0.149	0.192	0.231	0.263	0.288	0.300	0.297	0.272	0.223
3	0.090	0.167	0.244	0.314	0.376	0.429	0.465	0.482	0.469	0.422	0.329
4	0.126	0.232	0.339	0.435	0.521	0.589	0.636	0.652	0.624	0.543	0.395
5	0.158	0.287	0.420	0.537	0.639	0.718	0.768	0.776	0.724	0.599	0.383
6	0.184	0.330	0.482	0.612	0.724	0.806	0.849	0.840	0.753	0.571	0.272
7	0.199	0.354	0.512	0.646	0.757	0.830	0.855	0.816	0.679	0.424	0.025
8	0.198	0.345	0.495	0.617	0.709	0.757	0.749	0.662	0.459	0.117	-0.401
9	0.176	0.291	0.411	0.499	0.553	0.558	0.497	0.346	0.063	-0.381	-1.023
10	0.126	0.186	0.253	0.283	0.276	0.216	0.083	-0.146	-0.519	-1.067	-1.831
11	0.051	0.033	0.022	-0.027	-0.113	-0.254	-0.470	-0.784	-1.247	-1.890	-2.756
11'	0.051	0.033	0.022	-0.027	-0.113	-0.254	-0.470	-0.784	-1.247	-1.890	-2.756
10'	-0.043	-0.153	-0.257	-0.397	-0.573	-0.802	-1.105	-1.504	-2.048	-2.765	-1.831
9'	-0.144	-0.348	-0.548	-0.780	-1.047	-1.363	-1.743	-2.214	-2.817	-1.821	-1.023
8'	-0.240	-0.532	-0.820	-1.137	-1.484	-1.874	-2.320	-2.846	-1.879	-1.052	-0.401
7'	-0.323	-0.690	-1.054	-1.441	-1.853	-2.302	-2.798	-1.924	-1.148	-0.489	0.025
6'	-0.391	-0.818	-1.241	-1.684	-2.147	-2.638	-1.907	-1.226	-0.625	-0.118	0.272
5'	-0.444	-0.918	-1.388	-1.873	-2.374	-1.793	-1.241	-0.731	-0.280	0.097	0.383
4'	-0.484	-0.988	-1.490	-2.004	-1.569	-1.153	-0.758	-0.393	-0.073	0.195	0.395
3'	-0.495	-1.004	-1.512	-1.222	-0.940	-0.669	-0.413	-0.176	0.031	0.202	0.329
2'	-0.481	-0.970	-0.803	-0.641	-0.483	-0.332	-0.188	-0.057	0.059	0.153	0.223
1'	-0.454	-0.385	-0.316	-0.250	-0.184	-0.121	-0.062	-0.007	0.040	0.079	0.107
	+1.197	+2.583	+4.020	+5.287	+6.106	+6.423	+6.097	+5.108	+3.394	+1.423	+0.212
	-1.779	-3.955	-6.431	-8.912	-11.042	-12.795	-14.022	-14.585	-14.229	-13.210	-12.326
	-0.582	-1.372	-2.411	-3.625	-4.936	-6.372	-7.925	-9.477	-10.835	-11.787	-12.114

JIUN MASUDA
CONSULTING ENGINEER
JIJI BLDG, TOKYO

MADE BY M. Juida DATE 6-6-23 FILE NO
CHECKED BY DATE PAGE NO 40

CALCULATIONS FOR

常願寺川水路橋

Influence surfaces for Lower chord members.
Load on.

member	1	2	3	4	5	6	7	8	9	10	11
0	-0.186	-0.359	-0.534	-0.701	-0.862	-1.013	-1.149	-1.267	-1.358	-1.415	-1.432
1	-0.209	-0.402	-0.596	-0.781	-0.959	-1.122	-1.268	-1.391	-1.480	-1.526	-1.519
2	-0.237	-0.454	-0.673	-0.880	-1.076	-1.256	-1.413	-1.540	-1.622	-1.651	-1.612
3	-0.270	-0.514	-0.760	-0.992	-1.210	-1.406	-1.573	-1.703	-1.775	-1.777	-1.695
4	-0.302	-0.572	-0.844	-1.098	-1.336	-1.545	-1.719	-1.845	-1.901	-1.869	-1.729
5	-0.330	-0.619	-0.913	-1.186	-1.435	-1.653	-1.827	-1.943	-1.973	-1.897	-1.692
6	-0.352	-0.657	-0.965	-1.249	-1.506	-1.724	-1.890	-1.986	-1.979	-1.847	-1.559
7	-0.365	-0.674	-0.989	-1.272	-1.526	-1.733	-1.879	-1.944	-1.886	-1.681	-1.292
8	-0.363	-0.661	-0.965	-1.235	-1.469	-1.650	-1.761	-1.778	-1.655	-1.361	-0.857
9	-0.338	-0.605	-0.878	-1.112	-1.306	-1.443	-1.501	-1.453	-1.250	-0.856	-0.228
10	-0.289	-0.499	-0.718	-0.893	-1.028	-1.098	-1.095	-0.960	-0.665	-0.168	0.583
10'	-0.119	-0.159	-0.209	-0.214	-0.180	-0.080	0.102	0.398	0.862	1.529	0.583
9'	-0.018	-0.034	-0.081	0.167	0.294	0.478	0.739	1.107	1.630	0.584	-0.228
8'	0.077	0.217	0.354	0.524	0.730	0.987	1.317	1.740	0.691	-0.189	-0.857
7'	0.160	0.377	0.588	0.830	1.102	1.420	1.800	0.816	-0.046	-0.761	-1.292
6'	0.230	0.507	0.781	1.079	1.404	1.708	0.904	0.109	-0.582	-1.149	-1.559
5'	0.286	0.611	0.933	1.276	1.641	0.911	0.224	-0.405	-0.947	-1.385	-1.692
4'	0.330	0.693	1.053	1.431	0.833	0.262	-0.274	-0.761	-1.178	-1.508	-1.729
3'	0.352	0.729	1.104	0.640	0.188	-0.240	-0.641	-1.003	-1.309	-1.544	-1.695
2'	0.346	0.712	0.363	0.026	-0.299	-0.608	-0.895	-1.152	-1.363	-1.521	-1.612
1'	0.325	0.079	-0.169	-0.408	-0.638	-0.855	-1.055	-1.231	-1.373	-1.473	-1.519
0'	-0.186	-0.359	-0.534	-0.701	-0.862	-1.013	-1.149	-1.267	-1.358	-1.415	-1.432

0	1	2	3	4	5	6	7	8	9	10
-19.120	-18.455	-18.252	-18.412	-18.481	-18.205	-17.445	-16.048	-13.944	-10.988	-8.364
	0.404	1.447	3.013	4.602	5.882	6.782	7.093	6.637	5.114	3.474
	-18.051	-16.805	-15.399	-13.879	-12.323	-10.663	-8.955	-7.307	-5.874	-4.890

Influence surfaces for Diagonals. Load on.

member	1	2	3	4	5	6	7	8	9	10	11
1	-0.049	-0.092	-0.136	-0.175	-0.212	-0.242	-0.266	-0.279	-0.278	-0.260	-0.219
2	-0.052	-0.095	-0.140	-0.180	-0.217	-0.246	-0.269	-0.279	-0.273	-0.247	-0.197
3	-0.051	-0.094	-0.137	-0.176	-0.211	-0.238	-0.256	-0.262	-0.250	-0.215	-0.154
4	-0.046	-0.083	-0.121	-0.155	-0.183	-0.205	-0.217	-0.215	-0.196	-0.154	-0.082
5	-0.038	-0.067	-0.097	-0.122	-0.142	-0.155	-0.159	-0.149	-0.119	-0.068	0.014
6	-0.031	-0.053	-0.074	-0.092	-0.103	-0.108	-0.101	-0.081	0.039	0.028	0.126
7	-0.019	-0.028	-0.038	-0.043	-0.047	-0.032	0.012	0.023	0.079	0.164	0.280
8	-0.001	0.008	0.016	0.031	0.050	0.077	0.115	0.167	0.241	0.342	0.475
9	0.025	0.058	0.092	0.129	0.171	0.220	0.278	0.350	0.440	0.553	0.694
10	0.055	0.116	0.176	0.240	0.307	0.380	0.458	0.546	0.647	0.764	0.901
11	0.085	0.172	0.258	0.346	0.437	0.527	0.621	0.717	0.819	0.926	1.040
11'	-0.105	-0.209	-0.313	-0.415	-0.515	-0.615	-0.711	-0.806	-0.895	-0.978	1.040
10'	-0.111	-0.216	-0.323	-0.425	-0.524	-0.618	-0.706	-0.785	-0.850	1.054	0.901
9'	-0.105	-0.202	-0.299	-0.392	-0.480	-0.561	-0.633	-0.692	1.048	0.857	0.694
8'	-0.092	-0.174	-0.257	-0.333	-0.405	-0.469	-0.522	1.038	0.822	0.632	0.475
7'	-0.075	-0.141	-0.207	-0.268	-0.323	-0.370	1.022	0.799	0.596	0.422	0.280
6'	-0.060	-0.110	-0.160	-0.207	-0.247	0.998	0.783	0.583	0.403	0.249	0.126
5'	-0.047	-0.084	-0.123	-0.156	0.970	0.771	0.582	0.407	0.251	0.117	0.014
4'	-0.019	-0.029	-0.049	0.998	0.805	0.618	0.442	0.279	0.133	0.011	-0.082
3'	0.017	0.043	1.026	0.841	0.661	0.489	0.325	0.174	0.041	-0.070	-0.154
2'	0.043	0.993	0.828	0.667	0.509	0.359	0.215	0.084	-0.031	-0.126	-0.197
1'	0.931	0.790	0.648	0.511	0.376	0.248	0.126	0.015	-0.082	-0.162	-0.219
	-2.452	-2.352	-2.114	-1.745	-1.526	-1.466	-1.598	-2.253	-3.364	-4.558	-5.562
	3.645	3.698	3.617	3.286	3.112	3.170	3.385	4.014	4.915	5.644	5.948
	1.193	1.364	1.503	1.541	1.586	1.704	1.787	1.761	1.551	1.086	0.386

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CALCULATIONS FOR

常願寺川水路橋

Influence surfaces for vertical members.

Load on.

member	1	2	3	4	5	6	7	8	9	10	11
0	0.046	0.086	0.126	0.163	0.197	0.224	0.247	0.259	0.258	0.240	0.203
1	0.047	0.087	0.127	0.164	0.197	0.225	0.245	0.254	0.249	0.226	0.179
2	0.046	0.084	0.122	0.157	0.188	0.212	0.229	0.234	0.224	0.194	0.139
3	0.040	0.073	0.106	0.134	0.160	0.179	0.190	0.190	0.173	0.136	0.076
4	0.028	0.051	0.073	0.092	0.107	0.116	0.120	0.112	0.091	0.510	-0.009
5	0.016	0.027	0.038	0.045	0.050	0.049	0.044	0.029	0.003	-0.038	-0.098
6	-0.006	0.006	0.008	0.007	0.003	-0.006	-0.020	-0.040	-0.073	-0.118	-0.180
7	-0.006	-0.017	-0.026	-0.038	-0.052	-0.070	-0.092	-0.119	-0.156	-0.204	-0.265
8	-0.019	-0.040	-0.062	-0.085	-0.109	-0.136	-0.166	-0.199	-0.239	-0.286	-0.342
9	-0.032	-0.065	-0.098	-0.131	-0.165	-0.200	-0.236	-0.274	-0.314	-0.356	-0.402
10	-0.043	-0.086	-0.129	-0.171	-0.213	-0.254	-0.293	-0.332	-0.367	-0.401	-0.430
11	-0.008	-0.005	-0.003	-0.004	0.018	0.040	0.074	0.123	0.196	0.298	0.434
11'	-0.008	-0.005	-0.003	-0.004	0.018	0.040	0.074	0.123	0.196	0.298	0.434
10'	0.051	0.103	0.153	0.206	0.258	0.312	0.367	0422	0.481	-0.458	-0.430
9'	0.059	0.116	0.173	0.230	0.286	0.341	0.395	0.448	-0.502	-0.450	-0.402
8'	0.062	0.121	0.180	0.236	0.293	0.346	0.397	-0.551	-0.477	-0.406	-0.342
7'	0.061	0.118	0.175	0.230	0.284	0.333	-0.672	-0.517	-0.421	-0.336	-0.265
6'	0.059	0.112	0.167	0.218	0.267	-0.688	-0.566	-0.450	-0.346	-0.254	-0.180
5'	0.055	0.105	0.154	0.200	-0.755	-0.621	-0.492	-0.373	-0.265	-0.172	-0.098
4'	0.035	0.063	0.093	-0.883	-0.728	-0.579	-0.437	-0.305	-0.188	-0.088	-0.009
3'	-0.001	-0.009	-1.017	-0.848	-0.682	-0.522	-0.371	-0.231	-0.108	-0.004	0.076
2'	-0.030	-1.068	-0.902	-0.739	-0.580	-0.428	-0.283	-0.150	-0.032	0.066	0.139
1'	-1.052	-0.903	-0.753	-0.606	-0.463	-0.325	-0.195	-0.076	0.029	0.116	0.179
0'	-0.864	-0.732	-0.602	-0.473	-0.349	-0.230	-0.117	-0.013	0.076	0.150	0.203
	0	1	2	3	4	5	6	7	8	9	10	11
	-4.380	-4.373	-4.212	-3.793	-3.217	-2.914	-2.741	-2.941	-3.123	-3.225	-3.177	-1.940
	2.275	2.145	1.995	1.457	1.491	0.815	0.853	1.201	1.635	2.048	2.353	0.032
	-2.105	-2.228	-2.317	-2.336	-1.726	-1.999	-1.888	-1.740	-1.488	-1.177	-0.824	1.908

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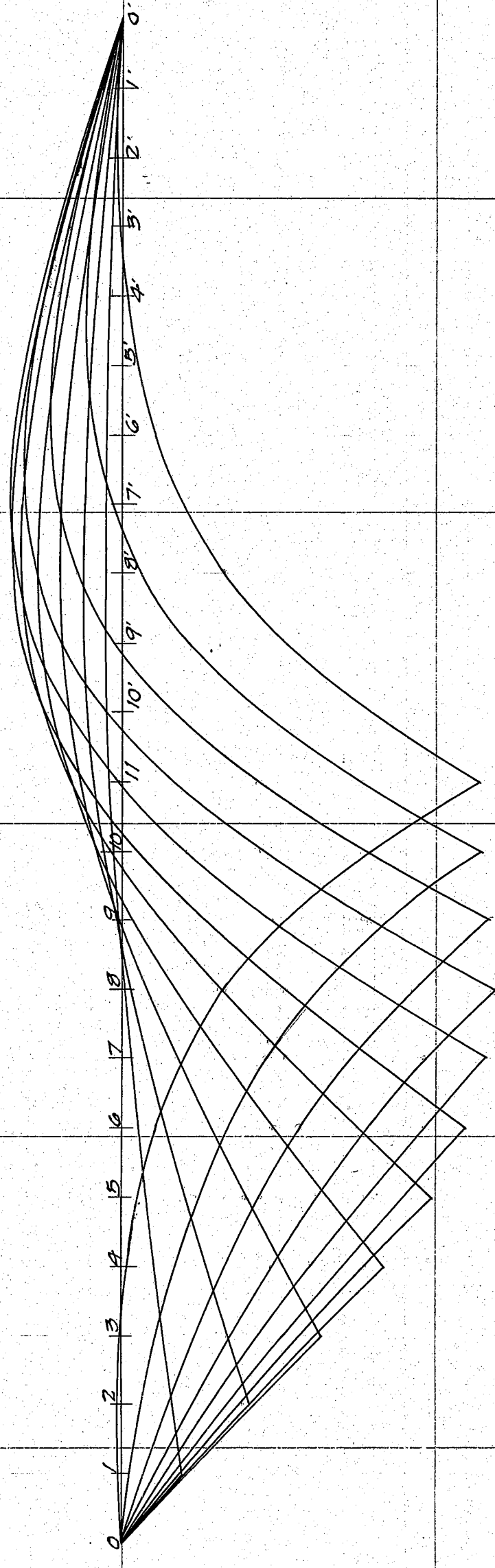
CALCULATIONS FOR

常願寺川水路橋

Influence Surfaces for upper chord members



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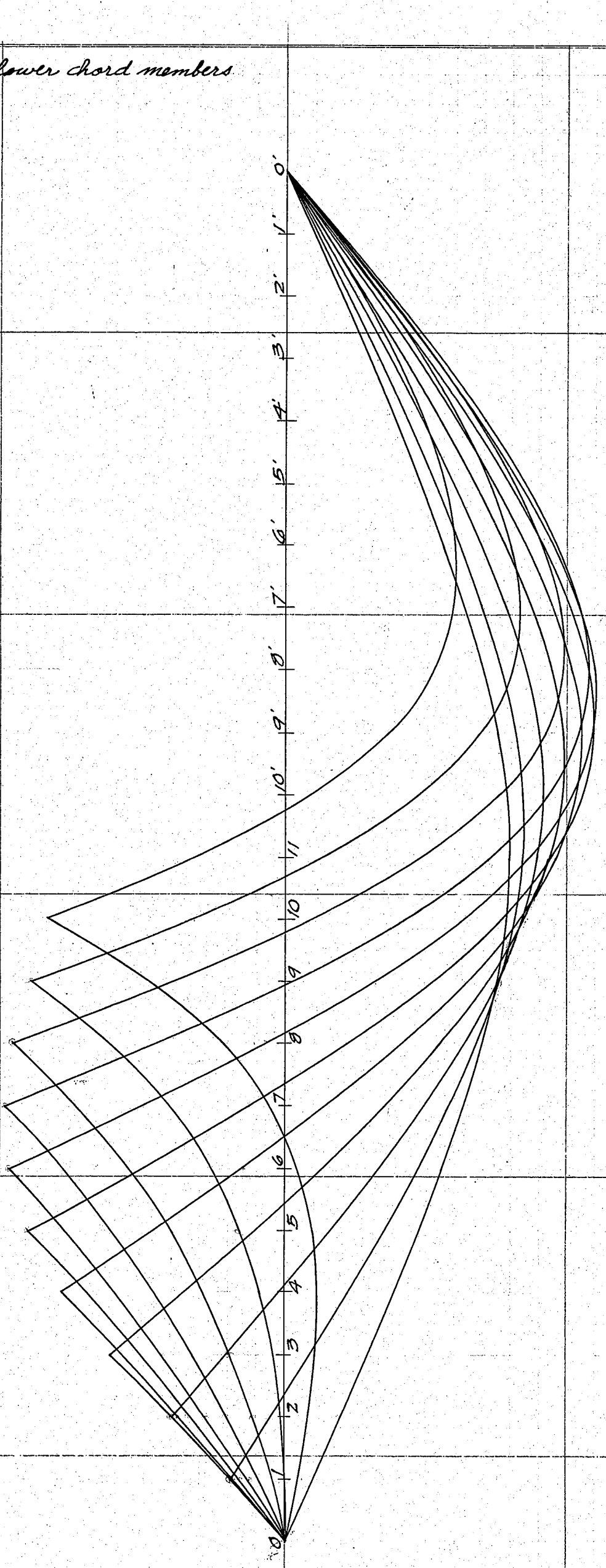
CALCULATIONS FOR

常願寺川水路橋

Influence surfaces for lower chord members



Scale of space.. $= \frac{1}{300}$
" " stress $1{,}000^{kg} = \frac{1}{300}^{m}$

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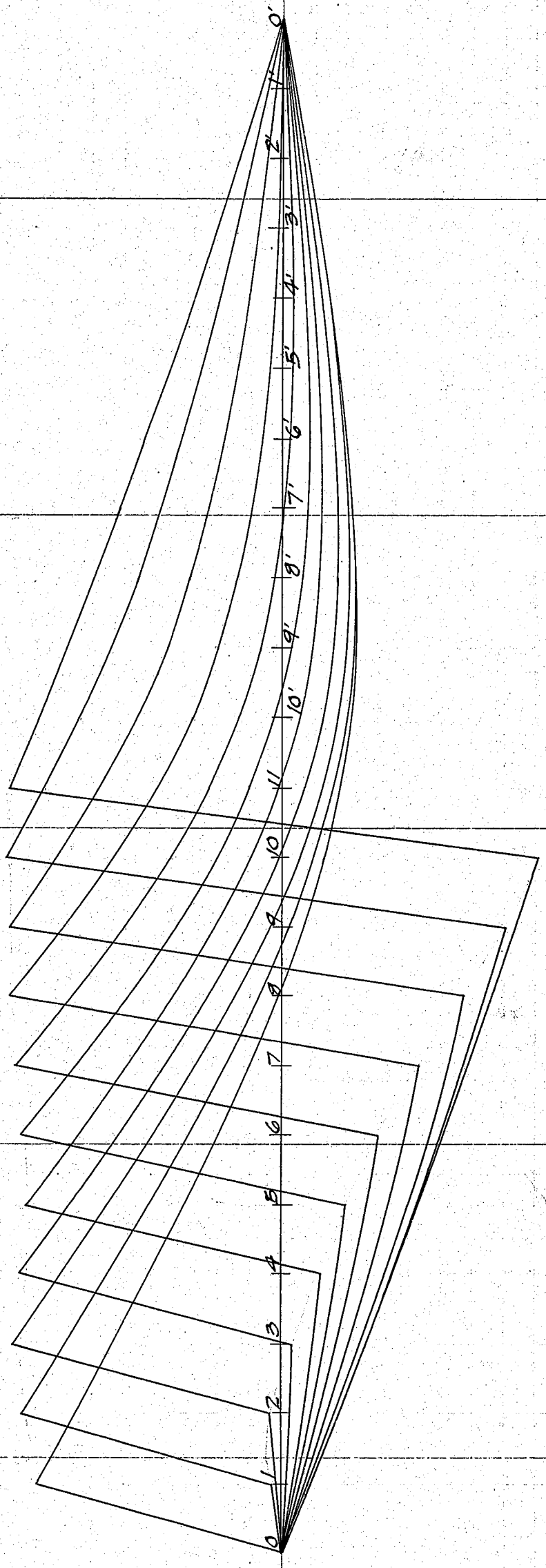
CALCULATIONS FOR

常願寺川水路橋

Influence surfaces for Diagonal members



Scale of space. = 1/300
" " Stress 1000 = 200 "

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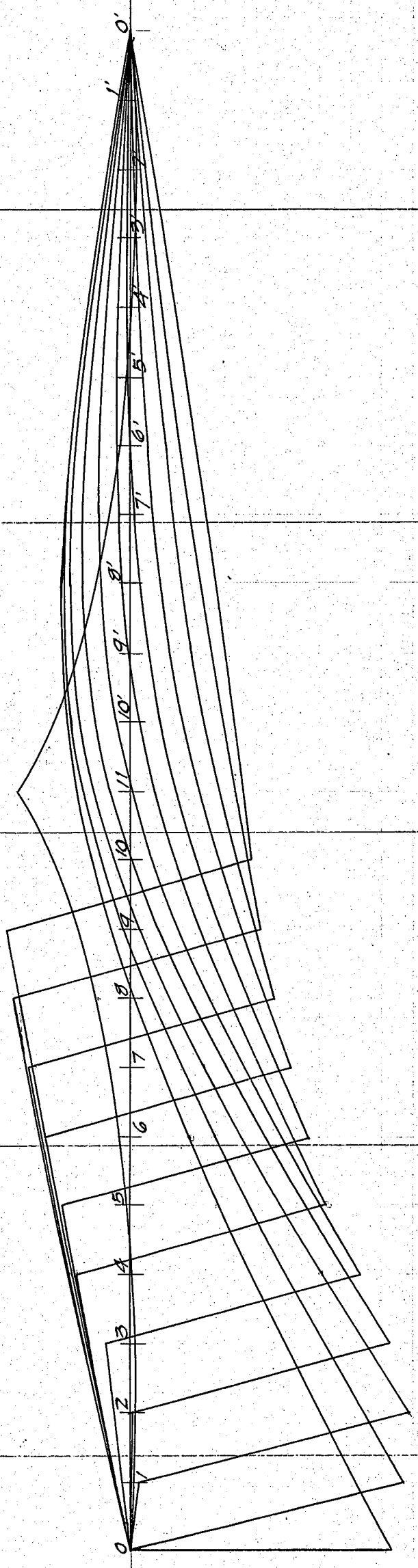
CHECKED BY DATE PAGE NO 45 -

CALCULATIONS FOR

常願寺川水路橋

Influence Surfaces for vertical members



Scale of space ... = 1/300
" stress 1000 kg = 1/200

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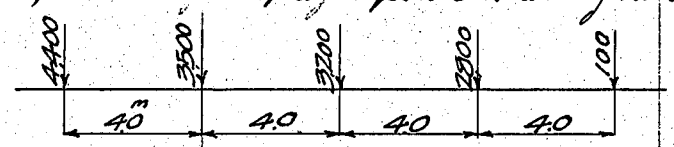
CALCULATIONS FOR

常願寺川水路橋

Stresses for each members

Panel loads

Dead load 7,600 } 9,900 kgs on all panel points
Water load 2,300 }
Live load 3,900 kgs on all panel points necessary to be loaded
1,600 " on a panel point having max. influence ordinates
Train load as follows



Snow load 1,000 kgs on all panel points necessary to be loaded.

		Dead Load 9,900 kgs		Live Load (Panel Load 3,900 kgs Single concantration 1,600 kgs)								Total L.L. stress	
	Members	Σ ordinate	stress	Σ + ord.	Σ − ord.	+stress	−stress	max.+ord	max.−ord	+stress	−stress	+stress	−stress
Upper chords	U_0-U_1	−0.582	−5,760	1.197	−1.779	4,670	−6,940	0.137	−0.454	220	−725	4,890	−7,665
	U_1-U_2	−1.372	−13,580	2.503	−3.955	10,750	−15,420	0.300	−0.970	480	−1,550	11,230	−16,970
	U_2-U_3	−2.411	−23,880	4.020	−6.431	15,680	−25,080	0.482	−1.512	770	−2,420	16,450	−27,500
	U_3-U_4	−3.625	−35,900	5.287	−8.912	20,600	−34,780	0.652	−2.004	1,040	−3,200	21,640	−37,980
	U_4-U_5	−4.936	−48,860	6.106	−11.042	23,820	−43,040	0.776	−2.374	1,240	−3,800	25,060	−46,840
	U_5-U_6	−6.372	−62,050	6.423	−12.795	25,050	−49,900	0.849	−2.630	1,360	−4,220	26,410	−54,120
	U_6-U_7	−7.925	−78,450	6.097	−14.022	23,770	−54,700	0.855	−2.798	1,365	−4,475	25,135	−59,175
	U_7-U_8	−9.477	−93,780	5.108	−14.585	19,930	−56,600	0.757	−2.846	1,210	−4,550	21,140	−64,150
	U_8-U_9	−10.835	−107,200	3.394	−14.229	13,240	−55,490	0.558	−2.817	890	−4,510	14,130	−60,000
	U_9-U_{10}	−11.787	−116,600	1.423	−13.210	5,550	−51,500	0.283	−2.765	450	−4,420	6,000	−55,920
	$U_{10}-U_{11}$	−12.114	−119,900	0.212	−12.326	835	−48,080	0.051	−2.756	80	−4,410	915	−52,490
Lower chords	L_0-L_1	−19.120	−189,300	—	−19.120	—	−74,600	—	−1.432	—	−2,290	—	−76,890
	L_1-L_2	−18.051	−178,700	0.404	−18.455	1,575	−72,000	0.325	−1.526	520	−2,440	2,095	−74,440
	L_2-L_3	−16.805	−166,400	1.447	−18.252	5,640	−71,200	0.712	−1.651	1,140	−2,640	6,780	−73,840
	L_3-L_4	−15.399	−152,500	3.013	−18.412	11,750	−71,800	1.104	−1.777	1,765	−2,840	13,515	−74,640
	L_4-L_5	−13.879	−137,400	4.602	−18.481	17,940	−72,100	1.431	−1.901	2,290	−3,040	20,230	−75,140
	L_5-L_6	−12.323	−122,000	5.882	−18.205	22,950	−71,000	1.641	−1.973	2,625	−3,155	25,575	−74,155
	L_6-L_7	−10.663	−105,500	6.782	−17.445	26,450	−68,000	1.760	−1.986	2,830	−3,180	29,280	−71,180
	L_7-L_8	−8.955	−88,650	7.093	−16.048	27,650	−62,500	1.800	−1.944	2,880	−3,110	30,530	−65,610
	L_8-L_9	−7.307	−72,350	6.637	−13.944	25,880	−54,400	1.740	−1.778	2,780	−2,845	28,660	−57,245
	L_9-L_{10}	−5.874	−58,150	5.114	−10.988	19,930	−42,850	1.630	−1.501	2,610	−2,400	22,540	−45,250
	$L_{10}-L_{11}$	−4.890	−48,400	3.474	−8.364	13,550	−32,600	1.529	−1.098	2,445	−1,755	15,995	−34,355
Diagonals	U_0-L_1	1.193	11,810	3.645	−2.452	14,220	−9,560	0.931	−0.279	1,490	−445	15,710	−10,005
	U_1-L_2	1.346	13,330	3.698	−2.352	14,410	−9,180	0.993	−0.279	1,590	−445	16,000	−9,625
	U_2-L_3	1.503	14,850	3.617	−2.114	14,100	−8,240	1.026	−0.262	1,640	−420	15,740	−8,660
	U_3-L_4	1.541	15,250	3.286	−1.745	12,800	−6,800	0.998	−0.217	1,595	−350	14,395	−7,150
	U_4-L_5	1.586	15,700	3.112	−1.526	12,140	−5,950	0.970	−0.159	1,550	−255	13,690	−6,205
	U_5-L_6	1.704	16,860	3.170	−1.466	12,360	−5,720	0.998	−0.247	1,595	−395	13,955	−6,115
	U_6-L_7	1.787	17,690	3.385	−1.598	13,200	−6,230	1.022	−0.370	1,635	−590	14,835	−6,820
	U_7-L_8	1.761	17,430	4.014	−2.253	15,650	−8,790	1.038	−0.522	1,660	−835	17,310	−9,625
	U_8-L_9	1.551	15,350	4.915	−3.364	19,160	−13,120	1.048	−0.692	1,675	−1,105	20,835	−14,225
	U_9-L_{10}	1.086	10,750	5.644	−4.558	22,020	−17,760	1.054	−0.850	1,685	−1,360	23,705	−19,120
	$U_{10}-L_{11}$	0.386	3,820	5.948	−5.562	23,200	−21,700	1.040	−0.978	1,660	−1,565	24,860	−23,265
Verticals	U_0-L_0	−2.105	−20,830	2.275	−4.380	8,870	−17,080	0.259	−1.000	410	−1,600	9,280	−18,680
	U_1-L_1	−2.220	−22,050	2.145	−4.373	8,360	−17,050	0.254	−1.052	405	−1,680	8,765	−18,730
	U_2-L_2	−2.317	−22,920	1.995	−4.212	7,790	−16,430	0.234	−1.068	375	−1,710	7,765	−18,140
	U_3-L_3	−2.336	−23,110	1.457	−3.793	5,680	−14,800	0.190	−1.017	300	−1,625	5,980	−16,425
	U_4-L_4	−1.726	−17,090	1.491	−3.217	5,820	−12,550	0.120	−0.883	190	−1,410	6,010	−13,960
	U_5-L_5	−1.999	−19,790	0.815	−2.814	3,180	−10,970	0.200	−0.755	320	−1,210	3,500	−12,180
	U_6-L_6	−1.888	−18,700	0.853	−2.741	3,330	−10,690	0.267	−0.688	430	−1,100	3,760	−11,790
	U_7-L_7	−1.740	−17,220	1.201	−2.941	4,680	−11,460	0.333	−0.622	530	−995	5,210	−12,455
	U_8-L_8	−1.488	−14,730	1.635	−3.123	6,380	−12,180	0.397	−0.557	635	−890	7,015	−13,070
	U_9-L_9	−1.177	−11,650	2.048	−3.225	7,980	−12,570	0.448	−0.502	720	−800	8,700	−13,370
	$U_{10}-L_{10}$	−0.824	−8,160	2.353	−3.177	9,180	−12,380	0.481	−0.458	770	−730	9,950	−13,110
	$U_{11}-L_{11}$	1.908	18,890	1.940	−0.032	7,560	−125	0.434	−0.008	690	−12	8,250	−137

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MADE BY M. Jinda DATE 5-6-28 FILE NO
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CALCULATIONS FOR

常願寺川水路橋

Temperature Stresses

Horizontal thrust due to temperature change

$$Ht = \frac{\Sigma \varepsilon to\, Sa\, l}{\Sigma Sa^2 f}$$

where Ht = Horizontal thrust due to temperature change
ε = Coefficient of expansion for steel due to temperature change of 1°C = 0.000012
to = Temperature change in degree C = ±30°
l = Length of each members
Sa = Stresses of each members due to redundancy H = -1 applied
$f = \frac{l}{EA}$

$\varepsilon to = \pm 0.000012 \times 30 = \pm 0.00036$

$$Ht = \frac{0.00036\, Sa\, l}{0.000078805} = \pm 0.4568\, \Sigma Sa\, l$$

Find $\Sigma Sa\, l$

	Upper chords			Lower chords			Diagonals			Verticals		
member	Sa	l	Sal	Sa	l	Sal	Sa	l	Sal	Sa	l	Sal
0	—	—	—	1.1480	4592	527.16	—	—	—	-0.5640	9464	-5337.7
1	-0.7960	4024	-1194.3	1.4539	449.1	652.95	0.6079	8243	5010.9	-0.6287	7648	-4809.3
2	-0.7031	4040	-2840.5	1.8643	439.7	819.73	0.6907	6887	4756.9	-0.6755	6174	-4170.5
3	-1.2319	4060	-5001.5	2.3868	431.3	1029.43	0.7643	5908	4515.5	-0.6803	5046	-3432.8
4	-1.8529	4085	-7569.1	2.9814	423.7	1263.22	0.7916	5272	4173.3	-0.6057	4264	-2582.7
5	-2.5220	4085	-10302.4	3.6182	417.1	1509.15	0.8062	4922	3968.1	-0.5128	3698	-1896.3
6	-3.2567	4060	-13222.2	4.3303	411.5	1781.92	0.8737	4725	4128.2	-0.4576	3214	-1470.7
7	-4.0477	4040	-16352.7	5.0443	407.0	2053.38	0.9157	4588	4201.2	-0.3723	2815	-1048.0
8	-4.8364	4024	-19461.7	5.8589	403.6	2364.65	0.9002	4501	4051.8	-0.2506	2503	-627.3
9	-5.5301	4012	-22186.0	6.5332	401.3	2621.77	0.7863	4457	3504.5	-0.0932	2280	-212.5
10	-6.0191	4004	-24100.5	7.0168	400.1	2807.42	0.5570	4453	2480.3	0.0935	2144	200.5
11	-6.1905	4000	-24762.0	—	—	—	0.1986	4489	891.5	0.0975	2100	204.8
Summary			-29398.74			34901.56			8336.44			-5036.30

$$\Sigma Sa\, l = -29398.74 + 34901.56 + 8336.44 - 5036.30 = 8802.96$$

$$Ht = \pm 0.4568 \times 8802.96 = \pm 4020\ kgs \quad \text{for } 30°C \text{ rise and fall}$$

Temperature Stresses of each members

$-Sa\, Ht$ for rise

		Upper chords		Lower chords		Diagonals		verticals	
Members	H	-Sa	-Sa Ht	-Sa	-Sa Ht	-Sa	-Sa Ht	-Sa	-Sa Ht
0	4020	—	—	-1.148	-4620	—	—	0.564	2270
1	"	0.297	1190	-1.454	-5840	-0.608	-2440	0.629	2530
2	"	0.703	2830	-1.864	-7490	-0.691	-2780	0.676	2720
3	"	1.232	4950	-2.387	-9590	-0.764	-3070	0.680	2730
4	"	1.853	7450	-2.981	-11980	-0.792	-3180	0.606	2430
5	"	2.522	10140	-3.618	-14530	-0.806	-3240	0.513	2060
6	"	3.257	13080	-4.330	-17400	-0.874	-3510	0.458	1840
7	"	4.048	16260	-5.094	-20480	-0.916	-3680	0.372	1495
8	"	4.836	19420	-5.859	-23520	-0.900	-3620	0.251	1010
9	"	5.530	22220	-6.533	-26250	-0.786	-3160	0.093	370
10	"	6.019	24190	-7.017	-28180	-0.557	-2240	-0.094	-380
11	"	6.191	24880	—	—	-0.199	-790	-0.098	-390

JIUN MASUDA
CONSULTING ENGINEER
JIJI BLDG, TOKYO

MADE BY M. Jinda DATE 6-5-29 FILE NO
CHECKED BY DATE PAGE NO 48

CALCULATIONS FOR

常願寺川水路橋

Snow Load Stresses
1,000kgo for panel concentration

	Upper chords		Lower chords		Diagonals		verticals	
member	Σ ord.	stress	Σ ord.	stress	Σ ord.	stress	Σ ord.	stress
0	—	—		-19120	1.193	1,190	-2.105	-2,110
1	-0.582	-590	-19.120	-18050	1346	1,350	-2.228	-2,230
2	-1.372	-1,370	-18.051	-16810	1503	1,500	-2.317	-2,320
3	-2.411	-2,410	-16805	-15400	1.541	1,540	-2.336	-2,340
4	-3.625	-3,630	-15.399	-13890	1.586	1,590	-1.726	-1,730
5	-4.936	-4,940	-13.879	-12320	1.704	1,700	-1.999	-2,000
6	-6.372	-6,370	-12.323	-10660	1.787	1,790	-1.888	-1,890
7	-7.925	-7,930	-10.663	-8960	1.761	1,760	-1.740	-1,740
8	-9.477	-9,480	-8.955	-7310	1.551	1,550	-1.488	-1,490
9	-10.835	-10,840	-7.307	-5870	1086	1,090	-1.177	-1,180
10	-11.787	-11,790	-5.874	-4890	0.306	390	-0.824	-820
11	-12.114	-12,110	-4.890	—	—	—	1.908	1,910

Train load stresses

Member U7-U8

load	-ordinates	+ordinates	-stress	+stress
4,400	-2.946	0.757	-12,500	3,330
3,500	-2.320	0.747	-8,120	2,610
3,200	-1.874	0.662	-5,990	2,120
2,800	-1.484	0.459	-4,150	1,270
100	-1.137	0.117	-110	10
			-30,870	9,340

L4-L5

load	-ordinates	+ordinates	-stress	+stress
4,400	-1.901	1.431	-8,360	6,300
3,500	-1.969	1.053	-6,540	3,690
3,200	-1.729	0.693	-5,530	2,220
2,800	-1.508	0.330	-4,230	920
100	-1.178	—	-100	—
			-24,760	13,130

U10-L11

load	-ordinates	+ordinates	-stress	+stress
4,400	-0.978	1.040	-4,300	4,580
3,500	-0.895	0.926	-3,130	3,240
3,200	-0.806	0.819	-2,580	2,620
2,800	-0.711	0.717	-1,990	2,010
100	-0.615	0.621	-60	60
			-12,060	12,510

U0-L0

load	-ordinates	+ordinates	-stress	+stress
4,400	-1.000	0.259	-4,400	1,140
3,500	-.864	0.258	-3,020	900
3,200	-.732	0.240	-2,340	770
2,800	-.602	0.203	-1,680	570
100	-.473	0.150	-50	15
			-11,490	3,395

Stresses of train load for all members always smaller than those for motor truck with uniform load.

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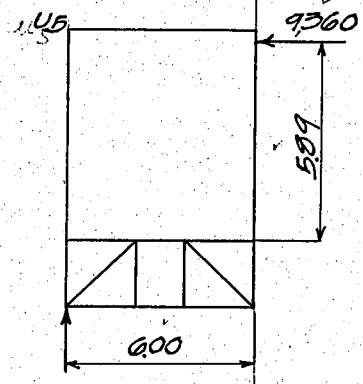
CALCULATIONS FOR

常願寺川水路橋

Stresses in truss members caused by vertical load on panel pt. 5 & 5' due to wind load transmitted through upper lateral bracing.



Horizontal force = 6.5 × 1,440 = 9,360 kgs

vertical reaction = 9,360 × 5.99 ÷ 6.0 = 9,330 kgs

Stresses of chord members act on panel points 5 and 5'

member	load	ord. of 5	stress	ord. of 5'	stress	Summary	chord st. (See lateral bracing)	Summary
U_0-U_1	9,330	-0.184	-1,715	0.103	960	-755		∓ 755
U_1-U_2	〃	-0.483	-4,500	0.231	2,155	-2,345		∓ 2,345
U_2-U_3	〃	-0.940	-8,770	0.376	3,510	÷5,260		∓ 5,260
U_3-U_4	〃	-1.569	-14,640	0.521	4,860	÷9,780		∓ 9,780
U_4-U_5	〃	-2.374	-22,150	0.639	5,960	÷16,190		∓ 16,190
U_5-U_6	〃	-2.147	-20,000	0.724	6,760	÷13,240	+6,340	∓ 6,900
U_6-U_7	〃	-1.853	-17,280	0.757	7,060	÷10,220	+11,600	± 1,380
U_7-U_8	〃	-1.484	-13,840	0.709	6,610	÷7,230	+16,050	± 8,820
U_8-U_9	〃	-1.047	-9,770	0.553	5,160	÷4,610	+19,400	± 14,790
U_9-U_{10}	〃	-0.573	-5,340	0.276	2,570	÷2,770	+21,200	± 18,430
$U_{10}-U_{11}$	〃	-0.113	-1,055	-0.113	-1,055	÷2,110	+24,900	± 22,790
L_0-L_1	〃	-0.862	-8,040	-0.862	-8,040	-16,080	-107,000	∓123,080
L_1-L_2	〃	-0.638	-5,950	-0.959	-8,950	÷14,900	-82,800	∓ 97,700
L_2-L_3	〃	-0.299	-2,790	-1.076	-10,400	÷13,190	-58,700	∓ 71,890
L_3-L_4	〃	0.188	1,750	-1.210	-11,300	÷9,550		∓ 9,550
L_4-L_5	〃	0.833	7,770	-1.336	-12,460	÷4,690		∓ 4,690
L_5-L_6	〃	1.641	15,310	-1.435	-13,400	+1,910		± 1,910
L_6-L_7	〃	1.404	13,090	-1.506	-14,050	-960		∓ 960
L_7-L_8	〃	1.102	10,270	-1.526	-14,250	÷3,980		∓ 3,980
L_8-L_9	〃	0.720	6,720	-1.469	-13,700	÷6,980		∓ 6,980
L_9-L_{10}	〃	0.294	2,740	-1.306	-12,180	÷9,440		∓ 9,440
$L_{10}-L_{11}$	〃	-0.180	-1,680	-1.028	-9,590	÷11,270		∓ 11,270
U_0-L_1	〃	0.376	3,510	-0.212	-1,980	± 1,530		± 1,530
U_1-L_2	〃	0.509	4,750	-0.217	-2,020	+2,730		± 2,730
U_2-L_3	〃	0.661	6,160	-0.211	-1,970	± 4,190		± 4,190
U_3-L_4	〃	0.805	7,510	-0.183	-1,710	± 5,800		± 5,800
U_4-L_5	〃	0.970	9,050	-0.142	-1,325	± 7,725		± 7,725
U_5-L_6	〃	-0.247	-2,300	-0.103	-960	÷3,260		∓ 3,260
U_6-L_7	〃	-0.323	-3,015	-0.042	-390	÷2,625		∓ 2,625
U_7-L_8	〃	-0.405	-3,780	0.050	470	÷3,310		∓ 3,310
U_8-L_9	〃	-0.480	-4,480	0.171	1,595	÷2,885		∓ 2,885
U_9-L_{10}	〃	-0.524	-4,890	0.307	2,860	-2,030		∓ 2,030
$U_{10}-L_{11}$	〃	-0.515	-4,800	0.437	4,080	± 720		∓ 720
U_0-L_0	〃	-0.349	-3,250	0.197	1,840	± 1,410		∓ 1,410
U_1-L_1	〃	-0.463	-4,320	0.197	1,840	± 2,480		∓ 2,480
U_2-L_2	〃	-0.580	-5,410	0.188	1,750	± 3,660		∓ 3,660
U_3-L_3	〃	-0.682	-6,360	0.160	1,490	± 4,870		∓ 4,870
U_4-L_4	〃	-0.728	-6,790	0.107	1,000	± 5,790		∓ 5,790
U_5-L_5	〃	-0.755	-7,040	0.050	470	± 6,570		∓ 6,570
U_6-L_6	〃	0.267	2,490	0.003	30	+2,520		± 2,520
U_7-L_7	〃	0.284	2,650	-0.052	-485	+2,165		± 2,165
U_8-L_8	〃	0.293	2,730	-0.109	-1,020	± 1,710		± 1,710
U_9-L_9	〃	0.286	2,670	-0.165	-1,540	+1,130		± 1,130
$U_{10}-L_{10}$	〃	0.258	2,410	-0.213	-1,990	+ 420		± 420
$U_{11}-L_{11}$	〃	0.018	170	0.018	170	± 340		± 340

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CONSULTING ENGINEER
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MADE BY_____ DATE_____ FILE NO_____
CHECKED BY_____ DATE_____ PAGE NO 50

CALCULATIONS FOR

常願寺川水路橋

Table of stresses for each members

	member	Dead & water Load stress	Live load +stress	Live load -stress	Summary D.L+L.L	Snow	Train load +stress	Train load -stress	Summary D.L+S.L+T.L	Wind	Summary Temp'.	Summary D.L+L.L+W.L+Temp.	Reqd section	
Upper chord members	U0-U1	-57.60	48.90	-76.65	-134.25	-5.80				∓ 7.55	± 11.90	-153.70	134.3	9/loss
	U1-U2	-135.80	112.30	-169.70	-305.50	-13.70				∓ 23.45	± 28.30	-357.25	300.55	〃
	U2-U3	-238.80	164.50	-275.00	-513.80	-24.10				∓ 52.60	± 49.50	-615.90	513.8	〃
	U3-U4	-359.00	216.40	-379.80	-738.80	-36.30				∓ 97.80	± 74.50	-911.10	739.8	〃
	U4-U5	-488.60	250.60	-468.40	-957.00	-49.40				∓ 161.90	± 101.40	-1220.30	977.0	〃
	U5-U6	-620.50	264.10	-541.20	-1161.70	-63.70				∓ 69.00	± 130.80	-1361.50	1161.7	〃
	U6-U7	-784.50	251.35	-591.75	-1376.25	-79.30				± 13.80	± 162.60	-1552.05	1376.3	〃
	U7-U8	-937.80	211.40	-641.50	-1579.30	-94.80	93.40	-308.70	-1341.30	± 88.20	± 194.20	-1801.70	1579.3	〃
	U8-U9	-1072.00	141.30	-600.00	-1672.00	-108.40				± 147.90	± 222.20	-2047.10	1672.0	〃
	U9-U10	-1166.00	60.00	-554.20	-1725.20	-117.90				± 184.30	± 241.90	-2156.30	1725.2	〃
	U10-U11	-1199.00	9.15	-524.90	-1723.90	-121.10				± 227.90	± 248.80	-2220.60	1760.0	〃
Lower chord members	L0-L1	-1893.00		-706.90	-2661.90	-191.20				∓ 1230.80	∓ 46.20	-3938.90	3150.0	〃
	L1-L2	-1787.00	20.95	-744.40	-2531.40	-180.50				∓ 977.00	∓ 58.40	-3566.80	2855.2	〃
	L2-L3	-1664.00	67.80	-738.40	-2402.40	-168.10				∓ 718.90	∓ 74.90	-3196.20	2555.8	〃
	L3-L4	-1525.00	135.15	-746.40	-2271.40	-154.00				∓ 495.50	∓ 95.90	-2460.80	2271.4	〃
	L4-L5	-1374.00	202.30	-751.40	-2125.40	-138.80	131.30	-247.60	-1760.40	∓ 46.90	∓ 119.80	-2292.10	2125.4	〃
	L5-L6	-1220.00	255.75	-741.55	-1961.55	-123.20				± 19.10	∓ 145.30	-2125.95	1961.6	〃
	L6-L7	-1055.00	292.80	-711.80	-1766.80	-106.60				∓ 9.60	∓ 174.00	-1950.40	1766.8	〃
	L7-L8	-886.50	305.30	-656.10	-1542.60	-89.60				∓ 39.80	∓ 204.80	-1787.20	1542.6	〃
	L8-L9	-723.50	286.60	-572.45	-1295.95	-73.10				∓ 69.80	∓ 235.20	-1600.95	1296.0	〃
	L9-L10	-581.50	225.40	-452.50	-1034.00	-58.70				∓ 94.40	∓ 262.50	-1390.90	1113.0	〃
	L10-L11	-484.00	159.95	-343.55	-827.55	-48.90				∓ 112.70	∓ 281.80	-1222.05	978.0	〃
Diagonal members	U0-L1	118.10	157.10	-100.05	275.20	11.90				± 15.30	∓ 24.40	314.90	229.5	net
	U1-L2	133.30	160.00	-96.25	293.30	13.50				± 27.30	∓ 27.80	348.40	244.5	〃
	U2-L3	148.50	157.40	-86.60	305.90	15.00				± 41.90	∓ 30.70	378.50	254.8	〃
	U3-L4	152.50	143.95	-71.50	296.45	15.40				± 58.00	∓ 31.80	386.25	257.5	〃
	U4-L5	157.00	136.90	-62.05	293.90	15.90				± 77.25	∓ 32.40	403.55	269.0	〃
	U5-L6	168.60	139.55	-61.15	308.15	17.00				∓ 32.60	∓ 35.10	375.85	257.0	〃
	U6-L7	176.90	148.35	-68.20	325.25	17.90				∓ 26.25	∓ 36.80	388.30	271.2	〃
	U7-L8	174.30	173.10	-96.25	347.40	17.60				∓ 33.10	∓ 36.20	416.70	289.5	〃
	U8-L9	153.50	208.35	-142.25	361.85 / 344.55	15.50				∓ 28.85	∓ 31.60	422.30	301.7	〃
	U9-L10	107.50	237.05	-191.20	⅔D 119.50 / 286.80	10.90				∓ 20.30	∓ 22.40	397.25 / 162.20 / 301.90	287.0 / 239.0	〃
	U10-L11	38.20	248.60	-232.65	⅔D 207.15	3.90	125.10	120.60	⅔D 95.10 / 167.20	∓ 7.20	∓ 7.90	-222.25		
Vertical members	U0-L0	-208.30	92.80	-186.80	-395.10	-21.10	33.95	-114.90	-344.30	∓ 14.10	± 22.70	-421.90	395.1	gross
	U1-L1	-220.50	87.65	-187.30	-407.80	-22.30				∓ 24.80	± 25.30	-457.90	419.0	〃
	U2-L2	-229.20	77.65	-181.40	-410.60	-23.20				∓ 36.60	± 27.20	-474.40	410.6	〃
	U3-L3	-231.10	59.80	-164.25	-395.35	-23.40				∓ 48.70	± 27.30	-471.35	395.4	〃
	U4-L4	-170.90	60.10	-139.60	-310.50	-17.30				∓ 57.90	± 24.30	-392.70	314.0	〃
	U5-L5	-197.90	35.00	-121.80	-319.70	-20.00				∓ 65.70	± 20.60	-406.00	327.0	〃
	U6-L6	-187.00	37.60	-117.90	-304.90	-18.90				± 25.20	± 18.40	-348.50	304.9	〃
	U7-L7	-172.20	52.10	-124.55	-296.75	-17.40				± 21.65	± 14.95	-333.35	296.8	〃
	U8-L8	-147.30	70.15	-130.70	-278.00	-14.90				± 17.10	± 10.10	-305.20	278.0	〃
	U9-L9	-116.50	87.00	-133.70	-250.20 / -214.70	-11.80				± 11.30	± 3.70	-265.20	250.2	〃
	U10-L10	-81.60	99.50	-131.10	-45.10	-8.20				± 4.20	± 3.80	220.70 / +53.10	212.7	〃
	U11-L11	-188.90	82.50	-1.37	+271.40	+19.10				± 3.40	± 3.90	+278.70	226.0	net

Note: Figures underlined shows governing stresses of corresponding member section.

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JIJI BLDG, TOKYO

MADE BY M. Jinda DATE 6-6-6 FILE NO
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CALCULATIONS FOR

Max. load on shoe

		Corresponding vertical load
Horizontal thrust		
Dead load thrust	7,600 · 16.657 = 126,500 kgs	7,600 · 11.00 = 83,600 kgs
water load thrust	2,300 · 16.657 = 38,300 »	2,300 · 11.00 = 25,300 »
Live load thrust	3,900 · 16.657 = 65,000 »	3,900 · 11.00 = 42,900 »
» extra conc.	1,600 · 1.247 = 1,995 »	1,600 · 0.50 = 800 »
Temperature change	± 4,020 »	—
Wind load		
» chord stress	$107{,}000 \cdot \frac{4.000}{45.92} = \pm 93{,}400$ »	$107{,}000 \cdot \frac{22.56}{45.92} = \pm 52{,}270$ »
» overturning eff.	$9{,}330 \cdot 0.751 = \pm 7{,}000$ »	± 9,330 »
» » direct on shoe		$\frac{\mp 9360 \cdot 113.92}{60} = \mp 17{,}750$ »
Snow load on shoe	1,000 · 16.657 = 16,660 »	1,000 · 11.00 = 11,000 »
Train load		
	4,400 · 1.233 = 5,420	$4{,}400 \cdot \frac{10}{22} = 2{,}000$
	3,500 · 1.247 = 4,360	$3{,}500 \cdot \frac{11}{22} = 1{,}750$
	3,200 · 1.233 = 3,945	$3{,}200 \cdot \frac{12}{22} = 1{,}745$
	2,800 · 1.183 = 3,310	$2{,}800 \cdot \frac{13}{22} = 1{,}655$
	100 · 1.104 = 110	$100 \cdot \frac{14}{22} = 60$
	17,145 kgs	7,210 kgs

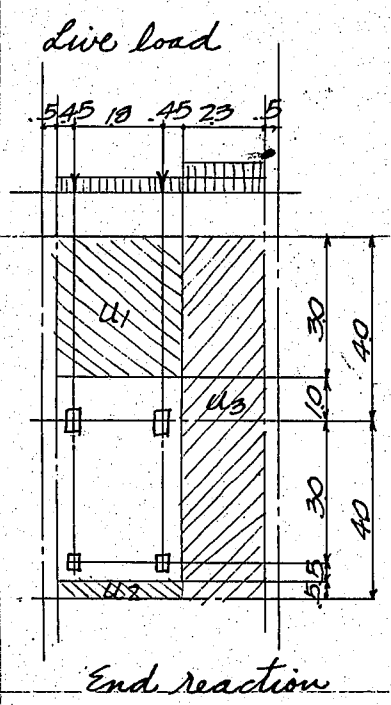
Summary

	max. hori. thrust	corresponding vert. load.	min. horiz. thrust	corresponding vert. load.
Dead load	126,500	83,600	126,500	83,600
water load	38,300	25,300	—	—
Live load	65,000	42,900	—	—
Extra conc.	1,995	800	—	—
	231,795	152,600	126,500	83,600
Temperature	4,020	—	- 4,020	—
wind. chord st.	93,400	52,270	-93,400	-52,270
» overturning eff.	7,000	9,330	- 7,000	- 9,330
» direct on shoe	—	17,750	—	-17,750
	336,215 kgs	231,950 kgs	22,080 kgs	4,250 kgs

Stress in hanger

Dead load for floor system, load on I & J hanger & etc. 4,500 see P9
1,700
800
6,000 kgs

Live load



Motor truck rear wheel conc 2,250
Impact coeff. $\frac{20}{60+8.0} = 29.4\%$ 2,250 · 29.4 = 660
2,910 kgs
Front wheel concentration with impact 970
Uniform load $w = \frac{100{,}000}{170 \cdot 8.0} = 562$ kgs/qm use 500 kgs/m²
Load on floor beam
Rear wheel = 2,910
Front wheel $\frac{970 \cdot 100}{400} = 240$
3,150 kgs
Uniform load U_1 $\frac{500 \cdot 30 \cdot 1.5}{4.0} = 562$
» U_2 $\frac{500 \cdot 5 \cdot 2.5}{4.0} = 16$
578 »
» U_3 500 · 4.0 = 2,000 »

End reaction
Rear wheel conc. $2{,}910 \cdot \frac{506}{600} = 2{,}450$
Unif. load $U_1 + U_2$ $578 \cdot \frac{415}{600} = 400$
U_3 $2{,}000 \cdot \frac{165}{600} = 550$
3,400 kgs

Required section = $\frac{9{,}400}{1{,}200} = 7.83$ cm² net

4ℓs 125 · 75 · 9 = 68.76 − 18.00 = 50.76 cm² net

Summary dead load 6,000
live load 3,400
9,400 kgs

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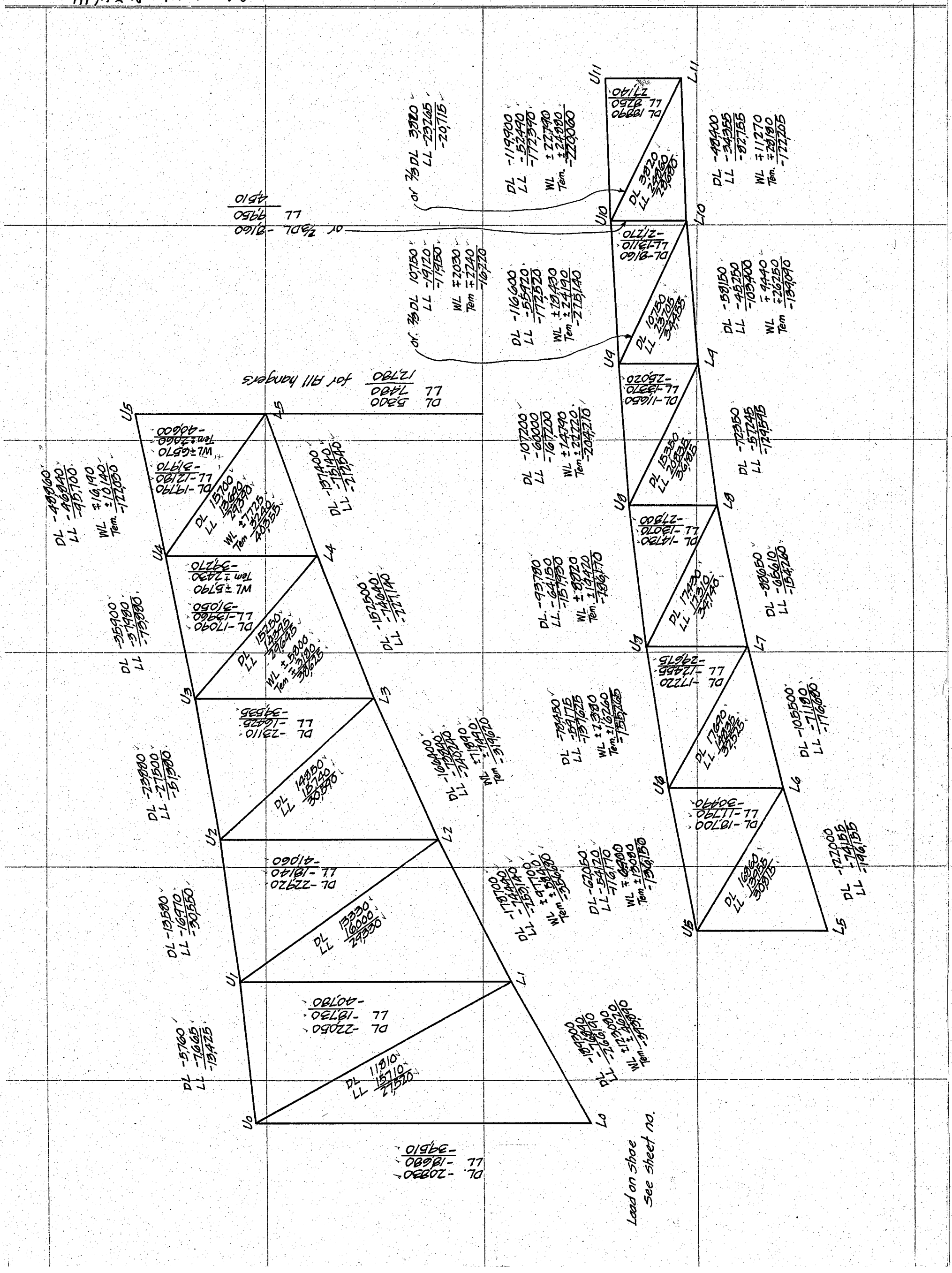
CHECKED BY DATE PAGE NO 52

CALCULATIONS FOR

常願寺川水路橋



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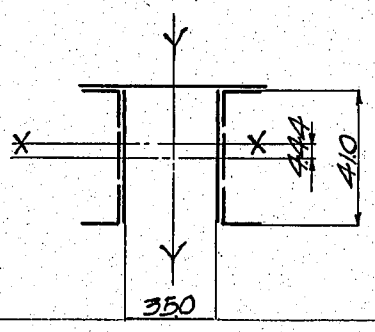
CALCULATIONS FOR

常願寺川水路橋

Final Sections of Members

Upper chord members

U9-U11



max. stress -220,060 kgs for DL+LL+WL.+Tem

1 Cov. Pl.	550×9	= 4950	× 20.95 = 1,037.0
4 ∠s	90×90×10	= 68.00	
2 Web Pls	400×9	= 72.00	
2 Side Pls	220×10	= 44.00	
		233.50	× 4.44 = 1,037.0

Moment of inertia about X-X axis

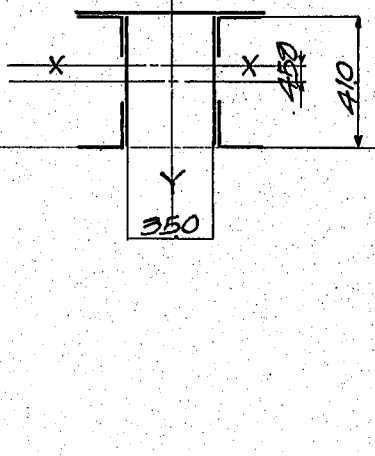
1 Cov. Pl	49.5 × 16.51²		= 13,480
2 ∠s	34.0 × 13.50² + 2494		= 6,450
2 ∠s	34.0 × 22.38² + 2494		= 17,280
2 Web Pls	72.0 × 4.44² +	9×40³/12	= 6220
2 Side Pls	44.0 × 4.44² +	9×22³/12	= 1670
			I = 45,100 cm⁴

Radius of gyration $r_x = \sqrt{\frac{45100}{233.5}} = 13.91$ $l/r = \frac{400.0}{13.91} = 28.78$

allowable unit compression = 1,500 × (1 - 0.0055 × 28.78) = 1,263 kgs use 1,000 × 1.25 = 1,250 kgs

Unit stress = $\frac{220060}{233.5} = 943$ kgs

U0-U9



max. stress -172,520 kgs for DL+LL

1 Cov. Pl	550×9	= 4950	× 20.95 = 1,037.0
4 ∠s	90×90×10	= 68.00	
2 Web Pls	400×9	= 72.00	
		189.50	× 5.48 = 1,037.0

Moment of inertia about X-X axis

1 Cov. Pl.	49.5 × 15.47²		= 11,840
2 ∠s	34.0 × 12.46² + 2494		= 5530
2 ∠s	34.0 × 23.42² + 2494		= 18,900
2 Web Pls	72.0 × 5.48² +	9×40³/12	= 6960
			I = 43230

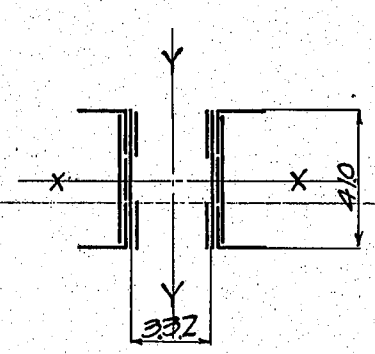
Radius of gyration = $r_x = \sqrt{\frac{43230}{189.5}} = 15.10$ $l/r_x = \frac{4012}{15.10} = 266$

allowable unit compression = 1,500 × (1 - 0.0055 × 266) = 1,230 kgs use 1,000 × 1.25 = 1,250 kg

unit stress = $\frac{172520}{189.5} = 910$ kgs/cm²

Lower chord Members

Lo-L1



governing stress -393,890 kgs for DL+LL+WL+Tem

4 ∠s	100×100×10	= 76.00	76.00 × 17.69² + 698	= 24450
2 Web Pls	400×12	= 96.00	24×40³/12	= 12,800
2 Side Pls	200×10	= 40.00	20×20³/12	= 1330
2 " "	370×14	= 103.50	28×37³/12	= 11,800
4 Pls	100×9	= 36.00	36 × 15.00² + 36×10³/12	= 8400
		351.50		I = 58,780 cm⁴

Radius of gyration $r_x = \sqrt{\frac{58780}{351.5}} = 12.94$ $l/r_x = \frac{459.2}{12.94} = 35.50$

allowable unit compression = 1,500 × (1 - 0.0055 × 35.5) = 1207 kgs use 1,000 × 1.25 = 1,250 kgs

unit stress = $\frac{393890}{351.5} = 1,120$ kgs

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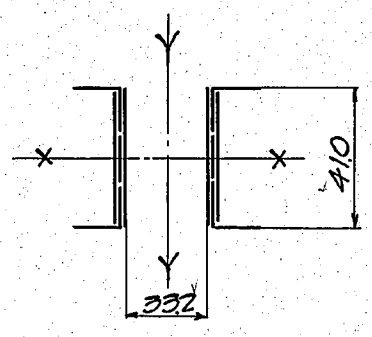
CHECKED BY DATE PAGE NO 54

CALCULATIONS FOR

常願寺川氷路橋

L1-L2



Governing stress -356,680 kgs DL+LL+WL+Tem

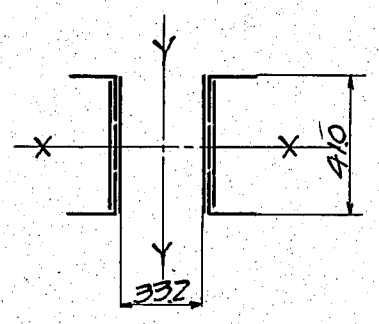
4 L's	100×100×10	= 76.00	76.0×17.69² + 698	= 24,450
2 Web P/s	400×12	= 96.00		= 12,800
2 side P/s	200×10	= 40.00		= 1,330
2 " "	370×12	= 88.80	24×37³/12	= 10,120
		300.80		I=48,700

Radius of gyration $r_x = \sqrt{\frac{48,700}{300.80}} = 12.73$ $\ell/r_x = \frac{449.1}{12.73} = 35.28$

allowable unit compression = 1500×(1−0.0055×35.28) = 1,210 kgs use 1,000×1.25=1,250 kgs

Unit stress = $\frac{356,680}{300.8} = 1,185$ kgs

L2-L3



Governing stress -319,620 kgs DL+LL+WL+Tem

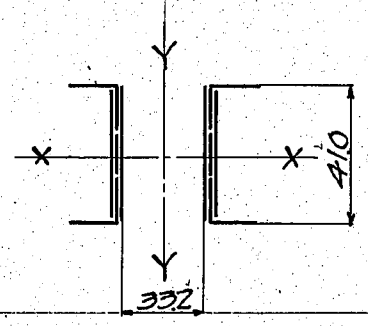
4 L's	100×100×10	= 76.00		= 24,450
2 Web P/s	400×12	= 96.00		= 12,800
2 side P/s	200×10	= 40.00		= 1,330
2 " "	370×9	= 66.60	18×37³/12	= 7,600
		278.60		I=46,180

Radius of gyration $r_x = \sqrt{\frac{46,180}{278.60}} = 12.86$ $\ell/r_x = \frac{439.7}{12.86} = 34.15$

allowable unit compression = 1,500×(1−0.0055×35.28) = 1,208 kgs use 1,000×1.25=1,250 kgs

unit stress = $\frac{319,620}{278.6} = 1,147$ kgs

L3-L6



Max. stress -227,140 kgs DL+LL

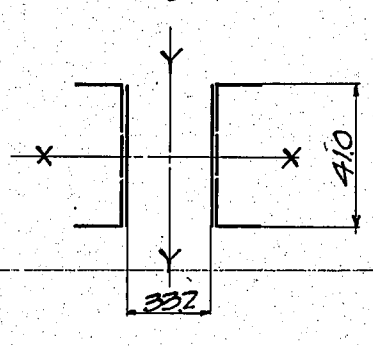
4 L's	100×100×10	= 76.00		= 24,450
2 Web P/s	400×9	= 72.00		= 9,610
2 side P/s	200×10	= 40.00		= 1,330
2 " "	370×9	= 66.60	18×40³/12	= 7,600
		254.60		42,990

Radius of gyration $r_x = \sqrt{\frac{42,990}{254.60}} = 12.99$ $\ell/r_x = \frac{433.1}{12.99} = 33.21$

allowable unit compression = 1,500×(1−0.0055×33.21) = 1,225 kgs use 1,000 kgs/cm²

unit stress = $\frac{227,140}{254.6} = 893$ kgs

L6-L8



Max. stress -176,680 kgs DL+LL

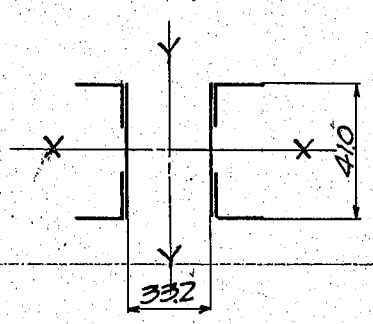
4 L's	100×100×10	= 76.00	24,450
2 Web P/s	400×9	= 72.00	9,610
2 side P/s	200×10	= 40.00	1,330
		188.00	35,390

Radius of gyration $r_x = \sqrt{\frac{35,390}{188.00}} = 13.72$ $\ell/r_x = \frac{411.5}{13.72} = 30.00$

allowable unit compression = 1,500×(1−0.0055×30.00) = 1,252 kgs use 1,000 kgs/cm²

unit stress = $\frac{176,680}{188.00} = 940$ kgs

L8-L11



Max. stress -129,595 kgs DL+LL

4 L's	100×100×10	= 76.00	24,450
2 Web P/s	400×9	= 72.00	9,610
		148.00	34,060

Radius of gyration $r_x = \sqrt{\frac{34,060}{148.00}} = 15.16$ $\ell/r_x = \frac{403.6}{15.16} = 26.61$

allowable unit compression = 1500×(1−0.0055×26.61) = 1290 kgs use 1,000 kgs/cm²

Unit stress = $\frac{129,595}{148.00} = 876$ kgs

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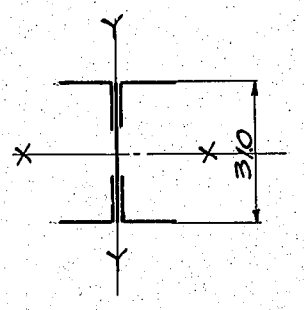
CHECKED BY DATE PAGE NO 55

CALCULATIONS FOR

常願寺川水路橋

Diagonal members
all members



Max. Stress +36,185 kgs DL + LL (for U8–L9)

Iy-y

4L 125×75×9 = 68.76 × 4.64² + 1,080 = 2,495

$r_y = \sqrt{\frac{2495}{68.76}} = 6.02$ $\ell/r_y = \frac{9243}{6.02} = 137$

Net Section required $= \frac{36185}{1200} = 30.15\ cm^2$

4L 125×75×9 = 68.76 − 18.00 = 50.76 cm² net

for compression U10–L10 & U9–L10

Max. Stress −20,715 kgs

$r_y = 6.02$ $\ell/r_y = \frac{4469}{602} = 74.6$

allowable unit compression = 1,500×(1−0.0055×74.6) = 996 kgs/cm²

unit stress $= \frac{20715}{68.76} = 302$ kgs

Vertical members
U0–L0

governing stress −39,510 kgs DL+LL

Section same as upper chord U0–U9

Sectional area = 189.50 cm²

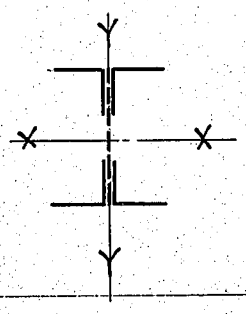
$r_x = 15.10$ $\ell/r_x = \frac{9464}{15.10} = 62.70$

allowable unit compression = 1500×(1−00055×62.70) = 983 kgs/cm²

unit stress $= \frac{39510}{189.5} = 209$ kgs

All verticals except U0–L0 & U5–L5 Max. Stress −41,060 kgs DL+LL

Section same as Diagonal members max. length 3.85



$r_y = 6.02$ $\ell/r_y = \frac{385}{6.02} = 64$

Ix–x

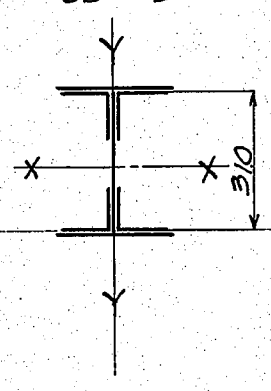
4L 125×75×9 = 68.76 × 13.79² + 300 = 13,350

$r_x = \sqrt{\frac{13350}{68.76}} = 13.94$ $\ell/r_x = \frac{765}{13.94} = 54.9$

allowable unit compression = 1,500×(1−0.0055×64) = 972 kgs/cm²

unit stress $= \frac{41060}{68.76} = 598$ kgs

U5–L5



governing stress −40,600 kgs DL+LL+WL+Tem

−31,970 , DL+LL

4L 125×75×9 = 68.76

1Pl 300×9 = 27.00

2Pls 260×12 = 62.40

158.16

$\frac{24\times 26^3}{12} = 3515$

$I_y = 6010$

Radius of gyration $r_y = \sqrt{\frac{6010}{158.16}} = 6.18$ $\ell/r_y = \frac{3698}{6.18} = 598$

allowable unit compression = 1500×(1−0.0055×598) = 1,006 kgs use 1,000 kgs/cm²

unit stress $= \frac{31970}{158.16} = 202$ kgs

Ix–x

4L 125×75×9 = 68.76 × 12.59² + 295 = 11,170

2Pls 260×12 = 62.40 × 15.05² = 14,130

1Pls 300×9 = 27.00 $\frac{9\times 30^3}{12} = 2020$

158.16

$I_x = 27,320$

Radius of gyration $r_x = \sqrt{\frac{27320}{158.16}} = 13.13$ $\ell/r_x = \frac{3698}{13.13} = 28.18$

allowable unit compression = 1500×(1−0.0055×28.18) = 1,266 kgs use 1,000 kgs/cm²

, , , for DL+LL+WL+Tem 1,250 ,

Direct stress $= \frac{40600}{158.16} =$ 257

Bending stress $= \frac{10400\times 100}{27320}\times 15.5 =$ 590

847 kgs/cm²

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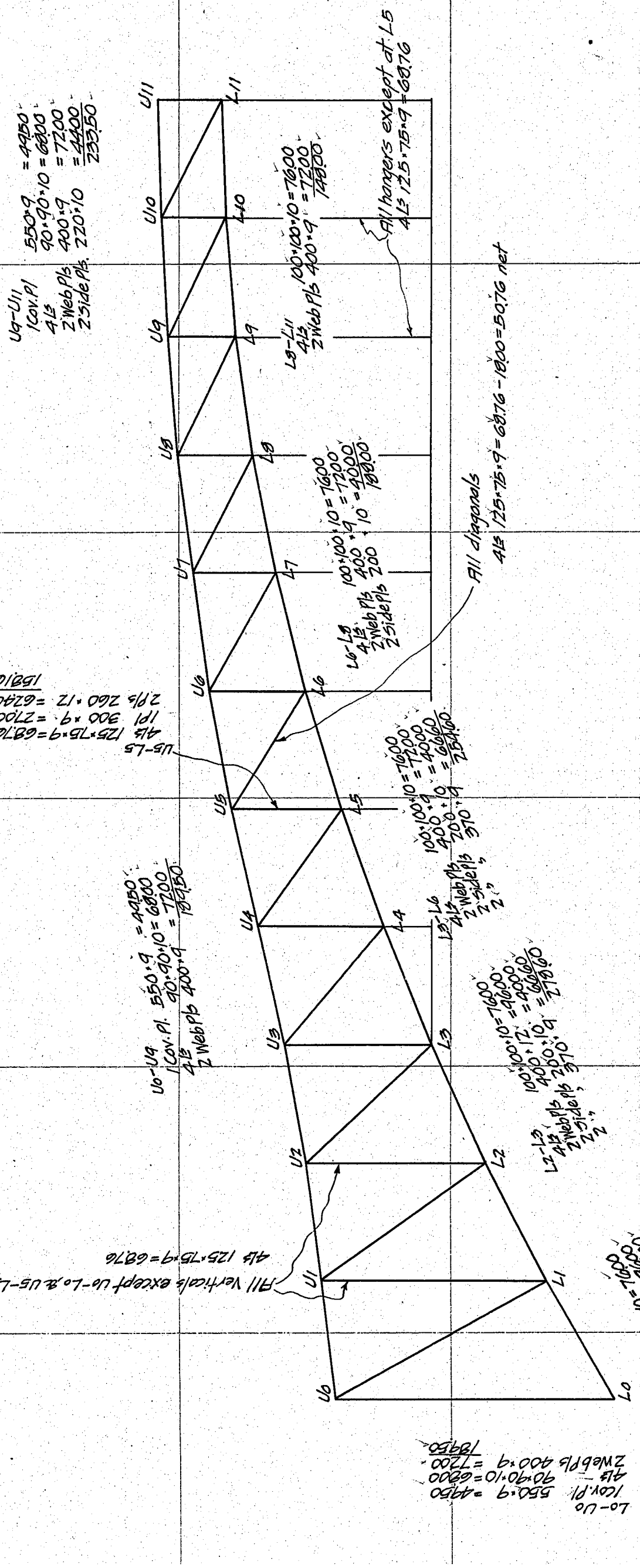
CHECKED BY DATE PAGE NO 56

CALCULATIONS FOR

常願寺川水路橋



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CALCULATIONS FOR

常願寺川水路橋

Vertical deflection of truss at center

General equation of deflection $s = \Sigma \frac{SL}{EA} T$ or $\frac{1}{E} \Sigma \frac{SL}{A} T$

where s = Deflection of any point in cm.
S = Stresses of each members.
T = Stresses of each members due to a unit load on the panel point at which deflection is desired in the direction of the deflection.
L = Length of each member in cm.
A = Sectional area of each member in cm^2 gross section.
E = Modulus of elasticity in $kg/cm^2 = 2{,}100{,}000$

		S_D D.L stress	S_U L.L stress	S_S single c	$S_U + S_S$	S_T	$S_D \cdot T$	$S_L \cdot T$	$S_T \cdot T$	L	A	$\frac{L}{A}$	$\frac{S_D L T}{A}$	$\frac{S_L L_T}{A}$	$\frac{S_T T_L}{A}$
	Member / Σordinates	9900	3900	T	1600										
Upper chord members	U0-U1	-0.582	-5,760	-2270	0.107	170	2,100	1,190	-0.16	-225	127	4024	189	2.13	-1,310	-479	270
	U1-U2	-1.372	-13.580	-5.350	0.223	360	-4.990	2.930	-3030	-1,112	634	4040	〃	2.14	-6,480	-2,380	1,356
	U2-U3	-2411	-23880	-9410	0329	530	-8.880	4950	-7850	-2920	1,627	4060	〃	2.15	-16,870	-6,280	3496
	U3-U4	-3.625	-35,900	-14.130	0395	630	-13.500	7.450	-14.180	-5330	2942	4085	〃	2.16	-30,620	-11,500	6355
	U4-U5	-4936	-48.860	-19.250	0383	610	-18,640	10,140	-18.700	-7,135	3882	4085	〃	〃	-40.380	-15,400	8380
	U5-U6	-6372	-62.050	-24.850	0272	440	-24.410	13,080	-16,880	-6,640	3551	4060	〃	2.15	-36300	-14.260	7,640
	U6-U7	-7.925	-78450	-30.900	0025	40	-30.960	16,260	-1960	-770	406	4040	〃	2.14	-4.190	-1.648	869
	U7-U8	-9.477	-93.780	-36.950	0401	640	-37.590	19420	31.580	15060	-7,790	4024	〃	2.13	80300	32.100	-16,580
	U8-U9	-10835	-107.200	-42.250	-1023	-1,640	-43.890	22,220	109,600	44910	-22,750	4012	〃	2.12	232,300	95,200	-48,200
	U9-U10	-11.787	-116,600	-45.950	-1831	-2930	-48.880	24.190	213,600	89,500	-44300	4004	233	1.72	367200	153800	-76,200
	U10-U11	-12,114	-119.900	-47,220	-2756	-4410	-51,630	24.880	330,200	142,300	-68,500	4000	〃	〃	568,000	245,000	-117,800
Lower chord members	L0-L1	-19.120	-189,300	-74.600	-1432	-2,240	-76,890	-4.620	27.1000	110,200	6,615	4592	351	1.31	355,000	144.300	8,665
	L1-L2	-18,051	-178,100	-70,400	-1,519	-2430	-72,830	-5,840	27,1300	110,600	8,870	4491	300	1.50	407,000	166,000	13300
	L2-L3	-16805	-166.400	-65,530	-1612	-2,580	-68,110	-7.490	268,100	109,750	12,070	4397	278	1.58	423,500	173,400	19070
	L3-L4	-15,399	-152,500	-60,000	-1,695	-2,710	-62,710	-9590	258,500	106,250	16,250	4313	254	1.70	439,500	180,500	27,600
	L4-L5	-13,879	-137,400	-54,100	-1,729	-2,760	-56,860	-11,980	237,200	98,300	20,680	4237	〃	1.67	396,000	164,200	34,500
	L5-L6	-12323	-122,000	-48,100	-1692	-2,710	-50,810	-14,530	206,200	86,000	24,600	4171	〃	1.64	338,000	141,000	40350
	L6-L7	-10,663	-105,500	-41,600	-1,559	-2,490	-44,090	-17,400	164,500	68,150	27,100	4115	188	2.19	360,000	150,500	59,350
	L7-L8	-8955	-88,650	-34,900	-1292	-2,070	-36,970	-20,480	114,500	47,750	26,450	4071	〃	2.16	247,300	103,200	57,100
	L8-L9	-7307	-72,350	-28,500	-0857	-1370	-29,870	-23,520	62,000	25,600	20,150	4036	148	2.73	169,300	69,850	55,000
	L9-L10	-5,074	-58,150	-22,920	-0228	-360	-23,280	-26,250	13,250	5300	5980	4013	〃	2.71	35,900	14,360	16,200
	L10-L11	-4890	-48,400	-19,080	0583	930	-18,150	-28,180	-28,200	-10570	-16,430	4001	〃	2.70	-76,100	-28,500	-44,400
Diagonal members	U0-L1	1.193	11.810	4650	0219	350	4300	-2440	-2580	-942	534	8243	60	12.12	-31,280	-11,420	64,700
	U1-L2	1346	13330	5250	0197	320	4930	-2,780	-2630	-970	548	6887	〃	10.13	-26,650	-9830	5,555
	U2-L3	1503	14850	5860	0154	250	5610	-3070	-2,290	-865	473	5908	〃	8.69	-19900	-7,520	4110
	U3-L4	1541	15250	6010	0082	130	5880	-3,180	-1250	-480	261	5272	〃	7.76	-9,690	-3730	2027
	U4-L5	1580	15,700	6190	0014	20	6210	-3240	220	87	-45	4972	〃	7.24	1590	630	-326
	U5-L6	1704	16860	6640	0126	200	6840	-3510	2125	962	-442	4725	〃	9.65	20500	9280	-4265
	U6-L7	1787	17690	6970	0280	450	7420	-3680	4950	2080	-1030	4588	〃	6.75	33400	14030	-6955
	U7-L8	1761	17430	6870	0475	760	7630	-3620	8280	3625	-1720	4501	〃	6.62	54800	24000	-11380
	U8-L9	1551	15350	6050	0694	1110	7160	-3160	10650	4970	-2190	4457	〃	6.55	69750	32550	-14340
	U9-L10	1086	10750	4240	0901	1440	5680	-2240	9690	5120	-2018	4453	〃	6.55	63400	33500	-13210
	U10-L11	0386	3820	1500	1040	1660	3160	-790	3970	3290	-822	4489	〃	6.60	26200	21700	-5420

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MADE BY M. Jinda DATE 6-6-1 FILE NO

CHECKED BY DATE PAGE NO 58

CALCULATIONS FOR

常願寺川水路橋

Vertical members

member	ordinate	SD. DL stress 9900	SU. LL stress 3900	T	Ss. Single	SL. SU+Ss	ST	SDT	SLT	STT	L	A	L/A	SDLT/A	SLLT/A	STTL/A
U0-L0	-2,105	-20,830	-8,210	0.203	320	-7,890	2,270	-4,230	-1,600	460	946.4	68	13.92	-58,800	-22,280	6,400
U1-L1	-2,228	-22,050	-8,690	0.179	290	-8,400	2,530	-3,950	-1,500	453	764.8	"	11.25	-44,500	-16,870	5,100
U2-L2	-2,317	-22,920	-9,040	0.139	210	-8,830	2,720	-3,190	-1,227	378	617.4	"	9.08	-28,950	-11,140	3,430
U3-L3	-2,336	-23,110	-9,110	0.076	120	-8,990	2,730	-1,760	-680	207	504.6	"	7.42	-13,050	-5,040	1,535
U4-L4	-1,726	-17,090	-6,660	-0.009	10	-6,650	2,430	154	60	-22	426.4	"	6.27	966	376	-138
U5-L5	-1,999	-19,790	-7,800	-0.098	-160	-7,960	2,060	1,940	780	-202	369.8	158	2.34	4,540	1,825	-473
U6-L6	-1,888	-18,700	-7,360	-0.180	-290	-7,650	1,840	3,370	1,376	-331	321.4	68	4.73	15,930	6,510	-1,565
U7-L7	-1,740	-17,220	-6,780	-0.265	-420	-7,200	1,495	4,560	1,910	-396	281.5	"	4.14	18,870	7,900	-1,640
U8-L8	-1,488	-14,730	-5,810	-0.342	-550	-6,360	1,010	5,020	2,175	-345	250.3	"	3.68	18,550	8,000	-1,270
U9-L9	-1,177	-11,650	-4,590	-0.402	-640	-5,230	370	4,685	2,100	-149	228.0	"	3.35	15,700	7,030	-499
U10-L10	-0,824	-8,160	-3,210	-0.430	-690	-3,900	-380	3,510	1,675	163	214.4	"	3.15	11,050	5,275	-514
U11-L11	1,908	18,890×½	7,440×½	0.434	690×½	28,130×½	-195	4,100	1,765	-85	210.0	"	3.09	12,660	5,450	-262
														4,787,206	2,011,466	452,872
														-445,070	-168,277	-364,923
														4,342,136	1,843,189	87,949

Dead load deflection $= \frac{4342136 \times 2}{2100000} = 4.1^{cm}$

Live load deflection $= \frac{1843189 \times 2}{2100000} = 1.8^{cm}$

5.9^{cm}

Temperature deflection $= \frac{87949 \times 2}{2100000} = 0.08^{cm}$ for rise of 30°C

Deflection due to Dead Load + ½ Live Load = 4.1 + 0.9 = 5.0 cm
5 centimeter camber shall be given to truss.

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MADE BY K. Inaba DATE 6-5-20 FILE NO
CHECKED BY DATE PAGE NO 59

CALCULATIONS FOR

常願寺川水路橋

Approximate weight of Floor Beam and Cross Frame for Pipe line.

Floor Beam	I I	250 - 150	@ 38.3	- 5.70	=	218.0 kg
Conn. Ls	4 Ls	130 - 130 - 12	@ 23.4	- 0.20	=	18.7
diagonals	4 Ls	125 - 75 - 9	@ 13.5	- 2.40	=	129.8
verticals	4 Ls	125 - 75 - 9	@ 13.5	- 1.80	=	97.2
Conn Ls	4 Ls	75 - 65 - 9	@ 9.26	- 0.60	=	22.2
gasset pls.	2 Pls	350 - 9	@ 24.73	- 0.60	=	29.7
" "	2 Pls	400 - 9	@ 28.26	- 0.65	=	36.7
" "	2 Pls	300 - 9	@ 21.20	- 0.50	=	21.2
bottom strut	4 Ls	75 - 75 - 9	@ 9.96	- 5.70	=	227.5
Centr web.	1 Pl.	300 - 9	@ 21.20	- 1.40	=	29.7
Conn. Ls	4 Ls	100 - 75 - 10	@ 13.00	- 0.65	=	33.8
tie pls.	2 Pls	125 - 9	@ 8.83	- 0.20	=	3.5
splice pls.	4 Pls	150 - 9	@ 10.60	- 0.15	=	6.4
lacing bars + washers. Say						15.0
Extra steel for pipe saddles. say.						30.0
misc. details Say.						10.6
						930.0 kg

Approximate weights of Structural steel for floor system.

Inside stringers	44 I s	250 - 125	@ 38.30	- 4.00	=	6740.
Outside "	44 I s	250 - 90	@ 34.60	- 4.00	=	6090
Conn. Ls	352 Ls	125 - 75 - 10	@ 14.90	- 0.20	=	1050
misc details + variations say						120
						14.000 kg or 14.00 kg tons.
Floor Beams with cross frames	23	@ 930			=	21.390
Extra steel for expansion joints	2	@ 305			=	610
						22.000 kg or 22.00 kg tons.
Summary for entire span					=	36.00 "

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CHECKED BY DATE PAGE NO 60

CALCULATIONS FOR

常願寺川水銃橋

Top Lateral Bracings	Diagonals	4Ls 125×90×9 @ 16.30	× 4.55	= 297	
	Connection	2 @ 15		30	
		1 @ 20		20	
		misc.		13	
			10 @ 360	=	3600 kg.
	Portal	4Ls 125×90×9 @ 1630	× 4.40	= 287	
		4Ls "	× 2.10	= 137	
		2Ls "	× 2.50	= 82	
		2 @ 20		40	
		2 @ 15		30	
		1 @ 20		20	
		misc.		14	
			2 @ 610	=	1220 kg
					4820 kg.
Sway Bracings	2Ls 125×90×9	@ 16.30	× 5.45	= 178	
	2Ls	@ 16.30	× 5.70	= 186	
	4Ls	@ 16.30	× 2.25	= 147	
	6Ls 75×75×9	@ 9.96	× 1.50	= 90	
	6Pls. 75×9	@ 5.30	× 1.50	= 48	
	2Pls. 300×9	@ 21.20	× 1.20	= 51	
	4Ls 125×75×9	@ 13.50	× 1.20	= 65	
	6 @ 5			30	
			misc	40	
			9 @ 835	=	7515
Portal Bracings	2Ls 125×90×9	@ 16.30	× 5.45	= 178	
	2Ls		× 5.70	= 186	
	4Ls		× 2.25	= 147	
	6Ls 75×75×9	@ 9.96	× 1.25	= 75	
	6Pls. 75×9	@ 5.3	× 1.25	= 40	
	2Pls. 300×9	@ 21.20	× .90	= 38	
	4Ls 125×75×9	@ 13.50	× .90	= 49	
	6 @ 5			30	
		misc.		37	
			2 @ 780	=	1560
					9075
Summary for top laterals complete					
Laterals				4820	
Sway and portals				9075	
				13895	kg.
Railway Deck. Thrust frames.	2Ls 75×75×9	@ 9.96	× 6.50	= 129	
	2Ls 75×75×9	@ 9.96	× .95	= 19	
	4Ls 75×75×9	@ 9.96	× 1.50	= 60	
	connection	13 @ 15 kg		= 195	
		misc.		22	
			4 @ 425	=	1700
Transverse Strut on stringers	1L 75×75×9	@ 9.96	× .57	= 57	
		misc. say		3	
			22 @ 60	=	1320

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CHECKED BY ____ DATE ____ PAGE NO 61

CALCULATIONS FOR

掌願寺川水門鉄橋

Longitudinal framing for thrust frame		L 175 × 75 × 9 @ 9.96 × 4.0	=	89	
		2 @ 15 kg	=	30	
		lacing bars	=	20	
		Connection plates 3 @ 21	=	63	
		2 L 90 × 90 × 10 @ 13.30 × 2.5	=	67	
			8 @ 260	=	2080
Longitudinal Strut		L 125 × 75 × 9 @ 13.5 × 4.0	=	540	
		2 Pls @ 10		20	
			16 @ 740	=	1185
do		L 125 × 75 × 9 @ 13.5 × 4.0	=	54	
		2 @ 10	=	20	
	lag	L 125 × 75 × 9 @ 13.5 × .8	=	11	
			20 @ 85	=	1700
			Complete for railway deck —		7985 kg.
Waterway Deck					
Panels 0 to 3	Diagonals	4 Ls 125 × 75 × 9 @ 13.5 × 3.10	=	168	
	Strut	4 Ls 125 × 75 × 9 @ 13.5 × 4.00	=	216	
		4 @ 9 kg		36	
		1 @ 20		20	
			6 @ 440	=	2640
Panel 3 to 4	Diagonals	8 Ls 125 × 90 × 9 @ 16.3 × 3.10	=	404	
	2 corners	2 @ 30		60	
	Centre	1 @ 36		36	
			2 @ 500	=	1000
Panel 4 to 5	Diagonals	8 Ls 125 × 90 × 9 @ 16.3 × 3.10	=	404	
	Centre	1 @ 36		36	
			2 @ 440	=	880
Panel 5 to 6	Diagonals	8 Ls 125 × 75 × 9 @ 13.5 × 3.10	=	335	
	Centre	1 @ 30		30	
			2 @ 365	=	730
Panel 6 to 11	Diagonals	4 Ls 125 × 75 × 9 @ 13.5 × 3.2	=	168	
	Centre			22	
			10 @ 195	=	1950
Transverse Strut at Expansion Joint					
		2 Ls 125 × 75 × 9 @ 13.5 × 5.7	=	154	
		7 Pls @ 15		30	
		2 @ 10		20	
		Lacing bars say		20	
		music say		6	
			2 @ 230	=	460
Longitudinal Strut		4 Ls 75 × 75 × 9 @ 19.96 × 4.0	=	459	
		End connection 2 @ 8	=	16	
		tie Pls.		16	
		lacing bars say		19	
		Connection and misc		20	
		5 brackets @ 30		60	
			22 @ 290	=	6380
			Complete for waterway deck —		14,040 kg

7200

426

6840

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CHECKED BY DATE PAGE NO 62

CALCULATIONS FOR

富山縣電気局常願寺川水路橋

Laterals for truss under water way Deck				
Panel pt 0 Sway	4Ls 130 × 130 × 9 @	17.70 × 3.85 =	272	
	2Ls 130 × 130 × 9 @	17.70 × 0.60 =	22	
	Center connection		20	
	Misc say		6	
			2@320 =	640
Panel pt 1 Sway	2Ls 130 × 130 × 9 @	17.70 × 6.40 =	226	
	Connections 2@20	=	40	
	Misc say		4	
			2@270 =	540
Panel pt 2 Sway	2Ls 130 × 130 × 9 @	17.70 × 2.90 =	103	
	3 connections @ 19		57	
			2@160 =	320
Diagonals average	4Ls 125 × 75 × 9 @	13.50 × 4.8 =	259	
	4Ls 75 × 75 × 9 @	9.96 × 4.8 =	191	
	4 Pls @ 5		20	
	Lacing bars		25	
	Misc		10	
			6@505 =	3030
Transverse strut at 0	4Ls 125 × 75 × 9 @	13.50 × 5.6 =	302	
	2 Pls @ 12		24	
	Connections 2@40		80	
	Lacing bars		50	
	Misc details say		24	
			2@480 =	960
L1 and L2	4Ls 75 × 75 × 9 @ 9.96 × 5.6 =		222	
	1Pl 450 × 9 @ 31.79 × 5.6 =		178	
	Connection Pls 2@40	=	80	
	Misc details		60	
			4@540 =	2160
L3	say		2@450 =	900
				8550

Complete for laterals for truss below waterway deck

Summary

Top lateral bracing complete	13895	
Railway Deck	7985	
Waterway Deck	14040	
Laterals for truss below decks	8550	
	44470	call this 44.5 tons

44500 ÷ 88 = 505 kg per lin. meter

Top Laterals complete	13895	÷ 88 =	158 kg/m
Bottom laterals complete	30575	÷ 88 =	347 "
	44470 kg		505 "

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MADE BY J. Matano DATE 6-5-26 FILE NO
CHECKED BY DATE PAGE NO 63

CALCULATIONS FOR

常願寺川水路橋

Weight of structural steel for Main Truss.
End Posts and Top chords.

Main Sections 4 Required.

1	Cover pl.	550 × 9	@	38.858	×	53.00	=	2,060
4	ls	90 × 90 × 10	@	13.30	×	54.10	=	2,875
2	web pls	400 × 9	@	28.26	×	54.10	=	3055
2	Side pls.	220 × 10	@	17.27	×	8.05	=	278
								8268 × 4 = 33,072 kg.

Details 4 Required.

22	gusset pls.	900 × 9	@	63.585	×	1.20	=	1678
1	"	420 × 9	@	29.673	×	.80	=	24
25	splice pls.	240 × 10	@	18.840	×	.60	=	282
42	Splice ls	100 × 100 × 10	@	14.900	×	.60	=	376
10.5	Cov. pl. spl. pls.	550 × 9	@	38.858	×	.70	=	286
1	" " at U_0	550 × 9	@	"	×	.40	=	16
5	Side pls U_9-U_{10}-U_{11}	400 × 9	@	28.260	×	.600	=	85
22	Tie pls for Top chords	530 × 9	@	37.445	×	.430	=	354
3	" " End posts	530 × 9	@	"	×	.310	=	35
1	" " "	530 × 9	@	"	×	.430	=	16
110	Lacing bars	70 × 9	@	4.946	×	.750	=	408
1.	Tie pl. for U_0.	530 × 9	@	37.445	×	1.30	=	49
2	Pls (sway conn pls)	550 × 9	@	38.858	×	.85	=	66
4	Ls Diaphragm for E.P.	75 × 75 × 9	@	9.960	×	.90	=	36
1	Pl. " "	300 × 9	@	21.195	×	.90	=	19
2	Pls Spl. of E.P.	400 × 9	@	28.260	×	.46	=	26
2	" "	220 × 9	@	15.543	×	.46	=	14
2	" "	530 × 9	@	37.445	×	.46	=	34
4	" "	75 × 9	@	5.299	×	.46	=	10
1	L for end post.	90 × 90 × 10	@	13.300	×	.40	=	5
1	Fill	220 × 9	@	15.543	×	1.00	=	16
								3835 × 4 = 15340 kg.
								= 48,412 "

Summary of End posts and Top chords

Lower Chords.

Main Sections 4 Required.

4	Ls L_0L_1	100 × 100 × 10	@	14.90	×	4.60	=	274
2	Pls "	400 × 12	@	37.68	×	"	=	347
2	Pls "	200 × 10	@	15.70	×	"	=	145
2	Pls "	370 × 14	@	40.66	×	"	=	374
4	Pls "	100 × 9	@	7.10	×	"	=	131
4	Ls L_1L_2	100 × 100 × 10	@	14.90	×	4.51	=	269
2	Pls "	400 × 12	@	37.68	×	"	=	340
2	Pls "	200 × 10	@	15.70	×	"	=	142
2	Pls "	370 × 12	@	34.85	×	"	=	314
4	Ls L_2L_3	100 × 100 × 10	@	14.90	×	4.42	=	264
2	Pls "	400 × 12	@	37.68	×	"	=	333
2	Pls "	200 × 10	@	15.70	×	"	=	139
2	Pls "	370 × 9	@	26.14	×	"	=	231
4	Ls L_3L_6	100 × 100 × 10	@	14.90	×	12.78	=	762
2	Pls "	400 × 9	@	28.26	×	"	=	723
2	Pls "	200 × 10	@	15.70	×	"	=	402
2	Pls "	370 × 9	@	26.14	×	"	=	668
4	Ls L_6L_7	100 × 100 × 10	@	14.90	×	4.135	=	247
2	Pls "	400 × 9	@	28.26	×	"	=	234
2	Pls "	200 × 10	@	15.70	×	"	=	130
4	Ls L_7L_8	100 × 100 × 10	@	14.90	×	4.090	=	244
2	Pls "	400 × 9	@	28.26	×	"	=	231

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MADE BY J. Matano DATE 6-5-26 FILE NO
CHECKED BY DATE PAGE NO 64

CALCULATIONS FOR

常願寺川水路橋

2Pls	$L_7 L_8$	200 × 10	@	15.70	×	4.09	=	128
4Ls	$L_8 L_{11}$	100 × 100 × 10	@	14.90	×	12.11	=	722
2Pls	"	400 × 9	@	28.26	×	"	=	684
								8478 × 4 = 33,912 kgs

Details of Lower Chords. 4 Required.

22	Gusset Pls.	900 × 9	@	63.59	×	1.20	=	1,685
2	" " at L_3	1000 × 9	@	70.65	×	2.00	=	282
2	" " "	600 × 9	@	42.39	×	1.20	=	102
2	" " at L_0	800 × 9	@	56.52	×	.80	=	90
4 Pls	Spl. for 2nd Web pl.	400 × 9	@	28.26	×	.80	=	90
4	Pin Pls.	370 × 13	@	37.76	×	.70	=	106
10	Pls Spl. Pl. for Side Pls.	390 × 13	@	39.80	×	1.00	=	398
20	Pls Angle spl.	100 × 13	@	10.21	×	.80	=	163
6	Pls. Spl.	390 × 13	@	39.80	×	.70	=	167
12	Pls Angle splice	100 × 13	@	10.21	×	.70	=	86
4	" Spl.	390 × 10	@	30.62	×	.70	=	86
8	" Angle spl.	100 × 10	@	7.85	×	.70	=	44
1	" Spl.	200 × 10	@	15.70	×	.60	=	9
2	Ls Angle spl.	100 × 100 × 13	@	19.10	×	.70	=	27
38	Tie Pls	550 × 9	@	38.86	×	.51	=	746
4	Pls Bott. Lateral	700 × 9	@	49.46	×	.90	=	178
260	Lac. bars	70 × 9	@	4.95	×	.77	=	990
3	Pls Diaph. $L_1 L_2 L_3$	300 × 9	@	21.20	×	.45	=	29
12	Ls "	100 × 75 × 10	@	13.00	×	.45	=	70
6	" "	100 × 100 × 10	@	14.90	×	.150	=	13
1	Pl. " L_3	300 × 9	@	21.20	×	.50	=	11
4	Ls " "	100 × 75 × 10	@	13.00	×	.50	=	26
7	Ls Lateral conn. $L_{0,1,2,3}$	100 × 75 × 10	@	13.00	×	.40	=	36
								5434 × 4 = 21,736 kgs
								= 55648 "

Summary of Lower Chords

Ties.

Main Section 4 Required.

4	Ls	125 × 75 × 9	@	13.50	×	32.00	=	1728 × 4 = 6,912 kgs

Details 4 Required.

9	Pls. Lateral Pls.	600 × 9	@	42.39	×	.70	=	267
9	" splice	260 × 9	@	18.37	×	.46	=	76
18	" "	70 × 9	@	4.95	×	.53	=	47
45	" "	300 × 9	@	21.20	×	.53	=	51
120	Lacing bars	60 × 9	@	4.24	×	.33	=	170
1	Tie Pl.	300 × 9	@	21.20	×	.70	=	15
								626 × 4 = 2,504 kgs.
								= 9,416 "

Summary of Ties

Verticals and Hangers.

Main Sections. 4 Required.

4	Ls	125 × 75 × 9	@	13.50	×	77.37	=	4175
1	Pl. Ts Us	300 × 9	@	21.20	×	6.70	=	142
2	Side Pls "	260 × 12	@	24.49	×	6.70	=	328
								4645 × 4 = 18,580 kgs

Details. 4 Required.

1	Tie Pl. $U_1 L_1$	300 × 9	@	21.20	×	2.70	=	57
23	Lacing bars "	60 × 9	@	4.24	×	.33	=	32
1	Tie Pl. $U_2 L_2$	300 × 9	@	21.20	×	2.00	=	42
24	Lac. bars "	60 × 9	@	4.24	×	.33	=	34
1	Tie Pl. U_3-L_3	300 × 9	@	21.20	×	1.20	=	25
21	Lac. bars "	60 × 9	@	4.24	×	.33	=	29

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MADE BY J. Matano DATE 6-5-27 FILE NO ____
CHECKED BY ____ DATE ____ PAGE NO 65

CALCULATIONS FOR

常願寺川水路橋

1 Tie Pl. M_4 T_4	300 × 9	@	21.20	× 1.80	=	38.
19. Lacing bars "	60 × 9	@	4.24	× .33	=	27
55 Tie Pls M_6 ~ 11	300 × 9	@	21.20	× 1.80	=	210
190. Lac. bars "	60 × 9	@	4.24	× .33	=	267
11 Pls splice	260 × 9	@	18.37	× .46	=	93
22 " "	70 × 9	@	4.95	× .53	=	58
55 " "	300 × 9	@	21.20	× .53	=	62
15 Pls T_4 ~ 11	260 × 9	@	18.37	× .60	=	162
15 Ls "	100 × 100 × 10	@	14.90	× .15	=	34
10.5 Ls Seat Ls of F.B.	90 × 90 × 10	@	13.30	× .26	=	36
10.5 Fills for F.B. conn.	260 × 9	@	18.37	× .60	=	116
					1322 × 4 =	5288 kgs.
					=	23,868 "

Summary of Verticals & Hangers.

Diagonals.
Main Sections. 4 Required.
4 Ls 125 × 75 × 9 @ 13.50 × 51.85 = 2800 × 4 = 11,200 kgs

Details 4 Required.
24 Tie Pls 300 × 9 @ 21.20 × .35 = 178
190 Lac. bars 60 × 9 @ 4.24 × .33 = 266
444 × 4 = 1,776
= 12,976 kgs

Summary of Diagonals

Summary of Structural steel for two Trusses.

	Main Sections	Details	Total	Percentage of Details.
End Posts and Top Chords.	33,072	15,340	48,412	46.4 %
Lower Chords.	33,912	21,736	55,648	64.1
Ties	6,912	2,504	9,416	36.2
Verticals and Hangers	18,580	5,288	23,868	28.5
Diagonals	11,200	1,776	12,976	15.9
	103,676 kgs	46,644 kgs	150,320 kgs.	45.0 % average.
		Call this	150.30 kg tons.	

Weight of Cast steel shoes, pins &c.

4 Bearing struts	@	92.0 kg	=	368
4 pins with nuts	@	80.0	=	320
4 Shoes	@	1,160.0	=	4,640
24 Anchor bolts	@	7.8	=	187
8 brackets for stringers, Exp. jt.	@	18.5	=	148
4 Shear blocks	@	400	=	160
			5,823 kgs.	Call this 5.90 kg tons.

Grand Summary of Structural steel in one span.

Floor system complete	36.00
Lateral bracing, sway, portals &c	44.50
Trusses complete	150.30
Steel castings &c	5.90
variations say	3.30
	240.00 kg. tons.

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常願寺川水路橋材料表.

Materials of Floor and Handrails.

Timbers

Sleepers.	栗材	18cm × 15cm × 3.10m	----------	178 挺
Planking	杉板	28 × 4.5 × 4.00m	----------	200 枚
〃	〃	28 × 4.5 × 4.06m	----------	20 〃
Platform	〃	25 × 4.5 × 4.00	----------	88 〃
〃	〃	30 × 4.5 × 0.65	----------	88 〃
Hook bolts, bolts, flatbars, washers etc.			----------	1.095 kg tons
Ladders.	4-Steel ladders @	140 kg = 160 kg or		0.16 kg tons.
Handrails	Structural shapes (angles)		—	2.282
	Gas pipes and castings		----	1.796
				4.078 kg tons
Handrails for Platform	gas pipes			0.455 〃
Saddles for Pipe line.	栗材			23. 組
Band, bolts, flat bars etc				0.525 kg tons

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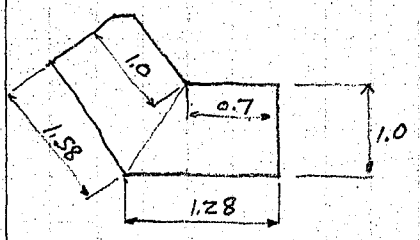
常願寺川水路橋材料表

Materials of Arch Piers.
Concrete 1:2:4 mixture

Left Piers

Cross section 0.99 × 1.0 = 0.99
1.29 × 1.0 = 1.29
2.28 sq. meters

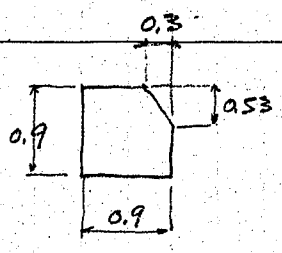
Volume 2 @ 2.28 × 1.40 = 6.384 cub.m.



Right Piers

Strut area. 0.9 × 0.9 = 0.810
less 0.3 × 0.53 = -0.159
0.651 sq. m.

Volume, strut. 0.651 × 4.60 = 2.995
body = 6.384
9.379 cub. m



Summary of Pier concrete.
Left piers 6.384
Right " 9.379
15.763 cub. meters.

Excavation.
Left Piers.

Average sectional area 3.5 × 5.5 × ½ = 9.63 m²
Average length say 10.00 m.
Volume 9.63 × 10.00 = 96.30
床堀. 6.40
102.70 cub. meters

Right Piers

Average sectional area 0.60 × 2.5 = 1.50 m²
Volume 1.50 × 12.0 = 18.00
床堀. 9.30
27.30 cub. meters

Summary of Excavation.
Left Piers 102.70
Right " 27.30
130.00 cub. meters

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常願寺川水路橋材料表

Materials of anchor pier.
Concrete 1:2:4 mixture.

Base	5.20m × 0.70 × 8.40	=	30.60	
wall	4.20 × 0.40 × 4.30	=	7.22	
"	2 × 3.75 × 0.40 × 4.30	=	12.90	
"	2 × 4.05 × 0.70 × 4.30	=	24.38	
"	3.60 × 0.60 × 4.30	=	9.29	
"	3.60 × 0.30 × 3.40	=	3.67	
Columns	2 × 1.80 × 0.60 × 4.30	=	9.30	
"	2 × 1.00 × 1.80 × 2.00	=	7.20	
			104.56	cub. meters.

Rubbles 87.0 cub. meters

Reinforcements, Plain bars. 2.943 kg. tons

Excavation ± 7m³ 2.50 × 8.0 × 11.5 = 230. cub. meters

Steel anchors. 16 sets required.
Materials for one set.

2 Bolts with double nuts	25mmϕ × 3.45m	=	33.00	
1 L	100 × 100 × 10 @ 14.9	× 0.50	=	7.45
1 Pl.	180 × 19 @ 26.85	× 0.40	=	10.75
1 [	8" × 3½" @ 33.8kg	× 0.40	=	13.52
1 eye bar	38mmϕ	× 0.60	=	6.93
			71.65	kgs

for 16 sets @ 71.65 = 1147 kg or 1.147 kg tons

Materials of Anchor Block.
Concrete 1:3:6 mixture.

2.00 × 2.50 × 2.30	=	11.50
1.95 × 2.50 × 1.80	=	8.78
1.80 × 2.50 × 0.30	=	1.35
21.63	× 2 =	43.26 cub. meters.

Rubbles 1.50 × 1.00 × 2.00 = 3.00 × 2 = 6.00 "

Steel anchors. 4 sets required.
Materials for one set.

8 Bolts with double nuts	25mmϕ × 4.30m	=	149.50	
1 L	100 × 100 × 10 @ 14.9	× 2.00	=	29.80
4 Pls	180 × 19 @ 26.85	× 0.40	=	43.00
4 [	8" × 3½" @ 33.8kg	× 0.40	=	54.10
4 eye bars	38mmϕ	× 0.60	=	27.70
			304.10	kgs

for 4 sets @ 304.1 = 1216.40 " or 1.216 kg tons

Excavation, Rock nearly same as for Concrete = 21.63 × 2 = 43.26 cub. meters

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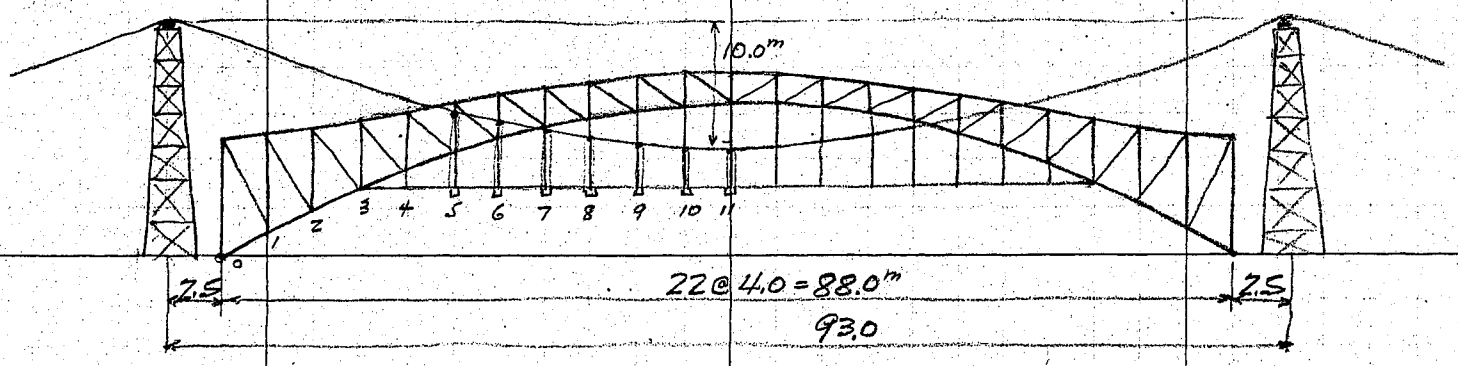
CALCULATIONS FOR

常願寺川水路橋

Erection Stresses.



Try Cable 8-3⅛" wires for one cable.
weight of cable 8@ 2.50 = 20 kg per lin meter.

$$\text{moment} = \frac{20 \times 93.0^2}{8} = 21{,}630 \text{ kgm}$$

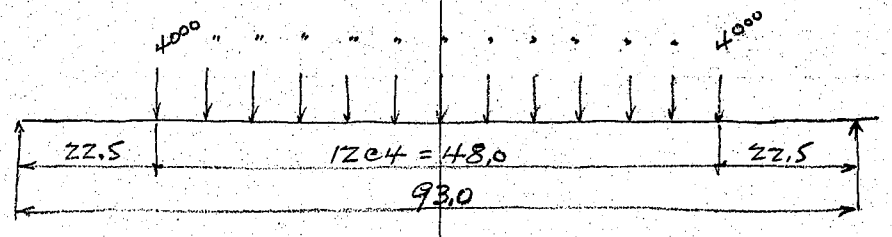
$$\text{Horizontal tension } H = \frac{21630}{10} = 2163 \text{ kg for one cable.}$$

Call this 2,200 kg

Load on one cable.
Let us assume that 13 panel points 5 to 5' to be suspended by the cable.
panel load.

Truss.	Lower chord	180 @ .785 × 4.07 =	575	
		details say 65% =	375	
	Diagonals	69@ .785 × 4.60 =	250	
		details say 16% =	40	
	Verticals	69 @ .785 × 8.40 =	455	
		details 29% =	132	
	Ties	69 @ .785 × 4.00 =	217	
		details 36% =	78	
				2,122 kg
Floor.	Stringers	162 × 4.00 =	648	
	Floor beam with framing	=	1,000	
	bottom lateral	347 × 4.00 =	1,388	
	misc.		100	
		½ × 3136 =	1,568	kg.
			310	
			4000	kg on one panel.

False works etc say



4000×6.5
= 26000 kg.

moment 26,000 × 46.5 = 1,210,000
4,000 × 4.0 × 21 = 336,000
874,000 kgm

Hor. Tension $H = \frac{874000}{10} = 87{,}400$ kg

Summary for H.

Cable	2200
Truss	87400
	89,600 kg.

Max. Tension in cable = 89600 × 1.06 = 95,000 kg

Tension on one rope = $\frac{95000}{8} = 11{,}900$ kg. Breaking strength of new 3⅛" rope = 35,000 kg

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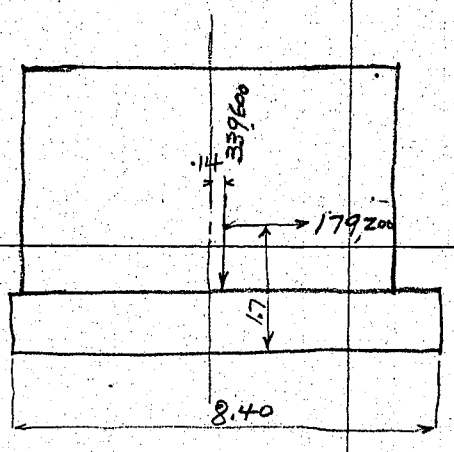
CALCULATIONS FOR

常願寺川水路橋

Stability of Anchor Block of cable.
Anchor Block on Right Bank.
Weight and center of gravity of Block.

				Hor. arm	Hor. moment	Vert arm	Vert. moment
Base	5.20 × 0.70 × 8.40 =	30.60 @2400 =	73,500	4.20	308,500	0.35	25,700
wall	4.20 × 0.40 × 4.30 =	7.22 c "	17,300	8.10	140,100	2.68	46,400
"	2 × 3.75 × 0.40 × 4.30 =	12.90 c "	31,000	6.43	199,000	2.68	83,100
"	2 × 4.05 × 0.70 × 4.30 =	24.38 c "	58,500	2.53	148,000	2.85	166,800
"	3.60 × 0.60 × 4.30 =	9.29 c "	22,300	0.80	17,800	2.73	60,900
"	3.60 × 0.30 × 3.40 =	3.67c "	8,800	4.40	38,700	2.40	21,100
Column	2 × 1.80 × 0.60 × 4.30 =	9.30 c "	22,300	4.40	98,100	2.27	50,600
"	2 × 1.00 × 1.80 × 2.00 =	7.20c "	17,300	4.40	76,100	6.00	103,800
		104.56 m³	251,000 kg	4.09 m	1026300	2.23 m	558,400
Rubbles.		87.0 m³ @1700 =	148,000	4.55	674,000	2.90	429,000
Earth	0.5 × 5.2 × 1.00 =	2.6 c 1600 =	4200	0.75	1000	1.20	5,000
"	0.2 × 7.9 × 1.50 =	2.4 c " =	3800	4.38	16600	1.48	5,600
"	0.1 × 5.0 × 2.00 =	1.0 c 16m =	1600	8.35	13400	1.70	2,700
			408600	4.26 m	1731300	2.45 m	1,000,700

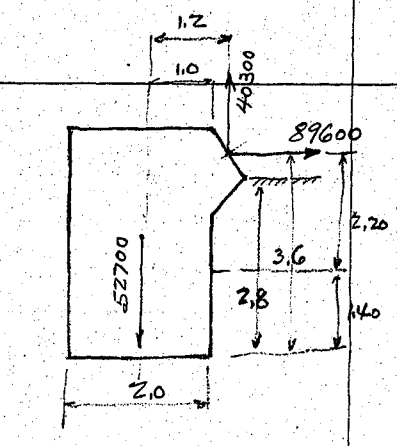
Horizontal Thrust = 89,600 kg × 2 = 179200 kg
vertical " = 89,600 × 0.385 = 34500 " × 2 = 69000 "
Total V. = 408,600 − 69000 = 339600 kg



moment toe
339600 × 4.26 = 1,447,000
179200 × 1.70 = − 304,500
1,142,500

$\frac{1,142,500}{339,600} = 3.37$

Eccentricity = 4.20 − 3.37 = 0.83 m
max. toe pressure = $\frac{339600}{5.2 \times 8.4}\left(1 \pm \frac{6 \times 0.83}{8.4}\right)$ (.593) = 12,400 kg/m² (1.13 ton/0') or 3,160 "
Sliding coef. = $\frac{179200}{339600} = 0.527$



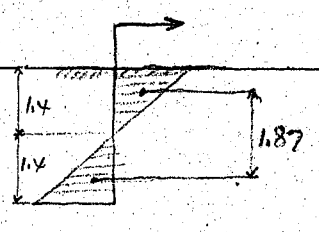
Weight of anchor blocks.

Concrete	21.63 @ 2200 =	47,600
rubble	3.0 @ 1700 =	5100
		52,700 kg

cuplift of cable 89600 × 0.45 = − 40,300 kg
12,400 kg

Shear on concrete = $\frac{89600}{200 \times 250}$ = 1.8 kg/cm²

moment on block
89,600 × 2.20 = 197000
40,300 × 1.20 = − 48,400
148,600 kgm. about



$\frac{148600}{1.87} = 79,500$

unit pressure = $\frac{79500 \times 2}{1.4 \times 2.5}$ = 45400 kg/m² or (0.415 ton/0')

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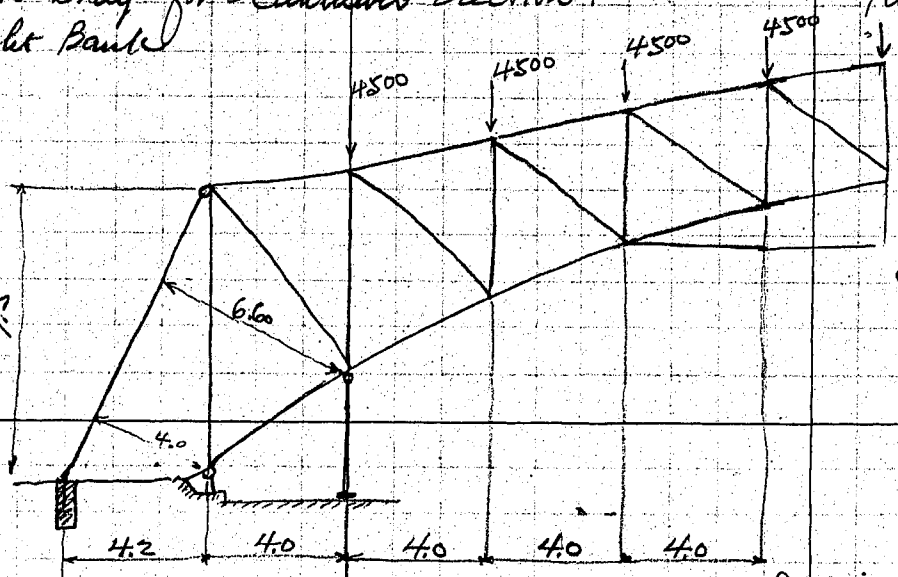
CALCULATIONS FOR

常願寺川水路橋

Back Stay for Cantilever Erection.
Right Bank



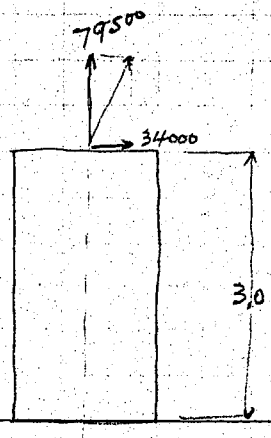
Panel load.

Lower chord	296@ .785 × 4.45 × 1.65 =	1705
vertical	69 @ × 5.78 × 1.29 =	404
Diagonal	69 @ × 6.58 × 1.16 =	414
Top chord	190 @ × 4.05 × 1.46 =	88
		2611
Floor + lateral.		1568
Falsework &c say		321
		4500 kg

Load on Back stay + front strut.

$\frac{4500 \times 4.0 \times 10}{} = 180{,}000$ kgm
Derrick say $3000 \times 16.0 = 48000$
228000 kgm

$\frac{228000}{6.6} = 34500$ kg
50% impact $= \frac{17300}{51800}$ kg

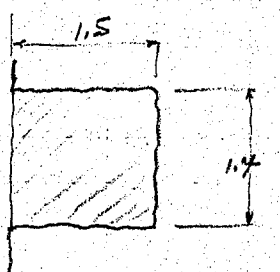


for 4m arm.
$51800 \times \frac{6.6}{4} = 85500$ kg

Vertical component = 85500 × 0.93 = 79500 kg
Horizontal " = 85500 × 0.40 = 34000 "

weight of Concrete = 1.5×1.4×3.3×2200 = 15250 kg.

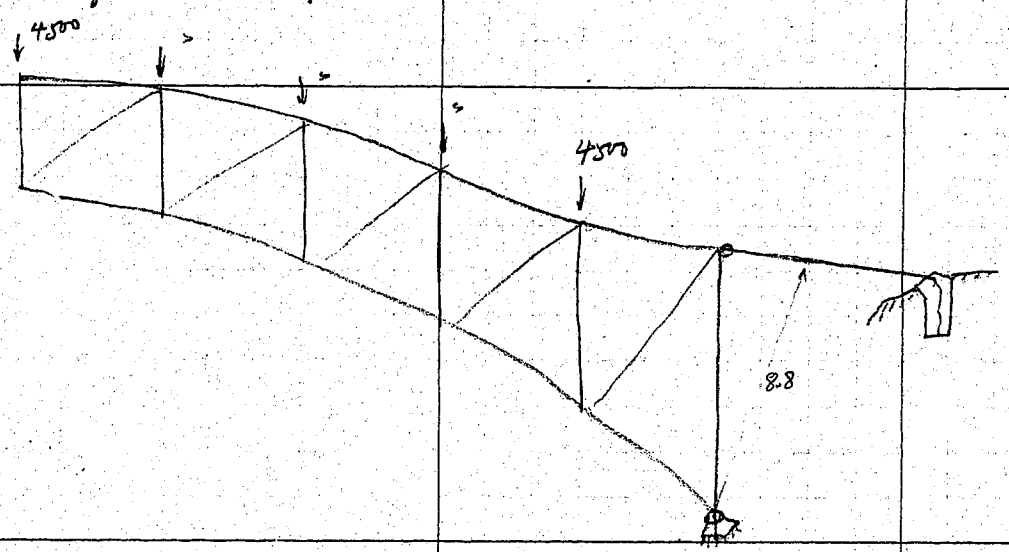
Up lift on block = 79500 − 15250 = 64250 kg



Bond area = 4.40 × 3.0 = 13.2 m² or 132,000 cm²
Bond stress between concrete and rock
$= \frac{64250}{132000} = 0.49$ kg/cm².

unit shear on concrete = $\frac{34000}{150 \times 140} = 1.62$ kg/cm².

Left Bank.



Load on stay
$= \frac{4500 \times 4.0 \times 15}{8.8} = 30{,}700$ kg.

50% imp $= \frac{15400}{46100}$ kg.

Hor. component = 46100 × .95 = 43800 kg
Shear on concrete
$= \frac{43800}{140 \times 150} = 2.08$ kg/cm²

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CALCULATIONS FOR

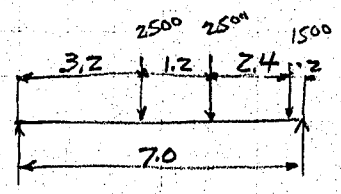
常願寺川水路橋

Approach 7m Beam Span.
Design of Inside Beam. Span length 7.0m assumed, spacing 1.0 m c to c.
Dead Load.

Floor planking	1.0 @ 29	=	29.
Sleepers	18.1.0 ÷ .5	=	36
rails and accessories say		=	25
Beam assumed		=	100
			190 kg per lin. meter

Dead Load moment = 1/8 · 190 · 7.0² = 1,165 kgm
Dead Load shear = 1/2 · 190 · 7.0 = 665 kg

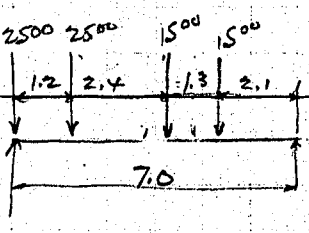
Live Load.



Engine load wheel concentration with 50% impact = 2500 kg.
following car " " " = 1,500 "

moment

2500 × 2.60 =	6500
2500 × 3.80 =	9500
1500 × 0.20 =	300
	16300 ÷ 7.0 = 2330 kg
2330 × 3.2	= 7450 kgm



Shear.

2500 × 5.8 =	14500
1500 × 3.4 =	5100
1500 × 2.1 =	3150
	22750 ÷ 7 = 3250
	2500
	5750 kg

Summary of moments and shears.

	moments	3rd shears
Dead load	1,165	665
Live Load	7450	5750
	8615 kgm	6415 kg

Try 1-I beam 400 × 150 @ 95.8 kg Sm = 1584 cm³
Allowable unit stress on flange
= 1200 (1 − 0.012 × 350/15) / 1.72 = 864 kg/cm² C

Unit stress = 8615 × 100 / 1584 = 542 "
unit shear = 6415 / 40 × 1.25 = 128 kg/cm²

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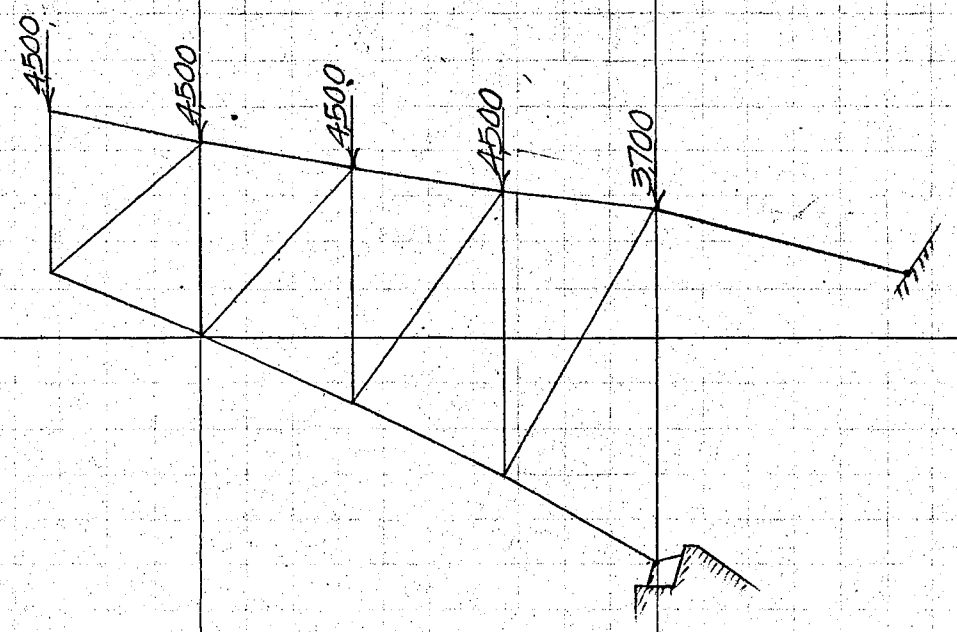
CALCULATIONS FOR
常願寺川水路橋

Deflection at panel point L4 during erection



Vertical Deflection

	Stress of members T. load on unity	Stress of members S
U_0~T	1×16.0÷8.000 = +1.818 ✓	4,500×(1+2+3+4)×4.0÷8,000 = 20,450 ✓
U_0~U_1	1×12.0÷7.602 = +1.579 ✓	4,500×(1+2+3) ×4.0÷7,602 = 14,200 ✓
U_1~U_2	1×8.0÷6.113 = +1.309 ✓	4,500×(1+2) ×4.0÷6113 = 8,840 ✓
U_2-U_3	1×4.0÷4.971 = +0.805 ✓	4,500×1 ×4.0÷4971 = 3,620 ✓
U_3-U_4	= 0 ✓	= 0 ✓
L_0-L_1	1×16.0÷8.244 = -1.941 ✓	4,500×(1+2+3+4)×4.0÷8244 = -21,820 ✓
L_1-L_2	1×12.0÷6.812 = -1.762 ✓	4,500×(1+2+3) ×4.0÷6812 = -15,850 ✓
L_2-L_3	1×8.0÷5.617 = -1.424 ✓	4,500×(1+2) ×4.0÷5,617 = -9,620 ✓
L_3-L_4	1×4.0÷4.680 = -0.855 ✓	4,500×1 ×4.0÷4,680 = -3,845 ✓
L_0-U_0	= -1.000 ✓	4,500×(4.0)+3,700 = -21,700 ✓
L_1-U_1	1×7.096÷19.096 = -0.372 ✓	4,500×{4×7.096+4.0×(1+2+3)}÷19.096 = -12,340 ✓
L_2-U_2	1×11.631÷19.631 = -0.597 ✓	4,500×{3×11.631+4.0×(1+2)}÷19.631 = -10,750 ✓
L_3-U_3	1×18.083÷22.083 = -0.819 ✓	4,500×{2×18.083+4.0×1} ÷22.083 = -8,190 ✓
L_4-U_4	= 0 ✓	= -4,500 ✓
U_0-L_1	1×4.846÷19.341 = +0.251 ✓	4,500×{4×4.846+4.0×(1+2+3)}÷19.341 = 10,090 ✓
U_1-L_2	1×8.754÷18.606 = +0.470 ✓	4,500×{3×8.754+4.0×(1+2)}÷18.606 = 9,250 ✓
U_2-L_3	1×13.894÷18.699 = +0.743 ✓	4,500×{2×13.894+4.0×1}÷18.699 = 7,650 ✓
U_3-L_4	1×21.811÷20.876 = +1.045 ✓	4,500×21.811 ÷20.876 = 4,710 ✓

Members	S	T_1	ST_1	L	A	$\frac{L}{A}$	$\frac{STL}{A}$
U_0-T	20,450	1.818	37,170	7000	97.00	7.21	268,000
U_0-U_1	14,200	1.579	22,420	4024	189.00	2.13	47,800
U_1-U_2	8,840	1.309	11,570	4040	〃	2.14	24,750
U_2-U_3	3,620	0.805	2,910	4060	〃	2.15	6,260
U_3-U_4	0	0	0	4085	〃	2.16	0
L_0-L_1	-21,820	-1.941	42,300	4592	373.00	1.23	52,050
L_1-L_2	-15,850	-1.762	27,920	4491	300.00	1.50	41,900
L_2-L_3	-9,620	-1.424	13,680	4397	278.00	1.59	21,620
L_3-L_4	-3,845	-0.855	3,290	4313	254.00	1.70	5,590
L_0-U_0	-21,700	-1.000	21,700	9464	189.00	5.01	108,700
L_1-U_1	-12,340	-0.372	4,590	7640	74.00	10.33	47,450
L_2-U_2	-10,750	-0.597	6,360	6174	〃	8.34	53,000
L_3-U_3	-8,190	-0.819	6,700	5046	〃	6.82	45,700
L_4-U_4	-4500	0	0	4264	〃	5.76	0
U_0-L_1	10,090	0.251	2,530	8243	105.00	7.86	19,880
U_1-L_2	9,250	0.470	4,350	6887	74.00	9.31	40,500
U_2-L_3	7,650	0.743	5,680	5908	〃	7.99	45,400
U_3-L_4	4,710	1.045	4,920	5272	〃	7.12	35,000
							863,600

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CALCULATIONS FOR
常願寺川 水路橋

$$\text{vertical deflection} = \frac{963{,}600}{2{,}100{,}000} = 0.411^{cm}$$

Horizontal deflection
Stress of members T2 load on unity

$U_0 - T$	1 × 7.736	÷ 8,800	=	0.879
$U_0 - U_1$	1 × 5480	÷ 7,602	=	0.721
$U_1 - U_2$	1 × 3438	÷ 6113	=	0.562
$U_2 - U_3$	1 × 1.612	÷ 4971	=	0324
$U_3 - U_4$			=	0
$L_0 - L_1$	1 × 1.728	÷ 8244	=	0.210
$L_1 - L_2$	1 × 2,168	÷ 6812	=	0.319
$L_2 - L_3$	1 × 2736	÷ 5,617	=	0487
$L_3 - L_4$	1 × 3434	÷ 4,680	=	0.734
$L_0 - U_0$			=	-0.564
$L_1 - U_1$	1 × 4269	÷ 19096	=	- 0.224
$L_2 - U_2$	1 × 5524	÷ 19631	=	- 0282
$L_3 - U_3$	1 × 7248	÷ 27083	=	- 0329
$L_4 - U_4$			=	0
$U_0 - L_1$	1 × 4021	÷ 19341	=	0208
$U_1 - L_2$	1 × 5115	÷ 18606	=	0275
$U_2 - L_3$	1 × 6556	÷ 18699	=	0350
$U_3 - L_4$	1 × 8790	÷ 20876	=	0421

Members	S	T_2	ST_2	L	A	$\frac{L}{A}$	$\frac{ST_2L}{A}$
$U_0 - T$	20450	0879	17970	700.0	9700	721	129500
$U_0 - U_1$	14200	0.721	10230	4024	18900	2.13	21800
$U_1 - U_2$	8840	0.562	4970	4040	〃	2.14	10630
$U_2 - U_3$	3620	0324	1170	4060	〃	2.15	2520
$U_3 - U_4$	0	0	0	4085	〃	2.16	0
$L_0 - L_1$	-21820	0.210	-4580	4592	37300	123	- 5630
$L_1 - L_2$	- 15850	0319	- 5060	4491	30000	150	- 7600
$L_2 - L_3$	- 9620	0487	-4685	4397	27800	158	- 7400
$L_3 - L_4$	- 3845	0.734	- 2820	4313	25400	170	- 4790
$L_0 - U_0$	- 21700	-0.564	12240	9464	18900	501	61300
$L_1 - U_1$	- 12340	-0.224	2760	7648	7400	1033	28500
$L_2 - U_2$	- 10750	-0282	3030	6174	〃	834	25300
$L_3 - U_3$	- 8190	-0329	2690	5046	〃	682	18350
$L_4 - U_4$	- 4500	0	0	4264	〃	576	0
$U_0 - L_1$	10090	0208	2100	8243	10500	786	16500
$U_1 - L_2$	9250	0275	2540	6887	7400	931	23600
$U_2 - L_3$	7650	0350	2680	5908	〃	799	21400
$U_3 - L_4$	4710	0421	1980	5272	〃	712	14100
							373500
							- 25420
							348080

$$\text{Horizontal deflection} = \frac{348080}{2{,}100{,}000} = 0.166^{cm}$$

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CALCULATIONS FOR

昭和六年七月

富山縣電氣局

小見支水路

常願寺川水路橋

鋼材材料調書

注意 表中×印ハ昭和六年七月拾八日訂正トス
青寫眞燒付 仝 七月二拾日

REVISED
DATE 6-7-4
DATE 6-7-18
DATE
DATE

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CALCULATIONS FOR

常願寺川水路橋材料表

			END POST U0L0 (& U0'L0')		4 Required			
	2	L	90×90×10	× 4640 4345	13.3	2390		
	2	"	"	× 4810 4640	"	251.4		
X	2	Web P/s	400 × 9	× 4145 4.645	28.26	496.8		
	2	gusset P/s	790 × 9	× 1.195	55814		133.4	
	2	L (Bent L)	90×90×10	× 530	13.3		14.1	
	1	Pl (at M0	230 × 9	× 280	16.25		4.6	
	1	L "	100×75×10	× 390	13.0		5.1	
	1	Pl (at T0	400 × 9	× 690	28.26		19.5	
	1	L "	100×75×10	× 390	13.0		5.1	
	1	Fill "	165 × 10	× 625	12.953		8.1	
	1	" "	255 × 9	× 370	18016		6.7	
	1	Pl "	340 × 9	× 690	24.021		16.6	
	1	L "	150.90.9	× 220	16.3		3.6	
	4	L (Splice	90×90×13	× 530	17.0		36.0	
	2	P/s "	160 × 9	× 220	11.304		5.0	
	2	" "	400 × 9	× 460	28.26		26.0	
	1	Pl "	530 × 9	× 550	37.445		20.6	
	2	Tie P/s	500 × 9	× 530	35.325		37.4	
	1	"	380 × 9	× 530	26847		14.2	
	1	"	290 × 9	× 530	20.489		10.9	
	22	Lacing bars	65 × 12	× 735	6.123		99.0	
	1	Pl (Sway com.	500 × 9	× 675	35.325		23.8	
	1	" "	530 × 9	× 785	37.445		29.4	
	1	Cov. Pl.	550 × 9	× 1.270	38858	49.3		
	1	"	"	× 1.720	"	66.8		
	1	"	"	× 525	"	20.4		
	1	"	"	× 795	"	30.9		
	1	"	"	× 4030	"	156.6		
	2	L (Diaphragm at T0)	125×75×9	× 615	13.5		16.6	
	2	" "	100×75×10	× 615	13.0		16.0	
	1	Web Pl "	310 × 9	× 615	21.902		13.5	
	2	P/s (Splice P/s at U0	210 × 9	× 230	14837		6.8	
	2	" "	380 × 9	× 400	26847		21.5	
	2	" "	240 × 9	× 260	16956		8.8	
X	2	Pl. (Splice P/s for web	400 × 9	× 460	28.26		26.0	
X						1311.2 +	628.3 = 1939.5	
							× 4	
X			FILLER FOR U0L0 & U0'L0'		1 Req'd		7758.0	
	2	Fills (for U0L0	220 × 10	× 320	17.27		11.1	
	2	" (" U0'L0'	"	× 470	"		16.2	
							27.3	
			TOP CHORD U0U1		4 Req'd.			
	1	Cov. Pl.	550 × 9	4.160	38858	161.6		
	2	L	90×90×10	4.160	13.3	110.7		
	2	"	"	3.880	"	103.2		
	2	Web P/s	400 × 9	4.160	28.26	235.1		
	2	gusset P/s (at U1	850 × 9	900	60.053		108.1	
	2	P/s "	225 × 9	395	15896		12.6	
	2	L "	90×90×13	625	17.0		21.3	
	2	" "	"	610	"		20.7	
	1	Pl. "	530 × 9	550	37.445		20.6	
	2	Tie P/s	500×9	530	35.325		37.5	
	8	Lac. bars.	65 × 12	735	6.123		36.0	
						610.6 +	256.8 = 867.4	
							× 4	
							3469.6	

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CALCULATIONS FOR

常願寺川水路橋 材料表

U1U2 — 4 Req'd.

1	Cov. Pl.	550 × 9	×	4,035	38.858	156.8		
2	LS	90 × 90 × 10	×	4,040	13.3	107.5		
2	〃	〃	×	4,050	〃	107.7		
2	Web Pls	400 × 9	×	4,050	28.26	228.9		
2	gusset Pls (at U2	810 × 9	×	935	57.227		107.0	
2	Pls 〃	225 × 9	×	405	15.896		12.9	
2	LS 〃	90 × 90 × 13	×	560	17.00		19.0	
2	〃 〃	〃	×	620	〃		21.1	
1	Pl. 〃	540 × 9	×	550	38.151		21.0	
1	Tie Pl.	430 × 9	×	530	30.380		16.1	
1	〃	500 × 9	×	530	35.325		18.7	
10	Lac. Bars	65 × 12	×	735	6.123		45.0	

600.9 + 260.8 = 861.7
× 4
3,4468

U2U3 — 4 Req'd.

1	Cov. Pl.	550 × 9	×	4,070	38.858	158.2		
2	LS	90 × 90 × 10	×	4,070	13.3	108.3		
2	〃	〃	×	4,065	〃	108.1		
2	Web Pls	400 × 9	×	4070	28.26	230.0		
2	gusset Pls (at U3	820 × 9	×	965	57.933		111.8	
2	LS 〃	90 × 90 × 13	×	585	17.00		19.9	
2	〃 〃	〃	×	645	〃		21.9	
1	Pl. 〃	490 × 9	×	550	34.619		19.0	
2	Pls 〃	230 × 9	×	435	16.25		14.1	
2	Tie Pls	500 × 9	×	530	35.325		37.4	
8	Lac. bars	65 × 12	×	735	6.123		36.0	

604.6 + 260.1 = 864.7
× 4
3,458.8

U3U4 — 4 Req'd.

1	Cov. Pl.	550 × 9	×	4,090	38.858	158.9		
2	LS	90 × 90 × 10	×	4080	13.3	108.5		
2	〃	〃	×	4,090	〃	108.8		
2	Web Pls	400 × 9	×	4,090	28.26	231.2		
2	gusset Pls (at U4	780 × 9	×	1,060	55.107		116.8	
2	Pls	220 × 9	×	450	15.543		14.0	
4	LS	90 × 90 × 13	×	600	17.0		40.8	
1	Pl.	520 × 9	×	550	36.738		20.2	
2	Tie Pls	500 × 9	×	530	35.325		37.4	
8	Lac. Bars	65 × 12	×	735	6.123		36.0	

607.4 + 265.2 = 872.6
× 4
3,490.4

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CALCULATIONS FOR

常願寺川水路橋材料表

U4U5

4 Req'd.

1	Cov Pl.		550 × 9	× 4.090	√ √ 38858	√ 158.9		
2	LS		90×90×10	× 4.090	√ √ 133	108.8 ·		
2	〃		〃	× 4.080	√ √ 〃	√ 108.5		
2	Web Pls		400 × 9	× 4.090	√ √ 28.26	231.2 ·		
2	Gusset Pls	(at U5	695 × 9	× 1.055	√ √ 49.102		√ 103.6	
2	Pls	〃	225 × 9	× 450	√ √ 15.896		√ 14.3	
2	LS	〃	90×90×13	× 590	√ √ 17.0		√ 20.1	
2	〃	〃	〃	× 600	√ √ 〃		√ 20.4	
1	Pl.	〃	510 × 9	× 550	√ √ 36032		√ 19.8	
2	Tie Pls		500 × 9	× 530	√ √ 35325		37.4 ·	
8	Lac. Bars		65 × 12	× 735	√ √ 6.123		√ 36.0	

607.4 √ + √251.6 = 859.0 √

× 4

3436.0 √

U5U6

4 Req'd.

1	Cov. Pl.		550 × 9	× 4.075	√ √ 38.858	158.3 ·		
2	LS		90×90×10	× 4.070	√ √ 13.3	108.3 ·		
2	〃		〃	× 4.060	√ √ 〃	√ 108.0		
2	Web Pls		400 × 9	× 4.070	√ √ 28.26	√ 230.0		
2	gusset Pls	(at U6	710 × 9	× 1,100	√ √ 50.162		110.4 ·	
2	Pls	〃	225 × 9	× 410	√ √ 15.896		√ 13.0 ·	
1	Pl.	〃	550 × 9	× 485	√ √ 38.358		√ 18.8	
1	〃	〃	355 × 9	× 895	√ √ 25.081		√ 22.4	
1	Fill.	〃	85 × 9	× 220	√ √ 6.005		√ 1.3	
2	LS	〃	90×90×13	× 695	√ √ 17.00		√ 23.6	
2	〃	〃	〃	× 560	√ √ 〃		√ 19.0	
1	Fill.	(at U5	205 × 9	× 525	√ √ 14.483		√ 7.6	
1	Pl.	〃	360 × 9	× 680	√ √ 25.434		√ 17.3	
2	Tie Pls		500 × 9	× 530	√ √ 35.325		37.4 ·	
8	Lac. Bars		65 × 12	× 735	√ √ 6.123		√ 36.0	

604.6 √ + √306.8 = 911.4 √

× 4 √

3645.6 √

U6U7

4 Req'd.

1	Cov. Pl.		550 × 9	× 4.055	√ √ √ 38858	157.6 ·		
2	LS		90×90×10	× 4.050	√ √ √ 13.3	√ 107.7		
2	〃		〃	× 4.040	√ √ √ 〃	√ 107.5		
2	Web Pls		400 × 9	× 4.050	√ √ √ 28.26	228.9 ·		
2	Gusset Pls	(at U7	705 × 9	× 1.170	√ √ 49.808		116.6 ·	
2	Pls		230 × 9	× 400	√ √ 16.250		√ 13.0	
1	Pl.		550 × 9	× 590	√ √ 38.858		√ 22.9	
1	〃		355 × 9	× 815	√ √ 25.081		√ 20.4	
1	Fill.		85 × 9	× 225	√ √ 6.005		1.4 ·	
2	LS		90×90×13	× 690	√ √ 17.0		√ 23.5	
2	〃		〃	× 630	√ √ 〃		√ 21.4	
2	Tie Pls		500 × 9	× 530	√ √ 35.325		37.4 ·	
8	Lac. Bars		65 × 12	× 735	√ √ 6.123		√ 36.0	

601.7 √ + √292.6 = 894.3 √

4 √

3,577.2 ·

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CALCULATIONS FOR

常願寺川水路橋材料表

U7 U8

4 Reqd.

1	Cov. Pl.	550 × 9	×	4,035		38.858	156.8	
2	LS	90×90×10	×	4.030		13.3	107.2	
2	〃	〃	×	4.020		〃	106.9	
2	Web Pls	400 × 9	×	4.030		28.26	227.8	
2	Gusset Pls (at U8	670 × 9	×	1.225		47.336		116.0
2	Pls 〃	225 × 9	×	395		15896		12.6
1	Pl. 〃	550 × 9	×	550		38858		21.4
1	〃 〃	360 × 9	×	775		25434		19.7
2	LS 〃	90×90×13	×	610		17.0		20.7
2	〃 〃	〃	×	625		〃		21.3
1	Tie Pl.	500 × 9	×	530		35325		18.7
1	〃	430 × 9	×	530		30.380		16.1
8	Lac. Bars	65 × 12	×	735		6123		36.0
1	Fill. (at U8	85 × 9	×	220		6005		1.3

597.7 + 283.8 = 882.5
× 4
3530.0

U8 U9

4 Reqd.

1	Cov. Pl.	550 × 9	×	4,025		38.858	156.4	
2	LS	90 × 90 × 10	×	4.020		13.3	106.9	
2	〃	〃	×	4,005		〃	106.5	
2	Web Pls	400 × 9	×	4.020		28.26	227.2	
2	Gusset Pls (at U9	665 × 9	×	1.285		46.982		120.7
2	Pls 〃	225 × 9	×	535		15.896		17.0
1	Pl. 〃	470 × 9	×	550		33.206		18.3
1	Fill.	85 × 9	×	200		6005		1.2
1	Pl.	355 × 9	×	685		25.091		17.2
2	LS	90 × 90 × 13	×	675		17.0		23.0
2	〃	〃	×	540		〃		18.4
2	Tie Pls	430 × 9	×	530		3038		32.2
8	Lac. Bars	65 × 12	×	735		6123		36.0

597.0 + 284.0 = 881.0
× 4
3524.0

U9 U10

4 Reqd.

1	Cov. Pl.	550 × 9	×	4.015		38.858	156.0	
2	LS	90×90×10	×	4.010		13.3	106.7	
2	〃	〃	×	4.000		〃	106.4	
2	Web Pls	400 × 9	×	4.010		28.26	226.6	
2	Side Pls	220 × 10	×	4,365		17.27	150.8	
2	Gusset Pls Cat U10	685 × 9	×	1.275		48.395		123.4
2	Pls	225 × 9	×	520		15.896		16.5
1	Pl.	530 × 9	×	550		37.445		20.6
1	Fill.	85 × 9	×	225		6005		1.4
1	Pl.	355 × 9	×	760		25.081		19.1
2	Tie Pls	430 × 9	×	530		30.38		32.2
8	Lac. Bars	65 × 12	×	735		6123		36.0
2	LS	90×90×13	×	660		17.00		22.4
2	〃	〃	×	595		〃		20.2

746.5 + 291.8 = 1,038.3
× 4
4,153.2

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CALCULATIONS FOR

常願寺川水路橋材料表

U10 U11 U10'　　2 Req'd.

1	Cov. Pl.	550 × 9	×	4.010	38.858	155.8		
2	L	90 × 90 × 10	×	4.005	13.3	106.5		
2	"	"	×	3.995	"	106.3		
2	Web Pls	400 × 9	×	4.005	28.26	226.4		
2	Side Pls	220 × 10	×	4.005	17.27	138.3		
2	Tie Pls	430 × 9	×	530	30.38		32.2	
2	"	495 × 9	×	530	34.972		37.1	
16	Lac. Bars	65 × 12	×	735	6.123		72.0	
1	Cov. Pl.	550 × 9	×	4.060	38.858	157.8		
2	L	90 × 90 × 10	×	4.055	13.3	107.9		
2	"	"	×	4.040	"	107.5		
2	Web Pls	400 × 9	×	4.055	28.26	229.2		
2	Side Pls	220 × 10	×	4.055	17.27	140.1		
2	L	90 × 90 × 13	×	460	17.0		15.6	
2	"	"	×	475	"		16.2	
1	Pl.	510 × 9	×	550	36.032		19.8	
1	"	335 × 9	×	510	23.668		12.1	
2	Pls	415 × 9	×	480	29.32		28.1	
2	"	225 × 9	×	480	15.896		15.3	
						1,475.8	+ 248.4 = 1,724.2	
							× 2	
							3,448.4	

× Summary for Top chords　　469653 Kgs ✓

LOWER CHORD LoLi　　4 Req'd.

2	L	100 × 100 × 10	×	4.590	14.90	136.8		
2	"	"	×	4.585	"	136.6		
2	Web Pls	400 × 12	×	4.590	37.68	34.59		
2	Side Pls	200 × 10	×	4.590	15.70	144.1		
2	"	370 × 12	×	4.405	34.854	307.1		
2	Inside Pls	400 × 9	×	2,980	28.260	168.4		
2	Pls (at Lo	940 × 9	×	975	66.411		129.5	
2	" "	695 × 9	×	780	49.102		76.6	
2	Pin Pls "	370 × 16	×	615	46.472		57.2	
2	Pls "	400 × 9	×	480	28.260		27.1	
1	Pl. "	735 × 9	×	920	51.928		47.8	
1	L "	90 × 90 × 10	×	325	13.3		4.3	
1	Pl. "	340 × 9	×	485	24.021		11.7	
2	Tie Pls	570 × 9	×	575	40.271		46.3	
22	Lac. Bars	65 × 12	×	780	6.123		105.1	
4	L (diaphragm)	90 × 75 × 9	×	370	11.0		16.3	
1	Pl. "	320 × 9	×	370	22.608		8.4	
2	Gusset Pls (at L1	860 × 9	×	1,050	60.759		127.6	
2	Fills "	380 × 12	×	780	35.796		55.8	
2	Pls "	385 × 12	×	1,420	36.267		103.0	
2	" "	415 × 9	×	1,420	29.32		83.3	
2	" "	400 × 9	×	640	28.260		36.2	
× 2	" "	100 × 10	×	620	7.850		9.7	
1	Pl "	880 × 9	×	930	62.172		57.8	
1	L "	90 × 90 × 10	×	320	13.3		4.3	
1	Pl. "	315 × 9	×	430	22.255		9.6	

次頁へ続く

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CHECKED BY DATE PAGE NO 6

CALCULATIONS FOR

常願寺川水路橋材料表

	2	L-S (diaphragm at L1	90×75×9	×	440	11.0	9.7	
	2	〃 〃	〃	×	310	〃	6.8	
	1	Pl. 〃	310×9	×	390	21.902	8.5	
	2	L-S 〃	90×90×10	×	160	13.3	4.3	
X							1,238.9 + 1046.9 = 2285.8	
							× 4	
X							9,143.2	
			L1L2			4 Req'd.		
	2	L-S	100×100×10	×	4,500	14.9	134.1	
	2	〃	〃	×	4,485	〃	133.7	
	2	Web Pls	400×12	×	4,500	37.68	339.1	
	2	Side Pls	200×10	×	4,500	15.70	141.3	
	2	〃	370×12	×	3,720	34.854	259.3	
	2	Tie Pls	500×9	×	575	35.325	40.6	
	24	Lac. Bars	65×12	×	780	6.123	114.6	
	4	L-S (diaphragm	90×75×9	×	370	11.0	16.3	
	1	Pl. 〃	340×9	×	370	24.021	8.9	
	2	Pls (at L2	970×9	×	785	68.531	107.6	
	2	Fills. 〃	380×12	×	785	35.796	56.2	
	2	Pls 〃	385×12	×	1,425	36.267	103.4	
	2	Fills 〃	320×3	×	370	7.536	5.6	
X	2	Pls 〃	100×10	×	540	7.850	8.5	
	1	Pl. 〃	875×9	×	920	61.819	56.9	
	2	L-S (diaphragm at L2	90×75×9	×	420	11.0	9.2	
	2	〃 〃	〃	×	360	〃	7.9	
	1	Pl. 〃	310×9	×	380	21.902	8.3	
	2	L-S 〃	90×90×10	×	160	13.3	4.3	
	1	L (at L2 lateral conn.	〃	×	320	〃	4.3	
	1	Pl. 〃	320×9	×	405	22.608	9.2	
X	2	Pls (at L2	385×9	×	1,100	27.200	59.8	
X							1007.5 + 621.6 = 1,629.1	
							× 4	
X							6,516.4	
			L2L3			4 Req'd.		
	2	L-S	100×100×10	×	4,410	14.9	131.4	
	2	〃	〃	×	4,390	〃	130.8	
	2	Web Pls	400×12	×	4,410	37.68	332.3	
	2	Side Pls	200×10	×	4,405	15.70	138.3	
	2	〃	370×9	×	3,395	26.141	177.5	
	2	Tie Pls	500×9	×	575	35.325	40.6	
	20	Lac. Bars	65×12	×	780	6.123	95.5	
	4	L-S (diaphragm	90×75×9	×	370	11.0	16.3	
	1	Pl. 〃	340×9	×	370	24.021	8.9	
	2	Pls (at L3	1,060×9	×	1,815	74.889	271.8	
	2	〃 〃	415×9	×	1,580	29.32	92.7	
	2	Fills 〃	370×3	×	920	8.714	16.0	
	2	Pls 〃	390×9	×	1,815	27.554	100.0	
	2	〃 〃	385×9	×	1,500	27.20	81.6	
X	2	〃 〃	100×10	×	610	7.850	9.6	
	1	Tie Pl 〃	480×9	×	575	33.912	19.5	
	1	Pl. 〃	595×9	×	870	42.037	36.6	
	2	L-S (diaphragm at L3	90×75×9	×	380	11.0	8.4	
	2	〃 〃	〃	×	300	〃	6.6	
	1	Pl. 〃	310×9	×	370	21.902	8.1	
	2	L-S 〃	90×90×10	×	160	13.3	4.3	

次頁へ続く

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CHECKED BY DATE PAGE NO 7

CALCULATIONS FOR

常願寺川水路橋材料表

X							910.3 + 8,165 = 17268	
X							× 4	
							69072	
		L3L4			4 Req'd.			
	2	L	100×100×10	× 4.330	" " 149	1290		
	2	,	,	× 4.305	" " "	1283		
	2	Web Pls	400 × 9	× 3.650	" " 28.26	2063		
	2	Side Pls	200 × 10	× 4.320	" " 15.70	1356		
	2	,	370 × 9	× 3.885	" " 26.141	2031		
	4	Tie Pls	500 × 9	× 550	" " 35.325		77.7	
	16	Lac. bars	65 × 12	× 745	" " 6.123		73.0	
	4	L (Diaphragm	90 × 75 × 9	× 370	" " 11.0		16.3	
	1	Pl. "	320 × 9	× 370	" " 22.608		8.4	
	2	gusset Pls (at L4	805 × 9	× 880	" " 56.873		100.1	
	2	Fills ,	380 × 9	× 880	" " 26.847		47.3	
	2	Pls ,	385 × 9	× 1.360	" " 27.2		74.0	
X	2	" ,	100 × 10	× 480	" " 7.850		7.5	
X	2	" ,	"	× 450	" " "		7.1	
X						802.3 +	411.4 = 1,213.7	
X							× 4	
							4,854.8	
		L4L5			4 Req'd.			
	2	L	100×100×10	× 4.250	" " 14.90	126.7		
	2	"	,	× 4.230	" " "	126.1		
	2	Web Pls	400 × 9	× 4.250	" " 28.26	240.2		
	2	Side Pls	200 × 10	× 4.245	" " 15.70	133.3		
	2	"	370 × 9	× 3.375	" " 26.141	176.5		
	3	Tie Pls	500 × 9	× 550	" " 35.325		58.3	
	1	"	430 × 9	× 550	" " 30.38		16.7	
	4	Lac. Bars	65 × 12	× 410	" " 6.123		10.0	
	16	"	"	× 745	" " "		73.0	
	4	L (Diaphragm	90 × 75 × 9	× 370	" " 11.0		16.3	
	1	Pl. "	320 × 9	× 370	" " 22.608		8.4	
	1	L	75 × 75 × 9	× 160	" " 9.96		1.6	
	1	"	"	× 370	" " "		3.7	
	2	Gusset Pls at L5	780 × 9	× 1.025	" " 55.107		113.0	
	2	Pls "	390 × 9	× 1.355	" " 27.554		74.7	
	2	Fills "	385 × 9	× 870	" " 27.20		47.3	
X	2	Pls "	100 × 10	× 460	" " 7.850		7.2	
X	2	" "	"	× 450	" " "		7.1	
X						802.8 +	437.3 = 1,240.1	
X							× 4	
							4,960.4	
		L5L6			4 Req'd.			
	2	L	100×100×10	× 4.190	" " 14.90	124.9		
	2	"	"	× 4.165	" " "	124.1		
	2	Web Pls	400 × 9	× 4.185	" " 28.26	236.5		
	2	Side Pls	200 × 10	× 4.180	" " 15.70	131.3		
	2	"	370 × 9	× 3.405	" " 26.141	178.0		
	2	Tie Pls	500 × 9	× 550	" " 35.325		38.9	

次頁へ続く

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CHECKED BY DATE PAGE NO 8

CALCULATIONS FOR

常願寺川水路橋材料表

	2	Tie Pls	430 × 9	× 550	30.38		33.4	
	20	Lac. bars	65 × 12	× 745	6.123		91.2	
	4	Ls (Diaphragm	90 × 75 × 9	× 370	11.0		16.3	
	1	Pl. "	320 × 9	× 370	22.608		8.4	
	2	gusset Pls (at L6	740 × 9	× 1,015	52.281		106.6	
	2	Pls "	385 × 9	× 935	27.20		50.9	
	2	" "	"	× 775	"		42.2	
X	2	" "	100 × 10	× 460	7.850		7.2	
X	2	" "	"	× 430	"		6.8	
X						794.8 +	401.9 =	1,196.7
							× 4	
X								4,786.8
			L6 L7		4 Req'd.			
	2	Ls	100 × 100 × 10	× 4,135	14.90	123.2		
	2	"	"	× 4,110	"	122.5		
	2	Web Pls	400 × 9	× 4,130	28.26	233.4		
	2	Side Pls	200 × 10	× 4,125	15.70	129.5		
	2	Tie Pls	500 × 9	× 550	35.325		38.9	
	2	"	430 × 9	× 550	30.38		33.4	
	20	Lac. bars	65 × 12	× 745	6.123		91.2	
	4	Ls (Diaphragm	90 × 75 × 9	× 370	11.0		16.3	
	1	Pl. "	320 × 9	× 370	22.608		8.4	
	2	gusset Pls (at L7	695 × 9	× 1,100	49.102		108.0	
	2	Pls "	380 × 9	× 700	26.847		37.6	
X	2	" "	100 × 10	× 460	7.850		7.2	
X	2	" "	"	× 440	"		6.9	
X						608.6 +	347.9 =	956.5
							× 4	
X								3,826.0
			L7 L8		4 Req'd.			
	2	Ls	100 × 100 × 10	× 4,090	14.90	121.9		
	2	"	"	× 4,065	"	121.1		
	2	Web Pls	400 × 9	× 4,085	28.26	230.9		
	2	Side Pls	200 × 10	× 4,080	15.70	128.1		
	2	Tie Pls	500 × 9	× 550	35.325		38.9	
	2	"	430 × 9	× 550	30.38		33.4	
	20	Lac. Bars	65 × 12	× 745	6.123		91.2	
	4	Ls (Diaphragm	90 × 75 × 9	× 370	11.0		16.3	
	1	Pl. "	320 × 9	× 370	22.608		8.4	
	2	Pls "	720 × 9	× 1,070	50.868		108.9	
	2	" "	385 × 9	× 750	27.2		40.8	
X	2	" "	100 × 10	× 505	7.850		7.9	
X	2	" "	"	× 485	"		7.6	
X						602.0 +	353.4 =	955.4
							× 4	
X								3,821.6
			L8 L9		4 Req'd.			
	2	Ls	100 × 100 × 10	× 4,050	14.9	120.7		
	2	"	"	× 4,025	"	119.9		
	2	Web Pls	400 × 9	× 4,045	28.26	228.6		
	3	Tie Pls	500 × 9	× 550	35.325		58.3	

次頁へ続ク

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MADE BY I.M. DATE 6-6-25 FILE NO
CHECKED BY DATE PAGE NO 9

CALCULATIONS FOR

常願寺川水路橋材料表

	1	Tie Pl.	430 × 9	×	550	3038	16.7		
	18	Lac. bars	65 × 12	×	745	6.123	82.1		
	2	gusset Pls (at L9	685 × 9	×	1,105	48.395	107.0		
	2	Pls ,	385 × 9	×	785	27.2	42.7		
	2	Fills ,	210 × 10	×	785	16.485	25.9		
X	2	Pls ,	100 × 10	×	540	7.850	8.5		
X	2	" "	"	×	600	"	9.4		
	2	Fills (at L8	200 × 10	×	480	15.70	15.1		
X							469.2 + 365.7 = 834.9		
							× 4		
X							3339.6		
			L9 L10			4 Req'd.			
	2	L8	100 × 100 × 10	×	4.025	14.90	119.9		
	2	"	"	×	4.005	"	119.3		
	2	Web Pls	400 × 9	×	4.020	28.26	227.0		
	3	Tie Pls	430 × 9	×	550	3038	50.1		
	1	"	500 × 9	×	550	35.325	19.4		
	18	Lac. bars	65 × 12	×	745	6.123	82.1		
	4	L8 (Diaphragm	90 × 75 × 9	×	370	11.0	16.3		
	1	Pl. "	320 × 9	×	370	22.608	8.4		
	2	Pls	670 × 9	×	1.165	47.336	110.3		
	2	"	380 × 9	×	760	26.847	40.8		
	2	Fills	210 × 10	×	760	16.485	25.1		
X	2	L8	100 × 10	×	520	7.850	8.2		
X	2	"	"	×	505	"	7.9		
X							466.2 + 368.6 = 834.8		
							× 4		
X							3339.2		
			L10 L11 L10'			2 Req'd.			
	2	L8	100 × 100 × 10	×	4.010	14.90	119.5		
	2	"	"	×	3.990	"	118.9		
	2	Web Pls	400 × 9	×	4.010	28.26	226.6		
	6	Tie Pls	430 × 9	×	550	3038	100.3		
	2	"	500 × 9	×	550	35.325	38.9		
	36	Lac. Bars	65 × 12	×	745	6123	164.2		
	8	L8 (Diaphragm	90 × 75 × 9	×	370	11.0	32.6		
	2	Pl. "	320 × 9	×	370	22.608	16.7		
	2	L8	100 × 100 × 10	×	4.060	14.90	121.0		
	2	"	"	×	4.040	"	120.4		
	2	Web Pls	400 × 9	×	4.060	28.26	229.5		
	2	gusset Pls	675 × 9	×	1.610	47.689	153.6		
	2	Pls	380 × 9	×	750	26.847	40.3		
	2	Fills	210 × 10	×	750	16.485	24.7		
X	2	Pls	100 × 10	×	505	7.850	7.9		
X	2	"	"	×	660	"	10.4		
X							935.9 + 589.6 = 1,525.5		
							× 2		
X							3,051.0		
X		Summary for Lower Chords				54,546.2 kgs			

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CHECKED BY DATE PAGE NO 10

CALCULATIONS FOR

常願寺川水路橋材料表

DIAGONALS U0L1

4 Req'd.

2	L5	125×90×13	×	7,250	20.6	298.7		
2	〃	〃	×	7,300	〃	300.8		
3	Tie Pl.	300×9	×	370	21.2		23.5	
28	Lac. bars	65×9	×	320	4.59		41.1	
						599.5	+ 64.6 = 664.1	
							× 4	
							2656.4	

U1L2

4 Req'd.

2	L5	125×90×9	×	6,160	14.6	179.9		
2	〃	〃	×	6.280	〃	183.4		
2	Tie Pls	300×9	×	350	21.2		14.8	
1	〃	〃	×	370	〃		7.8	
24	Lac. Bars	65×9	×	320	4.59		35.3	
						363.3	+ 57.9 = 421.2	
							× 4	
							1,684.8	

U2L3

4 Req'd.

2	L5	125×90×9	×	5,155	14.6	150.5		
2	〃	〃	×	5,335	〃	155.8		
2	Tie Pls	300×9	×	310	21.2		13.1	
21	Lac. Bars	65×9	×	320	4.59		30.8	
						306.3	+ 43.9 = 350.2	
							× 4	
							1,400.8	

U3L4

4 Req'd.

2	L5	125×90×9	×	4,540	14.6	132.6		
2	〃	〃	×	4,660	〃	136.1		
2	Tie Pls	250×9	×	300	17.66		10.6	
19	Lac. Bars	65×9	×	320	4.59		27.9	
						268.7	+ 38.5 = 307.2	
							× 4	
							1,228.8	

U4L5

4 Req'd.

4	L5	125×90×9	×	4,185	14.6	244.4		
2	Tie Pls	250×9	×	300	17.66		10.6	
16	Lac. Bars	65×9	×	320	4.59		23.5	
						244.4	+ 34.1 = 278.5	
							× 4	
							1,114.0	

U5L6

4 Req'd

4	L5	125×90×9	×	3,945	14.6	230.4		
2	Tie Pls	250×9	×	300	17.66		10.6	
15	Lac. Bars	65×9	×	320	4.59		22.0	
						230.4	+ 32.6 = 263.0	
							× 4	
							1,052.0	

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CHECKED BY DATE PAGE NO 11

CALCULATIONS FOR

常願寺川水路橋材料表

		U6L7		4 Req'd		
4	L	125×90×9	× 3,750	14.6	219.0	
2	Tie Pls	250×9	× 300	17.66	10.6	
14	Lac. Bars.	65×9	× 320	4.59	20.6	
					219.0 + 31.2 = 250.2	
					× 4	
					1,000.8	
		U7L8		4 Req'd.		
4	L	125×90×9	× 3.595	14.6	209.9	
2	Tie Pls	250×9	× 300	17.66	10.6	
14	Lac. bars.	65×9	× 320	4.59	20.6	
					209.9 + 31.2 = 241.1	
					× 4	
					964.4	
		U8L9		4 Req'd.		
4	ls	125×90×9	× 3455	14.6	201.8	
1	Tie Pl.	300×9	× 370	21.2	7.8	
1	"	"	× 355	"	7.5	
12	Lac. bars	65×9	× 320	4.59	17.6	
					201.8 + 32.9 = 234.7	
					× 4	
					938.8	
		U9L10		4 Req'd.		
4	ls	125×90×9	× 3.375	14.6	197.1	
1	Tie Pl.	300×9	× 300	21.2	6.4	
1	"	295×9	× 300	20.84	6.3	
12	Lac. bars	65×9	× 320	4.59	17.6	
					197.1 + 30.3 = 227.4	
					× 4	
					909.6	
		U10L11		2 Req'd.		
4	ls	125×90×9	× 3,355	14.6	195.9	
2	Tie Pls	300×9	× 320	21.2	13.6	
11	Lac. bars	65×9	× 320	4.59	16.2	
					195.9 + 29.8 = 225.7	
					× 2	
					451.4	
		U10'L11		2 Req'd.		
4	ls	125×90×9	× 3,405	14.6	198.9	
2	Tie Pls	300×9	× 320	21.2	13.6	
11	Lac. bars	65×9	× 320	4.59	16.2	
					198.9 + 29.8 = 228.7	
					× 2	
					457.4	

Summary for Diagonals 13,859.2 kgo

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CHECKED BY DATE PAGE NO 12

CALCULATIONS FOR

常願寺川水路橋材料表

VERTICAL UILI

4 Req'd.

X	2	L		125×90×9	×	7.410	14.6	216.4	
X	2	〃		〃	×	7.470	〃	218.1	
	1	Pl.	at M1	365×9	×	670	25.79		17.3
	1	L	〃	100×75×10	×	180	13.0		2.3
	1	Pl.	at T1	555×9	×	690	39.21		27.1
	1	Tie Pl.		300×9	×	500	21.20		10.6
	1	〃		〃	×	400	〃		8.5
	1	〃		〃	×	805	〃		17.1
	1	〃		〃	×	370	〃		7.8
	24	Lac. bars		65×9	×	320	4.59		35.3
X								434.5 +	126.0 = 560.5
									× 4
X									2,242.0

U2L2

4 Req'd.

	2	L		125×90×9	×	5.950	14.6	173.7	
	2	〃		〃	×	6.005	〃	175.3	
	1	Pl.	at M2	365×9	×	670	25.79		17.3
	1	L	〃	100×75×10	×	180	13.0		2.3
	1	Pl.	at T2	555×9	×	690	39.21		27.1
	1	Tie Pl.		300×9	×	480	21.20		10.2
	1	〃		〃	×	400	〃		8.5
	1	〃		〃	×	550	〃		11.7
	1	〃		〃	×	295	〃		6.3
	19	Lac. bars		65×9	×	320	4.59		27.9
								349.0 +	111.3 = 460.3
									× 4
									1,841.2

U3L3

4 Req'd.

	2	L		125×90×9	×	4,805	14.6	140.3	
	2	〃		〃	×	4.860	〃	141.9	
	1	Pl.	at M3	365×9	×	630	25.79		16.2
	1	L	〃	100×75×10	×	180	13.0		2.3
	1	Tie Pl.		300×9	×	480	21.20		10.2
	1	〃		〃	×	400	〃		8.5
	1	〃		〃	×	370	〃		7.8
	16	Lac. bars		65×9	×	320	4.59		23.5
								282.2 +	68.5 = 350.7
									× 4
									1,402.8

T4U4

4 Req'd.

	2	L		125×90×9	×	5.770	14.6	168.5	
	2	〃		〃	×	5800	〃	169.4	
	1	Pl.	at M4	335×9	×	630	23.67		14.9
	1	L	〃	100×75×10	×	180	13.0		2.3
	1	Pl.	at T4	260×9	×	530	18.37		9.7
	1	〃	〃	〃	×	610	〃		11.2
	2	L	〃	100×100×10	×	150	14.9		4.5
	1	Tie Pl.	〃	300×9	×	510	21.20		10.8
	1	〃		〃	×	1005	〃		21.3
	1	〃		〃	×	545	〃		11.6

次頁へ続く

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MADE BY I.M. DATE 6-6-25 FILE NO.
CHECKED BY DATE PAGE NO 13

CALCULATIONS FOR

常願寺川水路橋材料表

18	Lac. bars		65×9	× 320	4.59		26.4	
						337.9 +	112.7 = 450.6	
							× 4	
							1,802.4	
			T5U5		4 Req'd.			
2	L		125×90×9	× 6.595	14.6		192.6	
2	"		"	× 6.625	"		193.5	
1	Web Pl.		280×9	× 6,695	19.78		1324	
2	Side Pls		260×12	× 6,625	24.49		3245	
1	Pl.	at M5	365×9	× 610	25.79		15.7	
1	L	"	150×100×12	× 330	22.40		74	
1	L	"	100×75×10	× 520	13.0		6.8	
1	Pl.	at T5	260×9	× 610	18.37		11.2	
1	"	"	"	× 530	"		9.7	
2	L		100×100×10	× 150	14.9		4.5	
						843.0 +	55.3 = 898.3	
							× 4	
							3,593.2	
			M6U6		4 Req'd.			
2	L		125×90×9	× 4,735	14.6		138.3	
2	"		"	× 4,750	"		138.7	
1	Pl.		230×9	× 260	16.25		4.2	
1	Tie Pl.		300×9	× 700	21.20		14.8	
1	"		420×9	× 465	29.67		13.8	
1	"		300×9	× 620	21.20		13.1	
12	Lac. bars		65×9	× 370	4.59		17.6	
						277.0 +	63.5 = 340.5	
							× 4	
							1,362.0	
			M7U7		4 Req'd.			
2	L		125×90×9	× 5300	14.6		154.8	
2	"		"	× 5,310	"		155.1	
1	Pl.		230×9	× 260	16.25		4.2	
1	Tie Pl.		300×9	× 1,050	21.20		22.3	
1	"		"	× 740	"		15.7	
15	Lac. bars		65×9	× 320	4.59		22.0	
						309.9 +	64.2 = 374.1	
							× 4	
							1,496.4	
			M8U8		4 Req'd.			
2	L		125×90×9	× 5,740	14.6		167.6	
2	"		"	× 5,750	"		167.9	
1	Tie Pl.		300×9	× 980	21.20		20.8	
1	"		"	× 720	"		15.3	
18	Lac. bars		65×9	× 320	4.59		26.4	
						335.5 +	62.5 = 398.0	
							× 4	
							1,592.0	

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MADE BY I.M. DATE 6.6.25 FILE NO
CHECKED BY DATE PAGE NO 14

CALCULATIONS FOR

常願寺川水路橋材料表

			M9 U9			4 Req'd.			
4	L		125×90×9	×	6060	14.6	353.9		
1	Tie Pl.		300×9	×	1,010	21.2		21.4	
1	"		"	×	620	"		13.1	
19	Lac. bars		65×9	×	320	4.59		27.9	
							353.9 +	62.4 = 416.3	
								× 4	
								1.6652	
			M10 U10			4 Req'd.			
4	L		125×90×9	×	6245	14.6	364.7		
1	Tie Pl.		300×9	×	1,040	21.2		22.0	
1	"		"	×	620	"		13.1	
20	Lacing bars		65×9	×	320	4.59		29.4	
							364.7 +	64.5 = 429.2	
								× 4	
								1.7168	
			M11 U11			2 Req'd.			
4	L		125×90×9	×	6,380	14.6	372.6		
1	Tie Pl.		300×9	×	1,100	21.2		23.3	
1	"		"	×	620	"		13.1	
20	Lac. bars		65×9	×	320	4.59		29.4	
							372.6 +	65.8 = 438.4	
								× 2	
								876.8	
			T6 M6 to T11 M11			22 Req'd.			
4	L		125×90×9	×	2,560	14.6	149.5		
2	Pls	splice	260×9	×	520	18.37		19.1	
4	"	"	75×9	×	560	5.30		11.9	
1	Pl.	"	300×9	×	560	21.2		11.9	
1	Tie Pl.		300×9	×	410	"		8.7	
1	"		"	×	510	"		10.8	
2	L		100×100×10	×	150	14.9		4.5	
7	Lac. Bars		65×9	×	320	4.59		10.3	
1	Pl.		365×9	×	630	25.79		16.2	
1	L		100×75×10	×	180	13.0		2.3	
							149.5 +	95.7 = 245.2	
								× 22	
								5,394.4	
22	Pls		260×9	×	530	18.37		214.2	
14	"		"	×	610	"		156.9	
8	"		470×9	×	610	33.21		162.1	
								533.2	
		Summary for Verticals					25,518.4 kgs		

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CHECKED BY DATE PAGE NO 15

CALCULATIONS FOR

常願寺川水路橋材料表

TIES

	2	L	125×75×9	×	4.950	13.5	133.7		
	2	〃	〃	×	4.660	〃	125.8		
	4	〃	〃	×	3.230	〃	174.4		
	1	Tie Pl.	300×9	×	620	21.2		13.1	
	1	Pl. lateral conn.	690×9	×	790	48.75		38.5	
	1	〃 〃	〃	×	695	〃		33.9	
	1	Fill.	150×9	×	175	10.60		1.9	
	2	L	150×100×12	×	260	22.4		11.6	
	2	Pls Splice	270×9	×	460	19.08		17.6	
X	4	〃 〃	65×9	×	520	4.59		9.5	
	1	〃 〃	300×9	×	520	21.20		11.0	
	27	Lac. bars	65×9	×	330	4.59		40.9	
	1	L (lateral Conn, T3	90×90×10	×	465	13.30		6.2	
	2	L 〃 〃	〃	×	305	〃		8.1	
	2	〃 〃 〃	〃	×	230	〃		6.1	
	1	〃 〃 〃	〃	×	400	〃		5.3	
	1	Pl. 〃 〃	290×9	×	315	20.49		6.5	
	1	〃 〃 〃	390×9	×	460	27.55		12.7	
X							4339 +	2229 =	6568
								× 4	
X									26272

TE3R, TE4R & TE5R 4 Req'd.

	4	L	125×75×9	×	6.270	13.5	338.6		
	4	〃	〃	×	6.400	〃	345.6		
	4	〃	〃	×	6.000	〃	324.0		
	1	Pl. lateral Pl.	605×9	×	710	42.74		30.3	
	1	〃 〃	690×9	×	700	48.75		34.1	
	1	〃 〃	610×9	×	670	43.10		28.9	
	1	〃 〃	〃	×	620	〃		26.7	
	1	〃 〃	530×9	×	620	37.45		23.2	
	1	Fill.	150×9	×	300	10.60		3.2	
	6	Pls Splice	270×9	×	460	19.08		52.7	
X	12	〃 〃	65×9	×	520	4.59		28.6	
	3	〃 〃	300×9	×	520	21.20		33.1	
	66	Lac. bars	65×9	×	330	4.59		100.0	
	2	Ls	150×100×12	×	260	22.40		11.6	
X							1008.2 +	372.4 =	1380.6
								× 4	
X									5522.4

TE6 & TE7 2 Req'd.

	4	L	125×75×9	×	4.000	13.5	216.0		
	4	〃	〃	×	6.000	〃	324.0		
	3	Pls lateral Pl.	530×9	×	620	37.45		69.7	
	2	〃 Splice	270×9	×	460	19.08		17.6	
X	4	〃 〃	65×9	×	520	4.59		9.5	
	1	〃 〃	300×9	×	520	21.20		11.0	
	33	Lac. Bars	65×9	×	330	4.59		50.0	
X							540.0 +	157.8 =	697.8
								× 2	
X									1395.6

X Summary for Ties 9545.2 kgo

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CHECKED BY DATE PAGE NO 16

CALCULATIONS FOR
常願寺川水路橋材料表

										Sh.#
		TOP LATERAL BRACINGS			2 Req'd.					
2	L$	TL1R	125×90×9	× 4,270		14.6	√ 1247			19
2	〃	〃	〃	× 4,350		〃	√ 1270			〃
2	Pls	〃	370×9	× 720		26.14	√	√ 37.6		〃
1	L	TL2	125×90×9	× 2,510	√	14.6	√ 366			〃
1	〃	〃	〃	× 2,370	√	〃	√ 346			〃
2	L$	TL3R	〃	× 1,950	√	〃	√ 569			〃
2	〃	〃	〃	× 2,020	√	〃	√ 590			〃
4	〃	TL4	〃	× 4,505	√	〃	√ 2631			18
4	〃	TL5	〃	× 4,490	√	〃	√ 2622			〃
4	〃	TL6	〃	× 4,475	√	〃	√ 2613			〃
4	〃	TL7	〃	× 4,465	√	〃	√ 2608			〃
2	〃	TL8	〃	× 4,460	√	〃	√ 2605			〃
2	〃	TL8A	〃	× 4,500	√	〃	√ 1314			〃
							√ 18781	+ √ 37.6	= 19157	
									× 2	
									38314	

Summary for Top lateral bracings 38314 Kgs

		PORTAL BRACING PB1			2 Req'd.					
2	ls		125×90×9	× 5430		14.6	√ 1586			19
2	〃		〃	× 5660		〃	√ 1653			
12	〃		75×75×9	× 1220		9.96	√ 1458			
18	pls		250×9	× 250		17.66	√ 79.5			
8	Fills		125×9	× 160		8.83	√ 11.3			
4	〃		120×9	× 120		8.48	√ 4.1			
2	Pls		275×9	× 380		19.43	√ 148			
2	〃	(Conn.	310×9	× 890		21.90	√ 390			
4	Ls	〃	90×90×10	× 235		13.3	√ 12.5			
4	〃	〃	〃	× 435		〃	√ 23.1			
4	〃	(Knee brace	125×90×9	× 2,080		14.6	√ 121.5			
4	Washers	〃	70φ×9			@ 0.27	√ 1.1			
1	Pl.	〃	550×9	× 680		38.96	√ 26.4			
									8030	
									× 2	
									16060	

		SWAY BRACINGS SB1, 2, 3, 4 & 5 (共通部分) 9 Req'd.								
2	Ls		125×90×9	× 5,420		14.6	√ 1583			20
2	〃		〃	× 5,680		〃	√ 1659			
12	〃		75×75×9	× 1,450		9.96	√ 1733			
18	Washers		70φ×9			@ 0.27	√ 49			
8	Pls.		190×9	× 250		13.42	√ 268			
2	〃		320×9	× 1,190		22.61	√ 538			
4	〃		180×9	× 190		12.72	√ 9.7			
4	〃		70×9	× 255		4.95	√ 5.0			
4	〃		〃	× 145		〃	√ 2.9			
20	Washers		70φ×9			@ 0.27	√ 5.4			
									6060	
									× 9	
									54540	

		SB1			2 Req'd.					
1	Pl.	(lateral Pl.	455×9	× 570		32.15	√ 183			20
2	Pls		325×9	× 335		22.96	√ 154			
8	Ls	(Conn.	90×90×10	× 230		13.3	√ 245			
4	〃	〃	〃	× 500		〃	√ 266			

次頁へ続ク

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CHECKED BY DATE PAGE NO 17

CALCULATIONS FOR

常願寺川水路橋材料表

4	L (Knee brace)	125×90×9	× 2,380	14.6		139.0	
4	Washers	70φ×9		@ 0.27		1.1	
2	Fills	120×9	× 430	8.48		73	
						2322	
						× 2	
						4644	
		SB2		2 Req'd.			
1	Pl. (Top.)	455×9	× 570	32.15		18.3	20
2	Pl.	330×9	× 330	23.32		15.4	
8	L (conn.)	90×90×10	× 230	13.3		24.5	
4	〃 (〃)	〃	× 510	〃		27.1	
4	〃 (brace)	125×90×9	× 2,440	14.6		142.5	
4	Washers	70φ×9		@ 0.27		1.1	
2	Pls	240×9	× 260	16.96		8.8	
2	〃	215×9	× 370	15.19		11.2	
4	L	125×90×9	× 260	14.6		15.2	
4	〃	〃	× 385	〃		22.5	
						286.6	
						× 2	
						573.2	
		SB3		2 Req'd.			
1	Pl.	455×9	× 570	32.15		18.3	20
2	Pls	330×9	× 330	23.32		15.4	
8	L (Conn.)	90×90×10	× 230	13.3		24.5	
4	〃	〃	× 515	〃		27.4	
4	〃 (brace)	125×90×9	× 2,215	14.6		129.4	
4	Washers	70φ×9		@ 0.27		1.1	
2	Pls	215×9	× 370	15.19		11.2	
4	L	125×90×9	× 390	14.6		22.8	
						250.1	
						× 2	
						500.2	
		SB4		2 Req'd.			
1	Pl.	455×9	× 570	32.15		18.3	20
2	Pls	330×9	× 330	23.32		15.4	
4	L (Conn.)	90×90×10	× 225	13.3		12.0	
4	〃 〃	〃	× 230	〃		12.2	
4	〃 〃	〃	× 515	〃		27.4	
4	〃 (brace)	125×90×9	× 2080	14.6		121.5	
4	Washers	70φ×9		@ 0.27		1.1	
2	Pls	220×9	× 370	15.54		11.5	
4	L	125×90×9	× 380	14.6		22.2	
						241.6	
						× 2	
						483.2	

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CHECKED BY DATE PAGE NO 18R

CALCULATIONS FOR

常願寺川水路橋材料表

			SB5			1 Req'd.			
1	Pl.		570× 9	×	720	40.27		29.0	20
2	Pls		330 × 9	×	330	23.32		15.4	
4	L	(Conn.	90×90×10	×	225	13.3		12.0	
4	〃	〃	〃	×	750	〃		39.9	
4	〃	(brace	125×90×9	×	2,035	14.6		118.8	
4	Washers		70φ× 9			@ 0.27		1.1	
2	Pls		235 × 9	×	370	16.60		12.3	
4	L		125×90×9	×	375	14.6		21.9	
								250.4	
		Summary for Portal & Sway bracings, over head						9.331.4	kgs
		FLOOR BEAMS	FB1, 2, 3, 4 & 5			1 Req'd.			
21	Is	FB1. 2 & 3	250×125@38.3 kgs	×	5,660	× 38.3		4552.3	10 11 12 21
1	I	FB4	〃	×	5,620	× 〃		215.2	
1	〃	FB5	400×150@95.85 kgs	×	5,620	× 95.85		538.7	番外2
88	Ls	Conn.	130×130×9	×	190	× 17.7		295.9	
4	〃	〃	〃	×	290	× 〃		20.5	
								5622.6	
		Summary for Floor beams				5,622.6 kgs			
		STRINGERS				1 Req'd.			
40	L	(S1L, S5L, S3L, ES1L	250×90@34.6 kg.		3.980	34.6		5,508.3	10 12 21
4	〃	(S5L	〃	×	3,940	〃		545.3	番外2
40	Is	(S2, S4, SS2, ES2	250×125@38.3 kg	×	3,980	38.3		6,097.4	
4	〃	(S6	〃	×	3,940	〃		603.6	
317	Is	(Conn.	130×130×9	×	190	17.7		1049.3	
4	〃	〃 ES1.	〃	×	295	〃		20.9	
16	〃	(Bearing	150×90×9	×	280	16.3		73.0	
16	〃	(Conn. S3.4	150×150×12	×	190	27.1		82.4	
8	〃		75×75×9	×	260	9.96		20.7	12
8	Fills		75×3	×	125	1.77		1.8	〃
4	L	(Conn ES2	130×130×9	×	315	17.7		22.3	
		Summary for stringers				14.025.0 kgs		14,025.0	
		FLOOR FRAMES	FR1, 2, 1A, 1B, 2A & 2B			1 Req'd.			
84	L	(FR1	125×90×9	×	2410	14.60		2955.6	10 11
84	Washers	〃	70φ×9			@ 0.27		22.7	
80	L	(FR2	75×75×9	×	655	9.96		521.9	
40	Pls	〃	380×9	×	655	26.85		703.5	
80	L	〃	125×90×9	×	1.795	14.60		2096.6	
× 40	Fills	〃	90×9	×	320	6.36		81.4	
4	L	(FR1A	125×90×9	×	2,380	14.60		139.0	
4	Washers	〃	70φ×9			@ 0.27		1.1	
8	L	(FR2A	75×75×9	×	655	9.96		52.2	28
4	Pls	〃	380×9	×	655	26.85		70.3	
8	L	〃	125×90×9	×	1,800	14.60		210.2	
× 4	Fills	〃	90×9	×	320	6.36		8.1	
4	Pls	〃	265×9	×	360	18.72		27.0	
8	L	〃	75×75×9	×	360	9.96		28.7	
4	〃	(FR1B	125×90×9	×	2,250	14.6		131.4	番外2
4	Washers	〃	70φ×9	×		@ 0.27		1.1	〃
4	L	(FR2B	75×75×9	×	655	9.96		26.1	〃

次頁へ続く

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MADE BY I.M. DATE 6-7-7 FILE NO.
CHECKED BY DATE PAGE NO. 19R

CALCULATIONS FOR

常願寺川水路橋材料表

	2	Pls (FR2B	385×9	× 690	27.2	37.5	
	4	L	125×90×9	× 1,645	14.6	96.1	
X	2	Fills	90×9	× 320	6.36	4.1	
X						7,214.6	
			FR3. 4. 6. 6A & 6B (共通部分)		19 Req'd.		
	2	L	75×75×9	× 5,500	9.96	109.6	10
	2	"	"	× 5,660	"	112.7	
	2	Pls	400×9	× 605	28.26	34.2	
	10	Lac. bars	65×9	× 370	4.59	17.0	
	2	Pls	290×9	× 510	20.49	20.9	
	4	"	155×9	× 155	10.95	6.8	
	1	Pl.	300×9	× 1,360	21.20	28.8	
	2	L	100×75×10	× 170	13.0	4.4	
						334.4	
						19	
						6353.6	
			FR3		4 Req'd.		
	4	L (Conn.	100×75×10	× 450	13.0	23.4	10
	2	Fills	155×9	× 200	10.95	4.4	
	1	Pl.	310×9	× 530	21.90	11.6	
						39.4	
						× 4	
						157.6	
			FR4		2 Req'd.		
	4	L (Conn.	100×75×10	× 540	13.0	28.1	10
	1	Fill.	155×9	× 200	10.95	2.2	
	1	L	125×90×9	× 470	14.6	6.9	
	1	Pl.	310×9	× 350	21.9	7.7	
						44.9	
						× 2	
						89.8	
			FR6. 6A & 6B		13 Req'd.		
	4	L (Conn.	100×75×10	× 540	13.0	28.1	10
	2	Fills	155×9	× 200	10.95	4.4	
	1	Pl.	310×9	× 530	21.9	11.6	
						44.1	
						× 13	
						573.3	
			FR5 & 7		1 Req'd.		
	4	L	75×75×9	× 5470	9.96	217.9	
	4	"	"	× 5,620	"	223.9	番外 11 2
	4	"	125×75×9	× 450	13.5	24.3	
	4	"	100×75×10	× 450	13.00	23.4	
	20	Lac. bars	65×9	× 370	4.59	34.0	
	4	Pls	290×9	× 510	20.49	41.8	
	8	"	155×9	× 155	10.95	13.6	
	2	"	300×9	× 1,360	21.2	57.7	
	2	Fills.	155×9	× 200	10.95	4.4	
	4	L	100×75×10	× 170	13.0	8.8	
	2	Pls	310×9	× 350	21.9	15.3	
	2	" (for FR5	400×9	× 625	28.26	35.3	
	2	" (" FR7	415×9	× 605	29.32	35.5	
						735.9	
X		Summary for Floor frames				15,124.8 kgs	

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CHECKED BY DATE PAGE NO 20

CALCULATIONS FOR

常願寺川水路橋材料表

		LATERAL	THRUST FRAMES			4 Req'd.		
2	L's	(SB1	75×75×9	×	3.250	9.96 ✓	' 64.7	21
1	"	(SB2	"	×	6.630	" ✓	' 66.0	
1	Pl.	(P2	240×9	×	550	16.96 ✓	' 9.3	
4	Pls	P1	300×9	×	455	21.20 ✓	' 38.6	
2	L's	SB3	75×75×9	×	830	9.96 ✓	' 16.5	
4	"	SB4	"	×	1,540	" ✓	' 61.4	
4	Pls		260×9	×	360	18.37 ✓	' 26.5	
4	"		290×9	×	440	20.49 ✓	' 36.1	
6	Washers		70$^{\phi}$×9			@ 0.27	1.6	
							320.7	
							× 4	
							1,282.8	
		VERTICAL	THRUST FRAMES			4 Req'd.		
2	L's	SF1^{R}	90×90×10	×	3.710	13.30 ✓	' 98.7	21
16	Lac. bars	"	65×9	×	250	4.59 ✓	' 18.4	
1	Pl.	"	450×9	×	470	31.79 ✓	' 14.9	
2	L's	SB5	90×90×10	×	2.580	13.3 ✓	' 68.6	
							200.6	
							× 4	
							802.4	
		TRANSVERSE STRUT FOR AT TOP FLANGE OF STRINGERS				1 Req'd.		
20	L's	SRT1	75×75×9	×	5,655	9.96 ✓	' 1,126.5	21
2	"	SRT2	"	×	5595	" ✓	' 111.5	
2	"	SRT3	90×90×10	×	5,655	13.30 ✓	' 150.4	2
							1,388.4	
		LONGITUDINAL TIES				4 Req'd.		
1	L	LT1^{R}	125×90×9	×	3,595	14.60 ✓	' 52.5	23
1	"	"	"	×	1,865	" ✓	' 27.2	
1	"	"	"	×	5,730	" ✓	' 83.7	
1	"	LT2^{R}	"	×	1.865	" ✓	' 27.2	
1	"	"	"	×	3,330	" ✓	' 48.6	
1	"	"	"	×	5,315	" ✓	' 77.6	
2	Pls		365×9	×	610	25.79 ✓	' 31.5	
22	Washers		70$^{\phi}$×9			@ 0.27 ✓	' 5.9	
1	Pl.		190×9	×	390	13.42 ✓	' 5.2	
1	"		"	×	430	" ✓	' 5.8	
3	Pls		110×9	×	550	7.77 ✓	' 12.8	
1	"		190×9	×	450	13.42 ✓	' 6.0	
6	L's	(SF3, 4	125×90×9	×	3.710	14.60 ✓	' 32.50	
1	"	(SF2	"	×	3,585	" ✓	' 52.3	
1	"	(SF5	"	×	3,520	" ✓	' 51.4	
5	"	(For SF4, 5	"	×	510	" ✓	' 37.2	
1	Pl.		240×9	×	280	16.96 ✓	' 4.7	
1	L		150×100×12	×	240	22.4 ✓	' 5.4	
1	"		75×75×9	×	145	9.96 ✓	' 1.4	
1	"	SF6^{R}	125×90×9	×	1,460	14.60 ✓	' 21.3	15
1	"	SF7^{R}	"	×	1,620	" ✓	' 23.7	
1	Fill.	LT2^{R}	120×9		290	8.48 ✓	' 2.5	
							909.9	
							× 4	
							3,635.6	

Summary for Thrust frames and longitudinal ties 7,109.2 Kgs

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CHECKED BY DATE PAGE NO 21

CALCULATIONS FOR

常願寺川水路橋材料表

		LONGITUDINAL STRUT LS1, 2, 3, 4, 5 & 5A 16 Req'd.					
4	L	75×75×9	× 3,810	9.96		151.8	22
4	"	100×75×10	× 280	13.0		14.6	
2	Pls	300×9	× 370	21.2		15.7	
10	Lac. Bars	65×9	× 385	4.59		17.7	
1	Pl.	170×9	× 300	12.01		3.6	
						203.4	
						× 16	
						3254.4	
		LS6 & 7		4 Req'd.			
2	L	75×75×9	× 3,810	9.96		75.9	22
2	"	"	× 3,890	"		77.5	
2	"	100×75×10	× 290	13.0		7.5	
2	"	"	× 280	"		7.3	
2	Pls.	300×9	× 370	21.2		15.7	
10	Lac. bars	65×9	× 385	4.59		17.7	
1	Pl.	170×9	× 300	12.01		3.6	
						205.2	
						× 4	
						820.8	
		LS8		2 Req'd.			
4	L	75×75×9	× 3,760	9.96		149.8	22
2	"	"	× 292	"		5.8	
2	Fills	75×9	× 155	5.299		1.6	
1	L	90×90×10	× 190	13.3		2.5	
2	L	100×75×10	× 280	13.0		7.3	
1	Pl.	300×9	× 370	21.2		7.8	
9	Lac. bars	65×9	× 385	4.59		15.9	
1	Pl.	230×9	× 300	16.25		4.9	
1	"	630×9	× 820	44.51		36.5	
1	"	300×9	× 450	21.2		9.5	
						241.6	
						× 2	
						483.2	
		LATERAL PLATES FOR LS1 to 7		1 Req'd.			
6	Pls	LS1, 6	390×9	× 680	27.55	112.4	22
4	"	LS2, 7	640×9	× 820	45.22	148.3	
2	"	LS3.	520×9	× 830	36.74	61.0	
2	"	LS4.	520×9	× 710	"	52.2	
6	"	LS5, 5A	390×9	× 680	27.55	112.4	
						486.3	
		TRANSVERSE STRUT ST1		2 Req'd.			
1	L	125×90×9	× 5,680	14.60		82.9	22
1	"	"	× 5,640	"		82.3	
2	Pls	290×9	× 570	19.78		22.5	
2	"	220×9	× 500	15.54		15.5	
14	Lac. bars	65×9	× 410	(平均, 七サ) 4.59		26.3	
						229.5	
						× 2	
						459.0	

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CHECKED BY DATE PAGE NO 22

CALCULATIONS FOR

常願寺川 水路橋材料表

		BRACKET BK1			42 Req'd.		
1	L	100×100×10	×	470	14.9	7.0	22
1	Pl.	245×9	×	470	17.31	8.1	
2	LS	75×75×9	×	250	9.96	5.0	
						20.1	
						× 42	
						844.2	
		PIPE ANCHOR PS1			2 Req'd.		
2	LS	100×75×10	×	430	13.0	11.2	22
						11.2	
						× 2	
						22.4	
		Summary for longitudinal and transverse strut on water way deck				6,370.3 Kgs.	
		BOTTOM BRACINGS ON WATER WAY DECK					
24	LS	BL1R	125×90×9	×	3.110	14.6	1089.7	23
4	〃	BL2R	〃	×	2.990	〃	174.6	
4	〃	〃	〃	×	3.060	〃	178.7	
24	〃	BL3	〃	×	3.170	〃	1110.8	
8	〃	BL4	〃	×	3.100	〃	362.1	
4	〃	BL5R	〃	×	3.100	〃	181.0	
4	〃	〃	〃	×	3.030	〃	177.0	
40	〃	BL6R.7R.8R	〃	×	3.240	〃	1892.2	
							5166.1	
		BOTTOM LATERAL BRACINGS AL Lo to L3					
8	LS	LL1	90×90×10	×	4.715	13.30	501.7	26
8	〃	〃	125×90×9	×	4.715	14.60	550.7	
8	Tie Pls	〃	175×9	×	270	12.36	26.7	
20	〃	〃	170×9	×	175	12.01	42.0	
4	LS	LL2R	90×90×10	×	4.840	13.30	257.5	
4	〃	〃	〃	×	4.940	〃	262.0	
4	〃	〃	125×90×9	×	4.840	14.60	282.7	
4	〃	〃	〃	×	4.940	〃	288.5	
8	Tie Pls	〃	175×9	×	270	12.36	26.7	
20	〃	〃	170×9	×	175	12.01	42.0	
4	LS	LL3R	90×90×10	×	4.860	13.30	258.6	
4	〃	〃	〃	×	4.785	〃	254.6	
4	〃	〃	125×90×9	×	4.860	14.60	283.8	
4	〃	〃	〃	×	4.785	〃	279.4	
8	Pls	〃	175×9	×	270	12.36	26.7	
20	〃	〃	170×9	×	175	12.01	42.0	
							3,426.4	
		Summary for bottom lateral bracings					9,592.5 Kgs.	

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CHECKED BY DATE PAGE NO 23

CALCULATIONS FOR

常願寺川水路橋材料表

		SWAY BRACINGS UNDER WATER WAY DECK 2 Reg'd.							
2	L	SW1	130×130×9	×	3.735	17.7	132.2		27
2	〃	SW2	〃	×	3.825	〃	135.4		
2	〃		125×90×9	×	580	14.6		169	
1	Pl.		565×9	×	570	39.92		22.8	
2	L	SW3, 4	130×130×9	×	6.400	17.7	226.6		
1	Pl.		130×9	×	280	9.19		2.6	
8	L	BR1, 2	90×75×9	×	405	11.0		35.6	
4	Pls	〃	380×9	×	380	26.85		40.8	
8	L	〃	100×75×10	×	790	13.0		30.7	
2	〃	LSS2	125×75×9	×	5.345	13.5	144.3		
1	Web Pl.	〃	420×9	×	4.585	29.67	136.0		
4	L	〃	90×90×10	×	230	13.3		12.2	
2	〃	〃	〃	×	425	〃		11.3	
2	〃	〃	〃	×	290	〃		7.7	
2	Pls	〃	535×9	×	735	37.80		55.6	
2	L	〃	90×90×10	×	230	13.3		6.1	
4	Pls	〃	150×9	×	270	10.60		11.4	
1	L	〃	75×75×9	×	605	9.96		6.0	
1	Pl.	〃	360×9	×	550	25.43		14.0	〃
1	〃	〃	480×9	×	630	33.91		21.4	〃
2	L	SW5	130×130×9	×	2.900	17.7	102.7		28
1	Pl.	LSS3	230×9	×	790	16.25		12.8	〃
2	L	〃	100×75×10	×	790	13.0		20.5	〃
2	〃	〃	125×75×9	×	5.355	13.5	144.6		
2	〃	〃	75×75×9	×	5.355	9.96	106.7		
2	〃	〃	90×90×10	×	410	13.3		10.9	
2	〃	〃	〃	×	285	〃		7.6	
2	〃	〃	〃	×	230	〃		6.1	
1	L	〃	75×75×9	×	595	9.96		5.9	
1	Pl.	〃	360×9	×	540	25.43		13.7	
1	〃	〃	470×9	×	620	33.21		20.6	
4	L	LSS4	75×75×9	×	5.360	9.96	213.5		
1	Web Pl.	〃	510×9	×	4.455	36.03	160.5		
4	L	〃	90×90×10	×	305	13.3		16.2	
2	〃	〃	〃	×	410	〃		10.9	
2	〃	〃	〃	×	285	〃		7.6	
2	Pls	〃	600×9	×	820	42.39		69.5	
4	〃	〃	150×9	×	365	10.60		15.5	
2	Fills	〃	210×9	×	220	14.84		6.5	
1	L	〃	75×75×9	×	595	9.96		5.9	
1	Pl.	〃	355×9	×	550	25.08		13.8	
1	〃	〃	400×9	×	560	28.26		15.8	
2	L	〃	100×75×10	×	170	13.0		4.4	
4	〃	LSS1	125×75×9	×	5.345	13.5	288.6		
4	〃	〃	90×90×10	×	370	13.3		19.7	
2	Pls	〃	400×9	×	550	28.26		31.1	
2	L	〃	90×90×10	×	230	13.3		6.1	〃
22	Lac. bars	〃	65×9	×	535	4.59		54.0	〃
2	Ls	LSS2	75×75×9	×	5.345	9.96	106.5		
1	w web Pl	LSS3	420×9	×	5.540	29.67	164.4		

2062.0 + 669.7 = 2,731.7

2

5,463.4

Summary for Sway bracings under waterway deck 5,463.4 Kgs

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CALCULATIONS FOR

常願寺川水路橋材料表

D

HANGER HR1R — 4 Req'd.

1	L	90×90×10	× 2.440	13.30	32.5	12
1	Pl	90×9	× 270	6.36	1.7	
1	"	160×9	× 160	11.30	1.8	
					36.0	
					× 4	
					144.0	

Summary for hangers = 144.0 kgs.

CAST STEEL SHOES

			kgs		
4	Cast steel shoes	@	1,180.0	4,720.0	13
4	Pins & Nuts	@	84.0	336.0	
24	Anchor bolts	@	8.4	201.6	

CAST STEEL BEARING BLOCK FOR PIN AT L0

4	Cast steel	@	139.0 kgs	556.0	14

CAST STEEL SHEAR BLOCK AT T5

4 Sets	Cast steel	@	40.0 kgs	160.0	24

CAST STEEL BRACKETS FOR STRINGERS AT M5

8	Cast steel	@	13.6 kgs	108.8	12

Summary for Cast steel 6,082.4 kgs

TOTAL SUMMARY (Rivet heads ⇒ 含マズ)

		Kg. Tons.		
×	Summary for End posts and Top chords	46.9653		
×	Lower chords	54.5467	Kg.Tons	
	Diagonals.	13.8592	150.4343 (2trusses)	×
×	Verticals and Hangers	25.5184		
×	Ties	9.5452		
	Floor beams	5.6226		
×	Floor frames	15.1248	34.7724 (Floor System)	×
	Stringers	14.0250		
	Top lateral bracings	3.8314		
	Portal & Sway bracings	9.3314		
	Thrust frames and longitudinal ties	7.1092		
	Longitudinal & transverse Struts on water way deck	6.3703	40.8422 (Bracings etc.)	
	Bottom lateral bracings	8.5925		
	Sway bracings under water way deck	5.4634		
	Hangers HR1R	0.1440		
×		226.0489		
	Cast steel	6.0824		
×		232.1313	(Truss span Complete)	

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CHECKED BY _____ DATE _____ PAGE NO 25 R.

CALCULATIONS FOR

常願寺川水路橋材料表　追加材料表

		APPROACH SPAN FOR RIGHT BANK							
1	C	B1	380×100@67.3 Kgs	×	6.740	✓✓	67.3	453.6	
4	L	〃	130×130×9	×	270	✓	17.7		19.1
2	〃	〃	90×90×10	×	370	✓	13.3		9.8
2	Pls	〃	145×9	×	260	✓	10.24		5.3
2	Is	B2 & 3	400×150@95.8 Kgs	×	6.910	✓✓	95.8	1,324.0	
4	L	〃	130×130×9	×	290	✓	17.7		20.5
11	〃	〃	90×90×10	×	390	✓	13.3		57.1
11	Pls	〃	145×9	×	260	✓	10.24		29.3
2	Sole Pls	〃	300×16	×	340	✓	37.68		25.6
2	Bed 〃	〃	330×16	×	370	✓	41.45		30.7
1	C	B4	380×100@67.3 Kgs	×	6,910	✓✓	67.3	465.0	
3	Ls	〃	90×90×10	×	370	✓	13.3		14.8
3	Pls	〃	145×9	×	260	✓	10.24		8.0
2	Ls	〃	130×130×9	×	270	✓	17.7		9.6
1	Sole Pl.	〃	300×16	×	300	✓	37.68		11.3
1	Bed 〃	〃	330×16	×	330	✓	41.45		13.7
1	I Cross beam	CB1	400×150@95.8 Kgs	×	2.135	✓	95.8		204.5
2	Ls	〃	125×90×9	×	290	✓	14.6		8.5
1	Sole Pl.	〃	300×16	×	340	✓	37.68		12.8
1	Bed 〃	〃	330×16	×	370	✓	41.45		15.3
4	Ls	SU1	75×75×9	×	950	✓	9.96		37.8
2	Pls	〃	170×9	×	260	✓	12.01		6.2
12	Ls	SU2	75×75×9	×	925	✓	9.96		110.6
6	Pls		170×9	×	260	✓	12.01		18.7
8	Anchor bolts		32φ	×	600	✓	@ 4.2		33.6
								2,242.6 +	702.8 = 2,945.4
		APPROACH SPAN FOR LEFT BANK							
2	Cs	B5L	250×90@34.6 Kgs	×	4.140	✓	34.6	286.5	
4	Ls	〃	130×130×9	×	190	✓	17.7		13.5
4	〃	〃	100×75×10	×	240	✓	13.0		12.5
4	Pls	〃	145×9	×	210	✓	10.24		8.6
2	Sole Pls	〃	290×16	×	300	✓	36.42		21.9
2	Bed 〃	〃	320×16	×	330	✓	40.19		26.5
4	Is	B6	250×125@38.3 Kgs	×	4140	✓✓	38.3	634.2	
8	Ls	〃	130×130×9	×	190	✓	17.7		26.9
16	〃	〃	100×75×10	×	240	✓	13.0		49.9
16	Pls	〃	145×9	×	210	✓	10.24		34.4
4	Sole Pls	〃	300×16	×	320	✓	37.68		48.2
4	Bed Pls	〃	330×16	×	350	✓	41.45		58.0
6	Ls	TR1	75×75×9	×	935	✓	9.96		55.9
4	〃	TR2	〃	×	930	✓	〃		37.1
12	Anchor bolts		25φ	×	500	✓	@ 2.3		27.6
								920.7 +	421.0 = 1,341.7

GRAND SUMMARY

		Kg, Tons
X	Truss span complete	232.1313 ✓✓
	Aprroch span for Right bank	2.9454
	〃 〃 〃 Left bank	1.3417
X		236.4184 ✓✓

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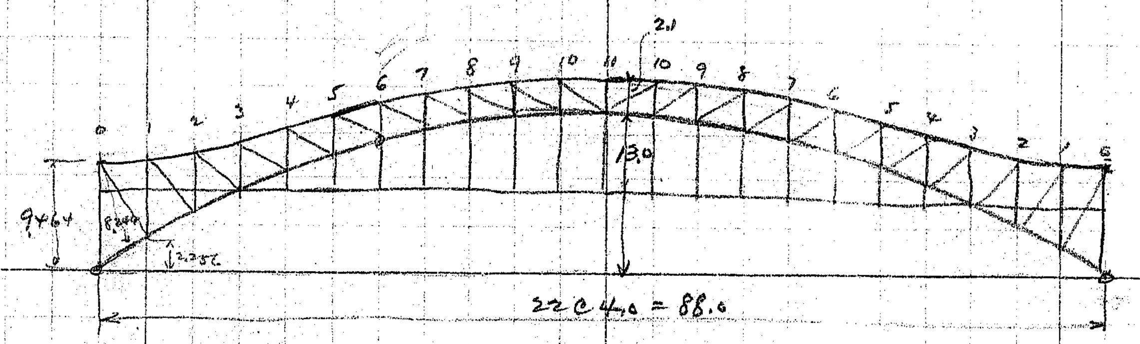
CALCULATIONS FOR

常盤寺川水路橋

Approximate Calculation of stresses for main truss.



13.0
2.1
15.1 × .975 = 14.7 m

Dead Load Thrust Dead panel load 8000 kg.

$H_D = \frac{8000 \times 60.5 \times 4}{14.70\ (14.5)} = 131,800$ kg

Vertical reaction on hinge

8000 × 10.5 = 84,000 kg

Water Load Thrust $H_W = \frac{2260 \times 60.5 \times 4}{14.7} = 37,300$ kg

2260 × 10.5 = 23800

Motor truck with unif load Thrust

$H_M = $ 3900 × 16.48 = 64300
800 × 11.0 × 4 / 14.7 = 2400
66700 kg
235800 kg

3900 × 10.5 = 41000
1600 ÷ 2 = 800
41800
149,600 kg

Top chord max stress $U_{10}-U_{11}$

8000
2260
3900
14160

149600 × 44.0 = 6580000
14,160 × 55 × 4 = − 3115000
235800 × 13.0 = − 3065000
400000 ÷ 2.10 = 191000 kg C. DL + LL + WL

Bottom chord max stress L_0-L_1

235800 × 9.464 = 2230000 ÷ 8.244 = 271,000 kg C DL + LL + WL
297000

8800

End vertical U_0-L_0

149600 × 4.0 = 598000
235800 × 2.256 = − 532000
66,000 ÷ 4.0 = 16500
Panel load. 4000 + 1130 + 1980 + 1600 = 8700
25200 kg C + 10000 = 35000 Side Span

Top chord U_0-U_1 8800 kg C

Diagonal U_0-L_1 1800 " C

Bottom chord $L_{10}-L_{11}$

149600 × 40.0 = 5980000
235800 × 15.037 = − 3545000
14160 × 45 × 4 = − 2550000
− 115000 ÷ 2.147 = 54000 C × 1.25 = 68000 C
− 480000

増田淳氏関係資料
(独立行政法人 土木研究所蔵)

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CALCULATIONS FOR

8000
2260
3900) 6160
1416o

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青森ちい水道橋

Diagonal $M_{10}-L_{11}$

$\frac{6160 \times 66}{22}$ = 18,500 × $\frac{4.5}{2.1}$ = 39600
LL = 20000

60,000 kg C

upper chord M_5-M_6

D.L. Thrust 131800 kg v = 84000

m = 84,000 × 24 = + 2015000
131800 × 10.314 = − 1360000
8000 × 60.0 = − 480000
175,000 ÷ 3.167 = 55,300

W.L. 55300 × $\frac{2260}{8000}$ 15,700

71000 kg C

L.L. say ⅔ × 71000 = 47500

118,500 kg C

Lower chord. L_5-L_6
D.L.

m 84000 × 20 = + 1680000
131800 × 12.83 = − 1692000
8000 × 40 = − 320000
332000 ÷ 3.546 = 94000

W.L. 94000 × $\frac{2260}{8000}$ = 26600
120600

L.L. 120600 × $\frac{2}{3}$ = 80400

201,000 kg C.

Diagonal M_5-L_6
D.L. 84000 × 50.562 = + 4245000
131800 × 18.163 = − 2395000
8000 × (30.562 × 5 + 4 × 15) = − 1703000
+ 147000 ÷ 20.789 = 7100 T

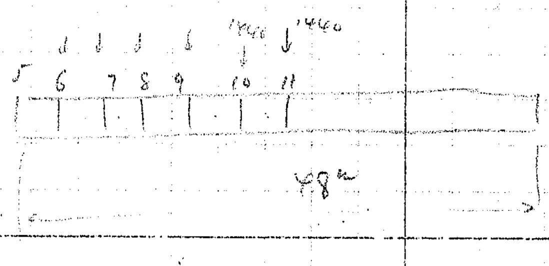
W.L. 7100 × $\frac{2260}{8000}$ = 2000
9100

LL 9100 × $\frac{2}{3}$ = 6100

15,200 T

vertical members for max. stress in Diagonal

wind stress. upper chord



$M_{10}-M_{11}$
360 kg/m

$\frac{360 \times 48^2}{8}$ = $\frac{104,000}{6.0}$ = 17,400 kg T or C

青瓦台の水路橋

44.434 88.88
46.436 92.87

Temperature stress.
Average S_a for H = -1 applied.

	Upper chord	Lower chord
0-1	-0.2968	1.1480
1-2	-0.7031	1.4526
2-3	-1.2519	1.8643
3-4	-1.8529	2.3868
4-5	-2.5220	2.9814
5-6	-3.2567	3.6182
6-7	-4.0477	4.3303
7-8	-4.8364	5.0949
8-9	-5.5301	5.8589
9-10	-6.0191	6.5332
10-11	-6.1905	7.0168
	-36.4872 ✓	42.2864 ✓
÷11 =	-3.315	3.840

$\Sigma S_a^2 \frac{L}{A}$

for top chord. $3.315^2 \times \frac{8886}{210} = 465$

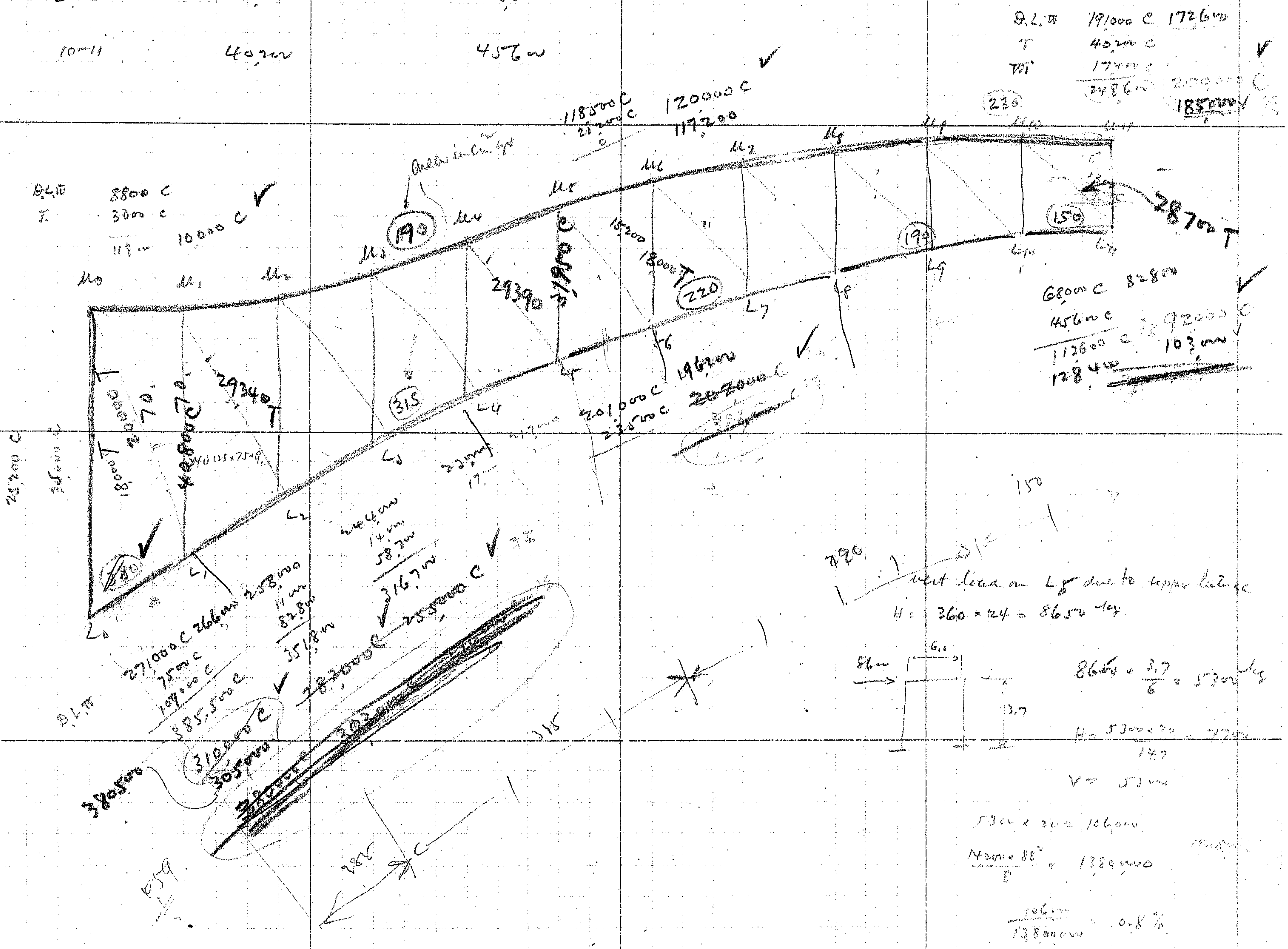
bottom " $3.84^2 \times \frac{9287}{246} = \underline{557}$
1022.5

$\alpha E t l = 0.000012 \times 2{,}100{,}000 \times 30 \times 8800$
$= 6640{,}000$

$H_t = \pm \frac{\alpha E t l}{\Sigma S_a^2 \frac{L}{A}} = \pm \frac{6640000}{1022.5} = \pm 6500$ kg.

Temp. stress.

	Upper chord	Lower chord
0-1	3000	7000
5-6	21,200	23,500
10-11	40,200	45600



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CALCULATIONS FOR

秀瓦李川水鉄橋

Sections of main truss members

Upper chords

max $U_{10}-U_{11}$ 200,000 C SR = 200.00 cm² gr

1 cov-pl.	550 × 9 =	49.50	
4 Ls	90×90×10 =	68.00	
2 web pls	400 × 9 =	72.00	
		189.50 — O	U_0 to U_9
2 pls	220 × 10 =	44.00	
		233.50 gr — O	~~U_9 U_{10} U_{11}~~

Lower chord.

4 Ls	100×100×10	=	76.00	
2 pls	400 × 9	=	72.00	
			148.00 cm² gr	L_8-L_{11}
4 Ls	100×100×10	=	76.00	$L_{10}-L_{11}$
2 pls	400 × 9	=	72.00	
2 pls	200 × 10	=	40.00	
			188.00	L_8-L_{10}
4 Ls	100×100×13	=	97.24	169
2 pls	400 × 9	=	72.00	
2 pls	200 × 13	=	52.00	L_5-8
			227.24	L_5-L_8
4 Ls	100×100×13	=	97.24	
2 pls	400 × 9	=	72.00	
2 pls	200 × 13	=	52.00	
2 pls	360 × 13	=	93.60	
			314.84	L_1-L_5
4 Ls	100×100×13	=	97.24	
4 pls	400 × 9	=	144.00	
2 pls	200 × 13	=	52.00	
2 pls	360 × 13 (9)	=	93.60	
			386.84	L_0-L_1

4 Ls 100×100×10 = 76.00
2 pls 400×12 = 96.00
172.00
L_4-L_6 2 pls 200 × 10 = 40.00
212.00
L_2-L_4 2 pls 360 × 9 = 64.8
276.8

L_1-L_2 2 pls 360 × 12
212.00
86.3
298.30

212
88.8
300.8

L_0-L_1 2 pls 370 × 14
212.00
103.6
315.6

370

188.0
52
240

188
65
253

2 × 36 × 9

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CALCULATIONS FOR

Approximate weight of structural steel

Stringers Complete		=	14,150
Floor Beams with cross frames complete		=	23,400
Handrails	2×25 kg = 50.0 × 88	=	4,400
bottom lateral br.	88 @ 145	=	12,750
top " "	88 @ 105	=	9,250
rods for handrail 19ϕ	44 @ 9.2	=	0,400
ladders	4 @ 50	=	0,200
			64,550

Handrail
pipes 1½" 1 @ 4.05 = 4.1
1¼" 2 @ 2.55 = 5.1
couplings = 0.8
Post 11.0
fills + bolts 1.5
22.5 kg/m

Trusses.	2 @ 84.750 =		169.500
			221.5
Shoes	4 @ 1.200 =		4.800
traction framings	4 @ 1.500 =		6.000
cross struts of stringers	22 @ 0.550 =		1,100
			245.950 kg call this 246.000 kg tons.

Approximate weight of structural steel in one truss

Upper chord.					
U_9-U_{11}-U_9	230	@ .785	× 16.01	=	2890
U_{10}-U_9	190	@ "	× 72.86	=	10,870
Bottom chord.					
L_{10}-L_{11}-L_{10}	150	@ .785	× 8.00	=	942
L_8 — L_{10}	190	@ "	× 16.10	=	2400
L_5 — L_8	220	@ "	× 24.71	=	4265
L_1 — L_5	315	@ "	× 34.88	=	8,630
L_0 — L_1	380	@ "	× 9.18	=	2,740
Diagonal. all members.	70.0	@ "	× 116.89	=	6420
Verticals. 3	70.0	@ "	× 154.73	=	8500
" end.	190.0	@ "	× 18.93	=	2820
ties	70.0	@ "	× 64.00	=	3518
"	35.0	@ "	24.0	=	660
					54653
		Details	55%	=	30.097
					84.750

8887

92.87

7648
6174
5046
5876
6706
7404
7972
8412
8726
8913
8976
154.73

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CALCULATIONS FOR

Design of Shoes

Horizontal Thrust H.

panel Pt.	H. unit
1	0.162
2	0.313
3	0.465
4	0.611
5	0.751
6	0.882
7	1.001
8	1.104
9	1.183
10	1.233
11	1.247
1	1
2	16.657 for one span

Panel Loads.

Dead Load 7600 kg.
Water " 2300 "
(motor truck) Live Load 3900 " with single concentration of 16000 kg.

Dead Load Thrust H_D = 7600 × 16.657 = 126700 kg
Water Load Thrust H_W = 2300 × 16.657 = 38300 "

Live Load Thrust (motor truck with uniform load)

3900 × 16.657 = 65000
16000 × 1.247 = 2000
H_L = 67000 kg.

Train Load Thrust.

10	1.233 ×	4400 =	5430
11	1.247	3500	4360
10	1.233	3200	3950
9	1.183	2800	3320
8	1.104	100	110
			17170 kg. for 50% impact
		17170 × 1m/150 =	14300
	snow	1000 × 16.657	16700
		H_E	31000 kg for 25% imp with snow

Temperature thrust ± 6500 kg

Vertical Load on shoe.

Dead Load	V_D = 7600 × 11.0 =	83600 kg
Water Load	V_W = 2300 × 11.0	25300 "
Live Load (Truck)	3900 × 11.0 = 42900	
	1600	
	V_L =	44500 kg

Wind Load

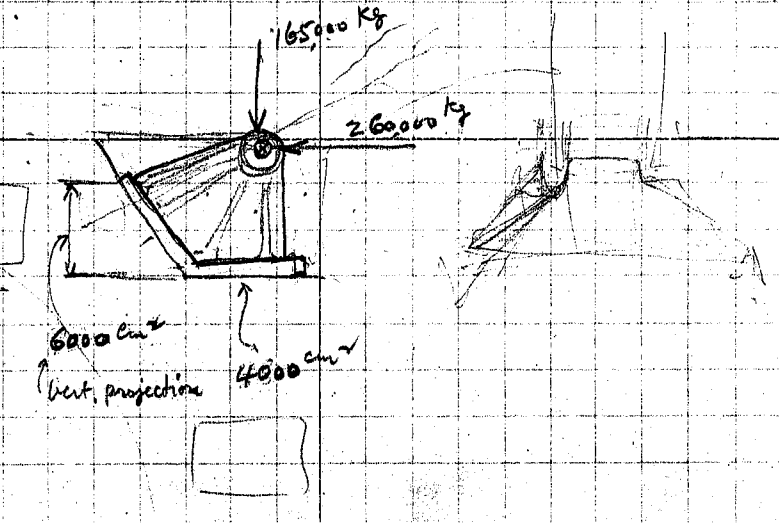
Reaction ± 107,000 kg.

Hor. component H_W = 107,000 × 4,000/4,592 = 93,200 kg

Vert. " V_W = 107,000 × 2,257/4,592 = 52,600 kg

Summmary of Loads on shoe.

	Hor. load.	Vert. load.
Dead Load.	126,700	83,600
Water Load.	38,300	25,300
Live Load	67,000	44,500
Wind Load	± 93,200	± 52,600
	325,200	206,000
max. load	+1/5 = (260,000)	+1/5 (165,000)
min load	33,600	31,000
DL+WL+LL	232,000	153,400



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CALCULATIONS FOR

		760ω	23ω	39ω	16ω	
	Panel load	DL	WL	LL	Concentration	
$M_8 - M_6$		-6,372	-6,372	-12,795	-2,628	
		-48400	-14650	-49900	-4220	-117,170 ✓
$M_{10} - M_{11}$		-12,114	-12,114	-12,326	-2,756	
		-92,200	-27,850	-48,100	-4400	-172,550 ✓
$L_0 - L_1$		-19,120	-19,120	-19,126	-1,432	
		-145,200	-44ω	-76ω	-2290	-266,090
$L_5 - L_6$		-12,323	-12,323	-18,205	-1,973	
		-93,700	-28,320	-71,ω	-3,160	-196,180
$L_{10} - L_{11}$		-4,890	-4,890	-8,164	-1,098	
		-37,200	-11,250	-32,600	-1,760	-82,810
Diag. $M_1 - L_a$		+1,346	+1,346	+3,698	+0,993	
		+10,230	+3,100	+14,420	+1,590	+29,340
〃 $M_4 - L_5$		+1,586	+1,586	+3,112	+0,970	
		+12,050	+3,650	+12,140	+1,550	+29,390

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CALCULATIONS FOR DL M LL Con

$M_{10}-L_{11}$	+0.386	+0.386	+5.948	+1.040	
	+2930	+890	+2320	+1660	+28680
vert. M_4-L_4	−2.228	−2.228	−4.873	−1.052	
	−16900	−5120	−17050	−1680	−40750
M_4-L_5	−1.995	−1.995	−2.814	−0.787	
	−15150	−4590	−10980	−1220	−31940

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増田淳事務所
電話丸ノ内七七七番

tower.

	5ヶ	×2	
.2×.2×18×16 = 11.5	3	5	
.2×.15×13.0×10 = 3.9	2	2	
.2×.1×7×16 = 2.3	3	3	
~~.2×.1×3.5×15×4 = 4.2~~	6	6	
.2×.06×3×44 = 1.6	4	4	
.2×.2×2.0×10 = .8	2	2	
	1	1	
.2×.3×2.1×12 2.3	2	2	
26.6 @ 40 =	1065		26.
5ヶ所へ組立	120		
saddle	100		
bolt. 18	150		
	1435		

キソ conc. 23 @ 16 = 350
切取り 20 @ 6 = 120
470
1900

据付材 500 1400 1000

東京市麹町區丸ノ内帝國劇場南側四階十七號室
増田淳事務所
電話丸ノ内七七七番

towers	左岸		1400
	右岸		1000
	anchor.	φc 100 =	200
	strut		200
	キソ (ボーリング)	φ@200 =	800
			3800
	ベント	φc 100	700
	木材		500
	足場	88 c r.	440
	ケーブル張り	m	200
			5640
	misc キカイ等地搬費		860
			6,500 円
	6500 / 240 =		27.00 円

増田淳事務所

Made by K. J. Date 6-5-27
Checked by Date Page no. 69

常願寺川 跨橋 單價表

1:2:4 コンクリート 1立米当										
	セメント	2.0	樽	4.50	9.00			Concrete		6.79
	洗ネカ利	1.00	立米	4.00	4.00	6.79		Reinforcement	1/30 × 120 =	0.67
	洗砂	0.50	〃	1.50	0.75			form	2.3 × 0.15 =	3.45
	統手間	1.70	人	1.20	2.04					10.91
					15.79円					
1:3:6 コンクリート 1立米当										
	セメント	1.33	樽	4.50	5.98					
	洗砂利	1.00	立米	4.00	4.00	6.79+				
	洗砂	0.50	〃	1.50	0.75					
	統手間	1.70	人	1.20	2.04					
					12.77円					

枕木 一挺当り

1.2×1.5×3.1 = 0.0838 m³ @ 90円 = 7.55

雑物 1.095×150円 = 164.3円 × 1.78 = 292 銭

8.47 + 0.33 = 8.80

当板 共3枚

2.8×0.045×4.0 = 0.050 m³ @ 50円 = 2.50 + 20 = 270

据鋲

枕1挺当

先孔	穿孔	114.3	@	4.50 =	515
	切込	15.7	@	10.00 =	157
		130.0 m³			672円 + 130 = 5.20円/m³

鉄沓 saddle

穿孔	0.045 m³	@	90 =	405
仕上取付	0.6 人	@	200 =	120
工作雑物	0.525 t	@	150+23 =	345
				870円

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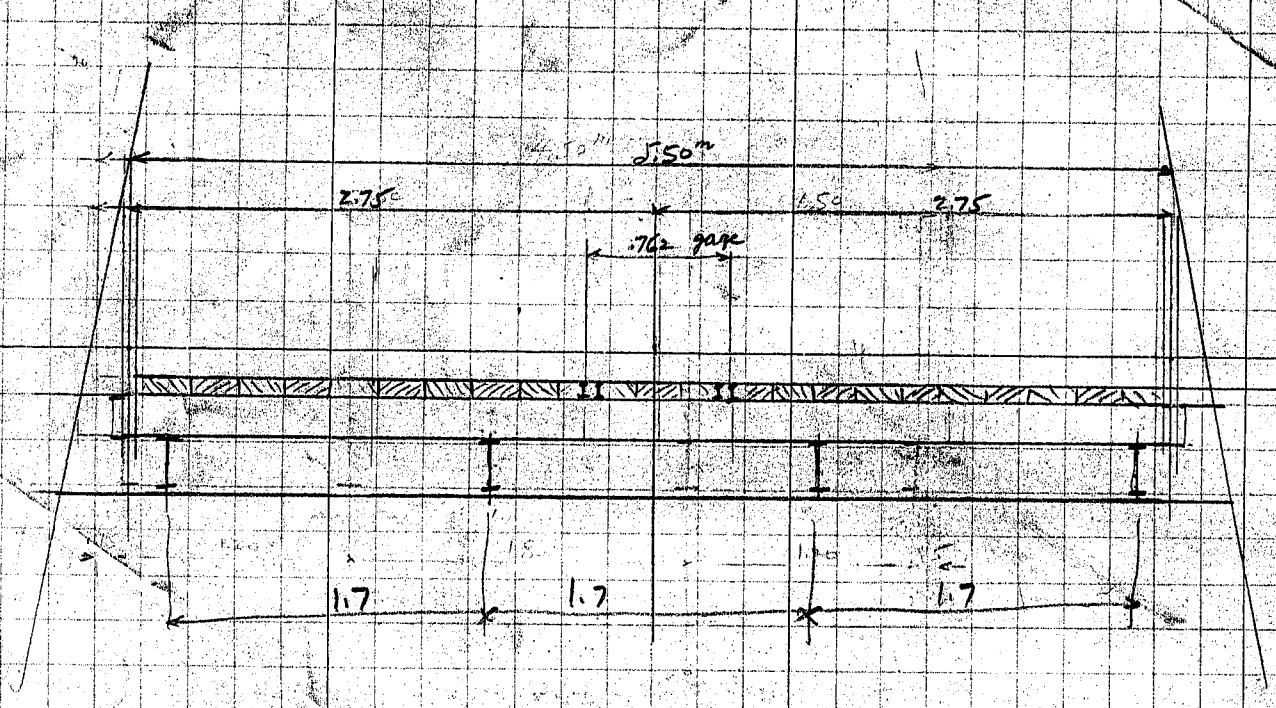
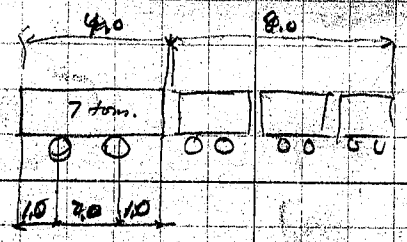
CALCULATIONS FOR

鉄筋コンクリート床版

Floor system
Cross section



Engine load. 7.00 kg tons. Uniff load 14 tons. total load 21.0 tons.



Engine one wheel load. $\frac{7}{4} = 1.75$ tons.

Impt. $I = L\left(\frac{6}{90+L}\right) = 1.75\left(\frac{60}{90+4.1}\right) =$

$= 1.75 \times .65 = \frac{1.15}{2.90}$ tons

又は 6.0 ton motor truck loadings

wheel loads.
rear wheel.
Impt. $\frac{20}{60+4.1} = 30\%$

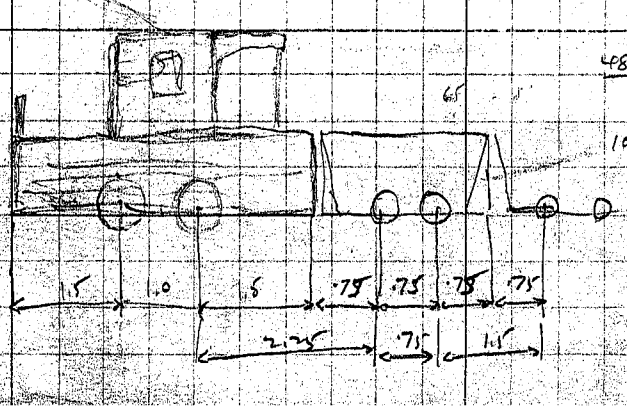
2250 kg.
675
2925 kg. for one wheel.

floor planking Span length 0.7m ← 60 cm

moment $2925 \times 0.70 \div 4 \div 512$ kgm.
assume eff. width .70 $m = 512 \div .7 = 730$ kgm
DL m. $50 \times .7^2 \div 10 =$
730 kgm

Sm reqd. $= \frac{730 \times 100}{60} = 1217$ cm³

use 7.5cm planking Sleeper spacing 60 cm



$2925 \times 0.5 \div 4 = 365$
$\div .7 = 610$ kg/m
$\frac{512 \times 1.2}{60} = 87 \times 1.8 = 696$
$\frac{100 \times 8^2}{6} = 746$
$\frac{365}{.6} = 610 \times .8 = 487$
$\frac{487 \times 10}{60} = 810 \times \frac{6}{5} = 972$
$\frac{100 \times 6^4}{6} = 1080$

650 400

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CALCULATIONS FOR

常磐新川水路橋

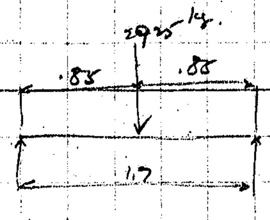
Sleeper. span length 1.7 m spacing 0.60 m c to c.

D.L.

Planking 7.5 cm × 0.60 @ 65 = 30
sleeper assumed .15×.25 @ 650 = 24
54

D.L. m = 1/10 × 54 × 1.7² = 16 kgm

L.L.



m = 2925 × 1.7 ÷ 4 = 1244
16
1260 kgm.

Sm reqd = (1260 × 100) / 60 = 2100 cm³.   (20×25²)/6

use 20×25   (20×25²)/6 = 2080

Dead Load of Floor system.

Planking 7.5 @ 650 = 49 × 5.5 = 270
Sleeper .20×.25 @ 650 = 33 × 5.5 / .6 = 300
rails 4 @ 12.5 kg/m = 50
accessories say 10
handrails 2 @ 30 = 60
misc. bolts &c. say 50
740 kg / lin m of bridge

(25) ×3.3 / 3.=<2.2   1.1 6.5

for one truss 740 ÷ 2 = 370

for one panel 370 × 4.1 = 1520 kg. for one truss.

Stringers D.L. floor 370 ÷ 1.5 = 250
beam 50
300

moment 1/8 × 300 × 4.1² = 630 kgm
LL. 2925 × 4.1 ÷ 4 = 3100
3730 kgm

Sm reqd. = (3730 × 100) / 1100 = 340 cm³

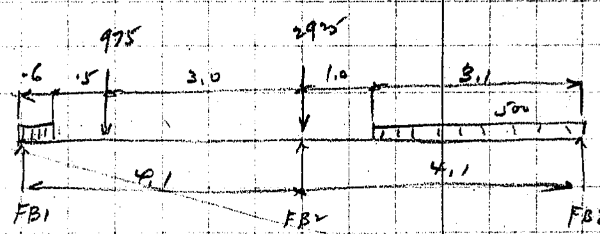
use 250 × 125 @ 38.3′ Sm = 414.9

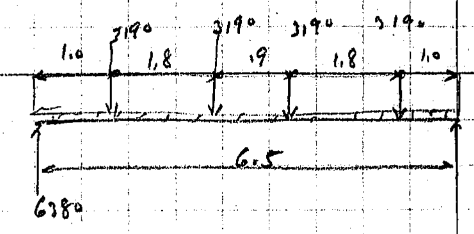
floor beams. span length 6.5 m spacing 4.1 m c to c.
D.L.
floor system 740 ÷ 5.5 = 135
stringer 40 × 4 × 4.1 ÷ 5.5 = 120
floor beam assumed 105
360 kg / lin m.

m = 1/8 × 360 × 6.5² = 1900 kgm

常盤東川水路橋.

Live Load.





wheel load 975 × 1.1 ÷ 4.1 = 265
2925
3190 kg.

unif load 500 × ·6² ÷ 8.2 = 22
500 × 3.1² ÷ 8.2 = 588
610 kg/lm.

Moment
wheel load 6380 × 2.80 = 17830
3190 × 1.80 = 5740
12110

unif load 1/8 × 610 × 6.5² = 3220
15330

DL m 1900
17230 kgm.

assume web 600 × 9 1/8 web = 6.8

flange stress = 17230 × 100 / 58 = 29800 kg C or T.

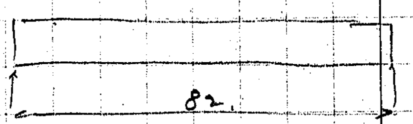
~~flange area reqd = 29800 / 1200 = 24.8 net~~
6.8
18.00 net.

use 2L 75×75×9 = 25.38 − 4.5 = 20.88

·9 2.5×2 ·9 Approx wt of floor beam.
4L 75×75×9 @ 9.96 = 39.9
web 600 × 9 = 42.4
82.3
Detail say 30% = 24.7
107.0 kg. call this 110 × 6.5 = 720 kg.

tie 500 × 8.2² / 8×7 = 6000 kg.
6000 / 1200 = 5.0 net.
5.5 kg/m

Lateral bracing

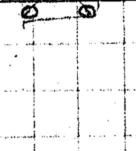


wind press assumed 250 kg/m² (exposed area)
end shear = 250 × 4.1 × 10,250 kg. × 2. = 20500
Diagonal stress 10250 × 1.42 = 14600 C or T — 12.2 cm² net = 24.4

for 3 panels at end 125×75×9
intermediate panels 2L 75×75×9

3 × 138 + 20 + 70 = 288/4.1 = 57 + 13 = 70 kg/m

Lateral bracing 120 kg/lin m



Dead Load on truss.

Dead Load wooden floor. 740
Stringers 4 @ 40 = 160
floor beam 720 ÷ 4.1 = 175
bott. lateral say ~~120~~ 150
top lateral with sway 130
Tie 2 @ 60 = 120
bott strut 50
cross frames 35
~~1380~~ 1410

trusses assumed 2400 2400
~~3780~~ 3810

Pipe Line 315
water 1135
1450
5260 ÷ 2 = 2630 kg/m for one truss

panel load = 2630 × 4.6 = 12000 kg.

100
500
57 lat.
55 strut
13 tie
250/00
3050
61
5100 × 67
315
315.

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MADE BY ______ DATE 6-5-11 **FILE NO** ______

CHECKED BY ______ DATE ______ **PAGE NO** 4

CALCULATIONS FOR

常磐橋水路橋

Design of Truss. Span length 82m = 20 @ 4.1m

Approximate Horizontal Thrust
Dead Load 2615 kg/lin m for one truss.
Thrust. $\frac{2630 \times 82^2}{8 \times 14.1}$ = 157,000 kg. × 1.025 (adjusting factor) = 161,000 kg.

Live Load. Uniform load = $\frac{100\,000}{170+82}$ = 396 kg/m² call this 400 kg/m² 400 × 2.75 = 1100 kg/m

1. Electric car load 7.0 ($\frac{60}{90+82}$) = 9.45 ÷ (3.0 × 4.0) = 800 kg/m²
− 400
400 kg/m² extra unif load.
extra unif load. 1.5 × 400 = 600 kg/m — 12m long

Thrust. full unif load.
$\frac{1100 \times 82^2}{8 \times 14.1}$ = 65,600 kg × 1.025 = 67,000 kg.
extra unif load
600 × 6 = 3600 × 41 = 147,500
$\frac{600 \times 6^2}{2}$ = 10,800
136,700 ÷ 14.1 = 9700 × 1.025 = 10,000 kg.
77,000 kg.

Summary of Thrust
Dead Load 161,000
Live Load 77,000
238,000 kg.

Stresses of truss members.
Crown. top chord
~~moment~~ DL $\frac{2630 \times 82^2}{8}$ = 2,210,000
157000 × 12.0 = 1,883,000
327,000 ÷ 2.1 = 156,000 kg C
LL. 156000 × $\frac{1100}{2630}$ = 65,100
136,100
10000 × 12 = 120,000
16100 ÷ 2.1 = 7,700
228,800 kg C 228.8 cm² gr

middle chord crown
m. DL $\frac{2630 \times 36.9 \times 45.1}{2}$ = 2,205,000
$\frac{w(l-a)a}{2}$ $\frac{l}{2}$ $\frac{l}{4}$ $\frac{l^2}{4}$
−1,880,000
225,000 ÷ 2.1 = 107,000 T
LL 107000 × $\frac{1100}{2630}$ = 44,700
5,300
157,000 T 131.0 net.
131 × 1.2 = 157 gr

at hinge lower chord
vert load. 2630 + 1100 = 3730 × 41 = 153,000
600 × 6 = 3,600
156600 × 2.1 = 329,000 kg C. 329 cm² gr

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MADE BY _____ DATE 6-5-11 FILE NO _____
CHECKED BY _____ DATE _____ PAGE NO 5

CALCULATIONS FOR

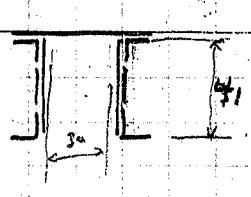
増田淳氏構造計算

Sections for truss members.

① Top chord at crown . 228,800 kg C 228.8 cm² gr. reqd.
② Lower " " " 157,000 " T 131.0 net "
③ " " " hinge 329,000 " C 329.0 gr. "

Section.

① Top chord. crown.



1 cov pl.	550 × 9	=	49.50
4 L's	90 × 75 × 9	=	56.16
2 pls	300 × 9	=	54.00
			159.66
2 pls.	150 × 9	=	27.00
			186.66
3 pls	270 × 9	=	48.60
			235.26

1/6.3

1 cov pl.	550 × 9	= 49.50
4 L's	90 × 90 × 10	= 68.64
2 pls	400 × 9	= 72.00
		189.5
2 pls	220 × 9	= 39.6
		229.1

1/5.8

③ Bottom chord hinge

4 L's	100 × 100 × 13	=	86.84	97.24
2 pls	400 × 9	=	72.00	72.00
			158.84	169.24 ②
2 pls	220 × 13	=	57.20	57.20
			216.04	226.44
2 pls	370 × 13	=	96.20	96.20
			312.24	322.64 ③

140 not enough

4 × 14
6 10

= 75 — 65
35
12 —
122
10
3
135
45 — 65

80 × 82 77
8 — 4r
241 —
250

60
35
25
5

12

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MADE BY _____ DATE 6-5-11 FILE NO _____
CHECKED BY _____ DATE _____ PAGE NO 6

CALCULATIONS FOR

桁及弦材の概算重量

Approximate wt. of Truss.

Top chord		Sectional Area	210.00 (average)	@	=785 × 83.0	=	13,680
Bottom 〃		〃	246.00	@	〃 × 83.0	=	16020
Lateral tie			50.00	@	〃 × 82.0	=	3220
verticals	4 L 5 150×90×9	=	83.20	@	〃 × 143×19	=	6800
〃			140.0	@	〃 × 8.5×2	=	2380
Diagonals.	〃		83.20	@	〃 × 5.8×20	=	7570
vertical hangers	〃		83.20	@	〃 × 3.5×13	=	2970
							52640 kg.
		Details say			50 %	=	26320
							78,960

61.5
t
62.4

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CHECKED BY_____ DATE_____ PAGE NO (7)

CALCULATIONS FOR

Estimate of cost

wooden floor.

planking	7.5cm	55.	97.	534 ㎡ @ 60¥	= 32m
Sleeper with bolts etc	16kg.	@ m			= 36m
misc.					200
					7,000 ¥