増田橋梁建築設計事務所
東京市品川區五反田五ノ一〇八
電話大崎(49)0678番

設計	日付	類別
照査	日付	第　頁

昭和十六年三月

株式會社大阪鐵工所

神奈川工場第二船渠築造工事

材料調書

増田橋梁建築設計事務所
東京市品川區五反田五ノ一〇八
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設計 陳 田　日付 16-3-19　類別 材料
照査　日付　第 / 頁

大阪鐵工所神奈川工場
第三號船渠

渠側用井筒 W1　所要数 10-基

井筒混凝土 (1:2:4)

側壁	2 c	.35 × .50 × 8.00	=	2.80
〃	2 c	.35 × .50 × 4.30	=	1.51
〃	2 c	4.95 × .40 × 8.00	=	31.68
〃		.35 × .10 × 6.70	=	.23
〃	2 c	1.15 × .40 × 4.50	=	4.14
〃	2 c	3.80 × .50 × 4.50	=	17.10
〃	2 c	4.20 × .50 × 8.00	=	33.60
〃	2 c	1.50 × .60 × 8.00	=	14.40
〃	2 c	4.20 × .60 × 4.30	=	21.67
〃	2 c	1.50 × .70 × 4.55	=	9.56
〃	2 c	.60 × .15 × 6.35	=	1.14
〃	2 c	.60 × .15 × 4.30	=	.77
欠口	2 c	.35 × .50 × 8.00	=	2.80
〃	2 c	.40 × .50 × 4.68	=	1.87
隔壁		4.50 × .30 × 4.50	=	6.08
〃		4.30 × .45 × 4.20	=	8.13
〃		1.00 × .45 × 4.38	=	1.97
〃 △上		.50 × .30 × .50	=	.08
▽下		.40 × .45 × .50	=	.09
持送	4 c	.30 × .30 × 10.80	=	3.89
噛合部	2 c	.40 × .24 × 11.40	=	2.19
				165.70 m³

井筒鐵筋

主鐵筋	直	22 - 16φ	c 1.58	× 31.00	=	1077.56
〃	〃	22 - 12φ	c 0.89	× 27.80	=	544.32
〃	曲	20 - 16φ	c 1.58	× 23.30	=	736.28
隔壁横筋		20 - 12φ	c 0.89	× 12.80	=	227.84
斜	〃	23 - 12φ	c 0.89	× 10.50	=	214.94
〃	〃	19 - 16φ	c 1.58	× 7.60	=	228.15
豎筋	〃	19 - 12φ	c 0.89	× 5.00	=	84.55
〃	〃	116 - 16φ	c 1.58	× 7.60	=	1392.93
隔壁豎筋	〃	116 - 12φ	c 0.89	× 5.50	=	567.82
突出部	〃	16 - 12φ	c 0.89	× 12.20	=	173.73
〃	〃	44 - 12φ	c 0.89	× 2.20	=	86.15
噛合部 ⊐	〃	14 - 12φ	c 0.89	× 1.50	=	18.69
底部豎	〃	22 - 12φ	c 0.89	× 2.30	=	45.03
〃	〃	60 - 16φ	c 1.58	× 2.00	=	189.60

予備 6%
5587.59 kg + 335.26 = 5922.85
5923 kg トス

井筒型枠

外面	2 -	8.00 × 11.40	=	182.40
〃	2 -	5.78 × 9.50	=	109.82
〃	2 -	6.23 × 1.90	=	23.67
内面	2 -	4.50 × 5.30	=	47.70
〃	2 -	4.30 × 4.20	=	36.12
〃	2 -	4.55 × 2.30	=	20.93
〃	4 -	3.45 × 1.50	=	20.70
〃	4 -	3.35 × 3.80	=	50.92

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大阪鉄工所神奈川工場

内面
〃
〃
隔壁
〃
〃
〃 底

4 - 3.18 × 4.20 = 53.42
4 - 3.08 × 1.00 = 12.32
2 - 6.60 × 1.30 = 17.16
2 - 4.50 × 4.50 = 40.50
2 - 4.30 × 5.20 = 44.72
4 - .40 × .50 = .80
.45 × 5.00 = 22.5
663.43 m²

井筒底詰混凝土 (1:3:6)

2 @ 3.18 × .50 × 4.30 = 13.67
2 @ 3.08 × 1.00 × 4.55 = 28.03
4.60 × .50 × 6.60 = 15.18
5.25 × .50 × 7.30 = 19.16
- .40 × .45 × .50 = - .09
75.95 m³

井筒上詰混凝土 (1:3:6)

2 @ 3.35 × .80 × 4.50 = 24.12 m³

井筒上詰用鐵筋

44 - 16φ @ 1.58 × 3.60 = 250.27
22 - 16φ @ 1.58 × 4.60 = 159.90 豫備5%
410.17 kg + 20.51 = 430.68
431 kg トス

井筒中詰 砂及粘土

2 @ 3.18 × 3.70 × 4.30 = 101.19 m³
- 4 @ .60 × .15 × 3.18 = - 1.14
- 2 @ .60 × .15 × 4.00 = - 0.72
99.33 m³

鋼桁 ∠ 100×100×7 @ 10.7 kg/m × 31.0 = 331.70
56 Bolts 16φ×350 @ 0.65 = 36.40
368.10 kg 之ヲ 368 kg トス

嚙合部木材

2 @ 0.10 × 0.29 × 11.40 = 0.66 m³

締付用ボールト

46 - 19φ × 550 @ 1.5 = 69.00 kg

井筒掘鑿

60 × 8.0 × 13.0 = 624 m³
.39 × 6.0 × 1.5 = 35.1
627.51 m³

井筒間隙掘鑿
.39 × 6.0 × 11.5 = 26.91 m³

井筒切取

側壁 2 @ .50 × .40 × 3.00 = 1.20
〃 2 @ .35 × .10 × 2.60 = 0.18
〃 2 @ 1.00 × .40 × 2.00 = 1.60
〃 4 @ 1.00 × .50 × 2.00 = 4.00
隔壁 1.60 × .30 × 1.70 = .82
〃 .50 × .30 × .25 = .04
〃 .60 × .30 × 2.00 = .36
前壁 1.50 × .40 × 7.20 = 4.32

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大阪鐵工所神奈川工場

前壁
,35 × ,10 × 7,20 = 0,25
3,00 × ,40 × 7,00 = 8,40
21,17 m³

渠壁混凝土 (1:3:6)
1,00 × 1,50 × 8,39 = 12,59
1,50 × 1,90 × 7,20 = 20,52
,50 × 1,00 × 6,70 = 3,35
1,50 × 2,00 × 6,70 = 20,10
,25 × 2,00 × 6,70 = 3,35
- ,35 × ,10 × 7,20 = - ,25
- 2 × ,35 × ,10 × 1,80 = - ,13
- ½ × ,50 × ,30 × ,50 = - ,04
- ,70 × ,30 × 2,90 = - ,61
1,00 × 1,00 × 7,20 = 7,20
66,08 m³

渠壁中詰 砂及粘土
2,40 × 3,00 × 6,70 = 48,24
- ,25 × 2,00 × 6,70 = -3,35
44,89 m³

渠側用井筒 W1A 所要数 12-基
井筒混凝土 (1:2:4)
16,570
側壁 - 2 @ ,20 × ,50 × 8,00 = - 1,60
〃 - 2 @ ,20 × ,60 × 4,30 = - 1,03
隔壁 - ,20 × ,45 × 4,30 = - ,39
持送 -4 @ ,30 × ,30 × ,20 = - ,07
噛合部 -2 @ ,40 × ,24 × ,20 = - ,04
162,57 m³

井筒鐵筋
55,875,9
竪筋 -116 - 16φ @ 1,58 × 0,20 = - 36,66
隔壁竪筋 - 16 - 12φ @ 0,89 × 0,20 = - 2,85 豫備 6%
554,08 kg + 33,28 = 588,96
588 kg ナス

井筒型枠
66,343
外面 - 2 - 8,00 × 0,20 = - 3,20
〃 - 2 - 5,78 × 0,20 = - 2,31
内面 - 4 - 3,18 × 0,20 = - 2,54
〃 - 2 - 4,30 × 0,20 = - 1,72
隔壁 - 2 - 4,30 × 0,20 = - 1,72
651,94 m²

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大阪鐵工所神奈川工場

井筒底詰混凝土 (1:3:6) 75.95 m³

井筒上詰混凝土 (1:3:6) 24.12 m³

井筒上詰用鐵筋 431 kg

井筒中詰 砂及粘土

-2 @ 3.18 × 0.20 × 4.30 = 9.33 − 5.47 = 93.86 m³

鋼沓 36810 kg 之ヲ 368 kg トス

嚙合部木材

2 @ 0.10 × 0.29 × 11.20 = 0.65 m³

締付用ボールト 69.00 kg

井筒掘鑿 6.0 × 8.0 × 12.80 = 614 m³
井筒切取 .39 × 6.0 × 1.50 = 35.1 } 617.51 m³ 井筒間隙掘鑿 .39 × 6.0 × 11.3 = 26.44 m³
21.17 m³

渠壁混凝土 (1:3:6) 66.08 m³

渠壁中詰 砂及粘土 44.66 m³

渠側用井筒 WIB 所要数 14-基

井筒混凝土 (1:2:4)

側壁	-2 @ .40 × .50 × 8.00 =	16.70 − 3.20	
〃	-2 @ .40 × .60 × 4.30 =	− 2.06	
隔壁	- .40 × .45 × 4.30 =	− .77	
持送	-4 @ .30 × .30 × .40 =	− .14	
嚙合部	-2 @ .40 × .24 × .40 =	− .08	
		15.45 m³	

井筒鐵筋

主鉄筋	-1-12φ @ 0.89 × 12.80	558.59 − 11.39	
主鉄筋曲	-1-16φ @ 1.58 × 23.30 =	− 36.81	
竪筋	-116-16φ @ 1.58 × 0.40 =	− 73.31	
隔壁竪筋	-16-12φ @ 0.89 × 0.40 =	− 5.70	豫備6%
〃 横	-1-12φ @ 0.89 × 10.50 =	546.38 kg + 32.62 = 578.00	
		578.8 kg トス	

井筒型枠

外面	-2-8.00 × 0.40 =	66.43 − 6.40	
〃	-2-5.78 × 0.40 =	− 4.62	
内面	-4-3.18 × 0.40 =	− 5.09	
内面及隔壁	-4-4.30 × 0.40 =	− 6.88	
		64.44 m²	

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大阪鐵工所神奈川工場

井筒底詰混凝土 (1:3:6) 75.95 m³

井筒上詰混凝土 (1:3:6) 24.12 m³

井筋上詰用鐵筋 431 kg

井筒中詰 砂及粘土

-2 c 3.18 × 0.40 × 4.30 = 99.33 − 10.94 = 88.39 m³

鋼 沓 36810 kg ∴ 368 kg トス

噛合部木材

2 c 0.10 × 0.29 × 11.00 = 0.64 m³

締付用ボールト 69.00 kg

井筒掘鑿 6.0 × 8.0 × 12.60 = 605 m³
井筒切取 .39 × 6.0 × 15.0 = 351
21.17 m³ } 608.51 m³

井筒間隙掘鑿 .39 × 6.0 × 11.1 = 25.97 m³

渠壁混凝土 (1:3:6) 66.08 m³

渠壁中詰 砂及粘土 44.66 m³

渠端部井筒 W2 所要数 3-基

井筒混凝土 (1:2:4)

側壁	2 c 5.30 × .40 × 7.40	=	31.38
〃	2 c 1.50 × .40 × 4.50	=	5.40
〃	2 c 3.80 × .50 × 4.50	=	17.10
〃	2 c .35 × .10 × 6.60	=	.46
〃	.35 × .10 × 6.10	=	.21
〃	2 c .35 × .10 × 4.50	=	.32
〃	2 c 3.80 × .50 × 7.40	=	28.12
〃	2 c 1.50 × .60 × 7.40	=	13.32
〃	2 c 3.80 × .60 × 4.30	=	19.61
〃	2 c 1.50 × .70 × 4.55	=	9.56
〃	2 c .60 × .15 × 5.75	=	1.04
〃	2 c .60 × .15 × 4.30	=	.77
双口	2 c .35 × .50 × 7.40	=	2.59
〃	2 c .40 × .50 × 4.68	=	1.87
隔壁	4.50 × .30 × 4.50	=	6.08
〃	4.30 × .45 × 3.80	=	7.35
〃	1.00 × .45 × 4.38	=	1.97
〃 △上	.50 × .30 × .50	=	.08
〃 ▽下	.40 × .45 × .50	=	.09
持送	4 c .30 × .30 × 10.40	=	3.74
噛合部	2 c .40 × .24 × 11.00	=	2.11
			153.17 m³

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大阪鐵工所神奈川工場

井筒鐵筋

主鐵筋 直 22 - 16φ @ 158 × 31.00 = 1077.56
〃 〃 22 - 12φ @ 089 × 25.40 = 497.33
〃 曲 〃 19 - 16φ @ 158 × 23.30 = 699.47
隔壁 横 19 - 12φ @ 089 × 11.60 = 196.16
斜 〃 22 - 12φ @ 089 × 10.50 = 205.59
豎筋 〃 19 - 16φ @ 158 × 7.60 = 228.15
〃 19 - 12φ @ 089 × 5.00 = 84.55
隔壁豎筋 108 - 16φ @ 158 × 7.20 = 1228.61
突出部 〃 108 - 12φ @ 089 × 5.50 = 528.66
〃 16 - 12φ @ 089 × 11.80 = 168.03
嘴部 □3 40 - 12φ @ 089 × 2.20 = 78.32
合部 12 - 12φ @ 089 × 1.50 = 16.02
底部豎 22 - 12φ @ 089 × 2.30 = 45.03
56 - 16φ @ 158 × 2.00 = 176.96 豫備 6%
523.44 + 31.383 = 554.427
5545 kg トス

井筒型枠

外面 2 - 7.40 × 11.00 = 162.80
〃 2 - 5.80 × 9.10 = 105.56
〃 2 - 6.23 × 1.90 = 23.67
内面 2 - 4.50 × 5.30 = 47.70
〃 2 - 4.30 × 3.80 = 32.68
〃 2 - 4.55 × 2.30 = 20.93
〃 4 - 3.15 × 1.50 = 18.90
〃 4 - 3.05 × 3.80 = 46.36
〃 4 - 2.88 × 3.80 = 43.78
〃 4 - 2.78 × 1.00 = 11.12
〃 2 - 6.00 × 1.30 = 15.60
隔壁 2 - 4.50 × 4.50 = 40.50
〃 2 - 4.30 × 4.80 = 41.28
〃 4 - .40 × .50 = .80
底 .45 × 5.00 = 2.25
613.93 m²

井筒底詰混凝土 (1:3:6)

2 @ 2.88 × .50 × 4.30 = 12.38
2 @ 2.78 × 1.00 × 4.55 = 25.30
4.60 × .50 × 6.00 = 13.80
5.25 × .50 × 6.70 = 17.59
- .40 × .45 × .50 = - .09
68.98 m³

井筒上詰混凝土 (1:3:6)

2 @ 3.05 × .80 × 4.50 = 21.96 m³

井筒上詰用鐵筋

44 - 16φ @ 158 × 3.30 = 229.42
20 - 16φ @ 158 × 4.60 = 145.36 豫備 5%
374.78 + 18.74 = 393.52 kg
394 kg トス

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大阪鐵工所神奈川工場

井筒中詰 砂及粘土

2 @ 2.88 × 3.30 × 4.30 = 81.73 m³
-4 @ .60 × .15 × 2.88 = -1.04
-2 @ .60 × .15 × 4.00 = -.72
} 79.97 m³

鋼 沓
1 L 100×100×7 @ 10.7kg × 2.98 = 31.886
54 Bolts 16φ×350 @ 0.65 = 35.10
35.396 kg 之ヲ 354 kg トス

噛合部木材 2 @ .10 × 0.30 × 11.00 = 0.66 m³

締付用ボールト
46 - 19φ × .550 @ 1.5 = 69.00 kg

井筒掘鑿 (三ヶ分)
6.0 × 7.4 × 12.60 = 559 m³
.45 × 6.0 × 1.50 = 4.05 m³
3-W2 3@559 + 4@4.05 = 169.320 m³

井筒間隙掘鑿
.45 × 6.0 × 11.1 = 29.97 m³
4@29.97 = 119.88 m³

井筒切取
側壁 2 @ .50 × .40 × 3.00 = 1.20
〃 2 @ .35 × .10 × 2.60 = .18
〃 2 @ 1.00 × .40 × 2.00 = 1.60
〃 4 @ 1.00 × .50 × 2.00 = 4.00
隔壁 1.60 × .30 × 1.70 = .82
〃 .50 × .30 × .25 = .04
〃 .60 × .30 × 2.00 = .36
前壁 1.50 × .40 × 6.60 = 3.96
〃 .35 × .10 × 6.40 = .22
〃 3.00 × .40 × 6.40 = 7.68
20.06 m³

渠壁混凝土 (1:3:6)
1.00 × 1.50 × 8.00 = 12.00
1.50 × 1.90 × 6.60 = 18.81
1.00 × 1.00 × 6.60 = 6.60
.50 × 1.00 × 6.10 = 3.05
1.50 × 2.00 × 6.10 = 18.30
.25 × 2.00 × 6.10 = 3.05
-.35 × .10 × 6.60 = -.23
-2 × .35 × .10 × 1.80 = -.13
-½ × .50 × .30 × .50 = -.04
-.70 × .30 × 2.90 = -.61
60.80 m³

渠壁中詰 砂及粘土
2.40 × 3.00 × 6.10 = 43.92
-.25 × 2.00 × 6.10 = -3.05
-.35 × .10 × 6.10 = -.21
40.66 m³

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大阪鐵工所神奈川工場
渠側用井筒 W3 所要数 2-基

井筒混凝土 (1:2:4)

側壁	2 @ .35 × .50 × 8.00	= 2.80	
〃	2 @ .35 × .50 × 4.30	= 1.51	
〃	2 @ 4.95 × .40 × 8.00	= 31.68	
〃	.35 × .10 × 6.70	= .23	
〃	2 @ 1.15 × .40 × 4.50	= 4.14	
〃	2 @ 3.80 × .50 × 4.50	= 17.10	
〃	2 @ 4.20 × .50 × 8.00	= 33.60	
〃	2 @ 4.00 × .60 × 8.00	= 38.40	
〃	2 @ 4.20 × .60 × 4.30	= 21.67	
〃	2 @ 4.00 × .70 × 4.75	= 26.60	
〃	2 @ .60 × .15 × 6.35	= 1.14	
〃	2 @ .60 × .15 × 4.30	= .77	
又口壁	2 @ .40 × .50 × 5.80	= 2.32	
隔壁	4.50 × .30 × 4.50	= 6.08	
又口壁	2 @ .35 × .50 × 8.00	= 2.80	
隔壁	4.30 × .45 × 4.20	= 8.13	
〃	3.50 × .45 × 4.75	= 7.48	
〃 △上	.50 × .30 × .50	= .08	
〃 ▽下	.40 × .45 × .50	= .09	
特送	4 @ .30 × .30 × 13.00	= 4.68	
噛合部	2 @ .40 × 2.45 × 13.90	= 2.72	
		214.02 m³	

井筒鐵筋 (A組29段, B組26段)

主鐵筋 直	29 - 16φ @ 1.58 × 31.00	= 1,420.41		
〃 〃	29 - 12φ @ 0.89 × 27.80	= 717.52		
〃 曲	26 - 16φ @ 1.58 × 23.30	= 957.16		
〃 〃	26 - 12φ @ 0.89 × 12.80	= 296.19		
隔壁横	35 - 12φ @ 0.89 × 10.50	= 327.08		(23+12 = 35段)
斜	26 - 16φ @ 1.58 × 7.60	= 312.21		
〃	26 - 12φ @ 0.89 × 5.00	= 115.70		
竪筋	116 - 16φ @ 1.58 × 10.40	= 1,906.11		6.4+4.0 = 10.4m
〃	116 - 12φ @ 0.89 × 5.50	= 567.82		
隔壁竪筋	16 - 12φ @ 0.89 × 14.90	= 212.18		5.9+4.0+5.0 = 14.9m
突出部	44 - 12φ @ 0.89 × 2.20	= 86.15		
〃	14 - 12φ @ 0.89 × 1.50	= 18.69		
噛合部 ⊏	30 - 12φ @ 0.89 × 2.30	= 61.41		2@15 = 30段 (両側分)
底部竪	60 - 16φ @ 1.58 × 2.00	= 189.60	豫備 7%	
		7188.23 + 503.18	= 7,691.41	
			≒7 7.619 tonス	

井筒型枠

外面	2 - 8.00 × 13.90	= 222.40
〃	2 - 5.79 × 9.50	= 110.01
内面	2 - 6.54 × 4.40	= 57.55
〃	2 - 4.50 × 5.30	= 47.70
〃	2 - 4.30 × 4.20	= 36.12
〃	2 - 4.75 × 4.80	= 45.60
〃	4 - 3.45 × 1.50	= 20.70
〃	4 - 3.35 × 3.80	= 50.92

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設計 陣田 日付 16-3-22 類別 材料
照査 日付 第 9頁

大阪鐵工所神奈川工場

内面 4 - 3,18 × 4,20 = 53,42
〃 4 - 3,08 × 3,50 = 43,12
〃 隔壁 2 - 6,60 × 1,30 = 17,16
〃 〃 2 - 4,50 × 4,50 = 40,50
〃 〃 2 - 4,30 × 7,70 = 66,22
〃 〃 4 - ,40 × ,50 = ,80
〃 底 ,45 × 5,50 = 2,48
81,470 m²

井筒底詰混凝土 (1:3:6)
2 - 3,08 × 1,50 × 4,95 = 45,74
5,15 × ,50 × 6,60 = 17,00
5,80 × ,50 × 7,30 = 21,17
- ,40 × ,45 × ,50 = -,09
83,82 m³

井筒上詰混凝土 (1:3:6)
2 @ 3,35 × ,80 × 4,50 = 24,12 m³

井筒上詰用鐵筋
44 - 16φ × 1,58 × 3,60 = 250,27
22 - 16φ × 1,58 × 4,60 = 159,90 豫備 5%
410,17 + 20,51 = 430,68
431 kg トス

井筒中詰 砂及粘土
2 @ 3,18 × 4,20 × 4,30 = 114,86
2 @ 3,08 × 2,00 × 4,55 = 56,06
- 1,86
169,06 m³

鋼沓
1L 100 × 100 × 7 @ 10,7 × 32,1 = 343,47
65 Bolts 16φ × 350 @ 0,65 = 42,25
385,72 kg ニヲ 386 kg トス

噛合部木材
2 @ 0,10 × 0,295 × 13,90 = 0,82 m³

締付用ボールト
56 - 19φ × 550 @ 1,5 = 84,00 kg

井筒掘鑿 6,6 × 8,0 × 15,5 = 818 m³ } 821,96 m³ 井筒間隙掘鑿
,40 × 6,6 × 1,5 = 3,96 } 40 × 6,6 × 14,0 - 36,96 m³

井筒切取 W1 = 仝シ 21,17
水抜孔 2 @ 1,30 × ,60 × 1,50 = 2,34
23,51 m³

渠壁混凝土 (1:3:6) 66,08 m³

渠壁中詰 砂及粘土 44,66 m³

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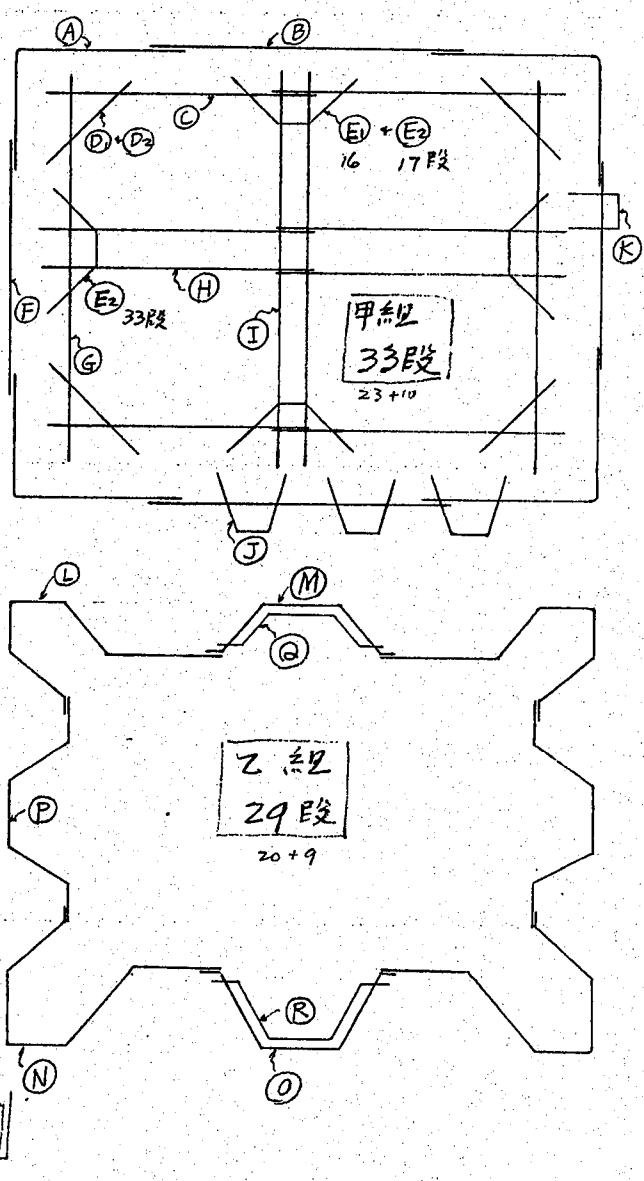
大阪鐵工所神奈川工場
渠口用井筒 W4 所要數 2-基

井筒混凝土 (1:2:4)

側壁		1.50 × .40 × 9.60	=	5.76
〃		9.00 × .50 × 9.60	=	43.20
〃		3.00 × .60 × 9.60	=	17.28
〃		1.50 × .70 × 9.60	=	10.08
〃		9.00 × .85 × 9.60	=	73.44
〃		2.60 × 1.00 × 9.60	=	24.96
〃		.35 × .10 × 8.80	=	.31
〃	2 @	1.50 × .40 × 5.90	=	7.08
〃	2 @	9.00 × .40 × 5.65	=	40.68
〃	2 @	3.10 × .50 × 5.40	=	16.74
〃	2 @	.35 × .10 × 5.90	=	.41
〃	2 @	.35 × .10 × 5.65	=	.40
水口		.35 × .50 × 9.60	=	1.68
〃		.90 × .55 × 9.60	=	4.75
〃	2 @	.30 × .40 × 6.10	=	1.46
隔壁		8.50 × .30 × 9.75	=	24.86
〃		2.50 × .30 × 8.30	=	6.23
〃		.75 × .30 × 5.90	=	1.33
〃		5.65 × .30 × 9.00	=	15.26
〃		2.50 × .30 × 5.40	=	4.05
〃	4 @	.50 × .30 × .50	=	.30
持送	2 @	.30 × .30 × 13.00	=	2.34
〃	6 @	.30 × .30 × 12.80	=	6.91
嗹合部		.25 × .40 × 13.90	=	1.39
突出部	3 @	.95 × .20 × 13.90	=	7.92
				318.82 m³

井筒鐵筋

Ⓐ	132 - 16φ @ 1.58 × 3.80	=	792.53	33@4
Ⓑ	66 - 16φ @ 〃 × 6.80	=	709.10	〃@2
Ⓒ	132 - 16φ @ 〃 × 5.20	=	1084.51	〃@4
Ⓓ1	64 - 16φ @ 〃 × 1.60	=	161.79	下釣 16@4
Ⓓ2	68 - 12φ @ 0.89 × 1.50	=	90.78	上釣 17@4
Ⓔ1	32 - 16φ @ 1.58 × 2.20	=	111.23	下釣 16@2
Ⓔ2	100 - 12φ @ 0.89 × 2.10	=	186.90	33×2+17×2
Ⓕ	66 - 12φ @ 〃 × 5.00	=	293.70	33@2
Ⓖ	66 - 12φ @ 〃 × 7.00	=	411.18	〃 〃
Ⓗ	160 - 12φ @ 〃 × 5.10	=	726.24	(30+10)@4
Ⓘ	80 - 12φ @ 〃 × 7.00	=	498.40	〃 @2
Ⓙ	99 - 12φ @ 〃 × 2.40	=	211.46	33 @3
Ⓚ	50 - 12φ @ 〃 × 1.50	=	66.75	33+10+7
Ⓛ	58 - 16φ @ 1.58 × 5.80	=	531.51	29@2
Ⓜ	29 - 16φ @ 〃 × 3.50	=	160.37	29@1
Ⓝ	58 - 16φ @ 〃 × 6.30	=	577.33	29@2
Ⓞ	29 - 16φ @ 〃 × 4.40	=	201.61	29@1
Ⓟ	58 - 12φ @ 0.89 × 5.40	=	278.75	29@2
Ⓠ	29 - 12φ @ 〃 × 2.60	=	67.11	29@1
Ⓡ	29 - 12φ @ 〃 × 3.50	=	90.34	〃 〃
豎筋	101 - 16φ @ 1.58 × 4.60	=	734.07	前 53+48 後
〃	202 - 16φ @ 〃 × 5.80	=	1851.13	2(53+48)
水口	40 - 16φ @ 〃 × 2.00	=	126.40	後 左右



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設計 陣田 日付 16-3-24 類別 材料
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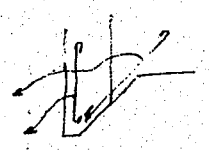
大阪鐵工所神奈川工場

左右壁 竪筋 58 - 12φ @ 0.89 × 4.50 = 23.229 28×2+2
〃 〃 116 - 12φ @ 〃 × 5.70 = 58.847 (28×2+2)×2
隔壁 〃 56 - 12φ @ 〃 × 3.20 = 15.949 36+20
〃 〃 56 - 12φ @ 〃 × 5.70 = 28.409 〃 〃
〃 〃 56 - 12φ @ 〃 × 5.00 = 24.920 〃 〃
〃 下傾斜 〃 8 - 12φ @ 〃 × 2.00 = 1.424
〃 〃 竪孔口 28 - 12φ @ 〃 × 2.00 = 4.984 豫備 5%



11.540.81 + 577.04 = 12,117.85
12,118 kg トス

井筒型枠

外面		9.60	× 13.90	=	134.44
〃		10.80	× 13.90	=	150.12
〃		7.00	× 13.90	=	97.30
〃		7.50	× 13.90	=	104.25
外面	2 @	.75	× 5.90	=	8.85
〃	2 @	.75	× 8.80	=	13.20
〃	2 @	.75	× 5.60	=	8.40
〃	2 @	.75	× 8.50	=	12.75
〃	2 @	5.35	× 9.00	=	96.30
〃	2 @	8.50	× 9.00	=	153.00
〃	2 @	3.80	× 5.10	=	38.76
〃	2 @	3.80	× 8.30	=	63.08
隔壁	2 @	.75	× 5.60	=	8.40
〃	2 @	5.35	× 9.00	=	96.30
〃	2 @	2.50	× 5.10	=	25.50
〃	2 @	8.50	× 9.75	=	165.75
〃	2 @	2.50	× 8.30	=	41.50
底		.30	× 5.60	=	1.68
〃		.30	× 8.80	=	2.64
	4 @	.50	× .50	=	1.00
					1223.22 m²

井筒底詰混凝土 (1:3:6)

	2 @	2.55	× 1.50 × 4.15	=	31.75
		5.40	× .50 × 8.60	=	23.22
		6.10	× .50 × 9.00	=	27.45
	- 2 @	.50	× .30 × .50	=	- .15
					82.27 m³

井筒上詰混凝土 (1:3:6)

		5.90	× 1.50 × 8.80	=	77.88
		- .75	× .30 × 5.90	=	- 1.33
		- .75	× .30 × 8.50	=	- 1.91
	- 2 @	.50	× .30 × .50	=	- .15
					74.49 m³

井筒中詰 砂及粘土

		5.35	× 9.00 × 8.50	=	409.28
		5.10	× 1.00 × 8.30	=	42.33
	2 @	- .35	× 0.10 × 5.35	=	- 0.37
					451.24 m³

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照査 日付 第 12頁

大阪鐵工所神奈川工場
鋼沓
1L 100×100×7 @ 10.7 × 36.6 = 391.62 ✓
67 Bolts 16φ × 350 @ 0.65 = 43.55 ✓
435.17 kg ニヲ435 kgトス

噛合部木材 0.10 × .30 × 13.90 = 0.42 m³

締付用ボールト
28 - 19φ × .550 @ 1.5 = 42.00 kg ✓

井筒掘鑿
7.0 × 9.6 × 15.5 = 1042 m³ ✓
.25 × 0.4 × 13.9 = 1.39
3@ .95 × 0.2 × 13.9 = 7.92
} 1051.31 m³

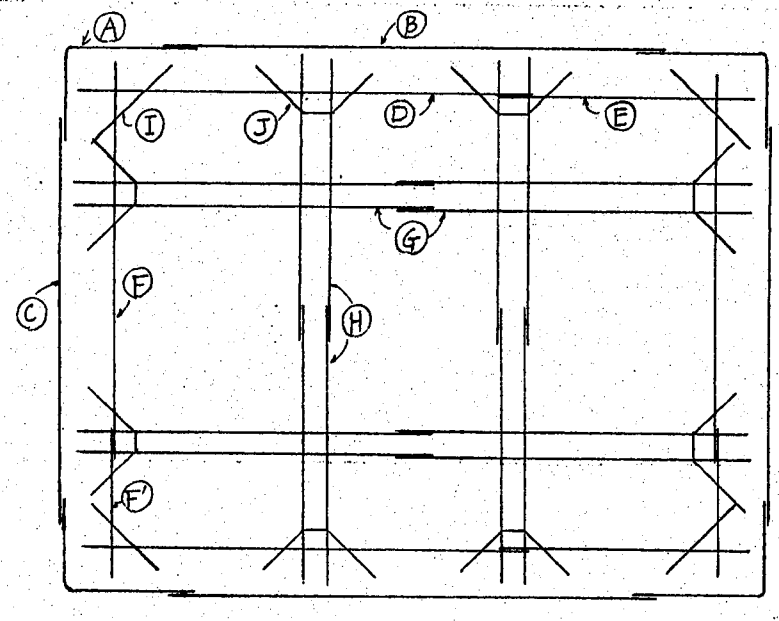
卿筒室用井筒 W5 所要数 1-基

井筒混凝土 (1:2:4)

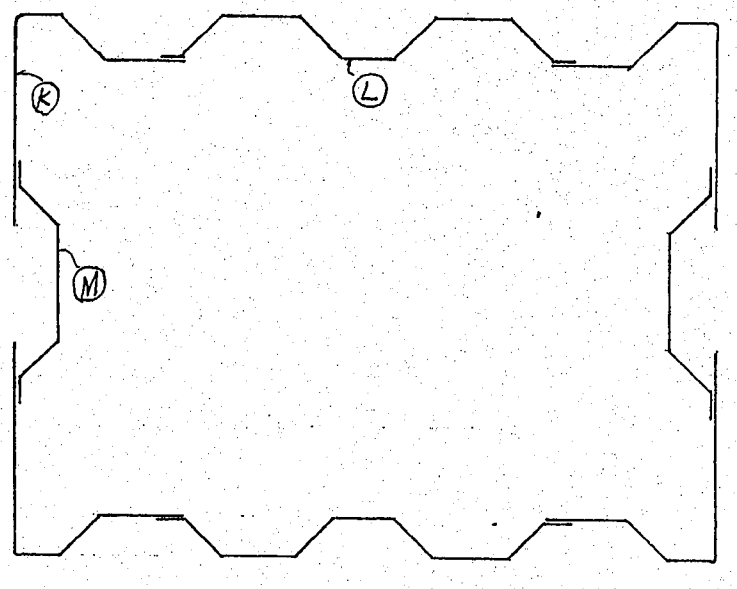
側壁	2 @	7.70	× .40 × 11.20 =	68.99	✓
〃	2 @	5.00	× .55 × 11.20 =	61.60	✓
〃	2 @	4.30	× .70 × 11.20 =	67.42	✓
〃	2 @	7.40	× .40 × 7.70 =	45.58	✓
〃	2 @	5.00	× .55 × 7.10 =	39.05	✓
〃	2 @	4.30	× .70 × 6.80 =	40.94	✓
〃	2 @	.35	× .10 × 10.40 =	.73	✓
〃	2 @	.35	× .10 × 7.40 =	.52	✓
水口	2 @	.50	× .40 × 11.20 =	4.48	✓
〃	2 @	.50	× .40 × 6.80 =	2.72	✓
隔壁	2 @	7.70	× .30 × 10.40 =	48.05	✓
〃	2 @	5.00	× .30 × 10.10 =	30.30	✓
〃	2 @	3.80	× .40 × 9.80 =	29.79	✓
〃	2 @	7.70	× .30 × 6.80 =	31.42	✓
〃	2 @	5.00	× .30 × 6.50 =	19.50	✓
〃	2 @	3.80	× .40 × 6.00 =	18.24	✓
〃	4 @	.50	× .40 × .50 =	.40	✓
持送	10 @	.30	× .30 × 16.87 =	15.18	
〃	8 @	.20	× .20 × 16.50 =	5.28	
				530.19 m³	

井筒鐵筋

甲組 48段



乙組 44段



高サ 間隔数
6.95m — 46
6.00 — 30
4.55 — 15
17.50 91
送リ — 1
92段

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照査 橋本 日付 16-3-27 第 13頁

大阪鐵工所神奈川工場

甲組 豎筋

Ⓐ	192 - 16φ	@ 158	× 440	=	133478		48@4
Ⓑ	96 - 16φ	@ 〃	× 760	=	115277		48@2
Ⓒ	96 - 16φ	@ 〃	× 610	=	92525		〃
Ⓓ	96 - 16φ	@ 〃	× 770	=	116794		〃
Ⓔ	96 - 16φ	@ 〃	× 430	=	65222		〃
Ⓕ	96 - 16φ	@ 〃	× 630	=	95558		〃
Ⓕ'	96 - 16φ	@ 〃	× 280	=	42470		〃
Ⓖ	192 - 16φ	@ 〃	× 600	=	182016		48@4
Ⓗ	192 - 16φ	@ 〃	× 460	=	139546		〃
Ⓘ	192 - 16φ	@ 〃	× 180	=	54605		〃
Ⓙ	384 - 16φ	@ 〃	× 260	=	157747		48@8

乙組 豎筋

Ⓚ	176 - 16φ	@ 〃	× 710	=	197437		44@4
Ⓛ	88 - 16φ	@ 〃	× 700	=	97328		44@2
Ⓜ	88 - 16φ	@ 〃	× 370	=	51445		〃
〃	336 - 16φ	@ 〃	× 580	=	307910		2(52+32)×2
〃	168 - 16φ	@ 〃	× 480	=	127411		2(52+32)
〃	168 - 16φ	@ 〃	× 400	=	106176		〃
〃	80 - 16φ	@ 〃	× 200	=	25280		2(23+17)
隔壁豎	120 - 16φ	@ 〃	× 450	=	85320		2(38+22)
〃	120 - 16φ	@ 〃	× 580	=	109968		〃
〃	120 - 16φ	@ 〃	× 480	=	91008		〃
〃	120 - 16φ	@ 〃	× 400	=	75840		〃
双口斜	16 - 16φ	@ 〃	× 200	=	5056		

豫備 5% 2@8

24754.17 + 1237.71 = 25,991.88
25,992 kg トス

井筒型枠

外面	2 @ 820	× 1740	=	28536	
〃	2 @ 1120	× 1740	=	38976	
内面	2 @ 770	× 980	=	15092	
〃	2 @ 770	× 680	=	10472	
〃	2 @ 500	× 950	=	9500	
〃	2 @ 500	× 650	=	6500	
〃	2 @ 510	× 900	=	9180	
〃	2 @ 510	× 600	=	6120	
隔壁	4 @ 770	× 980	=	30184	
〃	4 @ 500	× 950	=	19000	
〃	4 @ 380	× 900	=	13680	
〃	4 @ 770	× 680	=	20944	
〃	4 @ 500	× 650	=	13000	
〃	4 @ 380	× 600	=	9120	
底	2 @ 40	× 1030	=	824	
〃	2 @ 40	× 640	=	512	
	4 @ 150	× 60	=	120	

2317.60 m²

井筒底詰混凝土 (1:3:6)

	600	× 130 × 900	=	7020
	680	× 50 × 980	=	3332
	740	× 50 × 1040	=	3848
-	4@50	× 40 × 50	=	- 40

141.60 m³

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大阪鐵工所神奈川工場

鋼沓

1L 100×100×7 @ 10.7 × 4.27 = 456.89
7.8 Bolts 16φ × 350 @ 0.65 = 50.70
507.59 kg 又ヲ 508 kg トス

井筒掘鑿 8.20 × 11.20 × 17.00 = 1,561 m³

井筒切取

	.60	× .30 × 1.50 =	0.27
	1.10	× .30 × 2.00 =	0.66
	1.10	× .40 × 2.00 =	0.88
2@	1.60	× .40 × 2.00 =	2.56
2@	1.30	× .40 × 1.50 =	1.56
2@	1.30	× .70 × 1.50 =	2.73
			8.66 m³

井筒間隙填充

混凝土 (1:2:4) 8割
膠泥 (1:3) 2割

W1側

	.50	× .39 × 1.27 =	0.25
	2.00	× .39 × 2.27 =	1.77
	2.00	× .39 × 3.27 =	2.55
	7.00	× .39 × 4.27 =	11.66
	.23	× .39 × 2.00 =	0.18
			16.41 × 10 = 164.10

W1A側

			16.41
-	.20	× .39 × 4.27 =	- 3.33
			16.08 × 12 = 192.96

W1B側

			16.41
-	.40	× .39 × 4.27 =	- 6.67
			15.74 × 14 = 220.36

W2側

	.50	× .45 × 1.27 =	0.29
	2.00	× .45 × 2.27 =	2.03
	2.00	× .45 × 3.27 =	2.94
	6.60	× .45 × 4.27 =	12.68
	.23	× .45 × 2.00 =	0.21
			18.15
-	2.00	× .11 × 4.50 =	- 0.99
			17.16 × 4 = 68.64

W3側

	.50	× .40 × 1.27 =	0.25
	2.00	× .40 × 2.27 =	1.82
	2.00	× .40 × 3.27 =	2.62
	9.50	× .40 × 4.27 =	16.23
	.38	× .40 × 4.50 =	6.8
			21.60 × 2 = 43.20
			689.26 m³

混凝土 (1:2:4) 552 m³
膠泥 (1:3) 138 m³

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設計 陣 印 日付 16-3-25 類別 材料
照査 日付 第 15 頁

大阪鐵工所神奈川工場

渠底

渠底混凝土 (1:3:6)

排水渠		25.70	× 1.10	× 153.00	=	432.531
〃	-2@	.40	× .30	× 149.00	=	-35.76
〃		-.40	× .30	× 21.20	=	-2.54
溜桝壁	2@	-.40	× .30	× 18.00	=	-2.16
		1.50	× 1.00	× 7.00	=	21.00
		2.00	× 1.00	× 18.80	=	-37.60
						426.825 m³

渠底型枠

構造目地	18@	1.10	× 25.70	=	50.886
排水渠	4@	.30	× 149.00	=	178.80
〃	2@	.30	× 21.20	=	12.72
〃	2@	.30	× 18.00	=	10.80
溜桝壁	2@	1.50	× 6.00	=	18.00
					729.18 m²

渠底掘鑿

		26.00	× 12.25	× 153.00	=	48.731
	-2@	1.00	× 12.25	× 18.80	=	-461
溜桝	2@	3.00	× 1.50	× 5.00	=	45
						48.315 m³

割栗石 26.0 × 0.3 × 163.0 = 1.271.4 m³

鐵筋

306 - 16φ	@	1.58	× 4.00	=	1.933.92
612 - 16φ	@	〃	× 6.00	=	5.801.76
1980 - 16φ	@	〃	× 6.00	=	18.770.40
2.448 - 16φ	@	〃	× 5.70	=	22.046.69
					48.552.77 之ヲ 48.553 Kg トス

矢板 厚 4.5 cm 長 2.00 m 延長 372.00 m
0.045 × 2.00 × 372.00 = 33.48 m³

渠側階段

混凝土 (1:3:6)

4@	.10	× .30	× 9 × 1.00	=	1.08
4@	1.80	× 1.00	× 1.35	=	9.72
4@	2.00	× 1.00	× 3.70	=	29.60
4@	1.80	× 1.00	× 1.35	=	9.72
4@	.10	× .30	× 1.00 × 9	=	1.08
4@	2.00	× 1.00	× 7.40	=	59.20
4@	1.80	× 1.00	× 1.35	=	9.72
4@				=	1.08
4@	4.00	× 1.00	× 11.10	=	177.60
4@	2.00	× 1.00	× 3.70	=	29.60
8@	1.80	× 1.00	× 1.35	=	19.44
8@	.10	× .30	× 1.00 × 18	=	2.16
4@	.95	× 1.00	× 18.50	=	70.30
4@	.10	× .30	× 4 × .95	=	0.46
2@	.95	× 1.00	× 20.00	=	38.00
6@	1.00	× 2.00	× 0.52	=	6.24
2@	1.00	× 4.00	× 0.52	=	4.16
2@	.95	× 1.00	× 0.52	=	.99
2@	1.00	× 1.50	× 3.30	=	9.90
2@	.50	× 1.90	× 3.30	=	6.27
2@	2.00	× 2.90	× 2.30	=	26.68
2@	2.00	× 3.90	× 1.30	=	20.28
					533.28 m³

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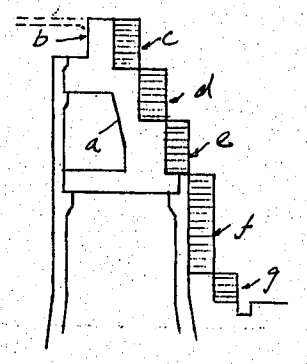
設計 陣田 日付 16-3-25 類別 材料
照査 日付 第 16 頁

大阪鐵工所神奈川工場
型枠

a	7C @	3.06 × 3.35 =		7.7908
a'	6 @	3.06 × 3.05 =		56.00
b	2 @	1.50 × 15.700 =		47.100
b		1.50 × 3.200 =		4.800
c	2 @	2.00 × 15.600 =		62.400
d	2 @	2.00 × 15.500 =		62.000
e	2 @	2.00 × 15.400 =		61.600
f	2 @	4.00 × 4.860 =		38.880
c		2.00 × 3.000 =		6.000
d		2.00 × 2.800 =		5.600
e		2.00 × 2.600 =		5.200
階段	C @	2.00 × 3.00 =		3.600
〃	2 @	4.00 × 7.00 =		5.600
〃	2 @	.95 × 1.50 =		2.85
断面	8 @	1.00 × 11.00 =		8.800
g	2 @	.95 × 5.820 =		11.058
				406.431 m²



渠口戸當部

石材

底部	44 @	0.75 × 0.50 × 1.00 =	16.50
両側	42 @	0.75 × 0.50 × 1.00 =	15.75
			32.25 m³

混凝土 (1:3:6)

両側	2 @	7.00 × 1.50 × 1.000 =	21.000
底部		7.00 × .50 × 2.600 =	9.100
〃		7.00 × 3.50 × 2.600 =	63.700
	-6 @	.95 × .20 × 14.00 =	- 15.96
石材		=	- 32.25
			88.979 m³

型枠

両側	4 @	1.50 × 10.00 =	60.00
〃	2 @	7.00 × 10.00 =	140.00
底部		1.10 × 26.00 =	28.60
〃		3.50 × 26.00 =	91.00
			319.60 m²

掘鑿

1.000 × 14.00 × 26.00 = 3640 m³

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大阪鐵工所神奈川工場
排水工事

徑 50cm 集水管 延長 18,00m
徑 30cm 主排水管 延長 2@150,00 = 300,00m
徑 12cm 副排水管 延長 18@26,00 = 468,00m

敷割栗石

	,50 × 1,00 × 18,00 =	9.0
2@	,40 × ,90 × 150,00 =	108.0
18@	,30 × ,70 × 26,00 =	98.3
		215.3m³

掘鑿 215 m³

神奈川工場第二船渠用材料一括表 其一

	混凝土 1:2:4 立米	混凝土 1:3:6 立米	膠泥 1:3 立米	鐵筋 瓲	型枠 平米	木材 立米	掘鑿 立米	割栗石 立米	セメント 瓲	砂 立米	砂利 立米
井筒 10-W1	1657.0	1661.5		635.40	663.4	6.60	627.5		945.53	166.0	331.9
〃 12-W1A	1950.8	1993.8		757.44	782.3	7.80	741.0		1121.84	197.3	394.5
〃 14-W1B	2232.3	2326.1		870.66	896.6	8.96	851.9		1293.98	227.9	455.8
〃 3-W2	459.5	455.2		178.17	184.2	1.98	169.3		260.93	45.8	91.5
〃 2-W3	428.0	348.0		161.00	162.9	1.64	164.4		225.56	38.8	77.6
〃 2-W4	637.6	313.5		242.36	244.6	0.84	210.3		288.89	47.6	95.1
〃 1-W5	530.2	141.6		259.92	231.8		156.1		212.84	33.6	67.2
井筒間隙填充	552.0		138.0						249.78	41.4	55.2
渠壁階段		533.3			406.4				122.66	26.7	53.3
渠底		4268.3		485.53	72.9	33.48	4831.5	1271.4	981.71	213.4	426.8
渠口戸當部		889.8			32.0		364.0		204.65	44.5	89.0
渠底集水設備							21.5	215.3			
合計	8447.4	12931.1	138.0	3590.48	3677.1	61.30	8137.5	1486.7	5908.37	1083.0	2137.9

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設計 津 西 日付 16-3-27 類別 材料
照査 日付 第 18 頁

神奈川工場第二船渠用材料一括表　其二

	井筒混凝土切取 立米	井筒中詰砂及粘土 立米	鋼 沓 形 鋼 瓲	ボールト 瓲	松杭 末200"長6,000 本	渠壁中詰砂及粘土 立米	井筒間隙搖鼈 立米	石材 立米	集排水管	松杭用鉄物 瓲	
井筒 10 - W1	211.7	993	3.680	0.690		449	269				
〃 12 - W1A	254.0	1,126	4.416	0.828		536	317				
〃 14 - W1B	296.4	1,237	5.152	0.966		625	364				
〃 3 - W2	60.2	240	1.062	0.207		122	120				
〃 2 - W3	47.0	338	0.772	0.168		89	74				
〃 2 - W4		902	0.870	0.084							
〃 1 - W5	8.7		0.508								
渠底					4521					15.439	
渠口戸當部								32.25			
渠底集水設備									一式		
合　計	878.0	4,836	16.460	2.943	4,521	1,821	1,144	32.25	一式	15.439	

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設計 準 回 日付 16-4-22 類別 材料
照査 日付 第 19 頁

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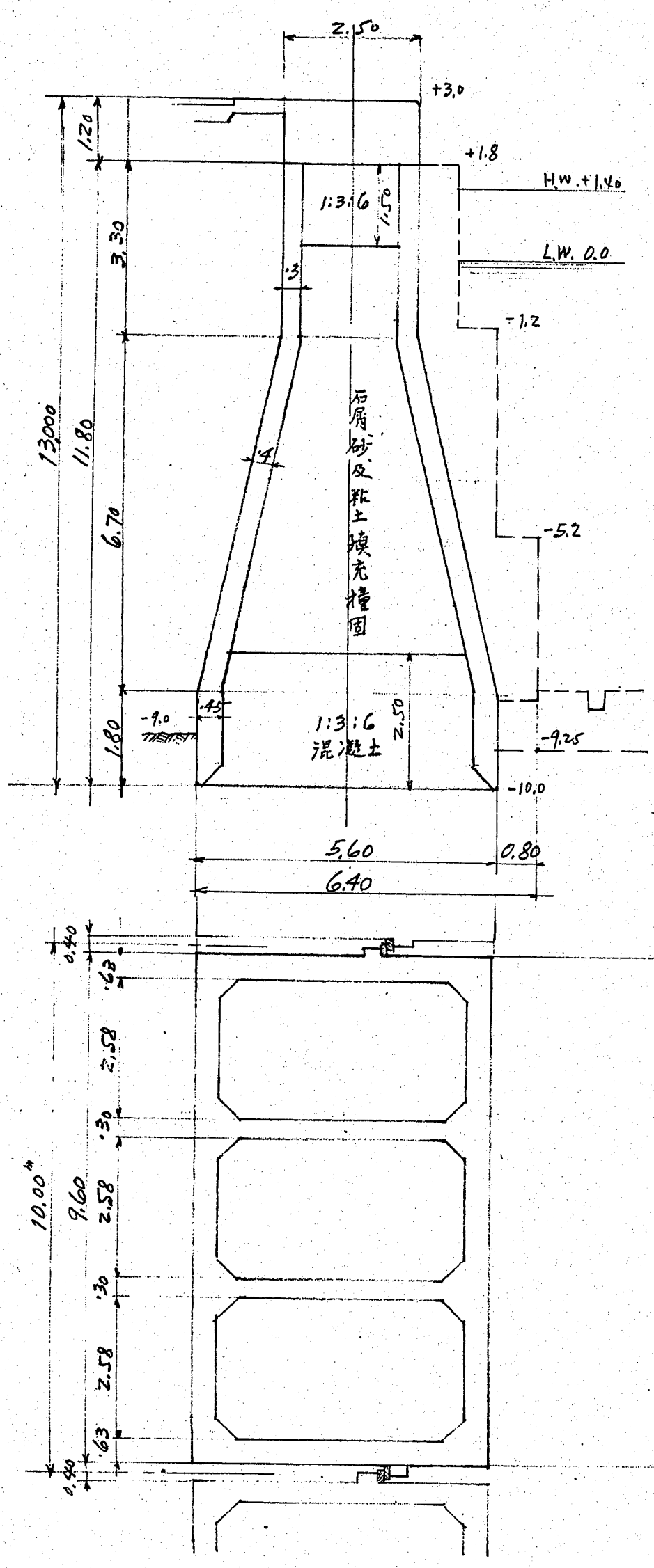
設計 稲葉 日付 16-2-26 類別 応力

照査 日付 第 1 頁

函館船渠株式会社室蘭第一船渠

應力計算書

渠壁 井筒 W1



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設計 矛俗葉　日付 16-2-26　類別 応力
照査　日付　第 乙 頁

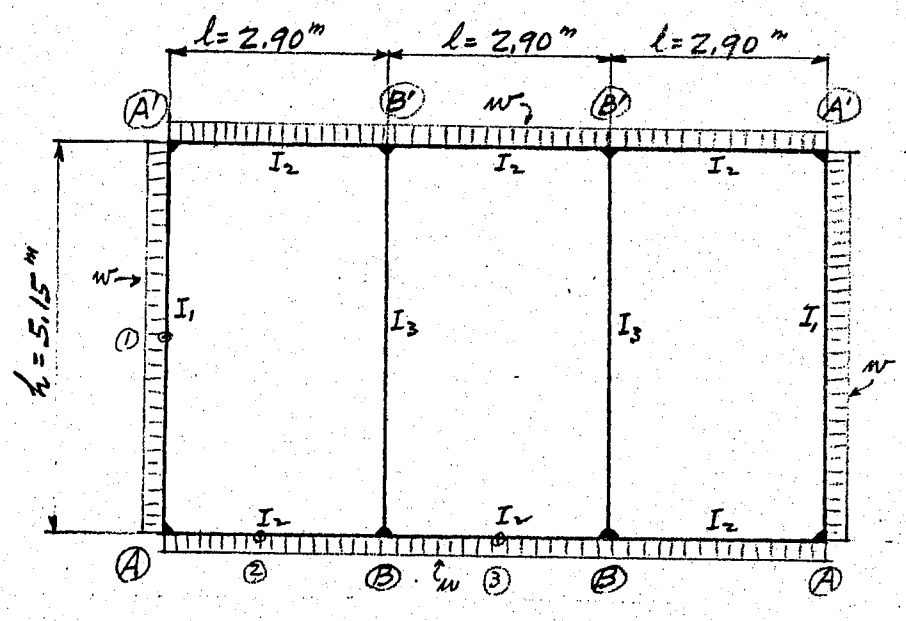
底部断面

土深 10.4m　(沈下作業中 H.W. 以上ノ土砂ヲ除去シ射水法ニヨリテ沈下セシメ、而ヲ底部約1.0米ハ硬質地盤内ニ入ルヲ以テ此部ハ土圧ヲ増加セザルモノト假定ス)

土圧.

沈下中ハ水圧ノ三分ノ二ト假定ス　$w = \frac{2}{3} \times 10.4 \times 1000 = 6930$ kg/m²

沈下停止中(水面以下土ヲ1900kg/m³トス)　$w' = \frac{1}{3} \times 10.4 \times 1900 = 6590$ 〃



$l = 2.90^m$, $h = 5.15^m$; $h^2 - l^2 = 18.12\ m^2$

$I_1 = \frac{1.0 \times 0.63^3}{12} = 0.0208\ m^4$　$k_1 = \frac{I_1}{h} = \frac{0.0208}{5.15} = 0.00404$

$I_2 = \frac{1.0 \times 0.45^3}{12} = 0.0076$　$k_2 = \frac{I_2}{l} = \frac{0.0076}{2.90} = 0.00262$

$I_3 = \frac{1.0 \times 0.30^3}{12} = 0.00225$　$k_3 = \frac{I_3}{h} = \frac{0.00225}{5.15} = 0.00044$

$3k_2 + k_3 = 0.00830$.

$k_1 + 2k_2 = 0.00928$

$k_2^2 = 0.000007$

$24E = 336(10)^8$

$2E = 28(10)^8$

$C_{AB} = C_{BA} = C_{BB} = \frac{wl^2}{12} = \frac{2.90^2}{12} w = 0.7008w$ kgm

$C_{AA'} = \frac{wh^2}{12} = \frac{5.15^2}{12} w = 2.210w$

撓角 $\theta_A = -\theta_A' = \frac{w(3k_2+k_3)(h^2-l^2)}{24E\{(k_1+2k_2)(3k_2+k_3)-k_2^2\}} = \frac{w \times 0.00830 \times 18.12}{336(10)^8(0.00928 \times 0.00830 - 0.000007)} = \frac{640w}{(10)^{10}}$

$\theta_B = -\theta_B' = -\frac{wk_2(h^2-l^2)}{24E\{(k_1+2k_2)(3k_2+k_3)-k_2^2\}} = -\frac{w \times 0.00262 \times 18.12}{336(10)^8(0.00928 \times 0.00830 - 0.000007)} = -\frac{202w}{(10)^{10}}$

$M_{AB} = 2Ek_2(2\theta_A + \theta_B) + C_{AB} = 28(10)^8 \times 0.00262 \times \frac{1078w}{(10)^{10}} + 0.7008w = 1.491w$

$M_{AA'} = 2Ek_1\theta_A - C_{AA'} = 28(10)^8 \times 0.00404 \times \frac{640w}{(10)^{10}} - 2.210w = -1.487w$

} 平均 1.489w トス

$M_{BA} = 2Ek_2(2\theta_B + \theta_A) - C_{BA} = 28(10)^8 \times 0.00262 \times \frac{236w}{(10)^{10}} - 0.7008w = -0.528w$

$M_{BB} = 2Ek_2\theta_B + C_{BB} = -28(10)^8 \times 0.00262 \times \frac{202w}{(10)^{10}} + 0.7008w = 0.553w$

$M_{BB'} = 2Ek_3\theta_B = -28(10)^8 \times 0.00044 \times \frac{202w}{(10)^{10}} = -0.025w$

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彎曲率. $w = 6930$ kg/m

$M_A = -1.489w = -10,300$ kgm
$M_{B2L} = -0.528w = -3,660$ "
$M_{B2R} = -0.553w = -3,830$ "
$M_{B3} = -0.025w = -170$ "

剪力.

$S_{A1} = 2.575w = 17820$ kg
$S_{A2} = -1.45w - \frac{1.489w - 0.528w}{2.90} = -1.782w = -12,330$ "
$S_{B2L} = 1.45w + \frac{0.528w - 1.489w}{2.90} = 1.118w = 7,760$ "
$S_{B2R} = -1.45w - 0 = -1.450w = -10,030$ "

軸力.

$N_1 = 1.782w = 12330$ kg
$N_2 = 2.575w = 17820$ "
$N_3 = 1.118w + 1.45w = 2.568w = 17,770$ "

最大正彎曲率.

部材 A-A', 中央

$\frac{wh^2}{8} = \frac{5.15^2}{8}w = 3.313w$
$M_A = -1.489w$
$M_1 = 1.824w = 12,630$ kgm

部材 A-B

剪力零ノ点.

$x = \frac{1.782w}{w} = 1.782$ m

$1.782w \times 1.782 = 3.078w$
$-\frac{1.782^2}{2}w = -1.539w$
$M_A = -1.489w$
$M_2 = 0.050w = 350$ kgm

部材 B-B, 中央

$\frac{wl^2}{8} = \frac{2.90^2}{8}w = 1.050w$
$M_{B2R} = -0.553w$
$M_3 = 0.497w = 3440$ kgm

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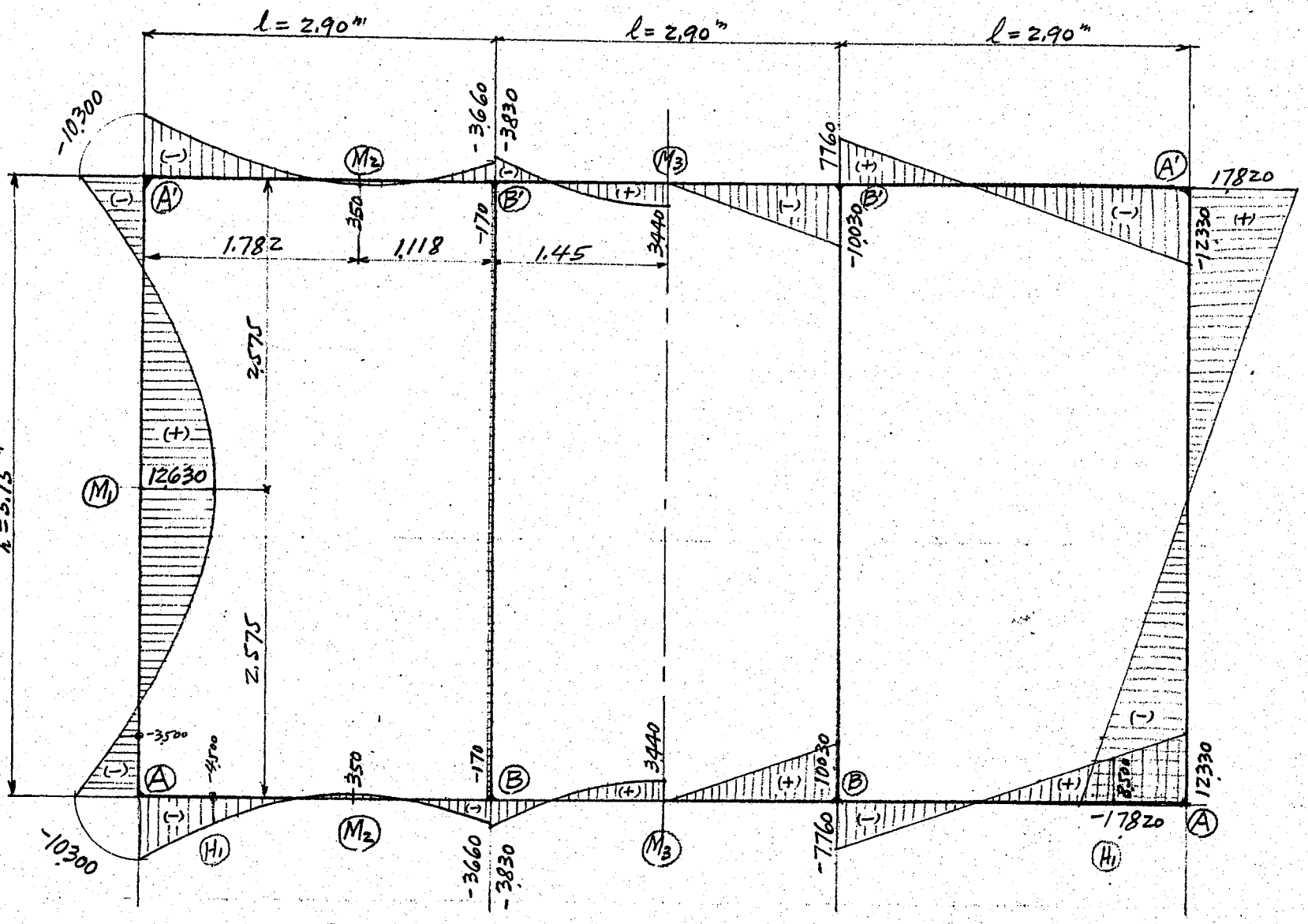
彎曲率及剪力圖 (底部斷面)



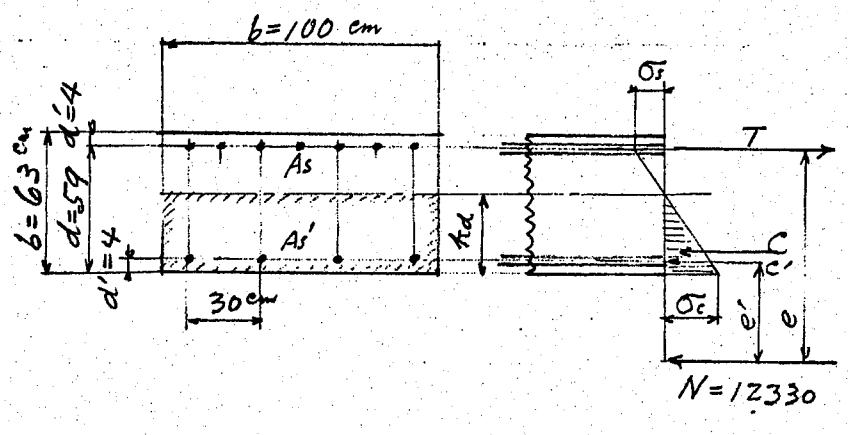
彎曲率圖　　剪力圖

縮尺 1:50

尺度 1cm = 10,000 kgm　　尺度 1cm = 10,000 kg

底部斷面應力.

(M1)　M1 = 12,630 kgm　N1 = 12,330 kg.c



柴田直光 著 1モグラムに依る鉄筋混凝土設計 46～49頁 解説及び C 才三圖參照.

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C列-風荷重=24

$A_s' = 3.33 - 16\phi = 6.70$ cm²

$p_0 = \frac{A_s}{bh} = \frac{13.41}{100\times63} = 0.00213$

$p_0' = \frac{A_s'}{bh} = \frac{6.70}{100\times63} = 0.00107$

$d/h = 59/63 = 0.937$

$d'/h = 4/63 = 0.063$

$u/h = 0.504$

$u = 31.7$ cm

$d-u = 27.3$ cm

$\frac{M}{N} = \frac{12630\times100}{12330} = 102.5$ cm

$d-u = 27.3$

$e = 129.8$ cm

$e' = e-55 = 74.8$ "

$e'/e = \frac{74.8}{129.8} = 0.576$

$\frac{Ne}{bd^2} = \frac{12330\times129.8}{100\times59^2} = 4.595$

$\frac{Ne}{bd^2\sigma_c} = 0.140$ $k = 0.280$

$$\sigma_c = \frac{\frac{Ne}{bd^2}}{\frac{Ne}{bd^2\sigma_c}} = \frac{4.595}{0.140} = 32.8 \text{ kg/cm}^2\ c$$

$$\sigma_s = n\sigma_c \frac{1-k}{k} = 15\times32.8\times\frac{1-0.28}{0.28} = 1265 \text{ kg/cm}^2\ T$$

$$\sigma_s' = \frac{n\sigma_c\left(k-\frac{d'}{d}\right)}{k} = \frac{15\times32.8(0.28-0.068)}{0.280} = 373 \text{ "}\ c$$

$b = 100$ cm, $h = 63$ cm
$d = 59$ ", $d' = 4$ "
$A_s = 6.67 - 16\phi = 13.41$ cm²
$p = \frac{A_s}{bd} = \frac{13.41}{100\times59} = 0.00227$
$p' = \frac{A_s'}{bd} = \frac{6.70}{100\times59} = 0.00114$
$d'/d = 4/59 = 0.068$

(M3) $M_3 = 3440$ kgm, $N = 17820$ kg. c,

$p_0 = \frac{7.54}{100\times45} = 0.00168$

$p_0' = \frac{3.77}{100\times45} = 0.00084$

$d/h = 41/45 = 0.911$

$d'/h = 4/45 = 0.089$

$u/h = 0.503$

$u = 22.6$ cm

$d-u = 18.4$

$\frac{M}{N} = \frac{3440\times100}{17820} = 19.3$

$d-u = 18.4$

$e = 37.7$ cm

$e' = e-37 = 0.7$ "

$e'/e = 0.7/37.7 = 0.019$

$\frac{Ne}{bd^2} = \frac{17820\cdot37.7}{100\times41^2} = 4.000$

$\frac{Ne}{bd^2\sigma_c} = 0.225$, $k = 0.520$

$\sigma_c = \frac{4.00}{0.225} = 17.8$ kg/cm²

$\sigma_s = 15\times17.8\times\frac{1-0.52}{0.52} = 247$ kg/cm²

$b = 100$, $h = 45$ cm
$d = 41$ cm, $d' = 4$ cm
$A_s = 6.67 - 12\phi = 7.54$ cm²
$A_s' = 3.33 - $ " $= 3.77$ "
$p = \frac{7.54}{100\times41} = 0.00184$
$p' = \frac{3.77}{100\times41} = 0.00092$
$d'/d = 4/41 = 0.098$

Hamach. (H1) $M = -4500$ kgm, $N = 17820$ kg. $S = -8500$ kg

$\frac{M}{N} = \frac{4500\times100}{17820} = 25.3$

$d-u = 18.4$

$e = 43.7$ cm

$e' = e-37 = 6.7$

$e'/e = 0.153$

$Ne/bd^2 = 17820\times43.7/100\times41^2 = 4.635$

$Ne/bd^2\sigma_c = 0.183$ $k = 0.400$

$\sigma_c = 4.635/0.183 = 25.3$ kg/cm²

$\sigma_s = 15\times25.3\times\frac{1-0.40}{0.40} = 570$ "

$\tau \fallingdotseq \frac{8500}{100\times7/8\times41} = 2.4$ kg/cm²

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設計 稲葉 日付 16-2-27 類別 応力
照査 日付 第 6 頁

節点 Ⓐ $M_A = -10,300$ kgm, $N = 17820$ kg, $S = 12330$ kg

$b = 100$ cm, $h = 45 + \frac{61.5}{3} = 65$ cm
$d = 61$ cm, $d' = 4$ cm.
$A_s = 6.67 - 16\phi = 13.41$ cm²
$A_s' = 3.37 - \,\,\,\, = 6.70$ "

$p_0 = \frac{13.41}{100\times65} = 0.00206$
$p_0' = \frac{6.70}{100\times65} = 0.00103$
$d/h = 61/65 = 0.94$
$d'/h = 4/65 = 0.062$
$u/h = 0.504$
$u = 32.8$
$d - u = 28.2$ cm

$\frac{M}{N} = \frac{10300\times100}{17820} = 57.8$
$d - u = 28.2$
$e = 86.0$ cm
$e' = e - 57 = 29.0$
$e'/e = 29.0/86.0 = 0.337$

$p = \frac{13.41}{100\times61} = 0.0022$
$p' = \frac{6.7}{100\times61} = 0.0011$
$d'/d = 4/61 = 0.066$

$\frac{Ne}{bd^2} = \frac{17820\times86.0}{100\times61^2} = 4.12$
$\frac{Ne}{bd^2\sigma_c} = 0.164$, $k = 0.340$
$\sigma_c = \frac{4.12}{0.164} = 25.1$ kg/cm²
$\sigma_s = 15\times25.1\cdot\frac{1-0.34}{0.34} = 731$ "
$\tau = \frac{12330}{100\times\frac{7}{8}\times61} = 2.3$ "

土深 5.0m ニ於ケル断面 $h = l = 2.90$ m

概算
土圧 $P_1 = \frac{2}{3}\times5.0\times1,000 = 3330$ kg/m²
$M_A = \frac{1}{12}\times3330\times2.90^2 = 2,330$ kgm
$M_1 = M_2 = M_3 = 2,330$ kgm ニ採ル
所要厚 $d = \sqrt{\frac{2330\times100}{7.6\times100}} = 17.5$ cm　$d = 36$ cm 被覆 4 cm 計 $h = 40$ cm トス
所要鉄筋量 $A_s = \frac{2330\times100}{1500\times\frac{7}{8}\times36} = 4.92$ cm²
12φ − 20 cm c to c = 5.66 cm².

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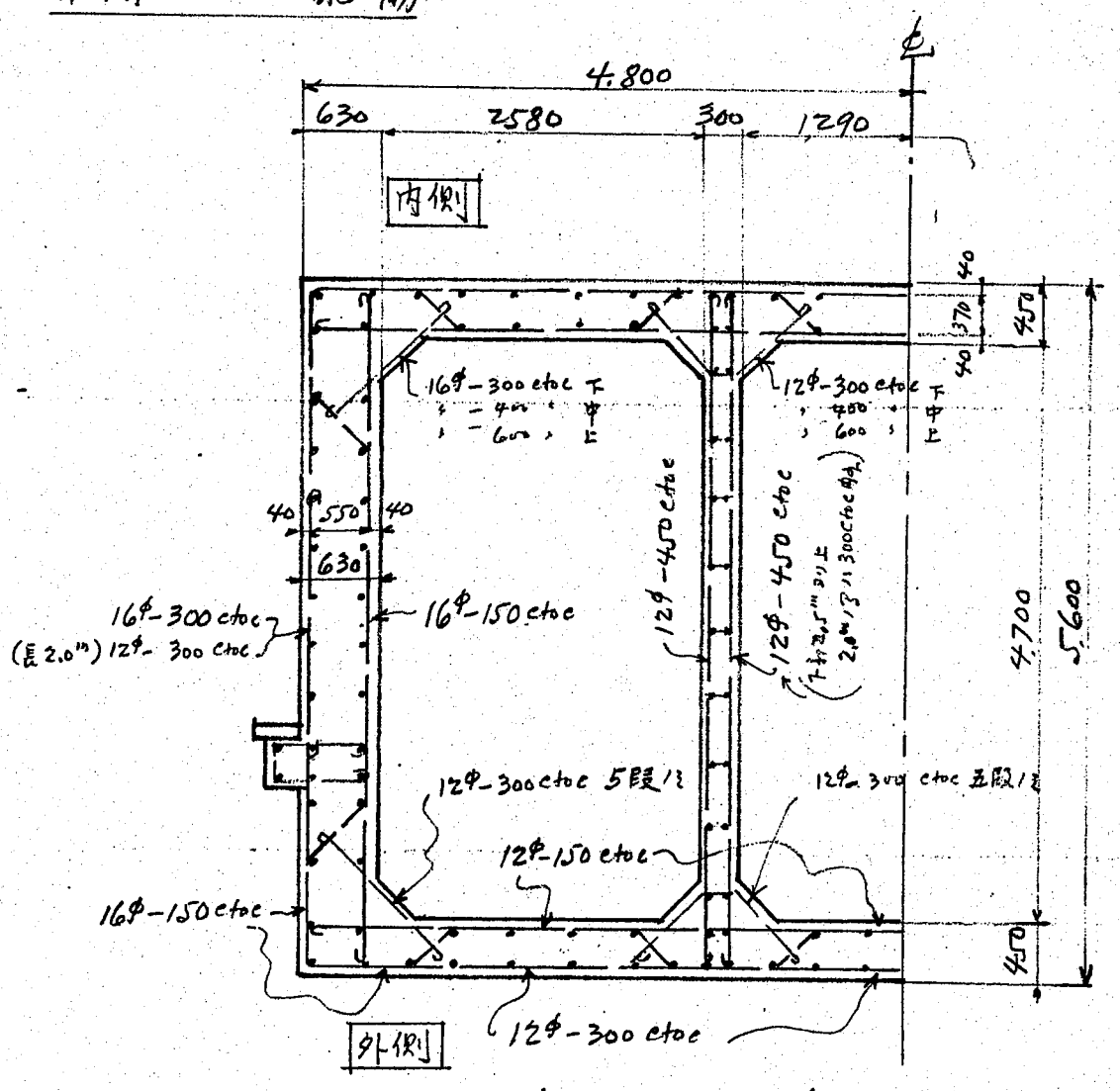
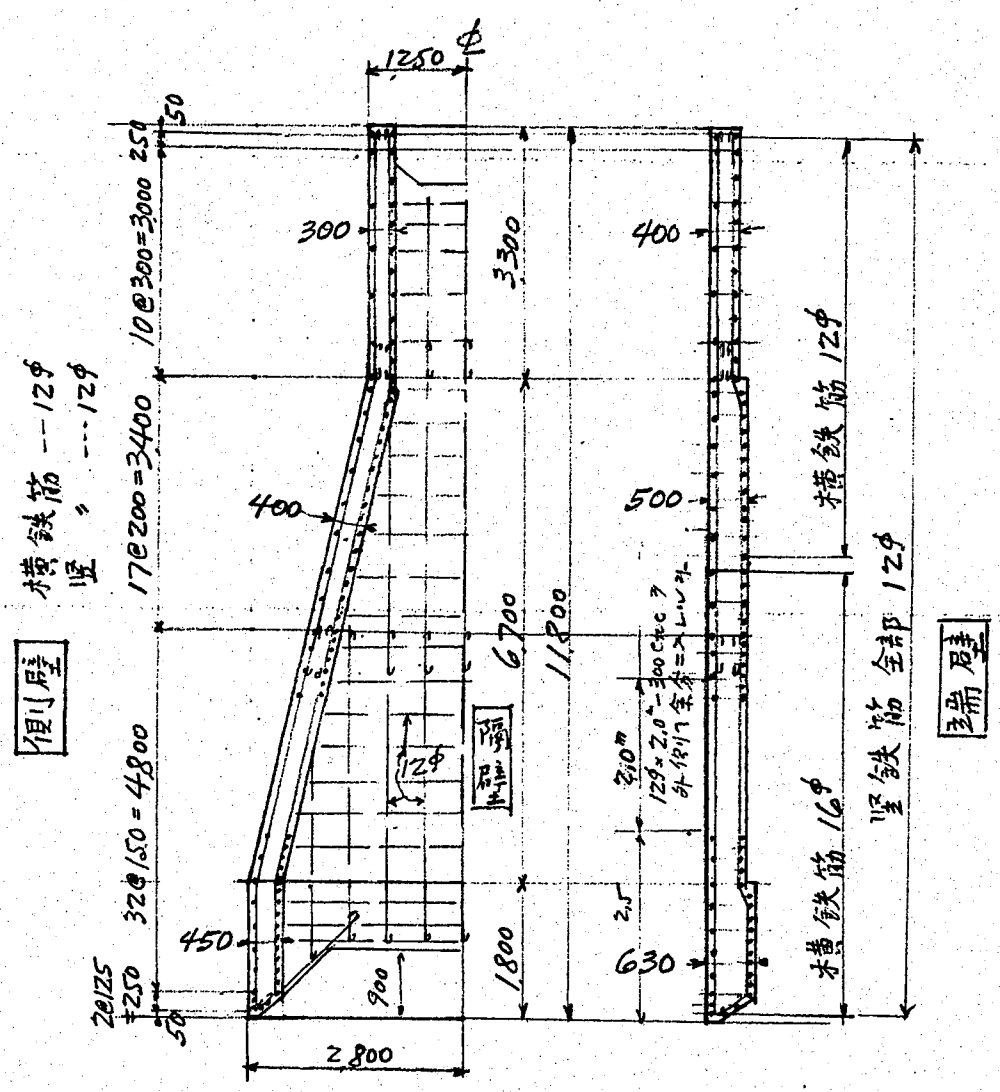
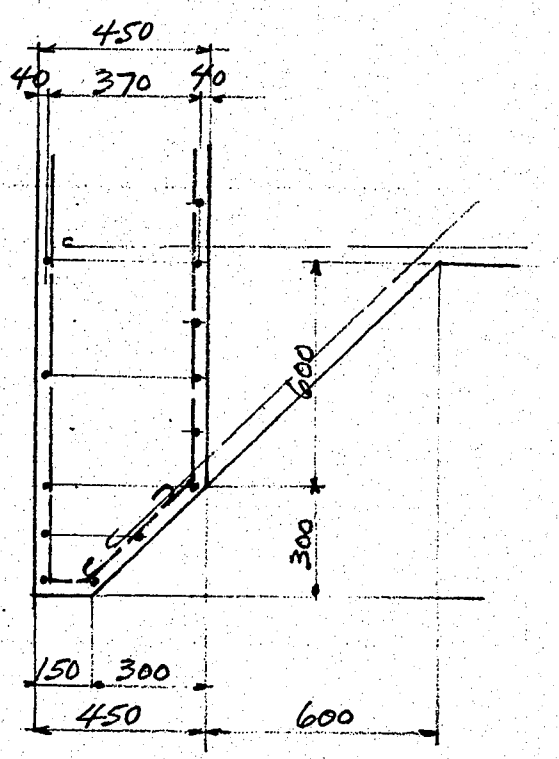
室蘭第一船渠

井筒W1ノ配筋



竪鉄筋ハ全部12φ.





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室蘭第一船渠

井筒ノ安定度

壁体ノ最モ危険ナル狀態ハ井筒内部ヲ填充シ終後ヶ渠内ノ土砂ヲ掘鑿シ終ル場合ニテ他ノ場合ハ何レモ之レヨリ安全ナリ.

井筒重量.

側壁	9.60 × 0.30 × 3.30 × 2	=	19.00	立米
〃	9.60 × 0.40 × 6.70 × 2	=	51.50	
〃	9.60 × 0.45 × 1.80 × 2	=	15.55	
端壁	1.90 × 0.40 × 3.30 × 2	=	5.05	
〃	3.30 × 0.50 × 6.70 × 2	=	22.10	
〃	4.70 × 0.63 × 1.80 × 2	=	10.65	
隔壁	1.90 × 0.30 × 1.80 × 2	=	2.05	
〃	3.30 × 0.30 × 6.70 × 2	=	13.25	
〃	4.70 × 0.30 × 0.90 × 2	=	2.55	
持送り	0.30 × 0.30 × 11.50 × 6	=	6.20	
			147.90 m³ @ 2400 = 355,000 kg	
上詰	1.90 × 8.20 × 1.50	=	23.35	
底詰	4.70 × 7.74 × 2.50	=	90.80	
持送控除	− 0.30 × 0.30 × 3.70 × 6	=	− 2.00	
隔壁	4.70 × 0.30 × 0.90 × 2	=	2.55	
			114.70 m³ @ 2200 = 252,000 kg	
中詰	3.15 × 7.74 × 6.00	=	146.00	
持送控除	− 0.30 × 0.30 × 6.00 × 6	= −	3.20	
			142.80 m³ @ 2000 = 286,000 kg	
		計	893,000 kg	

渠壁延長1米當重量 $W = \frac{893000}{9.60} = 93{,}000$ kg

土圧. $h = 11.4$ m

$E = \frac{1}{6} \times 1{,}900 \times 11.40^2 = 41{,}200$ kg 働点ノ高サ $\frac{h}{3} = 3.80$ m

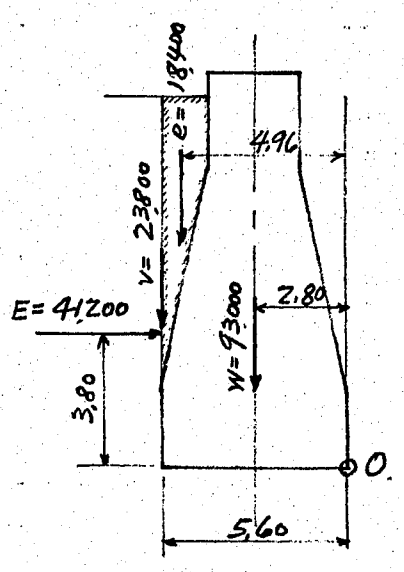
背土重量

	1.55 × 2.90	= 4.5
	0.78 × 6.70	= 5.2
e =	9.70 @ 1900 =	18,400 kg

背面摩擦力 $V = E \tan 30° = 41200 \times 0.577 = 23{,}800$ kg

O点ニ關スル能率

W	93,000 × 2.80	=	260,000
e	18,400 × 4.96	=	91,200
v	23,800 × 5.60	=	133,100
E	41200 × (−3.80)	=	−156,500
	ΣH = 41,200 kg ΣV = 135200 kg	2.425 m	327,800



変位 $e = 2.80 - 2.425 = 0.375$ m $< \frac{5.6}{6}$

底面最大圧力 $P = \frac{135200}{1.0 \times 5.60}\left(1 \pm \frac{6 \times 0.375}{5.60}\right) =$ 33,800 kg/m² 圧力
〃 14,400 〃 〃

滑動率 $= \frac{41200}{135200} = 0.305$

何レモ安全ナリ.

井筒 W2 及 W3 ハ夫々 W1 ニ準ズ

(1)

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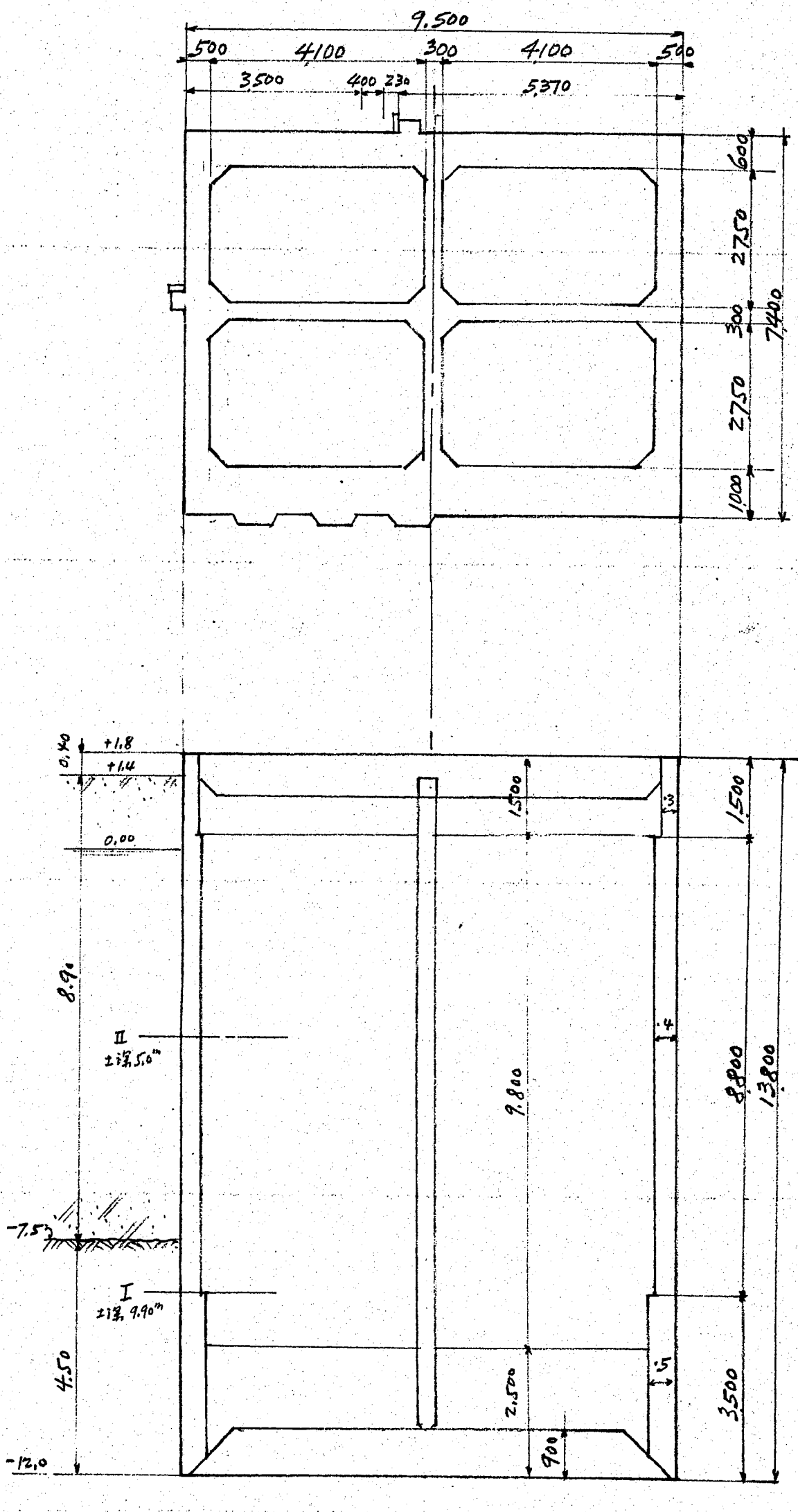
室蘭第一船渠

渠口用井筒 W4



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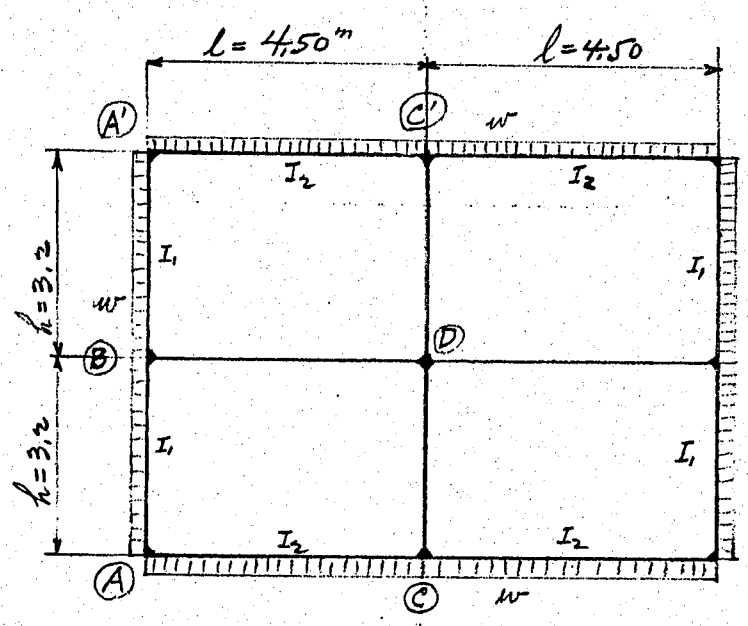
室蘭第一船渠

底部断面

土深 12.4米

土圧. 沈下中ハ水圧ノ三分ノ二ト假定ス $w = \frac{2}{3} \times 12.4 \times 1000 = 8270$ kg/m²

沈下停止中(水面以下ノ土重 1900kg/m³ト) $w' = \frac{1}{3} \times 12.4 \times 1900 = 7850$ 〃



$l = 4.50^m$, $h = 3.20^m$

$I_1 = \frac{1.0 \times 0.50^3}{12} = 0.01042^{m^4}$, $K_1 = \frac{0.01042}{3.2} = 0.003255$

$I_2 = \frac{1.0 \times 0.60^3}{12} = 0.01800^{m^4}$, $K_2 = \frac{0.01800}{4.50} = 0.00400$

$\theta_B = \theta_C = \theta_D = 0$

$C_{AC} = C_{CA} = \frac{w \times 4.5^2}{12} = 1.6875w$

$C_{AB} = C_{BA} = \frac{w \times 3.2^2}{12} = 0.8533w$

撓角

$\theta_A = \frac{C_{AB} - C_{AC}}{4E(K_1 + K_2)} = -\frac{0.8342w}{56(10)^8 \times 0.007255} = -\frac{2.0543}{(10)^8}w$

$M_{AC} = 4EK_2\theta_A + C_{AC} = -56(10)^8 \times 0.0040 \times \frac{2.0543}{(10)^8}w + 1.6875w = 1.2274w$

$M_{AB} = 4EK_1\theta_A - C_{AB} = -56(10)^8 \times 0.003255 \times \frac{2.0543}{(10)^8}w - 0.8533w = -1.2277w$

} 平均 $1.2276w$ トス

$M_{BA} = 2EK_1\theta_A + C_{BA} = -28(10)^8 \times 0.003255 \times \frac{2.0543}{(10)^8}w + 0.8533w = 0.6661w$

$M_{CA} = 2EK_2\theta_A - C_{CA} = -28(10)^8 \times 0.00400 \times \frac{2.0543}{(10)^8}w - 1.6875w = -1.9176w$

$M_{BD} = M_{DB} = M_{CD} = M_{DC} = 0$

彎曲率 $w = 8270$ kg/m

$M_A = -1.2276w = -1.2276 \times 8270 = -10,150$ kgm

$M_B = -0.6661w = -0.6661 \times$ 〃 $= -5,510$ 〃

$M_C = -1.9176w = -1.9176 \times$ 〃 $= -15,850$ 〃

剪力.

$S_{B1} = -1.60w + \frac{1.2276 - 0.6661}{3.2}w = -1.4245w = -11,770$ kg

$S_{A1} = 1.60w + \frac{1.2276 - 0.6661}{3.2}w = 1.7755w = 14680$ 〃

$S_{A2} = -2.25w + \frac{-1.2276 + 1.9176}{4.5}w = -2.0967w = -17,330$ 〃

$S_{C2} = 2.25w + \frac{1.9176 - 1.2276}{4.5}w = 2.4033w = 19,850$ 〃

軸力.

$N_1 = 17,330$ kg. C

$N_2 = 14,680$ 〃

$N_{BD} = 23,540$ 〃

$N_{CD} = 39,700$ 〃

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室蘭第一船渠

最大正彎曲率

部材 A-B

剪力零ノ点

$$x = \frac{1.7755w}{w} = 1.7755^m$$

$1.7755w \times 1.7755$	=	$3.1550w$
$-\frac{1.7755^2}{2}w$	=	$-1.5775w$
M_A	=	$-1.2276w$

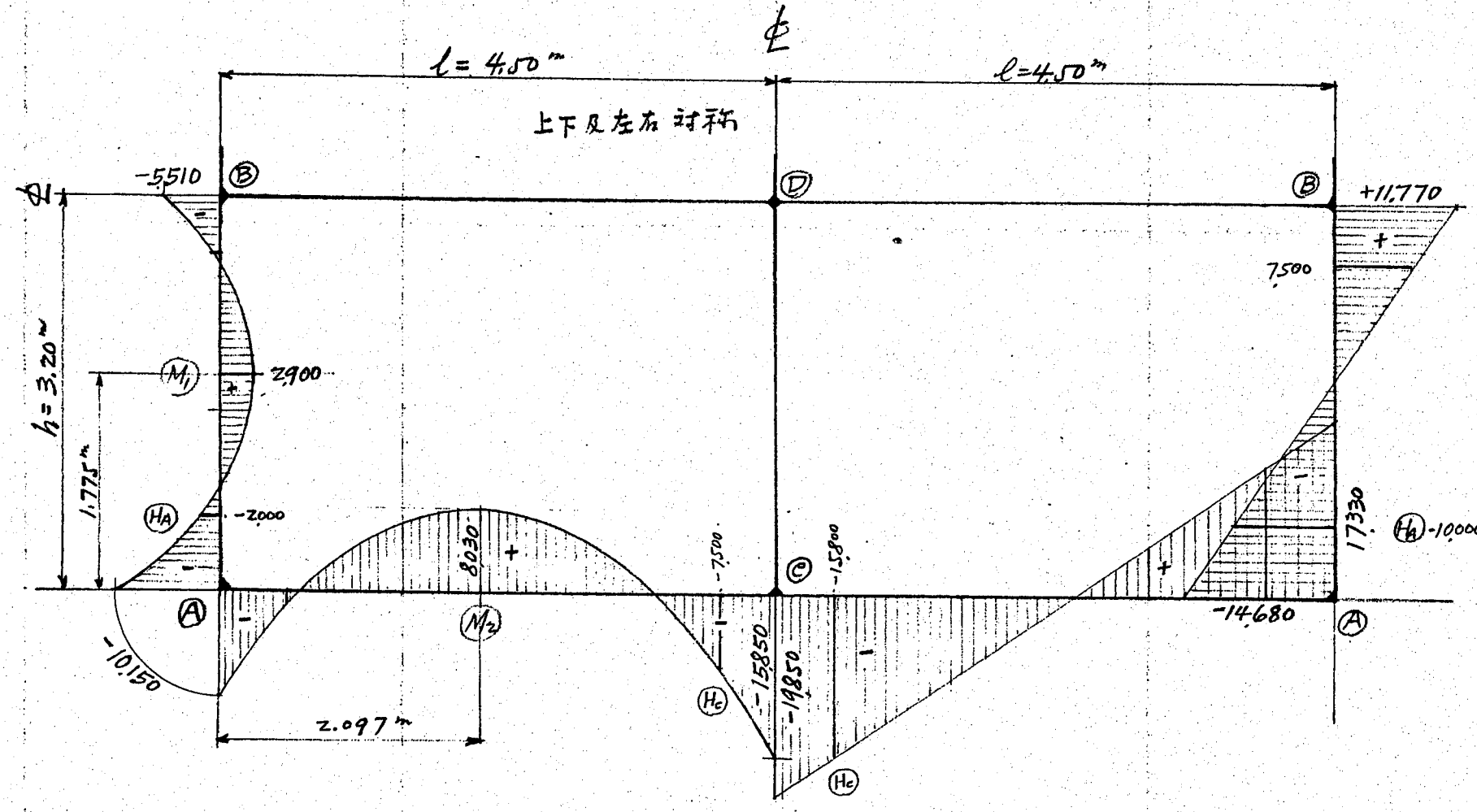
$$M_1 = 0.3499w = 2,900\ kgm$$

部材 A-C

$$x = 2.0967^m$$

$2.0967w \times 2.0967$	=	4.3970
$-\frac{2.0967^2}{2}w$	=	-2.1985
M_A	=	-1.2276

$$M_2 = 0.9709w = 8,030\ kgm$$



彎曲率圖

尺度 $\frac{1}{60}^m = 10,000\ kgm$

剪力圖

尺度 $\frac{1}{60}^m = 10,000\ kg$

縮尺 1:50

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室蘭第一船渠
底部断面應力

(M2) $M_2 = 8030$ kgm , $N_2 = 14680$ kg. c

$p_0 = \frac{10.06}{100\times60} = 0.00168$

$p_0' = 0.00084$

$d/h = 56/60 = 0.93$

$d'/h = 4/60 = 0.067$

$u/h = 0.503$

$u = 30.2$

$d-u = 25.8$ cm

$\frac{M}{N} = \frac{8030\times100}{14680} = 54.7$

$d-u = 25.8$

$e = 80.5$ cm

$e' = e-52 = 28.5$ "

$e'/e = 28.5/80.5 = 0.354$

$\frac{Ne}{bd^2} = \frac{14680\times80.5}{100\times56^2} = 3.765$

$\frac{Ne}{bd^2\sigma_c} = 0.151$, $k = 0.310$

$\sigma_c = \frac{3.765}{0.151} = 24.9$ kg/cm²

$\sigma_s = 15\times24.9\times\frac{1-0.310}{0.310} = 834$ "

$b=100$ cm, $h=60$ cm
$d=56$ cm, $d'=4$ cm
$A_s = 5-16\phi = 10.06$ cm²
$A_s' = 2.5-$ " $= 5.03$ "
$p = \frac{10.06}{100\times56} = 0.0018$
$p' = 0.0009$
$d'/d = 4/56 = 0.071$

(M1) $M_1 = 2900$ kgm , $N_1 = 17330$ kg. c

$p_0 = \frac{5.66}{100\times50} = 0.00113$

$p_0' = 0.00057$

$d/h = 46/50 = 0.920$

$d'/h = 4/50 = 0.080$

$u/h = 0.502$

$u = 25.1$

$d-u = 20.9$

$\frac{M}{N} = \frac{2900\times100}{17330} = 16.8$

$d-u = 20.9$

$e = 37.7$ cm

$e' = -4.3$ "

$e'/e = -0.114$

$\frac{Ne}{bd^2} = \frac{17330\times37.7}{100\times46^2} = 3.09$

$\frac{Ne}{bd^2\sigma_c} = 0.253$, $k = 0.60$

$\sigma_c = \frac{3.09}{0.253} = 12.2$ kg/cm²

$\sigma_s = 15\times12.2\times\frac{1-0.60}{0.60} = 122$ kg/cm².

$b=100$ cm, $h=50$ cm
$d=46$ ", $d'=4$ "
$A_s = 5-12\phi = 5.66$ cm²
$A_s' = 2.5-$ " $= 2.83$ "
$p = \frac{5.66}{100\times46} = 0.00123$
$p' = 0.00062$
$d'/d = 4/46 = 0.087$

(A) $M_A = -10150$ kgm , $N_2 = 14680$ kg. c , $S_{A2} = -17330$ kg

$p_0 = \frac{10.06}{100\times78} = 0.00129$

$p_0' = 0.00065$

$d/h = 74/78 = 0.950$

$d'/h = 4/78 = 0.051$

$u/h = 0.502$

$u = 39.2$

$d-u = 34.8$

$\frac{M}{N} = \frac{10150\times100}{14680} = 69.2$

$d-u = 34.8$

$e = 104.0$ cm

$e' = e-70. = 34.0$ "

$e'/e = 34.0/104.0 = 0.327$

$\frac{Ne}{bd^2} = \frac{14680\times104.0}{100\times74^2} = 2.79$

$\frac{Ne}{bd^2\sigma_c} = 0.140$ $k = 0.290$

$\sigma_c = \frac{2.79}{0.140} = 19.9$ kg/cm²

$\sigma_s = 15\times19.9\times\frac{1-0.290}{0.290} = 734$ "

$\tau = \frac{17330}{100\times7/8\times74} = 2.7$ "

$b=100$ cm, $h=60+\frac{55}{3}=78$ cm
$d=74$ cm, $d'=4$ cm
$A_s = 5-16\phi = 10.06$ cm²
$A_s' = 2.5-$ " $= 5.03$ "
$p = \frac{10.06}{100\times74} = 0.00136$
$p' = 0.00068$
$d'/d = 4/74 = 0.054$

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Ⓒ $M_C = -15{,}850$ kgm, $N_2 = 14{,}680$ kg c, $S = 19{,}850$ kg

$p_0 = \frac{15.08}{100\times75} = 0.00201$
$p_0' = \frac{5.03}{100\times75} = 0.00067$
$d/h = 71/75 = 0.95$
$d'/h = 4/75 = 0.053$
$u/h = 0.508$
$u = 38.1$
$d-u =$

$\frac{M}{N} = \frac{15850\times100}{14680} = 108.0$ cm
$d-u = 32.9$
$e = 140.9$ cm
$e' = e-67 = 73.9$ "
$e'/e = 0.525$

$\frac{Ne}{bd^2} = \frac{14680\times140.9}{100\times71^2} = 4.100$

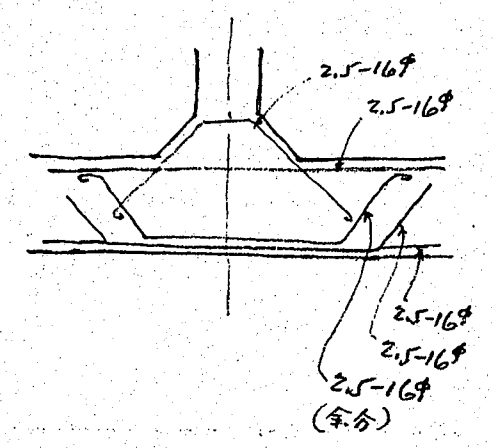
$\frac{Ne}{bd^2\sigma_c} = 0.134$, $k = 0.282$

$\sigma_c = \frac{4.100}{0.134} = 30.6$ kg/cm²

$\sigma_s = 15\times30.6\times\frac{1-0.282}{0.282} = 1168$ "

$\tau = \frac{19850}{100\times\frac{7}{8}\times71} = 3.2$ "

$b=100$ cm, $h = 60+\frac{45}{3} = 75$ cm
$d = 71$ cm, $d' = 4$ cm
$A_s = 7.5-16\phi = 15.08$ cm²
$A_s' = 2.5-\ \ = 5.03$ "
$p = \frac{15.08}{100\times71} = 0.00212$
$p' = \frac{5.03}{100\times71} = 0.00071$
$d'/d = 4/71 = 0.056$



Ⓑ $M_B = -5510$ kgm, $N_1 = 17{,}330$ kg c $S_{B1} = -11{,}770$ kg

$p_0 = \frac{5.66}{100\times65} = 0.00087$
$p_0' = 0.00044$
$d/h = 61/65 = 0.94$
$d'/h = 4/65 = 0.062$
$u/h = 0.503$
$u = 32.7$
$d-u = 28.3$

$\frac{M}{N} = \frac{5510\times100}{17330} = 31.8$
$d-u = 28.3$
$e = 60.1$ cm
$e' = e-5.7 = 3.1$ "
$e'/e = 0.052$

$\frac{Ne}{bd^2} = \frac{17330\times60.1}{100\times61^2} = 2.800$

$\frac{Ne}{bd^2\sigma_c} = 0.175$, $k = 0.390$

$\sigma_c = \frac{2.80}{0.175} = 16.0$ kg/cm²
$\sigma_s = 15\times16.0\times\frac{1-0.39}{0.39} = 376$ "
$\tau = \frac{11770}{100\times\frac{7}{8}\times61} = 2.2$ "

$b=100$ cm, $h = 50+\frac{45}{3} = 65$ cm
$d = 61$ cm, $d' = 4$ cm
$A_s = 5-12\phi = 5.66$ cm²
$A_s' = 2.5-\ \ = 2.83$ "
$p = \frac{5.66}{100\times61} = 0.00093$
$p' = 0.00047$
$d'/d = 4/61 = 0.066$

Ⓗc $M = -7500$ kgm, $N_2 = 14680$ kg c, $S = 15800$

$\tau = \frac{15800}{100\times\frac{7}{8}\times56} = 3.2$ kg/cm²

Ⓗa $M = 2000$ kgm, $N_1 = 17330$ kg c, $S = 10{,}000$ kg

$\tau = \frac{10000}{100\times\frac{7}{8}\times46} = 2.5$ kg/cm²

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室蘭第一船渠

断面 I-I 土深 9.90m

土圧 (沈下中) $w = \frac{2}{3} \times 9.90 \times 1000 = 6,600$ kg/m²

周壁ハ大体同一比率ノ厚テ底サヲ減ズルヲ以テ各点カハ土圧 w ニ正比例スルモノト看做ス

彎曲率 (10頁参照).

$M_A = -1.2276\,w = -1.2276 \times 6600 = -8,100$ kgm
$M_B = -0.6661\,w = -0.6661 \times \,\, = -4400$
$M_C = -1.9176\,w = -1.9176 \times \,\, = -12,650$

$M_1 = 0.3499\,w = 0.3499 \times 6600 = 2,310$
$M_2 = 0.9709\,w = 0.9709 \times \,\, = 6,410$

剪力

$S_{B1} = -1.4245\,w = -1.4245 \times 6,600 = -9,400$ kg
$S_{A1} = 1.7755\,w = 1.7755 \times \,\, = 11,700$
$S_{A2} = -2.0967\,w = -2.0967 \times \,\, = -13,820$
$S_{C2} = 2.4033\,w = 2.4033 \times \,\, = 15,850$

垂曲力

$N_1 = 13,820$ kg. C
$N_2 = 11,700$ " "
$N_{BD} = 18,800$ " "
$N_{CD} = 31,700$ " "

弯力.

(M₂) $M_2 = 6,410$ kgm, $N_2 = 11,700$ kg c

$\frac{M}{N} = \frac{6410 \times 100}{11700} = 54.8$

$u = 0.503 \times 50 = 25.1$
$d - u = 20.9$

$d - u = \frac{20.9}{75.7}$ cm
$e =$
$e' = 33.7$
$e/e = 0.445$

$\frac{Ne}{bd^2} = \frac{11700 \times 75.7}{100 \times 46^2} = 4,185$

$\frac{Ne}{bd^2\sigma_c} = 0.148$ $k = 0.305$

$\sigma_c = \frac{4.185}{0.148} = 28.3$ kg/cm²

$\sigma_s = 15 \times 28.3 \times \frac{1-0.305}{0.305} = 966$ "

$b = 100$ cm, $h = 50$ cm
$d = 46$ cm, $d' = 4$ cm
$A_s = 5-16^{\phi} = 10.06$ cm²
$A_s' = 2.5-$ " $= 5.03$
$p = \frac{10.06}{100 \times 46} = 0.00219$
$p' = 0.00110$
$d'/d = 4/46 = 0.087$

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室蘭第一船渠

設計 稲葉 日付 16-3-1 類別 応力
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(M1) $M_1 = 2310$ kgm, $N_1 = 13820$ kg.c

$p_0 = \frac{5.66}{100\times40} = 0.00141$
$p_0' = 0.00071$
$d/h = 36/40 = 0.900$
$d'/h = 4/40 = 0.100$
$u/h = 0.502$
$u = 20.1$
$d-u = 15.9$

$\frac{M}{N} = \frac{2310\times100}{13820} = 16.7$
$d-u = \frac{15.9}{32.6}$ cm
$e' = e-32 = 0.6$ "
$e'/e = 0.018$

$\frac{Ne}{bd^2} = \frac{13820\times32.6}{100\times36^2} = 3.475$
$\frac{Ne}{bd^2\sigma_c} = 0.221$, $k = 0.510$
$\sigma_c = \frac{3.475}{0.221} = 15.7$ kg/cm²
$\sigma_s = 15\times15.7\times\frac{1-0.51}{0.51} = 227$ "

$b=100$ cm, $h=40$ cm
$d=36$ cm, $d'=4$ cm
$A_s = 5-12\phi = 5.66$ cm²
$A_s' = 2.5-$ " $= 2.83$ "
$p = \frac{5.66}{100\times36} = 0.00157$
$p' = 0.00079$
$d'/d = 4/36 = 0.111$

Ⓐ $M_A = -8100$ kgm, $N_2 = 11700$ kg, $S_{A2} = -13820$ kg

$u/h = 0.502$
$u = 33.6$
$d-u = 29.4$ cm

$\frac{M}{N} = \frac{8100\times100}{11700} = 69.2$
$d-u = \frac{29.4}{98.6}$ cm
$e' = e-59 = 39.6$ "
$e'/e = 0.402$

$\frac{Ne}{bd^2} = \frac{11700\times98.6}{100\times63^2} = 2.935$
$\frac{Ne}{bd^2\sigma_c} = 0.134$, $k = 0.282$
$\sigma_c = \frac{2.935}{0.134} = 21.8$ kg/cm²
$\sigma_s = 15\times21.8\times\frac{1-0.282}{0.282} = 833$ "
$\tau = \frac{13820}{100\times\frac{7}{8}\times63} = 2.5$ "

$b=100$ cm, $h = 50+\frac{50}{3} = 67$ cm
$d=63$ cm, $d'=4$ cm
$A_s = 5-16\phi = 10.06$ cm²
$A_s' = 2.5-$ " $= 5.03$ "
$p = \frac{10.06}{100\times63} = 0.00160$
$p' = 0.00080$
$d'/d = 4/63 = 0.064$

Ⓒ $M_C = -12650$ kgm, $N_2 = 11700$ kg, $S_{C2} = 15850$ kg

$u/h = 0.508$
$u = 33.0$
$d-u = 28$ cm

$\frac{M}{N} = \frac{12650\times100}{11700} = 108.0$
28.0
$e = 136.0$ cm
$e' = e-57 = 79.0$ "
$e'/e = 0.581$

$\frac{Ne}{bd^2} = \frac{11700\times136.0}{100\times61^2} = 4.280$
$\frac{Ne}{bd^2\sigma_c} = 0.142$, $k = 0.290$
$\sigma_c = \frac{4.280}{0.142} = 30.1$ kg/cm²
$\sigma_s = 15\times30.1\times\frac{1-0.290}{0.290} = 1107$ kg/cm²
$\tau = \frac{15850}{100\times\frac{7}{8}\times61} = 3.0$ "

$b=100$, $h = 50+\frac{45}{3} = 65$ cm
$d=61$ cm $d'=4$ cm
$A_s = 7.5-16\phi = 15.08$
$A_s' = 2.5-$ " $= 5.03$
$p = \frac{15.08}{100\times61} = 0.00247$
$p' = \frac{5.03}{100\times61} = 0.00083$
$d'/d = 4/61 = 0.066$

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Ⓑ $M_B = -4{,}400$ kgm, $N_1 = 13820$ kg, c, $S_{B1} = -9{,}400$ kg

$A_s = 5-12\phi$
$A_s' = 2.5-12\phi$

断面 II-II　　土深 5.0m

土圧 (沈下中)　$w = \frac{2}{3} \times 1000 \times 5.0 = 3{,}330$ kg/m²

弯曲率 (近似値)

$M_A = -1.2276 \times 3330 = -4{,}090$ kgm
$M_B = -0.6661 \times \quad = -2{,}220$
$M_C = -1.9176 \times \quad = -6{,}390$

$M_1 = 0.3499 \times \quad = 1{,}170$
$M_2 = 0.9709 \times \quad = 3{,}240$

剪力

$S_{B1} = -1.4245 \times 3330 = -4{,}750$ kg
$S_{A1} = 1.7755 \times \quad = 5{,}920$
$S_{A2} = -2.0967 \times \quad = -6{,}980$
$S_{C2} = 2.4033 \times \quad = 8{,}010$

軸力

$N_1 = 6980$ kg, c
$N_2 = 5920$ "
$N_{BD} = 9{,}500$ "
$N_{CD} = 16{,}020$ "

応力.

Ⓜ₂　$M_2 = 3240$ kgm, $N_2 = 5920$ kg, c

$\frac{M}{N} = \frac{3240 \times 100}{5920} = 54.8$
$d-u = \frac{20.9}{75.7}$ cm
$e = \quad$
$e' = e-4/2 = 33.7$ "
$e'/e = 0.445$
$\frac{Ne}{bd^2} = \frac{5920 \times 75.7}{100 \times 46^2} = 2.115$
$\frac{Ne}{bd^2\sigma_c} = 0.1295 \qquad k = 0.265$
$\sigma_c = \frac{2.115}{0.1295} = 16.3$ kg/cm²
$\sigma_s = 15 \times 16.3 \times \frac{1-.265}{.265} = 679$ "

$b=100$ cm　$h=50$ cm
$d=46$ cm　$d'=4$ cm
$A_s = 3.33-16\phi = 6.70$ cm²
$A_s' = 1.67-\ " = 3.35$
$p = \frac{6.70}{100 \times 46} = 0.00146$
$p' = 0.00073$
$d'/d = 4/46 = 0.087$

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Ⓐ $M_A = -4090$ kgm, $N_2 = 5920$ kg.c $S_{A2} = 6980$ kg

$\frac{M}{N} = \frac{4090\times100}{5,920} = 69.2$

$d-u = 29.4$

$e = 98.6$ cm

$e' = 39.6$

$e'/e = 0.402$

$\frac{Ne}{bd^2} = \frac{5920\times98.6}{100\times63^2} = 1.484$

$\frac{Ne}{bd^2\sigma_c} = 0.114$ $k = 0.235$

$\sigma_c = \frac{1.484}{0.114} = 13.0$ kg/cm²

$\sigma_s = 15\times13.0\cdot\frac{0.765}{0.235} = 635$ "

$\tau = \frac{6980}{100\times\frac{7}{8}\times63} = 1.3$ "

$b=100$ cm, $h=50+\frac{50}{3}=67$ cm
$d=63$ cm, $d'=4$ cm
$A_s = 3.33-16\phi = 6.70$ cm²
$A_s' = 1.67-$ " $= 3.35$ "
$p = \frac{6.70}{100\times63} = 0.00106$
$p' = 0.00053$
$d'/d = 4/63 = 0.064$

Ⓒ $M_C = -6390$ kgm, $N_2 = 5920$ kg.c, $S_{C2} = 8010$ kg

$\frac{M}{N} = \frac{6390\times100}{5920} = 108.0$

$d-u = 28.0$

$e = 136.0$ cm

$e' = 79.0$

$e'/e = 0.581$

$\frac{Ne}{bd^2} = \frac{5920\times136.0}{100\times61^2} = 2.163$

$\frac{Ne}{bd^2\sigma_c} = 0.103$, $k = 0.205$

$\sigma_c = \frac{2.163}{0.103} = 21.0$ kg/cm²

$\sigma_s = 15\times21.0\times\frac{0.795}{0.205} = 1220$ "

$\tau = \frac{8010}{100\times\frac{7}{8}\times61} = 1.5$ "

$b=100$ cm, $h=50+\frac{45}{3}=65$ cm
$d=61$ cm, $d'=4$ cm
$A_s = 3.33-16\phi = 6.70$ cm²
$A_s' = 1.67-16\phi = 3.35$ "
$p = \frac{6.70}{100\times61} = 0.00110$
$p' = \frac{3.35}{100\times61} = 0.00055$
$d'/d = 4/61 = 0.066$

(extia bent bar 第三層)

Ⓑ $M_B = -2220$ kgm $N_1 = 6980$ kg $S_{B1} = -4750$ kg.

$A_s = 3.33-12\phi$
$A_s' = 1.67-12\phi$.

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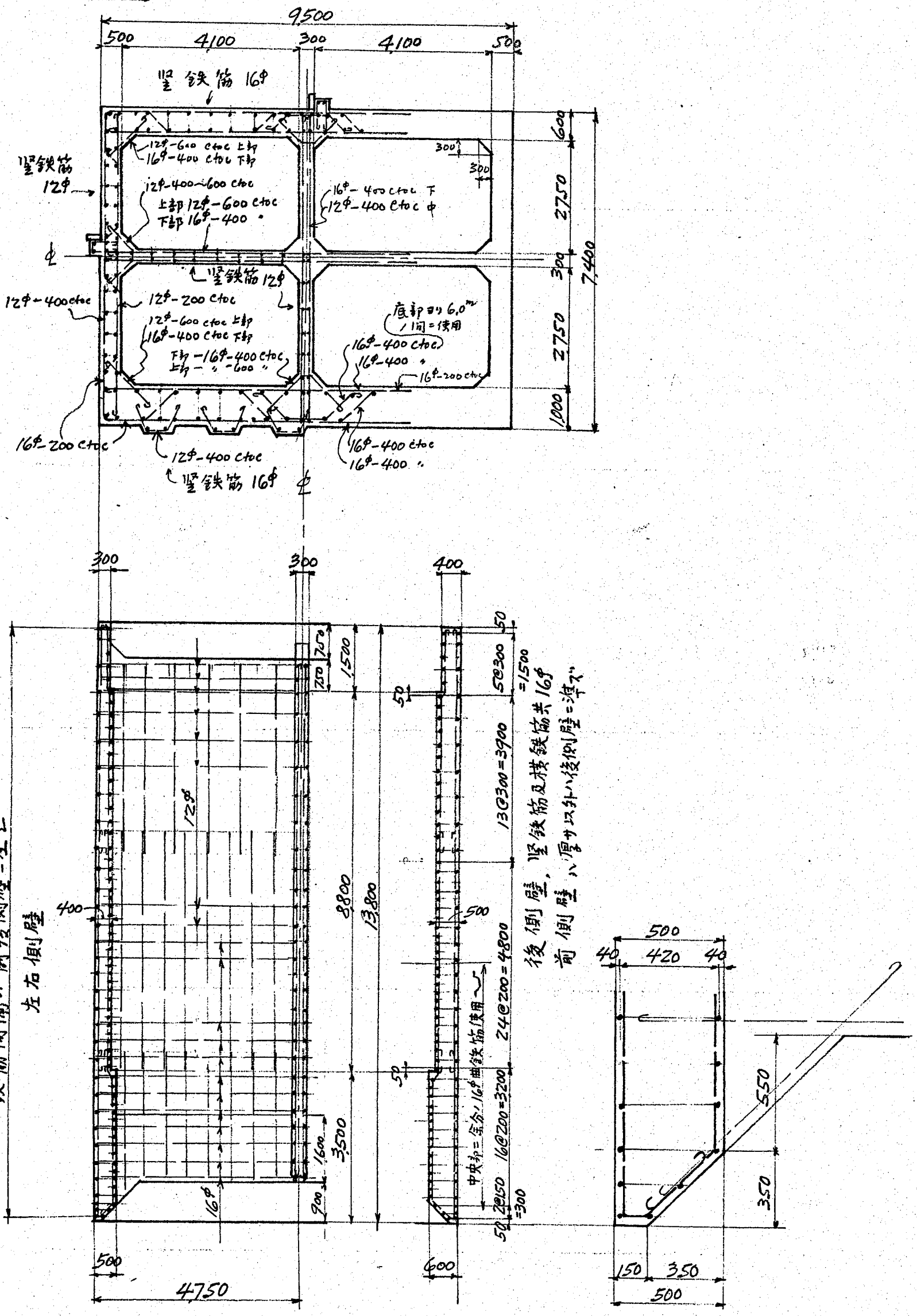
井筒 W4，配筋



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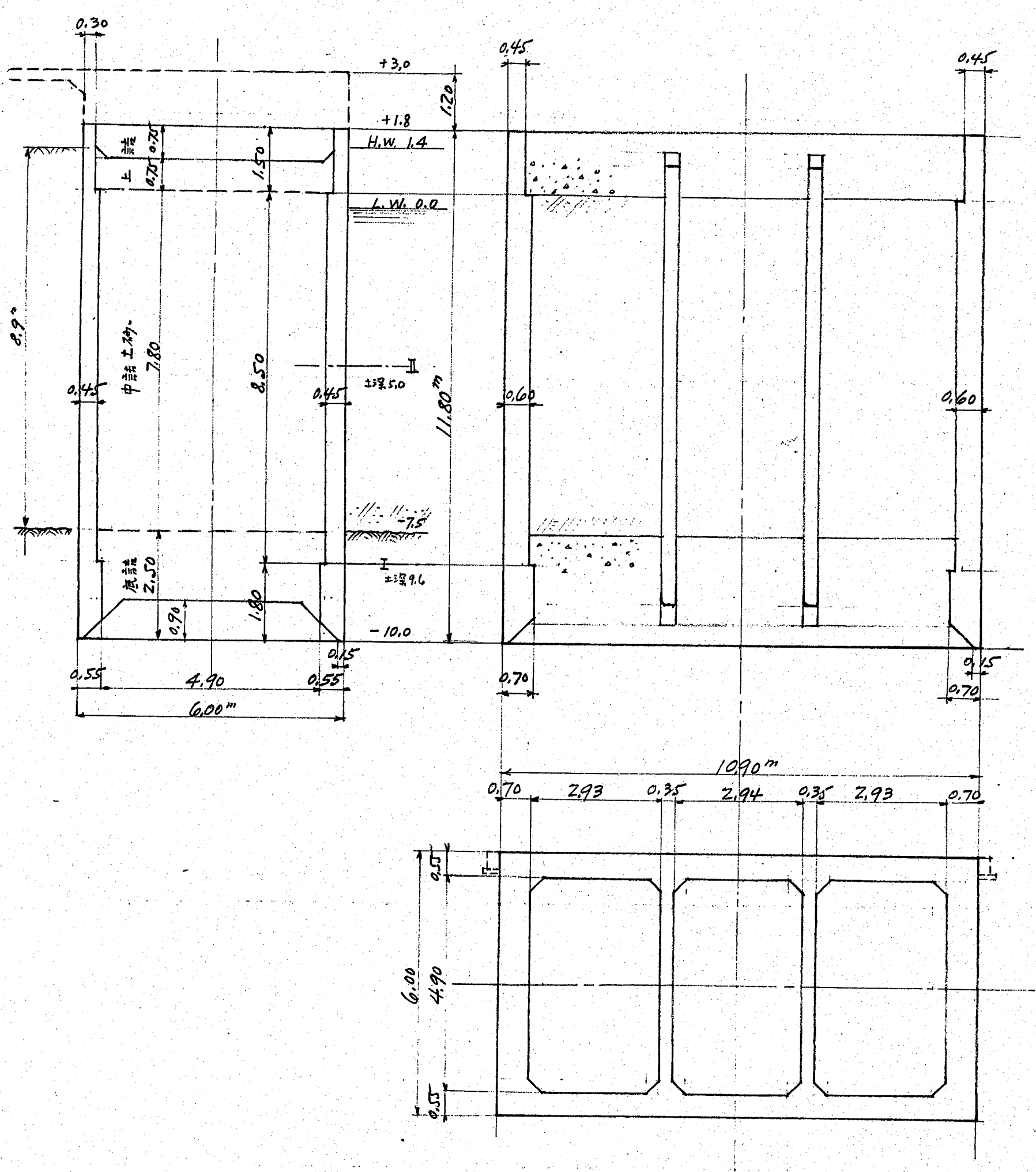
渠口用井筒 W5



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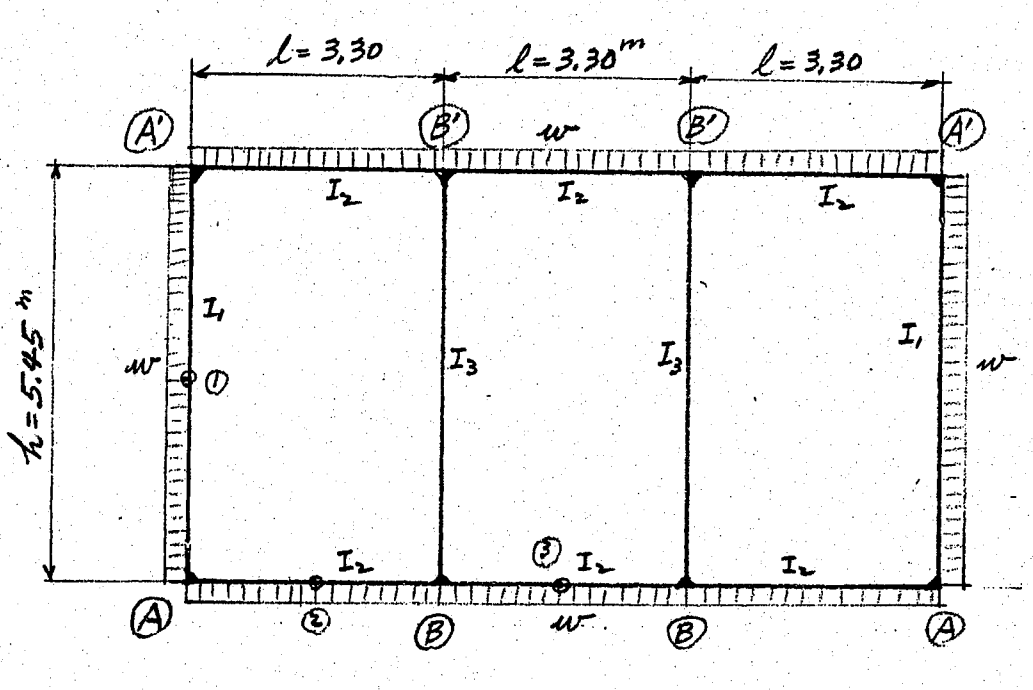
室蘭第一船渠

底部断面

土深 10.4m
土圧 (沈下中) $w = \frac{2}{3} \times 10.4 \times 1000 = 6930$ kg/m²
(沈下停止中) $w' = \frac{1}{3} \times 10.4 \times 1900 = 6590$ "



$l = 3.30^m$, $h = 5.45^m$, $h^2 - l^2 = 18.8125\ m^2$

$I_1 = \frac{1.0 \times 0.70^3}{12} = 0.02858$, $K_1 = \frac{I_1}{h} = \frac{0.02858}{5.45} = 0.005245$, $3K_2 + K_3 = 0.013255$

$I_2 = \frac{1.0 \times 0.55^3}{12} = 0.01386$, $K_2 = \frac{I_2}{l} = \frac{0.01386}{3.3} = 0.004200$, $K_1 + 2K_2 = 0.013645$

$I_3 = \frac{1.0 \times 0.35^3}{12} = 0.00357$, $K_3 = \frac{I_3}{h} = \frac{0.00357}{5.45} = 0.000655$, $K_2^2 = 0.000018$

$24E = 336\ (10)^8$

$2E = 28\ (10)^8$

$C_{AB} = C_{BA} = C_{BB} = \frac{wl^2}{12} = \frac{3.30^2}{12} w = 0.90750\ w$ kgm

$C_{AA'} = \frac{wh^2}{12} = \frac{5.45^2}{12} w = 2.4752\ w$

材端角

$\theta_A = \frac{w(3k_2 + k_3)(h^2 - l^2)}{24E\{(k_1 + 2k_2)(3k_2 + k_3) - k_2^2\}} = \frac{w \times 0.013255 \times 18.8125}{336(10)^8(0.013645 \times 0.013255 - 0.000018)} = \frac{45568\ w}{(10)^{12}}$

$\theta_B = -\frac{w k_2 (h^2 - l^2)}{24E\{(k_1 + 2k_2)(3k_2 + k_3) - k_2^2\}} = -\frac{w \times 0.004200 \times 18.8125}{336(10)^8(0.013645 \times 0.013255 - 0.000018)} = -\frac{14439\ w}{(10)^{12}}$

$M_{AB} = 2EK_2(2\theta_A + \theta_B) + C_{AB} = 28(10)^8 \times 0.004200 \times \frac{76697\ w}{(10)^{12}} + 0.90750\ w = 1.809\ w$

$M_{AA'} = 2EK_1\ \theta_A - C_{AA'} = 28(10)^8 \times 0.005245 \times \frac{45568\ w}{(10)^{12}} - 2.4752\ w = -1.806\ w$

} 平均 1.808 w トス

$M_{BA} = 2EK_2(2\theta_B + \theta_A) - C_{BA} = 28(10)^8 \times 0.004200 \times \frac{16690\ w}{(10)^{12}} - 0.90750\ w = -0.711\ w$

$M_{BB} = 2EK_2\ \theta_B + C_{BB} = 28(10)^8 \times 0.004200 \times \frac{-14439\ w}{(10)^{12}} + 0.90750\ w = 0.738\ w$

$M_{BB'} = 2EK_3\ \theta_B = 28(10)^8 \times 0.000655 \times \frac{-14439\ w}{(10)^{12}} = -0.027\ w$

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室蘭第一船渠

彎曲率　　$w = 6{,}930$ kg/m

$M_A = -1.808w = -12{,}530$ kgm
$M_{B2L} = -0.711w = -4{,}930$ 〃
$M_{B2R} = -0.738w = -5{,}110$ 〃
$M_{B3} = -0.027w = -190$ 〃

剪力

S_{A1}　$5.45w \div 2 = 2.725w = 18{,}880$ kg
$S_{A2} = -1.65w - \frac{1.808-0.711}{3.30}w = -1.982w = -13{,}730$ 〃
$S_{B2L} = 1.65w + \frac{0.711-1.808}{3.30}w = 1.318w = 9{,}140$ 〃
$S_{B2R} = -3.30w \div 2 = -1.650w = 11{,}430$ 〃

軸力.

$N_1 = 1.982w = 13730$ kg. C
$N_2 = 2.725w = 18880$ 〃 C
$N_3 = 1.318w + 1.650w = 2.968w = 20{,}570$ 〃 C

最大正彎曲率

部材 A-A', 中央.

$\frac{wl^2}{8} = \frac{5.45^2}{8}w = 3.713w$
$M_A = -1.808w$
$M_1 = 1.905w = 13{,}200$ kgm

部材 A-B.

剪力零ノ点
$x = \frac{1.982w}{w} = 1.982$ m
$1.982w \times 1.982 = 3.925w$
$-\frac{1.982^2}{2}w = -1.962w$
$M_A = -1.808w$
$M_2 = 0.155w = 1{,}070$ kgm

部材 BB, 中央.

$\frac{wl^2}{8} = \frac{3.30^2}{8}w = 1.361w$
$M_{B2R} = -0.738w$
$M_3 = 0.623w = 4320$ kgm

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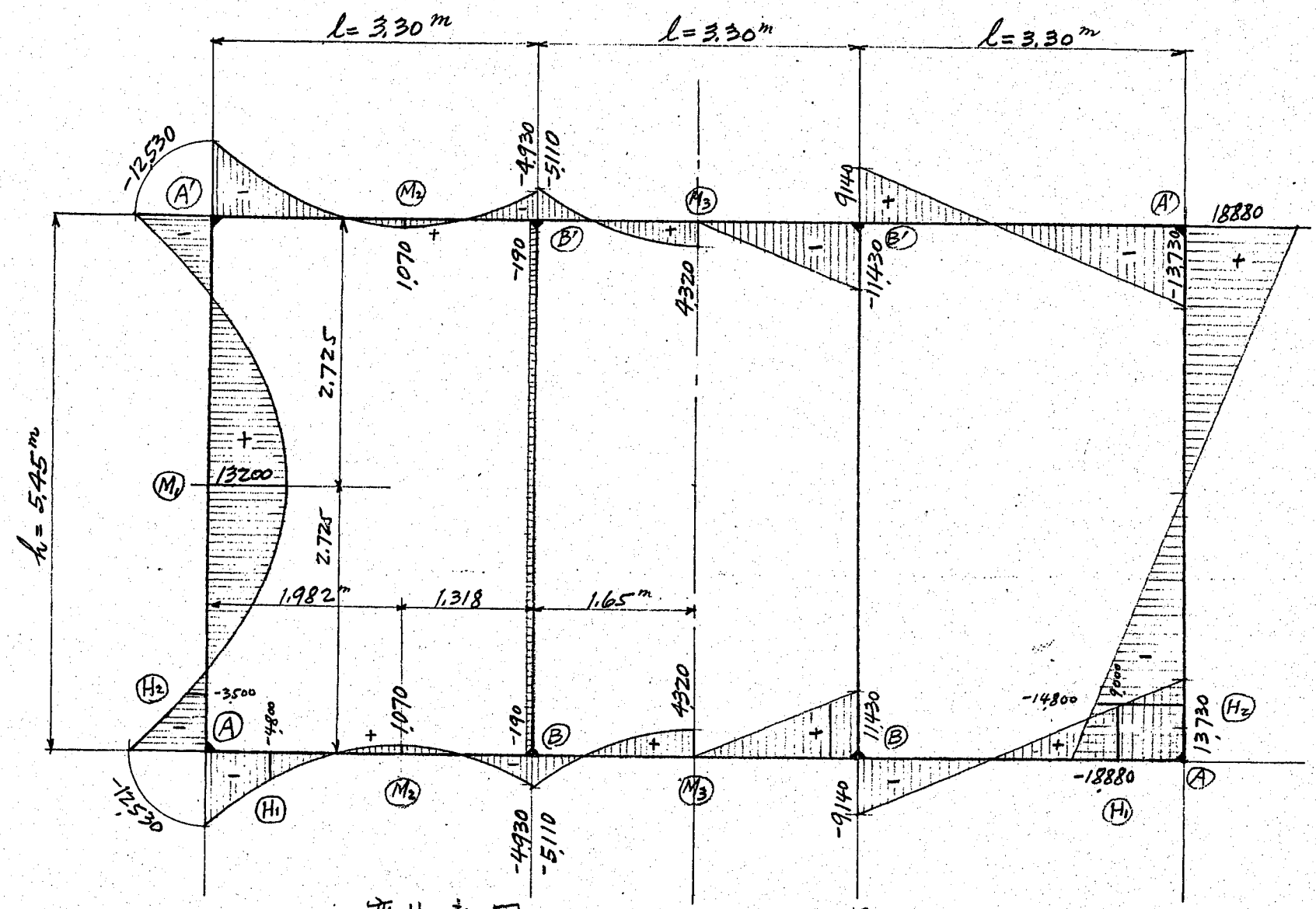
彎曲率及剪力圖 (底部斷面)



彎曲率圖 尺度 1cm=10,000 kgm

剪力圖 尺度 1cm=10000 kg.

縮尺 1:60

底部斷面應力

(M1) $M_1 = -13,200$ kgm , $N_1 = 13,730$ kg. C.

$p_0 = \frac{13.41}{100 \times 70} = 0.00192$

$p_0' = 0.00096$

$d/h = 66/70 = 0.943$

$d'/h = 4/70 = 0.057$

$u/h = 0.504$

$u = 35.3$

$d-u = 30.7$

$\frac{M}{N} = \frac{13200 \times 100}{13730} = 96.2$

$d-u = 30.7$

$e = 126.9$ cm

$e' = e - 6_2 = 64.9$ "

$e'/e = 0.511$

$\frac{Ne}{bd^2} = \frac{13730 \times 126.9}{100 \times 66^2} = 4.004$

$\frac{Ne}{bd^2\sigma_c} = 0.139$, $k = 0.280$

$\sigma_c = \frac{4.004}{0.139} = 28.8$ kg/cm²

$\sigma_s = 15 \times 28.8 \times \frac{1-0.280}{0.280} = 1111$ kg/cm²

$b = 100$ cm, $h = 70$ cm

$d = 66$ cm, $d' = 4$ cm

$A_s = 6.67 - 16\phi = 13.41$ cm²

$A_s' = 3.33 - 16\phi = 6.70$

$p = \frac{13.41}{100 \times 66} = 0.00203$

$p' = 0.00101$

$d'/d = 4/66 = 0.061$

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(M3) $M_3 = 4320$ kgm, $N_2 = 18880$ kg.c

$\frac{M}{N} = \frac{4320 \times 100}{18880} = 22.9$

$d-u = 23.4$

$e = 46.3$ cm

$e' = e - 47 = -0.7$ "

$e'/e = -\frac{0.7}{46.3} = -0.015$

$\frac{Ne}{bd^2} = \frac{18880 \times 46.3}{100 \times 51^2} = 3.360$

$\frac{Ne}{bd^2\sigma_c} = 0.219$, $k = 0.505$

$\sigma_c = \frac{3.360}{0.219} = 15.4$ kg/cm²

$\sigma_s = 15 \times 15.4 \times \frac{0.495}{0.505} = 227$ "

$b = 100$ cm, $h = 55$ cm
$d = 51$ cm, $d' = 4$ cm
$A_s = 6.67 - 12\phi = 7.54$ cm²
$A_s' = 3.33 - 12\phi = 3.77$ "
$p = \frac{7.54}{100 \times 51} = 0.00148$
$p' = 0.00074$
$d'/d = 4/51 = 0.079$

Haunch (H1) $M = -4800$ kgm , $N_2 = 18880$ kg.c , $S = -9000$ kg

$\frac{M}{N} = \frac{4800 \times 100}{18880} = 25.4$

$d-u = 23.4$

$e = 48.8$ cm

$e' = 1.8$ "

$e'/e = 0.037$

$\frac{Ne}{bd^2} = \frac{18880 \times 48.8}{100 \times 51^2} = 3.545$

$\frac{Ne}{bd^2\sigma_c} = 0.198$ $k = .450$

$\sigma_c = \frac{3.545}{0.198} = 17.9$ kg/cm²

$\sigma_s = 15 \times 17.9 \times \frac{0.55}{0.45} = 328$ "

$\tau = \frac{9000}{100 \times 7/8 \times 51} = 2.0$ "

(H2) $\tau = \frac{14800}{100 \times 7/8 \times 66} = 2.6$ kg/cm²

(A) $M_A = -12530$ kgm , $N_2 = 18880$ kg.c , $S_{A2} = -13730$ kg

$\frac{M}{N} = \frac{12530 \times 100}{18880} = 66.5$

$d-u = 33.7$

$e = 100.2$ cm

$e' = e - 68 = 32.2$ "

$e'/e = 0.321$

$\frac{Ne}{bd^2} = \frac{18880 \times 100.2}{100 \times 72^2} = 3.655$

$\frac{Ne}{bd^2\sigma_c} = 0.152$ $k = 0.315$

$\sigma_c = \frac{3.655}{0.152} = 24.0$ kg/cm²

$\sigma_s = 15 \times 24.0 \times \frac{0.685}{0.315} = 784$ "

$\tau = \frac{13730}{100 \times \frac{7}{8} \times 72} = 2.2$ "

$b = 100$ cm, $h = 55 + \frac{65}{3} = 76$ cm
$d = 72$ cm, $d' = 4$ cm
$A_s = 6.67 - 16\phi = 13.41$ cm²
$A_s' = 3.37 - 16\phi = 6.70$ "
$p = \frac{13.41}{100 \times 72} = 0.00186$
$p' = 0.00093$
$d'/d = 4/72 = 0.056$

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断面 I-I　土深 9.6 m
土圧（泥土中）　$w = \frac{2}{3} \cdot 9.6 \times 1000 = 6,400$ kg/m²

曲率（撓角.. -- 21頁参照）.

$M_A = -1.808 \times 6400 = -11,550$ kgm
$M_{B2L} = -0.711 \times \ = -4,550$ 〃
$M_{B2R} = -0.738 \times \ = -4730$ 〃
$M_{B3} = -0.027 \times \ = -170$ 〃

$M_1 = 1.905 \times \ = 12,180$ 〃
$M_2 = 0.155 \times \ = 990$ 〃
$M_3 = 0.623 \times \ = 3,980$ 〃

剪力

$S_{A1} = 2.725 \times 6400 = 17,430$ kg
$S_{A2} = -1.982 \times \ = -12680$ 〃
$S_{B2L} = 1.318 \times \ = 8,440$ 〃
$S_{B2R} = -1.650 \times \ = -10,550$ 〃

軸力.

$N_1 = 12,680$ kg. c
$N_2 = 17,430$ 〃
$N_3 = 18,990$ 〃

応力.

(M1)　$M_1 = 12,180$ kgm . $N_1 = 12,680$ kg. e

$\frac{M}{N} = \frac{12180 \times 100}{12680} = 96.2$

$d - u = 25.8$
$e = 122.0$ cm
$e' = e - 52 = 70.0$ 〃
$e'/e = 0.574$
$\frac{Ne}{bd^2} = \frac{12680 \times 122.0}{100 \times 56^2} = 4.930$
$\frac{Ne}{bd^2\sigma_c} = 0.145$, $k = 0.290$
$\sigma_c = \frac{4.930}{0.145} = 34.0$ kg/cm²
$\sigma_s = 15 \times 34.0 \times \frac{0.710}{0.290} = 1246$ kg/cm²

$b = 100$ cm, $h = 60$ cm
$d = 56$ cm, $d' = 4$ cm
$As = 6.67 - 16\phi = 13.41$ cm²
$As' = 3.33 - 16\phi = 6.70$ 〃
$p = \frac{13.41}{100 \times 56} = 0.00240$
$p' = 0.00120$
$d'/d = 4/56 = 0.0715$

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(M3) $M_3 = 3980$ kgm, $N_2 = 17430$ kg.c

$\frac{M}{N} = \frac{3980 \times 100}{17430} = 22.8$
$d-u = 18.4$
$e = 41.2$ cm
$e' = e - 37 = 4.2$
$e'/e = 0.102$
$\frac{Ne}{bd^2} = \frac{17430 \times 41.2}{100 \times 41^2} = 4.275$
$\frac{Ne}{bd^2\sigma_c} = 0.198$ $k = 0.440$
$\sigma_c = \frac{4.275}{0.198} = 21.6$ kg/cm²
$\sigma_s = 15 \times 21.6 \times \frac{0.56}{0.44} = 412$ "

$b = 100$ cm, $h = 45$ cm
$d = 41$ cm, $d' = 4$ cm
$A_s = 6.67 - 12\phi = 7.54$ cm²
$A_s' = 3.33 - 12\phi = 3.77$ "
$p = \frac{7.54}{100 \times 41} = 0.00184$
$p' = 0.00092$
$d'/d = 4/41 = 0.098$

(A) $M_A = -11550$ kgm, $N_2 = 17430$ kg.c, $S_{A2} = -12680$ kg

$\frac{M}{N} = \frac{11550 \times 100}{17430} = 66.3$
$d-u = 18.4$
$e = 84.7$ cm
$e' = e - 54 = 30.7$ "
$e'/e = 0.363$
$\frac{Ne}{bd^2} = \frac{17430 \times 847}{100 \times 58^2} = 4.390$
$\frac{Ne}{bd^2\sigma_c} = 0.143$ $k = 0.295$
$\sigma_c = \frac{4.390}{0.143} = 30.7$ kg/cm²
$\sigma_s = 15 \times 30.7 \times \frac{0.705}{0.295} = 1100$ kg/cm²
$\tau = \frac{12680}{100 \times \frac{7}{8} \times 58} = 2.5$ "

$b = 100$ cm, $h = 45 + \frac{57.5}{3} = 62$ cm
$d = 58$ cm, $d' = 4$ cm
$A_s = 6.67 - 16\phi = 13.41$ cm²
$A_s' = 3.33 - 16\phi = 6.70$ "
$p = \frac{13.41}{100 \times 58} = 0.00172$
$p' = 0.00086$
$d'/d = 4/58 = 0.069$

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室蘭第一船渠

断面 II-II 土深 5.0 m

土圧 (地下中) $w = \frac{2}{3} \times 5.00 \times 1000 = 3330$ kg/m²

彎曲率

M_A =	−1.808	× 3330 = −	6020	kgm
M_{B2^L} =	−0.711	× 〃 = −	2370	〃
M_{B2^R} =	−0.738	× 〃 = −	2460	〃
M_{B3} =	−0.027	× 〃 = −	90	〃
M_1 =	1.905	× 〃 =	6850	〃
M_2 =	0.155	× 〃 =	520	〃
M_3 =	0.623	× 〃 =	2080	〃

剪力

S_{A1} =	2.725	× 3330 =	9060	kg
S_{A2} =	−1.982	× 〃 = −	6600	〃
S_{B2^L} =	1.318	× 〃 =	4390	〃
S_{B2^R} =	−1.650	× 〃 = −	5490	〃

軸力

N_1 =	6600 kg. C
N_2 =	9060 〃 〃
N_3 =	9880 〃 〃

應力

(M₁) $M_1 = 6850$ kgm. $N_1 = 6600$ kg. C

$b = 100$ cm $h = 60$ cm
$d = 56$ cm $d' = 4$ cm
$A_s = 3.33 - 16\phi = 6.70$ cm²
$A_s' = 1.67 - 16\phi = 3.35$ 〃

$$\frac{M}{N} = \frac{6850 \times 100}{6600} = 103.8$$

$$d - u = \frac{25.8}{129.6} \text{ cm}$$

$e = 77.6$ 〃

$e'/e = 0.599$

$$p = \frac{6.70}{100 \times 56} = 0.00120$$

$p' = 0.00060$

$d'/d = 0.0715$

$$\frac{Ne}{bd^2} = \frac{6600 \times 129.6}{100 \times 56^2} = 2.730$$

$$\frac{Ne}{bd^2\sigma_c} = 0.108 \quad , \quad k = 0.220$$

$$\sigma_c = \frac{2.730}{0.108} = 25.3 \text{ kg/cm}^2$$

$$\sigma_s = 15 \times 25.3 \times \frac{0.780}{0.220} = 1343 \text{ 〃}$$

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室蘭第一船渠

(M3) $M_3 = 2080$ kgm, $N_2 = 9060$ kg.c.

$b = 100$ cm, $h = 45$ cm
$d = 41$ cm, $d' = 4$ cm
$A_s = 3.33 - 12\phi = 3.77$ cm²
$A_s' = 1.67 - 12\phi = 1.89$ "
$p = \frac{3.77}{100 \times 41} = 0.00092$
$p' = 0.00046$
$d'/d = 4/41 = 0.098$

$\frac{M}{N} = \frac{2080 \times 100}{9060} = 23.0$
$d - u = 18.4$
$e = 41.4$ cm
$e' = e - 37 = 4.4$ "
$e'/e = 0.106$

$\frac{Ne}{bd^2} = \frac{9060 \times 41.4}{100 \times 41^2} = 2.232$

$\frac{Ne}{bd^2\sigma_c} = 0.162$ $k = 0.360$

$\sigma_c = \frac{2.232}{0.162} = 13.8$ kg/cm²

$\sigma_s = 15 \times 13.8 \times \frac{0.640}{0.360} = 368$ "

(A) $M_A = -6020$ kgm, $N_2 = 9060$ kg.c, $S_{A2} = -6600$ kg

$b = 100$ cm, $h = 45 + \frac{5 \times 2.5}{3} = 62$ cm
$d = 58$ cm $d' = 4$ cm
$A_s = 3.33 - 16\phi = 6.70$ cm²
$A_s' = 1.67 - 16\phi = 3.35$ "
$p = \frac{6.70}{100 \times 58} = 0.00116$
$p' = 0.00058$
$d'/d = 0.069$

$\frac{M}{N} = \frac{6020 \times 100}{9060} = 66.5$
$d - u = 18.4$
$e = 84.9$ cm
$e' = e - 54 = 30.9$ "
$e'/e = 0.364$

$\frac{Ne}{bd^2} = \frac{9060 \times 84.9}{100 \times 58^2} = 2.290$
$\frac{Ne}{bd^2\sigma_c} = 0.120$, $k = 0.250$
$\sigma_c = \frac{2.290}{0.120} = 19.1$ kg/cm²
$\sigma_s = 15 \times 19.1 \times \frac{0.750}{0.250} = 860$ "
$\tau = \frac{6600}{100 \times \frac{7}{8} \times 58} = 1.3$ "

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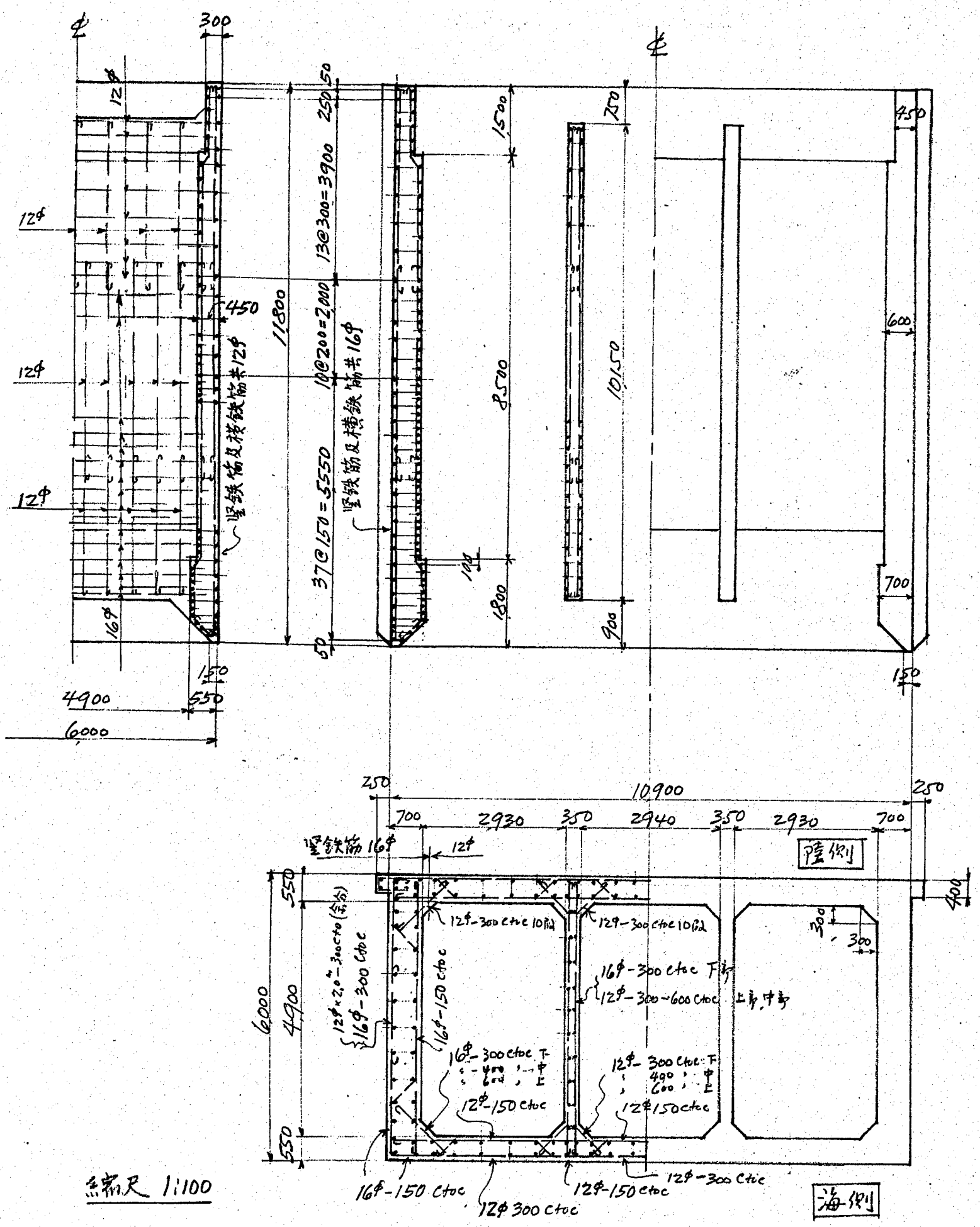
室蘭第一船渠

井筒W5ノ配筋



縮尺 1:100

底部断面

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室蘭第一船渠

井筒ノ安定度

壁体ノ最モ危険ナル状態ハ井筒内部ヲ填充シタル後チ前面ノ土砂ヲ掘鑿シタル場合ニテ他ノ場合ハ何レモ之レヨリモ安全ナリ。

井筒ノ重量

側壁	10.90 × 0.30 × 1.50 × 2 =	9.82	立米
〃	10.90 × 0.45 × 8.50 × 2 =	83.40	
〃	10.90 × 0.55 × 1.80 × 2. =	21.60	
端壁	5.40 × 0.45 × 1.50 × 2 =	7.29	
〃	5.10 × 0.60 × 8.50 × 2 =	52.00	
〃	4.90 × 0.70 × 1.80 × 2 =	12.35	
隔壁	5.40 × 0.35 × 0.75 × 2 =	2.84	
〃	5.10 × 0.35 × 8.50 × 2 =	30.35	
〃	4.90 × 0.35 × 0.90 × 2 =	3.09	
持送	0.30 × 0.30 × 11.20 × 2 =	2.02	
〃	0.30 × 0.30 × 10.50 × 4 =	3.78	
		228.54 @ 2,400 =	548,500
上読	9.30 × 1.50 × 5.40 =	75.30	
底読	9.00 × 5.10 × 0.70 =	32.12	
〃	8.80 × 4.90 × 0.90 =	38.80	
〃	9.50 × 4.90 × 0.90 =	41.85	
持送控除	− 0.30 × 0.30 × 2.70 × 2 = −	0.49	
〃 〃	− 0.30 × 0.30 × 2.35 × 4 = −	0.85	
		186.73 @ 2200 =	411,000
中読	9.01 × 5.10 × 7.80 =	358.00	
持送控除	− 0.30 × 0.30 × 7.80 × 6 = −	4.21	
		353.79 @ 2000 =	707,500
		計	1,667,000 kg

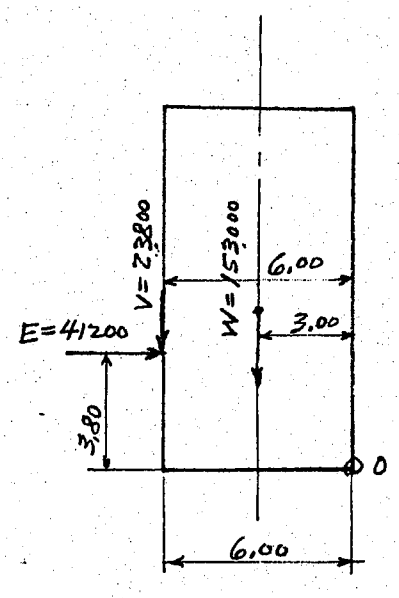
壁体延長1.0米当重量 $W = \frac{1,667,000}{10.90} = 153,000$ kg

土圧 $h = 11.4^m$

$E = \frac{1}{6} \times 1,900 \times 11.40^2 = 41200$ kg 働点ノ高サ $\frac{h}{3} = 3.80^m$

摩面摩擦力

$V = E \tan 30° = 41200 \times 0.577 = 23800$ kg



O点ニ関スル能率

W		153000 × 3.00 =	459,000	
E	41,200	×(−3.80) = −	156,600	
V		23800 × 6.00 =	142800	
ΣH =	41,200	ΣV = 176,800	2.52^m	445,200

$e = 3.0 - 2.52 = 0.48^m$

底面最大圧力 $P = \frac{176800}{1.0 \times 6.0}\left(1 \pm \frac{6 \times 0.48}{6.0}\right) = 43600$ kg/m² 圧力
又ハ 15300 〃 〃

滑動率 $= \frac{41200}{176800} = 0.233$

何レモ安全ナリ。

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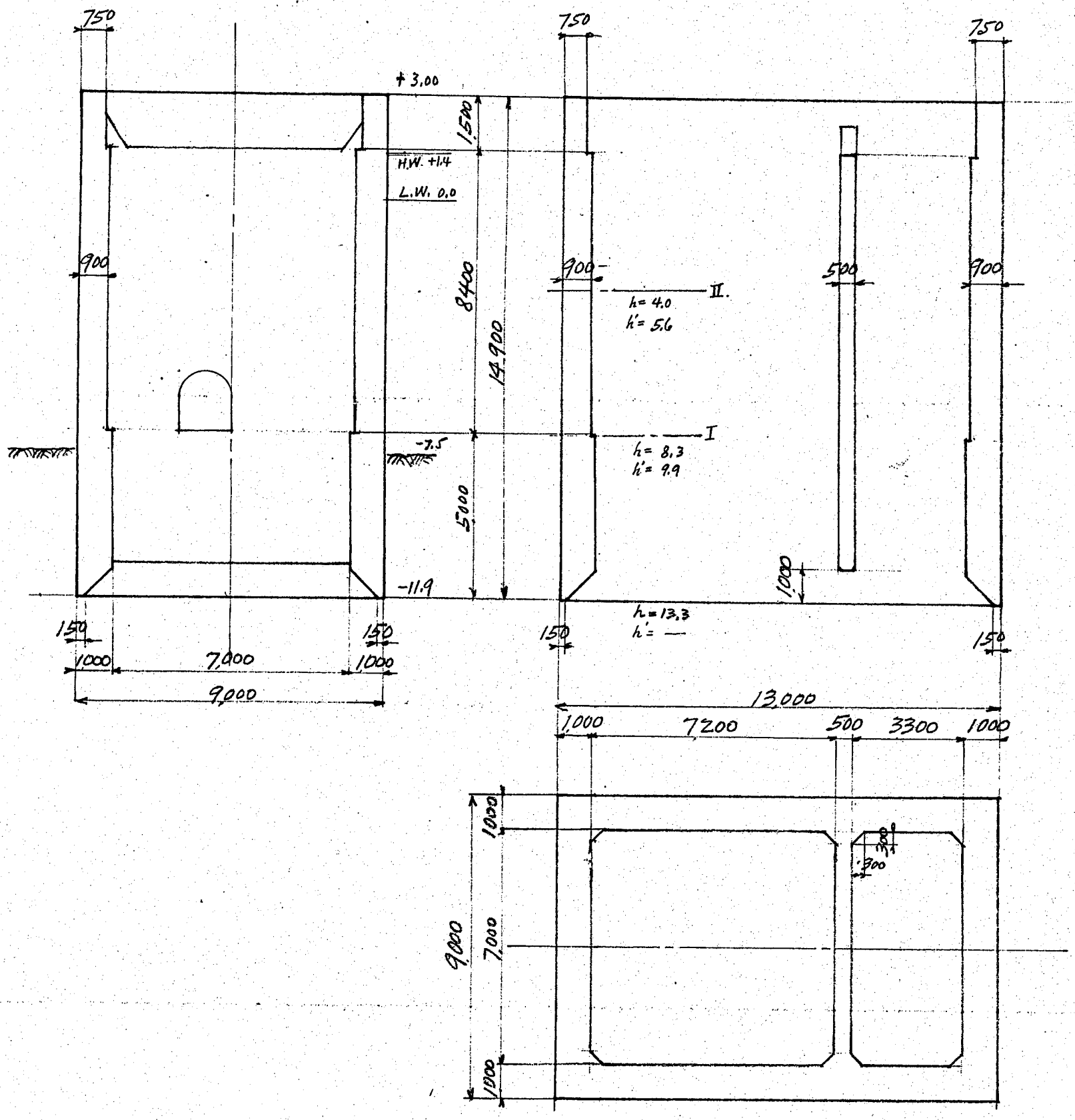
ポンプ室用井筒 W6



縮尺 1:150

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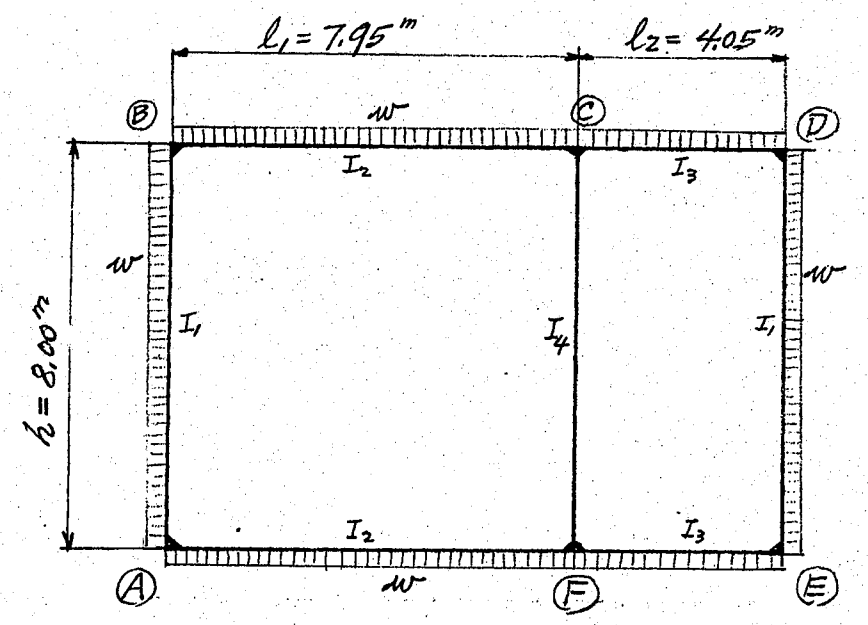
室蘭第一船渠

底部断面

土深 沈下中 12.30m 土圧 沈下中 $w = \frac{2}{3} \times 1000 \times 12.3 = 8200$ kg/m²
〃 沈下停止中 $w' = \frac{1}{3} \times 1900 - 12.3 = 7790$ 〃

後功性ヽ底部ハ内部ヲ填充スベキ=付其ハ土圧ヲ考慮セズ。



$$I_1 \} = I_2 \} = I_3 \} = \frac{1.0 \times 1.0^3}{12} = 0.083333 \text{ m}^4$$

$$I_4 = \frac{1.0 \times 0.5^3}{12} = 0.010417$$

$$K_1 = \frac{I_1}{h} = \frac{0.083333}{8.0} = 0.010417$$

$$K_2 = \frac{I_2}{l_1} = \frac{0.083333}{7.95} = 0.010482$$

$$K_3 = \frac{I_3}{l_2} = \frac{0.083333}{4.05} = 0.020576$$

$$K_4 = \frac{I_4}{h} = \frac{0.010417}{8.0} = 0.001302$$

$$C_{AB} \} = C_{BA} \} = C_{AF} \} = \frac{wh^2}{12} = \frac{8.0^2}{12} w = 5.333333w = C_1$$

$$C_{BC} \} = C_{CB} \} = \frac{wl_1^2}{12} = \frac{7.95^2}{12} w = 5.266875w = C_2$$

$$C_{CD} = \frac{wl_2^2}{12} = \frac{4.05^2}{12} w = 1.366875w = C_3$$

$$\theta_A = -\theta_B$$
$$\theta_F = -\theta_C$$
$$\theta_E = -\theta_D$$

$$(C_2 - C_1)/2E = -\frac{0.066458}{28(10)^8} = -\frac{2.3735}{(10)^{11}}$$

$$(C_3 - C_2)/2E = -\frac{3.900}{28(10)^8} = -\frac{139.2857}{(10)^{11}}$$

$$(C_1 - C_3)/2E = \frac{3.966458}{28(10)^8} = \frac{141.6592}{(10)^{11}}$$

$$\begin{cases} M_{BA} = 2Ek_1\theta_B + C_1 \\ M_{BC} = 2Ek_2(2\theta_B + \theta_C) - C_2 \end{cases}$$

$$\begin{cases} M_{CB} = 2Ek_2(2\theta_C + \theta_B) + C_2 \\ M_{CD} = 2Ek_3(2\theta_C + \theta_D) - C_3 \\ M_{CF} = 2Ek_4\theta_C \end{cases}$$

$$\begin{cases} M_{DC} = 2Ek_3(2\theta_D + \theta_C) + C_3 \\ M_{DE} = 2Ek_1\theta_D - C_1 \end{cases}$$

條件式、

$$(K_1 + 2K_2)\theta_B + K_2\theta_C = (C_2 - C_1)/2E$$
$$K_2\theta_B + (2K_2 + 2K_3 + K_4)\theta_C + K_3\theta_D = (C_3 - C_2)/2E$$
$$K_3\theta_C + (K_1 + 2K_3)\theta_D = (C_1 - C_3)/2E$$

上式ニ各係数ノ値ヲ代入スレバ次ノ如シ

$$0.031381\theta_B + 0.010482\theta_C = -2.3735w \div (10)^{11}$$
$$0.010482\theta_B + 0.063418\theta_C + 0.020576\theta_D = -139.2857w \div (10)^{11}$$
$$0.020576\theta_C + 0.051569\theta_D = 141.6592w \div (10)^{11}$$

之ヲ整理スレバ次ノ如シ

$$2.99380\theta_B + \theta_C = -226.4358w \div (10)^{11} \quad \cdots\cdots (1)$$
$$0.16528\theta_B + \theta_C + 0.32445\theta_D = -2196.3118w \div (10)^{11} \quad \cdots\cdots (2)$$
$$\theta_C + 2.50627\theta_D = 6884.6812w \div (10)^{11} \quad \cdots\cdots (3)$$

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(1)-(2) $2.82852\,\theta_B - 0.32445\,\theta_D = 1,969.8760\,w \div (10)^{11}$
(2)-(3) $0.16528\,\theta_B - 2.18182\,\theta_D = -9,080.9930\,w \div (10)^{11}$

$0.46750\,\theta_B - 0.05363\,\theta_D = 325.5811\,w \div (10)^{11}$
$0.46750\,\theta_B - 6.17132\,\theta_D = -25685.7703\,w \div (10)^{11}$

$6.11769\,\theta_D = 26011.3574\,w \div (10)^{11}$

$\theta_D = 4251.8257\,w \div (10)^{11} = 4.251826\,w \div (10)^{8}$
$\theta_B = 1,184.1893\,w \div (10)^{11} = 1.184189\,w \div (10)^{8}$
$\theta_C = -3,771.5420\,w \div (10)^{11} = -3.771542\,w \div (10)^{8}$

$M_{BA} = 28(10)^8 \times 0.010417 \times 1.184189\,w \div (10)^8 + 5.333333w = 5.6787w$
$M_{BC} = 28(10)^8 \times 0.010482 \times (-1.403164)\,w \div (10)^8 - 5.266875w = -5.6787w$ } 平衡ヲ保ツ

$M_{CB} = 28(10)^8 \times 0.010482 \times (-6.358895)\,w \div (10)^8 + 5.266875w = 3.4006w$
$M_{CD} = 28(10)^8 \times 0.020576 \times (-3.291258)\,w \div (10)^8 - 1.366875w = -3.2631w$
$M_{CF} = 28(10)^8 \times 0.001302 \times (-3.771542)\,w \div (10)^8 = -0.1375w$ } 〃

$M_{DC} = 28(10)^8 \times 0.020576 \times 4.732110\,w \div (10)^8 + 1.366875w = 4.0932w$
$M_{DE} = 28(10)^8 \times 0.010417 \times 4.251826\,w \div (10)^8 - 5.333333w = -4.0932w$ } 〃

彎曲率 $w = 8,200$ kg/m

$M_B = -5.6787w = -46,550$ kgm
$M_{CL} = -3.4006w = -27,900$ 〃
$M_{CR} = -3.2631w = -26,750$ 〃
$M_{CP} = -0.1375w = -1,130$ 〃
$M_D = -4.0932w = -33,550$ 〃

剪力.

$S_{B1} = -8.0w \div 2 = -4.0000w = -32,800$ kg
$S_{B2} = 3.975w + \frac{5.6787-3.4006}{7.95}w = 4.2616w = 34,900$ 〃
$S_{C2} = -3.975w - \frac{3.4006-5.6787}{7.95}w = -3.6884w = -30,200$ 〃
$S_{C3} = 2.025w + \frac{3.2631-4.0932}{4.05}w = 1.8200w = 14,900$ 〃
$S_{D3} = -2.025w - \frac{4.0932-3.2631}{4.05}w = -2.2300w = -18,300$ 〃
$S_{D1} = 8.0w \div 2 = 4.0000w = 32,800$ 〃

軸力.

$N_1 = 4.2616w = 34,900$ kg. C A-B
$N_2 = 4.0000w = 32,800$ 〃 〃 B-C
$N_3 = 4.0000w = 32,800$ 〃 〃 C-D
$N_4 = 3.6884w + 1.8200w = 5.5084w = 45,200$ 〃 〃 C-F
$N_1' = 2.2300w = 18,300$ 〃 〃 D-E

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最大正彎曲率

部材 A-B 中央

$\frac{wh^2}{8} = \frac{w \times 8^2}{8} = 8.0000w$

$M_B = -5.6787w$

$M_1 = 2.3213w = 19,050$ kgm.

部材 BC.

勞力零ノ点 $x = 4.2616$ m (B点ヨリノ距離)

$4.2616w \times 4.2616 = 18.1612w$

$-\frac{4.2616^2}{2}w = -9.0806w$

$M_B = -5.6787w$

$M_2 = 3.4019w = 27,900$ kgm

部材 CD.

$x = 2.230$ m (D点ヨリノ距離)

$2.2300w \times 2.2300 = 4.9730$

$-\frac{2.230^2}{2}w = -2.4865$

$M_D = -4.0932$

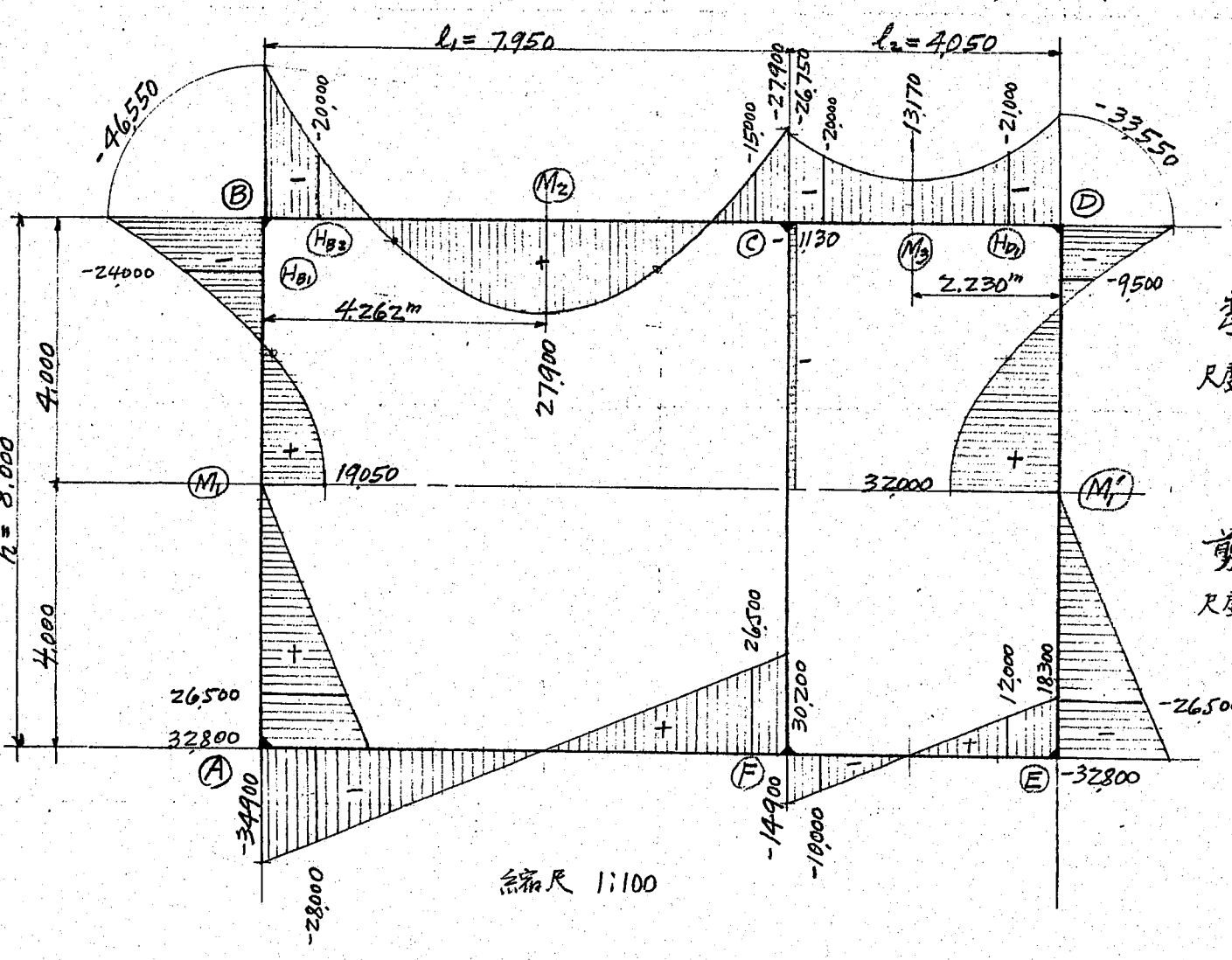
$M_3 = -1.6067w = -13,170$ kgm

部材 DE 中央.

$\frac{-wh^2}{8} = 8.0000w$

$M_D = -4.0932w$

$M_1' = 3.9068w = 32,000$ kgm



彎曲率圖
尺度 $\frac{1}{200}$ m = 10,000 kgm

剪力圖
尺度 $\frac{1}{200}$ m = 10,000 kg

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底部断面應力

(M1) $M_1' = 32{,}000$ kgm, $N_1' = 18{,}300$ kg.c

$p_0 = \frac{18.90}{100\times100} = 0.00189$
$p_0' = 0.00095$
$d/h = 95/100 = 0.950$
$d'/h = 5/100 = 0.05$
$u/h = 0.504$
$u = 50.4$
$d-u = 44.6$

$\frac{M}{N} = \frac{32000\times100}{18300} = 174.8$
$d-u = 44.6$
$e = 219.4$ cm
$e' = e-90 = 129.4$ "
$e'/e = 0.590$
$\frac{Ne}{bd^2} = \frac{18300\times219.4}{100\times95^2} = 4.44$
$\frac{Ne}{bd^2\sigma_c} = 0.135$, $k = 0.265$
$\sigma_c = \frac{4.44}{0.135} = 32.8$ kg/cm²
$\sigma_s = 15\times32.8\times\frac{0.735}{0.265} = 1363$ "

$b = 100$ cm, $h = 100$ cm
$d = 95$ cm, $d' = 5$ cm
$A_s = 6.67 - 19\phi = 18.90$ cm²
$A_s' = 3.33 - 19\phi = 9.45$ "
$p = \frac{18.90}{100\times95} = 0.00199$
$p' = 0.00100$
$d'/d = 5/95 = 0.0526$

(M1) $M_1 = 19050$ kgm, $N_1 = 34{,}900$ kg.C

$\frac{M}{N} = \frac{19050\times100}{34900} = 54.6$
$d-u \fallingdotseq 44.6$
$e = 99.2$ cm
$e' = e-90 = 9.2$ "
$e'/e = 0.093$
$\frac{Ne}{bd^2} = \frac{34900\times99.2}{100\times95^2} = 3.840$
$\frac{Ne}{bd^2\sigma_c} = 0.182$ $k = 0.400$
$\sigma_c = \frac{3.840}{0.182} = 21.1$ kg/cm²
$\sigma_s = 15\times21.1\times\frac{0.600}{0.400} = 475$ "

$b = 100$ cm, $h = 100$ cm
$d = 95$ ", $d' = 5$
$A_s = 6.67 - 16\phi = 13.41$ cm²
$A_s' = 3.33 - 16\phi = 6.70$
$p = \frac{13.41}{100\times95} = 0.00141$
$p' = 0.00071$
$d'/d = 0.0526$

(M2) $M_2 = 27{,}900$ kgm, $N_2 = 32{,}800$ kg.c

$p_0 = 0.00189$
$p_0' = 0.00067$
$d/h = 0.95$
$d'/h = 0.05$
$u/h = 0.506$
$u = 50.6$
$d-u = 44.4$ cm

$\frac{M}{N} = \frac{27900\times100}{32800} = 85.1$
$d-u = 44.4$
$e = 129.5$ cm
$e' = e-90 = 39.5$ "
$e'/e = 0.305$
$\frac{Ne}{bd^2} = \frac{32800\times129.5}{100\times95^2} = 4.710$
$\frac{Ne}{bd^2\sigma_c} = 0.1605$ $k = 0.340$
$\sigma_c = \frac{4.710}{0.1605} = 29.3$ kg/cm²
$\sigma_s = 15\times29.3\times\frac{0.660}{0.340} = 855$ "

$b = 100$ cm, $h = 100$ cm
$d = 95$ cm, $d' = 5$ cm
$A_s = 6.67 - 19\phi = 18.90$ cm²
$A_s' = 3.33 - 16\phi = 6.70$ "
$p = 0.00199$
$p' = 0.00071$
$d'/d = 0.0526$

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Ⓒ $M_3 = -13{,}170$ kgm , $N_3 = 32{,}800$ kg.c

$e = \frac{M}{N} = \frac{13170 \times 100}{32800} = 40.2$ cm

$e/h = \frac{40.2}{100} = 0.402$

$k = 0.440$, $c = 0.215$

$\sigma_c = \frac{N}{bhc} = \frac{32800}{100 \times 100 \times 0.215} = 15.3$ kg/cm²

$\sigma_s = n\sigma_c \frac{1-k-d'/h}{k}$

$= 15 \times 15.3 \frac{1-0.440-0.050}{0.440} = 265$ kg/cm².

$b = 100$ cm , $h = 100$ cm
$d = 95$ cm , $d' = 5$ cm
$A_s = A_s' = 3.33 - 16\phi = 6.70$ cm²
$p = p' = 0.00071$
$d'/d = 0.0526$
$d'/h = 0.050$

Ⓑ $M_B = -46{,}550$ kgm, $N_2 = 32{,}800$ kg.c $S_{B2} = 34{,}900$ kg

$p_0 = \frac{18.90}{100 \times 126} = 0.00150$
$p_0' = 0.00075$
$d/h = 121/126 = 0.960$
$d'/h = 5/126 = 0.0498$
$u/h = 0.504$
$u = 0.504 \times 126 = 63.5$ cm
$d-u = 121.0 - 63.5 = 57.5$ "

$\frac{M}{N} = \frac{46550 \times 100}{32800} = 141.9$
$d-u = 57.5$
$e = 199.4$ cm
$e' = e - 116 = 83.4$ "
$e'/e = 0.418$
$\frac{Ne}{bd^2} = \frac{32800 \times 199.4}{100 \times 121^2} = 4.460$

$\frac{Ne}{bd^2\sigma_c} = 0.137$ $k = 0.275$

$\sigma_c = \frac{4.460}{0.137} = 32.5$ kg/cm²

$\sigma_s = 15 \times 32.5 \times \frac{0.725}{0.275} = 1284$ "

$b = 100$ cm , $h = 100 + \frac{80}{3} = 126$ cm
$d = 121$ cm , $d' = 5$ cm
$A_s = 6.67 - 19\phi = 18.90$ cm²
$A_s' = 3.33 - 19\phi = 9.45$ "
$p = \frac{18.90}{100 \times 121} = 0.00156$
$p' = 0.00078$
$d'/d = 5/121 = 0.0414$

$\tau = \frac{34900}{100 \times \frac{7}{8} \times 121} = 3.3$ kg/cm².

Ⓓ $M_D = -33{,}550$ kgm , $N_1' = 18{,}300$ kg.c. $S_{D1} = 32{,}800$ kg.

$\frac{M}{N} = \frac{33550 \times 100}{18300} = 183.3$
$d-u = 57.5$
$e = 240.8$ cm
$e' = e - 116 = 124.8$ "
$e'/e = 0.518$
$\frac{Ne}{bd^2} = \frac{18300 \times 240.8}{100 \times 121^2} = 3.008$

$\frac{Ne}{bd^2\sigma_c} = 0.119$ $k = 0.240$

$\sigma_c = \frac{3.008}{0.119} = 25.3$ kg/cm²

$\sigma_s = 15 \times 25.3 \times \frac{0.760}{0.240} = 1200$ "

$\tau = \frac{32800}{100 \times \frac{7}{8} \times 121} = 3.1$ kg/cm².

$b = 100$ cm $h = 126$ cm
$d = 121$ " $d' = 5$ "
$A_s = \begin{cases} 3.33 - 19\phi = 9.45 \\ 3.33 - 16\phi = 6.70 \end{cases}$ $= 16.15$ cm²
$A_s' = 3.33 - 16\phi = 6.70$ "
$p = \frac{16.15}{100 \times 121} = 0.00134$
$p' = \frac{6.7}{100 \times 121} = 0.00055$
$d'/d = 0.414$

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© $M_{c2} = -27{,}900\ kgm$, $N_2 = 32{,}800\ kg$. C $S_{c2} = -30200\ kg$

$\frac{M}{N} = \frac{27900 \times 100}{32{,}800} = 85.2$

$d_1 \div 0.504 \times 118 = 59.5$

$d - u$ = $\frac{53.5}{138.7\ cm}$

$e =$

$e' = e - 10.8$ = 30.7 "

e'/e = 0.221

$\frac{Ne}{bd^2} = \frac{32800 \times 138.7}{100 \times 113^2} = 3.555$

$\frac{Ne}{bd^2\sigma_c} = 0.145$ $k = 0.300$

$\sigma_c = \frac{3.555}{0.145} = 24.5\ kg/cm^2$

$\sigma_s = 15 \times 24.5 \times \frac{0.700}{0.300} = 860$ "

$\tau = \frac{30200}{100 \times \frac{7}{8} \times 113} = 3.1$ "

$b = 100\ cm$, $h = 100 + \frac{55}{3} = 118\ cm$

$d = 113\ cm$, $d' = 5\ cm$

$A_s = 6.67 - 16\phi = 13.41\ cm^2$

$A_s' = 3.33 - 16\phi = 6.70$ "

$p = \frac{13.41}{100 \times 113} = 0.00119$

p' = 0.00059

$d'/d = 5/113 = 0.0443$

ハウン4

(HB1) $M = -24{,}000\ kgm$, $N_1 = 34{,}900\ kg$. C, $S = -26{,}500\ kg$

$\frac{M}{N} = \frac{24000 \times 100}{34900} = 68.8$

$d - u$ = $\frac{44.6}{113.4\ cm}$

$e =$

$e' = e - 90$ = 23.4 "

e'/e = 0.206

$\frac{Ne}{bd^2} = \frac{34900 \times 113.4}{100 \times 95^2} = 4.390$

$\frac{Ne}{bd^2\sigma_c} = 0.178$ $k = 0.375$

$\sigma_c = \frac{4.390}{0.178} = 24.7\ kg/cm^2$

$\sigma_s = 15 \times 24.7 \times \frac{0.625}{0.375} = 617$ "

$\tau = \frac{26500}{100 \times \frac{7}{8} \times 95} = 3.2$ "

$b = 100\ cm$, $h = 100\ cm$

$d = 95\ cm$, $d' = 5\ cm$

$A_s = 6.67 - 19\phi = 18.90\ cm^2$

$A_s' = 3.37 - 19\phi = 9.45$ "

p = 0.00199

p' = 0.00100

d'/d = 0.0526

(HB2) $M = -20{,}000\ kgm$, $N_2 = 32{,}800\ kg$. e, $S = 28{,}000\ kg$

断面は (HB1) と同じ

$\tau = \frac{28000}{100 \times \frac{7}{8} \times 95} = 3.4\ kg/cm^2$

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断面 I-I

土深 沈下中 8.30m 土圧 沈下中 $W = \frac{2}{3} \times 1000 \times 8.30 =$ 5530 kg/m
〃 〃 沈下停止中 $W' = \frac{1}{3} \times 1900 \times 8.30 =$ 5260 〃
後功程 9.90m 〃 後功程 $\frac{1}{3} \times 1600 \times 1.6 = 840 + 5260 = 6100$ 〃 $= W''$

彎曲率 (撓角 — 32頁参照)

		沈下中応力 ($W=5530$)	後功程応力 ($W''=6100$)
M_B	$= -5.6787 \times 5530 =$	$-31,400$ kgm	$-34,600$ kgm
M_{CL}	$= -3.4006 \times$ 〃 $=$	$-18,830$ 〃	$-20,780$ 〃
M_{CR}	$= -3.2631 \times$ 〃 $=$	-18030 〃	$-19,900$ 〃
M_{CP}	$= -0.1375 \times$ 〃 $=$	-760 〃	-840 〃
M_D	$= -4.0932 \times$ 〃 $=$	-22630 〃	$-24,950$ 〃
M_1	$= 2.3213 \times$ 〃 $=$	12820 〃	$14,150$ 〃
M_2	$= 3.4019 \times$ 〃 $=$	18800 〃	$20,750$ 〃
M_3	$= -1.6067 \times$ 〃 $=$	-8880 〃	-9800 〃
M_1'	$= 3.9068 \times$ 〃 $=$	$21,600$ 〃	$23,800$ 〃

剪力

S_{B1}	$= -4.0000 \times 5530 =$	$-22,100$ kg	$-24,400$ kg	
S_{B2}	$= 4.2616 \times$ 〃 $=$	$23,550$ 〃	$26,000$ 〃	
S_{C2}	$= -3.6884 \times$ 〃 $=$	-20380 〃	$-22,500$ 〃	
S_{C3}	$= 1.8200 \times$ 〃 $=$	$10,050$ 〃	$11,100$ 〃	
S_{D3}	$= -2.2300 \times$ 〃 $=$	-12320 〃	$-13,600$ 〃	
S_{D1}	$= 4.0000 \times$ 〃 $=$	$22,100$ 〃	$24,400$ 〃	

軸力

N_1	$= 4.2616 \times 5530 =$	$23,550$ kg.c	$26,000$ kg.c	A-B
N_2	$= 4.0000 \times$ 〃 $=$	$22,100$ 〃 〃	$24,400$ 〃 〃	B-C
N_3	$= 4.0000 \times$ 〃 $=$	$22,100$ 〃 〃	$24,400$ 〃 〃	C-D
N_4	$= 5.5084 \times$ 〃 $=$	$30,500$ 〃 〃	$33,600$ 〃 〃	C-F
N_1'	$= 2.2300 \times$ 〃 $=$	12320 〃 〃	$13,600$ 〃 〃	D-E

断面 I-I ニ於ケル應力 (後功程ノ応力ヲ以テ計算ス)

(M₁') $M_1' = 23,800$ kgm, $N_1' = 13,600$ kg.c.

$b = 100$ cm $h = 90$ cm
$d = 85$ cm $d' = 5$ cm
$A_s = 6.67 - 19\phi = 18.90$ cm²
$A_s' = 3.33 - 19\phi = 9.45$ 〃
$p = \frac{18.90}{100 \times 85} = 0.00222$
$p' = 0.00111$
$d'/d = 0.059$

$u = 0.504 \times 85 = 42.8$
$d - u = 42.2$ cm

$\frac{M}{N} = \frac{23,800 \times 100}{13,600} = 175.3$ cm
$d - u = \frac{42.2}{217.5}$ cm
$e =$
$e' = e - 80 = 137.5$ 〃
$e'/e = 0.633$
$\frac{Ne}{bd^2} = \frac{13600 \times 217.5}{100 \times 85^2} = 4.100$
$\frac{Ne}{bd^2\sigma_c} = 0.135$ $k = 0.265$
$\sigma_c = \frac{4.100}{0.135} = 30.4$ kg/cm²
$\sigma_s = 15 \times 30.4 \times \frac{0.735}{0.265} = 1262$ 〃

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Ⓑ $M_B = -34.600$ kgm , $N_2 = 24400$ kg.c $S_{B2} = 26000$ kg

$b=100^{cm}$, $h = 90 + \frac{80}{3} = 116$ cm

$d = 111$ cm, $d' = 5$ cm

$A_s = 6.67 - 19\phi = 18.90$ cm²

$A_s' = 3.33 - 19\phi = 9.45$ "

$p = \frac{18.90}{100 \times 111} = 0.00170$

$p' = 0.00085$

$d'/d = 5/111 = 0.045$

$u \fallingdotseq 0.504 \times 116 = 58.5$

$d - u = 52.5$

$\frac{M}{N} = \frac{34600 \times 100}{24400} = 142.0$

$d - u = 52.5$

$e = 194.5$ cm

$e' = e - 106 = 88.5$ "

$e'/e = 0.455$

$\frac{Ne}{bd^2} = \frac{24400 \times 194.5}{100 \times 111^2} = 3.850$

$\frac{Ne}{bd^2\sigma_c} = 0.136$ $k = 0.270$

$\sigma_c = \frac{3.850}{0.136} = 28.3$ kg/cm²

$\sigma_s = 15 \times 28.3 \times \frac{0.730}{0.270} = 1148$ "

$\tau = \frac{26,000}{100 \times \frac{7}{8} \times 111} = 2.7$ kg/cm²

Ⓓ $M_D = -24.950$ kgm , $N_1' = 13,600$ kg,c $S_{D1} = 24400$ kg

$b=100$ cm, $h = 90 + \frac{80}{3} = 116$ cm

$d = 111$ cm, $d' = 5$ cm

$A_s = \begin{cases} 3.33 - 19\phi = 9.45 \\ 3.33 - 16\phi = 6.70 \end{cases}$ 16.15 cm²

$A_s' = 3.33 - 16\phi = 6.70$ "

$p = \frac{16.15}{100 \times 111} = 0.00146$

$p' = \frac{6.70}{100 \times 111} = 0.00060$

$d'/d = 5/111 = 0.045$

$\frac{M}{N} = \frac{24,950 \times 100}{13600} = 183.6$

$d - u = 52.5$

$e = 236.1$ cm

$e' = e - 106 = 130.1$ "

$e'/e = 0.551$

$\frac{Ne}{bd^2} = \frac{13600 \times 236.1}{100 \times 111^2} = 2.610$

$\frac{Ne}{bd^2\sigma_c} = 0.117$ $k = 0.235$

$\sigma_c = \frac{2.610}{0.117} = 2.23$ kg/cm²

$\sigma_s = 15 \times 22.3 \times \frac{0.765}{0.235} = 1090$ "

$\tau = \frac{24400}{100 \times \frac{7}{8} \times 111} = 2.5$ "

(HB2)

$S = 28000 \times \frac{6100}{8200} = 20,800$ kg

$\tau = \frac{20800}{100 \times \frac{7}{8} \times 85} = 2.8$ kg/cm².

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断面 II-II

土深 沈下中 4.00m 土圧 沈下中 $w = \frac{2}{3} \times 1000 \times 4.00 = 2670$ kg/m²
〃 〃 〃 沈下停止中 $w' = 1/3 \times 1900 \times 4.00 = 2530$ 〃

後功格 5.60 〃

$\frac{1}{3} \times 1600 \times 1.6 = 850$
$\frac{1}{3} \times 1900 \times 4.0 = 2530$
$w'' = 3380$ kg/m²

彎曲率

M_B	=	−5.6787	× w''	=	−19,200	kgm
M_{CL}	=	−3.4006	× 〃	=	−11,500	〃
M_{CR}	=	−3.2631	× 〃	=	−11,020	〃
M_{CP}	=	−0.1375	× 〃	=	−470	〃
M_D	=	−4.0932	× 〃	=	−13,850	〃
M_1	=	2.3213	× 〃	=		
M_2	=	3.4019	× 〃	=	11,500	〃
M_3	=	−1.6067	× 〃	=	−5440	〃
M_1'	=	3.9068	× 〃	=	13,200	〃

剪力

S_{B1}	=	−4.0000	× 3380	=	−13,530	kg
S_{B2}	=	4.2616	× 〃	=	14,400	〃
S_{C2}	=	−3.6884	× 〃	=	−12,450	〃
S_{C3}	=	1.8200	× 〃	=	6,150	〃
S_{D3}	=	−2.2300	× 〃	=	7,540	〃
S_{D1}	=	4.0000	× 〃	=	13,530	〃

軸力

N_1	=	4.2616	× 3380	=	14,400	kg, C	A−B
N_2	=	4.0000	× 〃	=	13,530	〃 〃	B−C
N_3	=	4.0000	× 〃	=	13,530	〃 〃	C−D
N_4	=	5.5084	× 〃	=	18,600	〃 〃	C−F
N_1'	=	2.2300	× 〃	=	7,540	〃 〃	D−E

断面 II-II = 於ケル応力

(M₁') $M_1' =$ 13,200 kgm , $N_1' =$ 7,540 kg, C

$\frac{M}{N} = \frac{13200 \times 100}{7540} = 175.3$
$d-u = 42.2$
$e = 217.5$ cm
$e' = 137.5$ 〃
$e'/e = 0.633$
$\frac{Ne}{bd^2} = \frac{7540 \times 217.5}{100 \times 85^2} = 2.270$
$\frac{Ne}{bd^2\sigma_c} = 0.111$ $k = 0.220$
$\sigma_c = \frac{2.270}{0.111} = 20.4$ kg/cm²
$\sigma_s = 15 \times 20.4 \times \frac{0.780}{0.220} = 1087$ kg/cm²

$b = 100$ cm, $h = 90$ cm
$d = 85$ cm, $d' = 5$ cm
$A_s = 4.00 - 19\phi = 11.34$ cm²
$A_s' = 2.00 - 19\phi = 5.67$ 〃
$p = \frac{11.34}{100 \times 85} = 0.00133$
$p' = 0.00067$
$d'/d = 0.059$

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室蘭第一船渠

Ⓑ $M_B = -19{,}200$ kgm, $N_2 = 13530$ kg.c, $S_{B2} = 14400$ kg

$d = 0.504 \times 116 = 58.5$

$d-u = 52.5$

$\frac{M}{N} = \frac{19200 \times 100}{13530} = 141.8$

$d-u = 52.5$

$e = 194.3$ cm

$e' = e - 106 = 88.3$ "

$e'/e = 0.454$

$\frac{Ne}{bd^2} = \frac{13530 \times 194.3}{100 \times 111^2} = 2.135$

$\frac{Ne}{bd^2\sigma_c} = 0.110$ $k = 0.220$

$\sigma_c = \frac{2.135}{0.110} = 19.4$ kg/cm²

$\sigma_s = 15 \times 19.4 \times \frac{0.780}{0.220} = 1033$ kg/cm²

$\tau = \frac{14400}{100 \times \frac{7}{8} \times 111} = 1.5$ "

$b = 100$ cm, $h = 116$ cm

$d = 111$ cm, $d' = 5$ cm

$A_s = 4.00 - 19\phi = 11.34$ cm²

$A_s' = 2.00 - 19\phi = 5.67$ "

$p = \frac{11.34}{100 \times 111} = 0.00102$

$p' = 0.00051$

$d'/d = 5/111 = 0.045$

Ⓓ $M_D = -13{,}850$ kgm, $N_1' = 7540$ kg.c, $S_{D1} = 13530$ kg

$\frac{M}{N} = \frac{13850 \times 100}{7540} = 183.6$

$d-u = 52.5$

$e = 236.1$ cm

$e' = e - 106 = 130.1$

$e'/e = 0.551$

$\frac{Ne}{bd^2} = \frac{7540 \times 236.1}{100 \times 111^2} = 1.445$

$\frac{Ne}{bd^2\sigma_c} = 0.096$, $k = 0.195$

$\sigma_c = \frac{1.445}{0.096} = 15.1$ kg/cm²

$\sigma_s = 15 \times 15.1 \times \frac{0.805}{0.195} = 935$ "

$\tau = \frac{13530}{100 \times \frac{7}{8} \times 111} = 1.4$ "

$b = 100$ cm, $h = 116$ cm

$d = 111$ cm, $d' = 5$ cm

$A_s = \begin{cases} 2.00 - 19\phi = 5.67 \\ 2.00 - 16\phi = 4.02 \end{cases}$ $= 9.69$ cm²

$A_s' = 2.00 - 16\phi = 4.02$

$p = \frac{9.69}{100 \times 111} = 0.00087$

$p' = \frac{4.02}{100 \times 111} = 0.00036$

$d'/d = 0.045$

(H$_{B2}$)

$S = 28000 \times \frac{3380}{8200} = 11530$ kg

$\tau = \frac{11530}{100 \times \frac{7}{8} \times 85} = 1.6$ kg/cm²

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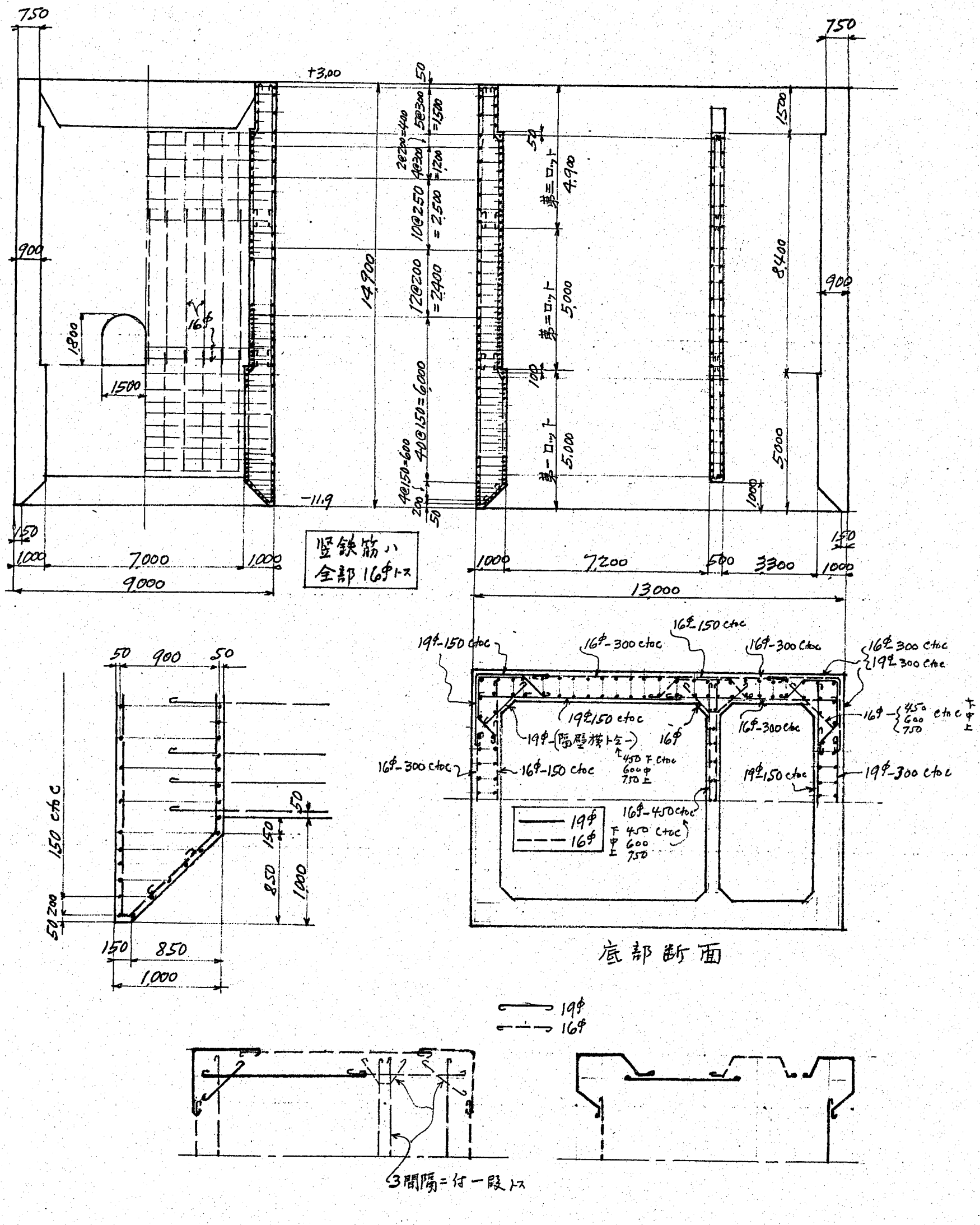
照査 日付 第 41 頁

室蘭第一船渠
ポンプ室用井筒 W6 ノ配筋



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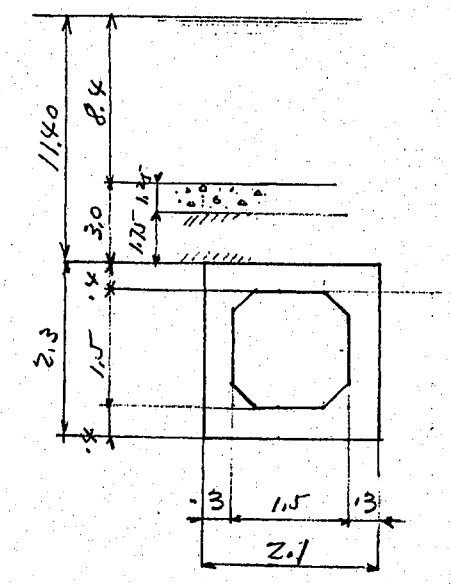
設計 稲葉 日付 16-3-10 類別 応力
照査 日付 第 42 頁

給排水隧道



上床荷重

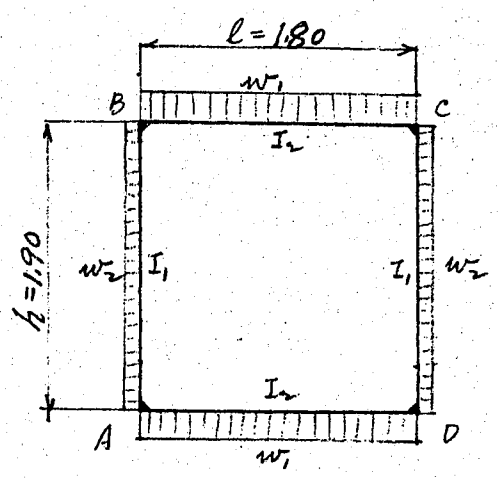
水	8.40 @ 1000 =	8,400
混凝土	1.75 @ 2200 =	2750
土	1.75 @ 1600 =	2,800
床版	0.40 @ 2400 =	960
	w_1 =	14,910 kg/m²

側壁荷重

$$14910 \times \frac{1-\sin 30^\circ}{1+\sin 30^\circ} = \frac{14910}{3} = 4980$$

$$0.75 \times 1600 \times \frac{1}{3} = 400$$

$$w_2 = 5380 \text{ kg/m}$$



$$I_1 = \frac{1.0 \times 0.3^3}{12} = 0.00225 \text{ m}^4 \qquad k_1 = \frac{I_1}{h} = \frac{0.00225}{1.90} = 0.001184$$

$$I_2 = \frac{1.0 \times 0.4^3}{12} = 0.00533 \qquad k_2 = \frac{I_2}{\ell} = \frac{0.00533}{1.80} = 0.002963$$

$$K = \frac{k_2}{k_1} = \frac{0.002963}{0.001184} = 2.5025$$

$$C_1 = \frac{1}{12(1+K)} = \frac{1}{12 \times 3.5025} = 0.02379$$

$$C_2 = \frac{K}{12(1+K)} = \frac{2.5025}{12 \times 3.5025} = 0.05958$$

$$\left.\begin{matrix} M_A \\ M_B \\ M_C \\ M_D \end{matrix}\right\} = -C_1 w_1 \ell^2 - C_2 w_2 h^2$$

$$= -0.02379 \times 14910 \times 1.80^2 - 0.05958 \times 5380 \times 1.90^2$$

$$= -1150 - 1160 = -2310 \text{ kgm}$$

M_1.

$$\frac{w_2 h^2}{8} = \frac{5380 \times 1.90^2}{8} = 2430$$

$$-2310$$

$$M_1 = 120 \text{ kgm}$$

M_2.

$$\frac{w_1 \ell^2}{8} = \frac{14910 \times 1.8^2}{8} = 6040$$

$$-2310$$

$$M_2 = 3730 \text{ kgm}$$

$S_{B2} = 14910 \times 0.90 = 13420$ kg
$S_{B1} = 5380 \times 0.95 = -5110$ "

$N_1 = 13420$ kg. C
$N_2 = 5110$ " C

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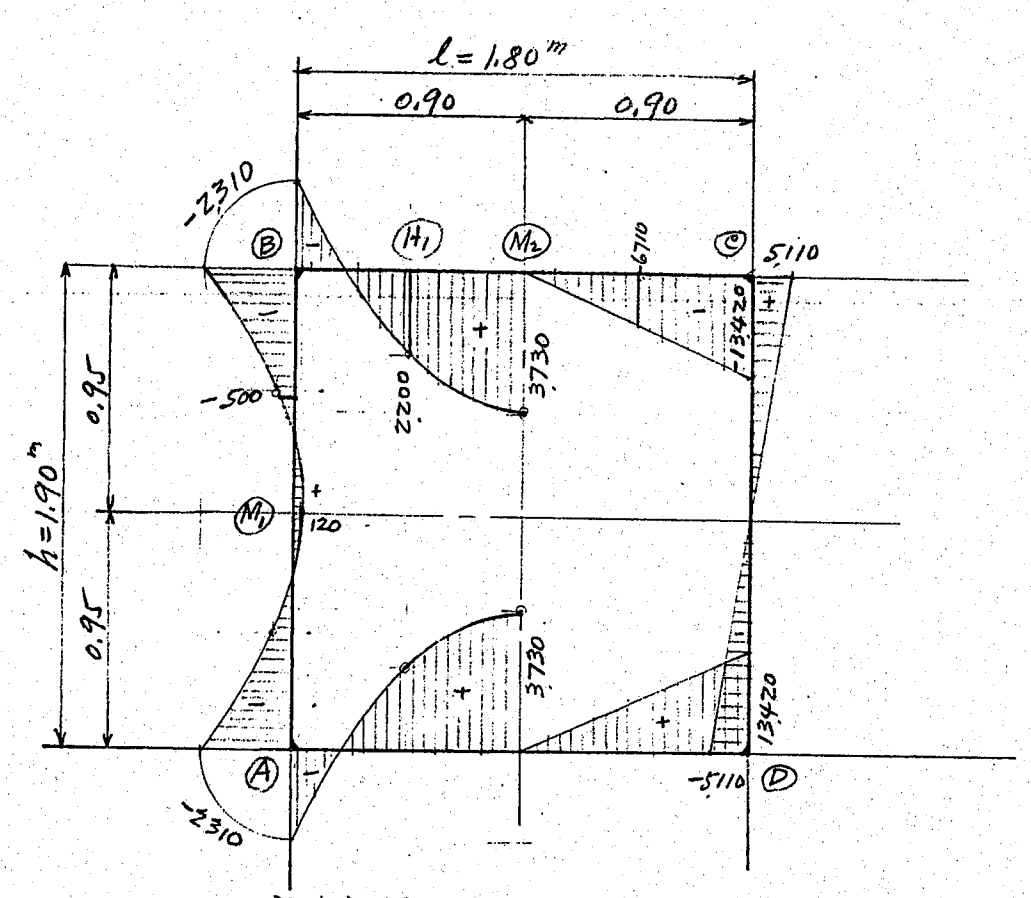
室蘭第一桟橋

彎曲率及剪力圖



彎曲率圖　　剪力圖

尺法 $\frac{1}{200}^{m}$ = 1,000 kgm　　$\frac{1}{100}^{m}$ = 10,000 kg

縮尺 1:30

(M2)　M_2 = 3730 kgm , N_2 = 5110 kg C

$p_0 = \frac{10.06}{100\times40} = 0.00252$

$p_0' = 0.00126$

$d/h = 36/40 = 0.90$

$d'/h = 4/40 = 0.100$

$u/h = 0.506$

$u = 20.2$ cm

$d-u = 15.8$ cm

$\frac{M}{N} = \frac{3730\times100}{5110} = 73.0$

$e = \frac{d-u}{88.8}$ cm

$e' = e-32 = 56.8$ "

$e'/e = 0.640$

$\frac{Ne}{bd^2} = \frac{5110\times88.8}{100\times36^2} = 3.500$

$\frac{Ne}{bd^2\sigma_c} = 0.148$　　$k = 0.295$

$\sigma_c = \frac{3.500}{0.148} = 23.6$ kg/cm²

$\sigma_s = 15\times23.6\times\frac{0.705}{0.295} = 848$ "

$b=100$ cm　$h=40$ cm

$d=36$ cm　$d'=4$ cm

$A_s = 5\text{-}16\phi = 10.06$ cm²

$A_s' = 2.5\text{-}16\phi = 5.03$ "

$p = \frac{10.06}{100\times36} = 0.0028$

$p' = 0.0014$

$d'/d = 4/36 = 0.111$

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室蘭第一桟橋

Ⓐ $M_{A1} = -2310$ kgm, $N_1 = 13420$ kg.c $S_{A1} = 5110$ kg

$\frac{M}{N} = \frac{2310\times100}{13420} = 17.2$

$d-u = 20,3$

$e = 37.5$

$e' = e - 37 = 0.5$

$e'/e = 0.013$

$\frac{Ne}{bd^2} = \frac{13420\times37.5}{100\times41^2} = 3.000$

$\frac{Ne}{bd^2\sigma_c} = 0.218$ $k = 0.500$

$\sigma_c = \frac{3000}{0.218} = 13.8$ kg/cm²

$\sigma_s = 15\times13.8\times\frac{0.5}{0.5} = 207$ 〃

$b=100$, $h = 30 + \frac{45}{3} = 45$ cm
$d = 41$ cm $d' = 4$ cm
$A_s = 5.0 - 12\phi = 5.66$ cm²
$A_s' = 2.5 - 12\phi = 2.83$ 〃
$p = \frac{5.66}{100\times41} = 0.00138$
$p' = 0.00064$
$d'/d = 4/41 = 0.098$

Ⓐ $M_{A2} = -2310$ kgm $N_2 = 5110$ kg.c $S_{A2} = -13420$ kg

$\frac{M}{N} = \frac{2310\times100}{5110} = 45.2$

$d-u = 23.8$

$e = 69.0$ cm

$e' = e - 48 = 21.0$ 〃

$e'/e = 0.305$

$\frac{Ne}{bd^2} = \frac{5110\times69.0}{100\times52^2} = 1.303$

$\frac{Ne}{bd^2\sigma_c} = 0.135$ $k = 0.280$

$\sigma_c = \frac{1.305}{0.135} = 9.7$ kg/cm²

$\sigma_s = 15\times9.7\times\frac{0.72}{0.28} = 373$ 〃

$\tau = \frac{13420}{100\times\frac{7}{8}\times52} = 2.95$ 〃

$b=100$, $h = 40 + \frac{50}{3} = 56$ cm
$d = 52$ cm, $d' = 4$ cm
$A_s = 5.0 - 12\phi = 5.66$ cm²
$A_s' = 2.5 - 12\phi = 2.83$ 〃
$p = \frac{5.66}{100\times52} = 0.00109$
$p' = 0.00055$
$d'/d = 4/52 = 0.077$

Ⓗ $M_{H1} = 2200$ kgm, $N_1 = 5110$ kg c $S = -6700$ kg

$e = \frac{M}{N} = \frac{2200\times100}{5110} = 43.1$ cm

$e/h = \frac{43.1}{40} = 1.078$

$d'/h = 4/40 = 0.100$

$k = 0.230$ $c = 0.075$

$f_c = \frac{N}{bhc} = \frac{5110}{100\times40\times0.075} = 17.1$ kg/cm²

$f_s = nf_c\frac{1-k-d'/h}{k} = 15\times17.1\frac{1-0.23-0.10}{0.230} = 748$ 〃

$\tau = \frac{6700}{100\times\frac{7}{8}\times36} = 2.1$ kg/cm²

$b=100$ cm $h=40$ cm
$d = 36$ cm $d' = 4$ cm
$A_s = 2.5 - 16\phi = 5.03$
$A_s' = 2.5 - 16\phi = 5.03$
$p = p' = \frac{5.03}{100\times40} = 0.00126$
$d'/d = 0.111$

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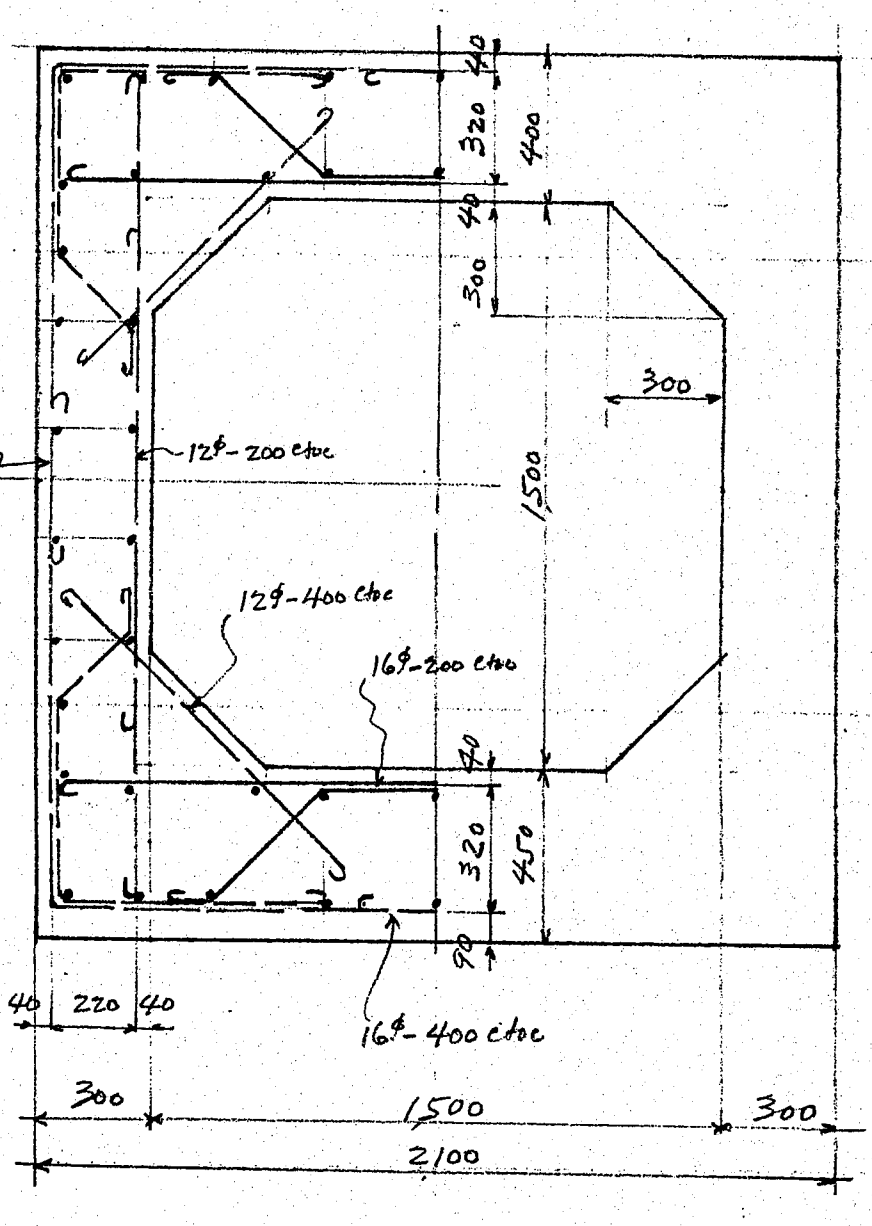
設計 稲葉 日付 13-3-10 類別 応力

照査 日付 第 45 頁

配筋図



—— 16φ
--- 12φ
豎鉄筋 12φ

縮尺 1:20

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設計	日付	類別	
照査	日付	第	頁

昭和十六年二月

函館船渠株式會社

室蘭工場

第一船渠材料調書

（間式井筒工法）

増田橋梁建築設計事務所
東京市品川區五反田五ノ一〇八
電話大崎(49)0678番

設計 橋本 日付 16-2-18 類別 材料
照査 日付 第 1 頁

函館船渠株式会社室蘭第一船渠

材料計算書

渠壁井筒 W1 所要数 38.

井筒混凝土 (1:2:4)

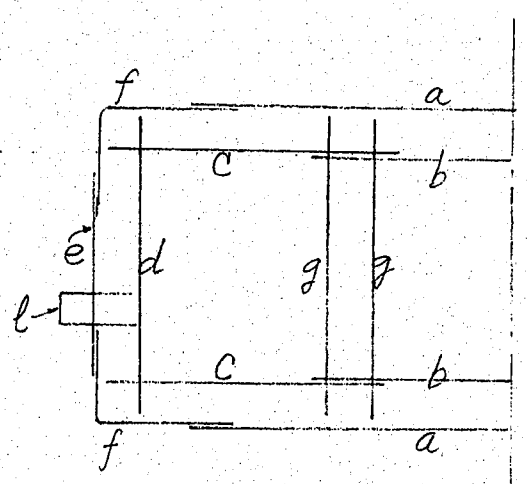
側壁	2.50	× 9.60	× 3.30	=	79.20
〃	−1.90	× 8.80	× 3.70	= −	61.86
〃	2.50	× 9.60	× 6.70 × ½	=	80.40
〃	5.60	× 9.60	× 6.70 × ½	=	180.10
〃	−1.90	× 8.60	× 6.10 × ½	= −	49.84
〃	−4.70	× 8.60	× 6.10 × ½	= −	123.28
〃	5.60	× 9.60	× 1.80	=	96.77
〃	−4.70	× 8.34	× 2.00	= −	78.40
〃	−0.30	× 0.30	× 8.34	= −	0.75
〃	−0.48	× 0.48	× 4.70	= −	1.08
〃	0.30	× 0.30	× 11.50 × 2	=	2.07
〃	0.25	× 0.40	× 11.60 × 2	=	2.32
仕切壁	1.90	× 0.30	× 2.95 × 2	=	3.36
〃	0.30	× 0.30	× 0.30 × 2	=	0.05
〃	½ × 1.90	× 0.30	× 6.10 × 2	=	3.48
〃	½ × 4.70	× 0.30	× 6.10 × 2	=	8.60
〃	4.70	× 0.30	× 1.10 × 2	=	3.10
〃	0.60	× 0.30	× 0.60 × 2	=	0.22
〃	0.30	× 0.30	× 11.00 × 4	=	3.96
					148.42 m³

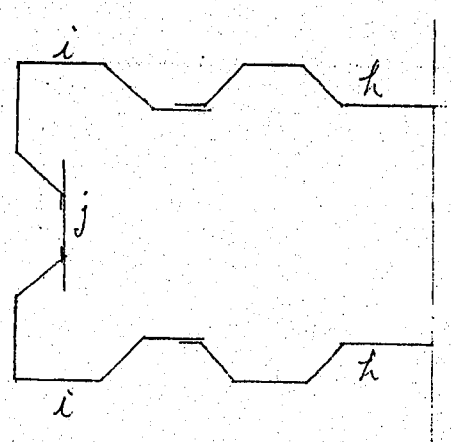
ニレテ 1490 トン米

井筒鐵筋 12mmφ

a	8.40 m	× 16	= 134.40
b	3.50	× 16	= 56.00
c	3.70	× 32	= 118.40
d	2.70	× 16	= 43.20
e	1.60	× 16	= 25.60
f	2.20	× 32	= 70.40
g	2.50	× 24	= 60.00
l	1.90	× 48	= 91.20
h	5.80	× 14	= 81.20
i	4.20	× 28	= 117.60
j	1.10	× 14	= 15.40
空	3.70	× 108	= 399.60
〃	2.80	× 16	= 44.80
			1,257.80 m

0.888 kg × 1,257.80 = 1,117. kg
ニテ 1,120 kg トス





16mmφ

a	8.60 m	× 34	= 292.40
b	3.70	× 34	= 125.80
c	3.90	× 68	= 265.20
d_1	4.30	× 36	= 154.80
d_2	6.00	× 16	= 96.00
e_1	3.60	× 36	= 129.60
e_2	4.90	× 16	= 78.40
f	2.40	× 68	= 163.20
g_1	4.30	× 48	= 206.30
g_2	5.80	× 8	= 46.40

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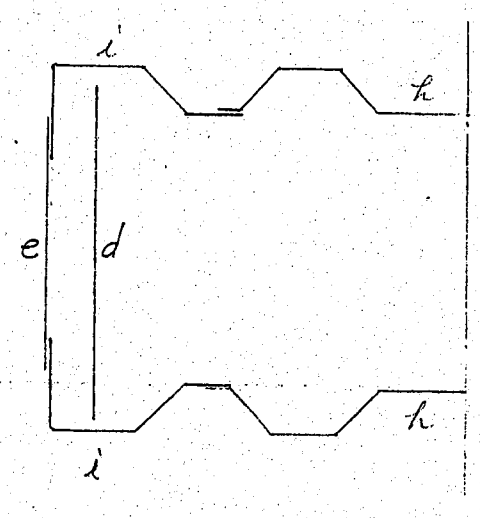
照査　日付　第 2 頁

16mmφ

h_1	6.20 × 22	=	136.40
h_2	6.30 × 6	=	37.80
i_1	4.50 × 92	=	414.00
i_2	4.60 × 36	=	165.60
j_1	3.80 × 22	=	83.60
j_2 竪	4.40 × 12	=	52.80
〃	4.50 × 16	=	72.00
〃	3.10 × 8	=	24.80
〃	4.20 × 32	=	134.40
〃	2.00 × 8	=	16.00
〃	4.50 × 120	=	540.00
〃	5.20 × 140	=	728.00
斜	1.60 × 20	=	32.00
〃	2.30 × 20	=	46.00
〃	2.00 × 8	=	16.00
			4057.50 m

1.58 kg × 4057.50 = 6410 kg
7.527 kg ∴ 7530 kg



井筒型枠

側壁	外	10.10 m × 11.80 m × 2	=	238.36
〃	〃	2.50 × 3.30 × 2	=	16.50
〃	〃	4.05 × 6.70 × 2	=	54.30
〃	〃	5.60 × 1.80 × 2	=	20.16
〃	内	6.40 × 3.30 × 2	=	42.24
〃	〃	6.20 × 6.70 × 2	=	83.10
〃	〃	5.94 × 1.80 × 2	=	21.38
〃	〃	1.30 × 3.30 × 2	=	8.58
〃	〃	2.65 × 6.70 × 2	=	35.50
〃	〃	4.10 × 1.80 × 2	=	14.76
〃	隅	0.42 × 11.50 × 4	=	19.32
〃	底	0.15 × 9.60 × 2	=	2.88
〃	〃	0.15 × 5.30 × 2	=	1.59
仕切壁		1.30 × 2.95 × 4	=	15.33
〃		2.65 × 6.10 × 4	=	64.62
〃		4.10 × 1.10 × 4	=	18.05
〃	隅	0.42 × 12.00 × 8	=	40.30
〃	底	0.30 × 3.50 × 2	=	2.10
〃	〃	0.30 × 0.85 × 4	=	1.02
				700.09 m² ∴ 700. m² トス

底詰混凝土 (1:3:6)

	4.70 m × 7.74 m × 2.50 m	=	90.95
−	0.30 × 0.30 × 2.00 × 6	= −	1.08
	4.70 × 0.30 × 0.90 × 2	=	2.54
	0.13 × 4.10 × 0.70 × 2	=	0.75
			93.16 m³ ∴ 94. m³ トス

中詰石屑及土砂

	3.17 × 8.00 × 5.60	=	142.02
−	0.30 × 0.30 × 7.80 × 6	= −	4.21
	1.90 × 8.20 × 2.20	=	34.28
			172.09 m³ ∴ 172. m³ トス

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上詰混凝土 (1:3:6)

m m m
1.90 × 8.20 × 1.50 = 23.37
1.90 × 0.30 × 0.75 × 2 = 0.86
− 0.30 × 0.30 × 0.30 × 2 = − 0.05
− 0.30 × 0.30 × 0.75 × 6 = − 0.41
23.77 m3 之レヲ 24 m3 トス

木杭　0.30 × 0.10 × 11.50 × 2 = 0.69 m3

ボールト　19mm φ × 550 − 48 本　48 @ 1.50 kg = 72 kg

掘鑿　5.60 × 9.60 × 13.00 = 698.88 m3 之レヲ 699 m3 トス

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設計 稲葉 日付 16-2-20 類別 材料
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函館船渠株式会社室蘭工場

第一船渠

渠端部井筒 W2 所要数 3

井筒混凝土 (1:2:4)

側壁 上	2 @	0.30 × 8.85 × 1.50	=	7.96
〃 〃	2 @	0.40 × 5.00 × 1.50	=	6.00
〃 中	2 @	0.40 × 8.85 × 8.30	=	58.70
〃 〃	2 @	0.50 × 4.80 × 8.30	=	39.85
〃 下	2 @	0.45 × 8.85 × 1.50	=	11.95
〃 〃	2 @	0.63 × 4.70 × 1.50	=	8.88
外口 控除	−	0.30 × 0.30 × 7.91	= (−)	0.71
〃 〃	−	0.48 × 0.48 × 4.90	= (−)	1.13
隔壁	2 @	5.00 × 0.30 × 0.75	=	2.25
〃	2 @	4.80 × 0.30 × 8.30	=	23.90
〃	2 @	4.70 × 0.30 × 0.60	=	1.69
〃 △ 上	2 @	0.30 × 0.30 × 0.30	=	0.05
〃 ▽ 下	2 @	0.45 × 0.30 × 0.45	=	0.12
持送	6 @	0.30 × 0.30 × 10.10	=	5.45
嘴金卷	2 @	0.40 × 0.25 × 11.18	=	2.23

167.19 ㌧ 168 ㌧

井筒鐵筋

主鉄筋 直	38 − 16φ @ 1.58 × 35.5		=	2130
〃 曲	19 − 〃 @ 〃 × 40.0		=	1200
〃 直	19 − 〃 @ 〃 × 23.0		=	690
〃 曲	19 − 〃 @ 〃 × 25.0		=	750
隔壁横	80 − 〃 @ 〃 × 5.8		=	733
斜 ⌐	20 − 〃 @ 〃 × 1.0		=	32
〃 ⌒	20 − 〃 @ 〃 × 2.0		=	63
竪鉄筋	190 − 〃 @ 〃 × 12.0		=	3600

9,198 ㌧ 9,200 ㌧

主鉄筋 直	8 − 12φ @ 0.888 × 35.0		=	249
〃 曲	4 − 〃 @ 〃 × 39.0		=	138
隔壁横	12 − 〃 @ 〃 × 5.7		=	61
竪鉄筋	190 − 〃 @ 〃 × 1.7		=	287
嘴金卷 □	44 − 〃 @ 〃 × 2.0		=	78

813 ㌧ 900 ㌧

10,100 ㎏

井筒型枠

外面		29.90 × 11.3	=	338.0
内面	2 @	7.45 × 0.75	=	11.2
〃 0.75	2 @	4.40 × 0.75	=	6.6
〃	4 @	0.42 × 0.75	=	1.3
〃	2 @	5.65 × 0.75	=	8.5
〃 0.75	6 @	4.40 × 0.75	=	19.8
〃	12 @	0.42 × 0.75	=	3.8

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室蘭第一船渠

内面
内面	8.3	2@ 5.45	×	8.30	=	90.5
〃		6@ 4.20	×	8.30	=	209.0
〃		12@ 0.42	×	8.30	=	41.8
〃	0.6	2@ 5.19	×	0.60	=	6.2
〃		6@ 4.10	×	0.60	=	14.8
〃		12@ 0.42	×	0.60	=	3.0
〃	0.9	2@ 6.99	×	0.90	=	12.6
〃		2@ 4.10	×	0.90	=	7.4
〃		4@ 0.42	×	0.90	=	1.5
底面	ルフ+15		0.30 ×	28.90	=	8.7
〃	(隔壁底)	2@	0.30 ×	5.00	=	3.0

787.7 ㎥ 之ヲ 790 平米トス

井筒底詰混凝土 (1:3:6)

	7.25	× 4.80 ×	1.0	=	34.80
	6.99	× 4.70 ×	0.6	=	19.70
	7.59	× 4.70 ×	0.90	=	32.10
持送控除	-6@ 0.3	× 0.3 ×	1.8	= (−)	0.97
双口					0.71
〃					1.13
隔壁持送控除				(−)	0.12

87.35 之レヲ 88 立米トス

井筒上詰混凝土 (1:3:6)

	8.05	× 5.0 ×	0.75	=	30.20
	-2@ 0.3	× 0.3 ×	0.75	= (−)	0.14
	7.45	× 5.0 ×	0.75	=	27.94
	-6@.3	× .3 ×	0.75	= (−)	0.41
				(−)	0.05

57.54 之レヲ 58 立米トス

井筒中詰 石屑,砂及粘土

	7.25	× 4.80 ×	7.30	=	254.
	-6@ 0.3	× 0.3 ×	7.30	= (−)	4

250 立米

嚙合部木材

	2@ 0.10 × 0.30 × 11.3	=	0.68 立米
鉄附ボルト	46 - 19φ × 550mm @1.5	=	69 瓦

井筒掘鑿　8.85 × 5.6 × 12.5 = 618 立米

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室蘭第一船渠

渠端部井筒 W3 所要数 2

井筒混凝土 (1:2:4)

側壁	上	2 @	0.30	× 10.40 × 3.3	=		20.60
〃	〃	2 @	0.40	× 1.90 × 3.3	=		5.02
〃	中	2 @	0.40	× 10.40 × 6.7	=		55.70
〃	〃	2 @	0.50	× 3.25 × 6.7	=		21.77
〃	下	2 @	0.45	× 10.40 × 1.8	=		16.85
〃	〃	2 @	0.63	× 4.70 × 1.8	=		10.65
水口控除		−	0.3	× 0.3 × 9.7	=	(−)	0.87
〃		−	0.48	× 0.48 × 5.0	=	(−)	1.15
隔壁		2 @	1.90	× 0.3 × 2.85	=		3.25
〃		2 @	3.30	× 0.3 × 6.20	=		12.27
〃		2 @	4.70	× 0.3 × 1.10	=		3.10
〃	上 △	2 @	0.3	× 0.3 × 0.3	=		0.05
〃	下 ▽	2 @	0.45	× 0.3 × 0.45	=		0.12
嗇合部			0.40	× 0.25 × 11.7	=		1.17
〃			1.80	× 0.4 × 3.3	=		2.38
〃			1.03	× 0.4 × 6.7	=		2.76
〃			0.40	× 0.25 × 1.7	=		0.17
持送		4 @	0.3	× 0.3 × 11.0	=		3.96
〃		3 @	0.3	× 0.3 × 11.8	=		3.20

161.00 之ヲ 161 立米トス

井筒鐵筋

井筒 W1 ヨリモ增加スル容積

16φ
2 @ 48 × 0.8 = 77
12 × 10 = 120
6 × 5 = 30
20 × 1.5 = 30
257 m @ 1.58 = 406 之ヲ 410 トス

W1 ト同一ノモノ 6410

16φ 計 6820 kg

12φ
2 @ 21 × 0.8 = 34
12 × 4 = 48
6 × 4 = 24
14 × 2 = 28
134 m @ 0.888 = 119 之ヲ 120 トス

W1 ト同一ノモノ 1,120

12φ 計 1240 kg

W3ノ鉄筋総量 = 8060 kg

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井筒型枠

外面		2 ℄	10.4	× 11.9	=	247.5
〃		2 ℄	2.5	× 3.3	=	16.5
〃		2 ℄	4.05	× 6.7	=	54.3
〃		2 ℄	5.6	× 1.8	=	20.2
〃	嘴金		0.5	× 11.8	=	5.9
〃	〃	2 ℄	1.55	× 3.3	=	10.2
〃	〃	2 ℄	0.78	× 6.7	=	10.4
〃	〃		0.5	× 11.8	=	5.9
内面						
〃	.75	2 ℄	9.00	× 0.75	=	13.5
〃		2 ℄	1.30	× 0.75	=	2.0
〃		4 ℄	0.42	× 0.75	=	1.3
〃	2.85	2 ℄	7.20	× 2.85	=	41.0
〃		6 ℄	1.30	× 2.85	=	22.2
〃		12 ℄	0.42	× 2.85	=	14.4
〃	6.2	2 ℄	7.00	× 6.20	=	86.8
〃		6 ℄	2.70	× 6.20	=	100.5
〃		12 ℄	0.42	× 6.20	=	31.3
〃	1.1	2 ℄	6.74	× 1.10	=	14.8
〃		6 ℄	4.10	× 1.10	=	27.1
〃		12 ℄	0.42	× 1.10	=	5.6
〃	0.9	2 ℄	8.54	× 0.9	=	15.4
〃		2 ℄	4.10	× 0.9	=	7.4
〃		4 ℄	0.42	× 0.4	=	0.7
底面	.15+.15		0.30	× 32.0	=	9.6
〃 (隔壁底)		2 ℄	0.30	× 5.0	=	3.0

767.5 ニヲ 768 平米トス

井筒底詰混凝土 (1:3:6)

		3 ℄	2.847	× 4.7 × 1.6	=	64.30
			9.14	× 4.7 × 0.9	=	38.60
挿送控除	−	6 ℄	0.3	× 0.3 × 2.1	= (−)	1.13
〃					(−)	0.12
丸口						0.87
〃						1.15

103.67 ニレヲ 104 立米トス

井筒上詰混凝土 (1:3:6)

			9.60	× 1.90 × 0.75	=	13.67
			9.00	× 1.90 × 0.75	=	12.83
挿送控除		− 2 ℄	0.3	× 0.3 × 1.50	= (−)	0.27
〃		− 4 ℄	0.3	× 0.3 × 0.95	= (−)	0.34

25.89 ニレヲ 26 立米トス

井筒中詰 石屑 砂及粘土

	9.00	× 1.9	× 2.1	=	36
	8.80	× 3.25	× 5.7	=	163
−6℄	0.3	× 0.3	× 7.8	= (−)	4

195 立米

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室蘭第一船渠

噛合部木材

2@ 0.10 × 0.30 × 11.8 = 0.71 立米
締付ボールト 48 − 19φ × 550mm @1.5 = 72 瓦千
井筒掘鑿 10.4 × 5.6 × 13.0 = 757 立米

渠口井筒 W4 所要数 2.

井筒混凝土 (1:2:4)

側壁	上		9.50 × 0.40 × 1.50	=		5.70
〃	〃		9.5 × 0.7 × 1.5	=		9.95
〃	〃	2@	6.3 × 0.3 × 1.5	=		5.67
〃	中		9.5 × 0.5 × 8.8	=		41.80
〃	〃		9.5 × 0.85 × 8.8	=		71.10
〃	〃	2@	6.05 × 0.4 × 8.8	=		42.6.
〃	下		9.5 × 0.6 × 3.5	=		19.93
〃	〃		9.5 × 1.0 × 3.5	=		33.20
〃	〃	2@	5.8 × 0.5 × 3.5	=		20.30
水口控除		−	0.45 × 0.23 × 8.6	=	(−)	0.89
〃		−	0.85 × 0.43 × 8.6	=	(−)	3.14
〃		− 2@	0.35 × 0.18 × 6.5	=	(−)	0.82
隔壁			8.9 × 0.3 × 0.75	=		2.00
〃			6.0 × 0.3 × 0.75	=		1.35
〃			8.7 × 0.3 × 8.8	=		22.95
〃			5.75 × 0.3 × 8.8	=		15.16
〃			8.5 × 0.3 × 2.6	=		6.63
〃			5.5 × 0.3 × 2.6	=		4.29
〃	上	2@	0.3 × 0.3 × 0.3	=		0.05
〃	下		0.3 × 0.3 × 0.15	=		0.01
〃	〃		0.4 × 0.4 × 0.3	=		0.05
噛合部	⊓	2@	0.4 × 0.25 × 13.7	=		2.74
〃	⌒⌒	3@	0.75 × 0.2 × 13.7	=		6.17
排送		2@	0.3 × 0.3 × 13.0	=		2.34
〃		6@	0.3 × 0.3 × 12.2	=		6.59

315.73 之ヲ 316 立米トス

井筒鐵筋

主鉄筋	直	48 − 16φ × 40.0m	=	1920	
〃	曲	24 − 16φ × 44.0	=	1,056	
〃	直	48 − 〃 × 20.0	=	960	
〃	曲	48 − 〃 × 18.0	=	864	
隔壁横		48 − 〃 × 11.0	=	528	
〃		48 − 〃 × 8.5	=	408	
壁鉄筋		215 − 〃 × 15.0	=	3,225	
斜 〃	⌒	40 − 〃 × 1.5	=	60	
〃 〃	⌒	60 − 〃 × 2.5	=	150	

9,171 m @1.58 = 14,500 kg

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主鉄筋	直	8.—	12φ × 39.0	=	312
〃	曲	4 —	〃 × 43.0	=	172
隔壁横		6 —	〃 × 8.0	=	48
〃		6 —	〃 × 10.0	=	60
壁鉄筋		215 —	〃 × 1.8	=	387
噛合部	コ	60 —	〃 × 2.0	=	120
〃	⊔	90 —	〃 × 2.0	=	180

1279㎜ @ 0.888 = 1140 ミリ 1200 kg/トス
鉄筋 合計 15700 kg

井筒型枠

外面			33.8 × 13.8	=	467.0
〃	噛合部	4 @	0.25 × 13.7	=	13.7
〃	〃	6 @	0.20 × 13.7	=	16.5
内面		2 @	8.30 × 0.75	=	12.5
〃	1.75	2 @	5.70 × 0.75	=	8.6
〃		4 @	0.42 × 0.75	=	1.3
〃		8 @	3.7 × 0.75	=	22.2
〃	0.75	4 @	2.45 × 0.75	=	7.4
〃		4 @	2.35 × 0.75	=	7.1
〃		16 @	0.42 × 0.75	=	5.0
〃		8 @	3.6 × 8.80	=	253.0
〃	8.8	4 @	2.3 × 8.80	=	80.8
〃		4 @	2.25 × 8.80	=	79.2
〃		16 @	0.42 × 8.80	=	59.1
〃		8 @	2.15 × 2.60	=	44.7
〃	2.6	8 @	3.50 × 2.60	=	72.8
〃		16 @	0.42 × 2.60	=	17.5
〃	丸ヒ		1.10 × 30.0	=	33.0
底面	〃		0.15 × 33.8	=	5.1
〃	(隔壁底)		0.30 × 5.8	=	1.7
〃	〃		0.30 × 8.2	=	2.5

1210.7 ミレヲ 1210 平米トス

井筒底詰混凝土 (1:3:6)

	4 @	2.75 × 1.6 × 4.10	=		72.20
		8.50 × 0.9 × 5.8	=		44.35
排送控除	— 8 @	0.3 × 0.3 × 1.6	=	(−)	1.15
〃				(−)	0.01
〃				(−)	0.05
丸ヒ					0.89
〃					3.14
〃					0.82

120.19 ミレヲ 120 立米トス

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室蘭第一船渠

井筒上詰混凝土 (1:3:6)

		8.9 × 0.75 × 6.3	=		42.00
		2@ 4.3 × 0.75 × 2.95	=		19.02
		2@ 4.3 × 0.75 × 3.05	=		19.68
持送控除	−	2@ 0.3 × 0.3 × 1.50	=	(−)	0.27
〃	−	6@ 〃 〃 × 0.95	=	(−)	0.51

79.92 立レ 80.0 立米トス

井筒中詰 石屑,砂及粘土

		2@ 2.90 × 4.2 × 8.8	=		214.20
		2@ 2.85 × 4.2 × 8.8	=		210.80
		4@ 2.75 × 4.1 × 1.0	=		45.10
持送控除	−	8@ 0.3 × 0.3 × 9.8	=	(−)	7.07

463.03 立レ 463.0 立米トス

噛合却 木材	2@ 0.10 × 0.30 × 13.8	=	0.83	立米
締付ボルト	56-19φ × 550	@1.5	= 84	瓩

井筒掘鑿　9.5 × 7.4 × 15.0 = 1055 立米

渠口井筒 W5　所要数量

井筒混凝土 (1:2:4)

側壁 上		2@ 9.5 × 0.40 × 1.5	=		11.40
〃 〃		2@ 10.1 × 0.30 × 1.5	=		9.09
〃 中		2@ 9.5 × 0.5 × 8.8	=		83.60
〃 〃		2@ 9.9 × 0.45 × 8.8	=		78.40
〃 下		2@ 9.5 × 0.6 × 1.5	=		17.10
〃 〃		2@ 9.7 × 0.55 × 1.5	=		16.00
丸口控除	−	0.45 × 0.45 × 8.7	=	(−)	1.76
〃	−	0.40 × 0.40 × 10.0	=	(−)	1.60
隔壁	2@	8.90 × 0.30 × 0.75	=		4.01
〃	2@	8.60 × 0.30 × 8.8	=		45.40
〃	2@	8.40 × 0.30 × 0.6	=		3.02
〃		9.50 × 0.30 × 0.75	=		2.14
〃		9.30 × 0.30 × 8.8	=		24.55
〃		9.10 × 0.30 × 0.6	=		1.64
〃 △上	3@	0.3 × 0.3 × 0.3	=		0.08
〃 ▽下	2@	0.35 × 0.35 × 0.3	=		0.07
〃 〃		0.3 × 0.3 × 0.3	=		0.03
噛合却	2@	0.4 × 0.25 × 11.7	=		2.34
持送	2@	0.3 × 0.3 × 11.3	=		2.04
〃	10@	0.3 × 0.3 × 10.7	=		9.64

307.19 立レ 308.0 立米トス

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宝蘭第一船渠

井筒鐵筋

主鉄筋	直	40 — 16φ	49.0	=	1960
〃	曲	20 — 〃	53.0	=	1060
〃	直	40 — 〃	20.0	=	800
〃	曲	40 — 〃	17.0	=	680
隔壁横		80 — 〃	10.5	=	840
〃		40 — 〃	12.0	=	480
竪鉄筋		310 — 〃	11.5	=	3565
斜	⌋	40 — 〃	1.5	=	60
〃	⌐	100 — 〃	2.5	=	250
					9695 @1.58 = 15,300 kg

主鉄筋	直	8 — 12φ	48.0	=	384
〃	曲	4 — 〃	52.0	=	208
隔壁横		12 — 〃	10.0	=	120
〃	〃	6 — 〃	11.5	=	69
竪鉄筋		310 — 〃	1.8	=	558
嗤合部	⊐	50 — 〃	2.0	=	100
					1439 @0.888 = 1,300 kg
					16,600 kg

井筒型枠

外面		40.8	× 11.8	=	482.0
〃	嗤合部	4@0.25	× 11.7	=	11.7
内面		2@9.5	× 0.75	=	14.3
〃	7.5	2@8.3	× 0.75	=	12.5
〃		4@0.42	× 0.75	=	1.3
〃		8@2.63	× 0.75	=	15.8
〃	7.5	4@2.44	× 〃	=	7.3
〃		12@3.70	× 〃	=	33.3
〃		24@0.42	× 〃	=	7.6
〃		8@2.53	× 8.8	=	178.3
〃	8.8	4@2.44	× 〃	=	85.8
〃		12@3.55	× 〃	=	374.5
〃		24@0.42	× 〃	=	88.6
〃		8@2.43	× 0.6	=	11.7
〃	0.6	4@2.44	× 〃	=	5.9
〃		12@3.45	× 〃	=	24.9
〃		24@0.42	× 〃	=	6.1
〃	9	36.2	× 1.1	=	39.8
底面	刃口	0.15	× 40.8	=	6.1
〃	隔壁	2@0.30	× 8.4	=	5.0
〃	〃	0.30	× 8.5	=	2.6
					1415.1 ニレフ 1415 平米トス

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井筒底詰混凝土 (1:3:6)

		8.40 × 9.7 × 0.9	=		73.48
	4@	3.03 × 4.05 × 0.6	=		29.40
	2@	3.04 × 〃 × 〃	=		14.78
	4@	3.13 × 4.15 × 1.0	=		52.00
	2@	3.04 × 〃 × 〃	=		25.23
持送控除	− 12@	0.3 × 0.3 × 0.6	=	(−)	0.65
〃				(−)	0.07
〃				(−)	0.03
丸口		0.45 × 0.45 × 8.7	=		1.76
〃		0.40 × 0.40 × 10.0	=		1.60

197.50 ニレテ 198 立米トス

井筒上詰混凝土 (1:3:6)

		8.9 × 0.75 × 10.1	=		67.50
	4@	4.3 × 0.75 × 3.23	=		41.70
	2@	4.3 × 0.75 × 3.04	=		19.63
持送控除	− 10@	0.3 × 0.3 × 0.95	=	(−)	0.86
	− 2@	〃 × 〃 × 1.50	=	(−)	0.27

127.70 ニレテ 128 立米トス

井筒中詰石屑.砂及粘土

	4@	3.13 × 4.15 × 7.80	=	404.4
	2@	3.04 × 4.15 × 7.80	=	196.6
持送控除	− 12@	0.3 × 0.3 × 7.80	= (−)	8.4

592.6 ニレテ 593 立米トス

嚙合却木材　2@ 0.10 × 0.30 × 11.80 = 0.71 立米

締付ボルト　48 − 19φ × 550 @1.5 = 72 kg

井筒掘鑿　9.5 × 10.9 × 13.0 = 1347 立米

井筒間隙填充 − { 混凝土 (1:2:4) 8割 / 膠泥 (1:3) 2割

W1. 側
1.50 × 0.40 × 11.80 = 7.08
1.55 × 〃 × 1.80 = 1.12
〃 × 〃 × 6.70 × ½ = 2.08
10.28 × 40 = 411.20

W2. 側
3.02 × 0.40 × 11.30 = 13.65 × 2 = 27.30

W3 側
3.02 × 0.41 × 11.80 = 14.61
1.55 × 3.02 × 3.30 = 15.45
〃 × 〃 × 6.70 × ½ = 15.68
45.74 × 2 = 91.48

W5 側
4.24 × 0.40 × 11.80 = 20.01 × 3 = 60.03

590.01 立米 ニレテ 590. 立米トス

混凝土 (1:2:4)　590 × 0.8 = 472. 立米
膠泥 (1:3)　590 × 0.2 = 118.

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ポンプ室井筒 W6. 所要数 1.

井筒混凝土 (1:2:4)

側壁
9.00 × 13.00 × 14.90 = 1,743.30
− 7.50 × 11.50 × 1.50 = − 129.38
− 7.20 × 11.20 × 8.40 = − 677.38
− 7.00 × 11.00 × 4.15 = − 319.55
− 7.85 × 11.85 × 0.85 = − 79.07
0.30 × 0.30 × 14.05 × 2 = 2.53

仕切壁
0.50 × 7.20 × 8.40 = 30.24
0.50 × 7.00 × 4.00 = 14.00
0.30 × 0.30 × 12.40 × 2 = 2.23
586.92 m3 之レヲ 587. m3 トス

井筒型枠

側壁
44.00 × 14.90 = 656.00
10.90 × 1.50 × 2 = 32.70
6.90 × 1.50 × 2 = 20.70
9.50 × 8.40 × 2 = 159.60
6.60 × 8.40 × 2 = 110.88
9.30 × 5.35 × 2 = 99.51
6.40 × 5.35 × 2 = 68.48
0.15 × 13.00 × 2 = 3.90
0.15 × 8.70 × 2 = 2.61
0.42 × 14.05 × 4 = 23.60

仕切壁
6.60 × 8.40 × 2 = 110.88
6.40 × 4.00 × 2 = 51.20
0.50 × 7.00 = 3.50
0.42 × 12.40 × 4 = 20.83
1,364.39 m2 之レヲ 1,364. m2 トス

井筒鐵筋

主鉄筋 直 96 − 19φ × 54.0 = 5184
〃 曲 46 − 〃 〃 × 58.0 = 2668
7,852 kg @ 2.23 = 17,500

隔壁横 80 − 16φ × 10.5 = 840
堅鉄筋 200 − 〃 × 18.0 = 3600
〃 30 − 〃 × 14.5 = 435
斜鉄筋 ノ 184 − 〃 × 2.0 = 368
〃 ⌐ 92 − 〃 × 3.0 = 276
5,519 kg @ 1.58 = 8,700
26,200 kg

掘鑿

9.00 × 13.00 × 14.90 = 1,743.30 m3 之レヲ 1744. m3 トス

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盤木受金物 所要数 117.

8 L's	100×100×10	@	14.90 kg/m	× 1.800 m	= 215. kg
2 Stiff. L's	90×90×10	@	13.30 kg/m	× 910 m	= 24. kg
2 Web P/s	380×9	@	26.85 kg/m	× 900 m	= 48. kg
4 L's	75×75×9	@	9.96 kg/m	× 700 m	= 28. kg
2 L's	75×75×9	@	〃 kg/m	× 1.000 m	= 20. kg
2 L's	75×75×9	@	〃 kg/m	× 930 m	= 19. kg
4 P/s	200×9	@	14.13 kg/m	× 250 m	= 14. kg
4 P/s	150×9	@	10.60 kg/m	× 230 m	= 10. kg
1 P/	420×9	@	29.67 kg/m	× 600 m	= 18. kg
4 Tie P/s	150×9	@	10.60 kg/m	× 420 m	= 18. kg
2 Tie P/s	200×12	@	18.84 kg/m	× 660 m	= 25. kg
4 Anc. Bolts	25φ×100	@	1.0		= 4. kg
Rivets & Fills					37. kg
					480 kg

総所要量 117@ 480 = 56,160 kg

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給排水隧道. 延長 26m.

混凝土 1:2:4

	2.3 × 0.40	=	0.92
	2.3 × 0.45	=	1.04
2@	1.5 × 0.40	=	1.20
2@	0.25 × 0.25	=	0.13

3.29 × 26.0 = 85.5 ニレテ 86 立米トス

型枠

2@	2.35	=	4.70
3@	1.0	=	3.00
4@	0.35	=	1.40

9.10 × 26.0 = 236.6 ニレテ 237 平米トス

鉄筋

直	60 − 16φ × 12.5	=	750m	
〃	60 − 〃 × 10.0	=	600	
曲	120 − 〃 × 13.5	=	1620	
			2970 @ 1.58 =	4700 kg
斜	240 − 12φ × 1.0	=	240	
縦	40 − 〃 × 30.0	=	1200	
			1440 @ 0.888 =	1,300 kg
				6000 kg

掘鑿 2.3 × 2.35 × 26.0 = 140 立米

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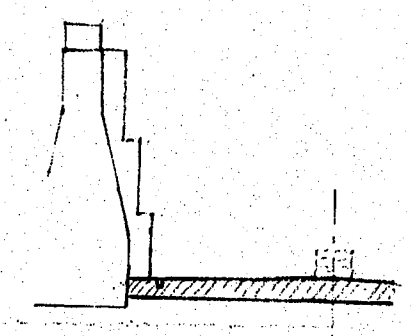
室蘭市-船渠

渠底

渠底混凝土(1:3:6)

	28.20′ × 1.00′ × 180.00′	=		5076.
	〃 × 0.25′ × 〃 × ½′	=		635
排水渠	— 0.30′ × 0.30′ × 179.00′ × 2′	=	−	32
〃	— 〃 × 〃 × 24.20′ × 3′	=	−	7
	28.20′ × 1.90′ × 15.20′	=		815
	— 〃 × 0.25′ × 〃 × ½′	=		54
湍栅壁	1.00′ × 3.00′ × 18.00′	=		54
〃 底	5.00′ × 7.00′ × 2.00′	=		70
				6665 立米



渠底型枠

構造目地用	19 @ 1.125 × 28.2	=	603
排水渠	4 @ 0.3 × 195.0	=	234
〃	6 @ 0.3 × 28.2	=	51
湍栅壁内面	4.0 × 18.0	=	72
			960 平米

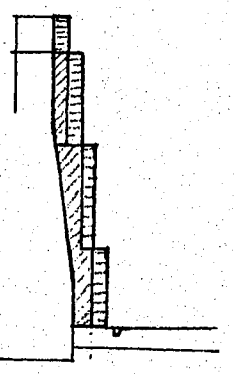
渠底掘鑿

	31.3 × 4.5 × 195.2	=	27500
	29.75 × 6.7 × 195.2	=	38850
	28.2 × 1.0 × 195.2	=	5500
湍栅	28.2 × 0.9 × 15.2	=	390
	5.0 × 4.0 × 7.0	=	140
			72,380 立米

渠側階段

渠側階段混凝土 (1:3:6 二割玉石混入)

第一段(高平均)	2 @ 0.87 × 2.75 × 195.2	=		934
〃 (中 〃)	2 @ 0.315 × 2.75 × 195.2	=		338
第二段	2 @ 0.70 × 4.00 × 195.2	=		1092
〃	2 @ 0.425 × 3.70 × 195.2	=		614
〃	2 @ 0.85 × 0.30 × 195.2	=		100
第三段	2 @ 0.75 × 3.00 × 195.2	=		879
階段 第一段 (平均高)	2 @ 0.80 × 2.75 × 141.2	=		622
〃 第二段	2 @ 0.80 × 4.00 × 115.4	=		739
〃 第三段	2 @ 0.80 × 3.00 × 89.6	=		430
〃 第四段	2 @ 0.80 × 1.20 × 72.2	=		139
				5887 立米



渠側型枠

階段	2 @ 10.95	× 195.2 m	=	4280
〃	2 @ 2.75	× 141.2	=	776
〃	2 @ 4.00	× 115.4	=	924
〃	2 @ 3.00	× 89.6	=	538
〃	2 @ 1.20	× 72.2	=	173
構造目地	2 @ 19	× 10.14 m²	=	386
〃 階段	2 @ 123.1	× 0.8	=	197
				7274 平米

0.87 × 2.75 = 2.39
·315 × 2.75 = 0.87
0.70 × 4.0 = 2.80
·425 × 3.7 = 1.57
·85 × ·3 = 0.26
0.75 × 3.0 = 2.25
10.14 m²

14 @ 2.75 = 38.5 m
12 @ 4.0 = 48.0
9 @ 3.0 = 27.0
8 @ 1.2 = 9.6
123.1 m

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室蘭第一船渠

渠壁天端混凝土 (1:3:6 二割玉石混入)

両側	2@	2.45 × 1.20 ×	195.2	=	1,147
端部		5.60 × 1.20 ×	36.3	=	244
渠口部		9.50 × 1.20 ×	48.7	=	556
					1947 平米

仝上 型枠

両側	4@	1.2 ×	195.2	=	938
〃 構造目地	38@	1.2 ×	2.45	=	112
端部 内面		1.2 ×	31.40	=	38
〃 外面		1.2 ×	36.30	=	44
〃 構造目地及端面	6@	1.2 ×	2.45	=	18
渠口部 陸側		1.2 ×	43.80	=	53
〃 海側		1.2 ×	48.70	=	58
〃 構造目地及端面	7@	1.2 ×	9.50	=	80
					1341 平米

ポンプ室井筒下部混凝土 (1:3:6)

		9.0 × 13.0 ×	8.30	=	972
井筒控除	(−)	5.0 × 1.0 ×	40.0	= (−)	200
隔壁 〃	(−)	4.0 × 0.5 ×	7.0	= (−)	14
水路 〃	(−)	2.5 × 4.0 ×	10.0	= (−)	100
〃 〃	(−)	1.5 × 1.5 ×	2.5	= (−)	6
					652 立米

仝上 型枠

	11.0 × 10.0	=	110
	4.5 × 2.5	=	11
	2.5 × 4.0	=	10
	雑孔		19
			150 平米

仝上 鉄筋　1000 瓩

仝上 掘鑿　9.0 × 13.0 × 3.3 = 386 立米

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室蘭ヲ一船渠

渠口戸當部.

石材

両側	34 @	1.20 × 0.75 × 0.58	=	17.75
底部	1 @	3.00 × 0.50 × 24.0	=	36.00
				53.75 立米

混凝土 (1:3:6)

両側	1.65 × 6.0 × 10.0	=	99.0
底部	6.5 × 0.7 × 26.6	=	121.0
〃	9.5 × 4.3 × 26.6	=	1,086.0
〃	− 2.5 × 0.3 × 26.6	= (−)	20.0
〃	− 3.0 × 1.5 × 26.6	= (−)	119.5
			1,166.5
石材 控除			−54
			1,112.5 立米 ニヲ 1,113 立米トス

型枠

両側	2 @	6.0 × 10.0	=	120
〃	4 @	1.65 × 10.0	=	66
底部 阪		1.2 × 26.6	=	32
〃 離		1.4 × 26.6	=	37
				255 平米

掘鑿 9.5 × 15.0 × 26.6 = 3,790 立米

エイプロン

混凝土(1:3:6)	12.5 × 1.0 × 90.0	=	1,125 立米
掘鑿	12.5 × 12.0 × 100.0	=	15,000 立米

渠口部 假埋立及締切 掘鑿工事 一式、

航路 浚渫工事 一式、

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室蘭第一船渠

附帯工事

渠側敷混凝土

混凝土 (1:3:6)

両側	2@	3.50	× 0.40	× 219.1	=	614.
端部		3.50	× 0.40	× 36.3	=	51
両側	2@	6.50	× 0.25	× 219.1	=	712
端部		6.50	× 0.25	× 43.0	=	70
キャプスタン(10瓲)ボラード	15@	4.0	× 1.50	× 2.0	=	180
キャプスタン 20HP 〃 30HP	4@	4.0	× 3.0	× 2.0	=	96
						1,723 立米

型枠

両側	2@	219.1	× 1.0	=	438
端部		54.8	× 1.0	=	55
キャプスタン, ボラード	15@	11.0	× 2.0	=	330
キャプスタン	4@	14.0	× 2.0	=	112
					935 平米

割栗基礎

2@	219.1	× 0.25 × 9.0	=	986
	36.3	× 0.25 × 9.0	=	82
				1068 立米

掘鑿 1723 + 1068 = 2,791 立米

燈柱	12 基
ボラード	14 〃
10瓲キャプスタン	6 台
20HP 〃	2 〃
30HP 〃	2 〃
クレーン軌條	一式
ポンプ及電導機	一式

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室蘭第一船渠

渠底集水設備

集水管　内至30粍陶管又ハ有孔混凝土管　延 195.2 米

吸水管　内至10粍　〃　〃　〃

19 @ 28.2 = 延 536 米

集水用砕石

吸水管用　19 @ 0.4 × 0.4 × 28.2 = 86

集水管用　0.5 × 0.5 × 195.2 = 49

135 立米

掘鑿 ——— 135 〃

船渠 注水並ニ排水管設備 一式

JIUN MASUDA
CONSULTING ENGINEER
GOTANDA, TOKYO.

CALCULATIONS FOR

MADE BY_____DATE_____FILE NO
CHECKED BY_____DATE_____PAGE NO_____

昭和十三年十二月

日本鉄株式會社

輪西新工場

九米繋船岸壁材料計算書

JIUN MASUDA
CONSULTING ENGINEER
GOTANDA, TOKYO.

MADE BY K. J. DATE 12-12-23 FILE NO 九米
CHECKED BY M. J. DATE 12-12-24 PAGE NO 1

CALCULATIONS FOR
九米繋船壁 材料表

A井筒混凝土

井筒断面積

断面A.

7.50 × 0.20	=	1.50
7.50 × 0.40	=	3.00
3.60 × 0.20 × 2	=	1.44
0.30 × 0.30 × 2	=	0.18
		6.12 m²

断面B.

7.50 × 0.30	=	2.25
7.50 × 0.60	=	4.50
3.30 × 0.30 × 3	=	2.97
0.30 × 0.30 × 4	=	0.36
		10.08 m²

断面C

7.50 × 0.45	=	3.38
7.50 × 0.60	=	4.50
3.15 × 0.45 × 2	=	2.84
3.15 × 0.30	=	0.95
0.30 × 0.30 × 4	=	0.36
		12.03 m²

平均 11.06 m²

断面D

7.50 × 0.325 × 2	=	4.88
3.55 × 0.325 × 2	=	2.31
		7.19 m²

断面E

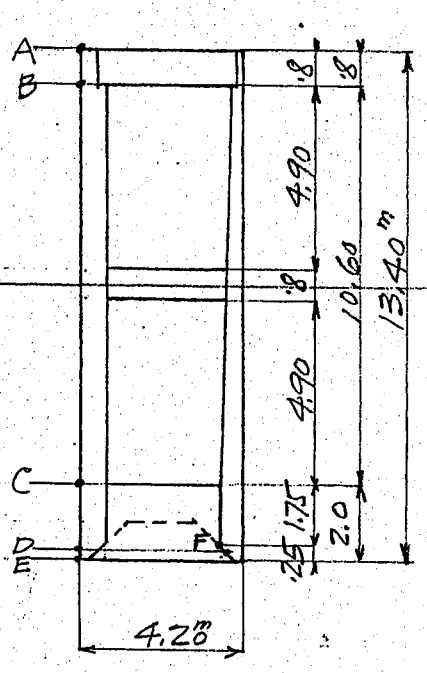
7.50 × 0.20 × 2	=	3.00
3.80 × 0.20 × 2	=	1.52
		4.52 m²

空虚面積
7.50 × 4.20 = 31.50
−6.12
25.38 m²

空虚面積
31.50 − 11.06 = 20.44 m²

31.50 − 12.03 = 19.47 m²

空虚面積
31.50 − 7.19 = 24.31 m²



井筒混凝土　配合 1:2:4

A B 間		6.12	× 0.80 =	4.90
B C 間		11.06	× 10.60 =	117.24
C F 間	(約)	12.03	× 1.75 =	21.05
F E 間		7.19	× 0.25 =	1.80
噛合		0.40 × 0.22 × 13.3 × 4	=	4.68
〃	(約)	0.40 × 0.15 × 1.30 × 20	=	1.56
隔壁底部差引	(約)	2.50 × 0.30 × 0.75	= (−)	0.56
				150.67 m³

中詰混凝土　配合 1:2:4

上部	25.38	× 0.80 =	20.30
中部	20.44	× 0.80 =	16.35
底部	19.47	× 1.75 =	34.07
〃	24.31	× 0.25 =	6.08
隔壁底部欠所		(+)	0.56
			77.36 m³

中詰砂　20.44 × 9.80 = 200. m³

JIUN MASUDA
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MADE BY K. I. DATE 12-12-23 FILE NO 九米
CHECKED BY M. J. DATE 12-12-24 PAGE NO 2

CALCULATIONS FOR
九米繋船壁材料表

A井筒型枠

井筒内面周長

断面 A

6,50	× 2	=	13,00	
3,00	× 2	=	6,00	
0,42	× 4	=	1,68	
				20,68 m

断面 B

2,70	× 4	=	10,80	
2,70	× 4	=	10,80	
0,42	× 8	=	3,36	
				24,96 m

断面 C

2,55	× 4	=	10,20	
2,55	× 4	=	10,20	
0,42	× 8	=	3,36	
				23,76 m

平均 24,36 m

断面 D

6,85	× 2	=	13,70	
3,55	× 2	=	7,10	
				20,80 m

井筒外面周長

7,50	× 2	=	15,00	
4,20	× 2	=	8,40	
0,22	× 8	=	1,76	
約 0,15	× 8 ÷ 2	=	0,60	
				25,76 m

井筒型枠

内面 AB間		20,68 × 0,80	=	16,54
〃 BC 〃		24,36 × 10,60	=	258,22
〃 CF 〃		23,76 × 1,75	=	41,58
〃 FE 〃		20,80 × 0,35	=	7,28
底面 E			=	4,52
隔壁下部差引	約	2,50 × 0,75 × 2	=	(−) 3,75
〃 底面		1,80 × 0,30	=	(+) 0,54
〃 〃		1,06 × 0,30 × 2	=	(+) 0,64
外面		25,76 × 13,40	=	345,18
				670,75 m²

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MADE BY K. J. DATE 12-12-22 FILE NO 九米
CHECKED BY M. J. DATE 12-12-24 PAGE NO 3

CALCULATIONS FOR
九米繋船壁材料表

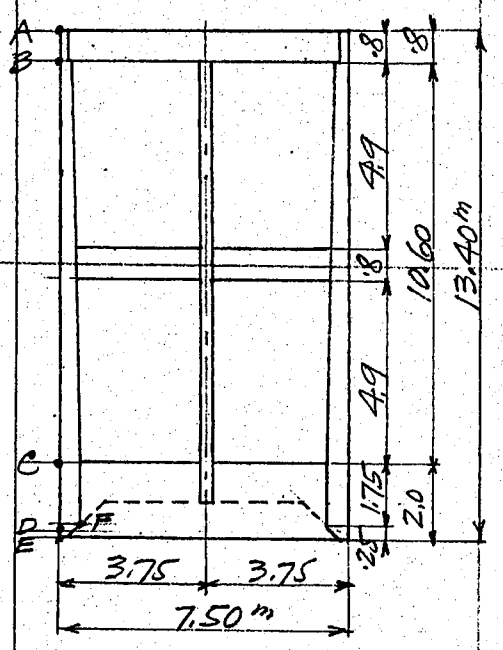
B井筒混凝土

井筒断面積

断面A

12.00 × 0.20 × 2 = 4.80
7.10 × 0.20 = 1.42
7.10 × 0.40 = 2.84
0.30 × 0.30 × 2 = 0.18
9.24 m²

空虚面積
12.0×7.5 = 90.00
− 9.24
80.76 m²



断面B.

12.00 × 0.30 × 3 = 10.80
3.30 × 0.30 × 6 = 5.94
3.30 × 0.60 × 2 = 3.96
0.30 × 0.30 × 12 = 1.08
21.78 m²

断面C.

12.00 × 0.45 × 2 = 10.80
12.00 × 0.30 = 3.60
3.15 × 0.45 × 2 = 2.84
3.15 × 0.60 × 2 = 3.78
3.15 × 0.30 × 4 = 3.78
0.30 × 0.30 × 12 = 1.08
25.88 m²

平均 23.83 m²

空虚面積
90.0 − 23.83 = 66.17 m²

90.0 − 25.88 = 64.12 m²

断面D.

12.00 × 0.325 × 2 = 7.80
6.85 × 0.325 × 2 = 4.45
12.25 m²

空虚面積
90.0 − 12.25 = 77.75 m²

断面E.

12.00 × 0.20 × 2 = 4.80
7.10 × 0.20 × 2 = 2.84
7.64 m²

井筒混凝土　配合 1:2:4

AB間		9.24	× 0.80 =	7.39
BC間		23.83	× 10.60 =	252.60
CF間	約	25.88	× 1.75 =	45.29
FE間		12.25	× 0.25 =	3.06
噛合		0.40 × 0.22 × 13.3 × 4	=	4.68
〃		0.40 × 0.15 × 1.30 × 10	=	0.78
隅壁底部差引		2.78 × 0.30 × 0.75 × 4	=	(−) 2.50
〃 〃 〃		10.35 × 0.30 × 0.75	=	(−) 2.33

308.97 m³

中詰混凝土　配合 1:2:4

上部	80.76	× 0.80 =	64.61
中部	66.17	× 0.80 =	52.94
底部	64.12	× 1.75 =	112.21
〃	77.75	× 0.25 =	19.44
隅壁底部鉄所		=	(+) 2.50
〃 〃 〃		=	(+) 2.33

254.03 m³

中詰砂

所要	66.17 × 9.80 × 2/3 =	432	m³
中詰砂混り鉱滓 所要	66.17 × 9.80 × 1/3 =	216	m³

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MADE BY K. J. DATE 12-12-22 FILE NO 九米
CHECKED BY M. J. DATE 12-12-25 PAGE NO 4

CALCULATIONS FOR
九米 繋船岸壁材料表

B井筒型枠
井筒内面周長
断面A

10.80	×	2	=	21.60
6.50	×	2	=	13.00
0.42	×	4	=	1.68
				36.28 m

断面B.

3.00	×	8	=	24.00
2.70	×	4	=	10.80
2.70	×	12	=	32.40
0.42	×	24	=	10.08
				77.28 m

断面C

2.85	×	4	=	11.40
3.00	×	4	=	12.00
2.70	×	4	=	10.80
2.55	×	12	=	30.60
0.42	×	24	=	10.08
				74.88 m

} 平均 = 76.08 m

断面D.

11.35	×	2	=	22.70
6.85	×	2	=	13.70
				36.40 m

井筒外面周長

12.00	×	2	=	24.00
7.50	×	2	=	15.00
0.22	×	8	=	1.76
約 0.15	×	4+2	=	0.30
				41.06 m

井筒型枠

内面 AB 間		36.28	× 0.80	=	29.02
〃 BC 〃		76.08	× 10.60	=	806.45
〃 CF 〃	(約)	74.88	× 1.75	=	131.04
〃 FE 〃		36.40	× 0.35	=	12.74
底面 E				=	7.64
隔壁下部気引	(約)	2.78	× 0.75 × 8	=	(−) 16.68
〃 〃	〃	10.35	× 0.75 × 2	=	(−) 15.53
〃 底面	〃	2.40	× 0.30 × 4	=	(+) 2.88
〃 〃	〃	9.60	× 0.30 × 1	=	(+) 2.88
〃 〃		1.06	× 0.30 × 6	=	(+) 19.08
外面		41.06	× 13.4	=	550.20
					1529.72 m²

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MADE BY 12-12-22 DATE M.J FILE NO 九米
CHECKED BY 12-12-24 DATE K.J. PAGE NO 5

CALCULATIONS FOR

九米繫船壁材料表

A井筒鐵筋

記號	直徑	員数	長	單位重量	一本重量	總重量	摘要
A 1	16mm	79	6.750m	1.58kg	10.67kg	842.9	前後壁 横筋
A 2	〃	79	7.700	〃	12.17	961.4	〃 〃 〃
A 3	〃	20	6.250	〃	9.88	197.6	前壁 〃
A 4	12	8 -	6.550	0.888	5.82	46.6	前後壁 〃
A 5	〃	10	7.600	〃	6.75	67.5	〃 〃 〃
A 6	16	64	6.450	1.58	10.19	652.2	側壁 〃
A 7	〃	94	4.350	〃	6.87	645.8	側隔壁 〃
A 8	〃	22	3.650	〃	5.77	126.9	頂壁 〃
A 9	〃	16	3.600	〃	5.69	91.0	〃 〃 〃
A 10	〃	12	3.550	〃	5.61	67.3	〃 〃 〃
A 11	12	8	6.350	0.888	5.64	45.1	〃 〃
A 12	〃	64	4.250	〃	3.77	241.3	側隔壁 〃
A 13	16	22	3.100	1.58	4.90	107.8	側壁 〃
A 14	〃	16	3.000	〃	4.74	75.8	〃 〃 〃
A 15	〃	12	2.900	〃	4.58	55.0	〃 〃 〃
A 16	〃	22	2.850	〃	4.50	99.0	後壁 〃
A 17	〃	16	2.750	〃	4.35	69.6	〃 〃 〃
A 18	〃	12	2.650	〃	4.19	50.3	〃 〃 〃
A 19	〃	11	2.700	〃	4.27	47.0	〃 〃 〃
A 20	〃	8	2.600	〃	4.11	32.9	〃 〃 〃
A 21	〃	6	2.500	〃	3.95	23.7	〃 〃 〃
A 22	〃	27	2.550	〃	4.03	108.8	隔壁 斜筋
A 23	12	13	2.450	0.888	2.18	28.3	〃 〃 〃
A 24	〃	8	2.200	〃	1.95	15.6	〃 〃 〃
A 25	〃	7	2.000	〃	1.78	12.5	〃 〃 〃
A 26	16	56	1.450	1.58	2.29	128.2	前壁 〃
A 27	12	60	1.300	0.888	1.15	69.0	側壁 〃
A 28	〃	10	1.050	〃	0.93	9.3	側隔壁 斜及竪筋 〃
A 29	16	18	5.850	1.58	9.24	166.3	前壁 竪筋
A 30	〃	72	5.150	〃	8.14	586.1	〃 〃 〃
A 31	〃	18	4.900	〃	7.74	139.3	〃 〃 〃
A 32	〃	12	3.400	〃	5.37	64.4	〃 〃
A 33	12	34	5.550	0.888	4.93	167.6	側,後壁 〃
A 34	〃	140	4.950	〃	4.40	616.0	側,後隔壁 〃
A 35	〃	48	5.050	〃	4.48	215.0	側,後壁 〃 〃
A 36	〃	20	3.300	〃	2.93	58.6	〃 〃
A 37	〃	44	4.800	〃	4.26	187.4	側後隔壁 〃
A 38	〃	34	2.050	〃	1.82	61.9	側後壁 〃
A 39	〃	4	4.400	〃	3.91	15.6	隔壁 〃
A 40	〃	6	3.950	〃	3.51	21.1	〃 〃 〃
A 41	〃	4	2.150	〃	1.91	7.6	〃 双口 〃
A 42	〃	32	2.400	〃	2.13	68.2	側壁突起部
A 43	〃	8	2.600	〃	2.31	18.5	〃 〃
A 44	〃	240	1.400	〃	1.24	297.6	〃 〃
A 45	〃	100	1.300	〃	1.15	115.0	〃 〃 〃
A 46	〃	16	2.100	〃	1.86	29.8	前壁 竪筋
						7754.4	計

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MADE BY M.J DATE 12-12-21 FILE NO 九米
CHECKED BY K.I DATE 12-12-25 PAGE NO 6

CALCULATIONS FOR

九米繋船壁材料表

B井筒鐵筋

記號	直徑	員数	長 m	單位重量 kg	一本重量 kg	總重量	摘要
B 1	16mm	158	6.300	1.58	9.95	1,572.1	前後壁横筋
B 2	〃	20	3.900	〃	6.16	123.2	前壁 横筋
B 3	〃	10	5.700	〃	9.01	90.1	〃
B 4	〃	79	7.650	〃	12.09	955.1	前後壁横筋
B 5	12	16	5.700	0.888	5.06	81.0	〃
B 6	〃	10	7.550	〃	6.70	67.0	〃
B 7	16	128	5.550	1.58	8.77	1,122.6	側壁 横筋 〃
B 8	〃	176	6.550	〃	10.35	1821.6	側隔壁 〃 〃
B 9	12	16	5.350	0.888	4.75	76.0	側壁 〃 〃
B 10	〃	112	6.400	〃	5.68	636.2	側隔壁 〃 〃
B 11	16	22	3.600	1.58	5.69	125.2	側壁 〃
B 12	〃	16	3.550	〃	5.61	89.8	〃 〃 〃
B 13	〃	12	3.500	〃	5.53	66.4	〃 〃 〃
B 14	〃	44	2.900	〃	4.58	201.5	〃 〃
B 15	〃	32	2.850	〃	4.50	144.0	〃 〃 〃
B 16	〃	24	2.750	〃	4.35	104.4	〃 〃 〃
B 17	〃	44	3.000	〃	4.74	208.6	〃 〃 〃
B 18	〃	32	2.900	〃	4.58	146.6	〃 〃 〃
B 19	〃	24	2.800	〃	4.42	106.1	〃 〃 〃
B 20	〃	33	2.800	〃	4.42	145.9	後壁 〃 〃
B 21	〃	24	2.700	〃	4.27	102.5	〃 〃 〃
B 22	〃	18	2.600	〃	4.11	74.0	〃 〃 〃
B 23	〃	22	3.200	〃	5.06	111.3	〃 〃
B 24	〃	16	3.100	〃	4.90	78.4	〃 〃 〃
B 25	〃	12	3.000	〃	4.74	56.9	〃 〃 〃
B 26	12	88	4.850	0.888	4.31	379.3	隔壁 〃
B 27	〃	88	3.400	〃	3.02	265.8	〃 〃 〃
B 28	16	27	2.550	1.58	4.03	108.8	前壁 斜筋
B 29	〃	56	1.450	〃	2.29	128.2	〃 〃
B 30	12	60	1.300	0.888	1.15	69.0	前後壁 〃 〃
B 31	〃	65	2.450	〃	2.18	141.7	隔壁 斜筋
B 32	〃	40	2.200	〃	1.95	78.0	隔側壁 〃 〃
B 33	〃	123	2.000	〃	1.78	218.9	〃 〃 〃
B 34	〃	10	1.050	〃	.93	9.3	後隔壁 〃
B 35	16	16	5.850	1.58	9.24	147.8	前壁 竪筋
B 36	〃	76	5.150	〃	8.14	618.6	〃 〃
B 37	〃	16	4.900	〃	7.74	123.8	〃 〃 〃
B 38	12	16	2.100	0.888	1.86	29.8	〃 〃
B 39	16	14	3.400	1.58	5.37	75.2	〃 〃
B 40	12	62	5.550	0.888	4.93	305.7	側後壁 〃
B 41	〃	320	4.950	〃	4.40	1408.0	側後隔壁 〃
B 42	〃	60	3.300	〃	2.93	175.8	側後壁 〃
B 43	〃	90	5.050	〃	4.48	403.2	〃 〃
B 44	〃	140	4.800	〃	4.26	596.4	側後隔壁 〃
B 45	〃	74	2.050	〃	1.82	134.7	側後壁 〃
B 46	〃	12	4.400	〃	3.91	46.9	隔壁 〃
B 47	〃	66	3.950	〃	3.51	231.7	〃 〃 〃
B 48	〃	12	2.150	〃	1.91	22.9	〃 斜筋 〃
B 49	〃	8	1.100	〃	.98	7.8	側壁 突部
B 50	〃	16	1.200	〃	1.07	17.1	〃 〃
B 51	〃	52	1.300	〃	1.15	59.8	〃 〃
B 52	〃	224	1.400	〃	1.24	277.8	〃 〃
B 53	〃	4	2.400	〃	2.13	8.5	〃 〃
B 54	〃	16	2.400	〃	2.13	34.1	〃 〃
						14,431.1	計

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MADE BY K. J DATE 12-12-23 FILE NO 九米
CHECKED BY M. J. DATE 12-12-25 PAGE NO 7

CALCULATIONS FOR
九米繋船壁材料表

土留混凝土	配合 1:3:6		
〃 型枠	3.15×3.10×400 =	3906.00	m3
〃 構造目地	6.35×400 =	2540.00	m2
		51	個所
井筒嵌合部土填充モルタル	配合 1:2		
	約 2.14×0.35×10.50 =	7.86	m3
〃 〃 木			
	25cm×10cm×延長 13.4 m 1モ1 一ケ所=付 四 挺		
井筒沈下掘鑿			
井筒A.			
	4.20×7.50×13.8 =	435	
	0.50×0.22×13.8×4 =	6	
		441	m3
井筒B.			
	7.50×12.00×13.8 =	1,242	
	0.50×0.22×13.8×4 =	6	
		1,248	m3
井筒頂上土留工	裏詰砂泥り鉱滓		
A井筒上	1.20×3.10×8.20 =	31	m3
B井筒上	9.00×3.10×7.50 =	209.	m3
繋船柱		26	個所
繋船環		25	〃
鉄梯子		8	個所
緩衝材	延長	400	米

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MADE BY K. J. DATE 12-12-23 FILE NO 九米
CHECKED BY 増川, J. DATE 12-12-25 PAGE NO 8

CALCULATIONS FOR
九米繋船壁材料表

九米繋船岸壁材料總括表.

岸壁延長 400米分

井筒混凝土	配合 1:2:4			
A 井筒	25基 @ 150.67	=	3766.75	
B 井筒	26基 @ 308.97	=	8033.22	
		計	11,799.97	立米
井筒中詰混凝土	配合 1:2:4			
A 井筒	25基 @ 77.36	=	1934.00	
B 井筒	26 〃 @ 254.03	=	6604.78	
		計	8,538.78	立米
井筒中詰砂				
A 井筒	25基 @ 200	=	5,000	
B 井筒	26 〃 @ 432	=	11,232	
		計	16,232	立米
井筒中詰砂混り鉱滓				
B 井筒	26基 @ 216	=	5,616	立米
井筒鉄筋				
A 井筒	25基 @ 7,754.4	=	193,860.0	
B 井筒	26基 @ 14,431.1	=	375,208.6	
			569,068.6	瓦
井筒型枠				
A 井筒	25基 @ 670.75	=	16,768.8	
B 井筒	26 〃 @ 1,529.72	=	39,772.7	
			56,541.5	平米
土留工混凝土	配合 1:3:6		3,906.00	立米
〃 型枠			2,540.0	平米
〃 構造目地			51	個所
井筒噛合部填充モルタル				
	51個所 @ 7.86	=	400.86	立米
〃 〃 楯木	25cm×10cm× 延長 13.4m 1モル(ボルト共)		204	挺
井筒沈下掘鑿				
A 井筒	25基 @ 441	=	11,025	
B 井筒	26 〃 @ 1,248	=	32,448	
			43,473	立米
井筒頂上土留工裏詰砂混り鉱滓				
A 井筒	25基 @ 31	=	775	
B 井筒	26 〃 @ 209	=	5,434	
			6,209	立米
繋船柱	(附属ボルト共)		26	個所
繋船環	(〃)		25	〃
鉄梯子	(附属金物共)		8	〃
緩衝材	(附属金物共)	延長	400	米

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CALCULATIONS FOR

MADE BY_____ DATE_____ FILE NO

CHECKED BY_____ DATE_____ PAGE NO_____

昭和十二年十二月

日本製鉄株式會社
輪西新工場

七米繋船岸壁材料計算書

JIUN MASUDA
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MADE BY K. J. DATE 12-12-22 FILE NO 七朱
CHECKED BY M. J. DATE 12-12-24 PAGE NO 1

CALCULATIONS FOR
七朱繁船壁材料表

A井筒混凝土

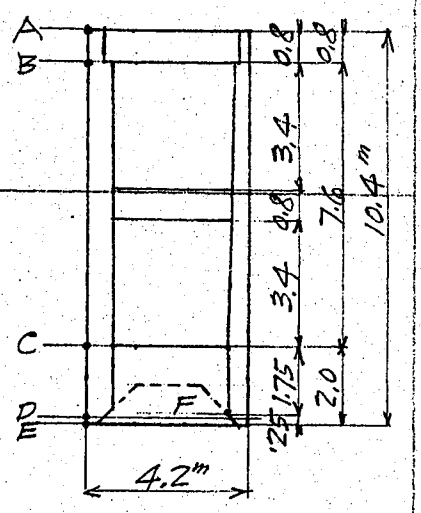
井筒断面積

断面 A

9.54×0.20	=	1.91
9.54×0.40	=	3.82
3.60×0.20	=	0.72
3.60×0.20	=	0.72
0.30×0.30×2	=	0.18
		7.35 m²

空虚面積

9.54×4.20 = 40.07
− 7.35
32.72 m²



断面 B

9.54×0.30	=	2.86
9.54×0.60	=	5.72
3.30×0.30×4	=	3.96
0.30×0.30×6	=	0.54
		13.08 m²

断面 C

9.54×0.45	=	4.29
9.54×0.60	=	5.72
3.15×0.45×2	=	2.84
3.15×0.30×2	=	1.89
0.30×0.30×6	=	0.54
		15.28 m²

平均 14.18 m²

空虚面積
40.07−14.18 = 25.89 m²

40.07−15.28 = 24.79 m²

断面 D

9.54×0.325×2	=	6.20
3.55×0.325×2	=	2.31
		8.51 m²

空虚面積
40.07−8.51 = 31.56 m²

断面 E

9.54×0.20×2	=	3.82
3.80×0.20×2	=	1.52
		5.34 m²

井筒混凝土　配合 1:2:4

AB 間		7.35	× 0.80	=	5.88
BC 間		14.18	× 7.60	=	107.77
CF 間	(約)	15.28	× 1.75	=	26.74
FE 間		8.51	× 0.25	=	2.13
嵌合		0.40×0.18×10.3×4		=	2.97
〃	(約)	0.40×0.12×1.30×16		=	1.00
隔壁底部差引	(約)	2.50×0.75×0.30×2		= (−)	1.13
					145.36 m³

中詰混凝土　配合 1:2:4

上部	32.72	× 0.80	= 26.18
中部	25.89	× 0.80	= 20.71
底部	24.79	× 1.75	= 43.38
〃	31.56	× 0.25	= 7.89
隔壁底部缺所			= (+) 1.13
			99.29 m³

中詰砂　25.89 × 6.80 = 176. m³

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CHECKED BY M. J. DATE 12-12-24 PAGE NO 2

CALCULATIONS FOR
七米繋船壁材料表

A 井筒型枠

井筒内面周長

断面 A

8.54	× 2	=	17.08
3.00	× 2	=	6.00
0.42	× 4	=	1.68
			24.76 m

断面 B

2.18	× 6	=	13.08
2.70	× 6	=	16.20
0.42	× 12	=	5.04
			34.32 m

断面 C

2.03	× 4	=	8.12
2.18	× 2	=	4.36
2.55	× 6	=	15.30
0.42	× 12	=	5.04
			32.82 m

平均 33.57 m

断面 D

8.89	× 2	=	17.78
3.55	× 2	=	7.10
			24.88 m

井筒外面周長

9.54	× 2	=	19.08
4.20	× 2	=	8.40
0.18	× 8	=	1.44
(約) 0.12	× 8 ÷ 2	=	0.48
			29.40 m

井筒型枠

内面 AB	間		24.76	× 0.80	= 19.81
〃 BC	〃		33.57	× 7.60	= 255.13
〃 CF	〃	(約)	32.82	× 1.75	= 57.44
〃 FE	〃		24.88	× 0.35	= 8.71
底面 E					5.34
隔壁下部差引		(約)	2.50 × 0.75 × 4		= (−) 7.50
〃 〃 底面			0.30 × 1.80 × 2		= (+) 1.08
〃 〃 〃		(約)	0.30 × 1.06 × 4		= (+) 1.27
外面			29.40 × 10.40		= 305.76

647.04 m²

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CALCULATIONS FOR
七米繋船壁材料表

B井筒 混凝土

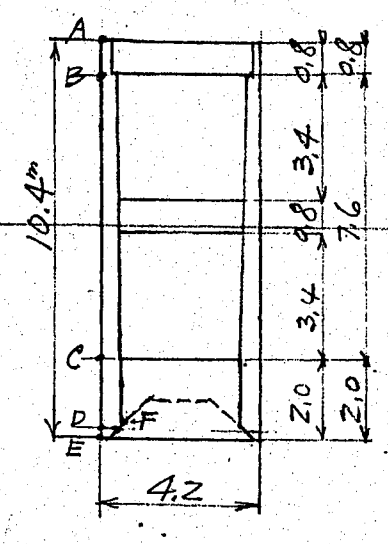
井筒断面積

断面 A

9.54 × 0.20 × 2 = 3.82
3.80 × 0.20 = 0.76
3.80 × 0.40 = 1.52
0.30 × 0.30 × 2 = 0.18
6.28 m²

空虚面積

9.54 × 4.20 = 40.07
− 6.28
33.79 m²



断面 B.

9.54 × 0.30 × 2 = 5.72
3.60 × 0.30 × 3 = 3.24
3.60 × 0.60 = 2.16
0.30 × 0.30 × 6 = 0.54
11.66 m²

断面 C

9.54 × 0.45 × 2 = 8.59
3.30 × 0.45 = 1.49
3.30 × 0.30 × 2 = 1.98
3.30 × 0.60 = 1.98
0.30 × 0.30 × 6 = 0.54
14.58 m²

平均 13.12 m²

空虚面積
40.07 − 13.12 = 26.95 m²

---- 40.07 − 14.58 = 25.49 m²

断面 D.

9.54 × 0.325 × 2 = 6.20
3.55 × 0.325 × 2 = 2.31
8.51 m²

空虚面積
40.07 − 8.51 = 31.56 m²

断面 E

9.54 × 0.20 × 2 = 3.82
3.80 × 0.20 × 2 = 1.52
5.34 m²

井筒混凝土 配合 1:2:4

A−B間	6.28	× 0.80 =	5.02
B−C間	13.12	× 7.60 =	99.71
C−F間 (約)	14.58	× 1.75 =	25.52
F−E間	8.51	× 0.25 =	2.13
噛合	0.40×0.18×10.30×4 =		2.97
〃	0.40×0.12×1.30×8 =		0.50
隔壁底部差引	2.55×0.75×0.30×2 =	(−)	1.15
			134.70 m³

中詰混凝土 配合 1:2:4

上部	33.79	× 0.80 =	27.03
中部	26.95	× 0.80 =	21.56
底部	25.49	× 1.75 =	44.61
〃	31.56	× 0.25 =	7.89
隔壁底部缺所		= (+)	1.15
			102.24 m³

中詰石ク

約 26.95 × 6.8 × 2/3 = 122 m³

中詰鉱滓及石ク

約 26.95 × 6.8 × 1/3 = 61 m³

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CALCULATIONS FOR
七米繋船岸壁材料表

B 井筒型枠
井筒内面周長
断面A.

8.34 × 2	=	16.68	
3.20 × 2	=	6.40	
0.42 × 4	=	1.68	
			24.76m

断面B.

2.18 × 4	=	8.72	
1.88 × 2	=	3.76	
3.00 × 6	=	18.00	
0.42 × 12	=	5.04	
			35.52 m

断面C

2.03 × 2	=	4.06	
2.18 × 2	=	4.36	
1.88 × 2	=	3.76	
2.70 × 6	=	16.20	
0.42 × 12	=	5.04	
			33.42 m

} 平均 34.47m

断面D

8.89 × 2	=	17.78	
3.55 × 2	=	7.10	
			24.88m

・井筒外面周長

9.54 × 2	=	19.08	
4.20 × 2	=	8.40	
0.18 × 8	=	1.44	
(糸夕) 0.12 × 4 ÷ 2	=	0.24	
			29.16 m

井筒型枠

内面 AB 間	24.76 × 0.80	=		19.81
〃 BC 〃	34.47 × 7.60	=		261.97
〃 CF 〃	(糸夕) 33.42 × 1.75	=		58.49
〃 FE 〃	24.88 × 0.35	=		8.71
底面 E				5.34
隔壁下部差引	2.55 × 0.75 × 4	=	(−)	7.65
〃 底面	0.30 × 1.80 × 2	=	(+)	1.08
〃 〃	0.30 × 1.06 × 4	=	(+)	1.27
外面	29.16 × 10.40	=		303.26
				652.28 m²

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CALCULATIONS FOR

七米繫船壁材料表

A井筒鐵筋

記號	直徑	員数	長	單位重量	一本重量	總重量	摘要	
A 1	12mm	21	5.000m	0.888kg	4.44kg	93.2kg	前壁竪筋	
A 2	〃	16	3.300	〃	2.93	46.9	前壁及口	
A 3	〃	19	3.600	〃	3.20	60.8	前壁竪筋	
A 4	〃	247	4.000	〃	3.55	876.9	各壁竪筋	〃
A 5	〃	81	3.600	〃	3.20	259.2	〃	〃
A 6	〃	19	2.050	〃	1.82	34.6	前壁上部	
A 7	〃	31	3.050	〃	2.71	84.0	側後壁及口	
A 8	〃	44	4.750	〃	4.22	185.7	側後壁竪筋	
A 9	〃	42	3.800	〃	3.37	141.5	〃	
A 10	〃	38	1.900	〃	1.69	64.2	側後壁上部	
A 11	〃	12	3.000	〃	2.66	31.9	隔壁竪筋	
A 12	〃	8	3.300	〃	2.93	23.4	〃	〃
A 13	16	74	4.400	1.58	6.95	514.3	側隔壁横筋	〃
A 14	12	68	4.300	0.888	3.82	259.8	〃	〃
A 15	16	8	2.200	1.58	3.48	27.8	隔壁及口	〃
A 16	12	40	5.300	0.888	4.71	188.4	前壁横筋	〃
A 17	〃	40	3.500	〃	3.11	124.4	〃	〃
A 18	〃	41	6.000	〃	5.33	218.5	〃	〃
A 19	〃	41	4.400	〃	3.91	160.3	〃	〃
A 20	〃	8	8.000	〃	7.10	56.8	〃	
A 21	〃	16	2.100	〃	1.86	29.8	隔壁斜筋	
A 22	〃	42	2.300	〃	2.04	85.7	〃	〃
A 23	〃	26	2.500	〃	2.22	57.7	〃	〃
A 24	〃	20	1.000	〃	0.89	17.8	後隔壁斜筋	
A 25	〃	24	1.200	〃	1.07	25.7	後壁斜筋	〃
A 26	〃	68	1.500	〃	1.33	90.4	〃	〃
A 27	〃	188	1.600	〃	1.42	267.0	側壁帶筋	
A 28	〃	29	6.700	〃	5.95	172.6	後壁横筋	
A 29	〃	29	3.700	〃	3.29	95.4	〃	〃
A 30	〃	28	8.000	〃	7.10	198.8	〃	〃
A 31	〃	28	2.550	〃	2.26	63.3	〃	
A 32	〃	28	2.250	〃	2.00	56.0	〃	〃
A 33	〃	14	2.650	〃	2.35	32.9	〃	〃
A 34	〃	12	2.350	〃	2.09	25.1	〃	〃
A 35	〃	12	2.100	〃	1.86	22.3	〃	〃
A 36	〃	6	2.450	〃	2.18	13.1	〃	〃
A 37	〃	24	2.300	〃	2.04	49.0	側壁突起部	
A 38	〃	8	1.800	〃	1.60	12.8	〃	
A 39	〃	24	1.000	〃	0.89	21.4	側壁帶筋	
A 40	〃	24	1.200	〃	1.07	25.7	〃	〃
A 41	〃	48	1.400	〃	1.24	59.5	〃	〃
A 42	16	28	2.850	1.58	4.50	126.0	側壁横筋	
A 43	〃	24	3.100	〃	4.90	117.6	〃	
A 44	〃	24	3.000	〃	4.74	113.8	〃	
A 45	〃	48	7.000	〃	11.06	530.9	〃	
A 46	〃	12	2.700	〃	4.27	51.2	〃	
A 47	〃	16	3.500	〃	5.53	88.5	〃	
A 48	〃	16	2.850	〃	4.50	72.0	〃	
A 49	12	8	6.900	0.888	6.13	49.0	〃	
						6,023.6 kg		

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CALCULATIONS FOR

七米繫船壁材料表

B井筒鐵筋

記號	直徑	員数	長	單位重量	一本重量	總重量	摘要	
B1	12mm	8	5.000m	0.888kg	4.44kg	35.5	前壁竪筋	
B2	〃	7	3.300	〃	2.93	20.5	前壁竪歯口	
B3	〃	8	3.600	〃	3.20	25.6	前壁竪筋	
B4	〃	253	4.000	〃	3.55	898.2	各壁竪筋	〃
B5	〃	83	3.600	〃	3.20	265.6	〃	〃
B6	〃	6	2.050	〃	1.82	10.9	前壁上部	
B7	〃	40	3.050	〃	2.71	108.4	側後壁歯口	
B8	〃	59	4.750	〃	4.22	249.0	側後壁竪筋	
B9	〃	55	3.800	〃	3.37	185.4	〃	
B10	〃	53	1.900	〃	1.69	89.6	側後壁上部	
B11	〃	12	3.000	〃	2.66	31.9	隔壁竪筋	
B12	〃	8	3.300	〃	2.93	23.4	〃	〃
B13	16	48	4.400	1.58	6.95	333.6	前後壁横筋	
B14	12	94	4.300	0.888	3.82	359.1	前後隔壁横筋	〃
B15	16	8	2.200	1.58	3.48	27.8	隔壁歯口	〃
B16	12	28	2.550	0.888	2.26	63.3	側壁横筋	
B17	〃	56	2.250	〃	2.00	112.0	〃	〃
B18	〃	28	2.650	〃	2.35	65.8	〃	〃
B19	〃	28	2.400	〃	2.13	59.6	〃	〃
B20	16	48	7.000	1.58	11.06	530.9	前後壁横筋	
B21	12	32	2.100	0.888	1.86	59.5	隔壁斜筋	
B22	〃	52	2.300	〃	2.04	106.1	〃	〃
B23	〃	8	6.900	〃	6.13	49.0	前後壁横筋	
B24	〃	8	1.000	〃	0.89	7.1	後壁斜筋	
B25	〃	24	1.200	〃	1.07	25.7	前後壁斜筋	〃
B26	〃	68	1.500	〃	1.33	90.4	〃	〃
B27	〃	56	8.000	〃	7.10	397.6	側壁横筋	〃
B28	〃	58	6.700	〃	5.95	345.1	〃	〃
B29	〃	58	3.700	〃	3.29	190.8	〃	〃
B30	16	12	3.100	1.58	4.90	58.8	前壁横筋	〃
B31	〃	24	2.850	〃	4.50	108.0	〃	
B32	〃	8	4.000	〃	6.32	50.6	〃	
B33	〃	16	2.750	〃	4.35	69.6	〃	
B34	12	12	2.350	0.888	2.09	25.1	側壁横筋	
B35	〃	24	2.100	〃	1.86	44.6	〃	〃
B36	〃	12	2.450	〃	2.18	26.2	〃	〃
B37	〃	12	2.250	〃	2.00	24.0	〃	〃
B38	〃	22	1.000	〃	0.89	19.6	側壁帯筋	
B39	〃	72	1.100	〃	0.98	70.6	〃	〃
B40	〃	22	1.200	〃	1.07	23.5	〃	〃
B41	〃	116	1.300	〃	1.15	133.4	〃	〃
B42	16	14	2.850	1.58	4.50	63.0	後壁横筋	
B43	〃	28	3.000	〃	4.74	132.7	〃	
B44	〃	6	2.700	〃	4.27	25.6	〃	
B45	〃	12	2.850	〃	4.50	54.0	〃	
B46	12	4	1.750	0.888	1.55	6.2	側壁突起部	
B47	〃	12	2.300	〃	2.04	24.5	〃	
						5,727.4	計	

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CALCULATIONS FOR
七米繋船壁材料表

井筒沈下掘鑿
A及ビB井筒一基当り.
平均沈下寸 11.0米 (El. +1.0m ヨリ -10.0m =至ル).
断面積 9.54×4.20 = 40.07
4@ 0.50×0.18 = 0.36
40.43 m²
一基当り掘鑿 = 40.43×11.0 = 445 m³

井筒噛合部填充膠泥 配合1:2
総 2.14m×.278m×8.5m= 5.06m³ 接手一個所当り

土留混凝土 配合1:3:6
延長 400 m
容積 3.15×3.10×400 = 3906.00 m³.

井筒頂上裏詰 砂混リ鉱滓
A井筒上 1.20×3.10×10.10m = 37.6 m³
B 〃 4.20×3.10× 6.54 = 85.2 m³
総量 28×(37.6+85.2) = 3438 m³

土留混凝土型枠
総面積 6.35×400 = 2540 m²

土留混凝土構造目地 56ヶ所
繋船柱 28ヶ所
繋船環 28ヶ所

鉄梯子 8ヶ所
緩衝材 延長 400米分 附属金物共

井筒噛合楔木
角材 20cm×10cm×延長 10.4m 井筒一基ニ付四挺宛
附属 ボールト共

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CALCULATIONS FOR
七米繋船壁材料表.

七米繋船岸壁材料總括表
岸壁延長400米分.

井筒混凝土 配合 1:2:4				
A井筒	28基 @ 145.36	= 4070.08		
B 〃	28 〃 @ 134.70	= 3,771.60		
		計	7,841.68	立米
井筒中詰混凝土 配合1:2:4				
A井筒	28基 @ 99.29	= 2780.12		
B井筒	28 〃 @ 102.24	= 2862.72		
		計	5,642.84	立米
井筒中詰砂				
A井筒	28基 @ 176	= 4,928		
B井筒	28 〃 @ 122	= 3416		
		計	8,344	立米
井筒中詰砂混り鉱滓				
B井筒	28基 @ 61	=	1,708	立米
井筒鐵筋				
A井筒	28基 @ 6,023.6	= 168,660.8		
B井筒	28 〃 @ 5,727.4	= 160,367.2		
			329,0280	瓲
井筒型枠				
A井筒	28基 @ 647.04	= 18,117.1		
B井筒	28 〃 @ 652.28	= 18,263.8		
		計	36,380.9	平米
土留工 混凝土 配合 1:3:6			3,906.00	立米
〃 型枠			2,540.0	平米
〃 構造目地			56	個所
井筒噛合部填充モルタル 配合 1:2				
	56個所 @ 5.06	=	283.36	立米
〃 〃 楯木	20cm × 10cm × 延長 10.4m	1モノ(ボルト共)	224	挺
井筒沈下据鑿				
AおよびB井筒	56基 @ 445	=	24,920	立米
井筒頂上土留工裏詰砂混り鉱滓			3,438	立米
繋船柱 (附属ボルト共)			28	ケ所
繋船環 (〃)			28	ケ所
鉄梯子 (附属金物共)			8	ケ所
緩衝材 (〃)		延長	400	米

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CALCULATIONS FOR

MADE BY_____DATE_____FILE NO
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昭和十二年十二月

日本製鐵株式會社
輪西新工場

九米繫船岸壁應力計算書

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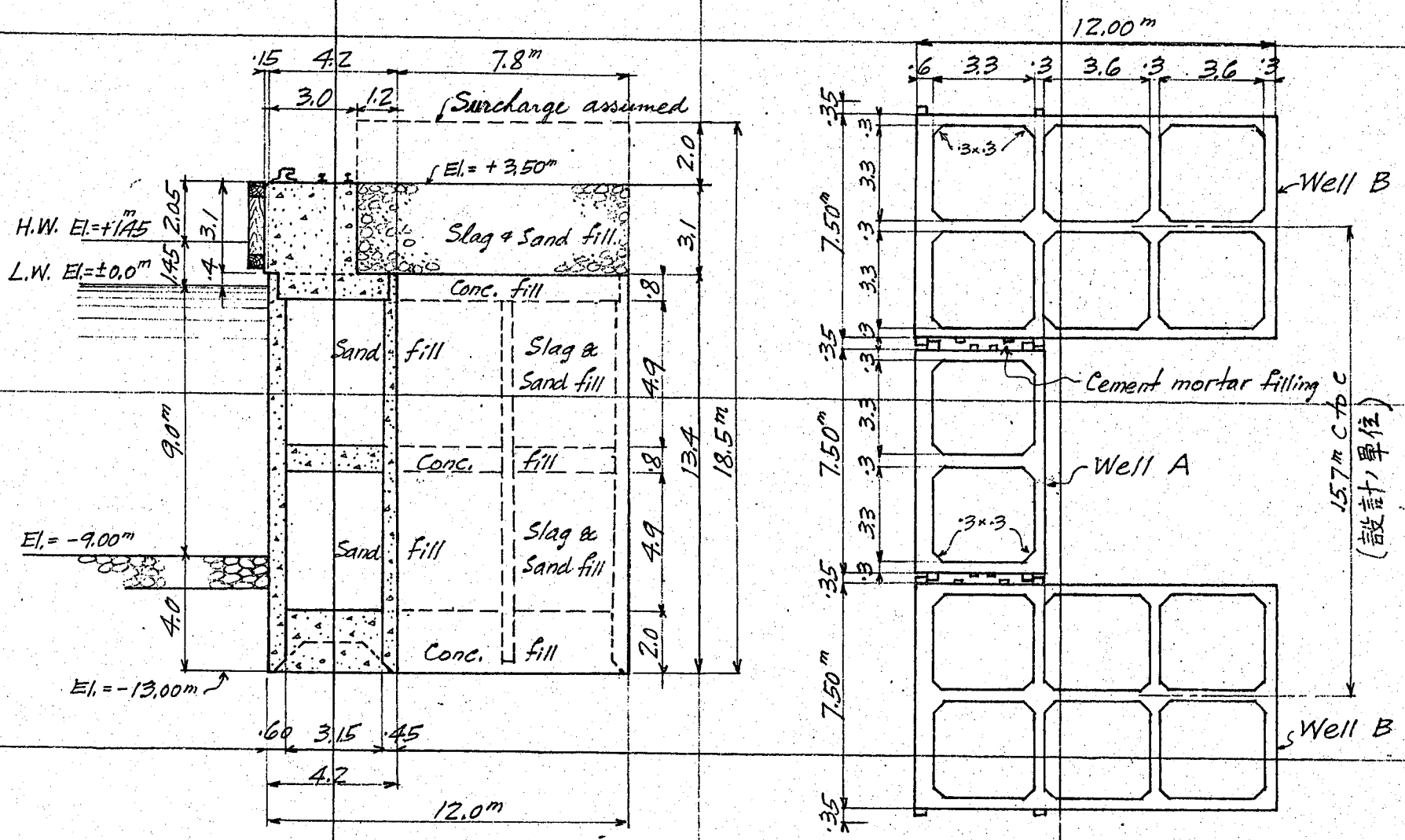
MADE BY K. J. DATE 12-12-4 FILE NO
CHECKED BY M. J DATE 12-12-27 PAGE NO 1

CALCULATIONS FOR
日本製鐵株式会社 輪西新工場
九米繋船岸壁應力計算書

We have desided as follows.
Total length of quay wall 400 meters.

Wells A	25@7.50 =	187.50
" B	26@7.50 =	195.00
Clearances betwin wells.	50@0.35 =	17.50
		400.00 m

General construction and main dimensions of quay wall as shown on sketch below.



CROSS SECTION — TOP VIEW

GENERAL SKETCH OF QUAY WALL.
Scale 1:200.

Design of Well.
Temporary earth pressure on well during sinking execution. (Refered to Ketchum's "Walls, Bins and Grain Elevactors" on page 120 and 121.)

$$L = \frac{wb}{2\mu}\left(1-e^{\frac{-2k\mu y}{b}}\right), \quad V = \frac{wb}{2k\mu}\left(1-e^{\frac{-2k\mu y}{b}}\right)$$

Where V = Vertical unit pressure in kg/m² at depth y meters,
L = lateral unit pressure in kg/m² at depth y meters,
w = weight of earth in kg/cub. m,
μ = $\tan\phi$ = Coefficient of friction of earth on earth,
ϕ = angle of repose of earth,
b = the distance in meters that the earth breaks arround the well,
k = a constant $\fallingdotseq \frac{1-\sin\phi}{1+\sin\phi}$

Let us assume that, $w = 1{,}600$ kg/cub.m, $b = 3.00$ m, $k = 1/3$, then we have the values of L for different depths, from the prepared diagram.

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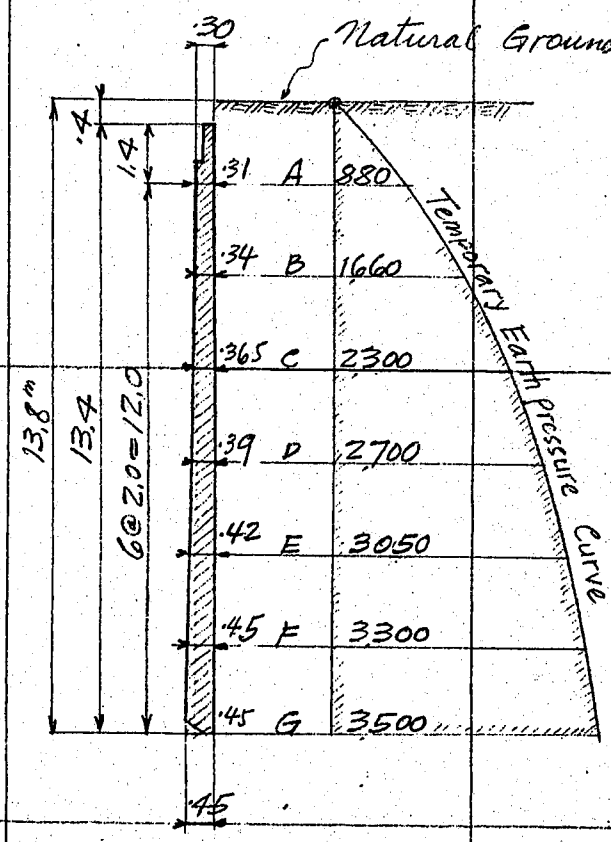
CALCULATIONS FOR

九米繋船岸壁

Temporary Earth pressure diagram.



Section at	Depth of earth Y in meters	Temporary earth pressure on wall, L in kg/m²
A	1.8	880
B	3.8	1,660
C	5.8	2,300
D	7.8	2,700
E	9.8	3,050
F	11.8	3,300
G	13.8	3,500

Bending moment on wall at several sections.
moment will be taken as $M = 1/12\ L l^2$
Front and rear walls.
span length = 3.60 m.
moment $M_1 = 1/12 \times 3.6^2 L = 1.08L$ kgm.
shear $S_1 = 1/2 \times 3.6\ L = 1.80L$ kg

Side walls.
span length = 3.90 m.
moment $M_2 = 1/12 \times 3.9^2 L = 1.27L$ kgm
shear $S_2 = 1/2 \times 3.9\ L = 1.95L$ kg

At Bottom section G. pressure L = 3,500 kg/m²

$M_1 = 1.08L = 1.08 \times 3{,}500 = 3780$ kgm
$S_1 = 1.80L = 1.80 \times 3{,}500 = 6300$ kg

$M_2 = 1.27L = 1.27 \times 3{,}500 = 4440$ kgm
$S_2 = 1.95L = 1.95 \times 3{,}500 = 6820$ kg

Effective depth required

$$d = \sqrt{\frac{4440 \times 100}{100 \times 7.13}} = 25 \text{ cm}$$

For Rear and Side walls, use 40 cm effective depth with an insulation of 5 cm. (at section G).

Steel area required for rear and side walls.

$$A_s = \frac{4440 \times 100}{1200 \times \frac{7}{8} \times 40} = 10.57 \text{ cm}^2$$

use 16φ bars
Spacing 2.011 ÷ 10.57 = 19.0 cm c to c

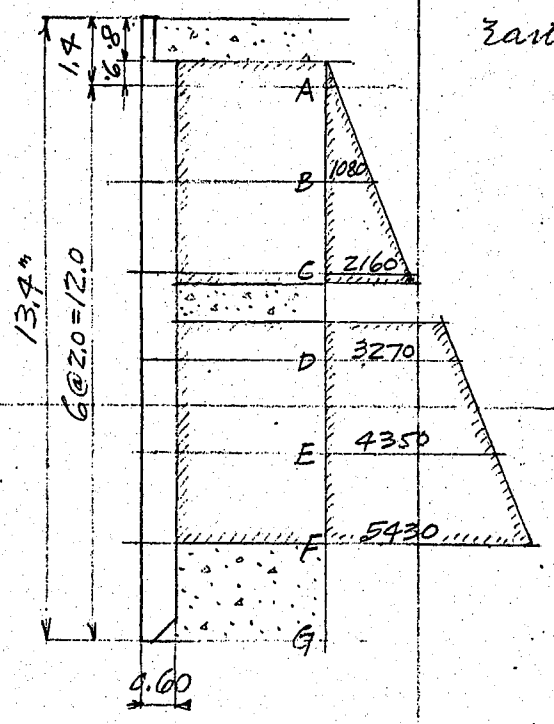
Steel area required for front wall.
Total depth of wall taken as 60 cm
use eff. depth of 52.5 cm with 7.5 cm insulation.

$$A_s = \frac{3780 \times 100}{1200 \times 7/8 \times 52.5} = 6.86 \text{ cm}^2$$

use the same reinforcements as for side walls.

Permanent earth pressure on front wall due to sand filling.
angle of repose of filling $\varphi = 20°$ $\frac{1-\sin 20°}{1+\sin 20°} = \frac{0.658}{1.342} = 0.490$

Earth pressure $p = 0.490 \cdot V$ sand $w = 1{,}700 - 1{,}000 \times 0.6 = 1{,}100$ kg/m³
conc " = 2200 − 1000 = 1200 "



Section at.	Vert. pressure Sand fill.	Conc. fill.	total. Y	Coef.	Earth pressure p
A	660	—	660 ×	0.490 =	320
B	2,860	—	2,860 ×	"	1,400 kg/m²
C	5,060	—	5,060	"	2,480
D	6,380	960	7,340	"	3600
E	8,580	960	9,540	"	4,670
F	10,780	960	11,740	"	5,750
G	—	—	—		

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CALCULATIONS FOR
九米繋船岸壁

Side and rear walls. (Temporary earth pressure).

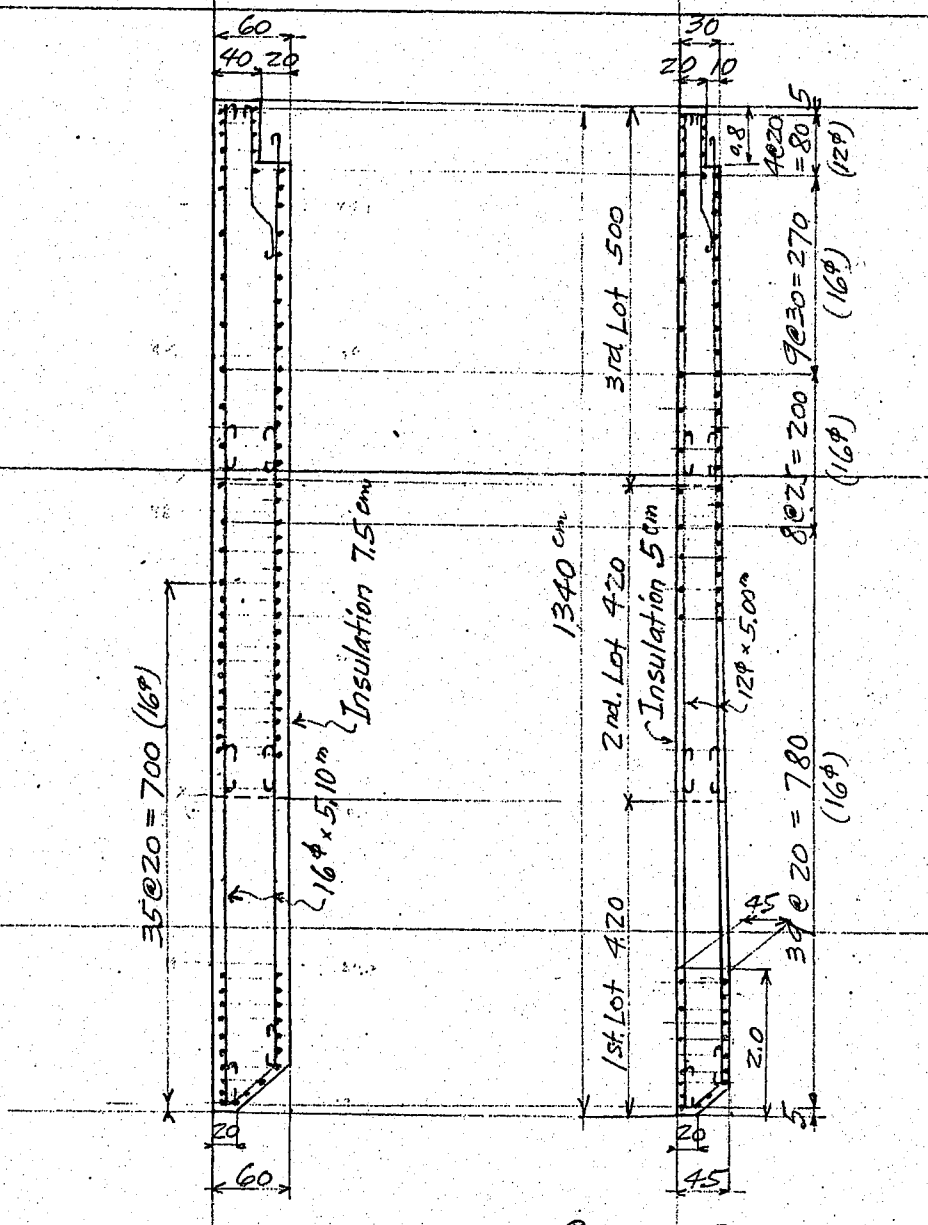
Section at	Earth pressure L in kg/m²	Moment $M_2 = 1.27L$ kgm	Shear $S_2 = 1.95L$ kg	Eff. depth d in cm	As req'd. in cm²	Req'd. spacing in cm. 12φ	16φ	Unit shear in kg/cm²
A	880	1,120	1720	26	4.10	27.6	49.1	0.8
B	1,660	2,110	3240	29	6.93	16.3	29.0	1.3
C	2,300	2,920	4480	31.5	8.83		22.8	1.6
D	2,700	3,430	5260	34	9.62		20.9	1.8
E	3,050	3,870	5950	37	9.97		20.2	1.8
F	3,300	4,190	6,440	40	9.98		20.2	1.8
G	3,500	4,440	6,830	40	10.57		19.0	2.0

Front wall. (Temporary earth pressure.)

	L	$M_1 = 1.08L$	$S_1 = 1.80L$	d	As	Spacing req'd. 12φ	16φ	Unit shear
A	880	950	1,580	52.5	1.72	65.7		0.3
B	1,660	1,790	2990	〃	3.25	34.8	61.8	0.7
C	2,300	2480	4140	〃	4.50		44.7	0.9
D	2,700	2920	4860	〃	5.30		38.0	1.1
E	3050	3290	5490	〃	5.97		33.7	1.2
F	3,300	3,560	5940	〃	6.46		31.2	1.3
G	3,500	3,780	6300	〃	6.86		29.3	1.4

Front wall (Permanent earth pressure due to sand filling)

	L	$M_1 = 1.08L$	$S_1 = 1.80L$	d	As	Spacing req'd 12φ	16φ	Unit shear
A	320	345	575	52.5	0.63			0.1
B	1,400	1,510	2,520	〃	2.74	41.5	73.5	0.6
C	2480	2680	4460	〃	4.86		41.5	1.0
D	3600	3890	6480	〃	7.06		28.5	1.4
E	4,670	5040	8410	〃	9.14		22.0	1.8
F	5,750	6210	10350	〃	11.24		18.0	2.3
G	—	—	—					



Reinforcements in walls.

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CALCULATIONS FOR
九米繋船岸壁

Stability of quay wall.

Weight and center of gravity of well A.

Top section of shell

7.50 × 0.60	=	4.50
7.50 × 0.30	=	2.25
3.30 × 0.30 × 3	=	2.97
0.3 × 0.3 × 4	=	0.36
		10.08 m²

Hollow area
7.50 × 4.20 = 31.50 − 10.08 = 21.42 m²

Bottom section of shell.

7.50 × 0.60	=	4.50
7.50 × 0.45	=	3.38
3.15 × 0.30 × 3	=	2.84
0.3 × 0.3 × 4	=	0.36
		11.08 m²

Hollow area
31.50 − 11.08 = 20.42 m²

average area of shell = (10.08 + 11.08) ÷ 2 = 10.58 m²
" " " hollow = (21.42 + 20.42) ÷ 2 = 20.92 m²

Shell concrete		10.58 × 13.40	=		141.8 m³ @ 2,400 kg =	340,300 kg
Concrete fill		21.42 × 0.80	=	17.1		
"	Say	20.92 × 0.80	=	16.7	74.6 @ 2,200 =	164,100 "
"		20.42 × 2.00	=	40.8		
Sand fill.		20.92 × 9.80	=		205.0 @ 2,100 =	430,000 "
Clearance fill		4.20 × 0.70 × 13.4	=	(mortar + concrete)	39.4 @ 2000 =	78800 "

Total weight of well A W_A = 1,013,200 kg

[30/22]	2 @ 0.26 × 3.27 × 4.9 @ 300 =	2500	1,008,900 × 2.10 = 2,118,700
[23/15]	2 × 0.19 × 3.19 × 4.9 @ 300 =	1800	2,500 × 0.47 = 1,200
			1800 × 0.50 = 900
			1,013,200 2.09m 2,120,800

C. g. 2.09m from toe.

Weight and center of gravity of well B,

Top section of shell.

7.50 × 0.60	=	4.50
7.50 × 0.30 × 3	=	6.75
3.60 × 0.30 × 6	=	6.48
3.30 × 0.30 × 3	=	2.97
0.30 × 0.30 × 12	=	1.08
		21.78 m²

Hollow area
7.5 × 12.00 = 90.00 − 21.78 = 68.22 m²

Bottom section of shell.

7.50 × 0.60	=	4.50
7.50 × 0.30 × 2	=	4.50
7.50 × 0.45	=	3.38
3.45 × 0.45 × 2	=	3.11
3.60 × 0.45 × 2	=	3.24
3.30 × 0.45 × 2	=	2.97
3.45 × 0.3	=	1.04
3.60 × 0.3	=	1.08
3.30 × 0.3	=	0.99
0.30 × 0.30 × 12	=	1.08
		25.89 m²

Hollow area 90.0 − 25.89 = 64.11 "

Average area of shell = (21.78 + 25.89) ÷ 2 = 23.84 m²
" " " hollow = (68.22 + 64.11) ÷ 2 = 66.16 "

Shell concrete		23.84 × 13.40	=		319.5 m³ @ 2,400 =	766,800
Concrete fill		68.22 × 0.80	=	54.6		
"	Say	66.16 × 0.80	=	52.9	235.7 @ 2200 =	518,500
"		64.11 × 2.00	=	128.2		
Sand fill	Say	2/3 × 66.16 × 4.9 × 2	=		432.0 @ 2100 =	907,200
Slag & sand fill	"	1/3 × " " "	=		216.0 @ 2,700 =	583,200

Total weight of well B W_B = 2,775,700 kg
C. g. 6.20 from toe.

Note. weight of sand filling

Sand	1.00	@ 1700	= 1700
void	0.40	@ 1000	= 400
			2,100 kg/m³

Weight of slag & sand filling

Slag	1.00	@ 1860	= 1,860 } 2540
Sand	0.40	@ 1700	= 680
water	0.16	@ 1000	= 160
			2,700 kg/m³

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CALCULATIONS FOR
九米繋船岸壁

Weight of Cap concrete.

3.10 × 3.15 × 15.70 = 153.3 m³ @ 2,200 = 337,300 kg = C
c.g. 1.43 m from toe.

Weight of Slag and sand filling over the top of wells.

filling on well A.

Slag and sand	1.20 × 8.2 × 3.10 =	30.5 @	2,540 =	77,500
water	1.20 × 8.2 × 1.05 =	10.3 @	160 =	1,600
Total weight of filling			E_A =	79,100 kg

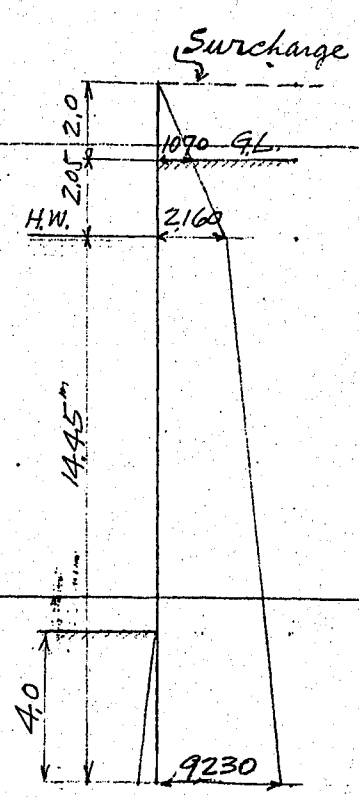
c.g. 3.60 m from toe.

filling on well B.

Slag and sand	7.50 × 9.0 × 3.10 =	209.3 @	2540 =	531,600
water	7.50 × 9.0 × 1.05 =	70.9 @	160 =	11,300
Total weight of filling			E_B =	542,900 kg

c.g. 7.50 m from toe

Earth pressure on wall.



assumptions.

weight of earth above H.W.L. = 1600 kg/m³
Angle of repose. $\phi = 30°$ $1-\sin\phi/1+\sin\phi = 0.333$ $\tan\phi = 0.577$

weight of earth below H.W.L. = 1,000 kg/m³ (2,000 − 1,000)
$\phi = 20°$ $1-\sin\phi/1+\sin\phi = 0.490$ $\tan\phi = 0.364$

1,600 × 0.333 × 2.00 = 1,070
1,600 × 0.333 × 4.05 = 2,160 } average intensity 1,615 kg/m²

H_1 = 1,615 × 2.05 × 15.70 = 52,000 kg
applied at 15.35 m above bottom

1,000 × 0.490 × 14.45 = 7,070
2,160
9,230 kg/m²
2,160 } av. press. 5,695 kg/m²

H_2 = 5,695 × 14.45 × 15.70 = 1,292,000 kg.
applied at 5.73 m above bottom.

1,000 × 0.490 × $\frac{4.0^2}{2}$ × 15.70 = H_3 = 61,500 kg
applied at 1.33 m above bottom.

Vertical component of earth pressure.

Rear side of well B.

52,000 × 0.577 = 30,000
1292,000 × 0.364 = 470,000
500,000 ÷ 15.7 = 31,900 kg/m. strip

V_1 = 31,900 × 7.50 = 239,000 kg arm 12.00 m from toe
Both sides of well B.
V_1' = 2 × 31,900 × 7.80 = 498,000 kg " 8.10 m " "
Rear side of well A
V_1'' = 31,900 × 8.20 = 261,000 kg " 4.20 m " "
Front side of wells A and B
V_3 = 61,500 × 0.364 = 22,400 kg " 0.0 m " "

Bouyancy

Bottom area of wall 8.20 × 4.20 = 34.4
7.50 × 12.00 = 90.0
124.4 m²

B = 1,000 × 124.4 × 14.45 = 1,797,000 kg arm 4.93 m from toe
(See below)

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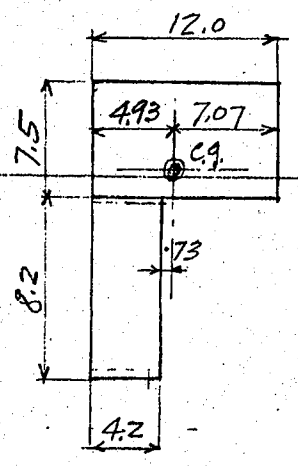
CALCULATIONS FOR
九米繋船岸壁

Center of gravity of bottom area of wall.

well B.	12.00 × 7.50 = 90.0	× 6.0	=	540.0
〃 A	4.20 × 8.20 = 34.4	× 2.1	=	72.2
	124.4 m²	4.93 m		612.2

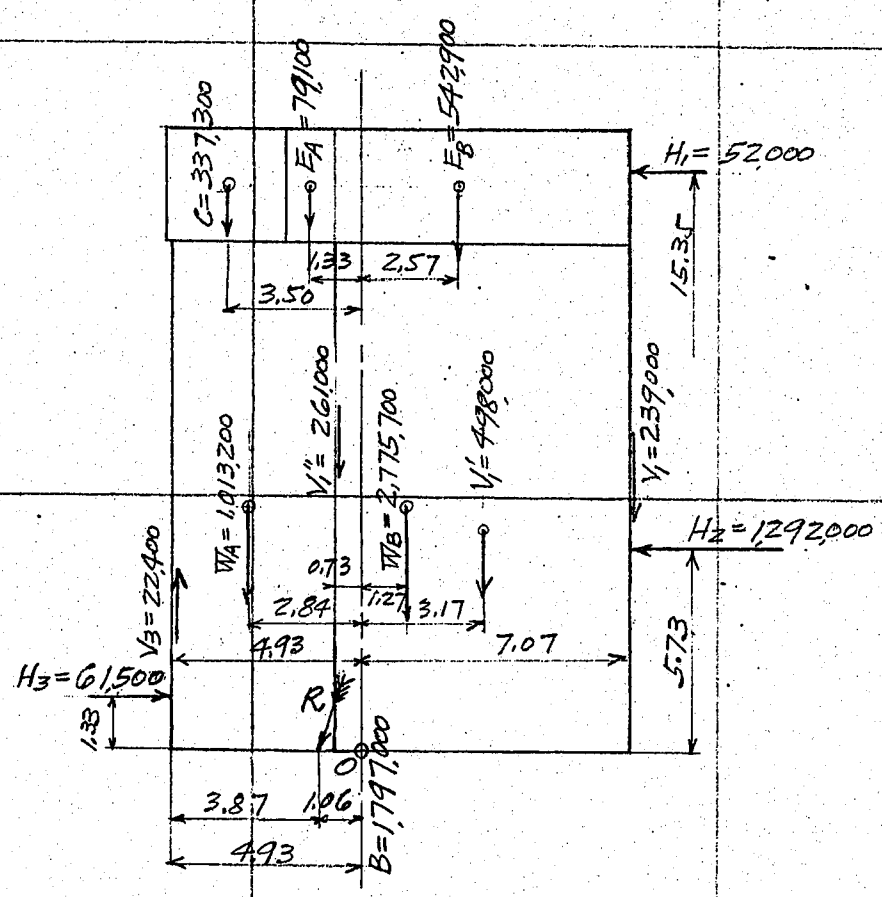
Moment of inertia of bottom area.



well B. $7.50 \times 12.0^3 \div 12 + 90.0 \times 1.07^2 = 1080 + 103. = 1,183$
〃 A $8.20 \times 4.2^3 \div 12 + 34.4 \times 2.83^2 = 50.6 + 275.4 = 326$
$I = 1,509\ m^4$

Extreme fibre. $y_1 = 4.93^m$, $y_2 = 7.07^m$

Overturning moment, origin at c.g. O of base area.



Loads	Hor. forces	Vert. forces		Lever arms		Moment about O.
W_A		1,013,200	×	2.84	=	2,880,000
W_B		2,775,700	×	−1.27	=	−3,525,000
C		337,300	×	3.50	=	1,180,000
E_A		79,100	×	1.33	=	105,000
E_B		542,900	×	−2.57	=	−1,395,000
V_1		239,000	×	−7.07	=	−1,690,000
V_1'		498,000	×	−3.17	=	−1,579,000
V_1''		261,000	×	0.73	=	190,500
V_3		−22,400	×	4.93	=	−110,500
H_1	52,000		×	15.35	=	798,000
H_2	1,292,000		×	5.73	=	7,400,000
H_3	−61,500		×	1.33	=	−82,000
B		−1,797,000	×	0.00	=	0
	$\Sigma H = 1,282,500\ kg$	$\Sigma V = 3,926,800\ kg$		1.06 m		$\Sigma M = 4,172,000\ kgm$

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CALCULATIONS FOR
九米繋船岸壁

Max. Bearing pressure.

$$= \frac{3926.800}{124.4} + \frac{4172.000}{1509} \times 4.93 = 31,600 + 13,650 = 45,250 \text{ kg/m}^2$$

$$\sigma_r = \frac{3.926.800}{124.4} - \frac{4.172.000}{1509} \times 7.07 = 31,600 - 19,550 = 12,050 \text{ "}$$

Ratio of $\frac{\Sigma H}{\Sigma V} = \frac{1282,500}{3926,800} = 0.327$

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CALCULATIONS FOR

MADE BY_____DATE_____FILE NO
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昭和十二年十二月

日本製鐵株式會社
輪西新工場

七米繫船岸壁應力計算書

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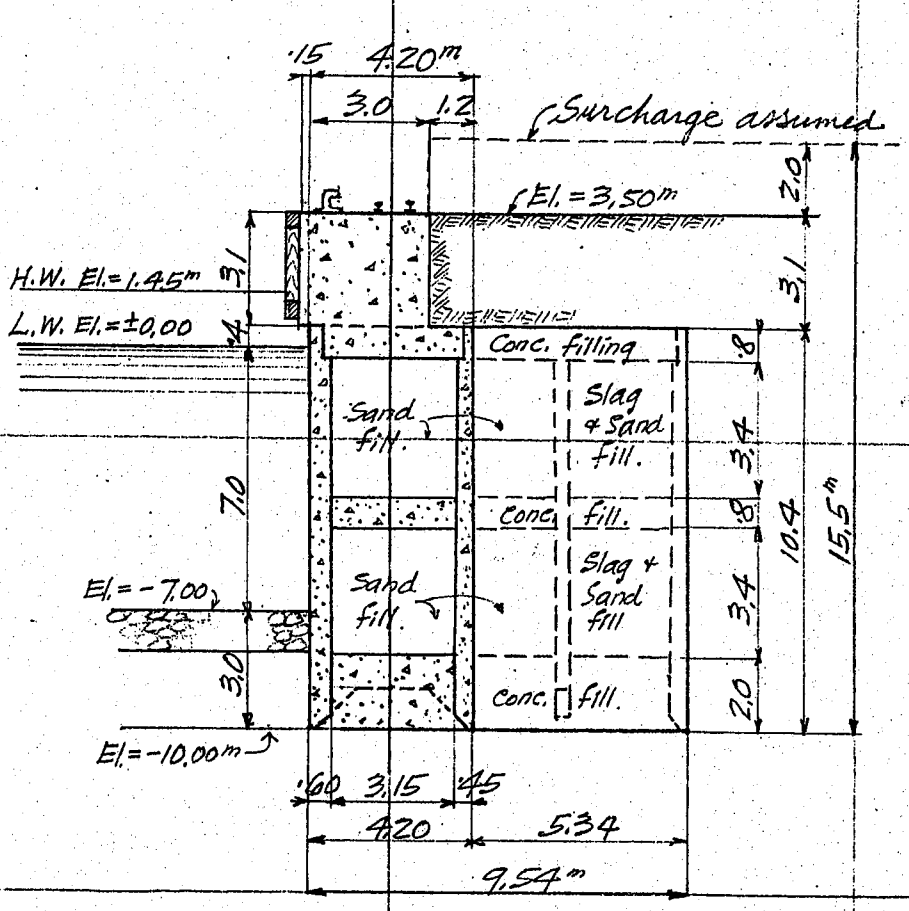
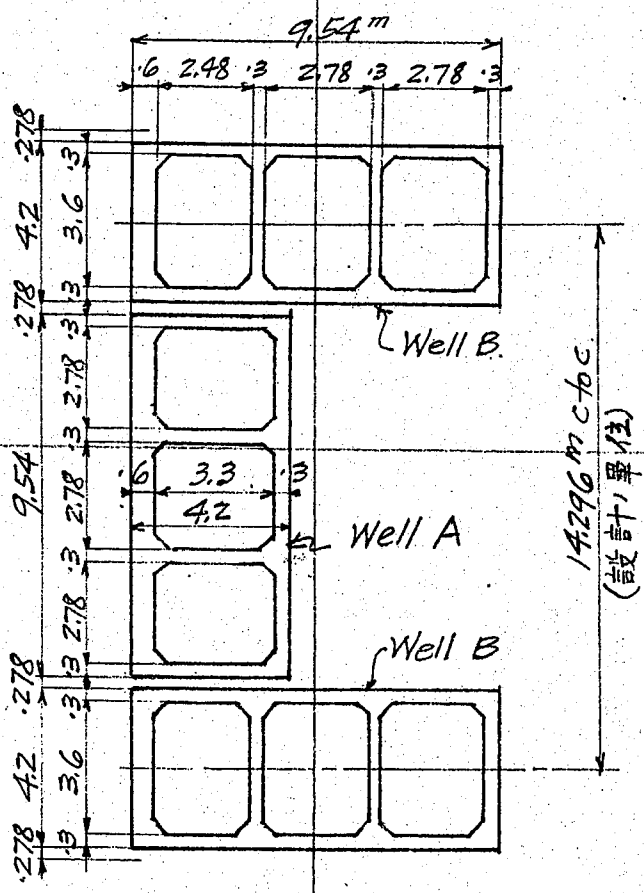
CALCULATIONS FOR
日本製鉄株式会社輪西新工場
七米繋船岸壁應力計算書

Total length of Quay wall, taken as 400 meters.

Wells A	28	@	9.540	= 267.12
wells B	28	@	4.200	= 117.60
clearances betwin wells	55	@	0.278	= 15.29
				400.01 meters.

General construction and main dimensions of quay wall, as shown on sketch below





CROSS SECTION TOP VIEW

GENERAL SKETCH OF QUAY WALL.

Scale 1:200.

Design of Well.

Temporary earth pressure on well during sinking execution. (Referred to Ketchum's "Walls, Bins and Grain Elevators" on page 120 and 121)

$$L = \frac{wb}{2\mu}\left(1 - e^{\frac{-2k\mu y}{b}}\right), \qquad V = \frac{wb}{2k\mu}\left(1 - e^{\frac{-2k\mu y}{b}}\right)$$

where V = Vertical unit pressure in kg/m² at depth y meters,
L = lateral unit pressure in kg/m² at depth y meters,
w = weight of earth in kg/cub. m,
μ = $\tan\phi$ = Coefficient of friction of earth on earth,
ϕ = angle of repose of earth,
b = the distance in meters that the earth breaks arround the well,
k = a constant $\fallingdotseq 1-\sin\phi / 1+\sin\phi$.

Let us assume that, $w = 1600$ kg/cub.m, $b = 3.00$ m, $k = 1/3$, then we have the values of L for different depths, from the prepared diagram.

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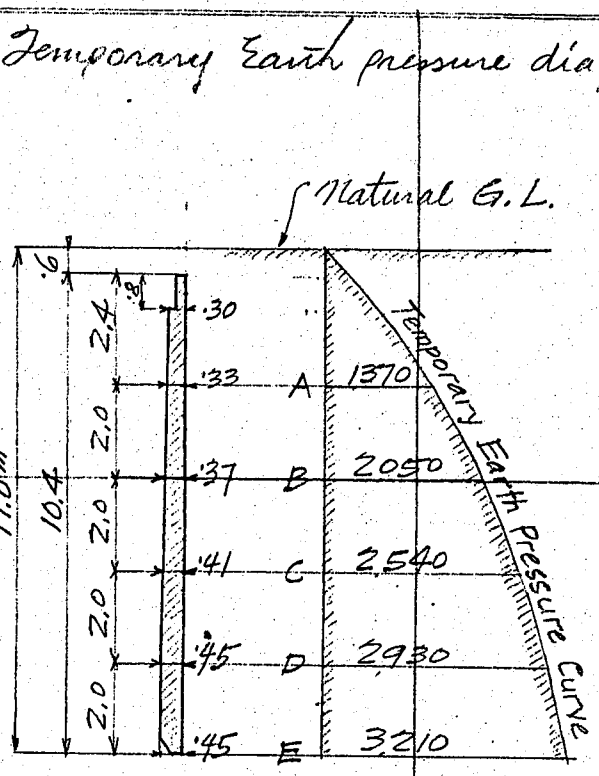
CALCULATIONS FOR
七米繋船岸壁

Temporary Earth pressure diagram.



Section at	Depth of earth Y in metres	Temporary earth pressure on wall, L in kg/m²
A	3,0	1370
B	5,0	2,050
C	7,0	2,540
D	9,0	2,930
E	11,0	3,210

Bending moment on walls at several sections.
Moment will be taken as $M = 1/12\ L\ l^2$

Side walls
span length $l = 3.08$ m
moment $M_1 = 1/12 \times 3.08^2 L = 0.79\ L$ kgm.
Shear $S_1 = 1/12 \times 3.08\ L = 1.54\ L$ kg

End walls.
Span length $l = 3.90$ m
moment $M_2 = 1/12 \times 3.90^2 L = 1.27\ L$ kgm
Shear $S_2 = 1/2 \times 3.90\ L = 1.95\ L$ kg

At Bottom section E pressure $L = 3210$ kg/m².

$M_1 = 0.79\ L = 0.79 \times 3210 = 2535$ kgm
$S_1 = 1.54\ L = 1.54 \times 3210 = 4940$ kg

$M_2 = 1.27\ L = 1.27 \times 3210 = 4075$ kgm
$S_2 = 1.95\ L = 1.95 \times 3210 = 6260$ kg

Effective depth required
$d = \sqrt{\frac{4075 \times 100}{100 \times 7.13}} = 24$ cm

For Rear walls and side walls, use 40 cm eff. depth with an insulation of 5 cm (at section E)

Steel area required for Rear wall of Well A and Side walls of well B

$A_s = \frac{2535 \times 100}{1200 \times 7/8 \times 40} = 6.03$ cm².

use 12φ Bars, spacing reqd. = 18.8 cm c to c.

Steel area required for end walls.

$A_s = \frac{4075 \times 100}{1200 \times 7/8 \times 40} = 9.70$ cm²

use 16φ Bars, spacing reqd = 20.7 cm c to c

Steel area required for front wall of Well A

$A_s = \frac{2535 \times 100}{1200 \times 7/8 \times 52.5} = 4.59$ cm²

use 12φ bars, spacing reqd. = 24.6 cm c to c

Steel area required for front wall of well B.

$A_s = \frac{4075 \times 100}{1200 \times 7/8 \times 52.5} = 7.38$ cm².

use 16φ bars, spacing reqd. = 27.3 cm c to c.

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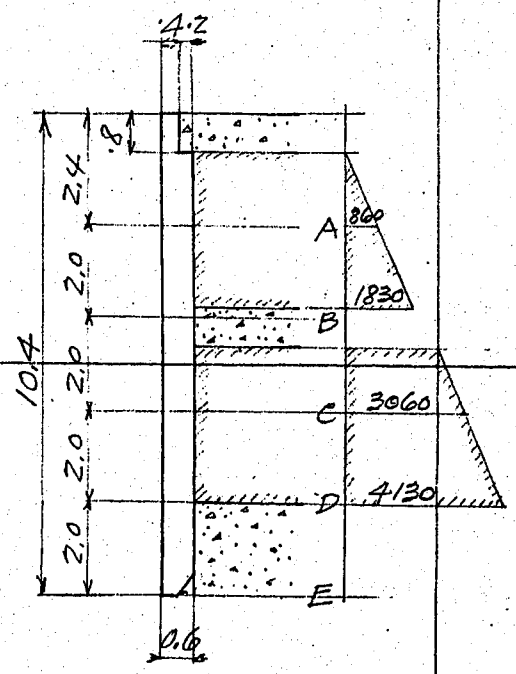
CALCULATIONS FOR
七米繋船岸壁

Permanent pressure on front walls due to sand filling.
Angle of repose of filling $\phi = 20°$, $\frac{1-\sin\phi}{1+\sin\phi} = \frac{0.658}{1.342} = 0.490$

Earth pressure $p = 0.490\,V$

Sand $w = 1700 - 1000 \times 1.6 = 1{,}100$ kg/m³
Conc. $w = 2200 - 1000 = 1{,}200$



Section at	Vert. pressure Sand. fill.	Conc. fill.	Total V.	coef.	Earth pressure p
A	1,760	—	1,760	× 0.490 =	860 kg/m²
B	3,740	—	3,740	〃	1,830
C	5,280	960	6,240	〃	3,060
D	7,480	960	8,440	〃	4,130
E	—	—	—	—	—

Rear wall of well A and side walls of well B. (Temporary earth pressure)

Section at	Earth pressure L in kg/m²	moment $M_1 = 0.79L$ kgm	Shear $S_1 = 1.54L$ kg	Eff. depth d in cm.	As reqd in cm²	Reqd Spacing in cm 12φ	16φ	unit shear in kg/cm²
A	1,370	1,080	2,110	28	3.68	30.7		0.9
B	2,050	1,620	3,160	32	4.83	23.4		1.1
C	2,540	2,010	3,910	36	5.32	21.3		1.2
D	2,930	2,315	4,510	40	5.52	20.5		1.3
E	3,210	2,535	4,940	40	6.03	18.8		1.4

End walls. (Temporary Earth pressure).

	L	$M_2 = 1.27L$	$S = 1.95L$	d	As	Spacing reqd 12φ	16φ	unit shear
A	1,370	1,740	2,670	28	5.92		34.0	1.1
B	2,050	2,600	4,000	32	7.73		26.0	1.4
C	2,540	3,220	4,950	36	8.52		23.6	1.6
D	2,930	3,720	5,710	40	8.85		22.7	1.6
E	3,210	4,075	6,260	40	9.70		20.7	1.8

Front wall of well A (Temporary Earth pressure)

	L	$M_1 = 0.79L$	$S_1 = 1.54L$	d	As	Spacing reqd 12φ	16φ	unit shear
A	1,370	1,080	2,110	52.5	1.96	57.7		0.5
B	2,050	1,620	3,160	〃	2.94	38.4		0.7
C	2,540	2,010	3,910	〃	3.65	31.0		0.9
D	2,930	2,315	4,510	〃	4.20	26.9		1.0
E	3,210	2,535	4,940	〃	4.59	24.6		1.1

Front wall of well A (Permanent pressure due to filling).

	L	$M_1 = 0.79L$	$S_1 = 1.54L$	d	As	Spacing reqd. 12φ	16φ	unit shear
A	860	680	1,325	52.5	1.23	92.0		0.3
B	1,830	1,445	2,820	〃	2.62	43.2		0.6
C	3,060	2,420	4,710	〃	4.39	25.8		1.0
D	4,130	3,260	6,360	〃	5.92	19.1		1.4
E	—	—	—	〃	—	—		

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CALCULATIONS FOR
七米繋船岸壁

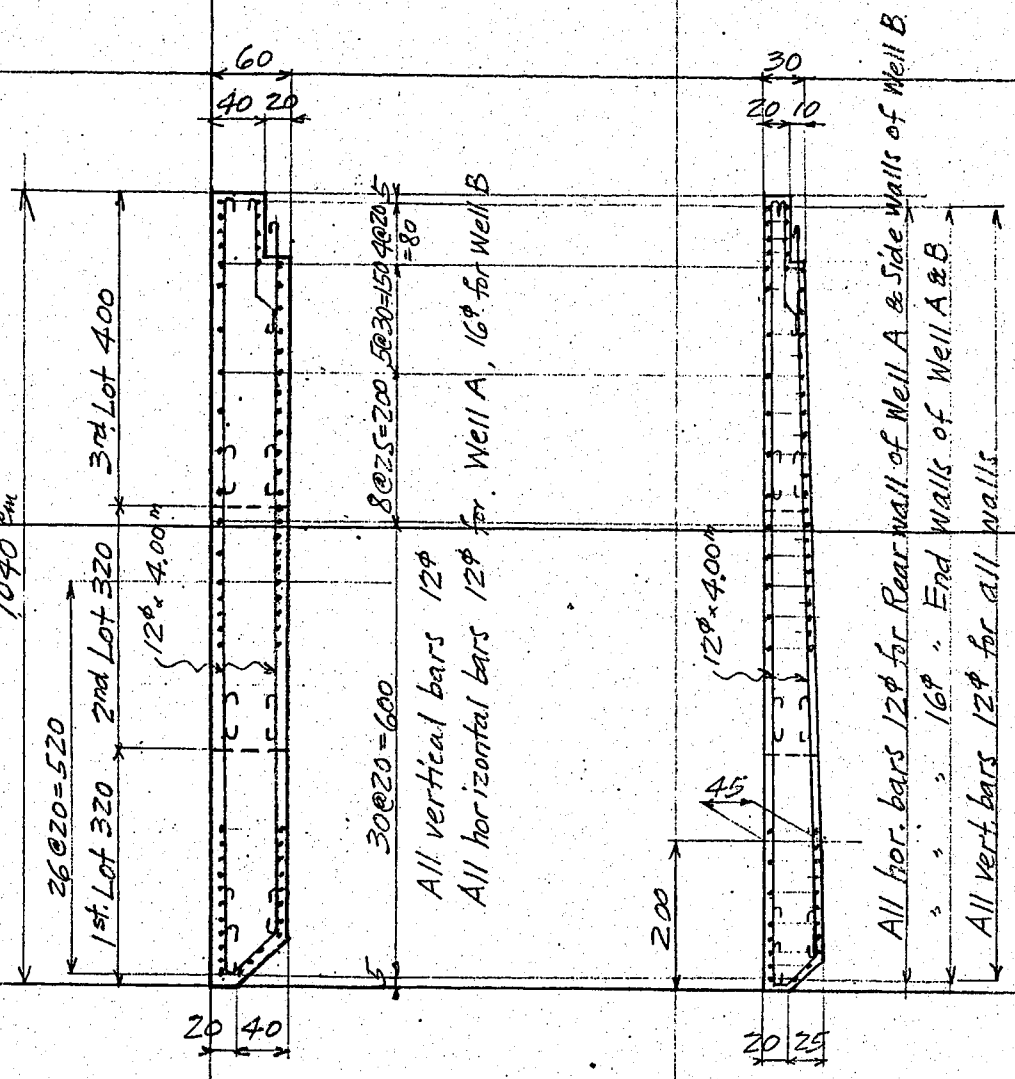
Front wall of well B. (Temporary Earth pressure)

Section at	Earth pressure L in Kg/m²	Moment $M_2=1.27L$ Kgm.	Shear $S_2=1.95L$ Kg	Eff. depth d in cm	As reqd in cm²	Reqd Spacing in cm 12φ	16φ	Unit Shear in Kg/cm²
A	1,370	1,740	2,670	52.5	3.16		63.7	0.6
B	2,050	2,600	4,000	〃	4.72		42.6	0.9
C	2,540	3,220	4,950	〃	5.84		34.4	1.1
D	2,930	3,720	5,710	〃	6.74		29.9	1.2
E	3,210	4,075	6,260	〃	7.40		27.3	1.4

Front wall of well B (Permanent pressure due to filling)

	L	$M_2=1.27L$	$S_2=1.95L$	d	As	Spacing reqd 12φ	16φ	Unit Shear
A	860	1,090	1,680	52.5	1.98		101.0	0.4
B	1,830	2,320	3,570	〃	4.21		47.8	0.8
C	3,060	3,880	5,960	〃	7.04		28.5	1.3
D	4,130	5,240	8,050	〃	9.50		21.1	1.8
E	—	—	—	〃	—		—	—

Reinforcements in walls.



FRONT WALLS. SIDE WALLS & END WALLS

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CALCULATIONS FOR
七米繋船岸壁

Stability of Quay Wall.

Weight and center of gravity of well A.

Top section of shell.

9.54 × 0.60	=	5.72
9.54 × 0.30	=	2.86
3.30 × 0.30 × 4	=	3.96
0.30 × 0.30 × 6	=	0.54
		13.08 m²

Hollow area
9.54 × 4.20 = 40.07 − 13.08 = 26.99 m²

Bottom section of shell.

9.54 × 0.60	=	5.72
9.54 × 0.45	=	4.29
3.15 × 0.30 × 2	=	1.89
3.15 × 0.45 × 2	=	2.84
0.30 × 0.30 × 6	=	0.54
		15.28 m²

Hollow area = 40.07 − 15.28 = 24.79 m²

Average area of shell = (13.08 + 15.28) ÷ 2 = 14.18 m²
" " hollow = (26.99 + 24.79) ÷ 2 = 25.89 m²

Shell concrete	14.18 × 8.40	=	119.11	149.67 m³ @ 2,400 kg =	359,000
"	15.28 × 2.00	=	30.56		
concrete fill	26.99 × 0.80	=	21.59	91.88 @ 2,200 =	202,000
"	25.89 × 0.80	=	20.71		
"	24.79 × 2.00	=	49.58		
Sand fill	25.89 × 6.80	=		176.05 @ 2,100 =	370,000
clearance fill	4.20 × 0.556 × 10.4	=	(mortar & concrete)	24.29 @ 2,000 =	49,000
	Total weight of well A			WA =	980,000 kg

30 / 23	3 @ 0.27 × 2.76 × 3.4 @ 300 =	2,300	976,100 × 2.10 =	2,049,800
22 / 15	3 @ 0.19 × 2.70 × 3.4 @ 300 =	1,600	2,300 × 0.46 =	1,100
			1,600 × 0.50 =	800
		980,000	2.095 m	2,051,700

C.g. 2.095 m from toe

Weight and center of gravity of well B.

Top section of shell.

9.54 × 0.30 × 2	=	5.72
3.60 × 0.30 × 3	=	3.24
3.60 × 0.60	=	2.16
0.30 × 0.30 × 6	=	0.54
		11.66 m²

Hollow area.
9.54 × 4.20 = 40.07 − 11.66 = 28.41 m²

Bottom section of shell.

9.54 × 0.45 × 2	=	8.59
3.30 × 0.30 × 2	=	1.98
3.30 × 0.45	=	1.49
3.30 × 0.60	=	1.98
0.30 × 0.30 × 6	=	0.54
		14.58 m²

Hollow area = 40.07 − 14.58 = 25.49 m²

Average area of shell = (11.66 + 14.58) ÷ 2 = 13.12 m²
" " " hollow = (28.41 + 25.49) ÷ 2 = 26.95 m²

Shell concrete	13.12 × 8.40	=	110.21	139.37 m³ @ 2,400 kg =	334,000
"	14.58 × 2.00	=	29.16		
Concrete fill	28.41 × 0.80	=	22.73	95.27 @ 2,200 =	210,000
"	26.95 × 0.80	=	21.56		
"	25.49 × 2.00	=	50.98		
Sand fill	say 2/3 × 26.95 × 6.80	=		122.17 @ 2,100 =	257,000
Slag + sand fill	1/3 × 26.95 × 6.80	=		61.09 @ 2,700 =	165,000
	Total weight of well B			WB =	966,000 kg

C.g. 4.87 m from toe

Note: weight of sand filling

Sand	1.00	@1700	= 1,700
Void	0.40	@1000	= 400
			2,100 kg/m³

weight of slag and sand filling

Slag	1.00	@1860	= 1860
Sand	0.40	@1700	= 680
water	0.16	@1000	= 160
			2700 kg/m³

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CALCULATIONS FOR
七米繋船岸壁

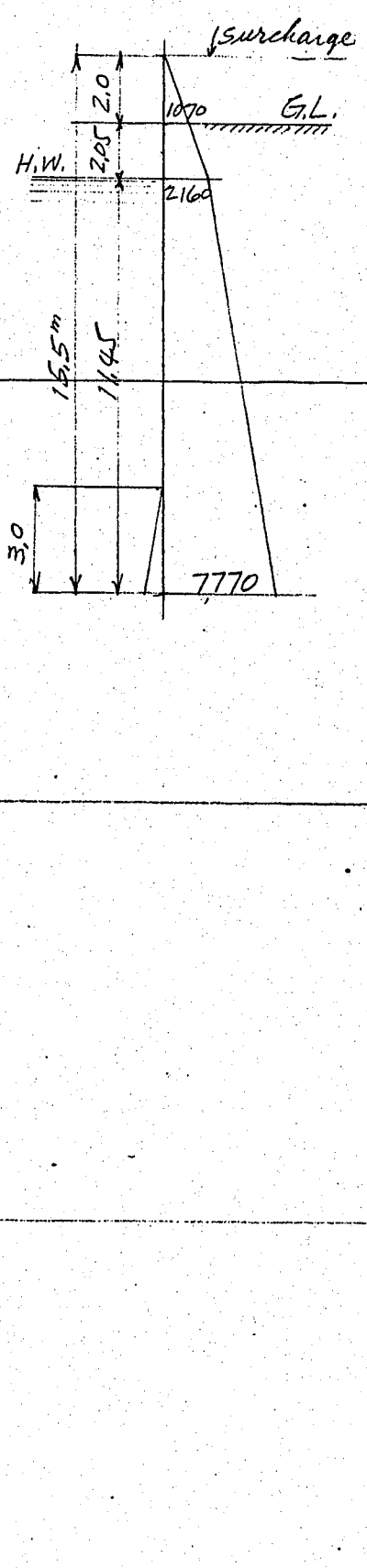
Weight of Cap concrete
3.10 × 3.15 × 14.296 = 139.5 m³ @ 2200 = 307,000 kg = C
C.g. 1.43 m from toe

Weight of slag and sand filling over the top of wells.
Filling on well A.
Slag and sand 1.20 × 10.096 × 3.10 = 37.55 m³ @ 2,540 = 95,300
water 1.20 × 10.096 × 1.05 = 12.70 @ 160 = 2,000
Total weight of filling E_A = 97,300 kg
C.g. 3.60m from toe.

Filling on well B.
Slag and sand 4.20 × 6.54 × 3.10 = 85.1 m³ @ 2540 = 216,200
water 4.20 × 6.54 × 1.05 = 28.8 @ 160 = 4,600
Total weight of filling E_B = 220,800 kg
C.g. 6.27 m from toe

Earth pressure on wall.
Assumptions
weight of earth above H.W.L. = 1600 kg/m³
angle of repose $\phi = 30°$ $1-\sin\phi/1+\sin\phi = 0.333$, $\tan\phi = 0.577$

Weight of earth below H.W.L = 1,000 kg/m³ (2000−1000)
$\phi = 20°$ $1-\sin\phi/1+\sin\phi = 0.490$, $\tan\phi = 0.364$



1,600 × 0.333 × 2.00 = 1070
1,600 × 0.333 × 4.05 = 2,160
} average intensity 1,615 kg/m²
H_1 = 1615 × 2.05 × 14.296 = 47,300 kg arm 12.36 m from bott.

1,000 × 0.490 × 11.45 = 5610
2160
7,770
2160
} average intensity 4,965 kg/m²

H_2 = 4,965 × 11.45 × 14.296 = 812,000 kg arm 4.64 from bott.

$H_3 = 1{,}000 \times 0.490 \times \frac{3.0^2}{2} \times 14.296$ = 31,500 arm 1.00 m " "

Vertical component of earth pressure.
Rear side of well B.
47,300 × 0.577 = 27,300
812,000 × 0.364 = 295,700
323,000 ÷ 14.296 = 22,600 kg/m strip of wall
V_1 = 4.20 × 22,600 = 95,000 kg arm 9.54 m from toe
Both sides of well B.
V_1' = 5.34 × 2 × 22,600 = 241,500 kg arm 6.87 m " "
Rear side of well A
V_1'' = 10.096 × 22600 = 228,000 kg arm 4.20 m " "
Front side of wells A+B
V_2 = 31,500 × 0.364 = 11,500 kg arm 0.00 " "

Bouyancy
Bottom area of well 10.096 × 4.20 = 42.4
9.54 × 4.20 = 40.1
82.5 m²

B = 1,000 × 11.45 × 82.5 = 944,000 kg arm 3.40 m from toe
(See below.)

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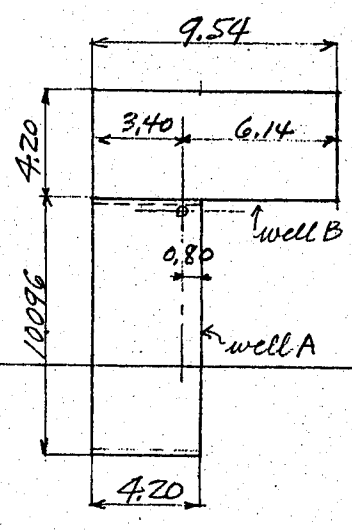
CALCULATIONS FOR
七米繋船岸壁

Center of gravity of Bottom area of wall.



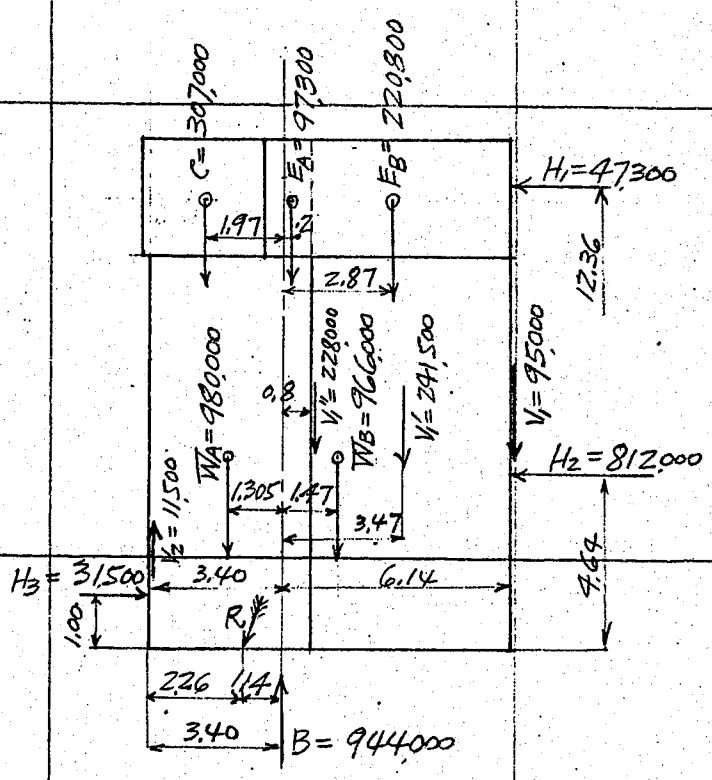
well B	9.54 × 4.20 =	40.1	× 4.77 =	191.2
〃 A	10.096 × 4.20 =	42.4	× 2.10 =	89.0
		82.5 m²	3.40 m	280.2

Moment of inertia of Bottom area.

well B.	4.2 × 9.54³ ÷ 12 +	40.1 × 1.37² =	304.0 + 75.2 =	379.2
〃 A	10.096 × 4.2³ ÷ 12 +	42.4 × 1.30² =	62.3 + 71.6 =	133.9
			I =	513.1 m⁴

Extreme fibre. $y_1 = 3.40$ m, $y_2 = 6.14$ m

Overturning moment, Origin at c.g. O of bottom area.



Loads	Hor. forces	Vert. forces		Lever arm		Moment about O.
W_A		980,000	×	1.305	=	1,278,000
W_B		966,000	×	− 1.47	=	− 1,420,000
C		307,000	×	1.97	=	604,000
E_A		97,300	×	−0.20	=	− 19,500
E_B		220,800	×	− 2.87	=	− 633,700
V_1		95,000	×	−6.14	=	− 583,000
V_1'		241,500	×	−3.47	=	− 838,000
V_1''		228,000	×	−0.80	=	− 182,400
V_2		− 11,500	×	3.40	=	− 39,100
H_1	47,300		×	12.36	=	585,000
H_2	812,000		×	4.64	=	3,765,000
H_3	− 31,500		×	1.00	=	− 31,500
B		− 944,000	×	0.00	=	0
	ΣH = 827,800 kg	ΣV = 2,180,100 kg		1.14 m		ΣM = 2,484,800

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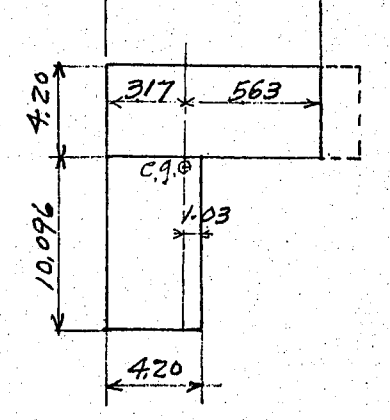
CALCULATIONS FOR
七米繋船岸壁

max. Bearing pressure.

$$= \frac{2,180,100}{82.5} + \frac{2484800}{513.1} \times 3.40 = 26430 + 16500 = 42930 \text{ kg/m}^2$$

$$\text{or} = \frac{2,180,100}{82.5} - \frac{2484800}{513.1} \times 6.14 = 26430 - 29730 = -3300 \text{ "}$$

Neglecting tension on heel, max. bearing pressure is as follows.
(after several trials).



Pressure area.

$4.20 \times 8.80 = 37.0 \times 4.40 = 162.8$
$10.096 \times 4.20 = 42.4 \times 2.10 = 89.0$
$79.4\ m^2 \quad 3.17\ m \quad 251.8$

Eccentricity $= 3.26 - 2.31 = 0.95\ m$

moment $= 2,180,100 \times 0.91 = 1983,000$ kgm.

Moment of inertia

$4.20 \times 8.8^3 \div 12 + 37.0 \times 1.23^2 = 2385 + 56.0 = 2945$
$10.096 \times 4.2^3 \div 12 + 42.4 \times 1.07^2 = 62.3 + 48.5 = 110.8$
$I = 4053\ m^4$

Extreme fibre $y_1 = 3.17\ m$, $y_2 = 5.63\ m$.

max. Bearing pressure

$$= \frac{2180,100}{79.4} + \frac{1983,000}{4053} \times 3.17 = 27,500 + 15500 = 43,000 \text{ kg/m}^2$$

$$\text{or} = \frac{2180,100}{79.4} - \frac{1983,000}{4053} \times .563 = 27,550 - 27,0 = -50 \text{ "}$$
approx. zero ↑

Ratio $\frac{\Sigma H}{\Sigma V} = \frac{827800}{2180,100} = 0.380$

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CALCULATIONS FOR 7m 岸壁

7m Quaywall.

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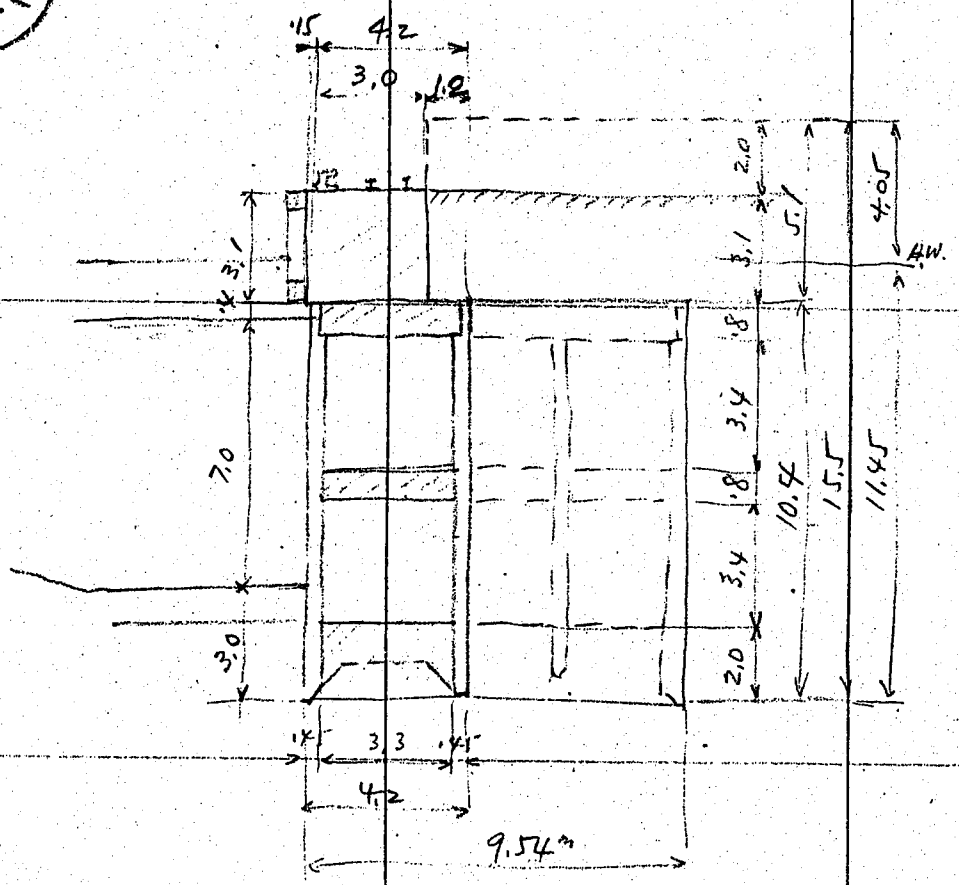

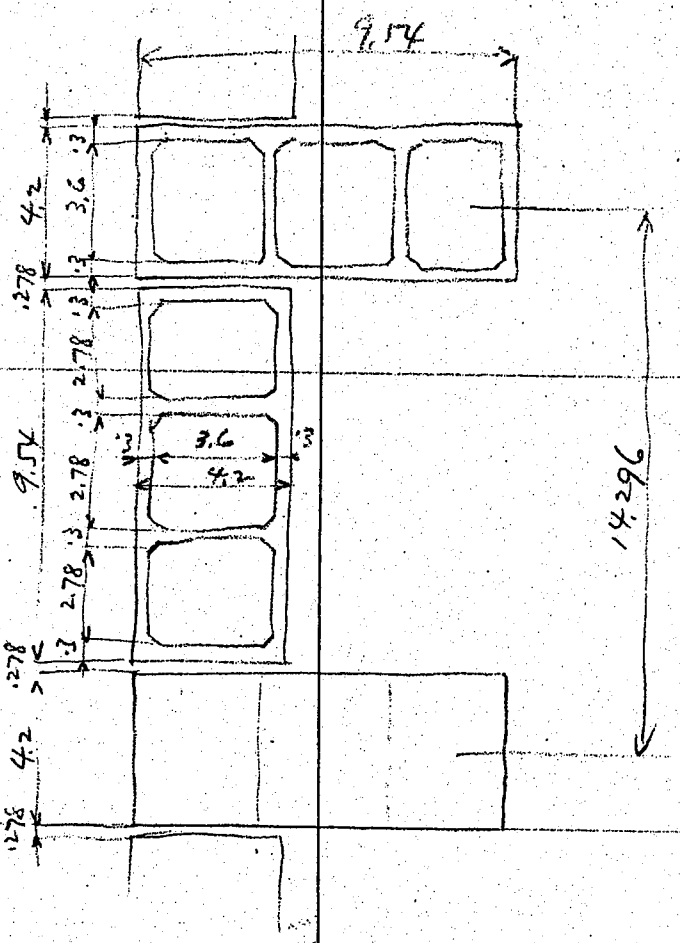

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CALCULATIONS FOR

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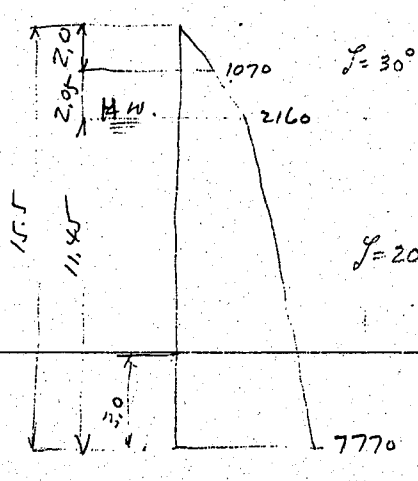
Earth pressure.



$\phi = 30°$ $K = 0.333$ $K' = 0.577$

$\phi = 20°$ $K = 0.490$ $K' = 0.364$

$\frac{1600}{3} \times 2.0 = 1070$
$\quad \times 4.05 = 2160$ } $1615 \times 2.05 \times 14.296 =$ 47,200 kg $= H_1'$ arm 12.36

$490 \times 11.45 + 2160 = 7770$ } $4965 \times 11.45 \times 14.296 =$ 812,000 kg $= H_1''$ 4.64

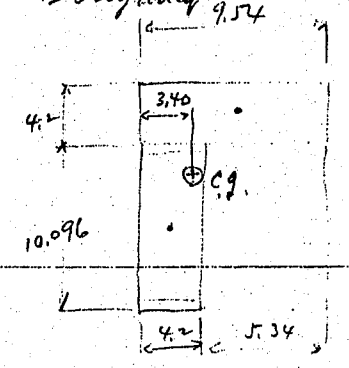
$47{,}200 \times 0.577 = 27{,}300$
$812{,}000 \times 0.364 = 295{,}700$ } 323,000

$V_1 = \frac{323000}{14.296} \times 4.2 =$ 95,000 arm 6.14

$V_1' = \quad \times 10.68 =$ 242,000 − 3.47
$V_1'' = \quad \times 10.096 =$ 228,000 − 0.80

$490 \times 4.5 \times 14.296 =$ 31,500 $= H_2$ arm 1.0
$V_2 = 31500 \times .364 =$ 11,500 3.4

Bouyancy



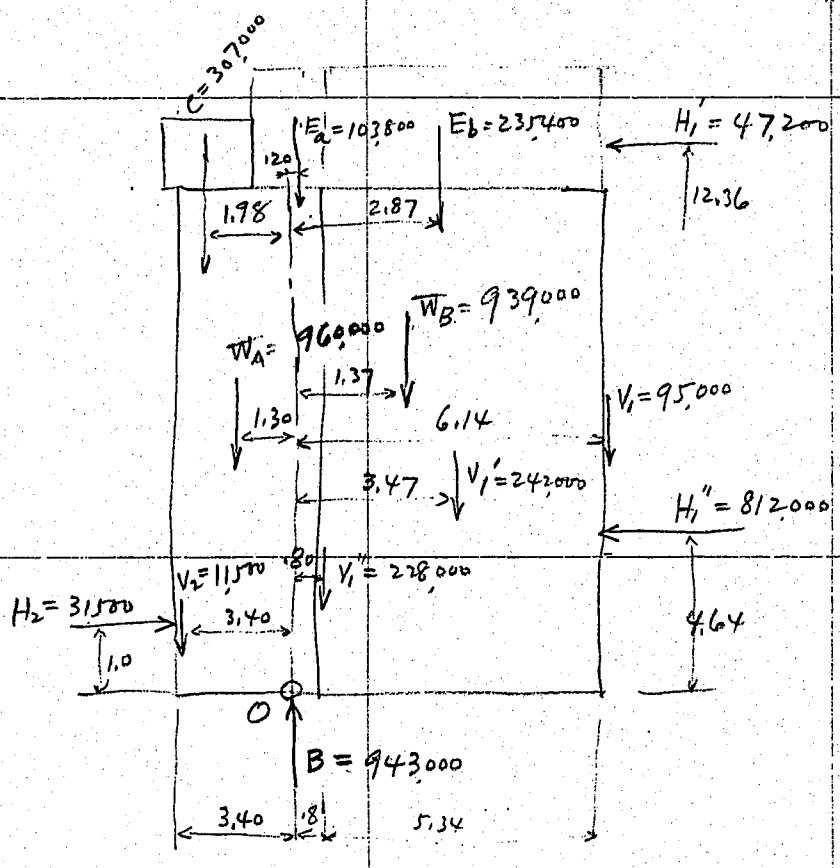
$9.54 \times 4.2 = 40.0 \times .477 = 190.8$
$10.096 \times 4.2 = 42.4 \times 2.10 = 89.0$
$82.4 \quad 3.40 \quad 279.8$

Bouyancy $B = 82.4 \times 11.45 \times 1000 =$ 943,000 kg. arm 0

Earth on well.

on well A $4.05 \times 1600 \times 10.096 \times 1.2 =$ 78,400
$1.05 \times 2000 \times \quad \times 1.2 =$ 25,400 } $= 103{,}800 = E_a$ arm 0.20

on well B. $4.05 \times 1600 \times 4.2 \times 6.54 =$ 177,700
$1.05 \times 2000 \times \quad \times \quad =$ 57,700 } $= 235{,}400 = E_b$ 2.87



Cap conc.

$3.1 \times 3.15 \times 14.296 =$ 139.5 m³ @ 2200 = 307,000

well A.

Top
$9.54 \times 0.30 \times 2 =$ 5.72
$3.60 \times 0.30 \times 4 =$ 4.32
$0.3 \times 0.3 \times 6 =$ 1.54
10.58 m²

Bottom
$9.54 \times 4.2 = 40.10 - 10.58 = 29.42$ m²

Both.
$9.54 \times 0.45 \times 2 =$ 8.58
$3.30 \times 0.45 \times 4 =$ 5.94
$.3 \times .3 \times 6 =$ 1.54
15.06 m²

Bottom $40.0 - 15.06 = 24.94$ m²

conc.
Shell $12.82 \times 8.4 =$ 107.6
" $15.06 \times 2.0 =$ 30.1 } @ 2400 = 33,0000
fill $29.42 \times 0.8 =$ 23.4
" $27.18 \times 0.8 =$ 21.7
" $24.94 \times 2.0 =$ 49.8 } @ 2200 = 209,000
232.7 m³ 539,000

Sand fill $27.18 \times 6.8 = 185$ m³ @ 2000 = 37,0000
909,000

W_B

Slag $61.5 \times 15 =$ 909,000
30,000
939,000 $= W_B$

To $9000 \times \frac{10.096}{9.54} =$ 960,000 $= W_A$

12.82
27.18

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CALCULATIONS FOR

	Moment abt c.g. Loads	Hor. forces	O. vert. forces	arm	moment abt. O
W_A			960,000	+1.30	1,248,000
W_B			939,000	-1.37	- 1,287,000
C			307,000	+1.98	608,000
E_a			103,800	-0.20	- 20,800
E_B			235,400	-2.87	- 676,000
V_1			95,000	-6.14	- 583,000
V_1'			242,000	-3.47	- 840,000
V_1''			228,000	-0.80	- 182,500
V_2			11,500	+3.40	39,100
H_1'		47,200		12.36	583,000
H_1''		812,000		4.64	3,768,000
H_2		- 31,500		1.00	- 31,500
B		827,700	-943000	0	0
			2178,700	1.21 m	2,625,300

Moment of inertia of bottom area.

well A. $10.096 \times 4.2^3 \div 12 = 62.3$
$42.4 \times 1.32 = 71.6$
well B $4.2 \times 9.54^3 \div 12 = 304.0$
$40.0 \times 1.37^2 = 75.1$
$I = 513.0\ m^3$

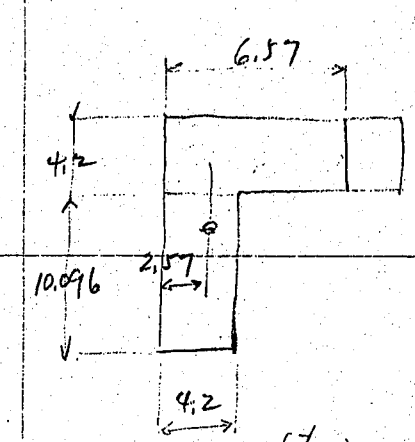
$y_1 = 3.40\ m$
$y_2 = 6.14\ m$

Max. Bearing pressure.

$= \frac{2625.300}{513} \times 3.40 + \frac{2,178.700}{82.4} = 17400 + 26500 = 43,900$

$= -\frac{2625.300}{513} \times 6.14 + \text{〃} = -31400 + 26500 = -4400$

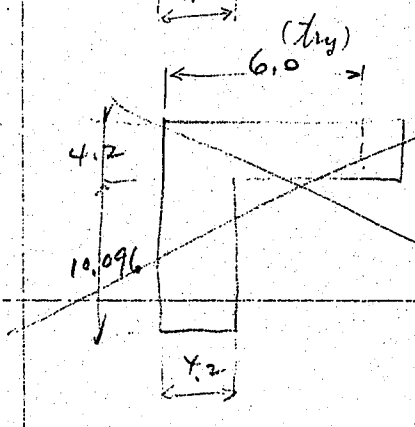
neglecting tension.
pressure area. $3 \times (3.40 - 1.21) = 6.57\ m$



Center of gravity.

$6.57 \times 4.20 = 27.6 \times 3.285 = 90.6$
$10.096 \times 4.20 = 42.4 \times 2.10 = 89.0$
$70.0\ m^2 \quad 2.57 \quad 179.6$

3.40 - 1.21 = 2.19
Σec. = 2.57 - 2.19 = 0.38



$6.00 \times 4.20 = 25.2 \times 3.0 = 75.6$
$10.096 \times 4.20 = 42.4 \times 2.1 = 89.0$
$67.6 \quad 164.6$

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CALCULATIONS FOR

Moment of inertia

$4.20 \times 6.57^3 \div 12$	=	992
27.6×0.715^2	=	14.1
$10.096 \times 4.2^3 \div 12$	=	62.3
42.4×0.47^2	=	9.4
$I =$		185.0

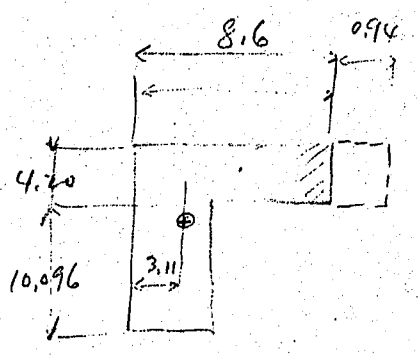
$M = 2,178,700 \times 0.38 = 849,000$ kgm

$y_1 = 2.57$
$y_2 = 4.00$

Max. Bearing pressure.

$\frac{2178700}{70.0} + \frac{849,000}{185} \times 2.57 = 31,100 + 11,800 = 42,900$

" $- \frac{849,000}{185} \times 4.0 = 31,100 - 18400 = +12,700$



$4.20 \times 8.6 =$	36.1	× 4.3 =	155.3	
$4.20 \times 10.096 =$	42.4	× 2.1 =	89.0	
	78.5	3.11	244.3	

$z_{cc} = 3.11 - 2.19 = 0.92$

$M = 2178700 \times 0.92 = 2003000$

$y_1 = 3.11 \quad y_2 = 5.49$

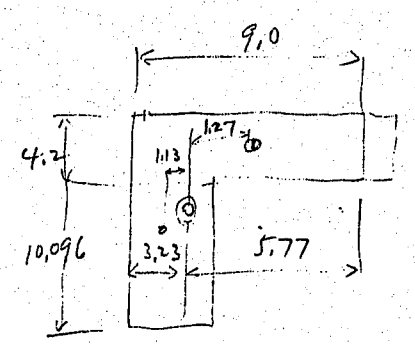
$4.20 \times 8.6^3 \div 12$	= 223.0
36.1×1.19^2	= 51.1
$10,096 \times 4.2^3 \div 12$	= 62.3
42.4×1.01^2	= 43.4
	379.8 m.m.

$\frac{2178,700}{78.5} + \frac{2003,000}{379.8} \times 3.11 = 27,750 + 16400 = 44,150$

" $- \frac{2003,000}{379.8} \times 5.49 = 27750 - 2890 = -1150$

max. bearing pressure.

$45,400$ kg/m² or 0.



$10,096 \times 4.2 =$	42.4	× 2.10 =	89.0	
$4.2 \times 9.0 =$	37.8	× 4.50 =	170	
	80.2	3.23	259.0	

$4.2 \times 9^3 \div 12 + 37.8 \times 1.27^2 = 285.4 + 60.9 = 344.3\ 315.9$ (255.0 ?)

$10,096 \times 4.2^3 \div 12 + 42.4 \times 1.13^2 = 62.3 + 52.2 = 114.5$

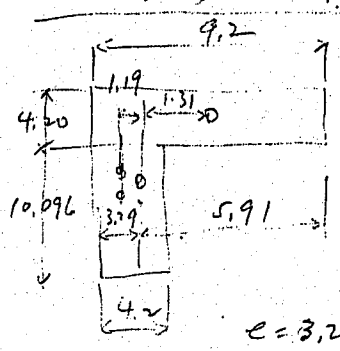
$I = 460.8\ 432.4 \quad y_1 = 3.23 \quad y_2 = 5.77$

$e = 3.23 - 2.31 = 0.92$

$M = 2,215,000 \times 0.92 = 2,035,000$ kgm.

$\frac{2215000}{80.2} + \frac{2,035,000}{460.8\ 432.4} \times 3.23 = 27600 + 14250\ 15200 = 41850\ 42800$

" $-$ " $\times 5.77 = 27,600 - 25500 = +2100$
$27,150 = +450$



$10,096 \times 4.2 =$	42.4	× 2.10 =	89.0	
$4.2 \times 9.2 =$	38.6	× 4.60 =	177.5	
	81.0	3.29	266.5	

$4.2 \times 9.2^3 \div 12 + 38.6 \times 1.31^2 = 273.0 + 66.2 = 339.2$

$10.096 \times 4.2^3 \div 12 + 42.4 \times 1.19^2 = 62.3 + 60.1 = 122.4$

$I = 461.6 \quad y_1 = 3.29 \quad y_2 = 5.91$

$e = 3.29 - 2.31 = 0.98$

$M = 2,215,000 \times 0.98 = 2,170,000$

$\frac{2215000}{81.0} + \frac{2,170000}{461.6} \times 3.29 = 27350 + 15450 = 42,800$

" $-$ " $\times 5.91 = 27,350 - 27750 = -400$

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CALCULATIONS FOR
7米繋船岸壁
工数概算

三混凝土	1:2:4	#筒A	28基	@ 190	= 5320 立米	@ 14,000	=	74,500
〃	〃	〃 B	28 〃	@ 202	= 5660 〃	@ 14,00	=	79,200
〃	1:3:6	土留	28 〃	@ 14.0	= 3920 〃	@ 12,30	=	48,200
鉄筋		#筒A,B共	56	@ 6.5	= 365 瓲	@ 120.00	=	43,800
型枠		#筒A,B	56	@ 700	= 39200 平米	@ 1.20	=	47,000
〃		土留	6.35m × 400		= 2540 〃	@ 1.20	=	3,100
#筒沈下(沈下量1米)		A,B	56	@ 440	= 24600 立米	@ 2.50	=	61,500
緩衝材及金物一式			35,000円 + 4000百(繋船柱8本増加分)				=	39,000
中詰砕石及転圧			56	@ 90	= 5000 立米	@ 0.50	=	2,500
土留撤去 転圧の為			28	@ 120	= 3400 〃	@ 0.50	=	1,700
#筒間隙埋充モルタル			56	@ 10	= 560 〃	@ 16.00	=	9,000
保険料及雑工事一式							=	15,500
						計		425,000 円

備考
(但し捨石根固工事ヲ含マズ)

6.15×4.5=27.7
9.15×11.5=11.5
39.31
=120.

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CALCULATIONS FOR
7米繋船岸壁

材料,

A well.

Top section
9.54 × 0.3 × 2 = 5.72
3.6 × 1.5 = 5.40
6 @ .3 × .3 = .54
11.66 m²

Bott. section
9.54 × 0.45 × 2 = 8.58
3.3 × 1.65 = 5.45
6 @ .3 × .3 = .54
14.53
平均 13.12

Conc. Shell.
13.12 × 8.4 = 110.2
14.53 × 2.0 = 29.1
139.3 m³

Form. Top.
3.6 × 6 = 21.6
2.78 × 4 = 11.1
2.48 × 2 = 5.0
.12 × .12 = 1.4
39.1 m²

Bott.
3.3 × 6 = 19.8
2.63 × 2 = 5.3
2.78 × 2 = 5.6
2.48 × 2 = 5.0
.12 × .12 = 1.4
37.1
平均 38.1 m²

Form.
38.1 × 8.4 = 320
37.1 × 2.0 = 74
394
(4.2+9.54) × 2 = 27.48 × 10.4 = 286
680 m²
控え 0.2 × 8 × 10.4 = 17
0.12 × 1.3 × 4 × 4 = 3
20
700 m²

Sand fill
13.12 × 6.8 = 90 m³

RC
9.54 × 4.2 × 11.0 = 440 m³

fill
~~11.66~~ × 0.8 = 9.3
13.12 × 0.8 = 11.5
14.53 × 2.0 = 29.1
49.9 m³ × 98
½計 189.2 m³
~~土砂 = 2541~~
3.15 × 3.1 × 14.296 = 140 m³ (28 reqd)

(B)
Conc. add
0.22 × 8.0 × 6.8 = 12. m³

Cap 6.35 × 400 = 2540

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CALCULATIONS FOR
車輪西新工場

七米繋船岸壁 工費豫算 延長 400米分.

混凝土工							自3
井筒混凝土	配合 1:2:4	7,841.68	立米	@ 14.00	=	109,784 ✓	22.3m
〃 中詰混凝土	〃 1:2:4	5,642.84	〃	@ 14.00	=	79,000 ✓	16.1m
土留工 混凝土	〃 1:3:6	3,906.00	〃	@ 12.20	=	47,653 ✓	11.1m
鐵筋工	丸 鋼	329.03	瓲	@ 120.00	=	39,484 ✓	3.3m
型枠工							
井筒型枠		36,380.9	平米	@ 1.20	=	43,657 ✓	46.7m
土留工型枠		2,540.0	〃	@ 1.20	=	3,048 ✓	
井筒中詰 砂		8,344.0	立米	@ 0.50	=	4172 ✓	
〃 砂混り鉉滓		1,708.0	〃	@ 0.50	=	854 ✓	5.0m
井筒頂上土留工裏詰 砂混り鉉滓		3,438.0	〃	@ 0.50	=	1,719 ✓	1.7m
井筒噛合部填充膠泥	配合 1:2	283.36	立米	@ 16.00	=	4534 ✓	8m
〃 〃	捨木 20cm×10cm×延長 10.4m(ボルト共)	224.0	挺	@ 12.00	=	2,688 ✓	2.7m
井筒沈下掘鑿		24,920.0	立米	@ 2.50	=	62,300 ✓	62.3m
繋船柱	(附属ボルト共)	28	個所	@ 475.00	=	13,300 ✓	
繋船環	(〃) ✓生木	28	〃	@ 15.50	=	434 ✓	1.0m
鉄梯子	(附属金物 ~~ボルト而付ボルト共~~)	8	〃	@ 150.00	=	1,200 ✓	
緩衝材	(附属金物共) 延長	400	米	@ 60.00	=	24,000 ✓	24.0m
雑工事	鉄梯子入組, 排水溝吐口, 執傚面ボルト込, 上面混凝土構造目地等一切 (据付費)					1,200 ✓	1.2m
保険料其他						1373 ✓	1.3m
						440,400円 ✓	199.5m

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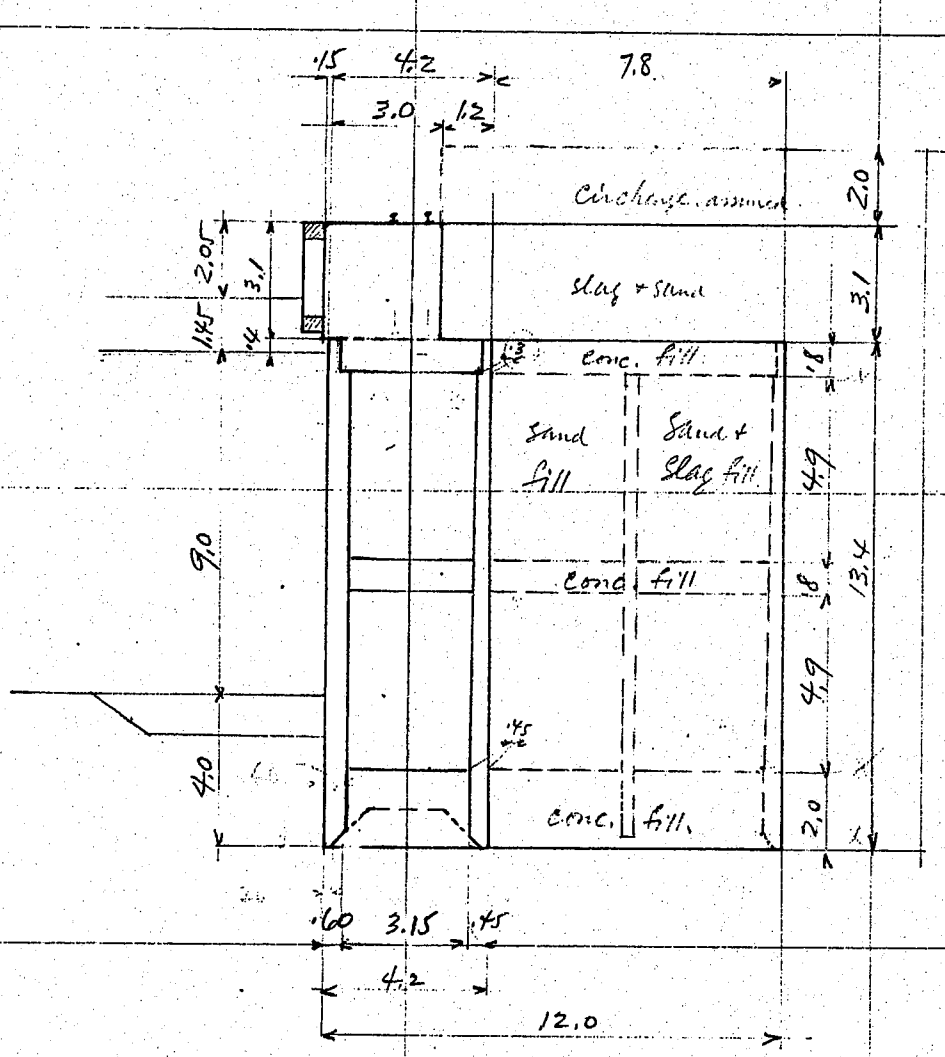
CALCULATIONS FOR 九米岸壁 柱状

9m Quay wall

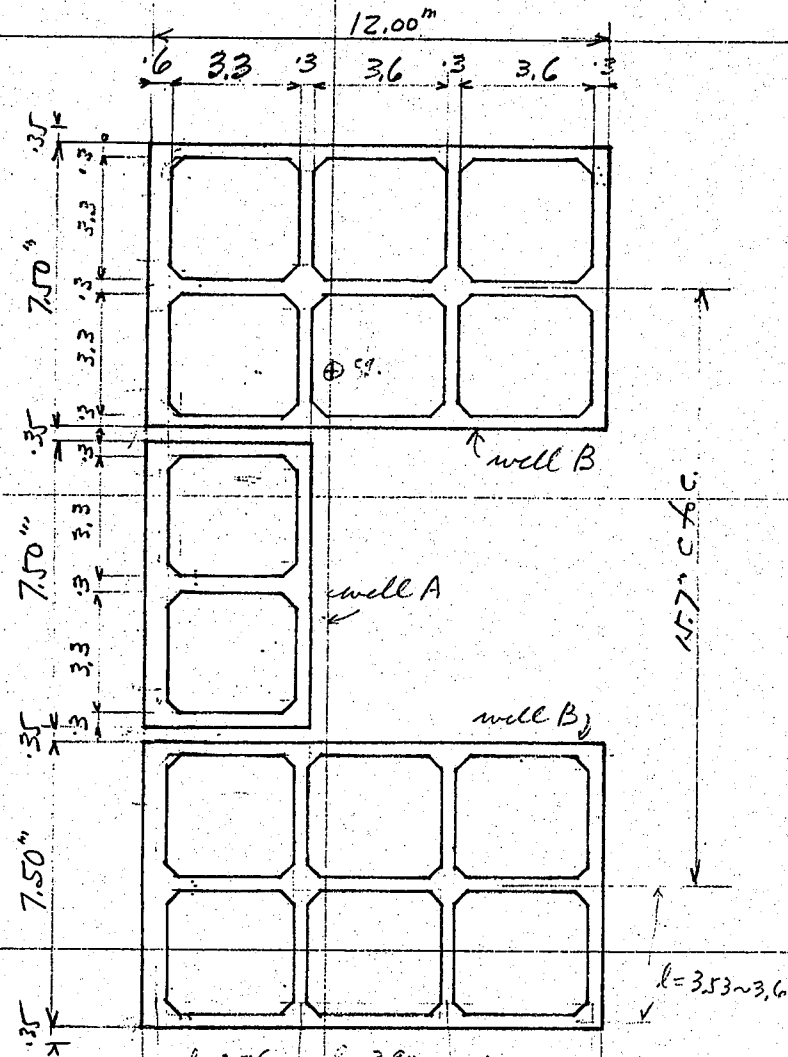
本

Total length of Quay wall 400.00 m.

Wells A	25 @ 7.5	=	187.5
" B	26 @ 7.5	=	195.0
clearances	50 @ .35	=	17.5
			400.00 m



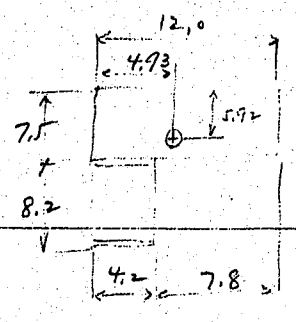
Cross section of wall.
Scale 1:200.



Top View

Weight of wall.
Bottom area

well A	4.2 × 8.2	=	34.4	×	2.1	= 72.2
" B	7.5 × 12.0	=	90.0	×	6.10	= 540.0
			124.4		4.93 m	612.2



34.4 × 11.6 = 399.
90.0 × 3.75 = 337.5
124.4 5.92 736.5

Weight of well A.
Shell top section.

	7.50 × 0.60	=	4.50
	7.50 × 0.30	=	2.25
	3.30 × 0.30 × 3	=	2.97
	.3 × .3 × 4	=	0.36
			10.08 m²
hollow	7.5 × 4.2 = 31.5 − 10.08	=	21.42 m²

Bott. section

	7.50 × 0.60	=	4.50
	7.50 × 0.45	=	3.38
	3.15 × 0.3 × 3	=	2.84
			0.36
			11.08 m²
hollow	31.5 − 11.08	=	20.42 m²

Average Shell 10.58
" 20.42

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CALCULATIONS FOR

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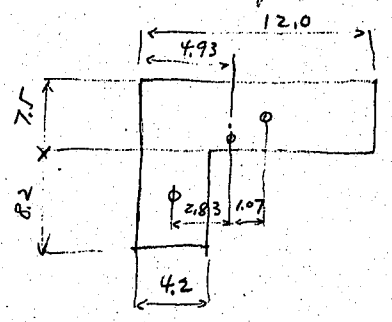
Moment about center of gravity c. of batt, area.

Loads	Hor. force	Vert. force	Lever arm	moment about o
W_A		~~703,000~~ 981,000	2.84	2,786,000
W_B		~~2464,000~~ 2,776,000	− 1.27	− 3,524,000
C		337,000	3.50	1180,000
E_A		87,400	1.33	116,000
E_B		592,000	− 2.57	− 1,521,000
V_1		373,000	− 7.07	− 2637,000
V_1'		775,000	− 3.17	− 2458,000
V_1''		408,000	0.73	298,000
V_3'		− 39,000	4.93	− 192,000
H_1	52,000		15.36	799,000
H_2	1576,000		5.57	8,765,000
H_3	− 83,700		1.33	− 111,000
B		− 1617,000	0	0
	1544300 Kg (.330)	4673,400	0.75 m	3,501,000 Kg/m
	1779,000 (.394)	4513,600	1.16	5229,000

黒ぎの土圧 $\varphi = 25°$
#1, #7 / 30°

Moment of inertia of bottom area



$34.4 \times 2.83^2 + 8.2 \times 4.2^3 \div 12 = 27.54 + 50.6 =$
$\frac{90.0}{124.4} \times 1.07^2 + 7.5 \times 12^3 \div 12 = 103.2 + 1078.8 =$ } 1,502,0 $m^4 = I$

$y_1 = 4.93 \quad y_2 = 7.07$

Max. Bearing pressure

$= \frac{4,673,400}{124.4} \pm \frac{3,501,000}{1502} \times 4.93 = 37,600 + 11,500 = 49100$ kg/m²

$= \frac{4,673,400}{124.4} - \frac{3,501,000}{1502} \times 7.07 = 37,600 - 16,500 = 21,100$ s

$\frac{\Sigma H}{\Sigma V} = \frac{1544300}{4673,400} = 0.330$

Estimate of cost.

Concrete 1:2:4	well A.	25@ 216.5 =	5420	20,000 m³ @ 14,00 =	280,000
	" B	26@ 560.0 =	14,580		
1:3:6	Cap	3.1 × 3.15 × 4.00 =		3,910 " @ 12,30 =	48,100
Reinforcement	well 4 6 3 cm	28 =		500 tons @ 120,0 =	60,000
Form.	well B	123 × 13.4 × 26 =	42,500	64500 m² @ 1.20 =	77,400
	" A	51 × 13.4 × 25 =	17,100		
	隔壁	3 × 51 × 13.4	2,100		
	Cap.	6.35 × 4.00 =	2,500		
well sinking excav.	A	25@ 8.2 × 4.2 × 13.8 =	11900	44,200 m³ @ 2.50 =	110,500
	B	26@ 12.0 × 7.5 × 13.8 =	32300		
前面 堀方		400 × 5 × 1 =		2,000 m³ @ 2.50 =	5,000
〃 埋戻				2,000 " @ 3.00 =	6,000
鉄筋材料費					35,000
保険取扱化粧					15,000
中堀 land & 鉄鋼				2880. @ .50 =	14,400
well 周囲を埋戻 2.5m-1/2 入				400 " @ 100 =	40,000
					691,400
				misc. expenses say.	8,600
					700,000

33,000
19,000

10 × 2.75 = 27
34.4 × 11.16 = 384
412

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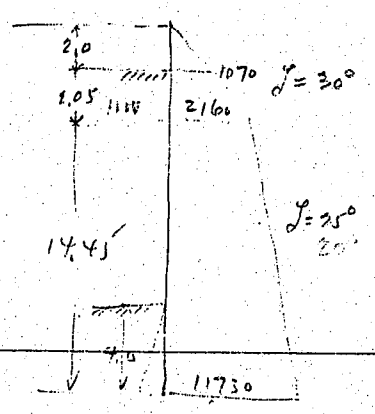
CALCULATIONS FOR

9 m. Quay wall

Earth pressure.



$k = 0.333$
$k' = 0.577$

$\frac{1-\sin 30°}{1+\sin 30°} \cdot \frac{0.577}{1.422} = 0.406$ 0.470

$k = 0.406$ 0.470
$k' = 0.466$ 0.361

$533 \times 2.0 = 1070$
$\times 4.05 = 2160$ } $1615 \times 2.05 \times 15.7 = 52{,}000$ kg $= H_1$ arm 15.36 from bott.

$2000 \times 0.406 \times 14.45 = 11730$

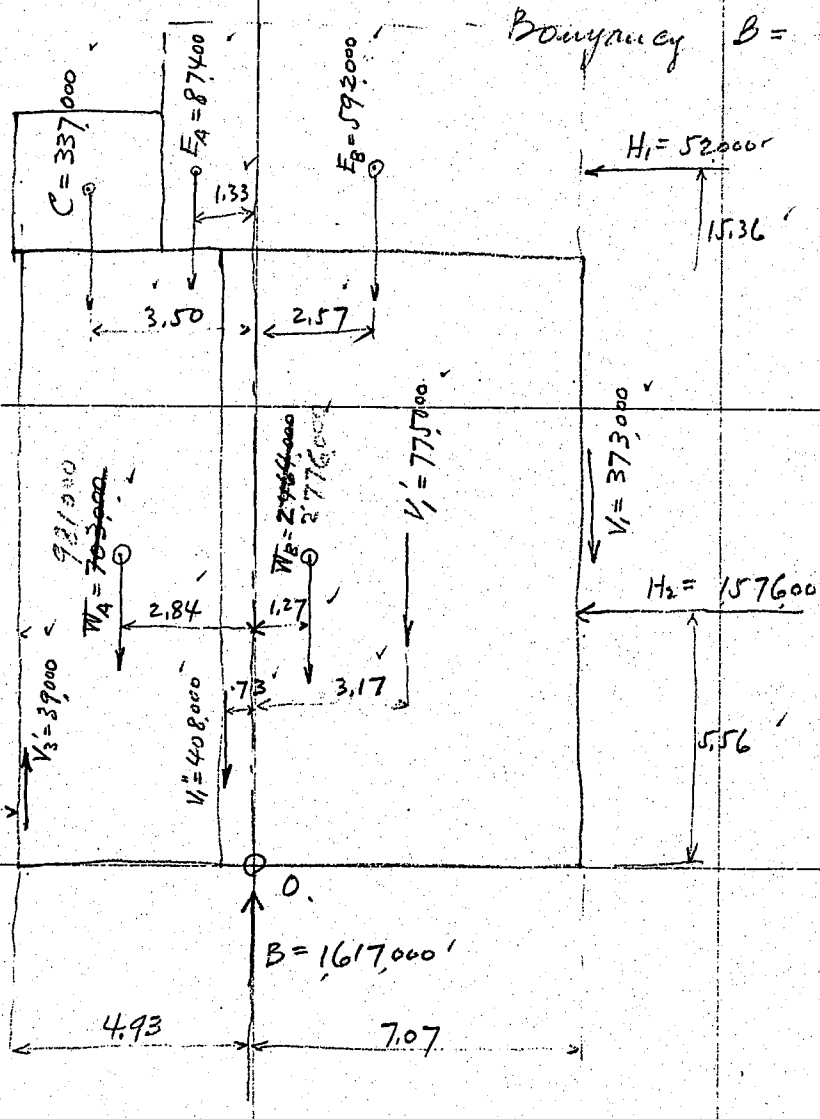
$\frac{2160}{2} \times 14.45 \times 15.7 = 6945 \times 14.45 \times 15.7 = 1576000 = H_2$ arm 5.56 from bott.

$\frac{2000 \times 4.0^2}{6} \times 15.7 = 83{,}700$ kg $= H_3$ arm 1.33 m from bott.

$0.577 \times 52000 = 30000$
$0.466 \times 1576 = 735$ 00
$765000 \div 15.7 = 49{,}700$ kg/m

$V_1 = 49700 \times 7.5 = 373000$ kg arm 12.00 m from toe
$V_1' = \quad \times 7.8 \times 2 = 775000$ " " 8.1 "
$V_1'' = \quad \times 8.2 = 408$ 00 " " 4.2 "
$V_3' = 83700 \times 0.466 = 39000$ " " 0.0 " "

Bouyancy $B = 124.4 \times 1000 \times 13.0 = 1617000$ kg arm 4.93 m



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CALCULATIONS FOR

9m Quay wall.

A well. Conc. 1:2:4.

Shell.	10.58 × 13.4 =	141.8		@ 2,400 =	340 000
fill	21.42 10.98 × 0.8 =	17.2 ~~8.1~~	74.7		164 000
〃	20.92 10.58 × 0.8 =	16.7 ~~8.5~~	~~39.8~~	@ 2200 =	~~88 000~~
〃	20.42 11.58 × 2.0 =	40.8 ~~23.2~~			
		216.5 ~~187.6~~ m³			
Sand fill	20.92 ~~10.58~~ × 9.8 =		~~104~~ 105 m³	@ 2,000 =	418 000 ~~208 000~~
1:3 mortar clearance fill.					
	4.20 × 0.7 × 13.4 =		39.4 m³	@ 1700 =	67000
					W_A = ~~703000~~ 981000 kg

	2 × .26 × 3.27 × 4.9 @=400 =	1670	700.140 × 2.10 =		1,470,500
	2 × .19 × 3.19 × 4.9 @= 400 =	1190	1670 × 0.47 =		800
			1190 × 0.50 =		600
			709 m	209 m	1471900

arm 2.09 from toe.

B well.

Shell top section

7.50 × 0.3 × 3 =	6.75	
7.50 × 0.6 =	4.50	
3.60 × 0.3 × 6 =	6.48	
3.30 × 0.3 × 3 =	2.97	
.3 × .3 × 12 =	1.08	
	21.78 m²	
hollow 7.5 × 12 = 90.0 − 21.78 =	68.22 m²	

Shell, section

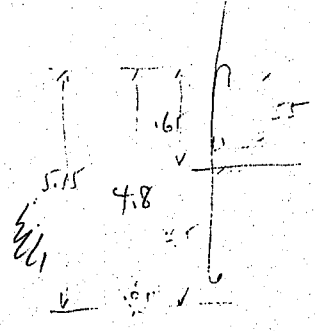
7.50 × 0.45 =	3.38	
7.50 × 0.3 〃 =	4.50	
7.50 × 0.6 =	4.50	
3.45 × .45 × 3 =	4.66	
3.30 × 0.45 × 6 =	8.91	
	1.08	
	27.03 m²	
hollow 7.5 × 12 = 90.0 − 27.03 =	62.97 〃	

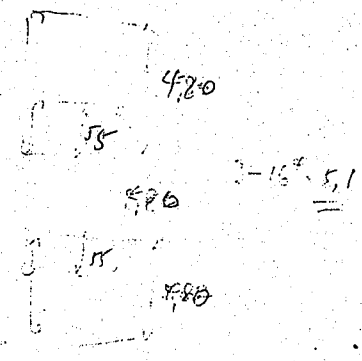
Average Shell 24.40 m²
fill 65.60 〃

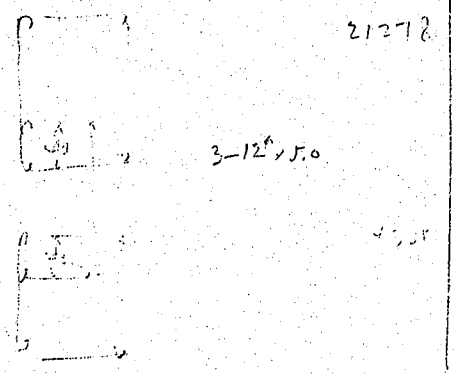
Shell conc. 1:2:4	24.40 × 13.4 =	327.0		@ 2400 =	785,000 × 6.0 =	4710 000	
fill	62.22 ~~21.78~~ × 0.8 =	~~54.5~~ ~~17.4~~			~~200 000~~ × 6.0 =	~~1 200 000~~	
〃	61.60 24.40 × 0.8 =	~~52.4~~ ~~19.5~~	~~94.0~~ 94.10	@ 2200 =			
〃	62.97 ~~27.03~~ × 2.0 =	~~125.9~~ ~~54.1~~	232.9				
		~~448.0~~ 448.0 m³					
1700 + 400 = 2100	Sand fill 2/3 × 6.56 × 9.8 =		428 m³	@ 2100 =	899 000 × 4.05 =	3640 000	
1850 + 680 + 160 = 2690 say 2700	Slag + Sand fill 1/3 × 6.76 × 9.8 =		215 〃	@ 2700 =	580 000 × 9.90 =	5740 000	

W_B = ~~2 464 000~~ 2 776 000 kg, 6.20 × 15.290 000 / 17 160 000 from toe

Cap. Conc. 1:3:6	3.14 3.15 × 15.7 =		153.4 m³	@ 2200 =	C = 337,000 kg arm 1.43 from toe
Fill on well A	Slag + Sand	8.2 × 1.2 × 3.1 =	30.5 m³	@ 2530 =	77 100
	water	8.2 × 1.0 × 1.05 =	10.3 〃	@ 1000 =	10 300
					E_A = 87400 kg arm 3.60 from toe
fill on well B.	Slag + Sand	9.0 × 7.5 × 3.1 =	206	@ 2530 =	521 000
	water	9.0 × 7.5 × 1.05 =	71	@ 1000 =	71 000
					E_B = 592,000 kg arm 7.10 from toe







15.0 6.5

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CALCULATIONS FOR
9米繋船岸壁
工費概算

混凝土	1:2:4	#筒A	25基 @ 217 =	5420	立米 @ 14.00 =	75,900
〃	〃	〃 B	26 @ 560 =	14,580	〃 @ 14.00 =	204,000
〃	1:3:6	土留工	3.1×3.15×400 =	3920	〃 @ 12.30 =	48,200
鉄筋		#筒A	25 @ 6.5 =	163	瓲 @ 120.00 =	19600
〃		〃 B	26 @ 15.0 =	390	〃 @ 120.00 =	46,800
型枠		#筒A	25 @ 730 =	18,300	平米 @ 1.20 =	22,000
〃		〃 B	26 @ 1700 =	44,000	〃 @ 1.20 =	52800
〃		土留工	6.35×400 =	2500	〃 @ 1.20 =	3,000
#筒沈下費(沈下高13.8米 ブえビ)		#筒A	25 @ 475 =	11,900	立米 @ 2.50 =	29,800
〃		〃 B	26 @ 1240 =	32,300	〃 @ 2.50 =	80,800
繋船杭其他金物(繋船杭6本@500=3000円増)				35000円+3000円	=	38,000
中詰砂及鋪均		25 @ 205 = 5100 26 @ 640 = 16,700 1.2×3.1×400 = 1,500 7.5×9×3.1×26 = 5,400		28,700	立米 @ 0.50 =	14,400
#筒間隙填充モルタル		51 @ 13	=	660	立米 @ 16.00 =	10,600
保険料及雑工事費一式						15,100
					計	661,000円

備考
(但し上記工事費ハ杭頭処理工事ヲ含マズ)

輸西新工場繋船岸壁設計ノ要旨

本設計ハ別紙奥図ニ示セル如ク大小二種ノ断面ヲ有スル鉄筋混凝土井筒ヲ支亜ニ沈下セシメ亜ニ堅体ノ上ニ上部工ヲ築造スルニ在リ此種ノ事故ヲ除キ且ツ工期ヲ短縮スルニ適スル構造トス

本設計ノ特徴次ノ如シ

(1) 他ノ工法ノ如ク締切工、水替費等或ハ浮函ノ進水設備等多額ノ費用ヲ要スル仮工事ヲ要セズ天然地盤上ニ井筒ヲ据付ケ開式ケーソン工法ニヨリテ何等ノ不安ナク徐々ニ井筒ヲ沈下セシムル而ニヲ地質ノ硬軟ニ拘ラズ何レノ地質ニモ適スル地質ニテ何等ノ施工ニ得ラレ且ツ他種工法ニ於ケル如ク締切ノ漏水又ハ崩壊、湧水ニ見舞ハレル危険ヲ有セズ浮函進水作業中ノ事故等過失又ハ天災ニ見舞ハレル危険ヲ全ク解放サレ而モ工期ヲ著シク短縮シ得ベシ

(2) 開式ケーソン工法ヲ用フルヲ以テ井筒外部ノ地盤ヲ殆ンド乱サズ他ノ工法ノ如ク一旦堀鑿後埋戻ヲ行フモノニ比シ均一ノ土圧ハ著シク軽減サレ設計以上ノ強ヲ有ス

(3) 割栗基礎上ニ構築セル一般岸壁工法或ハ捨石基礎上ニ据付ケタル浮函岸壁ニ於テハ常時ノ土圧又ハ地震等前方ニ滑出ス可キ構造ニシテ事実上此種ノ災害ヲ蒙ムリタル岸壁ノ倒壊多カルベシ本設計ニ於テハ井筒ヲ天然地盤ニ根入ヲ保タシメ関係上滑動ノ虞レ全ク無キヲ以テ設計以上ノ穏レセル安全ヲ有ス

(4) 捨石基礎上ニ浮函ヲ据付ケル工法ハ捨石ヲ施工スル為メ一箇年半乃至二箇年間自然沈下ヲ待ツ為メ目潰及捨石補足等ヲ要シ工期ノ遅延ヲ伴ヒ勿論ハ完了後ト雖モ後日ノ沈下ヲ免レズ本設計ニ於テハ其懸念ナシ

(5) 本設計ニ依レバ岸壁竣功後ト雖モ地盤ガ充分落ヒ着キ平衡状態ニ至ル迄ノ間ハ特ニ必要ニ応ジ前面ヲ多少後潜ニ予定以上ノ巨船繋留ノ必要ニ備フルコトヲ得

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CALCULATIONS FOR
輪西新工場

九米繋船岸壁工費豫算　延長400米分

混凝土工							
井筒混凝土	配合1:2:4	11,799.97	立米	@ 14.00	=	165,200 ✓	33,600
〃 中詰混凝土	〃 1:2:4	8,538.78	〃	@ 14.00	=	119,543 ✓	24,200
土留工混凝土	〃 1:3:6	3,906.00	〃	@ 12.20	=	47,653 ✓	11,100
鐵筋工	丸鋼	569.07	瓦屯	@ 120.00	=	68,288	5,700
型枠工							
井筒型枠		56,541.5	平米	@ 1.20	=	67,850 ✓	
土留工型枠		2,540.0	〃	@ 1.20	=	3,048 ✓	70,900
井筒中詰砂		16,232.0	立米	@ 0.50	=	8,116 ✓	
〃 〃 砂混り鉱滓		5,616.0	〃	@ 0.50	=	2,808 ✓	10,900
井筒頂上土留工裏詰砂混り鉱滓		6,209.0	〃	@ 0.50	=	3,105 ✓	3,100
井筒噛合部填充膠泥 配合1:2		400.86	〃	@ 16.00	=	6,414 ✓	1,100
〃 〃 木摺木	25cm×10cm×延長13.4m(ボルト共)	204.0	挺	@ 20.00	=	4,080 ✓	4,000
井筒沈下掘鑿		43,473.0	立米	@ 2.50	=	108,683 ✓	108,700
繋船柱	(附属ボルト共)	26	個所	@ 475.00	=	12,350 ✓	
繋船環	(〃)	25	〃	@ 15.50	=	388 ✓	1,000
鉄梯子	(附属金物及レール面ボルト共)	8	〃	@ 150.00	=	1,200 ✓	
緩衝材	(附属金物共) 延長	400	米	@ 60.00	=	24,000 ✓	24,000
雑工事	鉄梯子入組, 排水溝吐口, 手摺基面ボルト込 土留コンクリート構造目地					1200 ✓	1,200
保険料其他						1374 ✓	1,300
						645,300円 ✓	301,000

1:2:4 混凝土

セメント	0.30	瓦屯	@ 18.00 =	5.40 (2.0樽)
砕石	1.00	立米	@ 4.50 =	4.50
砂	0.50	〃	@ 2.50 =	1.25
練手子				2.85
				14.00 円/立米

1:3:6 混凝土

	0.20	@	18.00 =	3.60
				4.50
				1.25
				2.85
				12.20円/立米

1:2 膠泥

セメント	0.60	瓦屯	@ 18.00 =	10.80
砂	1.00	立米	@ 2.50 =	2.50
練手子				1.50
泥入手				1.20
				16.00 円/立米

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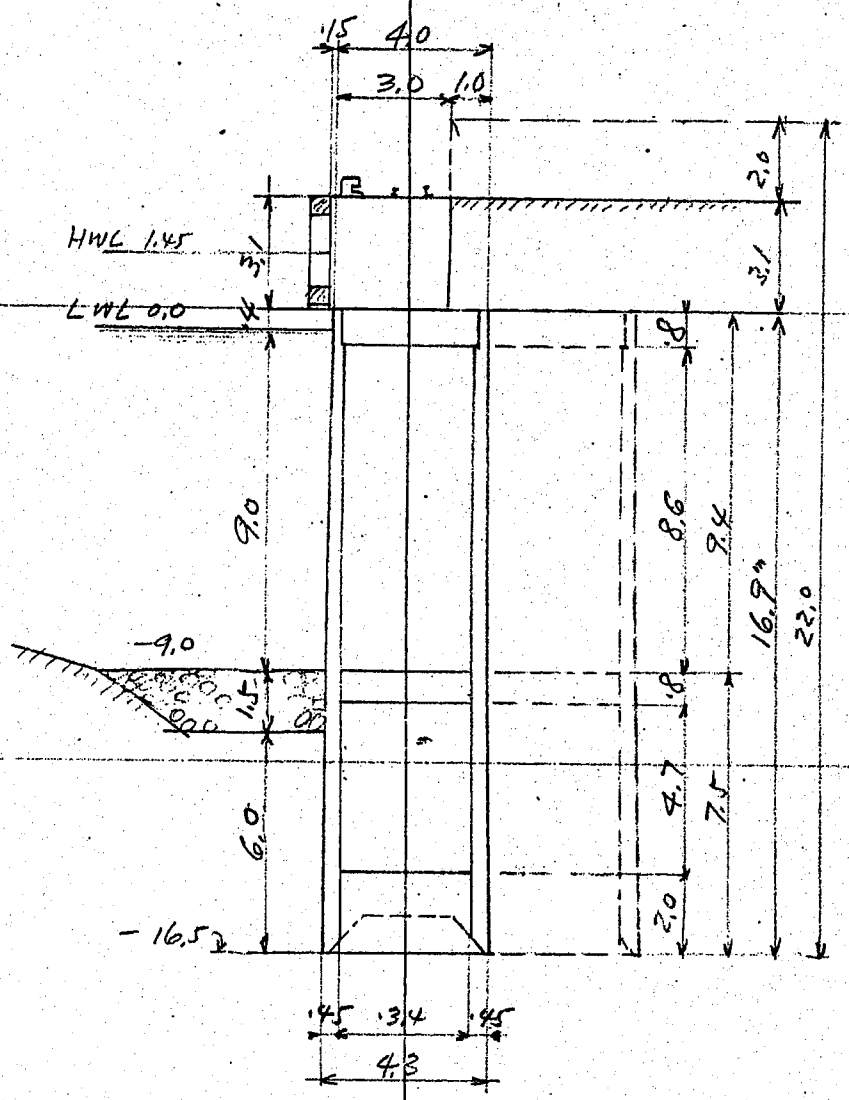
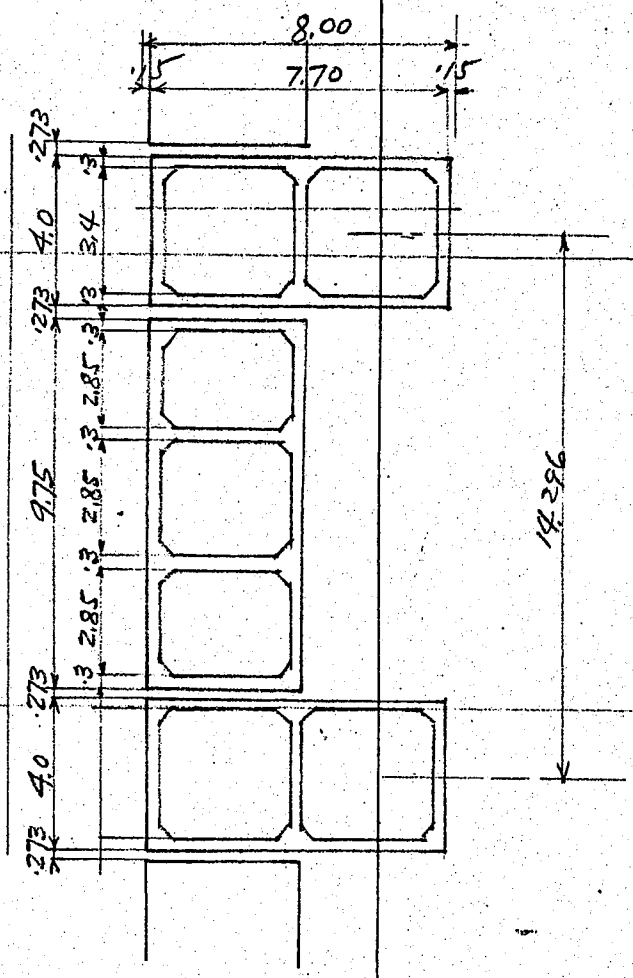
CALCULATIONS FOR

7.





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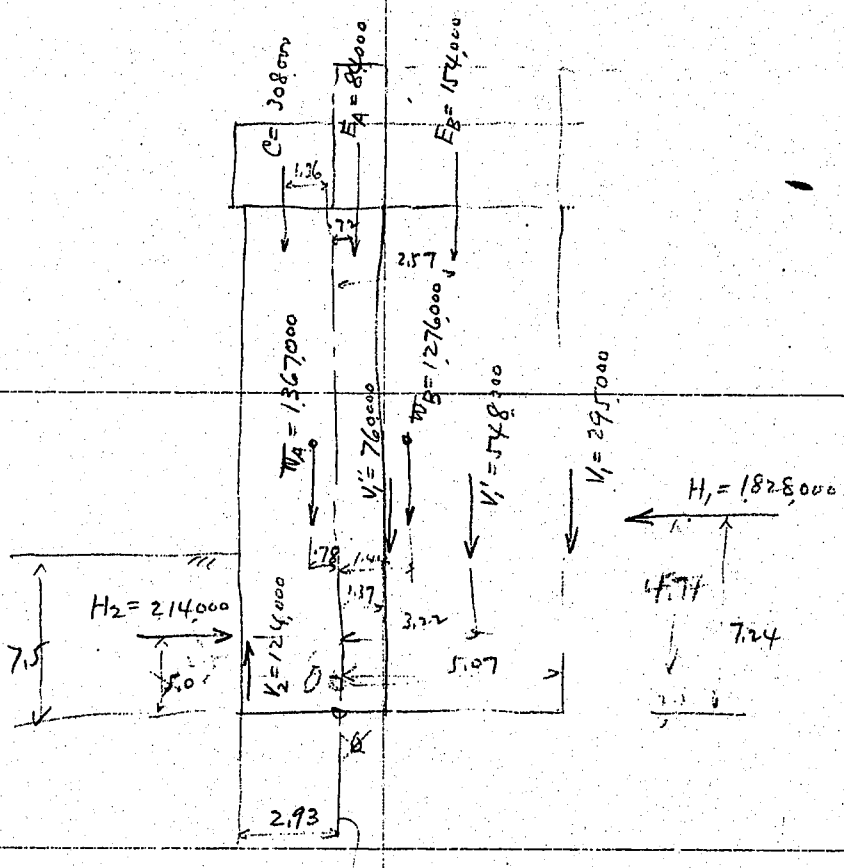
CALCULATIONS FOR
九米岸壁 比較設計

Earth pressure.
Rear side
$\frac{1600}{3} \times 2.00 = 1,070$
$\times 22.00 = 11,730$
$12,800 \div 2 = 64000$ kg/m² average
$H_1 = 64,000 \times 20.0 \times 14.29 = 1,828,000$ kg arm 7.24 m
Front side $H_2 = \frac{1}{6} \times 1600 \times 7.5^2 \times 14.29 = 214,000$ " arm 5.0 m

Weight of well B.
Shell conc 1:2:4 $9.90^{m^2} \times 16.9 = 167.3 \text{ m}^3 @ 2400 = 402,000$
fill Top $22.76 \times 0.8 = 18.2$
bott. $20.7 \times 2.0 = 41.4$
int $21.5 \times 1.8 = 17.2$
$76.8 \text{ m}^3 @ 2200 = 169,000$
244 m^3
571,000 kg
Sand fill $10.8 \times 13.3 = 144 @ 1,700 = 245,000$
Slag + sand fill $10.8 \times " = 144 @ 2500 = 360,000$
605,000 kg
W_B 1,276,000 kg

Weight of well A.
Shell conc 1:2:4 $12.69 \times 16.9 = 214.2 @ 2400 = 514,000$
fill. Top 12.8, Bott. 15.0, int 22.5 $100.3 \text{ m}^3 @ 2200 = 221,000$
735,000
Sand fill $28.0 \times 13.3 = 372. @ 1700 = 632,000$
W_A 1,367,000 kg
Earth on well. A $10.3 \times 5.1 = 52.5 @ 1600 = 84,000 = E_A$
" " B $9.0 \times 5.1 \times 4.7 = 96.0 @ " = 154,000 = E_B$

Cap conc. $140 @ 2200 = 308,000 = C$



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CALCULATIONS FOR

Moment about C.g. of bottom area.

Forces	Hor forces	Vert forces	lever arm	moment abt O.
W_A		1,367,000	× 0.78	= 1,065,000
W_B		1,276,000	−1.44	− 1,840,000
C		308,000	1.36	419,000
E_A		84,000	−0.72	− 60,000
E_B		154,000	−2.57	− 396,000
H_1	1828,000		7m 4.7	+3,240,000 8,670,000
H_2	− 214,000		~~5m~~ 0.00	− 1,070,000
V_1		295,000	−5.07	− 1,495,000
V_1'		548,000	−3.22	− 1,765,000
V_1''		760,000	−1.37	− 1,040,000
V_2		− 124,000	2.93	− 363,000
	1614,000 kg.	4668,000		6695,000 kgm. ÷ 14.296 = 2235 mm
				3,195,000 −

Hor. bearing pressure.

$$\sigma_b = \frac{12M}{t^2} = \frac{12 \times 22,500}{7.5^2} = 47700 \text{ kg/m}^2$$

$$\sigma_a = \frac{1}{3}\sigma_b = 15900$$

passive pressure of earth

$h = 2.5^m$

$$\sigma_a = 5350 \times \frac{3}{1} = 16,050$$

$$\sigma_b = 20 \times 1600 \times 3 = 96,000$$

1.5 @ 2500 = 3750
1.0 @ 16m = 16m
5350

Estimate of cost.

Concrete 1:2:4 well	28 @ (315 + 245)	= 15,700 m³	@14,00 =	220,000
" 1:3:6 cap.	28 @ 140	= 3,920 .	@ 12,30 =	48,200
reinforcements	28 @ (9.5 + 8.0) = 490 28 @ 1.0 = 28	} 518 tons	@ 120 =	62,200
forms.	28 @ (1130 + 870) · 5600	} 58500	@1,20 =	70,200
well sinking excavation	28 @ (730 + 542) =	35,600	@2.50 =	89,000
Steel shoes		62.0 tons	@200 =	12,400
前面土留方		3,000 m³	@2,50 =	7,500
埋戻		3,000 .	@3,00 =	9,000
鎧御材及金具				35,000
仮設材共化粧費				15,000
中埋材及鉄鐸		1600 m³	@5,0 =	8,000
				578,500 円 +α

(590000 円)

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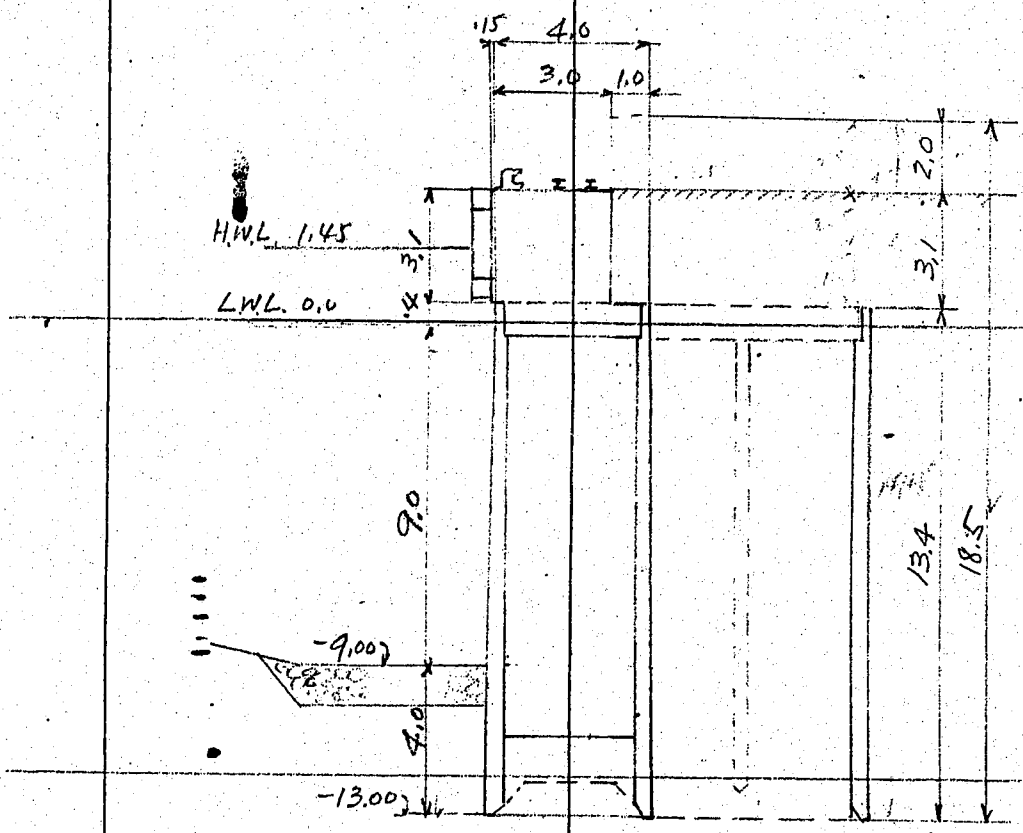
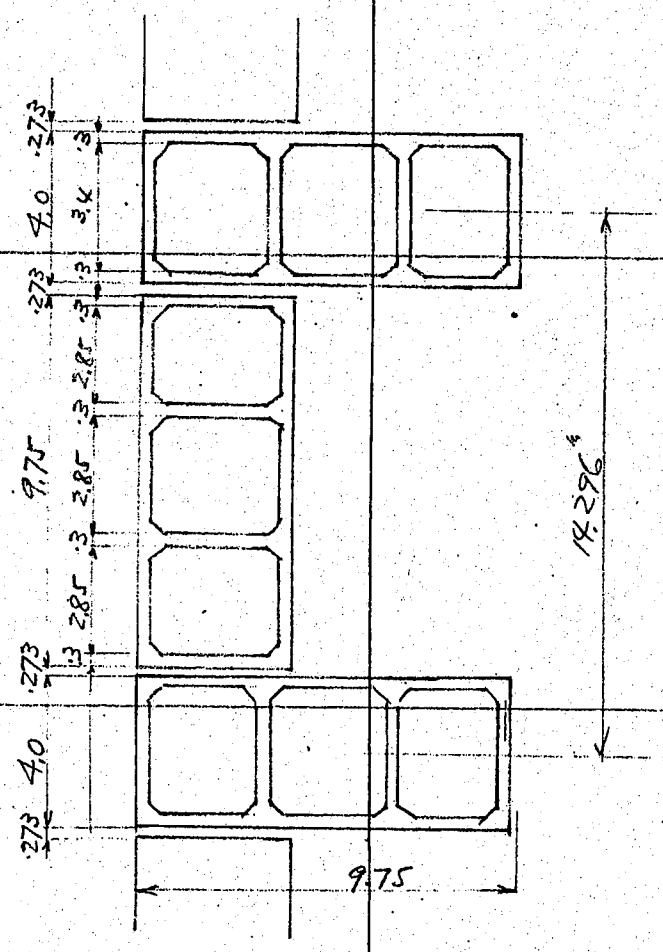
CALCULATIONS FOR

1-(7)





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CALCULATIONS FOR
九米岸壁 比較計算

Earth pressure.

1/3 × 1600 × 2 = 1070
1/3 × 1600 × 18.2 = 9870
average 5470 kg/m²

E = 5470 × 16.5 × 14296 = 1290000 kg.

Weight of well - A

Concrete	Shell	12.69 × 13.4 = 170.	@2400 =	408000
"	fill	28.53 × 0.8 = 23	78 @2200 =	172000
"	"	27.51 × 2.0 = 55		
			248 m³,	
Sand fill		28.0 × 10.6 =	297 @1700 =	504000
				580000 kg
				504000
			W_A =	1085000 kg

Weight of well B.

concrete fill		504m + 1000 + 297/3 × 900 =	594000	594000
			W_B =	1774000 kg

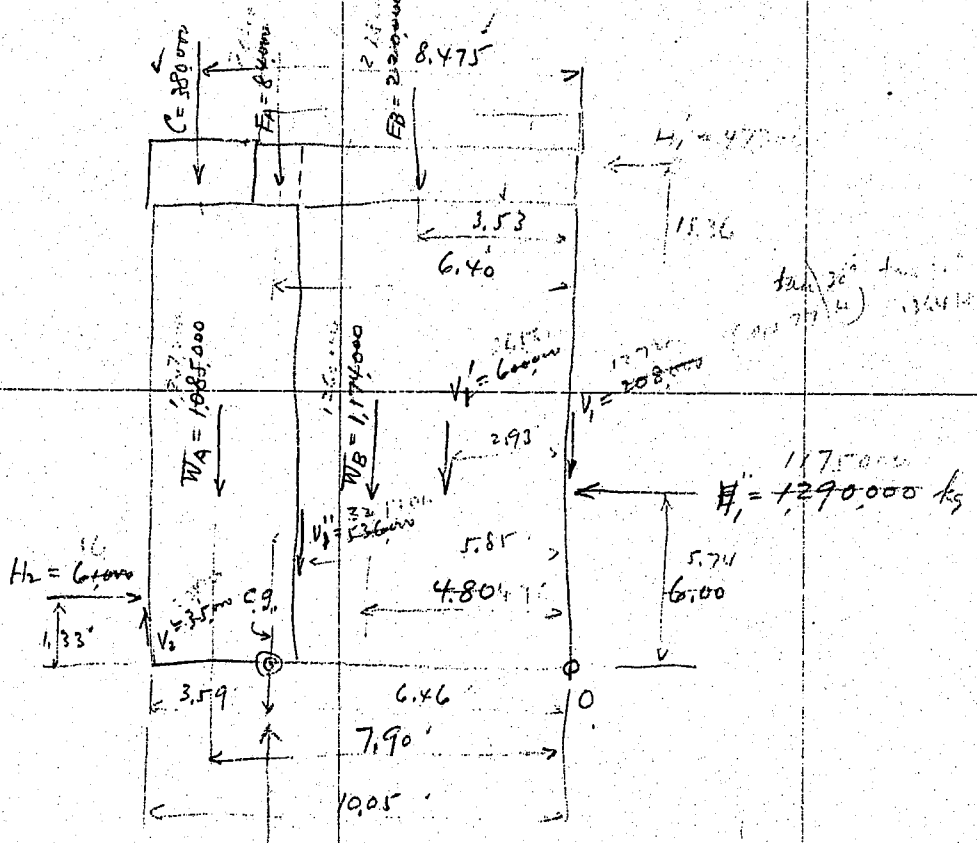
Slag 0.6 × 3000 = 1800
Sand 0.4 × 1700 = 680
2480 ≒ 2500
2500 − 160 =

	1085m × 4.875 =		5290000
	89m × 1.75 =		154000
		5444000 ÷ 1174m =	4.64 m
			4.3 m

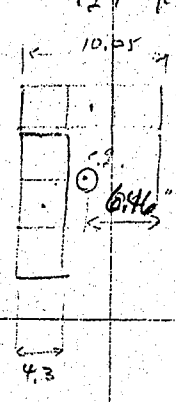
c.g. from rear.

Cap conc. 140 @2200 = 308000 kg

Earth on well A 5.1 × 10.3 = 525 @1600 = 840000 kg E_A
" " B 40 × 5.1 × 6.75 = 137.7 @1.. = 220000 " E_B



c.g. of Both areas



5.025
7.900
12.925 ÷ 2 = 6.46 m

H_2 = 1.49 × 10 × 4² × 1/4 × 2 = 59

V_1' = 11.5 × 1.7 × 1.0 = 19.5 tons
V_2' = 3.0 × 1.7 × 1.0 = 5.1 tons
V_3' = 14 × 2.0 × 1.0 = 28.0 tons

M = 8.4 × 10⁵ + 14.5 × 10⁵ = 116 × 10⁵

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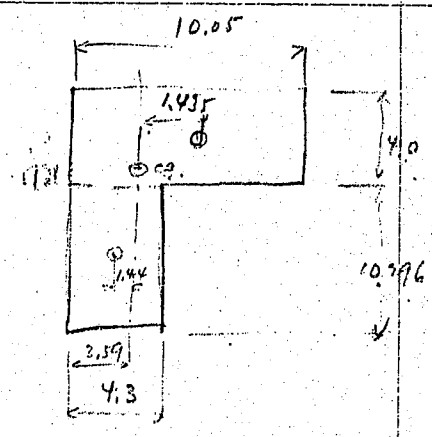
CALCULATIONS FOR

moment about back O.

Loads	Hor. force	arm read from Lec. m	moment about O.	
W_A		1,085.000 (1207.000) 7.90	8,580.000	9[illegible]
W_B		474.000 (1260.000) 4.80	5630.000	6[illegible]
C		380.000 8.48	3220.000	3[illegible]
E_A		84.000 (91.000) 6.40	540.000	58[illegible]
E_B		220.000 (355.000) 3.53	780.000	8[illegible]
H_1	+290.000 (1175.000)	6.00	7740.000	6[illegible]
H_2	−61.000 (−57.000)	1.33	− 80.000	− 75[illegible]
V_1		208.000 (1247.000) 0	0	0
V_1'		600.000 (365.000) 2.93	1760.000	1072.000
V_1''		536.000 (337.000) 5.85	3146.000	1972.000
V_2		−35.000 (−7.000) 10.05	−350.000	− 70.000
	+229.000	(1162.000)		0
	(1165.000)	4252.000	20760.000	30,592.000
		28144.000 7.28 m		
		1088		

Σec = ~~7.28~~ 10.88 − 6.46 = 0.82 cm front side

moment of inertia of bottom area



4×10.05 =	40.20	4×10.05³÷12 =	339
		40.20×1.435² =	83
4.3×10.296 =	44.30	10.296×4.3³÷12 =	68
		44.30×1.442 =	92
	84.50 m²	I =	582 m⁴

1020

moment on bottom area

M = 4252.000 × 0.82 = 3485.000 kg.m

max. bearing pressure

$$\frac{4252.000}{84.5} + \frac{3485.000 \times 3.59}{582} = 50,350 + 21,500 = 71850 \text{ kg/m}^2$$

$$\frac{4252.000}{84.5} - \frac{3485.000 \times 6.46}{582} = 50350 - 38700 = 11650$$

1150

V = 3,152.000 M = 30,960.000

9.82
6.46
e = 3.36 m

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CALCULATIONS FOR

Estimate of Cost.

-Concrete 1:2:4	well	56 @ 250 =	14000 m3 @14,m:	196000	294,000
" 1:3:6	Cap.	28 @ 140 =	3920 @ 12,30 =	48,200	48,200
Reinforcements	well	56 @ 7.5 =	420. tons @ 120 =	50400	75,600
	Cap	28 @ 1.0 =	28 @ 120	3400	3400
Forms	well	56 @ 900 =	50400m2 @1,20 =	60500	91,000
	Cap.	28 @ 90 =	2500 @ 1.20 =	3000	3,000
Caill sinking excav.	well	56 @ 575 =	32200m3 @2,50 =	80500	121,000
Steel shoes		56 @1.0 =	67.2 tons @200 =	13400	0
前面掘さく		400×5×1 =	2000 m3 @ 2,50 =	5000	5,000
埋戻し		"	2000 " @ 3.00 =	6000	6,000
鋳鉄材の金物				35,000	35,000
仮隔板及足場等				15000	15,000
中詰用砂の敷均等		1600m2 @ .5 =		8000	12,000
				6000	1,000
				525000	710,000

540,000

10.5×4 = 42
8.6×6 = 39.6
81.6

1.2 cm
1m 8

39×
81
3
123 × 13.4 =
23.4
26.4
1.2
51.

30.

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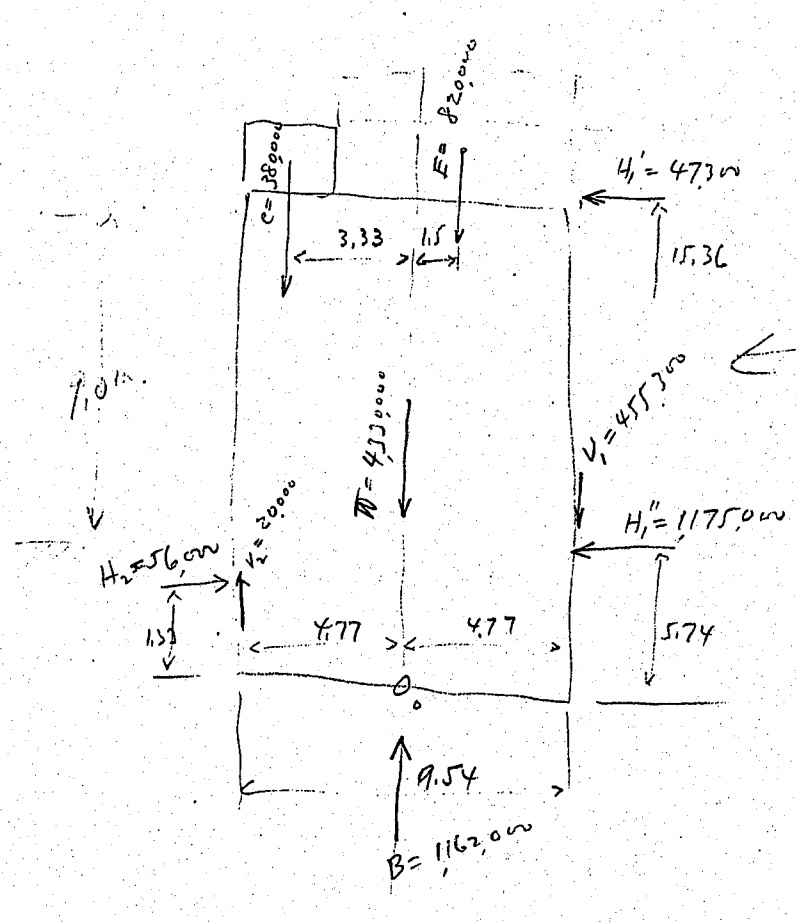
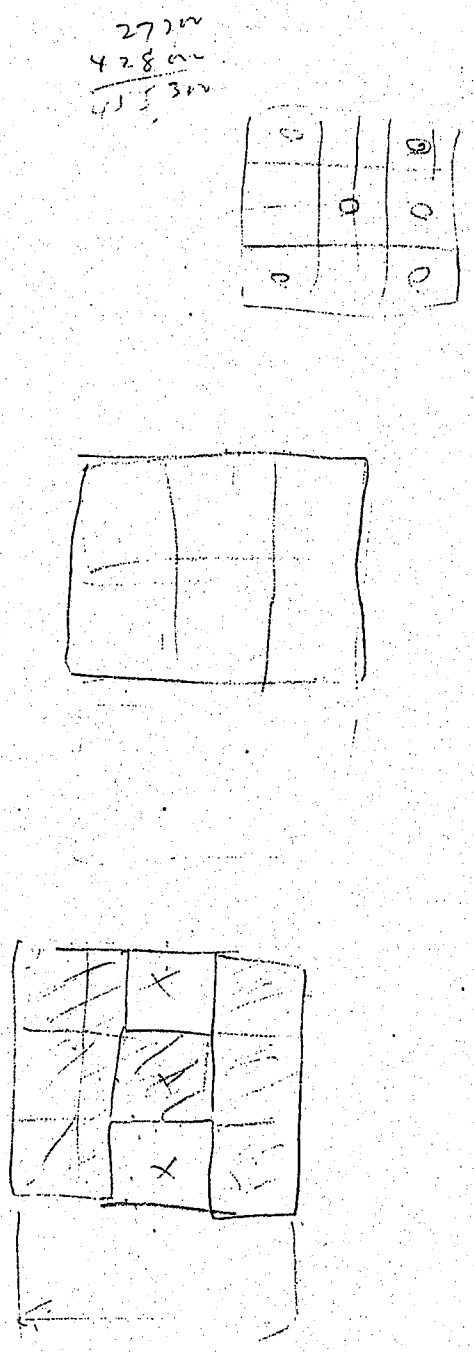


L	H	V	arm	M_o
W		4,330,000	0	0
C		380,000	3,33	1265,000
E		820,000	−1,50	−1,230,000
V_1		455,300	−4,77	−2,172,000
V_2		−20,000	4,77	−95,000
H_1'	473,00		15,36	726,0m
H_1''	1175,0m		5,74	6,745,000
H_2	−56,000		1,33	−74,0m
B		−1,162,000	0	0
	1,166,300	480,3300	1,07m	5,165,000

$$\text{max. toe pressure} = \frac{480.300}{14.296 \times 9,54}\left(1 \pm \frac{6 \times 1,07}{9,54}\right) = (+)^{1673}_{-}9,000 \quad (+)11,500$$



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14@9.75 136.50
14@4.0 56.0
4@.268 = 7.50 ×
200.00 ✓

14 @ 10 = 140

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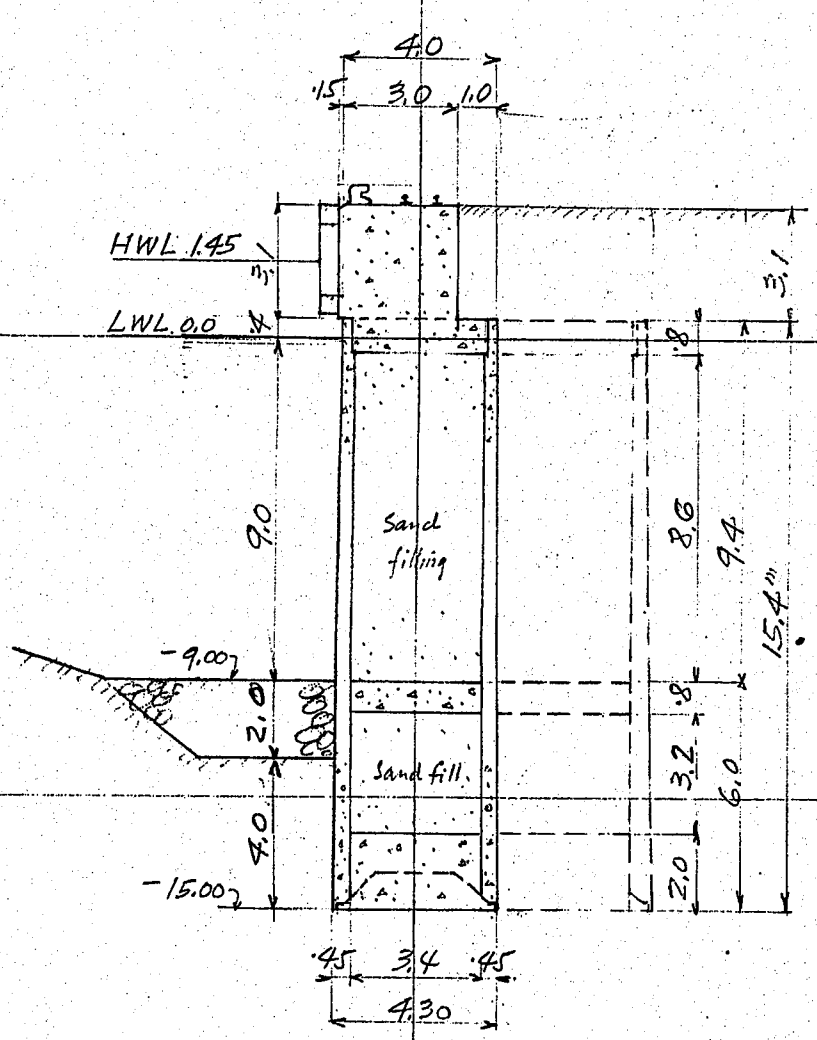
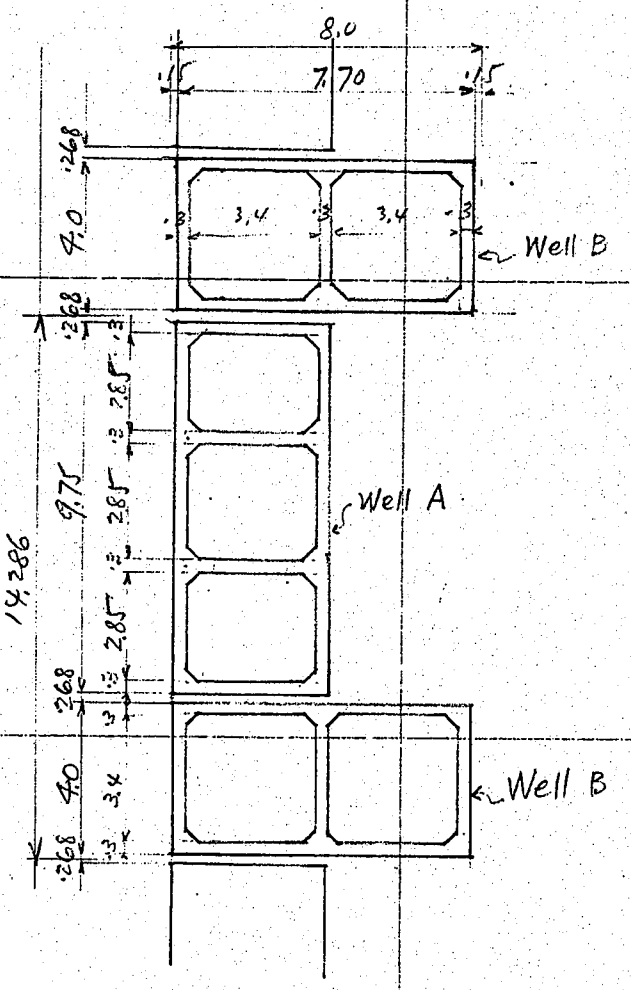
CALCULATIONS FOR
九米岸壁 No.3





Temporary Earth pressure on bottom 1 m slip
h = 14.5 m Span length $l_1 = 3.15$m $l_2 = 3.85$m

Temporary earth pressure $L = 3560$ kg/m²

Moment $M_1 = \frac{1}{12} \times 3560 \times 3.15^2 = 2,950$ kgm
$M_2 = \frac{1}{12} \times 3560 \times 3.85^2 = 4400$ "

Eff. $d = \sqrt{\frac{4400}{7.13}} = 24.9$ cm. use $d = 40$ with 5 cm modification.

$A_{s_1} = \frac{2950 \times 100}{1200 \times 7/8 \times 40} = 7.0$ cm²/m slip resist. 16φ × 25cm c to c = 8.04 cm²
$A_{s_2} = \frac{4400 \times 100}{1200 \times 7/8 \times 40} = 10.5$ " " 19φ × 25 cm c to c = 11.34 "
~~~~

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CALCULATIONS FOR

九米岸壁

weight of well A.

Concrete Shell Top area.

2@9.75×.3 = 5.85
4@3.40×.3 = 4.08
½×.3×.3×12 = 0.54
10.47 m²

Bott. area

2@9.75×.45 = 8.78
2@3.4×.45 = 3.06
2@3.4×.3 = 2.04
½×.3×.3×12 = 0.54
14.42 m²

Average area = 12.45 m²

3@3.40×2.85 = 29.07
−½×.3×.3×12 = −0.54
hollow area = 28.53 m²

Concrete shell 12.45 × 15.40 = 191.8 @2,400 = 460,000
filling 28.53 × 3.60 = 102.8 @2200 = 226,000
294.6 m³

Sand filling 28.53 × 11.80 = 336.5 m³ @1,700 = 572,000

Total weight of well A W_A = 1,258,000 kg ✓

weight of well B.

Shell. Top area 2@7.7×.30 = 4.62
3@3.4×.30 = 3.06
½×.3×.3×8 = 0.36
8.04 m²

Bott area 2@8.0×.45 = 7.20
2@3.4×.45 = 3.06
1@3.4×.3 = 1.02
½×.3×.3×8 = 0.36
11.64 m²

Average area = 9.84 m²

2@3.40×3.40 = 23.12
−½×.3×.3×8 = −.36
area of hollow = 22.76 m²

Concrete Shell 9.84×15.4 = 151.5 @2,400 = 364,000 ✓
filling 22.76×3.6 = 82.0 @2200 = 180,000
233.5 m³

Sand filling 22.76×11.8 = 268.5 @1700 = 456,000
564 m³
Total wt. of well B — W_B = 1,000,000 kg

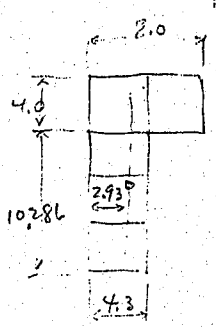
weight of Cap concrete

3.1×3.15×14.286 = 139.5 m³ @2,200 = C = 307,000 kg

weight of earth on well.

on well A. 3.1×1.0×10.0 = 31.0 m³ @1,600 = E_A = 49,600 kg
on well B. 4.27×4.7×3.1 = 62.2 @1600 = E_B = 99,600 g

Center of gravity of Bottom area.



10.286×4.3 = 44.2 × 2.15 = 95.0
4.0×8.0 = 32.0 × 4.0 = 128.0
76.2 m² 2.93 223.0

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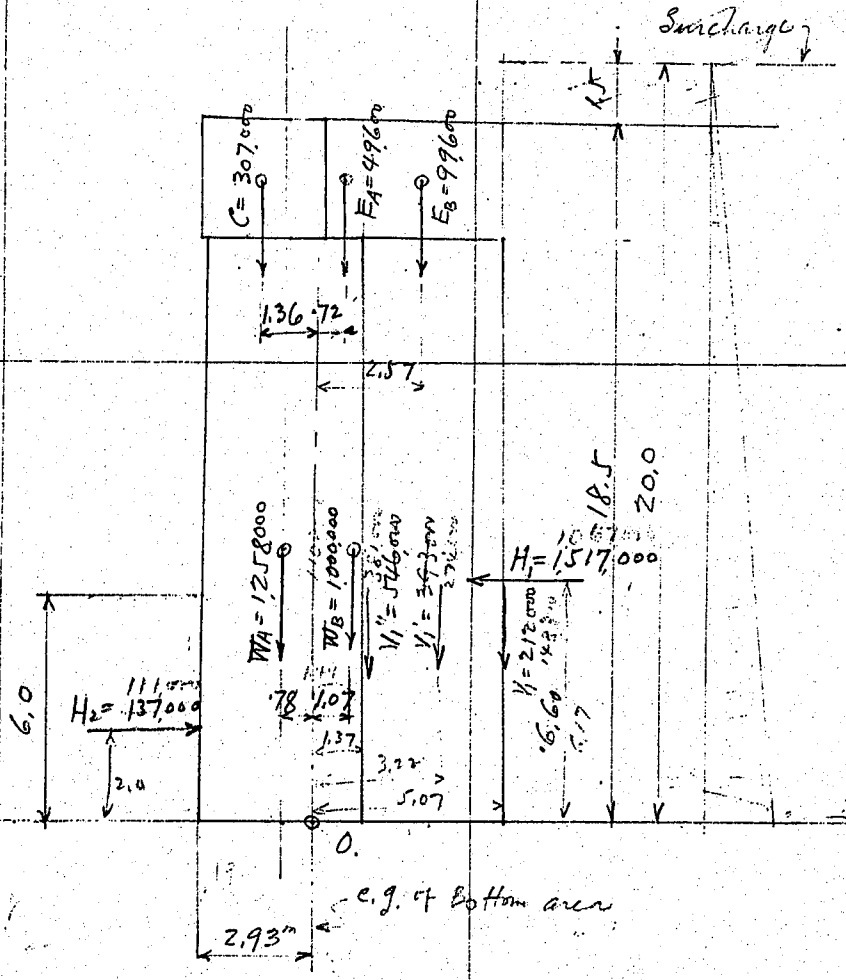
CALCULATIONS FOR
九米岸壁



Earth pressure.

1/3 × 1600 − 1.5 = 800 kg/m²
1/3 × 1600 × 20.0 = 10670 "
11470
= 5.735 × 18.5 = 106.100 kg

H_1 = 106100 × 14.286 = 1,517,000 kg
H_2 = 1/6 × 1600 × 6.0² × 14.286 = 137,000

V_1 = 0.5 × 106 ton × 4.0 = 212,000 kg
V_1' = " " × 3.7×2 = 393,000 "
V_1'' = 0.5 " × 10.286 " = 546 cm "

Moment about c.g. of bottom area = 0.

Forces.	Hor. forces	Vert. forces	arm.	Moment add'n.
W_A		1,258,000	0.78	982,000
W_B		1,000,000	−1.07	− 1,070,000
C		307,000	1.36	418,000
E_A		49,600	−0.72	− 36,000
E_B		99,600	−2.57	− 254,000
H_1	1,517,000		6.60	10,000,000
H_2	− 137,000		2.00	− 274,000
V_1		212,000	− 5.07	− 1,075,000
V_1'		393,000	− 3.22	− 1,265,000
V_1''		546,000	− 1.37	− 748,000
	ΣH = 1,380,000 kg	ΣV = 3865,200 kg	(1.73)	6678,000 kgm ÷ 14.286 = 468,000 kgm = M.

Horiz. bearing pressure on earth

$\sigma_b = \frac{12M}{h^2} = \frac{12 \times 468,000}{6^2}$ = 156,000 kg/m²

$\sigma_a = \frac{\sigma_b}{3}$ = 156000 ÷ 3 = 52,000 "

3rd pressure.

h = 2.0 σ_a = 1600 × 2.0 × 3.00 = 12,900 kg/m²

h = 6.0 σ_b = 1600 × 6.0 × 3.00 = 32,400 "

Bearing pressure at bottom.

= 3865,200 / 76.2 = 50700 kg/m²

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CALCULATIONS FOR 九米岸壁

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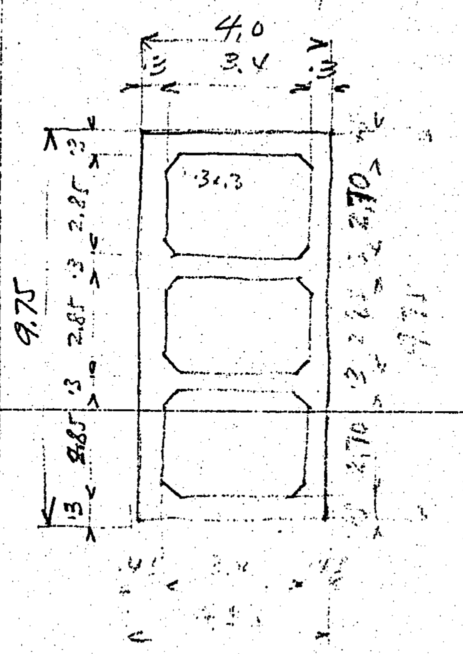
工費概算



黒字ハ頂部寸法
赤字・底部寸法

Well A.

Top section.

9.75 × 2 × .3 =	5.85		
3.4 × 4 × .3 =	4.08		
.3 × .3 × 6 =	0.54		
		10.47	
Guide .3 × .2 × 4 =		.24	
			10.71 m²

hollow area

9.75 × 4.0 = 39.00 − 10.47 = 28.53 "

Bottom section

9.75 × 2 × .45 =	8.78		
3.4 × 2 × .45 =	3.06		
3.4 × 2 × .3 =	2.04		
.3 × .3 × 6 =	0.54		
		14.42	
Guide .3 × .2 × 4 =		.24	
			14.66 m²

hollow area

9.75 × 4.3 = 41.93 − 14.42 = 27.51 m²

well concrete.

Shell. $\frac{10.71 + 14.66}{2}$ = 12.69 × 15.4 = 195.5 m³

Conc. fill. Top fill 28.53 × 0.8 = 22.8
bott. " 27.51 × 2.0 = 55.0
mid " say 28.1 × 0.8 = 22.5
100.3 m³ } 295.3 m³

Sand fill say 28.0 × 11.8 = 330.0 m³

Steel.

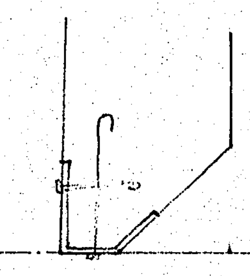
19φ 2 × 34 × 6.5 = 442
2 × 15 × 4.3 = 129
571 m @ 2.23 = 1275 kg

16φ 2 × 34 × 11.0 = 748
2 × 15 × 10.0 = 300
4 × 34 × 4.3 = 584
12 × 17 × 1.2 = 245
4 × 4 × 17 = 272
4 × 34 × 1.5 = 204
2353 m @ 1.58 = 3720

16φ vert. 130 × 17 = 2210 @ 1.58 3490
15
8,500 kg

form.

9.75 × 2 = 19.5
4.15 × 2 = 8.3
13 × 3 = 39.0
66.8 × 15.4 = 1,030 m²



Shoe steel say 28.1 m @ 40 kg = 1120 kg say 1,200 kg

Excavation 9.75 × 4.3 × 15.4 = 660 m³

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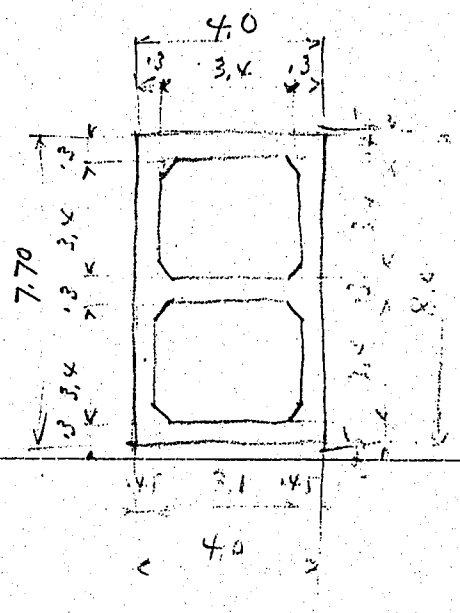
CALCULATIONS FOR
九米崎橋



Well B.

Top section

7.70 × 2 × .3 =	4.62	
3.40 × 3 × .3 =	3.06	
.3 × .3 × 4 =	.36	
	8.04	
Guide .3 × .2 × 4 =	.24	
	8.28 m²	

Bottom section

7.7 × 4.0 = 30.80 − 8.04 =		22.76 m²

Bottom section.

8.00 × 2 × .45 =	7.20	
3.1 × 2 × .45 =	2.79	
3.1 × 1 × .3 =	0.93	
.3 × .3 × 4 =	0.36	
	11.28	
Guide	.24	
	11.52 m²	

Bottom area.

8.0 × 4.0 = 32.00 − 11.28 = 20.72 m²

well concrete

Shell. $\frac{8.28 + 11.52}{2}$ = 9.90 × 15.4 = 152.4 m³

Concrete fill.

Top fill.	22.76 × 0.8 =	18.2	
bott. "	20.72 × 2.0 =	41.4	
int. " say	21.5 × 0.8 =	17.2	
	76.8 m³		229.2 m³

Sand fill say.
Slag + sand fill

10.8 × 11.8 =	128 m³
10.8 × 11.8 =	128 〃

Steel.

199

2 × 34 × 6.5 =	442
2 × 34 × 7.5 =	510
2 × 15 × 4.3 =	129
2 × 15 × 8.3 =	249
1,330 × 2.23 =	2970

169

	2 × 34 × 4.3 =	292
	8 × 17 × 1.2 =	163
カバー	4 × 4 × 17 =	272
〃	4 × 34 × 1.5 =	204
931 m × 1.58 =		1470
169 reinf.	100 × 17 =	1,700 × 1.58 = 2690
		70
		7,200 kg

form.

7.85 × 2 =	15.7
4 × 2 =	8.0
14.0 × 2 =	28.0
51.7 m × 15.4 =	800 m²

Share steel say 24.0 m @ 40 = 960 kg say 1,000 kg

Excavation 8 × 4.0 × 15.4 = 493 m³

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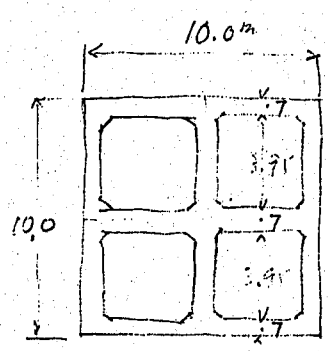
CALCULATIONS FOR
九本号橋

-Cap concrete		3.15 × 3.1 × 14.286 =	139.5 m³		
Estimate of cost/.					
Concrete	A well.	28 @ 295.3 =	8260		
	B "	28 @ 229.2 =	6420		
	Cap	28 @ 139.5 =	3920		
				18,600 m³ @ 14.00 =	260400
reinforcements					
	A well	28 @ 8.5 tons =	238.0		
	B "	28 @ 7.2 " =	202.0		
	Cap.	28 @ 1.0 " =	28.0		
				468.0 tons @ 120.00 =	56200
forms.					
	A well	28 @ 1030 m² =	28820		
	B "	28 @ 800 =	22400		
	Cap.	28 @ 90 =	2520		
				53740 m² @ 1.20 =	64500.
well sinking excavation.					
	A well	28 @ 660 m³ =	18480		
	B "	28 @ 493 =	13820		
				32300 m³ @ 2.50 =	80800
Steel shoes.					
	A well	28 @ 1.2 tons =	33.6		
	B "	28 @ 1.0 " =	28.0		
				61.6 tons @ 200. =	12300
前面掘方		400 × 5 × 2 =		4000. m³ @ 2.50 =	10000
埋戻		"		4000. " @ 3.00 =	12000
鉄筋材及雑材					35000
保険料其他諸費					15000
中詰砂・敷砂		28 @ 330 = 9240 28 @ 256 = 716.	} 1642 m³ @ 0.5	=	8200
					600
					555000 円

Design of well.



水深時 $h = 11.0$

water pressure $= 11.00 \times 1000 = 11{,}000\ kg/m^2$

Span length say $\ell = 5.0 - .7 = 4.30\ m$

$M = \frac{11000 \times 4.3^2}{12} = 17{,}000\ kgm$

Eff. depth req'd. $d = \sqrt{\frac{17000 \times 100}{100 \times 7.13}} = 49\ cm$

use $d = 65\ cm$ insulation 5 ~~total~~ depth 70 cm

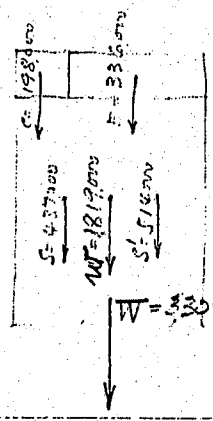
$A_s = \frac{17000 \times 100}{1200 \times \frac{7}{8} \cdot 93} = 17.4\ cm^2$ use $19^{\phi} \times 15\ cm = 18.9\ cm^2$

weight of well

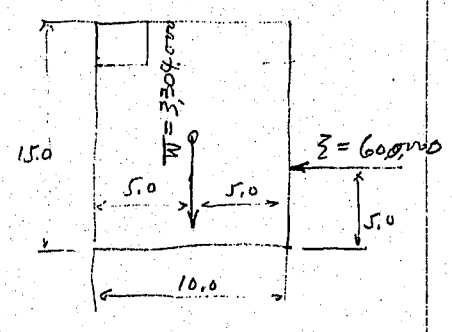
	$0.7 \times 10 \times 3.$	=	21.0		
	$0.7 \cdot 3.95 \times 6$	=	16.6		
	$\frac{1}{2} \times 0.5 \times 0.5 \times 16$	=	2.0		
			39.6	× 12.5 = 495 m³ @ 2400 =	1,187,000 kg
Concrete shell, concrete fill.	$3.95 \times 3.95 \times 4$	=	62.5		
		−	2.0		
			60.5	× 4.0 = 242 m³ @ 2200 =	632,000 "
					1,819,000 kg
Sand filling (front partition.)	30.25	×	8.5 = 257	@ 1700 =	437 m
Slag " (rear ")	30.25	×	8.5 = 257	@ 2000 =	514 m "
					951 m
					2,770,000 kg
Cap concrete	$3.0 \times 3.0 \times 10$	=	90.	@ 2200 =	198,000
Earth	$3.0 \times 7.0 \times 10$	=	210	@ 1600 =	336 m
					534 m kg

Center of gravity

well shell + conc. fill.	1819.000	×	5.00 =	9,100.000
Sand filling	437 m	×	7.50 =	3,280 m
slag "	514 m	×	2.50 =	1,285 m
cap conc	198 m	×	8.50 =	1685 m
Earth	336 m	×	3.50 =	1,177 m
	3304 m kg.		5.00 m	16527 m



Earth pressure. $\Sigma = \frac{1}{6} \times 1600 \times 15^2 \times 10 = 600{,}000\ kg$ / 10m



3304 m × 5.0 = 16507,000
600,000 × 5.0 = 3000,000
19507, m ÷ 3304 m = 5.90 m

Ecc. = 5.90 − 5.0 = 0.90 m

Resultant force within middle third.

Max. bearing pressure

$P = \frac{3304{,}000}{10 \times 10}\left(1 \pm \frac{6 \times 0.9}{10}\right) = 50900\ kg/m^2$

or 15200 "

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CALCULATIONS FOR

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materials.

well.

Shell	1:2:4 concrete		495 m³	@ 14.15	=	7010
filling	1:2:4 〃		242	@ 14.15	=	3425
form.	10×4 = 40 16×4 = 64 104 × 12.5	=	1,300 m²	@ 1,50	=	1,950
reinforcements						
19φ bars	70@50=3500m	@ 2.23	= 7.81			
16φ 〃	4×25×10 = 1000	@ 1.58	= 1.58			
〃 〃	360×13.5=4850	@ 1.58	= 7.66			
			17,000 tons	@ 1.35	=	2295
Sand filling			257 m³	@ 2.7	=	695
Slag 〃			257 〃	@ 0.2	=	50
crack filling	13" @ 100	=	1300 m	@ 4.0	=	5200

110+25=135

Cap concrete	1:3:6	3×3×10 =	90 m³	@ 12.35	=	1110
form			60 m²	@ 1.20	=	70
reinforcements			2 tons	@ 135	=	270
						22075 円
根固前面掘削		2×5×10 =	100 m³	@ 2.50	=	250
捨石			100 〃	@ 1.20	=	120
						55
						425
						22,500 円

岸壁及土留一式(根固共) 40 @ 22,500 円 = 900,000
盛土呈均

0.4×11 = 4.4
1.0×5 = 5.0
1.0×1.5 = 1.5
10.9×5 = 54.5
2×16×11×0.5 = 6.6
61 M' @ 2400 = 147 tons

$\sqrt{\frac{5740}{7.15}}$ × = 18.1

$A_s = \frac{57\ldots \times 100}{12000 \times \frac{7}{8} \times 30} = 18.2$

30+5

$A_s = \frac{\ldots \times 147}{\ldots} = 13.7\ cm^2$ 5-19φ = 18.18

4.5 ... = 6
1.5×4 = 6
51×5 = 255 m...
2×147 = 294 m...

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CALCULATIONS FOR

Concrete

セメント　1.0 ㎥　18.0円　一袋　15.0 18 = 2.70
石砕 ㎥　　　　　　　　　　4.50
砂 ㎥　　　　　　　　　　2.50

1:2:4

セメント	2 袋	@ 2.70 =	5.40	
砂 ㎥	1.0 ㎥	@ 4.00 =	4.50	8.71
砂利 ㎥	0.5 ㎥	@ 2.50 =	1.25	
採石 ㎥	2.0 ㎥	@ 1.50 =	3.00	

14.15 円/㎥

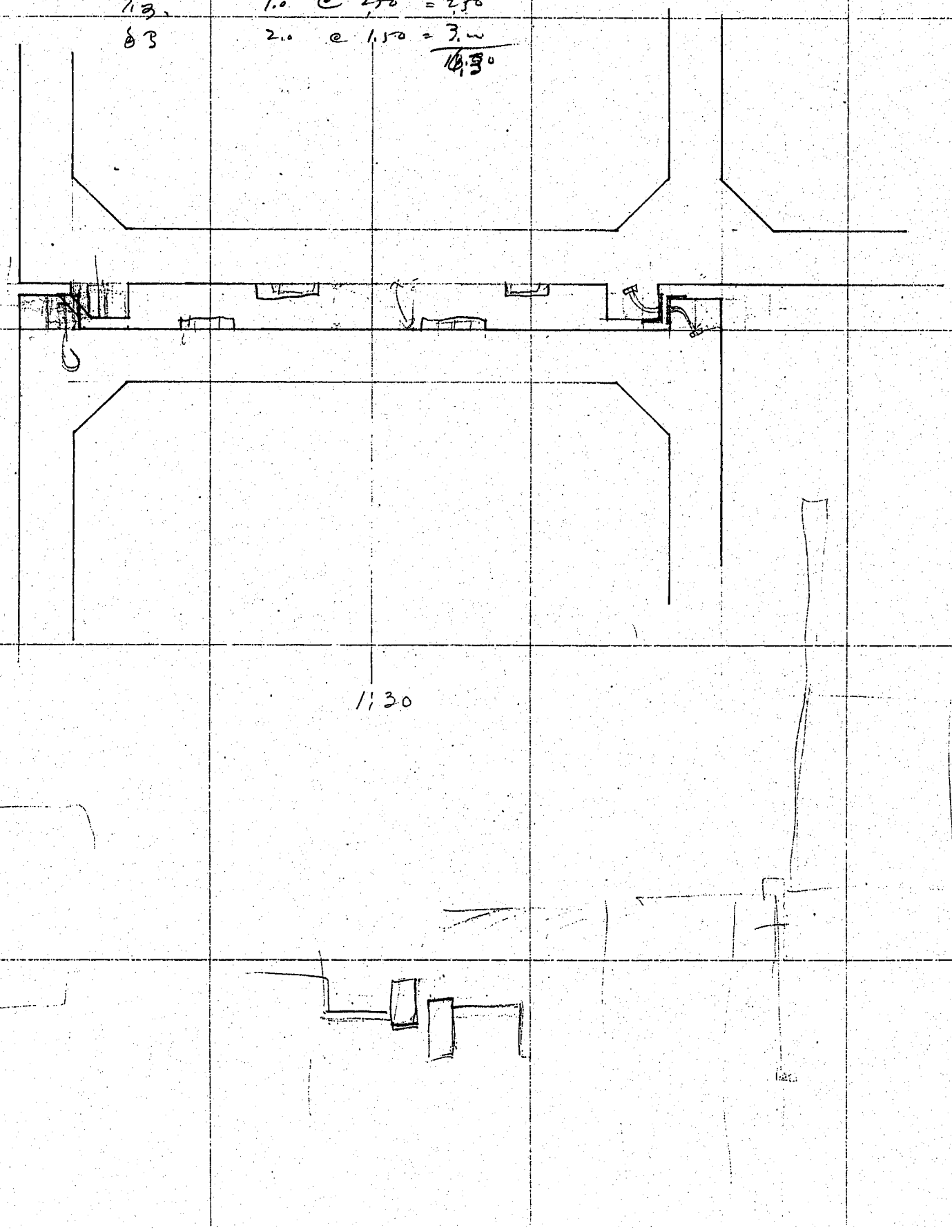
1:3:6

セメント	1.33	@ 2.70 =	3.60
			8.75

12.35 円/㎥

1:2 ㎜㎜

セメント	4	@ 2.70 =	10.80
石 ㎥	1.0	@ 2.50 =	2.50
砂 ㎥	2.0	@ 1.50 =	3.00
			16.30



370 ㎡
39
409 ㎡

32
241
270
=

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

CALCULATIONS FOR

MADE BY_____ DATE_____ FILE NO_____
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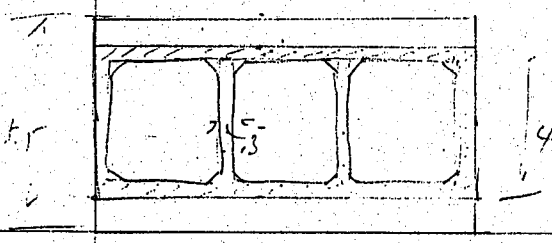
P 15 × 16cm/3 = 8,000 kg/m²
l = 3.0
M = 8000 × 3.0² / 8 = 9,000 kgm
d = √(9000/7.13) = 36 cm . 45+5
As = 9000 × 100 / (1200 × 7/8 × 45) = 19.00 cm² 19φ bars 15 cm c to c.



well shell conc. 182 m³.
中埋混凝土 頂部 30 × 1.0 = 30
底部 40 × 2.0 = 80
110
272 × 40 = 11,680 m³.
鉄筋 8.0 ton × 40 = 320 ton.

10.5 × 40 = 420
11680
conc. = 12100 m³.

上
10 × 2 = 20
3.2 × 4 = 12.8
32.8 × .3 = 9.8 m²
.3×.3/2 × 6 = .27
10.11 m²

下
10 × 2 = 20 × .5 = 10.0
4.5 × 4 × .3 = 5.4
.5
15.7 m²

10.1 × 8 = 80.8
15.7 × 7 = 101.0
181.8

20 × 15 = 300
4 × 8 × 2 = 64
5 × 7 × 2 = 70
3 × 12 × 15 = 540
974

7 × 10 × 2 = 140
10.5 × 2 = 21
型枠 1135 m² × 40 =

Steel
19φ 33 × 51 = 1680 × 2.23 = 3750
16φ 4.5 × 60 = 270 × 1.57 = 430
〃 17.0 × 150 = 2550 × 1.57 = 4000
8,180 kg

30 × 8 = 240
40 × 7 = 280
520 × 40 = 20800
7280
28,080

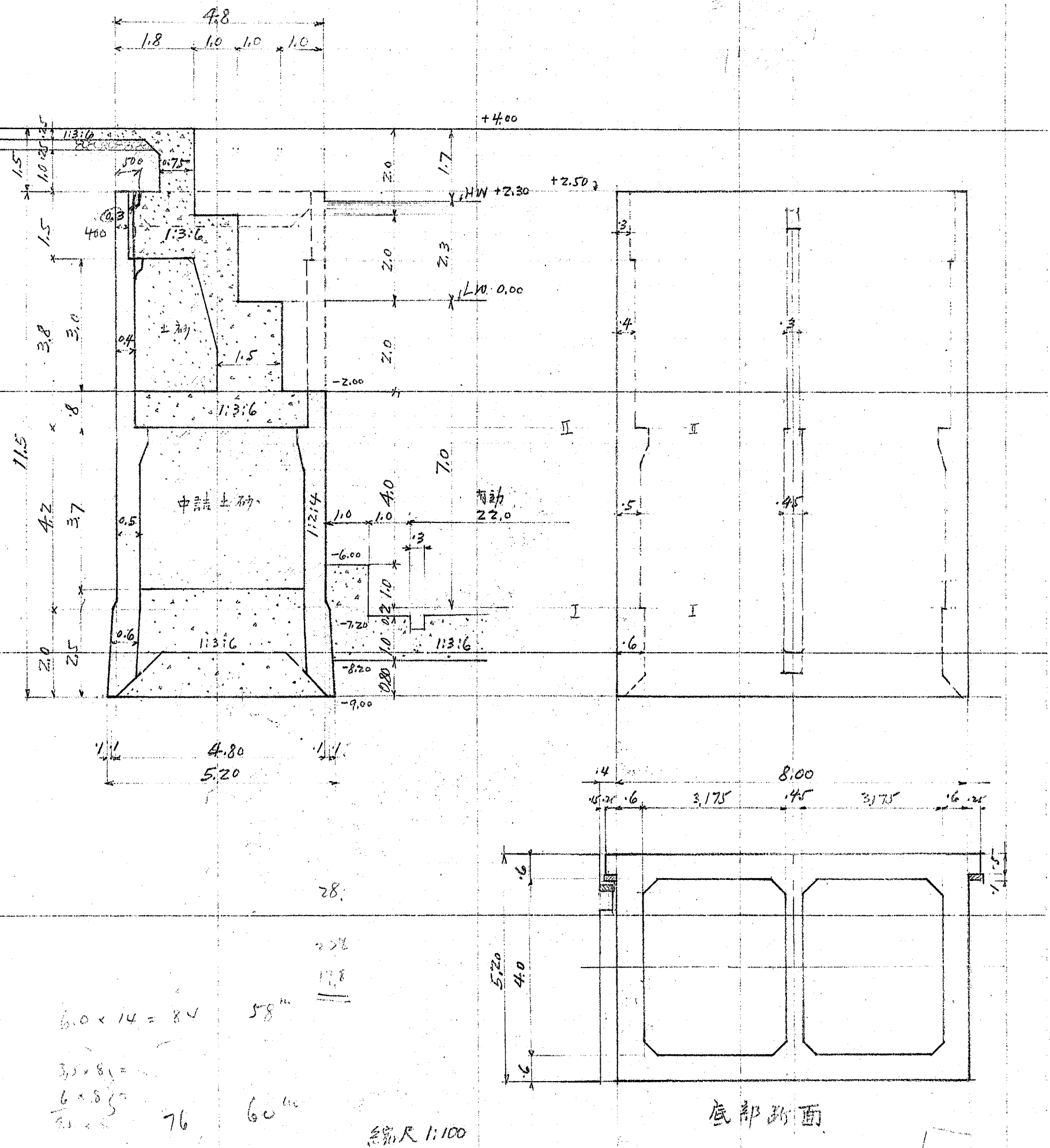
混凝土 12,100 m³ × 14.00 = 169,200
鉄筋 19φ&16φ 320 ton × 120,000 = 38,400
型枠 45,400 m² × 1.20 = 54,500
掘削 28,080 m³ × 2.50 = 70,200
332,300
1200 × 14.00 conc. 16,800
35,000
15,000
399,100

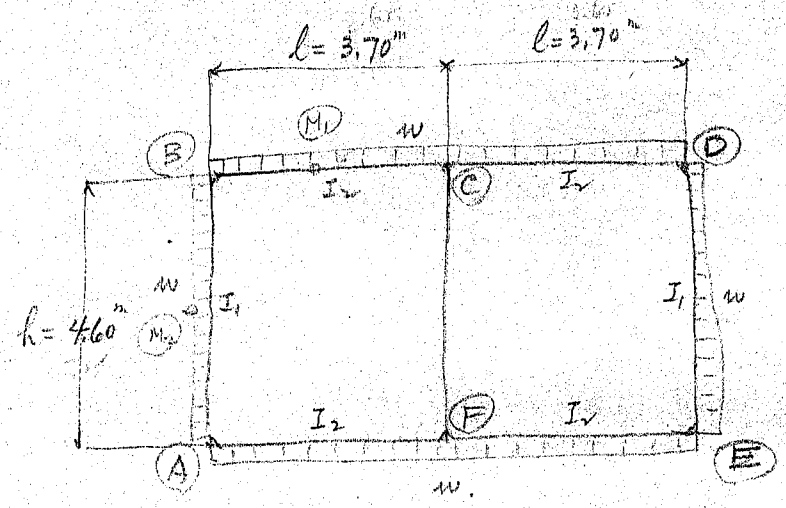
399,100
440,000

JIUN MASUDA
CONSULTING ENGINEER
SHOWA BLDG, TOKYO

MADE BY _____ DATE _____ FILE NO _____
CHECKED BY 稲葉 DATE 16-3-11 PAGE NO (1)

CALCULATIONS FOR
大阪鉄工 川崎工場 第二船渠





底辺計算

土深 沈下 11.5m

土圧 沈下 $\frac{2}{3} \times 1000 \times 11.5 = 7670$ kg/m² $= w$

〃 沈下停止 $\frac{1}{3} \times 1900 \times 11.5 = 7290$ 〃 $= w'$

$$I_1 = \frac{1.0 \times 0.6^3}{12} = 0.01800$$

$I_2 = 〃 = 0.01800$

$wl^2 = 13.69w$

$wh^2 = 21.160w$

$$K_1 = \frac{I_1}{h} = \frac{0.01800}{4.60} = 0.003913$$

$$K_2 = \frac{I_2}{l} = \frac{0.01800}{3.70} = 0.004865$$

$$K = \frac{K_2}{K_1} = \frac{0.004865}{0.003913} = 1.2433$$

$12(1+2K) = 12 \times 3.486 = 41.839$

$1+3K = 4.7299$

$$C_1 = \frac{1}{12(1+2K)} = \frac{1}{41.839} = 0.02390$$

$$C_2 = \frac{1+3K}{12(1+2K)} = \frac{4.7299}{41.839} = 0.11305$$

$$C_3 = \frac{K}{12(1+2K)} = \frac{1.2433}{41.839} = 0.02972$$

$$\left.\begin{matrix} M_A \\ M_B \\ M_D \\ M_E \end{matrix}\right\} = -C_1 wl^2 - 2C_3 wh^2 = -0.02390 \times 13.69w - 2 \times 0.02972 \times 21.160w$$
$$= -0.32719w - 1.25775w = \boxed{-1.585w}$$

$$\left.\begin{matrix} M_C \\ M_F \end{matrix}\right\} = -C_2 wl^2 + C_3 wh^2 = -0.11305 \times 13.690w + 0.02972 \times 21.160w$$
$$= -1.54765w + 0.62888w = \boxed{-0.919w}$$

$$S_{B2} = 1.85w + \frac{1.585 - 0.919}{3.7} w = 2.030w$$

$$S_{C2} = -1.85w + 0.180w = -1.670w$$

$$S_{B1} = -1.850w$$

(M1)

$x = 2.03$ m

$2.03 \times 2.03w = 4.1209$

$-\frac{2.03 \times 2.03}{2}w = -2.0605w$

$M_B = -1.585w$

$M_1 = 0.476w$

(M2)

$\frac{wh^2}{8} = \frac{4.6^2}{8}w = 2.645w$

$M_B = -1.585w$

$M_2 = 1.060w$

P.9 $w = 7670$ kg/m

M_B =	$-1.585\,w$	=	$-12{,}150$ kgm	$-1.814\,w$ =	$-13{,}900$ kgm
M_C =	$-0.919\,w$	=	$-7{,}050$ "	$-0.738\,w$ =	5650
M_1 =	$1.020\,w$	=	7830 "	$0.473\,w$ =	3170
M_2 =	$1.060\,w$	=	8130 "	$1.571\,w$ =	$11{,}500$ "

S_{B2} =	$2{,}030\,w$	=	$15{,}570$ kg	N_1 =	$15{,}570$ kg e
S_{C2} =	$-1.670\,w$	=	-12800 "	N_2 =	14180 " "
S_{B1} =	$-1.850\,w$	=	-14180 "		

(M2) $M_2 = 8{,}130$ kgm $N_2 = 14{,}180$ kg e

$b = 100$ cm, $h = 60$ cm

$d = 56$ cm $d' = 4$ cm

$p_t = \frac{8.04}{100 \times 60} = 0.00134$

$p' = 0.00067$

$d'/h = 4/60 = 0.0667$

$d'/d = 4/56 = 0.0715$

$A_s = 4 - 16^{\phi} = 8.04$ cm²

$A_s' = 2 - 16^{\phi} = 4.02$ cm²

$p = \frac{8.04}{100 \times 56} = 0.00144$

$p' = 0.00072$

$d'/d = 4/56 = 0.0715$

$\frac{M}{N} = \frac{8130 \times 100}{14180} = 57.4$ 71.0

$d - n = 25.8$ 30.8

83.2 cm 40.2

$e = 31.2$ 39.8

$e' = e - 5 = 26.2$

$e'/e = 0.375$ 0.391

$\frac{Ne}{bd^2} = \frac{14180 \times 83.2}{100 \times 56^2} = 3.760$ 3.910

$\frac{Ne}{bd^2\sigma_c} = 0.135$ $k = 0.280$ 0.260

$\sigma_c = \frac{3{,}760}{0.135} = 27.9$ kg/cm² (29.0)

$\sigma_s = 15 \times 27.9 \times \frac{72}{28 \times 60} = 1075$ (1035)

(B) $M_B = -12{,}150$ kgm, $N_2 = 14{,}180$ kg $e_{B2} = 15{,}570$ kg

$\frac{M}{N} = \frac{12150 \times 100}{14180} = 85.8$ 79.5

35.8 36.0

$d - n = 121.6$ cm 106.8

$e = 49.6$ 53.5

$e' = e - \frac{7}{2} = 46.1$

$e'/e = 0.408$ 0.317

$\frac{Ne}{bd^2} = \frac{14180 \times 121.6}{100 \times 76^2} = 2.995$ 3.480

$\frac{Ne}{bd^2\sigma_c} = 0.118$ $k = 0.245$ .260

$\sigma_c = \frac{2.995}{0.118} = 25.4$ (29.6) kg/cm²

$\sigma_s = 15 \times 25.4 \times \frac{.755}{.245} = 1174$ (1178)

$\tau = \frac{15570}{100 \times \frac{2}{8} \times 76} = 2.3$ (2.35)

$b = 100$ $h = 60 + \frac{60}{3} = 80$ cm

$d = 76$ cm $d' = 4$ cm

$A_s = 4 - 16^{\phi} = 8.04$ cm²

$A_s' = 2 - 16^{\phi} = 4.02$ cm²

$p = \frac{8.04}{100 \times 76} = 0.00106$

$p' = 0.00053$

$d'/d = 4/76 = 0.053$

(C) $M_0 = -7050$ kgm, $N_2 = 14,180$ kg.c $S_{c2} = -12,850$ kg

$\frac{M}{N} = \frac{7050 \times 100}{14180} = 49.7$ 29.4 ✓

$d - m_2$ 193 ✓ 35.4 25.4 ✓

$e =$ 85.1 ~ 64.8 ✓

$e' = e - 6g = 16.1 - 4.$ ✓

$e'/e = 0.189 - 0.065$ ✓

$\frac{Ne}{bd^2} = \frac{14180 \times 85.1}{100 \times 73^2} = 2.26 \sim 2.350$ ✓

$\frac{Ne}{bd^2\sigma_c} = 0.142$ $k = 0.3 \sim .49$

$\sigma_c = \frac{2135}{0.142} = 16.0$ (11.2) kg/cm²

$\sigma_s = 15 \times 16.0 \times \frac{17.51}{11.2} \times \frac{1}{0.49} = 560$ (175) ✓

$\tau = \frac{1285 \times 1.50}{100 \times \frac{2}{8} \times 73} = 2.0$ (1.8) ✓

$b = 100$ $h = 60 + \frac{25}{3} = 77$ ~ 80

$d = 73$ $d' = 4$

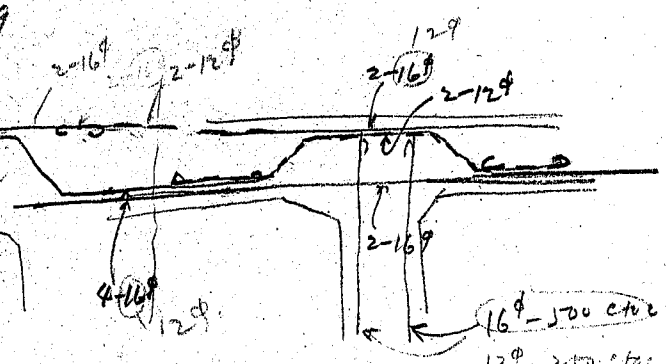
$A_s = \begin{matrix} 4-12\phi \\ 2-16\phi \\ 2-12\phi \end{matrix} = \begin{matrix} 4.02 \\ 2.26 \end{matrix}$ ← ←
$6.28\ cm^2$ 4.5 ✓

$A_s' = 2-16\phi = 4.02$ 2.26

$p = \frac{6.28}{100 \times 73} = 0.00086$ 6 ✓

$p' = \frac{4.02}{100 \times 73} = 0.00055$ 3.1

$d'/d = 4/73 = 0.055$



断面 I－I

土圧 9.5 ~

土圧 $w = \frac{2}{3} \times 100 \times 9.5 = 6330$ kg/m

$M_B = -1.585 \times 6330 = -10030$ kgm

$M_c = -0.919 \times$ 〃 $= -5820$ 〃

$M_1 = 1.020 \times$ 〃 $= 6460$ 〃

$M_2 = 1.060 \times$ 〃 $= 6710$ 〃

$S_{B2} = 2.03 \times$ 〃 $= 12840$ kg.c

$S_{c2} = -1.670 \times$ 〃 $= 10560$ 〃

$S_{B1} = -1.850 \times$ 〃 $= 11700$ 〃

$N_1 = 12840$ kg.c

$N_2 = 11700$ 〃

M_1 $M_1 = 3170$ kgm $N_2 = 1930$ kg

$\frac{M}{N} = \frac{3170 \times 100}{1930} = 16.4$

$d - u$ 51.8

$e =$ 42.2

$e' = e - 52 = -9.8$

$e'/e = -0.232$

$\frac{Ne}{bd^2} = \frac{1930 \times 42.2}{100 \times 52^2} = 2.600$

$\frac{Ne}{bd^2\sigma_c} = .231$ $k = 0.35$

$\sigma_c = \frac{2.60}{.231} = 11.3$

$\sigma_s = 15 \times 11.3 \times \frac{145}{15} = 159$

$b = 100$ $h = 60$

$d = 56$ $d' = 4$

$A_s = 4-12\phi = 4.52$

$A_s' = 2-12\phi = 2.26$

$p = \frac{4.52}{100 \times 56} = 0.00081$

$p' = 0.00041$

$d'/d = 4/56 = 0.0715$

$5.0 \times 4 = 2.00 \times 11$

$= 8\ cm$

611

(M₂) $M_2 = 6710$ kgm $N_2 = 11700$ kg

$\frac{M}{N} = \frac{6710\times100}{11700} = 57.4$

$d-u = \frac{20.9}{78.2}$ cm

$e =$

$e' = e - 4u = 36.3$

$e'/e = 0.464$

$\frac{Ne}{bd^2} = \frac{11700 \times 78.3}{100\times46^2} = 4.33$ kg/cm²

$\frac{Ne}{bd^2\sigma_c} = 0.137$ $k = 0.280$

$\sigma_c = \frac{4.33}{0.137} = 31.7$ kg/cm²

$\sigma_s = 15\times31.7\times\frac{1.7u}{1.28} = 1221$ kg/cm²

$b = 100$, $h = 50$ cm

$d = 46$, $d' = 4$

$A_s = 4-16\phi = 8.04$

$A_s' = 2-16\phi = 4.02$

$p = \frac{8.04}{100\times46} = 0.00175$

$p' = 0.00088$

$d'/d = 4/46 = 0.087$

(B) $M_B = -10030$ kgm, $N_2 = 11700$ kg $\sigma_{B2} = 1284.0$ kg/cm²

$\frac{M}{N} = \frac{10030\times1cm}{11700} = 85.8$

$d-u = \frac{29.8}{115.6}$ cm

$e = 0$

$e' = e - 6u = 55.6$

$e'/e = 0.481$

$\frac{Ne}{bd^2} = \frac{11,700\times115.6}{100\times64^2} = 3.30$

$\frac{Ne}{bd^2\sigma_c} = 0.120$ $k = 0.245$

$\sigma_c = \frac{3.30}{0.120} = 27.5$ kg/cm²

$\sigma_s = 15\times27.5\times\frac{.785}{1.245} = 1270$ kg/cm²

$\tau = \frac{1284.0}{100\times\frac{7}{8}.64} = 2.3$ kg/cm²

$b = 100$, $h = 50 + \frac{15}{5} = 68$ cm

$d = 64$ cm $d' = 4$

$A_s = 4-16\phi = 8.04$

$A_s' = 2-16\phi = 4.02$

$p = \frac{8.04}{100\times64} = 0.00126$

$p' = 0.00063$

$d'/d = 4/64 = 0.062$

C $M_c = -5820$ kgm $N_2 = 11,700$ kg $\sigma_{c2} = 1056.0$ kg/cm²

$A_s = \begin{matrix}2-16\phi = 4.02\\ 2-12\phi = 2.26\end{matrix}$ 6.28

$A_s' = 2-16\phi = 4.02$

断面 II－II

土圧 5.3m　　$w = \frac{2}{3} \times 1000 \times 5.3 = 3530$ kg/m

$M_B = -1.585 \times 3530 = -5600$ kgm
$M_C = -0.919$ 〃 $= 3240$ 〃
$M_1 = 1.020$ 〃 $= 3600$ 〃
$M_2 = 1.060$ 〃 $= 3740$ 〃

$S_{B2} = 2.030$ 〃 $= 7170$ kg
$S_{C2} = -1.670$ 〃 $= 5900$ 〃
$S_{B1} = -1.850$ 〃 $= 6530$ 〃

$N_1 = 7170$ kg
$N_2 = 6530$ 〃

(M2)　$M_2 = 3740$ kgm　　$N_2 = 6530$ kg

$\frac{M}{N} = \frac{3740 \times 100}{6530} =$ 57.3

$d - u =$ 16.9

$e =$ 73.2

$e' = e - 3 =$ 41.2

$e'/e =$ 0.563

$\frac{Ne}{bd^2} = \frac{6530 \times 73.2}{100 \times 36^2} = 3.690$

$\frac{Ne}{bd^2\sigma_c} = 0.140$ 0.132 $k = 0.290$ 0.270

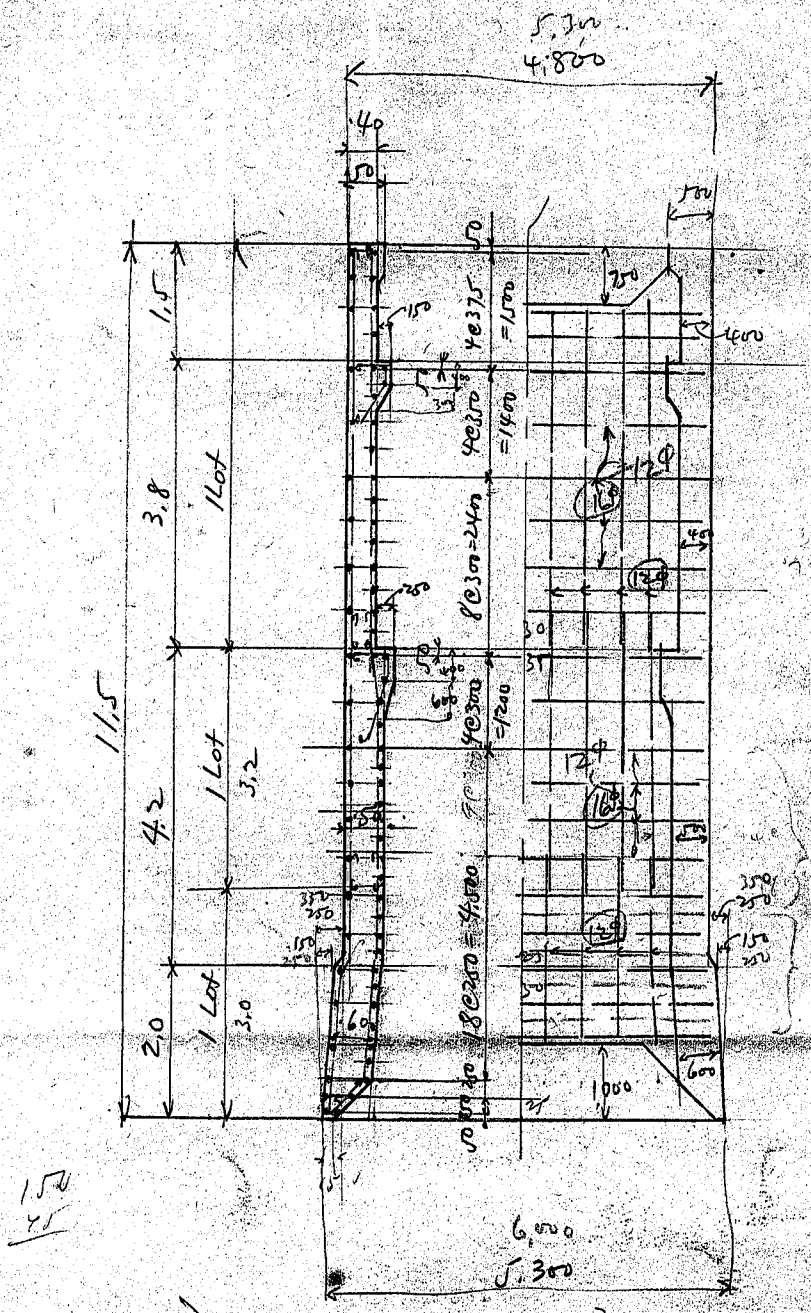
$\sigma_c = \frac{3.690}{0.140}$ 0.132 $= 27.9$ kg/cm²

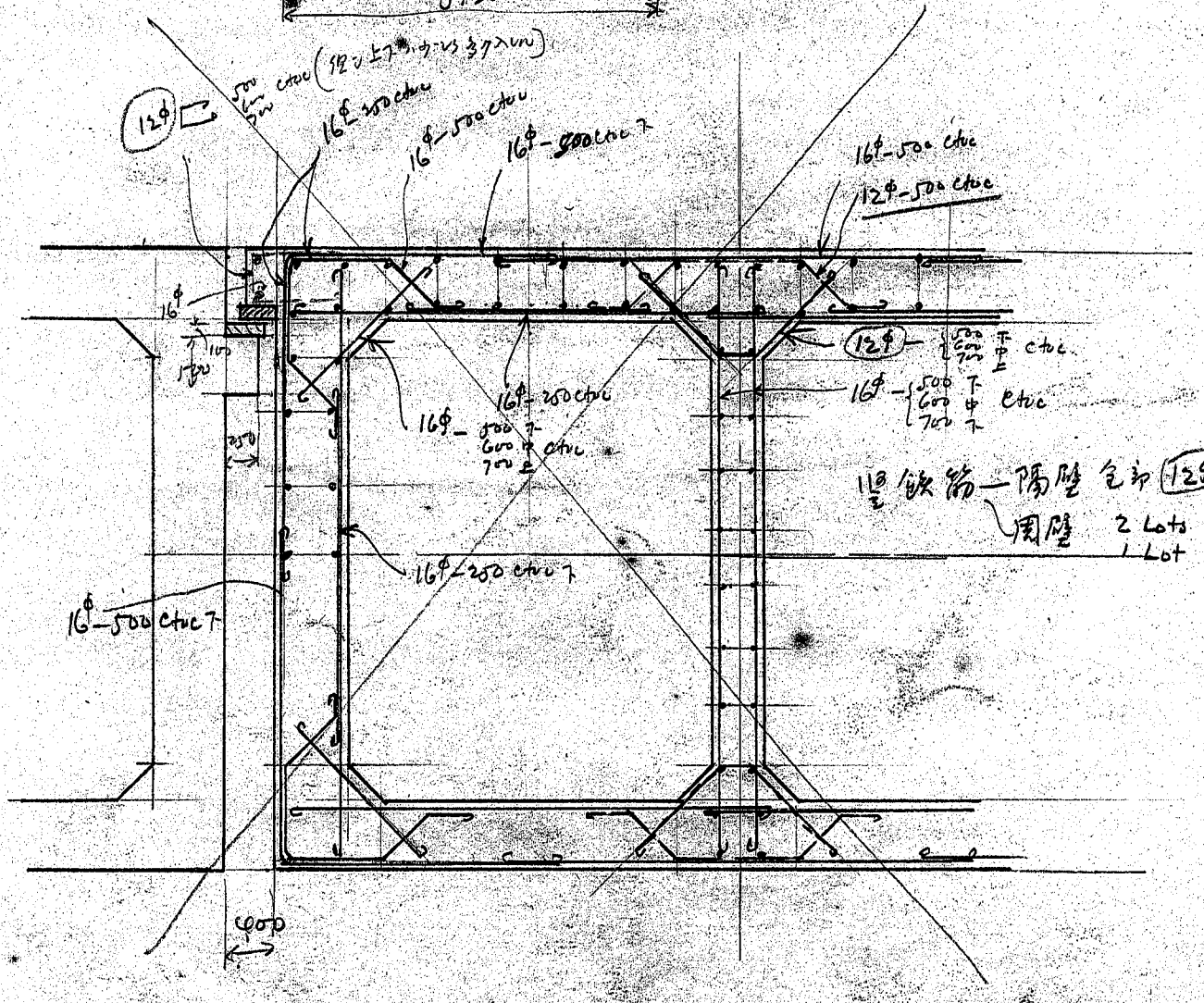
$\sigma_s = 1526 \times \frac{0.71}{0.29}$ 27.9 0.270 $= 990$ 1133 ✓

$b = 100$, $h = 40$
$d = 36$　　$d' = 4$

$A_s = 2 - 16\phi = 8.04$　　$3.33 - 16^{\phi} = 6.70$
$A_s' = 2 - 16\phi = 4.02$　　$1.67 - 16^{\phi} = 3.33$
$p = \frac{8.04}{100 \times 36} = 0.00224$　　$p = \frac{6.70}{100 \times 36} = 0.00186$
$p' = 0.00112$　　$p' =$ 0.00093
$d'/d = 4/36 = 0.111$

(7)





$\frac{630 \times 4.5}{2} = 630$

$630 \times 4 = 2520$

$T = \frac{2520 \times 1.5}{3.5} = 1080$ $A_s = \frac{1080}{130} = 8.3$

$12-12\phi = 13.5$

3.5

増田橋梁建築設計事務所
東京市品川區五反田五ノ一〇八
電話大崎(49)0678番

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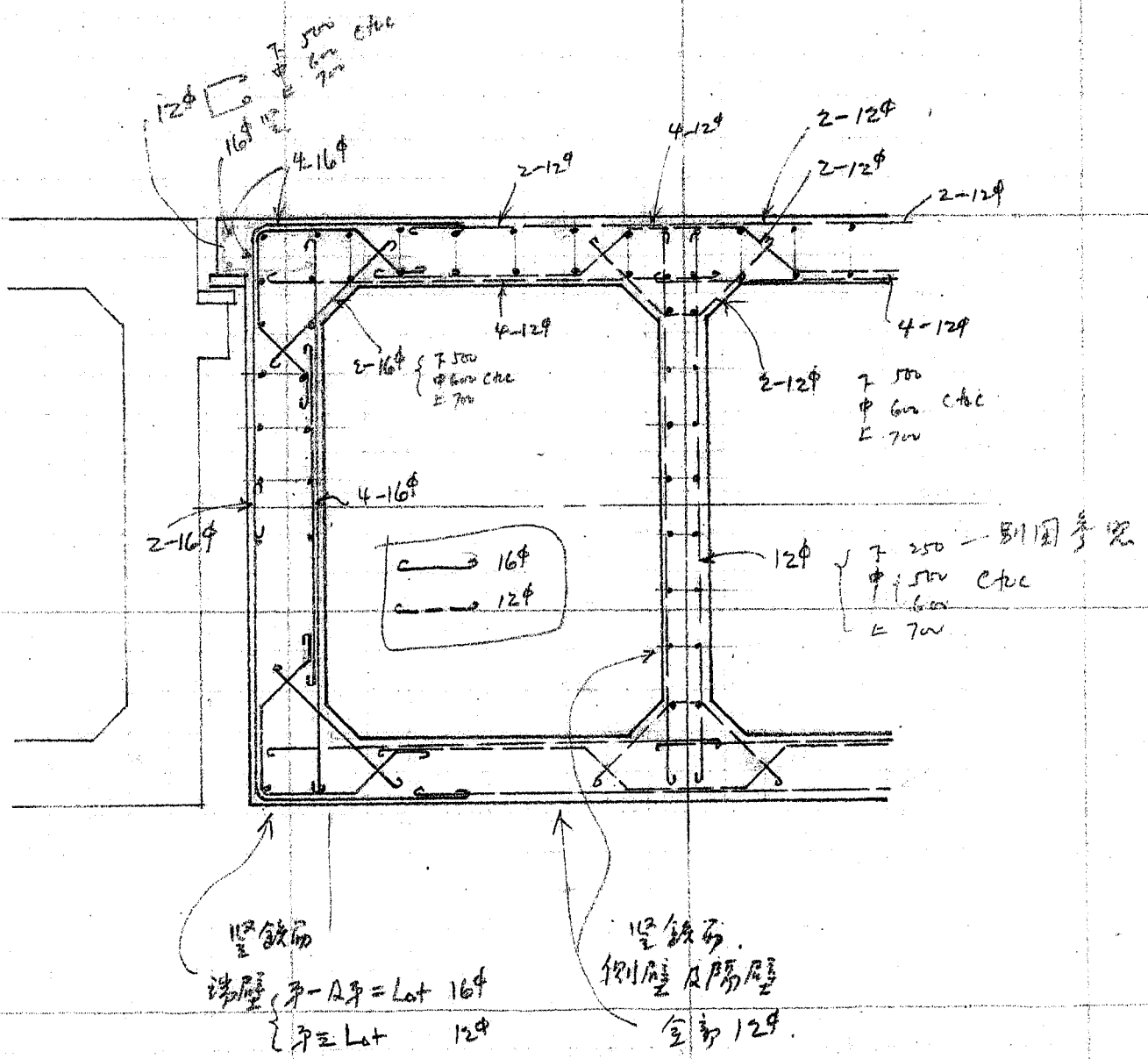
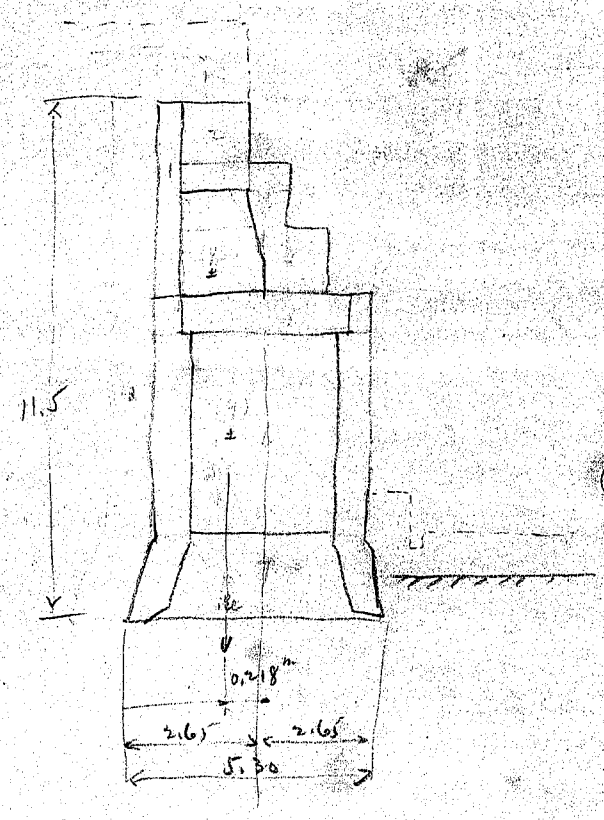
照査　日付　第 7A 頁



井筒天端造壁体ブ築造しみね 渠底マデ内部ブ掘鑿ニ対ル安定ヲ

(8)



1.	0.4×4.5×8.4 =	15.12	@2400 =	36300	× 2.2 =	79,900
2	0.5×1.4×8.4 =	5.88	@2200 =	12,900	× 1.3 =	16,800
3	2.0×2.4×8.4 =	40.30	@ 〃 =	88,700	× 0.8 =	71,000
4	2.0×3.4×8.4 =	57.10	@ 〃 =	125,700	× 0.3 =	37,700
5	0.8×4.8×8.4 =	32.30	@ 〃 =	71,100	× 0 =	0
6	3.7×4.8×8.4 =	149.20	@ 2400 =	358,500	× 0 =	0
7	2.5×5.15×8.4 =	108.00	@ 〃 =	259,200	× 0 =	0
(8)	−1.7×3.0×6.55 =	−33.40	@ 2500 =	−16,700	× 1.1 =	−18,400
(9)	−3.8×3.7×6.55 =	−92.20	@ 2700 =	−64,600	× 0 =	0
(10)	−3.95×2.5×6.85 =	−67.60	@ 2600 =	−13,500	× 0 =	0
				857,600 kg	0.218 m	187,700

$$W = \frac{857,600}{8.4} = 102,000\ kg$$

土圧 $\phi = 30°$

$$E = \frac{1}{6} \times 1600 \times 11.5^2 = 353,000\ kg$$

$$V = E\tan 25° = 353,000 \times 0.4663 = 165,000\ kg$$

W		102,000	× (−0.218) =	−22,300
V		165,000	× (−2.40) =	−396,000
E	353,000	× 3.83 =	1352,000	
	ΣH = 353,000 kg	ΣV = 1183,000 kg	0.618 m	733,000

$$e_{cc} = 0.618\ m < \frac{5.3}{6} = 0.88$$

$$P = \frac{1183,000}{1.0 \times 5.3}\left(1 \pm \frac{6 \times 0.618}{5.3}\right) = 38,000\ kg/m^2$$

0.70

$\frac{1}{8} \times 1000 \times 5.3^2 = 2310\ kg/m$

$d = \sqrt{\frac{231,000}{7.3}} = 56.3\ cm$ $d = 75$

$A_s = \frac{231,000}{1.3 \times \frac{7}{8} \times 7.1} = 27.1$

増田橋梁建築設計事務所
東京市品川區五反田五ノ一〇八
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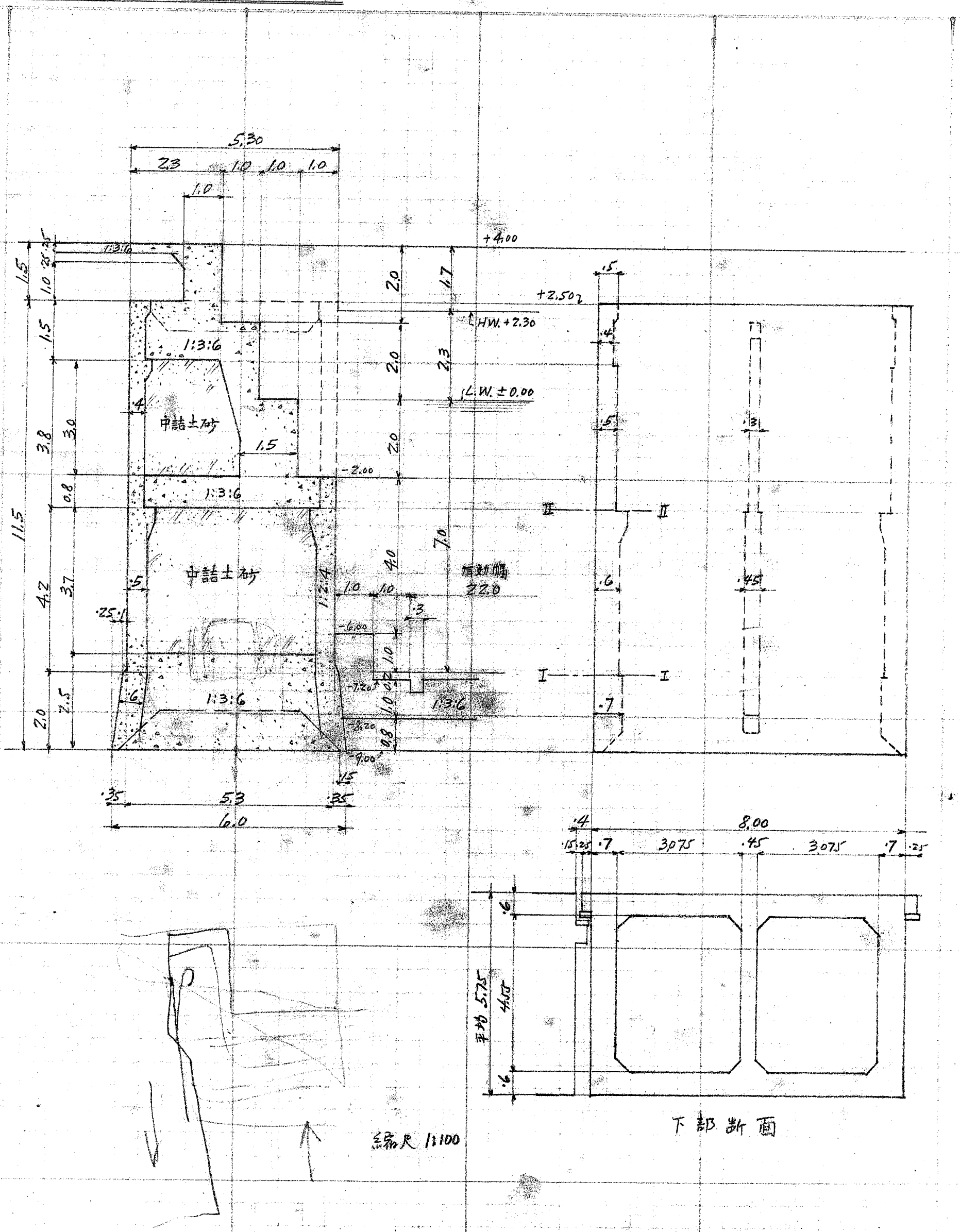
照査　稲葉　日付 16-3-13　第 9 頁

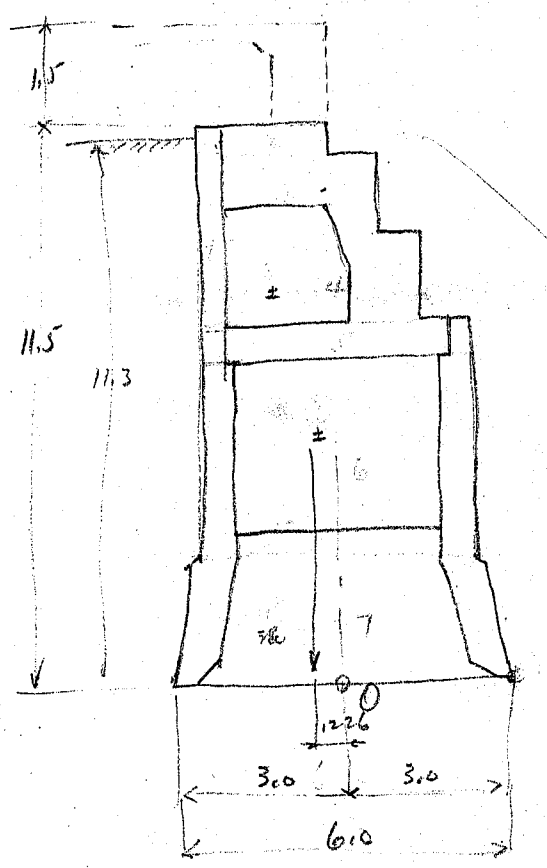
大阪鉄工所川崎工場 第二船渠



縮尺 1:100

下部断面

井筒天端迄躯体ヲ築造ニ於ケル梁底マデ内部ヲ掘鑿ニ於ケル時ノ安定ヲ



1	0.4×4.5×8.4	= 15.12 m³	@2400 =	36.3m	× 2.45 =	88.9m
2	0.5×1.9×8.4	= 7.98	@2200 =	17.6m	× 1.30 =	22.9m
3.	2.0×2.9×8.4	= 48.75	@ 〃 =	107.3m	× 0.80 =	85.9m
4.	2.0×3.9×8.4	= 65.50	@ 〃 =	144.0m	× 0.30 =	43.2m
5.	0.8×5.30×8.4	= 35.6	@ 〃 =	784m	× 0 =	0
6	4.2×5.3×8.4	= 187.0	@2400 =	449,000	× 0 =	0
7	2.0×5.75×8.4	= 96.6	@ 〃 =	231.8m	× 0 =	0
(8)	−2.2×3.0×6.7	= −44.✓	@ 500 =	−22,100	× 1.1 =	−24.3m
(9)	−4.3×3.7×6.35	= −101.0	@ 700 =	−70,700	× 0 =	0
(10)	−2.0×4.55×6.15	= −56.0	@ 200 =	−11,200	× 0 =	0
				960,400 kg	0.226 m²	216.6m

$$W = \frac{960400}{8.4} = 114.3m\ kg$$

$\pm$ 孔 $\quad \phi = 30°$

$E_h = \frac{1}{6} \times 1600 \times 11.3^2 = 34.0m\ kg$ $\quad \frac{11.3}{3} = 3.767^m$

$V = E \tan 25° = 34.0m \times 0.4663 = 15.9m\ kg$ $\quad \frac{6.0}{2} = 3.0^m$

$E_v = 0.35 \times 10.0 = 3.5 \times 1.6m = 5.6m\ kg$ $\quad 2.83^m$

Moment abt O

W	114.3m	×(−0.226) =	−25.9m
V	15.9m	×(−3.0m) =	−47.7m
E_V	5.6m	×(−2.83) =	−15.8m
		× 3.767 =	12.79m
E_H	34.0m		
			38.5m

$\Sigma H = 34.0m\ kg$ $\quad \Sigma V = 135.8m\ kg$ $\quad 0.283^m$

Eccentricity $e = 0.283^m$

$$P = \frac{135.8m}{1.0 \times 6.0}\left(1 \pm \frac{6 \times 0.283}{6.0}\right) = 29.0m\ kg/m^2$$

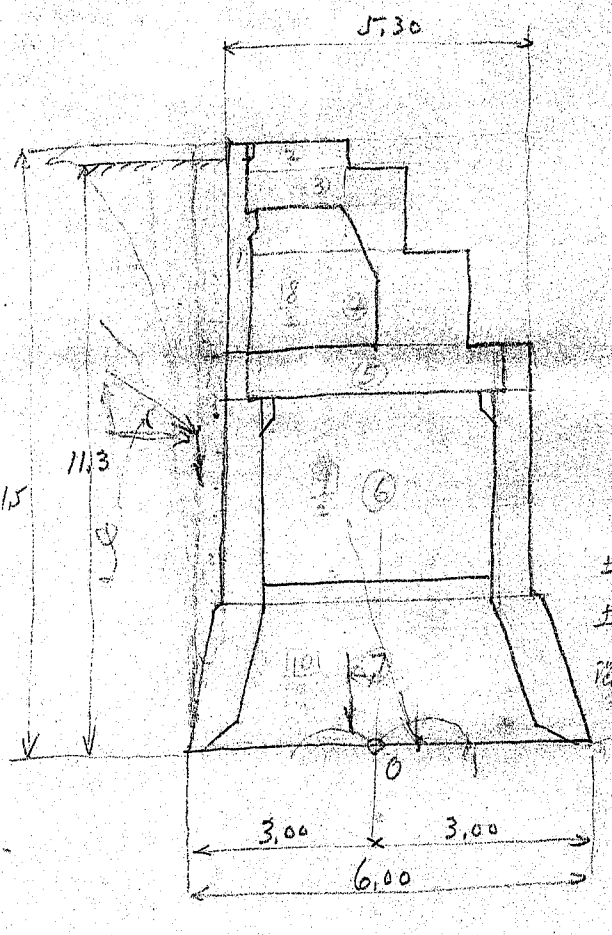
$\frac{H}{V} = \frac{34.0m}{135.8m} = 0.25$ ✓

$\frac{1-\sin\phi}{1+\sin\phi}$ $\quad \phi = 30° \quad \frac{0.5}{1.5} = 0.333$

$25° \quad \frac{.5774}{1.4226} = 0.406$ $\quad 1.27$

井筒天端造壁体ノ築造ニ付 梁巾マデ内部ヲ振動ニヨリ、空空ス

(10A)



①	0.40 × 4.50 × 8.40 =	15.12	@2,400 =	36300	× 2.45 =	88900		
▽ 〃	0.10 × 0.5 × 7.20 =	0.36	@ 〃 =	860	× 2.20 =	1900		
▽ 〃	0.15 × 0.6 × 6.90 =	0.62	@ 〃 =	1490	× 2.18 =	3200		
②	0.50 × 1.9 × 8.40 =	7.98	@ 2200 =	17550	× 1.30 =	22800		
③	2.00 × 2.90 × 8.40 =	48.73	@ 〃 =	107200	× 0.80 =	85800		
④	2.00 × 3.90 × 8.40 =	65.50	@ 〃 =	144200	× 0.30 =	43300		
⑤	0.80 × 5.30 × 8.40 =	35.65	@ 2200 =	78400	× 0 =	0		
⑥	4.30 × 5.30 × 8.40 =	186.7	@ 2400 =	448500	× 0 =	0		
⑦	2.00 × 5.75 × 8.40 =	96.6	@ 〃 =	231500	× 0 =	0		
				400	× 0 =	0		
Shoe								
± ⑧	2.2 × 3.0 × 6.70 =	44.2	@ −300 =	−13280	× 1.1 =	−14580		
± ⑨	4.3 × 3.70 × 6.35 =	100.9	@ −300 =	−50450	× 0 =	−0		
± ⑩	2.0 × 4.05 × 6.15 =	55.9	@ −200 =	−11180	× 0 =	−0		
				991490 kg		0.234 m		231370

$$W = \frac{991{,}490}{8.40} = 118{,}000\ kg$$

$\pm$ 下 $\varphi = 26°$ $\quad \sin\varphi = 0.44$ $\quad \frac{1-\sin\varphi}{1+\sin\varphi} = \frac{0.56}{1.44} = 0.389$

$$E_h = \frac{11.3^2}{2} \times 0.389 \times 1900 = 47100\ kg \qquad \frac{11.3}{3} = 3.767\ m$$

$$E_V = E\tan 26° = 47100 \times 0.488 = 23000\ kg \qquad \frac{6.0}{2} = 3.00\ m$$

$$V = 0.35 \times 10.3 \times 1900 = 6850\ kg \qquad 2.83\ m$$

OE = 重心 GL 迄

W	118000	× (−0.234)	= −	27700
E_V	23000	× (−3.00)	= −	69000
V	6850	× (−2.83)	= −	19400
E_h	47100	× 3.767	=	177300
	$\Sigma V = 147850\ kg$			61100
	$\Sigma H = 47100\ kg$			67700

$$\text{偏心 } e = 0.431\ m < \frac{6.0}{6}$$ 合力ハ底面中央三分ノ一以内ニアリ

$$\text{底面最大反力 } P = \frac{147850}{1.0 \times 6.0}\left(1 \pm \frac{6 \times 0.431}{6.0}\right) = \begin{matrix} 33900 \\ 34700 \\ 14550 \\ 13520 \end{matrix} \text{ kg/m}^2 = \begin{pmatrix} 3.10 \\ 3.17 \\ 1.33 \\ 1.24 \end{pmatrix} \text{ ton/m}^2$$

$$\frac{\Sigma H}{\Sigma V} = \frac{47100}{147850} = 0.330$$

⑨ ノ 上 ヲ

$$\text{底面 } M = 0.330 \times$$

$$\frac{740890}{8} = 92500\ kg$$

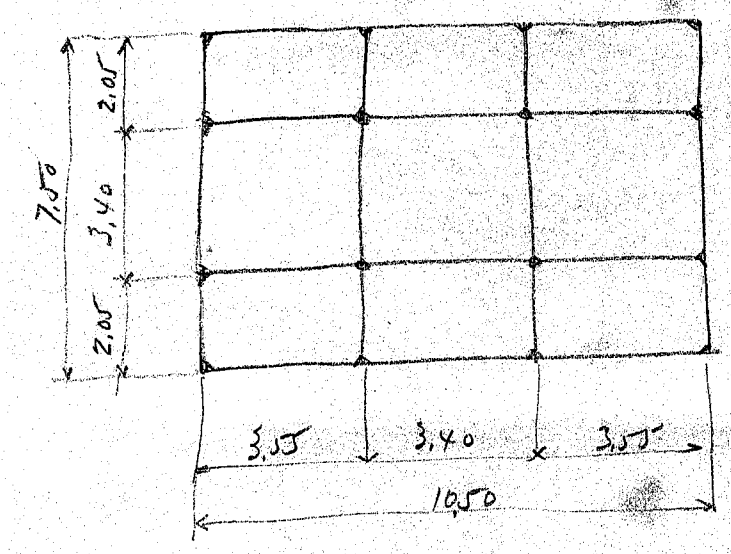
ポンプ室 井筒

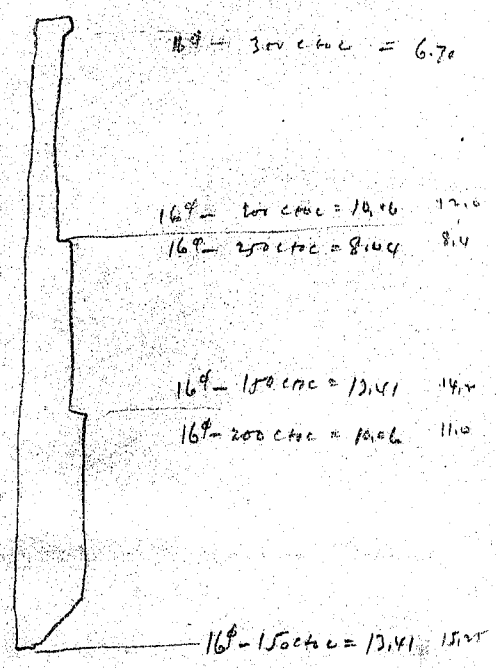
土圧　泥水中　$\frac{2}{3}\times 1000\ h_1 = 667\ h$　kg/m²

　　後功材　$\frac{1}{3}\times 1900\ h_2 = 633\ h$　〃

土深	泥水中	後功材
断面		
底版	15.3m	17.0
I－I	10.5	12.2
II－II	5.5	7.2

土圧 泥水中	土圧 後功材	曲げ率 $M=\frac{1}{12}wl^2$ $l=3.55$	$l=3.40$	$l=2.05$	剪力 $S=\frac{wl}{2}$ $l=3.55$
10,200 kg/m²	10,750 kg/m²	11280 kgm	10350	3760 kgm	19,100 kg
7000	7700	8100	7420	2690	13700
3670	4550	4780	4380	1590	8150





断面の算力

中央

底版　(l=3.55)　M=11280 kgm　S=19100 kg

$d=\sqrt{\frac{11280\times 100}{7.2}}=39.4$ cm

中央　端部

$d=65+15=80$

$h=70$ cm 85

$A_s=\frac{11280\times 100}{1300\times\frac{2}{8}\times 80}=12.4$ cm²　　11.1

$A_s=\frac{11280\times 100}{1300\times\frac{2}{8}\times 65}=15.25$ cm²

$s=\frac{19100}{100\times\frac{2}{8}\times 80}=2.76$

I－I　(l=3.55)　M=8100 kgm　S=13.7m

$d=50+15=65$

$h=55$　70

$A_s=\frac{8100\times 100}{1300\times\frac{2}{8}\times 50}=14.20$ cm² (11.0)

$A_s=\frac{8100\times 100}{1300\times\frac{2}{8}\times 65}=10.96$ cm²　　4.7,-

$s=\frac{137m}{100\times\frac{2}{8}\times 65}=2.4$

II－II　(l=3.55)　M=4780　S=8100

$d=55+15=70$

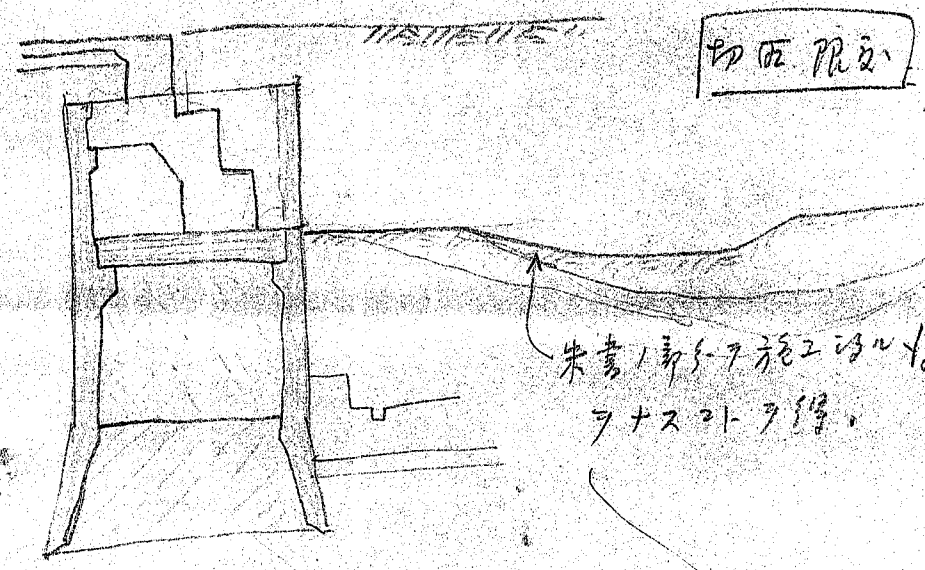
$h=40$　55

$A_s=\frac{4780\times 100}{1300\times\frac{2}{8}\times 35}=12.00$ cm² (8.4)

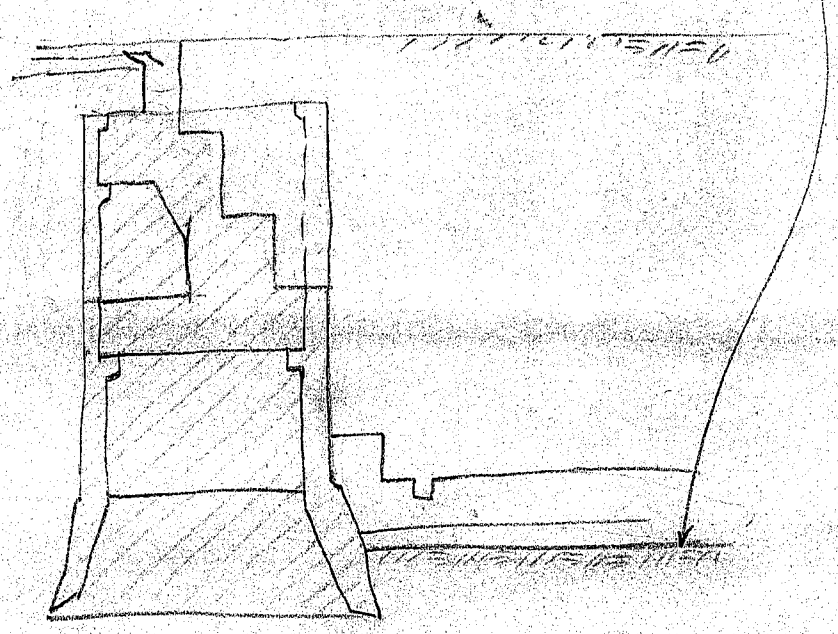
$A_s=\frac{4780\times 100}{1300\times\frac{2}{8}\times 55}=8.40$ cm²　　4.0

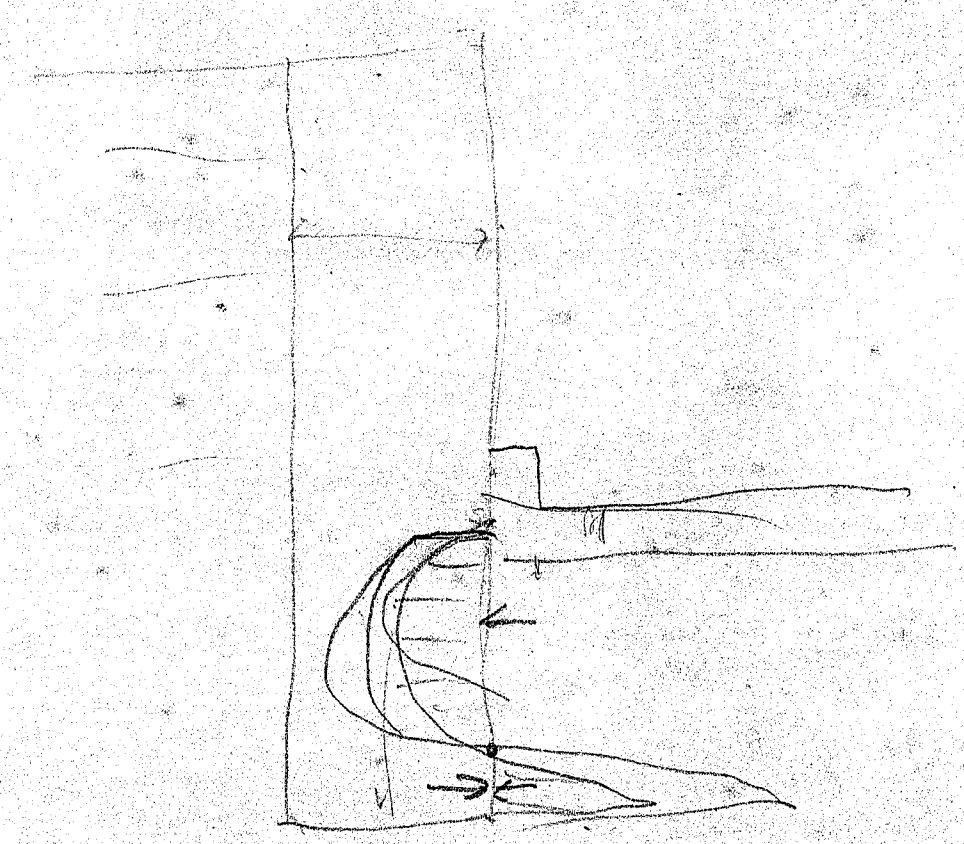
$s=\frac{8100}{100\times\frac{2}{8}\times 55}=1.7$

l=2.05



朱書ノ影ヲ施工済ル後、始メテ此線マデ切面ヲナスコトヲ得。





(1)

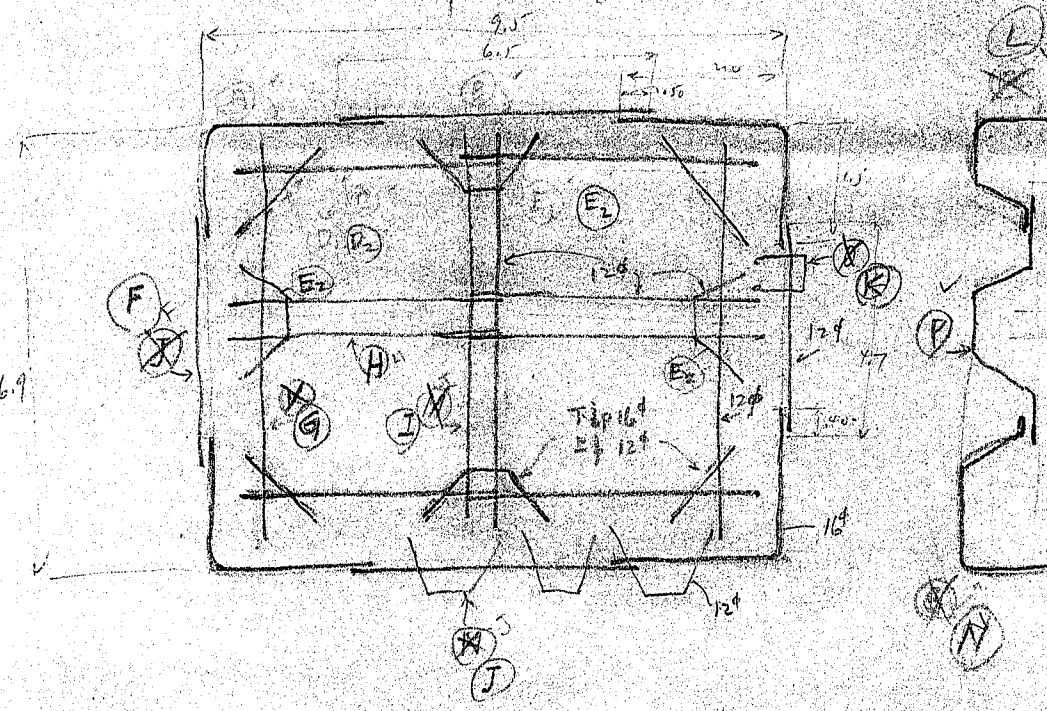
梁 n 用 井筒 W4

所要数 2基

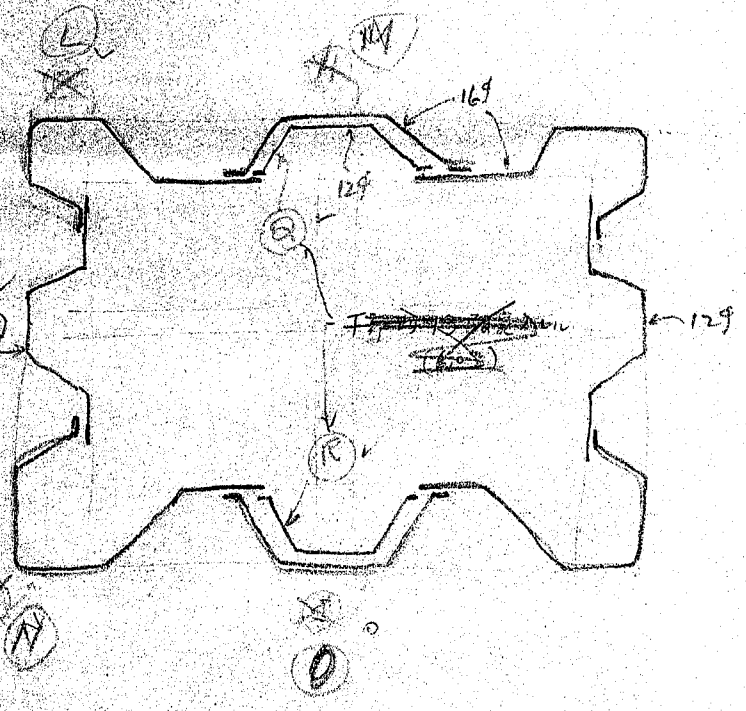
(屋外排水) 底版躯体 井筒 W4 配筋図参照

鉄筋

平組 (33個)



立組 (29個)



V.3 3.4 5.6

P 23 + 10 = 33

2 20 + 9 = 29

16φ

平32. ✓ (A) 132 − 16φ @ 1.58 × 3.800 = 793 ✓

✓ (B) 66 − " @ " × 6.800 = 709 ✓

✓ (C) 132 − " @ " × 5.200 = 1093 ✓

+ 16φ2. ✓ (D1) 64 − " @ " × 1.600 = 162 ✓

" ✓ (E1) 32 − " @ " × 2.20 = 111 ✓

立32. 2ヶ所 (K) (L) 58 − " @ " × 5.80 = 532 ✓

(G) (N) 58 − " @ " × 6.30 = 577 ✓

(H) (M) 29 − " @ " × 3.500 = 160 ✓

(I) (O) 29 − " @ " × 4.400 = 202 ✓

53+48=101

増 鉄筋 斜補強 101 − " @ " × 4.600 = 734 ✓

" 101 ✓ − " @ " × 5.800 = 926 ✓

" 101 ✓ − " @ " × 5.800 = 926 ✓

Ar 40 ✓ − " @ " × 2.00 = 126 ✓

7051

353

余掛 5% 7404 kg ニシテ 7.400 kgトス

16φ 鉄筋計

12φ

甲梁 ×17本	(D₂) ✓	68 — 12φ	@ 0.888	× 1.500 =	91 ✓
33×2 + 17×2	(E₂) ✓	100 — 〃	@ 〃	× 2.100 =	186 ✓
	(J)(F) ✓	66 — 〃	@ 〃	× 5.0m =	293 ✓
	(K) ✓ (G)	66 — 〃	@ 〃	× 7.0m =	410 ✓
(30+10)×4 下子10は余分	(L)(H) ✓	160 — 〃	@ 〃	× 5.100 =	725 ✓
(30+10)×2	(M) ✓ (I)	80 — 〃	@ 〃	× 7.0m =	497 ✓
33×3	(N) ✓ (J)	99 — 〃	@ 〃	× 2.400 =	211 ✓
余長 下 上 33+12+5	(O) ✓ (K)	50 — 〃	@ 〃	× 1.500 =	67 ✓

乙梁. 2×29	(P)	58 — 〃	@ 〃	× 5.400 =	278 ✓
	(Q)	29 — 〃	@ 〃	× 2.600 =	67 ✓
	(R)	29 — 〃	@ 〃	× 3.500 =	90. ✓

11本 鉄筋. 左右壁 2×28+2

	58 ✓ — 〃	@ 〃	× 4.500 =	232 ✓
	58 ✓ — 〃	@ 〃	× 5.700 =	294 ✓
	58 ✓ — 〃	@ 〃	× 5.700 =	294 ✓
隔壁 36+20	56 ✓ — 〃	@ 〃	× 3.200 =	159 ✓
〃	56 ✓ — 〃	@ 〃	× 5.700 =	283 ✓
〃	52 ✓ — 〃	@ 〃	× 5.000 =	249 ✓
〃	8 — 〃	@ 〃	× 2.000 =	14 ✓
開口	28 — 〃	@ 〃	× 2.000 =	50 ✓

4490

余備 5% = 225

4715 kg ≒ 4,720 kg 1本

12φ 鉄筋合計 12,120 kg

5.8
5.8
4.8
4.0

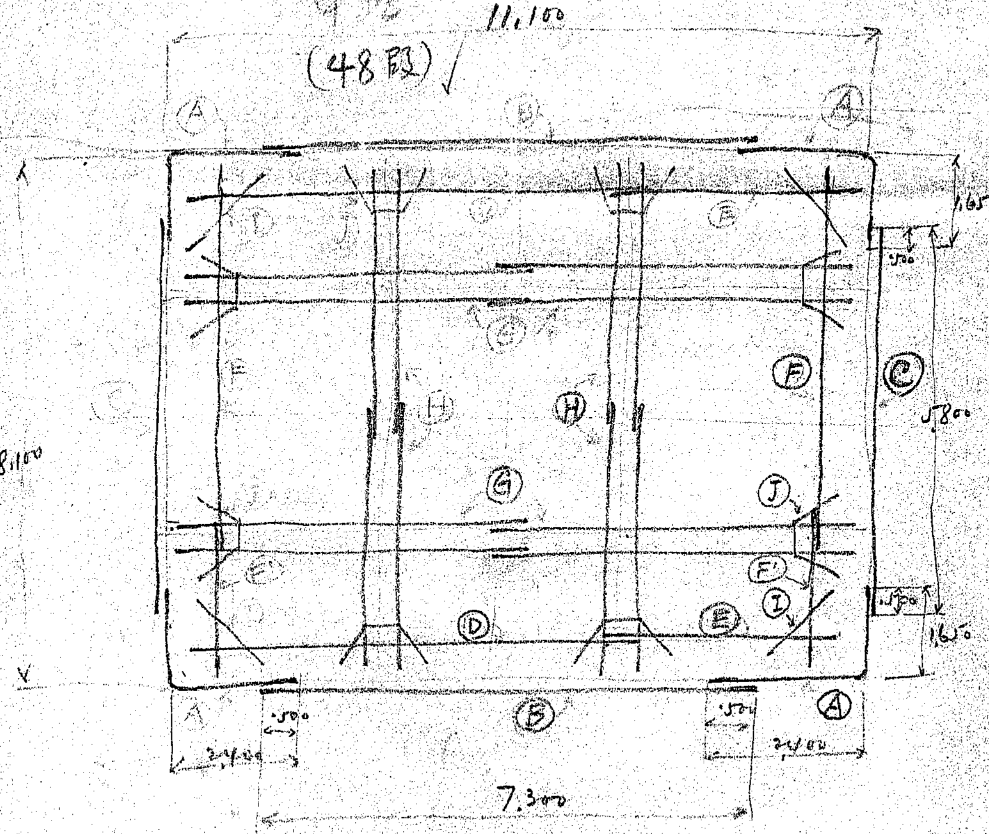
Spacing 46 × 150 = 6,950
30 × 200 = 6,000
15 × 300 = 4,550
91 / 92枚 … 17,500 m.

72−4=88 ÷2=44
44+4=48

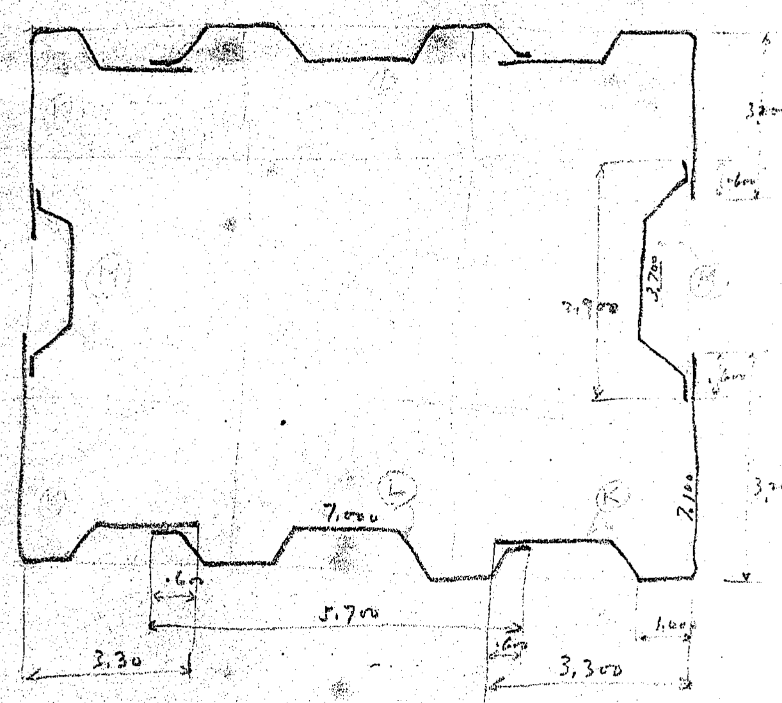
喞筒室用井筒 W5.

所要数 1基

甲組 (48段)✓



乙組 (44段)✓



甲組	Ⓐ	4@48=192 / 192 — 16φ @ 1.58 × 4,400 =	1335. ✓	15,168
〃	Ⓑ	96 — 〃 @ 〃 × 7,600 =	1,153 ✓	139.04
〃	Ⓒ	96 — 〃 @ 〃 × 6,100 =	925 ✓	
〃	Ⓓ	96 — 〃 @ 〃 × 7,700 =	1,168 ✓	
〃	Ⓔ	96 — 〃 @ 〃 × 4,300 =	652 ✓	
〃	Ⓕ	96 — 〃 @ 〃 × 6,300 =	956 ✓	
〃	Ⓕ'	96 — 〃 @ 〃 × 2,800 =	425 ✓	265.44
〃	Ⓖ	192 — 〃 @ 〃 × 6,000 =	1820 ✓	
〃	Ⓗ	192 — 〃 @ 〃 × 4,600 =	1395 ✓	189.6
〃	Ⓘ	192 — 〃 @ 〃 × 1,800 =	546 ✓	
〃	Ⓙ	384 — 〃 @ 〃 × 2,600 =	1,577 ✓	
乙組	Ⓚ	4@44=176 / 176 — 〃 @ 〃 × 7,100 =	1974 ✓	
〃	Ⓛ	88 — 〃 @ 〃 × 7,000 =	973 ✓	
〃	Ⓜ	88 — 〃 @ 〃 × 3,700 =	514 ✓	
竪鉄筋 側壁		168×2 = 336 — 〃 @ 〃 × 5,800 =	3079 ✓	
〃		168 — 〃 @ 〃 × 4,800 =	1,274 ✓	
〃		168 — 〃 @ 〃 × 4,000 =	1,062 ✓	
刃口		~~72~~ 80 — 〃 @ 〃 × 2,000 =	228 ✓	
		120 — 〃 @ 〃 × 4,500 =	(853) ✓	
隔壁		120 — 〃 @ 〃 × 5,800 =	1,100 ✓	
〃		120 — 〃 @ 〃 × 4,800 =	910 ✓	
〃		120 — 〃 @ 〃 × 4,000 =	758 ✓	
刃口斜		16 — 〃 @ 〃 × 2,000 =	50 ✓	

24,727

余備 5% = 1236

25,963 kg 之レヲ 25,960 kg トス

増田淳氏関係資料
（独立行政法人 土木研究所蔵）

(1)

大阪鐵工所神奈川工場
第二船渠築造工事
開式井筒工法計畫說明書

一、本計畫ノ船渠側壁及渠口部並ニ喞筒室ノ主体築造ニ開式井筒
工法（特許第〇〇〇〇號）ヲ採用スルモノニシテ工事ノ施工ヲ安全確實
ナラシメ現今入手シ得ル可能ナル鋼矢板ノ使用ヲ回避セントス若シ
又期ヲ短縮セシメ得ベク合理的ナル設備ノ工法ニシテ普大ナル効ノ如シ

一、図示ノ如ク渠壁ニ対シテハ幅六、〇米宛一、一米乃至一、一五米ノ鉄筋混凝土井筒
四一基ヲ所定ノ位置ニ並列施工シ之ヲ山岸壁ノ主体ヲ構築シ船渠
内部ノ土砂ヲ掘鑿スルニ皆部ノ土圧ヲ安全ニ支持セシメ井筒ノ
基礎ニ順序ヲ以テ井筒所定ノ位置ニ沈設シ地盤ヲ必要ナル
程度迄掘下ケタル後井筒ヲ順次ニ下部ヨリ
仰壁ナル高井迄築造シ終リタル後井筒周壁内部ヲ
コンクリートニテ充塡シ尚井筒ノ周囲ニ粘土ヲ
井筒ノ天端ガ地盤ニ近ヅキタル時沈下ヲ止メ井筒ノ上部ヨリ
ヲ打ケ足シヲ為シ沈下ヲ継続シ所定ノ深サニ達シタル後底部ヲ
二、五米ノ底板混凝土ヲ填充シ其上部ヨリ底部ヲ通ジテ
調合一、二、四ノ鉄筋混凝土ヲ施工シ井筒周壁ト底部トヲ
一体ト為ス斯クテ隔列井筒ノ沈下ヲ終了シタル後内部ノ
井筒ヲ築造シ沈下セシメ前記全様ノ
セシメテ底部ヲ填充シ渠壁ノ主体ヲ完成
トシ時期ヲ見テ埋立ヲ施行スベシ
特殊ノ設備ヲ施シ船渠内部ノ掘鑿ハ井筒ノ沈降ヲ阻止スル
ヲ以テ掘土ノ際ニ於ケル井筒ノ周囲ノ四〇程度ノ
完全ニ填充スルヲ以テ

一、井筒工事ハ(竪坑ノ土留ヲ兼ネル)主体ヲ完成シタル後、濾床面ノ土砂ヲ掻キ取リ、割石ヲ敷キ詰メ、其ノ内面ヲ濾床ノ形状ニ整ヘ、次ニ濾砂ヲ敷キ詰メ、更ニ井筒ノ形状ニ従ヒ階段ヲ取付ケ(本ヲ完成ス

一、濾床ノ部分ハ竪坑ニ対シテモ勿論ノコト井筒ノ中心ヨリモ本ヲ以テ偏セシメ

一、喞筒室用井筒ハ中心ヨリ東ニ一二米ノ一ニ位置トス

一、濾床底部地盤ハ相当良好ナル砂質粘土ヲ有スルモ多少ノ湧水ハ免レザルヲ以テ

往ヲ濾床底ニ泥濘土ノ部分ノ割栗石ヲ敷詰メ充分搗固メ且ツ濾床ニ於ケル濾水ヲ減殺セザル様濾床ノ内面ニ濾水ノ浸透ヲ防止スルト共ニ排水管ヲ設置スルコト

尚ホ竪坑ヲ主トシテ地盤ノ状態ニ依リ一二箇所ニ別ニ排水管ヲ併設スルコト

濾床底ハ濾水ノ流下ニ向ヒ一二分ノ勾配ヲ以テ傾斜セシメ

之レト直角ノ方向ニハ三米毎ニ中央ヲ最モ低クシ左右ニ一二分ノ勾配ヲ以テ傾斜セシメ

底面ノ濾水ヲ濾床ニ均等ニ集メ得ル様ニ集水溝ヲ設ケ

ヲ之等ノ集水溝ノ何レニモ均等ニ濾水ノ行キ亘ル様濾床ノ底面ヲ凹凸ニ仕上グルコト

一、開渠井筒工作ノ特徴

(イ) 通常ノ矢板切開工法ニ依ル鋼矢板ハ長一三米ノモノヲ使用シ一回ノ打込ミ長サハ二、五米毎ニ中心ヨリ一五糎ヅツ(ヲヲ)(跳)出シテ打込ミ一回ノ打込ミ長サハ二米ニ止メ以テ一日ニ施工シ得ル様ニ鋼矢板ノ使用ヲ回避シ得ル

(ロ) 矢板切開工法ニ比シ工期ヲ半減シ且ツ施工ノ一般ニ容易ニシテ危険ノ少キ

(ハ) 本工法ノ一般ニ施工容易ニシテ確実ニシテ矢板工法ニ比シ危険ノ少キ

(ニ) 矢板工法ニテハ竪坑ノ底部近傍ノ濾床壁部ノ状況ヲ観察スルコト能ハザルモ本工法ニ於テハ竪坑ノ底部ニ於テモ濾床壁ノ状況ヲ観察シ得ル様ニ施工シ得ル

(ホ) 矢板工法ニ於ケル護矢板ノ支保工錯結ニ
根継ニ方ヘ施工スル為メ掘穴ノ深サ、
多ク一般ニ根入ヲ取リ得ザルノミナラズ
動カヌモノト雖モ多クノ場合ニ於テ
又矢板工法ニ於ケル腹付ヲ行フ為メ
手際ノ好ヲ利用シ安全施工ニ心掛ケ
容易且確実ニ施工シ得ル材料ヲ補助
多大ノ便宜アリ

(ヘ) 矢板工法ニ於ケル各種ノ排水ヲ組合
スルニ必要ナル矢板体ノ施工ハ簡単
迅速及経済的ニシテ排水ニ関スル
使用方法ノ著シク多様ナリ得ル点ニ
多大ノ便宜アリ

(ト) 井筒工法ノ採用スル通常ノ方式ハ腹
ニ比シ欽的
ニシテ。施工ヲ要スルモ腹体ノ施
得ズ。従テ掘穴ハ広大ニシテ。主ニ
ヲ要シ(施工ニ)ノ使用ヲ困難ニ
得ル材料ノ入手比較的容易ニシテ

(チ) 本工法ニ於ケル腹体内初ハ根入ヲ
普通施工ノ際ハ優ニ体裁ヲ
ナシ

(リ) 矢板ヲ以テスル様ニシテハ腹穴ノ
ニヨリテモ之ガ施工ハ水ヲ
本工法ニ於ケル継手ハ堅牢
他ト比較シ継手ノ施工
開鑿シ得ル継手ニ施工ノ
施工ニ得ル。

JIUN MASUDA
CONSULTING ENGINEER
JIJI BLDG, TOKYO

CALCULATIONS FOR

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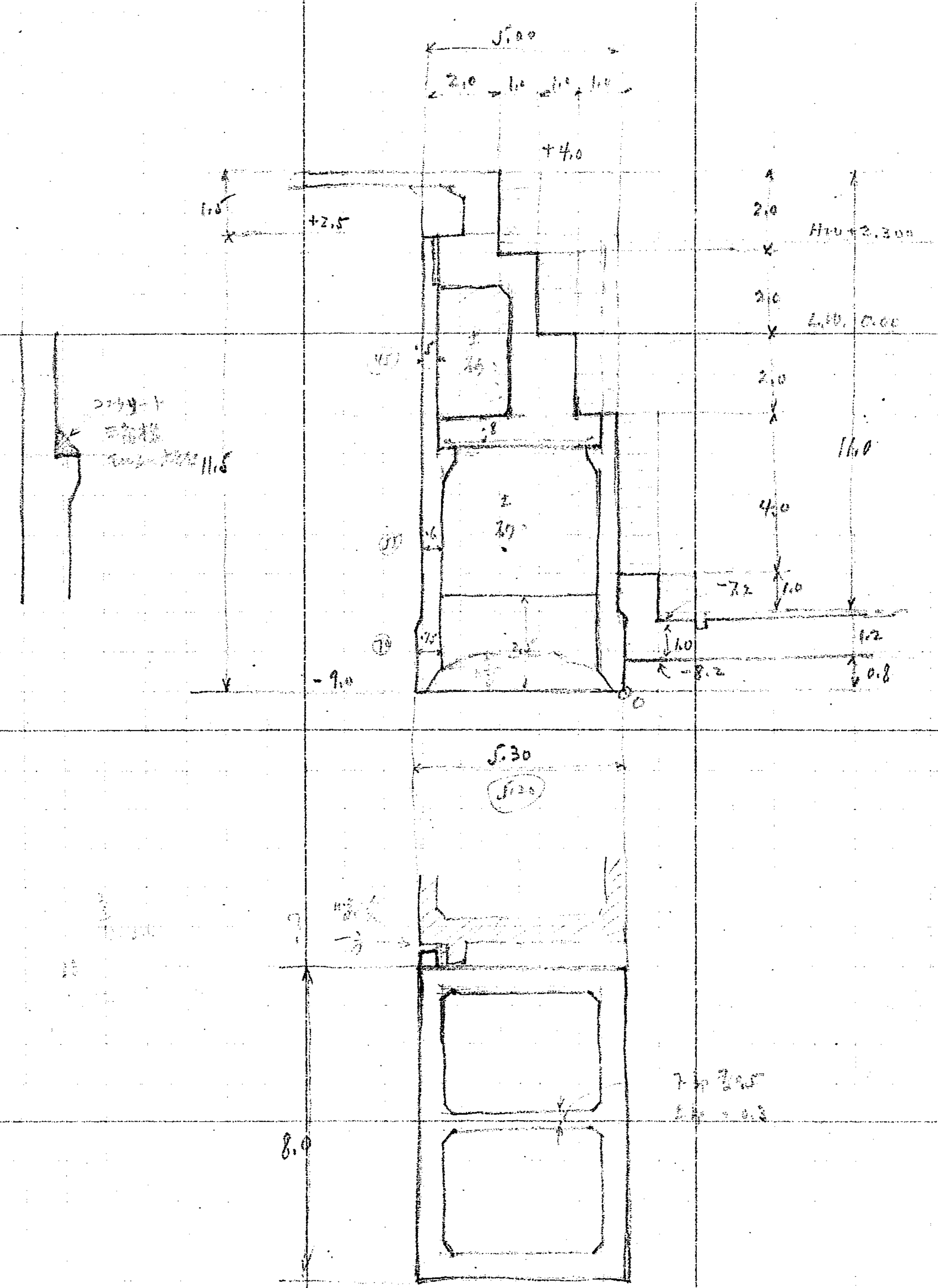

[illegible]

[illegible]	2.25	×	4.9 =	11.04	
1.5 × 1.5 =	2.25	×	3.9 =	8.78	
2.0 × 0.8 =	3.00	×	2.72 =	8.16	
2.0 × 1.0 =	2.00	×	1.65 =	3.30	
0.8 × 5.0 =	4.00	×	2.65 =	10.60	
2 @ 3.7 × 0.6 =	4.07	×	2.65 =	10.79	
2.5 × 5.3 =	13.25	×	2.65 =	35.11	
	31.02 m² @ 2300 = 71300 kg			87.78 @ 2300 =	202,000 kg·m

中詰土砂

3.0 × 1.7 =	5.10	×	3.8 =	19.38	
3.7 × 3.8 =	14.06	×	2.65 =	37.26	
	19.16 @ 1700 = 32600 kg			56.64 @ 1700 =	96,000

W = 103,900 　　　　M = 298,000

$x = \frac{298{,}000}{103{,}900} = 2.87$ m from ⓪

土圧　$E = \frac{1}{6} \times 1600 \times 11.5^2 = 35{,}300$ kg

$Y = E\tan 20° = 35{,}300 \times 0.36 = 12{,}700$ kg

W = 103,900 × 2.87 = 298,000
V = 12,700 × 5.30 = 67,300
H = 35,300 × (−3.82) = −135,200
116,600 　 1.97 　 230,100

$e = 2.65 - 1.97 = 0.68$

$p = \frac{116600}{10 \times 5.3}\left(1 \pm \frac{6 \times 0.68}{5.3}\right) = 38900$ kg/m²

$\frac{H}{V} = \frac{35300}{116600} = 0.30$

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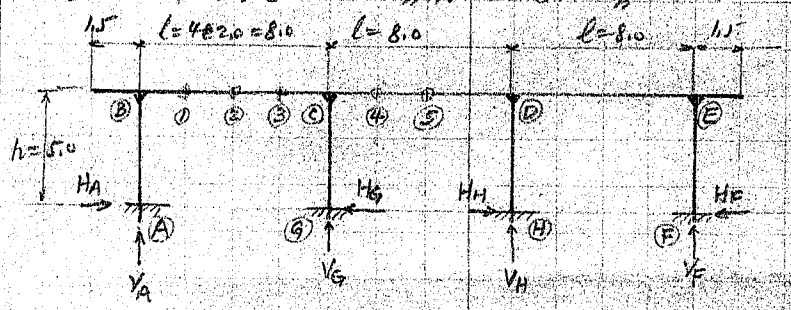
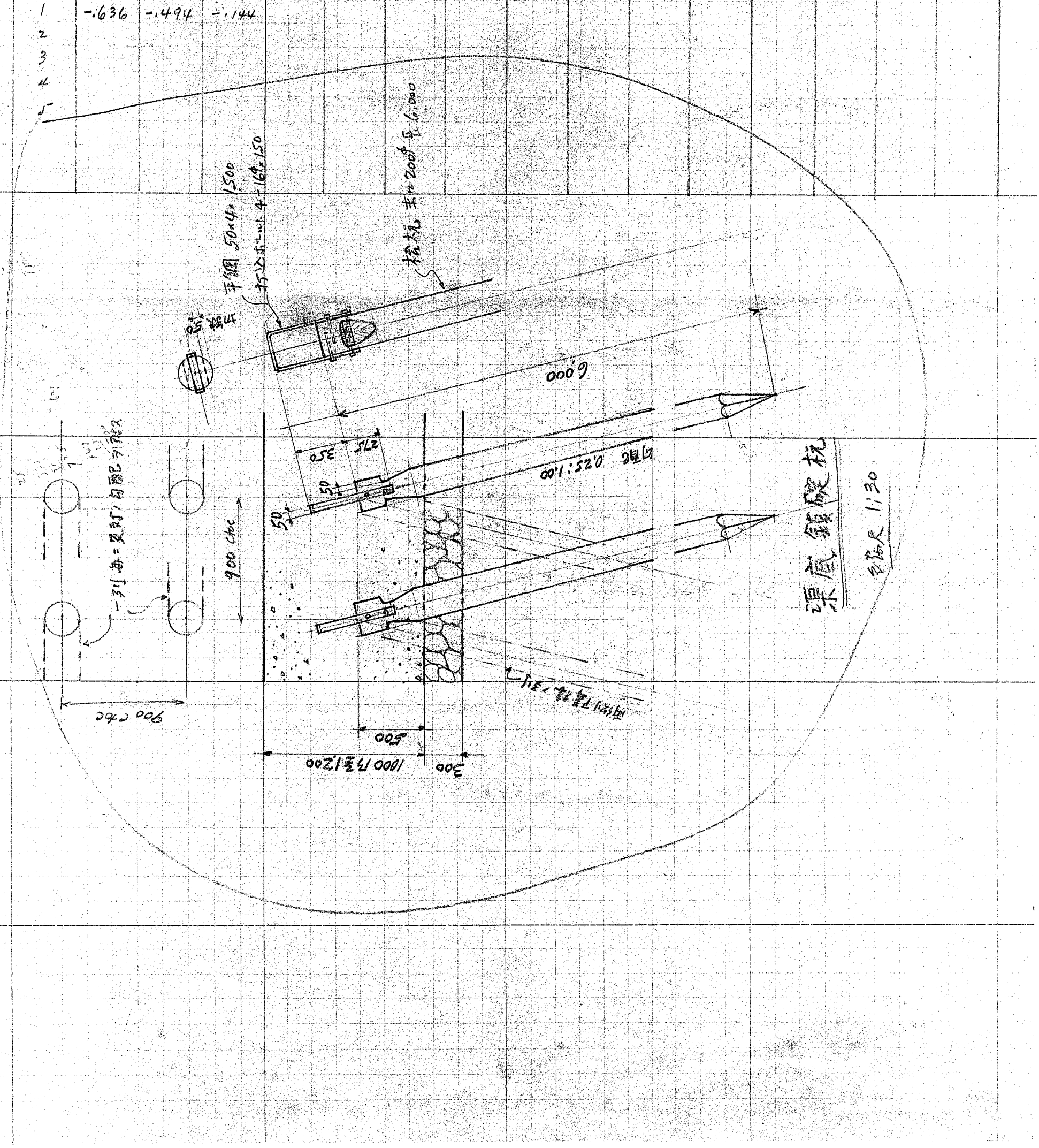
曲率、反力及剪力ノ影響面



載荷点	M_B	M_{C2L}	M_{C2R}	M_{D2L}	M_{D2R}	M_E	M_A	M_G	M_H	M_F	M_1	M_2	M_3	M_4	M_5
1	-.636	-.494	-.144												
2															
3															
4															
5															



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CALCULATIONS FOR

〇〇埠繋船壁築造工事計畫説明書

本繋船壁ハ全長630米ニテ約30度ノ角ヲ以テ〇字形ニ(屈曲ヒ二辺ヨリ成リ)~~曲~~ヲ~~ス~~ル~~ヲ~~ノ一辺ハ延長370米他ノ辺ハ260米ナリ、其方辺水深ハ壁面ニ於テ低水位以下7.0米壁面ノ前方10米ニ於テハ全ク10.2米トス

基礎地質ハ(標高低水位基準以下1米乃至-16米ノ範囲ニ於テ)其ノ殆ンド全部ガ〇〇質ノ青色頁岩ニテ其ノ間所ノ硬質粘土層ヲ以テ覆ハレ別紙圖面ニ示ス通リ甲種繋船壁ヲ築造シ其前面ハ-7.0米迄水中混凝土ヲ以テ設計ニ精築シ又其前面ヲ五分勾配ヲ以テ標高-10.2米ノ計畫面迄(岩盤ヲ)堀下ゲルモノトス、又岩盤低下部ニ於テハ圖示ノ通リ粘土層ヲ標高-12.0米迄掘鑿シ之ニ代フルニ厚サ4.0米ノ捨石(基礎)ヲ施シ其天端ヲ-8.0米、標高ニ對スル以上ニテ甲種繋船壁ヲ築造スルモノトス。

壁体構造及(精)施工法

甲種繋船壁

岸壁ノ躯体ハ長サ50米巾サ4.4米ノ長方形鉄筋混凝土枠ヲ(一ニ噸ヲ)50枠宛ノ1.4米ノ(一ニ)五區ヲ(一ニ噸ヲ)標準トシ其内部ヲ混凝土ヲ以テ充填シ(二ヶ所ニテ計59函)ノ(一ニ)50枠ヲ(一)隔ニ並列築造シ其接合ハ角枠ハ(四隔)両端ニ各20枠ノ實ヲ設ケテ壁ノ前後面ニ於ケル接合面ハ凹凸ヲ10枠ニ亘ル如ク掘仕上ゲ此ヲ適當ナル材料ニテ(目塞ヲ)充填シ枠内部50枠ノ(一)隔ヲ水中混凝土ニテ充填シ躯体ヲ完全ナル一体ニ連結スル躯体構築ノ工情ハ先ヅ現場ノ適當ナル個所ニテ」圖ノ如キ鉄筋混凝土枠ヲ多数製作シ置キ之ヲ現場ニ運搬シ築ノ棟堂上ヲ(移動)シ乍ラ接続ヲシ(一)層ニ木製デリック(揚力50瓲)ヲ(最下層ノ一枠ヲ別紙圖面ニ示ス作業用假鉄塔ヲ兩端ニ)備ヘ所定ノ高サニ吊揚シ基礎岩盤上ニ吊卸シ潜水夫ヲ使役シテ正確ニ据付ケ其上ニ(一)層ノ混凝土枠ヲ上記假鉄塔ヲ(ニ)移動セシメ吊卸シ各枠ヲ互ニ噛合ハス様(鋳)金ノ楔ヲ全面ニ渡シ置キ(ピン)ヲ(一)層ニ四箇所ニ挿入シ水密ナラシムルニハ各枠ノ上部ニ(概)ネ1米ノ高サニ枠ヲ高水位以上ノ高サ(一)層ヲ延長シ潜水夫ヲ使役シ假鉄塔ヲ取外シテ(一)ツヅツヲ順次ニ揚ケヲ他ノモノニ流用ス、斯ヲ枠内ニ(同ジ)高サ1.0米ノ1:3:6水中混凝土底詰ヲ施シ(機械化ポンプ)ヲ以テ内部ノ水ヲ排除シ1:2:4混凝土中詰及ビ頂高1.0米ノ1:3:6上詰

そ(引)ま(下)す

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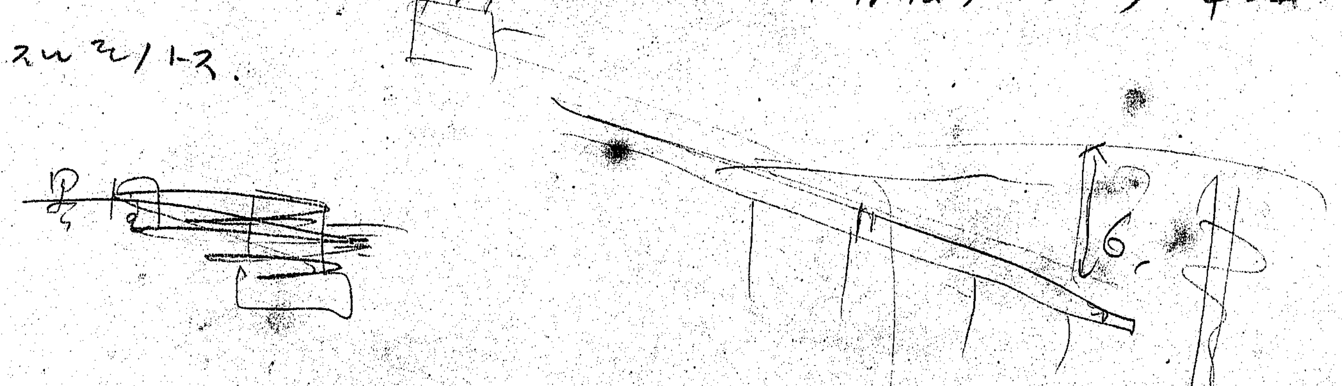
CALCULATIONS FOR 岸壁ノ件

混凝土ヲ施工シ各函ノ間隙部ヲ前記ノ通リ水中混凝土ニテ填充シ全長ニ亘リ
天端並混凝土及前面木造フェンダーヲ築造シテ岸壁ヲ完成ス
此ニ依リ後ニ述ブル乙種繋船壁ニ比シテ作業容易且ツ材料ヲ節約シ得ルヲ以テ経済的ナルノミナラズ又
工期ヲ著シク短縮シ得ラルルヲ以テ止ムヲ得ザル場合ニ乙種繋船壁ヲ用フルノ外総テ甲種繋船壁
ヲ採用スルコトトセリ

乙種繋船壁

岸壁ノ躯体ハ図ニ示ス如キ鉄筋混凝土製浮函ヲ用ヒ其寸法ハ奥行6.0米 長15.0米 高9.4米 側壁厚 下部55糎 上部45糎トシ隔壁厚30糎
ノ隔壁ヲ以テ縦横ニ区劃補強シ 底部ハ厚50糎ノ版トシ 前後ニ各1.0米ヲ突出セシメテ
底面巾ヲ8.0米トシ 之レヲ三分シテ計22個ヲ間隔50糎ニ縦列シ 其接合ハ浮函ノ四隅
ニ各20糎ノ突出部ヲ設ケテ壁ノ前後両面ニ於テ間隙ヲ各10糎ニ短縮シ 据付後此ヲ適当ナル
材料ニテ閉塞シ内部50糎ノ間隙ヲ水中混凝土ニテ填充シ躯体ヲ完全ナル一体ニ
連結スルモノトス 躯体構築ノ工法ハ先ヅ現場ノ適当ナル個所ニ浮函進水台(木造)ヲ
設ケ其上ニ図示ノ如キ鉄筋混凝土浮函ヲ製作シ 完全ニ其硬化セル後必要ニ応ジテ
適当ナル方法ヲ以テ浮函ノ一個宛ヲ進水台上ヨリ滑動進水セシム 斯クシテ進水シタル浮函ハ
上部高約1.1米ヲ水面上ニ突出セシメテ浮游スルヲ以テ之レヲ現場ニ曳航シ
所定ノ位置上部ニ碇着シタル後浮函上部ニ設ケタル6個ノ内径15糎ノ注水孔
ヨリ注水シ之ヲ徐々ニ沈下セシメ潜水夫ヲ使役シテ所定ノ高サニ敷均シタル
捨石面上ニ正確ニ沈下据付ケタルトキ(此据付ニ要スル時間ハ約7分間内外ニテ足ル) 浮函据付後ハ壁ノ上部ニ高1.0米ノ混凝土
仮ブロックヲ積上ゲ高水面以上ニ囲壁ヲ延長シ 浮函ノ前半区劃ニハ1:5:10
水中混凝土ヲ後半区劃ニハ土砂ヲ各高サ2.0米内外填充シタル後函内ノ水ヲ排除シ
前記仝様ノ材料ニテ填充シ 後部50糎ハ1:3:6混凝土ニテ上端ヲ~~仕上~~シ
各函ノ間隙部ヲ前記ノ通リ水中混凝土ニテ填充シ全長ニ亘リ天端並
混凝土及前面木造フェンダーヲ築造シテ岸壁ヲ完成ス

斯クシテ延長630米ニ亘ル全岸壁ヲ完成シタル後其背後ヲ水平ニ埋立テ平坦ナル地面
ヲ構築スルモノトス



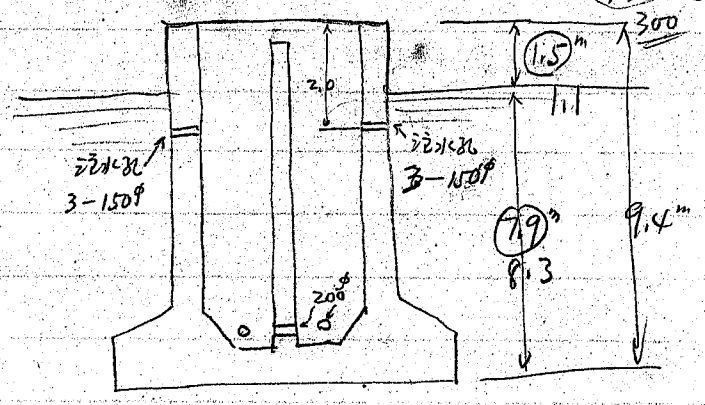
$q = Ca\sqrt{2gh}$ 　　$q = 0.0765 \times 0.70\sqrt{2\times 9.8 h} = 0.055\sqrt{h}$

$a = 0.150^{\phi} = 0.1765\ m^2$
$c \fallingdotseq 0.70$

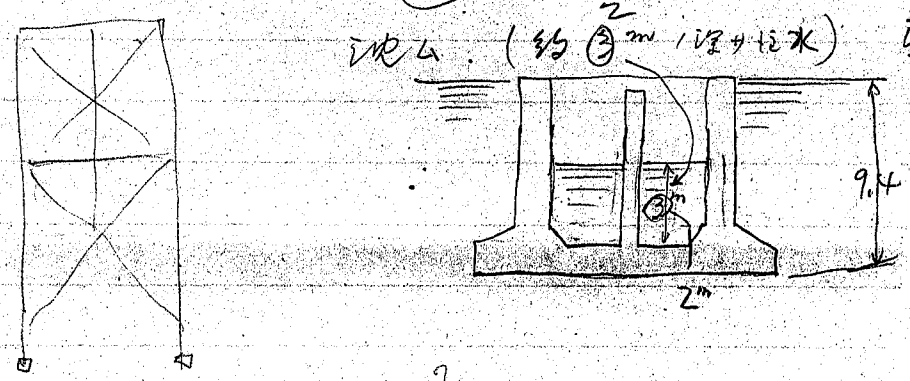
		q	孔数	孔当
空	$h = 0.5^m$	0.039		
	$h = 1.25$	0.062	}	$0.05 \times 6 = 0.30\ m^3/sec$
沈み	$h = 2.00$	0.078	}	$0.07 \times 6 = 0.42$ 〃

150^{m^3} ヲ注入スルニ要スル時 　$75 \div 0.30 = 250$
$75 \div 0.42 = 180$
$430\ sec = 7\ min\ 10\ sec$ 　5 min

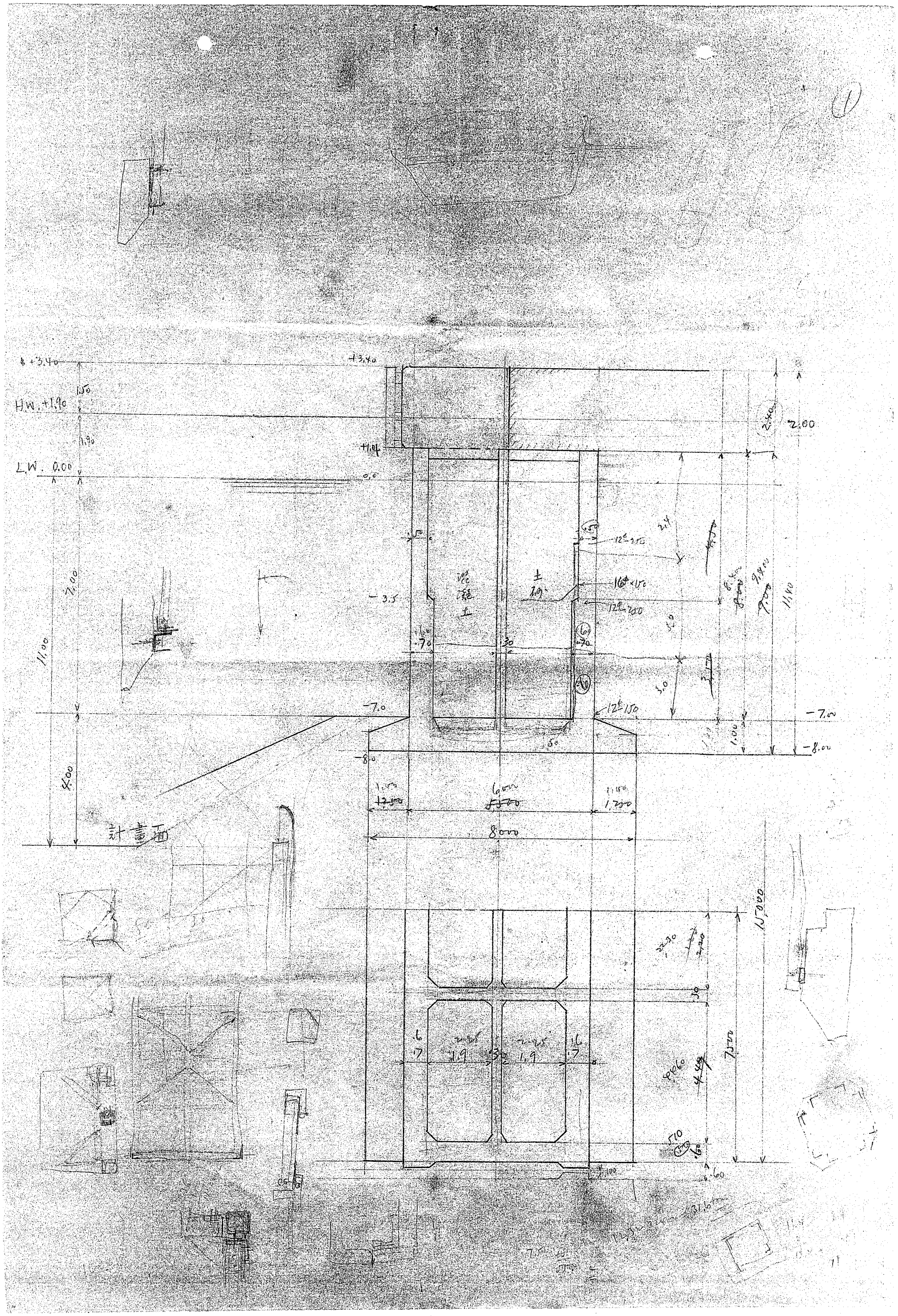
1
許容ノ3倍分間ヲ見ル



100
約 150 立米ノ水ヲ注入スルニ 　7~8分
沈ム.（約 3 m² ノ浮ヲ以テ水）
注水許容ヲ3倍ヲ約8分間内外
計算上ハ 7分10秒.
5分



鋳物一基ノ約ヲ2,200kg — 6基
鉄筋ヲ300kg.


+3.40
H.W. +1.90
1.50
1.90
L.W. 0.00
+1.40
0.0
2.40
2.00
2.40
5.50
12φ-250
16φ×150
12φ-200
1.00
.70
.30
-3.5
-7.0
-8.0
11.00
7.00
4.00
11.40
5.0
3.0
1.00
1.50
6.00
1.50
8.000
計畫面
7.000
2.90
2.20
.50
.60
.60
.60
1.9
1.9
.30
.17
.17
SR60
4.49
5.10

Caisson

Base　8.00 × 1.0 × 15.00 = 120.0 tf

wall 外側 2@ 3.50 × 0.60/0.70 × 15.00 = 735.63

〃　〃　2@ 4.50 × 0.50 × 15.00 = 675

〃　内側 2@ 4.30/4.90 × 0.60/0.50 × 8.00 = 412.32

〃　隔壁 2@ 0.30 × 4.3/4.6 = 7.57 = 181.70

〃　〃　3@ 0.30 × 4.4/4.47 = 7.57 = 287.30.1

350.00　340.5

4.00　4.5

354.00 = 828.00m

357.00 @ 24m = 8520.00 kg　Wc

γc

8.00 × 1.00 × 15 = 120　@1m = 120 m³/kg

6.0

150 × 0.5 = ~~8~~　8.2　@1m = 8.2m 1g/m

90.

8.2m − 120m = 732m / 85.2m = 8.6m

1.0

9.6

828.00m − 120m = 708m / (90m) = 7.88m

1.0

8.88　.γc上 12cm

C.g.

Caisson　828.000 × 0 = 0

Conc. fill　2.3 × 8.10 × 13.4 @ 22m = 542.00 × 1.3 = 705.00m

earth 〃　〃 @ 20m = 499.3m × (1.3) = − 649.1m

Cap conc.　2.4 × 3.2 × 15.0 @ 2m = 57.6m × 1.65 = 368.00m

fill　2.4 × 2.85 × 15.0 @ 16m = 164m × (−1.65) = −270.00m

Wc = 228.00m 1g　0.086"　197.00m

Earth pres. φ = 30°

Surcharge 300 1g/m² = 1.9m / 11.4 / 13.3 m

$E_h = \frac{2000 \times 13.3^2}{6} \times 15 = 885.00$m 1g　$E_v = 885.00 \times 0.364 = 322.00$ 1g

am = 5.00m　am = 4.0m

W_L = 1.0 × 10.4 × N @ 20m = 12,000 1g　am = 4.5m

150 =

300 =

(3)

Stability

W_c		2281.0m	× 0.086 =	197.0m
W_c		31.2m	× (−45.0m) =	−1403m
E_h	885m		× 5m =	4425m
E_v		32.2m	× (−4.0m) =	−128.8m
	$\Sigma H = 885$m	$\Sigma V_1 = 2915$m	0.662m	193.0m ← 浮力無視
浮力		−92.0m		
		1995.0m	0.968m	193.0m ← 浮力考慮

base 820mm

shaft 8.9@90mm = 801mm / 921mm

max, toe presure

浮力無視 $P_1 = \frac{2915\text{m}}{15 \times 8}\left(1 \pm \frac{6 \times 0.662}{8}\right) = 36.4\text{m}$ or 12.3m kg/m²

浮力考慮 $P_2 = \frac{1995\text{m}}{15 \times 8}\left(1 \pm \frac{6 \times 0.968}{8}\right) = 28.7\text{m}$ or 4.55

$\frac{\Sigma H}{\Sigma V_1} = \frac{885\text{m}}{2915\text{m}} = 0.304$ ← 浮力無視

$\frac{\Sigma H}{\Sigma V_2} = \frac{885\text{m}}{1995\text{m}} = 0.444$ ← 浮力考慮

Side wall,

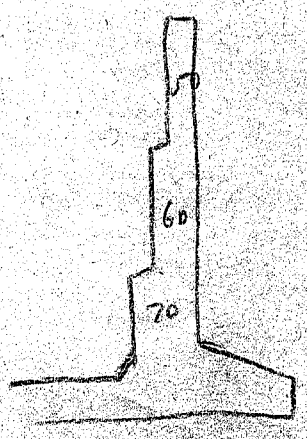
water pres. $8 \times 1\text{m} = 8\text{m}$ kg/m²

$h = 8.9\text{m}$ $M = \frac{1}{10/12} \times 8\text{m} \times 4.9\text{m}^2 = \frac{16\text{m}}{19.2\text{m}}$ tgm

$d = \sqrt{\frac{19.2\text{m}}{7.13}} = 47.4$ cm

use $d = 65$ cm ins. 5cm $h = 70$ cm

$A_s = \frac{16\text{m}}{100 \times 7/8 \times 65} = 18.8$ cm² 16φ−100 ctge = 20.1 cm²



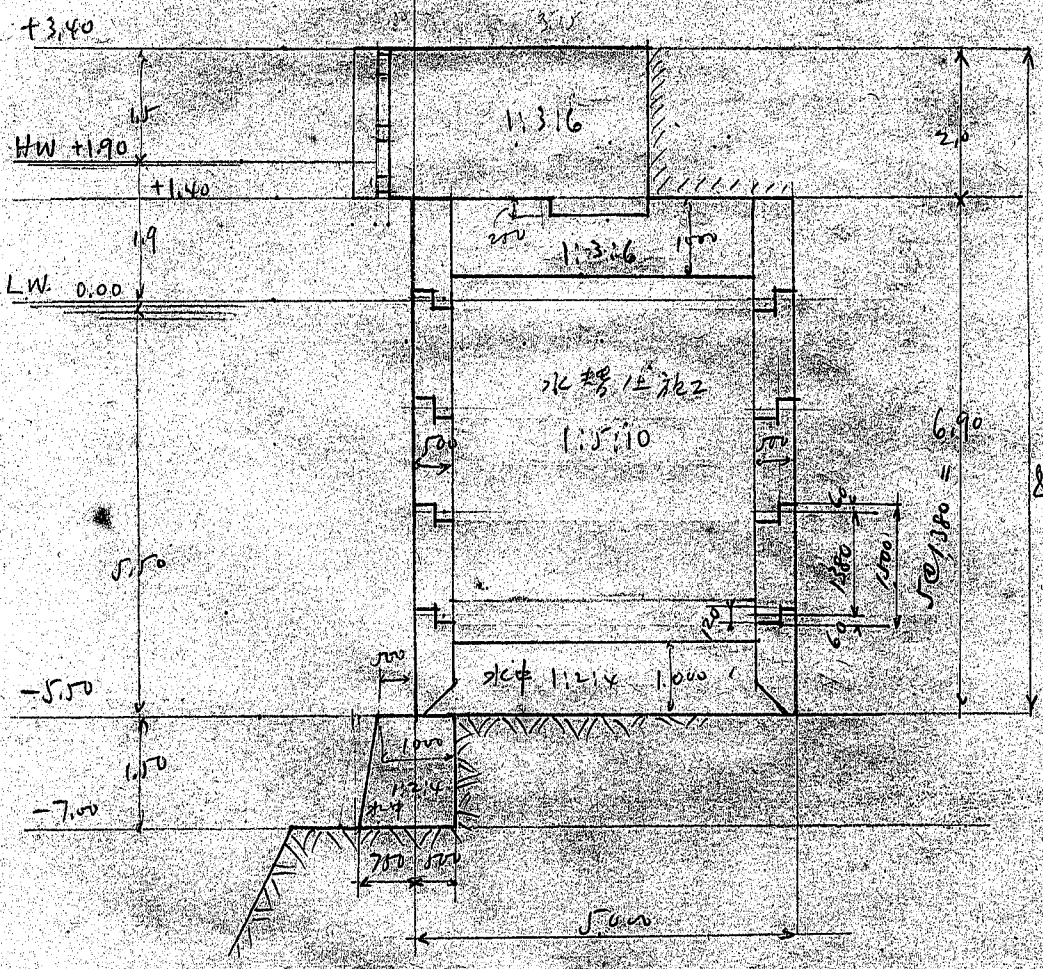
9@44 = 39.6m

φ@48 = 48m

φ@44 = 220mm

φ@48 = 230mm

(4)



150
35
185 138

5×5 = 25.0
4×4 = 16.0
9.0 @2mm = 21600
1.38@22mm = 30,400

wt.

5.0 × 5.0 × 6.9 = = 172.5
− 4.4 × 4.4 × 6.9 = −110.5

Shell 62.0 @ 2400 = 148,700 × 0 = 0
fill 110.5 @ 2200 = 243,000 × 0 = 0
76,000 × 1.075 = 817,000
296,000 −1575 = −466,000
cap. 3.45 × 2.0 × 5.0 = 34.5 @ 2mm =
上. 1.85 × 2.0 × 5.0 = 18.5 @ 16mm =
763,700 kg 0.046 35.1m
497,000

土圧

4.9 @ 2mm/3 = 1270
8.9
10.8 @ 2mm/3 = 7mm
8470 × 4.35 × 8.9 = 377000 × 5 = 188,500 kg E_h 3.41
E_V = 188m @ .36 = 68,400 kg

18.4/22 5-9

13.5

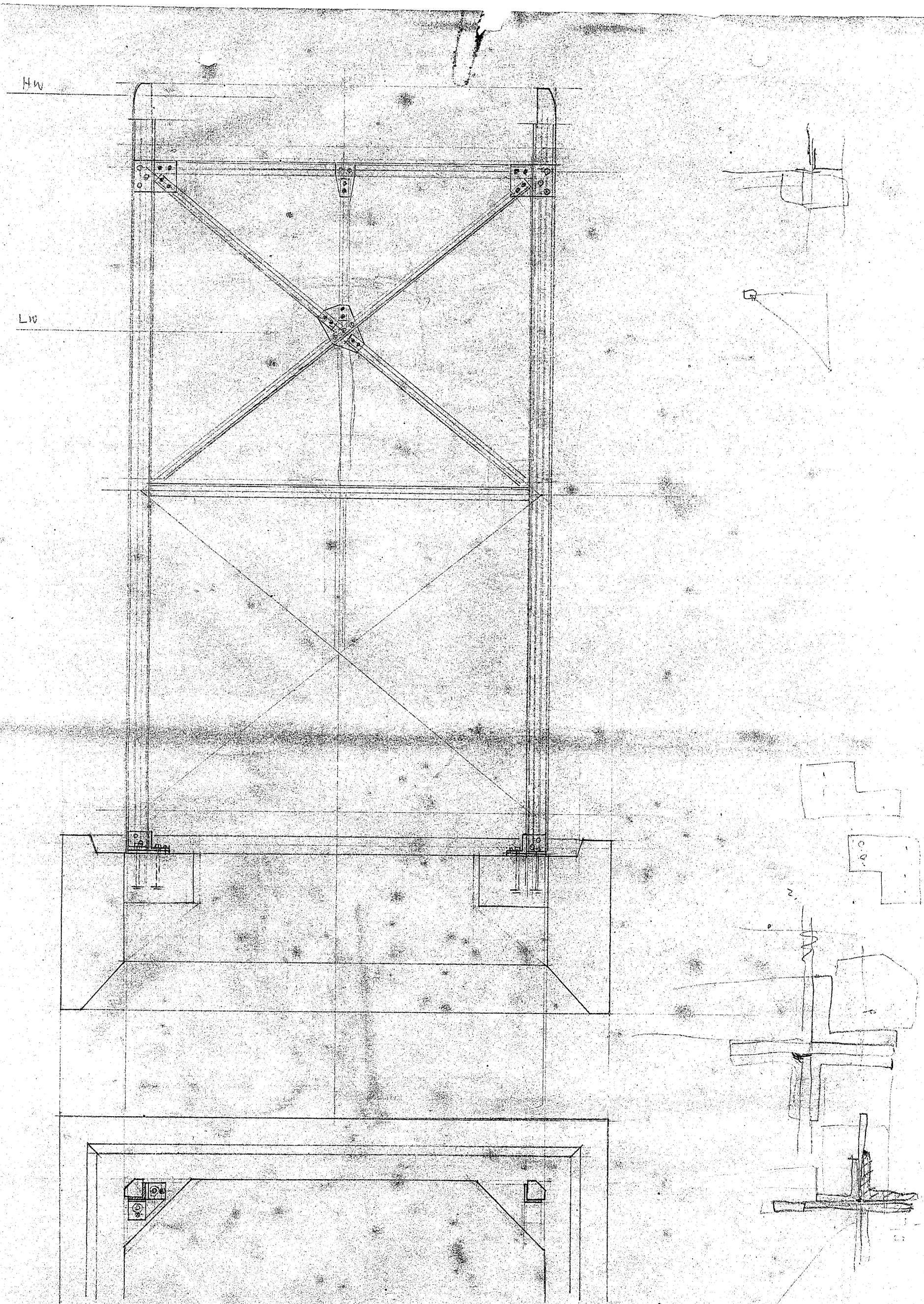
Stability

W_c		763700	× 0.046	= 35100
E_h	188m		× 3.41	= 642m
E_V		684m	× (-2.00)	= -171m
	ΣH = 188.0m	ΣV = 832.0m	0.608	506.0m
浮力	55.5×55.5@1m	-137.5m		0
		694.6m	0.729	506.0m

max. two pres.

浮力なし $P_1 = \frac{832.0}{5.5 \times 5.5}\left(1 \pm \frac{6 \times 1.608}{5.5}\right) = 57600$ or 9000 kg/m²

浮力あり $P_2 = \frac{694.6m}{5.5 \times 5.5}\left(1 \pm \frac{6 \times 1.729}{5.5}\right) = 52100$ or 3480



増田淳氏関係資料
（独立行政法人 土木研究所蔵）