JIUN MASUDA
CONSULTING ENGINEER
SHOWA BLDG. TOKYO

CALCULATIONS FOR

MADE BY_____ DATE_____ FILE NO_____
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大諸水門扉及捲揚装置設計書

昭和八年十月

JIUN MASUDA
CONSULTING ENGINEER
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MADE BY J. Masuda DATE 8-10-8 FILE NO
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CALCULATIONS FOR

Design of Taicho Lock gate for Sōrio Civil Engineering Branch Office

At the locality of Taicho (朝鮮慶尚南道金海郡大浦) the branch stream of Kakuto-kō River (洛東江) is shut off from the main with dyke to save the district from flood damage. As a part of this enterprise a lock for navigation and sluice gates for supplying water for irrigation shall be built in the suitable place along said dyke.

Lock and sluice gates are divided into the following classes:-

1. The sluice gates to regulate discharge rate and cut off flood.
   3 sets required 5.0 m wide, 3.5 high and 3.5 metre lift, provided Concrete Counter-weight to balance for gate.

2. Lock gates shall be located at front and rear of lock for navigation purpose. The front gates compose from a pair of upper and lower gates, the upper gate to protect flood and lower gate to shut off lock chamber, both gates 5.0 metre wide, 5.8 metre high, being compounded into 11.6 metre high. Lift of upper gate 5.8 metres while the lower gate lifts 11.6 metres. Both gates provided with Counter weight to balance for ~~the~~ own weight of gate
3. Charge and discharge sluice gates for lock chamber
   0.7 metre wide and 1.0 metre high, lifted 1.0 metre

Gates classified in (2) to be operated by motor as well as hand power, while the other gates operated by hand power only.
Class 1 & 3 sluice gates operated by mechanism set on concrete floor deck while the lock gates operated by mechanism set on platforms of towers which are built at front and rear of lock chamber.

In designing these structures the factor of safety of materials are assumed as specified below.

Structural steel in steel gates and towers	6
materials for mechanical parts	8
Link chain and hanging parts of gates and counter weights	10

The minimum thickness of structural steel limited to 9 mm

Designing water pressure against gates.

1. Intake sluice gate.	Outside water level	9.9 metres above sill
	Inside " "	2.2 "
2 Lock gates at front of lock	same as above.	
3. Lock gate at rear of lock	Outside water level	5.8 metres above sill.
	Inside " "	2.2 "
4. Sluice gate for charge of lock chamber	Outside water level	9.6 metres above sill
	Inside " "	1.9 " "
5 Sluice gate for discharge of lock chamber	Outside water level	5.5 metres above sill
	Inside " "	1.9 " "

Assumed water level when raising and lowering gates.

1. Intake sluice gates 3.5 metres on outside 1.7 metres on inside for raising and lowering, the water pressures on both side are balanced
2. Front lower gate for lock and rear gate, when raising, however when lowering dynamic pressure due to water velocity of 2 metres per second should be considered
3. Charge sluice gate of lock chamber Outside 5.2 metres inside 2.2 metres
   Discharge " " " " Outside 2.2 " inside 5.5 "

Wind Pressure assumed 380 Kgs per square metre of exposed surface.

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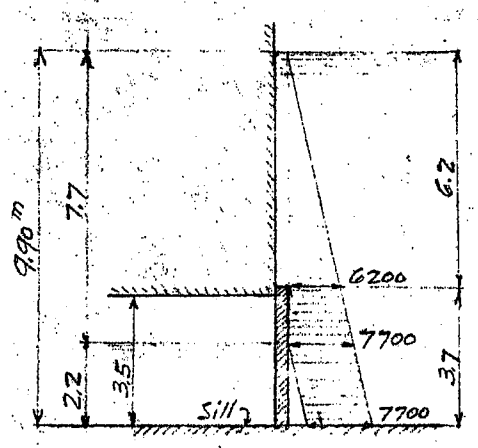
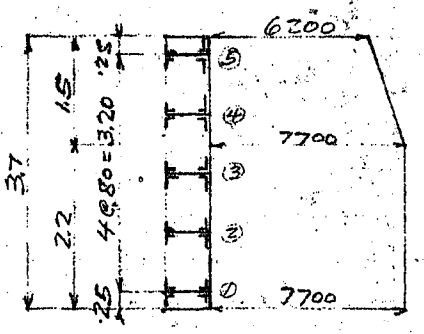
CALCULATIONS FOR

Taicho Lock Gates.
Design of Intake Stoney gates.
General dimensions of gate assumed as follows;
Clear width 5.00 meters, Effective span length = 5.20 meters;
Height of channel 3.50 " clear, Height of gate = 3.70 " ;
Maximum hydraulic pressure on gate
water level on front side 9.90 meters above sill.
" " " rear side 2.20 " " "
difference of level 7.70 meters.



Pressure diagrams.



Water pressure is assumed to be carried by 5 horizontal girders spaced at 80 cm c to c.
Horizontal loads on each girder are as follows.

On girder—

G1 0.65 × 7700 = 5000 kg/lin. m.

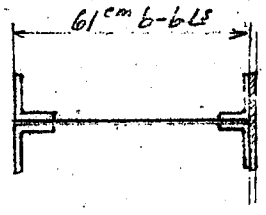
G2 0.80 × 7700 = 6160 "

G3 0.40 × 7700 = 3080
0.35 × 7700 = 2695
0.05 × 7675 = 385
6160 "

G4 0.40 × 7450 = 2980
0.40 × 7050 = 2820
5800 "

G5 0.40 × 6650 = 2660
0.25 × 6325 = 1580
4240 "

Stresses in girder G2 and G3.
Bending moment = 1/8 × 6160 × 5.20² = 20820 kgm
Shear = 1/2 × 6160 × 5.20 = 16000 kg
Total depth of girder assumed 61 cm b to b of flange Ls.



cover plate 600 × 9 = 54.00 cm²; 1/8 web area = 6.75 cm²
Effective depth say 61.00 − 1.07 − 2.09 = 57.84 cm
Flange stress = 20820 / 0.5784 = 36000 kg C or T

1Pl 300 × 9 = 27.0 × (−0.45) = −12.15
2Ls 125 × 90 × 9 = 37.08 × 2.18 = 80.80
64.08 1.07 68.65

Effective depth
61.0 − 1.07 − 2.09 = 57.84 cm

Flange area required.
for tension flange 36000 ÷ 780 = 46.20
for 1/8 web area less 6.75
39.45 cm² net

for compression flange 36000 ÷ 715 = 50.38
for 1/8 web area less 6.75
43.63 cm² gross.

(4-19φ rivets)
Use 2Ls 150 × 90 × 12 = 54.72 − 10.56 = 44.16 cm² net for tension flange.
For compression flange, considering skin plate of 30 cm wide as a cover plate of the girder
1 cov. pl. 300 × 9 = 27.00
2Ls 125 × 90 × 9 = 37.08
64.08 cm² gross.

For girders G1, G4, and G5, use the same details as above.

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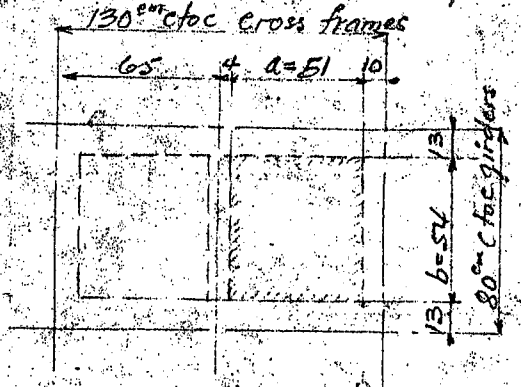
CALCULATIONS FOR

Taicho Lock Gates.

Stresses in skin plate 9 mm thick.



Stress in fibre along a, $f_a = \frac{b^4 w a^2}{2(a^4+b^4)t^2}$

" " " b, $f_b = \frac{a^4 w b^2}{2(a^4+b^4)t^2}$

where w = water pressure on plate = (7700 kg/m²) = 0.77 kg/cm²

t = thickness of plate = 0.90 cm

a = Shorter span length = 51 cm

b = longer " " = 54 "

Then.

$$f_a = \frac{54^4 \times 0.77 \times 51^2}{2(54^4+51^4)\times 0.9^2} = 689 \text{ kg/cm}^2$$

$$f_b = \frac{51^4 \times 0.77 \times 54^2}{2(54^4+51^4)\times 0.9^2} = 614 \text{ "}$$

Load on centre stiffener

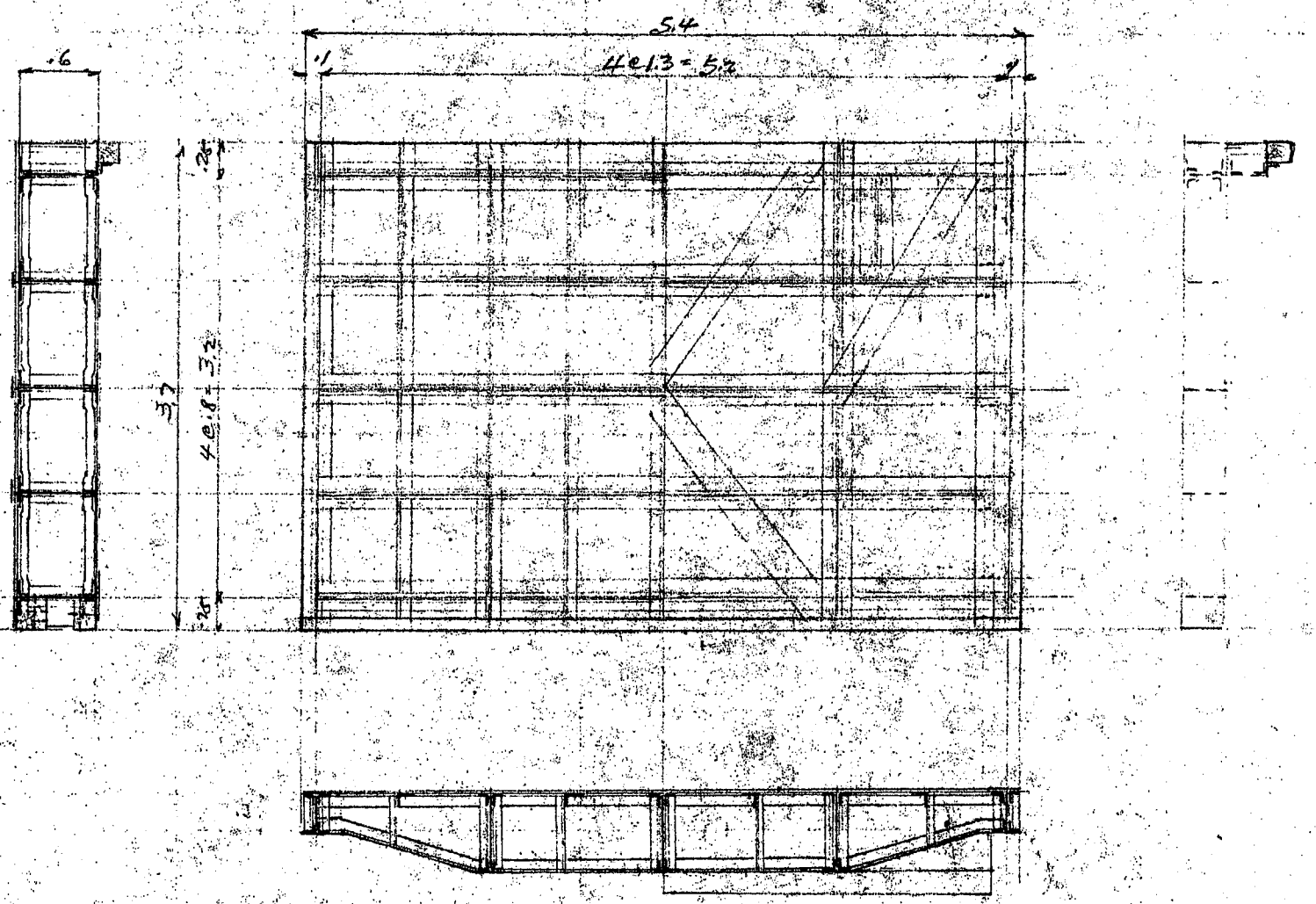
$$w_a = \frac{w b^4}{a^4+b^4} = \frac{0.77 \times 54^4}{51^4+54^4} = 0.429 \text{ kg/cm}^2 \text{ or } 4290 \text{ kg/m}^2$$

or $4290 \times 0.59 = 2530$ kg per lin meter

Bending moment $= 1/2 \cdot 2530 \cdot 0.8^2 = 135$ kgm

Section modulus required $= \frac{135 \times 100}{780} = 17.3 \text{ cm}^3$

Use L 90×75×9 ; $S_{xx} = 17.37 \text{ cm}^3$



Scale 1:50

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CALCULATIONS FOR

Gaeho Lock Gates

Approximate weight of gate

Flange	10Ls	150-90	×12	@ 21.5	× 5.30 =	1140
	10Ls	125-90	×9	@ 14.6	× 5.20 =	759
Web	5Pls	600	×9	@ 42.39	× 5.20 =	1102
Stiffs	2Pls	1000	×9	@ 70.65	× 5.40 =	763
	2Pls	800	×9	@ 56.52	× 5.40 =	611
Horizontal	3Pls	160	×9	@ 11.30	× 4.85 =	165
near bottom	1Pl	300	×9	@ 21.20	× 4.85 =	103
near bottom end	2Pls	320	×9	@ 24.73	× 3.60 =	178
Vert. Stiffs	80Ls	75×75	×9	@ 9.96	× 0.61 =	486
"	20Ls	"		@ "	× 0.42 =	84
"	40Ls	"		@ "	× 0.28 =	112
" fills	20 pls	75×	9	@ 5.30	× 0.11 =	12
Cross frame	3 Pls	600	×9	@ 42.39	× 3.60 =	457
	2 Pls	300	×9	@ 21.20	× 3.60 =	153
"	20Ls	75×75	×9	@ 9.96	× 3.60 =	717
Vert. Stiffs	4Ls	90×75	×9	@ 11.00	× 3.60 =	158
near Side girder	15Pls	160	×9	@ 11.30	× 0.42 =	71
" diag.	6 Pls	200	×9	@ 14.13	× 2.10 =	178
" " fill	12 Pls	200	×9	@ "	× 0.49 =	68
Lug Ls	10 Ls	90×75	×9	@ 11.00	× 0.30 =	33
brackets	2 Ls	90×75	×9	@ "	× 1.00 =	110
"	4 Ls	75×75	×9	@ 9.96	× 1.00 =	440
"	2 Ls	"		@ "	× 0.30 =	60
"	2Pls	300	×9	@ 21.20	× 1.10 =	47
diaphragm	8Ls	75×75	×9	@ 9.96	× 0.80 =	64
" fill	2 Pls	150	×9	@ 10.60	× 0.53 =	14
" "	2 Pls	150	×12	@ 14.13	× 0.49 =	14
" web	2 Pls	550	×9	@ 38.86	× 0.80 =	62
"	8Ls	75×75	×9	@ 9.96	× 0.55 =	44
Rivet heads		3½%				272
						8020 Kg

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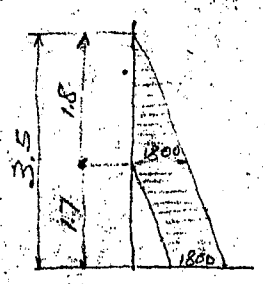
CALCULATIONS FOR

Taicho lock Gates.

Energy calculation for Intake stoney gate.

Water pressure on gate during operation.

water depth on front side 3.50
" " rear side 1.70
1.80 m @ 1000 = 1800 kg/m²



Total pressure on gate

1800 × 1.8 ÷ 2 = 1620
1800 × 1.70 = 3060
4680 × 5.20 = 24350 kg

Frictional coef. of bronze on bronze assumed 0.20

Sliding friction = 24350 × 0.20 = 4870 kg
Unbalance assumed (20% about) = 1600
Bouyancy say 8020 × 1.7/3.7 × 1/785 = − 470
6000 kg

Energy developed by one man.

lever arm of handle assumed 0.45 m
power developed by one man " 15 kg
No. of revolution of handle " 40 rev/min
Theoritical work done = 2 × 0.45 π × 40 × 15 = 1698 kgm/min

Total work done during one operation assuming a constant resistance of 6000 kg.

6000 × 3.50 = 21000 kgm

Total efficiency being 0.55 as the calculation below

Time required for one operation

21000 / 1698 × 0.55 = 23.5 min. by one man.

Use 25 minutes.

Link chain.

Weight of gate including waterproofing timbers say 8500 kg
Frictional resistance 4870
Bouyancy − 470
Mire loads say 300
13200 kg

Using 2 chains, load on one chain 6600 kg

標本ケエーン製作所製品 = 依り計算スル
No. 814 link chain 3+3=6 — 75 × 8 mm
pitch P = 100 mm
Ultimate tensile strength = 73000 kg
factor of safty = 73000 ÷ 6600 = 11.06.

Sprocket.

Pitch diameter of Chain sprocket wheel using no. of teeth N = 12

= P / Sin 180°/N = 100 / Sin 180°/12 = 100 / 0.25882 = 386.37 mm

Circumference of sprocket = π × 386.37 = 1215 mm = 1.215 m

Total no. of rev. = 3.50 / 1.215 = 2.88

Rev. per min of wheel = 2.88 / 25 min = 0.115

Gear ratio = 40 / 0.115 = 348

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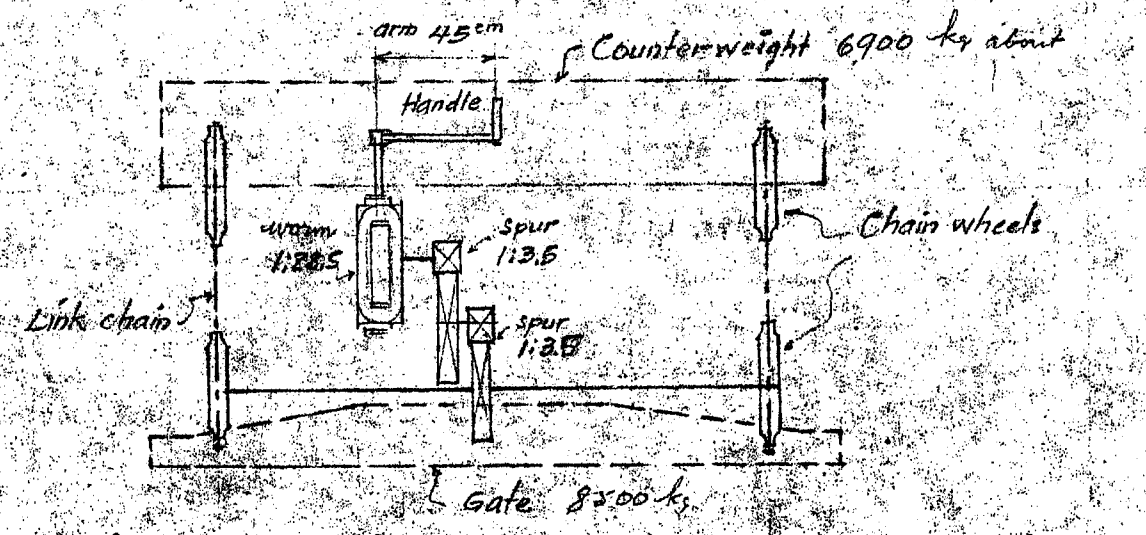
CALCULATIONS FOR

Taicho lock Gates

General arrangement of operating mechanism.

Gears	Gear ratio	efficiency
worm gear	1:28.5	0.75
Spur "	1:3.5	0.93
" "	1:3.5	0.93
2 chain sprocket	—	0.85
	Total gear ratio	Total efficiency
	28.5×3.5×3.5 = 349	0.75×0.93²×0.85 = 0.55



Counterweight. Reinforced concrete.

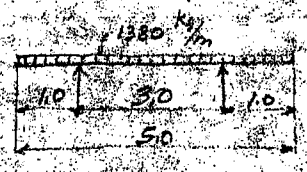
Total weight of gate = 8300 kg
Unbalance 1600
Counterweight required = 6900 kg

Misc 0.60×0.96×5.0 = 2.875 m³ @ 2400 = 6900 kg

Weight per lin m. = 6900/5 = 1380 kg

distance c to c of hangers assumed 3.0 m

moment = −½ · 1380 · 1.0² = −690 kgm at support
Shear = ±1380 kg



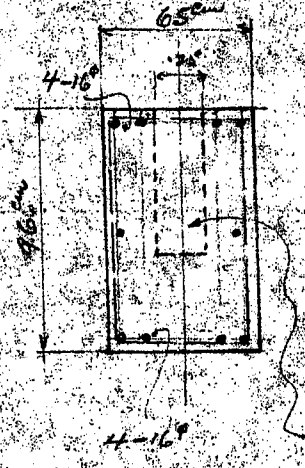
moment at centre of span.
⅛ · 1380 · 3.0² = 1553
less overhanging effect = 690
863 kgm

Shear = ½ · 1380 · 3.0 = 7070 kg

Steel area required = 863 × 100 / (780 × 7/8 × 90) = 1.40 cm²

for impact allowance 20% 0.281
1.680 cm²

Use 4-16φ bars = 8.04 cm² on top and bottom each.



5 Adjusting hollow pits @ 0.25×0.6×0.5

Revised

Counterweight 0.65×1.05×4.5 = 3.07 m³
Cwt required 6900
Unbalance of chain 2×6"C×50 kg = 600
hangers + guides etc less 200
7300 kg

7300 ÷ 2400 = 3.04 m³

4 adjusting hollow pits @ 0.30×0.65×0.5
= 0.39 m³

Steel scrap concrete req'd. (3200 kg/m³)
0.39 − 24cm/3200 = 0.29 m³

8-9-13

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MADE BY K. Iwata DATE 8-8-17 FILE NO
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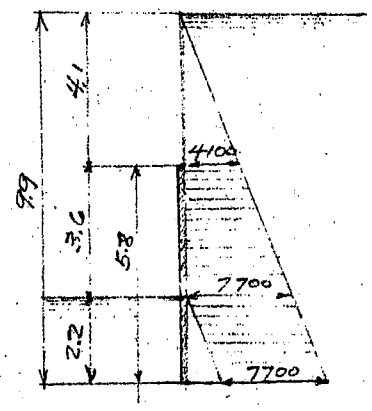
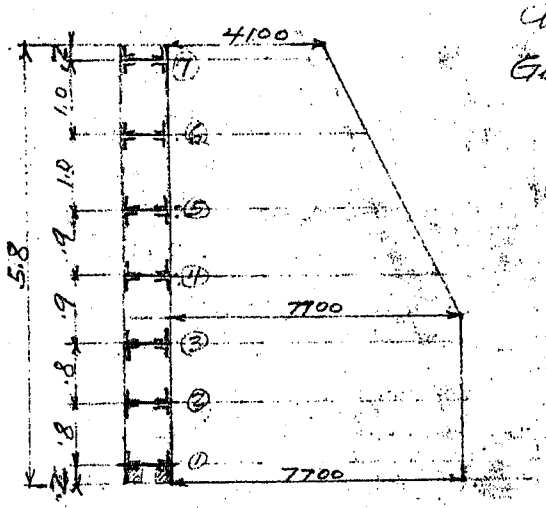
CALCULATIONS FOR

Taicho lock gates.
Design of Front lock-gate.
Lower gate.

General dimensions assumed as follows;
Span length say 5.20 m (5.00 m clear)
height 5.80 m o to o.
max. water pressure on gate
water depth on front side 9.90 m.
" " " rear " 2.20
difference 7.70 m @ 1000 = 7,700 kg/m²

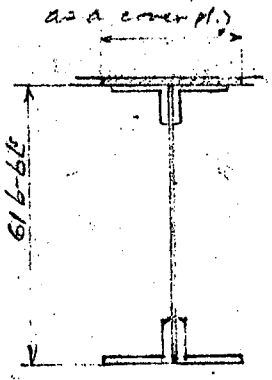




Water pressers on each horizontal girder.

Girder G1. say	7700 × 0.60	= 4620 kg/lin.m.
G2.	7700 × 0.80	= 6160 "
G3.	7700 × 0.80 = 6160	
	7675 − 0.05 = 380	
		6540 "
G4.	7200 × 0.90 =	6480 "
G5	6525 × 0.45 = 2940	
	6050 × 0.50 = 3025	
		5965 "
G6	5300 × 1.00 =	5300 "
G7	4550 × 0.50 = 2275	
	4200 × 0.20 = 840	
		3115 "

Horizontal Girder G3.



Bending moment = 1/8 · 6540 × 5.20² = 22100 kgm
End shear = 1/2 · 6540 × 5.20 = 17000 kg.
Assuming the depth of girder 61 cm b to b of Ls
web plate 600 × 9 = 54.00 cm², 1/8 web area = 6.75 cm²
Effective depth say 61.00 − 1.07 − 2.09 = 57.84 cm
Flange stress = 22100 / 0.5784 = 38,200 kg/c or T.

Tension flange area required = 38200/780 = 49.00
1/8 web area = − 6.75
42.25 cm² net

Compression " " = 38200/715 = 53.50 cm² gross.

1 Cov Pl.	300×9 = 27.00	× 0.45 =	12.15
2 Ls	125×90×9 = 37.08	− 2.18 =	80.80
	64.08	1.07	68.65

Use 2 Ls 150×90×12 = 54.72 − 10.56 = 44.16 cm² net for tension flange

2 Ls 125×90×9 = 37.08 "
1 Pl 300 × 9 = 27.00 "
64.08 cm² gross for Compression flange.

Use same details for other girders.

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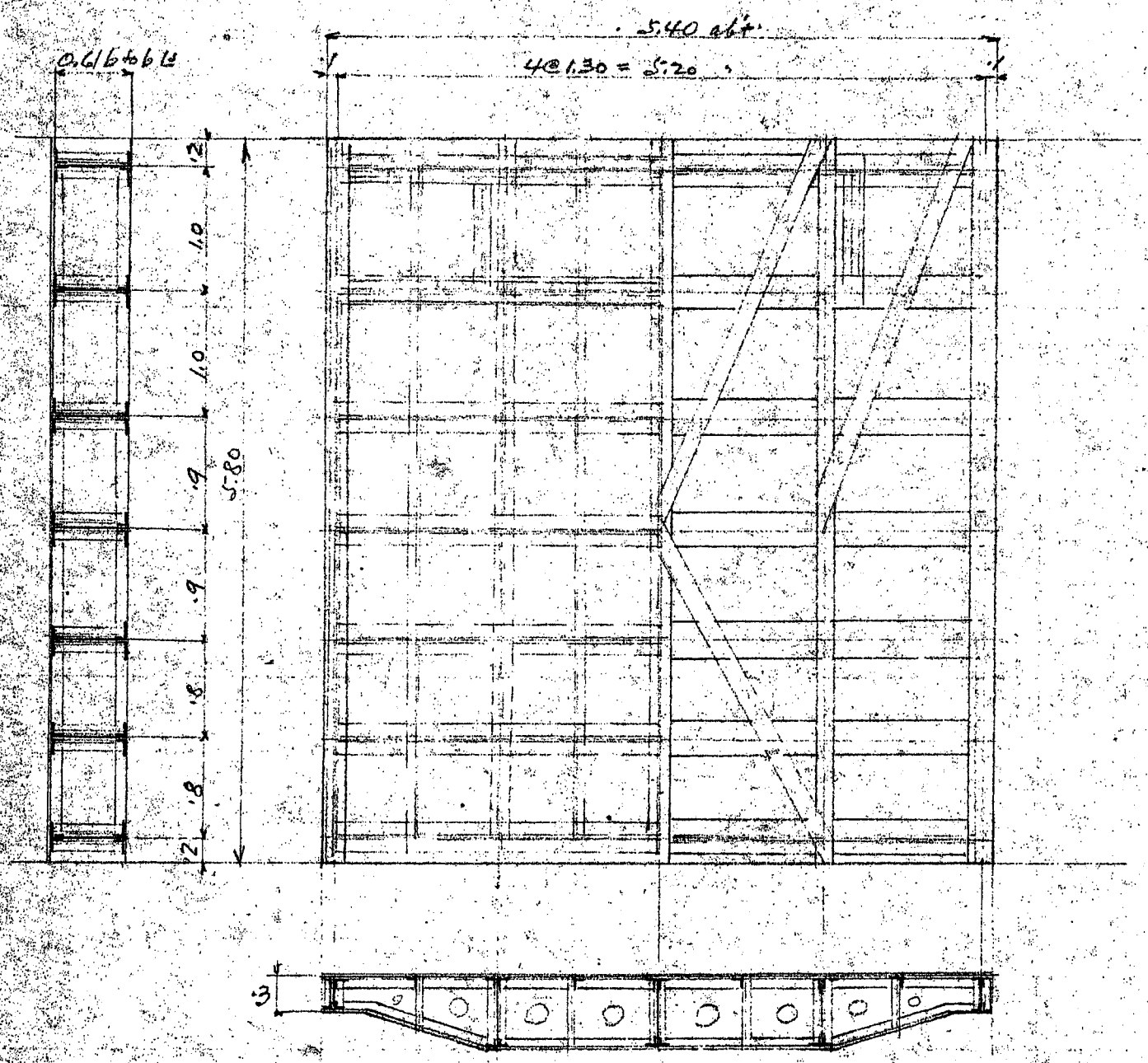
CALCULATIONS FOR

Taicho Lock Gates.
General sketch of gate.



Approximate weight of gate.

Hor. girders	7 web pls	600 × 9	@	42.39	× 5.20 =	1,543
"	14 Ls	125 × 90 × 9	@	14.60	× 5.20 =	1,063
"	14 Ls	150 × 90 × 12	@	21.50	× 5.30 =	1,595
" stiff Ls	56 Ls	90 × 90 × 10	@	13.30	× 0.28 =	209
"	28 fillr	200 × 12	@	18.84	× 0.11 =	58
"	28 "	80 × 3	@	1.88	× 0.20 =	11
"	28 Ls	75 × 75 × 9	@	9.96	× 0.45 =	126
"	112 Ls	"	@	"	× 0.42 =	469
Skin pls. (total)	1 Pl.	5400 × 9	@	381.51	× 5.80 =	2213
" Spl. pls.	5 pls	180 × 9	@	12.72	× 5.00 =	318
Diaphragms	20 Ls	75 × 75 × 9	@	9.96	× 5.80 =	1155
"	3 web pls	600 × 9	@	42.39	× 5.60 =	711
"	2 "	290 × 9	@	20.49	× 5.80 =	238
"	84 fillr	75 × 9	@	5.30	× 0.45 =	200
"	72 "	75 × 9	@	"	× 0.60 =	229
Skin pl. stiff Ls	4 Ls	90 × 75 × 9	@	11.00	× 5.40 =	238
Diagonal tension pls.	6 pls	200 × 9	@	14.13	× 3.30 =	280
Diaphragm for Hangers	2 @			40.0	=	80
Sear stiffe. vert. pls.	3 pls	160 × 9	@	11.3	× 5.80 =	197
Horizontal diaphragm on top bar						150
Rivet heads &c say						467
Total structural steel required						11550 kg.
less drain holes & triangular cuts of web 6.44 m² @ 70.65 =						- 455
add rollers, timbers &c say						405
Total weight of gate					=	11500 kg

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CALCULATIONS FOR

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Taicho Lock Gates.

Operating power calculation for lower gate.

Water pressure on gate during operation.

max. velocity of water during operation assumed 2 meters per second. = v (Lowering operation)

Dinamic pressure = mv

mass m = $\frac{2.0 \times 5.5 \times 5.0 \times 1000}{9.80}$ = 5610 kg.

mv = 5610 × 2.0 = 11220 kg

Static pressure due to entrance head for velocity of 2.0 m/sec.

vel. head say $\frac{v^2}{2g} = \frac{2^2}{2 \times 9.8}$ = 0.204 meter

Pressure = 5.70 × 5.20 × 0.204 × 1000 = 6,040 kg.

Total pressure on gate = 11220 + 6040 = 17260 kg

Frictional resistance = 17260 × 0.200 = 3450 kg

Resistance of water in the pockets of gate at start of lifting operation

velocity of gate assumed 11.6 m ÷ 6 min = 1.933 m/min or 0.0322 m/sec.

mass of water m ≒ $\frac{0.6 \times 5.2 \times 5.6 \times 1000}{9.8}$ = 1780 kg

resistance of water = mv = 1780 × 0.0322 = 70 kg.

Bouyancy say 11160 × $\frac{5.5}{5.8}$ × $\frac{1}{7.85}$ = 1350 kg

wind resistance during lifting operation, assuming wind pressure of 100 kg/m²

wind pressure on gate 5.8 × 5.4 × 100 = 3130 kg

" " " Counterweight 1.5 × 5.4 × 100 = 810

3940 kg.

frictional resistance = 3940 × 0.20 = 790 kg.

Total load during operations.

Lifting operation

Unbalance assumed	3500	4290 kg	wind resist. > water resist.
wind	790		

Lowering operation

unbalance	3500	−1370 kg ←
bouyancy	−1350	
water pressure	−3450	
water resistance	− 70	

注意
4290−1370 = 2920 kg
此場合 Cwt. ヲ 4290 kg
ノ力ヤザ引揚ゲルヿヲ
得ルヲ以テ差引 2920 kg
ノ力ニテ門扉ヲ下降セ
シムル能力ヲ有ス.

Time of one operation assumed 6 minutes, total lift = 11.6 meters

Uniform speed of chain = $\frac{11.60}{6}$ = 1.933 m/min

Theoritical HP required

HP = $\frac{4290 \times 1.933}{4560}$ = 1.82

Total efficiency of operating mechanism being 0.512 as the calculation below.

Actual HP required = 1.82 ÷ 0.512 = 3.55

Use 1 − 5 HP motor. (time of operation 6.0 minutes)

Link chain.

max. load on link chain

weight of gate	11500
frictional resistance	3450
bouyancy	−1350
water resistance	70
	13670 kg

増田淳氏関係資料
(独立行政法人 土木研究所蔵)

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MADE BY K. Inata DATE 8-8-17 FILE NO
CHECKED BY M.J. DATE 8-9-15 PAGE NO 10

CALCULATIONS FOR

Taicho Lock Gates.

Use 2 chains

load on one chain = 13670 ÷ 2 = 6835 kg

椿本チェーン製作所製品 =より計算スル

No. 814 link chain 3+3 = 6 — 75mm × 8mm pls.

pitch p = 100 mm

ultimate tensile strength = 73000 kg

factor of safty = $\frac{73000}{6835}$ = 10.7

pitch diameter of sprocket wheel = $\frac{P}{\sin\frac{180°}{12}}$ = $\frac{100}{\sin 15°}$ = 386.37 mm

Circumference of sprocket = 1215 mm or 1.215 m

Total no of revolution = $\frac{11.60}{1.215}$ = 9.54

Revolution per min = $\frac{9.54}{6}$ = 1.59

No. of revolution of motor shaft assumed 1150 per min.

Total gear ratio = $\frac{1150}{1.59}$ = 723

General arrangement of operating mechanism.

Gears	gear ratio	efficiency
worm gear	1: 25.5	0.75
Spur gear	1: 3.068	0.93
" "	1: 3.068	0.93
" "	1: 3.0	0.93
2 chain sprockets		0.85

Total gear ratio $25.5 \times 3.068^2 \times 3.0 = 723$.

Total efficiency $0.75 \times 0.93^3 \times 0.85 = 0.512$

Hand operation.

Energy developed by one man. = 1698 kgm/min see page 5

max. load for lifting operation = 4290 kg see 9

Efficiency assumed

worm gear spur gear 2 chain wheels

$0.930^4 \times 0.850 = 0.636$

Total energy required = 4290 × 11.6 = 49750 kgm.

Time req'd for one operation = $\frac{49750}{2 \times 1698 \times 0.636}$ = 23.0 min Use 25 min. by 2 men.

Total revolution of sprocket = $\frac{11.6}{1.215}$ = 9.55

No. of rev/min = $\frac{9.55}{25}$ = 0.382

No. of rev/min of handle 40

Total gear ratio = $\frac{40}{0.382}$ = 105

Gears	gear ratio	efficiency
Spur gear	$(1: 3.068)^2$	$(0.93)^2$
"	1: 3.0	0.93
"	1: 3.72	0.93
2 chain wheels		0.85

Total gear ratio $(3.068)^2 \times 3 \times 3.72 = 105$

Total efficiency $0.93^4 \times 0.85 = 0.636$

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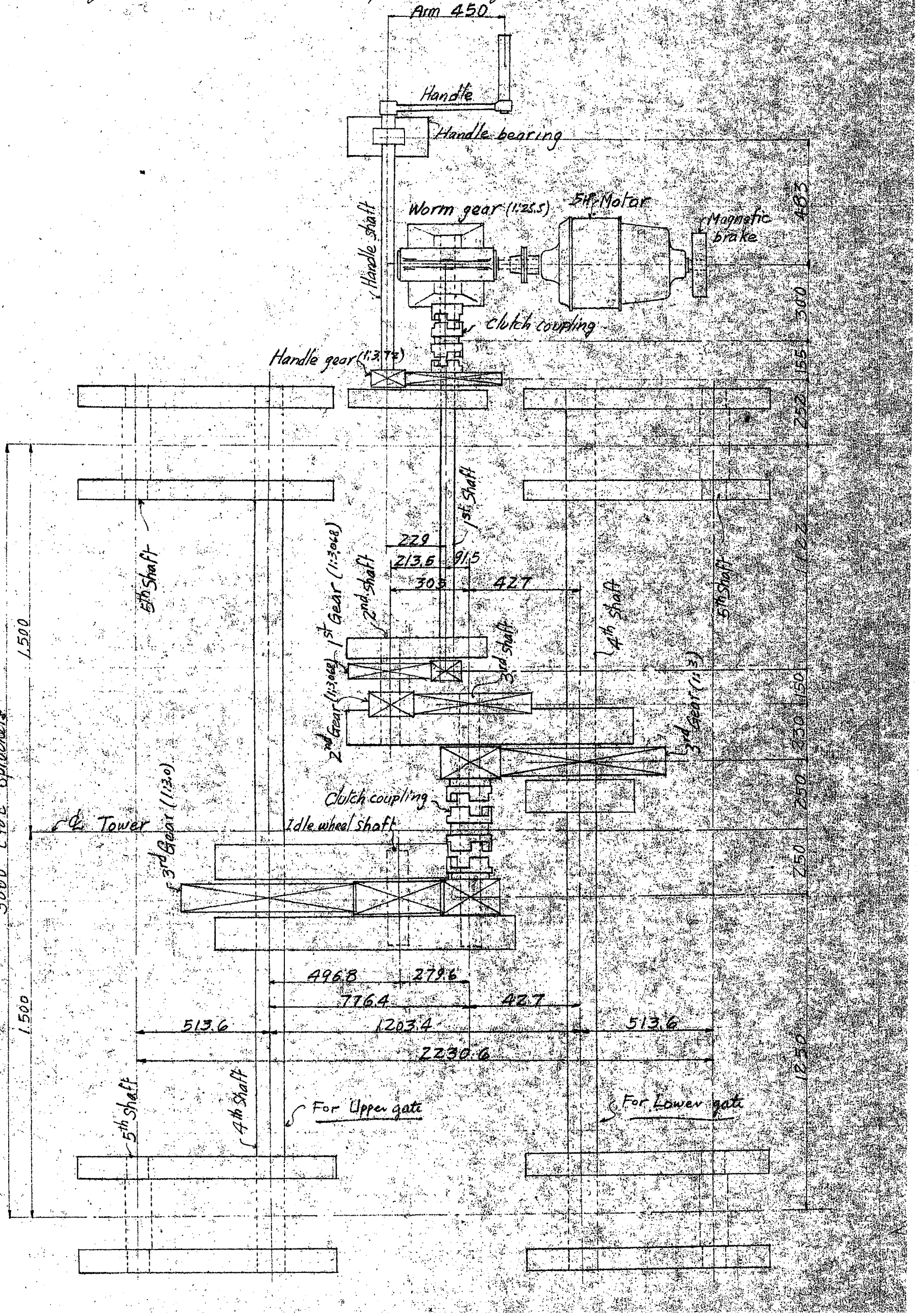
CHECKED BY M. J. DATE 8-9-15 PAGE NO 11

CALCULATIONS FOR

Taicha Lock gate

General arrangement of mechanism of front lock gates



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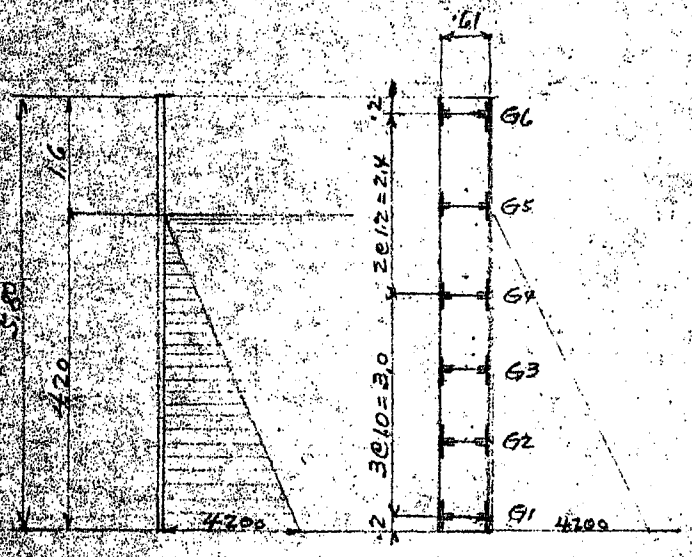
MADE BY S. Iwata DATE 8-8-18 FILE, NO
CHECKED BY M. J. DATE 8-9-15 PAGE NO 12

CALCULATIONS FOR

Tacche lock Gates

Design of clapper front lock gate.

General dimensions assumed as follows.
Span length say 5.20 meters (5.0 meter clear)
Height 5.80 meters. out to out.
Max. water pressure on gate.
Hydraulic head in front side 9.90 - 5.70 = 4.20 meters.
" " Rear " none.



Loads on each girder (approximate)

G1.	3850 × 0.70	=	2700	kg per lin meter.
G2.	3000 × 1.00	=	3000	"
G3	2000 × 1.00	=	2000	"
G4	1250 × 0.50 = 625 700 × 0.60 = 420		1045	"
G5	200 × 0.40	=	80	"

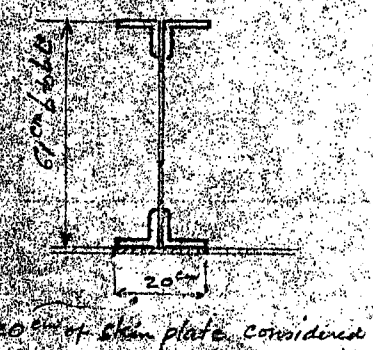
Horizontal girder G2.

Bending moment = 1/8 × 3000 × 5.20² = 10140 kgm
End shear = 1/2 × 3000 × 5.20 = 7800 kg

Total depth assumed 61 cm back to back of L
cover pl. 600 × 9 = 54.00 cm² 1/8 web area = 6.75 cm²
Effective depth say 61.00 - 1.52 - 2.56 = 56.92 cm
Flange stress = 10140 / 0.5692 = 17820 kg C or T

Tension flange area required = 17820 ÷ 780 = 22.85
1/8 web area = 6.75
16.10 cm² net

Compression " " = 17820 ÷ 715 = 24.92
1/8 web area = 6.75
18.17 cm² gross.



20 cm of skin plate considered as a cover pl.

1 Cover pl. 200 × 9 = 18.00 × 0.45 = 8.10
2L 90 × 90 × 10 = 34.00 × 2.52 = 87.00
52.00 1.52 78.90

Use 2L 90 × 90 × 10 = 34.00 - 8.80 = 25.20 cm² net for tension flange

1 Cover pl. 200 × 9 = 1800
2L 90 × 90 × 10 = 3400
52.00 cm² gross for compression flange.

For all other girders, use the same details as for G2.

General details of gate similar to those for Lower gate shown on page 8, except for skin plate on the curved side.

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MADE BY K. Inaba DATE 8-8-18 FILE NO ____
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CALCULATIONS FOR

Taicho lock gates.
Approximate weight of gate.

Horizontal girders	6 web pls	600 × 9	@ 42.39	× 5.20	=	1323
"	12 Ls	90 - 90 - 10	@ 13.30	× 5.20	=	830
"	12 Ls	"	@ "	- 5.30	=	845
" " Stiff Ls	48 Ls	"	@ "	- 0.28	=	179
	24 fills	200 × 10	@ 15.70	- 0.14	=	53
	24 "	90 - 10	@ 7.07	- 0.11	=	19
"	24 Ls	75 - 75 - 9	@ 9.96	- 0.45	=	108
"	96 Ls	"	@ "	- 0.61	=	583
Skin pls (total)	1 pl	5400 × 9	@ 381.51	× 5.80	=	2215
" Spl. pls.	4 pls	190 - 9	@ 13.42	× 5.00	=	268
hor. plate in recess top + bott.	2 pls	250 - 9	@ 17.66	× 5.00	=	177
Diaphgrams.	20 Ls	75 - 75 - 9	@ 9.96	× 5.80	=	1156
"	3 web pls	600 - 9	@ 42.39	- 5.60	=	712
"	2 "	290 - 9	@ 20.49	- 5.80	=	238
"	72 fills	75 - 9	@ 5.30	- 0.45	=	172
"	60 "	75 - 9	@ "	- 0.90 average	=	286
Skin pl. stiff. Ls	44 Ls	90 × 75 - 9	@ 11.00	- 5.40	=	238
vert. pls.	3 pls	160 - 9	@ 11.30	- 5.80	=	197
"	2 pls	200 - 9	@ 14.13	- 5.80	=	164
diagonal tension pls.	6 pls	200 - 9	@ "	- 3.30	=	280
diaphgrams for hangers	2		@ 40.00		=	80
horizontal diaphgrams	say				=	150
	rivet heads etc say					347
	Total structural steel required				=	10620 kg
	less, drain holes + triangular cut-out		5.5 m² @ 70.65		= -	390
	add rollers, timbers etc say					400
						10630 kg

Operating mechanism

Using a common motor + mechanical sets time of operation will be $\frac{6.0}{2} = 3.0$ minutes

Land operation time of operation = $\frac{25}{2} = 12.5$ minutes by 2 men.

note: unbalance being taken as 3300 kg.

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MADE BY K. Iwata DATE 8-8-29 FILE NO
CHECKED BY M. J. DATE 8-9-16 PAGE NO 14

CALCULATIONS FOR

Taicho Lock Gates
Rear Lock gate.

Use same details as for front upper gate. see page 13.

Total structural steel required = 10620 kg.
Total weight of gate with accessories = 10630 kg.

Loads during operation, refer to page 9.

Lifting operation.

Unbalance assumed	3300
wind	790
	4090 kg

Lowering operation

Unbalance	3300
boyancy say $10630 - \frac{515}{58} \times \frac{1}{7.85}$ =	− 1285
water pressure	− 3450
water resistance	− 70
	−1505 kg

Use similar mechanism as for front lock gate: see page 11.

Time of operation assumed 6 minutes, total lift of gate 11.60 metres.

Theoritical HP required

$$= \frac{4090 \times 1.93}{4.560} = 1.73$$

Effiency of gear.

	Gear ratio	Efficiency
Worm gear	1:25.5	0.75
Spur "	1: 3,068	0.93
" "	1: 3,068	0.93
" "	1: 3.0	0.93
bevel "	1: 1.	0.93
2 chain wheels	—	0.85

Total gear ratio $25.5 \times 3.068^2 \times 3.0 \times 1. = 723$

Total efficiency $0.75 \times 0.93^4 \times 0.85 = 0.477$

Actual HP required = 1.73 ÷ 0.477 = 3.63

Use 1 − 5HP motor. (time of operation being 6 min:)

Hand operation.

Energy developed by one man = 1698 kgm/min
Max. load during lifting operation = 4090 kg.
Effiency assumed.

	Gear ratio	Efficiency
Spur gear	$(1: 3.068)^2$	0.93^2
" "	1: 3.0	0.93
" "	1: 3.72	0.93
bevel "	1: 1	0.93
2 chain wheels	—	0.85

Total gear ratio $(3.068)^2 \times 3.0 \times 3.72 \times 1 = 105$

Total efficiency $(0.93)^5 \times 0.85 = 0.59$.

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MADE BY K.J. DATE 8-8-16 FILE NO
CHECKED BY M.J. DATE 8-9-16 PAGE NO 15

CALCULATIONS FOR

Daicho lock gate

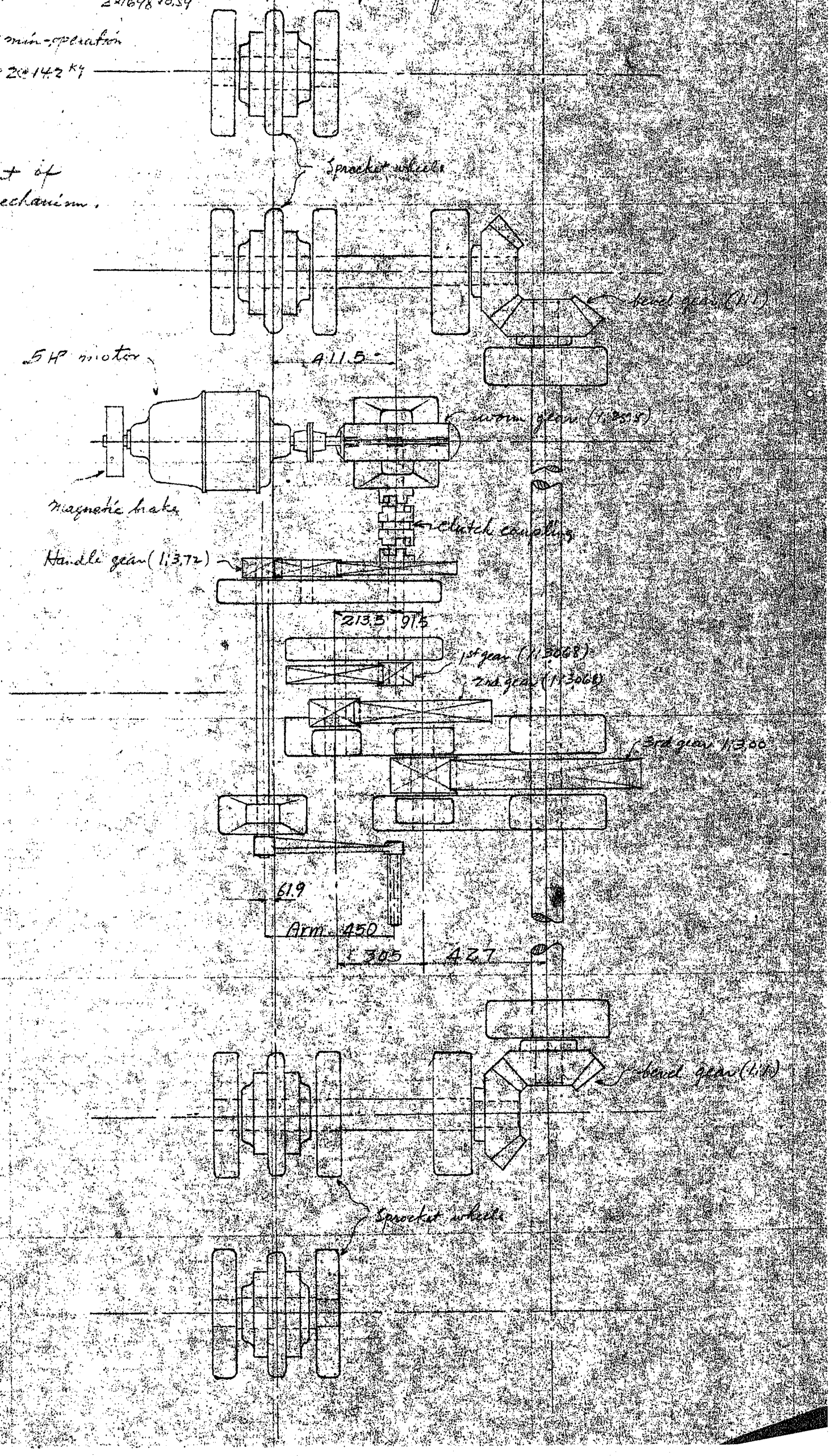
Total energy required = 4090 × 11.60 = 47400 kgm

Time required for one operation = $\frac{27400}{2 \times 1698 \times 0.59}$ = 23.7 min. by 2 men for handle power of 2 × 15 = 30 kg

Handle power for 25 min-operation

= $2 \times 15 \times \frac{23.7}{25}$ = 2 × 14.2 kg

General arrangement of rear gate operating mechanism.



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MADE BY K. Inaba DATE 8-8-20 FILE NO
CHECKED BY M. J. DATE 8-9-16 PAGE NO 16

CALCULATIONS FOR

Taicho Lock Gates

Design of Counterweights for lock gates.

Counterweight for front flower gate

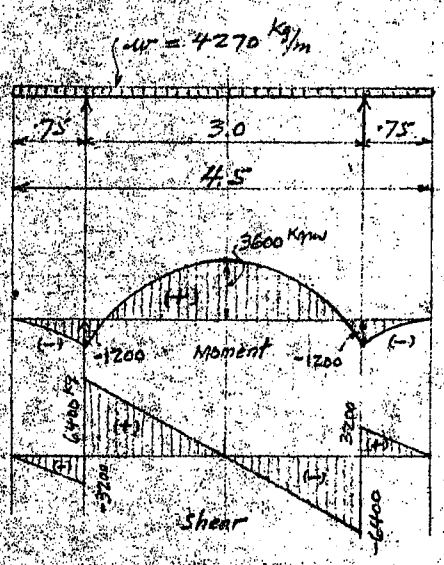
Total weight of gate	=	11500	see page 8
Unbalance being taken	=	3500	" " 9
Counterweight pull required		8000 kg	

Total lift of counterweight limitted to one-half of that of gate, or lift = $\frac{11.6}{2} = 5.8$ m abt.
Therefore total weight of counterweight shall be twice the counterweight pull.
or Total counterweight = 2 × 8000 = 16000 kg

Total length of cwt. assumed 4.50 meters out to out and distance c to c of chain 3.0 meters.

Load per lin. meter of cwt. girder

16000 ÷ 4.50	=	3560 kg
Impact assumed 20 %	=	710
		4270 kg per lin m.



Negative moment ½ × 4270 × 0.75² = −1200 kgm at support.
End Shear 4270 × 0.75 = 3200 kg outside of support.

positive moment ⅛ × 4270 × 3.00² = 4800
overhanging effect −1200
3600 kgm at center

End shear ½ × 4270 × 3 = 6400 kg inside of support.

Assumed cross section of cwt.

Effective depth say 130 − 202.15 = 125.7 cm
Chord stress = $\frac{3600 \times 100}{125.7}$ = 2870 kg T or C

Section required = $\frac{2870}{780}$ = 3.68 cm² net

use 2 ⌊ 75 × 75 × 9 = 25.38 − 7.92 = 17.46 cm² net

If the counterweight be supported at both ends 5 m c to c in repair or in other cases, the stresses will be as follows. (no impact)

Moment = ⅛ × 3560 × 5.0² = 11,130 kgm
Shear = ½ × 3560 × 5.0 = 8900 kg

Chord stress = $\frac{11130 \times 100}{125.7}$ = 8860 kg T or C

Unit stress = 8860 ÷ 17.46 = 507 kg/cm² T
or 8860 ÷ 25.38 = 349 " C

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MADE BY K. Inaba DATE 8-8-20 FILE NO
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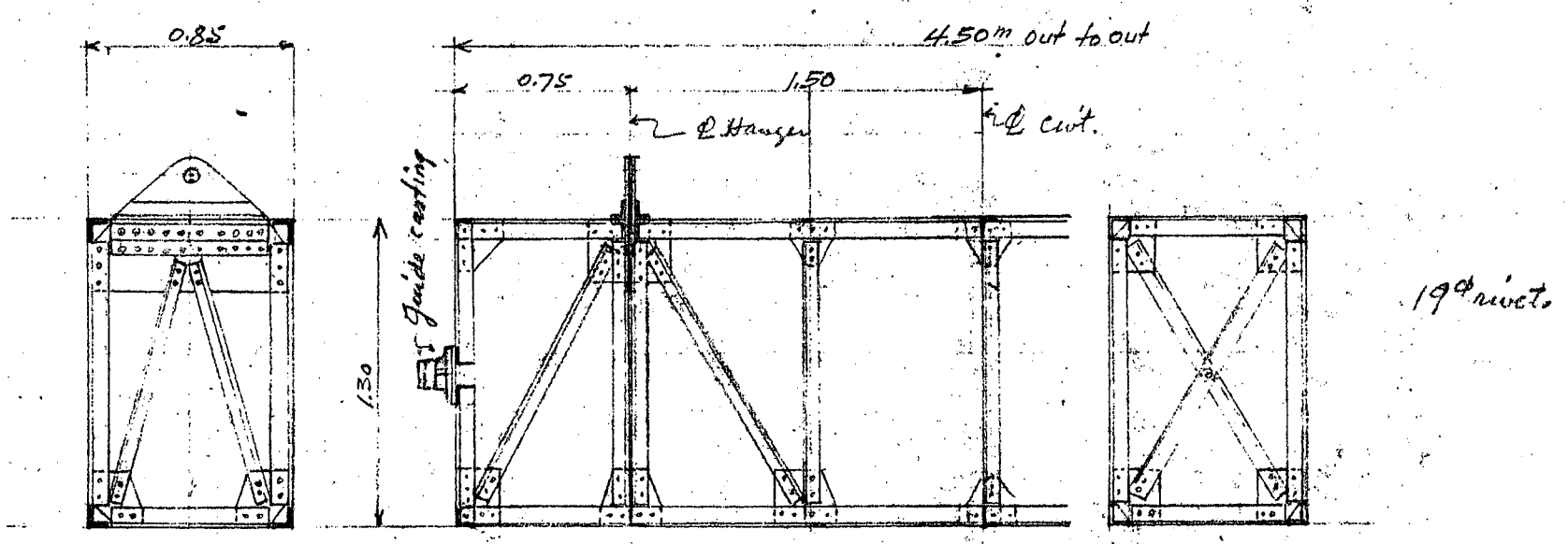
CALCULATIONS FOR

Taicho Lock Gates.
General sketch of Counterweight for front lower gate.



Approximate weight of counterweight girder.

Chords	4 Ls	75 × 75 × 9	@	9.96 ×	4.50	=		179
verticals	10 Ls	"	@	" ×	1.14	=		114
" under hangers	8 Ls	90 × 75 × 9	@	11.00 ×	1.14	=		100
diagonals	8 Ls	75 × 75 × 9	@	9.96 ×	1.25	=		100
horizontal	20 Ls	"	@	" ×	0.69	=		138
hangers.	4 Ls	"	@	" ×	1.10	=		44
"	2 Pls	600 × 9	@	42.39 ×	0.84	=		71
"	4 Pls	450 × 9	@	31.79 ×	0.69	=		88
center cross frame	2 Ls	75 × 75 × 9	@	9.96 ×	1.25	=		25
casting base	2 Pls	300 × 9	@	21.20 ×	0.84	=		36
gusset pls.	20 Pls	200 × 9	@	14.13 ×	0.20	=		57
"	20 Pls	220 × 9	@	15.54 ×	0.28	=		87
	4 Pls	280 × 9	@	19.78 ×	0.35	=		28
	16 Pls	200 × 9	@	14.13 ×	0.20	=		45
Rivet heads etc say								38
								1150 kg

Counterweight concrete

Total amount of cwt. = 16000 kg

Cwt. girder 1150
guides, chain sprockets say 350
1500 (unbalance of chain)
14500 + 1300 = 15800 kg

Volume of cwt. concrete
0.85 × 1.30 × 4.50 = 4.97 m³

Unbalance of chain
2 × 13m @ 50 kg = 1300 kg

Unit weight of cwt. concrete = 15800 ÷ 4.97 = 3180 kg per cub meter.

Let x be volume of steel scrap per cub. m. of cwt.

then $7850x + (1-x)1700 = 3180$

$6150x = 1480$

$x = 0.2405\ m^3$ $\quad 0.2405 \times 7850 = 1890$ kg

$1-x = 0.7595\ m^3$ $\quad 0.7595 \times 1700 = 1290$

3180 kg.

Total steel scrap required = $4.97\ m^3 \times 1890 = 9390$ kg

Total cement mortar (1:2) req'd. = 4.97 @ 0.7595 = 3.77 cub meter.

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MADE BY K. Inata DATE 8-8-20 FILE NO
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CALCULATIONS FOR

Taicho Rock gates.

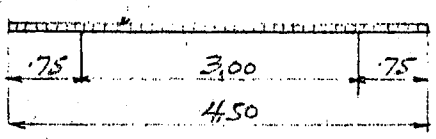
Counterweight for front upper gate.

Total weight of gate = 10630 See page 13.
Unbalance being taken as = - 3300 " "
Total counterweight required = 7330 kg

Total length of cwt. assumed 4.50 metres c to c. and distance c to c of chain 3.0 m.

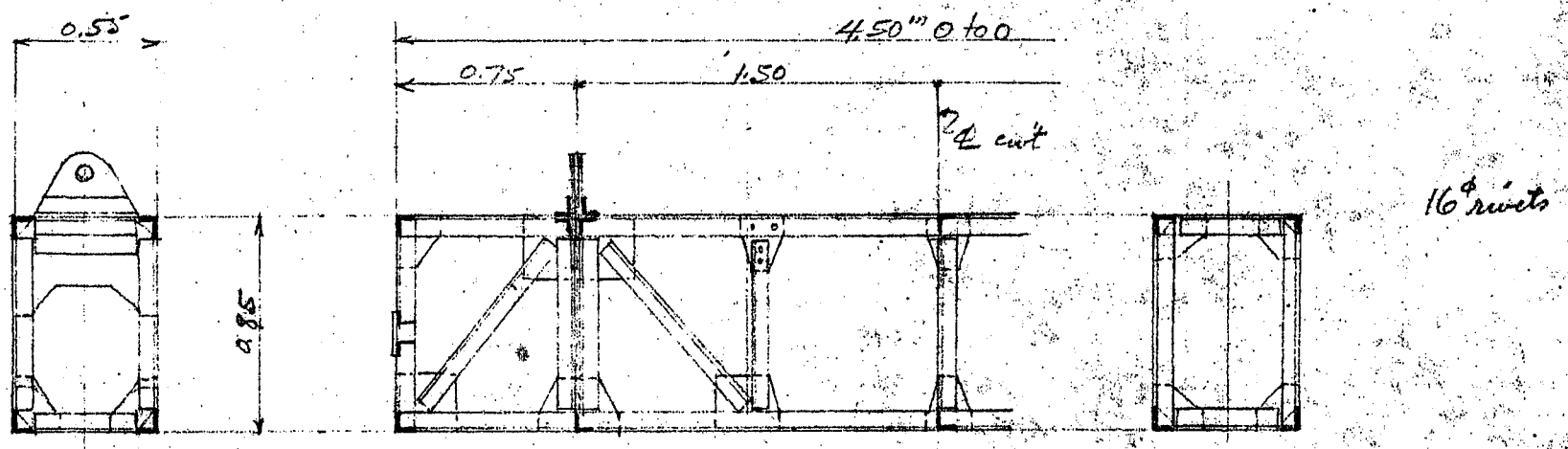
Load per lin. metre of cwt. girder.
7330 ÷ 4.50 = 1630 kg
Impact assumed 20% = 330
1960 kg. per lin. m.

w = 1960 kg/m



Neg. moment = - ½ × 1960 × 0.75² = -550 kgm at support.
End shear = 1960 × 0.75 = 1470 kg. outside of support.

Pos. moment = ⅛ × 1960 × 3.00² = 2210
overhanging effect - 550
1660 kgm at centre
End shear = ½ × 1960 × 3.0 = 2940 kg. inside of support.



Approximate weight of counterweight girder

Chords.	4Ls	65 × 65 × 8	@	7.66	× 4.50 =	138
verticals	10 Ls	"	@	"	× 0.71 =	54
" under hangers	8 Ls	75 × 75 × 9	@	9.90	× 0.71 =	57
diagonals	8 Ls	65 × 65 × 8	@	7.66	× 0.85 =	52
hangers	2 pls	540 × 9	@	38.15	× 0.65 =	50
"	4 pls	390 × 9	@	27.55	× 0.42 =	46
horizontals	20 Ls	65 × 65 × 8	@	7.66	× 0.41 =	63
roller base	2 pls	300 × 9	@	21.20	× 0.54 =	23
gusset pls.	44 pls	150 × 8.5 average	@	10.01	× 0.18 =	179
"	14 pls	220 × 9	@	15.54	× 0.20 =	44
"	4 pls	200 × 9	@	14.13	× 0.40 =	23
						21
						650 kg.

Counterweight concrete

Total amount of counterweight = 7330
Cwt. girder 650
girder, chain sprockets etc say 350
-1000
6330 + 600 = 6930 kg

Volume of cwt. concrete
0.85 × 0.55 × 4.65 = 2.705 m³
Unbalance of chain
2 × 6m @ 50 kg = 600 kg

Unit weight of cwt. concrete = 6930 ÷ 2.105 = 3290 kg per cub meter.

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MADE BY K. Inaba DATE 8-8-22 FILE NO
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CALCULATIONS FOR

Taicho Lock Gates.

Proportion of cwt. concrete.
Let x be volume of steel scraps per cub. metre of cwt.
Then. $7850x + (1-x)1700 = 3290$

$6150x = 1590$

$x = 0.2585$ $\quad 0.2585 \times 7850 = 2030$

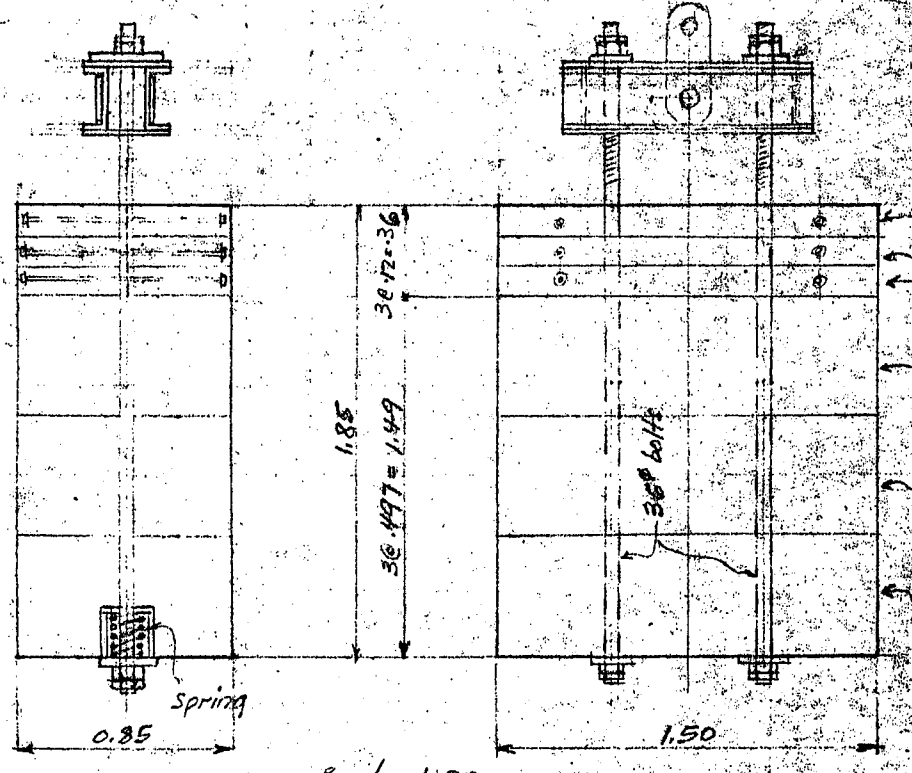
$1-x = 0.7415$ $\quad 0.7415 \times 1700 = 1260$

3290 kg/cub.m.

Total steel scrap required = 2.105 @ 2030 = 4270 kg
Total cement mortar (1:2) req'd. = 2.105 @ 0.7415 = 1.56 cub. metres.

Counterweight for Rear lock gate.

Total weight of gate = 10630 see page 44
Unbalance being taken as = -3300
Total cwt. pull required = 7330 kg
Lift of gate 11.6 m, lift of cwt. 11.8 m
Using 2 cwt. one on each side of tower
weight of 1 cwt. = 7330 kg



Scale 1:30.

Revised 8-9-13.

Unbalance of chains
2×12"×50 kg = 1200 kg.

Cwt. 7330
Hangers + guides −230
Unbalance of chains 1200
Total cwt req'd = 8300 kg

Take the lift of cwt. as 11.4 m
cwt. of one cwt.
= 8300 ÷ 2 = 4150 kg
volume of cast iron
4150 ÷ 7257 = 0.572 m³
Cubic Contents
0.70 × 0.70 × 1.17 = 0.572 m³

Structural steel for one cwt.

2 bolts 36ϕ × 2.50	@ 25.0	=	50.	
4 washers	@ 4	=	16	
2 ⊏ 250-90-9 @ 34.6 × 1.00		=	69	
2 cover pls 300 × 9 @ 21.2 × 1.00		=	42	
2 Side pls 200 × 9 @ 14.13 × 1.00		=	28	
2 ⊥ 240 × 9 @ 16.96 × 0.80		=	27	
2 ⊏ 125 × 65-6 @ 13.4 × 0.24		=	6	
Rivets + springs &c say			12	
			250 kg	

Total volume of cwt. = 0.85 × 1.5 × 1.85 = 2.36 m³
Counterweight concrete req'd. = 7330 − 250 = 7080 kg
unit weight of cwt concrete = 7080 ÷ 2.36 = 3000 kg per cub. m.

$x = 0.2115$ $\quad 0.2115 \times 7850 = 1660$

$1-x = 0.7885$ $\quad 0.7885 \times 1700 = 1340$

3000 kg.

Total steel scrap required = 2.36 @ 1660 = 3920 kg for one cwt.
Total cement mortar (1:2) req'd. = 2.36 @ 0.7885 = 1.86 cub.m.

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MADE BY K. Iwata DATE 8-8-23 FILE NO
CHECKED BY M. J. DATE 8-9-17 PAGE NO. 20.

CALCULATIONS FOR

Taicho lock Gates.

Charging Sluice gate.

General dimensions of gate assumed as follows:

Clear width = 0.70

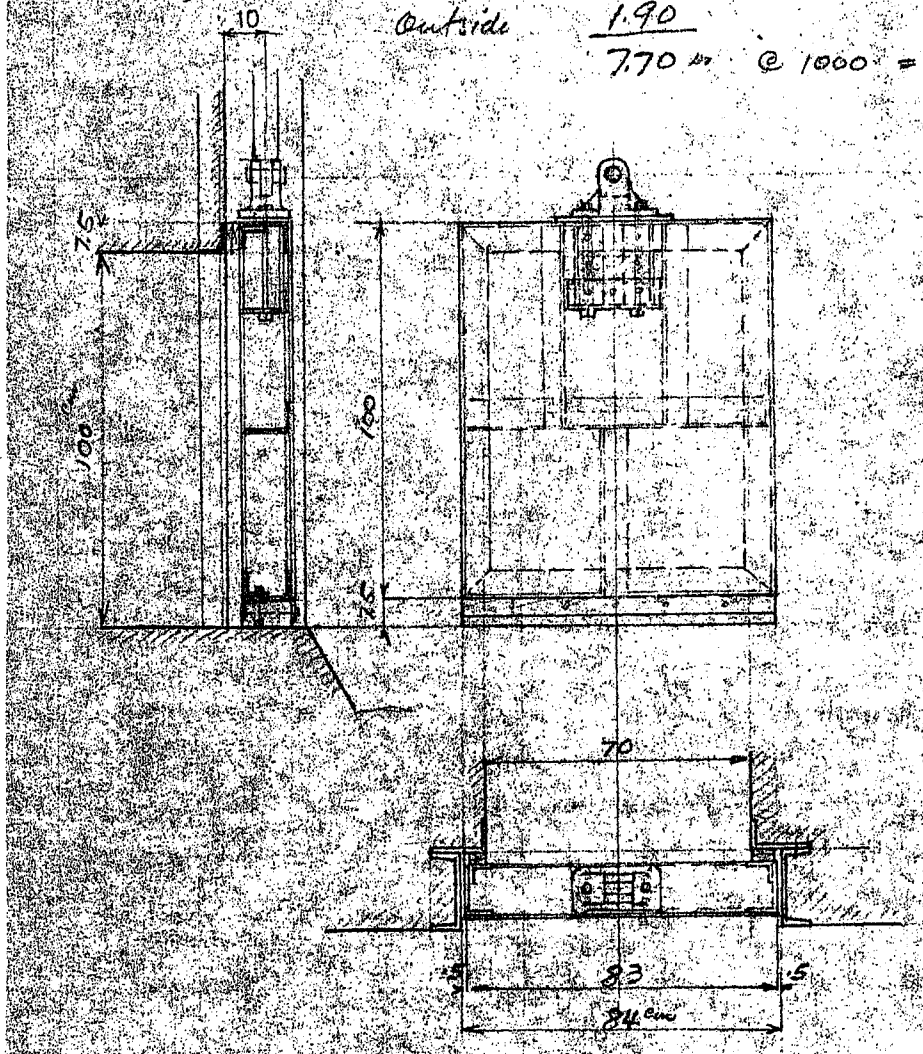
Clear height = 1.00

max. hydraulic pressure on gate.

Inside 9.60

Outside 1.90

7.70 m @ 1000 = 7700 kg/m² max.



Approximate weight of Sluice gate

3L	125 × 75 × 9	@	13.50 ×	0.83 =	33.6
2L	"	@	" ×	1.00 =	27.0
2L	"	@	" ×	0.55 =	14.9
1L	75 × 75 × 9	@	9.96 ×	0.45 =	4.5
1L	125 × 75 × 9	@	13.50 ×	0.25 =	3.4
2L	"	@	" ×	0.22 =	5.9
1 fill	60 × 9	@	4.24 ×	0.20 =	0.8
1 pl.	125 × 12	@	11.78 ×	0.35 =	4.1
1 skin pl.	820 × 9	@	57.93 ×	1.05 =	60.8
2L	65 × 65 × 8	@	7.66 ×	1.00 =	15.3
2L	"	@	" ×	0.83 =	12.7
Rivet heads + misc. details say					17.0
					200.0 kg

Approximate weight of moving parts.

Sluice gate 200 kg

Screw rod say 5.5φ @ 18.7 kg = 9.4 = 169

Casting on gate 15

Lead casting say 1.3" @ 25 kg = 33

bolts + misc say 3

420 kg.

Total load on screw rod

weight of gate + rod = 420

frictional resistance (water press) = 1018

1438 kg

Lever arm of handle assumed 400 mm

Pitch of square screw = 10 mm.

Efficiency assumed

1 bevel gear 0.93

ball bearing + screw 0.40

Total efficiency = 0.93 × 0.4 = 0.372

$$\text{Handle power reqd.} = \frac{1438 \times 10}{2\pi \times 400} \times \frac{1}{0.372} = 16.35 \text{ kg}$$

For 40 rev of handle per min. time required for 1.00 meter operation.

$$T = \frac{1000}{10 \times 40} = 2.50 \text{ minutes.}$$

Use a similar details for discharging sluice gate as above.

For this case, frictional resistance increase 100 kg and wt. of screw rod decrease 85 kg and power reqd will be nearly equal.

Hydraulic pressure on gate during operation.

Outside water depth 5.20 m above sill

inside " " 2.20 "

3.00

Pressure on gate 3.0 @ 1000 = 3000 kg/m²

all over the vertical plane of the gate.

Total pressure = 1.075 × 0.83 @ 3000 = 2680 kg

Coef. of friction for metal on metal assumed 0.38

Total resistance = 2680 × 0.38 = 1018 kg

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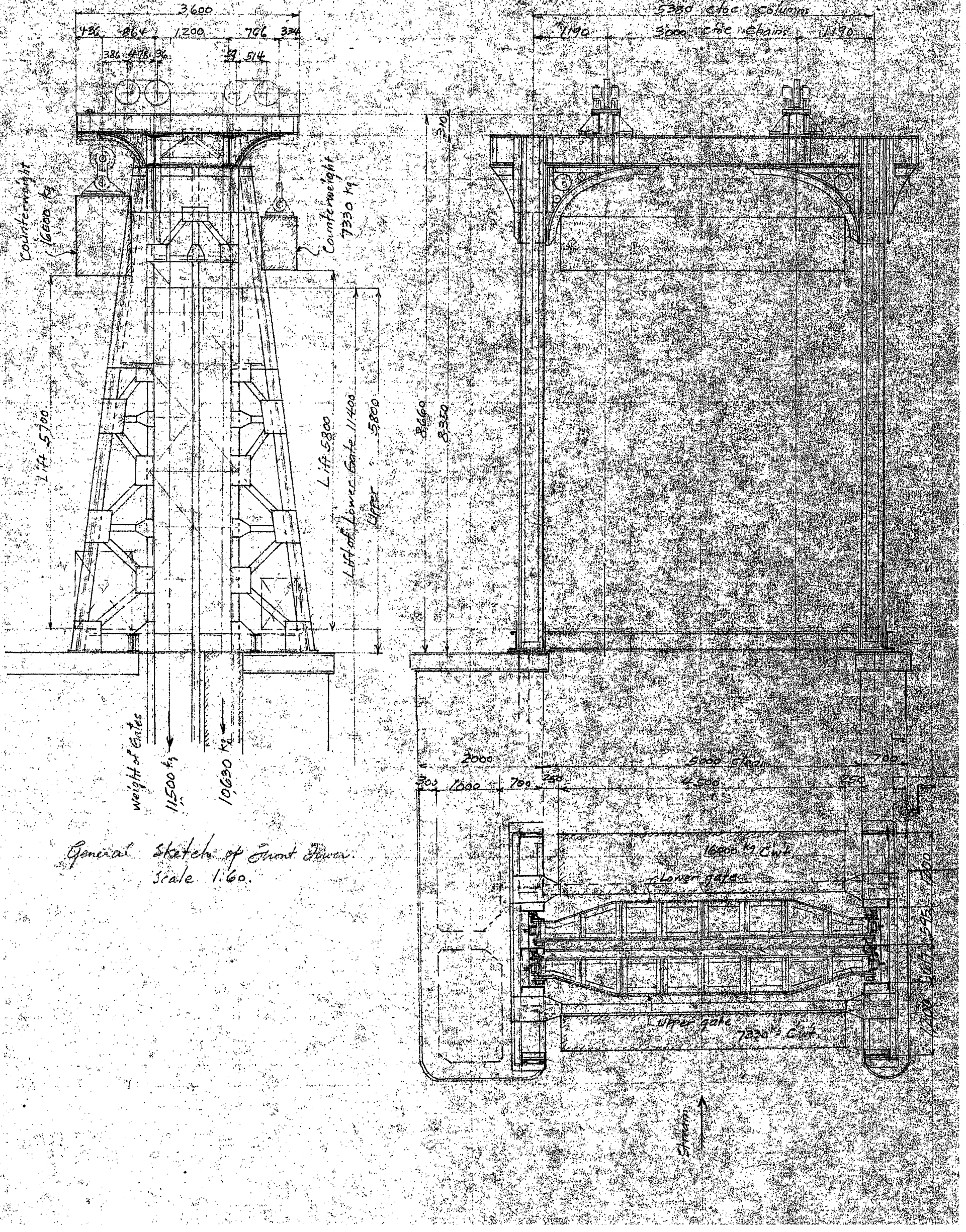
CALCULATIONS FOR

Taisho Lock Gates

Design of Front Tower.

General dimensions and construction assumed as shown in sketches below.



General Sketch of Front Tower.
Scale 1:60.

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MADE BY K. Inaba DATE 8-9-6 FILE NO
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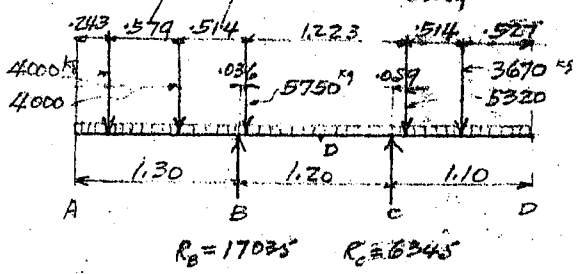
CALCULATIONS FOR

Taicho Lock Gates.

Design of Balancing Beam



weight of beam assumed 180 kg per lin. m.

at B.

moment = $-\frac{1}{2} \times 180 \times 1.3^2 = -150$ kgm
Shear = $-180 \times 1.3 = -230$ kg
" = $\frac{1}{2} \times 180 \times 1.2 = 110 + 25 = 135$ kg

150 − 120 = 30 kgm
30 ÷ 12 = 25 kg.

at C

moment = $-\frac{1}{2} \times 180 \times 1.1^2 = -110$ kgm
Shear = $180 \times 1.1 = 200$ kg
" = $-\frac{1}{2} \times 180 \times 1.2 = -110 + 25 = -85$ kg

at D.

moment. = $\frac{1}{8} \times 180 \times 1.2^2 = 30$
$-(110+650) \div 2 = -130$
-130 kgm

Stresses due to weight of gates and counterweights.

at B.

moment $-4000 \times 0.478 = -1910$
$-4000 \times 1.057 = -4230$
-6140 kgm

6140 − 2420 = 3720 kgm

Shear $-4000 \times 2 = -8000$ kg
" $5750 \times \frac{1.164}{1.20} = 5570 + 3100 = 8670$ kg

3720 ÷ 1.2 = 3100 kg

at C.

moment $-5320 \times 0.059 = -315$
$-3670 \times 0.573 = -2105$
-2420 kgm

Shear $5320 + 3670 = 8990$ kg
" $-5750 \times \frac{0.036}{1.20} = -170 + 3100 = 2930$ kg

at D.

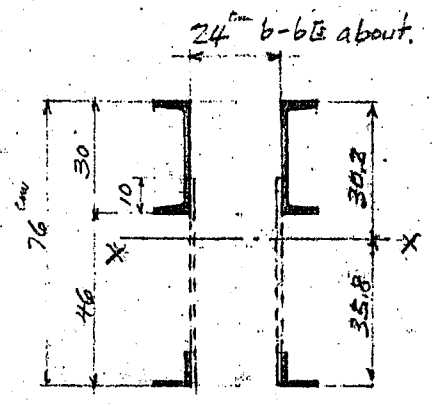
moment. $170 \times 0.60 = 100$
$-\frac{1}{2}(6140 + 2420) = -4280$
-4180 kgm.

Summary of moments and shears.

	Moments			Shear			
	B	C	D	B		C	
Due to Owen weight of Beam	− 150	− 110	− 130	− 230	135	− 185	200
" weight of gates + cwt.	− 6140	− 2420	− 4180	− 8000	8670	− 2930	8990
	− 6290	− 2530	− 4310	− 8230	8805	− 2845	9190

reaction = 17035 kg reaction = 6345 kg

Assumed section



2⊟ 300×90×9	= 97.14	× 15.0	=	1457
2⊔ 90×90×10	= 34.00	× 73.44	=	2497
	131.14 cm²	30.2 cm		3954

Moment of inertia with respect to X-X axis.

2⊟	$97.14 \times 15.2^2 + 6435 \times 2$ =	35320
2⊔	$34.00 \times 33.24^2 + 145 \times 2$ =	37830
		73150 cm⁴

Extreme fibre stress.

$= \frac{6290 \times 100 \times 30.2}{73150} = 260$ kg/cm² T

or $= \frac{6290 \times 100 \times 35.8}{73150} = 308$ " C

unit shear on web

$= \frac{9190}{2 \times 0.9 \times 30} = 170$ kg/cm²

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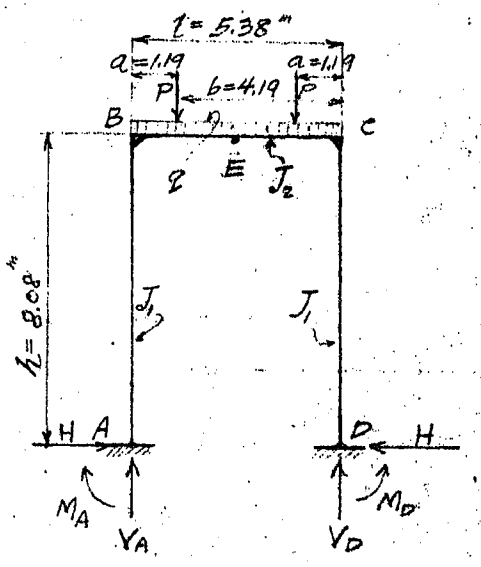
CALCULATIONS FOR

Taicho Lock Gates.

Stresses in Longitudinal Rahmen.



Moments of inertia. (for one gate + one cwt)

J_1

2I 380×100×10.5 = 138.78 — 2C 144.80 = 28960
2L 90-90-10 = 34.00 — 20 17.2 × 34.0 × 16.4 cm² = 7440
172.78 cm² — J_1 = 36400 cm⁴ = 0.000364 m⁴

J_2

1I 450×175×11 = 116.80 cm² — J_2 = 39210 cm⁴ = 0.000392 m⁴

Uniform Load on beam assumed as follows

Main beam assumed		135
balancing beams	2×1.90×230÷5.38 =	163
lateral bracing and struts say		40
machinery framing + platform say		200
Handrail say		35
mechanical equipment		360
misc dead load say		18
	q =	950 kg per unit length for 1 beam

Concentration due to lower gate and its counterweight

P = 17035* kg see page 22
call this 17040 kg

Stresses due to uniform load q. (Refer to Kleinlogel's "Rahmenformeln" on page 89.)

$$V_A = V_D = \frac{q\,l}{2} = \frac{950 \times 5.38}{2} = 2550 \text{ kg}$$

$$H = \frac{q\,l^2}{4h(K+2)} = \frac{950 \times 5.38^2}{4 \times 8.08 \times 3.535} = 240 \text{ kg}$$

$$M_B = M_C = -\frac{q\,l^2}{6(K+2)} = \frac{950 \times 5.38^2}{6 \times 3.535} = -1300 \text{ kgm}$$

$$M_A = M_D = +\frac{q\,l^2}{12(K+2)} = 650 \text{ "}$$

$$M_E = \frac{q\,l^2}{24} \cdot \frac{2+3K}{K+2} = \frac{950 \times 5.38^2 \times 6.605}{24 \times 3.535} = 2140 \text{ "}$$

$K = \frac{J_2}{J_1} \cdot \frac{h}{l} = \frac{0.000392}{0.000364} \cdot \frac{8.08}{5.38} = 1.535$

$K+2 = 3.535$

$2+3K = 6.605$

Stresses due to concentrated loads P. (see on page 98 of the same book)

$$V_A = V_D = P = 17040 \text{ kg}$$

$$H = \frac{3Pab}{hl(K+2)} = \frac{3 \times 17040 \times 1.19 \times 4.19}{8.08 \times 5.38 \times 3.535} = 1660 \text{ kg}$$

$$M_A = M_D = +H \cdot \frac{h}{3} = 1660 \times \frac{8.08}{3} = 4470 \text{ kgm}$$

$$M_B = M_C = -H \cdot \frac{2h}{3} = -1660 \times \frac{2 \times 8.08}{3} = -8940 \text{ kgm}$$

$$M_P = M_E = P \cdot a + M_B = 17035 \times 1.19 - 8940 = 11340 \text{ "}$$

Summary of stresses

	Uniform load.	Concentrated Load	Total	
$V_A = V_D$	2550	17040	19590	kg
H	240	1660	1900	"
$M_B = M_C$	−1300	−8940	−10240	kgm
$M_A = M_D$	650	+4470	+5120	"
M_E	2140	+11340	13480	"

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CALCULATIONS FOR

Taicha Lock Gates

Loads on columns due to their own weight. (for one gate and one cwt.)

Columns.	172.78 cm² @ .785 ×	8.35	=	1132
bracings say		80 × 6.00	=	480
details		50%	=	860
guides of gate say		25 × 6.2	=	155
" " cwt.		20 × 6.2	=	124
base metals. say				349
				3,100 kg on A or D.

Longitudinal wind stresses.

Wind pressure assumed 380 kg/m² of vertical exposed area.

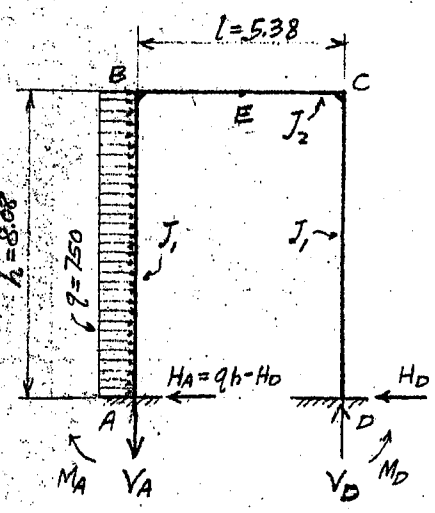
Exposed area assumed: (gates being lifted) for rear side railmen.

=

Gate		0.60 × 5.80	=	3,48
Tower say	2 × 0.55 =	1.10 × 8.35	=	9,18
platform		0.90 × 1.90	=	1.71
Counterweight say		1.30 × .85	=	1.10
misc say				0.53
				16.00 m² @ 380 = 6080 kg

Let us assume this wind pressure being distributed uniformly over the tower

6080 ÷ 8.08 = 750 kg/m.



$k = \frac{J_2}{J_1} \cdot \frac{h}{l} = 1.535$, $k+2 = 3.535$, $2k+3 = 6.070$, $6k+1 = 10.210$

$5k+9 = 16.675$, $12k = 18.420$.

$$V_A = -\frac{qh^2K}{l(6k+1)} = -\frac{750 \times 8.08^2 \times 1.535}{5.38 \times 10.210} = -1370 \text{ kg}$$

$$V_D = 1370 \text{ "}$$

$$H_D = \frac{qh}{8} \cdot \frac{2k+3}{k+2} = \frac{750 \times 8.08 \times 6.07}{8 \times 3.535} = 1300 \text{ "}$$

$$H_A = -(qh - H_D) = 750 \times 8.08 - 1300 = -4760 \text{ "}$$

$$M_A = -\frac{qh^2}{24}\left(12 - \frac{5k+9}{k+2} - \frac{12k}{6k+1}\right)$$

$$= -\frac{750 \times 8.08^2}{24}\left(12 - \frac{16.675}{3.535} - \frac{18.42}{10.21}\right) = -11170 \text{ kgm}$$

$$M_B = M_A - H_D h + \frac{qh^2}{2} = -11170 - 1300 \times 8.08 + \frac{750 \times 8.08^2}{2}$$

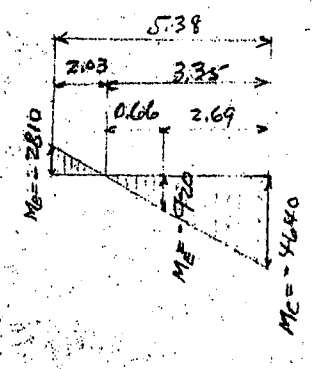
$$= 2810 \text{ kgm}$$

$$M_D = +\frac{qh^2}{24}\left(+\frac{5k+9}{k+2} - \frac{12k}{6k+1}\right) = 2038 \times 2.88 = 5870 \text{ "}$$

$$M_C = M_D - H_D h = 5870 - 1300 \times 8.08 = -7640 \text{ "}$$

M_E $5.38 \times \frac{4640}{7450} = 3.35$ m $\quad 3.35 - \frac{5.38}{2} = 0.66$

$$M_E = -4640 \times \frac{0.66}{3.35} = -920 \text{ kgm}$$



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CALCULATIONS FOR

Taicho Lock Gates.

Grand Summary of Stresses.

		Stresses for no wind	derived Stresses (wind →)	derived Stresses (← wind)	Combined stresses →	Combined stresses ←	Design Stresses
Reaction	V_A	19,590 + 3100 = 22690	− 1370 or +1370		21320	24060	24,060 kg
"	V_D	19,590 + 3100 = 22690	+ 1370 or −1370		24060	21320	"
Thrust	H_A	1900	± 4760 or 1300		− 2860	− 3200	3200 "
"	H_D	1900	± 1300 or −4760		3200	− 2860	"
Moment	M_B	− 10240	2810 or −4640		− 7430	−14,880	−14880 kgm
"	M_C	− 10,240	− 4640	2810	− 14880	7430	"
"	M_A	5120	− 11170 or 5870		− 6050	10990	10,990 "
"	M_D	5120	5870 or −11170		10990	−6050	"
"	M_E	13480	− 920	− 920	12560	12560	13480 "

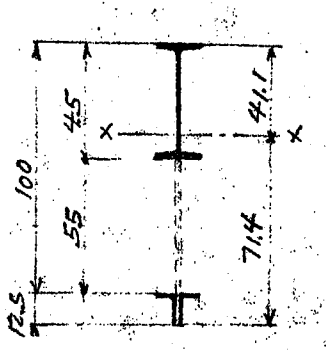
Unit stresses.

at E Extreme fibre stress = $\frac{13480 \times 100}{39210} \times 22.5 = 773$ kg/cm² T or C

at B × C.

moment of inertia of beam.

II 450×175×11	= 116.80 × 22.5 =	2630	116.80×18.6² + 39210 =	79600
2L 125×75×9	= 3438 × 104.19 =	3580	3438×63.09² + 270×2 =	137300
	151.18 41.1 cm	6210	J_B =	216,900 cm⁴



Extreme fibre stress = $\frac{14880 \times 100}{216900} \times 41.1 = 282$ kg/cm² T

" = $\frac{14880 \times 100}{216900} \times 7.14 = 490$ " C

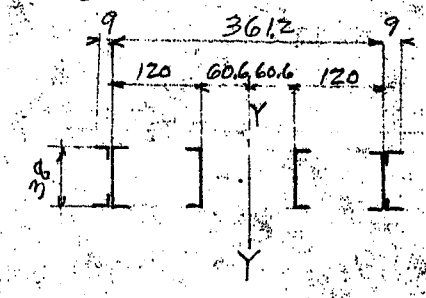
at A × D Extreme fibre stress = $\frac{10990 \times 100}{38400} \times 19.0 = 544$ C or T

Direct compression = 24,060 ÷ 172.78 cm² = 139 C

683 kg/cm² C

405 " T

Transverse wind stresses



moment of inertia of Column about Y–Y axis.

2L 380×100×10.5	= 138.78	× 63.01² + 557×2 =		552000
2L "	= 138.78	× 178.19² + 557×2 =		4406000
4L 90×90×10	= 68.00	× 183.16² + 125×4 =		2280000
	345.56 cm²	J_y =		7238,000 cm⁴

Wind × moment (on one side) =

gate	2.50 × 5.80 × 380 =	5510	× 2.90 =	16000
tower column	0.38×2×7.80×380 =	2250	× 3.90 =	8780
top beams	0.45 × 3.40 × 380 =	580	× 8.13 =	4720
misc. framings say	0.50 × 3.00 × 380 =	570	× 8.60 =	4900
				34400 kgm.

Wind stress on extreme fibre.

= $\frac{34400 \times 100 \times 189.6}{7238000} = 90$ kg/cm² T or C

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CALCULATIONS FOR

Jaicho Lock Gates.

Stresses during no wind at A + O.

moment = 5120 kgm
vert. load = 22690 kg

fibre stress = $\frac{5120 \times 100}{38400} \times 19.0$ = 253 T or C

direct stress = $\frac{22690}{172.78}$ = 131 C

Wind fibre stress = $\frac{90}{474}$ T or C
474 kg/cm² C
or 213 " T

Approximate weight of tower.

Balancing beams.	2 I	300 × 90 × 9	@ 38.10	× 3.60	=	275
" brackets	4 L	90 × 90 × 10	@ 13.30	× 1.00	=	53
" "	4 pls	450 × 9	@ 31.79	× 0.70	=	89
" struts	2 L	90 × 90 × 10	@ 13.30	× 1.00	=	27
" braces.	4 L	75 × 75 × 9	@ 9.96	× 0.55	=	22
" Top batt & I	4 pls	420 × 9	@ 29.67	× 0.45	=	53
" guss. pls	6 pls	300 × 9	@ 21.20	× 0.35	=	45
" Stiff. L's	22 L	75 × 75 × 9	@ 9.96	× 0.28	=	61
" Cov. pls	4 pls	420 × 9	@ 29.67	× 0.25	=	30
" "	2 pls	"	@ "	× 1.00	=	59
" end pls.	2 pls	300 × 9	@ 21.20	× 0.42	=	18
rivet heads + misc. details say						33
						765 × 2 = 1,530 kg

Main beams.	2 I	450 × 175 × 11	@ 91.70	× 6.80	=	1247
Stiff. L	32 L	75 × 75 × 9	@ 9.96	× 0.43	=	137
"	16 L	90 × 75 × 9	@ 11.00	× 1.20	=	211
brackets	8 L	125 × 75 × 9	@ 13.50	× 2.50	=	270
" (combined)	4 pls	700 × 11	@ 60.45	× 1.70	=	411
" "	8 L	90 × 75 × 9	@ 11.00	× 1.20	=	100
Struts	8 L	90 × 75 × 9	@ "	× 1.00	=	88
"	2 pls	450 × 9	@ 31.79	× 1.20	=	76
rivet heads + misc. details say						154
						2700 × 1 = 2700 kg

Column framing	5 I	380 × 100 × 10.5	@ 54.50	× 8.30	=	2260
"	4 L	90 × 90 × 10	@ 13.30	× 8.30	=	442
bracing (Diag)	24 L	90 × 75 × 9	@ 11.00	× 1.00	=	264
" (hor)	12 L	"	@ "	× 0.60	=	79
Strut (rear)	14 L	125 × 75 × 9	@ 13.5	× 1.15	=	218
diag "	6 pls	90 × 9	@ 6.36	× 1.30	=	50
Cov. pls.	4 pls	700 × 9	@ 49.46	× 3.20	=	633
2 comp pls	2 pls	750 × 9	@ 52.99	× 2.00	=	212
Top L's	2 L	150 × 150 × 14	@ 35.1	× 1.80	=	90
Gusset pls	34 pls	400 × 9	@ 28.26	× 0.50	=	481
"	10 pls	200 × 9	@ 14.13	× 0.30	=	42
guss. pls + comb L	7 sets		@ 25		=	175
base I's	1 I	300 × 90 × 9	@ 38.1	× 3.60	=	137
"	2 I's	"	@ "	× 0.90	=	69
base pls	2 pls	500 × 16	@ 62.80	× 1.35	=	170
" L's	2 L	150 × 150 × 15	@ 33.6	× 0.50	=	34
guides	4 L	75 × 50 × 8	@ 7.35	× 6.30	=	185
"	2 L	125 × 75 × 9	@ 13.50	× 6.30	=	170

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CALCULATIONS FOR

Taisho lock gates.

comm. pls & I.	2Pls	400 ×	9 @ 28.26 × 0.80 =	45	
" Diaphgram	2		@ 25 =	50	
rivet heads, bolts &c say				243	
				6050	× 2 = 12100 kg
Struts between towers	2 Is	300 × 150 × 8 @ 48.3 × 5.00 =		483	
Comm Ls & rivet heads. &c				17	
				500	× 1 = 500 kg

Guide metals in piers

	3Pls	380 × 100 × 10.5	@ 54.50 × 1.40 =	186	
fill on centre I	1 fill	90 × 12	@ 8.48 × 1.40 =	97	
rear side struts	2Ls	125 × 75 × 9	@ 13.50 × 1.15 =	403	
comms.	13 sets		@ 25 =	325	
tie pls top & bot.	2Pls	500 × 9	@ 35.33 × 1.40 =	99	
base Ls	2Ls	130 × 130 × 12	@ 23.4 × 1.15 =	54	
"	3Ls	"	@ " × 0.33 =	25	
base pl	1 Pl	380 × 15	@ 44.75 × 1.50 =	67	
rivet heads bolts &c say				69	
				3000	× 2 = 6000 kg

Machinery framing and platform say 3200 × 1 = 3200

Handrail, ladder &c say 1000 × 1 = 1000

Summary of structural steel in front tower = 27030 kg

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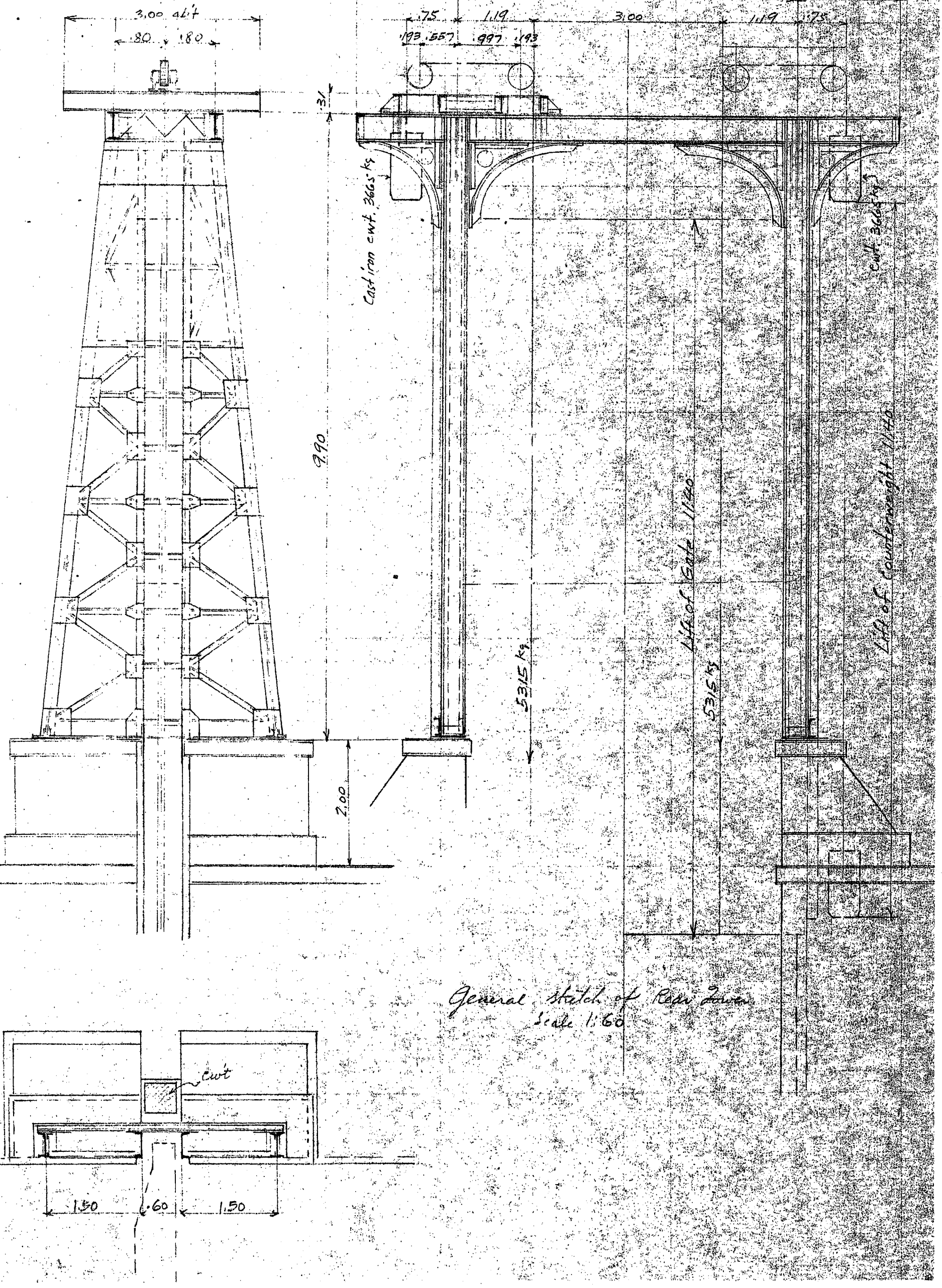
CALCULATIONS FOR

Taicho Lock Gates
Design of Rear Gate.



General Sketch of Rear Gate
Scale 1:60

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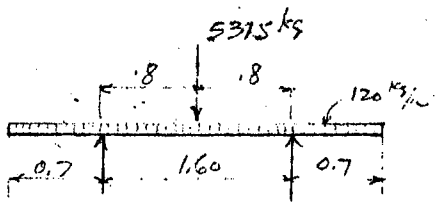
CALCULATIONS FOR

Taicha lock Gate.

Design of supporting beam of sprocket wheel.

Own weight of beam assumed 120 kg per lin m.



moment

at support $-\frac{1}{2} \times 120 \times 0.7^2 = -30$ kgm

at center $\frac{1}{8} \times 120 \times 1.6^2 = 40 - 30 = 10$ kgm

$5315 \times 1.6 \div 4 = 2130$

2140 kgm

max shear $120 \times 0.8 = 96$

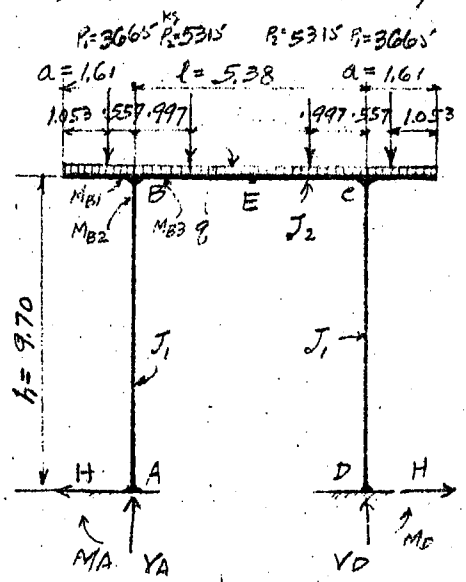
$5315 \div 2 = \frac{2658}{2754}$ kg

Use ZI 300×90×9 section modulus $= 429 \times 2 = 858$ cm³

Unit fibre stress $= \frac{2140 \times 100}{858} = 250$ kg/cm²

Unit shear on web $= \frac{2754}{2 \times 0.9 \times 30} = 51$ "

Stresses in Longitudinal Rahmen.



Moments of inertia J_1 and J_2.

J_1.

4E	380×100×10.5 = 277.56	4@ 14480	=	57920
4H	90×90×10 = 68.00	4@ 125 + 68.0×16.44²	=	18880
	345.56 cm²		J_1 =	76800 cm⁴
			α =	0.000768 1/m⁴

J_2

2I	400×150×10 = 183.46 cm²	2@ 23974	=	47950 cm⁴
			J_2 =	0.0004795 1/m⁴

Uniform load on main beam assumed $q = 1800$ kg/lin metre.

Concentration due to gate and etc.

$P_1 = 3665$ kg

$P_2 = 5315$ "

Constant $k = \frac{J_2}{J_1} \cdot \frac{h}{l} = \frac{0.0004795}{0.000768} \times \frac{9.70}{5.38} = 1.122$

$k+2 = 3.122$, $2+3k = 5.366$

$l^2 - 6a^2 = 5.38^2 - 6 \times 1.61^2 = 13.40$

$V_A = V_D = \frac{q(l+2a)}{2} = \frac{1800 \times 8.60}{2} = 7740$ kg

$H = \frac{q(l^2-6a^2)}{4h(k+2)} = \frac{1800 \times 13.40}{4 \times 9.70 \times 3.122} = 199$ kg

$M_A = M_D = \frac{q(l^2-6a^2)}{12(k+2)} = \frac{1800 \times 13.40}{12 \times 3.122} = 643$ kgm

$M_{B2} = M_{C2} = \frac{q(6a^2-l^2)}{6(k+2)} = -\frac{1800 \times 13.40}{6 \times 3.122} = -1286$ "

$M_{B3} = M_{C3} = -\frac{3qa^2k + ql^2}{6(k+2)} = -\frac{3 \times 1800 \times 1.61^2 \times 1.122 + 1800 \times 5.38^2}{6 \times 3.122} = -3620$ kgm

$M_{B1} = M_{C1} = -\frac{qa^2}{2} = -\frac{1800 \times 1.61^2}{2} = -2330$ kgm

$M_E = \frac{ql^2(2+3k) - 12qa^2k}{24(k+2)} = \frac{1800 \times 5.38^2 \times 5.366 - 12 \times 1800 \times 1.61^2 \times 1.122}{24 \times 3.122} = 2890$ kgm

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MADE BY K. Inaba DATE 8-9-13 FILE NO
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CALCULATIONS FOR

Taicha Lock Gate

Stresses due to concentrations P_1 on both overhanging arms.
For this case $a = a' = 0.557$ m. $P_1 = 3665$ kg

$V_A = V_D = P_1 = 3665$ kg

$H = -\frac{P_1 a'}{h} \cdot \frac{3}{K+2} = -\frac{3665 \times 0.557}{9.70} \cdot \frac{3}{3.122} = -202$ kg

$M_A = M_D = -\frac{P_1 a'}{K+2} = -\frac{3665 \times 0.557}{3.122} = -653$ kgm

$M_{B2} = M_{C2} = \frac{2P_1 a'}{K+2} = -1306$ "

$M_{B3} = M_{C3} = -P_1 a' \cdot \frac{k}{K+2} = -3665 \times 0.557 \times \frac{1.122}{3.122} = -733$ "

$M_{B1} = M_{C1} = -P_1 a' = -3665 \times 0.557 = -2043$ "

$M_E = M_{B3} = -733$ "

Stresses due to concentrations P_2 over span.
For this case $a'' = 0.997$ m, $b = 4.383$ m, $P_2 = 5315$ kg

$V_A = V_D = P_2 = 5315$ kg

$H = \frac{3Pa''b}{hl(K+2)} = \frac{3 \times 5315 \times 0.997 \times 4.383}{9.70 \times 5.38 \times 3.122} = 427$ "

$M_A = M_D = H \cdot \frac{h}{3} = 427 \cdot \frac{9.70}{3} = 1380$ kgm

$M_B = M_C = -H \cdot \frac{2h}{3} = -2760$ "

$M_E = P_2 a'' + M_B = 5315 \times 0.997 - 2760 = 2540$ "

Direct load on columns due to their own weight.

$V_A = V_D$ = say 7,500 kg.

H and M are all zero.

Summary of stresses.

	Unif. load.	Concentrated loads P_1	Concentrated loads P_2	Column loads.	Total stresses.	
$V_A = V_D$	7.740	3665	5.315	7,500	24,220	kg
H	199	− 202	429	—	424	"
$M_{B1} = M_{C1}$	−2330	− 2043	0	—	− 4373	kgm
$M_{B2} = M_{C2}$	−1286	1306	− 2760	—	−2740	"
$M_{B3} = M_{C3}$	−3620	− 733	− 2760	—	− 7133	"
$M_A = M_D$	643	− 653	1380	—	1370	"
M_E	2890	− 733	2540	—	4697	"

Longitudinal wind stress.

Wind pressure assumed as 380 kg/m²

Exposed area assumed

gate	0.60 × 5.80	=	3,48
tower say	2 × 1.00 · 9.90	=	19,80
Plat form	0.90 · 3.00	=	2.70
misc say			0,52
			26.50 m² @ 380 = 10,070 kg

Let us assumed this wind pressure assumed to be distributed over the tower

$q = 10,070 \div 9.70 = 1,040$ kg per lin. mete.

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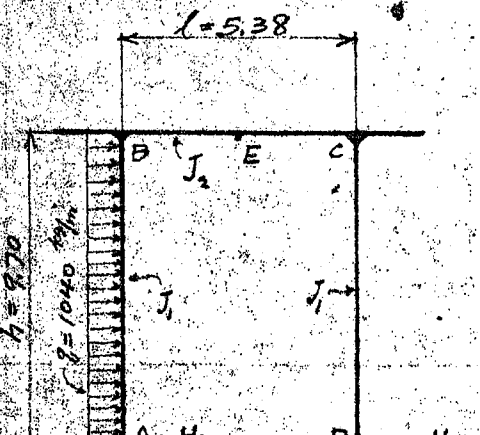
CALCULATIONS FOR

Taicho Lock gates.



$k = \frac{J_2}{J_1}\cdot\frac{h}{l} = 1.122$, $k+2 = 3.122$, $2k+3 = 5.244$,
$6k+1 = 7.732$, $5k+9 = 14.610$
$12k = 13.464$

$V_A = -\frac{qh^2k}{l(6k+1)} = -\frac{1040\times 9.70^2\times 1.122}{5.38\times 7.732} = -2640$ kg

V_D = 2640 "

$H_D = \frac{qh}{8}\cdot\frac{2k+3}{k+2} = \frac{1040\times 9.70}{8}\times\frac{5.244}{3.122} = 2115$ "

$H_A = -(qh - H_D) = -1040\times 9.70 + 2115 = -7960$ "

$M_A = -\frac{qh^2}{24}\left(12 - \frac{5k+9}{k+2} - \frac{12k}{6k+1}\right)$

$= -\frac{1040\times 9.7^2}{24}\left(12 - \frac{14.610}{3.122} - \frac{13.464}{7.732}\right) = -22,750$ kgm

$M_B = M_A - H_D h + \frac{qh^2}{2}$

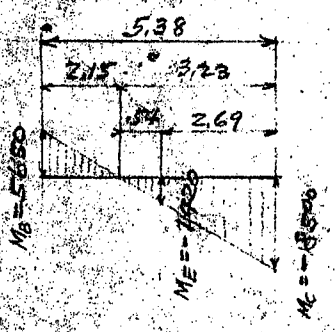
$= -22,750 - 2115\times 9.7 + \frac{1040\times 9.7^2}{2} = 5650$ "

$M_D = \frac{qh^2}{24}\left(\frac{5k+9}{k+2} - \frac{12k}{6k+1}\right)$ = 12,000 "

$M_C = M_D - H_D h = 12000 - 2115\times 9.70 = -8,500$ "

M_E $5.38\times\frac{8500}{14150} = 3.23$ $3.23 - \frac{5.38}{2} = 0.54$ m

$M_E = -8500\times\frac{.54}{3.23} = -1420$ kgm



Summary of stresses.

		Stresses for no wind	curved stresses →	curved stresses ←	Combined stresses →	Combined stresses ←	Design stresses	For one side.
Reaction	V_A	24220	− 2640	2640	21,580	26860	26860	13430 kg ←
"	V_D	24220	2640	− 2640	26,860	21,580	26860	" →
Thrust	H_A	424	− 7960	2115	− 7,536	2,539	− 7,536	− 3768 →
"	H_D	424	2115	− 7960	2539	− 7,536	− 7,536	− " ←
Moment	M_{B1}	− 4373	0	0	− 4373	− 4,373	− 4,373	− 2187 kgm
"	M_{B2}	− 2740	5650	− 8500	2910	−11240	−11,240	− 5620 ←
"	M_{B3}	− 7,113	5650	− 8500	− 1463	−15,613	− 15,613	− 7807 ←
"	M_{C1}	− 4,373	0	0	− 4373	− 4,373	− 4373	− 2187
"	M_{C2}	− 2,740	− 8,500	5650	−11240	2910	− 11240	− 5620 →
"	M_{C3}	− 7,113	− 8500	5650	− 15,613	− 1463	− 15,613	− 7807 →
"	M_A	1370	− 22,750	12,000	− 21380	13370	− 21,380	− 10,690 →
"	M_D	1370	12000	− 22,750	13370	− 21380	− 21,380	− " ←
"	M_E	4697	− 1420	− 1420	3277	3277	4697	2349

Unit stress.
at point E.

Extreme fibre stress $= \frac{2349\times 100}{23974}\times 20.0 = \pm 196$

Direct stress due to H $= \frac{424}{91.73} = \frac{-5}{191}$ kg/cm² T
or 201 " C

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MADE BY K. Inaba DATE 8-9-13 FILE NO
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CALCULATIONS FOR

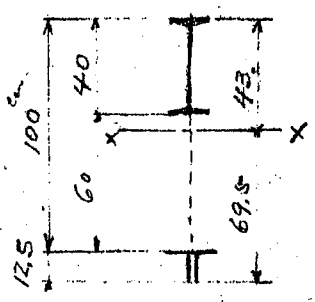
Taicho Lock Gates.

At Point B.

For Beam end. $M_{B3} = -7807$ kgm

moment of inertia of beam at B.

1I	400×150×10 =	91.73	× 20.00 =	1835	91.73×23² + 23974 =	72,500
2L	125×75×9 =	34.38	× 104.19 =	3580	34.38×64.19² + 270×2 =	129,200
		126.11 cm²		5415		201,700 cm⁴



Extreme fibre stress = $\frac{7807 \times 100}{201700} \times 43 = 167$ kg/cm² T

or = $\frac{7807 \times 100}{201700} \times 69.5 = 269$ " C

For column top B $M_{B2} = -5620$ kgm, Direct comp. = $V_B = 13430$ kg.
Smaller stresses than at A.

For column bottom A. $M_A = -10,690$ kgm, Direct comp. = $V_A = 21580 \div 2 = 10790$ kg

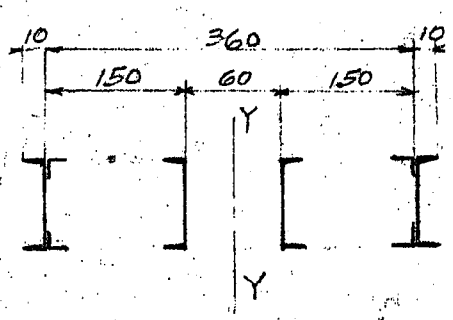
Extreme fibre stress = $\frac{10690 \times 100}{38400} \times 19 = 530$ kg/cm² T or C

Direct compression = $\frac{10790}{172.78} = 62$ " C

468 " T

or 592 " C

Transverse wind stresses



moment of inertia with respect to Y-Y axis.

2L	380×100×10.5 =	138.78	× 32.45² + 2×557 =	147000
2L	" =	138.78	× 182.41² + 2×557 =	4616000
4L	90×90×10 =	68.00	× 177.44² + 125×4 =	2140000
		345.56 cm²		Jy = 6903000 cm⁴

wind moment on one tower-frame

Gate	2.5×5.80× 380 =	5510	× 5.40 =	29750
Tower column	0.38×2×9.5 × " =	2750	× 4.75 =	13050
top beam	0.40×4.30 × " =	650	× 9.70 =	6300
misc framings say	0.50×3.5 × " =	670	× 10.20 =	6806
				55900 kgm.

wind stress on extreme fibre = $\frac{55900 \times 100}{6903000} \times 190 = 154$ kg/cm² T or C

Stresses during no wind at A & D.

$M_A = 1370$ kgm, Direct load $V_A = 24220$ kg.

fibre stress = $\frac{1370 \times 100}{36800} \times 19.0 = 34$ kg/cm² T or C

Direct stress = $\frac{24220}{345.56} = 70$ " C

104 " C

or 36 " C

Resultant stress during wind

104 + 154 = 258 kg/cm² C

154 − 36 = 118 " T

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MADE BY K. Iwata DATE 8-9-13 FILE NO
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CALCULATIONS FOR

Taicho Lock Gates.
Approximate weight of rear tower.

Supporting beams of sprocket.	4Is	300 × 90 × 9	@	38.10	×	3.00	=	457
" Brackets	8		@	21.00			=	168
" Struts	3Ls	90 × 90 × 10	@	13.30	×	1.45	=	58
" Lacing + guss pls	3		@	20.00			=	60
" Struts	4Cs	300 × 90 × 9	@	38.10	×	0.60	=	91
"	1		@	70.00			=	70
" brackets	2Cs		@	25.00			=	50
" Stiff	16Ls	90 × 75 × 9	@	11.00	×	0.28	=	49
" Cov. pls (combined)	2Pls	800 × 9	@	56.52	×	1.50	=	170
" misc. say							=	30
" Rivet heads &c say							=	47
								1250 × 2 = 2,500 kg
Main Beams.	2Is	400 × 150 × 10	@	72.00	×	8.60	=	1240
" Stiffs	32Ls	75 × 75 × 9	@	9.96	×	0.38	=	121
"	16Ls	90 × 75 × 9	@	11.00	×	1.20	=	211
" brackets	8Ls	125 × 75 × 9	@	13.50	×	2.60	=	281
"	8Ls	"	@	"	×	2.30	=	248
"	4Pls	750 × 9	@	52.99	×	1.00	=	212
"	4Pls	750 × 9	@	"	×	0.75	=	159
"	8Ls	90 × 75 × 9	@	11.00	×	0.90	=	79
"	8Ls	"	@	"	×	0.70	=	62
" Struts	8Ls	"	@	"	×	1.45	=	128
"	2Pls	400 × 9	@	28.26	×	1.60	=	90
" lateral br. say				35.0	×	3.00	=	105
" rivet heads + misc details say							=	114
								3050 × 1 = 3,050 kg
Column framings	2Cs	380 × 100 × 10.5	@	54.50	×	9.90	=	1079
"	2Is	"	@	"	×	9.50	=	1035
"	4Ls	90 × 90 × 10	@	13.30	×	9.50	=	505
" bracings (Diag.)	36Ls	90 × 75 × 9	@	11.00	×	1.20	=	475
" (hor.)	20Ls	"	@	"	×	0.90	=	198
" rear struts	9Cs	125 × 75 × 9	@	13.50	×	0.60	=	73
" Comm. pls	4Pls	700 × 9	@	49.46	×	2.00	=	396
" Top Ls	2Ls	150 × 150 × 11	@	25.10	×	2.00	=	100
" cov. pls	4Pls	950 × 9	@	67.12	×	2.53	=	684
" guss. pls	32Pls	400 × 9	@	28.26	×	0.50	=	452
"	20Pls	300 × 9	@	21.20	×	0.50	=	212
"	12Pls	200 × 9	@	14.13	×	0.30	=	51
" guss pls + comm	9 Sets		@	25.00			=	225
" base Is	1I	300 × 90 × 9	@	38.10	×	3.80	=	145
"	2Cs	"	@	"	×	1.30	=	99
" base pls	2Pls	500 × 16	@	62.80	×	1.65	=	207
" Ls	6Ls	150 × 150 × 15	@	33.60	×	0.33	=	71
" guides (gate)	2Cs	75 × 50 × 8	@	7.35	×	7.50	=	110
" (cwt)	1L	150 × 90 × 9	@	16.40	×	9.00	=	148
" tie pls of I-	4Pls	300 × 9	@	21.20	×	0.48	=	41
" rivet heads bolts, &c say							=	244
								6550 × 2 = 13,100 kg

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MADE BY K. Inaba DATE 8-9-13 FILE NO.
CHECKED BY M.J. DATE 8-9-21 PAGE NO 34

CALCULATIONS FOR

Taicho Lock Gates.

Guide metals in piers.

	ZB	380×100×10.5	@ 54.50	× 8.90	=	970
Rear side strut	2Ls	125×75×9	@ 13.50	× 0.60	=	178
Cover		11 sets	@ 25.00		=	275
Ins pls top+bott	2Pls	500× 9	@ 35.33	× 0.80	=	57
Base Ls	1L	130×130×12	@ 23.40	× 0.60	=	14
"	2Ls	"	@ "	× 0.35	=	16
base pl, gusset, rivet heads, bolts etc say	1Pl	380	×14 @ 41.76	× 0.90	=	38 180 72
						1800 ×2 = 3,600 kg
Machinery framing and platform say						2700 ×1 = 2700
Handrails, ladder etc say						1050
						26,000 kg

Summary of structural steel

Intake gates	3	@ 8,020	= 24,060	
guide metals in piers say	6	@ 1100	= 6600	
				30,660
Front lock gates				
upper gate	1	@ 10620	= 10620	
lower gate	1	@ 11,550	= 11550	
tower	1	@ 21,030	= 21030	
guide metals in piers	2	@ 3000	= 6000	
				49,200
Rear lock gate	1	@ 10,620	= 10620	
tower	1	@ 22,400	= 22,400	
guide metals in piers	2	@ 1800	= 3600	
				36,620
Counterweight girders for				
Intake gates say	3	@ 200	= 600	
front lower gate	1	@ 1150	= 1150	
" upper "	1	@ 650	= 650	
rear gate say	2	@ 200	= 400	
				2,800
Sluice gates	2	@ 200	= 400	
guide metals in piers say	2	@ 250	= 500	
				900
miscellaneous fittings etc say				820
				121,000 kg
			or	121.0 kg tons

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CALCULATIONS FOR

MADE BY_____ DATE_____ FILE NO_____
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大堰水門扉及捲揚装置

昭和八年十月

材料計算書

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MADE BY M. Jinda DATE 8-9-4 FILE NO
CHECKED BY Y. O DATE 8-9-25 PAGE NO M1

CALCULATIONS FOR

Materials of Taicho Lock gate

FRONT LOCK LOWER GATE

Horiz. girder	14	L	125·90·9	c	146	×	5173	=	10574
〃	7	Web Pls	600 × 9	c	42390	×	5163	=	15320
〃	14	L	150·90·12	c	215	×	5275	=	15878
〃	28	〃	75·75·9	c	996	×	425	=	1185
〃	112	〃	〃	c	〃	×	610	=	6805
Vertical end girder	6	〃	〃	c	〃	×	5755	=	3439
〃	2	Web Pls	290 × 9	c	20489	×	5755	=	2358
〃	2	L	125·75·9	c	135	×	5755	=	1554
〃	2	Pls	355 × 9	c	25081	×	5755	=	2887
〃	2	〃	285 × 9	c	20135	×	5755	=	2318
〃	28	L	125·90·9	c	146	×	282	=	1153
〃	28	〃	150·90·9	c	164	×	282	=	1295
〃	28	Fills	110 × 9	c	7772	×	145	=	316
〃	28	〃	145 × 3	c	3415	×	190	=	182
Vertical stiffener	8	L	90·75·9	c	110	×	773	=	680
〃	24	〃	75·75·9	c	996	×	773	=	1848
〃	8	〃	90·75·9	c	110	×	873	=	768
〃	24	〃	75·75·9	c	996	×	873	=	2087
〃	8	〃	90·75·9	c	110	×	973	=	856
〃	24	〃	75·75·9	c	996	×	973	=	2326
〃	24	Fills	70 × 9	c	4946	×	610	=	724
〃	24	〃	〃	c	〃	×	710	=	843
〃	24	〃	〃	c	〃	×	810	=	962
〃	6	Pls	600 × 9	c	42390	×	780	=	1984
〃	6	〃	〃	c	〃	×	880	=	2238
〃	6	〃	〃	c	〃	×	980	=	2493
〃	28	Fills	140 × 9	c	9891	×	210	=	582
Skin plate	1	Pl	920 × 9	c	64998	×	5360	=	3484
〃	1	〃	730 × 9	c	51575	×	5360	=	2764
〃	2	Pls	830 × 9	c	58640	×	5360	=	6286
〃	1	Pl	930 × 9	c	65705	×	5360	=	3522
〃	1	〃	1165 × 9	c	82307	×	5360	=	4412
〃	5	Pls	210 × 9	c	14837	×	5360	=	3976
〃	3	〃	180 × 9	c	12717	×	3100	=	1183
〃	4	〃	〃	c	〃	×	2645	=	336
〃	3	〃	〃	c	〃	×	455	=	174
Diagonal	2	〃	200 × 9	c	14130	×	2800	=	791
〃	2	〃	〃	c	〃	×	2240	=	633
〃	2	〃	〃	c	〃	×	880	=	249
〃	2	〃	〃	c	〃	×	1900	=	537
〃	2	〃	〃	c	〃	×	350	=	99
〃	2	〃	600 × 9	c	42390	×	1070	=	907
〃	6	〃	140 × 9	c	9891	×	140	=	83
〃	2	〃	310 × 9	c	21902	×	1000	=	438
〃	2	〃	〃	c	〃	×	1025	=	449
Horiz. girder	1	L	90·90·10	c	133	×	5030	=	669
〃	12	L	125·75·9	c	135	×	282	=	457
〃	12	Fills	70 × 9	c	4946	×	140	=	83
Diaphragm	8	L	75·75·9	c	996	×	991	=	790
〃	4	〃	〃	c	〃	×	530	=	211
〃	4	〃	〃	c	〃	×	500	=	199
〃	8	Fills	70 × 9	c	4946	×	340	=	135
〃	2	Pls	510 × 9	c	36032	×	980	=	706

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MADE BY M. Jinda DATE 8-9-20 FILE NO
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CALCULATIONS FOR

Materials of Taicho Lock gate

Hang point

8	L	75·75	×	9	c	996	× 820 =	653
2	P/s	380	×	9	c	26.847	× 840 =	45.1
4	P/s	220	×	9	c	15.543	× 670 =	41.7
4	Fill/s	70	×	9	c	4.946	× 290 =	5.7
4	P/s	210	×	9	c	14.837	× 325 =	19.3
2	"	180	×	9	@	12.717	590 =	15.0
2	"	"			@	"	1.410 =	35.9

11.950.8

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SHOWA BLDG. TOKYO

MADE BY M. Jinda DATE 8-9-5 FILE NO
CHECKED BY Y. O DATE 8-9-25 PAGE NO M3

CALCULATIONS FOR

Materials of Taisho Lock gate

FRONT LOCK UPPER GATE

Horiz girder	12	L	90·90·10	c	133	×	5275	=	841.9
〃 〃	6	Web Pl	600 · 9	c	42390	×	5163	=	1,313.2
〃 〃	10	L	90·90·10	c	133	×	5173	=	688.0
〃 〃	1	L	150·90· 9	c	164	×	4,880	=	80.0
〃 〃	1	〃	〃	c	〃	×	5173	=	84.8
〃 〃	24	L	75·75· 9	c	996	×	425	=	101.6
〃 〃	96	〃	〃	c	〃	×	610	=	583.3
Vertical end girder	6	〃	〃	c	〃	×	5,755	=	343.9
〃 〃	2	〃	125·75· 9	c	135	×	5,755	=	155.4
〃 〃	2	Pl	290 · 9	c	20489	×	5755	=	235.8
〃 〃	2	〃	355 · 9	c	25081	×	5755	=	288.7
〃 〃	2	〃	285 · 9	c	20135	×	5755	=	231.8
〃 〃	24	L	125·90· 9	c	146	×	282	=	98.8
〃 〃	24	〃	150·90· 9	c	164	×	282	=	111.0
〃 〃	22	Fills	110 · 10	c	8635	×	145	=	27.5
Vertical stiffener	12	L	90·75· 9	c	110	×	973	=	128.4
〃 〃	8	〃	〃	c	〃	×	1,173	=	103.2
〃 〃	36	〃	75·75· 9	c	996	×	973	=	348.9
〃 〃	24	〃	〃	c	〃	×	1,173	=	280.4
〃 〃	36	Fills	70 · 9	c	4946	×	810	=	144.2
〃 〃	24	〃	〃	c	〃	×	1,010	=	119.9
〃 〃	9	Pl	600 · 9	c	42390	×	980	=	373.9
〃 〃	6	〃	〃	c	〃	×	1,180	=	300.1
〃 〃	24	Fills	140 · 9	c	9891	×	210	=	49.9
〃 〃	3	Pl	180 · 9	c	12717	×	2,650	=	101.1
〃 〃	3	〃	〃	c	〃	×	465	=	17.7
〃 〃	1	〃	〃	c	〃	×	2,990	=	38.0
Skin plate	1	Pl	1130 · 9	c	79835	×	5460	=	435.9
〃 〃	2	Pl	950 · 9	c	67118	×	5460	=	732.9
〃 〃	1	Pl	1150 · 9	c	81248	×	5460	=	443.6
〃 〃	1	〃	1375 · 9	c	97144	×	5460	=	530.4
〃 〃	4	Pl	190 · 9	c	13424	×	5460	=	293.2
Diagonals	2	〃	200 · 9	c	14130	×	2280	=	64.4
〃 〃	2	〃	190 · 9	c	13424	×	250	=	6.7
〃 〃	2	〃	200 · 9	c	14130	×	1,100	=	31.1
〃 〃	2	〃	〃	c	〃	×	2,720	=	76.9
〃 〃	2	〃	〃	c	〃	×	1,400	=	39.6
〃 〃	2	〃	150 · 9	c	10598	×	880	=	18.7
〃 〃	2	〃	〃	c	〃	×	985	=	20.9
〃 〃	2	〃	145 · 9	c	10244	×	195	=	4.0
〃 〃	2	〃	180 · 9	c	12717	×	1670	=	42.5
〃 〃	2	〃	〃	c	〃	×	510	=	13.0
〃 〃	2	〃	575 · 9	c	40624	×	1270	=	103.2
〃 〃	6	〃	140 · 9	c	9891	×	140	=	8.3
〃 〃	10	L	125·75· 9	c	135	×	282	=	38.1
〃 〃	10	Fills	70 · 9	c	4946	×	140	=	6.9
Diaphragm	8	L	75·75· 9	c	996	×	1,191	=	94.9
〃 〃	4	〃	〃	c	〃	×	530	=	21.1
〃 〃	4	〃	〃	c	〃	×	500	=	19.9
〃 〃	8	Fills	70 · 9	c	4946	×	340	=	13.5
〃 〃	2	Pl	510 · 9	c	36032	×	1,180	=	85.0
Idang point	8	L	75·75· 9	c	996	×	910	=	72.5
〃 〃	2	Pl	380 · 9	c	26847	×	800	=	43.0
〃 〃	4	〃	220 · 9	c	15543	×	650	=	40.4
〃 〃	4	Fills	70 · 9	c	4946	×	520	=	10.3
〃 〃	4	Pl	190 · 9	c	13424	×	325	=	17.5
									10519.8

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SHOWA

MADE BY M. Jinda DATE 8-9-5 FILE NO
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CALCULATIONS FOR

Materials of Taicho Lock gate

REAR LOCK GATE 1- Required

Horiz. girder	12	L	90·90·10	c	133	× 5275	=	8419
〃 〃	12	〃	〃	c	〃	× 5173	=	8256
〃 〃	6	Web. Plt	600 × 9	c	42390	× 5163	=	13132
〃 〃	24	L	75·75·9	c	996	× 425	=	1016
〃 〃	96	〃	〃	c	〃	× 610	=	5833
Vert. end girder	6	L	〃	c	〃	× 5755	=	3439
〃 〃	2	〃	125·75·9	c	135	× 5755	=	1554
〃 〃	2	Plt	355 × 9	c	25081	× 5755	=	2887
〃 〃	2	〃	285 × 9	c	20135	× 5755	=	2318
〃 〃	2	〃	290 × 9	c	20489	× 5755	=	2358
〃 〃	24	L	125·90·9	c	146	× 282	=	988
〃 〃	24	〃	150·90·9	c	164	× 282	=	1110
〃 〃	24	Fillt	110 × 10	c	8635	× 145	=	300
〃 〃	24	〃	140 × 9	c	9891	× 210	=	499
Vertical stiffener	36	Fillt	70 × 9	c	4946	× 810	=	1442
〃 〃	24	〃	〃	c	〃	× 1010	=	1199
〃 〃	9	Plt	600 × 9	c	42390	× 980	=	3739
〃 〃	6	〃	〃	c	〃	× 1180	=	3001
〃 〃	12	L	90·75·9	c	110	× 973	=	1284
〃 〃	8	〃	〃	c	〃	× 1173	=	1032
〃 〃	36	〃	75·75·9	c	996	× 973	=	3489
〃 〃	24	〃	〃	c	〃	× 1173	=	2804
Skin plate	1	Pl	1130 × 9	c	79835	× 5360	=	4279
〃 〃	2	Plt	950 × 9	c	67118	× 5360	=	7195
〃 〃	1	Pl	1150 × 9	c	81249	× 5360	=	4355
〃 〃	1	〃	1375 × 9	c	97144	× 5360	=	5207
〃 〃	4	Plt	190 × 9	c	13424	× 5360	=	2878
〃	3	〃	180 × 9	c	12717	× 2650	=	1011
〃	3	〃	〃	c	〃	× 465	=	177
〃	1	Pl	〃	c	〃	× 2990	=	380
Diagonal	2	Plt	200 × 9	c	14130	× 2280	=	644
〃	2	〃	190 × 9	c	13424	× 280	=	75
〃	2	〃	200 × 9	c	14130	× 1100	=	311
〃	2	〃	〃	c	〃	× 2720	=	769
〃	2	〃	〃	c	〃	× 1400	=	396
〃	2	〃	245 × 9	c	17309	× 880	=	305
〃	2	〃	〃	c	〃	× 1040	=	360
〃	2	〃	180 × 9	c	12717	× 510	=	130
〃	2	〃	〃	c	〃	× 1670	=	425
〃	2	〃	600 × 9	c	42390	× 1270	=	1077
〃	6	〃	140 × 9	c	9891	× 140	=	83
〃	10	L	125·75·9	c	135	× 282	=	381
〃	10	Fillt	70 × 9	c	4946	× 140	=	69
Diaphragm	8	L	75·75·9	c	996	× 1191	=	949
〃	4	〃	〃	c	〃	× 530	=	211
〃	4	〃	〃	c	〃	× 500	=	199
〃	8	Fillt	70 × 9	c	4946	× 340	=	135
〃	2	Plt	510 × 9	c	36032	× 1180	=	850
Hang. joint	8	L	75·75·9	c	996	× 910	=	725
〃	2	Plt	380 × 9	c	26847	× 800	=	430
〃	4	〃	220 × 9	c	15543	× 650	=	404
〃	4	Fillt	70 × 9	c	4946	× 520	=	103
〃	4	Fillt	140 × 9	c	13424	× 325	=	175

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SHOWA BLDG, TOKYO

MADE BY M. Jinda DATE 8-9-15 FILE NO ___
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CALCULATIONS FOR

Materials of Taicho Lock gate

INTAKE GATE

Horiz. girder	10	L	150 × 90 × 12	t	21.5	× 5185 =	1,114.8
〃 〃	9	〃	125 × 90 × 9	t	14.6	× 5083 =	667.9
〃 〃	5	Web Pls	600 × 9	t	42390	× 5073 =	1,075.2
〃 〃	18	L	75 × 75 × 9	t	9.96	× 425 =	76.2
〃 〃	72	〃	〃	t	〃	× 610 =	437.4
〃 〃	2	〃	〃	t	〃	× 260 =	5.2
〃 〃	8	〃	〃	t	〃	× 340 =	27.1
Vertical girder	2	〃	125 × 75 × 9	t	13.5	× 3,655 =	98.7
〃 〃	6	〃	75 × 75 × 9	t	9.96	× 3,655 =	218.4
〃 〃	2	Pls	305 × 9	t	21548	× 3,655 =	157.5
〃 〃	2	〃	235 × 9	t	16603	× 3,655 =	121.4
〃 〃	20	L	90 × 90 × 10	t	13.3	× 282 =	75.0
〃 〃	20	〃	150 × 90 × 9	t	16.4	× 282 =	92.5
〃 〃	18	Fills	110 × 9	t	7.772	× 145 =	20.3
〃 〃	18	〃	145 × 3	t	3.415	× 190 =	11.7
〃 〃	2	Pls	290 × 9	t	20489	× 3,655 =	149.8
〃 〃	6	〃	140 × 9	t	9.891	× 140 =	8.3
〃 〃	8	L	90 × 75 × 9	t	11.0	× 282 =	24.8
〃 〃	8	Fills	70 × 9	t	4.946	× 140 =	5.5
〃 〃	20	〃	140 × 9	t	9.891	× 210 =	41.5
Vertical stiffener	16	L	90 × 75 × 9	t	11.0	× 798 =	140.4
〃 〃	48	〃	75 × 75 × 9	t	9.96	× 798 =	381.5
〃 〃	12	Pls	600 × 9	t	42.390	× 805 =	409.5
〃 〃	48	Fills	70 × 9	t	4.946	× 630 =	149.6
Skin plate	1	Pl	945 × 9	t	66.764	× 5,370 =	358.5
〃 〃	2	Pls	755 × 9	t	53.341	× 5,370 =	572.9
〃 〃	1	Pl	785 × 9	t	55.460	× 5,370 =	297.8
〃 〃	3	Pls	210 × 9	t	14.837	× 5,370 =	239.0
Diagonal	2	〃	200 × 9	t	14.130	× 2,060 =	58.2
〃	2	〃	〃	t	〃	× 1,880 =	53.1
〃	2	〃	〃	t	〃	× 1,940 =	54.8
	1	Pl	180 × 9	t	12.717	× 3,610 =	45.9
	2	Pls	〃	t	〃	× 2,585 =	65.7
	2	〃	〃	t	〃	× 590 =	15.0
Bracket	1	L	150 × 90 × 9	t	16.4	× 4,980 =	81.7
〃	2	L	90 × 90 × 10	t	13.3	× 910 =	24.2
〃	2	〃	75 × 75 × 9	t	9.96	× 385 =	7.7
〃	2	Pls	385 × 9	t	27.200	× 1,110 =	60.4
〃	2	Fills	145 × 9	t	10.244	× 1,130 =	23.2
〃	2	〃	85 × 9	t	6.005	× 555 =	6.7
〃	2	Pls	310 × 9	t	21.902	× 1,040 =	45.6
〃	2	〃	〃	t	〃	× 1,000 =	43.8
DM1	8	L	75 × 75 × 9	t	9.96	× 816 =	65.0
〃	4	L	〃	t	〃	× 530 =	21.1
〃	4	〃	〃	t	〃	× 500 =	19.9
〃	8	Fills	70 × 9	t	4.946	× 340 =	13.5
〃	2	Pls	510 × 9	t	36.032	× 805 =	58.0
〃	2	Fills	145 × 12	t	13.659	× 195 =	5.3
〃	2	Pls	600 × 9	t	42.390	× 875 =	74.2
HP1	8	L	75 × 75 × 9	t	9.96	× 650 =	51.8
〃	2	Pls	380 × 9	t	26.847	× 800 =	43.0
〃	4	〃	220 × 9	t	15.543	× 650 =	40.4
〃	4	Fills	70 × 9	t	4.946	× 210 =	4.2
〃	4	L	90 × 90 × 10	t	13.3	× 220 =	11.7
〃	4	Pls	210 × 9	t	14.837	× 270 =	16.0
							7,988.5

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~~TOKYO~~ SHOWA BLDG, TOKYO

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CALCULATIONS FOR

Materials of Taicho Lock gate.

TOWER FOR FRONT LOCK 1-Required

Columns	4	L	380	× 100	@	54.5	× 8335	=	1,817.0
"	2	"	"	"	@	"	× 7900	=	861.1
"	4	"	"	"	@	"	× 8450	=	1,842.1
"	8	L	90	× 90 × 10	@	13.3	× 8450	=	899.1
Bracing	8	"	90	× 75 × 9	@	11.0	× 1,170	=	103.0
"	8	"	"	"	@	"	× 940	=	82.7
"	8	"	"	"	@	"	× 935	=	82.3
"	8	"	"	"	@	"	× 790	=	69.5
"	8	"	"	"	@	"	× 730	=	64.2
"	4	"	"	"	@	"	× 840	=	37.0
"	4	"	"	"	@	"	× 770	=	33.9
"	12	Bars	70	× 9	@	4.946	× 2240	=	132.9
Gusset	8	P/s	380	× 9	@	26.847	× 500	=	107.4
"	8	"	370	× 9	@	26.141	× 400	=	83.7
"	8	"	380	× 9	@	26.847	× 480	=	103.1
"	4	"	250	× 9	@	17.663	× 290	=	20.5
"	4	"	"	"	@	"	× 340	=	24.0
"	8	"	190	× 9	@	13.424	× 230	=	24.7
"	4	"	240	× 9	@	16.956	× 400	=	27.1
"	4	"	230	× 9	@	16.250	× 250	=	16.3
"	4	"	340	× 9	@	24.021	× 390	=	37.5
"	8	"	190	× 9	@	13.424	× 365	=	39.2
"	4	"	370	× 9	@	26.141	× 400	=	41.8
"	4	"	250	× 9	@	17.663	× 370	=	26.1
"	4	"	230	× 9	@	16.250	× 250	=	16.3
"	4	"	250	× 9	@	17.663	× 340	=	24.0
"	4	"	260	× 9	@	18.369	× 350	=	25.7
"	12	"	70	× 9	@	4.946	× 305	=	18.1
"	4	"	85	× 9	@	6.005	× 365	=	8.8
"	4	"	290	× 9	@	20.489	× 385	=	31.6
Strut	8	"	90	× 75 × 9	@	11.0	× 720	=	63.4
"	8	"	"	"	@	"	× 490	=	43.1
"	8	"	"	"	@	"	× 350	=	30.8
"	4	"	150	× 150 × 11	@	25.1	× 1,800	=	180.7
"	4	"	125	× 90 × 9	@	14.6	× 1205	=	70.4
"	14	"	125	× 75 × 9	@	13.5	× 617	=	116.6
"	14	"	"	"	@	"	× 595	=	112.5
"	32	"	130	× 130 × 9	@	17.9	× 120	=	68.7
"	64	"	"	"	@	"	× 131	=	150.1
"	32	Fills	125	× 9	@	8.831	× 125	=	35.3
"	8	"	85	× 9	@	6.005	× 150	=	7.2
"	8	"	90	× 9	@	6.359	× 150	=	7.6
"	8	"	70	× 9	@	4.946	× 140	=	5.5
"	4	"	"	"	@	"	× 180	=	3.6
"	8	P/s	690	× 9	@	48.749	× 2595	=	1012.0
"	4	"	730	× 9	@	51.575	× 1935	=	399.2
"	8	"	275	× 9	@	19.429	× 450	=	69.9
Base frame	4	L	300	× 90	@	38.1	× 1300	=	198.1
"	2	"	"	"	@	"	× 1210	=	92.2
"	4	"	"	"	@	"	× 980	=	149.4
"	4	P/s	85	× 9	@	6.005	× 270	=	6.5
"	4	"	480	× 16	@	60.288	× 1350	=	325.6
"	2	"	90	× 16	@	11.304	× 1210	=	27.4
"	4	L	150	× 150 × 11	@	25.1	× 340	=	34.1
"	2	Fills	70	× 9	@	4.946	× 930	=	9.2
Gusset	4	P/s	230	× 9	@	16.250	× 280	=	18.2

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SHOWA BLDG, TOKYO

MADE BY M. Jinda DATE 8-9-21 FILE NO
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CALCULATIONS FOR

Materials of Taicho Lock gate

Base frame	4	Fl/s	145 × 10	@	11.383 ×	190	=	8.7
'	8	L's	150 × 90 × 9	@	16.4 ×	340	=	44.6
'	2	I's	300 × 150	@	48.3 ×	4490	=	482.0
'	8	L's	150 × 90 × 9	@	16.4 ×	260	=	34.1
'	4	Pl/s	220 × 9	@	15.543 ×	650	=	40.4
Main beam	2	I's	450 × 175	@	91.7 ×	6,780	=	1,243.5
'	24	L's	90 × 75 × 9	@	11.0 ×	420	=	110.7
Bracket	8	'	'	@	' ×	1200	=	105.6
'	8	'	'	@	' ×	350	=	30.8
'	4	Pl/s	500 × 9	@	35.325 ×	750	=	106.0
'	8	L's	125 × 75 × 9	@	13.5 ×	2230	=	240.8
'	8	'	90 × 75 × 9	@	11.0 ×	790	=	69.5
'	8	'	'	@	' ×	750	=	66.0
'	4	Pl/s	750 × 9	@	52.988 ×	950	=	201.4
'	4	'	200 × 9	@	14.130 ×	690	=	39.0
'	4	'	450 × 9	@	31.793 ×	730	=	92.8
Balancing beam	4	I's	300 × 90	@	38.1 ×	3600	=	548.6
'	28	L's	75 × 75 × 9	@	9.96 ×	280	=	78.1
Bracket	8	'	90 × 75 × 9	@	11.0 ×	870	=	76.6
'	8	'	'	@	' ×	420	=	37.0
'	8	Pl/s	530 × 9	@	37.445 ×	620	=	165.7
'	16	L's	75 × 75 × 9	@	9.96 ×	280	=	44.6
'	16	'	'	@	' ×	200	=	31.9
'	8	Pl/s	280 × 9	@	19.782 ×	280	=	44.3
'	8	'	310 × 9	@	21.902 ×	360	=	63.1
Diaphragm	8	L's	90 × 75 × 9	@	11.0 ×	420	=	37.0
'	8	'	75 × 75 × 9	@	9.96 ×	1,000	=	79.7
'	2	Pl/s	420 × 9	@	29.673 ×	1,130	=	73.9
Sway bracing	8	L's	90 × 75 × 9	@	11.0 ×	420	=	37.0
'	4	'	90 × 90 × 10	@	13.3 ×	1,000	=	53.2
'	8	'	75 × 75 × 9	@	9.96 ×	490	=	39.0
'	8	Pl/s	200 × 9	@	4.30 ×	250	=	28.3
'	4	'	230 × 9	@	16.250 ×	330	=	21.5
'	8	'	220 × 9	@	15.543 ×	250	=	31.1
'	4	Pl/s	250 × 9	@	17.663 ×	425	=	30.0
Roller guide	8	L's	75 × 50 × 9	@	8.20 ×	6595	=	432.6
Cut guide	4	'	125 × 75 × 9	@	13.5 ×	6400	=	345.6
'	4	'	150 × 90 × 9	@	16.4 ×	75	=	4.9
	92	wash. 70φ		@	30.2 ×	9	=	25.0
	30	anchor bolts 22φ × 400		@	1.42		=	42.6
	22	wash 90 × 10		@	7.065 ×	90	=	14.0
strut	16	L's	130 × 130 × 9	@	17.90 ×	225	=	64.4
'	16	'	'	@	' ×	135	=	38.7
								15,3586

GUIDE METAL IN PIER FOR FRONT LOCK 2-Required

3	E	380 × 100	@	545 ×	11,395	=	1,863.1
4	L's	75 × 50 × 9	@	8.20 ×	11,045	=	362.3
26	Pl/s	190 × 9	@	13.424 ×	235	=	82.0
13	'	70 × 9	@	4.946 ×	305	=	19.6
13	L's	125 × 75 × 9	@	13.5 ×	617	=	108.3
13	'	'	@	' ×	595	=	104.4

JIUN MASUDA
CONSULTING ENGINEER
~~FUJI~~ SHOWA BLDG, TOKYO

MADE BY M. Jinda DATE 8-9-21 FILE NO
CHECKED BY J.J DATE 8-9-25 PAGE NO M8

CALCULATIONS FOR

Materials of Saiche Lock gate

26	L	130 × 130 × 9	c	179	×	120	=	55.8
52	〃	〃	c	〃	×	131	=	121.9
26	Fills	125 × 9	c	8831	×	125	=	28.7
52	Wash.	70#	c	302	×	9	=	14.1
1	Pl	425 × 9	c	30026	×	1685	=	50.6
3	Pls	310 × 9	c	21902	×	510	=	33.5
4	〃	60 × 9	c	4239	×	510	=	8.6
1	Pl	500 × 9	c	35325	×	1410	=	49.8
1	〃	380 × 14	c	41762	×	1500	=	62.6
1	L	130 × 130 × 9	c	179	×	590	=	10.6
1	〃	〃	c	〃	×	510	=	9.1
2	L	〃	c	〃	×	310	=	11.1
1	L	〃	c	〃	×	245	=	4.4
4	L	〃	c	〃	×	125	=	9.0
13	〃	〃	c	〃	×	225	=	52.4
13	〃	〃	c	〃	×	135	=	31.4
6	Bolts	22ϕ · 400	c			142	=	8.5
								3101.8

TOWER FOR REAR LOCK 1- Required

Column	4	E	380 × 100	c	545	×	9930	=	21647
〃	8	L	90 · 90 · 10	c	133	×	9530	=	10140
〃	4	E	380 × 100	c	545	×	9500	=	20710
Diagonal	8	L	90 · 75 · 9	c	110	×	1380	=	121.4
〃	8	〃	〃	c	〃	×	1190	=	104.7
〃	8	〃	〃	c	〃	×	1180	=	103.8
〃	8	〃	〃	c	〃	×	1060	=	93.3
〃	8	〃	〃	c	〃	×	1050	=	92.4
〃	8	〃	〃	c	〃	×	920	=	81.0
〃	8	〃	〃	c	〃	×	900	=	79.2
〃	8	〃	75 · 75 · 9	c	996	×	950	=	75.7
〃	8	〃	〃	c	〃	×	860	=	68.5
Strut	8	〃	90 · 75 · 9	c	110	×	1050	=	92.4
〃	8	〃	〃	c	〃	×	880	=	77.4
〃	8	〃	〃	c	〃	×	720	=	63.4
〃	8	〃	75 · 75 · 9	c	996	×	630	=	50.2
〃	4	〃	150 · 150 · 11	c	251	×	1850	=	185.7
〃	8	Pls	930 × 9	c	65705	×	2475	=	1301.0
〃	4	〃	755 × 9	c	53341	×	1950	=	416.1
Gusset	8	〃	370 × 9	c	26141	×	460	=	96.2
〃	8	〃	350 × 9	c	24728	×	430	=	85.1
〃	8	〃	〃	c	〃	×	390	=	77.2
〃	8	〃	370 × 9	c	26141	×	380	=	79.5
〃	4	〃	240 × 9	c	16956	×	270	=	18.3
〃	4	〃	260 × 9	c	18369	×	320	=	23.5
〃	12	〃	190 × 9	c	13424	×	230	=	37.1
〃	4	〃	240 × 9	c	16956	×	350	=	23.7
〃	4	〃	250 × 9	c	17663	×	390	=	27.6
〃	4	〃	240 × 9	c	16956	×	240	=	16.3
〃	4	〃	270 × 9	c	19076	×	370	=	28.2
〃	4	〃	320 × 9	c	22608	×	395	=	35.7
〃	12	〃	190 × 9	c	13424	×	370	=	59.6

JIUN MASUDA
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~~IIIII~~ BLDG, TOKYO
SHOWA

MADE BY M.Jinda DATE 8-9-21 FILE NO.
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CALCULATIONS FOR

Materials of Taicho Lock gate

Gusset	4	Pls	350	× 9	c	24728	× 375	=	37.1
,,	4	,	385	× 9	c	27200	× 390	=	42.4
,	4	,	240	× 9	c	16956	× 375	=	25.4
,	4	,	190	× 9	c	13424	× 235	=	12.6
,	4	,	240	× 9	c	16956	× 425	=	28.8
	8	Fills	85	× 9	c	6005	× 140	=	6.7
	8	,	95	× 9	c	6712	× 140	=	7.5
	4	,	70	× 9	c	4946	× 130	=	2.6
Strut	18	L	125 × 75	× 9	c	135	× 585	=	142.2
,	36	,	130 × 130	× 9	c	17.9	× 120	=	77.3
,	36	,	,		c	,	× 131	=	84.4
,	18	Pls	125	× 9	c	8831	× 125	=	19.9
,	2	Fills	70	× 9	c	4946	× 300	=	3.0
Bracket	8	L	125 × 75	× 9	c	135	× 2530	=	273.2
,	8	,	90 × 75	× 9	c	11.0	× 850	=	74.8
,	8	,	75 × 75	× 9	c	9.96	× 780	=	62.2
,	4	Pls	850	× 9	c	60053	× 950	=	228.2
,	4	,	250	× 9	c	17663	× 550	=	38.9
,	4	,	240	× 9	c	16956	× 800	=	54.3
,	8	L	125 × 75	× 9	c	135	× 2,100	=	226.8
,	8	,	90 × 75	× 9	c	11.0	× 850	=	74.8
,	8	,	75 × 75	× 9	c	9.96	× 600	=	47.8
,	4	Pls	750	× 9	c	52988	× 850	=	180.2
,	4	,	220	× 9	c	15543	× 500	=	31.1
,	4	,	240	× 9	c	16956	× 550	=	37.3
Base frame	4	,	480	× 16	c	60288	× 1,660	=	400.3
,	4	L	300	× 90	c	38.1	× 1,600	=	243.8
,	2	,	,		c	,	× 590	=	45.0
,	4	,	,		c	,	× 1,290	=	196.6
,	4	L	150 × 150	× 11	c	25.1	× 340	=	34.1
,	8	,	150 × 90	× 9	c	16.4	× 340	=	44.6
,	4	Pls	85	× 9	c	6005	× 270	=	6.5
,	4	Fills	145	× 10	c	11383	× 190	=	8.7
Main beam	2	Is	400	× 150	c	72.0	× 8600		1,238.4
,	32	L	75 × 75	× 9	c	9.96	× 370	=	117.9
,	8	,	90 × 75	× 9	c	11.0	× 370	=	32.6
,	4	Pls	280	× 9	c	19.782	× 280	=	22.2
,	8	L	75 × 75	× 9	c	9.96	× 190	=	15.1
,	8	,	90 × 75	× 9	c	11.0	× 690	=	60.7
DM1	8	,	90 × 75	× 9	c	11.0	× 370	=	32.6
,	8	,	75 × 75	× 9	c	9.96	× 1,430	=	113.9
,	2	Pls	370	× 9	c	26141	× 1580	=	82.6
,	4	L	125 × 75	× 9	c	13.5	× 250	=	13.5
Roller Guide	4	,	75 × 50	× 9	c	8.20	× 9290	=	304.7
CWT Guide	2	,	150 × 90	× 9	c	16.4	× 9030	=	296.3
,	2	Bars	45	× 9	c	3179	× 9185	=	58.4
,	2	L	150 × 90	× 9	c	16.4	× 290	=	9.5
,	2	Bars	45	× 9	c	3179	× 290	=	1.8
,	52	Wash.	70ϕ		c	30.2	× 9	=	14.1
,	28	Bolts	22ϕ × 400		c	14.2		=	39.8
	20	Wash	70 × 10		c	5495	× 70	=	7.7
									14,124.8

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~~JIII~~ SHOWA BLDG. TOKYO

MADE BY M. Juda DATE 8-9-22 FILE NO
CHECKED BY J.I DATE 8-9-25 PAGE NO M10

CALCULATIONS FOR

Materials of Taicho Lock gate

GUIDE IN PIER FOR REAR LOCK 2-Required

	2	E	380 × 100	c	545 ×	8,595 =		9369
Strut	9	L	125 × 75 × 9	c	13.5 ×	585 =		71.1
"	18	"	130 × 130 × 9	c	17.9 ×	120 =		38.7
"	18	"	"	c	" ×	131 =		42.2
"	9	Pls	125 × 9	c	8831 ×	125 =		9.9
"	18	"	190 × 9	c	13424 ×	235 =		56.8
Roller guide	2	L	75 × 50 × 9	c	820 ×	8595 =		141.0
Cut guide	1	L	150 × 90 × 9	c	164 ×	2550 =		41.8
"	1	Bar	45 × 9	c	3179 ×	2550 =		8.1
"	5	Wash.	70ϕ	c	302 ×	9 =		1.4
"	1	Pl	425 × 9	c	30026 ×	1065 =		32.0
"	2	Pls	310 × 9	c	21902 ×	510 =		22.3
"	1	Pl	500 × 9	c	35325 ×	785 =		27.7
"	2	L	130 × 130 × 9	c	17.9 ×	310 =		11.1
"	1	L	"	c	" ×	585 =		10.5
"	2	L	"	c	" ×	131 =		4.7
"	1	Pl	380 × 14	c	41762 ×	880 =		36.8
"	4	Bolt	22ϕ × 400		c	142 =		5.7
								1498.7

GUIDE IN PIER FOR INTAKE GATE

GD 1 2-Required

	2	E	200 × 70	c	21.1 ×	5,975 =		252.1
	1	Bar	210 × 9	c	14837 ×	6150 =		91.2
	7	Bars	200 × 9	c	14130 ×	730 =		72.2
	1	Pl	500 × 9	c	35325 ×	730 =		25.8
	1	"	200 × 14	c	21980 ×	600 =		13.2
	1	L	100 × 100 × 10	c	149 ×	390 =		5.8
	2	L	"	c	" ×	195 =		5.8
	7	Bars	60 × 9	c	4239 ×	200 =		5.9
	4	Bolts	22ϕ × 350		c	096 =		3.8
								475.8

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SHOWA BLDG, TOKYO

MADE BY M. Jinda DATE 8-9-22 FILE NO.
CHECKED BY H.T DATE 8-9-28 PAGE NO. M 11

CALCULATIONS FOR

Materials of Taicho Lock gate

GD 2

same part for GP1				2 - Required				
	4	" P/s	400 × 9	c	28.260	× 440	=	49.7
				c	4758		=	951.6
								1,001.3

EDGE PROTECTOR & GUIDE ANGLE 1 - Required

EP1	3	L	150 × 90 × 9	c	16.4	× 5,000	=	246.0
"	96	Bars	60 × 9	c	4.239	× 340	=	138.4
GA1	6	L	150 × 90 × 9	c	16.4	× 10,300	=	1013.5
"	210	Bolts	16φ × 200	c	0.42		=	88.2
								1,486.1

Summary of guide in piers, edge protector + guide angle for intake gates

DG1	2	c	475.8	= 951.6
DG2	2	c	1,001.3	= 2,002.6
EP1+GA1	1	c	1,486.1	= 1,486.1
				4,440.3

C'WT OF LOWER GATE FOR FRONT LOCK 1 - Required

4	L	75 × 75 × 9	c	9.96	× 4,500	=	179.3
10	"	"	c	"	× 1,300	=	129.5
8	"	90 × 75 × 9	c	11.0	× 1,300	=	114.4
4	"	75 × 75 × 9	c	9.96	× 1,220	=	48.6
4	"	"	c	"	× 1,230	=	49.0
4	"	"	c	"	× 1,240	=	49.4
4	"	"	c	"	× 1,080	=	43.0
2	"	"	c	"	× 1,260	=	25.1
10	"	"	c	"	× 670	=	66.7
6	"	"	c	"	× 640	=	38.2
4	P/s	195 × 9	c	13.777	× 220	=	12.1
4	"	220 × 9	c	15.543	× 400	=	24.9
4	"	"	c	"	× 225	=	14.0
2	"	"	c	"	× 370	=	11.5
4	"	190 × 9	c	13.424	× 220	=	11.8
4	"	220 × 9	c	15.543	× 290	=	18.0
4	"	"	c	"	× 330	=	20.5
2	"	"	c	"	× 235	=	7.3
2	"	190 × 9	c	13.424	× 440	=	11.8
4	"	220 × 9	c	15.543	× 220	=	13.7
2	"	570 × 9	c	40.271	× 840	=	67.7
4	"	250 × 9	c	17.663	× 430	=	30.4
4	L	75 × 75 × 9	c	9.96	× 250	=	10.0
8	Fl/s	70 × 9	c	4.946	× 190	=	7.5
4	P/s	220 × 9	c	15.543	× 230	=	14.3
8	"	160 × 9	c	11.304	× 220	=	19.9
4	"	260 × 9	c	18.369	× 360	=	26.4
4	"	210 × 9	c	14.837	× 255	=	15.1
8	"	165 × 9	c	11.657	× 220	=	20.5
4	"	175 × 9	c	12.364	× 220	=	10.9
8	"	185 × 9	c	13.070	× 245	=	25.6
2	"	190 × 9	c	13.424	× 840	=	22.6
2	"	310 × 9	c	21.902	× 500	=	21.9
							1,181.6

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SHOWA BLDG. TOKYO

MADE BY M. Jinda DATE 8-9-22 FILE NO
CHECKED BY H.T DATE 8-9-28 PAGE NO M12

CALCULATIONS FOR

Materials of Taicho Lock gate

CWT OF UPPER GATE FOR FRONT LOCK 1- Required

4	L	65 × 65 × 8	@	7.66	×	4,500	=	137.9
4	"	"	@	"	×	830	=	25.4
4	"	"	@	"	×	890	=	27.3
4	"	"	@	"	×	900	=	27.6
6	"	"	@	"	×	710	=	32.6
8	P/s	170 × 9	@	12.011	×	175	=	16.8
4	"	175 × 9	@	12.364	×	380	=	18.8
6	"	160 × 9	@	11.304	×	175	=	11.9
6	"	175 × 9	@	12.364	×	300	=	22.3
4	"	"	@	"	×	260	=	12.9
8	"	120 × 9	@	8.478	×	270	=	18.3
2	"	180 × 9	@	12.717	×	460	=	11.7
2	"	300 × 9	@	21.195	×	520	=	22.0
4	L	65 × 65 × 9	@	7.66	×	530	=	16.2
12	"	"	@	"	×	410	=	37.7
8	P/s	145 × 9	@	10.244	×	175	=	14.3
4	"	175 × 9	@	12.364	×	210	=	10.4
4	"	160 × 9	@	11.304	×	175	=	7.9
12	"	110 × 9	@	7.772	×	175	=	16.3
8	"	200 × 9	@	14.130	×	200	=	22.6
2	"	180 × 9	@	12.717	×	540	=	13.7
2	"	540 × 9	@	38.151	×	540	=	41.2
4	"	180 × 9	@	12.717	×	300	=	15.3
4	L	65 × 65 × 9	@	7.66	×	180	=	5.5
8	Fill/s	60 × 9	@	4.239	×	140	=	4.7
12	L	75 × 75 × 9	@	9.96	×	710	=	84.9
								676.2

CWT HANGER FOR REAR LOCK GATE 2- Required

2	E	200 × 70	@	21.1	×	422	=	17.8
2	P/s	156 × 9	@	11.022	×	240	=	5.3
4	L	65 × 65 × 8	@	7.66	×	185	=	5.7
2	P/s	170 × 9	@	12.011	×	234	=	5.6
2	Bolts	25ϕ × 1,600	@			6.61	=	13.2
2	Wash.	100 × 19	@	14.915	×	230	=	6.9
4	Bolts	16ϕ × 60	@			0.20	=	0.8
2	Wash.	100 × 19	@	14.915	×	100	=	3.0
4	"	60 × 10	@	4.710	×	60	=	1.1
								59.4

CWT GUIDE + HANGER FOR INTAKE GATE 6- Required

2	L	100 × 100 × 10	@	14.9	×	350	=	10.3
2	Fills	90 × 9	@	6.359	×	290	=	3.7
2	E	200 × 70	@	21.1	×	630	=	26.6
2	P/s	156 × 9	@	11.022	×	490	=	10.8
4	L	65 × 65 × 8	@	7.66	×	185	=	5.7
2	P/s	170 × 9	@	12.011	×	234	=	5.6
2	Bolts	25ϕ × 1,530	@			6.34	=	12.7
2	Wash.	100 × 19	@	14.915	×	230	=	6.9
1	L	100 × 100 × 13	@	19.1	×	650	=	12.4
4	Bolts	16ϕ × 65	@			0.21	=	0.8
4	Wash.	60 × 10	@	4.710	×	60	=	1.1
4	Bolts	19ϕ × 200	@			0.62	=	2.5

JIUN MASUDA
CONSULTING ENGINEER
SHOWA BLDG, TOKYO

MADE BY H.T DATE 8-10-/ FILE NO
CHECKED BY M.J DATE 8-10-8 PAGE NO M13

CALCULATIONS FOR

Materials of Taicho Lock gate

PLATFORM FRAMING FOR FRONT TOWER 1- Req'd

Cross beam	2	I-	300×150	@	483	× 3,600	=	3478
"	1	I	"	@	"	× 1,580	=	763
"	1	"	"	@	"	× 1,520	=	734
"	1	I	300 × 90	@	381	× 1,375	=	524
"	1	"	"	@	"	× 3,600	=	1372
Beam	4	L	150×90×9	@	16.4	× 870	=	57.1
"	6	"	90×75×9	@	11.0	× 280	=	18.5
"	4	Pl	210 × 9	@	14837	× 270	=	160
Lateral	2	L	75×75×9	@	996	× 1,250	=	249
"	2	"	"	@	"	× 560	=	11.2
"	2	"	"	@	"	× 600	=	12.0
"	2	"	"	@	"	× 1,210	=	24.1
"	2	"	"	@	"	× 570	=	11.4
"	2	"	"	@	"	× 550	=	11.0
"	1	L	"	@	"	× 1,070	=	10.7
"	1	"	"	@	"	× 520	=	5.2
"	1	"	"	@	"	× 450	=	4.5
"	2	L	"	@	"	× 1,400	=	27.9
"	2	"	"	@	"	× 1,280	=	25.5
"	2	Pl	380 × 9	@	26,847	× 500	=	26.8
"	2	"	"	@	"	× 480	=	25.8
"	8	"	300 × 9	@	21,195	× 360	=	61.0
"	4	"	200 × 9	@	1413	× 550	=	31.1
"	4	"	"	@	"	× 360	=	20.3
"	1	Pl	"	@	"	× 370	=	5.2
"	2	Pl	320 × 9	@	22608	× 390	=	17.6
"	2	"	370 × 9	@	26141	× 390	=	20.4
"	4	Fill-	140 × 10	@	1099	× 160	=	7.0
"	2	"	175 × 9	@	12364	× 390	=	9.6
"	2	"	"	@	"	× 150	=	3.7
Fascia beam	1	L	150×90×9	@	16.4	× 1390	=	22.8
"	1	"	"	@	"	× 3580	=	58.7
"	2	L	"	@	"	× 5220	=	171.2
"	2	Pl	250 × 9	@	17663	× 275	=	9.7
"	2	"	310 × 9	@	21902	× 275	=	12.0
"	10	L	90×75×9	@	11.0	× 280	=	30.8
"	2	"	"	@	"	× 450	=	9.9
"	2	"	150×90×9	@	16.4	× 750	=	24.6
"	4	"	90×90×10	@	13.3	× 450	=	23.9
"	2	Pl	230 × 9	@	1625	× 450	=	14.6
Diaphragm	8	L	90×90×13	@	17.0	× 260	=	35.4
"	4	Pl	260 × 9	@	18369	× 290	=	21.3
"	2	"	320 × 16	@	40192	× 450	=	36.2
"	8	L	90×90×10	@	133	× 274	=	29.2
"	4	Fill-	110 × 13	@	11226	× 260	=	11.7
Worm gear Frame	2	I	200×80×7.5	@	24.6	× 1,000	=	49.2
"	1	Pl	210 × 9	@	14837	× 1,200	=	17.8
"	1	"	"	@	"	× 310	=	4.6
"	2	L	90×75×9	@	11.0	× 180	=	4.0
"	2	"	125×90×9	@	14.6	× 180	=	5.3
"	1	L	90×75×9	@	11.0	× 910	=	10.0
"	1	"	90×75×12	@	14.4	× 400	=	5.8
"	2	L	75×75×9	@	9.96	× 180	=	3.6

JIUN MASUDA
CONSULTING ENGINEER
SHOWA BLDG. TOKYO

MADE BY H.K DATE 8-10-1 FILE NO
CHECKED BY M.J DATE 8-10-8 PAGE NO M14

CALCULATIONS FOR

Materials of Taicho Lock gate

Motor Frame	2	E	250×90×9	c	346	×	1,070	= 74.0
	1	Pl	210 × 9	c	14837	×	1,240	= 18.4
	1	〃	500 × 9	c	35325	×	510	= 18.0
	2	L	90×90×10	c	13.3	×	230	= 6.1
	1	Pl	230 × 9	c	1625	×	200	= 3.3
	4	L	100×100×10	c	14.9	×	230	= 13.7
	1	Pl	250 × 9	c	17663	×	420	= 7.4
	1	L	90×75×9	c	11.0	×	1,120	= 12.3
	4	L	75×75×9	c	9.96	×	230	= 9.2
								1,950.3

Handrail 1- Required

	8	L	50×50×6	c	4.43	×	1,000	= 35.4
	4	〃	〃	c	〃	×	1,300	= 23.0
	2	〃	〃	c	〃	×	1,070	= 9.5
	12	〃	150×90×9	c	16.4	×	130	= 25.6
	12	〃	90×90×10	c	13.3	×	130	= 20.7
Top rail	1	L	50×50×6	c	4.43	×	17,700	= 78.4
Middle rail	1	9φ pipe 3/4"φ		c	1.69	×	17,700	= 29.9
Bottom rail	1	〃	〃	c	〃	×	4,200	= 7.1
Splice	4	Pls	44 × 6	c	2.072	×	210	= 1.7
〃	4	〃	38 × 6	c	1.79	×	250	= 1.8
	76	Bolts	16φ×45	c	0.17			= 12.9
								246.0

Ladder 1- Required

	2	L	65×50×5	c	4.36	×	9,330	= 81.4
	2	〃	150×90×9	c	16.4	×	150	= 4.9
	2	〃	65×65×6	c	5.91	×	900	= 10.6
	2	〃	90×90×7	c	9.59	×	200	= 3.8
	6	Pls	130 × 9	c	9.185	×	200	= 11.0
	2	L	90×90×10	c	13.3	×	130	= 3.5
	2	Bolts	12φ×250	c	0.31			= .7
	27	Bars	19φ(grip 510)	c	2.23	×	530	= 31.9
								147.8

General summary 2,344.1 Kgo

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MADE BY K. Iwata DATE 8-10-8 FILE NO
CHECKED BY H.T DATE 8-10-9 PAGE NO M15

CALCULATIONS FOR

Materials of Taicho Lock gates.
Platform framing over rear tower.
Framing.

Cross beams.	6 I	300 × 90 × 9	@	38.10	× 3,000	=	685.8
"	3 Is	300 × 150 × 8	@	48.30	× 3,000	=	434.7
"	2 I	300 × 90 × 9	@	38.10	× 1750	=	133.4
"	1 I	300 × 150 × 8	@	48.30	× 2,100	=	101.4
" fills. Pl.	6 Pls	150 × 9	@	10.60	× 150	=	9.5
Fascia beams	2 L	150 × 90 × 9	@	16.40	× 8,798	=	288.6
"	2 L	150 × 90 × 9	@	"	× 3000	=	98.4
" Connection Ls	24 Ls	90 × 75 × 9	@	11.00	× 280	=	73.9
" "	4 Ls	90 × 75 × 9	@	"	× 140	=	6.7
" " Pls.	4 Pls	275 × 9	@	19.43	× 310	=	24.1
Sprocket bases ⊟ C1	8 I	300 × 90 × 9	@	38.10	× 650	=	198.1
" Conn. Ls a1	32 Ls	90 × 75 × 9	@	11.00	× 280	=	98.6
Top struts	2 Ls	75 × 75 × 9	@	9.96	× 525	=	10.5
"	2 L	75 × 75 × 9	@	"	× 810	=	16.1
" Conn. Pls.	2 Pls	190 × 9	@	13.42	× 225	=	6.0
" " " P4	6 Pls	310 × 9	@	21.90	× 445	=	58.5
Motor & worm gear bases	2 I	250 × 90 × 9	@	34.60	× 1,030	=	71.3
"	2 I	200 × 80 × 7.5	@	24.60	× 730	=	35.9
" End conn.	2 L	90 × 75 × 9	@	11.00	× 230	=	5.1
" "	1 Pl.	200 × 9	@	14.13	× 230	=	3.2
" "	4 L	100 × 100 × 10	@	14.90	× 230	=	13.7
" "	1 Pl.	250 × 9	@	17.66	× 420	=	7.4
" "	2 L	90 × 75 × 9	@	11.00	× 180	=	4.0
" "	2 L	125 × 90 × 9	@	14.60	× 180	=	5.3
" Stiffeners	4 L	75 × 75 × 9	@	9.96	× 230	=	9.2
" tie pl. (top.)	1 Pl.	130 × 9	@	9.19	× 310	=	2.8
" gus. pls (bott.)	1 Pl.	240 × 9	@	16.96	× 730	=	12.4
" " "	1 Pl.	400 × 9	@	28.26	× 510	=	14.4
" " "	1 Pl.	240 × 9	@	16.96	× 700	=	11.9
" " "	1 Pl.	200 × 9	@	14.13	× 310	=	4.4
" Beam B1 & B3	2 L	150 × 90 × 9	@	16.40	× 880	=	28.9
" " "	4 L	90 × 75 × 9	@	11.00	× 280	=	12.3
" " "	4 Pls	190 × 9	@	13.42	× 270	=	14.5
" Beam B2	2 L	150 × 90 × 9	@	16.40	× 800	=	26.2
" " "	4 L	90 × 75 × 9	@	11.00	× 280	=	12.3
" " "	2 Pls	210 × 9	@	14.84	× 270	=	8.0
Bevel gear bases	2 I	300 × 150 × 8	@	48.30	× 650	=	62.8
" Conn. L	8 L	90 × 75 × 9	@	11.00	× 280	=	24.6
" " Pl. (top)	2 Pls	150 × 9	@	10.60	× 190	=	4.0
Tie plate at center on top.	1 Pl.	190 × 9	@	13.42	× 910	=	12.2
Lateral bracings.	2 L	75 × 75 × 9	@	9.96	× 900	=	17.9
" "	2 L	" " "	@	"	× 880	=	17.5
" "	2 L	" " "	@	"	× 680	=	13.5
" "	2 L	" " "	@	"	× 620	=	12.4
" "	2 L	" " "	@	"	× 730	=	14.5
" "	2 L	" " "	@	"	× 680	=	13.5
" "	4 L	" " "	@	"	× 860	=	34.3
" "	2 L	90 × 75 × 9	@	11.00	× 1820	=	40.0
" "	1 L	75 × 75 × 9	@	9.96	× 510	=	5.1
" plates	2 Pls	260 × 9	@	18.37	× 650	=	23.9
" "	2 Pls	230 × 9	@	16.25	× 445	=	14.5
" "	2 Pls	290 × 9	@	20.49	× 550	=	22.5
" "	"	290 × 9	@	"	× 520	=	21.3

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CALCULATIONS FOR

Materials of Taicho Lock gates.
Platform framing over rear tower continued.

Lateral plates		2Pls.	230	× 9 @	16.25	×	300	=	9.8
"	"	2Pls	360	× 9 @	25.43	×	690	=	35.1
"	"	2Pls	420	× 9 @	29.67	×	460	=	27.3
"	" P2	4Pls	190	× 9 @	13.42	×	200	=	10.7
"	"	2Pls	300	× 9 @	21.20	×	420	=	17.8
"	"	1Pl.	190	× 9 @	13.42	×	200	=	2.7
"	"	1Pl.	230	× 9 @	16.25	×	400	=	6.5
"	"	1Pl.	200	× 9 @	14.13	×	360	=	5.1
"	" P3	2Pls	380	× 9 @	26.85	×	910	=	48.9
Floor supports		2Ls	75 × 75	× 9 @	9.96	×	1170	=	23.3
"	tie pls	2Pls	130	× 9 @	9.19	×	210	=	3.9
						Summary			3,092.6

Handrails.

Posts.	2Ls	50 × 50	× 6 @	4.43	×	1,000	=	97.5
" Conn. Ls	2Ls	150 × 90	× 9 @	16.40	×	130	=	46.9
" "	2Ls	90 × 90	× 10 @	13.30	×	130	=	38.0
Top rails throughout	1L	50 × 50	× 6 @	443	×	24200	=	107.2
Middle rails	1	3/4"φ gas pipe	@	1.69	×	24200	=	40.9
Connection bolts	132 Bolts	16φ × 45	@	0.17			=	22.4
Toprail splices	4Pls	44	× 6 @	2.07	×	210	=	1.7
" "	4Pls	38	× 6 @	1.79	×	250	=	1.8
						Summary		356.4

Ladder.

Main Ls	2Ls	65 × 50	× 5 @	4.36	×	11220	=	97.8
Step bars.	33 bars	19φ (grip 510)	@	2.23	×	530	=	39.0
Top connections	2Ls	90 × 90	× 10 @	13.30	×	130	=	3.5
" "	2Pls	130	× 9 @	9.19	×	200	=	3.7
Struts	2Ls	65 × 65	× 6 @	5.91	×	2150	=	25.4
" connections	4Pls.	130	× 9 @	9.19	×	200	=	7.4
" "	2Ls	90 × 90	× 7 @	9.59	×	200	=	3.8
Base Ls	2Ls	150 × 90	× 9 @	16.40	×	150	=	4.9
Anchor bolts	2 bolts	12φ × 250	@	0.31			=	0.6
						Summary		186.1

Grand Summary 3,635.1 kg.

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MADE BY M. Iinda DATE 8-9-23 FILE NO
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CALCULATIONS FOR

Materials of Taicho Lock gate

SLUICE GATE 2-Required

1	Pl	820 · 9	@	57933	×	1,045	=	60.5
2	L's	125·75·9	@	135	×	830	=	22.4
2	"	"	@	"	×	1,000	=	27.0
1	L	"	@	"	×	830	=	11.2
2	L's	"	@	"	×	532	=	14.4
1	L	"	@	"	×	250	=	3.4
2	L's	"	@	"	×	202	=	5.5
1	Pl	60 · 9	@	4239	×	210	=	0.9
1	L	75·75·9	@	996	×	450	=	4.5
2	L's	65·65·8	@	766	×	812	=	12.4
2	"	"	@	"	×	982	=	15.0
2	Pl's	60 · 9	@	4239	×	462	=	3.9
2	"	"	@	"	×	632	=	5.4
4	"	165 · 9	@	11657	×	165	=	7.7
1	Pl	125 · 12	@	11775	×	380	=	4.5
3	Bolts	12ϕ × 90		@		015	=	0.5
6	"	12ϕ × 135		@		020	=	1.2
								200.4

GUIDE METAL 2-Required

2	E	200 · 70	@	21.1	×	2088	=	88.1
2	L's	150·90·9	@	164	×	2088	=	68.5
2	Pl's	45 · 16	@	5652	×	1500	=	17.0
2	"	227 · 12	@	21383	×	299	=	12.8
2	L's	150·150·11	@	25.1	×	156	=	7.8
2	"	150·90·9	@	164	×	218	=	7.2
2	"	"	@	"	×	700	=	23.0
6	"	150·150·11	@	25.1	×	75	=	11.3
2	Pl's	70 · 9	@	4946	×	1230	=	12.2
2	Pl's	"	@	"	×	180	=	1.8
2	"	277 · 9	@	19571	×	317	=	12.4
4	L's	90·90·10	@	133	×	156	=	8.3
4	Bolts	22ϕ × 370		@		138	=	5.5
								275.9

WORM GEAR FRAMING FOR INTAKE GATE 3-Required

2	E	230·80·8	@	28.4	×	700	=	39.8
4	L's	90·75·9	@	11.0	×	200	=	8.8
2	Pl's	230 · 9	@	16250	×	360	=	11.7
4	Bolts	19ϕ × 190		@		059	=	2.4
								62.7

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CALCULATIONS FOR

Materials of Taicho Lock gate
Summary of Structural steel

Embeded in concrete

Guide metal for front lock gate	2	@	3,101.8	= 6,203.6
Guide metal for rear lock gate	2	@	1,498.7	= 2,997.4
Guide metal + etc for intake gate	1	@	4,440.3	= 4,440.3
Guide metal for sluice gate	2	@	275.9	= 551.8
				14,193.1

Gate, tower counterweight + etc.

Front lock lower gate	1	@	11,950.8	= 11,950.8
Front lock upper gate	1	@	10,519.8	= 10,519.8
Rear lock gate	1	@	10,478.7	= 10,478.7
Intake gate	3	@	7,988.5	= 23,965.5
Tower for front lock	1	@	15,358.6	= 15,358.6
Tower for rear lock	1	@	14,124.8	= 14,124.8
CWT of lower gate for front lock	1	@	1,181.6	= 1,181.6
CWT of upper gate for front lock	1	@	676.2	= 676.2
CWT for rear lock gate	2	@	594	= 1,188
CWT for intake gate	6	@	99.1	= 594.6
Platform framing for front tower	1	@	2,344.1	= 2,344.1
Platform framing for rear tower	1	@	3,635.1	= 3,635.1
Sluice gate	2	@	200.4	= 400.8
Worm gear framing for intake gate	3	@	627	= 1,881
				95,537.5

109,730.6 kg.
or 109.731 kg tons

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MADE BY M. Jinda DATE 8-10-9 FILE NO. —
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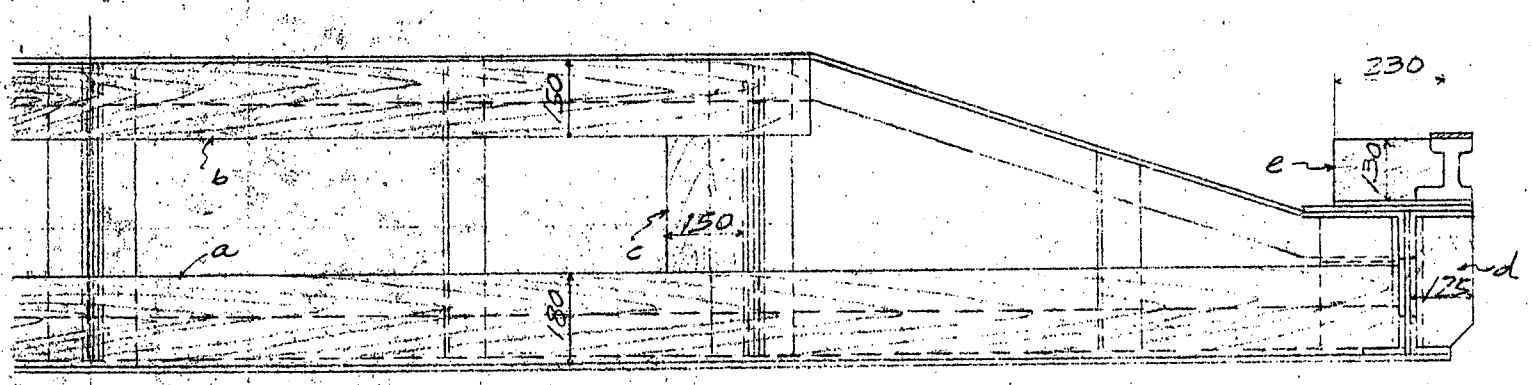
CALCULATIONS FOR

Materials of Taicho Lock gate
門扉用水止木材表(防腐剤注入塩地材)
Lower gate for front lock + Rear lock gate

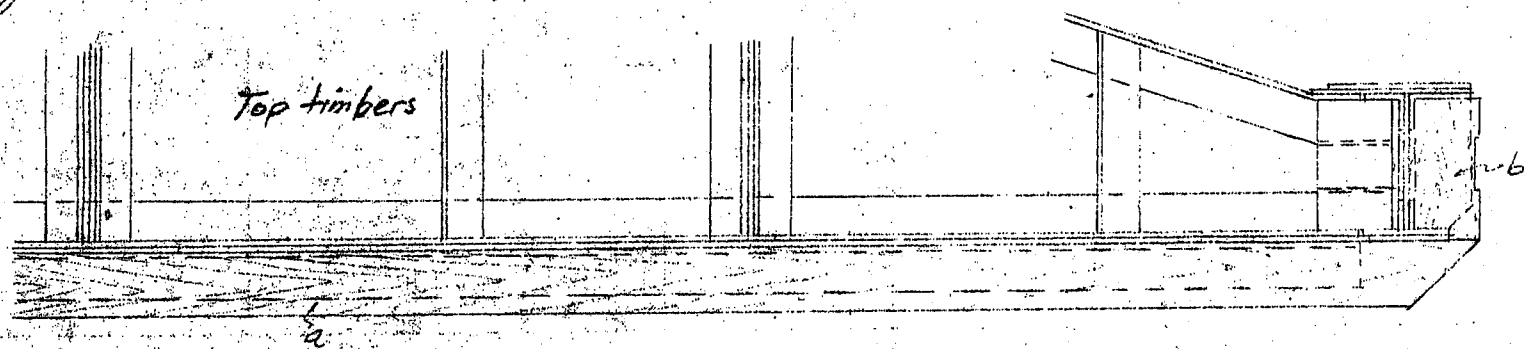
Bottom timbers



1-Required each

a	1	c	.1955 × .180 × 5.191	=	0.183
b	1	c	.1955 × .150 × 2.830	=	0.083
c	2	c	.1955 × .150 × .268	=	0.016
d	2	c	.1955 × .125 × .279	=	0.014
e	2	c	.1955 × .130 × .230	=	0.012
					0.308

Lower gate for front lock only

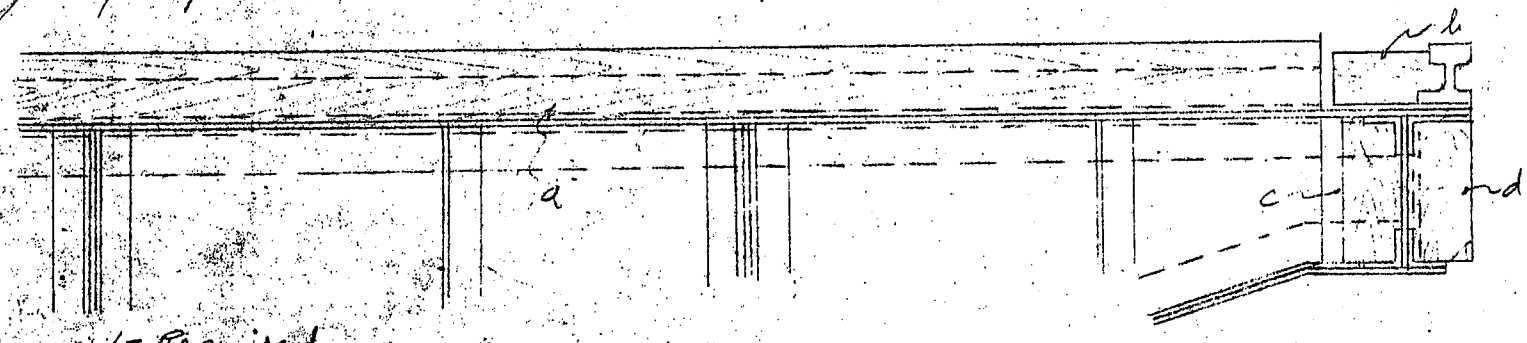


1-Required

a	1	c	.1955 × .150 × 5.490	=	0.161
b	2	c	.1955 × .145 × .300	=	0017
					0.178

Upper gate for front lock

Bottom timbers



1-Required

a	1	c	.1865 × .150 × 4.980	=	0.139
b	2	c	.1955 × .115 × .170	=	0.008
c	2	c	.1955 × .150 × .280	=	0.016
d	2	c	.1955 × .130 × .280	=	0014
					0.177

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CALCULATIONS FOR

Materials of Taicho lock gate

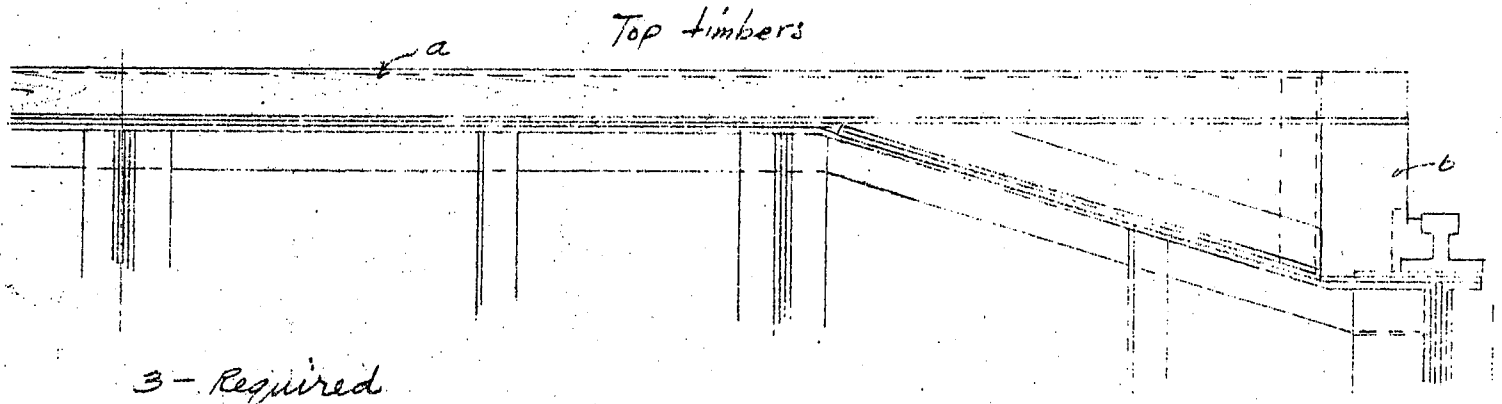
Intake gate

Sketch same as lower gate for front lock (Bottom timbers)

3-Required

a	1 c	.1955 × .180 × 5.101	=	0.180
b	1 c	.1955 × .150 × 2.830	=	0.083
c	2 c	.1955 × .150 × .268	=	0.016
d	2 c	.1955 × .090 × .279	=	0.010
e	2 c	.1955 × .130 × .230	=	0.012
				0.321

Top timbers



3-Required

a	1 c	.180 × .083 × 4.980	=	0.074
b	2 c	.270 × .180 × .310	=	0.030
				0.104

Sluice gate 2-Required (Bottom timber)

1 c .130 × .075 × .830 = 0.008

Summary

		Bottom	Top.		Total.
lower gate	1 c	0.308	+ 0.178	=	0.486
upper gate	1 c	0177		=	0.177
rear gate	1 c	0.308		=	0.308
intake gate	3 c	0.301	+ 0.104	=	1.215
Sluice gate	2 c	0.008		=	0.016

2.202 cub meters

Bearing plate (Brass)

on guide metal

lower gate of front lock	2 c	90 × 10 c 7.38 kg	×	17.300	=	255.348
upper gate of front lock	2 c	90 × 10 c 7.38	×	11.700	=	172.692
rear lock gate	2 c	90 × 10 c 7.38	×	17.300	=	255.348
intake gate	6 c	90 × 10 c 7.38	×	5.875	=	260.145
						943.533

on bearing casting

lower gate of front lock	2 c	7.22 kg/m	×	5.755	=	83.102
upper gate of front lock	2 c	"	×	5.755	=	83.102
rear lock gate	2 c	"	×	5.755	=	83.102
intake gate	6 c	"		3.610	=	156.385
						405.691

Summary 1.349.224 kg.

Bearing (cast iron) with Bolts

lower gate of front lock	2 c	50 kg/m	×	5.755	=	5755
upper gate of front lock	2 c	"	×	5.755	=	5755
rear lock gate	2 c	"	×	5.755	=	5755
intake gate	6 c	55 kg/m	×	3.610	=	11913
						2.917.8 kg.

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CALCULATIONS FOR

大堵水門扉機械装置材料内譯
ホテーブル明王ノヨー機械数量ナリ

Front lock gate operating mechanism

Gears

		Pinion (mild steel)		Spur wheel (cast iron)		Cast steel
1st Set		15.5 kg		34.0		
2nd Set		17.5		69.0		
3rd	77×2 =	154.0	2×155 =	310.0		
hand operation say		6.0		30.0		
Sprocket					10@121 =	1210.
		183.0 kgs		443.0 kg		1210 kgs.

Shafts (mild steel)

1st		27.1
2nd		16.1
3rd		46.0
idle wheel shaft		23.4
4th	2@260 =	520.0
5th	4@37.3 =	149.2
handle shaft		18.6
		800.4

Couplings + handle

		mild steel	Cast iron
3rd shaft couplings		35.0	
1st " "	(13+9) =	22.0	
handle			10.0
		57.0 kgs	10.0 kgs

Bearings

		Cast iron		Bushing (gun metal)
CB1		32.0		2.2
CB2		36.0		3.4
CB3		132.0		9.8
CB4		140.0		10.0
CB5	say	115.0		8.0
B1		60.0		6.0
CB6	4@510 =	2040.0	4@15.6 =	62.4
BH1		25.0		1.1
Bed casting for motor		30.0		
		2610.0 kgs		102.9 kgs.

Worm gear

Worm (forged steel)	wheel (phosphor bronze)	Casing (cast iron)	Bushing (gunmetal)
18.9 kgs	22.0 kgs	64.0 kgs	17.0 kgs.

Clutch handle and stand say 2@25 = 50
Latchet 20
70

Gear covers & other miscellaneous } assume proper amount.

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CALCULATIONS FOR

大津水門扉機械装置材料内訳概算

Rear Lock Gate Operating Mechanism

Gears

	Pinion (mild steel)	wheel (cast iron)	Cast steel
1st Set	5.5	34	
2nd	17.5	69	
3rd	50.0	310	
Bevel		4@ 70.6 =	282
Sprocket		4@ 121. =	484
hand operation	6.0	30	
Idle wheel		15	
	79.0 Kgs	458 Kgs	766 Kgs.

Shafts

1st		12.7
2nd		16.5
3rd		21.9
4th		236.0
5th	2@ 80.5 =	161.0
Shaft 5	2@ 37.3 =	74.6
handle shaft		16.0
idle wheel		2.8
		541.5 Kgs

Couplings and handle -

Bearings -

		Body (Cast iron)	Bushing (gun metal)
CBR1		45.0	3.0
CB2		36.0	3.4
CB3		132.0	9.8
CBR4		100.0	6.0
CBR6 + B5R	4@ 260 =	1040.0	31.2
BB	4@ 52 =	208.0	4@ 5 = 20.0
BKR		25.0	1.1
motor bed casting		30.0	
		1616.0 Kgs	74.5 Kgs.

Worm gears. same as front locks gate

Clutch handle + stand say 70 Kgs.

Gear covers + miscellaneous assume proper.

Intake gate operating mechanism (3 Required)

Gears

	Pinion (mild steel)	wheel (cast iron)	wheel (cast steel)	Pinion (forged steel)
1st	12.8	112		
2nd			121	33.4
Sprocket			4@121. = 484	
	12.8	112	605	33.4

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CALCULATIONS FOR

大清水川捲揚機械装置材料内譯概算

Shafts mild steel.

1st		30.0
2nd		30.8
3rd		259.0
5th	2@37.3 =	74.6
		384.4 kgs

Handle -

Bearings

	Body (cast iron)	Bushing (gun metal)
BW1	35	3.5
BW2	120	9.6
CBSR	2@260 = 520	? 31.2
CBRL	2@260 = 520	
BH1	25	1.0
	1220 kgs	45.5 kgs

Worm gear

worm (forged steel)	wheel (phosphor Br3)	Casing (cast iron)	Bushing (Phosphor Br3)
48.3 kgs.	53. kgs	108 kgs	14 kgs

Ladder gear cover and miscellaneous -

Changing Sluice gate mechanism

	mild steel	Cast iron	forged steel	Bushing	Gun metal	ball bearings
handle	4.9					
" shaft	3.9					
Bevel gear (2)	5.2					
shafts	1.1					
Stand		112		0.7		
female rod		36				
bearing top		21		2.1		1 set
male rod						
bearing sq		10.5	2.0		15.2	
shaft sq	27.2					
bearing (4)		40.0	14.8			
Shaft	126.0					
bottom casting		6.5				
Pein screw	3.0					
	168.3	226.	16.8	2.8	15.2	1 set