

ΕΛΕΓΧΟΣ ΘΕΜΕΛΙΩΣΗΣ

1 Level:

- Cracking : permissible
- Exposure : 1 - dry

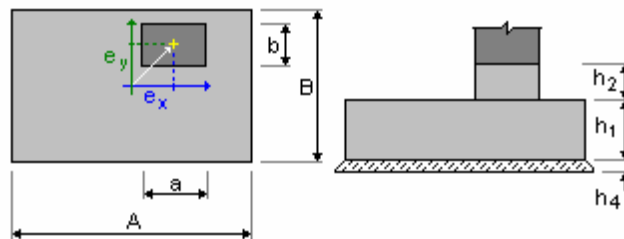
2 Spread footing: Foundation1

Number: 1

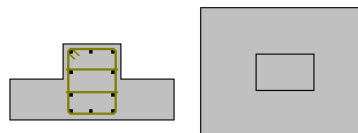
2.1 Material properties:

- Concrete : C20/25; Characteristic strength = 20.00 MPa
Unit weight = 2447.32 (kG/m³)
- Longitudinal reinforcement : type Characteristic strength = 500.00 MPa
- Transversal reinforcement : type Characteristic strength = 220.00 MPa

2.2 Geometry:



A	= 0.70 (m)	a	= 0.20 (m)
B	= 0.70 (m)	b	= 0.20 (m)
h1	= 0.60 (m)	e _x	= 0.00 (m)
h2	= 0.10 (m)	e _y	= 0.00 (m)
h4	= 0.00 (m)		



c = 5.0 (cm)

2.3 Calculation options:

- Geotechnic calculations according to : ENV 1997-1:1994
- Concrete calculations according to : ENV 1992-1-1:1991
- Include seismic dispositions
- Shape selection : without limits
- Conditions without drainage

Partial factors for soil properties:

	$\tan(\phi)$	c'	C_u	q_{max}
Case A	1.10	1.30	1.20	1.20
Case B	1.00	1.00	1.00	1.00
Case C	1.25	1.60	1.40	1.40
ALS	1.00	1.00	1.00	1.00

2.4 Loads:

2.4.1 Foundation loads:

Case	Nature	Group	N (kN)	Fx (kN)	Fy (kN)	Mx (kN*m)	My (kN*m)
LC5	design	----	6.28	-0.03	-0.48	0.29	0.24
LC6	design	----	6.36	0.02	-0.56	0.32	0.22
LC13	design	----	6.28	-0.04	-0.52	0.31	0.24
LC14	design	----	3.15	0.02	-0.58	0.34	0.11
LC15	design	----	3.48	0.00	-0.51	0.30	0.15
LC16	design	----	6.33	0.01	-0.56	0.32	0.22
LC17	design	----	6.31	-0.03	-0.50	0.30	0.25
LC18	design	----	6.33	0.01	-0.53	0.31	0.21

2.4.2 Backfill loads:

Case	Nature	Q1 (kN/m2)
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2.4.3 Combination list

1/	ULS : LC5 N=6.28 Mx=0.29 My=0.24 Fx=-0.03 Fy=-0.48
2/	ULS : LC6 N=6.36 Mx=0.32 My=0.22 Fx=0.02 Fy=-0.56
3/	ULS : LC13 N=6.28 Mx=0.31 My=0.24 Fx=-0.04 Fy=-0.52
4/	ULS : LC14 N=3.15 Mx=0.34 My=0.11 Fx=0.02 Fy=-0.58
5/	ULS : LC15 N=3.48 Mx=0.30 My=0.15 Fx=0.00 Fy=-0.51
6/	ULS : LC16 N=6.33 Mx=0.32 My=0.22 Fx=0.01 Fy=-0.56
7/	ULS : LC17 N=6.31 Mx=0.30 My=0.25 Fx=-0.03 Fy=-0.50
8/	ULS : LC18 N=6.33 Mx=0.31 My=0.21 Fx=0.01 Fy=-0.53
9/*	ULS : LC5 N=6.28 Mx=0.29 My=0.24 Fx=-0.03 Fy=-0.48
10/*	ULS : LC6 N=6.36 Mx=0.32 My=0.22 Fx=0.02 Fy=-0.56
11/*	ULS : LC13 N=6.28 Mx=0.31 My=0.24 Fx=-0.04 Fy=-0.52
12/*	ULS : LC14 N=3.15 Mx=0.34 My=0.11 Fx=0.02 Fy=-0.58
13/*	ULS : LC15 N=3.48 Mx=0.30 My=0.15 Fx=0.00 Fy=-0.51
14/*	ULS : LC16 N=6.33 Mx=0.32 My=0.22 Fx=0.01 Fy=-0.56
15/*	ULS : LC17 N=6.31 Mx=0.30 My=0.25 Fx=-0.03 Fy=-0.50
16/*	ULS : LC18 N=6.33 Mx=0.31 My=0.21 Fx=0.01 Fy=-0.53

2.5 Soil:

Soil level:	N ₁	= 0.00 (m)	
Column pier level:	N _a	= 0.00 (m)	
Minimum reference level:	N _f	= 0.00 (m)	
Water level:	N _{max.}	= -4.40 (m)	N _{min.} = -4.10 (m)

C-Cs

- Soil level: 0.00 (m)
- Unit weight: 1900.00 (kG/m3)
- Unit weight of solid: 2700.00 (kG/m3)
- Internal friction angle: 0.0 (Deg)
- Cohesion: 0.12 (MPa)

2.6 Calculation results:

2.6.1 Required reinforcement Spread footing:

bottom:

ULS : LC6 N=6.36 Mx=0.32 My=0.22 Fx=0.02 Fy=-0.56

$$M_y = 0.35 \text{ (kN*m)} \quad A_{sx} = 8.10 \text{ (cm}^2\text{/m)}$$

$$\text{ULS : LC6 N=6.36 } M_x=0.32 \text{ } M_y=0.22 \text{ } F_x=0.02 \text{ } F_y=-0.56$$

$$M_x = 0.49 \text{ (kN*m)} \quad A_{sy} = 8.10 \text{ (cm}^2\text{/m)}$$

$$A_{s \text{ min}} = 8.10 \text{ (cm}^2\text{/m)}$$

top:

$$A'_{sx} = 0.00 \text{ (cm}^2\text{/m)}$$

$$\text{ULS : LC14 N=3.15 } M_x=0.34 \text{ } M_y=0.11 \text{ } F_x=0.02 \text{ } F_y=-0.58$$

$$M_x = -0.07 \text{ (kN*m)} \quad A'_{sy} = 8.10 \text{ (cm}^2\text{/m)}$$

$$A_{s \text{ min}} = 8.10 \text{ (cm}^2\text{/m)}$$

Column pier:

$$\begin{aligned} \text{Longitudinal reinforcement} \quad A &= 1.20 \text{ (cm}^2\text{)} \quad A_{\text{min.}} = 1.20 \text{ (cm}^2\text{)} \\ A &= 2 * (A_{sx} + A_{sy}) \\ A_{sx} &= 0.18 \text{ (cm}^2\text{)} \quad A_{sy} = 0.42 \text{ (cm}^2\text{)} \end{aligned}$$

$$\mathbf{2.6.2 \quad Real reference level} = -0.70 \text{ (m)}$$

2.6.3 Stability analysis

Stress calculations

Soil type under foundation: not layered

Design combination **ULS : LC6 N=6.36 Mx=0.32 My=0.22 Fx=**

0.02 Fy=-0.56

$$\begin{aligned} \text{Load factors:} \quad & \mathbf{1.35} * \text{Foundation weight} \\ & \mathbf{1.35} * \text{Soil weight} \\ & \mathbf{1.00} * \text{Archimedes pressure} \end{aligned}$$

Calculation results: On the foundation level

Weight of foundation and soil over it: Gr = 10.79 (kN)

Design load:

$$N_r = 17.15 \text{ (kN)} \quad M_x = 0.71 \text{ (kN*m)} \quad M_y = 0.24 \text{ (kN*m)}$$

Soil profile parameters:

$$\begin{aligned} c &= 0.00 \text{ (MPa)} \\ \phi &= 0.00 \\ \gamma &= 0.00 \text{ (kG/m}^3\text{)} \end{aligned}$$

Stress in soil: 0.05 (MPa)

Design soil pressure 0.10 (MPa)

Safety factor: 1.84 > 1.4

Uplift

Uplift in ULS

Design combination

ULS : LC14 N=3.15 Mx=0.34 My=0.11 Fx=

0.02 Fy=-0.58

$$\begin{aligned} \text{Load factors:} \quad & \mathbf{1.00} * \text{Foundation weight} \\ & \mathbf{1.00} * \text{Soil weight} \\ & \mathbf{1.35} * \text{Archimedes pressure} \\ \text{Contact area:} \quad & s = 0.10 \\ & s_{\text{lim}} = 0.33 \end{aligned}$$

Sliding

0.02 Fy=-0.58

Design combination

ULS : LC14 N=3.15 Mx=0.34 My=0.11 Fx=

Load factors:

1.00 * Foundation weight

1.00 * Soil weight

1.35 * Archimedes pressure

Weight of foundation and soil over it: Gr = 7.99 (kN)

Design load:

Nr = 11.14 (kN) Mx = 0.74 (kN*m) My = 0.13 (kN*m)

Equivalent foundation dimensions: A₋ = 0.70 (m) B₋ = 0.70 (m)

Sliding area: 0.49 (m²)

Foundation/soil friction coefficient: tg(φ) = 0.00

Cohesion: C = 0.12 (MPa)

Soil pressure considered:

Hx = 0.02 (kN) Hy = -0.58 (kN)

Ppx = -1.57 (kN) Ppy = 1.57 (kN)

Pax = 1.57 (kN) Pay = -1.57 (kN)

Sliding force value F = 0.00 (kN)

Value of force preventing foundation sliding:

- On the foundation level: F(stab) = 4.46 (kN)

Stability for sliding: ∞

Rotation

About OX axis

Design combination

ULS : LC14 N=3.15 Mx=0.34 My=0.11 Fx=

0.02 Fy=-0.58

Load factors:

1.00 * Foundation weight

1.00 * Soil weight

1.35 * Archimedes pressure

Weight of foundation and soil over it: Gr = 7.99 (kN)

Design load:

Nr = 11.14 (kN) Mx = 0.74 (kN*m) My = 0.13 (kN*m)

Stability moment: M_{stab} = 3.90 (kN*m)

Rotation moment: M_{renv} = 0.74 (kN*m)

Stability for rotation: 5.272 > 1

About OY axis

Design combination:

ULS : LC17 N=6.31 Mx=0.30 My=0.25 Fx=-

0.03 Fy=-0.50

Load factors:

1.00 * Foundation weight

1.00 * Soil weight

1.35 * Archimedes pressure

Weight of foundation and soil over it: Gr = 7.99 (kN)

Design load:

Nr = 14.30 (kN) Mx = 0.65 (kN*m) My = 0.23 (kN*m)

Stability moment: M_{stab} = 5.02 (kN*m)

Rotation moment: M_{renv} = 0.25 (kN*m)

Stability for rotation: 20.43 > 1