増田橋梁建築設計事務所
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設計	日付	類別
照査	日付	第　頁

上海高速鐵道 鐵筋混凝土 暗渠應力計算書

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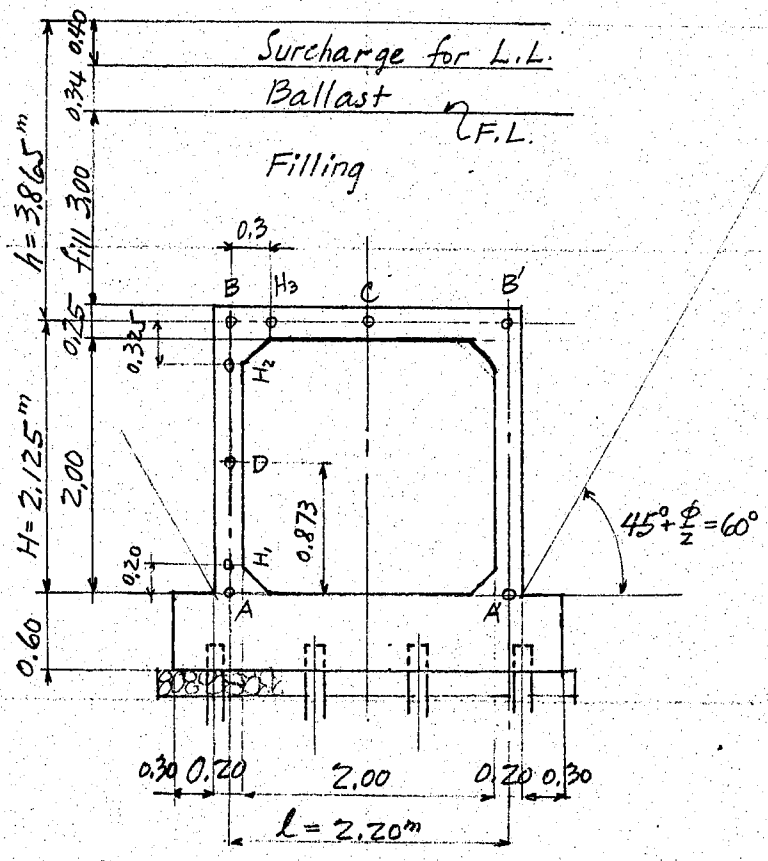
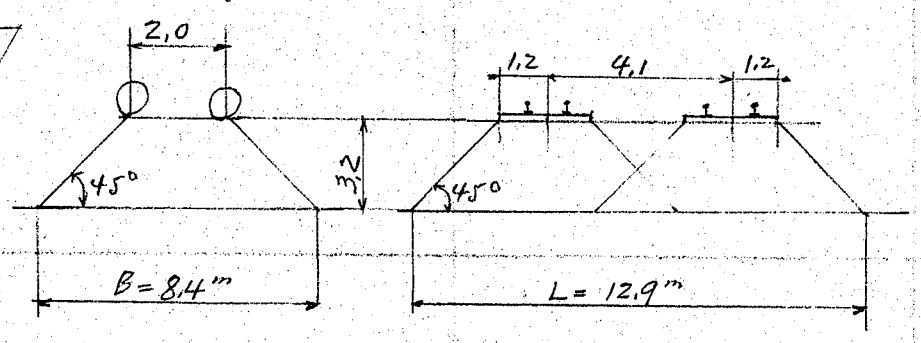
設計 稲葉 日付 16-10-3 類別 CVA3
照査 日付 第 1 頁

上海高速鉄道標準型暗渠 2×2m

土被 3.0m 標準型暗渠 2m×2m --- CVA3



Surcharge for live load



活荷重

4 @ 16500 = 66000 kg

分布荷重

$$p = \frac{66000}{8.4 \times 12.9} = 610 \text{ kg/m}^2$$

土ノ高サ=損害セル深サ

$$\frac{610}{1600} = 0.38\text{m} \text{ 之ヲ } 0.4\text{m トス}$$

ヒ"ール バウメル 氏 公式ヨリ依ル 暗渠天井ノ荷重.

$$p' = wh\left(1 - \frac{hK}{1+2HC}\right)$$

土ノ息角 $\phi = 30°$

$$C = \tan\left(45° - \frac{\phi}{2}\right) = \tan 30° = 0.58$$

$$K = \tan\phi C^2 = \tan^3 30° = 0.19$$

$$= 1600 \times 3.865\left(1 - \frac{3.865 \times 0.19}{1+2\times 2.125\times 0.58}\right) \quad (0.212)$$

$$= 4870 \text{ kg/m}^2$$

天井 0.28 @ 2400 = 670 kg/m²

$$P = 4870 + 670 = 5540 \text{ kg/m}^2$$

側壁土圧.

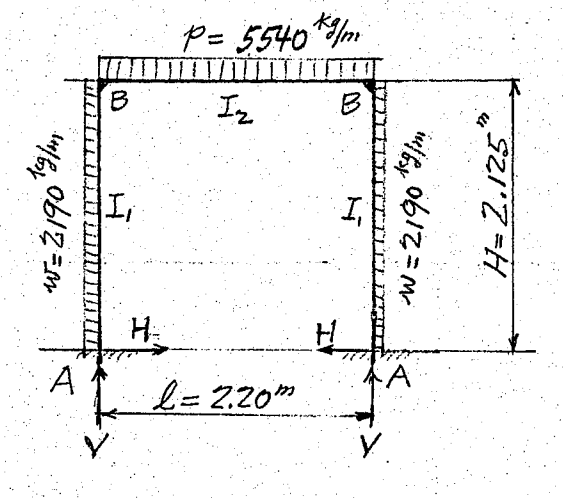
B点ニ於ケル土圧 $\frac{1}{3} \times 4870 = 1625$ kg/m²

$\frac{1}{3} \times 1600 \times 2.125 = 1130$

A点ニ於ケル土圧 2755 kg/m²

側壁平均土圧 $w = \frac{1625+2755}{2} = 2190$ kg/m²

荷重狀態



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設計 稲葉 日付 16-10-3 類別 CVA3
照査 日付 第 乙 頁

上海路渠 2×2m

部材ノ物理力学 並ニ諸係数.

側壁 $I_1 = \frac{1.0\times 0.2^3}{12} = 0.000667$, $K_1 = \frac{I_1}{H} = \frac{0.000667}{2.125} = 0.000314$

天井 $I_2 = \frac{1.0\times 0.25^3}{12} = 0.001302$, $K_2 = \frac{I_2}{l} = \frac{0.001302}{2.200} = 0.000592$

$2K_1 + K_2 = 0.001220$
$3K_1 + K_2 = 0.001534$
$5K_1 + 2K_2 = 0.002754$

天井荷重 p ノ ミ=依ル応力.

$M_A = \frac{pl^2 K_1}{12(2K_1+K_2)} = \frac{5540\times 2.20^2\times 0.000314}{12\times 0.001220} = 575$ kgm

$M_B = -2M_A = -1,150$ 〃

$H = \frac{M_A - M_B}{H} = \frac{575+1150}{2.125} = 812$ kg ⌐¬←

$V = \frac{pl}{2} = \frac{5540\times 2.20}{2} = 6094$ 〃 ↑↑

側壁 荷重 w ノ ミ=依ル応力.

$M_A = -\frac{wH^2(3K_1+K_2)}{12(2K_1+K_2)} = -\frac{2190\times 2.125^2\times 0.001534}{12\times 0.001220} = -1035$ kgm

$M_B = -\frac{wH^2K_2}{12(2K_1+K_2)} = -\frac{2190\times 2.125^2\times 0.000592}{12\times 0.001220} = -400$ 〃

$H = -\frac{wH(5K_1+2K_2)}{4(2K_1+K_2)} = -\frac{2190\times 2.125\times 0.002754}{4\times 0.001220} = -2625$ kg →

$V = 0$

合成應力

	荷重 P	荷重 w	合成応力	
M_A	575	−1,035	−460	kgm
M_B	−1150	−400	−1,550	〃
H	812	−2625	−1,813	kg ← →
V	6,094	0	6,094	〃 ↑ ↑

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設計 稽 日付 16-10-3 類別 CVA3
照査 日付 第 3 頁

上海婿渠 2×2m

剪力.

$S_A = -H = 1813\ kg$

$S_{H_1} = 1813 - 2190 \times 0.2 = 1375$ "

D. $x = \frac{1813}{2190} = 0.828$ m above A.

$S_D = 0$

$S_{H_2} = 1813 - 2190 \times 1.80 = -2130$ kg

側壁 $S_{B_1} = 1813 - 2190 \times 2.125 = -2840$ " $N_2 = 2840$ kg

天井 $S_{B_2} = \frac{5540 \times 2.20}{2} = 6094$ " $N_1 = 6094$ kg

$S_{H_3} = 6094 - 5540 \times 0.3 = 4432$ "

$S_C = 0$

中間点ノ彎曲率

M_{H_1}

$1813 \times 0.20 = 363$
$-\frac{1}{2} \times 2190 \times 0.20^2 = -44$
$M_A = -460$
$M_{H_1} = -141$ kgm $N = 6094$ kg

M_D

$1813 \times 0.873 = 1582$
$-\frac{1}{2} \times 2190 \times 0.873^2 = -834$
$M_A = -460$
$M_D = 288$ kgm $N = 6094$ kg

M_{H_2}

$1813 \times 1.80 = 3265$
$-\frac{1}{2} \times 2190 \times 1.80^2 = -3548$
$M_A = -460$
$M_{H_2} = -743$ kgm $N = 6094$ kg

M_{H_3}

$6094 \times 0.30 = 1828$
$-\frac{1}{2} \times 4870 \times 0.30^2 = -219$
$M_B = -1550$
$M_{H_3} = 59$ kgm $N = 2840$ kg

M_C

$\frac{1}{8} \times 5540 \times 2.20^2 = 3350$
$M_B = -1550$
$M_C = 1,800$ kgm $N = 2840$ kg

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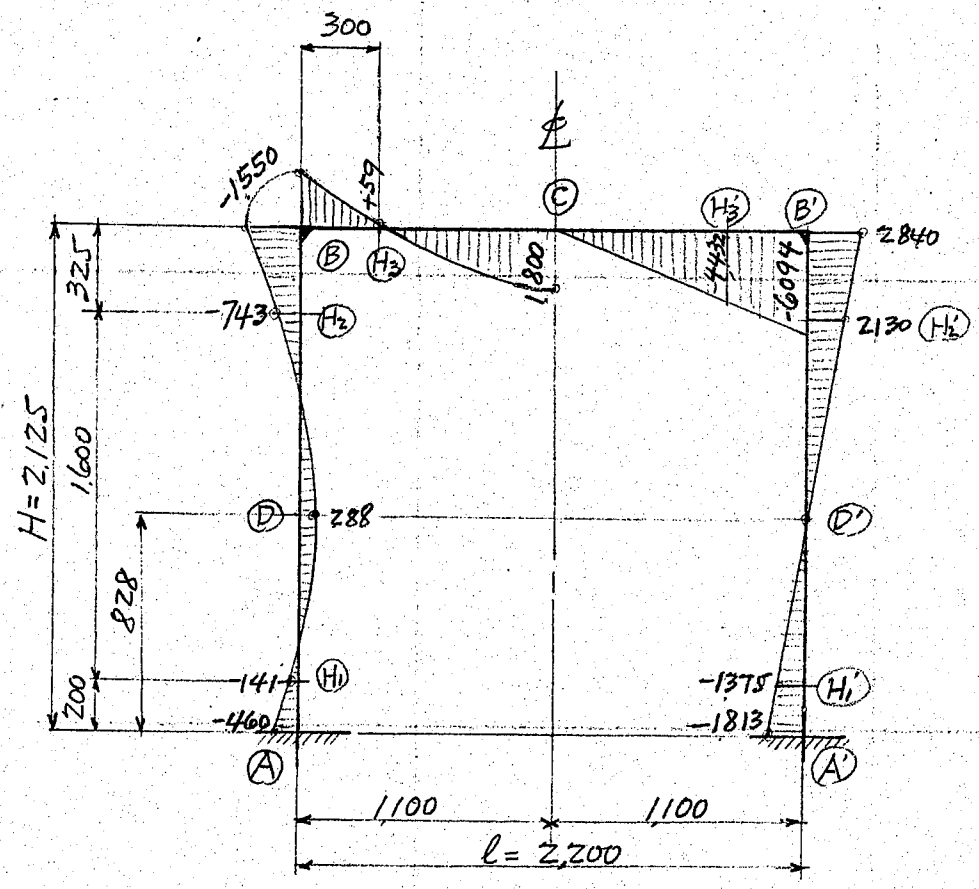
設計 稲葉 日付 16-10-4 類別 CVA3
照査 日付 第 4 頁

上海暗渠 2m×2m

彎曲率及剪力圖



彎曲率圖　剪力圖

尺度 彎曲率 $\frac{1}{200}^m$ = 1000 kgm
剪力 $\frac{1}{400}^m$ = 1000 kg
縮尺 1:30

断面應力ノ計算

天井

Ⓒ　M_c = 1,800 kgm　N = 2,840 kg　S = 0

$d/h = \frac{22}{25} = 0.880$
$d'/h = \frac{3}{25} = 0.120$
$p_0 = \frac{A_s}{bh} = 7.54/100\times25 = 0.00302$
$p_0' = \frac{A_s'}{bh} = 2.51/\,\,\,\, = 0.00100$
$u/h = 0.510$
$u = 12.8$ cm
$d-u = 9.2$ cm

$\frac{M}{N} = \frac{1800\times100}{2840} = 65.7$
$d-u = 9.2$
$e = 74.9$ cm
$e' = e-19 = 55.9$
$e'/e = 0.747$
$\frac{Ne}{bd^2} = \frac{2840\times74.9}{100\times22^2} = 4.390$
$\frac{Ne}{bd^2\sigma_c} = 0.146$　$k = 0.305$
$\sigma_c = \frac{4.390}{0.146} = 30.1$ kg/cm²
$\sigma_s = 15\times30.1\times\frac{0.695}{0.305} = 1028$ kg/cm²
$\tau = 0$

$b=100^{cm}$, $h=25^{cm}$
$d=22^{cm}$, $d'=3^{cm}$
$A_s = 6.67-12\phi = 7.54$ cm² (15 c to c)
$A_s' = 2.22-12\phi = 2.51$ (45 c to c)
$p = \frac{A_s}{bd} = \frac{7.54}{100\times22} = 0.00343$
$p' = \frac{A_s'}{bd} = \frac{2.51}{100\times22} = 0.00114$
$d'/d = \frac{3}{22} = 0.136$

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設計 稲葉 日付 16-10-4 類別 CVA3
照査 日付 第 5 頁

上海暗渠 2m×2m

(H3) $M_{H3} = 59$ kgm $N = 2840$ kg $S = 4432$ kg

$$\tau = \frac{4432}{100 \times \frac{7}{8} \times 32} = 2.3 \text{ kg/cm}^2$$

(B) $M_B = -1550$ kgm , $N = 2840$ kg , $S = 6094$ kg

$d/h = 32/35 = 0.914$
$d'/h = 3/35 = 0.086$
$p_0 = 7.54/35 \times 100 = 0.00215$
$p_0' = 2.51/$ 〃 $= 0.00072$
$u/h = 0.506$
$u = 17.7$ cm
$d-u = 14.3$ 〃

$\frac{M}{N} = \frac{1550 \times 100}{2840} = 54.6$
$d-u = 14.3$
$e = 68.9$ cm
$e' = e - 29 = 39.9$
$e'/e = 0.580$

$\frac{Ne}{bd^2} = \frac{2840 \times 68.9}{100 \times 32^2} = 1.91$

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

$\sigma_c = \frac{1.91}{0.140} = 13.7$ kg/cm²

$\sigma_s = 15 \times 13.7 \times \frac{0.710}{0.290} = 503$ 〃

$\tau = \frac{6094}{100 \times 0.903 \times 32} = 2.1$ 〃

$b=100$, $h = 25 + \frac{30}{3} = 35$ cm
$d = 32$, $d' = 3$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.22 - 12\phi = 2.51$
$p = 7.54/100 \times 32 = 0.00236$
$p' = 2.51/$ 〃 $= 0.00079$
$d'/d = 3/32 = 0.094$

側壁

(D) $M_D = 288$ kgm , $N = 6094$ kg , $S = 0$

$d/h = 17/20 = 0.850$
$d'/h = 3/20 = 0.150$
$p_0 = 7.54/100 \times 20 = 0.00377$
$p_0' = 2.51/$ 〃 $= 0.00126$
$u/h = 0.512$
$u = 10.2$ cm
$d-u = 6.8$ 〃

$\frac{M}{N} = \frac{288 \times 100}{6094} = 4.7$
$d-u = 6.8$
$e = 11.5$ cm
$e' = e - 14 = -2.5$ 〃
$e'/e = -0.22$

$\frac{Ne}{bd^2} = \frac{6094 \times 11.5}{100 \times 17^2} = 2.425$

$\frac{Ne}{bd^2\sigma_c} = 0.345$ $k = 0.98$

$\sigma_c = \frac{2.425}{0.345} = 7.0$ kg/cm²

$\sigma_s = 15 \times 7.0 \times \frac{0.02}{0.98} = 2$ 〃

$\tau = 0$

$b=100$, $h = 20$
$d = 17$ $d' = 3$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.22 - 12\phi = 2.51$
$p = 7.54/100 \times 17 = 0.00444$
$p' = 2.51/$ 〃 $= 0.00147$
$d'/d = 3/17 = 0.177$

(H2) $M_{H2} = -743$ kgm $N = 6094$ kg $S = -2130$ kg

$\frac{M}{N} = \frac{743 \times 100}{6094} = 12.2$ cm
$d-u = 6.8$
$e = 19.0$ cm
$e' = e - 14 = 5.0$ 〃
$e'/e = 0.263$

断面ハ Ⓓ ニ等シ

$$\frac{Ne}{bd^2} = \frac{6094 \times 19.0}{100 \times 17^2} = 4.01$$

$$\frac{Ne}{bd\sigma_c} = 0.221 \qquad k = 0.50$$

$$\sigma_c = \frac{4.01}{0.221} = 18.1 \text{ kg/cm}^2$$

$$\sigma_s = 15 \times 18.1 \times \frac{0.50}{0.50} = 271 \text{ "}$$

$$\tau = \frac{2130}{100 \times 0.833 \times 17} = 1.5 \text{ "}$$

基礎底面圧力

垂直荷重	V =	Σ@6094 =	12,188
側壁	2@0.2×2.0 @2400 =		1,920
基礎	3.0×0.6 @2200 =		3960
			18068 kg

} 14108

$$\frac{18068 \text{ kg}}{3.0} = 6020 \text{ kg/m}^2$$

杭間隔 1.00 m c to c 一列 4本宛.

$$\text{杭一本当荷重} = \frac{18068}{4} = 4517 \text{ kg}$$

杭 1509 × 3,500 Spacing 800 c to c crosswise
1000 " longitudinal.

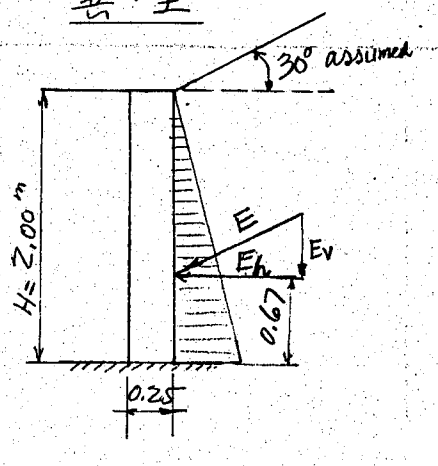
上向圧力 14108 ÷ 3.0 = 4,700 kg/m²

$$M = \frac{1}{12} \cdot 4700 \times 2.20^2 = 1890 \text{ kgm}$$

$$A_s = \frac{1890 \times 100}{1200 \times 7/8 \times 55} = 3.27 \text{ cm}^2$$

12φ − 30 cm c to c = 3.77 cm².
又は 16φ − 45 " = 4.47 "

翼壁



土圧 Cos 30° = 0.866

$$E = \frac{1}{2} \times 1600 \times 2.0^2 \times 0.866 = 2770 \text{ kg} \qquad E_h = 2770 \times 0.866 = 2400 \text{ kg}$$
$$E_v = 2770 \times 0.500 = 1385 \text{ "}$$

2400 × 0.67 = 1605
− 1385 × 0.125 = − 175
M = 1430 kgm

$$d = \sqrt{\frac{1430 \times 100}{100 \times 7.13}} = 14.2 \text{ cm} \qquad d = 22 \text{ cm} \text{ 被覆 } 3 \text{ cm} \text{ 計 } h = 25 \text{ cm}$$

$$A_s = \frac{1430 \times 100}{1200 \times 7/8 \times 22} = 6.20 \text{ cm}^2$$

12φ − 15 cm c to c = 7.54 cm² (H=1.55 m = テ 30 cm c to c. ニス)

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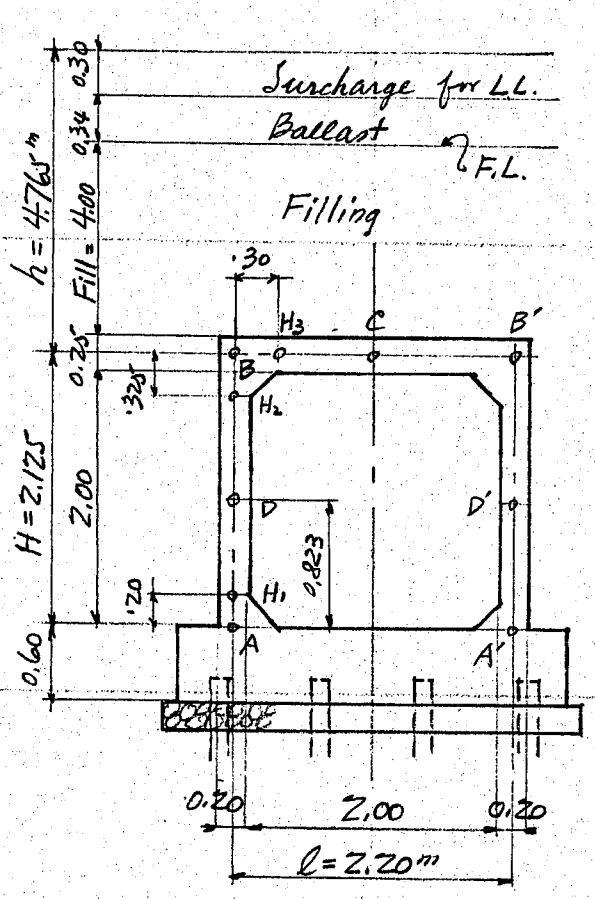
設計 [illegible] 日付 16-10-6 類別 CVA4
照査 日付 第 7 頁

上海高速鉄道標準型暗渠 2×2m

土被 4.0m 標準型暗渠 2×2m --- CVA4



活荷重

4@16500 = 66000 kg

分布荷重

分布長 $L = 4.1 + 2.4 + 4.2 \times 2 = 14.9^m$

分布巾 $B = 2.0 + 4.2 \times 2 = 10.4$

$$P_ℓ = \frac{66000}{14.9 \times 10.4} = 425 \ kg/m^2$$

土ノ高サ＝換算セル深サ

$$\frac{425}{1600} = 0.265^m$$ 之レヲ 0.3m トス

$$P' = wh\left(1 - \frac{hk}{1+2HC}\right) \qquad C=0.58 \quad k=0.19 \quad (第1頁参照)$$

$$= 1600 \times 4.765 \left(1 - \frac{4765 \times 0.19}{1+2 \times 2.125 \times 0.58}\right)$$

$$= 5630$$

天井 0.28@2400 = 670

天井総荷重 $P = 5630 + 670 = 6300 \ kg/m^2$

側壁土圧

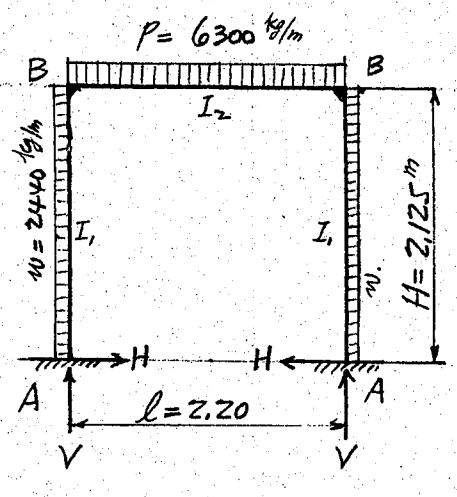
B点ニ於ケル土圧 $\frac{1}{3} \times 5630 = 1875$

A点 〃 〃 $\frac{1}{3} \times 1600 \times 2.125 = 1130$

$= 3005 \ kg/m^2$

側壁平均土圧 $w = \frac{1875 + 3005}{2} = 2440 \ kg/m^2$

荷重状態



各部材ノ寸法ハ CVA3 = 同ジ

$k_1 = 0.000314$ (第2頁参照)

$k_2 = 0.000592$

$2k_1 + k_2 = 0.001220$

$3k_1 + k_2 = 0.001534$

$5k_1 + 2k_2 = 0.002754$

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設計 稲葉 日付 16-10-6 類別 CVA4
照査 日付 第 8 頁

上海暗渠 2×2m

天井荷重 P ノミ ヨル応力

$$M_A = \frac{Pl^2 k_1}{12(2k_1+k_2)} = \frac{6300 \times 2.20^2 \times 0.000314}{12 \times 0.001220} = 655 \text{ kgm}$$

$$M_B = -2M_A = -1310 \text{ "}$$

$$H = \frac{M_A - M_B}{H} = \frac{655+1310}{2.125} = 925 \text{ kg} \quad \rightarrow\sqcap\leftarrow$$

$$V = \frac{Pl}{2} = \frac{6300 \times 2.20}{2} = 6930 \text{ kg} \quad \uparrow\sqcap\uparrow$$

側壁荷重 w ノミ ヨル応力

$$M_A = -\frac{wH^2(3k_1+k_2)}{12(2k_1+k_2)} = -\frac{2440 \times 2.125^2 \times 0.001534}{12 \times 0.001220} = -1155 \text{ kgm}$$

$$M_B = -\frac{wH^2 k_2}{12(2k_1+k_2)} = -\frac{2440 \times 2.125^2 \times 0.000592}{12 \times 0.001220} = -445 \text{ "}$$

$$H = -\frac{wH(5k_1+2k_2)}{4(2k_1+k_2)} = -\frac{2440 \times 2.125 \times 0.002754}{4 \times 0.001220} = -2930 \text{ kg} \quad \sqcap\rightarrow$$

$$V = 0$$

合成應力

	荷重 P	荷重 w	合成応力	
M_A	655	−1155	−500	kgm
M_B	−1310	−445	−1755	"
H	925	−2930	−2005	kg ←→
V	6930	0	6930	" ↑↑

剪力.

$$S_A = -H = 2005 \text{ kg}$$

$$S_{H1} = 2005 - 2440 \times 0.20 = 1517 \text{ "}$$

$$D \quad x = \frac{2005}{2440} = 0.823 \text{ m above A} \quad S_D = 0$$

$$S_{H2} = 2005 - 2440 \times 1.8 = -2385 \text{ kg}$$

側壁 $S_{B1} = 2005 - 2440 \times 2.125 = -3180$ " $N_2 = 3180$ kg

天井 $S_{B2} = \frac{6300 \times 2.20}{2} = 6930$ kg $N_1 = 6930$ "

$$S_{H3} = 6930 - 6300 \times 0.3 = 5040 \text{ "}$$

$$S_C = 0$$

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設計 稲葉 日付 16-10-6 類別 CVA4

照査 日付 第 9 頁

上海精渠 Z×Z^m

中間点ノ弯曲率

M_{H1}

$2,005 \times 0.20 = 400$

$-\frac{1}{2} \times 2440 \times 0.20^2 = -50$

$M_A = -500$

$M_{H1} = -150$ kgm　　$N = 6930$ kg

M_D

$2005 \times 0.823 = 1650$

$-\frac{1}{2} \times 2440 \times 0.823^2 = -825$

$M_A = -500$

$M_D = 325$ kgm　　$N = 6930$ kg

M_{H2}

$2005 \times 1.80 = 3610$

$-\frac{1}{2} \times 2440 \times 1.80^2 = -3950$

$M_A = -500$

$M_{H2} = -840$ kgm　　$N = 6930$ kg

M_{H3}.

$6930 \times 0.30 = 2080$

$-\frac{1}{2} \times 6300 \times 0.30^2 = -285$

$M_B = -1755$

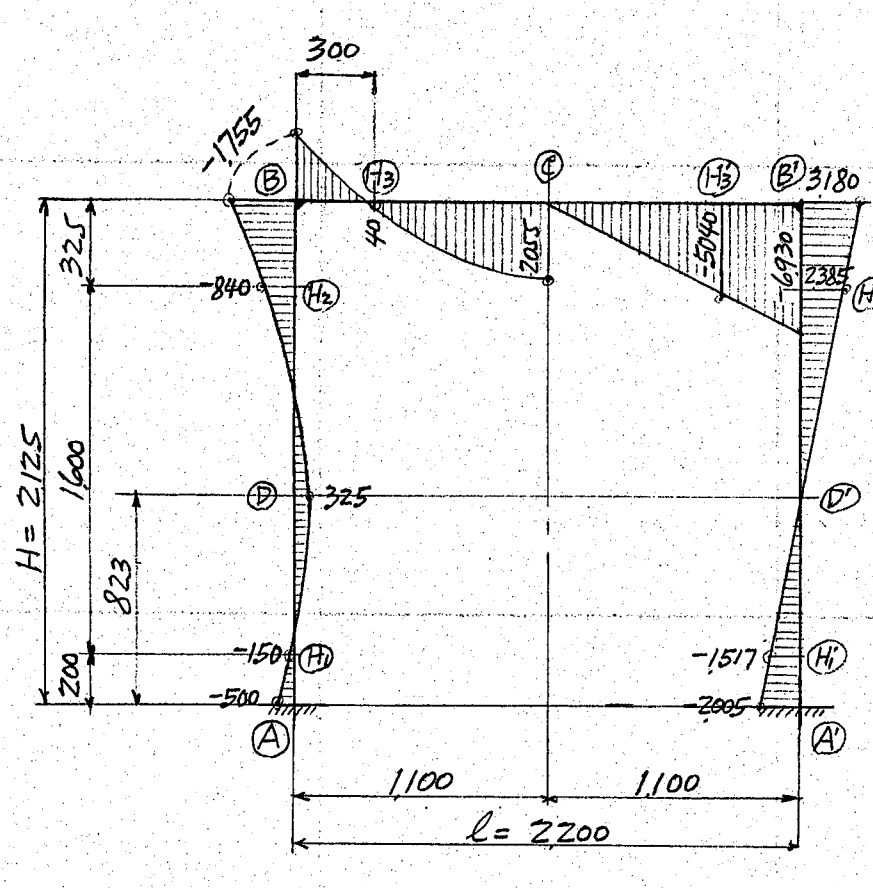
$M_{H3} = 40$ kgm　　$N = 3180$ kg

M_C

$\frac{1}{8} \times 6300 \times 2.20^2 = 3810$

$M_B = -1755$

$M_C = 2055$ kgm　　$N = 3180$ kg



尺度　弯曲率 $\frac{1}{200}$" = 1,000 kgm

剪力 $\frac{1}{400}$" = 1,000 kg

縮尺　1:30

弯曲率図　剪力図

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設計 稲葉 日付 16-10-6 類別 CVA4
照査 日付 第 10 頁

上海晴渠 2m×2m

断面応力計算

天井

Ⓒ $M_C = 2055$ kgm, $N = 3180$ kg, $S = 0$

$\frac{M}{N} = \frac{2055 \times 100}{3180} = 64.6$

$d - u = 9.2$

$e = 73.8$ cm

$e' = e - 19 = 54.8$ 〃

$e'/e = 0.743$

$\frac{Ne}{bd^2} = \frac{3180 \times 73.8}{100 \times 22^2} = 4.850$

$\frac{Ne}{bd^2\sigma_c} = 0.146$ $k = 0.305$

$\sigma_c = \frac{4.850}{0.146} = 33.2$ kg/cm²

$\sigma_s = 15 \times 33.2 \times \frac{0.695}{0.305} = 1135$ 〃

$\tau = 0$

断面ハ CVA3 ニ含ム
(第4頁参照)

Ⓗ3 $M_{H3} = 40$ kgm, $N = 3180$, $S = 5040$ kg

$\tau = \frac{5040}{100 \times 7/8 \times 22} = 2.6$ kg/cm²

Ⓑ $M_B = -1755$ kgm $N = 3180$ kg $S = 6930$ kg

$\frac{M}{N} = \frac{1755 \times 100}{3180} = 55.2$

$d - u = 14.3$

$e = 69.5$ cm

$e' = e - 29 = 40.5$ 〃

$e'/e = 0.584$

$\frac{Ne}{bd^2} = \frac{3180 \times 69.5}{100 \times 32^2} = 2.158$

$\frac{Ne}{bd^2\sigma_c} = 0.137$ $k = 0.285$

$\sigma_c = \frac{2.158}{0.137} = 15.8$ kg/cm²

$\sigma_s = 15 \times 15.8 \times \frac{0.715}{0.285} = 595$ 〃

$\tau = \frac{6930}{100 \times 0.905 \times 32} = 2.4$ 〃

断面ハ CVA3 ニ含ム
(第5頁参照)

側壁

Ⓓ $M_D = 325$ kgm $N = 6930$ kg $S = 0$

$\frac{M}{N} = \frac{325 \times 100}{6930} = 4.7$

$d - u = 6.8$

$e = 11.5$ cm

$e' = e - 14 = -2.5$ 〃

$e'/e = -0.22$

$\frac{Ne}{bd^2} = \frac{6930 \times 11.5}{100 \times 17^2} = 2.76$

断面ハ CVA3 ニ含ム
(第5頁参照)

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設計 稲葉 日付 16-10-6 類別 CVA4
照査 日付 第 11 頁

上海婿渠 2m×2m

$\frac{Ne}{bd^2\sigma_c} = 0.345$ ∴ $k = 0.98$

$\sigma_c = \frac{2.76}{0.345} = 8.0$ kg/cm²

$\sigma_s = 15 \times 8.0 \times \frac{0.02}{0.98} = 2.5$ 〃

$\tau = 0$

(H2) $M_{H2} = -840$ kgm $N = 6930$ kg, $S = -2385$ kg

$\frac{M}{N} = \frac{840 \times 100}{6930} = 12.1$ 断面 ⓓ = 全し

$d - u = \frac{6.8}{18.9}$ cm

$e =$

$e' = e - 1.4 = 4.9$ 〃

$e'/e = 0.263$

$\frac{Ne}{bd^2} = \frac{6930 \times 18.9}{100 \times 17^2} = 4.53$

$\frac{Ne}{bd^2\sigma_c} = 0.221$ $k = 0.50$

$\sigma_c = \frac{4.53}{0.221} = 20.5$ kg/cm²

$\sigma_s = 15 \times 20.5 \times \frac{0.50}{0.50} = 308$ 〃

$\tau = \frac{2385}{100 \times 0.833 \times 17} = 1.7$ 〃

底面圧力

室内荷重	$V =$	2 @ 6930	= 13860	} 15780
側壁	2@2.10×0.2	@ 2400	= 1920	
基礎	3.0 × 0.6	@ 2200	= 3960	
			19740 kg	= 6580 kg/m²
			3.0	

杭1間隔 一列4本 1,000 ctoc.

杭一本当荷重 $= \frac{19740}{4} = 4935$ kg

杭 150φ × 3500 Spacing Cross wise 800 ctoc
Length wise 1000 〃

上向圧力 15780 ÷ 3.0 = 5260 kg/m²

$M = \frac{1}{12} \times 5260 \times 2.20^2 = 2120$ kgm

$A_s = \frac{2120 \times 100}{1200 \times 7/8 \times 55} = 3.67$ cm²

12φ — 30cm ctoc = 3.77 cm².

又は 16φ — 45 〃 〃 = 4.47 〃

翼壁ハ 第6頁参照

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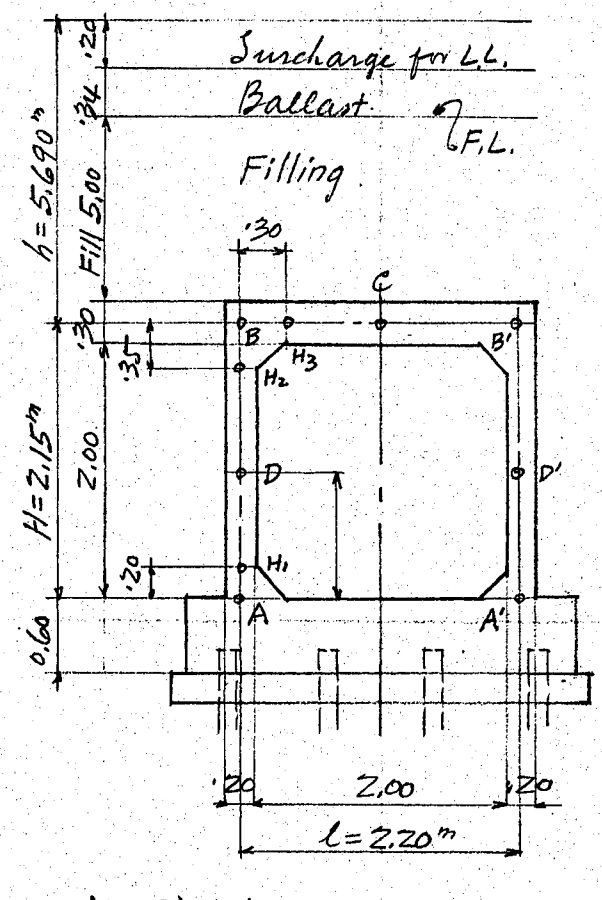
設計 稲葉 日付 16-10-6 類別 CVA5
照査 日付 第 1乙 頁

上海高速鉄道標準暗渠 2m×2m

土被 5.0m 標準型暗渠 2m×2m --- CVA5



活荷重

4@16500 = 66,000 kg

分布荷重

分布長 $L = 4.1 + 2.4 + 5.2\times2 = 16.9^m$

分布巾 $B = 2.0 + 5.2\times2 = 12.4^m$

$$P = \frac{66000}{16.9\times12.4} = 315\ kg/m^2$$

換算土深 $= \frac{315}{1600} = 0.197^m$ ニヨリ 0.20^m トス

$$P' = wh\left(1 - \frac{hK}{1+2HC}\right)$$

$C = 0.58$, $K = 0.19$ (第1頁参照)

$$= 1600\times5.69\left(1 - \frac{5.69\times0.19}{1+2\times2.15\times0.58}\right)$$

$= 6280\ kg/m^2$

天井 $0.33@2400 = 790\ kg/m^2$

天井綿荷重 $P = 6280 + 790 = 7,070\ kg/m^2$

側壁土圧

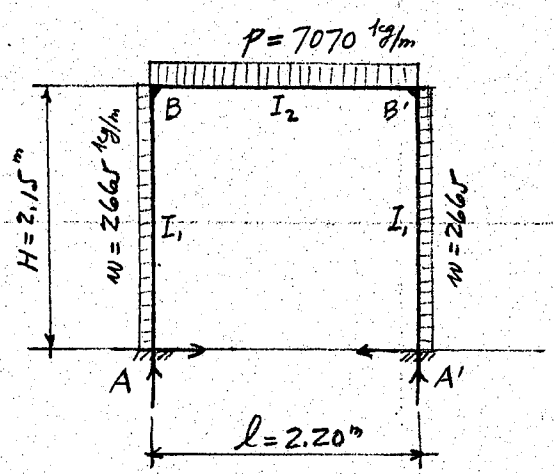
B点 = static earth pressure: $\frac{1}{3}\times6280 = 2090$

A点 = " : $\frac{1}{3}\times1600\times2.15 = 1150$

$3240\ kg/m^2$

側壁平均土圧 $w = \frac{2090+3240}{2} = 2,665\ kg/m^2$

荷重状態



部材ノ物質力学的係数

側壁 $I_1 = \frac{1.0\times0.2^3}{12} = 0.000667$, $K_1 = \frac{0.000667}{2.15} = 0.000310$

天井 $I_2 = \frac{1.0\times0.3^3}{12} = 0.002250$, $K_2 = \frac{0.002250}{2.200} = 0.001021$

$2K_1 + K_2 = 0.001641$

$3K_1 + K_2 = 0.001951$

$5K_1 + 2K_2 = 0.003592$

天井荷重ノ三ヨル応力

$$M_A = \frac{pl^2K_1}{12(2K_1+K_2)} = \frac{7070\times2.20^2\times0.000310}{12\times0.001641} = 540\ kgm$$

$M_B = -2M_A = -1080$ "

$$H = \frac{M_A - M_B}{H} = \frac{540+1080}{2.15} = 755\ kg$$

$$V = \frac{pl}{2} = \frac{7070\times2.20}{2} = 7780\ kg$$

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設計 稍 日付 16-10-7 類別 CVA5
照査 日付 第 13 頁

上海精渠 2m×2m

側壁荷重 w 1ミ=3N/m²

$$M_A = -\frac{wH^2(3K_1+K_2)}{12(2K_1+K_2)} = -\frac{2665\times 2.15^2\times 0.001951}{12\times 0.001641} = -1220\ \text{kgm}$$

$$M_B = -\frac{wH^2K_2}{12(2K_1+K_2)} = -\frac{2665\times 2.15^2\times 0.001021}{12\times 0.001641} = -640\ "$$

$$H = -\frac{wH(5K_1+2K_2)}{4(2K_1+K_2)} = -\frac{2665\times 2.15\times 0.003592}{4\times 0.001641} = -3140\ \text{kg}$$

$V = 0$

合成応力

	荷重 P	荷重 w	合成応力	
M_A	540	−1220	−680	kgm
M_B	−1080	−640	−1720	"
H	755	−3140	−2385	kg ← →
V	7780	0	7780	" ↑

剪力

$S_A = -H = 2385$ kg

$S_{H1} = 2385 - 2665\times 0.20 = 1850$ "

D $x = \frac{2385}{2665} = 0.895^m$ above A. $S_D = 0$

$S_{H2} = 2385 - 2665\times 1.8 = -2410$ kg

側壁 $S_{B1} = 2385 - 2665\times 2.15 = -3345$ " $N_2 = 3345$ kg

天井 $S_{B2} = \frac{7070\times 2.20}{2} = 7780$ kg $N_1 = 7780$ kg

$S_{H3} = 7780 - 7070\times 0.30 = 5660$ "

$S_C = 0$

中間点ノ曲率

M_{H1}

$2385\times 0.20 = 480$
$-\frac{1}{2}\times 2665\times 0.20^2 = -53$
$M_A = -680$
$M_{H1} = -253$ kgm, $N = 7780$ kg

M_D

$2385\times 0.895 = 2135$
$-\frac{1}{2}\times 2665\times 0.895^2 = -1065$
$M_A = -680$
$M_D = 390$ kgm, $N = 7780$ kg

M_{H2}

$2385\times 1.80 = 4290$
$-\frac{1}{2}\times 2665\times 1.80^2 = -4320$
$M_A = -680$
$M_{H2} = -710$ kgm $N = 7780$ kg

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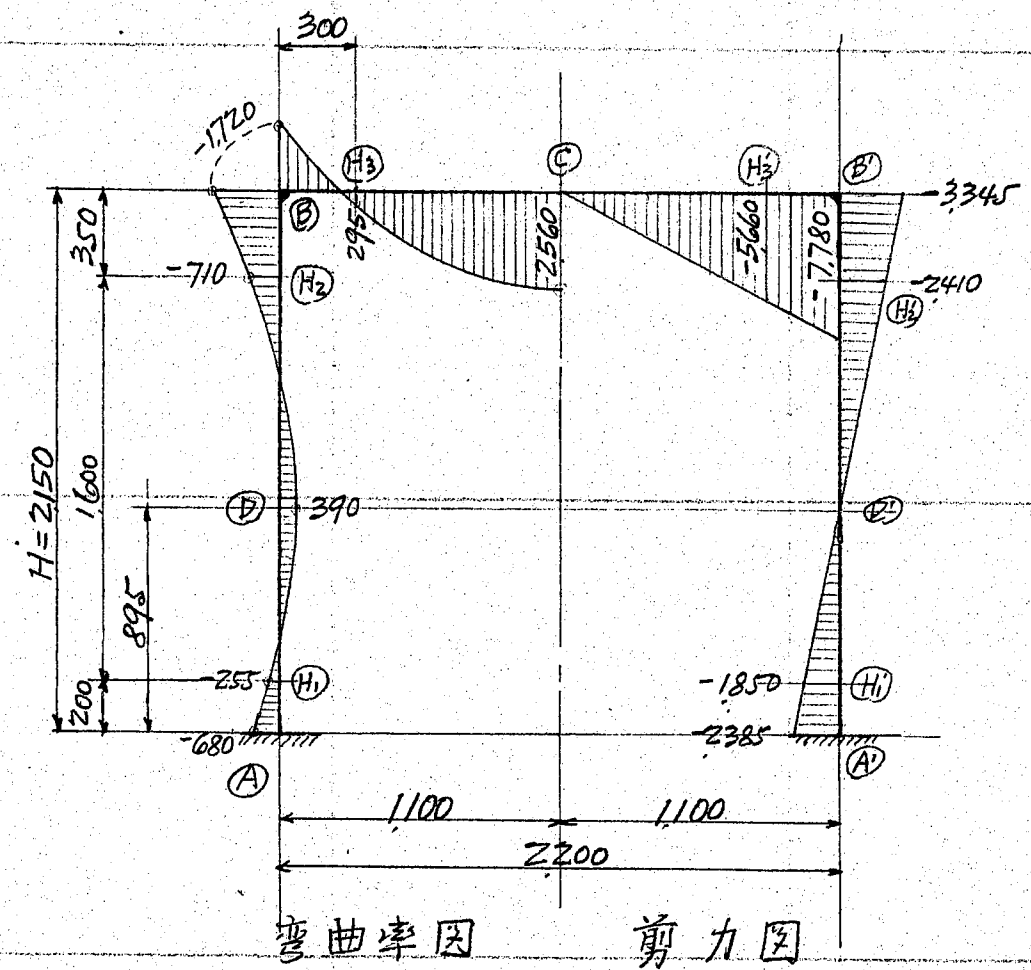
設計 福豪 日付 16-10-7 類別 CVA5
照査 日付 第 14 頁

上海蟠渠 2m×2m

M_{H3} 7780×0.30 $= 2335$
$-\frac{1}{2} \times 7070 \times 0.30^2$ $= -320$
M_B $= -1720$
$M_{H3} = 295$ kgm $N = 3345$ kg

M_C $\frac{1}{8} \times 7070 \times 2.20^2$ $= 4280$
M_B $= -1720$
$M_C = 2560$ kgm $N = 3345$ kg



尺度 曲率 $\frac{1}{200}^m = 1{,}000$ kgm
剪力 $\frac{1}{400}^m = 1{,}000$ kg

縮尺 1:30

断面応力ノ計算

天井

Ⓒ $M_C = 2560$ kgm $N = 3345$ kg $S = 0$

$d/h = 27/30 = 0.900$
$d'/h = 3/30 = 0.100$
$p_0 = 7.54/100 \times 30 = 0.00251$
$p_0' = 2.51/\,\,\,\, = 0.00083$
$u/h = 0.510$
$u = 15.3$ cm
$d-u = 11.7$ 〃

$\frac{M}{N} = \frac{2560 \times 100}{3345} = 76.5$
$d-u = 11.7$
$e = 88.2$ cm
$e' = e-24 = 64.2$ 〃
$e'/e = 0.728$
$\frac{Ne}{bd^2} = \frac{3345 \times 88.2}{100 \times 27^2} = 4.045$
$\frac{Ne}{bd^2\sigma_c} = 0.137$ $k = 0.285$
$\sigma_c = \frac{4.045}{0.137} = 29.6$ kg/cm²
$\sigma_s = 15 \times 29.6 \times \frac{.715}{.285} = 1113$ 〃
$\tau = 0$

$b = 100$ cm, $h = 30$ cm
$d = 27$ cm, $d' = 3$ cm
$A_s = 6.67 - 12\phi = 7.54$ cm² (15 ctac)
$A_s' = 2.22 - 12\phi = 2.51$ 〃 (45 ctac)
$p = 7.54/100 \times 27 = 0.00279$
$p' = 2.51/\,\,\,\, = 0.00093$
$d'/d = 3/27 = 0.111$

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設計 稲葉 日付 16-10-7 類別 CVA5
照査 日付 第 15 頁

上海精藻 2m×2m

(H3) M_{H3} = 295 kgm , N= 3345 kg S= 5660 kg

$$\tau = \frac{5660}{100 \times 7/8 \times 27} = 2.4 \text{ kg/cm}^2$$

側壁各断面ハ CVA3 ニ倣ヒ

基礎底面圧力

垂直荷重	V=	2@7780 = 15560	17,480
側壁		2@2.0×0.2@2400 = 1920	
基礎		3.0×0.6 @2200 = 3960	
		21440 kg	
		3.0	= 7150 kg/m²

杭1間隔 一列4本 1000 ctoc.

杭1本当荷重 = $\frac{21440}{4}$ = 5360 kg

杭 末口150φ 長3500

間隔 横 800 ctoc
縦 1000 ctoc.

上向圧力 17480÷3.0 = 5830 kg/m²

$M = \frac{1}{12} \times 5830 \times 2.20^2 = 2350$ kgm

$A_s = \frac{2350 \times 100}{1200 \times 7/8 \times 55} = 4.07$ cm²

16φ − 45° ° = 4.47 °

翼壁ハ第6頁参照

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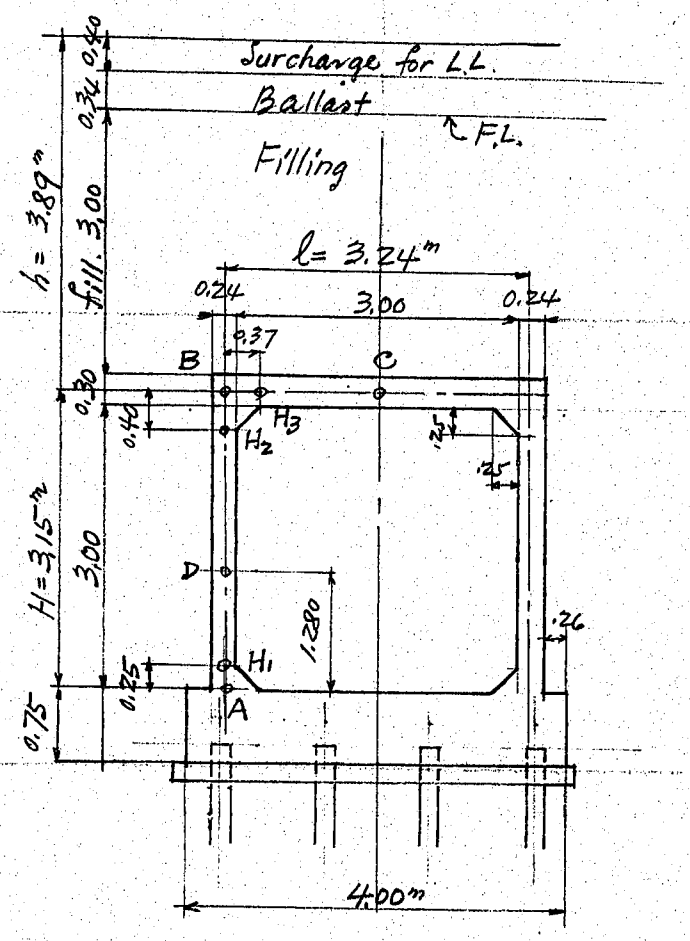
設計 稲葉 日付 16-10-13 類別 CVB3
照査 日付 第 16 頁

上海高速鉄道標準型暗渠 3×3m

土被 3.0m 標準型暗渠 3m×3m --- CVB3



荷重状態

活荷重
4@16500 = 66000 kg
分布荷重
分布長 L = 4.1+2.4+3.2×2 = 12.9m
分布巾 B = 2.0+ 3.2×2 = 8.4
分布荷重 $p' = \frac{66000}{8.4 \times 12.9} = 610$ kg/m²

土ノ高サ=換算セル深サ
$\frac{610}{1600} = 0.38$m ニシテ 0.4m トス

天井荷重 (第1頁参照)
$w h \left(1 - \frac{h_K}{1+2Hc}\right) = 1600 \times 3.89 \left(1 - \frac{3.89 \times 0.19}{1+2 \times 3.15 \times 0.58}\right) = 5240$ (.841)
天井自重 0.33@2400 = 790
天井荷重 p = 6030 kg/m²

側壁土圧
B点=於ケル土圧 $\frac{1}{3} \times 5240 = 1750$ kg/m²
$\frac{1}{3} \times 1600 \times 3.15 = 1680$
A点=於ケル土圧 3430 kg/m²

側壁平均土圧 $w = \frac{1750+3430}{2} = 2590$ kg/m²

部材ノ物自力率並=諸係数

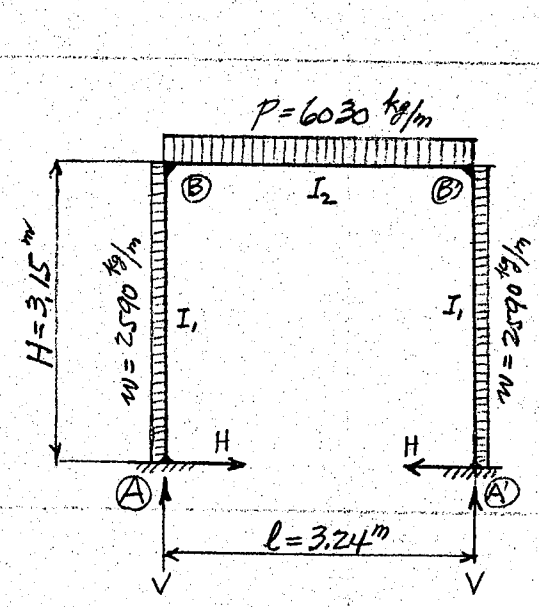
側壁 $I_1 = \frac{1.0 \times 0.24^3}{12} = 0.001152$

$K_1 = \frac{I_1}{H} = \frac{0.001152}{3.15} = 0.000366$

天井 $I_2 = \frac{1.0 \times 0.30^3}{12} = 0.00225$

$K_2 = \frac{I_2}{l} = \frac{0.00225}{3.24} = 0.000694$

$2K_1 + K_2 = 0.001426$
$3K_1 + K_2 = 0.001792$
$5K_1 + 2K_2 = 0.003218$



天井荷重 P ノ=依ル応力

$M_A = \frac{Pl^2 K_1}{12(2K_1+K_2)} = \frac{6030 \times 3.24^2 \times 0.000366}{12 \times 0.001426} = 1350$ kgm
$M_B = -2M_A = -2700$ "
$H = \frac{M_A - M_B}{H} = \frac{1350+2700}{3.15} = 1285$ kg
$V = \frac{Pl}{2} = \frac{6030 \times 3.24}{2} = 9770$ "

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設計 稲葉 日付 16-10-13 類別 CVB3
照査 日付 第 17 頁

上海塘渠 3×3m

側壁荷重 W ノミ = 底ル応力

$$M_A = -\frac{wH^2(3k_1+k_2)}{12(2k_1+k_2)} = -\frac{2590\times 3.15^2\times 0.001792}{12\times 0.001426} = -2690 \text{ kgm}$$

$$M_B = -\frac{wH^2 k_2}{12(2k_1+k_2)} = -\frac{2590\times 3.15^2\times 0.000694}{12\times 0.001426} = -1040 \text{ "}$$

$$H = -\frac{wH(5k_1+2k_2)}{4(2k_1+k_2)} = -\frac{2590\times 3.15\times 0.003218}{4\times 0.001426} = -4600 \text{ kg}$$

$$V = 0$$

合成応力

	荷重 P	荷重 W	合成応力		
M_A	1.350	−2.690	−1.340	kgm	
M_B	−2.700	−1.040	−3.740	"	
H	1.285	−4.600	−3.315	kg	← →
V	9.770	0	9.770	"	↑ ↑

剪力

$S_A = -H = 3.315$ kg

$S_{H_1} = 3315 - 2590\times 0.25 = 2.665$ "

D $x = 3315 \div 2590 = 1.280$ m above A.

$S_D = 0$

$S_{H2} = 3315 - 2590\times 2.75 = -3.805$ kg

側壁 $S_{B1} = 3315 - 2590\times 3.15 = -4845$ " $N_2 = 4845$ kg

天井 $S_{B2} = 6030\times 3.24 \div 2 = 9.770$ " $N_1 = 9.770$ "

$S_{H3} = 9770 - 6030\times 0.370 = 7.540$ "

$S_C = 0$

中間点ノ彎曲率

M_{H1} $3315\times 0.25 = 830$

$-\frac{1}{2}\times 2590\times 0.25^2 = -80$

$M_A = -1340$

$M_{H_1} = -590$ kgm $N = 9.770$ kg

M_D $3315\times 1.280 = 4240$

$-\frac{1}{2}\times 2590\times 1.280^2 = -2120$

$M_A = -1340$

$M_D = 780$ " $N = 9.770$ "

M_{H2} $3315\times 2.750 = 9120$

$-\frac{1}{2}\times 2590\times 2.750^2 = -9.790$

$M_A = -1340$

$M_{H2} = -2010$ " $N = 9.770$ "

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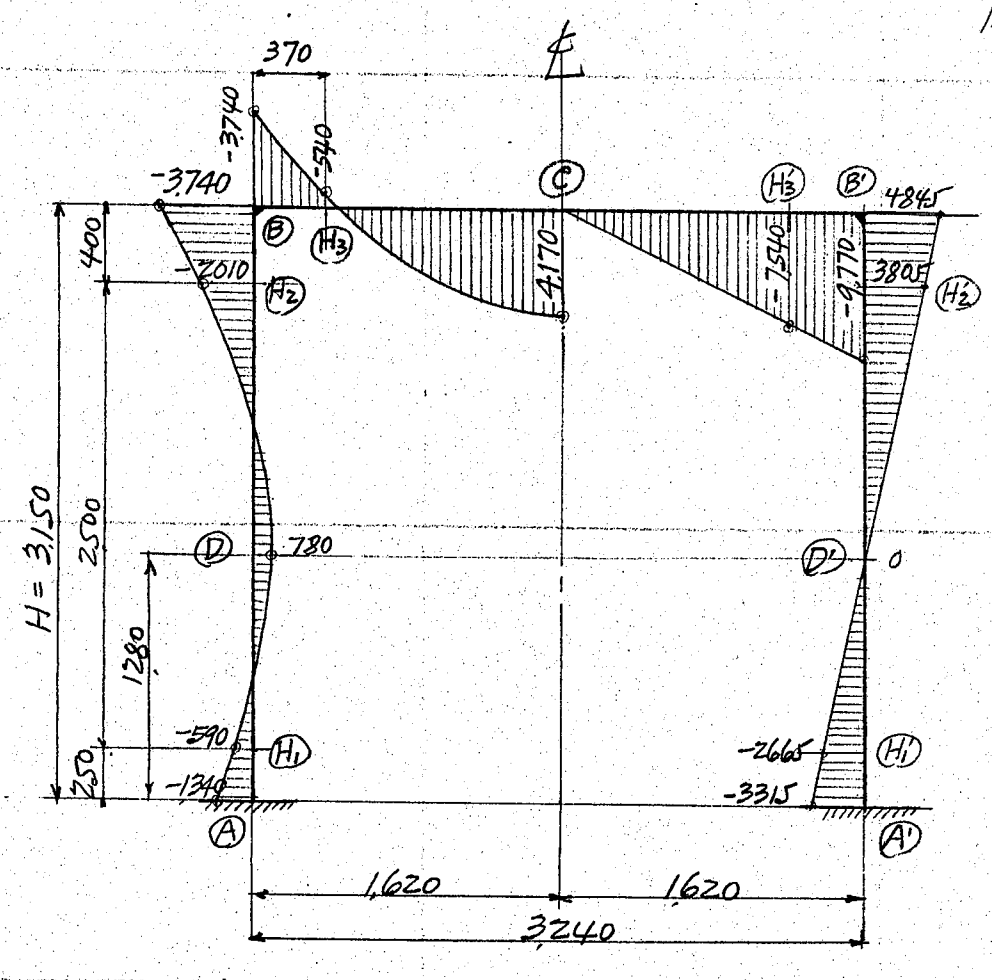
上海婿渠 3m×3m

設計 稲葉 日付 16-10-13 類別 CVB3
照査 日付 第 18 頁

M_{H3} $9770 \times 0.370 = 3610$
$-\frac{1}{2} \times 6030 \times 0.370^2 = -410$
$M_B = -3740$
$M_{H3} = -540$ kgm　　$N = 4845$ kg

M_C $\frac{1}{8} \times 6030 \times 3.24^2 = 7910$
$M_B = -3740$
$M_C = 4170$ kgm　　$N = 4845$ kg



尺度　弯曲率 $\frac{1}{300}$m = 1,000 kgm
剪力 $\frac{1}{500}$m = 1,000 kg
縮尺　1:40

弯曲率図　　剪力図

断面應力ノ計算

天井

© $M_C = 4170$ kgm　$N = 4845$ kg　$S = 0$

$d/h = 26/30 = 0.867$
$d'/h = 4/30 = 0.133$
$p_0 = 13.41/100 \times 30 = 0.00448$
$p_0' = 2.51/\ \ \ = 0.00084$
$u/h = 0.516$
$u = 15.4$ cm
$d-u = 10.6$ 〃

$\frac{M}{N} = \frac{4170 \times 100}{4845} = 86.1$
$d-u = 10.6$
$e = 96.7$ cm
$e' = e - 22 = 74.7$ 〃
$e'/e = 0.773$

$\frac{Ne}{bd^2} = \frac{4845 \times 96.7}{100 \times 26^2} = 6.925$

$\frac{Ne}{bd^2\sigma_c} = 0.164$　$k = 0.360$

$\sigma_c = \frac{6.925}{0.164} = 42.2$ kg/cm²

$\sigma_s = 15 \times 42.2 \times \frac{0.640}{0.360} = 1127$ kg/cm²

$\tau = 0$

$b = 100$ cm, $h = 30$ cm
$d = 26$ cm, $d' = 4$ cm
$A_s = 6.67 - 16\phi = 13.41$ cm²
$A_s' = 2.22 - 12\phi = 2.51$ 〃
$p = 13.41/100 \times 26 = 0.00516$
$p' = 2.51/\ \ \ = 0.00097$
$d'/d = 4/26 = 0.154$

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設計 稲葉 日付 16-10-13 類別 CVB3
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上海暗渠 3m×3m

(H3) $M_{H3} = -540$ kgm , $N = 4845$ kg $S_{H3} = 7540$ kg

$$\tau = \frac{7540}{100 \times 7/8 \times 26} = 3.3 \text{ kg/cm}^2$$

(B) $M_B = -3740$ kgm , $N = 4845$ kg $S_B = 9770$ kg

$d/h = 38/42 = 0.905$
$d'/h = 4/42 = 0.095$
$p_0 = 7.54/100 \times 42 = 0.00180$
$p_0' = 2.51/\,\text{〃} = 0.00060$
$u/h = 0.506$
$u = 19.2$ cm
$d-u = 18.8$ 〃

$\frac{M}{N} = \frac{3740 \times 100}{4845} = 77.2$
$d-u = 18.8$
$e = 96.0$ cm
$e' = e - 34 = 62.0$ 〃
$e'/e = 0.646$
$\frac{Ne}{bd^2} = \frac{4845 \times 96.0}{100 \times 38^2} = 3.22$
$\frac{Ne}{bd^2\sigma_c} = 0.123$ $k = 0.260$
$\sigma_c = \frac{3.22}{0.123} = 26.2$ kg/cm²
$\sigma_s = 15 \times 26.2 \times \frac{0.74}{0.26} = 1118$ 〃
$\tau = \frac{9770}{100 \times 0.913 \times 38} = 2.8$ 〃

$b=100$, $h = 30 + \frac{37}{3} = 42$
$d = 38$, $d' = 4$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.22 - 12\phi = 2.51$
$p = 7.54/100 \times 38 = 0.00199$
$p' = 2.51/\,\text{〃}\,\text{〃} = 0.00066$
$d'/d = 4/38 = 0.105$

側壁

(B) $M_B = -3740$ kgm , $N = 9770$ kg , $S_B = -4845$ kg

$d/h = 33/37 = 0.892$
$d'/h = 4/37 = 0.108$
$p_0 = 7.54/100 \times 37 = 0.00204$
$p_0' = 2.51/\,\text{〃} = 0.00068$
$u/h = 0.508$
$u = 18.8$
$d-u = 14.2$ cm

$\frac{M}{N} = \frac{3740 \times 100}{9770} = 38.3$
$d-u = 14.2$
$e = 52.5$ cm
$e' = e - 29 = 23.5$ 〃
$e'/e = 0.448$
$\frac{Ne}{bd^2} = \frac{9770 \times 52.5}{100 \times 33^2} = 4.710$
$\frac{Ne}{bd^2\sigma_c} = 0.153$, $k = 0.330$
$\sigma_c = \frac{4.710}{0.153} = 30.8$ kg/cm²
$\sigma_s = 15 \times 30.8 \times \frac{0.67}{0.33} = 938$ 〃
$\tau = \frac{4845}{100 \times 0.890 \times 33} = 1.7$ 〃

$b = 100$, $h = 24 + \frac{40}{3} = 37$
$d = 33$, $d' = 4$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.22 - 12\phi = 2.51$
$p = 7.54/100 \times 33 = 0.00229$
$p' = 2.51/\,\text{〃} = 0.00076$
$d'/d = 4/33 = 0.121$

(D) $M_D = 780$ kgm $N = 9770$ kg $S = 0$

$d/h = 21/24 = 0.876$
$d'/h = 3/24 = 0.125$
$p_0 = 7.54/100 \times 24 = 0.00314$
$p_0' = 2.51/\,\text{〃} = 0.00105$
$u/h = 0.51$
$u = 12.2$
$d-u = 8.8$ cm

$\frac{M}{N} = \frac{780 \times 100}{9770} = 8.0$
$d-u = 8.8$
$e = 16.8$ cm
$e' = e - 18 = -1.2$
$e'/e = -0.07$
$\frac{Ne}{bd^2} = \frac{9770 \times 16.8}{100 \times 21^2} = 3.73$

$b = 100$, $h = 24$
$d = 21$, $d' = 3$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.22 - 12\phi = 2.51$
$p = 7.54/100 \times 21 = 0.00359$
$p' = 2.51/\,\text{〃} = 0.00120$
$d'/d = 3/21 = 0.143$

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上海婿渠 3m×3m

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$\frac{Ne}{bd^2\sigma_c} = 0.289$ $k = 0.730$

$\sigma_c = \frac{3.73}{0.289} = 12.9$ kg/cm²

$\sigma_s = 15 \times 12.9 \times \frac{0.270}{0.730} = 72$ "

$\tau = 0$

(H2) $M_{H2} = -2010$ kgm , $N = 9770$ kg , $S = -3805$ kg 断面 (D) に合む

$\frac{M}{N} = \frac{2010 \times 100}{9770} = 20.6$
$d - u = 8.8$
$e = 29.4$ cm
$e' = e - 18 = 11.4$ "
$e'/e = 0.388$
$\frac{Ne}{bd^2} = \frac{9770 \times 29.4}{100 \times 21^2} = 6520$
$\frac{Ne}{bd^2\sigma_c} = 0.185$ $k = 0.400$

$\sigma_c = \frac{6520}{0.185} = 35.3$ kg/cm²

$\sigma_s = 15 \times 35.3 \times \frac{0.60}{0.40} = 794$ "

$\tau = \frac{3805}{100 \times 0.867 \times 21} = 2.1$ "

基礎底面圧力
垂直荷重
側壁 2@0.24×3@2400 = 3460
23000
基礎 4.0×0.75@2200 = 6600
29600 kg
4.0 = 7400 kg/m²

杭一列 4本 各列間隔 1.00m ctoc.
杭一本当荷重 = $\frac{29600}{4}$ = 7400 kg
杭 150φ × 4500 Spacing Crosswise 1.1m ctoc
Lengthwise 1.0m "

基礎鉄筋
上向圧力 = $\frac{23000}{4.0}$ = 5750 kg/m²

$M = \frac{1}{12} \times 5750 \times 3.24^2 = 5030$ kgm

$A_s = \frac{5030 \times 100}{1200 \times 7/8 \times 70} = 6.83$ cm²

16φ − 45cm ctoc = 4.48 (A Row = 挿入)
12φ − 45 " " = 2.52 (B と B Row 中3 = 挿入)
7.00 cm²

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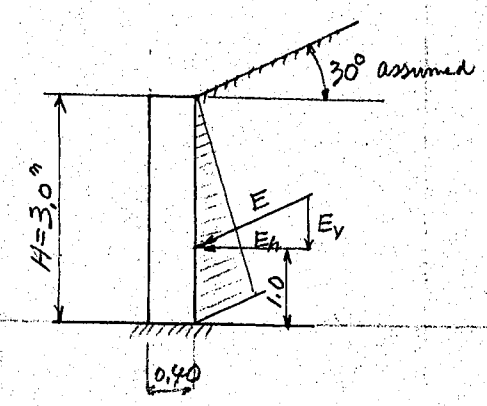
上海精渠 3m×3m

擁壁



土圧 Cos 30° = 0.866

$E = \frac{1}{2} \times 1600 \times 3.0^2 \times 0.866 = 6230$ kg

$E_h = 6230 \times 0.866 = 5,400$ kg
$E_V = 6230 \times 0.500 = 3,120$ "

5400 × 1.00 = 5400
− 3120 × 0.20 = − 625
M = 4775 kgm

$d = \sqrt{\frac{4775 \times 100}{100 \times 7.13}} = 26$ cm　　d=36 被覆 4 ㎝ h=40 cm

$A_s = \frac{4775 \times 100}{1200 \times 7/8 \times 36} = 12.63$ cm²

16φ− 15cm c to c = 13,41 cm².

$\tau = \frac{5400}{100 \times 7/8 \times 36} = 1.7$ kg/cm²

高サ 2m 1個所

$E = \frac{1}{2} \times 1600 \times 2.0^2 \times 0.866 = 2770$ kg

$E_h = 2770 \times 0.866 = 2400$ kg
$E_V = 2770 \times 0.500 = 1385$ "

2400 × 0.667 = 1600
−1385 × 0.20 = −280
1320 kgm

$A_s = \frac{1320 \times 100}{1200 \times 7/8 \times 36} = 3.50$ cm²

12φ− 300 c to c = 3.77 cm²

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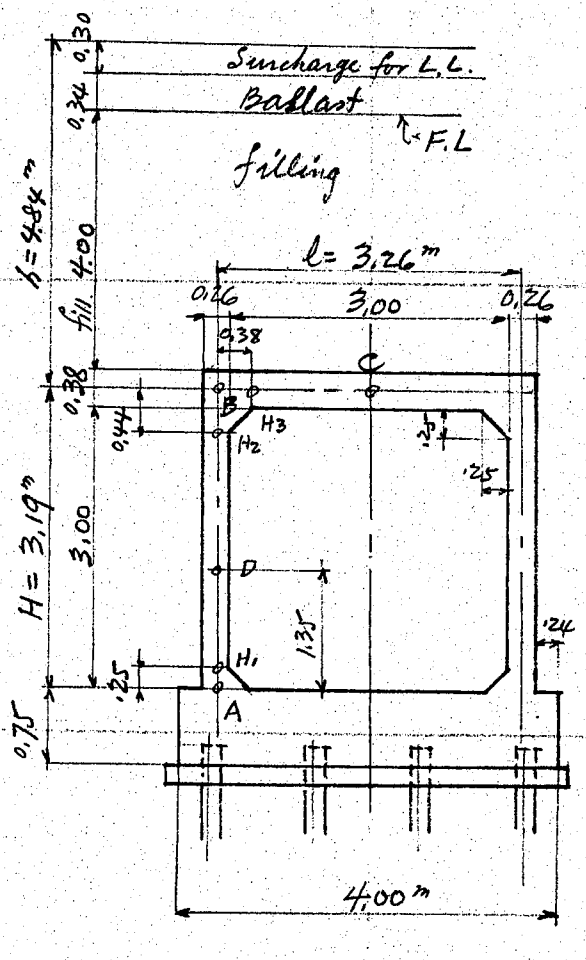
上海高速鉄道 標準型暗渠 4m×4m

土被 4m 標準型暗渠 3m×3m ―― CVB4



活荷重
4@16500 = 66000 kg

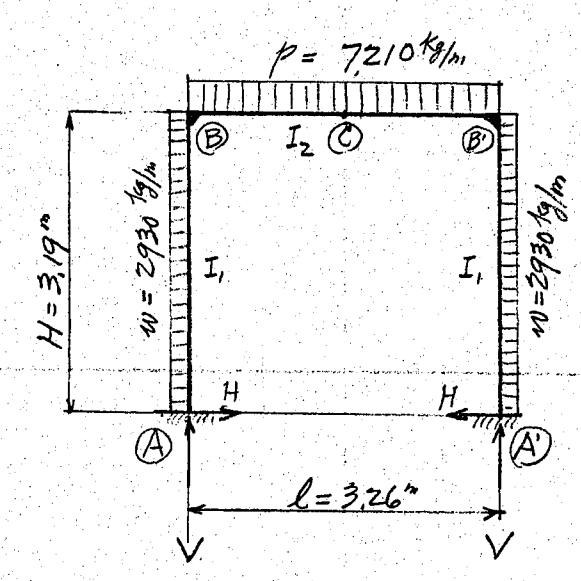
分布荷重
分布長 L = 4.1 + 2.4 + 4.2×2 = 14.9m
分布幅 B = 2.0 + 4.2×2 = 10.4m
分布荷重 = $\frac{66000}{14.9\times10.4}$ = 425 kg/m²
土ノ重サニ対抗スル盛土ノ深サ
$\frac{425}{1600}$ = 0.27m ニシテ 0.30m トス

天井荷重
$1600\times4.84\left(1-\frac{4.84\times0.19}{1+2\times3.19\times0.58}\right)$ = 6230
天井重量 0.41 e 2400 = 980
天井荷重 P = 7210 kg/m²

側壁土圧
B点ニ於ケル土圧
$\frac{1}{3}\times6230$ = 2080
$\frac{1}{3}\times1600\times3.19$ = 1700
3780
A点ニ於ケル土圧

側壁平均土圧 w = $\frac{2080+3780}{2}$ = 2930 kg/m²

荷重状態



部材ノ物量力率並ニ諸係数

側壁 $I_1 = \frac{1.0\times0.26^3}{12}$ = 0.001465
$K_1 = \frac{I_1}{H} = \frac{0.001465}{3.19}$ = 0.000459

天井 $I_2 = \frac{1.0\times0.38^3}{12}$ = 0.004573
$K_2 = \frac{I_2}{l} = \frac{0.004573}{3.26}$ = 0.001403

$2K_1+K_2$ = 0.002321
$3K_1+K_2$ = 0.002780
$5K_1+2K_2$ = 0.005101

天井荷重 p ニ対スル応力
$M_A = \frac{pl^2K_1}{12(2K_1+K_2)} = \frac{7210\times3.26^2\times0.000459}{12\times0.002321}$ = 1260 kgm
$M_B = -2M_A$ = −2520 〃
$H = \frac{M_A-M_B}{H} = \frac{1260+2520}{3.19}$ = 1185 kg
$V = \frac{pl}{2} = \frac{7210\times3.26}{2}$ = 11750 〃

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上海暗渠 3m×3m

側壁荷重 W 1/2 = 2W 応力

$$M_A = -\frac{WH^2(3K_1+K_2)}{12(2K_1+K_2)} = -\frac{2930\times3.19^2\times0.002780}{12\times0.002321} = -2970 \text{ kgm}$$

$$M_B = -\frac{WH^2K_2}{12(2K_1+K_2)} = -\frac{2930\times3.19^2\times0.001403}{12\times0.002321} = -1500 \text{ "}$$

$$H = -\frac{WH(5K_1+2K_2)}{4(2K_1+K_2)} = -\frac{2930\times3.19\times0.005101}{4\times0.002321} = -5140 \text{ kg}$$

$$V = 0$$

合成応力

	荷重 P	荷重 W	合成応力		
M_A	1,260	−2,970	−1,710	kgm	
M_B	−2,520	−1,500	−4020	"	
H	1,185	−5,140	−3955	kg	← →
V	11,750	0	11,750	"	↑ ↑

剪力

$S_A = -H =$ 3,955 kg

$S_{H1} = 3955 - 2930\times0.25 =$ 3,225 "

Ⓓ $x = \frac{3955}{2930} = 1.35$ m above A

$S_D =$ 0

$S_{H2} = 3955 - 2930\times2.75 =$ −4105 "

側壁 $S_{B1} = 3955 - 2930\times3.19 =$ −5400 " $N_2 =$ 5400 kg

天井 $S_{B2} = 7210\times3.26\div2 =$ 11,750 " $N_1 =$ 11,750 "

$S_{H3} = 11750 - 7210\times0.38 =$ 9010 "

$S_C =$ 0

中間点=於ケル彎曲率

M_{H1}

$3955\times0.25 =$ 990

$-\frac{1}{2}\times2930\times0.25^2 =$ −90

$M_A =$ −1710

$M_{H1} =$ −810 kgm

M_D

$3955\times1.35 =$ 5340

$-\frac{1}{2}\times2930\times1.35^2 =$ −2670

$M_A =$ −1710

$M_D =$ 960 kgm

M_{H2}

$3955\times2.75 =$ 10870

$\frac{1}{2}\times2930\times2.75^2 =$ −11060

$M_A =$ −1710

$M_{H2} =$ −1,900 kgm

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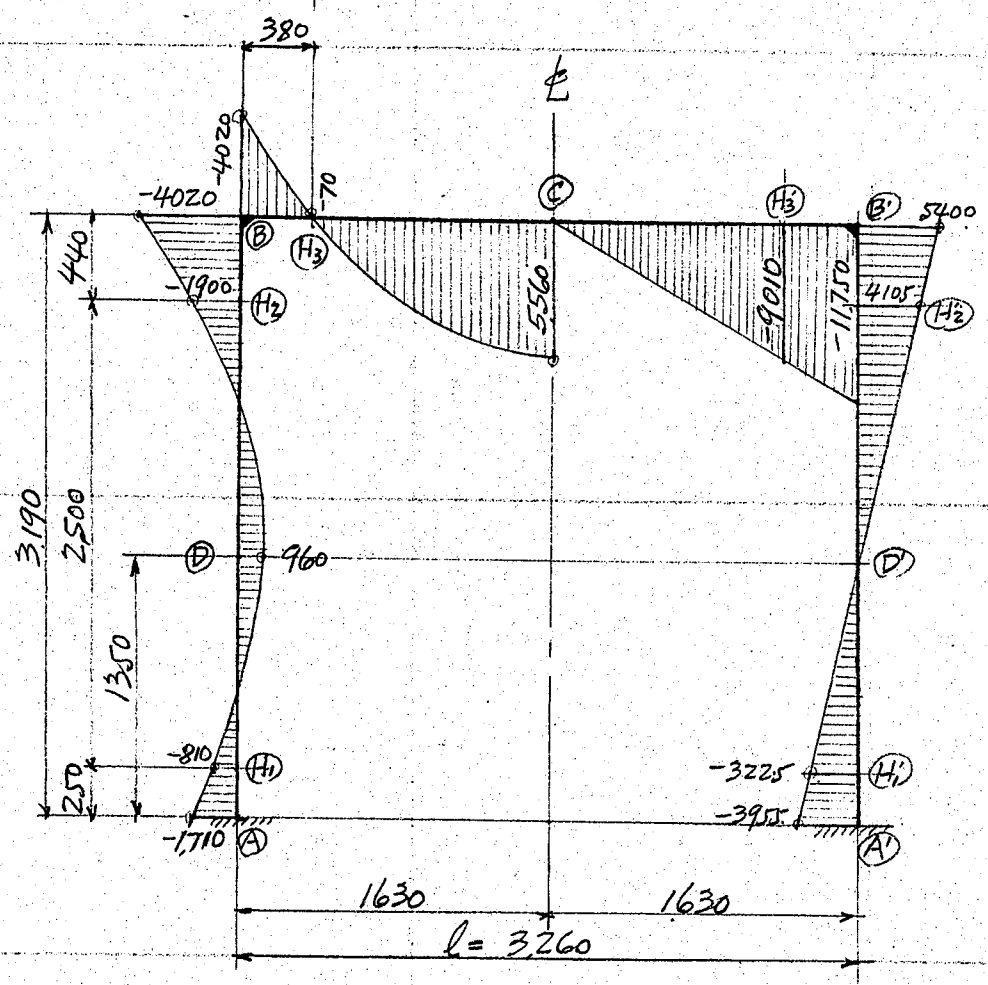
上海晴渠 3m×3m

設計 稲葉 日付 16-10-16 類別 CVB4
照査 日付 第 24 頁

M_{H3}. $11750 \times 0.380 = 4470$
$-\frac{1}{2} \times 7210 \times 0.380^2 = -520$
$M_B = -4020$
$M_{H3} = -70$ kgm

M_C $\frac{1}{8} \times 7210 \times 3.26^2 = 9580$
$M_B = -4020$
$M_D = 5560$ kgm



尺度 弯曲率 $\frac{1}{300}$m = 1000 kgm
剪力 $\frac{1}{500}$m = 1,000 kg

縮尺 1:40

弯曲率図 剪力図

断面應力ノ計算

天井.

Ⓒ $M_C = 5560$ kgm $N = 5400$ kg $S = 0$

$d/h = 34/38 = 0.895$
$d'/h = 4/38 = 0.105$
$p_0 = 13.41/100 \times 38 = 0.00353$
$p_0' = 2.51/\,, = 0.00066$
$u/h = 0.514$
$u = 19.5$ cm
$d-u = 14.5$,,

$\frac{M}{N} = \frac{5560 \times 100}{5400} = 103.0$
$d-u = 14.5$
$e = 117.5$ cm
$e' = e - 30 = 87.5$,,
$e'/e = 0.744$
$\frac{Ne'}{bd^2} = \frac{5400 \times 117.5}{100 \times 34^2} = 5.49$
$\frac{Ne}{bd^2\sigma_c} = 0.154$ $k = 0.330$
$\sigma_c = \frac{5.490}{0.154} = 35.6$ kg/cm²
$\sigma_s = 15 \times 35.6 \times \frac{0.670}{0.330} = 1085$,,
$\tau = 0$

$b = 100$ cm, $h = 38$ cm
$d = 34$ cm, $d' = 4$ cm
$A_s = 6.67 - 16\phi = 13.41$ cm²
$A_s' = 2.22 - 12\phi = 2.51$,,
$p = 13.41/100 \times 34 = 0.00395$
$p' = 2.51/\,, = 0.00074$
$d'/d = 4/34 = 0.118$

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上海猜渠 3m×3m

(H3) $M_{H3} = -70$ kgm　$N = 5400$ kg　$S = 9010$ kg

$$\tau = \frac{9010}{100 \times 7/8 \times 34} = 3.0 \text{ kg/cm}^2$$

(B) $M_B = -4020$ kgm , $N = 5400$ kg　$S_B = 11750$ kg

$d/h = 47/51 = 0.922$
$d'/h = 4/51 = 0.078$
$p_0 = 7.54/100 \times 51 = 0.00148$
$p_0' = 2.51/\ , = 0.00049$
$u/h = 0.508$
$u = 25.9$ cm
$d-u = 21.1$ 〃

$\frac{M}{N} = \frac{4020 \times 100}{5400} = 74.5$
$= 21.1$
$d-u = 95.6$ cm
$e =$
$e' = e - 43 = 52.6$ 〃
$e'/e = 0.550$
$\frac{Ne}{bd^2} = \frac{5400 \times 95.6}{100 \times 47^2} = 2.34$
$\frac{Ne}{bd^2\sigma_c} = 0.121$, $k = 0.255$
$\sigma_c = \frac{2.34}{0.121} = 19.4$ kg/cm²
$\sigma_s = 15 \times 19.4 \times \frac{0.745}{0.255} = 850$ 〃
$\tau = \frac{11750}{100 \times 0.915 \times 47} = 2.7$ 〃

$b=100$, $h = 38 + \frac{38}{3} = 51$
$d = 47$, $d' = 4$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.22 - 12\phi = 2.51$
$p = 7.54/100 \times 47 = 0.00160$
$p' = 2.51/\ , = 0.00053$
$d'/d = 4/47 = 0.085$

側壁

(B) $M_B = -4020$ kgm　$N = 11750$ kg　$S = -5400$ kg

$d/h = 37/41 = 0.903$
$d'/h = 4/41 = 0.098$
$p_0 = 7.54/100 \times 41 = 0.00184$
$p_0' = 2.51/\ , = 0.00061$
$u/h = 0.509$
$u = 21.0$ cm
$d-u = 16.0$ 〃

$\frac{M}{N} = \frac{4020 \times 100}{11750} = 34.2$
$= 16.0$
$d-u = 50.2$
$e =$
$e' = e - 33 = 17.2$
$e'/e = 0.343$
$\frac{Ne}{bd^2} = \frac{11750 \times 50.2}{100 \times 37^2} = 4.315$
$\frac{Ne}{bd^2\sigma_c} = 0.160$　$k = 0.350$
$\sigma_c = \frac{4.315}{0.160} = 27.0$ kg/cm²
$\sigma_s = 15 \times 27.0 \times \frac{0.650}{0.350} = 753$ 〃
$\tau = \frac{5400}{100 \times 0.883 \times 37} = 1.7$ 〃

$b=100$, $h = 26 + \frac{44}{3} = 41$
$d = 37$, $d' = 4$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.22 - 12\phi = 2.51$
$p = 7.54/100 \times 37 = 0.00204$
$p' = 2.51/\ , = 0.00068$
$d'/d = 4/37 = 0.108$

(D) $M_D = 960$ kgm　$N = 11750$ kg　$S = 0$

$d/h = 23/26 = 0.885$
$d'/h = 3/26 = 0.115$
$p_0 = 7.54/100 \times 26 = 0.00290$
$p_0' = 2.51/\ , = 0.00096$
$u/h = 0.508$
$u = 13.2$ cm
$d-u = 9.8$ 〃

$\frac{M}{N} = \frac{960 \times 100}{11750} = 8.2$
$= 9.8$
$d-u = 18.0$ cm
$e =$
$e' = e - 20 = -2.0$
$e'/e = -0.111$
$\frac{Ne}{bd^2} = \frac{11750 \times 18.0}{100 \times 23^2} = 4.00$

$b=100$, $h = 26$
$d = 23$, $d' = 3$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.22 - 12\phi = 2.51$
$p = 7.54/100 \times 23 = 0.00328$
$p' = 2.51/\ , = 0.00109$
$d'/d = 3/23 = 0.131$

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上海婧渠 3m×3m

$\frac{Ne}{bd^2\sigma_c} = 0.293$ $k = 0.75$

$\sigma_c = \frac{4.00}{0.293} = 13.7$ kg/cm²

$\sigma_s = 15 \times 13.7 \times \frac{1.25}{1.75} = 69$ "

$\tau = 0$

(H2) $M_{H2} = -1900$ kgm $N = 11750$ kg $S = -4105$ kg

数加ハ (D) = 含ム

$\frac{M}{N} = \frac{1900 \times 100}{11750} = 16.2$

$d - u = 9.8$

$e = 26.0$ cm

$e' = e - 20 = 6.0$ "

$e'/e = 0.231$

$\frac{Ne}{bd^2} = \frac{11750 \times 26.0}{100 \times 23^2} = 5.78$

$\frac{Ne}{bd^2\sigma_c} = .202$ $k = 0.450$

$\sigma_c = \frac{5.78}{0.202} = 28.6$ kg/cm²

$\sigma_s = 15 \times 28.6 \times \frac{0.55}{0.45} = 525$ "

$\tau = \frac{4105}{100 \times 0.85 \times 23} = 2.1$ "

基礎底面圧力

垂直荷重	$V = 2 @ 11750$	=	23,500
側壁	$2 @ 0.26 \times 3 @ 2400$	=	3740
			27,240 kg
基礎	$4.0 \times 0.75 @ 2200$	=	6600
			$\frac{33840}{4.0}$ kg = 8460 kg/m²

杭一本当り荷重 $= \frac{33840}{4} = 8460$ kg

杭 150φ × 4500 spacing crosswise 1.1 m ctoc
lengthwise 1.0 m ctoc

基礎鉄筋

上向圧力 $= \frac{27240}{4.0} = 6810$ kg/m²

$M = \frac{1}{2} \times 6810 \times 3.26^2 = 6040$ kgm

$A_s = \frac{6040 \times 100}{1200 \times 7/8 \times 70} = 8.22$ cm²

16φ − 22.5 cm ctoc $= 8.96$ cm²

翼壁 翼壁ハ CVB3 ニ含ム (第21頁参照)

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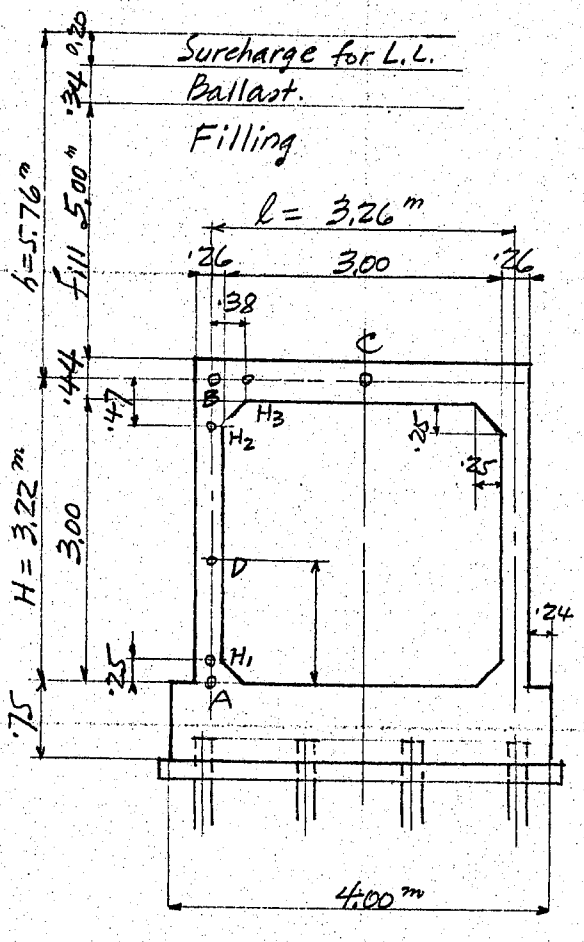
設計 稲葉 日付 16-10-18 類別 CVB5
照査 日付 第 27 頁

上海暗渠 3m×3m

土被 5.0m 標準型暗渠 3m×3m —— CVB5



活荷重

4@16500 = 66,000 kg

分布荷重

分布長 $L = 4.1 + 2.4 + 5.2 \times 2 = 16.9$ m

分布幅 $B = 2.0 + 5.2 \times 2 = 12.4$ m

$$\text{分布荷重} = \frac{66000}{16.9 \times 12.4} = 315 \text{ kg/m}^2$$

土ノ重サニヨル 損害ヲ與ヘル深サ

$$\frac{315}{1600} = 0.20 \text{ m}$$

天井荷重

$$1600 \times 5.76 \left(1 - \frac{5.76 \times 0.19}{1 + 2 \times 3.22 \times 0.58}\right) = 7100 \quad (.769)$$

天井重量 0.47@2400 = 1130

天井荷重 p = 8230 kg/m²

側壁土圧

B点ニ於ケル土圧

$\frac{1}{3} \times 7100 = 2370$

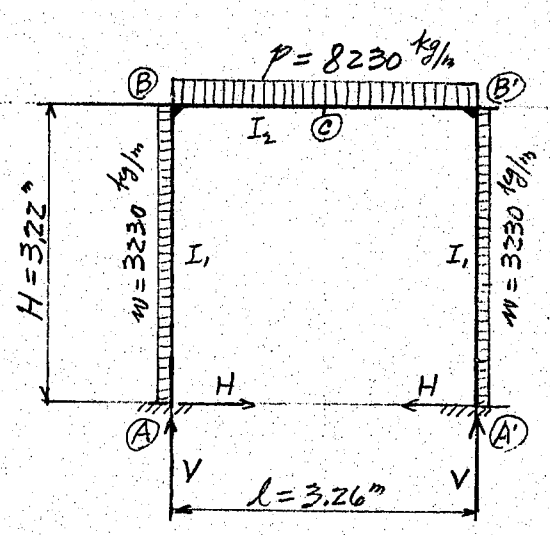
$\frac{1}{3} \times 1600 \times 3.23 = 1720$

4090 kg/m²

A点ニ於ケル土圧

側壁平均土圧 $w = \frac{2370 + 4090}{2} = 3230$ kg/m²

荷重狀態



部材ノ物量力率並ニ諸係数

側壁 $I_1 = \frac{1.0 \times 0.26^3}{12} = 0.001463$

$K_1 = \frac{I_1}{H} = \frac{0.001463}{3.22} = 0.000455$

天井 $I_2 = \frac{1.0 \times 0.44^3}{12} = 0.007100$

$K_2 = \frac{I_2}{\ell} = \frac{0.007100}{3.26} = 0.002178$

$2K_1 + K_2 = 0.003088$
$3K_1 + K_2 = 0.003543$
$5K_1 + 2K_2 = 0.006631$

天井荷重ノモメント應力

$$M_A = \frac{p\ell^2 k_1}{12(2k_1 + k_2)} = \frac{8230 \times 3.26^2 \times 0.000455}{12 \times 0.003088} = 1075 \text{ kgm}$$

$M_B = -2M_A = -2150$ "

$$H = \frac{M_A - M_B}{H} = \frac{1075 + 2150}{3.22} = 1000 \text{ kg}$$

$$V = \frac{p\ell}{2} = \frac{8230 \times 3.26}{2} = 13400 \text{ "}$$

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設計 [illegible] 日付 16-10-18 類別 CVB5
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上海暗渠 3m×3m

側壁荷重 w 1ミ=ヨル應力.

$$M_A = -\frac{wH^2(3K_1+K_2)}{12(2K_1+K_2)} = -\frac{3230\times 3.22^2\times 0.003543}{12\times 0.003088} = -3210 \text{ kgm}$$

$$M_B = -\frac{wH^2 K_2}{12(2K_1+K_2)} = -\frac{3230\times 3.22^2\times 0.002178}{12\times 0.003088} = -1970 \text{ "}$$

$$H = -\frac{wH(5K_1+2K_2)}{4(2K_1+K_2)} = -\frac{3230\times 3.22\times 0.006631}{4\times 0.003088} = -5590 \text{ kg}$$

$V = 0$

合成應力.

	荷重 P	荷重 w	合成應力		
M_A	1,075	-3,210	-2,135	kgm	
M_B	-2,150	-1,970	-4,120	"	
H	1,000	-5,590	-4,590	kg	← →
V	13,400	0	13,400	"	↑ ↑

剪力

$S_A = -H = 4590$ kg

$S_{H1} = 4590 - 3230\times 0.25 = 3780$ "

Ⓓ $x = \frac{4590}{3230} = 1.42$ m above A.

$S_D = 0$

$S_{H2} = 4590 - 3230\times 2.75 = -4290$ kg

側壁 $S_{B1} = 4590 - 3230\times 3.22 = -5810$ " $N_2 = 5810$ kg

天井 $S_{B2} = 8230\times 3.26\div 2 = 13400$ " $N_1 = 13400$ "

$S_{H3} = 13400 - 8230\times 0.38 = 10270$ "

$S_C = 0$

中間点=於ケル彎曲率

M_{H1}

$4590\times 0.25 = 1145$

$-\frac{1}{2}\times 3230\times 0.25^2 = -100$

$M_A = -2135$

$M_{H1} = -1090$ kgm

M_D

$4590\times 1.42 = 6520$

$-\frac{1}{2}\times 3230\times 1.42^2 = -3260$

$M_A = -2135$

$M_D = 1125$ kgm

M_{H2}

$4590\times 2.75 = 12610$

$-\frac{1}{2}\times 3230\times 2.75^2 = -12210$

$M_A = -2135$

$M_{H2} = -1735$ kgm

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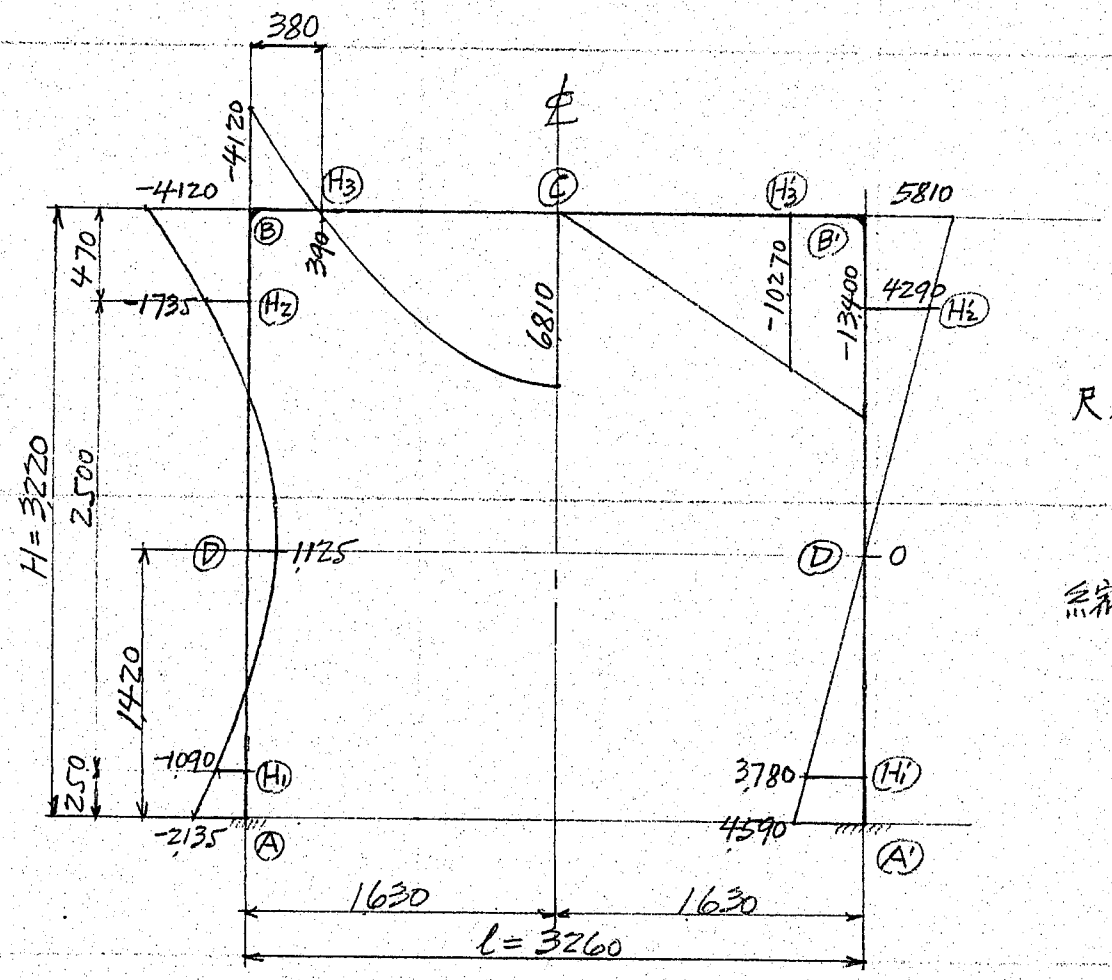
設計 稲葉 日付 16-10-18 類別 CVB5
照査 日付 第 29 頁

上海蹟渠 3m×3m

M_{H3} $13,400 \times 0.38 = 5100$
$-\frac{1}{2} \times 8230 \times 0.38^2 = -590$
$M_B = -4120$
$M_{H3} = 390$ kgm

M_C $\frac{1}{8} \times 8230 \times 3.26^2 = 10930$
$M_B = -4120$
$M_D = 6810$ kgm



彎曲率圖　　剪力圖

尺度　彎曲率 $\frac{1}{300}m = 1,000$ kgm
剪力 $\frac{1}{500}m = 1,000$ kg

縮尺　1:40

断面應力ノ計算

天井 ©

$M_C = 6810$ kgm　$N = 5810$ kg　$S = 0$

$\frac{M}{N} = \frac{6810 \times 100}{5810} = 117.2$
$d-u = 17.5$
$e = 134.7$ cm
$e' = e - 36 = 98.7$
$e'/e = 0.732$
$\frac{Ne}{bd^2} = \frac{5810 \times 134.7}{100 \times 40^2} = 4.890$
$\frac{Ne}{bd^2\sigma_c} = 0.143$　$k = 0.305$
$\sigma_c = \frac{4.890}{0.143} = 34.2$ kg/cm²
$\sigma_s = 15 \times 34.2 \times \frac{0.695}{0.305} = 1168$ 〃
$\tau = 0$

$d/h = 40/44 = 0.910$
$d'/h = 4/44 = 0.091$
$p_0 = 13.41/100 \times 44 = 0.00305$
$p_0' = 2.51/$ 〃 $= 0.00057$
$u/h = 0.514$
$u = 22.5$ cm
$d-u = 17.5$ 〃

$b = 100$ cm　$h = 44$ cm
$d = 40$　$d' = 4$
$A_s = 6.67 - 16\phi = 13.41$ cm²
$A_s' = 2.22 - 12\phi = 2.51$ 〃
$p = 13.41/100 \times 240 = 0.00335$
$p_1 = 2.51/$ 〃 $= 0.00063$
$d'/d = 4/40 = 0.100$

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設計 手指 日付 16-10-18 類別 CVB5
照査 日付 第 30 頁

上海晴渠 3m×3m

(H3) $M_{H3} = 390$ kgm　$N = 5810$ kg　$S = 10270$ kg

$\tau = \frac{10270}{100 \times 7/8 \times 40} = 2.9$ kg/cm²

(B) $M_B = -4120$ kgm　$N = 5810$ kg　$S_B = 13400$ kg

$d/h = 53/57 = 0.930$
$d'/h = 4/57 = 0.070$
$p_0 = 7.54/100 \times 57 = 0.00132$
$p_0' = 2.51/\ \ = 0.00044$
$u/h = 0.508$
$u = 29.0$ cm
$d-u = 24.0$

$\frac{M}{N} = \frac{4120 \times 100}{5810} = 71.0$
$d-u = 24.0$
$e = 95.0$ cm
$e' = e - 49 = 46.0$
$e'/e = 0.484$
$\frac{Ne}{bd^2} = \frac{5810 \times 95.0}{100 \times 53^2} = 1.965$
$\frac{Ne}{bd^2\sigma_c} = 0.123$　$k = 0.260$
$\sigma_c = \frac{1.965}{0.123} = 16.0$ kg/cm²
$\sigma_s = 15 \times 16.0 \times \frac{0.740}{0.260} = 684$ 〃
$\tau = \frac{13400}{100 \times 1913 \times 53} = 2.8$ 〃

$b=100$, $h = 44 + \frac{38}{3} = 57$
$d = 53$　$d' = 4$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.22 - 12\phi = 2.51$
$p = 7.54/100 \times 53 = 0.00142$
$p' = 2.51/\ \ = 0.00047$
$d'/d = 4/53 = 0.075$

側壁

(B) $M_B = -4120$ kgm　$N = 13400$ kg　$S = 5810$ kg

$d/h = 38/42 = 0.905$
$d'/h = 4/42 = 0.095$
$p_0 = 7.54/100 \times 42 = 0.00180$
$p_0' = 2.51/\ \ = 0.00060$
$u/h = 0.508$
$u = 21.3$ cm
$d-u = 16.7$ 〃

$\frac{M}{N} = \frac{4120 \times 100}{13400} = 30.8$
$d-u = 16.7$
$e = 47.5$ cm
$e' = e - 34 = 13.5$ 〃
$e'/e = 0.285$
$\frac{Ne}{bd^2} = \frac{13400 \times 47.5}{100 \times 38^2} = 4.41$
$\frac{Ne}{bd^2\sigma_c} = 0.164$　$k = 0.360$
$\sigma_c = \frac{4.41}{0.164} = 26.9$ kg/cm²
$\sigma_s = 15 \times 26.9 \times \frac{0.64}{0.36} = 718$ 〃
$\tau = \frac{5810}{100 \times 0.88 \times 38} = 1.7$ 〃

$b=100$, $h = 26 + \frac{47}{3} = 42$
$d = 38$, $d' = 4$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.22 - 12\phi = 2.51$
$p = 7.54/100 \times 38 = 0.00199$
$p' = 2.51/\ \ = 0.00066$
$d'/d = 4/38 = 0.105$

(D) $M_D = 1125$ kgm, $N = 13400$ kg　$S = 0$

$\frac{M}{N} = \frac{1125 \times 100}{13400} = 8.4$
$d-u = 9.8$ (第25表参照)
$e = 18.2$ cm
$e' = e - 20 = -1.8$
$e'/e = -0.100$
$\frac{Ne}{bd^2} = \frac{13400 \times 18.2}{100 \times 23^2} = 4.61$

$b=100$, $h = 26$
$d = 23$, $d' = 3$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.22 - 12\phi = 2.51$
$p = 7.54/100 \times 23 = 0.00328$
$p' = 2.51/\ \ = 0.00109$
$d'/d = 3/23 = 0.131$

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上海精渠 3m × 3m

設計 稲葉 日付 16-10-20 類別 CVB5
照査 日付 第 31 頁

$\frac{Ne}{bd^2\sigma_c} = 0.293$ $\therefore k = 0.75$

$\sigma_c = \frac{4.61}{0.293} = 15.7$ kg/cm²

$\sigma_s = 15 \times 15.7 \times \frac{1.25}{1.75} = 79$ "

$\tau = 0$

(H2) $M_{H2} = -1735$ kgm $N = 13400$ kg $S = 4290$ kg

断面ハ Ⓓ = 台ニ

$\frac{M}{N} = \frac{1735 \times 100}{13400} = 13.0$

$d-u = 9.8$

$e = 22.8$

$e' = e - z_0 = 2.8$

$e'/e = 0.123$

$\frac{Ne}{bd^2} = \frac{13400 \times 22.8}{100 \times 23^2} = 5.78$

$\frac{Ne}{bd^2\sigma_c} = 0.224$ $\therefore k = 0.51$

$\sigma_c = \frac{5.78}{0.224} = 26.8$ kg/cm²

$\sigma_s = 15 \times 26.8 \times \frac{0.49}{0.51} = 372$ "

$\tau = \frac{4290}{100 \times 183 \times 23} = 2.3$ "

基礎底面圧力

垂直荷重 $V = 2 @ 13400 = 26,800$

側壁 $2 @ 0.26 \times 3.0 @ 2400 = 3740$

30,540 kg

基礎 $4.0 \times 0.75 @ 2200 = 6600$

37,140 kg

$\frac{37140}{4.0} = 9280$ kg/m²

杭 一列 4本 各列間隔 1.0m c to c

杭一本当荷重 $= \frac{37140}{4} = 9,280$ kg

杭 180φ − 4.500 Crosswise spacing 1.1m c to c
lengthwise " 1.0m c to c

基礎鉄筋

上向圧力 $= \frac{30540}{4.0} = 7640$ kg/m²

$M = \frac{1}{2} \times 7640 \times 3.26^2 = 6770$ kgm

$A_s = \frac{6770 \times 100}{1200 \times 7/8 \times 70} = 9.22$ cm²

16φ − 22.5cm c to c = 8.96 "

翼壁 翼壁 ハ CVB3 = 台ニ (第21頁参照)

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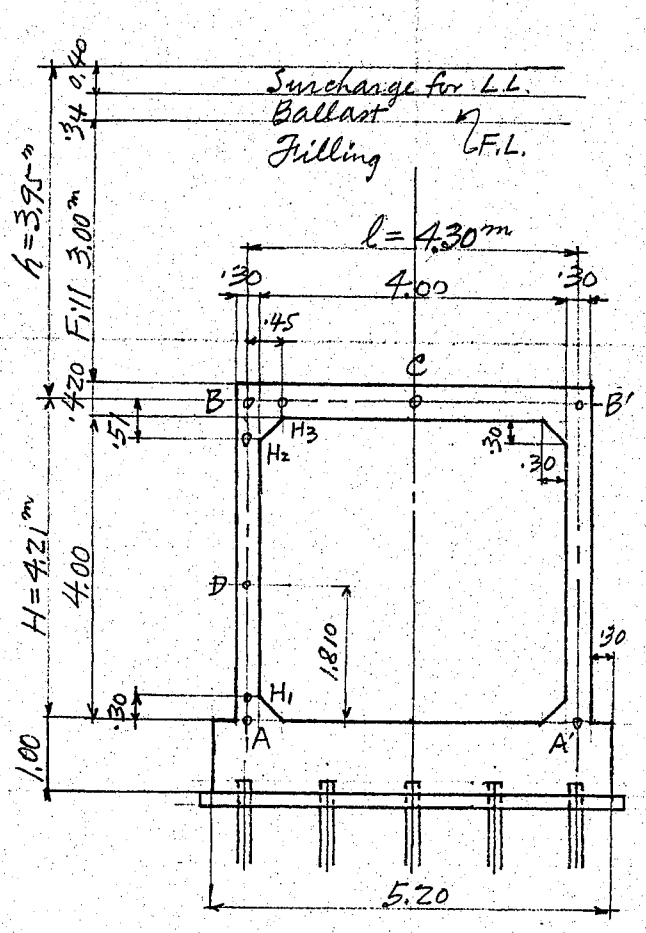
設計 稲葉 日付 16-10-25 類別 CVC3
照査 日付 第 32 頁

上海地下鉄道標準型暗渠 4m×4m

土被 3.0m 標準型暗渠 4m×4m ---- CVC3



活荷重

4@16500 = 66000 kg

分布荷重 $p' = 610$ kg/m² (第1頁參照)

土=接する部分 0.4m 〃

天井荷重

$$wh\left(1-\frac{hk}{1+2Hc}\right) = 1600\times 3.95\left(1-\frac{3.95\times 0.19}{1+2\times 4.21\times 0.58}\right) = 5510$$

(.8735)

天井自重 0.45@2400 = 1080

天井荷重 p = 6590 kg/m²

側壁土圧

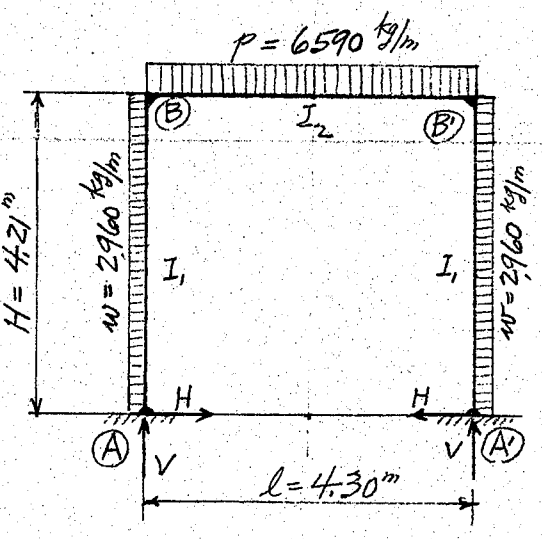
B点=於ケル土圧 $\frac{1}{3}\times 5510 = 1840$

$\frac{1}{3}\times 1600\times 4.21 = 2240$

A点=於ケル土圧 4080 kg/m²

側壁平均土圧 $w = \frac{1840+4080}{2} = 2960$ kg/m²

荷重狀態



部材ノ物量力率並ニ諸係数

側壁 $I_1 = \frac{1.0\times 0.30^3}{12} = 0.002250$

$k_1 = \frac{I_1}{H} = \frac{0.002250}{4.21} = 0.000534$

天井 $I_2 = \frac{1.0\times 0.42^3}{12} = 0.006174$

$k_2 = \frac{I_2}{l} = \frac{0.006174}{4.30} = 0.001436$

$2k_1+k_2 = 0.002504$
$3k_1+k_2 = 0.003038$
$5k_1+2k_2 = 0.005542$

天井荷重 p ノ Σ ニ依ル応力

$$M_A = \frac{pl^2k_1}{12(2k_1+k_2)} = \frac{6590\times 4.30^2\times 0.000534}{12\times 0.002504} = 2165 \text{ kgm}$$

$$M_B = -2M_A = -4330 \text{ 〃}$$

$$H = \frac{M_A-M_B}{H} = \frac{2165+4330}{4.21} = 1545 \text{ kg}$$

$$V = \frac{pl}{2} = \frac{6590\times 4.30}{2} = 14160 \text{ 〃}$$

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設計 稍葉 日付 16-10-25 類別 CVC3
照査 日付 第 33 頁

上海暗渠 4m × 4m

側壁荷重 w 1Z = 底ル應力

$$M_A = -\frac{wH^2(3K_1+K_2)}{12(2K_1+K_2)} = -\frac{2960\times 4.21^2\times 0.003038}{12\times 0.002504} = -\ 5300\ \text{kgm}$$

$$M_B = -\frac{wH^2K_2}{12(2K_1+K_2)} = -\frac{2960\times 4.21^2\times 0.001436}{12\times 0.002504} = -\ 2510\ \text{〃}$$

$$H = -\frac{wH(5K_1+2K_2)}{4(2K_1+K_2)} = -\frac{2960\times 4.21\times 0.005542}{4\times 0.002504} = -\ 6900\ \text{kg}$$

$$V = 0$$

合成應力

	荷重 P	荷重 w	合成應力	
M_A	2,165	−5,300	−3,135	kgm
M_B	−4330	−2,510	−6,840	〃
H	1,545	−6,900	−5,355	kg ← →
V	14,160	0	14,160	〃 ↑ ↑

剪力

$S_A = -H = 5,355$ kg
$S_{H1} = 5355 - 2960\times 0.30 = 4465$ 〃
Ⓓ $x = 5355 \div 2960 = 1.81^m$ above Ⓐ
$S_D = 0$
$S_{H2} = 5355 - 2960\times 3.70 = -5,595$ kg
側壁 $S_{B1} = 5355 - 2960\times 4.21 = -7,100$ 〃 $N_2 = 7,100$ kg
天井 $S_{B2} = 6590\times 4.30\div 2 = 14,160$ 〃 $N_1 = 14,160$ kg
$S_{H3} = 14160 - 6590\times 0.45 = 11,200$ 〃
$S_C = 0$

中間点ノ彎曲率

M_{H1}: $5355\times 0.30 = 1,605$; $-\frac{1}{2}\times 2960\times 0.30^2 = -130$; $M_A = -3,135$
$M_{H1} = -1,660$ kgm

M_D: $5355\times 1.81 = 9690$; $-\frac{1}{2}\times 2960\times 1.81^2 = -4850$; $M_A = -3135$
$M_D = 1,705$ kgm

M_{H2}: $5355\times 3.70 = 19800$; $-\frac{1}{2}\times 2960\times 3.70^2 = -20255$; $M_A = -3135$
$M_{H2} = -3590$ kgm

} $N = 14,160$ kg

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設計 稲葉 日付 16-10-28 類別 CVC3

照査 日付 第 34 頁

上海婿渠 4m × 4m

M_{H3}

$14160 \times 0.45 = 6380$

$-\frac{1}{2} \times 6590 \times 0.45^2 = -670$

$M_B = -6840$

$M_{H3} = -1130$ kgm

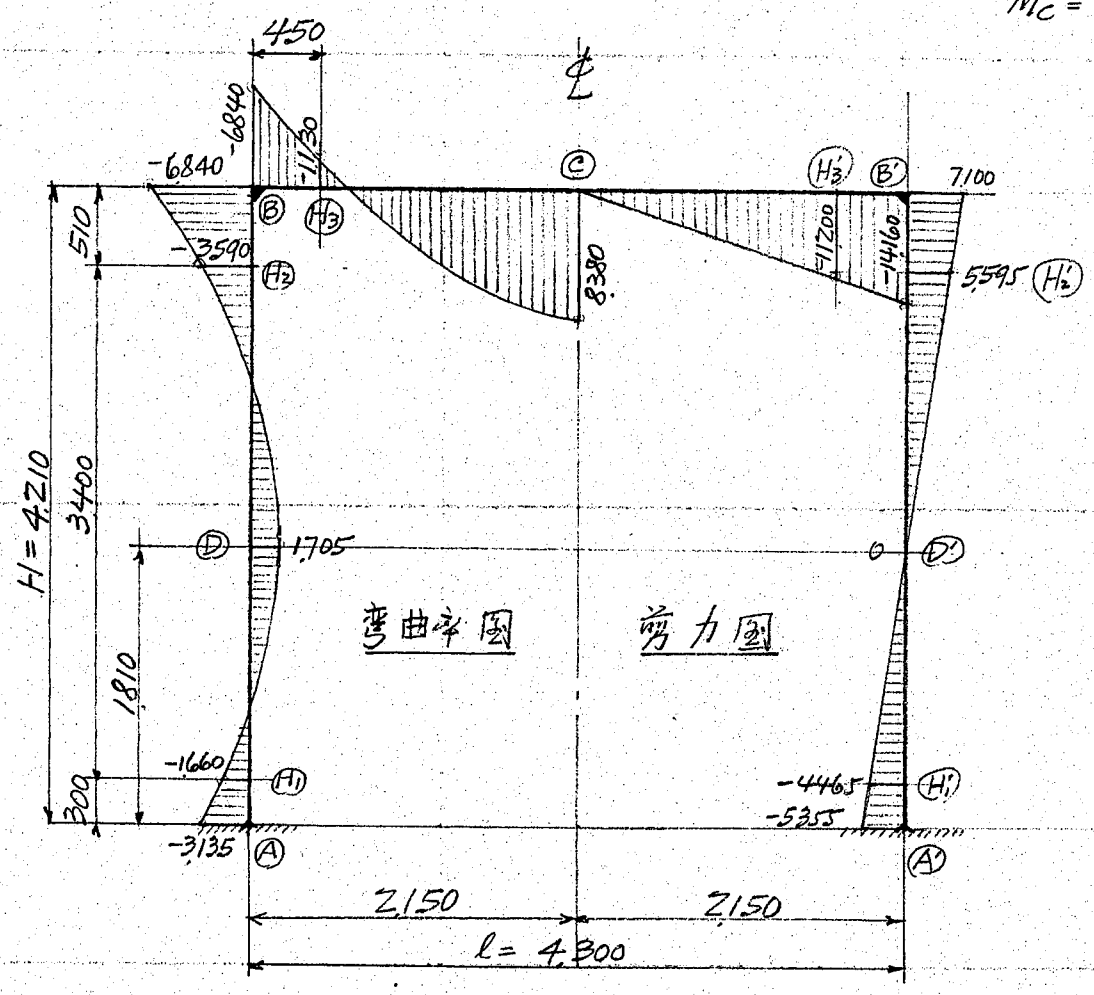
M_C

$\frac{1}{8} \times 6590 \times 4.30^2 = 15220$

$M_B = -6840$

$M_C = 8380$ kgm

$N = 7100$ kg



尺度 弯曲率 $\frac{1}{500}$ m = 1000 kgm

剪力 $\frac{1}{1000}$ m = 1000 kg

縮尺 1:50

断面應力ノ計算

天井

Ⓒ $M_C = 8380$ kgm $N = 7100$ kg $S = 0$

$b = 100$ cm, $h = 42$ cm

$d = 37$, $d' = 5$

$d/h = 37/42 = 0.88$

$d'/h = 5/42 = 0.119$

$A_s = 6.67 - 19\phi = 18.90$ cm²

$A_s' = 2.23 - 19\phi = 6.30$ "

$p_0 = 18.90/100 \times 42 = 0.00450$

$p_0' = 6.30/\ " = 0.00150$

$p = 18.90/100 \times 37 = 0.00511$

$p' = 6.30/\ " = 0.00170$

$d'/d = 5/37 = 0.135$

$u/h = 0.515$

$u = 21.6$ cm

$d-u = 15.4$ "

$\frac{M}{N} = \frac{8380 \times 100}{7100} = 118.0$

$d-u = 15.4$

$e = 133.4$ cm

$e' = e - 32 = 101.4$ "

$e'/e = 0.761$

$\frac{Ne}{bd^2} = \frac{7100 \times 133.4}{100 \times 37^2} = 6.92$

$\frac{Ne}{bd^2\sigma_c} = 0.171$ $k = 0.355$

$\sigma_c = \frac{6.92}{0.171} = 40.5$ kg/cm²

$\sigma_s = 15 \times 40.5 \times \frac{0.645}{0.355} = 1104$ kg/cm²

$\tau = 0$

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設計 稲葉 日付 16-10-28 類別 CVC3
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上海暗渠 4m × 4m

(H3) $M_{H3} = -1130$ kgm , $N = 7100$ kg , $S = 11200$ kg

$$\tau = \frac{11200}{100 \times 7/8 \times 37} = 3.5 \text{ kg/cm}^2$$

(B) $M_B = -6840$ kgm $N = 7100$ kg $S = 14160$ kg

$d/h = 52/57 = 0.912$
$d'/h = 5/57 = 0.0877$
$p_0 = 13.41/100 \times 57 = 0.00235$
$p_0' = 4.47/\,\text{〃} = 0.00078$
$u/h = 0.51$
$u = 29.0$ cm
$d-u = 23.0$

$\frac{M}{N} = \frac{6840 \times 100}{7100} = 96.4$
$d-u = 23.0$
$e = 119.4$ cm
$e' = e - 47 = 72.4$
$e/c = 0.606$

$\frac{Ne}{bd^2} = \frac{7100 \times 119.4}{100 \times 52^2} = 3.14$

$\frac{Ne}{bd^2\sigma_c} = 0.142$, $k = 0.295$

$\sigma_c = \frac{3.14}{0.142} = 22.1$ kg/cm²

$\sigma_s = 15 \times 22.1 \times \frac{0.705}{0.295} = 793$ 〃

$\tau = \frac{14160}{100 \times 0.902 \times 52} = 3.0$ 〃

$b = 100$, $h = 42 + \frac{45}{3} = 57$
$d = 52$, $d' = 5$
$A_s = 6.67 - 16\phi = 13.41$ cm²
$A_s' = 2.23 - 16\phi = 4.47$
$p = 13.41/100 \times 52 = 0.00258$
$p' = 4.47/\,\text{〃} = 0.00086$
$d'/d = 5/52 = 0.096$

側壁

(B) $M_B = -6840$ kgm , $N = 14160$ kg , $S = -7100$ kg

$d/h = 42/47 = 0.884$
$d'/h = 5/47 = 0.106$
$p_0 = 13.41/100 \times 47 = 0.00286$
$p_0' = 4.47/\,\text{〃} = 0.00095$
$u/h = 0.510$
$u = 24.0$ cm
$d-u = 18.0$

$\frac{M}{N} = \frac{6840 \times 100}{14160} = 48.3$
$d-u = 18.0$
$e = 66.3$ cm
$e' = e - 37 = 29.3$ 〃
$e/c = 0.442$

$\frac{Ne}{bd^2} = \frac{14160 \times 66.3}{100 \times 42^2} = 5.33$

$\frac{Ne}{bd^2\sigma_c} = 0.173$, $k = 0.365$

$\sigma_c = \frac{5.33}{0.173} = 30.8$ kg/cm²

$\sigma_s = 15 \times 30.8 \times \frac{0.635}{0.365} = 805$ 〃

$\tau = \frac{7100}{100 \times 0.877 \times 42} = 1.9$ 〃

$b = 100$ $h = 30 + \frac{51}{3} = 47$
$d = 42$ $d' = 5$
$A_s = 6.67 - 16\phi = 13.41$ cm²
$A_s' = 2.23 - 16\phi = 4.47$ 〃
$p = 13.41/100 \times 42 = 0.00320$
$p' = 4.47/\,\text{〃} = 0.00107$
$d'/d = 5/42 = 0.119$

(D) $M_D = 1705$ kgm $N = 14160$ kg $S = 0$

$d/h = 26/30 = 0.865$
$d'/h = 4/30 = 0.133$
$p_0 = 13.41/100 \times 30 = 0.00448$
$p_0' = 4.47/\,\text{〃} = 0.00149$
$u/h = 0.515$
$u = 15.4$ cm
$d-u = 10.6$ 〃

$\frac{M}{N} = \frac{1705 \times 100}{14160} = 12.0$
$d-u = 10.6$
$e = 22.6$ cm
$e' = e - 22 = 0.6$ 〃
$e/e = 0.027$

$\frac{Ne}{bd^2} = \frac{14160 \times 22.6}{100 \times 26^2} = 4.74$

$b = 100$, $h = 30$
$d = 26$ $d' = 4$
$A_s = 6.67 - 16\phi = 13.41$
$A_s' = 2.23 - 16\phi = 4.47$
$p = 13.41/100 \times 26 = 0.00517$
$p' = 4.47/\,\text{〃} = 0.00172$
$d'/d = 4/26 = 0.154$

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上海晴渠 4m×4m

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$\frac{Ne}{bd^2\sigma_c} = 0.271$ $k = 0.650$

$\sigma_c = \frac{4.74}{0.271} = 17.5$ kg/cm²

$\sigma_s = 15 \times 17.5 \times \frac{0.35}{0.65} = 141$ "

$\tau = 0$

(H2) $M_{H2} = -3590$ kgm, $N = 14160$ kg, $S = 5595$ kg

$\frac{M}{N} = \frac{3590 \times 100}{14160} = 25.4$

$e = \frac{10.6}{36.0}$ cm

$e' = e - 22 = 14.0$ "

$e'/e = 0.390$

$\frac{Ne}{bd^2} = \frac{14160 \times 36.0}{100 \times 26^2} = 7.55$

$\frac{Ne}{bd^2\sigma_c} = 0.210$, $k = 0.460$

$\sigma_c = \frac{7.55}{0.210} = 36.0$ kg/cm²

$\sigma_s = 15 \times 36.0 \times \frac{0.540}{0.460} = 634$ "

$\tau = \frac{5595}{100 \times 0.847 \times 26} = 2.5$ "

断面 (D) = 全巾

基礎底面圧力

垂直荷重	$V = 2 @ 14160$	=	28320
側壁自重	$2 @ 0.30 \times 4 @ 2400$	=	5760
			34,080 kg
基礎	$5.20 \times 1.00 @ 2200$	=	11.440
			45520 kg = 8,760 kg/m²
			5.20

杭一列 5本 各列間隔 1.00m c to c

杭一本当荷重 $= \frac{45520}{5} = 9,100$ kg

杭 180φ × 4.500 crosswise spacing 1.1m c to c
lengthwise " 1.0m c to c

基礎鉄筋

上向圧力 $= \frac{34080}{5.2} = 6550$ kg/m²

$M = \frac{1}{12} \times 6550 \times 4.30^2 = 10,080$ kgm

$A_s = \frac{10080 \times 100}{1200 \times 7/8 \times 95} = 10.1$ cm²

19φ −	45cm c to c =	6.30	(A Row = 挿入)
16φ −	" " =	4.48	(B と B row の中3 = 挿入)
		10.78 cm²	

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上海埠渠 4m×4m

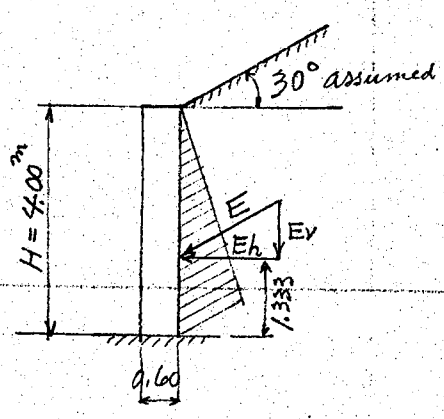
翼壁

土圧

Cos 30° = 0.866

$E = \frac{1}{2} \times 1600 \times 4.0^2 \times 0.866 = 11{,}080$ kg

$E_h = 11080 \times 0.866 = 9600$ kg
$E_V = 11080 \times 0.500 = 5540$ "



9600 × 1.333 = 12750
− 5540 × 0.30 = − 1660
M = 11,090 kgm

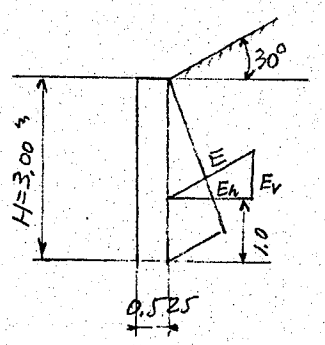
$d = \sqrt{\frac{11090 \times 100}{100 \times 7.13}} = 39.5$ cm　　$d = 55$ cm 被覆 5cm 仍 h = 60 cm とす

$A_s = \frac{11090 \times 100}{1200 \times 0.908 \times 55} = 18.53$ cm²

19φ − 15cm c to c = 18.90 cm²　　$p = \frac{18.90}{100 \times 55} = 0.00344$, $j = 0.908$

$\tau = \frac{9600}{100 \times .908 \times 55} = 1.9$ kg/cm²

高サ 3m ノ箇所.



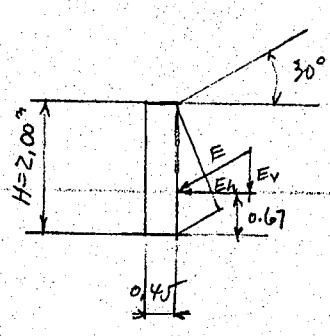
$E = \frac{1}{2} \times 1600 \times 3.0^2 \times 0.866 = 6230$ kg
$E_h = 6230 \times 0.866 = 5400$ kg
$E_V = 6230 \times 0.500 = 3120$ "

5400 × 1.00 = 5400
− 3120 × 0.263 = − 820
M = 4580 kgm

$A_s = \frac{4580 \times 100}{1200 \times 0.9 \times 47.5} = 8.94$ cm²

16φ − 20cm c to c = 10.06 cm²

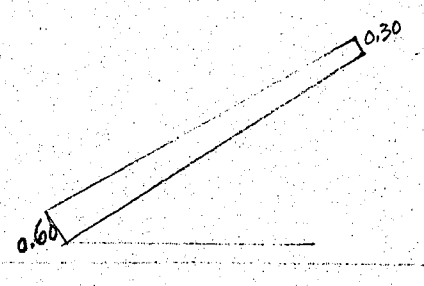
高サ 2m ノ箇所.



$E = \frac{1}{2} \times 1600 \times 2.0^2 \times 0.866 = 2770$ kg
$E_h = 2770 \times 0.866 = 2400$ kg
$E_V = 2770 \times 0.50 = 1385$ "

2400 × 0.67 = 1600
− 1385 × 0.225 = − 310
M = 1290 kgm

$A_s = \frac{1290 \times 100}{1200 \times 0.9 \times 40} = 2.99$ cm²



16φ − 40cm c to c = 5.03 cm².

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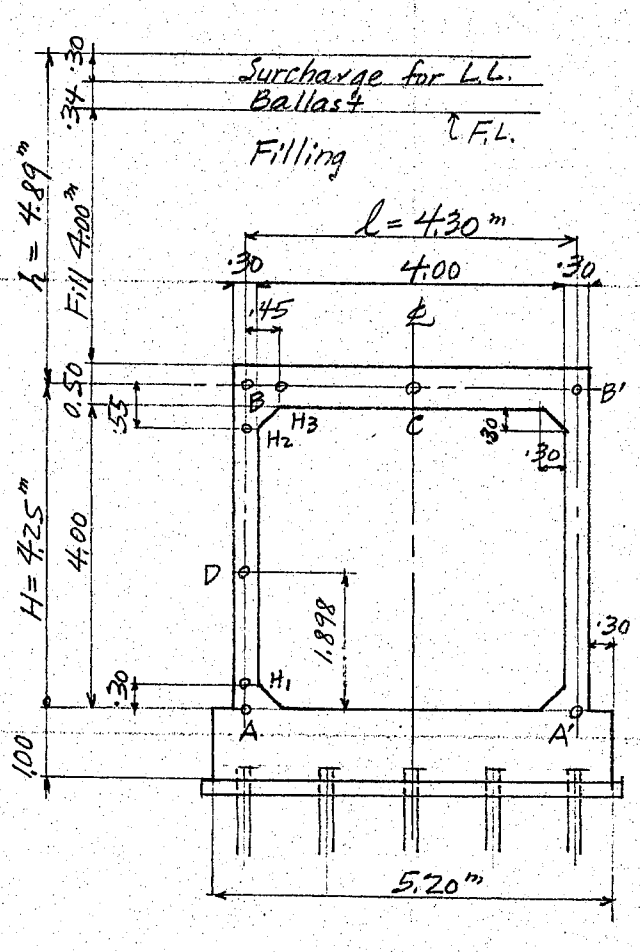
上海暗渠 4m×4m

土被 4.0m 標準型暗渠 4m×4m --- CVC4



活荷重
4@16500 = 66000 kg

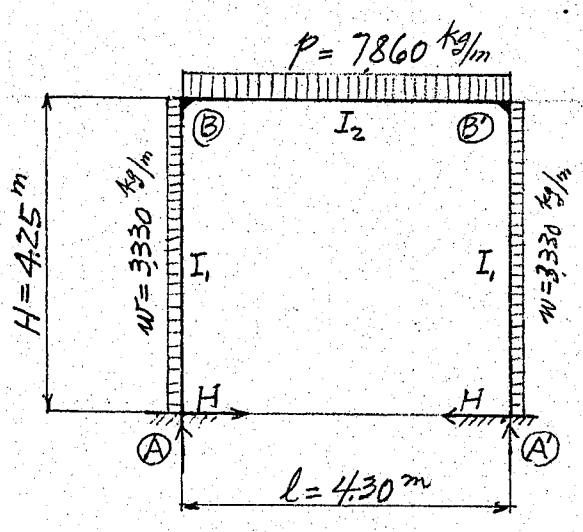
分布荷重 p' = 425 kg/m² (第22頁参照)
土に接する壁の深さ 0.38m

天井荷重
$w h \left(1-\frac{h k}{1+2HC}\right) = 1600\times 4.89\left(1-\frac{4.89\times 0.19}{1+2\times 4.25\times 0.58}\right)^{.843} = 6590$

天井重量 0.53@2400 = 1270
天井荷重 p = 7860 kg/m²

側壁土圧
B点=於ケル土圧 $\frac{1}{3}\times 6590 = 2200$
$\frac{1}{3}\times 1600\times 4.25 = 2265$
A点=於ケル土圧 = 4465 kg/m²
側壁平均土圧 $w = \frac{2200+4465}{2} = 3330$ kg/m²

荷重狀態



部材ノ物量力率並ニ諸係数

側壁 $I_1 = \frac{1.0\times 0.30^3}{12} = 0.002250$

$k_1 = \frac{I_1}{H} = \frac{0.002250}{4.25} = 0.000529$

天井 $I_2 = \frac{1.0\times 0.50^3}{12} = 0.010417$

$k_2 = \frac{I_2}{l} = \frac{0.010417}{4.30} = 0.002422$

$2k_1+k_2 = 0.003480$
$3k_1+k_2 = 0.004009$
$5k_1+2k_2 = 0.007489$

天井荷重 p ノ ミニ依ル応力

$M_A = \frac{pl^2k_1}{12(2k_1+k_2)} = \frac{7860\times 4.30^2\times 0.000529}{12\times 0.003480} = 1840$ kgm

$M_B = -2M_A = -3680$ "

$H = \frac{M_A-M_B}{H} = \frac{1840+3680}{4.25} = 1300$ kg

$V = \frac{pl}{2} = \frac{7860\times 4.30}{2} = 16900$ kg

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上海婿渠 4m×4m

側壁荷重 wによる応力

$$M_A = -\frac{wH^2(3K_1+K_2)}{12(2K_1+K_2)} = -\frac{3330\times 4.25^2\times 0.004009}{12\times 0.003480} = -5{,}770 \text{ kgm}$$

$$M_B = -\frac{wH^2K_2}{12(2K_1+K_2)} = -\frac{3330\times 4.25^2\times 0.002422}{12\times 0.003480} = -3{,}490 \text{ "}$$

$$H = -\frac{wH(5K_1+2K_2)}{4(2K_1+K_2)} = -\frac{3330\times 4.25\times 0.007489}{4\times 0.003480} = -7620 \text{ kg}$$

$$V = 0$$

合成応力

	荷重 p	荷重 w	合成応力	
M_A	1,840	−5,770	−3,930	kgm
M_B	−3,680	−3,490	−7,170	"
H	1,300	−7,620	−6,320	kg ← →
V	16,900	0	16,900	" ↑ ↑

剪力

$S_A = -H = 6{,}320$ kg

$S_{H1} = 6320 - 3330\times 0.30 = 5320$ "

Ⓓ $x = 6320 \div 3330 = 1.898^m$ above Ⓐ

$S_D = 0$

$S_{H2} = 6320 - 3330\times 3.70 = -6{,}000$ kg

側壁 $S_{B1} = 6320 - 3330\times 4.25 = -7830$ " $N_2 = 7830$ kg

天井 $S_{B2} = 7860\times 4.30 \div 2 = 16{,}900$ " $N_1 = 16{,}900$ kg

$S_{H3} = 16900 - 7860\times 0.45 = 13{,}370$ "

$S_C = 0$

中間点、弯曲率

M_{H1}

$6320\times 0.30 = 1{,}895$

$-\frac{1}{2}\times 3330\times 0.30^2 = -150$

$M_A = -3{,}930$

$M_{H1} = -2{,}185$ kgm

M_D

$6320\times 1.898 = 11{,}990$

$-\frac{1}{2}\times 3330\times 1.898^2 = -5{,}950$

$M_A = -3{,}930$

$M_D = 2{,}110$ kgm

M_{H2}

$6330\times 3.70 = 23400$

$-\frac{1}{2}\times 3330\times 3.70^2 = -22{,}800$

$M_A = -3{,}930$

$M_{H2} = -3{,}330$ kgm

} $N = 16{,}900$ kg

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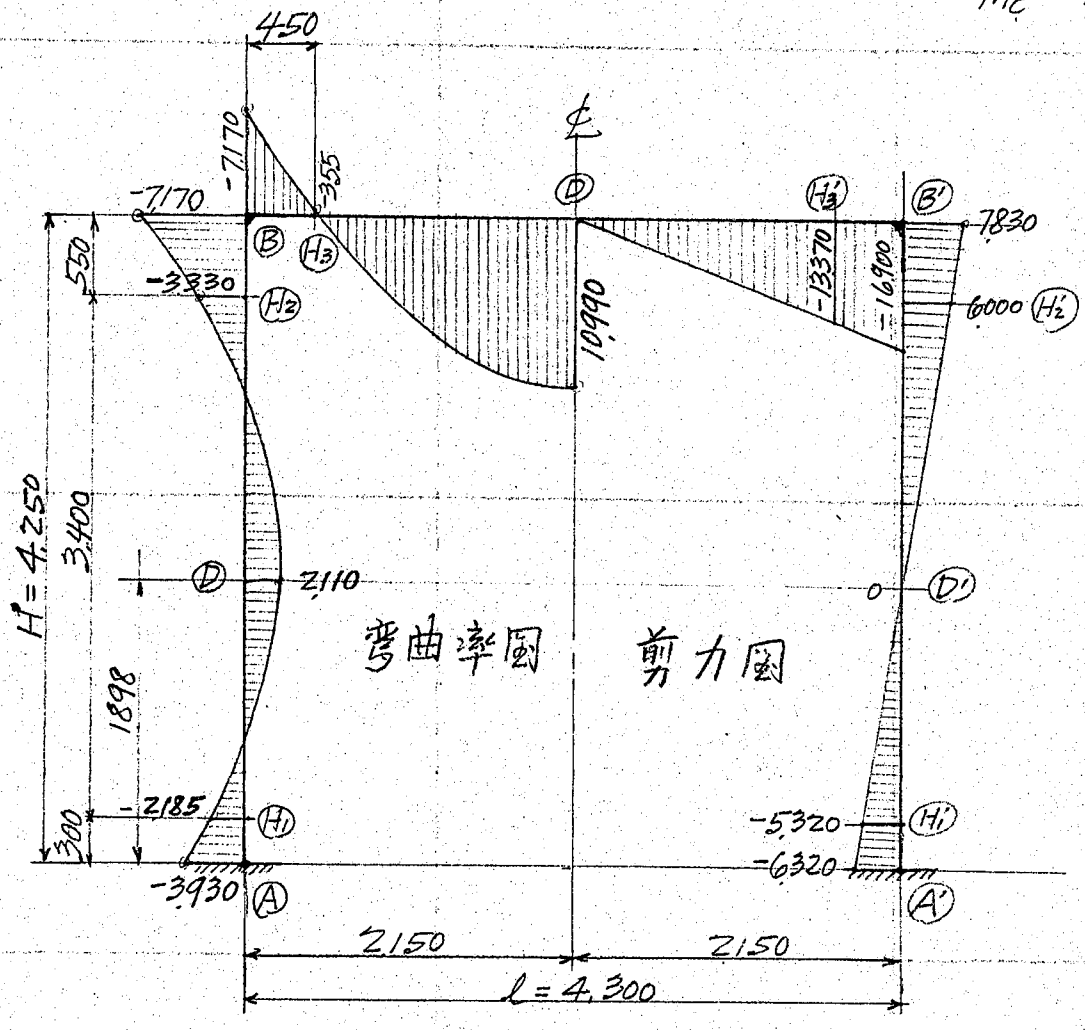
上海晴渠 4m×4m

M_{H3} $16900 \times 0.45 = 7610$
$-\frac{1}{2} \times 7860 \times 0.45^2 = -795$
$M_B = -7170$
$M_{H3} = -355$ kgm

M_C $\frac{1}{8} \times 7860 \times 4.30^2 = 18160$
$M_B = -7170$
$M_C = 10990$ kgm



尺度 弯曲率 $\frac{1}{500}$ m = 1000 kgm
剪力 $\frac{1}{1000}$ m = 1000 kgm
縮尺 1:50

断面應力ノ計算

天井

Ⓒ $M_C = 10990$ kgm $N = 7830$ kg $S = 0$

$d/h = 45/50 = 0.900$
$d'/h = 5/50 = 0.100$
$p_0 = 18.90/100 \times 50 = 0.00378$
$p_0' = 6.30/\ \ \ = 0.00126$
$u/h = 0.512$
$u = 25.60$ cm
$d-u = 19.40$ 〃

$\frac{M}{N} = \frac{10990 \times 100}{7830} = 140.5$
$d-u = 19.4$
$e = 159.9$ cm
$e' = e-40 = 119.9$ 〃
$e'/e = 0.751$
$\frac{Ne}{bd^2} = \frac{7830 \times 159.9}{100 \times 45^2} = 6.185$
$\frac{Ne}{bd^2\sigma_c} = 0.162$ $k = 0.330$
$\sigma_c = \frac{6.185}{0.162} = 38.2$ kg/cm²
$\sigma_s = 15 \times 38.2 \times \frac{0.67}{0.33} = 1163$ 〃
$\tau = 0$

$b = 100$ cm, $h = 50$ cm
$d = 45$, $d' = 5$
$A_s = 6.67 - 19\phi = 18.90$ cm²
$A_s' = 2.23 - 19\phi = 6.30$ 〃
$p = 18.90/100 \times 45 = 0.00420$
$p' = 6.30/\ \ \ = 0.00140$
$d''/d = 5/45 = 0.111$

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上海婿渠 4m × 4m

(H3) $M_{H3} = -355$ kgm　$N = 7830$ kg　$S = 13370$ kg

$$\tau = \frac{13370}{100 \times 7/8 \times 45} = 3.4 \text{ kg/cm}^2$$

(B) $M_B = -7170$ kgm,　$N = 7830$ kg　$S = 16900$ kg

$d/h = 60/65 = 0.923$
$d'/h = 5/65 = 0.077$
$p_0 = 13.41/100 \times 65 = 0.00206$
$p_0' = 4.47/\,, = 0.00069$
$u/h = 0.51$
$u = 33.2$ cm
$d-u = 26.8$ "

$\frac{M}{N} = \frac{7170 \times 100}{7830} = 91.7$
$d-u = 26.8$
$e = 118.5$ cm
$e' = e - 55 = 63.5$ "
$e'/e = 0.536$
$\frac{Ne}{bd^2} = \frac{7830 \times 118.5}{100 \times 60^2} = 2.58$
$\frac{Ne}{bd^2\sigma_c} = 0.139$　$k = 0.290$
$\sigma_c = \frac{2.58}{0.139} = 18.6$ kg/cm²
$\sigma_s = 15 \times 18.6 \times \frac{.710}{.290} = 684$ "
$\tau = \frac{16900}{100 \times 0.903 \times 60} = 3.1$ "

$b = 100$　$h = 50 + \frac{45}{3} = 65$
$d = 60$　$d' = 5$
$A_s = 6.67 - 16\phi = 13.41$ cm²
$A_s' = 2.23 - 16\phi = 4.47$ "
$p = 13.41/100 \times 60 = 0.00224$
$p' = 4.47/\,, = 0.00075$
$d'/d = 5/60 = 0.083$

側壁

(B) $M_B = -7170$ kgm,　$N = 16,900$ kg　$S = -7830$ kg

$d/h = 44/48 = 0.927$
$d'/h = 4/48 = 0.083$
$p_0 = 13.41/100 \times 48 = 0.00280$
$p_0' = 4.47/\,, = 0.00093$
$u/h = 0.51$
$u = 24.5$ cm
$d-u = 19.5$ "

$\frac{M}{N} = \frac{7170 \times 100}{16900} = 42.4$
$d-u = 19.5$
$e = 61.9$ cm
$e' = e - 40 = 21.9$ "
$e'/e = 0.354$
$\frac{Ne}{bd^2} = \frac{16900 \times 61.9}{100 \times 44^2} = 5.41$
$\frac{Ne}{bd^2\sigma_c} = 0.178$,　$k = 0.38$
$\sigma_c = \frac{5.41}{0.178} = 30.4$ kg/cm²
$\sigma_s = 15 \times 30.4 \times \frac{0.62}{0.38} = 744$ "
$\tau = \frac{7830}{100 \times .873 \times 44} = 2.0$ "

$b = 100$,　$h = 30 + \frac{55}{3} = 48$
$d = 44$,　$d' = 4$
$A_s = 6.67 - 16\phi = 13.41$
$A_s' = 2.23 - 16\phi = 4.47$
$p = 13.41/100 \times 44 = 0.00305$
$p' = 4.47/\,, = 0.00102$
$d'/d = 4/44 = 0.091$

(D) $M_D = 2110$ kgm　$N = 16900$ kg　$S = 0$

$d/h = 26/30 = 0.866$
$d'/h = 4/30 = 0.133$
$p_0 = 13.41/100 \times 30 = 0.00447$
$p_0' = 4.47/\,, = 0.00149$
$u/h = 0.516$
$u = 15.5$ cm
$d-u = 10.5$ "

$\frac{M}{N} = \frac{2110 \times 100}{16900} = 12.5$
$d-u = 10.5$
$e = 23.0$ cm
$e' = e - 22 = 1.0$ "
$e'/e = 0.044$
$\frac{Ne}{bd^2} = \frac{16900 \times 23.0}{100 \times 26^2} = 5.76$

$b = 100$,　$h = 30$
$d = 26$,　$d' = 4$
$A_s = 6.67 - 16\phi = 13.41$
$A_s' = 2.23 - 16\phi = 4.47$
$p = 13.41/100 \times 26 = 0.00516$
$p' = 4.47/\,, = 0.00172$
$d'/d = 4/26 = 0.154$

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上海精渠 4m×4m

設計 稲葉 日付 16-10-30 類別 CVC4
照査 日付 第 42 頁

$\frac{Ne}{bd^2\sigma_c} = 0.273$ $k = 0.66$

$\sigma_c = \frac{5.76}{.273} = 21.1$ kg/cm²

$\sigma_s = 15 \times 21.1 \times \frac{.34}{.66} = 163$ 〃

$\tau = 0$

(H2) $M_{H2} = -3330$ kgm $N = 16900$ kg $S = -6000$ kg 断面 ⓓ = 仝じ

$\frac{M}{N} = \frac{3330 \times 100}{16900} = 19.7$

$d-u = \frac{10.5}{30.2}$ cm

$e =$

$e' = e - 22 = 8.2$ 〃

$e'/e = 0.272$

$\frac{Ne}{bd^2} = \frac{16900 \times 30.2}{100 \times 26^2} = 7.55$

$\frac{Ne}{bd^2\sigma_c} = 0.222$ $k = 0.50$

$\sigma_c = \frac{7.55}{0.222} = 34.0$ kg/cm²

$\sigma_s = 15 \times 34.0 \times \frac{0.5}{0.5} = 510$ 〃

$\tau = \frac{6000}{100 \times .833 \times 26} = 2.8$ 〃

基礎底面圧力

垂直荷重	$V = 2@16900$	=	33800
側壁重量	$2@0.3 \times 4@2400$	=	5760
			39560 kg
基礎重量	$5.2 \times 1.0 @ 2200$	=	11440
			51000 kg = 9820 kg/m²
			5.2

杭一列 5本 各列間隔 1.00m c to c

杭1本当荷重 $= \frac{51000}{5} = 10200$ kg

杭 180φ × 5500 Crosswise spacing 1.1m c to c
lengthwise 〃 1.0 〃

基礎鉄筋

上向圧力 $= \frac{39560}{5.2} = 7610$ kg/m²

$M = \frac{1}{2} \times 7610 \times 4.3^2 = 11700$ kgm

$A_s = \frac{11700 \times 100}{1200 \times 0.9 \times 95} = 11.4$ cm²

19φ − 45cm c to c	=	6.30
16φ − 45 〃	=	4.48
		10.78 cm².

翼壁 CVC3 = 仝じ (第37頁参照)

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設計 稲葉 日付 16-10-30 類別 CVC5
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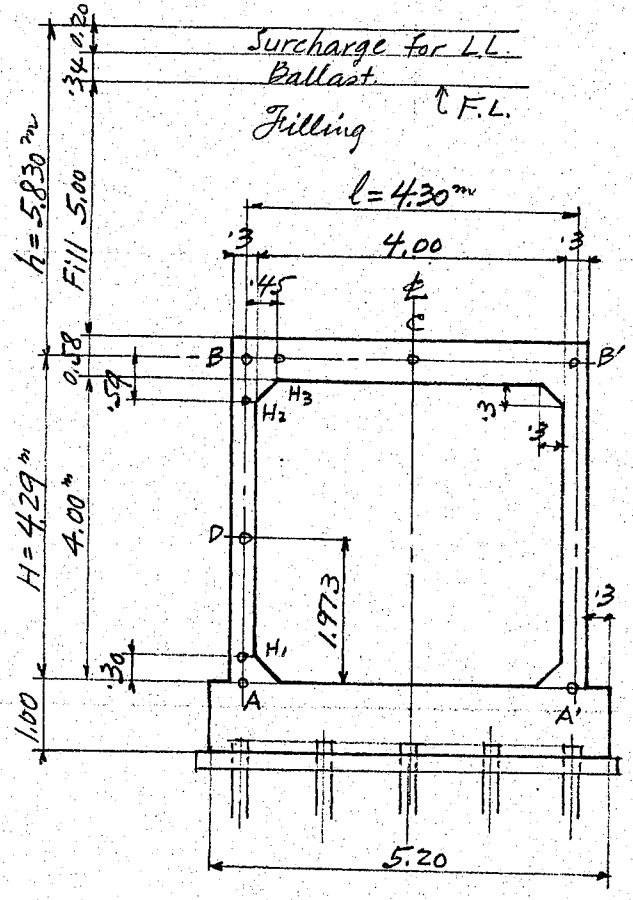
上海暗渠 4m×4m

土被 5.0m 標準型暗渠 4m×4m ---- CVC5.



活荷重
4@16500 = 66000 kg

分布荷重 p' = 315 kg/m² } (第27頁参照)
換算土厚 = 0.20m

天井荷重

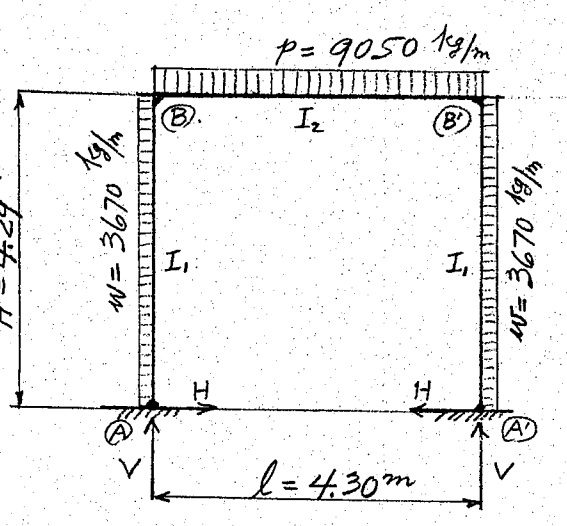
$$wh\left(1-\frac{hk}{1+2HC}\right)=1600\times5.83\left(1-\frac{5.83\times0.19}{1+2\times4.29\times0.58}\right)=7590$$

(.8145)

天井重量 0.61 @2400 = 1460
天井荷重 p = 9050 kg/m²

側壁土圧
B点 = 於ケル土圧 $\frac{1}{3}\times7590$ = 2530
$\frac{1}{3}\times1600\times4.29$ = 2285
A点 = 於ケル土圧 4815 kg/m²
側壁平均土圧 $W=\frac{2530+4815}{2}=3670$ kg/m

荷重状態



部材ノ物置力率並ニ諸係数

側壁 $I_1=\frac{1.0\times0.30^3}{12}=0.002250$

$K_1=\frac{I_1}{H}=\frac{0.002250}{4.29}=0.000524$

天井 $I_2=\frac{1.0\times0.58^3}{12}=0.016259$

$K_2=\frac{I_2}{l}=\frac{0.016259}{4.30}=0.003781$

$2K_1+K_2=0.004829$
$3K_1+K_2=0.005353$
$5K_1+2K_2=0.010182$

天井荷重 p ノ ミ = 依ル應力

$$M_A=\frac{pl^2K_1}{12(2K_1+K_2)}=\frac{9050\times4.30^2\times0.000524}{12\times0.004829}=1515\ \text{kgm}$$

$M_B=-2M_A$ = −3030 〃

$H=\frac{M_A-M_B}{H}=\frac{1515+3030}{4.29}$ = 1060 kg

$V=\frac{pl}{2}=\frac{9050\times4.30}{2}$ = 19460 kg

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上海賄渠 4m×4m

側壁荷重 w ノミ = 依レ度力

$$M_A = -\frac{wH^2(3K_1+K_2)}{12(2K_1+K_2)} = -\frac{3670\times 4.29^2\times 0.005353}{12\times 0.004829} = -6240 \text{ kgm}$$

$$M_B = -\frac{wH^2K_2}{12(2K_1+K_2)} = -\frac{3670\times 4.29^2\times 0.003781}{12\times 0.004829} = -4410 \text{ "}$$

$$H = -\frac{wH(5K_1+2K_2)}{4(2K_1+K_2)} = -\frac{3670\times 4.29\times 0.010182}{4\times 0.004829} = -8300 \text{ kg}$$

$$V = 0$$

合成應力

	荷重 P	荷重 w	合成應力			
M_A	1515	-6240	-4725	kgm		
M_B	-3030	-4410	-7440	"		
H	1060	-8300	-7240	kg	←	→
V	19460	0	19460	"	↑	↑

剪力

$S_A = -H = 7240$ kg
$S_{H1} = 7240 - 3670\times 0.30 = 6140$ "
Ⓓ $x = 7240 \div 3670 = 1.973$ m above Ⓐ
$S_D = 0$
$S_{H2} = 7240 - 3670\times 3.70 = -6340$ kg
側壁 $S_{B1} = 7240 - 3670\times 4.29 = -8500$ " $N_2 = 8500$ kg
天井 $S_{B2} = 9050\times 4.30\div 2 = 19460$ kg $N_1 = 19460$ kg
$S_{H3} = 19460 - 9050\times 0.45 = 15390$ "
$S_C = 0$

中間点ノ彎曲率

M_{H1} 7240 × 0.30 = 2170
$-\frac{1}{2}\times 3670\times 0.30^2 = -165$
$M_A = -4725$
$M_{H1} = -2720$ kgm

M_D 7240 × 1.973 = 14280
$-\frac{1}{2}\times 3670\times 1.973^2 = -7150$
$M_A = -4725$
$M_D = 2405$ kgm

M_{H2} 7240 × 3.70 = 26780
$-\frac{1}{2}\times 3670\times 3.70^2 = -25140$
$M_A = -4725$
$M_{H2} = -3085$ kgm

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設計 稲葉 日付 16-10-31 類別 CVC5

照査 日付 第 45 頁

上海婿渠 4m×4m

M_{H3} $19.460 \times 0.45 = 8.760$

$-\frac{1}{2} \times 9050 \times 0.45^2 = -915$

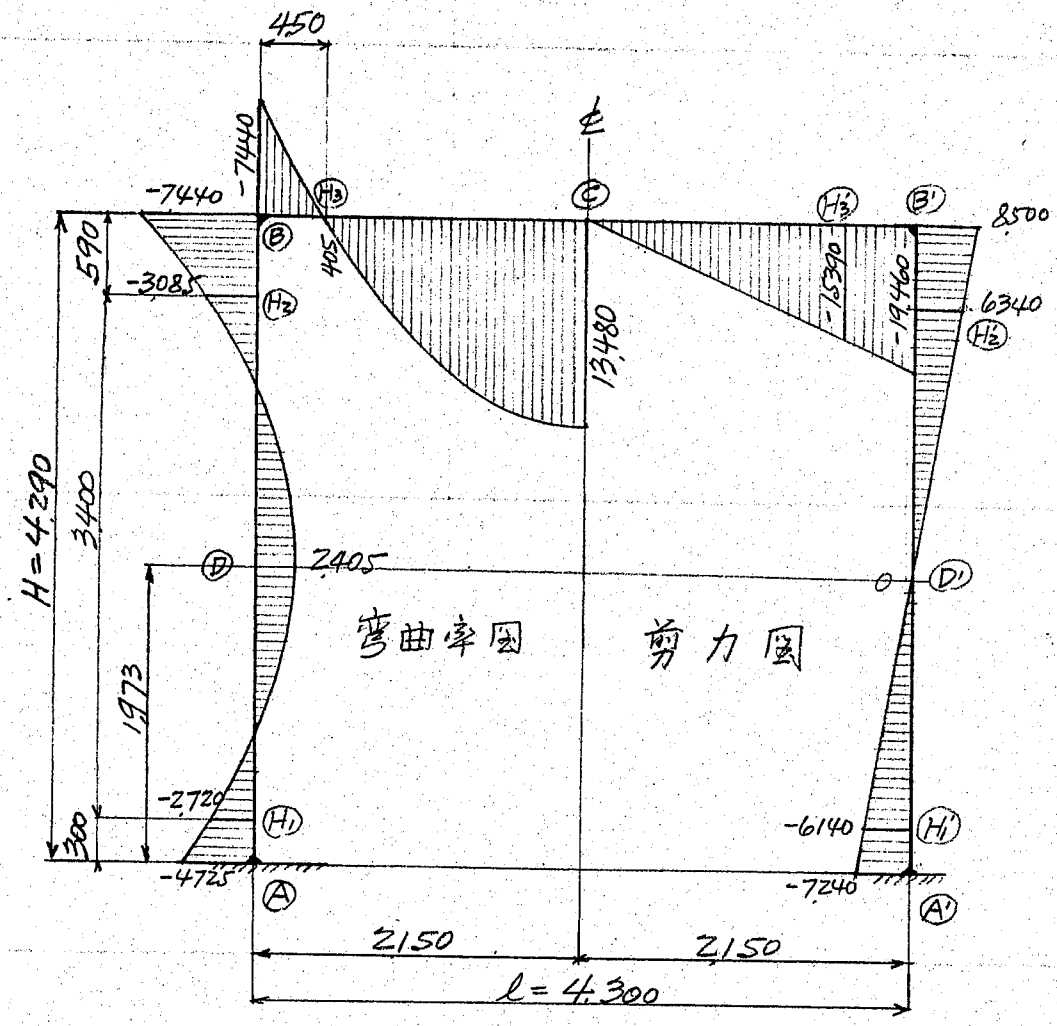
$M_B = -7440$

$M_{H3} = 405$ kgm

M_C $\frac{1}{8} \times 9050 \times 4.30^2 = 20920$

$M_B = -7440$

$M_C = 13480$ kgm



尺度 弯曲率 $\frac{1}{500}^m = 1{,}000$ kgm

剪力 $\frac{1}{1000}^m = 1{,}000$ kg

縮尺 1:50

断面應力ノ計算

天井

Ⓒ $M_C = 13{,}480$ kgm , $N = 8500$ kg $S = 0$

$d/h = 53/58 = 0.914$

$d'/h = 5/58 = 0.086$

$p_0 = 18.90/100 \times 58 = 0.00326$

$p_0' = 6.30/\,, = 0.00109$

$u/h = 0.514$

$u = 29.8$ cm

$d-u = 23.2$,

$\frac{M}{N} = \frac{13480 \times 100}{8500} = 158.6$

$d-u = 23.2$

$e = 181.8$ cm

$e' = e - 48 = 133.8$,

$e'/e = 0.736$

$\frac{Ne}{bd^2} = \frac{8500 \times 181.8}{100 \times 53^2} = 5.50$

$\frac{Ne}{bd^2\sigma_c} = 0.153$, $k = 0.31$

$\sigma_c = \frac{5.50}{0.153} = 35.9$ kg/cm²

$\sigma_s = 15 \times 35.9 \times \frac{0.69}{0.31} = 1197$,

$\tau = 0$

$b = 100$ cm $h = 58$ cm

$d = 53$ cm , $d' = 5$ cm

$A_s = 6.67 - 19\phi = 18.90$ cm²

$A_s' = 2.23 - 19\phi = 6.30$,

$p = 18.90/100 \times 53 = 0.00357$

$p' = 6.30/\,, = 0.00119$

$d'/d = 5/53 = 0.0943$

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設計 稍 日付 16-10-31 類別 CVC5
照査 日付 第 46 頁

上海 晴渠 4m×4m

(H3) $M_{H3} = 405$ kgm　$N = 8500$ kg, $S = 15390$ kg

$$\tau = \frac{15390}{100 \times 7/8 \times 53} = 3.3 \text{ kg/cm}^2$$

(B) $M_B = -7440$ kgm　$N = 8500$ kg, $S = 19460$ kg

$d/h = 68/73 = 0.931$
$d'/h = 5/73 = 0.0685$
$p_0 = 13.41/100 \times 73 = 0.00183$
$p_0' = 4.47/\ \text{〃} = 0.00061$
$u/h = 0.509$
$u = 37.2$ cm
$d-u = 30.8$ 〃

$\frac{M}{N} = \frac{7440 \times 100}{8500} = 87.6$
$d-u = 30.8$
$e = 118.4$ cm
$e' = e - 63 = 55.4$
$e'/e = 0.468$
$\frac{Ne}{bd^2} = \frac{8500 \times 118.4}{100 \times 68^2} = 2.177$
$\frac{Ne}{bd^2\sigma_c} = 0.138$　$k = 0.290$
$\sigma_c = \frac{2.177}{0.138} = 15.8$ kg/cm²
$\sigma_s = 15 \times 15.8 \times \frac{0.710}{0.290} = 580$ 〃
$\tau = \frac{19460}{100 \times .903 \times 68} = 3.2$ 〃

$b=100$, $h = 58 + \frac{45}{3} = 73$
$d=68$, $d'=5$
$A_s = 6.67 - 16\phi = 13.41$
$A_s' = 2.23 - 16\phi = 4.47$
$p = 13.41/100 \times 68 = 0.00197$
$p' = 4.47/\ \text{〃} = 0.00066$
$d'/d = 5/68 = 0.0735$

側壁

(B) $M_B = -7440$ kgm　$N = 19460$ kg　$S = -8500$ kg

$d/h = 44/50 = 0.880$
$d'/h = 4/50 = 0.080$
$p_0 = 13.41/100 \times 50 = 0.00268$
$p_0' = 4.47/\ \text{〃} = 0.00089$
$u/h = 0.506$
$u = 25.3$ cm
$d-u = 20.7$ 〃

$\frac{M}{N} = \frac{7440 \times 100}{19460} = 38.2$
$d-u = 20.7$
$e = 58.9$ cm
$e' = e - 42 = 16.9$ 〃
$e'/e = 0.287$
$\frac{Ne}{bd^2} = \frac{19460 \times 58.9}{100 \times 46^2} = 5.42$
$\frac{Ne}{bd^2\sigma_c} = 0.182$　$k = 0.395$
$\sigma_c = \frac{5.42}{0.182} = 29.8$ kg/cm²
$\sigma_s = 15 \times 29.8 \times \frac{0.605}{0.395} = 685$ 〃
$\tau = \frac{8500}{100 \times .868 \times 46} = 2.1$ 〃

$b=100$, $h = 30 + \frac{59}{3} = 50$
$d=46$, $d'=4$
$A_s = 6.67 - 16\phi = 13.41$
$A_s' = 2.23 - 16\phi = 4.47$
$p = 13.41/100 \times 46 = 0.00292$
$p' = 4.47/\ \text{〃} = 0.00097$
$d'/d = 4/46 = 0.087$

(D) $M_D = 2405$ kgm　$N = 19460$ kg　$S = 0$

$\frac{M}{N} = \frac{2405 \times 100}{19460} = 12.4$
$d-u = 10.5$ (341頁参照)
$e = 22.9$ cm
$e' = e - 22 = 0.9$ 〃
$e'/e = 0.039$
$\frac{Ne}{bd^2} = \frac{19460 \times 22.9}{100 \times 26^2} = 6.60$
$\frac{Ne}{bd^2\sigma_c} = 0.276$　$k = 0.67$
$\sigma_c = \frac{6.60}{0.276} = 23.9$ kg/cm²
$\sigma_s = 15 \times 23.9 \times \frac{.33}{.67} = 177$ 〃
$\tau = 0$

$b=100$, $h = 30$
$d=26$　$d'=4$
$A_s = 6.67 - 16\phi = 13.41$
$A_s' = 2.27 - 16\phi = 4.47$
$p = 13.41/100 \times 26 = 0.00516$
$p' = 4.47/\ \text{〃} = 0.00172$
$d'/d = 4/26 = 0.154$

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設計 稲葉 日付 16-10-31 類別 CVC5
照査 日付 第 47 頁

上海埠渠 4m×4m

(H2) $M_{H2} = -3085$ kgm $N = 19460$ kg $S = -6340$ kg

$\frac{M}{N} = \frac{3085 \times 100}{19460} = 15.9$

d-u = 10.5

e = 26.4 cm

e' = e − 22 = 4.4 "

e'/c = 0.167

$\frac{Ne}{bd^2} = \frac{19460 \times 26.4}{100 \times 26^2} = 7.62$

$\frac{Ne}{bd^2\sigma_c} = 0.247$ $k = 0.57$

$\sigma_c = \frac{7.62}{0.247} = 30.8$ kg/cm²

$\sigma_s = 15 \times 30.8 \times \frac{.43}{.57} = 349$ "

$\tau = \frac{6340}{100 \times .81 \times 26} = 3.0$ "

断面 ⑪ = 合レ

基礎底面圧力

重心荷重 $V = 2 @ 19460 = 38920$

側壁重量 $2 @ 0.3 \times 4.0 @ 2400 = 5760$

44680 kg

基礎重量 $5.2 \times 1.0 \times 2200 = 11440$

56120 kg

$\frac{56120}{5.2} = 10800$ kg/m²

杭 1列 5本 各列間隔 1.0m c to c

杭1本当荷重 $= \frac{56120}{5} = 11200$ kg

杭 180φ × 6000 crosswise spacing 1.10m c to c
lengthwise " 1.00 " "

基礎鉄筋

上向圧力 $= \frac{44680}{5.2} = 8600$ kg/m²

$M = \frac{1}{12} \times 8600 \times 4.30^2 = 13250$ kg

$A_s = \frac{13250 \times 100}{1200 \times 0.9 \times 95} = 12.9$ cm²

19φ − 22.5cm c to c = 12.6 cm²

翼壁 CVC3 = 合レ (予37頁参照)

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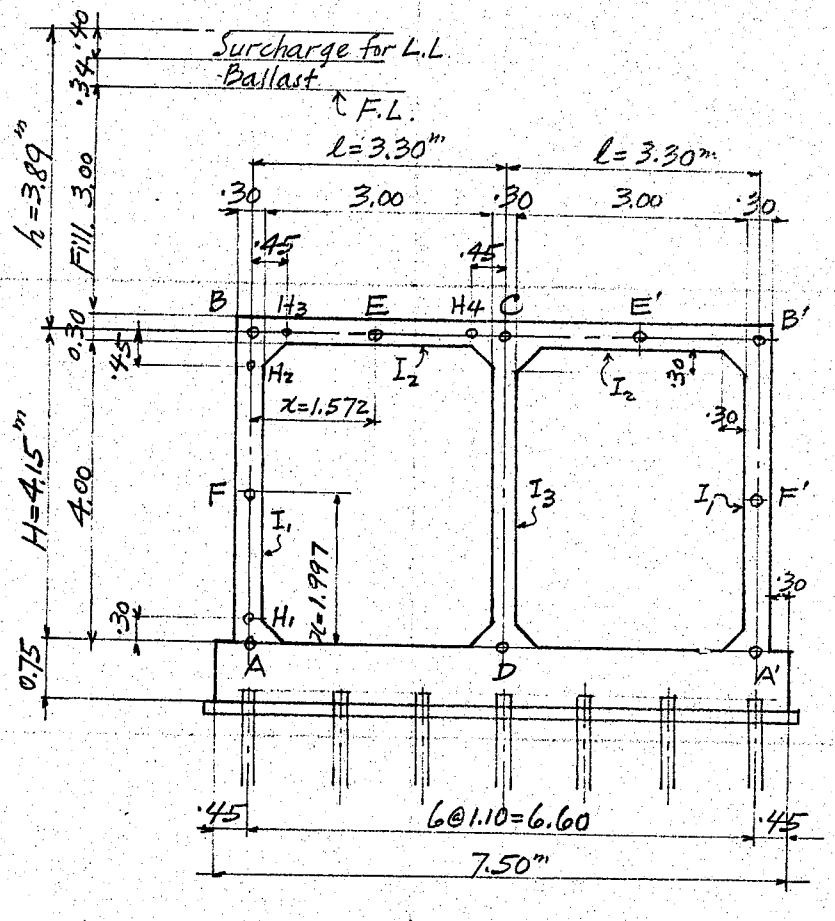
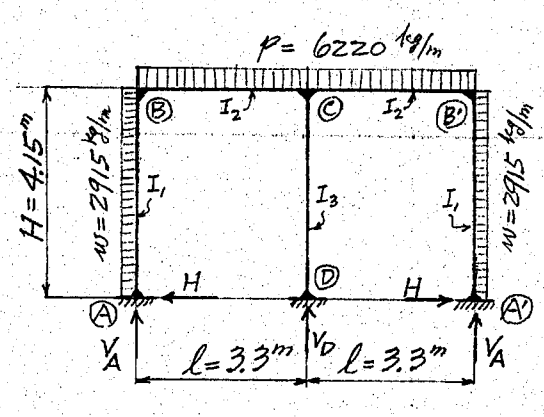
設計 稲葉 日付 16-11-12 類別 CVD3
照査 日付 第 48 頁

上海高速鐵道 標準型複式暗渠 3m×4m

土被 3.0m 標準型複式暗渠 3m×4m --- CVD3



荷重狀態



活荷重

4@16500 = 66000 kg
分布荷重 p' = 610 kg/m² } (第1頁参照)
換算土深 0.40m

天井荷重

$w h\left(1-\frac{hk}{1+2HC}\right)$ 式中 k = 0.19, C = 0.58

$= 1600 \times 3.89 \left(1-\frac{3.89\times 0.19}{1+2\times 4.15\times 0.58}\right) = 5430$ (873)

天井重量 0.33 @ 2400 = 790

天井荷重 = p = 6220 kg/m²

側壁土圧

B点 = static earth pressure: $\frac{1}{3}\times 5430 = 1810$

$\frac{1}{3}\times 1600 \times 4.15 = 2210$

A点 = static earth pressure: 4020 kg/m²

側壁平均土圧

$w = \frac{1810+4020}{2} = 2915$ kg/m²

諸係数

$I_1 = I_2 = I_3 = \frac{1.00\times 0.30^3}{12} = 0.002250\ (m)^4$

$k_1 = \frac{I_1}{H} = \frac{0.00225}{4.15} = 0.000542$

$k_2 = \frac{I_2}{l} = \frac{0.00225}{3.30} = 0.000682$

$\frac{k_1}{12(k_1+k_2)} = \frac{0.000542}{12\times 0.001224} = 0.0369$

$\frac{k_2}{12(k_1+k_2)} = \frac{0.000682}{12\times 0.001224} = 0.0464$

$\frac{k_1}{24(k_1+k_2)} = 0.0185$

$pl^2 = 6220\times 3.30^2 = 67740$
$wH^2 = 2915\times 4.15^2 = 50200$

$\frac{pl^2}{12} = 5640, \quad \frac{pl^2}{2} = 33870$

$\frac{wH^2}{12} = 4180, \quad \frac{wH^2}{2} = 25100$

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設計 稲葉 日付 16-11-12 類別 CVD3
照査 日付 第 49 頁

上海複式暗渠 3m×4m

節点曲率

$$M_B = -\frac{k_1}{12(k_1+k_2)}(pl^2-wH^2) - \frac{wH^2}{12} = -0.0369(67740-50200) - 4180 = -4830\ kgm$$ (1/12=0.0833, 1/24=0.0417)

$$M_{C2} = -\frac{k_2}{12(k_1+k_2)}(pl^2-wH^2) - \frac{pl^2}{12} = -0.0464(67740-50200) - 5640 = -6450\ "$$

$$M_A = \frac{k_1}{24(k_1+k_2)}(pl^2-wH^2) - \frac{wH^2}{12} = 0.0185(67740-50200) - 4180 = -3855\ "$$

$$M_{C3} = M_D = 0$$

反力

$$V_A = \frac{M_{C2}-M_B+m_{CB}}{l} = \frac{-6450+4830+33870}{3.30} = 9780\ kg$$

$$V_D = 2pl - 2V_A = 2\times6220\times3.30 - 2\times9780 = 21490\ "$$

$$H = \frac{M_B-M_A+m_{BA}}{H} = \frac{-4830+3855+25100}{4.15} = 5820\ "$$

剪力

$$S_A = H = 5820\ kg$$

$$S_{H1} = 5820 - 2915\times0.30 = 4945\ "$$

Ⓕ $x = \frac{5820}{2915} = 1.997^m$ above A.

$$S_F = 0$$

$$S_{H2} = 5820 - 2915\times3.70 = -4960\ kg$$

側壁 $S_{B1} = 5820 - 2915\times4.15 = -6260\ "$

天井 $S_{B2} = V_A = 9780\ "$

$$S_{H3} = 9780 - 6220\times0.45 = 6980\ "$$

Ⓔ $x = \frac{9780}{6220} = 1.572^m$ from B.

$$S_E = 0$$

$$S_{H4} = 9780 - 6220\times2.85 = -7950\ kg$$

$$S_{C2} = 9780 - 6220\times3.30 = -10745\ "$$

中央壁 $S_{C3} = S_D = 0$

中間点ノ曲率

M_{H1}

$$5820\times0.30 = 1745$$
$$-\tfrac{1}{2}\times2915\times0.30^2 = -130$$
$$M_A = -3855$$
$$M_{H1} = -2240\ kgm$$

M_F

$$5820\times1.997 = 11625$$
$$-\tfrac{1}{2}\times2915\times1.997^2 = -5805$$
$$M_A = -3855$$
$$M_F = 1965\ kgm$$

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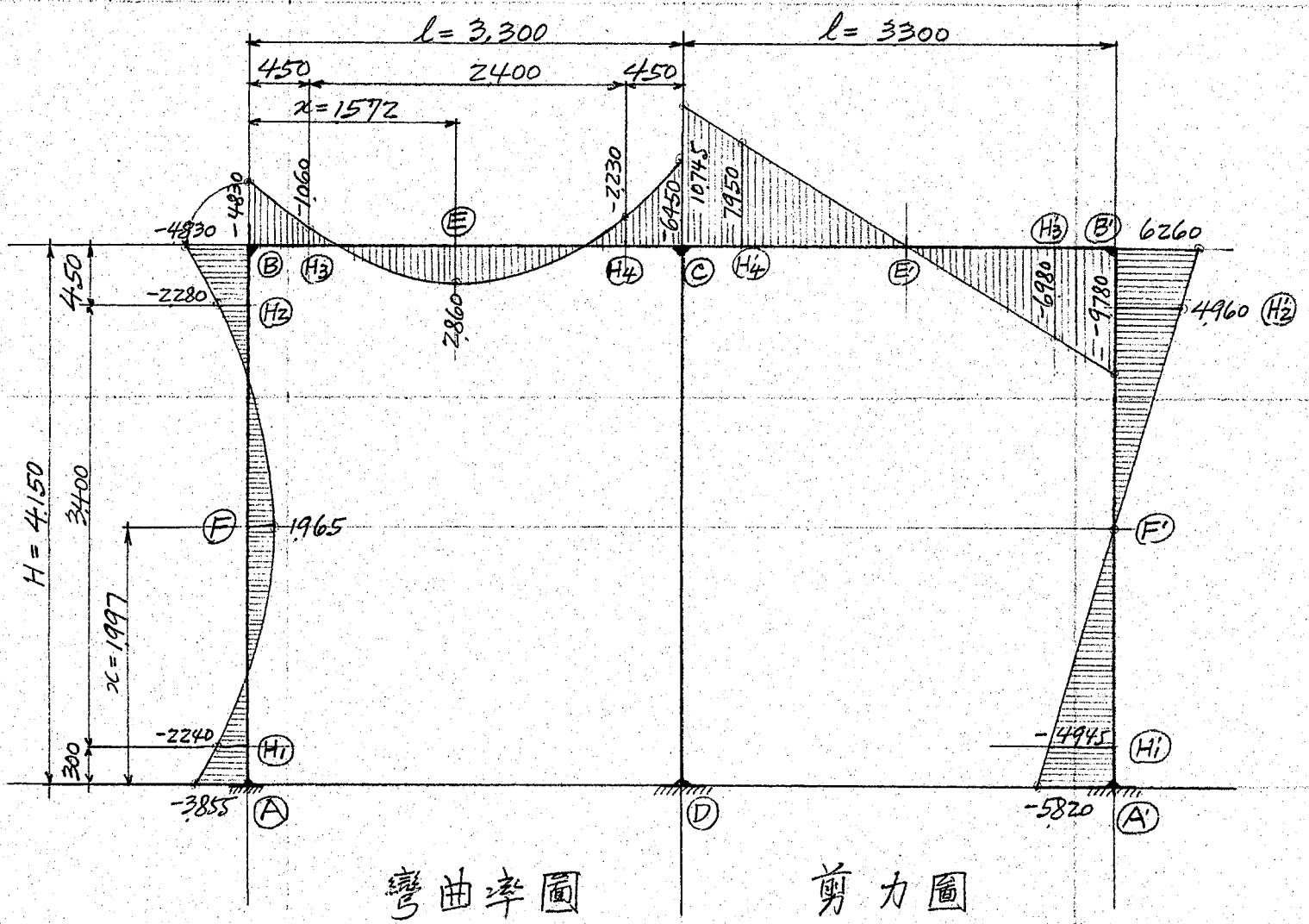
上海複式暗渠 3m×4m

M_{H2} $5820 \times 3.70 = 21525$
$-\frac{1}{2} \times 2915 \times 3.70^2 = -19950$
$M_A = -3855$
$M_{H2} = -2280$ kgm

M_{H3} $9780 \times 0.45 = 4400$
$-\frac{1}{2} \times 6220 \times 0.45^2 = -630$
$M_B = -4830$
$M_{H3} = -1060$ kgm

M_E $9780 \times 1.572 = 15370$
$-\frac{1}{2} \times 6220 \times 1.572^2 = -7680$
$M_B = -4830$
$M_E = 2860$ kgm

M_{H4} $9780 \times 2.85 = 27850$
$-\frac{1}{2} \times 6220 \times 2.85^2 = -25250$
$M_B = -4830$
$M_{H4} = -2230$ kgm



彎曲率圖　　剪力圖

尺度 $\frac{1}{500}$ m = 1,000 kgm　　$\frac{1}{500}$ m = 1,000 kg

縮尺 1:50

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上海複式暗渠 3m×4m

天井

ⓒ Mc = −6450 kgm, N = 6260 kg, S = −10,745 kg

d/h = 41/45 = 0.912
d'/h = 4/45 = 0.089
p₀ = 13.41/100×45 = 0.00298
p₀' = 4.47/〃 = 0.00099
u/h = 0.51
u = 22.9 cm
d−u = 18.1 〃

M/N = 6450×100/6260 = 103.0
e = (d−u) + 18.1 = 121.1 cm
e' = e − 37 = 84.1 〃
e'/e = 0.694
Ne/bd² = 6260×121.1/100×41² = 4.52
Ne/bd²σc = 0.148, k = 0.305
σc = 4.5²/0.148 = 30.6 kg/cm²
σs = 15×30.6×0.695/0.305 = 1045 〃
τ = 10745/100×.898×41 = 2.9 〃

b = 100 cm, h = 30 + 45/3 = 45 cm
d = 41, d' = 4
As = 6.67−16φ = 13.41 cm²
As' = 2.23−16φ = 4.47 〃
p = 13.41/100×41 = 0.00327
p' = 4.47/〃 = 0.00109
d'/d = 4/41 = 0.098

Ⓔ ME = 2860 kgm, N = 6260 kg, S = 0

d/h = 26/30 = 0.867
d'/h = 4/30 = 0.0133
p₀ = 13.41/100×30 = 0.00447
p₀' = 4.47/〃 = 0.00149
u/h = 0.51
u = 15.3 cm
d−u = 10.7 cm

M/N = 2860×100/6260 = 45.7
e = (d−u) + 10.7 = 56.4 cm
e' = e − 22 = 34.4 〃
e'/e = 0.610
Ne/bd² = 6260×56.4/100×26² = 5.23
Ne/bd²σc = 0.182, k = 0.390
σc = 5.23/0.182 = 28.7 kg/cm²
σs = 15×28.7×0.610/0.390 = 674 〃
τ = 0

b = 100, h = 30
d = 26, d' = 4
As = 6.67−16φ = 13.41
As' = 2.23−16φ = 4.47
p = 13.41/100×26 = 0.00516
p' = 4.47/〃 = 0.00172
d'/d = 4/26 = 0.154

Ⓑ MB = −4830 kgm, N = 6260 kg, S = 9,780 kg

d/h = 4/45 = 0.912
d'/h = 4/45 = 0.089
p₀ = 7.54/100×45 = 0.00167
p₀' = 2.51/〃 = 0.00056
u/h = 0.51
u = 22.9 cm
d−u = 18.1 〃

M/N = 4830×100/6260 = 77.2
e = (d−u) + 18.1 = 95.3 cm
e' = e − 37 = 58.3 〃
e'/e = 0.612
Ne/bd² = 6260×95.3/100×41² = 3.54
Ne/bd²σc = 0.126, k = 0.260
σc = 3.54/0.126 = 28.1 kg/cm²
σs = 15×28.1×0.740/0.260 = 1197 〃
τ = 9780/100×.913×41 = 2.6 〃

b = 100, h = 30 + 45/3 = 45
d = 41, d' = 4
As = 6.67−12φ = 7.54 cm²
As' = 2.23−12φ = 2.51 〃
p = 7.54/100×41 = 0.00184
p' = 2.51/〃 = 0.00061
d'/d = 4/41 = 0.098

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上海複式暗渠 3m×4m

(H3) $M_{H3} = -1060$ kgm, $N = 6260$ kg, $S = 6980$ kg

$$\tau = \frac{6980}{100 \times 7/8 \times 26} = 3.1 \text{ kg/cm}^2$$

(H4) $M_{H4} = -2230$ kgm, $N = 6260$ kg $S = -7950$ kg

$$\tau = \frac{7950}{100 \times 7/8 \times 26} = 3.5 \text{ kg/cm}^2$$

断面 E = 合ご

側 壁

(B) $M_B = -4830$ kgm, $N = 9780$ kg, $S = -6260$ kg

$$\frac{M}{N} = \frac{4830 \times 100}{9780} = 49.4$$

$d - u = 18.1$

$e = 67.5$ cm

$e' = e - 37 = 30.5$ "

$e'/e = 0.452$

$$\frac{Ne}{bd^2} = \frac{9780 \times 67.5}{100 \times 41^2} = 3.93$$

$$\frac{Ne}{bd^2\sigma_c} = 0.138, \quad k = 0.290$$

$$\sigma_c = \frac{3.93}{0.138} = 28.5 \text{ kg/cm}^2$$

$$\sigma_s = 15 \times 28.5 \times \frac{0.710}{0.290} = 1046 \text{ "}$$

$$\tau = \frac{6260}{100 \times .903 \times 41} = 1.7 \text{ "}$$

断面 天井 B = 合ご

(H2) $M_{H2} = -2280$ kgm, $N = 9780$ kg, $S = -4960$ kg

$d/h = 27/30 = 0.900$
$d'/h = 3/30 = 0.100$
$p_0 = 7.54/100 \times 30 = 0.00251$
$p_0' = 2.51/$ " $= 0.00084$
$u/h = 0.508$
$u = 15.2$ cm
$d - u = 11.8$ "

$$\frac{M}{N} = \frac{2280 \times 100}{9780} = 23.3$$

$d - u = 11.8$

$e = 35.1$ cm

$e' = e - 24 = 11.1$ "

$e'/e = 0.316$

$$\frac{Ne}{bd^2} = \frac{9780 \times 35.1}{100 \times 27^2} = 4.710$$

$$\frac{Ne}{bd^2\sigma_c} = 0.178 \quad k = 0.390$$

$$\sigma_c = \frac{4.71}{0.178} = 26.5 \text{ kg/cm}^2$$

$$\sigma_s = 15 \times 26.5 \times \frac{.161}{.39} = 622 \text{ "}$$

$$\tau = \frac{4960}{100 \times .87 \times 27} = 2.1 \text{ "}$$

$b = 100$, $h = 30$
$d = 27$, $d' = 3$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.23 - 12\phi = 2.51$
$p = 7.54/100 \times 27 = 0.00279$
$p' = 2.51/$ " $= 0.00093$
$d'/d = 3/27 = 0.111$

(F) $M_F = 1965$ kgm $N = 9780$ kg $S = 0$

安全 ナリ.

断面 H_2 = 合ご

(H1) $M_{H1} = -2240$ kg $N = 9780$ kg $S = 4945$ kg

$$\tau = \frac{4945}{100 \times 7/8 \times 27} = 2.1 \text{ kg/cm}^2$$

断面 H_2 = 合ご

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上海複式暗渠 3m × 4m

Ⓐ $M_A = -3855$ kgm

$d/h = 37/40 = 0.925$
$d'/h = 3/40 = 0.075$
$p_0 = 7.54/100\times40 = 0.00189$
$p_0' = 2.51/\,\,\,\, = 0.00063$
$u/h = 0.51$
$u = 20.4$ cm
$d-u = 16.6$ "

$N = 9780$ kg, $S = 5820$ kg

$\frac{M}{N} = \frac{3855\times100}{9780} = 39.4$
$d-u = 16.6$
$e = 56.0$ cm
$e' = e-34 = 22.0$ "
$e'/e = 0.393$
$\frac{Ne}{bd^2} = \frac{9780\times56.0}{100\times37^2} = 3.955$
$\frac{Ne}{bd^2\sigma_c} = 0.150 \quad k = 0.320$
$\sigma_c = \frac{3.955}{0.150} = 26.4$ kg/cm²
$\sigma_s = 15\times26.4\times\frac{1.68}{.32} = 840$ "
$\tau = \frac{5820}{100\times.893\times37} = 1.8$ "

$b = 100$, $h = 30+\frac{30}{3} = 40$
$d = 37$, $d' = 3$
$A_s = 6.67-12\phi = 7.54$
$A_s' = 2.23-12\phi = 2.51$
$p = 7.54/100\times37 = 0.00204$
$p' = 2.51/\,\,\,\, = 0.00068$
$d'/d = 3/37 = 0.081$

中央壁

彎曲率 並=剪力ハ零ナリ $N = 21{,}490$ kg

垂圧應力 N = 21,490
壁自重 0.3×4.0@2400 = 2880
24,370 kg

断面
混凝土 100×30 = 3000
鉄筋 2×15×2.51 = 75 (2.23−12φ = 2.51)
3,075 cm²

$\sigma_c = \frac{24370}{3075} = 7.9$ kg/cm² $\quad \frac{l}{b} = \frac{340\text{cm}}{30} = 11.3 < 15$

基礎底面圧力

垂直荷重 $2V_A + V_D = 9780\times2 + 21490 = 41{,}050$
壁自重 3@0.3×4.0@2400 = 8,650
49,700 kg
基礎自重 7.50×0.75@2200 = 12,400
62,100 kg

底面圧力 $= \frac{62100}{7.50} = 8290$ kg/m²

杭 一列7本 各列間隔 1.00m c to c
杭一本当荷重 $= \frac{62100}{7} = 8870$ kg

杭 吉n 180φ 長 4,500
間隔 横 1.10m c to c
縦 1.00m c to c

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上海複式暗渠 3m×4m

基礎鉄筋

上向圧力 $= \frac{49700}{7.5} = 6630\ kg/m^2$

$M = \frac{1}{12} \times 6630 \times 3.30^2 = 6020\ kgm$

$A_s = \frac{6020 \times 100}{1200 \times 0.9 \times 70} = 7.96\ cm^2$

16φ − 225 c to c $= 8.94\ cm^2$

翼壁

暗渠 CVC3 ニ準ズ
(第37頁参照)

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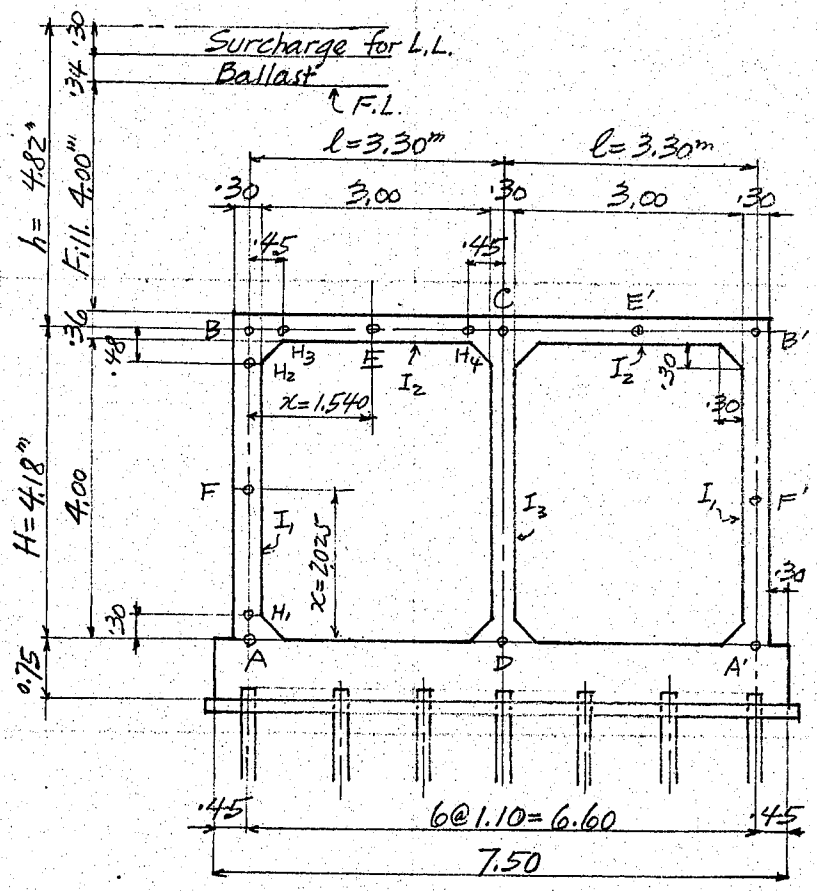
上海複式暗渠 3m×4m

土被4.0m標準型複式暗渠 3m×4m----CVD4



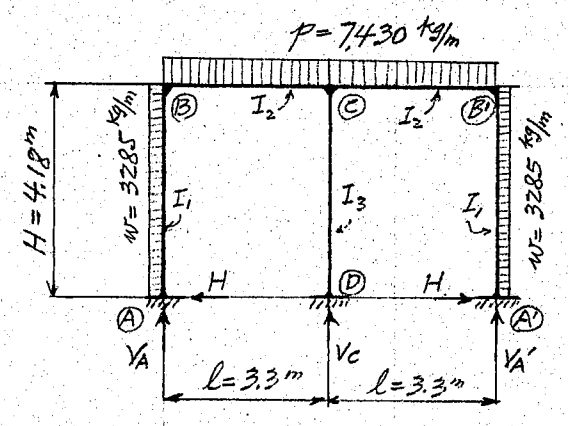
活荷重
4@16500= 66,000 kg
分布荷重 p'= 425 kg/m² } (第7頁參照)
換算土厚 0.30m

天井荷重
$awh\left(1-\frac{hk}{1+2HC}\right)$ 式 = k=0.19, C=0.58

$= 1600\times 4.82\left(1-\frac{4.82\times 0.19}{1+2\times 4.18\times 0.58}\right) = 6,500$
天井重量 0.39@2400 = 930
天井荷重 $p =$ 7,430 kg/m²

側壁土圧
B点=於ケル土圧 $\frac{1}{3}\times 6500 =$ 2,170
$\frac{1}{3}\times 1600\times 4.18 =$ 2,230
A点=於ケル土圧 4400 kg/m²
側壁平均土圧
$w = \frac{2170+4400}{2} =$ 3,285 kg/m²

荷重狀態



諸係数
$I_1 = \frac{1.00\times 0.30^3}{12} = 0.002250\,(m)^4$
$I_2 = \frac{1.00\times 0.36^3}{12} = 0.003888$ "
$K_1 = \frac{I_1}{H} = \frac{0.002250}{4.18} = 0.000538$
$K_2 = \frac{I_2}{l} = \frac{0.003888}{3.30} = 0.001178$

$\frac{K_1}{12(K_1+K_2)} = \frac{0.000538}{12\times 0.001716} = 0.0261$
$\frac{K_1}{24(K_1+K_2)} = 0.0131$
$\frac{K_2}{12(K_1+K_2)} = \frac{0.001178}{12\times 0.001716} = 0.0572$

$pl^2 = 7.430\times 3.3^2 = 80.900$
$wH^2 = 3.285\times 4.18^2 = 57.400$

$\frac{pl^2}{12} = 6.740$, $\frac{pl^2}{2} = 40.450$
$\frac{wH^2}{12} = 4,780$, $\frac{wH^2}{2} = 28,700$

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上海複式暗渠 3m×4m

節点弯曲率

$$M_B = -\frac{k_1}{12(k_1+k_2)}(Pl^2-wH^2)-\frac{wH^2}{12} = -0.0261(80900-57400)-4780 = -5390 \text{ kgm}$$ (23500)

$$M_{C2} = -\frac{k_2}{12(k_1+k_2)}(Pl^2-wH^2)-\frac{Pl^2}{12} = -0.0572(80900-57400)-6740 = -8080 \text{ "}$$

$$M_A = \frac{k_1}{24(k_1+k_2)}(Pl^2-wH^2)-\frac{wH^2}{12} = 0.0131(80900-57400)-4780 = -4470 \text{ "}$$

$$M_{C3} = M_D = 0$$

反力

$$V_A = \frac{M_{C2}-M_B+\sum M_{CB}}{l} = \frac{-8080+5390+40450}{3.30} = 11440 \text{ kg}$$

$$V_D = 2Pl-2V_A = 2\times7430\times3.3-2\times11440 = 26160 \text{ "}$$

$$H = \frac{M_B-M_A+M_{BA}}{H} = \frac{-5390+4470+28700}{4.18} = 6650 \text{ "}$$

剪力

側壁 $S_A = H = 6650$ kg

$S_{H1} = 6650-3285\times0.30 = 5660$ "

(E) $x = \frac{6650}{3285} = 2.025$ m above A

$S_F = 0$

$S_{H2} = 6650-3285\times3.70 = -5500$ kg

$S_{B1} = 6650-3285\times4.18 = -7070$ "

天井 $S_{B2} = V_A = 11440$ "

$S_{H3} = 11440-7430\times0.45 = 8100$ "

(E) $x = \frac{11440}{7430} = 1.540$ m from B.

$S_E = 0$

$S_{H4} = 11440-7430\times2.85 = -9720$ kg

$S_{C2} = 11440-7430\times3.30 = -13060$ "

中央壁 $S_{C3} = S_D = 0$

中間点、弯曲率

M_{H1}

$6650\times0.30 = 1995$

$-\frac{1}{2}\times3285\times0.30^2 = -150$

$M_A = -4470$

$M_{H1} = -2625$ kgm

M_F

$6650\times2.025 = 13450$

$-\frac{1}{2}\times3285\times2.025^2 = -6740$

$M_A = -4470$

$M_F = 2240$ kgm

M_{H2}

$6650\times3.70 = 24600$

$-\frac{1}{2}\times3285\times3.70^2 = -22480$

$M_A = -4470$

$M_{H2} = -2350$ kgm

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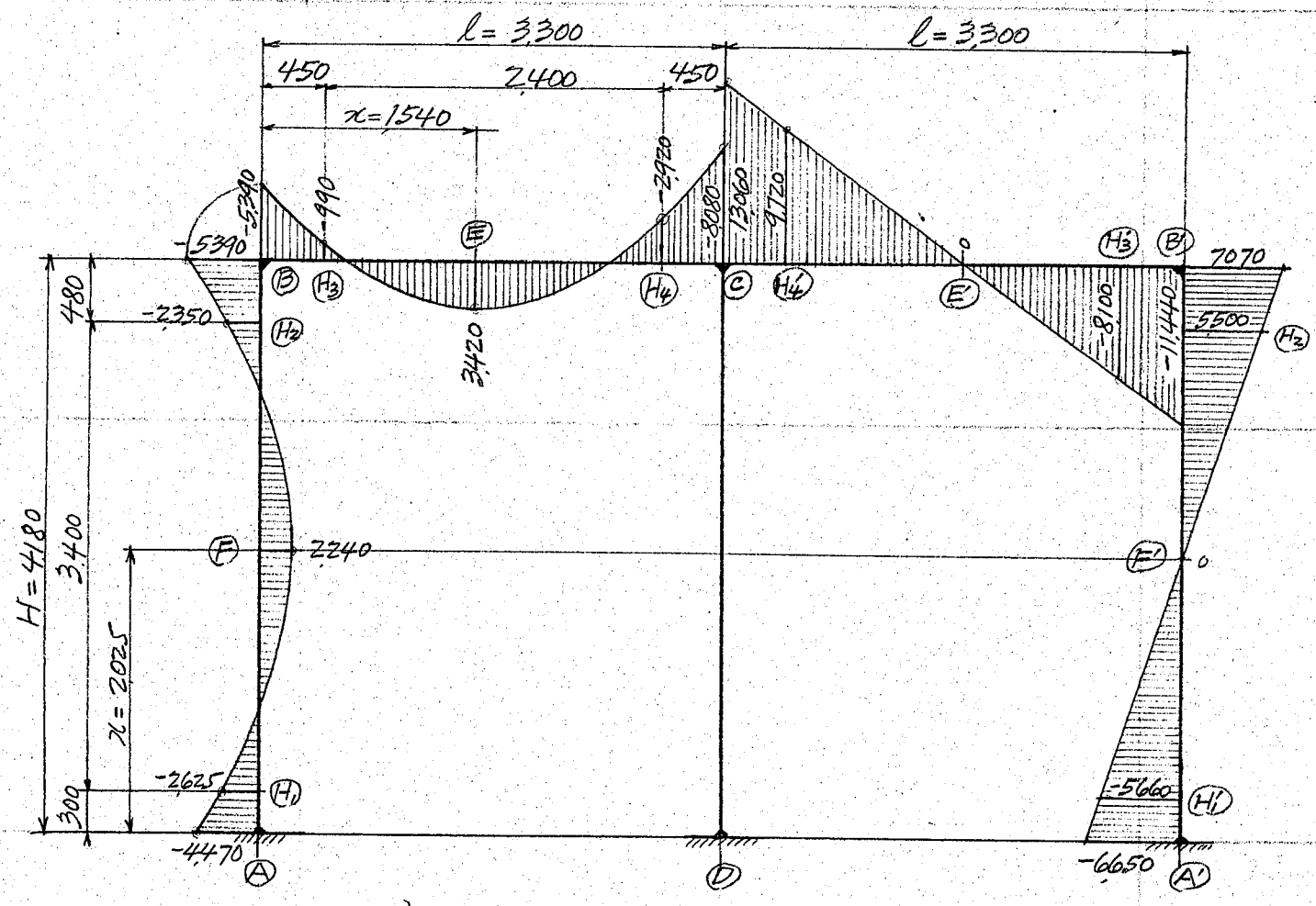
上海複式暗渠 3m×4m

M_{H3} 11440 × 0.45 = 5,150
$-\frac{1}{2}$ × 7430 × 0.45^2 = − 750
M_B = − 5390
M_{H3} = −990 kgm

M_E 11440 × 1.540 = 17,620
$-\frac{1}{2}$ × 7430 × 1.540^2 = − 8,810
M_B = − 5390
M_E = 3,420 kgm

M_{H4} 11440 × 2.85 = 32,620
$-\frac{1}{2}$ × 7430 × 2.85^2 = − 30,150
M_B = − 5390
M_{H4} = − 2,920 kgm



彎曲率圖　　剪力圖

尺度 $\frac{1}{500}$m = 1000 kgm　　$\frac{1}{500}$m = 1000 kg

縮尺 1:50

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上海複式暗渠 3m×4m

断面應力ノ計算

天井

Ⓒ $M_C = -8{,}080$ kgm, $N = 7070$ kg, $S_C = -13{,}060$ kg

$d/h = 47/51 = 0.922$
$d'/h = 4/51 = 0.078$
$p_0 = 13.41/100\times51 = 0.00263$
$p_0' = 4.47/\,\text{〃} = 0.00088$
$u/h = 0.51$
$u = 26.0$ cm
$d-u = 21.0$ 〃

$\frac{M}{N} = \frac{8080\times100}{7070} = 114.2$
$d-u = 21.0$
$e = 135.2$ cm
$e' = e-43 = 92.2$ 〃
$e'/e = 0.682$
$\frac{Ne}{bd^2} = \frac{7070\times135.2}{100\times47^2} = 4.33$
$\frac{Ne}{bd^2\sigma_c} = 0.140$, $k = 0.290$
$\sigma_c = \frac{4.33}{0.140} = 30.9$ kg/cm²
$\sigma_s = 15\times30.9\times\frac{0.71}{0.29} = 1136$ 〃
$\tau = \frac{13060}{100\times.903\times47} = 3.1$ 〃

$b=100^{cm}$, $h = 36+\frac{45}{3} = 51^{cm}$
$d = 47^{cm}$, $d' = 4^{cm}$
$A_s = 6.67-16\phi = 13.41^{cm^2}$
$A_s' = 2.23-16\phi = 4.47$ 〃
$p = 13.41/100\times47 = 0.00285$
$p' = 4.47/\,\text{〃} = 0.00095$
$d'/d = 4/47 = 0.085$

Ⓔ $M_E = 3{,}420$ kgm, $N = 7070$ kg, $S = 0$

$d/h = 32/36 = 0.890$
$d'/h = 4/36 = 0.111$
$p_0 = 13.41/100\times36 = 0.00373$
$p_0' = 4.47/\,\text{〃} = 0.00124$
$u = .514\times36 = 18.5$ cm
$d-u = 13.5$ 〃

$\frac{M}{N} = \frac{3420\times100}{7070} = 48.4$
$d-u = 13.5$
$e = 61.9$ cm
$e' = e-28 = 33.9$ 〃
$e'/e = 0.548$
$\frac{Ne}{bd^2} = \frac{7070\times61.9}{100\times32^2} = 4.275$
$\frac{Ne}{bd^2\sigma_c} = 0.174$, $k = 0.370$
$\sigma_c = \frac{4.275}{0.174} = 24.6$ kg/cm²
$\sigma_s = 15\times24.6\times\frac{0.630}{0.370} = 628$ 〃
$\tau = 0$

$b=100$, $h=36$
$d=32$, $d'=4$
$A_s = 6.67-16\phi = 13.41$
$A_s' = 2.23-16\phi = 4.47$
$p = 13.41/100\times32 = 0.00420$
$p' = 4.47/\,\text{〃} = 0.00140$
$d'/d = 4/32 = 0.125$

Ⓑ $M_B = -5390$ kgm, $N = 7070$ kg, $S = 11{,}440$ kg

$d/h = 47/51 = 0.922$
$d'/h = 4/51 = 0.078$
$p_0 = 7.54/100\times51 = 0.00148$
$p_0' = 2.51/\,\text{〃} = 0.00049$
$u = .508\times51 = 25.9$ cm
$d-u = 21.1$ 〃

$\frac{M}{N} = \frac{5390\times100}{7070} = 76.3$
$d-u = 21.1$
$e = 97.4$ cm
$e' = e-43 = 54.4$ 〃
$e'/e = 5.59$
$\frac{Ne}{bd^2} = \frac{7070\times97.4}{100\times47^2} = 3.115$
$\frac{Ne}{bd^2\sigma_c} = 0.122$, $k = 0.255$
$\sigma_c = \frac{3.115}{0.122} = 25.5$ kg/cm²
$\sigma_s = 15\times25.5\times\frac{.745}{.255} = 1118$ 〃
$\tau = \frac{11440}{100\times.915\times47} = 2.7$ 〃

$b=100$, $h = 36+\frac{45}{3} = 51$
$d=47$, $d'=4$
$A_s = 6.67-12\phi = 7.54$
$A_s' = 2.23-12\phi = 2.51$
$p = 7.54/100\times47 = 0.00160$
$p' = 2.51/\,\text{〃} = 0.00053$
$d'/d = 4/47 = 0.085$

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設計 稲葉 日付 16-11-14 類別 CVD4
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上海複式暗渠 3"×4"

(H3) $M_{H3} = -990$ kgm, $N = 7070$ kg, $S = 8100$ kg

$$\tau = \frac{8100}{100 \times 7/8 \times 32} = 2.9 \text{ kg/cm}^2$$

$A_s = 6.67 - 12\phi$
$A_s' = 2.23 - 12\phi$

(H4) $M_{H4} = -2920$ kgm, $N = 7070$ kg, $S = -9720$ kg

$$\tau = \frac{9720}{100 \times 7/8 \times 32} = 3.5 \text{ kg/cm}^2$$

断面ハ(E)ニナシ

側壁

(B) $M_B = -5390$ kgm, $N = 11440$ kg, $S = -7070$ kg

$d/h = 43/46 = 0.935$
$d'/h = 3/46 = 0.065$
$p_0 = 7.54/100 \times 46 = 0.00164$
$p_0' = 2.51/\,\text{〃} = 0.00055$
$u = 0.508 \times 46 = 23.4$ cm
$d - u = 19.6$ 〃

$\frac{M}{N} = \frac{5390 \times 100}{11440} = 47.1$
$d - u = 19.6$
$e = 66.7$ cm
$e' = e - 40 = 26.7$ 〃
$e/e = 0.400$
$\frac{Ne}{bd^2} = \frac{11440 \times 66.7}{100 \times 43^2} = 4.13$
$\frac{Ne}{bd^2\sigma_c} = 0.139$, $k = 0.295$

$b = 100$, $h = 30 + \frac{48}{3} = 46$
$d = 43$, $d' = 3$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.23 - 12\phi = 2.51$
$p = 7.54/100 \times 43 = 0.00175$
$p' = 2.51/\,\text{〃} = 0.00058$
$d'/d = 3/43 = 0.070$

$\sigma_c = \frac{4.13}{0.139} = 29.7$ kg/cm²
$\sigma_s = 15 \times 29.7 \times \frac{0.705}{0.295} = 1065$ 〃
$\tau = \frac{7070}{100 \times 0.90 \times 43} = 1.8$ 〃

(H1) $M_{H1} = -2625$ kgm, $N = 11440$ kg, $S = 5660$ kg

$d/h = 27/30 = 0.900$
$d'/h = 3/30 = 0.100$
$p_0 = 7.54/100 \times 30 = 0.00251$
$p_0' = 2.51/\,\text{〃} = 0.00084$
$u = .508 \times 30 = 15.2$ cm
$d - u = 11.8$ 〃

$\frac{M}{N} = \frac{2625 \times 100}{11440} = 23.0$
$d - u = 11.8$
$e = 34.8$ cm
$e' = e - 24 = 10.8$ 〃
$e/e = 0.299$
$\frac{Ne}{bd^2} = \frac{11440 \times 348}{100 \times 27^2} = 5.462$
$\frac{Ne}{bd^2\sigma_c} = 0.182$, $k = 0.400$

$b = 100$, $h = 30$
$d = 27$, $d' = 3$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.23 - 12\phi = 2.51$
$p = 7.54/100 \times 27 = 0.00279$
$p' = 2.51/\,\text{〃} = 0.00093$
$d'/d = 3/27 = 0.111$

$\sigma_c = \frac{5.462}{0.182} = 30.0$ kg/cm²
$\sigma_s = 15 \times 30.0 \times \frac{160}{140} = 675$ 〃
$\tau = \frac{5660}{100 \times .867 \times 27} = 2.4$ 〃

(F) $M_F = 2240$ kgm, $N = 11440$ kg, $S = 0$
安全ナリ

断面ハ(H1)ニナシ

(H2) $M_{H2} = -2350$ kgm, $N = 11440$ kg, $S = -5500$ kg
安全ナリ

〃

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上海複式暗渠 3m×4m

Ⓐ $M_A = -4470$ kgm , $N = 11440$ kg $S = 6650$ kg

$\frac{M}{N} = \frac{4470 \times 100}{11440} = 39.1$

$d-u = 16.6$ (第53頁Ⓐ参照)

$e = 55.7$ cm

$e' = e - 34 = 21.7$,

$e'/e = 0.39$

$\frac{Ne}{bd^2} = \frac{11440 \times 55.7}{100 \times 37^2} = 4.66$

$\frac{Ne}{bd^2\sigma_c} = 0.150$ $k = 0.32$

$\sigma_c = \frac{4.66}{0.15} = 31.1$ kg/cm²

$\sigma_s = 15 \times 31.1 \times \frac{\cdot 68}{\cdot 32} = 991$,

$\tau = \frac{6650}{100 \times \cdot 893 \times 37} = 2.0$,

$b=100$, $h = 30 + \frac{30}{3} = 40$
$d = 37$, $d' = 3$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.23 - 12\phi = 2.51$
$p = 7.54/100 \cdot 37 = 0.00204$
$p' = 2.51/$, $= 0.00068$
$d'/d = 3/37 = 0.081$

中央壁

湾曲率重＝剪力小共＝零ヤリ $N = 26160$ kg

直圧応力 $N =$ 26,160
壁自重 0.3×4.0 @2400 = 2880
29,040 kg c

断面
混凝土 $100 \times 30 = 3,000$
鉄筋 $2 \times 15 \times 2.51 = 75$ (2.23 − 12φ = 2.51 cm²)
3,075 cm²

$\sigma_c = \frac{29040}{3075} = 9.5$ kg/cm²

$\ell/b = \frac{340\text{ cm}}{30} = 11.3 < 15$

基礎底面圧力

垂直荷重 $2V_A + V_D = 2 \times 11440 + 26160 = 49040$
壁ノ自重 3@0.3×4.0@2400 = 8640
57,690 kg

基礎重量 7.5×0.75@2200 = 12400
70,090 kg

底面圧力 $= \frac{70090}{7.50} = 9350$ kg/m²

杭1列 7本, 各列間隔 1.00m c to c
杭1本当荷重 $= \frac{70090}{7} = 10,010$ kg

杭 末n 180φ 長 5500
間隔 横 1.10m c to c
縦 1.00m c to c

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上海複式暗渠 3m×4m

基礎鉄筋

上向圧力 = $\frac{57690}{7.5\times1.0}$ = 7700 kg/m²

$M = \frac{1}{2}\times 7700\times 3.3^2$ = 6,980 kgm

$A_s = \frac{6980\times100}{1200\times0.9\times70}$ = 9.23 cm²

16φ − 225 c to c = 8.94 cm²

翼壁

暗渠 CVC3 = 準ず
(第37ページ参照)

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設計 [illegible] 日付 16-11-14 類別 CVD5
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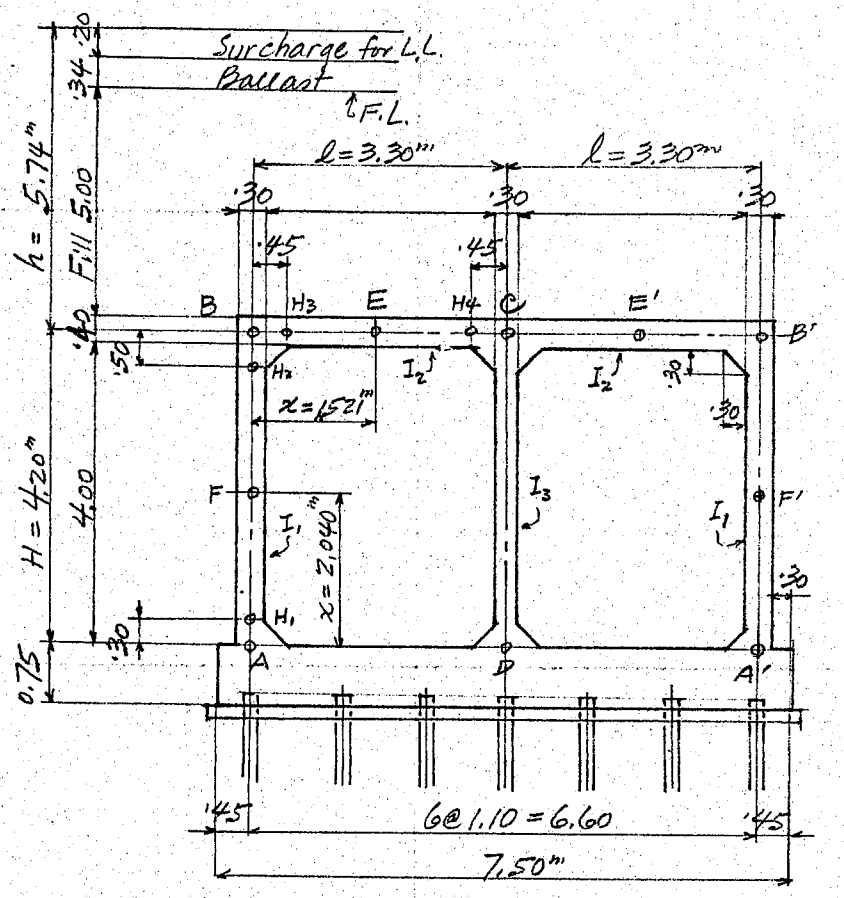
上海複式暗渠 3m×4m

土被 5.74m 標準型複式暗渠 3m×4m --- CVD5



活荷重
4@16,500 = 66,000 kg
分布荷重 p' = 315 kg/m² } (第27頁参照)
擁壁土圧 = 0.20m

天井荷重
$wh\left(1-\frac{hk}{1+2HC}\right)$ 式: K=0.19, C=0.58

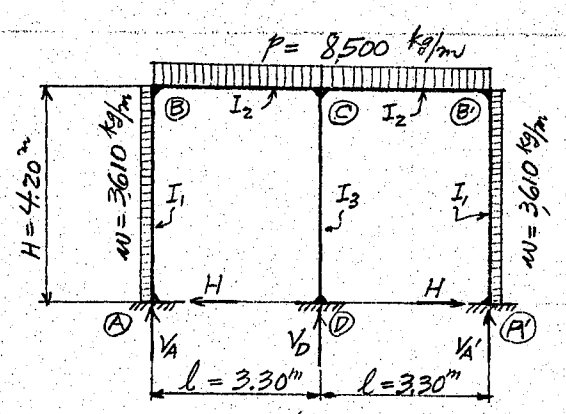
$= 1600\times5.74\left(1-\frac{5.74\times0.19}{1+2\times4.20\times0.58}\right) = 7470$

天井1m当 0.43@2400 = 1030
天井荷重 p = 8,500 kg/m²

側壁土圧
B点=於ケル土圧 $\frac{1}{3}\times7470$ = 2,490
$\frac{2}{3}\times1600\times4.20$ = 2240
A点=於ケル土圧 4,730 kg/m²

側壁平均土圧
$w = \frac{2490+4730}{2}$ = 3610 kg/m²

荷重狀態



諸係数

$I_1 = \frac{1.00\times0.30^3}{12} = 0.002250\ (m)^4$

$I_2 = \frac{1.00\times0.40^3}{12} = 0.005333\ (m)^4$

$K_1 = \frac{I_1}{H} = \frac{0.002250}{4.200} = 0.000536$

$K_2 = \frac{I_2}{l} = \frac{0.005333}{3.300} = 0.001616$

$\frac{K_1}{12(K_1+K_2)} = \frac{0.000536}{12\times0.002152} = 0.0208$

$\frac{K_1}{24(K_1+K_2)} = 0.0104$

$\frac{K_2}{12(K_1+K_2)} = \frac{0.001616}{12\times0.002152} = 0.0626$

$pl^2 = 8,500\times3.30^2 = 92,570$
$wH^2 = 3,610\times4.20^2 = 63,680$
$\therefore pl^2-wH^2 = 28,890$

$\frac{pl^2}{12} = 7,715$, $\frac{pl^2}{2} = 46,285$

$\frac{wH^2}{12} = 5,305$, $\frac{wH^2}{2} = 31,840$

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上海複式精渠 3m×4m

節点弯曲率

$$M_B = -\frac{k_1}{12(k_1+k_2)}(pl^2 - wH^2) - \frac{wH^2}{12} = -0.0208 \times {}^{-600}28{,}890 - 5{,}305 = -5{,}905 \text{ kgm}$$

$$M_{C2} = -\frac{k_2}{12(k_1+k_2)}(pl^2 - wH^2) - \frac{pl^2}{12} = -0.0626 \times {}^{-1810}28{,}890 - 7{,}715 = -9{,}525 \text{ "}$$

$$M_A = \frac{k_1}{24(k_1+k_2)}(pl^2 - wH^2) - \frac{wH^2}{12} = 0.0104 \times {}^{300}28{,}890 - 5{,}305 = -5{,}005 \text{ "}$$

$$M_{C3} = M_D = 0$$

支力

$$V_A = \frac{M_{C2} - M_B + m_{CB}}{l} = \frac{-9525 + 5905 + 46285}{3.30} = 12{,}930 \text{ kg}$$

$$V_D = 2pl - 2V_A = 2 \times 8500 \times 3.30 - 12930 \times 2 = 30{,}240 \text{ "}$$

$$H = \frac{M_B - M_A + m_{BA}}{H} = \frac{-5905 + 5005 + 31840}{4.20} = 7{,}365 \text{ "}$$

剪力

側壁 $S_A = H = 7{,}365$ kg
$S_{H1} = 7365 - 3610 \times 0.30 = 6280$ "
Ⓔ $x = \frac{7365}{3610} = 2.040$ m from A $S_E = 0$
S_{H2} $7{,}365 - 3610 \times 3.70 = -5{,}985$ kg
S_{B1} $7365 - 3610 \times 4.20 = -7{,}800$ "

天井 $S_{B2} = V_A = 12{,}930$ "
$S_{H3} = 12930 - 8500 \times 0.45 = 9{,}100$ "
Ⓔ $x = \frac{12930}{8500} = 1.521$ m from B. $S_E = 0$
$S_{H4} = 12930 - 8500 \times 2.85 = -11{,}300$ kg
$S_{C2} = 12930 - 8500 \times 3.30 = -15120$ "

中央壁 $S_{C3} = S_D = 0$

中間点ノ弯曲率

M_{H1}
$7{,}365 \times 0.30 = 2210$
$-\frac{1}{2} \times 3610 \times 0.30^2 = -160$
$M_A = -5{,}005$
$M_{H1} = -2{,}955$ kgm

M_F
$7{,}365 \times 2.040 = 15020$
$-\frac{1}{2} \times 3610 \times 2.040^2 = -7{,}505$
$M_A = -5{,}005$
$M_F = 2{,}510$ kgm

M_{H2}
$7{,}365 \times 3.700 = 27240$
$-\frac{1}{2} \times 3610 \times 3.700^2 = -24{,}745$
$M_A = -5{,}005$
$M_{H2} = -2{,}510$ kgm

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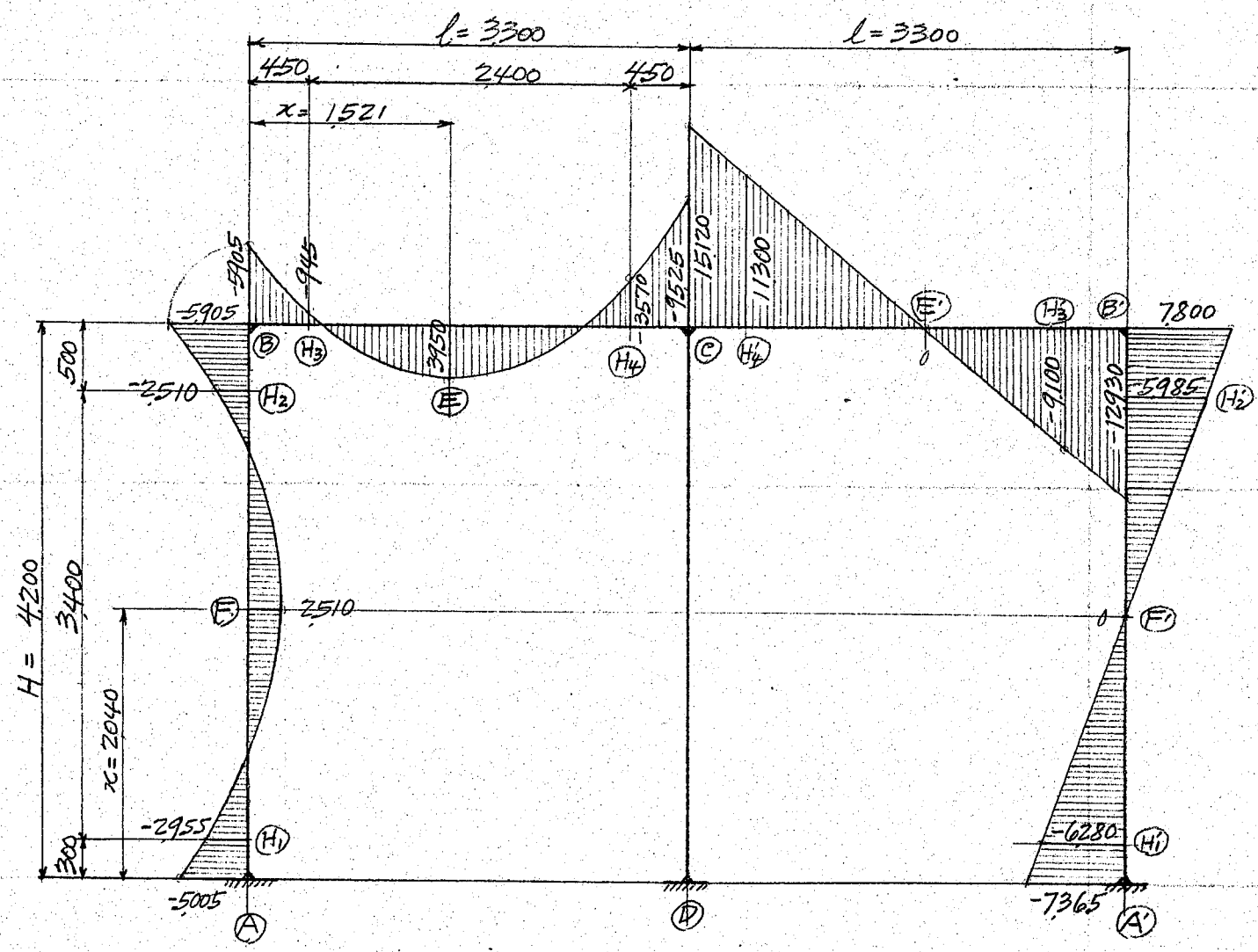
上海複式暗渠 3"×4"

M_{H3} $12930 \times 0.45 = 5820$
$-\frac{1}{2} \times 8500 \cdot 0.45^2 = -860$
$M_B = -5905$
$M_{H3} = -945$ kgm

M_E $12930 \times 1.521 = 19680$
$-\frac{1}{2} \times 8500 \times 1.521^2 = -9825$
$M_B = -5905$
$M_E = 3950$ kgm

M_{H4} $12930 \times 2.85 = 36880$
$-\frac{1}{2} \times 8500 \cdot 2.85^2 = -34545$
$M_B = -5905$
$M_{H4} = -3570$ kgm



彎曲率圖　　剪力圖

尺度 $\frac{1}{500}$ m = 1000 kgm　　$\frac{1}{500}$ m = 1000 kg

縮尺 1:50

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上海複式暗渠 3m×4m

断面應力計算

天井

Ⓒ $M_C = 9525$ kgm, $N = 7800$ kg, $S = -15120$ kg

$d/h = 51/55 = 0.928$
$d'/h = 4/55 = 0.073$
$p_0 = 13.41/100\times55 = 0.00244$
$p_0' = 4.47/\,, = 0.00081$
$u = 0.51\times55 = 28.1$ cm
$d-u = 22.9$ "

$\frac{M}{N} = \frac{9525\times100}{7800} = 122.0$
$d-u = \frac{22.9}{144.9}$ cm
$e =$
$e' = e-47 = 97.9$ "
$e'/e = 0.675$
$\frac{Ne}{bd^2} = \frac{7800\times144.9}{100\times51^2} = 4.34$
$\frac{Ne}{bd^2\sigma_c} = 0.139$ $k = 0.285$
$\sigma_c = \frac{4.34}{0.139} = 31.2$ kg/cm²
$\sigma_s = 15\times31.2\times\frac{0.715}{0.285} = 1173$ "
$\tau = \frac{15120}{100\times.905\times51} = 3.3$ "

$b = 100$ cm, $h = 40+\frac{45}{3} = 55$ cm
$d = 51$ cm, $d' = 4$ cm
$A_s = 6.67-16\phi = 13.41$ cm²
$A_s' = 2.23-16\phi = 4.47$ "
$p = 13.41/100-51 = 0.00263$
$p' = 4.47/\,, = 0.00088$
$d'/d = 4/51 = 0.0785$

Ⓔ $M_E = 3950$ kgm, $N = 7800$ kg, $S = 0$

$d/h = 36/40 = 0.900$
$d'/h = 4/40 = 0.100$
$p_0 = 13.41/100\times40 = 0.00335$
$p_0' = 4.47/100\times40 = 0.00112$
$u = 0.512\times40 = 20.5$ cm
$d-u = 15.5$ "

$\frac{M}{N} = \frac{3950\times100}{7800} = 50.7$
$d-u = \frac{15.5}{66.2}$ cm
$e =$
$e' = e-32 = 34.2$ "
$e'/e = 0.517$
$\frac{Ne}{bd^2} = \frac{7800\times66.2}{100\times36^2} = 3.98$
$\frac{Ne}{bd^2\sigma_c} = 0.172$, $k = 0.365$
$\sigma_c = \frac{3.98}{0.172} = 23.2$ kg/cm²
$\sigma_s = 15\times23.2\times\frac{0.635}{.365} = 606$ "
$\tau = 0$ "

$b = 100$, $h = 40$
$d = 36$, $d' = 4$
$A_s = 6.67-16\phi = 13.41$
$A_s' = 2.23-16\phi = 4.47$
$p = 13.41/100\times36 = 0.00373$
$p' = 4.47/\,, = 0.00124$
$d'/d = 4/36 = 0.111$

Ⓑ $M_B = -5905$ kgm, $N = 7800$, $S = 12930$ kg

$d/h = 51/55 = 0.928$
$d'/h = 4/55 = 0.073$
$p_0 = 7.54/100\times55 = 0.00137$
$p_0' = 2.51/\,, = 0.00046$
$u = 0.506\times55 = 27.8$ cm
$d-u = 23.2$ "

$\frac{M}{N} = \frac{5905\times100}{7800} = 75.7$
$d-u = \frac{23.2}{98.9}$ cm
$e =$
$e' = e-47 = 51.9$ "
$e'/e = 0.525$
$\frac{Ne}{bd^2} = \frac{7800\times98.9}{100\times51^2} = 2.965$
$\frac{Ne}{bd^2\sigma_c} = 0.120$ $k = 0.255$
$\sigma_c = \frac{2.965}{0.120} = 24.7$ kg/cm²
$\sigma_s = 15\times24.7\times\frac{0.745}{0.255} = 1082$ "
$\tau = \frac{12930}{100\times.915\times51} = 2.8$ "

$b = 100$, $h = 40+\frac{45}{3} = 55$
$d = 51$, $d' = 4$
$A_s = 6.67-12\phi = 7.54$
$A_s' = 2.23-12\phi = 2.51$
$p = 7.54/100\times51 = 0.00148$
$p' = 2.51/\,, = 0.00049$
$d'/d = 4/51 = 0.0785$

(H3) $M_{H3} = -945$ kgm, $N = 7800$ kg $S = 9,100$ kg

$$\tau = \frac{9100}{100 \times 7/8 \times 36} = 2.9 \text{ kg/cm}^2$$

$A_s = 6.67 - 12\phi$
$A_s' = 2.23 - 12\phi$

(H4) $M_{H4} = -3570$ kgm $N = 7800$ kg $S = -11,300$ kg

$$\tau = \frac{11300}{100 \times 7/8 \times 36} = 3.6 \text{ kg/cm}^2$$

断面 ⓔ = 全く

側壁

Ⓑ $M_B = -5905$ kgm, $N = 12930$ kg $S = -7,800$ kg

$d/h = 44/47 = 0.936$
$d'/h = 3/47 = 0.064$
$p_0 = 7.54/47 \times 100 = 0.00160$
$p_0' = 2.51/\,\text{〃} = 0.00053$
$u = 0.508 \times 47 = 23.9$
$d - u = 20.1$

$\frac{M}{N} = \frac{5905 \times 100}{12930} = 45.7$
$d - u = 20.1$
$e = 65.8$ cm
$e' = e - 41 = 24.8$
$e'/e = 0.377$
$\frac{Ne}{bd^2} = \frac{12930 \times 65.8}{100 \times 44^2} = 4.40$
$\frac{Ne}{bd^2\sigma_c} = 0.142$ $k = 0.300$

$\sigma_c = \frac{4.40}{0.142} = 31.0$ kg/cm²
$\sigma_s = 15 \times 31.0 \times \frac{.70}{.30} = 1086$ 〃
$\tau = \frac{7800}{100 \times .90 \times 44} = 2.0$ 〃

$b = 100$, $h = 30 + \frac{50}{3} = 47$ cm
$d = 44$, $d' = 3$
$A_s = 6.67 - 12\phi = 7.54$ cm²
$A_s' = 2.23 - 12\phi = 2.51$ 〃
$p = 7.54/100 \times 44 = 0.00171$
$p' = 2.51/\,\text{〃} = 0.00057$
$d'/d = 3/44 = 0.0682$

(H1) $M_{H1} = -2955$ kgm, $N = 12930$ kg $S = 6,280$ kg

$d/h = 27/30 = 0.900$
$d'/h = 3/30 = 0.100$
$p_0 = 7.54/100 \times 30 = 0.00251$
$p_0' = 2.51/\,\text{〃} = 0.00084$
$u = .508 \times 30 = 15.2$ cm
$d - u = 11.8$ 〃

$\frac{M}{N} = \frac{2955 \times 100}{12930} = 22.8$
$d - u = 11.8$
$e = 34.6$ cm
$e' = e - 24 = 10.6$ 〃
$e'/e = 0.307$
$\frac{Ne}{bd^2} = \frac{12930 \times 34.6}{100 \times 27^2} = 6.14$
$\frac{Ne}{bd^2\sigma_c} = 0.180$ $k = 0.395$

$\sigma_c = \frac{6.14}{0.180} = 34.1$ kg/cm²
$\sigma_s = 15 \times 34.1 \times \frac{.605}{.395} = 784$ 〃
$\tau = \frac{6280}{100 \times .868 \times 27} = 2.7$ 〃

$b = 100$, $h = 30$
$d = 27$, $d' = 3$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.23 - 12\phi = 2.51$
$p = 7.54/100 \times 27 = 0.0279$
$p' = 2.51/\,\text{〃} = 0.0093$
$d'/d = 3/27 = 0.111$

(F) $M_F = 2,510$ kgm, $N = 12,930$ kg, $S = 0$
安全 ヨリ

断面 ⓗ = 全く

(H2) $M_{H2} = -2510$ kgm, $N = 12,930$ kg, $-S = 5985$ kg
安全 ヨリ

全く

Ⓐ $M_A = -5005$ kgm, $N = 12930$ kg, $S = 7365$ kg

$\frac{M}{N} = \frac{5005 \times 100}{12930} = 38.7$
$d - u = 16.6$ (別53頁Ⓐ参照)
$e = 55.3$ cm
$e' = e - 34 = 21.3$
$e/e = 0.385$

$b = 100$, $h = 30 + \frac{30}{3} = 40$
$d = 37$, $d' = 3$
$A_s = 6.67 - 12\phi = 7.54$
$A_s' = 2.23 - 12\phi = 2.51$
$p = 7.54/100 \times 37 = 0.00204$
$p' = 2.51/\,\text{〃} = 0.00068$
$d'/d = 3/37 = 0.081$

上海複式暗渠 3m×4m

$\frac{Ne}{bd^2} = \frac{12930 \times 55.3}{100 \times 37^2} = 5.23$

$\frac{Ne}{bd^2\sigma_c} = 0.150$ $k = 0.320$

$\sigma_c = \frac{5.23}{0.150} = 34.9$ kg/cm²

$\sigma_s = 15 \times 34.9 \times \frac{.680}{.320} = 1112$ "

$\tau = \frac{7365}{100 \times .927 \times 37} = 2.1$ "

中央壁　　曲率無=剪力, 共=零 ∴ $N = 30240$ kg

直圧応力 $N =$ 30240
壁重量 $0.3 \times 4.0 \times 2400 =$ 2880
33120 kg c

断面 = 3075 cm² (第60表参照)

$\sigma_c = \frac{33120}{3075} = 10.8$ kg/cm² $\quad \frac{l}{b} = \frac{340}{30} = 11.3 < 15$

基礎底面圧力

垂直荷重 $2V_A + V_D = 2 \times 12930 + 30240 =$ 56100 kg
壁1重量 $3 @ 0.30 \times 4.0 @ 2400 =$ 8650
64750
基礎重量 $7.5 \times 0.75 @ 2200 =$ 12400
77150 kg

底面圧力 $= \frac{77150}{7.5 \times 1.0} = 10280$ kg/m²

杭1列7本, 各列間隔 1.00m c to c.
杭1本当荷重 $= \frac{77150}{7} = 11200$ kg

杭末n 180φ 長 6,000　　間隔, 横 1.10m c to c, 縦 1.00m c to c

基礎鉄筋

上向圧力 $= \frac{64750}{7.5 \times 1.0} = 8630$ kg/m²

$M = \frac{1}{2} \times 8630 \times 3.30^2 = 7830$ kgm

$A_s = \frac{7830 \times 100}{1200 \times .9 \times 70} = 10.33$ cm²

{ 16φ-450 c to c = 4.47
{ 19φ-450 " = 6.30
10.77 cm²

翼壁

暗渠 CVC3 = 準ず
(第37頁参照)

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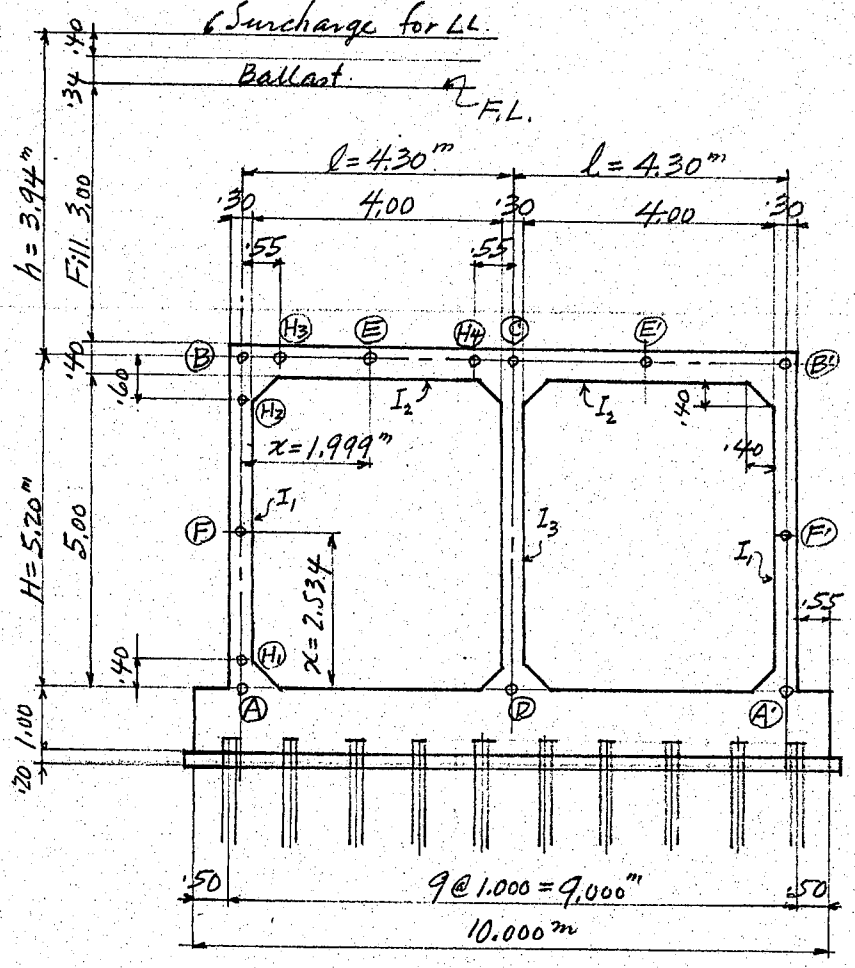
上海高速鐵道 標準型複式暗渠 4m×5m

土被 3.0m 標準型複式暗渠 4m×5m --- CVE3



荷重状態

活荷重

4@16500 = 66000 kg
分布荷重 p' = 610 kg/m²
換算土深 0.40 m
} (第1頁参照)

天井荷重

$wh\left(1-\frac{hk}{1+2HC}\right)$ 式 k=0.19, C=0.58

$= 1600 \times 3.94\left(1-\frac{3.94\times 0.19}{1+2\times 5.20\times 0.58}\right) = 5630$

天井ノ重量 0.43 @2400 = 1030
天井荷重 ---- p = 6,660 kg/m²

側壁土圧

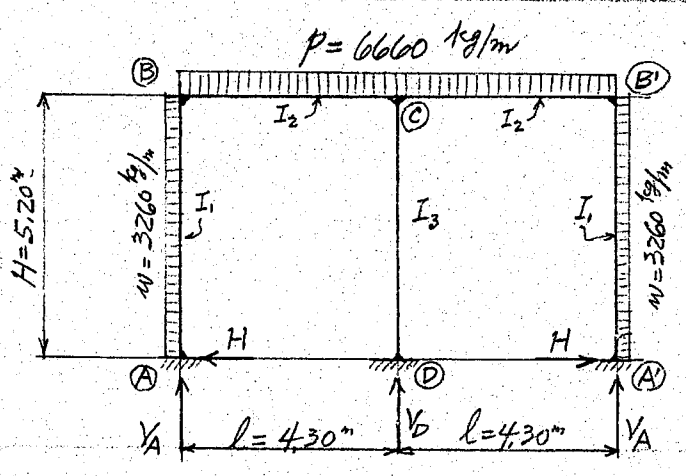
B点=於ケル土圧 $\frac{1}{3}\times 5630 = 1875$
$\frac{1}{3}\times 1600\times 5.20 = 2770$
A点=於ケル土圧 4,645
側壁平均土圧

$w = \frac{1875+4645}{2} = 3260$ kg/m²

諸係数

$I_1 = \frac{1.00\times 0.30^3}{12} = 0.002250$ (m)⁴

$I_2 = \frac{1.00\times 0.40^3}{12} = 0.005333$ (m)⁴



$K_1 = \frac{I_1}{H} = \frac{0.002250}{5.20} = 0.000433$

$K_2 = \frac{I_2}{l} = \frac{0.005333}{4.30} = 0.001240$

} $K_1+K_2 = 0.001673$

$\frac{K_1}{12(K_1+K_2)} = \frac{0.000433}{12\times 0.001673} = 0.0216$

$\frac{K_1}{24(K_1+K_2)} = \frac{0.000433}{24\times 0.001673} = 0.0108$

$\frac{K_2}{12(K_1+K_2)} = \frac{0.001240}{12\times 0.001673} = 0.0618$

$pl^2 = 6660\times 4.30^2 = 123140$
$wH^2 = 3260\times 5.20^2 = 88150$
} $pl^2 - wH^2 = 34990$

$\frac{pl^2}{12} = 10260$, $\frac{pl^2}{2} = 61570$

$\frac{wH^2}{12} = 7345$, $\frac{wH^2}{2} = 44075$

上海標準複式暗渠 4m×5m

節点弯曲率

$$M_B = -\frac{k_1}{12(k_1+k_2)}(pl^2-wH^2)-\frac{wH^2}{12} = -0.0216^{-750}\times 34990 - 7345 = -8100\ kgm$$

$$M_{C2} = -\frac{k_2}{12(k_1+k_2)}(pl^2-wH^2)-\frac{pl^2}{12} = -0.0618^{-2160}\times 34990 - 10260 = -12420\ "$$

$$M_A = \frac{k_1}{24(k_1+k_2)}(pl^2-wH^2)-\frac{wH^2}{2} = 0.0108^{380}\times 34990 - 7345 = -6965\ "$$

$$M_{C3} = M_D = 0$$

反力

$$V_A = \frac{M_{C2}-M_B+m_{BC}}{l} = \frac{-12420+8100+61570}{4.30} = 13310\ kg$$

$$V_D = 2pl - 2V_A = 2\times 6660\times 4.30 - 2\times 13310 = 30660\ "$$

$$H = \frac{M_B-M_A+m_{BA}}{H} = \frac{-8100+6965+44075}{5.20} = 8260\ "$$

剪力

側壁 $S_A = H = 8260\ kg$

$S_{H1} = 8260 - 3260\times 0.40 = 6955\ "$

Ⓕ $x = \frac{8260}{3260} = 2.534\ m$ above A.

$S_F = 0$

$S_{H2} = 8260 - 3260\times 4.60 = -6735\ kg$

$S_{B1} = 8260 - 3260\times 5.20 = -8690\ "$

天井 $S_{B2} = V_A = 13310\ kg$

$S_{H3} = 13310 - 6660\times 0.55 = 9650\ "$

Ⓔ $x = \frac{13310}{6660} = 1.999\ m$ from B.

$S_E = 0$

$S_{H4} = 13310 - 6660\times 3.75 = -11660\ kg$

$S_{C2} = 13310 - 6660\times 4.30 = 15330\ "$

中央壁 $S_{C3} = S_D = 0$

中間点=於ケル弯曲率

M_{H1}

$8260\times 0.40 = 3305$

$-\frac{1}{2}\times 3260\times 0.40^2 = -260$

$M_A = -6965$

$M_{H1} = -3920\ kgm$

M_F

$8260\times 2.534 = 20930$

$-\frac{1}{2}\times 3260\times 2.534^2 = -10455$

$M_A = -6965$

$M_F = 3510\ kgm$

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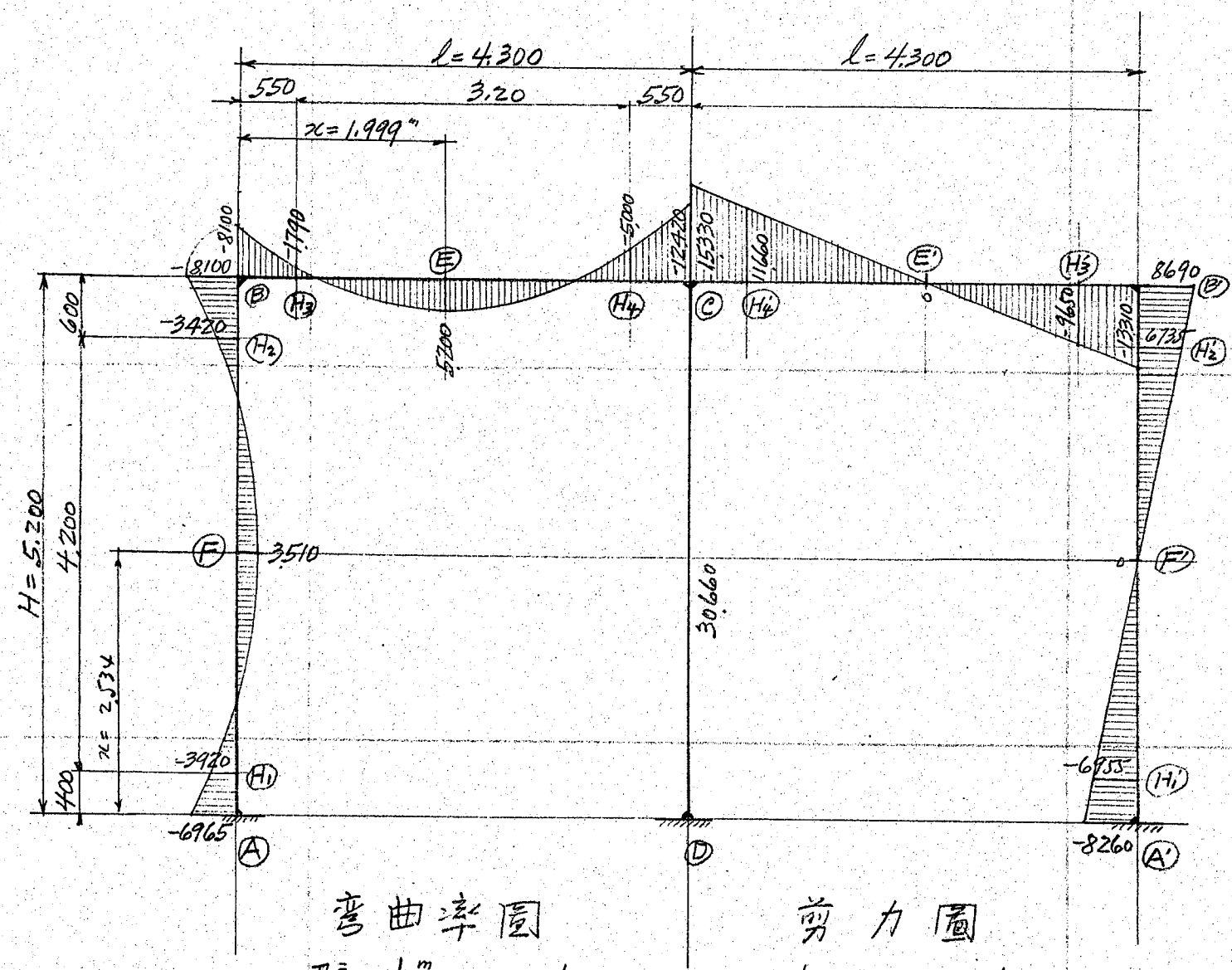
上海複式暗渠 4m×5m

M_{H2} $8260 \times 4.60 = 37995$
$-\frac{1}{2} \times 3260 \times 4.60^2 = -34450$
$M_A = -6965$
$M_{H2} = -3420$ kgm

M_{H3} $13310 \times 0.55 = 7320$
$-\frac{1}{2} \times 6660 \times 0.55^2 = -1010$
$M_B = -8100$
$M_{H3} = -1790$ kgm

M_E $13310 \times 1.999 = 26620$
$-\frac{1}{2} \times 6660 \times 1.999^2 = -13320$
$M_B = -8100$
$M_E = 5200$ kgm

M_{H4} $13310 \times 3.75 = 49900$
$-\frac{1}{2} \times 6660 \times 3.75^2 = -46800$
$M_B = -8100$
$M_{H4} = -5000$ kgm.



彎曲率圖 尺度 $\frac{1}{100}^m = 10{,}000$ kgm

剪力圖 $\frac{1}{100}^m = 10{,}000$ kg

縮尺 1:60

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上海複式暗渠 4"×5"

Ⓒ $M_{C2} = -12420$ kgm, $N = 8690$ kg, $S = -15330$ kg

$d/h = 53/55 = 0.964$
$d'/h = 5/55 = 0.091$
$p_0 = 18.90/100\times55 = 0.00344$
$p_0' = 4.47/\,, = 0.00081$
$u = .514\times58 = 29.8$ cm
$d-u = 23.2$ "

$\frac{M}{N} = \frac{12420\times100}{8690} = 143.0$
$d-u = 23.2$
$e = 166.2$ cm
$e' = e-48 = 118.2$ "
$e'/e = 0.712$
$\frac{Ne}{bd^2} = \frac{8690\times166.2}{100\times53^2} = 5.14$
$\frac{Ne}{bd^2\sigma_c} = 0.149$, $k = 0.315$
$\sigma_c = \frac{5.14}{0.149} = 34.5$ kg/cm²
$\sigma_s = 15\times34.5\times\frac{.685}{.315} = 1125$ "
$\tau = \frac{15330}{100\times.895\times53} = 3.2$ "

$b=100$ cm, $h = 40+\frac{55}{3} = 58$ cm
$d = 53$ cm, $d' = 5$ cm
$A_s = 6.67-19\phi = 18.90$ cm²
$A_s' = 2.22-16\phi = 4.47$ "
$p = 18.90/100\times53 = 0.00357$
$p' = 4.47/\,, = 0.00085$
$d'/d = 5/53 = 0.0944$

Ⓔ $M_E = 5200$ kgm, $N = 8690$ kg, $S = 0$

$d/h = 35/40 = 0.875$
$d'/h = 5/40 = 0.125$
$p_0 = 13.41/100\times40 = 0.00336$
$p_0' = 4.47/\,, = 0.00112$
$u = 0.509\times40 = 20.4$ cm
$d-u = 14.6$ "

$\frac{M}{N} = \frac{5200\times100}{8690} = 59.9$
$d-u = 14.6$
$e = 74.5$ cm
$e' = e-30 = 44.5$ "
$e'/e = 0.598$
$\frac{Ne}{bd^2} = \frac{8690\times74.5}{100\times35^2} = 5.285$
$\frac{Ne}{bd^2\sigma_c} = 0.164$ $k = 0.35$
$\sigma_c = \frac{5.285}{0.164} = 32.2$ kg/cm²
$\sigma_s = 15\times32.2\times\frac{.65}{.35} = 898$ "
$\tau = 0$

$b=100$, $h=40$
$d=35$ $d'=5$
$A_s = 6.67-16\phi = 13.41$
$A_s' = 2.22-16\phi = 4.47$
$p = 13.41/100\times35 = 0.00383$
$p' = 4.47/\,, = 0.00128$
$d'/d = 5/35 = 0.143$

Ⓗ4 $M_{H4} = -5000$ kgm, $N = 8690$ kg, $S = -11660$ kg

$\tau = \frac{11660}{100\times\frac{7}{8}\times35} = 3.8$ kg/cm²

$b=100$, $h=40$
$d=35$ $d'=5$
$A_s = 6.67-19\phi$
$A_s' = 2.22-19\phi$

Ⓗ3 $M_{H3} = -1790$ kgm, $N = 8690$ kg, $S = 9650$ kg

$\tau = \frac{9650}{100\times\frac{7}{8}\times35} = 3.2$ kg/cm²

$b=100$, $h=40$
$d=35$, $d'=5$
$A_s = 6.67-16\phi$
$A_s' = 2.22-16\phi$

Ⓑ $M_B = -8100$ kgm, $N = 8690$ kg, $S = -13310$ kg

$d/h = 53/58 = 0.914$
$d'/h = 5/58 = 0.086$
$p_0 = 13.41/100\times58 = 0.00231$
$p_0' = 4.47/\,, = 0.00077$
$u = 0.51\times58 = 29.6$
$d-u = 23.4$ cm

$\frac{M}{N} = \frac{8100\times100}{8690} = 93.2$
$d-u = 23.4$
$e = 116.6$ cm
$e' = e-48 = 68.6$ "
$e'/e = 0.588$
$\frac{Ne}{bd^2} = \frac{8690\times116.6}{100\times53^2} = 3.61$

$b=100$, $h = 40+\frac{55}{3} = 58$
$d=53$, $d'=5$
$A_s = 6.67-16\phi = 13.41$
$A_s' = 2.22-16\phi = 4.47$
$p = 13.41/100\times53 = 0.00253$
$p' = 4.47/\,, = 0.00084$
$d'/d = 5/53 = 0.0944$

上海複式暗渠 4m×5m

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側壁

Ⓑ $M_B = -8100$ kgm , $N = 13310$ kg , $S = -8690$ kg

$d/h = 46/50 = 0.920$
$d'/h = 4/50 = 0.080$
$p_0 = 13.41/100\times50 = 0.00268$
$p_0' = 4.47/\,\text{〃} = 0.00089$
$u = 0.51\times50 = 25.5$ cm
$d-u = 20.5$ 〃

$\frac{M}{N} = \frac{8100\times100}{13310} = 60.8$
$d-u = 20.5$
$e = 81.3$ cm
$e' = e-4^{cm} = 39.3$ 〃
$e'/e = 0.483$
$\frac{Ne}{bd^2} = \frac{13310\times81.3}{100\times46^2} = 5.12$
$\frac{Ne}{bd^2\sigma_c} = 0.159$, $k = 0.330$

$\sigma_c = \frac{5.12}{0.159} = 32.2$ kg/cm²
$\sigma_s = 15\times32.2\times\frac{.665}{.335} = 960$ 〃
$\tau = \frac{8690}{100\times.888\times46} = 2.1$ 〃

$b = 100$, $h = 30+\frac{60}{3} = 50$
$d = 46$, $d' = 4$
$A_s = 6.67-16^{\phi} = 13.41$
$A_s' = 2.22-16^{\phi} = 4.47$
$p = 13.41/100\times46 = 0.00292$
$p' = 4.47/\,\text{〃} = 0.00097$
$d'/d = 4/46 = 0.087$

Ⓗ₁ $M_{H1} = -3920$ kgm , $N = 13310$ kg , $S = 6955$ kg

$d/h = 26/30 = 0.867$
$d'/h = 4/30 = 0.133$
$p_0 = 13.41/100\times30 = 0.00447$
$p_0' = 4.47/\,\text{〃} = 0.00149$
$u = 0.514\times30 = 15.4$ cm
$d-u = 10.6$ 〃

$\frac{M}{N} = \frac{3920\times100}{13310} = 29.5$
$d-u = 10.6$
$e = 40.1$ cm
$e' = e-2^{cm} = 18.1$ 〃
$e'/e = 0.452$
$\frac{Ne}{bd^2} = \frac{13310\times40.1}{100\times26^2} = 7.90$
$\frac{Ne}{bd^2\sigma_c} = 0.200$, $k = 0.435$
$\sigma_c = \frac{7.90}{.20} = 39.5$ kg/cm²
$\sigma_s = 15\times39.5\times\frac{.565}{.435} = 769$ 〃
$\tau = \frac{6955}{100\times.855\times26} = 3.1$ 〃

$b = 100$, $h = 30$
$d = 26$ $d' = 4$
$A_s = 6.67-16^{\phi} = 13.41$
$A_s' = 2.22-16^{\phi} = 4.47$
$p = 13.42/100\times26 = 0.00517$
$p' = 4.47/\,\text{〃} = 0.00172$
$d'/d = 4/26 = 0.154$

Ⓕ $M_F = 3510$ kgm , $N = 13310$ kg , $S = 0$
Ⓗ₂ $M_{H2} = -3420$ 〃 , $N =$ 〃 , $S = -6735$ kg
} 断面ハ共 = Ⓗ₁ = 含ム

安全ナリ

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上海複式暗渠 4m×5m

Ⓐ $M_A = -6965$ kgm, $N = 13310$ kg, $S = 8260$ kg

$d/h = 39/43 = 0.906$
$d'/h = 4/43 = 0.093$
$p_0 = 13.41/100 \times 43 = 0.00312$
$p_0' = 4.47/\,, \quad = 0.00104$
$u = .512 \times 43 = 22.0$
$d-u = 17.0$

$\frac{M}{N} = \frac{6965 \times 100}{13310} = 52.3$
$e = d-u = 17.0$
$e' = e - 35 = 34.3$
$e'/e = 0.495$
$\frac{Ne}{bd^2} = \frac{13310 \times 69.3}{100 \times 39^2} = 6.065$
$\frac{Ne}{bd^2\sigma_c} = .169 \quad k = .360$
$\sigma_c = \frac{6065}{.169} = 35.9$ kg/cm²
$\sigma_s = 15 \times 35.9 \times \frac{.640}{.360} = 958$,
$\tau = \frac{8260}{100 \times .88 \times 39} = 2.4$,

$b=100$, $h = 30 + \frac{40}{3} = 43$
$d = 39$, $d' = 4$
$A_s = 6.67 - 16\phi = 13.41$
$A_s' = 2.22 - 16\phi = 4.47$
$p = 13.41/100 \times 39 = 0.00344$
$p' = 4.47/\,, \quad = 0.00115$
$d'/d = 4/39 \quad = 0.1026$

中央壁

曲げ導き = 力ハ零ヨリ

直圧応力 $N = 30660$
壁重量 $.3 \times 5.0 @ 2400 = 3600$
34260 kg

断面
混凝土 $100 \times 30 = 3000$
鉄筋 $2 \times 15 \times 4.47 = 134$ $(2.22 - 16\phi)$
3134 cm²

$\sigma_c = \frac{34260}{3134} = 10.9$ kg/cm², $\frac{l}{h} = \frac{420}{30} = 14.0 < 15$

基礎底面圧力

垂直荷重 $\Sigma V_A + V_D = 13310 \times 2 + 30660 = 57280$
壁重量 $3 @ 0.3 \times 5.0 @ 2400 = 10800$
68080 kg
基礎重量 $10.0 \times 1.0 @ 2200 = 22000$
90,080 kg

底面圧力 $= \frac{90080}{10.0} = 9,010$ kg/m²

杭 1列 10本 各列間隔 1.00m c to c
杭1本当荷重 $= 90080 \div 10 = 9,010$ kg
杭 ㎜ 180φ 長 4.500 間隔, 縦横共 1.0m c to c.

基礎鉄筋

上向圧力 $= \frac{68080}{10.0} = 6810$ kg/m²
$M = \frac{1}{2} \times 6810 \times 4.30^2 = 10,480$ kgm
$S = \frac{1}{2} \times 6810 \times 4.30 = 14,630$ kg
$A_s = \frac{10480 \times 100}{1200 \times .9 \times 95} = 10.21$ cm²
16φ − 450 c to c = 4.47
19φ − 450 , = 6.30
10.77 cm².
$\tau = \frac{14630}{100 \times .9 \times 95} = 1.7$ kg/cm²

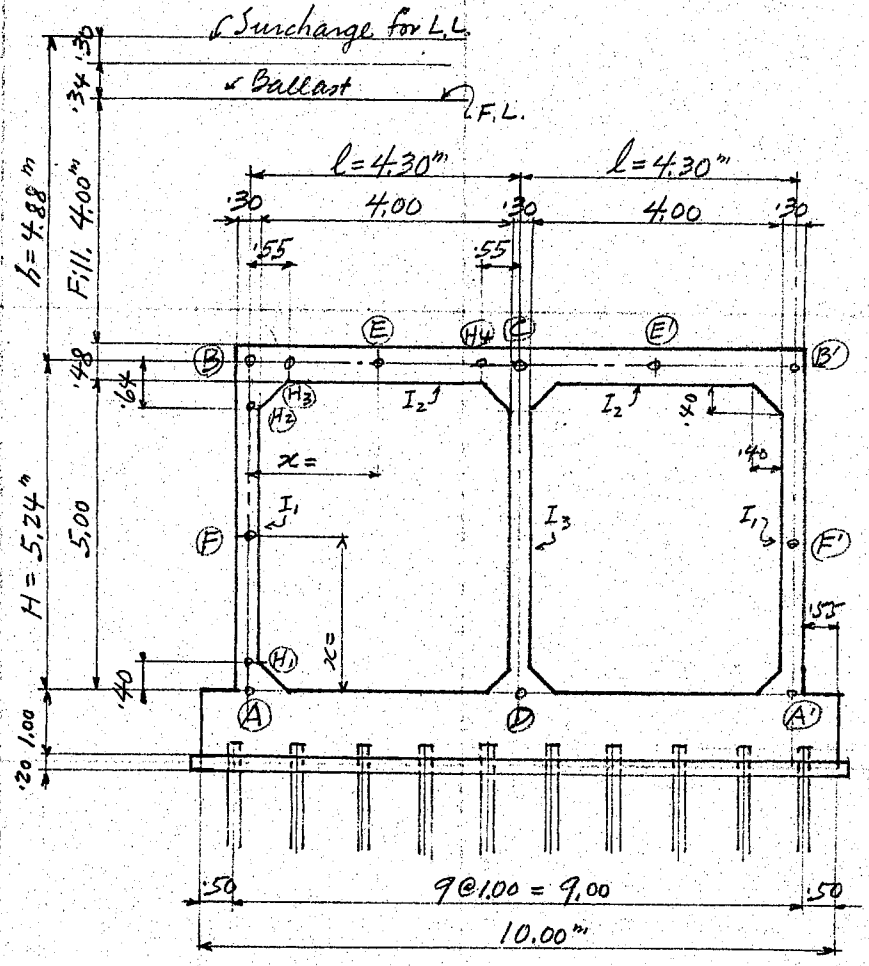
翼壁 現場ノ状況ニ依リ適宜設計スベシ

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 稲葉 日付 16-11-19 類別 CVE4
照査 日付 第 74 頁

上海複式暗渠 4m×5m

土被 4.0m 標準型複式暗渠 4m×5m --- CVE4



活荷重

4@16500 = 66,000 kg
分布荷重 p' = 425 kg/m² } (第7頁参照)
埋篶土深 0.30 m

天井荷重

$w h \left(1 - \frac{hk}{1+2HC}\right)$ 差し k=0.19, C=0.58

$= 1600 \times 4.88 \left(1 - \frac{4.88 \times 0.19}{1+2 \times 5.24 \times 0.58}\right) = 6780$

天井荷重 0.51@2400 = 1220

天井荷重 p = 8,000 kg/m²

側壁土圧

B点=於ケル土圧 $\frac{1}{3} \times 6780$ = 2260

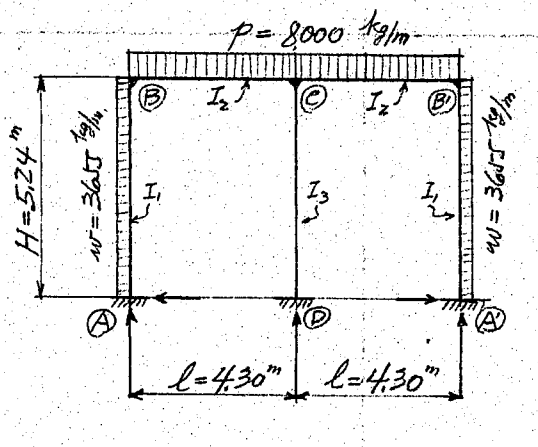
$\frac{1}{3} \times 1.600 \times 5.24$ = 2790

A点=於ケル土圧 5050 kg/m²

側壁平均土圧

$w = \frac{2260+5050}{2} = 3655$ kg/m²

荷重状態



諸係数

$I_1 = \frac{1.00 \times 0.30^3}{12} = 0.002250\ (m)^4$

$I_2 = \frac{1.00 \times 0.48^3}{12} = 0.009216$ "

$k_1 = \frac{I_1}{H} = \frac{0.002250}{5.24} = 0.000429$

$k_2 = \frac{I_2}{l} = \frac{0.009216}{4.30} = 0.002143$ } $k_1+k_2 = 0.002572$

$\frac{k_1}{12(k_1+k_2)} = \frac{0.000429}{12 \times 0.002572} = 0.0139$

$\frac{k_1}{24(k_1+k_2)} = 0.0070$

$\frac{k_2}{12(k_1+k_2)} = \frac{0.002143}{12 \times 0.002572} = 0.0694$

$Pl^2 = 8000 \times 4.30^2 = 147,800$
$wH^2 = 3655 \times 5.24^2 = 100,300$ } $Pl^2 - wH^2 = 47,500$

$\frac{Pl^2}{12} = 12,320$, $\frac{Pl^2}{2} = 73,900$

$\frac{wH^2}{12} = 8,360$, $\frac{wH^2}{2} = 50,150$

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設計 稲葉 日付 16-11-19 類別 CVE4
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上海複式暗渠 4m×5m

節点弯曲率

$$M_B = -\frac{K_1}{12(K_1+K_2)}(Pl^2 - WH^2) - \frac{WH^2}{12} = -0.0139 \times 47500 - 8360 = -9,010 \text{ kgm}$$ (-650)

$$M_{C2} = -\frac{K_2}{12(K_1+K_2)}(Pl^2 - WH^2) - \frac{Pl^2}{12} = -0.0694 \times 47500 - 12320 = -15,620$$ (-3300)

$$M_A = \frac{K_1}{24(K_1+K_2)}(Pl^2 - WH^2) - \frac{WH^2}{12} = 0.0070 \times 47500 - 8360 = -8,030$$ (330)

$M_{C3} = M_D = 0$

反力

$$V_A = \frac{M_{C2} - M_B + M_{CB}}{l} = \frac{-15620 + 9010 + 73900}{4.30} = 15,650 \text{ kg}$$

$$V_D = 2pL - 2V_A = 2 \times 8000 \times 4.30 - 15650 \times 2 = 37,500$$

$$H = \frac{M_B - M_A + M_{BA}}{H} = \frac{-9010 + 8030 + 50150}{5.24} = 9,385$$

剪力

側壁 $S_A = H = 9,385$ kg

$S_{H1} = 9385 - 3655 \times 0.4 = 7,920$

Ⓕ $x = \frac{9385}{3655} = 2.568^m$ above Ⓐ

$S_F = 0$

$S_{H2} = 9385 - 3655 \times 4.60 = -7,430$ kg

$S_{B1} = 9385 - 3655 \times 5.24 = -9,770$

天井 $S_{B2} = V_A = 15,650$ kg

$S_{H3} = 15650 - 8000 \times 0.55 = 11,250$

Ⓔ $x = \frac{15650}{8000} = 1.956^m$ from Ⓑ

$S_E = 0$

$S_{H4} = 15650 - 8000 \times 3.75 = -14350$ kg

$S_{C2} = 15650 - 8000 \times 4.30 = -18,750$

中央壁 $S_{C3} = S_D = 0$

中間点弯曲率

M_{H1}

$9385 \times 0.40 = 3755$

$-\frac{1}{2} \times 3655 \times 0.40^2 = -290$

$M_A = -8030$

$M_{H1} = -4,565$ kgm

M_F

$9,385 \times 2.568 = 24080$

$-\frac{1}{2} \times 3655 \times 2.568^2 = -12050$

$M_A = -8030$

$M_F = 4,000$ kgm

M_{H2}

$9385 \times 4.60 = 43150$

$-\frac{1}{2} \times 3655 \times 4.60^2 = -38350$

$M_A = -8,030$

$M_{H2} = -3430$ kgm

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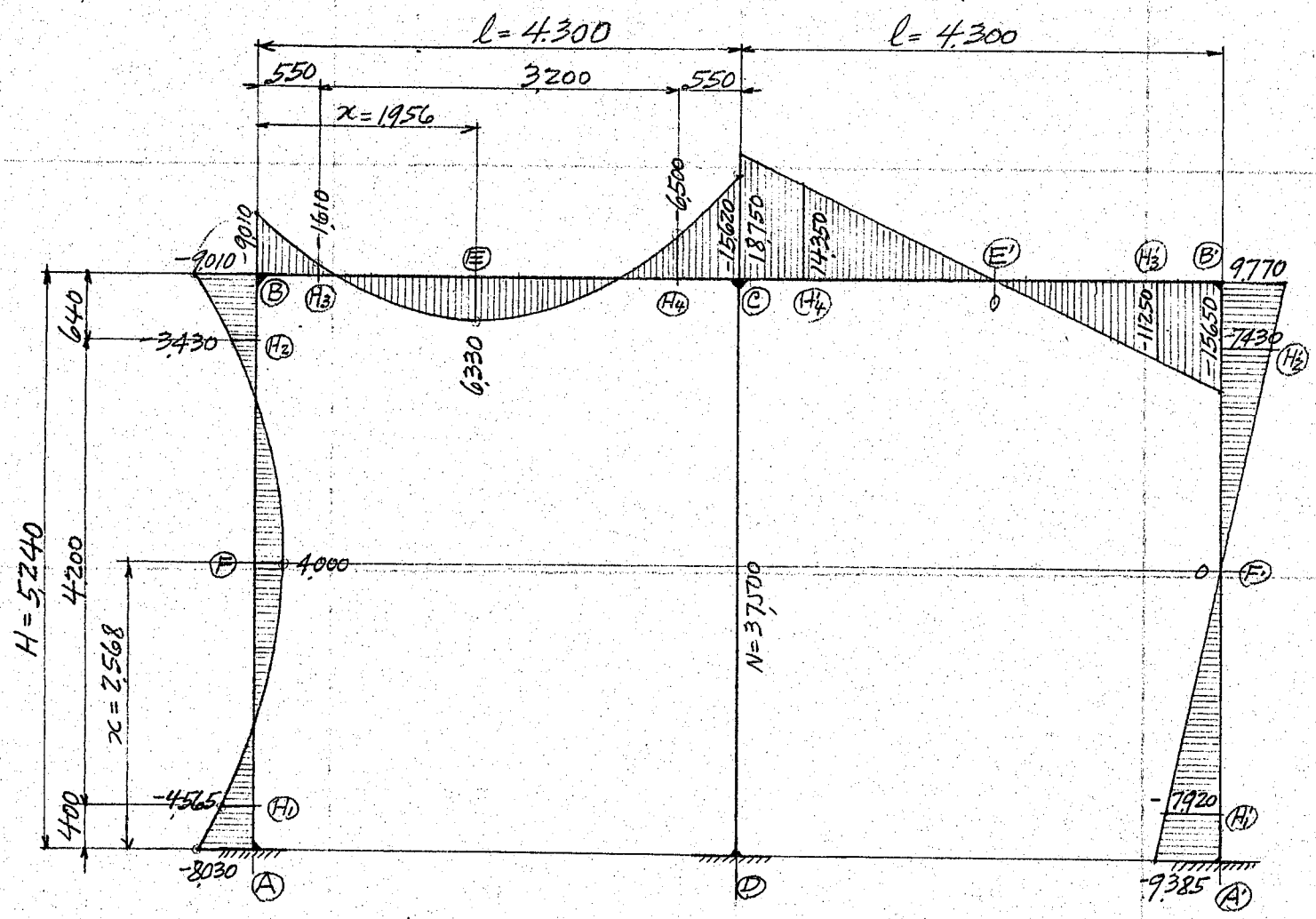
上海複式暗渠 4m×5m

M_{H3}
$15{,}650 \times 0.55 = 8610$
$-\frac{1}{2} \times 8000 \times 0.55^2 = -1{,}210$
$M_B = -9010$
$M_{H3} = -1{,}610$ kgm

M_E
$15{,}650 \times 1.956 = 30640$
$-\frac{1}{2} \times 8000 \times 1.956^2 = -15300$
$M_B = -9010$
$M_E = 6330$ kgm

M_{H4}
$15650 \times 3.750 = 58700$
$-\frac{1}{2} \times 8000 \times 3.750^2 = -56190$
$M_B = -9010$
$M_{H4} = -6{,}500$ kgm



彎曲率圖　　剪力圖

尺度 $\frac{1}{100}$m = 10,000kgm　　$\frac{1}{100}$m = 10,000 kg

縮尺 1:60

断面應力ノ計算

天井 Ⓒ $M_{C2} = -15620$ kgm , $N = 9770$ kg , $S = -18750$ kg

$d/h = 61/66 = 0.924$
$d'/h = 5/66 = 0.076$
$p_0 = 18.90/100 \times 66 = 0.00286$
$p_0' = 6.30/\,, = 0.00095$
$u = 0.51 \times 66 = 33.6$ cm
$d-u = 27.4$,

$\frac{M}{N} = \frac{15620 \times 100}{9770} = 160.0$
$e = d-u = 27.4$
$e' = e - 56 = 131.4$ cm
$e'/e = 0.702$
$\frac{Ne}{bd^2} = \frac{9770 \times 187.4}{100 \times 61^2} = 4.920$
$\frac{Ne}{bd^2\sigma_c} = 0.147$, $k = 0.30$

$b = 100^{cm}$, $h = 48 + \frac{55}{3} = 66^{cm}$
$d = 61^{cm}$, $d' = 5^{cm}$
$A_s = 6.67 - 19\phi = 18.90$ cm²
$A_s' = 2.22 - 19\phi = 6.30$,
$p = 18.90/100 \times 61 = 0.00310$
$p' = 6.30/\,, = 0.00103$
$d'/d = 5/61 = 0.082$

$\sigma_c = \frac{4.920}{0.147} = 33.5$ kg/cm²

$\sigma_s = 15 \times 33.5 \times \frac{0.70}{0.30} = 1172$ "

$\tau = \frac{18750}{100 \times 0.90 \times 61} = 3.4$ "

(H4) $M_{H4} = -6500$ kgm, $N = 9770$ kg, $S = -14350$ kg

$d/h = 43/48 = 0.895$
$d'/h = 5/48 = 0.104$
$p_0 = 18.90/100 \times 48 = 0.00394$
$p_0' = 4.47/\," = 0.00093$
$u = .514 \times 48 = 24.7$ cm
$d - u = 18.3$ "

$\frac{M}{N} = \frac{6500 \times 100}{9770} = 66.5$
$d - u = 18.3$
$e = 84.8$ cm
$e' = e - 3.8 = 46.8$ "
$e'/e = 0.552$
$\frac{Ne}{bd^2} = \frac{9770 \times 84.8}{100 \times 43^2} = 4.48$
$\frac{Ne}{bd^2\sigma_c} = 0.175$, $k = 0.380$
$\sigma_c = \frac{4.48}{0.175} = 25.6$ kg/cm²
$\sigma_s = 15 \times 25.6 \times \frac{0.62}{0.38} = 627$ "
$\tau = \frac{14350}{100 \times 1873 \times 43} = 3.8$ "

$b = 100$, $h = 48$
$d = 43$, $d' = 5$
$A_s = 6.67 - 19\phi = 18.90$
$A_s' = 2.22 - 16\phi = 4.47$
$p = 18.90/100 \times 43 = 0.00440$
$p' = 4.47/\," = 0.00104$
$d'/d = 5/43 = 0.116$

(E) $M_E = 6330$ kgm, $N = 9770$ kg, $S = 0$

$d/h = 43/48 = 0.895$
$d'/d = 5/48 = 0.104$
$p_0 = 13.41/100 \times 48 = 0.00280$
$p_0' = 4.47/\," = 0.00093$
$u = .508 \times 48 = 24.4$ cm
$d - u = 18.6$ "

$\frac{M}{N} = \frac{6330 \times 100}{9770} = 64.8$
$d - u = 18.6$
$e = 83.4$ cm
$e' = e - 3.8 = 45.4$ "
$e'/e = 0.545$
$\frac{Ne}{bd^2} = \frac{9770 \times 83.4}{100 \times 43^2} = 4.405$
$\frac{Ne}{bd^2\sigma_c} = 0.158$, $k = 0.333$
$\sigma_c = \frac{4.405}{0.158} = 27.9$ kg/cm²
$\sigma_s = 15 \times 27.9 \times \frac{.665}{.333} = 832$ "
$\tau = 0$

$b = 100$, $h = 48$
$d = 43$, $d' = 5$
$A_s = 6.67 - 16\phi = 13.41$
$A_s' = 2.22 - 16\phi = 4.47$
$p = 13.41/100 \times 43 = 0.00312$
$p' = 4.47/\," = 0.00104$
$d'/d = 5/43 = 0.116$

(H3) $M_{H3} = -1610$ kgm, $N = 9770$ kg, $S = 11250$ kg

$\tau = \frac{11250}{100 \times 7/8 \times 43} = 3.0$ kg/cm²

(B) $M_B = -9010$ kgm, $N = 9770$ kg, $S = 15650$ kg

$d/h = 61/66 = 0.924$
$d'/h = 5/66 = 0.076$
$p_0 = 13.41/100 \times 66 = 0.00203$
$p_0' = 4.47/\," = 0.00068$
$u = 0.51 \times 66 = 33.6$ cm
$d - u = 27.4$ "

$\frac{M}{N} = \frac{9010 \times 100}{9770} = 92.3$
$d - u = 27.4$
$e = 119.7$ cm
$e' = e - 5.6 = 63.7$ "
$e'/e = 0.532$

$b = 100$, $h = 48 + \frac{5.5}{3} = 66$
$d = 61$, $d' = 5$
$A_s = 6.67 - 16\phi = 13.41$
$A_s' = 2.27 - 16\phi = 4.47$
$p = 1341/100 \times 61 = 0.00220$
$p' = 4.47/\," = 0.00073$
$d'/d = 5/61 = 0.082$

杉布、(E)と合ス。

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設計 稲葉 日付 16-11-19 類別 CVE4
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上海複式 暗渠 4m×5m

$\frac{Ne}{bd^2} = \frac{9770 \times 119.7}{100 \times 61^2} = 3.144$

$\frac{Ne}{bd^2\sigma_c} = 0.138$, $k = 0.290$

$\sigma_c = \frac{3.144}{0.138} = 24.9$ kg/cm²

$\sigma_s = 15 \times 24.9 \times \frac{.710}{.290} = 916$ "

$\tau = \frac{15650}{100 \times .903 \times 61} = 2.8$ "

側壁 Ⓑ $M_B = -9010$ kgm , $N = 15650$ kg , $S = -9,770$ kg

$d/h = 47/51 = 0.921$
$d'/h = 4/51 = 0.078$
$p_0 = 13.41/100 \times 51 = 0.00263$
$p_0' = 4.47/$ " $= 0.00088$
$u = 0.51 \times 51 = 26.0$ cm
$d - u = 21.0$ "

$\frac{M}{N} = \frac{9010 \times 100}{15650} = 57.6$
$d - u = 21.0$
$e = 78.6$ cm
$e' = e - 43 = 35.6$ "
$e'/e = 0.453$
$\frac{Ne}{bd^2} = \frac{15650 \times 78.6}{100 \times 47^2} = 5.578$
$\frac{Ne}{bd^2\sigma_c} = 0.161$ $k = 0.340$
$\sigma_c = \frac{5.578}{0.161} = 34.7$ kg/cm²
$\sigma_s = 15 \times 34.7 \times \frac{0.660}{0.340} = 1010$ "
$\tau = \frac{9770}{100 \times .887 \times 47} = 2.3$ "

$b = 100$, $h = 30 + \frac{64}{3} = 51$
$d = 47$, $d' = 4$
$A_s = 6.67 - 16^\phi = 13.41$
$A_s' = 2.22 - 16^\phi = 4.47$
$p = 13.41/100 \times 47 = 0.00285$
$p' = 4.47/$ " $= 0.000 95$
$d'/d = 4/47 = 0.085$

Ⓗ $M_{H1} = -4565$ kgm , $N = 15650$ kg , $S = 7920$ kg

$d/h = 26/30 = 0.867$
$d'/h = 4/30 = 0.133$
$p_B = 13.41/100 \times 30 = 0.00447$
$p_B' = 8.95/$ " $= 0.00298$
$u = .508 \times 30 = 15.2$ cm
$d - u = 10.8$ "

$\frac{M}{N} = \frac{4565 \times 100}{15650} = 29.2$
$d - u = 10.8$
$e = 40.0$ cm
$e' = e - 22 = 18.0$ "
$e'/e = 0.450$
$\frac{Ne}{bd^2} = \frac{15650 \times 40.0}{100 \times 26^2} = 9.26$
$\frac{Ne}{bd^2\sigma_c} = 0.211$, $k = 0.425$
$\sigma_c = \frac{9.26}{0.211} = 43.8$ kg/cm²
$\sigma_s = 15 \times 43.8 \times \frac{.575}{.425} = 891$ "
$\tau = \frac{7920}{100 \times .858 \times 26} = 3.5$ "

$b = 100$, $h = 30$
$d = 26$, $d' = 4$
$A_s = 6.67 - 16^\phi = 13.41$
$A_s' = 4.44 - 16^\phi = 8.95$
$p = 13.41/100 \times 26 = 0.00517$
$p' = 8.95/$ " $= 0.00344$
$d'/d = 4/26 = 0.154$

Ⓕ $M_F = 4000$ kg.m , $N = 15650$ kg , $S = 0$

$d/h = 26/30 = 0.867$
$d'/h = 4/30 = 0.133$
$p_0 = 1341/100 \times 30 = 0.00447$
$p_0' = 4.41/$ " $= 0.00149$
$u = 0.514 \times 30 = 15.4$ cm
$d - u = 10.6$ "

$\frac{M}{N} = \frac{4000 \times 100}{15650} = 25.6$
$d - u = 10.6$
$e = 36.2$ cm
$e' = e - 22 = 14.2$ "
$e'/e = 0.393$
$\frac{Ne}{bd^2} = \frac{15650 \times 36.2}{100 \times 26^2} = 8.39$

$b = 100$, $h = 30$
$d = 26$, $d' = 4$
$A_s = 6.67 - 16^\phi = 13.41$
$A_s' = 2.22 - 16^\phi = 4.47$
$p = 13.41/100 \times 26 = 0.00517$
$p' = 4.47/$ " $= 0.00172$
$d'/d = 4/26 = 0.154$

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上海福式婧渠4"×5"

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$\frac{Ne}{bd^2\sigma_c} = 0.207$, $k = 0.455$

$\sigma_c = \frac{8.39}{0.207} = 40.5$ kg/cm²

$\sigma_s = 15 \times 40.5 \times \frac{1545}{1455} = 728$ "

$\tau = 0$

(H2) $M_{H2} = -3430$ kgm, $N = 15650$ kg, $S = -7430$ kg

$\tau = \frac{7430}{100 \times 7/8 \times 26} = 3.3$ kg/cm²

断面 (F) = 合ビ

Ⓐ $M_A = -8030$ kgm, $N = 15650$ kg, $S = 9385$ kg

$\frac{M}{N} = \frac{8030 \times 100}{15650} = 51.3$

$d - u = 17.0$ cm (第73頁Ⓐ参照)

$e = 68.3$ "

$e' = e - 3s = 33.3$ "

$e'/e = 0.488$

$\frac{Ne}{bd^2} = \frac{15650 \times 68.3}{100 \times 39^2} = 7.03$

$\frac{Ne}{bd^2\sigma_c} = 0.170$, $k = 0.360$

$\sigma_c = \frac{7.03}{0.170} = 41.3$ kg/cm²

$\sigma_s = 15 \times 41.3 \times \frac{0.640}{0.360} = 1102$ "

$\tau = \frac{9385}{100 \times 0.88 \times 39} = 2.7$ "

$b = 100$, $h = 30 + \frac{40}{3} = 43$
$d = 39$, $d' = 4$
$A_s = 6.67 - 16^{\phi} = 13.41$
$A_s' = 2.22 - 16^{\phi} = 4.41$
$p = 13.41/100 \times 39 = 0.00344$
$p' = 4.41/$ " $= 0.001115$
$d'/d = 4/39 = 0.1026$

中央壁

曲率率 = 剪力 ÷ 幅 = 零 +リ

直圧荷力	$N =$	37.500
壁重量	$0.3 \times 5.0 \times 2400 =$	3600
		41,100 kg

断面

混凝土	$100 \times 30 =$	3,000
鉄筋	$15 \times 2 \times 4.47 =$	134 (2.22−16φ)
		3134 cm²

$\sigma_c = \frac{41100}{3134} = 13.1$ kg/cm²

$\frac{l}{b} = \frac{420}{30} = 14 < 15$

基礎底面圧力

垂直荷重	$2V_A + V_D = 15650 \times 2 + 37500 =$	68,800
壁重量	$3@0.3 \times 5.0 @ 2400 =$	10800
		79600 kg
基礎重量	$10.0 \times 1.0 @ 2200 =$	22000
		101,600 kg

底面圧力 $= \frac{101600}{10.0} = 10,160$ kg/m²

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上海複式暗渠4m×5m

杭 1列 10本 各列間隔 1.0m c to c
杭一本当荷重 = $\frac{101600}{10}$ = 10,160 kg
杭 末n 180φ 長 5500
間隔縦横共 1.0m c to c.

基礎鉄筋

上向圧力 = $\frac{79600}{10.0}$ = 7,960 kg/m²

$M = \frac{1}{2} \times 7960 \times 4.30^2 =$ 12,250 kgm

$S = \frac{1}{2} \times 7960 \times 4.30 =$ 17,100 kg

$A_s = \frac{12250 \times 100}{1200 \times 19 \times 95} =$ 11.95 cm²

19φ − 22.5 c to c = 12.60 cm²

$\tau = \frac{17100}{100 \times 9 \times 95} =$ 2.0 kg/cm²

翼壁

現場ノ状況ニ依リ適宜設計スベシ

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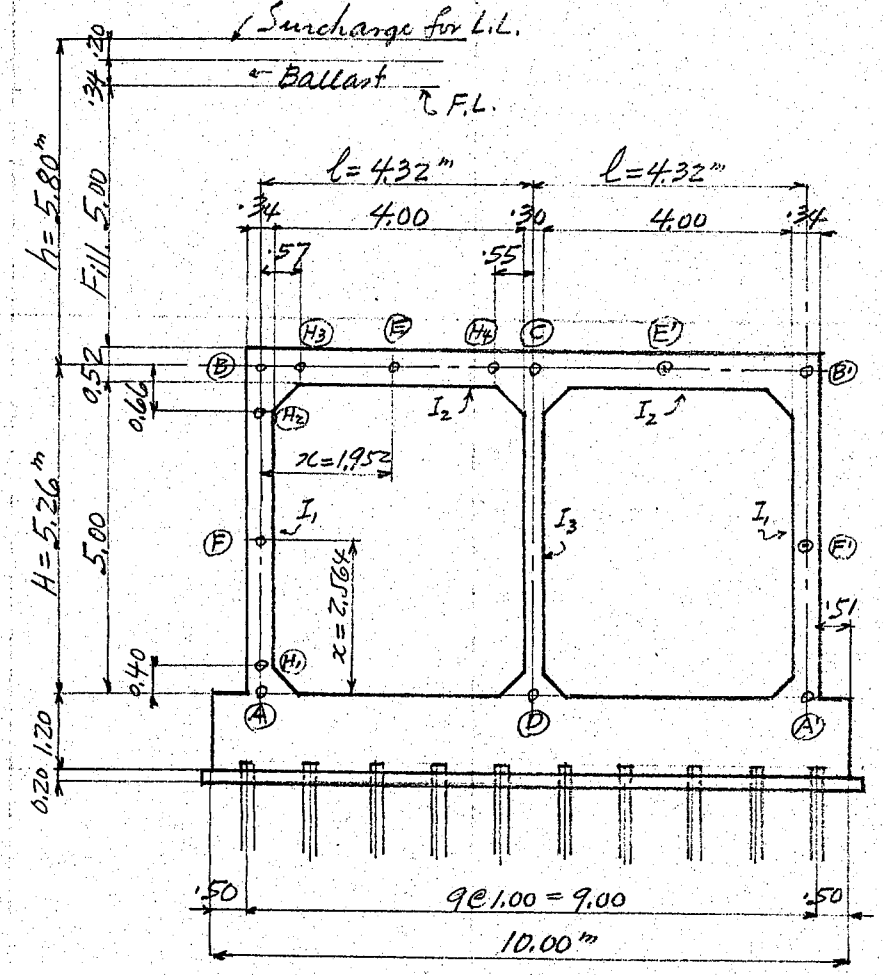
設計 稲葉 日付 16-11-20 類別 CVE5
照査 日付 第 81 頁

上海複式暗渠 4m×5m

土被 5.0m 標準型複式暗渠 4m×5m --- CVE5



活荷重

4@16500 = 66,000 kg
分布荷重 p = 315 kg/m²
撒芽土深 0.20m
} (第27頁参照)

天井荷重

$wh\left(1-\frac{5k}{1+2HC}\right)$ 差= $k=0.19$, $C=0.58$

$= 1600\times 5.80\left(1-\frac{5.80\times 0.19}{1+2\times 5.26\times 0.58}\right) = 7830$
天井重差 0.55@2400 = 1320
天井荷重 --- p = 9150 kg/m²

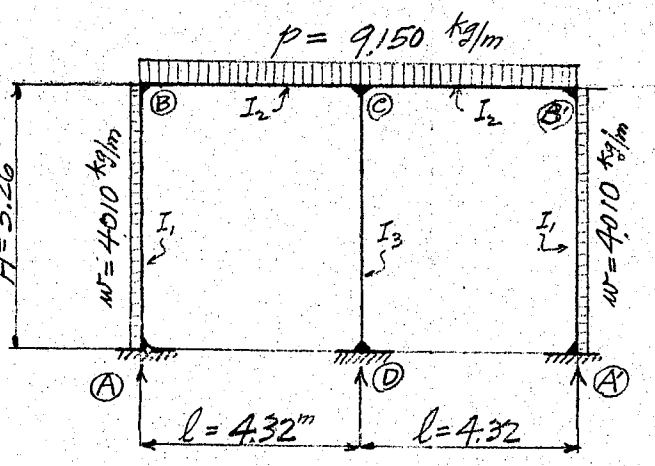
側壁土圧

B点 = 於ケル土圧 $\frac{1}{3}\times 7830$ = 2610
$\frac{1}{3}\times 1600\times 5.26$ = 2800
A点 = 於ケル土圧 5410

側壁平均土圧

$w = \frac{2610+5410}{2} = 4010$ kg/m²

荷重狀態



諸係数

$I_1 = \frac{1.00\times 0.343^3}{12} = 0.003275$ (m⁴)

$I_2 = \frac{1.00\times 0.52^3}{12} = 0.011717$

$k_1 = \frac{I_1}{H} = \frac{0.003275}{5.26} = 0.000623$
$k_2 = \frac{I_2}{l} = \frac{0.011717}{4.32} = 0.002712$
} $k_1+k_2 = 0.003335$

$\frac{k_1}{12(k_1+k_2)} = \frac{0.000623}{12\times 0.003335} = 0.0156$

$\frac{k_1}{24(k_1+k_2)} = 0.0078$

$\frac{k_2}{12(k_1+k_2)} = \frac{0.002712}{12\times 0.003335} = 0.0678$

$Pl^2 = 9.150\times 4.32^2 = 170.500$
$wH^2 = 4.010\times 5.26^2 = 110.900$
} $Pl^2 - wH^2 = 59.600$

$\frac{Pl^2}{12} = 14.210$, $\frac{Pl^2}{2} = 85.250$

$\frac{wH^2}{12} = 9.240$ $\frac{wH^2}{2} = 55.450$

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設計 稲葉 日付 16-11-21 類別 CVE5
照査 日付 第 82 頁

上海複式暗渠 4m×5m

節点彎曲率

$$M_B = -\frac{K_1}{12(K_1+K_2)}(pl^2-wH^2) - \frac{wH^2}{12} = -0.0156^{-930} \times 59600 - 9240 = -10170 \text{ kgm}$$

$$M_{C2} = -\frac{K_2}{12(K_1+K_2)}(pl^2-wH^2) - \frac{pl^2}{12} = -0.0678^{-4040} \times 59600 - 14210 = -18250 \text{ "}$$

$$M_A = \frac{K_1}{24(K_1+K_2)}(pl^2-wH^2) - \frac{wH^2}{12} = 0.0078^{470} \times 59600 - 9240 = -8770 \text{ "}$$

$$M_{C3} = M_D = 0$$

反力

$$V_A = \frac{M_{C2} - M_B + M_{CB}}{l} = \frac{-18250+10170+85250}{4.32} = 17860 \text{ kg}$$

$$V_D = 2pl - 2V_A = 2 \times 9150 \times 4.32 - 17860 \times 2 = 43340 \text{ "}$$

$$H = \frac{M_B - M_A + M_{BA}}{H} = \frac{-10170+8770+55450}{5.26} = 10280 \text{ kg}$$

剪力

側壁 $S_A = H = 10280$ kg

$S_{H1} = 10280 - 4010 \times 0.4 = 8680$ "

Ⓕ $x = \frac{10280}{4010} = 2.564^m$ above A. $S_F = 0$

$S_{H2} = 10280 - 4010 \times 4.60 = -8170$ "

$S_{B1} = 10280 - 4010 \times 5.26 = -10810$ "

天井 $S_{B2} = V_A = 17860$ "

$S_{H3} = 17860 - 9150 \times 0.57 = 12640$ "

Ⓔ $x = \frac{17860}{9150} = 1.952^m$ from B. $S_E = 0$

$S_{H4} = 17860 - 9150 \times 3.77 = -16640$ "

$S_{C2} = 17860 - 9150 \times 4.32 = -21670$ "

中央壁 $S_{C3} = S_D = 0$

中間点，彎曲率

M_{H1}

	10280×0.40	=	4115
	$-\frac{1}{2} \times 4010 \times 0.40^2$	= −	320
	M_A	= −	8770
		M_{H1} = −	4975 kgm

M_F

	10280×2.564	=	26380
	$-\frac{1}{2} \times 4010 \times 2.564^2$	= −	13190
	M_A	= −	8770
		M_F =	4420 kgm

M_{H2}

	10280×4.60	=	47330
	$-\frac{1}{2} \times 4010 \times 4.60^2$	= −	42380
	M_A	= −	8770
		M_{H2} = −	3800 kgm

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設計 稲葉 日付 16-11-21 類別 CVE5
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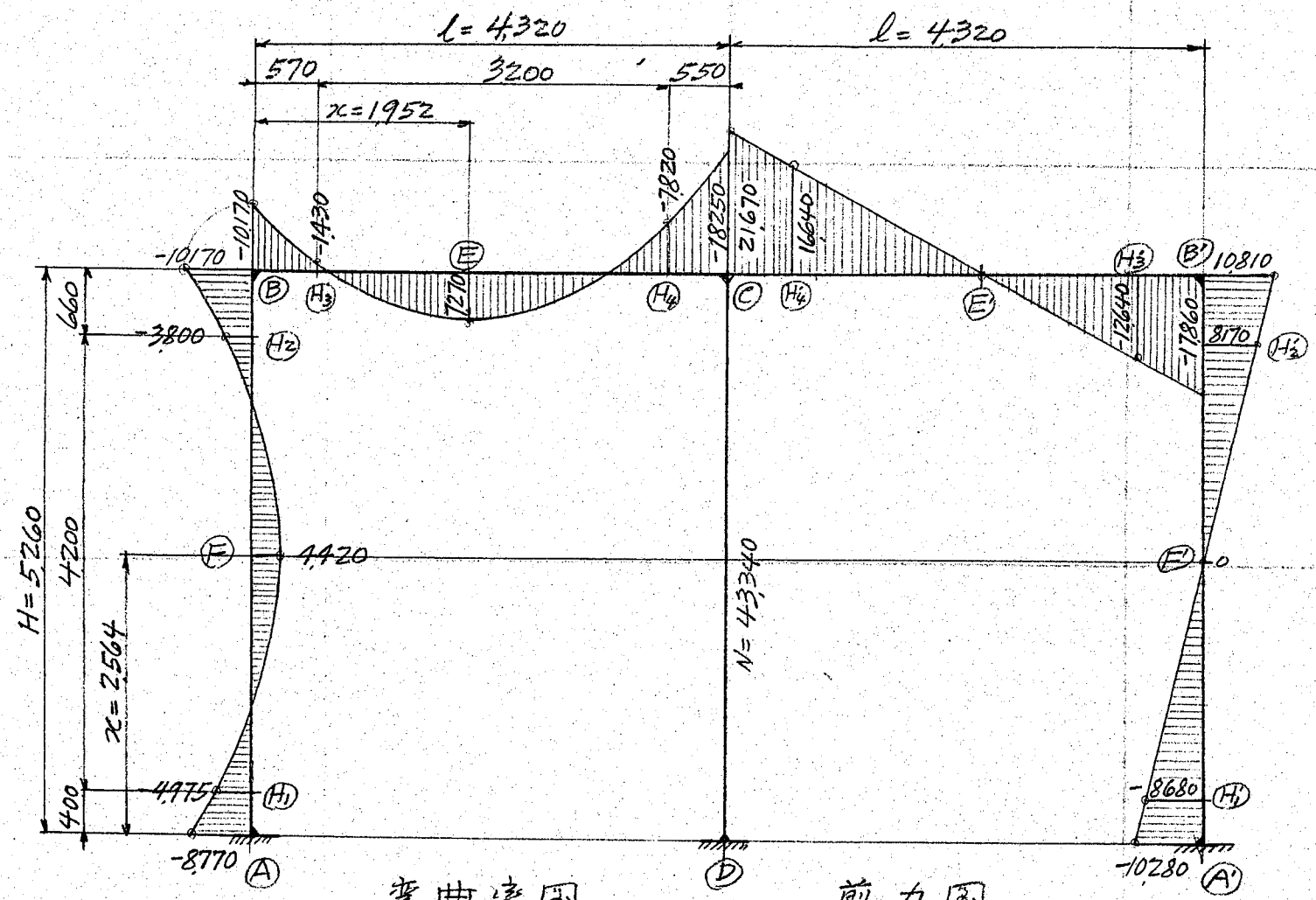
上海複式暗渠 4m × 5m

M_{H3}
$17860 \times 0.57 = 10170$
$-\frac{1}{2} \times 9150 \times 0.57^2 = -1430$
$M_B = -10170$
$M_{H3} = -1430$ kgm

M_E
$17860 \times 1.952 = 34880$
$-\frac{1}{2} \times 9150 \times 1.952^2 = -17440$
$M_B = -10170$
$M_E = 7270$ kgm

M_{H4}
$17860 \times 3.770 = 67350$
$-\frac{1}{2} \times 9150 \times 3.770^2 = -65000$
$M_B = -10170$
$M_{H4} = -7820$ kgm



彎曲率圖 尺度 100m = 10,000 kgm
剪力圖 100m = 10,000 kg
縮尺 1:60

断面應力ノ計算

天井 © $M_{C2} = -18250$ kgm , $N = 10810$ kg, $S = -21670$ kg

$d/h = 65/70 = 0.928$
$d'/h = 5/70 = 0.0714$
$p_0 = 22.68/100 \times 70 = 0.00324$
$p_0' = 7.56/$ 〃 $= 0.00108$
$u = 0.512 \times 70 = 35.8$ cm
$d - u = 29.2$ 〃

$\frac{M}{N} = \frac{18250 \times 100}{10810} = 168.8$
$d - u = 29.2$
$e = 198.0$ cm
$e' = e - 60 = 138.0$ 〃
$e'/e = 0.697$
$\frac{Ne}{bd^2} = \frac{10810 \times 198.0}{100 \times 65^2} = 5.07$
$\frac{Ne}{bd^2\sigma_c} = 0.152$, $k = 0.310$
$\sigma_c = 5.07/0.152 = 33.4$ kg/cm²
$\sigma_s = 15 \times 33.4 \times \frac{.690}{.310} = 1116$ 〃

$b = 100$ cm, $h = 52 + \frac{55}{3} = 70$ cm
$d = 65$ cm, $d' = 5$ cm
$A_s = 8 - 19\phi = 22.68$ cm²
$A_s' = 2.67 - 19\phi = 7.56$ 〃
$p = 22.68/100 \times 65 = 0.00349$
$p' = 7.56/$ 〃 $= 0.00116$
$d'/d = 5/65 = 0.077$

$\tau = \frac{21670}{100 \times .897 \times 65} = 3.7$ kg/cm²

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設計 稲葉 日付 16-11-21 類別 CVE5
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上海複式暗渠 4m×5m

(H4) $M_{H4} = -7820$ kgm, $N = 10810$ kg, $S = -16640$ kg

$d/h = 47/52 = 0.904$
$d'/h = 5/52 = 0.096$
$p_0 = 22.68/100\times52 = 0.00436$
$p_0' = 5.37/\,\text{〃} = 0.00103$
$u = 0.518\times52 = 26.9$ cm
$d-u = 20.1$ 〃

$\frac{M}{N} = \frac{7820\times100}{10810} = 78.2$
$d-u = 20.1$
$e = 98.3$ cm
$e' = e-42 = 56.3$ 〃
$e'/e = 0.573$
$\frac{Ne}{bd^2} = \frac{10810\times98.3}{100\times47^2} = 4.815$
$\frac{Ne}{bd^2\sigma_c} = 0.179$ $k = 0.385$
$\sigma_c = \frac{4.815}{0.179} = 26.9$ kg/cm²
$\sigma_s = 15\times26.9\times\frac{0.615}{0.385} = 645$ 〃
$\tau = \frac{16640}{100\times.872\times47} = 4.1$ 〃

$b=100$, $h=52$
$d=47$, $d'=5$
$A_s = 8-19\phi = 22.68$
$A_s' = 2.67-16\phi = 5.37$
$p = 22.68/100\times47 = 0.00483$
$p' = 5.37/\,\text{〃} = 0.00114$
$d'/d = 5/47 = 0.106$

(E) $M_E = 7270$ kgm, $N = 10810$ kg, $S = 0$

$d/h = 47/52 = 0.904$
$d'/h = 5/52 = 0.096$
$p_0 = 16.09/100\times52 = 0.00310$
$p_0' = 5.37/\,\text{〃} = 0.00103$
$u = .512\times52 = 26.6$ cm
$d-u = 20.4$ 〃

$\frac{M}{N} = \frac{7270\times100}{10810} = 67.2$
$d-u = 20.4$
$e = 87.6$ cm
$e' = e-42 = 45.6$ 〃
$e'/e = 0.620$
$\frac{Ne}{bd^2} = \frac{10810\times87.6}{100\times47^2} = 4.285$
$\frac{Ne}{bd^2\sigma_c} = 0.157$ $k = 0.330$
$\sigma_c = \frac{4.285}{0.157} = 27.3$ kg/cm²
$\sigma_s = 15\times27.3\times\frac{0.670}{0.330} = 832$ 〃
$\tau = 0$

$b=100$, $h=52$
$d=47$, $d'=5$
$A_s = 8-16\phi = 16.09$
$A_s' = 2.67-16\phi = 5.37$
$p = 16.09/100\times47 = 0.00343$
$p' = 5.37/\,\text{〃} = 0.00114$
$d'/d = 5/47 = 0.106$

(H3) $M_{H3} = -1430$ kgm, $N = 10810$ kg, $S = 12640$ kg

$\tau = \frac{12640}{100\times\frac{7}{8}\times47} = 3.1$ kg/cm²

断面 E = とる

(B) $M_B = -10170$ kgm, $N = 10810$ kg, $S = 17860$ kg

$d/h = 66/71 = 0.930$
$d'/h = 5/71 = 0.070$
$p_0 = 16.09/100\times71 = 0.00227$
$p_0' = 5.37/\,\text{〃} = 0.00076$
$u = 0.51\times71 = 36.2$ cm
$d-u = 29.8$ 〃

$\frac{M}{N} = \frac{10170\times100}{10810} = 94.1$
$d-u = 29.8$
$e = 123.9$ cm
$e' = e-61 = 62.9$ 〃
$e'/e = 0.508$
$\frac{Ne}{bd^2} = \frac{10810\times123.9}{100\times66^2} = 3.08$
$\frac{Ne}{bd^2\sigma_c} = 0.148$ $k = 0.310$
$\sigma_c = \frac{3.08}{0.148} = 20.8$ kg/cm²
$\sigma_s = 15\times20.8\times\frac{.69}{.31} = 695$ 〃
$\tau = \frac{17860}{100\times.897\times66} = 3.0$ 〃

$b=100$, $h=52+\frac{57}{3}=71$
$d=66$, $d'=5$
$A_s = 8-16\phi = 16.09$
$A_s' = 2.67-16\phi = 5.37$
$p = 16.09/100\times66 = 0.00244$
$p' = 5.37/\,\text{〃} = 0.00081$
$d'/d = 5/66 = 0.076$

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設計 稲葉 日付 16-11-21 類別 CVE5
照査 日付 第 85 頁

上海複式焙渠 4m×5m

側壁 Ⓑ $M_B = -10170$ kgm, $N = 17860$ kg, $S = -10810$ kg

$d/h = 51/56 = 0.910$
$d'/h = 5/56 = 0.089$
$p_0 = 16.09/100\times56 = 0.00287$
$p_0' = 5.37/\,, = 0.00096$
$u = 0.51\times56 = 28.6$ cm
$d-u = 22.4$ "

$\frac{M}{N} = \frac{10170\times100}{17860} = 57.0$
$d-u = 22.4$
$e = 79.4$ cm
$e' = e-46 = 33.4$ "
$e'/e = 0.421$
$\frac{Ne}{bd^2} = \frac{17860\times79.4}{100\times51^2} = 5.45$
$\frac{Ne}{bd^2\sigma_c} = 0.170$ $k = 0.360$
$\sigma_c = 5.45/0.170 = 32.1$ kg/cm²
$\sigma_s = 15\times32.1\times\frac{.640}{.360} = 856$ "
$\tau = \frac{10810}{100\times.88\times51} = 2.4$ "

$b=100$, $h = 34+\frac{66}{3} = 56$
$d=51$, $d'=5$
$A_s = 8-16^9 = 16.09$
$A_s' = 2.67-16^9 = 5.37$
$p = 16.09/100\times51 = 0.00315$
$p_0' = 5.37/\,, = 0.00105$
$d'/d = 5/51 = 0.098$

Ⓗ1 $M_{H1} = -4975$ kgm, $N = 17860$ kg, $S = +8680$ kg

$d/h = 30/34 = 0.882$
$d'/h = 4/34 = 0.118$
$p_0 = 16.09/100\times34 = 0.00473$
$p_0' = 5.37/\,, = 0.00158$
$u = .515\times34 = 17.5$ cm
$d-u = 12.5$ "

$\frac{M}{N} = \frac{4975\times100}{17860} = 27.9$
$d-u = 12.5$
$e = 40.4$ cm
$e' = e-26 = 14.4$ "
$e'/e = 0.357$
$\frac{Ne}{bd^2} = \frac{17860\times40.4}{100\times30^2} = 8.03$
$\frac{Ne}{bd^2\sigma_c} = 0.213$, $k = 0.465$
$\sigma_c = 8.03/0.213 = 37.7$ kg/cm²
$\sigma_s = 15\times37.7\times\frac{.535}{.465} = 652$ "
$\tau = \frac{8680}{100\times.845\times30} = 3.4$ "

$b=100$, $h=34$
$d=30$, $d'=4$
$A_s = 8-16^9 = 16.09$
$A_s' = 2.67-16^9 = 5.37$
$p = 16.09/100\times30 = 0.00537$
$p' = 5.37/\,, = 0.00179$
$d'/d = 4/30 = 0.133$

Ⓕ $M_F = 4420$ kgm, $N = 17860$ kg, $S = 0$

右ヒサシ

断面 H_1 ニ全ジ

Ⓗ2 $M_{H2} = -3800$ kgm, $N = 17860$ kg, $S = -8170$ kg

$\tau = \frac{8170}{100\times.78\times30} = 3.1$ kg/cm²

全上

Ⓐ $M_A = -8770$ kgm, $N = 17860$ kg, $S = 10280$ kg

$d/h = 43/47 = 0.915$
$d'/h = 4/47 = 0.085$
$p_0 = 16.09/100\times47 = 0.00342$
$p_0' = 5.37/\,, = 0.00114$
$u = 0.512\times47 = 24.1$ cm
$d-u = 18.9$ "

$\frac{M}{N} = \frac{8770\times100}{17860} = 49.1$
$d-u = 18.9$
$e = 68.0$ cm
$e' = e-39 = 29.0$ "
$e'/e = 0.427$
$\frac{Ne}{bd^2} = \frac{17860\times68.0}{100\times43^2} = 6.57$
$\frac{Ne}{bd^2\sigma_c} = 0.180$ $k = 0.380$

$b=100$, $h = 34+\frac{40}{3} = 47$
$d=43$, $d'=4$
$A_s = 8-16^9 = 16.09$
$A_s' = 2.67-16^9 = 5.37$
$p = 16.09/100\times43 = 0.00375$
$p' = 5.37/\,, = 0.00125$
$d'/d = 4/43 = 0.0885$

$\sigma_c = 6575/0.180 = 36.5$ kg/cm²

$\sigma_s = 15 \times 36.5 \times \frac{0.620}{0.380} = 895$ "

$\tau = \frac{10280}{100 \times .878 \times 43} = 2.7$ "

中央壁

湾曲率差=勞力の差=零 ナリ

直圧応力 N= 43340

壁重量 0.3×5.0×2400 = 3600

46940 kg

断面

混凝土 100×30 = 3000

鉄筋 2×15×5.37 = 161 (2.67-16φ)

3161 cm²

$\sigma_c = \frac{46940}{3161} = 14.9$ kg/cm², $f_c = 420/30 = 14 < 15$

基礎底面圧力

垂直荷重 $2V_A + V_D = 17860 \times 2 + 43340 = 79060$ kg

壁重量 0.30×5.0@2400 = 3600

2@0.34×5.0@2400 = 8170

11770

90830 kg

基礎重量 10.0×1.2@2200 = 26400

117230 kg

底面圧力 = $\frac{117230}{10.0} = 11720$ kg/m²

杭1列10本 各列間隔 1.0" c to c

杭1本当荷重 = 11720 kg

杭末は180φ 長 6,000 間隔一組横筋各 1.0" c to c.

基礎鉄筋

上向圧力 = $\frac{90830}{10.0} = 9080$ kg/m²

$M = \frac{1}{2} \times 9080 \times 4.32^2 = 14100$ kgm

$S = \frac{1}{2} \times 9080 \times 4.32 = 19600$ kg

$A_s = \frac{14100 \times 100}{1200 \times 0.90 \times 115} = 11.37$ cm²

19φ − 225 c to c = 12.60 cm²

$\tau = \frac{19600}{100 \times .90 \times 115} = 1.9$ kg/cm²

翼壁

現場ノ状況ニ依リ適宜設計スベシ

終リ

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設計　日付　類別

照査　日付　第　頁

上海高速鐵道
鐵筋混凝土大型暗渠應力計算書

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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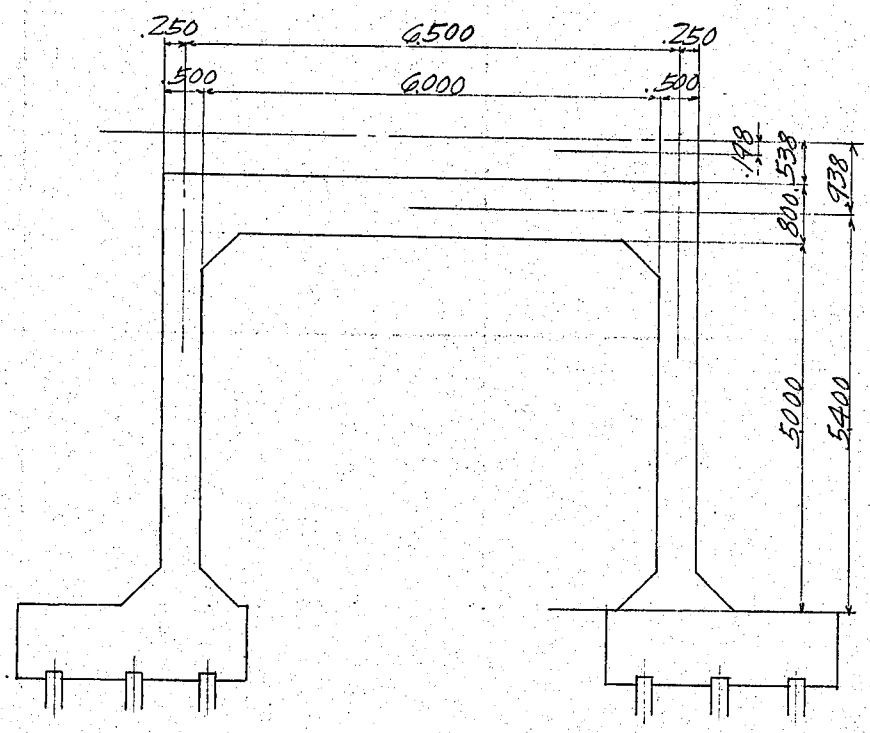
照査	日付	第	ノ頁

鐵筋混凝土暗渠

暗渠ノ設計

支間 $l = 6.500\,m$, $h = 5.400\,m$ 巾 $= 7.600\,m$



死荷重

軌道	800 ÷ 3.80	=	210
道床	35 × 19	=	665
床版	80 × 24	=	1,920
持送其他			55
			2,850 kg/m

假定斷面及物量力率

$$A_1 = 1.00 \times 0.50 = 0.50\ m^2$$

$$I_1 = \frac{bh^3}{12} = \frac{1.00 \times 0.50^3}{12} = 0.0104\ m^4$$

$$A_2 = 1.00 \times 0.80 = 0.80\ m^2$$

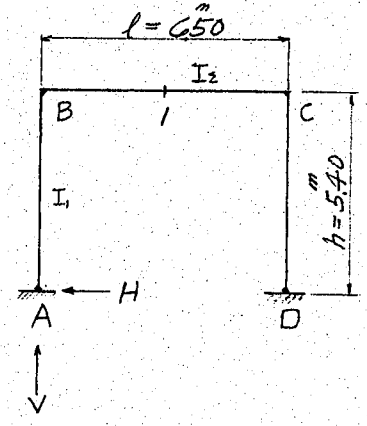
$$I_2 = \frac{1.00 \times 0.80^3}{12} = 0.0427\ m^4$$

$$K_1 = \frac{I_1}{h} = \frac{0.0104}{5.40} = 0.00193$$

$$K_2 = \frac{I_2}{l} = \frac{0.0427}{6.50} = 0.00657$$

$$2K_1 + K_2 = 0.01043$$

死荷重應力



$$C_{BC} = \frac{wl^2}{12} = \frac{2,850 \times 6.50^2}{12} = 10,040\ kgm$$

$$M_A = \frac{K_1 C_{BC}}{2K_1 + K_2} = \frac{0.00193 \times 10,040}{0.01043} = 1,860\ kgm$$

$$M_B = -2M_A = -3,720\ kgm$$

$$H_A = -\frac{M_A - M_B}{h} = -\frac{1860 + 3,720}{5.40} = -1,030\ kg \rightarrow$$

$$V_A = \frac{wl}{2} = \frac{2,850 \times 650}{2} = 9,260\ kg$$

$$S_{AB} = S_{BA} = -1,030\ kg$$

$$S_{BC} = 9,260\ kg$$

$$\frac{wl^2}{8} = \frac{2,850 \times 6.50^2}{8} = 15,050$$

$$-3,720$$

$$M_1 = 11,330\ kgm$$

土圧ヨル應力

安息角 $= 30°$

活荷重ヨル餘盛ナキ場合

$$w_1 = \frac{1}{3} w h_1 = \frac{1}{3} \times 1,600 \times 0.74 = 395\ kg/m^2$$

$$w_2 = \frac{1}{3} w h_2 = \frac{1}{3} \times 1,600 \times 6.14 = 3,280\ kg/m^2$$

$$C_{AB} = \frac{(3w_2 + 2w_1)h^2}{60} = \frac{(3 \times 3280 + 2 \times 395) \times 540^2}{60} = 5,170\ kgm$$

$$C_{BA} = \frac{(2w_2 + 3w_1)h^2}{60} = \frac{(2 \times 3280 + 3 \times 395) \times 540^2}{60} = 3,770\ kgm$$

$$M_{AB} = \frac{h^2}{6}(w_2 + 2w_1) = \frac{540^2}{6}(3280 + 2 \times 395) = 19,800\ kgm$$

$$M_{BA} = \frac{h^2}{6}(2w_2 + w_1) = \frac{540^2}{6}(2 \times 3280 + 395) = 33,800\ kgm$$

$K_1 + 6K_2 = 0.04135$, $K_1 + 9K_2 = 0.06106$, $K_1 + 3K_2 = 0.02164$

$K_1^2 + 12K_1K_2 + 3K_2^2 = 0.000286$, $7K_1 + 9K_2 = 0.07263$

$5K_1 - 3K_2 = -0.01006$, $K_1^2 - 3K_2^2 = -0.0001258$

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鐵筋混凝土暗渠

$$M_A = -\frac{1}{2(K_1+6K_2)}\left\{(K_1+9K_2)C_{AB}+(K_1+3K_2)m_{AB}+\frac{(K_1^2+12K_1K_2+3K_2^2)C_{BA}}{2K_1+K_2}\right\}$$

$$=-\frac{1}{0.0827}\left\{0.06106\times5170+0.02164\times19800+\frac{0.000286}{0.01043}\times3770\right\}=-10250\ kgm$$

$$M_B=\frac{K_2}{2(K_1+6K_2)}\left\{3(m_{AB}-C_{AB})-\frac{(7K_1+9K_2)C_{BA}}{2K_1+K_2}\right\}$$

$$=\frac{0.00657}{0.0827}\left\{3\times(19800-5170)-\frac{0.07263\times3770}{0.01043}\right\}=1400\ kgm$$

$$M_C=-\frac{K_2}{2(K_1+6K_2)}\left\{3(m_{AB}-C_{AB})-\frac{(5K_1-3K_2)C_{BA}}{2K_1+K_2}\right\}$$

$$=-\frac{0.00657}{0.0827}\left\{3\times(19800-5170)+\frac{0.01006\times3770}{0.01043}\right\}=-3780\ kgm$$

$$M_D=\frac{1}{2(K_1+6K_2)}\left\{(K_1+3K_2)(m_{AB}-C_{AB})-\frac{(K_1^2-3K_2^2)C_{BA}}{2K_1+K_2}\right\}$$

$$=\frac{1}{0.0827}\left\{0.02164\times(19800-5170)+\frac{0.0001258}{0.01043}\times3770\right\}=4380\ kgm$$

$$H_A=\frac{m_{BA}+M_B-M_A}{h}=\frac{33800+1400+10250}{5.40}=8420\ kg\ \leftarrow$$

$$H_D=\frac{M_D-M_C}{h}=-\frac{4380+3780}{5.40}=-1510\ kg\ \leftarrow$$

$$V_A=\frac{m_{AB}+M_A-M_D}{l}=-\frac{19800-10250-4380}{6.5}=-795\ kg$$

$$V_D=795\ kg$$

$$S_{AB}=8420\ kg$$

$$S_{BA}=8420-\frac{395+3280}{2}\times5.40=-1500\ kg$$

$$S_{BC}=-795=S_{CB}$$

活荷重ニヨル餘盛ヲ考ヘタル場合

換算餘盛ノ高　$\frac{16500}{3.80\times1.50}=2900\div1600=1.81\ m$

$$w_1=\frac{1}{3}\times1600\times2.55=1360\ kg/m^2$$

$$w_2=\frac{1}{3}\times1600\times7.95=4240\ kg/m^2$$

$$C_{AB}=\frac{(3\times4240+2\times1360)\times540^2}{60}=7500\ kgm$$

$$C_{BA}=\frac{(2\times4240+3\times1360)\times540^2}{60}=6100\ kgm$$

$$m_{AB}=\frac{540^2}{6}\times(4240+2\times1360)=33800\ kgm$$

$$m_{BA}=\frac{540^2}{6}\times(2\times4240+1360)=47900\ kgm$$

$$M_A=-\frac{1}{0.0827}\left\{0.06106\times7500+0.02164\times33800+0.0274\times6100\right\}=-16400\ kgm$$

$$M_B=\frac{0.00657}{0.0827}\left\{3\times26300-6.96\times6100\right\}=2890\ kgm$$

$$M_C=-0.0795\left\{3\times26300+0.964\times6100\right\}=-6740\ kgm$$

$$M_D=\frac{1}{0.0827}\left\{0.02167\times26300-0.01207\times6100\right\}=7790\ kgm$$

$$H_A=\frac{47900+2890+16400}{5.40}=12450\ kg\ \leftarrow$$

$$H_D=-\frac{7790+6740}{5.40}=-2690\ kg\ \leftarrow$$

$$V_A=-\frac{33800-16400-7790}{6.5}=-1480\ kg$$

$$V_D=+1480\ kg$$

$$S_{AB}=12450\ kg$$

$$S_{BC}=-1480\ kg$$

$$S_{BA}=12450-\frac{1360+4240}{2}\times5.40=-2670\ kg$$

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設計	日付	類別	
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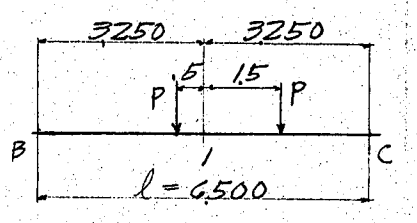
鐵筋混凝土暗渠
活荷重應力



特殊活荷重　P=16,500 kg
暗渠一米当り　P=16,500÷3.80=4,350 kg
kl=2.75 m，場合
k=0.423

$$M_A=\frac{Pkl(1-k)K_1\{(4k-1)K_1+(2k+5)K_2\}}{2(2K_1+K_2)(K_1+6K_2)}$$

$$=\frac{4350\times2.75\times0.577\times0.00193\times(0.692\times0.00193+5.846\times0.00657)}{2\times0.01043\times0.04135}=595\ kgm$$

$$M_B=-\frac{Pkl(1-k)K_1\{4(1-k)K_1+(13-2k)K_2\}}{2(2K_1+K_2)(K_1+6K_2)}$$

$$=-\frac{4350\times2.75\times0.577\times0.00193\times(2.308\times0.00193+12.154\times0.00657)}{2\times0.01043\times0.04135}=-1,303\ kgm$$

$$M_C=-\frac{Pkl(1-k)K_1\{4kK_1+(11+2k)K_2\}}{2(2K_1+K_2)(K_1+6K_2)}$$

$$=-\frac{4350\times2.75\times0.577\times0.00193\times(1.692\times0.00193+11.846\times0.00657)}{2\times0.01043\times0.04135}=-1,253\ kgm$$

$$M_D=\frac{Pkl(1-k)K_1\times\{(3-4k)K_1+(7-2k)K_2\}}{2(2K_1+K_2)(K_1+6K_2)}$$

$$=\frac{4350\times2.75\times0.577\times0.00193\times(1.308\times0.00193+6.154\times0.00657)}{2\times0.01043\times0.04135}=663\ kgm$$

$$H=-\frac{3Pkl(1-k)K_1}{2h(2K_1+K_2)}=-\frac{3\times4350\times2.75\times0.577\times0.00193}{2\times5.40\times0.01043}=-355\ kg\ \rightarrow$$

$$V_A=P(1-k)\left\{1+\frac{k(1-2k)K_1}{K_1+K_2}\right\}=4,350\times0.577\times\left(1+\frac{0.423\times0.154\times0.00193}{0.0085}\right)$$
$$=2,550\ kg$$

$$V_D=Pk\left\{1-\frac{(1-k)(1-2k)K_1}{K_1+6K_2}\right\}=4,350\times0.423\times\left(1-\frac{0.577\times0.154\times0.00193}{0.04135}\right)$$
$$=1,830\ kg$$

$S_{AB}=S_{BA}=-355\ kg$
$S_{BC}=2,550\ kg$
$S_{CB}=-1,830\ kg$

kl=4.75 m，場合　k=0.731

$$M_A=\frac{4,350\times4.75\times0.269\times0.00193\times(1.924\times0.00193+6.462\times0.00657)}{2\times0.01043\times0.04135}=574\ kgm$$

$$M_B=-12,430\times(1.076\times0.00193+11,538\times0.00657)=-968\ kgm$$

$$M_C=-12,430\times(2.924\times0.00193+12.462\times0.00657)=-1,088\ kgm$$

$$M_D=12,430\times(0.076\times0.00193+5.538\times0.00657)=454\ kgm$$

$$H=-\frac{3\times10.72}{2\times5.40\times0.01043}=-285\ kg\ \rightarrow$$

$$V_A=4,350\times0.269\times\left(1-\frac{0.731\times0.462\times0.00193}{0.0085}\right)=1,160\ kg$$

$$V_D=4,350\times0.731\times\left(1+\frac{0.269\times0.462\times0.00193}{0.04135}\right)=3,190\ kg$$

$S_{AB}=S_{BA}=-285\ kg$
$S_{BC}=1,160\ kg$
$S_{CB}=-3,190\ kg$

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設計	日付	類別	
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鐵筋混凝土暗渠

活荷重應力，總計

M_A	M_B	M_C	M_D	H	V_A	V_D
595	-1,303	-1,253	663	-355	2,550	1,830
574	-968	-1,088	454	-285	1,160	3,190
1,169 kgm	-2,271 kgm	-2,341 kgm	1,117 kgm	-640 kg	3,710 kg	5,020 kg

S_{AB}, S_{BA}	S_{BC}	S_{CB}
-355	2,550	-1,830
-285	1,160	-3,190
-640 kg	3,710 kg	-5,020 kg

徑間中央 1呎 1 彎曲率

$$R_B = 4{,}350 \times (3.75 + 1.75) \div 6.50 = 3{,}680 \text{ kg}$$
$$M_1 = 3{,}680 \times 3.25 - 4{,}350 \times 0.5 = 9{,}785 \text{ kgm}$$
$$-2{,}306$$
$$M_1 = 7{,}479 \text{ kgm}$$

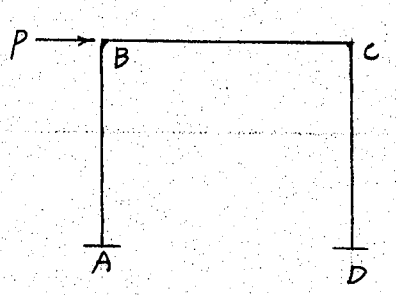
衝撃荷重應力

衝撃係数 $i = \frac{25}{56.5} = 0.443$

$M_A = 518$ kgm , $M_B = -1{,}006$ kgm , $M_C = -1{,}037$ kgm , $M_D = 495$ kgm , $H = -284$ kg
$V_A = 1{,}640$ kg , $V_D = 2{,}220$ kg , $S_{AB} = S_{BA} = -280$ kg , $S_{BC} = 1{,}640$ kg
$S_{CB} = -2{,}220$ kg ; $M_1 = 3{,}310$ kgm

制動荷重應力

$$P = 2 \text{ @ } 16{,}500 \times 0.15 = 4{,}950 \text{ kg} \div 3.8 = 1{,}300 \text{ kg}$$



$$M_A = -\frac{Ph(K_1+3K_2)}{2(K_1+6K_2)} = -\frac{1300 \times 540 \times 0.02164}{2 \times 0.04135} = -1{,}840 \text{ kgm}$$

$$M_B = \frac{3PhK_2}{2(K_1+6K_2)} = \frac{3 \times 1300 \times 540 \times 0.000657}{2 \times 0.04135} = 1{,}670 \text{ kgm}$$

$M_C = -1{,}670$ kgm
$M_D = 1{,}840$ kgm
$H = \frac{P}{2} = 650$ kg ←

$$V_A = -\frac{3PhK_2}{l(K_1+6K_2)} = -515 \text{ kg}$$

$S_{AB} = S_{BA} = 650$ kg
$S_{BC} = -515$ kg

温度應力 (上昇，場合)

$t = 15°C$, $\varepsilon = 0.00001$

$$R = \frac{\varepsilon t l}{2h} = \frac{0.00001 \times 15 \times 650}{2 \times 540} = 0.00009$$

$$M_A = \frac{6EK_1R(K_1+K_2)}{2K_1+K_2} = \frac{6 \times 1{,}400{,}000{,}000 \times 0.00193 \times 0.00009 \times 0.0085}{0.01043} = 1{,}190 \text{ kgm}$$

$$M_B = -\frac{6EK_1K_2R}{2K_1+K_2} = -920 \text{ kgm}$$

$M_C = -920$ kgm
$M_D = 1{,}190$ kgm

$$H = -\frac{M_A - M_B}{h} = -\frac{1{,}190+920}{540} = -390 \text{ kg} \rightarrow , V = 0$$

$S_{AB} = S_{BA} = -390$ kg
$S_{BC} = 0$

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設計　日付　類別

照査　日付　第 5 頁

鐵筋混凝土暗渠

應力，總計

死荷重，餘盛ナキ場合，土圧，活荷重及温度應力，和

	M_A	M_B	M_1	H	V	S_{AB}	S_{BA}	S_{BC}
死荷重	1,860	-3,720	11,330	-1,030	9,260	-1,030	-1,030	9,260
土圧	-5,870	-2,380	-2,380	6,910	0	6,910	-3,000	0
活荷重	1,169	-2,271	7,479	-640	3,710	-640	-640	3,710
衝撃	518	-1,006	3,310	-284	1,640	-280	-280	1,640
温度，変化	1,190	-920	920	390	0	390	±390	0
	-1,133 kgm	-10,297 kgm	20,659 kgm	5,346 kg	14,610 kg	5,346 kg	-4,560 kg	14,610 kg
							-5,340 kg	

$N = 14,610$ kg, $N_{BA} = 14,610$ kg　$N = 4,560$ kg
$N_{BC} = 5,340$ kg

S_{BC}，最大

$kl = 2.000$　　$k = 0.308$

$$S_{BC} = P(1-k)\left\{1 + \frac{k(1-2k)K_1}{K_1+K_2}\right\} = 4,350 \times 0.692 \times \left(1 + \frac{0.308 \times 0.384 \times 0.00193}{0.0085}\right) = 3,090 \text{ kg}$$

4,350
7,440 kg

	S_{BC}
死荷重	9,260
土圧	0
活荷重	7,440
衝撃	3,300
温度，変化	0
	20,000 kg

死荷重，餘盛アル場合，土圧及温度應力，和

	M_A	M_B	H	V	S_{AB}	S_{BA}	S_{BC}
死荷重	1,860	-3,720	-1,030	9,260	-1,030	-1,030	9,260
土圧	-8,610	-3,850	9,760	0	9,760	-5,340	0
温度，変化	-1,190	-920	390	0	390	-390	0
	-7,940 kgm	-8,490 kgm	9,120 kg	9,260 kg	9,120 kg	-6,760 kg	9,260 kg

$N = 9,260$ kg　$N_{BA} = 9,260$ kg
$N_{BC} = 6,760$ kg

側壁，最大正彎曲率

$$w_1 x + \frac{w_2 - w_1}{2h} x^2 - 6,370 = 0$$

$1,360x + 267x^2 - 6,370 = 0$　　$x = 2.96$ m

$$M = M_B - S_{BA}x - \frac{w_1 x^2}{2} - \frac{w_2 - w_1}{2h} \times \frac{x^3}{3}$$

$$= -7,570 + 6,370 \times 2.96 - \frac{1,360 \times 2.96^2}{2} - 267 \times \frac{2.96^3}{3} = +3,030 \text{ kgm}$$

240 (温度，変化)

$M_2 = 3,270$ kgm
$N = 9,260$ kg

死荷重，不対称土圧，制動荷重及温度應力，和

	M_A	M_B	H	V	S_{AB}	S_{BA}	S_{BC}
死荷重	1,860	-3,720	-1,030	9,260	-1,030	-1,030	9,260
土圧	-12,020	-890	10,940	-685	10,930	-4,170	-695
制動荷重	-1,840	-1,670	650	±515	650	-650	515
温度，変化	-1,190	-920	390	0	390	-390	0
	-13,190 kgm	-7,200 kgm	10,950 kg	9,080 kg	10,940 kg	-6,240 kg	9,080 kg
				8,060 kg			

$N = 8,060$ kg　$N_{BA} = 9,080$ kg
$N_{BC} = 6,240$ kg

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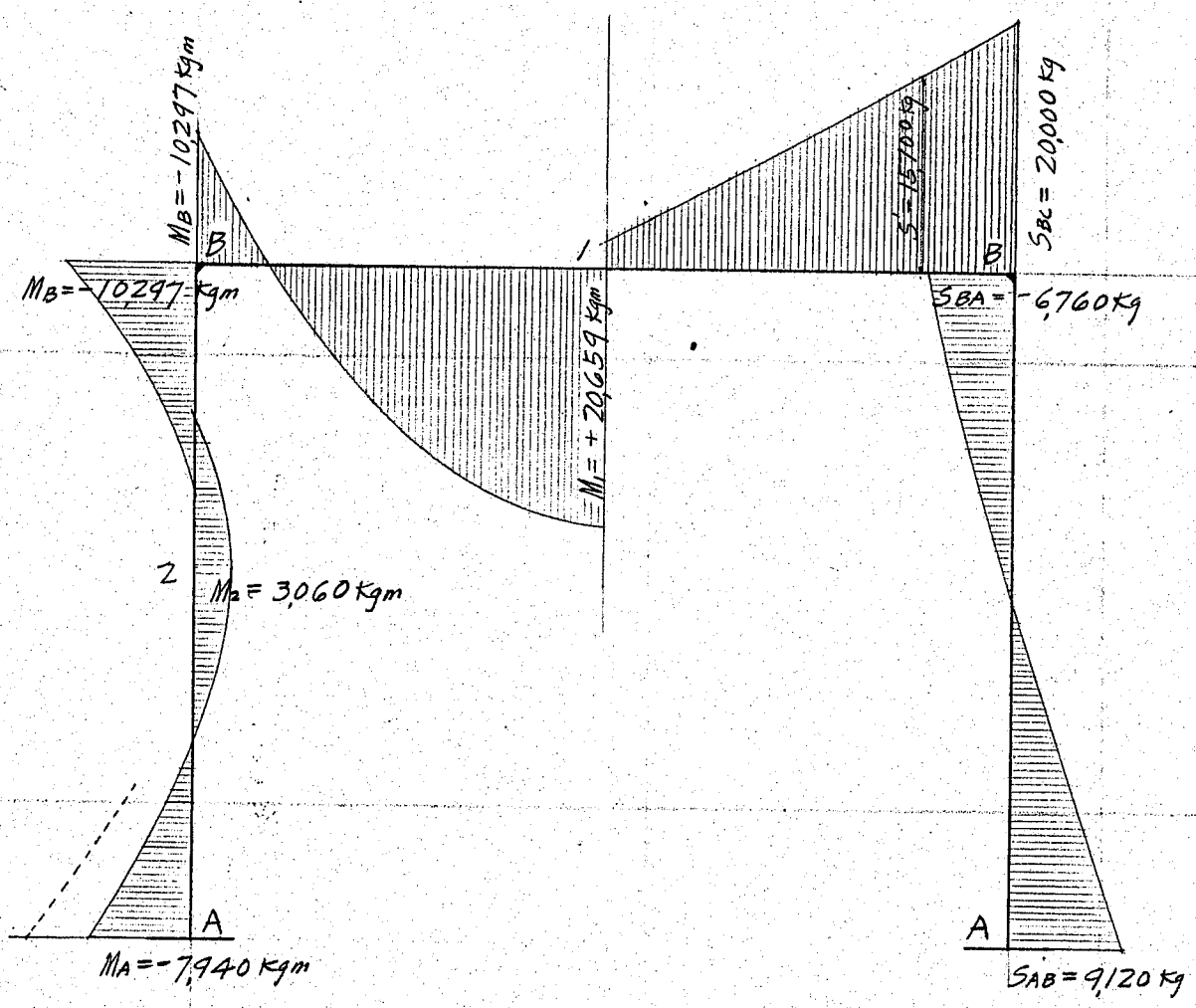
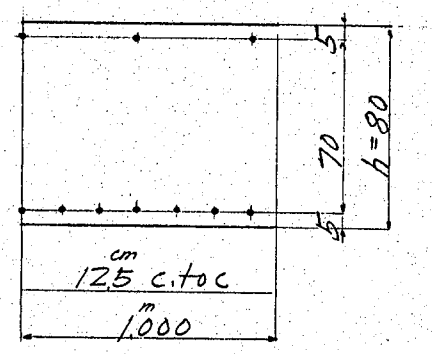
照査　日付　第 6 頁

鐵筋混凝土暗渠



斷面，設計

1 点　M_1 = 20,659 kgm　N = 4,560 kg



A_s = 19 mmϕ 12.5 cm c.to c = 8@ 2.84 = 22.7 cm²

A_s' = 19 mmϕ 37.5 cm c.to c = 7.6 cm²

$p_0 = \frac{A_s}{bh} = \frac{22.7}{100 \times 80} = 0.00284$

$p_0' = \frac{A_s'}{bh} = 0.00095$, $d/h = 75/80 = 0.938$, $d'/h = 5/80 = 0.0625$

$u/h = 0.512$　$u = 0.512 \times 80 = 41.0$, $41.0 - 5 = 36.0$ cm

$p = \frac{A_s}{bd} = \frac{22.7}{100 \times 75} = 0.00303$

$p' = \frac{A_s'}{bd} = 0.00101$

$\frac{M}{N} = \frac{20,659 \times 100}{4,560} = 453$

36

$e = 489$ cm , $e' = 417$ cm , $e'/e = 0.853$

$d'/d = 5/75 = 0.0667$, $k = 0.27$, $\frac{Ne}{bd^2 f_c} = 0.135$

$f_c = \frac{4560 \times 489}{100 \times 75^2 \times 0.135} = 29.4$ kg/cm²

$f_s = n f_c \times \frac{1-k}{k} = 15 \times 29.4 \times \frac{0.73}{0.27} = 1,192$ kg/cm²

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鐵筋混凝土暗渠

Bc 点

$M_{BC} = -10{,}297$ kgm, $N = 5{,}340$ kg　$h = 80 + \frac{75}{3} = 105$ cm

$A_s = 16^{mm\phi}$ 12.5 cm c.to c $= 8 @ 2.01 = 16.08$ cm²

$A_s' = 16^{mm\phi}$ 37.5 cm c.to c $= 5.36$ cm²

$p_0 = \frac{16.08}{100 \times 105} = 0.00153$, $p_0' = 0.00051$, $d/h = 100/105 = 0.952$

$d'/h = 5/105 = 0.0476$, $u/h = 0.506$, $u = 53.1$, $53.1 - 5 = 48.1$ cm

$p = \frac{16.08}{100 \times 100} = 0.00161$, $p' = 0.00054$

$\frac{M}{N} = \frac{10{,}297 \times 100}{5{,}340} = 193$ cm

$e = 241.1$ cm, $e' = 144.9$ cm, $e'/e = 0.601$

$d'/d = 0.05$, $k = 0.24$, $\frac{Ne}{bd^2 f_c} = 0.116$

$f_c = \frac{5340 \times 241.1}{100 \times 100^2 \times 0.116} = 11.1$ kg/cm²

$f_s = 15 \times 11.1 \times \frac{0.76}{0.24} = 527$ kg/cm²

$s = \frac{S}{bjd} = \frac{20000}{100 \times 7/8 \times 100} = 2.3$ kg/cm²

$s = \frac{S'}{bjd} = \frac{15700}{100 \times 7/8 \times 75} = 2.4$ kg/cm²

Z 点

$M_Z = 3{,}270$ kgm, $N = 9{,}260$ kg, $h = 50$ cm

$A_s = 16^{mm\phi}$ 12.5 c.to c $= 16.08$ cm²

$A_s' = 16^{mm\phi}$ 37.5 c.to c $= 5.36$ cm²

$p_0 = \frac{16.08}{100 \times 50} = 0.00322$, $p_0' = 0.00107$, $d/h = 0.9$, $d'/h = 0.1$

$u/h = 0.512$, $u = 25.6$ cm, $25.6 - 5 = 20.6$ cm

$p = \frac{16.08}{100 \times 45} = 0.00357$, $p' = 0.00119$

$\frac{M}{N} = \frac{3270 \times 100}{9260} = 35.3$

$e = 55.9$ cm, $e' = 14.7$ cm, $e'/e = 0.263$

$d'/d = 0.111$, $k = 0.44$, $\frac{Ne}{bd^2 f_c} = 0.202$

$f_c = \frac{9260 \times 55.9}{100 \times 45^2 \times 0.202} = 12.7$ kg/cm²

$f_s = 15 \times 12.7 \times \frac{0.56}{0.44} = 243$ kg/cm²

BA 点

$M_B = -10{,}297$ kgm, $N = 14{,}610$ kg, $h = 50 + \frac{90}{3} = 80$ cm

$A_s = 16^{mm\phi}$ 12.5 cm c. to c. $= 16.08$ cm²

$A_s' = 16^{mm\phi}$ 37.5 cm c. to c. $= 5.36$ cm²

$p_0 = \frac{16.08}{100 \times 80} = 0.00201$, $p_0' = 0.00067$, $d/h = 0.94$, $d'/h = 0.063$

$u/h = 0.508$, $u = 40.7$ cm, $40.7 - 5 = 35.7$ cm

$p = 0.0021$, $p' = 0.00070$

$\frac{M}{N} = \frac{10{,}297 \times 100}{14{,}610} = 70.5$

$e = 106.2$ cm, $e' = 34.8$ cm, $e'/e = 0.328$

$d'/d = 0.067$, $k = 0.34$, $\frac{Ne}{bd^2 f_c} = 0.16$

$f_c = \frac{14{,}610 \times 106.2}{100 \times 75^2 \times 0.16} = 17.2$ kg/cm²

$f_s = 15 \times 17.2 \times \frac{0.66}{0.34} = 501$ kg/cm²

$s = \frac{6760}{100 \times 7/8 \times 75} = 1.0$ kg/cm²

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鐵筋混凝土暗渠

A_B 点

$M_{AB} = -7{,}940$ Kgm , $N = 9{,}260$ Kg , $h = 50 + \frac{50}{3} = 66.7$ cm

$A_s = 16^{mm\phi}$ 12.5 cm c. to c. $= 16.08$ cm²

$A_s' = 16^{mm\phi}$ 37.5 cm c. to c. $= 5.36$ cm²

$p_0 = 0.00241$, $p_0' = 0.0008$, $d/h = 0.925$, $d'/h = 0.075$

$u/h = 0.51$, $u = 34.0$, $34.0 - 5 = 29.0$ cm

$p = 0.00261$, $p' = 0.00087$

$\frac{M}{N} = \frac{7{,}940 \times 100}{9{,}260} = 85.8$ cm

$\frac{29.0}{2}$

$e = 114.8$ cm , $e' = 56.8$ cm , $e'/e = 0.495$

$\frac{d'}{d} = 0.081$, $K = 0.33$, $\frac{Ne}{bd^2 f_c} = 0.157$

$f_c = \frac{9{,}260 \times 114.8}{100 \times 61.7^2 \times 0.157} = 17.8$ Kg/cm²

$f_s = 15 \times 17.8 \times \frac{0.67}{0.33} = 542$ Kg/cm²

$s = \frac{9{,}120}{100 \times 7/8 \times 61.7} = 1.7$ Kg/cm²

$M_{AB} = -13{,}190$ Kgm , $N = 8{,}060$ Kg

$\frac{M}{N} = \frac{13{,}190 \times 100}{8{,}060} = 164$

$\frac{29}{2}$

$e = 193$ cm , $e' = 135$ cm , $e'/e = 0.70$

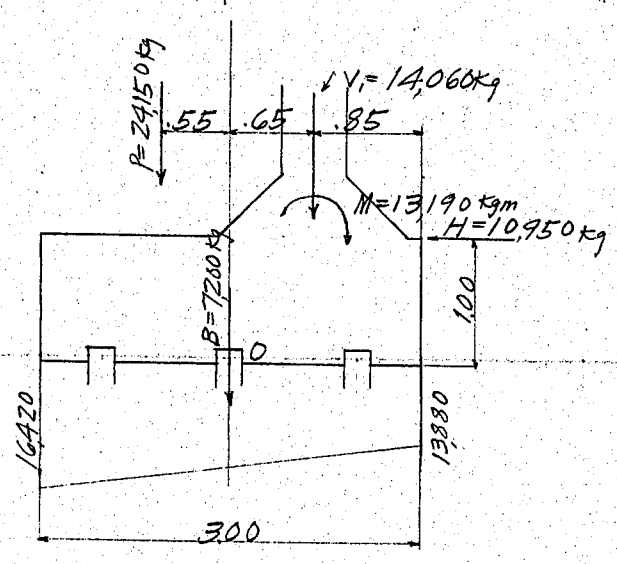
$K = 0.28$, $\frac{Ne}{bd^2 f_c} = 0.132$

$f_c = \frac{3{,}435 \times 193}{100 \times 61.7^2 \times 0.132} = 13.2$ Kg/cm $\div 1.15 = 11.5$ Kg/cm²

$f_s = 15 \times 13.2 \times \frac{0.72}{0.28} = 509 \div 1.15 = 443$ Kg/cm²

$s = \frac{10{,}940}{100 \times 7/8 \times 61.7 \times 1.15} = 1.8$ Kg/cm²

基礎，設計



$P = 1.00 \times 1.90 \times 7.95 \times 1{,}600 = 24{,}150$ Kg

$B = 1.00 \times 1.00 \times 3.00 \times 2{,}400 = 7{,}200$ Kg

$V_1 = 0.50 \times 1.00 \times 5.00 \times 2{,}400 = 6{,}000$

$8{,}060$

$14{,}060$ Kg

O 点 = 対ケル能率

	V	H	M
P	24,150	× 0.55 =	13,270
V_1	14,060	× −0.65 = −	9,140
B	7,200		
		10,950 × 1.00 =	10,950
			− 13,190
			1,890 Kgm

45,410 Kg

$e = 1{,}890 \div 45{,}410 = 0.042$ m

$p = \frac{45{,}410}{3.00 \times 1.00} \times \left(1 \pm \frac{6 \times 0.042}{3.0}\right) = 16{,}420$ Kg/m²

$= 13{,}880$ Kg/m²

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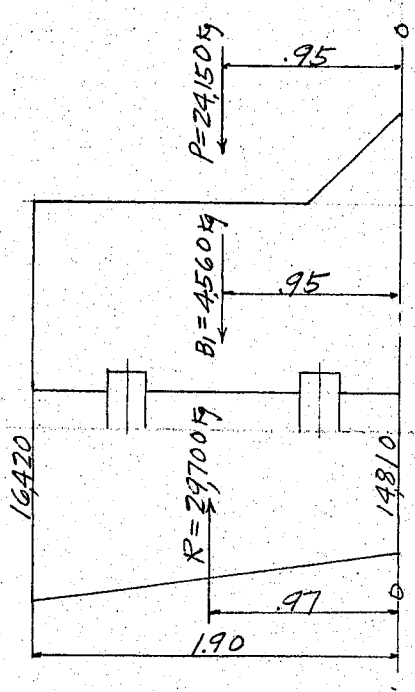
鐵筋混凝土暗渠



$B_1 = 100 \times 1.00 \times 1.90 \times 2400 = 4560\ kg$

$R = \frac{16420 + 14810}{2} \times 1.90 = 29700\ kg$

0-0 廻リニ於ケル能率

$29700 \times 0.97 = 28800$
$-24150 \times 0.95 = -23000$
$-4560 \times 0.95 = -4330$
$S = 990\ kg$ $\qquad 1470\ kgm$

$A_s = 16^{mm\phi}\ 50\ cm.\ c.to\ c = 4.02\ cm^2$

$P = \frac{4.02}{100 \times 10.7} = 0.000377$

$j = 0.965 \qquad k = 0.105$

$f_s = \frac{M}{A_s j d} = \frac{1470 \times 100}{4.02 \times 0.965 \times 10.7} = 355\ kg/cm^2$

$f_c = \frac{f_s k}{n(1-k)} = 355 \times \frac{0.105}{15 \times 0.895} = 2.8\ kg/cm^2$

$S = \frac{S}{b j d} = \frac{990}{100 \times 0.965 \times 10.7} = 0.1\ kg/cm^2$

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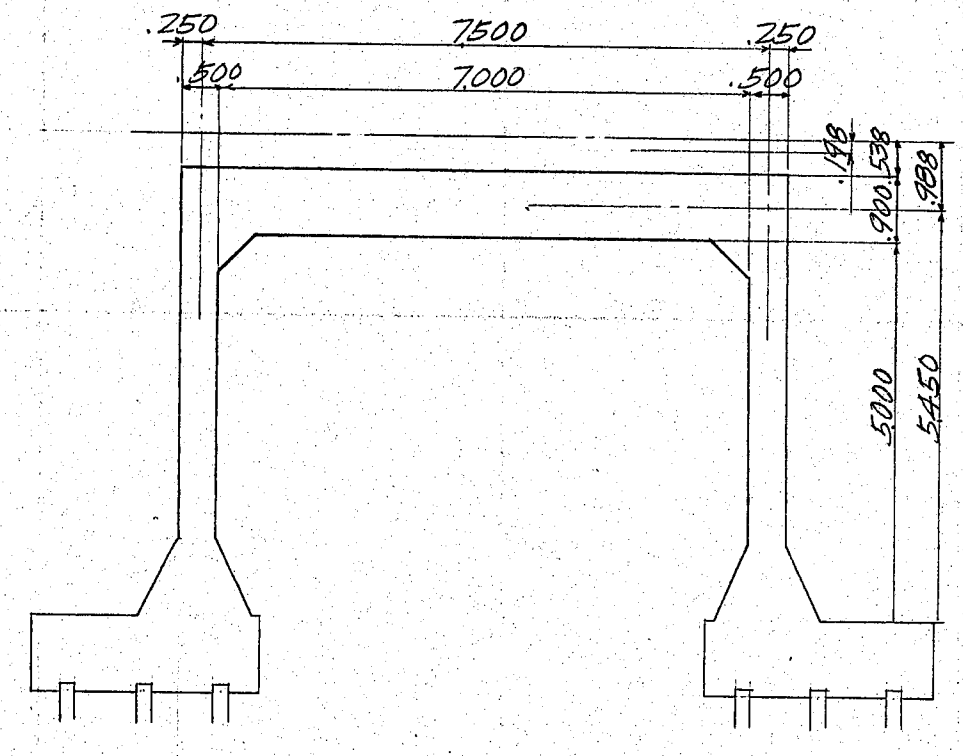
鐵筋混凝土暗渠

暗渠，設計

支間　$l = 7.500\,m$，$h = 5.450\,m$，巾 $= 7.600\,m$



死荷重

軌道	800 ÷ 380 =	210
道床	35 × 1.9 =	665
床版	90 × 24 =	2,160
特送其他		55
		3,090 kg/m²

假定斷面及物量力率

$A_1 = 1.00 \times 0.50 = 0.50\,m^2$

$I_1 = \frac{bh^3}{12} = 0.0104\,m^4$

$A_2 = 1.00 \times 0.90 = 0.90\,m^2$

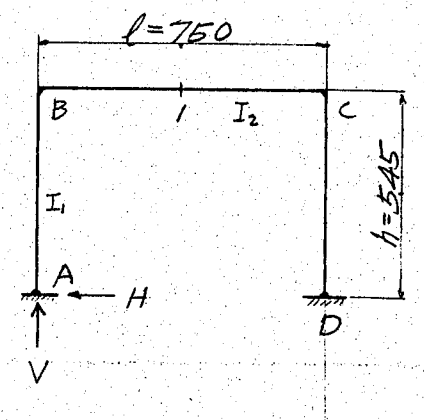
$I_2 = \frac{1.00 \times 0.90^3}{12} = 0.0608$

$k_1 = \frac{0.0104}{5.45} = 0.00191$

$k_2 = \frac{0.0608}{7.5} = 0.0081$

$2k_1 + k_2 = 0.01192$

死荷重應力



$C_{BC} = \frac{3090 \times 7.50^2}{12} = 14500\ kgm$

$M_A = \frac{k_1 C_{BC}}{2k_1 + k_2} = \frac{0.00191 \times 14500}{0.01192} = 2320\ kgm$

$M_B = -2M_A = -4640\ kgm$

$H_A = -\frac{M_A - M_B}{h} = -\frac{2320 + 4640}{545} = -1280\ kg \rightarrow$

$V_A = \frac{wl}{2} = \frac{3090 \times 7.50}{2} = 11600\ kg$

$S_{AB} = S_{BA} = -1280\ kg$

$S_{BC} = 11600\ kg$

$\frac{wl^2}{8} = \frac{3090 \times 7.50^2}{8} = 21700\ kgm$

-4640

$M_1 = 17060\ kgm$

土圧ニヨル應力

安息角 $= 30°$

活荷重ニヨル餘盛ナキ場合

$w_1 = 395\ kg/m^2$

$w_2 = \frac{1}{3} \times 1600 \times 6.19 = 3300\ kg/m^2$

$C_{AB} = \frac{(3w_2 + 2w_1)h^2}{60} = \frac{(3 \times 3300 + 2 \times 395) \times 545^2}{60} = 5290\ kgm$

$C_{BA} = \frac{(2w_2 + 3w_1)h^2}{60} = \frac{(2 \times 3300 + 3 \times 395) \times 545^2}{60} = 3850\ kgm$

$m_{AB} = \frac{545^2}{6} \times (3300 + 790) = 20250\ kgm$

$m_{BA} = \frac{545^2}{6} \times (6600 + 395) = 34650\ kgm$

$k_1 + 6k_2 = 0.05051$，$k_1 + 9k_2 = 0.07481$，$k_1 + 3k_2 = 0.02621$

$k_1^2 + 12k_1k_2 + 3k_2^2 = 0.000386$，$7k_1 + 9k_2 = 0.08627$

$5k_1 - 3k_2 = -0.01475$，$k_1^2 - 3k_2^2 = -0.000193$

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$$M_A = -\frac{1}{2(K_1+6K_2)}\left\{(K_1+9K_2)C_{AB}+(K_1+3K_2)m_{AB}+\frac{(K_1^2+12K_1K_2+3K_2^2)C_{BA}}{2K_1+K_2}\right\}$$

$$= -\frac{1}{0.10102}\{0.07481\times 5{,}290+0.02621\times 20{,}250+0.0324\times 3{,}850\} = -10{,}400\ kgm$$

$$M_B = \frac{K_2}{2(K_1+6K_2)}\left\{3(m_{AB}-C_{AB})-\frac{(7K_1+9K_2)C_{BA}}{2K_1+K_2}\right\}$$

$$= \frac{0.0081}{0.10102}\{44{,}880-7{,}24\times 3{,}850\} = 1{,}360\ kgm$$

$$M_C = -\frac{K_2}{2(K_1+6K_2)}\left\{3(m_{AB}-C_{AB})-\frac{(5K_1-3K_2)}{2K_1+K_2}C_{BA}\right\}$$

$$= -\frac{0.0081}{0.10102}\{44{,}880+1{,}237\times 3{,}850\} = -3{,}980\ kgm$$

$$M_D = \frac{1}{2(K_1+6K_2)}\left\{(K_1+3K_2)(m_{AB}-C_{AB})-\frac{(K_1^2-3K_2^2)}{2K_1+K_2}C_{BA}\right\}$$

$$= \frac{1}{0.10102}\{0.02621\times 14{,}960+0.0162\times 3{,}850\} = 4{,}500\ kgm$$

$$H_A = \frac{m_{BA}+M_B-M_A}{h} = \frac{34{,}650+1360+10{,}400}{5{,}45} = 8{,}520\ kg \longleftarrow$$

$$H_D = \frac{M_D-M_C}{h} = -\frac{4{,}500+3{,}980}{5{,}45} = -1{,}560\ kg \longleftarrow$$

$$V_A = \frac{m_{AB}+M_A-M_D}{l} = \frac{20{,}250-10{,}400-4{,}500}{7.5} = -710\ kg$$

$$V_D = +710\ kg$$

$$S_{AB} = 8{,}520\ kg$$

$$S_{BA} = 8{,}520 - \frac{395+3300}{2}\times 5.45 = -1{,}520\ kg$$

$$S_{BC} = -710\ kg$$

活荷重ヨル餘盛ヲ考ヘタル場合

換算餘盛高 = 1.81m

$$w_1 = \frac{1}{3}\times 1{,}600\times 2.60 = 1{,}390\ kg/m^2$$

$$w_2 = \frac{1}{3}\times 1{,}600\times 8.05 = 4{,}290\ kg/m^2$$

$$C_{AB} = \frac{(3\times 4{,}290+2\times 1{,}390)\times 545^2}{60} = 7{,}750\ kgm$$

$$C_{BA} = \frac{(2\times 4{,}290+3\times 1{,}390)\times 545^2}{60} = 6{,}310\ kgm$$

$$m_{AB} = \frac{545^2}{6}\times(4{,}290+2\times 1{,}390) = 35{,}000\ kgm$$

$$m_{BA} = \frac{545^2}{6}\times(2\times 4{,}290+1{,}390) = 44{,}400\ kgm$$

$$M_A = -\frac{1}{0.10102}\{0.07481\times 7{,}750+0.02621\times 35{,}000+0.0324\times 6{,}310\} = -16{,}850\ kgm$$

$$M_B = \frac{0.0081}{0.10102}\{81{,}750-7{,}24\times 6{,}310\} = 2{,}890\ kgm$$

$$M_C = -\frac{0.0081}{0.10102}\{81{,}750+1{,}237\times 6{,}310\} = -7{,}180\ kgm$$

$$M_D = \frac{1}{0.10102}\{0.02621\times 27{,}250+0.0162\times 6{,}310\} = 8{,}080\ kgm$$

$$H_A = \frac{44{,}400+2890+16{,}850}{5{,}45} = 12{,}680\ kg \longleftarrow$$

$$H_D = -\frac{8080+7180}{5{,}45} = -2{,}800\ kg \longleftarrow$$

$$V_A = -\frac{35{,}000-16{,}850-8080}{7.5} = -1{,}340\ kg$$

$$V_D = +1{,}340\ kg$$

$$S_{AB} = 12{,}680\ kg \qquad S_{BC} = -1{,}340\ kg$$

$$S_{BA} = 12{,}680 - \frac{1390+4290}{2}\times 5.45 = -2{,}800\ kg$$

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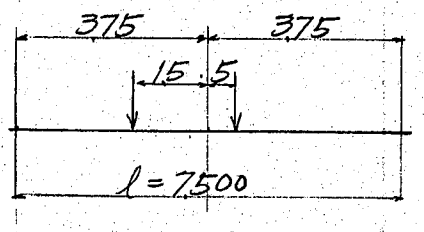
鐵筋混凝土暗渠
活荷重應力



特殊荷重　$P = 16,500\ kg$
暗渠一米当り　$P = 16,500 \div 3.80 = 4,350\ kg$
$kl = 2.25\ m$, 場合　$k = 0.3$

$$M_A = \frac{4350 \times 225 \times 0.7 \times 0.00191 \times \{0.2 \times 0.00191 + 5.6 \times 0.0081\}}{2 \times 0.01192 \times 0.0505} = 497\ kgm$$

$$M_B = -10,880 \times \{2.8 \times 0.00191 + 13.6 \times 0.0081\} = -1,255\ kgm$$

$$M_C = -10,880 \times \{1.2 \times 0.00191 + 11.6 \times 0.0081\} = -1,048\ kgm$$

$$M_D = 10,880 \times \{1.8 \times 0.00191 + 6.4 \times 0.0081\} = 602\ kgm$$

$$H = -\frac{3 \times 1308}{2 \times 5.45 \times 0.01192} = -302\ kg \rightarrow$$

$$V_A = 4,350 \times 0.70 \times \left\{1 + \frac{0.3 \times 0.4 \times 0.00191}{0.01001}\right\} = 3,050\ kg$$

$$V_D = 4,350 \times 0.30 \times \left\{1 - \frac{0.7 \times 0.4 \times 0.00191}{0.05051}\right\} = 1,300\ kg$$

$S_{AB} = S_{BA} = -302\ kg$
$S_{BC} = 3,050\ kg$
$S_{CB} = -1,300\ kg$

$kl = 4.25\ m$, 場合　$k = 0.567$

$$M_A = \frac{4,350 \times 4.25 \times 0.433 \times 0.00191 \times \{1.268 \times 0.00191 + 6.134 \times 0.0081\}}{2 \times 0.01192 \times 0.0505}$$

$$= 12,710 \times 0.0521 = 662\ kgm$$

$$M_B = -12,710 \times \{1.732 \times 0.00191 + 11.866 \times 0.0081\} = -1,263\ kgm$$

$$M_C = -12,710 \times \{2.268 \times 0.00191 + 12.134 \times 0.0081\} = -1,304\ kgm$$

$$M_D = 12,710 \times \{0.732 \times 0.00191 + 5.866 \times 0.0081\} = 606\ kgm$$

$$H = -\frac{3 \times 1528}{2 \times 5.45 \times 0.01192} = -353\ kg \rightarrow$$

$$V_A = 4,350 \times 0.433 \times \left\{1 - \frac{0.567 \times 0.134 \times 0.00191}{0.01001}\right\} = 1,910\ kg$$

$$V_D = 4,350 \times 0.567 \times \left\{1 + \frac{0.433 \times 0.134 \times 0.00191}{0.05051}\right\} = 2,470\ kg$$

$S_{AB} = S_{BA} = -353\ kg$
$S_{BC} = 1,910\ kg$
$S_{CB} = -2,470\ kg$

活荷重應力，總計

M_A	M_B	M_C	M_D	H	V_A	V_D	S_{AB}, S_{BA}	S_{BC}	S_{CB}
497	-1,255	-1,048	602	-302	3,050	1,300	-302	3,050	-1,300
662	-1,263	-1,304	606	-353	1,910	2,470	-353	1,910	-2,470
1,159 kgm	-2,518 kgm	-2,352 kgm	1,208 kgm	-655 kg	4,960 kg	3,770 kg	-655 kg	4,960 kg	-3,770 kg

徑間中央ノ点，彎曲率

$$R_B = 4,350 \times (5.25 + 3.25) \div 7.50 = 4,930\ kg$$
$$M_1 = 4,930 \times 3.75 - 4,350 \times 1.50 = 11,960$$
$$-2,435$$
$$M_1 = 9,525\ kgm$$

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鐵筋混凝土暗渠

衝撃荷重應力

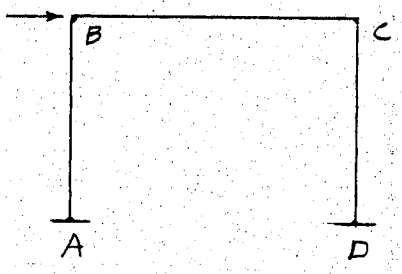
衝撃係数 $i = \frac{25}{57.5} = 0.435$

$M_A = 504$ kgm, $M_B = -1,095$ kgm, $M_C = -1,023$ kgm, $M_D = 526$ kgm, $H = -285$ kg
$V_A = 2,160$ kg, $V_D = 1,640$ kg, $S_{AB} = S_{BA} = -285$ kg, $S_{BC} = 2,160$ kg, $S_{CB} = -1,640$ kg
$M_1 = 4,145$ kgm

制動荷重應力

$P = 1,300$ kg

$$M_A = -\frac{1300 \times 5.45 \times 0.02621}{2 \times 0.05051} = -1,840 \text{ kgm}$$



$$M_B = \frac{3 \times 1300 \times 5.45 \times 0.0081}{2 \times 0.05051} = 1,705 \text{ kgm}$$

$M_C = -1,705$ kgm
$M_D = 1,840$ kgm
$H = 650$ kg ←
$V_A = -450$ kg
$S_{AB} = S_{BA} = 650$ kg
$S_{BC} = -450$ kg

温度應力（上昇，場合）

$t = 15°C$, $\varepsilon = 0.00001$

$$R = \frac{0.00001 \times 15 \times 7.50}{2 \times 5.45} = 0.000103$$

$$M_A = \frac{6 \times 1,400,000,000 \times 0.000103 \times 0.00191 \times 0.01001}{0.01192} = 1,390 \text{ kgm}$$

$M_B = -1,126$ kgm
$M_C = -1,126$ kgm
$M_D = 1,390$ kgm

$$H = -\frac{1,390 + 1,126}{5.45} = -460 \text{ kg}$$

$S_{AB} = S_{BA} = -460$ kg　　$V = 0$
$S_{BC} = 0$

應力，總計

死荷重，餘盛ナキ場合，土圧，活荷重及温度應力，和

	M_A	M_B	M_1	H	V	S_{AB}	S_{BA}	S_{BC}
死荷重	2,320	-4,640	17,060	-1,280	11,600	-1,280	-1,280	11,600
土圧	-5,900	-2,620	-2,620	6,960	0	6,960	-3,080	0
活荷重	1,159	-2,518	9,525	655	3,770	-655	-655	4,960
衝撃	504	-1,095	4,145	-285	2,160	-285	-285	2,160
温度変化	1,390	-1,126	1,126	460	0	460	±460	0
	-527 kgm	-11,999 kgm	29,236 kgm	6,510 kg	17,530 kg	5,200 kg	-5,760 kg -4,840 kg	18,720 kg

$N = 17,530$ kg　$N_{BA} = 17,530$ kg　$N = 4,840$ kg
$N_{BC} = 5,760$ kg

S_{BC}，最大

$kl = 2.00$, $k = 0.267$

$$S_{BC} = 4,350 \times 0.733 \times \left\{1 + \frac{0.267 \times 0.466 \times 0.00191}{0.01.001}\right\} = 3,270 \text{ kg}$$

4,350

7,620 kg

	S_{BC}
死荷重	11,600
土圧	0
活荷重	7,620
衝撃	3,320
温度変化	0
	22,540 kg

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鐵筋混凝土暗渠

死荷重,餘盛アル場合ノ土圧及温度應力ノ和

	M_A	M_B	H	V	S_{AB}	S_{BA}	S_{BC}
死荷重	2,320	-4,640	-1,280	11,600	-1,280	-1,280	11,600
土圧	-8,770	-4,290	9,880	0	9,880	-5,600	0
温度ノ変化	-1,390	-1,126	460	0	460	-460	0
	-7,840kgm	-10,056kgm	9,060kg	11,600kg	9,060kg	-7,340kg	11,600kg

$N = 11,600$kg　$N_{BA} = 11,600$kg
$N_{BC} = 7,340$kg

側壁,最大正彎曲率

$$w_1 x + \frac{w_2 - w_1}{2h} x^2 - 6,880 = 0$$

$$266x^2 + 1,390x - 6,880 = 0 \qquad x = 3.10\ m$$

$$M = -8,930 + 6,880 \times 3.10 - \frac{1390 \times 3.10^2}{2} - 266 \times \frac{3.10^3}{3} = 3,070\ kgm$$

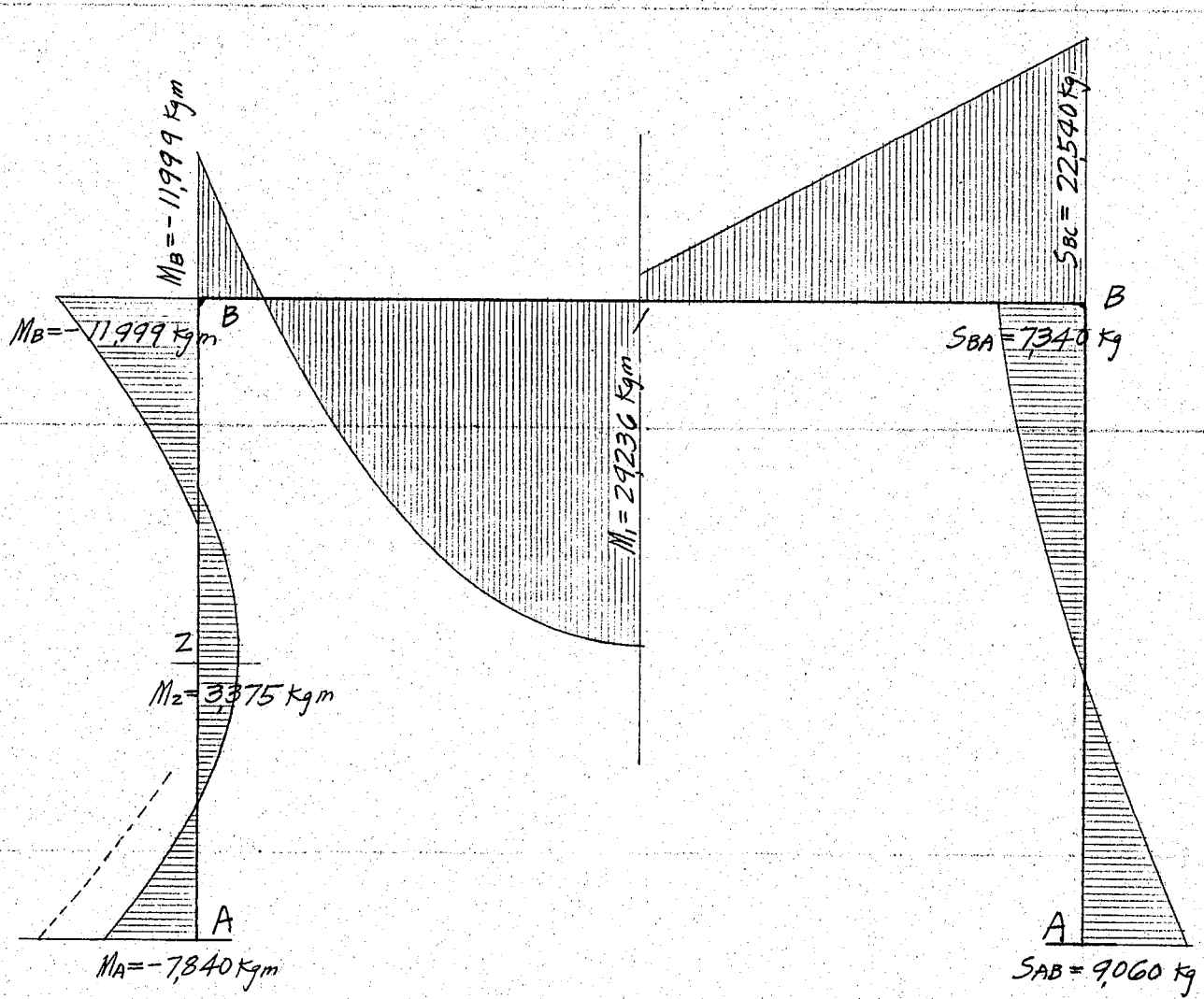
305 (温度ノ変化)

$M_z = 3,375$ kgm
$N = 11,600$ kg

死荷重,不対稱土圧,制動荷重及温度應力ノ和

	M_A	M_B	H	V	S_{AB}	S_{BA}	S_{BC}
死荷重	2,320	-4,640	-1,280	11,600	-1,280	-1,280	11,600
土圧	-12,350	-1,090	11,120	-630	11,120	-4,360	-630
制動荷重	-1,840	-1,705	650	±450	650	-650	450
温度ノ変化	-1,390	-1,126	460	0	460	-460	0
	-13,260kgm	-8,561kgm	10,950kg	10,520kg	10,950kg	-6,750kg	11,420kg

$N = 10,520$kg　$N_{BA} = 11,420$kg
$N_{BC} = 6,750$kg



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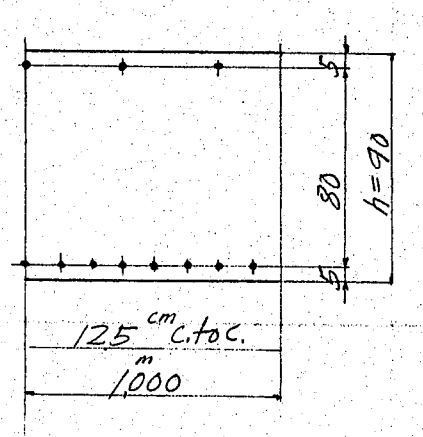
設計　日付　類別
照査　日付　第 15 頁

鐵筋混凝土暗渠
斷面ノ設計

1 端

$M_1 = 29{,}236\ kgm$, $N = 4840\ kg$



$A_s = 22^{mm\phi}\ 12.5\ cm$ c. to c. $= 8 @ 3.80 = 30.4\ cm^2$
$A_s' = 22^{mm\phi}\ 37.5\ cm$ c. to c. $= 10.1\ cm^2$
$p_0 = \frac{30.4}{100 \times 90} = 0.00338$
$p_0' = 0.00113$, $d/h = 0.945$, $d'/h = 0.056$
$u/h = 0.508$, $u = 45.7\ cm$, $45.7 - 5 = 40.7\ cm$
$p = 0.00358$, $p' = 0.00119$
$\frac{M}{N} = \frac{29{,}236 \times 100}{4{,}840} = 604$
$\frac{40.7}{}$
$e = 644.7\ cm$, $e' = 563.3\ cm$, $e'/e = 0.874$
$d'/d = 0.0588$, $k = 0.29$, $\frac{Ne}{bd^2 f_c} = 0.144$
$f_c = \frac{4840 \times 644.7}{100 \times 85^2 \times 0.144} = 30\ kg/cm^2$
$f_s = 15 \times 30 \times \frac{0.71}{0.29} = 1102\ kg/cm^2$

Bc 端

$M_{Bc} = -11{,}999\ kgm$, $N = 5760\ kg$, $h = 90 + \frac{75}{3} = 115\ cm$
$A_s = 16^{mm\phi}\ 12.5\ cm$ c. to c. $= 16.08\ cm^2$
$A_s' = 16^{mm\phi}\ 37.5\ cm$ c. to c $= 5.36\ cm^2$
$p_0 = \frac{16.08}{100 \times 115} = 0.0014$, $p_0' = 0.00047$, $d/h = 0.956$, $d'/h = 0.0435$
$u/h = 0.506$, $u = 58.2\ cm$, $58.2 - 5 = 53.2\ cm$
$p = \frac{16.08}{100 \times 110} = 0.00146$, $p' = 0.00049$
$\frac{M}{N} = \frac{11{,}999 \times 100}{5760} = 208.3$
$\frac{53.2}{}$
$e = 261.5\ cm$, $e' = 155.1\ cm$, $e'/e = 0.593$
$d'/d = 0.0455$, $k = 0.24$, $\frac{Ne}{bd^2 f_c} = 0.115$
$f_c = \frac{5760 \times 261.5}{100 \times 110^2 \times 0.115} = 10.8\ kg/cm^2$
$f_s = 15 \times 10.8 \times \frac{0.76}{0.24} = 513\ kg/cm^2$
$S = \frac{22540}{100 \times 7/8 \times 110} = 2.3\ kg/cm^2$

2 端

$M_2 = 3375\ kgm$, $N = 11{,}600\ kg$, $h = 50\ cm$
$A_s = 16^{mm\phi}\ 12.5\ cm$ c. to c. $= 16.08\ cm^2$
$A_s' = 16^{mm\phi}\ 37.5\ cm$ c. to c $= 5.36\ cm^2$
$u = 25.6\ cm$, $25.6 - 5 = 20.6\ cm$
$p = 0.00357$, $p' = 0.00119$
$\frac{M}{N} = \frac{3375 \times 100}{11{,}600} = 29.1$
$\frac{20.6}{}$
$e = 49.7\ cm$, $e' = 8.5\ cm$, $e'/e = 0.171$, $d'/d = 0.111$
$k = 0.48$, $\frac{Ne}{bd^2 f_c} = 0.213$
$f_c = \frac{11{,}600 \times 49.7}{100 \times 45^2 \times 0.213} = 13.5\ kg/cm^2$
$f_s = 15 \times 13.5 \times \frac{0.52}{0.48} = 219\ kg/cm^2$

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設計　日付　類別

照査　日付　第　16　頁

鐵筋混凝土暗渠

BA 点

$M_B = -11{,}999\ kgm$, $N = 17{,}530\ kg$, $h = 50 + \frac{95}{3} = 82\ cm$

$A_s = 16^{mm}\phi\ 12.5\ cm$ c. to c $= 16.08\ cm^2$

$A_s' = 16^{mm}\phi\ 37.5\ cm$ c. to c $= 5.36\ cm^2$

$p_0 = 0.00196$, $p_0' = 0.00065$, $d/h = 0.94$, $d'/h = 0.061$

$u/h = 0.508$, $u = 41.7\ cm$ $41.7 - 5 = 36.7\ cm$

$p = 0.00209$, $p' = 0.0007$,

$$\frac{M}{N} = \frac{11{,}999 \times 100}{17{,}530} = 68.4$$

$\frac{36.7}{}$

$e = 105.1\ cm$, $e' = 31.7\ cm$, $e'/e = 0.302$

$d'/d = 0.065$, $k = 0.345$, $\frac{Ne}{bd^2 f_c} = 0.162$

$$f_c = \frac{17{,}530 \times 105.1}{100 \times 77^2 \times 0.162} = 19.2\ kg/cm^2$$

$$f_s = 15 \times 19.2 \times \frac{0.625}{0.375} = 480\ kg/cm^2$$

$$s = \frac{7340}{100 \times 7/8 \times 77} = 1.1\ kg/cm^2$$

AB 点

$M_A = -13{,}260\ kgm$, $N = 10{,}520\ kg$, $h = 50 + \frac{100}{3} = 83\ cm$

$A_s = 16^{mm}\phi\ 12.5\ cm$ c. to c $= 16.08\ cm^2$

$A_s' = 16^{mm}\phi\ 37.5\ cm$ c. to c $= 5.36\ cm^2$

$p_0 = 0.00194$, $p_0' = 0.00063$, $d/h = 0.94$, $d'/h = 0.06$

$u/h = 0.508$, $u = 42.2\ cm$, $42.2 - 5 = 37.2\ cm$

$p = 0.00206$, $p' = 0.00069$

$$\frac{M}{N} = \frac{13{,}260 \times 100}{10{,}520} = 126$$

$\frac{37.2}{}$

$e = 163.2\ cm$, $e' = 88.8\ cm$, $e'/e = 0.544$

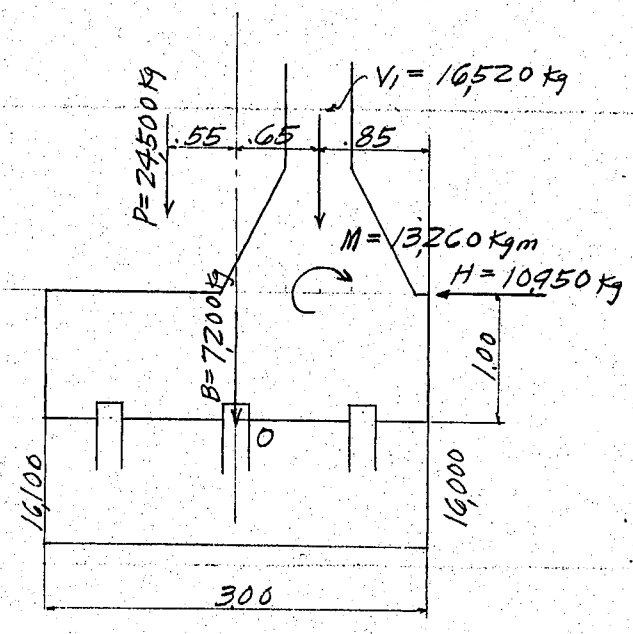
$d'/d = 0.064$, $k = 0.28$, $\frac{Ne}{bd^2 f_c} = 0.134$

$$f_c = \frac{10{,}520 \times 163.2}{100 \times 78^2 \times 0.134} = 21.1 \div 1.15 = 18.3\ kg/cm^2$$

$$f_s = 15 \times 18.3 \times \frac{0.72}{0.28} = 705\ kg/cm^2$$

$$s = \frac{10{,}950}{100 \times 7/8 \times 78} = 1.6\ kg/cm^2$$

基礎，設計



$P = 1.00 \times 1.90 \times 8.05 \times 1{,}600 = 24{,}500\ kg$

$B = 1.00 \times 1.00 \times 3.00 \times 2{,}400 = 7{,}200\ kg$

$V_1 = 0.50 \times 1.00 \times 5.00 \times 2{,}400 = 6{,}000$

$10{,}520$

$16{,}520\ kg$

O 点 = 於ケル能率

	V	H		M
P	24,500		× 0.55	= 13,480
V_1	16,520		× −0.65	= −10,740
B	7,200			
		10,950	× 1.00	= 10,950
				= −13,260
	48,220 kg			430 kgm

$e = 430 \div 48{,}220 = .001\ m$

$$P = \frac{48{,}220}{3.00 \times 1.00} \times \left(1 \pm \frac{6 \times .001}{3.0}\right) = 16{,}100\ kg/m^2$$

$16{,}000\ kg/m^2$

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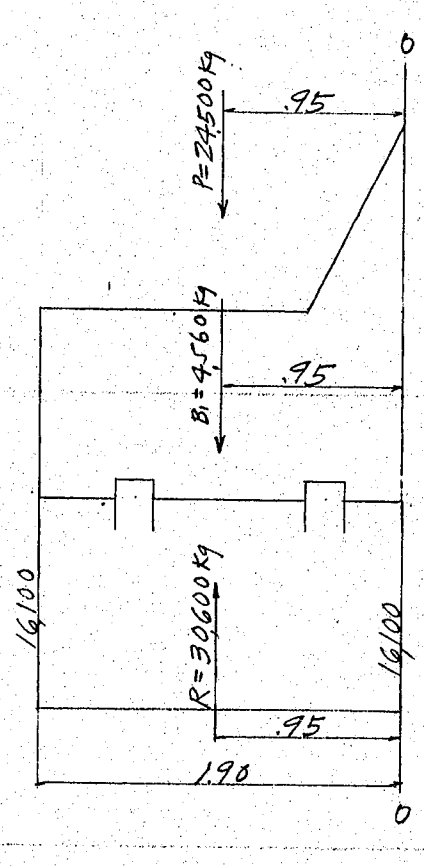
設計	日付	類別
照査	日付	第 17 頁

鐵筋混凝土暗渠



$B_1 = 1{,}00 \times 1{,}00 \times 1.90 \times 2{,}400 = 4{,}560\ kg$

$R = 16{,}100 \times 1{,}90 = 30{,}600\ kg$

0－0 点 = 於ケル能率

$30{,}600 \times .95 = 29{,}100$

$-24{,}500 \times .95 = -23{,}700$

$-4{,}560 \times .95 = -4{,}330$

$S = 1{,}540\ kg$ $\quad M = 1{,}070\ kgm$

$A_s = 16^{mm}\phi\ 50\ cm\ c.to\ c = 4.02\ cm^2$

$p = \dfrac{4.02}{100 \times 106.7} = 0.000377$

$j = 0.965,\quad k = 0.105$

$f_s = \dfrac{1{,}070 \times 100}{4.02 \times 0.965 \times 106.7} = 259\ kg/cm^2$

$f_c = 259 \times \dfrac{0.105}{15 \times 0.895} = 2.0\ kg/cm^2$

$s = \dfrac{1540}{100 \times 0.965 \times 106.7} = 0.15\ kg/cm^2$

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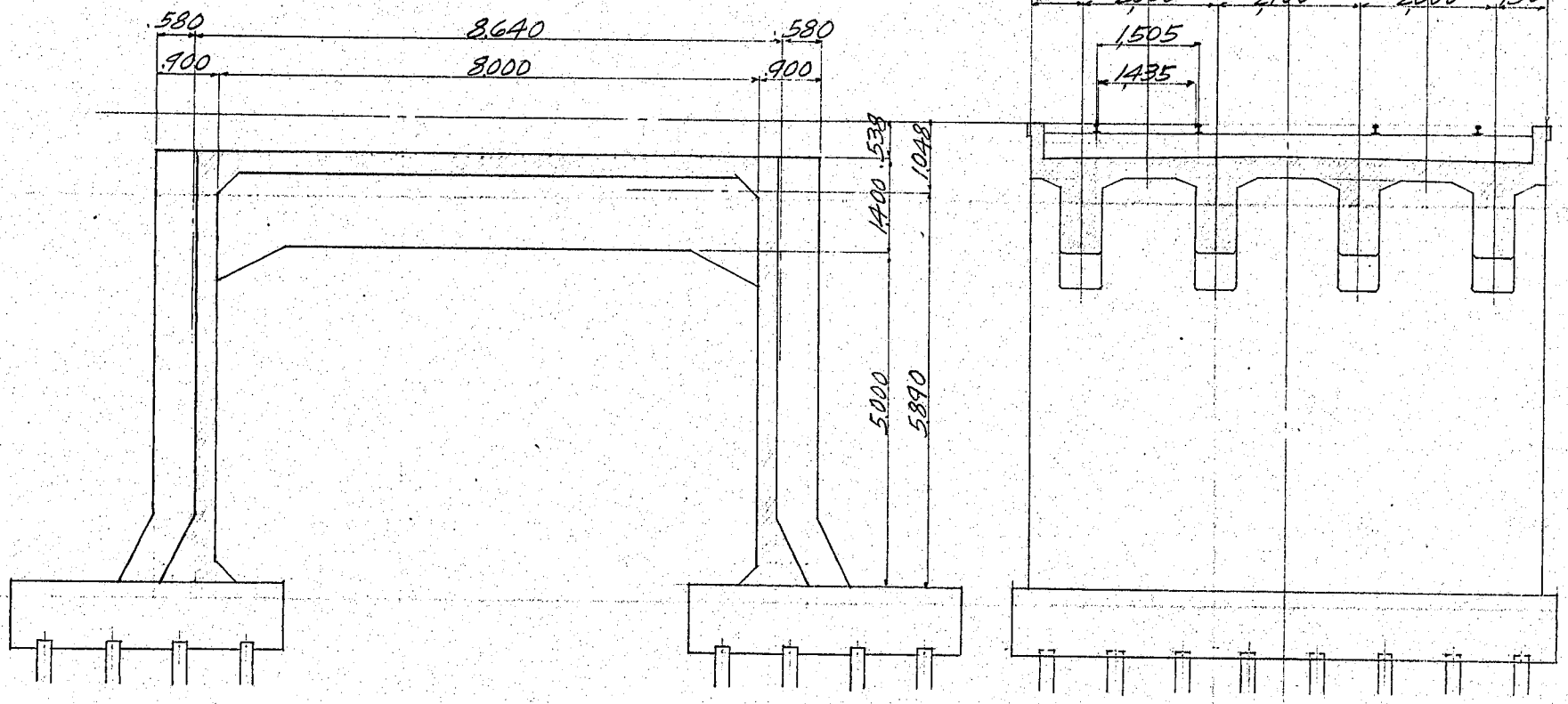
設計	日付	類別
照査	日付	第 18 頁

鐵筋混凝土暗渠

暗渠，設計
支間 $l = 8.640\ m$, $h = 5.510\ m$



床版，設計
死荷重

軌道	800 ÷ 3.80	=	210
道床	35 cm ×	19 kg =	665
床版	30 cm ×	24 kg =	720
特送其他			25
			1,620 kg/m²

死荷重彎曲率 $1/10 \times 1,620 \times 2.0^2 = 648\ kgm$
死荷重剪力 $1/2 \times 1,620 \times 2.0 = 1,620\ kg$

活荷重

電車輪荷重 1軸＝付 16,500 kg
縱，分布 $a = 1.00 + 2 \times 0.35 = 1.70\ m$
橫，分布 $b = 2.42 + 2 \times 0.35 = 3.12\ m$
分布荷重 $\dfrac{16,500}{1.70 \times 3.12} = 3,110\ kg/m^2$

活荷重彎曲率 $1/10 \times 3,110 \times 2.0^2 = 1,244\ kgm$
活荷重剪力 $1/2 \times 3,110 \times 2.0 = 3,110\ kg$

衝撃

$$i = \frac{25}{50+2} = 0.481$$

衝撃荷重彎曲率 598 kgm
衝撃荷重剪力 1,495 kg

總計

	彎曲率	剪力
死荷重	648	1,620
活荷重	1,244	3,110
衝撃荷重	598	1,495
	2,490 kgm	6,225 kg

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設計　日付　類別
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鐵筋混凝土暗渠

所要有効深　$d=\sqrt{\frac{2490\times100}{100\times7.13}}=18.7\,cm$

使用有効深　27
被覆　3
30 cm

使用鐵筋量　16 mm φ 20 cm c.to c　5 @ 2.01 = 10.05 cm²

$p=\frac{As}{bd}=\frac{10.05}{100\times27}=0.00372$, $j=0.906$, $K=0.283$

$f_s=\frac{M}{Asjd}=\frac{2490\times100}{10.05\times0.906\times27}=1,013$ kg/cm²

$f_c=\frac{2M}{jKbd^2}=\frac{2\times2490\times100}{0.906\times0.283\times100\times27^2}=26.7$ kg/cm²

$s=\frac{S}{bjd}=\frac{6225}{100\times0.906\times37}=1.9$ kg/cm²

$s=\frac{6225}{5\times5.03\times0.906\times37}=7.4$ kg/cm² < 5.5 × 2

側壁，設計

換算餘盛，高　$\frac{16,500}{3.80\times1.50}=2,900\div1,600=1.81$ m

$w=1/3\times1,600\times805=4290$ kg/m²
彎曲率　$M=1/10\times4,290\times2.0^2=1,720$ kgm
剪力　$S=1/2\times4290\times2.0=4,290$ kg
床版ト同一断面ヲ用フレバ

$f_s=700$ kg/cm²
$f_c=18.4$ kg/cm²
$s=1.3$ kg/cm²

ラーメンノ設計

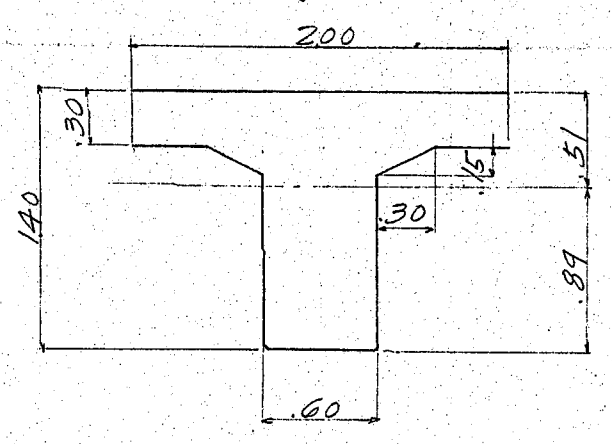
死荷重

軌道	800 ÷ 2		400
バラスト	2.05 × 0.35	@ 1,900 =	1,360
床版	2.05 × 0.30	@ 2,400 =	1,475
桁	0.60 × 1.10	@ 2,400 =	1,585
持送リ	0.30 × 0.15	@ 〃 =	110
			70

$w=5,000$ kg/m

假定断面

主桁



中立軸，位置

2.00 × 0.30 =	0.60	× 0.15 =	0.090		
1.10 × 0.60 =	0.66	× 0.85 =	0.561		
0.15 × 0.30 =	0.045	× 0.35 =	0.016		
	1.305		0.512		0.667

物量力率

$\frac{2.00\times0.30^3}{12}+0.60\times0.36^2=0.0823$

$\frac{0.60\times1.10^3}{12}+0.66\times0.34^2=0.1427$

$\frac{2\times0.3\times0.15^3}{36}+0.045\times0.16^2=0.0012$

$I_2=0.2262\ m^4$

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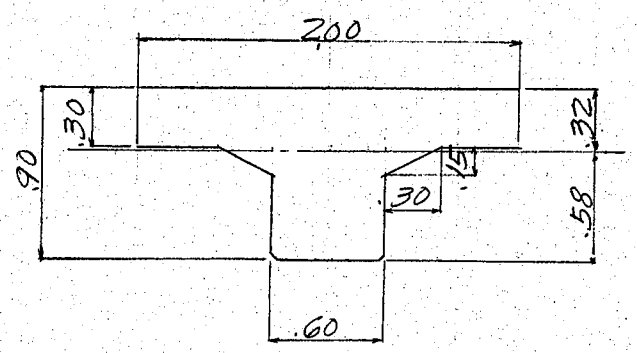
設計	日付	類別	
照査	日付	第	20 頁

鐵筋混凝土暗渠
側壁



中立軸ノ位置

$2.00 \times 0.30 = 0.60 \times 0.15 = 0.090$
$0.60 \times 0.60 = 0.36 \times 0.60 = 0.216$
$0.15 \times 0.30 = 0.045 \times 0.35 = 0.016$
$1.005 \quad 0.32 \quad 0.322$

物量力率

$$\frac{2.00 \times 0.30^3}{12} + 0.60 \times 0.17^2 = 0.0218$$

$$\frac{0.60 \times 0.60^3}{12} + 0.36 \times 0.28^2 = 0.0390$$

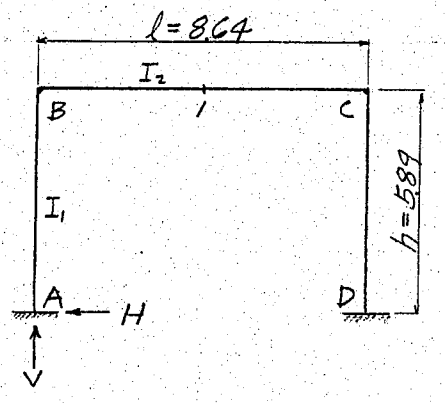
$$\frac{2 \times 0.3 \times 0.15^3}{36} + 0.045 \times 0.03^2 = 0.0001$$

$$I_1 = 0.0609 \ m^4$$

$$K_1 = \frac{I_1}{h} = \frac{0.0609}{5.89} = 0.0103$$

$$K_2 = \frac{I_2}{l} = \frac{0.2262}{8.64} = 0.0262 \quad , \quad 2K_1 + K_2 = 0.0468$$

死荷重應力



$$C_{BC} = \frac{wl^2}{12} = \frac{5,000 \times 8.64^2}{12} = 31,100 \ kgm$$
$$M_A = \frac{K_1 C_{BC}}{2K_1 + K_2} = \frac{0.0103 \times 31,100}{0.0468} = 6,850 \ kgm$$
$$M_B = -2M_A = -13,700 \ kgm$$
$$H_A = -\frac{M_A - M_B}{h} = -\frac{20,550}{5.89} = -3,490 \ kg$$
$$V_A = \frac{wl}{2} = \frac{5,000 \times 8.64}{2} = 21,600 \ kg$$
$$S_{AB} = S_{BA} = -3,490 \ kg$$
$$S_{BC} = 21,600 \ kg$$
$$\frac{wl^2}{8} = \frac{5,000 \times 8.64^2}{8} = 46,650$$
$$-13,700$$
$$M_1 = 32,950 \ kgm$$

土圧ニヨル應力
安息角 = 30°
活荷重ニヨル餘盛ナキ場合

$$w_1 = 1/3 \times w h_1 = 1/3 \times 1,600 \times 0.85 = 453 \ kg/m^2 \times 2.05 = 930 \ kg/m^2$$
$$w_2 = 1/3 \times w h_2 = 1/3 \times 1,600 \times 6.74 = 3,595 \ kg/m^2 \times 2.05 = 7,370 \ kg/m^2$$
$$C_{AB} = \frac{(3w_2 + 2w_1)h^2}{60} = \frac{(22,110 + 1,860) \times 5.89^2}{60} = 13,860 \ kgm$$
$$C_{BA} = \frac{(2w_2 + 3w_1)h^2}{60} = \frac{(14740 + 2,790) \times 5.89^2}{60} = 10,140 \ kgm$$

$$m_{AB} = \frac{h^2}{6}(w_2 + 2w_1) = \frac{5.89^2}{6} \times 9,230 = 53,400 \ kgm$$
$$m_{BA} = \frac{h^2}{6}(2w_2 + w_1) = \frac{5.89^2}{6} \times 15,670 = 90,700 \ kgm$$

$K_1 + 6K_2 = 0.1675$, $K_1 + 9K_2 = 0.2461$, $K_1 + 3K_2 = 0.0889$
$K_1^2 + 12K_1K_2 + 3K_2^2 = 0.0054$, $K_1^2 - 3K_2^2 = -0.00195$
$7K_1 + 9K_2 = 0.3079$, $5K_1 - 3K_2 = -0.0271$

$$M_A = -\frac{1}{2(K_1 + 6K_2)}\left\{(K_1 + 9K_2)C_{AB} + (K_1 + 3K_2)m_{AB} + \frac{(K_1^2 + 12K_1K_2 + 3K_2^2)C_{BA}}{2K_1 + K_2}\right\}$$
$$= -\frac{1}{0.335}\{0.2461 \times 13,860 + 0.0889 \times 53,400 + 0.1154 \times 10,140\} = -27,850 \ kgm$$

$$M_B = \frac{K_2}{2(K_1 + 6K_2)}\left\{3(m_{AB} - C_{AB}) - \frac{(7K_1 + 9K_2)C_{BA}}{2K_1 + K_2}\right\}$$
$$= .0782 \times \{3 \times 39,540 - 6,58 \times 10,140\} = 4,060 \ kgm$$

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鐵筋混凝土暗渠

$$M_C = -\frac{K_2}{2(K_1+6K_2)}\left\{3(M_{AB}-C_{AB})-\frac{(5K_1-3K_2)C_{BA}}{2K_1+K_2}\right\}$$
$$= -.0782\times\left\{3\times 39{,}540+0.579\times 10{,}140\right\} = -9{,}740\ kgm$$
$$M_D = \frac{1}{2(K_1+6K_2)}\left\{(K_1+3K_2)(M_{AB}-C_{AB})-\frac{(K_1^2-3K_2^2)C_{BA}}{2K_1+K_2}\right\}$$
$$= \frac{1}{0.335}\left\{0.0889\times 39{,}540+0.0417\times 10{,}140\right\} = 11{,}770\ kgm$$

$$H_A = \frac{M_{BA}+M_B-M_A}{h} = \frac{90{,}700+4060+27{,}850}{5.89} = 20{,}820\ kg$$

$$H_D = -\frac{M_D-M_C}{h} = -\frac{11{,}770+9{,}740}{5{,}89} = -3{,}650\ kg$$

$$V_A = \frac{M_{AB}+M_A-M_D}{l} = \frac{53{,}400-27{,}850-11{,}770}{8.64} = -1{,}600\ kg$$

$V_D = 1{,}600\ kg$
$S_{AB} = 20{,}820\ kg$
$S_{BA} = 20{,}820 - \frac{930+7{,}370}{2}\times 5.89 = -3{,}630\ kg$
$S_{BC} = S_{CB} = -1{,}600\ kg$

活荷重ヨル餘盛ヲ考ヘタル場合
換算餘盛ノ高 $= 1.81\ m$

$w_1 = 1/3\times 1{,}600\times 2.66 = 1{,}420\ kg/m^2\times 2.05 = 2{,}910\ kg/m^2$
$w_2 = 1/3\times 1{,}600\times 8.55 = 4560\ kg/m^2\times 2.05 = 9{,}350\ kg/m^2$
$C_{AB} = \frac{(28{,}050+5{,}820)\times 5.89^2}{60} = 19{,}580\ kgm$

$C_{BA} = \frac{(18{,}700+8{,}730)\times 5.89^2}{60} = 15{,}870\ kgm$

$M_{AB} = \frac{5.89^2}{6}\times 15{,}170 = 87{,}700\ kgm$
$M_{BA} = \frac{5.89^2}{6}\times 21{,}610 = 125{,}000\ kgm$

$$M_A = -\frac{1}{0.335}\left\{0.2461\times 19{,}580+0.0889\times 87{,}700+0.1154\times 15{,}870\right\} = -43{,}150\ kgm$$

$M_B = 0.0782\times\left\{3\times 68{,}120-6.58\times 15{,}870\right\} = 7{,}820\ kgm$
$M_C = -0.0782\times\left\{3\times 68{,}120+0.579\times 15{,}870\right\} = -16{,}720\ kgm$
$M_D = \frac{1}{0.335}\left\{0.0889\times 68{,}120+0.0417\times 15{,}870\right\} = 20{,}060\ kgm$

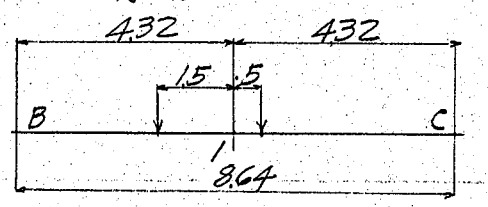
$H_A = \frac{125{,}000+7{,}820+43{,}150}{5.89} = 29{,}900\ kg$

$H_D = -\frac{20{,}060+16{,}720}{5.89} = -6{,}250\ kg$

$V_A = -\frac{87{,}700-43{,}150-20{,}060}{8.64} = -2{,}830\ kg$

$V_D = 2{,}830\ kg$
$S_{AB} = 29{,}900\ kg$
$S_{BA} = 29{,}900 - \frac{2910+9{,}350}{2}\times 5.89 = -6{,}200\ kg$
$S_{BC} = S_{CB} = -2{,}830\ kg$

活荷重應力



特殊活荷重　$P = 8{,}250\ kg$
$kl = 2.82\ m$ ノ場合　$k = .326$

$$M_A = \frac{PKl(1-K)K_1\{(4K-1)K_1+(2K+5)K_2\}}{2(2K_1+K_2)(K_1+6K_2)}$$
$$= \frac{8{,}250\times 2.82\times 0.674\times 0.0103\times\{0.304\times 0.0103+5.652\times 0.0262\}}{2\times 0.0468\times 0.1675} = 1{,}580\ kgm$$

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鐵筋混凝土暗渠

$$M_B = -\frac{P\lambda l(1-\lambda)\lambda_1\{4(1-\lambda)\lambda_1+(13-2\lambda)\lambda_2\}}{2(2\lambda_1+\lambda_2)(\lambda_1+6\lambda_2)}$$

$$= -10{,}310\times\{2{,}696\times0.0103+13{,}652\times0.0262\} = -3{,}980\ \text{kgm}$$

$$M_C = -\frac{P\lambda l(1-\lambda)\lambda_1\{4\lambda\lambda_1+(11+2\lambda)\lambda_2\}}{2(2\lambda_1+\lambda_2)(\lambda_1+6\lambda_2)}$$

$$= -10{,}310\times\{1{,}304\times0.0103+11{,}652\times0.0262\} = -3{,}290\ \text{kgm}$$

$$M_D = \frac{P\lambda l(1-\lambda)\lambda_1\{(3-4\lambda)\lambda_1+(7-2\lambda)\lambda_2\}}{2(2\lambda_1+\lambda_2)(\lambda_1+6\lambda_2)}$$

$$= 10{,}310\times\{1{,}696\times0.0103+6{,}348\times0.0262\} = 1{,}890\ \text{kgm}$$

$$H = -\frac{3P\lambda l(1-\lambda)\lambda_1}{2h(2\lambda_1+\lambda_2)} = -\frac{485}{2\times5{,}89\times0.0468} = -890\ \text{kg}\ \rightarrow$$

$$V_A = P(1-\lambda)\left\{1+\frac{\lambda(1-2\lambda)\lambda_1}{\lambda_1+6\lambda_2}\right\} = 8{,}250\times0.674\times1.00697 = 5{,}640\ \text{kg}$$

$$V_D = P\lambda\left\{1-\frac{(1-\lambda)(1-2\lambda)\lambda_1}{\lambda_1+6\lambda_2}\right\} = 8{,}250\times0.326\times\{1-0.0144\} = 2{,}650\ \text{kg}$$

$S_{AB} = S_{BA} = -890\ \text{kg}$
$S_{BC} = 5{,}640\ \text{kg}$
$S_{CB} = -2{,}650\ \text{kg}$

$\lambda l = 4.82\ m$ 1場合，$\lambda = 0.558$

$$M_A = \frac{8{,}250\times482\times0.442\times0.0103\times\{1232\times0.0103+6116\times0.0262\}}{2\times0.0468\times0.1675} = 1{,}995\ \text{kgm}$$

$$M_B = -11{,}550\times\{1.768\times0.0103+11.884\times0.0262\} = -3{,}810\ \text{kgm}$$
$$M_C = -11{,}550\times\{2{,}232\times0.0103+12{,}116\times0.0262\} = -3{,}930\ \text{kgm}$$
$$M_D = 11{,}550\times\{0.768\times0.0103+5.884\times0.0262\} = 1{,}870\ \text{kgm}$$
$$H = -\frac{543}{0.551} = -990\ \text{kg}\ \rightarrow$$

$$V_A = 8{,}250\times0.442\times0.996 = 3{,}630\ \text{kg}$$
$V_D = 4{,}620\ \text{kg}$
$S_{AB} = -990\ \text{kg} = S_{BA}$
$S_{BC} = 3{,}630\ \text{kg}$
$S_{CB} = -4{,}620\ \text{kg}$

活荷重應力，總計

M_A	M_B	M_C	M_D	H	V_A	V_D	S_{AB}, S_{BA}	S_{BC}	S_{CB}
1,580	-3,980	-3,290	1,890	-890	5,640	2,650	-890	5,640	-2,650
1,995	-3,810	-3,930	1,870	-990	3,630	4,620	-990	3,630	-4,620
3,575 kgm	-7,780 kgm	-7,220 kgm	3,760 kgm	-1,880 kg	9,270 kg	7,270 kg	-1,880 kg	9,270 kg	-7,270 kg

徑間中央1点，弯曲率

$$R_B = 8{,}250\times(5.82+3.82)\div8.64 = 9{,}200\ \text{kg}$$
$$m_1 = 9{,}200\times4.32-8{,}250\times1.50 = 27{,}370$$
$$-\ 7{,}780$$
$$M_1 = 19{,}590\ \text{kgm}$$

衝撃荷重應力

衝撃係数　$i = \frac{25}{58.64} = 0.426$

$M_A = 1{,}520\ \text{kgm}$，$M_B = -3{,}315\ \text{kgm}$，$M_C = -3{,}075\ \text{kgm}$，$M_D = 1{,}600\ \text{kgm}$
$H = -800\ \text{kg}$，$V_A = 3{,}950\ \text{kg}$，$V_D = 3{,}100\ \text{kg}$，$S_{AB} = S_{BA} = -800\ \text{kg}$
$S_{BC} = 3{,}950\ \text{kg}$，$S_{CB} = -3{,}100\ \text{kg}$，$M_1 = 8{,}340\ \text{kgm}$

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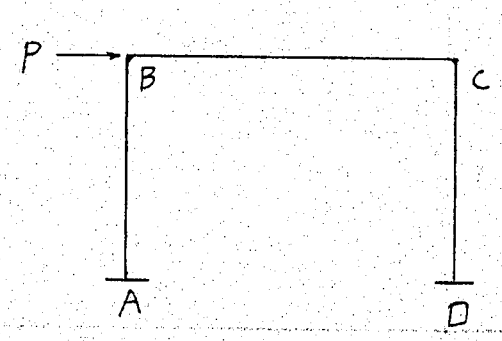
鐵筋混凝土暗渠
制動荷重應力

$P = 2 @ 8{,}250 \times 0.15 = 2{,}480\ kg$



$$M_A = -\frac{Ph(K_1+3K_2)}{2(K_1+6K_2)} = -\frac{2{,}480 \times 5.89 \times 0.0889}{2 \times 0.1675} = -3{,}380\ kgm$$

$$M_B = \frac{3PhK_2}{2(K_1+6K_2)} = \frac{3 \times 2{,}480 \times 5.89 \times 0.0262}{2 \times 0.1675} = 3{,}430\ kgm$$

$M_C = -3{,}430\ kgm$
$M_D = 3{,}380\ kgm$
$H = \frac{P}{2} = 1{,}240\ kg \leftarrow$

$$V_A = -\frac{3PhK_2}{l(K_1+6K_2)} = -790\ kg$$

$S_{AB} = S_{BA} = 1{,}240\ kg$
$S_{BC} = -790\ kg$

温度應力　(上昇，場合)
$t = 15°C$, $\varepsilon = 0.00001$

$$R = \frac{\varepsilon t l}{2h} = \frac{0.00001 \times 15 \times 8.64}{2 \times 5.89} = 0.00011$$

$$M_A = \frac{6EK_1R(K_1+K_2)}{2K_1+K_2} = \frac{6 \times 1{,}400{,}000{,}000 \times 0.0103 \times 0.00011 \times 0.0365}{0.0468} = 7{,}430\ kgm$$

$$M_B = -\frac{6EK_1K_2R}{2K_1+K_2} = -5{,}340\ kgm$$

$M_C = -5{,}340\ kgm$
$M_D = 7{,}430\ kgm$
$H = -\frac{M_A - M_B}{h} = -\frac{7{,}430 + 5{,}340}{5.89} = -2{,}170\ kg \rightarrow$

$V = 0$
$S_{AB} = S_{BA} = -2{,}170\ kg$
$S_{BC} = 0$

應力，總計
死荷重，餘盛土キ場合，土圧，活荷重及温度應力，和

	M_A	M_B	M_1	H	V	S_{AB}	S_{BA}	S_{BC}
死荷重	6,850	-13,700	32,950	-3,490	21,600	-3,490	-3,490	21,600
土圧	-16,080	-5,680	-5,680	17,170	0	17,170	-5230	0
活荷重	3,575	-7,780	19,590	-1,880	9,270	-1,880	-1,880	9,270
衝撃	1,520	-3,315	8,340	-800	3,950	-800	-800	3,950
温度変化	7,430	-5,340	5,340	2,170	0	2,170	±2,170	0
	3,295 kgm	-35,815 kgm	60,540 kgm	13,170 kg	34,820 kg	13,170 kg	-13,570 kg	34,820 kg
							-9,230 kg	

$N = 34{,}820\ kg$ $N_{BA} = 34{,}820\ kg$ $N = 9{,}230\ kg$
$N_{BC} = 13{,}570\ kg$

S_{BC}，最大
$kl = 2.000$, $k = 0.232$

$$S_{BC} = P(1-k)\left\{1 + \frac{k(1-2k)K_1}{K_1+K_2}\right\} = 8{,}250 \times 0.768 \times 1.0351 = 6{,}560\ kg$$

	S_{BC}
死荷重	21,600
土圧	0
活荷重	14,810
衝撃	6,310
温度変化	0
	42,720 kg

8,250
14,810 kg

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鐵筋混凝土暗渠

死荷重，餘盛アル場合，土圧，温度應力ノ和

	M_A	M_B	H	V	S_{AB}	S_{BA}	S_{BC}
死荷重	6,850	-13,700	-3,490	21,600	-3,490	-3,490	21,600
土圧	-23,090	-8,900	23,650	0	23,650	-12,450	0
温度変化	-7,430	-5,340	2,170	0	2,170	-2,170	0
	-23,670 kgm	-27,940 kgm	22,330 kg	21,600 kg	22,330 kg	-18,110 kg	21,600 kg

$N = 21,600$ kg　$N_{BA} = 21,600$ kg
$N_{BC} = 18,110$ kg

側壁，最大正弯曲率

$$w_1 x + \frac{w_2 - w_1}{2h} x^2 - 15,940 = 0$$

$$547x^2 + 2,910x - 15,940 = 0 \qquad x = 3.36 \text{ m}$$

$$M = M_B - S_{BA}x - \frac{w_1 x^2}{2} - \frac{w_2 - w_1}{2h} \times \frac{x^3}{3}$$

$$= -22,600 + 15,940x - \frac{2,910 \times 3.36^2}{2} - \frac{6,440 \times 3.36^3}{6 \times 5.89} = 7,620 \text{ kgm}$$

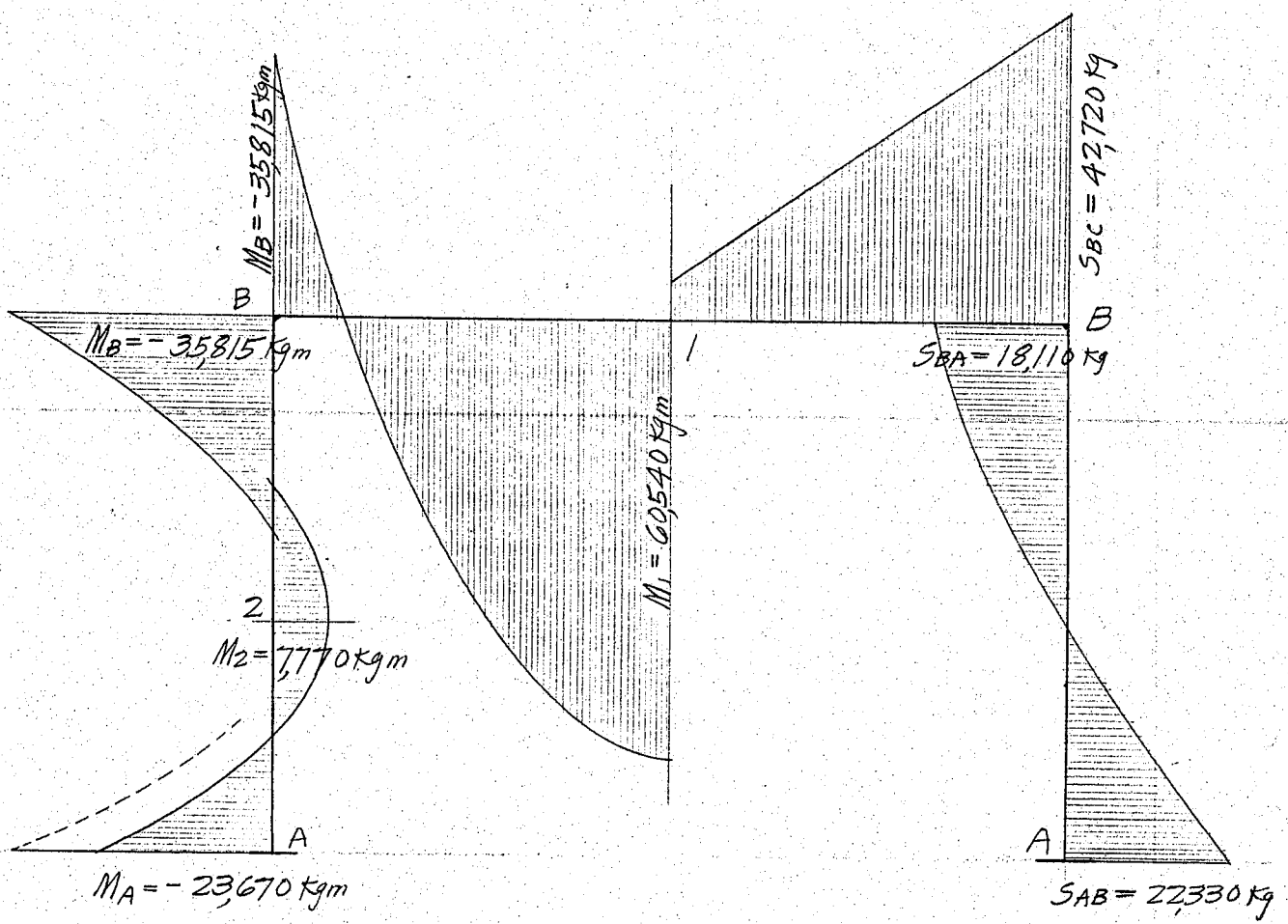
150 (温度，変化)

$M_2 = 7,770$ kgm
$N = 21,600$ kg

死荷重，不対称土圧，制動荷重及温度應力，和

	M_A	M_B	H	V	S_{AB}	S_{BA}	S_{BC}
死荷重	6,850	-13,700	-3,490	21,600	-3,490	-3,490	21,600
土圧	-31,380	-1,920	26,250	-1,230	26,250	-7,800	-2,830
制動荷重	-3,380	-3,430	1,240	∓790	1,240	-1,240	790
温度変化	-7,430	-5,340	2,170	0	2,170	-2,170	0
	-35,340 kgm	-24,390 kgm	26,170 kg	19,580 kg	26,170 kg	-14,700 kg	19,560 kg

$N = 19,580$ kg　$N_{BA} = 21,160$ kg　21,160 kg
$N_{BC} = 14,700$ kg



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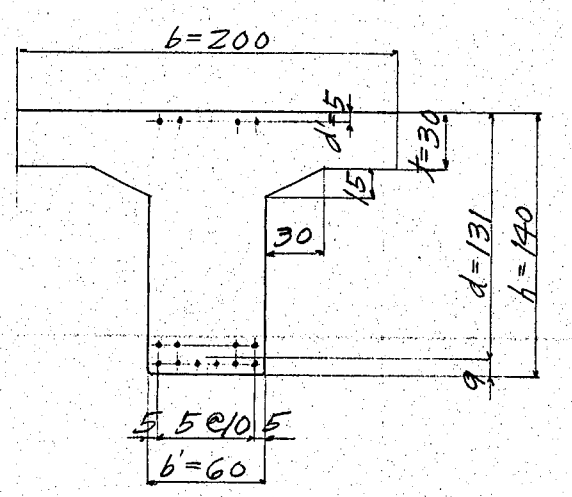
鐵筋混凝土暗渠 斷面ノ設計

1 点



$M_1 = 60{,}540$ kgm　$N = 9{,}230$ kg

$A_s = 10 @ 22\phi = 10 @ 3{,}80 = 38.0$ cm²

$A_s' = 4 @ 22\phi = 4 @ 3{,}80 = 15.2$ cm²

$$p = \frac{A_s}{bd} = \frac{38.0}{200 \times 131} = 0.00145$$

$$p' = \frac{A_s'}{bd} = \frac{15.2}{200 \times 131} = 0.00058$$

$t/d = 0.229$

中立軸ハ突縁中ニアリ矩形桁トシテ設計ス

$d/h = 131/140 = 0.936$, $d'/h = 5/140 = 0.0357$

$$p_0 = \frac{A_s}{bh} = 0.00136, \quad p_0' = 0.00054$$

$u/h = 0.506$, $u = 0.506 \times 140 = 70.8$ cm　$70.8 - 5 = 65.8$ cm

$d''/d = 0.0382$

$$\frac{M}{N} = \frac{60{,}540 \times 100}{9{,}230} = 656$$

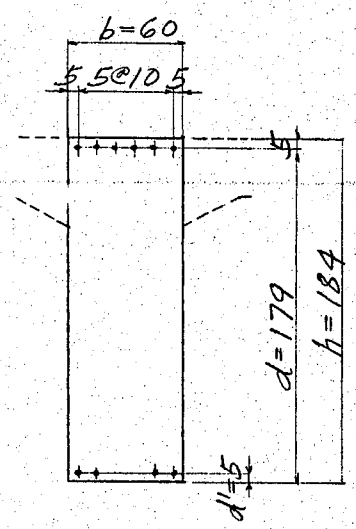
$$\frac{65.8}{e = 721.8 \text{ cm}}, \quad e' = 590.2 \text{ cm}, \quad e'/e = 0.82$$

$k = 0.20$　$\dfrac{Ne}{bd^2 f_c} = 0.10$

$$f_c = \frac{9230 \times 721.8}{200 \times 131^2 \times 0.10} = 19.4 \text{ kg/cm}^2$$

$$f_s = 15 \times 19.4 \times \frac{0.80}{0.20} = 1{,}164 \text{ kg/cm}^2$$

Bc 点



$M_{Bc} = -35{,}815$ kgm, $N = 13{,}570$ kg, $h = 140 + \frac{132}{3} = 184$ cm

$A_s = 6 @ 19^{mm}\phi = 6 @ 2{,}835 = 17.0$ cm²

$A_s' = 4 @ 19^{mm}\phi = 4 @ 2{,}835 = 11.3$ cm²

$$p_0 = \frac{A_s}{bh} = \frac{17.0}{60 \times 184} = 0.00154$$

$$p_0' = \frac{A_s'}{bh} = \frac{11.3}{60 \times 184} = 0.00102, \quad d'/h = 5/184 = 0.0272, \quad d/h = 179/184 = .973$$

$u/h = 0.503$, $u = 92.5$ cm, $92.5 - 5 = 87.5$ cm

$$p = \frac{A_s}{bd} = 0.00158$$

$$p' = \frac{A_s'}{bd} = 0.00100$$

$$\frac{M}{N} = \frac{35{,}815 \times 100}{13{,}570} = 264$$

$$\frac{87.5}{e = 351.5 \text{ cm}}, \quad e' = 176.5 \text{ cm}, \quad e'/e = 0.502$$

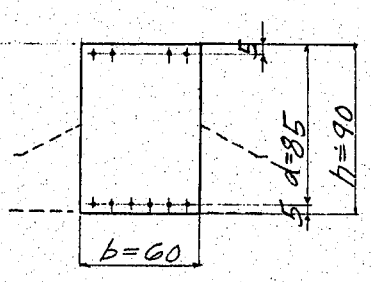
$d''/d = 0.0279$, $k = 0.25$, $\dfrac{Ne}{bd^2 f_c} = 0.13$

$$f_c = \frac{13{,}570 \times 351.5}{60 \times 179^2 \times 0.13} = 19.1 \text{ kg/cm}^2$$

$$f_s = 15 \times 19.1 \times \frac{0.75}{0.25} = 860 \text{ kg/cm}^2$$

$$s = \frac{20000}{60 \times \frac{7}{8} \times 179} = 2.1 \text{ kg/cm}^2$$

2 点



$M_2 = 7{,}770$ kgm, $N = 21{,}600$ kg

$A_s = 6 @ 19^{mm}\phi = 17.0$ cm²

$A_s' = 4 @ 19^{mm}\phi = 11.3$ cm²

$$p_0 = \frac{17.0}{60 \times 90} = 0.00236$$

$$p_0' = \frac{11.3}{60 \times 90} = 0.00157$$

$d'/h = 0.0556$, $d/h = 0.945$

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鐵筋混凝土暗渠

$u/h = 0.506$, $u = 45.6$, $45.6 - 5 = 40.6$ cm

$p = \frac{17.0}{60 \times 85} = 0.00334$

$p' = \frac{11.3}{60 \times 85} = 0.00222$

$\frac{M}{N} = \frac{7,770 \times 100}{21,600} = 36.0$

40.6

$e = 76.6$ cm , $e' = -3.4$ cm , $e'/e = 0.0444$

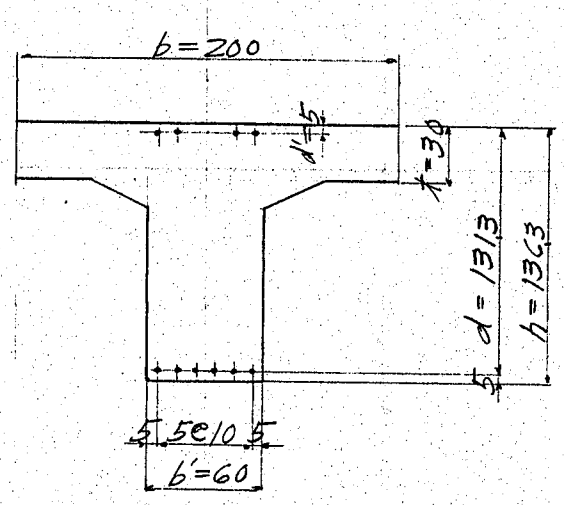
$d'/d = 0.0588$, $K = 0.59$, $\frac{Ne}{bd^2 f_c} = 0.267$

$f_c = \frac{21,600 \times 76.6}{60 \times 85^2 \times 0.267} = 14.3$ kg/cm²

$f_s = 15 \times 14.3 \times \frac{041}{059} = 149$ kg/cm²

BA 点

$M_{BA} = -35,815$ kgm , $N = 34,820$ kg , $h = 90 + \frac{139}{3} = 136.3$ cm



$A_s = 6 @ 19^{mm}\phi = 17.0$ cm²

$A_s' = 4 @ 19^{mm}\phi = 11.3$ cm²

$p = \frac{17.0}{200 \times 131.3} = 0.00065$, $t/d = 0.229$.

$p' = \frac{11.3}{200 \times 131.3} = 0.00043$

中立軸ハ突縁中ニアリ矩形桁トシテ設計ス

$d/h = 131.3/136.3 = 0.963$, $d'/h = 0.0367$

$p_0 = 0.00062$, $p_0' = 0.00042$

$u/h = 0.502$, $u = 68.4$ cm , $68.4 - 5 = 63.4$ cm

$\frac{M}{N} = \frac{35,815 \times 100}{34,820} = 102.8$ cm

63.4

$e = 166.2$ cm , $e' = 39.4$ cm , $e'/e = 0.237$

$d'/d = 0.0381$, $K = 0.24$, $\frac{Ne}{bd^2 f_c} = 0.117$

$f_c = \frac{34,820 \times 166.2}{200 \times 131.3^2 \times 0.117} = 14.3$ kg/cm²

$f_s = 15 \times 14.3 \times \frac{0.76}{0.24} = 679$ kg/cm²

$s = \frac{18110}{60 \times 7/8 \times 131.3} = 2.6$ kg/cm²

AB 点

$M_{AB} = -35340$ kgm , $N = 19,580$ kg , $S = 26,170$ kg

$h = 90 + 100/3 = 123.3$ cm

$A_s = 6 @ 19^{mm}\phi = 17.0$ cm²

$A_s' = 4 @ 19^{mm}\phi = 11.3$ cm²

$p = \frac{17.0}{200 \times 118.3} = 0.000718$

$p' = \frac{11.3}{200 \times 118.3} = 0.000478$, $t/d = 0.254$

中立軸ハ突縁中ニアリ矩形桁トシテ設計ス

$d/h = 0.96$, $d'/h = 0.0406$

$p_0 = 0.000689$, $p_0' = 0.000458$

$u/h = 0.502$, $u = 61.9$ cm , $61.9 - 5 = 56.9$ cm

$\frac{M}{N} = \frac{35340 \times 100}{19,580} = 181$

56.9

$e = 237.9$ cm , $e' = 124.1$ cm , $e'/e = 0.522$

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鐵筋混凝土暗渠

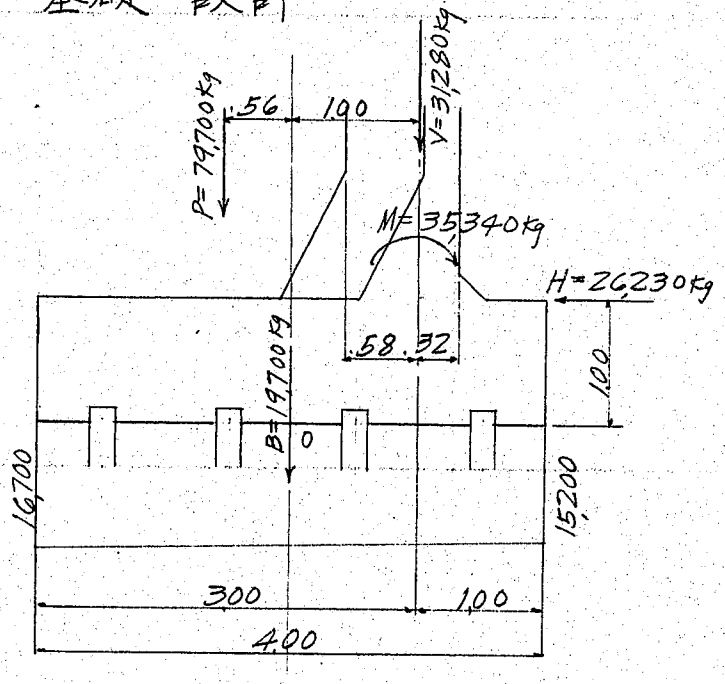
$d'/d = 0.0422$, $k = 0.19$, $\frac{Ne}{bd^2 f_c} = 0.094$

$f_c = \frac{19580 \times 2379}{200 \times 1183^2 \times 0.094} = 17.7\ kg/cm^2 \div 1.15 = 15.4\ kg/cm^2$

$f_s = 15 \times 17.7 \times \frac{0.81}{0.19} = 748\ kg/cm^2 \div 1.15 = 650\ kg/cm^2$

$s = \frac{26170}{60 \times 7/8 \times 1183} = 4.2\ kg/cm^2 \div 1.15 = 3.7\ kg/cm^2$

基礎，設計



2.42 × 2.05 × 8.55 × 1,600 = 67,800 × 1.21 = 82,000
0.60 × 1.45 × 8.55 × 1,600 = 11,900 × 2.72 = 32,400
P = 79,700kg 1.44m 114,400kgm

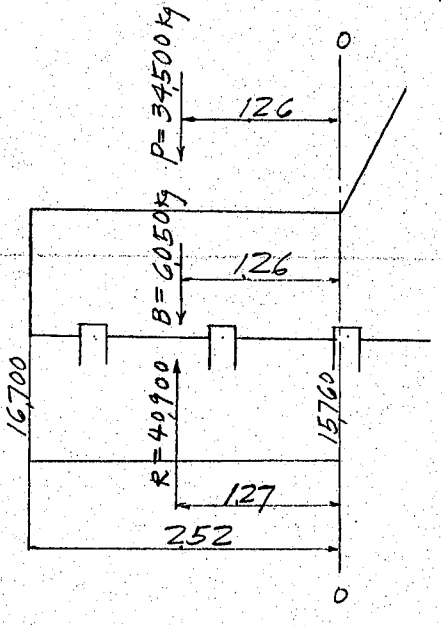
B = 2.05 × 1.00 × 4.00 × 2,400 = 19,700 kg
V = 0.30 × 2.05 × 5.00 × 2,400 = 7,380
0.60 × 0.60 × 5.00 × 2,400 = 4,320
19,580
V = 31,280 kg

$2{,}170 \times \frac{2.05}{2} = 2{,}230$
2,170
60
26,170
H = 26,230 kg

0 点 = 於ケル能率

V	H	
79,700	× 0.56	= 44,600
31,280	× -1.00	= -31,280
19,700		
	26,230 × 1.00	= 26,230
		= -35,340
130,680 kg	0.032 m	4,210 kgm

$P = \frac{130{,}680}{4.00 \times 2.05} \times \left(1 \pm \frac{6 \times 0.032}{4.00}\right) = 16{,}700\ kg/m^2$
$15{,}200\ kg/m^2$



P = 2.52 × 1.00 × 8.55 × 1,600 = 34,500 kg
B = 2.52 × 1.00 × 1.00 × 2,400 = 6,050 kg
R = 1/2 × (16,700 + 15,760) × 2.52 = 40,900 kg

0-0 点 = 於ケル能率

40,900	× 1.27	= 51,950
-34,500	× 1.26	= -43,600
-6,050	× 1.26	= -7,620
S = 350 kg		M = 730 kgm

As = 16mmφ 50 cm c.to c = 4.02 cm²

$P = \frac{4.02}{100 \times 100} = 0.0004$, $j = 0.965$, $K = 0.105$

$f_s = \frac{730 \times 100}{4.02 \times 0.965 \times 90} = 209\ kg/cm^2$

$f_c = 209 \times \frac{0.105}{15 \times 0.895} = 1.6\ kg/cm^2$

$S = \frac{350}{100 \times .965 \times 90} = 0.04\ kg/cm^2$

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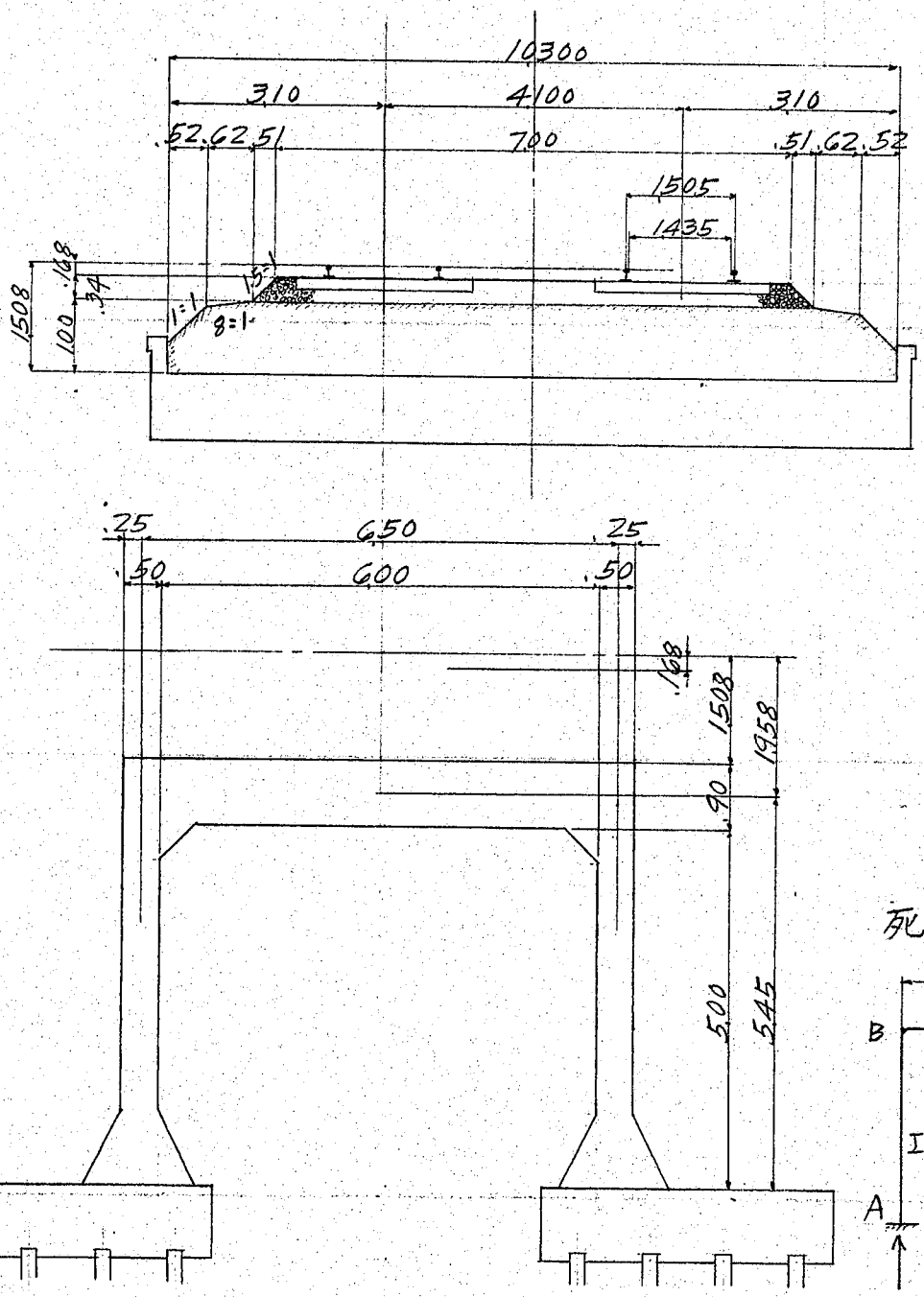
鐵筋混凝土暗渠

暗渠，設計
土被 1米，支間 $l = 6.500^{m}$ ， $h = 5.45^{m}$



死荷重
軌道　2 e 800 ÷ 10,30 = 155
道床　34 × 19 = 646
土被　1,00 × 1,600 = 1,600
床版　0,90 × 2,400 = 2,160
特送其他　59
4,620 kg/m²

假定斷面及物量力率

$A_1 = 1{,}00 \times 0{,}50 = 0{,}50\ m^2$

$I_1 = 0.0104\ m^4$

$A_2 = 1{,}00 \times 0{,}90 = 0{,}90\ m^2$

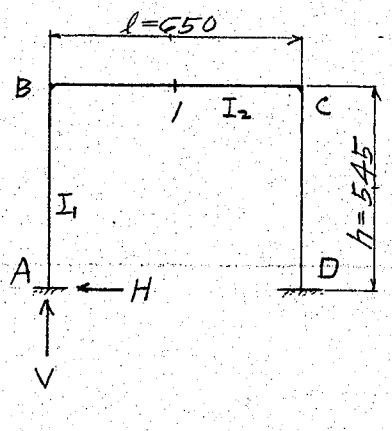
$I_2 = \frac{bh^3}{12} = \frac{1.00 \times 0.90^3}{12} = 0.0608\ m^4$

$K_1 = \frac{I_1}{h} = \frac{0.0104}{5{,}45} = 0.00191$

$K_2 = \frac{I_2}{l} = \frac{0.0608}{6{,}50} = 0.00935$

$2K_1 + K_2 = 0.01317$

死荷重應力



$C_{BC} = \frac{wl^2}{12} = \frac{4620 \times 6.5^2}{12}$

$= 16{,}270\ kgm$

$M_A = \frac{K_1 C_{BC}}{2K_1 + K_2}$

$= \frac{0.00191 \times 16270}{0.01317}$

$= 2{,}360\ kgm$

$M_B = -4{,}720\ kgm$

$H_A = -\frac{M_A - M_B}{h} = -\frac{2{,}360 + 4{,}720}{5{,}45} = -1{,}300\ kg \rightarrow$

$V_A = \frac{wl}{2} = \frac{4{,}620 \times 6{,}50}{2} = 15{,}020\ kg$

$S_{AB} = S_{BA} = -1{,}300\ kg$

$S_{BC} = 15{,}020\ kg$

$\frac{wl^2}{8} = \frac{4{,}620 \times 6{,}50^2}{8} = 24{,}400$

$-4{,}720$

$M_1 = 19{,}680\ kgm$

土圧＝ヨル應力
安息角 = 30°
活荷重＝ヨル餘盛ナキ場合

$w_1 = \frac{1}{3} w h_1 = \frac{1}{3} \times 1{,}600 \times 1.790 = 954\ kg/m^2$

$w_2 = \frac{1}{3} w h_2 = \frac{1}{3} \times 1{,}600 \times 7.240 = 3{,}860\ kg/m^2$

$C_{AB} = \frac{(3w_2 + 2w_1)h^2}{60} = \frac{(11{,}580 + 1{,}908) \times 5{,}45^2}{60} = 6{,}680\ kgm$

$C_{BA} = \frac{(2w_2 + 3w_1)h^2}{60} = \frac{(7{,}720 + 2{,}862) \times 5{,}45^2}{60} = 5{,}240\ kgm$

$m_{BA} = \frac{h^2(2w_2 + w_1)}{6} = \frac{8{,}674 \times 5{,}45^2}{6} = 42{,}950\ kgm$

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設計	日付	類別	
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鐵筋混凝土暗渠

$$M_A = -\left(C_{AB} + \frac{K_1 C_{BA}}{2K_1+K_2}\right) = -\left(6{,}680 + \frac{0.00191\times 5240}{0.01317}\right) = -7{,}440\ kgm$$

$$M_B = -\frac{K_2 C_{BA}}{2K_1+K_2} = -\frac{0.00935\times 5{,}240}{0.01317} = -3{,}720\ kgm$$

$M_C = -3{,}720\ kgm$
$M_D = -7{,}440\ kgm$

$$H_A = \frac{m_{BA}+M_B-M_A}{h} = \frac{42{,}950-3{,}720+7{,}440}{5{,}45} = 8{,}660\ kg \leftarrow$$

$V = 0$
$S_{AB} = 8{,}660\ kg$

$$S_{BA} = 8{,}660 - \frac{954+3860}{2}\times 5.45 = -4{,}460\ kg$$

$S_{BC} = 0$

活荷重＝ヨル餘盛ヲ考ヘタル場合
換算餘盛ノ高 ＝1.81 m

$w_1 = 1/3 \times 1{,}600 \times 3{,}60 = 1{,}920\ kg/m^2$
$w_2 = 1/3 \times 1{,}600 \times 9{,}05 = 4830\ kg/m^2$

$$C_{AB} = \frac{(14{,}490+3840)\times 5{,}45^2}{60} = 9{,}080\ kgm$$

$$C_{BA} = \frac{(9{,}660+5{,}760)\times 5{,}45^2}{60} = 7{,}630\ kgm$$

$$m_{BA} = \frac{11{,}580\times 5{,}45^2}{6} = 57{,}300\ kgm$$

$$M_A = -\left(9{,}080 + \frac{0.00191\times 7{,}630}{0.01317}\right) = -10{,}190\ kgm$$

$$M_B = -\frac{0.00935\times 7{,}630}{0.01317} = -5{,}420\ kgm$$

$$H = \frac{57{,}300-5{,}420+10{,}190}{5{,}45} = 11{,}380\ kg \leftarrow$$

$V = 0$
$S_{AB} = 11{,}380\ kg$

$$S_{BA} = 11{,}380 - \frac{1{,}920+4830}{2}\times 5{,}45 = -7{,}020\ kg$$

$S_{BC} = 0$

活荷重應力

特殊活荷重　$P = 16{,}500\ kg$
縦，分布　$a = 2.00 + 2\times 1{,}34 + 1{,}50 = 6{,}18\ m$
横，分布　$b = 6.52 + 2\times 1{,}34 = 9{,}20\ m$

$$w = \frac{4\times 16{,}500}{6{,}18\times 9{,}2} = 1{,}160\ kg/m^2$$

$M_A = 590\ kgm$
$M_B = -1{,}190\ kgm$
$H = -330\ kg \rightarrow$
$V = 3{,}770\ kg$
$S_{AB} = S_{BA} = -330\ kg$
$S_{BC} = 3{,}770\ kg$
$M_1 = 4{,}940\ kgm$

衝撃荷重應力

衝撃係数　$i = 0.443$

$M_A = 260\ kgm$
$M_B = -530\ kgm$
$H = -150\ kg \rightarrow$
$V = 1{,}670\ kg$

$S_{AB} = S_{BA} = -150\ kg$
$S_{BC} = 1{,}670\ kg$
$M_1 = 2{,}190\ kgm$

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鐵筋混凝土暗渠

溫度應力（上昇ノ場合）

$t = 15°C$, $\varepsilon = 0.00001$

$$R = \frac{\varepsilon t l}{2h} = \frac{0.00001 \times 15 \times 650}{2 \times 545} = 0.00009$$

$$M_A = \frac{6EK_1R(K_1+K_2)}{2K_1+K_2} = \frac{6 \times 1400000000 \times 0.00191 \times 0.00009 \times 0.01126}{0.01317} = 1235 kgm$$

$$M_B = -\frac{6EK_1K_2R}{2K_1+K_2} = -1025 kgm$$

$$H = -\frac{M_A - M_B}{h} = -\frac{1235+1025}{545} = -415 kg \rightarrow, \quad V = 0$$

$$S_{AB} = S_{BA} = -415 kg$$

$$S_{BC} = 0$$

應力ノ總計

死荷重，餘盛ナキ場合ノ土圧，活荷重及溫度應力ノ和

	M_A	M_B	M_1	H	V	S_{AB}	S_{BA}	S_{BC}
死荷重	2,360	-4,720	19,680	-1,300	15,020	-1,300	-1,300	15,020
土圧	-7,440	-3,720	-3,720	8,660	0	8,660	-4,460	0
活荷重	590	-1,190	4,940	-330	3,770	-330	-330	3,770
衝撃	260	-530	2,190	-150	1,670	-150	-150	1,670
溫度ノ変化	-1,235	-1,025	1,025	415	0	415	±415	0
	-5,465 kgm	-11,185 kgm	24,115 kgm	7,295 kg	20,460 kg	7,295 kg	-5,825 kg	20,460 kg
							-6,655 kg	

$N = 20,460 kg$ $N_{BA} = 20,460 kg$ $N = 5,825 kg$

$N_{BC} = 6,655 kg$

死荷重，餘盛アル場合ノ土圧及溫度應力ノ和

	M_A	M_B	H	V	S_{AB}	S_{BA}	S_{BC}
死荷重	2,360	-4,720	-1,300	15,020	-1,300	-1,300	15,020
土圧	-10,190	-5,420	11,380	0	11,380	-7,020	0
溫度ノ変化	-1,235	-1,025	415	0	415	-415	0
	-9,065 kgm	-11,165 kgm	10,495 kg	15,020	10,495 kg	-8,735 kg	15,020 kg

$N = 15,020 kg$ $N_{BA} = 15,020 kg$

$N_{BC} = 8,735 kg$

側壁ノ最大正彎曲率

$$w_1 x + \frac{w_2 - w_1}{2h} x^2 - 8,320 = 0$$

$$267x^2 + 1,920x - 8,320 = 0, \quad x = 3.04 m$$

$$M = M_B - S_{BA}x - \frac{w_1 x^2}{2} - \frac{w_2 - w_1}{2h} \times \frac{x^3}{3}$$

$$= -10,140 + 8,320 \times 3.04 - 960 \times 3.04^2 - 267 \times \frac{3.04^3}{3} = 3,790$$

235

$M_2 = 4,025 kgm$

$N = 15,020 kg$

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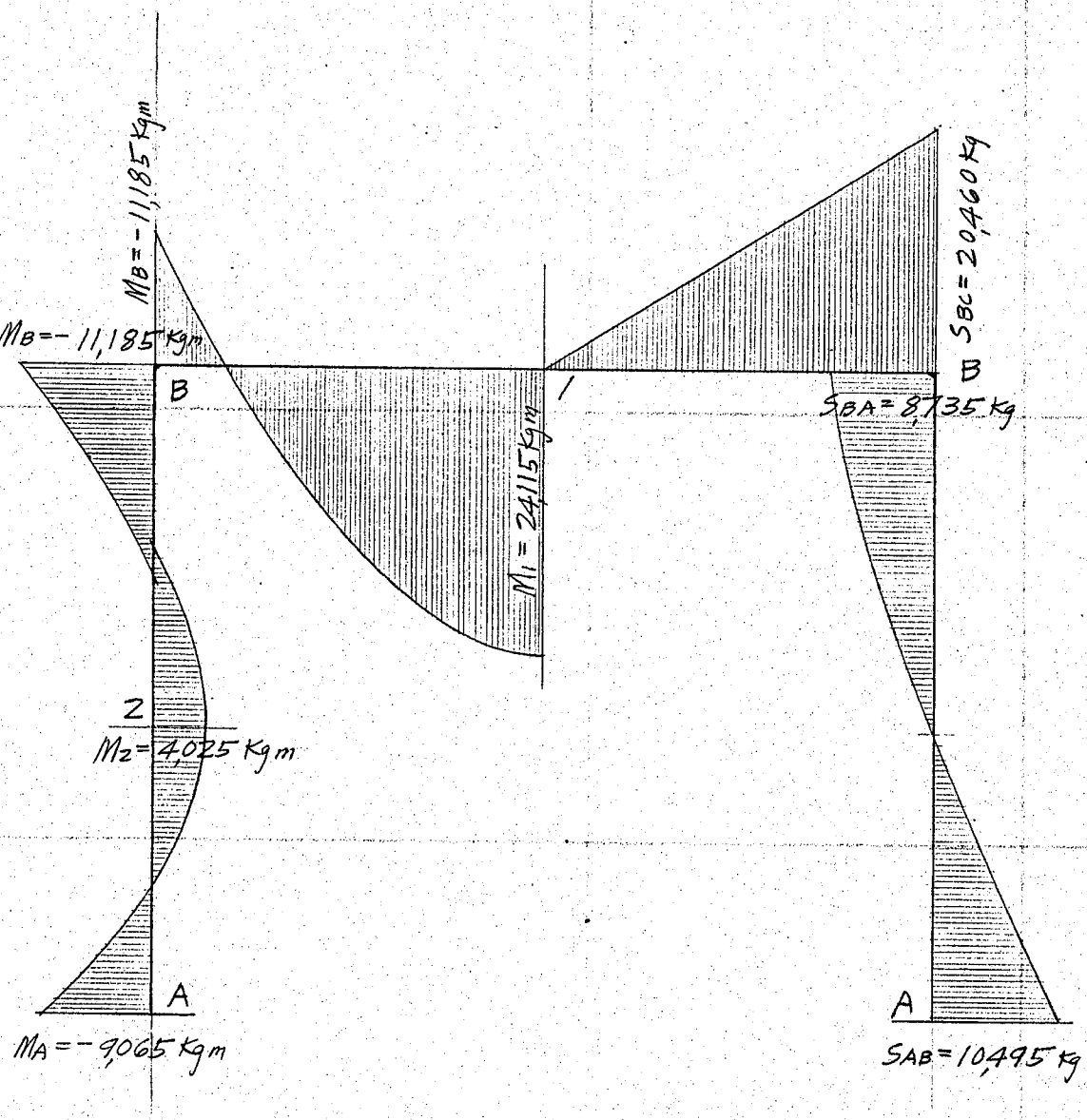
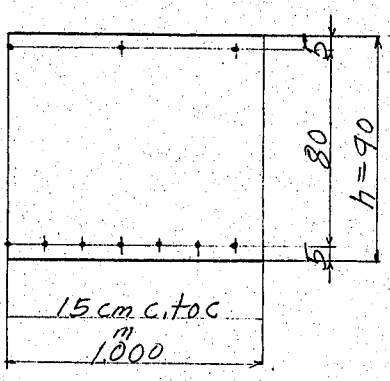
鐵筋混凝土暗渠



斷面，設計

1 点



$M_1 = 24{,}115$ Kgm , $N = 5{,}825$ Kg

$A_s = 22^{mm\phi}$ 15 cm c.to c $= 6.67 \times 3.80 = 25.4$ cm²

$A_s' = 22^{mm\phi}$ 45 cm c.to c $= 2.22 \times 3.80 = 8.4$ cm²

$p_0 = \dfrac{25.4}{100 \times 90} = 0.00282$

$p_0' = 0.00094$, $d/h = 0.945$, $d'/h = 0.0556$

$u/h = 0.510$, $u = 45.9$ cm , $45.9 - 5 = 40.9$ cm

$p = 0.00299$, $p' = 0.0010$

$\dfrac{M}{N} = \dfrac{24{,}115 \times 100}{5{,}825} = 414$

$e = 454.9$ cm , $e' = 373.1$ cm , $e'/e = 0.82$

$d'/d = 0.0588$, $K = 0.27$, $\dfrac{Ne}{bd^2 f_c} = 0.135$.

$f_c = \dfrac{5825 \times 454.9}{100 \times 85^2 \times 0.135} = 27.2$ kg/cm²

$f_s = 15 \times 27.2 \times \dfrac{0.73}{0.27} = 1{,}103$ kg/cm²

Bc 点

$M_{BC} = -11{,}185$ Kgm , $N = 6{,}655$ Kg , $S = 20{,}460$ Kg , $h = 90 + \dfrac{75}{3} = 115$ cm

$A_s = 16^{mm\phi}$ 15 cm c.to c $= 6.67 \times 2.01 = 13.4$ cm²

$A_s' = 16^{mm\phi}$ 45 cm c.to c $= 2.22 \times 2.01 = 4.5$ cm²

$p_0 = \dfrac{13.4}{100 \times 115} = 0.00117$, $p_0' = 0.00039$, $d/h = 0.956$, $d'/h = 0.0435$

$u/h = 0.506$, $u = 58.2$, $58.2 - 5 = 53.2$ cm

$p = 0.00122$, $p' = 0.00041$

$\dfrac{M}{N} = \dfrac{11{,}185 \times 100}{6{,}655} = 168.2$

$e = 221.4$ cm , $e' = 115$ cm , $e'/e = 0.519$

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鐵筋混凝土暗渠

$d'/d = 0.0455$, $k = 0.22$, $\frac{Ne}{bd^2 f_c} = 0.108$

$f_c = \frac{6655 \times 2214}{100 \times 110^2 \times 0.108} = 113\ kg/cm^2$

$f_s = 15 \times 113 \times \frac{0.78}{0.22} = 562\ kg/cm^2$

$s = \frac{20460}{100 \times 7/8 \times 110} = 2.1\ kg/cm^2$

2 点

$M_2 = 4025\ kgm$, $N = 15020 kg$, $h = 50\ cm$

$A_s = 16^{mm\phi}$ 15cm c.to c. $= 6.67 \times 2.01 = 13.4\ cm^2$

$A_s' = 16^{mm\phi}$ 45cm c.to c. $= 2.22 \times 2.01 = 4.5\ cm^2$

$p_0 = \frac{13.4}{100 \times 50} = 0.00268$, $p_0' = 0.00089$, $d/h = 0.9$, $d'/h = 0.1$

$u/h = 0.51$, $u = 25.5\ cm$, $25.5 - 5 = 20.5\ cm$

$d'/d = 0.111$, $p = 0.00298$, $p' = 0.0010$

$\frac{M}{N} = \frac{4025 \times 100}{15020} = 26.8$

$\frac{205}{e = 47.3\ cm}$, $e' = 6.3\ cm$, $e'/e = 0.133$

$k = 0.48$, $\frac{Ne}{bd^2 f_c} = 0.214$

$f_c = \frac{15020 \times 47.3}{100 \times 45^2 \times 0.214} = 164\ kg/cm^2$

$f_s = 15 \times 164 \times \frac{0.52}{0.48} = 266\ kg/cm^2$

BA 点

$M_{BA} = -11,185\ kgm$, $N = 20460\ kg$, $S_{BA} = 8735\ kg$, $h = 50 + \frac{95}{3} = 82\ cm$

$A_s = 16^{mm\phi}$ 15cm c.to c $= 13.4\ cm^2$

$A_s' = 16^{mm\phi}$ 45cm c.to c $= 4.5\ cm^2$

$p_0 = 0.00164$, $p_0' = 0.00055$, $d/h = 0.94$, $d'/h = 0.061$

$u/h = 0.507$, $u = 41.6\ cm$, $41.6 - 5 = 36.6\ cm$

$p = 0.00174$, $p' = 0.00058$

$\frac{M}{N} = \frac{11,185 \times 100}{20460} = 54.7$

$\frac{36.6}{e = 91.3\ cm}$, $e' = 18.1\ cm$, $e'/e = 0.198$

$d'/d = 0.065$, $k = 0.36$, $\frac{Ne}{bd^2 f_c} = 0.167$

$f_c = \frac{20460 \times 913}{100 \times 77^2 \times 0.167} = 18.8\ kg/cm^2$

$f_s = 15 \times 18.8 \times \frac{0.64}{0.36} = 501\ kg/cm^2$

$s = \frac{8735}{100 \times 7/8 \times 77} = 1.3\ kg/cm^2$

AB 点

$M_{AB} = -9065\ kgm$, $N = 15020\ kg$, $s = 10495 kg$, $h = 50 + \frac{100}{3} = 83\ cm$

$A_s = 16^{mm\phi}$ 15cm c.to c. $= 13.4\ cm^2$, $p_0 = 0.00162$, $d/h = 0.94$

$A_s' = 16^{mm\phi}$ 45cm c.to c $= 4.5\ cm^2$, $p_0' = 0.00054$, $d'/h = 0.06$

$u/h = 0.508$, $u = 42.2\ cm$, $42.2 - 5 = 37.2\ cm$

$p = 0.00172$, $p' = 0.00058$

$\frac{M}{N} = \frac{9065 \times 100}{15020} = 60.4$

$\frac{37.2}{e = 97.6\ cm}$, $e' = 23.2$, $e'/e = 0.238$

$d'/d = 0.064$, $k = 0.34$, $\frac{Ne}{bd^2 f_c} = 0.158$

$f_c = \frac{15020 \times 97.6}{100 \times 78^2 \times 0.158} = 15.3\ kg/cm^2$

$f_s = 15 \times 15.3 \times \frac{0.66}{0.34} = 446\ kg/cm^2$

$s = \frac{10495}{100 \times 7/8 \times 78} = 1.5\ kg/cm^2$

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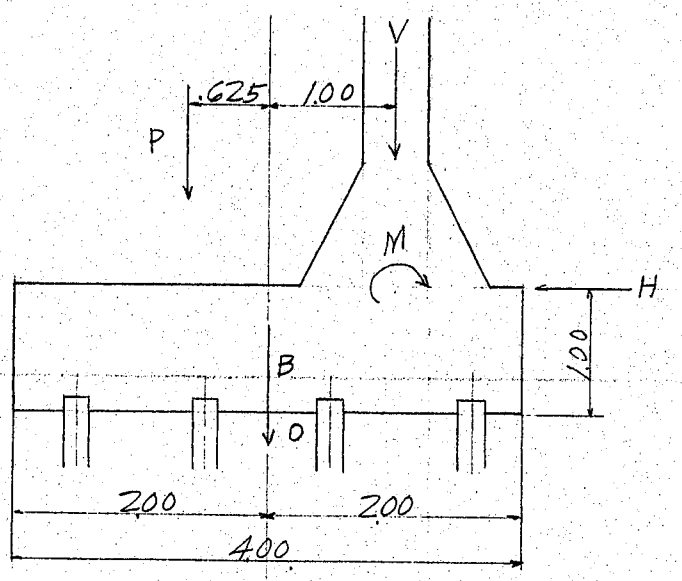
鐵筋混凝土暗渠基礎ノ設計



死荷重餘盛ナキ場合ノ土圧、活荷重及溫度應力ノ加

P = 1.00 × 2.75 × 7.24 × 1.600 = 31,850 kg
1.00 × 0.50 × 5.00 × 2.400 = 6,000
20,460
V = 26,460 kg
B = 1.00 × 4.00 × 1.00 × 2.400 = 9,600 kg
M = −5,465 kgm
H = 7,295 kg

O 点ニ於ケル能率

	V	H		M
P	31,850		× 0.625 =	19,900
V	26,460		× −1.000 =	−26,460
B	9,600		× 0 =	0
H		7,295	× 1.00 =	7,295
M			=	−5,465
	67,910 kg			−4,730 kgm

e = 4,730 ÷ 67,910 = 0.07 m

$$P = \frac{67,910}{4.00 \times 1.00} \times \left(1 \pm \frac{6 \times 0.07}{4.00}\right) = 18,760 \text{ kg/m}^2, \quad 15,200 \text{ kg/m}^2$$

死荷重餘盛アル場合ノ土圧及溫度應力ノ和

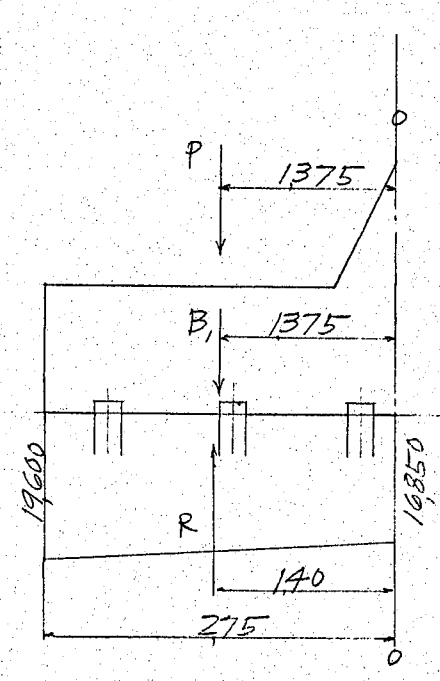
P = 1.00 × 2.75 × 9.05 × 1.600 = 39,800 kg
V = 6,000 + 15,020 = 21,020 kg
B = 9,600 kg
M = −9,065 kgm
H = 10,495 kg

O 点ニ於ケル能率

	V	H		M
P	39,800		× 0.625 =	24,880
V	21,020		× −1.000 =	−21,020
B	9,600		× 0 =	0
H		10,495	× 1.000 =	10,495
M			=	−9,065
	70,420 kg			5,290 kgm

e = 5,290 ÷ 70,420 = 0.075 m

$$P = \frac{70,420}{4.00 \times 1.00} \times \left(1 \pm \frac{6 \times 0.075}{4.00}\right) = 19,600 \text{ kg/m}^2, \quad 15,600 \text{ kg/m}^2$$



B_1 = 1.00 × 2.75 × 1.00 × 2.400 = 6,600 kg
R = (19,600 + 16,850) / 2 × 2.75 = 50,100 kg

O−O 点ニ於ケル能率

50,100	× 1.40	=	70,100
−39,800	× 1.375	=	−54,700
−6,600	× 1.375	=	−9,070

S = 3,700 kg　　M = 6,330 kgm

$$f_s = \frac{6330 \times 100}{6.03 \times 0.96 \times 106.7} = 1,025 \text{ kg/cm}^2$$

$$f_c = 1,025 \times \frac{012}{15 \times 0.88} = 7.2 \text{ kg/cm}^2$$

$$S = \frac{3700}{100 \times 0.96 \times 106.7} = 0.4 \text{ kg/cm}^2$$

h = 111.7 cm , d = 106.7 cm
A_s = 1C mmφ 333 c.t.o.c = 6.03 cm²
$P = \frac{6.03}{100 \times 106.7} = 0.000565$
j = 0.96　　k = 012

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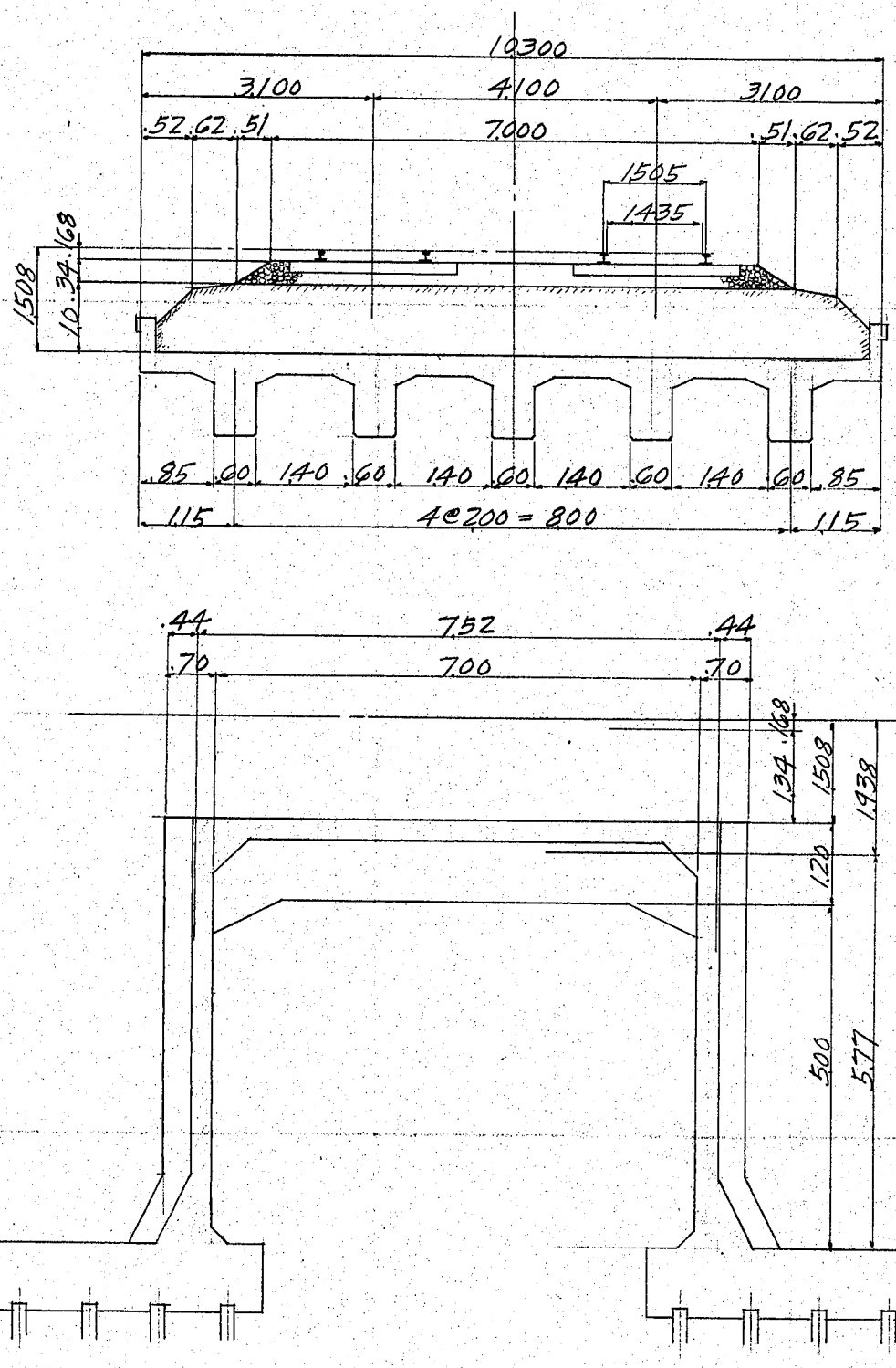
鐵筋混凝土暗渠

暗渠，設計
土被 1 米，支間 $l = 7.52\,m$, $h = 5.77\,m$, 巾 $= 10.30\,m$



床版，設計
死荷重

軌道	800 ÷ 515	= 155
道床	35 cm × 19 kg	= 665
床版	30 × 24	= 720
持送其他		60
土被	100 × 1,600	= 1,600
		3,200 kg/m²

死荷重彎曲率
$1/10 \times 3{,}200 \times 2.0^2 = 1{,}280\ kgm$
死荷重剪力
$1/2 \times 3{,}200 \times 2.0 = 3{,}200\ kg$

活荷重
電車輪荷重 1 軸 = 付 16,500 kg
縱，分布 $a = 1.00 + 2@1.35 = 3.70\ m$
橫，分布 $b = 2.42 + 2@1.35 = 5.12\ m$
分布荷重 $\dfrac{16{,}500}{3.70 \times 5.12} = 870\ kg/m^2$

活荷重彎曲率
$1/10 \times 870 \times 2.0^2 = 348\ kgm$
活荷重剪力
$1/2 \times 870 \times 2.0 = 870\ kg$

衝擊 $i = 0.481$
衝擊彎曲率 167 kgm
衝擊剪力 419 kg

總計

	彎曲率	剪力
死荷重	1,280	3,200
活荷重	348	870
衝擊	167	419
	1,795 kgm	4,489 kg

所要有効深 27 cm 被覆 3 cm 總厚 30 cm
使用鉄筋量 16 mmφ 20 cm c.to c $A_s = 10.05\ cm^2$
$p = 0.00372$, $j = 0.906$, $k = 0.283$

$$f_s = \frac{M}{A_s j d} = \frac{1{,}795 \times 100}{10.05 \times 0.906 \times 27} = 730\ kg/cm^2$$

$$f_c = \frac{2M}{jkbd^2} = \frac{2 \times 1{,}795 \times 100}{0.906 \times 0.283 \times 100 \times 27^2} = 19.2\ kg/cm^2$$

$$s = \frac{S}{bjd} = \frac{4{,}489}{100 \times 0.906 \times 27} = 1.8\ kg/cm^2$$

$$v = \frac{4{,}489}{5 \times 5.03 \times 0.906 \times 37} = 5.3\ kg/cm^2$$

跳出床版，設計
彎曲率 $1/2 \times 3{,}200 \times 1.15^2 = 2{,}117\ kgm$
剪力 $3{,}200 \times 1.15 = 3{,}680\ kg$
所要有効深 37 cm 被覆 3 cm 總厚 40 cm
使用鐵筋量 16 mmφ 20 cm c.to c $= 10.05\ cm^2$
$p = \dfrac{A_s}{bd} = \dfrac{10.05}{100 \times 37} = 0.00272$, $j = 0.916$, $k = 0.278$

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鐵筋混凝土暗渠

$$f_s = \frac{2117 \times 100}{10.05 \times 0.916 \times 37} = 621 \text{ kg/cm}^2$$

$$f_c = \frac{2 \times 2117 \times 100}{0.916 \times 0.278 \times 100 \times 37^2} = 12.1 \text{ kg/cm}^2$$

$$N = \frac{3680}{100 \times 0.916 \times 37} = 1.1 \text{ kg/cm}^2$$

側壁，設計

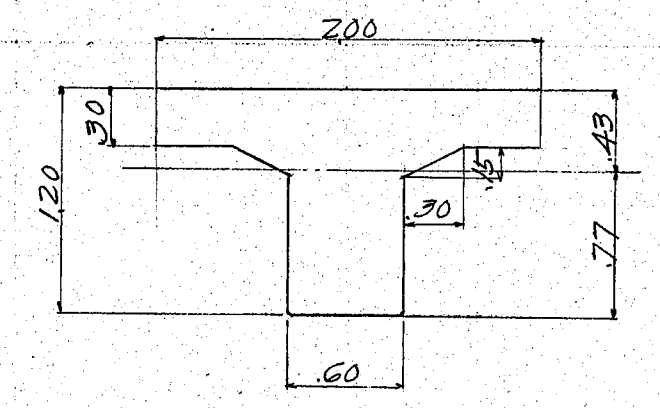
換算餘盛，高　1.81 m

$w = 1/3 \times 1,600 \times 8.85 = 4,720 \text{ kg/m}^2$
彎曲率　$1/10 \times 4720 \times 2.00^2 = 1,890 \text{ kgm}$
剪　力　$1/2 \times 4720 \times 2.00 = 4,720 \text{ kg}$
床版ト同一斷面ヲ用フレバ
$f_s = 769 \text{ kg/cm}^2$
$f_c = 20.2 \text{ kg/cm}^2$
$s = 1.9 \text{ kg/cm}^2$

ラーメンノ設計
死荷重

軌　道	800 ÷ 515 × 2.00	= 311
バラスト	35 × 19 × 2.00	= 1,330
床　版	30 × 24 × 2.00	= 1,440
桁	.60 × .90 × 2,400	= 1,295
持送り		= 74
土　被	1.00 × 1,600 × 2.00	= 3,200
		w = 7,650 kg/m

假定斷面
主　桁



中立軸，位置

2.00 × .30 = 0.60	× 0.15 =	0.090
0.90 × .60 = 0.54	× 0.75 =	0.405
0.15 × .30 = 0.045	× 0.35 =	0.016
1.185	0.431	0.511

物量力率

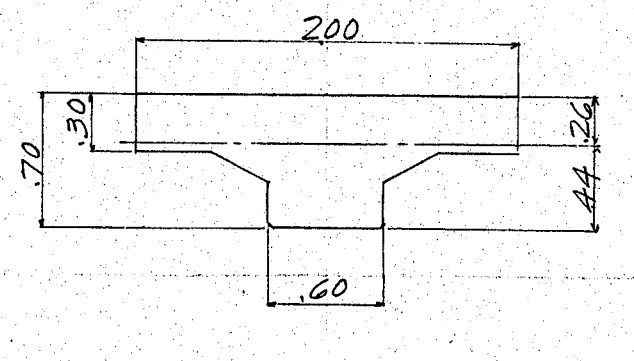
$$\frac{2.00 \times 0.30^3}{12} + 0.60 \times 0.28^2 = 0.0515$$

$$\frac{0.60 \times .90^3}{12} + 0.75 \times 0.32^2 = 0.1133$$

$$\frac{2 \times 0.3 \times 0.15^3}{36} + 0.045 \times 0.08^2 = 0.0003$$

$$I_2 = 0.1651 \text{ m}^4$$

側　壁



中立軸，位置

2.00 × .30 = 0.60	× 0.15 =	0.090
0.40 × .60 = 0.24	× 0.50 =	0.120
0.15 × .30 = 0.045	× 0.35 =	0.016
0.885	0.26	0.226

物量力率

$$\frac{2.00 \times 0.30^3}{12} + 0.60 \times 0.11^2 = 0.0118$$

$$\frac{0.60 \times 0.40^3}{12} + 0.24 \times 0.24^2 = 0.0170$$

$$\frac{2 \times 0.3 \times 0.15^3}{36} + 0.045 \times 0.09^2 = 0.0004$$

$$I_1 = 0.0292 \text{ m}^4$$

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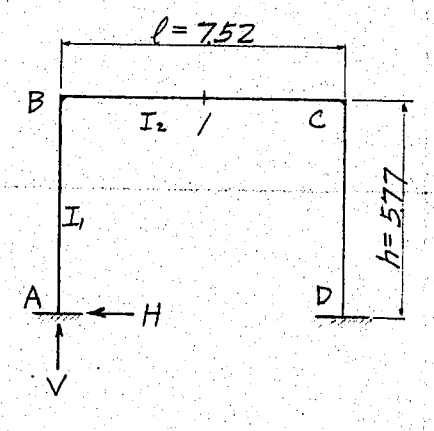
鐵筋混凝土暗渠

$$K_1 = \frac{I_1}{h} = \frac{0.0292}{5.77} = 0.00506$$

$$K_2 = \frac{I_2}{l} = \frac{0.1651}{7.52} = 0.02195 \qquad 2K_1 + K_2 = 0.03207$$

死荷重應力



$$C_{BC} = \frac{wl^2}{12} = \frac{7.650 \times 7.52^2}{12} = 36{,}050 \text{ kgm}$$

$$M_A = \frac{K_1 C_{BC}}{2K_1 + K_2} = \frac{0.00506 \times 36{,}050}{0.03207} = 5{,}690 \text{ kgm}$$

$$M_B = -2M_A = -11{,}380 \text{ kgm}$$

$$H_A = -\frac{M_A - M_B}{h} = -\frac{17{,}070}{5.77} = -2{,}960 \text{ kg} \rightarrow$$

$$V_A = \frac{wl}{2} = \frac{7.650 \times 7.52}{2} = 28{,}800 \text{ kg}$$

$$S_{AB} = S_{BA} = -2{,}960 \text{ kg}$$

$$S_{BC} = 28{,}800 \text{ kg}$$

$$\frac{wl^2}{8} = \frac{7.650 \times 7.52^2}{8} = 54{,}100$$

$$-11{,}380$$

$$M_1 = 42{,}720 \text{ kgm}$$

土圧ニヨル應力

安息角 = 30°

活荷重ニヨル餘盛ナキ場合

$$w_1 = \frac{1}{3} w h_1 = \frac{1}{3} \times 1{,}600 \times 1.77 = 942 \text{ kg/m}^2 \times 2.00 = 1{,}884 \text{ kg/m}^2$$

$$w_2 = \frac{1}{3} w h_2 = \frac{1}{3} \times 1{,}600 \times 7.54 = 4{,}020 \times 2.00 = 8{,}040 \text{ kg/m}^2$$

$$C_{AB} = \frac{(3w_2 + 2w_1)h^2}{60} = \frac{27{,}888 \times 5.77^2}{60} = 15{,}470 \text{ kgm}$$

$$C_{BA} = \frac{(2w_2 + 3w_1)h^2}{60} = \frac{21{,}732 \times 5.77^2}{60} = 12{,}070 \text{ kgm}$$

$$m_{AB} = \frac{h^2}{6}(w_2 + 2w_1) = \frac{5.77^2}{6} \times 11{,}808 = 65{,}500 \text{ kgm}$$

$$m_{BA} = \frac{h^2}{6}(2w_2 + w_1) = \frac{5.77^2}{6} \times 17{,}964 = 99{,}600 \text{ kgm}$$

$$M_A = -\left(C_{AB} + \frac{K_1 C_{BA}}{2K_1 + K_2}\right) = -\left(15{,}470 + \frac{0.00506 \times 12{,}070}{0.03207}\right) = -17{,}370 \text{ kgm}$$

$$M_B = -\frac{K_2 C_{BA}}{2K_1 + K_2} = -\frac{0.02195 \times 12{,}070}{0.03207} = -8{,}260 \text{ kgm}$$

$$M_C = -8{,}260 \text{ kgm}, \quad M_D = -17{,}370 \text{ kgm}$$

$$H_A = \frac{m_{BA} + M_B - M_A}{h} = \frac{99{,}600 - 8{,}260 + 17{,}370}{5.77} = 18{,}830 \text{ kg} \leftarrow$$

$$V = 0$$

$$S_{AB} = 18{,}830 \text{ kg}$$

$$S_{BA} = 18{,}830 - \frac{1{,}884 + 8{,}040}{2} \times 5.77 = -9{,}570 \text{ kg}$$

$$S_{BC} = 0$$

活荷重ニヨル餘盛ヲ考ヘタル場合

換算餘盛ノ高 = 1.81 m

$$w_1 = \frac{1}{3} \times 1{,}600 \times 3.58 \times 2.00 = 3{,}820 \text{ kg/m}^2$$

$$w_2 = \frac{1}{3} \times 1{,}600 \times 9.35 \times 2.00 = 9{,}970 \text{ kg/m}^2$$

$$C_{AB} = \frac{37{,}550 \times 5.77^2}{60} = 20{,}830 \text{ kgm}$$

$$C_{BA} = \frac{31{,}400 \times 5.77^2}{60} = 17{,}420 \text{ kgm}$$

$$m_{BA} = \frac{5.77^2}{6} \times 23{,}760 = 131{,}800 \text{ kgm}$$

$$M_A = -\left(20{,}830 + \frac{0.00506 \times 17{,}420}{0.03207}\right) = -23{,}580 \text{ kgm}$$

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鐵筋混凝土暗渠

$$M_B = -\frac{0.02195 \times 17{,}420}{0.03207} = -11{,}930\ kgm$$

$$H = \frac{131{,}800 - 11{,}930 + 23{,}580}{5.77} = 25{,}750\ kg \leftarrow$$

$V = 0$

$S_{AB} = 25{,}750\ kg$

$S_{BA} = 25{,}750 - \frac{3820 + 9{,}970}{2} \times 5.77 = -14{,}050\ kg$

$S_{BC} = 0$

活荷重應力

特殊活荷重　$P = 16{,}500\ kg$
縱ノ分布　$a = 5.68\ m$
橫ノ分布　$b = 9.20\ m$
$w = 1{,}260\ kg/m^2$

$M_A = 940\ kgm$
$M_B = -1{,}880\ kgm$
$H = -490\ kg \rightarrow$
$V = 4{,}740\ kg$
$S_{AB} = S_{BA} = -490\ kg$
$S_{BC} = 4{,}740\ kg$
$M_1 = 7{,}030\ kgm$

衝撃荷重應力

衝撃係数　$i = 0.435$

$M_A = 410\ kgm$　　$S_{AB} = S_{BA} = -210\ kg$
$M_B = -820\ kgm$　　$S_{BC} = 2{,}060\ kg$
$H = -210\ kg \rightarrow$　　$M_1 = 3{,}060\ kg$
$V = 2{,}060\ kg$

溫度應力　(上昇ノ場合)

$t = 15°C$, $\varepsilon = 0.00001$

$$R = \frac{\varepsilon t l}{2h} = \frac{0.00001 \times 15 \times 752}{2 \times 5.77} = 0.000098$$

$$M_A = \frac{6EK_1R(K_1+K_2)}{2K_1+K_2} = \frac{6 \times 1{,}400{,}000{,}000 \times 0.00506 \times 0.000098 \times 0.02701}{0.03207} = 3{,}510\ kgm$$

$$M_B = -\frac{6EK_1K_2R}{2K_1+K_2} = -2{,}850\ kgm$$

$$H = -\frac{M_A - M_B}{h} = -\frac{3510 + 2850}{5.77} = -1{,}100\ kg \rightarrow \quad V = 0$$

$S_{AB} = S_{BA} = -1{,}100\ kg$
$S_{BC} = 0$

應力ノ總計

死荷重，餘盛ナキ場合ノ土圧，活荷重及溫度應力ノ和

	M_A	M_B	M_1	H	V	S_{AB}	S_{BA}	S_{BC}
死荷重	5,690	-11,380	42,720	-2,960	28,800	-2,960	-2,960	28,800
土圧	-17,370	-8,260	-8,260	18,830	0	18,830	-9,570	0
活荷重	940	-1,880	7,030	-490	4,740	-490	-490	4,740
衝撃	410	-820	3,060	-210	2,060	-210	-210	2,060
溫度ノ變化	-3510	-2,850	2850	1,100	0	-1,100	∓1,100	0
	-13,840 kgm	-25,190 kgm	47,400 kgm	16,270 kg	35,600 kg	14,070 kg	-14,330 kg	35,600 kg
							-12,130 kg	

$N = 35{,}600\ kg$　$N_{BA} = 35{,}600\ kg$　$N = 12{,}130\ kg$
$N_{BC} = 14{,}330\ kg$

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鐵筋混凝土暗渠

死荷重，餘盛アル場合ノ土圧及温度應力ノ和

	M_A	M_B	H	V	S_{AB}	S_{BA}	S_{BC}
死荷重	5,690	-11,380	-2,960	28,800	-2,960	-2,960	28,800
土圧	-23,580	-11,930	25,750	0	25,750	-14,050	0
温度變化	-3,510	-2,850	1,100	0	1,100	-1,100	0
	-21,400kgm	-26,160kgm	23,890kg	28,800kg	23,890kg	-18,110kg	28,800kg.

$N = 28,800$kg　$N_{BA} = 28,800$kg

$N_{BC} = 18,110$kg

側壁ノ最大正彎曲率

$$w_1 x + \frac{w_2 - w_1}{2h} x^2 - 17,010 = 0$$

$$534 x^2 + 3820 x - 17010 = 0 \qquad x = 3.11\ m$$

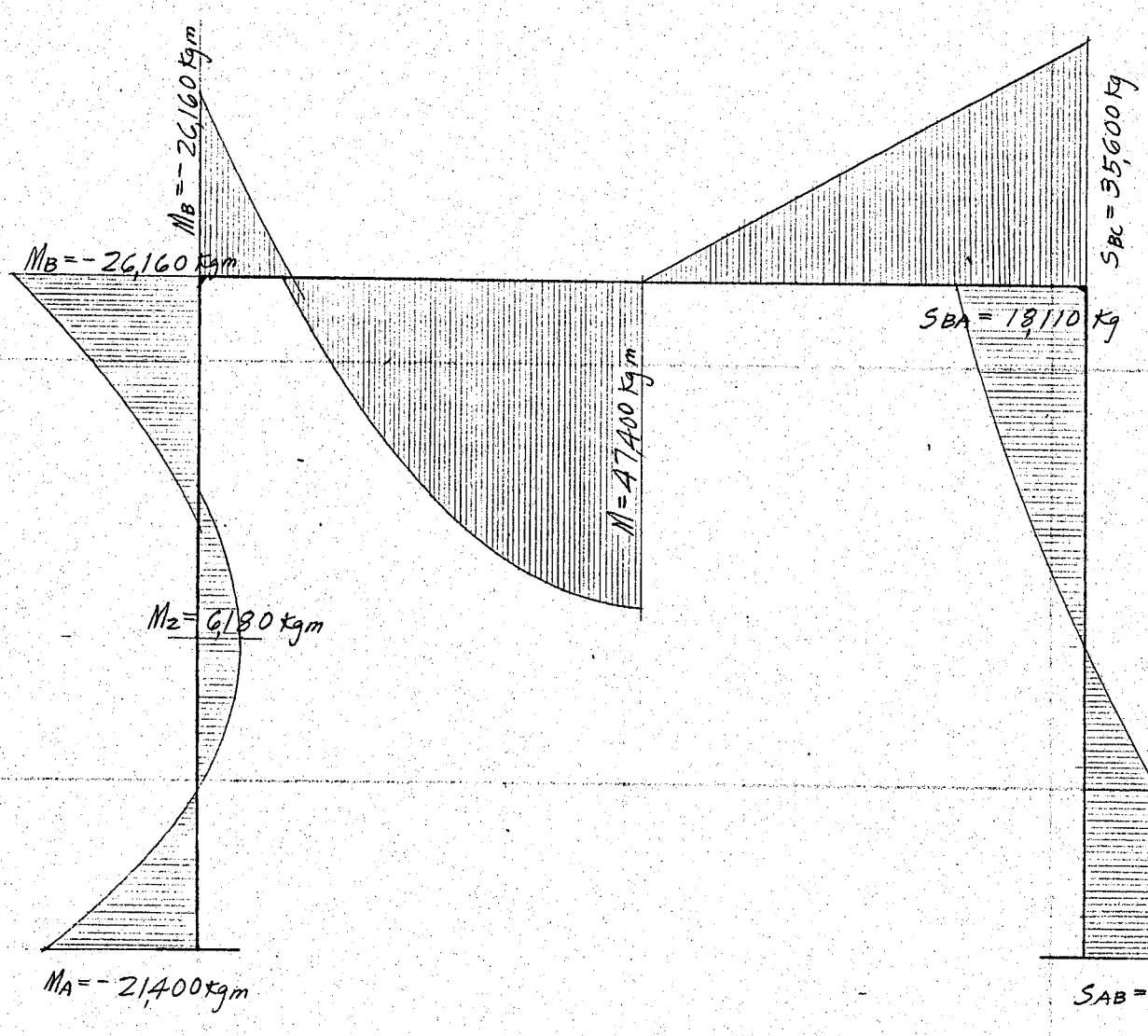
$$M = M_B - S_{BA} x - \frac{w_1 x^2}{2} - \frac{w_2 - w_1}{2h} \times \frac{x^3}{3}$$

$$= -23310 + 17,010 \times 3.11 - 1,910 \times 3.11^2 - 533 \times \frac{3.11^3}{3} = 5,220$$

960

$M_z = 6,180$kgm

$N = 28,800$kg



斷面，設計

1 呎

$M_1 = 47,400$ kgm ,　$N = 12,130$ kg

$A_s = 10 @ 22\phi = 10 @ 3.80 = 38.0\ cm^2$

$A_s' = 4 @ 22\phi = 4 @ 3.80 = 15.2\ cm^2$

$$p = \frac{A_s}{bd} = \frac{38.0}{200 \times 111} = 0.00171$$

$$p' = \frac{A_s}{bd} = \frac{15.2}{200 \times 111} = 0.00069 , \quad t/d = \frac{30}{111} = 0.27$$

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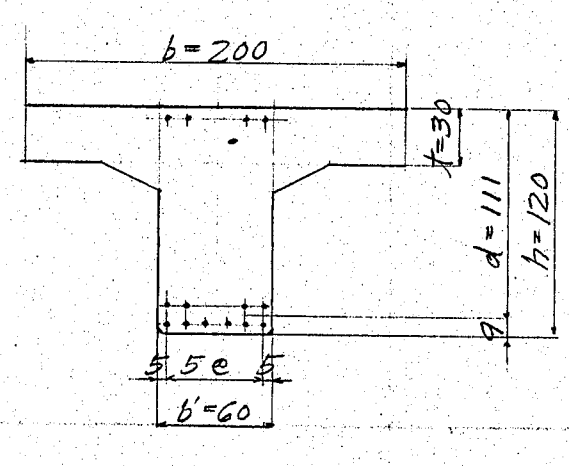
鐵筋混凝土暗渠



中立軸ハ突縁中ニアリ矩形桁トシテ設計ス

$d/h = \frac{111}{120} = 0.925$, $d'/h = \frac{5}{120} = 0.0417$

$P_0 = \frac{A_s}{bh} = \frac{38.0}{200\times120} = 0.00158$

$P_0' = \frac{A_s'}{bh} = \frac{15.2}{200\times120} = 0.00063$

$u/h = 0.506$, $u = 0.506\times120 = 60.7$ cm $60.7-5 = 55.7$ cm

$\frac{M}{N} = \frac{47400\times100}{12,130} = 391$

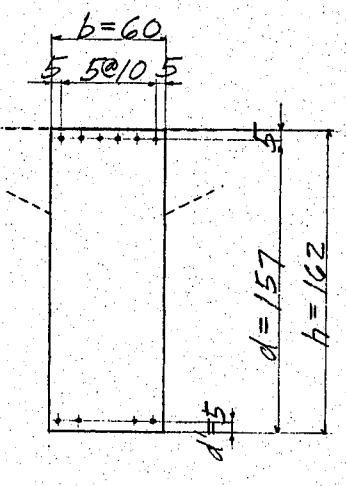
$e = 446.7$ cm , $e' = 335.3$ cm , $e'/e = 0.751$

$d'/d = 0.045$, $K = 0.225$, $\frac{Ne}{bd^2f_c} = 0.112$

$f_c = \frac{12,130\times446.7}{200\times111^2\times0.112} = 19.6$ kg/cm²

$f_s = 15\times19.6\times\frac{0.775}{0.225} = 1,013$ kg/cm²

Bc 断



$M = -26,160$ kgm , $N = 18,110$ kg , $h = 120 + \frac{126}{3} = 162$ cm

$A_s = 6 @ 19^{mm\phi} = 6 @ 2.835 = 17.0$ cm²

$A_s' = 4 @ 19^{mm\phi} = 4 @ 2.835 = 11.3$ cm²

$P_0 = \frac{A_s}{bh} = \frac{17.0}{60\times162} = 0.00175$, $d'/h = 0.0309$

$P_0' = \frac{A_s'}{bh} = \frac{11.3}{60\times162} = 0.00116$, $d/h = 0.969$

$u/h = 0.504$, $u = 81.6$ cm , $81.6-5 = 76.6$ cm

$\frac{M}{N} = \frac{26,160\times100}{18,110} = 144.5$, $p = 0.00181$, $p' = 0.0012$

$e = 221.1$ cm , $e' = 67.9$ cm , $e'/e = 0.307$

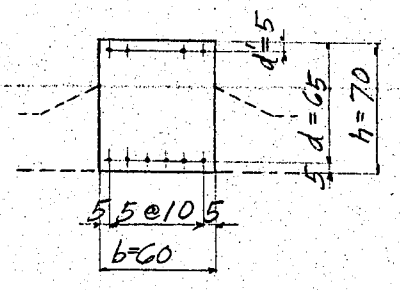
$d'/d = 0.0319$, $K = 0.31$, $\frac{Ne}{bd^2f_c} = 0.156$

$f_c = \frac{18,110\times221.1}{60\times157^2\times0.156} = 17.4$ kg/cm²

$f_s = 15\times17.4\times\frac{0.69}{0.31} = 581$ kg/cm²

$S = \frac{35,600}{60\times\frac{7}{8}\times157} = 4.3$ kg/cm²

2 断



$M = 6,180$ kgm , $N = 28,800$ kg

$A_s = 6 @ 19^{\phi} = 17.0$ cm²

$A_s' = 4 @ 19^{\phi} = 11.3$ cm²

$P_0 = \frac{17.0}{60\times70} = 0.00405$, $d/h = 0.929$, $d'/h = 0.0714$

$P_0' = \frac{11.3}{60\times70} = 0.00269$

$u/h = 0.508$, $u = 35.6$ cm , $35.6-5 = 30.6$ cm

$P = 0.00436$, $P' = 0.0029$

$\frac{M}{N} = \frac{6,180\times100}{28,800} = 21.5$

$e = 52.1$ cm , $e' = -9.1$ cm , $e'/e = 0.175$

$d'/d = 0.077$, $K = 0.78$, $\frac{Ne}{bd^2f_c} = 0.325$

$f_c = \frac{28,800\times52.1}{60\times65^2\times0.325} = 18.2$ kg/cm²

$f_s = 15\times18.2\times\frac{0.22}{0.78} = 77$ kg/cm²

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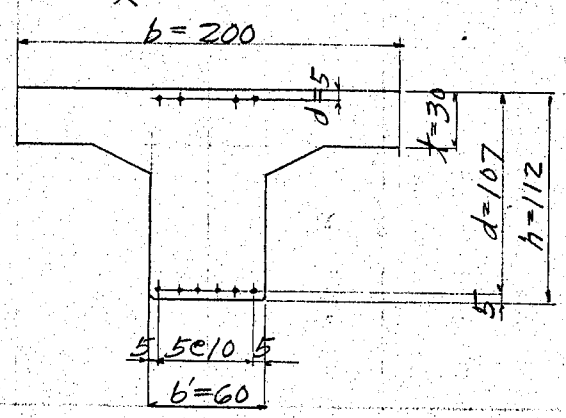
設計	日付	類別	
照査	日付	第	40頁

鐵筋混凝土暗渠

BA 点



$M_{BA} = -26{,}160\ kgm$, $N = 28{,}800\ kg$, $S = 18{,}110\ kg$

$h = 70 + 127/3 = 112\ cm$

$A_s = 6 @ 19^{mm\phi} = 17.0\ cm^2$

$A_s' = 4 @ 19^{mm\phi} = 11.3\ cm^2$

$p_0 = \frac{17.0}{200 \times 112} = 0.000759$, $t/d = 0.28$

$p_0' = \frac{11.3}{200 \times 112} = 0.000504$

$p = \frac{17.0}{200 \times 107} = 0.000794$

$p' = \frac{11.3}{200 \times 107} = 0.000528$

中立軸ハ突縁中ニアリ矩形桁トシテ設計ス

$d/h = 0.955$, $d'/h = 0.0447$

$u/h = 0.502$, $u = 56.2\ cm$, $56.2 - 5 = 51.2\ cm$

$\frac{M}{N} = \frac{26160 \times 100}{28800} = 90.8$

$\frac{51.2}{e = 142.0\ cm}$, $e' = 39.6\ cm$, $e'/e = 0.279$

$d'/d = 0.0467$, $k = 0.24$, $\frac{Ne}{bd^2 f_c} = 0.115$

$f_c = \frac{28800 \times 142.0}{200 \times 107^2 \times 0.115} = 15.5\ kg/cm^2$

$f_s = 15 \times 15.5 \times \frac{0.76}{0.24} = 736\ kg/cm^2$

$s = \frac{18110}{60 \times 7/8 \times 107} = 3.2\ kg/cm^2$

AB 点

$M_{AB} = -21{,}400\ kgm$, $N = 28{,}800\ kg$, $S = 23{,}890\ kg$, $h = 70 + 100/3 = 103\ cm$

$A_s = 6 @ 19^{mm\phi} = 17.0\ cm^2$

$A_s' = 4 @ 19^{mm\phi} = 11.3\ cm^2$

$p = \frac{17.0}{200 \times 98} = 0.000867$ $t/d = 0.306$

$p' = \frac{11.3}{200 \times 98} = 0.000577$

中立軸ハ突縁中ニアリ矩形桁トシテ設計ス

$d/h = 0.952$, $d'/h = 0.051$

$p_0 = 0.000825$, $p_0' = 0.000549$

$u/h = 0.504$, $u = 51.9\ cm$, $51.9 - 5 = 46.9\ cm$

$\frac{M}{N} = \frac{21400 \times 100}{28800} = 74.3$

$\frac{46.9}{e = 121.2\ cm}$, $e' = 27.4\ cm$, $e'/e = 0.226$

$d'/d = 0.051$, $k = 0.27$, $\frac{Ne}{bd^2 f_c} = 0.13$

$f_c = \frac{28800 \times 121.2}{200 \times 98^2 \times 0.13} = 14.0\ kg/cm^2$

$f_s = 15 \times 14.0 \times \frac{0.73}{0.27} = 568\ kg/cm^2$

$s = \frac{23890}{60 \times 7/8 \times 98} = 4.6\ kg/cm^2$

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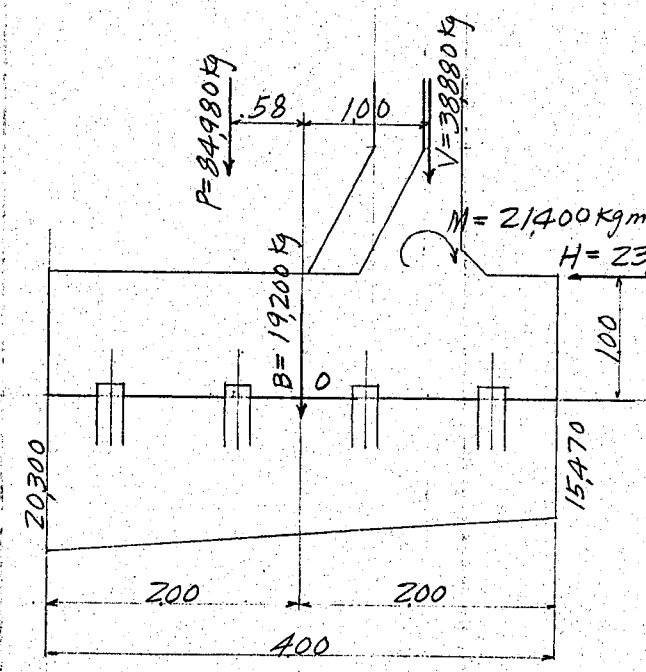
設計	日付	類別	
照査	日付	第	41頁

鐵筋混凝土暗渠基礎，設計



2.56 × 2.00 × 9.35 × 1,600 = 76,600 × 1.72 = 131,800
1.40 × 0.40 × 9.35 × 1,600 = 8,380 × 0.24 = 2,010
P = 84,980kg 1.58 133,810

B = 2.00 × 4.00 × 1.00 × 2,400 = 19,200 kg

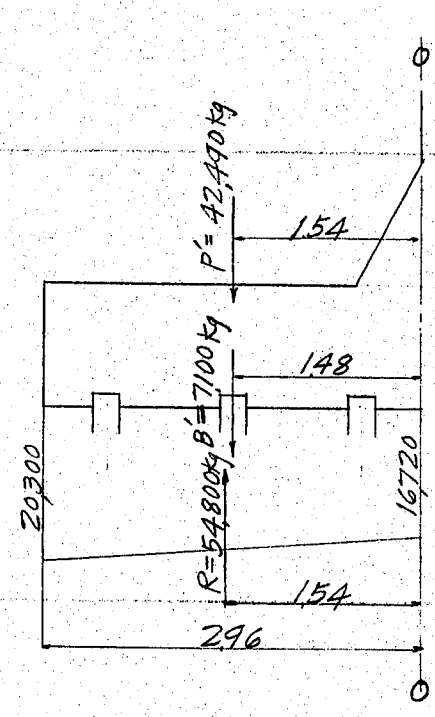
0.30 × 2.00 × 5.00 × 2,400 = 7,200
0.60 × 0.40 × 5.00 × 2,400 = 2,880
28,800
V = 38,880 kg

0点＝於ケル能率

	V	H		
P	84,980	× 0.58	=	49,250
V	38,880	× − 1.00	=	− 38,880
B	19,200			
		23,890 × 1.00	=	23,890
			=	− 21,400
	143,060 kg	0.09 m		12,860 kgm

$$P = \frac{143060}{4.00 \times 2.00} \times \left(1 \pm \frac{6 \times 0.09}{4.00}\right) = 20,300 \text{ kg/m}^2$$
$$= 15,470 \text{ kg/m}^2$$

P' = 1/2 × 84,980 = 42,490 kg
B = 2.96 × 1.00 × 1.00 × 2,400 = 7,100 kg
R = 1/2 (16,720 + 20,300) × 2.96 = 54,800 kg



0－0点＝於ケル能率

54,800	× 1.54	=	84,400
− 7,100	× 1.48	=	− 10,520
− 42,490	× 1.54	=	− 65,400
S = 5,210 kg			8,480 kgm

A_s = 16 mmφ 25 cm c. to c. = 8.04 cm²
$p = \frac{8.04}{100 \times 100} = 0.0008$, $j = 0.952$, $k = 0.145$, $d = 90 + \frac{50}{3} = 106.7$ cm

$$f_s = \frac{8480 \times 100}{8.04 \times 0.952 \times 106.7} = 1,040 \text{ kg/cm}^2$$

$$f_c = 1,040 \times \frac{0.145}{15 \times 0.855} = 11.8 \text{ kg/cm}^2$$

$$s = \frac{5210}{100 \times 0.952 \times 106.7} = 0.5 \text{ kg/cm}^2$$

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設計	日付	類別
照査	日付	第　頁

上海高速鐵道 扶壁附擁壁應力計算書

壁高 七.〇米 六.〇米 及び 五.〇米

RETAINING WALLS WITH BUTTRESS

MARK R.W.B

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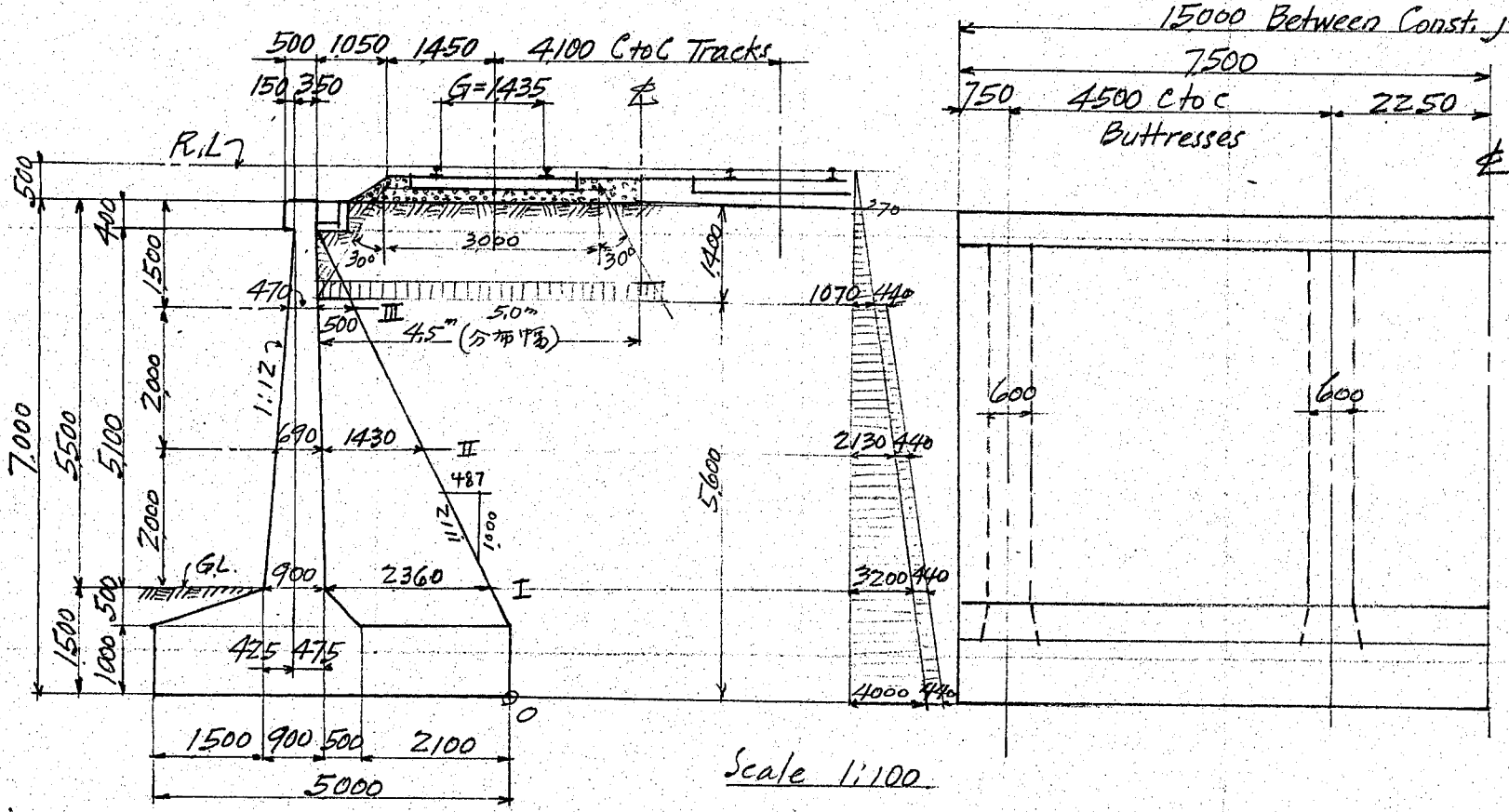
設計 稲葉 日付 16-8-18 類別 RWBT
照査 日付 第 1 頁

上海高速鐵道、扶壁式鐵筋混凝土擁壁

鐵筋混凝土 扶壁式擁壁高 7.0m RWBT



設計條件

電車荷重 60 噸電車　　軸荷重 15,000 kg

道床面上分布荷重　$\frac{15000 \times 2}{5.0 \times 3.0} = 2000$ kg/m²

土の安息角　$\phi = 30°$,　$C = \frac{1-\sin\phi}{1+\sin\phi} = \frac{1}{3}$,

土の摩擦角　$\theta = 20°$　　$\tan 20° = 0.364$

土圧

断面	土深	C	土圧	P	N	荷重=ωN 土圧	土圧計	
Ⅰ	6.0m	$\frac{1}{3}\times1600\times6.0$ =	3,200 kg/m²	$2000\times\frac{3.0}{4.5}$ =	$1333\times\frac{1}{3}$ =	440	3,640 kg/m²	(道床中心より壁背面マデノ巾ヲ 4.5m)
Ⅱ	4.0	〃 〃 ×4.0 =	2,130	〃	〃	440	2,570 〃	
Ⅲ	2.0	〃 〃 ×2.0 =	1,070	〃	〃	440	1,510 〃	

(Hool's Concrete Engineer's Handbook 581頁参照)

底面	7.5	〃 〃 ×7.50 =	4,000	〃	〃	440	4,440 〃	

前面壁

支間 4.50m, 連続版トス

断面		彎曲率		
Ⅰ	$M_1 = \pm\frac{wl}{10}$	$= \pm 3640\times\frac{4.50^2}{10} = \pm 7370$ kgm	$S_1 = \frac{wl}{2}$	$= 3640\times\frac{4.50}{2} = 8190$ kg
Ⅱ	M_2	$= \pm 2570\times$ 〃 $= \pm 5200$ 〃	S_2	$= 2570\times$ 〃 $= 5780$ 〃
Ⅲ	M_3	$= \pm 1510\times$ 〃 $= \pm 3060$ 〃	S_3	$= 1510\times$ 〃 $= 3400$ 〃

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設計 稲葉 日付 16-8-19 類別 RWB7
照査 日付 第 之頁

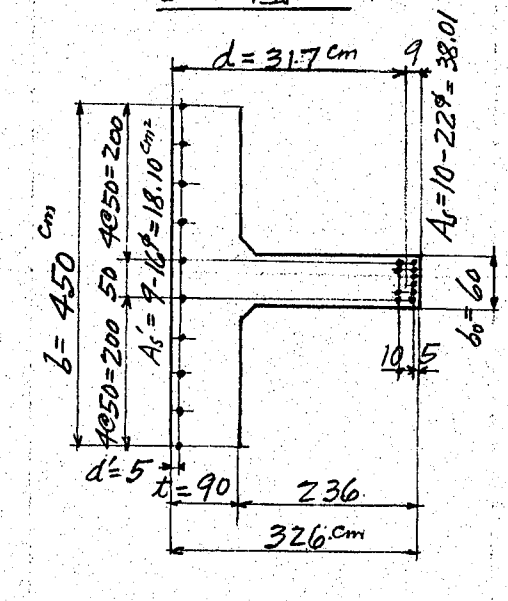
上海 扶壁式擁壁 高 7.0m

断面	所要有効厚	使用有効厚	所要鉄筋量	剪応力
I	$d_1=\sqrt{\frac{7370\times100}{100\times7.13}}=32.2^{cm}$	$d_1=85^{cm}$	$A_{s1}=\frac{7370\times100}{1200\times\frac{7}{8}\times85}=8.25^{cm^2}$	$\tau_1=\frac{8190}{100\times\frac{7}{8}\times85}=1.1^{kg/cm^2}$
II	$d_2=\sqrt{\frac{5200\times100}{100\times7.13}}=27.0$ "	$d_2=64$ "	$A_{s2}=\frac{5200\times100}{1200\times\frac{7}{8}\times64}=7.74$ "	$\tau_2=\frac{5780}{100\times\frac{7}{8}\times64}=1.0$ "
III	$d_3=\sqrt{\frac{3060\times100}{100\times7.13}}=20.7$ "	$d_3=42$ "	$A_{s3}=\frac{3060\times100}{1200\times\frac{7}{8}\times42}=6.94$ "	$\tau_3=\frac{3400}{100\times\frac{7}{8}\times42}=0.9$ "

使用鉄筋量 下部高 1.2m --- A_s = 16φ-20cm c to c = 10.06 cm^2
上部 4.3m --- A_s = 16φ-25cm c to c = 8.04 cm^2

扶壁

断面 I



土圧
壁頂 $\frac{1}{3}\times1600\times0.50=$ 270
断面 I 3200
3,470 ÷ 2 = 1,735 kg/m²

1,735×4.5×5.5 =	42900	× 1.98 =	85000
440×4.5×4.1 =	8120	× 2.05 =	16,600
E_1 =	51,020 kg	M_1 =	101,600 kgm
		S_1 =	51,020 kg

鉄筋 Slope Coef.
A_s = 10-22φ = 38.01 cm^2 ÷ 1.112 = 34.20 cm^2 (鋳鉄扶壁ハ此多シ 8-22φ=30.41 又ハ 10-19φ=28.35 トス)
A_s' = 9-16φ = 18.10 "

$p=\frac{A_s}{bd}=\frac{34.20}{450\times317}=0.00024$, $t/d=\frac{90}{317}=0.284$

$p'=\frac{A_s'}{bd}=\frac{18.01}{450\times317}=0.00013$, $d'/d=\frac{5}{317}=0.016$

$$k=\frac{np+\frac{1}{2}(\frac{t}{d})^2+np'(\frac{d'}{d})}{np+\frac{t}{d}+np'}=\frac{0.00360+0.0404+0.00003}{0.00360+0.2840+0.00195}=\frac{0.04403}{0.28955}=0.152$$

$k<\frac{t}{d}$ ナル故 中立軸ハ突縁内ニ在リ故ニ矩形断面ト仮定ス

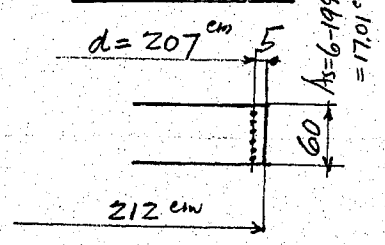
$k=0.135$, $j=1-\frac{d'}{d}+\frac{k^2}{2np(1-k)}(\frac{d'}{d}-\frac{k}{3})$
$=1-0.016+\frac{0.0182\times(-0.029)}{0.00720\times0.865}=0.899$ (.085)

$\sigma_s=\frac{101,600\times100}{34.20\times0.899\times317}=1045$ kg/cm²

$\sigma_c=\frac{1045\times0.135}{15\times0.865}=10.9$ "

$\tau=\frac{51020}{60\times0.899\times317}=3.0$ "

断面 II



土圧
壁頂 270
断面 II 2130
2400 ÷ 2 = 1200 kg/m²

1200×4.5×3.5 =	18900	× 1.30 =	24600
440×4.5×2.1 =	4050	× 1.05 =	4250
E_2 =	22950	M_2 =	28,850 kgm
		S_2 =	22950 kg

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設計 稲葉 日付 16-8-19 類別 RWB7
照査 日付 第 3 頁

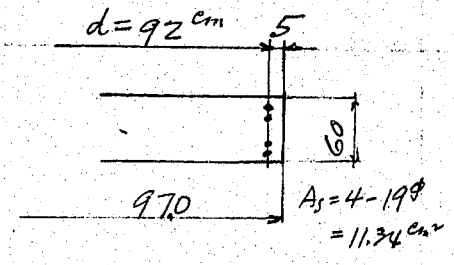
上海扶壁式擁壁 高 7.0m

所要鉄筋量 $A_s = \frac{28850 \times 100}{1200 \times 7/8 \times 207} \times 1.112$ (slope coef.) $= 14.75\ cm^2$

使用鉄筋量 $6-19\phi = 17.01\ cm^2$ (端部扶壁ニハ 4-19φヲ用フ)

剪応力 $\tau = \frac{22950}{60 \times 7/8 \times 207} = 2.1\ kg/cm^2$

断面 III



土圧 壁頂 270
断面III 1070
1340÷2 = 670 kg/m²

670×4.5×1.5 =	4520 × 0.60 =	2710
440×4.5×0.1 =	200 × 0.05 =	10
E_3 =	4720kg	M_3 =	2720 kgm
		S_3 =	4720 kg

所要鉄筋量 $A_s = \frac{2720 \times 100}{1200 \times 7/8 \times 92} \times 1.112 = 3.13\ cm^2$

使用鉄筋量 $4-19\phi = 11.34\ cm^2$ (端部扶壁ニハ4-19φ)

剪応力 $\tau = \frac{4720}{60 \times 7/8 \times 92} = 1.0\ kg/cm^2$

擁壁ノ安定度

擁壁ノ重量及重心

基礎コンクリート	0.50×0.40×4.50 =	0.90	× 2.975 =	2.68
前面壁	0.625×5.10×4.50 =	14.33	× 3.030 =	43.45
扶壁	1.90×0.50×4.50 =	4.28	× 3.300 =	14.11
基礎	1.30×0.60×5.60 =	4.37	× 1.780 =	7.78
	1.00×5.00×4.50 =	22.50	× 2.50 =	56.25
		46.38m³	2.683m	124.27

W_c = 46.38 @ 2400 = 111,200 kg

背土重量及重心

背土	2.65×6.00×4.50 =	71.50	× 1.330 =	95.20
〃 扶壁部控除		−4.37	× 1.780 =	− 7.78
		67.13m³	1.302m	87.42

	67.13 @ 1600 =	107400	× 1.302 =	139800
荷重分布	2.60×4.50×1333 =	15600	× 1.300 =	20300
	We =	123,000kg	1.302m	160,100

土圧

壁頂 267
壁底 4000
4267÷2 = 2133 kg/m²

土圧	2133×7.0×4.5 =	64000	× 2.476 =	158,500
荷重ニ対ス土圧	440×5.6×4.5 =	11100	× 2.80 =	31,100
	E_h =	75,100kg	2.525m	189,600

$E_v = E_h \tan 20° = 75100 \times 0.364 = 27,400\ kg.$

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設計 稲葉 日付 16-8-19 類別 RWB7
照査 日付 第 4 頁

上海扶壁式擁壁 高 7.0m

O点 (Heel) =関スル能率

	H	V	arm	M
Wc		111200	× 2.683 =	298500
We		123000	× 1.302 =	160100
Eh	75100		× 2.525 =	189600
Ev		27400	× 0 =	0
	ΣH = 75100 kg	ΣV = 261,600 kg	2.480 m	648200

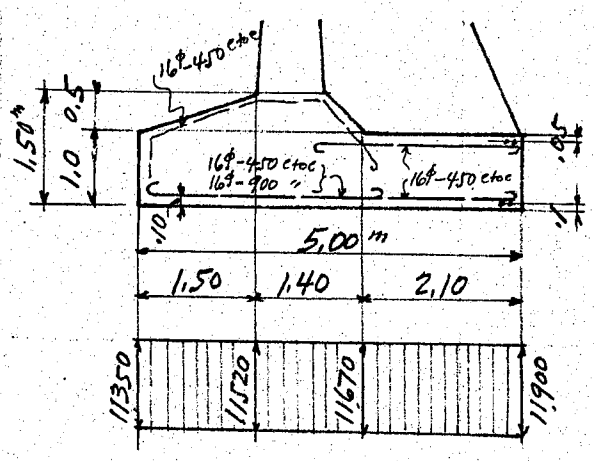
変位 $e = 2.480 - 2.500 = -0.020$ m (後方)

底面圧力 $p = \frac{261600}{4.5 \times 5.0}\left(1 \pm \frac{6 \times 0.020}{5.0}\right) = 11,900$ kg/m² at Heel.
2〃 11,350 〃 at Toe

滑動率 $\frac{\Sigma H}{\Sigma V} = \frac{75100}{261600} = 0.287$

基礎杭 松丸太末口18cmφ × 6.00m 間隔 90cm × 100cm c to c
杭一本当荷重 = 11900 × 0.9 × 1.0 = 10,700 kg

基礎



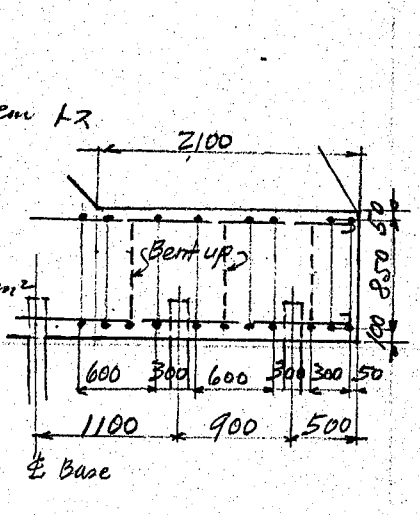
背部基礎

下向圧力 土 6.50m @1600 = 10400
〃 分布荷重 1330
〃 基礎 1.0 @2400 = 2400
〃 Ev $\frac{27400}{4.50 \times 2.60}$ = 2340

上向圧力 P −11670
4800 kg/m² (下向)

支間 4.5m, 連続版
$M = \pm \frac{1}{10} \times 4800 \times 4.50^2 = \pm 9730$ kgm
$S = \frac{1}{2} \times 4800 \times 4.5 = 10800$ kg

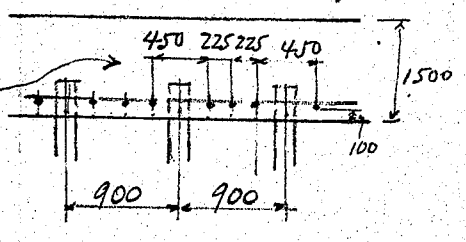
所要有効厚 $d = \sqrt{\frac{9730 \times 100}{100 \times 7.13}} = 37.0$ cm d = 90cm トス
所要鉄筋量 $A_s = \frac{9730 \times 100}{1200 \times 7/8 \times 90} = 10.28$ cm²
使用鉄筋量 A_s = 16φ − 18cm c to c average = 11.17 cm²
剪応力 $\tau = \frac{10800}{100 \times 7/8 \times 90} = 1.4$ kg/cm²



前部基礎

上向圧力 11440 × 1.50 = 17200 × 0.75 = 12,880
下向 〃 1.25 @2400 × 1.50 = −4500 × 0.75 = −3370
水平反力 $75100 \times \frac{1.5 \times 1.0}{4.5 \times 5.0}$ = −5000 × 0.75 = −3750
M = 5760 kgm, S = 12,700 kg

所要鉄筋量 $A_s = \frac{5760 \times 100}{1200 \times 7/8 \times 140} = 3.92$ cm²
使用 〃 A_s = 16φ − 30cm c to c average = 6.70 cm²
剪応力 $\tau = \frac{12700}{100 \times 7/8 \times 140} = 1.0$ kg/cm²



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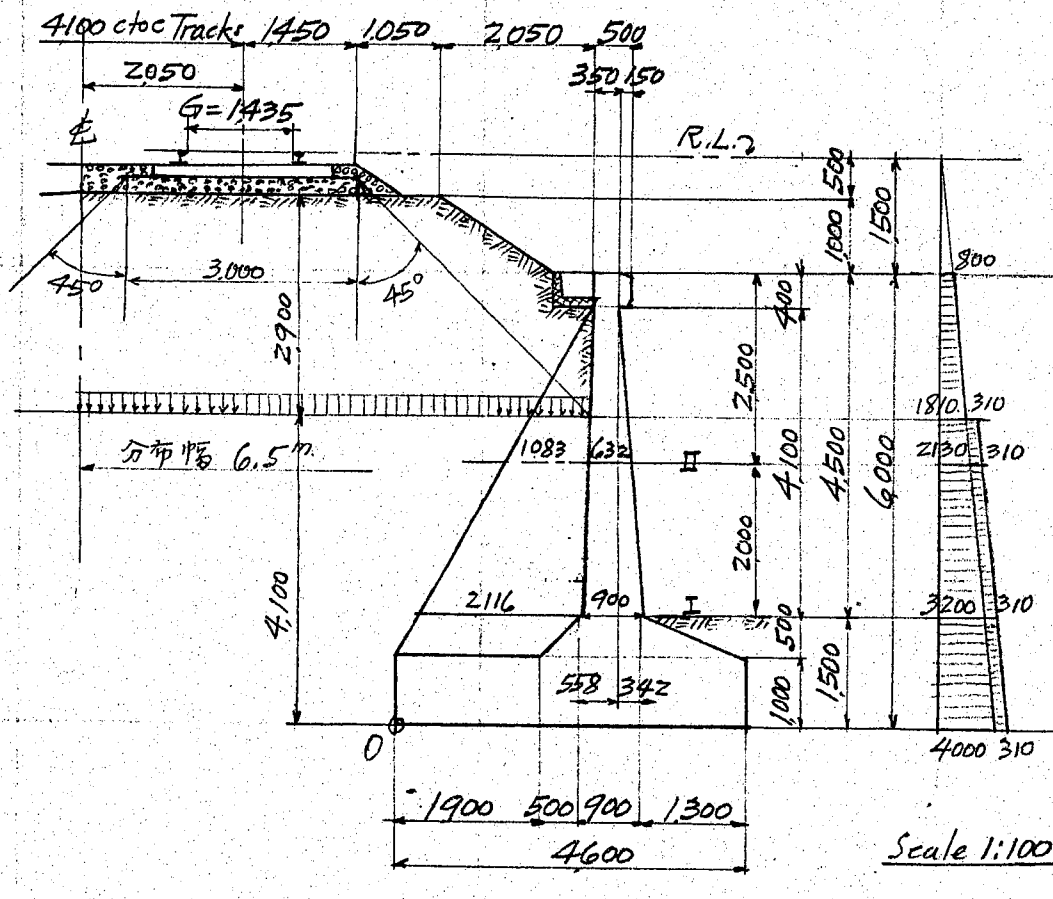
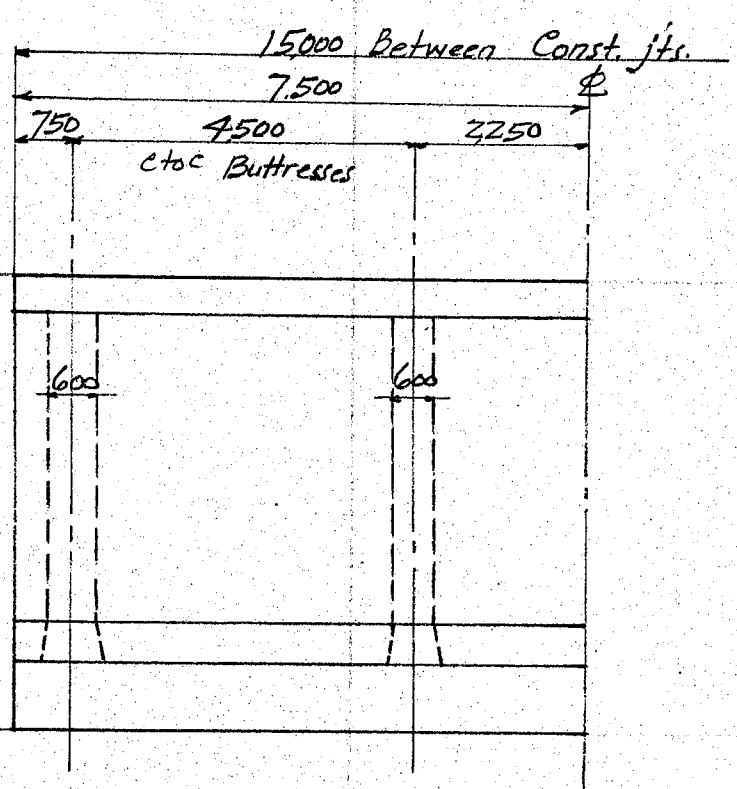
設計 稲葉 日付 16-8-20 類別 RWB6+1
照査 日付 第 5 頁

上海 扶壁式擁壁高 6.0m (土羽高1.0m附)

鐵筋混凝土 扶壁式擁壁高 6.0m 土羽高1.0m附 RWB6+1





Scale 1:100

土圧

断面	土深	C.	土圧	道床分布荷重	P	N	荷重ニヨル土圧	土圧計
壁頂	1.5m	$\frac{1}{3}\times 1600\times 1.5 =$	800 kg/m²				—	800 kg/m²
II	4.0	〃 〃	4.0 = 2130	$2000\times\frac{3.0}{6.5}=924\times\frac{1}{3}=$			310 kg/m²	2440
I	6.0	〃 〃	6.0 = 3200	〃	〃	〃	310	3510
底面	7.5	〃 〃	7.5 = 4000	〃	〃	〃	310	4310

前面壁　支間 4.5m ノ連續版トス.

断面　彎曲率

I　$M_1 = \pm 3510\times\frac{4.5^2}{10} = 7110$ kgm　　$S_1 = 3510\times\frac{4.5}{2} = 7900$ kg

II　$M_2 = \pm 2440\times$ 〃 $= 4940$ 〃　　$S_2 = 2440\times$ 〃 $= 5500$ 〃

断面	所要有効厚	使用有効厚	所要鉄筋量	剪応力
I	$d_1=\sqrt{\frac{7110\times 100}{100\times 7.13}} = 31.6$ cm	$d_1 = 85$ cm	$A_{S1}=\frac{7110\times 100}{1200\times\frac{7}{8}\times 85} = 7.97$ cm²	$\tau_1=\frac{7900}{100\times\frac{7}{8}\times 85} = 1.1$ kg/cm²
II	$d_2=\sqrt{\frac{4940\times 100}{100\times 7.13}} = 26.3$ 〃	$d_2 = 58$	$A_{S2}=\frac{4940\times 100}{1200\times\frac{7}{8}\times 58} = 8.10$ 〃	$\tau_2=\frac{5500}{100\times\frac{7}{8}\times 58} = 1.1$ 〃

使用鉄筋量

下部 1.2m　16φ − 20cm ctoc = 10.06 cm²
上部 3.3m　16φ − 25cm ctoc = 8.04 〃

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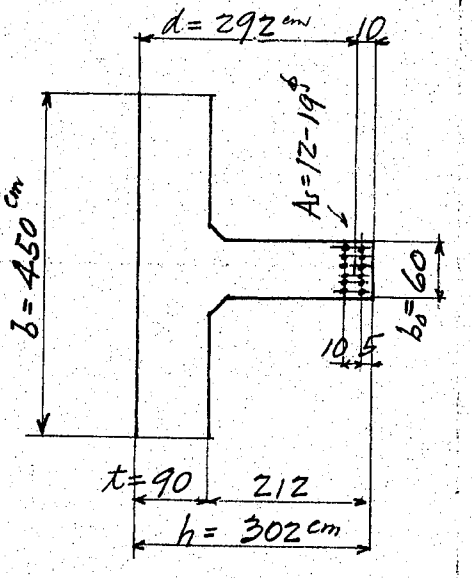
設計 稲葉 日付 16-8-20 類別 RWB 6+1
照査 日付 第 6 頁

上海扶壁式擁壁高 6.0m(土羽高1.0m附)

扶壁

断面 I



土圧 壁頂 800
断面 I 3200
4000÷2 = 2,000 kg/m² average.

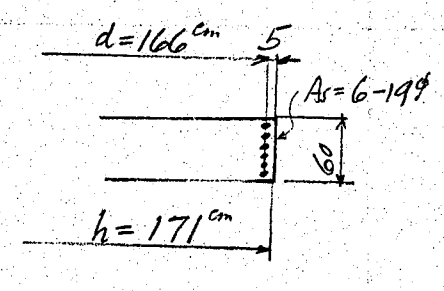
2000×4.5×4.5 = 40500 × 1.80 = 72900
310×4.5×2.6 = 3630 × 1.30 = 4720
E_1 = 44,130 kg M_1 = 77,620 kgm
S_1 = 44,130 kg

所要鐵筋量 $A_s = \frac{77,620}{1200\times 7/8\times 292} \times 1.112$ (Slope coef.) = 28.20 cm²

使用 〃 12-19φ = 34.02 cm² (端部扶壁ニハ此 2/3 即チ 8-19φ=22.68 又ハ 12-16φ=24.13 ト云)

剪応力 $\tau = \frac{44130}{60\times 7/8\times 293} = 2.9$ kg/cm²

断面 II



土圧 壁頂 800
断面 II 2130
2930÷2 = 1465 kg/m² 平均

1465×4.5×2.5 = 16500 × 1.062 = 17540
310×4.5×0.6 = 840 × 0.30 = 250
E_2 = 17340 kg M_2 = 17790 kgm
S_2 = 17340 kg

所要鉄筋量 $A_s = \frac{17790\times 100}{1200\times 7/8\times 166} \times 1.112$ (Slope coef.) = 11.35 cm²

使用 〃 6-19φ = 17.01 cm² (端部扶壁ニハ 4-19φ=11.34 又ハ 6-16φ=12.07 ト云)

剪応力 $\tau = \frac{17340}{60\times 7/8\times 166} = 2.0$ kg/cm²

擁壁ノ安定度

擁壁ノ重量及重心

笠コンクリート	0.50×0.40×4.5 =	0.90	× 2.858	=	2.57
前面壁	0.625×4.10×4.5 =	11.52	× 2.800	=	32.25
〃	1.80×0.50×4.5 =	4.05	× 3.100	=	12.55
扶壁	0.60×1.20×4.6 =	3.31	× 1.600	=	5.30
基礎	1.00×4.60×4.50 =	20.69	× 2.300	=	47.60
		40.47 m³	2.480 m		100.27

We = 40.47 @2400 = 97,000 kg

背土重量及重心

背土	2.50×5.60×4.5 @1600 =	100,700	× 1.20	=	120,800
〃	扶壁部控除 −3.31@1600 =	−5,300	× 1.600	=	−8,500
荷重分布	2.50×4.5 @924 =	10400	× 1.25	=	13000
	We =	105,800 kg	1.083 m		125,300

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照査 日付 第 7 頁

上海扶壁式擁壁 高6.0m (土羽高1.0m附)

土圧

壁頂 800
壁底 4000
4800÷2 = 2,400 kg/m² 平均

土圧
荷重=加土圧

2400 × 6.0 × 4.5 = 64800 × 2.34 = 151600
310 × 4.1 × 4.5 = 5700 × 2.05 = 11700
E_h = 70,500kg 2.32m 163300

E_V = 70500 × 0.364 = 25,600 kg

O点 (Heel) = 關する能率

	H	V			M_O
Wc		97000	×	2.48	= 240,500
We		10.5800	×	1.083	= 104800
E_h	70,500		×	2.32	= 163,500
E_V		25600	×	0	= 0
	ΣH = 70,500 kg	ΣV = 228,400 kg		2.23m	508,800

変偏 e = 2.23 − 2.30 = −0.07 m (後方)

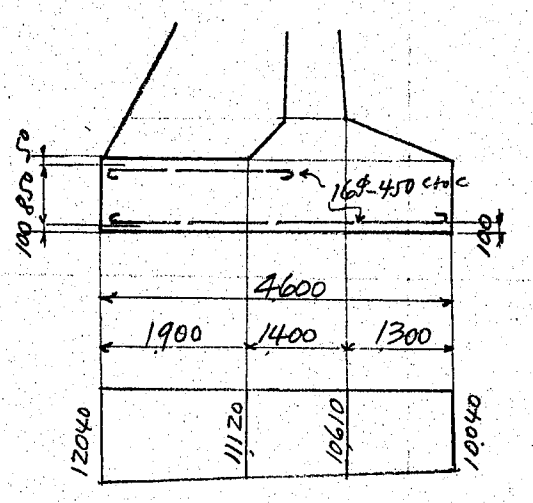
底面圧力 $p = \frac{228400}{4.5 \times 4.6}\left(1 \pm \frac{6 \times 0.07}{4.6}\right)$ = 12,040 kg/m² at Heel
〃 10,040 〃 at Toe

滑動率 $\frac{\Sigma H}{\Sigma V} = \frac{70500}{228400} = 0.309$

基礎杭
松丸太 末口 18cmφ × 5.5m, 間隔 90cm × 90cm etc.
杭一本当荷重 = 12040 × 0.81 = 9750 kg

基礎

背部基礎



下向圧力 土 6.0 @1600 = 9600
〃 分布荷重 920
〃 基礎 1.0 @2400 = 2,400
〃 E_V 25600 / 4.5×2.4 = 2370

上向圧力 −11,120
4,170 kg/m² (下向)

RW7 擁壁下同一 鉄筋使用
(第4頁参照)

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設計 稲葉 日付 16-8-20 類別 RWB 6+1
照査 日付 第 8 頁

上海 扶壁式擁壁 高6.0m(土羽高1.0m附)

前部基礎

上向圧力　10330×1.30 = 13450×0.65 = 8750
下向 〃　1.25@2400×1.30 = −3900×0.65 = −2540
水平支力　70500×$\frac{1\times1.3}{4.5\times4.6}$ = −4430×0.75 = −3320
M = 2890 kgm
S = 9550 kg

所要鉄筋量 $A_s = \frac{2890\times100}{1200\times\frac{7}{8}\times140} = 1.97\ cm^2$
使用 〃　16φ−45cm c to c = 4.47 cm^2
剪応力　$\tau = \frac{9550}{100\times\frac{7}{8}\times140} = 0.8\ kg/cm^2$

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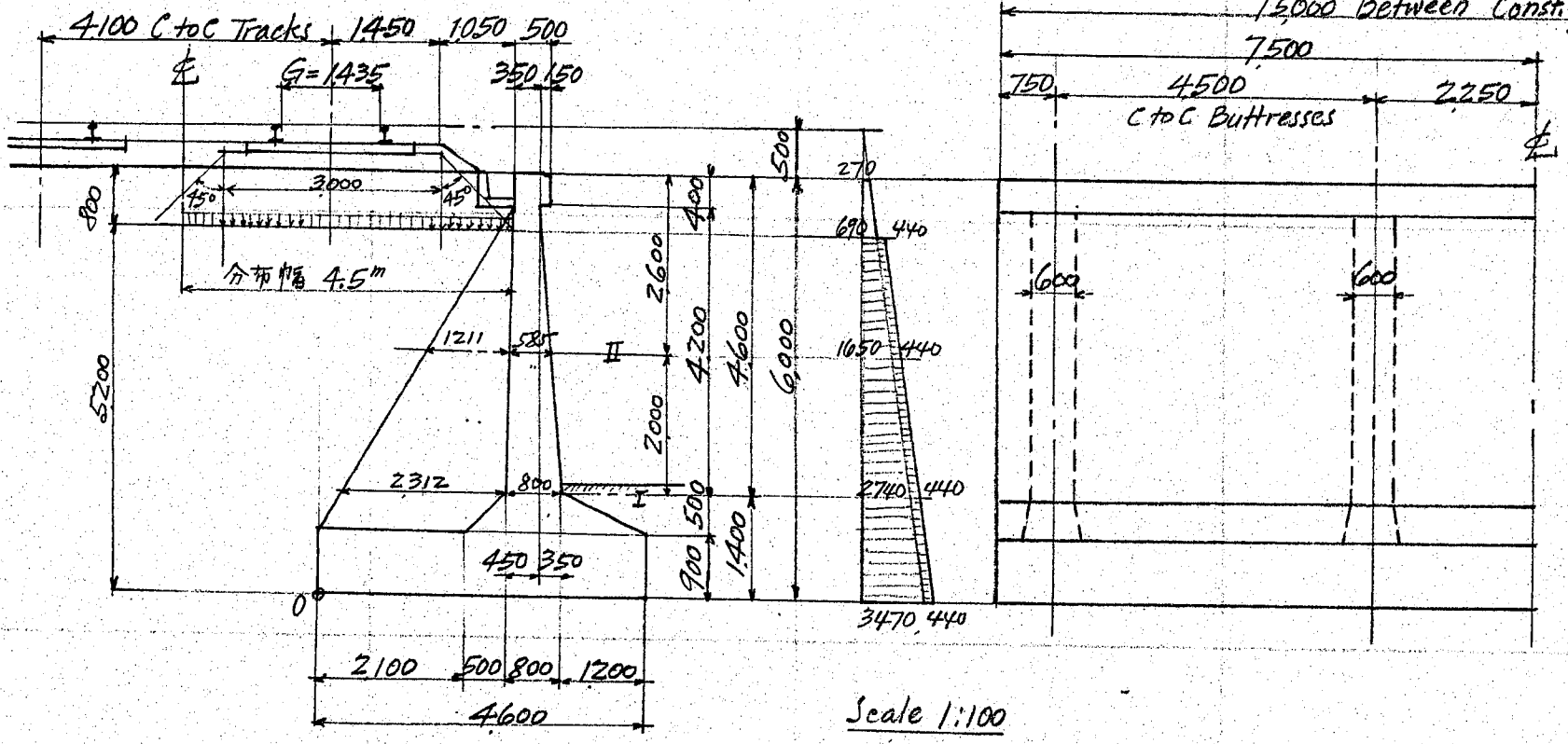
設計 稲葉 日付 16-8-20 類別 RWB6
照査 日付 第 9 頁

上海扶壁式擁壁高6.0m

鐵筋混凝土扶壁式擁壁高6.0m RWB6



Scale 1:100

土圧

断面	土深	C	土圧	道床分布荷重	P	N	荷重ニヨル土圧	土圧計
壁頂	0.5m	$\frac{1}{3}\times1600\times0.50=$	270 kg/m²					270 kg/m²
II	3.1	〃 〃	3.10 = 1650	2,000 × $\frac{3.0}{4.5}$ = 1330 × $\frac{1}{3}$			= 440 kg/m²	2090 〃
I	5.1	〃 〃	5.10 = 2740	〃	〃	〃	= 440	3180 〃
底面	6.5	〃 〃	6.50 = 3470	〃	〃	〃	= 440	3910 〃

前面壁

支間 4.5m, 連續版ト又

断面	彎曲率	剪力
I	$M_1 = 3180\times\frac{4.5^2}{10} =$ 6,440 kgm	$S_1 = 3180\times\frac{4.5}{2} =$ 7,160 kg
II	$M_2 = 2090\times$ 〃 = 4,240	$S_2 = 2090\times$ 〃 = 4,700

断面	所要有効厚	使用有効厚	所要鉄筋量	剪応力
I	$d_1=\sqrt{\frac{6440\times100}{100\times7.13}} =$ 30.0 cm	d_1 = 75 cm	$A_{s1}=\frac{6440\times100}{1200\times\frac{7}{8}\times75} =$ 8.18 cm²	$\tau_1=\frac{7160}{100\times\frac{7}{8}\times75} =$ 1.1 kg/cm²
II	$d_2=\sqrt{\frac{4240\times100}{100\times7.13}} =$ 24.4 〃	d_2 = 53 〃	$A_{s2}=\frac{4240\times100}{1200\times\frac{7}{8}\times53} =$ 7.63 〃	$\tau_2=\frac{4700}{100\times\frac{7}{8}\times53} =$ 1.0 〃

使用鉄筋

下部 1.2m　16φ − 20cm c to c = 10.06 cm²
上部 3.4m　16φ − 25cm c to c = 8.04 cm²

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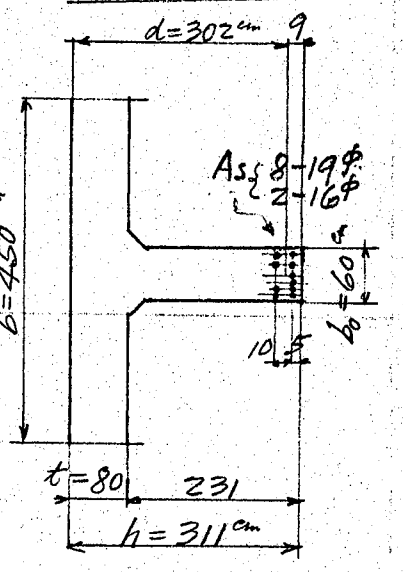
設計 稲葉 日付 16-8-20 類別 RWB 6
照査 日付 第 10 頁

上海 扶壁式擁壁 高 6.0m

扶壁

断面 I



土圧 壁頂 270
断面 I 2740
3010 ÷2 = 1505 kg/m² 平均

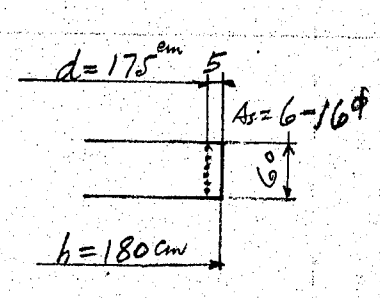
1,505×4.5×4.6 = 31,200 × 1.670 = 52100
440×4.5×3.80 = 7530 × 1.90 = 14300
E_1 = 38730 kg M_1 = 66,400 kgm
S_1 = 38730 kg

所要鉄筋量 $A_s = \frac{66400\times100}{1200\times7/8\times302} \times 1.112$ (Slope coef.) = 23.3 cm²

使用 〃 8-19φ = 22.68, 2-16φ = 4.02 } = 26.70 cm² (端部扶壁ハ此ノ為ニ 4-19φ = 11.34, 4-16φ = 8.04, 17.34 cm² トス)

勞應力 $t = \frac{38730}{60\times7/8\times302}$ = 2.4 kg/cm²

断面 II



土圧 壁頂 270
断面 II 1650
1920 ÷2 = 960 kg/m² 平均

960×4.5×2.60 = 11240 kg × 0.91 = 10,230
440×4.5×1.80 = 3560 × 0.90 = 3210
E_2 = 14800 kg M_2 = 13,440 kgm
S_2 = 14,800 kg

所要鉄筋量 $A_s = \frac{13440\times100}{1200\times7/8\times175} \times 1.112$ = 8.13 cm²

使用 〃 6-16φ = 12.07 cm² (端部扶壁ハ 4-16φトス)

勞應力 $t = \frac{14800}{60\times7/8\times175}$ = 1.6 kg/cm²

擁壁ノ安慶度

擁壁ノ重量及重心

竪混凝土				
前面壁	0.50×0.40×4.50 =	0.90 × 2.95 =		2.65
〃	0.575×4.20×4.50 =	10.85 × 3.00 =		32.55
扶壁	1.650×0.50×4.50 =	3.71 × 3.25 =		12.06
基礎	0.60×1.30×4.70 =	3.67 × 1.74 =		6.38
	0.90×4.60×4.50 =	18.63 × 2.30 =		42.85
		37.76 m³ 2.555		96.49

Wc = 37.76 @ 2400 = 90,600 kg

背土重量及重心

背土	2.60(平均)×5.40×4.50 @1600 =	101,000 ×	1.30 =	131,300
〃 扶壁部控除	−3.67 @1600 =	−5900 ×	1.74 =	−10,200
分布荷重	2.6×4.5 @1330 =	15600 ×	1.30 =	20300
	We =	110,700 kg	1.278 m	141,400

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設計 稲葉 日付 16-8-21 類別 RWB6
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上海扶壁式擁壁高 6.0m

土圧

壁頂 270
壁底 3470
3740÷2 = 1870 kg/m² 平均

土圧	1870 × 6.0 × 4.50	=	50500	× 2.13	=	107500
荷重=ヨル土圧	440 × 5.2 × 4.50	=	10300	× 2.60	=	26800
	E_h =		60800 kg	2.21 m		134300

E_V = 52800 × 0.364 = 19200 kg

0点 (Heel) = 関スル能率

We		90,600	× 2.555	=	231300	
We		110,700	× 1.278	=	141400	
E_h	60800		× 2.21	=	134300	
E_V		19200	× 0	=	0	
	ΣH=60800 kg	ΣV=220500 kg	2.300 m		507000	

変偶 e = 0

底面圧力 $p = \frac{220500}{4.5 \times 4.6}$ = 10650 kg/m² (at Toe and Heel)

滑動率 $\Sigma H/\Sigma V$ = 60800/220500 = 0.276

基礎杭
松丸太 末n 18cm × 5.5m 間隔 90cm × 90cm c to c
杭一本当荷重 = 10650 × 0.81 = 8630 kg

基礎

背部基礎

下向圧力	土	5.60 @ 1600	=	8970
〃	分布荷重			1330
〃	基礎	0.90 @ 2400	=	2160
〃	E_V	$\frac{19200}{4.5 \times 2.6}$	=	1640

上向圧力 −10650
3450 kg/m² (下向)

$M = \pm \frac{1}{10} \times 3450 \times 4.5^2$ = 6990 kgm

$A_s = \frac{6990 \times 100}{1200 \times 7/8 \times 80}$ = 8.32 cm²

16φ − 18cm c to c average (第4頁参照 RWB7 = 合計)

前部基礎

上向圧力	10650 × 1.20	=	12800 × 0.60	= 7680
下向 〃	1.15 × 1.20 @ 2450	=	−3300 × 0.60	= −1980
水平支力	$60800 \times \frac{1.2 \times 1.0}{4.5 \times 4.6}$	=	3500 × −0.70	= −2450

M = 3250 kgm S = 9500 kg

$A_s = \frac{3250 \times 100}{1200 \times 7/8 \times 130}$ = 2.38 cm²

16φ − 45cm c to c = 4.48 cm².

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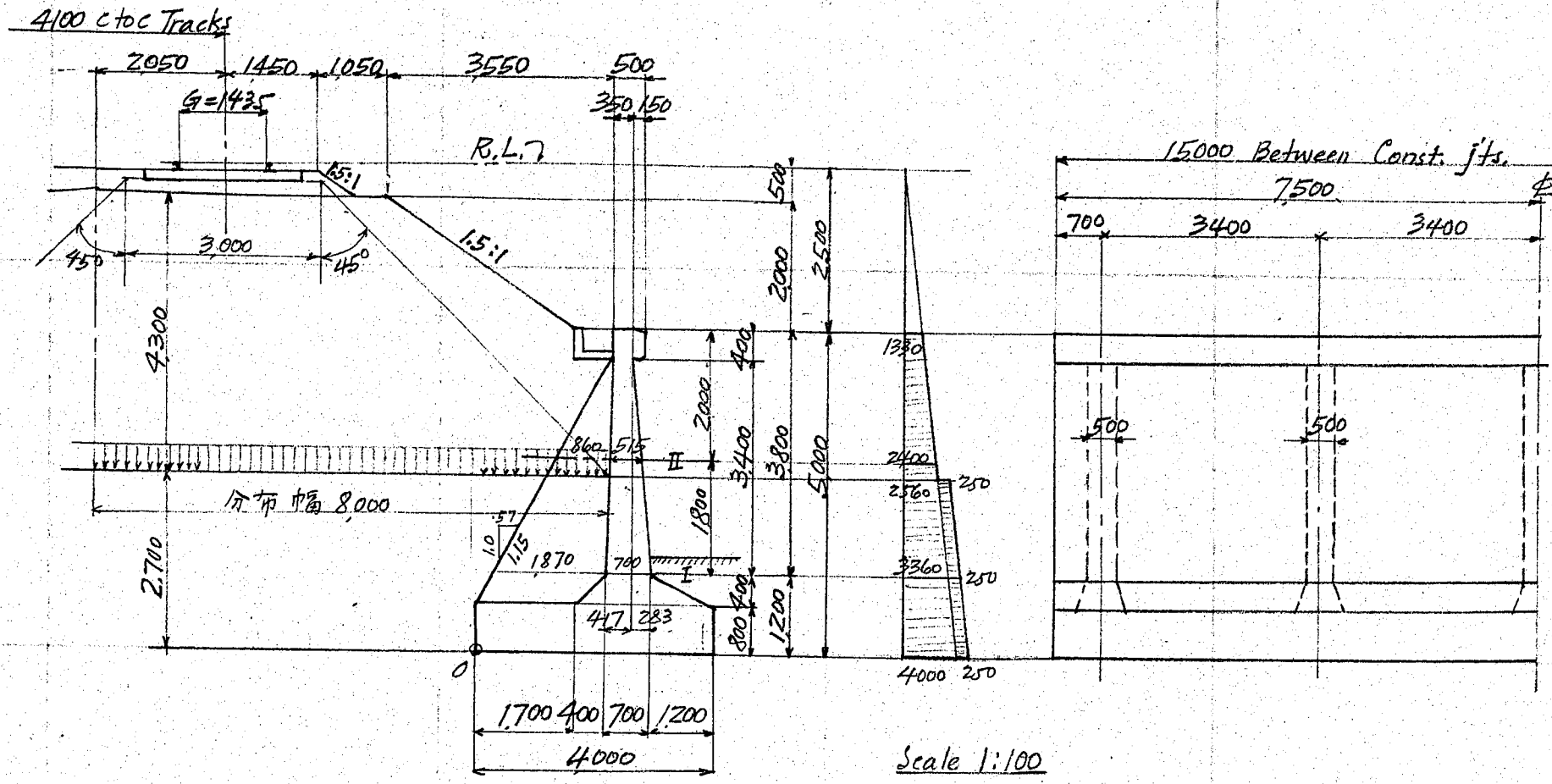
設計 稲葉 日付 16-8-21 類別 RWB5+2
照査 日付 第 12 頁

上海 扶壁式擁壁 高5.0m (土羽高2m附)

鉄筋混凝土 扶壁式擁壁 高5.0m RWB5+2



Scale 1:100

土圧

断面	土深		土圧
壁頂	2.5m	$\frac{1}{3}\times1600\times2.5=$	1330 kg/m²
II	4.5	〃 〃 4.5 =	2400
I	6.3	〃 〃 6.3 =	3360
底面	7.5	〃 〃 7.5 =	4000

道床分布 荷重ニヨル

指置	P	N	土圧	土圧計
			——	1330 kg/m²
			——	2400 〃
			$2000\times\frac{3.0}{8.0}=750\times\frac{1}{3}=$ 250 kg/m²	3610 〃
			〃 〃 250 〃	4250 〃

前面壁　支間 4.5m ノ連続版トス

断面　　彎曲率

I　$M_1=\pm 3610\times\frac{3.4^2}{10}=4170$ kgm　　$S_1=3610\times\frac{3.4}{2}=6140$ kg

II　$M_2=\pm 2400\times\ 〃\ =2780$ 〃　　$S_2=2400\times\ 〃\ =4080$ 〃

断面	所要有効巾	使用有効巾	所要鉄筋巾	
I	$d_1=\sqrt{\frac{4170\times100}{100\times7.13}}=24.2$ cm	$d_1=65$ cm	$A_{s1}=\frac{4170\times100}{1200\times\frac{7}{8}\times65}=6.11$ cm²	16φ-30cm c to c = 6.70 cm²
II	$d_2=\sqrt{\frac{2780\times100}{100\times7.13}}=19.7$ cm	$d_2=46$ cm	$A_{s2}=\frac{2780\times100}{1200\times\frac{7}{8}\times46}=5.76$ 〃	〃 〃

剪応力

断面		
I	$S_1=6140$	$\tau_1=\frac{6140}{100\times\frac{7}{8}\times65}=1.1$ kg/cm²
II	$S_2=4080$	$\tau_2=\frac{4080}{100\times\frac{7}{8}\times46}=1.0$ 〃

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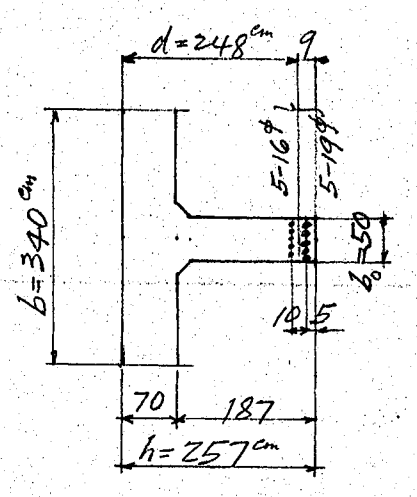
設計 稲葉 日付 16-8-21 類別 R.WB 5+2
照査 日付 第 13 頁

上海扶壁式擁壁高 5.0m (土被高 2.0m 附)

扶壁

断面 I



土圧 壁頂 1330
断面 I 3360
4690÷2 = 2,345 kg/m² 平均

2,345×3.4×3.8 = 30250 × 1.625 = 49200
250×3.4×1.5 = 1280 × 0.75 = 960
31530 kg M_1 = 50160 kgm
S_1 = 31530 kg

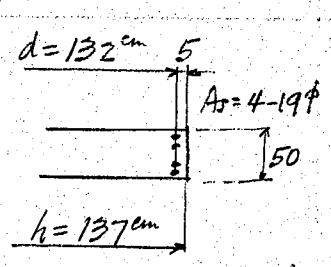
所要鉄筋量 $A_{s1} = \frac{50160\times100}{1200\times\frac{7}{8}\times248} \times 1.15$ (Slope coef.) = 22.12 cm²

使用鉄筋量 5-19φ = 14.18 外層
5-16φ = 10.05 内層
24.23 cm²

(両縁部扶壁ニハ 4-19φ = 11.34, 4-16φ = 8.04 } 19.38 cm² トス)

筋応力 $\tau_1 = \frac{31530}{50\times\frac{7}{8}\times248}$ = 2.9 kg/cm²

断面 II



土圧 壁頂 1330
断面 II 2400
3730÷2 = 1865 kg/m² 平均

1865×3.4×2.00 = 12,670 kg
M_2 = 12670×0.905 = 11,470 kgm
S_2 = 12,670 kg

所要鉄筋量 $A_{s2} = \frac{11470\times100}{1200\times\frac{7}{8}\times132} \times 1.15$ = 9.51 cm²

使用 〃 4-19φ = 11.34 cm²

(両端部扶壁モ 4-19φ トス)

筋応力 $\tau_2 = \frac{12670}{50\times\frac{7}{8}\times132}$ = 2.2 kg/cm²

擁壁ノ安定度

擁壁ノ重量及重心

堅 混凝土				
前面壁	0.50×0.40×3.40 =	0.68 × 2.417 =		1.65
〃	0.525×3.40×3.40 =	6.07 × 2.42 =		14.68
扶壁	1.50×0.40×3.40 =	2.04 × 2.65 =		5.40
〃	0.50×1.05×3.80 =	2.00 × 1.42 =		2.84
基礎	0.80×4.00×3.40 =	10.87 × 2.00 =		21.74
		21.66 m³	2.135 m	46.31

We = 21.66 @ 2400 = 52,000 kg

背土ノ重量及重心

背土	2.13·4.70×3.40 @1600 =	54400 × 1.00 =	54,400
〃 扶壁部控除	−2.00 @1600 =	−3200 × 1.42 =	− 4,550
分布荷重	2.1×3.4 @ 750 =	5360 × 1.05 =	5630
	We =	56,560 kg 0.98 m	55,480

土圧

	265×3.4×5.0 =	45300 × 2.085 =	94400
	250×2.7×3.4 =	2300 × 1.35 =	3100
	E_h =	47,600 kg 2.046 m	97500

E_v = 47600×0.364 = 17,300 kg

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設計 手塚 日付 16-8-21 類別 RWB5+2
照査 日付 第 14 頁

上海 扶壁式擁壁 高 5.0m (土羽高 2.0m 附)

0点(heel) = 関する 能率

	H	V			
Wc		52000	× 2.135	=	111.000
We		56.560	× 0.980	=	55.480
Eh	47.600		× 2.046	=	97.500
Ev		17300	× 0	=	0
	ΣH = 47,600 kg	ΣV = 125,860 kg	2.095 m		263.980

変偏 e = 2.095 − 2.00 = 0.095 m (左偏)

底面圧力 $p = \frac{125860}{3.4 \times 4.0}\left(1 \pm \frac{6 \times 0.095}{4.0}\right)$ = 10570 kg/m² (Toe)
〃 7950 〃 (Heel)

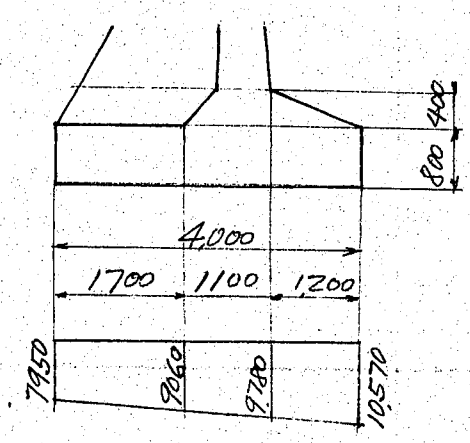
滑動率 $\frac{\Sigma H}{\Sigma V} = \frac{47600}{125860} = 0.378$

基礎杭 杉丸太 末口 18cm φ × 5.5m 間隔 100cm × 90cm

杭一本当荷重 = 10570 × 0.9 × 1.0 = 9,500 kg

基礎

背部基礎



下向圧力 土 5.0 @1600 = 8,000
〃 分布荷重 750
〃 基礎 0.8 @2400 = 1920
〃 Ev $\frac{17300}{3.4 \times 2.1}$ = 2430

上向圧力 p $\frac{-7950}{5150}$ kg/m² (下向)

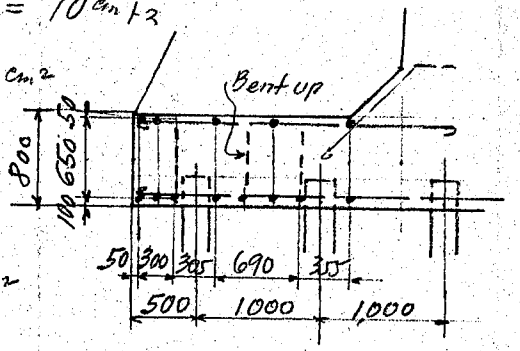
$M = \pm \frac{1}{10} \times 5150 \times 3.4^2 = 5950$ kgm

$S = \frac{1}{2} \times 5150 \times 3.4 = 8750$ kg

所要有効厚 $d = \sqrt{\frac{5950 \times 100}{100 \times 7.13}} = 28.9$ cm. d = 70cm とる

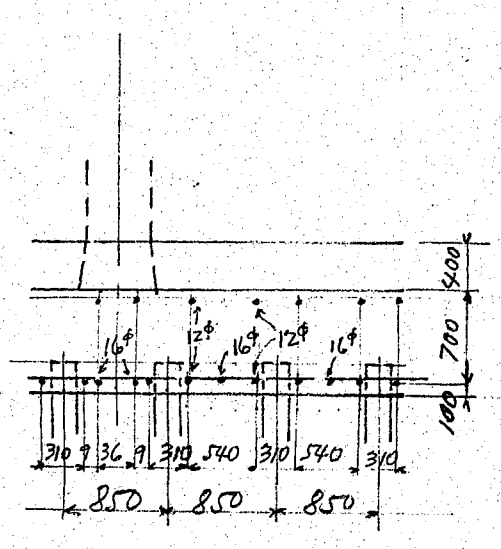
所要鉄筋量 $A_s = \frac{5950 \times 100}{1200 \times 7/8 \times 70} = 8.10$ cm²

使用 〃 4−16φ = 8.04 cm² 平均



労応力 $t = \frac{8750}{100 \times 7/8 \times 70} = 1.4$ kg/cm²

前部基礎



上向圧力 10200 × 1.20 = 12240 × 0.60 = 7350
下向 〃 1.0 @2400 × 1.2 = −2880 × 0.60 = −1730
水平反力 $\frac{47600}{3.4 \times 4.0} \times 1.0 \times 1.2 = -4200 \times 0.60 = -2520$

M = 3100 kgm
S = 9360 kg

所要鉄筋量 $A_s = \frac{3100 \times 100}{1200 \times 7/8 \times 110} = 2.68$ cm²

使用 〃 杭ノ一間隔 85cm = 2本 2−12φ = 2.26 / 1−16φ = 2.01 } 4.27 cm²
即ち 4.27 ÷ 0.85 = 5.03 cm²/m. strip

労応力 $t = \frac{9360}{100 \times 7/8 \times 110} = 1.0$ kg/cm²

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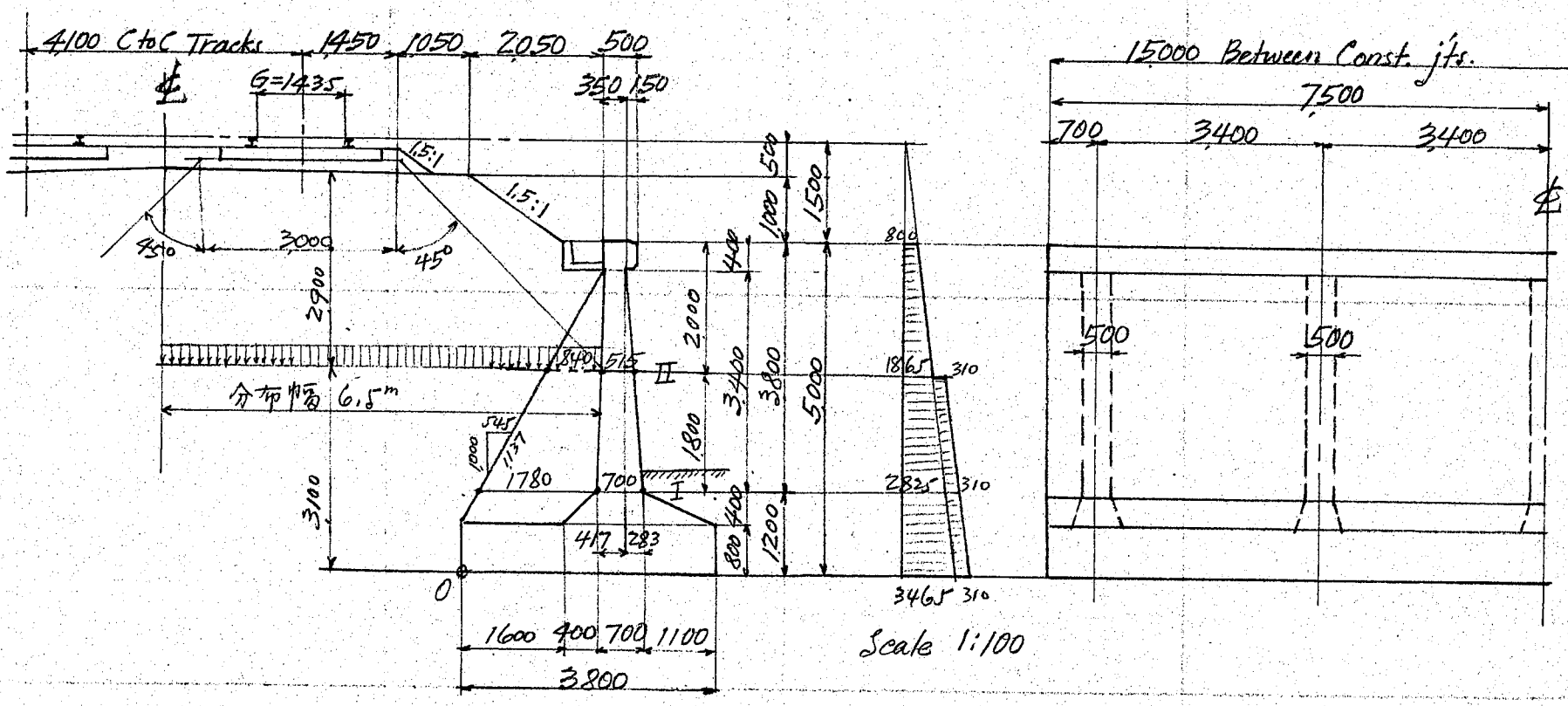
設計 稲葉 日付 16-8-22 類別 RWB 5+1
照査 日付 第 15 頁

上海扶壁式擁壁高5.0m(土羽高1.0m附)

鉄筋混凝土扶壁式擁壁高5.0m RWB 5+1



土圧

断面	土深		土圧	道床分布荷重	荷重=係N 土圧	土圧計
壁頂	1.5m	$\frac{1}{3}\times1600\times1.5=$	800 kg/m²			800 kg/m²
II	3.5	〃 3.5=	1865	$2000\times\frac{3.0}{6.5}=925\times\frac{1}{3}$	P N = 310 kg/m²	2175
I	5.3	〃 5.3=	2825	〃	〃 310	3135
底面	6.5	〃 6.5=	3465	〃	〃 310	3775

前面壁

断面

I $M_1=\pm3135\times\frac{3.4^2}{10}=\pm3620$ kgm $S_1=3135\times\frac{3.4}{2}=5330$ kg

II $M_2=\pm2175\times$ 〃 $=\pm2515$ 〃 $S_2=2175\times$ 〃 $=3700$ 〃

断面	所要有効巾	使用有効巾	所要鉄筋量	使用鉄筋量
I	$d_1=\sqrt{\frac{3620\times100}{100\times7.13}}=22.5$ cm	$d_1=65$ cm	$A_{s1}=\frac{3620\times100}{1200\times7/8\times65}=5.31$ cm²	12φ-20cm c to c = 5.66 cm²
II	$d_2=\sqrt{\frac{2515\times100}{100\times7.13}}=18.8$	$d_2=46$	$A_{s2}=\frac{2515\times100}{1200\times7/8\times46}=5.21$	〃 〃

剪応力

断面

I $S_1=5330$ kg $\tau_1=\frac{5330}{100\times7/8\times65}=0.9$ kg/cm²

II $S_2=3700$ 〃 $\tau_2=\frac{3700}{100\times7/8\times46}=0.7$ 〃

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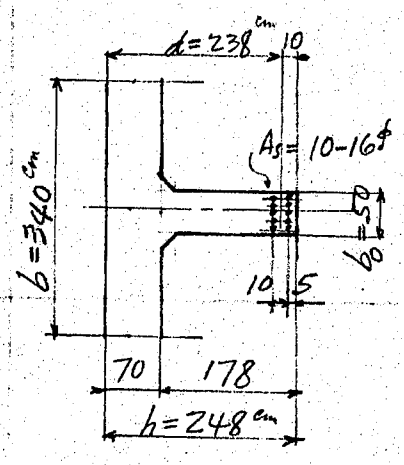
照査 日付 第 16 頁

上海扶壁式擁壁高 5.0m (土羽高 1.0m 附)

扶壁

断面 I



土圧 壁頂 800
断面 I 2825
3625÷2 = 1813 kg/m² 平均

1813 × 3.4 × 3.80 = 23,400 × 1.543 = 36100
310 × 3.4 × 1.80 = 1900 × 0.90 = 1,700
25300 M₁ = 37800 kgm S₁ = 25300 kg

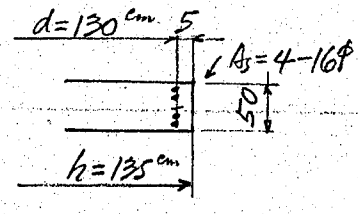
Slope Coef.

所要鉄筋量 $A_{s1} = \frac{37800 \times 100}{1200 \times 7/8 \times 238} \times 1.137 = 17.20\ cm^2$

使用 〃 10-16φ = 20.11 cm² (両端部扶壁には 8-16φ 1本)

剪応力 $\tau = \frac{25300}{50 \times 7/8 \times 238} = 2.4\ kg/cm^2$

断面 II



土圧 壁頂 800
断面 II 1865
2665 ÷ 2 = 1333 kg/m² average.

1333 × 3.4 × 2.00 = 9080 × 0.870 = 7900 kgm = M₂
9080 kg = S₂

所要鉄筋量 $A_{s2} = \frac{7900 \times 100}{1200 \times 7/8 \times 130} \times 1.137 = 6.57\ cm^2$

使用 〃 4-16φ = 8.04 cm² (端部扶壁も 4-16φ 1本)

剪応力 $\tau = \frac{9080}{50 \times 7/8 \times 130} = 1.6\ kg/cm^2$

擁壁ノ安定度

擁壁ノ重量及重心

鉄筋混凝土				
前面壁	0.50 × 0.40 × 3.40 =	0.68 × 2,317 =	1,58	
〃	0.525 × 3.40 × 3.40 =	6.07 × 2.32 =	14.08	
扶壁	0.40 × 1.45 × 3.40 =	1.97 × 2.60 =	5.12	
基礎	0.50 × 1.00 × 3.80 =	1.90 × 1.35 =	2.57	
	0.80 × 3.80 × 3.40 =	1034 × 1.90 =	19.65	
		20.96 m³ 2.05 m	43,00	

Wc = 20.96 @2400 = 50,300 kg

背土ノ重量及重心

背土	2.03 × 4.70 × 3.40 @1600 =	51800 × 0.98 =	50,800
〃 扶壁部控除	−1.90 @ 1600 =	−3040 × 1.35 =	−4,100
分布荷重	2.0 × 3.4 @ 935 =	6280 × 1.0 =	6280
	We = 55040 kg	0.962 m	52,980

土圧

壁頂 800
底面 3775 } = 4575 ÷ 2 = 2288 kg/m² 平均

2288 × 3.4 × 5.0 = 38900 × 1.96 = 76,300
310 × 3.1 × 3.4 = 3270 × 1.70 = 5600
42,170 kg 1.942 m 81,900

$E_V = 42170 \times 0.364 = 15400\ kg$

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設計 稲葉 日付 16-8-22 類別 R.W.B 5+1
照査 日付 第 17 頁

上海扶壁式擁壁高 5.0m (土羽高1.0m附)

0点 (Heel) = 関スル 能率

Wc		50300 × 2.05 =	103000
We		55040 × 0.962 =	52980
		〃 1.942 =	81900
Eh	42,170	15400 × 0 =	0
Ev	—		237880
	ΣH = 42,170 kg	ΣV = 120740 kg 1.967m	

変偶 $e = 1.967 - 1.900 = 0.067^{m}$ (左側)

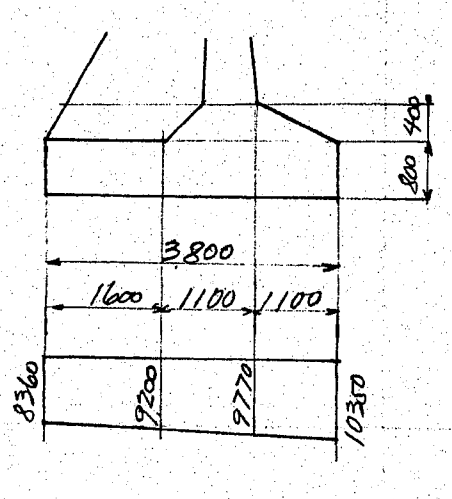
底面圧力 $P = \frac{120740}{3.4 \times 3.8}\left(1 \pm \frac{6 \times 0.067}{3.8}\right) = \begin{matrix} 10350 \\ 8360 \end{matrix}$ kg/m² (Toe) 〃 (Heel)

滑動率 $\frac{\Sigma H}{\Sigma V} = \frac{42170}{120740} = 0.349$

基礎杭 松丸太 末口 18cm × 5.5m 間隔 0.9 × 0.9
杭一本当荷重 = 10350 × 0.81 = 8400 kg

基礎

背部基礎



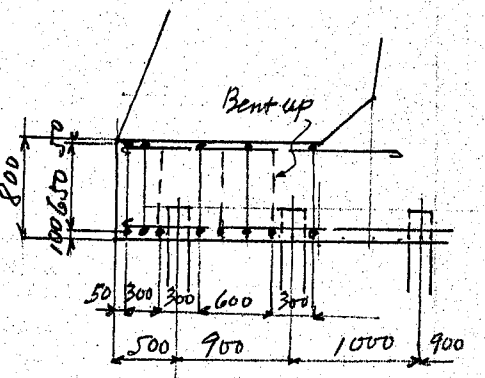
下向圧力	土 5.0 @ 1600 =	8000
〃	分布荷重	925
〃	基礎 0.8@2400 =	1920
〃	Ev $\frac{15400}{2.0 \times 3.4}$ =	2270
上向圧力	P =	$-\frac{8360}{4755}$ kg/m² (下向)

$M = \pm \frac{1}{10} \times 4755 \times 3.4^2 = \pm 5500$ kgm
$S = \frac{1}{2} \times 4755 \times 3.4 = 8080$ kg

所要鉄筋量 $A_s = \frac{5500 \times 100}{1200 \times 7/8 \times 70} = 7.48$ cm²

杭ノ一間隔 90cm = 35と 4-16φ = 8.04 cm²
即ち $\frac{8.04}{.9} = 8.93$ cm²/meter strip

労働力 $\tau = \frac{8080}{100 \times 7/8 \times 70} = 1.3$ kg/cm²



前部基礎

上向圧力	10060 × 1.10 = 11070 × 0.55 =	6090
下向 〃	1.0 @ 2400 × 1.10 = −2640 × 0.55 =	−1450
水平反力	42170 × $\frac{1.0 \times 1.1}{3.40 \times 3.80}$ = 3600 × 0.60 =	−2160
	M =	2480 kgm, S = 8430 kg

所要鉄筋量 $A_s = \frac{2480 \times 100}{1200 \times 7/8 \times 110} = 2.15$ cm²

使用鉄筋量, 杭ノ一間隔 85cm = 1寸 2-12φ = 2.26, 1-16φ = 2.01 } = 4.27 cm²

即ち $4.27 \times \frac{100}{85} = 5.03$ cm²/m. strip

労働力 $\tau = \frac{8430}{100 \times 7/8 \times 110} = 0.9$ kg/cm²

配筋ハ RWB 6+2 = 合ム (第14頁末尾参照)

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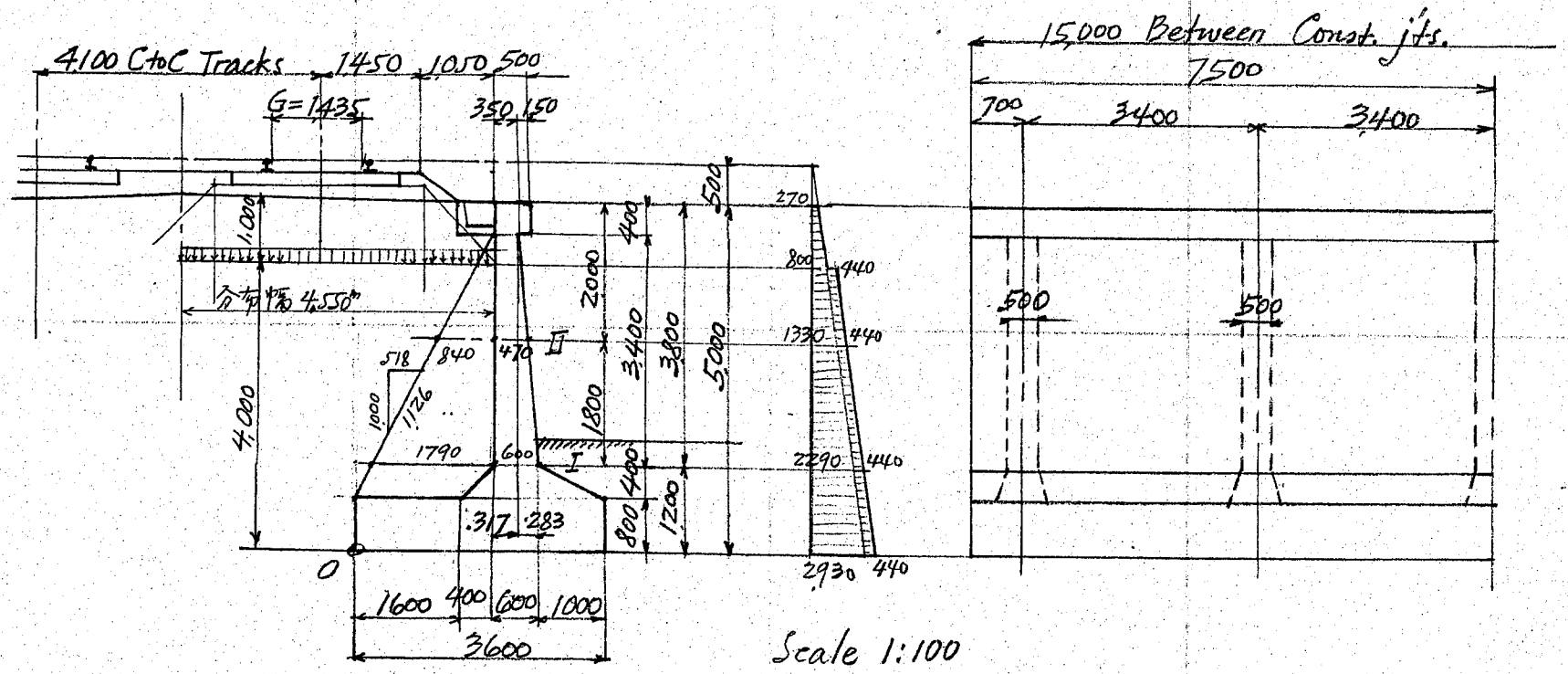
設計 稲葉 日付 16-8-22 類別 RWB5
照査 日付 第 18 頁

上海扶壁式擁壁高5.0m

鉄筋混凝土 扶壁式擁壁高5.0m RWB5



土圧

断面	土深		土圧	分布荷重	荷重=20% 土圧	土圧計
壁頂	0.5m	$\frac{1}{3}\times1600\times0.5=$	270 kg/m²			270
II	2.5	〃 〃 2.5 =	1330	$2000\times\frac{3.0}{4.57}=1320\times\frac{1}{3}=$	440 kg/m²	1770
I	4.3	〃 〃 4.3 =	2290	〃	〃 = 440	2730
底面	5.5	〃 〃 5.5 =	2930	〃	〃 = 440	3370

前面壁

断面

I $M_1=\pm 2730\times\frac{3.4^2}{10}=\pm 3155$ kgm $\quad S_1=2730\times\frac{3.40}{2}=4640$ kg

II $M_2=\pm 1770\times$ 〃 $=\pm 2045$ 〃 $\quad S_2=1770\times$ 〃 $=3010$ 〃

断面	所要有効厚		使用有効厚	所要鉄筋量		使用鉄筋量
I	$d_1=\sqrt{\frac{3155\times100}{100\times7.13}}=$	21.0 cm	$d_1=$ 55 cm	$A_{s1}=\frac{3155\times100}{1200\times\frac{7}{8}\times55}=$	5.46 cm²	12φ−20cm c to c = 5.66 cm²
II	$d_2=\sqrt{\frac{2045\times100}{100\times7.13}}=$	16.9 〃	$d_2=$ 42	$A_{s2}=\frac{2045\times100}{1200\times\frac{7}{8}\times42}=$	4.63	〃 〃 〃

剪応力

断面

I $S_1=4640$ kg $\quad \tau_1=\frac{4640}{100\times\frac{7}{8}\times55}=1.0$ kg/cm²

II $S_2=3010$ kg $\quad \tau_2=\frac{3010}{100\times\frac{7}{8}\times42}=0.8$ 〃

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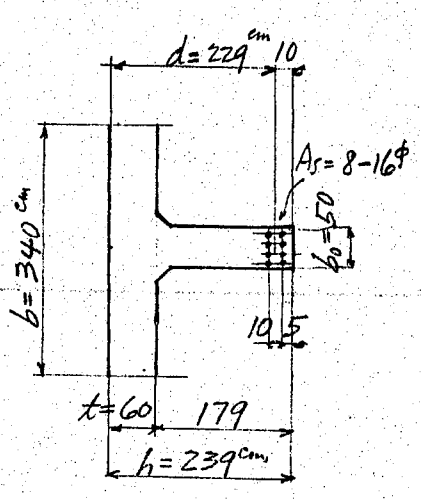
設計 稲葉 日付 16-8-23 類別 RWB5
照査 日付 第 19 頁

上海 扶壁式擁壁高 5.0m

扶壁

断面 I

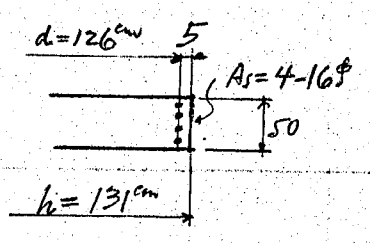


土圧 壁頂 270
断面 I 2290
2560÷2 = 1280 kg/m² 平均

1,280 × 3.4 × 3.80 = 16550 × 1,400 = 23180
440 × 3.4 × 2.80 = 4180 × 1,400 = 5850
20,730 kg M₁ = 29030 kgm , S₁ = 20730 kg

所要鉄筋量 $A_{s1} = \frac{29030\times100}{1200\times7/8\times229}$ (Slope Coef.) × 1.126 = 13.60 cm²
使用 〃 8-16φ = 16.09 cm² (両端部扶壁ハ 6-16φヲ用フ)
剪応力 $\tau_1 = \frac{20730}{50\times7/8\times229}$ = 2.1 kg/cm²

断面 II



土圧 壁頂 270
断面 II 1330
1600÷2 = 800 kg/m² 平均

800 × 3.40 × 2.0 = 5440 kg × 0.778 = 4230
440 × 3.40 × 1.0 = 1500 × 0.50 = 750
S_2 = 6940 kg M_2 = 4980 kgm

所要鉄筋量 $A_{s2} = \frac{4980\times100}{1200\times7/8\times126}$ × 1.126 = 4.24 cm²
使用 〃 4-16φ = 8.04 cm² (両端部扶壁モ全一)
剪応力 $\tau_2 = \frac{6940}{50\times7/8\times126}$ = 1.3 kg/cm²

擁壁ノ安定度

擁壁ノ重量及重心

堅 混凝土				
前面壁	0.50 × 0.40 × 3.40	= 0.68	× 2.217	= 1.51
〃	0.475 × 3.40 × 3.40	= 5.49	× 2.22	= 12.18
〃	0.40 × 1.30 × 3.40	= 1.77	× 2.45	= 4.34
扶壁	0.50 × 1.19 × 3.80	= 2.26	× 1.35	= 3.05
基礎	0.80 × 3.60 × 3.40	= 9.78	× 1.80	= 17.60
		19.98m³	1.935m	38.68

We = 19.98 @ 2400 = 48,000 kg

指土ノ重量及重心

指土	1.98 × 4.70 × 3.40	@1600 = 50700	× 0.95	= 48200
〃 扶壁部控除		−2.26 @1600 = −3620	× 1.35	= − 4880
分布荷重	2.0 × 3.40	@1320 = 8980	× 1.0	= 8980
		We = 56060 kg	0.933m	52,300

土圧

壁頂 270
底面 2930
3200÷2 = 1600 kg/m² 平均

1600 × 3.4 × 5.0 = 27200 × 1.80 = 49000
440 × 3.4 × 4.0 = 6000 × 2.00 = 12000
E_h = 33,200 kg 1.837m 61,000
E_v = 33200 × 0.364 = 12,100 kg

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設計 稲葉 日付 16-8-23 類別 RWB5
照査 日付 第 20 頁

上海扶壁式擁壁高5.0m

0点(Heel)=関スル能率

	H	V		M
Wc		48,000	× 1.935 =	93,000
We		56060	× 0.933 =	52,300
Eh	33200		× 1.837 =	61,000
Ev		12100	× 0 =	0
	ΣH= 33,200 kg	ΣV= 116,160	1.775 m	206,300

妻偏 $e = 1.775 - 1.800 = -0.025$ m (左例)

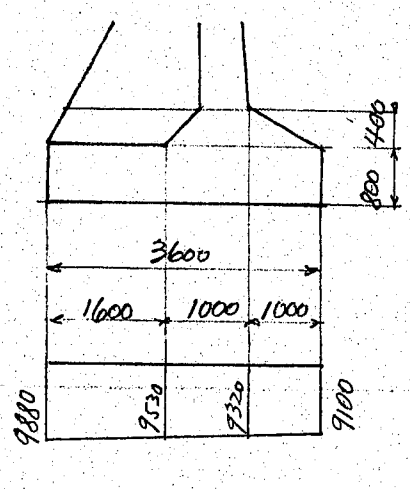
底面圧力 $P = \frac{116160}{3.4 \times 3.6}\left(1 \pm \frac{6 \times 0.042}{3.6}\right) = 9880$ kg/m² (Heel)
又は 9100 〃 (Toe)

滑動率 $\frac{\Sigma H}{\Sigma V} = \frac{33200}{116160} = 0.286$

基礎杭 杉丸太 末口 18cmφ × 5.5m 間隔 90cm × 90cm
杭一本当荷重 = 9880 × 0.81 = 8,000 kg

基礎石

背部基礎



下向圧力 土 470 @ 1600 = 7520
〃 分布荷重 1320
〃 基礎 0.8 @ 2400 = 1920
〃 Ev $\frac{12100}{2.0 \times 3.4}$ = 1780

上向圧力 −9530
3010 kg/m² (下向)

$M = \pm \frac{1}{10} \times 3010 \times 3.4^2 = \pm$ 3475 kgm

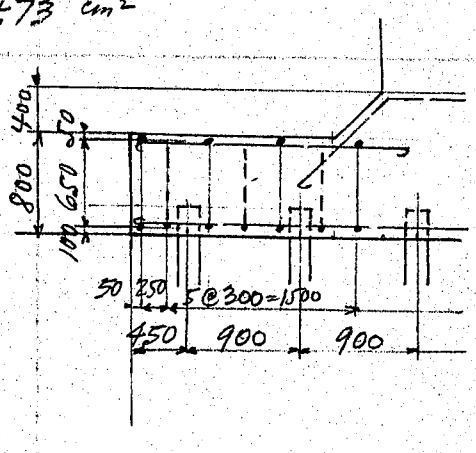
$S = \frac{1}{2} \times 3010 \times 3.4 =$ 5120 kg

所要鉄筋量 $A_s = \frac{3475 \times 100}{1200 \times 7/8 \times 70} = 4.73$ cm²

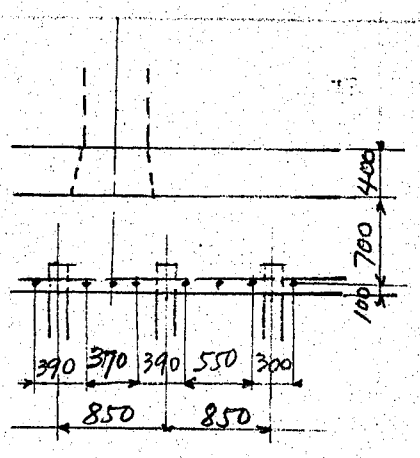
杭一間隔 90cm 二対シ 3−16φ = 6.03 cm²

即チ $\frac{6.03}{0.9} = 6.70$ cm²/m. Strip.

労働力 $t = \frac{5120}{100 \times 7/8 \times 70} = 0.8$ kg/cm²



前部基礎



上向圧力 9210 × 1.0 = 9210 × 0.5 = 4600
下向 〃 1.0 @ 2400 × 1.0 = −2400 × 0.5 = −1200
水平反力 33200 × $\frac{1.0 \times 1.0}{3.4 \times 3.6}$ = 2700 × 0.6 = −1620

M= 1780 kgm S= 6810 kg

所要鉄筋量 $A_s = \frac{1780 \times 100}{1200 \times 7/8 \times 110} = 1.54$ cm²

使用鉄筋量, 杭ノ一間隔 85cm ニ対シ 3−12φ = 3.39 cm²

即チ $\frac{3.39}{0.85} = 3.99$ cm²/m. Strip.

労働力 $t = \frac{6810}{100 \times 7/8 \times 110} = 0.7$ kg/cm²

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設計	日付	類別
照査	日付	第　頁

上海高速鐵道
直立式擁壁應力計算書
壁高 五.〇米 四.〇米 三.〇米及二.〇米

CANTILEVER TYPE RETAINING WALLS

MARK R.W.C

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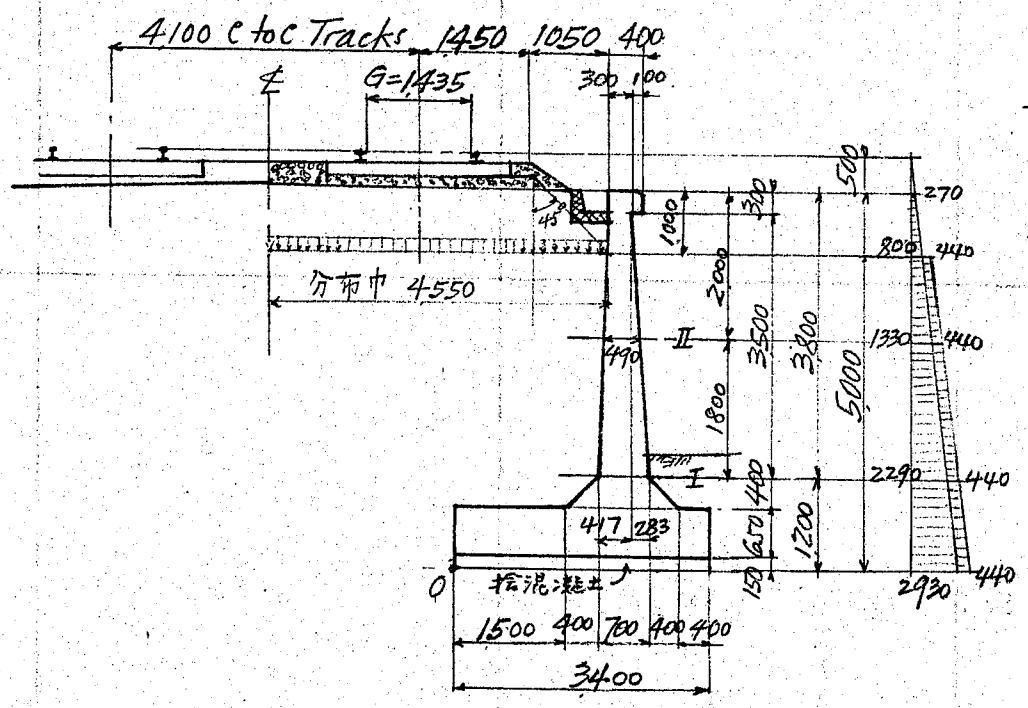
設計 稲葉 日付 16-9-1 類別 RWC 5
照査 日付 第 1 頁

上海 直立式擁壁高 5.0m

鐵筋混凝土 直立式擁壁高 5.0m RWC 5



設計條件

電車荷重 60噸電車 軸荷重 15,000kg

道床上分布荷重 $\frac{15000\times 2}{5.0\times 3.0} = 2{,}000$ kg/m²

土ノ安息角 $\phi = 30°$ $C = \frac{1-\sin\phi}{1+\sin\phi} = \frac{1}{3}$

土ノ摩擦角 $\theta = 20°$ $\tan 20° = 0.364$

土圧

断面	土深		土圧	分布荷重	荷重=DW 土圧	土圧計
壁頂	0.50m	$\frac{1}{3}\times 1600\times 0.5 =$	270 kg/m²		—	270 kg/m²
II	2.50	〃 〃 2.5 =	1330	$2000\times\frac{3.00}{4.55} = 1320\times\frac{1}{3} =$	440 kg/m²	1,770
I	4.30	〃 〃 4.3 =	2290	〃 〃	440	2,730
底面	5.50	〃 〃 5.5 =	2930	〃 〃	440	3370

断面 I

270
2290
2560÷2 = 1,280 × 3.80 = 4870 × 1.40 = 6820
440 × 2.80 = 1,230 × 1.40 = 1720
S_1 = 6,100 kg 8,540 kgm = M_1

所要有効厚 $d_1 = \sqrt{\frac{8540\times 100}{100\times 7.13}} = 34.6$ cm $d_1 = 65$ cm 被覆 5cm 計算 70 cm

所要鉄筋量 $A_{s1} = \frac{8540\times 100}{1200\times\frac{7}{8}\times 65} = 12.50$ cm²

使用 〃 16φ − 15cm c to c = 13.41 cm²

剪応力 $\tau_1 = \frac{6100}{100\times\frac{7}{8}\times 65} = 1.1$ kg/cm²

断面 II

800 × 2.00 = 1,600 × 0.8 = 1280
440 × 1.0 = 440 × 0.5 = 220
S_2 = 2,040 kg M_2 = 1,500 kgm

$A_{s2} = \frac{1500\times 100}{1200\times\frac{7}{8}\times 44} = 3.25$ cm²

16φ − 45cm c to c = 4.47 cm²

$\tau_2 = \frac{2040}{100\times\frac{7}{8}\times 44} = 0.5$ kg/cm²

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設計 稲葉 日付 16-9-2 類別 RWC5
照査 日付 第 2 頁

上海直立式擁壁高5.0m

擁壁ノ安定度

擁壁ノ重量及重心

鉄筋混凝土	0.40×0.30	=	0.12	× 2.317	=	0.28
壁	0.50×3.50	=	1.75	× 2.21	=	3.87
〃	1.10×0.40	=	0.44	× 2.25	=	0.99
基礎	0.65×3.40	=	2.21	× 1.70	=	3.76
〃 捨混凝土	0.15×3.40	=	0.51	× 1.70	=	0.87
			5.03m³	1.94m		9.77

$W_c = 5.03 \times 2400 = 12060$ kg

埋土ノ重量及重心

埋土	1.90×4.70 =	8.94m³ @1600 =	14,300
分布荷重	1.90×1320 =		2500
		W_e =	16,800kg	arm = 0.95m

土圧

壁頂	270					
底面	2930					
3200÷2 =	1600	× 5.0 =	8000	× 1.80 =	14,400
440	× 4.0 =	1760	× 2.00 =	3520
		E_h =	9760kg	1.835m	17920

$E_v = 9760 \times 0.36 = 3550$ kg arm = 0.

O点ニ関スル能率

W_c		12060	× 1.94	=	23400
W_e		16800	× 0.95	=	15950
E_h	9760		× 1.835	=	17920
E_v		3550	× 0	=	0
	ΣH = 9760kg	ΣV = 32410kg	1.765m		57270

変位 1.765 − 1.70 = 0.065m (前方)

$$底面圧力 = \frac{32410}{1.0 \times 3.4}\left(1 \pm \frac{6 \times 0.065}{3.4}\right) = 10,640 \text{ kg/m}^2 \text{ (toe)}$$

8,450 〃 (heel)

滑動率 $\frac{\Sigma H}{\Sigma V} = \frac{9760}{32410} = 0.301$

基礎杭 末口180φ 長5.5m 間隔 0.9m×1.0m

杭一本当荷重 = 10,640 × 0.9 × 1.0 = 9,600 kg

基礎

踵部基礎

下向圧力	土	4.70 @ 1600	=	7520
	分布荷重		=	13,20
	基礎	0.65 @ 2400	=	1560
	E_v	3550/1.9	=	1870
上向圧力	say			−8450
				3820 kg/m² (下向)

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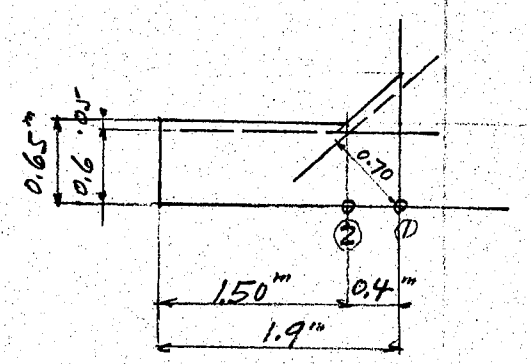
設計 稲葉 日付 16-9-2 類別 RWC 5
照査 日付 第 3 頁

上海直立式橋壁 高 5.0m



① 断面

$M_1 = \frac{1}{2} \times 3820 \times 1.9^2 = 6900$ kgm

$S_1 = 3820 \times 1.9 = 7260$ kg

$A_{s1} = \frac{6900 \times 100}{1200 \times 7/8 \times 70} = 9.40$ cm²

16φ-30cm c to c = 6.70
12φ-30 〃 = 3.77
} 10.47 cm²

$\tau_1 = \frac{7260}{100 \times 7/8 \times 73} = 1.1$ kg/cm²

$d = 60 + \frac{40}{3} = 73$ cm

② 断面

$M_2 = \frac{1}{2} \times 3820 \times 1.5^2 = 4300$ kgm

$S_2 = 3820 \times 1.5 = 5730$ kg

$A_{s2} = \frac{4300 \times 100}{1200 \times 7/8 \times 60} = 6.82$ cm²

16φ - 30 cm c to c = 6.70 cm²

$\tau_2 = \frac{5730}{100 \times 7/8 \times 60} = 1.1$ kg/cm²

前部基礎

上向圧力 10,640
下向き 0.65×2400 = − 1560
9080 kg/m

$M = \frac{1}{2} \times 9080 \times 0.8^2 = 2900$ kgm

$S = 9080 \times 0.8 = 7280$ kg

$d = 60 + \frac{40}{3} = 73$ cm

$A_s = \frac{2900 \times 100}{1200 \times 7/8 \times 73} = 3.77$ cm²

12φ − 30 cm c to c = 3.77 cm²

$\tau = \frac{7280}{100 \times 7/8 \times 73} = 1.1$ kg/cm².

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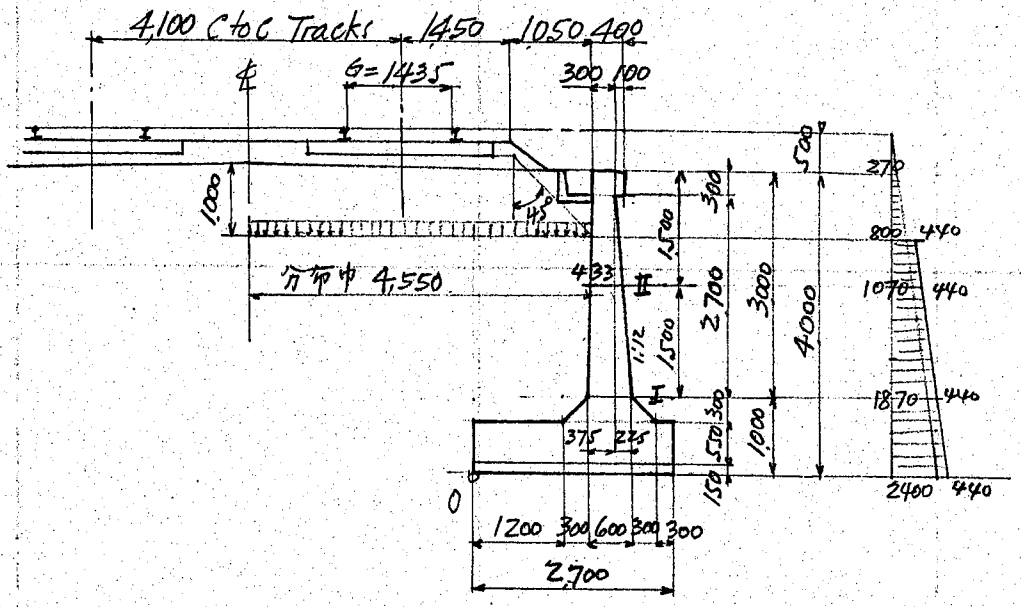
設計 稲葉 日付 16-9-3 類別 R.W.C 4
照査 日付 第 4 頁

上海直立式擁壁高4.0m

鐵筋混凝土 直立式擁壁高 4.0m RWC 4



土圧

荷重=3tn

断面	土深		土圧	分布荷重	土圧	土圧計
壁頂	0.50m	$\frac{1}{3}\times1600\times0.5=$	270 kg/m²		—	270 kg/m²
II	2.00	〃 $\times2.0=$	1070	$2000\times\frac{3.0}{4.55}=1320\times\frac{1}{3}=$	440 kg/m²	1510
I	3.50	〃 $\times3.5=$	1870	〃 〃 $=$	440	2310
底面	4.50	〃 $\times4.5=$	2400	〃 〃 $=$	440	2840

断面 I

270
1870
2140 ÷2 = 1070 × 3.0 = 3210 × 1.125 = 3610
440 × 2.0 = 880 × 1.00 = 880
S_1 = 4090 kg M_1 = 4490 kgm

所要有効深 $d_1=\sqrt{\frac{4490\times100}{100\times7.13}}=25.1$ cm $d_1=57$ cm 総厚 $h_1=60$ cm とす

所要鉄筋量 $A_{s1}=\frac{4490\times100}{1200\times\frac{7}{8}\times57}=7.49$ cm²

使用 〃 12φ— 15cm c to c = 7.54 cm²

$\tau_1=\frac{4090}{100\times\frac{7}{8}\times57}=0.8$ kg/cm²

断面 II

270
1,070
1340 ÷2 = 670 × 1.5 = 1,000 × 0.64 = 640
440 × 0.5 = 220 × 0.25 = 60
S_2 = 1220 kg M_2 = 700 kgm

$A_{s2}=\frac{700\times100}{1200\times\frac{7}{8}\times40}=1.67$ cm² $d_2=40$ $h_2=43$ cm

12φ— 45cm c to c = 2.52 cm²

$\tau_2=\frac{1220}{100\times\frac{7}{8}\times40}=0.4$ kg/cm²

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設計 稲葉 日付 16-9-3 類別 RWC 4
照査 日付 第 5 頁

上海直立式擁壁高 4.0m

擁壁ノ安定度

擁壁ノ重量及重心

鉄筋コンクリート	0.30 × 0.40	=	0.12 × 1.775	=	0.21
立壁	0.45 × 2.70	=	1.22 × 1.78	=	2.17
〃	0.90 × 0.30	=	0.27 × 1.80	=	0.49
基礎	0.70 × 2.70	=	1.89 × 1.35	=	2.55
			3.50 m³	1.547 m	5.42

W_c = 3.50 @2400 = 8400 kg

背土ノ重量及重心

土	1.50 × 3.80	=	5.70 @ 1600	= 9120
分布荷重	1.50 × 1320	=		1980
			W_e = 11,100 kg	arm = 0.75 m

土圧

壁頂 270
底面 2400
2670÷2 = 1335 × 4.0 = 5340 × 1.468 = 7840
440 × 3.0 = 1320 × 1.50 = 1980
E_h = 6660 kg 1.473 m 9820

E_V = 6660 × 0.364 = 2430 kg arm 0.

O点 (Heel) = 関スル能率

W_c		8,400	× 1.547	=	12980
W_e		11.100	× 0.750	=	8340
E_h	6660		× 1.473	=	9820
E_V		2430	× 0	=	0
ΣH =	6,660 kg	ΣV = 21,930 kg	1.420		31,140

変偏 e = 1.420 − 1.350 = 0.070 m (前方)

底面圧力 = $\frac{21930}{1.0 \times 2.70}\left(1 \pm \frac{6 \times 0.07}{2.70}\right)$ = 9400 kg/m² (Toe)
0.155
〃 7680 〃 (Heel)

滑動率 $\frac{\Sigma H}{\Sigma V} = \frac{6660}{21930} = 0.304$

基礎杭

松丸太 末口 180φ 長 5.500
打込間隔 0.90 × 1.10 m
杭一本当許大荷重 = 9400 × 0.99 = 9,300 kg

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設計 稲葉 日付 16-9-3 類別 RWC 4
照査 日付 第 6 頁

上海直立式擁壁高 4.0m

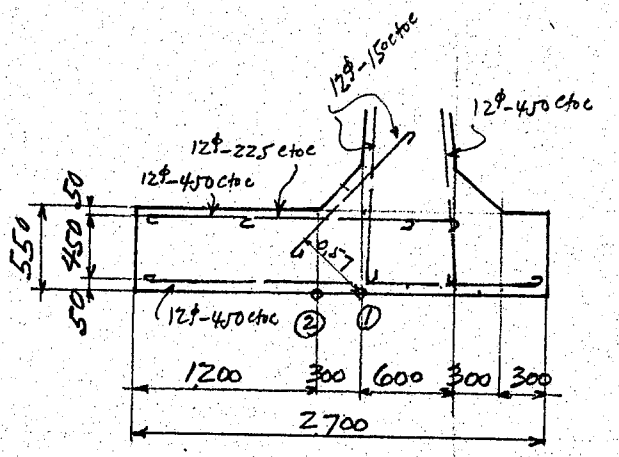
基礎

背部基礎

下向圧力

土	3.80 @ 1.600 =	6080
分布荷重	=	1320
基礎	0.70 @ 2400 =	1680
E_V	2430 ÷ 1.5 =	1620
say		7680
		3020 kg/m² (下向)

上向圧力



断面 ①

$M_1 = \frac{1}{2} \times 3020 \times 1.50^2 = 3400$ kgm

$S_1 = 3020 \times 1.50 = 4530$ kg

$A_{s1} = \frac{3400 \times 100}{1200 \times 7/8 \times 57} = 5.68$ cm²

12φ − 15cm ctoc = 7.54 cm²

$\tau_1 = \frac{4530}{100 \times 7/8 \times 60} = 0.9$ kg/cm²　　$d = 50 + \frac{30}{3} = 60$ cm

断面 ②

$M_2 = \frac{1}{2} \times 3020 \times 1.20^2 = 2180$ kgm

$S_2 = 3020 \times 1.20 = 3620$ kg

$A_{s2} = \frac{2180 \times 100}{1200 \times 7/8 \times 50} = 4.15$ cm²

12φ − 22.5cm ctoc = 5.04 cm²

$\tau_2 = \frac{3620}{100 \times 7/8 \times 50} = 0.8$ kg/cm²

前部基礎

上向圧力	say	9400
下向 〃	0.55 @ 2400 =	−1320
		8080 kg/m²

$M = \frac{1}{2} \times 8080 \times 0.6^2 = 1450$ kgm

$S = 8080 \times 0.6 = 4848$ kg

$A_s = \frac{1450 \times 100}{1200 \times 7/8 \times 60} = 2.30$ cm²　　$d = 50 + \frac{30}{3} = 60$ cm

12φ − 45cm ctoc = 2.52 cm²

$\tau = \frac{4848}{100 \times 7/8 \times 60} = 0.9$ kg/cm²

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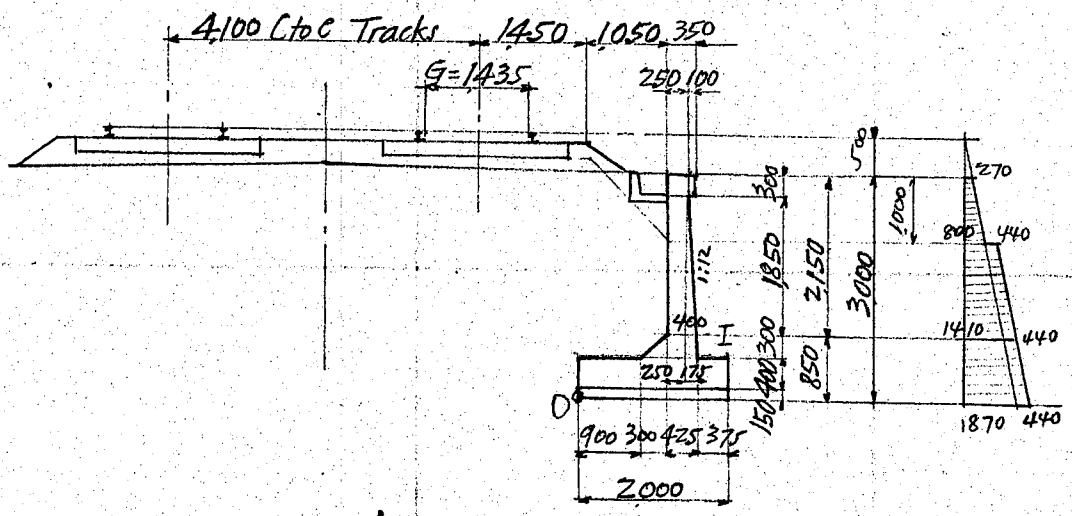
設計 稲葉 日付 16-9-4 類別 RWC3
照査 日付 第 7 頁

上海直立式擁壁高 3.0m

鐵筋混凝土 直立式擁壁高 3.0m RWC3



土圧

断面	土深	土圧	荷重=係ル土圧	土圧計
壁頂	0.5m	$\frac{1}{3}\times1600\times0.5=$ 270 kg/m²		270 kg/m
I	2.65	〃 2.65 = 1410	$2000\times\frac{3.0}{4.55}=1320\times\frac{1}{3}=$ 440 kg/m	1850
底面	3.50	〃 3.50 = 1870	〃 〃 440	2310

断面 I

270
1410
1680÷2 = 840 × 2.15 = 1810 kg × 0.833 = 1510
440 × 1.15 = 510 × 0.575 = 290
S_1 = 2320 kg M_1 = 1800 kgm

所要有効深 $d=\sqrt{\frac{1800\times100}{100\times7.13}}=15.9$ cm d = 37 cm h = 40 cm とす

所要鉄筋量 $A_s=\frac{1800\times100}{1200\times7/8\times37}=4.64$ cm²

使用 〃 12φ − 20 cm c to c = 5.66 cm²

$\tau=\frac{2320}{100\times7/8\times37}=0.7$ kg/cm²

擁壁ノ安定度

擁壁ノ重量及重心

鉄筋混凝土	0.35 × 0.30	=	0.11	× 1.375	=	0.15
主壁	0.325 × 1.85	=	0.60	× 1.365	=	0.82
〃	0.563 × 0.30	=	0.17	× 1.325	=	0.23
基礎	0.55 × 2.00	=	1.10	× 1.00	=	1.10
			1.98 m³	1.162 m		2.30

We = 1.98 @ 2400 = 4750 kg

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設計 稲葉 日付 16-9-4 類別 RWC3

照査 日付 第 8 頁

上海直立式擁壁高 3.0m

埋土ノ重量及重心

土
分布荷重

1.20 × 2.95 @1600 = 5660
1320 × 1.20 = 1580
We = 7230 kg arm 0.60 m

土圧

壁頂 270
底面 1870
2140÷2 = 1070 × 3.00 = 3210 × 1.125 = 3610
440 × 2.00 = 880 × 1.0 = 880
E_h = 4090 kg 1.098 m 4490

E_v = 4090 × 0.364 = 1490 kg

O点 (Heel) = 關スル能率

Wc		4.750 × 1.162 =	5520
We		7.230 × 0.600 =	4340
E_h	4.090	× 1.098 =	4490
E_v		1490 × 0 =	0
ΣH =	4090 kg	13470 kg 1.065 m	14350

変傷 e = 1.065 − 1.00 = 0.065 m (前方)

底面圧力 = $\frac{13470}{1.0 \times 2.0}\left(1 \pm \frac{6 \times 0.065}{2.0}\right)$ = 8050 kg/m² (Toe)
2, 5420 (Heel)

滑動率 $\frac{\Sigma H}{\Sigma V} = \frac{4090}{13470} = 0.304$

基礎杭

松丸太 末口 180φ 長 5.500
杭一本当荷重 = 8050 × 1.0 × 1.1 = 8.855 kg

基礎

背部基礎

下向圧力	土	2.95 @1600	=	4720
〃	分布荷重		=	1320
〃	基礎	0.55 @2400	=	1320
〃	E_v	1490 ÷ 1.20	=	1240
上向圧力	Say			−5420
				3180 kg/m² (下向)

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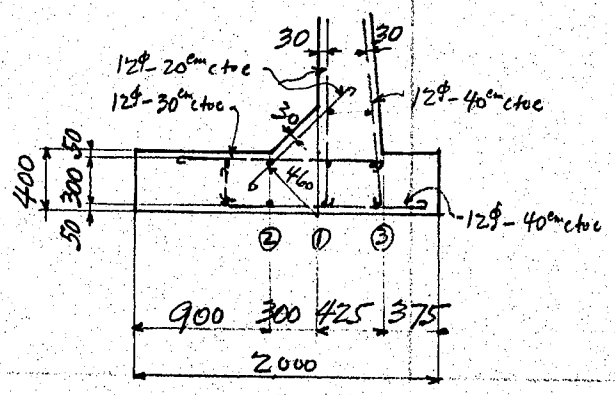
設計 稲葉 日付 16-9-4 類別 RWC 3
照査 日付 第 9 頁

上海直立式擁壁 高3.0m



断面①

$M_1 = \frac{1}{2} \times 3180 \times 1.20^2 = 2250$ kgm

$S_1 = 3180 \times 1.20 = 3820$ kg

$A_{s1} = \frac{2250 \times 100}{1200 \times 7/8 \times 46} = 4.66$ cm²

12φ − 20 cm c to c = 5.66 cm²

$\tau_1 = \frac{3820}{100 \times 7/8 \times 46} = 1.0$ kg/cm²

断面②

$M_2 = \frac{1}{2} \times 3180 \times 0.90^2 = 1290$ kgm

$S_2 = 3180 \times 0.90 = 2870$ kg

$A_{s2} = \frac{1290 \times 100}{1200 \times 7/8 \times 35} = 3.51$ cm²

12φ − 30 cm c to c = 3.77 cm²

$\tau_2 = \frac{2870}{100 \times 7/8 \times 35} = 0.9$ kg/cm²

前部基礎

上向応力 8050
下向 〃 0.40 @2400 = −960
7090 kg/m²

断面③

$M_3 = \frac{1}{2} \times 7090 \times 0.375^2 = 500$ kgm

$A_{s3} = \frac{500 \times 100}{1200 \times \frac{7}{8} \times 35} = 1.36$ cm²

12φ − 40 cm c to c = 2.83 cm²

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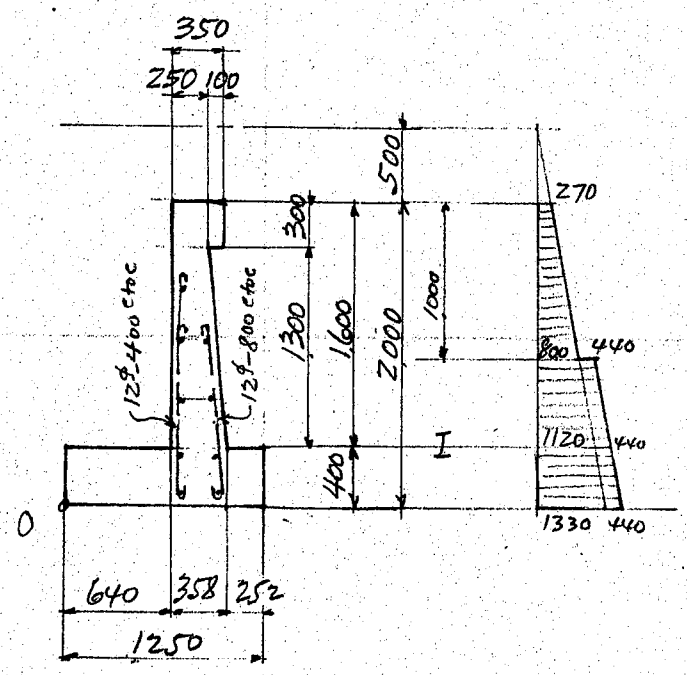
設計 稲葉 日付 16-9-3 類別 RWC 2
照査 日付 第 10 頁

上海直立式擁壁 高 2.0m

鉄筋混凝土 直立式擁壁高 2.0m RWC 2.



断面 I

270
1120
1390÷2 = 695 × 1.60 = 1110 × 0.625 = 693
440 × 0.60 = 264 × 0.30 = 79
S_1 = 1374 kg M_1 = 772 kgm

$$A_{s1} = \frac{772 \times 100}{1200 \times \frac{7}{8} \times 32.8} = 2.24 \text{ cm}^2$$

12φ - 40 cm c to c = 2.83 cm²

擁壁ノ安定度

擁壁ノ重量及重心

基礎混凝土	0.35 × 0.30	=	0.11 × 0.815 =	0.090
主壁	0.304 × 1.30	=	0.40 × 0.794 =	0.317
基礎	0.40 × 1.25	=	0.50 × 0.625 =	0.313
			1.01 0.712	0.720

Wc = 1.01 @ 2400 = 2420 kg

背土重量及重心

土	0.640 × 2.10 @ 1600	=	2150
分布荷重	1320 × 0.64	=	850
		We =	3000 kg arm 0.32m

土圧

壁頂	270			
底加	1330			
	1600÷2 = 800	× 0.890 =		710
	440 × 1.0 = 440	× 0.50 =		220
	E_h = 1240 kg	0.750m		930
	E_V = 1240 × 0.364 =			450 kg

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設計 稲葉 日付 16-9-3 類別 R.WC 2
照査 日付 第 11 頁

上海直立式擁壁高2.0m

0点=壁下端

Wc		2,420 × 0.712 =	1720
We		3000 × 0.320 =	960
Eh	1240	× 0.750 =	930
Ev		450 × 0 =	0
	ΣH = 1240 kg	ΣV = 5870 kg	0.615 m	3610

重偏 $e = 0.615 - 0.625 = -0.010$ m (後方)

底面圧力 $= \frac{5870}{1.0 \times 1.25}\left(1 \pm \frac{6 \times 0.010}{1.25}\right) = 4920$ kg/m² (heel)
(0.048)
2, 4480 〃 (toe)

剛床地形ノ=テ基礎杭ヲ用ヒズ.

滑動率 $\frac{\Sigma H}{\Sigma V} = \frac{1240}{5870} = 0.212$

基礎

背部基礎

下向圧力

土	2.10 @1600 =	3360
分布荷重		1320
基礎	0.4 @2400 =	960
Ev	450 ÷ 0.64 =	700
		−4800
上向圧力 say		1540 kg/m²

$M = \frac{1}{2} \times 1540 \times 0.64^2 = 315$ kgm

$S = 1540 \times 0.64 = 985$ kg.

$\sigma_c = \frac{315 \times 100 \times 6}{100 \times 40^2} = 1.18$ kg/cm² $< \frac{45}{10} = 4.5$ kg/cm².

鉄筋不用.

$\tau = \frac{985}{100 \times 40} \times \frac{3}{2} = 0.4$ kg/cm². ✓

前部基礎.

上向圧力		4,480
下向 〃	0.40 @2400 =	−960
		3520 kg/m²

$M = \frac{1}{2} \times 3520 \times 0.25^2 = 112$ kgm.

$S = 3520 \times 0.25 = 890$ kg

鉄筋不用.

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設計　日付　類別

照査　日付　第　頁

上海高速鐵道
隧道出入口開桓應力計算書

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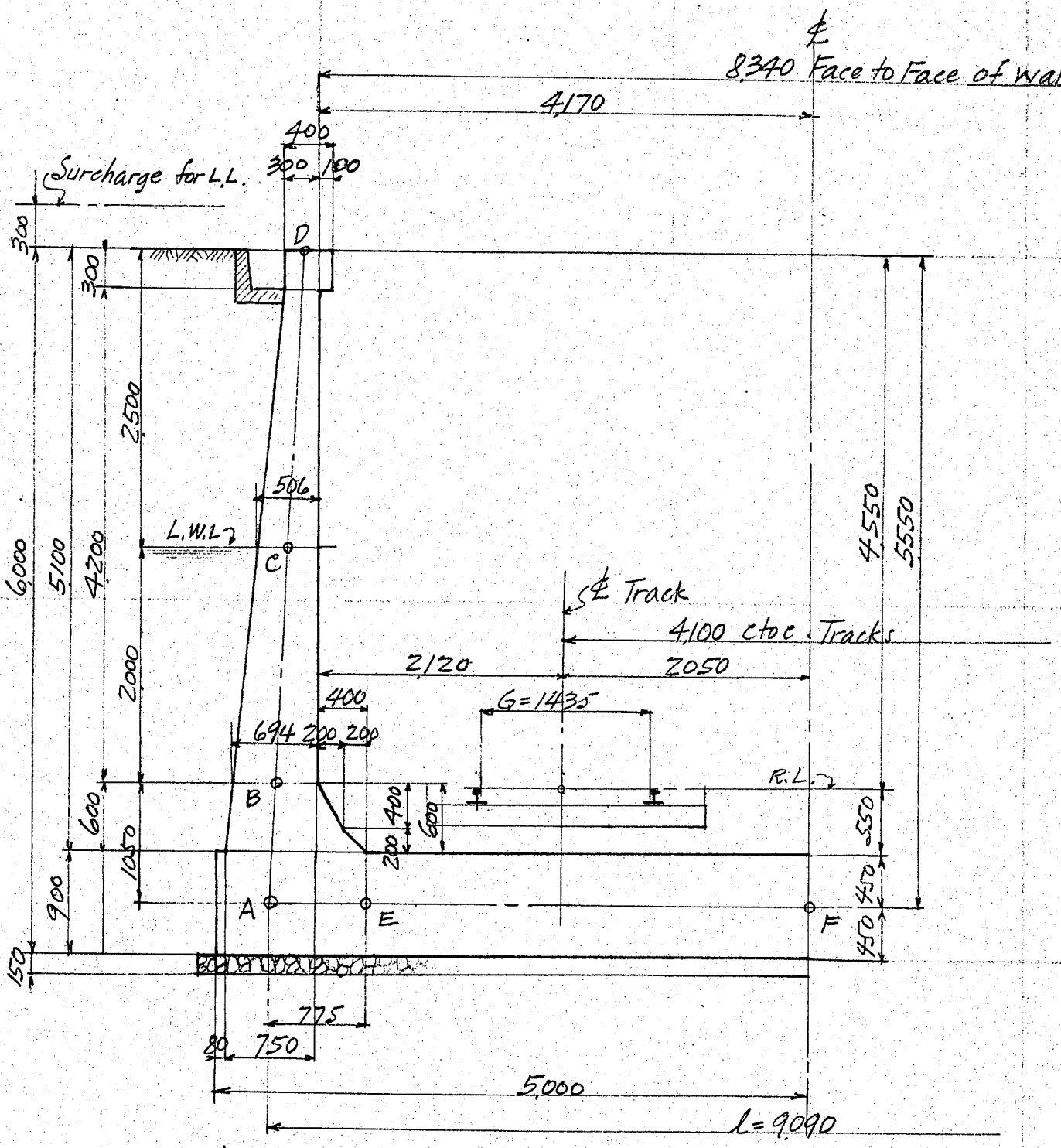
設計 稲葉 日付 16-12-3 類別 OC6
照査 日付 第 1 頁

上海高速鐵道 隧道出入口開框

隧道出入口開框 高 6.0m --- OC6



Scale 1:50

設計條件

土地下水位　地表面下 2.5m ト假定ス
土ノ息角　φ = 30° トス　土圧係数 $c = \frac{1-\sin\phi}{1+\sin\phi} = \frac{1}{3}$
土ノ容重
　土地下水位以上　1,600 kg/m³
　〃　以下　2,000 〃
活荷重　30 cm ノ土 (83.500 kg/m²) トス

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設計 稲葉 日付 16-12-3 類別 OC6
照査 日付 第 2 頁

上海隧道出入口開渠

土圧

断面		土深			
壁頂	D	0.30m	1/3 × 1600 × 0.30 =		
	C	2.80	〃 〃 × 2.80 =		
	B	4.80	〃 〃 × 4.80 =	2560	
			1/3 × 400 × 2.00 =	270	
	A	5.85	1/3 × 1600 × 5.85 =	3120	
			1/3 × 400 × 3.05 =	410	

土圧 160 kg/m²

			総土圧
1.490	825 × 2.50 =		2060 kg
2.830	2160 × 2.00 =	4320 + 2060 =	6380 〃
3.530	3180 × 1.05 =	3340 + 6380 =	9720 〃

彎曲率

断面		総土圧			彎曲率		所要有効深	使用有効深
D		—			—			
C		2060	× 0.875 =		1800 kgm	$d_C=\sqrt{\frac{1800\times100}{100\times7.13}}$ = 15.9 cm		d = 45.6 cm
B	4320		× 0.895 =	3860				
	2060		× 2.875 =	5920				
		6380	1.532m		9780 〃	$d_B=\sqrt{\frac{9780\times100}{100\times7.13}}$ = 37.0		d = 64.4
A	3340		× 0.508 =	1700				
	6380		× 2.582 =	16470				
		9720			18170 〃	$d_A=\sqrt{\frac{18170\times100}{100\times7.13}}$ = 50.5	75 + 105/3 = 110	d = 105 cm

鉄筋

断面

所要鉄筋量

C $A_s = \frac{1800\times100}{1200\times7/8\times45.6} = 3.76\ cm^2$ 16φ − 400 ctoc = 4.47 cm²

B $A_s = \frac{9780\times100}{1200\times7/8\times64.4} = 14.45\ cm^2$ { 16φ − 450 ctoc = 4.47 / 16φ − 〃 〃 = 4.47 / 19φ − 450 〃 = 6.30 } 15.24 cm²

A $A_s = \frac{18170\times100}{1200\times7/8\times105} = 16.45\ cm^2$ 含上 15.24 cm²

断面A.

$p = \frac{15.24}{100\times105} = 0.00145$ $k = 0.190$ $j' = 0.938$

$\sigma_s = \frac{18170\times100}{15.24\times0.938\times105} = 1206\ kg/cm^2$

$\sigma_c = \frac{\sigma_s k}{n(1-k)} = \frac{1206\times0.190}{15\times0.810} = 18.9$ 〃

$\tau = \frac{9720}{100\times.938\times105} = 1.0$ 〃

側壁重量

笠	0.40 × 0.30 =	0.12	
躯体	0.525 × 4.80 =	2.52	
持送	1/2 × 0.20 × 0.40 =	0.04	
〃	1/2 × 0.20 × 0.20 =	0.02	
〃	0.20 × 0.20 =	0.04	
		2.74 @2400 =	6580
背土	0.30 × 5.40 =	1.62 @1600 =	2590
〃	0.58 × 2.60 =	1.51 @ 400 =	600
			9770 kg

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設計 稲葉 日付 16-12-3 類別 OC6
照査 日付 第 3 頁

上海隧道出入口開桓

底面反力 = $\frac{9770}{5.0}$ = 1955 kg/m²

F点(下床中央)

$M_A = \frac{1}{8} \times 1955 \times 9.09^2 = 20200$
$= -18170$
$M_F = 2030$ kgm

$A_s = \frac{2030 \times 100}{1200 \times 7/8 \times 82} = 2.36$ cm²
16φ-400 ctoc = 4.47 〃

E点

$M_E = -\frac{1}{12} \times 1955 \times 3.77^2 = -13900$
$= 2030$
$M_E = -11870$ kgm

$A_s = \frac{11870 \times 100}{1200 \times 7/8 \times 82} = 13.80$ cm²
16φ-400 ctoc = 4.47
〃 〃 = 4.47
19φ-400 〃 = 6.30
15.24 cm²

底面圧力

側壁及指上	2@9770	= 19,540
下床	0.90×10.00@2400	= 21,600
バラスト	0.40×8.3@2000	= 6640
軌道	600+400	= 1000
	死荷重	= 48,780 kg
60噸電車	$\frac{2 \times 60,000}{18.0}$	= 6,670
30% impact	活荷重	2000 / 8,670
		57,450 kg

底面圧力 = $\frac{57450}{10.0}$ = 5750 kg/m²

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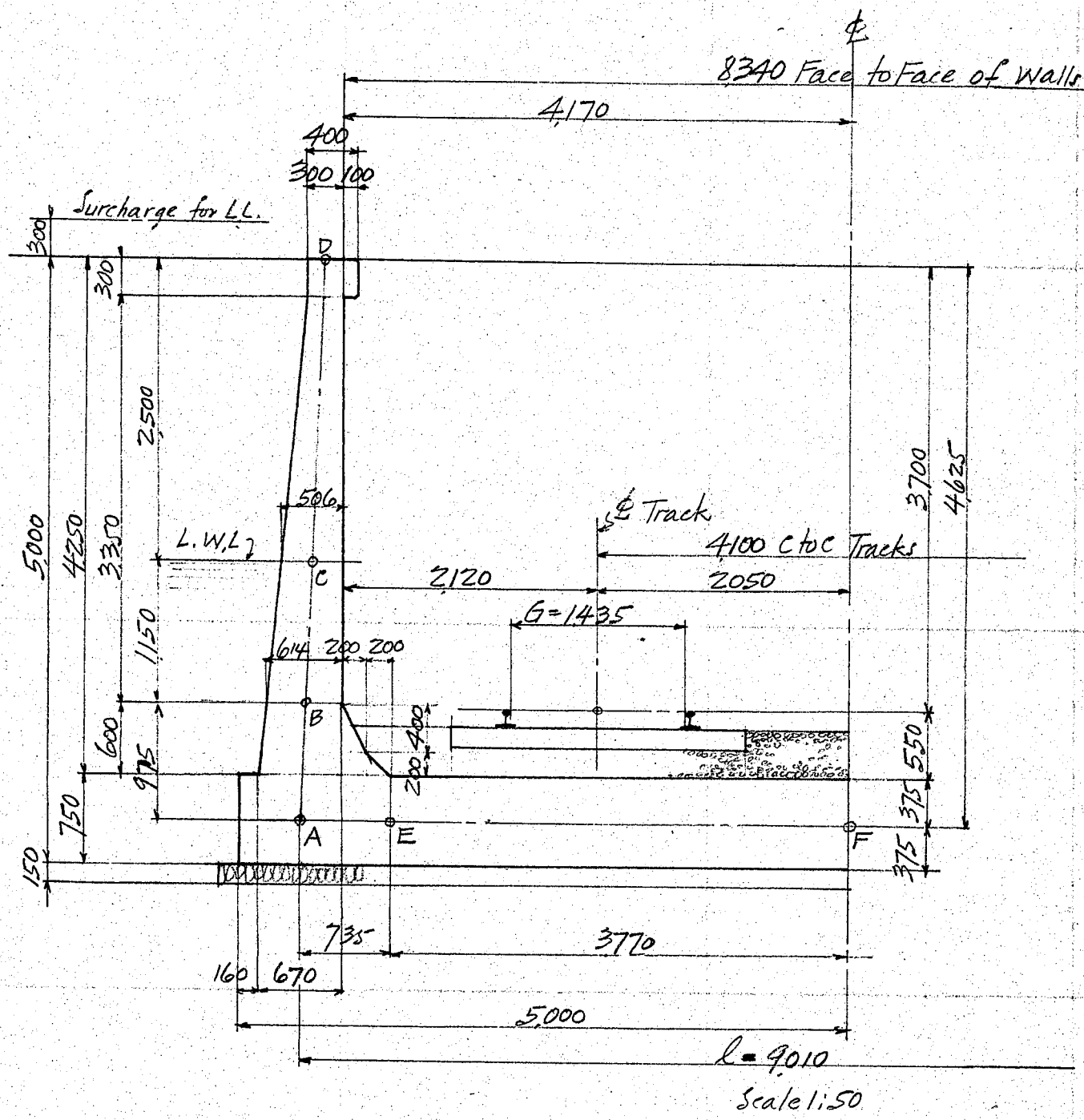
設計 稲葉 日付 16-12-3 類別 OC5
照査 日付 第 4 頁

上海隧道出入口開桝

隧道出入口開桝 高5.0m…OC5



土圧

断面	土深		土圧	総土圧
D	0.30m	(第2頁参照)	160 kg/m²	—
C	2.80	(〃)	1,490	2060 kg
B	3.95	⅓×1600×3.95 = 2110		
		⅓×400×1.15 = 150	2260	1875×1.15 = 2160+2060 = 4220 〃
A	4.625	⅓×1600×4.625 = 2460		
		⅓×400×2.125 = 280	2740	2500×0.975 = 2440+4220 = 6660 〃

彎曲率

断面		総土圧			彎曲率	所要有効深	使用有効深
C		2,060 kg	× 0.875 =		1800 kgm	d_c = 15.9 cm	d = 45.6 cm
B	2160		× 0.536 =	1,160			
	2060		× 2.025 =	4170	5330 〃	$d_B=\sqrt{\frac{5330\times100}{100\times7.13}}$ = 27.4	d = 56.4 〃
	4220 〃		1.263 〃				
A	2440		× 0.473 =	1150			$67+\frac{97.5}{3}$ = 99.5
	4220		× 2.238 =	9450	10,600 〃	$d_A=\sqrt{\frac{10600\times100}{100\times7.13}}$ = 38.6	d = 94.5 cm
	6660 〃						

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照査 日付 第 5 頁

上海隧道出入口 開框

鐵筋 斷面

C　A_s = (第3圖參照) 3.76 cm² 16φ−400 ctoc = 5.03 cm²

B　$A_s = \frac{5330\times100}{1200\times\frac{7}{8}\times56.4} = 9.01$ 16φ−200 ctoc = 10.06 cm²

A　$A_s = \frac{10600\times100}{1200\times\frac{7}{8}\times94.5} = 10.69$ 16φ−200 ctoc = 10.06 cm²

斷面A

$p = \frac{10.06}{100\times94.5} = 0.00107$, $k = 0.167$, $j = 0.944$

$\sigma_s = \frac{10600\times100}{10.06\times0.944\times94.5} = 1180$ kg/cm²

$\sigma_c = \frac{1180\times0.167}{15\times0.833} = 15.8$

$\tau = \frac{6660}{100\times0.944\times94.5} = 0.75$

側壁重量

壁	0.40×0.30	=	0.12
躯体	0.457×3.35	=	1.53
持送	0.04+0.02+0.04	=	0.10
			1.75 @2400 = 4200
增土	0.345×4.55	=	1.57 @1600 = 2,510
〃	0.242×1.75	=	0.42 @400 = 170
			6,880 kg

底面支力 $= \frac{6880}{5.0} = 1380$ kg/m²

F点（下永中央）

$\frac{1}{8}\times1380\times9.01^2 = 14,000$

$M_A = -10,600$

$M_F = 3400$ kgm

$A_s = \frac{3400\times100}{1200\times\frac{7}{8}\times67} = 4.83$ cm²

16φ−400 ctoc = 5.03 cm²

E点

$-\frac{1}{2}\times1380\times3.77^2 = -9800$

$M_F = 3400$

$M_E = -6,400$ kgm

$A_s = \frac{6400\times100}{1200\times\frac{7}{8}\times67} = 9.10$ cm²

16φ−200 ctoc = 10.06 cm²

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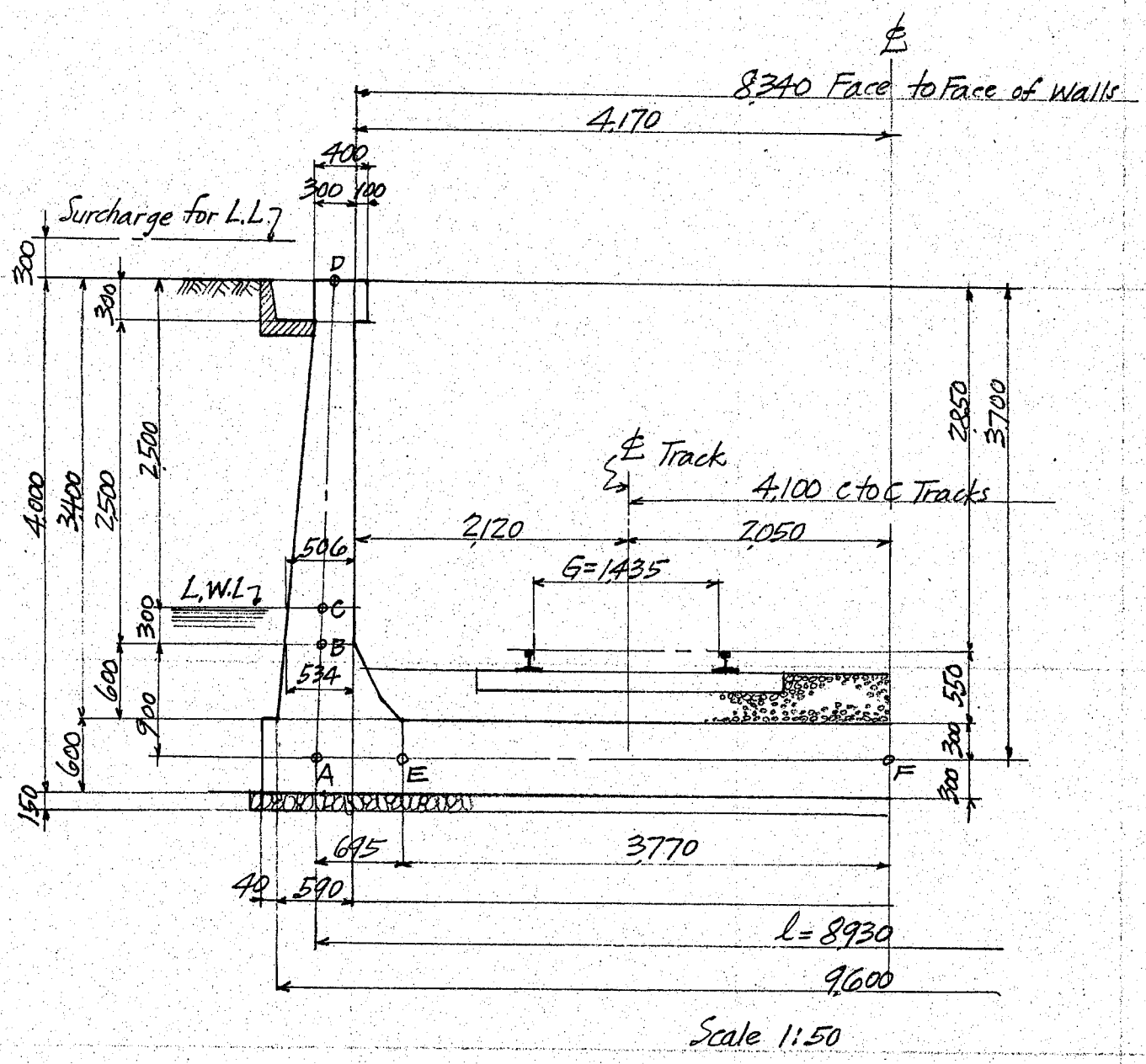
設計 稲葉 日付 16-12-4 類別 OC4
照査 日付 第 6 頁

上海隧道出入口開框

隧道出入口開框高4.0m --- OC4



Scale 1:50

土圧

断面	土深		
D	0.30m	(第2頁参照)	
C	2.80	(〃)	
B	3.10	½×1600×3.10 =	16.60
		½×400×0.30 =	40
A	4.0	½×1600×4.00 =	2140
		½×400×1.20 =	160

土圧		総土圧
160 kg/m²		
1490		2060 kg
1,700	1595×0.30 = 480 + 2060 =	2540 〃
2,300	2,000×0.90 = 1800 + 2540 =	4340 〃

彎曲率

断面		総土圧		
C		2060 kg	× 0.875 =	
B	480		× 0.147 =	70
	2060		× 1.175 =	2420
	2,540 〃		0.981	
A	1800		× 0.428 =	770
	2540		× 1.881 =	4780
	4,340 〃			

彎曲率		所要有効深	使用有効深
1,800 kgm	d_c =	= 15.9 cm	d = 45.6 cm
2,490 〃	$d_B = \sqrt{\frac{2490\times100}{100\times7.13}}$ =	18.7 cm	d = 48.4 〃
5,550 〃	$d_A = \sqrt{\frac{5550\times100}{100\times7.13}}$ =	27.9 cm	59 + 90/3 = 89 d = 89 - 5 = 84 cm

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設計 稲葉 日付 16-12-4 類別 O.C.4
照査 日付 第 7 頁

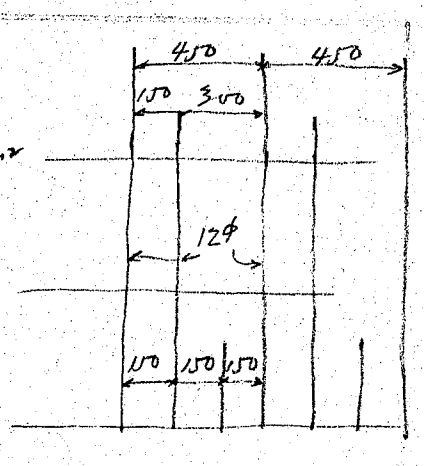
上海隧道出入口開粗

鐵筋斷面

C　$A_s = \frac{1800 \times 100}{1200 \times 7/8 \times 45.6} = 3.76\ cm^2$　　12φ − {150/300} ctoc = 5.03 cm²

B　$A_s = \frac{2490 \times 100}{1200 \times 7/8 \times 48.4} = 4.90$ "　　12φ − {150/300} ctoc = 5.03 cm²

A　$A_s = \frac{5550 \times 100}{1200 \times 7/8 \times 84.0} = 6.29$ "　　12φ − 150 ctoc = 7.54 cm²



側壁重量

笠	0.40 × 0.30	=	0.12
躯体	0.445 × 3.10	=	1.38
持送	0.04+0.02+0.04	=	0.10
			1.60 @ 2400 = 3840
背土	0.185 × 3.70	=	0.68 @ 1600 = 1090
	0.082 × 0.90	=	0.07 @ 400 = 30
			4960

底面反力 $= \frac{4960}{4.85} = 1,020\ kg/m^2$

F点（下床中央）

$M_A = \frac{1}{8} \times 1020 \times 8.93^2 = 10,150$
$= -5550$
$M_F = 4600\ kgm$

$A_s = \frac{4600 \times 100}{1200 \times 7/8 \times 52} = 8.43\ cm^2$

16φ − 450 ctoc = 4.47
2 − 12φ − 450 " = 5.03
9.50 cm²

E点

$-\frac{1}{2} \times 1020 \times 3.77^2 = -7,240$
$M_E = 5250$
$M_E = -1,990\ kgm$

$A_s = \frac{1990 \times 100}{1200 \times 7/8 \times 52} = 3.65\ cm^2$

2 − 12φ − 450 ctoc = 5.03 cm²

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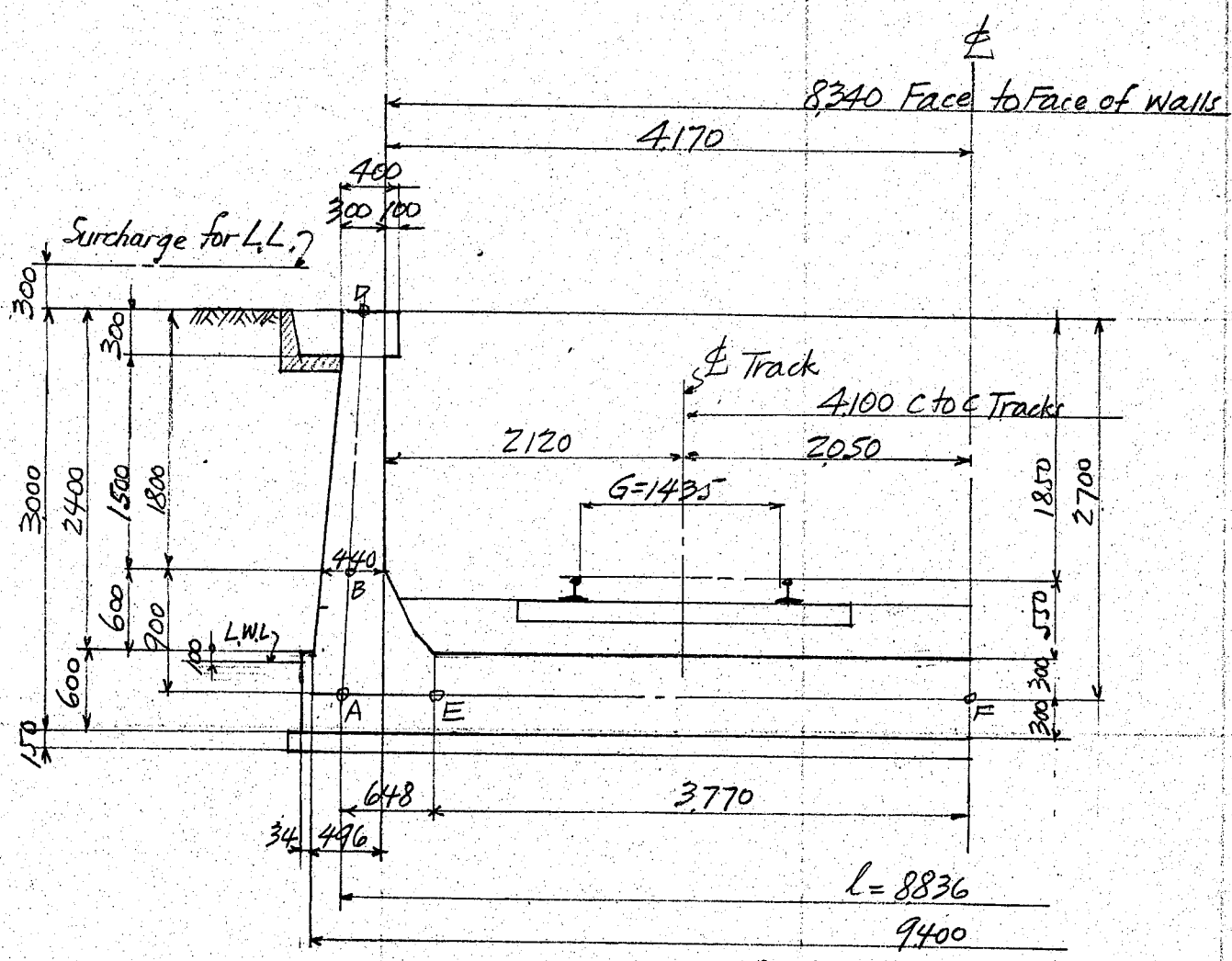
設計 稲葉 日付 16-12-4 類別 OC3
照査 日付 第 8 頁

上海隧道出入口開桁

隧道出入口開桁 高サ 3.0m --- OC3



Scale 1:50

土圧

断面	土深		土圧		総土圧
D	0.30m	(第2頁参照)	160 kg/m²		
B	2.10	½×1600×2.10 =	1,120	640×1.80 =	1150 kg
A	3.00	⅓×1600×3.00 = 1600 ⅓×400×0.20 = 30	1630	1375×0.90 = 1240+1150 = 2390	

彎曲率

断面			彎曲率	所要有効深	使用有効深
B		1150×0.673 =	775 kgm	$d_B=\sqrt{\frac{775\times100}{100\times7.13}}$ = 10.4cm	d = 39 cm
A	1240	×0.422 = 520			49.6+90/3 = 79.6
	1150	×1.573 = 1.810			
	2390		2330 kgm	$d_A=\sqrt{\frac{1810\times100}{100\times7.13}}$ = 16.0cm	d = 74.6 cm

鉄筋

断面			
B	$A_s=\frac{775\times100}{1200\times7/8\times39}$ =	1.89 cm²	12φ − 600 c to c = 1.89 cm²
A	$A_s=\frac{2230\times100}{1200\times7/8\times74.6}$ =	2.85 cm²	12φ − 300 c to c = 3.77 cm²

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設計 稲葉 日付 16-12-4 類別 0C3
照査 日付 第 9 頁

上海隧道出入口開柱

側壁重量

壁	0.40 × 0.30 =	0.12	
躯体	0.398 × 2.10 =	0.84	
持送	0.04 + 0.02 + 0.04 =	0.10	
		1.06 @2400 =	2550
培土	0.132 × 2.70 = 0.36 @1600 =		580
			3130 kg

底面反力 $= \frac{3130}{4.70} = 665$ kg/m²

F点(下床中央)

$M_A = \frac{1}{8} \times 665 \times 8.836^2 = 6480$

$-M_F = 6480 - 2330 = 4150$ kgm

$A_s = \frac{4150 \times 100}{1200 \times 7/8 \times 52} = 7.60$ cm²

12φ−150 c to c = 7.54 cm² ✓

E点

$M_F = -\frac{1}{2} \times 665 \times 3.77^2 = -4730$

$M_E = -4730 + 4150 = -580$ kgm

$A_s = \frac{580 \times 100}{1200 \times 7/8 \times 52} = 1.06$ cm²

12φ−600 c to c = 1.89 cm² ✓

高サ3m未満ノ部分ハ総テ地下水位以上トスルヲ以テ両側ニ別々ノ基礎ヲ施工シ其上ニ石積其他適当ナル擁壁ヲ築造スルモノトス.