

BASIC DESIGN DATA

Basic Design input

Span and Cross section Data

C/C of expansion gap	=	81.50 m	(Sq.)
C/C of bearing	=	80.00 m	(Sq.)
Distance of bearing to expansion gap	=	0.75 m	(Sq.)
Carriageway width	=	9.50 m	
Total width	=	12.50 m	
Footpath Width (Left side)	=	0.00 m	
Footpath Width (Right side)	=	0.00 m	
Crash Barrier Width (Left side)	=	0.50 m	
Crash Barrier Width (Right side)	=	0.50 m	
Handrail Width (Left side)	=	0.00 m	
Handrail Width (Right side)	=	0.50 m	
Skew Angle	=	0.00 °	0.000 radians

Superstructure Details

Type of superstructure	=	Truss
Depth of superstructure	=	1.085 m
Thickness of wearing coat	=	0.065 m
Cross-slope	=	0.025
Thickness of bearing	=	0.150 m
Thickness of nearest bearing+pedestal	=	0.350 m
Height of crash barrier	=	0.900 m

Material Data

Grade of concrete	f_{ck}	=	M35	
Design strength of concrete	f_{cd}	=	15.6 MPa	
Grade of steel	f_{yk}	=	Fe500	
Design strength of steel	f_{yd}	=	434.7826 MPa	
Density of concrete		=	2.5 t/m ³	
Density of wearing course		=	2.2 t/m ³	
Coefficient of Thermal Expansion of concrete		=	1.20E-05 /°C	(Cl.215.4, IRC 6 2010)
Shrinkage strain		=	2.0E-04	(Cl.217.3, IRC 6 2010)
Modulus of Elasticity of steel	E_s	=	2.0E+05 MPa	
Modulus of Elasticity of concrete	E_c	=	3.2E+04 MPa	
Mean axial tensile strength of concrete	f_{ctm}	=	2.8	

Typical Levels

Formation Level "FRL"	=	1080.000 m
Dirt wall top level	=	1080.000 m
Bearing level	=	1078.850 m
Abutment cap level "CTL"	=	1078.500 m
Stem top level	=	1077.500 m
Front Ground level "GL"	=	1076.346 m
HFL	=	1076.346 m
Scour level	=	1076.346 m
Footing Top Level	=	1074.846 m
Footing bottom level	=	1072.346 m
Footing bottom level (Actual)	=	1072.346 m

Soil Parameters

Angle of Shear resistance " ϕ "	=	32 °
Density of Dry Backfill " γ_d "	=	1.80 t/m ³
Density of submerged Backfill " γ_{sub} "	=	0.80 t/m ³
Live load surcharge	=	1.20 m
Type of soil	=	Hard Soil
Coefficient of friction between (Soil/Rock and concrete)	=	0.70

Abutment Dimensions (Square)

Type of abutment	=	wall type abutment
Column		
Number	=	1
Diameter/width	=	1.00 m at top 1.00 m at bottom
Distance of c/l of bearing from face of dirt wall in longitudinal dirn.	=	0.75 m

Abutment cap

Length at top (longitudinal direction)	=	1.570 m
Length at bottom (longitudinal direction)	=	1.00 m
Length at top (transverse direction)	=	12.50 m
Length at bottom (transverse direction)	=	12.50 m
Depth (Constant portion)	=	0.50 m
Depth (Varying portion)	=	0.50 m

Dirt Wall

Thickness	=	0.30 m
Length	=	12.50 m

Return wall

Thickness	=	0.50 m
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Pedestal

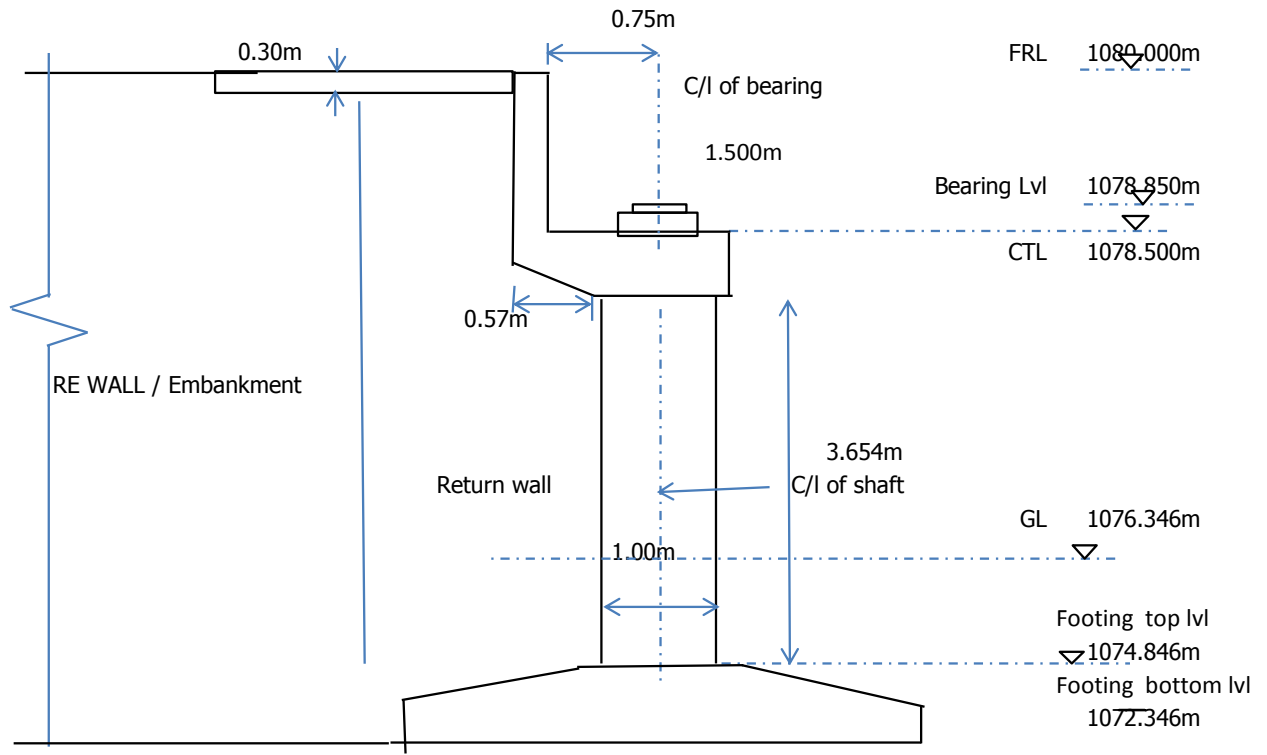
Length in longitudinal direction	=	0.90 m
Length in transverse direction	=	0.90 m
Height	=	0.20 m
Number	=	4

Seismic arrestor

Length in longitudinal direction	=	0.75 m
Length in transverse direction	=	0.80 m
Height	=	0.60 m
Number	=	2

Foundation Data

Type of foundation	=	Open
Length of footing (along L-L direction)	=	9.5 m
Length of footing (along T-T direction)	=	12.5 m
Total Thickness of footing	=	2.5 m
Factor by which seismic force is increased for	=	1.25 (Cl.219.8, IRC 6 2010)



Longitudinal Section

Distance between bearing c/l and shaft c/l in longitudinal dirn. = 0 m

Load Data

Dead Load

Total weight of longitudinal girders = 1504.1 t

SIDL

Load intensity due to wearing course = 0.2 t/m²

Self weight of crash barrier = 1 t/m

Self weight of railing = 0.15 t/m

Live Load

1 Lane 70R-Wheeled

Load = 100 t

Length of Load = 13.4 m

CG of load = 5.12 m

1 Lane Class A

Load = 55.4 t

Length of Load = 18.8 m

CG of load = 9.091 m

% Reduction = 90 %

Fraction of live load remaining in seismic case = 0.2

Factor by which seismic force is increased for design of foundation = 1.25 (Cl.219.8, IRC 6 2010)

Wind Load

Basic Wind Speed = 0 m/s Fig. 6, IRC:6-2010

Type of terrain = Terrain with obstruction

Parameters for wind force on superstructure (except truss) Refer Cl. 209.3.3 to 209.3.5, IRC:6-2010

	For DL+SIDL	For LL
Gust Factor, G	2.0	2.0
Drag Coefficient, C _D	1.1	1.2
Lift Coefficient, C _L	0.75	-

Parameters for wind force on substructure

For Abutment Cap

Gust Factor, G = 2

Drag Coefficient, C_D = 0.8 Table 5, IRC:6-2010

Bearing Data

Type of bearing = POT-PTFE

Clear Cover

Dirt Wall Bracket = 50 mm

Dirt Wall = 50 mm

Abutment Cap = 50 mm

Abutment Stem = 50 mm

Footing = 75 mm

DEAD LOAD AND SIDL REACTION FROM SUPERSTRUCTURE

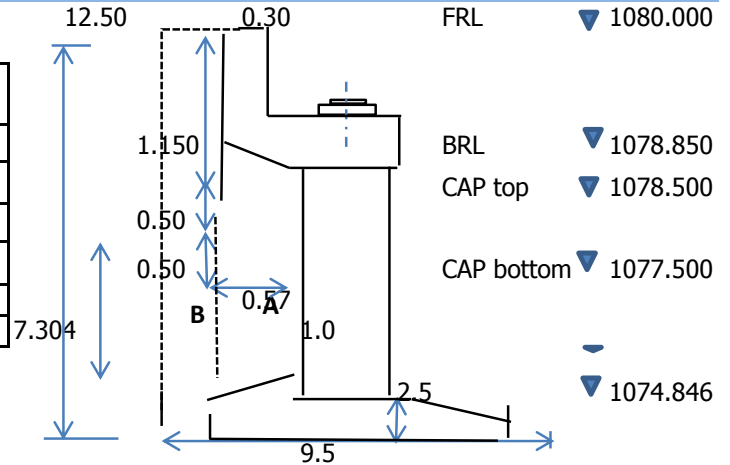
Longitudinal eccentricity bearing c/l from c/l of shaft	=	0 m
<u>Dead Load of Superstructure</u>		
Total weight of longitudinal girders+deck	=	1504.1 t
Total weight of diaphragm	=	0 t
Total weight of deck slab	=	0 t
Total weight of superstructure	=	1504.1 t
Reaction	=	752.05 t
Total reaction on abutment	=	752.05 t
Longitudinal moment	=	0 t-m
Transverse eccentricity of DL from c/l of abutment	=	0 m
Transverse Moment	=	0 t-m
<u>SIDL (crash barrier, railing, footpath) - excluding wearing course</u>		
Crash barrier weight	=	163 t
Weight of safety kerb	=	29.07 t
Longitudinal moment (crash barrier)	=	0 t-m
Longitudinal moment (railing)	=	0 t-m
<u>SIDL (wearing course)</u>		
Load intensity due to wearing course	=	0.2 t/m ²
DL of wearing course	=	154.85 t
Total reaction on abutment (SIDL due to w/c)	=	77.425 t
Longitudinal moment (wearing course)	=	0 t-m

CALCULATION OF DEAD LOAD OF ABUTMENT AND FOUNDATION

Total width of abutment

Dead Load calculation

S.no	Description	vertical load	Lever arm	Moments (t-m)
1	Dirt wall	11	0.92	9.92
2	Bracket	2.34	1.22	2.86
3	Cap varying	20.08	0.15	3.06
4	cap uniform	24.53	0.29	6.99
5	seismic arrester	1.80	0.00	0.00
6	Abutment shaft	83	0.00	0.00



Seismic force on Sub structure

Seismic coefficient	a_{hl}	a_{ht}	a_v
	0.216	0.216	0.14

At shaft

S.no	Description	dead Load(T)	Seismic forces(T)			Lever arm(m)		Moments(T-m)	
			Long	Trans	Vertical	Horizontal	Vertical	Long	Trans
1	Dirt wall	11	2.33	2.33	1.51	4.23	0.92	8.46	9.85
2	Bracket	2	0.51	0.51	0.33	4.35	1.22	1.80	2.20
3	Cap varying	20	4.34	4.34	2.81	2.90	0.15	12.17	12.59
4	cap uniform	25	5.30	5.30	3.43	3.40	0.29	17.06	18.04
5	seismic arrester	2	0.39	0.39	0.25	3.95	0.00	1.54	1.54
6	Abutment shaft	83	17.91	17.91	11.61	1.33	0.00	23.77	23.77
Total at shaft bottom		142	31	31	20			65	68

Combined CG of seismic forces on sub structure from pile cap top
 RL of Cg of seismic force

2.11m
 1076.95m

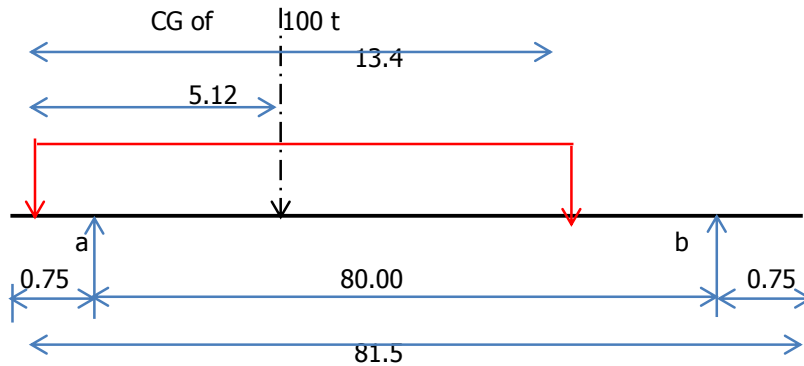
LIVE LOAD CALCULATION (NORMAL CASE)

Reaction due to DL of superstructure	=	752.05 t
Reaction due to SIDL exl w/c	=	81.5 t
Reaction due to SIDL due to w/c	=	77.43 t

Transverse moment has been calculated for the most eccentric placement of live load

Bearing type is POT-PTFE

1 1 lane 70R-Wheeled



Live Load Reactions

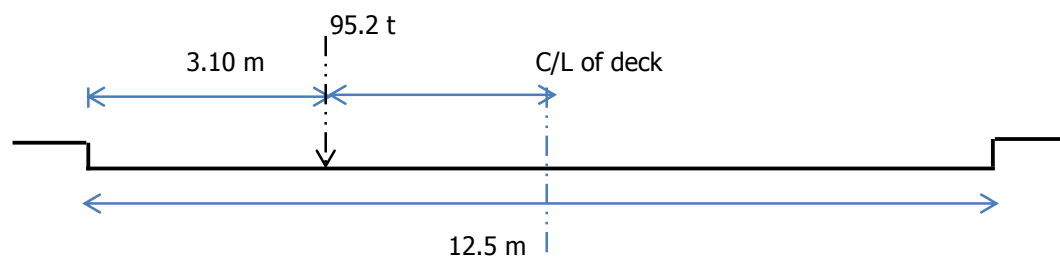
Ra	=	$100.0 \times (81.5 - 5.1 - 0.8) / 8$	=	94.5 t
Rb	=	$100.0 - 94.5$	=	5.5 t

Braking force	=	20% of 100.00 t	
	=	20.0 t	acts at 1.2 m above road
Change in Reaction due to braking force	=	0.7 t	

Maximum Vertical force on abutment	=	95.2 t
Minimum Vertical force on abutment	=	4.8 t

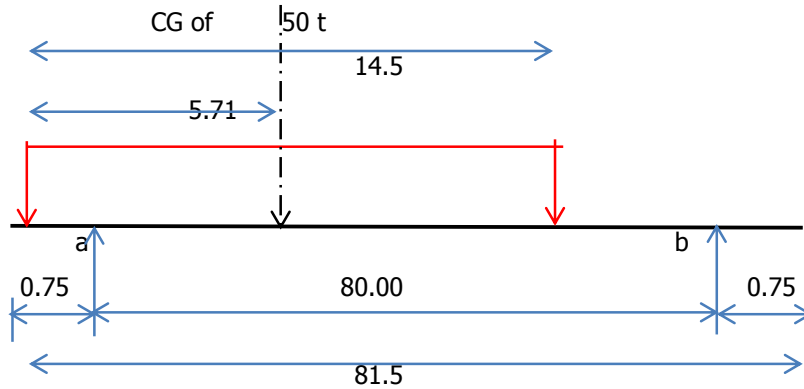
Total horizontal force at bearing level	=	Fh
	=	20.0 t

Total Horizontal force (Longitudinal)	HL	=	20.0 t
Total Horizontal force (Transverse)	HT	=	0.0 t



Eccentricity (with footpath case)	=	3.155 m
Eccentricity (without footpath case)	=	3.155 m

2 1 lane Class A



Live Load Reactions

$$R_a = 50.0 \times (81.5 - 5.7 - 0.8) / 80 = 46.9 \text{ t}$$

$$R_b = 50.0 - 46.9 = 3.1 \text{ t}$$

$$\begin{aligned} \text{Braking force} &= 20\% \text{ of } 50.00 \text{ t} \\ &= 10.0 \text{ t} \end{aligned} \quad \text{acts at 1.2 m above road}$$

$$\text{Change in Reaction due to braking force} = 0.3 \text{ t}$$

$$\text{Maximum Vertical force on abutment} = 47.2 \text{ t}$$

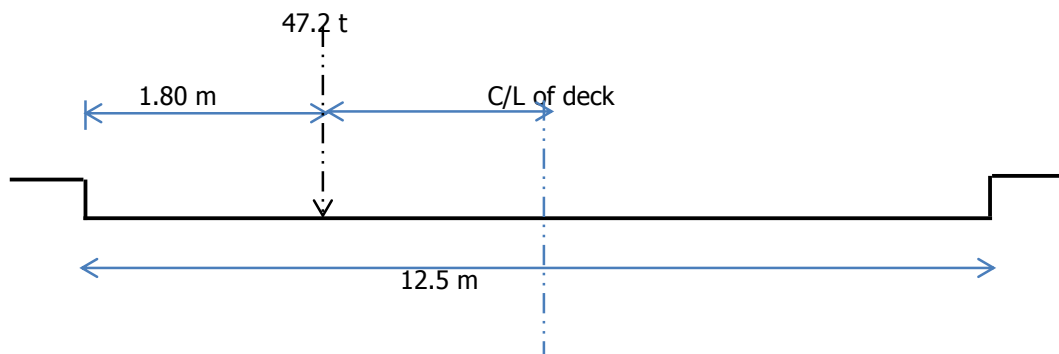
$$\text{Minimum Vertical force on abutment} = 2.8 \text{ t}$$

$$\text{Total horizontal force at bearing level} = F_h$$

$$= 10.0 \text{ t}$$

$$\text{Total Horizontal force (Longitudinal)} \quad \text{HL} = 10.0 \text{ t}$$

$$\text{Total Horizontal force (Transverse)} \quad \text{HT} = 0.0 \text{ t}$$



$$\text{Eccentricity (with footpath case)} = 4.45 \text{ m}$$

$$\text{Eccentricity (without footpath case)} = 4.45 \text{ m}$$

$$\text{Transverse Moment} \quad \text{MT} = 210.0 \text{ t-m}$$

3 2 lane Class A

Live Load Reactions

Ra	=	90% of 2x46.9 t	=	84.4 t	
Rb	=	90% of 2x3.1 t	=	5.6 t	
Braking force	=	1x(20% of 50.00 t + 5% of 50.00) t	=	12.5 t	acts at 1.2 m above road
Change in Reaction due to braking force	=		=	0.4 t	

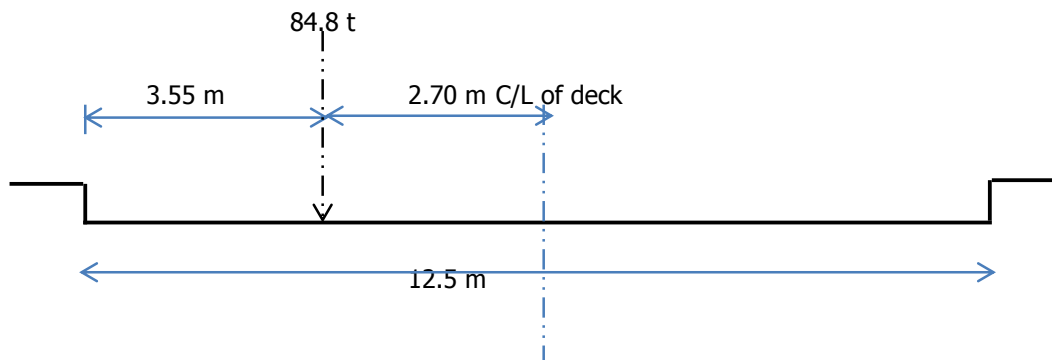
Maximum Vertical force on abutment	=	84.8 t
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Minimum Vertical force on abutment	=	5.2 t
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Total horizontal force at bearing level	=	Fh
	=	12.5 t

Total Horizontal force (Longitudinal)	HL	=	12.5 t
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Total Horizontal force (Transverse)	HT	=	0.0 t
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Transverse Moment	MT	=	228.9 t-m
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4 1 lane 70R-W + 1 lane Class A

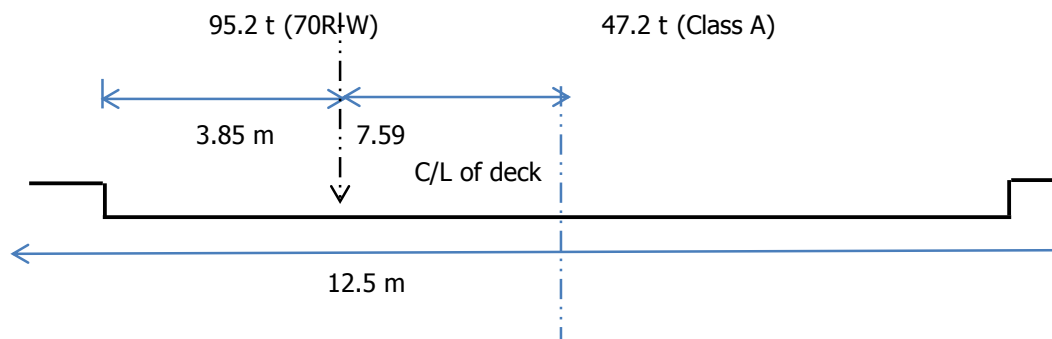
Live Load Reactions

$$\begin{aligned} R_a &= 90\% \text{ of } (94.5 \text{ t} + 46.9) = 127.3 \text{ t} \\ R_b &= 90\% \text{ of } (5.5 \text{ t} + 3.1 \text{ t}) = 7.7 \text{ t} \end{aligned}$$

$$\begin{aligned} \text{Vertical Reaction on abutment} &= 127.29 \text{ t} \\ \text{Braking force} &= 0.9 \times (20\% \text{ of } 100.00 \text{ t} + 5\% \text{ of } 50.00) \text{ t} \\ &= 20.3 \text{ t} \quad \text{acts at 1.2 m above road level} \\ \text{Change in Reaction due to braking force} &= 0.6 \text{ t} \end{aligned}$$

$$\begin{aligned} \text{Maximum Vertical force on abutment} &= 127.9 \text{ t} \\ \text{Minimum Vertical force on abutment} &= 7.1 \text{ t} \\ \text{Longitudinal moment} &= 0.0 \text{ t-m} \end{aligned}$$

$$\begin{aligned} \text{Total horizontal force at bearing level} &= F_h \\ &= 20.3 \text{ t} \\ \text{Total Horizontal force (Longitudinal)} &= HL = 20.3 \text{ t} \\ \text{Total Horizontal force (Transverse)} &= HT = 0.0 \text{ t} \end{aligned}$$



$$\begin{aligned} \text{Transverse eccentricity of 70R-W} &= 2.405 \text{ m} \\ \text{Transverse eccentricity of Class A} &= -1.34 \text{ m} \\ \text{Transverse Moment Maximum} &= MT = 90\% \text{ of } (95.2 \times 2.405 + 47.2 \times -1.3) \\ &= 149.2 \text{ t-m} \\ \text{Transverse Moment Minimum} &= MT \end{aligned}$$

5 IRC Class Special vehicle

$$\begin{aligned} \text{Reaction from left span } R_b &= 0 \text{ T} \quad \text{staad} \\ \text{Reaction from Right span} &= 110 \text{ T} \quad \text{input} \\ \text{Total Reaction on Abutment} &= 110 \text{ T} \\ \text{Longitudinal moment} &= 0 \text{ Tm} \\ \text{Trans verse eccentricity from Carraigeway} &= 0.3 \text{ m} \quad \text{Ammendment no 1} \\ & \quad \text{/January 2014 clause} \\ \text{Eccentricity of carrageway from Cl of deck} &= 0 \text{ m} \\ \text{Total ecc from CL of bridge} &= 0.3 \text{ m} \\ \text{Transverse Moment} &= 33 \text{ Tm} \end{aligned}$$

End of One Span Loaded

Summary of forces (Live loads)

Load Case		Pmax	ML	MT	HL	HT
		t	t-m	t-m	t	t
1 lane 70R-W	Pmax	95.2	0.0	300.4	20.0	0.0
	Pmin	4.8	0.0	15.1	20.0	0.0
1 lane Class A	Pmax	47.2	0.0	210.0	10.0	0.0
	Pmin	2.8	0.0	12.5	10.0	0.0
2 lane Class A	Pmax	84.8	0.0	228.9	12.5	0.0
	Pmin	5.2	0.0	14.1	12.5	0.0
70RW+1LCA	Pmax	127.3	0.0	149.17	20.3	0.0
	Pmin	7.1	0.0	8.98	20.3	0.0
IRC Class Special vehicle	Pmax	110	0	33	0	0

DESIGN OF ABUTMENT

1. Inputs

Dimensions & r/f details:

Abutment width, B	=	1000	mm	
Abutment length, L	=	12500	mm	
No. layers along width (B)	=	8		-total no. of layers (no need to subtract anything)
No. layers along length (L)	=	120		
Bar diameter along width	$\phi(B_1)$	=	12	mm
	$\phi(B_2)$	=	12	mm
Bar diameter along length	$\phi(L_1)$	=	20	
	$\phi(L_2)$	=	25	
	c'	=	75	mm
	f_{ck}	=	35	MPa
	f_y	=	500	MPa

Calculations:

Total no. of bars	=	252
Bar spacing @ width	=	121 mm
Bar spacing @ depth	=	104 mm
Area of steel	=	97961.1 mm ²
steel %	=	0.784 %



2. Interaction curve

