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DIRECTORATE GENERAL OF LAND TRANSPORT
AND INLAND WATERWAYS

TENDER DOCUMENTS
FOR
NEW RAILWAY LINE FOR CENGKARENG AIRPORT CONSTRUCTION PROJECT

STRUCTURAL CALCULATION SHEETS

PACKAGE I CIVIL AND ARCHITECTURAL WORK

3 of 11

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STRUCTURAL CALCULATION SHEETS

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§§5. VIADUCT V047

CONTENT

§1. Design criteria

1-1 Type of structure

Elevated structure of Rahmen (Rigid frame) type made of R.C.

1-2 Type of track

Ballast type track

1-3 Type of substructure

Foundation piles are P.C. piles driven into the ground.

(1). Type of footing

Cannected type footing.

(2). Bearing stratum

Dcs stratum. Supposed $N > 30$

1-4 Design Load

(1). Dead Load (Unit Weight)

Track assembly weight	0.45	t/m
Ballast	1.9	t/m³
Reinforced Concrete	2.5	t/m³
Plain Concrete	2.35	t/m³

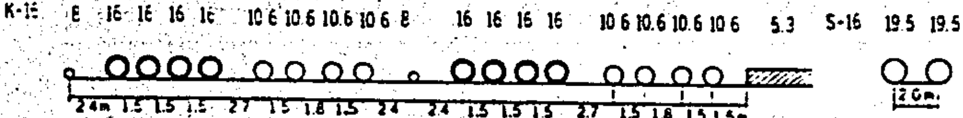
Steel materials 7.85 t/m³

Handrail 0.2 t/m

Material will be used actual unit weight of relevant.

(2). Train Load

Train Load will be equivalent to KS-16



(K-Loading) (S-Loading)

Equivalent uniformly distributed load

span (m)	KS-16		
	W M1 (t/m)	W M2 (t/m)	W S (t/m)
7	5.6	4.8	6.4
8	5.4	4.6	6.0
9	5.2	4.4	5.8
10	5.1	4.2	5.6

WM1 : Applied for positive span bending moment, also for negative span bending moment at the first support point.

WM2 : Applied for negative bending moment at the intermediate support point.

Ws : Applied for shearing stress.

(3). Impact Load

The impact of train load shall be the train load multipied by the following impact coefficient

Impact coefficient (KS-Loading)

Span ℓ (m)	0	5	10	20
impact coefficient (i)	0.60	0.48	0.43	0.37

For the double track structure, impact coefficient is reduced followed the equation.

$$i = i_o \times \left(1 - \frac{\ell}{200}\right)$$

ℓ : Span length (m)

(4). Centrifugal Load

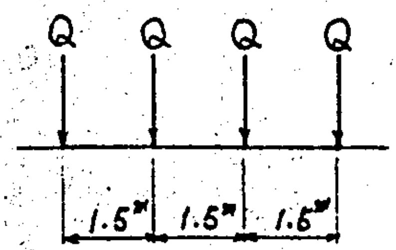
The magnitude of centrifugal load shall be the train load multiplied by the following coefficient as shown below. The working height of load is 1.8^m above the rail level. The acting direction of load is horizontal and right angle to the track.

Curve Radius R (m)	Centrifugal Coefficient α
R ≦ 700	0.12
700 < R ≦ 1000	0.10
1000 < R ≦ 1800	0.08
1800 < R	0

(5). Train Lateral Load

Train lateral load under KS loading scheme shall be Q loading diagram as shown on the figure which is 15% of a driving axle load per track under K-loading scheme working horizontall on the track at rail level in direction of right angle to the track.

In the case of structure supporting the line with two or more tracks. Train lateral load is assumed as the load of only one track.



(6). Brake Load and Traction

Brakeload and traction load per track shall be the value as indicated below, working parallel to the track in the track center profile at 1.8 m above rail level.

Brakeload	15% of the train load
Traction load	25% of the weight of the driving axle

(7). Earth Pressure

Coulomb and Rankine's coefficient of earth pressure will be used

(8). Seismic Effect

Seismic effect of eartquake is assumed as dead load and surcharge load multiplied by seismic coefficient plus seismic earth pressure.

$K_h = 0.10$ ····· in horizontal direction.

$K_v = 0$ ······ in vertical direction.

(9). Temperature Load

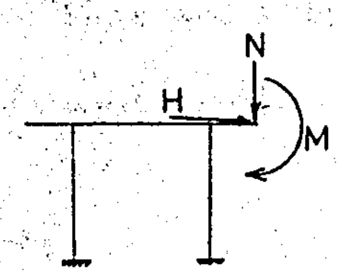
The temperature change considered in the structural analysis of statically indeterminate structure and the drying shrinkage shall be as follows:

Temperature Change ± 10°C

Drying Shrinkage - 15°C

Coefficient of temperture swelling of reinforced concrete shall be $1 \times 10^{-5} / 1C°$

(10). Load caused by catenary pole



Ordinary case

$$\begin{cases} M = 5.0^{t \cdot m} \\ N = 2.0^{t} \\ H = 0.5^{t} \end{cases}$$

(11). Perestrian Load

For the structure of station and platform

slab	500 kg/m²
beam	350 kg/m²
earthquake case	210 kg/m²

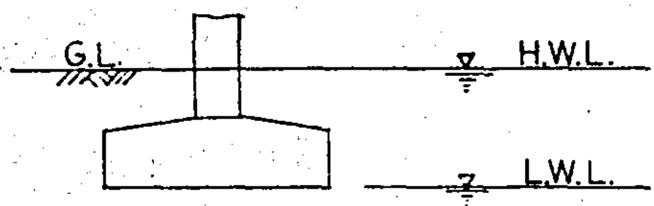
1-5. Other conditions

(1). Effect of Gelber girder

Construction of shoe used for Gelber girder is made. combined rubber shoe and steel rod stopper. Employed the said type of shoe for both support ends and accordingly eliminated distinction between movable and fixed end, shoe are supposed to share the load evenly half and half.

(2). Water level

Water level for the design is supposed as follows.



L.W.L. ······ Stays at the bottom face level of footing.

H.W.L. ······ Stays at ground level.

(3). Concrete minimum Cover

slab part 25 mm (net thickness)

beam 30 mm (do)

column 35 mm (do)

footing top or side face 50 mm (net thickness)

bottom face 150 (from bar center to concrete face)

1-6. Material and allowable stress

(1). Material

1). Concrete $\sigma_{ck} = 240$ kg/cm²

2). Reinforcing bar SD30

3). Max size of coarse aggregate 25 mm

(2). Allowable Stress

1). Reinforced Concrete

			Design stress
Allowable compressive stress			90 kg/cm²
Allowable Shearing Stress	Diagonal tension member	Bending shear τ_{a1}	3.9 "
		Punching shear τ_{ap}	5.4 "
		τ_{a2}	17 "
Allowable bonding stress		Deformed reinforcing bar	18 "

2). Reinforcing Bar

Type of reinforcing bar	SD30
Allowable tensile stress determined by yielding point	1800 kg/cm²

Allowable stress for analysis, against cracking

Surrounding condition	Allowable value corresponding to dead load	
	Slab	beam
Permanent wet condition	σ_{sa1} = 1200 kg/cm²	σ_{sa1} = 1400 kg/cm²
	σ_{sa2} = 1400 "	σ_{sa2} = 1600 "
Alternate dry and wet condition	σ_{sa1} = 800 "	σ_{sa1} = 1000 "
	σ_{sa2} = 1000 "	σ_{sa2} = 1200 "

$$\sigma_{sa1} : \alpha = \frac{\sigma_{l+i}}{\sigma_d + \sigma_{l \cdot i}} \geqq 0.25$$

$$\sigma_{sa2} : \alpha = \frac{\sigma_{l+i}}{\sigma_d + \sigma_{l \cdot i}} < 0.25$$

σ_d : Tensile stress of re-bar subjectod dead load

$\sigma_{l \cdot i}$: Tensile stress of re-bar subjected train load and impact load

1-7 Allowable stress, subjected combined load

(1) Track carrying structure

Combination of load	Given Extra
D + T + I (+E)	1.00
D + T + I + C (+E)	1.00
D + T + I + C + TL (+E)	1.15
D + T + I + B (+E)	1.15
D + TE (+E)	1.15
D + S (+E)	1.50

D : Dead load

T : Train load

I : Impact load

C : Centrifugal load

TL : Train lateral load

TE : Temperature load

B : Brake load

S : Seismic Force

E : Catenary pole

Load listed above with (+) expression is considered when the combined load including (+) brought dangerous result.

(2). Platform structure

Combination of load	Given Extra
D + P + EP	1.00
D + P + EP+TE	1.15
D + P + EP+S	1.50

D : Dead load

P : Pedestrian load

EP : Earth pressure

TE : Temperature load

S : Seismic Force

1-8. Allowable Reaction of pile

$$Q = 30 \cdot \overline{N} \cdot A_P$$

$\overline{N}$: Mean N value obtained from the N values measured within 4D vertical distance from pile bottom. $\overline{N} = 25$

A_P : Base area of pile. $A_P = \frac{1}{4} \cdot \pi \times 0.35^2 = 0.0962 m^2$

Q : Ultimate reaction of pile.

D : Diameter $D = 0.35^m$

$$Q = 30 \times 25 \times 0.0962 = 72^t$$

Under ordinary condition $R_a = \frac{Q}{F} = \frac{72}{3} = 24 \,t/\text{Pile}$

Under the condition of ordinary plus temporary

$$R_a = \frac{72}{2} = 36 \,t/\text{Pile}$$

Under the condition of earthquake

$$R_a = \frac{72}{1.5} = 48 \,t/\text{Pile}$$

Over-turning analysis

Under ordinary condition

Ratio of minimum and maximum reaction of pile shall be 0.3 or more. $\frac{R_{min}}{R_{max}} > 0.3$

1-9. Calculation for the pile elasticity, horizontal direction

$$Kh = 0.4 \times \alpha' \times \alpha E_o Bh^{-\frac{3}{4}}$$

Where

Kh : Coefficient of elasticity, horizontal direction (kg/cm³)

α' : Correction factor for the pile sides
α' = 1.2 (circular section)

α : For the permanent load α = 2
For the Temporary load α = 4

E_o : Deformation factor of the ground.
Assumed the average N value to be E_o = 2 kg/cm² as observed from the boring log.

Bh : Equivalent width of the pile
$Bh = \sqrt{D \times l_m}$
D : Diameter of pile
l_m: Depth of the first nonmove pint.

$$\beta = \sqrt[4]{\frac{Kh \cdot D}{4 \cdot E \cdot I}}$$

D: Diameter of pile

I: Moment of inertia of pile

E: Modulus of elasticity. $E = 3.5 \times 10^5$ kg/cm²

$$Kn = 0.32\ (\alpha E_o)^{1.103} \times D^{-0.310} \times (EI)^{-0.103}$$

$$l_m = \frac{\pi}{2\beta}$$

$D = 35$ cm

$E = 3.5 \times 10^5$ kg/cm²

$E_o = 2$ kg/cm²

Under the condition	For the permanent load	For the Temporary load
$(\alpha.E)^{-0.103}$	9.91	21.29
I	62130	62130
$D^{-0.310}$	0.332	0.332
$(E.I)^{-0.103}$	0.086	0.086
Kn	0.091	0.195
β	2.46×10^{-3}	2.98×10^{-3}

1-10. P.C. Pile

(1). Given conditions for preparing M N Diagram.

Coefficient to be multiplied to basic allowable stress	Allowable compressive stress of concrete	Allowable tensile stress of Tendon used for P.C. pile
1.0	150 kg/cm²	90 kg/mm²
1.1	165 〃	100 〃
1.2	180 〃	110 〃
1.5	225 〃	135 〃
1.65	250 〃	150 〃

Young's modulus of concrete.

$E_c = 3.5 \times 10^5$ kg/cm²

Young's modulus of Tendon

$E_s = 2.0 \times 10^6$ kg/cm²

$$n = \frac{E_s}{E_c} = 5.7$$

Design standard of concrete stress

$\sigma_{ok} = 500$ kg/cm²

Prestressing Tendon

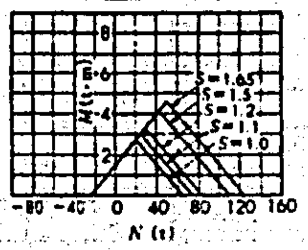
$\sigma_{pa} = 0.6\ \sigma_{pu}$ or $0.75\ \sigma_{py}$

$= 90$ kg/mm² ($\phi 7.0$ mm)

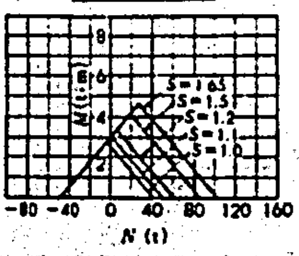
Where, concrete stress shall be $\sigma_c > 0$.

Diameter of pile (mm)	Wall thickness of pile (mm)	Category of pile prestressing	Cross sectional area of Tendon used for P.C. pile (cm²)	MN Diagram No.
350	65	A	3.1	1
		B	6.1	2
500	90	A	6.1	3
		B	12.2	4

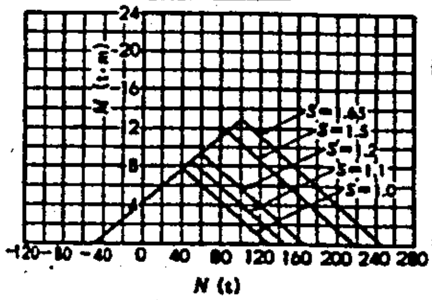
1 D350-A



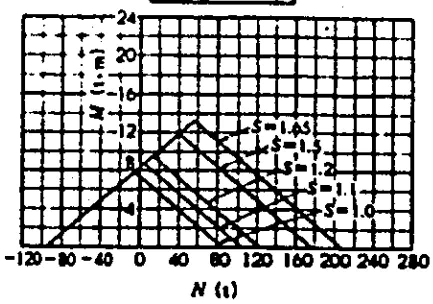
2 D350-B



3 D500-A

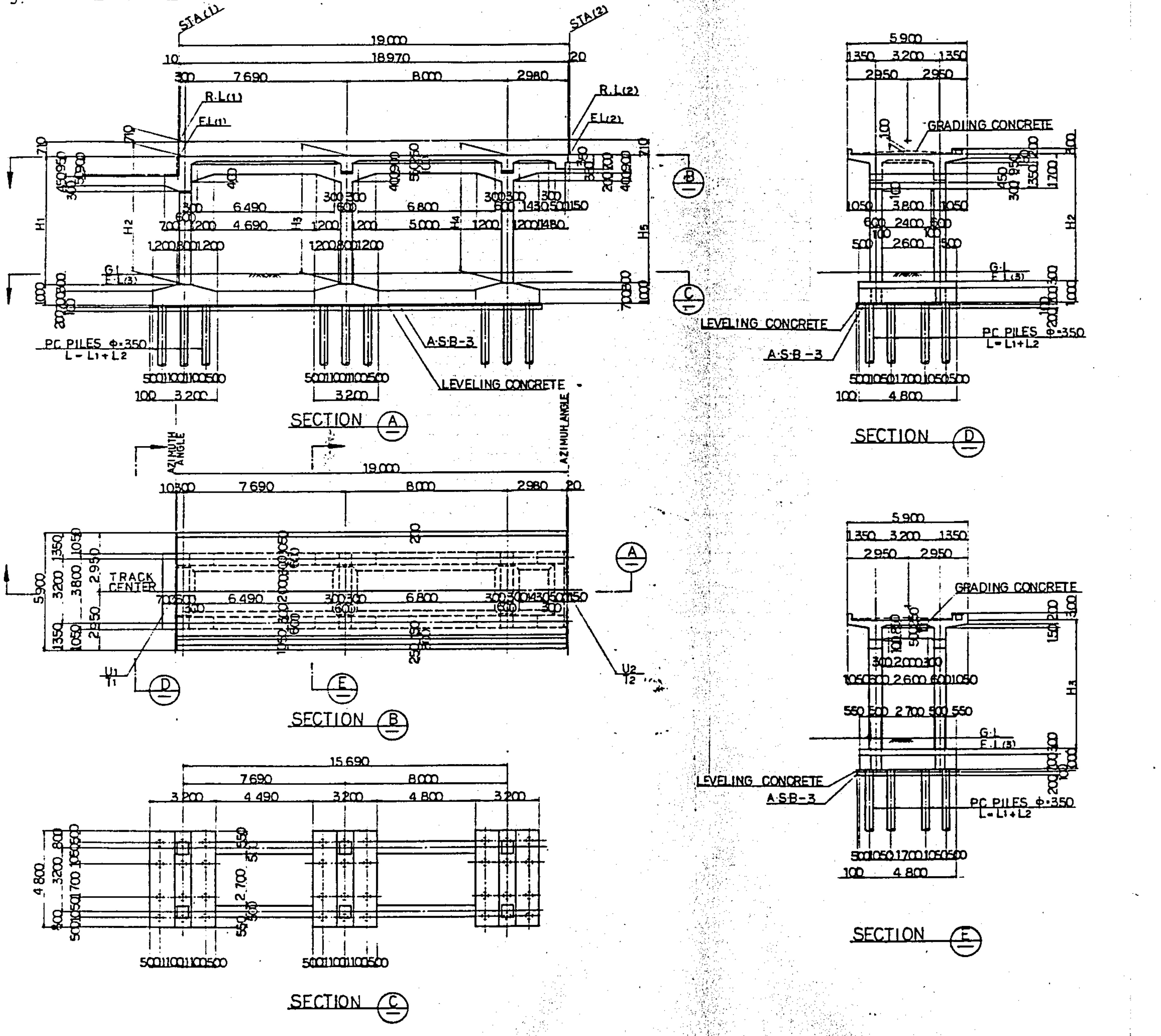


4 D500-B



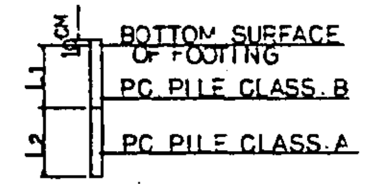
MN Diagram

§ 2 GENERAL VIEW



NOTES;

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS UNLESS OTHERWISE INDICATED
2. REFERENCE DRAWING FOR BAR ARRANGEMENT: CS-151~157
3. TYPES OF PC PILE



4. GRADING CONCRETE SHALL BE SIMULTANEOUSLY PLACED WITH SLAB CONCRETE

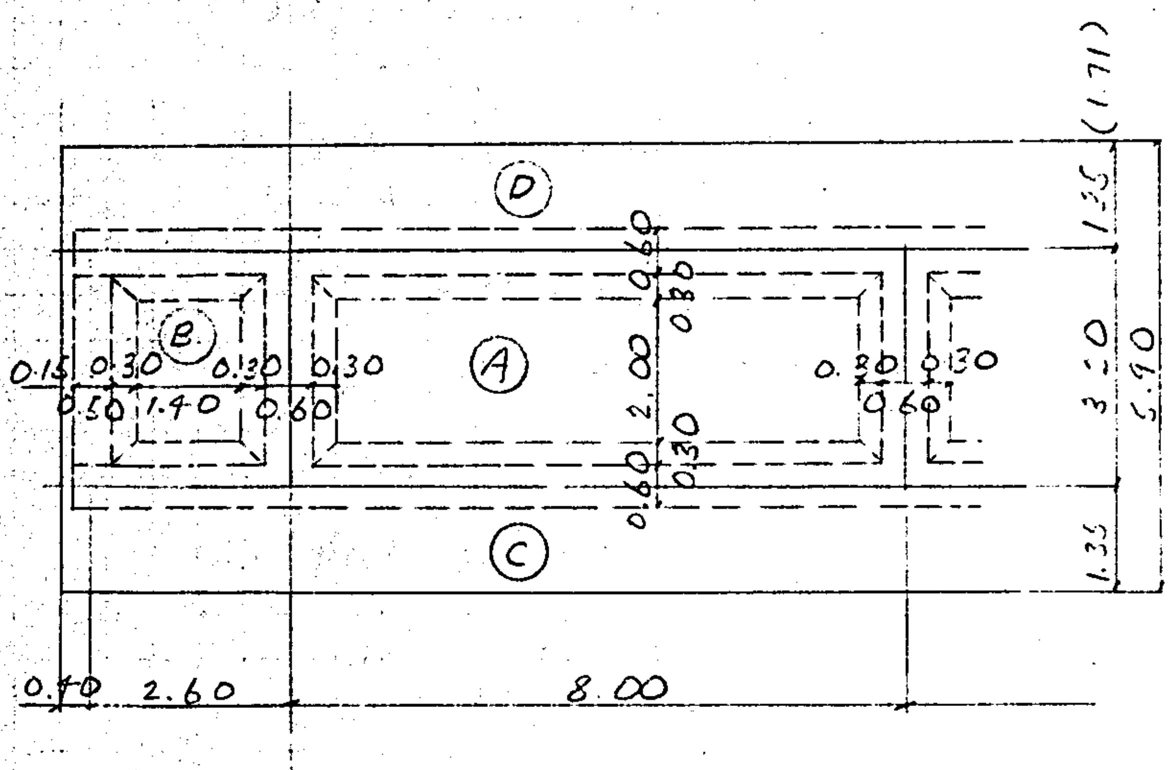
DIMENSION SCHEDULE

	V008	V010	V017	V047	V085
STA (1)	13^{K}689^{M}000	13^{K}765^{M}000	14^{K}202^{M}000	15^{K}649^{M}000	17^{K}041^{M}000
STA (2)	13^{K}708^{M}000	13^{K}746^{M}000	14^{K}183^{M}000	15^{K}668^{M}000	17^{K}022^{M}000
R.L (1)	8^{M}470	8^{M}470	8^{M}960	8^{M}724	8^{M}754
R.L (2)	〃	〃	8^{M}903	〃	8^{M}706
AZIMUTH ANGLE (θ1)	350° 39' 55"58	350° 39' 55"58	2° 29' 30"68	1° 06' 02"00	345° 30' 45"40
DO (θ2)	〃	〃	〃	〃	〃
U 1	12^{K}082^{M}577	12^{K}094^{M}904	12^{K}119^{M}106	11^{K}998^{M}631	12^{K}064^{M}127
T 1	−2^{K}482^{M}419	−2^{K}407^{M}425	−1^{K}972^{M}658	−533^{M}731	−848^{M}914
U 2	12^{K}085^{M}659	12^{K}091^{M}823	12^{K}119^{M}933	11^{K}998^{M}266	12^{K}059^{M}374
T 2	−2^{K}463^{M}670	−2^{K}426^{M}173	−1^{K}991^{M}640	−514^{M}734	−830^{M}518
E L (1)	7^{M}760	7^{M}760	8^{M}250	8^{M}014	8^{M}044
E L (2)	〃	〃	8^{M}193	〃	7^{M}996
E L (3)	0^{M}700	0^{M}700	0^{M}700	0^{M}194	0^{M}400
G L	1^{M}300	1^{M}300	1^{M}300	0^{M}700	0^{M}900
H 1	7060	7060	7550	7820	7644
H 2	〃	〃	7541	〃	7643
H 3	〃	〃	7517	〃	7624
H 4	〃	〃	7493	〃	7604
H 5	〃	〃	7492	〃	7596
PC PILES 1	11 000	11 000	11 000	8 000	8 000
PC PILES 2	———	———	———	7 000	14 000

NOTES:

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS UNLESS OTHERWISE INDICATED
2. REFERENCE DRAWING FOR GENERAL VIEW: CS-149

§ 3 Slab calculation (single track section)



1. Slab for calculation

Slab (A) ----- One-way slab

Slab (B) ---- Two-way slab

Slab (C) ---- Cantilever slab

Slab (D) ----- do

2 . Calculation of slab (A)

(1) Four sides fixed span

$l_{dx} = 3.20 - 0.60 = 2.60^{m}$

$l_{dy} = 8.00 - 0.60 = 7.40^{m}$

(2) Four sides semi - fixed span

$l_{lx} = 2.60 + 0.25 = 2.85^{m}$

$l_{ly} = 7.40 + 0.25 = 7.65^{m}$

(3) Span ratio

$$m_d = \frac{l_{dx}}{l_{dy}} = \frac{2.60}{7.40} = 0.35 < 0.4$$

$$m_l = \frac{l_{lx}}{l_{ly}} = \frac{2.85}{7.65} = 0.37 < 0.4$$

From the above the slab is considered as a one - way slab for calculation.

(4) Calculation of load

(a) Dead load

Average thickness of ballast $h = \frac{0.619 + 0.419}{2} = 0.52^{m}$

Ballast	$1.90^{t/m^3} \times 0.52$	$= 0.99^{t/m^2}$
Weight of slab	$2.50'' \times 0.25$	$= 0.63''$
grading concrete	$2.35'' \times 0.07$	$= 0.16''$
Weight of Track assembly	$0.45^{t/m} \times 1/2.89$	$= 0.16''$
		$W_d = 1.94^{t/m^2}$

(b) Train load + Impact

KS - 16

$l = 2.85 \quad i = 0.532$

$$W = \frac{P}{a \times b} = \frac{16}{1.50 \times 2.89} = 3.69^{t/m^2}$$

$$W_{l+i} = 3.69 \times 1.532 = 5.65^{t/m^2}$$

(5) Bending moment

(a) Dead load

At the support point

$M_d = 1/12 \times 1.94 \times 2.60^2 = 1.09^{t \cdot m}$

At the span center point

$M_{max} = 1/24 \times 1.94 \times 2.60^2 = 0.55^{t \cdot m}$

(b) Train load + Impact

At the support point

$M_{l+i} = 1/12 \times 5.65 \times 2.85^2 = 3.82^{t \cdot m}$

At the span center point

$M_{l+i} = 1/16 \times 5.65 \times 2.85^2 = 2.87^{t \cdot m}$

(c) Combined moment (D + T + i)

At the support point

$\Sigma M = 1.09 + 3.89 = 4.98^{t \cdot m}$

At the span center point

$\Sigma M_{max} = 0.55 + 2.87 = 3.42^{t \cdot m}$

Shearing stress ($h/2$ point)

$S = 1/2 \times (1.94 + 5.65) \times (2.60 - 0.35) = 8.54^{t}$

3 Calcultion of slab (B)

(1) Four side fixed span

$l_{dx} = 3.20 - 0.60 = 2.60^{m}$

$l_{dy} = 2.60 - 0.60 = 2.00^{m}$

(2) Four side semi - fixed span

$l_{ex} = 2.60 + 0.25 = 2.85^{m}$

$l_{ey} = 2.00 + 0.25 = 2.25^{m}$

(3) Span raito

$$m_d = \frac{l_{dy}}{l_{dx}} = \frac{2.00}{2.60} = 0.77 > 0.4$$

$$m_e = \frac{l_{ey}}{l_{ex}} = \frac{2.25}{2.85} = 0.79 > 0.4$$

From the above the slab is considered as a two - way slab for calculation.

(4) Calculation of load

(a) Dead load

$w_d = 1.94^{t/m^2}$ (From Ⓐ slab)

(b) Train load + Impact

$w_\ell = 3.69^{t/m^2}$

$\ell = 3.69^m$ $i = 0.546$

$w_{d-\ell} = 3.69 \times 1.546 = 5.70^{t/m^2}$

(5) Bending moment

(a) Dead load

(i) Sharing of load

$\ell dx = 2.60^m$ $\ell dy = 2.00^m$

Coefficient of load sharing in the direction of x or y

$$C_x = \frac{\ell dy^4}{\ell dx^4 + \ell dy^4} = \frac{2.00^4}{2.60^4 + 2.00^4} = 0.259$$

$$C_y = \frac{\ell dx^4}{\ell dx^4 + \ell dy^4} = \frac{2.60^4}{2.60^4 + 2.00^4} = 0.741$$

Shared load

$w_{dx} = 1.94 \times 0.259 = 0.50^{t/m^2}$

$w_{dy} = 1.94 \times 0.741 = 1.44$ "

At the span center point

$$M_x = 1/24 \times 0.50 \times 2.60^2 = 0.14^{t \cdot m}$$

$$M_y = 1/24 \times 1.44 \times 2.00^2 = 0.24$$ "

Torsional cofficient ϕ_x, ϕ_y

$$\phi_x = \phi_y = \frac{5}{18} \times \frac{l_{dx}^2 \cdot l_{dy}^2}{l_{dx}^4 + l_{dy}^4}$$

$$= \frac{5}{18} \times \frac{2.60^2 \times 2.00^2}{2.60^4 + 2.00^4} = 0.122$$

Hence,

$$M_x = 0.14 \times (1 - 0.122) = 0.12^{t \cdot m}$$

$$M_y = 0.24 \times (1 - 0.122) = 0.21$$ "

At the support point ($l_{dx} > l_{dy}$)

$$M_x' = -1/24 \times 1.44 \times 2.00^2 = -0.32^{t \cdot m}$$

$$M_y' = -1/12 \times 1.44 \times 2.00^2 = -0.48$$ "

(b) Train load + Impact

(i) Sharing of load

Coefficient of load sharing in the direction of x or y

$$C_x = \frac{l_y^4}{l_x^4 + l_y^4} = \frac{2.25^4}{2.85^4 + 2.25^4} = 0.280$$

$$C_y = \frac{l_x^4}{l_x^4 + l_y^4} = \frac{2.85^4}{2.85^4 + 2.25^4} = 0.720$$

Shared load

$$W_{lx} = 5.70 \times 0.28 = 1.59 \; t/m^2$$

$$W_{ly} = 5.70 \times 0.72 = 4.11 \; "$$

(ii) Bending moment

At the span center point

Four sides simple span

$$M_x = 1/8 \times 1.59 \times 2.85^2 = 1.62 \; t \cdot m$$

$$M_y = 1/8 \times 4.11 \times 2.25^2 = 2.60 \; "$$

$$\varphi_x = \varphi_y = \frac{5}{6} \times \frac{2.85^2 \times 2.25^2}{2.85^4 + 2.25^4} = 0.374$$

Hence,

$$M'_x = 1.62 \times (1 - 0.374) = 1.01 \; t \cdot m$$

$$M'_y = 2.60 \times (1 - 0.374) = 1.63 \; "$$

Four side fixed span

$M_x = 1/24 \times 1.59 \times 2.85^2 \quad = 0.54^{t\cdot m}$

$M_y = 1/24 \times 4.11 \times 2.25^2 \quad = 0.87''$

$\phi_x = \phi_y = \frac{5}{18} \times \frac{2.85^2 \times 2.25^2}{2.85^4 + 2.25^4} = 0.125$

Hence,

$M_x'' = 0.54 \times (1 - 0.125) \quad = 0.47^{t\cdot m}$

$M_y'' = 0.74 \times (1 - 0.125) \quad = 0.76''$

Hence,

$M_x = \frac{M_x' + M_y''}{2} = \frac{1.01 + 0.47}{2} = 0.74^{t\cdot m}$

$M_y = \frac{M_y' + M_y''}{2} = \frac{1.63 + 0.76}{2} = 1.19''$

As the support point

$M_x = -1/24 \times 5.70 \times 2.25^2 \quad = -1.20^{t\cdot m}$

$M_y = -1/12 \times 4.11 \times 2.25^2 \quad = -1.73^{t\cdot m}$

Combined moment

		D	T + I	D + T + I
At the support point	x	-0.48	-1.73	-2.21
	y	-0.32	-1.20	-1.53
At the span center point	x	0.21	1.19	1.40
	y	0.12	0.74	0.87

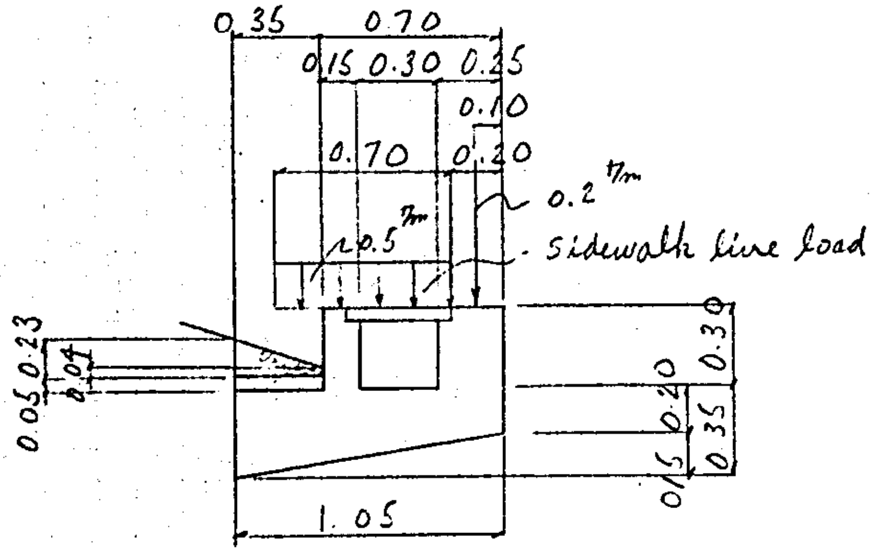
Shering stress (h/2 point)

D + T + I

$W_{d+l+i} = 1.437 + 4.105 = 5.542$ t/m

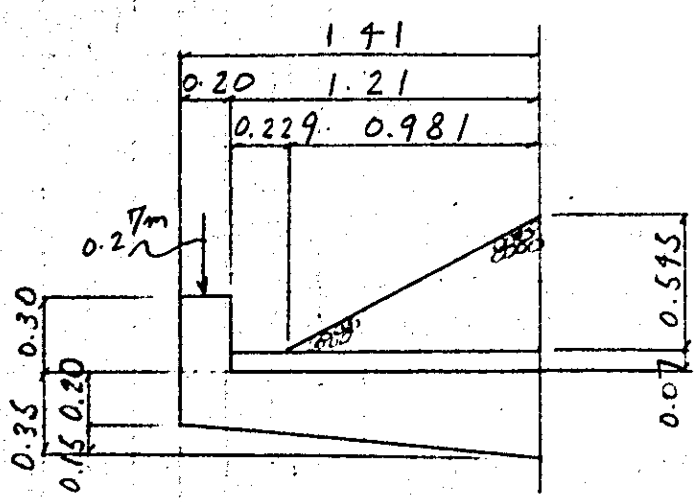
$S = 1/2 \times 5.542\ (2.00 - 0.35) = 4.57$ t

4 Calculation of slab ©



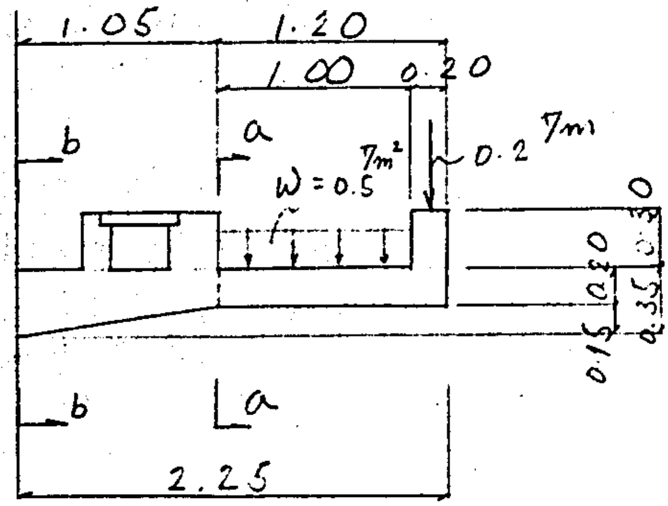
	Calculation	N (t/m)	x (m)	M (t·m)
Slab	2.50 t/m³ × 0.20 × 1.05	0.50	0.525	0.26
〃	2.50 × 0.15 × 1/2 × 1.05	0.20	0.350	0.07
Curb	2.50 × 0.25 × 0.30	0.19	0.925	0.18
Ballast stopper	2.50 × 0.15 × 0.30	0.11	0.425	0.05
Duct cover	2.50 × 0.05 × 0.30	0.04	0.650	0.03
Cable		0.06	0.650	0.04
Grading Concrete	2.35 t/m³ × 0.05 × 0.35	0.04	0.175	0.01
Ballast	1.90 × 0.04 × 0.35	0.03	0.175	0.01
〃	1.90 × 0.19 × 1/2 × 0.35	0.06	0.117	0.01
Handrail		0.20	0.950	0.19
Sidewalk live load	0.50 × 0.70	(0.35)	0.500	(0.18)
Total		1.43 t (1.78)		0.85 t·m (1.03)

5 Calculation of slabe ⓓ



	Calculation	N (t/m)	x (m)	M (t·m)
Slab	2.50 (T/m³) × 0.20 × 1.41	0.71	0.705	0.50
〃	2.50 × 0.15 × ½ × 1.41	0.26	0.470	0.12
Curb	2.50 × 0.20 × 0.30	0.15	1.310	0.20
grading Concrete	2.35 × 0.07 × 1.21	0.20	0.605	0.12
Ballast	1.90 × 0.981 × 0.545 × ½	0.51	0.327	0.17
Handrail		0.20	1.310	0.26
Total		2.03		1.37 t·m

6 Calculation of the cantilever slab for equipment space.



1) Section a-a

Calculation of load

Curb	$2.50^{T/m^3} \times 0.20 \times 0.30$	$= 0.15^{T/m}$
Slab	$w_1 = 2.50 \times 0.20 \times 1.00$	$= 0.50$
Weight of elements on slab	$w_2 = 0.50 \times 1.00$	$= 0.50$
Handrail		$= 0.20$

Moment of section a-a

$$Ma = (0.15 + 0.20) \times 1.10 + \tfrac{1}{2} \times 0.50 \times 1.20^2 + \tfrac{1}{2} \times 0.50 \times 1.00^2 = 1.00^{t\cdot m}$$

$$S = 0.15 + 0.20 + 0.50 \times 1.20 + 0.50 \times 1.0 = 1.45^{t}$$

2) Section b ~ b

M_b = Moment of slab Ⓒ + Moment of section a ~ a

$M_b = 0.85 + 1.00 - 1.45 \times 1.05 = 3.37^{t \cdot m}$

$S_b = 1.78 + 1.45 = 3.23^{t}$

	Slab Ⓐ		Slab Ⓑ		Slab Ⓒ	
	x Direction		x direction		Cantilever slab	
	support	Center	support	Center		
M (tm)	-4.98	3.42	-2.21	1.40	1.03	0.85
N (t)						
S (t)	8.54					
b (cm)	100	100	100	100	100	100
h (cm)	35(29)	25	35	25	35	35
d (cm)	31.8(25.8)	21.8	30.5	20.5	31.8	31.8
d' (cm)	3.2	3.2	4.5	4.5	3.2	3.2
As (cm^2)	D13-12.5 = 10.136	D13-12.5 = 10.136	D13-20 = 6.335	D13-20 6.335	D13-12.5 = 10.136	D13-12.5 = 10.136
p	0.00319	0.00465	0.00208	0.00309	—	—
As' (cm^2)						
p'						
e=M/N (cm)						
e=M/N+u (cm)						
e=M/N−u (cm)						
e/h						
d/e						
d'/h						
d'/d						
Ne/bd^2 (kg/cm^2)	4.925	7.196	2.376	3.33	—	—
k						
c						
j						
1/Lc	8.28	7.19	9.79	8.37	—	—
1/Ls	344	240	520	355	—	—
$\beta=\sigma s/\sigma c$						
σc (kg/cm^2)	40.8	51.8	23.3	27.9	—	—
σs (kg/cm^2)	1690	1730	1230	1180	—	—
τ (kg/cm^2)	3.31					
σsa (kg/cm^2)	1800	1800	1800	1800	1800	1000
σca (kg/cm^2)	90	90	90	90	90	
τa (kg/cm^2)	3.9					
	D+T+i	D+T+i	D+T+i	D+T+i	D+T	D

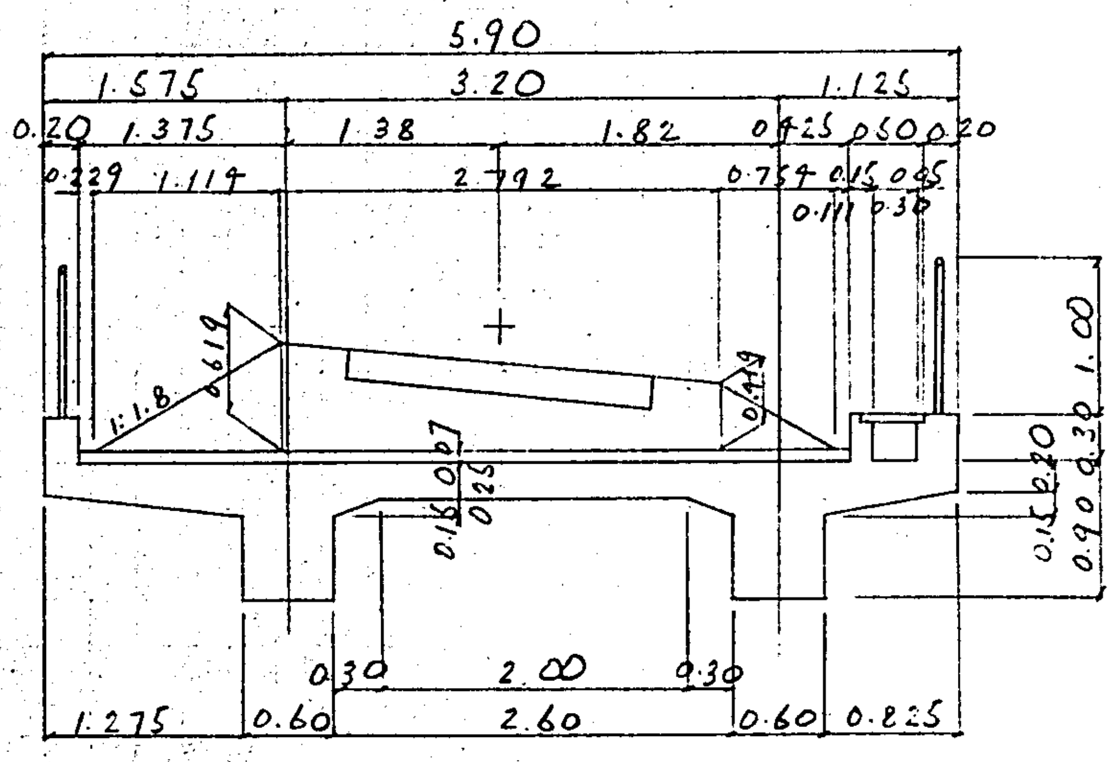
	Slab (D)	Slab of signal space		
	Cantilever slab	Section b~b	Section a~a	
M (tm)	1.37	3.37	1.00	
N (t)				
S (t)			1.45	
b (cm)	100	100	100	
h (cm)	35	35	20	
d (cm)	31.8	31.8	16.8	
d' (cm)	3.2	3.2	3.2	
As (cm²)	D13-12.5 = 10.136	D13-12.5 D13-25 = 15.204	D13-12.5 = 10.136	
p	0.00319	0.00478	0.00603	
As' (cm²)				
p'				
e=M/N (cm)				
e=M/N+u (cm)				
e=M/N−u (cm)				
e/h				
d/e				
d'/h				
d'/d				
Ne/bd² (kg/cm²)	1.355	3.332	3.543	
k				
c				
j				
1/Lc	8.28	7.11	6.55	
1/Ls	344	234	187	
β=σs/σc				
σc (kg/cm²)	—	23.7	23.2	
σs (kg/cm²)	470	780	660	
τ (kg/cm²)			0.86	
σsa (kg/cm²)	1,000	1000	1000	
σca (kg/cm²)	—	90	90	
τa (kg/cm²)			3.90	
	O	D	D	

§ 4 Calculation of Torsional moment

Span $l = 8.00^m$ (Section ②-② of viaduct)

$l = 7.69^m$ (Section ①-① of viaduct)

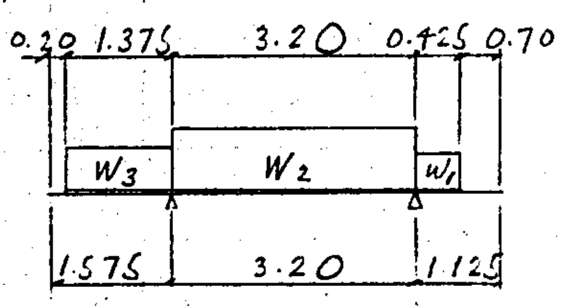
1. Weight of elments on the slab



(1) Concentrated loads

Curb and Handrail (left)	$2.50^{t/m^3} \times 0.20 \times 0.30 \times 0.20$	$= 0.35^{t/m}$
Curb (right)	$2.50^{t/m^3} \times 0.25 \times 0.30$	= 0.19 "
Handrail (right)		= 0.20 "
Ballast stopper (right)	$2.50^{t/m^3} \times 0.15 \times 0.30$	= 0.11 "
Duct cover (right)	$2.50 \times 0.05 \times 0.30$	= 0.04 "
Cable (right)		= 0.06 "

(2) Weight of elements on the slab except track weight



$W_1 = 1.90^{t/m^3} \times 0.419 \times 0.754 \times 1/2 \times 1/0.754 + 2.35^{t/m^3} \times 0.07 = 0.56^{t/m}$

$W_2 = 1.90 \times (0.619 + 0.419) \times 1/2 + 2.35 \times 0.07 = 1.15$

$W_3 = 1.90 \times 0.619 \times 1.114 \times 1/2 \times 1/1.114 + 2.35 \times 0.07 = 0.75$

2 Train load

$l = 8.00^{m}$

Distribution loads

KS-16

$W_{H_2} = 4.60 \times 2 = 9.2^{t/m}$

· A1 end of viaduct

LL = 7.69

· A1 intermediate of viaduct

$LL = 8.00^{m}$

· Points of computing stress

$X_1 = 0.30^m$

$X_2 = 0.95$ (h/2 point)

$X_3 = 1.50^m$

L=19.0

TATE BARI NO NEJIRI MOMENT

NEJIRI KEISU NO KEISAN

SMALL HR = 0.200 SMALL BER = 0.825
SMALL HL = 0.200 SMALL BEL = 1.275

MAGE DANMEN NIJI MOMENT I = 0.06905

NEJIRI DANMEN NIJI MOMENT IT = 0.04733

SLAB NO MAGE DANMEN NIJI MOMENT IS = 0.00130

NEJIRI KEISU SMALL K1 = 0.6388 SMALL K2 =-0.1229

KAJYU HENSIN NI YORU NEJIRI MOMENT

SHIKAJYU WD = 12.643 SMALL ED =-0.190

RESSHA KAJYU WL = 18.400 SMALL EL = 0.000

SYOGEKI KEISU SMALL I1 = 0.436

	X	D	L	I	D+L+I
MT A	0.000	-1.673	0.000	0.000	-1.673
MT 1	0.300	-1.543	0.000	0.000	-1.543
MT 2	0.950	-1.260	0.000	0.000	-1.260
MT 3	1.500	-1.021	0.000	0.000	-1.021
MT C	3.845	0.000	0.000	0.000	0.000

No 36

KOTEITAN MOMENT NO SANI YORU NEJIRI MOMENT

SHIKAJYU (CHUKAN SLAB)	SMALL CY = 0.971	SMALL WDY = 2.146		
RESSHA KAJYU	SMALL WLL = 3.183	SMALL WLR = 0.000		
SAIKAHABA	SMALL BLD = 0.00	SMALL BL = 2.89	SMALL BR = 2.89	SMALL BRD = 0.00
SHOGEKI KEISU	SMALL I2= 0.515	SMALL IL= 0.600	SMALL IR= 0.600	

SHITEN MOMENT NO SA

SHIKAJYU	ML = -2.207	MR = -1.793
RESSHA KAJYU	ML = 8.159	MR = -3.159
SHOGEKI KAJYU	ML = 4.201	MR = -4.201

L BARI

	X	D	L	I	D+L+I
MT A	0.000	-1.189	6.215	3.200	8.225
MT 1	0.300	-1.097	5.730	2.950	7.583
MT 2	0.950	-0.896	4.679	2.409	6.193
MT 3	1.500	-0.725	3.790	1.951	5.016
MT C	3.845	0.000	0.000	0.000	0.000

R BARI

	X	D	L	I	D+L+I
MT A	0.000	-0.874	-6.215	-3.200	-10.288
MT 1	0.300	-0.806	-5.730	-2.950	-9.485
MT 2	0.950	-0.658	-4.679	-2.409	-7.746
MT 3	1.500	-0.533	-3.790	-1.951	-6.275
MT C	3.845	0.000	0.000	0.000	0.000

NEJIRI MOMENT NO GOSEI

SHUBARI FUKUBU NO NEJIRI MOMENT BUNTANRITHU

L BARI	ALFA L1 = 0.880	ALFA L2 = 0.809
R BARI	ALFA R1 = 0.894	ALFA R2 = 0.830

L BARI

	X	D	L	I	D+L+I	SHUBARI NO BUNTAN
MT A	0.000	-2.863	6.215	3.200	6.551	
MT 1	0.300	-2.639	5.730	2.950	6.040	5.315
MT 2	0.950	-2.155	4.679	2.409	4.933	3.991
MT 3	1.500	-1.746	3.790	1.951	3.996	3.233
MT C	3.845	0.000	0.000	0.000	0.000	0.000

R BARI

	X	D	L	I	D+L+I	SHUBARI NO BUNTAN
MT A	0.000	-2.547	-6.215	-3.200	-11.962	
MT 1	0.300	-2.349	-5.730	-2.950	-11.028	-9.862
MT 2	0.950	-1.913	-4.679	-2.409	-9.006	-7.478
MT 3	1.500	-1.554	-3.790	-1.951	-7.295	-6.057
MT C	3.845	0.000	0.000	0.000	0.000	0.000

L=30.0 (DENCHU NASHI)

TATE BARI NO NEJIRI MOMENT

NEJIRI KEISU NO KEISAN

SMALL HR = 0.200   SMALL BER = 0.825
SMALL HL = 0.200   SMALL BEL = 1.275

MAGE DANMEN NIJI MOMENT   I = 0.06905

NEJIRI DANMEN NIJI MOMENT   IT = 0.04733

SLAB NO MAGE DANMEN NIJI MOMENT   IS = 0.00130

NEJIRI KEISU   SMALL K1 = 0.6216   SMALL K2 =-0.1255

KAJYU HENSIN NI YORU NEJIRI MOMENT

SHIKAJYU   WD = 12.643   SMALL ED =-0.190

RESSHA KAJYU   WL = 18.400   SMALL EL = 0.000

SYOGEKI KEISU   SMALL I1 = 0.432

	X	D	L	I	D+L+I
MT A	0.000	-1.830	0.000	0.000	-1.830
MT 1	0.300	-1.692	0.000	0.000	-1.692
MT 2	0.950	-1.395	0.000	0.000	-1.395
MT 3	1.500	-1.143	0.000	0.000	-1.143
MT C	4.000	0.000	0.000	0.000	0.000

No 70

KAJYU HENSIN NI YORU NEJIRI MOMENT

SHIKAJYU	WD = 12.643	SMALL ED = -0.190
RESSHA KAJYU	WL = 9.200	SMALL EL = 0.000
SYOGEKI KEISU	SMALL I1 = 0.432	

	X	D	L	I	D+L+I
MT A	0.000	-1.830	0.000	0.000	-1.830
MT 1	0.300	-1.692	0.000	0.000	-1.692
MT 2	0.950	-1.395	0.000	0.000	-1.395
MT 3	1.500	-1.143	0.000	0.000	-1.143
MT C	4.000	0.000	0.000	0.000	0.000

KOTEITAN MOMENT NO SANI YORU NEJIRI MOMENT

SHIKAJYU (CHUKAN SLAB)	SMALL CY = 0.975	SMALL WDY = 2.155		
RESSHA KAJYU	SMALL WLL = 3.183	SMALL WLR = 0.000		
SAIKAHABA	SMALL BLD = 0.00	SMALL BL = 2.89	SMALL BR = 2.89	SMALL BRD = 0.00
SHOGEKI KEISU	SMALL I2= 0.515 (0.523)	SMALL IL= 0.600	SMALL IR= 0.600	

SHITEN MOMENT NO SA

SHIKAJYU	ML = -2.212	MR = -1.949
RESSHA KAJYU	ML = 8.574	MR = -8.574
SHOGEKI KAJYU	ML = 4.414	MR = -4.414

L BARI

	X	D	L	I	D+L+I
MT A	0.000	-1.130	6.406	3.298	8.573
MT 1	0.300	-1.045	5.925	3.050	7.930
MT 2	0.950	-0.862	4.884	2.515	6.537
MT 3	1.500	-0.706	4.003	2.061	5.358
MT C	4.000	0.000	0.000	0.000	0.000

R BARI

	X	D	L	I	D+L+I
MT A	0.000	-0.934	-6.406	-3.298	-10.637
MT 1	0.300	-0.864	-5.925	-3.050	-9.839
MT 2	0.950	-0.712	-4.884	-2.515	-8.111
MT 3	1.500	-0.584	-4.003	-2.061	-6.648
MT C	4.000	0.000	0.000	0.000	0.000

NEJIRI MOMENT NO GOSEI

SHUBARI FUKUBU NO NEJIRI MOMENT BUNTANRITHU

L BARI	ALFA L1 = 0.880	ALFA L2 = 0.809
R BARI	ALFA R1 = 0.894	ALFA R2 = 0.830

L BARI

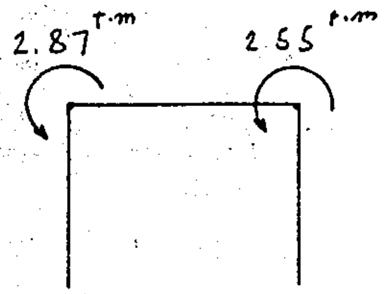
	X	D	L	I	D+L+I	SHUBARI NO BUNTAN
MT A	0.000	-2.960	6.406	3.298	6.743	
MT 1	0.300	-2.738	5.925	3.050	6.238	5.489
MT 2	0.950	-2.257	4.884	2.515	5.142	4.160
MT 3	1.500	-1.850	4.003	2.061	4.215	3.410
MT C	4.000	0.000	0.000	0.000	0.000	0.000

R BARI

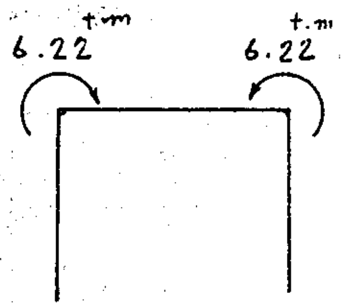
	X	D	L	I	D+L+I	SHUBARI NO BUNTAN
MT A	0.000	-2.764	-6.406	-3.298	-12.467	
MT 1	0.300	-2.556	-5.925	-3.050	-11.532	-10.313
MT 2	0.950	-2.107	-4.884	-2.515	-9.506	-7.893
MT 3	1.500	-1.727	-4.003	-2.061	-7.792	-6.469
MT C	4.000	0.000	0.000	0.000	0.000	0.000

Rigid frame analysis on transverse
Section ①-① of viaduct (Span $l = 7.69^{m}$)

Dead load

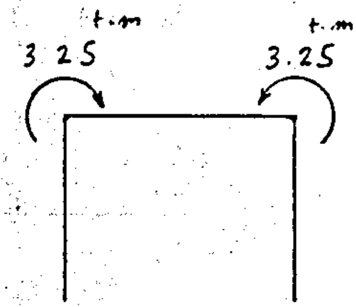


Train load



Impact load

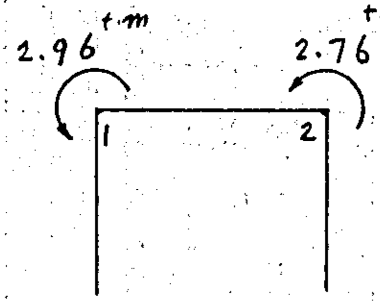
$M_{I(i)} = 6.22 \times 0.523 = 3.25^{t \cdot m}$

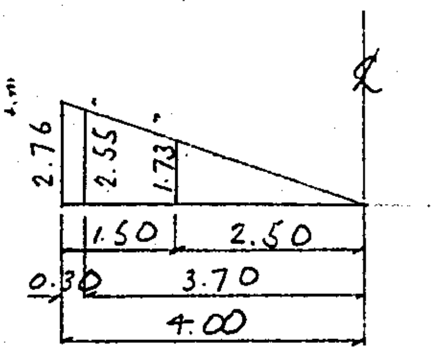


Rigid frame analysis on transverse

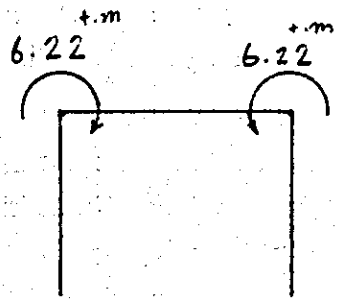
Section ②-② of viaduct (Span $l = 8.0^m$)

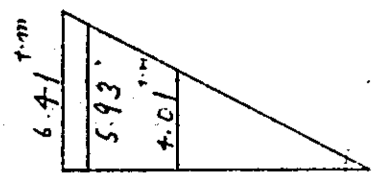
Dead load





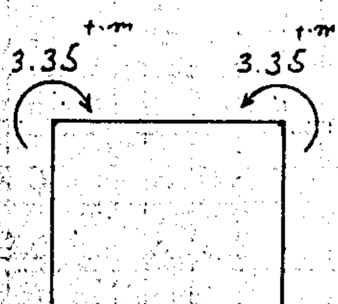
Train load

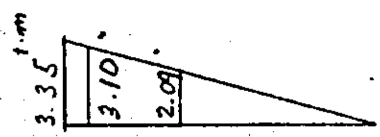




Impact load

$M_{I(i)} = 6.22 \times 0.523^{(i)} = 3.35^{t.m}$

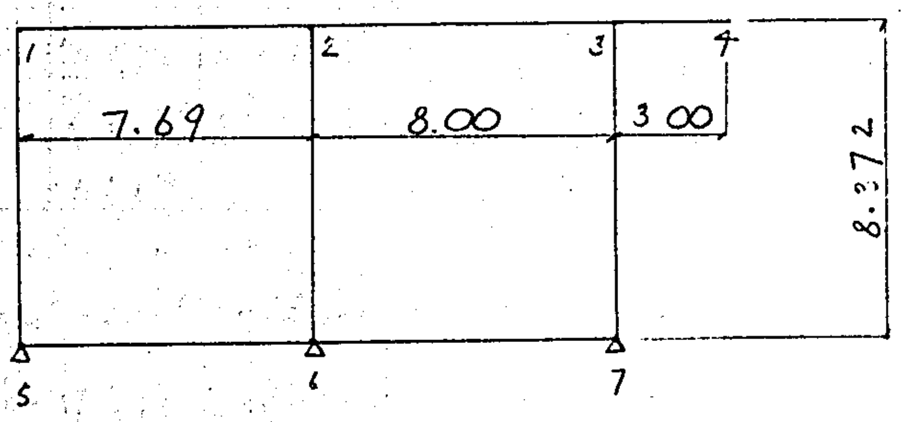




§ 5 Rigid frame analysis in longitudinal direction of elevated structure

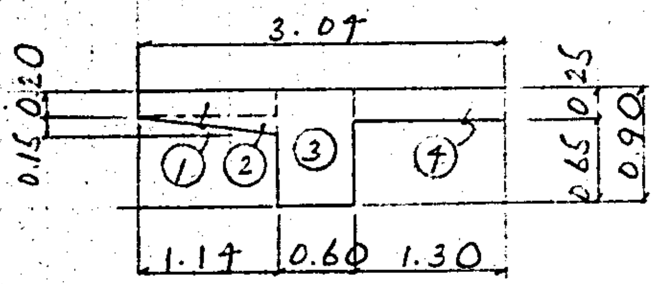
[1] Element for rigid frame analysis

1 Configulation and dimension of rigid from



2 Cross-sectional area and moment of Inertia of the member

(1) Member (1~2. 2~3. 3~4)



Effective width

$b_e = 1.14 + 0.60 + \frac{2.60}{2} = 3.13^{m}$

	b (m)	h (m)	A (m²)	y (m)	A·y (m³)
①	1.14	0.20	0.228	0.100	0.02280
②	1.14	½ × 0.15	0.086	0.250	0.02150
③	0.60	0.90	0.540	0.450	0.24300
④	1.30	0.25	0.325	0.125	0.04063
Σ			1.179		0.32793

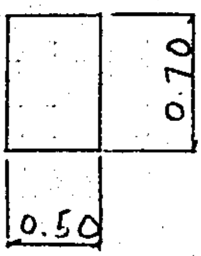
$$y = \frac{0.32793}{1.179} = 0.278^{m}$$

	$b^{(m)}$	$h^{(m)}$	$A^{(m^2)}$	$y_0^{(m)}$	$I_0^{(m^4)}$	$A\cdot y_0^{2\,(m^4)}$	$I_0+A y_0^{2\,(m^4)}$
①	1.14	0.20	0.228	0.178	0.00076	0.00722	0.00798
②	1.14	½×0.15	0.086	0.028	0.00011	0.00008	0.00019
③	0.60	0.90	0.540	0.172	0.03645	0.01598	0.05243
④	1.30	0.25	0.325	0.153	0.00169	0.00761	0.00930
Σ			1.179		0.03901	0.03089	0.06990

Cross-Sectional Area $A = 1.179^{m^2}$

Moment of Inertia $I = 0.0699^{m^4}$

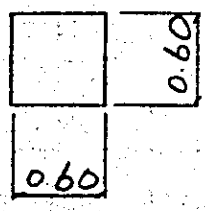
(2) Member (5-6, 6-7)



$A = 0.50 \times 0.70 = 0.350^{m^2}$

$$I = \frac{0.50 \times 0.70^3}{12} = 0.01429^{m^4}$$

(3) Member (1-5, 2-6, 3-7)



$A = 0.60 \times 0.60 = 0.360^{m^2}$

$$I = \frac{0.60 \times 0.60^3}{12} = 0.01080^{m^4}$$

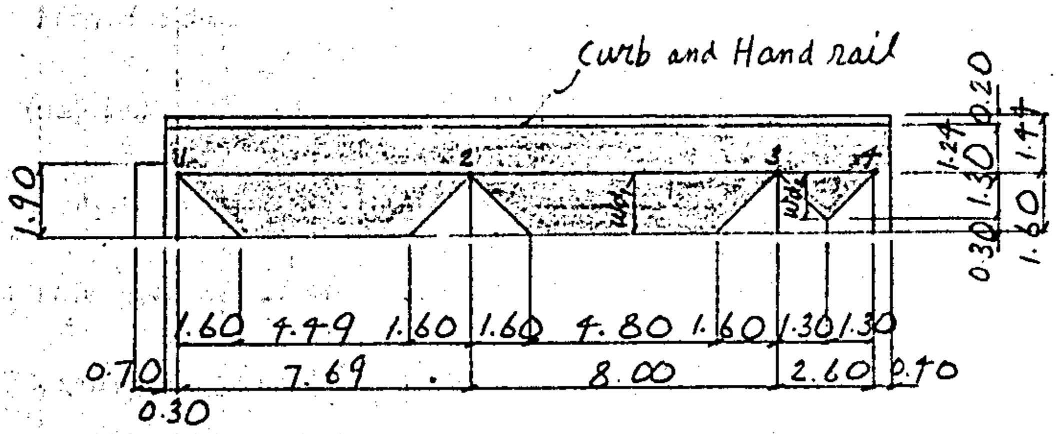
(4) Axial height

$$h = 8.00 - 0.278 + 0.30 + 0.7/2 = 8.372^{m}$$

[2] Calculation of loads

1. Dead load

(1) Member (1~2~3~4)



(a) Distributed load

Ballast	1.90 × 0.42	= 0.80 t/m²
Grading Concrete	2.35 × 0.07	= 0.16 "
Track weight	0.45 × 1/2.89	= 0.16 "
Slab	2.50 × 0.25	= 0.63 "
		w_d = 1.75 t/m

$w_{d1} = 1.75 \times 1.60 = 2.80$ t/m

$w_{d2} = 1.75 \times 1.30 = 2.28$ "

(b) Distributed load

Ballast	0.80 t/m² × 1.24	=	0.99 t/m
Curb	2.50 t/m³ × 0.20 × 0.30	=	0.15 "
Handrail		=	0.20 "
Cantilever Slab	2.50 " × (0.20 + 0.35) × ½ × 1.14	=	0.78 "
Longitudinal beam	2.50 " × 0.30 (0.90 + 0.65)	=	1.16 "
Haunch of slab	2.50 " × 0.30 × 0.10 × 1/2	=	0.04 "
Grading Concrete	2.35 × 0.07 × 1.24	=	0.20 "
		$w_{d\cdot 3}$ =	3.52 t/m

(C) Concentrated loads of elments acting at joint P_1 as shown below.

Distributed load	1.75 t/m² × 1.60 × 1.60 × ½	=	2.24 t
Distributed load	1.75 " × 0.30 × 1.60	=	0.84 "
Cross beam	2.50 " × 0.60 × 1.45 × 1.90	=	4.13 "
Beam for Bridge support	2.50 × (0.75 + 0.15) × ½ × 0.70	=	1.05 "
Haunch of slab	2.50 " × 0.30 × 0.10 × ½ × 1.00	=	0.04 "
Longitudinal beam haunch	2.50 " × 0.40 × 1.20 × ½ × 0.60	=	0.36 "
Deficit of Longitudinal Beam Weight	− 2.50 × 0.60 × 0.65 × 0.30	=	− 0.29 "
Deficit of Column Weight	− 2.50 × 0.60 × 0.60 × (1.70 − 0.278)	=	− 1.28 "

Reaction of T-beam Superstructure = 33.5 t

P_1 = 40.60 t

Joint P_2

Distributed load	1.75 t/m² × 1.60 × 1.60 × ½ × 2	= 4.48 t
Haunch of slab	2.50 × 0.30 × 0.10 × ½ × 1.0 × 2	= 0.08
Longitudinal beam haunch	2.50 × 0.40 × 1.20 × ½ × 0.60 × 2	= 0.72
Transversal beam	2.50 × 0.60 × 0.60 × 2.60	= 2.34
Addition of Column weight	2.50 × 0.60 × 0.60 × (0.278 − 0.25)	= 0.03
Deficit of Longitudinal beam weight	− 2.50 × 0.65 × 0.60 × 0.60	= − 0.59
	P_2	= 7.06 t

Joint P_3

Distributed load	1.75 t/m² × 1.60 × 1.60 × ½	= 2.24 t
Distributed load	1.75 × (0.30 + 1.60) × ½ × 1.30	= 2.16
Haunch of slab	2.50 t/m³ × 0.30 × 0.10 × ½ × 1.0 × 2	= 0.08
Longitudinal beam haunch	2.50 × 0.40 × 1.20 × ½ × 0.60 × 2	= 0.72
Transverse beam	2.50 × 0.60 × 0.60 × 2.60	= 2.34
Addition of Column weight	2.50 × 0.60 × 0.60 × (0.278 − 0.25)	= 0.03
Deficit of Longitudinal beam weight	− 2.50 × 0.65 × 0.60 × 0.60	= − 0.59
	P_3	= 6.98 t

Joint P4

Distributed load	$1.75 \times (0.3 + 1.6) \times 1/2 \times 1.30$	$= 2.16^{t}$
Distributed load	$1.75 \times 0.40 \times 1.60$	$= 1.12$ "
Haunch of slab	$2.50^{t/m^3} \times 0.30 \times 0.10 \times 1/2 \times 1.00$	$= 0.04$ "
Addition of Column weight	2.50 " $\times 0.15 \times 0.10 \times 1.60$	$= 0.06$ "
Transverse side beam	2.50 " $\times 0.50 \times 0.45 \times 1.30$	$= 0.73$ "
	P_4	$= 4.11^{t}$

(d) Moment at joint caused by beam of bridge support and T - beam bridge

$$M_4 = 33.51 \times 0.66 + 1.05 \times \left\{ 0.7/3 \times \frac{2 \times 0.45 + 0.75}{0.45 + 0.75} + 0.30 \right\}$$

$$= 22.12 + 0.65 \qquad = 22.77^{t \cdot m}$$

(2) Member (5 ~ 6 ~ 7 ~ 8)

Distributed Loads

Eerth pressure	$1.80^{t/m^3} \times 0.50 \times 0.90$	$= 0.81^{t/m}$
Bracing beam	2.50 " $\times 0.50 \times 0.70$	$= 0.88$ "
		$1.69^{t/m}$

(3) Column Weight

$$q = 2.50^{t/m^3} \times 0.60 \times 0.60 \qquad = 0.90^{t/m}$$

2 Train load and Impact

(1) Train Load

KS - 16

(a) Distributed load acting on rigid - frame

Span $\ell = 8.00^{m}$

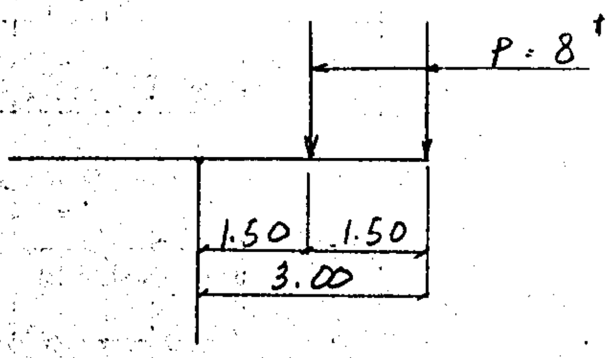
$W_{M1} = 5.40 \times 2 \times 1/2 = 5.40^{t/m}$

$W_{M2} = 4.60 \times 2 \times 1/2 = 4.60$ "

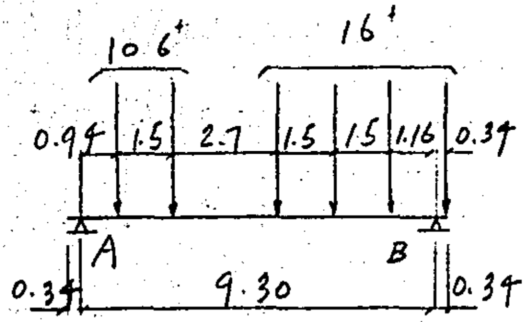
$S_s = 6.0 \times 2 \times 1/2 = 6.00$ "

b) Cantilever beam

Span $\ell = 3.00^{m}$



(c) Reaction of T-beam Supertructure



$$R_B = \frac{1}{9.30} \times \{16 \times (5.14 + 6.64 + 8.14 + 9.64) + 10.6 \times (0.94 + 2.44)\} \times 1/2 = 27.36^t$$

(2) Impact Coefficient

(a) Within eigid fram Section

Average span

$\ell = (7.69 + 8.00) \times 1/2 = 7.845^m$

$i = 0.452$

$\ell = 3.00^m$

$i = 0.528$

(b) Within T-beam bridge section

$\ell = 9.30^m$

$i = 0.437$

(3) Train Load + Impact

(a) Within rigid frame section

$w_{M1} = 5.40^{t/m} \times (1 + 0.452) = 7.84^{t/m}$

$w_{M2} = 4.60^{"} \times ($ do $) = 6.68^{"}$

$w_{S} = 6.00^{"} \times ($ do $) = 8.71^{"}$

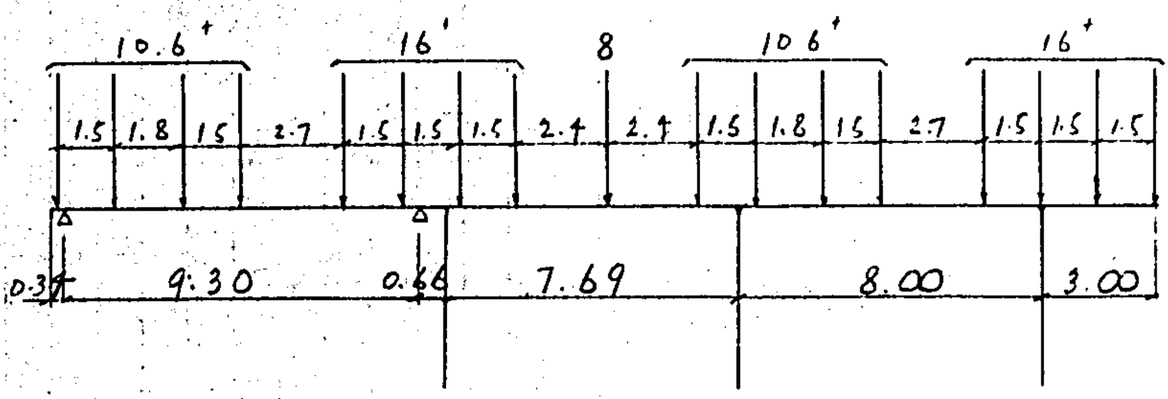
$P = 8.0^{t} \times 1.528 = 12.22^{t}$

(b) Reaction of T-beam bridge and joint moment

$R_{(l+i)} = 27.36 \times 1.437 = 39.32^{t}$

$M_{x(l+i)} = 39.32 \times 0.66 = 25.95^{t \cdot m}$

3. Break load



15% of the train load

(a) Within elevated structure sectioin.

$T_1 = (16 \times 6 + 10.6 \times 4 + 8) \times 0.15 = 21.96$

(b) Within T-beam bridge section

$T_2 = (16 \times 2 + 10.6 \times 4) \times 0.15 \times 1/2 = 5.58^t$

(c) Total brak load

acting within elevated structure section

$\Sigma H = 21.96 + 5.58 = 27.54^t$

$H = 27.54 \times 1/2 = 13.77^t$

4. Force of temperature change and/or Drying contraction

Temperaturl rise +10°C

Temperature drop + Drying contraction

-25°C

5 Dead load + Seismic force

$K_H = 0.1$

(1) Within viaduct section

Track weight	$0.45^{t/m} \times 19.00$	=	8.55^{t}
Ballast	$1.90^{t/m^3} \times 0.20 \times 2.792 \times 1/2 \times 19.00$	=	10.08
do	$1.90 \times 0.419 \times 2.792 \times 19.00$	=	42.23
do	$1.90 \times 0.619 \times 1.114 \times 1/2 \times 19.00$	=	12.45
do	$1.90 \times 0.419 \times 0.754 \times 1/2 \times 19.00$	=	5.70
grading Concrete	$2.35 \times 0.07 \times 5.00 \times 19.00$	=	15.63
Handrail	$0.20^{t/m} \times 19.00 \times 2$	=	7.60
Curb	$2.50^{t/m^3} \times 0.30 \times 0.20 \times 18.98$	=	2.85
do	$2.50 \times 0.30 \times 0.25 \times 18.98$	=	3.56
Ballast stopper	$2.50 \times 0.30 \times 0.15 \times 18.98$	=	2.14
Duct cover	$2.50 \times 0.05 \times 0.30 \times 18.98$	=	0.71
Cable Weight	$0.06^{t/m} \times 19.00$	=	1.14
Cantilever slab	$2.50^{t/m^3} \times (0.2+0.35) \times 1/2 \times 1.14 \times 18.98$	=	14.88
do	$2.50 \times (0.2+0.35) \times 1/2 \times 0.96 \times 18.98$	=	12.53
Slab	$2.50 \times 0.25 \times 3.80 \times 18.98$	=	45.08
Haunch of slab	$2.50 \times 0.3 \times 0.1 \times 1/2 \times (7.09 \times 2 + 7.40 \times 2 + 2.05 \times 2 + 2.00 \times 6)$	=	1.69

Longitudinal beam	$2.50^{t/m^3} \times 0.6 \times 0.65 \times (7.09+7.4+2.55) \times 2$	=	33.23^{t}
Longitudinal beam Haunch	$2.50 \times 0.40 \times 1.20 \times 1/2 \times 0.60 \times 10$	=	3.60"
Cross beam	$2.50 \times 0.60 \times 0.60 \times 2.60 \times 2$	=	4.68"
do	$2.50 \times 0.50 \times 0.45 \times 2.60$	=	1.46"
do	$2.50 \times 0.15 \times 0.10 \times 2.60$	=	0.10"
do	$2.50 \times 0.60 \times 1.45 \times 2.60$	=	5.66"
Beam for Bridge support	$2.50 \times (0.45+0.75) \times 1/2 \times 0.70 \times 3.80$	=	3.99"
Column (1/2)	$0.90^{t/m} \times (7.722 \times 1/2 + 0.278 - 0.25) \times 6$	=	21.00"
Sopport of electric pole	$2.50^{t/m^3} \times (0.6+0.9) \times 1/2 \times 1.60 \times 0.75$	=	2.25"
do	$2.50 \times (0.75 \times 0.75 - 3.142 \times 0.45^2 \times 1/4) \times 1.0$	=	1.01"
Electric pole load		=	2.00
			265.80

$$\Sigma H = 265.80 \times 0.10 = 26.58^{t}$$

(2) Within T-beam bridge section

$$W = (33.11 + 33.51) \times 2 = 133.24^{t}$$

$$H = 133.24 \times 0.1 \times 1/2 = 6.66^{t}$$

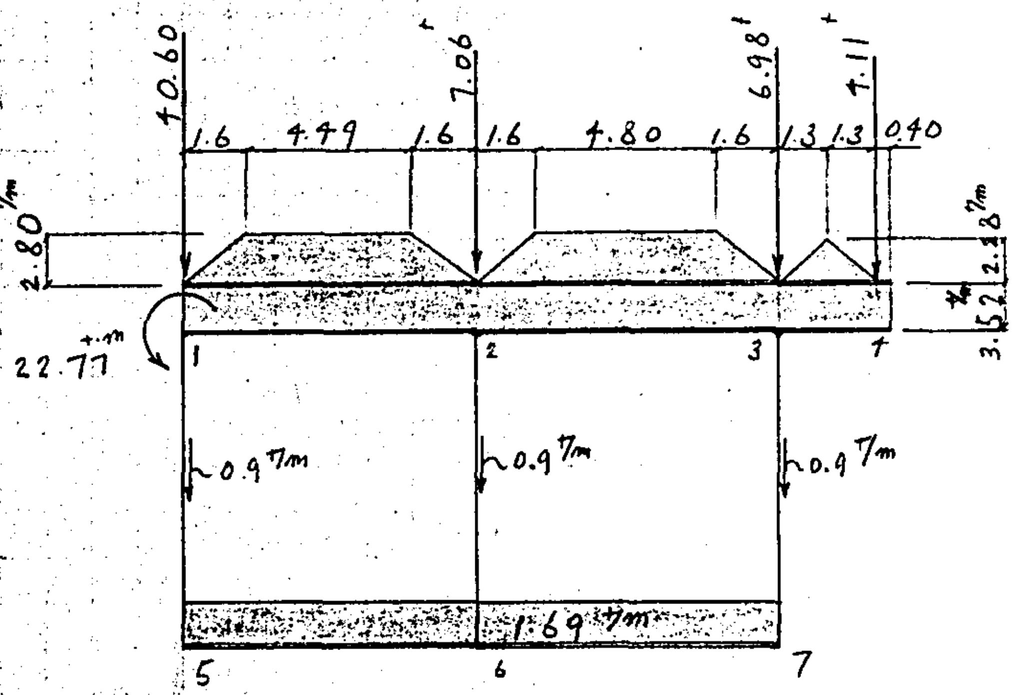
(3) Total Seismic load

acting within elevated structure section

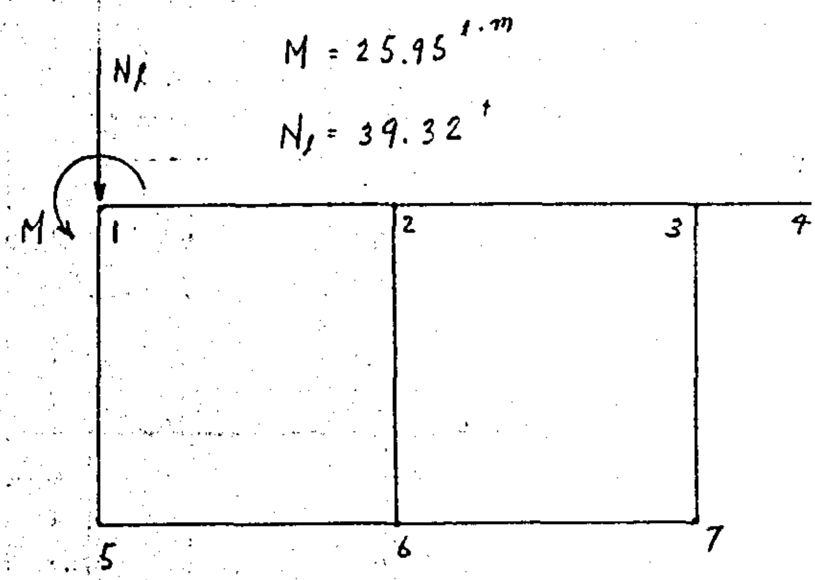
$$H = (26.58 + 6.66) \times 1/2 = 16.62^{t}$$

[3] Loading diagram

Case 1 Dead Load



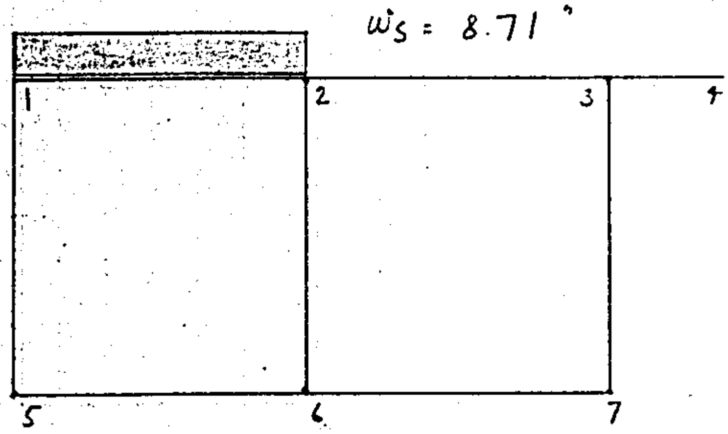
Case 2 Train Load + Impact (1)



Case 3 Train Load + Impact (2)

$w_M = 7.84$ T/m

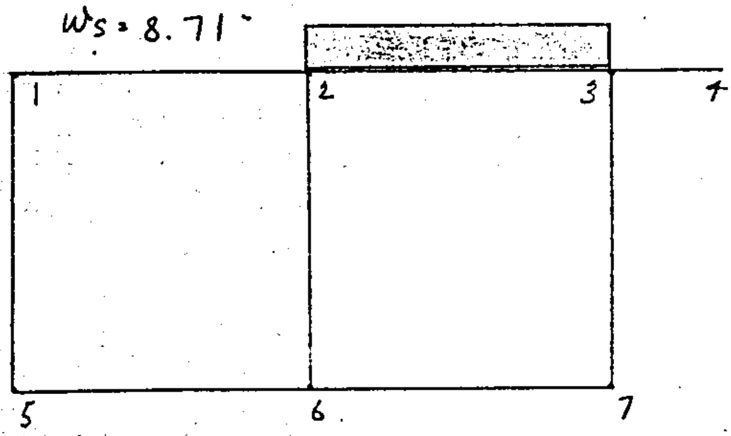
$w_S = 8.71$ "



Case 4 Train Load + Impact (3)

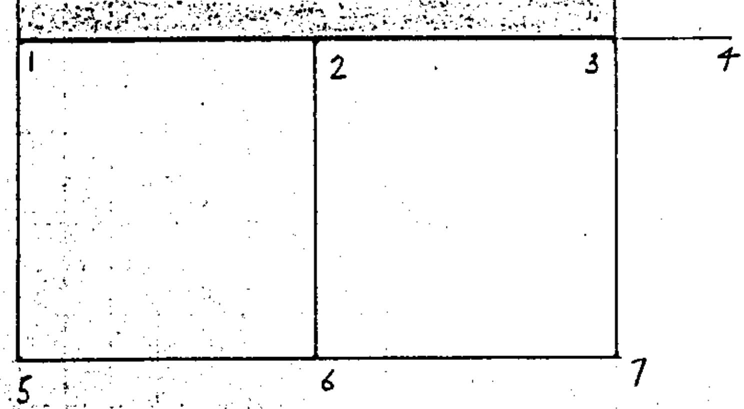
$w_M = 7.84$ T/m

$w_S = 8.71$ "

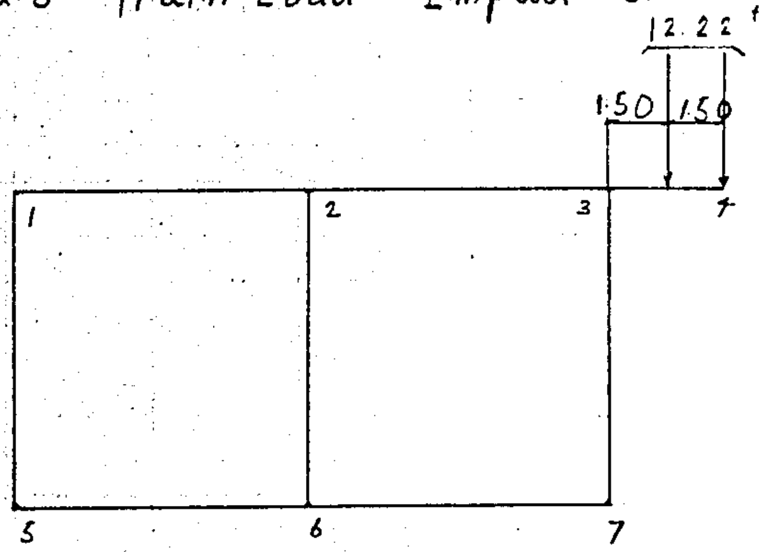


Case 5 Train Load + Impact (4)

$w_M = 6.68$ T/m $w_S = 8.71$ T/m

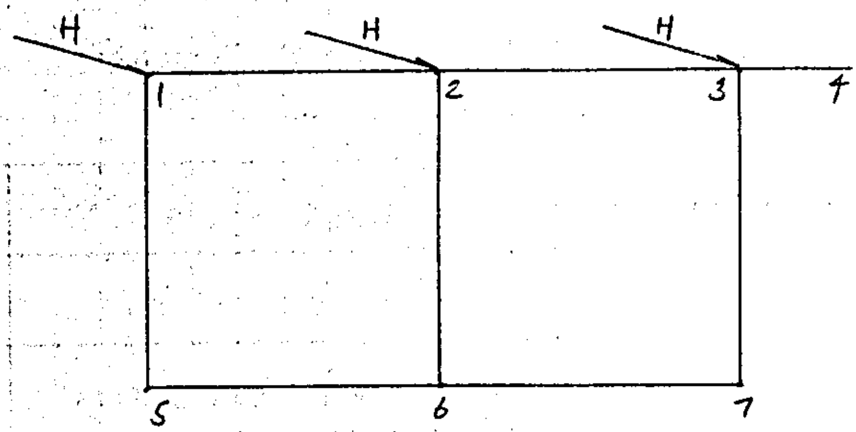


Case 6 Train Load + Impact (5)

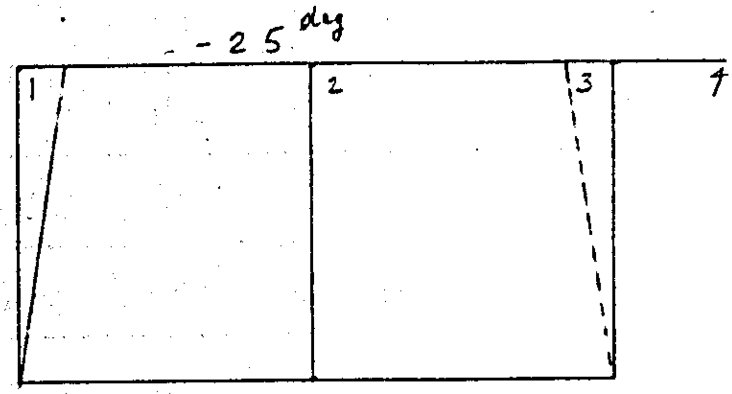


Case 7 Brak load

$H = 13.77 \times 1/3 = 4.59^t$



Case 8 Temperature drop + Drying contraction

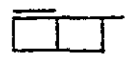
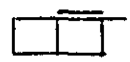
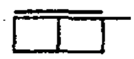
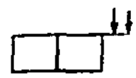


Case 9 Seismic load

$$\text{Case 7} \times \frac{16.62}{13.77} = \text{Case 7} \times 1.207$$

(4) Combination of load

Basic load

Case No	Kind of load	Loading pattern
1	Dead Load	
2	Train Load + Impact (1)	
3	do (2)	
4	do (3)	
5	do (4)	
6	do (5)	
7	Brak load	
8	Temperature + Contraction	−25°C
9	Seismic Load	Case 7 × 1.207

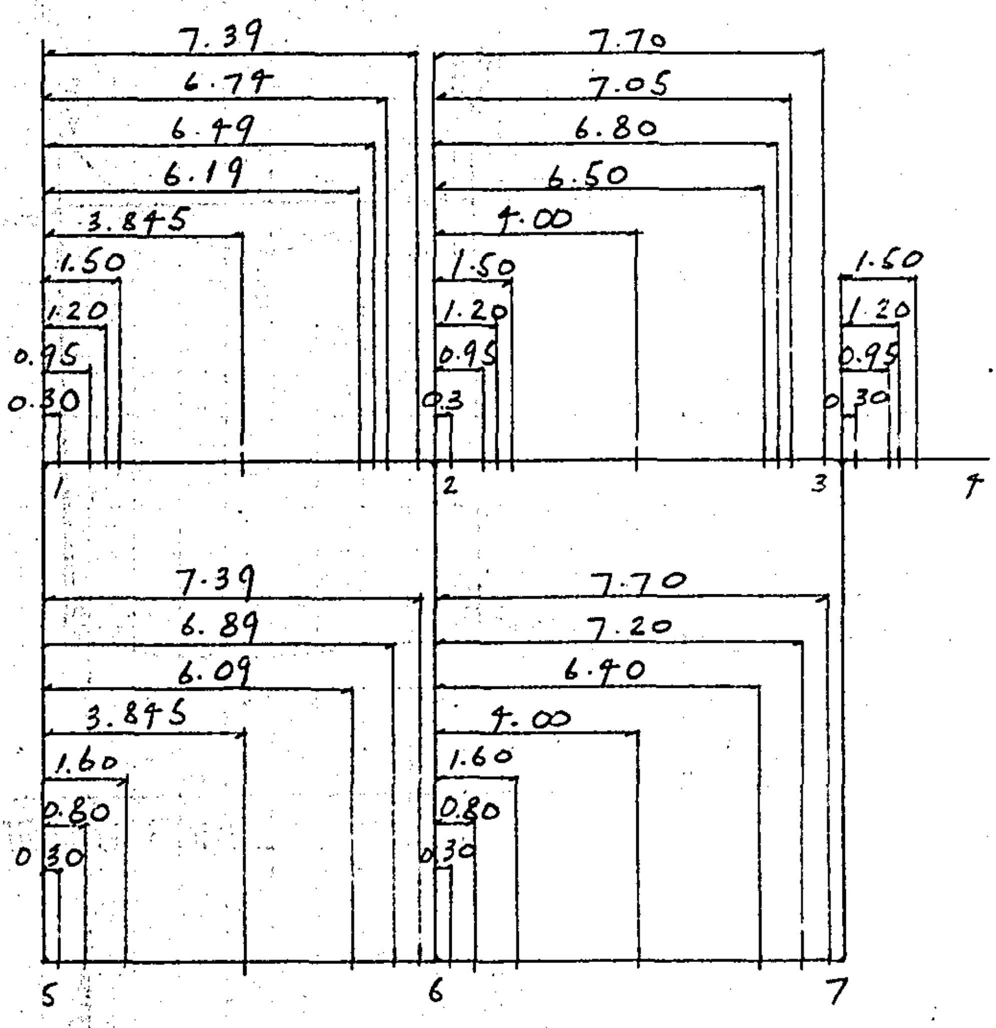
Combined loads.

Case No	Combination of loads	α
10	1 + 2 + 3	1.0000
11	1 + 3	do
12	1 + 4	do
13	1 + 5	do
14	1 + 2 + 5 + 6	do
15	1 + 8	0.8696
16	1 + 2 + 5 + 6 + 7	do
17	1 + 2 + 2 + 5 - 7	do
18	1 + 9	0.6667
19	1 - 9	do

Critical case

Case 10 ~ Case 19

(5) Point of computing stresses

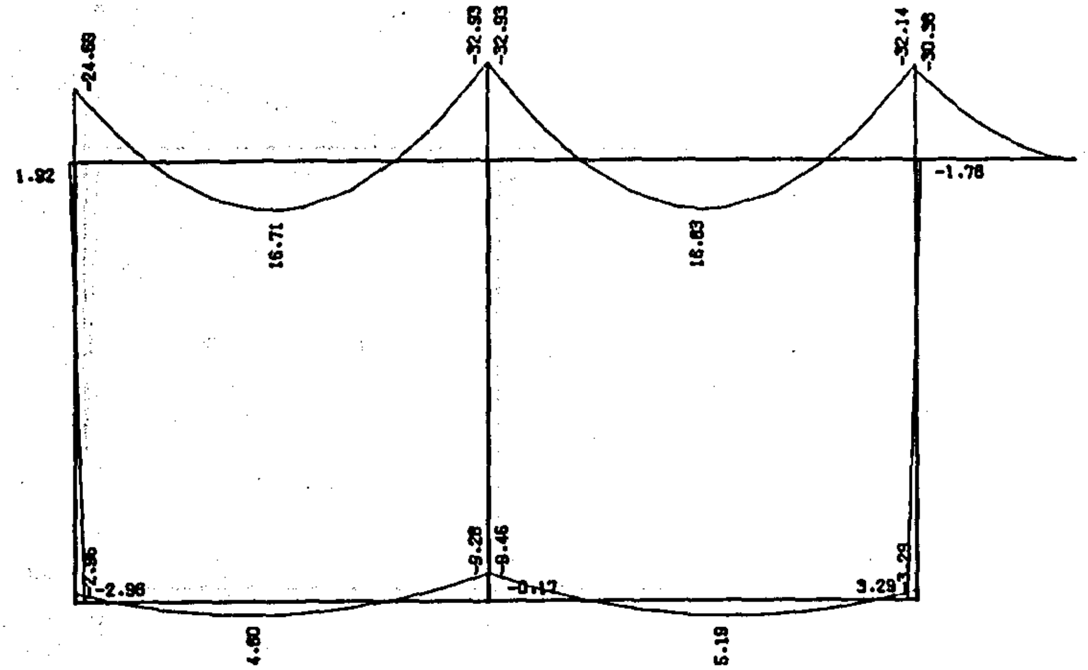


(6) Stress diagrams

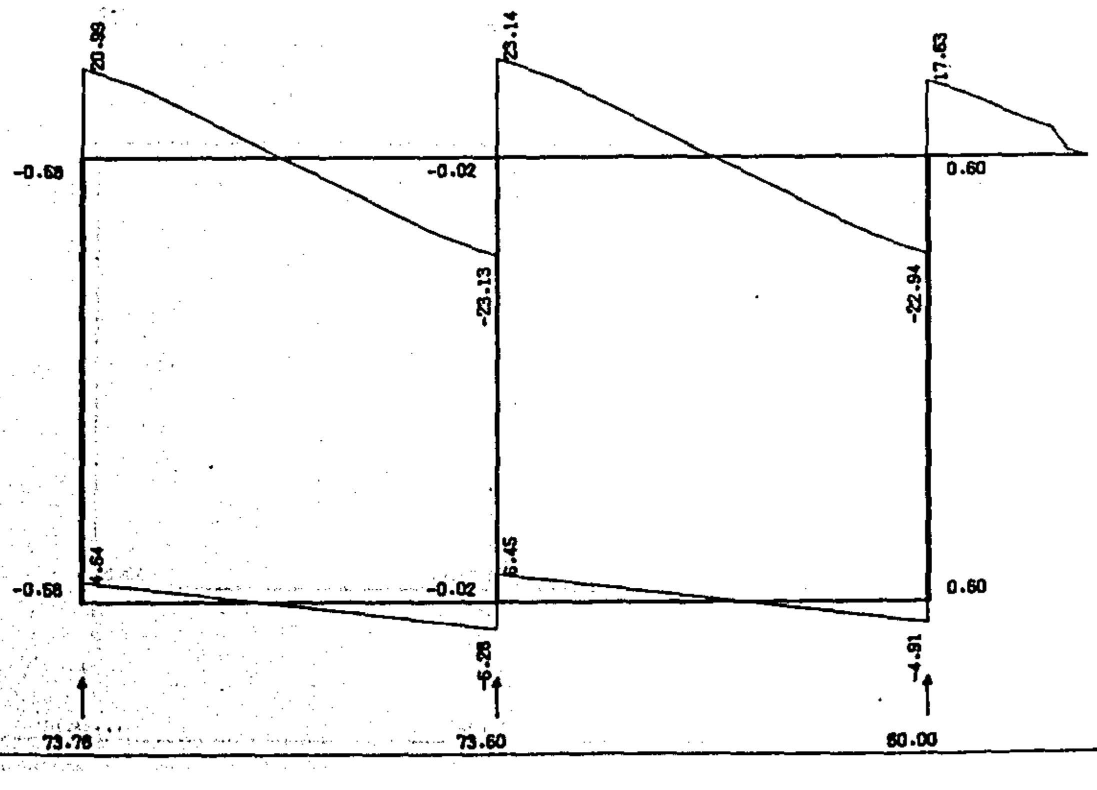
VIADUCT OF SINGLE TRACK (8*2+3=19) L-1

CASE 1

BENDING MOMENT



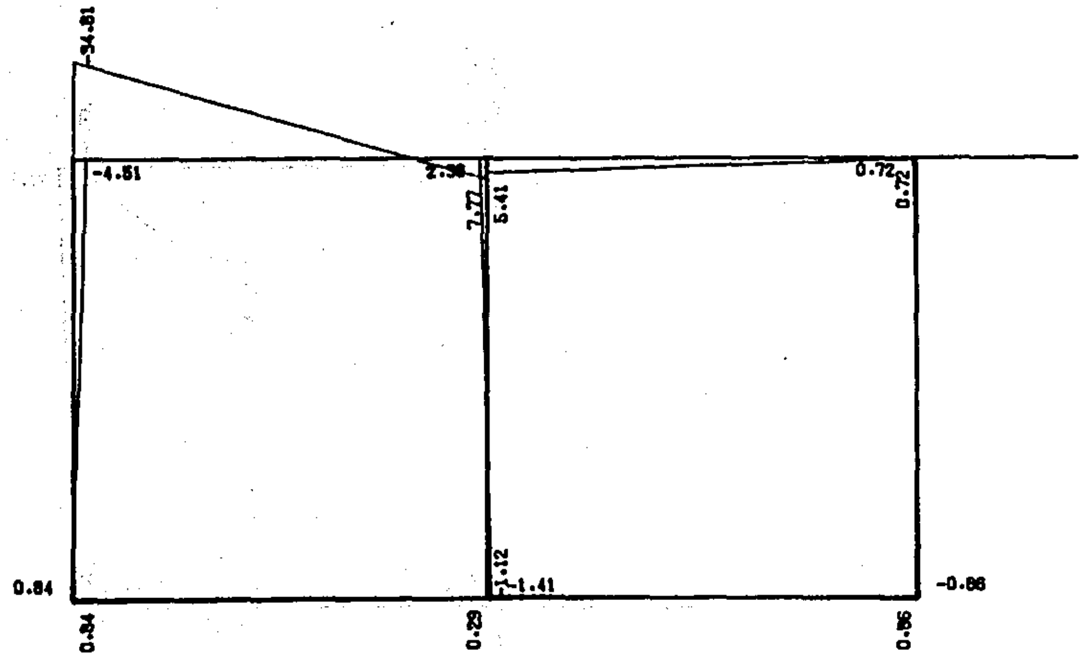
SHEARING FORCE



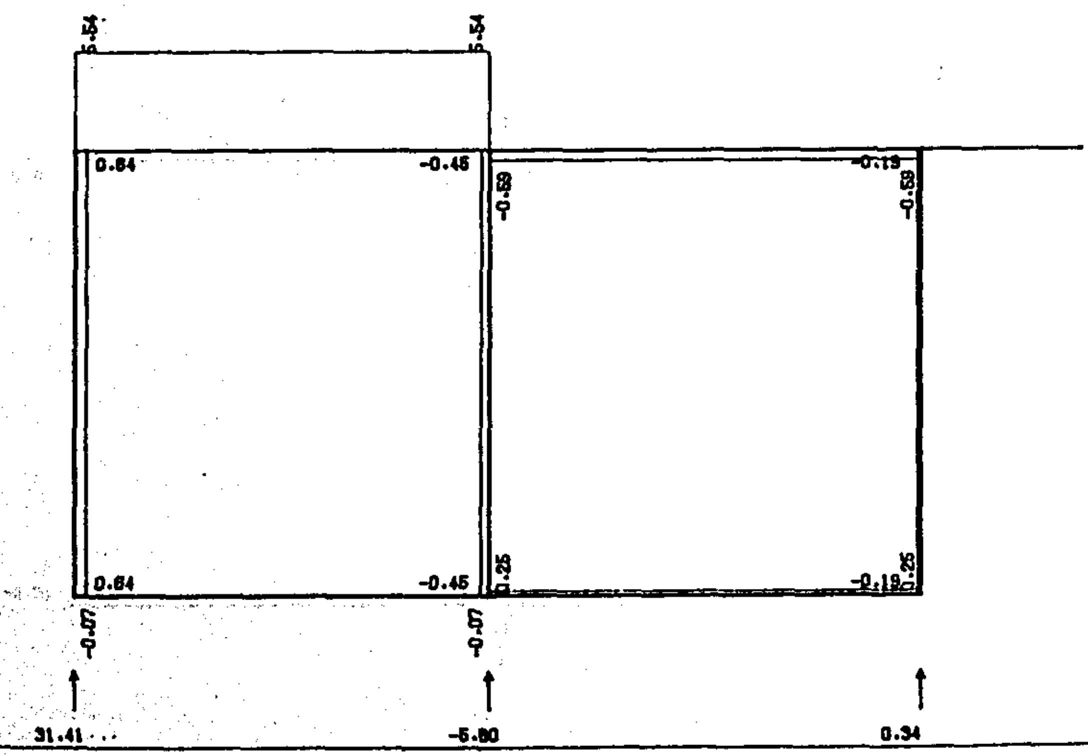
VIADUCT OF SINGLE TRACK (8*2+3=19) L-1

CASE 2

BENDING MOMENT



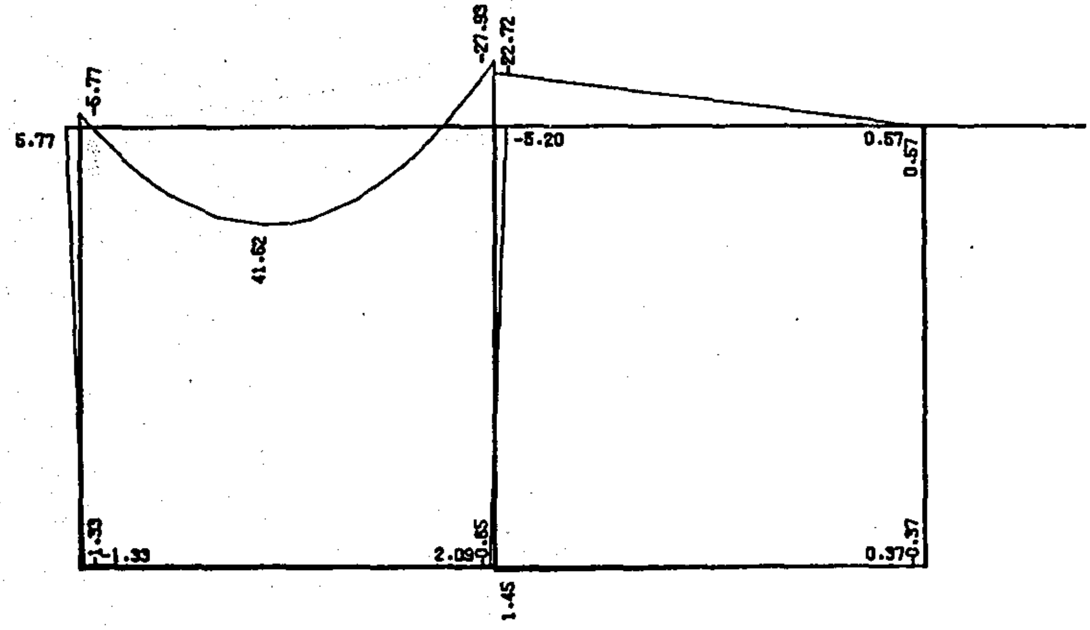
SHEARING FORCE



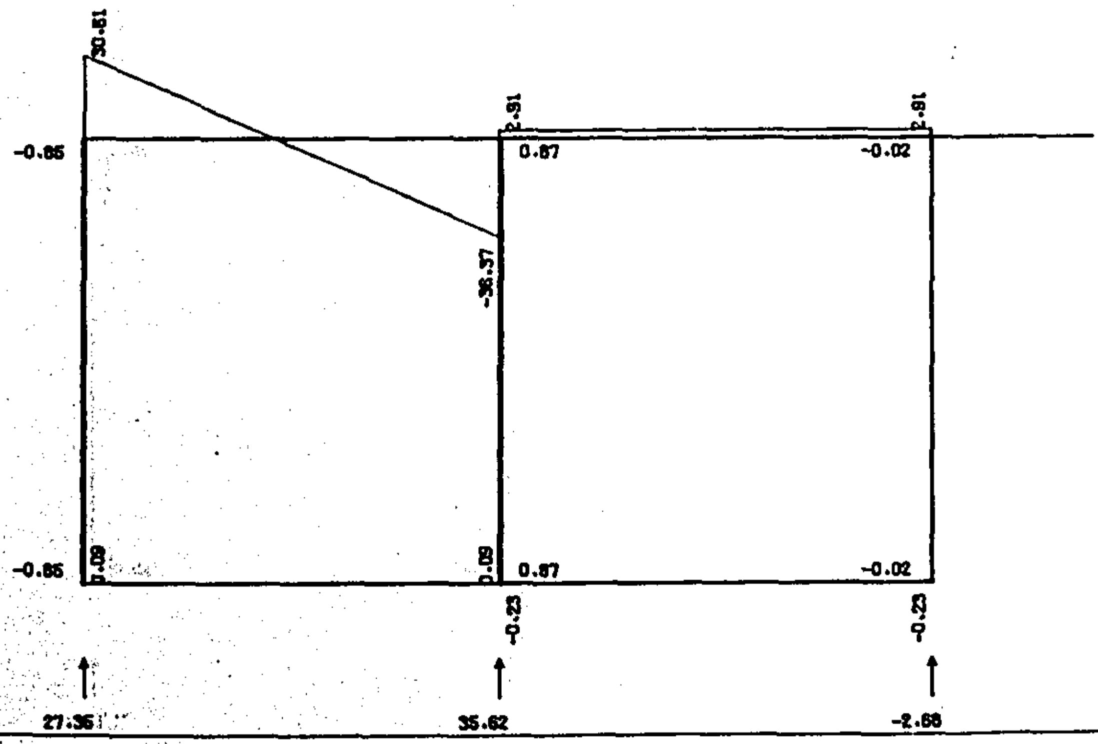
VIADUCT OF SINGLE TRACK (8*2+3=19) L-1

CASE 3

BENDING MOMENT



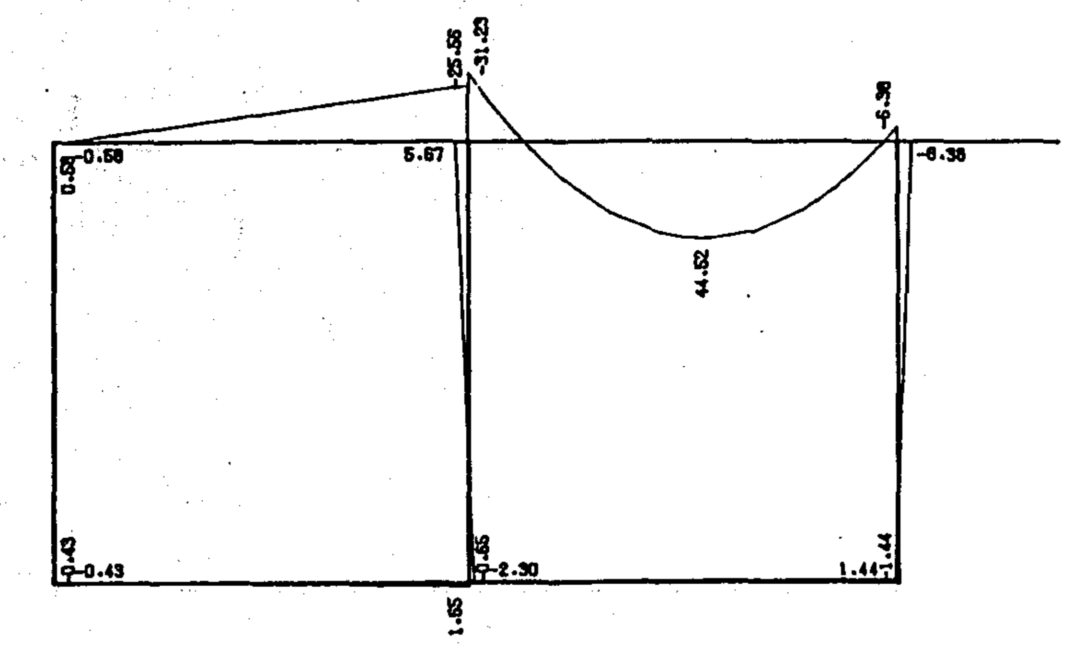
SHEARING FORCE



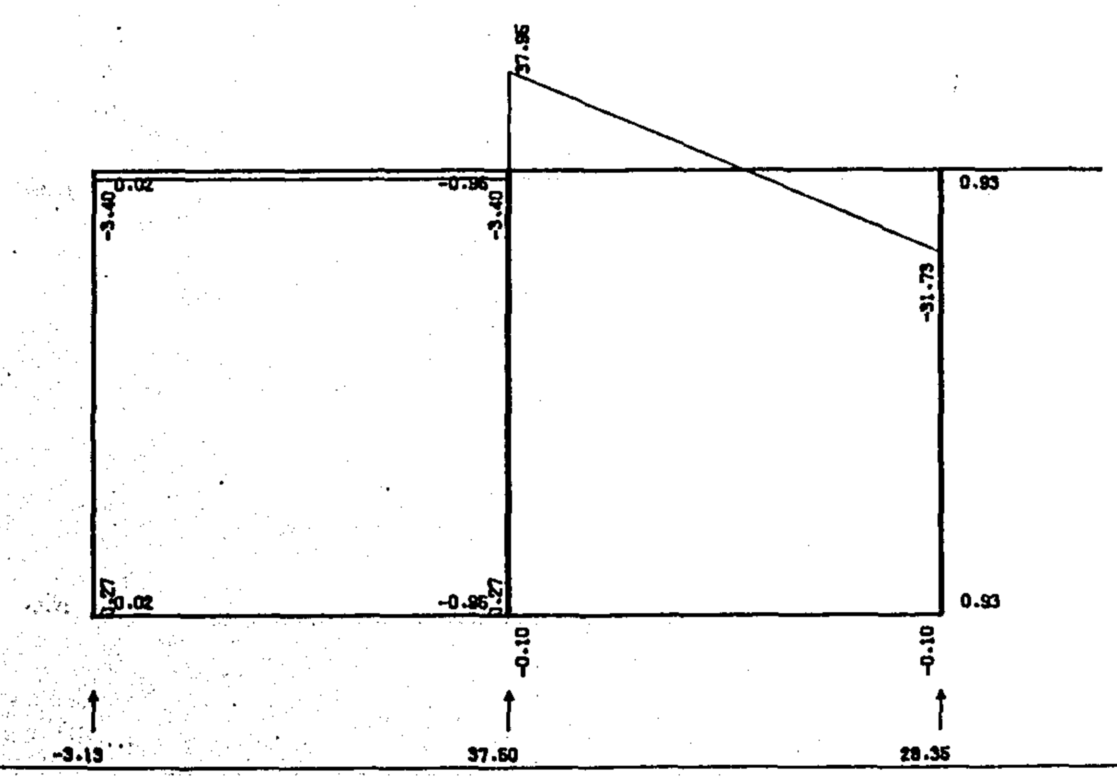
VIADUCT OF SINGLE TRACK (8*2+3=19) L-1

CASE 4

BENDING MOMENT



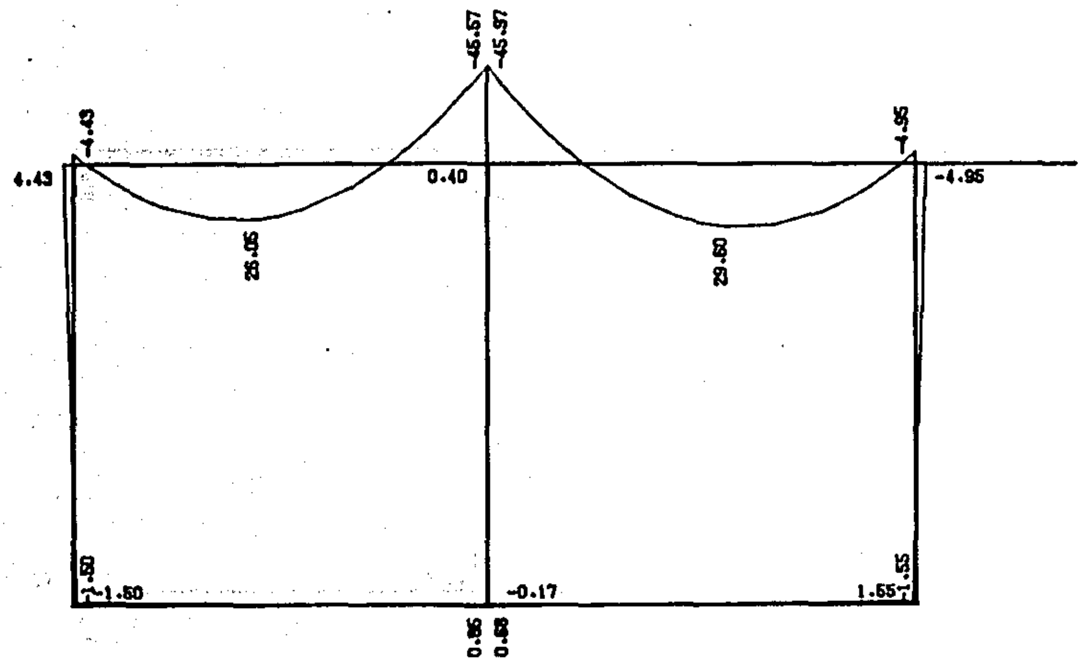
SHEARING FORCE



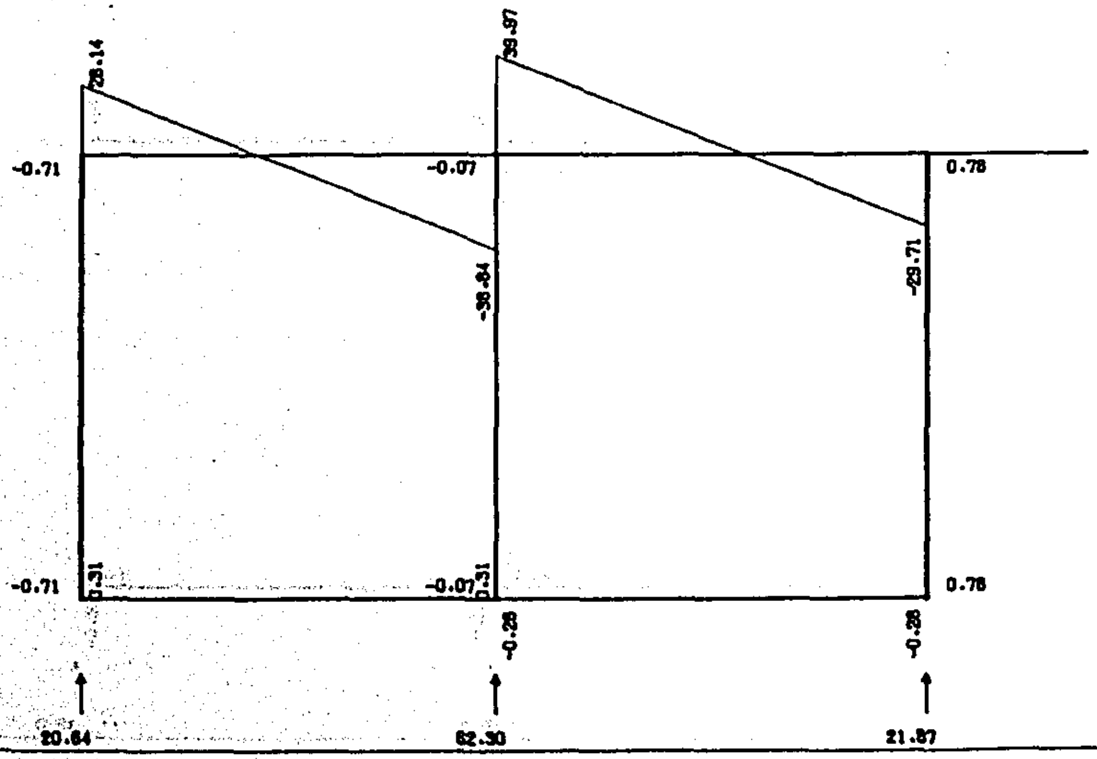
VIADUCT OF SINGLE TRACK (8*2+3=19) L-1

CASE 5

BENDING MOMENT



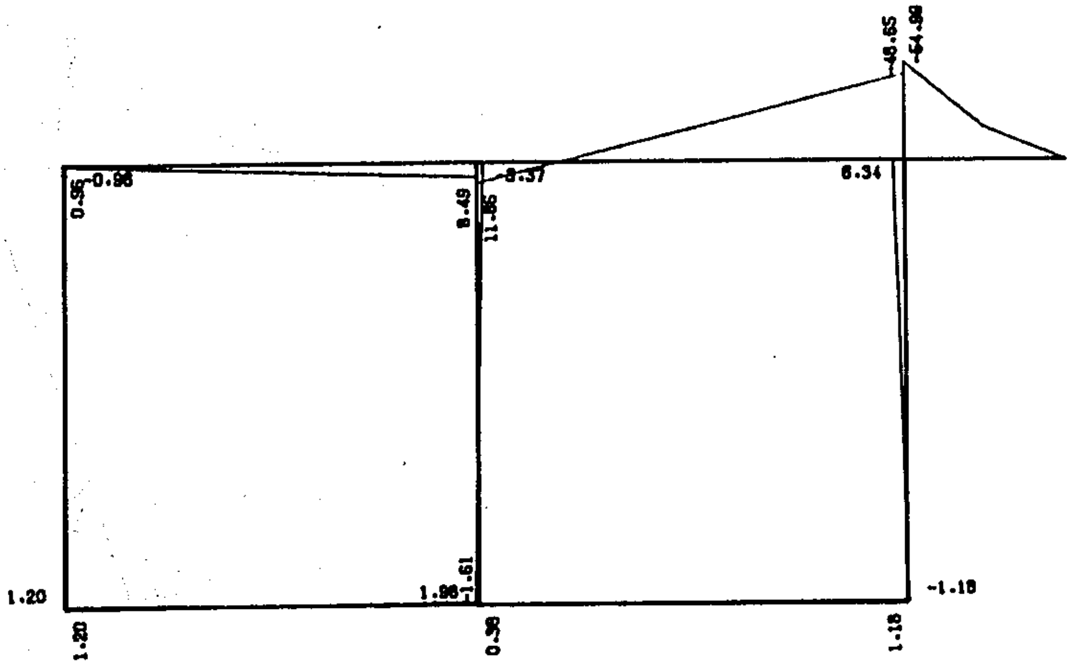
SHEARING FORCE



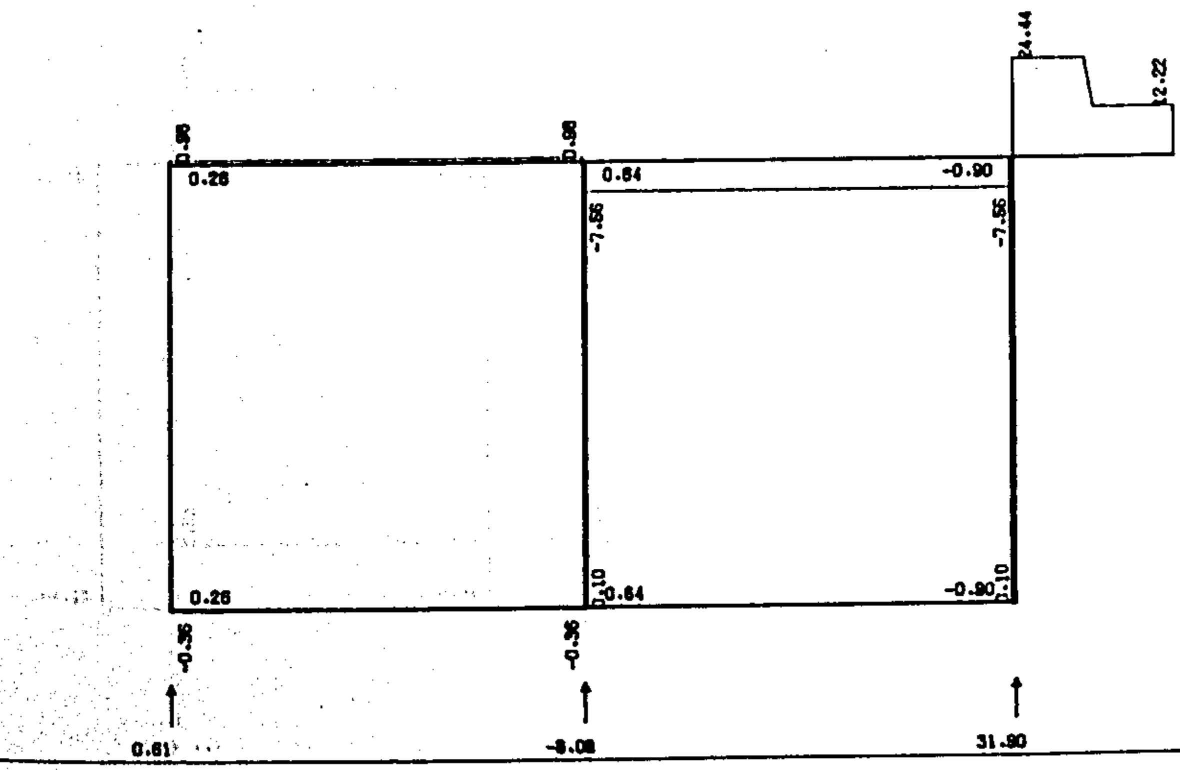
VIADUCT OF SINGLE TRACK (8*2+3=19) L-1

CASE 6

BENDING MOMENT



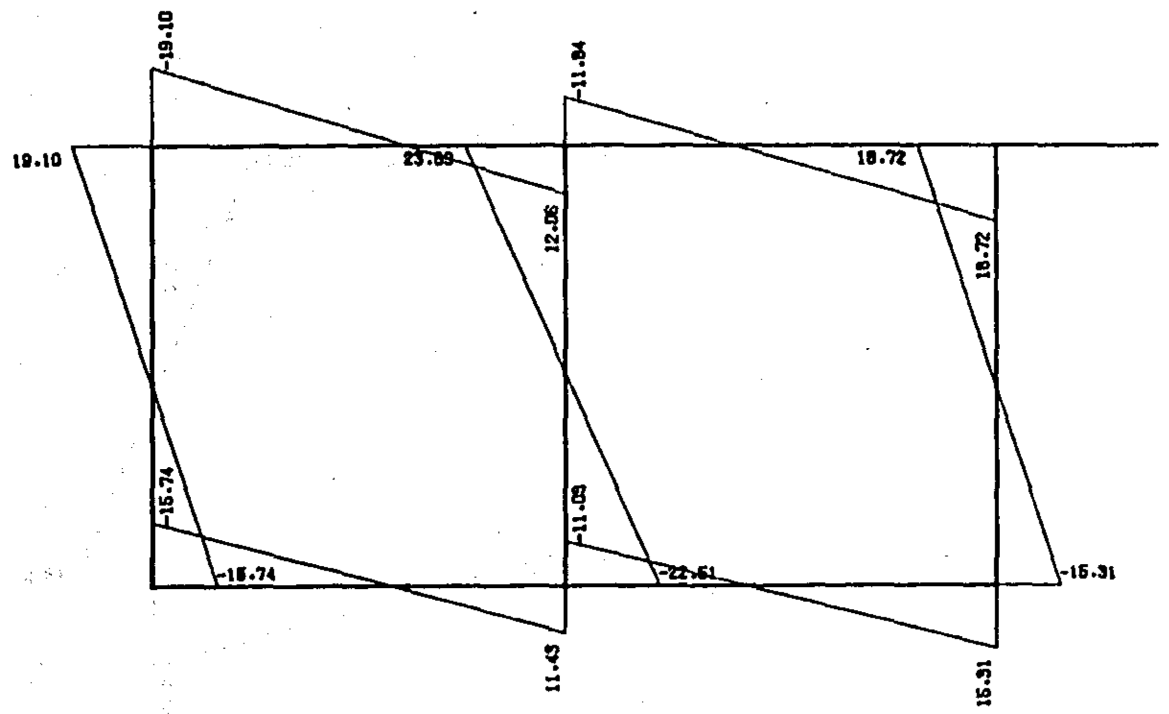
SHEARING FORCE



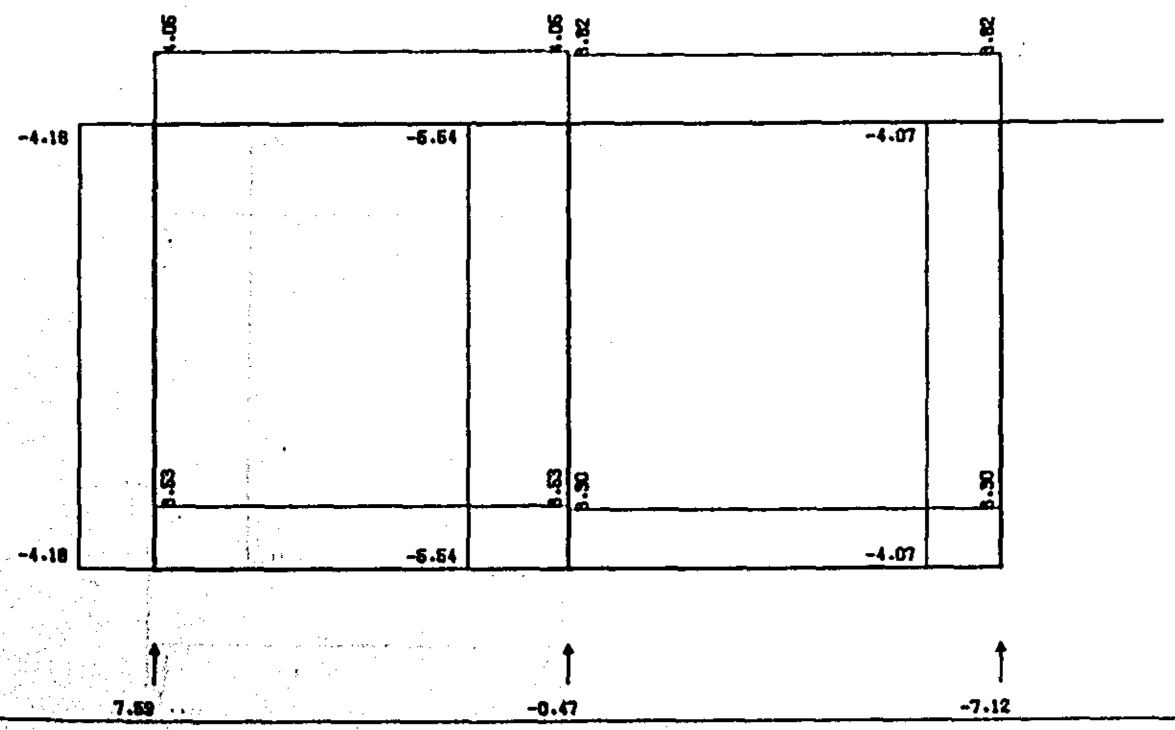
VIADUCT OF SINGLE TRACK (8*2+3=19) L-1

CASE 7

BENDING MOMENT



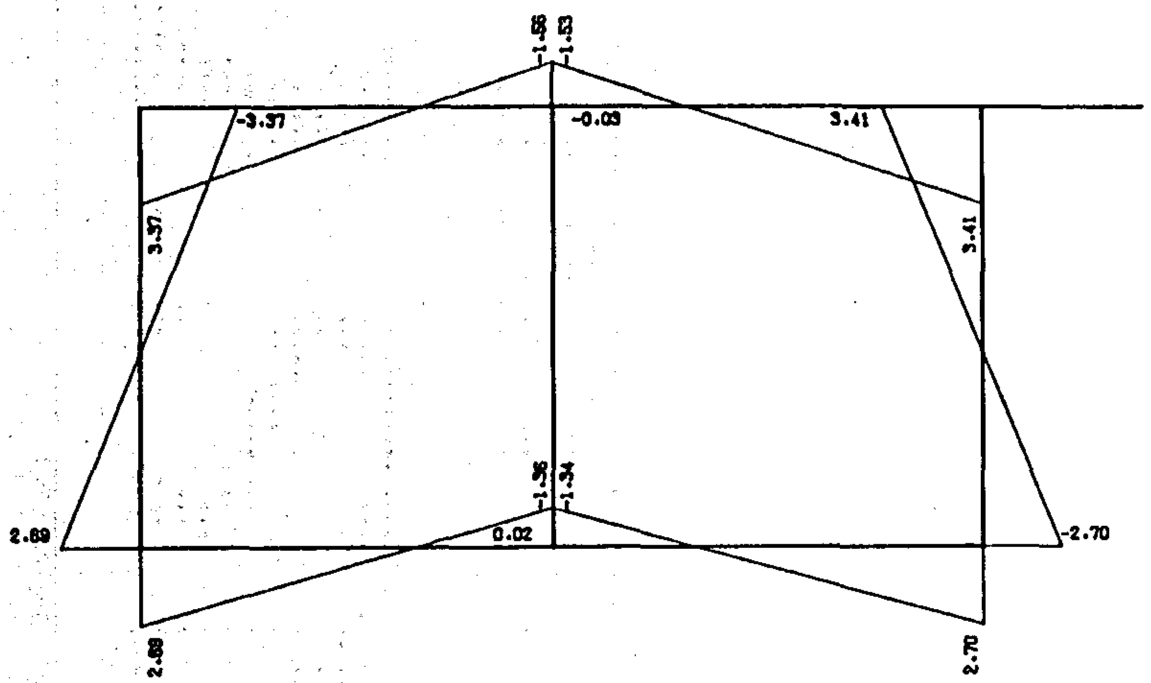
SHEARING FORCE



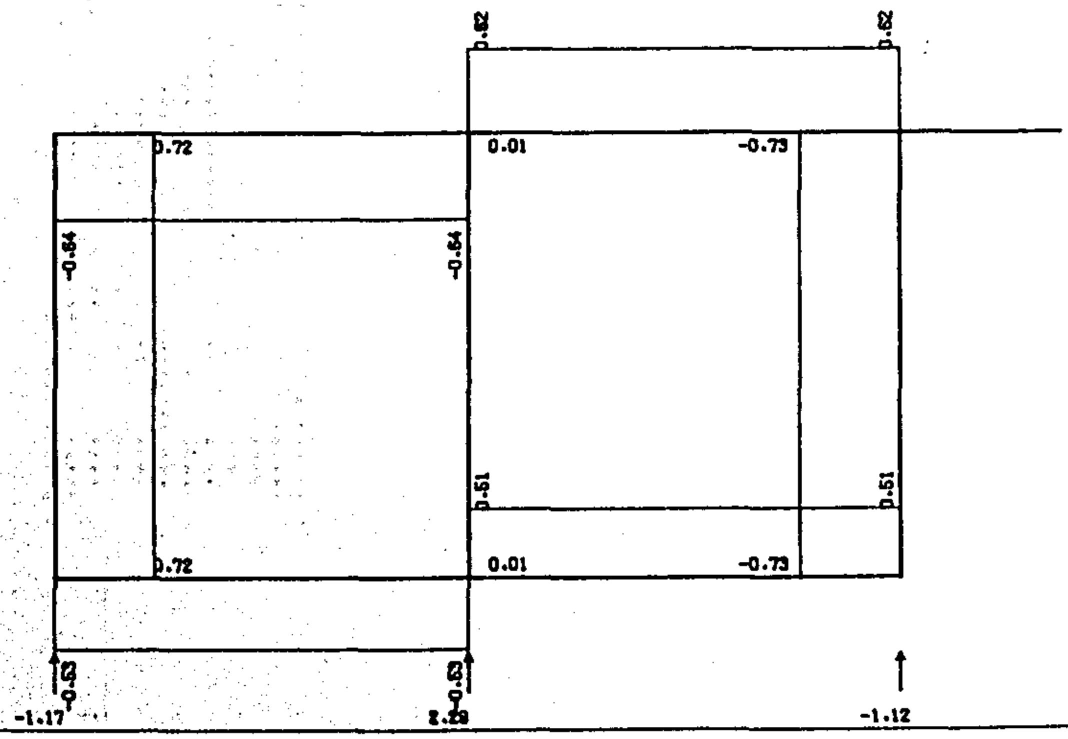
VIADUCT OF SINGLE TRACK (8*2+3=19) L-1

CASE 8

BENDING MOMENT



SHEARING FORCE



[7] Result of computor analysis

KANSY

PLANE

CRC

CENTURY RESEARCH CENTER CORP.

VIADUCT OF SINGLE TRACK (8*2+3=19) L-1

V6.3

No 75

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*** INPUT DATA ***                                                              CRC-FANSY   V6.3
         5   10        20        30        40        50        60        70        80     CARD NUMBER
        ................................................................................
TITLE     VIADUCT OF SINGLE TRACK (8*2+3=19) L-1                                              1
CONTROL          8                                                                            2
PLOT              1        2                                                                  3
SHEAR            1    2    1    2                                                             4
JOINT            1            0.000     0.000                                                 5
                 2            7.690     0.000                                                 6
                 3           15.690     0.000                                                 7
                 4           18.690     0.000                                                 8
                 5            0.000    -8.372                                                 9
                 6            7.690    -8.372                                                10
                 7           15.690    -8.372                                                11
MEMBER           1  1 1    1    2                                                            12
                 2  1 1    2    3                                                            13
                 3  1 1    3    4                                                            14
                 4  2 1    5    6                                                            15
                 5  2 1    6    7                                                            16
                 6  3 1    1    5                                                            17
                 7  3 1    2    6                                                            18
                 8  3 1    3    7                                                            19
SUPPORT          5  001                                                                      20
                 6  101                                                                      21
                 7  101                                                                      22
SECTION          1    0       1.179   0.06990                                                23
                 2    0       0.350   0.01429                                                24
                 3    0       0.360   0.01080                                                25
PROPERTY         1            2.7E6               1.0E-5                                     26
POINT        1    0.300       0.950     1.200     1.500     3.845     6.190     6.490        27
                  6.740       7.390                                                          28
             2    0.300       0.950     1.200     1.500     4.000     6.500     6.800        29
                  7.050       7.700                                                          30
             3    0.300       0.950     1.200     1.500                                      31
             4    0.300       0.650     1.600     3.845     6.090     7.040     7.390        32
             5    0.300       0.650     1.600     4.000     6.400     7.350     7.700        33
PICKUP           1    1    10   19                                                           34
LOAD             10                                                                          35
DL               1    2      -2.800     1.600     1.600               2                      36
L                3    2       0.000    -2.280     0.000     1.700                            37
L                3    2      -2.280     0.000     1.300     0.400                            38
LL               1  3 2      -3.520    -3.520     0.000     0.000                            39
LL               4  5 2      -1.420    -1.420     0.000     0.000                            40
J                1            0.000   -40.600    22.770                                      41
J                2            0.000    -7.060                                                42
                 3            0.000    -6.980                                                43
C                3    2      -4.110     2.600                                                44
L                6    2      -0.900    -0.900                         7    8                 45
END                                                                                          46
LOAD             2RI  1                                                                      47
J                1                    -25.950    39.320                                      48
END                                                                                          49
LOAD             3RI  2                                                  1.110970            50
L                1    2      -7.840    -7.840                                                51
END                                                                                          52
LOAD             4RI  3                                                  1.110970            53
L                2    2      -7.840    -7.840                                                54
END                                                                                          55
LOAD             5RI  4                                                  1.303890            56
LL               1  2 2      -6.680    -6.680                                                57
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=== INPUT DATA ===                                                    CRC-FANSY   V6.3
        5    10        20        30        40        50        60        70        80     CARD NUMBER
        ................................................................................
        END                                                                                   58
        LOAD          6RI  5                                                                  59
        C             3    2   -12.220     1.500                                              60
        J             4                   -12.220                                             61
        END                                                                                   62
        LOAD          7B                                                                      63
        J             1         -4.590                           2    3                       64
        END                                                                                   65
        LOAD          8TC                                                                     66
        T             1    2       -25                                                        67
        END                                                                                   68
        LOAD          9ED                                                                     69
        MIX                1  1.207  7                                                        70
        END                                                                                   71
        MT2      10   1.0000    1    2    3                                                   72
                 11   1.0000    1    3                                                        73
                 12   1.0000    1    4                                                        74
                 13   1.0000    1    5                                                        75
                 14   1.0000    1    2    5    6                                              76
                 15   0.8696    1    8                                                        77
                 16   0.8696    1    2    5    6    7                                         78
                 17   0.8696    1    2    5    6   -7                                         79
                 18   0.6667    1    9                                                        80
                 19   0.6667    1   -9                                                        81
        FINISH                                                                                82
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TITLE..VIADUCT OF SINGLE TRACK (8*2+3=19) L-1 CRC-FANSY V6.3

CONTROL DATA

METHOD	STRUCTURE	J.RENUMBER	M.RENUMBER	S.F. DIS.	UNI.SPRING	STAN.STIF.	BARA	SKEW MEM.
DIS	*RAHMEN*	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*

LOAD TITLE

```
LOAD  1   CASE  1                              LOAD  2   CASE  2
LOAD  3   CASE  3                              LOAD  4   CASE  4
LOAD  5   CASE  5                              LOAD  6   CASE  6
LOAD  7   CASE  7                              LOAD  8   CASE  8

MIX   9   CASE  9 (SHI KAJYU JISHIN)           MIX  10   CASE  10 (1+2+3)
MIX  11   CASE  11 (1+3)                       MIX  12   CASE  12 (1+4)
MIX  13   CASE  13 (1+5)                       MIX  14   CASE  14 (1+2+5+6)
MIX  15   CASE  15 (1+8)                       MIX  16   CASE  16 (1+2+5+6+7)
MIX  17   CASE  17 (1+2+5+6-7)                 MIX  18   CASE  18 (1+9)
MIX  19   CASE  19 (1-9)
```

PICK UP LOAD CASE

PICK 1 10 11 12 13 14 15 16 17 18 19

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TITLE..VIADUCT OF SINGLE TRACK (8*2+3=19) L-1 CRC-FANSY V6.3

JOINT DATA

JOINT NUMBER 7

JOINT	X	Y
1	0.0000	0.0000
2	7.6900	0.0000
3	15.6900	0.0000
4	18.6900	0.0000
5	0.0000	-8.3720
6	7.6900	-8.3720
7	15.6900	-8.3720

MEMBER DATA

MEMBER NUMBER 8

MEMBER	ITAN	JTAN	CONNECT. ITAN	JTAN	LENGTH	A	I
1	1	2	FIX	FIX	7.6900	1.17900	.0699000
2	2	3	FIX	FIX	8.0000	1.17900	.0699000
3	3	4	FIX	FIX	3.0000	1.17900	.0699000
4	5	6	FIX	FIX	7.6900	.35000	.0142900
5	6	7	FIX	FIX	8.0000	.35000	.0142900
6	1	5	FIX	FIX	8.3720	.36000	.0108000
7	2	6	FIX	FIX	8.3720	.36000	.0108000
8	3	7	FIX	FIX	8.3720	.36000	.0108000

PROPERTY DATA

PROPERTY NUMBER 1

PROPERTY	E	G	EPS
1	2.700E+06	0.	1.000E-05

SUPPORT DATA

SUPPORT NUMBER 3

SUPPORT	X	Y	THET Z
5	FIX	FIX	FREE
6	FREE	FIX	FREE
7	FREE	FIX	FREE

No 79

TITLE..VIADUCT OF SINGLE TRACK (8*2+3=19) L-1 CRC-FANSY V6.3

STRUCTURAL FIGURE

```
+---------------+---------------+-------+
I 1             I 2             I 3      4
I               I               I
I               I               I
I               I               I
I               I               I
I               I               I
I               I               I
I               I               I
I               I               I
I               I               I
I               I               I
+---------------+---------------+
# 5             # 6             # 7
```

TITLE..VIADUCT OF SINGLE TRACK (8*2+3=19) L-1 CRC-FANSY V6.3

MOVE DATA

MEMBER	ITAN	JTAN	POINT 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	......	......	.300	.950	1.200	1.500	3.845	6.190	6.490	6.740	7.390					
2	......	......	.300	.950	1.200	1.500	4.000	6.500	6.800	7.050	7.700					
3	......	......	.300	.950	1.200	1.500										
4	......	......	.300	.650	1.600	3.845	6.090	7.040	7.390							
5	......	......	.300	.650	1.600	4.000	6.400	7.350	7.700							
6	......	......														
7	......	......														
8	......	......														

No 81

LOAD DATA

	M/J	NAME	D	W1	W2	L1	L2
LOAD - 1		CASE 1					
MEMBER	1	LINEAR	Y	0.000	-2.800	0.000	6.090
		LINEAR	Y	-2.800	-2.800	1.600	1.600
		LINEAR	Y	-2.800	0.000	6.090	0.000
		LINEAR	Y	-3.520	-3.520	0.000	0.000
	2	LINEAR	Y	0.000	-2.800	0.000	6.400
		LINEAR	Y	-2.800	-2.800	1.600	1.600
		LINEAR	Y	-2.800	0.000	6.400	0.000
		LINEAR	Y	-3.520	-3.520	0.000	0.000
	3	LINEAR	Y	0.000	-2.280	0.000	1.700
		LINEAR	Y	-2.280	0.000	1.300	.400
		LINEAR	Y	-3.520	-3.520	0.000	0.000
		CONCENT	Y	-4.110		2.600	
	4	LINEAR	Y	-1.420	-1.420	0.000	0.000
	5	LINEAR	Y	-1.420	-1.420	0.000	0.000
	6	LINEAR	Y	-.900	-.900	0.000	0.000
	7	LINEAR	Y	-.900	-.900	0.000	0.000
	8	LINEAR	Y	-.900	-.900	0.000	0.000
JOINT	1	JOINTLOAD	Y	-40.600			
		JOINTLOAD	Z	22.770			
	2	JOINTLOAD	Y	-7.060			
	3	JOINTLOAD	Y	-6.980			
LOAD - 2		CASE 2					
JOINT	1	JOINTLOAD	Y	-25.950			
		JOINTLOAD	Z	39.320			
LOAD - 3		CASE 3					
MEMBER	1	SHEAR		1.11097(S/M)			
	2	SHEAR		1.11097(S/M)			
MEMBER	1	LINEAR	Y	-7.840	-7.840	0.000	0.000
LOAD - 4		CASE 4					
MEMBER	1	SHEAR		1.11097(S/M)			
	2	SHEAR		1.11097(S/M)			
MEMBER	2	LINEAR	Y	-7.840	-7.840	0.000	0.000
LOAD - 5		CASE 5					
MEMBER	1	SHEAR		1.30389(S/M)			
	2	SHEAR		1.30389(S/M)			
MEMBER	1	LINEAR	Y	-6.680	-6.680	0.000	0.000
	2	LINEAR	Y	-6.680	-6.680	0.000	0.000
LOAD - 6		CASE 6					
MEMBER	3	CONCENT	Y	-12.220		1.500	
JOINT	4	JOINTLOAD	Y	-12.220			
LOAD - 7		CASE 7					

TITLE..VIADUCT OF SINGLE TRACK (8*2+3=19) L-1 CRC-FANSY V6.3

LOAD DATA

	M/J	NAME	D	W1	W2	L1	L2
JOINT	1	JOINTLOAD	X	-4.590			
	2	JOINTLOAD	X	-4.590			
	3	JOINTLOAD	X	-4.590			

LOAD - . 8 CASE 8

MEMBER	1	TEMP		-25.0(DO)			
	2	TEMP		-25.0(DO)			

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TITLE..VIADUCT OF SINGLE TRACK (8*2+3=19) L-1 CRC-FANSY V6.3

MIX DATA

MIX NUMBER 11

LOAD	SS	N	S1	K1	S2	K2	S3	K3	S4	K4	S5	K5	S6	K6	S7	K7	S8	K8
9	1.0000	1	1.2070	7														
10	1.0000	3	1.0000	1	1.0000	2	1.0000	3										
11	1.0000	2	1.0000	1	1.0000	3												
12	1.0000	2	1.0000	1	1.0000	4												
13	1.0000	2	1.0000	1	1.0000	5												
14	1.0000	4	1.0000	1	1.0000	2	1.0000	5	1.0000	6								
15	.8696	2	1.0000	1	1.0000	8												
16	.8696	5	1.0000	1	1.0000	2	1.0000	5	1.0000	6	1.0000	7						
17	.8696	5	1.0000	1	1.0000	2	1.0000	5	1.0000	6	-1.0000	7						
18	.6667	2	1.0000	1	1.0000	9												
19	.6667	2	1.0000	1	-1.0000	9												

TITLE..VIADUCT OF SINGLE TRACK (8*2+3=19) L-1 CRC-FANSY V6.3

No 84

PICK UP 1

	MOMENT MAXIMUM					MOMENT MINIMUM				
	L	CASE	M	Q	N	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =										
ITAN	0.000	(19)	-1.090	10.733	-.733	0.000	(16)	-71.364	51.911	.031
1	.300	(19)	2.019	9.976	-.733	.300	(16)	-58.233	48.652	.031
2	.950	(11)	9.997	39.191	-1.431	.950	(16)	-32.717	41.121	.031
3	1.200	(11)	18.753	35.663	-1.431	1.200	(16)	-24.041	38.053	.031
4	1.500	(11)	28.148	31.285	-1.431	1.500	(16)	-14.514	34.246	.031
5	3.845	(11)	57.815	-3.951	-1.431	3.845	(12)	4.219	-4.470	-.566
6	6.190	(11)	9.616	-39.188	-1.431	6.190	(12)	-23.640	-19.282	-.566
7	6.490	(18)	.316	-8.505	-.044	6.490	(12)	-29.693	-21.047	-.566
8	6.740	(18)	-1.924	-9.405	-.044	6.740	(12)	-35.126	-22.397	-.566
9	7.390	(18)	-8.714	-11.404	-.044	7.390	(13)	-62.720	-58.224	-1.291
JTAN	7.690	(18)	-12.251	-12.161	-.044	7.690	(13)	-78.503	-61.972	-1.291
MAX	3.418	(11)	58.211	2.470	-1.431	3.418	(12)	5.552	-1.770	-.566
= = MEMBER 2 (2 - 3) G = =										
ITAN	0.000	(19)	-12.431	12.352	.020	0.000	(13)	-78.907	63.107	-1.381
1	.300	(19)	-8.836	11.596	.020	.300	(13)	-62.878	59.359	-1.381
2	.950	(19)	-1.922	9.597	.020	.950	(11)	-32.748	21.916	-.581
3	1.200	(19)	.366	8.696	.020	1.200	(11)	-27.436	20.566	-.581
4	1.500	(12)	8.478	40.772	-1.539	1.500	(11)	-21.527	18.801	-.581
5	4.000	(12)	60.742	3.206	-1.539	4.000	(11)	5.748	3.010	-.581
6	6.500	(12)	24.506	-34.361	-1.539	6.500	(17)	-27.347	-38.531	.202
7	6.800	(12)	14.229	-38.738	-1.539	6.800	(17)	-38.077	-42.338	.202
8	7.050	(12)	4.737	-42.266	-1.539	7.050	(17)	-47.756	-45.405	.202
9	7.700	(18)	-2.807	-11.464	-.825	7.700	(17)	-75.880	-52.936	.202
JTAN	8.000	(18)	-6.362	-12.221	-.825	8.000	(17)	-90.214	-56.196	.202
MAX	4.444	(12)	60.768	-3.474	-1.539	4.444	(11)	6.462	.201	-.581
= = MEMBER 3 (3 - 4) G = =										
ITAN	0.000	(18)	-20.254	11.757	-.000	0.000	(14)	-85.369	42.074	-.000
1	.300	(18)	-16.838	11.000	-.000	.300	(14)	-72.913	40.939	-.000
2	.950	(18)	-10.311	9.000	-.000	.950	(14)	-47.238	37.939	-.000
3	1.200	(18)	-8.172	8.099	-.000	1.200	(14)	-37.920	36.587	-.000
4	1.500	(18)	-5.914	6.968	-.000	1.500	(14)	-27.200	22.671	-.000
JTAN	3.000	(12)	.000	.000	-.000	3.000	(17)	-.000	10.627	.000

TITLE..VIADUCT OF SINGLE TRACK (8*2+3=19) L-1 CRC-FANSY V6.3

PICK UP 1

MOMENT MAXIMUM

	-----L---	-CASE-	-----M---	-----Q---	-----N---
* * MEMBER 4 (5 - 6) G * *					
ITAN	0.000	(17)	11.583	.847	8.697
1	.300	(17)	11.781	.476	8.697
2	.650	(17)	11.872	.044	8.697
3	1.600	(17)	11.357	-1.129	8.697
4	3.845	(17)	5.711	-3.901	8.697
5	6.090	(18)	3.952	.169	-7.343
6	7.040	(18)	3.686	-.730	-7.343
7	7.390	(18)	3.372	-1.061	-7.343
JTAN	7.690	(18)	3.011	-1.345	-7.343
MAX	.650	(17)	11.872	.044	8.697
* * MEMBER 5 (6 - 7) G * *					
ITAN	0.000	(19)	2.611	1.646	3.674
1	.300	(19)	3.062	1.362	3.674
2	.650	(19)	3.481	1.031	3.674
3	1.600	(17)	4.259	.825	3.790
4	4.000	(16)	6.360	3.599	-3.280
5	6.400	(16)	11.440	.635	-3.280
6	7.350	(16)	11.486	-.538	-3.280
7	7.700	(16)	11.222	-.970	-3.280
JTAN	8.000	(16)	10.875	-1.341	-3.280
MAX	7.111	(16)	11.579	-.243	-3.280
* * MEMBER 6 (1 - 5) C * *					
ITAN	0.000	(16)	17.370	-3.961	-102.995
JTAN	8.372	(17)	11.583	3.277	-102.500
* * MEMBER 7 (2 - 6) C * *					
ITAN	0.000	(16)	20.247	-4.733	-88.106
JTAN	8.372	(17)	19.776	4.907	-95.062
* * MEMBER 8 (3 - 7) C * *					
ITAN	0.000	(16)	16.588	-3.280	-85.148
JTAN	8.372	(17)	15.749	3.790	-98.344

MOMENT MINIMUM

	-----L---	-CASE-	-----M---	-----Q---	-----N---
* * MEMBER 4 (5 - 6) G * *					
ITAN	0.000	(16)	-15.787	6.992	-8.014
1	.300	(16)	-13.745	6.621	-8.014
2	.650	(16)	-11.503	6.189	-8.014
3	1.600	(18)	-6.351	4.420	-7.343
4	3.845	(18)	1.186	2.295	-7.343
5	6.090	(17)	-6.159	-6.673	8.697
6	7.040	(17)	-13.056	-7.846	8.697
7	7.390	(17)	-15.878	-8.279	8.697
JTAN	7.690	(17)	-18.417	-8.649	8.697
MAX	4.272	(18)	2.080	1.890	-7.343
* * MEMBER 5 (6 - 7) G * *					
ITAN	0.000	(16)	-17.914	8.538	-3.280
1	.300	(16)	-15.408	8.168	-3.280
2	.650	(16)	-12.625	7.735	-3.280
3	1.600	(16)	-5.834	6.562	-3.280
4	4.000	(19)	1.622	-2.141	3.674
5	6.400	(19)	-6.243	-4.413	3.674
6	7.350	(17)	-11.410	-6.275	3.790
7	7.700	(17)	-13.682	-6.707	3.790
JTAN	8.000	(17)	-15.749	-7.076	3.790
MAX	3.556	(19)	2.480	-1.720	3.674
* * MEMBER 6 (1 - 5) C * *					
ITAN	0.000	(17)	-15.855	3.277	-95.948
JTAN	8.372	(16)	-15.787	-3.961	-109.547
* * MEMBER 7 (2 - 6) C * *					
ITAN	0.000	(17)	-21.309	4.907	-88.510
JTAN	8.372	(16)	-19.381	-4.733	-94.659
* * MEMBER 8 (3 - 7) C * *					
ITAN	0.000	(19)	-16.244	3.674	-34.779
JTAN	8.372	(16)	-10.875	-3.280	-91.700

TITLE..VIADUCT OF SINGLE TRACK (8*2+3=19) L-1 CRC-FANSY V6.3

PICK UP 1

	SHEAR MAXIMUM					SHEAR MINIMUM				
	L	CASE	M	Q	N	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =										
ITAN	0.000	(10)	-65.273	57.135	-.792	0.000	(19)	-1.090	10.733	-.733
1	.300	(10)	-49.656	53.387	-.792	.300	(19)	2.019	9.976	-.733
2	.950	(10)	-19.549	44.727	-.792	.950	(19)	7.880	7.977	-.733
3	1.200	(10)	-9.409	41.199	-.792	1.200	(19)	9.763	7.077	-.733
4	1.500	(10)	1.647	36.821	-.792	1.500	(19)	11.712	5.900	-.733
5	3.845	(16)	25.020	3.604	.031	3.845	(13)	41.090	-6.422	-1.291
6	6.190	(18)	2.694	-7.328	-.044	6.190	(13)	-9.713	-41.658	-1.291
7	6.490	(18)	.316	-8.505	-.044	6.490	(13)	-21.351	-46.036	-1.291
8	6.740	(18)	-1.924	-9.405	-.044	6.740	(13)	-31.898	-49.564	-1.291
9	7.390	(18)	-8.714	-11.404	-.044	7.390	(13)	-62.720	-58.224	-1.291
JTAN	7.690	(18)	-12.251	-12.161	-.044	7.690	(13)	-78.503	-61.972	-1.291
= = MEMBER 2 (2 - 3) G = =										
ITAN	0.000	(13)	-78.907	63.107	-1.381	0.000	(19)	-12.431	12.352	.020
1	.300	(13)	-62.878	59.359	-1.381	.300	(19)	-8.836	11.596	.020
2	.950	(13)	-31.523	50.698	-1.381	.950	(19)	-1.922	9.597	.020
3	1.200	(13)	-20.771	47.171	-1.381	1.200	(19)	.366	8.696	.020
4	1.500	(13)	-8.887	42.793	-1.381	1.500	(19)	2.801	7.520	.020
5	4.000	(13)	44.804	5.227	-1.381	4.000	(17)	22.638	-5.863	.202
6	6.500	(18)	8.673	-7.388	-.825	6.500	(14)	-18.454	-40.488	-.293
7	6.800	(18)	6.277	-8.565	-.825	6.800	(14)	-29.647	-44.866	-.293
8	7.050	(18)	4.022	-9.465	-.825	7.050	(14)	-39.822	-48.394	-.293
9	7.700	(18)	-2.807	-11.464	-.825	7.700	(14)	-69.680	-57.054	-.293
JTAN	8.000	(18)	-6.362	-12.221	-.825	8.000	(14)	-85.018	-60.802	-.293
= = MEMBER 3 (3 - 4) G = =										
ITAN	0.000	(14)	-85.369	42.074	-.000	0.000	(19)	-20.254	11.757	.000
1	.300	(14)	-72.913	40.939	-.000	.300	(19)	-16.838	11.000	.000
2	.950	(14)	-47.238	37.939	-.000	.950	(19)	-10.311	9.000	.000
3	1.200	(14)	-37.920	36.587	-.000	1.200	(19)	-8.172	8.099	.000
4	1.500	(14)	-27.200	22.671	-.000	1.500	(19)	-5.914	6.968	.000
JTAN	3.000	(14)	-.000	12.220	-.000	3.000	(19)	-.000	.000	.000
= = MEMBER 4 (5 - 6) G = =										
ITAN	0.000	(16)	-15.787	6.992	-8.014	0.000	(19)	10.693	.248	8.121
1	.300	(16)	-13.745	6.621	-8.014	.300	(19)	10.725	-.036	8.121
2	.650	(16)	-11.503	6.189	-8.014	.650	(19)	10.654	-.367	8.121
3	1.600	(16)	-6.181	5.016	-8.014	1.600	(19)	9.878	-1.266	8.121
4	3.845	(18)	1.186	2.295	-7.343	3.845	(17)	5.711	-3.901	8.697
5	6.090	(18)	3.952	.169	-7.343	6.090	(17)	-6.159	-6.673	8.697
6	7.040	(18)	3.686	-.730	-7.343	7.040	(17)	-13.056	-7.846	8.697
7	7.390	(18)	3.372	-1.061	-7.343	7.390	(17)	-15.878	-8.279	8.697
JTAN	7.690	(18)	3.011	-1.345	-7.343	7.690	(17)	-18.417	-8.649	8.697

No 86

No 87

TITLE..VIADUCT OF SINGLE TRACK (8*2+3=19) L-1 CRC-FANSY V6.3

PICK UP 1

SHEAR MAXIMUM

	L	CASE	M	Q	N
= = MEMBER	5 (	6 - 7) G = =			
ITAN	0.000	(16)	-17.914	8.538	-3.280
1	.300	(16)	-15.408	8.168	-3.280
2	.650	(16)	-12.625	7.735	-3.280
3	1.600	(16)	-5.834	6.562	-3.280
4	4.000	(16)	6.360	3.599	-3.280
5	6.400	(18)	9.901	.896	-2.868
6	7.350	(18)	10.325	-.003	-2.868
7	7.700	(18)	10.266	-.335	-2.868
JTAN	8.000	(18)	10.123	-.619	-2.868
= = MEMBER	6 (	1 - 5) C = =			
ITAN	0.000	(17)	-15.855	3.277	-95.948
JTAN	8.372	(17)	11.563	3.277	-102.500
= = MEMBER	7 (	2 - 6) C = =			
ITAN	0.000	(17)	-21.309	4.907	-86.510
JTAN	8.372	(17)	19.776	4.907	-95.062
= = MEMBER	8 (	3 - 7) C = =			
ITAN	0.000	(17)	-15.977	3.790	-91.792
JTAN	8.372	(17)	15.749	3.790	-98.344

SHEAR MINIMUM

	L	CASE	M	Q	N
= = MEMBER	5 (	6 - 7) G = =			
ITAN	0.000	(19)	2.611	1.646	3.674
1	.300	(19)	3.062	1.362	3.674
2	.650	(19)	3.481	1.031	3.674
3	1.600	(19)	4.033	.131	3.674
4	4.000	(19)	1.622	-2.141	3.674
5	6.400	(17)	-6.006	-5.102	3.790
6	7.350	(17)	-11.410	-6.275	3.790
7	7.700	(17)	-13.682	-6.707	3.790
JTAN	8.000	(17)	-15.749	-7.078	3.790
= = MEMBER	6 (	1 - 5) C = =			
ITAN	0.000	(16)	17.370	-3.961	-102.995
JTAN	8.372	(16)	-15.787	-3.961	-109.547
= = MEMBER	7 (	2 - 6) C = =			
ITAN	0.000	(16)	20.247	-4.733	-88.106
JTAN	8.372	(16)	-19.381	-4.733	-94.659
= = MEMBER	8 (	3 - 7) C = =			
ITAN	0.000	(16)	16.588	-3.280	-85.148
JTAN	8.372	(16)	-10.875	-3.280	-91.700

TITLE..VIADUCT OF SINGLE TRACK (8*2+3=19) L-1 CRC-FANSY V6.3

No 88

PICK UP 1

AXIAL MAXIMUM | AXIAL MINIMUM

= = MEMBER 1 (1 - 2) G = =

	L (max)	CASE	M	Q	N	L (min)	CASE	M	Q	N
ITAN	0.000	(15)	-18.546	17.696	.123	0.000	(11)	-30.468	51.599	-1.431
1	.300	(15)	-13.382	16.709	.123	.300	(11)	-16.511	47.851	-1.431
2	.950	(15)	-3.334	14.101	.123	.950	(11)	9.997	39.191	-1.431
3	1.200	(15)	.046	12.927	.123	1.200	(11)	18.753	35.663	-1.431
4	1.500	(15)	3.698	11.392	.123	1.500	(11)	28.148	31.285	-1.431
5	3.845	(15)	15.319	-1.488	.123	3.845	(11)	57.815	-3.951	-1.431
6	6.190	(15)	-3.281	-14.368	.123	6.190	(11)	9.616	-39.188	-1.431
7	6.490	(15)	-7.825	-15.903	.123	6.490	(11)	-2.150	-43.566	-1.431
8	6.740	(15)	-11.950	-17.077	.123	6.740	(11)	-12.882	-47.094	-1.431
9	7.390	(15)	-23.932	-19.685	.123	7.390	(11)	-44.527	-55.754	-1.431
JTAN	7.690	(15)	-29.989	-20.672	.123	7.690	(11)	-60.854	-59.502	-1.431

= = MEMBER 2 (2 - 3) G = =

	L (max)	CASE	M	Q	N	L (min)	CASE	M	Q	N
ITAN	0.000	(17)	-43.309	44.469	.202	0.000	(12)	-64.166	61.086	-1.539
1	.300	(17)	-32.493	41.210	.202	.300	(12)	-47.403	57.338	-1.539
2	.950	(17)	-11.991	33.679	.202	.950	(12)	-14.817	48.677	-1.539
3	1.200	(17)	-5.244	30.611	.202	1.200	(12)	-3.722	45.150	-1.539
4	1.500	(17)	1.969	26.804	.202	1.500	(12)	8.478	40.772	-1.539
5	4.000	(17)	22.638	-5.863	.202	4.000	(12)	60.742	3.206	-1.539
6	6.500	(17)	-27.347	-38.531	.202	6.500	(12)	24.506	-34.361	-1.539
7	6.800	(17)	-38.077	-42.338	.202	6.800	(12)	14.229	-38.738	-1.539
8	7.050	(17)	-47.756	-45.405	.202	7.050	(12)	4.737	-42.266	-1.539
9	7.700	(17)	-75.680	-52.936	.202	7.700	(12)	-23.682	-50.927	-1.539
JTAN	8.000	(17)	-90.214	-56.196	.202	8.000	(12)	-38.521	-54.674	-1.539

= = MEMBER 3 (3 - 4) G = =

	L (max)	CASE	M	Q	N	L (min)	CASE	M	Q	N
ITAN	0.000	(17)	-74.237	36.588	.000	0.000	(16)	-74.237	36.588	-.000
1	.300	(17)	-63.405	35.601	.000	.300	(16)	-63.405	35.601	-.000
2	.950	(17)	-41.078	32.991	.000	.950	(16)	-41.078	32.991	-.000
3	1.200	(17)	-32.975	31.816	.000	1.200	(16)	-32.975	31.816	-.000
4	1.500	(17)	-23.653	19.715	.000	1.500	(16)	-23.653	19.715	-.000
JTAN	3.000	(17)	-.000	10.627	.000	3.000	(16)	-.000	10.627	-.000

= = MEMBER 4 (5 - 6) G = =

	L (max)	CASE	M	Q	N	L (min)	CASE	M	Q	N
ITAN	0.000	(17)	11.563	.847	8.697	0.000	(16)	-15.767	6.992	-8.014
1	.300	(17)	11.781	.476	8.697	.300	(16)	-13.745	6.621	-8.014
2	.650	(17)	11.872	.044	8.697	.650	(16)	-11.503	6.189	-8.014
3	1.600	(17)	11.357	-1.129	8.697	1.600	(16)	-6.181	5.016	-8.014
4	3.845	(17)	5.711	-3.901	8.697	3.845	(16)	1.968	2.244	-8.014
5	6.090	(17)	-6.159	-6.673	8.697	6.090	(16)	3.894	-.528	-8.014
6	7.040	(17)	-13.056	-7.846	8.697	7.040	(16)	2.834	-1.702	-8.014
7	7.390	(17)	-15.878	-8.279	8.697	7.390	(16)	2.163	-2.134	-8.014
JTAN	7.690	(17)	-16.417	-8.649	8.697	7.690	(16)	1.468	-2.504	-8.014

TITLE..VIADUCT OF SINGLE TRACK (8*2+3=19) L-1 CRC-FANSY V6.3

PICK UP 1

AXIAL MAXIMUM

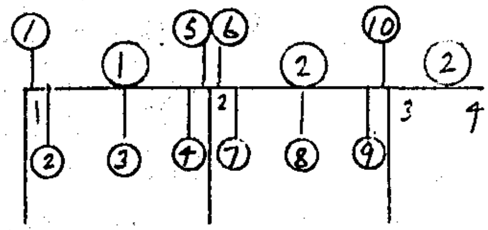
	L	CASE	M	Q	N
= = MEMBER 5 (6 - 7) G = =					
ITAN	0.000	(17)	1.359	2.801	3.790
1	.300	(17)	2.143	2.430	3.790
2	.650	(17)	2.918	1.998	3.790
3	1.600	(17)	4.259	.825	3.790
4	4.000	(17)	2.683	-2.139	3.790
5	6.400	(17)	-6.006	-5.102	3.790
6	7.350	(17)	-11.410	-6.275	3.790
7	7.700	(17)	-13.682	-6.707	3.790
JTAN	8.000	(17)	-15.749	-7.078	3.790
= = MEMBER 6 (1 - 5) C = =					
ITAN	0.000	(19)	-14.090	2.960	-37.801
JTAN	8.372	(19)	10.693	2.960	-42.824
= = MEMBER 7 (2 - 6) C = =					
ITAN	0.000	(18)	19.230	-4.475	-35.368
JTAN	8.372	(18)	-18.234	-4.475	-40.392
= = MEMBER 8 (3 - 7) C = =					
ITAN	0.000	(18)	13.891	-2.868	-28.631
JTAN	8.372	(18)	-10.123	-2.868	-33.655

AXIAL MINIMUM

	L	CASE	M	Q	N
= = MEMBER 5 (6 - 7) G = =					
ITAN	0.000	(16)	-17.914	8.538	-3.280
1	.300	(16)	-15.408	8.168	-3.280
2	.650	(16)	-12.625	7.735	-3.280
3	1.600	(16)	-5.834	6.562	-3.280
4	4.000	(16)	6.360	3.599	-3.280
5	6.400	(16)	11.440	.635	-3.280
6	7.350	(16)	11.486	-.538	-3.280
7	7.700	(16)	11.222	-.970	-3.280
JTAN	8.000	(16)	10.875	-1.341	-3.280
= = MEMBER 6 (1 - 5) C = =					
ITAN	0.000	(10)	3.183	-.792	-120.340
JTAN	8.372	(10)	-3.443	-.792	-127.875
= = MEMBER 7 (2 - 6) C = =					
ITAN	0.000	(13)	.404	-.090	-116.213
JTAN	8.372	(13)	-.348	-.090	-123.748
= = MEMBER 8 (3 - 7) C = =					
ITAN	0.000	(14)	.351	.293	-101.736
JTAN	8.372	(14)	2.802	.293	-109.271

No 89

[8] Calculation of upper beam



(1) Calculation of Tensile stress caused by bending

(a) Summary of stresses

(i) At the support point

		(1)				(2)			
		①	CASE	⑤	CASE	⑥	CASE	⑩	CASE
Combined stress	Top	-71.36	16	-78.50	13	-78.91	13	-90.21	17
	Bottom	—		—		—		—	
Dead load		-24.69	1	-32.93	1	-32.93	1	-32.14	1

(ii) Transit point to haunch

		(1)				(2)			
		②	CASE	④	CASE	⑦	CASE	⑨	CASE
Combined stress	Top	-24.04	16	-29.69	12	-27.44	11	-38.08	17
	Bottom	18.75	11	—		—		—	

(iii) Span moment

		(1)		(2)	
		③	CASE	⑧	CASE
Combined stress	Bottom	57.82	11	60.74	12

(b) Allowable stress of upper beam.

safe against cracking

$\alpha = \dfrac{M_L}{\Sigma M}$ $\alpha \geq 0.25$ ----- $\sigma_{sa} = 1000^{kg/cm^2}$

$\alpha < 0.25$ ----- $\sigma_{sa} = 1200$ "

(i) At the support point 1.

Dead load $M_d = -24.69^{t \cdot m}$ (case 1)

Train load + Impact $M_L = -40.58$ " (case 2+3)

$\Sigma M = -65.27^{t \cdot m}$

$\alpha = \dfrac{-40.58}{-65.27} = 0.62 > 0.25$

$\therefore \sigma_{sa} = 1000^{kg/cm^2}$

(ii) At the support point 2

Dead load $M_d = -32.93^{t \cdot m}$ (case 1)

Train load + Impact $M_L = -45.57^{t \cdot m}$ (case 5)

$\Sigma M = -78.50^{t \cdot m}$

$\alpha = \dfrac{-45.57}{-78.50} = 0.58 > 0.25$

$\therefore \sigma_{sa} = 1000^{kg/m^2}$

iii) At the support point 3

Dead load $M_d = 32.14^{t\cdot m}$ (case 1)

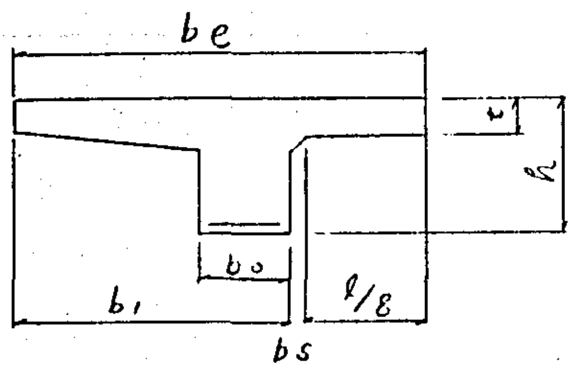
Train load + Impact $M_L = 53.60$ " (case 5+6)

$\Sigma = 85.74^{t\cdot m}$

$$\alpha = \frac{-53.60}{-85.74} = 0.63 > 0.25$$

$\therefore \sigma_{sa} = 1000^{kg/cm^2}$

Effective width of T-beam compression fibre



$$be = b_1 + bs + \frac{l}{8}$$

$$be = 1.65 + 0.1 + \frac{0.6 \times 80}{8}$$

$$= 2.35^{m} < 2.95^{m}$$

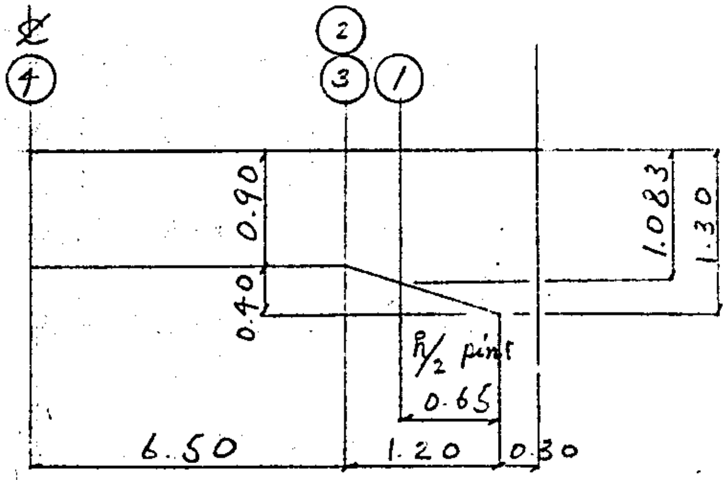
Bending stress calculation

	⑤	⑩	④	⑨	⑧	
M (tm)	-78.91	-90.21	-29.69	-38.08	60.77	
N (t)						
~~S~~ B (t)					235	
b (cm)	60	60	60	60	60	
h (cm)	130	130	90	90	90	
d (cm)	122.4	122.4	84.9	82.4	81.9	
d' (t) (cm)	7.6	7.6	5.1	7.6	8.1 (25)	
As (cm²)	D25-10 = 50.67	D25-12 = 60.804	D25-6 = 30.402	D25-8 = 40.536	D25-10 = 50.67	
p	0.00690	0.00828	0.00597	0.00820	0.00263	
As' (cm²)						
p'						
e=M/N (cm)					x = 20.45	
e=M/N+u (cm)						
e=M/N−u (cm)						
e/h						
d/e						
d'/h						
d'/d						
Ne/bd² (kg/cm²)	8.778	10.04	6.865	9.347	3.855	
k						
c						
j						
1/Lc	6.27	5.90	6.58	5.92	8.91	
1/Ls	165	139	189	140	414	
β=σs/σc						
σc (kg/cm²)	55.0	59.2	45.2	55.3	34.4	
σs (kg/cm²)	1450	1390	1300	1310	1590	
τ (kg/cm²)						
σsa (kg/cm²)	1800	1800	1800	1800	1800	
σca (kg/cm²)	90	90	90	90	90	
τa (kg/cm²)						

(2) Calculation of shearing stress

Calculation at 2-3 beam

1) Shearing stress caused by bending



i) Correction for shearing stress

$$S = S_0 - \frac{M}{d} \cdot \tan\alpha$$

Where M : Bending moment (t·m)

d : Effective heigh (m)

α : Angle of elevation of the member

	S_0 (t)	M (t·m)	d (m)	tan α	S (t)
①	51.25	-30.96	1.002	1/3	40.95
②	43.24	-20.08	0.819	1/3	35.07
③	43.24	—	0.819	—	43.24
④	5.17	—	0.819	—	5.17

ii) Shearing stress

$$\tau = \frac{S}{b \cdot d}$$

Where,

τ : Shearing stress (kg/cm²)

S : Shearing force (kg)

b : Width of member (cm)

d : Effective height of member

$$\tau_1 = \frac{40.95 \times 10^3}{60 \times 100.2} = 6.81 \ \mathrm{kg/cm^2} > 3.9 \ \mathrm{kg/cm^2}$$

$$\tau_2 = \frac{35.07 \times 10^3}{60 \times 81.9} = 7.14 \ " > "$$

$$\tau_3 = \frac{43.29 \times 10^3}{60 \times 81.9} = 8.80 \ " > "$$

$$\tau_4 = \frac{5.17 \times 10^3}{60 \times 81.9} = 1.05 \ " < "$$

2) Shearing stress caused by torsional moment

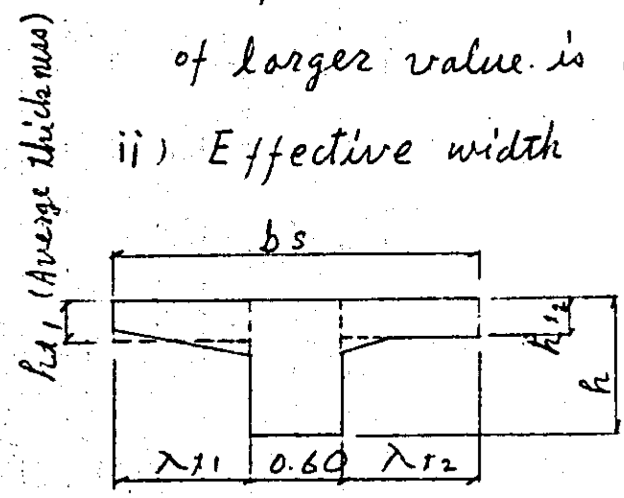
i) Torsional moment

Refer the result of computor analysis on torsional moment.

Point		Distance (m)	M_t (t·m)
⓪	Column front	0.30	12.52
①	½ point	0.95	11.58
②	Transit pt. of haunch	1.50	7.83
③	"	1.50	7.83
④	Mid-span	4.00	0

(Note) For further calculation, torsional moment of larger value is used

ii) Effective width



One side effective width of projected flange subjected to the torsional moment is calculated followed the equation

$$\lambda_t = 3 \cdot h_t$$

Cantilever part $\lambda_{t1} \leqq l_c$

Intermediate part $\lambda_{t2} \leqq l_b/2$

Where;

λ_t : One side effective width of projected flange (m)

h_t : Thickness of projected flange (m)

l_b : net clearance between girders $l_b = 2.60^m$

l_c : projecting length of cantilever slab $l_c = 1.05^m$

$ht_1 = 0.275^m$ (Average thickness) $ht_2 = 0.25^m$

$\lambda t_1 = 3 \times 0.275 = 0.875^m < 1.05^m$

$\lambda t_2 = 3 \times 0.25 = 0.75^m < \frac{l_b}{2} = 1.30^m$

Column front $h_0 = 1.30^m$

$l/2$ point $h_1 = 1.083^m$

Transit pt. of haunch $h_2 = h_3 = 0.90^m$

iii) Shearing stress caused by Torsion on T section

Torsional shearing stress is calculated followed the equation.

$$\tau_{ti} = \frac{M_T}{I_T} \times b_i \cdot \eta_i$$

Where τ_{ti} : Shearing stress of concrete calculated on each rectangular section (Kg/cm^2)

M_t : Torsional moment (Kg/cm^2)

b_i : Shorter side of each rectangular section (cm)

η_i : Referred table - 40 (2)

I_t : Torsional moment of inertia (m^4)

$$I_t = \Sigma k_i \cdot a_i \cdot b_i^3$$

a_i : Longer side of each rectangular section

k_i : Referred Table - 40 (2)

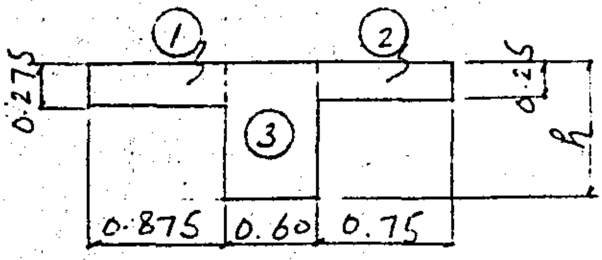
Table - 40 (2) Coefficient η_i

a/b	1.0	1.2	1.5	1.75	2.0	2.5	3.0	4.0	5.0
η_i	0.675	0.759	0.848	0.895	0.930	0.968	0.985	0.997	1.0

Table - 40 (3) Coefficient k_i

a/b	1.0	1.2	1.5	1.75	2.0	2.5	3.0	4.0	5.0
k_i	0.140	0.166	0.196	0.214	0.229	0.249	0.263	0.281	0.292

a) Torsional moment of inertia



		a (m)	b (m)	a/b	k	$I_t = k \cdot a \cdot b^3$ (m^4)
①		0.875	0.275	3.00	0.263	$0.263 \times 0.875 \times 0.275^3 = 0.00479$
②		0.750	0.25	3.00	0.263	$0.263 \times 0.750 \times 0.250^3 = 0.00308$
③	Column front	1.30	0.60	2.177	0.236	$0.236 \times 1.300 \times 0.60^3 = 0.06627$
	h/2 pt.	1.083	0.60	1.805	0.217	$0.217 \times 1.083 \times 0.60^3 = 0.05076$
	Transit pt. of hanch	0.90	0.60	1.500	0.195	$0.195 \times 0.900 \times 0.60^3 = 0.03771$

Column front

$$\Sigma I_{t0} = 0.00479 + 0.00308 + 0.06627$$

$$= 0.07414^{m^4} = 7.414 \times 10^6 \ cm^4$$

h/2 point

$$\Sigma I_{t1} = 0.00479 + 0.00308 + 0.05076$$

$$= 0.05863^{m^4} = 5.863 \times 10^6 \ cm^4$$

Transit point of haunch

$$\Sigma I_{t2} = 0.00479 + 0.00308 + 0.03791$$

$$= 0.04578^{m^4} = 4.578 \times 10^6 \ cm^4$$

b) Torsional moment beared by longitudinal beam (for calculation of axial re-bars)

$$M_t = M_T \times \frac{I_{t3}}{\Sigma I_t}$$

Column front

$$M_{t0} = 12.52 \times \frac{6.627 \times 10^6}{7.414 \times 10^6} = 11.19^{tm}$$

h/2 point

$$M_{t1} = 11.58 \times \frac{5.076 \times 10^6}{7.414 \times 10^6} = 7.93$$

Transit point of haunch

$$M_{t2} = 7.83 \times \frac{3.791 \times 10^6}{7.414 \times 10^6} = 4.00$$

c) Torsional shearing stress of longitudinal beam

h/2 point

$M_x = 7.93^{t \cdot m}$

$h = 108.3^{cm}$ $b = 60^{cm}$

$$\frac{h}{b} = \frac{108.3}{60} = 1.805$$

Table - 40(2) $\eta = 0.903$

$$\tau_{t1} = \frac{7.93 \times 10^5}{5.863 \times 10^6} \times 60 \times 0.903 = 7.33^{kg/cm^2} > 3.90^{kg/cm^2}$$

Transit point of haunch

$M_t = 4.00^{t \cdot m}$

$h = 90^{cm}$ $b = 60^{cm}$

$$\frac{h}{b} = \frac{90}{60} = 1.50$$

Table - 40 (2) $\eta = 0.848$

$$\tau_{t2} = \frac{4.00 \times 10^5}{3.791 \times 10^6} \times 60 \times 0.848 = 5.37^{kg/cm^2} > 3.90^{kg/cm^2}$$

d) Combined shearing stress

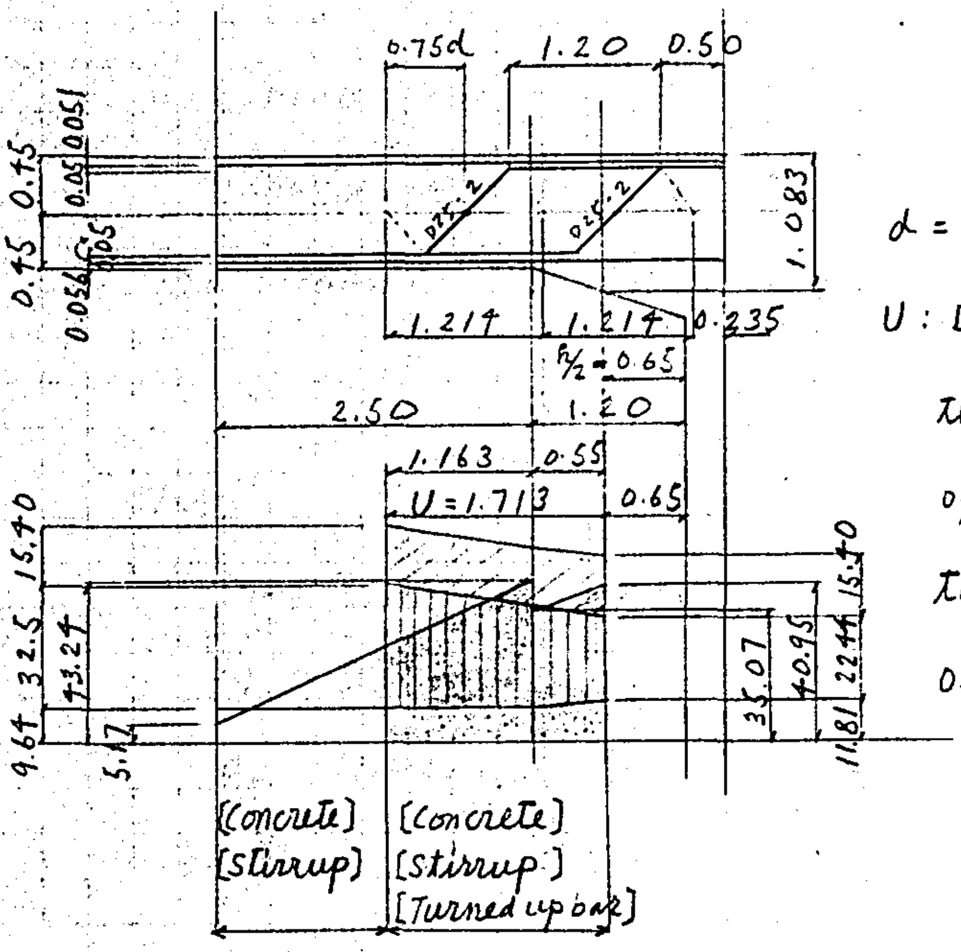
Torsion is considered.

$\tau_a = 17 \times 1.30 = 22 \ kg/cm^2$

l/2 point	6.81 + 7.33	= 14.14 kg/cm²	< 22. kg/cm²
Transit pt. of haunch	7.14 + 5.37	= 12.51 "	< "
	8.80 + 5.37	= 14.17 "	< "

Calculated as above, diagonal tension re-bars are examined.

3) Calculation of diagonal tension re-bars.



$d = 81.9^{cm}$

U : Distance from the neutral point of turned up bar to the point of 0.75 d

i) Shearing force beared by concrete

$$S_c = 1/2 \times \tau_c \cdot b \cdot d$$

Where

S_c : Shearing force beared by concrete (t)

τ_c : $\sigma_{ck} = 240\ kg/cm^2$. $\tau_c = 3.9\ kg/cm^2$

b : Width of cross section of member (cm)

d : Effective height of member (cm)

$S_{c1} = 1/2 \times 3.9 \times 60 \times 100.7 \times 10^{-3} = 11.81^t$

$S_{c2} = 1/2 \times 3.9 \times 60 \times 82.4 \times 10^{-3} = 9.64^t$

iii) Shearing force beared by stirrup

Arrange stirrups D13 - 2 sets in 20.0^{cm} ctc

(a) Torsional shearing stress

$$\rho_{st} = \frac{M_t \cdot s}{0.8 \cdot A_v \cdot b_1 \cdot h_1} \times \frac{a_1}{b_1}$$

Where

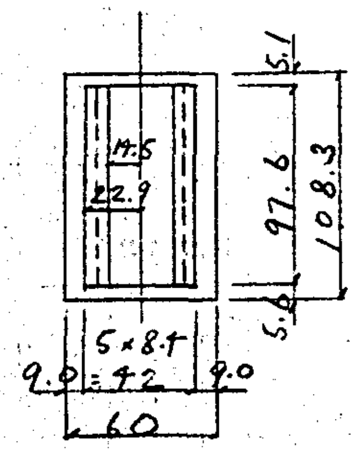
M_t : Torsional moment (t·m)

s : ctc distance of stirrup (cm)

A_v : Gross cross section of coupled stirrups (cm²)

b_1, h_1 : Length of short/long side of stirrup

a) At the 1/2 point



$M_t = 7.93^{t \cdot m}$

$s = 20^{cm}$

$A_v = 1.267 \times 4 = 5.07^{cm^2}$

$h_1 = 97.6 + 2.5 + 1.3 = 101.4^{cm}$

$b_1 = \frac{22.9^2 + 14.5^2}{22.9 + 14.5} \times 2 = 39.3^{cm}$

$$\sigma_{s1} = \frac{7.93 \times 10^5 \times 20}{0.8 \times 5.07 \times 39.3 \times 101.4} \times \frac{22.9 \times 2}{39.3}$$

$$= 1144 \ ^{kg/cm^2} < 1800 \ ^{kg/cm^2}$$

b) At the Transit point of haunch

$M_t = 4.00^{t.m}$

$s = 20^{cm}$

$A_p = 1.267 \times 4 = 5.07^{cm^2}$

$b_1 = 39.3^{cm}$

$h_1 = 90 - 5.1 - 5.6 + 2.5 + 1.3 = 83.1^{cm}$

$$\sigma_{s1} = \frac{4.00 \times 10^5 \times 20}{0.8 \times 5.07 \times 39.3 \times 83.1} \times \frac{22.9 \times 2}{39.3}$$

$$= 704 \ ^{kg/cm^2} < 1800 \ ^{kg/cm^2}$$

c) At U point

$$M_t = \frac{4.00}{2.50} \times 1.163 = 1.86^{t.m}$$

$s = 20^{cm}$

$A_p = 1.267 \times 4 = 5.07^{cm^2}$

$h_1 = 83.1^{cm}$

$$\sigma_{s1} = \frac{1.86 \times 10^5 \times 20}{0.8 \times 5.07 \times 39.3 \times 83.1} \times \frac{22.9 \times 2}{39.3}$$

$$= 327 \ ^{kg/cm^2} < 1800 \ ^{kg/cm^2}$$

(b) Bending shear beared by stirrup

In the case when combined with Torsional moment, allowable shearing stress is 20 percent increased.

$\sigma_{sa} = 1800 \times 1.2 = 2160 \ kg/cm^2$

$$S_v = \frac{(\sigma_{sa} - \sigma_{st}) \cdot A_v \cdot d}{1.15\ s}$$

a) At the h/2 point

$2160 - 1144 = 1016 \ kg/cm^2 < 1800 \ kg/cm^2$

$d = 100.2 \ cm$

$$S_v = \frac{1016 \times 5.07 \times 100.2}{1.15 \times 20 \times 10^3} = 22.44^t$$

b) At the point Transit of haunch

$2160 - 704 = 1456 \ kg/cm^2 < 1800 \ kg/cm^2$

$d = 81.9 \ cm$

$$S_v = \frac{1456 \times 5.07 \times 81.9}{1.15 \times 20 \times 10^3} = 26.29^t$$

c) At U point

$2160 - 327 = 1833 \ kg/cm^2 > 1800 \ kg/cm^2$

$d = 81.9$

$$S_v = \frac{1800 \times 5.07 \times 81.9}{1.15 \times 20 \times 10^3} = 32.50^t$$

(C) Shearing force beared by turned up bar

$$S_{br} = \frac{\sigma_{sa} \cdot A_s \cdot d \cdot (\sin\theta + \cos\theta)}{1.15 \cdot s}$$

Where,

σ_{sa} : Allowable tensile stress of bar (kg/cm²)

A_s : Cross section of turned up bar (cm²)

$A_s = D25 - 2 = 10.134^{cm^2}$

d : Effective height of member $d = 81.9^{cm}$

θ : Elevation angle of turned up bar with the axis of member $\theta = 45°$

s : Spacing of turned up bars in axial direction of member (m)

$$S_{br} = \frac{1800 \times 10.314 \times 81.9 \times 1.414}{1.15 \times 1.214 \times 10^5} = 15.40^{t}$$

4) Calculation of bars in axial direction

Required bars are calculated fallowed the equation

$$As = \frac{Mt (b_1 + h_1)}{0.8 \times \sigma_{sa} \times b_1 \cdot h_1}$$

Where

As : Bars in axial direction

Mt : Torsional moment

σ_{sa} : Allowable stress of bar

b_1, h_1 : Length of shorter / Longer side of stirrup

i) At column front

$Mt = 11.19^{t \cdot m}$

$\sigma_{sa} = 1800^{kg/cm^2}$

$b_1 = 22.90 \times 2 = 45.8^{cm}$

$h_1 = 130 - 5.1 - 5.6 + 2.5 + 1.3 = 123.1^{cm}$

$$As = \frac{11.19 \times 10^5 (45.8 + 123.1)}{0.8 \times 1800 \times 45.8 \times 123.1} = 23.28^{cm^2}$$

Required bar arrangement for longer side

$$As_{h_1} = 23.28 \times \frac{123.1}{(45.8 + 123.1) \times 2} = 8.48^{cm^2}$$

$$As = \begin{matrix} D19 - 2 \\ D25 - 1 \end{matrix} > 10.797^{cm^2} > As_{h_1} = 8.48^{cm^2}$$

ii At the point Transit of hounch

$M_t = 4.00^{t\cdot m}$

$b_1 = 45.8^{cm}$

$h_1 = 90 - 5.1 - 5.6 + 2.5 - 1.3 = 83.1^{cm}$

$$A_s = \frac{4.00 \times 10^5 (45.8 + 83.1)}{0.8 \times 1800 \times 45.8 \times 83.1} = 9.41^{cm^2}$$

Required bar arrangement for longer side

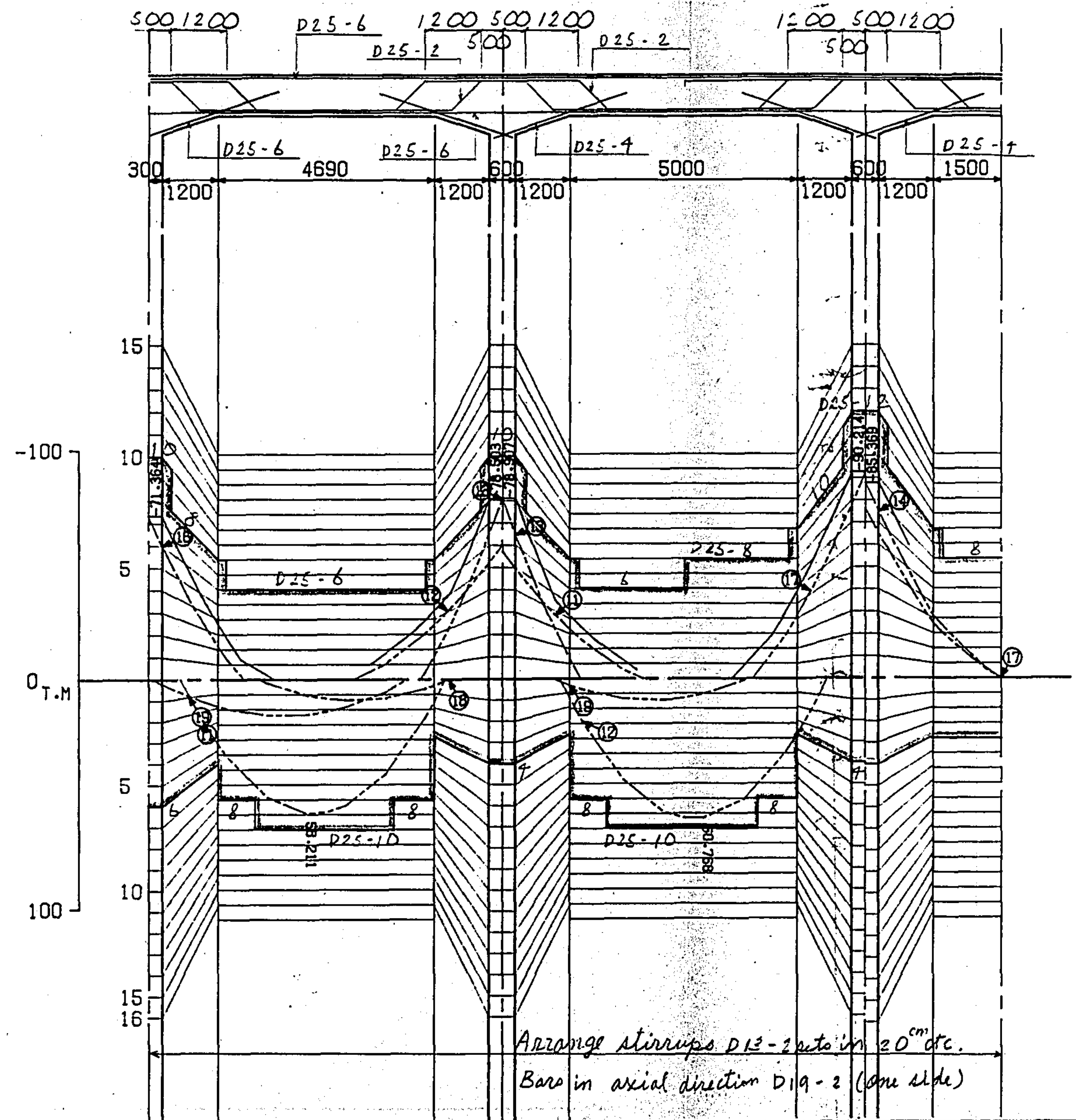
$$A_{sh_1} = 9.41 \times \frac{83.1}{(45.8 + 83.1) \times 2} = 3.03^{cm^2}$$

$A_s = D19 - 2 = 5.73^{cm^2} > A_{sh_1} = 3.03^{cm^2}$

VIADUCT OF SINGLE TRACK L=19 L-1

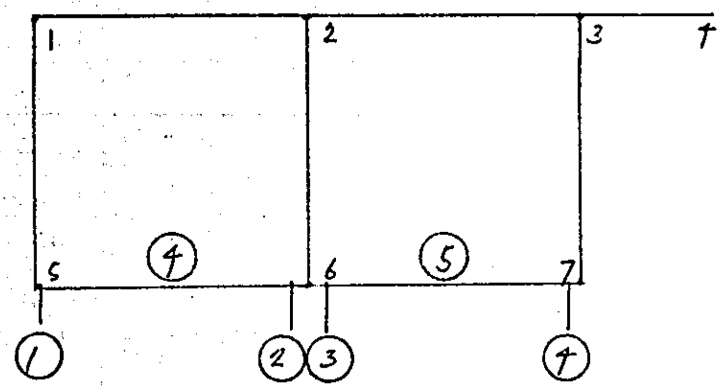
PICK UP 1

SCALE 1/100
CM/TON 5.0/100



(1)

[9] Calculation of buried beam



1 Calculation of compressive stress caused by bending

(1) Summary of stresses

		④				⑤			
		①	CASE	②	CASE	③	CASE	④	CASE
Combined stress	Top	-15.79	16	-18.42	17	-17.91	16	-15.75	17
	Bottom	11.58	17	3.01	18	2.61	19	11.55	16
Dead load		-2.96	1	-9.28	1	-9.46	1	-3.29	1

	Top side	Bottom side	
M (tm)	-18.42	11.58	
N (t)			
S (t)			
b (cm)	50	50	
h (cm)	70	70	
d (cm)	62.4	55	
d' (cm)	7.6	15	
As (cm²)	D25-4 = 20.268	D25-4 = 20.268	
p	0.00650	0.00737	
As' (cm²)			
p'			
e=M/N (cm)			
e=M/N+u (cm)			
e=M/N−u (cm)			
e/h			
d/e			
d'/h			
d'/d			
Ne/bd² (kg/cm²)	9.46	7.656	
k			
c			
j			
1/Lc	6.40	6.13	
1/Ls	175	159	
β=σs/σc			
σc (kg/cm²)	60.5	46.9	
σs (kg/cm²)	1650	1190	
τ (kg/cm²)			
σsa (kg/cm²)	1800	1800	
σca (kg/cm²)	90	90	
τa (kg/cm²)			

Calculation of shearing stress

$S = 7.85^{t}$ (h/2 point) (Case 17)

$$\tau = \frac{7.85 \times 10^3}{50 \times 55} = 2.85^{kg/cm^2} < 3.9^{kg/cm^2}$$

Therefore,

stirrup

Use D13 - one set in 25 cm ctc.

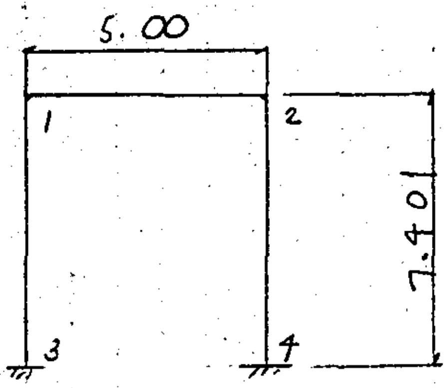
Bar arrangement in axial direction

Use D16 - 2 bares (one side)

§ 6 Rigid frame analyis on transversal Section(①-①) of elevated structure

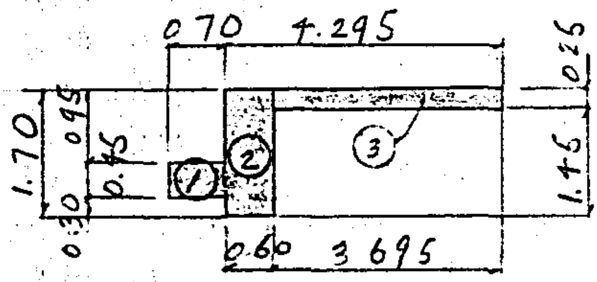
(1) Elements for rigid frame analysis

1. Configulation and dimension of rigid frame



2. Cross-Sectional area and moment of Inertia of the member

(1) Member (1~2)



Effective Width

$be = 0.60 + \frac{7.39}{2}$

$= 4.295^m$

	$b^{(m)}$	$h^{(m)}$	$A^{(m^2)}$	$y_{(m)}$	$A \cdot y^{(m^3)}$
①	0.70	0.45	0.315	1.175	0.37013
②	0.60	1.70	1.020	0.850	0.86700
③	3.695	0.25	0.924	0.125	0.11550
Σ			2.259		1.35263

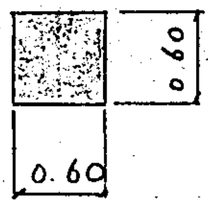
$$y = \frac{1.35263}{2.259} = 0.599^{m}$$

	$b^{(m)}$	$h^{(m)}$	$A^{(m^2)}$	$y_0^{(m)}$	$I_0^{(m^4)}$	$A \cdot y_0^2 \, (m^4)$	$I_0 + A \cdot y_0^2 \, (m^4)$
①	0.70	0.45	0.315	0.576	0.00532	0.10451	0.10983
②	0.60	1.70	1.020	0.251	0.24565	0.06426	0.30991
③	3.695	0.25	0.924	0.474	0.00481	0.20760	0.21241
Σ			2.259		0.25578	0.37637	0.63215

Cross-Sectional Area $A = 2.259^{m^2}$

Moment of Inertia $I = 0.63215^{m^4}$

(2) Member (1-3 , 2-4)



$$A = 0.60 \times 0.60 = 0.360^{m^2}$$

$$I = \frac{0.60 \times 0.60^3}{12} = 0.01080^{m^4}$$

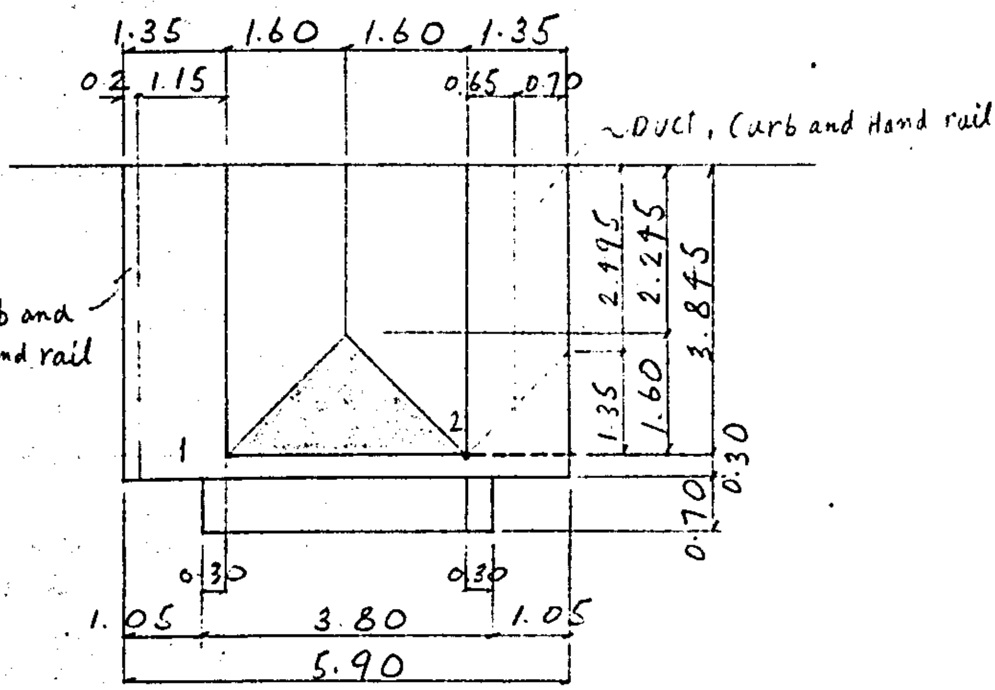
(3) Axial height

$$h = 8.0 - 0.599 = 7.401^{m}$$

[2] Calculation of loads

1. Dead load

(1) Member (1-2)



(a) Disthibuted load

Ballast	$1.90^{t/m^3} \times 0.42$	$= 0.80^{t/m^2}$
Grading Concrete	2.35×0.07	$= 0.16$
Track Weight	$0.45 \times 1/2.89$	$= 0.16$
		$w' = 1.12^{t/m^2}$
Slab	$2.50^{t/m^3} \times 0.25$	$= 0.63$
		$w = 1.75^{t/m}$

$$w_{d1} = 1.75 \times 1.60 = 2.80^{t/m}$$

(b) Distributed load

Distribution load	$1.15^{t/m^2} \times 0.30$	=	$0.53\ ^{t/m}$
Haunch of slab	$2.50^{t/m^3} \times 0.30 \times 0.10 \times 1/2$	=	0.04 "
Beam	$2.50" \times 0.60 \times 1.45$	=	2.18 "
Beam for bridge seat	$2.50" \times (0.45+0.75) \times 1/2 \times 0.70$	=	1.07 "
		w_{d_2} =	$3.82\ ^{t/m}$

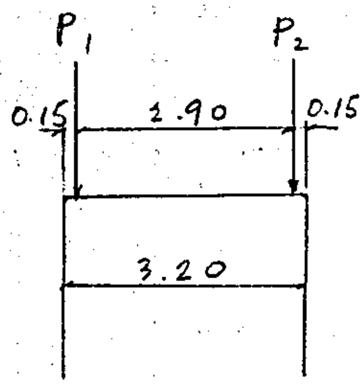
(c) Concentrated loads of elment acting at joint P_1 as shown below

Weight of elments on the slab except track weight	$1.12^{t/m^2} \times 1.15 \times (3.845+0.30)$	=	5.34^{t}
Distributed load	$1.75" \times (2.245+3.845) \times 1/2 \times 1.60$	=	8.53 "
Beam for Bridge support	$2.50" \times (0.45+0.75) \times 1/2 \times 0.70 \times 0.30$	=	0.32 "
Longitudinal beam	$2.50" \times 0.60 \times 0.65 \times 3.545$	=	3.46 "
Haunch of longitudinal beam	$2.50" \times 0.40 \times 1.20 \times 1/2 \times 0.60$	=	0.36 "
Curb	$2.50" \times 0.20 \times 0.30 \times (3.845+0.30)$	=	0.62 "
Handrail	$0.20^{t/m} \times (3.845+0.30)$	=	0.83 "
Cantilever slab	$2.5^{t/m^3} \times (0.2+0.35) \times 1/2 \times 1.05 \times (3.845+0.30)$	=	2.99 "
Haunch of slob	$2.50^{t/m^3} \times 0.30 \times 0.10 \times 1/2 \times 3.245$	=	0.12 "
Deficit of Column Weight	$-2.50^{t/m^3} \times 0.60 \times 0.30 \times (1.70-0.599)$	=	-0.50 "
Addition of Column Weight	$2.50" \times 0.60 \times 0.30 \times (0.599-0.25)$	=	0.16 "
		P_1 =	22.23

Joint 2

Weight of elments on the slab except track weight	$1.12^{t/m^3} \times 0.65 \times (3.845 + 0.30)$	=	3.02^t
Distributed load	$1.75'' \times (2.245 + 3.845) \times 1/2 \times 1.60$	=	$8.53''$
Beam for Bridge support	$2.50^{t/m^3} \times (0.45 + 0.15) \times 1/2 \times 0.70 \times 0.30$	=	$0.32''$
Longitudinal beam	$2.50'' \times 0.60 \times 0.65 \times 3.545$	=	$3.46''$
Haunch of longitudinal beam	$2.50'' \times 0.40 \times 1.20 \times 1/2 \times 0.60$	=	$0.36''$
Curb	$2.50'' \times 0.25 \times 0.30 \times (3.845 + 0.30)$	=	$0.78''$
Handrail	$0.20 \times (3.845 + 0.30)$	=	$0.83''$
Ballast stopper	$2.50 \times 0.15 \times 0.30 \times (3.845 - 0.30)$	=	$0.47''$
Duct cover	$2.50 \times 0.05 \times 0.30 \times (3.845 + 0.30)$	=	$0.16''$
Cable	$0.06 \times (3.845 + 0.30)$	=	$0.25''$
Cantilever slab	$2.5^{t/m^3} \times (0.2 + 0.36) \times 1/2 \times 1.05 \times (3.845 + 0.30)$	=	$2.99''$
Haunch of slab	$2.50'' \times 0.30 \times 0.10 \times 1/2 \times 3.245$	=	$0.12''$
Deficit of Column weight	$-2.50'' \times 0.60 \times 0.30 \times (1.70 - 0.599)$	=	$-0.50''$
Addition of Column weight	$2.50'' \times 0.60 \times 0.30 \times (0.599 - 0.25)$	=	$0.16''$
	P_2	=	20.95^T

(d) Reaction of T-beam superstructure



$P_1 = 33.11^t$

$P_2 = 33.51^t$

e) Torsional moment from longitudinal beam

$M_L = -2.87^{t\cdot m}$

$M_R = -2.55^{t\cdot m}$

(2) Column Weight

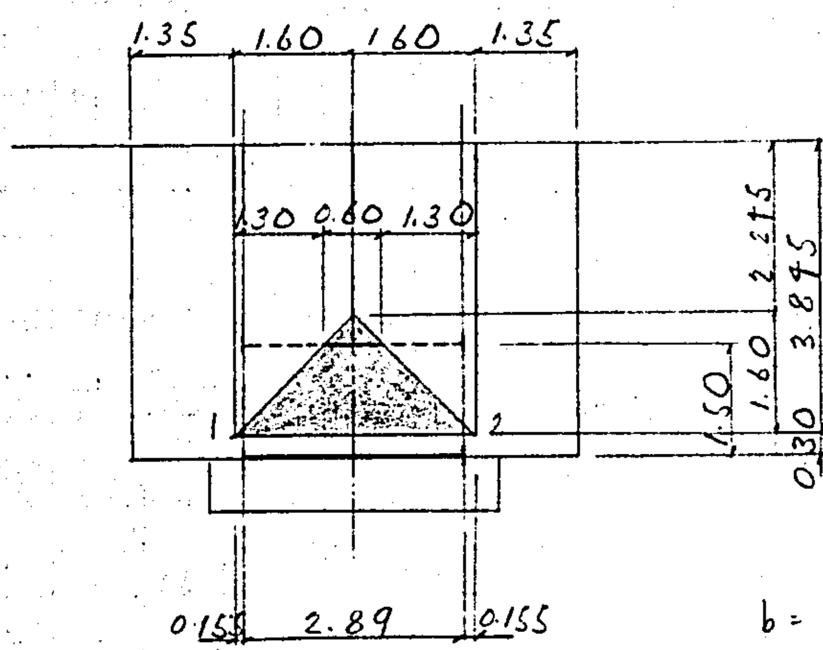
$q = 2.50 \times 0.60 \times 0.6 \quad = 0.90^{t/m}$

2 Train load and Impact

(1) Train load

KS - 16

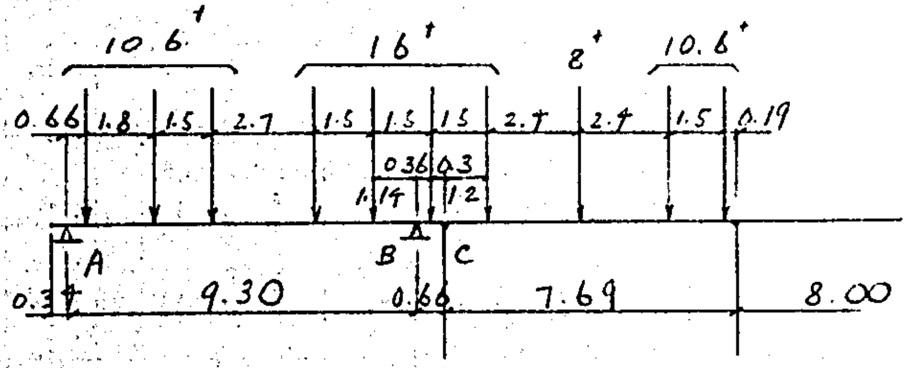
1) Distributed load acting on rigid - frame



b = 2.89 m

$$W_e = \frac{16}{2.89} = 5.54\ ^{t}/m$$

2) Concentrated load caused by axial loads acting on longitudinal beams and T-beams of the bridge



(a) Concentrated load caused by axial load acting on longitudinal beam

$$R_C = \frac{1}{7.69}\{10.6(0.19+1.69) + 8 \times 4.09 + 16(6.49 + 7.99)\} = 36.97^t$$

$$P = 36.97 - 5.54 \times (2.89 + 0.60) = 17.64^t$$

Joint 1, 2

$$P_{1,2} = \frac{17.64}{2} = 8.82^t$$

(b) Concentrated load caused by axial load on T-beam bridge.

$$R_B = \frac{1}{9.30}\{10.6(0.66+2.46+3.96) + 16(6.66 + 8.16\} = 33.57^t$$

Reaction of T-beam bridge

$$P = \frac{33.57}{2} = 16.79^t$$

(2) Impact conffiecient

a) Within rigid frame section

$l_1 = 3.20^m$ $i = 0.523$

(Average length)
$l_2 = 7.845^m$ $i = 0.452$

b) Within T-beam bridge section

$l = 9.30^m$ $i = 0.437$

(3) Train Load + Impact

a) Load acting on rigid frame

$w_{l+i} = 5.54 \times (1+0.523) = 8.44^{t/m}$

$P_{l+i_{1,2}} = 8.82 \times (1+0.452) = 12.81^{t}$

b) Reaction of T-beam bridge

$P_{l+i} = 16.79 \times 1.437 = 24.13^{t}$

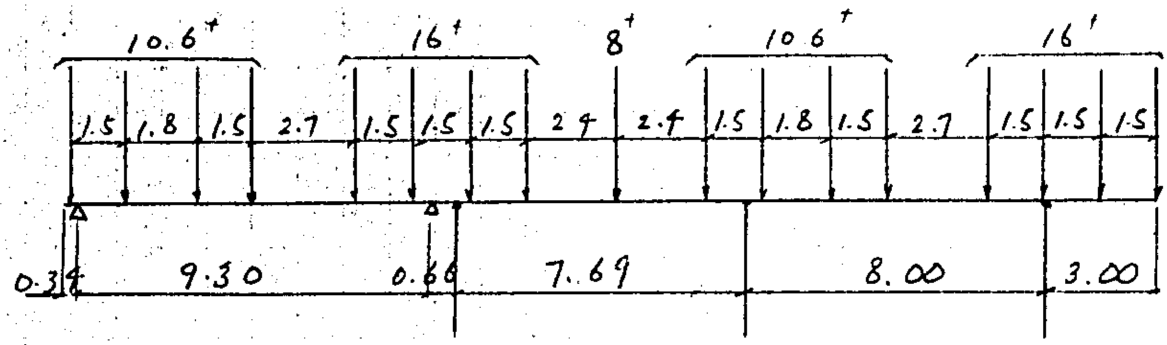
(4) Torsional moment from longitudinal beam

$M_{L(l+i)} = 9.47^{t.m}$

$M_{R(l+i)} = -9.47^{t.m}$

3 Centrifugal load

R = 500 α = 0.12



a) Within elevated structure (viaduct) section

$H = (16 \times 6 + 10.6 \times 4 + 8) \times 0.12 = 17.57^t$

b) Within T-beam bridge section

$H = (16 \times 2 + 10.6 \times 4) \times 0.12 = 8.93^t$

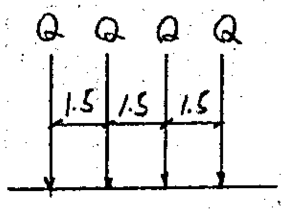
Acting horizontal force for calculation

Horizontal force is assumed, on Rahmen structure total force is beared by each Rahmen evenly, and also assumed on T-section simple beam 1/2 force is beared by Rahmen structure.

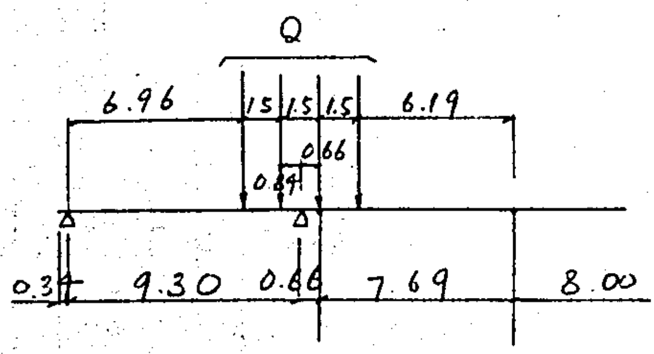
Hence,

$H = 17.57 \times 1/3 + 8.93 \times 1/2 = 10.32^t$

4 Train lateral load



$Q = 16 \times 0.15 = 2.40^{t}$



$$H = \frac{2.40}{9.30}(6.96 + 8.46) + \frac{2.40 \times 6.19}{7.69} + 2.40$$

$$= 3.98 + 1.93 + 2.40 \qquad = 8.31^{t}$$

5 Force of temperature change and/or Drying contraction

Temperature drop + Drying contraction

$t = -25°C$

6 Dead load + Seismic force

$k_H = 0.1$

(1) Within elevated structure (viaduct) section.

$\Sigma W = 265.8 - 2.0$ (electric pole) $= 263.8^t$

$\Sigma H = 263.8 \times 0.1 = 26.38^t$

(2) Within T-beam bridge section

$R_d = 33.11 + 33.51 = 66.62^t$

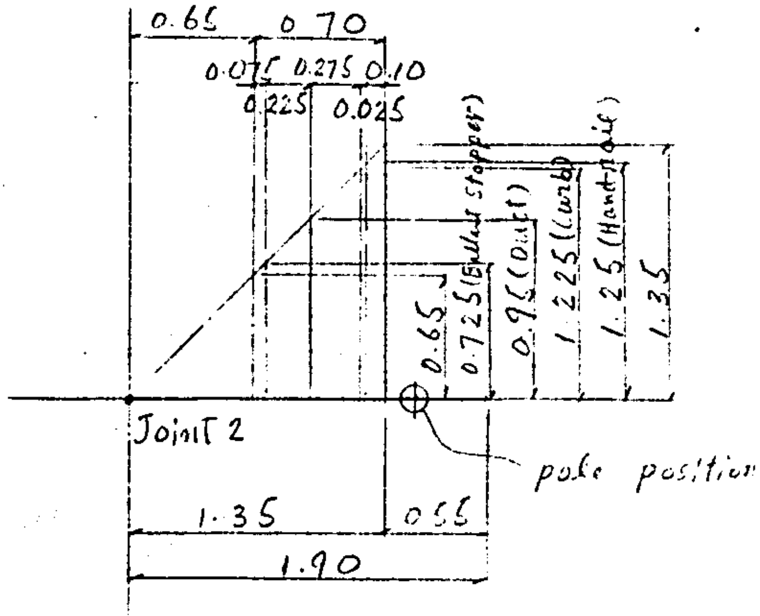
$\Sigma H = 66.62 \times 0.1 = 6.66^t$

(3) Total Seismic load

acting within elevated structure (viaduct) section

$H = 26.38 \times 1/3 + 6.66 = 15.45^t$

7 Load of electric pole, support of electric pole and related installations



Calculation of load

Electric Pole load

$H = 0.50^{t}$

$V = 2.00^{t}$

$M = 5.00^{t \cdot m}$

Sopport of electric pole	$W_1 = 2.50^{t/m^3} \times 0.75 \times 0.325$	$= 0.61^{t/m}$
do	$W_2 = 2.50 \times 0.75 \times 0.625$	$= 1.17$
Cantilever slab	$W_3 = 2.50 \times 0.275 \times 1.35$	$= 0.93$
Ballast, Sloping Concrete	$W_4 = (1.90^{t/m^3} \times 0.42 + 2.35 \times 0.17) \times 0.65$	$= 0.63$
Stand of electric pole	$P_1 = 2.5 \times (0.75 \times 0.75 - 3.142 \times 0.45^2 / 4) \times 1.0$	$= 1.01^{t}$
Sopport of electric pole	$P_2 = 2.50 \times 0.75 \times 0.55 \times 0.275$	$= 0.28$

Handrail $P_3 = 0.20 \times 1.25 = 0.25^t$

Curb $P_4 = 2.50 \times 0.25 \times 0.30 \times 1.225 = 0.23^t$

Duct $P_5 = (2.50 \times 0.05 \times 0.3 + 0.06) \times 0.95 = 0.09^t$

Ballast stopper $P_6 = 2.50 \times 0.15 \times 0.30 \times 0.725 = 0.08^t$

Load of joint 2

Dead load

Concentrated Load

$N = 2.00 + (1.17 + 0.61) \times 1/2 \times 1.60 + 1.01 + 0.28 = 4.71^t$

Deficit of concentrated load

$-N = 0.93^{t/m} \times 1.35 \times 1/2 + 0.63^{t/m} \times 0.65 \times 1/2 + 0.25 + 0.23$

$+ 0.09 + 0.08 = -1.48^t$

$\Sigma N = 3.23^t$

Horizontal load

$H = \pm 0.50^t$

Moment

$M = \pm 5.0 + 2.00 \times 1.525 + 1/6 (2 \times 0.61 + 1.17) \times 1.90^2$

$+ 0.93 \times 1.35^2 \times 1/3 + 0.63 \times 0.65^2 \times 1/3 + 1.01 \times 1.525$

$+ 0.28 \times 1.625 + 0.25 \times 1.25 + 0.23 \times 1.225 + 0.09$

$\times 0.95 + 0.08 \times 0.725$

$= \pm 5.00 + 3.05 + 1.44 + 0.56 + 0.09 + 1.54 + 0.46$

$+ 0.31 + 0.28 + 0.09 + 0.06 \qquad = 12.88^{t\cdot m}$

(2.88)

Seismic load

$N = 3.01^{t}$

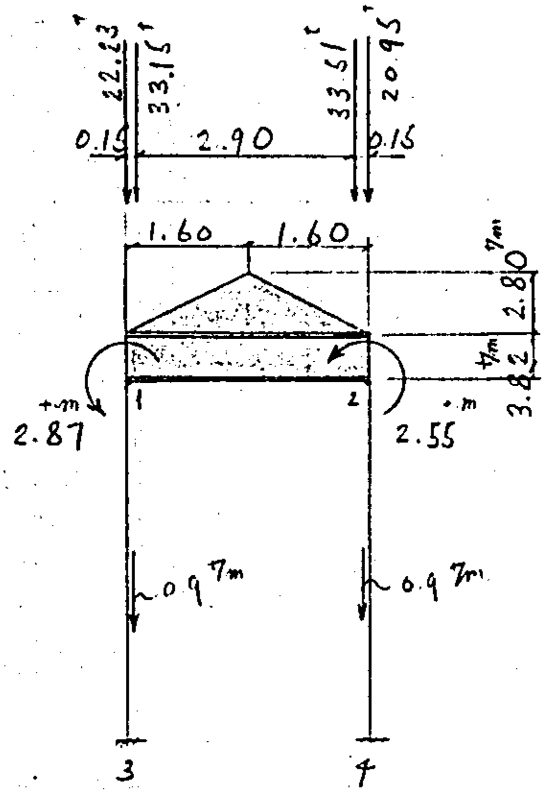
$H = 0.50 + 2.0 \times 0.1 \qquad = \pm 0.70^{t}$

$M = 12.88^{t\cdot m}$

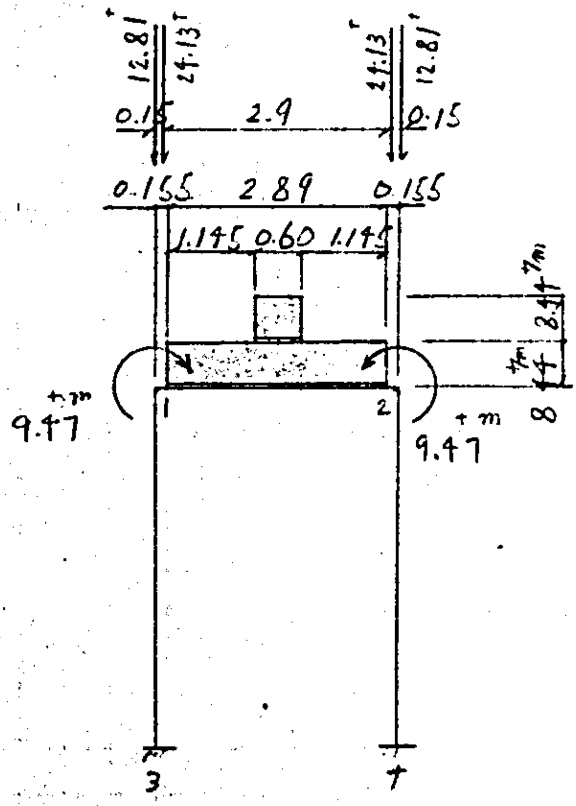
(2.88)

(3) Loading diagram

Case 1 Dead load

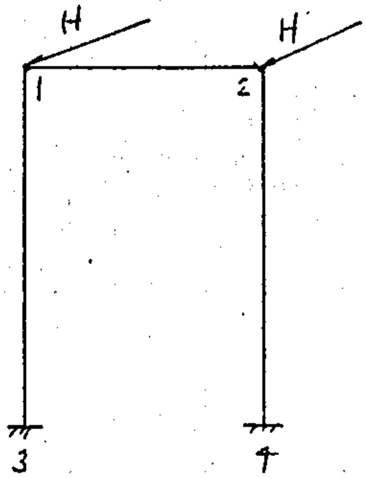


Case 2 Train load + Impact

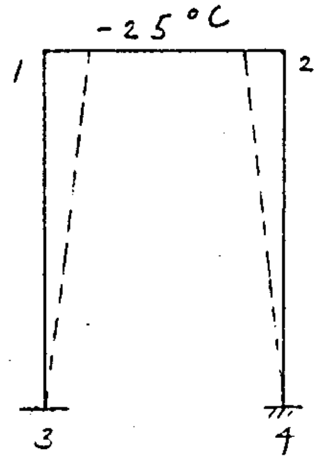


Case 3 Centrifugal load

$$H = \frac{10.32}{2} = 5.16$$

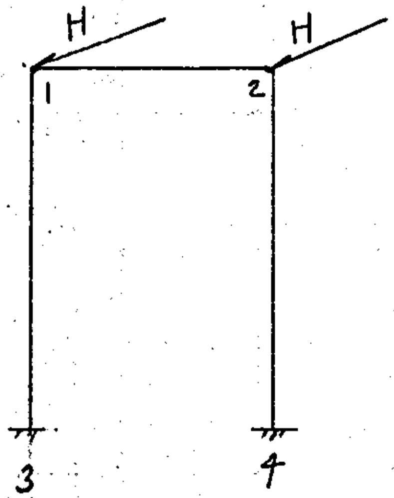


Case 4 Temperature drop + Drying contraction

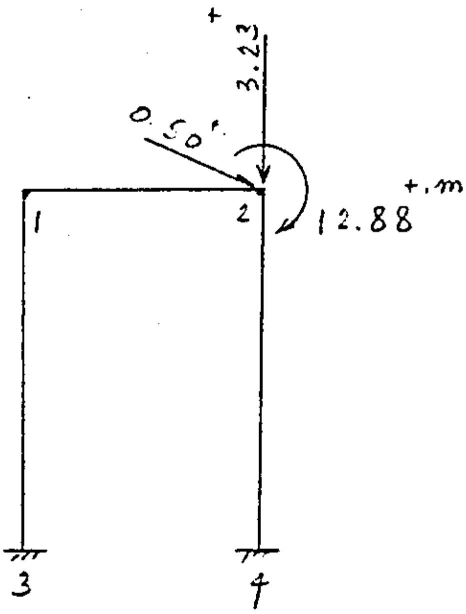


Case 5 Seismic load

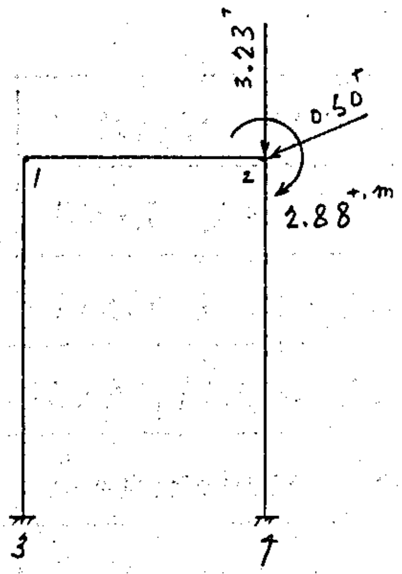
$$H = \frac{15.45}{2} = 7.73^{+}$$



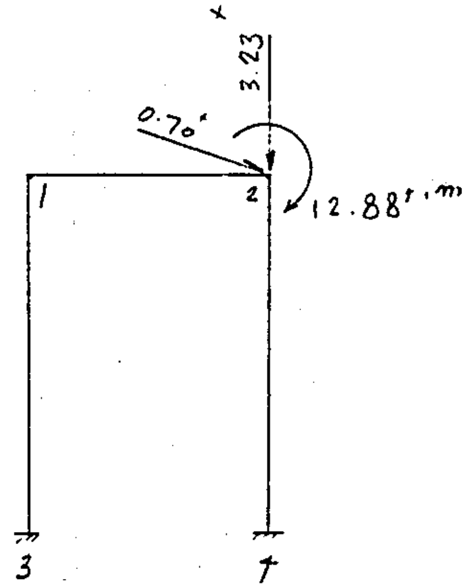
Case 6 Electric pole load (1)



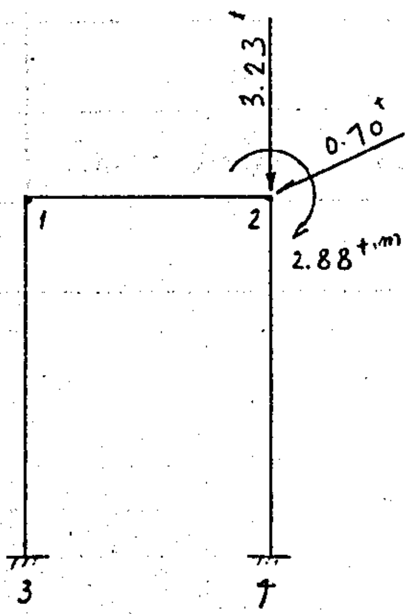
Case 7 Electric pole load (2)



Case 8 Electric pole load (3)



Case 9 Electric pole load (4)



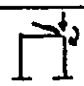
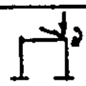
Case 10 Train lateral load

$$\text{Case 3} \times \frac{8.31}{10.32}$$

$$= \text{Case 3} \times 0.805$$

(4) Combination of loads

Basic load

Case No	Kind of load	Loading pattern
1	Dead load	
2	Train load + Impact	
3	Centrifugal load	
4	Temperature + contraction	$-25°C$
5	Seismic load	
6	Electric pole load (1)	
7	do (2)	
8	do (3)	
9	do (4)	
10	Train lateral load	case 3 × 1.176

Combined load

Case No	Combination of loads	α
11	1 + 2	1.0000
12	1 + 2 + 3	〃
13	1 + 4	0.8696
14	1 + 2 + 3 + 10	〃
15	1 + 5	0.6667
16	1 + 2 + 6	1.0
17	1 + 2 + 3 + 7	〃
18	1 + 2 + 3 + 7 + 10	0.8696
19	1 + 2 + 6 - 10	〃
20	1 - 5 + 8	0.6667
21	1 + 5 + 9	〃

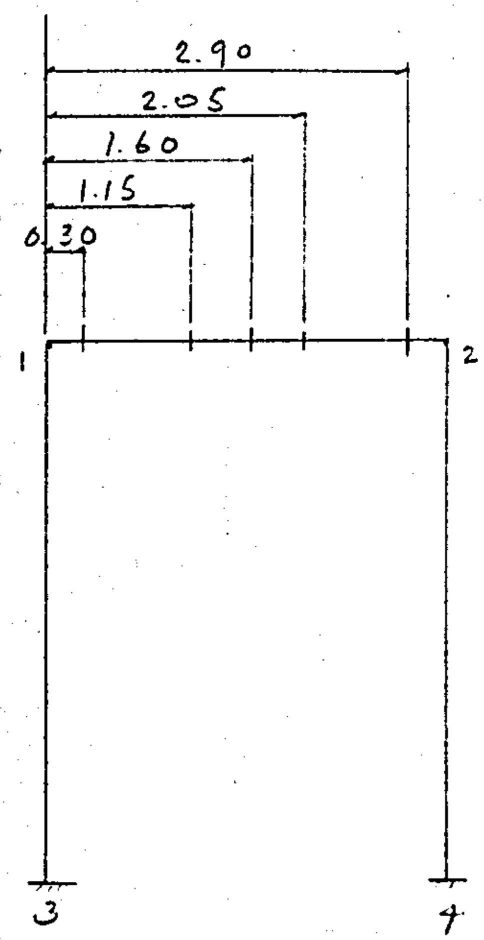
Pick up critical case

No 1 case 11 ~ case 15

No 2 case 16 ~ case 21

No 3 case 11 ~ case 21

[5] Points of computing stresses

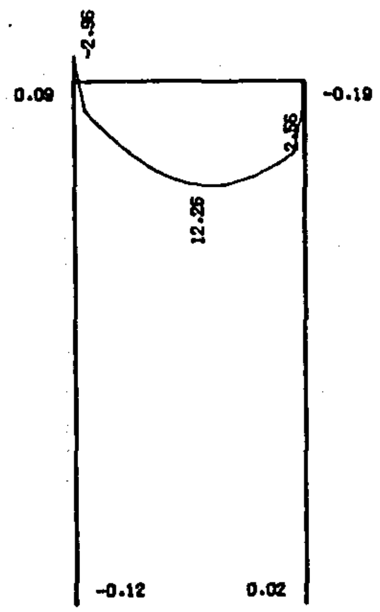


[6] Stress diagrams

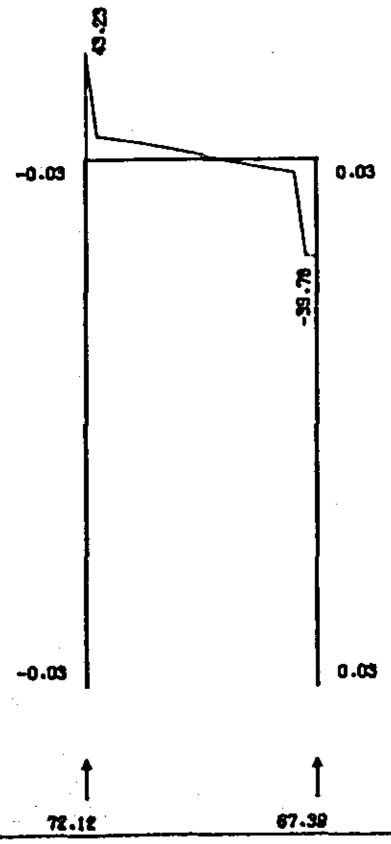
VIADUCT OF SINGLE TRACK (2*8+3=19) C-1

CASE 1

BENDING MOMENT



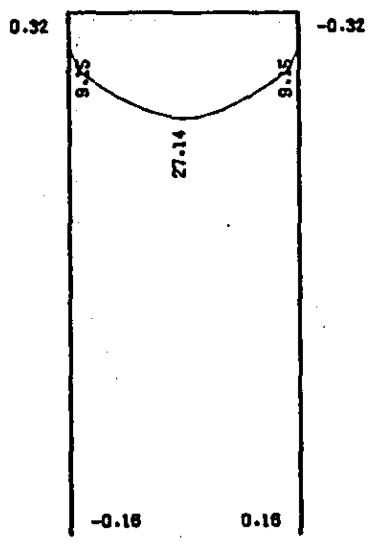
SHEARING FORCE



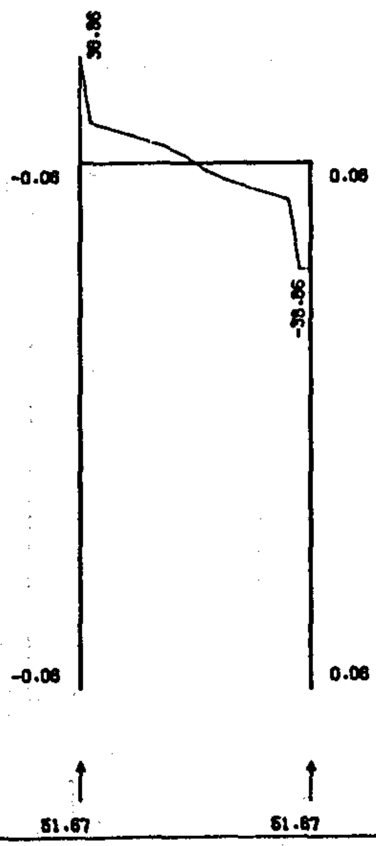
VIADUCT OF SINGLE TRACK (2*8+3=19) C-1

CASE 2

BENDING MOMENT



SHEARING FORCE

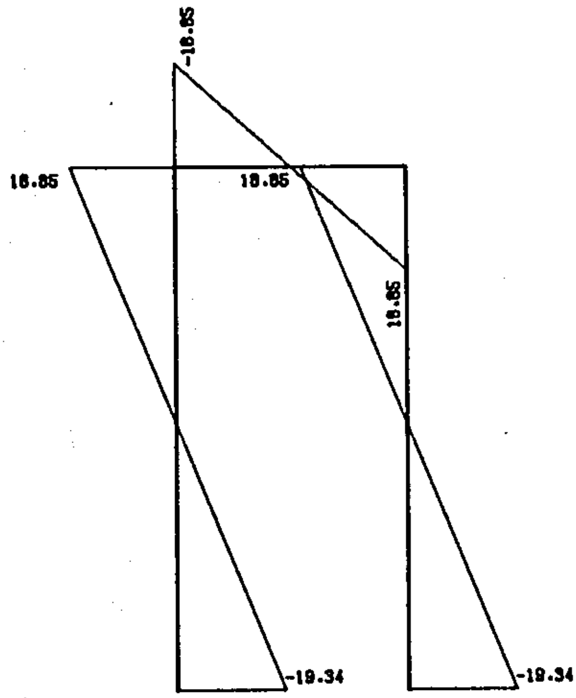


No 137

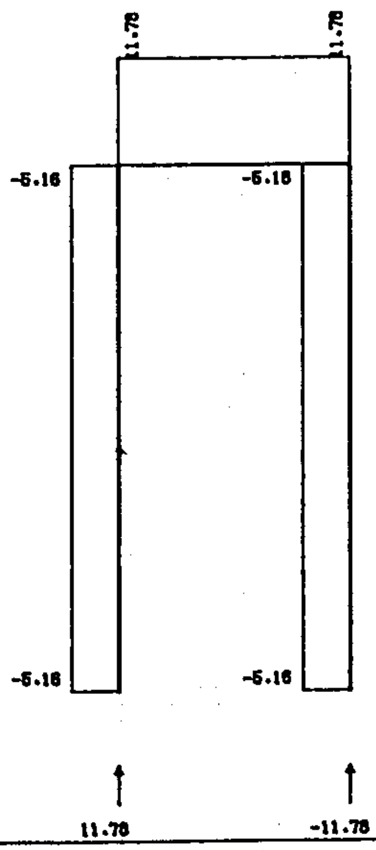
VIADUCT OF SINGLE TRACK (2*8+3=19) C-1

CASE 3

BENDING MOMENT



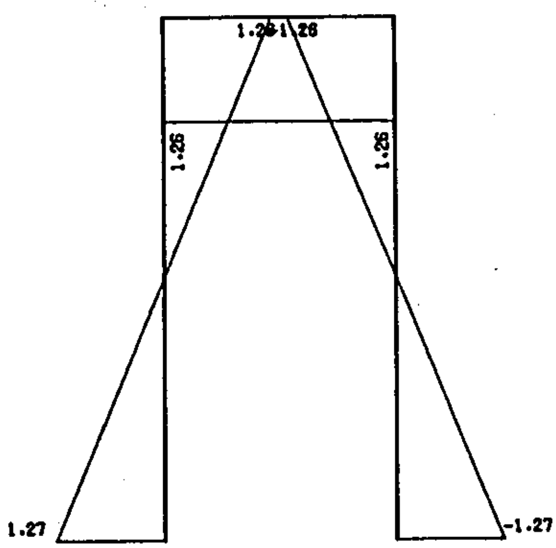
SHEARING FORCE



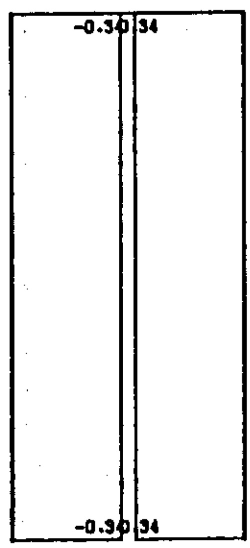
VIADUCT OF SINGLE TRACK (2*8+3=19) C-1

CASE 4

BENDING MOMENT



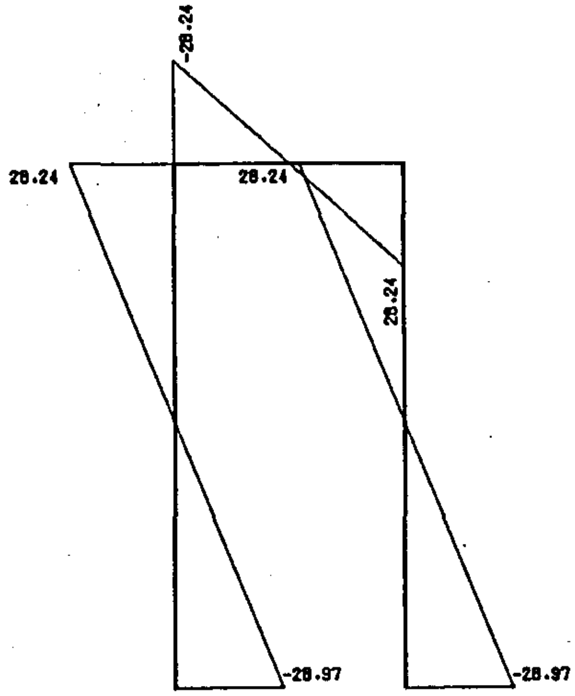
SHEARING FORCE



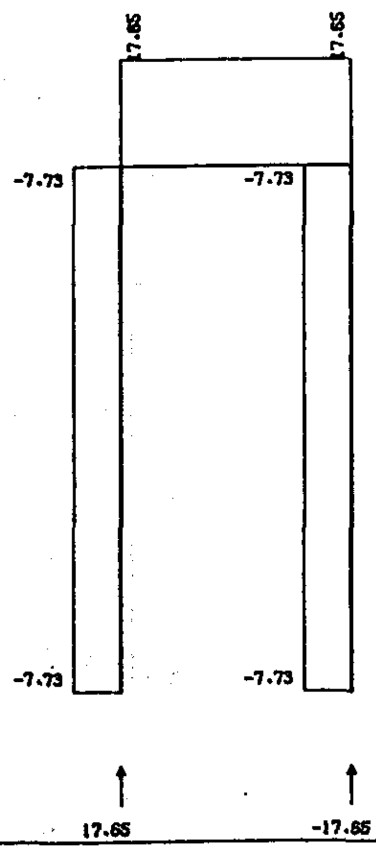
VIADUCT OF SINGLE TRACK (2*8+3=19) C-1

CASE 5

BENDING MOMENT



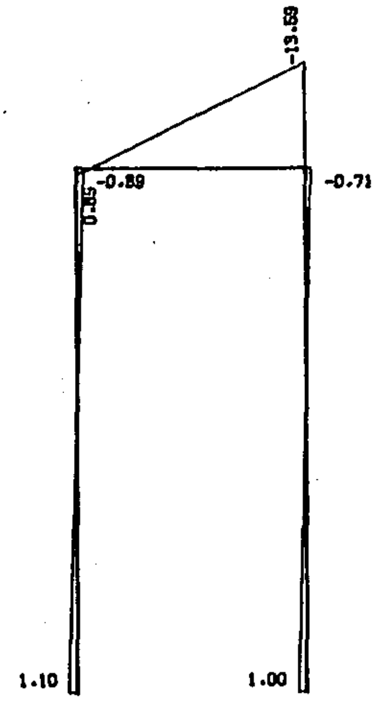
SHEARING FORCE



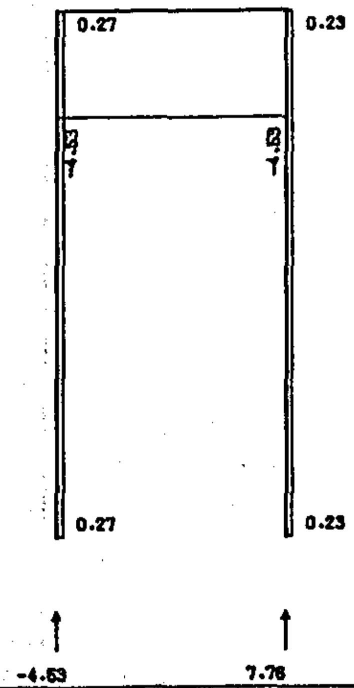
VIADUCT OF SINGLE TRACK (2*8+3=19) C-1

CASE 6

BENDING MOMENT



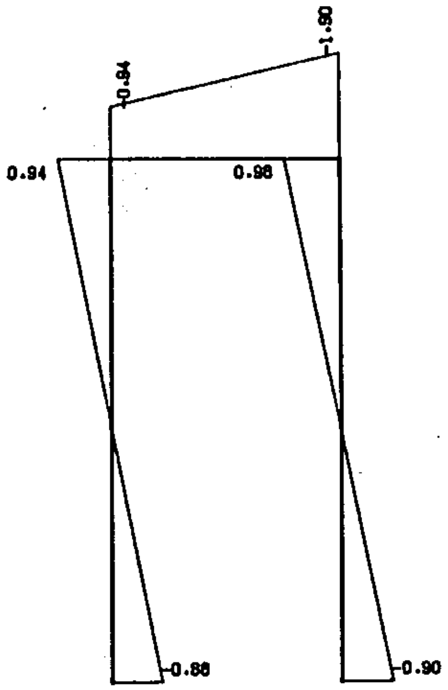
SHEARING FORCE



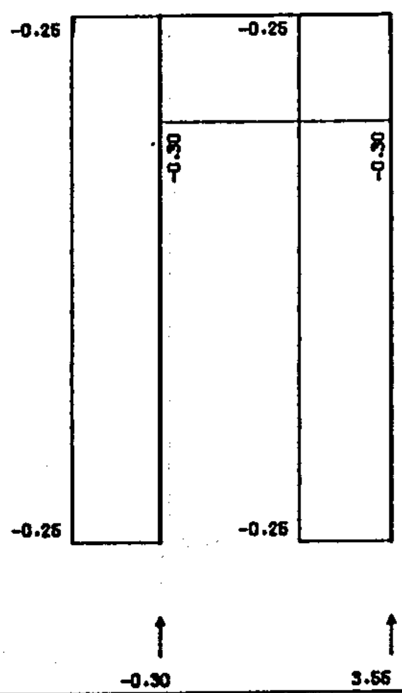
VIADUCT OF SINGLE TRACK (2*8+3=19) C-1

CASE 7

BENDING MOMENT



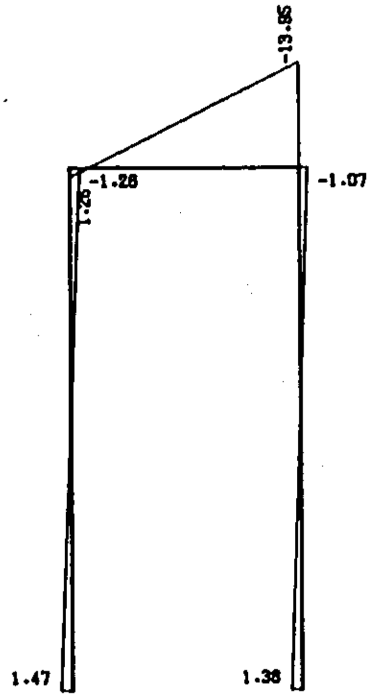
SHEARING FORCE



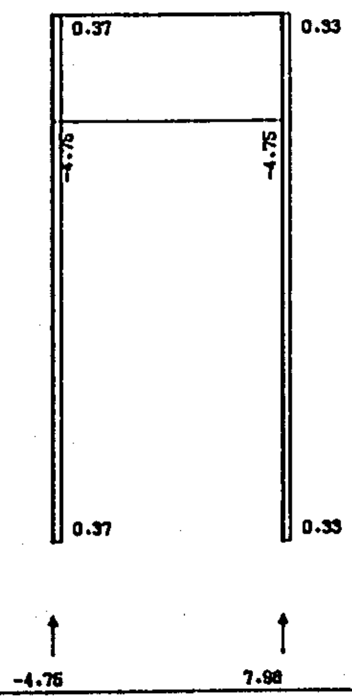
VIADUCT OF SINGLE TRACK (2*8+3=19) C-1

CASE 8

BENDING MOMENT



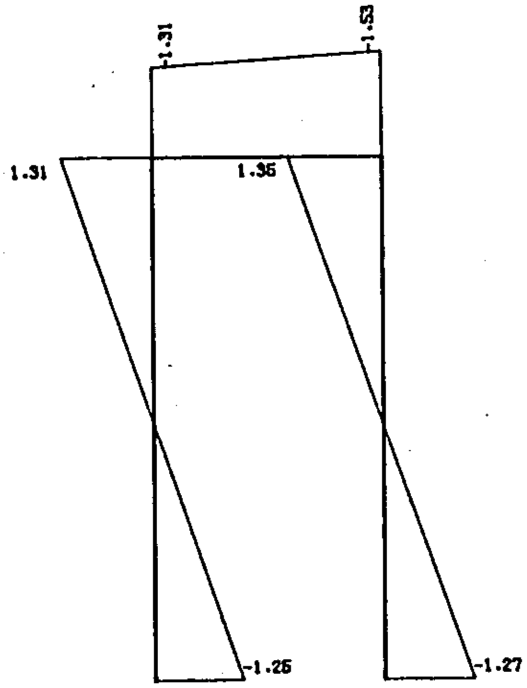
SHEARING FORCE



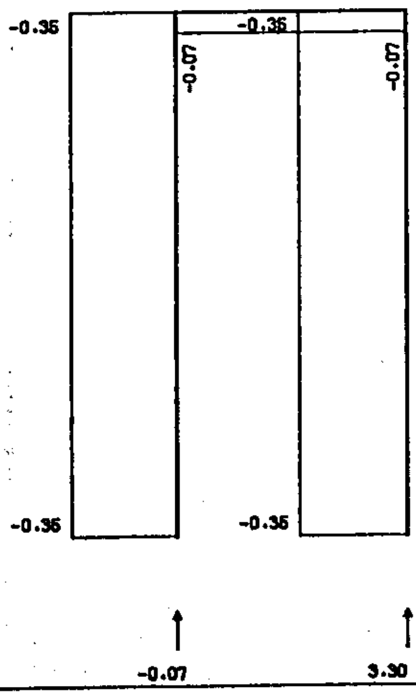
VIADUCT OF SINGLE TRACK (2*8+3=19) C-1

CASE 9

BENDING MOMENT



SHEARING FORCE



[7] Result of computor analysis

RANSY

PLANE

CRC

CENTURY RESEARCH CENTER CORP.

VIADUCT OF SINGLE TRACK (2*8+3=19) C-1

V6.3

No 145

```
*** INPUT DATA ***                                                       CRC-FANSY   V6.3
          5   10       20       30       40       50       60       70       80    CARD NUMBER
     ................................................................................
     TITLE     VIADUCT OF SINGLE TRACK (2*8+3=19) C-1                                    1
     CONTROL       3                                                                     2
     PLOT           1      2                                                             3
     TYPE1-1-1                                                                           4
     L=3.2  H=7.401  M1=2.259,0.63215  M2-3=0.36,0.01080  P1-3=2.7E6  S=0                5
     POINT     1     0.150     0.300     1.150     1.600     2.050     2.900     3.050     6
     PICKUP        1    1    11   15                                                     7
                   2    1    16   21                                                     8
                   3    1    11   21                                                     9
     LOAD          1D                                                                   10
     J             1                  -22.230     2.870                                 11
                   2                  -20.950     2.750                                 12
     C             1    2   -33.150     0.150   -33.150    -0.150                       13
     L             1    2    -3.820    -3.820                                           14
                   2    2    -0.900    -0.900                  3                        15
     D             1  2 2     0.000    -2.800     1.600    -2.800     0.000     1.600   16
     END                                                                                17
     LOAD          2RI                                                                  18
     J             1                  -12.810    -9.470                                 19
                   2                  -12.810     9.470                                 20
     C             1    2   -24.130     0.150   -24.130    -0.150                       21
     L             1    2    -8.440    -8.440     0.155     0.155                       22
                   1    2    -8.440    -8.440     1.300     1.300                       23
     END                                                                                24
     LOAD          3C                                                                   25
     J             1         -5.160                                2                    26
     END                                                                                27
     LOAD          4TC                                                                  28
     T             1            -25                                                     29
     END                                                                                30
     LOAD          5ED                                                                  31
     J             1         -7.730                                2                    32
     END                                                                                33
     LOAD          6P   1                                                               34
     J             2          0.500    -3.230   -12.880                                 35
     END                                                                                36
     LOAD          7P   2                                                               37
     J             2         -0.500    -3.250    -2.880                                 38
     END                                                                                39
     LOAD          8EP  1                                                               40
     J             2          0.700    -3.230   -12.880                                 41
     END                                                                                42
     LOAD          9EP  2                                                               43
     J             2         -0.700    -3.230    -2.880                                 44
     END                                                                                45
     LOAD         10RS                                                                  46
     MIX                1  0.805   3                                                    47
     END                                                                                48
     MT2      11   1.0000    1    2                                                     49
              12   1.0000    1    2    3                                                50
              13   0.8696    1    4                                                     51
              14   0.8696    1    2    3   10                                           52
              15   0.6667    1    5                                                     53
              16   1.0000    1    2    6                                                54
              17   1.0000    1    2    3    7                                           55
              18   0.8696    1    2    3    7   10                                      56
              19   0.8696    1    2    6  -10                                           57
```

No 176

```
=== INPUT DATA ===                                                   CRC-FANSY  V6.3
          5  10     20     30     40     50     60     70     80    CARD NUMBER
        ...........................................................................
             20   0.6667   1   -5   8                                      58
             21   0.6667   1    5   9                                      59
       FINISH                                                              60
```

No 147

TITLE..VIADUCT OF SINGLE TRACK (2*8+3=19) C-1 CRC-FANSY V6.3

CONTROL DATA

METHOD	STRUCTURE	J.RENUMBER	M.RENUMBER	S.F. DIS.	UNI.SPRING	STAN.STIF.	BARA	SKEW MEM.
DIS	*RAHMEN*	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*

LOAD TITLE

LOAD 1	CASE 1	LOAD 2	CASE 2
LOAD 3	CASE 3	LOAD 4	CASE 4
LOAD 5	CASE 5	LOAD 6	CASE 6
LOAD 7	CASE 7	LOAD 8	CASE 8
LOAD 9	CASE 9		
MIX 10	CASE 10 (SYARYOU YOKO KAJYU)	MIX 11	CASE 11 (1+2)
MIX 12	CASE 12 (1+2+3)	MIX 13	CASE 13 (1+4)
MIX 14	CASE 14 (1+2+3+10)	MIX 15	CASE 15 (1+5)
MIX 16	CASE 16 (1+2+6)	MIX 17	CASE 17 (1+2+3+7)
MIX 18	CASE 18 (1+2+3+7+10)	MIX 19	CASE 19 (1+2+6-10)
MIX 20	CASE 20 (1-5+8)	MIX 21	CASE 21 (1+5+9)

PICK UP LOAD CASE

PICK 1	11	12	13	14	15						
PICK 2	16	17	18	19	20	21					
PICK 3	11	12	13	14	15	16	17	18	19	20	21

TITLE..VIADUCT OF SINGLE TRACK (2*8+3=19) C-1 CRC-FANSY V6.3

JOINT DATA

JOINT NUMBER 4

JOINT	X	Y
1	0.0000	7.4010
2	3.2000	7.4010
3	0.0000	0.0000
4	3.2000	0.0000

MEMBER DATA

MEMBER NUMBER 3

MEMBER	ITAN	JTAN	CONNECT. ITAN	JTAN	LENGTH	A	I
1	1	2	FIX	FIX	3.2000	2.25900	.6321500
2	1	3	FIX	FIX	7.4010	.36000	.0108000
3	2	4	FIX	FIX	7.4010	.36000	.0108000

PROPERTY DATA

PROPERTY NUMBER 1

PROPERTY	E		G	EPS
1	2.700E+06	0.		1.000E-05

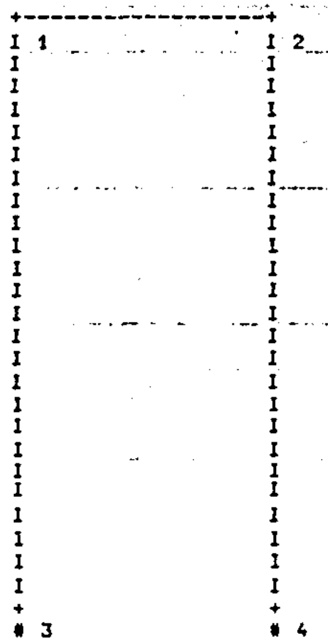
SUPPORT DATA

SUPPORT NUMBER 2

SUPPORT	X	Y	THET Z
3	FIX	FIX	FIX
4	FIX	FIX	FIX

TITLE..VIADUCT OF SINGLE TRACK (2*8+3=19) C-1 CRC-FANSY V6.3

STRUCTURAL FIGURE



No 149

TITLE..VIADUCT OF SINGLE TRACK (2*8+3=19) C-1   CRC-FANSY V6.3

MOVE DATA

MEMBER	ITAN	JTAN	POINT 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	......	......	.150	.300	1.150	1.600	2.050	2.900	3.050							
2	......	......														
3	......	......														

115 150

TITLE..VIADUCT OF SINGLE TRACK (2*8+3=19) C-1 CRC-FANSY V6.3

LOAD DATA

	M/J	NAME	D	W1	W2	L1	L2
LOAD - 1		CASE 1					
MEMBER	1	LINEAR	Y	-3.820	-3.820	0.000	0.000
		LINEAR	Y	0.000	-2.800	0.000	1.600
		LINEAR	Y	-2.800	0.000	1.600	0.000
		CONCENT	Y	-33.150		.150	
		CONCENT	Y	-33.150		3.050	
	2	LINEAR	Y	-.900	-.900	0.000	0.000
	3	LINEAR	Y	-.900	-.900	0.000	0.000
JOINT	1	JOINTLOAD	Y	-22.230			
		JOINTLOAD	Z	2.870			
	2	JOINTLOAD	Y	-20.950			
		JOINTLOAD	Z	2.750			
LOAD - 2		CASE 2					
MEMBER	1	LINEAR	Y	-8.440	-8.440	.155	.155
		LINEAR	Y	-8.440	-8.440	1.300	1.300
		CONCENT	Y	-24.130		.150	
		CONCENT	Y	-24.130		3.050	
JOINT	1	JOINTLOAD	Y	-12.810			
		JOINTLOAD	Z	-9.470			
	2	JOINTLOAD	Y	-12.810			
		JOINTLOAD	Z	9.470			
LOAD - 3		CASE 3					
JOINT	1	JOINTLOAD	X	-5.160			
	2	JOINTLOAD	X	-5.160			
LOAD - 4		CASE 4					
MEMBER	1	TEMP		-25.0(DO)			
LOAD - 5		CASE 5					
JOINT	1	JOINTLOAD	X	-7.730			
	2	JOINTLOAD	X	-7.730			
LOAD - 6		CASE 6					
JOINT	2	JOINTLOAD	X	.500			
		JOINTLOAD	Y	-3.230			
		JOINTLOAD	Z	-12.880			
LOAD - 7		CASE 7					
JOINT	2	JOINTLOAD	X	-.500			
		JOINTLOAD	Y	-3.250			
		JOINTLOAD	Z	-2.880			
LOAD - 8		CASE 8					

11-151

LOAD DATA

	M/J	NAME	D	W1	W2	L1	L2
JOINT	2	JOINTLOAD	X	.700			
		JOINTLOAD	Y	-3.230			
		JOINTLOAD	Z	-12.880			

LOAD - 9 CASE 9

	M/J	NAME	D	W1	W2	L1	L2
JOINT	2	JOINTLOAD	X	-.700			
		JOINTLOAD	Y	-3.230			
		JOINTLOAD	Z	-2.880			

No 153

TITLE..VIADUCT OF SINGLE TRACK (2*8+3=19) C-1 CRC-FANSY V6.3

MIX DATA

MIX NUMBER 12

LOAD	SS	N	S1	K1	S2	K2	S3	K3	S4	K4	S5	K5	S6	K6	S7	K7	S8	K8
10	1.0000	1	.8050	3														
11	1.0000	2	1.0000	1	1.0000	2												
12	1.0000	3	1.0000	1	1.0000	2	1.0000	3										
13	.8696	2	1.0000	1	1.0000	4												
14	.8696	4	1.0000	1	1.0000	2	1.0000	3	1.0000	10								
15	.6667	2	1.0000	1	1.0000	5												
16	1.0000	3	1.0000	1	1.0000	2	1.0000	6										
17	1.0000	4	1.0000	1	1.0000	2	1.0000	3	1.0000	7								
18	.8696	5	1.0000	1	1.0000	2	1.0000	3	1.0000	7	1.0000	10						
19	.8696	4	1.0000	1	1.0000	2	1.0000	6	-1.0000	10								
20	.6667	3	1.0000	1	-1.0000	5	1.0000	8										
21	.6667	3	1.0000	1	1.0000	5	1.0000	9										

TITLE..VIADUCT OF SINGLE TRACK (2*8+3=19) C-1 CRC-FANSY V6.3

PICK UP 1

MOMENT MAXIMUM						MOMENT MINIMUM					
	L	CASE	M	Q	N		L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =						= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(11)	6.190	82.086	-.093	ITAN	0.000	(14)	-24.206	89.875	-.081
1	.150	(11)	18.459	24.214	-.093	1	.150	(15)	-14.741	18.091	-.019
2	.300	(11)	21.955	22.358	-.093	2	.300	(15)	-12.059	17.670	-.019
3	1.150	(11)	36.162	10.858	-.093	3	1.150	(15)	1.794	14.786	-.019
4	1.600	(11)	39.196	1.726	-.093	4	1.600	(15)	8.036	12.918	-.019
5	2.050	(12)	43.017	4.376	-.093	5	2.050	(13)	11.693	-.935	.273
6	2.900	(14)	47.036	2.053	-.081	6	2.900	(13)	9.221	-4.697	.273
7	3.050	(14)	47.220	-49.372	-.081	7	3.050	(13)	8.475	-34.073	.273
JTAN	3.200	(14)	39.775	-49.887	-.081	JTAN	3.200	(13)	3.325	-34.589	.273
MAX	3.050	(14)	47.220	-49.372	-.081	MAX	2.050	(13)	11.693	-.935	.273
= = MEMBER 2 (1 - 3) C = =						= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(14)	29.945	-8.180	-120.346	ITAN	0.000	(13)	-1.017	.273	-56.923
JTAN	7.401	(13)	1.001	.273	-62.715	JTAN	7.401	(14)	-30.595	-8.180	-126.138
= = MEMBER 3 (2 - 4) C = =						= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(14)	29.148	-8.019	-79.245	ITAN	0.000	(11)	-.506	.093	-112.393
JTAN	7.401	(11)	.181	.093	-119.054	JTAN	7.401	(14)	-30.197	-8.019	-85.037

No 155

TITLE..VIADUCT OF SINGLE TRACK (2*8+3=19) C-1 CRC-FANSY V6.3

PICK UP 1

SHEAR MAXIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(12)	-12.661	93.868	-.093
1	.150	(14)	-10.763	39.549	-.081
2	.300	(14)	-4.948	37.935	-.081
3	1.150	(14)	23.124	27.935	-.081
4	1.600	(14)	34.085	19.994	-.081
5	2.050	(14)	41.119	12.053	-.081
6	2.900	(15)	21.528	8.166	-.019
7	3.050	(15)	22.721	-14.356	-.019
JTAN	3.200	(15)	20.537	-14.751	-.019
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(13)	-1.017	.273	-56.923
JTAN	7.401	(13)	1.001	.273	-62.715
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(11)	-.506	.093	-112.393
JTAN	7.401	(11)	.181	.093	-119.054

SHEAR MINIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(13)	-1.479	37.591	.273
1	.150	(13)	4.122	8.249	.273
2	.300	(13)	5.318	7.699	.273
3	1.150	(13)	10.342	3.938	.273
4	1.600	(13)	11.577	1.501	.273
5	2.050	(11)	37.715	-7.405	-.093
6	2.900	(11)	26.444	-18.905	-.093
7	3.050	(11)	23.465	-78.041	-.093
JTAN	3.200	(11)	11.714	-78.633	-.093
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(14)	29.945	-8.180	-120.346
JTAN	7.401	(14)	-30.595	-8.180	-126.138
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(14)	29.148	-8.019	-79.245
JTAN	7.401	(14)	-30.197	-6.019	-85.037

No 156

TITLE..VIADUCT OF SINGLE TRACK (2*8+3=19) C-1 CRC-FANSY V6.3

PICK UP 1

AXIAL MAXIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(13)	-1.479	37.591	.273
1	.150	(13)	4.122	8.249	.273
2	.300	(13)	5.318	7.699	.273
3	1.150	(13)	10.342	3.938	.273
4	1.600	(13)	11.577	1.501	.273
5	2.050	(13)	11.693	-.935	.273
6	2.900	(13)	9.221	-4.697	.273
7	3.050	(13)	8.475	-34.073	.273
JTAN	3.200	(13)	3.325	-34.589	.273
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(15)	18.887	-5.172	-55.408
JTAN	7.401	(15)	-19.392	-5.172	-59.849
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(15)	18.704	-5.135	-28.719
JTAN	7.401	(15)	-19.301	-5.135	-33.160

AXIAL MINIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(12)	-12.661	93.868	-.093
1	.150	(12)	1.376	35.995	-.093
2	.300	(12)	6.639	34.139	-.093
3	1.150	(12)	30.860	22.640	-.093
4	1.600	(12)	39.196	13.508	-.093
5	2.050	(12)	43.017	4.376	-.093
6	2.900	(12)	41.760	-7.123	-.093
7	3.050	(12)	40.549	-66.259	-.093
JTAN	3.200	(12)	30.565	-66.852	-.093
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(12)	19.261	-5.253	-128.908
JTAN	7.401	(12)	-19.615	-5.253	-135.569
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(11)	-.506	.093	-112.393
JTAN	7.401	(11)	.181	.093	-119.054

No 157

TITLE..VIADUCT OF SINGLE TRACK (2*8+3=19) C-1 CRC-FANSY V6.3

PICK UP 2

	MOMENT MAXIMUM						MOMENT MINIMUM				
	L	CASE	M	Q	N		L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =						= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(19)	19.357	59.199	.153	ITAN	0.000	(18)	-25.023	89.615	-.294
1	.150	(19)	28.198	8.873	.153	1	.150	(21)	-15.619	18.044	-.249
2	.300	(19)	29.411	7.259	.153	2	.300	(21)	-12.944	17.623	-.249
3	1.150	(16)	31.852	6.333	.176	3	1.150	(21)	.870	14.739	-.249
4	1.600	(17)	37.777	13.209	-.338	4	1.600	(20)	3.805	-13.785	.227
5	2.050	(17)	41.464	4.077	-.338	5	2.050	(20)	-2.827	-15.653	.227
6	2.900	(18)	45.464	1.793	-.294	6	2.900	(20)	-17.418	-18.537	.227
7	3.050	(18)	45.609	-49.631	-.294	7	3.050	(20)	-20.231	-41.060	.227
JTAN	3.200	(18)	38.125	-50.147	-.294	JTAN	3.200	(20)	-26.419	-41.455	.227
MAX	3.050	(18)	45.609	-49.631	-.294	MAX	1.422	(21)	4.734	13.637	-.249
= = MEMBER 2 (1 - 3) C = =						= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(18)	30.763	-8.394	-120.086	ITAN	0.000	(20)	-19.607	5.381	-28.705
JTAN	7.401	(20)	20.217	5.381	-33.146	JTAN	7.401	(18)	-31.358	-8.394	-125.878
= = MEMBER 3 (2 - 4) C = =						= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(18)	30.003	-8.240	-82.331	ITAN	0.000	(20)	-19.666	5.393	-57.576
JTAN	7.401	(20)	20.247	5.393	-62.016	JTAN	7.401	(18)	-30.979	-8.240	-88.123

No 158

TITLE..VIADUCT OF SINGLE TRACK (2*8+3=19) C-1 CRC-FANSY V6.3

PICK UP 2

SHEAR MAXIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(17)	-13.601	93.569	-.338
1	.150	(18)	-11.619	39.289	-.294
2	.300	(18)	-5.844	37.675	-.294
3	1.150	(18)	22.008	27.675	-.294
4	1.600	(18)	32.851	19.734	-.294
5	2.050	(18)	39.768	11.793	-.294
6	2.900	(21)	20.520	6.119	-.249
7	3.050	(21)	21.706	-14.403	-.249
JTAN	3.200	(21)	19.516	-14.799	-.249
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(20)	-19.607	5.381	-28.705
JTAN	7.401	(20)	20.217	5.381	-33.146
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(20)	-19.666	5.393	-57.576
JTAN	7.401	(20)	20.247	5.393	-62.016

SHEAR MINIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(20)	17.694	13.884	.227
1	.150	(20)	19.747	-8.612	.227
2	.300	(20)	18.424	-9.034	.227
3	1.150	(20)	9.580	-11.917	.227
4	1.600	(20)	3.805	-13.785	.227
5	2.050	(19)	21.796	-18.623	.153
6	2.900	(19)	1.639	-28.623	.153
7	3.050	(16)	10.557	-82.566	.176
JTAN	3.200	(16)	-1.873	-83.159	.176
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(18)	30.763	-8.394	-120.086
JTAN	7.401	(18)	-31.358	-8.394	-125.878
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(18)	30.003	-8.240	-82.331
JTAN	7.401	(18)	-30.979	-8.240	-88.123

No 157

TITLE..VIADUCT OF SINGLE TRACK (2*8+3=19) C-1 CRC-FANSY V6.3

PICK UP 2

	AXIAL MAXIMUM						AXIAL MINIMUM				
	L	CASE	M	Q	N		L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =						= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(20)	17.694	13.884	.227	ITAN	0.000	(17)	-13.601	93.569	-.338
1	.150	(20)	19.747	-8.612	.227	1	.150	(17)	.390	35.696	-.338
2	.300	(20)	18.424	-9.034	.227	2	.300	(17)	5.609	33.840	-.338
3	1.150	(20)	9.580	-11.917	.227	3	1.150	(17)	29.575	22.341	-.338
4	1.600	(20)	3.805	-13.785	.227	4	1.600	(17)	37.777	13.209	-.338
5	2.050	(20)	-2.827	-15.653	.227	5	2.050	(17)	41.464	4.077	-.338
6	2.900	(20)	-17.418	-18.537	.227	6	2.900	(17)	39.952	-7.422	-.338
7	3.050	(20)	-20.231	-41.060	.227	7	3.050	(17)	38.696	-66.558	-.338
JTAN	3.200	(20)	-26.419	-41.455	.227	JTAN	3.200	(17)	28.668	-67.151	-.338
= = MEMBER 2 (1 - 3) C = =						= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(20)	-19.607	5.381	-28.705	ITAN	0.000	(17)	20.201	-5.498	-128.609
JTAN	7.401	(20)	20.217	5.381	-33.146	JTAN	7.401	(17)	-20.493	-5.498	-135.270
= = MEMBER 3 (2 - 4) C = =						= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(21)	19.602	-5.371	-30.919	ITAN	0.000	(16)	-1.213	.324	-120.149
JTAN	7.401	(21)	-20.150	-5.371	-35.360	JTAN	7.401	(16)	1.184	.324	-126.810

No 160

TITLE,.VIADUCT OF SINGLE TRACK (2*8+3=19) C-1 CRC-FANSY V6.3

PICK UP 3

MOMENT MAXIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(19)	19.357	59.199	.153
1	.150	(19)	26.198	8.873	.153
2	.300	(19)	29.411	7.259	.153
3	1.150	(11)	36.162	10.858	-.093
4	1.600	(11)	39.196	1.726	-.093
5	2.050	(12)	43.017	4.376	-.093
6	2.900	(14)	47.036	2.053	-.081
7	3.050	(14)	47.220	-49.372	-.081
JTAN	3.200	(14)	39.775	-49.887	-.081
MAX	3.050	(14)	47.220	-49.372	-.081
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(18)	30.763	-8.394	-120.086
JTAN	7.401	(20)	20.217	5.381	-33.146
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(18)	30.003	-8.240	-82.331
JTAN	7.401	(20)	20.247	5.393	-62.016

MOMENT MINIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(18)	-25.023	89.615	-.294
1	.150	(21)	-15.619	18.044	-.249
2	.300	(21)	-12.944	17.623	-.249
3	1.150	(21)	.870	14.739	-.249
4	1.600	(20)	3.805	-13.785	.227
5	2.050	(20)	-2.827	-15.653	.227
6	2.900	(20)	-17.418	-18.537	.227
7	3.050	(20)	-20.231	-41.060	.227
JTAN	3.200	(20)	-26.419	-41.455	.227
MAX	1.422	(21)	4.734	13.637	-.249
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(20)	-19.607	5.381	-28.705
JTAN	7.401	(18)	-31.358	-8.394	-125.878
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(20)	-19.666	5.393	-57.576
JTAN	7.401	(18)	-30.979	-8.240	-88.123

TITLE..VIADUCT OF SINGLE TRACK (2*8+3=19) C-1 CRC-FANSY V6.3

No 161

PICK UP 3

SHEAR MAXIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(12)	-12.661	93.868	-.093
1	.150	(14)	-10.763	39.549	-.081
2	.300	(14)	-4.948	37.935	-.081
3	1.150	(14)	23.124	27.935	-.081
4	1.600	(14)	34.085	19.994	-.081
5	2.050	(14)	41.119	12.053	-.081
6	2.900	(15)	21.528	8.166	-.019
7	3.050	(15)	22.721	-14.356	-.019
JTAN	3.200	(15)	20.537	-14.751	-.019
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(20)	-19.607	5.381	-28.705
JTAN	7.401	(20)	20.217	5.381	-33.146
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(20)	-19.666	5.393	-57.576
JTAN	7.401	(20)	20.247	5.393	-62.016

SHEAR MINIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(20)	17.694	13.884	.227
1	.150	(20)	19.747	-8.612	.227
2	.300	(20)	18.424	-9.034	.227
3	1.150	(20)	9.580	-11.917	.227
4	1.600	(20)	3.805	-13.785	.227
5	2.050	(19)	21.796	-18.623	.153
6	2.900	(19)	1.639	-28.623	.153
7	3.050	(16)	10.557	-82.566	.176
JTAN	3.200	(16)	-1.873	-83.159	.176
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(18)	30.763	-8.394	-120.086
JTAN	7.401	(18)	-31.358	-8.394	-125.878
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(18)	30.003	-8.240	-82.331
JTAN	7.401	(18)	-30.979	-8.240	-88.123

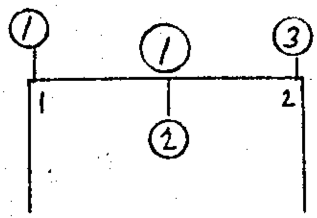
No 162

TITLE..VIADUCT OF SINGLE TRACK (2*8+3=19) C-1 CRC-FANSY V6.3

PICK UP 3

	AXIAL MAXIMUM					AXIAL MINIMUM				
	L	CASE	M	Q	N	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =										
ITAN	0.000	(13)	-1.479	37.591	.273	0.000	(17)	-13.601	93.569	-.338
1	.150	(13)	4.122	8.249	.273	.150	(17)	.390	35.696	-.338
2	.300	(13)	5.318	7.699	.273	.300	(17)	5.609	33.840	-.338
3	1.150	(13)	10.342	3.938	.273	1.150	(17)	29.575	22.341	-.338
4	1.600	(13)	11.577	1.501	.273	1.600	(17)	37.777	13.209	-.338
5	2.050	(13)	11.693	-.935	.273	2.050	(17)	41.464	4.077	-.338
6	2.900	(13)	9.221	-4.697	.273	2.900	(17)	39.952	-7.422	-.338
7	3.050	(13)	8.475	-34.073	.273	3.050	(17)	38.696	-66.558	-.338
JTAN	3.200	(13)	3.325	-34.589	.273	3.200	(17)	28.668	-67.151	-.338
= = MEMBER 2 (1 - 3) C = =										
ITAN	0.000	(20)	-19.607	5.381	-28.705	0.000	(12)	19.261	-5.253	-128.908
JTAN	7.401	(20)	20.217	5.381	-33.146	7.401	(12)	-19.615	-5.253	-135.569
= = MEMBER 3 (2 - 4) C = =										
ITAN	0.000	(15)	18.704	-5.135	-28.719	0.000	(16)	-1.213	.324	-120.149
JTAN	7.401	(15)	-19.301	-5.135	-33.160	7.401	(16)	1.184	.324	-126.810

[8] Calculation of upper beam



1 Calculation of tensive stress caused by bending

(1) Summary of stresses

(a) At the support point

		①			
		①	CASE	③	CASE
Combined stress	Top	-25.02	18	-26.39	20
	Bottom	19.36	19	47.22	14
Dead load		-2.96	1	2.60	1

(b) Span moment

		①			
		③	CASE		
Combined stress	Bottom	39.22	11	—	

(2) Allowable stress of upper beam

Safe against cracking

$\alpha = \dfrac{M_L}{\Sigma M}$ $\alpha \geq 0.25$ ----- $\sigma_{sa} = 1000^{kg/cm^2}$

$\alpha < 0.25$ ----- $\sigma_{sa} = 1200$ "

At the support point 1 . 2

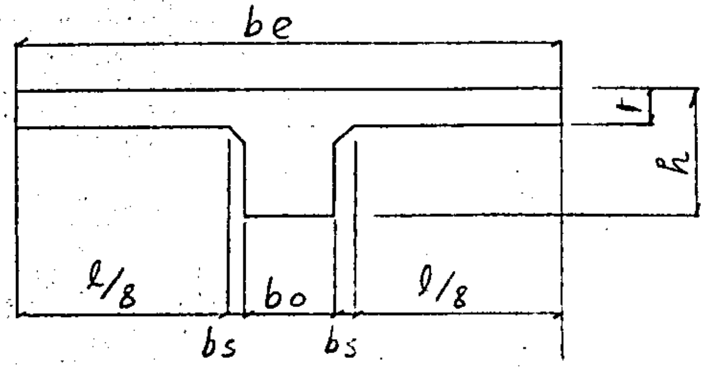
Dead load $M_d = -2.96^{t.m}$ (case 1)

Train load + Impact $M_L = 9.15^{t.m}$ (case 2)

From the above, allowable stress is determined as follows.

$\sigma_{sa} = 1200^{kg/cm^2}$

Effective with of T-beam compression fibre



$$be = bo + 2\left(bs + \frac{1}{8} l\right)$$

$$= 0.60 + 2\left(0.1 + \frac{1}{8} \times 0.6 \times 3.2\right)$$

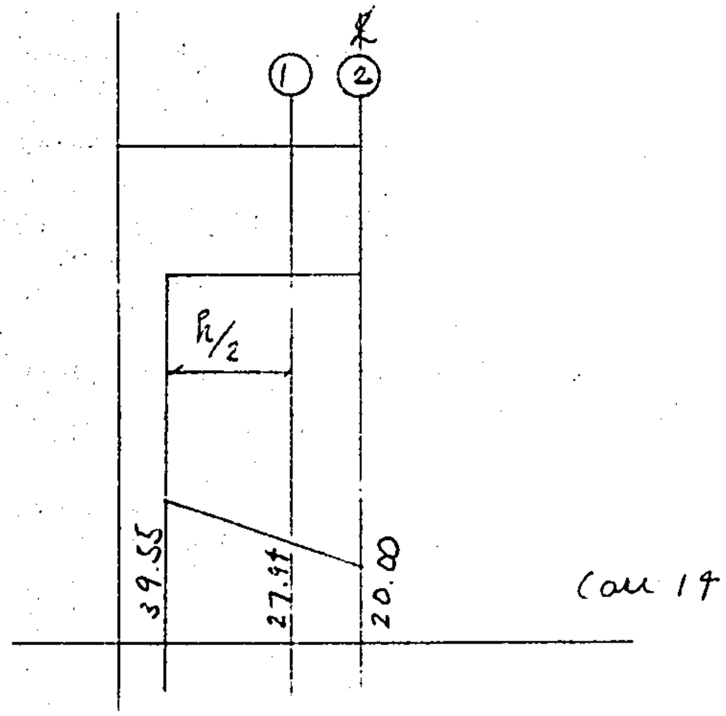
$$= 1.28^{m} < 8.0^{m}$$

Calculation of bending stress

	Top side	Bottom side	
M (tm)	-26.39	47.22	
N (t)			
~~S~~ B (t)		128	
b (cm)	60	60	
h (cm)	170	170	
d (cm)	162.4	164.4	
d' (t) (cm)	7.6	5.6(25)	
As (cm²)	D25-4 =20.268	D25-5 = 25.335	
p	0.00208	0.00104	
As' (cm²)			(Note)
p'			Reinforcing bar area to be used
e=M/N (cm)		x = 28.62 cm	shall be the minimum.
e=M/N+u (cm)			The area is assumed as 4/3 of the
e=M/N−u (cm)			necessary area.
e/h			
d/e			
d'/h			
d'/d			
Ne/bd² (kg/cm²)	1.668		
k		0.174	
c			
j		0.944	
1/Lc	9.79		
1/Ls	519		
β=σs/σc			
σc (kg/cm²)	16.3	16.9	
σs (kg/cm²)	870	1200	
τ (kg/cm²)			
σsa (kg/cm²)	1800	1800	
σca (kg/cm²)	90	90	
τa (kg/cm²)			

2 Calculation of shearing stress

(1) Shearing stress caused bending



$$\tau = \frac{S}{b \cdot d}$$

$$\tau_1 = \frac{27.94 \times 10^3}{60 \times 164.9} = 2.83 \ \mathrm{kg/cm^2} < 3.9 \ \mathrm{kg/cm^2}$$

$$\tau_2 = \frac{20.00 \times 10^3}{60 \times 164.9} = 2.03 \ '' < 3.9 \ ''$$

(2) Torsional moment

Since shoes of T-section simple beam are set at inside of column outline, Torsional moment in beam is assumed not acting. Similarly, since slab is treated as a one-way slab for calculation, torsional moment in beam is assumed not acting along the Rahmen side.

From the above analyses, calculations on stirrup and axial bars are omitted.
Stirrup are arranged with use of D13 - 2 sets 25^{cm} ctc.

Axial bars are arranged as shown below.

$$As = D16 - \begin{cases} 3^{bars} \text{ (T-section simple beam side)} \\ 4 \text{ " (Rahmen side)} \end{cases}$$

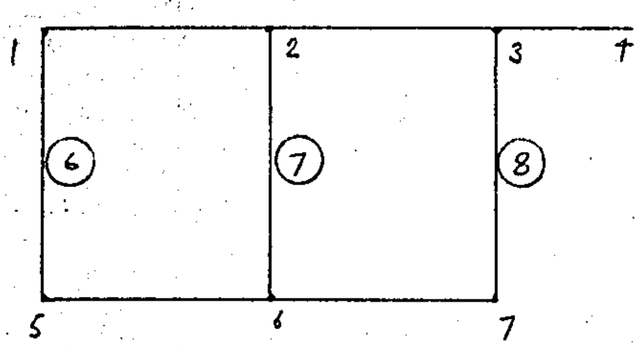
[9] Calculation of electric pole beam

	Top side	
M (tm)	14.29	
N (t)		
S (t)		
b (cm)	75	(Note)
h (cm)	90	Moment of electric pole beam.
d (cm)	82.4	
d' (cm)	7.6	Referred to the block No 18
As (cm²)	D25-5 = 25.34	
p	0.0041	
As' (cm²)		
p'		
e=M/N (cm)		
e=M/N+u (cm)		
e=M/N−u (cm)		
e/h		
d/e		
d'/h		
d'/d		
Ne/bd^2 (kg/cm²)	2.80	
k		
c		
j		
1/Lc	7.529	
1/Ls	270	
$\beta=\sigma s/\sigma c$		
σc (kg/cm²)	21.2	
σs (kg/cm²)	760	
τ (kg/cm²)		
σsa (kg/cm²)	1000	
σca (kg/cm²)	90	
τa (kg/cm²)		
	D	

§ 7 Calculation of column

(1) Calculation of bending stress

1. Rahmen (Rigid frame) calculation in railway profile.

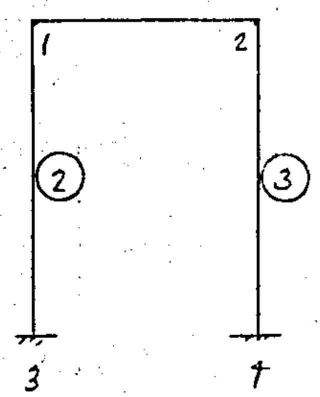


			CASE	M (t·m)	N (t)				CASE	M (t·m)	N (t)
⑥	1-5	M max	16	17.37	103.00	⑧	3-7	M max	16	16.59	85.15
		N min	19	14.09	37.80			N min	19	16.24	34.78
	5-1	M max	16	15.79	109.55		7-3	M max	17	15.75	98.34
		N min	19	10.69	42.82			N min	18	10.12	33.66
⑦	2-6	M max	17	21.31	88.51						
		N min	18	19.23	35.37						
	6-2	M max	17	19.78	95.06						
		N min	18	18.23	40.39						

Stress calculation

	⑥	⑦	⑧	
M (tm)	14.09	19.23	16.24	
N (t)	37.80	35.37	34.78	
S (t)				
b (cm)	60	60	60	
h (cm)	60	60	60	
d (cm)				
d' (cm)	6.1	6.1	6.1	
As (cm²)	D25-4 = 20.268	D25-4 = 20.268	D25-4 = 20.268	
p	0.00563	0.00563	0.00563	
As' (cm²)	〃	〃	〃	
p'				
e=M/N (cm)	37.3	54.4	46.7	
e=M/N+u (cm)				
e=M/N−u (cm)				
e/h				
d/e				
d'/h	0.102	0.102	0.102	
d'/d				
Ne/bd² (kg/cm²)				
k	0.467	0.397	0.421	
c	0.222	0.155	0.179	
j				
1/Lc				
1/Ls				
β=σs/σc				
σc (kg/cm²)	47.3	63.4	54.0	
σs (kg/cm²)	660	1200	920	
τ (kg/cm²)				
σsa (kg/cm²)	1800	1800	1800	
σca (kg/cm²)	90	90	90	
τa (kg/cm²)				

2 ①-① Rahmen (Rigid frame) calculation in the direction of railway cross section



			CASE	M (t·m)	N (t)				CASE	M (t·m)	N (t)
②	1-3	M max	18	30.76	120.09	③	2-4	M max	18	30.00	82.33
		N min	20	19.61	28.71			N min	15	18.70	28.72
	3-1	M max	18	31.36	125.88		4-2	M max	18	30.98	88.12
		N min	20	20.22	33.15			N min	15	19.30	35.16

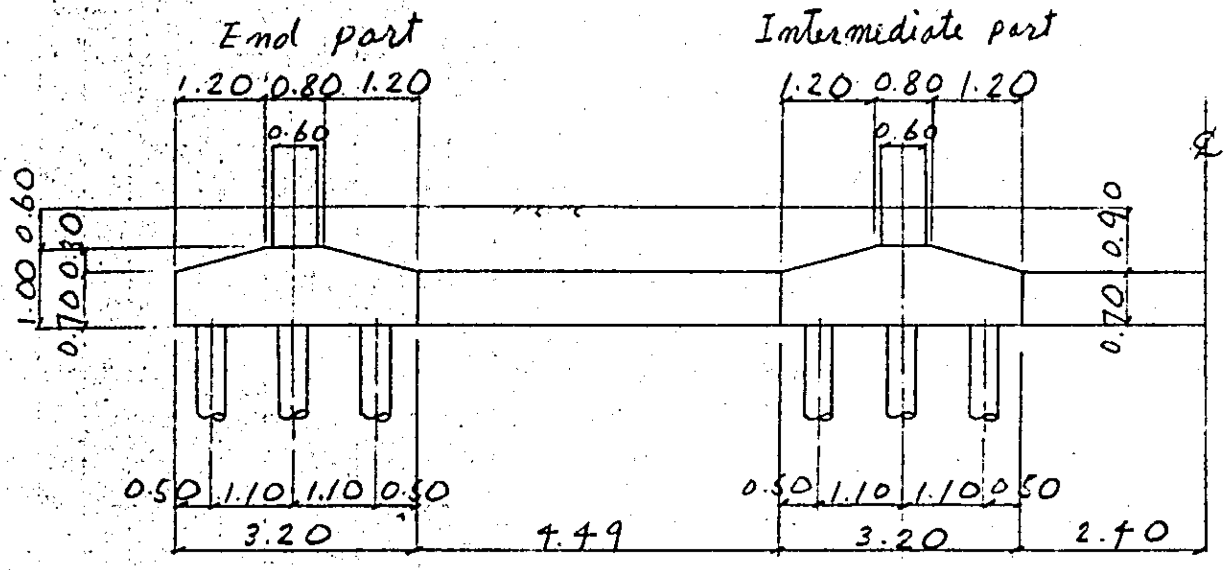
Stress calculation

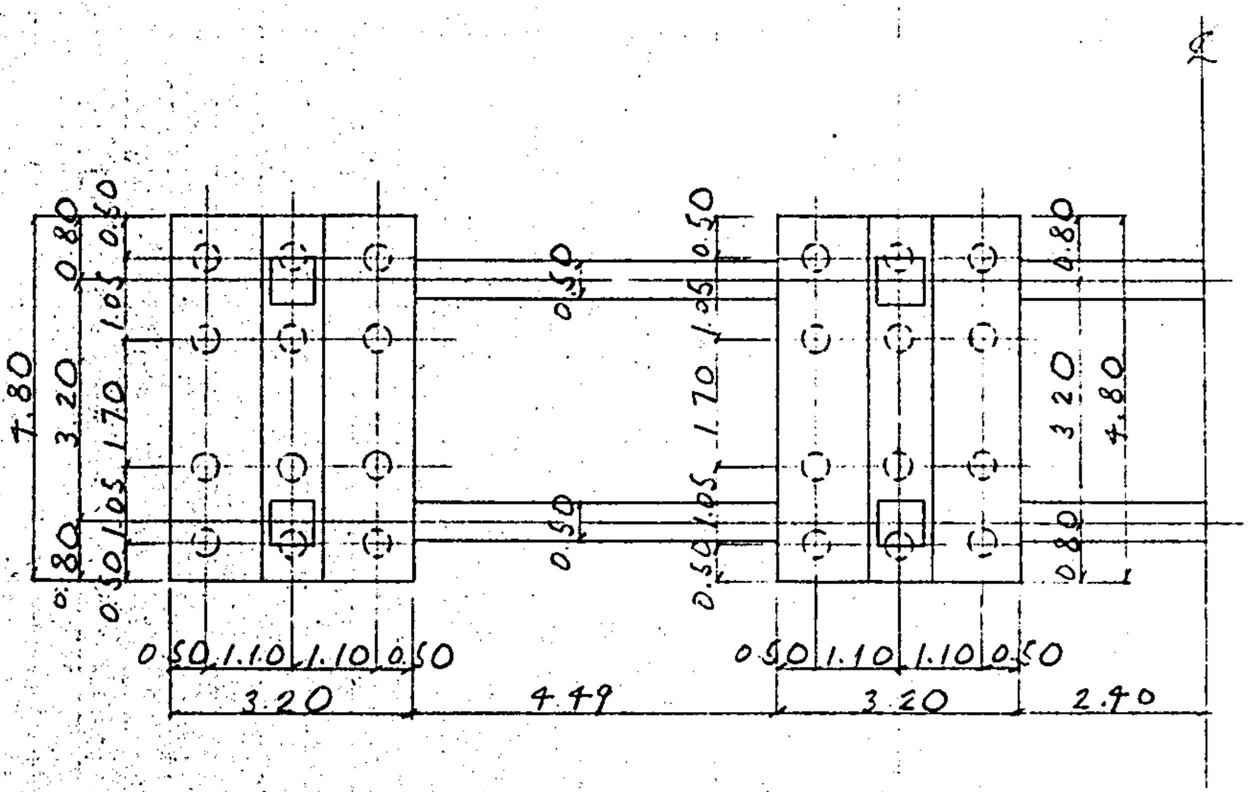
	②	②	③	③	
M (tm)	30.76	31.36	30.00	30.98	
N (t)	120.09	125.88	82.33	88.12	
S (t)					
b (cm)	60	60	60	60	
h (cm)	60	60	60	60	
d (cm)					
d' (cm)	6.1	6.1	6.1	6.1	
As (cm²)	D25 - 7 = 35.469	D25 - 7 = 35.469	D25 - 7 = 35.469	D25 - 7 = 35.469	
p	0.00985	0.00985	0.00985	0.00985	
As' (cm²)	"	"	"	"	
p'					
e=M/N (cm)	25.61	24.91	36.44	35.16	
e=M/N+u (cm)					
e=M/N−u (cm)					
e/h					
d/e					
d'/h	0.102	0.102	0.102	0.102	
d'/d					
Ne/bd² (kg/cm²)					
k	0.642	0.652	0.534	0.543	
c	0.386	0.395	0.286	0.295	
j					
1/Lc					
1/Ls					
β=σs/σc					
σc (kg/cm²)	86.4	88.5	79.9	82.9	
σs (kg/cm²)	520	500	820	810	
τ (kg/cm²)					
σsa (kg/cm²)	1800	1800	1800	1800	
σca (kg/cm²)	90	90	90	90	
τa (kg/cm²)					

§ 8 Basic criteria for calculation

1 Anslysis in direction of railway profile

(1) configulation and dimension





(2) Own weight footing and buried beam, and weight of earth (column part)

End part

$N_{F1} = (0.8 + 3.20) \times 1/2 \times 0.30 \times 4.80 \times 2.50^{t/m^3} = 7.20^{t}$

$N_{F2} = (3.20 \times 0.70 \times 4.80 + 0.50 \times 0.70 \times 2.245 \times 2)$

$\times 2.50^{t/m^3} - 0.90^{t/m} \times 0.65 \times 2 \qquad = 29.63^{t}$

$N_G = \{(1.20 \times 0.30 \times 1/2 \times 2 + 3.20 \times 0.60) \times 4.80$

$+ 0.50 \times 0.90 \times 2.245 \times 2 - 0.60 \times 0.6$

$\times 0.60 \times 2)\} \times 1.80^{t/m^3} \qquad = 22.56^{t}$

59.39^{t}

(3) Supporting power of piles and calculation of footing

*1 Axial load at bottom of column

*2 Weight of footing, buried beam and earth

(a) Ordinary case (Dead load) α = 1.0 case 1

$N = \overset{*1}{69.12} \times 2 + \overset{*2}{59.39} = 197.63^{t}$

(b) Ordinary case + Temporary case (D + T + I)

α = 1.0 case 10

$N = \overset{*1}{127.88} \times 2 + \overset{*2}{59.39} = 315.15^{t}$

(c) Ordinary case + Temporory case (D + T + I + B)

α = 1.15 case 16

$N = \overset{*1}{125.98} \times 2 + \overset{*2}{59.39} = 311.35^{t}$

(d) Eerthquake case (D + S) α = 1.50 case 18

$N = \overset{*1}{74.03} \times 2 + \overset{*2}{59.39} = 207.45^{t}$

(60.59) (180.57^{t}

Horizontal resisting force beared by one pile

Horizontal force at the bottom of column

$H = 6.72 \times 2 = 13.44^{t}$

Footing and buried beam

$H = (7.20 + 29.63) \times \frac{0.70}{2.50} \times 0.10 = 1.03^{t}$

Horizontal force of half portion of column

$H = 0.90^{7m} \times 7.722 \times 1/2 \times 2 \times 0.1 = 0.69^{t}$

$\Sigma H = 13.44 + 1.03 - 0.69 = 15.16^{t}$

$H = \frac{15.16}{12} = 1.26\ ^{t}/\text{Pile}$

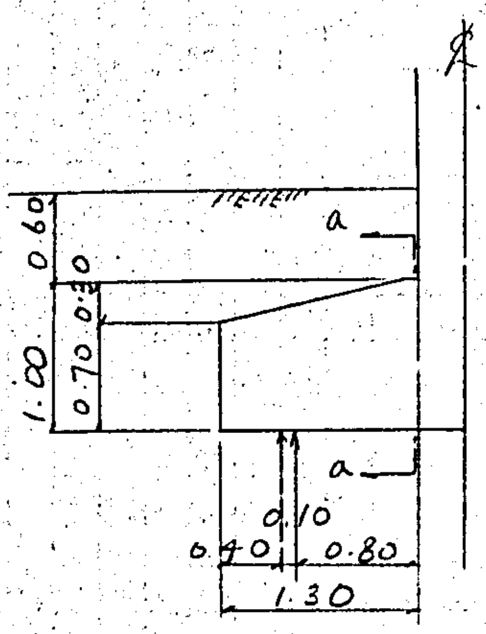
Reaction beared by one pile

$n = 12$

	ΣN (t)	$P = \frac{\Sigma N}{n}$ (t/pile)
D ($\alpha = 0.89$)	197.63	16.47
D + T + I ($\alpha = 1.00$)	315.15	26.26
D + T + I + B ($\alpha = 1.15$)	311.35	25.95
D + S ($\alpha = 1.50$)	207.45 (180.57)	17.29 (15.05)

(4) Calculation of bending moment

Analysis is made calculated bending moment at the column front



Weight of footing and earth pressure

$W_1 = 2.50^{t/m^3} \times 1.00 + 1.80 \times 0.60$

$= 3.58^{t/m}$

$W_2 = 2.50^{t/m^3} \times 0.70 + 1.80 \times 0.90$

$= 3.37^{t/m}$

Reaction of pile

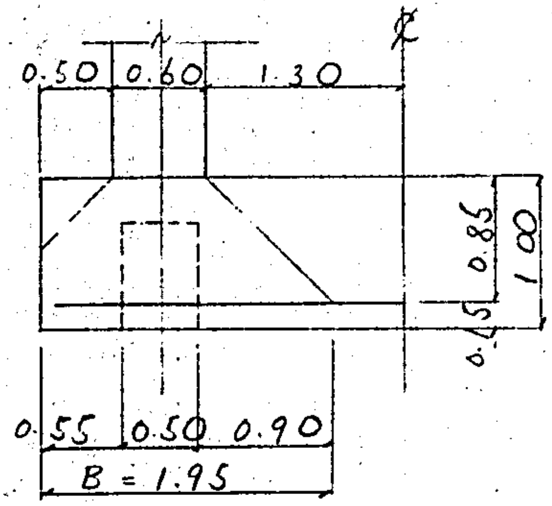
$P = 26.26^{t/pile}$

$Ma = 26.26 \times 0.90 \times 4 - 1/6\,(2 \times 3.37 - 3.58)$

$\times 1.30^2 \times 4.80$

$= 94.54 - 13.95 = 80.59^{t.m}$

Effective width



$B = 0.50 + 0.60 + 0.85 = 1.95^{m}$

Effective width

$B_0 = 1.95 - 0.50 = 1.55^{m}$

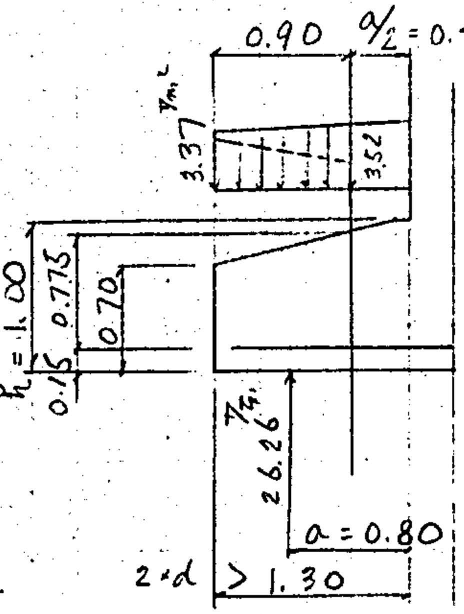
Bending moment per unit one meter

$$M = \frac{80.59}{1.55} = 51.99^{tm}$$

(Note) Referred to the block Vo.125 and omitted calculation, reinforcement is assumed as

$As = D32 - 15^{cm}$ ctc.

(5) Calculation of shearing force caused by bending



$a = 0.8 < 2h = 2.0$

a/2 point

Considered the full with

$$\gamma_0 = \frac{2}{\left(\frac{0.4}{0.775}\right)} = 3.88 < 4.0$$

$$\gamma_1 = \frac{2}{\left(\frac{1.3}{0.775}\right)} = 1.19 < 4.0$$

$$q_0' = \frac{3.50}{3.88} = 0.90^{t/m}$$

$$q_1' = \frac{3.37}{1.19} = 2.83$$

Considered the full width (pile)

$$\gamma = \frac{2}{\left(\frac{0.8}{0.775}\right)} = 1.938 < 4.0$$

$$P' = \frac{26.26}{1.938} = 13.55 \ ^{t}/\text{pile}$$

Shearing force

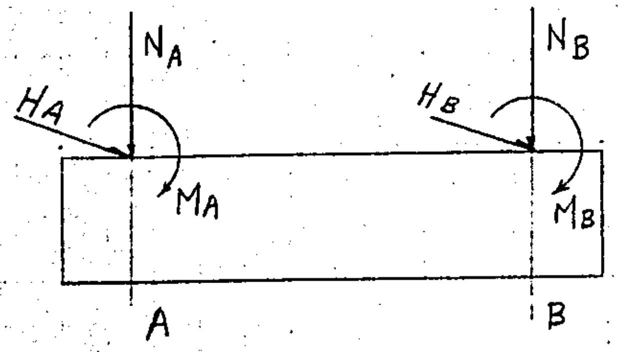
$$S = \{13.55 \times 4 - (0.90 + 2.83) \times 1/2 \times 0.8 \times 4.8\} \times 1/4.8$$

$$= (54.20 - 7.16) \times 1/4.8 = 11.76^{t}$$

$$\tau = \frac{11.76 \times 10^3}{100 \times 77.5} = 1.52\ kg/cm^2 < 3.9\ kg/cm^2$$

2. Analysis in the direction of railway cross section

Stress at the bottom of column



CASE	Combination of loads		A	B
1	D, $\alpha = 1.00$, case 1	M	-0.12	0.02
		N	75.90	74.40
		H	-0.03	0.03
2	D+L+I+C, $\alpha = 1.00$, case 12	M	-19.62	-19.16
		N	139.35	111.05
		H	-5.25	-5.07
3	D+L+I+C+TL, $\alpha = 1.15$, case 14	M	-35.19	-34.73
		N	148.84	104.81
		H	-9.41	-9.23
4	D+S, $\alpha = 1.50$, Case 20	M	30.33	30.38
		N	53.50	100.03
		H	8.07	8.09

Load of electric pole $N = 3.28^t$ (B side)

Weight of buried beam, earth

$N = (2.50^{t/m^3} \times 0.50 \times 0.70 + 1.80^{t/m^3} \times 0.50 \times 0.9) \times 4.49 \times 1/2 = 3.78^t$

** INPUT DATA **

1) KIHON DATA *Basic data*

HASHIRA HONSU= 2 (HON)　KUI RETSUSU= 4 (RETSU)　CASE SU= 4 (CASE)

NA= 20.000 (T)　GANMA 1= 2.500 (T/M**3)　GANMA 2= 1.800 (T/M**3)

2) FOOTING SUNPOU (M)

L1= 0.000	L2= 4.800	L3= 0.000
B1= 1.200	B2= .800	B3= 1.200
H1= .700	H2= .300	H3= .600

3) HASHIRA KYORI OYOBI DANMENSUNPOU (M)

HASHIRA NO.	CL	A	B	HASHIRA NO.	CL	A	B
1	.800	.600	.600	2	4.000	.600	.600

4) KUI KYORI OYOBI HONSU (M) (HON)

KUI RETSU NO.	KL	NN	KUI RETSU NO.	KL	NN
1	.500	3	3	3.250	3
2	1.550	3	4	4.300	3

No 185

5) CASE DATA KH,ALPHA,BETA,HW HASHIRA KATAN NO ORYOKU (M) (TM) (T)

CASE 1 KH= 0.000 ALPHA= 1.0000 BETA= .246000 HW= 0.000 D

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-.120	75.900	-.030	2	.020	74.400	.030

CASE 2 KH= 0.000 ALPHA= 1.0000 BETA= .298000 HW= 0.000 D+T+I-C

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-19.620	139.350	-5.250	2	-19.160	111.050	-5.070

CASE 3 KH= 0.000 ALPHA= 1.1500 BETA= .298000 HW= 0.000 D+T+I-C-TL

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-35.190	148.840	-9.410	2	-34.730	104.810	-9.230

CASE 4 KH= .028 ALPHA= 1.5000 BETA= .298000 HW= 0.000 D+S

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	30.330	53.500	8.070	2	30.380	100.030	8.090

FOOTING Calculation of stability. (Supporting power of pile) PAGE

* CASE 1- 1 * (JYOUJI) NO 5 0 (Ordinary) (DELTA N NASI)

1) HASHIRA KATAN ORYOKU (TM) (T)

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-.120	75.900	-.030	2	.020	74.400	.030

2) FOOTING KAMEN ORYOKU (TM) (T) (M)

MO= 485.424 NO= 203.302 HO= 0.000 EO= 2.388 E= -.012

3) FOOTING JIJU OYOBI JUSINDAKASA (T) (M)

NF1= 26.880 NF2= 7.200 NG= 18.922 GH= .449

4) KUI HANRYOKU (T)

SKN= 12 SIG KN= 12 PH = 0.000 KL = 2.400 I= 25.995 KE = -.012

P 1= 17.125 (Max) P 2= 17.024 P 3= 16.860 P 4= 16.759 (Min)

No 186

* CASE 3- 1 * (JYOUJI) NO 7 D+T+I-C-TL (Ordinary + Temporary) (DELTA N NASI)

1) HASHIRA KATAN ORYOKU (TM) (T)

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-35.190	148.840	-9.410	2	-34.730	104.810	-9.230

2) FOOTING KAMEN ORYOKU (TM) (T) (M)

MO= 576.956 NO= 306.652 HO= -18.640 EO= 1.881 E= -.519

3) FOOTING JIJU OYOBI JUSINDAKASA (T) (M)

NF1= 26.880 NF2= 7.200 NG= 18.922 GH= .449

4) KUI HANRYOKU (T)

SKN= 12 SIG KN= 12 PH = -1.553 KL = 2.400 I= 25.995 KE = -.519

P 1= 35.176 (Max) P 2= 30.754 P 3= 20.355 P 4= 13.932 (Min)

No 187

No 168

* CASE 4- 1 * (JISHINJI--->) NO 8 D+S (Earthquake) (DELTA N NASI)

1) HASHIRA KATAN ORYOKU (TM) (T)

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	30.330	53.500	8.070	2	30.380	100.030	8.090

2) FOOTING KAMEN ORYOKU (TM) (T) (M)

MO= 647.423 NO= 206.532 HO= 17.114 EO= 3.135 E= .735

3) FOOTING JIJU OYOBI JUSINDAKASA (T) (M)

NF1= 26.880 NF2= 7.200 NG= 18.922 GH= .449

4) KUI HANRYOKU (T)

SKN= 12 SIG KN= 12 PH = 1.426 KL = 2.400 I= 25.995 KE = .735

P 1= 6.120 (Min) P 2= 12.249 P 3= 22.173 P 4= 28.302 (Max)

* CASE 1- 1 * (JYOUJI) NO 1 D (DELTA N ARI)

1) HASHIRA KATAN ORYOKU (TM) (T)

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-.120	75.900	-.030	2	.020	74.400	.030

2) FOOTING KAMEN ORYOKU (TM) (T) (M)

MO= 485.424 NO= 203.302 HO= 0.000 EO= 2.388 E= -.012

3) FOOTING JIJU OYOBI JUSINDAKASA (T) (M)

NF1= 26.880 NF2= 7.200 NG= 18.922 GH= .449

4) KUI HANRYOKU (T)

SKN= 12 SIG KN= 12 PH = 0.000 KL = 2.400 I= 25.995 KE = -.012

P 1= 17.125 P 2= 17.024 P 3= 16.860 P 4= 16.759

11o 189

No 190

* CASE 1- 1 * (JYOUJI) NO 1 D (DELTA N ARI)

5) FOOTING KAKUTEN MOMENT OYOBI SENDANRYOKU (M) (TM) (T)

DISTANCE	MOMENT	SENDAN	M/ALPHA	S/ALPHA
.500	-1.401	-5.602	-1.401	-5.602
	-1.401	45.772	-1.401	45.772
.800**	11.856	42.605	11.856	42.605
	11.719	-33.295	11.719	-33.295
1.100*	1.256	-36.462	1.256	-36.462
1.550	-16.286	-41.504	-16.286	-41.504
	-16.286	9.567	-16.286	9.567
2.400)	-12.202	.043	-12.202	.043
3.250	-16.213	-9.480	-16.213	-9.480
	-16.213	41.100	-16.213	41.100
3.700*	1.148	36.058	1.148	36.058
4.000**	11.491	32.892	11.491	32.892
	11.527	-41.508	11.527	-41.508
4.300	-1.400	-44.675	-1.400	-44.675
	-1.400	5.602	-1.400	5.602

* CASE 2- 1 * (JYOUJI) NO 2 D+T+I-C (DELTA N ARI)

1) HASHIRA KATAN ORYOKU (TM) (T)

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-19.620	139.350	-5.250	2	-19.160	111.050	-5.070

2) FOOTING KAMEN ORYOKU (TM) (T) (M)

MD= 633.784 ND= 303.402 HD= -10.320 ED= 2.089 E= -.311

3) FOOTING JIJU OYOBI JUSINDAKASA (T) (M)

NF1= 26.880 NF2= 7.200 NG= 18.922 GH= .449

4) KUI HANRYOKU (T)

SKN= 12 SIG KN= 12 PH = -.860 KL = 2.400 I= 25.995 KE = -.311

P 1= 33.447 P 2= 28.936 P 3= 21.631 P 4= 17.120

No 192

* CASE 2- 1 * (JYOUJI) NO 2 D+T+I-C (DELTA N ARI)

5) FOOTING KAKUTEN MOMENT OYOBI SENDANRYOKU (M) (TM) (T)

DISTANCE	MOMENT	SENDAN	M/ALPHA	S/ALPHA
.500	-1.401	-5.602	-1.401	-5.602
	-6.889	94.740	-6.889	94.740
.800**	21.058	91.573	21.058	91.573
	-1.453	-47.777	-1.453	-47.777
1.100*	-16.261	-50.943	-16.261	-50.943
1.550	-40.320	-55.985	-40.320	-55.985
	-45.808	30.822	-45.808	30.822
2.400)	-23.656	21.299	-23.656	21.299
3.250	-9.600	11.775	-9.600	11.775
	-15.088	76.669	-15.088	76.669
3.700*	18.279	71.627	18.279	71.627
4.000**	39.292	68.460	39.292	68.460
	17.340	-42.590	17.340	-42.590
4.300	4.088	-45.757	4.088	-45.757
	-1.401	5.602	-1.401	5.602

No 193

* CASE 3- 1 * (JYOUJI) NO 3 D+T+I-C-TL (DELTA N ARI)

1) HASHIRA KATAN ORYOKU (TM) (T)

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-35.190	148.840	-9.410	2	-34.730	104.810	-9.230

2) FOOTING KAMEN ORYOKU (TM) (T) (M)

MO= 576.956 NO= 306.652 HO= -18.640 EO= 1.881 E= -.519

3) FOOTING JIJU OYOBI JUSINDAKASA (T) (M)

NF1= 26.880 NF2= 7.200 NG= 18.922 GH= .449

4) KUI HANRYOKU (T)

SKN= 12 SIG KN= 12 PH = -1.553 KL = 2.400 I= 25.995 KE = -.519

P 1= 39.462 P 2= 31.776 P 3= 19.332 P 4= 11.646

No 197

* CASE 3- 1 * (JYOUJI) NO 3 D+T+I-C-TL (DELTA N ARI)

5) FOOTING KAKUTEN MOMENT OYOBI SENDANRYOKU (M) (TM) (T)

DISTANCE	MOMENT	SENDAN	M/ALPHA	S/ALPHA
.500	-1.401	-5.602	-1.218	-4.871
	-11.313	112.785	-9.837	98.074
.800**	22.047	109.618	19.172	95.320
	-18.325	-39.222	-15.935	-34.106
1.100*	-30.566	-42.389	-26.579	-36.860
1.550	-50.776	-47.431	-44.153	-41.244
	-60.688	47.898	-52.772	41.651
2.400)	-24.022	38.375	-20.889	33.370
3.250	4.549	28.852	3.956	25.088
	-5.363	86.848	-4.664	75.520
3.700*	32.584	81.807	28.334	71.136
4.000**	56.651	78.640	49.262	68.383
	16.838	-26.170	14.642	-22.757
4.300	8.512	-29.337	7.402	-25.510
	-1.400	5.602	-1.218	4.871

* CASE 4- 1 * (JISHINJI--->) NO 4 D+S (DELTA N ARI)

1) HASHIRA KATAN ORYOKU (TM) (T)

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	30.330	53.500	8.070	2	30.380	100.030	8.090

2) FOOTING KAMEN ORYOKU (TM) (T) (M)

MO= 647.423 NO= 206.532 HO= 17.114 EO= 3.135 E= .735

3) FOOTING JIJU OYOBI JUSINDAKASA (T) (M) .

NF1= 26.880 NF2= 7.200 NG= 18.922 GH= .449

4) KUI HANRYOKU (T)

SKN= 12 SIG KN= 12 PH = 1.426 KL = 2.400 I= 25.995 KE = .735

P 1= 4.021 P 2= 11.310 P 3= 23.112 P 4= 30.401

No 196

* CASE 4- 1 *   (JISHINJI--->)   NO 4   D+S   (DELTA N ARI)

5) FOOTING KAKUTEN MOMENT OYOBI SENDANRYOKU (M) (TM) (T)

DISTANCE	MOMENT	SENDAN	M/ALPHA	S/ALPHA
.500	-1.401	-5.602	-.934	-3.735
	7.701	6.460	5.134	4.307
.800**	9.164	3.294	6.109	2.196
	43.938	-50.206	29.292	-33.471
1.100*	28.401	-53.373	18.934	-35.582
1.550	3.249	-58.415	2.166	-38.943
	12.350	-24.485	8.233	-16.323
2.400)	-12.509	-34.008	-8.340	-22.672
3.250	-45.464	-43.531	-30.309	-29.021
	-36.363	25.804	-24.242	17.203
3.700*	-25.885	20.762	-17.257	13.842
4.000**	-20.131	17.595	-13.421	11.730
	14.704	-82.435	9.803	-54.956
4.300	-10.502	-85.601	-7.001	-57.068
	-1.401	5.602	-.934	3.735

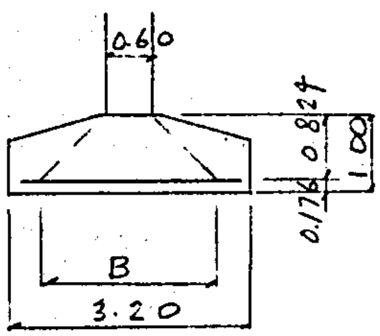
Stress calculation

Effective width

Top side

$B = 3.20^m$

Bottom side



$B = 0.60 + 0.824 \times 2 = 2.25^m$

	Top side	Bottom side	
M (tm)	-52.77	49.26	
N (t)			
S (t)			
b (cm)	320	225	
h (cm)	100	100	
d (cm)	91.8	82.4	
d' (cm)	8.2	17.6	
As (cm²)	D25-7 =35.469	D19·15 ctc =42.975	
p	0.00121	0.00232	
As' (cm²)			
p'			
e=M/N (cm)			
e=M/N+u (cm)			
e=M/N−u (cm)			
e/h			
d/e			
d' /h			
d' /d			
Ne/bd² (kg/cm²)	1.957	3.224	
k			
c			
j			
1/Lc	12.26	9.372	
1/Ls	879	467	
β=σs/σc			
σc (kg/cm²)	24.0	30.2	
σs (kg/cm²)	1720	1510	
τ (kg/cm²)			
σsa (kg/cm²)	1800	1800	
σca (kg/cm²)	90	90	
τa (kg/cm²)			
	D+T+I+C+TL	D+T+I+C+TL	

Shearing stress

$$S = 38.38^{t} \qquad (D+T+I-C-TL)$$

$$\tau = \frac{38.38 \times 10^3}{320 \times 85} = 1.41 \ kg/cm^2 < 3.9 \ kg/cm^2$$

Stability calculation

	allowable supporting power	case	P max (t)	P min (t)	H max (t)
Ordinary	24 t	1	17.13	16.76	0
Ordinary + Temporary	36 t	14	35.18	13.93	1.55
Earthquake	48 t	20	28.30	6.12	1.43

Analysis on the body of pile

$\beta = 0.298^{1/m}$

In direction of railway profile

$H = 15.16 \times 1/12 = 1.26^{t}$ (Seismic load) ($\alpha = 1.5$)

$M = 0.322 \times \frac{H}{\beta} = 0.322 \times \frac{1.26}{0.298} = 1.36^{t \cdot m}$

$N = 15.05^{t}$

In direction of railway cross section

Gelber girder post

$H = 1.55^{t}$ (D + T + I - C - TL) ($\alpha = 1.15$)

$M = 0.322 \times \frac{1.55}{0.298} = 1.67^{t \cdot m}$

$\begin{cases} N_{max} = 39.46^{t} \\ N_{min} = 11.65^{t} \end{cases}$

$H = 1.43^{t}$ (D + S) ($\alpha = 1.5$)

$M = 0.322 \times \frac{1.43}{0.298} = 1.55^{t \cdot m}$

$\begin{cases} N_{max} = 30.40^{t} \\ N_{min} = 4.02^{t} \end{cases}$

Cantilever part

$H = 1.21^{t}$ $(D + T + I - C - TL)$ $(\alpha = 1.15)$

$$M = 0.322 \times \frac{1.21}{0.298} = 1.31^{t \cdot m}$$

$$\begin{cases} N_{max} = 39.00^{t} \\ N_{min} = 6.41^{t} \end{cases}$$

§9. Calculation of shoes and beam supporting parts

[1] Calculation of shoes

1. Calculation of load

(1) Dead Load

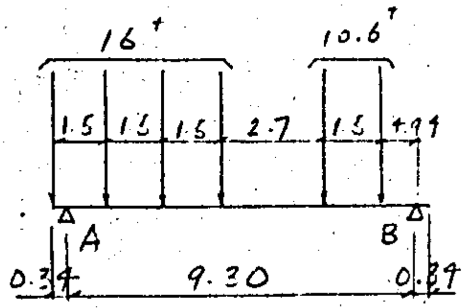
Reaction of T section simple beam

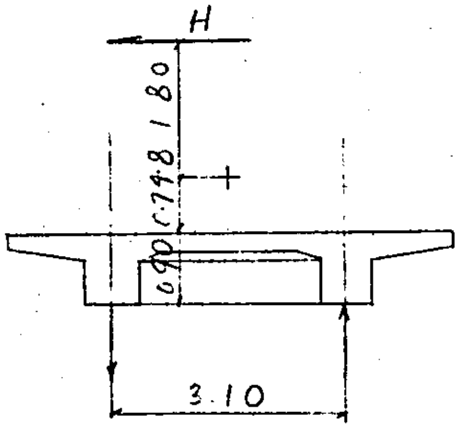
$R_d = 33.51^t$/one shoe

(2) Train + Impact Load

$R_{l+i} = 38.65^t$

(3) Centrifugal Load





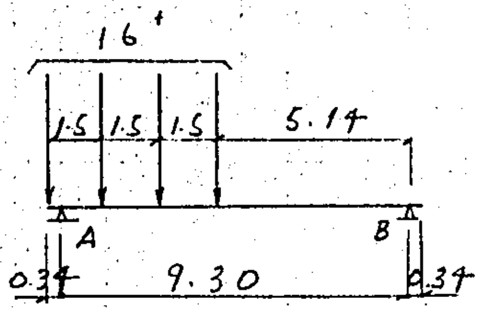
$R = 500^m \qquad \alpha = 0.12$

$$R_l = \frac{1}{9.30}\{16 \times 4 \times 7.39 + 10.6 \times 2 \times 1.69\} = 54.71^t$$

$$H = 54.71 \times 0.12 = 6.57^t$$

$$N = \pm \frac{H \cdot h}{l} = \pm \frac{6.57 \times 3.448}{3.10} = \pm 7.31^t$$

(4) Lateral load caused by Rolling stocks



$$R_A = \frac{1}{9.30} \times 16 \times 4 \times 7.39 = 50.86^t$$

$$H = 50.86 \times 0.15^t = 7.63$$

$$N = \pm \frac{H \cdot h}{l} = \pm \frac{7.63 \times 1.648}{3.10} = \pm 4.06^t$$

(5) Summary of reaction of beam

	REACTION
Dead	33.51
Train + Impact	38.65
Contrifugal	7.31
Train Lateral	4.06
D + T + i + C	79.47
D + T + i + C + TL	83.53
(α = 1.15)	72.63

2 Calculation of rubber shoes

(1) Required area for supporting load

$$15 \leqq \frac{R}{A} \leqq 80$$

$R_{max} = 79.47^t$

$R_{min} = 33.51^t$

Hence

$$\frac{R_{max}}{80} \leqq A \leqq \frac{R_{min}}{15}$$

$$\frac{R_{max}}{80} = \frac{79.47 \times 10^3}{80} = 993^{cm^2}$$

$$\frac{R_{min}}{15} = \frac{33.51 \times 10^3}{15} = 2234^{cm^2}$$

Assumed the size of rubber shoe as $60^{cm} \times 30^{cm}$

$$A = 50 \times 25 = 1250^{cm^2}$$

(2) Thickness of rubber shoe

(Note)

The thickness of rubber shoe is assumed to be indentical with that of for double track girder.

Therefore, calculation of the thickness is omitted.

Thickness of the layer $t = 12^{mm}$ use one layer

Gross thickness 1.4^{mm} (Including stainless steel cover plats)

[2] Calculation of stopper made of steel rod

1 Horizontal force acting the stopper

(1) Centrifugal Load

$H = 6.57 \times 1/2 = 3.29^{t}$

(2) Train Lateral Load

$H = 7.63 \times 1/2 = 3.82^{t}$

(3) Seismic Load

1) Horizontal seismic load applied for the stopper design

$K_{sh} = \Delta 4 \cdot K_h$

$\Delta 4$; Extra factor

In direction of bridge axis $\Delta 4 = 1.2$

In direction of cross section $\Delta 4 = 1.4$

K_h; Horizontal seismic load for design $K_H = 0.1$

Horizontal seismic load applied for the stopper design will be,

Bridge axis $K_{sh} = 1.2 \times 0.1 = 0.12$

Cross section $K_{sh} = 1.4 \times 0.1 = 0.14$

2) Horizontal force acting the stopper

i) Bridge axis

One unit stopper per one main girder is equipped, with semi-rigid construction.

Seismic force due to dead weight

$H_{sh} = K_{sh} \times R_d$

$= 0.12 \times 33.51 = 4.02^t$

ii) Cross sectional direction

Seismic load due to dead weight

$H_{sh} = K_{sh} \times R_d$

$= 0.14 \times 33.51 = 4.69^t$

iii) Summary of horizontal forces

	Horizontal force
C + T·L	7.11
(α : 1.15)	6.18
T·L	3.82
(α = 1.15)	3.32
S	4.69
(α : 1.6)	2.93

2. Stress calculation of the stopper made of steel rod

(1) Curved section

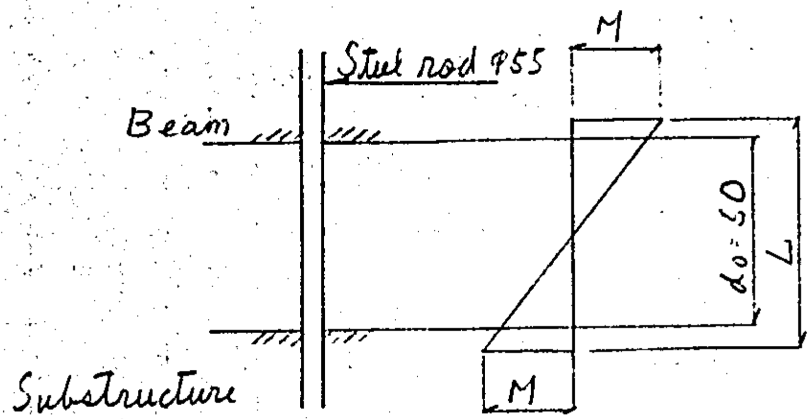
i) Shearing stress

Steel rod $\phi = 55^{mm}$ (SS41) $As = 23.76^{cm^2}$

$$\tau = \frac{H}{As}$$

$$= \frac{7.11 \times 10^3}{23.76} = 299^{kg/cm^2} < 850 \times 1.15 = 977^{kg/cm^2}$$

ii) Bending stress



$$L = do + 1/2\ \phi = 50 + 55 \times 1/2 = 78^{mm}$$

$$H = 7.11^{t}$$

$$M = 1/2 \cdot H \cdot L$$

$$= 1/2 \times 7.10 \times 0.078 = 0.277^{t \cdot m}$$

Section modulus $Z = \frac{\pi \times \phi^3}{32} = 0.098 \cdot \phi^3$

$$\sigma_s = \frac{M}{Z}$$

$$= \frac{0.277 \times 10^5}{0.098 \times 5.5^3} = 1700 \, kg/cm^2 < 1500 \times 1.15$$

$$= 1725 \, kg/cm^2$$

iii) Combined stress

$$\sqrt{\left(\frac{\sigma_s}{\sigma_{sa}}\right)^2 + \left(\frac{\tau}{\tau_a}\right)^2} = \sqrt{\left(\frac{1700}{1725}\right)^2 + \left(\frac{299}{977}\right)^2}$$

$$= 1.03 < 1.1$$

(2) Straight section

i) Shearing stress

Steel rod $\phi 46^{mm}$ (SS41) $A_s = 16.62^{cm^2}$

$H = 3.82^t$

$$\tau = \frac{3.82 \times 10^3}{16.62} = 230 \, kg/cm^2 < 850 \times 1.15$$

$$= 977 \, kg/cm^2$$

ii) Bending stress

$L = 50 + 46 \times 1/2 = 73^{mm}$

$H = 3.82^t$

$M = 1/2 \times H \cdot L$

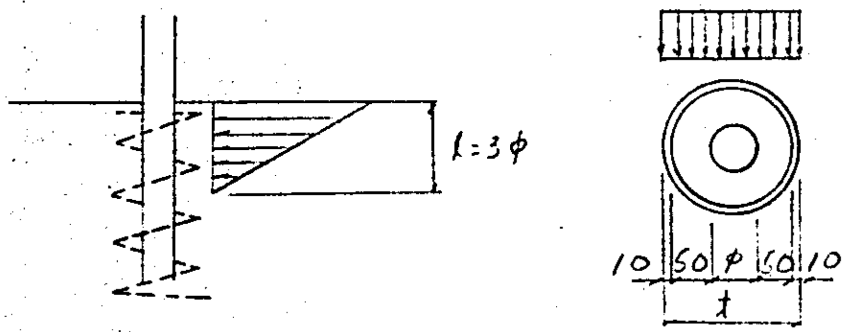
$= 1/2 \times 3.82 \times 0.073 = 0.139^{t \cdot m}$

$$\sigma_s = \frac{0.139 \times 10^5}{0.098 \times 4.6^3} = 1457 \ kg/cm^2 < 1500 \times 1.15$$
$$= 1725 \ kg/cm^2$$

iii) Combined stress

$$\sqrt{\left(\frac{1457}{1725}\right)^2 + \left(\frac{230}{977}\right)^2} = 0.88 < 1.1$$

3 Calculation of bearing stress of concrete



$$\sigma_c = \frac{2H}{l t}$$

$H = 7.10^t$

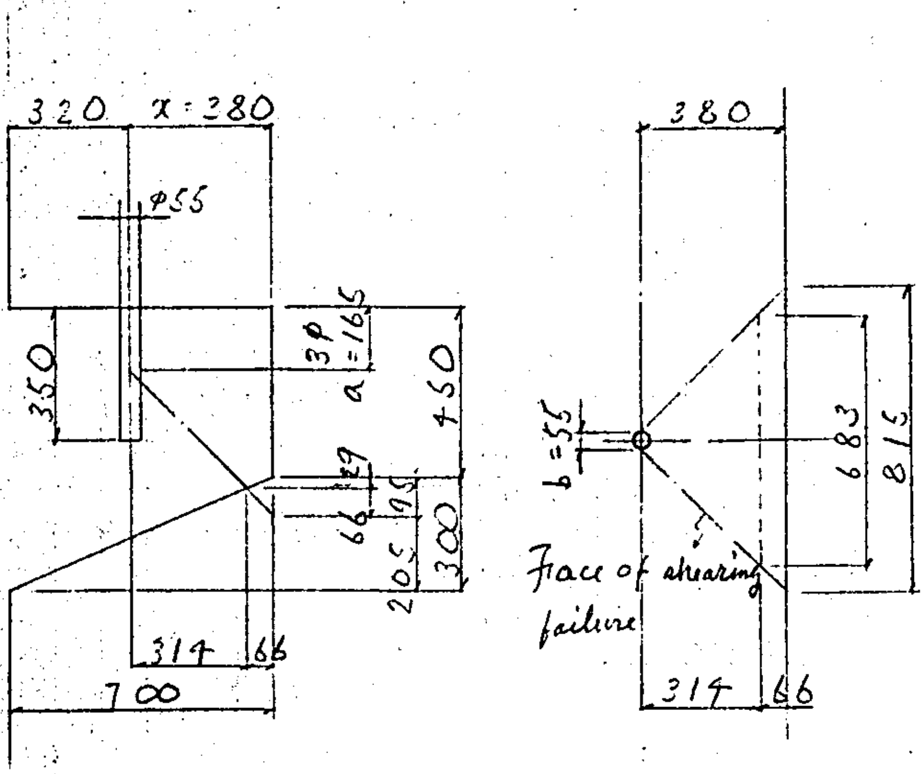
$l = 3 \cdot \phi = 3 \times 5.5 = 16.5^{cm}$

$t = 5.5 + (5.0 + 1.0) \times 2 = 17.5$

$$\sigma_c = \frac{2 \times 7.10 \times 10^3}{16.5 \times 17.5} = 49.2 \ kg/cm^2 < \sigma_{ca} = 270 \times 0.8$$
$$= 216 \ kg/cm^2$$

(2) Calculation of related parts of the stopper installation

1 Calculation of shearing stress



Shearing stress is calculated, referred the R.C standard 182 (1)

$$\tau = \frac{H}{A\tau}$$

$$A\tau = \sqrt{2}\, x\,(2x + 2a + b)$$

τ : Shearing stress

Aτ : area of the face of shearing failure

$$A\tau = \sqrt{2} \times 34 \times (2 \times 34 + 2 \times 12.6 + 4.2)$$

$$- (81.5 + 68.3) \times 1/2 \times 6.6 \times \sqrt{2}$$

$$= 4682.60 - 699.00 = 3983.60\ cm^2$$

$H = 7.10^t \quad (C + T.L)$

$\tau = \dfrac{7.10 \times 10^3}{3983.6} = 1.78 \ kg/cm^2 < 3.9 \ kg/cm^2$

2. Reinforcing bar arrangement around the part of stopper installation

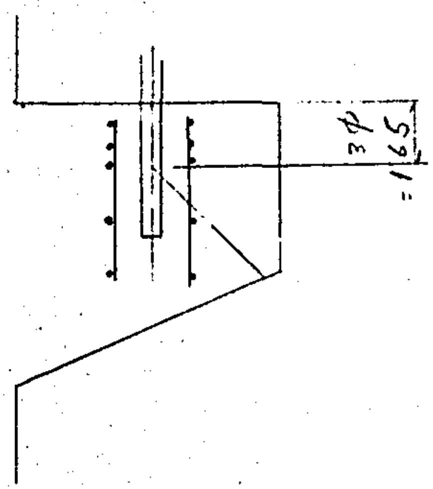
Referred the R.C standard 184 (2)

$As' = \dfrac{H}{\sigma sa}$

$= \dfrac{7.10 \times 10^3}{1800 \times 1.15} = 3.43 \ cm^2$

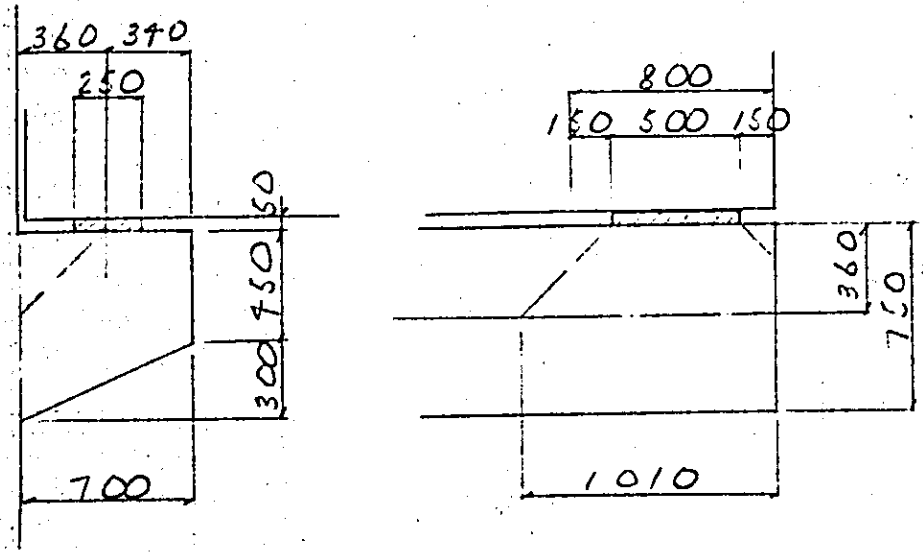
$As = D13 - 3本 = 3.80 \ cm^2 > As' = 3.43 \ cm^2$

Therefore, D13 - 3本 bars are arranged within the range of 3φ



[3] Calculation of beam supporting part

1. Bending stress calculation



Effective width $B = 0.50 + 0.15 + 0.36 = 1.01^{m}$

(1) Calculation of load

(a) Reaction of T section simple beam

Referred the summary table of shoe calculation beam reaction.

$R_d = 33.51^{t}$

$R_{l+i} = 38.65^{t}$

$R_c = \pm 7.31^{t}$

(b) Own weight of beam support part

$W_1 = 2.50^{t/m^3} \times 0.75 = 1.88^{t/m}$

$W_2 = 2.50 \times 0.45 = 1.13$ "

(2) Calculation of bending moment

Stress per $B = 1.00^{m}$ of effective width

(a) Dead Load

$M_d = \{33.51 \times 0.36 + 1/6\,(2 \times 1.13 + 1.88) \times 0.70^2$

$\times 1.05\} \times 1/1.05 \qquad = 11.83^{t \cdot m}$

(b) T + I + C

$M_{l+i} = (38.69 + 7.31) \times 0.36 \times 1/1.05 = 15.77^{t \cdot m}$

(C) D + T + I

$\Sigma M_{d+l+i} = 11.83 + 15.77 \quad = 27.60^{t \cdot m}$

(3) Allowable stress, safe against cracking

$M_d = 11.83^{t \cdot m}$

$M_{l+i} = 15.77$ "

$\Sigma M = 27.60^{t \cdot m}$

$\alpha = \dfrac{M_L}{\Sigma M} = \dfrac{11.83}{27.60} = 0.43 > 0.25$

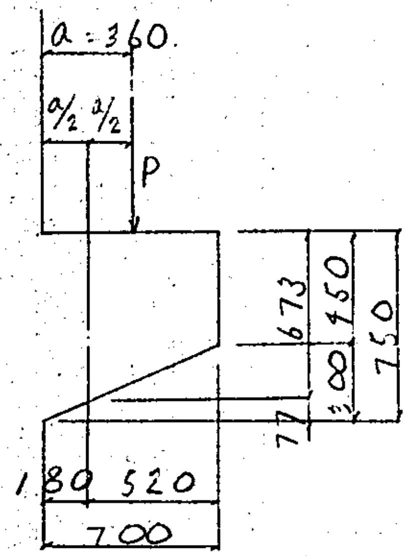
Hence, determined $\sigma_{sa} = 1000^{kg/cm^2}$

Calculation of bending stress

	D	D + L + i	
M (tm)	11.83	27.60	
N (t)			
S (t)			
b (cm)	100	100	
h (cm)	75	75	
d (cm)	69.3	69.3	
d' (cm)	5.7	5.7	
As (cm²)	D22-150 = 25.806	〃	
p	0.00372	0.00372	
As' (cm²)			
p'			
e= M/N (cm)			
e= M/N+u (cm)			
e= M/N−u (cm)			
e/h			
d/e			
d' /h			
d' /d			
Ne/bd² (kg/cm²)	2.463	5.747	
k			
c			
j			
1/Lc	7.80	7.80	
1/Ls	297	297	
β= σs/σc			
σc (kg/cm²)	—	44.8	
σs (kg/cm²)	730	1700	
τ (kg/cm²)			
σsa (kg/cm²)	1,000	1800	
σca (kg/cm²)	—	90	
τa (kg/cm²)			

2. Calculation of shearing stress

Referred R·C standard 39 (1).(a).(b)



Shearing stress is calculated at the a/2 point

Effective width is assumed as the full width

$b = 190^{cm}$

$d = 67.3 - 5.7 = 61.6^{cm}$

(1) Shearing force {D + L + i + (TL) + C}

$P = 33.51 + 38.65 + 4.06 + 7.31 = 83.53^{t}$ (79.47)

$a = 0.36^{m}$ $\quad d = 0.616^{m}$

$r = \dfrac{2}{a/d} = \dfrac{2 \times 0.619}{0.36} = 3.439 < 4$

$\therefore r = 3.439$

$S = \dfrac{P}{r} = \dfrac{83.53}{3.439} = 24.29^{t}$

$\Sigma S = 24.29 + 2.50^{t/m^3} \times (0.45 + 0.673) \times 1/2 \times 0.52 \times 1.90 = 25.68^{t}$

(2) Shearing stress

$\tau = \dfrac{S}{b \cdot d} = \dfrac{25.68 \times 10^3}{190 \times 61.6} = 2.19^{kg/cm^2} < 3.9^{kg/cm^2}$

(3) Bar arrangement for resisting against diagonal Tension

Shearing force per unit one meter

$S = \Sigma S / \text{Effective with } B = 1.90^{m}$

$= \frac{79.47}{1.90} = 41.83$

$A_s' = \frac{S \cdot \sqrt{2}}{\sigma_{sa}}$

$= \frac{41.83 \times 1.414 \times 10^3}{1800} = 32.86^{cm^2}$

$A_s = D25 - 15^{cm}\,ctc = 33.78^{cm^2} > A_s' = 32.86^{cm^2}$

3 Extre bars are arranged at the side face of beam support

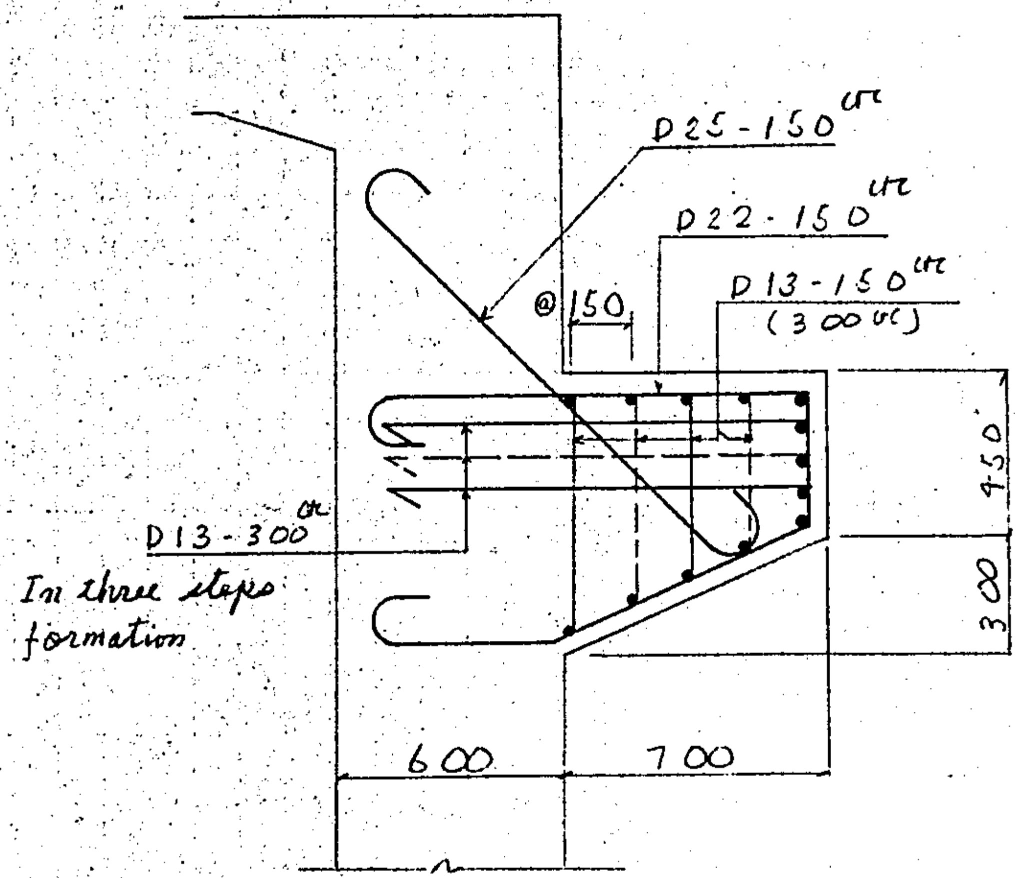
Extra bars are arranged at the side face, with use of bars of 40% cross section of bending stress and installed in three steps formation

$A_s = 25.806 \times 0.40 = 10.32^{cm^2}$

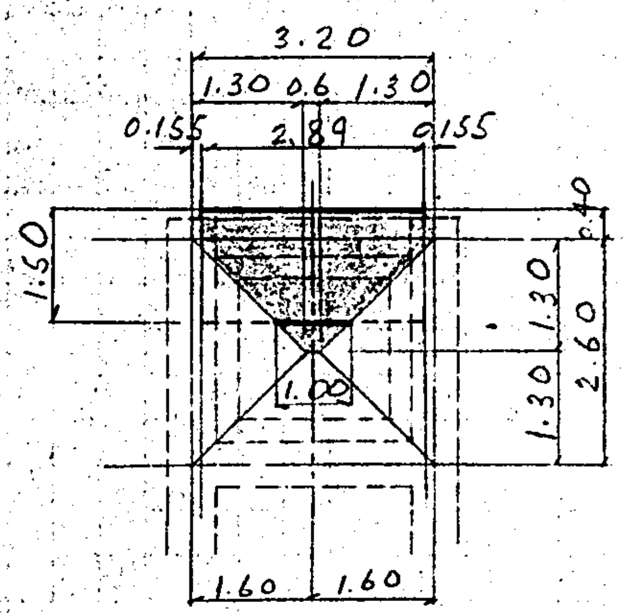
Use extre bars of D13-300^{ctc} (3.33 bars) - in three step then,

$A_s = 1.267 \times 3.33 \times 3 = 12.66^{cm^2} > A_s' = 10.32^{cm^2}$

4 Bar arrangement chart



§ 10. Calculation of out side girder



1 Calculation of load

(1) Dead load

Ballast	$1.90^{t/m^3} \times 0.52$	$= 0.99^{t/m^2}$
Weight of slab	2.50 " × 0.25	= 0.63 "
Grading concrete	2.35 " × 0.07	= 0.16 "
Track weight	0.45 " × 1/2.89	= 0.16 "
		$w = 1.94^{t/m^2}$

$$w_{d1} = 1.94^{t/m^2} \times 1.30 = 2.52^{t/m}$$

Distributed load

Distributed load	$1.94^{t/m^2} \times 0.40$	=	$0.78^{t/m}$
Addition of slab weight	$2.50'' \times 0.15 \times 0.15$	=	$0.06''$
Weight of beam	$2.50'' \times 0.50 \times 0.45$	=	$0.56''$
Haunch of slab	$2.50'' \times 0.30 \times 0.1 \times 1/2$	=	$0.04''$
		w_{d_2} =	$1.44^{t/m}$

(2) Train load + Impact

KS-16

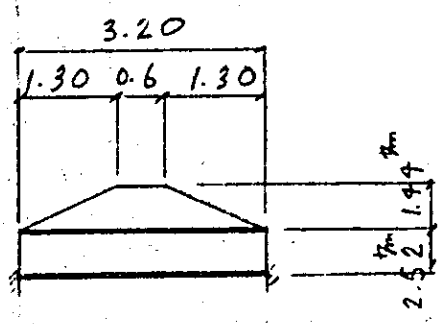
$$w_l = \frac{16}{2.89} = 5.54^{t/m}$$

$l = 3.20^m$ $\quad i = 0.523$

$$w_{l+i} = 5.54 \times 1.523 = 8.44^{t/m}$$

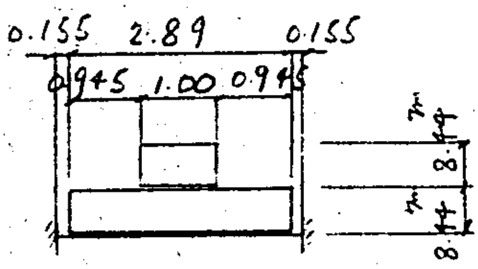
2. Loading diagram

(1) Dead load case 1



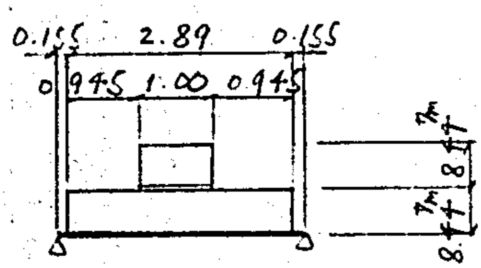
Both ends fixed support

(2) Train load + Impact (1) case 2



Both ends fixed support

(3) Train load + Impact (2) case 3



Both ends simple support

SIDE BEAM [CRC547 RAHMEN]

** CONTROL DATA **

SETTEN SU	2
BUZAI SU	1
SHITEN SU	2
KIHON KAJYU CASE SU	3
KUMIAWASE CASE SU	0
PICK UP CASE SU	0
BUNPU BANE TYPE SU	0
SUPPORT TYPE SU	2

** JOINT DATA **

PT.	X(M)	Y(M)
1	0.000	0.000
2	3.200	0.000

** MEMBER DATA **

K	ITAN	JTAN	IP	JP	L (M)	A(M2)	I(M4)	E(T/M2)	EPS
1	1	2	0	0	3.2000	1.000000	1.000000	.2700E+07	.1000E-04

** SUPPORT TYPE **

<TYPE NO. 1>

SUPPORT	KX (T/M)	KY (T/M)	KZ (T-M/RAD)
1	0.	0.	0.
2	0.	0.	0.

<TYPE NO. 2>

SUPPORT	KX (T/M)	KY (T/M)	KZ (T-M/RAD)
1	1.	0.	1.
2	0.	0.	1.

** CHAKUMOKU TEN DATA & LENGTH **

MEMBER	I-DISTANCE				
1	0.000	.800	1.600	2.400	3.200

No 227

KIHON KAJYU CASE 1
BUNPU BANE TYPE NO. 1
SUPPORT TYPE NO. 1
LOAD TITLE D

[SW]	[NN]	[LL]	[A]	[B]	[C]	[D]
4	1	2	0.000	-1.440	0.000	1.300
4	1	2	-1.440	-1.440	1.300	.600
4	1	2	-1.440	0.000	1.900	1.300
3	1	2	-2.520	0.000	0.000	0.000

KIHON KAJYU CASE 2
BUNPU BANE TYPE NO. 1
SUPPORT TYPE NO. 1
LOAD TITLE L+I (1)

[SW]	[NN]	[LL]	[A]	[B]	[C]	[D]
4	1	2	-8.440	-8.440	.155	2.890
4	1	2	-8.440	-8.440	1.100	1.000

KIHON KAJYU CASE 3
BUNPU BANE TYPE NO. 1
SUPPORT TYPE NO. 2
LOAD TITLE L+I (2)

[SW]	[NN]	[LL]	[A]	[B]	[C]	[D]
4	1	2	-8.440	-8.440	.155	2.890
4	1	2	-8.440	-8.440	1.100	1.000

No 225

R E A C T I O N

CASE 1 D

SUPPORT	X (TON)	Y (TON)	Z (TON.M)
1	0.000	5.400	-3.056
2	0.000	5.400	3.056

CASE 2 L+I (1)

SUPPORT	X (TON)	Y (TON)	Z (TON.M)
1	0.000	16.416	-10.370
2	0.000	16.416	10.370

CASE 3 L+I (2)

SUPPORT	X (TON)	Y (TON)	Z (TON.M)
1	0.000	16.416	0.000
2	0.000	16.416	0.000

D E F L E C T I O N

CASE 1 D

JOINT	X (MM)	Y (MM)	Z (M.RAD)
1	0.000	0.000	0.000
2	0.000	0.000	0.000

CASE 2 L+I (1)

JOINT	X (MM)	Y (MM)	Z (M.RAD)
1	0.000	0.000	0.000
2	0.000	0.000	0.000

CASE 3 L+I (2)

JOINT	X (MM)	Y (MM)	Z (M.RAD)
1	0.000	0.000	-.006
2	0.000	0.000	.006

MEMBER FORCE

CASE 1 D

* * MEMBER 1 (1 - 2) * *

I	L(M)	B.M(T.M)	S.F(T)	A.F(T)
1	0.000	-3.056	5.400	0.000
	.800	.363	3.030	0.000
	1.600	1.607	.000	0.000
	2.400	.363	-3.030	0.000
2	3.200	-3.056	-5.400	0.000

CASE 2 L+I (1)

* * MEMBER 1 (1 - 2) * *

I	L(M)	B.M(T.M)	S.F(T)	A.F(T)
1	0.000	-10.370	16.416	0.000
	.800	1.007	10.972	0.000
	1.600	6.029	-.000	0.000
	2.400	1.007	-10.972	0.000
2	3.200	-10.370	-16.416	0.000

CASE 3 L+I (2)

* * MEMBER 1 (1 - 2) * *

I	L(M)	B.M(T.M)	S.F(T)	A.F(T)
1	0.000	0.000	16.416	0.000
	.800	11.377	10.972	0.000
	1.600	16.399	.000	0.000
	2.400	11.377	-10.972	0.000
2	3.200	0.000	-16.416	0.000

	Top side / Bottom side	
M (tm)	-13.43	
N (t)		
S (t)		
b (cm)	50	
h (cm)	70	
d (cm)	62.7	
d' (cm)	7.3	
As (cm²)	D19 - 5 = 14.33	M = - 3.06 (d) - 10.37 (T+I) = -13.43 t·m
p	0.00457	
As' (cm²)		
p'		
e=M/N (cm)		
e=M/N+u (cm)		
e=M/N−u (cm)		
e/h		
d/e		
d'/h		
d'/d		
Ne/bd² (kg/cm²)	6.832	
k		
c		
j		
1/Lc	7.24	
1/Ls	244	
β=σs/σc		
σc (kg/cm²)	49.4	
σs (kg/cm²)	1670	
τ (kg/cm²)		
σsa (kg/cm²)	1800	
σca (kg/cm²)	90	
τa (kg/cm²)		
	D + T + I	

(1) Calculation of shearing stress

$\ell/2$ point

$$S = \frac{21.82 - 13.97}{0.80} \times (0.80 - 0.65) + 13.97$$

$$= 15.44^{t}$$

$$\tau = \frac{15.44 \times 10^3}{50 \times 62.7} = 4.93^{kg/cm^2} > 3.9^{kg/cm^2}$$

(2) Shearing force beared by concrete

$$S_c = 1/2 \times \tau_a \times b \times d$$

$$= 1/2 \times 39 \times 0.50 \times 0.627 = 6.11^{t}$$

(3) Shearing force beared by stirrup

$$S_v = \frac{\sigma_{sa} \times A_v \times d}{1.15 \times s}$$

Arrange stirrups D13 - 2 sets in 20^{cm} ctc.

$$A_v = 1.27 \times 2 = 2.53^{cm^2}$$

$$S_v = \frac{1800 \times 2.53 \times 62.7}{1.15 \times 20 \times 10^3} = 12.41^{t}$$

(4) Resultant resisting shear

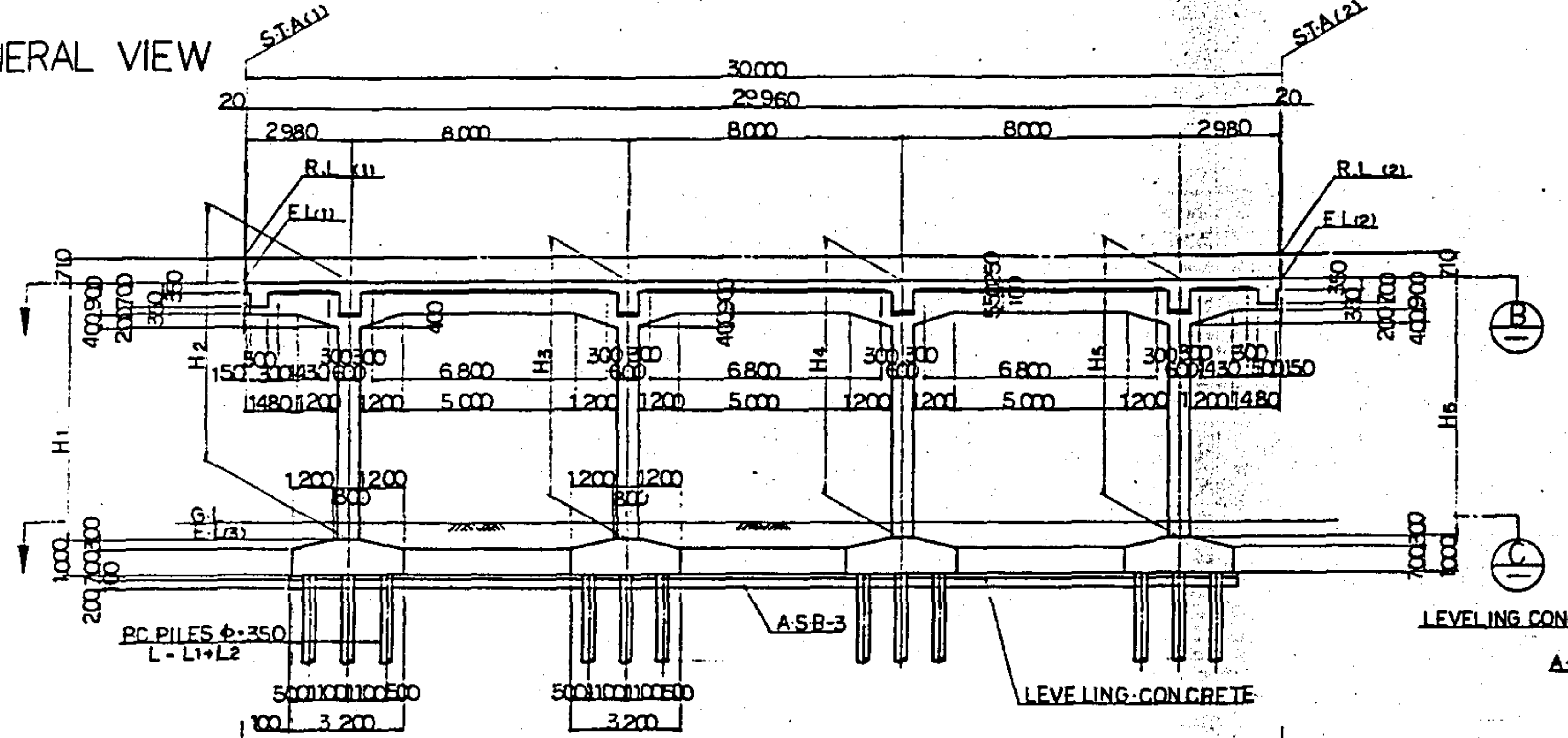
$$S_r = 6.11 + 12.41 = 18.52^{t} > S = 15.44^{t}$$

No.

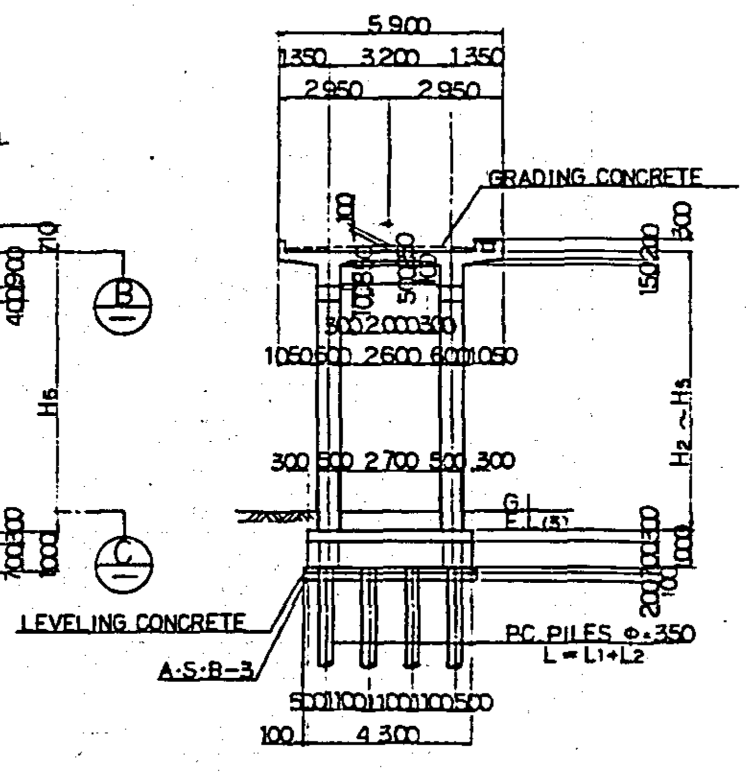
§§6. VIADUCT V048

CONTENT

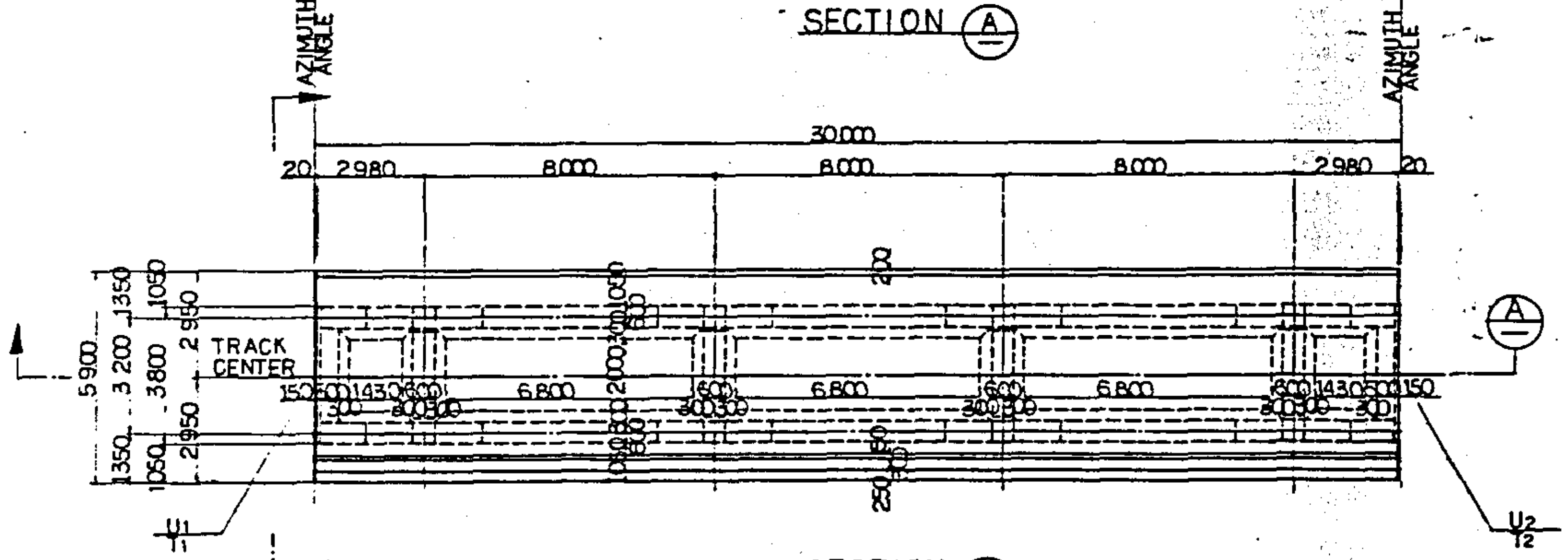
§1. GENERAL VIEW



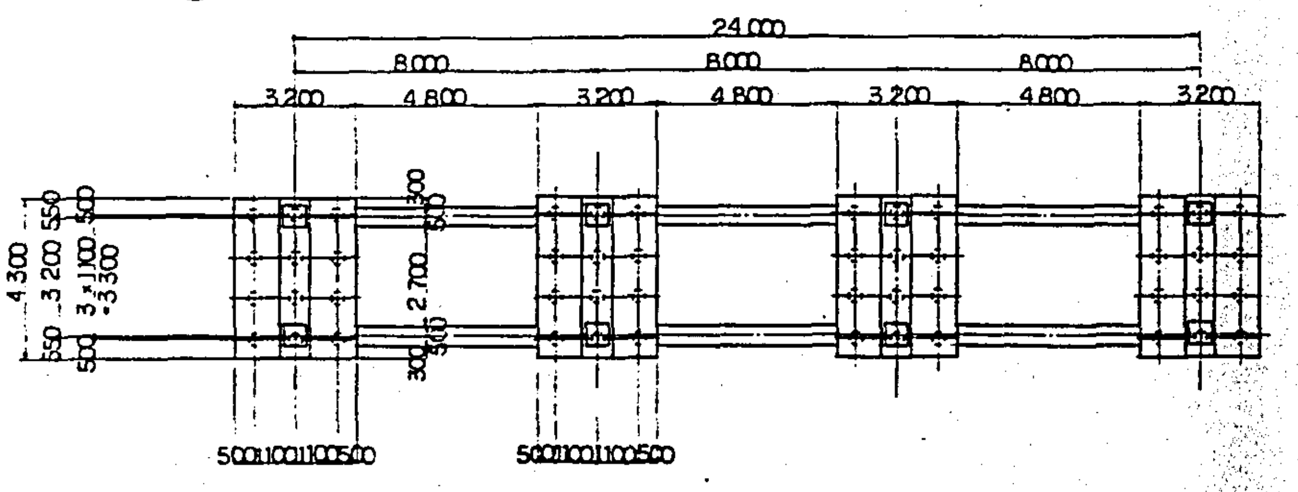
SECTION (A)



SECTION (D)



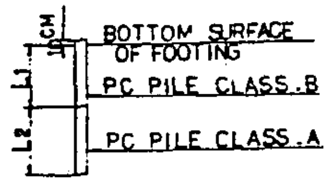
SECTION (B)



SECTION (C)

NOTES ;

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS UNLESS OTHERWISE INDICATED
2. REFERENCE DRAWING FOR BAR ARRANGEMENT : CS-160 - 164
3. TYPES OF PC PILE



4. GRADING CONCRETE SHALL BE SIMULTANEOUSLY PLACED WITH SLAB CONCRETE

DIMENSION SCHEDULE NO1

30+3x8.0+3.0=30.00

	V002	V003	V024	V025	V026	V048	V049	V080	V081	V082	V083	V084	V099	V100
STA (1)	$13^{K}436^{M}000$	$13^{K}466^{M}000$	$14^{K}649^{M}000$	$14^{K}679^{M}000$	$14^{K}709^{M}000$	$15^{K}668^{M}000$	$15^{K}698^{M}000$	$16^{K}872^{M}000$	$16^{K}902^{M}000$	$16^{K}932^{M}000$	$16^{K}962^{M}000$	$16^{K}992^{M}000$	$17^{K}662^{M}000$	$17^{K}692^{M}000$
STA (2)	$13^{K}466^{M}000$	$13^{K}496^{M}000$	$14^{K}679^{M}000$	$14^{K}709^{M}000$	$14^{K}739^{M}000$	$15^{K}698^{M}000$	$15^{K}728^{M}000$	$16^{K}902^{M}000$	$16^{K}932^{M}000$	$16^{K}962^{M}000$	$16^{K}992^{M}000$	$17^{K}022^{M}000$	$17^{K}692^{M}000$	$17^{K}722^{M}000$
R.L (1)	$4^{M}794$	$5^{M}394$	$6^{M}986$	$6^{M}539$	$6^{M}113$	$8^{M}724$	$8^{M}724$	$7^{M}806$	$7^{M}986$	$8^{M}166$	$8^{M}346$	$8^{M}526$	$8^{M}754$	$8^{M}754$
R.L (2)	$5^{M}394$	$5^{M}994$	$6^{M}539$	$6^{M}113$	$5^{M}924$	″	″	$7^{M}986$	$8^{M}166$	$8^{M}346$	$8^{M}526$	$8^{M}726$	″	″
AZIMUTH ANGLE (θ1)	350° 39′ 55″58	350° 39′ 55″58	9° 43′ 08″64	9° 43′ 08″64	9° 43′ 08″64	1° 06′ 02″00	1° 06′ 02″00	345° 30′ 45″40	345° 30′ 45″40	345° 30′ 45″40	345° 30′ 45″40	345° 30′ 45″40	346° 30′ 45″40	345° 30′ 45″40
DO (θ2)	″	″	″	″	″	″	″	″	″	″	″	″	″	″
U 1	$12^{K}041^{M}541$	$12^{K}046^{M}407$	$12^{K}082^{M}840$	$12^{K}077^{M}775$	$12^{K}072^{M}711$	$11^{K}998^{M}266$	$11^{K}997^{M}690$	$12^{K}021^{M}849$	$12^{K}029^{M}354$	$12^{K}036^{M}859$	$12^{K}044^{M}364$	$12^{K}051^{M}869$	$12^{K}219^{M}481$	$12^{K}226^{M}986$
T 1	$-2^{K}732^{M}068$	$-2^{K}702^{M}466$	$-1^{K}527^{M}696$	$-1^{K}498^{M}127$	$-1^{K}468^{M}557$	$-514^{M}734$	$-484^{M}740$	$685^{M}288$	$714^{M}334$	$743^{M}380$	$772^{M}426$	$801^{M}472$	$1^{K}450^{M}168$	$1^{K}479^{M}214$
U 2	$12^{K}046^{M}407$	$12^{K}051^{M}273$	$12^{K}077^{M}775$	$12^{K}072^{M}711$	$12^{K}067^{M}646$	$11^{K}997^{M}690$	$11^{K}997^{M}114$	$12^{K}029^{M}354$	$12^{K}036^{M}859$	$12^{K}044^{M}364$	$12^{K}051^{M}869$	$12^{K}059^{M}374$	$12^{K}226^{M}986$	$12^{K}234^{M}491$
T 2	$-2^{K}702^{M}466$	$-2^{K}672^{M}863$	$-1^{K}498^{M}127$	$-1^{K}468^{M}557$	$-1^{K}438^{M}988$	$-484^{M}740$	$-454^{M}745$	$714^{M}334$	$743^{M}380$	$772^{M}426$	$801^{M}472$	$830^{M}518$	$1^{K}479^{M}214$	$1^{K}508^{M}260$
E L (1)	$4^{M}084$	$4^{M}684$	$6^{M}276$	$5^{M}829$	$5^{M}355$	$8^{M}014$	$8^{M}014$	$7^{M}096$	$7^{M}276$	$7^{M}456$	$7^{M}636$	$7^{M}816$	$8^{M}044$	$8^{M}044$
E L (2)	$4^{M}684$	$5^{M}284$	$5^{M}829$	$5^{M}355$	$5^{M}214$	″	″	$7^{M}276$	$7^{M}456$	$7^{M}636$	$7^{M}816$	$7^{M}996$	″	″
E L (3)	$0^{M}300$	$0^{M}300$	$0^{M}900$	$0^{M}900$	$0^{M}900$	$0^{M}194$	$0^{M}194$	$0^{M}400$	$0^{M}400$	$0^{M}400$	$0^{M}400$	$0^{M}400$	$0^{M}694$	$0^{M}694$
G L	$0^{M}800$	$0^{M}800$	$1^{M}400$	$1^{M}400$	$1^{M}400$	$0^{M}700$	$0^{M}700$	$0^{M}900$	$0^{M}900$	$0^{M}900$	$0^{M}900$	$0^{M}900$	$1^{M}200$	$1^{M}200$
H 1	3784	4384	5376	4929	4455	7820	7820	6696	6876	7056	7236	7416	7350	7350
H 2	3844	4444	5331	4882	4441	″	″	6714	6894	7074	7254	7434	″	″
H 3	4004	4604	5212	4755	4403	″	″	6762	6942	7122	7302	7482	″	″
H 4	4164	4764	5093	4629	4366	″	″	6810	6990	7170	7350	7530	″	″
H 5	4324	4924	4974	4502	4328	″	″	6858	7038	7218	7398	7578	″	″
H 6	4384	4984	4929	4455	4314	″	″	6876	7056	7236	7416	7596	″	″
PC PILES L1	10 000	10 000	12 000	12 000	12 000	8 000	8 000	8 000	8 000	8 000	8 000	8 000	8 000	8 000
PC PILES L2	——	——	——	——	——	8 000	8 000	13 000	13 000	13 000	14 000	14 000	11 000	11 000

DIMENSION SCHEDULE NO2

	V121	V122
STA (1)	$18^{K}412^{M}000$	$18^{K}442^{M}000$
STA (2)	$18^{K}442^{M}000$	$18^{K}472^{M}000$
R L (1)	$8^{M}334$	$8^{M}784$
R L (2)	$8^{M}784$	$9^{M}234$
AZIMUTH ANGLE (θ1)	30° 26′ 59″73	30° 26′ 59″73
DO (θ2)	″	″
U 1	$12^{K}154^{M}003$	$12^{K}138^{M}800$
T 1	$2^{K}162^{M}443$	$2^{K}188^{M}305$
U 2	$12^{K}138^{M}800$	$12^{K}123^{M}596$
T 2	$2^{K}188^{M}305$	$2^{K}214^{M}167$
E L (1)	$7^{M}624$	$8^{M}074$
E L (2)	$8^{M}074$	$8^{M}524$
E L (3)	$0^{M}900$	$0^{M}900$
G L	$1^{M}400$	$1^{M}400$
H 1	6724	7174
H 2	6769	7219
H 3	6889	7339
H 4	7009	7459
H 5	7129	7579
H 6	7174	7624
PC PILES L1	8 000	8 000
PC PILES L2	7 000	7 000

NOTES;

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS UNLESS OTHERWISE INDICATED
2. REFERENCE DRAWING FOR GENERAL VIEW : CS-158

§2. Calculation of slab

Note :

Referred to the block V047

§3. Calculation of torsional moment

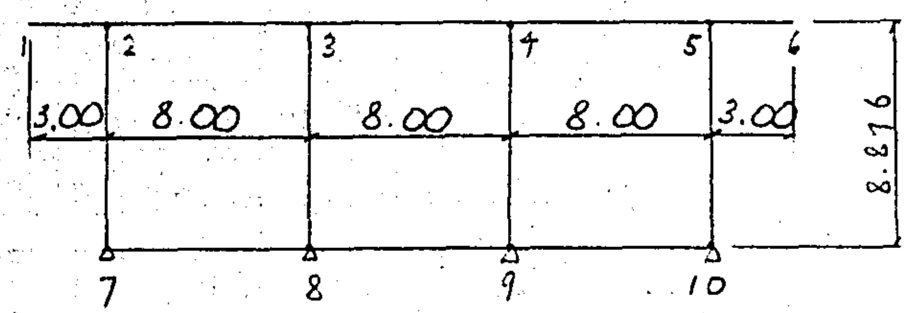
Note

Referred to the block V047

§4. Rigid frame analysis in longitudinal direction of elevated structure

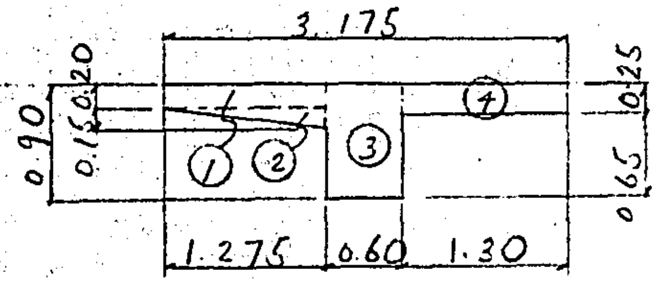
(1) Element for rigid frame analysis

1 Configulation and dimension of rigid frame



2 Cross-sectional aneo and moment of Inertia of the member

(1) Member (1-2, ~ 5-6)



Effective width

$be = 1.275 + 0.60 + \frac{2.60}{2} = 3.175^{m}$

	b (m)	h (m)	A (m^2)	y (m)	A · y (m^3)
①	1.275	0.20	0.255	0.100	0.02550
②	1.275	½·0.15	0.096	0.250	0.02400
③	0.60	0.90	0.540	0.450	0.24300
④	1.30	0.25	0.325	0.125	0.04063
Σ			1.216		0.33313

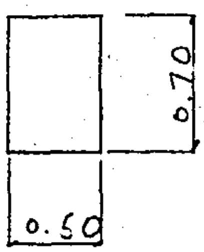
$$y = \frac{0.33313}{1.218} = 0.274^{m}$$

	$b^{(m)}$	$h^{(m)}$	$A^{(m^2)}$	$y_0^{(m)}$	$I_0^{(m^4)}$	$A \cdot y_0^2 \, (m^4)$	$I_0 + A \cdot y_0^2 \, (m^4)$
①	1.275	0.20	0.255	0.174	0.00085	0.00773	0.00858
②	1.275	½×0.15	0.096	0.024	0.00012	0.00006	0.00018
③	0.60	0.90	0.540	0.176	0.03645	0.01673	0.05318
④	1.30	0.25	0.325	0.149	0.00169	0.00722	0.00891
Σ			1.216		0.03911	0.03174	0.07085

Cross-Sectional Arer $A = 1.216^{m^2}$

Moment of Inertia $I = 0.07085^{m^4}$

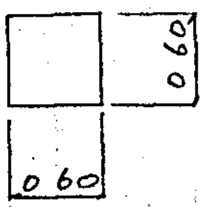
(2) Member (7-8 ~ 9-10)



$A = 0.50 \times 0.70 = 0.350^{m^2}$

$$I = \frac{0.5 \times 0.70^3}{12} = 0.01429^{m^4}$$

(3) Member (2-7, 3-8, 4-9, 5-10)



$A = 0.60 \times 0.60 = 0.360^{m^2}$

$$I = \frac{0.60 \times 0.60^3}{12} = 0.01080^{m^4}$$

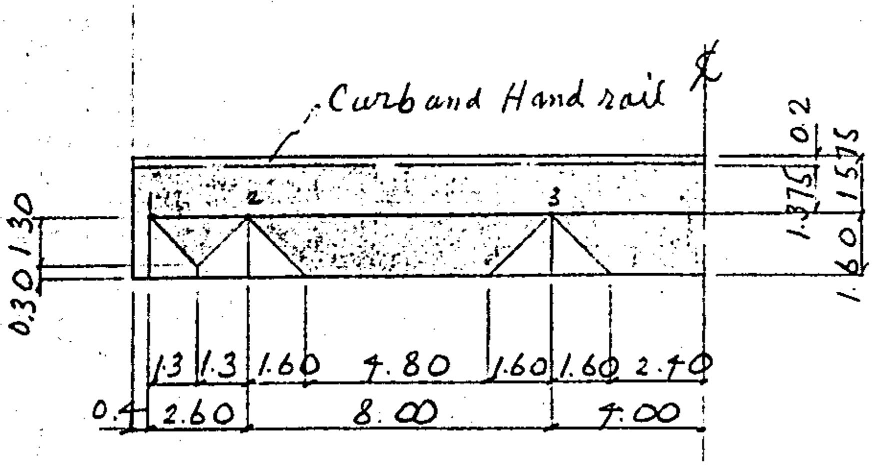
(4) Axial heigh

$$h = 8.50 - 0.274 - 0.30 + 0.70/2 = 8.876^{m}$$

[2] Calculation of load

1 Dead load

(1) Member (1~2~3~4~5~6)



(a) Distributed load

Ballast	1.90 t/m³ × 0.42	= 0.80 t/m²
Sloping concrete	2.35 " × 0.07	= 0.16 "
Track weight	0.45 t/m × 1/2.89	= 0.16 "
Slab	2.50 t/m³ × 0.25	= 0.63 "
		w_d = 1.75 t/m²

w_{d1} = 1.75 t/m² × 1.30 = 2.28 t/m

w_{d2} = 1.75 × 1.60 = 2.80 "

(b) Distributed load

Ballast	0.80 t/m² × 1.375	= 1.10 t/m
Curb	2.50 t/m³ × 0.20 × 0.30	= 0.15 "
Handrail		= 0.20 "
Contilever Slab	2.50 t/m³ × (0.20 + 0.35) × ½ × 1.275	= 0.88
Longitudinal beam	2.50 × 0.30 × (0.90 + 0.65)	= 1.16 "
Haunch of slab	2.50 × 0.30 × 0.10 × ½	= 0.04 "
Sloping Concrete	2.35 × 0.07 × 1.375	= 0.20 "
		3.73 t/m

(C) Concentrate load of elments acting at joint P1, P6 as shown below

Distributed load	1.75 t/m² × (0.30 + 1.60) × ½ × 1.30	= 2.16 t
do	1.75 × 0.40 × 1.60	= 1.12 "
Haunch of slab	2.50 t/m³ × 0.30 × 0.10 × ½ × 1.00	= 0.04 "
Addition of slab	2.50 × 0.15 × 0.10 × 1.60	= 0.06 "
Transverse side beam	2.50 × 0.50 × 0.45 × 1.30	= 0.73 "
		$P_{1,6}$ = 4.11 t

Joint P2, P5

Distributed load	1.75 t/m² × 1.60 × 1.60 × 1/2	=	2.24 t
do	1.75 " × (0.30 + 1.60) × 1/2 × 1.30	=	2.16 "
Haunch of slab	2.50 t/m³ × 0.30 × 0.10 × 1/2 × 1.0 × 2	=	0.08 "
Haunch of longitudinal beam	2.50 " × 0.40 × 1.20 × 1/2 × 0.60 × 2	=	0.72 "
Transverse beam	2.50 " × 0.60 × 0.60 × 2.60	=	2.34 "
Addition of Column weight	2.50 " × 0.60 × 0.60 × (0.274 − 0.25)	=	0.02 "
Deficit of longitnal beam weight	− 2.50 × 0.65 × 0.60 × 0.60	=	− 0.59 "
		$P_{2.5}$ =	6.97 "

Joint P3, P4

Distributed load	1.75 t/m² × 1.60 × 1.60 × 1/2 × 2	=	4.48 t
Haunch of slab	2.50 × 0.30 × 0.10 × 1/2 × 1.0 × 2	=	0.08 "
Haunch of longitudinal beam	2.50 " × 0.40 × 1.20 × 1/2 × 0.60 × 2	=	0.72 "
Transverse beam	2.50 × 0.60 × 0.60 × 2.60	=	2.34 "
Addition of Column weight	2.50 " × 0.60 × 0.60 × (0.274 − 0.25)	=	0.02 "
Deficit of longitnal beam weight	− 2.50 × 0.65 × 0.60 × 0.60	=	− 0.59 "
		$P_{3.4}$ =	7.05 t

(2) Member (7 ~ 8 ~ 9 ~ 10)

Eerth pressure	$1.80^{t/m^3} \times 0.50 \times 0.90$	$= 0.81^{t/m}$
Bracing beam	$2.50'' \times 0.50 \times 0.70$	$= 0.88''$
		1.69 "

(3) Column Weight

$q = 2.50^{t/m^3} \times 0.60 \times 0.60 \quad = 0.90^{t/m}$

2. Train load and Impact

(1) Train load

KS - 16.

(a) Distributed load acting on rigid - fram

Span $l = 8.00^{m}$

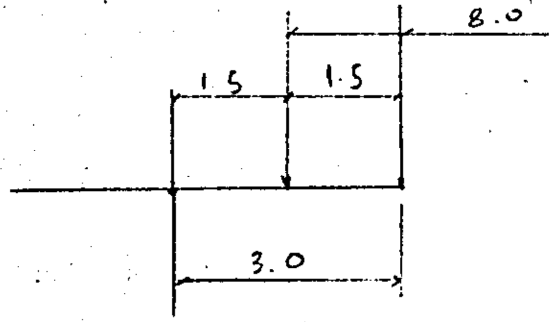
$w_{M1} = 5.40^{t/m} \times 2 \times 1/2 = 5.40^{t/m}$

$w_{M2} = 4.60^{t/m} \times 2 \times 1/2 = 4.60$

$w_S = 6.0'' \times 2 \times 1/2 = 6.00$

b) Cantilever beam

Span $l = 3.00$



(2) Impact coefficient

$l = 8.00^{m}$ $i = 0.45$

$l = 3.00$ " $i = 0.528$

(3) Train load + Impact

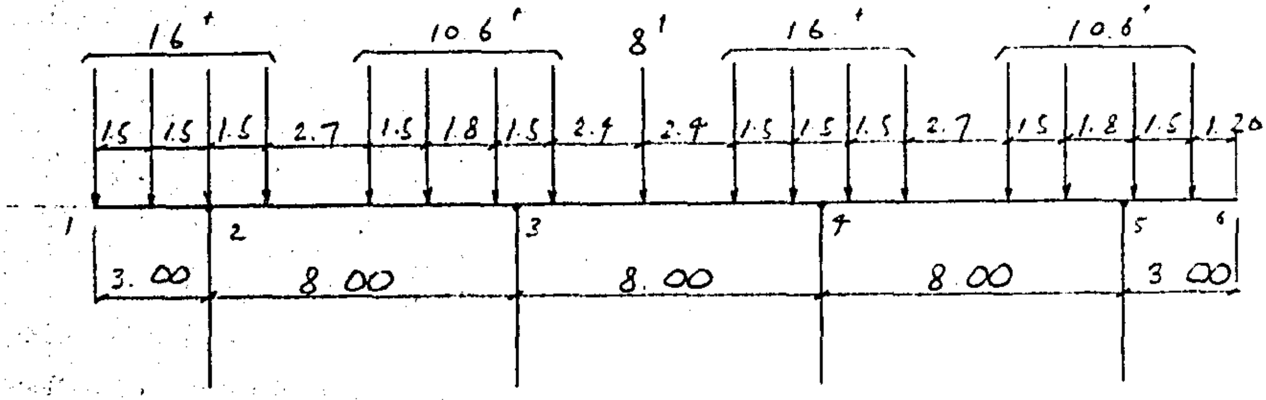
$w_{M1} = 5.40 \times (1 + 0.452) = 7.83^{t/m}$

$w_{M2} = 4.60 \times (\text{do}) = 6.67$ "

$w_{S} = 6.00 \times (\text{do}) = 8.70$ "

$P = 8.0^{t} \times 1.528 = 12.22^{t/m}$

3. Brake load



15% of the train load

$T = (16 \times 8 + 10.6 \times 8 + 8) \times 0.15 = 33.12^{t}$

$H = 33.12 \times 1/2 = 16.56^{t}$

4 Force of temperature change and / or Drying contraction

Temperature rise + 10°C

Temperature drop + Drying contraction

-25°C

5 Dead load + Seismic force

$K_H = 0.1$

Track Weight	$0.45^{t/m} \times 30.0$	=	13.50^t
Ballast	$1.90^{t/m^3} \times 0.20 \times 2.792 \times 1/2 \times 30.00$	=	15.91^t
do	$1.90 \times 0.419 \times 2.792 \times 30.00$	=	66.68^t
do	$1.90 \times 0.619 \times 1.114 \times 1/2 \times 30.00$	=	19.65^t
do	$1.90 \times 0.419 \times 0.754 \times 1/2 \times 30.00$	=	9.00^t
Sloping Concrete	$2.35 \times 0.07 \times 5.00 \times 30.00$	=	24.68^t
Handrail	$0.20^{t/m} \times 30.0 \times 2$	=	12.00^t
Curb	$2.50^{t/m^3} \times 0.30 \times 0.20 \times 29.98$	=	4.50^t
do	$2.50 \times 0.30 \times 0.25 \times 29.98$	=	5.62^t
Ballast stopper	$2.50 \times 0.30 \times 0.15 \times 29.98$	=	3.37^t
Duct cover	$2.50 \times 0.05 \times 0.30 \times 29.98$	=	1.12^t
Cable weight	$0.06^{t/m} \times 30.00$	=	1.80^t
Cantilever slab	$2.50^{t/m^3} \times (0.2+0.35) \times 1/2 \times 1.275 \times 29.98$	=	26.28^t
do	$2.50 \times (0.2+0.35) \times 1/2 \times 0.95 \times 29.98$	=	19.58^t
Slab	$2.50 \times 0.25 \times 3.80 \times 29.98$	=	71.20^t
Hounch of slab	$2.50 \times 0.30 \times 0.10 \times 1/2 \times (7.40 \times 6 + 2.55 \times 4$		
	$+ 2.00 \times 10)$	=	2.72^t

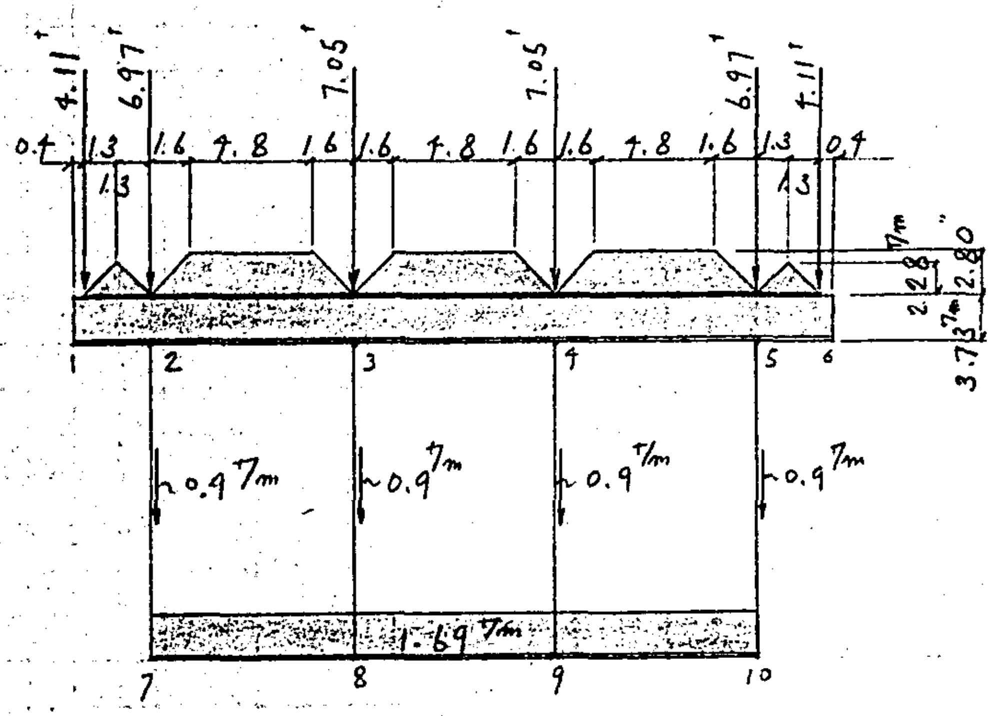
Longitudinal beam	$2.50^{t/m^3} \times 0.60 \times 0.65 \times (7.4 \times 6 + 2.55 \times 4) =$	53.24^t
Haunch of longitudinal beam	$2.50'' \times 0.40 \times 1.20 \times 1/2 \times 0.60 \times 16 =$	$5.76''$
Transverse beam	$2.50'' \times 0.60 \times 0.60 \times 2.60 \times 4 =$	$9.36''$
do	$2.50'' \times 0.50 \times 0.45 \times 2.60 \times 2 =$	$2.93''$
Column (1/2)	$0.90^{t/m} \times (8.226 \times 1/2 + 0.274 - 0.25) \times 8 =$	$29.79''$
Support of electric pole	$2.50^{t/m^3} \times (0.6 + 0.9) \times 1/2 \times 1.60 \times 0.75 =$	$2.25''$
do	$2.50 \times (0.75 \times 0.75 - 3.142 \times 0.45^2 \times 1/4) \times 1.0 =$	$1.01''$
Electric pole load	$=$	$2.00''$
		403.95^t

$$\Sigma H = 403.95 \times 0.10 = 40.40^t$$

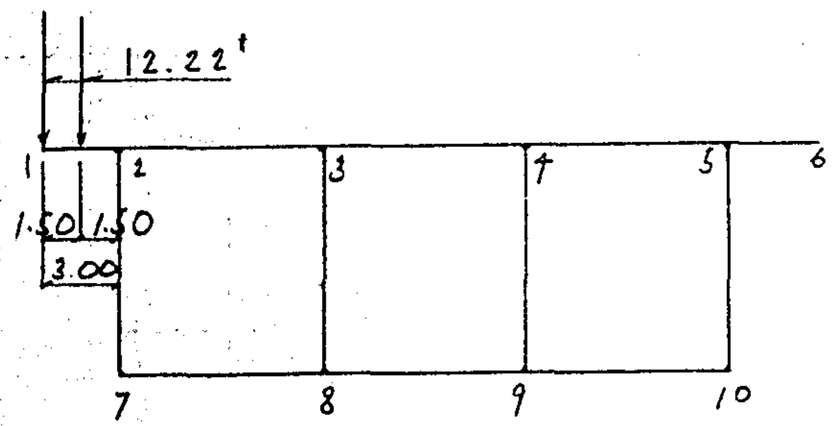
$$H = 40.40 \times 1/2 = 20.20^t$$

[3] Loading diagram

Case 1 Dead load



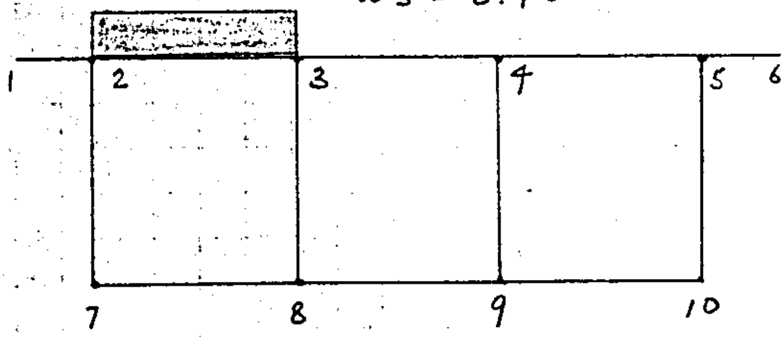
Case 2 Train load + Impact (1)



Case 3 Train load + Impact (2)

$w_{M1} = 7.83$ t/m

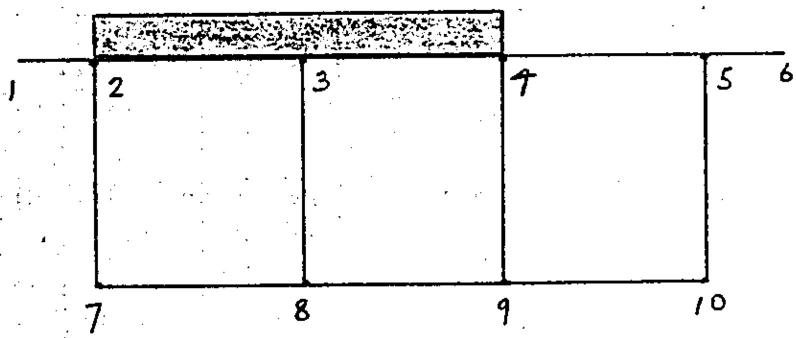
$w_S = 8.70$ "



Case 4 Train load + Impact (3)

$w_{M2} = 6.67$ t/m

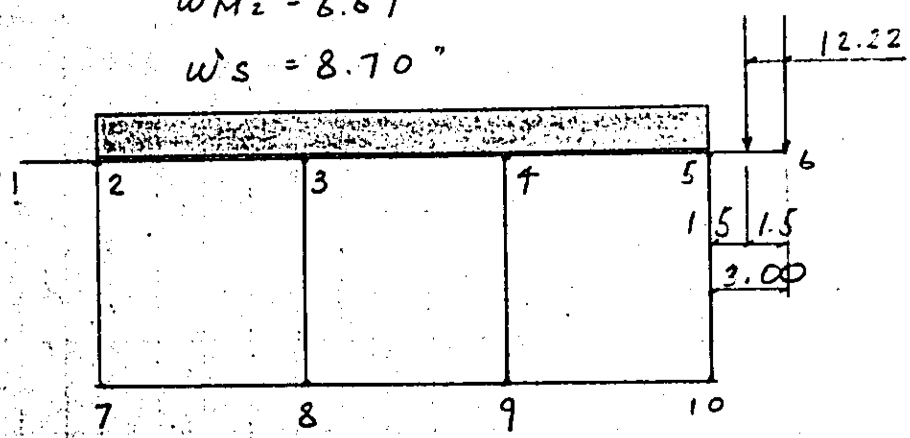
$w_S = 8.70$ t/m



Case 5 Train load + Impact (4)

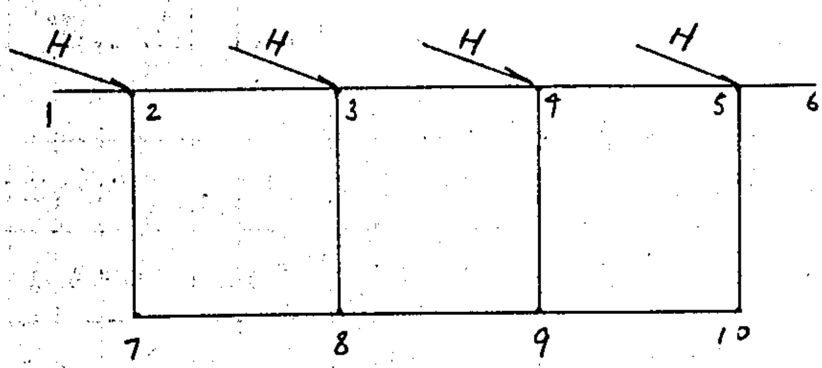
$w_{M2} = 6.67$ t/m

$w_S = 8.70$ "

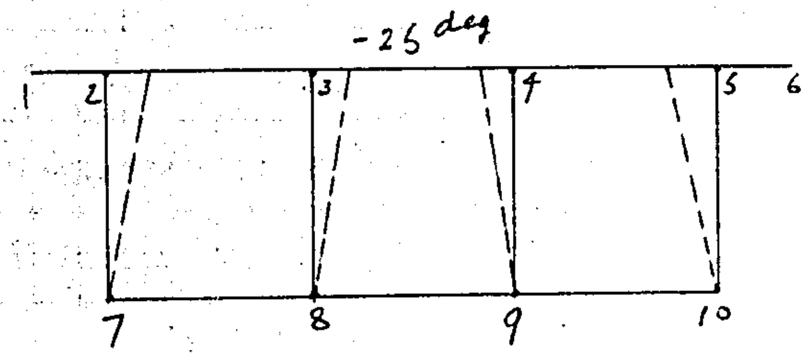


Case 6. Brake load

$$H = \frac{16.56}{4} = 4.14^t$$



Case 7 Temperature drop + Drying contraction

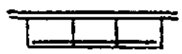
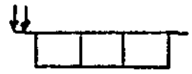
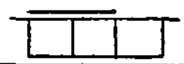
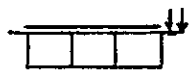


Case 8 Seismic load

$$\text{Case } 6 \times \frac{20.20}{16.56} = \text{Case } 6 \times 1.220$$

(4) Combination of loads

Basic load

Case No	Kind of load	Loading pattern
1	Dead Load	
2	Train Load + Impact (1)	
3	do (2)	
4	do (3)	
5	do (4)	
6	Brake load	
7	Temperature + Contraction	-25 °C
8	Seismic load	Case 6 × 1.220

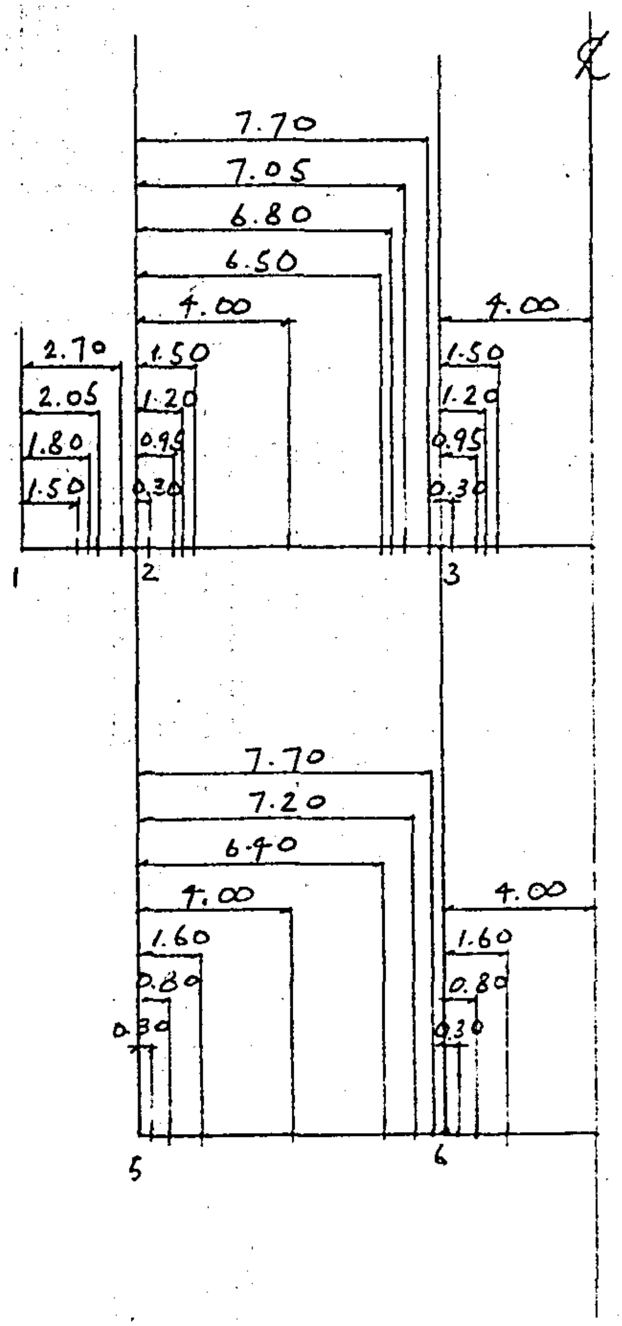
Combined loads

Case No	Combination of loads	α
9	1 + 2 + 3	1.0000
10	1 + 3	do
11	1 + 4	do
12	1 + 2 + 5	do
13	1 + 7	0.8696
14	1 + 2 + 5 + 6	do
15	1 + 8	0.6667

Critical case

Case 9 ~ Case 15

[5] Point of computing stresses

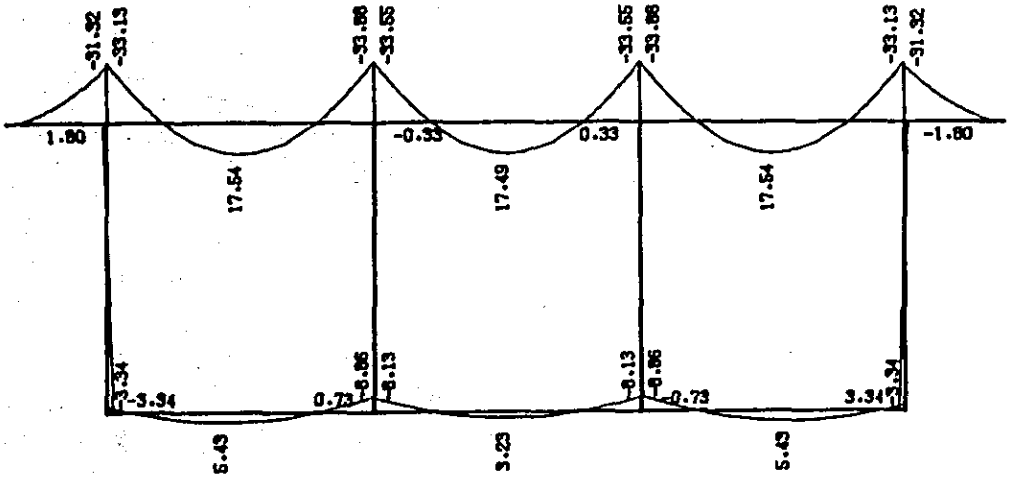


(6) Stress diagram

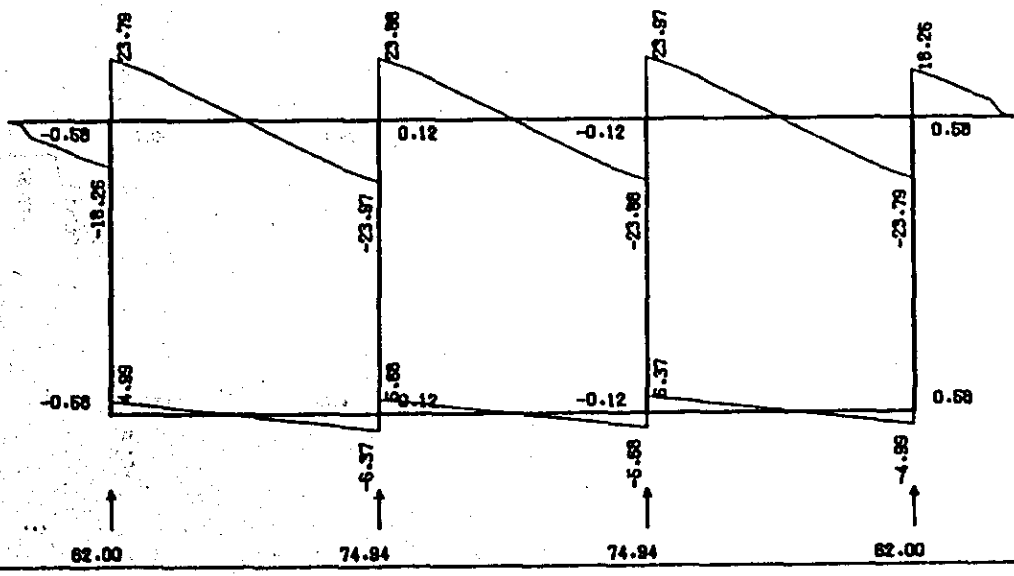
VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1

CASE 1

BENDING MOMENT



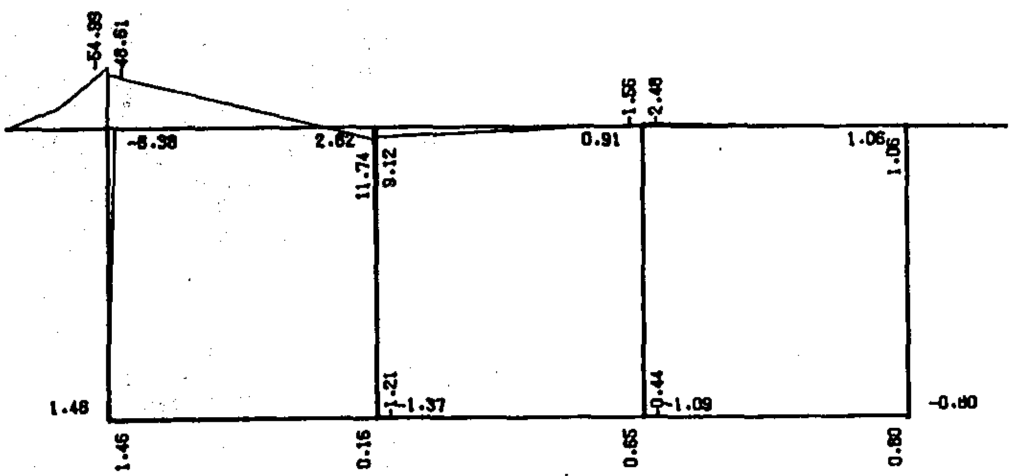
SHEARING FORCE



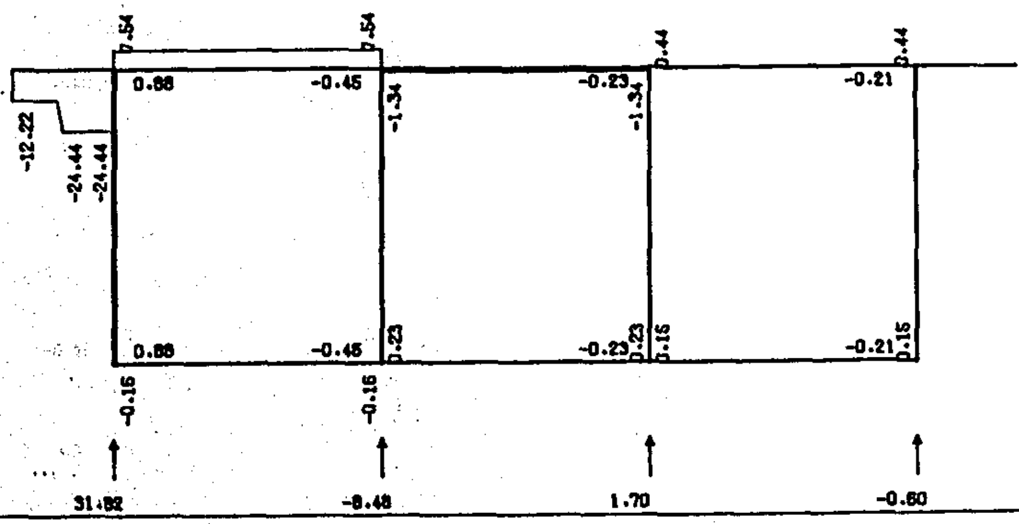
VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1

CASE 2

BENDING MOMENT



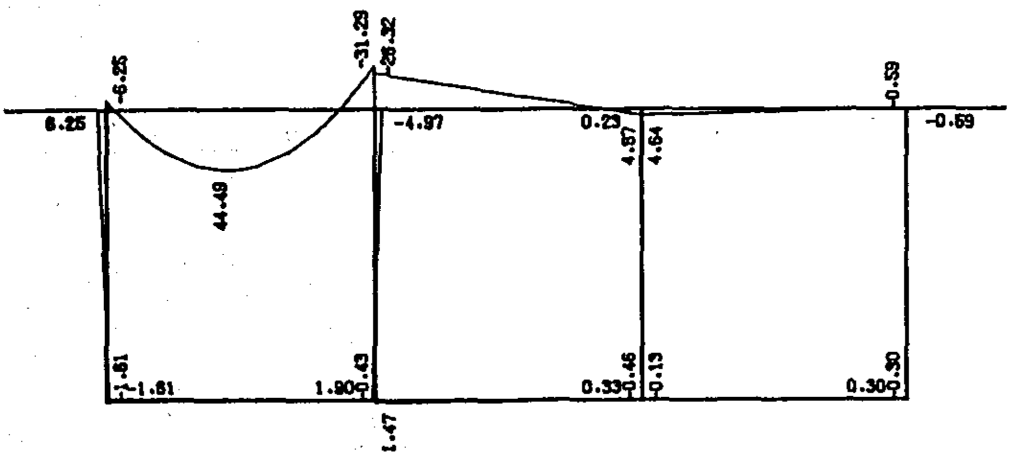
SHEARING FORCE



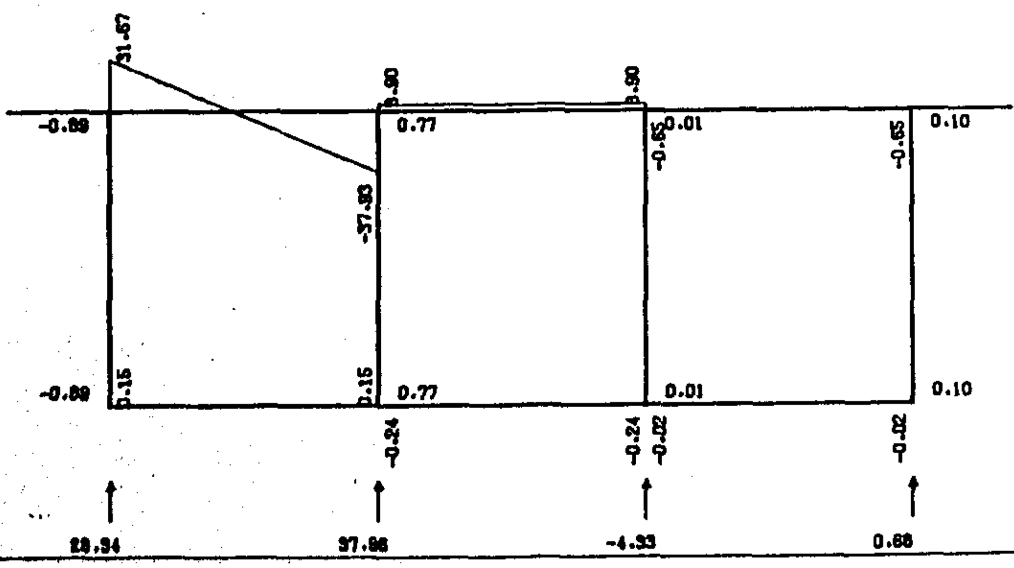
VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1

CASE 3

BENDING MOMENT



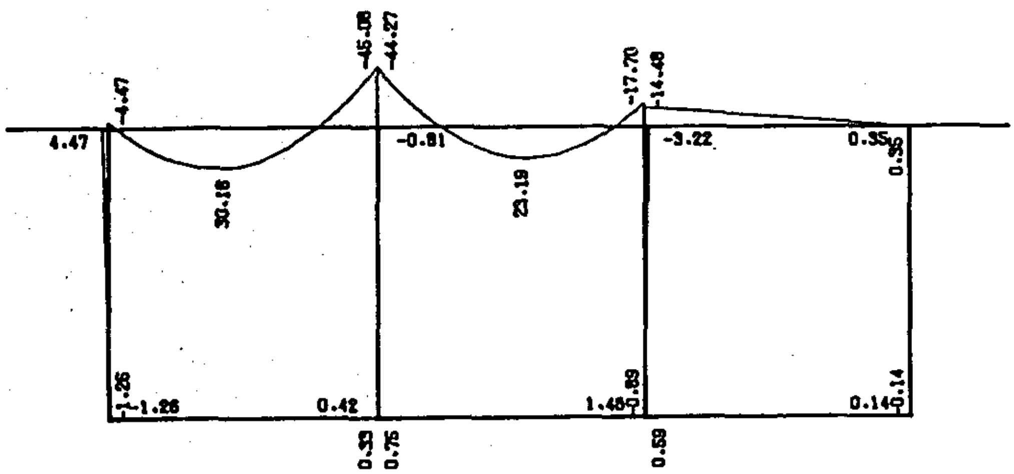
SHEARING FORCE



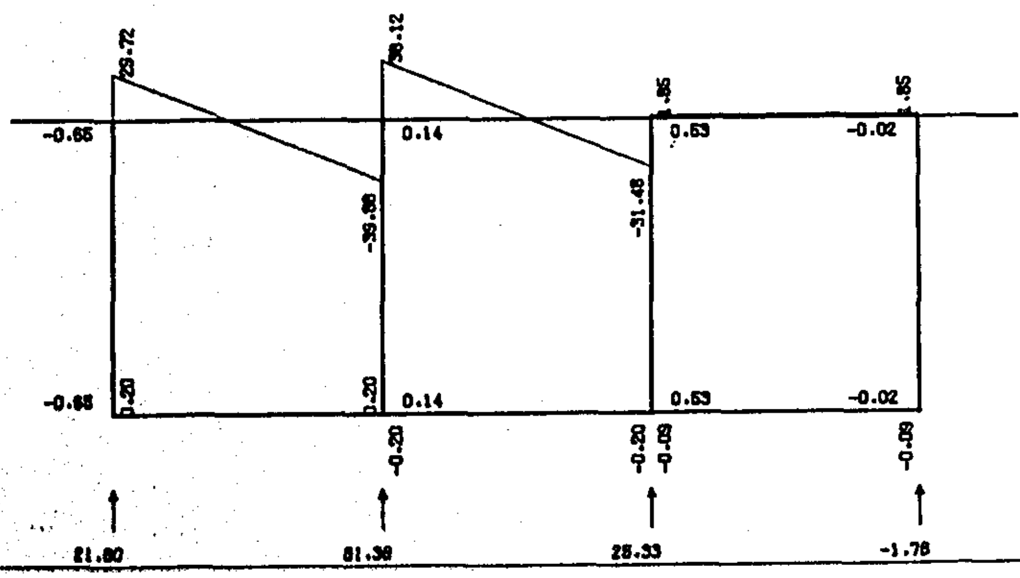
VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1

CASE 4 (

BENDING MOMENT



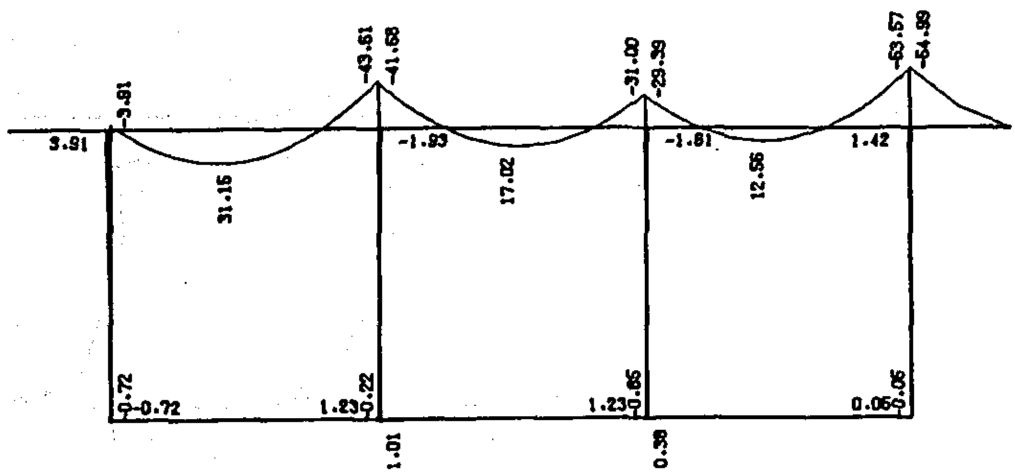
SHEARING FORCE



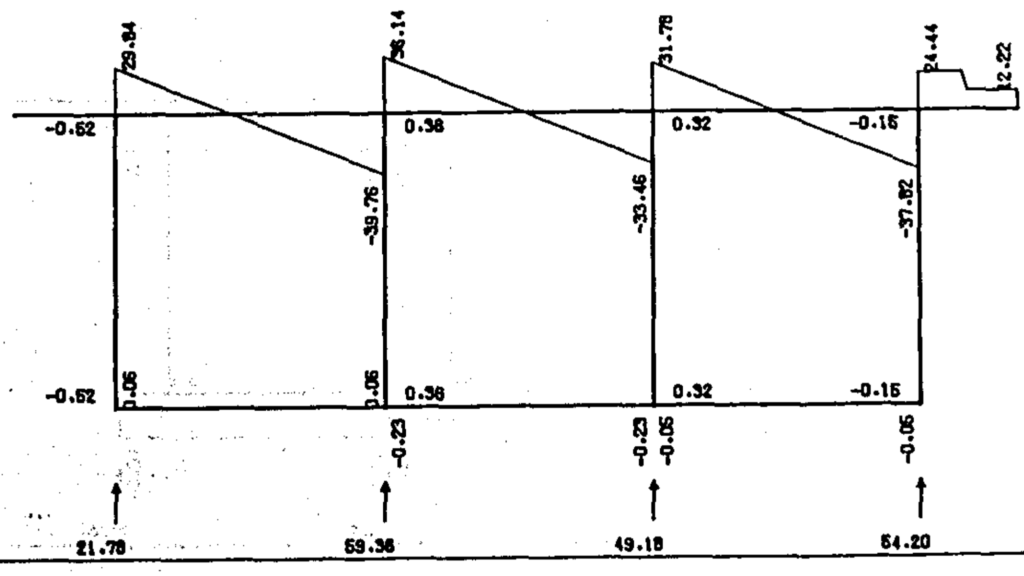
VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1

CASE 5

BENDING MOMENT



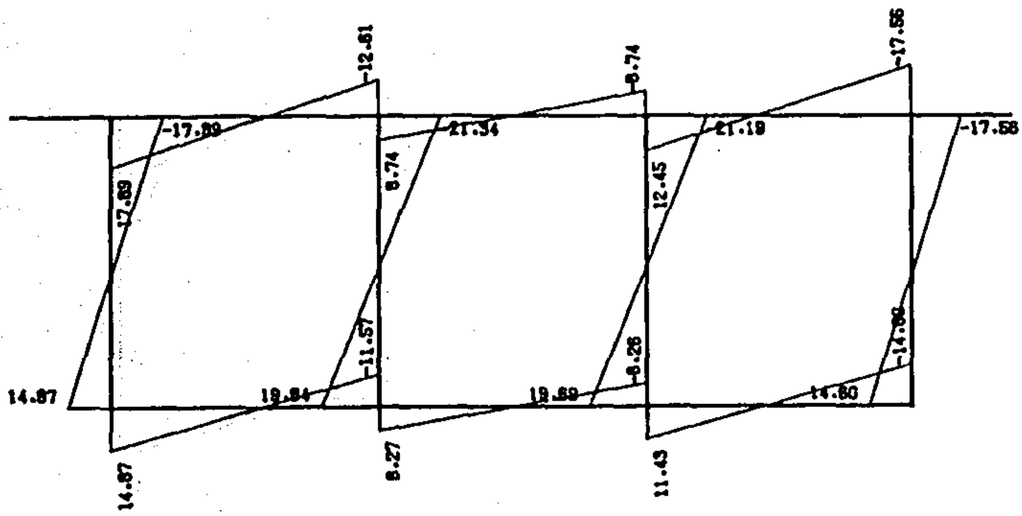
SHEARING FORCE



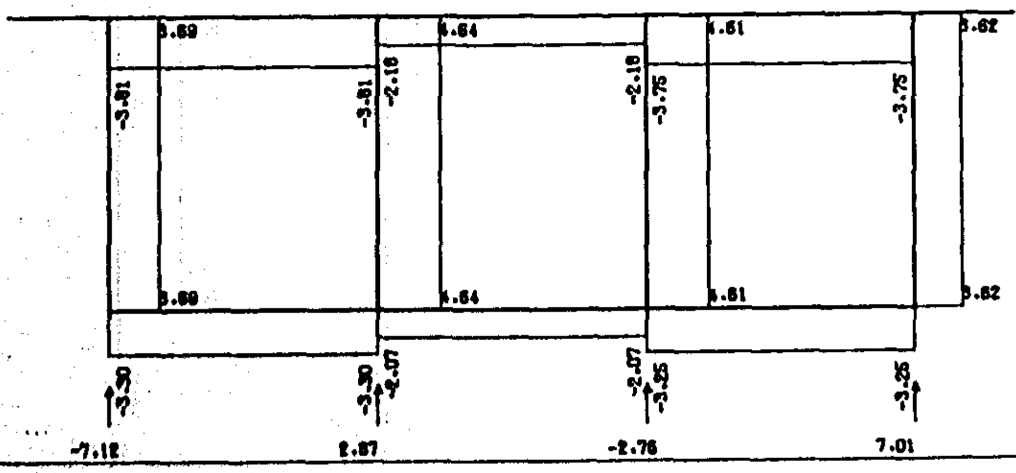
VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1

CASE 6

BENDING MOMENT



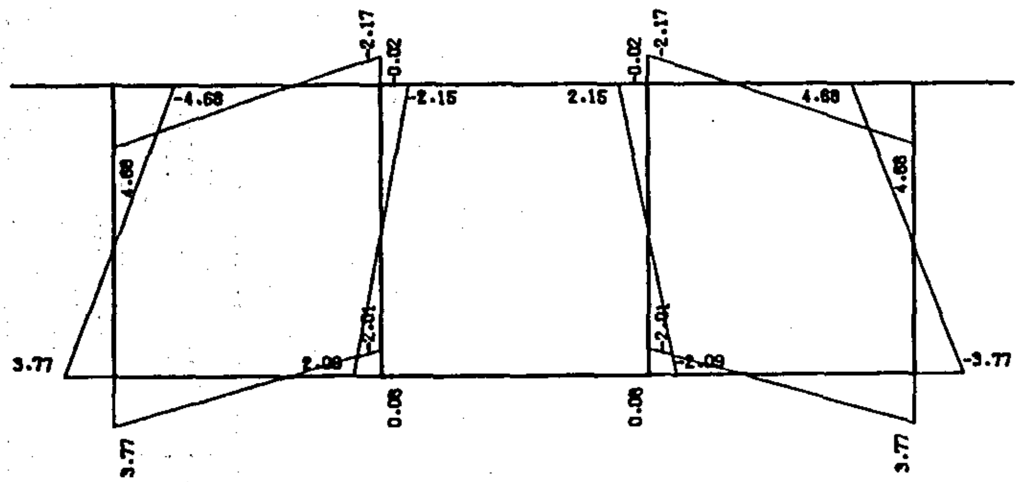
SHEARING FORCE



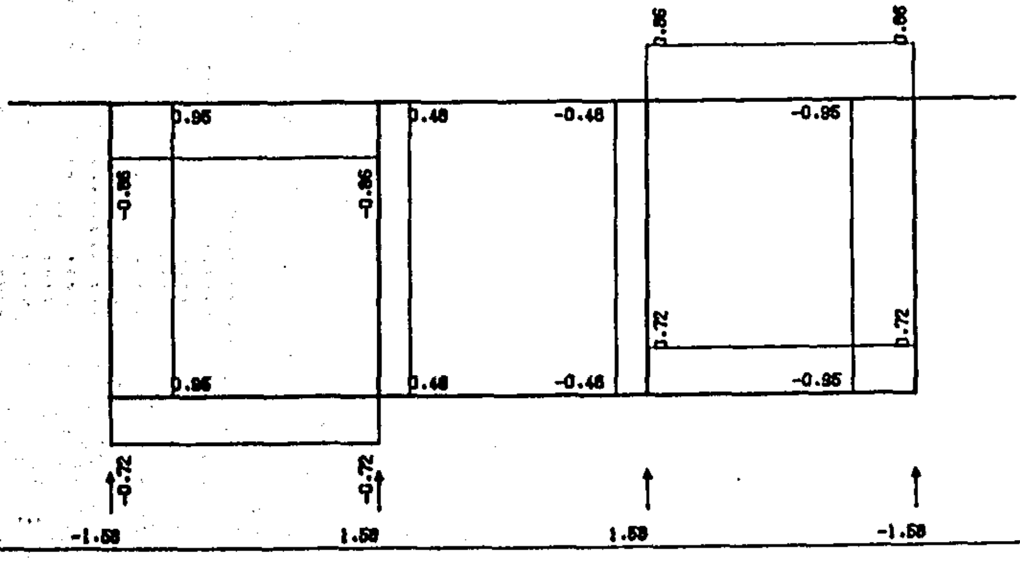
VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1

CASE 7

BENDING MOMENT



SHEARING FORCE



[7] Result of computor analysis.

FANSY

PLANE

CR

CENTURY RESEARCH CENTER CORP.

VIADUCT OF SINGLE TRACK (3+3+8+3=30) L-1

V6.3

```
=== INPUT DATA ===                                                            CRC-FANSY   V6.3
        5   10        20        30        40        50        60        70        80   CARD NUMBER
        ..........................................................................
TITLE     VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1                                          1
CONTROL       12                                                                            2
PLOT           1        2                                                                   3
SHEAR          1    3    2    3     4                                                       4
JOINT          1          0.000     0.000                                                   5
               2          3.000     0.000                                                   6
               3         11.000     0.000                                                   7
               4         19.000     0.000                                                   8
               5         27.000     0.000                                                   9
               6         30.000     0.000                                                  10
               7          3.000    -8.876                                                  11
               8         11.000    -8.876                                                  12
               9         19.000    -8.876                                                  13
              10         27.000    -8.876                                                  14
MEMBER         1  1 1    1    2                                                            15
               2  1 1    2    3                                                            16
               3  1 1    3    4                                                            17
               4  1 1    4    5                                                            18
               5  1 1    5    6                                                            19
               6  2 1    7    8                                                            20
               7  2 1    8    9                                                            21
               8  2 1    9   10                                                            22
               9  3 1    2    7                                                            23
              10  3 1    3    8                                                            24
              11  3 1    4    9                                                            25
              12  3 1    5   10                                                            26
SUPPORT        7  001                                                                      27
               8  101                                                                      28
               9  101                                                                      29
              10  101                                                                      30
SECTION        1    0     1.216   0.07085                                                  31
               2    0     0.350   0.01429                                                  32
               3    0     0.360   0.01080                                                  33
PROPERTY       1          2.7E6               1.0E-5                                       34
POINT     1     1.500     1.800     2.050     2.700                                        35
          2     0.300     0.950     1.200     1.500     4.000     6.500     6.800          36
                7.050     7.700=       3=         4                                        37
          5     0.300     0.950     1.200     1.500                                        38
          6     0.300     0.650     1.600     4.000     6.400     7.350     7.700          39
           =        7=        8                                                            40
PICKUP         1    1    9   15                                                            41
LOAD           10                                                                          42
J              2                   -6.970                        5                         43
               3                   -7.050                        4                         44
C              1    2    -4.110     0.400                                                  45
               5    2    -4.110     2.600                                                  46
LL             1  5 2    -3.730    -3.730                                                  47
               6  8 2    -1.420    -1.420                                                  48
L              1    2     0.000    -2.280     0.400     1.300                              49
               1    2    -2.280     0.000     1.700     0.000                              50
               5    2     0.000    -2.280     0.000     1.700                              51
               5    2    -2.260     0.000     1.300     0.400                              52
DL             2    2    -2.800     1.600     1.600              3    4                    53
L              9    2    -0.900    -0.900                       10   11   12               54
END                                                                                        55
LOAD           2RI  1                                                                      56
J              1                  -12.220                                                  57
```

```
=== INPUT DATA ===                                                          CRC-FANSY   V6.3
                5  10      20       30        40        50        60        70        80     CARD NUMBER
    ........................................................................................
    C              1    2  -12.220     1.500                                                  58
    END                                                                                       59
    LOAD           3RI  2                                                  1.111110           60
    L              2    2   -7.830    -7.830                                                  61
    END                                                                                       62
    LOAD           4RI  3                                                  1.304350           63
    LL             2  3 2   -6.670    -6.670                                                  64
    END                                                                                       65
    LOAD           5RI  4                                                  1.304350           66
    LL             2  4 2   -6.670    -6.670                                                  67
    C              5    2  -12.220    -1.500                                                  68
    J              6                 -12.220                                                  69
    END                                                                                       70
    LOAD           6B                                                                         71
    J              2         4.140                                 3    4    5                72
    END                                                                                       73
    LOAD           7TC                                                                        74
    T              2    4      -25                                                            75
    END                                                                                       76
    LOAD           8ED                                                                        77
    MIX                 1  1.220  6                                                           78
    END                                                                                       79
    MT2        9   1.0000    1    2    3                                                      80
              10   1.0000    1    3                                                           81
              11   1.0000    1    4                                                           82
              12   1.0000    1    2    5                                                      83
              13   0.8696    1    7                                                           84
              14   0.8696    1    2    5    6                                                 85
              15   0.6667    1    8                                                           86
    FINISH                                                                                    87
```

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1 CRC-FANSY V6.3

CONTROL DATA

METHOD	STRUCTURE	J.RENUMBER	M.RENUMBER	S.F. DIS.	UNI.SPRING	STAN.STIF.	BARA	SKEW MEM.
DIS	*RAHMEN*	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*

LOAD TITLE

LOAD 1	CASE 1	LOAD 2	CASE 2
LOAD 3	CASE 3	LOAD 4	CASE 4
LOAD 5	CASE 5	LOAD 6	CASE 6
LOAD 7	CASE 7		
MIX 8	CASE 8 (SHI KAJYU JISHIN)	MIX 9	CASE 9 (1+2+3)
MIX 10	CASE 10 (1+3)	MIX 11	CASE 11 (1+4)
MIX 12	CASE 12 (1+2+5)	MIX 13	CASE 13 (1+7)
MIX 14	CASE 14 (1+2+5+6)	MIX 15	CASE 15 (1+8)

PICK UP LOAD CASE

PICK 1 9 10 11 12 13 14 15

JOINT DATA

JOINT NUMBER 10

JOINT	X	Y
1	0.0000	0.0000
2	3.0000	0.0000
3	11.0000	0.0000
4	19.0000	0.0000
5	27.0000	0.0000
6	30.0000	0.0000
7	3.0000	-8.8760
8	11.0000	-8.8760
9	19.0000	-8.8760
10	27.0000	-8.8760

MEMBER DATA

MEMBER NUMBER 12

MEMBER	ITAN	JTAN	CONNECT. ITAN	JTAN	LENGTH	A	I
1	1	2	FIX	FIX	3.0000	1.21600	.0708500
2	2	3	FIX	FIX	8.0000	1.21600	.0708500
3	3	4	FIX	FIX	8.0000	1.21600	.0708500
4	4	5	FIX	FIX	8.0000	1.21600	.0708500
5	5	6	FIX	FIX	3.0000	1.21600	.0708500
6	7	8	FIX	FIX	8.0000	.35000	.0142900
7	8	9	FIX	FIX	8.0000	.35000	.0142900
8	9	10	FIX	FIX	8.0000	.35000	.0142900
9	2	7	FIX	FIX	8.8760	.36000	.0108000
10	3	8	FIX	FIX	8.8760	.36000	.0108000
11	4	9	FIX	FIX	8.8760	.36000	.0108000
12	5	10	FIX	FIX	8.8760	.36000	.0108000

PROPERTY DATA

PROPERTY NUMBER 1

PROPERTY	E	G	EPS
1	2.700E+06	0.	1.000E-05

SUPPORT DATA

SUPPORT NUMBER 4

SUPPORT	X	Y	THET Z
7	FIX	FIX	FREE
8	FREE	FIX	FREE
9	FREE	FIX	FREE
10	FREE	FIX	FREE

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1 CRC-FANSY V6.3

STRUCTURAL FIGURE

```
+----+--------------------+-------------------+--------------------+----+
   1 I 2                  I 3                 I 4                  I 5   6
     I                    I                   I                    I
     I                    I                   I                    I
     I                    I                   I                    I
     I                    I                   I                    I
     I                    I                   I                    I
     I                    I                   I                    I
     +--------------------+-------------------+--------------------+
     # 7                  # 8                 # 9                  #10
```

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1 CRC-FANSY V6.3

MOVE DATA

MEMBER	ITAN	JTAN	POINT 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	......	......	1.500	1.800	2.050	2.700										
2	......	......	.300	.950	1.200	1.500	4.000	6.500	6.800	7.050	7.700					
3	......	......	.300	.950	1.200	1.500	4.000	6.500	6.800	7.050	7.700					
4	......	......	.300	.950	1.200	1.500	4.000	6.500	6.800	7.050	7.700					
5	......	......	.300	.950	1.200	1.500										
6	......	......	.300	.650	1.600	4.000	6.400	7.350	7.700							
7	......	......	.300	.650	1.600	4.000	6.400	7.350	7.700							
8	......	......	.300	.650	1.600	4.000	6.400	7.350	7.700							
9	......	......														
10	......	......														
11	......	......														
12	......	......														

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1 CRC-FANSY V6.3

LOAD DATA

	M/J	NAME	D	W1	W2	L1	L2
LOAD - 1		CASE 1					
MEMBER	1	LINEAR	Y	-3.730	-3.730	0.000	0.000
		LINEAR	Y	0.000	-2.280	.400	1.300
		LINEAR	Y	-2.280	0.000	1.700	0.000
		CONCENT	Y	-4.110		.400	
	2	LINEAR	Y	-3.730	-3.730	0.000	0.000
		LINEAR	Y	0.000	-2.800	0.000	6.400
		LINEAR	Y	-2.800	-2.800	1.600	1.600
		LINEAR	Y	-2.800	0.000	6.400	0.000
	3	LINEAR	Y	-3.730	-3.730	0.000	0.000
		LINEAR	Y	0.000	-2.800	0.000	6.400
		LINEAR	Y	-2.800	-2.800	1.600	1.600
		LINEAR	Y	-2.800	0.000	6.400	0.000
	4	LINEAR	Y	-3.730	-3.730	0.000	0.000
		LINEAR	Y	0.000	-2.800	0.000	6.400
		LINEAR	Y	-2.800	-2.800	1.600	1.600
		LINEAR	Y	-2.800	0.000	6.400	0.000
	5	LINEAR	Y	-3.730	-3.730	0.000	0.000
		LINEAR	Y	0.000	-2.280	0.000	1.700
		LINEAR	Y	-2.280	0.000	1.300	.400
		CONCENT	Y	-4.110		2.600	
	6	LINEAR	Y	-1.420	-1.420	0.000	0.000
	7	LINEAR	Y	-1.420	-1.420	0.000	0.000
	8	LINEAR	Y	-1.420	-1.420	0.000	0.000
	9	LINEAR	Y	-.900	-.900	0.000	0.000
	10	LINEAR	Y	-.900	-.900	0.000	0.000
	11	LINEAR	Y	-.900	-.900	0.000	0.000
	12	LINEAR	Y	-.900	-.900	0.000	0.000
JOINT	2	JOINTLOAD	Y	-6.970			
	3	JOINTLOAD	Y	-7.050			
	4	JOINTLOAD	Y	-7.050			
	5	JOINTLOAD	Y	-6.970			
LOAD - 2		CASE 2					
MEMBER	1	CONCENT	Y	-12.220		1.500	
JOINT	1	JOINTLOAD	Y	-12.220			
LOAD - 3		CASE 3					
MEMBER	2	SHEAR		1.11111(S/M)			
	3	SHEAR		1.11111(S/M)			
	4	SHEAR		1.11111(S/M)			
MEMBER	2	LINEAR	Y	-7.830	-7.830	0.000	0.000
LOAD - 4		CASE 4					
MEMBER	2	SHEAR		1.30435(S/M)			
	3	SHEAR		1.30435(S/M)			
	4	SHEAR		1.30435(S/M)			
MEMBER	2	LINEAR	Y	-6.670	-6.670	0.000	0.000
	3	LINEAR	Y	-6.670	-6.670	0.000	0.000

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1 CRC-FANSY V6.3

LOAD DATA

	M/J	NAME	D	W1	W2	L1	L2
LOAD - 5		CASE 5					
MEMBER	2	SHEAR		1.30435(S/M)			
	3	SHEAR		1.30435(S/M)			
	4	SHEAR		1.30435(S/M)			
MEMBER	2	LINEAR	Y	-6.670	-6.670	0.000	0.000
	3	LINEAR	Y	-6.670	-6.670	0.000	0.000
	4	LINEAR	Y	-6.670	-6.670	0.000	0.000
	5	CONCENT	Y	-12.220		1.500	
JOINT	6	JOINTLOAD	Y	-12.220			
LOAD - 6		CASE 6					
JOINT	2	JOINTLOAD	X	4.140			
	3	JOINTLOAD	X	4.140			
	4	JOINTLOAD	X	4.140			
	5	JOINTLOAD	X	4.140			
LOAD - 7		CASE 7					
MEMBER.	2	TEMP		-25.0(DO)			
	3	TEMP		-25.0(DO)			
	4	TEMP		-25.0(DO)			

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1 CRC-FANSY V6.3

MIX DATA

MIX NUMBER 8

LOAD	SS	N	S1	K1	S2	K2	S3	K3	S4	K4	S5	K5	S6	K6	S7	K7	S8	K8
8	1.0000	1	1.2200	6														
9	1.0000	3	1.0000	1	1.0000	2	1.0000	3										
10	1.0000	2	1.0000	1	1.0000	3												
11	1.0000	2	1.0000	1	1.0000	4												
12	1.0000	3	1.0000	1	1.0000	2	1.0000	5										
13	.8696	2	1.0000	1	1.0000	7												
14	.8696	4	1.0000	1	1.0000	2	1.0000	5	1.0000	6								
15	.6667	2	1.0000	1	1.0000	8												

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1 CRC-FANSY V6.3

PICK UP 1

	MOMENT MAXIMUM						MOMENT MINIMUM				
	L	CASE	M	Q	N		L	CASE	M	Q	N
* * MEMBER 1 (1 - 2) G * *						* * MEMBER 1 (1 - 2) G * *					
ITAN	0.000	(11)	.000	-.000	.000	ITAN	0.000	(9)	-.000	-12.220	-.000
1	1.500	(15)	-6.071	-7.178	.000	1	1.500	(9)	-27.436	-35.206	-.000
2	1.800	(15)	-8.399	-8.351	.000	2	1.800	(9)	-38.260	-36.965	-.000
3	2.050	(15)	-10.605	-9.287	.000	3	2.050	(9)	-47.679	-38.369	-.000
4	2.700	(15)	-17.348	-11.378	.000	4	2.700	(9)	-73.679	-41.506	-.000
JTAN	3.000	(15)	-20.884	-12.177	.000	JTAN	3.000	(9)	-86.314	-42.704	-.000
* * MEMBER 2 (2 - 3) G * *						* * MEMBER 2 (2 - 3) G * *					
ITAN	0.000	(15)	-7.535	12.758	-.752	ITAN	0.000	(9)	-87.980	62.999	-.580
1	.300	(15)	-3.825	11.959	-.752	1	.300	(9)	-70.652	59.191	-.580
2	.950	(10)	4.536	42.857	-1.464	2	.950	(12)	-40.192	48.569	-.217
3	1.200	(10)	14.169	39.279	-1.464	3	1.200	(12)	-29.979	44.991	-.217
4	1.500	(10)	24.599	34.842	-1.464	4	1.500	(12)	-18.757	40.554	-.217
5	4.000	(10)	61.413	-3.225	-1.464	5	4.000	(15)	13.844	-3.163	-.752
6	6.500	(9)	8.903	-33.747	-.580	6	6.500	(14)	-11.486	-34.254	-.579
7	6.800	(9)	-1.199	-38.185	-.580	7	6.800	(14)	-20.941	-38.113	-.579
8	7.050	(9)	-10.559	-41.763	-.580	8	7.050	(11)	-30.963	-51.253	-1.225
9	7.700	(13)	-25.026	-20.551	.324	9	7.700	(11)	-62.720	-60.043	-1.225
JTAN	8.000	(13)	-31.351	-21.593	.324	JTAN	8.000	(11)	-78.964	-63.851	-1.225
MAX	3.556	(10)	61.427	3.544	-1.464	MAX	3.556	(15)	14.820	-1.228	-.752
* * MEMBER 3 (3 - 4) G * *						* * MEMBER 3 (3 - 4) G * *					
ITAN	0.000	(15)	-15.263	14.144	-.266	ITAN	0.000	(11)	-77.823	62.001	-.966
1	.300	(15)	-11.137	13.346	-.266	1	.300	(11)	-62.135	58.194	-.966
2	.950	(15)	-3.115	11.255	-.266	2	.950	(10)	-35.413	23.446	-.570
3	1.200	(15)	-.417	10.320	-.266	3	1.200	(10)	-29.725	22.043	-.570
4	1.500	(15)	2.499	9.101	-.266	4	1.500	(10)	-23.382	20.215	-.570
5	4.000	(11)	39.867	3.321	-.966	5	4.000	(10)	6.771	3.899	-.570
6	6.500	(11)	6.920	-34.745	-.966	6	6.500	(14)	-7.318	-35.002	-.122
7	6.800	(11)	-2.559	-39.183	-.966	7	6.800	(14)	-16.998	-38.861	-.122
8	7.050	(13)	-11.148	-16.998	.844	8	7.050	(14)	-25.813	-41.972	-.122
9	7.700	(10)	-22.661	-18.783	-.570	9	7.700	(14)	-51.742	-49.616	-.122
JTAN	8.000	(10)	-28.679	-19.981	-.570	JTAN	8.000	(12)	-66.110	-58.680	-.191
MAX	4.444	(11)	40.039	-3.448	-.966	MAX	4.444	(10)	7.859	.997	-.570

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1 CRC-FANSY V6.3

PICK UP 1

	MOMENT MAXIMUM					MOMENT MINIMUM				
	L	CASE	M	Q	N	L	CASE	M	Q	N
= = MEMBER 4 (4 - 5) G = =										
ITAN	0.000	(15)	-12.459	12.932	.034	0.000	(12)	-65.745	56.193	-.217
1	.300	(15)	-8.697	12.133	.034	.300	(12)	-51.799	52.385	-.217
2	.950	(15)	-1.463	10.043	.034	.950	(11)	-25.754	21.495	-.556
3	1.200	(15)	.933	9.108	.034	1.200	(11)	-20.553	20.092	-.556
4	1.500	(15)	3.485	7.889	.034	1.500	(11)	-14.796	18.264	-.556
5	4.000	(12)	28.711	-2.487	-.217	4.000	(15)	9.618	-2.989	.034
6	6.500	(13)	.668	-13.362	.324	6.500	(14)	-26.689	-38.528	.261
7	6.800	(13)	-3.582	-14.951	.324	6.800	(14)	-37.426	-42.387	.261
8	7.050	(13)	-7.474	-16.171	.324	7.050	(14)	-47.123	-45.498	.261
9	7.700	(13)	-18.906	-18.898	.324	7.700	(14)	-75.343	-53.143	.261
JTAN	8.000	(13)	-24.735	-19.939	.324	8.000	(14)	-89.747	-56.454	.261
MAX	4.000	(12)	28.711	-2.487	-.217	4.000	(15)	9.618	-2.989	.034
= = MEMBER 5 (5 - 6) G = =										
ITAN	0.000	(15)	-20.884	12.177	.000	0.000	(12)	-86.314	42.704	-.000
1	.300	(15)	-17.348	11.378	.000	.300	(12)	-73.679	41.506	-.000
2	.950	(15)	-10.605	9.287	.000	.950	(12)	-47.679	38.369	-.000
3	1.200	(15)	-8.399	8.351	.000	1.200	(12)	-38.260	36.965	-.000
4	1.500	(15)	-6.071	7.178	.000	1.500	(12)	-27.436	22.986	-.000
JTAN	3.000	(13)	.000	.000	-.000	3.000	(14)	-.000	10.627	.000
= = MEMBER 6 (7 - 8) G = =										
ITAN	0.000	(14)	10.674	1.377	11.380	0.000	(10)	-4.948	5.137	1.464
1	.300	(14)	11.031	1.007	11.380	.300	(10)	-3.471	4.711	1.464
2	.650	(14)	11.308	.575	11.380	.650	(10)	-1.909	4.214	1.464
3	1.600	(14)	11.296	-.599	11.380	1.600	(10)	1.453	2.865	1.464
4	4.000	(14)	6.304	-3.562	11.380	4.000	(10)	4.239	-.543	1.464
5	6.400	(12)	-.389	-4.200	.217	6.400	(14)	-5.802	-6.526	11.380
6	7.350	(11)	-4.822	-5.249	1.225	7.350	(14)	-12.559	-7.699	11.380
7	7.700	(11)	-6.747	-5.746	1.225	7.700	(14)	-15.329	-8.131	11.380
JTAN	8.000	(11)	-8.534	-6.172	1.225	8.000	(14)	-17.824	-8.502	11.380
MAX	.889	(14)	11.410	.280	11.380	3.556	(10)	4.340	.088	1.464

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1 CRC-FANSY V6.3

PICK UP 1

MOMENT MAXIMUM

	L	CASE	M	Q	N
= = MEMBER 7 (8 - 9) G = =					
ITAN	0.000	(15)	1.307	2.106	7.000
1	.300	(15)	1.896	1.822	7.000
2	.650	(15)	2.476	1.491	7.000
3	1.600	(15)	3.465	.591	7.000
4	4.000	(10)	3.738	-.240	.570
5	6.400	(9)	-.652	-3.415	.136
6	7.350	(13)	-4.045	-4.137	-.844
7	7.700	(13)	-5.569	-4.569	-.844
JTAN	8.000	(13)	-6.995	-4.939	-.844
MAX	2.667	(14)	3.934	-.151	7.323
= = MEMBER 8 (9 - 10) G = =					
ITAN	0.000	(15)	3.390	1.600	3.334
1	.300	(15)	3.827	1.316	3.334
2	.650	(15)	4.230	.985	3.334
3	1.600	(14)	5.074	.822	3.340
4	4.000	(12)	5.601	.792	.217
5	6.400	(13)	4.732	-1.735	-.324
6	7.350	(13)	2.526	-2.908	-.324
7	7.700	(13)	1.432	-3.341	-.324
JTAN	8.000	(13)	.375	-3.711	-.324
MAX	5.333	(13)	5.880	-.418	-.324
= = MEMBER 9 (2 - 7) C = =					
ITAN	0.000	(10)	8.050	-1.464	-77.209
JTAN	8.876	(14)	10.674	3.021	-92.958
= = MEMBER 10 (3 - 8) C = =					
ITAN	0.000	(12)	.364	.026	-105.683
JTAN	8.876	(14)	17.769	4.057	-100.264
= = MEMBER 11 (4 - 9) C = =					
ITAN	0.000	(13)	2.157	-.520	-48.490
JTAN	8.876	(14)	16.608	3.983	-97.485
= = MEMBER 12 (5 - 10) C = =					
ITAN	0.000	(13)	2.504	-.324	-41.883
JTAN	8.876	(14)	14.954	3.340	-99.536

MOMENT MINIMUM

	L	CASE	M	Q	N
= = MEMBER 7 (8 - 9) G = =					
ITAN	0.000	(12)	-8.332	5.680	.191
1	.300	(12)	-6.692	5.254	.191
2	.650	(12)	-4.940	4.757	.191
3	1.600	(12)	-1.061	3.408	.191
4	4.000	(15)	2.158	-1.681	7.000
5	6.400	(14)	-5.233	-4.761	7.323
6	7.350	(14)	-10.313	-5.934	7.323
7	7.700	(14)	-12.465	-6.366	7.323
JTAN	8.000	(14)	-14.431	-6.736	7.323
MAX	3.556	(13)	2.762	.549	-.844
= = MEMBER 8 (9 - 10) G = =					
ITAN	0.000	(13)	-9.452	6.168	-.324
1	.300	(13)	-7.657	5.797	-.324
2	.650	(13)	-5.704	5.365	-.324
3	1.600	(13)	-1.164	4.192	-.324
4	4.000	(15)	2.217	-2.187	3.334
5	6.400	(15)	-5.757	-4.459	3.334
6	7.350	(14)	-10.612	-6.278	3.340
7	7.700	(14)	-12.885	-6.710	3.340
JTAN	8.000	(14)	-14.954	-7.081	3.340
MAX	3.556	(15)	3.095	-1.766	3.334
= = MEMBER 9 (2 - 7) C = =					
ITAN	0.000	(14)	-16.139	3.021	-86.012
JTAN	8.876	(10)	-4.948	-1.464	-85.198
= = MEMBER 10 (3 - 8) C = =					
ITAN	0.000	(14)	-18.242	4.057	-93.317
JTAN	8.876	(12)	.594	.026	-113.671
= = MEMBER 11 (4 - 9) C = =					
ITAN	0.000	(14)	-18.745	3.983	-90.539
JTAN	8.876	(13)	-2.457	-.520	-55.436
= = MEMBER 12 (5 - 10) C = =					
ITAN	0.000	(15)	-15.485	3.334	-35.733
JTAN	8.876	(13)	-.375	-.324	-48.629

TITLE..VIADUCT OF SINGLE TRACK (3+3+8+3=30) L-1 CRC-FANSY V6.3

PICK UP 1

SHEAR MAXIMUM

	L	CASE	M	Q	N
= = MEMBER	1 (	1 - 2) G = =			
ITAN	0.000	(13)	-.000	.000	.000
1	1.500	(15)	-6.071	-7.178	.000
2	1.800	(15)	-8.399	-8.351	.000
3	2.050	(15)	-10.605	-9.287	.000
4	2.700	(15)	-17.348	-11.378	.000
JTAN	3.000	(15)	-20.884	-12.177	.000
= = MEMBER	2 (	2 - 3) G = =			
ITAN	0.000	(9)	-87.980	62.999	-.580
1	.300	(9)	-70.652	59.191	-.580
2	.950	(9)	-36.903	50.401	-.580
3	1.200	(9)	-25.384	46.823	-.580
4	1.500	(9)	-12.691	42.385	-.580
5	4.000	(9)	42.981	4.319	-.580
6	6.500	(15)	-7.669	-14.041	-.752
7	6.800	(15)	-12.067	-15.260	-.752
8	7.050	(15)	-16.000	-16.195	-.752
9	7.700	(15)	-27.233	-18.286	-.752
JTAN	8.000	(15)	-32.841	-19.084	-.752
= = MEMBER	3 (	3 - 4) G = =			
ITAN	0.000	(11)	-77.823	62.001	-.966
1	.300	(11)	-62.135	58.194	-.966
2	.950	(11)	-31.579	49.403	-.966
3	1.200	(11)	-21.158	45.825	-.966
4	1.500	(11)	-9.686	41.387	-.966
5	4.000	(10)	6.771	3.899	-.570
6	6.500	(10)	-3.888	-12.417	-.570
7	6.800	(15)	-10.366	-13.873	-.266
8	7.050	(15)	-13.953	-14.809	-.266
9	7.700	(15)	-24.285	-16.899	-.266
JTAN	8.000	(15)	-29.477	-17.698	-.266
= = MEMBER	4 (	4 - 5) G = =			
ITAN	0.000	(12)	-65.745	56.193	-.217
1	.300	(12)	-51.799	52.385	-.217
2	.950	(12)	-25.019	43.595	-.217
3	1.200	(12)	-16.050	40.017	-.217
4	1.500	(12)	-6.321	35.579	-.217
5	4.000	(11)	10.480	1.948	-.556
6	6.500	(13)	.668	-13.362	.324
7	6.800	(13)	-3.582	-14.951	.324
8	7.050	(15)	-19.694	-16.021	.034
9	7.700	(15)	-30.814	-18.111	.034
JTAN	8.000	(15)	-36.369	-18.910	.034

SHEAR MINIMUM

	L	CASE	M	Q	N
= = MEMBER	1 (	1 - 2) G = =			
ITAN	0.000	(9)	-.000	-12.220	-.000
1	1.500	(9)	-27.436	-35.206	-.000
2	1.800	(9)	-38.260	-36.965	-.000
3	2.050	(9)	-47.679	-38.369	-.000
4	2.700	(9)	-73.679	-41.506	-.000
JTAN	3.000	(9)	-86.314	-42.704	-.000
= = MEMBER	2 (	2 - 3) G = =			
ITAN	0.000	(15)	-7.535	12.758	-.752
1	.300	(15)	-3.825	11.959	-.752
2	.950	(15)	3.296	9.869	-.752
3	1.200	(15)	5.648	8.933	-.752
4	1.500	(15)	8.148	7.715	-.752
5	4.000	(11)	46.125	-5.171	-1.225
6	6.500	(11)	-8.052	-43.237	-1.225
7	6.800	(11)	-20.079	-47.675	-1.225
8	7.050	(11)	-30.963	-51.253	-1.225
9	7.700	(11)	-62.720	-60.043	-1.225
JTAN	8.000	(11)	-78.964	-63.851	-1.225
= = MEMBER	3 (	3 - 4) G = =			
ITAN	0.000	(15)	-15.263	14.144	-.266
1	.300	(15)	-11.137	13.346	-.266
2	.950	(15)	-3.115	11.255	-.266
3	1.200	(15)	-.417	10.320	-.266
4	1.500	(15)	2.499	9.101	-.266
5	4.000	(14)	33.301	-1.900	-.122
6	6.500	(12)	-2.954	-38.066	-.191
7	6.800	(12)	-13.430	-42.504	-.191
8	7.050	(12)	-23.021	-46.082	-.191
9	7.700	(12)	-51.418	-54.872	-.191
JTAN	8.000	(12)	-66.110	-58.680	-.191
= = MEMBER	4 (	4 - 5) G = =			
ITAN	0.000	(15)	-12.459	12.932	.034
1	.300	(15)	-8.697	12.133	.034
2	.950	(15)	-1.463	10.043	.034
3	1.200	(15)	.933	9.108	.034
4	1.500	(15)	3.485	7.889	.034
5	4.000	(14)	22.746	-5.426	.261
6	6.500	(12)	-18.757	-40.554	-.217
7	6.800	(12)	-29.979	-44.991	-.217
8	7.050	(12)	-40.192	-48.569	-.217
9	7.700	(12)	-70.206	-57.360	-.217
JTAN	8.000	(12)	-85.644	-61.167	-.217

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1 CRC-FANSY V6.3

PICK UP 1

	SHEAR MAXIMUM					SHEAR MINIMUM				
	L	CASE	M	Q	N	L	CASE	M	Q	N
= = MEMBER 5 (5 - 6) G = =										
ITAN	0.000	(12)	-86.314	42.704	-.000	0.000	(15)	-20.884	12.177	.000
1	.300	(12)	-73.679	41.506	-.000	.300	(15)	-17.348	11.378	.000
2	.950	(12)	-47.679	38.369	-.000	.950	(15)	-10.605	9.287	.000
3	1.200	(12)	-38.260	36.965	-.000	1.200	(15)	-8.399	8.351	.000
4	1.500	(12)	-27.436	22.986	-.000	1.500	(15)	-6.071	7.178	.000
JTAN	3.000	(12)	-.000	12.220	-.000	3.000	(11)	.000	-.000	.000
= = MEMBER 6 (7 - 8) G = =										
ITAN	0.000	(11)	-4.596	5.188	1.225	0.000	(15)	9.867	.639	10.854
1	.300	(11)	-3.104	4.762	1.225	.300	(15)	10.016	.355	10.854
2	.650	(11)	-1.524	4.265	1.225	.650	(15)	10.082	.023	10.854
3	1.600	(11)	1.886	2.916	1.225	1.600	(15)	9.677	-.876	10.854
4	4.000	(11)	4.795	-.492	1.225	4.000	(14)	6.304	-3.562	11.380
5	6.400	(11)	-.476	-3.900	1.225	6.400	(14)	-5.802	-6.526	11.380
6	7.350	(11)	-4.822	-5.249	1.225	7.350	(14)	-12.559	-7.699	11.380
7	7.700	(11)	-6.747	-5.746	1.225	7.700	(14)	-15.329	-8.131	11.380
JTAN	8.000	(13)	-9.452	-6.168	-.324	8.000	(14)	-17.824	-8.502	11.380
= = MEMBER 7 (8 - 9) G = =										
ITAN	0.000	(12)	-8.332	5.680	.191	0.000	(15)	1.307	2.106	7.000
1	.300	(12)	-6.692	5.254	.191	.300	(15)	1.896	1.822	7.000
2	.650	(12)	-4.940	4.757	.191	.650	(15)	2.476	1.491	7.000
3	1.600	(12)	-1.061	3.408	.191	1.600	(15)	3.465	.591	7.000
4	4.000	(12)	3.028	-.000	.191	4.000	(14)	2.636	-1.797	7.323
5	6.400	(13)	-.673	-2.964	-.844	6.400	(14)	-5.233	-4.761	7.323
6	7.350	(13)	-4.045	-4.137	-.844	7.350	(14)	-10.313	-5.934	7.323
7	7.700	(13)	-5.569	-4.569	-.844	7.700	(14)	-12.465	-6.366	7.323
JTAN	8.000	(13)	-6.995	-4.939	-.844	8.000	(14)	-14.431	-6.736	7.323
= = MEMBER 8 (9 - 10) G = =										
ITAN	0.000	(9)	-9.428	6.503	.470	0.000	(15)	3.390	1.600	3.334
1	.300	(9)	-7.541	6.077	.470	.300	(15)	3.827	1.316	3.334
2	.650	(9)	-5.501	5.580	.470	.650	(15)	4.230	.985	3.334
3	1.600	(9)	-.840	4.231	.470	1.600	(15)	4.738	.085	3.334
4	4.000	(13)	5.340	1.228	-.324	4.000	(15)	2.217	-2.187	3.334
5	6.400	(13)	4.732	-1.735	-.324	6.400	(14)	-5.205	-5.105	3.340
6	7.350	(13)	2.526	-2.908	-.324	7.350	(14)	-10.612	-6.278	3.340
7	7.700	(13)	1.432	-3.341	-.324	7.700	(14)	-12.885	-6.710	3.340
JTAN	8.000	(13)	.375	-3.711	-.324	8.000	(14)	-14.954	-7.081	3.340
= = MEMBER 9 (2 - 7) C = =										
ITAN	0.000	(14)	-16.139	3.021	-86.012	0.000	(10)	8.050	-1.464	-77.209
JTAN	8.876	(14)	10.674	3.021	-92.958	8.876	(10)	-4.948	-1.464	-85.198

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1 CRC-FANSY V6.3

PICK UP 1

SHEAR MAXIMUM

	L	CASE	M	Q	N
= = MEMBER 10 (3 - 8) C = =					
ITAN	0.000	(14)	-18.242	4.057	-93.317
JTAN	8.876	(14)	17.769	4.057	-100.264
= = MEMBER 11 (4 - 9) C = =					
ITAN	0.000	(14)	-18.745	3.983	-90.539
JTAN	8.876	(14)	16.608	3.983	-97.485
= = MEMBER 12 (5 - 10) C = =					
ITAN	0.000	(14)	-14.688	3.340	-92.589
JTAN	8.876	(14)	14.954	3.340	-99.536

SHEAR MINIMUM

	L	CASE	M	Q	N
= = MEMBER 10 (3 - 8) C = =					
ITAN	0.000	(12)	.364	.026	-105.683
JTAN	8.876	(12)	.594	.026	-113.671
= = MEMBER 11 (4 - 9) C = =					
ITAN	0.000	(13)	2.157	-.520	-48.490
JTAN	8.876	(13)	-2.457	-.520	-55.436
= = MEMBER 12 (5 - 10) C = =					
ITAN	0.000	(13)	2.504	-.324	-41.883
JTAN	8.876	(13)	-.375	-.324	-48.829

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1 CRC-FANSY_ V6.3

PICK UP 1

AXIAL MAXIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(14)	-.000	-10.627	.000
1	1.500	(14)	-23.859	-30.615	.000
2	1.800	(14)	-33.271	-32.145	.000
3	2.050	(14)	-41.462	-33.366	.000
4	2.700	(14)	-64.071	-36.094	.000
JTAN	3.000	(14)	-75.059	-37.135	.000
= = MEMBER 2 (2 - 3) G = =					
ITAN	0.000	(13)	-24.735	19.939	.324
1	.300	(13)	-18.906	18.898	.324
2	.950	(13)	-7.474	16.171	.324
3	1.200	(13)	-3.582	14.951	.324
4	1.500	(13)	.668	13.362	.324
5	4.000	(13)	16.346	-.827	.324
6	6.500	(13)	-3.467	-15.016	.324
7	6.800	(13)	-8.213	-16.605	.324
8	7.050	(13)	-12.519	-17.825	.324
9	7.700	(13)	-25.026	-20.551	.324
JTAN	8.000	(13)	-31.351	-21.593	.324
= = MEMBER 3 (3 - 4) G = =					
ITAN	0.000	(13)	-29.194	20.766	.844
1	.300	(13)	-23.117	19.724	.844
2	.950	(13)	-11.148	16.998	.844
3	1.200	(13)	-7.049	15.778	.844
4	1.500	(13)	-2.550	14.189	.844
5	4.000	(13)	15.195	-.000	.844
6	6.500	(13)	-2.550	-14.189	.844
7	6.800	(13)	-7.049	-15.778	.844
8	7.050	(13)	-11.148	-16.998	.844
9	7.700	(13)	-23.117	-19.724	.844
JTAN	8.000	(13)	-29.194	-20.766	.844
= = MEMBER 4 (4 - 5) G = =					
ITAN	0.000	(13)	-31.351	21.593	.324
1	.300	(13)	-25.026	20.551	.324
2	.950	(13)	-12.519	17.825	.324
3	1.200	(13)	-8.213	16.605	.324
4	1.500	(13)	-3.467	15.016	.324
5	4.000	(13)	16.346	.827	.324
6	6.500	(13)	.668	-13.362	.324
7	6.800	(13)	-3.582	-14.951	.324
8	7.050	(13)	-7.474	-16.171	.324
9	7.700	(13)	-18.906	-18.898	.324
JTAN	8.000	(13)	-24.735	-19.939	.324

AXIAL MINIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(9)	-.000	-12.220	-.000
1	1.500	(9)	-27.436	-35.206	-.000
2	1.800	(9)	-38.260	-36.965	-.000
3	2.050	(9)	-47.679	-38.369	-.000
4	2.700	(9)	-73.679	-41.506	-.000
JTAN	3.000	(9)	-86.314	-42.704	-.000
= = MEMBER 2 (2 - 3) G = =					
ITAN	0.000	(10)	-39.375	55.455	-1.464
1	.300	(10)	-24.310	51.648	-1.464
2	.950	(10)	4.536	42.857	-1.464
3	1.200	(10)	14.169	39.279	-1.464
4	1.500	(10)	24.599	34.842	-1.464
5	4.000	(10)	61.413	-3.225	-1.464
6	6.500	(10)	8.476	-41.291	-1.464
7	6.800	(10)	-3.889	-45.729	-1.464
8	7.050	(10)	-15.134	-49.306	-1.464
9	7.700	(10)	-48.172	-58.097	-1.464
JTAN	8.000	(10)	-65.171	-61.905	-1.464
= = MEMBER 3 (3 - 4) G = =					
ITAN	0.000	(11)	-77.823	62.001	-.966
1	.300	(11)	-62.135	58.194	-.966
2	.950	(11)	-31.579	49.403	-.966
3	1.200	(11)	-21.158	45.825	-.966
4	1.500	(11)	-9.686	41.387	-.966
5	4.000	(11)	39.867	3.321	-.966
6	6.500	(11)	6.920	-34.745	-.966
7	6.800	(11)	-2.559	-39.183	-.966
8	7.050	(11)	-11.320	-42.761	-.966
9	7.700	(11)	-37.558	-51.551	-.966
JTAN	8.000	(11)	-51.253	-55.359	-.966
= = MEMBER 4 (4 - 5) G = =					
ITAN	0.000	(10)	-29.241	23.321	-.679
1	.300	(10)	-22.420	22.123	-.679
2	.950	(10)	-9.019	18.988	-.679
3	1.200	(10)	-4.445	17.585	-.679
4	1.500	(10)	.560	15.757	-.679
5	4.000	(10)	19.568	-.559	-.679
6	6.500	(10)	-2.235	-16.875	-.679
7	6.800	(10)	-7.576	-18.703	-.679
8	7.050	(10)	-12.429	-20.106	-.679
9	7.700	(10)	-26.557	-23.241	-.679
JTAN	8.000	(10)	-33.713	-24.439	-.679

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TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3*3D) L-1 CRC-FANSY V6.3

PICK UP 1

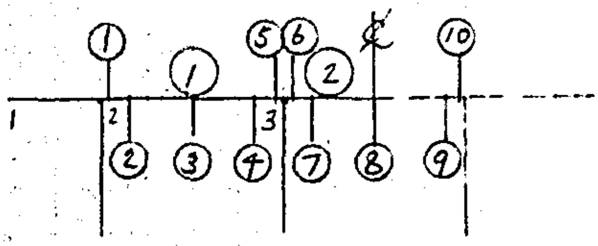
	AXIAL MAXIMUM					AXIAL MINIMUM				
	L	CASE	M	Q	N	L	CASE	M	Q	N
= = MEMBER 5 (5 - 6) G = =										
ITAN	0.000	(14)	-75.059	37.135	.000	0.000	(13)	-27.240	15.882	-.000
1	.300	(14)	-64.071	36.094	.000	.300	(13)	-22.628	14.841	-.000
2	.950	(14)	-41.462	33.366	.000	.950	(13)	-13.833	12.113	-.000
3	1.200	(14)	-33.271	32.145	.000	1.200	(13)	-10.955	10.892	-.000
4	1.500	(14)	-23.859	19.989	.000	1.500	(13)	-7.919	9.362	-.000
JTAN	3.000	(14)	-.000	10.627	.000	3.000	(13)	.000	.000	-.000
= = MEMBER 6 (7 - 8) G = =										
ITAN	0.000	(14)	10.674	1.377	11.380	0.000	(13)	.375	3.711	-.324
1	.300	(14)	11.031	1.007	11.380	.300	(13)	1.432	3.341	-.324
2	.650	(14)	11.308	.575	11.380	.650	(13)	2.526	2.908	-.324
3	1.600	(14)	11.296	-.599	11.380	1.600	(13)	4.732	1.735	-.324
4	4.000	(14)	6.304	-3.562	11.380	4.000	(13)	5.340	-1.228	-.324
5	6.400	(14)	-5.802	-6.526	11.380	6.400	(13)	-1.164	-4.192	-.324
6	7.350	(14)	-12.559	-7.699	11.380	7.350	(13)	-5.704	-5.365	-.324
7	7.700	(14)	-15.329	-8.131	11.380	7.700	(13)	-7.657	-5.797	-.324
JTAN	8.000	(14)	-17.824	-8.502	11.380	8.000	(13)	-9.452	-6.168	-.324
= = MEMBER 7 (8 - 9) G = =										
ITAN	0.000	(14)	-.055	3.142	7.323	0.000	(13)	-6.995	4.939	-.844
1	.300	(14)	.832	2.772	7.323	.300	(13)	-5.569	4.569	-.844
2	.650	(14)	1.727	2.340	7.323	.650	(13)	-4.045	4.137	-.844
3	1.600	(14)	3.392	1.167	7.323	1.600	(13)	-.673	2.964	-.844
4	4.000	(14)	2.636	-1.797	7.323	4.000	(13)	2.884	-.000	-.844
5	6.400	(14)	-5.233	-4.761	7.323	6.400	(13)	-.673	-2.964	-.844
6	7.350	(14)	-10.313	-5.934	7.323	7.350	(13)	-4.045	-4.137	-.844
7	7.700	(14)	-12.465	-6.366	7.323	7.700	(13)	-5.569	-4.569	-.844
JTAN	8.000	(14)	-14.431	-6.736	7.323	8.000	(13)	-6.995	-4.939	-.844
= = MEMBER 8 (9 - 10) G = =										
ITAN	0.000	(14)	2.178	2.798	3.340	0.000	(13)	-9.452	6.168	-.324
1	.300	(14)	2.961	2.427	3.340	.300	(13)	-7.657	5.797	-.324
2	.650	(14)	3.735	1.995	3.340	.650	(13)	-5.704	5.365	-.324
3	1.600	(14)	5.074	.822	3.340	1.600	(13)	-1.164	4.192	-.324
4	4.000	(14)	3.491	-2.141	3.340	4.000	(13)	5.340	1.228	-.324
5	6.400	(14)	-5.205	-5.105	3.340	6.400	(13)	4.732	-1.735	-.324
6	7.350	(14)	-10.612	-6.278	3.340	7.350	(13)	2.526	-2.908	-.324
7	7.700	(14)	-12.885	-6.710	3.340	7.700	(13)	1.432	-3.341	-.324
JTAN	8.000	(14)	-14.954	-7.081	3.340	8.000	(13)	.375	-3.711	-.324
= = MEMBER 9 (2 - 7) C = =										
ITAN	0.000	(15)	-13.349	2.616	-29.581	0.000	(9)	1.666	-.580	-109.193
JTAN	8.876	(15)	9.867	2.616	-34.907	8.876	(9)	-3.484	-.580	-117.181

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) L-1 CRC-FANSY V6.3

PICK UP 1

	AXIAL MAXIMUM						AXIAL MINIMUM				
	L	CASE	M	Q	N		L	CASE	M	Q	N
= = MEMBER 10 (3 - 8) C = =						= = MEMBER 10 (3 - 8) C = =					
ITAN	0.000	(15)	-17.578	3.853	-37.928	ITAN	0.000	(11)	-1.141	.259	-116.662
JTAN	8.876	(15)	16.626	3.853	-43.254	JTAN	8.876	(11)	1.155	.259	-124.651
= = MEMBER 11 (4 - 9) C = =						= = MEMBER 11 (4 - 9) C = =					
ITAN	0.000	(15)	-17.018	3.667	-35.330	ITAN	0.000	(12)	-.364	-.026	-105.683
JTAN	8.876	(15)	15.529	3.667	-40.656	JTAN	8.876	(12)	-.594	-.026	-113.671
= = MEMBER 12 (5 - 10) C = =						= = MEMBER 12 (5 - 10) C = =					
ITAN	0.000	(15)	-15.485	3.334	-35.733	ITAN	0.000	(12)	.670	.217	-102.721
JTAN	8.876	(15)	14.103	3.334	-41.059	JTAN	8.876	(12)	2.593	.217	-110.710

[8] Calculation of upper beam



(1) Calculation of tensile stress caused by bending

(a) Summary of stresses

(i) At the support point

		(1)				(2)			
		①	CASE	⑤	CASE	⑥	CASE	⑩	CASE
Combined stress	Top	-89.75	14	-78.96	11	-77.82	11	-66.11	12
	Bottom	—		—		—		—	
Dead load		-33.13	1	-33.88	1	-33.55	1	-33.55	1

(ii) Transit point to haunch

		(1)				(2)			
		②	CASE	④	CASE	⑦	CASE	⑨	CASE
Combined stress	Top	-37.42	12	-20.94	12	-29.73	10	-17.00	12
	Bottom	14.17	10	—		—		—	

(iii) Span moment

		(1)		(2)	
		③	CASE	⑧	CASE
Combined stress	Bottom	61.41	10	—	

(b) Allowable stress of upper beam.

Safe against cracking

$\alpha = \frac{M_L}{\Sigma M}$ $\alpha \geq 0.25$ ---------- $\sigma_{sa} = 1000$ kg/cm²

$\alpha < 0.25$ ---------- $\sigma_{sa} = 1200$ "

(i) At the support point 1

Dead load $M_d = -33.10^{t.m}$ (case 1)

Train Load + Impact $M_L = -48.60$ " (case 2)

$\Sigma M = -81.70^{t.m}$

$$\alpha = \frac{-48.60}{-81.70} = 0.59 > 0.25$$

$\therefore$ $\sigma_{sa} = 1000$ kg/cm²

(ii) At the support point 2

Dead load $M_d = -33.88^{t.m}$ (case 1)

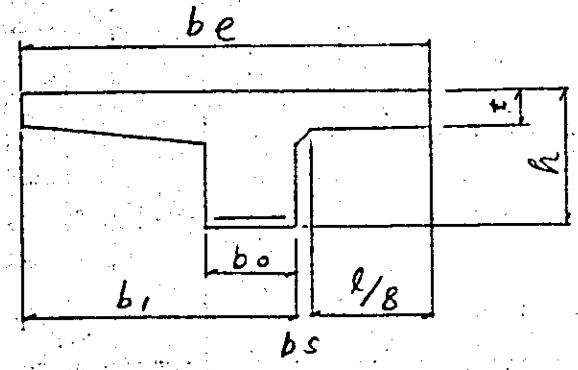
Train Load + Impact $M_L = -45.08$ " (case 4)

$\Sigma M = -78.96^{t.m}$

$$\alpha = \frac{-45.08}{-78.96} = 0.57 > 0.25$$

$\therefore$ $\sigma_{sa} = 1000$ kg/cm²

Effective width of T-beam compression fibre



$$be = b_1 + bs + \frac{l}{8}$$

$$be = 1.65 + 0.1 + \frac{0.6 \times 8.0}{8}$$

$$= 2.35^m < 2.95^m$$

Bending stress calculation

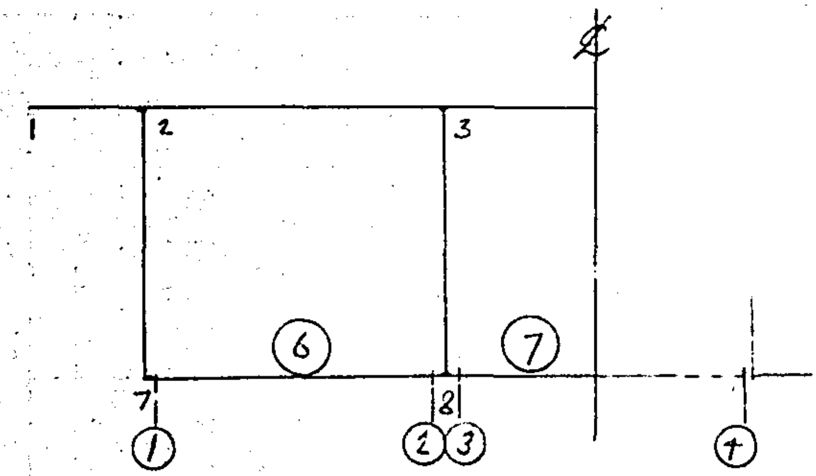
	①	⑤	②	⑦	③	
M (tm)	-89.75	-78.96	-37.42	-29.73	61.43	
N (t)						
~~S~~ B (t)					235	
b (cm)	60	60	60	60	60	
h (cm)	130	130	90	90	90	
d (cm)	122.4	122.4	82.4	84.9	81.9	
d' (t) (cm)	7.6	7.6	7.6	5.1	8.1 (25)	
As (cm²)	D25-12 = 60.804	D25-10 = 50.67	D25-8 = 40.536	D25-6 = 30.402	D25-10 = 50.67	
p	0.00828	0.00690	0.00820	0.00597	0.00263	
As' (cm²)						
p'						
e=M/N (cm)					x = 20.45	
e=M/N+u (cm)						
e=M/N−u (cm)						
e/h						
d/e						
d'/h						
d'/d						
Ne/bd² (kg/cm²)	9.984	8.784	9.185	6.879	3.897	
k						
c						
j						
1/Lc	5.90	6.27	5.92	6.58	8.91	
1/Ls	139	165	140	189	414	
β=σs/σc						
σc (kg/cm²)	58.9	55.0	54.4	45.3	34.7	
σs (kg/cm²)	1390	1450	1290	1300	1610	
τ (kg/cm²)						
σsa (kg/cm²)	1800	1800	1800	1800	1800	
σca (kg/cm²)	90	90	90	90	90	
τa (kg/cm²)						
	D+T+I+B	D+T+I	D+T+I	D+T+I	D+T+I	

(2) Calculation of shearing stress

(Note)

Referred to the No. 47

[9] Calculation of buried beam



1. Calculation of compressive stress caused by bending

(1) Summary of stresses

		⑥				⑦			
		①	CASE	②	CASE	③	CASE	④	CASE
Combined stress	Top	-14.95	14	-17.82	14	-8.33	12	-14.43	14
	Bottom	10.67	14	3.39	15	1.31	15	——	
Dead load		-3.39	1	-8.86	1	-8.13	1	-8.13	1

	Top side	Bottom side
M (tm)	-17.82	10.67
N (t)		
S (t)		
b (cm)	50	50
h (cm)	70	70
d (cm)	62.4	55
d' (cm)	7.6	15
As (cm²)	D25-4 =20.268	D25-4 = 20.268
p	0.00650	0.00737
As' (cm²)		
p'		
e=M/N (cm)		
e=M/N+u (cm)		
e=M/N−u (cm)		
e/h		
d/e		
d'/h		
d'/d		
Ne/bd² (kg/cm²)	9.153	7.055
k		
c		
j		
1/Lc	6.40	6.13
1/Ls	175	155
β=σs/σc		
σc (kg/cm²)	58.5	43.2
σs (kg/cm²)	1600	1090
τ (kg/cm²)		
σsa (kg/cm²)	1800	1800
σca (kg/cm²)	90	90
τa (kg/cm²)		
	D+T+I+B	D+T+I+B

Calculation of shearing stress

$S = 7.70^{t}$ (h/2 point) (case 14)

$\tau = \dfrac{7.70 \times 10^3}{50 \times 55} = 2.80^{kg/cm^2} < 3.9^{kg/cm^2}$

Therefore,

Stirrup

Use D13 - one set in 25 cm ctc

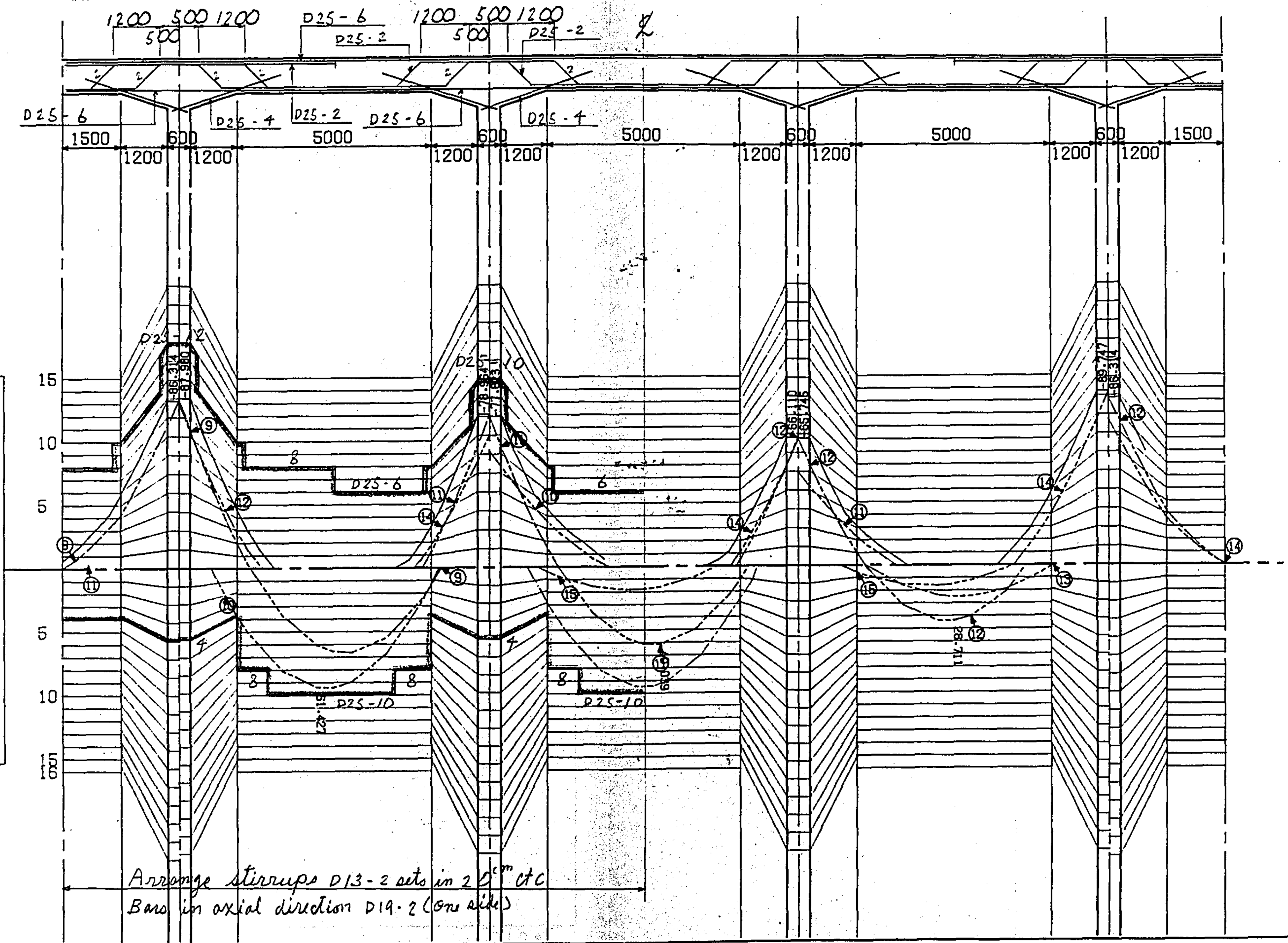
Bar arrangement in axial direction

Use D16 - 2 bares (one side)

VIADUCT OF SINGLE TRACK L=30 L-1

PICK UP 1

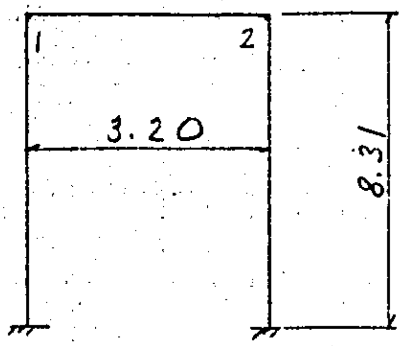
SCALE 1/100
CM/TON 5.0/100



§5. Rigid fram analyis on transversal Section (②-②) of elevated structure

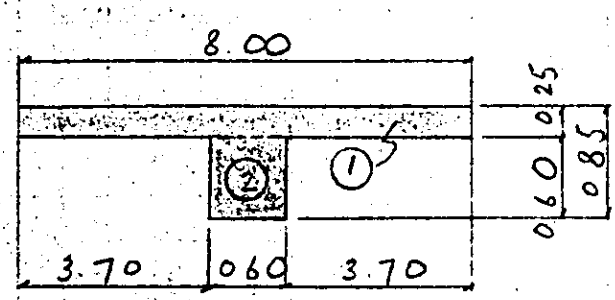
[1] Elements for rigid frame analysis

1. Configulation and dimension of rigid frame



2 Cross-Sectional area and moment of Inertia of the member

(1) Member (1-2)



Effective width

$b = 8.00/2 \times 2$

$= 8.00^m$

	b (m)	h (m)	A (m²)	y (m)	A · y (m³)
①	8.00	0.25	2.000	0.125	0.25000
②	0.60	0.60	0.360	0.550	0.19800
Σ			2.360		0.44800

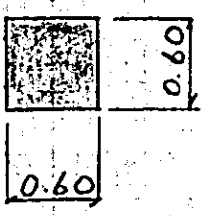
$$y = \frac{0.4480}{2.360} = 0.190^{m}$$

	$b^{(m)}$	$h^{(m)}$	$A^{(m^2)}$	$y_0^{(m)}$	$I_0^{(m^4)}$	$A \cdot y_0^{2\,(m^4)}$	$I_0 + A \cdot y_0^{2\,(m^4)}$
①	8.00	0.25	2.000	0.065	0.01042	0.00845	0.01887
②	0.60	0.60	0.360	0.360	0.01080	0.04666	0.05746
			2.360		0.02122	0.05511	0.07633

Cross-Sectional Area $A = 2.360^{m^2}$

Moment of Inertia $I = 0.07633^{m^4}$

(2) Member (1-3, 2-4)



$A = 0.60 \times 0.60 = 0.360^{m^2}$

$$I = \frac{0.60 \times 0.60^3}{12} = 0.01080^{m^4}$$

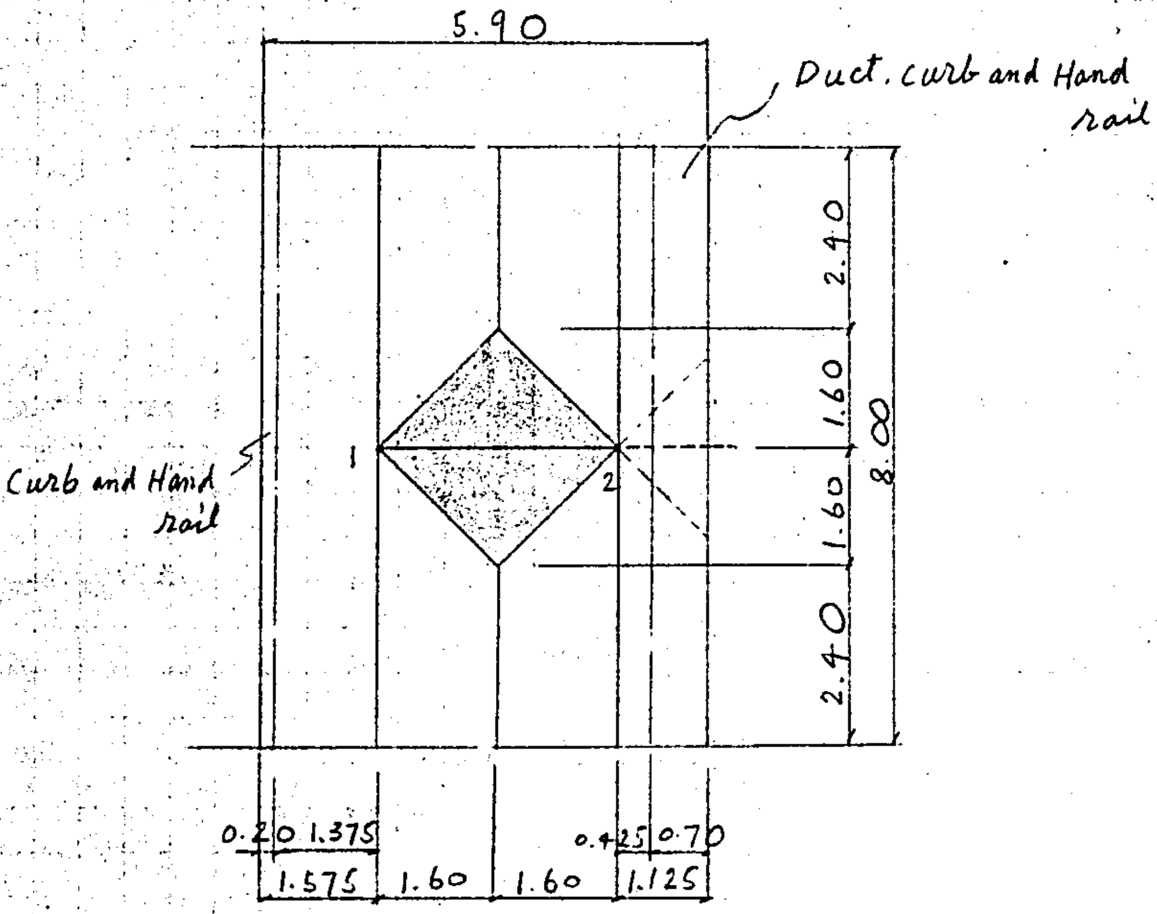
(3) Axial height

$h = 8.50 - 0.19 = 8.310^{m}$

[2] Calculation of loads

1 Dead load

(1) Member (1-2)



(a) Distributed load

Ballast	$1.90^{t/m^3} \times 0.42$	$= 0.80^{t/m^2}$
Grading Concrete	2.35×0.07	$= 0.16$ "
Track weight	$0.45 \times 1/2.89$	$= 0.16$ "
		$w' = 1.12\ t/m^2$
Slab	$2.50^{t/m^3} \times 0.25$	$= 0.63$
		$w = 1.75\ t/m^2$

$w_{d1} = 1.75 \times 1.60 \times 2 = 5.60^{t/m}$

(b) Distributed load

Haunch of slab	$2.50^{t/m^3} \times 0.30 \times 0.10 \times 1/2 \times 2$	$= 0.08^{t/m}$
Beam	$2.50 \times 0.60 \times 0.60$	$= 0.90$ "
		$w_{d2} = 0.98^{t/m}$

(C) Concentrated load of elements acting at joint P_1 as shown below.

Weight of elments on the slab except track weight	$1.12^{t/m^2} \times 1.375 \times 8.00$	$= 12.32$ "
Distributied load	$1.75 \times (2.40 + 9.00) \times 1/2 \times 1.60 \times 2$	$= 17.92$ "
Longitudinal beam	$2.50^{t/m^3} \times 0.60 \times 0.65 \times 7.40$	$= 7.22$ "
Haunch of longitudinal beam	$2.50 \times 0.40 \times 1.20 \times 1/2 \times 0.60 \times 2$	$= 0.72$ "
Curb	$2.50 \times 0.20 \times 0.30 \times 8.00$	$= 1.20$ "
Handrail	0.20×8.0	$= 1.60$ "
Contilever slab	$2.50^{t/m^3} \times (0.2 + 0.35) \times 1/2 \times 1.275 \times 8.00$	$= 7.01$ "
Haunch of slab	$2.50 \times 0.30 \times 0.10 \times 1/2 \times 6.80$	$= 0.26$ "
Deficit of Transverse beam	-0.98×0.60	$= -0.59$ "
Deficit of column weight	$-2.50 \times 0.60 \times 0.60 \times (0.25 - 0.198)$	$= -0.05$
		$P_1 = 47.61$ "

joint 2

Weight of elements on the slab except track weight	$1.12^{t/m^2} \times 0.425 \times 8.00$	$= 3.81^{t}$
Distributed weight	$1.75'' \times (2.40+4.00) \times 1/2 \times 1.60 \times 2$	$= 17.92''$
Longitudinal beam	$2.50'' \times 0.60 \times 0.65 \times 7.40$	$= 7.22''$
Haunch of longitudinal beam	$2.50'' \times 0.40 \times 1.20 \times 1/2 \times 0.60 \times 2$	$= 0.72''$
Curb	$2.50'' \times 0.25 \times 0.30 \times 8.00$	$= 1.50''$
Handrail	$0.20^{t/m} \times 8.00$	$= 1.60''$
Ballast stopper	$2.50^{t/m^3} \times 0.15 \times 0.30 \times 8.00$	$= 0.90''$
Duct lib	$2.50'' \times 0.05 \times 0.30 \times 8.00$	$= 0.30''$
Cable	0.06×8.00	$= 0.48''$
Cantilever slab	$2.50^{t/m^3} \times (0.2+0.35) \times 1/2 \times 0.825 \times 8.0$	$= 4.54''$
Haunch of slab	$2.50 \times 0.30 \times 0.10 \times 1/2 \times 6.80$	$= 0.26''$
Deficit of transverse beam	-0.98×0.60	$= -0.59''$
Deficit of Column Weight	$-2.50 \times 0.60 \times 0.60 \times (0.25-0.198)$	$= -0.05''$
		$P_2 = 38.61^{t}$

d) Torsional moment from longitudinal beam

$$M_L = -2.96 \times 2 = -5.92^{t\cdot m}$$

$$M_R = -2.764 \times 2 = -5.53$$

(2) Column Weight

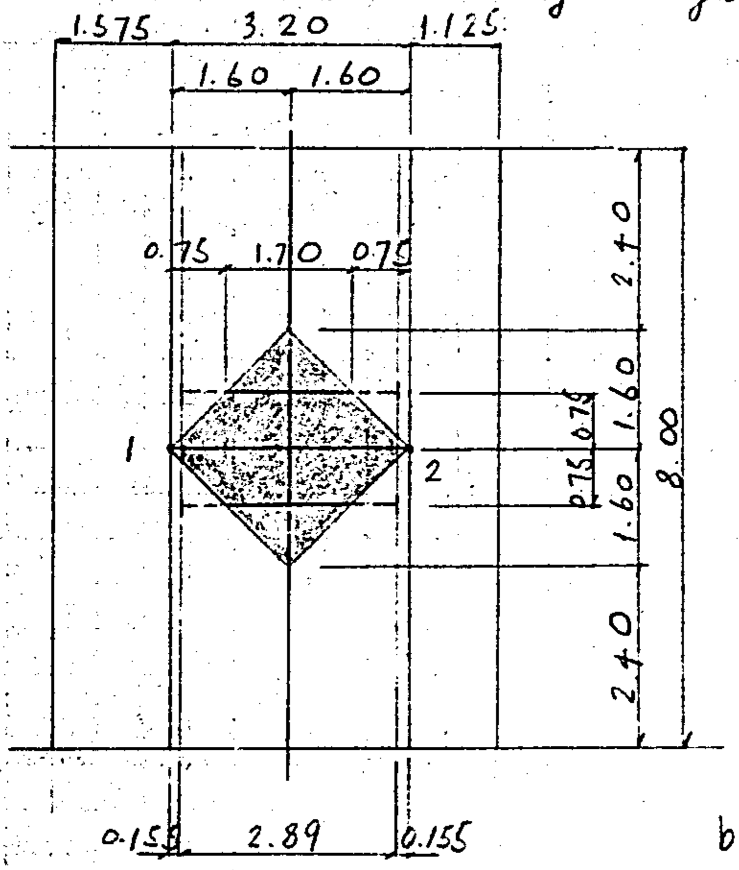
$g = 2.50 \times 0.60 \times 0.60 = 0.90$ T/m

2. Train Load and Impact

(1) Train load

KS-16

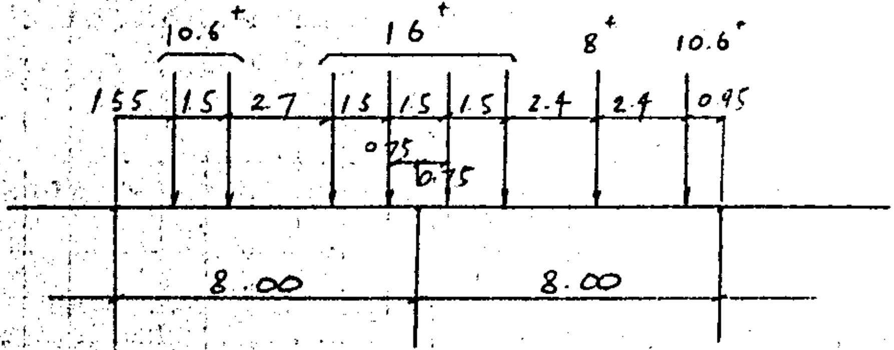
1) Distributed load acting on rigid-frame



$b = 2.89^{m}$

$$w_l = \frac{16}{2.89} = 5.54^{t/m}$$

2) Concentrated load caused by axial load acting on longitudinal beam



$$R_C = \frac{1}{8.0}\{10.6(1.55+3.05)+16(5.75+7.25)$$

$$+10.6\times0.95+8\times3.36+16(5.75+7.25)\}$$

$$=62.71^{t}$$

$$P = 62.71 - 5.54\times1.70\times2 \qquad = 43.87^{t}$$

(2) Impact coefficient

$l = 3.20^{m} \qquad i = 0.523$

$l = 8.00^{m} \qquad i = 0.45$

(3) Train load + Impact

$w_{g+i} = 5.54 \times (1+0.523) = 8.44^{t/m}$

Joint 1. 2

$$P_{1,2)} = \frac{43.87}{2}\times(1+0.45) = 31.81^{t}$$

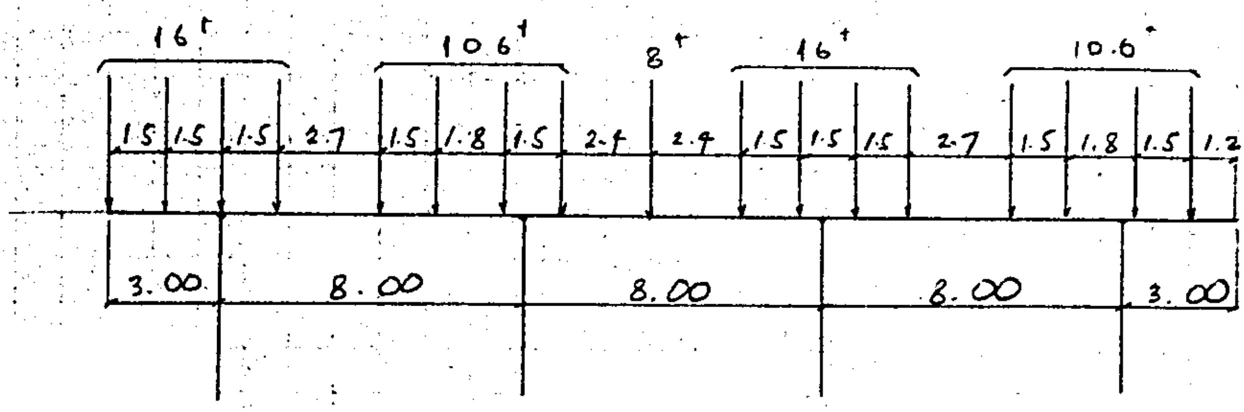
(4) Torsional moment of longitudinal beam

$M_{L(l+1)} = 9.76\times2 \qquad = 19.52^{t.m}$

$M_{R(l+1)} = -9.76\times2 \qquad = -19.52$ "

3. Centrifugal load

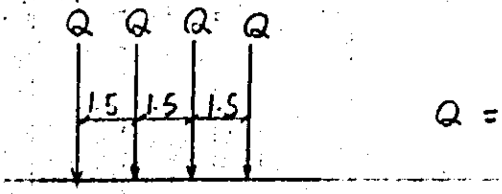
$R = 500^{m}$ $\alpha = 0.12$



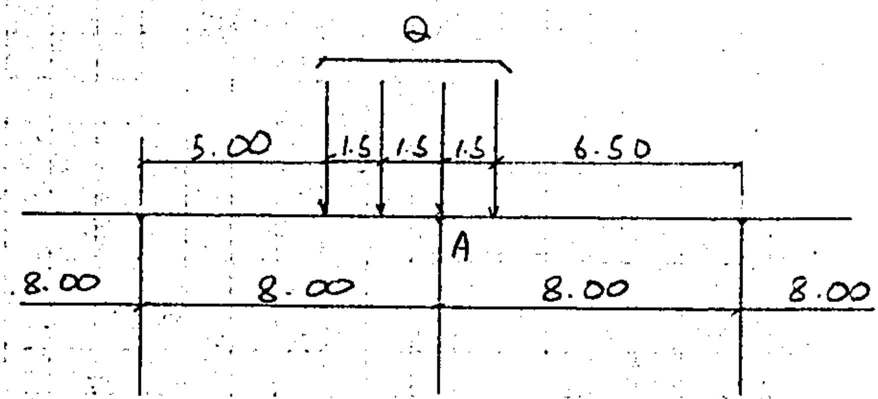
$\Sigma H = (16 \times 8 + 10.6 \times 8 + 8) \times 0.12 = 26.50^{t}$

$H = 26.50 \times 1/4 = 6.63^{t}$

4 Train lateral load



$Q = 16 \times 0.15 = 2.40^{t}$



$$R_A = \frac{2.40}{8.00} \times (5.00 + 6.50 / 2) + 2.40 = 7.80^{t}$$

5 Forces of temperature change and/or Drying contraction

Temperature drop + Drying contraction

$t = -25°C$

6 Dead load + Seismic force

$kH = 0.1$

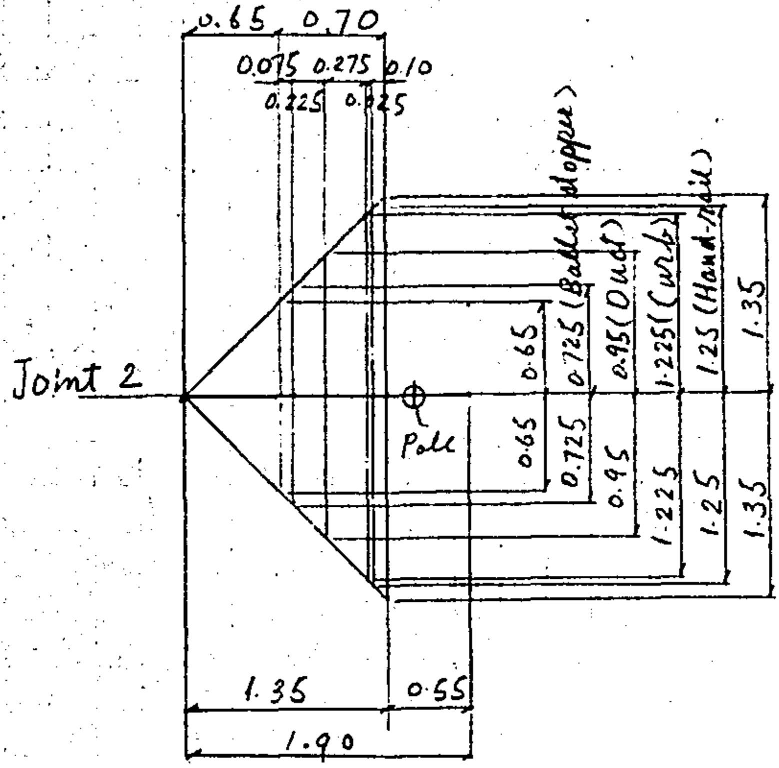
$\Sigma W = 403.95^{t}$

$\Sigma H = 403.95 \times 0.1 = 40.40^{t}$

Acting within elevated structure (viaduct) section

$H = 40.40 \times 1/4 = 10.10^{t}$

7 Load of electric pole, support of electric pole and ralated installations.



Calculation of load

Electric pole load

$H = 0.50^{t}$

$V = 2.00^{t}$

$M = 5.00^{t \cdot m}$

Sopport of electric pole	$w_1 = 2.50^{t/m^3} \times 0.75 \times 0.325$	$= 0.61^{t/m}$
do	$w_2 = 2.50 \times 0.75 \times 0.625$	$= 1.17$ "
Contilever slab	$w_3 = 2.50 \times 0.275 \times 1.35 \times 2$	$= 1.86$ "
Ballast, Sloping Concrete	$w_4 = (1.9^{t/m^3} \times 0.42 + 2.35 \times 0.07) \times 0.65 \times 2$	$= 1.25$ "
Stand of electric pole	$P_1 = 2.5 \times (0.75 \times 0.75 - 3.142 \times 0.45^2 \times 1/4) \times 1.0$	$= 1.01^{t}$

Sopport of electric pole $P_2 = 2.50^{t/m^3} \times 0.75 \times 0.75 \times 0.275 = 0.28^t$

Handrail $P_3 = 0.20 \times 1.25 \times 2 = 0.50$

Curb $P_4 = 2.50 \times 0.25 \times 0.30 \times 1.225 \times 2 = 0.46$

Duct $P_5 = (2.5 \times 0.05 \times 0.3 + 0.06) \times 0.95 \times 2 = 0.19$

Ballast stopper $P_6 = 2.50 \times 0.15 \times 0.3 \times 0.725 \times 2 = 0.16$

Load of joint 2

Dead load

Concentrated load

$N = 2.0 + (1.17 + 0.61) \times 1/2 \times 1.60 + 1.01 + 0.28 = 4.71^t$

Deficit of concentroted load

$-N = 1.86^{t/m} \times 1.35 \times 1/2 \times 2 + 1.25 \times 0.65 \times 1/2 \times 2 + 0.50$

$+ 0.46 + 0.19 + 0.16 \qquad = -4.63^t$

$\Sigma N = 0.08^t$

Horizontal load

$H = \pm 0.50^t$

Moment

$M = \pm 5.00 + 2.00 \times 1.525 + 1/6 (2 \times 0.61 + 1.17) \times 1.90^2$

$+ 1.86 \times 1.35^2 \times 1/3 + 1.25 \times 0.65^2 \times 1/3 + 1.01 \times 1.525$

$+ 0.28 \times 1.625 + 0.50 \times 1.25 + 0.46 \times 1.225 + 0.19 \times 0.95$

$+ 0.16 \times 0.725$

$= \pm 5.00 + 3.05 + 1.44 + 1.13 + 0.18 + 1.54$

$+ 0.46 + 0.63 + 0.56 + 0.18 + 0.12 = 14.29^{t.m}$

$(4.29^{?})$

Seismic load

$N = 0.08^{t}$

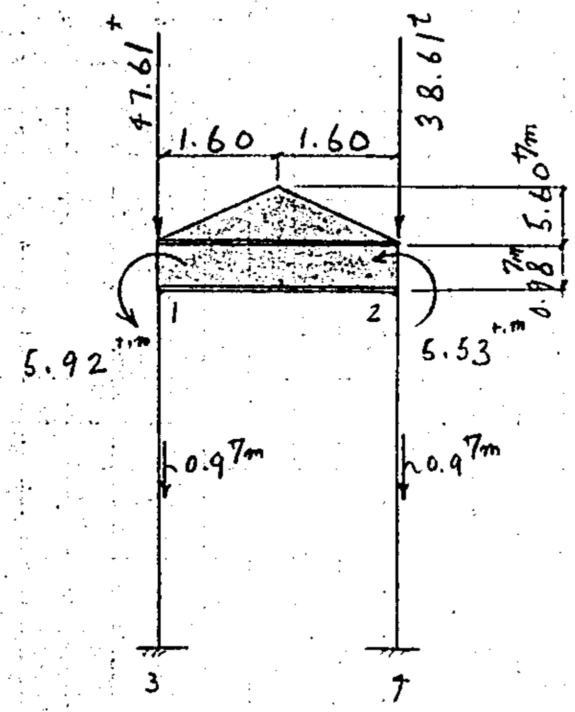
$H = 0.50 + 2.0 \times 0.1 = \pm 0.70^{t}$

$M = 14.29^{t.m}$

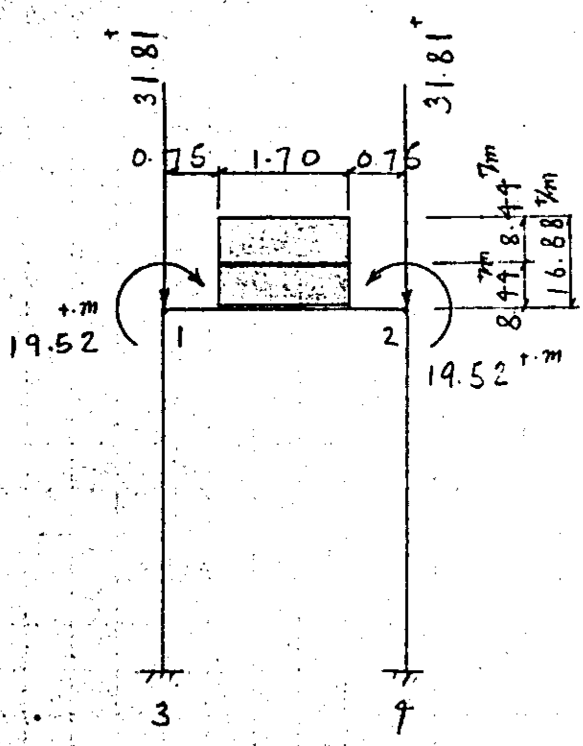
(4.29)

(3) Loading diagram

Case 1. Dead load

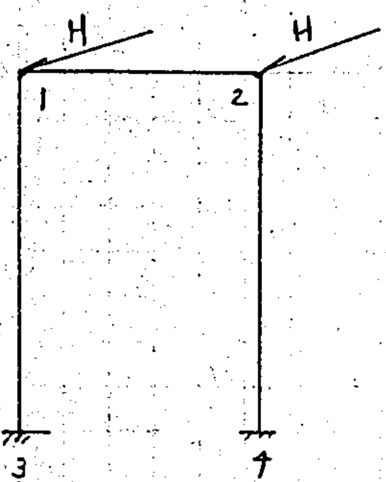


Case 2 Train load + Impact

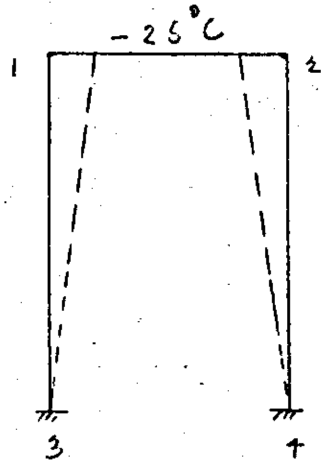


Case 3 Centrifugal load

$$H = \frac{6.63}{2} = 3.32^{t}$$

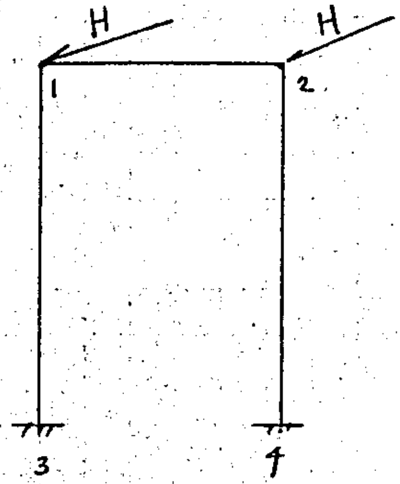


Case 4 Temperature + Contraction

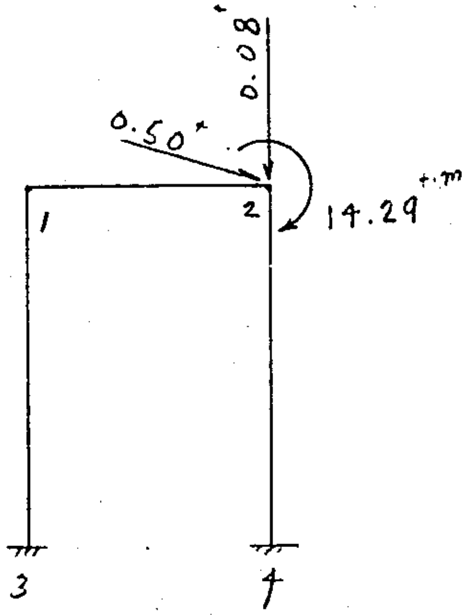


Case 5 Seismic load

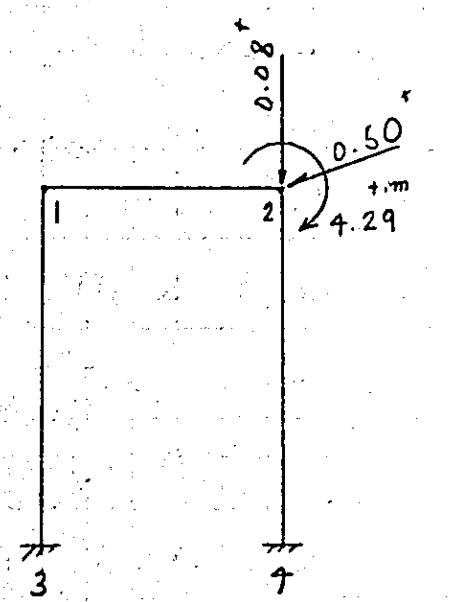
$$H = \frac{10.10}{2} = 5.05^{t}$$



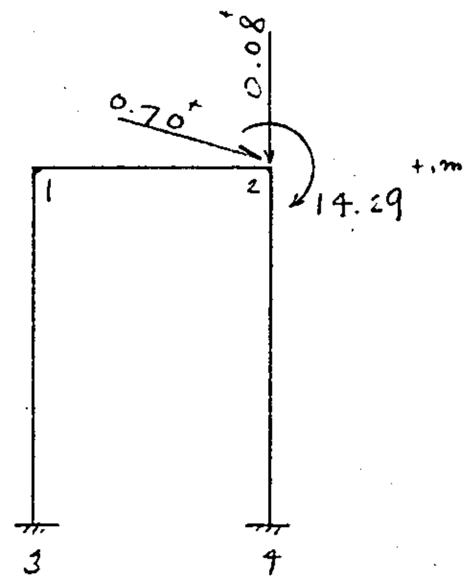
Case 6 Electric pole load (1)



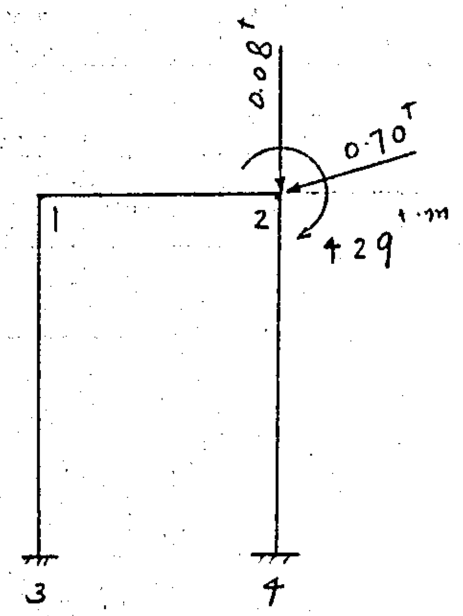
Case 7 Electric pole load (2)



Case 8 Electric pole load (3)



Case 9 Electric pole load (4)



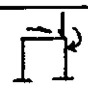
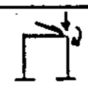
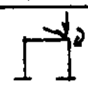
Case 10 Train lateral load

$$\text{Case 3} \times \frac{7.80}{6.63}$$

$$= \text{Case 3} \times 1.176$$

(4) Combination of loads

Basic load

Case No	Kind of load	Loading pattern
1	Dead load	
2	Train load + Impact	
3	Centrifugal load	
4	Temperature + contraction	− 25°C
5	Seismic load	
6	Electric pole load (1)	
7	do (2)	
8	do (3)	
9	do (4)	
10	Train lateral load	Case 3 × 1.176

Combined load

Case No	Combination of load	α
11	1 + 2	1.0000
12	1 + 2 + 3	〃
13	1 + 4	0.8696
14	1 + 2 + 3 + 10	〃
15	1 + 5	0.6667
16	1 + 2 + 6	1.0
17	1 + 2 + 3 + 7	〃
18	1 + 2 + 3 + 7 + 10	0.8696
19	1 + 2 + 6 - 10	〃
20	1 - 5 + 8	0.6667
21	1 + 5 + 9	〃

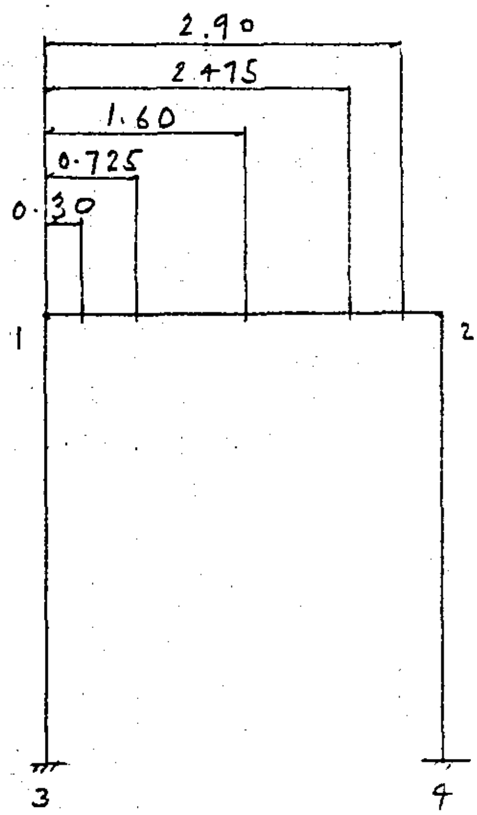
Pick up critical case

No 1 case 11 ~ case 15

No 2 case 16 ~ case 21

No 3 case 11 ~ case 21

[5] Points of computing stresses

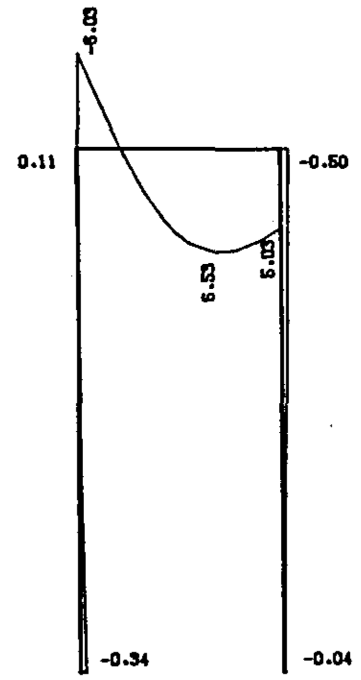


[6] stress diagram

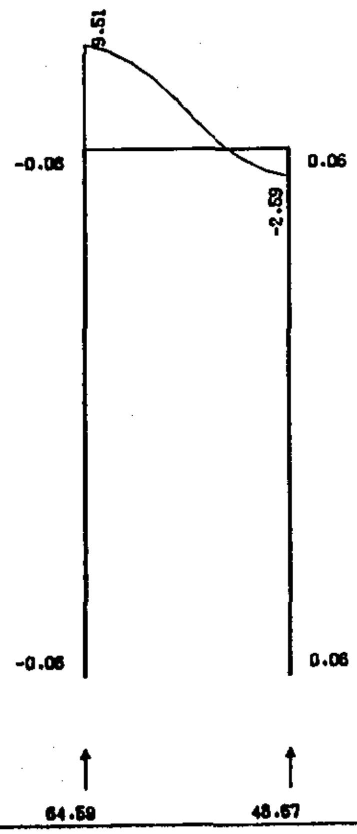
VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2

CASE 1

BENDING MOMENT



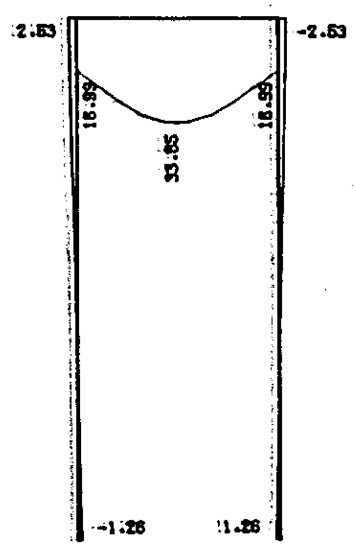
SHEARING FORCE



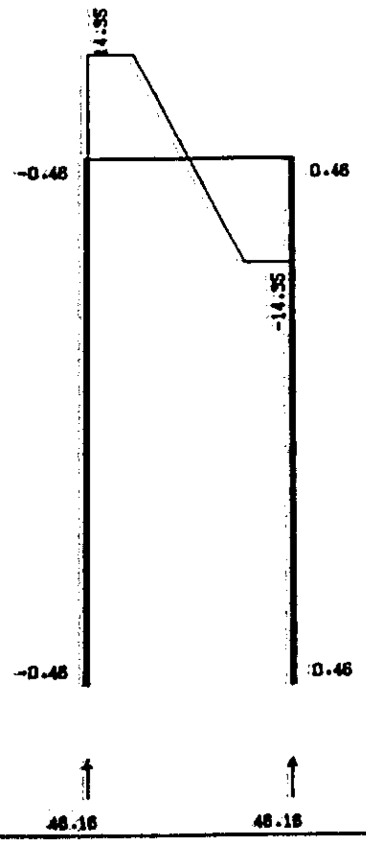
VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2

CASE 2

BENDING MOMENT



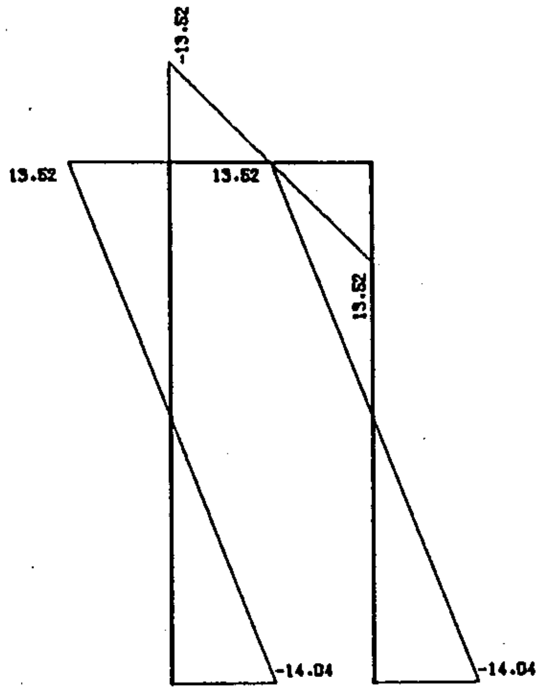
SHEARING FORCE



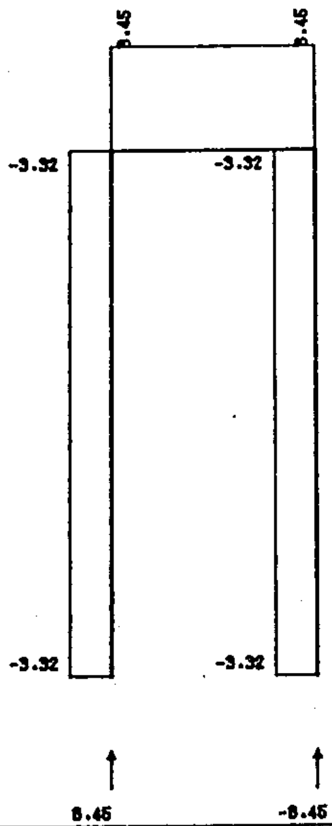
VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2

CASE 3

BENDING MOMENT



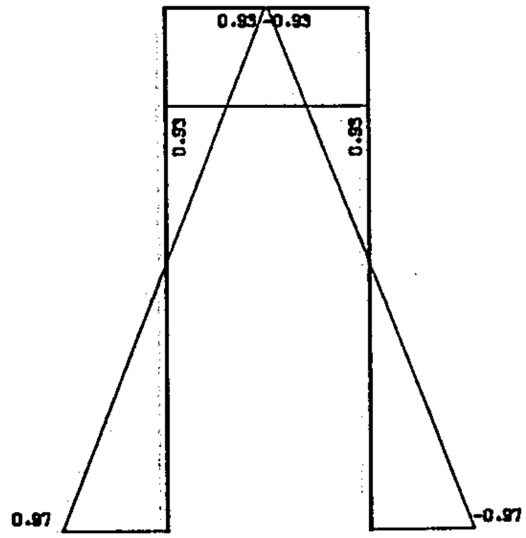
SHEARING FORCE



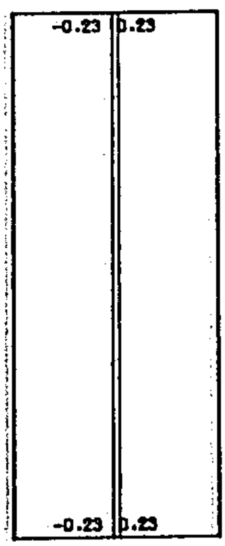
VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2

CASE 4

BENDING MOMENT



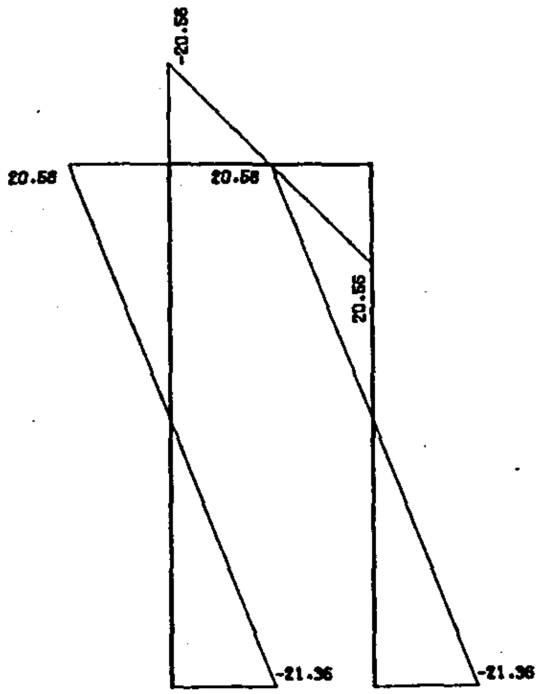
SHEARING FORCE



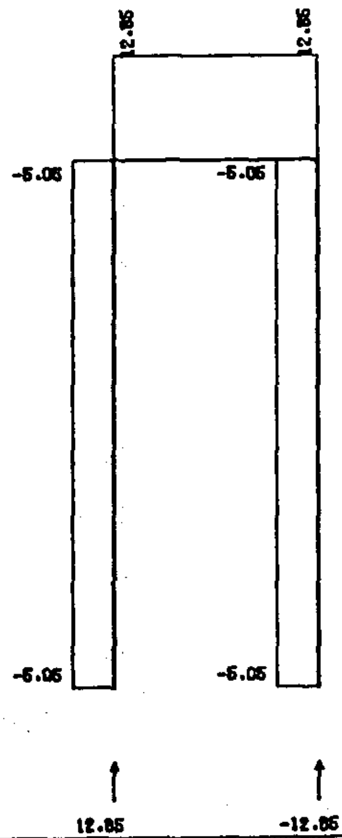
VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2

CASE 5

BENDING MOMENT



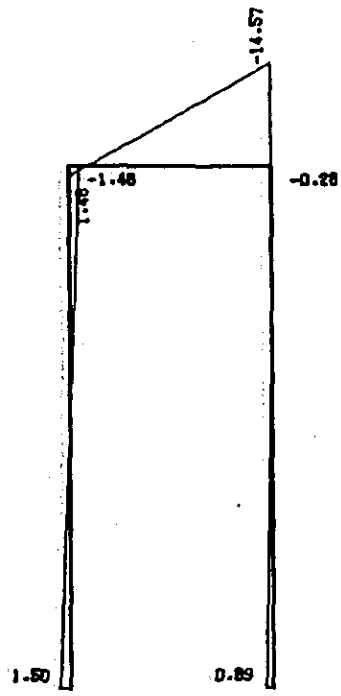
SHEARING FORCE



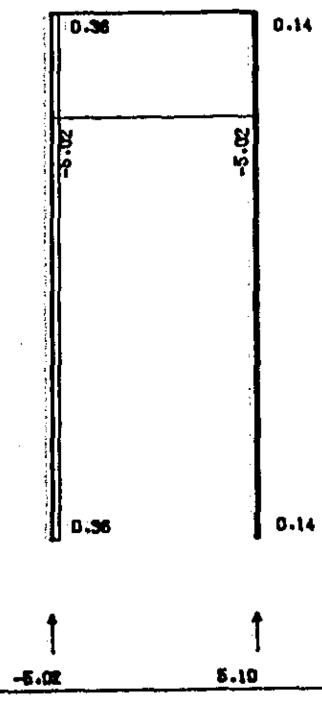
VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2

CASE 6

BENDING MOMENT



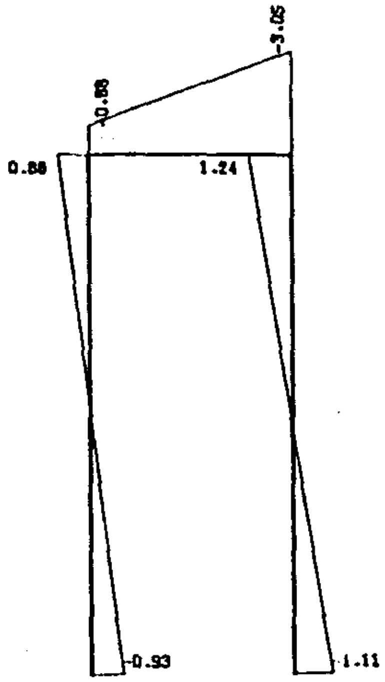
SHEARING FORCE



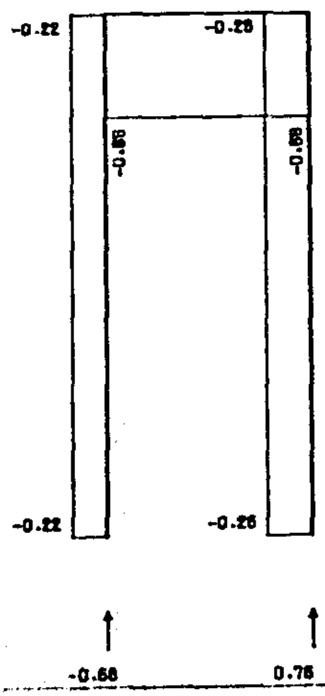
VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2

CASE 7

BENDING MOMENT



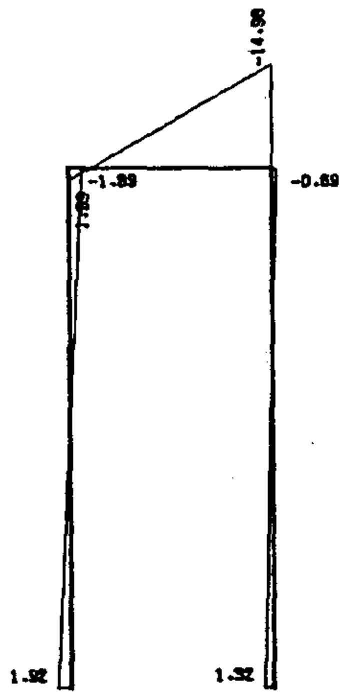
SHEARING FORCE



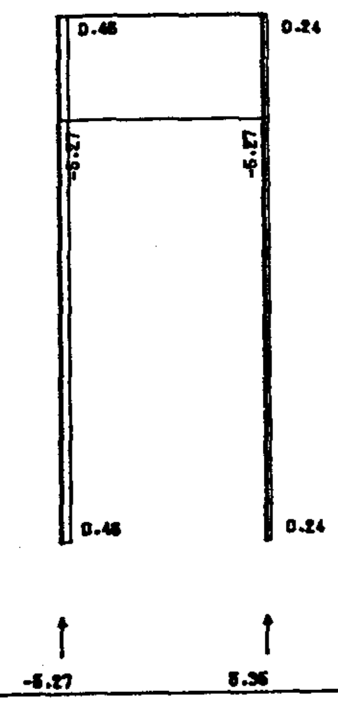
VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2

CASE 8

BENDING MOMENT



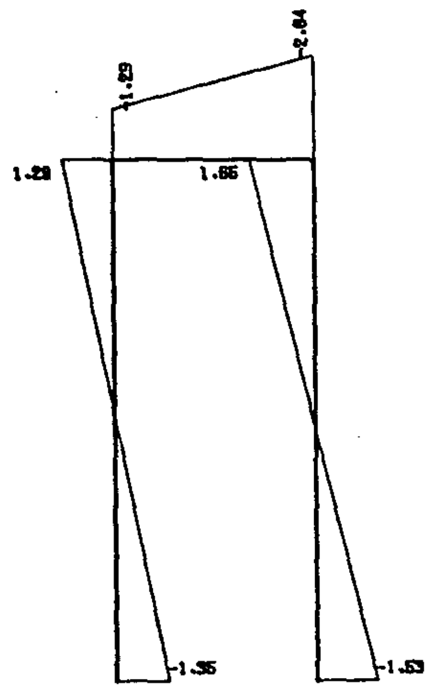
SHEARING FORCE



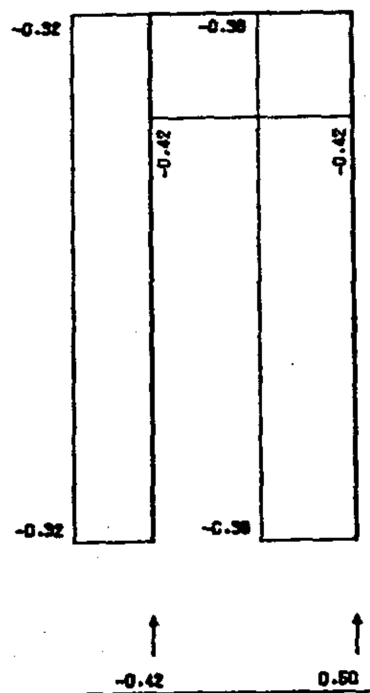
VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2

CASE 9

BENDING MOMENT



SHEARING FORCE



[7] Result of computor analysis

FANSY

PLANE

CRC

CENTURY RESEARCH CENTER CORP.

VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2

V6.3

```
=== INPUT DATA ===                                                              CRC-FANSY   V6.3
      5   10      20       30       40       50       60       70       80    CARD NUMBER
 ...............................................................................
 TITLE      VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2                                    1
 CONTROL        3                                                                       2
 PLOT            1       2                                                              3
 TYPE1-1-1                                                                              4
 L=3.2  H=8.302  M1=2.390,0.09024  M2-3=0.36,0.01080  P1-3=2.7E6  S=0                   5
 POINT     1      0.300     0.725     1.600     2.475     2.900                         6
 PICKUP         1    1    11   15                                                       7
                2    1    16   21                                                       8
                3    1    11   21                                                       9
 LOAD           1D                                                                     10
 J              1                   -47.610     5.920                                  11
                2                   -38.610     5.530                                  12
 L              1    2    -0.980    -0.980                                             13
                2    2    -0.900    -0.900                      3                      14
 D              1  2 2     0.000    -5.600      1.600    -5.600   0.000    1.600       15
 END                                                                                   16
 LOAD           2RI                                                                    17
 J              1                   -31.810   -19.520                                  18
                2                   -31.810    19.520                                  19
 L              1    2   -16.880    -16.880     0.750     0.750                        20
 END                                                                                   21
 LOAD           3C                                                                     22
 J              1         -3.320                                2                      23
 END                                                                                   24
 LOAD           4TC                                                                    25
 T              1            -25                                                       26
 END                                                                                   27
 LOAD           5ED                                                                    28
 J              1         -5.050                                2                      29
 END                                                                                   30
 LOAD           6P   1                                                                 31
 J              2          0.500    -0.080    -14.290                                  32
 END                                                                                   33
 LOAD           7P   2                                                                 34
 J              2         -0.500    -0.080     -4.290                                  35
 END                                                                                   36
 LOAD           8EP  1                                                                 37
 J              2          0.700    -0.080    -14.290                                  38
 END                                                                                   39
 LOAD           9EP  2                                                                 40
 J              2         -0.700    -0.080     -4.290                                  41
 END                                                                                   42
 LOAD           10RS                                                                   43
 MIX                 1  1.176   3                                                      44
 END                                                                                   45
 MT2       11   1.0000    1    2                                                       46
           12   1.0000    1    2    3                                                  47
           13   0.8696    1    4                                                       48
           14   0.8696    1    2    3   10                                             49
           15   0.6667    1    5                                                       50
           16   1.0000    1    2    6                                                  51
           17   1.0000    1    2    3    7                                             52
           18   0.8696    1    2    3    7   10                                        53
           19   0.8696    1    2    6  -10                                             54
           20   0.6667    1   -5    8                                                  55
           21   0.6667    1    5    9                                                  56
  FINISH                                                                               57
```

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3*30) C-2 CRC-FANSY V6.3

CONTROL DATA

METHOD	STRUCTURE	J.RENUMBER	M.RENUMBER	S.F. DIS.	UNI.SPRING	STAN.STIF.	BARA	SKEW MEM.
DIS	*RAHMEN*	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*

LOAD TITLE

```
LOAD  1   CASE  1                                     LOAD  2   CASE  2
LOAD  3   CASE  3                                     LOAD  4   CASE  4
LOAD  5   CASE  5                                     LOAD  6   CASE  6
LOAD  7   CASE  7                                     LOAD  8   CASE  8
LOAD  9   CASE  9

MIX  10   CASE  10 (SYARYOU YOKO KAJYU)               MIX  11   CASE  11 (1+2)
MIX  12   CASE  12 (1+2+3)                            MIX  13   CASE  13 (1+4)
MIX  14   CASE  14 (1+2+3+10)                         MIX  15   CASE  15 (1+5)
MIX  16   CASE  16 (1+2+6)                            MIX  17   CASE  17 (1+2+3+7)
MIX  18   CASE  18 (1+2+3+7+10)                       MIX  19   CASE  19 (1+2+6-10)
MIX  20   CASE  20 (1-5+8)                            MIX  21   CASE  21 (1+5+9)
```

PICK UP LOAD CASE

```
PICK  1     11  12  13  14  15
PICK  2     16  17  18  19  20  21
PICK  3     11  12  13  14  15  16  17  18  19  20  21
```

89

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2 CRC-FANSY V6.3

JOINT DATA

JOINT NUMBER 4

JOINT	X	Y
1	0.0000	8.3020
2	3.2000	8.3020
3	0.0000	0.0000
4	3.2000	0.0000

MEMBER DATA

MEMBER NUMBER 3

MEMBER	ITAN	JTAN	CONNECT. ITAN	JTAN	LENGTH	A	I
1	1	2	FIX	FIX	3.2000	2.39000	.0902400
2	1	3	FIX	FIX	8.3020	.36000	.0108000
3	2	4	FIX	FIX	8.3020	.36000	.0108000

PROPERTY DATA

PROPERTY NUMBER 1

PROPERTY	E	G	EPS
1	2.700E+06	0.	1.000E-05

SUPPORT DATA

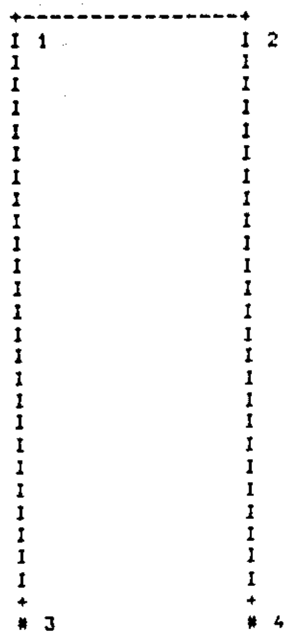
SUPPORT NUMBER 2

SUPPORT	X	Y	THET Z
3	FIX	FIX	FIX
4	FIX	FIX	FIX

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2

CRC-FANSY V6.3

STRUCTURAL FIGURE



TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2 CRC-FANSY V6.3

MOVE DATA

MEMBER	ITAN	JTAN	POINT 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	......	......	.300	.725	1.600	2.475	2.900									
2	......	......														
3	......	......														

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2 CRC-FANSY V6.3

LOAD DATA

	M/J	NAME	D	W1	W2	L1	L2
LOAD - 1		CASE 1					
MEMBER	1	LINEAR	Y	-.980	-.980	0.000	0.000
		LINEAR	Y	0.000	-5.600	0.000	1.600
		LINEAR	Y	-5.600	0.000	1.600	0.000
	2	LINEAR	Y	-.900	-.900	0.000	0.000
	3	LINEAR	Y	-.900	-.900	0.000	0.000
JOINT	1	JOINTLOAD	Y	-47.610			
		JOINTLOAD	Z	5.920			
	2	JOINTLOAD	Y	-38.610			
		JOINTLOAD	Z	5.530			
LOAD - 2		CASE 2					
MEMBER	1	LINEAR	Y	-16.880	-16.880	.750	.750
JOINT	1	JOINTLOAD	Y	-31.810			
		JOINTLOAD	Z	-19.520			
	2	JOINTLOAD	Y	-31.810			
		JOINTLOAD	Z	19.520			
LOAD - 3		CASE 3					
JOINT	1	JOINTLOAD	X	-3.320			
	2	JOINTLOAD	X	-3.320			
LOAD - 4		CASE 4					
MEMBER	1	TEMP		-25.0(DO)			
LOAD - 5		CASE 5					
JOINT	1	JOINTLOAD	X	-5.050			
	2	JOINTLOAD	X	-5.050			
LOAD - 6		CASE 6					
JOINT	2	JOINTLOAD	X	.500			
		JOINTLOAD	Y	-.080			
		JOINTLOAD	Z	-14.290			
LOAD - 7		CASE 7					
JOINT	2	JOINTLOAD	X	-.500			
		JOINTLOAD	Y	-.080			
		JOINTLOAD	Z	-4.290			
LOAD - 8		CASE 8					
JOINT	2	JOINTLOAD	X	.700			
		JOINTLOAD	Y	-.080			
		JOINTLOAD	Z	-14.290			
LOAD - 9		CASE 9					

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2 CRC-FANSY V6.3

LOAD DATA

	M/J	NAME	D	W1	W2	L1	L2
JOINT	2	JOINTLOAD	X	-.700			
		JOINTLOAD	Y	-.080			
		JOINTLOAD	Z	-4.290			

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2 CRC-FANSY V6.3

MIX DATA

MIX NUMBER 12

LOAD	SS	N	S1	K1	S2	K2	S3	K3	S4	K4	S5	K5	S6	K6	S7	K7	S8	K8
10	1.0000	1	1.1760	3														
11	1.0000	2	1.0000	1	1.0000	2												
12	1.0000	3	1.0000	1	1.0000	2	1.0000	3										
13	.8696	2	1.0000	1	1.0000	4												
14	.8696	4	1.0000	1	1.0000	2	1.0000	3	1.0000	10								
15	.6667	2	1.0000	1	1.0000	5												
16	1.0000	3	1.0000	1	1.0000	2	1.0000	6										
17	1.0000	4	1.0000	1	1.0000	2	1.0000	3	1.0000	7								
18	.8696	5	1.0000	1	1.0000	2	1.0000	3	1.0000	7	1.0000	10						
19	.8696	4	1.0000	1	1.0000	2	1.0000	6	-1.0000	10								
20	.6667	3	1.0000	1	-1.0000	5	1.0000	8										
21	.6667	3	1.0000	1	1.0000	5	1.0000	9										

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2 CRC-FANSY V6.3

PICK UP 1

MOMENT MAXIMUM

	-----L---	-CASE-	-----M---	-----Q---	-----N---
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(11)	10.958	23.854	-.512
1	.300	(11)	18.055	23.403	-.512
2	.725	(11)	27.773	22.224	-.512
3	1.600	(11)	39.384	3.458	-.512
4	2.475	(14)	43.404	2.677	-.445
5	2.900	(14)	44.304	1.652	-.445
JTAN	3.200	(14)	44.734	1.259	-.445
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(14)	27.878	-6.727	-105.796
JTAN	8.302	(13)	.546	.151	-56.166
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(14)	22.951	-5.837	-59.978
JTAN	8.302	(11)	1.225	.512	-94.830

MOMENT MINIMUM

	-----L---	-CASE-	-----M---	-----Q---	-----N---
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(15)	-17.733	14.906	-.037
1	.300	(15)	-13.301	14.605	-.037
2	.725	(15)	-7.246	13.819	-.037
3	1.600	(15)	3.688	10.874	-.037
4	2.475	(13)	6.399	-.834	.151
5	2.900	(13)	5.808	-1.859	.151
JTAN	3.200	(13)	5.184	-2.252	.151
MAX	2.133	(13)	6.486	.388	.151
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(13)	-.709	.151	-49.668
JTAN	8.302	(14)	-27.973	-6.727	-112.293
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(11)	-3.025	.512	-87.358
JTAN	8.302	(14)	-25.509	-5.837	-66.475

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2 CRC-FANSY V6.3

PICK UP 1

SHEAR MAXIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(14)	-16.052	36.732	-.445
1	.300	(14)	-5.084	36.339	-.445
2	.725	(14)	10.162	35.314	-.445
3	1.600	(14)	34.248	18.996	-.445
4	2.475	(15)	11.784	7.929	-.037
5	2.900	(15)	14.972	7.143	-.037
JTAN	3.200	(15)	17.064	6.842	-.037
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(13)	-.709	.151	-49.668
JTAN	8.302	(13)	.546	.151	-56.166
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(11)	-3.025	.512	-87.358
JTAN	8.302	(11)	1.225	.512	-94.830

SHEAR MINIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(13)	-4.439	8.267	.151
1	.300	(13)	-2.011	7.874	.151
2	.725	(13)	1.137	6.849	.151
3	1.600	(13)	5.619	3.007	.151
4	2.475	(11)	33.825	-15.307	-.512
5	2.900	(11)	27.046	-16.486	-.512
JTAN	3.200	(11)	22.025	-16.938	-.512
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(14)	27.878	-6.727	-105.796
JTAN	8.302	(14)	-27.973	-6.727	-112.293
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(14)	22.951	-5.837	-59.978
JTAN	8.302	(14)	-25.509	-5.837	-66.475

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2 CRC-FANSY V6.3

PICK UP 1

AXIAL MAXIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(13)	-4.439	8.267	.151
1	.300	(13)	-2.011	7.874	.151
2	.725	(13)	1.137	6.849	.151
3	1.600	(13)	5.619	3.007	.151
4	2.475	(13)	6.399	-.834	.151
5	2.900	(13)	5.808	-1.859	.151
JTAN	3.200	(13)	5.184	-2.252	.151
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(15)	13.786	-3.404	-46.648
JTAN	8.302	(15)	-14.472	-3.404	-51.629
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(15)	13.378	-3.330	-18.899
JTAN	8.302	(15)	-14.268	-3.330	-23.881

AXIAL MINIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(12)	-2.561	32.304	-.512
1	.300	(12)	7.071	31.852	-.512
2	.725	(12)	20.380	30.673	-.512
3	1.600	(12)	39.384	11.908	-.512
4	2.475	(12)	41.218	-6.858	-.512
5	2.900	(12)	38.031	-8.037	-.512
JTAN	3.200	(12)	35.544	-8.488	-.512
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(12)	16.161	-3.832	-111.724
JTAN	8.302	(12)	-15.652	-3.832	-119.195
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(11)	-3.025	.512	-87.358
JTAN	8.302	(11)	1.225	.512	-94.830

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2 CRC-FANSY V6.3

PICK UP 2

MOMENT MAXIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(19)	24.646	7.741	-.133
1	.300	(19)	26.916	7.348	-.133
2	.725	(19)	29.840	6.323	-.133
3	1.600	(17)	37.420	11.229	-.729
4	2.475	(18)	41.180	2.087	-.634
5	2.900	(18)	41.830	1.062	-.634
JTAN	3.200	(18)	42.083	.669	-.634
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(18)	28.642	-6.916	-105.206
JTAN	8.302	(20)	15.291	3.636	-30.978
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(18)	24.030	-6.083	-60.638
JTAN	8.302	(19)	16.203	3.963	-95.536

MOMENT MINIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(21)	-18.590	14.624	-.248
1	.300	(21)	-14.243	14.323	-.248
2	.725	(21)	-8.308	13.537	-.248
3	1.600	(20)	-.673	-9.777	.269
4	2.475	(20)	-10.647	-12.722	.269
5	2.900	(20)	-16.236	-13.508	.269
JTAN	3.200	(20)	-20.339	-13.809	.269
MAX	1.422	(21)	.429	11.335	-.248
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(20)	-14.894	3.636	-25.997
JTAN	8.302	(18)	-28.777	-6.916	-111.703
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(19)	-16.697	3.963	-89.039
JTAN	8.302	(18)	-26.471	-6.083	-67.135

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2 CRC-FANBY V6.3

PICK UP 2

SHEAR MAXIMUM

	L	CASE	M	Q	N
* * MEMBER 1 (1 - 2) G * *					
ITAN	0.000	(18)	-16.816	36.142	-.634
1	.300	(18)	-6.025	35.749	-.634
2	.725	(18)	8.970	34.724	-.634
3	1.600	(18)	32.540	18.406	-.634
4	2.475	(21)	10.228	7.646	-.248
5	2.900	(21)	13.295	6.860	-.248
JTAN	3.200	(21)	15.303	6.559	-.248
* * MEMBER 2 (1 - 3) C * *					
ITAN	0.000	(20)	-14.894	3.636	-25.997
JTAN	8.302	(20)	15.291	3.636	-30.978
* * MEMBER 3 (2 - 4) C * *					
ITAN	0.000	(19)	-16.697	3.963	-89.039
JTAN	8.302	(19)	16.203	3.963	-95.536

SHEAR MINIMUM

	L	CASE	M	Q	N
* * MEMBER 1 (1 - 2) G * *					
ITAN	0.000	(20)	10.948	-5.745	.269
1	.300	(20)	9.184	-6.046	.269
2	.725	(20)	6.463	-6.832	.269
3	1.600	(19)	28.559	-9.996	-.133
4	2.475	(19)	12.348	-26.314	-.133
5	2.900	(19)	.927	-27.339	-.133
JTAN	3.200	(19)	-7.341	-27.732	-.133
* * MEMBER 2 (1 - 3) C * *					
ITAN	0.000	(18)	28.642	-6.916	-105.206
JTAN	8.302	(18)	-28.777	-6.916	-111.703
* * MEMBER 3 (2 - 4) C * *					
ITAN	0.000	(18)	24.030	-6.083	-60.638
JTAN	8.302	(18)	-26.471	-6.083	-67.135

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2 CRC-FANSY V6.3

PICK UP 2

	AXIAL MAXIMUM						AXIAL MINIMUM				
	L	CASE	M	Q	N		L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =						= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(20)	10.948	-5.745	.269	ITAN	0.000	(17)	-3.439	31.625	-.729
1	.300	(20)	9.184	-6.046	.269	1	.300	(17)	5.989	31.174	-.729
2	.725	(20)	6.463	-6.832	.269	2	.725	(17)	19.010	29.995	-.729
3	1.600	(20)	-.673	-9.777	.269	3	1.600	(17)	37.420	11.229	-.729
4	2.475	(20)	-10.647	-12.722	.269	4	2.475	(17)	38.661	-7.536	-.729
5	2.900	(20)	-16.236	-13.508	.269	5	2.900	(17)	35.185	-8.715	-.729
JTAN	3.200	(20)	-20.339	-13.609	.269	JTAN	3.200	(17)	32.495	-9.167	-.729
= = MEMBER 2 (1 - 3) C = =						= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(20)	-14.894	3.636	-25.997	ITAN	0.000	(17)	17.039	-4.049	-111.045
JTAN	8.302	(20)	15.291	3.636	-30.978	JTAN	8.302	(17)	-16.577	-4.049	-118.517
= = MEMBER 3 (2 - 4) C = =						= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(21)	14.476	-3.585	-19.235	ITAN	0.000	(16)	-3.303	.653	-92.454
JTAN	8.302	(21)	-15.287	-3.585	-24.217	JTAN	8.302	(16)	2.117	.653	-99.926

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2 CRC-FANSY V6.3

PICK UP 3

	MOMENT MAXIMUM						MOMENT MINIMUM				
	-----L---	-CASE-	-----M---	-----Q---	-----N---		-----L---	-CASE-	-----M---	-----Q---	-----N---
= = MEMBER	1 (	1 - 2) G	= =			= = MEMBER	1 (	1 - 2) G	= =		
ITAN	0.000	(19)	24.646	7.741	-.133	ITAN	0.000	(21)	-18.590	14.624	-.248
1	.300	(19)	26.916	7.348	-.133	1	.300	(21)	-14.243	14.323	-.248
2	.725	(19)	29.840	6.323	-.133	2	.725	(21)	-8.308	13.537	-.248
3	1.600	(11)	39.384	3.458	-.512	3	1.600	(20)	-.673	-9.777	.269
4	2.475	(14)	43.404	2.677	-.445	4	2.475	(20)	-10.647	-12.722	.269
5	2.900	(14)	44.304	1.652	-.445	5	2.900	(20)	-16.236	-13.508	.269
JTAN	3.200	(14)	44.734	1.259	-.445	JTAN	3.200	(20)	-20.339	-13.809	.269
						MAX	1.422	(21)	.429	11.335	-.248
= = MEMBER	2 (	1 - 3) C	= =			= = MEMBER	2 (	1 - 3) C	= =		
ITAN	0.000	(18)	28.642	-6.916	-105.206	ITAN	0.000	(20)	-14.894	3.636	-25.997
JTAN	8.302	(20)	15.291	3.636	-30.978	JTAN	8.302	(18)	-28.777	-6.916	-111.703
= = MEMBER	3 (	2 - 4) C	= =			= = MEMBER	3 (	2 - 4) C	= =		
ITAN	0.000	(18)	24.030	-6.083	-60.638	ITAN	0.000	(19)	-16.697	3.963	-89.039
JTAN	8.302	(19)	16.203	3.963	-95.536	JTAN	8.302	(18)	-26.471	-6.083	-67.135

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2　　　CRC-FANSY V6.3

PICK UP 3

SHEAR MAXIMUM

	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(14)	-16.052	36.732	-.445
1	.300	(14)	-5.084	36.339	-.445
2	.725	(14)	10.162	35.314	-.445
3	1.600	(14)	34.248	18.996	-.445
4	2.475	(15)	11.784	7.929	-.037
5	2.900	(15)	14.972	7.143	-.037
JTAN	3.200	(15)	17.064	6.842	-.037
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(20)	-14.894	3.636	-25.997
JTAN	8.302	(20)	15.291	3.636	-30.978
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(19)	-16.697	3.963	-89.039
JTAN	8.302	(19)	16.203	3.963	-95.536

SHEAR MINIMUM

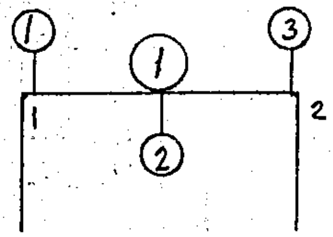
	L	CASE	M	Q	N
= = MEMBER 1 (1 - 2) G = =					
ITAN	0.000	(20)	10.948	-5.745	.269
1	.300	(20)	9.184	-6.046	.269
2	.725	(20)	6.463	-6.832	.269
3	1.600	(19)	28.559	-9.996	-.133
4	2.475	(19)	12.348	-26.314	-.133
5	2.900	(19)	.927	-27.339	-.133
JTAN	3.200	(19)	-7.341	-27.732	-.133
= = MEMBER 2 (1 - 3) C = =					
ITAN	0.000	(18)	28.642	-6.916	-105.206
JTAN	8.302	(18)	-28.777	-6.916	-111.703
= = MEMBER 3 (2 - 4) C = =					
ITAN	0.000	(18)	24.030	-6.083	-60.638
JTAN	8.302	(18)	-26.471	-6.083	-67.135

TITLE..VIADUCT OF SINGLE TRACK (3+3*8+3=30) C-2 CRC-FANSY V6.3

PICK UP 3

	AXIAL MAXIMUM					AXIAL MINIMUM				
	-----L---	-CASE-	-----M---	-----Q---	-----N---	-----L---	-CASE-	-----M---	-----Q---	-----N---
= = MEMBER 1 (1 - 2) G = =										
ITAN	0.000	(20)	10.948	-5.745	.269	0.000	(17)	-3.439	31.625	-.729
1	.300	(20)	9.184	-6.046	.269	.300	(17)	5.989	31.174	-.729
2	.725	(20)	6.463	-6.832	.269	.725	(17)	19.010	29.995	-.729
3	1.600	(20)	-.673	-9.777	.269	1.600	(17)	37.420	11.229	-.729
4	2.475	(20)	-10.647	-12.722	.269	2.475	(17)	38.661	-7.536	-.729
5	2.900	(20)	-16.236	-13.508	.269	2.900	(17)	35.185	-8.715	-.729
JTAN	3.200	(20)	-20.339	-13.809	.269	3.200	(17)	32.495	-9.167	-.729
= = MEMBER 2 (1 - 3) C = =										
ITAN	0.000	(20)	-14.894	3.636	-25.997	0.000	(12)	16.161	-3.832	-111.724
JTAN	8.302	(20)	15.291	3.636	-30.978	8.302	(12)	-15.652	-3.832	-119.195
= = MEMBER 3 (2 - 4) C = =										
ITAN	0.000	(15)	13.378	-3.330	-18.899	0.000	(16)	-3.303	.653	-92.454
JTAN	8.302	(15)	-14.268	-3.330	-23.881	8.302	(16)	2.117	.653	-99.926

[8] Calculation of upper beam



1 Calculation of compressive stress caused by bending

(1) Summary of stress

(a) At the support point

		①			
		①	CASE	③	CASE
Combined stress	Top.	-18.59	21	-20.34	20
	Bottom	24.65	19	44.73	14
Dead load		-6.04	1	5.03	1

(b) Span moment

		①			
		②	CASE		
Combined stress	Bottom	39.38	11		

(2) Allowable stress of upper beam

. Safe against cracking

$$\alpha = \frac{M_L}{\Sigma M} \qquad \alpha \geqq 0.25 \cdots\cdots \sigma_{sa} = 1000 \ kg/cm^2$$
$$\alpha < 0.25 \cdots\cdots \sigma_{sa} = 1200 \ "$$

At the support point 1, 2

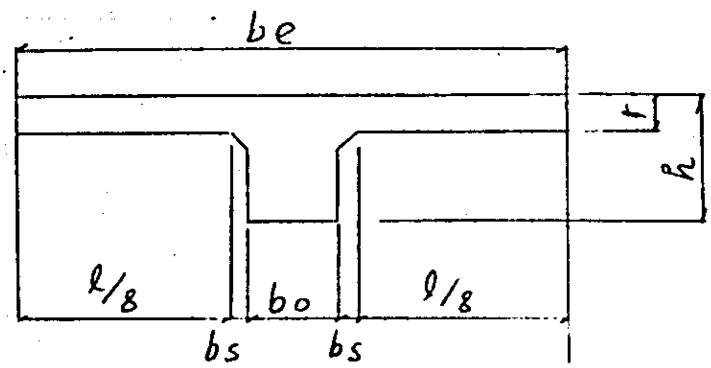
Dead load $M_d = -6.04^{t \cdot m}$ (Case 1)

Train load + Impact $M_L = 16.99^{t \cdot m}$ (Case 2)

From the above, allowable stress is determined as follows.

$\sigma_{sa} = 1200 \ kg/cm^2$

Effective with of T- beam compression fibre



$$be = bo + 2\left(bs + \frac{1}{8}\,l\right)$$

$$= 0.60 + 2\left(0.1 + \frac{1}{8} \times 0.6 \times 3.2\right)$$

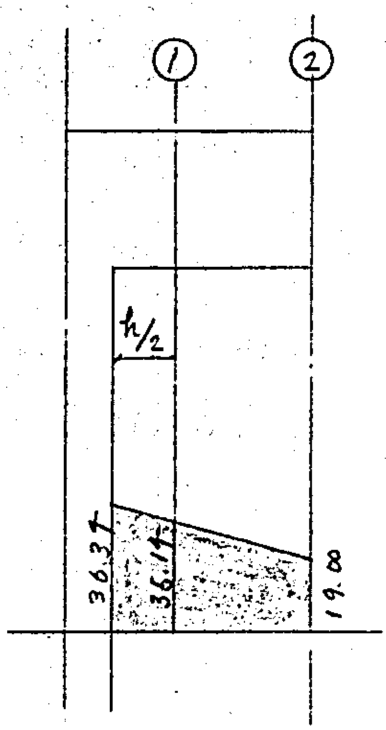
$$= 1.28^{m} < 8.0^{m}$$

Calculation of bending stress

	Top side	Bottom side	
M (tm)	-20.34	49.73	
N (t)			
~~S~~ B (t)		128	
b (cm)	60	60	
h (cm)	85	85	
d (cm)	77.4	76.9	
d' (t) (cm)	7.6	8.1 (25)	
As (cm²)	D25-4 =20.27	D25-8 =40.54	
p	0.00436	0.00412	
As' (cm²)			
p'			
e=M/N (cm)		x = 22.78 (cm)	
e=M/N+u (cm)			
e=M/N−u (cm)			
e/h			
d/e			
d'/h			
d'/d			
Ne/bd² (kg/cm²)	5.659	5.909	
k			
c			
j			
1/Lc	7.36	7.52	
1/Ls	255	269	
β=σs/σc			
σc (kg/cm²)	41.6	44.4	
σs (kg/cm²)	1440	1590	
τ (kg/cm²)			
σsa (kg/cm²)	1800	1800	
σca (kg/cm²)	90	90	
τa (kg/cm²)			
	D+S+EP	D+T+I+C+TL	

2 Calculation of shearing stress

(1) Shearing stress caused by bending



Case 17

$$\tau = \frac{S}{b \cdot d}$$

$$\tau_1 = \frac{35.17 \times 10^3}{60 \times 76.9} = 7.62\ kg/cm^2 > 3.9\ kg/cm^2$$

$$\tau_2 = \frac{19.00 \times 10^3}{60 \times 76.9} = 4.12\ " > 3.9\ "$$

(2) Calculation of diagonal Tension re-bars

(a) Calculation of resisting shearing force

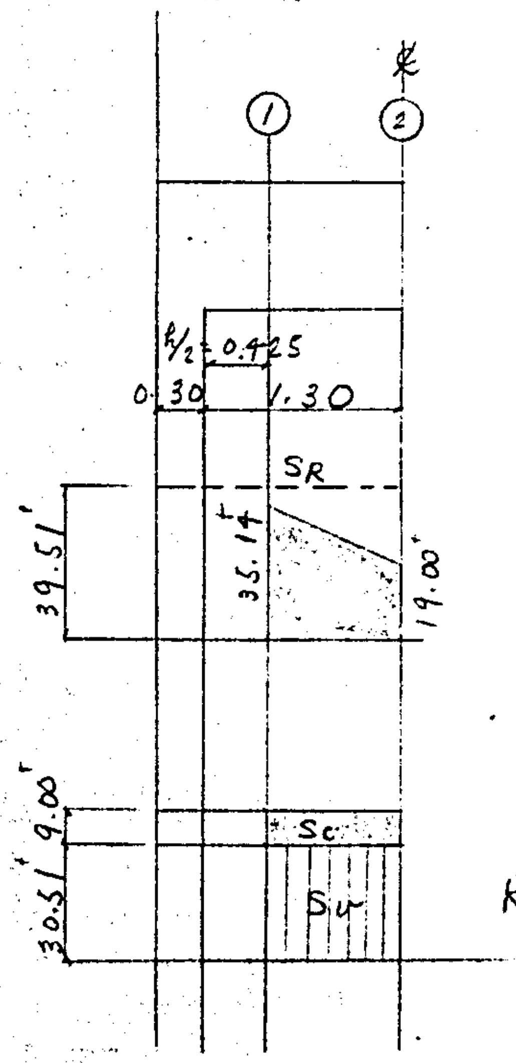
$$\Sigma S_R = S_c + S_v + S_b$$

Where

S_c ; Shearing force beared by concrete (t)

S_v ; shearing force beared by stirrups (t)

S_b ; Shearing force beared by turned up bar (t)



Shearing force diagram

Resitance shearing force diagram

(b) Shearing force beared by concrete

$S_c = 1/2 \times \tau_a \times b \times d$

where,

τ_a : $\sigma_{ck} = 240 \, kg/cm^2$ $\tau_a = 3.90 \, kg/cm^2$

b : Width of cross section of member (cm)

d : Effective height of member

$S_c = 1/2 \times 3.9 \times 60 \times 76.9 \times 10^{-3} = 9.00^t$

(c) Shearing force beared by stirrups

$$S_v = \frac{A_v \cdot \sigma_{sa} \times d}{1.15 \times s}$$

where;

A_v : Total cross section area of stirrups within the section s (cm^2)

σ_{sa} : Allowable tensile stress of bar (kg/cm^2)

s : Spacing of stirrups in axial direction of member.

$A_v = 1.267 \times 4 = 5.07 \, cm^2$

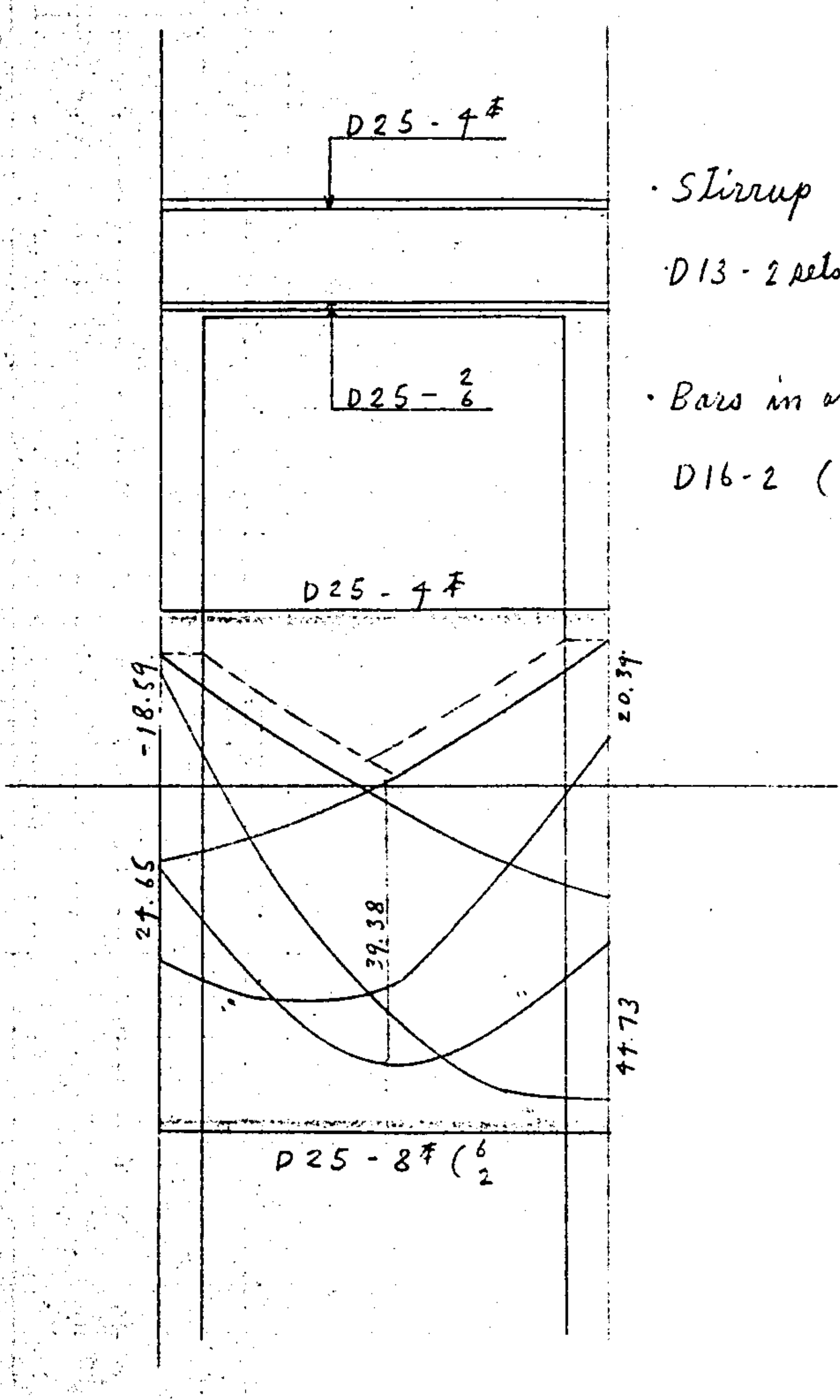
$$S_{v_1} = \frac{5.07 \times 1800 \times 76.9}{1.15 \times 20 \times 10^3} = 30.51^t$$

(d) Total of shearing forces

$\Sigma S_R = S_c + S_v + S_b$

$= 9.00 + 30.51 + 0 = 39.51^t > S = 35.14^t$

Resisting moment diagram



· Stirrup

D13 - 2 sets 20(cm) ctc

· Bars in axial direction

D16 - 2 (one side)

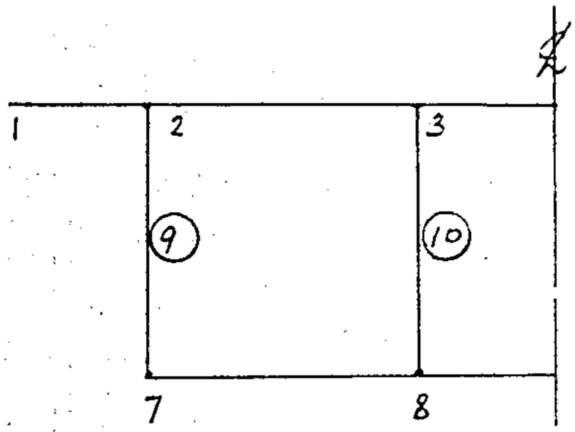
(9) Calculation of support of electric pole

M (tm)	14.29	
N (t)		
S (t)		
b (cm)	75	
h (cm)	90	(Note)
d (cm)	82.4	Moment of electric pole beam ;
d' (cm)	7.6	
As (cm²)	D25-5 = 25.335	Referred to the calculation of load (Load of electric pole, support of electric pole
p	0.00410	and Ralated installations)
As' (cm²)		
p'		
e=M/N (cm)		
e=M/N+u (cm)		
e=M/N−u (cm)		
e/h		
d/e		
d'/h		
d'/d		
Ne/bd² (kg/cm²)	2.806	
k		
c		
j		
1/Lc	7.53	
1/Ls	270	
β=σs/σc		
σc (kg/cm²)	21.1	
σs (kg/cm²)	760	
τ (kg/cm²)		
σsa (kg/cm²)	1200	
σca (kg/cm²)	90	
τa (kg/cm²)		
	D+EP	

§6. Calculation of column

(1) Calculation of bending stress

1 Rahmen (Rigid frame) calculation in railway profile

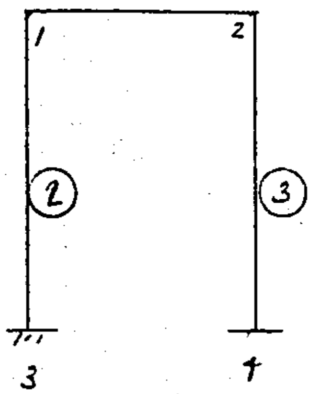


			CASE	M (t·m)	N (t)				CASE	M (t·m)	N (t)
9	2-7	M max	14	16.14	86.01	10	3-8	M max	14	18.73	90.54
		N min	15	15.49	35.73			N min	15	17.02	35.33
	7-2	M max	14	14.95	99.54		8-3	M max	14	17.77	100.26
		N min	15	14.10	41.06			N min	15	16.43	43.25

Stress calculation

	⑨	⑩	
M (tm)	15.49	17.02	
N (t)	35.73	35.33	
S (t)			
b (cm)	60	60	
h (cm)	60	60	
d (cm)			
d' (cm)	6.1	6.1	
As (cm²)	D25-4 =20.268	D25-4 =20.268	
p	0.00563	0.00563	
As' (cm²)	〃	〃	
p'			
e=M/N (cm)	43.35	48.17	
e=M/N+u (cm)			
e=M/N−u (cm)			
e/h			
d/e			
d'/h	0.102	0.102	
d'/d			
Ne/bd² (kg/cm²)			
k	0.435	0.416	
c	0.192	0.174	
j			
1/Lc			
1/Ls			
β=σs/σc			
σc (kg/cm²)	51.7	56.5	
σs (kg/cm²)	830	980	
τ (kg/cm²)			
σsa (kg/cm²)	1800	1800	
σca (kg/cm²)	90	90	
τa (kg/cm²)			
	D+S	D+S	

2. ② ② Rahmen (Rigid frame) calculation in the direction of railway cross section



Member	Section		CASE	M (t·m)	N (t)
②	1-3	M max	18	28.64	105.21
		N min	20	15.29	30.98
	3-1	M max	18	28.78	111.70
		N min	20	15.29	30.98
③	2-4	M max	18	29.03	60.64
		N min	15	13.38	18.90
	4-2	M max	18	26.47	67.14
		N min	15	14.27	23.88

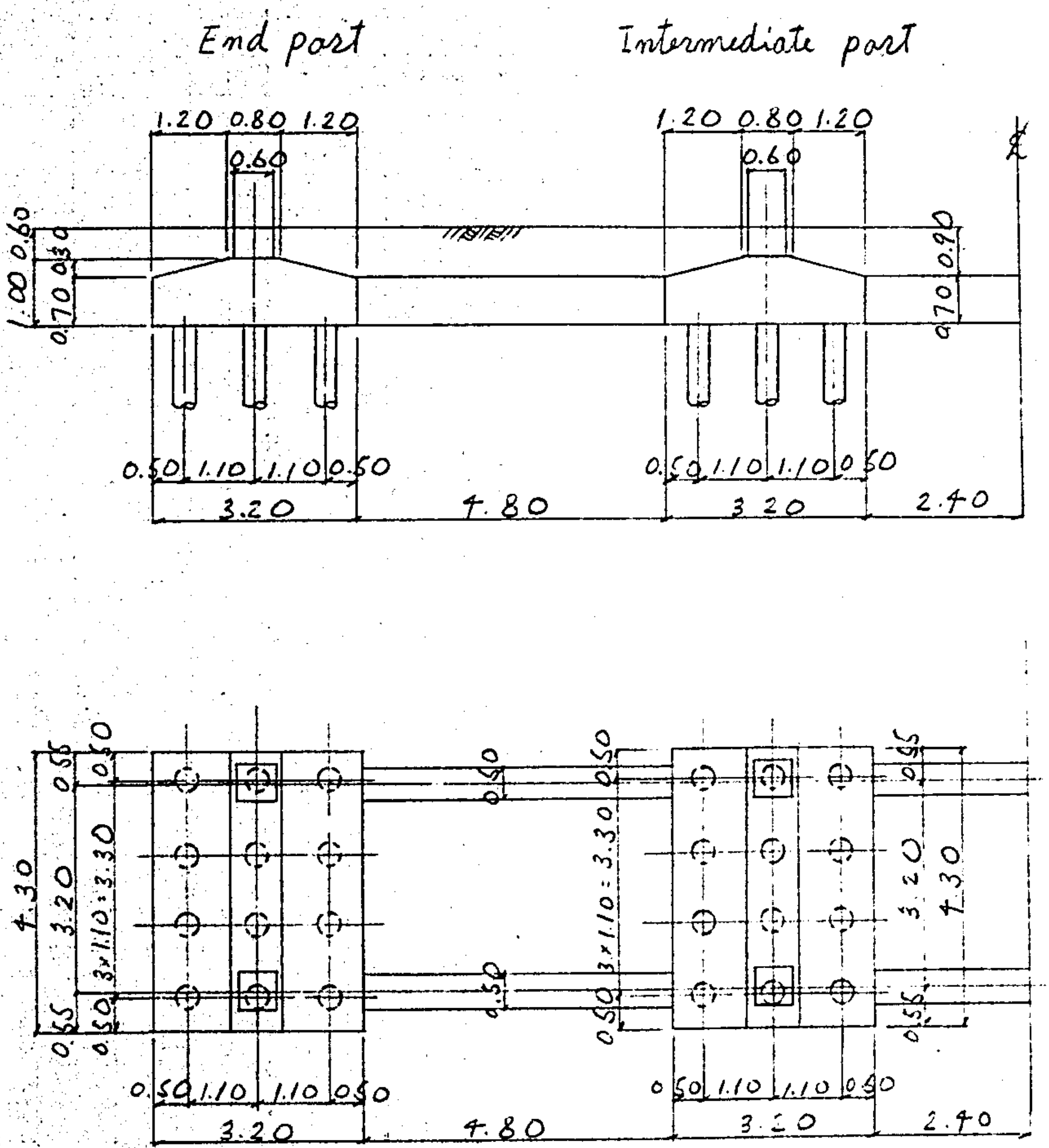
Stress calculation

	②	②	③	
M (tm)	28.64	28.78	26.47	
N (t)	105.21	111.70	67.14	
S (t)				
b (cm)	60	60	60	
h (cm)	60	60	60	
d (cm)				
d' (cm)	6.1	6.1	6.1	
As (cm^2)	D25-6 = 30.402	D25-6 = 30.402	D25-6 = 30.402	
p	0.00845	0.00845	0.00845	
As' (cm^2)	"	"	"	
p'				
e=M/N (cm)	27.22	25.77	39.43	
e=M/N+u (cm)				
e=M/N−u (cm)				
e/h				
d/e				
d'/h	0.102	0.102	0.102	
d'/d				
Ne/bd² (kg/cm^2)				
k	0.604	0.624	0.499	
c	0.346	0.362	0.249	
j				
1/Lc				
1/Ls				
β=σs/σc				
σc (kg/cm^2)	84.6	85.7	74.8	
σs (kg/cm^2)	620	570	900	
τ (kg/cm^2)				
σsa (kg/cm^2)	1800	1800	1800	
σca (kg/cm^2)	90	90	90	
τa (kg/cm^2)				
	D+T+I+C+TL	D+T+I+C+TL	D+T+I+C+TL	

§7. Basic criteria for calculation

1 Analysis in direction of railway profile

(1) Configulation and dimension



2) Own weight of footing and buried beam, and weight of earth (column part)

Intermediate part

$N_{F1} = (0.80 + 3.20) \times 1/2 \times 0.30 \times 4.30 \times 2.50^{t/m^3} = 6.45^t$

$N_{F2} = (3.20 \times 0.70 \times 4.30 + 0.50 \times 0.70 \times 2.40 \times 4)$

$\times 2.50^{t/m^3} - 0.90^{t/m} \times 0.65 \times 2 = 31.31^t$

$N_G = \{(1.20 \times 0.30 \times 1/2 \times 2 + 3.20 \times 0.60) \times 430$

$+ 0.50 \times 0.90 \times 240 \times 4 - 0.60 \times 0.60 \times 0.60$

$\times 2)\} \times 1.80^{t/m^3} = 24.65^t$

62.41^t

Horizontal resisting force beared by one pile

Horizontal force at the bottom of column

$H = 5.78 \times 2 \qquad = 11.56$

Footing and buried beam

$H = (6.95 + 31.31) \times \frac{0.70}{2.50} \times 0.10 = 1.06^{t}$

Horizontal force of half portion of column

$H = 0.90 \times 8.227 \times 1/2 \times 2 \times 0.1 \qquad = 0.74^{t}$

$\Sigma H = 11.56 + 1.06 + 0.74 \qquad = 13.36^{t}$

$H = \frac{13.36}{12} = 1.11^{t}$/pile

(3) Supporting power of pile and calculation of footing

*1 Axial load at bottom of column

*2 Weight of footing, buried beam and earth

(a) Ordinary case (Dead load) $\alpha = 1.0$ Case I

$$N = \overset{*1}{62.89} \times 2 + \overset{*2}{62.41} = 188.19^t$$

(b) Ordinary case + Temporary case (D+T+I)

$\alpha = 1.0$ Case II

$$N = \overset{*1}{124.65} \times 2 + \overset{*2}{62.41} = 311.71^t$$

(c) Ordinary case + Temporary case (D+T+I+B)

$\alpha = 1.15$ Case 14

$$N = 115.30 \times 2 + 62.41 = 293.01^t$$

(d) Eerthquake case (D+S) $\alpha = 1.50$ Case 15

$$N = 64.88 \times 2 + 62.41 = 192.17^t$$

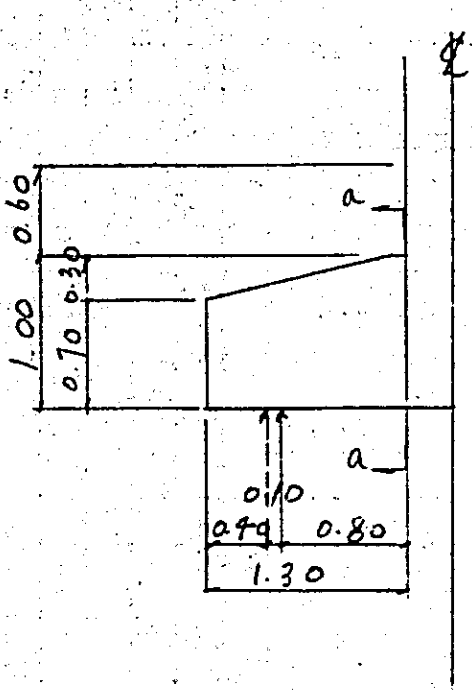
Reaction beared by one pile

$n = 12$

	ΣN (t)	$P = \frac{\Sigma N}{n}$ (t/pile)
D $\alpha = 0.89$	188.19	15.68
D + T + I $\alpha = 1.00$	311.71	25.98
D + T + I + B $\alpha = 1.15$	293.01	24.42
D + S $\alpha = 1.5$	192.17	16.01

(4) Calculation of bending moment

Analysis is made calculated bending moment at the column front



Weight of footing and earth pressure

$W_1 = 2.50^{t/m^3} \times 1.00 + 1.80 \times 0.60$

$= 3.58^{t/m}$

$W_2 = 2.50 \times 0.70 + 1.80 \times 0.90$

$= 3.37$

Reaction of pile

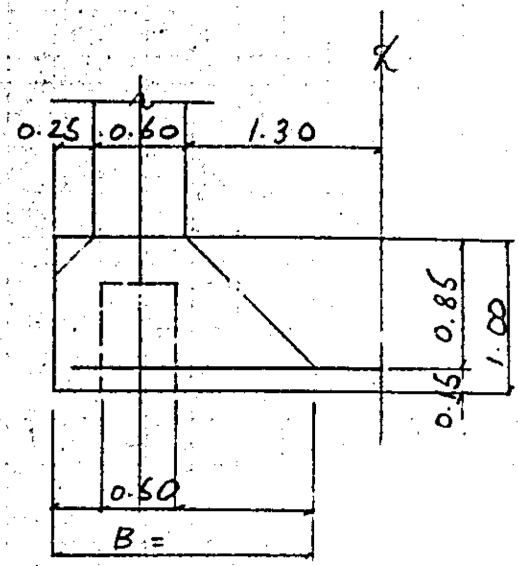
$P = 25.98 \ {}^{t}/\text{pile}$

$M_a = 25.98 \times 0.90 \times 4 - 1/6\,(2 \times 3.38 + 3.58)$

$\times 1.30^2 \times 4.30$

$= 93.53 - 12.52 \quad = 81.01^{t.m}$

Effective width



$$B = 0.25 + 0.60 + 0.85 = 1.70^{m}$$

Effective width

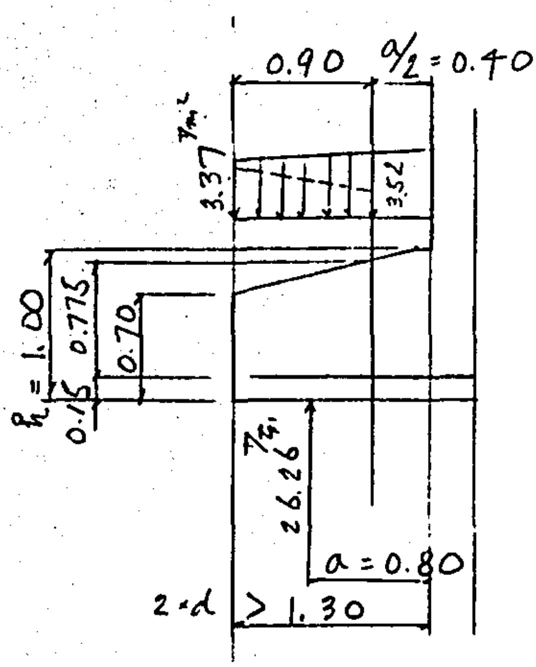
$$B_0 = 1.70 - 0.60 = 1.20^{m}$$

Bending moment per unit one meter

$$M = \frac{81.01}{1.20} = 67.51^{t \cdot m}$$

	Bottom side	
M (tm)	67.51	
N (t)		
S (t)		
b (cm)	100	
h (cm)	100	
d (cm)	85	
d' (cm)	15	
As (cm²)	D32 - 15 cm/cm = 52.946	
p	0.00623	
As' (cm²)		
p'		
e=M/N (cm)		
e=M/N+u (cm)		
e=M/N−u (cm)		
e/h		
d/e		
d'/h		
d'/d		
Ne/bd² (kg/cm²)	9.394	
k		
c		
j		
1/Lc	6.49	
1/Ls	182	
β=σs/σc		
σc (kg/cm²)	60.6	
σs (kg/cm²)	1700	
τ (kg/cm²)		
σsa (kg/cm²)	1800	
σca (kg/cm²)	90	
τa (kg/cm²)		
	D+L+I	

(5) Calculation of shearing force caused by bending



$a = 0.8 < 2h = 2.0$

a/2 point

Considered the full with

$$\Gamma_0 = \frac{2}{\left(\frac{0.4}{0.775}\right)} = 3.88 < 4.0$$

$$\Gamma_1 = \frac{2}{\left(\frac{1.3}{0.775}\right)} = 1.19 < 4.0$$

$$q_0' = \frac{3.50}{3.88} = 0.90^{t/m}$$

$$q_1' = \frac{3.37}{1.19} = 2.83$$

Considered the full width (pile)

$$\Gamma = \frac{2}{\left(\frac{0.8}{0.775}\right)} = 1.938 < 4.0$$

$$P' = \frac{25.98}{1.938} = 13.41^{t/pile}$$

Shearing force

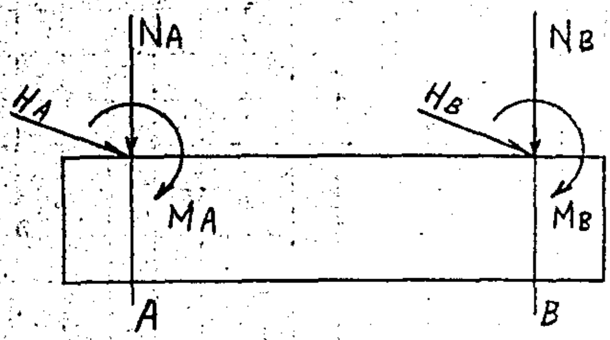
$$S = \{13.41 \times 4 - (0.90 + 2.83) \times 1/2 \times 0.8 \times 4.3\} \times 1/4.3$$

$$= (53.64 - 6.42) \times 1/4.3 = 10.98^{t}$$

$$\tau = \frac{10.98 \times 10^3}{100 \times 77.5} = 1.42\ kg/cm^2 < 3.9\ kg/cm^2$$

2. Analysis in the direction of railway cross section

stress at the bottom of column



CASE	Combination of loads			A	B
1	D	$\alpha = 1.00$	M	-0.35	-0.04
			N	72.68	60.04
		case 1	H	-0.06	0.06
2	D+T+L	$\alpha = 1.00$	M	-15.65	-3.83
			N	127.29	97.75
		case 12	H	-3.83	-2.81
3	D+T+I+C+TL	$\alpha = 1.15$	M	-32.17	-29.34
			N	137.23	87.82
		case 14	H	-7.79	-6.72
4	T+S	$\alpha = 1.50$	M	22.94	22.64
			N	54.56	78.25
		case 20	H	5.46	5.34

Load of eletric pole $N = 3.28^{t}$ (B side)

Weight of buried beam, earth

$$N = (2.50^{t/m^3} \times 0.5 \times 0.70 + 1.80^{t/m^3} \times 0.50 \times 0.9) \times 4.80 \times 1/2 \times 2 = 8.09^{t}$$

** INPUT DATA **

1) KIHON DATA *Basic data*

HASHIRA HONSU= 2 (HON)   KUI RETSUSU= 4 (RETSU)   CASE SU= 4 (CASE)

NA= 20.000 (T)   GANMA 1= 2.500 (T/M**3)   GANMA 2= 1.800 (T/M**3)

2) FOOTING SUNPOU (M)

L1= 0.000	L2= 4.300	L3= 0.000
B1= 1.200	B2= .800	B3= 1.200
H1= .700	H2= .300	H3= .600

3) HASHIRA KYORI OYOBI DANMENSUNPOU (M)

HASHIRA NO.	CL	A	B	HASHIRA NO.	CL	A	B
1	.550	.600	.600	2	3.750	.600	.600

4) KUI KYORI OYOBI HONSU (M) (HON)

KUI RETSU NO.	KL	NN	KUI RETSU NO.	KL	NN
1	.500	3	3	2.700	3
2	1.600	3	4	3.800	3

5) CASE DATA KH;ALPHA;BETA;HW HASHIRA KATAN NO ORYOKU (M) (TM) (T)

CASE 1 KH= 0.000 ALPHA= 1.0000 BETA= .246000 HW= 0.000 D

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-.350	72.680	-.060	2	-.040	60.040	.060

CASE 2 KH= 0.000 ALPHA= 1.0000 BETA= .298000 HW= 0.000 D+T+I-C

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-15.650	127.290	-3.830	2	-3.830	97.750	-2.810

CASE 3 KH= 0.000 ALPHA= 1.1500 BETA= .298000 HW= 0.000 D+T+I-C-TL

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-32.170	137.230	-7.740	2	-29.340	87.820	-6.720

CASE 4 KH= .028 ALPHA= 1.5000 BETA= .298000 HW= 0.000 D+S

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	22.940	54.560	5.460	2	22.640	78.250	5.340

FOOTING Calculation of stability (Supporting power of pile). PAGE

* CASE 1- 1 * (JYOUJI) NO 5 D (Ordinary) (DELTA N NASI)

1) HASHIRA KATAN ORYOKU (TM) (T)

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-.350	72.680	-.060	2	-.040	60.040	.060

2) FOOTING KAMEN ORYOKU (TM) (T) (M)

MO= 366.643 NO= 180.120 HO= 0.000 EO= 2.036 E= -.114

3) FOOTING JIJU OYOBI JUSINDAKASA (T) (M)

NF1= 24.080 NF2= 6.450 NG= 16.870 GH= .449

4) KUI HANRYOKU (T)

SKN= 12 SIG KN= 12 PH = 0.000 KL = 2.150 I= 18.150 KE = -.114

P 1= 16.884 (Max) P 2= 15.635 P 3= 14.385 P 4= 13.136 (Min)

* CASE 3- 1 * (JYOUJI) NO 7 D+T+I-C-TL (Ordinary + Temporary) (DELTA N NASI)

1) HASHIRA KATAN ORYOKU (TM) (T)

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-32.170	137.230	-7.740	2	-29.340	87.820	-6.720

2) FOOTING KAMEN ORYOKU (TM) (T) (M)

MO= 430.741 NO= 272.450 HO= -14.460 EO= 1.581 E= -.569

3) FOOTING JIJU OYOBI JUSINDAKASA (T) (M)

NF1= 24.080 NF2= 6.450 NG= 16.870 GH= .449

4) KUI HANRYOKU (T)

SKN= 12 SIG KN= 12 PH = -1.205 KL = 2.150 I= 18.150 KE = -.569

P 1= 35.797 (Max) P 2= 27.402 P 3= 18.006 P 4= 8.611 (Min)

* CASE 4- 1 * (JISHINJI--->) NO 8 D+S (Earthquake) (DELTA N NASI)

1) HASHIRA KATAN ORYOKU (TM) (T)

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	22.940	54.560	5.460	2	22.640	78.250	5.340

2) FOOTING KAMEN ORYOKU (TM) (T) (M)

MD= 482.119 ND= 180.210 HD= 11.655 ED= 2.675 E= .525

3) FOOTING JIJU OYOBI JUSINDAKASA (T) (M)

NF1= 24.080 NF2= 6.450 NG= 16.870 GH= .449

4) KUI HANRYOKU (T)

SKN= 12 SIG KN= 12 PH = .971 KL = 2.150 I= 18.150 KE = .525

P 1= 6.411 (Min) P 2= 12.149 P 3= 17.886 P 4= 23.624 (Max)

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* CASE 1- 1 * (JYOUJI) NO 1 D (DELTA N ARI)

1) HASHIRA KATAN ORYOKU (TM) (T)

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-.350	72.680	-.060	2	-.040	60.040	.060

2) FOOTING KAMEN ORYOKU (TM) (T) (M)

MO= 366.643 NO= 180.120 HO= 0.000 EO= 2.036 E= -.114

3) FOOTING JIJU OYOBI JUSINDAKASA (T) (M)

NF1= 24.080 NF2= 6.450 NG= 16.870 GH= .449

4) KUI HANRYOKU (T)

SKN= 12 SIG KN= 12 PH = 0.000 KL = 2.150 I= 18.150 KE = -.114

P 1= 16.884 P 2= 15.635 P 3= 14.385 P 4= 13.136

* CASE 1- 1 * (JYOUJI) NO 1 D (DELTA N ARI)

5) FOOTING KAKUTEN MOMENT OYOBI SENDANRYOKU (M) (TM) (T)

DISTANCE	MOMENT	SENDAN	M/ALPHA	S/ALPHA
.250*	-.350	-2.801	-.350	-2.801
.500	-1.380	-5.440	-1.380	-5.440
	-1.380	45.212	-1.380	45.212
.550**	.867	44.684	.867	44.684
	.484	-27.996	.484	-27.996
.850*	-8.390	-31.163	-8.390	-31.163
1.600	-34.913	-39.566	-34.913	-39.566
	-34.913	7.338	-34.913	7.338
2.150)	-32.571	1.176	-32.571	1.176
2.700	-33.619	-4.986	-33.619	-4.986
	-33.619	38.170	-33.619	38.170
3.450*	-8.143	29.767	-8.143	29.767
3.750**	.312	26.600	.312	26.600
	.305	-33.440	.305	-33.440
3.800	-1.380	-33.968	-1.380	-33.968
	-1.380	5.440	-1.380	5.440
4.050*	-.350	2.801	-.350	2.801

* CASE 2- 1 * (JYOUJI) NO 2 D+T+I-C (DELTA N ARI)

1) HASHIRA KATAN ORYOKU (TM) (T)

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-15.650	127.290	-3.830	2	-3.830	97.750	-2.810

2) FOOTING KAMEN ORYOKU (TM) (T) (M)

MO= 512.361 NO= 272.440 HO= -6.640 EO= 1.881 E= -.269

3) FOOTING JIJU OYOBI JUSINDAKASA (T) (M)

NF1= 24.080 NF2= 6.450 NG= 16.870 GH= .449

4) KUI HANRYOKU (T)

SKN= 12 SIG KN= 12 PH = -.553 KL = 2.150 I= 18.150 KE = -.269

P 1= 30.387 P 2= 25.265 P 3= 20.142 P 4= 15.019

* CASE 2- 1 * (JYOUJI) NO 2 D+T+I-C (DELTA N ARI

5) FOOTING KAKUTEN MOMENT OYOBI SENDANRYOKU (M) (TM) (T)

DISTANCE	MOMENT	SENDAN	M/ALPHA	S/ALPHA
.250*	-.350	-2.801	-.350	-2.801
.500	-1.380	-5.440	-1.380	-5.440
	-4.911	85.722	-4.911	85.722
.550**	-.638	85.194	-.638	85.194
	-18.398	-42.096	-18.398	-42.096
.850*	-31.501	-45.262	-31.501	-45.262
1.600	-68.599	-53.665	-68.599	-53.665
	-72.130	22.129	-69.130	22.129
2.150)	-61.654	15.966	-61.654	15.966
2.700	-54.567	9.804	-54.567	9.804
	-58.098	70.230	-58.098	70.230
3.450*	-8.577	61.827	-8.577	61.827
3.750**	9.496	58.660	9.496	58.660
	4.119	-39.090	4.119	-39.090
3.800	2.151	-39.618	2.151	-39.618
	-1.380	5.440	-1.380	5.440
4.050*	-.350	2.801	-.350	2.801

* CASE 3- 1 * (JYOUJI) NO 3 D+T+I-C-TL (DELTA N ARI)

1) HASHIRA KATAN ORYOKU (TM) (T)

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	-32.170	137.230	-7.740	2	-29.340	87.820	-6.720

2) FOOTING KAMEN ORYOKU (TM) (T) (M)

MO= 430.741 NO= 272.450 HO= -14.460 EO= 1.581 E= -.569

3) FOOTING JIJU OYOBI JUSINDAKASA (T) (M)

NF1= 24.080 NF2= 6.450 NG= 16.870 GH= .449

4) KUI HANRYOKU (T)

SKN= 12 SIG KN= 12 PH = -1.205 KL = 2.150 I= 18.150 KE = -.569

P 1= 39.003 P 2= 28.137 P 3= 17.271 P 4= 6.405

* CASE 3- 1 * (JYOUJI) NO 3 D+T+I-C-TL (DELTA N ARI)

5) FOOTING KAKUTEN MOMENT OYOBI SENDANRYOKU (M) (TM) (T)

DISTANCE	MOMENT	SENDAN	M/ALPHA	S/ALPHA
.250*	-.350	-2.801	-.304	-2.436
.500	-1.380	-5.440	-1.200	-4.730
	-9.070	111.569	-7.887	97.017
.550**	-3.505	111.041	-3.048	96.558
	-39.937	-26.189	-34.728	-22.773
.850*	-48.269	-29.356	-41.973	-25.527
1.600	-73.437	-37.759	-63.858	-32.834
	-81.126	46.653	-70.544	40.568
2.150)	-57.162	40.491	-49.706	35.209
2.700	-36.587	34.328	-31.814	29.851
	-44.276	86.142	-38.501	74.906
3.450*	17.179	77.739	14.938	67.599
3.750**	40.026	74.572	34.805	64.845
	6.985	-13.248	6.074	-11.520
3.800	6.309	-13.776	5.486	-11.979
	-1.380	5.440	-1.200	4.730
4.050*	-.350	2.801	-.304	2.436

* CASE 4- 1 * (JISHINJI--->) NO 4 D+S (DELTA N ARI)

1) HASHIRA KATAN ORYOKU (TM) (T)

HASHIRA NO.	M	N	H	HASHIRA NO.	M	N	H
1	22.940	54.560	5.460	2	22.640	78.250	5.340

2) FOOTING KAMEN ORYOKU (TM) (T) (M)

MO= 482.119 NO= 180.210 HO= 11.655 EO= 2.675 E= .525

3) FOOTING JIJU OYOBI JUSINDAKASA (T) (M)

NF1= 24.080 NF2= 6.450 NG= 16.870 GH= .449

4) KUI HANRYOKU (T)

SKN= 12 SIG KN= 12 PH = .971 KL = 2.150 I= 18.150 KE = .525

P 1= 4.634 P 2= 11.556 P 3= 18.479 P 4= 25.401

* CASE 4- 1 *   (JISHINJI--->)   NO 4   D+S   (DELTA N ARI)

5) FOOTING KAKUTEN MOMENT OYOBI SENDANRYOKU (M) (TM) (T)

DISTANCE	MOMENT	SENDAN	M/ALPHA	S/ALPHA
.250*	-.350	-2.801	-.233	-1.867
.500	-1.380	-5.440	-.920	-3.627
	4.818	8.461	3.212	5.640
.550**	5.227	7.933	3.485	5.289
	31.174	-46.627	20.783	-31.085
.850*	16.711	-49.794	11.141	-33.196
1.600	-23.785	-58.197	-15.857	-38.798
	-17.588	-23.529	-11.725	-15.686
2.150)	-32.223	-29.691	-21.482	-19.794
2.700	-50.247	-35.853	-33.498	-23.902
	-44.049	19.583	-29.366	13.056
3.450*	-32.513	11.180	-21.675	7.454
3.750**	-29.634	8.014	-19.756	5.342
	-4.053	-70.236	-2.702	-46.824
3.800	-7.578	-70.764	-5.052	-47.176
	-1.380	5.440	-.920	3.627
4.050*	-.350	2.801	-.233	1.867

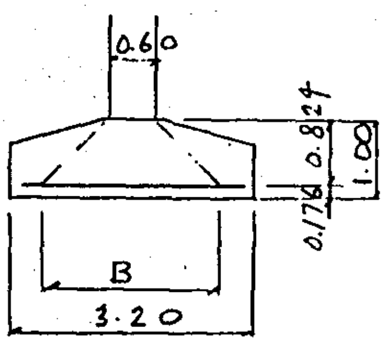
Stress calculation

Effective width

Top side

$B = 3.20^m$

Bottom side



$B = 0.60 + 0.824 \times 2 = 2.25^m$

	Top side	Bottom side	
M (tm)	-69.13	34.81	
N (t)			
S (t)			
b (cm)	320	225	
h (cm)	100	100	
d (cm)	91.6	82.6	
d' (cm)	8.4	17.4	
As (cm^2)	D29-7 ≐ 44.968	D16-15cm ctc = 29.85	
p	0.00153	0.00161	
As' (cm^2)			
p'			
e = M/N (cm)			
e = M/N + u (cm)			
e = M/N − u (cm)			
e/h			
d/e			
d'/h			
d'/d			
Ne/bd^2 (kg/cm^2)	2.575	2.268	
k			
c			
j			
1/Lc	11.09	10.88	
1/Ls	697	666	
$\beta = \sigma s/\sigma c$			
σc (kg/cm^2)	28.5	24.7	
σs (kg/cm^2)	1790	1510	
τ (kg/cm^2)			
σsa (kg/cm^2)	1.800	1800	
σca (kg/cm^2)	90	90	
τa (kg/cm^2)			
	D+T+I-C	D+T+I-C-TL	

Shearing stress

$S = 86.14 \quad (D+T+I-C-TL)$

$$\tau = \frac{86.14 \times 10^3}{320 \times 85} = 3.17 \, kg/cm^2 < 3.9 \, kg/cm^2$$

Stability Calculation

	allowable supporting power	case	P max (t)	P min (t)	H max (t)
Ordinary	24	1	16.88	13.14	0
Ordinary + Temporary	36	14	35.80	8.61	1.21
Earthquake	48	20	23.62	6.41	0.97