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

設計	日付	類別
照査	日付	第　頁

上海高速鐵道

鐵筋混凝土複線桁橋

支間八、〇米三徑間、兩脇各一、五米
高六、〇米 應力計算書

Reinforced Concrete Rahmen Bridge.

Double Track

3 Continuous spans @ 8.0m, 6.0m high

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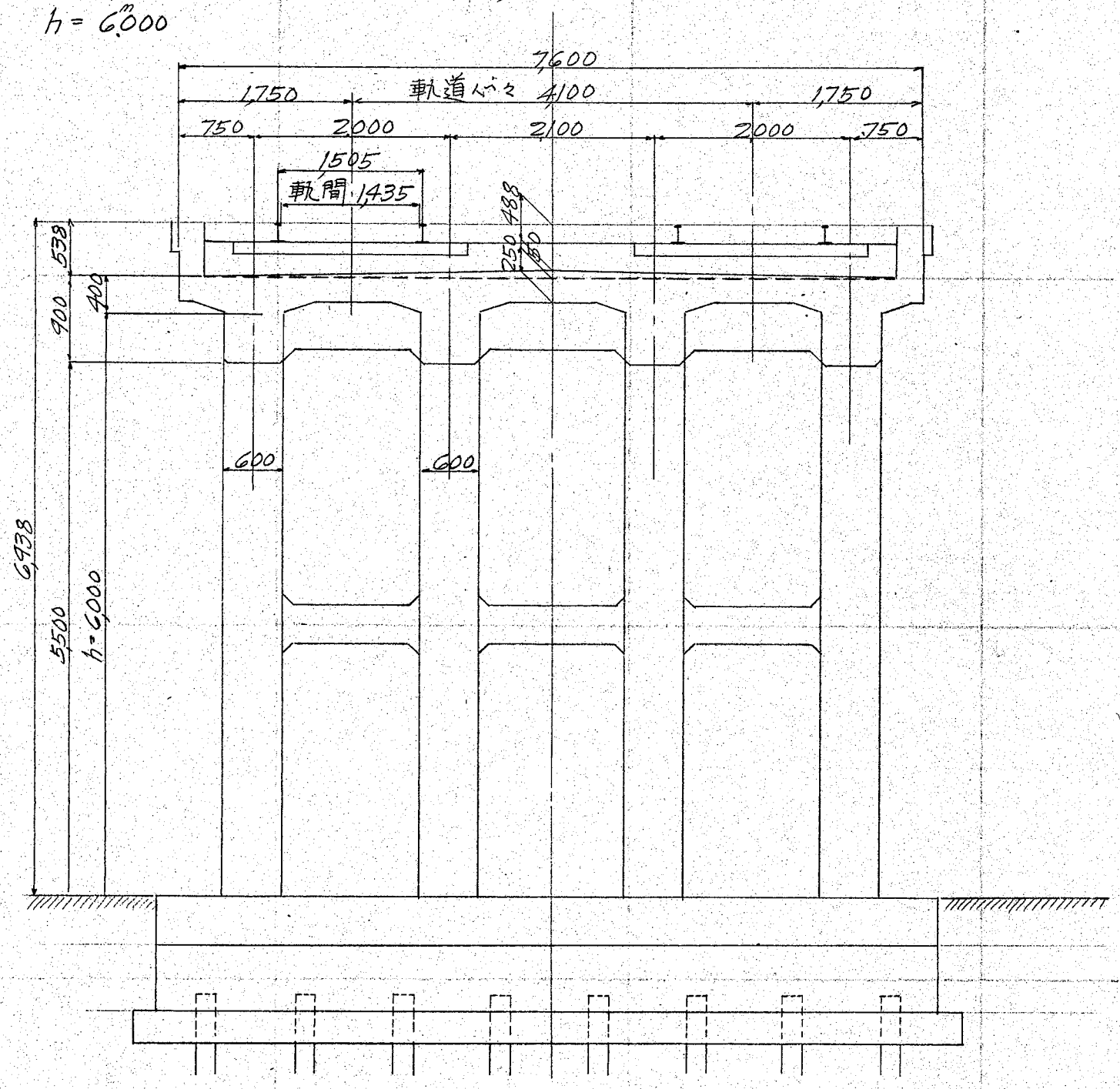
設計　日付　類別 S16

照査　日付　第　/ 頁

鐵筋混凝土高架橋
複線電車軌道 (60 噸電車)
支間 8.000m　四脚式両腕付枠形ラーメン
h = 6.000m



縮尺 1:60

床版ノ設計
h=5,000ノ場合ト同一ノモノヲ用フ

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 × 0.25	@ 2,400	= 1,230
桁	0.60 × 0.65	@ 〃	= 940
持送り	0.30 × 0.15	@ 〃	= 110
			60
			wd = 4,100 kg/m

假定断面
主桁　中立軸ノ位置

2.00 × 0.25	=	0.500	× 0.125	=	0.0625
0.60 × 0.65	=	0.390	× 0.575	=	0.2243
0.30 × 0.15	=	0.045	× 0.300	=	0.0135
		0.935	0.32		0.3003

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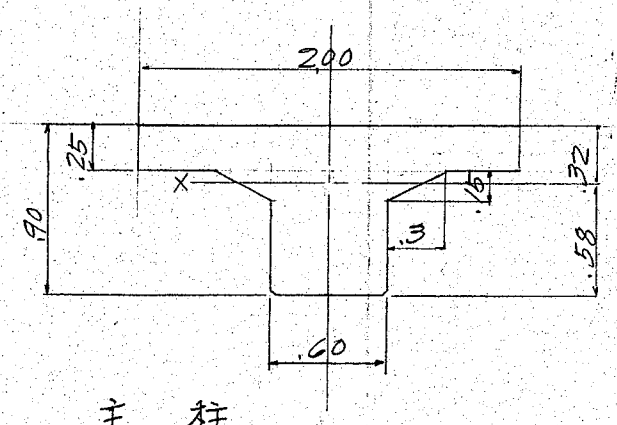
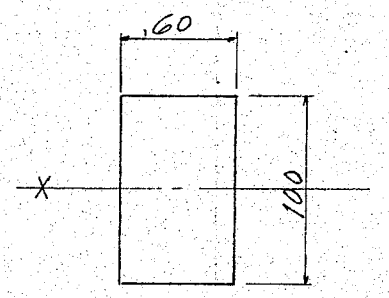
設計　日付　類別 8h6
照査　日付　第 2 頁

鐵筋混凝土高架橋



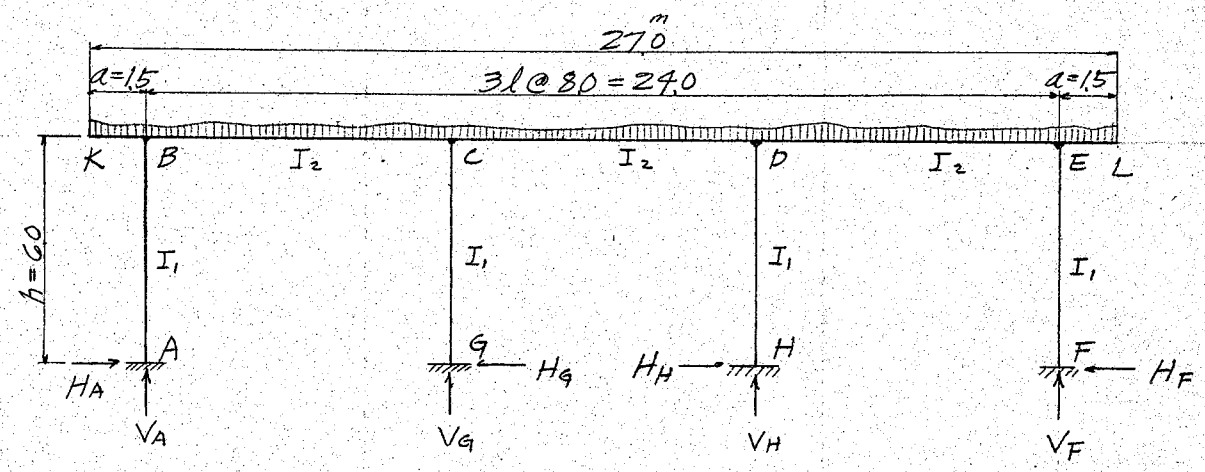
主　柱



物量力率

$$\frac{2.00\times0.25^3}{12}+0.500\times0.195^2=0.0216$$
$$\frac{0.6\times0.65^3}{12}+0.390\times0.255^2=0.0391$$
$$\frac{2\times0.3\times0.015^3}{36}+0.045\times0.02^2=0.0001$$
$$I_2=0.0608\ m^4$$

$$A=1.0\times0.6=0.60\ m^2$$
$$I_1=\frac{.60\times1.00^3}{12}=0.05\ m^4$$



$$K_1=\frac{I_1}{h},\quad K_2=\frac{I_2}{l}$$

$$M_{BA}=2EK_1(2\theta_B-3R)=-M_{BI}$$
$$M_{BC}=2EK_2(2\theta_B+\theta_C)-C_{BC}=M_{BR}$$
$$M_{BK}=m_{BK}=-M_{BL}$$

$$M_{CB}=2EK_2(2\theta_C+\theta_B)+C_{CB}=-M_{CL}$$
$$M_{CD}=2EK_2(2\theta_C+\theta_D)-C_{CD}=M_{CR}$$
$$M_{CG}=2EK_1(2\theta_C-3R)=-M_{CI}$$

$$M_{DC}=2EK_2(2\theta_D+\theta_C)+C_{DC}=-M_{DL}$$
$$M_{DE}=2EK_2(2\theta_D+\theta_E)-C_{DE}=M_{DR}$$
$$M_{DH}=2EK_1(2\theta_D-3R)=M_{DI}$$

$$M_{ED}=2EK_2(2\theta_E+\theta_D)+C_{ED}=-M_{EL}$$
$$M_{EF}=2EK_1(2\theta_E-3R)=M_{EI}$$
$$M_{EL}=-m_{EL}=M_{ER}$$

$$M_{AB}=2EK_1(\theta_B-3R)=M_A$$
$$M_{GC}=2EK_1(\theta_C-3R)=M_G$$
$$M_{HD}=2EK_1(\theta_D-3R)=-M_H$$
$$M_{FE}=2EK_1(\theta_E-3R)=-M_F$$

條件式

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	$2K_B$	K_2			$-3K_1$	=	$(C_{BC}-m_{BK})/2E$
2	K_2	$2K_C$	K_2		$-3K_1$	=	$(C_{CD}-C_{CB})/2E$
3		K_2	$2K_D$	K_2	$-3K_1$	=	$(C_{DE}-C_{DC})/2E$
4			K_2	$2K_E$	$-3K_1$	=	$(m_{EL}-C_{ED})/2E$
5	K_1	K_1	K_1	K_1	$-8K_1$	=	0

$I_1=0.05\ m^4$, $I_2=0.0608\ m^4$, $h=6.00^m$, $l=8.00^m$
$K_1=\frac{I_1}{h}=0.00833$, $K_2=\frac{I_2}{l}=0.0076$, $K_B=K_E=K_1+K_2=0.01593$
$3K_1=0.02499$, $8K_1=0.06664$, $K_C=K_D=K_1+2K_2=0.02353$

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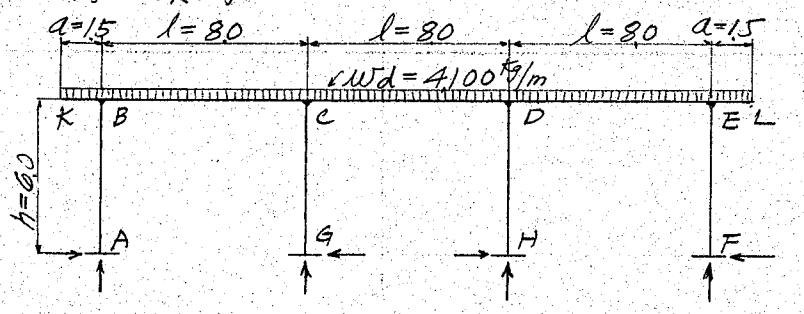
照査　日付　第 3頁

鐵筋混凝土高架橋

番號	Q_B	Q_C	Q_D	Q_E	R		荷重項
1	4.192	1			-3288	=	$(C_{BC}-M_{BK})/2.13(10)^7$
2	1	6.192	1		-3288	=	$(C_{CD}-C_{CB})/2.13(10)^7$
3		1	6.192	1	-3288	=	$(C_{DE}-C_{DC})/2.13(10)^7$
4			1	4.192	-3288	=	$(M_{EL}-C_{ED})/2.13(10)^7$
5	1	1	1	1	-8.000	=	0

死荷重應力



$wd = 4,100$ kg/m

荷重項
$C_{BC}=C_{CB}=C_{CD}=C_{DC}=C_{DE}=C_{ED}=21,870$ kgm
$M_{BK}=M_{EL}=4,610$ kgm
$C_{BC}-M_{BK}/2.13(10)^7=0.00081$
$C_{CD}-C_{CB}/2.13(10)^7=0$
$C_{DE}-C_{DC}/2.13(10)^7=0$
$M_{EL}-C_{ED}/2.13(10)^7=-0.00081$

$Q_B = 0.0002025$, $Q_C = -0.0000390$

$M_{BA} = 28(10)^8 \times 0.00833 \times 0.000405 = 9,450$ kgm
$M_{BC} = 28(10)^8 \times 0.0076 \times (0.000405 - 0.000039) - 21,870 = -14,060$ kgm
$M_{BK} = 4,610$ kgm

$M_{CB} = 28(10)^8 \times 0.0076 \times (-0.000078 + 0.0002025) + 21,870 = 24,520$ kgm
$M_{CD} = 28(10)^8 \times 0.0076 \times (-0.000039) - 21,870 = -22,700$ kgm
$M_{CG} = 28(10)^8 \times 0.00833 \times (-0.000078) = -1,820$ kgm

$M_{AB} = 28(10)^8 \times 0.00833 \times 0.0002025 = 4720$ kgm
$M_{GC} = 28(10)^8 \times 0.00833 \times -0.000039 = -910$ kgm

彎曲率

$M_{BL} = -9450$ kgm　$M_{CL} = -24520$ kgm　$M_A = 4,720$ kgm
$M_{BR} = -14,060$ kgm　$M_{CR} = -22,700$ kgm　$M_G = -910$ kgm
$M_{BL} = -4,610$ kgm　$M_{C1} = 1,820$ kgm

垂直力

$$V_A = \frac{14060 - 24520}{8.0} + 4,100 \times 5.5 = 21,240 \text{ kg}$$

$$V_G = \frac{-14060 + 24520}{8.0} + 4,100 \times 8.0 = 34,110 \text{ kg}$$

水平反力

$$H_A = \frac{9450 + 4720}{6.0} = 2,365 \text{ kg} \longrightarrow$$

$$H_G = \frac{1820 + 910}{6.0} = 455 \text{ kg} \longleftarrow$$

剪力

$S_{BL} = -4,100 \times 1.5 = -6,150$ kg
$S_{BR} = 21,240 - 6,150 = 15,090$ kg
$S_1 = 15,090 - 2 \times 4,100 = 6,890$ kg
$S_3 = 15,090 - 6 \times 4,100 = -9,510$ kg
$S_{CL} = 15,090 - 4,100 \times 8.00 = -17,710$ kg
$S_{CR} = -17,710 + 34,110 = 16,400$ kg
$S_4 = 16,400 - 2 \times 4,100 = 8,200$ kg
$S_{B1} = -2,365$ kg
$S_{C1} = 455$ kg

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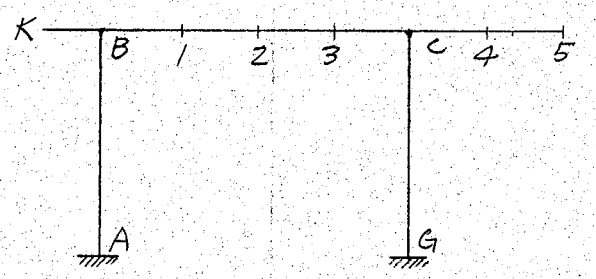
設計　日付　類別 8h6
照査　日付　第 4 頁

鐵筋混凝土高架橋
格点弯曲率



格点弯曲率（單桁トレテ）

桁中央　$M = 32,800$ kgm
¼ 点　$M = 24,600$ kgm

格点 1　$24,600 - 14,060 - \frac{24520-14060}{4} = 7,925$ kgm

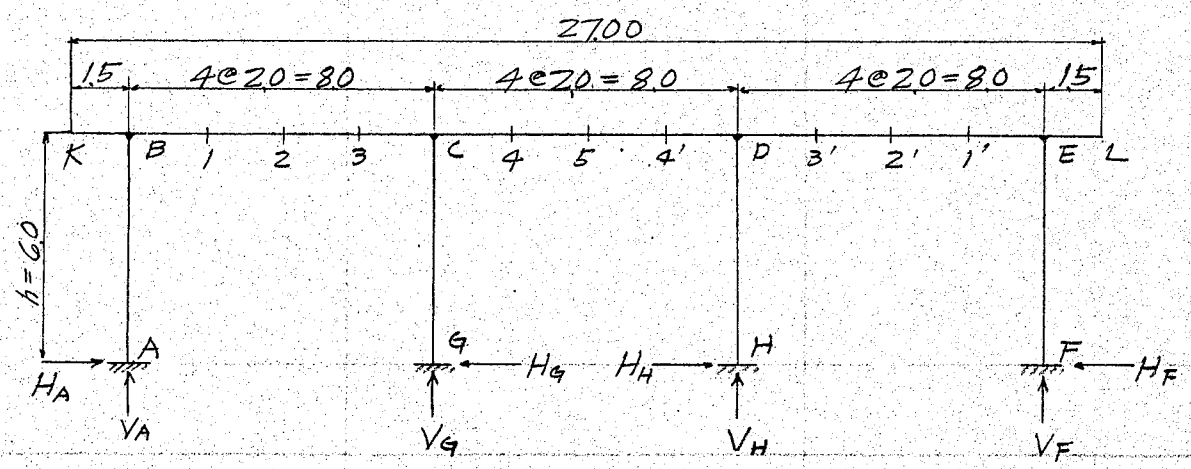
格点 2　$32,800 - 14,060 - \frac{2(24520-14060)}{4} = 13,510$ kgm

格点 3　$24,600 - 14,060 - \frac{3(24520-14060)}{4} = 2,700$ kgm

格点 4　$24,600 - 22,700 = 1,900$ kgm

格点 5　$32,800 - 22,700 = 10,100$ kgm

活荷重



D 荷重 1 kg が K 点ニ作用セル場合

$M_{BK} = 1.5$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	4.192	1			-3.288	=	$-0.704 \div (10)^7$
2	1	6.192	1		-3.288	=	0
3		1	6.192	1	-3.288	=	0
4			1	4.192	-3.288	=	0
5	1	1	1	1	-8.000	=	0

$\theta_B = -1,929 \div (10)''$, $\theta_C = 199 \div (10)''$, $\theta_D = -141 \div (10)''$, $\theta_E = -166 \div (10)''$, $R = -255 \div (10)''$

$M_{BA} = 28(10)^8 \times 0.00833 \times (-3858 + 765) \div (10)'' = -0.722$
$M_{BC} = 28(10)^8 \times 0.0076 \times (-3858 + 199) \div (10)'' = -0.778$
$M_{BK} = 1.5$

$M_{CB} = 28(10)^8 \times 0.0076 \times (398 - 1,929) \div (10)'' = -0.326$
$M_{CD} = 28(10)^8 \times 0.0076 \times (398 - 141) \div (10)'' = 0.055$
$M_{CG} = 28(10)^8 \times 0.00833 \times (398 + 765) \div (10)'' = 0.271$

$M_{DC} = 28(10)^8 \times 0.0076 \times (-282 + 199) \div (10)'' = -0.018$
$M_{DE} = 28(10)^8 \times 0.0076 \times (-282 - 166) \div (10)'' = -0.095$
$M_{DH} = 28(10)^8 \times 0.00833 \times (-282 + 765) \div (10)'' = 0.113$

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鐵筋混凝土高架橋

$M_{ED} = 28(10)^8 \times 0.0076 \times (-332 - 141) \div (10)'' = -0.101$
$M_{EF} = 28(10)^8 \times 0.00833 \times (-332 + 765) \div (10)'' = 0.101$

$M_{AB} = 28(10)^8 \times 0.00833 \times (-1929 + 765) \div (10)'' = -0.272$
$M_{GL} = 28(10)^8 \times 0.00833 \times (199 + 765) \div (10)'' = 0.225$
$M_{HD} = 28(10)^8 \times 0.00833 \times (-141 + 765) \div (10)'' = 0.145$
$M_{FE} = 28(10)^8 \times 0.00833 \times (-166 + 765) \div (10)'' = 0.140$

單位弯曲率

$M_{BI} = 0.722$	$M_{CL} = 0.326$	$M_{DL} = 0.018$	$M_{EL} = 0.101$
$M_{BR} = -0.778$	$M_{CR} = 0.055$	$M_{DR} = -0.095$	$M_{EI} = 0.101$
$M_{BL} = -1.500$	$M_{CI} = -0.271$	$M_{DI} = 0.113$	

$M_A = -0.272$　　$M_H = -0.145$
$M_G = 0.225$　　$M_F = -0.140$

單位垂直力

$V_A = 1.000 + \frac{0.778 + 0.326}{8.0} = 1.138$

$V_G = \frac{-0.778 - 0.326 - 0.055 + 0.018}{8.0} = -0.143$

$V_H = \frac{0.055 - 0.018 + 0.095 + 0.101}{8.0} = 0.029$

$V_F = \frac{-0.095 - 0.101}{8.0} = -0.024$

水平反力

$H_A = \frac{0.722 + 0.272}{6.0} = 0.166 \leftarrow$

$H_G = \frac{0.271 + 0.225}{6.0} = 0.083 \rightarrow$

$H_H = \frac{0.113 + 0.145}{6.0} = 0.043 \rightarrow$

$H_F = \frac{0.101 + 0.140}{6.0} = 0.040 \rightarrow$

剪　力

$S_{BL} = -1.000$
$S_{BR} = 1.138 - 1.000 = 0.138 = S_{CL}$
$S_{CR} = 0.138 - 0.143 = -0.005 = S_{DL}$
$S_{DR} = S_{EL} = -0.005 + 0.029 = 0.024$
$S_A = S_{BI} = 0.166$
$S_G = S_{CI} = -0.083$
$S_H = S_{DI} = -0.043$
$S_F = S_{EI} = -0.040$

2) 荷重 1 kg が 1 点 = 作用セル 場合

$C_{BC} = 1.125$　　$C_{BC}/2.13(10)^7 = 0.528/(10)^7$
$C_{CB} = 0.375$　　$C_{CB}/2.13(10)^7 = 0.176/(10)^7$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	4.192	1			-3.288	=	$0.528 \div (10)^7$
2	1	6.192	1		-3.288	=	$-0.176 \div (10)^7$
3		1	6.192	1	-3.288	=	0
4			1	4.192	-3.288	=	0
5	1	1	1	1	-8.000	=	0

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鐵筋混凝土高架橋

$\theta_B = 1{,}496 \div (10)''$, $\theta_C = -466 \div (10)''$, $\theta_D = 145 \div (10)''$, $\theta_E = 89 \div (10)''$, $R = 158 \div (10)''$

$M_{BA} = 28(10)^8 \times 0.00833 \times (2{,}992 - 474) \div (10)'' = 0.587$
$M_{BC} = 28(10)^8 \times 0.0076 \times (2{,}992 - 466) \div (10)'' - 1.125 = -0.587$

$M_{CB} = 28(10)^8 \times 0.0076 \times (-932 + 1{,}496) \div (10)'' + 0.375 = 0.495$
$M_{CD} = 28(10)^8 \times 0.0076 \times (-932 + 145) \div (10)'' = -0.167$
$M_{CG} = 28(10)^8 \times 0.00833 \times (-932 - 474) \div (10)'' = -0.328$

$M_{DC} = 28(10)^8 \times 0.0076 \times (290 - 466) \div (10)'' = -0.037$
$M_{DE} = 28(10)^8 \times 0.0076 \times (290 + 89) \div (10)'' = 0.080$
$M_{DH} = 28(10)^8 \times 0.00833 \times (290 - 474) \div (10)'' = -0.043$

$M_{ED} = 28(10)^8 \times 0.0076 \times (178 + 145) \div (10)'' = 0.069$
$M_{EF} = 28(10)^8 \times 0.00833 \times (178 - 474) \div (10)'' = -0.069$

$M_{AB} = 28(10)^8 \times 0.00833 \times (1496 - 474) \div (10)'' = 0.238$
$M_{GC} = 28(10)^8 \times 0.00833 \times (-466 - 474) \div (10)'' = -0.219$
$M_{HD} = 28(10)^8 \times 0.00833 \times (145 - 474) \div (10)'' = -0.077$
$M_{FE} = 28(10)^8 \times 0.00833 \times (89 - 474) \div (10)'' = -0.090$

單位彎曲率

$M_{BI} = -0.587$	$M_{CL} = -0.495$	$M_{DL} = 0.037$	$M_{EL} = -0.069$
$M_{BR} = -0.587$	$M_{CR} = -0.167$	$M_{DR} = 0.080$	$M_{EI} = -0.069$
	$M_{CI} = 0.328$	$M_{DI} = -0.043$	

$M_A = 0.238$　　$M_H = 0.077$
$M_G = -0.219$　　$M_F = 0.090$

單位垂直力

$$V_A = \frac{0.587 - 0.495 + 1.0 \times 6.0}{8.0} = 0.761$$

$$V_G = \frac{-0.587 + 0.495 + 0.167 + 0.037 + 1 \times 2.0}{8.0} = 0.264$$

$$V_H = \frac{-0.167 - 0.037 - 0.080 - 0.069}{8.0} = -0.044$$

$$V_F = \frac{0.080 + 0.069}{8.0} = 0.019$$

水平反力

$$H_A = \frac{0.587 + 0.238}{6.0} = 0.138 \rightarrow$$

$$H_G = \frac{0.328 + 0.219}{6.0} = 0.091 \leftarrow$$

$$H_H = \frac{0.043 + 0.077}{6.0} = 0.020 \leftarrow$$

$$H_F = \frac{0.069 + 0.090}{6.0} = 0.027 \leftarrow$$

剪力

$S_{BR} = 0.761$
$S_{CL} = 0.761 - 1.000 = -0.239$
$S_{CR} = S_{DL} = -0.239 + 0.264 = 0.025$
$S_{DR} = S_{EL} = 0.025 - 0.044 = -0.019$
$S_{BI} = S_A = -0.138$
$S_{CI} = S_G = 0.091$
$S_{DI} = S_H = 0.020$

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鐵筋混凝土高架橋

$S_{E1} = S_F = 0.027$

3) 荷重1kgが2点=作用セル場合

$C_{BC} = C_{CB} = 1.000$　　$C_{BC}/2.13 = C_{CB}/2.13 = 0.4695/(10)^7$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	4.192	1			-3.288	=	$0.4695\div(10)^7$
2	1	6.192	1		-3.288	=	$-0.4695\div(10)^7$
3			6.192	1	-3.288	=	0
4		1	1	4.192	-3.288	=	0
5	1	1	1	1	-8.000	=	0

$\theta_B = 1.419\div(10)''$, $\theta_C = -977\div(10)''$, $\theta_D = 199\div(10)''$, $\theta_E = 17\div(10)''$, $R = 82\div(10)''$

$M_{BA} = 28(10)^8 \times 0.00833 \times (2.838 - 246)\div(10)'' = 0.604$
$M_{BC} = 28(10)^8 \times 0.0076 \times (2.838 - 977)\div(10)'' - 1.000 = -0.604$

$M_{CB} = 28(10)^8 \times 0.0076 \times (-1.954 + 1.419)\div(10)'' + 1.000 = 0.886$
$M_{CD} = 28(10)^8 \times 0.0076 \times (-1.954 + 199)\div(10)'' = -0.373$
$M_{CG} = 28(10)^8 \times 0.00833 \times (-1.954 - 246)\div(10)'' = -0.513$

$M_{DC} = 28(10)^8 \times 0.0076 \times (398 - 977)\div(10)'' = -0.123$
$M_{DE} = 28(10)^8 \times 0.0076 \times (398 + 17)\div(10)'' = 0.088$
$M_{DH} = 28(10)^8 \times 0.00833 \times (398 - 246)\div(10)'' = 0.035$

$M_{ED} = 28(10)^8 \times 0.0076 \times (34 + 199)\div(10)'' = 0.050$
$M_{EF} = 28(10)^8 \times 0.00833 \times (34 - 246)\div(10)'' = -0.050$

$M_{AB} = 28(10)^8 \times 0.00833 \times (1.419 - 246)\div(10)'' = 0.274$
$M_{GC} = 28(10)^8 \times 0.00833 \times (-977 - 246)\div(10)'' = -0.285$
$M_{HD} = 28(10)^8 \times 0.00833 \times (199 - 246)\div(10)'' = -0.011$
$M_{FE} = 28(10)^8 \times 0.00833 \times (17 - 246)\div(10)'' = -0.053$

單位彎曲率

$M_{B1} = -0.604$　$M_{CL} = -0.886$　$M_{DL} = 0.123$　$M_{EL} = -0.050$　$M_A = 0.274$
$M_{BR} = -0.604$　$M_{CR} = -0.373$　$M_{DR} = 0.088$　$M_{E1} = -0.050$　$M_G = -0.285$
$M_{C1} = 0.513$　$M_{D1} = 0.035$　$M_H = 0.011$
$M_F = 0.053$

單位垂直力

$$V_A = \frac{0.604 - 0.886 + 1.0 \times 4.0}{8.0} = 0.465$$

$$V_G = \frac{-0.604 + 0.886 + 0.373 + 0.123 + 1.0 \times 4.0}{8.0} = 0.597$$

$$V_H = \frac{-0.373 - 0.123 - 0.088 - 0.050}{8.0} = -0.079$$

$$V_F = \frac{0.088 + 0.050}{8.0} = 0.017$$

水平反力

$$H_A = \frac{0.604 + 0.274}{6.0} = 0.146 \rightarrow$$

$$H_G = \frac{0.513 + 0.285}{6.0} = 0.133 \leftarrow$$

$$H_H = \frac{0.035 - 0.011}{6.0} = 0.004 \rightarrow$$

$$H_F = \frac{0.050 + 0.053}{6.0} = 0.017 \leftarrow$$

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鐵筋混凝土高架橋

剪力

$S_{BR} = 0,465$
$S_{CL} = 0,465 - 1,000 = -0,535$
$S_{CR} = S_{DL} = -0,535 + 0,597 = 0,062$
$S_{DR} = S_{EL} = 0,062 - 0,079 = -0,017$
$S_{BI} = S_A = -0,146$
$S_{CI} = S_G = 0,133$
$S_{DI} = S_H = -0,004$
$S_F = S_{EI} = 0,017$

4) 荷重 1kg が 3 点 = 作用せん場合

$C_{BC} = 0,375$　　$C_{BC}/2,13(10)^7 = 0,176/(10)^7$
$C_{CB} = 1,125$　　$C_{CB}/2,13(10)^7 = 0,528/(10)^7$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	4,192	1			-3,288	=	$0,176 \div (10)^7$
2	1	6,192	1		-3,288	=	$-0,528 \div (10)^7$
3		1	6,192	1	-3,288	=	0
4			1	4,192	-3,288	=	0
5	1	1	1	1	-8,000	=	0

$\theta_B = 631 \div (10)''$, $\theta_C = -999 \div (10)''$, $\theta_D = 153 \div (10)''$, $\theta_E = -64 \div (10)''$, $R = -35 \div (10)''$

$M_{BA} = 28(10)^8 \times 0.00833 \times (1,262 + 105) \div (10)'' = 0,319$
$M_{BC} = 28(10)^8 \times 0.0076 \times (1,262 - 999) \div (10)'' - 0,375 = -0,319$

$M_{CB} = 28(10)^8 \times 0.0076 \times (-1,998 + 631) \div (10)'' + 1,125 = 0,834$
$M_{CD} = 28(10)^8 \times 0.0076 \times (-1,998 + 153) \div (10)'' = -0,393$
$M_{CG} = 28(10)^8 \times 0.00833 \times (-1,998 + 105) \div (10)'' = -0,441$

$M_{DC} = 28(10)^8 \times 0.0076 \times (306 - 999) \div (10)'' = -0,148$
$M_{DE} = 28(10)^8 \times 0.0076 \times (306 - 64) \div (10)'' = 0,052$
$M_{DH} = 28(10)^8 \times 0.00833 \times (306 + 105) \div (10)'' = 0,096$

$M_{ED} = 28(10)^8 \times 0.0076 \times (-128 + 153) \div (10)'' = 0,005$
$M_{EF} = 28(10)^8 \times 0.00833 \times (-128 + 105) \div (10)'' = -0,005$

$M_{AB} = 28(10)^8 \times 0.00833 \times (631 + 105) \div (10)'' = 0,172$
$M_{GC} = 28(10)^8 \times 0.00833 \times (-999 + 105) \div (10)'' = -0,209$
$M_{HD} = 28(10)^8 \times 0.00833 \times (153 + 105) \div (10)'' = 0,060$
$M_{FE} = 28(10)^8 \times 0.00833 \times (-64 + 105) \div (10)'' = 0,010$

單位彎曲率

$M_{BI} = -0,319$　$M_{CL} = -0,834$　$M_{DL} = 0,148$　$M_{EL} = -0,005$　$M_A = 0,172$
$M_{BR} = -0,319$　$M_{CR} = -0,393$　$M_{DR} = 0,052$　$M_{EI} = -0,005$　$M_G = -0,209$
$M_{CI} = 0,441$　$M_{DI} = 0,096$　$M_H = -0,060$
$M_F = -0,010$

單位垂直力

$$V_A = \frac{0,319 - 0,834 + 1 \times 2,0}{8,0} = 0,186$$

$$V_G = \frac{-0,319 + 0,834 + 0,393 + 0,148 + 1 \times 6,0}{8,0} = 0,882$$

$$V_H = \frac{-0,393 - 0,148 - 0,052 - 0,005}{8,0} = -0,075$$

$$V_F = \frac{0,052 + 0,005}{8,0} = 0,007$$

鐵筋混凝土高架橋

水平反力

$$H_A = \frac{0.319 + 0.172}{6.0} = 0.082 \longrightarrow$$

$$H_G = \frac{0.441 + 0.209}{6.0} = 0.108 \longleftarrow$$

$$H_H = \frac{0.096 + 0.060}{6.0} = 0.026 \longrightarrow$$

$$H_F = \frac{-0.005 + 0.010}{6.0} = 0.001 \longrightarrow$$

剪　力

$S_{BR} = 0.186$
$S_{CL} = 0.186 - 1.000 = -0.814$
$S_{CR} = -0.814 + 0.882 = 0.068 = S_{DL}$
$S_{DR} = S_{EL} = 0.068 - 0.075 = -0.007$
$S_{BI} = S_A = -0.082$
$S_{CI} = S_G = 0.108$
$S_{DI} = S_H = -0.026$
$S_{EI} = S_F = -0.001$

5) 荷重 1 kg が 4 点に作用せる場合

$C_{CD} = 1.125$　　$C_{CP}/2.13(10)^7 = 0.528/(10)^7$
$C_{DC} = 0.375$　　$C_{DC}/2.13(10)^7 = 0.176/(10)^7$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	4.192	1			-3288	=	0
2	1	6.192	1		-3288	=	$0.528 \div (10)^7$
3		1	6.192	1	-3.288	=	$-0.176 \div (10)^7$
4			1	4.192	-3288	=	0
5	1	1	1	1	-8.000	=	0

$\theta_B = -184 \div (10)''$, $\theta_C = 989 \div (10)''$, $\theta_D = -434 \div (10)''$, $\theta_E = 155 \div (10)''$, $R = 66 \div (10)''$

$M_{BA} = 28(10)^8 \times 0.00833 \times (-368 - 198) \div (10)'' = -0.132$
$M_{BC} = 28(10)^8 \times 0.0076 \times (-368 + 989) \div (10)'' = 0.132$

$M_{CB} = 28(10)^8 \times 0.0076 \times (1.978 - 184) \div (10)'' = 0.382$
$M_{CD} = 28(10)^8 \times 0.0076 \times (1.978 - 434) \div (10)'' - 1.125 = -0.797$
$M_{CG} = 28(10)^8 \times 0.00833 \times (1.978 - 198) \div (10)'' = 0.415$

$M_{DC} = 28(10)^8 \times 0.0076 \times (-868 + 989) \div (10)'' + 0.375 = 0.401$
$M_{DE} = 28(10)^8 \times 0.0076 \times (-868 + 155) \div (10)'' = -0.152$
$M_{DH} = 28(10)^8 \times 0.00833 \times (-868 - 198) \div (10)'' = -0.249$

$M_{ED} = 28(10)^8 \times 0.0076 \times (310 - 434) \div (10)'' = -0.026$
$M_{EF} = 28(10)^8 \times 0.00833 \times (310 - 198) \div (10)'' = 0.026$

$M_{AB} = 28(10)^8 \times 0.00833 \times (-184 - 198) \div (10)'' = -0.089$
$M_{GC} = 28(10)^8 \times 0.00833 \times (989 - 198) \div (10)'' = 0.184$
$M_{HD} = 28(10)^8 \times 0.00833 \times (-434 - 198) \div (10)'' = -0.147$
$M_{FE} = 28(10)^8 \times 0.00833 \times (155 - 198) \div (10)'' = -0.010$

單位彎曲率

$M_{BI} = 0.132$　　$M_{CL} = -0.382$　　$M_{DL} = -0.401$　　$M_{EL} = 0.026$　　$M_A = -0.089$
$M_{BR} = 0.132$　　$M_{CR} = -0.797$　　$M_{DR} = -0.152$　　$M_{EI} = 0.026$　　$M_G = 0.184$
　　$M_{CI} = -0.415$　　$M_{DI} = -0.249$　　$M_H = 0.147$
　　$M_F = 0.010$

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鐵筋混凝土高架橋

單位垂直力

$$V_A = \frac{-0.132 - 0.382}{8.0} = -0.064$$

$$V_G = \frac{0.132 + 0.382 + 0.797 - 0.401 + 1.0 \times 6.0}{8.0} = 0.864$$

$$V_H = \frac{-0.797 + 0.401 + 0.152 + 0.026 + 1.0 \times 2.0}{8.0} = 0.223$$

$$V_F = \frac{-0.152 - 0.026}{8.0} = -0.023$$

水平反力

$$H_A = \frac{0.132 + 0.089}{6.0} = 0.037 \longleftarrow$$

$$H_G = \frac{0.415 + 0.184}{6.0} = 0.100 \longrightarrow$$

$$H_H = \frac{0.249 + 0.147}{6.0} = 0.066 \longleftarrow$$

$$H_F = \frac{0.026 - 0.010}{6.0} = 0.003 \longrightarrow$$

剪　力

$S_{BR} = S_{CL} = -0.064$
$S_{CR} = -0.064 + 0.864 = 0.800$
$S_{DL} = 0.800 - 1.000 = -0.200$
$S_{DR} = -0.200 + 0.223 = 0.023$
$S_{BI} = S_A = 0.037$
$S_{CI} = S_G = -0.100$
$S_{DI} = S_H = 0.066$
$S_{EI} = S_F = -0.003$

6) 荷重1kgが5呎=作用せし場合

$C_{CD} = C_{DC} = 1.000$　$C_{CD}/2.13(10)^7 = C_{DC}/2.13(10)^7 = 0.4695/(10)^7$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	4.192	1			-3.288	=	0
2	1	6.192	1		-3.288	=	$0.4695 \div (10)^7$
3		1	6.192	1	-3.288	=	$-0.4695 \div (10)^7$
4			1	4.192	-3.288	=	0
5	1	1	1	1	-8.000	=	0

$\theta_B = -226 \div (10)^{11}$, $\theta_C = 949 \div (10)^{11}$, $\theta_D = -949 \div (10)^{11}$, $\theta_E = 226 \div (10)^{11}$, $R = 0$

$M_{BA} = 28(10)^8 \times 0.00833 \times (-452) \div (10)^{11} = -0.105$
$M_{BC} = 28(10)^8 \times 0.0076 \times (-452 + 949) \div (10)^{11} = 0.105$

$M_{CB} = 28(10)^8 \times 0.0076 \times (1.898 - 226) \div (10)^{11} = 0.355$
$M_{CD} = 28(10)^8 \times 0.0076 \times (949) \div (10)^{11} - 1.000 = -0.798$
$M_{CG} = 28(10)^8 \times 0.00833 \times (1.898) \div (10)^{11} = 0.443$

$M_{AB} = 28(10)^8 \times 0.00833 \times (-226) \div (10)^{11} = -0.053$
$M_{GC} = 28(10)^8 \times 0.00833 \times (949) \div (10)^{11} = 0.221$

單位彎曲率

$M_{BI} = 0.105$　$M_{CL} = -0.355$　$M_A = -0.053$
$M_{BR} = 0.105$　$M_{CR} = -0.798$　$M_G = 0.221$
$M_{CI} = -0.443$

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鐵筋混凝土高架橋

單位垂直力

$$V_A = \frac{-0.105 - 0.355}{8.0} = -0.058$$

$$V_G = \frac{0.105 + 0.355 + 1 \times 4.0}{8.0} = 0.558$$

水平反力

$$H_A = \frac{0.105 + 0.053}{6.0} = 0.026 \quad \leftarrow$$

$$H_G = \frac{0.443 + 0.221}{6.0} = 0.111 \quad \rightarrow$$

剪力

$S_{BR} = S_{CL} = -0.058$
$S_{CR} = 0.500$
$S_{BI} = S_A = 0.026$
$S_{CI} = S_G = -0.111$

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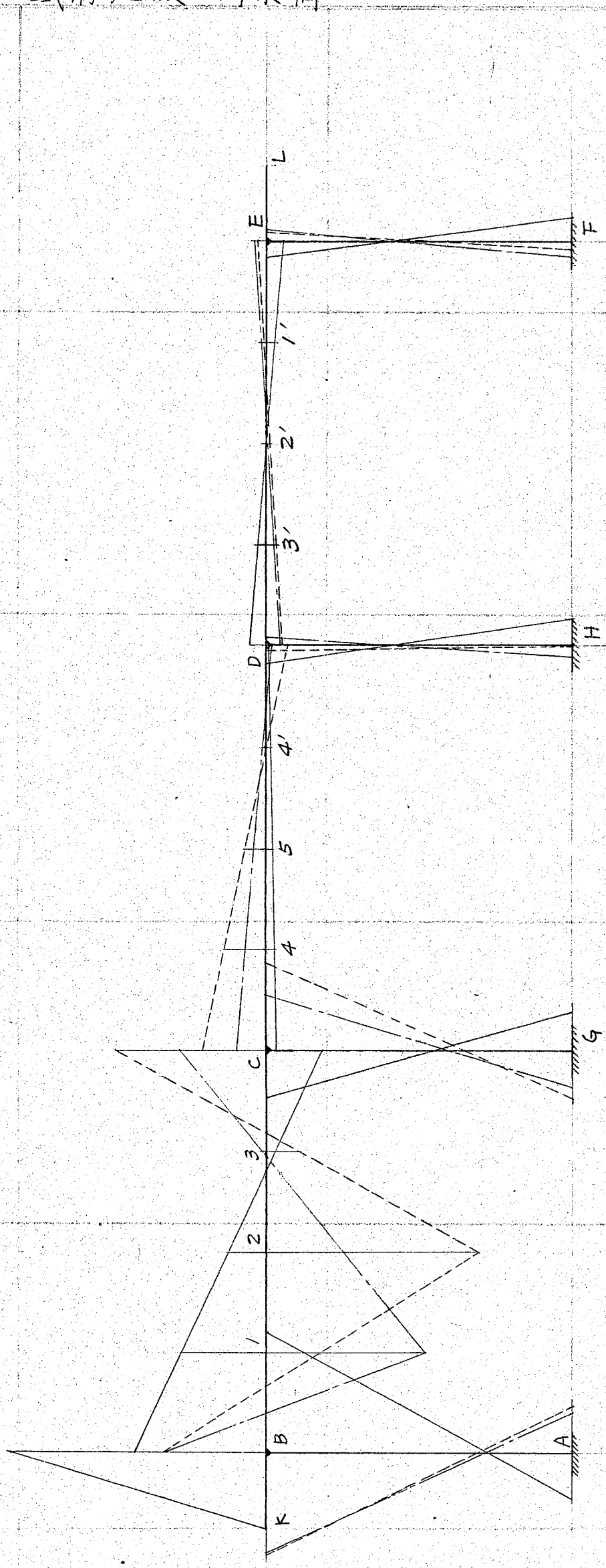
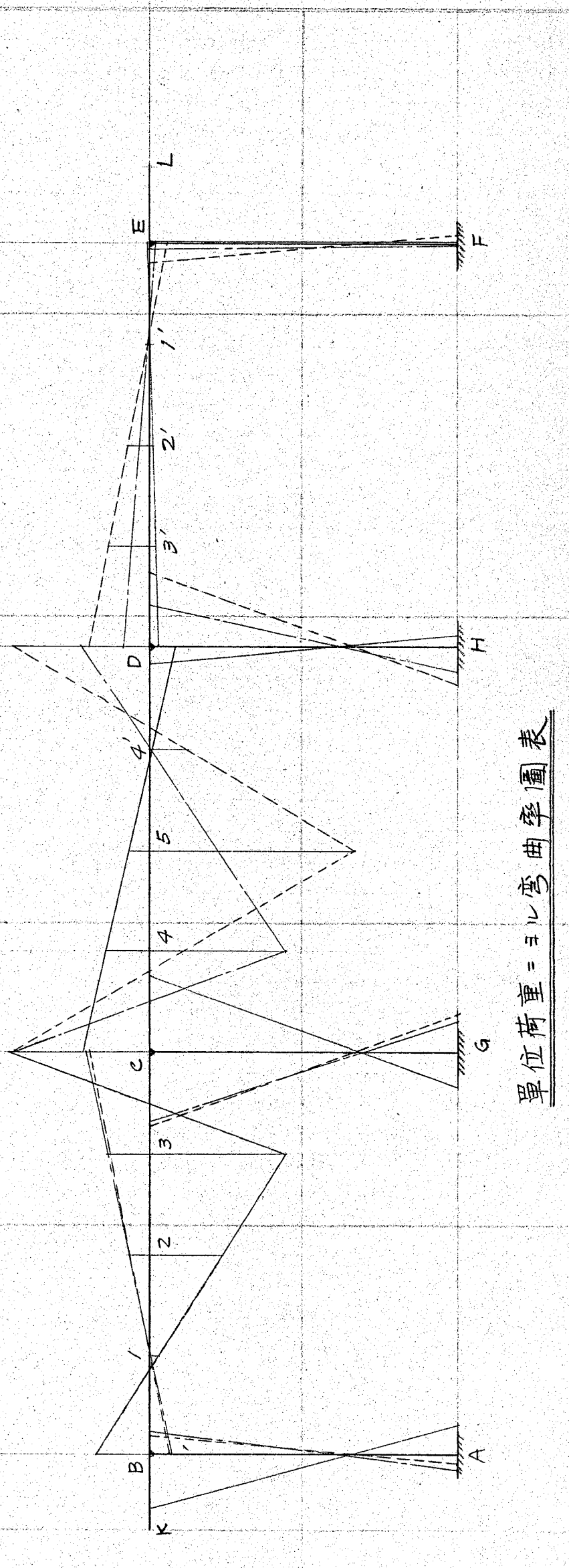
鐵筋混凝土高架橋





単位荷重＝ヨル弯曲率圖表

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 (08) 0678 番

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照査
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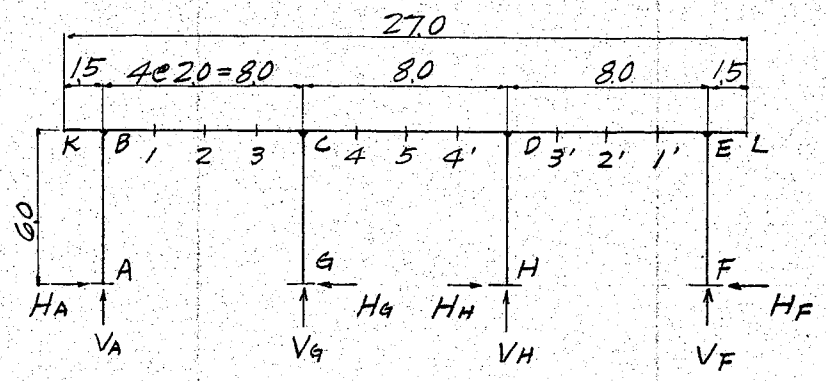
日付
類別 S46
第 13 頁

鐵筋混凝土高架橋

弯曲率,剪力及反力影響線



弯曲率

載荷点	M_{BL}	M_{BR}	M_{B1}	M_1	M_2	M_3	M_{CL}	M_{CR}	M_{C1}	M_4	M_E	M_A	M_G
K	-1.500	-0.778	0.722	-0.502	-0.226	+0.050	0.326	0.055	-0.271	0.046	0.036	-0.272	0.225
1	—	-0.587	-0.587	0.936	0.459	-0.018	-0.495	-0.167	0.328	-0.116	-0.065	0.238	-0.219
2	—	-0.604	-0.604	0.325	1.255	0.184	-0.886	-0.373	0.513	-0.249	-0.125	0.274	-0.285
3	—	-0.319	-0.319	0.052	0.423	0.795	-0.834	-0.393	0.441	-0.258	-0.123	0.172	-0.209
4	—	0.132	0.132	0.003	-0.125	-0.253	-0.382	-0.797	-0.415	0.802	0.401	-0.089	0.184
5	—	0.105	0.105	-0.010	-0.125	-0.240	-0.355	-0.798	-0.443	0.202	1.202	-0.053	0.221
4'	—	0.026	0.026	-0.019	-0.063	-0.108	-0.152	-0.401	-0.249	0	0.401	0.010	0.147
3'	—	-0.005	-0.005	0.009	0.023	0.038	0.052	0.148	0.096	0.013	-0.123	-0.010	-0.060
2'	—	-0.050	-0.050	-0.015	0.019	0.053	0.088	0.123	0.035	-0.001	-0.125	0.053	0.011
1'	—	-0.069	-0.069	-0.032	0.005	0.043	0.080	0.037	-0.043	-0.014	-0.065	0.090	0.077
L	—	0.101	0.101	0.052	0.003	-0.046	-0.095	0.018	0.113	0.027	0.036	-0.140	-0.145

反力

載荷点	V_A	V_G	H_A	H_G
K	1.138	-0.143	-0.166	-0.083
B	1.000	—	—	—
1	0.761	0.264	0.138	0.091
2	0.465	0.597	0.146	0.133
3	0.186	0.882	0.082	0.108
C	—	1.000	—	—
4	-0.064	0.864	-0.037	-0.100
5	-0.058	0.558	-0.026	-0.111
4'	-0.023	0.223	-0.003	-0.066
D	—	—	—	—
3'	0.007	-0.075	-0.001	0.026
2'	0.017	-0.079	0.017	0.004
1'	0.019	-0.044	0.027	-0.020
E	—	—	—	—
L	-0.024	0.029	-0.040	0.043

剪力

S_{BL}	S_{BR}	S_{CL}	S_{CR}	S_A, S_{B1}	S_G, S_{C1}
-1.000	0.138	0.138	-0.005	0.166	-0.083
-1.000	1.000	—	—	—	—
—	0.761	-0.239	0.025	-0.138	0.091
—	0.465	-0.535	0.062	-0.146	0.133
—	0.186	-0.814	0.068	-0.082	0.108
—	—	-1.000	1.000	—	—
—	-0.064	-0.064	0.800	0.037	-0.100
—	-0.058	-0.058	0.500	0.026	-0.111
—	-0.023	-0.023	0.200	0.003	-0.066
—	—	—	—	—	—
—	0.007	0.007	-0.068	0.001	0.026
—	0.017	0.017	-0.062	-0.017	0.004
—	0.019	0.019	-0.025	-0.027	-0.020
—	—	—	—	—	—
—	-0.024	-0.024	0.005	0.040	0.043

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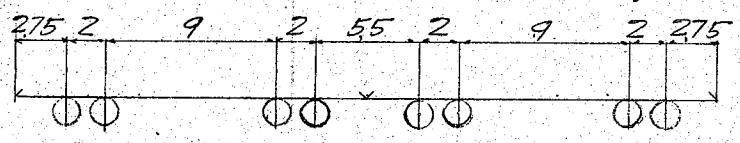
鐵筋混凝土高架橋

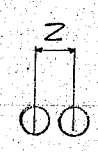
活荷重應力

60 瓲電車　桁一本=付 7,500 kg



徑間 800m, 桁=対シ
輪荷重　7,500
衝撃 i = 34.5 %　2,590
10,090 kg

特殊荷重　桁一本=付 8,250 kg



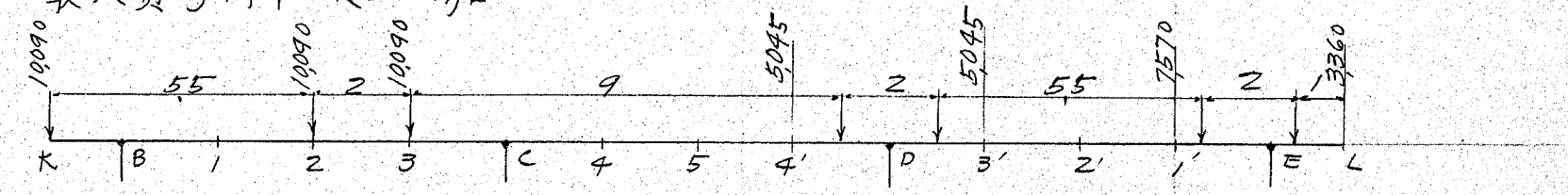
8,250
2,850
11,100 kg

跳ネ腕=対シ
輪荷重　7,500
衝撃　2,910.
10,410 kg

8,250
3,200
11,450 kg

BL 点
$M_{BL} = -1,500 \times 11,450 = -17,170$ kgm
$V_A = 1,138 \times 11,450 = 13,030$ kg
$S_{BL} = -1,000 \times 11,450 = -11,450$ kg
$H_A = -0.166 \times 11,450 = -19,000$ kg
$M_A = -0.272 \times 11,450 = -3,115$ kgm

BR 点
最大負彎曲率, 起ル場合



荷重点

			-M		H_A
K	10,090	-0.778	-7,850	-0.166	-1,675
2	10,090	-0.604	-6,130	0.146	1,473
3	10,090	-0.319	-3,220	0.082	828
4'	5,045	0.026	131	-0.003	-15
3'	5045	-0.005	-25	-0.001	-5
1'	7,570	-0.069	-522	0.027	204
L	3,360	0.101	339	-0.040	-134
			-17,277 kgm		676 kg

最大正彎曲率, 起ル場合 (h = 5.000, 場合ト同一荷重狀態)

荷重点

			M		H_A
4	11,100	0.132	1,465	-0.037	-411
5	〃	0.105	1,165	-0.026	-289
			2,630 kgm		-700 kg

最大剪力, 起ル場合

荷重点

			S_{BR}
B	11,100	1,000	11,100
1	〃	0.761	8,450
			19,550 kg

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鐵筋混凝土高架橋

1 奥

最大負弯曲率ノ起ル場合

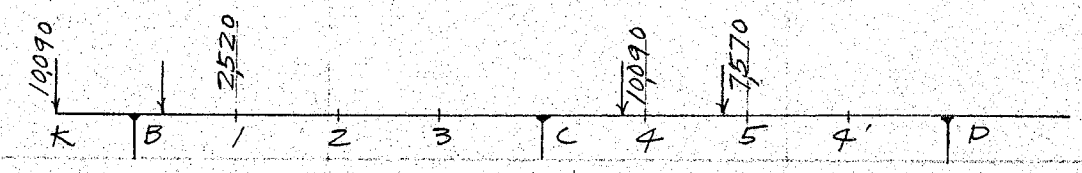
荷重奥			-M		HA
K	10,090	-0,502	-5,070	-0,166	-1,675
2'	〃	-0,015	-152	0,017	172
1'	〃	-0,032	-323	0,027	273
			-5,545 kgm		-1,230 kg

最大正弯曲率ノ起ル場合

荷重奥			M		HA		S1
1	11,100	0,936	10,380	0,138	1,530	0,761	8,450
2	〃	0,325	3,610	0,146	1,620	0,465	5,160
			13,990 kgm		3,150 kg		13,610 kg

2 奥

最大負弯曲率ノ起ル場合



荷重奥			-M		HA
K	10,090	-0,226	-2,280	-0,166	-1,675
1	2,520	0,459	1,156	0,138	348
4	10,090	-0,125	-1,260	-0,037	-373
5	7,570	-0,125	-946	-0,026	-197
			-3,330 kgm		-1,897 kg

最大正弯曲率ノ起ル場合

荷重奥			M		HA
1	11,100	0,459	5,095	0,138	1,532
2	〃	1,255	13,980	0,146	1,620
			19,025 kgm		3,152 kg

3 奥

最大負弯曲率ノ起ル場合

荷重奥			-M		HA
4	11,100	-0,253	-2,810	-0,037	-411
5	〃	-0,240	-2,665	-0,026	-289
			-5,475 kgm		-700 kg

最大正弯曲率ノ起ル場合

荷重奥			M		HA		S3
2	11,100	0,184	2,042	0,146	1,620	-0,535	-5,940
3	〃	0,795	8,820	0,082	910	-0,814	-9,040
			10,862 kgm		2,530 kg		-14,980 kg

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鐵筋混凝土高架橋

C_L 点
最大負曲率ノ起ル場合

荷重点			-M		HA
2	10,090	-0,886	-8,940	0,146	1,473
3	10,090	-0,834	-8,420	0,082	827
4	2,545	-0,382	- 972	-0,037	- 94
5	10,090	-0,355	-3,580	-0,026	- 262
4'	7,570	-0,152	-1,150	-0,003	- 23
1'	7,570	0,080	606	0,027	204
L	3,365	-0,095	- 320	-0,040	- 135
			-22,776 kgm		1,990 kg

最大正曲率ノ起ル場合

荷重点			M		HA
K	10,090	0,326	3,290	-0,166	-1,675
2'	〃	0,088	886	0,017	172
1'	〃	0,080	808	0,027	273
			4,984 kgm		-1,230 kg

最大剪力ノ起ル場合

荷重点			SCL
3	11,100	-0,814	-9,040
C	〃	-1,000	-11,100
			-20,140 kg

C_R 点
最大負曲率ノ起ル場合

荷重点			-M		N
1	7,570	-0,167	-1,263	-0,047	-356
2	10,090	-0,373	-3,760	-0,013	-131
3	2,525	-0,393	- 992	0,026	66
4	10090	-0,797	-8,040	-0,063	-636
5	10,090	-0,798	-8,050	-0,085	-856
2'	5,045	0,123	620	-0,013	- 66
1'	10,090	0,037	373	-0,047	-474
			-21,112 kgm		-2,453 kg

最大正曲率ノ起ル場合

荷重点			M		N
K	10,090	0,055	555	0,083	838
3'	〃	0,148	1,493	0,027	273
2'	〃	0,123	1,242	-0,013	-131
			3,290 kgm		980 kg

最大剪力ノ起ル場合

荷重点			SCR
C	11,100	1,000	11,100
4	〃	0,800	8,880
			19,980 kg

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鐵筋混凝土高架橋

4 桁
最大負彎曲率，起ル場合

荷重桁			-M		N
2	11,100	-0,249	-2765	-0,013	-144
3	〃	-0,258	-2865	0,026	289
			-5,630 kgm		145 kg

最大正彎曲率，起ル場合

荷重桁			M		N		S
4	11,100	0,802	8,900	-0,063	-700	0,800	8,880
5	11,100	0,202	2,240	-0,085	-944	0,500	5,550
			11,140 kgm		-1,644 kg		14,430 kg

5 桁
最大負彎曲率，起ル場合

荷重桁			-M		N
2	10,090	-0,125	-1,260	-0,013	-131
3	〃	-0,123	-1,240	0,026	262
3′	〃	-0,123	-1,240	0,026	262
2′	〃	-0,125	-1,260	-0,013	-131
			-5,000 kgm		262 kg

最大正彎曲率，起ル場合

荷重桁			M		N
4	11,100	0,401	4,450		
5	〃	1,202	13,330		
			17,780 kgm		-1,644 kg

B1 桁
最大正彎曲率，起ル場合

荷重桁			M		VA
K	10,090	0,722	7,280	1,138	11,500
L	10,090	0,101	1,020	-0,024	-242
			8,300 kgm		11,258 kg

最大負彎曲率，起ル場合

荷重桁			-M		VA
1	11,100	-0,587	-6,520	0,761	8,440
2	〃	-0,604	-6,700	0,465	5,160
			-13,220 kgm		13,600 kg

A 桁
最大正彎曲率，起ル場合

荷重桁			M		VA		HA
1	10,090	0,238	2,400	0,761	7,680	0,138	1,392
2	〃	0,274	2,770	0,465	4,690	0,146	1,473
2′	〃	0,053	535	0,017	172	0,017	171
1′	〃	0,090	910	0,019	192	0,027	272
			6,615 kgm		12,734 kg		3,308 kg

最大負彎曲率，起ル場合

荷重桁			-M		VA		HA
K	10,090	-0,272	-2,740	1,138	11,480	-0,166	-1,675
L	〃	-0,140	-1,410	-0,024	-242	-0,040	-404
			-4,150 kgm		11,238 kg		-2,079 kg

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鐵筋混凝土高架橋

C1点
最大正彎曲率ノ起ル場合
荷重点

			M		Vg
2	10,090	0.513	5,180	0.597	6,020
3	〃	0.441	4,450	0.882	8,900
L	〃	0.113	1,140	0.029	293
			10,770 kgm		15,213 kg

最大負彎曲率ノ起ル場合
荷重点

			-M		Vg
4	11,100	-0.415	-4,610	0.864	9,590
5	〃	-0.443	-4,915	0.558	6,200
			-9,525 kgm		15,790 kg

V_A ノ最大
荷重点

			V_A		M_A		H_A
K	10,090	1.138	11,500	-0.272	-2,740	-0.166	-1,675
B	2,520	1.000	2,520	—		—	—
I	7,570	0.761	5,760	0.238	1,800	0.138	1,045
			19,780 kg		-940 kgm		630 kg

G点
最大正彎曲率ノ起ル場合
荷重点

			M		Vg
4	11,100	0.184	2,040		
5	〃	0.221	2,450		
			4,490 kgm		15,790 kg

最大負彎曲率ノ起ル場合
荷重点

			-M		Vg		Hg
I	10,900	-0.219	-2,390	0.264	2,665	0.091	918
2	〃	-0.285	-2,875	0.597	6,020	0.133	1,342
L	〃	-0.145	-1,460	0.029	293	0.043	434
			-6,725 kgm		8,978 kg		2,694 kg

Vg ノ最大
荷重点

			Vg		Mg		Hg
3	11,100	0.882	9,800	-0.209	-2,320	0.108	1,200
C	〃	1.000	11,100	—	—	—	—
			20,900 kg		-2,320 kgm		1,200 kg

H_A 及 S_A ノ最大
荷重点

I	10,090	0.138	1,392
2	〃	0.146	1,472
2'	〃	0.017	172
I'	〃	0.027	273

S_A = -3,309 kg
H_A = 3,309 kg

荷重点

K	10,090	-0.166	-1,675
L	〃	-0.040	-404

H_A = -2,079 kg
S_A = 2,079 kg

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鐵筋混凝土高架橋

Hg 及 Sg, 最大荷重点

2	10,090	0.133	1342
3	〃	0.108	1,090
L	〃	0.043	434

$H_G = 2866$ Kg
$S_G = 2866$ Kg

荷重点

大	10,090	-0.083	-838
4	10,090	-0.100	-1,009
5	10,090	-0.111	-1,120
2'	5045	0.004	20
1'	10,090	-0.020	-202

$H_G = S_G = -3144$ Kg

温度應力 (温度上昇, 場合)

温度, 変化　大 = 15°C　　$K_1 = 0.00833$
膨張係数　$\varepsilon = 0.00001$　　$K_2 = 0.0076$

$M_{BA} = 2EK_1(2\theta_B - 3R_1)$　　$M_{AB} = 2EK_1(\theta_B - 3R_1)$
$M_{BC} = 2EK_2(2\theta_B + \theta_C)$　　$M_{GC} = 2EK_1(\theta_C - 3R_1)$

$M_{CB} = 2EK_2(2\theta_C + \theta_B)$
$M_{CD} = 2EK_2\theta_C$
$M_{CG} = 2EK_1(2\theta_C - 3R_2)$

$R_1 = -\frac{3\varepsilon t l}{2h} = -\frac{3\times 0.00001\times 15\times 8.0}{2\times 6.0} = -0.0003$

$R_2 = -\frac{\varepsilon t l}{2h} = -\frac{0.00001\times 15\times 8.0}{2\times 6.0} = -0.0001$

$\theta_B = \frac{3\{K_1K_2R_2 - K_1(2K_1+3K_2)R_1\}}{K_2^2 - 2(K_1+K_2)(2K_1+3K_2)} = -\frac{23081}{(10)^8}$

$\theta_C = \frac{3\{K_1K_2R_1 - 2(K_1+K_2)K_1R_2\}}{K_2^2 - 2(K_1+K_2)(2K_1+3K_2)} = -\frac{1888}{(10)^8}$

$2EK_1 = 0.2332\,(10)^8$
$2EK_2 = 0.2128\,(10)^8$
$-3R_1 = \frac{90000}{(10)^8}$
$-3R_2 = \frac{30000}{(10)^8}$

$M_{BA} = 0.2332\,(-46162 + 90,000) = 10,220$ Kgm
$M_{BC} = 0.2128\,(-46162 - 1888) = -10,220$ Kgm

$M_{CB} = 0.2128\,(-3776 - 23,081) = -5,720$ Kgm
$M_{CD} = 0.2128\,(-1888) = -400$ Kgm
$M_{CG} = 0.2332\,(-3776 + 30,000) = 6,120$ Kgm

$M_{AB} = 0.2332\,(-23081 + 90,000) = 15,610$ Kgm
$M_{GC} = 0.2332\,(-1888 + 30,000) = 6,560$ Kgm

格点弯曲率

$M_{B1} = -10,220$ Kgm　　$M_{CL} = 5,720$ Kgm　　$M_A = 15,610$ Kgm
$M_{BR} = -10,220$ Kgm　　$M_{CR} = -400$ Kgm　　$M_G = 6,560$ Kgm
$M_{C1} = -6,120$ Kgm

$M_1 = -6,230$ Kgm
$M_2 = -2,250$ Kgm
$M_3 = 1,735$ Kgm
$M_4 = M_5 = -400$ Kgm

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鐵筋混凝土高架橋

無直力

$$V_A = \frac{10,220 + 5,720}{8.0} = 1,990\ kg$$

$$V_G = -1,990\ kg$$

水平反力

$$H_A = \frac{10,220 + 15,610}{6.0} = 4,310\ kg \rightarrow$$

$$H_G = \frac{6120 + 6560}{6.0} = 2,110\ kg \rightarrow$$

剪　力

$$S_{BR} = 1,990\ kg = S_{CL}$$
$$S_{CR} = 0$$
$$S_A = S_{B1} = -4,310\ kg$$
$$S_G = S_{C1} = -2,110\ kg$$

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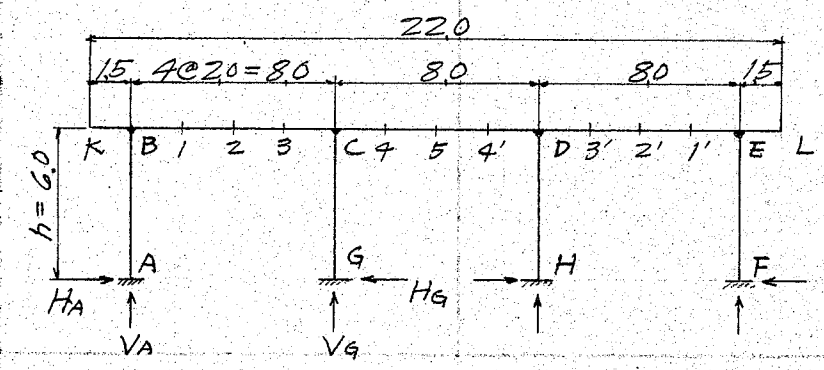
鐵筋混凝土高架橋
應力一括表



彎曲率(Kgm)及軸圧力(Kg)

	彎曲率	MBL	MBR	MBI	M1	M2	M3	MCL	MCR	MCI	M4	M5	MA	MG
最大正彎曲率	死荷重	-4,610	-14,060	-9450	7925	13510	2700	-24520	-22700	1820	1900	10100	4720	-910
	活荷重		2,630	8300	13990	19025	10862	4984	3290	10770	11,140	17,780	6615	4490
	温度ノ変化		10220	10220	6230	2250	1735	5720	400	6120	400	400	15610	6560
	合成應力		-1210	9070	28,145	34785	15297	-13816	-19010	18710	13440	28280	26945	10140
	軸圧力													
	死荷重		2365	21240	2365	2365	2365	2365	-1910	34110	-1910	-1910	21240	34110
	活荷重		-700	11,258	3150	3152	2530	-1230	980	15213	-1644	-1644	12734	15790
	温度ノ変化		-4310	-1990	-4310	-4310	4310	4310	6420	1990	6420	6420	1990	-1990
	合成應力		-2645	30,508	1205	1207	9205	5445	5490	51313	2866	2866	35964	47910

	彎曲率	MBL	MBR	MBI	M1	M2	M3	MCL	MCR	MCI	M4	M5	MA	MG
最大負彎曲率	死荷重	-4,610	-14,060	-9450	7925	13510	2700	-24520	-22700	1820	1900	10100	4720	-910
	活荷重	-17,170	-17277	-13220	-5545	-3330	-5475	-22776	-21112	-9525	-5630	-5000	-4150	-6725
	温度ノ変化	—	-10220	-10220	-6230	-2250	-1735	-5720	-400	-6120	-400	-400	-15610	-6560
	合成應力	-21780	-41557	-32890	-3850	7930	-4510	-53016	-44212	-13825	4130	4700	-15040	-14195
	軸圧力													
	死荷重		2365	21240	2365	2365	2365	2365	-1910	34110	-1910	-1910	21240	34110
	活荷重		676	13600	-1230	-1897	-700	1990	-2453	15790	145	262	11238	8978
	温度ノ変化		4310	1990	4310	4310	-4310	-4310	-6420	-1990	-6420	-6420	-1990	1990
	合成應力		7351	36830	5445	4778	-2645	45	-10783	47910	-8185	-8068	30488	45078

最大反力及剪力

	VA	VG	HA	HG	SA,SBI	SG,SCI	SBL	SBR	SCL	SCR	S1	S3	S4
死荷重	21240	34110	2365	455	-2365	455	-6150	15090	-17710	16400	6890	-9510	8200
活荷重	19780	20900	3309	2866	-3309	2866	-11450	19550	-20140	19980	13610	-14980	14430
温度ノ変化	1990	1990	4310	2110	-4310	2110	—	1990	-1990	0	1990	-1990	0
合成應力	43010	57000	9984	5431	-9984	5431	-17600	36630	-39840	36380	22490	-26480	22630
	M	M	HA	HG	SA,SBI	SG,SCI							
死荷重	4720	-910	2365	455	-2365	455							
活荷重	-940	-2320	-2079	-3149	2079	-3149							
温度ノ変化	15610	-6560	-4310	-2110	4310	-2110							
合成應力	19390	-9790	-4024	-4804	4024	-4804							

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鐵筋混凝土高架橋

斷面，設計　(h=5.00，場合ト同一斷面ヲ用フ)

2 点　$M_2 = 34{,}785$ kgm，$N = 1{,}207$ kg
$A_s = 10 @ 22\phi = 38.01$ cm²，$t = 25$ cm，$d = 81$ cm，$t/d = 0.309$，$b = 200$ cm
$P = 0.00235$，$j = 0.922$，$K = 0.234$

$$f_s = \frac{34{,}785 \times 100}{38.01 \times 0.922 \times 81} = 1{,}225 \text{ kg/cm}^2$$

$$f_c = \frac{1225 \times 0.234}{15(1-0.234)} = 25.0 \text{ kg/cm}^2$$

5 点　$M_5 = 28{,}280$ kgm，$N = 2{,}866$ kg
$A_s = 10 @ 22\phi = 38.01$ cm²，$t = 25$ cm，$d = 81$ cm，$b = 200$ cm
$j = 0.922$，$K = 0.234$

$$f_s = \frac{28{,}280 \times 100}{38.01 \times 0.922 \times 81} = 996 \text{ kg/cm}^2$$

$$f_c = \frac{996 \times 0.234}{15(1-0.234)} = 19.7 \text{ kg/cm}^2$$

C_L 点　$M_{CL} = -53{,}016$ kgm，$N = 45$ kg，$S = 39{,}840$ kg
$A_s = 10 @ 22\phi = 38.01$ cm²，$b = 60$ cm，$d = 151$ cm
$j = 0.901$，$K = 0.297$

$$f_s = \frac{53{,}016 \times 100}{38.01 \times 0.901 \times 151} = 1026 \text{ kg/cm}^2$$

$$f_c = \frac{1026 \times 0.297}{15(1-0.297)} = 28.9 \text{ kg/cm}^2$$

$$v = \frac{39{,}840}{60 \times 0.901 \times 151} = 4.9 \text{ kg/cm}^2$$

$$u = \frac{39{,}840}{69.1 \times 0.901 \times 151} = 4.2 \text{ kg/cm}^2$$

柱

B_1 点　$M_{B1} = -32{,}890$ kgm，$N = 36{,}830$ kg，$S = 9{,}984$ kg
$d' = 5$ cm，$d = 115$ cm，$h = 120$ cm
$A_s = 6 @ 22\phi = 22.8$ cm²
$A_s' = 4 @ 22\phi = 15.2$ cm²
$P = 0.0033$　$d'/d = 0.0435$　$d/h = 0.958$
$P' = 0.0022$　$d'/h = 0.0417$　$u = 60.7$ cm　$d-u = 54.3$ cm

$$\frac{M}{N} = \frac{32{,}890}{36{,}830} \times 100 = 89.3$$

$d-u = 54.3$

$e = 143.6$ cm

$e' = 143.6 - 110 = 33.6$ cm　$e'/e = 0.234$

$K = 0.41$　$\frac{Ne}{bd^2 f_c} = 0.207$

$$f_c = \frac{36{,}830 \times 143.6}{60 \times 115^2 \times 0.207} = 32.2 \text{ kg/cm}^2$$

$$f_s = 15 \times 32.2 \times \frac{0.59}{0.41} = 695 \text{ kg/cm}^2$$

$$v = \frac{9{,}984}{60 \times 7/8 \times 115} = 1.7 \text{ kg/cm}^2$$

$$u = \frac{9{,}984}{69.1 \times 6 \times 7/8 \times 115} = 2.4 \text{ kg/cm}^2$$

C_1 点　$M_{C1} = 18{,}710$ kgm，$N = 5{,}313$ kg，$S = 5{,}431$ kg
$d' = 5$ cm，$d = 115$ cm，$h = 120$ cm
$A_s = 6 @ 19\phi = 17.05$ cm²
$A_s' = 4 @ 19\phi = 11.37$ cm²

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設計　日付　類別 SHC
照査　日付　第 23 頁

鐵筋混凝土高架橋

$P = 0.0025$　$d'/d = 0.0435$　$d'/h = 0.958$
$P' = 0.0016$　$d''/h = 0.0417$　$d-u = 543$

$\frac{M}{N} = \frac{18,710}{51,313} \times 100 = 36.5$

$d-u = 543$
$e = 90.8$ cm

$e' = 90.8 - 110 = -19.2$ cm　$e'/e = 0.212$
$k = 0.75$　$\frac{Ne}{bd^2 f_c} = 0.303$

$f_c = \frac{51313 \times 90.8}{60 \times 115^2 \times 0.303} = 19.4$ kg/cm²

$f_s = 15 \times 19.4 \times \frac{025}{075} = 97$ kg/cm²

A 桁

$M_A = 26,945$ kgm, $N = 35,964$ kg, $S = 9,984$ kg
$d' = 5$ cm, $d = 93$ cm, $h = 100$ cm
$A_s = 8 @ 22^\phi = 30.4$ cm², $P = 0.00545$, $d'/d = 0.538$, $d'/h = 0.5$, $d/h = 0.93$
$A_s' = 4 @ 22^\phi = 15.2$ cm², $P' = 0.00272$, $u = 51.4$ cm, $d-u = 41.6$ cm

$\frac{M}{N} = \frac{26,945}{35,964} \times 100 = 75.0$

$d-u = 41.6$
$e = 116.6$ cm

$e' = 116.6 - 88 = 28.6$ cm, $e'/e = 0.245$
$k = 0.48$　$\frac{Ne}{bd^2 f_c} = 0.237$

$f_c = \frac{35,964 \times 116.6}{60 \times 115^2 \times 0.237} = 22.3$ kg/cm²

$f_s = 15 \times 22.3 \times \frac{052}{0.48} = 362$ kg/cm²

$\nu = \frac{9,984}{60 \times 7/8 \times 93} = 2.0$ kg/cm²

$u = \frac{9,984}{6.91 \times 8 \times 7/8 \times 93} = 2.2$ kg/cm²

G 桁

$M_G = 14,195$ kgm, $N = 45,078$ kg, $S = 5,431$ kg
$d' = 5$ cm, $d = 95$ cm, $h = 100$ cm
$A_s = 6 @ 19^\phi = 17.05$ cm², $d'/d = 0.526$, $d'/h = 0.5$, $d/h = 0.95$
$A_s' = 4 @ 19^\phi = 11.37$ cm², $u = 0.507 \times 100 = 50.7$ cm
$P = 0.00299$　$d-u = 44.3$ cm
$P' = 0.002$

$\frac{M}{N} = \frac{14,195 \times 100}{45,078} = 31.5$

$d-u = 443$
$e = 75.8$ cm

$e' = 75.8 - 90 = -14.2$ cm　$e'/e = 0.187$
$k = 0.73$　$\frac{Ne}{bd^2 f_c} = 0.303$

$f_c = \frac{45,078 \times 75.8}{60 \times 95^2 \times 0.303} = 20.8$ kg/cm²

$f_s = 15 \times 20.8 \times \frac{027}{0.73} = 115$ kg/cm²

$\nu = \frac{5431}{60 \times 7/8 \times 95} = 1.1$ kg/cm²

$u = \frac{5431}{5.96 \times 6 \times 7/8 \times 95} = 1.8$ kg/cm²

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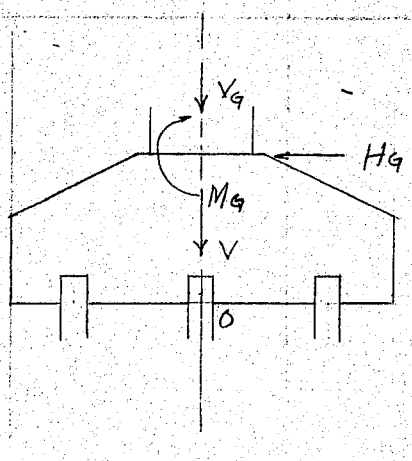
照査　日付　第 24 頁

鐵筋混凝土高架橋
基礎
G 橋

G 橋	Mg max			Vg max		
	Mg	Vg	Hg	Mg	Vg	Hg
死荷重	-910	34,110	455	-910	34,110	455
活荷重	-6,725	8,978	2,694	-2,320	20,900	1,200
温度ノ変化	-6560	1,990	2,110	-6560	1,990	2,110
合成應力	-14,195	45,078	5,259	-9,790	57,000	3,765



0 橋 = 於ケル能率（最大彎曲率ノ場合）

Vg		45,078	
V		23,020	
Hg	5,259	× 1.2 =	6,310
Mg		=	- 14,195

ΣV = 68,098 kg　ΣM = - 7,885 kgm

$e = 7,885 \div 68,098 = 0.116\ m$

$p = \frac{68098}{3.0 \times 2.0} \times \left(1 \pm \frac{6 \times 0.116}{3.0}\right) = 13,980\ kg/m^2$
$8,720\ kg/m^2$

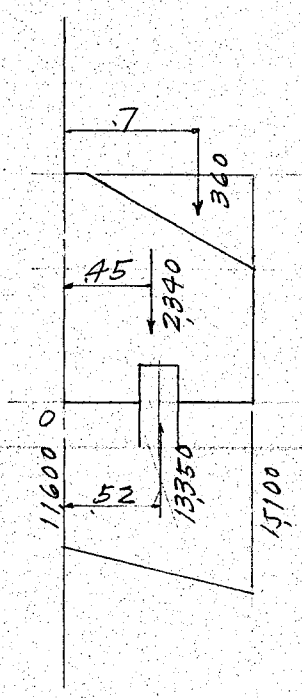
0 橋 = 於ケル能率（最大垂直力ノ場合）

Vg		57,000	
V		23,020	
Hg	3,765	× 1.2 =	4,520
Mg		=	- 9,790

ΣV = 80,020 kg　ΣM = - 5,270 kgm

$e = 5,270 \div 80,020 = 0.066\ m$

$p = \frac{80020}{3.0 \times 2.0} \times \left(1 \pm \frac{6 \times 0.066}{3.0}\right) = 15,100\ kg/m^2$
$11,600\ kg/m^2$



0 橋 = 於ケル能率

13,350	× .52 =	6,940
- 2,340	× .45 =	- 1,053
- 360	× .70 =	- 252

S = 10,650 kg　M = 5,635 kgm

使用厚 110 cm
$A_s = 3 @ 16\phi = 6.03\ cm^2$
$p = 0.00055$, $k = 0.12$, $j = 0.96$

$f_s = \frac{5,635 \times 100}{6.03 \times .96 \times 110} = 884\ kg/cm^2$

$f_c = \frac{2 \times 5,635 \times 100}{.96 \times .12 \times 100 \times 110^2} = 8.1\ kg/cm^2$

$s = \frac{10,650}{100 \times .96 \times 110} = 1.01\ kg/cm^2$

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鐵筋混凝土高架橋

A 点

A点	+Mmax			−Mmax			Vmin			Vmax		
	MA	VA	HA	MA	VA	HA	MA	VA	HA	MA	VA	HA
死荷重	4720	21240	2365	4720	21240	2365	4720	21240	2365	4720	21240	2365
活荷重	6615	12734	3308	-4510	11238	-2079	-1516	-1354	-700	-940	19780	630
温度ノ変化	15610	1990	4310	-15610	-1990	-4310	-15610	-1990	-4310	15610	1990	4310
合成應力	26945	35964	9983	-15040	30488	-4024	-12466	17896	-2645	19390	43010	7305

Vmin ノ場合

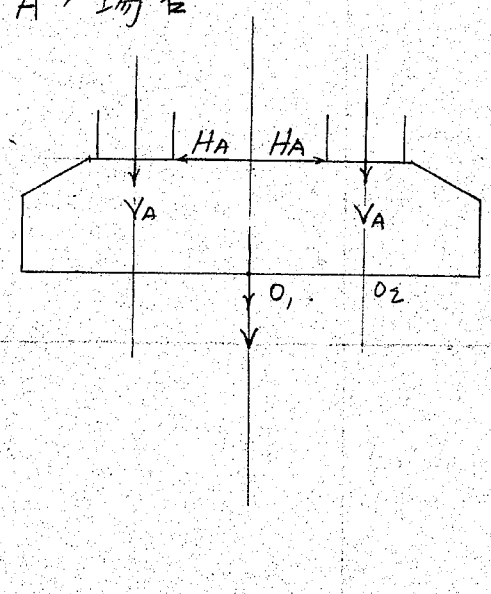
荷重点

			VA		MA		HA
4	11,100	-0.064	-710	-0.089	-988	-0.037	-411
5	11,100	-0.058	-644	-0.053	-588	-0.026	-289
			-1,354 kg		-1,576 kgm		-700 kg

條件組合セ

A (1) & (1)
B (2) & (2)
C (1) & (3)
D (4) & (4)

A ノ場合



總重量

VA　2 @ 35,964 = 71,928
V　= 55,410
127,338 kg

底面圧力　$p = \frac{127,338}{2.0 \times 6.0} = 10,600$ kg/m²

O1 点ニ於ケル曲率

V	-½ × 55,410 × 1.50	= -41,600
P	½ × 2 × 10,600 × 3.0²	= 95,400
VA	-35,964 × 1.5	= -53,900
HA	-9,983 × .75	= -7,490
MA		= 26,945

M_{O1} = 19,355 kgm -- 9,680 kgm/m

B ノ場合

總荷重

VA　2 @ 30,488 = 60,976
V　= 55,410
116,386 kg

底面圧力　$p = \frac{116,386}{2.0 \times 6.0} = 9,700$ kg/m²

O1 点ニ於ケル曲率

V		= -41,600
P	½ × 2 × 9,700 × 3.00²	= 87,300
VA	-30,488 × 1.5	= -45,700
HA	4,024 × 0.75	= 3,020
MA		= -15,040

M_{O1} = -12,020 kgm ---- -6,010 kgm/m

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照査　日付　第 26 頁

鐵筋混凝土高架橋

C，場合

O1 点＝対ス心弯曲率（基礎全幅＝対スル場合）

V			55,410		
VA			35,964		
VA			17,896		
HA	− 9,983	× 1,5	= −14,980		
HA	− 2,645	× 1,5	= − 3,965		
MA			= 26,995	↷ +M	
MA			= 12,466		
	ΣV = 109270 kg		20,466 kgm		

e = 20,466 ÷ 109,270 = 0.187 m

$$P = \frac{109270}{20\times6.0}\times\left(1 \pm \frac{6\times0187}{6.0}\right) = 10{,}800 \text{ kg/m}^2$$
$$7{,}400 \text{ 〃}$$

D，場合

總荷重

VA	2 @ 43,010	=	86020
V		=	55,410
			141,430 kg

底面圧力　$P = \frac{141430}{20\times6.0} = 11{,}780 \text{ kg/m}^2$

O1 点＝対ス心弯曲率

V		=	− 41,600
P	1/2 × 2 × 11,780 × 3.00²	=	106,000
VA	− 43,010 × 1.5	= −	64,500
HA	− 7,305 × 0.75	= −	5,480
MA		=	19,390

MO1 = 13,810 kgm ---- 6,905 kgm/m

断面，設計

+ max M = 9,680 kgm　使用厚 = 140 cm (有効)

As = 4 @ 16φ = 8.04 cm²

p = 0.00057, K = 0.12, j = 0.96

$$f_s = \frac{9680\times100}{8.04\times0.96\times140} = 896 \text{ kg/cm}^2$$

$$f_c = \frac{2\times9680\times100}{0.96\times0.12\times100\times140^2} = 8.6 \text{ kg/cm}^2$$

− max M = − 6,010 kgm

As = 3 @ 16φ = 6.03 cm²

p = 0.00043, K = 0.11, j = 0.965

$$f_s = \frac{6010\times100}{6.03\times0.965\times140} = 738 \text{ kg/cm}^2$$

$$f_c = \frac{2\times6010\times100}{0.965\times0.11\times100\times140^2} = 58 \text{ kg/cm}^2$$

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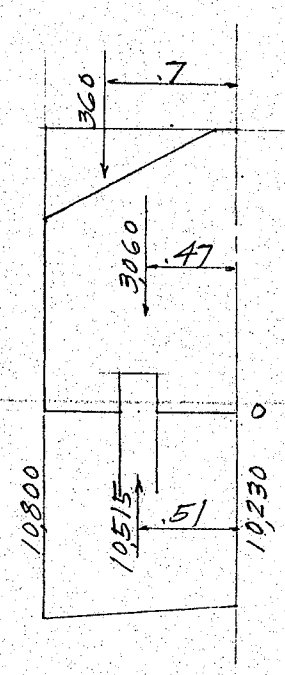
設計　日付　類別 8h6

照査　日付　第 27 頁

鐵筋混凝土高架橋



0 点ニ於ケル能率

10,515 × ,51 = 5360
−360 × ,70 = − 250
−3,060 × ,47 = −1,440
S = 7,095 ㎏　　M = 3,670 ㎏m

使用厚 = 150 cm　有効厚 = 140 cm
As = 2 ⌀ 16 = 4.02 cm²
P = 0.00029,　j = 0.97,　K = 0.1

$$f_s = \frac{3670 \times 100}{4.02 \times 0.97 \times 140} = 672 \text{ kg/cm}^2$$

$$f_c = \frac{2 \times 3670 \times 100}{.97 \times 0.1 \times 100 \times 140^2} = 3.9 \text{ kg/cm}^2$$

$$s = \frac{7095}{100 \times 0.97 \times 140} = 0.5 \text{ kg/cm}^2$$

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設計　　日付　　類別

照査　　日付　　第　　頁

上海高速鐵道

鐵筋混凝土複線高架桁橋

支間八.〇米三徑間兩脇各一.五米

高 五.〇米 應力計算書

Reinforced Concrete Rahmen Bridge

Double Track

3 continuous spans @ 8.0m, 5.0m high.

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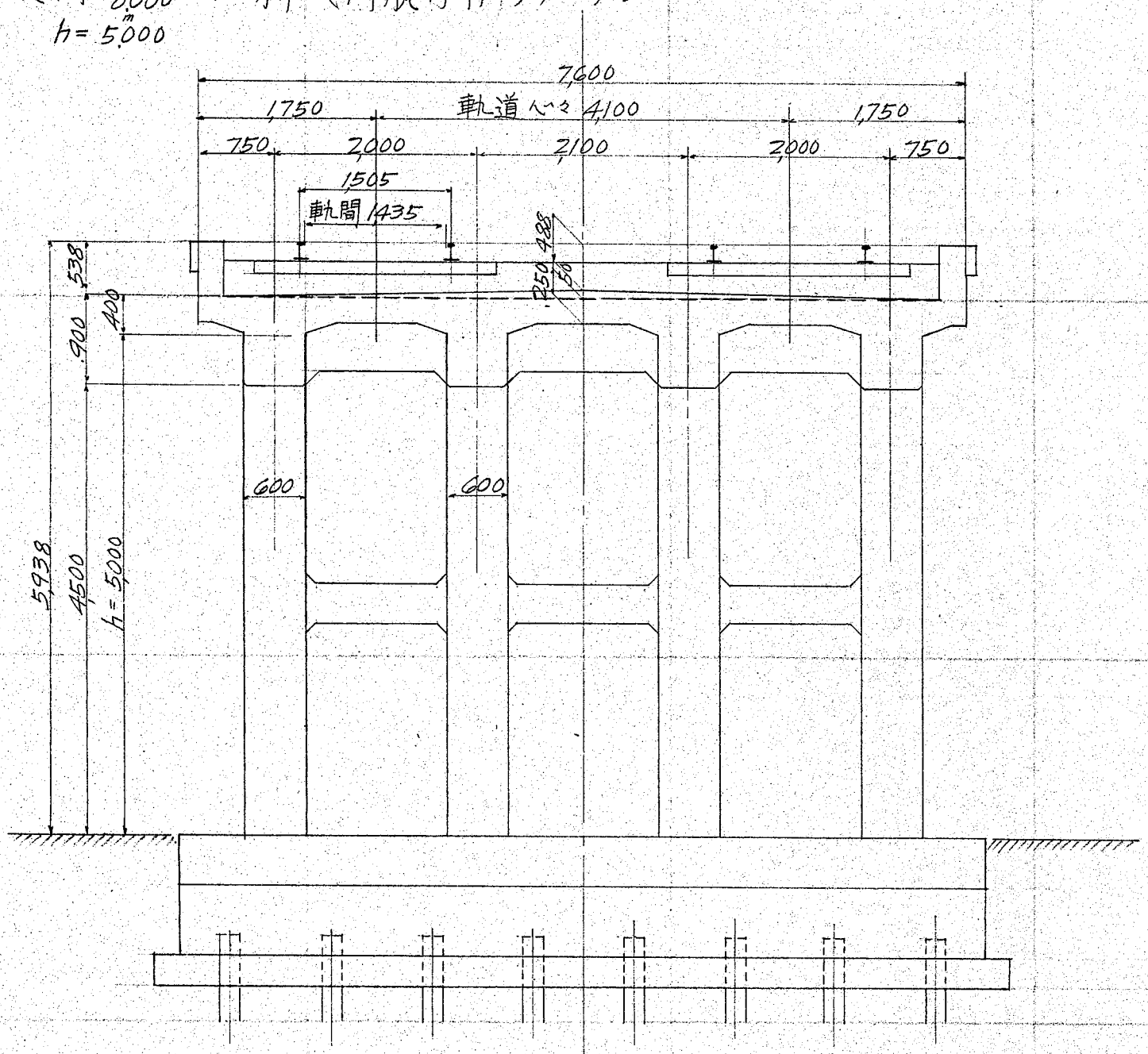
設計　日付　類別 8h5
照査　日付　第　/頁

鐵筋混凝土高架橋
複線電車軌道（60瓲電車）
支間 8.000 四脚式両腕付枠形ラーメン
h=5.000



縮尺 1:60

床版，設計

死荷重

床版	25cm	@ 24kg	= 600
道床	35	@ 19	= 665
軌道	800	÷ 3.0	= 267
特送其他			68
			1,600 kg/m²

死荷重彎曲率　1/10 × 1,600 × 2.0² = 640 kgm
死荷重剪力　1/2 × 1,600 × 2.0 = 1,600 kg

活荷重

電車輪荷重　1車由 = 付 16,500 kg
縦，分布　a = 1.00 + 2 @ 0.35 = 1.70m
横，分布　b = 2.42 + 2 @ 0.35 = 3.12m
分布荷重　16,500 / (1.70 × 3.12) = 3,110

衝撃　i = 20/(50+L) = 0.385　1200
4,310 kg/m²

活荷重彎曲率　1/10 × 4,310 × 2.0² = 1,725 kgm
活荷重剪力　1/2 × 4,310 × 2.0 = 4,310 kg

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設計　日付　類別 8h5
照査　日付　第 2頁

鐵筋混凝土高架橋

合成應力

	彎曲率	勞力
死荷重	640	1,600
活荷重	1,725	4,310
	2,365 kgm	5,910 kg

所要有効深　$d=\sqrt{\frac{2365\times100}{100\times7.13}}=18.2$ cm

使用有効深　22 cm
被覆　3
計　25 cm

使用鉄筋量　16mmφ − 20 cm c.to c.　5@2.01 = 10.05 cm²

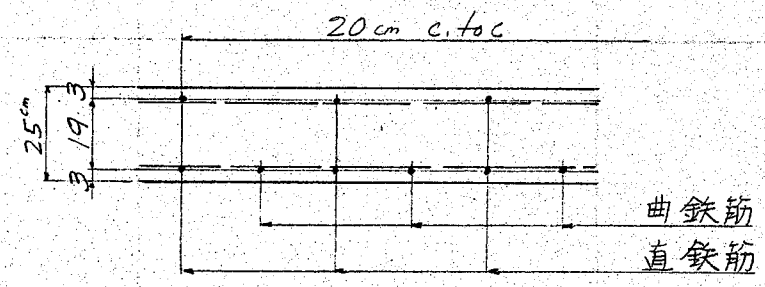
$p=\frac{A_s}{bd}=\frac{10.05}{100\times22}=0.00457$　$j=0.897$, $K=0.32$

$f_s=\frac{M}{A_s jd}=\frac{2365\times100}{10.05\times0.897\times22}=1,193$ kg/cm²

$f_c=\frac{2M}{jKbd^2}=\frac{2\times2365\times100}{0.897\times0.32\times100\times22^2}=34.0$ kg/cm²

$s=\frac{S}{bjd}=\frac{5910}{100\times0.897\times32}=2.1$ kg/cm²

$v=\frac{5910}{5\times5.03\times0.897\times32}=8.2$ kg/cm² < 5.5×2



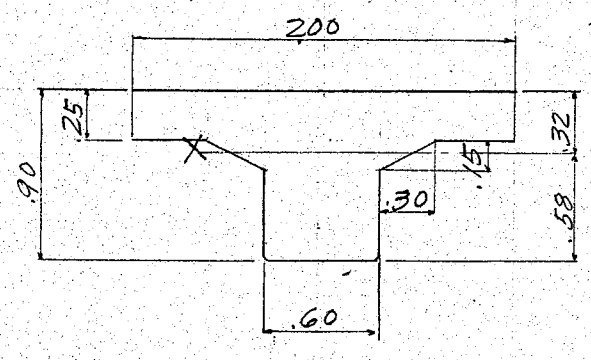
ラーメン設計

死荷重

軌道	800 ÷ 2	= 400
バラスト	2.05 × 0.35 @ 1,900	= 1,360
床版	2.05 × 0.25 @ 2,400	= 1,230
桁	0.60 × 0.65 @ 〃	= 940
持送り	0.30 × 0.15 @ 〃	= 110
		60
		w_d = 4,100 kg/m

假定断面

主桁



中立軸ノ位置

2.00 × 0.25	= 0.500 × 0.125	= 0.0625
0.60 × 0.65	= 0.390 × 0.575	= 0.2243
0.30 × 0.15	= 0.045 × 0.300	= 0.0135
	0.935　0.32	0.3003

物量力率

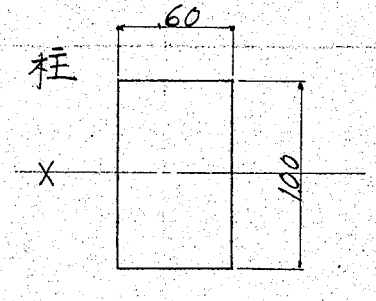
$\frac{2.00\times0.25^3}{12}+0.500\times0.195^2=0.0216$

$\frac{0.6\times0.65^3}{12}+0.390\times0.255^2=0.0391$

$\frac{2\times0.3\times0.015^3}{36}+0.045\times0.02^2=0.0001$

$I_2=0.0608$ m⁴

主柱



$A=1.0\times0.6=0.60$ m²

$I_1=\frac{.60\times1.00^3}{12}=0.0500$ m⁴

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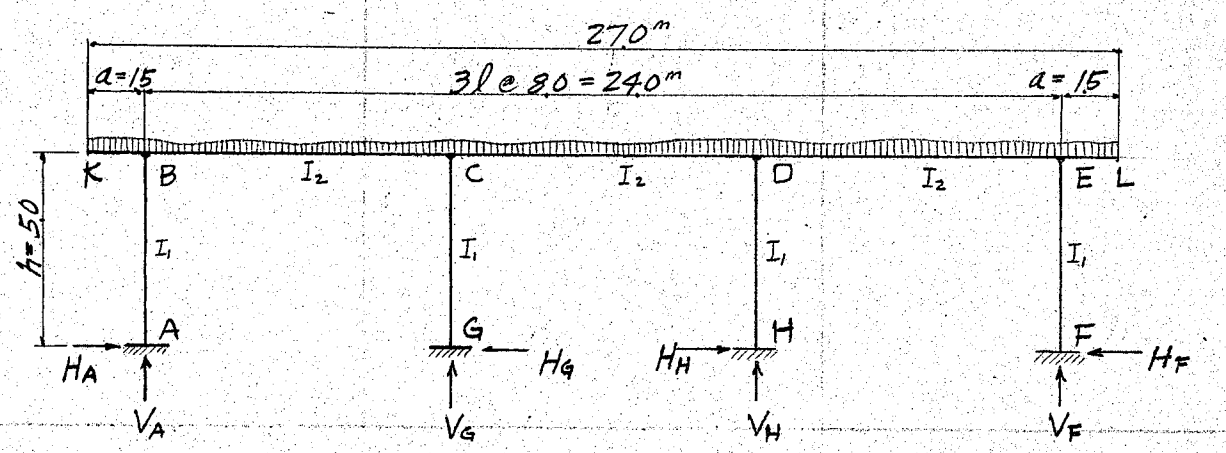
設計　日付　類別 8h5
照査　日付　第 3 頁

鐵筋混凝土高架橋



$$K_1 = \frac{I_1}{h}\ ,\quad K_2 = \frac{I_2}{l}$$

$$\begin{cases} M_{BA} = 2EK_1(2\theta_B - 3R) & = -M_{BI} \\ M_{BC} = 2EK_2(2\theta_B + \theta_C) - C_{BC} & = M_{BR} \\ M_{BK} = m_{BK} & = -M_{BL} \end{cases}$$

$$\begin{cases} M_{CB} = 2EK_2(2\theta_C + \theta_B) + C_{CB} & = -M_{CL} \\ M_{CD} = 2EK_2(2\theta_C + \theta_D) - C_{CD} & = M_{CR} \\ M_{CG} = 2EK_1(2\theta_C - 3R) & = -M_{CI} \end{cases}$$

$$\begin{cases} M_{DC} = 2EK_2(2\theta_D + \theta_C) + C_{DC} & = -M_{DL} \\ M_{DE} = 2EK_2(2\theta_D + \theta_E) - C_{DE} & = M_{DR} \\ M_{DH} = 2EK_1(2\theta_D - 3R) & = M_{DI} \end{cases}$$

$$\begin{cases} M_{ED} = 2EK_2(2\theta_E + \theta_D) + C_{ED} & = -M_{EL} \\ M_{EF} = 2EK_1(2\theta_E - 3R) & = M_{EI} \\ M_{EL} = -m_{EL} & = M_{ER} \end{cases}$$

$$\begin{cases} M_{AB} = 2EK_1(\theta_B - 3R) & = M_A \\ M_{GC} = 2EK_1(\theta_C - 3R) & = M_G \\ M_{HD} = 2EK_1(\theta_D - 3R) & = -M_H \\ M_{FE} = 2EK_1(\theta_E - 3R) & = -M_F \end{cases}$$

條件式

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	$2K_B$	K_2			$-3K_1$	=	$(C_{BC}-m_{BK})/2E$
2	K_2	$2K_C$	K_2		$-3K_1$	=	$(C_{CD}-C_{CB})/2E$
3		K_2	$2K_D$	K_2	$-3K_1$	=	$(C_{DE}-C_{DC})/2E$
4			K_2	$2K_E$	$-3K_1$	=	$(m_{EL}-C_{ED})/2E$
5	K_1	K_1	K_1	K_1	$-8K_1$	=	0

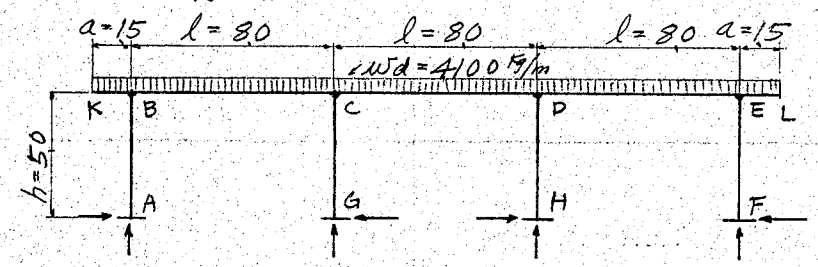
$I_1 = 0.0500\ m^4$, $I_2 = 0.0608\ m^4$, $h = 5.00^m$, $l = 8.00^m$

$K_1 = \frac{I_1}{h} = 0.0100$, $K_2 = \frac{I_2}{l} = 0.00760$ $\quad K_B = K_E = K_1 + K_2 = 0.0176$

$3K_1 = 0.0300$, $8K_1 = 0.0800$ $\quad K_C = K_D = K_1 + 2K_2 = 0.0252$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	4.63	1			-3.95	=	$(C_{BC}-m_{BK})/2.13(10)^7$
2	1	6.63	1		-3.95	=	$(C_{CD}-C_{CB})/2.13(10)^7$
3		1	6.63	1	-3.95	=	$(C_{DE}-C_{DC})/2.13(10)^7$
4			1	4.63	-3.95	=	$(m_{EL}-C_{ED})/2.13(10)^7$
5	1	1	1	1	-8.00	=	0

死荷重應力



$w_d = 4100\ kg/m$

荷重項 $C_{BC} = C_{CB} = C_{CD} = C_{DC} = C_{DE} = C_{ED} = \frac{4100 \times 8^2}{12}$

$= 21{,}870\ kgm$

$m_{BK} = m_{EL} = \frac{4100 \times 1.5^2}{2} = 4610\ kgm$

$(C_{BC} - m_{BK})/2.13(10)^7 = \frac{21870 - 4610}{21{,}300{,}000} = 0.00081$

$C_{CD} - C_{CB}/2.13(10)^7 = 0$

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$C_{DE} - C_{DC}/2.13(10)^7 = 0$
$M_{EL} - C_{ED}/2.13(10)^7 = -0.00081$
$\theta_B = 0.0001818$, $\theta_C = -0.0000323$

$M_{BA} = 28(10)^8 \times 0.01 \times 0.0003636 = 10{,}180$ Kgm
$M_{BC} = 28(10)^8 \times 0.0076 \times (0.0003636 - 0.0000323) - 21{,}870 = -14{,}820$ Kgm
$M_{BK} = 4610$ Kgm

$M_{CB} = 28(10)^8 \times 0.0076 \times (-0.0000646 + 0.0001818) + 21{,}870 = 24{,}360$ Kgm
$M_{CD} = 28(10)^8 \times 0.0076 \times (-0.0000646 + 0.0000323) - 21{,}870 = -22{,}560$ Kgm
$M_{CG} = 28(10)^8 \times 0.01 \times (-0.0000646) = -1{,}800$ Kgm

$M_{AB} = 28(10)^8 \times 0.01 \times (0.0001818) = 5{,}090$ Kgm
$M_{GC} = 28(10)^8 \times 0.01 \times (-0.0000323) = -900$ Kgm

弯曲率

$M_{BI} = -10{,}190$ Kgm　　$M_{CL} = -24{,}360$ Kgm　　$M_A = 5{,}090$ Kgm
$M_{BR} = -14{,}810$ Kgm　　$M_{CR} = -22{,}560$ Kgm　　$M_G = -900$ Kgm
$M_{BL} = -4{,}620$ Kgm　　$M_{CI} = 1{,}800$ Kgm

垂直力

$$V_A = \frac{14{,}810 - 24{,}360}{8.0} + 4{,}100 \times 5.5 = 21{,}360 \text{ Kg}$$

$$V_G = \frac{-14{,}810 + 24{,}360}{8.0} + 4{,}100 \times 8.0 = 33{,}990 \text{ Kg}$$

水平反力

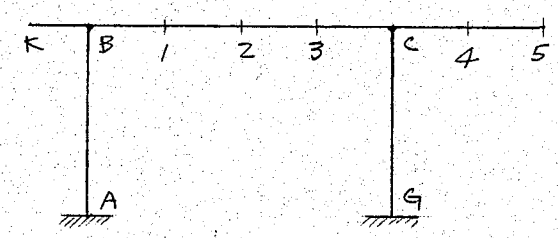
$$H_A = \frac{10{,}190 + 5{,}090}{5.0} = 3{,}060 \text{ Kg} \rightarrow$$

$$H_G = \frac{1{,}800 + 900}{5.0} = 540 \text{ Kg} \leftarrow$$

剪力

$S_{BL} = -4{,}100 \times 1.5 = -6{,}150$ Kg
$S_{BR} = 21{,}360 - 6{,}150 = 15{,}210$ Kg
$S_{CL} = -4{,}100 \times 8.00 + 15{,}210 = -17{,}590$ Kg
$S_{CR} = -17{,}590 + 33{,}990 = 16{,}400$ Kg
$S_{BI} = -3{,}060$ Kg
$S_{CI} = 540$ Kg

格点弯曲率



格点單桁弯曲率

桁中点　$\frac{4100 \times 8.0^2}{8.0} = 32{,}800$ Kgm
1/4点　$\frac{3 \times 4100 \times 8.0^2}{32.0} = 24{,}600$ Kgm

格点 1　$24{,}600 - 14{,}810 - \frac{24360 - 14810}{4} = 7{,}400$ Kgm
格点 2　$32{,}800 - 14{,}810 - \frac{2(24360 - 14810)}{4} = 13{,}210$ Kgm
格点 3　$24{,}600 - 14{,}810 - \frac{3(24360 - 14810)}{4} = 2{,}620$ Kgm
格点 4　$24{,}600 - 22{,}560 = 2{,}040$ Kgm
格点 5　$32{,}800 - 22{,}560 = 10{,}240$ Kgm

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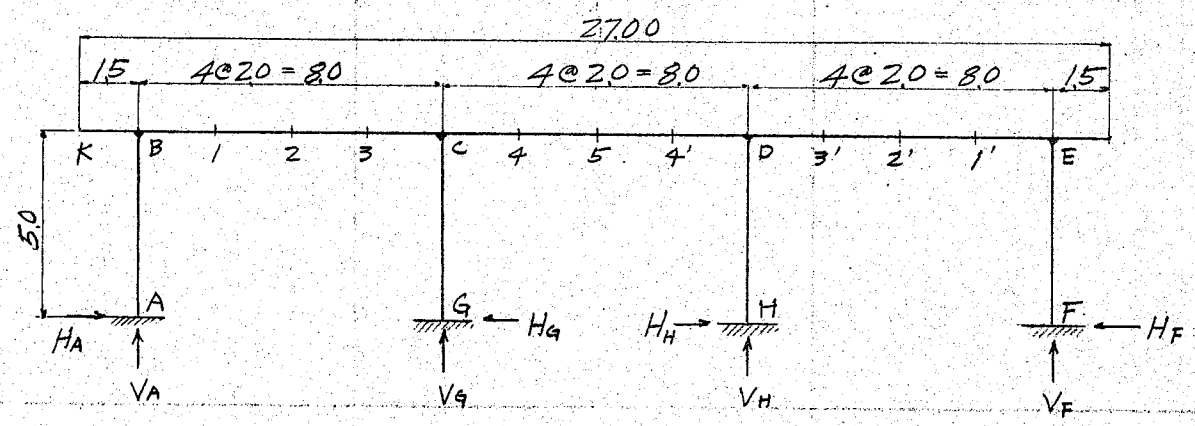
鐵筋混凝土高架橋
活荷重



1) 荷重 1kg が水夷ニ作用セル場合

$M_{BK} = 1.5$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	4.63	1			-3.95	=	$-0.704 \div (10)^7$
2	1	6.63	1		-3.95	=	0
3		1	6.63	1	-3.95	=	0
4			1	4.63	-3.95	=	0
5	1	1	1	1	-8.00	=	0

$\theta_B = -1757 \div (10)''$, $\theta_C = 142 \div (10)''$, $\theta_D = -138 \div (10)''$, $\theta_E = -176 \div (10)''$, $R = -241 \div (10)''$

$M_{BA} = 28(10)^8 \times 0.01 \times (-3514 + 723) \div (10)'' = -0.776$
$M_{BC} = 28(10)^8 \times 0.0076 \times (-3514 + 142) \div (10)'' = -0.724$
$M_{BK} = 1.500$

$M_{CB} = 28(10)^8 \times 0.0076 \times (284 - 1757) \div (10)'' = -0.313$
$M_{CD} = 28(10)^8 \times 0.0076 \times (284 - 138) \div (10)'' = 0.031$
$M_{CG} = 28(10)^8 \times 0.01 \times (284 + 723) \div (10)'' = 0.282$

$M_{DC} = 28(10)^8 \times 0.0076 \times (-276 + 142) \div (10)'' = -0.029$
$M_{DE} = 28(10)^8 \times 0.0076 \times (-276 - 176) \div (10)'' = -0.096$
$M_{DH} = 28(10)^8 \times 0.01 \times (-276 + 723) \div (10)'' = 0.125$

$M_{ED} = 28(10)^8 \times 0.0076 \times (-352 - 138) \div (10)'' = -0.104$
$M_{EF} = 28(10)^8 \times 0.01 \times (-352 + 723) \div (10)'' = 0.104$

$M_{AB} = 28(10)^8 \times 0.01 \times (-1757 + 723) \div (10)'' = -0.289$
$M_{GC} = 28(10)^8 \times 0.01 \times (142 + 723) \div (10)'' = 0.242$
$M_{HD} = 28(10)^8 \times 0.01 \times (-138 + 723) \div (10)'' = 0.164$
$M_{FE} = 28(10)^8 \times 0.01 \times (-176 + 723) \div (10)'' = 0.153$

單位彎曲率

$M_{B1} = 0.776$　$M_{BR} = -0.724$　$M_{BL} = -1.500$
$M_{CL} = 0.313$　$M_{CR} = 0.031$　$M_{C1} = -0.282$
$M_{DL} = 0.029$　$M_{DR} = -0.096$　$M_{D1} = 0.125$
$M_{EL} = 0.104$　$M_{E1} = 0.104$

$M_A = -0.289$　$M_H = -0.164$
$M_G = 0.242$　$M_F = -0.153$

單位垂直力

$V_A = 1.000 + \frac{0.724 + 0.313}{8.0} = 1.130$

鐵筋混凝土高架橋

$$V_G = \frac{-0.724 - 0.313 - 0.031 + 0.029}{8.0} = -0.130$$

$$V_H = \frac{0.031 - 0.029 + 0.096 + 0.104}{8.0} = 0.025$$

$$V_F = -\frac{0.096 + 0.104}{8.0} = -0.025$$

水平反力

$$H_A = \frac{0.776 + 0.289}{5.0} = 0.213 \longleftarrow$$

$$H_G = \frac{0.282 + 0.242}{5.0} = 0.105 \longrightarrow$$

$$H_H = \frac{0.125 + 0.164}{5.0} = 0.058 \longrightarrow$$

$$H_F = \frac{0.104 + 0.153}{5.0} = 0.051 \longrightarrow$$

剪　力

$S_{BL} = -1.000$
$S_{BR} = 1.130 - 1.000 = 0.130 = S_{CL}$
$S_{CR} = S_{DL} = 0.130 - 0.130 = 0$
$S_{DR} = S_{EL} = +0.025$
$S_{BI} = S_A = 0.213$
$S_{CI} = S_G = -0.105$
$S_{DI} = S_H = -0.058$
$S_{EI} = S_F = -0.051$

2) 荷重1ケが1点に作用せる場合

$C_{BC} = PKl(1-K)^2 = 1.125$　　$C_{BC}/2.13(10)^7 = 0.528/(10)^7$
$C_{CB} = PK^2l(1-K) = 0.375$　　$C_{CB}/2.13(10)^7 = 0.176/(10)^7$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	4.63	1			-3.95	=	$0.528/(10)^7$
2	1	6.63	1		-3.95	=	$-0.176/(10)^7$
3		1	6.63	1	-3.95	=	0
4			1	4.63	-3.95	=	0
5	1	1	1	1	-8.00	=	0

$\theta_B = 1354 \div (10)''$, $\theta_C = -402 \div (10)''$, $\theta_D = 134 \div (10)''$, $\theta_E = 97 \div (10)''$, $R = 148 \div (10)''$

$M_{BA} = 28(10)^8 \times 0.01 \times (2708 - 444) \div (10)'' = 0.634$
$M_{BC} = 28(10)^8 \times 0.0076 \times (2708 - 402) \div (10)'' - 1.125 = -0.634$

$M_{CB} = 28(10)^8 \times 0.0076 \times (-804 + 1354) \div (10)'' + 0.375 = 0.492$
$M_{CD} = 28(10)^8 \times 0.0076 \times (-804 + 134) \div (10)'' = -0.143$
$M_{CG} = 28(10)^8 \times 0.01 \times (-804 - 444) \div (10)'' = -0.349$

$M_{DC} = 28(10)^8 \times 0.0076 \times (268 - 402) \div (10)'' = -0.029$
$M_{DE} = 28(10)^8 \times 0.0076 \times (268 + 97) \div (10)'' = 0.078$
$M_{DH} = 28(10)^8 \times 0.01 \times (268 - 444) \div (10)'' = -0.049$

$M_{ED} = 28(10)^8 \times 0.0076 \times (194 + 134) \div (10)'' = 0.070$
$M_{EF} = 28(10)^8 \times 0.01 \times (194 - 444) \div (10)'' = -0.070$

$M_{AB} = 28(10)^8 \times 0.01 \times (1354 - 444) \div (10)'' = 0.255$
$M_{GC} = 28(10)^8 \times 0.01 \times (-402 - 444) \div (10)'' = -0.237$
$M_{HD} = 28(10)^8 \times 0.01 \times (134 - 444) \div (10)'' = -0.087$

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$M_{FE} = 28(10)^8 \times 0.01 \times (97-444) \div (10)'' = -0.097$

單位彎曲率

$M_{BI} = -0.634$　$M_{CL} = -0.492$　$M_{DL} = 0.029$　$M_{EL} = -0.070$
$M_{BR} = -0.634$　$M_{CR} = -0.143$　$M_{DR} = 0.078$　$M_{EI} = -0.070$
$M_{CI} = 0.349$　$M_{DI} = -0.049$

$M_A = 0.255$　$M_H = 0.087$
$M_G = -0.237$　$M_F = 0.097$

單位垂直力

$$V_A = \frac{0.634 - 0.492 + 1.0 \times 6.6}{8.0} = 0.768$$

$$V_G = \frac{-0.634 + 0.492 + 0.143 + 0.029 + 1 \times 2.0}{8.0} = 0.254$$

$$V_H = \frac{-0.143 - 0.029 - 0.078 - 0.070}{8.0} = -0.040$$

$$V_F = \frac{0.078 + 0.070}{8.0} = 0.018$$

水平反力

$$H_A = \frac{0.634 + 0255}{5.0} = 0.178 \longrightarrow$$

$$H_G = \frac{0.349 + 0.237}{5.0} = 0.117 \longleftarrow$$

$$H_H = \frac{0.049 + 0.087}{5.0} = 0.027 \longleftarrow$$

$$H_F = \frac{0.070 + 0.097}{5.0} = 0.034 \longleftarrow$$

剪　力

$S_{BR} = 0.768$
$S_{CL} = 0.768 - 1.000 = -0.232$
$S_{CR} = S_{DL} = -0.232 + 0.254 = 0.022$
$S_{DR} = S_{EL} = 0.022 - 0.040 = -0.018$
$S_{BI} = S_A = -0.178$
$S_{CI} = S_G = 0.117$
$S_{DI} = S_H = 0.027$
$S_{EI} = S_F = 0.034$

3) 荷重 1kg が 2 点に作用せる場合

$C_{BC} = C_{CB} = 1.000$　$C_{BC}/2.13 = C_{CB}/2.13 = 0.4695/(10)^7$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	4.63	1			-3.95	=	$0.4695/(10)^7$
2	1	6.63	1		-3.95	=	$-0.4695/(10)^7$
3		1	6.63	1	-3.95	=	0
4			1	4.63	-3.95	=	0
5	1	1	1	1	-8.00	=	0

$\theta_B = 1267 \div (10)''$, $\theta_C = -882 \div (10)''$, $\theta_D = 172 \div (10)''$, $\theta_E = 24 \div (10)''$, $R = 73 \div (10)''$

$M_{BA} = 28(10)^8 \times 0.01 \times (2534 - 219) \div (10)'' = 0.648$
$M_{BC} = 28(10)^8 \times 0.0076 \times (2534 - 882) \div (10)'' - 1.000 = -0.648$

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$M_{CB} = 28(10)^8 \times 0.0076 \times (-1,764 + 1,267) \div (10)'' + 1,000 = 0.894$
$M_{CD} = 28(10)^8 \times 0.0076 \times (-1,764 + 172) \div (10)'' = -0.339$
$M_{CG} = 28(10)^8 \times 0.01 \times (-1,764 - 219) \div (10)'' = -0.555$

$M_{DC} = 28(10)^8 \times 0.0076 \times (344 - 882) \div (10)'' = -0.114$
$M_{DE} = 28(10)^8 \times 0.0076 \times (344 + 24) \div (10)'' = 0.079$
$M_{DH} = 28(10)^8 \times 0.01 \times (344 - 219) \div (10)'' = 0.035$

$M_{ED} = 28(10)^8 \times 0.0076 \times (48 + 172) \div (10)'' = 0.048$
$M_{EF} = 28(10)^8 \times 0.01 \times (48 - 219) \div (10)'' = -0.048$

$M_{AB} = 28(10)^8 \times 0.01 \times (1,267 - 219) \div (10)'' = 0.294$
$M_{GC} = 28(10)^8 \times 0.01 \times (-882 - 219) \div (10)'' = -0.308$
$M_{HD} = 28(10)^8 \times 0.01 \times (172 - 219) \div (10)'' = -0.013$
$M_{FE} = 28(10)^8 \times 0.01 \times (24 - 219) \div (10)'' = -0.055$

單位彎曲率

$M_{BI} = -0.648$　$M_{CL} = -0.894$　$M_{DL} = 0.114$　$M_{EL} = -0.048$
$M_{BR} = -0.648$　$M_{CR} = -0.339$　$M_{DR} = 0.079$　$M_{EI} = -0.048$
$M_{CI} = 0.555$　$M_{DI} = 0.035$

$M_A = 0.294$　$M_H = 0.013$
$M_G = -0.308$　$M_F = 0.055$

單位垂直力

$$V_A = \frac{0.648 - 0.894 + 1 \times 4.0}{8.0} = 0.469$$

$$V_G = \frac{-0.648 + 0.894 + 0.339 + 0.114 + 1 \times 4.0}{8.0} = 0.587$$

$$V_H = \frac{-0.339 - 0.114 - 0.079 - 0.048}{8.0} = -0.072$$

$$V_F = \frac{0.079 + 0.048}{8.0} = 0.016$$

水平反力

$$H_A = \frac{0.648 + 0.294}{5.0} = 0.189 \rightarrow$$

$$H_G = \frac{0.555 + 0.308}{5.0} = 0.173 \leftarrow$$

$$H_H = \frac{0.035 - 0.013}{5.0} = 0.004 \rightarrow$$

$$H_F = \frac{0.048 + 0.055}{5.0} = 0.021 \leftarrow$$

剪力

$S_{BR} = 0.469$
$S_{CL} = 0.469 - 1.000 = -0.531$
$S_{CR} = S_{DL} = -0.531 + 0.587 = 0.056$
$S_{DR} = S_{EL} = 0.056 - 0.072 = -0.016$
$S_{BI} = S_A = -0.189$
$S_{CI} = S_G = 0.173$
$S_{DI} = S_H = -0.004$
$S_{FI} = S_F = 0.021$

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4) 荷重 1kg が 3点=作用セル場合

$C_{BC} = 0.375$　　$C_{BC}/2.13(10)^7 = 0.176/(10)^7$
$C_{CB} = 1.125$　　$C_{CB}/2.13(10)^7 = 0.528/(10)^7$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	4.63	1			-3.95	=	$0.176/(10)^7$
2	1	6.63	1		-3.95	=	$-0.528/(10)^7$
3		1	6.63	1	-3.95	=	0
4			1	4.63	-3.95	=	0
5	1	1	1	1	-8.00	=	0

$\theta_B = 546 \div (10)''$, $\theta_C = -921 \div (10)''$, $\theta_D = 124 \div (10)''$, $\theta_E = -60 \div (10)''$, $R = -39 \div (10)''$

$M_{BA} = 28(10)^8 \times 0.01 \times (1{,}092 + 117) \div (10)'' = 0.339$
$M_{BC} = 28(10)^8 \times 0.0076 \times (1{,}092 - 921) \div (10)'' - 0.375 = -0.339$

$M_{CB} = 28(10)^8 \times 0.0076 \times (-1{,}842 + 546) \div (10)'' + 1.125 = 0.850$
$M_{CD} = 28(10)^8 \times 0.0076 \times (-1{,}842 + 124) \div (10)'' = -0.366$
$M_{CG} = 28(10)^8 \times 0.01 \times (-1{,}842 + 117) \div (10)'' = -0.484$

$M_{DC} = 28(10)^8 \times 0.0076 \times (248 - 921) \div (10)'' = -0.143$
$M_{DE} = 28(10)^8 \times 0.0076 \times (248 - 60) \div (10)'' = 0.040$
$M_{DH} = 28(10)^8 \times 0.01 \times (248 + 117) \div (10)'' = 0.103$

$M_{ED} = 28(10)^8 \times 0.0076 \times (-120 + 124) \div (10)'' = 0.001$
$M_{EF} = 28(10)^8 \times 0.01 \times (-120 + 117) \div (10)'' = -0.001$

$M_{AB} = 28(10)^8 \times 0.01 \times (546 + 117) \div (10)'' = 0.186$
$M_{GC} = 28(10)^8 \times 0.01 \times (-921 + 117) \div (10)'' = -0.225$
$M_{HD} = 28(10)^8 \times 0.01 \times (124 + 117) \div (10)'' = 0.068$
$M_{FE} = 28(10)^8 \times 0.01 \times (-60 + 117) \div (10)'' = 0.016$

單位彎曲率

$M_{BI} = -0.339$	$M_{CL} = -0.850$	$M_{DL} = 0.143$	$M_{EL} = -0.001$	$M_A = 0.186$
$M_{BR} = -0.339$	$M_{CR} = -0.366$	$M_{DR} = 0.040$	$M_{EI} = -0.001$	$M_G = -0.225$
	$M_{CI} = 0.484$	$M_{DI} = 0.103$		$M_H = -0.068$
				$M_F = -0.016$

單位垂直力

$$V_A = \frac{0.339 - 0.850 + 1 \times 2.0}{8.0} = 0.186$$

$$V_G = \frac{-0.339 + 0.850 + 0.366 + 0.143 + 1 \times 6.0}{8.0} = 0.878$$

$$V_H = \frac{-0.143 - 0.366 - 0.040 - 0.001}{8.0} = -0.069$$

$$V_F = \frac{0.040 + 0.001}{8.0} = 0.005$$

水平反力

$$H_A = \frac{0.339 + 0.186}{5.0} = 0.105 \longrightarrow$$

$$H_G = \frac{0.484 + 0.225}{5.0} = 0.142 \longleftarrow$$

$$H_H = \frac{0.103 + 0.068}{5.0} = 0.034 \longrightarrow$$

$$H_F = \frac{-0.001 + 0.016}{5.0} = 0.003 \longrightarrow$$

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鐵筋混凝土高架橋

剪力

$S_{BR} = 0.186$
$S_{CL} = 0.186 - 1.000 = -0.814$
$S_{CR} = S_{DL} = -0.814 + 0.878 = 0.064$
$S_{DR} = S_{EL} = 0.064 - 0.069 = -0.005$
$S_{BI} = S_A = -0.105$
$S_{CI} = S_G = 0.142$
$S_{DI} = S_H = -0.034$
$S_{EI} = S_F = 0.003$

5) 荷重1ヶが4点ニ作用セル場合

$C_{CD} = 1.125$　$C_{CD}/2.13(10)^7 = 0.528/(10)^7$
$C_{DC} = 0.375$　$C_{DC}/2.13(10)^7 = 0.176/(10)^7$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	4.63	1			-3.95	=	0
2	1	6.63	1		-3.95	=	$0.528/(10)^7$
3		1	6.63	1	-3.95	=	$-0.176/(10)^7$
4			1	4.63	-3.95	=	0
5	1	1	1	1	-8.00	=	0

$\theta_B = -141 \div (10)''$　$\theta_C = 915 \div (10)''$　$\theta_D = -385 \div (10)''$　$\theta_E = 140 \div (10)''$　$R = 66 \div (10)''$

$M_{BA} = 28(10)^8 \times 0.01 \times (-282 - 198) \div (10)'' = -0.134$
$M_{BC} = 28(10)^8 \times 0.0076 \times (-282 + 915) \div (10)'' = 0.134$

$M_{CB} = 28(10)^8 \times 0.0076 \times (1,830 - 141) \div (10)'' = 0.359$
$M_{CD} = 28(10)^8 \times 0.0076 \times (1,830 - 385) \div (10)'' - 1.125 = -0.816$
$M_{CG} = 28(10)^8 \times 0.01 \times (1,830 - 198) \div (10)'' = 0.457$

$M_{DC} = 28(10)^8 \times 0.0076 \times (-770 + 915) \div (10)'' + 0.375 = 0.405$
$M_{DE} = 28(10)^8 \times 0.0076 \times (-770 + 140) \div (10)'' = -0.134$
$M_{DH} = 28(10)^8 \times 0.01 \times (-770 - 198) \div (10)'' = -0.271$

$M_{ED} = 28(10)^8 \times 0.0076 \times (280 - 385) \div (10)'' = -0.023$
$M_{EF} = 28(10)^8 \times 0.01 \times (280 - 198) \div (10)'' = +0.023$

$M_{AB} = 28(10)^8 \times 0.01 \times (-141 - 198) \div (10)'' = -0.095$
$M_{GC} = 28(10)^8 \times 0.01 \times (915 - 198) \div (10)'' = 0.201$
$M_{HD} = 28(10)^8 \times 0.01 \times (-385 - 198) \div (10)'' = -0.163$
$M_{FE} = 28(10)^8 \times 0.01 \times (140 - 198) \div (10)'' = -0.016$

單位彎曲率

$M_{BI} = 0.134$　$M_{CL} = -0.359$　$M_{DL} = -0.405$　$M_{EL} = 0.023$　$M_A = -0.095$
$M_{BR} = 0.134$　$M_{CR} = -0.816$　$M_{DR} = -0.134$　$M_{EI} = 0.023$　$M_G = 0.201$
$M_{CI} = -0.457$　$M_{DI} = -0.271$　$M_H = 0.163$
$M_F = 0.016$

單位垂直力

$$V_A = \frac{-0.134 - 0.359}{8.0} = -0.061$$

$$V_G = \frac{0.134 + 0.359 + 0.816 - 0.405 + 1 \times 6.0}{8.0} = 0.863$$

$$V_H = \frac{-0.816 + 0.405 + 0.134 + 0.023 + 1 \times 2.0}{8.0} = 0.218$$

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$$V_F = \frac{-0.134-0.023}{8.0} = -0.020$$

水平反力

$$H_A = \frac{0.134+0.095}{5.0} = 0.046 \longleftarrow$$

$$H_G = \frac{0.457+0.201}{5.0} = 0.132 \longrightarrow$$

$$H_H = \frac{0.271+0.163}{5.0} = 0.087 \longleftarrow$$

$$H_F = \frac{0.023-0.016}{} = 0.001 \longrightarrow$$

剪　力

$S_{BR} = S_{CL} = -0.061$
$S_{CR} = -0.061 + 0.863 = 0.802$
$S_{DL} = 0.802 - 1.000 = -0.198$
$S_{DR} = S_{EL} = -0.198 + 0.218 = 0.020$
$S_{BI} = S_A = 0.046$
$S_{CI} = S_G = -0.132$
$S_{DI} = S_H = 0.087$
$S_{EI} = S_F = -0.001$

6) 荷重1kが5点に作用せる場合

$C_{CD} = C_{DC} = 1.000$　　$C_{CD}/2.13(10)^7 = C_{DC}/2.13(10)^7 = 0.4695/(10)^7$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	4.63	1			-3.95	=	0
2	1	6.63	1		-3.95	=	$0.4695/(10)^7$
3		1	6.63	1	-3.95	=	$-0.4695/(10)^7$
4			1	4.63	-3.95	=	0
5	1	1	1	1	-8.00	=	0

$\theta_B = -187 \div (10)''$　$\theta_C = 867 \div (10)''$　$\theta_D = -867 \div (10)''$　$\theta_E = 187 \div (10)''$　$R = 0$

$M_{BA} = 28(10)^8 \times 0.01 \times (-374) \div (10)'' = -0.105$
$M_{BC} = 28(10)^8 \times 0.0076 \times (-374+867) \div (10)'' = 0.105$

$M_{CB} = 28(10)^8 \times 0.0076 \times (1,734-187) \div (10)'' = 0.330$
$M_{CD} = 28(10)^8 \times 0.0076 \times (1,734-867) \div (10)'' - 1,000 = -0.815$
$M_{CG} = 28(10)^8 \times 0.01 \times (1,734) \div (10)'' = 0.485$

$M_{AB} = 28(10)^8 \times 0.01 \times (-187) \div (10)'' = -0.052$
$M_{GC} = 28(10)^8 \times 0.01 \times (867) \div (10)'' = 0.243$

單位彎曲率

$M_{BI} = 0.105$　$M_{CL} = -0.330$　$M_A = -0.052$
$M_{BR} = 0.105$　$M_{CR} = -0.815$　$M_G = 0.243$
$M_{CI} = -0.485$

單位垂直力

$$V_A = \frac{-0.105-0.330}{8.0} = -0.054$$

$$V_G = \frac{0.105+0.330+1\times 4.0}{8.0} = 0.554$$

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鐵筋混凝土高架橋

水平反力

$$H_A = \frac{0.105 + 0.052}{5.0} = 0.031 \longleftarrow$$

$$H_G = \frac{0.485 + 0.243}{5.0} = 0.146 \longrightarrow$$

剪　力

$S_{BR} = S_{CL} = -0.054$
$S_{CR} = -0.054 + 0.554 = 0.500$
$S_{BI} = S_A = 0.031$
$S_{CI} = S_G = -0.146$

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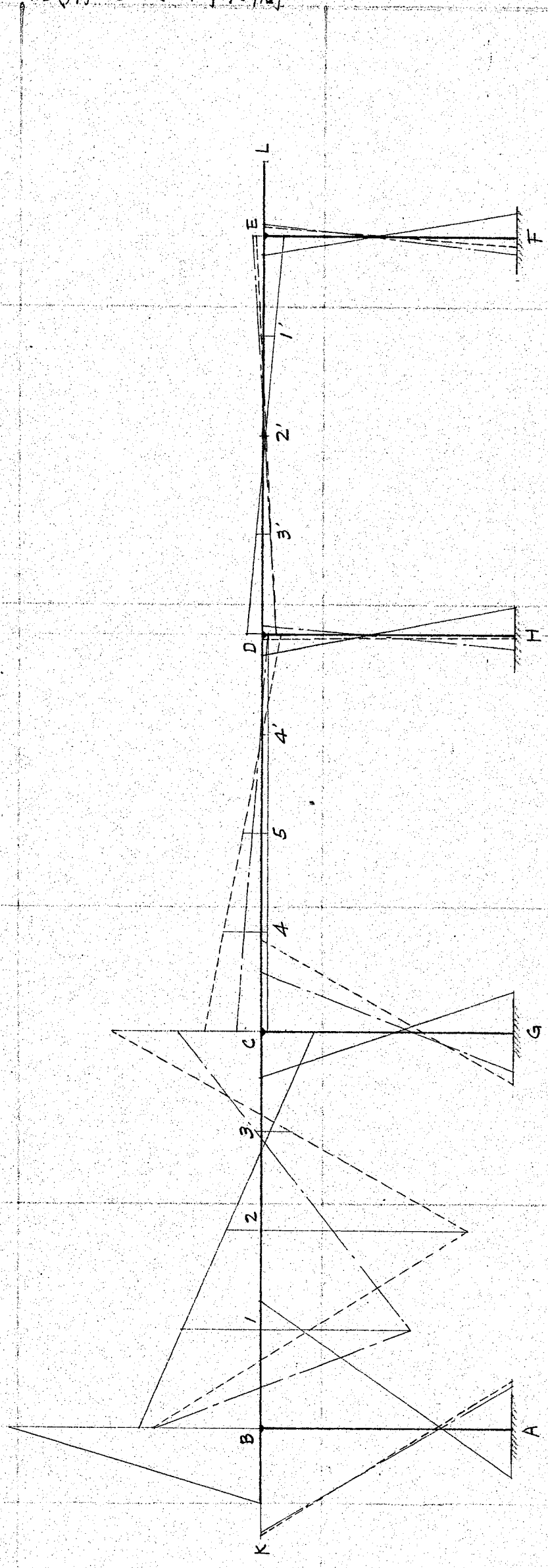
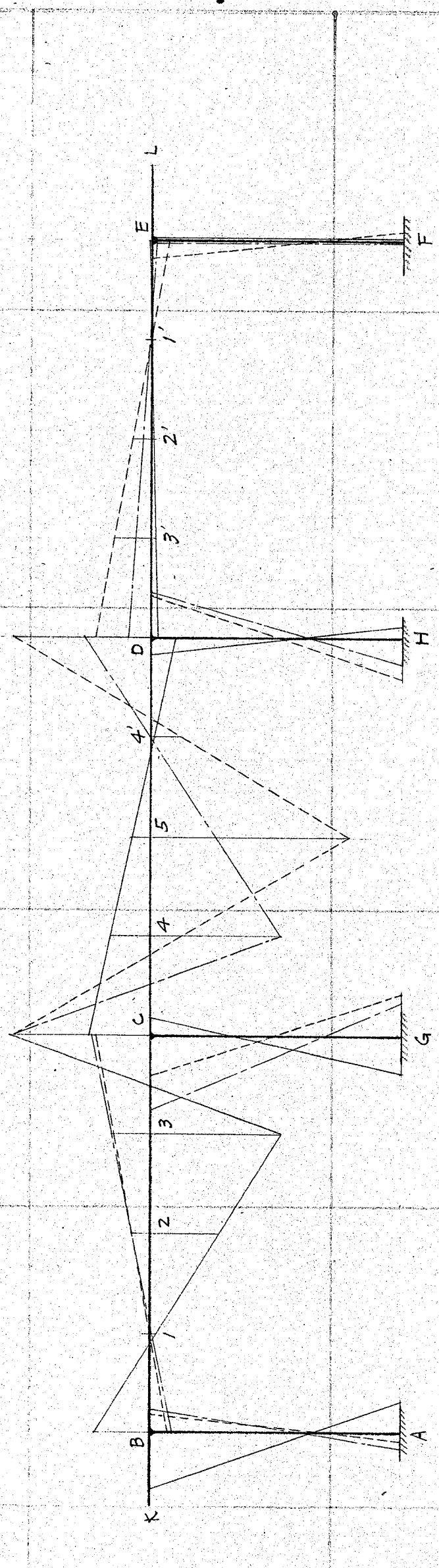
鐵筋混凝土高架橋





單位荷重ニヨル曲率圖表

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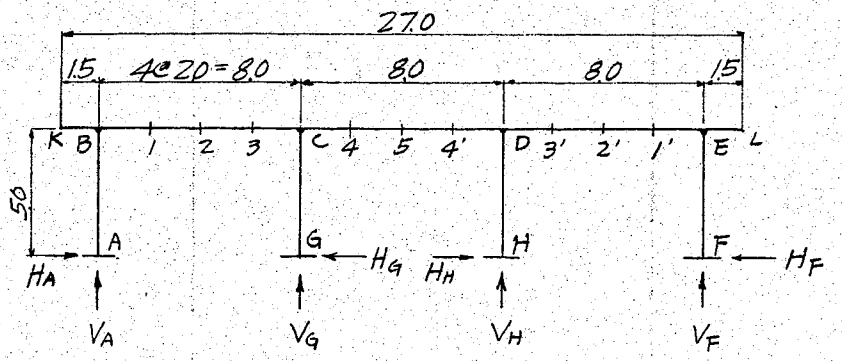
弯曲率剪力及反力，影響線



載荷点	弯曲率												
	M_{BL}	M_{BR}	M_{B1}	M_1	M_2	M_3	M_{CL}	M_{CR}	M_{C1}	M_4	M_5	M_A	M_G
K	-1.500	-0.724	0.776	-0.465	-0.205	0.054	0.313	0.031	-0.282	0.031	0.030	-0.289	0.242
1	—	-0.634	-0.634	0.901	0.437	-0.028	-0.492	-0.143	0.349	-0.100	-0.057	0.255	-0.237
2	—	-0.648	-0.648	0.290	1.229	0.167	-0.894	-0.339	0.555	-0.226	-0.112	0.294	-0.308
3	—	-0.339	-0.339	0.033	0.405	0.778	-0.850	-0.366	0.484	-0.239	-0.112	0.186	-0.225
4	—	0.134	0.134	0.011	-0.113	-0.236	-0.359	-0.816	-0.457	0.787	0.389	-0.095	0.201
5	—	0.105	0.105	-0.004	-0.113	-0.221	-0.330	-0.815	-0.485	0.185	1.185	-0.052	0.243
4'	—	0.023	0.023	-0.016	-0.056	-0.095	-0.134	-0.405	-0.271	-0.008	0.389	0.016	0.163
3'	—	-0.001	-0.001	0.009	0.019	0.030	0.040	0.143	0.103	0.016	-0.112	-0.016	-0.068
2'	—	-0.048	-0.048	-0.016	0.016	0.047	0.079	0.114	0.035	+0.001	-0.112	0.055	0.013
1'	—	-0.070	-0.070	-0.033	0.004	0.041	0.078	0.029	-0.049	-0.014	-0.057	0.097	0.087
L	—	0.104	0.104	0.054	0.004	-0.046	-0.096	0.029	0.125	0.030	0.030	-0.153	-0.164

載荷点	反力				剪力					
	V_A	V_G	H_A	H_G	S_{BL}	S_{BR}	S_{CL}	S_{CR}	S_A, S_{B1}	S_G, S_{C1}
K	1.130	-0.130	-0.213	-0.105	-1.000	0.130	0.130	0	0.213	-0.105
B	1.000	—	—	—	-1.000	1.000	—	—	—	—
1	0.768	0.254	0.178	0.117	—	0.768	-0.232	0.022	-0.178	0.117
2	0.469	0.587	0.189	0.173	—	0.469	-0.531	0.056	-0.189	0.173
3	0.186	0.878	0.105	0.142	—	0.186	-0.814	0.064	-0.105	0.142
C	—	1.000	—	—	—	—	-1.000	1.000	—	—
4	-0.061	0.863	-0.046	-0.132	—	-0.061	-0.061	0.802	0.046	-0.132
5	-0.054	0.554	-0.031	-0.146	—	-0.054	-0.054	0.500	0.031	-0.146
4'	-0.020	0.218	-0.001	-0.087	—	-0.020	-0.020	0.198	0.001	-0.087
D	—	—	—	—	—	—	—	—	—	—
3'	0.005	-0.069	-0.003	0.034	—	0.005	0.005	-0.064	-0.003	0.034
2'	0.016	-0.072	0.021	0.004	—	0.016	0.016	-0.056	-0.021	0.004
1'	0.018	-0.040	0.034	-0.027	—	0.018	0.018	-0.022	-0.034	-0.027
E	—	—	—	—	—	—	—	—	—	—
L	-0.025	0.025	-0.051	0.058	—	-0.025	-0.025	0	0.051	0.058

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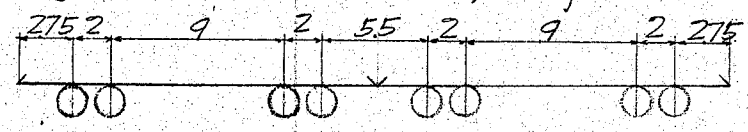
鐵筋混凝土高架橋

活荷重應力

60 噸電車　桁一本=付 7,500 kg



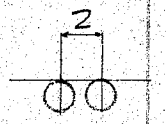
徑間 8.00，桁=対シ

輪荷重　7,500
衝撃 $i = \frac{20}{50+8} = 34.5\ \%$　2,590
10,090 kg

跳出脫=対シ

輪荷重　7,500
衝撃 $i = \frac{20}{50+15} = 38.8\ \%$　2,910
10,410 kg

特殊荷重　桁一本=付 8,250 kg



8,250
2,850
11,100 kg

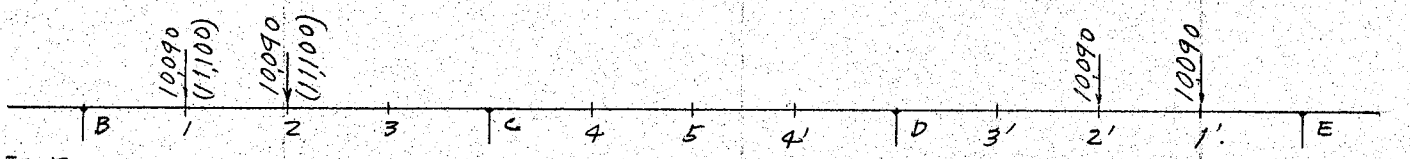
8,250
3,200
11,450 kg

BL 点

$M_{BL} = -1{,}500 \times 11{,}450 = -17{,}170$ kgm
$V_A = 1{,}130 \times 11{,}450 = 12{,}940$ kg
$S_{BL} = -1{,}000 \times 11{,}450 = -11{,}450$ kg
$H_A = -0.213 \times 11{,}450 = -2{,}440$ kg
$M_A = -0.289 \times 11{,}450 = -3{,}310$ kg

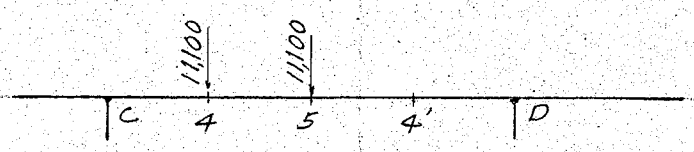
BR 点

最大負彎曲率，起ル場合



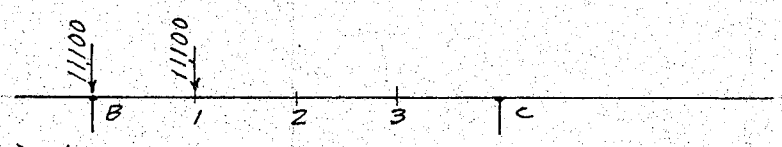
荷重点			−M		−M	H_A	
1	10,090	−0.634	−6,400	11,100	−7,040	0.178	1,975
2	〃	−0.648	−6,540	〃	−7,190	0.189	2,100
2'	〃	−0.048	−484				
1'	〃	−0.070	−706				
			−14,130 kgm		−14,230 kgm		4,075 kg

最大正彎曲率，起ル場合



荷重点			M		H_A
4	11,100	0.134	1,487	−0.046	−510
5	〃	0.105	1,165	−0.031	−344
			2,652 kgm		−854 kg

最大剪力，起ル場合



荷重点			S_{BR}
B	11,100	1,000	11,100
1	〃	0.768	8,520
			19,620 kg

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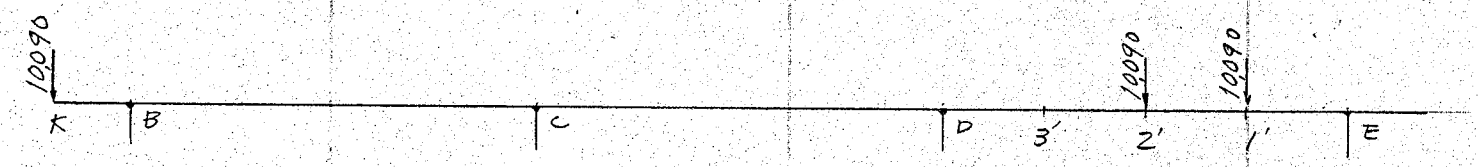
鐵筋混凝土高架橋

1 径間

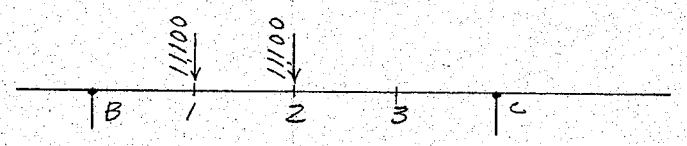
最大負弯曲率ノ起ル場合



荷重径間

			-M		H_A
K	10,090	-0.465	-4,695	-0.213	-2,150
2'	〃	-0.016	-162	0.021	212
1'	〃	-0.033	-333	0.034	343
			-5190 kgm		-1,595 kg

最大正弯曲率ノ起ル場合

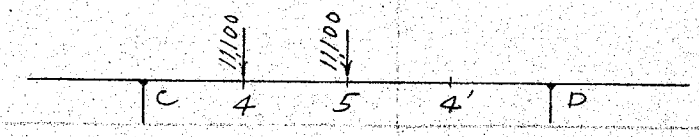


荷重径間

			M		H_A		S_1
1	11,100	0.901	10,000	0.178	1,977	0.768	8,520
2	〃	0.290	3,220	0.189	2,098	0.469	5,210
			13,220 kgm		4,075 kg		13,730 kg

2 径間

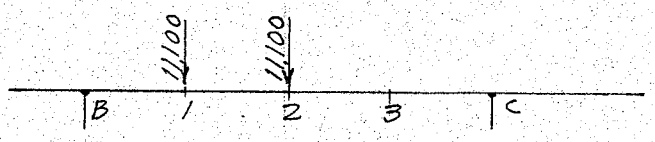
最大負弯曲率ノ起ル場合



荷重径間

			M		H_A
4	11,100	-0.113	-1255	-0.046	510
5	11,100	-0.113	-1255	-0.031	344
			-2,510 kg		854 kg

最大正弯曲率ノ起ル場合

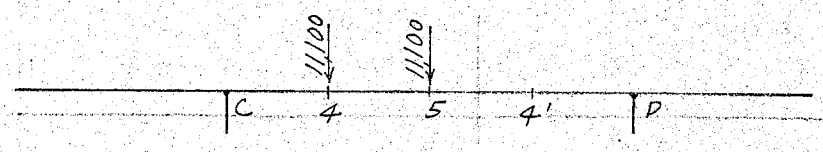


荷重径間

			M		H_A
1	11,100	0.437	4,850	0.178	1,975
2	〃	1.229	13,640	0.189	2,097
			18,490 kgm		4,072 kg

3 径間

最大負弯曲率ノ起ル場合



荷重径間

			-M	H_A
4	11,100	-0.236	-2,620	
5	〃	-0.221	-2,450	
			-5,070 kgm	854 kg

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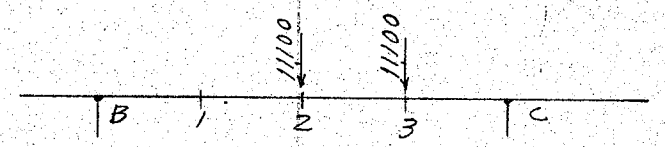
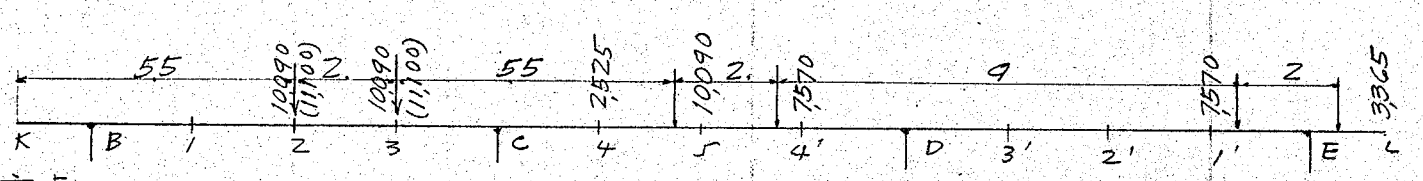
鐵筋混凝土高架橋

最大正弯曲率ノ起ル場合



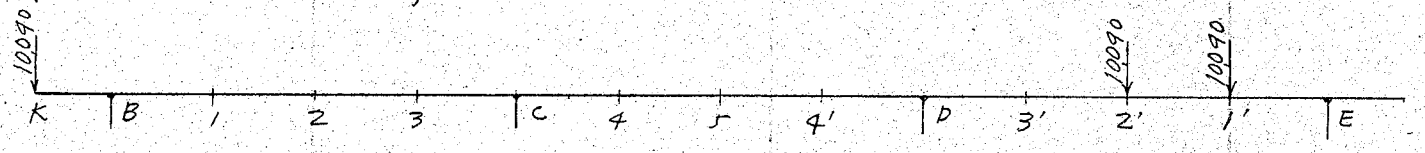
荷重点			M		H_A		S_3
2	11,100	0.167	1,853	0.189	2,097	-0.531	-5,895
3	〃	0.778	8,632	0.105	1,165	-0.814	-9040
			10,485 kgm		3,262 kg		-14,935 kg

C_L 点最大負弯曲率ノ起ル場合



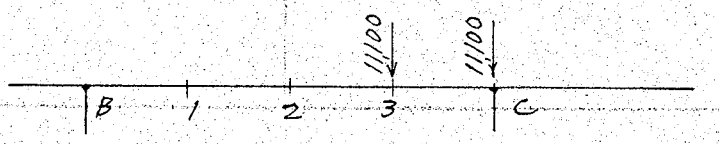
荷重点			-M		H_A
2	10,090	-0,894	-9,020	0.189	1,905
3	10,090	-0,850	-8,580	0.105	1,060
4	2545	-0,359	- 913	-0,046	- 117
5	10,090	-0,330	- 3,330	-0,031	- 313
4'	7,570	-0,134	- 1,017	-0.001	- 8
1'	7,570	0,078	590	0,034	257
L	3,365	-0,096	- 323	-0,051	- 172
			-22,593 kgm		2,612 kg

最大正弯曲率ノ起ル場合



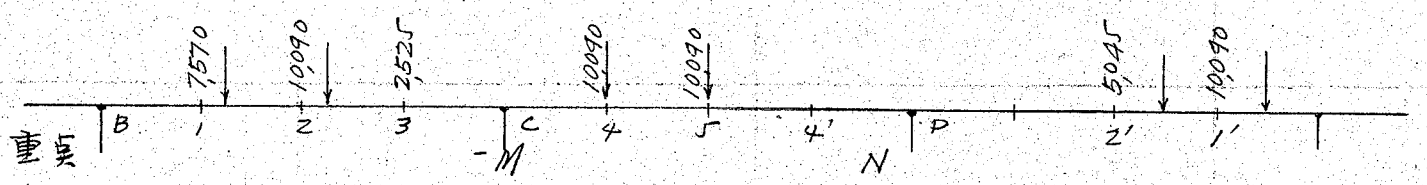
荷重点			M		H_A
K	10,090	0313	3,160	-0,213	-2,150
2'	〃	0,079	797	0,021	212
1'	〃	0,078	787	0.034	343
			4,744 kgm		-1,595 kg

最大剪力ノ起ル場合



荷重点			S
3	11,100	-0,814	-9,040
C	〃	-1,000	-11,100
			-20,140 kg

C_R 点最大負弯曲率ノ起ル場合



荷重点			-M		N
1	7,570	-0,143	-1,082	-0.061	-462
2	10,090	-0,339	-3,420	-0.016	-161
3	2,525	-0,366	- 924	0.037	93

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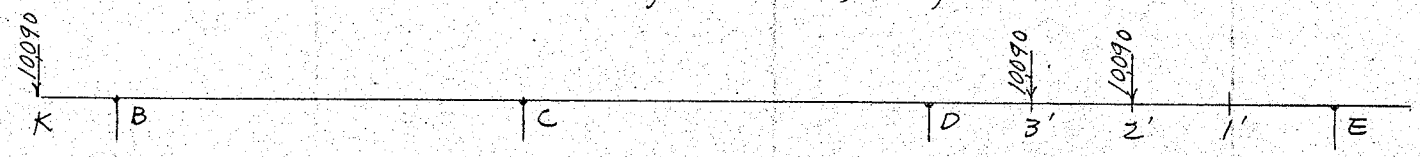
鐵筋混凝土高架橋

荷重矣

			−M		N
4	10,090	−0.816	−8,230	−0.086	−868
5	〃	−0.815	−8,220	−0.115	−1,160
2′	5,045	0.114	575	−0.017	−86
1′	10,090	0.029	293	−0.061	−615
			−21,008 kgm		−3,259 kg

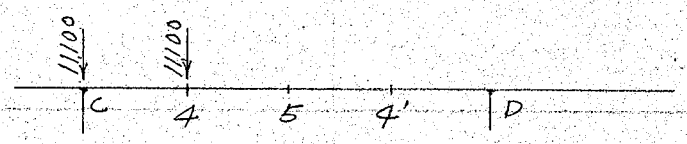
最大正彎曲率，起～場合



荷重矣

			M		N
K	10,090	0.031	313	0.108	1,088
3′	〃	0.143	1,443	0.037	373
2′	〃	0.114	1,150	−0.017	−171
			2,906 kgm		1,290 kg

最大剪力，起～場合

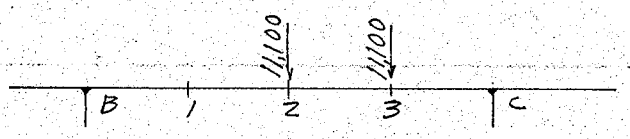


荷重矣

			S
C	11,100	1,000	11,100
4	11,100	0.802	8,900
			20,000 kg

4矣

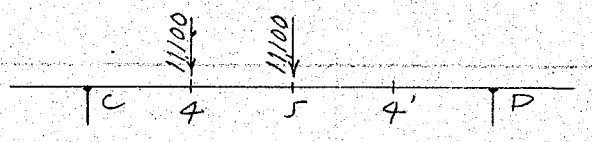
最大負彎曲率，起～場合



荷重矣

			−M		N
2	11,100	−0.226	−2,510	−0.016	−178
3	〃	−0.239	−2,650	0.037	411
			−5,160 kgm		233 kg

最大正彎曲率，起～場合

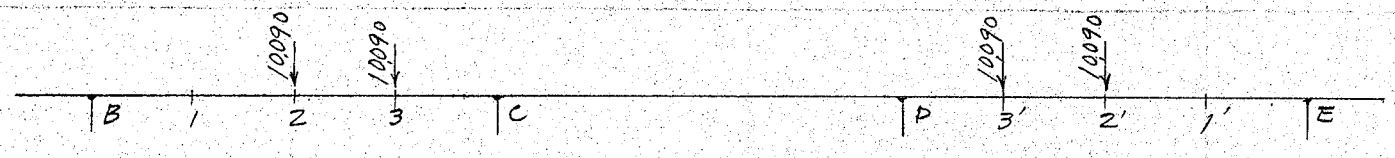


荷重矣

			M		N		S_4
4	11,100	0.787	8,730	−0.086	−954	0.802	8,900
5	〃	0.185	2,052	−0.115	−1,276	0.500	5,550
			10,782 kgm		−2,230 kg		14,450 kg

5矣

最大負彎曲率，起～場合



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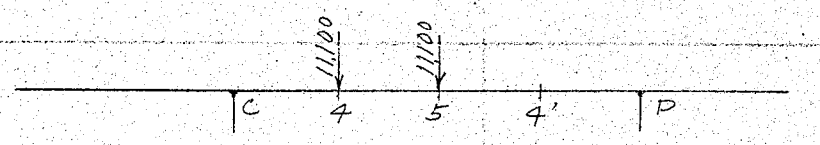
鐵筋混凝土高架橋

荷重矣

			−M		N
2	10,090	−0.112	−1,130	−0.016	−162
3	〃	−0.112	−1,130	0.037	373
3′	〃	−0.112	−1,130	0.037	373
2′	〃	−0.112	−1,130	−0.017	−172
			−4,520 kgm		412 kg

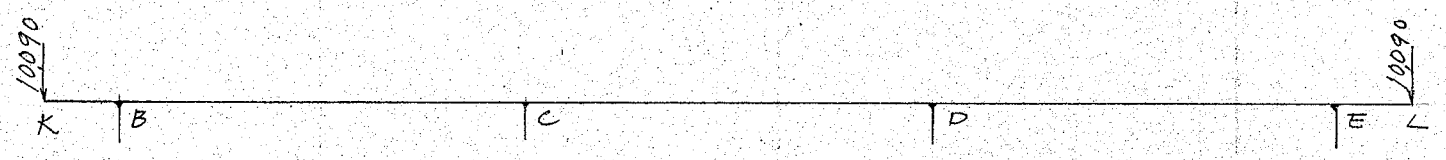
最大正弯曲率ノ起ル場合



荷重矣

			M		N
4	11,100	0.389	4315	−0.086	−954
5	〃	1,185	13150	−0.115	−1,276
			17,465 kgm		−2230 kg

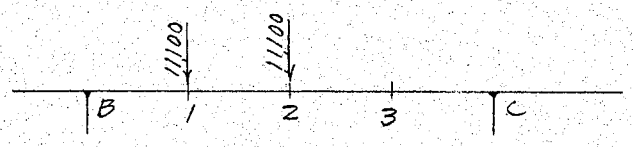
B₁ 矣
最大正弯曲率ノ起ル場合



荷重矣

			M		VA
K	10,090	0.776	7,830	1,130	11,400
L	10,090	0.104	1,050	−0.025	−252
			8,880 kgm		11,148 kg

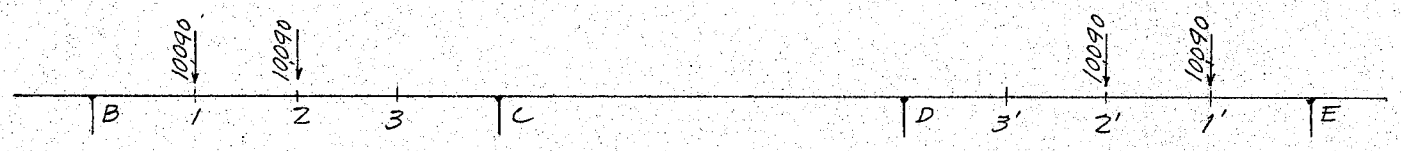
最大負弯曲率ノ起ル場合



荷重矣

			−M		VA
1	11,100	−0.634	−7,040	0.768	8520
2	〃	−0.648	−7,190	0.469	5205
			−14,230 kgm		13,725 kg

A 矣
最大正弯曲率ノ起ル場合



荷重矣

			M		VA		HA
1	10,090	0.255	2,574	0.768	7,750	0.178	1,796
2	〃	0.294	2,968	0.469	4,735	0.189	1,907
2′	〃	0.055	555	0.016	162	0.021	212
1′	〃	0.097	969	0.018	182	0.034	343
			7,066 kgm		12,829 kg		4,258 kg

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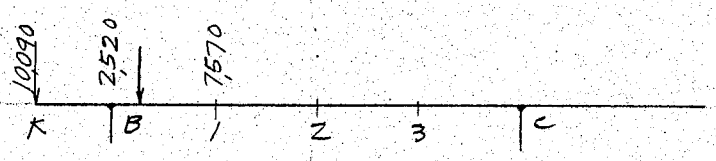
鐵筋混凝土高架橋

最大負彎曲率ノ起ル場合(B1点ノ最大正彎曲率ノ起ル場合ト同ジ荷重狀態)

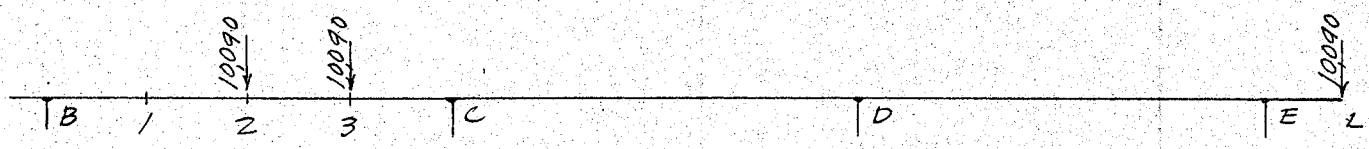
荷重点			-M	VA	HA
K	10,090	-0.289	-2,915	-0.213	-2,150
L	〃	-0.153	-1543	-0.051	-515
			-4,458 kgm	11,148 kg	-2,665 kg

VA ノ最大



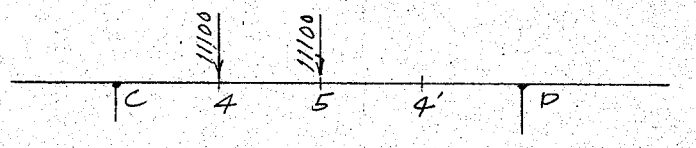
荷重点			VA	MA		HA
K	10,090	1.130	11,400	-0.289	-2,915	-0.213	-2,148
B	2,520	1.000	2,520	—	—	—	—
1	7,570	0.768	5,810	0.255	1,930	0.178	1,347
			19,730 kg		-985 kgm		-801 kg

C1点
最大正彎曲率ノ起ル場合



荷重点			M		VG
2	10,090	0.555	5,600	0.587	5,920
3	〃	0.484	4,885	0.878	8,860
L	〃	0.125	1,262	0.025	252
			11,747 kgm		15,032 kg

最大負彎曲率ノ起ル場合

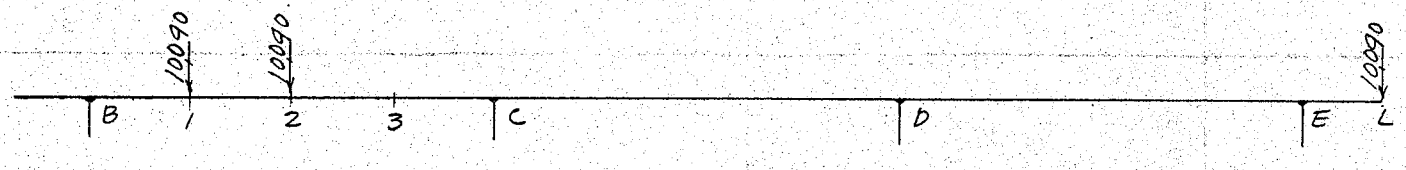


荷重点			-M		VG
4	11,100	-0.457	-5,070	0.863	9,570
5	〃	-0.485	-5380	0.554	6,150
			-10,450 kgm		15,720 kg

G点
最大正彎曲率ノ起ル場合(C1点ノ最大負彎曲率ノ起ル場合ト同ジ荷重狀態)

荷重点			M	VG
4	11,100	0.201	2,230	
5	〃	0.243	2,700	
			4,930 kgm	15,720 kg

最大負彎曲率ノ起ル場合



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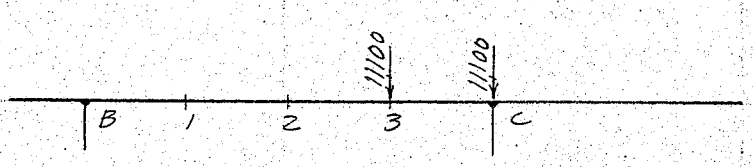
鐵筋混凝土高架橋

荷重点

			−M		Vg		Hg
1	10,090	-0.237	-2,392	0.254	2,562	0.117	1,180
2	〃	-0.308	-3,108	0.587	5,922	0.173	1,745
L	〃	-0.164	-1,655	0.025	252	0.058	585
			-7,155 kgm		8,736 kg		3,510 kg

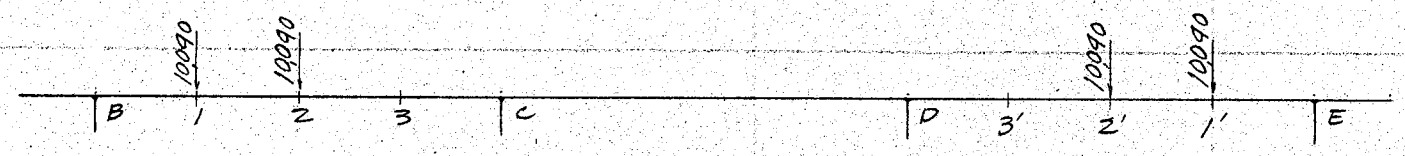
Vg，最大



荷重点

			Vg		M		Hg
3	11,100	0.878	9,750	-0.225	-2,500	0.142	1,576
C	〃	1.000	11,100	—	—	—	—
			20,850 kgm		-2,500 kg		1,576 kg

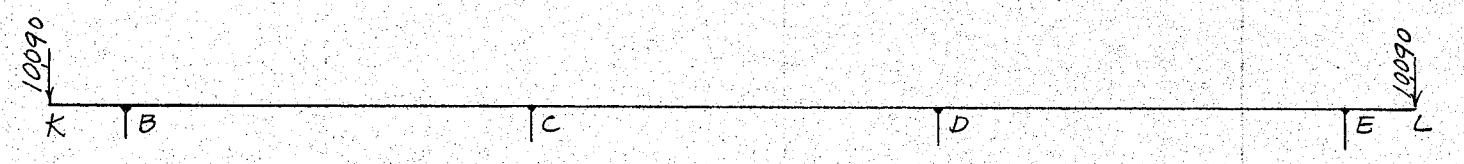
HA及SA，最大



荷重点

1	10,090	0.178	1,796
2	〃	0.189	1,907
2'	〃	0.021	212
1'	〃	0.034	343

HA = 4,258 kg
SA = -4,258 kg

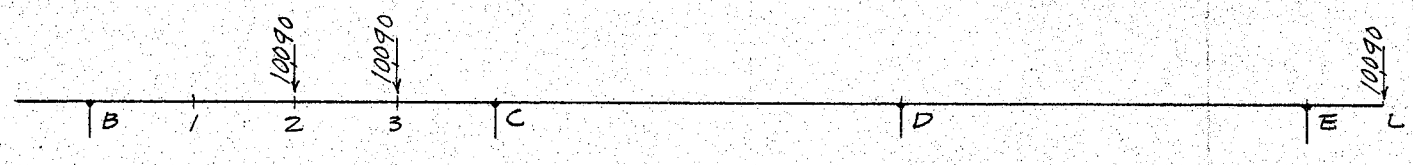


荷重点

K	10,090	-0.213	-2,150
L	〃	-0.051	-515

HA = -2,665 kg
SA = 2,665 kg

Hg及Sg，最大



荷重点

			Hg, Sg
2	10,090	0.173	1,745
3	〃	0.142	1,433
L	〃	0.058	585
			3,763 kg

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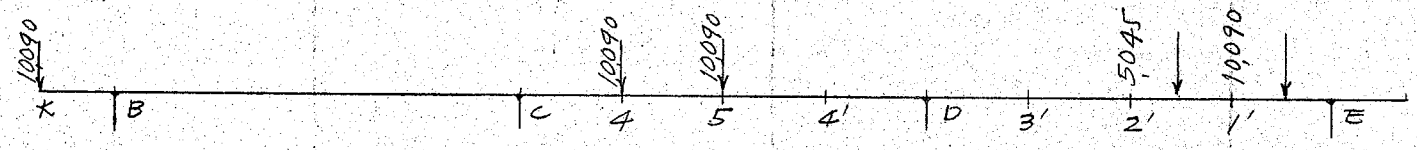
鐵筋混凝土高架橋

Hg 及 Sg' 最大



荷重表

K	10,090	-0,105	-1,060
4	10,090	-0,132	-1,333
5	10,090	-0,146	-1,473
2'	5,045	0.004	20
1'	10,090	-0,027	-272
			-4,118 kg

温度應力 (温度上昇ノ場合)

温度ノ変化、 $t = 15°C$　　$K_1 = 0.01$
膨張係数　　$\varepsilon = 0.00001$　　$K_2 = 0.0076$

$$\begin{cases} M_{BA} = 2EK_1(2\theta_B - 3R_1) \\ M_{BC} = 2EK_2(2\theta_B + \theta_C) \end{cases} \qquad \begin{cases} M_{AB} = 2EK_1(\theta_B - 3R_1) \\ M_{GC} = 2EK_1(\theta_C - 3R_2) \end{cases}$$

$$\begin{cases} M_{CB} = 2EK_2(2\theta_C + \theta_B) \\ M_{CD} = 2EK_2\theta_C \\ M_{CG} = 2EK_1(2\theta_C - 3R_2) \end{cases}$$

$$R_1 = -\frac{3\varepsilon t l}{2h} = -\frac{3\times 0.00001\times 15\times 800}{2\times 5.0} = -0.00036$$

$$R_2 = -\frac{\varepsilon t l}{2h} = -\frac{0.00001\times 15\times 800}{2\times 5.0} = -0.00012$$

$$\theta_B = \frac{3\{K_1K_2R_2 - K_1(2K_1+3K_2)R_1\}}{K_2^2 - 2(K_1+K_2)(2K_1+3K_2)} = -\frac{30017}{(10)^8}$$

$$\theta_C = \frac{3\{K_1K_2R_1 - 2(K_1+K_2)K_1R_2\}}{K_2^2 - 2(K_1+K_2)(2K_1+3K_2)} = -\frac{3081}{(10)^8}$$

$2EK_1 = 0.28(10)^8$
$2EK_2 = 0.2128(10)^8$
$3R_1 = -\frac{108,000}{(10)^8}$

$3R_2 = -\frac{36000}{(10)^8}$

$M_{BA} = 0.28(-60,034 + 108,000) = 13,430$ kgm
$M_{BC} = 0.2128(-60,034 - 3,081) = -13,430$

$M_{CB} = 0.2128(-6,162 - 30,017) = -7,700$
$M_{CD} = 0.2128\times 3,081 = -660$
$M_{CG} = 0.28(-6,162 + 3,600) = 8,360$

$M_{AB} = 0.28(-30,017 + 108,000) = 21,840$
$M_{GC} = 0.28(-3,081 + 36,000) = 9,220$

格点弯曲率

$M_{B1} = -13,430$ kgm　　$M_{C1} = 7,700$ kgm　　$M_A = 21,840$ kgm　　$M_1 = -8,150$ kgm
$M_{BR} = -13,430$ kgm　　$M_{CR} = -660$ kgm　　$M_G = 9,220$ kgm　　$M_2 = -2,870$ kgm
$M_{C1} = -8,350$ kgm　　$M_3 = 2,410$ kgm
$M_4 = M_5 = 660$ kgm

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鐵筋混凝土高架橋

垂直力

$$V_A = \frac{13,430 + 7,700}{8.0} = 2,645\ kg$$

$$V_G = -2,645\ kg$$

水平反力

$$H_A = \frac{13,430 + 21,840}{5.0} = 7,050\ kg \rightarrow$$

$$H_G = \frac{8,350 + 9220}{5.0} = 3,510\ kg \rightarrow$$

剪力

$$S_{BR} = S_{CL} = 2,645\ kg$$
$$S_{CR} = 0$$
$$S_{B1} = S_A = -7,050\ kg$$
$$S_{G1} = S_G = -3,510\ kg$$

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東京市品川區五反田五ノ一〇八
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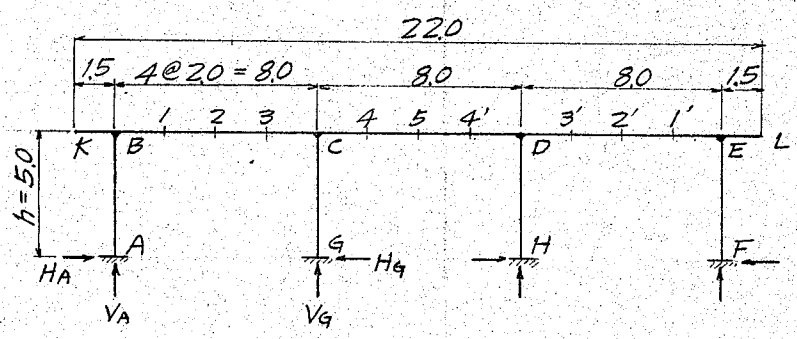
設計　日付　類別 8h5
照査　日付　第 24頁

鐵筋混凝土高架橋 應力一括表



弯曲率(Kgm)及軸圧力(kg)

	弯曲率	M_{BL}	M_{BR}	M_{B1}	M_1	M_2	M_3	M_{CL}	M_{CR}	M_{C1}	M_4	M_5	M_A	M_G
最大正弯曲率	死荷重	-4,620	-14,810	-10,190	7,400	13,210	2,620	-24,360	-22,560	1,800	2,040	10,240	5,090	-900
	活荷重		2,652	8,880	13,220	18,490	10,485	4,744	2,906	11,747	10,782	17,465	7,066	4,930
	温度'变化		13,430	13,430	8,150	2,870	2,410	7,700	660	8,350	660	660	21,840	9,220
	合成應力		1,272	12,120	28,770	34,570	15,515	-11,916	-18,994	21,897	13,482	28,365	33,996	13,250
	軸圧力													
	死荷重		3,060	21,360	3,060	3,060	3,060	3,060	-2,520	33,990	-2,520	-2,520	21,360	33,990
	活荷重		-854	11,148	4,075	4,072	3,262	-1,595	1,290	15,032	-2,230	-2,230	12,829	15,720
	温度'变化		-7,050	-2,645	-7,050	-7,050	7,050	7,050	10,560	2,645	-10,560	-10,560	2,645	-2,645
	合成應力		-4,844	29,863	85	82	13,372	8,515	9,330	51,667	-15,310	-15,310	36,834	47,065

	弯曲率	M_{BL}	M_{BR}	M_{B1}	M_1	M_2	M_3	M_{CL}	M_{CR}	M_{C1}	M_4	M_5	M_A	M_G
最大負弯曲率	死荷重	-4,620	-14,810	-10,190	7,400	13,210	2,620	-24,360	-22,560	1,800	2,040	10,240	5,090	-900
	活荷重	-17,170	-14,230	-14,230	-5,190	-2,510	-5,070	-22,593	-21,008	-10,450	-5,160	-4,520	-4,458	-7,155
	温度'变化	—	-13,430	-13,430	-8,150	-2,870	-2,410	-7,700	-660	-8,350	-660	-660	-21,840	-9,220
	合成應力	-21,790	-42,470	-37,850	-5,940	7,830	-4,860	-54,653	-44,228	-17,000	-3,780	5,060	-21,208	-17,275
	軸圧力													
	死荷重		3,060	21,360	3,060	3,060	3,060	3,060	-2,520	33,990	-2,520	-2,520	21,360	33,990
	活荷重		4,075	13,725	-1,595	854	854	2,612	-3,259	15,720	233	412	11,148	8,736
	温度'变化		7,050	2,645	7,050	7,050	-7,050	-7,050	-10,560	-2,645	10,560	10,560	-2,645	2,645
	合成應力		14,185	37,730	8,515	10,964	-3,136	-1,378	-16,339	47,065	8,273	8,452	29,863	45,371

最大反力及剪力

	V_A	V_G	H_A	H_G	S_A S_{B1}	S_G S_{C1}	S_{BL}	S_{BR}	S_{CL}	S_{CR}	S_1	S_3	S_4
死荷重	21,360	33,990	3,060	540	-3,060	540	-6,150	15,210	-17,590	16,400	7,010	-9,390	8,200
活荷重	19,730	20,850	4,258	3,763	-4,258	3,763	-11,450	19,620	-20,140	20,000	13,730	-14,935	14,450
温度'变化	2,645	2,645	7,050	3,510	-7,050	3,510	—	2,645	-2,645	0	2,645	-2,645	0
合成應力	43,735	57,485	14,368	7,813	-14,368	7,813	-17,600	37,475	-40,375	36,400	23,385	-26,970	22,650
	M	M	H_A	H_G	S_A S_{B1}	S_G S_{C1}							
死荷重	5,090	-900	3,060	540	-3,060	540							
活荷重	-985	-2,500	-2,665	-4,118	2,665	-4,118							
温度'变化	21,840	-9,220	-7,050	-3,510	7,050	-3,510							
合成應力	25,945	-12,620	-6,655	-7,088	6,655	-7,088							

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設計　日付　類別 8h5
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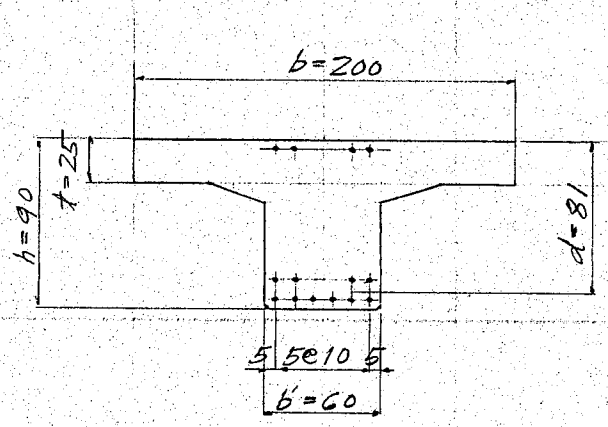
鐵筋混凝土高架橋

斷面ノ設計

2 点　$M_2 = 34{,}570\ kgm$　$N = 82\ kg$



$A_s = 10 @ 22\phi = 10 @ 3801 = 38.01\ cm^2$

$t = 25\ cm$, $d = 81\ cm$, $t/d = 25/81 = 0.309$, $b = 200\ cm$

$$p = \frac{A_s}{bd} = \frac{38.01}{200 \times 81} = 0.00235$$

中立軸ハ突縁中ニアリ

$j = 0.922$, $K = 0.234$

$$f_s = \frac{M}{A_s j d} = \frac{34{,}570 \times 100}{38.01 \times 0.922 \times 81} = 1{,}215\ kg/cm^2$$

$$f_c = \frac{f_s K}{n(1-K)} = \frac{1{,}215 \times 0.234}{15(1-0.234)} = 24.8\ kg/cm^2$$

5 点　$M_5 = 28{,}365\ kgm$　$N = 15{,}310\ kg$

$A_s = 10 @ 22\phi = 38.01\ cm^2$

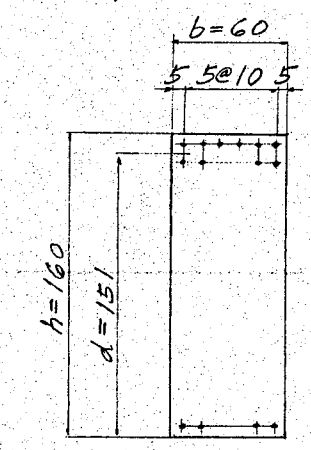
$t = 25\ cm$, $d = 81\ cm$, $b = 200\ cm$

$j = 0.922$　$K = 0.234$

$$f_s = \frac{28{,}365 \times 100}{38.01 \times 0.922 \times 81} = 999\ kg/cm^2$$

$$f_c = \frac{999 \times 0.234}{15(1-0.234)} = 20.4\ kg/cm^2$$

C_L 点　$M_{CL} = -54{,}653\ kgm$　$N = -1{,}378\ kg$, $S = 40{,}375\ kg$



$A_s = 10 @ 22\phi = 38.01\ cm^2$

$b = 60\ cm$, $d = 151\ cm$

$$p = \frac{38.01}{60 \times 151} = 0.0042$$

$j = 0.901$, $K = 0.297$

$$f_s = \frac{54{,}653 \times 100}{38.01 \times 0.901 \times 151} = 1{,}058\ kg/cm^2$$

$$f_c = \frac{1{,}058 \times 0.297}{15(1-0.297)} = 29.8\ kg/cm^2$$

$$\nu = \frac{S}{bjd} = \frac{40{,}375}{60 \times 0.901 \times 151} = 5.0\ kg/cm^2$$

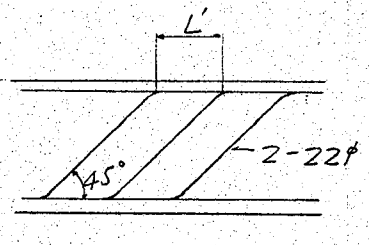
$$u = \frac{40{,}375}{69.1 \times 0.901 \times 151} = 4.3\ kg/cm^2$$

腹鐵筋　$A_b = 2 @ 22\phi = 7.602\ cm^2$

抵抗水平剪力　$H_v = 1.414\, A_b \sigma_s$

$= 1.414 \times 7.602 \times 1{,}200 = 12{,}900\ kg$

抵抗剪應力　$\tau' = \dfrac{1.414 \times A_b \sigma_s}{L' b_0} = \dfrac{1.414 \times 7.602 \times 1{,}200}{L' \times 60} = \dfrac{215}{L'}$



L'	τ'
40 cm	5.4 kg/cm²
50	4.3
60	3.6
70	3.1

抵抗剪力　$H_v = A_s \sigma_s$　$A_s = 2 - 16\phi = 4.02\ cm^2$

$= 4.02 \times 1{,}200 = 4{,}820\ kg$

抵抗剪應力　$\tau' = \dfrac{A_s \sigma_s}{a b_0} = \dfrac{4820}{a \times 60} = \dfrac{80.5}{a}$

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設計　日付　類別 8h5
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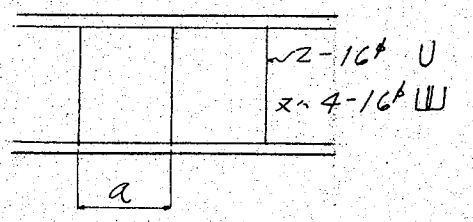
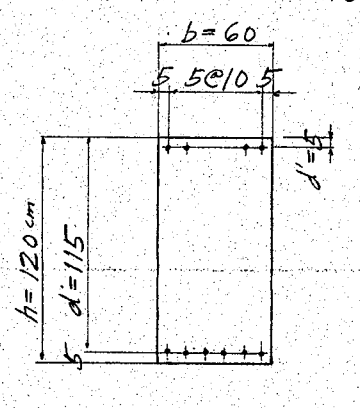
鐵筋混凝土高架橋



U	山	
a	a	τ'
12.5 cm	25	6.4 kg/cm²
15	30	5.4
20	40	4.0
25	50	3.2
30	60	2.7
40	80	2.0
50	100	1.6
60	120	1.34

柱

B1 点　$M_{B1} = -37{,}850$ kgm, $N = 37{,}730$ kg　$S = -14{,}368$ kg



$d' = 5$ cm, $d = 115$ cm, $h = 120$ cm

$A_s = 6 @ 22\phi = 22.8$ cm²

$A_s' = 4 @ 22\phi = 15.2$ cm²

$p = \frac{22.8}{60 \times 115} = 0.0033$

$p' = \frac{15.2}{60 \times 115} = 0.0022$

$d'/d = 5/115 = 0.0435$

$d'/\eta = 0.0417$

$d/h = 0.958$

$u = 0.506 \times 120 = 60.7$

$d - u = 115 - 60.7 = 54.3$

$\frac{M}{N} = \frac{37{,}850}{37{,}730} \times 100 = 100.3$

$d - u = 54.3$

$e = 154.6$ cm

$e' = e - 110 = 44.6$ cm　$e'/e = 44.6/154.6 = 0.289$

$k = 0.39$　$\frac{Ne}{bd^2 f_c} = 0.199$

$f_c = \frac{Ne}{bd^2 \times 0.199} = \frac{37{,}730 \times 154.6}{60 \times 115^2 \times 0.199} = 37.0$ kg/cm²

$f_s = n f_c \frac{1-k}{k} = 15 \times 37.0 \times \frac{0.61}{0.39} = 868$ kg/cm²

$\nu = \frac{14{,}368}{60 \times 7/8 \times 115} = 2.4$ kg/cm²

$u = \frac{14{,}368}{6.91 \times 6 \times 7/8 \times 115} = 3.4$ kg/cm²

C1 点　$M_{C1} = 21{,}897$ kgm　$N = 51{,}667$ kg　$S = 7{,}813$ kg

$d' = 5$ cm, $d = 115$ cm, $h = 120$ cm

$A_s = 6 @ 19\phi = 6 @ 2.84 = 17.05$ cm²

$A_s' = 4 @ 19\phi = 4 @ 2.84 = 11.37$ cm²

$p = \frac{17.05}{60 \times 115} = 0.0025$

$p' = \frac{11.37}{60 \times 115} = 0.0016$

$d'/d = 0.0435$

$d'/h = 0.0417$

$d/h = 0.958$

$u = 0.506 \times 120 = 60.7$

$\frac{M}{N} = \frac{21{,}897}{51{,}667} \times 100 = 42.4$ cm　$d - u = 54.3$

$d - u = 54.3$

$e = 96.7$ cm

$e' = e - 110 = -13.3$ cm　$e'/e = \frac{13.3}{96.7} = 0.138$

$k = 0.66$　$\frac{Ne}{bd^2 f_c} = 0.278$

$f_c = \frac{51667 \times 96.7}{60 \times 115^2 \times 0.278} = 22.6$ kg/cm²

$f_s = 15 \times 22.6 \times \frac{0.34}{0.66} = 175$ kg/cm²

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設計　日付　類別 8h5
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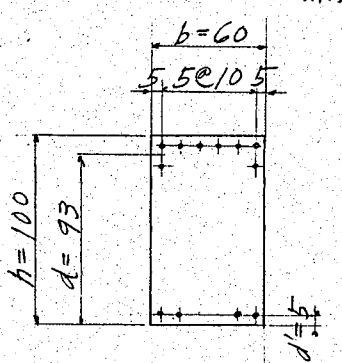
鐵筋混凝土高架橋

A 点



$M_A = 33{,}996$ kg, $N = 36{,}834$ kg　$S = -14{,}368$ kg

$d' = 5$ cm, $d = 93$ cm; $h = 100$ cm

$A_s = 8 @ 22\phi = 8 \times 3.801 = 30.4$ cm²

$A_s' = 4 @ 22\phi = 4 \times 3.801 = 15.2$ cm²

$p = \frac{30.4}{60 \times 93} = 0.00545$　$d'/d = 0.538$, $d'/h = 0.5$, $d/h = 0.93$

$\mu = 0.514 \times 100 = 51.4$ cm

$p' = \frac{15.2}{60 \times 93} = 0.00272$　$d - \mu = 41.6$ cm

$\frac{M}{N} = \frac{33{,}996}{36{,}834} \times 100 = 92.3$

$d - \mu = 41.6$

$\ell = 133.9$ cm

$\ell' = 133.9 - 88 = 45.9$ cm, $e'/\ell = 0.343$

$K = 0.44$　$\frac{Ne}{bd^2 f_c} = 0.215$

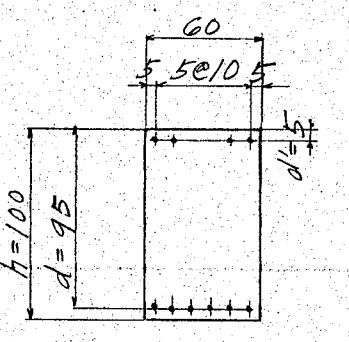
$f_c = \frac{36{,}834 \times 133.9}{60 \times 93^2 \times 0.215} = 44.2$ kg/cm²

$f_s = 15 \times 44.2 \times \frac{0.56}{0.44} = 843$ kg/cm²

$\nu = \frac{14{,}368}{60 \times 7/8 \times 93} = 2.9$ kg/cm²

$\mu = \frac{14{,}368}{6.91 \times 8 \times 7/8 \times 93} = 3.2$ kg/cm²

G 点



$M_G = -17{,}275$ kgm, $N = 45{,}371$ kg, $S = 7{,}813$ kg

$d' = 5$ cm, $d = 95$ cm, $h = 100$ cm

$A_s = 6 @ 19\phi = 17.05$ cm²

$A_s' = 4 @ 19\phi = 11.37$ cm²

$p = \frac{17.05}{60 \times 95} = 0.00299$　$d'/d = 0.526$, $d'/h = 0.5$, $d/h = 0.95$

$\mu = 0.507 \times 100 = 50.7$ cm

$p' = \frac{11.37}{60 \times 95} = 0.002$　$d - \mu = 44.3$ cm

$\frac{M}{N} = \frac{17{,}275 \times 100}{45{,}371} = 38.1$

$d - \mu = 44.3$

$\ell = 82.4$ cm

$\ell' = 82.4 - 90 = -7.6$　$e'/\ell = 0.092$

$K = 0.63$　$\frac{Ne}{bd^2 f_c} = 0.278$

$f_c = \frac{45{,}371 \times 82.4}{60 \times 95^2 \times 0.278} = 24.9$ kg/cm²

$f_s = 15 \times 24.9 \times \frac{0.37}{0.63} = 219$ kg/cm²

$\nu = \frac{7{,}813}{60 \times 7/8 \times 95} = 1.6$ kg/cm²

$\mu = \frac{7{,}813}{5.96 \times 6 \times 7/8 \times 95} = 2.6$ kg/cm²

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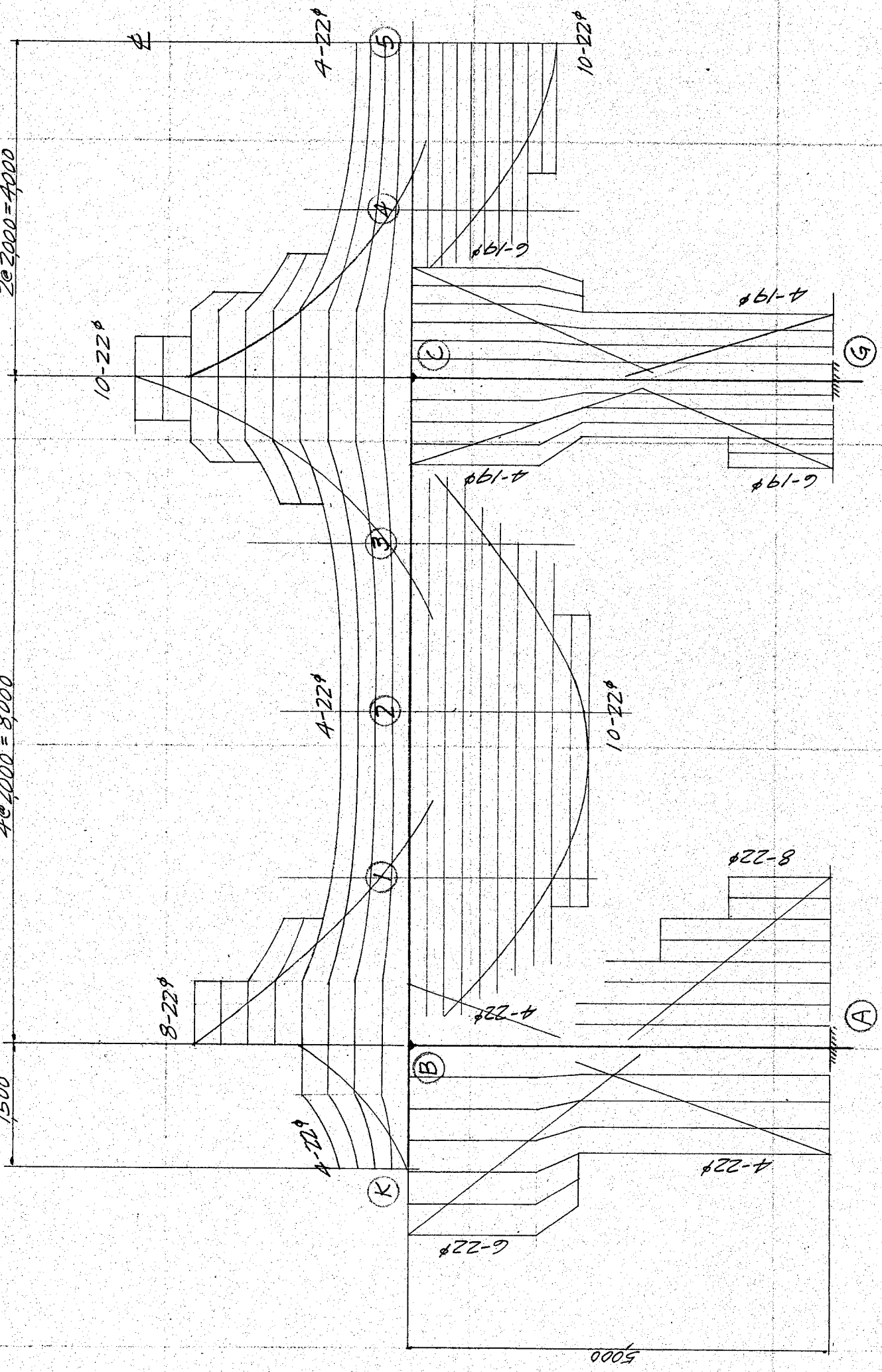
鐵筋混凝土高架橋



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設計　日付　類別 8h5
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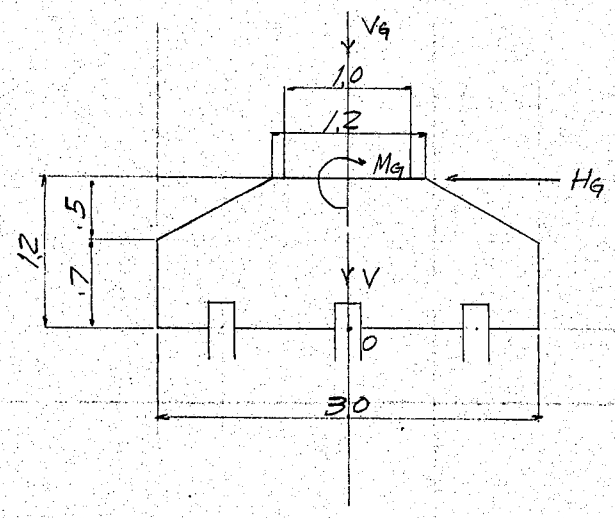
鐵筋混凝土高架橋

基礎

G 点

G 点	M_G max			V_G max		
	M_G	V_G	H_G	M_G	V_G	H_G
死荷重	-900	33990	540	-900	33990	540
活荷重	-7155	8736	3510	-2500	20850	1576
温度ノ変化	-9220	2645	3510	-9220	2645	3510
合成應力	-17275	45371	7560	-12620	57485	5626

基礎ー基分ノ重量



柱	.60 × 1.00 × 4.49 @ 2,400 =	6,460 kg
土	.50 × .90 × 2.00 @ 1,600 =	1,440 〃
基礎	.50 × 2.1 × 2.00 @ 2,400 =	5,040 〃
〃	.70 × 3.0 × 2.00 @ 2,400 =	10,080 〃
	V =	23,020 kg

O 点ニ於ケル能率(最大弯曲率ノ場合)

V_G	45,371		
V	23,020		
H_G	7,560	× 1.2 =	9,070
M_G		=	-17275
	ΣV = 68,391 kg		ΣM = -8,205 kgm

$e = 8,205 \div 68,391 = 0.12\ m$

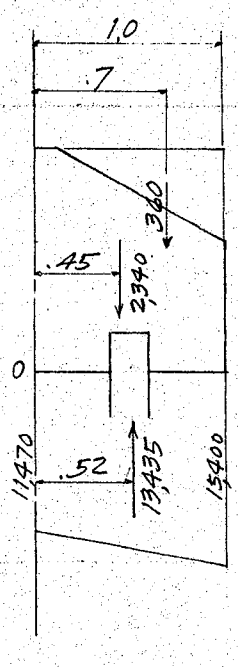
$$p = \frac{68,391}{3.0 \times 2.0} \times \left(1 \pm \frac{6 \times 0.12}{3.0}\right) = 14,130\ kg/m^2$$
$$= 8,660\ 〃$$

O 点ニ於ケル能率(最大垂直力ノ場合)

V_G	57,485		
V	23,020		
H_G	5,626	× 1.2 =	6,750
M_G		=	-12,620
	ΣV = 80,505 kg		ΣM = -5,870 kgm

$e = 5,870 \div 80,505 = 0.073\ m$

$$p = \frac{80,505}{3.0 \times 2.0} \times \left(1 \pm \frac{6 \times 0.073}{3.0}\right) = 15,400\ kg/m^2$$
$$= 11,470\ kg/m^2$$



O 点ニ於ケル能率

13,435	× 0.52 =	6,980
-2,340	× 0.45 =	-1,053
-360	× 0.70 =	-252
S = 10,735 kg		M = 5,675 kgm

所要厚 $d = \sqrt{\frac{M}{bR}} = \sqrt{\frac{5,675 \times 100}{100 \times 7.13}} = 28.2\ cm$

使用厚 110 cm

所要鐵筋量 $A_s = \frac{M}{f_s j d} = \frac{5,675 \times 100}{1,200 \times 7/8 \times 110} = 4.9\ cm^2$

$A_s = 3 @ 16^{\phi} = 3 @ 2.01 = 6.03\ cm^2$

$$p = \frac{A_s}{bd} = \frac{6.03}{100 \times 110} = 0.00055$$

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設計　日付　類別 8h5
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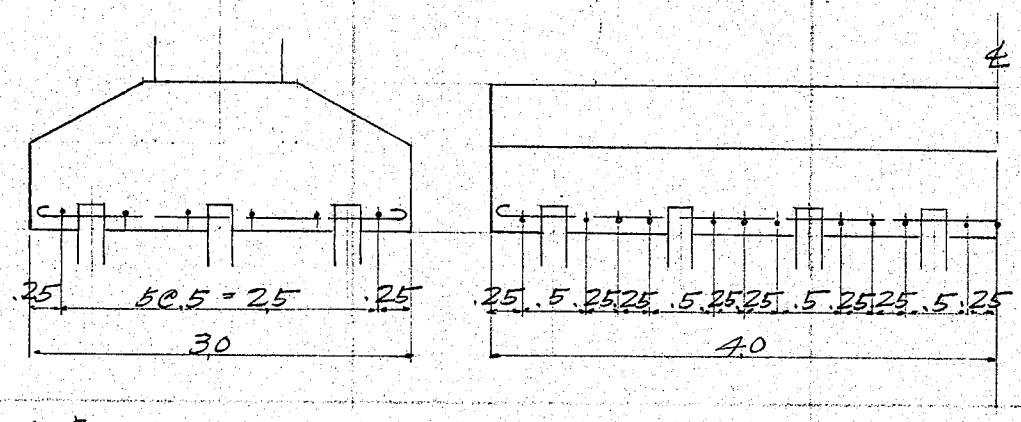
鐵筋混凝土高架橋



$k = 0.12$　　$j = 0.96$

$$f_s = \frac{5{,}675 \times 100}{603 \times 96 \times 110} = 891 \text{ kg/cm}^2$$

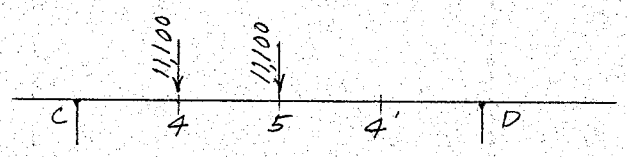
$$f_c = \frac{2 \times 5{,}675 \times 100}{96 \times 12 \times 100 \times 110^2} = 8.1 \text{ kg/cm}^2$$

$$s = \frac{10735}{100 \times 96 \times 110} = 1.02 \text{ kg/cm}^2$$

A 点

A 点	$+M_{max}$			$-M_{max}$			V_{min}			$V_{max.}$		
	M_A	V_A	H_A	M_A	V_A	H_A	M_A	V_A	H_A	M_A	V_A	H_A
死荷重	5090	21360	3060	5090	21360	3060	5090	21360	3060	5090	21360	3060
活荷重	7066	12829	4258	-4458	11148	-2665	-1632	-1276	-854	-985	19730	-801
温度ノ変化	21840	2645	7050	-21840	-2645	-7050	-21840	-2645	-7050	21840	2645	7050
合成應力	33996	36834	14368	-21208	29863	-6655	-18382	+17439	-4844	25945	43735	9309

V_{min} ノ場合



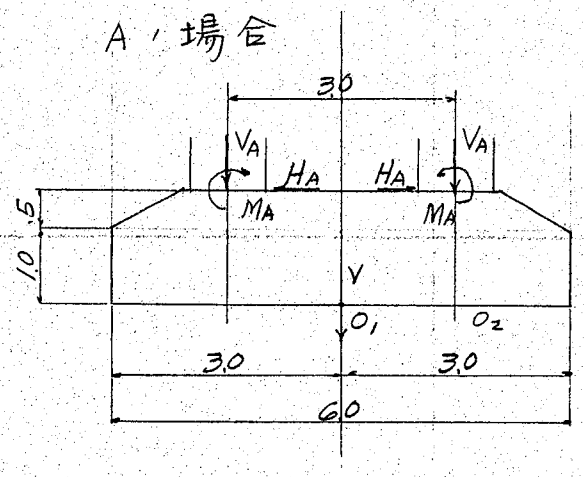
荷重点

			V_A		M_A		H_A
4	11,100	-0.061	-677	-0.095	-1,055	-0.046	-510
5	11,100	-0.054	-599	-0.052	-577	-0.031	-344
			-1,276 kg		-1,632 kgm		-854 kg

條件組合セ

A	(1) + (1)
B	(2) + (2)
C	(1) + (3)
D	(4) + (4)

A ノ場合



基礎重量

柱　2 @ .60 × 1.00 × 4.49 @ 2,400 = 12,930
土　.50 × .90 × 2.00 @ 1,600 = 1,440
基礎　.50 × 5.10 × 2.00 @ 2,400 = 12,240
基礎　1.00 × 6.00 × 2.00 @ 2,400 = 28,800
V = 55,410 kg

總荷重

V_A　2 @ 36,834 = 73,668
V　55,410
129,078 kg

底面圧力　$p = \frac{129{,}078}{2.0 \times 6.0} = 10{,}750 \text{ kg/m}^2$

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設計　日付　類別 8h5
照査　日付　第 31頁

鐵筋混凝土高架橋

01 点ニ於ケル弯曲率

V	− ½ × 55,410 × 1.50	=	− 41,600	
P	½ × 2 × 10,750 × 3.00²	=	96,750	
V_A	− 36,834 × 1.5	=	− 55,250	
H_A	− 14,368 × 0.75	=	− 10,780	
M_A		=	33,996	

M_{01} = 23,116 kgm ··· 11,560 kgm/m

B、場合

總荷重

V_A	2 @ 29,863 =	59,726
V		55,410
		115,136 kg

底面圧力 $p = \frac{115,136}{2.0 \times 6.0} = 9,600$ kg/m²

01 点ニ於ケル弯曲率

V		=	− 41,600
P	½ × 2 × 9,600 × 3.00²	=	86,400
V_A	− 29,863 × 1.5	=	− 44,800
H_A	6,655 × 0.75	=	4,990
M_A		=	− 21,208

M_{01} = − 16,218 kgm ··· − 8,109 kgm/m

C、場合

01 点ニ於ケル弯曲率（基礎全幅ニ対スル場合）

V		55,410			
V_A		36,834			
V_A		17,439			
H_A	− 14,368		× 1.5	= − 21,550	
H_A	− 4,844		× 1.5	= − 7,270	
M_A				= 33,996	↷ +M
M_A				= 18,382	

ΣV = 109,683 kg　　ΣM = 23,558 kgm

e = 23,558 ÷ 109,683 = 0.215 m

$p = \frac{109,683}{2.0 \times 6.0} \times \left(1 \pm \frac{6 \times 0.215}{6.0}\right) = 11,100$ kg/m²
7,170 〃

D、場合

總荷重

V_A	2 @ 43,735 =	87,470
V	=	55,410
		142,880 kg

底面圧力 $p = \frac{142,880}{2.0 \times 6.0} = 11,900$ kg/m²

01 点ニ於ケル弯曲率

V		=	− 41,600
P	½ × 2 × 11,900 × 3.00²	=	107,200
V_A	− 43,735 × 1.5	=	− 65,600
H_A	− 9,309 × 0.75	=	− 6,980
M_A		=	25,945

M_{01} = 18,965 kgm ··· 9,480 kgm/m

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設計　日付　類別 8h5
照査　日付　第 32 頁

鐵筋混凝土高架橋 断面，設計

$+max\ M = 11{,}560\ kgm$

所要厚 $d = \sqrt{\frac{M}{bR}} = \sqrt{\frac{11{,}560\times100}{100\times7.13}} = 40.3\ cm$

使用厚 140 cm (有効)

所要鐵筋量 $As = \frac{M}{f_s j d} = \frac{11{,}560\times100}{1{,}200\times7/8\times140} = 7.86\ cm^2$

$As = 4\ @\ 16^{\phi} = 4\ @\ 2.01 = 8.04\ cm^2$

$p = \frac{8.04}{100\times140} = 0.000\,57$, $K = 0.12$, $j = 0.96$

$f_s = \frac{11{,}560\times100}{8.04\times0.96\times140} = 1{,}070\ kg/cm^2$

$f_c = \frac{2\times11{,}560\times100}{.96\times.12\times100\times140^2} = 10.2\ kg/cm^2$

$-max\ M = -8{,}109\ kgm$

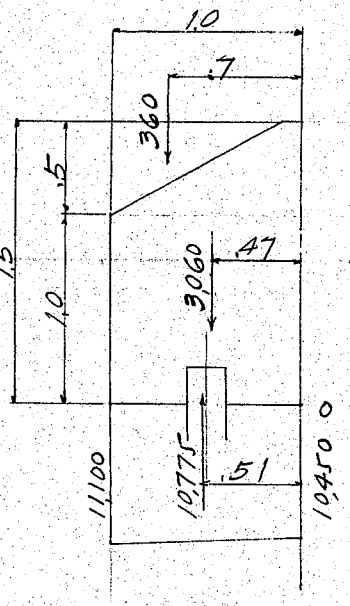
所要鐵筋量 $As = \frac{8{,}109\times100}{1{,}200\times7/8\times140} = 5.5\ cm^2$

$As = 3\ @\ 16^{\phi} = 6.03\ cm^2$

$p = \frac{6.03}{100\times140} = 0.000\,43$ $K = 0.11$ $j = 0.965$

$f_s = \frac{8{,}109\times100}{6.03\times.965\times140} = 995\ kg/cm^2$

$f_c = \frac{2\cdot8{,}109\times100}{.965\times0.11\times100\times140^2} = 7.8\ kg/cm^2$



0 点 = 於 ヤ 心 能 率

10,775	× .51	=	5,495
-3,060	× .47	=	-1,440
-360	× .70	=	-250

$S = 7{,}355\ kg$ $M = 3{,}805\ kg.m$

使用厚 150 cm 有効厚 = 140 cm

所要鐵筋量 $As = \frac{3805\times100}{1{,}200\times7/8\times140} = 2.6\ cm^2$

$As = 2\ @\ 16^{\phi} = 4.02\ cm^2$

$P = \frac{4.02}{100\times140} = 0.000\,29$, $j = 0.97$, $K = 0.1$

$f_s = \frac{3805\times100}{4.02\times0.97\times140} = 697\ kg/cm^2$

$f_c = \frac{2\times3805\times100}{.97\times0.1\times100\times140^2} = 40\ kg/cm^2$

$S = \frac{7355}{100\times0.97\times140} = 0.5\ kg/cm^2$

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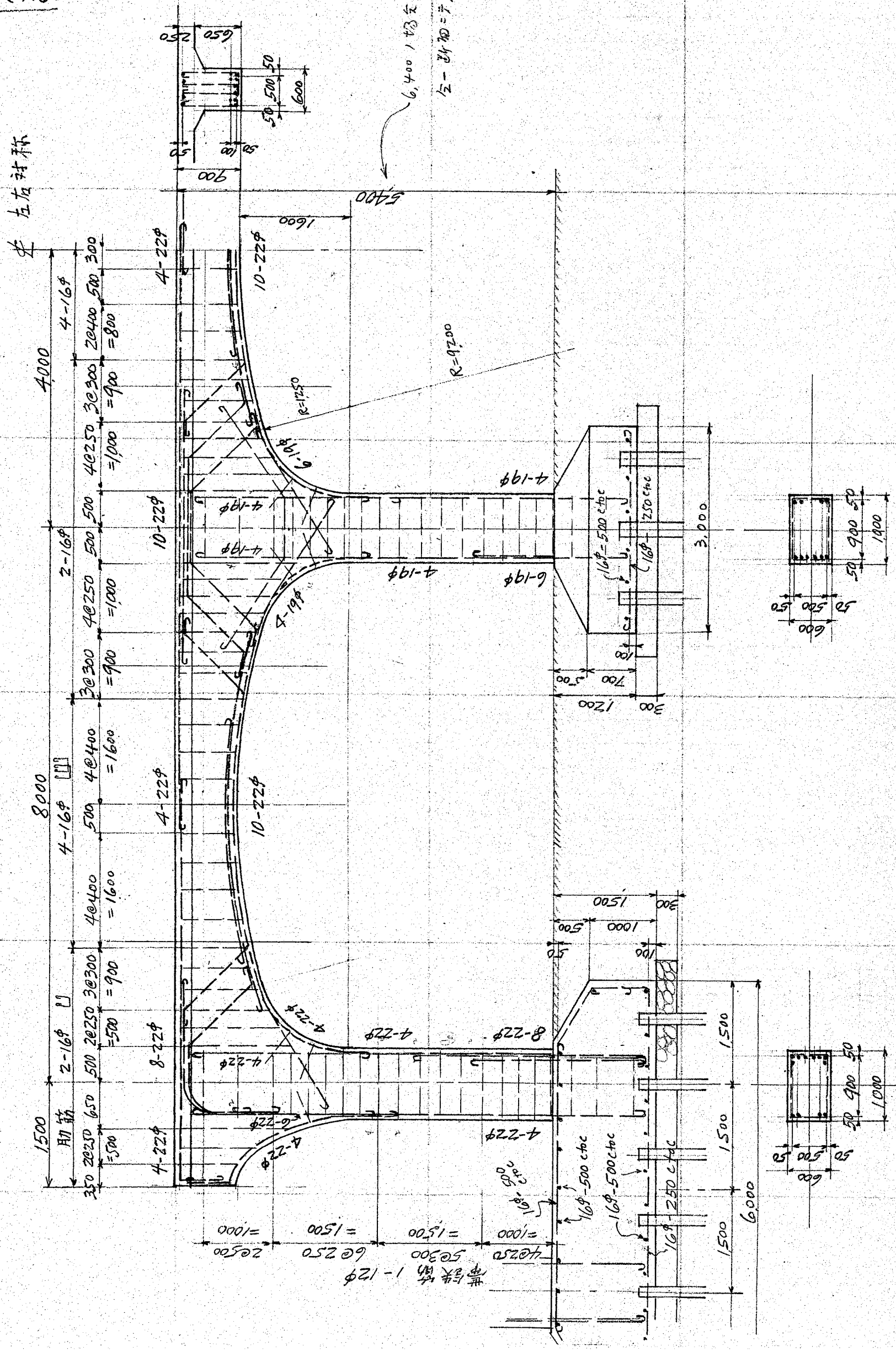
設計　日付　類別 845
照査　日付　第 33 頁

鐵筋混凝土高架橋

配筋圖

縮尺 1:60



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設計	日付	類別
照査	日付	第　頁

上海高速鐵道
鐵筋混凝土複線桁橋
支間六.〇米三径間、両脇各三.〇米
高六.〇米　應力計算書

Reinforced Concrete Rahmen Bridge
Double Track
3 continuous spans @ 6.0m, 6.0m high.

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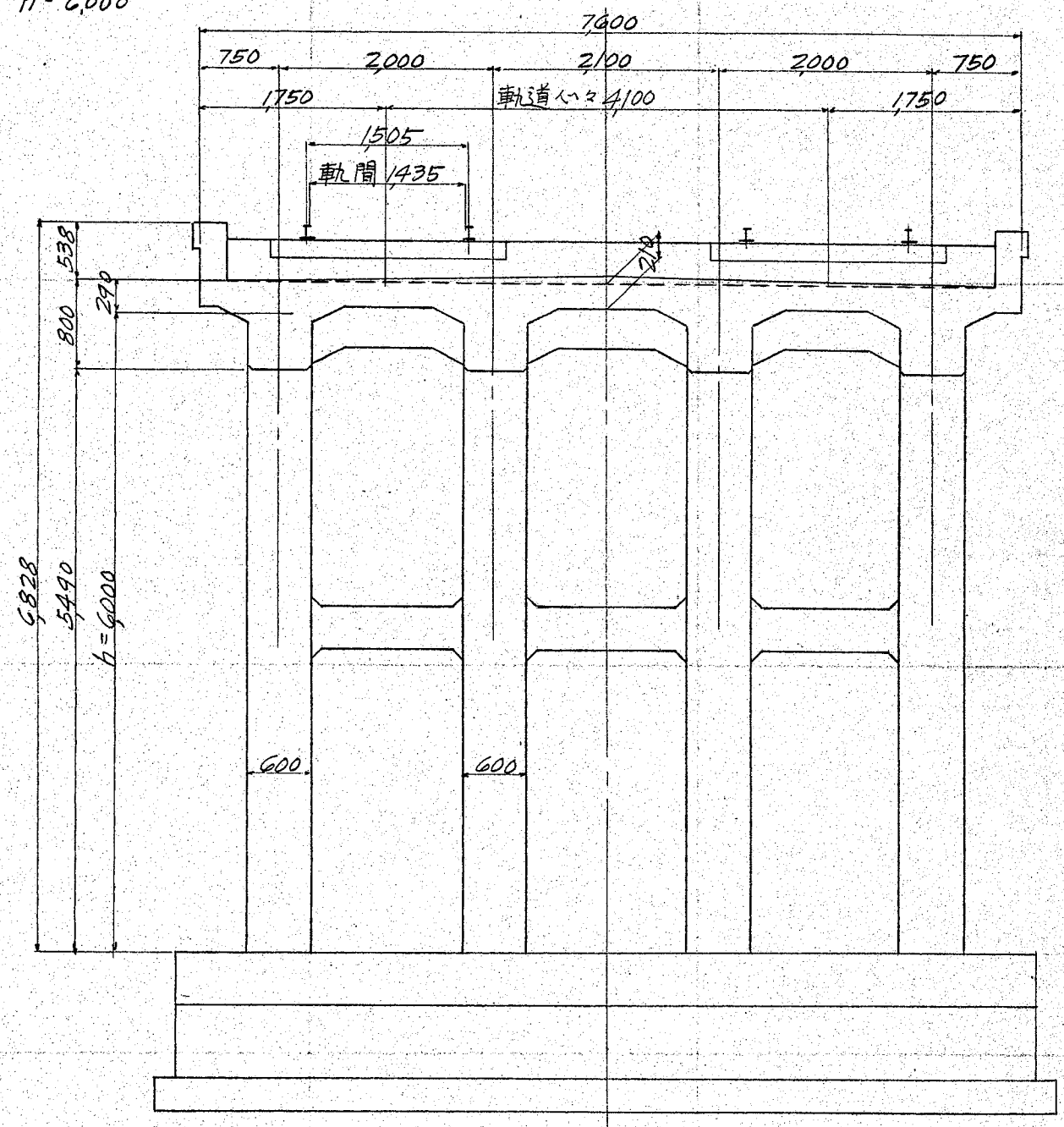
設計　日付　9　類別 GH6

照査　日付　第　/ 頁

鐵筋混凝土高架橋
複線電車軌道(60瓲電車)
支間 6.000m　四脚両腕式枠形ラーメン
h=6.000m



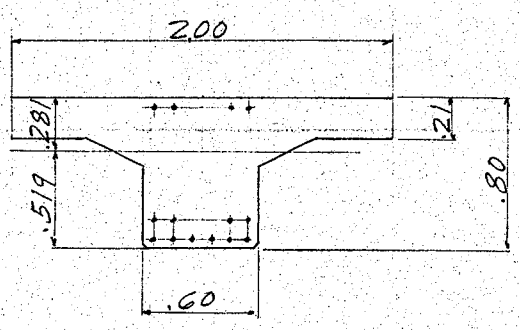
床版ノ設計
h=5,000ノ場合ト同一

ラーメンノ設計
死荷重

軌道			=	600 kg/m
道床		0.276 × 3.55 × 1,900	=	1,860 〃
床版		0.21 × 3.85 × 2,400	=	1,940 〃
側壁		0.25 × 3.58 × 2,400	=	215 〃
〃		0.05 × 2.20 × 2,400	=	24 〃
持送	2@	0.15 × 0.30 × 2,400	=	216 〃
主桁	2@	0.60 × 0.59 × 2,400	=	1,700 〃
				6,555 kg/m

桁一本ニ付 3,300 kg/m トス

假定斷面
主桁



中立軸ノ位置

2.00 × .21	= 0.42 × .70	=	0.294
.60 × .59	= 0.35 × .30	=	0.105
.30 × .15	= 0.045 × .54	=	0.024
	0.815 .519		0.423

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設計　日付　類別 6h6
照査　日付　第　2頁

鐵筋混凝土高架橋

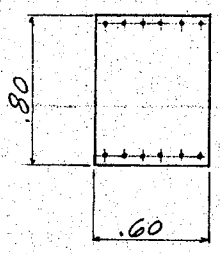
物量力率

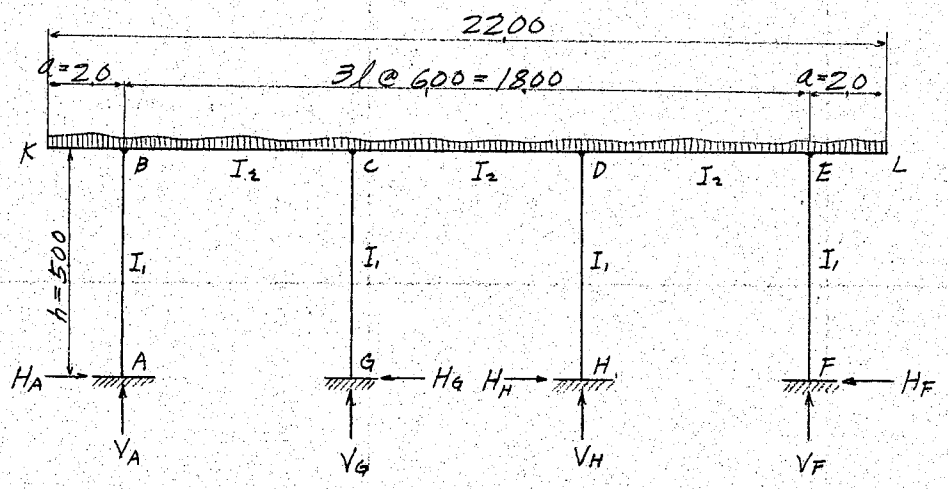
$$0.42 \times .176^2 + \frac{2.00 \times .21^3}{12} = 0.0145$$
$$0.35 \times .224^2 + \frac{.60 \times .59^3}{12} = 0.0279$$
$$0.045 \times .021^2 + \frac{.30 \times .15^3}{18} = 0.0001$$
$$0.0425\ m^4$$

主柱

物量力率

$$\frac{.60 \times .80^3}{12} = 0.0256\ m^4$$





$$k_1 = \frac{I_1}{h}, \quad k_2 = \frac{I_2}{l}$$

$$\begin{cases} M_{BA} = 2Ek_1(2\theta_B - 3R) \\ M_{BC} = 2Ek_2(2\theta_B + \theta_C) - C_{BC} \\ M_{BK} = m_{BK} \end{cases}$$

$$\begin{cases} M_{CB} = 2Ek_2(2\theta_C + \theta_B) + C_{CB} \\ M_{CG} = 2Ek_1(2\theta_C - 3R) \\ M_{CD} = 2Ek_2(2\theta_C + \theta_D) - C_{CD} \end{cases}$$

$$\begin{cases} M_{DC} = 2Ek_2(2\theta_D + \theta_C) + C_{DC} \\ M_{DE} = 2Ek_2(2\theta_D + \theta_E) - C_{DE} \\ M_{DH} = 2Ek_1(2\theta_D - 3R) \end{cases}$$

$$\begin{cases} M_{ED} = 2Ek_2(2\theta_E + \theta_D) + C_{ED} \\ M_{EF} = 2Ek_1(2\theta_E - 3R) \\ M_{EL} = -m_{EL} \end{cases}$$

$$M_{AB} = 2Ek_1(\theta_B - 3R)$$
$$M_{GC} = 2Ek_1(\theta_C - 3R)$$
$$M_{HD} = 2Ek_1(\theta_D - 3R)$$
$$M_{FE} = 2Ek_1(\theta_E - 3R)$$

條件式

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	$2(k_1+k_2)$	k_2			$-3k_1$	=	$(C_{BC} - m_{BK})/2E$
2	k_2	$2(k_1+2k_2)$	k_2		$-3k_1$	=	$(C_{CD} - C_{CB})/2E$
3		k_2	$2(k_1+2k_2)$	k_2	$-3k_1$	=	$(C_{DE} - C_{DC})/2E$
4			k_2	$2(k_1+k_2)$	$-3k_1$	=	$(m_{EL} - C_{ED})/2E$
5	k_1	k_1	k_1	k_1	$-8k_1$	=	0

$I_1 = 0.0256\ m^4$, $I_2 = 0.0425\ m^4$, $h = 6.00^m$, $l = 6.00^m$

$k_1 = \frac{I_1}{h} = 0.00427$, $k_2 = \frac{I_2}{l} = 0.00708$, $2(k_1+k_2) = 0.0227$

$2(k_1 + \frac{1}{2}k_2) = 0.03686$, $8k_1 = 0.03416$, $3k_1 = 0.01281$

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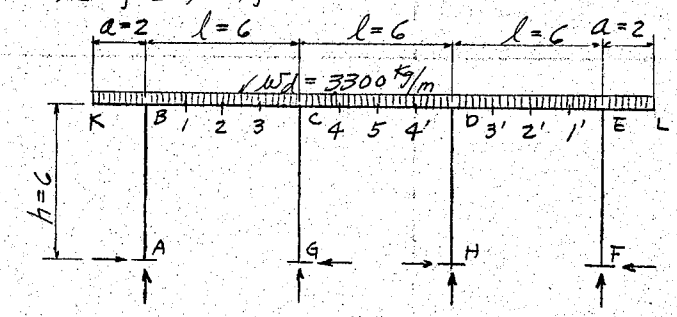
設計　日付　類別 6h6
照査　日付　第 3頁

鐵筋混凝土高架橋

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	0.0227	0.00708			-0.01281	=	$C_{BC}-M_{BK}$
2	0.00708	0.03686	0.00708		-0.01281	=	$C_{CD}-C_{CB}$
3		0.00708	0.03686	0.00708	-0.01281	=	$C_{DE}-C_{DC}$
4			0.00708	0.0227	-0.01281	=	$M_{EL}-C_{ED}$
5	0.00427	0.00427	0.00427	0.00427	-0.03416	=	0

死荷重応力



$w_d = 3{,}300$ kg/m

荷重項　$C_{BC}=C_{CB}=C_{DC}=C_{CD}=C_{ED}=C_{DE}=9{,}900$ kgm
$M_{BK}=M_{EL}=6{,}600$ kgm
$C_{BC}-M_{BK}=3{,}300$ kgm
$\theta_B=-\theta_E$, $\theta_C=-\theta_D$, $R=0$

$\theta_B = 157{,}000$, $\theta_C = -37{,}330$

$M_{BA} = 0.00427\times(314{,}000) = 1{,}341$ kgm
$M_{BC} = 0.00708\times(314{,}000-37{,}330)-9{,}900 = -7{,}941$ kgm
$M_{BK} = 6{,}600$ kgm

$M_{CB} = 0.00708\times(-74{,}660+157{,}000)+9{,}900 = 10{,}483$ kgm
$M_{CG} = 0.00427\times(-74{,}660) = -319$ kgm
$M_{CD} = 0.00708\times(-37{,}330)-9{,}900 = -10{,}164$ kgm

$M_{AB} = 0.00427\times 157{,}000 = 670$ kgm
$M_{GC} = 0.00427\times -37{,}330 = -159$ kgm

弯曲率

$M_{BA} = -1{,}341$ kgm　$M_{CB} = -10{,}483$ kgm　$M_{AB} = 670$ kgm
$M_{BC} = -7{,}941$ 〃　$M_{CG} = 319$ kgm　$M_{GC} = -159$ 〃
$M_{BK} = -6{,}600$ 〃　$M_{CD} = -10{,}164$ 〃

垂直反力

$$V_A = \frac{-10{,}483+7{,}941}{6}+3{,}300\times 5.0 = 16{,}076\ \text{kg}$$

$$V_G = \frac{10{,}483+7{,}941}{6}+3{,}300\times 6.0 = 20{,}224\ \text{kg}$$

水平反力

$$H_A = \frac{1{,}341+670}{6} = 335\ \text{kg}\ \rightarrow$$

$$H_G = \frac{319+159}{6} = 80\ \text{kg}\ \leftarrow$$

剪力

$S_{BK} = -3{,}300\times 2.0 = -6{,}600$ kg
$S_{BC} = 16{,}076-6{,}600 = 9{,}476$ kg
$S_{CB} = 9{,}476-3{,}300\times 6.0 = -10{,}324$ kg
$S_{CD} = -10{,}324+20224 = 9{,}900$ kg
$S_{BA} = S_{AB} = -335$ kg
$S_{GC} = S_{CG} = 80$ kg

格点弯曲率

桁中央單桁弯曲率　$\frac{3{,}300\times 6.0^2}{8.0} = 14{,}850$ kgm

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設計　日付　類別 6h6
照査　日付　第 4 頁

鐵筋混凝土高架橋

桁¼点單桁彎曲率　$\frac{3\times3300\times60^2}{32}=11{,}140$ kgm

格点 1　$11{,}140-7{,}941-\frac{10{,}483-7{,}941}{4}=2{,}563$ kgm

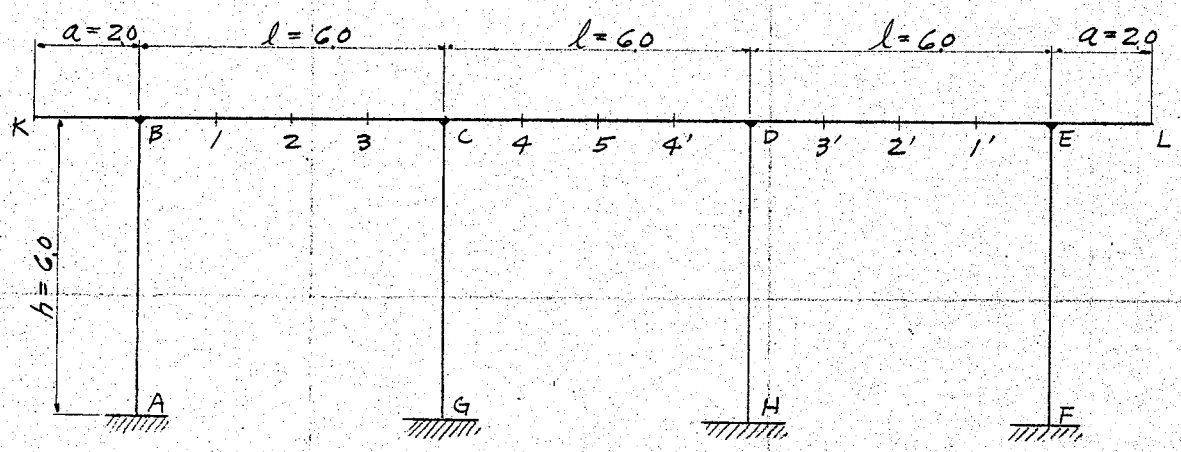
格点 2　$14{,}850-7{,}941-\frac{10{,}483-7{,}941}{2}=5{,}637$ kgm

格点 3　$11{,}140-7{,}941-\frac{3\times(10{,}483-7{,}941)}{4}=1{,}292$ kgm

格点 4　$11{,}140-10{,}164=976$ kgm

格点 5　$14{,}850-10{,}164=4{,}686$ kgm

活荷重



1) 荷重 1kg が K点=作用せル場合

$m_{BK}=2.0$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	0.0227	0.00708			-0.01281	=	-2.000
2	0.00708	0.03686	0.00708		-0.01281	=	0
3		0.00708	0.03686	0.00708	-0.01281	=	0
4			0.00708	0.0227	-0.01281	=	0
5	0.00427	0.00427	0.00427	0.00427	-0.03416	=	0

$\theta_B=-99.8$, $\theta_C=16.3$, $\theta_D=-6.3$, $\theta_E=-4.7$, $R=-11.8$

$M_{BA}=0.00427\times(-199.6+35.4)=-0.701$
$M_{BC}=0.00708\times(-199.6+16.3)=-1.299$
$M_{BK}=2.000$

$M_{CB}=0.00708\times(32.6-99.8)=-0.476$
$M_{CG}=0.00427\times(32.6+35.4)=0.290$
$M_{CD}=0.00708\times(32.6-6.3)=0.186$

$M_{DC}=0.00708\times(-12.6+16.3)=0.026$
$M_{DE}=0.00708\times(-12.6-4.7)=-0.123$
$M_{DH}=0.00427\times(-12.6+35.4)=0.097$

$M_{ED}=0.00708\times(-9.4-6.3)=-0.112$
$M_{EF}=0.00427\times(-9.4+35.4)=0.112$
$M_{EL}=0$
$M_{AB}=0.00427\times(-99.8+35.4)=-0.275$
$M_{GC}=0.00427\times(16.3+35.4)=0.221$
$M_{HD}=0.00427\times(-6.3+35.4)=0.124$
$M_{FE}=0.00427\times(-4.7+35.4)=0.131$

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設計　日付　類別 GhG
照査　日付　第 5 頁

鐵筋混凝土高架橋

單位彎曲率

$M_{BA} = 0.701$　$M_{CB} = 0.476$　$M_{DC} = -0.026$　$M_{ED} = 0.112$
$M_{BC} = -1.299$　$M_{CG} = -0.290$　$M_{DE} = -0.123$　$M_{EF} = 0.112$
$M_{BK} = -2.000$　$M_{CD} = 0.186$　$M_{DH} = 0.097$　$M_{EL} = 0$

$M_{AB} = -0.275$　$M_{HD} = -0.129$
$M_{GC} = 0.221$　$M_{FE} = -0.131$

單位垂直力

$$V_A = 1.000 + \frac{1.299 + 0.476}{6.0} = 1.296 \text{ kg}$$

$$V_G = \frac{-1.299 - 0.476}{6.0} + \frac{-0.186 - 0.026}{6.0} = -0.331 \text{ kg}$$

$$V_H = \frac{0.186 + 0.026}{6.0} + \frac{0.123 + 0.112}{6.0} = 0.074 \text{ kg}$$

$$V_F = \frac{-0.123 - 0.112}{6.0} = -0.039 \text{ kg}$$

水平反力

$$H_A = \frac{0.701 + 0.275}{6.0} = 0.163 \text{ kg} \longleftarrow$$

$$H_G = \frac{0.221 + 0.290}{6.0} = 0.085 \text{ kg} \longrightarrow$$

$$H_H = \frac{0.097 + 0.129}{6.0} = 0.036 \text{ kg} \longrightarrow$$

$$H_F = \frac{0.131 + 0.112}{6.0} = 0.042 \text{ kg} \longrightarrow$$

剪力

$S_{BK} = -1.000$ kg
$S_{BC} = 1.296 - 1.000 = 0.296$ kg
$S_{CB} = 0.296$ kg
$S_{CD} = 0.296 - 0.331 = -0.035$ kg
$S_{DC} = -0.035$ kg
$S_{DE} = -0.035 + 0.074 = 0.039$ kg
$S_{ED} = 0.039$ kg
$S_{BA} = S_{AB} = 0.163$ kg
$S_{CG} = S_{GC} = -0.085$ kg
$S_{DH} = S_{HD} = -0.036$ kg
$H_{EF} = S_{FE} = -0.042$ kg

2) 荷重 1kg が 1 点に作用せる場合

$C_{BC} = 0.844$
$C_{CB} = 0.281$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	0.0227	0.00708			-0.01281	=	0.844
2	0.00708	0.03686	0.00708		-0.01281	=	-0.281
3		0.00708	0.03686	0.00708	-0.01281	=	0
4			0.00708	0.0227	-0.01281	=	0
5	0.00427	0.00427	0.00427	0.00427	-0.03416	=	0

$\theta_B = 44.4$, $\theta_C = -15.5$, $\theta_D = 4.3$, $\theta_E = 1.1$, $R = 4.3$

$M_{BA} = 0.00427 \times (88.8 - 12.9) = 0.324$
$M_{BC} = 0.00708 \times (88.8 - 15.5) - 0.844 = -0.324$
$M_{BK} = 0$

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○ $M_{CB} = 0.00708 \times (-31.0 + 44.4) + 0.281 = 0.376$
○ $M_{CG} = 0.00427 \times (-31.0 - 12.9) = -0.187$
$M_{CD} = 0.00708 \times (-31.0 + 43) = -0.189$

○ $M_{DC} = 0.00708 \times (8.6 - 15.5) = -0.050$
$M_{DE} = 0.00708 \times (8.6 + 1.1) = 0.068$
$M_{DH} = 0.00427 \times (8.6 - 12.9) = -0.018$

$M_{ED} = 0.00708 \times (22 + 4.3) = 0.046$
$M_{EF} = 0.00427 \times (22 - 12.9) = -0.046$

$M_{AB} = 0.00427 \times (44.4 - 12.9) = 0.134$
$M_{GC} = 0.00427 \times (-15.5 - 12.9) = -0.121$
$M_{HD} = 0.00427 \times (4.3 - 12.9) = -0.037$
$M_{FE} = 0.00427 \times (1.1 - 12.9) = -0.050$

單位彎曲率

$M_{BA} = -0.324$	$M_{CB} = -0.376$	$M_{DC} = 0.050$	$M_{ED} = -0.046$
$M_{BC} = -0.324$	$M_{CG} = 0.187$	$M_{DE} = 0.068$	$M_{EF} = -0.046$
	$M_{CD} = -0.189$	$M_{DH} = -0.018$	

$M_{AB} = 0.134$　$M_{HD} = 0.037$
$M_{GC} = -0.121$　$M_{FE} = 0.050$

單位垂直力

$$V_A = \frac{0.324 - 0.376 + 1 \times 4.5}{6.0} = 0.741\ \text{Kg}$$

$$V_G = \frac{-0.324 + 0.376 + 0.189 + 0.050 + 1 \times 1.5}{6.0} = 0.299\ \text{Kg}$$

$$V_H = \frac{-0.189 - 0.050 - 0.068 - 0.046}{6.0} = -0.059\ \text{Kg}$$

$$V_F = \frac{0.068 + 0.046}{6.0} = 0.019\ \text{Kg}$$

水平反力

$$H_A = \frac{0.324 + 0.134}{6.0} = 0.076\ \text{Kg} \longrightarrow$$

$$H_G = \frac{0.187 + 0.121}{6.0} = 0.051\ \text{Kg} \longleftarrow$$

$$H_H = \frac{0.018 + 0.037}{6.0} = 0.009\ \text{Kg} \longleftarrow$$

$$H_F = \frac{0.046 + 0.050}{6.0} = 0.016\ \text{Kg} \longleftarrow$$

剪力

$S_{BC} = 0.741\ \text{Kg}$
$S_{CB} = 0.741 - 1.000 = -0.259\ \text{Kg}$
$S_{CD} = S_{DC} = -0.259 + 0.299 = 0.040\ \text{Kg}$
$S_{DE} = S_{ED} = 0.040 - 0.059 = -0.019\ \text{Kg}$
$S_{AB} = S_{BA} = -0.076\ \text{Kg}$
$S_{CG} = S_{GC} = 0.051\ \text{Kg}$
$S_{DH} = S_{HD} = 0.009\ \text{Kg}$
$S_{EF} = S_{FE} = 0.016\ \text{Kg}$

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3) 荷重1kgが2点に作用せる場合

$C_{BC} = C_{CB} = 0.750$

番號	Q_B	Q_C	Q_D	Q_E	R		荷重項
1	0.0227	0.00708			-0.01281	=	0.750
2	0.00708	0.03686	0.00708		-0.01281	=	-0.750
3		0.00708	0.03686	0.00708	-0.01281	=	0
4			0.00708	0.0227	-0.01281	=	0
5	0.00427	0.00427	0.00427	0.00427	-0.03416	=	0

$Q_B = 43.5$, $Q_C = -29.1$, $Q_D = 6.6$, $Q_E = -0.6$, $R = 2.5$

$M_{BA} = 0.00427 \times (87.0 - 7.5) = 0.340$
$M_{BC} = 0.00708 \times (87.0 - 29.1) - 0.75 = -0.340$

$M_{CB} = 0.00708 \times (-58.2 + 43.5) + 0.75 = 0.646$
$M_{CG} = 0.00427 \times (-58.2 - 7.5) = -0.281$
$M_{CD} = 0.00708 \times (-58.2 + 6.6) = -0.365$

$M_{DC} = 0.00708 \times (13.2 - 29.1) = -0.113$
$M_{DE} = 0.00708 \times (13.2 - 0.6) = 0.089$
$M_{DH} = 0.00427 \times (13.2 - 7.5) = 0.024$

$M_{ED} = 0.00708 \times (-1.2 + 6.6) = 0.038$
$M_{EF} = 0.00427 \times (-1.2 - 7.5) = -0.038$

$M_{AB} = 0.00427 \times (43.5 - 7.5) = 0.154$
$M_{GC} = 0.00427 \times (-29.1 - 7.5) = -0.156$
$M_{HD} = 0.00427 \times (6.6 - 7.5) = -0.004$
$M_{FE} = 0.00427 \times (-0.6 - 7.5) = -0.035$

單位彎曲率

$M_{BA} = -0.340$	$M_{CB} = -0.646$	$M_{DC} = 0.113$	$M_{ED} = -0.038$
$M_{BC} = -0.340$	$M_{CG} = 0.281$	$M_{DE} = 0.089$	$M_{EF} = -0.038$
	$M_{CD} = -0.365$	$M_{DH} = 0.024$	

$M_{AB} = 0.154$	$M_{HD} = 0.004$
$M_{GC} = -0.156$	$M_{FE} = 0.035$

單位垂直力

$$V_A = \frac{0.340 - 0.646 + 1 \times 3.0}{6.0} = 0.449$$

$$V_G = \frac{-0.340 + 0.646 + 0.365 + 0.113 + 1 \times 3.0}{6.0} = 0.631$$

$$V_H = \frac{-0.365 - 0.113 - 0.089 - 0.038}{6.0} = -0.101$$

$$V_F = \frac{0.089 + 0.038}{6.0} = 0.021$$

水平反力

$$H_A = \frac{0.340 + 0.154}{6.0} = 0.082 \longrightarrow$$

$$H_G = \frac{0.281 + 0.156}{6.0} = 0.073 \longleftarrow$$

$$H_H = \frac{0.024 - 0.004}{6.0} = 0.003 \longrightarrow$$

$$H_F = \frac{0.038 + 0.035}{6.0} = 0.011 \longleftarrow$$

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剪力

$S_{BC} = 0.449$
$S_{CB} = 0.449 - 1.000 = -0.551$
$S_{CD} = S_{DC} = -0.551 + 0.631 = 0.080$
$S_{DE} = S_{ED} = 0.080 - 0.101 = -0.021$
$S_{BA} = S_{AB} = -0.082$
$S_{CG} = S_{GC} = 0.073$
$S_{DH} = S_{HD} = -0.003$
$S_{FE} = S_{EF} = 0.011$

4) 荷重1ヶ所ヨリ其ニ作用スル場合

$C_{BC} = 0.281$
$C_{CB} = 0.844$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	0.0227	0.00708			-0.01281	=	0.281
2	0.00708	0.03686	0.00708		-0.01281	=	-0.844
3		0.00708	0.03686	0.00708	-0.01281	=	0
4			0.00708	0.0227	-0.01281	=	0
5	0.00427	0.00427	0.00427	0.00427	-0.03416	=	0

$\theta_B = 20.9$, $\theta_C = -28.1$, $\theta_D = 5.6$, $\theta_E = -2.0$, $R = -0.45$

$M_{BA} = 0.00427 \times (418 + 1.4) = 0.184$
$M_{BC} = 0.00708 \times (418 - 28.1) - 0.281 = -0.184$

$M_{CB} = 0.00708 \times (-562 + 20.9) + 0.844 = 0.593$
$M_{CG} = 0.00427 \times (-562 + 1.4) = -0.234$
$M_{CD} = 0.00708 \times (-562 + 5.6) = -0.359$

$M_{DC} = 0.00708 \times (112 - 28.1) = -0.120$
$M_{DE} = 0.00708 \times (112 - 2.0) = 0.066$
$M_{DH} = 0.00427 \times (112 + 1.4) = 0.054$

$M_{ED} = 0.00708 \times (-4.0 + 5.6) = 0.011$
$M_{EF} = 0.00427 \times (-4.0 + 1.4) = -0.011$

$M_{AB} = 0.00427 \times (20.9 + 1.4) = 0.095$
$M_{GC} = 0.00427 \times (-28.1 + 1.4) = -0.114$
$M_{HD} = 0.00427 \times (5.6 + 1.4) = 0.030$
$M_{FE} = 0.00427 \times (-2.0 + 1.4) = -0.003$

單位彎曲率

$M_{BA} = -0.184$	$M_{CB} = -0.593$	$M_{DC} = 0.120$	$M_{ED} = -0.011$
$M_{BC} = -0.184$	$M_{CG} = 0.234$	$M_{DE} = 0.066$	$M_{EF} = -0.011$
	$M_{CD} = -0.359$	$M_{DH} = 0.054$	

$M_{AB} = 0.095$　　$M_{HD} = -0.030$
$M_{GC} = -0.114$　　$M_{FE} = 0.003$

單位垂直力

$$V_A = \frac{0.184 - 0.593 + 1 \times 1.5}{6.0} = 0.182$$

$$V_G = \frac{-0.184 + 0.593 + 0.359 + 0.120 + 1 \times 4.5}{6.0} = 0.898$$

鐵筋混凝土高架橋

$$V_H = \frac{-0.359 - 0.120 - 0.066 - 0.011}{6.0} = -0.093$$

$$V_F = \frac{0.066 + 0.011}{6.0} = 0.013$$

水平反力

$$H_A = \frac{0.184 + 0.095}{6.0} = 0.047 \longrightarrow$$

$$H_G = \frac{0.234 + 0.114}{6.0} = 0.058 \longleftarrow$$

$$H_H = \frac{0.054 + 0.030}{6.0} = 0.014 \longrightarrow$$

$$H_F = \frac{0.011 + 0.003}{6.0} = 0.002 \longleftarrow$$

剪　力

$S_{BC} = 0.182$
$S_{CB} = 0.182 - 1.000 = -0.818$
$S_{CD} = -0.818 + 0.898 = 0.080 = S_{DC}$
$S_{DE} = S_{ED} = 0.080 - 0.093 = -0.013$
$S_{AB} = S_{BA} = -0.047$
$S_{CG} = S_{GC} = 0.058$
$S_{DH} = S_{HD} = -0.014$
$S_{EF} = S_{FE} = 0.002$

5) 荷重1kgが4点に作用せる場合

$C_{CD} = 0.844$
$C_{DC} = 0.281$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	0.0227	0.00708			-0.01281	=	0
2	0.00708	0.03686	0.00708		-0.01281	=	0.844
3		0.00708	0.03686	0.00708	-0.01281	=	-0.281
4			0.00708	0.0227	-0.01281	=	0
5	0.00427	0.00427	0.00427	0.00427	-0.03416	=	0

$\theta_B = -7.8$, $\theta_C = 27.4$, $\theta_D = -13.4$, $\theta_E = 5.0$, $R = 1.4$

$M_{BA} = 0.00427 \times (-15.6 - 4.2) = -0.084$
$M_{BC} = 0.00708 \times (-15.6 + 27.4) = 0.084$

$M_{CB} = 0.00708 \times (54.8 - 7.8) = 0.334$
$M_{CG} = 0.00427 \times (54.8 - 4.2) = 0.216$
$M_{CD} = 0.00708 \times (54.8 - 13.4) - 0.844 = -0.550$

$M_{DC} = 0.00708 \times (-26.8 + 27.4) + 0.281 = 0.286$
$M_{DE} = 0.00708 \times (-26.8 + 5.0) = -0.154$
$M_{DH} = 0.00427 \times (-26.8 - 4.2) = -0.132$

$M_{ED} = 0.00708 \times (10.0 - 13.4) = -0.025$
$M_{EF} = 0.00427 \times (10.0 - 4.2) = 0.025$

$M_{AB} = 0.00427 \times (-7.8 - 4.2) = -0.051$
$M_{GC} = 0.00427 \times (27.4 - 4.2) = 0.099$
$M_{HD} = 0.00427 \times (-13.4 - 4.2) = -0.075$
$M_{FE} = 0.00427 \times (5.0 - 4.2) = 0.003$

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單位彎曲率

$M_{BA} = 0.084$　$M_{CB} = -0.334$　$M_{DC} = -0.286$　$M_{ED} = 0.025$
$M_{BC} = 0.084$　$M_{CG} = -0.216$　$M_{DE} = -0.154$　$M_{EF} = 0.025$
$M_{CD} = -0.550$　$M_{DH} = -0.132$

$M_{AB} = -0.051$　$M_{HD} = 0.075$
$M_{GC} = 0.099$　$M_{FE} = -0.003$

單位垂直力

$$V_A = \frac{-0.084 - 0.334}{6.0} = -0.070$$

$$V_G = \frac{0.084 + 0.334 + 0.550 - 0.286 + 1 \times 4.5}{6.0} = 0.864$$

$$V_H = \frac{-0.550 + 0.286 + 0.154 + 0.025 + 1 \times 1.5}{6.0} = 0.236$$

$$V_F = \frac{-0.025 - 0.154}{6.0} = -0.030$$

水平反力

$$H_A = \frac{0.084 + 0.051}{6.0} = 0.023 \leftarrow$$

$$H_G = \frac{0.216 + 0.099}{6.0} = 0.053 \rightarrow$$

$$H_H = \frac{0.132 + 0.075}{6.0} = 0.035 \leftarrow$$

$$H_F = \frac{0.025 + 0.003}{6.0} = 0.005 \rightarrow$$

剪力

$S_{BC} = -0.070 = S_{CB}$
$S_{CD} = -0.070 + 0.864 = 0.794$
$S_{DC} = 0.794 - 1.000 = -0.206$
$S_{DE} = S_{ED} = -0.206 + 0.236 = 0.030$
$S_{BA} = S_{AB} = 0.023$
$S_{CG} = S_{GC} = -0.053$
$S_{DH} = S_{HD} = 0.035$
$S_{FE} = S_{EF} = -0.005$

6) 荷重 1kg が 5 点に作用せる場合

$C_{CD} = C_{DC} = 0.75$
$Q_B = -8.5$, $Q_C = 27.2$

$M_{BA} = 0.00427 \times (-17.0) = -0.072$
$M_{BC} = 0.00708 \times (-17.0 + 27.2) = 0.072$

$M_{CB} = 0.00708 \times (54.4 - 8.5) = 0.325$
$M_{CG} = 0.00427 \times (54.4) = 0.232$
$M_{CD} = 0.00708 \times (54.4 - 27.2) - 0.750 = -0.557$

$M_{AB} = 0.00427 \times (-8.5) = -0.036$
$M_{GC} = 0.00427 \times (27.2) = 0.116$

單位彎曲率

$M_{BA} = 0.072$　$M_{CB} = -0.325$　$M_{AB} = -0.036$
$M_{BC} = 0.072$　$M_{CG} = -0.232$　$M_{GC} = 0.116$
$M_{CD} = -0.557$

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單位無直力

$$V_A = V_F = \frac{-0.072 - 0.325}{6.0} = -0.066$$

$$V_G = V_H = \frac{0.072 + 0.325 + 1 \times 3.0}{6.0} = 0.566$$

水平反力

$$H_A = \frac{0.072 + 0.036}{6.0} = 0.018 \longleftarrow$$

$$H_G = \frac{0.232 + 0.116}{6.0} = 0.058 \longrightarrow$$

剪力

$S_{BC} = S_{CB} = -0.066$
$S_{CD} = -0.066 + 0.566 = 0.500$
$S_{BA} = S_{AB} = 0.018$
$S_{GC} = S_{CG} = -0.058$

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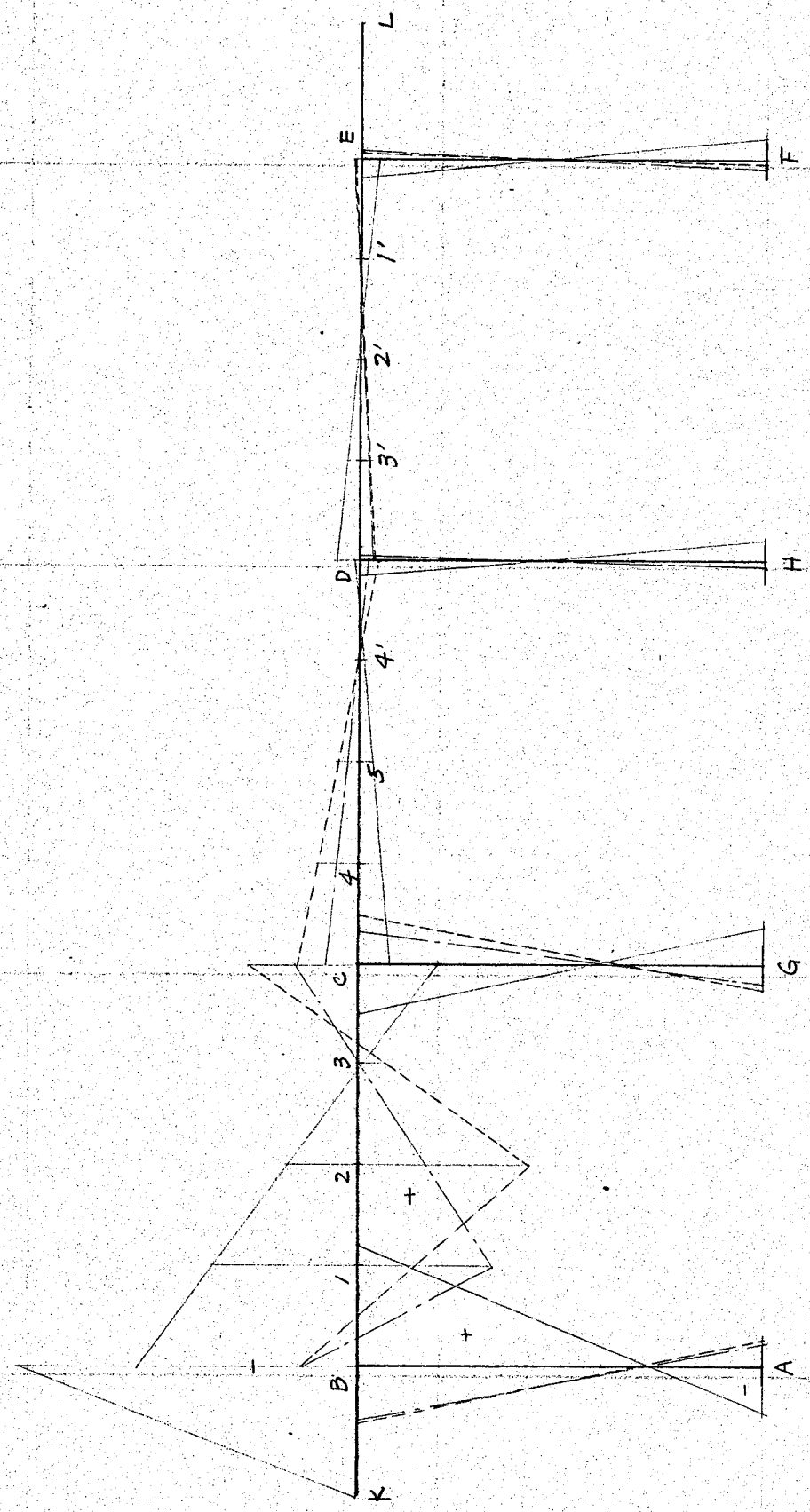

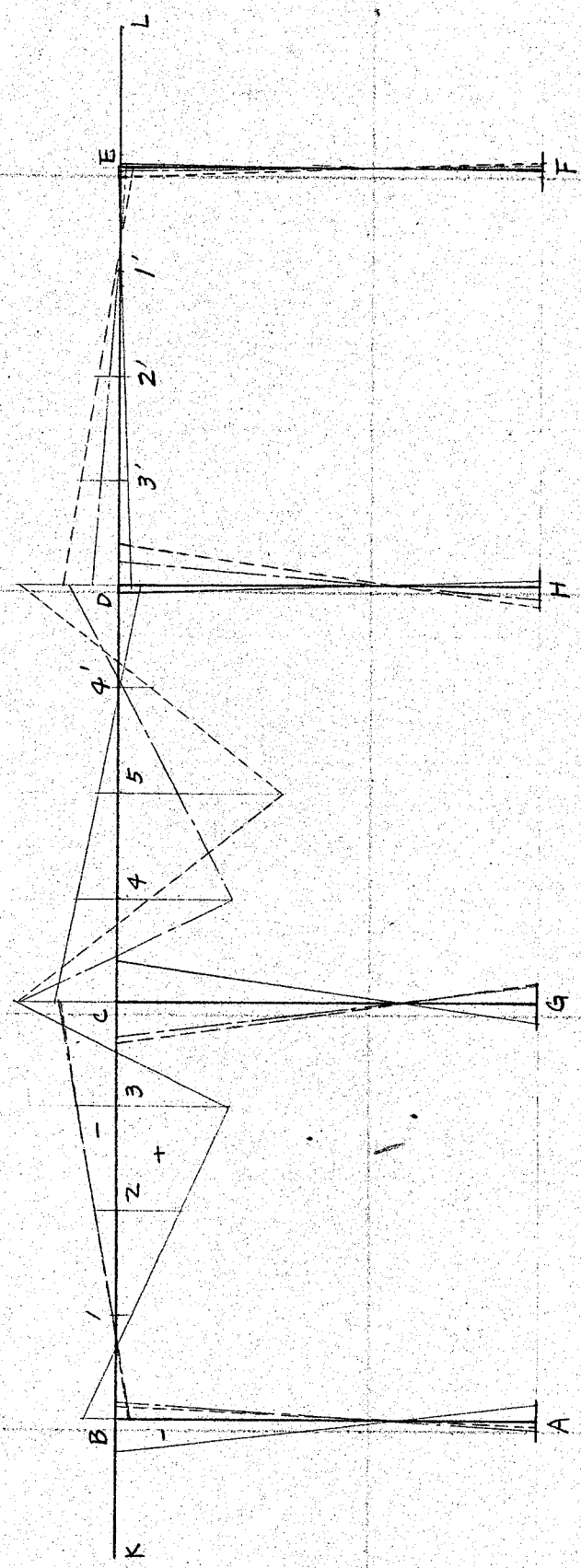

単位荷重ニヨル剪曲率圖表

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東京都品川區五反田五ノ一〇八
電話 六 ㊀ (㊁) 〇 六 七 八 番

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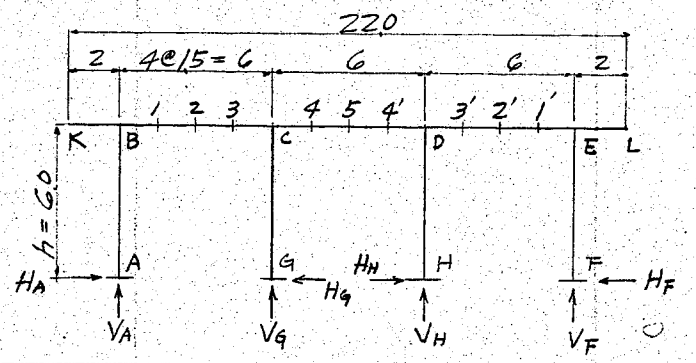
弯曲率,剪力及反力影響面



弯曲率

載荷点	M_{BK}	M_{BC}	M_{BA}	M_1	M_2	M_3	M_{CB}	M_{CD}	M_{CG}	M_4	M_5	M_{AB}	M_{GL}
K	-2.000	-1299	0.701	-0856	-0411	0032	0476	0186	-0290	0133	0080	-0275	0221
1	—	-0324	-0324	0788	0400	0012	-0376	-0189	0187	-0129	-0070	0134	-0121
2	—	-0340	-0340	0333	1007	0180	-0646	-0365	0281	-0246	-0126	0154	-0156
3	—	-0184	-0184	0089	0361	0634	-0593	-0359	0234	-0239	-0120	0095	-0114
4	—	0084	0084	-0020	-0125	-0229	-0334	-0550	-0216	0641	0332	-0051	0099
5	—	0072	0072	-0027	-0126	-0226	-0325	-0557	-0232	0193	0943	-0036	0116
4'	—	0025	0025	-0020	-0064	-0109	-0154	-0286	-0132	0023	0332	-0003	0075
3'	—	-0011	-0011	0008	0027	0047	0066	0120	0054	0	-0120	0003	-0030
2'	—	-0038	-0038	-0006	0025	0057	0089	0113	0024	-0007	-0126	0035	0004
1'	—	-0046	-0046	-0018	0011	0039	0068	0050	-0018	-0010	-0070	0050	0037
L	—	0112	0112	0053	-0006	-0064	-0123	-0026	0097	0027	0080	-0131	-0124

反力

載荷点	V_A	V_G	H_A	H_G
K	1296	-0331	-0163	-0085
B	1000	—	—	—
1	0741	0299	0076	0051
2	0449	0631	0082	0073
3	0182	0898	0047	0058
C	—	1000	—	—
4	-0070	0864	-0023	-0053
5	-0066	0566	-0018	-0058
4'	-0030	0236	-0005	-0035
D	—	—	—	—
3'	0013	-0093	0002	0014
2'	0021	-0101	0011	0003
1'	0019	-0059	0016	-0009
E	—	—	—	—
L	-0039	0074	-0042	0036

剪力

載荷点	S_{BK}	S_{BC}	S_{CB}	S_{CD}	S_{AB}, S_{BA}	S_{CG}, S_{GC}
K	-1000	0296	0296	-0035	0163	-0085
B	-1000	1000	—	—	—	—
1	—	0741	-0259	0040	-0076	0051
2	—	0449	-0551	0080	-0082	0073
3	—	0182	-0818	0080	-0047	0058
C	—	—	-1000	1000	—	—
4	—	-0070	-0070	0794	0023	-0053
5	—	-0066	-0066	0500	0018	-0058
4'	—	-0030	-0030	0206	0005	-0035
D	—	—	—	—	—	—
3'	—	0013	0013	-0080	-0002	0014
2'	—	0021	0021	-0080	-0011	0003
1'	—	0019	0019	-0040	-0016	-0009
E	—	—	—	—	—	—
L	—	-0039	-0039	0035	0042	0036

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設計　日付　類別 6h6
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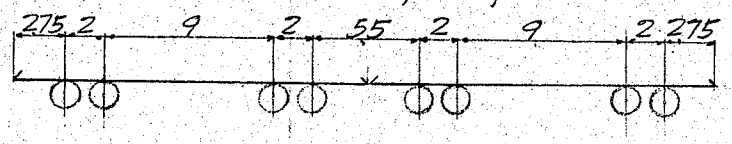
鐵筋混凝土高架橋

活荷重應力

60噸電車　桁一本ニ付 7,500 kg



徑間 6"00，桁ニ対シ
輸荷重　7,500
衝撃 $i = \frac{20}{50+6} = 35.7\%$　2,680
10,180 kg

跳ね腕ニ対シ
輸荷重　7,500
衝撃 $i = \frac{20}{50+2} = 38.5\%$　2890
10,390 kg

Bk 点
$M_{BK} = -2.000 \times 10,390 = -20,780$ kgm
$V_A = 2.296 \times 10,390 = 23,850$ kg
$S_{BK} = -1.000 \times 10,390 = 10,390$ kg

Bc 点
最大負曲率ノ起ル場合 (h=5,000 ト仝シ載荷狀態)

荷重点			-M		H_A
K	10,180	-1.299	-13,230	-0.163	-1,660
2	6,790	-0.340	-2,310	0.082	557
3	6,790	-0.184	-1,248	0.047	319
3'	3,390	-0.011	-37	0.002	7
2'	6,790	-0.038	-258	0.011	75
1'	10,180	-0.046	-468	0.016	163
			-17,551 kgm		-539 kg ←

最大剪力ノ起ル場合 (h=5,000 ト仝シ載荷狀態)

荷重点			S_{BC}
B	11,195	1.000	11,195
1	7,460	0.741	5,530
2	3,730	0.449	1,675
			18,400 kg

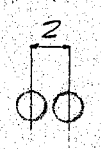
最大正曲率ノ起ル場合

荷重点			M		H_A
4	6,790	0.084	570	-0.023	-156
5	10,180	0.072	733	-0.018	-183
L	10,180	0.112	1,140	-0.042	-428
			2,443 kgm		-767 kg

1 点
最大負曲率ノ起ル場合

			-M		-M		H_A
K	10,180	-0.856	-8,720	11,195	-9,580	-0.163	-1,823
3'	3,390	0.008	27				
2'	6,790	-0.006	-41				
1'	10,180	-0.018	-183				
			-8,917 kgm		-9,580 kgm		-1,823 kg

特殊荷重　桁一本ニ付 8,250 kg



8,250
2,945
11,195 kg

8,250
3,175
11,425 kg

$M_{BK} = -2.000 \times 11,425 = -22,850$ kgm
$V_A = 2.296 \times 11,425 = 26,220$ kg
$S_{BK} = -1.000 \times 11,425 = -11,425$ kg
$H_A = -0.163 \times 11,425 = -1,860$ kg
$M_{AB} = -0.275 \times 11,425 = -3,140$ kg

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最大正弯曲率，起～場合
荷重点

			M		H_A		S_1
1	11,195	0.788	8820	0.076	850	0.741	8,290
2	7,460	0.333	2,485	0.082	612	0.449	3,350
3	3,730	0.089	332	0.047	175	0.182	679
			11,637 kgm		1,637 kg		12,319 kg

2点
最大負弯曲率，起～場合
荷重点

			-M		H_A
K	10,180	-0.411	-4,185	-0.163	-1,660
4	10,180	-0.125	-1,273	-0.023	-234
5	6,790	-0.126	-856	-0.018	-122
4'	3,390	-0.064	-217	-0.005	-170
L	2,545	-0.006	-15	-0.042	-107
			-6,546 kgm		-2,293 kg

最大正弯曲率，起～場合
荷重点

			M		H_A
1	7,460	0.400	2,985	0.076	567
2	11,195	1.007	11,270	0.082	918
			14,255 kgm		1,485 kg

3点
最大負弯曲率，起～場合
荷重点

			-M		H_A
4	11,195	-0.229	-2,562	-0.023	-257
5	7,460	-0.226	-1,685	-0.018	-134
4'	3,730	-0.109	-407	-0.005	-19
			-4,654 kgm		-410 kg

最大正弯曲率，起～場合
荷重点

			M		S
1	3,730	0.012	45	-0.259	-966
2	7,460	0.180	1,342	-0.551	-4,110
3	11,195	0.634	7,100	-0.818	-9,160
			8,487 kgm		-14,236 kg

荷重点

			M		H_A
1	3,390	0.012	41	0.076	258
2	6,790	0.180	1,222	0.082	557
3	10,180	0.634	6,458	0.047	479
3'	6,790	0.047	319	0.002	14
2'	10,180	0.057	580	0.011	112
			8,620 kgm		1,420 kg

C_B点
最大負弯曲率，起～場合
荷重点

			M		H_A
2	10,180	-0.646	-6,580	0.082	835
3	6,790	-0.593	-4,028	0.047	319
4'	10,180	-0.154	-1,568	-0.005	-51
3'	3,390	0.066	224	0.002	7
			-11,952 kgm		1,110 kg

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最大正弯曲率，起ル場合 荷重点

			M		HA
K	10,180	0,476	4,850	-0,163	-1,660
2'	10,180	0,089	906	0,011	112
1'	6,790	0,068	462	0,016	109
			6,218 kgm		-1,439 kg

最大剪力，起ル場合 荷重点

			Scb
2	3,730	-0,551	-2,057
3	7,460	-0,818	-6,100
C	11,195	-1,000	-11,195
			-19,352 kg

C点

最大負弯曲率，起ル場合 荷重点

			-M		N
1	6,790	-0,189	-1,283	-0,025	-170
2	3,390	-0,365	-1,237	-0,009	-31
4	10,180	-0,550	-5,600	-0,030	-306
5	6,790	-0,557	-3,780	-0,040	-272
4'	3,390	-0,286	-970	-0,030	-102
L	2,545	-0,026	-66	0,078	199
			-12,936 kgm		-682 kg

最大正弯曲率，起ル場合 荷重点

			M		N
K	10,180	0,186	1,895	0,078	793
3'	10,180	0,120	1,222	0,012	122
2'	6,790	0,113	767	-0,008	-54
1'	3,390	0,050	170	-0,025	-85
			4,054 kgm		776 kg

最大剪力，起ル場合 荷重点

			S
C	11,195	1,000	11,195
4	7,460	0,794	5,920
5	3,730	0,500	1,865
			18,980 kg

4点

最大負弯曲率，起ル場合 荷重点

			M		N
2	11,195	-0,246	-2,752	-0,009	-101
3	7,460	-0,239	-1,783	0,011	82
			-4,535 kgm		-19 kg

最大正弯曲率，起ル場合 荷重点

			M		N		Sco
4	11,195	0,641	7,170	-0,030	-336	0,794	8,890
5	7,460	0,193	1,440	-0,040	-298	0,500	3,730
4'	3,730	0,023	86	-0,030	-112	0,206	768
			8,696 kgm		-746 kg		13,388 kg

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5 点
最大負彎曲率，起ゝ場合
荷重点

			−M		N
3	10,180	−0.120	−1,222	0.011	112
2	6,790	−0.126	− 856	−0.009	− 61
1	3,390	−0.070	− 237	−0.025	− 85
			−2,315 × 2 = −4,630 Kgm		−34 × 2 = −68 Kg

最大正彎曲率，起ゝ場合
荷重点

			M		N
4	7,460	0.332	2,476	−0.030	− 224
5	11,195	0.943	10,550	−0.040	− 448
			13,026 Kgm		− 672 Kg

BA 点
最大正彎曲率，起ゝ場合
荷重点

			M		VA
K	10,180	0.701	7,140	1.296	13,200
4	6,790	0.084	570	−0.070	− 475
5	10,180	0.072	733	−0.066	− 672
			8,443 Kgm		12,053 Kg

最大負彎曲率，起ゝ場合
荷重点

			M		VA
1	11,195	−0.324	−3,620	0.741	8,290
2	7,460	−0.340	−2,535	0.449	3,350
3	3,730	−0.184	− 685	0.182	678
			−6,840 Kgm		12,318 Kg

AB 点
最大正彎曲率，起ゝ場合
荷重点

			M	VA		HA
1	11,195	0.134	1,500		0.076	850
2	7,460	0.154	1,150		0.082	612
3	3,730	0.095	354		0.047	175
			3,004 Kgm	12,318 Kg		1,637 Kg

最大負彎曲率，起ゝ場合
荷重点

			M	VA
K	10,180	−0.275	−2,800	
4	6,790	−0.051	− 347	
5	10,180	−0.036	− 367	
			−3,514 Kgm	12,053 Kg

VA，最大
荷重点

			VA		MAB		HA
K	11,195	1.296	14,500	−0.275	−3,075	−0.163	−1,823
B	11,195	1.000	11,195	—		—	
			25,695 Kg		−3,075 Kgm		−1,823 Kg

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鐵筋混凝土高架橋

Cg 点
最大正弯曲率，起ル場合
荷重点

			M		Vg
2	10,180	0.281	2,862	0.631	6,430
3	6,790	0.234	1,588	0.898	6,100
C	3,390	—	—	1.000	3,390
L	10,180	0.097	988	0.074	753
			5,438 kgm		16,673 kg

最大負弯曲率，起ル場合
荷重点

			M		Vg
K	10,180	-0.290	-2,953	-0.331	-3,370
C	3,390	—	—	1.000	3,390
4	6,790	-0.216	-1,467	0.864	5,865
5	10,180	-0.232	-2,363	0.566	5,765
			-6,783 kgm		11,650 kg

Gc 点
最大正弯曲率，起ル場合
荷重点

			M	Vg		Hg
K	10,180	0.221	2,250		-0.085	-867
c	3,390	—	—		—	—
4	6,790	0.099	672		-0.053	-360
5	10,180	0.116	1,182		-0.058	-591
			4,104 kgm	11,650 kg		-1,818 kg

最大負弯曲率，起ル場合
荷重点

			M	Vg
1	6,790	-0.121	-822	0.299	2,030
2	10,180	-0.156	-1,590	0.631	6,430
L	10,180	-0.124	-1,260	0.074	753
			-3,672 kgm		9,213 kg

Vg，最大
荷重点

			Vg		MGc		Hg
2	3,730	0.631	2,353	-0.156	-582	0.073	272
3	7,460	0.898	6,700	-0.114	-850	0.058	433
C	11,195	1.000	11,195	—		—	—
			20,248 kgm		-1,432 kg		705 kg

HA 及 SAB，最大
荷重点

1	6,790	0.076	516
2	10,180	0.082	835
3′	3,390	0.002	7
2′	6,790	0.011	75
1′	10,180	0.016	163

HA = 1,596 kg
SAB = -1,596 kg

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鐵筋混凝土高架橋

荷重実

K	10,180	-0.163	-1660
4	6,790	-0.023	-156
5	10,180	-0.018	-183
L	10,180	-0.042	-428

$H_A = -2427$ Kg
$S_{AB} = 2427$ Kg

HG 及 SGC
荷重実

1	3390	0.051	173
2	6,790	0.073	496
3	10,180	0.058	591
L	10,180	0.036	367

$H_G = 1,627$ Kg
$S_{GC} = 1,627$ Kg

荷重実

K	10,180	-0.085	-866
4	6,790	-0.053	-360
5	10,180	-0.058	-591

$H_G = S_{GC} = -1,817$ Kg

温度應力 (温度上昇ノ場合)

温度ノ変化　$t = \pm 15°C$　　$K_1 = 0.00427$
膨張係数　$\varepsilon = 0.00001$　　$K_2 = 0.00708$

$M_{BA} = 2EK_1(2\theta_B - 3R_1)$　　$M_{AB} = 2EK_1(\theta_B - 3R_1)$
$M_{BC} = 2EK_2(2\theta_B + \theta_C)$　　$M_{GC} = 2EK_1(\theta_C - 3R_2)$

$M_{CB} = 2EK_2(2\theta_C + \theta_B)$
$M_{CD} = 2EK_2\theta_C$
$M_{CG} = 2EK_1(2\theta_C - 3R_2)$

$$\theta_B = \frac{3\{K_1K_2R_2 - K_1(2K_1+3K_2)R_1\}}{K_2^2 - 2(K_1+K_2)(2K_1+3K_2)}$$

$$\theta_C = \frac{3\{K_1K_2R_1 - 2K_1(K_1+K_2)R_2\}}{K_2^2 - 2(K_1+K_2)(2K_1+3K_2)}$$

$K_1K_2 = 0.00427 \times 0.00708 = 0.0000302$
$(2K_1+3K_2) = 0.00854 + 0.02124 = 0.02978$
$K_1+K_2 = 0.01135$

$$R_1 = -\frac{3\varepsilon t l}{2h} = -\frac{3 \times 0.00001 \times 15 \times 6.0}{2 \times 6.0} = -0.000225$$

$$R_2 = -\frac{\varepsilon t l}{2h} = -\frac{0.00001 \times 15 \times 6.0}{2 \times 6.0} = -0.000075$$

$\theta_B = -0.0001263$, $\theta_C = -0.00000225$

$M_{BA} = 2 \times 1,400,000,000 \times 0.00427 \times (-0.0002526 + 0.000675) = 5,050$ Kgm
$M_{BC} = 2 \times 1,400,000,000 \times 0.00708 \times (-0.0002526 - 0.00000225) = -5,050$ Kgm

$M_{CB} = 2 \times 1,400,000,000 \times 0.00708 \times (-0.0000045 - 0.0001263) = -2595$ Kgm
$M_{CD} = 2 \times 1,400,000,000 \times 0.00708 \times -0.00000225 = -45$ Kgm
$M_{CG} = 2 \times 1,400,000,000 \times 0.00427 \times (-0.0000045 + 0.000225) = 2640$ Kgm

$M_{AB} = 2 \times 1,400,000,000 \times 0.00427 \times (-0.0001263 + 0.000675) = 6560$ Kgm
$M_{GC} = 2 \times 1,400,000,000 \times 0.00427 \times (-0.00000225 + 0.000225) = 2660$ Kgm

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鐵筋混凝土高架橋

格点弯曲率

$M_{BA} = -5{,}050$ Kgm　$M_{CB} = 2{,}595$ Kgm　$M_{AB} = 6{,}560$ Kgm　$M_1 = -3{,}005$ Kgm
$M_{BC} = -5{,}050$ Kgm　$M_{CD} = -45$ Kgm　$M_{GC} = 2{,}660$ Kgm　$M_2 = -1{,}138$ Kgm
$M_{CG} = -2{,}640$ Kgm　$M_3 = 728$ Kgm
$M_4 = M_5 = -45$ Kgm

無直力

$$V_A = \frac{5{,}050 + 2{,}595}{6.0} = 1{,}275 \text{ Kg}$$

$V_G = -1{,}275$ Kg

水平反力

$$H_A = \frac{5{,}050 + 6{,}560}{6.0} = 1{,}940 \text{ Kg} \longrightarrow$$

$$H_G = \frac{2{,}640 + 2{,}660}{6.0} = 883 \text{ Kg} \longrightarrow$$

剪力

$S_{BC} = S_{CB} = 1{,}275$ Kg
$S_{CD} = 0$
$S_{BA} = S_{AB} = -1{,}940$ Kg
$S_{CG} = S_{GC} = -883$ Kg

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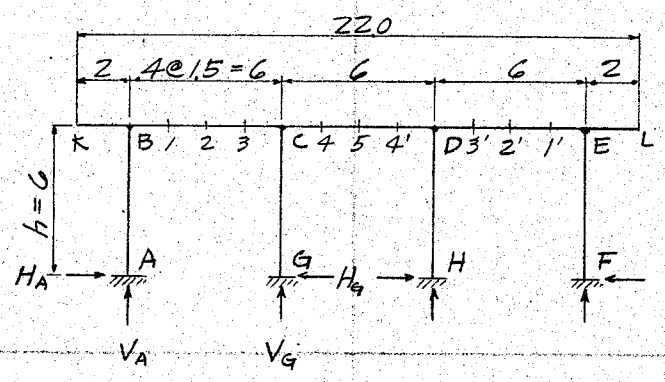
鐵筋混凝土高架橋
應力一括表



彎曲率(kgm)及軸圧力(kg)

	彎曲率	M_{BK}	M_{BC}	M_{BA}	M_1	M_2	M_3	M_{CB}	M_{CD}	M_{CG}	M_4	M_5	M_{AB}	M_{GC}
最大正彎曲率	死荷重	-6600	-7941	-1341	2563	5637	1292	-10483	-10164	319	976	4686	670	-159
	活荷重		2443	8443	11637	14255	8620	6218	4054	5438	8696	13026	3004	4104
	温度変化		5050	5050	3005	1138	728	2595	45	2640	45	45	6560	2660
	合成應力		-448	12152	17205	21030	10640	-1670	-6065	8397	9717	17757	10234	6605
	軸圧力													
	死荷重		335	16076	335	335	335	335	-255	20224	-255	-255	16076	20224
	活荷重		-767	12053	1637	1485	1420	-1439	776	16673	-746	-672	12318	11650
	温度変化		-1940	-1275	-1940	-1940	1940	1940	2823	1275	2823	2823	1275	-1275
	合成應力		-2372	26854	32	-120	3695	836	3344	38172	1822	1896	29669	30599

	彎曲率	M_{BK}	M_{BC}	M_{BA}	M_1	M_2	M_3	M_{CB}	M_{CD}	M_{CG}	M_4	M_5	M_{AB}	M_{GC}
最大負彎曲率	死荷重	-6600	-7941	-1341	2563	5637	1292	-10483	-10164	319	976	4686	670	-159
	活荷重	-22850	-17551	-6840	-9580	-6546	-4654	-11952	-12936	-6783	-4535	-4630	-3514	-3672
	温度変化	—	-5050	-5050	-3005	-1138	-728	-2595	-45	-2640	-45	-45	-6560	-2660
	合成應力	-29450	-30542	-13231	-10022	-2047	-4090	-25030	-23145	-9104	-3604	11	-9404	-6491
	軸圧力													
	死荷重		335	16076	335	335	335	335	-255	20224	-255	-255	16076	20224
	活荷重		-539	12318	-1823	-2293	-410	1110	-682	11650	-19	-68	12053	9213
	温度変化		1940	1275	1940	1940	-1940	-1940	-2823	-1275	-2823	-2823	-1275	1275
	合成應力		1736	29669	452	-18	-2015	-495	-3760	30599	-3097	-3146	26854	30712

最大反力及剪力

	V_A	V_G	H_A	H_G	S_{AB}, S_{BA}	S_{CG}, S_{GC}	S_{BK}	S_{BC}	S_{CB}	S_{CD}	S_1	S_3	S_4
死荷重	16076	20224	335	80	-335	80	-6600	9476	-10324	9900	4526	-5374	4950
活荷重	26220	20248	1596	1627	-1596	1627	-11425	18400	-19352	18980	12319	-14236	13388
温度変化	1275	1275	1940	883	-1940	883	—	1275	-1275	0	1275	-1275	0
合成應力	43571	41747	3871	2590	3871	2590	-18025	29151	-30951	28880	18120	-20885	18338
	M	M	H_A	H_G	S_{AB}, S_{BA}	S_{CG}, S_{GC}							
死荷重	670	-159	335	80	-335	80							
活荷重	-3140	-1432	-2427	-1817	2427	-1817							
温度変化	6560	-2660	-1940	-883	1940	-883							
合成應力	4090	-4251	-4032	-2620	4032	-2620							

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設計　日付　類別 GhG
照査　日付　第 22 頁

鐵筋混凝土高架橋

斷面，設計 (h=5.000m，場合ト同一斷面ヲ使用)

2 奥

$M_2 = 21{,}030$ Kgm , $T = -120$ Kg

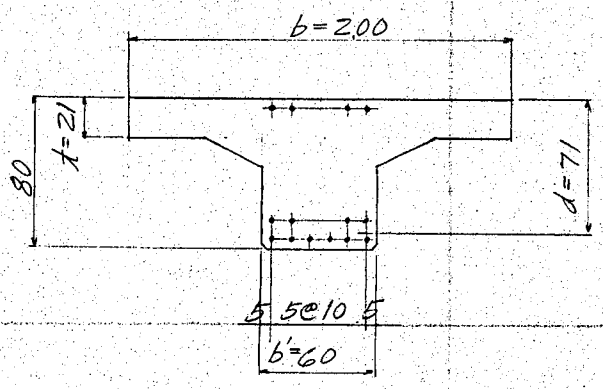
$A_s = 10 @ 19\phi = 10 @ 2.84 = 28.4$ cm²

$t = 21$ cm, $d = 71$ cm , $t/d = 0.296$, $b = 200$ cm

$p = 0.002$

中立軸ハ突縁中ニアリ

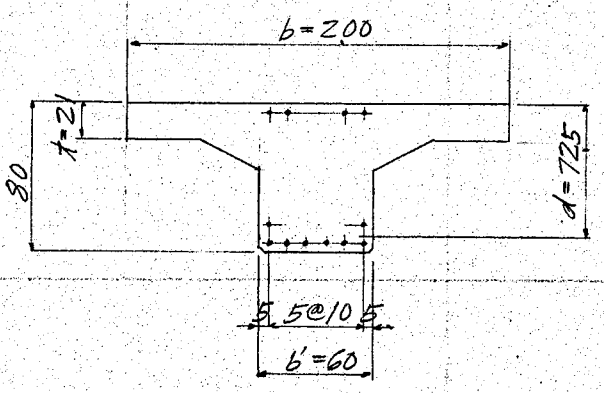
$K = 0.218$, $j = 0.927$



$$f_s = \frac{21030 \times 100}{28.4 \times 0.927 \times 71} = 1{,}125 \text{ Kg/cm}^2$$

$$f_c = \frac{1{,}125 \times 0.218}{15 \times (1 - 0.218)} = 20.9 \text{ Kg/cm}^2$$

5 奥



$M_5 = 17{,}757$ Kgm $T = 1{,}896$ Kg

$A_s = 8 @ 19\phi = 22.7$ cm²

$t = 21$ cm , $d = 72.5$ cm , $t/d = 0.290$, $b = 200$ cm

$p = 0.00157$

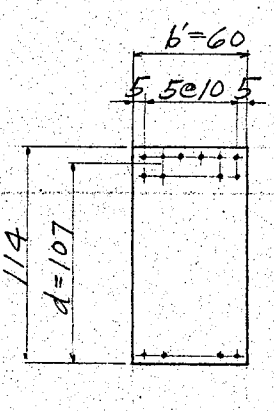
中立軸ハ突縁中ニアリ

$K = 0.197$, $j = 0.934$

$$f_s = \frac{17757 \times 100}{22.7 \times 0.934 \times 72.5} = 1{,}155 \text{ Kg/cm}^2$$

$$f_c = \frac{1{,}155 \times 0.197}{15 \times (1 - 0.197)} = 18.9 \text{ Kg/cm}^2$$

BC 奥



$M_{BC} = -30{,}542$ Kgm , $T = 1{,}736$ Kg , $S_{BC} = 29{,}151$ Kg

$b = 60$ cm , $d = 107$ cm , $A_s = 10 @ 19\phi = 28.4$ cm²

$p = 0.00442$

$K = 0.304$, $j = 0.899$

$$f_s = \frac{30{,}542 \times 100}{28.4 \times 0.899 \times 107} = 1{,}118 \text{ Kg/cm}^2$$

$$f_c = \frac{1{,}118 \times 0.304}{15 \times (1 - 0.304)} = 32.6 \text{ Kg/cm}^2$$

$$S = \frac{29{,}151}{60 \times 0.889 \times 107} = 5.1 \text{ Kg/cm}^2$$

肋鉄筋，最小間隔

$A_s = 4 @ 12\phi = 4.52$ cm²

$$S = \frac{4.52 \times 1{,}200 \times 0.899 \times 107}{29{,}151} = 17.9 \text{ cm} \quad c \text{ to } c.$$

附着力

$b_0 = 10 @ 19\phi = 59.7$ cm

$$v = \frac{29{,}151}{59.7 \times 0.899 \times 107} = 5.1 \text{ Kg/cm}^2$$

C 奥

$M_{CB} = -25{,}030$ Kgm , $T = -495$ Kg , $S = 30{,}951$ Kg

$K = 0.304$, $j = 0.899$

$$f_s = \frac{25{,}030}{28.4 \times 0.899 \times 107} = 916 \text{ Kg/cm}^2$$

$$f_c = \frac{916 \times 0.304}{15 \times (1 - 0.304)} = 26.7 \text{ Kg/cm}^2$$

肋鐵筋，最小間隔

$A_s = 4 @ 12\phi = 4.52$ cm²

$$S' = \frac{4.52 \times 1{,}200 \times 0.899 \times 107}{30{,}951} = 16.9 \text{ cm} \quad c, \text{ to } c.$$

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設計　日付　類別 GhC

照査　日付　第 23 頁

鐵筋混凝土高架橋

柱 AB 点

附着力

$$b_0 = 59.7\,cm$$

$$u = \frac{30,951}{59.7 \times 0.899 \times 107} = 5.4\ kg/cm^2$$

$M = 10,234\,kgm$, $N = 29669\,kg$, $S = 4,032\,kg$

$d' = 5\,cm$, $d = 75\,cm$, $h = 80\,cm$

$A_s = 6 @ 19\phi = 17.05\,cm^2$

$e = 10234 \div 29,669 = 34.5\,cm$

$e/h = 34.5/80 = 0.432$, $p = 0.00355$, $d'/h = 0.0625$

$K = 0.55$, $C = 0.285$

$$f_c = \frac{29669}{60 \times 80 \times 0.285} = 21.7\ kg/cm^2$$

$$f_s = 15 \times 21.7 \times \frac{0.45}{0.55} = 266\ kg/cm^2$$

$$s = \frac{4,032}{60 \times 7/8 \times 75} = 1.0\ kg/cm^2$$

BA 点

$M = -13,231\,kgm$, $N = 29,669\,kg$, $S = 4,032\,kg$

$d' = 15.2\,cm$, $d = 98.8\,cm$, $h = 114\,cm$

$A_s = 10 @ 19\phi = 28.4\,cm^2$

$e = 13,231 \div 29,669 = 44.7\,cm$

$e/h = 44.7 \div 114 = 0.392$, $p = 0.00473$, $d'/h = 0.133$

$K = 0.58$ $C = 0.31$

$$f_c = \frac{29,669}{60 \times 114 \times 0.31} = 14.0\ kg/cm^2$$

$$f_s = 15 \times 14.0 \times \frac{0.42}{0.58} = 152\ kg/cm^2$$

$$s = \frac{4,032}{60 \times 7/8 \times 98.8} = 0.8\ kg/cm^2$$

GC 点

$M = 6,605\,kgm$, $N = 30,599\,kg$, $S = 2,620\,kg$

$d' = 5\,cm$, $d = 75\,cm$, $h = 80\,cm$

$A_s = 4 @ 19\phi = 11.4\,cm^2$

$e = 6,605 \div 30,599 = 21.6\,cm$

$e/h = 0.27$, $p = 0.00238$, $d'/h = 0.0625$

$K = 0.77$ $C = 0.41$

$$f_c = \frac{30,599}{60 \times 80 \times 0.41} = 15.6\ kg/cm^2$$

$$f_s = 15 \times 15.6 \times \frac{0.23}{0.77} = 70\ kg/cm^2$$

$$s = \frac{2,620}{60 \times 7/8 \times 75} = 0.7\ kg/cm^2$$

CG 点

$M = -9,104\,kgm$, $N = 30,599\,kg$, $S = 2,620\,kg$

$d' = 13.5\,cm$, $d = 100.5\,cm$, $h = 114\,cm$

$A_s = 8 @ 19\phi = 22.7\,cm^2$

$e = 9,104 \div 30,599 = 29.8\,cm$

$e/h = 29.8 \div 114 = 0.261$, $p = 0.00332$

$d'/h = 0.118$ $K = 0.785$ $C = 0.43$

$$f_c = \frac{30,599}{60 \times 114 \times 0.43} = 10.4\ kg/cm^2$$

$$f_s = 15 \times 10.4 \times \frac{0.215}{0.785} = 42.7\ kg/cm^2$$

$$s = \frac{2,620}{60 \times 7/8 \times 100.5} = 0.5\ kg/cm^2$$

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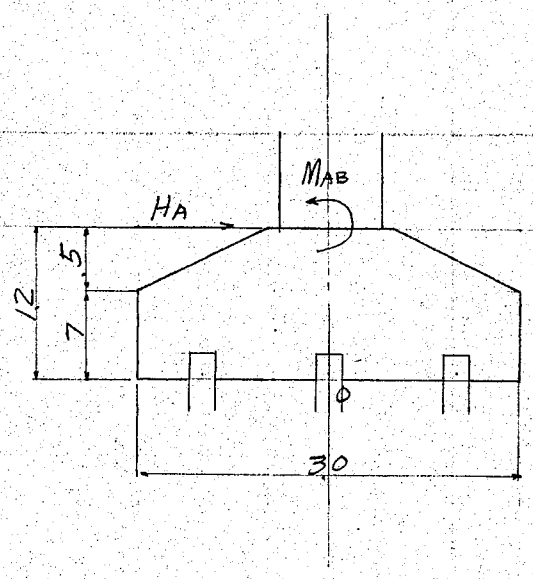
設計　日付　類別 6h6
照査　日付　第 24 頁

鐵筋混凝土高架橋
基礎

A 点	M_{AB} max.			V_A max.		
	M_{AB}	V_A	H_A	M_{AB}	V_A	H_A
死荷重	670	16076	335	670	16,076	335
活荷重	3004	12,318	1,637	-3140	26220	-1860
温度ノ変化	6560	1275	1940	6560	1275	1,940
合成應力	10,234	29669	3912	4090	43571	415

G 点	M_{GC} max.			V_G max.		
	M_{GC}	V_G	H_G	M_{GC}	V_G	H_G
死荷重	-159	20224	80	-159	20224	80
活荷重	4104	11650	-1818	-1432	20248	705
温度ノ変化	2660	-1275	-883	-2660	1275	883
合成應力	6605	30599	-2621	-4251	41747	1668

基礎一柱分ノ重量



柱　.60 × .80 × 4.49 @ 2,400 = 5,170
土　.50 × 1.00 × 2.00 @ 1,600 = 1,600
基礎 .50 × 2.0 × 2.00 @ 2,400 = 4,800
〃　.70 × 3.0 × 2.00 @ 2,400 = 10,080
V = 21,650 kg

0点ニ於ケル能率（最大曲率ノ場合）

V_A	29,669		
V	21,650		
H_A	-3,912	× 1.20 =	-4,690
M_{AB}		=	10,234
	ΣV = 51,319 kg		5,544 kgm

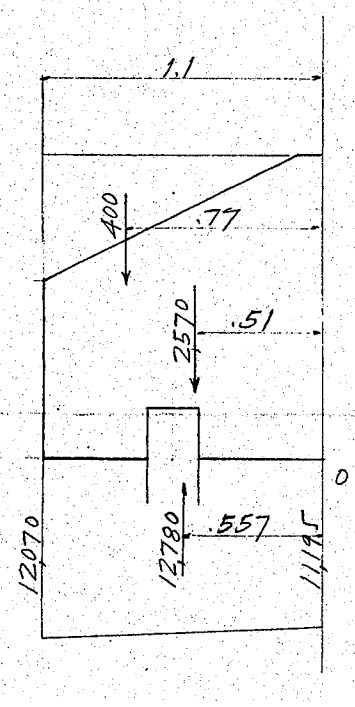
$e = 5,544 \div 51,319 = 0.108\,m$

$$p = \frac{51,319}{3.0 \times 2.0} \times \left(1 \pm \frac{6 \times .108}{3.0}\right) = 10,400\ kg/m^2,\ 6,700\ kg/m^2$$

1.216　10,400
.784　6,700

0点ニ於ケル能率（最大垂直力ノ場合）

V_A	43,571		
V	21,650		
H_A	-415	× 1.20 =	-498
M_{AB}		=	4090
	65,221 kg		3,592 kgm



$e = 3,592 \div 65,221 = 0.055\,m$

$$p = \frac{65221}{3.0 \times 2.0} \times \left(1 \pm \frac{6 \times 0.055}{3.0}\right) = 12,070\ kg/m^2,\ 9,680\ kg/m^2$$

0点ニ於ケル能率

12,780 × 0.557	=	7120
-2,570 × -0.51	=	-1,310
- 400 × -0.77	=	- 310
S = 9,810 kg		5,500 kgm

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設計　日付　類別 6h6
照査　日付　第 25 頁

鐵筋混凝土高架橋

所要厚 $d=\sqrt{\frac{5500\times100}{100\times7.13}}=27.8$ cm

使用厚 97cm (有効)

所要鐵筋量 $A_s=\frac{5500\times100}{1200\times7/8\times97}=5.4$ cm²

16mmφ 33 cm c. to c.
$A_s=3$ e/16φ $=6.03$ cm²

$p=0.00062$, $k=0.13$, $j=0.955$

$f_s=\frac{5500\times100}{6.03\times.955\times97}=985$ kg/cm²

$f_c=\frac{2\times5500\times100}{.955\times.13\times100\times97^2}=9.4$ kg/cm²

$s=\frac{9810}{100\times0.955\times97}=1.06$ kg/cm²

断面及配筋ハ全ク h=500, 場合ト同シ

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設計　日付　類別

照査　日付　第　頁

上海高速鐵道

鐵筋混凝土複線桁橋

支間六、〇米三徑間、兩脇各二、〇米
高五、〇米　應力計算書

Reinforced Concrete Rahmen Bridge
Double Track
3 Continuous spans @ 6.0m , 5.0m high.

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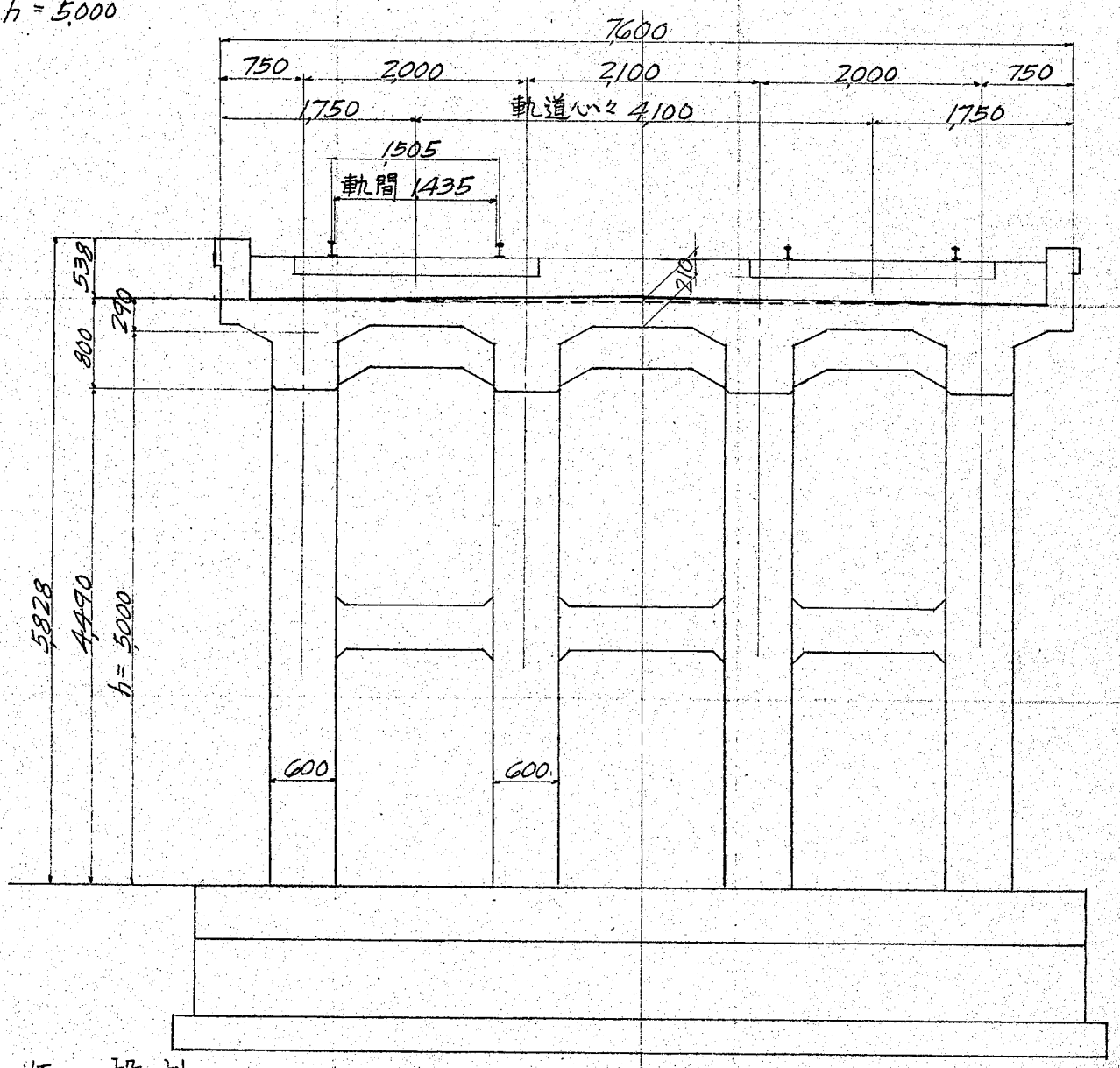
設計　日付　類別 64.5
照査　日付　第　/　頁

鐵筋混凝土高架橋

複線電車軌道(60瓲電車)
支間 6.000 四脚式両腕付拱形ラーメン
h = 5.000



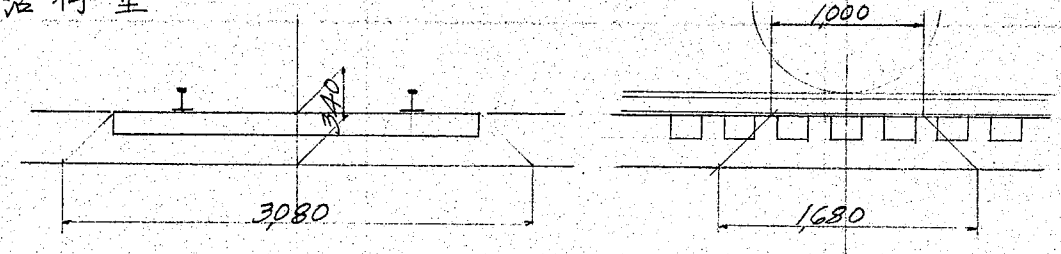
床版，設計

死荷重

軌道	600 ÷ 2.40	=	250 kg/m
道床	1.000 × 0.26 × 1,900	=	494 〃
床版	1.000 × 0.21 × 2,400	=	504 〃
			1,248 〃 之ヲ 1,250 kg/m トス

死荷重彎曲率　$1/10 \times 1{,}250 \times 2.00^2 = 500$ kgm
死荷重剪力　$1/2 \times 1{,}250 \times 2.00 = 1{,}250$ kg

活荷重



16,500 ÷ (3,080 × 1,680) = 3,190 kg/m²

活荷重彎曲率　$1/10 \times 3{,}190 \times 2.00^2 = 1{,}275$ kgm
活荷重剪力　$1/2 \times 3{,}190 \times 2.00 = 3{,}190$ kg

衝撃係数　$i = \frac{20}{50+L} = \frac{20}{52} = 0.385$

衝撃荷重彎曲率　1,275 × 0.385 = 491 kgm
衝撃荷重剪力　3,190 × 0.385 = 1,228 kg

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設計　日付　類別 Gh5
照査　日付　第　2頁

鐵筋混凝土高架橋

	彎曲率	剪力
死荷重	500	1,250
活荷重	1,275	3,190
衝撃	491	1,228
	2,266 Kgm	5,668 Kg

所要厚 $d=\sqrt{\frac{M}{bK}}=\sqrt{\frac{2266\ 100}{100\times 7.13}}=17.8$ cm

使用有効厚 18.0 cm 被覆 3.0 cm 床版厚 21 cm

所要鉄筋量 $A_s=\frac{M}{f_s j d}=\frac{2,266\times 100}{1,200\times 7/8\times 18.0}=12.0$ cm²

使用量 16 mmϕ 丸鋼 15 cm ヘ 2　6.66 × 2.01 = 13.4 cm²

$p=\frac{A_s}{bd}=\frac{13.4}{100\times 18.0}=0.00745$　$K=0.373$, $j=0.875$

$f_s=\frac{M}{A_s j d}=\frac{2266\times 100}{13.4\times 0.875\times 18.0}=1,073$ kg/cm²

$f_c=\frac{2M}{jKbd^2}=\frac{2\times 2,266\times 100}{0.875\times 0.373\times 100\times 18.0^2}=42.8$ kg/cm²

$s=\frac{S}{bjd}=\frac{5,668}{100\times 0.875\times 28.0}=2.3$ kg/cm²

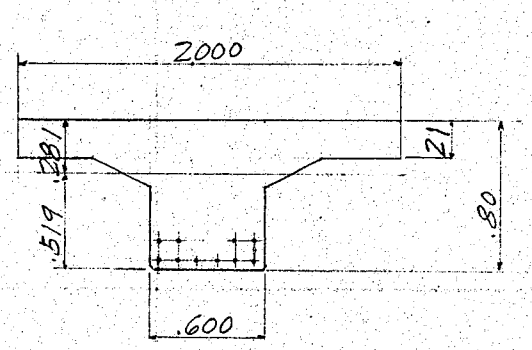
ラーメン，設計

死荷重

軌道			=	600 kg/m
道床	0.276	× 3.55 × 1,900	=	1,860 〃
床版	0.21	× 3.85 × 2,400	=	1,940 〃
側壁	0.25	× 3.58 × 2,400	=	215 〃
〃	0.05	× .20 × 2,400	=	24 〃
持送	2e 0.15	× .30 × 2,400	=	216 〃
主桁	2e 0.60	× .59 × 2,400	=	1,700 〃
				6,555 〃 桁一本＝付 3,300 kg/m トス

假定斷面

主桁



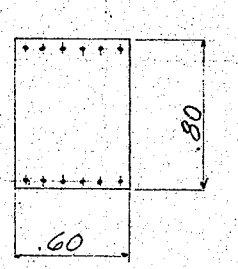
中立軸ノ位置

2.00 × .21	= 0.42 × .70	=	0.294
.60 × .59	= 0.35 × .30	=	0.105
.30 × .15	= 0.045 × .54	=	0.024
	0.815	.519	0.423

物量力率

$0.42\times .176^2+\frac{200\times 21^3}{12}=0.0145$
$0.35\times .224^2+\frac{.60\times .59^3}{12}=0.0279$
$0.045\times .021^2+\frac{.30\times 15^3}{18}=0.0001$
$0.0425\ m^4$

主柱



物量力率

$\frac{.60\times .80^3}{12}=0.0256\ m^4$

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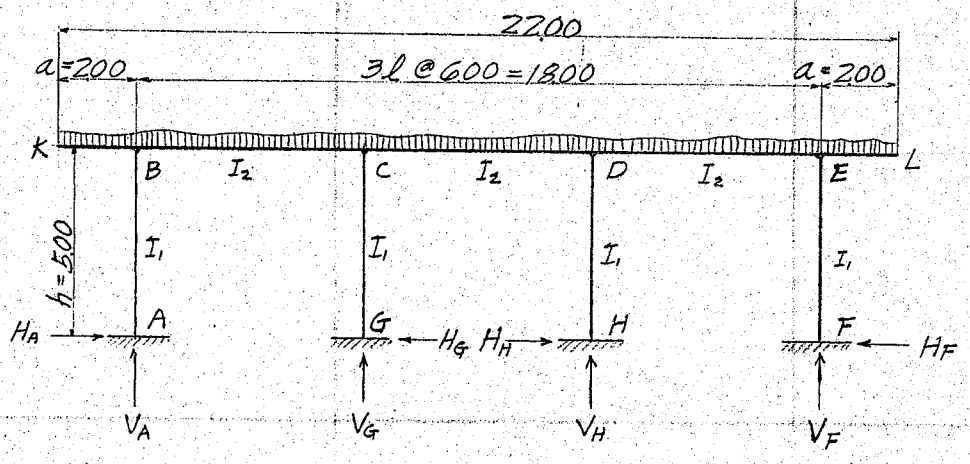
鐵筋混凝土高架橋



$K_1 = \frac{I_1}{h}$　$K_2 = \frac{I_2}{l}$

$$\begin{cases} M_{BA} = 2EK_1(2\theta_B - 3R) \\ M_{BC} = 2EK_2(2\theta_B + \theta_C) - C_{BC} \\ M_{BK} = m_{BK} \end{cases}$$

$$\begin{cases} M_{CB} = 2EK_2(2\theta_C + \theta_B) + C_{CB} \\ M_{CG} = 2EK_1(2\theta_C - 3R) \\ M_{CD} = 2EK_2(2\theta_C + \theta_D) - C_{CD} \end{cases}$$

$$\begin{cases} M_{DC} = 2EK_2(2\theta_D + \theta_C) + C_{DC} \\ M_{DE} = 2EK_2(2\theta_D + \theta_E) - C_{DE} \\ M_{DH} = 2EK_1(2\theta_D - 3R) \end{cases}$$

$$\begin{cases} M_{ED} = 2EK_2(2\theta_E + \theta_D) + C_{ED} \\ M_{EF} = 2EK_1(2\theta_E - 3R) \\ M_{EL} = -m_{EL} \end{cases}$$

$$\begin{aligned} M_{AB} &= 2EK_1(\theta_B - 3R) \\ M_{GC} &= 2EK_1(\theta_C - 3R) \\ M_{HD} &= 2EK_1(\theta_D - 3R) \\ M_{FE} &= 2EK_1(\theta_E - 3R) \end{aligned}$$

條件式

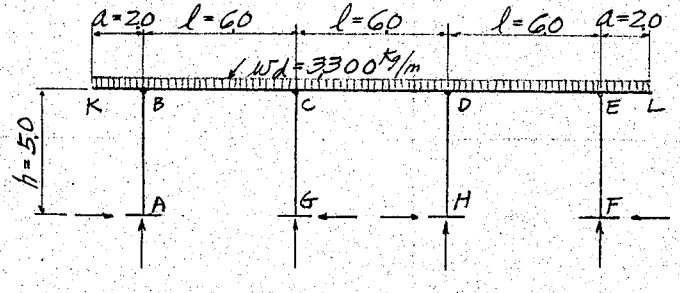
番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	$2(K_1+K_2)$	K_2			$-3K_1$	=	$(C_{BC}-m_{BK})/2E$
2	K_2	$2(K_1+2K_2)$	K_2		$-3K_1$	=	$(C_{CD}-C_{CB})/2E$
3		K_2	$2(K_1+2K_2)$	K_2	$-3K_1$	=	$(C_{DE}-C_{DC})/2E$
4			K_2	$2(K_1+K_2)$	$-3K_1$	=	$(m_{EL}-C_{ED})/2E$
5	K_1	K_1	K_1	K_1	$-8K_1$	=	0

$I_1 = 0.0256\ m^4$, $I_2 = 0.0425\ m^4$, $h = 5.00^m$, $l = 6.00^m$

$K_1 = \frac{I_1}{h} = 0.00512$, $K_2 = \frac{I_2}{l} = 0.00708$, $2(K_1+K_2) = 0.0244$, $2(K_1+2K_2) = 0.03856$
$8K_1 = 0.04096$, $3K_1 = 0.01536$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	0.0244	0.00708			-0.01536	=	$C_{BC}-m_{BK}$
2	0.00708	0.03856	0.00708		-0.01536	=	$C_{CD}-C_{CB}$
3		0.00708	0.03856	0.00708	-0.01536	=	$C_{DE}-C_{DC}$
4			0.00708	0.0244	-0.01536	=	$m_{EL}-C_{ED}$
5	0.00512	0.00512	0.00512	0.00512	-0.04096	=	0

死荷重応力



$w_d = 3{,}300$ kg/m

荷重項 $C_{BC} = C_{CB} = C_{CD} = C_{DC} = C_{DE} = C_{ED} = \frac{3300 \times 6^2}{12} = 9{,}900$ kgm

$m_{BK} = m_{EL} = \frac{3300 \times 2.0^2}{2} = 6{,}600$ kgm

$C_{BC} - m_{BK} = 3{,}300$ kgm

$\theta_B = -\theta_E$, $\theta_C = -\theta_D$, $R = 0$

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鐵筋混凝土高架橋

$Q_B = 144,672$, $Q_C = -32,541$

$M_{BA} = 0.00512 \times (2 \times 144,672) = 1,482$ kgm
$M_{BC} = 0.00708 \times (289,344 - 32,541) - 9,900 = -8,082$ kgm
$M_{BK} = 6,600$ kgm

$M_{CB} = 0.00708 \times (-65,082 + 144,672) + 9,900 = 10,464$ kgm
$M_{CG} = 0.00512 \times (-65,082) = -333$ kgm
$M_{CD} = 0.00708 \times (-65,082 + 32,541) - 9,900 = -10,131$ kgm

$M_{AB} = 0.00512 \times (144,672) = 741$ kgm
$M_{GC} = 0.00512 \times (-32,541) = -167$ kgm

弯曲率

$M_{AB} = 741$ kgm　$M_{GC} = -167$ kgm　$M_{CD} = -10,131$ kgm
$M_{BA} = -1,482$ kgm　$M_{CG} = 333$ kgm　$M_{BC} = -8,082$ kgm
$M_{BK} = -6,600$ kgm　$M_{CB} = -10,464$ kgm

垂直反力

$$V_A = \frac{-10,464 + 8,082}{6} + 3,300 \times 5.0 = 16,104 \text{ kg}$$

$$V_G = \frac{10,464 - 8,082}{6} + 3,300 \times 6.0 = 20,196 \text{ kg}$$

水平反力

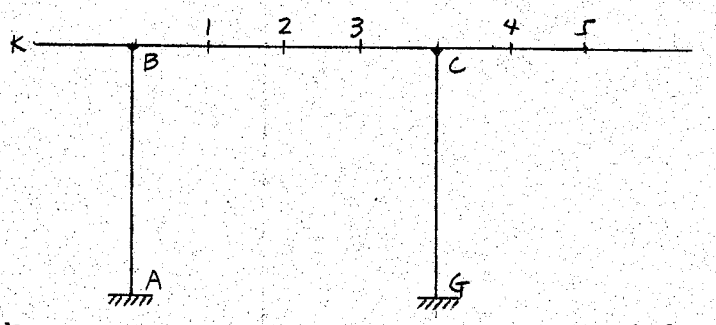
$$H_A = \frac{741 + 1482}{5} = 445 \text{ kg} \longrightarrow$$

$$H_G = \frac{167 + 333}{5} = 100 \text{ kg} \longleftarrow$$

剪力

$S_{BK} = -3,300 \times 2.0 = -6,600$ kg
$S_{BC} = 16,104 - 6,600 = 9,504$ kg
$S_{CB} = 9,504 - 3,300 \times 6.0 = -10,296$ kg
$S_{CD} = -10,296 + 20,196 = 9,900$ kg
$S_{BA} = -445$ kg
$S_{AB} = -445$ kg
$S_{GC} = +100$ kg
$S_{GC} = +100$ kg

格点弯曲率



格点 1　$11,140 - 8,082 - \frac{10,464 - 8,082}{4} = 2,462$ kgm
格点 2　$14850 - 8,082 - \frac{10,464 - 8,082}{2} = 5,576$ kgm
格点 3　$11,140 - 8,082 - \frac{3(10,464 - 8,082)}{4} = 1,271$ kgm
格点 4　$11,140 - 10,131 = 1,009$ kgm

格点單桁弯曲率

桁中央　$\frac{3,300 \times 6.0^2}{8.0} = 14,850$ kgm
1/4 点　$\frac{3 \times 3300 \times 6.0^2}{32} = 11,140$ kgm

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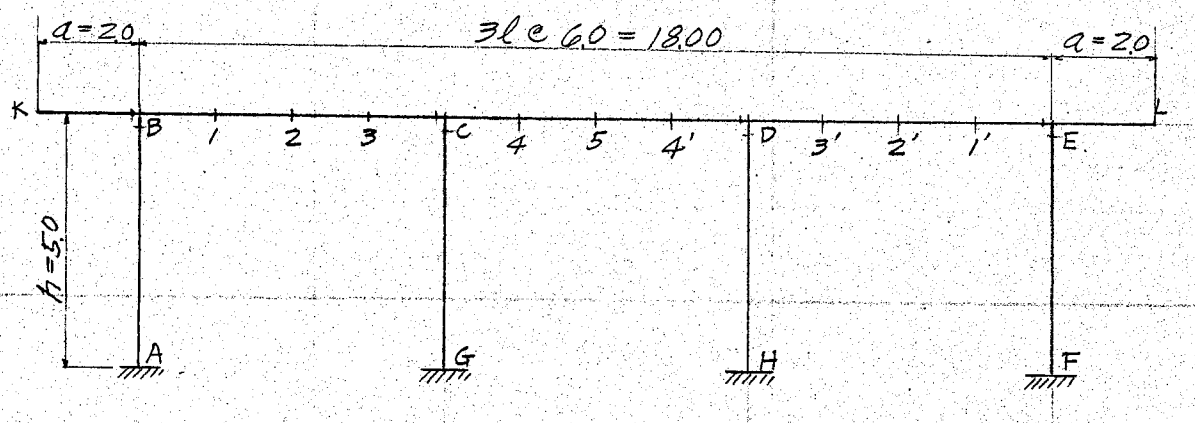
鐵筋混凝土高架橋

格点5　14,850 − 10,131 = 4,719 kgm

活荷重



1) 荷重1kgがK点=作用せん場合

$m_{BK} = 2.0$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	0.0244	0.00708			-0.01536	=	-2.0
2	0.00708	0.03856	0.00708		-0.01536	=	0
3		0.00708	0.03856	0.00708	-0.01536	=	0
4			0.00708	0.0244	-0.01536	=	0
5	0.00512	0.00512	0.00512	0.00512	-0.04096	=	0

$\theta_B = -93.1'$　$\theta_C = 13.7'$　$\theta_D = -6.1'$　$\theta_E = -5.4'$　$R = -11.4'$

$M_{BA} = 0.00512 \times (-18.62 + 34.2) = -0.078$
$M_{BC} = 0.00708 \times (-18.62 + 13.7) = -1.222$
$M_{BK} = 2.000$

$M_{CB} = 0.00708 \times (27.4 - 93.1) = -0.465$
$M_{CG} = 0.00512 \times (27.4 + 34.2) = 0.315$
$M_{CD} = 0.00708 \times (27.4 - 6.1) = 0.150$

$M_{DC} = 0.00708 \times (-12.2 + 13.7) = 0.011$
$M_{DE} = 0.00708 \times (-12.2 - 5.4) = -0.124$
$M_{DH} = 0.00512 \times (-12.2 + 34.2) = 0.113$

$M_{ED} = 0.00708 \times (-10.8 - 6.1) = -0.120$
$M_{EF} = 0.00512 \times (-10.8 + 34.2) = 0.120$
$M_{EL} = 0$

$M_{AB} = 0.00512 \times (-93.1 + 34.2) = -0.302$
$M_{GC} = 0.00512 \times (13.7 + 34.2) = 0.245$
$M_{HD} = 0.00512 \times (-6.1 + 34.2) = 0.144$
$M_{FE} = 0.00512 \times (-5.4 + 34.2) = 0.147$

単位彎曲率

$M_{BA} = 0.778$　$M_{CB} = 0.465$　$M_{DC} = -0.011$　$M_{ED} = +0.120$
$M_{BC} = -1.222$　$M_{CG} = -0.315$　$M_{DE} = -0.124$　$M_{EF} = +0.120$
$M_{BK} = -2.000$　$M_{CD} = 0.150$　$M_{DH} = 0.113$　$M_{EL} = 0$

$M_{AB} = -0.302$　$M_{HD} = -0.144$
$M_{GC} = 0.245$　$M_{FE} = -0.147$

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鐵筋混凝土高架橋

單位垂直力

$$V_A = 1.000 + \frac{1.222 + 0.465}{6.0} = 1.281\ kg$$

$$V_G = \frac{-1.222 - 0.465}{6.0} + \frac{-0.150 - 0.011}{6.0} = -0.308\ kg$$

$$V_H = \frac{0.150 + 0.011}{6.0} + \frac{0.124 + 0.120}{6.0} = 0.068\ kg$$

$$V_F = \frac{-0.124 - 0.120}{6.0} = -0.041\ kg$$

水平反力

$$H_A = \frac{0.778 + 0.302}{5.0} = 0.216\ kg \leftarrow$$

$$H_G = \frac{0.315 + 0.245}{5.0} = 0.112\ kg \rightarrow$$

$$H_H = \frac{0.113 + 0.144}{5.0} = 0.051\ kg \rightarrow$$

$$H_F = \frac{0.120 + 0.147}{5.0} = 0.053\ kg \rightarrow$$

剪力

$S_{BK} = -1.000\ kg$
$S_{BC} = 1.281 - 1.000 = 0.281\ kg$
$S_{CB} = 0.281$
$S_{CD} = 0.281 - 0.308 = -0.027\ kg$
$S_{DC} = -0.027\ kg$
$S_{DE} = -0.027 + 0.068 = 0.041\ kg$
$S_{ED} = 0.041\ kg$
$S_{BA} = 0.216\ kg$
$S_{AB} = 0.216\ kg$
$S_{CG} = -0.112\ kg$
$S_{GC} = -0.112\ kg$
$S_{DH} = -0.051\ kg$
$S_{HD} = -0.051\ kg$
$S_{EF} = -0.053\ kg$
$S_{FE} = -0.053\ kg$

2) 荷重 1 kg が 1 点 = 作用セル場合

$C_{BC} = PKl(1-K)^2 = 0.844$
$C_{CB} = PK^2l(1-K) = 0.281$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	0.00244	0.00708			-0.01536	=	0.844
2	0.00708	0.03856	0.00708		-0.01536	=	-0.281
3		0.00708	0.03856	0.00708	-0.01536	=	0
4			0.00708	0.00244	-0.01536	=	0
5	0.00512	0.00512	0.00512	0.00512	-0.04096	=	0

$\theta_B = 41.2$　$\theta_C = -14.0$　$\theta_D = 3.9$　$\theta_E = 1.4$　$R = 4.1$

$M_{BA} = 0.00512 \times (82.4 - 12.3) = 0.360$
$M_{BC} = 0.00708 \times (82.4 - 14.0) - 0.844 = -0.360$

$M_{CB} = 0.00708 \times (-28.0 + 41.2) + 0.281 = 0.375$
$M_{CG} = 0.00512 \times (-28.0 - 12.3) = -0.205$
$M_{CD} = 0.00708 \times (-28.0 + 3.9) = -0.170$

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鐵筋混凝土高架橋

$M_{DC} = 0.00708 \times (7.8 - 14.0) = -0.043$
$M_{DE} = 0.00708 \times (7.8 + 14) = 0.066$
$M_{DH} = 0.00512 \times (7.8 - 12.3) = -0.023$

$M_{ED} = 0.00708 \times (2.8 + 3.9) = 0.048$
$M_{EF} = 0.00512 \times (2.8 - 12.3) = -0.048$

$M_{AB} = 0.00512 \times (41.2 - 12.3) = 0.148$
$M_{GL} = 0.00512 \times (-14.0 - 12.3) = -0.135$
$M_{HD} = 0.00512 \times (3.9 - 12.3) = -0.043$
$M_{FE} = 0.00512 \times (1.4 - 12.3) = -0.056$

單位弯曲率

$M_{BA} = -0.360$　$M_{CB} = -0.375$　$M_{DC} = 0.043$　$M_{ED} = -0.048$
$M_{BC} = -0.360$　$M_{CG} = 0.205$　$M_{DE} = 0.066$　$M_{EF} = -0.048$
$M_{CD} = -0.170$　$M_{DH} = -0.023$

$M_{AB} = 0.148$　$M_{HD} = +0.043$
$M_{GC} = -0.135$　$M_{FE} = +0.056$

單位垂直力

$$V_A = \frac{0.360 - 0.375 + 1 \times 4.5}{6.0} = 0.748 \text{ kg}$$

$$V_G = \frac{-0.360 + 0.375 + 0.170 + 0.043 + 1 \times 1.5}{6.0} = 0.288 \text{ kg}$$

$$V_H = \frac{-0.170 - 0.043 - 0.066 - 0.048}{6.0} = -0.055 \text{ kg}$$

$$V_F = \frac{0.066 + 0.048}{6.0} = 0.019 \text{ kg}$$

水平支力

$$H_A = \frac{0.360 + .148}{5.0} = 0.102 \longrightarrow$$

$$H_G = \frac{0.205 + 0.135}{5.0} = 0.068 \longleftarrow$$

$$H_H = \frac{0.023 + 0.043}{5.0} = 0.013 \longleftarrow$$

$$H_F = \frac{0.048 + 0.056}{5.0} = 0.021 \longleftarrow$$

剪力

$S_{BC} = 0.748$ kg
$S_{CB} = 0.748 - 1.000 = -0.252$ kg
$S_{CD} = -0.252 + 0.288 = 0.036$ kg
$S_{DC} = 0.036$ kg
$S_{DE} = 0.036 - 0.055 = -0.019$ kg
$S_{ED} = -0.019$ kg
$S_{BA} = -0.102$ kg
$S_{AB} = -0.102$ kg
$S_{CG} = 0.068$ kg
$S_{GC} = 0.068$ kg
$S_{DH} = 0.013$ kg
$S_{HD} = 0.013$ kg
$S_{EF} = 0.021$ kg
$S_{FE} = 0.021$ kg

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鐵筋混凝土高架橋

3) 荷重 1kg が 2 点 = 作用セル場合

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	0.0244	0.00708			-0.01536	=	0.75
2	0.00708	0.03856	0.00708		-0.01536	=	-0.75
3		0.00708	0.03856	0.00708	-0.01536	=	0
4			0.00708	0.0244	-0.01536	=	0
5	0.00512	0.00512	0.00512	0.00512	-0.04096	=	0

$C_{BC} = C_{CB} = 0.750$

$\theta_B = 40.0$　$\theta_C = -27.0$　$\theta_D = 5.9$　$\theta_E = -0.3$　$R = 2.3$

○ $M_{BA} = 0.00512 \times (80.0 - 6.90) = 0.375$
$M_{BC} = 0.00708 \times (80.0 - 27.0) - 0.75 = -0.375$

○ $M_{CB} = 0.00708 \times (-54.0 + 40.0) + 0.75 = 0.652$
○ $M_{CG} = 0.00512 \times (-54.0 - 6.9) = -0.311$
$M_{CD} = 0.00708 \times (-54.0 + 5.9) = -0.341$

○ $M_{DC} = 0.00708 \times (11.8 - 27.0) = -0.107$
$M_{DE} = 0.00708 \times (11.8 - 0.3) = 0.082$
$M_{DH} = 0.00512 \times (11.8 - 6.9) = 0.025$

○ $M_{ED} = 0.00708 \times (-0.6 + 5.9) = 0.038$
$M_{EF} = 0.00512 \times (-0.6 - 6.9) = -0.038$

$M_{AB} = 0.00512 \times (40.0 - 6.9) = 0.169$
$M_{GC} = 0.00512 \times (-27.0 - 6.9) = -0.174$
○ $M_{HD} = 0.00512 \times (5.9 - 6.9) = -0.005$
○ $M_{FE} = 0.00512 \times (-0.3 - 6.9) = -0.037$

單位彎曲率

$M_{BA} = -0.375$　$M_{CB} = -0.652$　$M_{DC} = 0.107$　$M_{ED} = -0.038$
$M_{BC} = -0.375$　$M_{CG} = 0.311$　$M_{DE} = 0.082$　$M_{EF} = -0.038$
$M_{CD} = -0.341$　$M_{DH} = +0.025$

$M_{AB} = 0.169$　$M_{HD} = +0.005$
$M_{GC} = -0.174$　$M_{FE} = +0.037$

單位垂直力

$$V_A = \frac{0.375 - 0.652 + 1 \times 30}{6.0} = 0.454$$

$$V_G = \frac{-0.375 + 0.652 + 0.341 + .107 \times 1 \times 30}{6.0} = 0.621$$

$$V_H = \frac{-0.341 - 0.107 - 0.082 - 0.038}{6.0} = -0.095$$

$$V_F = \frac{0.082 + 0.038}{6.0} = 0.020$$

水平反力

$$H_A = \frac{0.375 + 0.169}{5.0} = 0.109 \longrightarrow$$

$$H_G = \frac{0.311 + 0.174}{5.0} = 0.097 \longleftarrow$$

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$$H_H = \frac{0.025-0.005}{5.0} = 0.004 \longrightarrow$$

$$H_F = \frac{0.038+0.037}{5.0} = 0.015 \longleftarrow$$

剪力

$S_{BC} = 0.454$
$S_{CB} = 0.454 - 1.00 = -0.546$
$S_{CD} = -0.546 + 0.621 = 0.075$
$S_{DC} = 0.075$
$S_{DE} = 0.075 - 0.095 = -0.020$
$S_{ED} = -0.020$
$S_{BA} = S_{AB} = -0.109$
$S_{CG} = S_{GC} = 0.097$
$S_{DH} = S_{HD} = -0.004$
$S_{EF} = S_{FE} = 0.015$

4) 荷重1kgが3点ニ作用セル場合

$C_{BC} = 0.281$
$C_{CB} = 0.844$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	0.0244	0.00708			-0.01536	=	0.281
2	0.00708	0.03856	0.00708		-0.01536	=	-0.844
3		0.00708	0.03856	0.00708	-0.01536	=	0
4			0.00708	0.0244	-0.01536	=	0
5	0.00512	0.00512	0.00512	0.00512	-0.04096	=	0

$\theta_B = 18.8 \quad \theta_C = -26.5 \quad \theta_D = 5.0 \quad \theta_E = -1.8 \quad R = -0.6$

$M_{BA} = 0.00512 \times (37.6 + 1.8) = 0.202$
$M_{BC} = 0.00708 \times (37.6 - 26.5) - 0.281 = -0.202$

$M_{CB} = 0.00708 \times (-53.0 + 18.8) + 0.844 = 0.602$
$M_{CG} = 0.00512 \times (-53.0 + 1.8) = -0.262$
$M_{CD} = 0.00708 \times (-53.0 + 5.0) = -0.340$

$M_{DC} = 0.00708 \times (10.0 - 26.5) = -0.118$
$M_{DE} = 0.00708 \times (10.0 - 1.8) = 0.058$
$M_{DH} = 0.00512 \times (10.0 + 1.8) = 0.060$

$M_{ED} = 0.00708 \times (-3.6 + 5.0) = 0.009$
$M_{EF} = 0.00512 \times (-3.6 + 1.8) = -0.009$

$M_{AB} = 0.00512 \times (18.8 + 1.8) = 0.101$
$M_{GC} = 0.00512 \times (-26.5 + 1.8) = -0.126$
$M_{HD} = 0.00512 \times (5.0 + 1.8) = 0.035$
$M_{FE} = 0.00512 \times (-1.8 + 1.8) = 0$

單位彎曲率

$M_{BA} = -0.202$　$M_{BC} = -0.202$
$M_{CB} = -0.602$　$M_{CG} = 0.262$　$M_{CD} = -0.340$
$M_{DC} = 0.118$　$M_{DE} = 0.058$　$M_{DH} = +0.060$
$M_{ED} = -0.009$　$M_{EF} = -0.009$

$M_{AB} = 0.101$　$M_{GC} = -0.126$
$M_{HD} = -0.035$　$M_{FE} = 0$

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鐵筋混凝土高架橋

單位垂直力

$$V_A = \frac{0.202 - 0.602 + 1 \times 1.5}{6.0} = 0.183$$

$$V_G = \frac{-0.202 + 0.602 + 0.340 + 0.118 + 1 \times 4.5}{6.0} = 0.893$$

$$V_H = \frac{-0.340 - 0.118 - 0.058 - 0.009}{6.0} = -0.087$$

$$V_F = \frac{0.058 + 0.009}{6.0} = 0.011$$

水平反力

$$H_A = \frac{0.202 + 0.101}{5.0} = 0.061 \longrightarrow$$

$$H_G = \frac{0.262 + 0.126}{5.0} = 0.078 \longleftarrow$$

$$H_H = \frac{0.060 + 0.035}{5.0} = 0.019 \longrightarrow$$

$$H_F = \frac{0.009}{5.0} = 0.002 \longleftarrow$$

剪　力

- $S_{BC} = 0.183$
- $S_{CB} = 0.183 - 1.00 = -0.817$
- $S_{CD} = -0817 + 0.893 = 0.076$
- $S_{DC} = 0.076$
- $S_{DE} = 0.076 - 0.087 = -0.011$
- $S_{ED} = -0.011$
- $S_{BA} = S_{AB} = -0.061$
- $S_{CG} = S_{GC} = 0.078$
- $S_{DH} = S_{HD} = -0.019$
- $S_{EF} = S_{FE} = 0.002$

5) 荷重1㎏が4点に作用せる場合

$C_{CD} = 0.844$
$C_{DC} = 0.281$

番號	θ_B	θ_C	θ_D	θ_E	R		荷重項
1	0.0244	0.00708			-0.01536	=	0
2	0.00708	0.03856	0.00708		-0.01536	=	0844
3		0.00708	0.03856	0.00708	-0.01536	=	-0281
4			0.00708	0.0244	-0.01536	=	0
5	0.00512	0.00512	0.00512	0.00512	-0.04096	=	0

$\theta_B = -6.6$　$\theta_C = 25.9$　$\theta_D = -12.3$　$\theta_E = 4.5$　$R = 1.4$

- $M_{BA} = 0.00512 \times (-13.2 - 4.2) = -0.090$
  $M_{BC} = 0.00708 \times (-13.2 + 25.9) = 0.090$

- $M_{CB} = 0.00708 \times (51.8 - 6.6) = 0.320$
- $M_{CG} = 0.00512 \times (51.8 - 4.2) = 0.244$
  $M_{CD} = 0.00708 \times (51.8 - 12.3) - 0.844 = -0.564$

- $M_{DC} = 0.00708 \times (-24.6 + 25.9) + 0.281 = 0.290$
  $M_{DE} = 0.00708 \times (-24.6 + 4.5) = -0.142$
  $M_{DH} = 0.00512 \times (-24.6 - 4.2) = -0.148$

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鐵筋混凝土高架橋

$M_{ED} = 0.00708 \times (9.0 - 12.3) = -0.024$
$M_{EF} = 0.00512 \times (9.0 - 4.2) = 0.024$

$M_{AB} = 0.00512 \times (-6.6 - 4.2) = -0.055$
$M_{GC} = 0.00512 \times (25.9 - 4.2) = 0.111$
$M_{HD} = 0.00512 \times (-12.3 - 4.2) = -0.084$
$M_{FE} = 0.00512 \times (4.5 - 4.2) = 0.002$

單位彎曲率

$M_{BA} = 0.090$　$M_{CB} = -0.320$　$M_{DC} = -0.290$　$M_{ED} = 0.024$
$M_{BC} = 0.090$　$M_{CG} = -0.244$　$M_{DE} = -0.142$　$M_{EF} = +0.024$
$M_{CD} = -0.564$　$M_{DH} = -0.148$

$M_{AB} = -0.055$　$M_{HD} = +0.084$
$M_{GC} = 0.111$　$M_{FE} = -0.002$

單位垂直力

$$V_A = \frac{-0.090 - 0.320}{6.0} = -0.068$$

$$V_G = \frac{0.090 + 0.320 + 0.564 - 0.290 + 1 \times 4.5}{6.0} = 0.864$$

$$V_H = \frac{-0.564 + 0.290 + 0.142 + 0.024 + 1 \times 1.5}{6.0} = 0.232$$

$$V_F = \frac{-0.142 - 0.024}{6.0} = -0.028$$

水平反力

$$H_A = \frac{0.090 + 0.055}{5.0} = 0.029 \leftarrow$$

$$H_G = \frac{0.244 + 0.111}{5.0} = 0.071 \rightarrow$$

$$H_H = \frac{0.148 + 0.084}{5.0} = 0.046 \leftarrow$$

$$H_F = \frac{0.024 + 0.002}{5.0} = 0.005 \rightarrow$$

剪力

$S_{BC} = S_{CB} = -0.068$
$S_{CD} = -0.068 + 0.864 = 0.796$
$S_{DC} = 0.796 - 1.00 = -0.204$
$S_{DE} = S_{ED} = -0.204 + 0.232 = 0.028$
$S_{BA} = S_{AB} = 0.029$
$S_{CG} = S_{GC} = -0.071$
$S_{DH} = S_{HD} = 0.046$
$S_{EF} = S_{FE} = -0.005$

6) 荷重 1kg が 5 点に作用せる場合

$C_{CD} = C_{DC} = 0.75$
$Q_B = -7.4$　$Q_C = 25.5$

$M_{BA} = 0.00512 \times (-14.8) = -0.076$
$M_{BC} = 0.00708 \times (-14.8 + 25.5) = 0.076$

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鐵筋混凝土高架橋

$M_{CB} = 0.00708 \times (510 - 74) = 0.309$
$M_{CG} = 0.00512 \times (510) = 0.261$
$M_{CD} = 0.00708 \times (510 - 255) - 075 = -0.570$

$M_{AB} = 0.00512 \times (-74) = -0.038$
$M_{GC} = 0.00512 \times (255) = 0.131$

單位彎曲率

$M_{BA} = 0.076$　$M_{CB} = -0.309$　$M_{AB} = -0.038$
$M_{BC} = 0.076$　$M_{CG} = -0.261$　$M_{GC} = 0.131$
$M_{CD} = -0.570$

單位垂直力

$$V_A = V_F = \frac{-0.076 - 0.309}{6.0} = -0.064$$

$$V_G = V_H = \frac{+0.076 + 0.309 + 1 \times 3.0}{6.0} = 0.564$$

水平反力

$$H_A = \frac{0.076 + 0.038}{5.0} = 0.023 \leftarrow$$

$$H_G = \frac{0.261 + 0.131}{5.0} = 0.078 \rightarrow$$

剪力

$S_{BC} = S_{CB} = -0.064$
$S_{CD} = -0.064 + 0.564 = 0.500$
$S_{BA} = S_{AB} = 0.023$
$S_{CG} = S_{GC} = 0.078$

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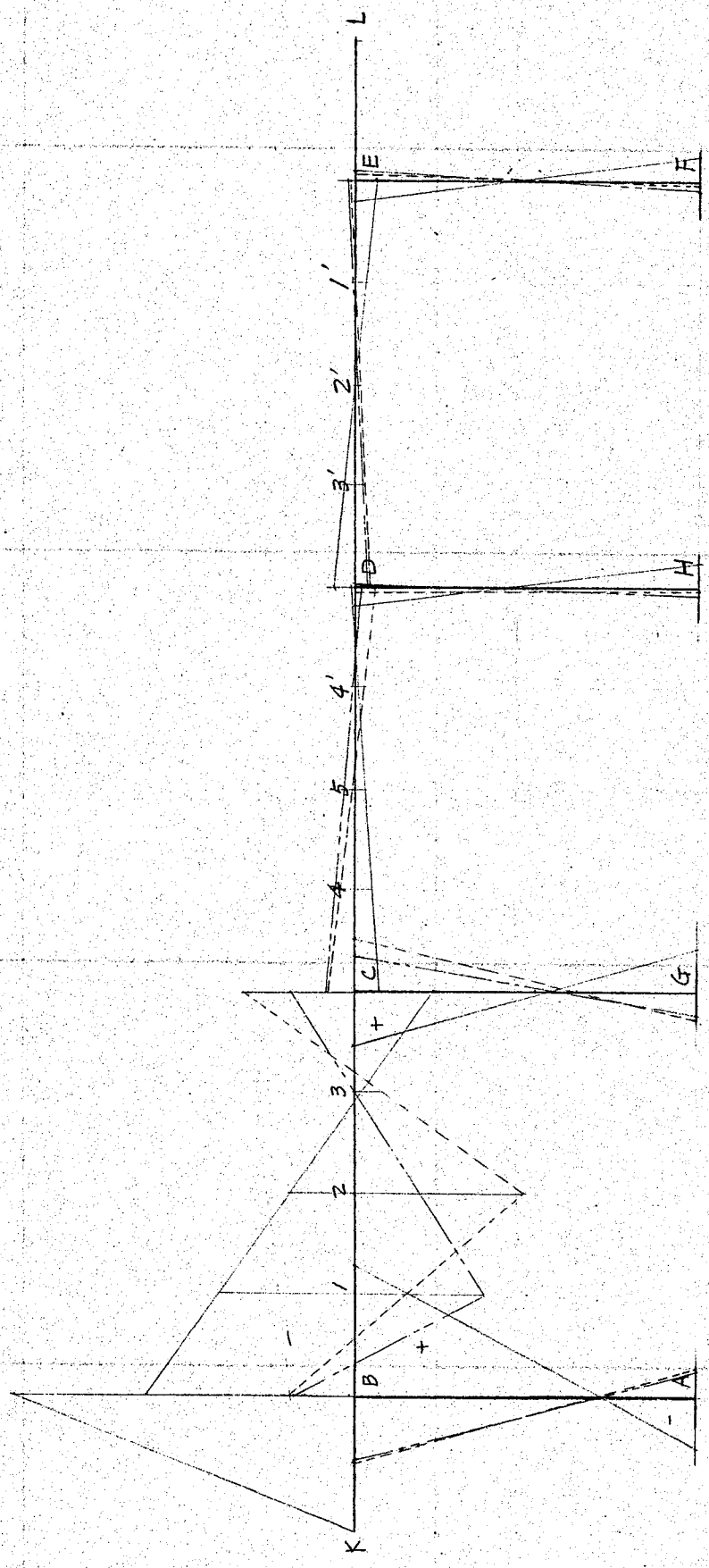
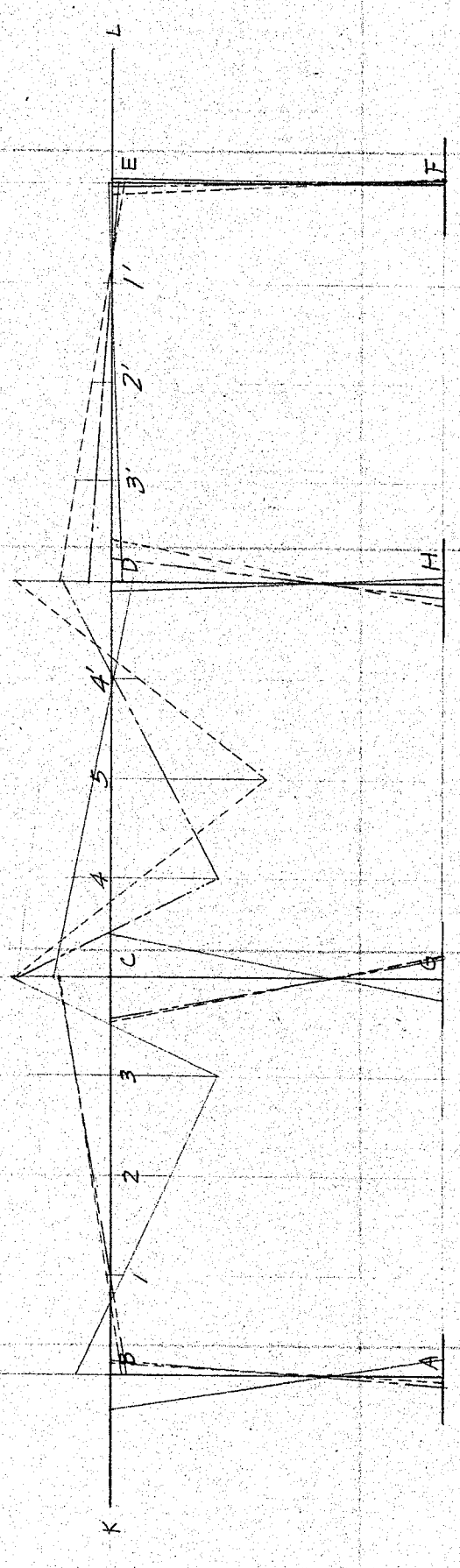
鐵筋混凝土高架橋





単位荷重ニヨル彎曲率圖表

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鉄筋混凝土高架橋

設計　日付　類別 G65
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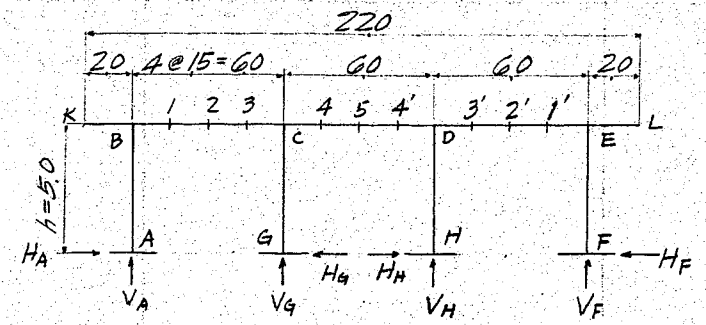
弯曲率，剪力及反力，影響面



弯曲率

載荷点	M_{BK}	M_{BC}	M_{BA}	M_1	M_2	M_3	M_{CB}	M_{CD}	M_{CG}	M_4	M_5	M_{AB}	M_{GC}
K	-2.000	-1.222	0.778	-0.800	-0.379	0.043	0.465	0.150	-0.315	0.110	0.070	-0.302	0.245
1	—	-0.360	-0.360	0.761	0.382	0.004	-0.375	-0.170	0.205	-0.117	-0.064	0.148	-0.135
2	—	-0.375	-0.375	0.306	0.987	0.167	-0.652	-0.341	0.311	-0.229	-0.117	0.169	-0.174
3	—	-0.202	-0.202	0.073	0.348	0.623	-0.602	-0.340	0.262	-0.226	-0.111	0.101	-0.126
4	—	0.090	0.090	-0.013	-0.115	-0.218	-0.320	-0.564	-0.244	0.629	0.323	-0.055	0.111
5	—	0.076	0.076	-0.020	-0.117	-0.213	-0.309	-0.570	-0.261	0.180	0.930	-0.038	0.131
4'	—	0.024	+0.024	-0.018	-0.058	-0.101	-0.142	-0.290	-0.148	0.017	0.323	-0.002	+0.084
3'	—	-0.009	-0.009	0.008	0.025	0.041	0.058	0.118	+0.060	0.003	-0.111	0	-0.035
2'	—	-0.038	-0.038	-0.008	0.022	0.052	0.082	0.107	+0.025	-0.005	-0.117	+0.037	+0.005
1'	—	-0.048	-0.048	-0.019	0.009	0.038	0.066	0.043	-0.023	-0.010	-0.064	+0.056	+0.043
L	—	0.120	+0.120	0.059	-0.002	-0.063	-0.124	-0.011	+0.113	0.029	0.070	-0.147	-0.144

反力

載荷点	V_A	V_G	H_A	H_G
K	1.281	-0.308	-0.216	-0.112
B	1.000	—	—	—
1	0.748	0.288	0.102	0.068
2	0.454	0.621	0.109	0.097
3	0.183	0.893	0.061	0.078
C	—	1.000	—	—
4	-0.068	0.864	-0.029	-0.071
5	-0.064	0.564	-0.023	-0.078
4'	-0.028	0.232	-0.005	-0.046
D	—	—	—	—
3'	0.011	-0.087	0.002	0.019
2'	0.020	-0.095	0.015	0.004
1'	0.019	-0.055	0.021	-0.013
E	—	—	—	—
L	-0.041	0.068	-0.053	0.051

剪力

載荷点	S_{BK}	S_{BC}	S_{CB}	S_{CD}	S_{AB}, S_{BA}	S_{CG}, S_{GC}
K	-1.000	0.281	0.281	-0.027	0.216	-0.112
B	-1.000	1.000	—	—	—	—
1	—	0.748	-0.252	0.036	-0.102	0.068
2	—	0.454	-0.546	0.075	-0.109	0.097
3	—	0.183	-0.817	0.076	-0.061	0.078
C	—	—	-1.000	1.000	—	—
4	—	-0.068	-0.068	0.796	0.029	-0.071
5	—	-0.064	-0.064	0.500	0.023	-0.078
4'	—	-0.028	-0.028	+0.204	+0.005	-0.046
D	—	—	—	—	—	—
3'	—	+0.011	+0.011	-0.076	-0.002	+0.019
2'	—	0.020	0.020	-0.075	-0.015	+0.004
1'	—	+0.019	+0.019	-0.036	-0.021	-0.013
E	—	—	—	—	—	—
L	—	-0.041	-0.041	0.027	0.053	0.051

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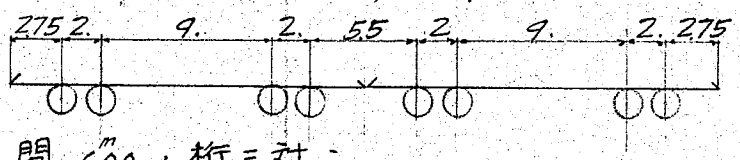
鐵筋混凝土高架橋

活荷重應力

60瓲電車 桁一本=付 7,500kg

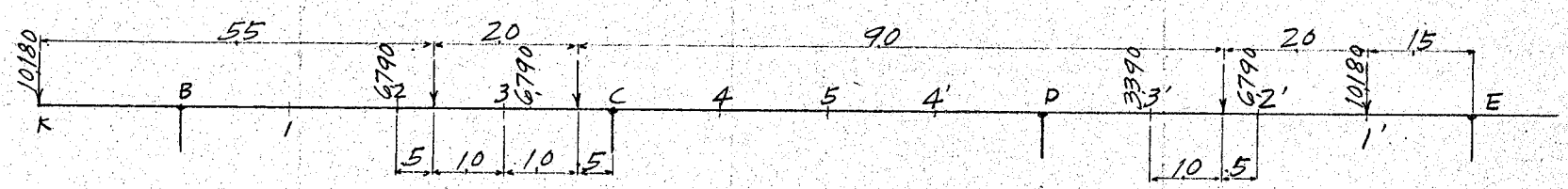


徑間 6.00, 桁=対シ
輪荷重　7,500
衝撃 $i = \frac{20}{50+6} = 35.7\%$　2,680
10,180kg

跳出腕=対シ
輪荷重　7,500
衝撃 $i = \frac{20}{50+2} = 38.5\%$　2,890
10,390kg

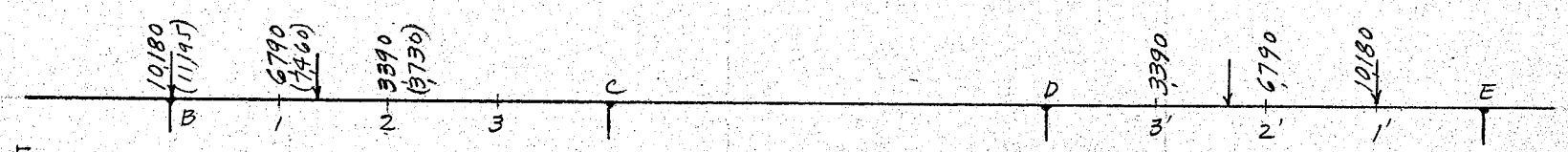
Bk 点
$M_{BK} = -2.000 \times 10,390 = -20,780$ kgm
$V_A = 2.281 \times 10,390 = 23,700$ kg
$S_{BK} = -1.000 \times 10,390 = -10,390$,

Bc 点
最大負弯曲率1起ル場合



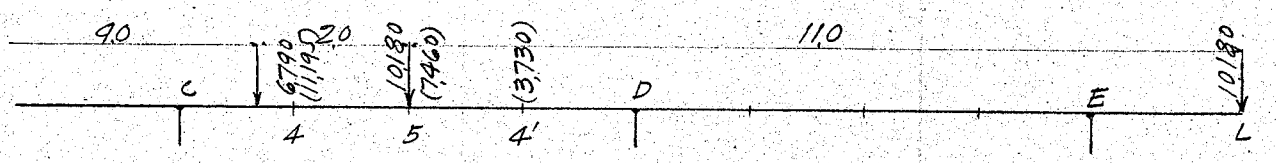
荷重点			−M	H_A
K	10,180	-1.222	-12450	-.216 -2,200
2	6,790	-.375	-2545	.109 740
3	6,790	-.202	-1,370	.061 414
3'	3,390	-.009	- 31	.002 7
2'	6,790	-.038	- 258	.015 102
1'	10,180	-.048	- 489	.021 214
			-17,143 kgm	-723 kg ←

最大剪力1起ル場合

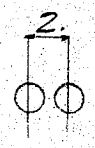


荷重点			S_{BC}	S_{BC}
B	10,180	1.000	10,180	11,195
1	6,790	.748	5,080	7,460 5,580
2	3,390	.454	1,540	3,730 1,694
3'	3,390	.011	37	
2'	6,790	.020	136	
1'	10,180	.019	194	
			17,167 kg	18,469 kg

最大正弯曲率1起ル場合



特殊荷重 桁一本=付 8,250kg



8,250
2,945
11,195kg

8,250
3,175
11,425kg

$M_{BK} = -2.000 \times 11,425 = -22,850$ kgm
$V_A = 2.281 \times 11,425 = 26,050$ kg
$S_{BK} = -1.000 \times 11,425 = -11,425$ kg
$H_A = -0.216 \times 11,425 = -2,467$ kg
$M_{AB} = -0.302 \times 11,425 = -3,450$ kg

	−M	H_A
11,195	-13,670	-2,417

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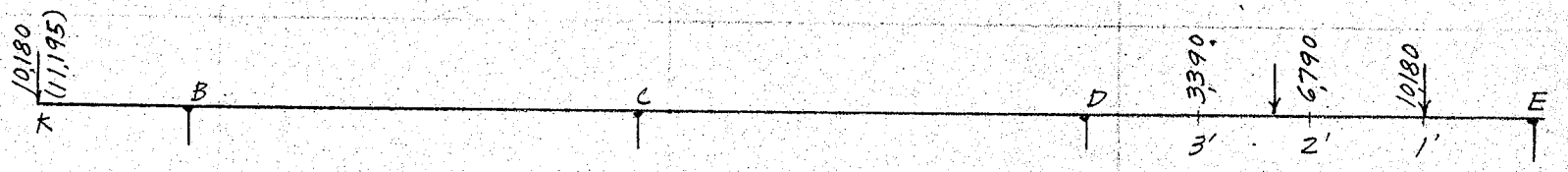
鐵筋混凝土高架橋

荷重車

			M		HA	M	
4	6,790	0.090	611	-.029	-197	11,195	1,007
5	10,180	.076	774	-.023	-234	7,460	567
4'	—	.024	—	-.005	—	3,730	90
L	10,180	.120	1,222	-.053	- 540		
			2,607 kgm		-971 kg		1,664 kg

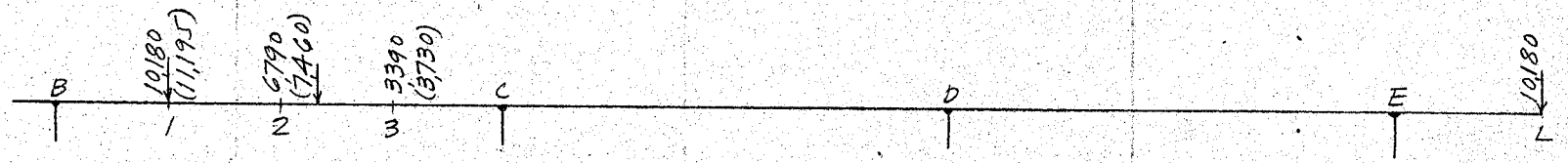
1 点
最大負彎曲率ノ起ル場合



荷重車

			-M		HA	-M	HA
K	10,180	-0.800	-8,150	-.216	-2,200	11,195 - 8,950	-2,420
3'	3,390	.008	27	.002	7		
2'	6,790	-.008	-54	.015	102		
1'	10,180	-.019	-193	.021	214		
			-8,370 kgm		-1,877 kg		

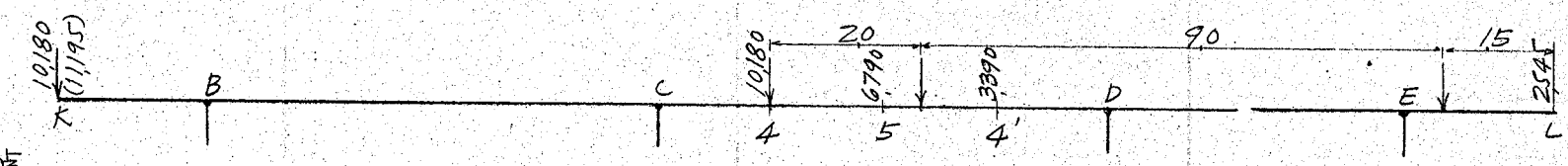
最大正彎曲率ノ起ル場合



荷重車

			M		HA	M	HA		S1
1	10,180	0.761	7,750	.102	1,038	11,195	8,510	1,142	0.748	8,370
2	6,790	.306	2,078	.109	740	7,460	2,282	813	0.454	3,390
3	3,390	.073	247	.061	207	3,730	272	228	0.183	682
L	10,180	.059	601	-.053	- 540					
			10,676 kgm		1,445 kg		11,064 kgm	2,183 kg		12,442 kg

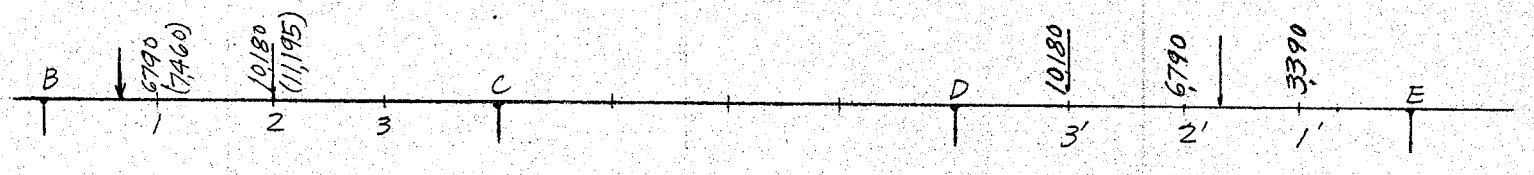
2 点
最大負彎曲率ノ起ル場合



荷重車

			-M		HA	-M	HA
K	10,180	-0.379	-3,860	-.216	-2,200	11,195 - 4,240	-2,418
4	10,180	-.115	-1,172	-.029	- 295		
5	6,790	-.117	-794	-.023	- 156		
4'	3,390	-.058	-197	-.005	- 17		
L	2,545	-.002	- 5	-.053	-135		
			-6,028 kgm		-2,803 kg		

最大正彎曲率ノ起ル場合



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電話大崎(49)0678番

設計　日付　類別 Gh5
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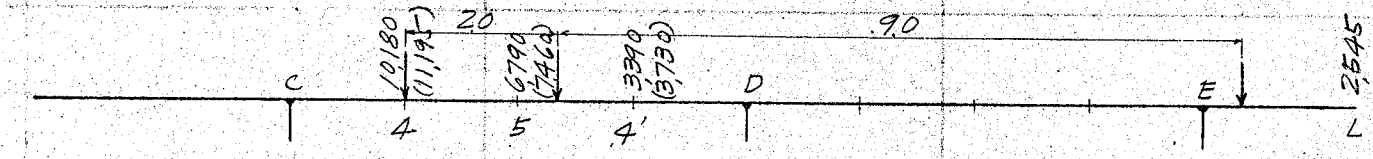
鐵筋混凝土高架橋

荷重表

			M		HA		M	HA
1	6,790	.382	2,595	0.102	692	7,460	2,850	761
2	10,180	.987	10,050	0.109	1,110	11,195	11,050	1,218
3'	10,180	.025	255	0.002	20			
2'	6,790	.022	149	0.015	102			
1'	3390	.009	31	0.021	71			
			13,080 kgm		1,995 kg		13,900 kg	1,979 kg

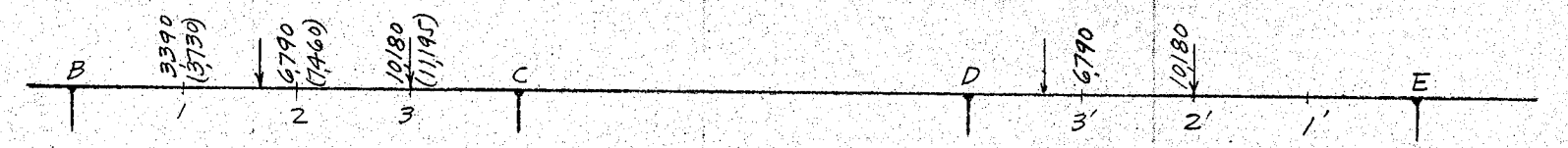
3 点
最大負曲率，起～場合



荷重表

			−M		HA		−M	HA
4	10,180	-0.218	-2,220	-0,029	-295	11,195	-2,440	-325
5	6,790	-0.213	-1,446	-0,023	-156	7,460	-1,588	-172
4'	3,390	-0.101	-342	-0,005	-17	3,730	-377	-19
L	2,545	-0,063	-160	-0,053	-135			
			-4,168 kgm		-603 kg		-4,405 kgm	-516 kg

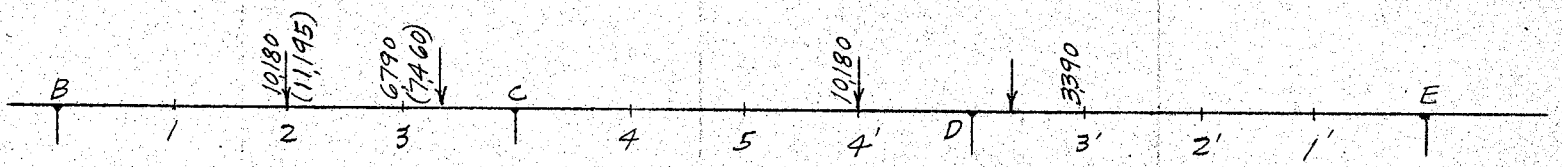
最大正曲率，起～場合



荷重表

			M		HA		M	HA		S
1	3,390	0.004	14	0.102	346	3,730	15	381	-0.252	-940
2	6,790	0.167	1,134	0.109	740	7,460	1,246	813	-0.546	-3,070
3	10,180	0.623	6,345	0.061	621	11,195	6,970	682	-0.817	-9,140
3'	6,790	0.041	279	0.002	14					
2'	10,180	0.052	530	0.015	153					
			8,302 kgm		1,874 kg		8,231 kgm	1,876 kg		-13,150 kg

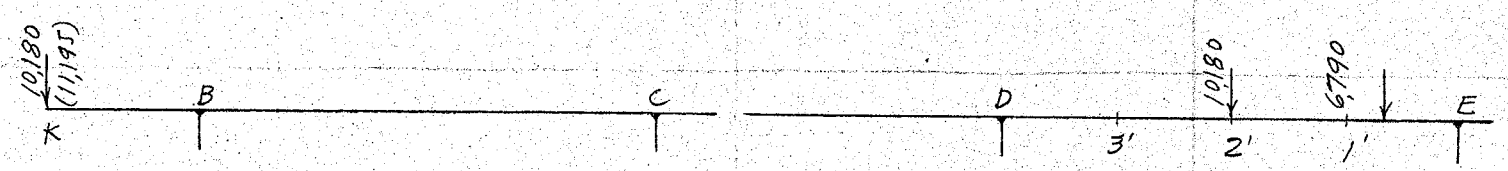
CB 点
最大負曲率，起～場合



荷重表

			−M		HA		−M
2	10,180	-0,652	-6,640	0,109	1,110	11,195	-7,285
3	6,790	-0,602	-4,090	0,061	414	7,460	-4,490
4'	10,180	-0,142	-1,446	-0,005	-51		
3'	3,390	0,058	197	0,002	7		
			-11,979 kgm		1,480 kg		-11,775

最大正曲率，起～場合



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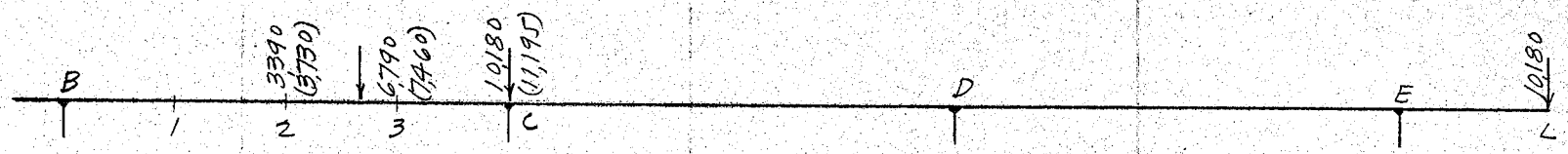
鐵筋混凝土高架橋

荷重表

			M		HA		M
K	10,180	0.465	4,735	-0.216	-2200	11,195	5,200
2'	10,180	0.082	835	0.015	153		
1'	6,790	0.066	448	0.021	143		
			6,018 kgm		-1,904 kg		

最大剪力，起～場合

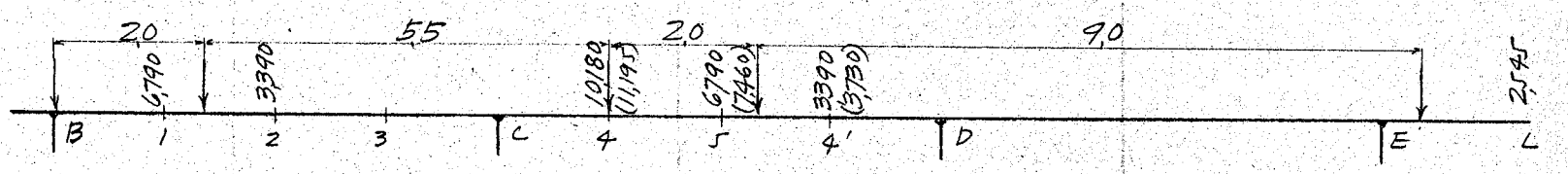


荷重表

			Scb		Scb
2	3390	-0.546	-1850	3730	-2038
3	6790	-0.817	-5550	7460	-6095
C	10,180	-1,000	-10,180	11,195	-11,195
L	10,180	-0.041	-418		
			-17,998 kg		-19,328 kg

Cd 表

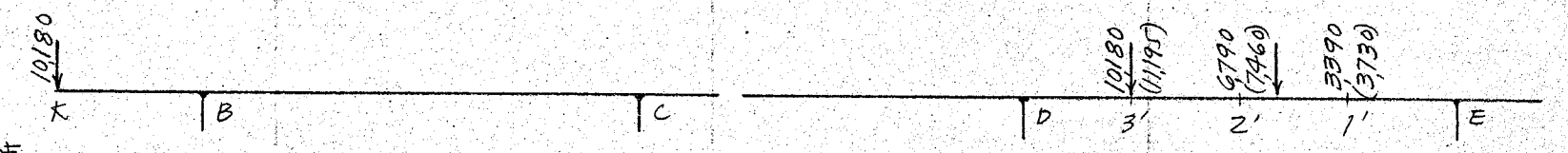
最大負彎曲率，起～場合



荷重表

			-M		N		-M
1	6,790	-0.170	-1,155	-0.034	-231		
2	3390	-0.341	-1,155	-0.012	-41		
4	10,180	-0.564	-5,740	-0.042	-427	11,195	-6310
5	6,790	-0.570	-3,870	-0.055	-373	7,460	-4,255
4'	3390	-0.290	-983	-0.041	-139	3,730	-1,082
L	2,545	-0.011	-28	0.104	265		
			-12,931 kgm		-946 kg		-11,647 kgm

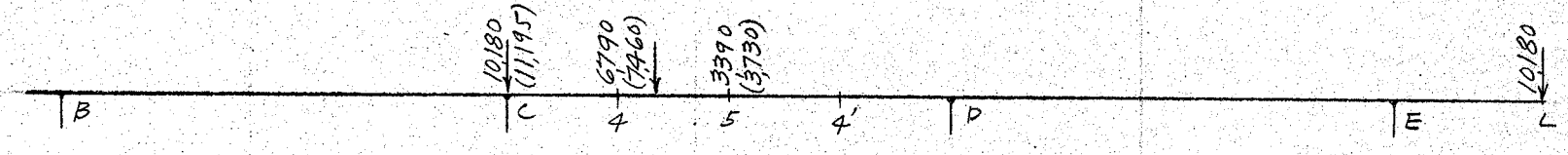
最大正彎曲率，起～場合



荷重表

			M		N		M
K	10,180	0.150	1,528	0.104	1,060		
3'	10,180	0.118	1,202	0.017	173	11,195	1,320
2'	6,790	0.107	727	-0.011	-75	7,460	798
1'	3,390	0.043	146	-0.034	-115	3,730	160
			3,603 kgm		1,043 kg		2,278 kgm

最大剪力，起～場合



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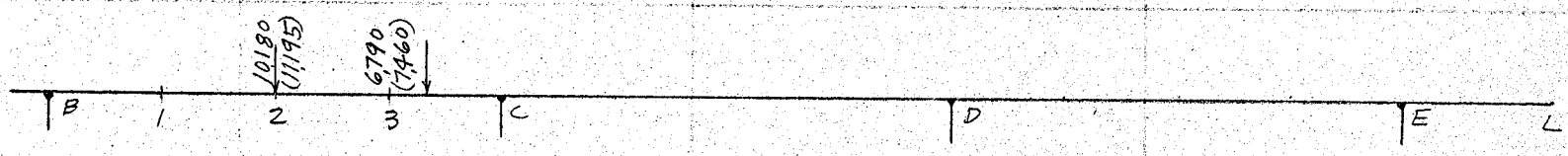
鐵筋混凝土高架橋

荷重表

			Sc0		Sc0
C	10,180	1.000	10,180	11,195	11,195
4	6,790	0.796	5,400	7,460	5,940
5	3,390	0.500	1,695	3,730	1,865
L	10,180	0.027	275		
			17,550 kg		19,000 kg

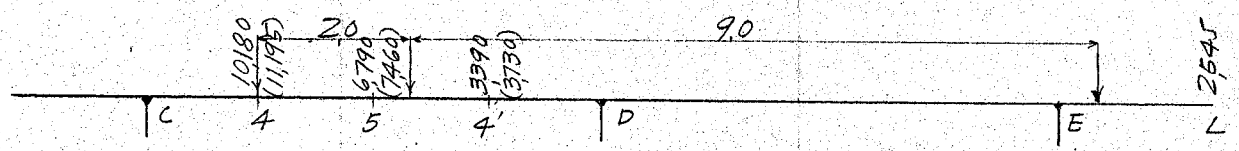
4点
最大負彎曲率，起ル場合



荷重表

			-M		N		-M	N
2	10,180	-0.229	-2,330	-0.012	-122	11,195	-2565	-134
3	6,790	-0.226	-1,535	0.017	116	7,460	-1,686	127
			-3,865 kgm		-6 kg		-4,251 kgm	-7 kg

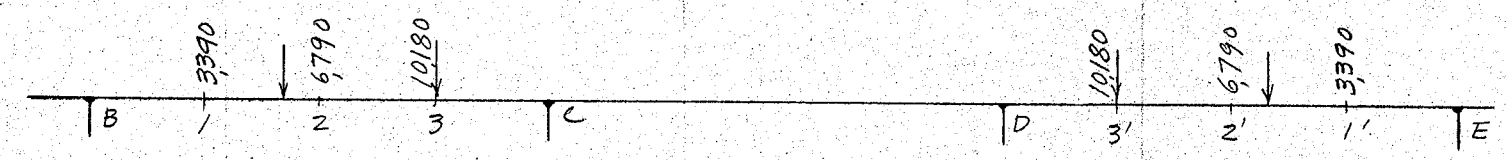
最大正彎曲率，起ル場合



荷重表

			M		N		M	N		S
4	10,180	0.629	6,410	-0.042	-428	11,195	7,040	-470	0.796	8,910
5	6,790	0.180	1,222	-0.055	-374	7,460	1,343	-410	0.500	3,730
4'	3,390	0.017	58	-0.041	-139	3,730	63	-153	0.204	761
L	2,545	0.029	74	0.104	265					
			7,764 kg		-676 kg		8,446 kgm	-1,033 kg		13,401 kg

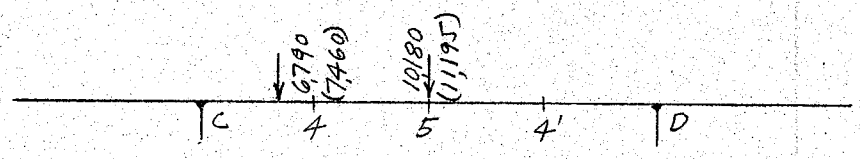
5点
最大負彎曲率，起ル場合



荷重表

			-M		N
3	10,180	-0.111	-1,130	0.017	173
2	6,790	-0.117	-794	-0.012	-82
1	3,390	-0.064	-217	-0.034	-115
			-2,141 × 2 = -4,282 kgm		-24 × 2 = -48 kg

最大正彎曲率，起ル場合



荷重表

			M		N
4	7,460	0.323	2,410	-0.042	-314
5	11,195	0.930	10,400	-0.055	-615
			12,810 kgm		-929 kg

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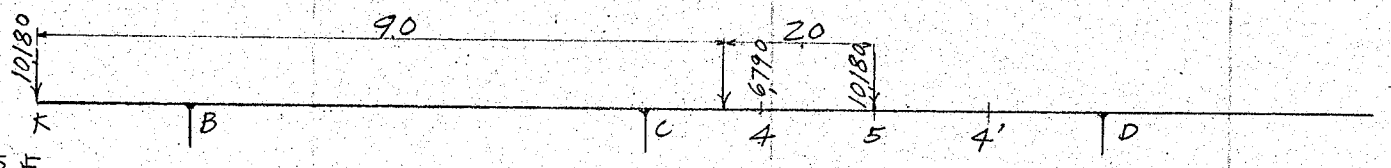
鐵筋混凝土高架橋

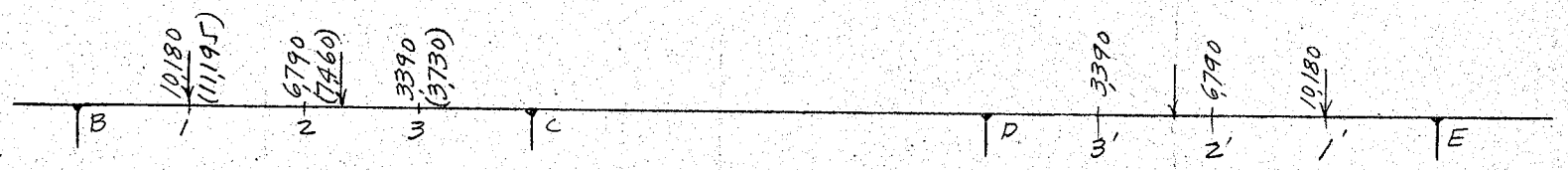
BA 桁
最大正曲率ノ起ル場合



荷重桁

			M		VA
A	10,180	0.778	7,930	1.281	13,050
4	6,790	0.090	611	-0.068	− 462
5	10,180	0.076	774	-0.064	− 652
			9315 tm		11,936 kg

最大負曲率ノ起ル場合



荷重桁

			-M		VA
1	11,195	-0.360	-4,030	0.748	8,370
2	7,460	-0.375	-2,800	0.454	3,388
3	3,730	-0.202	− 753	0.183	682
			-7,583 tm		12,440 kg

AB 桁
最大正曲率ノ起ル場合（BA桁ノ最大負曲率ノ起ル場合ト同ジ荷重狀態）

荷重桁

			M	VA		HA
1	11,195	0.148	1,657		0.102	1,142
2	7,460	0.169	1,260		0.109	813
3	3,730	0.101	377		0.061	228
			3,294 tm	12,440 kg		2,183 kg

最大負曲率ノ起ル場合（BA桁ノ最大正曲率ノ起ル場合ト同ジ荷重狀態）

荷重桁

			-M	VA
K	10,180	-0.302	-3,075	
4	6,790	-0.055	− 373	
5	10,180	-0.038	− 387	
			-3,835 tm	11,936 kg

VA ノ最大

荷重桁

			VA		MAB		VA	MAB		HA
K	10,180	1.281	13050	-0.302	-3,075	11,195	14330	-3,880	-0.216	-2,415
B	10,180	1.000	10,180	—	—	11,195	11,195		—	
3'	3390	0.011	37	0	—					
2'	6790	0.020	136	+0.037	− 251					
1'	10,180	0.019	194	+0.056	− 570					
			23,597 kg		-2,254 tm		25,525 kg	-3,880 tm		-2,415 kg

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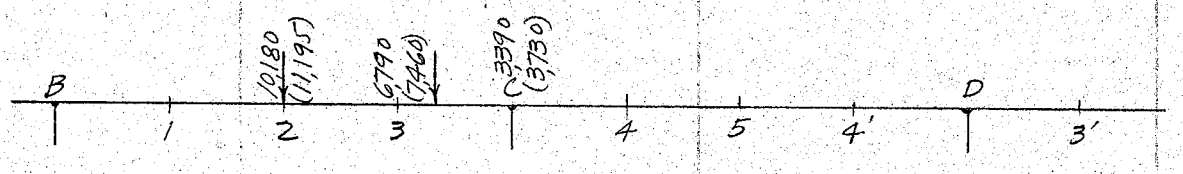
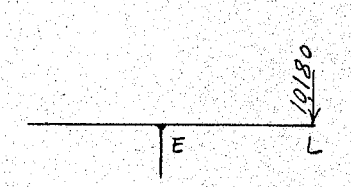
照査　日付　第 21 頁

鐵筋混凝土高架橋

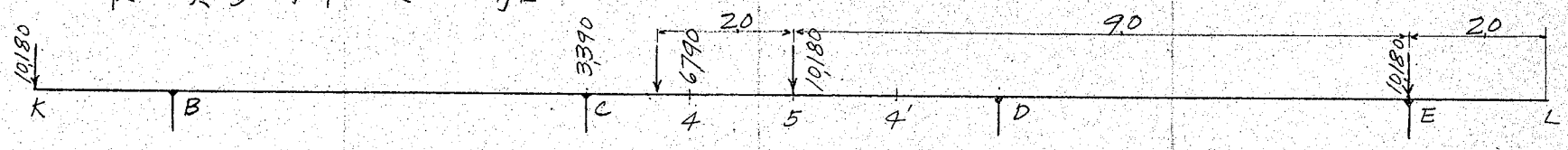
Cg 点 最大正弯曲率，起～場合





荷重点			M	Vg		M	Vg
2	10,180	0.311	3,165	0.621	6,320	11,195	3,480	6,950
3	6,790	0.262	1,780	0.893	6,065	7,460	1,955	6,660
C	3,390	—	—	1.000	3,390	3,730	—	3,730
L	10,180	0.113	1,150	0.232	2,362		5,435 kgm	17,340 kg
			6,095 kgm		18,137 kg			

最大負弯曲率，起～場合

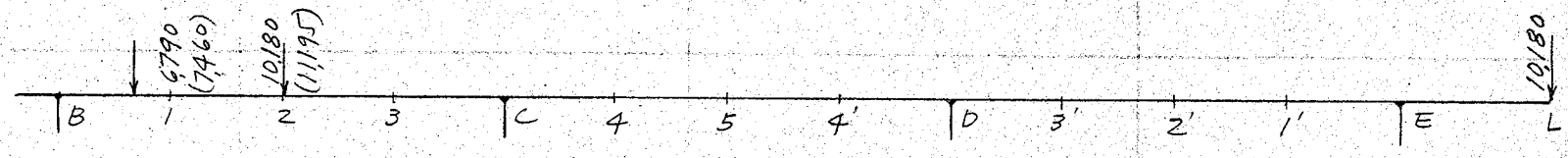


荷重点			-M	Vg
K	10,180	-0.315	-3,210	-0.308	-3,135
C	3,390	—	—	1.000	3,390
4	6,790	-0.244	-1,656	0.864	5,870
5	10,180	-0.261	-2,660	0.564	5,740
			-7,526 kgm		11,865 kg

Gc 点 最大正弯曲率，起～場合（Cg 点，最大負弯曲率ト同じ荷重状態）

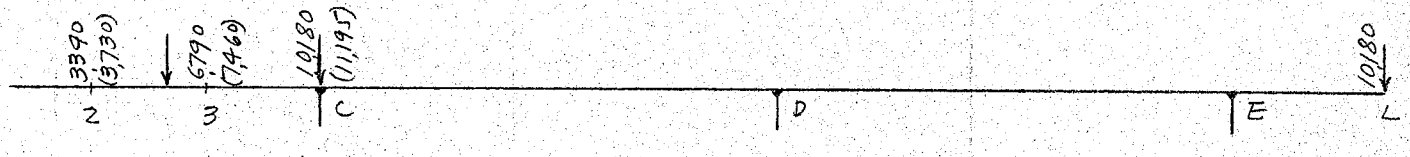
荷重点			M	Vg	Hg
K	10,180	0.245	2,495		-0.112	-1,140
C	3,390	—	—		—	—
4	6,790	0.111	754		-0.071	-482
5	10,180	0.131	1,334		-0.078	-794
			4,583 kgm	11,865 kg		-2,416 kg

最大負弯曲率，起～場合



荷重点			-M	Vg	M
1	6,790	-0.135	-917	0.288	1,955	7,460	-1,007
2	10,180	-0.174	-1,772	0.621	6,322	11,195	-1,946
L	10,180	-0.144	-1,466	0.232	2,363		
			-4,155 kgm		10,640 kg		-2953 kgm

Vg，最大



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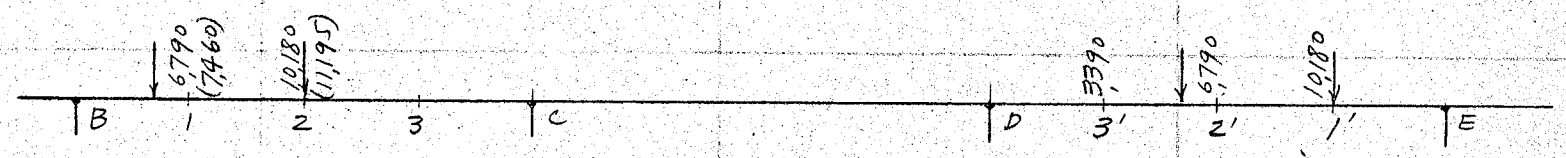
鐵筋混凝土高架橋

荷重表

			Vg		M		Vg	M		Hg
2	3390	0.621	2,105	+0.174	-590	3730	2317	-649	0.097	362
3	6790	0.893	6,060	-0.126	-856	7,460	6,660	-940	0.078	582
C	10,180	1.000	10,180	—	—	11,195	11,195	—	—	—
L	10,180	0.068	693	-0.144	-1466					
			19,038 kg		-2,912 kgm		20,172 kg	-1,589 kgm		944 kg

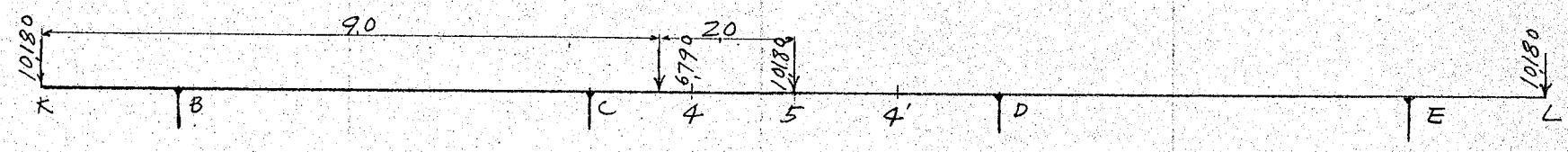
HA 及 SAB，最大



荷重表

1	6,790	0.102	693
2	10,180	0.109	1,110
3'	3390	0.002	7
2'	6,790	0.015	102
1'	10,180	0.021	213

H_A = 2,125 kg
S_{AB} = -2,125 kg

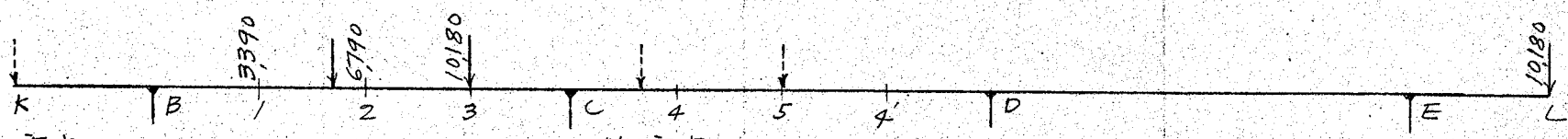


荷重表

K	10,180	-0.216	-2200
4	6,790	-0.029	- 197
5	10,180	-0.023	- 234
L	10,180	-0.053	- 540

H_A = -3,171 kg
S_{AB} = 3,171 kg

Hg 及 SGC，最大



荷重表

			Hg, SGC
1	3,390	0.068	231
2	6,790	0.097	658
3	10,180	0.078	794
L	10,180	0.051	519
			2,202 kg

荷重表

			Hg, SGC
K	10,180	-0.112	-1,140
4	6,790	-0.071	- 482
5	10,180	-0.078	- 794
			-2,416 kg

温度應力（温度上昇，場合）

温度，変化 $t = \pm 15°C$
膨張係数 $\varepsilon = 0.00001$

$K_1 = 0.00512$
$K_2 = 0.00708$

$$\begin{cases} M_{BA} = 2EK_1(2\theta_B - 3R_1) \\ M_{BC} = 2EK_2(2\theta_B + \theta_C) \end{cases}$$

$$M_{AB} = 2EK_1(\theta_B - 3R_1)$$
$$M_{GC} = 2EK_1(\theta_C - 3R_2)$$

$$\begin{cases} M_{CB} = 2EK_2(2\theta_C + \theta_B) \\ M_{CD} = 2EK_2\theta_C \\ M_{CG} = 2EK_1(2\theta_C - 3R_2) \end{cases}$$

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$$\theta_B = \frac{3\{K_1K_2R_2 - K_1(2K_1+3K_2)R_1\}}{K_2^2 - 2(K_1+K_2)(2K_1+3K_2)}$$

$$\theta_C = \frac{3\{K_1K_2R_1 - 2K_1(K_1+K_2)R_2\}}{K_2^2 - 2(K_1+K_2)(2K_1+3K_2)}$$

$K_1K_2 = 0.00512 \times 0.00708 = 0.0000363$
$(2K_1+3K_2) = (0.01024 + 0.02124) = 0.03148$
$K_1+K_2 = 0.00512 + 0.00708 = 0.0122$

$$R_1 = -\frac{3\varepsilon t l}{2h} = -\frac{3\times 0.00001\times 15\times 6.0}{2\times 5.0} = -0.00027$$

$$R_2 = -\frac{\varepsilon t l}{2h} = -\frac{0.00001\times 15\times 6.0}{2\times 5.0} = -0.00009$$

$$\theta_B = \frac{3\{0.0000363\times -0.00009 - 0.00512\times 0.03148\times -0.00027\}}{0.00708^2 - 2\times 0.0122\times 0.03148} = -0.000168$$

$$\theta_C = \frac{3\{0.0000363\times -0.00027 - 2\times 0.00512\times 0.0122\times -0.00009\}}{0.00708^2 - 2\times 0.0122\times 0.03148} = -0.000006$$

$M_{BA} = 2\times 1{,}400{,}000{,}000\times 0.00512\times(-0.000336 + 0.00081) = 6{,}800$ kgm
$M_{BC} = 2\times 1{,}400{,}000{,}000\times 0.00708\times(-0.000336 - 0.000006) = -6{,}800$ kgm

$M_{CB} = 2\times 1{,}400{,}000{,}000\times 0.00708\times(-0.000012 - 0.000168) = -3{,}580$ kgm
$M_{CD} = 2\times 1{,}400{,}000{,}000\times 0.00708\times(-0.000006) = -120$ kgm
$M_{CG} = 2\times 1{,}400{,}000{,}000\times 0.00512\times(-0.000012 + 0.00027) = 3{,}700$ kgm

$M_{AB} = 2\times 1{,}400{,}000{,}000\times 0.00512\times(-0.000168 + 0.00081) = 9{,}200$ kgm
$M_{GC} = 2\times 1{,}400{,}000{,}000\times 0.00512\times(-0.000006 + 0.00027) = 3{,}780$ kgm

格点彎曲率

$M_{BA} = -6{,}800$ kgm　$M_{CB} = 3{,}580$ kgm　$M_{AB} = 9{,}200$ kgm　$M_1 = -3{,}205$ kgm
$M_{BC} = -6{,}800$ kgm　$M_{CD} = -120$ kgm　$M_{GC} = 3{,}780$ kgm　$M_2 = -1{,}610$ kgm
$M_{CG} = -3{,}700$ kgm　$M_3 = 990$ kgm
$M_4 = M_5 = -120$ kgm

垂直力

$$V_A = \frac{6800 + 3{,}580}{6.0} = 1{,}730 \text{ kg}$$

$V_G = -1{,}730$ kg

水平反力

$$H_A = \frac{6800 + 9200}{5.0} = 3{,}200 \text{ kg} \rightarrow$$

$$H_G = \frac{3700 + 3780}{5.0} = 1{,}500 \text{ kg} \rightarrow$$

剪力

$S_{BC} = S_{CB} = 1{,}730$ kg
$S_{CD} = 0$
$S_{BA} = S_{AB} = -3{,}200$ kg
$S_{GC} = S_{CG} = -1{,}500$ kg

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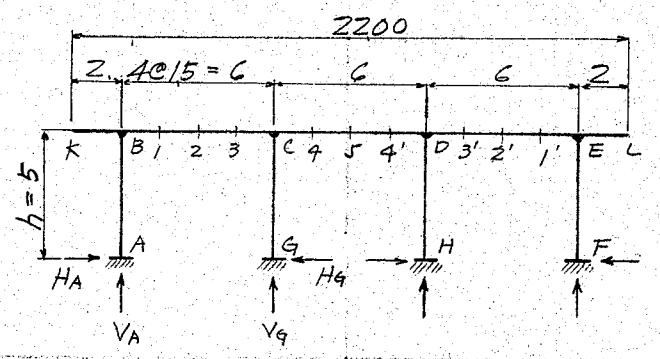
應力一括表



弯曲率（Kgm）及軸圧力（Kg）

	弯曲率	MBK	MBC	MBA	M1	M2	M3	MCB	MCD	MCG	M4	M5	MAB	MGC
最大正弯曲率	死荷重	-6600	-8082	-1482	2462	5576	1271	-10464	-10131	333	1009	4719	741	-167
	活荷重		2607	9315	11064	13900	8302	6018	3603	6095	8446	12810	3294	4583
	温度，変化		6800	6800	3205	1610	490	3580	120	3700	120	120	9200	3780
	合成應力		1325	14633	16731	21086	10563	-866	-6408	10128	9575	17644	13235	8196
	軸圧力													
	死荷重		445	16104	445	445	445	445	-345	20196	-345	-345	16104	20196
	活荷重		-971	11936	2183	1979	1874	-1904	1043	18137	-1033	-929	12440	11865
	温度，変化		-3200	-1730	-3200	-3200	3200	3200	4700	1730	4700	4700	1730	-1730
	合成應力		-3726	26310	-572	-776	5519	1741	5398	40063	3322	3426	30274	30331

	弯曲率	MBK	MBC	MBA	M1	M2	M3	MCB	MCD	MCG	M4	M5	MAB	MGC
最大負弯曲率	死荷重	-6600	-8082	-1482	2462	5576	1271	-10464	-10131	333	1009	4719	741	-167
	活荷重	-22850	-17143	-7583	-8950	-6028	-4405	-11979	-12931	-7526	-4251	-4282	-3835	-4155
	温度，変化	——	-6800	-6800	-3205	-1610	-490	-3580	-120	-3700	-120	-120	-9200	-3780
	合成應力	-29450	-32025	-15865	-9693	-2062	-4124	-26023	-23182	-10893	-3362	317	-12294	-8102
	軸圧力													
	死荷重		445	16104	445	445	445	445	-345	20196	-345	-345	16104	20196
	活荷重		-723	12440	-2420	-2803	-516	1480	-946	11865	-7	-48	11936	10640
	温度，変化		3200	1730	3200	3200	-3200	-3200	-4700	-1730	-4700	-4700	-1730	1730
	合成應力		2922	30274	1225	842	-3271	-1275	-5991	30331	-5052	-5093	26310	32566

最大反力及剪力

	VA	VG	HA	HG	SAB, SBA	SCG, SGC	SBK	SBC	SCB	SCD	S1	S3	S4
死荷重	16104	20196	445	100	-445	100	-6600	9504	-10296	9900	4554	-5346	4950
活荷重	26050	20172	2125	2202	-2125	2202	-11425	18469	-19328	19000	12442	-13150	13401
温度，変化	1730	1730	3200	1500	-3200	1500	—	1730	-1730	0	1730	-1730	0
合成應力	43884	42098	5770	3802	-5770	3802	-18025	29703	-31354	28900	18726	-20226	18351
	M	M	HA	HG	SAB, SBA	SCG, SGC							
死荷重	741	-167	445	100	-445	100							
活荷重	-3450	-1589	-3171	-2416	3171	-2416							
温度，変化	9200	-3780	-3200	-1500	3200	-1500							
合成應力	6491	-5536	-5926	-3816	5926	-3816							

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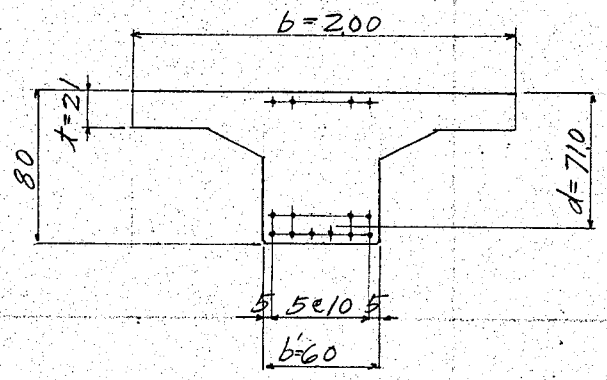
斷面，設計

2点　$M_2 = 21{,}086\ kgm$; $T = -776\ kg$

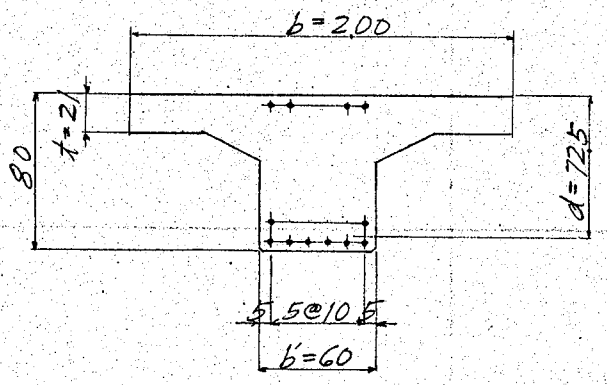


$A_s = 10 @ 19\phi = 10 @ 2.84 = 28.4\ cm^2$
$t = 21\ cm$, $d = 71\ cm$, $t/d = \frac{21}{71} = 0.296$, $b = 200\ cm$
$p = \frac{A_s}{bd} = \frac{28.4}{200 \times 71} = 0.002$
中立軸ハ突縁中ニアリ
$k = 0.218$, $j = 0.927$

$$f_s = \frac{M}{A_s j d} = \frac{21{,}086 \times 100}{28.4 \times 0.927 \times 71} = 1{,}127\ kg/cm^2$$

$$f_c = \frac{f_s k}{n(1-k)} = \frac{1{,}127 \times 0.218}{15 \times (1-0.218)} = 21.0\ kg/cm^2$$

5点　$M_5 = 17{,}649\ kgm$, $T = 3{,}426\ kg$

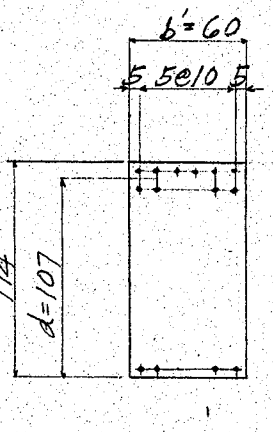


$A_s = 8 @ 19\phi = 8 @ 2.84 = 22.7\ cm^2$
$t = 21\ cm$, $d = 72.5\ cm$ $t/d = \frac{21}{72.5} = 0.290$, $b = 200\ cm$
$p = \frac{A_s}{bd} = \frac{22.7}{200 \times 72.5} = 0.00157$
中立軸ハ突縁中ニアリ
$k = 0.197$, $j = 0.934$

$$f_s = \frac{17{,}649 \times 100}{22.7 \times 0.934 \times 72.5} = 1{,}148\ kg/cm^2$$

$$f_c = \frac{1{,}148 \times 0.197}{15 \times (1-0.197)} = 18.8\ kg/cm^2$$

Bc点　$M_{BC} = -32{,}025\ kgm$, $T = 2{,}922\ kg$　$S_{BC} = 29{,}703\ kg$



$b = 60\ cm$, $d = 107\ cm$, $A_s = 10 @ 19\phi = 28.4\ cm^2$
$p = \frac{A_s}{bd} = \frac{28.4}{60 \times 107} = 0.00442$
$k = 0.304$, $j = 0.899$

$$f_s = \frac{32{,}025 \times 100}{28.4 \times 0.899 \times 107} = 1{,}173\ kg/cm^2$$

$$f_c = \frac{1{,}173 \times 0.304}{15 \times (1-0.304)} = 34.2\ kg/cm^2$$

$$S = \frac{S}{bjd} = \frac{29{,}703}{60 \times 0.899 \times 107} = 5.2\ kg/cm^2$$

肋鉄筋，最小間隔

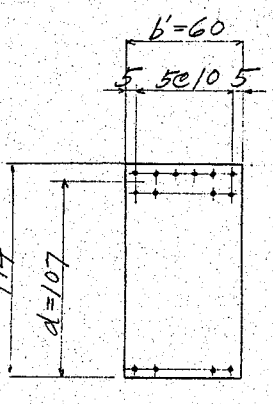
$$S' = \frac{A_s f_s j d}{S} \qquad A_s = 4 @ 12\phi = 4 @ 1.13 = 4.52\ cm^2$$

$$= \frac{452 \times 1200 \times 0.899 \times 107}{29{,}703} = 17.6\ cm\ c.\ to\ c.$$

附着力

$$\nu = \frac{S}{b_0 j d} = \frac{29{,}703}{59.7 \times 0.899 \times 107} = 5.2\ kg/cm^2 \qquad b_0 = 10 c 19\phi = 59.7\ cm$$

C点　$M_{CB} = -26{,}023\ kgm$, $T = -1{,}275\ kg$, $S_{CB} = 31{,}359\ kg$



$k = 0.304$, $j = 0.899$

$$f_s = \frac{26{,}023 \times 100}{28.4 \times 0.899 \times 107} = 953\ kg/cm^2$$

$$f_c = \frac{953 \times 0.304}{15 \times (1-0.304)} = 27.8\ kg/cm^2$$

肋鉄筋，最小間隔　$A_s = 4 c 12\phi = 4.52\ cm^2$

$$S' = \frac{452 \times 1200 \times 0.899 \times 107}{31{,}354} = 16.7\ cm\ c.to\ c.$$

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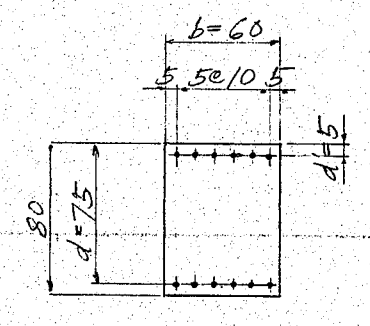
附着力

$$s = \frac{31354}{59.7 \times 0.899 \times 107} = 5.5\ \text{kg/cm}^2 \qquad b_0 = 59.7\ \text{cm}$$

柱 AB 端

$M = 13235\ \text{kgm}$　$N = 30274\ \text{kg}$，$S = 5926\ \text{kg}$



$d' = 5\ \text{cm}$，$d = 75\ \text{cm}$，$h = 80\ \text{cm}$

$A_s = 6\text{e}19^{\phi} = 6\text{e}2.84 = 17.05\ \text{cm}^2$

$e = 13235 \div 30274 = 43.8\ \text{cm}$

$e/h = 43.8 \div 80 = 0.548$

$$p = \frac{A_s}{bh} = \frac{17.05}{60 \times 80} = 0.00355$$

$$\frac{d'}{h} = \frac{5}{80} = 0.0625$$

$K = 0.472$，$C = 0.228$

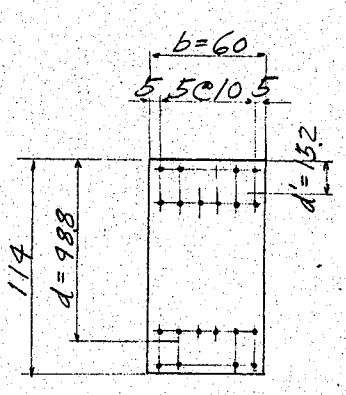
$$f_c = \frac{N}{bhC} = \frac{30274}{60 \times 80 \times 0.228} = 27.7\ \text{kg/cm}^2$$

$$f_s = n f_c \frac{1-K}{K} = 15 \times 27.7 \times \frac{0.528}{0.472} = 465\ \text{kg/cm}^2$$

$$s = \frac{5926}{60 \times 7/8 \times 75} = 1.5\ \text{kg/cm}^2$$

BA 端

$M = 15865\ \text{kgm}$，$N = 30274\ \text{kg}$，$S = 5926\ \text{kg}$



$d' = 15.2\ \text{cm}$，$d = 98.8\ \text{cm}$，$h = 114\ \text{cm}$

$A_s = 10\text{e}19^{\phi} = 10\text{e}2.84 = 28.4\ \text{cm}^2$

$e = 15865 \div 30274 = 52.5\ \text{cm}$

$e/h = 52.5 \div 114 = 0.46$

$$p = \frac{28.4}{60 \times 114} = 0.00473$$

$$\frac{d'}{h} = 15.2 \div 114 = 0.133$$

$K = 0.515$，$C = 0.262$

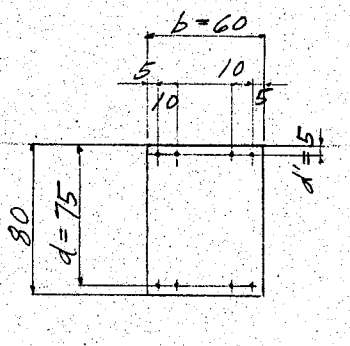
$$f_c = \frac{N}{bhc} = \frac{30274}{60 \times 114 \times 0.262} = 16.9\ \text{kg/cm}^2$$

$$f_s = n f_c \cdot \frac{1-K}{K} = 15 \times 16.9 \times \frac{0.485}{0.515} = 239\ \text{kg/cm}^2$$

$$s = \frac{5926}{60 \times 7/8 \times 98.8} = 1.1\ \text{kg/cm}^2$$

GC 端

$M = 8196\ \text{kgm}$，$N = 30331\ \text{kg}$，$S = 3816\ \text{kg}$



$d' = 5\ \text{cm}$，$d = 75\ \text{cm}$，$h = 80\ \text{cm}$

$A_s = 4\text{e}19^{\phi} = 4\text{e}2.84 = 11.4\ \text{cm}^2$

$e = 8196 \div 30331 = 27.0\ \text{cm}$

$e/h = 27.0 \div 80 = 0.34$

$$p = \frac{A_s}{bh} = \frac{11.4}{60 \times 80} = 0.00238$$

$d'/h = 0.0625$

$K = 0.635$，$C = 0.333$

$$f_c = \frac{30331}{60 \times 80 \times 0.333} = 19.0\ \text{kg/cm}^2$$

$$f_s = 15 \times 19.0 \times \frac{0.365}{0.635} = 164\ \text{kg/cm}^2$$

$$s = \frac{3816}{60 \times 7/8 \times 75} = 1.0\ \text{kg/cm}^2$$

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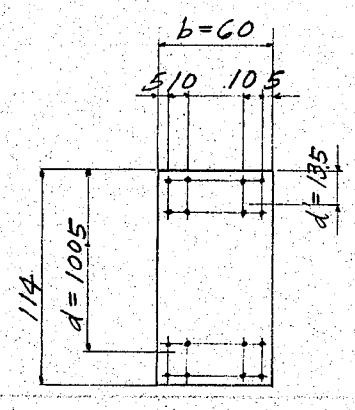
C G 矣



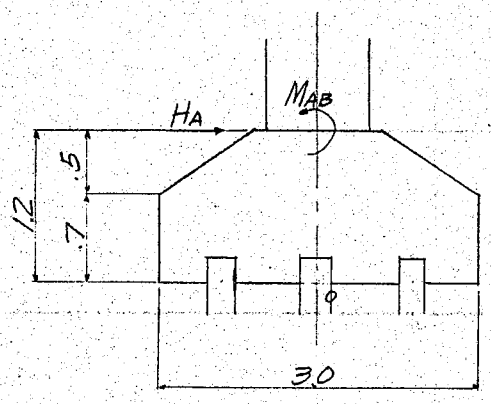
$M = 10{,}893\ kgm$, $N = 30{,}331\ kg$, $S = 3{,}816\ kg$
$d' = 13.5\ cm$, $d = 100.5\ cm$, $h = 114\ cm$
$A_s = 8\phi 19 = 8\phi 2.84 = 22.7\ cm^2$
$e = 10{,}893 \div 30{,}331 = 35.9\ cm$
$e/h = 35.9 \div 114 = 0.32$
$p = \dfrac{22.7}{60 \times 114} = 0.00332$
$d'/h = 13.5 \div 114 = 0.118$
$k = 0.665$, $c = 0.36$
$f_c = \dfrac{30{,}331}{60 \times 114 \times 0.36} = 123\ kg/cm^2$
$f_s = 15 \times 123 \times \dfrac{0.335}{0.665} = 93\ kg/cm^2$
$S = \dfrac{3{,}816}{60 \times 7/8 \times 100.5} = 0.7\ kg/cm^2$

基礎

A 矣	M_{AB} max.			V_A max.		
	M_{AB}	V_A	H_A	M_{AB}	V_A	H_A
死荷重	741	16,104	445	741	16,104	445
活荷重	3,294	12,440	2,183	-3,450	26,050	-2,467
温度,変化	9,200	1,730	3,200	9,200	1,730	3,200
合成應力	13,235	30,274	5,828	6,491	43,884	1,178

G 矣	M_{GC} max.			V_G max		
	M_{GC}	V_G	H_G	M_{GC}	V_G	H_G
死荷重	-167	20,196	100	-167	20,196	100
活荷重	4,583	11,865	-2,416	-1,589	20,172	944
温度,変化	3,780	-1,730	-1,500	-3,780	1,730	1,500
合成應力	8,196	30,331	-3,816	-5,536	42,098	2,544

基礎一柱分,重量



柱	.60 × .80 × 4.49	@ 2,400	= 5,170
土	.50 × 1.00 × 2.00	@ 1,600	= 1,600
基礎	.50 × 2.0 × 2.00	@ 2,400	= 4,800
〃	.70 × 3.0 × 2.00	@ 2,400	= 10,080
			V = 21,650 kg

O 矣ニ於ケル能率(最大彎曲率ノ場合)

V_A	30,274		
V	21,650		
H_A	-5,828	× 1.20	= -6,990
M_{AB}			= 13,235
	$\Sigma V = 51{,}924\ kg$		$\Sigma M = 6{,}245\ kgm$

$e = 6{,}245 \div 51{,}924 = 0.120\ m$

$P = \dfrac{51{,}924}{3.0 \times 2.0} \times \left(1 \pm \dfrac{6 \times .12}{3.0}\right) = 10{,}730\ kg/m^2$
$6{,}570\ kg/m^2$

O 矣ニ於ケル能率(最大無直力ノ場合)

V_A	43,884		
V	21,650		
H_A	-1,178	× 1.20	= -1,415
M_{AB}			= 6,491
	$\Sigma V = 65{,}534\ kg$		$\Sigma M = 5{,}076\ kgm$

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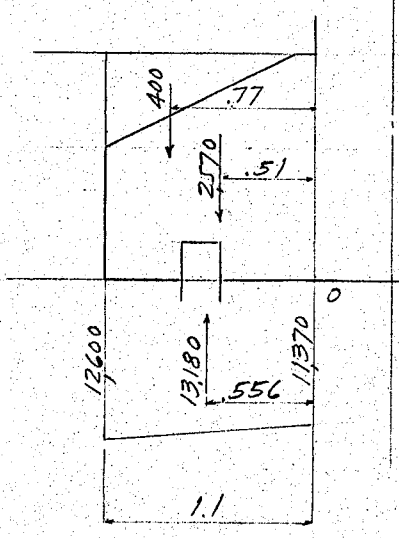

$e = 5,076 \div 65,534 = 0.077$

$$p = \frac{65,534}{3.0 \times 2.0} \times \left(1 \pm \frac{6 \times 0.077}{3.0}\right) = 12,600 \text{ kg/m}^2, \ 9,240 \text{ kg/m}^2$$

0 基 = 於ケ心 能率

13,180 × 0.556	=	7,330
− 2,570 × 0.51	= −	1,310
− 400 × 0.77	= −	310

$S = 10,210$ kg　　$M = 5,710$ kgm

所要厚 $d = \sqrt{\frac{M}{bR}} = \sqrt{\frac{5710 \times 100}{100 \times 7.13}} = 28.3$ cm

使用厚 97 cm (有効)

所要鐵筋量 $A_s = \frac{M}{f_s j d} = \frac{5,710 \times 100}{1,200 \times 7/8 \times 97} = 5.7$ cm²

16 mm φ 33 cm c. to c.

$A_s = 3 @ 16\phi = 3 @ 2.01 = 6.03$ cm²

$$p = \frac{A_s}{bd} = \frac{6.03}{100 \times 97} = 0.00062$$

$k = 0.13$　　$j = 0.955$

$$f_s = \frac{M}{A_s j d} = \frac{5,710 \times 100}{6.03 \times 0.955 \times 97} = 1,020 \text{ kg/cm}^2$$

$$f_c = \frac{2M}{jkbd^2} = \frac{2 \times 5,710 \times 100}{0.955 \times 0.13 \times 100 \times 97^2} = 9.8 \text{ kg/cm}^2$$

$$s = \frac{S}{bjd} = \frac{10,210}{100 \times 0.955 \times 97} = 1.1 \text{ kg/cm}^2$$

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設計　日付　類別 Gh5

照査　日付　第 29 頁

鐵筋混凝土高架橋
彎曲率圖表