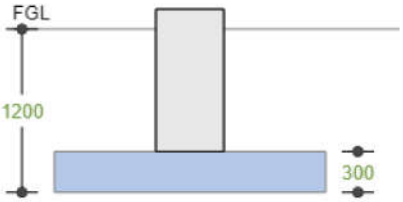
1.0 INPUT

1.1 Design Options

Foundation Types	**Soil Supported**
Design Code	**British Standard**
Unit	**SI Unit**



1.2 Foundation

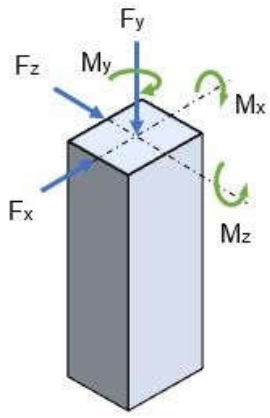
Depth of the Foundation below GL	D_f	= **1200** mm
Depth of the Water Table below GL	D_{wt}	= **350** mm
Extend of Minimum Soil Cover	S_{cve}	= **Full**
Minimum Soil Cover above Pad	S_{cv}	= **900** mm

1.3 Pad Size

Length of the Pad (X - Dir)	L_f	= **2500** mm
Breadth of the Pad (Z - Dir)	B_f	= **1200** mm
Thickness of the Pad	T_f	= **300** mm
Clear Cover for Pad	C_{pad}	= **50** mm

1.4 Soil Parameters

Allowable Net Bearing Pressure	SBC	= **200** kN/m²
Contact Percentage	C_p	= **80** %
Density of Soil	γ_{soil}	= **18.5** kN/m³
Density of Ground Water	γ_w	= **9.81** kN/m³
Angle of Internal Friction	Φ	= **30** deg
Coefficient of Friction	μ	= **0.35**



Load convention

1.5 Reinforced Concrete Properties

Density of Concrete	γ_{conc}	= **24** kN/m³
Strength of Concrete	f_{cu}	= **35** N/mm²
Strength of Reinforcement	f_y	= **500** N/mm²
Strength of Links	f_{yv}	= **500** N/mm²
Modulus of Elasticity of Steel	E_s	= **200** kN/mm²

1.6 Passive Resistance

Include Passive Resistance	**No**
Pedestal Resistance	**None**

1.7 Material Partial Safety Factors

Concrete in Flexure/Compression	γ_{mc}	= **1.5**
Concrete in Shear	γ_{mcs}	= **1.25**
Reinforcement	γ_{ms}	= **1.15**

1.8 Stability Safety Factors

F.O.S against Sliding	γ_{Slide}	= **1.5**

F.O.S against Overturning	γ_{over}	= **1.5**
F.O.S against Uplift	γ_{UP}	= **1.2**

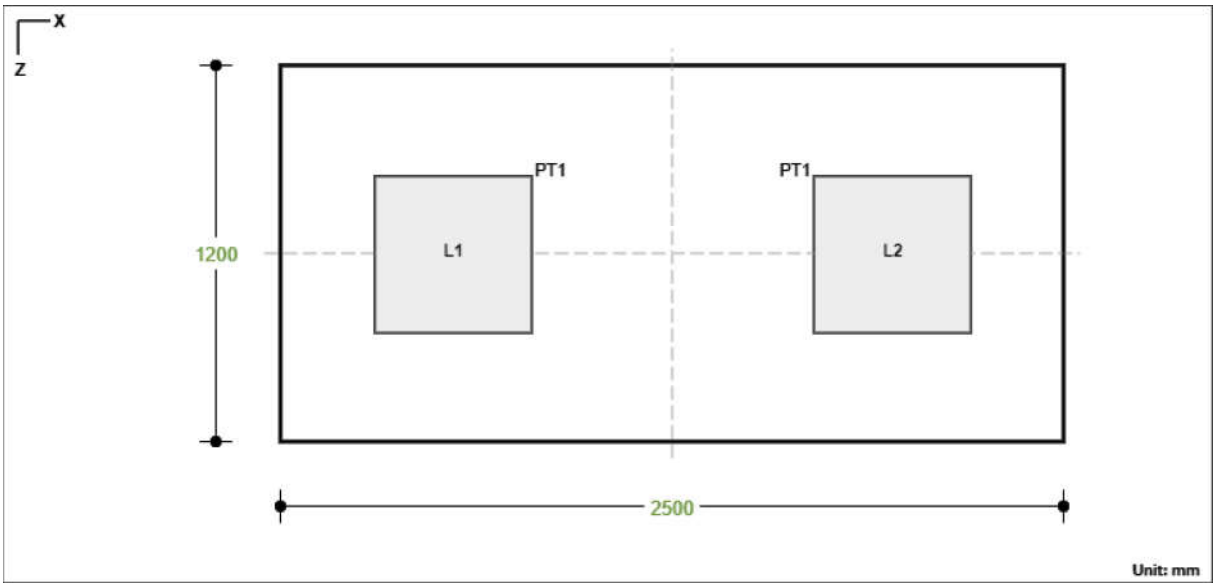
1.9 Crack Width

Check for Crack Width		**Yes**
Allowable Crack Width	W_c	= **0.2** mm

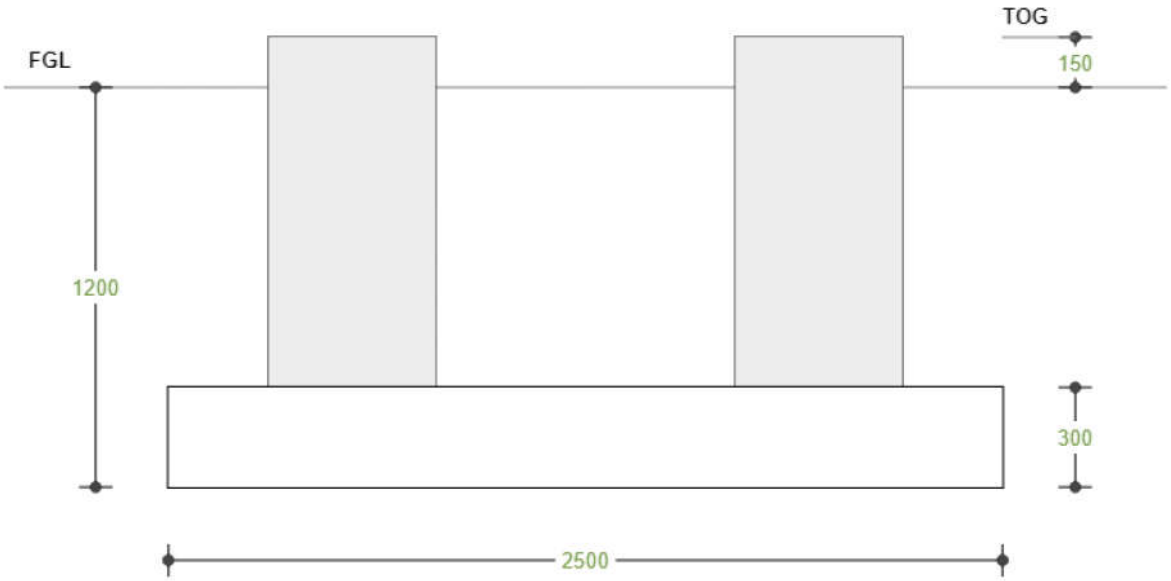
1.10 Torsion Check

Check for Torsion	**No**

1.11 Foundation Plan



1.12 Foundation Elevation



1.13 Pedestals

1.13.1 Types

Notation	Type	Shape	L (mm)	B (mm)	TOG (mm)
PT1	Pedestal	Square	500	500	150
PT2	Pedestal	Rectangle	500	500	150
PT3	Pedestal	Circle	500	0	150
PT4	Pedestal	Octagon	200	0	150

1.13.2 Location of Pedestals

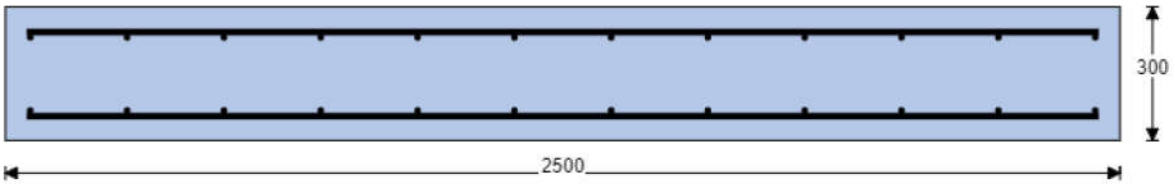
Location No	Pedestal Type	Location (mm)		Rotation (deg)
		X	Z	
L1	PT1	550	600	0
L2	PT1	1950	600	0

1.14 Reinforcement

Clear Cover for Pedestal C_{ped} = **50** mm

Clear Cover for Pad C_{pad} = **50** mm

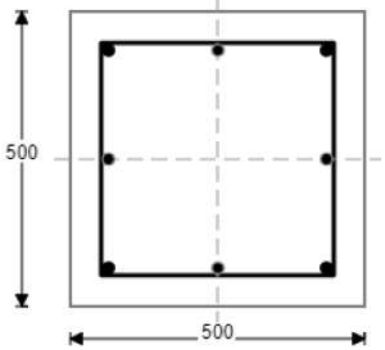
1.14.1 Pad Reinforcement Details



X - Direction - Bottom : #12 @ 200 mm C/C (565 mm² - 0.19 %)
Top : #12 @ 200 mm C/C (565 mm² - 0.19 %)
Z - Direction - Bottom : #12 @ 200 mm C/C (565 mm² - 0.19 %)
Top : #12 @ 200 mm C/C (565 mm² - 0.19 %)

1.14.2 Pedestal Reinforcement Details

Pedestal Type : PT1



Rebars : (2513.27 mm² - 1.01 %)
(C) : 4 - 20 dia (L) : 1 - 20 dia
(B) : 1 - 20 dia Ties : 10 mm @ 150 C/ C

1.15 Loads

1.15.1 Load Cases

No	Description	Load Type
LC1	Dead	Dead
LC2	Live	Live
LC3	Wind	Wind
LC4	Seismic	Seismic
LC5	None	Other

1.15.2 Loads on Pedestal

Load on Pedestal Location L1 (PT1)

Load Case	Horizontal F_x (kN)	Vertical F_y (kN)	Horizontal F_z (kN)	Moment M_x (kN.m)	Moment M_y (kN.m)	Moment M_z (kN.m)
LC1	0.000	100.000	0.000	0.000	0.000	0.000
LC2	0.000	150.000	0.000	0.000	0.000	0.000
LC3	-15.000	0.000	0.000	0.000	0.000	0.000
LC4	-15.000	0.000	0.000	0.000	0.000	0.000
LC5	0.000	0.000	-10.000	0.000	0.000	0.000

Load on Pedestal Location L2 (PT1)

Load Case	Horizontal F_x (kN)	Vertical F_y (kN)	Horizontal F_z (kN)	Moment M_x (kN.m)	Moment M_y (kN.m)	Moment M_z (kN.m)
LC1	0.000	100.000	0.000	0.000	0.000	0.000
LC2	0.000	150.000	0.000	0.000	0.000	0.000
LC3	-15.000	0.000	0.000	0.000	0.000	0.000
LC4	-15.000	0.000	0.000	0.000	0.000	0.000
LC5	0.000	0.000	-10.000	0.000	0.000	0.000

1.15.3 Serviceability Load Combinations

No	Combination
SLS1	Dead + Live
SLS2	Dead + Wind
SLS3	Dead + Seismic
SLS4	Dead + None
SLS5	Dead + 0.9Live
SLS6	Dead + 0.9Wind
SLS7	Dead + 0.9Seismic
SLS8	Dead + 0.9None

1.15.4 Service Load Conditions Allowable Factors

Description	Allowable Factors				
	SBC Inc (%)	Overturning FOS	Sliding FOS	Uplift FOS	Crack Check
SLS1	0	1.5	1.5	1.2	Yes
SLS2	0	1.5	1.5	1.2	Yes
SLS3	0	1.5	1.5	1.2	No

Description	Allowable Factors				
	SBC Inc (%)	Overturning FOS	Sliding FOS	Uplift FOS	Crack Check
SLS4	0	1.5	1.5	1.2	Yes
SLS5	0	1.5	1.5	1.2	Yes
SLS6	0	1.5	1.5	1.2	No
SLS7	0	1.5	1.5	1.2	Yes
SLS8	0	1.5	1.5	1.2	Yes

1.15.5 Ultimate Load Combinations

No	Combination
ULS1	1.4Dead + 1.6Live
ULS2	1.2Dead + 1.6Wind
ULS3	1.2Dead + 1.6Seismic
ULS4	1.2Dead + 1.6None
ULS5	1.4Dead + 1.4Live
ULS6	1.4Dead + 1.4Wind
ULS7	1.4Dead + 1.4Seismic
ULS8	1.4Dead + 1.4None

2.0 OUTPUT

2.1 Service Loads on Pedestal

Unfactored Load on Pedestal Location L1 (PT1)

Load Case	Horizontal F_x (kN)	Vertical F_y (kN)	Horizontal F_z (kN)	Moment M_x (kN.m)	Moment M_y (kN.m)	Moment M_z (kN.m)
SLS1	0.000	250.000	0.000	0.000	0.000	0.000
SLS2	-15.000	100.000	0.000	0.000	0.000	0.000
SLS3	-15.000	100.000	0.000	0.000	0.000	0.000
SLS4	0.000	100.000	-10.000	0.000	0.000	0.000
SLS5	0.000	235.000	0.000	0.000	0.000	0.000
SLS6	-13.500	100.000	0.000	0.000	0.000	0.000
SLS7	-13.500	100.000	0.000	0.000	0.000	0.000
SLS8	0.000	100.000	-9.000	0.000	0.000	0.000

Unfactored Load on Pedestal Location L2 (PT1)

Load Case	Horizontal F_x (kN)	Vertical F_y (kN)	Horizontal F_z (kN)	Moment M_x (kN.m)	Moment M_y (kN.m)	Moment M_z (kN.m)
SLS1	0.000	250.000	0.000	0.000	0.000	0.000
SLS2	-15.000	100.000	0.000	0.000	0.000	0.000
SLS3	-15.000	100.000	0.000	0.000	0.000	0.000
SLS4	0.000	100.000	-10.000	0.000	0.000	0.000
SLS5	0.000	235.000	0.000	0.000	0.000	0.000
SLS6	-13.500	100.000	0.000	0.000	0.000	0.000
SLS7	-13.500	100.000	0.000	0.000	0.000	0.000
SLS8	0.000	100.000	-9.000	0.000	0.000	0.000

2.2 Factored Loads on Pedestal

Factored Load on Pedestal Location L1 (PT1)

Load Case	Horizontal F_x (kN)	Vertical F_y (kN)	Horizontal F_z (kN)	Moment M_x (kN.m)	Moment M_y (kN.m)	Moment M_z (kN.m)
ULS1	0.000	380.000	0.000	0.000	0.000	0.000
ULS2	-24.000	120.000	0.000	0.000	0.000	0.000
ULS3	-24.000	120.000	0.000	0.000	0.000	0.000
ULS4	0.000	120.000	-16.000	0.000	0.000	0.000
ULS5	0.000	350.000	0.000	0.000	0.000	0.000
ULS6	-21.000	140.000	0.000	0.000	0.000	0.000
ULS7	-21.000	140.000	0.000	0.000	0.000	0.000
ULS8	0.000	140.000	-14.000	0.000	0.000	0.000

Factored Load on Pedestal Location L2 (PT1)

Load Case	Horizontal F_x (kN)	Vertical F_y (kN)	Horizontal F_z (kN)	Moment M_x (kN.m)	Moment M_y (kN.m)	Moment M_z (kN.m)
ULS1	0.000	380.000	0.000	0.000	0.000	0.000
ULS2	-24.000	120.000	0.000	0.000	0.000	0.000
ULS3	-24.000	120.000	0.000	0.000	0.000	0.000
ULS4	0.000	120.000	-16.000	0.000	0.000	0.000
ULS5	0.000	350.000	0.000	0.000	0.000	0.000
ULS6	-21.000	140.000	0.000	0.000	0.000	0.000
ULS7	-21.000	140.000	0.000	0.000	0.000	0.000
ULS8	0.000	140.000	-14.000	0.000	0.000	0.000

2.3 Soil and Self-Weight of Foundation

Self-Weight of Pad	S_{wf} = **21.6** kN
Self-Weight of Pedestals	S_{wpd} = **12.6** kN
Minimum Soil Overburden	SIM_{nWt} = **41.6** kN
Maximum Soil Overburden	SIM_{xWt} = **41.6** kN
Water Weight above Pad	W_{rfp} = **13.5** kN
Deduction Weight of Suspended Soil	SID_{nWt} = **13.5** kN
Buoyancy Deduction Load	B_{fuf} = **25.0** kN
Total Weight under Min. Soil Condition	$M_{nCWt} = S_{wf} + S_{wpd} + W_{rfp} + SIM_{nWt} - SID_{nWt} - B_{fuf}$ = **50.8** kN
Total Weight under Max. Soil Condition	$M_{xCWt} = S_{wf} + S_{wpd} + SIM_{xWt}$ = **75.8** kN

2.4 Serviceability Check for SLS combinations

2.4.1 Stability Resistance

Comb	Sliding Resistance (kN)			Overturning Resisting Moment (kN.m)					
	Frictional	Passive	Total	Self-X	Self-Z	Passive-X	Passive-Z	Total-X	Total-Z
SLS1	192.8	0.0	192.8	330.5	688.5	0.0	0.0	330.5	688.5
SLS2	87.8	0.0	87.8	150.5	313.5	0.0	0.0	150.5	313.5
SLS3	87.8	0.0	87.8	150.5	313.5	0.0	0.0	150.5	313.5
SLS4	87.8	0.0	87.8	150.5	313.5	0.0	0.0	150.5	313.5
SLS5	182.3	0.0	182.3	312.5	651.0	0.0	0.0	312.5	651.0
SLS6	87.8	0.0	87.8	150.5	313.5	0.0	0.0	150.5	313.5
SLS7	87.8	0.0	87.8	150.5	313.5	0.0	0.0	150.5	313.5

Comb	Sliding Resistance (kN)			Overturning Resisting Moment (kN.m)					
	Frictional	Passive	Total	Self-X	Self-Z	Passive-X	Passive-Z	Total-X	Total-Z
SLS8	87.8	0.0	87.8	150.5	313.5	0.0	0.0	150.5	313.5

2.4.2 Overturning Check

SLS Comb	Overturning (kN.m)		Resisting (kN.m)		FOS Overturning		
	Moment X	Moment Z	Moment X	Moment Z	Actual X	Actual Z	Allowable
SLS1	0.0	0.0	330.5	688.5	100.00	100.00	1.50
SLS2	0.0	40.5	150.5	313.5	100.00	7.74	1.50
SLS3	0.0	40.5	150.5	313.5	100.00	7.74	1.50
SLS4	-27.0	0.0	150.5	313.5	5.57	100.00	1.50
SLS5	0.0	0.0	312.5	651.0	100.00	100.00	1.50
SLS6	0.0	36.5	150.5	313.5	100.00	8.60	1.50
SLS7	0.0	36.5	150.5	313.5	100.00	8.60	1.50
SLS8	-24.3	0.0	150.5	313.5	6.19	100.00	1.50

2.4.3 Sliding and Uplift Check

SLS Comb	Resultant Shear (kN)	Resisting Force (kN)	FOS Sliding		FOS Uplift			
			Actual	Allowable	Uplift Force (kN)	Resisting Force (kN)	Actual	Allowable
SLS1	0.0	192.8	100.00	1.50	0.0	50.8	100.00	1.2
SLS2	30.0	87.8	2.93	1.50	0.0	50.8	100.00	1.2
SLS3	30.0	87.8	2.93	1.50	0.0	50.8	100.00	1.2
SLS4	20.0	87.8	4.39	1.50	0.0	50.8	100.00	1.2
SLS5	0.0	182.3	100.00	1.50	0.0	50.8	100.00	1.2
SLS6	27.0	87.8	3.25	1.50	0.0	50.8	100.00	1.2
SLS7	27.0	87.8	3.25	1.50	0.0	50.8	100.00	1.2
SLS8	18.0	87.8	4.88	1.50	0.0	50.8	100.00	1.2

2.4.4 Bearing Pressure Check

SLS Comb	Minimum Soil Condition			Maximum Soil Condition			Bearing Pressure		
	Axial Force (kN)	Moment X (kN.m)	Moment Z (kN.m)	Axial Force (kN)	Moment X (kN.m)	Moment Z (kN.m)	Actual (kN/m²)	Allowable (kN/m²)	Contact %
SLS1	550.8	0.0	0.0	575.8	0.0	0.0	191.94	222.20	100.0
SLS2	250.8	0.0	40.5	275.8	0.0	40.5	124.34	222.20	100.0
SLS3	250.8	0.0	40.5	275.8	0.0	40.5	124.34	222.20	100.0
SLS4	250.8	-27.0	0.0	275.8	-27.0	0.0	136.94	222.20	100.0
SLS5	520.8	0.0	0.0	545.8	0.0	0.0	181.94	222.20	100.0
SLS6	250.8	0.0	36.5	275.8	0.0	36.5	121.10	222.20	100.0
SLS7	250.8	0.0	36.5	275.8	0.0	36.5	121.10	222.20	100.0
SLS8	250.8	-24.3	0.0	275.8	-24.3	0.0	132.44	222.20	100.0

2.4.5 Crack Width Check

Position	Combination	Location (m)	Moment (kN.m/m)	Crack Width (mm)	
				Actual	Allowable
Bottom - X	SLS2	1.70	9.23	0.0000	0.2
Top - X	SLS1	1.25	15.76	0.0000	0.2
Bottom - Z	SLS1	0.35	10.30	0.0000	0.2
Top - Z	-	-	0.00	0.0000	0.2

2.5 Ultimate Design

2.5.1 Pad - Check for Bending Moment

- X Direction - Bottom ----------

Critical Ultimate Load Combination	= **ULS2**
Critical Moment Location	= **1.70** m
Design Moment	= **14.6** kN.m
Moment Capacity (for given Reinforcement)	= **65.8** kN.m
Reinforcement Provided	= **0.19** %
Min. Reinforcement Required	= **0.24** %
Provided Rebar Spacing	= **200** mm
Allowed Maximum Rebar Spacing	= **300.0** mm

- X Direction - Top ----------

Critical Ultimate Load Combination	= **ULS1**
Critical Moment Location	= **1.25** m
Design Moment	= **23.9** kN.m
Moment Capacity (for given Reinforcement)	= **65.8** kN.m
Reinforcement Provided	= **0.19** %
Min. Reinforcement Required	= **0.24** %
Provided Rebar Spacing	= **200** mm
Allowed Maximum Rebar Spacing	= **300.0** mm

- Z Direction - Bottom ----------

Critical Ultimate Load Combination	= **ULS1**
Critical Moment Location	= **0.35** m
Design Moment	= **15.6** kN.m
Moment Capacity (for given Reinforcement)	= **66.0** kN.m
Reinforcement Provided	= **0.19** %
Min. Reinforcement Required	= **0.24** %
Provided Rebar Spacing	= **200** mm
Allowed Maximum Rebar Spacing	= **300.0** mm

2.5.2 Pad - Check for Shear

Position	Critical Combination	Location (m)	Shear Force (kN/m)	Design Stress (N/mm²)	Strength (N/mm²)
Bottom - X	ULS2	1.46	48.8	0.200	0.491
Top - X	ULS1	1.04	54.1	0.222	0.491
Bottom - Z	ULS1	1.09	28.6	0.123	0.506
Top - Z	-	-	0.0	0.000	0.506

2.5.3 Check for Punching Shear

Pedestal	ULS Comb	Punching at	Punch. Force (kN)	Tension Face	Punch. Stress (N/mm²)	Strength (N/mm²)
L1	ULS1	Face	319.2	Bottom	0.671	4.733
	ULS2	1.5 d	29.5	Top	0.103	0.428
L2	ULS1	Face	319.2	Bottom	0.671	4.733
	ULS2	1.5 d	47.8	Bottom	0.167	0.428

2.5.4 Pedestal Design

◯ Pedestal - PT1 (500x500 Size Square) Design Check {L1, L2}

- Design Check - Bending Moment

Design Pedestal Location	= **L1**
Design Load Combination	= **ULS2**
Design Axial Load (+ve Compression)	= **127.6** kN
Design Moment - X (Resolved)	= **0.0** kN.m
Design Moment - Z (Resolved)	= **25.2** kN.m
- Axial Compression Load Capacity	= **4961.8** kN
- Axial Tension Load Capacity	= **1092.7** kN
- Moment - X Capacity (Biaxial)	= **0.0** kN.m
- Moment - Z Capacity (Biaxial)	= **237.8** kN.m
- Design Ratio for Bending Moment	= **0.106**
- Reinforcement Provided	= **1.0** %
- Min. Reinforcement Required	= **0.4** %
- Vertical Rebar Spacing	= **180.0** mm

- Design Check for Shear

Design Pedestal Location	= **L1**
Design Load Combination	= **ULS2**
Design Axial Load (+ve Compression)	= **127.6** kN
Design Moment - X (Resolved)	= **0.0** kN.m
Design Moment - Z (Resolved)	= **25.2** kN.m
Design Shear - X (Resolved)	= **24.0** kN
Design Shear - Z (Resolved)	= **0.0** kN
- Maximum Shear Stress	= **0.112** N/mm^2
- Maximum Allowable Shear Stress	= **4.733** N/mm^2
- Design Ties Spacing	= **Not Required**
- Provided Ties Spacing	= **150** mm
- Maximum Allowed Ties Spacing	= **320** mm

3.0 SUMMARY

3.1 Stability Checks (SLS)

Stability Condition	Critical Condition	Actual	Allowable	Status
FOS Overturning X	SLS4	5.574	1.500	Pass
FOS Overturning Z	SLS2	7.741	1.500	Pass
FOS Sliding (Resultant)	SLS2	2.926	1.500	Pass
FOS Uplift	SLS1	100.0	1.200	Pass
Bearing Pressure (kN/m^2)	SLS1	191.9	222.2	Pass
Contact (%)	SLS1	100.0	80.0	Pass

3.2 Crack Width Check

Stability Condition	Critical Condition	Actual (mm)	Allowable (mm)	Status
Bottom - X	SLS2	0.0000	0.200	Pass
Top - X	SLS1	0.0000	0.200	Pass
Bottom - Z	SLS1	0.0000	0.200	Pass
Top - Z	-	0.0000	0.200	Pass

3.3 Pad Design

3.3.1 Pad Minimum Reinforcement

Position	Provided	Min. Percentage	Max. Spacing	Status
Bottom - X	12Φ at 200 c/c (0.19%)	0.13 %	300.0	Pass
Bottom - Z	12Φ at 200 c/c (0.19%)	0.13 %	300.0	Pass
Top- X	12Φ at 200 c/c (0.19%)	0.13 %	300.0	Pass
Top- Z	12Φ at 200 c/c (0.19%)	0.13 %	300.0	Pass

3.3.2 Pad Moment Capacity

Position	Combination	Required (kN.m/m)	Capacity (kN.m/m)	Status
Bottom - X	ULS2	14.56	65.79	Pass
Top - X	ULS1	23.94	65.79	Pass
Bottom - Z	ULS1	15.64	65.96	Pass
Top - Z	-	0.00	65.96	Pass

3.3.3 Pad Shear Capacity

Position	Combination	Required (kN/m)	Capacity (kN/m)	Status
Bottom - X	ULS2	48.8	119.9	Pass
Top - X	ULS1	54.1	119.9	Pass
Bottom - Z	ULS1	28.6	117.4	Pass
Top - Z	-	0.0	117.4	Pass

3.3.4 Punching Shear

Location	Combination	Punching at	Face	Actual (N/mm²)	Strength (N/mm²)	Status
L1	ULS1	Face	Bottom	0.671	4.733	Pass
L1	ULS2	1.5d	Top	0.103	0.428	Pass

3.4 Pedestal Design

3.4.1 Pedestal Bending Moment

Type	Applicable Locations	Critical Location	Combination	Design Ratio	Status
PT1	L1, L2	L1	ULS2	0.106	Pass

3.4.2 Pedestal Shear

Type	Applicable Locations	Critical Location	Combination	Provided Spacing (mm)	Max. Spacing (mm)	Status
PT1	L1, L2	L1	ULS2	150.0	320.0	Pass