

INTRODUCTION

1. General

This design note pertains to the design of abutment A1. The Super structure is consist of RCC Deck Slab over Steel Plate Girder w of overall span 81.500 m supported on POT CUM PTFE Bearing. Skew angle is 0 degree. The substructure consists of RCC wall type abutment on open foundation.

Following components of substructure and foundation are designed

- 1 Abutment Shaft
- 2 Abutment cap
- 3 Dirt wall
- 4 Footing
- 5 Return wall

2. Codes and Specifications

Following codes have been used in the design

<u>Sl.No.</u>	<u>Code</u>	<u>Year of Publication</u>
1	IRC : 6	2017
2	IRC : 112	2011
3	IRC : 78	2014

3. Loads

- 1 Dead load (Due to self weight of superstructure, substructure, foundation and backfill weight)
- 2 Superimposed Dead Load (SIDL) excluding wearing course due to crash barrier, footpath and railing (if present)
- 3 Superimposed Dead Load (SIDL) due to wearing course
- 4 Carriageway live load
 - i. 1 lane of 70R Wheeled
 - ii. 1 lane of Class A
 - iii. 3 lane of Class A
 - iv. 1 lane of 70R Wheeled + 1 lane of Class A
- 5 Footpath Live Load (FPLL) (if footpath is present)
- 6 Earth pressure due to backfill
- 7 Seismic force

Wind load is not considered as it is not governing

4. Load Combinations for Limit State

Following Limit States are considered

A Ultimate Limit State (For verification of Equilibrium)

- A-1 Basic Combination
- A-2 Seismic Combination

B Ultimate Limit State (For verification of structural strength)

- B-1 Basic Combination
- B-2 Seismic Combination

C Serviceability Limit State

- C-1 Rare Combination (For checking stress limits)
- C-2 Quasi-permanent Combination (For checking crack width in RCC structures)

D Combination for Design of Foundation

- D-1 Combination 1
- D-2 Combination 2
- D-3 Seismic Combination

Accidental combination is not considered for abutment

5. Design Philosophy

Design is done using limit state method

i. Stability against Overturning and Sliding

Overturning and sliding stability is checked using load combinations of Basic and Seismic Combinations of Table 3.1, Annexure B of IRC:6-2014. The restoring/resisting effects should be greater than sliding/overturning effects.

ii. Base Pressure Check

Base pressure check is performed from load combinations of unfactored loads according to notification no 78, dated 28th July 2012

iii. Design of Abutment shaft

Abutment shaft is designed as rectangular column subjected to axial load and biaxial bending

ULS and SLS strengths of abutment section is checked using AdSec 8.2 (OASYS software).

Basic and seismic combination is used for checking ULS strength. Rare combination is used for checking stress. Quasi-permanent combination is used for checking crack width.

iv. Design of Footing

ULS design is done using Combination 1 and Seismic Combination while stress is checked using Combination 2.

Crack width is controlled by adjusting bar diameter and spacing.

v. Design of Abutment Cap

The Abutment cap is reinforced with a total minimum of 1% steel distributed equally at both faces and in both directions. Cantilever/corbel action is checked in longitudinal direction.

vi. Design of Dirt Wall

Dirt wall is checked for ULS for basic combination. Stress is checked using rare combination

vii. Design of End Return Wall

End return wall is checked for basic combination.

BASIC DESIGN DATA

1 Basic Design Data

1.1 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)	=	0.50 m	
Handrail Width (Right side)	=	0.00 m	
Skew Angle	=	0.0 °	0.000 radians

1.2 Superstructure Details

Depth of superstructure	=	1.085 m
Thickness of wearing coat	=	0.065 m
Cross-slope	=	2.50%
Thickness of bearing	=	0.150 m
Thickness of pedestal (minimum)	=	0.200 m
Minimum thickness of wedge	=	0.000 m

1.3 Material Data

Grade of concrete	f_{ck}	=	M35	
Design strength of concrete	f_{cd}	=	15.63 MPa	
Grade of steel	f_{yk}	=	Fe500	
Design strength of steel	f_{yd}	=	434.8 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 MPa	

1.4 Typical Levels

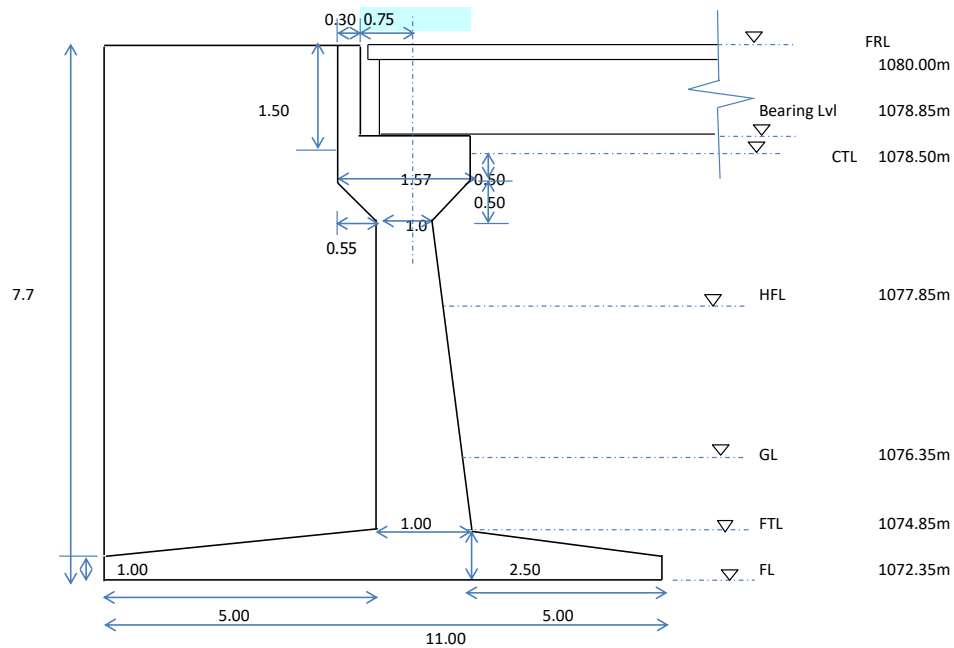
Formation Level "FRL"	=	1080.000 m
Dirt wall level	=	1080.000 m
Bearing level	=	1078.850 m
Abutment cap level "CTL"	=	1078.500 m
Stem top level	=	1077.500 m
Front Ground level "GL"	=	1076.346 m
Scour level	=	1076.346 m
Footing top level	=	1074.846 m
Founding level (actual)	=	1072.346 m
Founding level (design) "FL"	=	1072.346 m
Highest flood level "HFL"	=	1077.846 m

1.5 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
Net Safe Bearing Capacity	=	40.00 t/m ²
Gross Safe Bearing Capacity (LWL)	=	47.20 t/m ²
Gross Safe Bearing Capacity (HFL)	=	43.20 t/m ²
Live load surcharge	=	1.20 m
Type of soil	=	Hard Soil
Coefficient of friction between (Soil/Rock and concrete)	=	0.70

1.6 Abutment Dimensions (Square)

Length of abutment cap in L-L direction at top	=	1.57 m
Length of abutment cap in L-L direction at bottom	=	1.00 m
Width of abutment (sq)	=	12.50 m
Width of footing (SQ)	=	11.00 m
Width of heel(sq)	=	5.00 m
Minimum footing thickness	=	1.00 m
Heel thickness at root	=	2.50 m
Toe thickness at root	=	2.50 m
Stem top thickness(straight)	=	1.00 m
Stem bottom thickness(straight)	=	1.00 m
Dirtwall thickness	=	0.30 m
Depth of abutment cap (Constant portion)	=	0.50 m
Depth of abutment cap (Varying portion)	=	0.50 m
Thickness of return wall (Avg.)	=	0.500 m
No. of return wall	=	2
Horizontal distance of CG of abutment shaft from vertical face	=	0.50 m
Provision of weep holes in abutment wall	=	Yes



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

= 0.00 m

C/I of bearing is to the left of c/l of shaft

1.7 Partial Safety Factors

(As per Annex B of IRC:6-2010)

Also refer latest amendment, notification no 78, dated 28th July 2012

Partial safety factor for relevant loads are presented here

For Loads

Ultimate Limit State (For Verification of Equilibrium)

(Table 3.1, Annex B, IRC:6-2010)

Load	Basic Comb		Seismic Comb	
	Overturning or Sliding	Resisting	Overturning or Sliding	Resisting
Dead Load	1.05	0.95	1.05	1.0
SIDL (except surfacing)	1.05	0.95	1.05	1.0
SIDL (surfacing)	1.35	1	1.35	1.0
Live load and associated loads (Leading)	1.5	0	-	-
Live load and associated loads (Accompanying)	1.15	0	0.2	0
Water Current	-	0	1.0	-
Buoyancy	1.0	-	1.0	-
Earth Pressure	1.5	-	1.0	-
Live Load Surcharge	1.2	0	-	-
Thermal Load (Leading)	1.5	0	-	-
Thermal Load (Accompanying)	0.9	0	0.5	-
Seismic Effect (During service)	-	-	1.5	-
Seismic Effect (During construction)	-	-	0.75	-

Ultimate Limit State (For Verification of Structural Strength)

(Table 3.2, Annex B, IRC:6-2010)

Load	Basic Comb	Seismic Comb
Dead Load	1.35	1.35
SIDL (except surfacing)	1.35	1.35
SIDL (surfacing)	1.75	1.75
Live load and associated loads (Leading)	1.5	0
Live load and associated loads (Accompanying)	1.15	0.2
Water Current	1	1
Buoyancy	0.15	0.15
Earth Pressure	1.5	1
Live Load Surcharge	1.2	0.2
Seismic Effect (During service)	-	1.5
Seismic Effect (During construction)	-	0.75

Serviceability Limit State

Load	Rare Comb	Quasi-permanent Comb
Dead Load	1	1
SIDL (except surfacing)	1	1
SIDL (surfacing)	1	1
Live load and associated loads (Leading)	1	0
Live load and associated loads (Accompanying)	0.75	0
Earth Pressure	1.0	1.0
Live Load Surcharge	0.8	0
Water Current	1	-
Buoyancy	0.15	0.15
Thermal Load (Leading)	1.0	-
Thermal Load (Accompanying)	0.6	0.5

Combination for Base Pressure and Design of Foundation

(Table 3.4, Annex B, IRC:6-2010)

Load	Comb 1	Comb 2	Seismic Comb
Dead Load	1.35	1	1.35
SIDL (except surfacing)	1.35	1	1.35
SIDL (surfacing)	1.75	1	1.75
Live load and associated loads (Leading)	1.5	1.3	0
Live load and associated loads (Accompanying)	1.15	1	0.2
Water Current	1	1	1
Buoyancy (Base Pressure)	1	1	1
Buoyancy (Structural Design)	0.15	0.15	0.15
Earth Pressure	1.5	1.3	-
Live Load Surcharge	1.2	1	0.2
Thermal load	0.9	0.8	0.5
Seismic Effect (During service)	-	-	1.5
Seismic Effect (During construction)	-	-	0.75

For Materials

Material	Basic Comb	Seismic Comb
Concrete	1.5	1.5
Reinforcing steel	1.15	1.15

1.8 Load Data

Dead Load

Total weight of superstructure solid slab	=	1504.1 t	After 10% increase
Transverse eccentricity of DL from c/l of abutment	=	0.00 m	

SIDL

Excluding wearing course

Self weight of crash barrier	=	1 t/m
Self weight of railing	=	0.3 t/m
Transverse eccentricity of crash barrier (with footpath case)	=	0.00 m
Transverse eccentricity of crash barrier (without footpath case)	=	0.00 m
Transverse eccentricity of railing	=	0.00 m
Total weight of footpath/services	=	0.00 t
Transverse eccentricity of footpath/services	=	0.00 m

Wearing course

Load intensity due to wearing course	=	0.22 t/m ²
Transverse eccentricity of wearing course (with footpath case)	=	0 m
Transverse eccentricity of wearing course (without footpath case)	=	0 m

FPLL

Maximum intensity of footpath live load	=	0 kg/m ²	Cl. 206.1, IRC:6-2010
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Live Load

% Reduction (in case of three lanes)	=	90 %	(Cl.205, IRC 6 2010)
Fraction of live load remaining in seismic case	=	1	

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	=	9.09 m

% Reduction	=	90 %
Fraction of live load remaining in seismic case	=	0.2

1.9 Bearing Data

Type of bearing	=	POT-PTFE
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1.10 Clear Cover

Dirt Wall	=	50 mm
Abutment Cap	=	50 mm
Abutment Stem	=	75 mm
Footing	=	75 mm

1.11

Seismic Zone	=	V
Importance Factor	=	1.2
Response Reduction Factor	=	2.5 Cl. 219.5.5, NOTES (iii), IRC:6-2010)
Temperature variation	=	35 °C
Condition of exposure	=	Moderate
Factor by which seismic force is increased for design of foundation	=	1.25 (Cl.219.8, IRC 6 2010)

1.12 Sign Convention

Resisting moment (about toe)	Positive
Overturning moment (about toe)	Negative
Horizontal forces away from earth side	Positive
Horizontal forces towards earth side	Negative
Downward force	Positive
Upward force/uplift	Negative
In the transverse direction	
Eccentricity towards footpath side	Positive
Eccentricity away from footpath side	Negative

LOAD CALCULATION FROM SUPERSTRUCTURE

2 Load Calculation from Superstructure

2.1 Dead Load of Superstructure

Total weight of superstructure	=	1504.10 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	=	0.00 m
Transverse Moment	=	0 t-m

2.2 SIDL (crash barrier, railing, footpath) - excluding wearing course

With Footpath Case

Crash barrier weight	=	163 t
Railing weight	=	24.45 t
Footpath/services weight	=	0.00 t
Total reaction on abutment (SIDL excluding w/c)	=	93.725 t
Longitudinal moment (crash barrier)	=	0 t-m
Longitudinal moment (railing)	=	0 t-m
Longitudinal moment (footpath/services)	=	0 t-m
Total Longitudinal Moment (SIDL excluding w/c)	=	0 t-m
Transverse eccentricity of crash barrier	=	0.00 m
Transverse Moment (crash barrier)	=	0 t-m
Transverse eccentricity of railing	=	0.00 m
Transverse Moment (railing)	=	0.00 t-m
Transverse eccentricity of footpath/services	=	0.00 m
Transverse Moment (footpath/services)	=	0 t-m
Total transverse moment (SIDL excluding w/c)	=	0.00 t-m

Without Footpath Case

Crash barrier weight	=	163 t
Railing weight	=	0 t
Footpath/services weight	=	0.00 t
Total reaction on abutment (SIDL excluding w/c)	=	81.5 t
Longitudinal moment (crash barrier)	=	0 t-m
Longitudinal moment (railing)	=	0 t-m
Longitudinal moment (footpath/services)	=	0 t-m
Total Longitudinal Moment (SIDL excluding w/c)	=	0 t-m
Transverse eccentricity of crash barrier	=	0.00 m
Transverse Moment (crash barrier)	=	0 t-m
Transverse eccentricity of railing	=	0.00 m
Transverse Moment (railing)	=	0.00 t-m
Transverse eccentricity of footpath/services	=	0.00 m
Transverse Moment (footpath/services)	=	0 t-m
Total transverse moment (SIDL excluding w/c)	=	0.00 t-m

2.3 SIDL (wearing course)

With Footpath Case

Load intensity due to wearing course	=	0.22 t/m ²
DL of wearing course	=	170.335 t
Total reaction on abutment (SIDL excluding w/c)	=	85.1675 t

Longitudinal moment (wearing course) = 0 t-m

Transverse eccentricity of wearing course = 0 m

Transverse Moment (wearing course) = 0 t-m

Without Footpath Case

Load intensity due to wearing course	=	1 t/m ²
DL of wearing course	=	206.195 t
Total reaction on abutment (SIDL excluding w/c)	=	103.0975 t

Longitudinal moment (wearing course) = 0 t-m

Transverse eccentricity of wearing course = 0 m

Transverse Moment (wearing course) = 0 t-m

2.4 Summary of Loads from Superstructure

With Footpath Case

At Bearing Level

Load Item	P	ML	MT	HL	HT
	t	t-m	t-m	t-m	t-m
DL	752.05	0	0	0	0
SIDL (excluding w/c) (with footpath case)	93.725	0	0	0	0
SIDL (w/c) (with footpath case)	85.1675	0	0	0	0
SIDL (excluding w/c) (without footpath case)	81.5	0	0.00	0	0
SIDL (w/c) (without footpath case)	103.0975	0	0	0	0

At Abutment Shaft Bottom Level

Load Item	P	ML	MT	HL	HT
	t	t-m	t-m	t-m	t-m
DL	752.05	0	0	0	0
SIDL (excluding w/c) (with footpath case)	93.725	0	0	0	0
SIDL (w/c) (with footpath case)	85.1675	0	0	0	0
SIDL (excluding w/c) (without footpath case)	81.5	0	0	0	0
SIDL (w/c) (without footpath case)	103.10	0.00	0	0	0

At Foundation Bottom Level

Load Item	P	ML (about toe)	MT (about footing c/l)	HL	HT
	t	t-m	t-m	t-m	t-m
DL	752.05	4136.3	0	0	0
SIDL (excluding w/c) (with footpath case)	93.725	515.5	0	0	0
SIDL (w/c) (with footpath case)	85.1675	468.4	0	0	0
SIDL (excluding w/c) (without footpath case)	81.5	448.3	0	0	0
SIDL (w/c) (without footpath case)	103.0975	567.0	0	0	0

SEISMIC COEFFICIENT CALCULATION :

3 Seismic Coefficient Calculation

T	=	Fundamental Time Period	=	$2.0 \cdot \sqrt{D/1000F}$
D	=	Appropriate Dead Load of the Superstructure and Live Load in KN	=	9578.13 KN
F	=	Horizontal Force in KN required to be applied at the centre of the mass of the superstructure for 1mm horizontal deflection at the top of the pier along the considered direction of horizontal Force		
		Horizontal Force in Longitudinal Direction applied	=	10 KN
L	=	Height of the Abutment above fixity Level including abutment cap	=	4.004 m
G	=	Grade of Concrete for Abutment	=	M35
E	=	Modulus of Elasticity of Concrete	=	32000.0 Mpa
			=	$3.20E+06 \text{ t/m}^2$
b	=	width/dia of pier	=	1.000 m
I	=	Moment of Inertia of the Pier	=	1.042 m ⁴

Shear Rating is zero

l	=	Length of the elastomeric Bearing	=	450 mm
b	=	Breadth of the elastomeric Bearing	=	400 mm
heff	=	Thickness of the elastomeric bearing	=	80 mm
A	=	Effective area of elastomeric bearing	=	169944 mm ²
G	=	Shear Modulus	=	1.0 Mpa
Vr	=	Shear Rating of Bearing (per bearing) $G \cdot A / heff$	=	0.00 KN/mm
n	=	No. of Bearing over abutment	=	0

Deflection at the top of the pier

δ_1	=	Deflection due to shear rating of bearing	=	0.000 mm
δ_2	=	$FL^3/3EI$	=	0.0064 mm
δ	=	Total deflection of pier at top	=	0.006 mm
F	=	Horizontal Force in KN reqd. for 1 mm deflection	=	1557.82 KN
T	=	Fundamental Time Period $2.0 \cdot \sqrt{D/1000F}$	=	0.157 sec
Sa/g	=	Average response acceleration coefficient (depending upon fundamental time period T)	=	2.50

The project stretch is in seismic zone

V

Type of Soil			Hard Soil
Z	=	Zone factor	= 0.36
I	=	Importance factor	= 1.2
R	=	Response reduction factor	= 2.5

A_h	=	Horizontal Seismic Coefficient $(Z/2) \cdot (S_a/g) / (R/I)$	=	0.2160
			say	0.2160
A_v	=	Vertical Seismic Coefficient (Clause 222.3 of latest amendments)	=	0.1440
		$2/3 \cdot A_h$	say	0.1400

CALCULATION OF ACTIVE & PASSIVE EARTH PRESSURE COEFFICIENTS

4 Earth Pressure Coefficient Calculation

alpha (a)	90.0	1.57		
Beta (b)	0.00	0.00		
delta (d)	21.3	0.37		
phi(p)	32.0	0.56		
Sin(a+p)	0.848048		sin(a-p)	0.848048
Sin(a)	1		sin(a)	1
sin(a-d)	0.93148		sin(a+d)	0.93148
sin(p+d)	0.802123		sin(p+d)	0.802123
sin(p-b)	0.529919		sin(p+b)	0.529919
sin(a-b)	1		sin(a+b)	1
ka	0.275		kp	7.333
Kah	0.256		Kph	6.831
Kav	0.100		Kpv	2.668

Earth Pressure Coefficient in Seismic Case

Case-1 (By taking $\lambda = \tan^{-1}(\alpha h/(1+\alpha v))$)

Active earth pressure coefficient, Ca =

$$\frac{(1+\alpha v) \cos(\phi - \lambda - \alpha)}{\cos \lambda \cos^2 \alpha \cos(\delta + \alpha + \lambda)} \times \left(\frac{1}{1 + \frac{\sin(\phi + \delta) \sin(\phi - \lambda)}{\cos(\alpha - \lambda) \cos(\delta + \alpha + \lambda)}} \right)^{0.5} \quad 2$$

$$= 1.189 \times 0.398$$

$$Ca = 0.473$$

ah	=	Horizontal seismic coefficient	=	0.216
av	=	Vertical seismic coefficient	=	0.140
φ	=	angle of internal friction	=	32 deg
λ	=	$\tan^{-1}(ah/(1+av))$	=	10.73 deg
α	=	angle which earth face of wall makes with vertical	=	0 deg
I	=	slope of earthfill	=	0 deg
δ	=	angle of friction between wall and earthfill	=	21.33333 deg

Case-2 (By taking $\lambda = \tan^{-1}(\alpha h/(1-\alpha v))$)

Active earth pressure coefficient, Ca =

$$\frac{(1-\alpha v) \cos(\phi - \lambda - \alpha)}{\cos \lambda \cos^2 \alpha \cos(\delta + \alpha + \lambda)} \times \left(\frac{1}{1 + \frac{\sin(\phi + \delta) \sin(\phi - \lambda)}{\cos(\alpha - \lambda) \cos(\delta + \alpha + \lambda)}} \right)^{0.5} \quad 2$$

$$= 0.985 \times 0.416$$

$$Ca = 0.410$$

ah	=	Horizontal seismic coefficient	=	0.216
av	=	Vertical seismic coefficient (0.5ah)	=	0.140
φ	=	angle of internal friction	=	32 deg
λ	=	$\tan^{-1}(ah/(1-av))$	=	14.10 deg
α	=	angle which earth face of wall makes with vertical	=	0 deg
I	=	slope of earthfill	=	0 deg
δ	=	angle of friction between wall and earthfill	=	21.3 deg

Horz. Active earth pressure coeff. in seismic case is taken as, $Ca \cdot \cos 20$

0.440

Vert. Active earth pressure coeff. in seismic case is taken as, $Ca \cdot \cos 20$

0.172

Dynamic Increment (Horz.)

0.184

Dynamic Increment (Vert.)

0.072

LIVE LOAD CALCULATION (NORMAL CASE)

6 Live Load Calculation

Following live load cases are considered

- 1 lane 70R-Wheeled
- 2 1 Lane Class A
- 3 3 Lane Class A
- 4 1 lane 70R-Wheeled + 1 Lane Class A

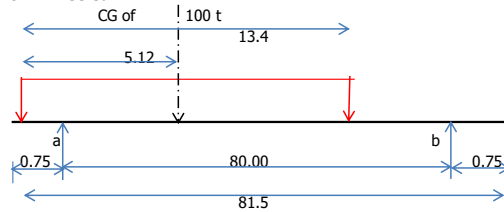
Reaction due to DL of superstructure	=	752.05 t
Reaction due to SIDL exl w/c	=	93.725 t
Reaction due to SIDL due to w/c	=	103.10 t

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

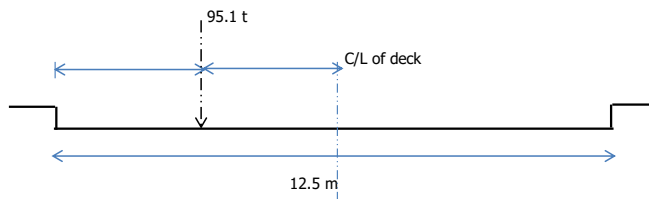
Ra	=	$100.0 \times (81.5 - 5.1 - 0.8) / 80.0$	=	94.5 t
Rb	=	$100.0 - 94.5$	=	5.5 t

Vertical Reaction on abutment	=	94.54 t
Braking force	=	20% of 100.00 t
	=	20.0 t
Change in Reaction due to braking force	=	0.6 t

acts at 1.2 m above road surface

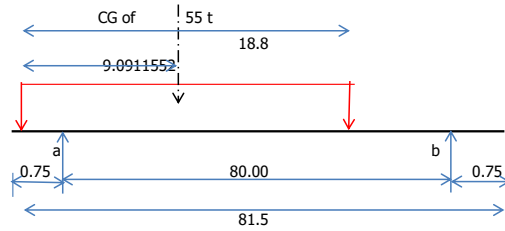
Maximum Vertical force on abutment	=	95.1 t
Minimum Vertical force on abutment	=	94.0 t
Longitudinal moment	=	0.0 t-m

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)	=	2.655 m
Eccentricity (without footpath case)	=	3.155 m
Transverse Moment	MT	= 300.1 t-m

2 1 lane Class A

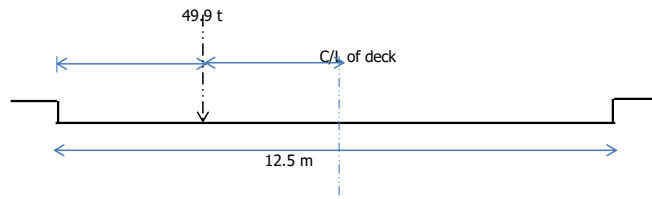


Live Load Reactions

$$\begin{aligned} R_a &= 55.4 \times (81.5 - 9.1 - 0.8) / 80.0 = 49.6 \text{ t} \\ R_b &= 55.4 - 49.6 = 5.8 \text{ t} \end{aligned}$$

$$\begin{aligned} \text{Vertical Reaction on abutment} &= 49.62 \text{ t} \\ \text{Braking force} &= 20\% \text{ of } 55.40 \text{ t} = 11.1 \text{ t} \quad \text{acts at 1.2 m above road surface} \\ \text{Change in Reaction due to braking force} &= 0.3 \text{ t} \\ \text{Maximum Vertical force on abutment} &= 49.9 \text{ t} \\ \text{Minimum Vertical force on abutment} &= 49.3 \text{ t} \\ \text{Longitudinal moment} &= 0.0 \text{ t-m} \end{aligned}$$

$$\begin{aligned} \text{Total horizontal force at bearing level} &= F_h = 11.1 \text{ t} \\ \text{Total Horizontal force (Longitudinal)} &= H_L = 11.1 \text{ t} \\ \text{Total Horizontal force (Transverse)} &= H_T = 0.0 \text{ t} \end{aligned}$$

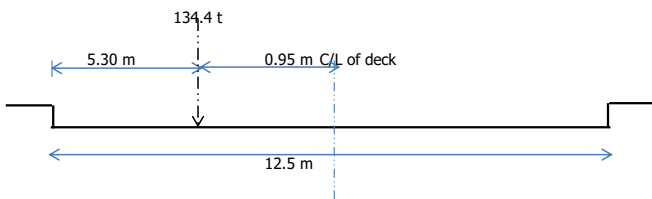


$$\begin{aligned} \text{Eccentricity (with footpath case)} &= 3.95 \text{ m} \\ \text{Eccentricity (without footpath case)} &= 4.45 \text{ m} \\ \text{Transverse Moment} &= MT = 222.3 \text{ t-m} \end{aligned}$$

3 3 lane Class A

$$\begin{aligned} \text{Live Load Reactions} \\ R_a &= 90\% \text{ of } 3 \times 49.6 \text{ t} = 134.0 \text{ t} \\ R_b &= 90\% \text{ of } 3 \times 5.8 \text{ t} = 15.6 \text{ t} \\ \text{Vertical Reaction on abutment} &= 133.98 \text{ t} \\ \text{Braking force} &= 0.9 \times (20\% \text{ of } 55.40 \text{ t} + 5\% \text{ of } 55.40 \text{ t}) = 12.5 \text{ t} \quad \text{acts at 1.2 m above road surface} \\ \text{Change in Reaction due to braking force} &= 0.4 \text{ t} \\ \text{Maximum Vertical force on abutment} &= 134.4 \text{ t} \\ \text{Minimum Vertical force on abutment} &= 133.6 \text{ t} \\ \text{Longitudinal moment} &= 0.0 \text{ t-m} \end{aligned}$$

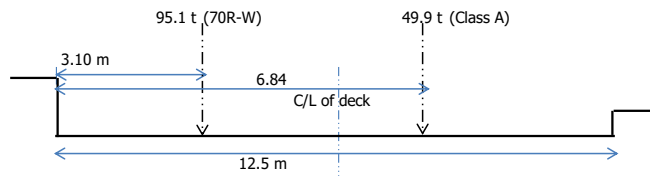
$$\begin{aligned} \text{Total horizontal force at bearing level} &= F_h = 12.5 \text{ t} \\ \text{Total Horizontal force (Longitudinal)} &= H_L = 12.5 \text{ t} \\ \text{Total Horizontal force (Transverse)} &= H_T = 0.0 \text{ t} \end{aligned}$$



$$\text{Transverse Moment} \quad MT = 127.6 \text{ t-m}$$

4 1 lane 70R-W + 1 lane Class A

Live Load Reactions			
Ra	=	90% of (94.5 t + 49.6 t)	= 129.7 t
Rb	=	90% of (5.5 t + 5.8 t)	= 10.1 t
Vertical Reaction on abutment			
Braking force	=	0.9x(20% of 100.00 t + 5% of 55.40) t	
	=	20.5 t	acts at 1.2 m above road surface
Change in Reaction due to braking force	=	0.6 t	
Maximum Vertical force on abutment	=	130.3 t	
Minimum Vertical force on abutment	=	129.1 t	
Longitudinal moment	=	0.0 t-m	
Total horizontal force at bearing level			
	=	Fh	
	=	20.5 t	
Total Horizontal force (Longitudinal)		HL	= 20.5 t
Total Horizontal force (Transverse)		HT	= 0.0 t



Transverse eccentricity of 70R-W	=	3.155 m
Transverse eccentricity of Class A	=	-0.59 m
Transverse Moment	MT	= 90% of (95.1*3.155 + 49.9*-0.6)
		= 243.6 t-m

Summary

Load Case	Pmax	Pmin	ML	MT	HL	HT
	t	t	t-m	t-m	t	t
1 lane 70R-W	95.1	94.0	0.0	300.1	20.0	0.0
1 lane Class A	49.9	49.3	0.0	222.3	11.1	0.0
3 lane Class A	134.4	133.6	0.0	127.6	12.5	0.0
1 lane 70R-W + 1 lane Class A	130.3	129.1	0.0	243.6	20.5	0.0

LL1 Maximum Reaction Case
LL2 Maximum Moment Case

SEISMIC FORCES AT BEARING LEVEL FROM SUPERSTRUCTURE

7 Seismic Forces at Bearing Level from Superstructure

Following live load cases are considered

- 1 lane 70R-Wheeled
- 2 1 Lane Class A
- 3 3 Lane Class A
- 4 1 lane 70R-Wheeled + 1 Lane Class A

Reaction due to self weight of superstructure	=	752.05 t
Total SIDL reaction	=	178.8925 t
Horizontal seismic coefficient (long.)	a_{hl}	= 0.216
Horizontal seismic coefficient (trans.)	a_{ht}	= 0.216
Vertical seismic coefficient	a_v	= 0.140
Seismic force on DL + SIDL , long. Dirn.		= 201.1 t
Seismic force on DL + SIDL , trans. Dirn.		= 201.1 t
Seismic force on DL + SIDL , vert. Dirn.		= 130.3 t
r1	= Full seismic force in longitudinal direction	= $a_{hl}*(DL+SIDL)$
r2	= Full seismic force in transverse direction	= $a_{ht}*(DL+SIDL+Appropriate LL)$
r3	= Full seismic force in vertical direction	= $a_v*(DL+SIDL+Appropriate LL)$

1 1 lane 70R-Wheeled

Live Load Reaction on abutment	=	94.54 t
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Full Design Seismic Forces

r1	=	201.1 t
r2	=	221.5 t
r3	=	143.6 t

Longitudinal Seismic Case

Seismic force at bearing level (Longitudinal)	=	$2*r1$	=	402.2 t
Seismic force at bearing level (Transverse)	=	$0.3r2$	=	66.5 t
	HL Seismic		=	402.2 t
	HT Seismic		=	66.5 t

Transverse Seismic Case

Seismic force at bearing level (Longitudinal)	=	$2*0.3r1$	=	120.7 t
Seismic force at bearing level (Transverse)	=	$r2$	=	221.5 t
	HL Seismic		=	120.7 t
	HT Seismic		=	221.5 t

Vertical Seismic force at bearing level = $0.3*r3$	=	43.1 t
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Vertical Seismic Case

Seismic force at bearing level (Longitudinal)	=	$2*0.3r1$	=	132.9 t
Seismic force at bearing level (Transverse)	=	$0.3r2$	=	66.5 t
	HL Seismic		=	132.9 t
	HT Seismic		=	66.5 t

Vertical Seismic force at bearing level = $r3$	=	143.6 t
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2 1 lane Class A

Live Load Reaction on abutment	=	49.62 t
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Full Design Seismic Forces

r1	=	201.1 t
r2	=	211.8 t
r3	=	137.3 t

Longitudinal Seismic Case

Seismic force at bearing level (Longitudinal)	=	$2*r1$	=	402.2 t
Seismic force at bearing level (Transverse)	=	$0.3r2$	=	63.5 t
	HL Seismic		=	402.2 t
	HT Seismic		=	63.5 t

Transverse Seismic Case

Seismic force at bearing level (Longitudinal)	=	$2*0.3r1$	=	120.7 t
Seismic force at bearing level (Transverse)	=	$r2$	=	211.8 t
	HL Seismic		=	120.7 t
	HT Seismic		=	211.8 t

Vertical Seismic force at bearing level = $0.3*r3$	=	41.2 t
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Vertical Seismic Case

Seismic force at bearing level (Longitudinal)	=	$2*0.3r1$	=	127.1 t
Seismic force at bearing level (Transverse)	=	$0.3r2$	=	63.5 t
	HL Seismic		=	127.1 t
	HT Seismic		=	63.5 t

Vertical Seismic force at bearing level = $r3/2$	=	137.3 t
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3 3 lane Class A

Live Load Reaction on abutment = 133.98 t

Full Design Seismic Forces

r1 = 201.1 t
r2 = 230.0 t
r3 = 149.1 t

Longitudinal Seismic Case

Seismic force at bearing level (Longitudinal) = $2 \cdot r1$ = 402.2 t
Seismic force at bearing level (Transverse) = $0.3r2$ = 69.0 t
HL Seismic = 402.2 t
HT Seismic = 69.0 t

Transverse Seismic Case

Seismic force at bearing level (Longitudinal) = $2 \cdot 0.3r1$ = 120.7 t
Seismic force at bearing level (Transverse) = $r2$ = 230.0 t
HL Seismic = 120.7 t
HT Seismic = 230.0 t

Vertical Seismic force at bearing level = $0.3 \cdot r3$ = 44.7 t

Vertical Seismic Case

Seismic force at bearing level (Longitudinal) = $2 \cdot 0.3r1$ = 138.0 t
Seismic force at bearing level (Transverse) = $0.3r2$ = 69.0 t
HL Seismic = 138.0 t
HT Seismic = 69.0 t

Vertical Seismic force at bearing level = $r3/2$ = 74.5 t

4 1 lane 70R-W + 1 lane Class A

Live Load Reaction on abutment = 129.75 t

Full Design Seismic Forces

r1 = 201.1 t
r2 = 229.1 t
r3 = 148.5 t

Longitudinal Seismic Case

Seismic force at bearing level (Longitudinal) = $2 \cdot r1$ = 402.2 t
Seismic force at bearing level (Transverse) = $0.3r2$ = 68.7 t
HL Seismic = 402.2 t
HT Seismic = 68.7 t

Transverse Seismic Case

Seismic force at bearing level (Longitudinal) = $2 \cdot 0.3r1$ = 120.7 t
Seismic force at bearing level (Transverse) = $r2$ = 229.1 t
HL Seismic = 120.7 t
HT Seismic = 229.1 t

Vertical Seismic force at bearing level = $0.3 \cdot r3$ = 44.5 t

Vertical Seismic Case

Seismic force at bearing level (Longitudinal) = $2 \cdot 0.3r1$ = 137.5 t
Seismic force at bearing level (Transverse) = $0.3r2$ = 68.7 t
HL Seismic = 137.5 t
HT Seismic = 68.7 t

Vertical Seismic force at bearing level = $r3/2$ = 74.2 t

Summary of Seismic Forces at Bearing Level From Superstructure

Longitudinal Seismic

Load Case	Pmax	Pmin	ML	MT	HL Seismic	HT Seismic
	t	t	t-m	t-m	t	t
1 lane 70R-W	43.07	-43.07	0.00	0.00	402.17	66.45
1 lane Class A	41.18	-41.18	0.00	0.00	402.17	63.54
3 lane Class A	44.73	-44.73	0.00	0.00	402.17	69.01
1 lane 70R-W + 1 lane Class A	44.55	-44.55	0.00	0.00	402.17	68.73

Transverse Seismic

Load Case	Pmax	Pmin	ML	MT	HL Seismic	HT Seismic
	t	t	t-m	t-m	t	t
1 lane 70R-W	43.07	-43.07	0.00	0.00	120.65	221.50
1 lane Class A	41.18	-41.18	0.00	0.00	120.65	211.80
3 lane Class A	44.73	-44.73	0.00	0.00	120.65	230.02
1 lane 70R-W + 1 lane Class A	44.55	-44.55	0.00	0.00	120.65	229.11

Vertical Seismic

Load Case	Pmax	Pmin	ML	MT	HL Seismic	HT Seismic
	t	t	t-m	t-m	t	t
1 lane 70R-W	143.57	-143.57	0.00	0.00	132.90	66.45
1 lane Class A	137.28	-137.28	0.00	0.00	127.08	63.54
3 lane Class A	74.54	-74.54	0.00	0.00	138.01	69.01
1 lane 70R-W + 1 lane Class A	74.25	-74.25	0.00	0.00	137.47	68.73

Final Summary

SL1 Seismic forces corresponding to LL1
SL2 Seismic forces corresponding to LL2
SL3 Seismic forces corresponding to LL3

At Bearing Level

Longitudinal Seismic

Load Case	Pmax	Pmin	ML	MT	HL Seismic	HT Seismic
	t	t	t-m	t-m	t	t
SL1	44.55	-44.55	0.00	0.00	402.17	68.73
SL2	43.07	-43.07	0.00	0.00	402.17	66.45

Transverse Seismic

Load Case	Pmax	Pmin	ML	MT	HL Seismic	HT Seismic
	t	t	t-m	t-m	t	t
SL1	44.55	-44.55	0.00	0.00	120.65	229.11
SL2	43.07	-43.07	0.00	0.00	120.65	221.50

Vertical Seismic

Load Case	Pmax	Pmin	ML	MT	HL Seismic	HT Seismic
	t	t	t-m	t-m	t	t
SL1	74.25	-74.25	0.00	0.00	137.47	68.73
SL2	143.57	-143.57	0.00	0.00	132.90	66.45

At Abutment Shaft Bottom Level

Longitudinal Seismic

Load Case	Pmax	Pmin	ML	MT	HL Seismic	HT Seismic
	t	t	t-m	t-m	t	t
SL1	44.55	-44.55	1610.3	275.2	402.17	68.73
SL2	43.07	-43.07	1610.3	266.1	402.17	66.45

Transverse Seismic

Load Case	Pmax	Pmin	ML	MT	HL Seismic	HT Seismic
	t	t	t-m	t-m	t	t
SL1	44.55	-44.55	483.1	917.4	120.65	229.11
SL2	43.07	-43.07	483.1	886.9	120.65	221.50

Vertical Seismic

Load Case	Pmax	Pmin	ML	MT	HL Seismic	HT Seismic
	t	t	t-m	t-m	t	t
SL1	74.25	-74.25	550.4	275.2	137.47	68.73
SL2	143.57	-143.57	532.1	266.1	132.90	66.45

At Foundation Bottom Level

Longitudinal Seismic

Load Case	Pmax	Pmin	ML due to HL (about toe)	ML due to P (about toe)	MT(about footing c/l)	HL Seismic	HT Seismic
	t	t	t-m	t-m	t-m	t	t
SL1	44.55	-44.55	-2615.7	245.0	526.1	402.17	68.73
SL2	43.07	-43.07	-2615.7	236.9	508.6	402.17	66.45

Transverse Seismic

Load Case	Pmax	Pmin	ML due to HL (about toe)	ML due to P (about toe)	MT(about footing c/l)	HL Seismic	HT Seismic
	t	t	t-m	t-m	t-m	t	t
SL1	44.55	-44.55	-784.7	245.0	1753.6	120.65	229.11
SL2	43.07	-43.07	-784.7	236.9	1695.4	120.65	221.50

Vertical Seismic

Load Case	Pmax	Pmin	ML due to HL (about toe)	ML due to P (about toe)	MT(about footing c/l)	HL Seismic	HT Seismic
	t	t	t-m	t-m	t-m	t	t
SL1	74.25	-74.25	-894.1	408.4	526.1	137.47	68.73
SL2	143.57	-143.57	-864.4	789.6	508.6	132.90	66.45

CALCULATION OF FORCES DUE TO FPLL

8 Calculation of forces due to FPLL

Maximum intensity of FPLL	P'	=	0 kg/m ²
Effective Span	L	=	80.0 m
Width of footpath (Left side)	W	=	0 m
Width of footpath (Right side)	W	=	0 m

Intensity of FPLL (Left side)

P	=	0	Cl. 206.3, IRC:6-2010
	=	0.0 kg/m ²	
	=	0.0 t/m ²	

Intensity of FPLL (Right side)

P	=	0	Cl. 206.3, IRC:6-2010
	=	0.0 kg/m ²	
	=	0.0 t/m ²	

FPLL1 Max Reaction Case
FPLL2 Maximum Moment Case

Summary of forces due to FPLL

At Bearing Level

	Pmax	ML	MT	HL	HT
	t	t-m	t-m	t	t
FPLL1	0.0	0.0	0.0	0.0	0.0
FPLL2	0.0	0.0	0.0	0.0	0.0

At Abutment Shaft Bottom Level

	Pmax	ML	MT	HL	HT
	t	t-m	t-m	t	t
FPLL1	0.0	0.0	0.0	0.0	0.0
FPLL2	0.0	0.0	0.0	0.0	0.0

At Foundation Bottom Level

	Pmax	ML (about toe)	MT (about footing c/l)	HL	HT
	t	t-m	t-m	t	t
FPLL1	0.0	0.0	0.0	0.0	0.0
FPLL2	0.0	0.0	0.0	0.0	0.0

CALCULATION OF FORCES DUE TO EARTH PRESSURE

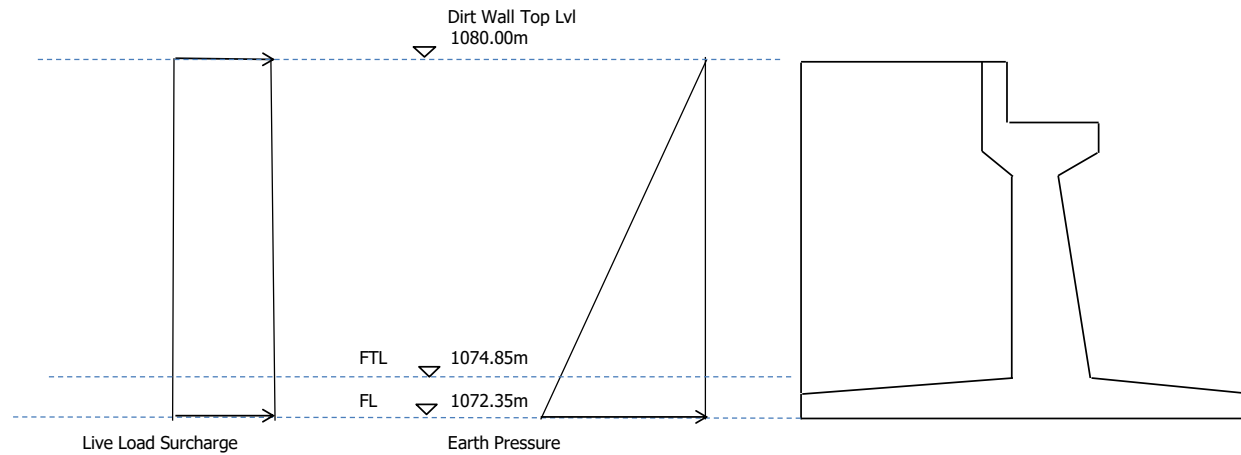
9 Calculation of Forces due to Earth Pressure

Provision of weep holes in abutment wall

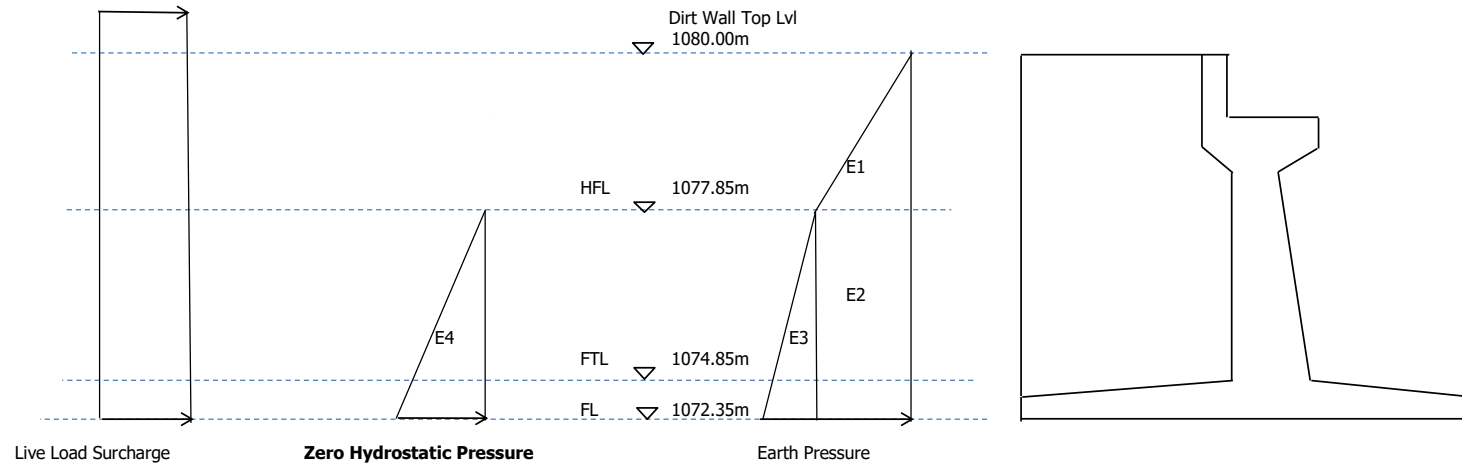
Yes

No hydrostatic force needs to be applied

LWL CASE



HFL CASE



Horizontal force due to earth pressure on abutment acts in L-L direction

Width of abutment (Skew)	b	=	12.5 m
Horizontal Earth Pressure Coefficient	K_{ah}	=	0.256
Horizontal Earth Pressure Coefficient	K_{av}	=	0.100
Dynamic Increment (Horz.)		=	0.184
Dynamic Increment (Vert.)		=	0.072

Abutment Shaft Bottom Level

Normal Case

LWL

Horizontal force in long. Dirn.	=	$0.5 * K_{ah} * \gamma * H^2 * b$
	=	76.5 t
Lever arm from abutment shaft bottom	=	$0.42 * H$
	=	2.16468 m
ML	=	165.6 t-m

HFL

Horizontal force		
E1	=	13.4 t
Lever arm from abutment shaft bottom	=	3.90468 m
E2	=	37.2 t
Lever arm from abutment shaft bottom	=	1.5 m
E3	=	11.5 t
Lever arm from abutment shaft bottom	=	1.26 m
E4	=	0.0 t
Lever arm from abutment shaft bottom	=	0 m
Total horizontal force in long. Dirn.	=	62.1 t
ML	=	122.5 t-m

Sesimic Case

LWL

Horizontal Force

Static Component	Lever arm	Dynamic Increment	Lever arm
t	m	t	m
76.5	1.72	55.1	2.577

Total horizontal force in long. Dirn. = 131.6 t
ML = 273.4 t-m

HFL

Horizontal Force

	Static Component	Lever arm	Dynamic Increment	Lever arm
	t	m	t	m
E1	13.4	3.90468	9.6	4.077
E2	37.2	1.5	26.8	1.5
E3	11.5	1.26	8.3	1.5
E4	0.0	0	0	0

Total horizontal force in long. Dirn. = 106.8 t
ML = 214.4 t-m

Summary of forces at Abutment Shaft bottom level

Normal Case

	HL	ML due to HL
	t	t-m
LWL	76.5	165.6
HFL	62.1	122.5

Seismic Case

	HL	ML due to HL
	t	t-m
LWL	131.6	273.4
HFL	106.8	214.4

Foundation Bottom Level

Normal Case

LWL

Horizontal force in long. Dirn.	=	$0.5 \cdot k_{ah} \cdot \gamma \cdot H^2 \cdot b$
	=	168.7 t
Lever arm from foundation bottom	=	$0.42 \cdot H$
	=	3.21468 m
ML	=	-542.4 t-m

HFL

Horizontal force	=	
E1	=	13.4 t
Lever arm from foundation bottom	=	3.90468 m
E2	=	68.2 t
Lever arm from foundation bottom	=	2.75 m
E3	=	38.7 t
Lever arm from foundation bottom	=	2.31 m
E4	=	0.0 t
Lever arm from foundation bottom	=	0 m
Total horizontal force in long. Dirn.	=	120.3 t
ML	=	-329.3 t-m

Vertical Force	=	$0.5 \cdot k_{av} \cdot \gamma \cdot H^2 \cdot b$	=	65.9 t
Lever arm from toe	=		=	11.00 m
ML	=		=	725.3 t-m

Vertical force	=	
E1	=	5.2 t
Lever arm from toe	=	11.00 m
E2	=	26.7 t
Lever arm from toe	=	11.00 m
E3	=	15.1 t
Lever arm from toe	=	11.00 m

Vertical force	=	47.0 t
ML	=	517.3 t-m

Sesimic Case

LWL

Horizontal Force

Static Component	Lever arm	Dynamic Increment	Lever arm
t	m	t	m
168.7	2.55	121.5	3.827

Total horizontal force in long. Dirn. = 290.2 t
ML = -895.3 t-m

HFL

Horizontal Force

	Static Component	Lever arm	Dynamic Increment	Lever arm
	t	m	t	m
E1	13.4	6.40468	9.6	6.577
E2	68.2	2.75	49.1	2.75
E3	38.7	2.31	27.9	2.75
E4	0.0	0	0	0

Total horizontal force in long. Dirn. = 206.9 t
ML = -637.7 t-m

Vertical Force

Static Component	Lever arm	Dynamic Increment	Lever arm
t	m	t	m
65.9	11.00	47.4	11.00

Total Vertical force = 113.3 t
ML = 1246.6 t-m

Vertical Force

	Static Component	Lever arm	Dynamic Increment	Lever arm
	t	m	t	m
E1	5.2	11.00	3.8	11.00
E2	26.7	11.00	19.2	11.00
E3	15.1	11.00	10.9	11.00

Total Vertical force = 80.8 t
ML = 889.0 t-m

Summary of forces at Foundation bottom level

Normal Case

	P	HL	ML due to HL (about toe)	ML due to P (about toe)
	t	t	t-m	t-m
LWL	65.9	168.7	-542.4	725.3
HFL	47.0	120.3	-329.3	517.3

Seismic Case

	P	HL	ML due to HL (about toe)	ML due to P (about toe)
	t	t	t-m	t-m
LWL	113.3	290.2	-895.3	1246.6
HFL	80.8	206.9	-637.7	889.0

Live Load Surcharge

Abutment Shaft Bottom Level

Normal Case

Horizontal force = 35.6 t
Lever arm = 2.577 m
ML = 91.80 t-m

Seismic Case

Horizontal force

Static Component	Lever arm	Dynamic Increment	Lever arm
t	m	t	m
35.6	2.58	25.6	2.58

Total horizontal force in long. Dirn. = 61.3 t
ML = 157.9 t-m

Summary of forces due to Live Load Surcharge at Abutment Shaft bottom level

Normal Case

	HL	ML due to HL
	t	t-m
LWL	35.6	91.8
HFL	35.6	91.8

Seismic Case

	HL	ML due to HL
	t	t-m
LWL	61.3	157.9
HFL	61.3	157.9

Foundation Bottom Level

Normal Case

Horizontal force = 52.9 t
Lever arm = 3.8 m
ML = -202.47 t-m

Seismic Case

Horizontal force

Static Component	Lever arm	Dynamic Increment	Lever arm
t	m	t	m
52.9	3.83	38.1	3.83

Total horizontal force in long. Dirn. = 91.0 t
ML = -348.2 t-m

Summary of forces due to Live Load Surcharge at Foundation bottom level

Normal Case

	P	HL	ML due to HL (about toe)
	t	t	t-m
LWL	0.0	52.9	-202.5
HFL	0.0	52.9	-202.5

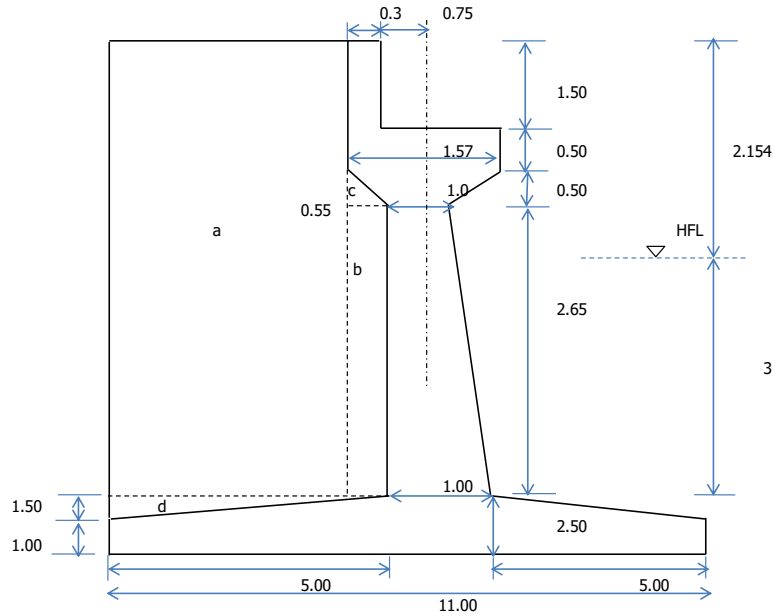
Seismic Case

	P	HL	ML due to HL (about toe)
	t	t	t-m
LWL	0.0	91.0	-348.2
HFL	0.0	91.0	-348.2

CALCULATION OF FORCES ON ABUTMENT AND FOUNDATION

10 Calculation of Forces on Abutment and Foundation

Abutment dimensions (square) are shown below



Width of abutment (Skew) b = 12.5 m
 Return Wall is on 2 side
 Horizontal distance of CG of abutment shaft from vertical face = 0.50 m

Normal Case

Component	Weight	Horizontal Lever Arm from bearing c/l	ML	Hor. Lever Arm from toe	ML about toe
	t	m	t-m	m	t-m
Dirt Wall Bracket	0	0	0.0	5.50	0.0
Dirt Wall	14.1	0.9	12.7	6.40	90.0
Abutment Cap	44.6	0.265	11.8	5.77	257.2
Abutment Shaft	82.9	0.00	0.0	5.50	456.2
Total	141.6		24.5		803.3

Hor. eccentricity of weight of substructure from c/l of bearing = 0.17 m

Width of abutment shaft at HFL = 1.0 m
 Volume of abutment shaft submerged in water = 37.5 m³
 Buoyancy on abutment shaft = -37.50 t
 Longitudinal moment due to buoyancy about toe = -206.3 t-m

Seismic Case

Component	Weight	Full Design Seismic Forces		
	t	r1	r2	r3
Dirt Wall Bracket	0.0	0.0	0.0	0.0
Dirt Wall	14.1	3.0	3.0	2.0
Abutment Cap	44.6	9.6	9.6	6.2
Abutment Shaft	82.9	17.9	17.9	11.6
Back fill	585.4	126.5	126.5	82.0

θ is skew angle

Longitudinal Seismic

Component	HL ($r1*\cos\theta+0.3r2*\sin\theta$)	HT ($r1*\sin\theta+0.3r2*\cos\theta$)	V (0.3r3)	Hor.Lever Arm from bearing c/l	Vert. Lever Arm from shaft bottom	ML due to HL	ML due to V	MT	Match Line
	t	t	t	m	m	t-m	t-m	t-m	
Dirt Wall Bracket	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.0	
Dirt Wall	3.0	0.9	0.6	0.90	4.4	13.4	0.5	4.0	
Abutment Cap	9.6	2.9	1.9	0.27	3.2	30.4	0.5	9.1	
Abutment Shaft	17.9	5.4	3.5	0.00	1.5	26.9	0.0	8.1	
Back fill	126.5	37.9	24.6	-2.50	3.3	420.7	-61.5	126.2	
Total	157.0	47.1	30.5			491.4	-60.4	147.4	

Hor.Lever Arm from toe	Vert. Lever Arm from foundation bottom	ML due to HL (about toe)	ML due to V (about toe)	MT
m	m	t-m	t-m	t-m
5.50	2.5	0.0	0.0	0.0
6.40	6.9	21.0	3.8	6.3
5.77	5.7	54.5	10.8	16.3
5.50	4.0	71.7	19.2	21.5
8.5	3.3	420.7	209.0	126.2
		567.8	242.7	170.3

Transverse Seismic

Component	HL ($0.3r1*\cos\theta+r2*\sin\theta$)	HT ($0.3r1*\sin\theta+r2*\cos\theta$)	V (0.3r3)	Hor.Lever Arm from bearing c/l	Vert. Lever Arm from shaft bottom	ML due to HL	ML due to V	MT	Match Line
	t	t	t	m	m	t-m	t-m	t-m	
Dirt Wall Bracket	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.0	
Dirt Wall	0.9	3.0	0.6	0.90	4.4	4.0	0.5	13.4	
Abutment Cap	2.9	9.6	1.9	0.27	3.2	9.1	0.5	30.4	
Abutment Shaft	5.4	17.9	3.5	0.00	1.5	8.1	0.0	26.9	
Back fill	37.9	126.5	24.6	-2.50	3.33	126.2	-61.5	420.7	
Total	47.1	157.0	30.5			147.4	-60.4	491.4	

Hor.Lever Arm from bearing c/l	Vert. Lever Arm from shaft bottom	ML due to HL	ML due to V	MT
m	m	t-m	t-m	t-m
5.50	2.5	0.0	0.0	0.0
6.40	6.9	6.3	3.8	21.0
5.77	5.7	16.3	10.8	54.5
5.50	4.0	21.5	19.2	71.7
8.50	3.33	126.2	209.0	420.7
		44.1	33.7	147.1

Vertical Seismic

Component	HL ($0.3r1*\cos\theta+0.3r2*\sin\theta$)	HT ($0.3r1*\sin\theta+0.3r2*\cos\theta$)	V (r3)	Hor.Lever Arm from bearing c/l	Vert. Lever Arm from shaft bottom	ML due to HL	ML due to V	MT	Match Line
	t	t	t	m	m	t-m	t-m	t-m	
Dirt Wall Bracket	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.0	
Dirt Wall	0.9	0.9	2.0	0.90	4.4	4.0	1.8	4.0	
Abutment Cap	2.9	2.9	6.2	0.27	3.2	9.1	1.7	9.1	
Abutment Shaft	5.4	5.4	11.6	0.00	1.5	8.1	0.0	8.1	
Back fill	37.9	37.9	82.0	-2.50	3.33	126.2	-204.9	126.2	
Total	47.1	47.1	101.8			147.4	-201.5	147.4	

Hor.Lever Arm from bearing c/l	Vert. Lever Arm from shaft bottom	ML due to HL	ML due to V	MT
m	m	t-m	t-m	t-m
5.50	2.5	0.0	0.0	0.0
6.40	6.9	6.3	12.6	6.3
5.77	5.7	16.3	36.0	16.3
5.50	4.0	21.5	63.9	21.5
		44.1	112.5	44.1

Summary of Forces at Abutment Shaft Bottom Level**Normal Case****LWL**

Component	Pmax	Pmin	ML	MT	HL	HT
	t	t	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	24.5	0	0	0

HFL

Component	Pmax	Pmin	ML	MT	HL	HT
	t	t	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	24.5	0	0	0
Buoyancy	-37.50	-37.50	0	0	0	0

Seismic Case**Longitudinal Seismic****LWL**

Component	Pmax	Pmin	ML	MT	HL	HT
	t	t	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	24.5	0.0	0.0	0.0
Seismic Force on Substr.	30.5	-30.5	551.8	147.4	157.0	47.1

HFL

Component	Pmax	Pmin	ML	MT	HL	HT
	t	t	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	24.5	0.0	0.0	0.0
Buoyancy	-37.5	-37.5	0.0	0.0	0.0	0.0
Seismic Force on Substr.	30.5	-30.5	551.8	147.4	157.0	47.1

Transverse Seismic**LWL**

Component	Pmax	Pmin	ML	MT	HL	HT
	t	t	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	24.5	0.0	0.0	0.0
Seismic Force on Substr.	30.5	-30.5	207.9	491.4	47.1	157.0

HFL

Component	Pmax	Pmin	ML	MT	HL	HT
	t	t	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	24.5	0.0	0.0	0.0
Buoyancy	-37.5	-37.5	0.0	0.0	0.0	0.0
Seismic Force on Substr.	30.5	-30.5	207.9	491.4	47.1	157.0

Vertical Seismic**LWL**

Component	Pmax	Pmin	ML	MT	HL	HT
	t	t	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	24.5	0.0	0.0	0.0
Seismic Force on Substr.	101.8	-101.8	348.9	147.4	47.1	47.1

HFL

Component	Pmax	Pmin	ML	MT	HL	HT
	t	t	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	24.5	0.0	0.0	0.0
Buoyancy	-37.5	-37.5	0.0	0.0	0.0	0.0
Seismic Force on Substr.	101.8	-101.8	348.9	147.4	47.1	47.1

End of Summary of Forces at Abutment Shaft Bottom Level

Calculation of Weight of foundation

Rectangular Part	=	137.5 m ³
Volume	=	343.75 t
Weight		
Trapezoidal Part		
Volume	=	112.5 m ³
Weight	=	281.25 t
Total Volume of foundation	=	250.0 m ³
Total Weight of foundation	=	625 t
Buoyancy force on foundation	=	-250 t
Lever arm from toe	=	5.5 m
Moment due to wt. Of foundation about toe	=	3437.5 t-m
Moment due to buoyancy force on foundation about toe ML	=	-1375.0 t-m

Calculation for Return Wall

Portion	Weight	Hor.Lever Arm from toe in L-L dirn.	ML about toe
	t	m	t-m
a	57.3	8.78	503.1
b	3.6	6.28	22.9
c	0.34	6.37	2.2
d	9.38	9.33	87.5
Total	70.7		615.7

Horizontal eccentricity of CG of return wall from toe in longitudinal direction	=	8.7 m
Horizontal eccentricity of return wall in transverse dirn.	=	0 m
Transverse Moment due to wt. of return wall MT	=	0.0 t-m
Submerged height of return wall in HFL case upto foundation top level	=	3 m
Submerged volume of return wall	=	18.75 m ³
Buoyancy force on return wall	=	-18.75 t
Longitudinal moment due to buoyancy force on return wall	=	-163.3 t-m
Transverse moment due to buoyancy about centerline of footing	=	0 t-m

Calculation for Backfill Weight

Width of backfill in transverse direction (Skew)	=	11.5 m
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LWL

Portion	Weight	Hor.Lever Arm from toe in L-L dirn.	ML about toe
	t	m	t-m
a	474.8	8.78	4166.0
b	30.2	6.28	189.6
c	2.85	6.37	18.1
d	77.63	9.33	724.5
Total	585.4		5098.3

HFL

Portion	Weight	Hor.Lever Arm from toe in L-L dirn.	ML about toe
	t	m	t-m
a	321.2	8.78	2818.8
b	11.2	6.28	70.5
c	2.85	6.37	18.1
d	34.50	9.33	322.0
Total	369.8		3229.5

Summary of Forces at Foundation Bottom Level

Normal Case

LWL

Component	Pmax	Pmin	ML due to HL (about toe)	ML due to P (about toe)	MT	HL	HT
	t	t	t-m	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	0.0	803.3	0.0	0.0	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0	0.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0	0.0	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0	0.0	0.0

HFL

Component	Pmax	Pmin	ML due to HL (about toe)	ML due to P (about toe)	MT	HL	HT
	t	t	t-m	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	0.0	803.3	0.0	0.0	0.0
Buoyancy on substr.	-37.50	-37.50	0.0	-206.3	0.0	0.0	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0	0.0	0.0
Buoyancy on fdn.	-250.00	-250.00	0.0	-1375.0	0.0	0.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0	0.0	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0	0.0	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0	0.0	0.0

Seismic Case

Longitudinal Seismic

LWL

Component	Pmax	Pmin	ML due to HL (about toe)	ML due to P (about toe)	MT	HL	HT
	t	t	t-m	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	0.0	803.3	0.0	0.0	0.0
Seismic Force on Substr.	30.5	-30.5	-567.8	242.7	170.3	157.0	47.1
Weight of fdn	625.0	625.0	0.0	3437.5	0.0	0.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0	0.0	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0	0.0	0.0

HFL

Component	Pmax	Pmin	ML due to HL (about toe)	ML due to P (about toe)	MT	HL	HT
	t	t	t-m	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	0.0	803.3	0.0	0.0	0.0
Seismic Force on Substr.	30.5	-30.5	-567.8	242.7	170.3	157.0	47.1
Buoyancy on substr.	-37.5	-37.5	0.0	-206.25	0.0	0.0	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0	0.0	0.0
Buoyancy on fdn.	-250.00	-250.00	0	-1375.0	0	0	0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0	0.0	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0	0.0	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0	0.0	0.0

Transverse Seismic

LWL

Component	Pmax	Pmin	ML due to HL (about toe)	ML due to P (about toe)	MT	HL	HT
	t	t	t-m	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	0.0	803.3	0.0	0.0	0.0
Seismic Force on Substr.	30.5	-30.5	44.1	242.7	170.3	47.1	157.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0	0.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0	0.0	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0	0.0	0.0

HFL

Component	Pmax	Pmin	ML due to HL (about toe)	ML due to P (about toe)	MT	HL	HT
	t	t	t-m	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	0.0	803.3	0.0	0.0	0.0
Seismic Force on Substr.	30.5	-30.5	44.1	242.7	170.3	47.1	157.0
Buoyancy on substr.	-37.5	-37.5	0.0	-206.25	0.0	0.0	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0	0.0	0.0
Buoyancy on fdn.	-250.00	-250.00	0	-1375	0	0	0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0	0.0	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0	0.0	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0	0.0	0.0

Vertical Seismic**LWL**

Component	Pmax	Pmin	ML due to HL (about toe)	ML due to P (about toe)	MT	HL	HT
	t	t	t-m	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	0.0	803.3	0.0	0.0	0.0
Seismic Force on Substr.	101.8	-101.8	44.1	112.5	44.1	47.1	47.1
Weight of fdn	625.0	625.0	0.0	3437.5	0.0	0.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0	0.0	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0	0.0	0.0

HFL

Component	Pmax	Pmin	ML due to HL (about toe)	ML due to P (about toe)	MT	HL	HT
	t	t	t-m	t-m	t-m	t	t
Weight of Substr.	141.6	141.6	0.0	803.3	0.0	0.0	0.0
Seismic Force on Substr.	101.8	-101.8	44.1	112.5	44.1	47.1	47.1
Buoyancy on substr.	-37.5	-37.5	0.0	-206.25	0.0	0.0	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0	0.0	0.0
Buoyancy on fdn.	-250	-250	0	-1375	0	0	0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0	0.0	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0	0.0	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0	0.0	0.0

End of Summary of Forces at Abutment Shaft Bottom Level

11.LOAD COMBINATION (LIMIT STATE)

LOAD COMBINATION (LIMIT STATE)

Annex B, IRC:6-2010

Following Limit States are considered

A Ultimate Limit State (For verification of Equilibrium)

- A-1 Basic Combination
- A-2 Seismic Combination

B Ultimate Limit State (For verification of structural strength)

- B-1 Basic Combination
- B-2 Seismic Combination

C Serviceability Limit State

- C-1 Rare Combination (For checking stress limits)
- C-2 Quasi-permanent Combination (For checking crack width in RCC structures)

D Combination for Design of Foundation

- D-1 Combination 1
- D-2 Combination 2
- D-3 Seismic Combination

LOAD COMBINATION (LIMIT STATE)

12.DESIGN OF ABUTMENT SHAFT

B Ultimate Limit State (For verification of structural strength)

B-1 Basic Combination

1 LWL

1.1 Maximum Reaction Case

1.2 Maximum Moment Case

2 HFL

2.1 Maximum Reaction Case

2.2 Maximum Moment Case

At Abutment Shaft Bottom Level

Span present Condition

1 LWL

1.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1.35	752.1	752.1	0.0	0.0	0	0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	0.0	0	0	110.0	110.0	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	0.0	0	0	180.4	180.4	0.0	0.0	0.0	0.0
LL1	1.5	134.4	133.6	49.9	127.6	12.5	0	201.5	200.4	74.9	191.4	18.7	0.0
FPLL1	1.15	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1.5	0.0	0.0	165.6	0.0	76.5	0.0	0.0	0.0	248.4	0.0	114.8	0.0
LL Surcharge	1.2	0.0	0.0	91.8	0.0	35.6	0	0.0	0.0	110.2	0.0	42.7	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Total								1698.4	1697.3	466.5	191.4	176.2	0.0

1.2 Maximum Moment Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1.35	752.1	752.1	0.0	0.0	0.0	0.0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	93.7	93.7	0.0	0.0	0.0	0.0	126.5	126.5	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	85.2	85.2	0.0	0.0	0.0	0.0	149.0	149.0	0.0	0.0	0.0	0.0
LL2	1.5	95.1	94.0	80.1	300.1	20.00	0	142.7	140.9	120.1	450.2	30.0	0.0
FPLL2	1.15	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1.5	0.00	0.00	165.61	0.00	76.5	0.0	0.0	0.0	248.4	0.0	114.8	0.0
LL Surcharge	1.2	0.0	0.0	91.8	0.0	35.6	0.0	0.0	0.0	110.2	0.0	42.7	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Total								1624.7	1622.9	511.7	450.2	187.5	0.0

2 HFL

2.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1.35	752.1	752.1	0.0	0.0	0.0	0.0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	0.0	0.0	0.0	110.0	110.0	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	0.0	0.0	0.0	180.4	180.4	0.0	0.0	0.0	0.0
LL1	1.5	134.4	133.6	49.9	127.6	12.5	0.0	201.5	200.4	74.9	191.4	18.7	0.0
FPLL1	1.15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1.5	0.0	0.0	122.5	0.0	62.1	0.0	0.0	0.0	183.8	0.0	93.2	0.0
LL Surcharge	1.2	0.0	0.0	91.8	0.0	35.6	0.0	0.0	0.0	110.2	0.0	42.7	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								1692.8	1691.7	401.9	191.4	154.6	0.0

2.2 Maximum Moment Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1.35	752.1	752.1	0.0	0.0	0.0	0.0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	93.7	93.7	0.0	0.0	0.0	0.0	126.5	126.5	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	85.2	85.2	0.0	0.0	0.0	0.0	149.0	149.0	0.0	0.0	0.0	0.0
LL2	1.5	95.1	94.0	80.1	300.1	20.0	0.0	142.7	140.9	120.1	450.2	30.0	0.0
FPLL2	1.15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1.5	0.0	0.0	122.5	0.0	62.1	0.0	0.0	0.0	183.8	0.0	93.2	0.0
LL Surcharge	1.2	0.0	0.0	91.8	0.0	35.6	0.0	0.0	0.0	110.2	0.0	42.7	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								1619.1	1617.3	447.1	450.2	165.9	0.0

Span Dislodged Condition

1 LWL

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
Earth Pressure	1.5	0.00	0.00	165.61	0.00	76.50	0.00	0.0	0.0	248.4	0.0	114.8	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Total								191.2	191.2	281.5	0.0	114.8	0.0

2 HFL

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
Earth Pressure	1.5	0.0	0.0	122.5	0.0	62.1	0.0	0.0	0.0	183.8	0.0	93.2	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								185.5	185.5	216.8	0.0	93.2	0.0

Summary

Service Condition

		Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t
1	1.1	1698.4	1697.3	466.5	191.4	176.2	0.0
	1.2	1624.7	1622.9	511.7	450.2	187.5	0.0
2	2.1	1692.8	1691.7	401.9	191.4	154.6	0.0
	2.2	1619.1	1617.3	447.1	450.2	165.9	0.0

Span Dislodged Condition

	Pmax	Pmin	ML	MT	HL	HT
	t	t	t-m	t-m	t	t
1	191.2	191.2	281.5	0.0	114.8	0.0
2	185.5	185.5	216.8	0.0	93.2	0.0

B Ultimate Limit State (For verification of structural strength)

B-2 Seismic Combination

- | | |
|-----------------------------|-----------------------------|
| 1 LWL | 2 HFL |
| 1.1 Longitudinal Seismic | 2.1 Longitudinal Seismic |
| 1.1.1 Maximum Reaction Case | 2.1.1 Maximum Reaction Case |
| 1.1.2 Maximum Moment Case | 2.1.2 Maximum Moment Case |
| 1.2 Transverse Seismic | 2.2 Transverse Seismic |
| 1.2.1 Maximum Reaction Case | 2.2.1 Maximum Reaction Case |
| 1.2.2 Maximum Moment Case | 2.2.2 Maximum Moment Case |
| 1.3 Vertical Seismic | 2.3 Vertical Seismic |
| 1.3.1 Maximum Reaction Case | 2.3.1 Maximum Reaction Case |
| 1.3.2 Maximum Moment Case | 2.3.2 Maximum Moment Case |

Span present Condition

1 LWL

1.1 Longitudinal Seismic

1.1.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1.35	752.1	752.1	0.0	0.0	0.0	0.0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	0.0	0.0	0.0	110.0	110.0	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	0.0	0.0	0.0	180.4	180.4	0.0	0.0	0.0	0.0
LL1	0.2	134.4	133.6	49.9	127.6	12.5	0.0	26.9	26.7	10.0	25.5	2.5	0.0
FPLL1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	44.5	-44.5	1610.3	275.2	402.2	68.7	66.8	-66.8	2415.4	412.8	603.3	103.1
Earth Pressure	1	0.0	0.0	273.4	0.0	131.6	0.0	0.0	0.0	273.4	0.0	131.6	0.0
LL Surcharge	0.2	0.0	0.0	157.9	0.0	61.3	0.0	0.0	0.0	31.6	0.0	12.3	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	1.5	30.5	-30.5	551.8	147.4	157.0	47.1	45.8	-45.8	827.7	221.1	235.6	70.7
Total								1636.4	1411.0	3591.1	659.4	985.1	173.8

1.1.2 Maximum Moment Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax t	Pmin t	ML t-m	MT t-m	HL t	HT t	Pmax t	Pmin t	ML t-m	MT t-m	HL t	HT t
DL Sup	1.35	752.1	752.1	0.0	0.0	0.0	0.0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	93.7	93.7	0.0	0.0	0.0	0.0	126.5	126.5	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	85.2	85.2	0.0	0.0	0.0	0.0	149.0	149.0	0.0	0.0	0.0	0.0
LL2	0.2	95.1	94.0	80.1	300.1	20.0	0.0	19.0	18.8	16.0	60.0	4.0	0.0
FPLL2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	43.1	-43.1	1610.3	266.1	402.2	66.5	64.6	-64.6	2415.4	399.1	603.3	99.7
Earth Pressure	1	0.0	0.0	273.4	0.0	131.6	0.0	0.0	0.0	273.4	0.0	131.6	0.0
LL Surcharge	0.2	0.0	0.0	157.9	0.0	61.3	0.0	0.0	0.0	31.6	0.0	12.3	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	1.5	30.5	-30.5	551.8	147.4	157.0	47.1	45.8	-45.8	827.7	221.1	235.6	70.7
Total								1611.4	1390.4	3597.1	680.2	986.6	170.3

1.2 Transverse Seismic

1.2.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax t	Pmin t	ML t-m	MT t-m	HL t	HT t	Pmax t	Pmin t	ML t-m	MT t-m	HL t	HT t
DL Sup	1.35	752.1	752.1	0.0	0.0	0.0	0.0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	0.0	0.0	0.0	110.0	110.0	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	0.0	0.0	0.0	180.4	180.4	0.0	0.0	0.0	0.0
LL1	0.2	134.4	133.6	49.9	127.6	12.5	0.0	26.9	26.7	10.0	25.5	2.5	0.0
FPLL1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	44.5	-44.5	483.1	917.4	120.7	229.1	66.8	-66.8	724.6	1376.0	181.0	343.7
Earth Pressure	1	0.0	0.0	273.4	0.0	131.6	0.0	0.0	0.0	273.4	0.0	131.6	0.0
LL Surcharge	0.2	0.0	0.0	157.9	0.0	61.3	0.0	0.0	0.0	31.6	0.0	12.3	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	1.5	30.5	-30.5	207.9	491.4	47.1	157.0	45.8	-45.8	311.8	737.0	70.7	235.6
Total								1636.4	1411.0	1384.4	2138.6	398.0	579.2

1.2.2 Maximum Moment Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1.35	752.1	752.1	0.0	0.0	0.0	0.0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	93.7	93.7	0.0	0.0	0.0	0.0	126.5	126.5	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	85.2	85.2	0.0	0.0	0.0	0.0	149.0	149.0	0.0	0.0	0.0	0.0
LL2	0.2	95.1	94.0	80.1	300.1	20.0	0.0	19.0	18.8	16.0	60.0	4.0	0.0
FPLL2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	43.1	-43.1	483.1	886.9	120.7	221.5	64.6	-64.6	724.6	1330.4	181.0	332.3
Earth Pressure	1	0.0	0.0	273.4	0.0	131.6	0.0	0.0	0.0	273.4	0.0	131.6	0.0
LL Surcharge	0.2	0.0	0.0	157.9	0.0	61.3	0.0	0.0	0.0	31.6	0.0	12.3	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	1.5	30.5	-30.5	207.9	491.4	47.1	157.0	45.8	-45.8	311.8	737.0	70.7	235.6
Total								1611.4	1390.4	1390.4	2127.4	399.5	567.8

1.3 Vertical Seismic

1.3.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1.35	752.1	752.1	0.0	0.0	0.0	0.0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	0.0	0.0	0.0	110.0	110.0	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	0.0	0.0	0.0	180.4	180.4	0.0	0.0	0.0	0.0
LL1	0.2	134.4	133.6	49.9	127.6	12.5	0.0	26.9	26.7	10.0	25.5	2.5	0.0
FPLL1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	74.2	-74.2	550.4	275.2	137.5	68.7	111.4	-111.4	825.6	412.8	206.2	103.1
Earth Pressure	1	0.0	0.0	273.4	0.0	131.6	0.0	0.0	0.0	273.4	0.0	131.6	0.0
LL Surcharge	0.2	0.0	0.0	157.9	0.0	61.3	0.0	0.0	0.0	31.6	0.0	12.3	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	1.5	101.8	-101.8	348.9	147.4	47.1	47.1	152.7	-152.7	523.3	221.1	70.7	70.7
Total								1787.8	1259.6	1696.9	659.4	423.2	173.8

1.3.2 Maximum Moment Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1.35	752.1	752.1	0.0	0.0	0.0	0.0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	93.7	93.7	0.0	0.0	0.0	0.0	126.5	126.5	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	85.2	85.2	0.0	0.0	0.0	0.0	149.0	149.0	0.0	0.0	0.0	0.0
LL2	0.2	95.1	94.0	80.1	300.1	20.0	0.0	19.0	18.8	16.0	60.0	4.0	0.0
FPLL2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	143.6	-143.6	532.1	266.1	132.9	66.5	215.4	-215.4	798.2	399.1	199.4	99.7
Earth Pressure	1	0.0	0.0	273.4	0.0	131.6	0.0	0.0	0.0	273.4	0.0	131.6	0.0
LL Surcharge	0.2	0.0	0.0	157.9	0.0	61.3	0.0	0.0	0.0	31.6	0.0	12.3	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	1.5	101.8	-101.8	348.9	147.4	47.1	47.1	152.7	-152.7	523.3	221.1	70.7	70.7
Total								1869.1	1132.8	1675.5	680.2	417.9	170.3

2 HFL

2.1 Longitudinal Seismic

2.1.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1.35	752.1	752.1	0.0	0.0	0.0	0.0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	0.0	0.0	0.0	110.0	110.0	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	0.0	0.0	0.0	180.4	180.4	0.0	0.0	0.0	0.0
LL1	0.2	134.4	133.6	49.9	127.6	12.5	0.0	26.9	26.7	10.0	25.5	2.5	0.0
FPLL1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	44.5	-44.5	1610.3	275.2	402.2	68.7	66.8	-66.8	2415.4	412.8	603.3	103.1
Earth Pressure	1	0.0	0.0	214.4	0.0	106.8	0.0	0.0	0.0	214.4	0.0	106.8	0.0
LL Surcharge	0.2	0.0	0.0	157.9	0.0	61.3	0.0	0.0	0.0	31.6	0.0	12.3	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	1.5	30.5	-30.5	551.8	147.4	157.0	47.1	45.8	-45.8	827.7	221.1	235.6	70.7
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								1630.8	1405.4	3532.1	659.4	960.4	173.8

2.1.2 Maximum Moment Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1.35	752.1	752.1	0.0	0.0	0.0	0.0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	93.7	93.7	0.0	0.0	0.0	0.0	126.5	126.5	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	85.2	85.2	0.0	0.0	0.0	0.0	149.0	149.0	0.0	0.0	0.0	0.0
LL2	0.2	95.1	94.0	80.1	300.1	20.0	0.0	19.0	18.8	16.0	60.0	4.0	0.0
FPLL2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	43.1	-43.1	1610.3	266.1	402.2	66.5	64.6	-64.6	2415.4	399.1	603.3	99.7
Earth Pressure	1	0.0	0.0	214.4	0.0	106.8	0.0	0.0	0.0	214.4	0.0	106.8	0.0
LL Surcharge	0.2	0.0	0.0	157.9	0.0	61.3	0.0	0.0	0.0	31.6	0.0	12.3	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	1.5	30.5	-30.5	551.8	147.4	157.0	47.1	45.8	-45.8	827.7	221.1	235.6	70.7
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								1605.8	1384.8	3538.1	680.2	961.9	170.3

2.2 Transverse Seismic

2.2.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1.35	752.1	752.1	0.0	0.0	0.0	0.0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	0.0	0.0	0.0	110.0	110.0	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	0.0	0.0	0.0	180.4	180.4	0.0	0.0	0.0	0.0
LL1	0.2	134.4	133.6	49.9	127.6	12.5	0.0	26.9	26.7	10.0	25.5	2.5	0.0
FPLL1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	44.5	-44.5	483.1	917.4	120.7	229.1	66.8	-66.8	724.6	1376.0	181.0	343.7
Earth Pressure	1	0.0	0.0	214.4	0.0	106.8	0.0	0.0	0.0	214.4	0.0	106.8	0.0
LL Surcharge	0.2	0.0	0.0	157.9	0.0	61.3	0.0	0.0	0.0	31.6	0.0	12.3	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	1.5	30.5	-30.5	207.9	491.4	47.1	157.0	45.8	-45.8	311.8	737.0	70.7	235.6
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								1630.8	1405.4	1325.4	2138.6	373.2	579.2

2.2.2 Maximum Moment Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1.35	752.1	752.1	0.0	0.0	0.0	0.0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	93.7	93.7	0.0	0.0	0.0	0.0	126.5	126.5	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	85.2	85.2	0.0	0.0	0.0	0.0	149.0	149.0	0.0	0.0	0.0	0.0
LL2	0.2	95.1	94.0	80.1	300.1	20.0	0.0	19.0	18.8	16.0	60.0	4.0	0.0
FPLL2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	43.1	-43.1	483.1	886.9	120.7	221.5	64.6	-64.6	724.6	1330.4	181.0	332.3
Earth Pressure	1	0.0	0.0	214.4	0.0	106.8	0.0	0.0	0.0	214.4	0.0	106.8	0.0
LL Surcharge	0.2	0.0	0.0	157.9	0.0	61.3	0.0	0.0	0.0	31.6	0.0	12.3	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	1.5	30.5	-30.5	207.9	491.4	47.1	157.0	45.8	-45.8	311.8	737.0	70.7	235.6
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								1605.8	1384.8	1331.4	2127.4	374.7	567.8

2.3 Vertical Seismic

2.3.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1.35	752.1	752.1	0.0	0.0	0.0	0.0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	0.0	0.0	0.0	110.0	110.0	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	0.0	0.0	0.0	180.4	180.4	0.0	0.0	0.0	0.0
LL1	0.2	134.4	133.6	49.9	127.6	12.5	0.0	26.9	26.7	10.0	25.5	2.5	0.0
FPLL1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	74.2	-74.2	550.4	275.2	137.5	68.7	111.4	-111.4	825.6	412.8	206.2	103.1
Earth Pressure	1	0.0	0.0	214.4	0.0	106.8	0.0	0.0	0.0	214.4	0.0	106.8	0.0
LL Surcharge	0.2	0.0	0.0	157.9	0.0	61.3	0.0	0.0	0.0	31.6	0.0	12.3	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	1.5	101.8	-101.8	348.9	147.4	47.1	47.1	152.7	-152.7	523.3	221.1	70.7	70.7
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								1782.2	1253.9	1637.9	659.4	398.4	173.8

2.3.2 Maximum Moment Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1.35	752.1	752.1	0.0	0.0	0.0	0.0	1015.3	1015.3	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1.35	93.7	93.7	0.0	0.0	0.0	0.0	126.5	126.5	0.0	0.0	0.0	0.0
SIDL(w/c)	1.75	85.2	85.2	0.0	0.0	0.0	0.0	149.0	149.0	0.0	0.0	0.0	0.0
LL2	0.2	95.1	94.0	80.1	300.1	20.0	0.0	19.0	18.8	16.0	60.0	4.0	0.0
FPLL2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	143.6	-143.6	532.1	266.1	132.9	66.5	215.4	-215.4	798.2	399.1	199.4	99.7
Earth Pressure	1	0.0	0.0	214.4	0.0	106.8	0.0	0.0	0.0	214.4	0.0	106.8	0.0
LL Surcharge	0.2	0.0	0.0	157.9	0.0	61.3	0.0	0.0	0.0	31.6	0.0	12.3	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	1.5	101.8	-101.8	348.9	147.4	47.1	47.1	152.7	-152.7	523.3	221.1	70.7	70.7
Buovancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								1863.4	1127.1	1616.6	680.2	393.1	170.3

Span Dislodged Condition

1 LWL

1.1 Longitudinal Seismic

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
Earth Pressure	1	0.0	0.0	273.4	0.0	131.6	0.0	0.0	0.0	273.4	0.0	131.6	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	0.75	30.5	-30.5	551.8	147.4	157.0	47.1	22.9	-22.9	413.9	110.6	117.8	35.3
Total								214.1	168.3	720.3	110.6	249.4	35.3

1.2 Transverse Seismic

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
Earth Pressure	1	0.0	0.0	273.4	0.0	131.6	0.0	0.0	0.0	273.4	0.0	131.6	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	0.75	30.5	-30.5	207.9	491.4	47.1	157.0	22.9	-22.9	155.9	368.5	35.3	117.8
Total								214.1	168.3	462.3	368.5	166.9	117.8

1.3 Vertical Seismic

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
Earth Pressure	1	0.0	0.0	273.4	0.0	131.6	0.0	0.0	0.0	273.4	0.0	131.6	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	0.75	101.8	-101.8	348.9	147.4	47.1	47.1	76.3	-76.3	261.7	110.6	35.3	35.3
Total								267.5	114.8	568.1	110.6	166.9	35.3

2 HFL

2.1 Longitudinal Seismic

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
Earth Pressure	1	0.0	0.0	214.4	0.0	106.8	0.0	0.0	0.0	214.4	0.0	106.8	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	0.75	30.5	-30.5	551.8	147.4	157.0	47.1	22.9	-22.9	413.9	110.6	117.8	35.3
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								208.4	162.6	661.3	110.6	224.6	35.3

2.2 Transverse Seismic

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
Earth Pressure	1	0.0	0.0	214.4	0.0	106.8	0.0	0.0	0.0	214.4	0.0	106.8	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	0.75	30.5	-30.5	207.9	491.4	47.1	157.0	22.9	-22.9	155.9	368.5	35.3	117.8
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								208.4	162.6	403.3	368.5	142.1	117.8

2.3 Vertical Seismic

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
Earth Pressure	1	0.0	0.0	214.4	0.0	106.8	0.0	0.0	0.0	214.4	0.0	106.8	0.0
Weight of Substr.	1.35	141.6	141.6	24.5	0.0	0.0	0.0	191.2	191.2	33.0	0.0	0.0	0.0
Seismic Force on Substr.	0.75	101.8	-101.8	348.9	147.4	47.1	47.1	76.3	-76.3	261.7	110.6	35.3	35.3
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								261.9	109.2	509.1	110.6	142.1	35.3

Summary

Service Condition

			Pmax	Pmin	ML	MT	HL	HT
			t	t	t-m	t-m	t	t
1	1.1	1.1.1	1636.4	1411.0	3591.1	659.4	985.1	173.8
		1.1.2	1611.4	1390.4	3597.1	680.2	986.6	170.3
	1.2	1.2.1	1636.4	1411.0	1384.4	2138.6	398.0	579.2
		1.2.2	1611.4	1390.4	1390.4	2127.4	399.5	567.8
	1.3	1.3.1	1787.8	1259.6	1696.9	659.4	423.2	173.8
		1.3.2	1869.1	1132.8	1675.5	680.2	417.9	170.3
2	2.1	2.1.1	1630.8	1405.4	3532.1	659.4	960.4	173.8
		2.1.2	1605.8	1384.8	3538.1	680.2	961.9	170.3
	2.2	2.2.1	1630.8	1405.4	1325.4	2138.6	373.2	579.2
		2.2.2	1605.8	1384.8	1331.4	2127.4	374.7	567.8
	2.3	2.3.1	1782.2	1253.9	1637.9	659.4	398.4	173.8
		2.3.2	1863.4	1127.1	1616.6	680.2	393.1	170.3

Span Dislodged Condition

			Pmax	Pmin	ML	MT	HL	HT
			t	t	t-m	t-m	t	t
1	1.1		214.1	168.3	720.3	110.6	249.4	35.3
	1.2		214.1	168.3	462.3	368.5	166.9	117.8
	1.3		267.5	114.8	568.1	110.6	166.9	35.3
2	2.1		208.4	162.6	661.3	110.6	224.6	35.3
	2.2		208.4	162.6	403.3	368.5	142.1	117.8
	2.3		261.9	109.2	509.1	110.6	142.1	35.3

C Serviceability Limit State
C-1 Rare Combination (For checking stress limits)

1 LWL

1.1 Maximum Reaction Case

1.2 Maximum Moment Case

2 HFL

2.1 Maximum Reaction Case

2.2 Maximum Moment Case

At Abutment Shaft Bottom Level

Span present Condition

1 LWL

1.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1	752.1	752.1	0.0	0.0	0	0	752.1	752.1	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1	81.5	81.5	0.0	0.0	0	0	81.5	81.5	0.0	0.0	0.0	0.0
SIDL(w/c)	1	103.1	103.1	0.0	0.0	0	0	103.1	103.1	0.0	0.0	0.0	0.0
LL1	1	134.4	133.6	49.9	127.6	12.5	0	134.4	133.6	49.9	127.6	12.5	0.0
FPLL1	0.75	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1	0.0	0.0	165.6	0.0	76.5	0.0	0.0	0.0	165.6	0.0	76.5	0.0
LL Surcharge	0.8	0.0	0.0	91.8	0.0	35.6	0	0.0	0.0	73.4	0.0	28.5	0.0
Weight of Substr.	1	141.6	141.6	24.5	0.0	0.0	0.0	141.6	141.6	24.5	0.0	0.0	0.0
Total								1212.6	1211.9	313.4	127.6	117.5	0.0

1.2 Maximum Moment Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1	752.1	752.1	0.0	0.0	0.0	0.0	752.1	752.1	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1	93.7	93.7	0.0	0.0	0.0	0.0	93.7	93.7	0.0	0.0	0.0	0.0
SIDL(w/c)	1	85.2	85.2	0.0	0.0	0.0	0.0	85.2	85.2	0.0	0.0	0.0	0.0
LL2	1	95.1	94.0	80.1	300.1	20	0	95.1	94.0	80.1	300.1	20.0	0.0
FPLL2	0.75	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1	0.00	0.00	165.61	0.00	76.5	0.0	0.0	0.0	165.6	0.0	76.5	0.0
LL Surcharge	0.8	0.0	0.0	91.8	0.0	35.6	0.0	0.0	0.0	73.4	0.0	28.5	0.0
Weight of Substr.	1	141.6	141.6	24.5	0.0	0.0	0.0	141.6	141.6	24.5	0.0	0.0	0.0
Total								1167.7	1166.5	343.6	300.1	125.0	0.0

2 HFL

2.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1	752.1	752.1	0.0	0.0	0.0	0.0	752.1	752.1	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1	81.5	81.5	0.0	0.0	0.0	0.0	81.5	81.5	0.0	0.0	0.0	0.0
SIDL(w/c)	1	103.1	103.1	0.0	0.0	0.0	0.0	103.1	103.1	0.0	0.0	0.0	0.0
LL1	1	134.4	133.6	49.9	127.6	12.5	0.0	134.4	133.6	49.9	127.6	12.5	0.0
FPLL1	0.75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1	0.0	0.0	122.5	0.0	62.1	0.0	0.0	0.0	122.5	0.0	62.1	0.0
LL Surcharge	0.8	0.0	0.0	91.8	0.0	35.6	0.0	0.0	0.0	73.4	0.0	28.5	0.0
Weight of Substr.	1	141.6	141.6	24.5	0.0	0.0	0.0	141.6	141.6	24.5	0.0	0.0	0.0
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								1207.0	1206.2	270.4	127.6	103.1	0.0

2.2 Maximum Moment Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1	752.1	752.1	0.0	0.0	0.0	0.0	752.1	752.1	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1	93.7	93.7	0.0	0.0	0.0	0.0	93.7	93.7	0.0	0.0	0.0	0.0
SIDL(w/c)	1	85.2	85.2	0.0	0.0	0.0	0.0	85.2	85.2	0.0	0.0	0.0	0.0
LL2	1	95.1	94.0	80.1	300.1	20.0	0.0	95.1	94.0	80.1	300.1	20.0	0.0
FPLL2	0.75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1	0.0	0.0	122.5	0.0	62.1	0.0	0.0	0.0	122.5	0.0	62.1	0.0
LL Surcharge	0.8	0.0	0.0	91.8	0.0	35.6	0.0	0.0	0.0	73.4	0.0	28.5	0.0
Weight of Substr.	1	141.6	141.6	24.5	0.0	0.0	0.0	141.6	141.6	24.5	0.0	0.0	0.0
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								1162.1	1160.9	300.5	300.1	110.6	0.0

Span Dislodged Condition

1 LWL

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
Earth Pressure	1	0.00	0.00	165.61	0.00	76.50	0.00	0.0	0.0	165.6	0.0	76.5	0.0
Weight of Substr.	1	141.6	141.6	24.5	0.0	0.0	0.0	141.6	141.6	24.5	0.0	0.0	0.0
Total								141.6	141.6	190.1	0.0	76.5	0.0

2 HFL

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
Earth Pressure	1	0.0	0.0	122.5	0.0	62.1	0.0	0.0	0.0	122.5	0.0	62.1	0.0
Weight of Substr.	1	141.6	141.6	24.5	0.0	0.0	0.0	141.6	141.6	24.5	0.0	0.0	0.0
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								136.0	136.0	147.0	0.0	62.1	0.0

Summary

Service Condition

		Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t
1	1.1	1212.6	1211.9	313.4	127.6	117.5	0.0
	1.2	1167.7	1166.5	343.6	300.1	125.0	0.0
2	2.1	1207.0	1206.2	270.4	127.6	103.1	0.0
	2.2	1162.1	1160.9	300.5	300.1	110.6	0.0

Span Dislodged Condition

	Pmax	Pmin	ML	MT	HL	HT
	t	t	t-m	t-m	t	t
1	141.6	141.6	190.1	0.0	76.5	0.0
2	136.0	136.0	147.0	0.0	62.1	0.0

C Serviceability Limit State
C-2 Quasi-permanent Combination (For checking crack width in RCC structures)

- 1 LWL
 - 1.1 Maximum Reaction Case
 - 1.2 Maximum Moment Case
- 2 HFL
 - 2.1 Maximum Reaction Case
 - 2.2 Maximum Moment Case

At Abutment Shaft Bottom Level

Span present Condition

1 LWL

1.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1	752.1	752.1	0.0	0.0	0	0	752.1	752.1	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1	81.5	81.5	0.0	0.0	0	0	81.5	81.5	0.0	0.0	0.0	0.0
SIDL(w/c)	1	103.1	103.1	0.0	0.0	0	0	103.1	103.1	0.0	0.0	0.0	0.0
LL1	0	134.4	133.6	49.9	127.6	12.5	0	0.0	0.0	0.0	0.0	0.0	0.0
FPLL1	0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1	0.0	0.0	165.6	0.0	76.5	0.0	0.0	0.0	165.6	0.0	76.5	0.0
LL Surcharge	0	0.0	0.0	91.8	0.0	35.6	0	0.0	0.0	0.0	0.0	0.0	0.0
Weight of Substr.	1	141.6	141.6	24.5	0.0	0.0	0.0	141.6	141.6	24.5	0.0	0.0	0.0
Total								1078.3	1078.3	190.1	0.0	76.5	0.0

1.2 Maximum Moment Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1	752.1	752.1	0.0	0.0	0.0	0.0	752.1	752.1	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1	93.7	93.7	0.0	0.0	0.0	0.0	93.7	93.7	0.0	0.0	0.0	0.0
SIDL(w/c)	1	85.2	85.2	0.0	0.0	0.0	0.0	85.2	85.2	0.0	0.0	0.0	0.0
LL2	0	95.1	94.0	80.1	300.1	20	0	0.0	0.0	0.0	0.0	0.0	0.0
FPLL2	0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1	0.00	0.00	165.61	0.00	76.5	0.0	0.0	0.0	165.6	0.0	76.5	0.0
LL Surcharge	0	0.0	0.0	91.8	0.0	35.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weight of Substr.	1	141.6	141.6	24.5	0.0	0.0	0.0	141.6	141.6	24.5	0.0	0.0	0.0
Total								1072.6	1072.6	190.1	0.0	76.5	0.0

2 HFL

2.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1	752.1	752.1	0.0	0.0	0.0	0.0	752.1	752.1	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1	81.5	81.5	0.0	0.0	0.0	0.0	81.5	81.5	0.0	0.0	0.0	0.0
SIDL(w/c)	1	103.1	103.1	0.0	0.0	0.0	0.0	103.1	103.1	0.0	0.0	0.0	0.0
LL1	0	134.4	133.6	49.9	127.6	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FPLL1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1	0.0	0.0	122.5	0.0	62.1	0.0	0.0	0.0	122.5	0.0	62.1	0.0
LL Surcharge	0	0.0	0.0	91.8	0.0	35.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weight of Substr.	1	141.6	141.6	24.5	0.0	0.0	0.0	141.6	141.6	24.5	0.0	0.0	0.0
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								1072.6	1072.6	147.0	0.0	62.1	0.0

2.2 Maximum Moment Case

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
DL Sup	1	752.1	752.1	0.0	0.0	0.0	0.0	752.1	752.1	0.0	0.0	0.0	0.0
SIDL(excl. w/c)	1	93.7	93.7	0.0	0.0	0.0	0.0	93.7	93.7	0.0	0.0	0.0	0.0
SIDL(w/c)	1	85.2	85.2	0.0	0.0	0.0	0.0	85.2	85.2	0.0	0.0	0.0	0.0
LL2	0	95.1	94.0	80.1	300.1	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FPLL2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1	0.0	0.0	122.5	0.0	62.1	0.0	0.0	0.0	122.5	0.0	62.1	0.0
LL Surcharge	0	0.0	0.0	91.8	0.0	35.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weight of Substr.	1	141.6	141.6	24.5	0.0	0.0	0.0	141.6	141.6	24.5	0.0	0.0	0.0
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								1066.9	1066.9	147.0	0.0	62.1	0.0

Span Dislodged Condition

1 LWL

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
Earth Pressure	1	0.00	0.00	165.61	0.00	76.50	0.00	0.0	0.0	165.6	0.0	76.5	0.0
Weight of Substr.	1	141.6	141.6	24.5	0.0	0.0	0.0	141.6	141.6	24.5	0.0	0.0	0.0
Total								141.6	141.6	190.1	0.0	76.5	0.0

2 HFL

	Partial Safety Factor	Unfactored						Factored					
		Pmax	Pmin	ML	MT	HL	HT	Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t	t	t	t-m	t-m	t	t
Earth Pressure	1	0.0	0.0	122.5	0.0	62.1	0.0	0.0	0.0	122.5	0.0	62.1	0.0
Weight of Substr.	1	141.6	141.6	24.5	0.0	0.0	0.0	141.6	141.6	24.5	0.0	0.0	0.0
Buoyancy on substr.	0.15	-37.5	-37.5	0.0	0.0	0.0	0.0	-5.6	-5.6	0.0	0.0	0.0	0.0
Total								136.0	136.0	147.0	0.0	62.1	0.0

Summary

Service Condition

		Pmax	Pmin	ML	MT	HL	HT
		t	t	t-m	t-m	t	t
1	1.1	1078.3	1078.3	190.1	0.0	76.5	0.0
	1.2	1072.6	1072.6	190.1	0.0	76.5	0.0
2	2.1	1072.6	1072.6	147.0	0.0	62.1	0.0
	2.2	1066.9	1066.9	147.0	0.0	62.1	0.0

Span Dislodged Condition

	Pmax	Pmin	ML	MT	HL	HT
	t	t	t-m	t-m	t	t
1	141.6	141.6	190.1	0.0	76.5	0.0
2	136.0	136.0	147.0	0.0	62.1	0.0

LOAD COMBINATION (LIMIT STATE)

13.OVERTURNING AND SLIDING STABILITY

A Ultimate Limit State (For Verification of Equilibrium)

A-1 Basic Combination

Overturning Stability

- 1 LWL
- 1.1 Maximum Reaction Case
- 1.2 Maximum Moment Case
- 2 HFL
- 2.1 Maximum Reaction Case
- 2.2 Maximum Moment Case

Sliding Stability

- 1 LWL
- 1.1 Maximum Reaction Case
- 1.2 Maximum Moment Case
- 2 HFL
- 2.1 Maximum Reaction Case
- 2.2 Maximum Moment Case

Overturning Stability

1 LWL

1.1 Maximum Reaction Case

		Unfactored ML (about toe)	Remarks	Partial Safety Factor	Factored ML (about toe)	Factored Overturning ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL_Sup		4136.3	R	0.95	3929.5	0.0	3929.5
SIDL(excl. w/c)		515.5	R	0.95	489.7	0.0	489.7
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL1	Due to HL	-81.1	O	1.5	-121.6	-121.6	0.0
	Due to P	738.9	R	0	0.0	0.0	0.0
FPLL1		0.0	O	1.15	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Earth Pressure	Due to HL	-542.4	O	1.5	-813.6	-813.6	0.0
	Due to P	725.3	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-202.5	O	1.2	-243.0	-243.0	0.0
Weight of Substr.		803.3	R	0.95	763.2	0.0	763.2
Weight of fdn		3437.5	R	0.95	3265.6	0.0	3265.6
Return Wall Wt.		615.7	R	0.95	584.9	0.0	584.9
Backfill Wt.		5098.3	R	0.95	4843.3	0.0	4843.3

LEGENDS

O	Overturning
S	Sliding
U	Uplift
R	Resisting
FOS	Factor of Safety
F _O	FOS for Overturning
F _S	FOS for Sliding

Service Condition

M _O	=	-1178.1
M _R	=	14344.7
F _O	=	12.18

Span Dislodged Condition

M _O	=	-1056.5
M _R	=	9457.1
F _O	=	8.95

1.2 Maximum Moment Case

		Unfactored ML (about toe)	Remarks	Partial Safety Factor	Factored ML (about toe)	Factored Overturning ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL_Sup		4136.3	R	0.95	3929.5	0.0	3929.5
SIDL(excl. w/c)		515.5	R	0.95	489.7	0.0	489.7
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL2	Due to HL	-130.1	O	1.5	-195.1	-195.1	0.0
	Due to P	523.2	R	0	0.0	0.0	0.0
FPLL2		0.0	O	1.15	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Earth Pressure	Due to HL	-542.4	O	1.5	-813.6	-813.6	0.0
	Due to P	725.3	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-202.5	O	1.2	-243.0	-243.0	0.0
Weight of Substr.		803.3	R	0.95	763.2	0.0	763.2
Weight of fdn		3437.5	R	0.95	3265.6	0.0	3265.6
Return Wall Wt.		615.7	R	0.95	584.9	0.0	584.9
Backfill Wt.		5098.3	R	0.95	4843.3	0.0	4843.3

Service Condition

M_O	=	-1251.7
M_R	=	14344.7
F_O	=	11.46

Span Dislodged Condition

M_O	=	-1056.5
M_R	=	9457.1
F_O	=	8.95

2 HFL

2.1 Maximum Reaction Case

		Unfactored ML (about toe)	Remarks	Partial Safety Factor	Factored ML (about toe)	Factored Overturning ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL_Sup		4136.3	R	0.95	3929.5	0.0	3929.5
SIDL(excl. w/c)		515.5	R	0.95	489.7	0.0	489.7
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL1	Due to HL	-81.1	O	1.5	-121.6	-121.6	0.0
	Due to P	738.9	R	0	0.0	0.0	0.0
FPLL1		0.0	O	1.15	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Earth Pressure	Due to HL	-329.3	O	1.5	-493.9	-493.9	0.0
	Due to P	517.3	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-202.5	O	1.2	-243.0	-243.0	0.0
Weight of Substr.		803.3	R	0.95	763.2	0.0	763.2
Buoyancy on substr.		-206.3	O	1	-206.3	-206.3	0.0
Weight of fdn		3437.5	R	0.95	3265.6	0.0	3265.6
Buoyancy on fdn.		-1375.0	O	1	-1375.0	-1375.0	0.0
Return Wall Wt.		615.7	R	0.95	584.9	0.0	584.9
Buoyancy on Return wall.		-163.3	O	1	-163.3	-163.3	0.0
Backfill Wt.		5098.3	R	0.95	4843.3	0.0	4843.3

Service Condition

M_O	=	-2603.0
M_R	=	14344.7
F_O	=	5.51

Span Dislodged Condition

M_O	=	-2481.4
M_R	=	9457.1
F_O	=	3.81

2.2 Maximum Moment Case

		Unfactored ML (about toe)	Remarks	Partial Safety Factor	Factored ML (about toe)	Factored Overturning ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL_Sup		4136.3	R	0.95	3929.5	0.0	3929.5
SIDL(excl. w/c)		515.5	R	0.95	489.7	0.0	489.7
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL2	Due to HL	-130.1	O	1.5	-195.1	-195.1	0.0
	Due to P	523.2	R	0	0.0	0.0	0.0
FPLL2		0.0	O	1.15	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Earth Pressure	Due to HL	-329.3	O	1.5	-493.9	-493.9	0.0
	Due to P	517.3	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-202.5	O	1.2	-243.0	-243.0	0.0
Weight of Substr.		803.3	R	0.95	763.2	0.0	763.2
Buoyancy on substr.		-206.3	O	1	-206.3	-206.3	0.0
Weight of fdn		3437.5	R	0.95	3265.6	0.0	3265.6
Buoyancy on fdn.		-1375.0	O	1	-1375.0	-1375.0	0.0
Return Wall Wt.		615.7	R	0.95	584.9	0.0	584.9
Buoyancy on Return wall.		-163.3	O	1	-163.3	-163.3	0.0
Backfill Wt.		5098.3	R	0.95	4843.3	0.0	4843.3

Service Condition

M_O	=	-2676.5
M_R	=	14344.7
F_O	=	5.36

Span Dislodged Condition

M_O	=	-2481.4
M_R	=	9457.1
F_O	=	3.81

Sliding Stability

1 LWL

1.1 Maximum Reaction Case

	Unfactored HL	Remarks	Partial Safety Factor	Factored HL	Unfactored Pmin	Remarks	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL_Sup	0.0	R	0.95	0.0	752.1	R	0.95	714.4
SIDL(excl. w/c)	0.0	R	0.95	0.0	93.7	R	0.95	89.0
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL1	12.5	S	1.5	18.7	133.6	R	0	0.0
FPLL1	20.0	S	1.15	23.0	0.0	U	1.15	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Earth Pressure	168.7	S	1.5	253.1	65.9	R	0	0.0
LL Surcharge	52.9	S	1.2	63.5	0.0	U	1.2	0.0
Weight of Substr.	0.0	R	0.95	0.0	141.6	R	0.95	134.5
Weight of fdn	0.0	R	0.95	0.0	625.0	R	0.95	593.8
Return Wall Wt.	0.0	R	0.95	0.0	70.7	R	0.95	67.2
Backfill Wt.	0.0	R	0.95	0.0	585.4	R	0.95	556.2

Service Condition

ΣH	=	358.3
ΣP	=	2240.3
μ	=	0.70
F_S	=	$\mu \Sigma P / \Sigma H$
	=	4.38

Span Dislodged Condition

ΣH	=	316.6
ΣP	=	1351.6
μ	=	0.70
F_S	=	$\mu \Sigma P / \Sigma H$
	=	2.99

1.2 Maximum Moment Case

	Unfactored HL	Remarks	Partial Safety Factor	Factored HL	Unfactored Pmin	Remarks	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL_Sup	0.0	R	0.95	0.0	752.1	R	0.95	714.4
SIDL(excl. w/c)	0.0	R	0.95	0.0	93.7	R	0.95	89.0
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL2	20.0	S	1.5	30.0	95.1	R	0	0.0
FPLL2	0.0	R	0	0.0	0.0	U	1.15	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Earth Pressure	168.7	S	1.5	253.1	65.9	R	0	0.0
LL Surcharge	52.9	S	1.2	63.5	0.0	U	1.2	0.0
Weight of Substr.	0.0	R	0.95	0.0	141.6	R	0.95	134.5
Weight of fdn	0.0	R	0.95	0.0	625.0	R	0.95	593.8
Return Wall Wt.	0.0	R	0.95	0.0	70.7	R	0.95	67.2
Backfill Wt.	0.0	R	0.95	0.0	585.4	R	0.95	556.2

Service Condition

ΣH	=	346.6
ΣP	=	2240.3
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	4.52

Span Dislodged Condition

ΣH	=	316.6
ΣP	=	1351.6
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	2.99

2 HFL

2.1 Maximum Reaction Case

	Unfactored HL	Remarks	Partial Safety Factor	Factored HL	Unfactored Pmin	Remarks	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL_Sup	0.0	R	0.95	0.0	752.1	R	0.95	714.4
SIDL(excl. w/c)	0.0	R	0.95	0.0	93.7	R	0.95	89.0
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL1	12.5	S	1.5	18.7	133.6	R	0	0.0
FPLL1	20.0	S	1.15	23.0	0.0	U	1.15	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Earth Pressure	120.3	S	1.5	180.5	47.0	R	0	0.0
LL Surcharge	52.9	S	1.2	63.5	0.0	U	1.2	0.0
Weight of Substr.	0.0	R	0.95	0.0	141.6	R	0.95	134.5
Buoyancy on substr.	0.0	R	0	0.0	-37.5	U	1	-37.5
Weight of fdn	0.0	R	0.95	0.0	625.0	R	0.95	593.8
Buoyancy on fdn.	0.0	R	0	0.0	-250.0	U	1	-250.0
Return Wall Wt.	0.0	R	0.95	0.0	70.7	R	0.95	67.2
Buoyancy on Return wall.	0.0	R	0	0.0	-18.8	U	1	-18.8
Backfill Wt.	0.0	R	0.95	0.0	585.4	R	0.95	556.2

Service Condition

ΣH	=	285.7
ΣP	=	1934.0
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	4.74

Span Dislodged Condition

ΣH	=	244.0
ΣP	=	1045.4
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	3.00

2.2 Maximum Moment Case

	Unfactored HL	Remarks	Partial Safety Factor	Factored HL	Unfactored Pmin	Remarks	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL_Sup	0.0	R	0.95	0.0	752.1	R	0.95	714.4
SIDL(excl. w/c)	0.0	R	0.95	0.0	93.7	R	0.95	89.0
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL2	20.0	S	1.5	30.0	95.1	R	0	0.0
FPLL2	0.0	R	0	0.0	0.0	U	1.15	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Earth Pressure	120.3	S	1.5	180.5	47.0	R	0	0.0
LL Surcharge	52.9	S	1.2	63.5	0.0	U	1.2	0.0
Weight of Substr.	0.0	R	0.95	0.0	141.6	R	0.95	134.5
Buoyancy on substr.	0.0	R	0	0.0	-37.5	U	1	-37.5
Weight of fdn	0.0	R	0.95	0.0	625.0	R	0.95	593.8
Buoyancy on fdn.	0.0	R	0	0.0	-250.0	U	1	-250.0
Return Wall Wt.	0.0	R	0.95	0.0	70.7	R	0.95	67.2
Buoyancy on Return wall.	0.0	R	0	0.0	-18.8	U	1	-18.8
Backfill Wt.	0.0	R	0.95	0.0	585.4	R	0.95	556.2

Service Condition

ΣH	=	274.0
ΣP	=	1934.0
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	4.94

Span Dislodged Condition

ΣH	=	244.0
ΣP	=	1045.4
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	3.00

Summary

	Normal	Seismic
FOS against overturning	2	1.5
FOS against sliding	1.5	1.25

Point no 2, Annexure B, IRC:6-2010

		Service Condition				Span Dislodged Condition			
		F_0	Check	F_s	Check	F_0	Check	F_s	Check
1	1.1	12.18	OK	4.38	OK	8.95	OK	2.99	OK
	1.2	11.46	OK	4.52	OK	8.95	OK	2.99	OK
2	2.1	5.51	OK	4.74	OK	3.81	OK	3.00	OK
	2.2	5.36	OK	4.94	OK	3.81	OK	3.00	OK

A Ultimate Limit State (For Verification of Equilibrium)

A-2 Seismic Combination

Overturning Stability

- 1 LWL
 - 1.1 Longitudinal Seismic
 - 1.1.1 Maximum Reaction Case
 - 1.1.2 Maximum Moment Case
 - 1.2 Transverse Seismic
 - 1.2.1 Maximum Reaction Case
 - 1.2.2 Maximum Moment Case
 - 1.3 Vertical Seismic
 - 1.3.1 Maximum Reaction Case
 - 1.3.2 Maximum Moment Case

- 2 HFL
 - 2.1 Longitudinal Seismic
 - 2.1.1 Maximum Reaction Case
 - 2.1.2 Maximum Moment Case
 - 2.2 Transverse Seismic
 - 2.2.1 Maximum Reaction Case
 - 2.2.2 Maximum Moment Case
 - 2.3 Vertical Seismic
 - 2.3.1 Maximum Reaction Case
 - 2.3.2 Maximum Moment Case

Sliding Stability

- 1 LWL
 - 1.1 Longitudinal Seismic
 - 1.1.1 Maximum Reaction Case
 - 1.1.2 Maximum Moment Case
 - 1.2 Transverse Seismic
 - 1.2.1 Maximum Reaction Case
 - 1.2.2 Maximum Moment Case
 - 1.3 Vertical Seismic
 - 1.3.1 Maximum Reaction Case
 - 1.3.2 Maximum Moment Case

- 2 HFL
 - 2.1 Longitudinal Seismic
 - 2.1.1 Maximum Reaction Case
 - 2.1.2 Maximum Moment Case
 - 2.2 Transverse Seismic
 - 2.2.1 Maximum Reaction Case
 - 2.2.2 Maximum Moment Case
 - 2.3 Vertical Seismic
 - 2.3.1 Maximum Reaction Case
 - 2.3.2 Maximum Moment Case

LEGENDS

O	Overturning
S	Sliding
U	Uplift
R	Resisting
FOS	Factor of Safety
F _O	FOS for Overturning
F _S	FOS for Sliding

Overturning Stability

1 LWL

1.1 Longitudinal Seismic

1.1.1 Maximum Reaction Case

		Unfactored ML (about toe)	Remarks (O/R)	Partial Safety Factor	Factored ML (about toe)	Factored Overturni ng ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL_Sup		4136.3	R	1	4136.3	0.0	4136.3
SIDL(excl. w/c)		515.5	R	1	515.5	0.0	515.5
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL1	Due to HL	-81.1	O	0	0.0	0.0	0.0
	Due to P	738.9	R	0	0.0	0.0	0.0
FPLL1		0.0	O	0.2	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Seismic Force on Superstr.	Due to HL	-2615.7	O	1.5	-3923.5	-3923.5	0.0
	Due to P	245.0	R	1.5	367.5	0.0	367.5
Earth Pressure	Due to HL	-895.3	O	1	-895.3	-895.3	0.0
	Due to P	1246.6	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-348.2	O	-	0.0	0.0	0.0
Weight of Substr.		803.3	R	1	803.3	0.0	803.3
Seismic Force on Substr.	Due to HL	-567.8	O	0	0.0	0.0	0.0
	Due to P	242.7	R	1.5	364.1	0.0	364.1
Weight of fdn		3437.5	R	1	3437.5	0.0	3437.5
Return Wall Wt.		615.73	R	1	615.7	0.0	615.7
Backfill Wt.		5098.3	R	1	5098.3	0.0	5098.3

Service Condition

M_O	=	-4818.8
M_R	=	15806.6
F_O	=	3.28

Span Dislodged Condition

M_O	=	-895.3
M_R	=	10686.5
F_O	=	11.94

1.1.2 Maximum Moment Case

		Unfactored ML (about toe)	Remarks (O/R)	Partial Safety Factor	Factored ML (about toe)	Factored Overturni ng ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL Sup		4136.3	R	1	4136.3	0.0	4136.3
SIDL(excl. w/c)		515.5	R	1	515.5	0.0	515.5
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL2	Due to HL	-130.1	O	0	0.0	0.0	0.0
	Due to P	523.2	R	0	0.0	0.0	0.0
FPLL2		0.0	O	0.2	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Seismic Force on Superstr.	Due to HL	-2615.7	O	1.5	-3923.5	-3923.5	0.0
	Due to P	236.9	R	1.5	355.3	0.0	355.3
Earth Pressure	Due to HL	-895.3	O	1	-895.3	-895.3	0.0
	Due to P	1246.6	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-348.2	O	-	0.0	0.0	0.0
Weight of Substr.		803.3	R	1	803.3	0.0	803.3
Seismic Force on Substr.	Due to HL	-567.8	O	0	0.0	0.0	0.0
	Due to P	242.7	R	1.5	364.1	0.0	364.1
Weight of fdn		3437.5	R	1	3437.5	0.0	3437.5
Return Wall Wt.		615.7	R	1	615.7	0.0	615.7
Backfill Wt.		5098.3	R	1	5098.3	0.0	5098.3

Service Condition

M_O	=	-4818.8
M_R	=	15794.4
F_O	=	3.28

Span Dislodged Condition

M_O	=	-895.3
M_R	=	10674.3
F_O	=	11.92

1.2 Transverse Seismic
1.2.1 Maximum Reaction Case

		Unfactored ML (about toe)	Remarks (O/R)	Partial Safety Factor	Factored ML (about toe)	Factored Overturni ng ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL Sup		4136.3	R	1	4136.3	0.0	4136.3
SIDL(excl. w/c)		515.5	R	1	515.5	0.0	515.5
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL1	Due to HL	-81.1	O	0	0.0	0.0	0.0
	Due to P	738.9	R	0	0.0	0.0	0.0
FPLL1		0.0	O	0.2	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Seismic Force on Superstr.	Due to HL	-784.7	O	1.5	-1177.1	-1177.1	0.0
	Due to P	245.0	R	1.5	367.5	0.0	367.5
Earth Pressure	Due to HL	-895.3	O	1	-895.3	-895.3	0.0
	Due to P	1246.6	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-348.2	O	-	0.0	0.0	0.0
Weight of Substr.		803.3	R	1	803.3	0.0	803.3
Seismic Force on Substr.	Due to HL	44.1	R	0	0.0	0.0	0.0
	Due to P	242.7	R	0	0.0	0.0	0.0
Weight of fdn		3437.5	R	1	3437.5	0.0	3437.5
Return Wall Wt.		615.7	R	1	615.7	0.0	615.7
Backfill Wt.		5098.3	R	1	5098.3	0.0	5098.3

Service Condition

$M_O = -2072.3$
 $M_R = 15442.5$
 $F_O = 7.45$

Span Dislodged Condition

$M_O = -895.3$
 $M_R = 10322.3$
 $F_O = 11.53$

1.2.2 Maximum Moment Case

		Unfactored ML (about toe)	Remarks (O/R)	Partial Safety Factor	Factored ML (about toe)	Factored Overturni ng ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL Sup		4136.3	R	1	4136.3	0.0	4136.3
SIDL(excl. w/c)		515.5	R	1	515.5	0.0	515.5
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL2	Due to HL	-130.1	O	0	0.0	0.0	0.0
	Due to P	523.2	R	0	0.0	0.0	0.0
FPLL2		0.0	O	0.2	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Seismic Force on Superstr.	Due to HL	-784.7	O	1.5	-1177.1	-1177.1	0.0
	Due to P	236.9	R	1.5	355.3	0.0	355.3
Earth Pressure	Due to HL	-895.3	O	1	-895.3	-895.3	0.0
	Due to P	1246.6	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-348.2	O	-	0.0	0.0	0.0
Weight of Substr.		803.3	R	1	803.3	0.0	803.3
Seismic Force on Substr.	Due to HL	44.1	R	0	0.0	0.0	0.0
	Due to P	242.7	R	0	0.0	0.0	0.0
Weight of fdn		3437.5	R	1	3437.5	0.0	3437.5
Return Wall Wt.		615.7	R	1	615.7	0.0	615.7
Backfill Wt.		5098.3	R	1	5098.3	0.0	5098.3

Service Condition

M_O	=	-2072.3
M_R	=	15430.3
F_O	=	7.45

Span Dislodged Condition

M_O	=	-895.3
M_R	=	10310.1
F_O	=	11.52

1.3 Vertical Seismic
1.3.1 Maximum Reaction Case

		Unfactored ML (about toe)	Remarks (O/R)	Partial Safety Factor	Factored ML (about toe)	Factored Overturni ng ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL Sup		4136.3	R	1	4136.3	0.0	4136.3
SIDL(excl. w/c)		515.5	R	1	515.5	0.0	515.5
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL1	Due to HL	-81.1	O	0	0.0	0.0	0.0
	Due to P	738.9	R	0	0.0	0.0	0.0
FPLL1		0.0	O	0.2	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Seismic Force on Superstr.	Due to HL	-894.1	O	1.5	-1341.1	-1341.1	0.0
	Due to P	408.4	R	1.5	612.5	0.0	612.5
Earth Pressure	Due to HL	-895.3	O	1	-895.3	-895.3	0.0
	Due to P	1246.6	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-348.2	O	-	0.0	0.0	0.0
Weight of Substr.		803.3	R	1	803.3	0.0	803.3
Seismic Force on Substr.	Due to HL	44.1	R	0	0.0	0.0	0.0
	Due to P	112.5	R	0	0.0	0.0	0.0
Weight of fdn		3437.5	R	1	3437.5	0.0	3437.5
Return Wall Wt.		615.7	R	1	615.7	0.0	615.7
Backfill Wt.		5098.3	R	1	5098.3	0.0	5098.3

Service Condition

$M_O = -2236.4$
 $M_R = 15687.5$
 $F_O = 7.01$

Span Dislodged Condition

$M_O = -895.3$
 $M_R = 10567.4$
 $F_O = 11.80$

1.3.2 Maximum Moment Case

		Unfactored ML (about toe)	Remarks (O/R)	Partial Safety Factor	Factored ML (about toe)	Factored Overturni ng ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL Sup		4136.3	R	1	4136.3	0.0	4136.3
SIDL(excl. w/c)		515.5	R	1	515.5	0.0	515.5
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL2	Due to HL	-130.1	O	0	0.0	0.0	0.0
	Due to P	523.2	R	0	0.0	0.0	0.0
FPLL2		0.0	O	0.2	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Seismic Force on Superstr.	Due to HL	-864.4	O	1.5	-1296.6	-1296.6	0.0
	Due to P	789.6	R	1.5	1184.4	0.0	1184.4
Earth Pressure	Due to HL	-895.3	O	1	-895.3	-895.3	0.0
	Due to P	1246.6	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-348.2	O	-	0.0	0.0	0.0
Weight of Substr.		803.3	R	1	803.3	0.0	803.3
Seismic Force on Substr.	Due to HL	44.1	R	0	0.0	0.0	0.0
	Due to P	112.5	R	0	0.0	0.0	0.0
Weight of fdn		3437.5	R	1	3437.5	0.0	3437.5
Return Wall Wt.		615.7	R	1	615.7	0.0	615.7
Backfill Wt.		5098.3	R	1	5098.3	0.0	5098.3

Service Condition

$$\begin{aligned} M_O &= -2191.9 \\ M_R &= 16259.4 \\ F_O &= 7.42 \end{aligned}$$

Span Dislodged Condition

$$\begin{aligned} M_O &= -895.3 \\ M_R &= 11139.2 \\ F_O &= 12.44 \end{aligned}$$

2 HFL

2.1 Longitudinal Seismic

2.1.1 Maximum Reaction Case

		Unfactored ML (about toe)	Remarks (O/R)	Partial Safety Factor	Factored ML (about toe)	Factored Overturni ng ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL Sup		4136.3	R	1	4136.3	0.0	4136.3
SIDL(excl. w/c)		515.5	R	1	515.5	0.0	515.5
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL1	Due to HL	-81.1	O	0	0.0	0.0	0.0
	Due to P	738.9	R	0	0.0	0.0	0.0
FPLL1		0.0	O	0.2	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Seismic Force on Superstr.	Due to HL	-2615.7	O	1.5	-3923.5	-3923.5	0.0
	Due to P	245.0	R	1.5	367.5	0.0	367.5
Earth Pressure	Due to HL	-637.7	O	1	-637.7	-637.7	0.0
	Due to P	889.0	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-348.2	O	-	0.0	0.0	0.0
Weight of Substr.		803.3	R	1	803.3	0.0	803.3
Seismic Force on Substr.	Due to HL	-567.8	O	0	0.0	0.0	0.0
	Due to P	242.7	R	1.5	364.1	0.0	364.1
Buoyancy on substr.		-206.3	O	1	-206.3	-206.3	0.0
Weight of fdn		3437.5	R	1	3437.5	0.0	3437.5
Buoyancy on fdn.		-1375.0	O	1	-1375.0	-1375.0	0.0
Return Wall Wt.		615.7	R	1	615.7	0.0	615.7
Buoyancy on Return wall.		-163.3	O	1	-163.3	-163.3	0.0
Backfill Wt.		5098.3	R	1	5098.3	0.0	5098.3

Service Condition

$$\begin{aligned} M_O &= -6305.8 \\ M_R &= 15806.6 \\ F_O &= 2.51 \end{aligned}$$

Span Dislodged Condition

$$\begin{aligned} M_O &= -2382.2 \\ M_R &= 10686.5 \\ F_O &= 4.49 \end{aligned}$$

2.1.2 Maximum Moment Case

		Unfactored ML (about toe)	Remarks (O/R)	Partial Safety Factor	Factored ML (about toe)	Factored Overturni ng ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL Sup		4136.3	R	1	4136.3	0.0	4136.3
SIDL(excl. w/c)		515.5	R	1	515.5	0.0	515.5
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL2	Due to HL	-130.1	O	0	0.0	0.0	0.0
	Due to P	523.2	R	0	0.0	0.0	0.0
FPLL2		0.0	O	0.2	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Seismic Force on Superstr.	Due to HL	-2615.7	O	1.5	-3923.5	-3923.5	0.0
	Due to P	236.9	R	1.5	355.3	0.0	355.3
Earth Pressure	Due to HL	-637.7	O	1	-637.7	-637.7	0.0
	Due to P	889.0	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-348.2	O	-	0.0	0.0	0.0
Weight of Substr.			O	1.05	0.0	0.0	0.0
Seismic Force on Substr.	Due to HL	-567.8	O	1.5	-851.7	-851.7	0.0
	Due to P	242.7	R	1.5	364.1	0.0	364.1
Buoyancy on substr.		-206.3	O	1	-206.3	-206.3	0.0
Weight of fdn		3437.5	R	1	3437.5	0.0	3437.5
Buoyancy on fdn.		-1375.0	O	1	-1375.0	-1375.0	0.0
Return Wall Wt.		615.7	R	1	615.7	0.0	615.7
Buoyancy on Return wall.		-163.3	O	1	-163.3	-163.3	0.0
Backfill Wt.		5098.3	R	1	5098.3	0.0	5098.3

Service Condition

M _O	=	-7157.5
M _R	=	14991.1
F _O	=	2.09

Span Dislodged Condition

M _O	=	-3234.0
M _R	=	9870.9
F _O	=	3.05

2.2 Transverse Seismic

2.2.1 Maximum Reaction Case

		Unfactored ML (about toe)	Remarks (O/R)	Partial Safety Factor	Factored ML (about toe)	Factored Overturni ng ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL Sup		4136.3	R	1	4136.3	0.0	4136.3
SIDL(excl. w/c)		515.5	R	1	515.5	0.0	515.5
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL1	Due to HL	-81.1	O	0	0.0	0.0	0.0
	Due to P	738.9	R	0	0.0	0.0	0.0
FPLL1		0.0	O	0.2	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Seismic Force on Superstr.	Due to HL	-784.7	O	1.5	-1177.1	-1177.1	0.0
	Due to P	245.0	R	1.5	367.5	0.0	367.5
Earth Pressure	Due to HL	-637.7	O	1	-637.7	-637.7	0.0
	Due to P	889.0	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-348.2	O	-	0.0	0.0	0.0
Weight of Substr.			O	1.05	0.0	0.0	0.0
Seismic Force on Substr.	Due to HL	44.1	R	1.5	66.2	0.0	66.2
	Due to P	242.7	R	0	0.0	0.0	0.0
Buoyancy on substr.		-206.3	O	1	-206.3	-206.3	0.0
Weight of fdn		3437.5	R	1	3437.5	0.0	3437.5
Buoyancy on fdn.		-1375.0	O	1	-1375.0	-1375.0	0.0
Return Wall Wt.		615.7	R	1	615.7	0.0	615.7
Buoyancy on Return wall.		-163.3	O	1	-163.3	-163.3	0.0
Backfill Wt.		5098.3	R	1	5098.3	0.0	5098.3

Service Condition

M _O	=	-3559.3
M _R	=	14705.4
F _O	=	4.13

Span Dislodged Condition

M _O	=	-2382.2
M _R	=	9585.2
F _O	=	4.02

2.2.2 Maximum Moment Case

		Unfactored ML (about toe)	Remarks (O/R)	Partial Safety Factor	Factored ML (about toe)	Factored Overturni ng ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL Sup		4136.3	R	1	4136.3	0.0	4136.3
SIDL(excl. w/c)		515.5	R	1	515.5	0.0	515.5
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL2	Due to HL	-130.1	O	0	0.0	0.0	0.0
	Due to P	523.2	R	0	0.0	0.0	0.0
FPLL2		0.0	O	0.2	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Seismic Force on Superstr.	Due to HL	-784.7	O	1.5	-1177.1	-1177.1	0.0
	Due to P	236.9	R	1.5	355.3	0.0	355.3
Earth Pressure	Due to HL	-637.7	O	1	-637.7	-637.7	0.0
	Due to P	889.0	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-348.2	O	-	0.0	0.0	0.0
Weight of Substr.			O	1.05	0.0	0.0	0.0
Seismic Force on Substr.	Due to HL	44.1	R	1.5	66.2	0.0	66.2
	Due to P	242.7	R	0	0.0	0.0	0.0
Buoyancy on substr.		-206.3	O	1	-206.3	-206.3	0.0
Weight of fdn		3437.5	R	1	3437.5	0.0	3437.5
Buoyancy on fdn		-1375.0	O	1	-1375.0	-1375.0	0.0
Return Wall Wt.		615.7	R	1	615.7	0.0	615.7
Buoyancy on Return wall.		-163.3	O	1	-163.3	-163.3	0.0
Backfill Wt.		5098.3	R	1	5098.3	0.0	5098.3

Service Condition

M _O	=	-3559.3
M _R	=	14693.2
F _O	=	4.13

Span Dislodged Condition

M _O	=	-2382.2
M _R	=	9573.0
F _O	=	4.02

2.3 Vertical Seismic

2.3.1 Maximum Reaction Case

		Unfactored ML (about toe)	Remarks (O/R)	Partial Safety Factor	Factored ML (about toe)	Factored Overturni ng ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL Sup		4136.3	R	1	4136.3	0.0	4136.3
SIDL(excl. w/c)		515.5	R	1	515.5	0.0	515.5
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL1	Due to HL	-81.1	O	0	0.0	0.0	0.0
	Due to P	738.9	R	0	0.0	0.0	0.0
FPLL1		0.0	O	0.2	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Seismic Force on Superstr.	Due to HL	-894.1	O	1.5	-1341.1	-1341.1	0.0
	Due to P	408.4	R	1.5	612.5	0.0	612.5
Earth Pressure	Due to HL	-637.7	O	1	-637.7	-637.7	0.0
	Due to P	889.0	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-348.2	O	-	0.0	0.0	0.0
Weight of Substr.			O	1.05	0.0	0.0	0.0
Seismic Force on Substr.	Due to HL	44.1	R	1.5	66.2	0.0	66.2
	Due to P	112.5	R	0	0.0	0.0	0.0
Buoyancy on substr.		-206.3	O	1	-206.3	-206.3	0.0
Weight of fdn		3437.5	R	1	3437.5	0.0	3437.5
Buoyancy on fdn		-1375.0	O	1	-1375.0	-1375.0	0.0
Return Wall Wt.		615.7	R	1	615.7	0.0	615.7
Buoyancy on Return wall.		-163.3	O	1	-163.3	-163.3	0.0
Backfill Wt.		5098.3	R	1	5098.3	0.0	5098.3

Service Condition

M _O	=	-3723.3
M _R	=	14950.4
F _O	=	4.02

Span Dislodged Condition

M _O	=	-2382.2
M _R	=	9830.2
F _O	=	4.13

2.3.2 Maximum Moment Case

		Unfactored ML (about toe)	Remarks (O/R)	Partial Safety Factor	Factored ML (about toe)	Factored Overturni ng ML (about toe)	Factored Resisting ML (about toe)
		t-m			t-m	t-m	t-m
DL Sup		4136.3	R	1	4136.3	0.0	4136.3
SIDL(excl. w/c)		515.5	R	1	515.5	0.0	515.5
SIDL(w/c)		468.4	R	1	468.4	0.0	468.4
LL2	Due to HL	-130.1	O	0	0.0	0.0	0.0
	Due to P	523.2	R	0	0.0	0.0	0.0
FPLL2		0.0	O	0.2	0.0	0.0	0.0
Shear Rating		0.0	O	1	0.0	0.0	0.0
Seismic Force on Superstr.	Due to HL	-864.4	O	1.5	-1296.6	-1296.6	0.0
	Due to P	789.6	R	1.5	1184.4	0.0	1184.4
Earth Pressure	Due to HL	-637.7	O	1	-637.7	-637.7	0.0
	Due to P	889.0	R	0	0.0	0.0	0.0
LL Surcharge	Due to HL	-348.2	O	-	0.0	0.0	0.0
Weight of Substr.			O	1.05	0.0	0.0	0.0
Seismic Force on Substr.	Due to HL	44.1	R	1.5	66.2	0.0	66.2
	Due to P	112.5	R	0	0.0	0.0	0.0
Buoyancy on substr.		-206.3	O	1	-206.3	-206.3	0.0
Weight of fdn		3437.5	R	1	3437.5	0.0	3437.5
Buoyancy on fdn		-1375.0	O	1	-1375.0	-1375.0	0.0
Return Wall Wt.		615.7	R	1	615.7	0.0	615.7
Buoyancy on Return wall		-163.3	O	1	-163.3	-163.3	0.0
Backfill Wt.		5098.3	R	1	5098.3	0.0	5098.3

Service Condition

M_O	=	-3678.8
M_R	=	15522.3
F_O	=	4.22

Span Dislodged Condition

M_O	=	-2382.2
M_R	=	10402.1
F_O	=	4.37

Sliding Stability

1 LWL

1.1 Longitudinal Seismic

1.1.1 Maximum Reaction Case

	Unfactored HL	Remarks (S/R)	Partial Safety Factor	Factored HL	Unfactore d Pmin	Remarks (U/R)	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL Sup	0.0	R	1	0.0	752.1	R	1	752.1
SIDL(excl. w/c)	0.0	R	1	0.0	93.7	R	1	93.7
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL1	12.5	S	0	0.0	133.6	R	0	0.0
FPLL1	0.0	R	0	0.0	0.0	U	0.2	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Seismic Force on Superstr.	137.5	S	0	0.0	-44.5	U	0	0.0
Earth Pressure	290.2	S	1	290.2	113.3	R	0	0.0
LL Surcharge	91.0	S	-	0.0	0.0	U	-	0.0
Weight of Substr.	0.0	R	1	0.0	141.6	R	1	141.6
Seismic Force on Substr.	157.0	S	0	0.0	-30.5	U	0	0.0
Weight of fdn	0.0	R	1	0.0	625.0	R	1	625.0
Return Wall Wt.	0.0	R	1	0.0	70.7	R	1	70.7
Backfill Wt.	0.0	R	1	0.0	585.4	R	1	585.4

Service Condition

ΣH	=	290.2
ΣP	=	2353.7
μ	=	0.70
F_S	=	$\mu \Sigma P / \Sigma H$
	=	5.68

Span Dislodged Condition

ΣH	=	290.2
ΣP	=	1422.8
μ	=	0.70
F_S	=	$\mu \Sigma P / \Sigma H$
	=	3.43

1.1.2 Maximum Moment Case

	Unfactored HL	Remarks (S/R)	Partial Safety Factor	Factored HL	Unfactored Pmin	Remarks (U/R)	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL Sup	0.0	R	1	0.0	752.1	R	1	752.1
SIDL(excl. w/c)	0.0	R	1	0.0	93.7	R	1	93.7
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL2	20.0	S	0	0.0	133.6	R	0	0.0
FPLL2	0.0	R	0	0.0	0.0	U	0.2	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Seismic Force on Superstr.	402.2	S	0	0.0	-43.1	U	0	0.0
Earth Pressure	290.2	S	1	290.2	113.3	R	0	0.0
LL Surcharge	91.0	S	-	0.0	0.0	U	-	0.0
Weight of Substr.	0.0	R	1	0.0	141.6	R	1	141.6
Seismic Force on Substr.	157.0	S	0	0.0	-30.5	U	0	0.0
Weight of fdn	0.0	R	1	0.0	625.0	R	1	625.0
Return Wall Wt.	0.0	R	1	0.0	70.7	R	1	70.7
Backfill Wt.	0.0	R	1	0.0	585.4	R	1	585.4

Service Condition

$$\begin{aligned}\Sigma H &= 290.2 \\ \Sigma P &= 2353.7 \\ \mu &= 0.70 \\ F_s &= \mu \Sigma P / \Sigma H \\ &= 5.68\end{aligned}$$

Span Dislodged Condition

$$\begin{aligned}\Sigma H &= 290.2 \\ \Sigma P &= 1422.8 \\ \mu &= 0.70 \\ F_s &= \mu \Sigma P / \Sigma H \\ &= 3.43\end{aligned}$$

1.2 Transverse Seismic

1.2.1 Maximum Reaction Case

	Unfactored HL	Remarks (S/R)	Partial Safety Factor	Factored HL	Unfactored Pmin	Remarks (U/R)	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL Sup	0.0	R	1	0.0	752.1	R	1	752.1
SIDL(excl. w/c)	0.0	R	1	0.0	93.7	R	1	93.7
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL1	12.5	S	0	0.0	133.6	R	0	0.0
FPLL1	0.0	R	0	0.0	0.0	U	0.2	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Seismic Force on Superstr.	120.7	S	0	0.0	-44.5	U	0	0.0
Earth Pressure	290.2	S	1	290.2	113.3	R	0	0.0
LL Surcharge	91.0	S	-	0.0	0.0	U	-	0.0
Weight of Substr.	0.0	R	1	0.0	141.6	R	1	141.6
Seismic Force on Substr.	47.1	S	0	0.0	-30.5	U	0	0.0
Weight of fdn	0.0	R	1	0.0	625.0	R	1	625.0
Return Wall Wt.	0.0	R	1	0.0	70.7	R	1	70.7
Backfill Wt.	0.0	R	1	0.0	585.4	R	1	585.4

Service Condition

$$\begin{aligned}\Sigma H &= 290.2 \\ \Sigma P &= 2353.7 \\ \mu &= 0.70 \\ F_s &= \mu \Sigma P / \Sigma H \\ &= 5.68\end{aligned}$$

Span Dislodged Condition

$$\begin{aligned}\Sigma H &= 290.2 \\ \Sigma P &= 1422.8 \\ \mu &= 0.70 \\ F_s &= \mu \Sigma P / \Sigma H \\ &= 3.43\end{aligned}$$

1.2.2 Maximum Moment Case

	Unfactored HL	Remarks (S/R)	Partial Safety Factor	Factored HL	Unfactored Pmin	Remarks (U/R)	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL Sup	0.0	R	1	0.0	752.1	R	1	752.1
SIDL(excl. w/c)	0.0	R	1	0.0	93.7	R	1	93.7
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL2	20.0	S	0	0.0	133.6	R	0	0.0
FPLL2	0.0	R	0	0.0	0.0	U	0.2	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Seismic Force on Superstr.	120.7	S	0	0.0	-43.1	U	0	0.0
Earth Pressure	290.2	S	1	290.2	113.3	R	0	0.0
LL Surcharge	91.0	S	-	0.0	0.0	U	-	0.0
Weight of Substr.	0.0	R	1	0.0	141.6	R	1	141.6
Seismic Force on Substr.	47.1	S	0	0.0	-30.5	U	0	0.0
Weight of fdn	0.0	R	1	0.0	625.0	R	1	625.0
Return Wall Wt.	0.0	R	1	0.0	70.7	R	1	70.7
Backfill Wt.	0.0	R	1	0.0	585.4	R	1	585.4

Service Condition

$$\begin{aligned}\Sigma H &= 290.2 \\ \Sigma P &= 2353.7 \\ \mu &= 0.70 \\ F_s &= \mu \Sigma P / \Sigma H \\ &= 5.68\end{aligned}$$

Span Dislodged Condition

$$\begin{aligned}\Sigma H &= 290.2 \\ \Sigma P &= 1422.8 \\ \mu &= 0.70 \\ F_s &= \mu \Sigma P / \Sigma H \\ &= 3.43\end{aligned}$$

1.3 Vertical Seismic

1.3.1 Maximum Reaction Case

	Unfactored HL	Remarks (S/R)	Partial Safety Factor	Factored HL	Unfactored Pmin	Remarks (U/R)	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL Sup	0.0	R	1	0.0	752.1	R	1	752.1
SIDL(excl. w/c)	0.0	R	1	0.0	93.7	R	1	93.7
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL1	12.5	S	0	0.0	133.6	R	0	0.0
FPLL1	0.0	R	0	0.0	0.0	U	0.2	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Seismic Force on Superstr.	137.5	S	0	0.0	-74.2	U	1.5	-111.4
Earth Pressure	290.2	S	1	290.2	113.3	R	0	0.0
LL Surcharge	91.0	S	-	0.0	0.0	U	-	0.0
Weight of Substr.	0.0	R	1	0.0	141.6	R	1	141.6
Seismic Force on Substr.	47.1	S	0	0.0	-101.8	U	0	0.0
Weight of fdn	0.0	R	1	0.0	625.0	R	1	625.0
Return Wall Wt.	0.0	R	1	0.0	70.7	R	1	70.7
Backfill Wt.	0.0	R	1	0.0	585.4	R	1	585.4

Service Condition

$$\begin{aligned}\Sigma H &= 290.2 \\ \Sigma P &= 2242.3 \\ \mu &= 0.70 \\ F_s &= \mu \Sigma P / \Sigma H \\ &= 5.41\end{aligned}$$

Span Dislodged Condition

$$\begin{aligned}\Sigma H &= 290.2 \\ \Sigma P &= 1422.8 \\ \mu &= 0.70 \\ F_s &= \mu \Sigma P / \Sigma H \\ &= 3.43\end{aligned}$$

1.3.2 Maximum Moment Case

	Unfactored HL	Remarks (S/R)	Partial Safety Factor	Factored HL	Unfactored Pmin	Remarks (U/R)	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL Sup	0.0	R	1	0.0	752.1	R	1	752.1
SIDL(excl. w/c)	0.0	R	1	0.0	93.7	R	1	93.7
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL2	20.0	S	0	0.0	133.6	R	0	0.0
FPLL2	0.0	R	0	0.0	0.0	U	0.2	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Seismic Force on Superstr.	132.9	S	0	0.0	-143.6	U	1.5	-215.4
Earth Pressure	290.2	S	1	290.2	113.3	R	0	0.0
LL Surcharge	91.0	S	-	0.0	0.0	U	-	0.0
Weight of Substr.	0.0	R	1	0.0	141.6	R	1	141.6
Seismic Force on Substr.	47.1	S	0	0.0	-101.8	U	0	0.0
Weight of fdn	0.0	R	1	0.0	625.0	R	1	625.0
Return Wall Wt.	0.0	R	1	0.0	70.7	R	1	70.7
Backfill Wt.	0.0	R	1	0.0	585.4	R	1	585.4

Service Condition

ΣH	=	290.2
ΣP	=	2138.4
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	5.16

Span Dislodged Condition

ΣH	=	290.2
ΣP	=	1422.8
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	3.43

2 HFL

2.1 Longitudinal Seismic

2.1.1 Maximum Reaction Case

	Unfactored HL	Remarks (S/R)	Partial Safety Factor	Factored HL	Unfactored Pmin	Remarks (U/R)	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL Sup	0.0	R	1	0.0	752.1	R	1	752.1
SIDL(excl. w/c)	0.0	R	1	0.0	93.7	R	1	93.7
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL1	12.5	S	0	0.0	133.6	R	0	0.0
FPLL1	0.0	R	0	0.0	0.0	U	0.2	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Seismic Force on Superstr.	137.5	S	0	0.0	-44.5	U	1.5	-66.8
Earth Pressure	206.9	S	1	206.9	80.8	R	0	0.0
LL Surcharge	91.0	S	-	0.0	0.0	U	-	0.0
Weight of Substr.	0.0	R	1	0.0	141.6	R	1	141.6
Seismic Force on Substr.	157.0	S	0	0.0	-30.5	U	0	0.0
Buoyancy on substr.	0.0	R	0	0.0	-37.5	U	1	-37.5
Weight of fdn	0.0	R	1	0.0	625.0	R	1	625.0
Buoyancy on fdn.	0.0	R	0	0.0	-250.0	U	1	-250.0
Return Wall Wt.	0.0	R	1	0.0	70.7	R	1	70.7
Buoyancy on Return wall.	0.0	R	0	0.0	-18.8	U	1	-18.8
Backfill Wt.	0.0	R	1	0.0	585.4	R	1	585.4

Service Condition

ΣH	=	206.9
ΣP	=	1980.6
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	6.70

Span Dislodged Condition

ΣH	=	206.9
ΣP	=	1116.5
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	3.78

2.1.2 Maximum Moment Case

	Unfactored HL	Remarks (S/R)	Partial Safety Factor	Factored HL	Unfactored Pmin	Remarks (U/R)	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL Sup	0.0	R	1	0.0	752.1	R	1	752.1
SIDL(excl. w/c)	0.0	R	1	0.0	93.7	R	1	93.7
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL2	20.0	S	0	0.0	133.6	R	0	0.0
FPLL2	0.0	R	0	0.0	0.0	U	0.2	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Seismic Force on Superstr.	402.2	S	0	0.0	-43.1	U	1.5	-64.6
Earth Pressure	206.9	S	1	206.9	80.8	R	0	0.0
LL Surcharge	91.0	S	-	0.0	0.0	U	-	0.0
Weight of Substr.	0.0	R	1	0.0	141.6	R	1	141.6
Seismic Force on Substr.	157.0	S	0	0.0	-30.5	U	0	0.0
Buoyancy on substr.	0.0	R	0	0.0	-37.5	U	1	-37.5
Weight of fdn	0.0	R	1	0.0	625.0	R	1	625.0
Buoyancy on fdn.	0.0	R	0	0.0	-250.0	U	1	-250.0
Return Wall Wt.	0.0	R	1	0.0	70.7	R	1	70.7
Buoyancy on Return wall.	0.0	R	0	0.0	-18.8	U	1	-18.8
Backfill Wt.	0.0	R	1	0.0	585.4	R	1	585.4

Service Condition

ΣH	=	206.9
ΣP	=	1982.9
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	6.71

Span Dislodged Condition

ΣH	=	206.9
ΣP	=	1116.5
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	3.78

2.2 Transverse Seismic

2.2.1 Maximum Reaction Case

	Unfactored HL	Remarks (S/R)	Partial Safety Factor	Factored HL	Unfactored Pmin	Remarks (U/R)	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL Sup	0.0	R	1	0.0	752.1	R	1	752.1
SIDL(excl. w/c)	0.0	R	1	0.0	93.7	R	1	93.7
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL1	12.5	S	0	0.0	133.6	R	0	0.0
FPLL1	0.0	R	0	0.0	0.0	U	0.2	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Seismic Force on Superstr.	120.7	S	0	0.0	-44.5	U	1.5	-66.8
Earth Pressure	206.9	S	1	206.9	80.8	R	0	0.0
LL Surcharge	91.0	S	-	0.0	0.0	U	-	0.0
Weight of Substr.	0.0	R	1	0.0	141.6	R	1	141.6
Seismic Force on Substr.	47.1	S	0	0.0	-30.5	U	0	0.0
Buoyancy on substr.	0.0	R	0	0.0	-37.5	U	1	-37.5
Weight of fdn	0.0	R	1	0.0	625.0	R	1	625.0
Buoyancy on fdn.	0.0	R	0	0.0	-250.0	U	1	-250.0
Return Wall Wt.	0.0	R	1	0.0	70.7	R	1	70.7
Buoyancy on Return wall.	0.0	R	0	0.0	-18.8	U	1	-18.8
Backfill Wt.	0.0	R	1	0.0	585.4	R	1	585.4

Service Condition

ΣH	=	206.9
ΣP	=	1980.6
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	6.70

Span Dislodged Condition

ΣH	=	206.9
ΣP	=	1116.5
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	3.78

2.2.2 Maximum Moment Case

	Unfactored HL	Remarks (S/R)	Partial Safety Factor	Factored HL	Unfactored Pmin	Remarks (U/R)	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL Sup	0.0	R	1	0.0	752.1	R	1	752.1
SIDL(excl. w/c)	0.0	R	1	0.0	93.7	R	1	93.7
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL2	20.0	S	0	0.0	133.6	R	0	0.0
FPLL2	0.0	R	0	0.0	0.0	U	0.2	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Seismic Force on Superstr.	120.7	S	0	0.0	-43.1	U	1.5	-64.6
Earth Pressure	206.9	S	1	206.9	80.8	R	0	0.0
LL Surcharge	91.0	S	-	0.0	0.0	U	-	0.0
Weight of Substr.	0.0	R	1	0.0	141.6	R	1	141.6
Seismic Force on Substr.	47.1	S	0	0.0	-30.5	U	0	0.0
Buoyancy on substr.	0.0	R	0	0.0	-37.5	U	1	-37.5
Weight of fdn	0.0	R	1	0.0	625.0	R	1	625.0
Buoyancy on fdn.	0.0	R	0	0.0	-250.0	U	1	-250.0
Return Wall Wt.	0.0	R	1	0.0	70.7	R	1	70.7
Buoyancy on Return wall.	0.0	R	0	0.0	-18.8	U	1	-18.8
Backfill Wt.	0.0	R	1	0.0	585.4	R	1	585.4

Service Condition

ΣH	=	206.9
ΣP	=	1982.9
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	6.71

Span Dislodged Condition

ΣH	=	206.9
ΣP	=	1116.5
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	3.78

2.3 Vertical Seismic

2.3.1 Maximum Reaction Case

	Unfactored HL	Remarks (S/R)	Partial Safety Factor	Factored HL	Unfactored Pmin	Remarks (U/R)	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL Sup	0.0	R	1	0.0	752.1	R	1	752.1
SIDL(excl. w/c)	0.0	R	1	0.0	93.7	R	1	93.7
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL1	12.5	S	0	0.0	133.6	R	0	0.0
FPLL1	0.0	R	0	0.0	0.0	U	0.2	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Seismic Force on Superstr.	137.5	S	0	0.0	-74.2	U	1.5	-111.4
Earth Pressure	206.9	S	1	206.9	80.8	R	0	0.0
LL Surcharge	91.0	S	-	0.0	0.0	U	-	0.0
Weight of Substr.	0.0	R	1	0.0	141.6	R	1	141.6
Seismic Force on Substr.	47.1	S	0	0.0	-101.8	U	0	0.0
Buoyancy on substr.	0.0	R	0	0.0	-37.5	U	1	-37.5
Weight of fdn	0.0	R	1	0.0	625.0	R	1	625.0
Buoyancy on fdn.	0.0	R	0	0.0	-250.0	U	1	-250.0
Return Wall Wt.	0.0	R	1	0.0	70.7	R	1	70.7
Buoyancy on Return wall.	0.0	R	0	0.0	-18.8	U	1	-18.8
Backfill Wt.	0.0	R	1	0.0	585.4	R	1	585.4

Service Condition

ΣH	=	206.9
ΣP	=	1936.1
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	6.55

Span Dislodged Condition

ΣH	=	206.9
ΣP	=	1116.5
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	3.78

2.3.2 Maximum Moment Case

	Unfactored HL	Remarks (S/R)	Partial Safety Factor	Factored HL	Unfactored Pmin	Remarks (U/R)	Partial Safety Factor	Factored Pmin
	t			t	t			t
DL Sup	0.0	R	1	0.0	752.1	R	1	752.1
SIDL(excl. w/c)	0.0	R	1	0.0	93.7	R	1	93.7
SIDL(w/c)	0.0	R	1	0.0	85.2	R	1	85.2
LL2	20.0	S	0	0.0	133.6	R	0	0.0
FPLL2	0.0	R	0	0.0	0.0	U	0.2	0.0
Shear Rating	0.0	R	1	0.0	0.0	U	1	0.0
Seismic Force on Superstr.	132.9	S	0	0.0	-143.6	U	1.5	-215.4
Earth Pressure	206.9	S	1	206.9	80.8	R	0	0.0
LL Surcharge	91.0	S	-	0.0	0.0	U	-	0.0
Weight of Substr.	0.0	R	1	0.0	141.6	R	1	141.6
Seismic Force on Substr.	47.1	S	0	0.0	-101.8	U	0	0.0
Buoyancy on substr.	0.0	R	0	0.0	-37.5	U	1	-37.5
Weight of fdn	0.0	R	1	0.0	625.0	R	1	625.0
Buoyancy on fdn.	0.0	R	0	0.0	-250.0	U	1	-250.0
Return Wall Wt.	0.0	R	1	0.0	70.7	R	1	70.7
Buoyancy on Return wall.	0.0	R	0	0.0	-18.8	U	1	-18.8
Backfill Wt.	0.0	R	1	0.0	585.4	R	1	585.4

Service Condition

ΣH	=	206.9
ΣP	=	1832.1
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	6.20

Span Dislodged Condition

ΣH	=	206.9
ΣP	=	1116.5
μ	=	0.70
F_s	=	$\mu \Sigma P / \Sigma H$
	=	3.78

Summary

Point no 2, Annexure B, IRC:6-2010

	Normal	Seismic
FOS against overturning	2	1.5
FOS against sliding	1.5	1.25

			Service Condition				Span Dislodged Condition			
			F _o	Check	F _s	Check	F _o	Check	F _s	Check
LWL CASE	Long. Seis	Max. Rxn.	3.28	OK	5.68	OK	11.94	OK	3.43	OK
		Max. Mom.	3.28	OK	5.68	OK	11.92	OK	3.43	OK
	Trans. Seis	Max. Rxn.	7.45	OK	5.68	OK	11.53	OK	3.43	OK
		Max. Mom.	7.45	OK	5.68	OK	11.52	OK	3.43	OK
	Vert. Seis	Max. Rxn.	7.01	OK	5.41	OK	11.80	OK	3.43	OK
		Max. Mom.	7.42	OK	5.16	OK	12.44	OK	3.43	OK
HFL CASE	Long. Seis	Max. Rxn.	2.51	OK	6.70	OK	4.49	OK	3.78	OK
		Max. Mom.	2.09	OK	6.71	OK	3.05	OK	3.78	OK
	Trans. Seis	Max. Rxn.	4.13	OK	6.70	OK	4.02	OK	3.78	OK
		Max. Mom.	4.13	OK	6.71	OK	4.02	OK	3.78	OK
	Vert. Seis	Max. Rxn.	4.02	OK	6.55	OK	4.13	OK	3.78	OK
		Max. Mom.	4.22	OK	6.20	OK	4.37	OK	3.78	OK

LOAD COMBINATION (UNFACTORED)

14.BASE PRESSURE CHECK OF OPEN FOUNDATION

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Combination for Base Pressure

Base pressure is checked for unfactored loads as per amendment in notification no 78, dated 28th July, 2012

Normal Case

- 1 LWL
 - 1.1 Maximum Reaction Case
 - 1.2 Maximum Moment Case
- 2 HFL
 - 2.1 Maximum Reaction Case
 - 2.2 Maximum Moment Case

Span present Condition**1 LWL****1.1 Maximum Reaction Case**

Load Item	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	93.7	93.7	0.0	515.5	0.0
SIDL(w/c)	85.2	85.2	0.0	468.4	0.0
LL1	134.4	133.6	-81.1	738.9	127.6
FPLL1	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Earth Pressure	65.94	65.94	-542.38	725.35	0.00
LL Surcharge	0.0	0.0	-202.5	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2554.0	2553.3	-825.9	16539.3	127.6

Eccentricity of vertical load from c/l of footing = 1.0 m
 Longitudinal Moment about c/l of footing ML = 0.0 t-m

1.2 Maximum Moment Case

Load Item	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	93.7	93.7	0.0	515.5	0.0
SIDL(w/c)	85.2	85.2	0.0	468.4	0.0
LL2	95.1	94.0	-130.1	523.2	300.1
FPLL2	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Earth Pressure	65.94	65.9	-542.4	725.3	0.0
LL Surcharge	0.0	0.0	-202.5	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2514.8	2513.6	-874.9	16323.5	300.1

Eccentricity of vertical load from c/l of footing = 1.0 m
 Longitudinal Moment about c/l of footing ML = 0.0 t-m

2 HFL
2.1 Maximum Reaction Case

Load Item	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	93.7	93.7	0.0	515.5	0.0
SIDL(w/c)	85.2	85.2	0.0	468.4	0.0
LL1	134.4	133.6	-81.1	738.9	127.6
FPLL1	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Earth Pressure	47.02	47.0	-329.3	517.3	0.0
LL Surcharge	0.0	0.0	-202.5	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Buoyancy on substr.	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Buoyancy on fdn.	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2228.8	2228.1	-612.8	14586.7	127.6

Eccentricity of vertical load from c/l of footing = 1.0 m
Longitudinal Moment about c/l of footing ML = 0.0 t-m

2.2 Maximum Moment Case

Load Item	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	93.7	93.7	0.0	515.5	0.0
SIDL(w/c)	85.2	85.2	0.0	468.4	0.0
LL2	95.1	94.0	-130.1	523.2	300.1
FPLL2	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Earth Pressure	47.0	47.0	-329.3	517.3	0.0
LL Surcharge	0.0	0.0	-202.5	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Buoyancy on substr.	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Buoyancy on fdn.	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2189.6	2188.4	-661.8	14370.9	300.1

Eccentricity of vertical load from c/l of footing = 1.1 m
Longitudinal Moment about c/l of footing ML = 0.0 t-m

Span Dislodged Condition

1 LWL

Load Item	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
Earth Pressure	65.94	65.94	-542.38	725.35	0.00
Weight of Substr.	141.61	141.61	0.00	803.33	0.00
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	1488.7	1488.7	-542.4	10680.2	0.0
Eccentricity of vertical load from c/l of footing				=	1.7 m
Longitudinal Moment about c/l of footing				ML =	0.0 t-m

2 HFL

Load Item	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
Earth Pressure	47.0	47.0	-329.3	517.3	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Buoyancy on substr.	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Buoyancy on fdn.	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	1163.5	1163.5	-329.3	8727.5	0.0
Eccentricity of vertical load from c/l of footing				=	2.0 m
Longitudinal Moment about c/l of footing				ML =	0.0 t-m

Summary

Service Condition

		Pmax	Pmin	ML	MT
		t	t	t-m	t-m
1	1.1	2554.0	2553.3	0.0	127.6
	1.2	2514.8	2513.6	0.0	300.1
2	2.1	2228.8	2228.1	0.0	127.6
	2.2	2189.6	2188.4	0.0	300.1

Span Dislodged Condition

	Pmax	Pmin	ML	MT
	t	t	t-m	t-m
1	1488.7	1488.7	0.0	0.0
2	1163.5	1163.5	0.0	0.0

**Combination for Base Pressure
Seismic Case**

- 1 LWL
 - 1.1 Longitudinal Seismic
 - 1.1.1 Maximum Reaction Case
 - 1.1.2 Maximum Moment Case
 - 1.2 Transverse Seismic
 - 1.2.1 Maximum Reaction Case
 - 1.2.2 Maximum Moment Case
 - 1.3 Vertical Seismic
 - 1.3.1 Maximum Reaction Case
 - 1.3.2 Maximum Moment Case

- 2 HFL
 - 2.1 Longitudinal Seismic
 - 2.1.1 Maximum Reaction Case
 - 2.1.2 Maximum Moment Case
 - 2.2 Transverse Seismic
 - 2.2.1 Maximum Reaction Case
 - 2.2.2 Maximum Moment Case
 - 2.3 Vertical Seismic
 - 2.3.1 Maximum Reaction Case
 - 2.3.2 Maximum Moment Case

Factor by which seismic force is increased for design of foundation = 1.25

Span present Condition

- 1 LWL
 - 1.1 Longitudinal Seismic
 - 1.1.1 Maximum Reaction Case

Load Item	Unfactored				
	Pmax	Pmin	ML due to HL about	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	81.5	81.5	0.0	448.3	0.0
SIDL(w/c)	103.1	103.1	0.0	567.0	0.0
LL1	26.9	26.7	-16.2	147.8	25.5
FPLL1	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	55.7	-55.7	-3269.6	306.3	657.6
Earth Pressure	113.3	113.3	-895.3	1246.6	0.0
LL Surcharge	0.0	0.0	-348.2	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	38.2	-38.2	-709.8	303.4	212.9
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2593.5	2405.6	-5239.1	17110.5	896.1

Eccentricity of vertical load from c/l of footing = 1.1 m
 Longitudinal Moment about c/l of footing ML = 2392.7 t-m

1.1.2 Maximum Moment Case

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	81.5	81.5	0.0	448.3	0.0
SIDL(w/c)	103.1	103.1	0.0	567.0	0.0
LL2	19.0	18.8	-26.0	104.6	60.0
FPLL2	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	53.8	-53.8	-3269.6	296.1	635.8
Earth Pressure	113.3	113.3	-895.3	1246.6	0.0
LL Surcharge	0.0	0.0	-348.2	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	38.2	-38.2	-709.8	303.4	212.9
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2583.8	2399.5	-5248.9	17057.2	908.7

Eccentricity of vertical load from c/l of footing = 1.1 m

Longitudinal Moment about c/l of footing ML = 2402.5 t-m

1.2 Transverse Seismic

1.2.1 Maximum Reaction Case

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	81.5	81.5	0.0	448.3	0.0
SIDL(w/c)	103.1	103.1	0.0	567.0	0.0
LL1	26.9	26.7	-16.2	147.8	25.5
FPLL1	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	55.7	-55.7	-980.9	306.3	2192.0
Earth Pressure	113.3	113.3	-895.3	1246.6	0.0
LL Surcharge	0.0	0.0	-348.2	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	38.2	-38.2	55.2	303.4	212.9
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2593.5	2405.6	-2185.4	17110.5	2430.5

Eccentricity of vertical load from c/l of footing = 1.1 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

1.2.2 Maximum Moment Case

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	81.5	81.5	0.0	448.3	0.0
SIDL(w/c)	103.1	103.1	0.0	567.0	0.0
LL2	19.0	18.8	-26.0	104.6	60.0
FPLL2	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	53.8	-53.8	-980.9	296.1	2119.2
Earth Pressure	113.3	113.3	-895.3	1246.6	0.0
LL Surcharge	0.0	0.0	-348.2	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	38.2	-38.2	55.2	303.4	212.9
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2583.8	2399.5	-2195.2	17057.2	2392.2

Eccentricity of vertical load from c/l of footing = 1.1 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

1.3 Vertical Seismic

1.3.1 Maximum Reaction Case

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	81.5	81.5	0.0	448.3	0.0
SIDL(w/c)	103.1	103.1	0.0	567.0	0.0
LL1	26.9	26.7	-16.2	147.8	25.5
FPLL1	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	92.8	-92.8	-1117.6	510.5	657.6
Earth Pressure	113.33	113.3	-895.3	1246.6	0.0
LL Surcharge	0.0	0.0	-348.2	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	127.2	-127.2	55.2	140.6	55.2
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2719.7	2279.4	-2322.1	17151.8	738.3

Eccentricity of vertical load from c/l of footing = 0.8 m

Longitudinal Moment about c/l of footing ML = 128.4 t-m

1.3.2 Maximum Moment Case

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	81.5	81.5	0.0	448.3	0.0
SIDL(w/c)	103.1	103.1	0.0	567.0	0.0
LL2	19.0	18.8	-26.0	104.6	60.0
FPLL2	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	179.5	-179.5	-1080.5	987.0	635.8
Earth Pressure	113.3	113.3	-895.3	1246.6	0.0
LL Surcharge	0.0	0.0	-348.2	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	127.2	-127.2	55.2	140.6	55.2
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2798.5	2184.8	-2294.8	17585.2	751.0

Eccentricity of vertical load from c/l of footing = 0.8 m
Longitudinal Moment about c/l of footing ML = 101.1 t-m

2 HFL

2.1 Longitudinal Seismic

2.1.1 Maximum Reaction Case

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	81.5	81.5	0.0	448.3	0.0
SIDL(w/c)	103.1	103.1	0.0	567.0	0.0
LL1	26.9	26.7	-16.2	147.8	25.5
FPLL1	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	55.7	-55.7	-3269.6	306.3	657.6
Earth Pressure	80.8	80.8	-637.7	889.0	0.0
LL Surcharge	0.0	0.0	-348.2	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	38.2	-38.2	-709.8	303.4	212.9
Buoyancy on substr.	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Buoyancy on fdn.	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2254.7	2066.8	-4981.5	15008.3	896.1

Eccentricity of vertical load from c/l of footing = 1.2 m
Longitudinal Moment about c/l of footing ML = 2374.1 t-m

2.1.2 Maximum Moment Case

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	81.5	81.5	0.0	448.3	0.0
SIDL(w/c)	103.1	103.1	0.0	567.0	0.0
LL2	19.0	18.8	-26.0	104.6	60.0
FPLL2	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	53.8	-53.8	-3269.6	296.1	635.8
Earth Pressure	80.8	80.8	-637.7	889.0	0.0
LL Surcharge	0.0	0.0	-348.2	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	38.2	-38.2	-709.8	303.4	212.9
Buoyancy on substr.	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Buoyancy on fdn.	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2245.0	2060.8	-4991.3	14955.0	908.7

Eccentricity of vertical load from c/l of footing = 1.2 m

Longitudinal Moment about c/l of footing ML = 2383.9 t-m

2.2 Transverse Seismic

2.2.1 Maximum Reaction Case

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	81.5	81.5	0.0	448.3	0.0
SIDL(w/c)	103.1	103.1	0.0	567.0	0.0
LL1	26.9	26.7	-16.2	147.8	25.5
FPLL1	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	55.7	-55.7	-980.9	306.3	2192.0
Earth Pressure	80.8	80.8	-637.7	889.0	0.0
LL Surcharge	0.0	0.0	-348.2	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	38.2	-38.2	55.2	303.4	212.9
Buoyancy on substr.	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Buoyancy on fdn.	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2254.7	2066.8	-1927.8	15008.3	2430.5

Eccentricity of vertical load from c/l of footing = 1.2 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

2.2.2 Maximum Moment Case

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	81.5	81.5	0.0	448.3	0.0
SIDL(w/c)	103.1	103.1	0.0	567.0	0.0
LL2	19.0	18.8	-26.0	104.6	60.0
FPLL2	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	53.8	-53.8	-980.9	296.1	2119.2
Earth Pressure	80.8	80.8	-637.7	889.0	0.0
LL Surcharge	0.0	0.0	-348.2	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	38.2	-38.2	55.2	303.4	212.9
Buoyancy on substr.	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Buoyancy on fdn.	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2245.0	2060.8	-1937.6	14955.0	2392.2

Eccentricity of vertical load from c/l of footing = 1.2 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

2.3 Vertical Seismic

2.3.1 Maximum Reaction Case

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	81.5	81.5	0.0	448.3	0.0
SIDL(w/c)	103.1	103.1	0.0	567.0	0.0
LL1	26.9	26.7	-16.2	147.8	25.5
FPLL1	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	92.8	-92.8	-1117.6	510.5	657.6
Earth Pressure	80.8	80.8	-637.7	889.0	0.0
LL Surcharge	0.0	0.0	-348.2	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	127.2	-127.2	55.2	140.6	55.2
Buoyancy on substr.	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Buoyancy on fdn.	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2380.9	1940.7	-2064.5	15049.7	738.3

Eccentricity of vertical load from c/l of footing = 0.8 m

Longitudinal Moment about c/l of footing ML = 109.8 t-m

2.3.2 Maximum Moment Case

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
DL Sup	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	81.5	81.5	0.0	448.3	0.0
SIDL(w/c)	103.1	103.1	0.0	567.0	0.0
LL2	19.0	18.8	-26.0	104.6	60.0
FPLL2	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	179.5	-179.5	-1080.5	987.0	635.8
Earth Pressure	80.8	80.8	-637.7	889.0	0.0
LL Surcharge	0.0	0.0	-348.2	0.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	127.2	-127.2	55.2	140.6	55.2
Buoyancy on substr.	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Buoyancy on fdn.	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	2459.7	1846.1	-2037.2	15483.1	751.0

Eccentricity of vertical load from c/l of footing = 0.8 m
 Longitudinal Moment about c/l of footing ML = 82.5 t-m

Span Dislodged Condition

1 LWL

1.1 Longitudinal Seismic

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
Earth Pressure	113.3	113.3	-895.3	1246.6	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	38.2	-38.2	-709.8	303.4	212.9
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	1574.3	1497.9	-1605.1	11504.9	212.9

Eccentricity of vertical load from c/l of footing = 1.8 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

1.2 Transverse Seismic

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
Earth Pressure	113.3	113.3	-895.3	1246.6	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	38.2	-38.2	55.2	303.4	212.9
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	1574.3	1497.9	-840.1	11504.9	212.9

Eccentricity of vertical load from c/l of footing = 1.8 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

1.3 Vertical Seismic

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
Earth Pressure	113.3	113.3	-895.3	1246.6	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	127.2	-127.2	55.2	140.6	55.2
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	1663.3	1408.9	-840.1	11342.0	55.2

Eccentricity of vertical load from c/l of footing = 1.3 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

2 HFL

2.1 Longitudinal Seismic

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
Earth Pressure	80.8	80.8	-637.7	889.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	38.2	-38.2	-709.8	303.4	212.9
Buoyancy on substr.	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Buoyancy on fdn.	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	1235.5	1159.2	-1347.5	9402.7	212.9

Eccentricity of vertical load from c/l of footing = 2.1 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

2.2 Transverse Seismic

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
Earth Pressure	80.8	80.8	-637.7	889.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	38.2	-38.2	55.2	303.4	212.9
Buoyancy on substr.	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Buoyancy on fdn.	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	1235.5	1159.2	-582.5	9402.7	212.9

Eccentricity of vertical load from c/l of footing = 2.1 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

2.3 Vertical Seismic

	Unfactored				
	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
	t	t	t-m	t-m	t-m
Earth Pressure	80.8	80.8	-637.7	889.0	0.0
Weight of Substr.	141.6	141.6	0.0	803.3	0.0
Seismic Force on Substr.	127.2	-127.2	55.2	140.6	55.2
Buoyancy on substr.	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	625.0	625.0	0.0	3437.5	0.0
Buoyancy on fdn.	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	70.7	70.7	0.0	615.7	0.0
Buoyancy on Return wall.	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	585.4	585.4	0.0	5098.3	0.0
Total	1324.6	1070.1	-582.5	9239.9	55.2

Eccentricity of vertical load from c/l of footing = 1.5 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

Summary**Service Condition**

			Pmax	Pmin	ML	MT
			t	t	t-m	t-m
1	1.1	1.1.1	2593.5	2405.6	2392.7	896.1
		1.1.2	2583.8	2399.5	2402.5	908.7
	1.2	1.2.1	2593.5	2405.6	0.0	2430.5
		1.2.2	2583.8	2399.5	0.0	2392.2
	1.3	1.3.1	2719.7	2279.4	128.4	738.3
		1.3.2	2798.5	2184.8	101.1	751.0
2	2.1	2.1.1	2254.7	2066.8	2374.1	896.1
		2.1.2	2245.0	2060.8	2383.9	908.7
	2.2	2.2.1	2254.7	2066.8	0.0	2430.5
		2.2.2	2245.0	2060.8	0.0	2392.2
	2.3	2.3.1	2380.9	1940.7	109.8	738.3
		2.3.2	2459.7	1846.1	82.5	751.0

Span Dislodged Condition

		Pmax	Pmin	ML	MT
		t	t	t-m	t-m
1	1.1	1574.3	1497.9	0.0	212.9
	1.2	1574.3	1497.9	0.0	212.9
	1.3	1663.3	1408.9	0.0	55.2
2	2.1	1235.5	1159.2	0.0	212.9
	2.2	1235.5	1159.2	0.0	212.9
	2.3	1324.6	1070.1	0.0	55.2

BASE PRESSURE FOR DESIGN OF FOUNDATION

Area of base	A	=	137.5 m ²
Longitudinal Section Modulus	zl	=	252.1 m ³
Transverse Section Modulus	zt	=	286.5 m ³

RCC Deck Slab over Steel Plate Girder w of overall span 81.500 m supported on POT CUM PTFE Bearing.

Combination for Base Pressure Foundation

Span Present Condition

			Forces/Moments				For Pmax				For Pmin			
			Pmax	Pmin	ML	MT	P/A+ML/zl+MT/zt	P/A+ML/zl- MT/zt	P/A-ML/zl- MT/zt	P/A- ML/zl+MT/zt	P/A+ML/zl+MT/zt	P/A+ML/zl- MT/zt	P/A-ML/zl- MT/zt	P/A- ML/zl+MT/zt
			t	t	t-m	t-m	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²
1	1.1	1.1.1	2554.0	2553.3	0.0	127.6	19.0	18.1	18.1	19.0	19.0	18.1	18.1	19.0
		1.1.2	2514.8	2513.6	0.0	300.1	19.3	17.2	17.2	19.3	19.3	17.2	17.2	19.3
2	2.1	2.1.1	2228.8	2228.1	0.0	127.6	16.7	15.8	15.8	16.7	16.6	15.8	15.8	16.6
		2.1.2	2189.6	2188.4	0.0	300.1	17.0	14.9	14.9	17.0	17.0	14.9	14.9	17.0

One Span Dislodged Condition

			Forces/Moments				For Pmax				For Pmin			
			Pmax	Pmin	ML	MT	P/A+ML/zl+MT/zt	P/A+ML/zl- MT/zt	P/A-ML/zl- MT/zt	P/A- ML/zl+MT/zt	P/A+ML/zl+MT/zt	P/A+ML/zl- MT/zt	P/A-ML/zl- MT/zt	P/A- ML/zl+MT/zt
			t	t	t-m	t-m	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²
1			1488.7	1488.7	0.0	0.0	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
2			1163.5	1163.5	0.0	0.0	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5

Seismic Combination

Span Present Condition

			Forces/Moments				For Pmax				For Pmin			
			Pmax	Pmin	ML	MT	P/A+ML/zl+MT/zt	P/A+ML/zl- MT/zt	P/A-ML/zl- MT/zt	P/A- ML/zl+MT/zt	P/A+ML/zl+MT/zt	P/A+ML/zl- MT/zt	P/A-ML/zl- MT/zt	P/A- ML/zl+MT/zt
			t	t	t-m	t-m	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²
1	1.1	1.1.1	2593.5	2405.6	2392.7	896.1	31.5	25.2	6.2	12.5	30.1	23.9	4.9	11.1
		1.1.2	2583.8	2399.5	2402.5	908.7	31.5	25.1	6.1	12.4	30.2	23.8	4.7	11.1
	1.2	1.2.1	2593.5	2405.6	0.0	2430.5	27.3	10.4	10.4	27.3	26.0	9.0	9.0	26.0
		1.2.2	2583.8	2399.5	0.0	2392.2	27.1	10.4	10.4	27.1	25.8	9.1	9.1	25.8
	1.3	1.3.1	2719.7	2279.4	128.4	738.3	22.9	17.7	16.7	21.8	19.7	14.5	13.5	18.6
		1.3.2	2798.5	2184.8	101.1	751.0	23.4	18.1	17.3	22.6	18.9	13.7	12.9	18.1
2	2.1	2.1.1	2254.7	2066.8	2374.1	896.1	28.9	22.7	3.9	10.1	27.6	21.3	2.5	8.7
		2.1.2	2245.0	2060.8	2383.9	908.7	29.0	22.6	3.7	10.0	27.6	21.3	2.4	8.7
	2.2	2.2.1	2254.7	2066.8	0.0	2430.5	24.9	7.9	7.9	24.9	23.5	6.5	6.5	23.5
		2.2.2	2245.0	2060.8	0.0	2392.2	24.7	8.0	8.0	24.7	23.3	6.6	6.6	23.3
	2.3	2.3.1	2380.9	1940.7	109.8	738.3	20.3	15.2	14.3	19.5	17.1	12.0	11.1	16.3
		2.3.2	2459.7	1846.1	82.5	751.0	20.8	15.6	14.9	20.2	16.4	11.1	10.5	15.7

One Span Dislodged Condition

		Forces/Moments				For Pmax				For Pmin			
		Pmax	Pmin	ML	MT	P/A+ML/zl+MT/zt	P/A+ML/zl MT/zt	P/A-ML/zl-MT/zt	P/A-ML/zl+MT/zt	P/A+ML/zl+MT/zt	P/A+ML/zl MT/zt	P/A-ML/zl-MT/zt	P/A-ML/zl+MT/zt
		t	t	t-m	t-m	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²
1	1.1	1574.3	1497.9	0.0	212.9	12.2	10.7	10.7	12.2	11.6	10.2	10.2	11.6
	1.2	1574.3	1497.9	0.0	212.9	12.2	10.7	10.7	12.2	11.6	10.2	10.2	11.6
	1.3	1663.3	1408.9	0.0	55.2	12.3	11.9	11.9	12.3	10.4	10.1	10.1	10.4
2	2.1	1235.5	1159.2	0.0	212.9	9.7	8.2	8.2	9.7	9.2	7.7	7.7	9.2
	2.2	1235.5	1159.2	0.0	212.9	9.7	8.2	8.2	9.7	9.2	7.7	7.7	9.2
	2.3	1324.6	1070.1	0.0	55.2	9.8	9.4	9.4	9.8	8.0	7.6	7.6	8.0

LWL

Maximum Axial Force Condition

Maximum Base Pressure

Minimum Base Pressure

= 31.5 t/m²

= 6.1 t/m²

Minimum Axial Force Condition

Maximum Base Pressure

Minimum Base Pressure

= 30.2 t/m²

= 4.7 t/m²

Maximum Base Pressure

= 31.5 t/m² OK

Minimum Base Pressure

= 4.7 t/m² OK

HFL

Maximum Axial Force Condition

Maximum Base Pressure

Minimum Base Pressure

= 29.0 t/m²

= 3.7 t/m²

Minimum Axial Force Condition

Maximum Base Pressure

Minimum Base Pressure

= 27.6 t/m²

= 2.4 t/m²

Maximum Base Pressure

= 29.0 t/m² OK

Minimum Base Pressure

= 2.4 t/m² OK

LOAD COMBINATION (LIMIT STATE)

15.DESIGN OF OPEN FOUNDATION

D Combination for Design of Foundation

D-1 Combination 1

1 LWL

1.1 Maximum Reaction Case

1.2 Maximum Moment Case

2 HFL

2.1 Maximum Reaction Case

2.2 Maximum Moment Case

Span present Condition

1 LWL

1.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	448.3	0.0	110.0	110.0	0.0	605.1	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	567.0	0.0	180.4	180.4	0.0	992.3	0.0
LL1	1.5	134.4	133.6	-81.1	738.9	127.6	201.5	200.4	-121.6	1108.4	191.4
FPLL1	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1.5	65.94	65.94	-542.38	725.35	0.00	98.9	98.9	-813.6	1088.0	0.0
LL Surcharge	1.2	0.0	0.0	-202.5	0.0	0.0	0.0	0.0	-243.0	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3526.9	3525.8	-1178.1	22816.8	191.4

Total

Eccentricity of vertical load from c/l of footing = 1.0 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

1.2 Maximum Moment Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	93.7	81.5	0.0	515.5	0.0	126.5	110.0	0.0	695.9	0.0
SIDL(w/c)	1.75	85.2	103.1	0.0	468.4	0.0	149.0	180.4	0.0	819.7	0.0
LL2	1.5	95.1	94.0	-130.1	523.2	300.1	142.7	140.9	-195.1	784.8	450.2
FPLL2	1.15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1.5	65.9	65.9	-542.4	725.3	0.0	98.9	98.9	-813.6	1088.0	0.0
LL Surcharge	1.2	0.0	0.0	-202.5	0.0	0.0	0.0	0.0	-243.0	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3453.2	3466.3	-1251.7	22411.4	450.2

Total

Eccentricity of vertical load from c/l of footing = 1.0 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

2 HFL
2.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	448.3	0.0	110.0	110.0	0.0	605.1	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	567.0	0.0	180.4	180.4	0.0	992.3	0.0
LL1	1.5	134.4	133.6	-81.1	738.9	127.6	201.5	200.4	-121.6	1108.4	191.4
FPLL1	1.15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1.5	47.0	47.0	-329.3	517.3	0.0	70.5	70.5	-493.9	775.9	0.0
LL Surcharge	1.2	0.0	0.0	-202.5	0.0	0.0	0.0	0.0	-243.0	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Buoyancy on substr.	1	-37.5	-37.5	0.0	-206.3	0.0	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Buoyancy on fdn.	1	-250.0	-250.0	0.0	-1375.0	0.0	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Buoyancy on Return wall.	1	-18.8	-18.8	0.0	-163.3	0.0	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3192.3	3191.2	-858.5	20760.2	191.4

Total

Eccentricity of vertical load from c/l of footing = 1.0 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

2.2 Maximum Moment Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	448.3	0.0	110.0	110.0	0.0	605.1	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	567.0	0.0	180.4	180.4	0.0	992.3	0.0
LL2	1.5	95.1	94.0	-130.1	523.2	300.1	142.7	140.9	-195.1	784.8	450.2
FPLL2	1.15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1.5	47.0	47.0	-329.3	517.3	0.0	70.5	70.5	-493.9	775.9	0.0
LL Surcharge	1.2	0.0	0.0	-202.5	0.0	0.0	0.0	0.0	-243.0	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Buoyancy on substr.	1	-37.5	-37.5	0.0	-206.3	0.0	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Buoyancy on fdn.	1	-250.0	-250.0	0.0	-1375.0	0.0	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Buoyancy on Return wall.	1	-18.8	-18.8	0.0	-163.3	0.0	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3133.4	3131.7	-932.0	20436.6	450.2

Total

Eccentricity of vertical load from c/l of footing = 1.0 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

Span Dislodged Condition

1 LWL

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
Earth Pressure	1.5	65.94	65.94	-542.38	725.35	0.00	98.9	98.9	-813.6	1088.0	0.0
Weight of Substr.	1.35	141.61	141.61	0.00	803.33	0.00	191.2	191.2	0.0	1084.5	0.0
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							2019.6	2019.6	-813.6	14527.0	0.0

Eccentricity of vertical load from c/l of footing = 1.7 m
 Longitudinal Moment about c/l of footing ML = 0.0 t-m

2 HFL

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
Earth Pressure	1.5	47.0	47.0	-329.3	517.3	0.0	70.5	70.5	-493.9	775.9	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Buoyancy on substr.	1	-37.5	-37.5	0.0	-206.3	0.0	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Buoyancy on fdn.	1	-250.0	-250.0	0.0	-1375.0	0.0	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Buoyancy on Return wall.	1	-18.8	-18.8	0.0	-163.3	0.0	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							1685.0	1685.0	-493.9	12470.4	0.0

Eccentricity of vertical load from c/l of footing = 1.9 m
 Longitudinal Moment about c/l of footing ML = 0.0 t-m

Summary

Service Condition

		Pmax	Pmin	ML	MT
		t	t	t-m	t-m
1	1.1	3526.9	3525.8	0.0	191.4
	1.2	3453.2	3466.3	0.0	450.2
2	2.1	3192.3	3191.2	0.0	191.4
	2.2	3133.4	3131.7	0.0	450.2

Span Dislodged Condition

	Pmax	Pmin	ML	MT
	t	t	t-m	t-m
1	2019.6	2019.6	0.0	0.0
2	1685.0	1685.0	0.0	0.0

D Combination for Design of Foundation
D-2 Combination 2

- 1 LWL
 1.1 Maximum Reaction Case
 1.2 Maximum Moment Case
 2 HFL
 2.1 Maximum Reaction Case
 2.2 Maximum Moment Case

Span present Condition

1 LWL
1.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL_Sup	1	752.1	752.1	0.0	4136.3	0.0	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	1	81.5	81.5	0.0	448.3	0.0	81.5	81.5	0.0	448.3	0.0
SIDL(w/c)	1	103.1	103.1	0.0	567.0	0.0	103.1	103.1	0.0	567.0	0.0
LL1	1.3	134.4	133.6	-81.1	738.9	127.6	174.7	173.7	-105.4	960.6	165.9
FPLL1	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1.3	65.9	65.9	-542.4	725.3	0.0	85.7	85.7	-705.1	942.9	0.0
LL Surcharge	1	0.0	0.0	-202.5	0.0	0.0	0.0	0.0	-202.5	0.0	0.0
Weight of Substr.	1	141.6	141.6	0.0	803.3	0.0	141.6	141.6	0.0	803.3	0.0
Weight of fdn	1	625.0	625.0	0.0	3437.5	0.0	625.0	625.0	0.0	3437.5	0.0
Return Wall Wt.	1	70.7	70.7	0.0	615.7	0.0	70.7	70.7	0.0	615.7	0.0
Backfill Wt.	1	585.4	585.4	0.0	5098.3	0.0	585.4	585.4	0.0	5098.3	0.0
Total							2619.8	2618.8	-1013.0	17009.9	165.9

Eccentricity of vertical load from c/l of footing = 1.0 m
 Longitudinal Moment about c/l of footing ML = 0.0 t-m

1.2 Maximum Moment Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL_Sup	1	752.1	752.1	0.0	4136.3	0.0	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	1	93.7	81.5	0.0	515.5	0.0	93.7	81.5	0.0	515.5	0.0
SIDL(w/c)	1	85.2	103.1	0.0	468.4	0.0	85.2	103.1	0.0	468.4	0.0
LL2	1.3	95.1	94.0	-130.1	523.2	300.1	123.7	122.1	-169.1	680.1	390.2
FPLL2	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1.3	65.9	65.9	-542.4	725.3	0.0	85.7	85.7	-705.1	942.9	0.0
LL Surcharge	1	0.0	0.0	-202.5	0.0	0.0	0.0	0.0	-202.5	0.0	0.0
Weight of Substr.	1	141.6	141.6	0.0	803.3	0.0	141.6	141.6	0.0	803.3	0.0
Weight of fdn	1	625.0	625.0	0.0	3437.5	0.0	625.0	625.0	0.0	3437.5	0.0
Return Wall Wt.	1	70.7	70.7	0.0	615.7	0.0	70.7	70.7	0.0	615.7	0.0
Backfill Wt.	1	585.4	585.4	0.0	5098.3	0.0	585.4	585.4	0.0	5098.3	0.0
Total							2563.1	2567.3	-1076.7	16698.1	390.2

Eccentricity of vertical load from c/l of footing = 1.0 m
 Longitudinal Moment about c/l of footing ML = 0.0 t-m

2 HFL
2.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL_Sup	1	752.1	752.1	0.0	4136.3	0.0	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	1	81.5	81.5	0.0	448.3	0.0	81.5	81.5	0.0	448.3	0.0
SIDL(w/c)	1	103.1	103.1	0.0	567.0	0.0	103.1	103.1	0.0	567.0	0.0
LL1	1.3	134.4	133.6	-81.1	738.9	127.6	174.7	173.7	-105.4	960.6	165.9
FPLL1	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1.3	47.0	47.0	-329.3	517.3	0.0	61.1	61.1	-428.1	672.5	0.0
LL Surcharge	1	0.0	0.0	-202.5	0.0	0.0	0.0	0.0	-202.5	0.0	0.0
Weight of Substr.	1	141.6	141.6	0.0	803.3	0.0	141.6	141.6	0.0	803.3	0.0
Buoyancy on substr.	1	-37.5	-37.5	0.0	-206.3	0.0	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	1	625.0	625.0	0.0	3437.5	0.0	625.0	625.0	0.0	3437.5	0.0
Buoyancy on fdn.	1	-250.0	-250.0	0.0	-1375.0	0.0	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	1	70.7	70.7	0.0	615.7	0.0	70.7	70.7	0.0	615.7	0.0
Buoyancy on Return wall.	1	-18.8	-18.8	0.0	-163.3	0.0	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	1	585.4	585.4	0.0	5098.3	0.0	585.4	585.4	0.0	5098.3	0.0
Total							2288.9	2288.0	-735.9	14994.9	165.9

Eccentricity of vertical load from c/l of footing = 1.1 m
Longitudinal Moment about c/l of footing ML = 0.0 t-m

2.2 Maximum Moment Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL_Sup	1	752.1	752.1	0.0	4136.3	0.0	752.1	752.1	0.0	4136.3	0.0
SIDL(excl. w/c)	1	93.7	81.5	0.0	515.5	0.0	93.7	81.5	0.0	515.5	0.0
SIDL(w/c)	1	85.2	103.1	0.0	468.4	0.0	85.2	103.1	0.0	468.4	0.0
LL2	1.3	95.1	94.0	-130.1	523.2	300.1	123.7	122.1	-169.1	680.1	390.2
FPLL2	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth Pressure	1.3	47.0	47.0	-329.3	517.3	0.0	61.1	61.1	-428.1	672.5	0.0
LL Surcharge	1	0.0	0.0	-202.5	0.0	0.0	0.0	0.0	-202.5	0.0	0.0
Weight of Substr.	1	141.6	141.6	0.0	803.3	0.0	141.6	141.6	0.0	803.3	0.0
Buoyancy on substr.	1	-37.5	-37.5	0.0	-206.3	0.0	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	1	625.0	625.0	0.0	3437.5	0.0	625.0	625.0	0.0	3437.5	0.0
Buoyancy on fdn.	1	-250.0	-250.0	0.0	-1375.0	0.0	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	1	70.7	70.7	0.0	615.7	0.0	70.7	70.7	0.0	615.7	0.0
Buoyancy on Return wall.	1	-18.8	-18.8	0.0	-163.3	0.0	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	1	585.4	585.4	0.0	5098.3	0.0	585.4	585.4	0.0	5098.3	0.0
Total							2232.3	2236.4	-799.6	14683.1	390.2

Eccentricity of vertical load from c/l of footing = 1.1 m
Longitudinal Moment about c/l of footing ML = 0.0 t-m

Span Dislodged Condition

1 LWL

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
Earth Pressure	1.3	65.9	65.9	-542.4	725.3	0.0	85.7	85.7	-705.1	942.9	0.0
Weight of Substr.	1	141.6	141.6	0.0	803.3	0.0	141.6	141.6	0.0	803.3	0.0
Weight of fdn	1	625.0	625.0	0.0	3437.5	0.0	625.0	625.0	0.0	3437.5	0.0
Return Wall Wt.	1	70.7	70.7	0.0	615.7	0.0	70.7	70.7	0.0	615.7	0.0
Backfill Wt.	1	585.4	585.4	0.0	5098.3	0.0	585.4	585.4	0.0	5098.3	0.0
Total							1508.5	1508.5	-705.1	10897.8	0.0

Eccentricity of vertical load from c/l of footing = 1.7 m
 Longitudinal Moment about c/l of footing ML = 0.0 t-m

2 HFL

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
Earth Pressure	1.3	47.0	47.0	-329.3	517.3	0.0	61.1	61.1	-428.1	672.5	0.0
Weight of Substr.	1	141.6	141.6	0.0	803.3	0.0	141.6	141.6	0.0	803.3	0.0
Buoyancy on substr.	1	-37.5	-37.5	0.0	-206.3	0.0	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	1	625.0	625.0	0.0	3437.5	0.0	625.0	625.0	0.0	3437.5	0.0
Buoyancy on fdn.	1	-250.0	-250.0	0.0	-1375.0	0.0	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	1	70.7	70.7	0.0	615.7	0.0	70.7	70.7	0.0	615.7	0.0
Buoyancy on Return wall.	1	-18.8	-18.8	0.0	-163.3	0.0	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	1	585.4	585.4	0.0	5098.3	0.0	585.4	585.4	0.0	5098.3	0.0
Total							1177.6	1177.6	-428.1	8882.7	0.0

Eccentricity of vertical load from c/l of footing = 2.0 m
 Longitudinal Moment about c/l of footing ML = 0.0 t-m

Summary

Service Condition

		Pmax	Pmin	ML	MT
		t	t	t-m	t-m
1	1.1	2619.8	2618.8	0.0	165.9
	1.2	2563.1	2567.3	0.0	390.2
2	2.1	2288.9	2288.0	0.0	165.9
	2.2	2232.3	2236.4	0.0	390.2

Span Dislodged Condition

	Pmax	Pmin	ML	MT
	t	t	t-m	t-m
1	1508.5	1508.5	0.0	0.0
2	1177.6	1177.6	0.0	0.0

D Combination for Design of Foundation

D-3 Seismic Combination

1 LWL

- 1.1 Longitudinal Seismic
 - 1.1.1 Maximum Reaction Case
 - 1.1.2 Maximum Moment Case
- 1.2 Transverse Seismic
 - 1.2.1 Maximum Reaction Case
 - 1.2.2 Maximum Moment Case
- 1.3 Vertical Seismic
 - 1.3.1 Maximum Reaction Case
 - 1.3.2 Maximum Moment Case

2 HFL

- 2.1 Longitudinal Seismic
 - 2.1.1 Maximum Reaction Case
 - 2.1.2 Maximum Moment Case
- 2.2 Transverse Seismic
 - 2.2.1 Maximum Reaction Case
 - 2.2.2 Maximum Moment Case
- 2.3 Vertical Seismic
 - 2.3.1 Maximum Reaction Case
 - 2.3.2 Maximum Moment Case

Factor by which seismic force is increased for design of foundation = 1.25

Span present Condition

1 LWL

1.1 Longitudinal Seismic

1.1.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	448.3	0.0	110.0	110.0	0.0	605.1	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	567.0	0.0	180.4	180.4	0.0	992.3	0.0
LL1	0.2	134.4	133.6	-81.1	738.9	127.6	26.9	26.7	-16.2	147.8	25.5
FPLL1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	44.5	-44.5	-2615.7	245.0	526.1	83.5	-83.5	-4904.4	459.4	986.4
Earth Pressure	-	113.3	113.3	-895.3	1246.6	0.0	0.0	0.0	0.0	0.0	0.0
LL Surcharge	0.2	0.0	0.0	-348.2	0.0	0.0	0.0	0.0	-69.6	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	1.5	30.5	-30.5	-567.8	242.7	170.3	57.3	-57.3	-1064.7	455.1	319.4
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3394.1	3112.4	-6055.0	21682.8	1331.3

Eccentricity of vertical load from c/l of footing = 0.9 m

Longitudinal Moment about c/l of footing ML = 3039.8 t-m

1.1.2 Maximum Moment Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	93.7	81.5	0.0	515.5	0.0	126.5	110.0	0.0	695.9	0.0
SIDL(w/c)	1.75	85.2	103.1	0.0	468.4	0.0	149.0	180.4	0.0	819.7	0.0
LL2	0.2	95.1	94.0	-130.1	523.2	300.1	19.0	18.8	-26.0	104.6	60.0
FPLL2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	43.1	-43.1	-2615.7	236.9	508.6	80.8	-80.8	-4904.4	444.2	953.7
Earth Pressure	-	113.3	113.3	-895.3	1246.6	0.0	0.0	0.0	0.0	0.0	0.0
LL Surcharge	0.2	0.0	0.0	-348.2	0.0	0.0	0.0	0.0	-69.6	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on	1.5	30.5	-30.5	-567.8	242.7	170.3	57.3	-57.3	-1064.7	455.1	319.4
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3368.6	3107.2	-6064.8	21542.6	1333.1

Eccentricity of vertical load from c/l of footing = 0.9 m
Longitudinal Moment about c/l of footing ML = 3049.6 t-m

1.2 Transverse Seismic

1.2.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	448.3	0.0	110.0	110.0	0.0	605.1	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	567.0	0.0	180.4	180.4	0.0	992.3	0.0
LL1	0.2	134.4	133.6	-81.1	738.9	127.6	26.9	26.7	-16.2	147.8	25.5
FPLL1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	44.5	-44.5	-784.7	245.0	1753.6	83.5	-83.5	-1471.3	459.4	3288.0
Earth Pressure	-	113.3	113.3	-895.3	1246.6	0.0	0.0	0.0	0.0	0.0	0.0
LL Surcharge	0.2	0.0	0.0	-348.2	0.0	0.0	0.0	0.0	-69.6	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on	1.5	30.5	-30.5	44.1	242.7	170.3	57.3	-57.3	82.7	455.1	319.4
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3394.1	3112.4	-1474.4	21682.8	3632.9

Eccentricity of vertical load from c/l of footing = 0.9 m
Longitudinal Moment about c/l of footing ML = 0.0 t-m

1.2.2 Maximum Moment Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	93.7	81.5	0.0	515.5	0.0	126.5	110.0	0.0	695.9	0.0
SIDL(w/c)	1.75	85.2	103.1	0.0	468.4	0.0	149.0	180.4	0.0	819.7	0.0
LL2	0.2	95.1	94.0	-130.1	523.2	300.1	19.0	18.8	-26.0	104.6	60.0
FPLL2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	43.1	-43.1	-784.7	236.9	1695.4	80.8	-80.8	-1471.3	444.2	3178.9
Earth Pressure	-	113.3	113.3	-895.3	1246.6	0.0	0.0	0.0	0.0	0.0	0.0
LL Surcharge	0.2	0.0	0.0	-348.2	0.0	0.0	0.0	0.0	-69.6	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	1.5	30.5	-30.5	44.1	242.7	170.3	57.3	-57.3	82.7	455.1	319.4
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3368.6	3107.2	-1484.2	21542.6	3558.3

Eccentricity of vertical load from c/l of footing = 0.9 m
Longitudinal Moment about c/l of footing ML = 0.0 t-m

1.3 Vertical Seismic

1.3.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	448.3	0.0	110.0	110.0	0.0	605.1	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	567.0	0.0	180.4	180.4	0.0	992.3	0.0
LL1	0.2	134.4	133.6	-81.1	738.9	127.6	26.9	26.7	-16.2	147.8	25.5
FPLL1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	74.2	-74.2	-894.1	408.4	526.1	139.2	-139.2	-1676.4	765.7	986.4
Earth Pressure	-	113.3	113.3	-895.3	1246.6	0.0	0.0	0.0	0.0	0.0	0.0
LL Surcharge	0.2	0.0	0.0	-348.2	0.0	0.0	0.0	0.0	-69.6	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	1.5	101.8	-101.8	44.1	112.5	44.1	190.9	-190.9	82.7	210.9	82.7
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3583.4	2923.1	-1679.5	21744.8	1094.7

Eccentricity of vertical load from c/l of footing = 0.6 m
Longitudinal Moment about c/l of footing ML = 0.0 t-m

1.3.2 Maximum Moment Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	93.7	81.5	0.0	515.5	0.0	126.5	110.0	0.0	695.9	0.0
SIDL(w/c)	1.75	85.2	103.1	0.0	468.4	0.0	149.0	180.4	0.0	819.7	0.0
LL2	0.2	95.1	94.0	-130.1	523.2	300.1	19.0	18.8	-26.0	104.6	60.0
FPLL2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	143.6	-143.6	-864.4	789.6	508.6	269.2	-269.2	-1620.7	1480.5	953.7
Earth Pressure	-	113.3	113.3	-895.3	1246.6	0.0	0.0	0.0	0.0	0.0	0.0
LL Surcharge	0.2	0.0	0.0	-348.2	0.0	0.0	0.0	0.0	-69.6	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	1.5	101.8	-101.8	44.1	112.5	44.1	190.9	-190.9	82.7	210.9	82.7
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3690.6	2785.2	-1633.7	22334.7	1096.4

Eccentricity of vertical load from c/l of footing = 0.6 m
Longitudinal Moment about c/l of footing ML = 0.0 t-m

2 HFL

2.1 Longitudinal Seismic

2.1.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	448.3	0.0	110.0	110.0	0.0	605.1	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	567.0	0.0	180.4	180.4	0.0	992.3	0.0
LL1	0.2	134.4	133.6	-81.1	738.9	127.6	26.9	26.7	-16.2	147.8	25.5
FPLL1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	44.5	-44.5	-2615.7	245.0	526.1	83.5	-83.5	-4904.4	459.4	986.4
Earth Pressure	-	80.8	80.8	-637.7	889.0	0.0	0.0	0.0	0.0	0.0	0.0
LL Surcharge	0.2	0.0	0.0	-348.2	0.0	0.0	0.0	0.0	-69.6	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	1.5	30.5	-30.5	-567.8	242.7	170.3	57.3	-57.3	-1064.7	455.1	319.4
Buoyancy on substr.	1	-37.5	-37.5	0.0	-206.3	0.0	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Buoyancy on fdn.	1	-250.0	-250.0	0.0	-1375.0	0.0	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Buoyancy on Return wall.	1	-18.8	-18.8	0.0	-163.3	0.0	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3087.8	2806.1	-6055.0	19938.2	1331.3

Eccentricity of vertical load from c/l of footing = 1.0 m
Longitudinal Moment about c/l of footing ML = 3099.9 t-m

2.1.2 Maximum Moment Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	93.7	81.5	0.0	515.5	0.0	126.5	110.0	0.0	695.9	0.0
SIDL(w/c)	1.75	85.2	103.1	0.0	468.4	0.0	149.0	180.4	0.0	819.7	0.0
LL2	0.2	95.1	94.0	-130.1	523.2	300.1	19.0	18.8	-26.0	104.6	60.0
FPLL2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	43.1	-43.1	-2615.7	236.9	508.6	80.8	-80.8	-4904.4	444.2	953.7
Earth Pressure	-	80.8	80.8	-637.7	889.0	0.0	0.0	0.0	0.0	0.0	0.0
LL Surcharge	0.2	0.0	0.0	-348.2	0.0	0.0	0.0	0.0	-69.6	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	1.5	30.5	-30.5	-567.8	242.7	170.3	57.3	-57.3	-1064.7	455.1	319.4
Buoyancy on substr.	1	-37.5	-37.5	0.0	-206.3	0.0	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Buoyancy on fdn.	1	-250.0	-250.0	0.0	-1375.0	0.0	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Buoyancy on Return wall.	1	-18.8	-18.8	0.0	-163.3	0.0	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3062.4	2801.0	-6064.8	19798.0	1333.1

Eccentricity of vertical load from c/l of footing = 1.0 m
Longitudinal Moment about c/l of footing ML = 3109.7 t-m

2.2 Transverse Seismic

2.2.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	448.3	0.0	110.0	110.0	0.0	605.1	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	567.0	0.0	180.4	180.4	0.0	992.3	0.0
LL1	0.2	134.4	133.6	-81.1	738.9	127.6	26.9	26.7	-16.2	147.8	25.5
FPLL1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	44.5	-44.5	-784.7	245.0	1753.6	83.5	-83.5	-1471.3	459.4	3288.0
Earth Pressure	-	80.8	80.8	-637.7	889.0	0.0	0.0	0.0	0.0	0.0	0.0
LL Surcharge	0.2	0.0	0.0	-348.2	0.0	0.0	0.0	0.0	-69.6	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	1.5	30.5	-30.5	44.1	242.7	170.3	57.3	-57.3	82.7	455.1	319.4
Buoyancy on substr.	1	-37.5	-37.5	0.0	-206.3	0.0	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Buoyancy on fdn.	1	-250.0	-250.0	0.0	-1375.0	0.0	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Buoyancy on Return wall.	1	-18.8	-18.8	0.0	-163.3	0.0	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3087.8	2806.1	-1474.4	19938.2	3632.9

Eccentricity of vertical load from c/l of footing = 1.0 m
Longitudinal Moment about c/l of footing ML = 0.0 t-m

2.2.2 Maximum Moment Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	93.7	81.5	0.0	515.5	0.0	126.5	110.0	0.0	695.9	0.0
SIDL(w/c)	1.75	85.2	103.1	0.0	468.4	0.0	149.0	180.4	0.0	819.7	0.0
LL2	0.2	95.1	94.0	-130.1	523.2	300.1	19.0	18.8	-26.0	104.6	60.0
FPLL2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	43.1	-43.1	-784.7	236.9	1695.4	80.8	-80.8	-1471.3	444.2	3178.9
Earth Pressure	-	80.8	80.8	-637.7	889.0	0.0	0.0	0.0	0.0	0.0	0.0
LL Surcharge	0.2	0.0	0.0	-348.2	0.0	0.0	0.0	0.0	-69.6	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	1.5	30.5	-30.5	44.1	242.7	170.3	57.3	-57.3	82.7	455.1	319.4
Buoyancy on substr.	1	-37.5	-37.5	0.0	-206.3	0.0	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Buoyancy on fdn.	1	-250.0	-250.0	0.0	-1375.0	0.0	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Buoyancy on Return wall.	1	-18.8	-18.8	0.0	-163.3	0.0	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3062.4	2801.0	-1484.2	19798.0	3558.3

Eccentricity of vertical load from c/l of footing = 1.0 m
Longitudinal Moment about c/l of footing ML = 0.0 t-m

2.3 Vertical Seismic

2.3.1 Maximum Reaction Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	81.5	81.5	0.0	448.3	0.0	110.0	110.0	0.0	605.1	0.0
SIDL(w/c)	1.75	103.1	103.1	0.0	567.0	0.0	180.4	180.4	0.0	992.3	0.0
LL1	0.2	134.4	133.6	-81.1	738.9	127.6	26.9	26.7	-16.2	147.8	25.5
FPLL1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	74.2	-74.2	-894.1	408.4	526.1	139.2	-139.2	-1676.4	765.7	986.4
Earth Pressure	-	80.8	80.8	-637.7	889.0	0.0	0.0	0.0	0.0	0.0	0.0
LL Surcharge	0.2	0.0	0.0	-348.2	0.0	0.0	0.0	0.0	-69.6	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	1.5	101.8	-101.8	44.1	112.5	44.1	190.9	-190.9	82.7	210.9	82.7
Buoyancy on substr.	1	-37.5	-37.5	0.0	-206.3	0.0	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Buoyancy on fdn.	1	-250.0	-250.0	0.0	-1375.0	0.0	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Buoyancy on Return wall.	1	-18.8	-18.8	0.0	-163.3	0.0	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3277.1	2616.8	-1679.5	20000.2	1094.7

Eccentricity of vertical load from c/l of footing = 0.6 m
Longitudinal Moment about c/l of footing ML = 0.0 t-m

2.3.2 Maximum Moment Case

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
DL Sup	1.35	752.1	752.1	0.0	4136.3	0.0	1015.3	1015.3	0.0	5584.0	0.0
SIDL(excl. w/c)	1.35	93.7	81.5	0.0	515.5	0.0	126.5	110.0	0.0	695.9	0.0
SIDL(w/c)	1.75	85.2	103.1	0.0	468.4	0.0	149.0	180.4	0.0	819.7	0.0
LL2	0.2	95.1	94.0	-130.1	523.2	300.1	19.0	18.8	-26.0	104.6	60.0
FPL12	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Rating	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic Force on Superstr.	1.5	143.6	-143.6	-864.4	789.6	508.6	269.2	-269.2	-1620.7	1480.5	953.7
Earth Pressure	-	80.8	80.8	-637.7	889.0	0.0	0.0	0.0	0.0	0.0	0.0
LL Surcharge	0.2	0.0	0.0	-348.2	0.0	0.0	0.0	0.0	-69.6	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	1.5	101.8	-101.8	44.1	112.5	44.1	190.9	-190.9	82.7	210.9	82.7
Buoyancy on substr.	1	-37.5	-37.5	0.0	-206.3	0.0	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Buoyancy on fdn.	1	-250.0	-250.0	0.0	-1375.0	0.0	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Buoyancy on Return wall.	1	-18.8	-18.8	0.0	-163.3	0.0	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							3384.4	2478.9	-1633.7	20590.1	1096.4

Eccentricity of vertical load from c/l of footing

= 0.6 m

Longitudinal Moment about c/l of footing ML

= 0.0 t-m

Span Dislodged Condition

1 LWL

1.1 Longitudinal Seismic

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
Earth Pressure	-	113.3	113.3	-895.3	1246.6	0.0	0.0	0.0	0.0	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	0.75	30.5	-30.5	-567.8	242.7	170.3	28.6	-28.6	-532.3	227.6	159.7
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							1949.4	1892.1	-532.3	13666.6	159.7

Eccentricity of vertical load from c/l of footing

= 1.5 m

Longitudinal Moment about c/l of footing ML

= 0.0 t-m

1.2 Transverse Seismic

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
Earth Pressure	-	113.3	113.3	-895.3	1246.6	0.0	0.0	0.0	0.0	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	0.75	30.5	-30.5	44.1	242.7	170.3	28.6	-28.6	41.4	227.6	159.7
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							1949.4	1892.1	41.4	13666.6	159.7

Eccentricity of vertical load from c/l of footing

= 1.5 m

Longitudinal Moment about c/l of footing ML

= 0.0 t-m

1.3 Vertical Seismic

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
Earth Pressure	-	113.3	113.3	-895.3	1246.6	0.0	0.0	0.0	0.0	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	0.75	101.8	-101.8	44.1	112.5	44.1	95.4	-95.4	41.4	105.4	41.4
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							2016.2	1825.3	41.4	13544.4	41.4

Eccentricity of vertical load from c/l of footing = 1.2 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

2 HFL

2.1 Longitudinal Seismic

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
Earth Pressure	-	80.8	80.8	-637.7	889.0	0.0	0.0	0.0	0.0	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	0.75	30.5	-30.5	-567.8	242.7	170.3	28.6	-28.6	-532.3	227.6	159.7
Buoyancy on substr.	1	-37.5	-37.5	0.0	-206.3	0.0	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Buoyancy on fdn.	1	-250.0	-250.0	0.0	-1375.0	0.0	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Buoyancy on Return wall.	1	-18.8	-18.8	0.0	-163.3	0.0	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							1643.1	1585.9	-532.3	11922.0	159.7

Eccentricity of vertical load from c/l of footing = 1.8 m

Longitudinal Moment about c/l of footing ML = 0.0 t-m

2.2 Transverse Seismic

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
Earth Pressure	-	80.8	80.8	-637.7	889.0	0.0	0.0	0.0	0.0	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	0.75	30.5	-30.5	44.1	242.7	170.3	28.6	-28.6	41.4	227.6	159.7
Buoyancy on substr.	1	-37.5	-37.5	0.0	-206.3	0.0	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Buoyancy on fdn.	1	-250.0	-250.0	0.0	-1375.0	0.0	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Buoyancy on Return wall.	1	-18.8	-18.8	0.0	-163.3	0.0	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							1643.1	1585.9	41.4	11922.0	159.7

Eccentricity of vertical load from c/l of footing = 1.8 m
Longitudinal Moment about c/l of footing ML = 0.0 t-m

2.3 Vertical Seismic

	Partial Safety Factor	Unfactored					Factored				
		Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT	Pmax	Pmin	ML due to HL about toe	ML due to P about toe	MT
		t	t	t-m	t-m	t-m	t	t	t-m	t-m	t-m
Earth Pressure	-	80.8	80.8	-637.7	889.0	0.0	0.0	0.0	0.0	0.0	0.0
Weight of Substr.	1.35	141.6	141.6	0.0	803.3	0.0	191.2	191.2	0.0	1084.5	0.0
Seismic Force on Substr.	0.75	101.8	-101.8	44.1	112.5	44.1	95.4	-95.4	41.4	105.4	41.4
Buoyancy on substr.	1	-37.5	-37.5	0.0	-206.3	0.0	-37.5	-37.5	0.0	-206.3	0.0
Weight of fdn	1.35	625.0	625.0	0.0	3437.5	0.0	843.8	843.8	0.0	4640.6	0.0
Buoyancy on fdn.	1	-250.0	-250.0	0.0	-1375.0	0.0	-250.0	-250.0	0.0	-1375.0	0.0
Return Wall Wt.	1.35	70.7	70.7	0.0	615.7	0.0	95.5	95.5	0.0	831.2	0.0
Buoyancy on Return wall.	1	-18.8	-18.8	0.0	-163.3	0.0	-18.8	-18.8	0.0	-163.3	0.0
Backfill Wt.	1.35	585.4	585.4	0.0	5098.3	0.0	790.4	790.4	0.0	6882.6	0.0
Total							1709.9	1519.1	41.4	11799.9	41.4

Eccentricity of vertical load from c/l of footing = 1.4 m
Longitudinal Moment about c/l of footing ML = 0.0 t-m

Summary**Service Condition**

			Pmax	Pmin	ML	MT
			t	t	t-m	t-m
1	1.1	1.1.1	3394.1	3112.4	3039.8	1331.3
		1.1.2	3368.6	3107.2	3049.6	1333.1
	1.2	1.2.1	3394.1	3112.4	0.0	3632.9
		1.2.2	3368.6	3107.2	0.0	3558.3
	1.3	1.3.1	3583.4	2923.1	0.0	1094.7
		1.3.2	3690.6	2785.2	0.0	1096.4
2	2.1	2.1.1	3087.8	2806.1	3099.9	1331.3
		2.1.2	3062.4	2801.0	3109.7	1333.1
	2.2	2.2.1	3087.8	2806.1	0.0	3632.9
		2.2.2	3062.4	2801.0	0.0	3558.3
	2.3	2.3.1	3277.1	2616.8	0.0	1094.7
		2.3.2	3384.4	2478.9	0.0	1096.4

Span Dislodged Condition

		Pmax	Pmin	ML	MT
		t	t	t-m	t-m
1	1.1	1949.4	1892.1	0.0	159.7
	1.2	1949.4	1892.1	0.0	159.7
	1.3	2016.2	1825.3	0.0	41.4
2	2.1	1643.1	1585.9	0.0	159.7
	2.2	1643.1	1585.9	0.0	159.7
	2.3	1709.9	1519.1	0.0	41.4

BASE PRESSURE FOR DESIGN OF FOUNDATION

Area of base	A	=	137.5 m ²	Corner 1	p1	=	P/A+ML/zl+MT/zt
Longitudinal Section Modulus	zl	=	252.1 m ³	Corner 2	p2	=	P/A-ML/zl+MT/zt
Transverse Section Modulus	zt	=	286.5 m ³	Corner 3	p3	=	P/A-ML/zl-MT/zt
				Corner 4	p4	=	P/A+ML/zl-MT/zt

D Combination for Base Pressure and Design of Foundation

D-1 Combination 1

Service Condition

		Forces/Moments				For Pmax				For Pmin			
		Pmax	Pmin	ML	MT	P/A+ML/zl+MT/zt	P/A+ML/zl-MT/zt	P/A-ML/zl-MT/zt	P/A-ML/zl+MT/zt	P/A+ML/zl+MT/zt	P/A+ML/zl-MT/zt	P/A-ML/zl-MT/zt	P/A-ML/zl+MT/zt
		t	t	t-m	t-m	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²
1	1.1	3526.9	3525.8	0.0	191.4	26.3	25.0	25.0	26.3	26.3	25.0	25.0	26.3
	1.2	3453.2	3466.3	0.0	450.2	26.7	23.5	23.5	26.7	26.8	23.6	23.6	26.8
2	2.1	3192.3	3191.2	0.0	191.4	23.9	22.5	22.5	23.9	23.9	22.5	22.5	23.9
	2.2	3133.4	3131.7	0.0	450.2	24.4	21.2	21.2	24.4	24.3	21.2	21.2	24.3

One Span Dislodged Condition

		Forces/Moments				For Pmax				For Pmin			
		Pmax	Pmin	ML	MT	P/A+ML/zl+MT/zt	P/A+ML/zl-MT/zt	P/A-ML/zl-MT/zt	P/A-ML/zl+MT/zt	P/A+ML/zl+MT/zt	P/A+ML/zl-MT/zt	P/A-ML/zl-MT/zt	P/A-ML/zl+MT/zt
		t	t	t-m	t-m	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²
1		2019.6	2019.6	0.0	0.0	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
2		1685.0	1685.0	0.0	0.0	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3

D-2 Combination 2

Service Condition

		Forces/Moments				For Pmax				For Pmin			
		Pmax	Pmin	ML	MT	P/A+ML/zl+MT/zt	P/A+ML/zl-MT/zt	P/A-ML/zl-MT/zt	P/A-ML/zl+MT/zt	P/A+ML/zl+MT/zt	P/A+ML/zl-MT/zt	P/A-ML/zl-MT/zt	P/A-ML/zl+MT/zt
		t	t	t-m	t-m	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²
1	1.1	2619.8	2618.8	0.0	165.9	19.6	18.5	18.5	19.6	19.6	18.5	18.5	19.6
	1.2	2563.1	2567.3	0.0	390.2	20.0	17.3	17.3	20.0	20.0	17.3	17.3	20.0
2	2.1	2288.9	2288.0	0.0	165.9	17.2	16.1	16.1	17.2	17.2	16.1	16.1	17.2
	2.2	2232.3	2236.4	0.0	390.2	17.6	14.9	14.9	17.6	17.6	14.9	14.9	17.6

One Span Dislodged Condition

	Forces/Moments				For Pmax				For Pmin			
	Pmax	Pmin	ML	MT	P/A+ML/zl+MT/zt	P/A+ML/zl-MT/zt	P/A-ML/zl-MT/zt	P/A-ML/zl+MT/zt	P/A+ML/zl+MT/zt	P/A+ML/zl-MT/zt	P/A-ML/zl-MT/zt	P/A-ML/zl+MT/zt
	t	t	t-m	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²
1	1508.5	1508.5	0.0	0.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
2	1177.6	1177.6	0.0	0.0	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6

**D-3 Seismic Combination
Service Condition**

			Forces/Moments				For Pmax				For Pmin			
			Pmax	Pmin	ML	MT	P/A+ML/zl+MT/zt	P/A+ML/zl-MT/zt	P/A-ML/zl-MT/zt	P/A-ML/zl+MT/zt	P/A+ML/zl+MT/zt	P/A+ML/zl-MT/zt	P/A-ML/zl-MT/zt	P/A-ML/zl+MT/zt
			t	t	t-m	t-m	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²
1	1.1	1.1.1	3394.1	3112.4	3039.8	1331.3	41.4	32.1	8.0	17.3	39.3	30.0	5.9	15.2
		1.1.2	3368.6	3107.2	3049.6	1333.1	41.3	31.9	7.7	17.1	39.3	30.0	5.8	15.2
	1.2	1.2.1	3394.1	3112.4	0.0	3632.9	37.4	12.0	12.0	37.4	35.3	10.0	10.0	35.3
		1.2.2	3368.6	3107.2	0.0	3558.3	36.9	12.1	12.1	36.9	35.0	10.2	10.2	35.0
	1.3	1.3.1	3583.4	2923.1	0.0	1094.7	29.9	22.2	22.2	29.9	25.1	17.4	17.4	25.1
		1.3.2	3690.6	2785.2	0.0	1096.4	30.7	23.0	23.0	30.7	24.1	16.4	16.4	24.1
2	2.1	2.1.1	3087.8	2806.1	3099.9	1331.3	39.4	30.1	5.5	14.8	37.4	28.1	3.5	12.8
		2.1.2	3062.4	2801.0	3109.7	1333.1	39.3	30.0	5.3	14.6	37.4	28.1	3.4	12.7
	2.2	2.2.1	3087.8	2806.1	0.0	3632.9	35.1	9.8	9.8	35.1	33.1	7.7	7.7	33.1
		2.2.2	3062.4	2801.0	0.0	3558.3	34.7	9.9	9.9	34.7	32.8	7.9	7.9	32.8
	2.3	2.3.1	3277.1	2616.8	0.0	1094.7	27.7	20.0	20.0	27.7	22.9	15.2	15.2	22.9
		2.3.2	3384.4	2478.9	0.0	1096.4	28.4	20.8	20.8	28.4	21.9	14.2	14.2	21.9

One Span Dislodged Condition

			Forces/Moments				For Pmax				For Pmin			
			Pmax	Pmin	ML	MT	P/A+ML/zl+MT/zt	P/A+ML/zl-MT/zt	P/A-ML/zl-MT/zt	P/A-ML/zl+MT/zt	P/A+ML/zl+MT/zt	P/A+ML/zl-MT/zt	P/A-ML/zl-MT/zt	P/A-ML/zl+MT/zt
			t	t	t-m	t-m	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²	t/m ²
1	1.1	1.1	1949.4	1892.1	0.0	159.7	14.7	13.6	13.6	14.7	14.3	13.2	13.2	14.3
	1.2	1.2	1949.4	1892.1	0.0	159.7	14.7	13.6	13.6	14.7	14.3	13.2	13.2	14.3
	1.3	1.3	2016.2	1825.3	0.0	41.4	14.8	14.5	14.5	14.8	13.4	13.1	13.1	13.4
2	2.1	2.1	1643.1	1585.9	0.0	159.7	12.5	11.4	11.4	12.5	12.1	11.0	11.0	12.1
	2.2	2.2	1643.1	1585.9	0.0	159.7	12.5	11.4	11.4	12.5	12.1	11.0	11.0	12.1
	2.3	2.3	1709.9	1519.1	0.0	41.4	12.6	12.3	12.3	12.6	11.2	10.9	10.9	11.2

Maximum Axial Force Condition

Maximum Base Pressure = 41.4 t/m²

Minimum Base Pressure = 5.3 t/m²

Minimum Axial Force Condition

Maximum Base Pressure = 39.3 t/m²

Minimum Base Pressure = 3.4 t/m²

Critical Case for design

ULTIMATE LIMIT STATE (ULS)

(COMB 1 and SEISMIC COMB)

Max pressure at toe and corresponding pressure at heel

LWL

Corner	Gross Pressure t/m ²
1	41.4
2	17.3
3	8.0
4	32.1

HFL

Corner	Gross Pressure t/m ²
1	39.4
2	14.8
3	5.5
4	30.1

Min pressure at heel and corresponding pressure at toe

LWL

Corner	Gross Pressure t/m ²
1	41.3
2	17.1
3	7.7
4	31.9

HFL

Corner	Gross Pressure t/m ²
1	39.3
2	14.6
3	5.3
4	5.3

SERVICEABILITY LIMIT STATE (ULS)

(COMB 2)

Max pressure at toe and corresponding pressure at heel

LWL

Corner	Gross Pressure t/m ²
1	20.0
2	20.0
3	17.3
4	17.3

HFL

Corner	Gross Pressure t/m ²
1	17.6
2	17.6
3	14.9
4	14.9

Min pressure at heel and corresponding pressure at toe

LWL

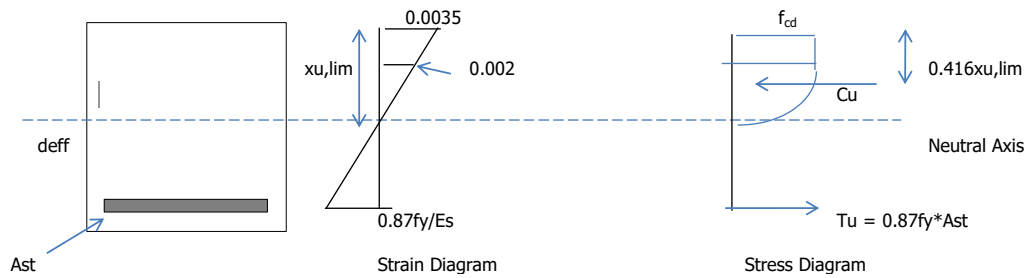
Corner	Gross Pressure t/m ²
1	11.0
2	11.0
3	11.0
4	11.0

HFL

Corner	Gross Pressure t/m ²
1	8.6
2	8.6
3	8.6
4	8.6

MOMENT OF RESISTANCE OF RECTANGULAR CONCRETE SECTION

As per IRC:112-2011



ULTIMATE LIMIT STATE

Grade of Concrete	f_{ck}	=	35	N/mm ²
As per clause 6.4.2.8, IRC:112-2011				
	f_{cd}	=	$\frac{\alpha * f_{ck}}{\gamma_m}$	= 15.63
	α	=	0.67	
Grade of steel	f_y	=	500	N/mm ²
	f_{yd}	=	434.8	N/mm ²

Refer Fig. 6.2 of IRC:112-2011

For steel reinforcement, simplified bilinear diagram is used

$$\begin{aligned}
 \text{Minimum strain in steel reinforcement} &= 0.87f_y/E_s = 2.0E+05 \text{ MPa} \\
 C_u &= f_{cd} * b * (3/7 * x_{u,lim} + 2/3 * 4/7 * x_{u,lim}) \\
 &= 17/21 * f_{cd} * b * x_{u,lim} \\
 &= 0.8095 * f_{cd} * b * x_{u,lim} \\
 \text{cg of compression block from top} &= 0.416x_{u,lim} \\
 T_u &= (f_y/1.15) * A_{st}
 \end{aligned}$$

$$R_{lim} = M_{u,lim}/bd^2 = 0.8095f_{cd} * (x_u/d) * (1 - 0.416 * x_u/d)$$

$$x_{u,lim}/d = 0.617$$

$$R_{lim} = M_{u,lim}/bd^2 = 5.80$$

It is not necessary to check maximum strain limit as ideal plastic branch is used
Clause 8.2.1 (f), IRC:112-2011

Calculation of Reinforcement

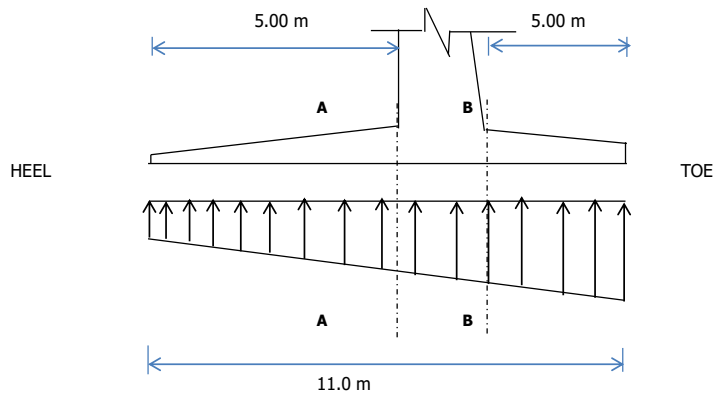
Tensile reinforcement can be calculated from the following formula

$$\frac{P_t}{100} = \frac{A_{st}}{bd} = 0.973 \frac{f_{cd}}{f_{yd}} \left[1 - \sqrt{1 - 2.055 \frac{R}{f_{cd}}} \right] \quad \text{where,} \quad R = M_u/bd^2$$

Limiting percentage of steel reinforcement for balanced section

$$P_{t,lim} = 97.3 \frac{f_{cd}}{f_{yd}} \left[1 - \sqrt{1 - 2.055 \frac{R_{lim}}{f_{cd}}} \right] \quad \text{where,} \quad R_{lim} = M_{u,lim}/bd^2$$

DESIGN OF HEEL AND TOE SLAB



- Case 1 Max pressure at toe and corresponding pressure at heel
 Case 2 Min pressure at heel and corresponding pressure at toe

ULTIMATE LIMIT STATE, ULS (COMB 1 AND SEISMIC COMBINATION)

Pressure (t/m ²)	Section					
	Heel End	A-A	Toe End	B-B	At deff from A-A	At deff from B-B
Gross Pressure (Case 1)	12.6	23.6	36.7	25.8	18.3	31.5
Gross Pressure (Case 2)	12.4	23.4	36.6	25.6	18.1	36.6
Net Pressure (Case 1)	-0.2	19.5	23.6	17.3	10.0	25.5
Net Pressure (Case 2)	-0.4	19.3	23.5	17.2	9.8	30.6

Design of Heel Slab

Design for Flexure

Critical section is at face of wall

Overall depth of section		=	2500 mm	
Design Moment per m width	M_u	=	79.9 t-m	bottom to top
	M_u	=	77.20 t-m	bottom to top
	R_{lim}	=	5.80 MPa	
Effective depth required	d_{reqd}	=	$\sqrt{M_u/(R*b)}$	= 370.9 mm
Effective depth provided	$d_{provided}$	=	2412.5 mm	OK At bottom
	$d_{provided}$	=	2417 mm	OK At bottom
	R	=	M_u/bd^2	= 0.1372
$A_{st, required}$	=	764.6 mm ²		
Minimum $A_{st, required}$ per meter width	=	3512.6 mm ²	(max. Of $0.26f_{ctm}/f_{yk}*b_t*d$ and $0.0013b_t*d$)	
Governing $A_{st, required}$ per meter width	=	3512.6 mm ²		
Provide	25 mm dia bars at	130 mm c/c	+	At bottom
	0 mm dia bars at	200 mm c/c		
$A_{st, provided}$	=	3776.0 mm ²		
		OK		

Design for One Way Shear

Critical section is at deff distance from the face of abutment wall

$$\text{Overall depth of section} = 1776.3 \text{ mm}$$

$$\text{Design shear force per m width } V_u = 12.7 \text{ t}$$

$$\text{Tensile Reinforcement } A_{sl} = 3776.0 \text{ mm}^2$$

$$\text{Width of beam } b_w = 1000 \text{ mm}$$

$$\text{Effective Depth } d = 1688.8 \text{ mm}$$

$$A_c = 1.69\text{E}+06 \text{ mm}^2$$

$$N_{Ed} = 0 \text{ kN}$$

$$K = 1 + \sqrt{\frac{200}{d}} \leq 2 = 1.34$$

$$v_{min} = 0.031K^{3/2}f_{ck}^{1/2} = 0.29$$

$$\sigma_{cp} = N_{Ed}/A_c < 0.2f_{cd} = 0$$

$$\rho_l = \frac{A_{sl}}{b_w d} \leq 0.02 = 0.00224$$

Shear Capacity of section

Cl. 10.3.2, IRC:112-2011

$$V_{Rd,c} = [0.12K(80\rho_l f_{ck})^{0.33} + 0.15\sigma_{cp}]b_w d \geq (v_{min} + 0.15\sigma_{cp})b_w d$$

$$= 49.9 \text{ t}$$

$$> 12.7 \text{ t}$$

OK

Design of Toe Slab

Design for Flexure

Critical section is at face of wall

$$\text{Overall depth of section} = 2500 \text{ mm}$$

$$\text{Design Moment per m width } M_u = 321.9 \text{ t-m} \quad \text{bottom to top} \quad \text{Case 1}$$

$$M_u = 320.2 \text{ t-m} \quad \text{bottom to top} \quad \text{Case 2}$$

$$\text{Design } M_u = 321.9 \text{ t-m}$$

$$R_{lim} = 5.80 \text{ MPa}$$

$$\text{Effective depth required } d_{reqd} = \sqrt{M_u/(R*b)} = 744.7 \text{ mm}$$

$$\text{Effective depth provided } d_{provided} = 2412.5 \text{ mm} \quad \text{OK}$$

$$R = M_u/bd^2 = 0.55$$

$$A_{st, \text{ required}} = 3125.7 \text{ mm}^2$$

$$\text{Minimum } A_{st, \text{ required}} \text{ per meter width} = 3512.6 \text{ mm}^2 \quad (\text{max. Of } 0.26f_{ctm}/f_{yk}*b_t*d \text{ and } 0.0013b_t*d)$$

$$\text{Governing } A_{st, \text{ required}} \text{ per meter width} = 3512.6 \text{ mm}^2$$

$$\text{Provide } \begin{array}{l} 25 \text{ mm dia bars at } 100 \text{ mm c/c} \\ 20 \text{ mm dia bars at } 100 \text{ mm c/c} \end{array} + \text{ at bottom}$$

$$A_{st, \text{ provided}} = 8050.3 \text{ mm}^2$$

OK

Design for One Way Shear

Critical section is at deff distance from the face of abutment wall

Overall depth of section = 1776.3 mm

Design shear force per m width V_u = 63.5 t

Tensile Reinforcement A_{st} = 8050.3 mm²

Width of beam b_w = 1000 mm

Effective Depth d = 1688.8 mm

A_c = 1.69E+06 mm²

N_{Ed} = 0 kN

$$K = 1 + \sqrt{\frac{200}{d}} \leq 2 = 1.34$$

v_{min} = $0.031K^{3/2}f_{ck}^{1/2}$ = 0.29

σ_{cp} = N_{Ed}/A_c < $0.2f_{cd}$ = 0

ρ_l = $\frac{A_{st}}{b_w d}$ ≤ 0.02 = 0.00477

Shear Capacity of section Cl. 10.3.2, IRC:112-2011

$V_{Rd,c}$ = $[0.12K(80\rho_l f_{ck})^{0.33} + 0.15\sigma_{cp}]b_w d \geq (v_{min} + 0.15\sigma_{cp})b_w d$

= 64.1 t

> 63.5 t

OK

Distribution Reinforcement

Secondary reinforcement required per meter = 702.52 mm²

(20% of main reinforcement, Cl. 16.6.6.1, IRC:112-2011)

Provide 12 mm dia bars at 150 mm c/c

$A_{st, provided}$ = 754.0 mm²

OK

SERVICEABILITY LIMIT STATE, SLS (COMB 2)

Pressure (t/m ²)	Section					
	Heel End	A-A	Toe End	B-B	At deff from A-A	At deff from B-B
Gross Pressure (Case 1)	18.6	21.4	18.6	18.6	21.4	18.6
Gross Pressure (Case 2)	11.0	10.3	11.0	11.0	10.3	11.0
Net Pressure (Case 1)	5.8	17.3	15.3	10.2	2.8	18.6
Net Pressure (Case 2)	-1.8	6.2	7.6	2.5	-8.3	11.0

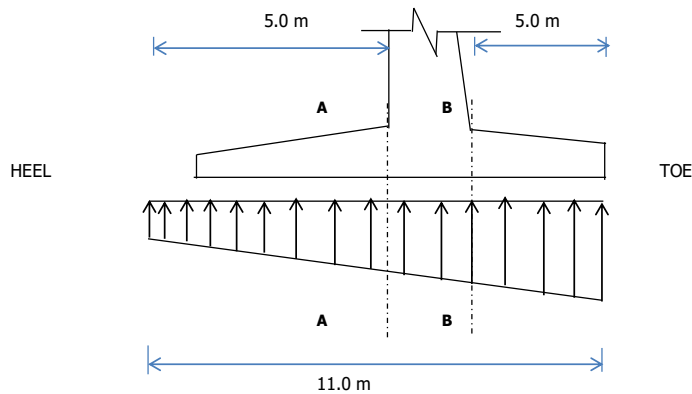
Modular ratio m = 6.25

Permissible stress in concrete = 16.8 MPa

= 400 MPa

Side	Face	Moment	deff	Ast.provid ed	Neutral axis depth	Stress in concrete	Stress in steel	Check
		t-m	mm	mm ² /m	mm	MPa	MPa	
Heel	Top	120.75	2417	3015.9	283.60	3.67	172.40	OK
	Bottom	10.78	2412.5	3776.0	314.67	0.30	12.37	OK
Toe	Bottom	211.9	2412.5	8050.3	444.96	4.21	116.26	OK

DESIGN OF HEEL AND TOE SLAB



Case 1 Max pressure at toe and corresponding pressure at heel
 Case 2 Min pressure at heel and corresponding pressure at toe

ULTIMATE LIMIT STATE, ULS (COMB 1 AND SEISMIC COMBINATION)

Pressure (t/m ²)	Section					
	Heel End	A-A	Toe End	B-B	At deff from A-A	At deff from B-B
Gross Pressure (Case 1)	10.2	21.3	34.8	23.6	15.9	29.4
Gross Pressure (Case 2)	9.9	15.5	22.3	16.7	12.8	22.3
Net Pressure (Case 1)	-2.6	17.3	21.7	15.1	7.7	23.4
Net Pressure (Case 2)	-2.9	11.5	9.2	8.2	4.5	16.3

Design of Heel Slab

Design for Flexure

Critical section is at face of wall

Overall depth of section	=	2500 mm	
Design Moment per m width	M_u	=	49.9 t-m
	M_u	=	23.91 t-m
	R_{lim}	=	5.80 MPa
Effective depth required	d_{reqd}	=	$\sqrt{M_u/(R*b)}$ = 293.3 mm
Effective depth provided	$d_{provided}$	=	2412.5 mm OK At bottom
	$d_{provided}$	=	2417 mm OK At bottom
	R	=	M_u/bd^2 = 0.09
$A_{st, required}$	=	477.3 mm ²	
Minimum $A_{st, required}$ per meter width	=	3512.6 mm ²	(max. Of $0.26f_{ctm}/f_{yk} * b_t * d$ and $0.0013b_t * d$)
Governing $A_{st, required}$ per meter width	=	3512.6 mm ²	
Provide	25 mm dia bars at	130 mm c/c	+
	0 mm dia bars at	200 mm c/c	At bottom
$A_{st, provided}$	=	3776.0 mm ²	
		OK	

Design for One Way Shear

Critical section is at deff distance from the face of abutment wall

$$\text{Overall depth of section} = 1776.3 \text{ mm}$$

$$\text{Design shear force per m width } V_u = 6.5 \text{ t}$$

$$\text{Tensile Reinforcement } A_{sl} = 3776.0 \text{ mm}^2$$

$$\text{Width of beam } b_w = 1000 \text{ mm}$$

$$\text{Effective Depth } d = 1688.8 \text{ mm}$$

$$A_c = 1.69\text{E}+06 \text{ mm}^2$$

$$N_{Ed} = 0 \text{ kN}$$

$$K = 1 + \sqrt{\frac{200}{d}} \leq 2 = 1.34$$

$$v_{min} = 0.031K^{3/2}f_{ck}^{1/2} = 0.29$$

$$\sigma_{cp} = N_{Ed}/A_c < 0.2f_{cd} = 0$$

$$\rho_l = \frac{A_{sl}}{b_w d} \leq 0.02 = 0.00224$$

Shear Capacity of section

Cl. 10.3.2, IRC:112-2011

$$V_{Rd,c} = [0.12K(80\rho_l f_{ck})^{0.33} + 0.15\sigma_{cp}]b_w d \geq (v_{min} + 0.15\sigma_{cp})b_w d$$

$$= 49.9 \text{ t}$$

$$> 6.5 \text{ t}$$

OK

Design of Toe Slab

Design for Flexure

Critical section is at face of wall

$$\text{Overall depth of section} = 2500 \text{ mm}$$

$$\text{Design Moment per m width } M_u = 297.9 \text{ t-m} \quad \text{bottom to top} \quad \text{Case 1}$$

$$M_u = 118.7 \text{ t-m} \quad \text{bottom to top} \quad \text{Case 2}$$

$$\text{Design } M_u = 297.9 \text{ t-m}$$

$$R_{lim} = 5.80 \text{ MPa}$$

$$\text{Effective depth required } d_{reqd} = \sqrt{M_u/(R*b)} = 716.5 \text{ mm}$$

$$\text{Effective depth provided } d_{provided} = 2412.5 \text{ mm} \quad \text{OK}$$

$$R = M_u/bd^2 = 0.51$$

$$A_{st, \text{ required}} = 2889.0 \text{ mm}^2$$

$$\text{Minimum } A_{st, \text{ required per meter width}} = 3512.6 \text{ mm}^2 \quad (\text{max. Of } 0.26f_{ctm}/f_{yk} * b_t * d \text{ and } 0.0013b_t * d)$$

$$\text{Governing } A_{st, \text{ required per meter width}} = 3512.6 \text{ mm}^2$$

$$\text{Provide } 25 \text{ mm dia bars at } 100 \text{ mm c/c} + \text{ at bottom}$$

$$20 \text{ mm dia bars at } 100 \text{ mm c/c}$$

$$A_{st, \text{ provided}} = 8050.3 \text{ mm}^2$$

OK

Design for One Way Shear

Critical section is at deff distance from the face of abutment wall

Overall depth of section = 1776.3 mm

Design shear force per m width V_u = 58.3 t

Tensile Reinforcement A_{sl} = 8050.3 mm²
 Width of beam b_w = 1000 mm
 Effective Depth d = 1688.8 mm
 A_c = 1.69E+06 mm²
 N_{Ed} = 0 kN

$$K = 1 + \sqrt{\frac{200}{d}} \leq 2 = 1.34$$

$V_{min} = 0.031K^{3/2}f_{ck}^{1/2} = 0.29$

$\sigma_{cp} = N_{Ed}/A_c < 0.2f_{cd} = 0$

$\rho_l = \frac{A_{sl}}{b_w d} \leq 0.02 = 0.00477$

Shear Capacity of section Cl. 10.3.2, IRC:112-2011
 $V_{Rd,c} = [0.12K(80\rho_l f_{ck})^{0.33} + 0.15\sigma_{cp}]b_w d \geq (v_{min} + 0.15\sigma_{cp})b_w d$
 $= 64.1 \text{ t}$
 $> 58.3 \text{ t}$ OK

Distribution Reinforcement

Secondary reinforcement required per meter = 702.52 mm²
 (20% of main reinforcement, Cl. 16.6.6.1, IRC:112-2011)

Provide 12 mm dia bars at 150 mm c/c
 $A_{st, provided} = 754.0 \text{ mm}^2$
 OK

SERVICEABILITY LIMIT STATE, SLS (COMB 2)

Pressure (t/m ²)	Section					
	Heel End	A-A	Toe End	B-B	At deff from A-A	At deff from B-B
Gross Pressure (Case 1)	16.2	19.0	16.2	16.2	19.0	16.2
Gross Pressure (Case 2)	8.6	7.9	8.6	8.6	7.9	8.6
Net Pressure (Case 1)	3.4	14.9	3.1	7.8	0.4	16.2
Net Pressure (Case 2)	-4.2	3.9	-4.5	0.1	-10.7	8.6

Modular ratio $m = 6.25$

Permissible stress in concrete = 16.8 MPa
 = 400 MPa

Side	Face	Moment	deff	Ast.provided	Neutral axis depth	Stress in concrete	Stress in steel	Check
		t-m	mm	mm ² /m	mm	MPa	MPa	
Heel	Top	90.79	2417	3015.9	283.60	2.76	129.62	OK
	Bottom	-19.18	2412.5	3776.0	314.67	0.53	22.02	OK
Toe	Bottom	19.8	2412.5	8050.3	444.96	0.39	10.88	OK

DESIGN OF ABUTMENT CAP

16 Design of Abutment Cap

The Abutment cap has been designed as per Clause 716.2.1 , IRC :78- 2000 .

The Abutment cap shall be reinforced with a total minimum of 1% steel distributed equally at both faces and in both directions assuming a cap thickness of 800 mm.

Length of Abutment cap 12.50 m

Width of Abutment cap 1.57 m

Depth of Abutment cap 1.00 m

Area of steel required (mm^2) 7850 mm^2

Providing steel by distributing at top & bottom = 27 nos. 20 ϕ

Area of steel provided (mm^2) 8482 mm^2 OK

Reinforcement in the direction of width of Abutment :-

Area of steel required (mm^2)/m 5000 mm^2

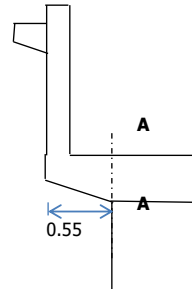
Providing 2 legged stirrups, 12 mm dia.

Spacing if stirrups required 45.2 mm

Spacing Provided 45 mm OK

Check for section at face of abutment shaft

Abutment cap is checked at face A-A



Line of action of self weight of dirt wall, a_v	=	0.4 m
Overall depth of cap	=	1.00 m
Effective depth of cap, d	=	0.94 m
a_v/d	=	0.42

Abutment cap is checked as corbel

Consider 1m length of cantilever

	Wt	Lever arm	Moment
	t	m	t-m
Wt of dirt wall	1.13	0.4	0.45
Wt of bracket	0.338	0.7	0.24
Reaction from approach slab	2.625	0.7	1.84
Wt of abutment cap upto face A-A	1.03125	0.24	0.25
Live load	5.18	0.4	2.07

Refer dirt wall design

Summary

	Moment	Shear
	t-m	t
Dead load	2.78	5.12
Live load	2.07	5.18

Basic combination

Design moment	=	6.86	t-m
Design shear	=	14.68	t

Check for Cantilever Action

Effective depth required	=	0.109	m	OK
$R = M_u/bd^2$	=	0.077		
Ast required	=	167.43	mm ² /m	
Minimum Ast required	=	1374.464	mm ² /m	
Governing Ast required	=	1374.464	mm ² /m	
Ast provided	=	2513.274	mm ² /m	OK

Tensile Reinforcement	A_{sl}	=	2513.3	mm ²
Width of beam	b_w	=	1000	mm
Effective Depth	d	=	944.0	mm
	A_c	=	9.44E+05	mm ²
	N_{Ed}	=	0	kN

$$K = 1 + \sqrt{\frac{200}{d}} \leq 2$$

$$= 1.46$$

$$V_{min} = 0.031K^{3/2}f_{ck}^{1/2} = 0.32$$

$$\sigma_{cp} = N_{Ed}/A_c < 0.2f_{cd} = 0$$

$$\rho_l = \frac{A_{sl}}{b_w d} \leq 0.02 = 0.00266$$

Shear Capacity of section

$$V_{Rd,c} = [0.12K(80\rho_l f_{ck})^{0.33} + 0.15\sigma_{cp}]b_w d$$

$$\geq (v_{min} + 0.15\sigma_{cp})b_w d$$

$$= 32.1 \text{ t}$$

$$> 14.7 \text{ t} \quad \text{OK}$$

Cl. 10.3.2, IRC:112-2011

Rare combination (For stress check)

Design moment	=	4.85	t-m
---------------	---	------	-----

Modular ratio	=	6.25
Effective depth provided	=	944.0 mm
Ast provided	=	2513.3 mm ²

Neutral axis depth	=	157.2 mm
Cracked moment of inertia	=	1.1019E+10 mm ⁴
Section modulus (concrete)	=	70087295.7 mm ³
Section modulus (steel)	=	14005126 mm ³

Stress in concrete	=	0.69 MPa	OK
Stress in steel	=	21.6 MPa	OK

Check for Corbel Action

Assumed width	=	1000 mm
Design shear force at face A-A in basic combination	=	14.7 t

$$v = 0.6(1 - f_{ck}/310)$$

$$= 0.532$$

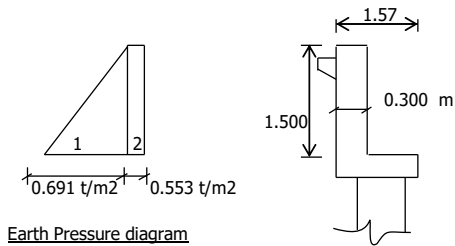
$$\text{Shear resistance} = 0.5b_w d v f_{cd}$$

$$= 3927497 \text{ N}$$

$$= 392.7 \text{ t} \quad \text{Safe in shear}$$

DESIGN OF DIRTWALL

17 Design of Dirt Wall



Design values :

$$\gamma = 1.80 \text{ t/m}^3$$

$$k_a = 0.256$$

$$\text{Thickness of dirtwall} = 0.300 \text{ m}$$

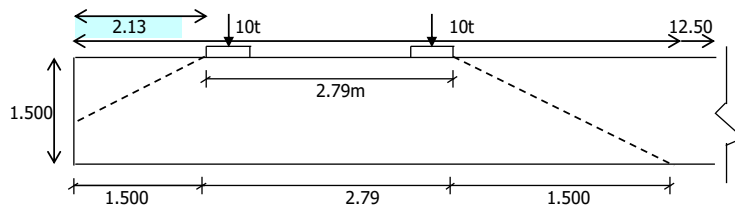
$$\text{height of dirtwall, } h = 1.500 \text{ m}$$

$$\begin{aligned} 1) \text{Earth Pressure due to surcharge equivalent to 1.2m of earthfill} &= k_a * \gamma * 1.2 \\ &= 0.553 \text{ t/m}^2 \\ 2) \text{Earth Pressure due to backfill of earth} &= k_a * \gamma * h \\ &= 0.691 \text{ t/m}^2 \end{aligned}$$

$$\begin{aligned} \text{Bending moment at the base of dirtwall due to earth pressure (1)} &= k_a * \gamma * 1.2 * h^2 / 2 \\ &= 0.622 \text{ t-m/m} \end{aligned}$$

$$\begin{aligned} \text{Bending moment at the base of dirtwall due to earth pressure (1)} &= k_a * \gamma * h^3 * 0.42 / 2 \\ &= 0.327 \text{ t-m/m} \end{aligned}$$

Calculation of force and moment due to the effect of braking :(considering 40t bogie loading)



$$\text{Effective width} = 5.790 \text{ m}$$

$$\begin{aligned} \text{Braking force, } 0.2 * 20 &= 4 \text{ t} \\ \text{Braking force including impact of 50\%} &= 6 \text{ t} \\ \text{Braking force per metre width} &= 1.04 \text{ t} \end{aligned}$$

$$\text{Bending moment at the base of dirtwall due to effect of braking} = 1.55 \text{ t-m/m}$$

Bending Moment at the bottom of dirt wall for Basic Combination

Load Item	Partial Safety Factor	Unfactored	Factored
		B. M	B. M
		t-m/m	t-m/m
LL Surcharge	1.2	0.62	0.75
Earth Pressure	1.5	0.33	0.49
Braking	1.5	1.55	2.33
Total Factored B.M		3.57	

Design

Design factored moment at the base of dirtwall (t-m) = 3.57 t-m/m
 Overall Depth Provided = 300 mm
 Clear cover = 50 mm

$$R_{lim} = 5.80 \text{ MPa}$$

$$\text{Effective depth required } d_{reqd} = \sqrt{(M_u / (R * b))} = 78.4 \text{ mm}$$

$$\text{Effective depth provided } d_{provided} = 234 \text{ mm}$$

$$R = M_u / b d^2 = 0.65$$

$$A_{st, \text{ required}} = 358.5 \text{ mm}^2$$

$$\text{Minimum } A_{st, \text{ required}} \text{ per meter width} = 340.7 \text{ mm}^2 \quad (\text{max. Of } 0.26 f_{ctm} / f_{yk} * b_t * d \text{ and } 0.0013 b_t * d)$$

$$\text{Governing } A_{st, \text{ required}} \text{ per meter width} = 358.5 \text{ mm}^2$$

Provide 12φ @ 110 c/c

$$A_{st, \text{ provided}} = 1028.2 \text{ mm}^2$$

OK

Distribution Reinforcement

Secondary reinforcement required per meter = 71.7 mm²
 (20% of main reinforcement, Cl. 16.6.6.1, IRC:112-2011)

Provide 10φ @ 200 c/c

$$A_{st, \text{ provided}} = 392.7 \text{ mm}^2$$

OK

Serviceability Limit State (Stress Check)**Bending Moment at the bottom of dirt wall for Rare Combination**

Load Item	Partial Safety Factor	Unfactored	Factored
		B. M	B. M
		t-m/m	t-m/m
LL Surcharge	0.8	0.62	0.50
Earth Pressure	1	0.33	0.33
Braking	1	1.55	1.55
Total Factored B.M		2.38	

Modular ratio = 6.25
 Effective depth provided = 234 mm
 Ast provided = 1028.2 mm²

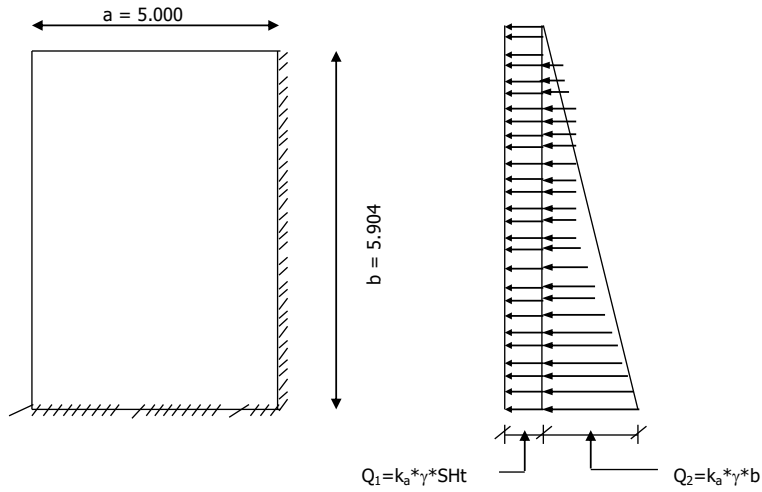
Neutral axis depth = 48.8 mm
 Cracked moment of inertia = 259143199 mm⁴
 Section modulus (concrete) = 5311548.5 mm³
 Section modulus (steel) = 1399175.5 mm³

Stress in concrete = 4.48 MPa OK
 Stress in steel = 106.3 MPa OK

DESIGN OF END RETURN WALL

18 Design of End Return Wall

RECTANGULAR PART



$$k_a = 0.256$$

$$\gamma = 1.8 \text{ m}$$

$$\text{Live load Surcharge (Sht)} = 1.200 \text{ m}$$

Partial Safety Factors (Basic Combination)

$$\text{For LL Surcharge} = 1.2$$

$$\text{For Earth Pressure} = 1.5$$

For M35 concrete
Fe500 steel reinf.

$$R_{lim} = 5.80 \text{ MPa}$$

The end return wall has been designed as a plate fixed on its two faces i.e. at the base and on one of its vertical sides.
(Refer Table 26 of Formula of Stress & Strain by Roark & Young).

S.NO.	Height of return wall (m) "b"	Length of return wall (m) "a"	"a/b"	Uniform load due to live load surcharge over entire plate									
				Q ₁ (t/m ²)	β ₁	β ₂	γ ₁	γ ₂	Unfactored			Factored	
									(at x=a & z=0) M _{b1} (t-m/m)	(at x=0 & z=b) M _{a1} (t-m/m)	(t-m/m)	M _{b1}	M _{a1}
1	5.90	5.00	0.847	0.553	1.449	1.412	1.150	0.966	-4.65	-4.54		-5.6	-5.4

"a/b"	Varying load due to earth pressure over entire plate								
	Q ₂ (t/m ²)	β ₁	β ₂	γ ₁	γ ₂	Factored		Unfactored	
						(at x=a & z=0) M _{b2} (t-m/m)	(at x=0 & z=0.6b) M _{a2} (t-m/m)	M _{b2}	M _{a2}
0.847	2.721	0.598	0.323	0.554	0.215	-9.46	-5.10	-14.2	-7.7

Design of end return wall									
Thk. at top	Deff reqd.	Deff provided	Thk. at bottom	Factored Moment in vertical direction(M _v)	R= M _u /(bd ²)	A _{st} for vertical reinforcement (mm ²)	Factored Moment in horizontal direction(M _h)	R= M _u /(bd ²)	A _{st} for horizontal reinforcement (mm ²)
500	185	444	500	19.77	1.00	1060	-13.10	0.664412	694

Vertical reinforcement						Horizontal reinforcement					
Earth face			Outer face			Earth face			Outer face		
bar dia	spacing reqd	spacing provided				bar dia	spacing reqd	spacing provided			
12φ	107 c/c	80 c/c	12φ	@	150	12φ	163 c/c	120 c/c	12φ	@	150 c/c

Ast provided (vertical) = **1413.7** mm²/m

Minimum reinforcement required at outer face

=

Ast provided (horizontal) = **942.5** mm²/m

646.5 mm²/m (max. Of 0.26f_{ctm}/f_{yk}*b_t*d and 0.0013b_t*d)

CHECK FOR SHEAR

For "a/b"	Uniform load due to live load surcharge over entire plate								
	Q ₁ (t/m ²)	β ₁	β ₂	γ ₁	γ ₂	Unfactored		Factored	
						(at x=a & z=0) R ₁ (t/m)	(at x=0 & z=0.8b) R ₂ (t/m)	R ₁	R ₂
0.847	0.553	1.449	1.412	1.150	0.966	3.75	3.15	4.5	3.8

For "a/b"	Varying load due to earth pressure over entire plate								
	Q ₂ (t/m ²)	β ₁	β ₂	γ ₁	γ ₂	Unfactored		Factored	
						(at x=a & z=0) R ₃ (t/m)	(at x=0 & z=0.6b) R ₄ (t/m)	R ₃	R ₄
0.847	2.721	0.598	0.323	0.554	0.215	8.90	3.46	13.4	5.2

Section		At x = a & z = 0	At x = 0 & z = 0.6*b	
D		444	500	mm
Grade of Concrete		M 35	M 35	
Deff		444	444	mm
Factored Design Shear Force (R1+R3)	V	17.86	8.97	(t/m)
steel provided for bending	ρl < 0.02	0.003	0.003	
K= 1+sqrt(200/d)<=2		1.671	1.671	
V _{min} = 0.031*K ^{3/2} *f _{ck} ^{1/2}		0.396	0.396	
σ _{cp}		0.00	0.00	
Shear Capacity	V _{Rd,c}	18.3	18.3	t
Check		OK	OK	
Dia of links		10	0	
Spacing of links		150 mm c/c	100 mm c/c	
z = 0.9*d		399.6	399.6	mm
cotθ		2.5	2.5	
Shear Capacity of steel reinf=				
A _{sw} /s*z*f _{ywd} *cotθ	V _{Rd,s}	26.2	0.0	t
Check		No Shear Reinf.	No Shear Reinf.	