



**ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΠΕΡΙΦΕΡΕΙΑ ΘΕΣΣΑΛΙΑΣ
ΝΟΜΟΣ ΜΑΓΝΗΣΙΑΣ
ΔΗΜΟΣ ΡΗΓΑ ΦΕΡΑΙΟΥ**

*Δ/ΝΣΗ ΤΕΧΝΙΚΩΝ ΥΠΗΡΕΣΙΩΝ &
ΠΕΡΙΒΑΛΛΟΝΤΟΣ
ΤΕΧΝΙΚΗ ΥΠΗΡΕΣΙΑ*

ΕΡΓΟ :

**ΑΝΑΒΑΘΜΙΣΗ ΤΟΥ ΕΠΑ.Λ.
ΒΕΛΕΣΤΙΝΟΥ ΤΟΥ ΔΗΜΟΥ ΡΗΓΑ
ΦΕΡΑΙΟΥ ΣΕ ΠΡΟΤΥΠΟ ΕΠΑ.Λ.**

Αρ. Μελέτης: 6 /2023

ΠΡΟΫΠΟΛΟΓΙΣΜΟΥ:480.000,00 €

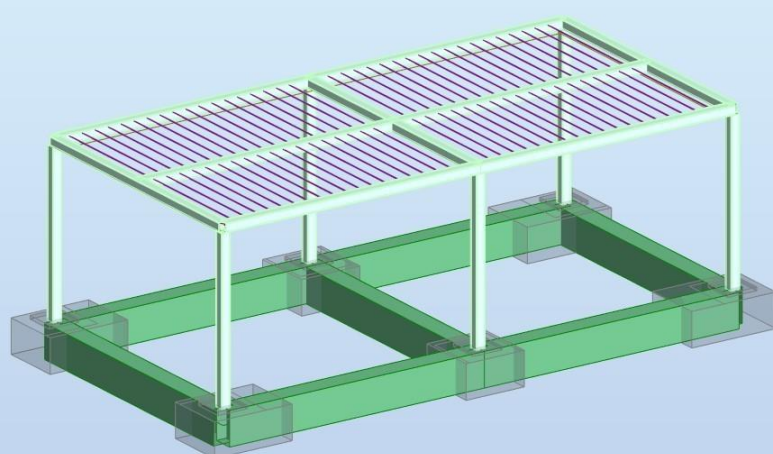
ΣΥΜΠΕΡΙΛΑΜΒΑΝΕΤΕ Ο ΦΠΑ

Αρ. Πρωτ: 530/19-01-2023

**ΧΡΗΜΑΤΟΔΟΤΗΣΗ :
ΤΑΜΕΙΟ ΑΝΑΚΑΜΨΗΣ**

**ΣΤΑΤΙΚΗ ΜΕΛΕΤΗ ΠΕΡΓΚΟΛΑΣ
(ΑΠΟΤΕΛΕΣΜΑΤΑ ΘΕΜΕΛΙΩΣΗΣ)**

ΠΕΡΓΚΟΛΑ ΒΕΛΕΣΤΙΝΟ ΜΕ ΚΟΙΛΕΣ ΔΙΑΤΟΜΕΣ ΑΠΟΤΕΛΕΣΜΑΤΑ ΘΕΜΕΛΙΩΣΗΣ



— B R30x50
— NZSE 10x15x0.2
— TCAR 135x5

ΠΕΔΙΟ

1 Spread footing: ΠΕΔΙΟ 1Γ elements: 1

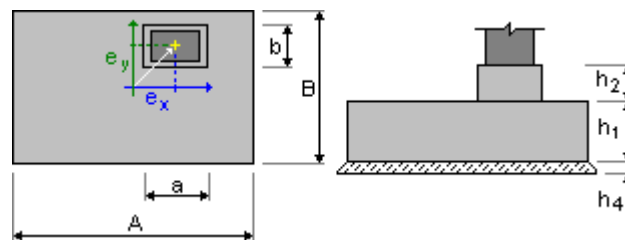
Number of identical

1.1 Basic data

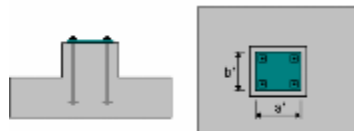
1.1.1 Assumptions

- Geotechnic calculations according to : EN 1997-1:2004/A1:2013
- Concrete calculations according to : EN 1992-1-1:2004/A1:2014
- Shape selection : without limits

1.1.2 Geometry:



A	= 0,90 (m)	a	= 0,80 (m)
B	= 1,30 (m)	b	= 0,80 (m)
h1	= 0,50 (m)	ex	= 0,00 (m)
h2	= 0,00 (m)	ey	= -0,25 (m)
h4	= 0,05 (m)		



a'	= 45,0 (cm)
b'	= 45,0 (cm)
Cnom1	= 6,0 (cm)
Cnom2	= 6,0 (cm)
Cover deviations: Cdev = 1,0(cm), Cdur = 0,0(cm)	

1.1.3 Materials

- Concrete : C25/30; Characteristic strength = 25,00 MPa
Unit weight = 2501,36 (kG/m3)
Rectangular stress distribution [3.1.7(3)]
- Longitudinal reinforcement : type B500C Characteristic strength = 500,00 MPa
Ductility class: C
Horizontal branch of the stress-strain diagram
- Transversal reinforcement : type B500C Characteristic strength = 500,00 MPa
- Additional reinforcement: : type B500C Characteristic strength = 500,00 MPa

1.1.4 Loads:**Foundation loads:**

Case	Nature	Group	N (kN)	Fx (kN)	Fy (kN)	Mx (kN*m)	My (kN*m)		
ULS 1	design(Structural)	----	32,38	-3,03	-1,77	-14,09	3,74		
ULS 2	design(Structural)	----	35,11	-3,89	-2,27	-15,03	3,04		
ULS 3	design(Structural)	----	32,38	-3,03	-1,77	-14,09	3,74		
ULS 4	design(Structural)	----	35,11	-3,89	-2,27	-15,03	3,04		
ULS 5	design(Structural)	----	35,11	-3,89	-2,27	-15,03	3,04		
ULS 6	design(Structural)	----	35,11	-3,89	-2,27	-15,03	3,04		
ULS 7	design(Structural)	----	30,20	-2,35	-1,37	-13,34	4,31		
ULS 8	design(Structural)	----	30,20	-2,35	-1,37	-13,34	4,31		
ULS 9	design(Structural)	----	30,20	-2,35	-1,37	-13,34	4,31		
ULS 10	design(Structural)	----	32,92	-3,21	-1,87	-14,28	3,60		
ULS 11	design(Structural)	----	32,92	-3,21	-1,87	-14,28	3,60		
ULS 12	design(Structural)	----	32,92	-3,21	-1,87	-14,28	3,60		
ULS 13	design(Structural)	----	30,20	-2,35	-1,37	-13,34	4,31		
ULS 14	design(Structural)	----	35,65	-4,07	-2,37	-15,22	2,90		
ULS 15	design(Structural)	----	35,65	-4,07	-2,37	-15,22	2,90		
ULS 16	design(Structural)	----	35,65	-4,07	-2,37	-15,22	2,90		
ULS 17	design(Structural)	----	35,65	-4,07	-2,37	-15,22	2,90		
SEISM 1	design	----	28,01	-1,66	-0,98	-12,58	4,87		
SEISM 2	design	----	28,01	-1,66	-0,98	-12,58	4,87		
SEISM 3	design	----	28,01	-1,66	-0,98	-12,58	4,87		
SEISM 4	design	----	28,01	-1,66	-0,98	-12,58	4,87		
SEISM 5	design	----	28,01	-1,66	-0,98	-12,58	4,87		
SEISM 6	design	----	28,01	-1,66	-0,98	-12,58	4,87		
SEISM 7	design	----	28,01	-1,66	-0,98	-12,58	4,87		
SEISM 8	design	----	28,01	-1,66	-0,98	-12,58	4,87		
SEISM 9	design	----	21,03	-1,32	-0,78	-9,42	3,53		
SLS 1	design(Non-structural)	----	26,13	-2,92	-1,70	-11,18	2,22		
SLS 2	design(Non-structural)	----	26,13	-2,92	-1,70	-11,18	2,22		
SLS 3	design(Non-structural)	----	26,13	-2,92	-1,70	-11,18	2,22		
SLS 4	design(Non-structural)	----	25,40	-2,69	-1,57	-10,93	2,41		
SLS 5	design(Non-structural)	----	25,40	-2,69	-1,57	-10,93	2,41		
SLS 6	design(Non-structural)	----	25,40	-2,69	-1,57	-10,93	2,41		
SLS 7	design(Non-structural)	----	25,40	-2,69	-1,57	-10,93	2,41		
TEMP NEGATIVE	design(Structural)	----			-0,07	0,26	0,64	-1,29	0,44
ULS 18	design(Structural)	----	32,43	-3,23	-2,25	-13,12	3,41		
ULS 19	design(Structural)	----	32,38	-3,03	-1,77	-14,09	3,74		
ULS 20	design(Structural)	----	32,43	-3,23	-2,25	-13,12	3,41		
ULS 21	design(Structural)	----	32,38	-3,03	-1,77	-14,09	3,74		
ULS 22	design(Structural)	----	32,43	-3,23	-2,25	-13,12	3,41		
ULS 23	design(Structural)	----	32,38	-3,03	-1,77	-14,09	3,74		
ULS 24	design(Structural)	----	32,43	-3,23	-2,25	-13,12	3,41		
ULS 25	design(Structural)	----	56,70	-5,46	-3,46	-23,93	6,30		
ULS 26	design(Structural)	----	32,43	-3,23	-2,25	-13,12	3,41		
ULS 27	design(Structural)	----	56,70	-5,46	-3,46	-23,93	6,30		
ULS 28	design(Structural)	----	35,71	-4,26	-2,85	-14,25	2,56		
ULS 29	design(Structural)	----	59,98	-6,49	-4,05	-25,06	5,45		
ULS 30	design(Structural)	----	30,30	-2,74	-2,34	-11,40	3,64		
ULS 31	design(Structural)	----	78,84	-7,20	-4,75	-33,02	9,42		
ULS 32	design(Structural)	----	32,38	-3,03	-1,77	-14,09	3,74		
ULS 33	design(Structural)	----	35,11	-3,89	-2,27	-15,03	3,04		
ULS 34	design(Structural)	----	30,20	-2,35	-1,37	-13,34	4,31		
ULS 35	design(Structural)	----	32,92	-3,21	-1,87	-14,28	3,60		
ULS 36	design(Structural)	----	30,20	-2,35	-1,37	-13,34	4,31		
ULS 37	design(Structural)	----	35,65	-4,07	-2,37	-15,22	2,90		
SLS 8	design(Non-structural)	----	26,13	-2,92	-1,70	-11,18	2,22		
SLS 9	design(Non-structural)	----	25,40	-2,69	-1,57	-10,93	2,41		
SLS 10	design(Non-structural)	----	26,17	-3,08	-2,09	-10,40	1,95		
SLS 11	design(Non-structural)	----	44,86	-4,63	-2,92	-18,80	4,45		
SLS 12	design(Non-structural)	----	26,17	-3,08	-2,09	-10,40	1,95		
SLS 13	design(Non-structural)	----	44,86	-4,63	-2,92	-18,80	4,45		

Backfill loads:

Case	Nature	Q1 (kN/m2)
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1.1.5 Combination list

1/ ULS : ULS 1 N=32,38 Mx=-14,09 My=3,74 Fx=-3,03 Fy=-1,77
2/ ULS : ULS 2 N=35,11 Mx=-15,03 My=3,04 Fx=-3,89 Fy=-2,27
3/ ULS : ULS 3 N=32,38 Mx=-14,09 My=3,74 Fx=-3,03 Fy=-1,77
4/ ULS : ULS 4 N=35,11 Mx=-15,03 My=3,04 Fx=-3,89 Fy=-2,27
5/ ULS : ULS 5 N=35,11 Mx=-15,03 My=3,04 Fx=-3,89 Fy=-2,27
6/ ULS : ULS 6 N=35,11 Mx=-15,03 My=3,04 Fx=-3,89 Fy=-2,27
7/ ULS : ULS 7 N=30,20 Mx=-13,34 My=4,31 Fx=-2,35 Fy=-1,37
8/ ULS : ULS 8 N=30,20 Mx=-13,34 My=4,31 Fx=-2,35 Fy=-1,37
9/ ULS : ULS 9 N=30,20 Mx=-13,34 My=4,31 Fx=-2,35 Fy=-1,37
10/ ULS : ULS 10 N=32,92 Mx=-14,28 My=3,60 Fx=-3,21 Fy=-1,87
11/ ULS : ULS 11 N=32,92 Mx=-14,28 My=3,60 Fx=-3,21 Fy=-1,87
12/ ULS : ULS 12 N=32,92 Mx=-14,28 My=3,60 Fx=-3,21 Fy=-1,87
13/ ULS : ULS 13 N=30,20 Mx=-13,34 My=4,31 Fx=-2,35 Fy=-1,37
14/ ULS : ULS 14 N=35,65 Mx=-15,22 My=2,90 Fx=-4,07 Fy=-2,37
15/ ULS : ULS 15 N=35,65 Mx=-15,22 My=2,90 Fx=-4,07 Fy=-2,37
16/ ULS : ULS 16 N=35,65 Mx=-15,22 My=2,90 Fx=-4,07 Fy=-2,37
17/ ULS : ULS 17 N=35,65 Mx=-15,22 My=2,90 Fx=-4,07 Fy=-2,37
18/ ULS : TEMP NEGATIVE N=-0,07 Mx=-1,29 My=0,44 Fx=0,26 Fy=0,64
19/ ULS : ULS 18 N=32,43 Mx=-13,12 My=3,41 Fx=-3,23 Fy=-2,25
20/ ULS : ULS 19 N=32,38 Mx=-14,09 My=3,74 Fx=-3,03 Fy=-1,77
21/ ULS : ULS 20 N=32,43 Mx=-13,12 My=3,41 Fx=-3,23 Fy=-2,25
22/ ULS : ULS 21 N=32,38 Mx=-14,09 My=3,74 Fx=-3,03 Fy=-1,77
23/ ULS : ULS 22 N=32,43 Mx=-13,12 My=3,41 Fx=-3,23 Fy=-2,25
24/ ULS : ULS 23 N=32,38 Mx=-14,09 My=3,74 Fx=-3,03 Fy=-1,77
25/ ULS : ULS 24 N=32,43 Mx=-13,12 My=3,41 Fx=-3,23 Fy=-2,25
26/ ULS : ULS 25 N=56,70 Mx=-23,93 My=6,30 Fx=-5,46 Fy=-3,46
27/ ULS : ULS 26 N=32,43 Mx=-13,12 My=3,41 Fx=-3,23 Fy=-2,25
28/ ULS : ULS 27 N=56,70 Mx=-23,93 My=6,30 Fx=-5,46 Fy=-3,46
29/ ULS : ULS 28 N=35,71 Mx=-14,25 My=2,56 Fx=-4,26 Fy=-2,85
30/ ULS : ULS 29 N=59,98 Mx=-25,06 My=5,45 Fx=-6,49 Fy=-4,05
31/ ULS : ULS 30 N=30,30 Mx=-11,40 My=3,64 Fx=-2,74 Fy=-2,34
32/ ULS : ULS 31 N=78,84 Mx=-33,02 My=9,42 Fx=-7,20 Fy=-4,75
33/ ULS : ULS 32 N=32,38 Mx=-14,09 My=3,74 Fx=-3,03 Fy=-1,77
34/ ULS : ULS 33 N=35,11 Mx=-15,03 My=3,04 Fx=-3,89 Fy=-2,27
35/ ULS : ULS 34 N=30,20 Mx=-13,34 My=4,31 Fx=-2,35 Fy=-1,37
36/ ULS : ULS 35 N=32,92 Mx=-14,28 My=3,60 Fx=-3,21 Fy=-1,87
37/ ULS : ULS 36 N=30,20 Mx=-13,34 My=4,31 Fx=-2,35 Fy=-1,37
38/ ULS : ULS 37 N=35,65 Mx=-15,22 My=2,90 Fx=-4,07 Fy=-2,37
39/ SLS : SLS 1 N=26,13 Mx=-11,18 My=2,22 Fx=-2,92 Fy=-1,70
40/ SLS : SLS 2 N=26,13 Mx=-11,18 My=2,22 Fx=-2,92 Fy=-1,70
41/ SLS : SLS 3 N=26,13 Mx=-11,18 My=2,22 Fx=-2,92 Fy=-1,70
42/ SLS : SLS 4 N=25,40 Mx=-10,93 My=2,41 Fx=-2,69 Fy=-1,57
43/ SLS : SLS 5 N=25,40 Mx=-10,93 My=2,41 Fx=-2,69 Fy=-1,57
44/ SLS : SLS 6 N=25,40 Mx=-10,93 My=2,41 Fx=-2,69 Fy=-1,57
45/ SLS : SLS 7 N=25,40 Mx=-10,93 My=2,41 Fx=-2,69 Fy=-1,57
46/ SLS : SLS 8 N=26,13 Mx=-11,18 My=2,22 Fx=-2,92 Fy=-1,70
47/ SLS : SLS 9 N=25,40 Mx=-10,93 My=2,41 Fx=-2,69 Fy=-1,57
48/ SLS : SLS 10 N=26,17 Mx=-10,40 My=1,95 Fx=-3,08 Fy=-2,09
49/ SLS : SLS 11 N=44,86 Mx=-18,80 My=4,45 Fx=-4,63 Fy=-2,92
50/ SLS : SLS 12 N=26,17 Mx=-10,40 My=1,95 Fx=-3,08 Fy=-2,09
51/ SLS : SLS 13 N=44,86 Mx=-18,80 My=4,45 Fx=-4,63 Fy=-2,92
52/ ALS : SEISM 1 N=28,01 Mx=-12,58 My=4,87 Fx=-1,66 Fy=-0,98
53/ ALS : SEISM 2 N=28,01 Mx=-12,58 My=4,87 Fx=-1,66 Fy=-0,98
54/ ALS : SEISM 3 N=28,01 Mx=-12,58 My=4,87 Fx=-1,66 Fy=-0,98
55/ ALS : SEISM 4 N=28,01 Mx=-12,58 My=4,87 Fx=-1,66 Fy=-0,98
56/ ALS : SEISM 5 N=28,01 Mx=-12,58 My=4,87 Fx=-1,66 Fy=-0,98
57/ ALS : SEISM 6 N=28,01 Mx=-12,58 My=4,87 Fx=-1,66 Fy=-0,98
58/ ALS : SEISM 7 N=28,01 Mx=-12,58 My=4,87 Fx=-1,66 Fy=-0,98
59/ ALS : SEISM 8 N=28,01 Mx=-12,58 My=4,87 Fx=-1,66 Fy=-0,98
60/ ALS : SEISM 9 N=21,03 Mx=-9,42 My=3,53 Fx=-1,32 Fy=-0,78
61/* ULS : ULS 1 N=32,38 Mx=-14,09 My=3,74 Fx=-3,03 Fy=-1,77
62/* ULS : ULS 2 N=35,11 Mx=-15,03 My=3,04 Fx=-3,89 Fy=-2,27
63/* ULS : ULS 3 N=32,38 Mx=-14,09 My=3,74 Fx=-3,03 Fy=-1,77
64/* ULS : ULS 4 N=35,11 Mx=-15,03 My=3,04 Fx=-3,89 Fy=-2,27
65/* ULS : ULS 5 N=35,11 Mx=-15,03 My=3,04 Fx=-3,89 Fy=-2,27
66/* ULS : ULS 6 N=35,11 Mx=-15,03 My=3,04 Fx=-3,89 Fy=-2,27
67/* ULS : ULS 7 N=30,20 Mx=-13,34 My=4,31 Fx=-2,35 Fy=-1,37
68/* ULS : ULS 8 N=30,20 Mx=-13,34 My=4,31 Fx=-2,35 Fy=-1,37
69/* ULS : ULS 9 N=30,20 Mx=-13,34 My=4,31 Fx=-2,35 Fy=-1,37
70/* ULS : ULS 10 N=32,92 Mx=-14,28 My=3,60 Fx=-3,21 Fy=-1,87
71/* ULS : ULS 11 N=32,92 Mx=-14,28 My=3,60 Fx=-3,21 Fy=-1,87
72/* ULS : ULS 12 N=32,92 Mx=-14,28 My=3,60 Fx=-3,21 Fy=-1,87
73/* ULS : ULS 13 N=30,20 Mx=-13,34 My=4,31 Fx=-2,35 Fy=-1,37
74/* ULS : ULS 14 N=35,65 Mx=-15,22 My=2,90 Fx=-4,07 Fy=-2,37

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75/* ULS : ULS 15 N=35,65 Mx=-15,22 My=2,90 Fx=-4,07 Fy=-2,37
76/* ULS : ULS 16 N=35,65 Mx=-15,22 My=2,90 Fx=-4,07 Fy=-2,37
77/* ULS : ULS 17 N=35,65 Mx=-15,22 My=2,90 Fx=-4,07 Fy=-2,37
78/* ULS : TEMP NEGATIVE N=-0,07 Mx=-1,29 My=0,44 Fx=0,26 Fy=0,64
79/* ULS : ULS 18 N=32,43 Mx=-13,12 My=3,41 Fx=-3,23 Fy=-2,25
80/* ULS : ULS 19 N=32,38 Mx=-14,09 My=3,74 Fx=-3,03 Fy=-1,77
81/* ULS : ULS 20 N=32,43 Mx=-13,12 My=3,41 Fx=-3,23 Fy=-2,25
82/* ULS : ULS 21 N=32,38 Mx=-14,09 My=3,74 Fx=-3,03 Fy=-1,77
83/* ULS : ULS 22 N=32,43 Mx=-13,12 My=3,41 Fx=-3,23 Fy=-2,25
84/* ULS : ULS 23 N=32,38 Mx=-14,09 My=3,74 Fx=-3,03 Fy=-1,77
85/* ULS : ULS 24 N=32,43 Mx=-13,12 My=3,41 Fx=-3,23 Fy=-2,25
86/* ULS : ULS 25 N=56,70 Mx=-23,93 My=6,30 Fx=-5,46 Fy=-3,46
87/* ULS : ULS 26 N=32,43 Mx=-13,12 My=3,41 Fx=-3,23 Fy=-2,25
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90/* ULS : ULS 29 N=59,98 Mx=-25,06 My=5,45 Fx=-6,49 Fy=-4,05
91/* ULS : ULS 30 N=30,30 Mx=-11,40 My=3,64 Fx=-2,74 Fy=-2,34
92/* ULS : ULS 31 N=78,84 Mx=-33,02 My=9,42 Fx=-7,20 Fy=-4,75
93/* ULS : ULS 32 N=32,38 Mx=-14,09 My=3,74 Fx=-3,03 Fy=-1,77
94/* ULS : ULS 33 N=35,11 Mx=-15,03 My=3,04 Fx=-3,89 Fy=-2,27
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99/* SLS : SLS 1 N=26,13 Mx=-11,18 My=2,22 Fx=-2,92 Fy=-1,70
100/* SLS : SLS 2 N=26,13 Mx=-11,18 My=2,22 Fx=-2,92 Fy=-1,70
101/* SLS : SLS 3 N=26,13 Mx=-11,18 My=2,22 Fx=-2,92 Fy=-1,70
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104/* SLS : SLS 6 N=25,40 Mx=-10,93 My=2,41 Fx=-2,69 Fy=-1,57
105/* SLS : SLS 7 N=25,40 Mx=-10,93 My=2,41 Fx=-2,69 Fy=-1,57
106/* SLS : SLS 8 N=26,13 Mx=-11,18 My=2,22 Fx=-2,92 Fy=-1,70
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109/* SLS : SLS 11 N=44,86 Mx=-18,80 My=4,45 Fx=-4,63 Fy=-2,92
110/* SLS : SLS 12 N=26,17 Mx=-10,40 My=1,95 Fx=-3,08 Fy=-2,09
111/* SLS : SLS 13 N=44,86 Mx=-18,80 My=4,45 Fx=-4,63 Fy=-2,92
112/* ALS : SEISM 1 N=28,01 Mx=-12,58 My=4,87 Fx=-1,66 Fy=-0,98
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114/* ALS : SEISM 3 N=28,01 Mx=-12,58 My=4,87 Fx=-1,66 Fy=-0,98
115/* ALS : SEISM 4 N=28,01 Mx=-12,58 My=4,87 Fx=-1,66 Fy=-0,98
116/* ALS : SEISM 5 N=28,01 Mx=-12,58 My=4,87 Fx=-1,66 Fy=-0,98
117/* ALS : SEISM 6 N=28,01 Mx=-12,58 My=4,87 Fx=-1,66 Fy=-0,98
118/* ALS : SEISM 7 N=28,01 Mx=-12,58 My=4,87 Fx=-1,66 Fy=-0,98
119/* ALS : SEISM 8 N=28,01 Mx=-12,58 My=4,87 Fx=-1,66 Fy=-0,98
120/* ALS : SEISM 9 N=21,03 Mx=-9,42 My=3,53 Fx=-1,32 Fy=-0,78

```

1.2 Geotechnical design

1.2.1 Assumptions

- Cohesion reduction coefficient: 0,00
- Smooth precast foundation 6.5.3(10)
- Sliding with soil pressure considered: for X and Y directions
- Design approach: 1
A1 + M1 + R1
 - γ_{ϕ} = 1,00
 - $\gamma_{c'}$ = 1,00
 - γ_{cu} = 1,00
 - γ_{qu} = 1,00
 - γ_{γ} = 1,00
 - $\gamma_{R,v}$ = 1,00
 - $\gamma_{R,h}$ = 1,00
- A2 + M2 + R1

$$\gamma_{\phi'} = 1,25$$

$$\gamma_{c'} = 1,25$$

$$\gamma_{cu} = 1,40$$

$$\gamma_{qu} = 1,40$$

$$\gamma_{\gamma} = 1,00$$

$$\gamma_{R,v} = 1,00$$

$$\gamma_{R,h} = 1,00$$

1.2.2 Soil:

Soil level:	N_1	= 0,00 (m)
Column pier level:	N_a	= 0,00 (m)
Minimum reference level:	N_i	= -0,50 (m)

Clay

- Soil level: 0.00 (m)
- Unit weight: 2243.38 (kG/m³)
- Unit weight of solid: 2753.23 (kG/m³)
- Internal friction angle: 25.0 (Deg)
- Cohesion: 0.06 (MPa)

1.2.3 Limit states

Stress calculations

Soil type under foundation: not layered

Design combination **ULS : ULS 31 N=78,84 Mx=-33,02 My=9,42 Fx=-**

7,20 Fy=-4,75

Load factors: **1.35** * Foundation weight
1.35 * Soil weight

Calculation results: On the foundation level

Weight of foundation and soil over it: Gr = 19,37 (kN)

Design load:

$$N_r = 98,21 \text{ (kN)} \quad M_x = -10,93 \text{ (kN*m)} \quad M_y = 5,82 \text{ (kN*m)}$$

Allowable stress calculation method: Semi-empirical - stress limit

Load eccentricity:

$$|e_B| = 0,06 \text{ (m)} \quad |e_L| = 0,11 \text{ (m)}$$

Equivalent foundation dimensions:

$$B' = B - 2|e_B| = 0,78 \text{ (m)}$$

$$L' = L - 2|e_L| = 1,08 \text{ (m)}$$

$$q_u = 0.30 \text{ (MPa)}$$

$$p_{le}^* = 0,32 \text{ (MPa)}$$

$$D_e = D_{min} - d = 0,50 \text{ (m)}$$

$$k_p = 0,91$$

$$q'_0 = 0,01 \text{ (MPa)}$$

$$q_u = k_p * (p_{le}^*) + q'_0 = 0,30 \text{ (MPa)}$$

$$\text{Stress in soil: } q_{ref} = 0.16 \text{ (MPa)}$$

$$\text{Safety factor: } q_{lim} / q_{ref} = 1.9 > 1$$

Uplift

Fy=-1,37	<u>Uplift in ULS</u>	
	Design combination	ULS : ULS 7 N=30,20 Mx=-13,34 My=4,31 Fx=-2,35
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Contact area:	s = 0,17 s _{lim} = 0,17

Sliding

6,49 Fy=-4,05	Design combination	ULS : ULS 29 N=59,98 Mx=-25,06 My=5,45 Fx=-
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 14,35 (kN)
	Design load:	
	Nr = 74,33 (kN)	Mx = -8,04 (kN*m) My = 2,21 (kN*m)
	Equivalent foundation dimensions:	A _u = 0,90 (m) B _u = 1,30 (m)
	Sliding area:	1,17 (m ²)
	Foundation/soil friction coefficient:	tan(δ _d) = 0,30
	Cohesion:	c _u = 0.06 (MPa)
	Soil pressure considered:	
	Hx = -6,49 (kN)	Hy = -4,05 (kN)
	Ppx = 2,71 (kN)	Ppy = 3,05 (kN)
	Pax = -1,00 (kN)	Pay = -0,50 (kN)
	Sliding force value	H _d = 5,02 (kN)
	Value of force preventing foundation sliding:	
	- On the foundation level:	R _d = 22,25 (kN)
	Stability for sliding:	4.436 > 1

Average settlement

4,63 Fy=-2,92	Soil type under foundation:	not layered
	Design combination	SLS : SLS 13 N=44,86 Mx=-18,80 My=4,45 Fx=-
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 14,35 (kN)
	Average stress caused by design load:	q = 0,05 (MPa)
	Thickness of the actively settling soil:	z = 1,80 (m)
	Stress on the level z:	
	- Additional:	σ _{zd} = 0,01 (MPa)
	- Caused by soil weight:	σ _γ = 0,05 (MPa)
	Settlement:	
	- Original	s' = 0,0 (cm)
	- Secondary	s'' = 0,0 (cm)
	- TOTAL	S = 0,0 (cm) < S _{adm} = 5,0 (cm)
	Safety factor:	135.2 > 1

Settlement difference

4,63 Fy=-2,92	Design combination	SLS : SLS 13 N=44,86 Mx=-18,80 My=4,45 Fx=-
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight

Settlement difference: $S = 0,0 \text{ (cm)} < S_{adm} = 5,0 \text{ (cm)}$
 Safety factor: $181.6 > 1$

Rotation

7,20 Fy=-4,75

About OX axis
 Design combination **ULS : ULS 31 N=78,84 Mx=-33,02 My=9,42 Fx=-**

Load factors: **1.00** * Foundation weight
1.00 * Soil weight

Weight of foundation and soil over it: $Gr = 14,35 \text{ (kN)}$
 Design load:
 $N_r = 93,19 \text{ (kN)}$ $M_x = -10,93 \text{ (kN*m)}$ $M_y = 5,82 \text{ (kN*m)}$

Stability moment: $M_{stab} = 82,66 \text{ (kN*m)}$
 Rotation moment: $M_{renv} = 33,02 \text{ (kN*m)}$
 Stability for rotation: $2.504 > 1$

7,20 Fy=-4,75

About OY axis
 Design combination **ULS : ULS 31 N=78,84 Mx=-33,02 My=9,42 Fx=-**

Load factors: **1.00** * Foundation weight
1.00 * Soil weight

Weight of foundation and soil over it: $Gr = 14,35 \text{ (kN)}$
 Design load:
 $N_r = 93,19 \text{ (kN)}$ $M_x = -10,93 \text{ (kN*m)}$ $M_y = 5,82 \text{ (kN*m)}$

Stability moment: $M_{stab} = 45,53 \text{ (kN*m)}$
 Rotation moment: $M_{renv} = 9,42 \text{ (kN*m)}$
 Stability for rotation: $4.832 > 1$

1.3 RC design

1.3.1 Assumptions

- Exposure : XC2
- Structure class : S1

1.3.2 Analysis of punching and shear

Punching

4,75

Design combination **ULS : ULS 31 N=78,84 Mx=-33,02 My=9,42 Fx=-7,20 Fy=-**

Load factors: **1.35** * Foundation weight
1.35 * Soil weight

Design load:
 $N_r = 98,21 \text{ (kN)}$ $M_x = -10,93 \text{ (kN*m)}$ $M_y = 5,82 \text{ (kN*m)}$

Length of critical circumference: $1,44 \text{ (m)}$
 Punching force: $59,66 \text{ (kN)}$
 Section effective height $h_{eff} = 0,43 \text{ (m)}$
 Reinforcement ratio: $\rho = 0.14 \%$
 Shear stress: $0,17 \text{ (MPa)}$
 Admissible shear stress: $1,91 \text{ (MPa)}$
 Safety factor: $11.56 > 1$

1.3.3 Required reinforcement

Spread footing:

bottom:

ULS : ULS 31 N=78,84 Mx=-33,02 My=9,42 Fx=-7,20 Fy=-4,75

My = 5,58 (kN*m) $A_{sx} = 5,81 \text{ (cm}^2\text{/m)}$

ULS : ULS 31 N=78,84 Mx=-33,02 My=9,42 Fx=-7,20 Fy=-4,75

Mx = 23,73 (kN*m) $A_{sy} = 5,81 \text{ (cm}^2\text{/m)}$ $A_{s \text{ min}} = 5,81 \text{ (cm}^2\text{/m)}$

top:

 $A'_{sx} = 0,00 \text{ (cm}^2\text{/m)}$ $A'_{sy} = 0,00 \text{ (cm}^2\text{/m)}$ $A_{s \text{ min}} = 0,00 \text{ (cm}^2\text{/m)}$ **Column pier:**Longitudinal reinforcement $A = 0,00 \text{ (cm}^2)$ $A_{\text{min.}} = 0,00 \text{ (cm}^2)$ $A = 2 * (Asx + Asy)$ $Asx = 0,00 \text{ (cm}^2)$ $Asy = 0,00 \text{ (cm}^2)$ **1.3.4 Provided reinforcement****Spread footing:****Bottom:**

Along X axis:

7 B500C 12 $l = 0,92 \text{ (m)}$ $e = 1*0,53 + 6*0,18$

Along Y axis:

5 B500C 12 $l = 1,32 \text{ (m)}$ $e = 1*0,33 + 4*0,17$

Pier

Longitudinal reinforcement

Along X axis:

2 B500C 12 $l = 2,09 \text{ (m)}$ $e = 1*0,29 + 1*0,58$

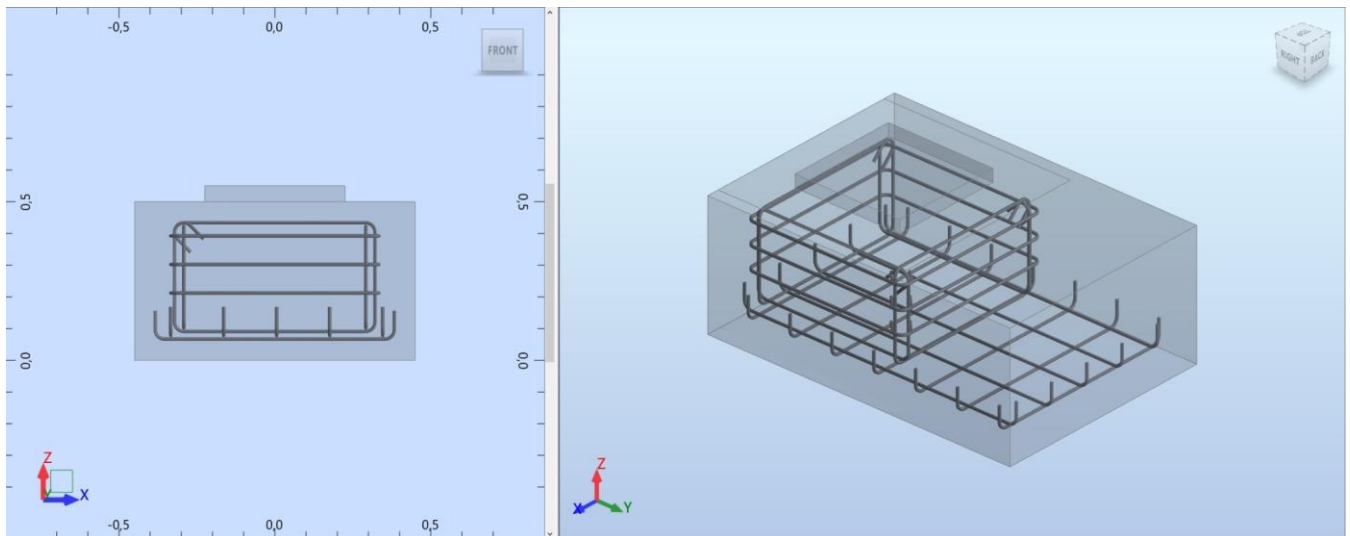
Along Y axis:

2 B500C 12 $l = 2,14 \text{ (m)}$ $e = 1*0,54 + 1*0,58$ **Transversal reinforcement**3 B500C 12 $l = 2,83 \text{ (m)}$ $e = 1*0,21 + 2*0,09$ **2 Material survey:**

- Concrete volume = 0,59 (m3)
- Formwork = 2,20 (m2)
- Steel B500C
 - Total weight = 26,67 (kG)
 - Density = 45,59 (kG/m3)

- Average diameter = 12,0 (mm)
- Survey according to diameters:

Diameter	Length (m)	Number of identical elements:
12	0,92	7
12	1,32	5
12	2,09	2
12	2,14	2
12	2,83	3



Spread footing: Number of identical

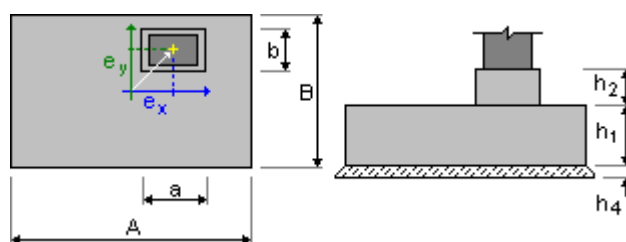
ΠΕΔΙΟ 1Α elements: 1

1.1 Basic data

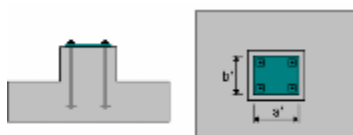
1.1.1 Assumptions

- Geotechnic calculations according to : EN 1997-1:2004/A1:2013
- Concrete calculations according to : EN 1992-1-1:2004/A1:2014
- Shape selection : without limits

1.1.2 Geometry:



A	= 0,90 (m)	a	= 0,80 (m)
B	= 1,30 (m)	b	= 0,80 (m)
h1	= 0,50 (m)	ex	= 0,00 (m)
h2	= 0,00 (m)	ey	= -0,25 (m)
h4	= 0,05 (m)		



a'	= 45,0 (cm)
b'	= 45,0 (cm)
Cnom1	= 6,0 (cm)
Cnom2	= 6,0 (cm)
Cover deviations: Cdev = 1,0(cm), Cdur = 0,0(cm)	

1.1.3 Materials

- Concrete : C25/30; Characteristic strength = 25,00 MPa
Unit weight = 2501,36 (kG/m3)
Rectangular stress distribution [3.1.7(3)]
- Longitudinal reinforcement : type B500C Characteristic strength =
500,00 MPa
Ductility class: C
Horizontal branch of the stress-strain diagram
- Transversal reinforcement : type B500C Characteristic strength =
500,00 MPa
- Additional reinforcement: : type B500C Characteristic strength =
500,00 MPa

1.1.4 Loads:

Foundation loads:

Case	Nature	Group	N (kN)	Fx (kN)	Fy (kN)	Mx (kN*m)	My (kN*m)		
ULS 1	design(Structural)	----	32,38	3,03	-1,77	-14,09	-3,74		
ULS 2	design(Structural)	----	35,11	3,89	-2,27	-15,03	-3,04		
ULS 3	design(Structural)	----	32,38	3,03	-1,77	-14,09	-3,74		
ULS 4	design(Structural)	----	35,11	3,89	-2,27	-15,03	-3,04		
ULS 5	design(Structural)	----	35,11	3,89	-2,27	-15,03	-3,04		
ULS 6	design(Structural)	----	35,11	3,89	-2,27	-15,03	-3,04		
ULS 7	design(Structural)	----	30,20	2,35	-1,37	-13,34	-4,31		
ULS 8	design(Structural)	----	30,20	2,35	-1,37	-13,34	-4,31		
ULS 9	design(Structural)	----	30,20	2,35	-1,37	-13,34	-4,31		
ULS 10	design(Structural)	----	32,92	3,21	-1,87	-14,28	-3,60		
ULS 11	design(Structural)	----	32,92	3,21	-1,87	-14,28	-3,60		
ULS 12	design(Structural)	----	32,92	3,21	-1,87	-14,28	-3,60		
ULS 13	design(Structural)	----	30,20	2,35	-1,37	-13,34	-4,31		
ULS 14	design(Structural)	----	35,65	4,07	-2,37	-15,22	-2,90		
ULS 15	design(Structural)	----	35,65	4,07	-2,37	-15,22	-2,90		
ULS 16	design(Structural)	----	35,65	4,07	-2,37	-15,22	-2,90		
ULS 17	design(Structural)	----	35,65	4,07	-2,37	-15,22	-2,90		
SEISM 1	design	----	28,01	1,66	-0,98	-12,58	-4,87		
SEISM 2	design	----	28,01	1,66	-0,98	-12,58	-4,87		
SEISM 3	design	----	28,01	1,66	-0,98	-12,58	-4,87		
SEISM 4	design	----	28,01	1,66	-0,98	-12,58	-4,87		
SEISM 5	design	----	28,01	1,66	-0,98	-12,58	-4,87		
SEISM 6	design	----	28,01	1,66	-0,98	-12,58	-4,87		
SEISM 7	design	----	28,01	1,66	-0,98	-12,58	-4,87		
SEISM 8	design	----	28,01	1,66	-0,98	-12,58	-4,87		
SEISM 9	design	----	21,03	1,32	-0,78	-9,42	-3,53		
SLS 1	design(Non-structural)	----	26,13	2,92	-1,70	-11,18	-2,22		
SLS 2	design(Non-structural)	----	26,13	2,92	-1,70	-11,18	-2,22		
SLS 3	design(Non-structural)	----	26,13	2,92	-1,70	-11,18	-2,22		
SLS 4	design(Non-structural)	----	25,40	2,69	-1,57	-10,93	-2,41		
SLS 5	design(Non-structural)	----	25,40	2,69	-1,57	-10,93	-2,41		
SLS 6	design(Non-structural)	----	25,40	2,69	-1,57	-10,93	-2,41		
SLS 7	design(Non-structural)	----	25,40	2,69	-1,57	-10,93	-2,41		
TEMP NEGATIVE	design(Structural)	----	----	----	-0,07	-0,26	0,64	-1,29	-0,44
ULS 18	design(Structural)	----	32,43	3,23	-2,25	-13,12	-3,41		
ULS 19	design(Structural)	----	32,38	3,03	-1,77	-14,09	-3,74		
ULS 20	design(Structural)	----	32,43	3,23	-2,25	-13,12	-3,41		
ULS 21	design(Structural)	----	32,38	3,03	-1,77	-14,09	-3,74		
ULS 22	design(Structural)	----	32,43	3,23	-2,25	-13,12	-3,41		
ULS 23	design(Structural)	----	32,38	3,03	-1,77	-14,09	-3,74		
ULS 24	design(Structural)	----	32,43	3,23	-2,25	-13,12	-3,41		
ULS 25	design(Structural)	----	56,70	5,46	-3,46	-23,93	-6,30		
ULS 26	design(Structural)	----	32,43	3,23	-2,25	-13,12	-3,41		
ULS 27	design(Structural)	----	56,70	5,46	-3,46	-23,93	-6,30		
ULS 28	design(Structural)	----	35,71	4,26	-2,85	-14,25	-2,56		
ULS 29	design(Structural)	----	59,98	6,49	-4,05	-25,06	-5,45		
ULS 30	design(Structural)	----	30,30	2,74	-2,34	-11,40	-3,64		
ULS 31	design(Structural)	----	78,84	7,20	-4,75	-33,02	-9,42		
ULS 32	design(Structural)	----	32,38	3,03	-1,77	-14,09	-3,74		
ULS 33	design(Structural)	----	35,11	3,89	-2,27	-15,03	-3,04		
ULS 34	design(Structural)	----	30,20	2,35	-1,37	-13,34	-4,31		
ULS 35	design(Structural)	----	32,92	3,21	-1,87	-14,28	-3,60		
ULS 36	design(Structural)	----	30,20	2,35	-1,37	-13,34	-4,31		
ULS 37	design(Structural)	----	35,65	4,07	-2,37	-15,22	-2,90		
SLS 8	design(Non-structural)	----	26,13	2,92	-1,70	-11,18	-2,22		
SLS 9	design(Non-structural)	----	25,40	2,69	-1,57	-10,93	-2,41		
SLS 10	design(Non-structural)	----	26,17	3,08	-2,09	-10,40	-1,95		
SLS 11	design(Non-structural)	----	44,86	4,63	-2,92	-18,80	-4,45		
SLS 12	design(Non-structural)	----	26,17	3,08	-2,09	-10,40	-1,95		
SLS 13	design(Non-structural)	----	44,86	4,63	-2,92	-18,80	-4,45		

Backfill loads:

Case	Nature	Q1 (kN/m2)
------	--------	---------------

1.1.5 Combination list

- 1/ ULS : ULS 1 N=32,38 Mx=-14,09 My=-3,74 Fx=3,03 Fy=-1,77
2/ ULS : ULS 2 N=35,11 Mx=-15,03 My=-3,04 Fx=3,89 Fy=-2,27

3/ ULS : ULS 3 N=32,38 Mx=-14,09 My=-3,74 Fx=3,03 Fy=-1,77
4/ ULS : ULS 4 N=35,11 Mx=-15,03 My=-3,04 Fx=3,89 Fy=-2,27
5/ ULS : ULS 5 N=35,11 Mx=-15,03 My=-3,04 Fx=3,89 Fy=-2,27
6/ ULS : ULS 6 N=35,11 Mx=-15,03 My=-3,04 Fx=3,89 Fy=-2,27
7/ ULS : ULS 7 N=30,20 Mx=-13,34 My=-4,31 Fx=2,35 Fy=-1,37
8/ ULS : ULS 8 N=30,20 Mx=-13,34 My=-4,31 Fx=2,35 Fy=-1,37
9/ ULS : ULS 9 N=30,20 Mx=-13,34 My=-4,31 Fx=2,35 Fy=-1,37
10/ ULS : ULS 10 N=32,92 Mx=-14,28 My=-3,60 Fx=3,21 Fy=-1,87
11/ ULS : ULS 11 N=32,92 Mx=-14,28 My=-3,60 Fx=3,21 Fy=-1,87
12/ ULS : ULS 12 N=32,92 Mx=-14,28 My=-3,60 Fx=3,21 Fy=-1,87
13/ ULS : ULS 13 N=30,20 Mx=-13,34 My=-4,31 Fx=2,35 Fy=-1,37
14/ ULS : ULS 14 N=35,65 Mx=-15,22 My=-2,90 Fx=4,07 Fy=-2,37
15/ ULS : ULS 15 N=35,65 Mx=-15,22 My=-2,90 Fx=4,07 Fy=-2,37
16/ ULS : ULS 16 N=35,65 Mx=-15,22 My=-2,90 Fx=4,07 Fy=-2,37
17/ ULS : ULS 17 N=35,65 Mx=-15,22 My=-2,90 Fx=4,07 Fy=-2,37
18/ ULS : TEMP NEGATIVE N=-0,07 Mx=-1,29 My=-0,44 Fx=-0,26 Fy=0,64
19/ ULS : ULS 18 N=32,43 Mx=-13,12 My=-3,41 Fx=3,23 Fy=-2,25
20/ ULS : ULS 19 N=32,38 Mx=-14,09 My=-3,74 Fx=3,03 Fy=-1,77
21/ ULS : ULS 20 N=32,43 Mx=-13,12 My=-3,41 Fx=3,23 Fy=-2,25
22/ ULS : ULS 21 N=32,38 Mx=-14,09 My=-3,74 Fx=3,03 Fy=-1,77
23/ ULS : ULS 22 N=32,43 Mx=-13,12 My=-3,41 Fx=3,23 Fy=-2,25
24/ ULS : ULS 23 N=32,38 Mx=-14,09 My=-3,74 Fx=3,03 Fy=-1,77
25/ ULS : ULS 24 N=32,43 Mx=-13,12 My=-3,41 Fx=3,23 Fy=-2,25
26/ ULS : ULS 25 N=56,70 Mx=-23,93 My=-6,30 Fx=5,46 Fy=-3,46
27/ ULS : ULS 26 N=32,43 Mx=-13,12 My=-3,41 Fx=3,23 Fy=-2,25
28/ ULS : ULS 27 N=56,70 Mx=-23,93 My=-6,30 Fx=5,46 Fy=-3,46
29/ ULS : ULS 28 N=35,71 Mx=-14,25 My=-2,56 Fx=4,26 Fy=-2,85
30/ ULS : ULS 29 N=59,98 Mx=-25,06 My=-5,45 Fx=6,49 Fy=-4,05
31/ ULS : ULS 30 N=30,30 Mx=-11,40 My=-3,64 Fx=2,74 Fy=-2,34
32/ ULS : ULS 31 N=78,84 Mx=-33,02 My=-9,42 Fx=7,20 Fy=-4,75
33/ ULS : ULS 32 N=32,38 Mx=-14,09 My=-3,74 Fx=3,03 Fy=-1,77
34/ ULS : ULS 33 N=35,11 Mx=-15,03 My=-3,04 Fx=3,89 Fy=-2,27
35/ ULS : ULS 34 N=30,20 Mx=-13,34 My=-4,31 Fx=2,35 Fy=-1,37
36/ ULS : ULS 35 N=32,92 Mx=-14,28 My=-3,60 Fx=3,21 Fy=-1,87
37/ ULS : ULS 36 N=30,20 Mx=-13,34 My=-4,31 Fx=2,35 Fy=-1,37
38/ ULS : ULS 37 N=35,65 Mx=-15,22 My=-2,90 Fx=4,07 Fy=-2,37
39/ SLS : SLS 1 N=26,13 Mx=-11,18 My=-2,22 Fx=2,92 Fy=-1,70
40/ SLS : SLS 2 N=26,13 Mx=-11,18 My=-2,22 Fx=2,92 Fy=-1,70
41/ SLS : SLS 3 N=26,13 Mx=-11,18 My=-2,22 Fx=2,92 Fy=-1,70
42/ SLS : SLS 4 N=25,40 Mx=-10,93 My=-2,41 Fx=2,69 Fy=-1,57
43/ SLS : SLS 5 N=25,40 Mx=-10,93 My=-2,41 Fx=2,69 Fy=-1,57
44/ SLS : SLS 6 N=25,40 Mx=-10,93 My=-2,41 Fx=2,69 Fy=-1,57
45/ SLS : SLS 7 N=25,40 Mx=-10,93 My=-2,41 Fx=2,69 Fy=-1,57
46/ SLS : SLS 8 N=26,13 Mx=-11,18 My=-2,22 Fx=2,92 Fy=-1,70
47/ SLS : SLS 9 N=25,40 Mx=-10,93 My=-2,41 Fx=2,69 Fy=-1,57
48/ SLS : SLS 10 N=26,17 Mx=-10,40 My=-1,95 Fx=3,08 Fy=-2,09
49/ SLS : SLS 11 N=44,86 Mx=-18,80 My=-4,45 Fx=4,63 Fy=-2,92
50/ SLS : SLS 12 N=26,17 Mx=-10,40 My=-1,95 Fx=3,08 Fy=-2,09
51/ SLS : SLS 13 N=44,86 Mx=-18,80 My=-4,45 Fx=4,63 Fy=-2,92
52/ ALS : SEISM 1 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
53/ ALS : SEISM 2 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
54/ ALS : SEISM 3 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
55/ ALS : SEISM 4 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
56/ ALS : SEISM 5 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
57/ ALS : SEISM 6 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
58/ ALS : SEISM 7 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
59/ ALS : SEISM 8 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
60/ ALS : SEISM 9 N=21,03 Mx=-9,42 My=-3,53 Fx=1,32 Fy=-0,78
61/* ULS : ULS 1 N=32,38 Mx=-14,09 My=-3,74 Fx=3,03 Fy=-1,77
62/* ULS : ULS 2 N=35,11 Mx=-15,03 My=-3,04 Fx=3,89 Fy=-2,27
63/* ULS : ULS 3 N=32,38 Mx=-14,09 My=-3,74 Fx=3,03 Fy=-1,77
64/* ULS : ULS 4 N=35,11 Mx=-15,03 My=-3,04 Fx=3,89 Fy=-2,27
65/* ULS : ULS 5 N=35,11 Mx=-15,03 My=-3,04 Fx=3,89 Fy=-2,27
66/* ULS : ULS 6 N=35,11 Mx=-15,03 My=-3,04 Fx=3,89 Fy=-2,27
67/* ULS : ULS 7 N=30,20 Mx=-13,34 My=-4,31 Fx=2,35 Fy=-1,37
68/* ULS : ULS 8 N=30,20 Mx=-13,34 My=-4,31 Fx=2,35 Fy=-1,37
69/* ULS : ULS 9 N=30,20 Mx=-13,34 My=-4,31 Fx=2,35 Fy=-1,37
70/* ULS : ULS 10 N=32,92 Mx=-14,28 My=-3,60 Fx=3,21 Fy=-1,87
71/* ULS : ULS 11 N=32,92 Mx=-14,28 My=-3,60 Fx=3,21 Fy=-1,87
72/* ULS : ULS 12 N=32,92 Mx=-14,28 My=-3,60 Fx=3,21 Fy=-1,87
73/* ULS : ULS 13 N=30,20 Mx=-13,34 My=-4,31 Fx=2,35 Fy=-1,37
74/* ULS : ULS 14 N=35,65 Mx=-15,22 My=-2,90 Fx=4,07 Fy=-2,37
75/* ULS : ULS 15 N=35,65 Mx=-15,22 My=-2,90 Fx=4,07 Fy=-2,37
76/* ULS : ULS 16 N=35,65 Mx=-15,22 My=-2,90 Fx=4,07 Fy=-2,37

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77/* ULS : ULS 17 N=35,65 Mx=-15,22 My=-2,90 Fx=4,07 Fy=-2,37
78/* ULS : TEMP NEGATIVE N=-0,07 Mx=-1,29 My=-0,44 Fx=-0,26 Fy=0,64
79/* ULS : ULS 18 N=32,43 Mx=-13,12 My=-3,41 Fx=3,23 Fy=-2,25
80/* ULS : ULS 19 N=32,38 Mx=-14,09 My=-3,74 Fx=3,03 Fy=-1,77
81/* ULS : ULS 20 N=32,43 Mx=-13,12 My=-3,41 Fx=3,23 Fy=-2,25
82/* ULS : ULS 21 N=32,38 Mx=-14,09 My=-3,74 Fx=3,03 Fy=-1,77
83/* ULS : ULS 22 N=32,43 Mx=-13,12 My=-3,41 Fx=3,23 Fy=-2,25
84/* ULS : ULS 23 N=32,38 Mx=-14,09 My=-3,74 Fx=3,03 Fy=-1,77
85/* ULS : ULS 24 N=32,43 Mx=-13,12 My=-3,41 Fx=3,23 Fy=-2,25
86/* ULS : ULS 25 N=56,70 Mx=-23,93 My=-6,30 Fx=5,46 Fy=-3,46
87/* ULS : ULS 26 N=32,43 Mx=-13,12 My=-3,41 Fx=3,23 Fy=-2,25
88/* ULS : ULS 27 N=56,70 Mx=-23,93 My=-6,30 Fx=5,46 Fy=-3,46
89/* ULS : ULS 28 N=35,71 Mx=-14,25 My=-2,56 Fx=4,26 Fy=-2,85
90/* ULS : ULS 29 N=59,98 Mx=-25,06 My=-5,45 Fx=6,49 Fy=-4,05
91/* ULS : ULS 30 N=30,30 Mx=-11,40 My=-3,64 Fx=2,74 Fy=-2,34
92/* ULS : ULS 31 N=78,84 Mx=-33,02 My=-9,42 Fx=7,20 Fy=-4,75
93/* ULS : ULS 32 N=32,38 Mx=-14,09 My=-3,74 Fx=3,03 Fy=-1,77
94/* ULS : ULS 33 N=35,11 Mx=-15,03 My=-3,04 Fx=3,89 Fy=-2,27
95/* ULS : ULS 34 N=30,20 Mx=-13,34 My=-4,31 Fx=2,35 Fy=-1,37
96/* ULS : ULS 35 N=32,92 Mx=-14,28 My=-3,60 Fx=3,21 Fy=-1,87
97/* ULS : ULS 36 N=30,20 Mx=-13,34 My=-4,31 Fx=2,35 Fy=-1,37
98/* ULS : ULS 37 N=35,65 Mx=-15,22 My=-2,90 Fx=4,07 Fy=-2,37
99/* SLS : SLS 1 N=26,13 Mx=-11,18 My=-2,22 Fx=2,92 Fy=-1,70
100/* SLS : SLS 2 N=26,13 Mx=-11,18 My=-2,22 Fx=2,92 Fy=-1,70
101/* SLS : SLS 3 N=26,13 Mx=-11,18 My=-2,22 Fx=2,92 Fy=-1,70
102/* SLS : SLS 4 N=25,40 Mx=-10,93 My=-2,41 Fx=2,69 Fy=-1,57
103/* SLS : SLS 5 N=25,40 Mx=-10,93 My=-2,41 Fx=2,69 Fy=-1,57
104/* SLS : SLS 6 N=25,40 Mx=-10,93 My=-2,41 Fx=2,69 Fy=-1,57
105/* SLS : SLS 7 N=25,40 Mx=-10,93 My=-2,41 Fx=2,69 Fy=-1,57
106/* SLS : SLS 8 N=26,13 Mx=-11,18 My=-2,22 Fx=2,92 Fy=-1,70
107/* SLS : SLS 9 N=25,40 Mx=-10,93 My=-2,41 Fx=2,69 Fy=-1,57
108/* SLS : SLS 10 N=26,17 Mx=-10,40 My=-1,95 Fx=3,08 Fy=-2,09
109/* SLS : SLS 11 N=44,86 Mx=-18,80 My=-4,45 Fx=4,63 Fy=-2,92
110/* SLS : SLS 12 N=26,17 Mx=-10,40 My=-1,95 Fx=3,08 Fy=-2,09
111/* SLS : SLS 13 N=44,86 Mx=-18,80 My=-4,45 Fx=4,63 Fy=-2,92
112/* ALS : SEISM 1 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
113/* ALS : SEISM 2 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
114/* ALS : SEISM 3 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
115/* ALS : SEISM 4 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
116/* ALS : SEISM 5 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
117/* ALS : SEISM 6 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
118/* ALS : SEISM 7 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
119/* ALS : SEISM 8 N=28,01 Mx=-12,58 My=-4,87 Fx=1,66 Fy=-0,98
120/* ALS : SEISM 9 N=21,03 Mx=-9,42 My=-3,53 Fx=1,32 Fy=-0,78

```

1.2 Geotechnical design

1.2.1 Assumptions

- Cohesion reduction coefficient: 0,00
- Smooth precast foundation 6.5.3(10)
- Sliding with soil pressure considered: for X and Y directions
- Design approach: 1
A1 + M1 + R1
 - $\gamma_{\phi'}$ = 1,00
 - $\gamma_{c'}$ = 1,00
 - γ_{cu} = 1,00
 - γ_{qu} = 1,00
 - γ_{γ} = 1,00
 - $\gamma_{R,v}$ = 1,00
 - $\gamma_{R,h}$ = 1,00
- A2 + M2 + R1
 - $\gamma_{\phi'}$ = 1,25

$$\gamma_{c'} = 1,25$$

$$\gamma_{cu} = 1,40$$

$$\gamma_{qu} = 1,40$$

$$\gamma_{\gamma} = 1,00$$

$$\gamma_{R,v} = 1,00$$

$$\gamma_{R,h} = 1,00$$

1.2.2 Soil:

Soil level:	N_1	= 0,00 (m)
Column pier level:	N_a	= 0,00 (m)
Minimum reference level:	N_f	= -0,50 (m)

Clay

- Soil level: 0.00 (m)
- Unit weight: 2243.38 (kG/m³)
- Unit weight of solid: 2753.23 (kG/m³)
- Internal friction angle: 25.0 (Deg)
- Cohesion: 0.06 (MPa)

1.2.3 Limit states

Stress calculations

$$F_x=7,20 \quad F_y=-4,75$$

Soil type under foundation: not layered

Design combination **ULS : ULS 31 N=78,84 Mx=-33,02 My=-9,42**

Load factors: **1.35** * Foundation weight

1.35 * Soil weight

Calculation results: On the foundation level

Weight of foundation and soil over it: Gr = 19,37 (kN)

Design load:

$$N_r = 98,21 \text{ (kN)} \quad M_x = -10,93 \text{ (kN*m)} \quad M_y = -5,82 \text{ (kN*m)}$$

Allowable stress calculation method: Semi-empirical - stress limit

Load eccentricity:

$$|e_B| = 0,06 \text{ (m)} \quad |e_L| = 0,11 \text{ (m)}$$

Equivalent foundation dimensions:

$$B' = B - 2|e_B| = 0,78 \text{ (m)}$$

$$L' = L - 2|e_L| = 1,08 \text{ (m)}$$

$$q_u = 0.30 \text{ (MPa)}$$

$$p_{le}^* = 0,32 \text{ (MPa)}$$

$$D_e = D_{min} - d = 0,50 \text{ (m)}$$

$$k_p = 0,91$$

$$q'_0 = 0,01 \text{ (MPa)}$$

$$q_u = k_p * (p_{le}^*) + q'_0 = 0,30 \text{ (MPa)}$$

Stress in soil: $q_{ref} = 0.16 \text{ (MPa)}$

Safety factor: $q_{lim} / q_{ref} = 1.9 > 1$

Uplift

Fy=-1,37	<u>Uplift in ULS</u>	
	Design combination	ULS : ULS 7 N=30,20 Mx=-13,34 My=-4,31 Fx=2,35
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Contact area:	s = 0,17 s _{lim} = 0,17

Sliding

Fx=6,49 Fy=-4,05	Design combination	ULS : ULS 29 N=59,98 Mx=-25,06 My=-5,45
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 14,35 (kN)
	Design load:	
	Nr = 74,33 (kN)	Mx = -8,04 (kN*m) My = -2,21 (kN*m)
	Equivalent foundation dimensions:	A _u = 0,90 (m) B _u = 1,30 (m)
	Sliding area:	1,17 (m ²)
	Foundation/soil friction coefficient:	tan(δ _d) = 0,30
	Cohesion:	c _u = 0.06 (MPa)
	Soil pressure considered:	
	Hx = 6,49 (kN)	Hy = -4,05 (kN)
	Ppx = -2,71 (kN)	Ppy = 3,05 (kN)
	Pax = 1,00 (kN)	Pay = -0,50 (kN)
	Sliding force value	H _d = 5,02 (kN)

Value of force preventing foundation sliding:
 - On the foundation level: R_d = 22,25 (kN)
 Stability for sliding: 4.436 > 1

Average settlement

Fx=4,63 Fy=-2,92	Soil type under foundation:	not layered
	Design combination	SLS : SLS 13 N=44,86 Mx=-18,80 My=-4,45
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 14,35 (kN)
	Average stress caused by design load:	q = 0,05 (MPa)
	Thickness of the actively settling soil:	z = 1,80 (m)
	Stress on the level z:	
	- Additional:	σ _{zd} = 0,01 (MPa)
	- Caused by soil weight:	σ _γ = 0,05 (MPa)
	Settlement:	
	- Original	s' = 0,0 (cm)
	- Secondary	s'' = 0,0 (cm)
	- TOTAL	S = 0,0 (cm) < S _{adm} = 5,0 (cm)
	Safety factor:	135.2 > 1

Settlement difference

Fx=4,63 Fy=-2,92	Design combination	SLS : SLS 13 N=44,86 Mx=-18,80 My=-4,45
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Settlement difference:	S = 0,0 (cm) < S _{adm} = 5,0 (cm)

Safety factor: 181.6 > 1

Rotation

Fx=7,20 Fy=-4,75

About OX axis
 Design combination: **ULS : ULS 31 N=78,84 Mx=-33,02 My=-9,42**

Load factors: **1.00** * Foundation weight
1.00 * Soil weight

Weight of foundation and soil over it: Gr = 14,35 (kN)

Design load:
 Nr = 93,19 (kN) Mx = -10,93 (kN*m) My = -5,82 (kN*m)

Stability moment: Mstab = 82,66 (kN*m)

Rotation moment: Mrenv = 33,02 (kN*m)

Stability for rotation: 2.504 > 1

Fx=7,20 Fy=-4,75

About OY axis
 Design combination: **ULS : ULS 31 N=78,84 Mx=-33,02 My=-9,42**

Load factors: **1.00** * Foundation weight
1.00 * Soil weight

Weight of foundation and soil over it: Gr = 14,35 (kN)

Design load:
 Nr = 93,19 (kN) Mx = -10,93 (kN*m) My = -5,82 (kN*m)

Stability moment: Mstab = 45,53 (kN*m)

Rotation moment: Mrenv = 9,42 (kN*m)

Stability for rotation: 4.832 > 1

1.3 RC design

1.3.1 Assumptions

- Exposure : XC2
- Structure class : S1

1.3.2 Analysis of punching and shear

Punching

4,75

Design combination: **ULS : ULS 31 N=78,84 Mx=-33,02 My=-9,42 Fx=7,20 Fy=-**

Load factors: **1.35** * Foundation weight
1.35 * Soil weight

Design load:
 Nr = 98,21 (kN) Mx = -10,93 (kN*m) My = -5,82 (kN*m)

Length of critical circumference: 1,44 (m)

Punching force: 59,66 (kN)

Section effective height heff = 0,43 (m)

Reinforcement ratio: $\rho = 0.14 \%$

Shear stress: 0,17 (MPa)

Admissible shear stress: 1,91 (MPa)

Safety factor: 11.56 > 1

1.3.3 Required reinforcement

Spread footing:

bottom:

ULS : ULS 31 N=78,84 Mx=-33,02 My=-9,42 Fx=7,20 Fy=-4,75
 My = 5,58 (kN*m) $A_{sx} = 5,81 \text{ (cm}^2\text{/m)}$

ULS : ULS 31 N=78,84 Mx=-33,02 My=-9,42 Fx=7,20 Fy=-4,75
 Mx = 23,73 (kN*m) $A_{sy} = 5,81 \text{ (cm}^2\text{/m)}$

$A_{s \text{ min}} = 5,81 \text{ (cm}^2\text{/m)}$

top:

$A'_{sx} = 0,00 \text{ (cm}^2\text{/m)}$

$A'_{sy} = 0,00 \text{ (cm}^2\text{/m)}$

$A_{s \text{ min}} = 0,00 \text{ (cm}^2\text{/m)}$

Column pier:

Longitudinal reinforcement $A = 0,00 \text{ (cm}^2)$ $A_{\text{min.}} = 0,00 \text{ (cm}^2)$
 $A = 2 * (Asx + Asy)$
 $Asx = 0,00 \text{ (cm}^2)$ $Asy = 0,00 \text{ (cm}^2)$

1.3.4 Provided reinforcement

Spread footing:

Bottom:

Along X axis:

7 B500C 12 $l = 0,92 \text{ (m)}$ $e = 1 * -0,53 + 6 * 0,18$

Along Y axis:

5 B500C 12 $l = 1,32 \text{ (m)}$ $e = 1 * -0,33 + 4 * 0,17$

Pier

Longitudinal reinforcement

Along X axis:

2 B500C 12 $l = 2,09 \text{ (m)}$ $e = 1 * -0,29 + 1 * 0,58$

Along Y axis:

2 B500C 12 $l = 2,14 \text{ (m)}$ $e = 1 * -0,54 + 1 * 0,58$

Transversal reinforcement

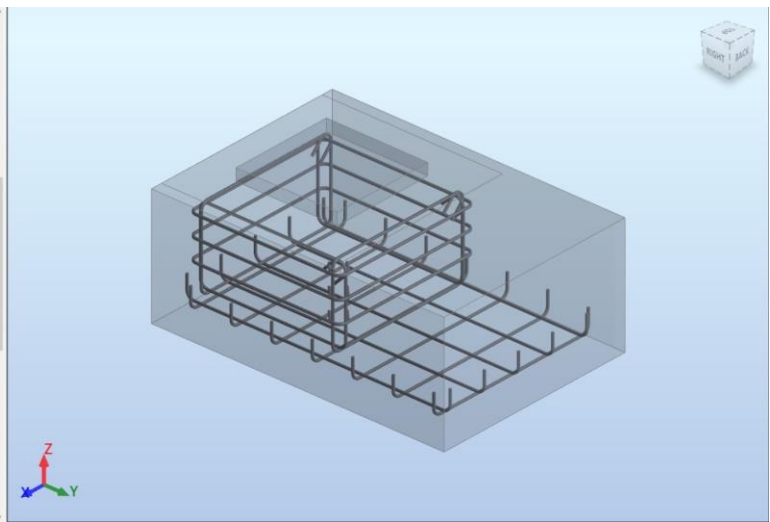
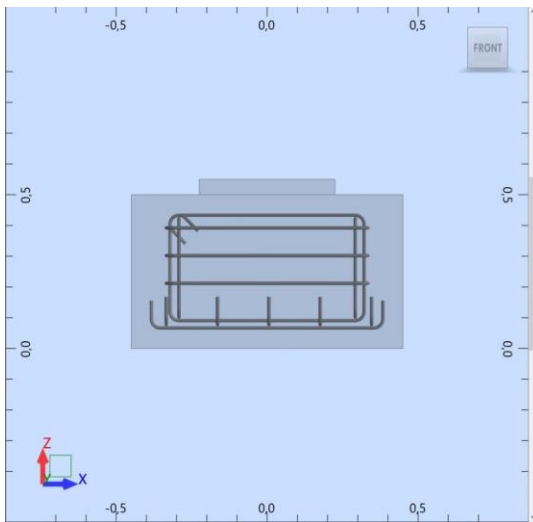
3 B500C 12 $l = 2,83 \text{ (m)}$ $e = 1 * 0,21 + 2 * 0,09$

2 Material survey:

- Concrete volume = 0,59 (m3)
- Formwork = 2,20 (m2)
- Steel B500C
 - Total weight = 26,67 (kG)
 - Density = 45,59 (kG/m3)
 - Average diameter = 12,0 (mm)

- Survey according to diameters:

Diameter	Length (m)	Number of identical elements:
12	0,92	7
12	1,32	5
12	2,09	2
12	2,14	2
12	2,83	3



1 ΠΕΔΙΟ 3Γ elements: 1

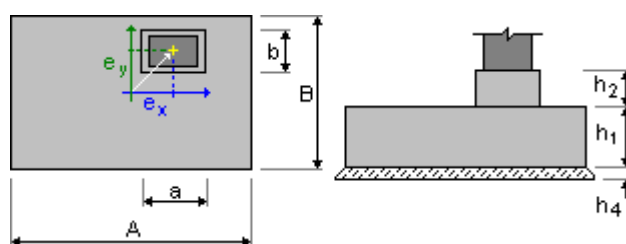
Number of identical

1.1 Basic data

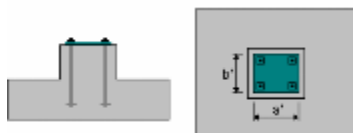
1.1.1 Assumptions

- Geotechnic calculations according to : EN 1997-1:2004/A1:2013
- Concrete calculations according to : EN 1992-1-1:2004/A1:2014
- Shape selection : without limits

1.1.2 Geometry:



A	= 0,90 (m)	a	= 0,80 (m)
B	= 0,90 (m)	b	= 0,80 (m)
h1	= 0,50 (m)	ex	= 0,00 (m)
h2	= 0,00 (m)	ey	= 0,00 (m)
h4	= 0,05 (m)		



a'	= 45,0 (cm)
b'	= 45,0 (cm)
Cnom1	= 6,0 (cm)
Cnom2	= 6,0 (cm)
Cover deviations: Cdev = 1,0(cm), Cdur = 0,0(cm)	

1.1.3 Materials

- Concrete : C25/30; Characteristic strength = 25,00 MPa
Unit weight = 2501,36 (kG/m3)
Rectangular stress distribution [3.1.7(3)]
- Longitudinal reinforcement : type B500C Characteristic strength = 500,00 MPa
Ductility class: C
Horizontal branch of the stress-strain diagram
- Transversal reinforcement : type B500C Characteristic strength = 500,00 MPa
- Additional reinforcement: : type B500C Characteristic strength = 500,00 MPa

1.1.4 Loads:

Foundation loads:

Case	Nature	Group	N (kN)	Fx (kN)	Fy (kN)	Mx (kN*m)	My (kN*m)		
ULS 1	design(Structural)	----	38,46	-0,18	0,00	-0,41	5,80		
ULS 2	design(Structural)	----	42,09	-0,23	0,00	-0,54	5,67		
ULS 3	design(Structural)	----	38,46	-0,18	0,00	-0,41	5,80		
ULS 4	design(Structural)	----	42,09	-0,23	0,00	-0,54	5,67		
ULS 5	design(Structural)	----	42,09	-0,23	0,00	-0,54	5,67		
ULS 6	design(Structural)	----	42,09	-0,23	0,00	-0,54	5,67		
ULS 7	design(Structural)	----	35,56	-0,13	0,00	-0,30	5,90		
ULS 8	design(Structural)	----	35,56	-0,13	0,00	-0,30	5,90		
ULS 9	design(Structural)	----	35,56	-0,13	0,00	-0,30	5,90		
ULS 10	design(Structural)	----	39,19	-0,19	0,00	-0,43	5,77		
ULS 11	design(Structural)	----	39,19	-0,19	0,00	-0,43	5,77		
ULS 12	design(Structural)	----	39,19	-0,19	0,00	-0,43	5,77		
ULS 13	design(Structural)	----	35,56	-0,13	0,00	-0,30	5,90		
ULS 14	design(Structural)	----	42,82	-0,24	0,00	-0,56	5,64		
ULS 15	design(Structural)	----	42,82	-0,24	0,00	-0,56	5,64		
ULS 16	design(Structural)	----	42,82	-0,24	0,00	-0,56	5,64		
ULS 17	design(Structural)	----	42,82	-0,24	0,00	-0,56	5,64		
SEISM 1	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 2	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 3	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 4	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 5	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 6	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 7	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 8	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 9	design	----	24,57	-0,07	0,00	-0,16	4,43		
SLS 1	design(Non-structural)	----	31,34	-0,17	0,00	-0,40	4,19		
SLS 2	design(Non-structural)	----	31,34	-0,17	0,00	-0,40	4,19		
SLS 3	design(Non-structural)	----	31,34	-0,17	0,00	-0,40	4,19		
SLS 4	design(Non-structural)	----	30,37	-0,16	0,00	-0,37	4,23		
SLS 5	design(Non-structural)	----	30,37	-0,16	0,00	-0,37	4,23		
SLS 6	design(Non-structural)	----	30,37	-0,16	0,00	-0,37	4,23		
SLS 7	design(Non-structural)	----	30,37	-0,16	0,00	-0,37	4,23		
TEMP NEGATIVE	design(Structural)	----			0,14	0,14	-0,00	0,00	0,35
ULS 18	design(Structural)	----	38,36	-0,28	0,00	-0,41	5,54		
ULS 19	design(Structural)	----	38,46	-0,18	0,00	-0,41	5,80		
ULS 20	design(Structural)	----	38,36	-0,28	0,00	-0,41	5,54		
ULS 21	design(Structural)	----	38,46	-0,18	0,00	-0,41	5,80		
ULS 22	design(Structural)	----	38,36	-0,28	0,00	-0,41	5,54		
ULS 23	design(Structural)	----	38,46	-0,18	0,00	-0,41	5,80		
ULS 24	design(Structural)	----	38,36	-0,28	0,00	-0,41	5,54		
ULS 25	design(Structural)	----	67,23	-0,39	0,00	-0,71	9,95		
ULS 26	design(Structural)	----	38,36	-0,28	0,00	-0,41	5,54		
ULS 27	design(Structural)	----	67,23	-0,39	0,00	-0,71	9,95		
ULS 28	design(Structural)	----	42,71	-0,35	0,00	-0,56	5,38		
ULS 29	design(Structural)	----	71,58	-0,45	0,00	-0,87	9,80		
ULS 30	design(Structural)	----	35,35	-0,35	0,00	-0,30	5,38		
ULS 31	design(Structural)	----	93,09	-0,56	0,00	-0,92	14,20		
ULS 32	design(Structural)	----	38,46	-0,18	0,00	-0,41	5,80		
ULS 33	design(Structural)	----	42,09	-0,23	0,00	-0,54	5,67		
ULS 34	design(Structural)	----	35,56	-0,13	0,00	-0,30	5,90		
ULS 35	design(Structural)	----	39,19	-0,19	0,00	-0,43	5,77		
ULS 36	design(Structural)	----	35,56	-0,13	0,00	-0,30	5,90		
ULS 37	design(Structural)	----	42,82	-0,24	0,00	-0,56	5,64		
SLS 8	design(Non-structural)	----	31,34	-0,17	0,00	-0,40	4,19		
SLS 9	design(Non-structural)	----	30,37	-0,16	0,00	-0,37	4,23		
SLS 10	design(Non-structural)	----	31,25	-0,26	0,00	-0,40	3,99		
SLS 11	design(Non-structural)	----	53,38	-0,33	0,00	-0,61	7,55		
SLS 12	design(Non-structural)	----	31,25	-0,26	0,00	-0,40	3,99		
SLS 13	design(Non-structural)	----	53,38	-0,33	0,00	-0,61	7,55		

Backfill loads:

Case	Nature	Q1 (kN/m2)
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1.1.5 Combination list

1/	ULS : ULS 1 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
2/	ULS : ULS 2 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
3/	ULS : ULS 3 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
4/	ULS : ULS 4 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00

5/ ULS : ULS 5 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
6/ ULS : ULS 6 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
7/ ULS : ULS 7 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
8/ ULS : ULS 8 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
9/ ULS : ULS 9 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
10/ ULS : ULS 10 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
11/ ULS : ULS 11 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
12/ ULS : ULS 12 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
13/ ULS : ULS 13 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
14/ ULS : ULS 14 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
15/ ULS : ULS 15 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
16/ ULS : ULS 16 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
17/ ULS : ULS 17 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
18/ ULS : TEMP NEGATIVE N=0,14 Mx=0,00 My=0,35 Fx=0,14 Fy=-0,00
19/ ULS : ULS 18 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
20/ ULS : ULS 19 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
21/ ULS : ULS 20 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
22/ ULS : ULS 21 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
23/ ULS : ULS 22 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
24/ ULS : ULS 23 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
25/ ULS : ULS 24 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
26/ ULS : ULS 25 N=67,23 Mx=-0,71 My=9,95 Fx=-0,39 Fy=0,00
27/ ULS : ULS 26 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
28/ ULS : ULS 27 N=67,23 Mx=-0,71 My=9,95 Fx=-0,39 Fy=0,00
29/ ULS : ULS 28 N=42,71 Mx=-0,56 My=5,38 Fx=-0,35 Fy=0,00
30/ ULS : ULS 29 N=71,58 Mx=-0,87 My=9,80 Fx=-0,45 Fy=0,00
31/ ULS : ULS 30 N=35,35 Mx=-0,30 My=5,38 Fx=-0,35 Fy=0,00
32/ ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-0,56 Fy=0,00
33/ ULS : ULS 32 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
34/ ULS : ULS 33 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
35/ ULS : ULS 34 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
36/ ULS : ULS 35 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
37/ ULS : ULS 36 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
38/ ULS : ULS 37 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
39/ SLS : SLS 1 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
40/ SLS : SLS 2 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
41/ SLS : SLS 3 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
42/ SLS : SLS 4 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
43/ SLS : SLS 5 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
44/ SLS : SLS 6 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
45/ SLS : SLS 7 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
46/ SLS : SLS 8 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
47/ SLS : SLS 9 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
48/ SLS : SLS 10 N=31,25 Mx=-0,40 My=3,99 Fx=-0,26 Fy=0,00
49/ SLS : SLS 11 N=53,38 Mx=-0,61 My=7,55 Fx=-0,33 Fy=0,00
50/ SLS : SLS 12 N=31,25 Mx=-0,40 My=3,99 Fx=-0,26 Fy=0,00
51/ SLS : SLS 13 N=53,38 Mx=-0,61 My=7,55 Fx=-0,33 Fy=0,00
52/ ALS : SEISM 1 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
53/ ALS : SEISM 2 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
54/ ALS : SEISM 3 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
55/ ALS : SEISM 4 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
56/ ALS : SEISM 5 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
57/ ALS : SEISM 6 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
58/ ALS : SEISM 7 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
59/ ALS : SEISM 8 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
60/ ALS : SEISM 9 N=24,57 Mx=-0,16 My=4,43 Fx=-0,07 Fy=0,00
61/* ULS : ULS 1 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
62/* ULS : ULS 2 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
63/* ULS : ULS 3 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
64/* ULS : ULS 4 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
65/* ULS : ULS 5 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
66/* ULS : ULS 6 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
67/* ULS : ULS 7 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
68/* ULS : ULS 8 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
69/* ULS : ULS 9 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
70/* ULS : ULS 10 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
71/* ULS : ULS 11 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
72/* ULS : ULS 12 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
73/* ULS : ULS 13 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
74/* ULS : ULS 14 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
75/* ULS : ULS 15 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
76/* ULS : ULS 16 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
77/* ULS : ULS 17 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
78/* ULS : TEMP NEGATIVE N=0,14 Mx=0,00 My=0,35 Fx=0,14 Fy=-0,00

79/* ULS : ULS 18 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
 80/* ULS : ULS 19 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
 81/* ULS : ULS 20 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
 82/* ULS : ULS 21 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
 83/* ULS : ULS 22 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
 84/* ULS : ULS 23 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
 85/* ULS : ULS 24 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
 86/* ULS : ULS 25 N=67,23 Mx=-0,71 My=9,95 Fx=-0,39 Fy=0,00
 87/* ULS : ULS 26 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
 88/* ULS : ULS 27 N=67,23 Mx=-0,71 My=9,95 Fx=-0,39 Fy=0,00
 89/* ULS : ULS 28 N=42,71 Mx=-0,56 My=5,38 Fx=-0,35 Fy=0,00
 90/* ULS : ULS 29 N=71,58 Mx=-0,87 My=9,80 Fx=-0,45 Fy=0,00
 91/* ULS : ULS 30 N=35,35 Mx=-0,30 My=5,38 Fx=-0,35 Fy=0,00
 92/* ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-0,56 Fy=0,00
 93/* ULS : ULS 32 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
 94/* ULS : ULS 33 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
 95/* ULS : ULS 34 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
 96/* ULS : ULS 35 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
 97/* ULS : ULS 36 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
 98/* ULS : ULS 37 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
 99/* SLS : SLS 1 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
 100/* SLS : SLS 2 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
 101/* SLS : SLS 3 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
 102/* SLS : SLS 4 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
 103/* SLS : SLS 5 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
 104/* SLS : SLS 6 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
 105/* SLS : SLS 7 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
 106/* SLS : SLS 8 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
 107/* SLS : SLS 9 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
 108/* SLS : SLS 10 N=31,25 Mx=-0,40 My=3,99 Fx=-0,26 Fy=0,00
 109/* SLS : SLS 11 N=53,38 Mx=-0,61 My=7,55 Fx=-0,33 Fy=0,00
 110/* SLS : SLS 12 N=31,25 Mx=-0,40 My=3,99 Fx=-0,26 Fy=0,00
 111/* SLS : SLS 13 N=53,38 Mx=-0,61 My=7,55 Fx=-0,33 Fy=0,00
 112/* ALS : SEISM 1 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 113/* ALS : SEISM 2 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 114/* ALS : SEISM 3 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 115/* ALS : SEISM 4 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 116/* ALS : SEISM 5 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 117/* ALS : SEISM 6 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 118/* ALS : SEISM 7 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 119/* ALS : SEISM 8 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 120/* ALS : SEISM 9 N=24,57 Mx=-0,16 My=4,43 Fx=-0,07 Fy=0,00

1.2 Geotechnical design

1.2.1 Assumptions

- Cohesion reduction coefficient: 0,00
- Smooth precast foundation 6.5.3(10)
- Sliding with soil pressure considered: for X and Y directions
- Design approach: 1
A1 + M1 + R1

$$\gamma_{\phi'} = 1,00$$

$$\gamma_{c'} = 1,00$$

$$\gamma_{cu} = 1,00$$

$$\gamma_{qu} = 1,00$$

$$\gamma_{\gamma} = 1,00$$

$$\gamma_{R,v} = 1,00$$

$$\gamma_{R,h} = 1,00$$

$$A2 + M2 + R1$$

$$\gamma_{\phi'} = 1,25$$

$$\gamma_{c'} = 1,25$$

$$\gamma_{cu} = 1,40$$

$$\gamma_{qu} = 1,40$$

$$\gamma_{\gamma} = 1,00$$

$$\gamma_{R,v} = 1,00$$

$$\gamma_{R,h} = 1,00$$

1.2.2 Soil:

Soil level:	N_1	= 0,00 (m)
Column pier level:	N_a	= 0,00 (m)
Minimum reference level:	N_f	= -0,50 (m)

Clay

- Soil level: 0.00 (m)
- Unit weight: 2243.38 (kG/m³)
- Unit weight of solid: 2753.23 (kG/m³)
- Internal friction angle: 25.0 (Deg)
- Cohesion: 0.06 (MPa)

1.2.3 Limit states

Stress calculations

Soil type under foundation: not layered

Design combination **ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-**

0,56 Fy=0,00

Load factors: **1.35** * Foundation weight

1.35 * Soil weight

Calculation results: On the foundation level

Weight of foundation and soil over it: Gr = 13,41 (kN)

Design load:

$$N_r = 106,50 \text{ (kN)} \quad M_x = -0,92 \text{ (kN*m)} \quad M_y = 13,92 \text{ (kN*m)}$$

Allowable stress calculation method: Semi-empirical - stress limit

Load eccentricity:

$$|e_B| = 0,13 \text{ (m)} \quad |e_L| = 0,01 \text{ (m)}$$

Equivalent foundation dimensions:

$$B' = B - 2|e_B| = 0,64 \text{ (m)}$$

$$L' = L - 2|e_L| = 0,88 \text{ (m)}$$

$$q_u = 0.30 \text{ (MPa)}$$

$$p_{le}^* = 0,32 \text{ (MPa)}$$

$$D_e = D_{min} - d = 0,50 \text{ (m)}$$

$$k_p = 0,94$$

$$q'_{o} = 0,01 \text{ (MPa)}$$

$$q_u = k_p * (p_{le}^*) + q'_{o} = 0,31 \text{ (MPa)}$$

Stress in soil: $q_{ref} = 0.25 \text{ (MPa)}$

Safety factor: $q_{lim} / q_{ref} = 1.233 > 1$

Uplift

0,56 Fy=0,00	<u>Uplift in ULS</u>	
	Design combination	ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Contact area:	s = 0,16 s _{lim} = 0,17

Sliding

Fx=0,14 Fy=-0,00	Design combination	ULS : TEMP NEGATIVE N=0,14 Mx=0,00 My=0,35
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 9,93 (kN)
	Design load:	
	Nr = 10,07 (kN)	Mx = 0,00 (kN*m) My = 0,42 (kN*m)
	Equivalent foundation dimensions:	A ₋ = 0,90 (m) B ₋ = 0,90 (m)
	Sliding area:	0,81 (m ²)
	Foundation/soil friction coefficient:	tan(δ _d) = 0,30
	Cohesion:	c _u = 0.06 (MPa)
	Soil pressure considered:	
	Hx = 0,14 (kN)	Hy = -0,00 (kN)
	Ppx = -3,05 (kN)	Ppy = 3,05 (kN)
	Pax = 0,50 (kN)	Pay = -0,50 (kN)
	Sliding force value	H _d = 0,00 (kN)
	Value of force preventing foundation sliding:	
	- On the foundation level:	R _d = 3,02 (kN)
	Stability for sliding:	∞

Average settlement

Fy=0,00	Soil type under foundation:	not layered
	Design combination	SLS : SLS 13 N=53,38 Mx=-0,61 My=7,55 Fx=-0,33
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 9,93 (kN)
	Average stress caused by design load:	q = 0,08 (MPa)
	Thickness of the actively settling soil:	z = 1,80 (m)
	Stress on the level z:	
	- Additional:	σ _{zd} = 0,01 (MPa)
	- Caused by soil weight:	σ _{zγ} = 0,05 (MPa)
	Settlement:	
	- Original	s' = 0,1 (cm)
	- Secondary	s'' = 0,0 (cm)
	- TOTAL	S = 0,1 (cm) < S _{adm} = 5,0 (cm)
	Safety factor:	89.94 > 1

Settlement difference

Fy=0,00	Design combination	SLS : SLS 13 N=53,38 Mx=-0,61 My=7,55 Fx=-0,33
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Settlement difference:	S = 0,1 (cm) < S _{adm} = 5,0 (cm)

Safety factor: 45.43 > 1

Rotation

Fy=0,00	<u>About OX axis</u>	
	Design combination	ULS : ULS 28 N=42,71 Mx=-0,56 My=5,38 Fx=-0,35
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 9,93 (kN)
	Design load:	Nr = 52,64 (kN) Mx = -0,56 (kN*m) My = 5,21 (kN*m)
	Stability moment:	Mstab = 23,69 (kN*m)
	Rotation moment:	Mrenv = 0,56 (kN*m)
	Stability for rotation:	42.08 > 1
0,56 Fy=0,00	<u>About OY axis</u>	
	Design combination:	ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 9,93 (kN)
	Design load:	Nr = 103,03 (kN) Mx = -0,92 (kN*m) My = 13,92 (kN*m)
	Stability moment:	Mstab = 46,64 (kN*m)
	Rotation moment:	Mrenv = 14,20 (kN*m)
	Stability for rotation:	3.284 > 1

1.3 RC design

1.3.1 Assumptions

- Exposure : XC2
- Structure class : S1

1.3.2 Analysis of punching and shear

Punching

Fy=0,00	Design combination	ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-0,56
	Load factors:	1.35 * Foundation weight 1.35 * Soil weight
	Design load:	Nr = 106,50 (kN) Mx = -0,92 (kN*m) My = 13,92 (kN*m)
	Length of critical circumference:	2,34 (m)
	Punching force:	49,39 (kN)
	Section effective height	heff = 0,43 (m)
	Reinforcement ratio:	$\rho = 0.14 \%$
	Shear stress:	0,08 (MPa)
	Admissible shear stress:	3,82 (MPa)
	Safety factor:	48 > 1

1.3.3 Required reinforcement

Spread footing:

bottom:

ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-0,56 Fy=0,00
 My = 8,27 (kN*m) $A_{sx} = 5,81 \text{ (cm}^2\text{/m)}$

ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-0,56 Fy=0,00
 Mx = 5,04 (kN*m) $A_{sy} = 5,81 \text{ (cm}^2\text{/m)}$

$A_{s \text{ min}} = 5,81 \text{ (cm}^2\text{/m)}$

top:

$A'_{sx} = 0,00 \text{ (cm}^2\text{/m)}$

$A'_{sy} = 0,00 \text{ (cm}^2\text{/m)}$

$A_{s \text{ min}} = 0,00 \text{ (cm}^2\text{/m)}$

Column pier:

Longitudinal reinforcement $A = 0,00 \text{ (cm}^2)$ $A_{\text{min.}} = 0,00 \text{ (cm}^2)$

$A = 2 * (Asx + Asy)$

$Asx = 0,00 \text{ (cm}^2)$ $Asy = 0,00 \text{ (cm}^2)$

1.3.4 Provided reinforcement**Spread footing:****Bottom:**

Along X axis:

5 B500C 12 $l = 0,92 \text{ (m)}$ $e = 1*-0,33 + 4*0,17$

Along Y axis:

5 B500C 12 $l = 0,92 \text{ (m)}$ $e = 1*-0,33 + 4*0,17$

Pier

Longitudinal reinforcement

Along X axis:

2 B500C 12 $l = 2,09 \text{ (m)}$ $e = 1*-0,29 + 1*0,58$

Along Y axis:

2 B500C 12 $l = 2,14 \text{ (m)}$ $e = 1*-0,29 + 1*0,58$

Transversal reinforcement

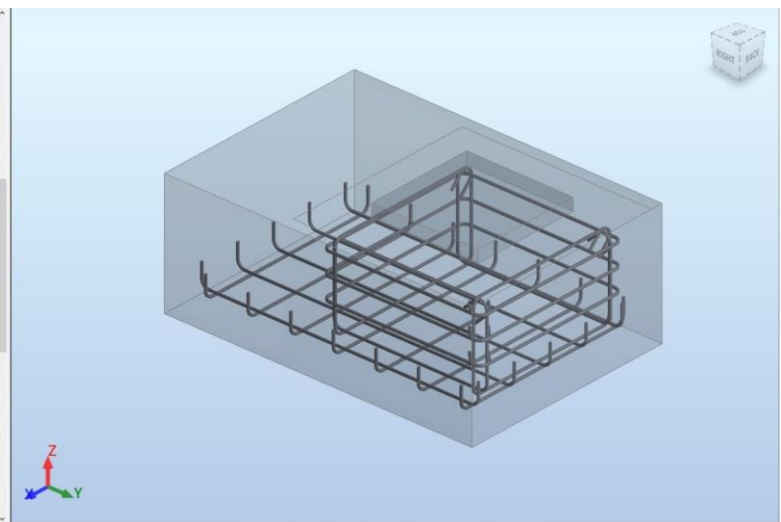
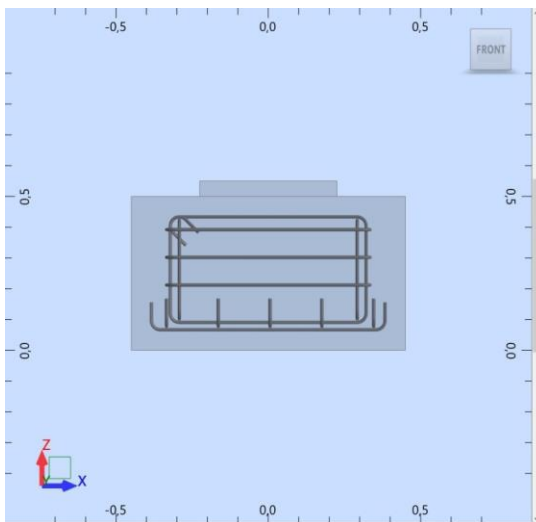
3 B500C 12 $l = 2,83 \text{ (m)}$ $e = 1*0,21 + 2*0,09$

2 Material survey:

- Concrete volume = 0,41 (m3)
- Formwork = 1,80 (m2)
- Steel B500C
 - Total weight = 23,26 (kG)
 - Density = 57,42 (kG/m3)
 - Average diameter = 12,0 (mm)

- Survey according to diameters:

Diameter	Length (m)	Number of identical elements:
12	0,92	10
12	2,09	2
12	2,14	2
12	2,83	3



1 ΠΕΔΙΟ 3A elements: 1

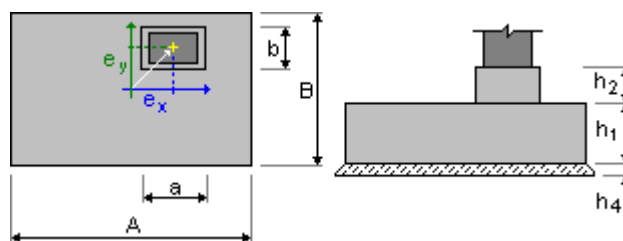
Number of identical

1.1 Basic data

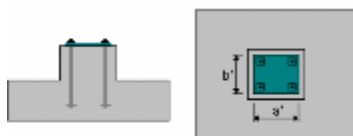
1.1.1 Assumptions

- Geotechnic calculations according to : EN 1997-1:2004/A1:2013
- Concrete calculations according to : EN 1992-1-1:2004/A1:2014
- Shape selection : without limits

1.1.2 Geometry:



A	= 0,90 (m)	a	= 0,80 (m)
B	= 1,30 (m)	b	= 0,80 (m)
h1	= 0,50 (m)	ex	= 0,00 (m)
h2	= 0,00 (m)	ey	= 0,25 (m)
h4	= 0,05 (m)		



a'	= 45,0 (cm)
b'	= 45,0 (cm)
Cnom1	= 6,0 (cm)
Cnom2	= 6,0 (cm)
Cover deviations: Cdev = 1,0(cm), Cdur = 0,0(cm)	

1.1.3 Materials

- Concrete : C25/30; Characteristic strength = 25,00 MPa
Unit weight = 2501,36 (kG/m3)
Rectangular stress distribution [3.1.7(3)]
- Longitudinal reinforcement 500,00 MPa : type B500C Characteristic strength =
Ductility class: C
Horizontal branch of the stress-strain diagram
- Transversal reinforcement 500,00 MPa : type B500C Characteristic strength =
- Additional reinforcement: : type B500C Characteristic strength =
500,00 MPa

1.1.4 Loads:

Foundation loads:

Case	Nature	Group	N (kN)	Fx (kN)	Fy (kN)	Mx (kN*m)	My (kN*m)		
ULS 1	design(Structural)	----	32,65	3,14	1,77	13,68	-3,67		
ULS 2	design(Structural)	----	35,46	4,03	2,26	14,50	-2,94		
ULS 3	design(Structural)	----	32,65	3,14	1,77	13,68	-3,67		
ULS 4	design(Structural)	----	35,46	4,03	2,26	14,50	-2,94		
ULS 5	design(Structural)	----	35,46	4,03	2,26	14,50	-2,94		
ULS 6	design(Structural)	----	35,46	4,03	2,26	14,50	-2,94		
ULS 7	design(Structural)	----	30,40	2,43	1,37	13,03	-4,25		
ULS 8	design(Structural)	----	30,40	2,43	1,37	13,03	-4,25		
ULS 9	design(Structural)	----	30,40	2,43	1,37	13,03	-4,25		
ULS 10	design(Structural)	----	33,21	3,32	1,87	13,84	-3,52		
ULS 11	design(Structural)	----	33,21	3,32	1,87	13,84	-3,52		
ULS 12	design(Structural)	----	33,21	3,32	1,87	13,84	-3,52		
ULS 13	design(Structural)	----	30,40	2,43	1,37	13,03	-4,25		
ULS 14	design(Structural)	----	36,03	4,21	2,36	14,66	-2,79		
ULS 15	design(Structural)	----	36,03	4,21	2,36	14,66	-2,79		
ULS 16	design(Structural)	----	36,03	4,21	2,36	14,66	-2,79		
ULS 17	design(Structural)	----	36,03	4,21	2,36	14,66	-2,79		
SEISM 1	design	----	28,15	1,71	0,98	12,38	-4,83		
SEISM 2	design	----	28,15	1,71	0,98	12,38	-4,83		
SEISM 3	design	----	28,15	1,71	0,98	12,38	-4,83		
SEISM 4	design	----	28,15	1,71	0,98	12,38	-4,83		
SEISM 5	design	----	28,15	1,71	0,98	12,38	-4,83		
SEISM 6	design	----	28,15	1,71	0,98	12,38	-4,83		
SEISM 7	design	----	28,15	1,71	0,98	12,38	-4,83		
SEISM 8	design	----	28,15	1,71	0,98	12,38	-4,83		
SEISM 9	design	----	21,14	1,36	0,78	9,25	-3,50		
SLS 1	design(Non-structural)	----	26,39	3,03	1,70	10,77	-2,14		
SLS 2	design(Non-structural)	----	26,39	3,03	1,70	10,77	-2,14		
SLS 3	design(Non-structural)	----	26,39	3,03	1,70	10,77	-2,14		
SLS 4	design(Non-structural)	----	25,64	2,79	1,57	10,56	-2,34		
SLS 5	design(Non-structural)	----	25,64	2,79	1,57	10,56	-2,34		
SLS 6	design(Non-structural)	----	25,64	2,79	1,57	10,56	-2,34		
SLS 7	design(Non-structural)	----	25,64	2,79	1,57	10,56	-2,34		
TEMP NEGATIVE	design(Structural)	----	----	----	-0,07	-0,26	-0,64	1,29	-0,44
ULS 18	design(Structural)	----	32,70	3,34	2,25	12,71	-3,34		
ULS 19	design(Structural)	----	32,65	3,14	1,77	13,68	-3,67		
ULS 20	design(Structural)	----	32,70	3,34	2,25	12,71	-3,34		
ULS 21	design(Structural)	----	32,65	3,14	1,77	13,68	-3,67		
ULS 22	design(Structural)	----	32,70	3,34	2,25	12,71	-3,34		
ULS 23	design(Structural)	----	32,65	3,14	1,77	13,68	-3,67		
ULS 24	design(Structural)	----	32,70	3,34	2,25	12,71	-3,34		
ULS 25	design(Structural)	----	57,17	5,65	3,46	23,22	-6,17		
ULS 26	design(Structural)	----	32,70	3,34	2,25	12,71	-3,34		
ULS 27	design(Structural)	----	57,17	5,65	3,46	23,22	-6,17		
ULS 28	design(Structural)	----	36,08	4,41	2,84	13,69	-2,46		
ULS 29	design(Structural)	----	60,55	6,72	4,05	24,19	-5,29		
ULS 30	design(Structural)	----	30,50	2,82	2,34	11,09	-3,59		
ULS 31	design(Structural)	----	79,45	7,44	4,75	32,10	-9,25		
ULS 32	design(Structural)	----	32,65	3,14	1,77	13,68	-3,67		
ULS 33	design(Structural)	----	35,46	4,03	2,26	14,50	-2,94		
ULS 34	design(Structural)	----	30,40	2,43	1,37	13,03	-4,25		
ULS 35	design(Structural)	----	33,21	3,32	1,87	13,84	-3,52		
ULS 36	design(Structural)	----	30,40	2,43	1,37	13,03	-4,25		
ULS 37	design(Structural)	----	36,03	4,21	2,36	14,66	-2,79		
SLS 8	design(Non-structural)	----	26,39	3,03	1,70	10,77	-2,14		
SLS 9	design(Non-structural)	----	25,64	2,79	1,57	10,56	-2,34		
SLS 10	design(Non-structural)	----	26,44	3,19	2,08	10,00	-1,88		
SLS 11	design(Non-structural)	----	45,26	4,79	2,92	18,18	-4,34		
SLS 12	design(Non-structural)	----	26,44	3,19	2,08	10,00	-1,88		
SLS 13	design(Non-structural)	----	45,26	4,79	2,92	18,18	-4,34		

Backfill loads:

Case	Nature	Q1 (kN/m2)
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1.1.5 Combination list

1/	ULS : ULS 1 N=32,65 Mx=13,68 My=-3,67 Fx=3,14 Fy=1,77
2/	ULS : ULS 2 N=35,46 Mx=14,50 My=-2,94 Fx=4,03 Fy=2,26

3/ ULS : ULS 3 N=32,65 Mx=13,68 My=-3,67 Fx=3,14 Fy=1,77
 4/ ULS : ULS 4 N=35,46 Mx=14,50 My=-2,94 Fx=4,03 Fy=2,26
 5/ ULS : ULS 5 N=35,46 Mx=14,50 My=-2,94 Fx=4,03 Fy=2,26
 6/ ULS : ULS 6 N=35,46 Mx=14,50 My=-2,94 Fx=4,03 Fy=2,26
 7/ ULS : ULS 7 N=30,40 Mx=13,03 My=-4,25 Fx=2,43 Fy=1,37
 8/ ULS : ULS 8 N=30,40 Mx=13,03 My=-4,25 Fx=2,43 Fy=1,37
 9/ ULS : ULS 9 N=30,40 Mx=13,03 My=-4,25 Fx=2,43 Fy=1,37
 10/ ULS : ULS 10 N=33,21 Mx=13,84 My=-3,52 Fx=3,32 Fy=1,87
 11/ ULS : ULS 11 N=33,21 Mx=13,84 My=-3,52 Fx=3,32 Fy=1,87
 12/ ULS : ULS 12 N=33,21 Mx=13,84 My=-3,52 Fx=3,32 Fy=1,87
 13/ ULS : ULS 13 N=30,40 Mx=13,03 My=-4,25 Fx=2,43 Fy=1,37
 14/ ULS : ULS 14 N=36,03 Mx=14,66 My=-2,79 Fx=4,21 Fy=2,36
 15/ ULS : ULS 15 N=36,03 Mx=14,66 My=-2,79 Fx=4,21 Fy=2,36
 16/ ULS : ULS 16 N=36,03 Mx=14,66 My=-2,79 Fx=4,21 Fy=2,36
 17/ ULS : ULS 17 N=36,03 Mx=14,66 My=-2,79 Fx=4,21 Fy=2,36
 18/ ULS : TEMP NEGATIVE N=-0,07 Mx=1,29 My=-0,44 Fx=-0,26 Fy=-0,64
 19/ ULS : ULS 18 N=32,70 Mx=12,71 My=-3,34 Fx=3,34 Fy=2,25
 20/ ULS : ULS 19 N=32,65 Mx=13,68 My=-3,67 Fx=3,14 Fy=1,77
 21/ ULS : ULS 20 N=32,70 Mx=12,71 My=-3,34 Fx=3,34 Fy=2,25
 22/ ULS : ULS 21 N=32,65 Mx=13,68 My=-3,67 Fx=3,14 Fy=1,77
 23/ ULS : ULS 22 N=32,70 Mx=12,71 My=-3,34 Fx=3,34 Fy=2,25
 24/ ULS : ULS 23 N=32,65 Mx=13,68 My=-3,67 Fx=3,14 Fy=1,77
 25/ ULS : ULS 24 N=32,70 Mx=12,71 My=-3,34 Fx=3,34 Fy=2,25
 26/ ULS : ULS 25 N=57,17 Mx=23,22 My=-6,17 Fx=5,65 Fy=3,46
 27/ ULS : ULS 26 N=32,70 Mx=12,71 My=-3,34 Fx=3,34 Fy=2,25
 28/ ULS : ULS 27 N=57,17 Mx=23,22 My=-6,17 Fx=5,65 Fy=3,46
 29/ ULS : ULS 28 N=36,08 Mx=13,69 My=-2,46 Fx=4,41 Fy=2,84
 30/ ULS : ULS 29 N=60,55 Mx=24,19 My=-5,29 Fx=6,72 Fy=4,05
 31/ ULS : ULS 30 N=30,50 Mx=11,09 My=-3,59 Fx=2,82 Fy=2,34
 32/ ULS : ULS 31 N=79,45 Mx=32,10 My=-9,25 Fx=7,44 Fy=4,75
 33/ ULS : ULS 32 N=32,65 Mx=13,68 My=-3,67 Fx=3,14 Fy=1,77
 34/ ULS : ULS 33 N=35,46 Mx=14,50 My=-2,94 Fx=4,03 Fy=2,26
 35/ ULS : ULS 34 N=30,40 Mx=13,03 My=-4,25 Fx=2,43 Fy=1,37
 36/ ULS : ULS 35 N=33,21 Mx=13,84 My=-3,52 Fx=3,32 Fy=1,87
 37/ ULS : ULS 36 N=30,40 Mx=13,03 My=-4,25 Fx=2,43 Fy=1,37
 38/ ULS : ULS 37 N=36,03 Mx=14,66 My=-2,79 Fx=4,21 Fy=2,36
 39/ SLS : SLS 1 N=26,39 Mx=10,77 My=-2,14 Fx=3,03 Fy=1,70
 40/ SLS : SLS 2 N=26,39 Mx=10,77 My=-2,14 Fx=3,03 Fy=1,70
 41/ SLS : SLS 3 N=26,39 Mx=10,77 My=-2,14 Fx=3,03 Fy=1,70
 42/ SLS : SLS 4 N=25,64 Mx=10,56 My=-2,34 Fx=2,79 Fy=1,57
 43/ SLS : SLS 5 N=25,64 Mx=10,56 My=-2,34 Fx=2,79 Fy=1,57
 44/ SLS : SLS 6 N=25,64 Mx=10,56 My=-2,34 Fx=2,79 Fy=1,57
 45/ SLS : SLS 7 N=25,64 Mx=10,56 My=-2,34 Fx=2,79 Fy=1,57
 46/ SLS : SLS 8 N=26,39 Mx=10,77 My=-2,14 Fx=3,03 Fy=1,70
 47/ SLS : SLS 9 N=25,64 Mx=10,56 My=-2,34 Fx=2,79 Fy=1,57
 48/ SLS : SLS 10 N=26,44 Mx=10,00 My=-1,88 Fx=3,19 Fy=2,08
 49/ SLS : SLS 11 N=45,26 Mx=18,18 My=-4,34 Fx=4,79 Fy=2,92
 50/ SLS : SLS 12 N=26,44 Mx=10,00 My=-1,88 Fx=3,19 Fy=2,08
 51/ SLS : SLS 13 N=45,26 Mx=18,18 My=-4,34 Fx=4,79 Fy=2,92
 52/ ALS : SEISM 1 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 53/ ALS : SEISM 2 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 54/ ALS : SEISM 3 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 55/ ALS : SEISM 4 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 56/ ALS : SEISM 5 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 57/ ALS : SEISM 6 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 58/ ALS : SEISM 7 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 59/ ALS : SEISM 8 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 60/ ALS : SEISM 9 N=21,14 Mx=9,25 My=-3,50 Fx=1,36 Fy=0,78
 61/* ULS : ULS 1 N=32,65 Mx=13,68 My=-3,67 Fx=3,14 Fy=1,77
 62/* ULS : ULS 2 N=35,46 Mx=14,50 My=-2,94 Fx=4,03 Fy=2,26
 63/* ULS : ULS 3 N=32,65 Mx=13,68 My=-3,67 Fx=3,14 Fy=1,77
 64/* ULS : ULS 4 N=35,46 Mx=14,50 My=-2,94 Fx=4,03 Fy=2,26
 65/* ULS : ULS 5 N=35,46 Mx=14,50 My=-2,94 Fx=4,03 Fy=2,26
 66/* ULS : ULS 6 N=35,46 Mx=14,50 My=-2,94 Fx=4,03 Fy=2,26
 67/* ULS : ULS 7 N=30,40 Mx=13,03 My=-4,25 Fx=2,43 Fy=1,37
 68/* ULS : ULS 8 N=30,40 Mx=13,03 My=-4,25 Fx=2,43 Fy=1,37
 69/* ULS : ULS 9 N=30,40 Mx=13,03 My=-4,25 Fx=2,43 Fy=1,37
 70/* ULS : ULS 10 N=33,21 Mx=13,84 My=-3,52 Fx=3,32 Fy=1,87
 71/* ULS : ULS 11 N=33,21 Mx=13,84 My=-3,52 Fx=3,32 Fy=1,87
 72/* ULS : ULS 12 N=33,21 Mx=13,84 My=-3,52 Fx=3,32 Fy=1,87
 73/* ULS : ULS 13 N=30,40 Mx=13,03 My=-4,25 Fx=2,43 Fy=1,37
 74/* ULS : ULS 14 N=36,03 Mx=14,66 My=-2,79 Fx=4,21 Fy=2,36
 75/* ULS : ULS 15 N=36,03 Mx=14,66 My=-2,79 Fx=4,21 Fy=2,36
 76/* ULS : ULS 16 N=36,03 Mx=14,66 My=-2,79 Fx=4,21 Fy=2,36

77/* ULS : ULS 17 N=36,03 Mx=14,66 My=-2,79 Fx=4,21 Fy=2,36
 78/* ULS : TEMP NEGATIVE N=-0,07 Mx=1,29 My=-0,44 Fx=-0,26 Fy=-0,64
 79/* ULS : ULS 18 N=32,70 Mx=12,71 My=-3,34 Fx=3,34 Fy=2,25
 80/* ULS : ULS 19 N=32,65 Mx=13,68 My=-3,67 Fx=3,14 Fy=1,77
 81/* ULS : ULS 20 N=32,70 Mx=12,71 My=-3,34 Fx=3,34 Fy=2,25
 82/* ULS : ULS 21 N=32,65 Mx=13,68 My=-3,67 Fx=3,14 Fy=1,77
 83/* ULS : ULS 22 N=32,70 Mx=12,71 My=-3,34 Fx=3,34 Fy=2,25
 84/* ULS : ULS 23 N=32,65 Mx=13,68 My=-3,67 Fx=3,14 Fy=1,77
 85/* ULS : ULS 24 N=32,70 Mx=12,71 My=-3,34 Fx=3,34 Fy=2,25
 86/* ULS : ULS 25 N=57,17 Mx=23,22 My=-6,17 Fx=5,65 Fy=3,46
 87/* ULS : ULS 26 N=32,70 Mx=12,71 My=-3,34 Fx=3,34 Fy=2,25
 88/* ULS : ULS 27 N=57,17 Mx=23,22 My=-6,17 Fx=5,65 Fy=3,46
 89/* ULS : ULS 28 N=36,08 Mx=13,69 My=-2,46 Fx=4,41 Fy=2,84
 90/* ULS : ULS 29 N=60,55 Mx=24,19 My=-5,29 Fx=6,72 Fy=4,05
 91/* ULS : ULS 30 N=30,50 Mx=11,09 My=-3,59 Fx=2,82 Fy=2,34
 92/* ULS : ULS 31 N=79,45 Mx=32,10 My=-9,25 Fx=7,44 Fy=4,75
 93/* ULS : ULS 32 N=32,65 Mx=13,68 My=-3,67 Fx=3,14 Fy=1,77
 94/* ULS : ULS 33 N=35,46 Mx=14,50 My=-2,94 Fx=4,03 Fy=2,26
 95/* ULS : ULS 34 N=30,40 Mx=13,03 My=-4,25 Fx=2,43 Fy=1,37
 96/* ULS : ULS 35 N=33,21 Mx=13,84 My=-3,52 Fx=3,32 Fy=1,87
 97/* ULS : ULS 36 N=30,40 Mx=13,03 My=-4,25 Fx=2,43 Fy=1,37
 98/* ULS : ULS 37 N=36,03 Mx=14,66 My=-2,79 Fx=4,21 Fy=2,36
 99/* SLS : SLS 1 N=26,39 Mx=10,77 My=-2,14 Fx=3,03 Fy=1,70
 100/* SLS : SLS 2 N=26,39 Mx=10,77 My=-2,14 Fx=3,03 Fy=1,70
 101/* SLS : SLS 3 N=26,39 Mx=10,77 My=-2,14 Fx=3,03 Fy=1,70
 102/* SLS : SLS 4 N=25,64 Mx=10,56 My=-2,34 Fx=2,79 Fy=1,57
 103/* SLS : SLS 5 N=25,64 Mx=10,56 My=-2,34 Fx=2,79 Fy=1,57
 104/* SLS : SLS 6 N=25,64 Mx=10,56 My=-2,34 Fx=2,79 Fy=1,57
 105/* SLS : SLS 7 N=25,64 Mx=10,56 My=-2,34 Fx=2,79 Fy=1,57
 106/* SLS : SLS 8 N=26,39 Mx=10,77 My=-2,14 Fx=3,03 Fy=1,70
 107/* SLS : SLS 9 N=25,64 Mx=10,56 My=-2,34 Fx=2,79 Fy=1,57
 108/* SLS : SLS 10 N=26,44 Mx=10,00 My=-1,88 Fx=3,19 Fy=2,08
 109/* SLS : SLS 11 N=45,26 Mx=18,18 My=-4,34 Fx=4,79 Fy=2,92
 110/* SLS : SLS 12 N=26,44 Mx=10,00 My=-1,88 Fx=3,19 Fy=2,08
 111/* SLS : SLS 13 N=45,26 Mx=18,18 My=-4,34 Fx=4,79 Fy=2,92
 112/* ALS : SEISM 1 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 113/* ALS : SEISM 2 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 114/* ALS : SEISM 3 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 115/* ALS : SEISM 4 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 116/* ALS : SEISM 5 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 117/* ALS : SEISM 6 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 118/* ALS : SEISM 7 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 119/* ALS : SEISM 8 N=28,15 Mx=12,38 My=-4,83 Fx=1,71 Fy=0,98
 120/* ALS : SEISM 9 N=21,14 Mx=9,25 My=-3,50 Fx=1,36 Fy=0,78

1.2 Geotechnical design

1.2.1 Assumptions

- Cohesion reduction coefficient: 0,00
- Smooth precast foundation 6.5.3(10)
- Sliding with soil pressure considered: for X and Y directions
- Design approach: 1

A1 + M1 + R1

$$\gamma_{\phi'} = 1,00$$

$$\gamma_{c'} = 1,00$$

$$\gamma_{cu} = 1,00$$

$$\gamma_{qu} = 1,00$$

$$\gamma_{\gamma} = 1,00$$

$$\gamma_{R,v} = 1,00$$

$$\gamma_{R,h} = 1,00$$

A2 + M2 + R1

$$\gamma_{\phi'} = 1,25$$

$$\gamma_{c'} = 1,25$$

$$\gamma_{cu} = 1,40$$

$$\gamma_{qu} = 1,40$$

$$\gamma_{\gamma} = 1,00$$

$$\gamma_{R,v} = 1,00$$

$$\gamma_{R,h} = 1,00$$

1.2.2 Soil:

Soil level:	N_1	= 0,00 (m)
Column pier level:	N_a	= 0,00 (m)
Minimum reference level:	N_f	= -0,50 (m)

Clay

- Soil level: 0.00 (m)
- Unit weight: 2243.38 (kG/m³)
- Unit weight of solid: 2753.23 (kG/m³)
- Internal friction angle: 25.0 (Deg)
- Cohesion: 0.06 (MPa)

1.2.3 Limit states

Stress calculations

Soil type under foundation: not layered

Design combination **ULS : ULS 31 N=79,45 Mx=32,10 My=-9,25 Fx=7,44**

Fy=4,75

Load factors: **1.35** * Foundation weight
1.35 * Soil weight

Calculation results: On the foundation level

Weight of foundation and soil over it: Gr = 19,37 (kN)

Design load:

$$N_r = 98,82 \text{ (kN)} \quad M_x = 9,86 \text{ (kN*m)} \quad M_y = -5,54 \text{ (kN*m)}$$

Allowable stress calculation method: Semi-empirical - stress limit

Load eccentricity:

$$|e_B| = 0,06 \text{ (m)} \quad |e_L| = 0,10 \text{ (m)}$$

Equivalent foundation dimensions:

$$B' = B - 2|e_B| = 0,79 \text{ (m)}$$

$$L' = L - 2|e_L| = 1,10 \text{ (m)}$$

$$q_u = 0,30 \text{ (MPa)}$$

$$p_{le}^* = 0,32 \text{ (MPa)}$$

$$D_e = D_{min} - d = 0,50 \text{ (m)}$$

$$k_p = 0,91$$

$$q'_0 = 0,01 \text{ (MPa)}$$

$$q_u = k_p * (p_{le}^*) + q'_0 = 0,30 \text{ (MPa)}$$

Stress in soil: $q_{ref} = 0,15 \text{ (MPa)}$

Safety factor: $q_{lim} / q_{ref} = 1.962 > 1$

Uplift

Fy=1,37	<u>Uplift in ULS</u>	
	Design combination	ULS : ULS 7 N=30,40 Mx=13,03 My=-4,25 Fx=2,43
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Contact area:	s = 0,16 s _{lim} = 0,17

Sliding

Fy=4,05	Design combination	ULS : ULS 29 N=60,55 Mx=24,19 My=-5,29 Fx=6,72
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 14,35 (kN)
	Design load:	
	Nr = 74,90 (kN)	Mx = 7,03 (kN*m) My = -1,93 (kN*m)
	Equivalent foundation dimensions:	A _u = 0,90 (m) B _u = 1,30 (m)
	Sliding area:	1,17 (m ²)
	Foundation/soil friction coefficient:	tan(δ _d) = 0,30
	Cohesion:	c _u = 0.06 (MPa)
	Soil pressure considered:	
	Hx = 6,72 (kN)	Hy = 4,05 (kN)
	Ppx = -2,71 (kN)	Ppy = -3,05 (kN)
	Pax = 1,00 (kN)	Pay = 0,50 (kN)
	Sliding force value	H _d = 5,23 (kN)

Value of force preventing foundation sliding:
 - On the foundation level: R_d = 22,42 (kN)
 Stability for sliding: 4.285 > 1

Average settlement

Fy=2,92	Soil type under foundation:	not layered
	Design combination	SLS : SLS 13 N=45,26 Mx=18,18 My=-4,34 Fx=4,79
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 14,35 (kN)
	Average stress caused by design load:	q = 0,05 (MPa)
	Thickness of the actively settling soil:	z = 1,80 (m)
	Stress on the level z:	
	- Additional:	σ _{zd} = 0,01 (MPa)
	- Caused by soil weight:	σ _{zγ} = 0,05 (MPa)
	Settlement:	
	- Original	s' = 0,0 (cm)
	- Secondary	s'' = 0,0 (cm)
	- TOTAL	S = 0,0 (cm) < S _{adm} = 5,0 (cm)
	Safety factor:	134.1 > 1

Settlement difference

Fy=2,92	Design combination	SLS : SLS 13 N=45,26 Mx=18,18 My=-4,34 Fx=4,79
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Settlement difference:	S = 0,0 (cm) < S _{adm} = 5,0 (cm)

Safety factor: 243.6 > 1

Rotation

Fy=4,75	<u>About OX axis</u>	
	Design combination	ULS : ULS 31 N=79,45 Mx=32,10 My=-9,25 Fx=7,44
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 14,35 (kN)
	Design load:	Nr = 93,80 (kN) Mx = 9,86 (kN*m) My = -5,54 (kN*m)
	Stability moment:	Mstab = 83,21 (kN*m)
	Rotation moment:	Mrenv = 32,10 (kN*m)
	Stability for rotation:	2.592 > 1
	<u>About OY axis</u>	
	Design combination:	ULS : ULS 31 N=79,45 Mx=32,10 My=-9,25 Fx=7,44
Fy=4,75	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 14,35 (kN)
	Design load:	Nr = 93,80 (kN) Mx = 9,86 (kN*m) My = -5,54 (kN*m)
	Stability moment:	Mstab = 45,93 (kN*m)
	Rotation moment:	Mrenv = 9,25 (kN*m)
	Stability for rotation:	4.963 > 1

1.3 RC design

1.3.1 Assumptions

- Exposure : XC2
- Structure class : S1

1.3.2 Analysis of punching and shear

Punching

Fy=4,75	Design combination	ULS : ULS 31 N=79,45 Mx=32,10 My=-9,25 Fx=7,44
	Load factors:	1.35 * Foundation weight 1.35 * Soil weight
	Design load:	Nr = 98,82 (kN) Mx = 9,86 (kN*m) My = -5,54 (kN*m)
	Length of critical circumference:	1,44 (m)
	Punching force:	60,00 (kN)
	Section effective height	heff = 0,43 (m)
	Reinforcement ratio:	$\rho = 0.14 \%$
	Shear stress:	0,16 (MPa)
	Admissible shear stress:	1,91 (MPa)
	Safety factor:	11.83 > 1

1.3.3 Required reinforcement

Spread footing:

bottom:

ULS : ULS 31 N=79,45 Mx=32,10 My=-9,25 Fx=7,44 Fy=4,75
 My = 5,54 (kN*m) $A_{sx} = 5,81 \text{ (cm}^2\text{/m)}$

ULS : ULS 31 N=79,45 Mx=32,10 My=-9,25 Fx=7,44 Fy=4,75
 Mx = 23,21 (kN*m) $A_{sy} = 5,81 \text{ (cm}^2\text{/m)}$

$A_{s \text{ min}} = 5,81 \text{ (cm}^2\text{/m)}$

top:

$A'_{sx} = 0,00 \text{ (cm}^2\text{/m)}$

$A'_{sy} = 0,00 \text{ (cm}^2\text{/m)}$

$A_{s \text{ min}} = 0,00 \text{ (cm}^2\text{/m)}$

Column pier:

Longitudinal reinforcement $A = 0,00 \text{ (cm}^2)$ $A_{\text{min.}} = 0,00 \text{ (cm}^2)$

$A = 2 * (Asx + Asy)$

$Asx = 0,00 \text{ (cm}^2)$ $Asy = 0,00 \text{ (cm}^2)$

1.3.4 Provided reinforcement**Spread footing:****Bottom:**

Along X axis:

7 B500C 12 $l = 0,92 \text{ (m)}$ $e = 1*-0,53 + 6*0,18$

Along Y axis:

5 B500C 12 $l = 1,32 \text{ (m)}$ $e = 1*-0,33 + 4*0,17$

Pier

Longitudinal reinforcement

Along X axis:

2 B500C 12 $l = 2,09 \text{ (m)}$ $e = 1*-0,29 + 1*0,58$

Along Y axis:

2 B500C 12 $l = 2,14 \text{ (m)}$ $e = 1*-0,04 + 1*0,58$

Transversal reinforcement

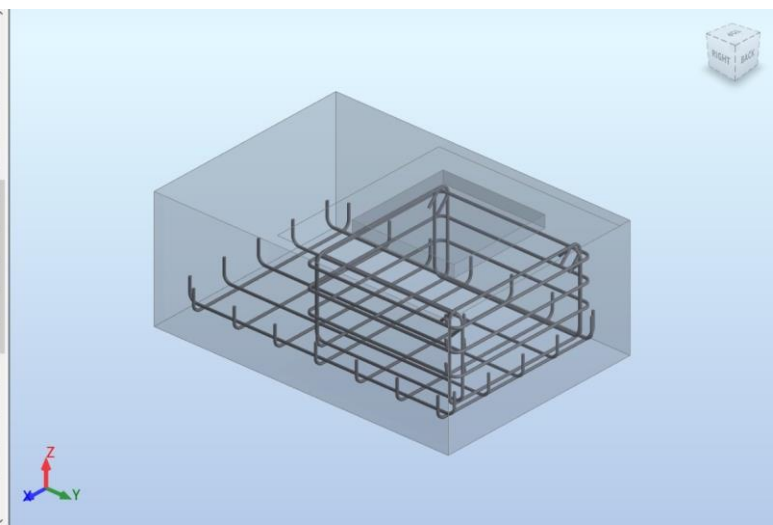
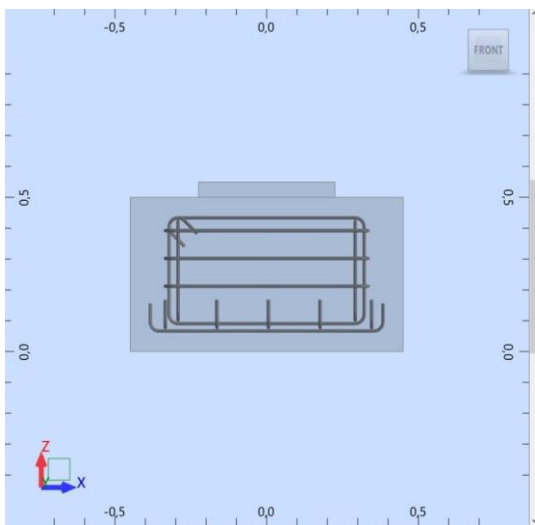
3 B500C 12 $l = 2,83 \text{ (m)}$ $e = 1*0,21 + 2*0,09$

2 Material survey:

- Concrete volume = 0,59 (m3)
- Formwork = 2,20 (m2)
- Steel B500C
 - Total weight = 26,67 (kG)
 - Density = 45,59 (kG/m3)
 - Average diameter = 12,0 (mm)

- Survey according to diameters:

Diameter	Length (m)	Number of identical elements:
12	0,92	7
12	1,32	5
12	2,09	2
12	2,14	2
12	2,83	3



1 ΠΕΔΙΟ 2Γ elements: 1

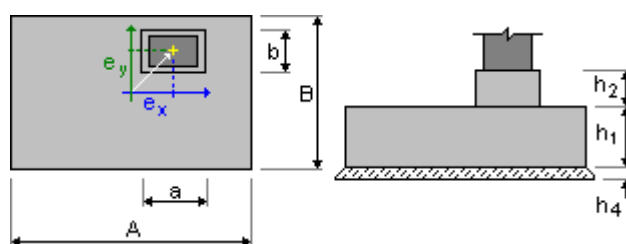
Number of identical

1.1 Basic data

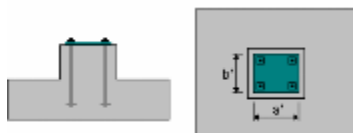
1.1.1 Assumptions

- Geotechnic calculations according to : EN 1997-1:2004/A1:2013
- Concrete calculations according to : EN 1992-1-1:2004/A1:2014
- Shape selection : without limits

1.1.2 Geometry:



A	= 0,90 (m)	a	= 0,80 (m)
B	= 0,90 (m)	b	= 0,80 (m)
h1	= 0,50 (m)	e_x	= 0,00 (m)
h2	= 0,00 (m)	e_y	= 0,00 (m)
h4	= 0,05 (m)		



a'	= 45,0 (cm)
b'	= 45,0 (cm)
c_{nom1}	= 6,0 (cm)
c_{nom2}	= 6,0 (cm)
Cover deviations: $C_{dev} = 1,0(\text{cm})$, $C_{dur} = 0,0(\text{cm})$	

1.1.3 Materials

- Concrete : C25/30; Characteristic strength = 25,00 MPa
Unit weight = 2501,36 (kG/m³)
Rectangular stress distribution [3.1.7(3)]
- Longitudinal reinforcement : type B500C Characteristic strength = 500,00 MPa
Ductility class: C
Horizontal branch of the stress-strain diagram
- Transversal reinforcement : type B500C Characteristic strength = 500,00 MPa
- Additional reinforcement: : type B500C Characteristic strength = 500,00 MPa

1.1.4 Loads:

Foundation loads:

Case	Nature	Group	N (kN)	Fx (kN)	Fy (kN)	Mx (kN*m)	My (kN*m)		
ULS 1	design(Structural)	----	38,46	-0,18	0,00	-0,41	5,80		
ULS 2	design(Structural)	----	42,09	-0,23	0,00	-0,54	5,67		
ULS 3	design(Structural)	----	38,46	-0,18	0,00	-0,41	5,80		
ULS 4	design(Structural)	----	42,09	-0,23	0,00	-0,54	5,67		
ULS 5	design(Structural)	----	42,09	-0,23	0,00	-0,54	5,67		
ULS 6	design(Structural)	----	42,09	-0,23	0,00	-0,54	5,67		
ULS 7	design(Structural)	----	35,56	-0,13	0,00	-0,30	5,90		
ULS 8	design(Structural)	----	35,56	-0,13	0,00	-0,30	5,90		
ULS 9	design(Structural)	----	35,56	-0,13	0,00	-0,30	5,90		
ULS 10	design(Structural)	----	39,19	-0,19	0,00	-0,43	5,77		
ULS 11	design(Structural)	----	39,19	-0,19	0,00	-0,43	5,77		
ULS 12	design(Structural)	----	39,19	-0,19	0,00	-0,43	5,77		
ULS 13	design(Structural)	----	35,56	-0,13	0,00	-0,30	5,90		
ULS 14	design(Structural)	----	42,82	-0,24	0,00	-0,56	5,64		
ULS 15	design(Structural)	----	42,82	-0,24	0,00	-0,56	5,64		
ULS 16	design(Structural)	----	42,82	-0,24	0,00	-0,56	5,64		
ULS 17	design(Structural)	----	42,82	-0,24	0,00	-0,56	5,64		
SEISM 1	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 2	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 3	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 4	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 5	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 6	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 7	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 8	design	----	32,66	-0,09	0,00	-0,20	6,00		
SEISM 9	design	----	24,57	-0,07	0,00	-0,16	4,43		
SLS 1	design(Non-structural)	----	31,34	-0,17	0,00	-0,40	4,19		
SLS 2	design(Non-structural)	----	31,34	-0,17	0,00	-0,40	4,19		
SLS 3	design(Non-structural)	----	31,34	-0,17	0,00	-0,40	4,19		
SLS 4	design(Non-structural)	----	30,37	-0,16	0,00	-0,37	4,23		
SLS 5	design(Non-structural)	----	30,37	-0,16	0,00	-0,37	4,23		
SLS 6	design(Non-structural)	----	30,37	-0,16	0,00	-0,37	4,23		
SLS 7	design(Non-structural)	----	30,37	-0,16	0,00	-0,37	4,23		
TEMP NEGATIVE	design(Structural)	----			0,14	0,14	-0,00	0,00	0,35
ULS 18	design(Structural)	----	38,36	-0,28	0,00	-0,41	5,54		
ULS 19	design(Structural)	----	38,46	-0,18	0,00	-0,41	5,80		
ULS 20	design(Structural)	----	38,36	-0,28	0,00	-0,41	5,54		
ULS 21	design(Structural)	----	38,46	-0,18	0,00	-0,41	5,80		
ULS 22	design(Structural)	----	38,36	-0,28	0,00	-0,41	5,54		
ULS 23	design(Structural)	----	38,46	-0,18	0,00	-0,41	5,80		
ULS 24	design(Structural)	----	38,36	-0,28	0,00	-0,41	5,54		
ULS 25	design(Structural)	----	67,23	-0,39	0,00	-0,71	9,95		
ULS 26	design(Structural)	----	38,36	-0,28	0,00	-0,41	5,54		
ULS 27	design(Structural)	----	67,23	-0,39	0,00	-0,71	9,95		
ULS 28	design(Structural)	----	42,71	-0,35	0,00	-0,56	5,38		
ULS 29	design(Structural)	----	71,58	-0,45	0,00	-0,87	9,80		
ULS 30	design(Structural)	----	35,35	-0,35	0,00	-0,30	5,38		
ULS 31	design(Structural)	----	93,09	-0,56	0,00	-0,92	14,20		
ULS 32	design(Structural)	----	38,46	-0,18	0,00	-0,41	5,80		
ULS 33	design(Structural)	----	42,09	-0,23	0,00	-0,54	5,67		
ULS 34	design(Structural)	----	35,56	-0,13	0,00	-0,30	5,90		
ULS 35	design(Structural)	----	39,19	-0,19	0,00	-0,43	5,77		
ULS 36	design(Structural)	----	35,56	-0,13	0,00	-0,30	5,90		
ULS 37	design(Structural)	----	42,82	-0,24	0,00	-0,56	5,64		
SLS 8	design(Non-structural)	----	31,34	-0,17	0,00	-0,40	4,19		
SLS 9	design(Non-structural)	----	30,37	-0,16	0,00	-0,37	4,23		
SLS 10	design(Non-structural)	----	31,25	-0,26	0,00	-0,40	3,99		
SLS 11	design(Non-structural)	----	53,38	-0,33	0,00	-0,61	7,55		
SLS 12	design(Non-structural)	----	31,25	-0,26	0,00	-0,40	3,99		
SLS 13	design(Non-structural)	----	53,38	-0,33	0,00	-0,61	7,55		

Backfill loads:

Case	Nature	Q1 (kN/m2)
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1.1.5 Combination list

1/	ULS : ULS 1 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
2/	ULS : ULS 2 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
3/	ULS : ULS 3 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
4/	ULS : ULS 4 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00

5/ ULS : ULS 5 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
6/ ULS : ULS 6 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
7/ ULS : ULS 7 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
8/ ULS : ULS 8 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
9/ ULS : ULS 9 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
10/ ULS : ULS 10 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
11/ ULS : ULS 11 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
12/ ULS : ULS 12 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
13/ ULS : ULS 13 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
14/ ULS : ULS 14 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
15/ ULS : ULS 15 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
16/ ULS : ULS 16 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
17/ ULS : ULS 17 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
18/ ULS : TEMP NEGATIVE N=0,14 Mx=0,00 My=0,35 Fx=0,14 Fy=-0,00
19/ ULS : ULS 18 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
20/ ULS : ULS 19 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
21/ ULS : ULS 20 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
22/ ULS : ULS 21 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
23/ ULS : ULS 22 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
24/ ULS : ULS 23 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
25/ ULS : ULS 24 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
26/ ULS : ULS 25 N=67,23 Mx=-0,71 My=9,95 Fx=-0,39 Fy=0,00
27/ ULS : ULS 26 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
28/ ULS : ULS 27 N=67,23 Mx=-0,71 My=9,95 Fx=-0,39 Fy=0,00
29/ ULS : ULS 28 N=42,71 Mx=-0,56 My=5,38 Fx=-0,35 Fy=0,00
30/ ULS : ULS 29 N=71,58 Mx=-0,87 My=9,80 Fx=-0,45 Fy=0,00
31/ ULS : ULS 30 N=35,35 Mx=-0,30 My=5,38 Fx=-0,35 Fy=0,00
32/ ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-0,56 Fy=0,00
33/ ULS : ULS 32 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
34/ ULS : ULS 33 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
35/ ULS : ULS 34 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
36/ ULS : ULS 35 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
37/ ULS : ULS 36 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
38/ ULS : ULS 37 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
39/ SLS : SLS 1 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
40/ SLS : SLS 2 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
41/ SLS : SLS 3 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
42/ SLS : SLS 4 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
43/ SLS : SLS 5 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
44/ SLS : SLS 6 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
45/ SLS : SLS 7 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
46/ SLS : SLS 8 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
47/ SLS : SLS 9 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
48/ SLS : SLS 10 N=31,25 Mx=-0,40 My=3,99 Fx=-0,26 Fy=0,00
49/ SLS : SLS 11 N=53,38 Mx=-0,61 My=7,55 Fx=-0,33 Fy=0,00
50/ SLS : SLS 12 N=31,25 Mx=-0,40 My=3,99 Fx=-0,26 Fy=0,00
51/ SLS : SLS 13 N=53,38 Mx=-0,61 My=7,55 Fx=-0,33 Fy=0,00
52/ ALS : SEISM 1 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
53/ ALS : SEISM 2 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
54/ ALS : SEISM 3 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
55/ ALS : SEISM 4 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
56/ ALS : SEISM 5 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
57/ ALS : SEISM 6 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
58/ ALS : SEISM 7 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
59/ ALS : SEISM 8 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
60/ ALS : SEISM 9 N=24,57 Mx=-0,16 My=4,43 Fx=-0,07 Fy=0,00
61/* ULS : ULS 1 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
62/* ULS : ULS 2 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
63/* ULS : ULS 3 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
64/* ULS : ULS 4 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
65/* ULS : ULS 5 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
66/* ULS : ULS 6 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
67/* ULS : ULS 7 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
68/* ULS : ULS 8 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
69/* ULS : ULS 9 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
70/* ULS : ULS 10 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
71/* ULS : ULS 11 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
72/* ULS : ULS 12 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
73/* ULS : ULS 13 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
74/* ULS : ULS 14 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
75/* ULS : ULS 15 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
76/* ULS : ULS 16 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
77/* ULS : ULS 17 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
78/* ULS : TEMP NEGATIVE N=0,14 Mx=0,00 My=0,35 Fx=0,14 Fy=-0,00

79/* ULS : ULS 18 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
 80/* ULS : ULS 19 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
 81/* ULS : ULS 20 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
 82/* ULS : ULS 21 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
 83/* ULS : ULS 22 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
 84/* ULS : ULS 23 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
 85/* ULS : ULS 24 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
 86/* ULS : ULS 25 N=67,23 Mx=-0,71 My=9,95 Fx=-0,39 Fy=0,00
 87/* ULS : ULS 26 N=38,36 Mx=-0,41 My=5,54 Fx=-0,28 Fy=0,00
 88/* ULS : ULS 27 N=67,23 Mx=-0,71 My=9,95 Fx=-0,39 Fy=0,00
 89/* ULS : ULS 28 N=42,71 Mx=-0,56 My=5,38 Fx=-0,35 Fy=0,00
 90/* ULS : ULS 29 N=71,58 Mx=-0,87 My=9,80 Fx=-0,45 Fy=0,00
 91/* ULS : ULS 30 N=35,35 Mx=-0,30 My=5,38 Fx=-0,35 Fy=0,00
 92/* ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-0,56 Fy=0,00
 93/* ULS : ULS 32 N=38,46 Mx=-0,41 My=5,80 Fx=-0,18 Fy=0,00
 94/* ULS : ULS 33 N=42,09 Mx=-0,54 My=5,67 Fx=-0,23 Fy=0,00
 95/* ULS : ULS 34 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
 96/* ULS : ULS 35 N=39,19 Mx=-0,43 My=5,77 Fx=-0,19 Fy=0,00
 97/* ULS : ULS 36 N=35,56 Mx=-0,30 My=5,90 Fx=-0,13 Fy=0,00
 98/* ULS : ULS 37 N=42,82 Mx=-0,56 My=5,64 Fx=-0,24 Fy=0,00
 99/* SLS : SLS 1 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
 100/* SLS : SLS 2 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
 101/* SLS : SLS 3 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
 102/* SLS : SLS 4 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
 103/* SLS : SLS 5 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
 104/* SLS : SLS 6 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
 105/* SLS : SLS 7 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
 106/* SLS : SLS 8 N=31,34 Mx=-0,40 My=4,19 Fx=-0,17 Fy=0,00
 107/* SLS : SLS 9 N=30,37 Mx=-0,37 My=4,23 Fx=-0,16 Fy=0,00
 108/* SLS : SLS 10 N=31,25 Mx=-0,40 My=3,99 Fx=-0,26 Fy=0,00
 109/* SLS : SLS 11 N=53,38 Mx=-0,61 My=7,55 Fx=-0,33 Fy=0,00
 110/* SLS : SLS 12 N=31,25 Mx=-0,40 My=3,99 Fx=-0,26 Fy=0,00
 111/* SLS : SLS 13 N=53,38 Mx=-0,61 My=7,55 Fx=-0,33 Fy=0,00
 112/* ALS : SEISM 1 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 113/* ALS : SEISM 2 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 114/* ALS : SEISM 3 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 115/* ALS : SEISM 4 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 116/* ALS : SEISM 5 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 117/* ALS : SEISM 6 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 118/* ALS : SEISM 7 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 119/* ALS : SEISM 8 N=32,66 Mx=-0,20 My=6,00 Fx=-0,09 Fy=0,00
 120/* ALS : SEISM 9 N=24,57 Mx=-0,16 My=4,43 Fx=-0,07 Fy=0,00

1.2 Geotechnical design

1.2.1 Assumptions

- Cohesion reduction coefficient: 0,00
- Smooth precast foundation 6.5.3(10)
- Sliding with soil pressure considered: for X and Y directions
- Design approach: 1
A1 + M1 + R1

$$\gamma_{\phi'} = 1,00$$

$$\gamma_{c'} = 1,00$$

$$\gamma_{cu} = 1,00$$

$$\gamma_{qu} = 1,00$$

$$\gamma_{\gamma} = 1,00$$

$$\gamma_{R,v} = 1,00$$

$$\gamma_{R,h} = 1,00$$

$$A2 + M2 + R1$$

$$\gamma_{\phi'} = 1,25$$

$$\gamma_{c'} = 1,25$$

$$\gamma_{cu} = 1,40$$

$$\gamma_{qu} = 1,40$$

$$\gamma_{\gamma} = 1,00$$

$$\gamma_{R,v} = 1,00$$

$$\gamma_{R,h} = 1,00$$

1.2.2 Soil:

Soil level:	N_1	= 0,00 (m)
Column pier level:	N_a	= 0,00 (m)
Minimum reference level:	N_f	= -0,50 (m)

Clay

- Soil level: 0.00 (m)
- Unit weight: 2243.38 (kG/m³)
- Unit weight of solid: 2753.23 (kG/m³)
- Internal friction angle: 25.0 (Deg)
- Cohesion: 0.06 (MPa)

1.2.3 Limit states

Stress calculations

Soil type under foundation: not layered

Design combination **ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-**

0,56 Fy=0,00

Load factors: **1.35** * Foundation weight

1.35 * Soil weight

Calculation results: On the foundation level

Weight of foundation and soil over it: Gr = 13,41 (kN)

Design load:

$$N_r = 106,50 \text{ (kN)} \quad M_x = -0,92 \text{ (kN*m)} \quad M_y = 13,92 \text{ (kN*m)}$$

Allowable stress calculation method: Semi-empirical - stress limit

Load eccentricity:

$$|e_B| = 0,13 \text{ (m)} \quad |e_L| = 0,01 \text{ (m)}$$

Equivalent foundation dimensions:

$$B' = B - 2|e_B| = 0,64 \text{ (m)}$$

$$L' = L - 2|e_L| = 0,88 \text{ (m)}$$

$$q_u = 0.30 \text{ (MPa)}$$

$$p_{le}^* = 0,32 \text{ (MPa)}$$

$$D_e = D_{min} - d = 0,50 \text{ (m)}$$

$$k_p = 0,94$$

$$q'_{o} = 0,01 \text{ (MPa)}$$

$$q_u = k_p * (p_{le}^*) + q'_{o} = 0,31 \text{ (MPa)}$$

Stress in soil: $q_{ref} = 0.25 \text{ (MPa)}$

Safety factor: $q_{lim} / q_{ref} = 1.233 > 1$

Uplift

0,56 Fy=0,00	<u>Uplift in ULS</u>	
	Design combination	ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Contact area:	s = 0,16 s _{lim} = 0,17

Sliding

Fx=0,14 Fy=-0,00	Design combination	ULS : TEMP NEGATIVE N=0,14 Mx=0,00 My=0,35
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 9,93 (kN)
	Design load:	
	Nr = 10,07 (kN)	Mx = 0,00 (kN*m) My = 0,42 (kN*m)
	Equivalent foundation dimensions:	A ₋ = 0,90 (m) B ₋ = 0,90 (m)
	Sliding area:	0,81 (m ²)
	Foundation/soil friction coefficient:	tan(δ _d) = 0,30
	Cohesion:	c _u = 0.06 (MPa)
	Soil pressure considered:	
	Hx = 0,14 (kN)	Hy = -0,00 (kN)
	Ppx = -3,05 (kN)	Ppy = 3,05 (kN)
	Pax = 0,50 (kN)	Pay = -0,50 (kN)
	Sliding force value	H _d = 0,00 (kN)
	Value of force preventing foundation sliding:	
	- On the foundation level:	R _d = 3,02 (kN)
	Stability for sliding:	∞

Average settlement

Fy=0,00	Soil type under foundation:	not layered
	Design combination	SLS : SLS 13 N=53,38 Mx=-0,61 My=7,55 Fx=-0,33
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 9,93 (kN)
	Average stress caused by design load:	q = 0,08 (MPa)
	Thickness of the actively settling soil:	z = 1,80 (m)
	Stress on the level z:	
	- Additional:	σ _{zd} = 0,01 (MPa)
	- Caused by soil weight:	σ _{zγ} = 0,05 (MPa)
	Settlement:	
	- Original	s' = 0,1 (cm)
	- Secondary	s'' = 0,0 (cm)
	- TOTAL	S = 0,1 (cm) < S _{adm} = 5,0 (cm)
	Safety factor:	89.94 > 1

Settlement difference

Fy=0,00	Design combination	SLS : SLS 13 N=53,38 Mx=-0,61 My=7,55 Fx=-0,33
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Settlement difference:	S = 0,1 (cm) < S _{adm} = 5,0 (cm)

Safety factor: 45.43 > 1

Rotation

Fy=0,00	<u>About OX axis</u>	
	Design combination	ULS : ULS 28 N=42,71 Mx=-0,56 My=5,38 Fx=-0,35
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 9,93 (kN)
	Design load:	Nr = 52,64 (kN) Mx = -0,56 (kN*m) My = 5,21 (kN*m)
	Stability moment:	Mstab = 23,69 (kN*m)
	Rotation moment:	Mrenv = 0,56 (kN*m)
	Stability for rotation:	42.08 > 1
0,56 Fy=0,00	<u>About OY axis</u>	
	Design combination:	ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 9,93 (kN)
	Design load:	Nr = 103,03 (kN) Mx = -0,92 (kN*m) My = 13,92 (kN*m)
	Stability moment:	Mstab = 46,64 (kN*m)
	Rotation moment:	Mrenv = 14,20 (kN*m)
	Stability for rotation:	3.284 > 1

1.3 RC design

1.3.1 Assumptions

- Exposure : XC2
- Structure class : S1

1.3.2 Analysis of punching and shear

Punching

Fy=0,00	Design combination	ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-0,56
	Load factors:	1.35 * Foundation weight 1.35 * Soil weight
	Design load:	Nr = 106,50 (kN) Mx = -0,92 (kN*m) My = 13,92 (kN*m)
	Length of critical circumference:	2,34 (m)
	Punching force:	49,39 (kN)
	Section effective height	heff = 0,43 (m)
	Reinforcement ratio:	$\rho = 0.14 \%$
	Shear stress:	0,08 (MPa)
	Admissible shear stress:	3,82 (MPa)
	Safety factor:	48 > 1

1.3.3 Required reinforcement

Spread footing:

bottom:

ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-0,56 Fy=0,00
 My = 8,27 (kN*m) $A_{sx} = 5,81 \text{ (cm}^2\text{/m)}$

ULS : ULS 31 N=93,09 Mx=-0,92 My=14,20 Fx=-0,56 Fy=0,00
 Mx = 5,04 (kN*m) $A_{sy} = 5,81 \text{ (cm}^2\text{/m)}$

$A_{s \text{ min}} = 5,81 \text{ (cm}^2\text{/m)}$

top:

$A'_{sx} = 0,00 \text{ (cm}^2\text{/m)}$

$A'_{sy} = 0,00 \text{ (cm}^2\text{/m)}$

$A_{s \text{ min}} = 0,00 \text{ (cm}^2\text{/m)}$

Column pier:

Longitudinal reinforcement $A = 0,00 \text{ (cm}^2)$ $A_{\text{min.}} = 0,00 \text{ (cm}^2)$

$A = 2 * (Asx + Asy)$

$Asx = 0,00 \text{ (cm}^2)$ $Asy = 0,00 \text{ (cm}^2)$

1.3.4 Provided reinforcement**Spread footing:****Bottom:**

Along X axis:

5 B500C 12 $l = 0,92 \text{ (m)}$ $e = 1 * -0,33 + 4 * 0,17$

Along Y axis:

5 B500C 12 $l = 0,92 \text{ (m)}$ $e = 1 * -0,33 + 4 * 0,17$

Pier

Longitudinal reinforcement

Along X axis:

2 B500C 12 $l = 2,09 \text{ (m)}$ $e = 1 * -0,29 + 1 * 0,58$

Along Y axis:

2 B500C 12 $l = 2,14 \text{ (m)}$ $e = 1 * -0,29 + 1 * 0,58$

Transversal reinforcement

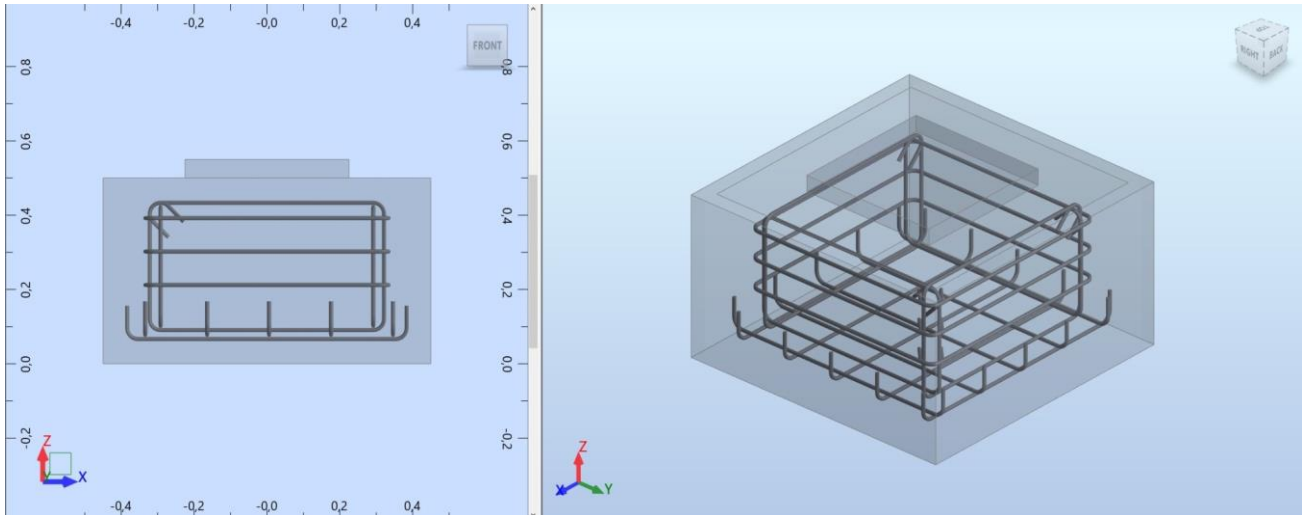
3 B500C 12 $l = 2,83 \text{ (m)}$ $e = 1 * 0,21 + 2 * 0,09$

2 Material survey:

- Concrete volume = 0,41 (m3)
- Formwork = 1,80 (m2)
- Steel B500C
 - Total weight = 23,26 (kG)
 - Density = 57,42 (kG/m3)
 - Average diameter = 12,0 (mm)

- Survey according to diameters:

Diameter	Length (m)	Number of identical elements:
12	0,92	10
12	2,09	2
12	2,14	2
12	2,83	3



1 ΠΕΔΙΟ 2A elements: 1

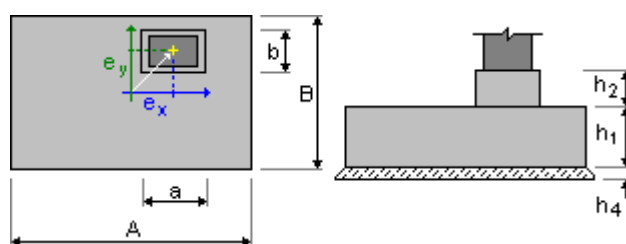
Number of identical

1.1 Basic data

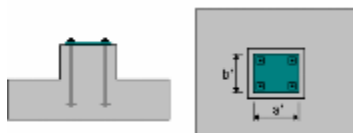
1.1.1 Assumptions

- Geotechnic calculations according to : EN 1997-1:2004/A1:2013
- Concrete calculations according to : EN 1992-1-1:2004/A1:2014
- Shape selection : without limits

1.1.2 Geometry:



A	= 0,90 (m)	a	= 0,80 (m)
B	= 0,90 (m)	b	= 0,80 (m)
h1	= 0,50 (m)	e_x	= 0,00 (m)
h2	= 0,00 (m)	e_y	= 0,00 (m)
h4	= 0,05 (m)		



a'	= 45,0 (cm)
b'	= 45,0 (cm)
c_{nom1}	= 6,0 (cm)
c_{nom2}	= 6,0 (cm)
Cover deviations: $C_{dev} = 1,0(\text{cm})$, $C_{dur} = 0,0(\text{cm})$	

1.1.3 Materials

- Concrete : C25/30; Characteristic strength = 25,00 MPa
Unit weight = 2501,36 (kG/m³)
Rectangular stress distribution [3.1.7(3)]
- Longitudinal reinforcement : type B500C Characteristic strength = 500,00 MPa
Ductility class: C
Horizontal branch of the stress-strain diagram
- Transversal reinforcement : type B500C Characteristic strength = 500,00 MPa
- Additional reinforcement: : type B500C Characteristic strength = 500,00 MPa

1.1.4 Loads:

Foundation loads:

Case	Nature	Group	N (kN)	Fx (kN)	Fy (kN)	Mx (kN*m)	My (kN*m)		
ULS 1	design(Structural)	----	38,46	0,18	0,00	-0,41	-5,80		
ULS 2	design(Structural)	----	42,09	0,23	0,00	-0,54	-5,67		
ULS 3	design(Structural)	----	38,46	0,18	0,00	-0,41	-5,80		
ULS 4	design(Structural)	----	42,09	0,23	0,00	-0,54	-5,67		
ULS 5	design(Structural)	----	42,09	0,23	0,00	-0,54	-5,67		
ULS 6	design(Structural)	----	42,09	0,23	0,00	-0,54	-5,67		
ULS 7	design(Structural)	----	35,56	0,13	0,00	-0,30	-5,90		
ULS 8	design(Structural)	----	35,56	0,13	0,00	-0,30	-5,90		
ULS 9	design(Structural)	----	35,56	0,13	0,00	-0,30	-5,90		
ULS 10	design(Structural)	----	39,19	0,19	0,00	-0,43	-5,77		
ULS 11	design(Structural)	----	39,19	0,19	0,00	-0,43	-5,77		
ULS 12	design(Structural)	----	39,19	0,19	0,00	-0,43	-5,77		
ULS 13	design(Structural)	----	35,56	0,13	0,00	-0,30	-5,90		
ULS 14	design(Structural)	----	42,82	0,24	0,00	-0,56	-5,64		
ULS 15	design(Structural)	----	42,82	0,24	0,00	-0,56	-5,64		
ULS 16	design(Structural)	----	42,82	0,24	0,00	-0,56	-5,64		
ULS 17	design(Structural)	----	42,82	0,24	0,00	-0,56	-5,64		
SEISM 1	design	----	32,66	0,09	0,00	-0,20	-6,00		
SEISM 2	design	----	32,66	0,09	0,00	-0,20	-6,00		
SEISM 3	design	----	32,66	0,09	0,00	-0,20	-6,00		
SEISM 4	design	----	32,66	0,09	0,00	-0,20	-6,00		
SEISM 5	design	----	32,66	0,09	0,00	-0,20	-6,00		
SEISM 6	design	----	32,66	0,09	0,00	-0,20	-6,00		
SEISM 7	design	----	32,66	0,09	0,00	-0,20	-6,00		
SEISM 8	design	----	32,66	0,09	0,00	-0,20	-6,00		
SEISM 9	design	----	24,57	0,07	0,00	-0,16	-4,43		
SLS 1	design(Non-structural)	----	31,34	0,17	0,00	-0,40	-4,19		
SLS 2	design(Non-structural)	----	31,34	0,17	0,00	-0,40	-4,19		
SLS 3	design(Non-structural)	----	31,34	0,17	0,00	-0,40	-4,19		
SLS 4	design(Non-structural)	----	30,37	0,16	0,00	-0,37	-4,23		
SLS 5	design(Non-structural)	----	30,37	0,16	0,00	-0,37	-4,23		
SLS 6	design(Non-structural)	----	30,37	0,16	0,00	-0,37	-4,23		
SLS 7	design(Non-structural)	----	30,37	0,16	0,00	-0,37	-4,23		
TEMP NEGATIVE	design(Structural)	----			0,14	-0,14	-0,00	0,00	-0,35
ULS 18	design(Structural)	----	38,36	0,28	0,00	-0,41	-5,54		
ULS 19	design(Structural)	----	38,46	0,18	0,00	-0,41	-5,80		
ULS 20	design(Structural)	----	38,36	0,28	0,00	-0,41	-5,54		
ULS 21	design(Structural)	----	38,46	0,18	0,00	-0,41	-5,80		
ULS 22	design(Structural)	----	38,36	0,28	0,00	-0,41	-5,54		
ULS 23	design(Structural)	----	38,46	0,18	0,00	-0,41	-5,80		
ULS 24	design(Structural)	----	38,36	0,28	0,00	-0,41	-5,54		
ULS 25	design(Structural)	----	67,23	0,39	0,00	-0,71	-9,95		
ULS 26	design(Structural)	----	38,36	0,28	0,00	-0,41	-5,54		
ULS 27	design(Structural)	----	67,23	0,39	0,00	-0,71	-9,95		
ULS 28	design(Structural)	----	42,71	0,35	0,00	-0,56	-5,38		
ULS 29	design(Structural)	----	71,58	0,45	0,00	-0,87	-9,80		
ULS 30	design(Structural)	----	35,35	0,35	0,00	-0,30	-5,38		
ULS 31	design(Structural)	----	93,09	0,56	0,00	-0,92	-14,20		
ULS 32	design(Structural)	----	38,46	0,18	0,00	-0,41	-5,80		
ULS 33	design(Structural)	----	42,09	0,23	0,00	-0,54	-5,67		
ULS 34	design(Structural)	----	35,56	0,13	0,00	-0,30	-5,90		
ULS 35	design(Structural)	----	39,19	0,19	0,00	-0,43	-5,77		
ULS 36	design(Structural)	----	35,56	0,13	0,00	-0,30	-5,90		
ULS 37	design(Structural)	----	42,82	0,24	0,00	-0,56	-5,64		
SLS 8	design(Non-structural)	----	31,34	0,17	0,00	-0,40	-4,19		
SLS 9	design(Non-structural)	----	30,37	0,16	0,00	-0,37	-4,23		
SLS 10	design(Non-structural)	----	31,25	0,26	0,00	-0,40	-3,99		
SLS 11	design(Non-structural)	----	53,38	0,33	0,00	-0,61	-7,55		
SLS 12	design(Non-structural)	----	31,25	0,26	0,00	-0,40	-3,99		
SLS 13	design(Non-structural)	----	53,38	0,33	0,00	-0,61	-7,55		

Backfill loads:

Case	Nature	Q1 (kN/m2)
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1.1.5 Combination list

1/	ULS : ULS 1 N=38,46 Mx=-0,41 My=-5,80 Fx=0,18 Fy=0,00
2/	ULS : ULS 2 N=42,09 Mx=-0,54 My=-5,67 Fx=0,23 Fy=0,00
3/	ULS : ULS 3 N=38,46 Mx=-0,41 My=-5,80 Fx=0,18 Fy=0,00
4/	ULS : ULS 4 N=42,09 Mx=-0,54 My=-5,67 Fx=0,23 Fy=0,00

5/ ULS : ULS 5 N=42,09 Mx=-0,54 My=-5,67 Fx=0,23 Fy=0,00
6/ ULS : ULS 6 N=42,09 Mx=-0,54 My=-5,67 Fx=0,23 Fy=0,00
7/ ULS : ULS 7 N=35,56 Mx=-0,30 My=-5,90 Fx=0,13 Fy=0,00
8/ ULS : ULS 8 N=35,56 Mx=-0,30 My=-5,90 Fx=0,13 Fy=0,00
9/ ULS : ULS 9 N=35,56 Mx=-0,30 My=-5,90 Fx=0,13 Fy=0,00
10/ ULS : ULS 10 N=39,19 Mx=-0,43 My=-5,77 Fx=0,19 Fy=0,00
11/ ULS : ULS 11 N=39,19 Mx=-0,43 My=-5,77 Fx=0,19 Fy=0,00
12/ ULS : ULS 12 N=39,19 Mx=-0,43 My=-5,77 Fx=0,19 Fy=0,00
13/ ULS : ULS 13 N=35,56 Mx=-0,30 My=-5,90 Fx=0,13 Fy=0,00
14/ ULS : ULS 14 N=42,82 Mx=-0,56 My=-5,64 Fx=0,24 Fy=0,00
15/ ULS : ULS 15 N=42,82 Mx=-0,56 My=-5,64 Fx=0,24 Fy=0,00
16/ ULS : ULS 16 N=42,82 Mx=-0,56 My=-5,64 Fx=0,24 Fy=0,00
17/ ULS : ULS 17 N=42,82 Mx=-0,56 My=-5,64 Fx=0,24 Fy=0,00
18/ ULS : TEMP NEGATIVE N=0,14 Mx=0,00 My=-0,35 Fx=-0,14 Fy=-0,00
19/ ULS : ULS 18 N=38,36 Mx=-0,41 My=-5,54 Fx=0,28 Fy=0,00
20/ ULS : ULS 19 N=38,46 Mx=-0,41 My=-5,80 Fx=0,18 Fy=0,00
21/ ULS : ULS 20 N=38,36 Mx=-0,41 My=-5,54 Fx=0,28 Fy=0,00
22/ ULS : ULS 21 N=38,46 Mx=-0,41 My=-5,80 Fx=0,18 Fy=0,00
23/ ULS : ULS 22 N=38,36 Mx=-0,41 My=-5,54 Fx=0,28 Fy=0,00
24/ ULS : ULS 23 N=38,46 Mx=-0,41 My=-5,80 Fx=0,18 Fy=0,00
25/ ULS : ULS 24 N=38,36 Mx=-0,41 My=-5,54 Fx=0,28 Fy=0,00
26/ ULS : ULS 25 N=67,23 Mx=-0,71 My=-9,95 Fx=0,39 Fy=0,00
27/ ULS : ULS 26 N=38,36 Mx=-0,41 My=-5,54 Fx=0,28 Fy=0,00
28/ ULS : ULS 27 N=67,23 Mx=-0,71 My=-9,95 Fx=0,39 Fy=0,00
29/ ULS : ULS 28 N=42,71 Mx=-0,56 My=-5,38 Fx=0,35 Fy=0,00
30/ ULS : ULS 29 N=71,58 Mx=-0,87 My=-9,80 Fx=0,45 Fy=0,00
31/ ULS : ULS 30 N=35,35 Mx=-0,30 My=-5,38 Fx=0,35 Fy=0,00
32/ ULS : ULS 31 N=93,09 Mx=-0,92 My=-14,20 Fx=0,56 Fy=0,00
33/ ULS : ULS 32 N=38,46 Mx=-0,41 My=-5,80 Fx=0,18 Fy=0,00
34/ ULS : ULS 33 N=42,09 Mx=-0,54 My=-5,67 Fx=0,23 Fy=0,00
35/ ULS : ULS 34 N=35,56 Mx=-0,30 My=-5,90 Fx=0,13 Fy=0,00
36/ ULS : ULS 35 N=39,19 Mx=-0,43 My=-5,77 Fx=0,19 Fy=0,00
37/ ULS : ULS 36 N=35,56 Mx=-0,30 My=-5,90 Fx=0,13 Fy=0,00
38/ ULS : ULS 37 N=42,82 Mx=-0,56 My=-5,64 Fx=0,24 Fy=0,00
39/ SLS : SLS 1 N=31,34 Mx=-0,40 My=-4,19 Fx=0,17 Fy=0,00
40/ SLS : SLS 2 N=31,34 Mx=-0,40 My=-4,19 Fx=0,17 Fy=0,00
41/ SLS : SLS 3 N=31,34 Mx=-0,40 My=-4,19 Fx=0,17 Fy=0,00
42/ SLS : SLS 4 N=30,37 Mx=-0,37 My=-4,23 Fx=0,16 Fy=0,00
43/ SLS : SLS 5 N=30,37 Mx=-0,37 My=-4,23 Fx=0,16 Fy=0,00
44/ SLS : SLS 6 N=30,37 Mx=-0,37 My=-4,23 Fx=0,16 Fy=0,00
45/ SLS : SLS 7 N=30,37 Mx=-0,37 My=-4,23 Fx=0,16 Fy=0,00
46/ SLS : SLS 8 N=31,34 Mx=-0,40 My=-4,19 Fx=0,17 Fy=0,00
47/ SLS : SLS 9 N=30,37 Mx=-0,37 My=-4,23 Fx=0,16 Fy=0,00
48/ SLS : SLS 10 N=31,25 Mx=-0,40 My=-3,99 Fx=0,26 Fy=0,00
49/ SLS : SLS 11 N=53,38 Mx=-0,61 My=-7,55 Fx=0,33 Fy=0,00
50/ SLS : SLS 12 N=31,25 Mx=-0,40 My=-3,99 Fx=0,26 Fy=0,00
51/ SLS : SLS 13 N=53,38 Mx=-0,61 My=-7,55 Fx=0,33 Fy=0,00
52/ ALS : SEISM 1 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
53/ ALS : SEISM 2 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
54/ ALS : SEISM 3 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
55/ ALS : SEISM 4 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
56/ ALS : SEISM 5 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
57/ ALS : SEISM 6 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
58/ ALS : SEISM 7 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
59/ ALS : SEISM 8 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
60/ ALS : SEISM 9 N=24,57 Mx=-0,16 My=-4,43 Fx=0,07 Fy=0,00
61/* ULS : ULS 1 N=38,46 Mx=-0,41 My=-5,80 Fx=0,18 Fy=0,00
62/* ULS : ULS 2 N=42,09 Mx=-0,54 My=-5,67 Fx=0,23 Fy=0,00
63/* ULS : ULS 3 N=38,46 Mx=-0,41 My=-5,80 Fx=0,18 Fy=0,00
64/* ULS : ULS 4 N=42,09 Mx=-0,54 My=-5,67 Fx=0,23 Fy=0,00
65/* ULS : ULS 5 N=42,09 Mx=-0,54 My=-5,67 Fx=0,23 Fy=0,00
66/* ULS : ULS 6 N=42,09 Mx=-0,54 My=-5,67 Fx=0,23 Fy=0,00
67/* ULS : ULS 7 N=35,56 Mx=-0,30 My=-5,90 Fx=0,13 Fy=0,00
68/* ULS : ULS 8 N=35,56 Mx=-0,30 My=-5,90 Fx=0,13 Fy=0,00
69/* ULS : ULS 9 N=35,56 Mx=-0,30 My=-5,90 Fx=0,13 Fy=0,00
70/* ULS : ULS 10 N=39,19 Mx=-0,43 My=-5,77 Fx=0,19 Fy=0,00
71/* ULS : ULS 11 N=39,19 Mx=-0,43 My=-5,77 Fx=0,19 Fy=0,00
72/* ULS : ULS 12 N=39,19 Mx=-0,43 My=-5,77 Fx=0,19 Fy=0,00
73/* ULS : ULS 13 N=35,56 Mx=-0,30 My=-5,90 Fx=0,13 Fy=0,00
74/* ULS : ULS 14 N=42,82 Mx=-0,56 My=-5,64 Fx=0,24 Fy=0,00
75/* ULS : ULS 15 N=42,82 Mx=-0,56 My=-5,64 Fx=0,24 Fy=0,00
76/* ULS : ULS 16 N=42,82 Mx=-0,56 My=-5,64 Fx=0,24 Fy=0,00
77/* ULS : ULS 17 N=42,82 Mx=-0,56 My=-5,64 Fx=0,24 Fy=0,00
78/* ULS : TEMP NEGATIVE N=0,14 Mx=0,00 My=-0,35 Fx=-0,14 Fy=-0,00

79/* ULS : ULS 18 N=38,36 Mx=-0,41 My=-5,54 Fx=0,28 Fy=0,00
 80/* ULS : ULS 19 N=38,46 Mx=-0,41 My=-5,80 Fx=0,18 Fy=0,00
 81/* ULS : ULS 20 N=38,36 Mx=-0,41 My=-5,54 Fx=0,28 Fy=0,00
 82/* ULS : ULS 21 N=38,46 Mx=-0,41 My=-5,80 Fx=0,18 Fy=0,00
 83/* ULS : ULS 22 N=38,36 Mx=-0,41 My=-5,54 Fx=0,28 Fy=0,00
 84/* ULS : ULS 23 N=38,46 Mx=-0,41 My=-5,80 Fx=0,18 Fy=0,00
 85/* ULS : ULS 24 N=38,36 Mx=-0,41 My=-5,54 Fx=0,28 Fy=0,00
 86/* ULS : ULS 25 N=67,23 Mx=-0,71 My=-9,95 Fx=0,39 Fy=0,00
 87/* ULS : ULS 26 N=38,36 Mx=-0,41 My=-5,54 Fx=0,28 Fy=0,00
 88/* ULS : ULS 27 N=67,23 Mx=-0,71 My=-9,95 Fx=0,39 Fy=0,00
 89/* ULS : ULS 28 N=42,71 Mx=-0,56 My=-5,38 Fx=0,35 Fy=0,00
 90/* ULS : ULS 29 N=71,58 Mx=-0,87 My=-9,80 Fx=0,45 Fy=0,00
 91/* ULS : ULS 30 N=35,35 Mx=-0,30 My=-5,38 Fx=0,35 Fy=0,00
 92/* ULS : ULS 31 N=93,09 Mx=-0,92 My=-14,20 Fx=0,56 Fy=0,00
 93/* ULS : ULS 32 N=38,46 Mx=-0,41 My=-5,80 Fx=0,18 Fy=0,00
 94/* ULS : ULS 33 N=42,09 Mx=-0,54 My=-5,67 Fx=0,23 Fy=0,00
 95/* ULS : ULS 34 N=35,56 Mx=-0,30 My=-5,90 Fx=0,13 Fy=0,00
 96/* ULS : ULS 35 N=39,19 Mx=-0,43 My=-5,77 Fx=0,19 Fy=0,00
 97/* ULS : ULS 36 N=35,56 Mx=-0,30 My=-5,90 Fx=0,13 Fy=0,00
 98/* ULS : ULS 37 N=42,82 Mx=-0,56 My=-5,64 Fx=0,24 Fy=0,00
 99/* SLS : SLS 1 N=31,34 Mx=-0,40 My=-4,19 Fx=0,17 Fy=0,00
 100/* SLS : SLS 2 N=31,34 Mx=-0,40 My=-4,19 Fx=0,17 Fy=0,00
 101/* SLS : SLS 3 N=31,34 Mx=-0,40 My=-4,19 Fx=0,17 Fy=0,00
 102/* SLS : SLS 4 N=30,37 Mx=-0,37 My=-4,23 Fx=0,16 Fy=0,00
 103/* SLS : SLS 5 N=30,37 Mx=-0,37 My=-4,23 Fx=0,16 Fy=0,00
 104/* SLS : SLS 6 N=30,37 Mx=-0,37 My=-4,23 Fx=0,16 Fy=0,00
 105/* SLS : SLS 7 N=30,37 Mx=-0,37 My=-4,23 Fx=0,16 Fy=0,00
 106/* SLS : SLS 8 N=31,34 Mx=-0,40 My=-4,19 Fx=0,17 Fy=0,00
 107/* SLS : SLS 9 N=30,37 Mx=-0,37 My=-4,23 Fx=0,16 Fy=0,00
 108/* SLS : SLS 10 N=31,25 Mx=-0,40 My=-3,99 Fx=0,26 Fy=0,00
 109/* SLS : SLS 11 N=53,38 Mx=-0,61 My=-7,55 Fx=0,33 Fy=0,00
 110/* SLS : SLS 12 N=31,25 Mx=-0,40 My=-3,99 Fx=0,26 Fy=0,00
 111/* SLS : SLS 13 N=53,38 Mx=-0,61 My=-7,55 Fx=0,33 Fy=0,00
 112/* ALS : SEISM 1 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
 113/* ALS : SEISM 2 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
 114/* ALS : SEISM 3 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
 115/* ALS : SEISM 4 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
 116/* ALS : SEISM 5 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
 117/* ALS : SEISM 6 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
 118/* ALS : SEISM 7 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
 119/* ALS : SEISM 8 N=32,66 Mx=-0,20 My=-6,00 Fx=0,09 Fy=0,00
 120/* ALS : SEISM 9 N=24,57 Mx=-0,16 My=-4,43 Fx=0,07 Fy=0,00

1.2 Geotechnical design

1.2.1 Assumptions

- Cohesion reduction coefficient: 0,00
- Smooth precast foundation 6.5.3(10)
- Sliding with soil pressure considered: for X and Y directions
- Design approach: 1
A1 + M1 + R1

$$\gamma_{\phi'} = 1,00$$

$$\gamma_{c'} = 1,00$$

$$\gamma_{cu} = 1,00$$

$$\gamma_{qu} = 1,00$$

$$\gamma_{\gamma} = 1,00$$

$$\gamma_{R,v} = 1,00$$

$$\gamma_{R,h} = 1,00$$

$$A2 + M2 + R1$$

$$\gamma_{\phi'} = 1,25$$

$$\gamma_{c'} = 1,25$$

$$\gamma_{cu} = 1,40$$

$$\gamma_{qu} = 1,40$$

$$\gamma_{\gamma} = 1,00$$

$$\gamma_{R,v} = 1,00$$

$$\gamma_{R,h} = 1,00$$

1.2.2 Soil:

Soil level:	N_1	= 0,00 (m)
Column pier level:	N_a	= 0,00 (m)
Minimum reference level:	N_f	= -0,50 (m)

Clay

- Soil level: 0.00 (m)
- Unit weight: 2243.38 (kG/m³)
- Unit weight of solid: 2753.23 (kG/m³)
- Internal friction angle: 25.0 (Deg)
- Cohesion: 0.06 (MPa)

1.2.3 Limit states

Stress calculations

F_x=0,56 F_y=0,00

Soil type under foundation: not layered

Design combination **ULS : ULS 31 N=93,09 M_x=-0,92 M_y=-14,20**

Load factors: **1.35** * Foundation weight

1.35 * Soil weight

Calculation results: On the foundation level

Weight of foundation and soil over it: Gr = 13,41 (kN)

Design load:

$$N_r = 106,50 \text{ (kN)} \quad M_x = -0,92 \text{ (kN*m)} \quad M_y = -13,92 \text{ (kN*m)}$$

Allowable stress calculation method: Semi-empirical - stress limit

Load eccentricity:

$$|e_B| = 0,13 \text{ (m)} \quad |e_L| = 0,01 \text{ (m)}$$

Equivalent foundation dimensions:

$$B' = B - 2|e_B| = 0,64 \text{ (m)}$$

$$L' = L - 2|e_L| = 0,88 \text{ (m)}$$

$$q_u = 0.30 \text{ (MPa)}$$

$$p_{le}^* = 0,32 \text{ (MPa)}$$

$$D_e = D_{min} - d = 0,50 \text{ (m)}$$

$$k_p = 0,94$$

$$q'_{o} = 0,01 \text{ (MPa)}$$

$$q_u = k_p * (p_{le}^*) + q'_{o} = 0,31 \text{ (MPa)}$$

Stress in soil: $q_{ref} = 0.25 \text{ (MPa)}$

Safety factor: $q_{lim} / q_{ref} = 1.233 > 1$

Uplift

Fx=0,56 Fy=0,00	<u>Uplift in ULS</u>	
	Design combination	ULS : ULS 31 N=93,09 Mx=-0,92 My=-14,20
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Contact area:	s = 0,16 s _{lim} = 0,17

Sliding

Fx=-0,14 Fy=-0,00	Design combination	ULS : TEMP NEGATIVE N=0,14 Mx=0,00 My=-0,35
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 9,93 (kN)
	Design load:	
	Nr = 10,07 (kN)	Mx = 0,00 (kN*m) My = -0,42 (kN*m)
	Equivalent foundation dimensions:	A ₋ = 0,90 (m) B ₋ = 0,90 (m)
	Sliding area:	0,81 (m ²)
	Foundation/soil friction coefficient:	tan(δ _d) = 0,30
	Cohesion:	c _u = 0.06 (MPa)
	Soil pressure considered:	
	Hx = -0,14 (kN)	Hy = -0,00 (kN)
	Ppx = 3,05 (kN)	Ppy = 3,05 (kN)
	Pax = -0,50 (kN)	Pay = -0,50 (kN)
	Sliding force value	H _d = 0,00 (kN)
	Value of force preventing foundation sliding:	
	- On the foundation level:	R _d = 3,02 (kN)
	Stability for sliding:	∞

Average settlement

Fy=0,00	Soil type under foundation:	not layered
	Design combination	SLS : SLS 13 N=53,38 Mx=-0,61 My=-7,55 Fx=0,33
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 9,93 (kN)
	Average stress caused by design load:	q = 0,08 (MPa)
	Thickness of the actively settling soil:	z = 1,80 (m)
	Stress on the level z:	
	- Additional:	σ _{zd} = 0,01 (MPa)
	- Caused by soil weight:	σ _{zγ} = 0,05 (MPa)
	Settlement:	
	- Original	s' = 0,1 (cm)
	- Secondary	s'' = 0,0 (cm)
	- TOTAL	S = 0,1 (cm) < S _{adm} = 5,0 (cm)
	Safety factor:	89.94 > 1

Settlement difference

Fy=0,00	Design combination	SLS : SLS 13 N=53,38 Mx=-0,61 My=-7,55 Fx=0,33
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Settlement difference:	S = 0,1 (cm) < S _{adm} = 5,0 (cm)

Safety factor: 45.43 > 1

Rotation

Fy=0,00	<u>About OX axis</u>	
	Design combination	ULS : ULS 28 N=42,71 Mx=-0,56 My=-5,38 Fx=0,35
	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 9,93 (kN)
	Design load:	Nr = 52,64 (kN) Mx = -0,56 (kN*m) My = -5,21 (kN*m)
	Stability moment:	Mstab = 23,69 (kN*m)
	Rotation moment:	Mrenv = 0,56 (kN*m)
	Stability for rotation:	42.08 > 1
	<u>About OY axis</u>	
	Design combination:	ULS : ULS 31 N=93,09 Mx=-0,92 My=-14,20
Fx=0,56 Fy=0,00	Load factors:	1.00 * Foundation weight 1.00 * Soil weight
	Weight of foundation and soil over it:	Gr = 9,93 (kN)
	Design load:	Nr = 103,03 (kN) Mx = -0,92 (kN*m) My = -13,92 (kN*m)
	Stability moment:	Mstab = 46,64 (kN*m)
	Rotation moment:	Mrenv = 14,20 (kN*m)
	Stability for rotation:	3.284 > 1

1.3 RC design

1.3.1 Assumptions

- Exposure : XC2
- Structure class : S1

1.3.2 Analysis of punching and shear

Punching

Fy=0,00	Design combination	ULS : ULS 31 N=93,09 Mx=-0,92 My=-14,20 Fx=0,56
	Load factors:	1.35 * Foundation weight 1.35 * Soil weight
	Design load:	Nr = 106,50 (kN) Mx = -0,92 (kN*m) My = -13,92 (kN*m)
	Length of critical circumference:	2,34 (m)
	Punching force:	49,39 (kN)
	Section effective height	heff = 0,43 (m)
	Reinforcement ratio:	$\rho = 0.14 \%$
	Shear stress:	0,08 (MPa)
	Admissible shear stress:	3,82 (MPa)
	Safety factor:	48 > 1

1.3.3 Required reinforcement

Spread footing:

bottom:

ULS : ULS 31 N=93,09 Mx=-0,92 My=-14,20 Fx=0,56 Fy=0,00
 My = 8,27 (kN*m) $A_{sx} = 5,81 \text{ (cm}^2\text{/m)}$

ULS : ULS 31 N=93,09 Mx=-0,92 My=-14,20 Fx=0,56 Fy=0,00
 Mx = 5,04 (kN*m) $A_{sy} = 5,81 \text{ (cm}^2\text{/m)}$

$A_{s \text{ min}} = 5,81 \text{ (cm}^2\text{/m)}$

top:

$A'_{sx} = 0,00 \text{ (cm}^2\text{/m)}$

$A'_{sy} = 0,00 \text{ (cm}^2\text{/m)}$

$A_{s \text{ min}} = 0,00 \text{ (cm}^2\text{/m)}$

Column pier:

Longitudinal reinforcement $A = 0,00 \text{ (cm}^2)$ $A_{\text{min.}} = 0,00 \text{ (cm}^2)$

$A = 2 * (Asx + Asy)$

$Asx = 0,00 \text{ (cm}^2)$ $Asy = 0,00 \text{ (cm}^2)$

1.3.4 Provided reinforcement**Spread footing:****Bottom:**

Along X axis:

5 B500C 12 $l = 0,92 \text{ (m)}$ $e = 1*-0,33 + 4*0,17$

Along Y axis:

5 B500C 12 $l = 0,92 \text{ (m)}$ $e = 1*-0,33 + 4*0,17$

Pier

Longitudinal reinforcement

Along X axis:

2 B500C 12 $l = 2,09 \text{ (m)}$ $e = 1*-0,29 + 1*0,58$

Along Y axis:

2 B500C 12 $l = 2,14 \text{ (m)}$ $e = 1*-0,29 + 1*0,58$

Transversal reinforcement

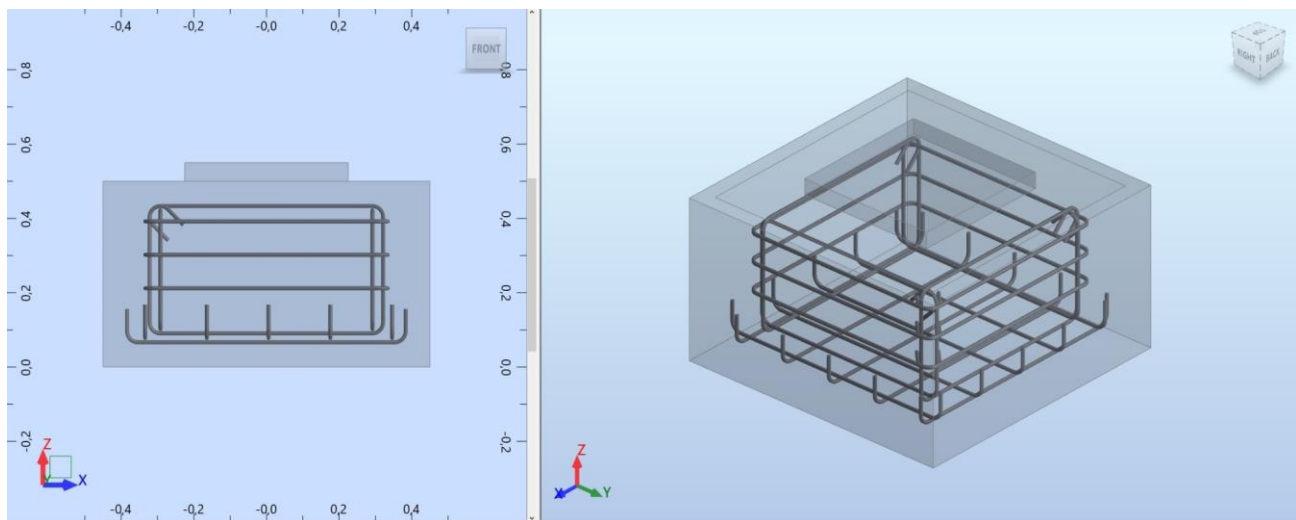
3 B500C 12 $l = 2,83 \text{ (m)}$ $e = 1*0,21 + 2*0,09$

2 Material survey:

- Concrete volume = 0,41 (m3)
- Formwork = 1,80 (m2)
- Steel B500C
 - Total weight = 23,26 (kG)
 - Density = 57,42 (kG/m3)
 - Average diameter = 12,0 (mm)

- Survey according to diameters:

Diameter	Length (m)	Number of identical elements:
12	0,92	10
12	2,09	2
12	2,14	2
12	2,83	3



ΔΟΚΟΣ 1

1 Level:

- Name : Level ±0,00
- Reference level : 0,00 (m)
- Maximum cracking : 0,30 (mm)
- Exposure : XC2
- Concrete creep coefficient : $\phi_{\pi} = 1,40$
- Cement class : N
- Concrete age (loading moment) : 90 (days)
- Concrete age : 5 (years)
- Concrete age after erecting a structure : 365 (years)
- Structure class : S1
- Fire resistance class : no requirements
- FFB Recommendations 7.4.3(7) : 0,00

2 Beam: Beam16 elements: 1

Number of identical

2.1 Material properties:

- Concrete : C25/30 $f_{ck} = 25,00$ (MPa)
 Rectangular stress distribution [3.1.7(3)]
 Density : 2501,36 (kg/m³)
 Aggregate size : 20,0 (mm)
- Longitudinal reinforcement: : B500C $f_{yk} = 500,00$ (MPa)
 Horizontal branch of the stress-strain diagram
 Ductility class : C
- Transversal reinforcement: : B500C $f_{yk} = 500,00$ (MPa)
 Horizontal branch of the stress-strain diagram
 Ductility class : C
- Additional reinforcement: : B500C $f_{yk} = 500,00$ (MPa)
 Horizontal branch of the stress-strain diagram

2.2 Geometry:

2.2.1	Span	Position	L supp. (m)	L (m)	R supp. (m)
	P1	Span 0,90	2,98	0,90	
	Span length: $L_o = 3,88$ (m)				
	Section from 0,00 to 2,98 (m)				
	30,0 x 50,0 (cm)				
	without left slab				
	without right slab				

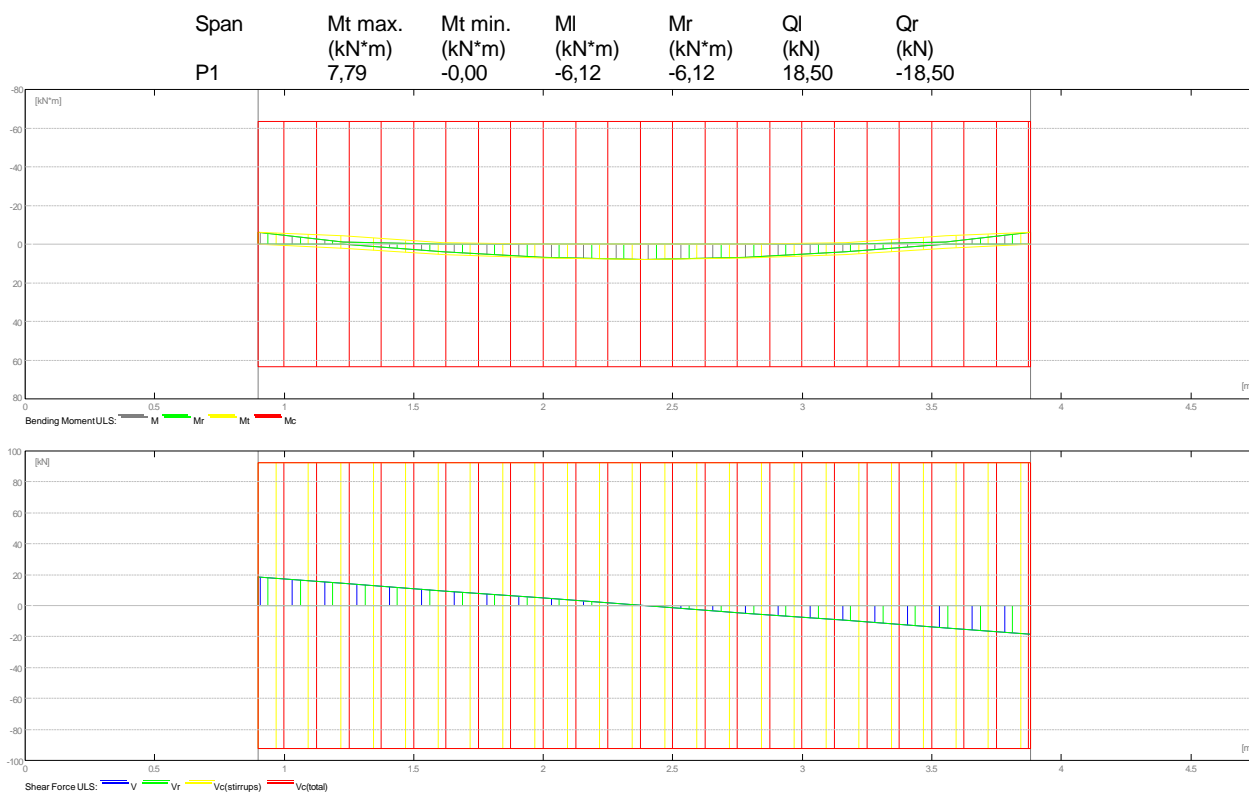
2.3 Calculation options:

- Regulation of combinations : EN 1990:2002
- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast beam : no
- Cover :
 - : bottom $c = 6,0$ (cm)
 - : side $c1 = 6,0$ (cm)
 - : top $c2 = 6,0$ (cm)
- Cover deviations : $C_{dev} = 1,0$ (cm), $C_{dur} = 0,0$ (cm)
- Coefficient $\beta_2 = 0.50$: long-term or cyclic load
- Method of shear calculations : strut inclination

2.4 Calculation results:

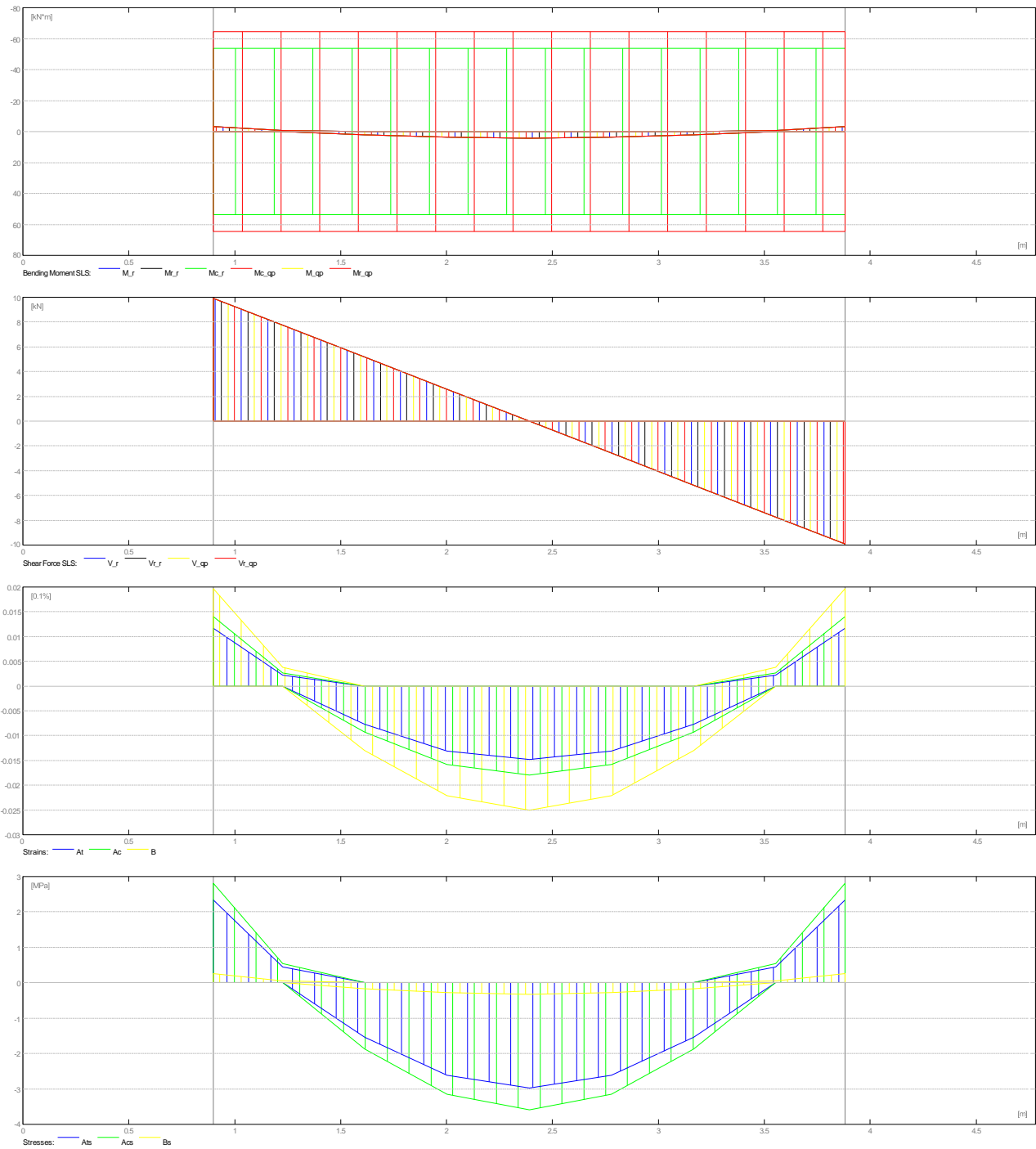
The "Freeze Reinforcement" option is switched on. The distribution of reinforcing bars has not been modified.

2.4.1 Internal forces in ULS



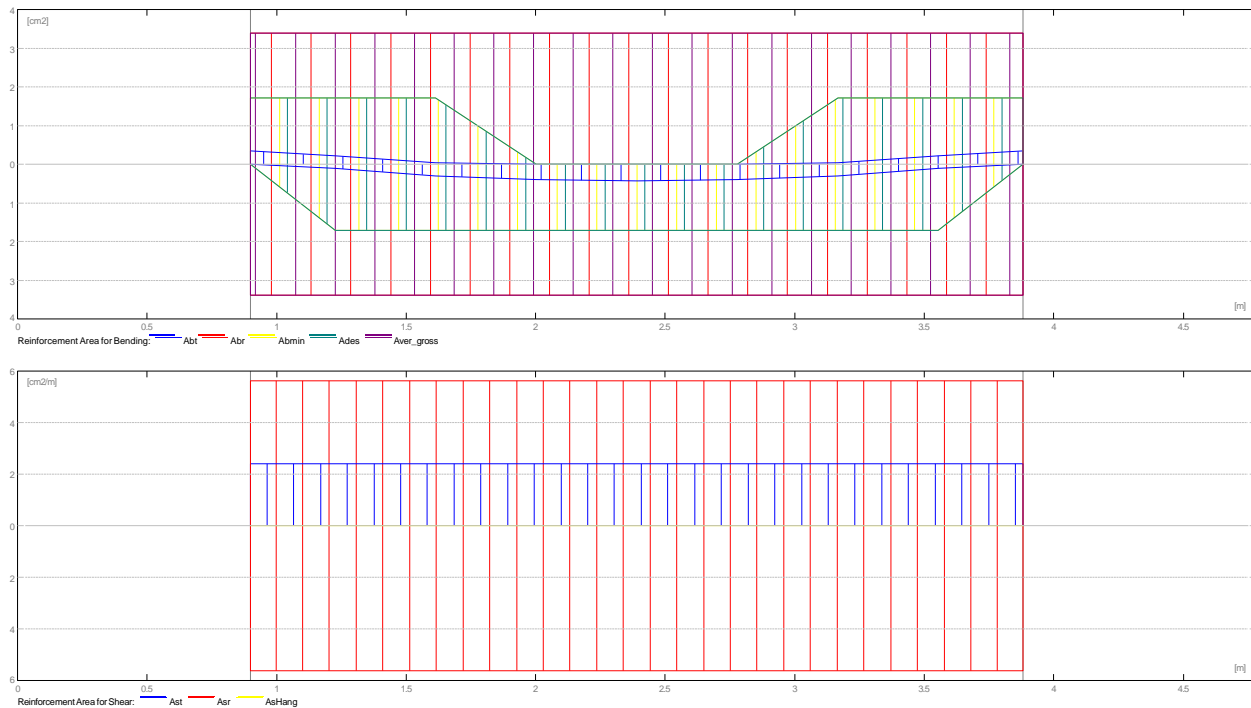
2.4.2 Internal forces in SLS

Span	Mt max. (kN*m)	Mt min. (kN*m)	MI (kN*m)	Mr (kN*m)	Ql (kN)	Qr (kN)
P1	4,18	0,00	-3,28	-3,28	9,92	-9,92



2.4.3 Required reinforcement area

Span	Span (cm ²)		Left support (cm ²)		Right support (cm ²)	
	bottom	top	bottom	top	bottom	top
P1	0,43	0,00	0,00	0,34	0,00	0,34



2.4.4 Deflection and cracking

wt(QP) Total due to quasi-permanent combination

wt(QP)dop Allowable due to quasi-permanent combination

Dwt(QP) Deflection increment from the quasi-permanent load combination after erecting a structure.

Dwt(QP)dop Admissible deflection increment from the quasi-permanent load combination after erecting a structure.

wk - width of perpendicular cracks

Span	wt(QP) (cm)	wt(QP)dop (cm)	Dwt(QP) (cm)	Dwt(QP)dop (cm)	wk (mm)
P1	0,0	1,6	-0,0	0,8	0,0

2.5 Theoretical results - detailed results:

2.5.1 P1 : Span from 0,90 to 3,88 (m)

Abscissa (m)	ULS		SLS		A bottom (cm²)	A top (cm²)
	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)		
0,90	0,00	-6,12	0,00	-3,28	0,00	0,34
1,23	2,11	-4,24	0,00	-0,63	0,11	0,21
1,61	5,51	-0,61	2,17	0,00	0,30	0,03
2,00	7,34	-0,00	3,68	0,00	0,40	0,00
2,39	7,79	0,00	4,18	0,00	0,43	0,00
2,78	7,34	-0,00	3,68	0,00	0,40	0,00
3,17	5,51	-0,61	2,17	0,00	0,30	0,03
3,55	2,11	-4,24	0,00	-0,63	0,11	0,21
3,88	0,00	-6,12	0,00	-3,28	0,00	0,34

Abscissa (m)	ULS		SLS	afp (mm)
	V max. (kN)	V max. (kN)		
0,90	18,50	9,92	0,0	
1,23	14,45	7,75	0,0	
1,61	9,64	5,17	0,0	
2,00	4,82	2,58	0,0	

2,39	-0,00	-0,00	0,0
2,78	-4,82	-2,58	0,0
3,17	-9,64	-5,17	0,0
3,55	-14,45	-7,75	0,0
3,88	-18,50	-9,92	0,0

2.6 Reinforcement:

2.6.1 P1 : Span from 0,90 to 3,88 (m)

Longitudinal reinforcement:

- bottom (B500C)
 - 3 $\phi 12$ $l = 4,80$ from 0,06 to 4,72
- support (B500C)
 - 3 $\phi 12$ $l = 4,79$ from 0,06 to 4,71

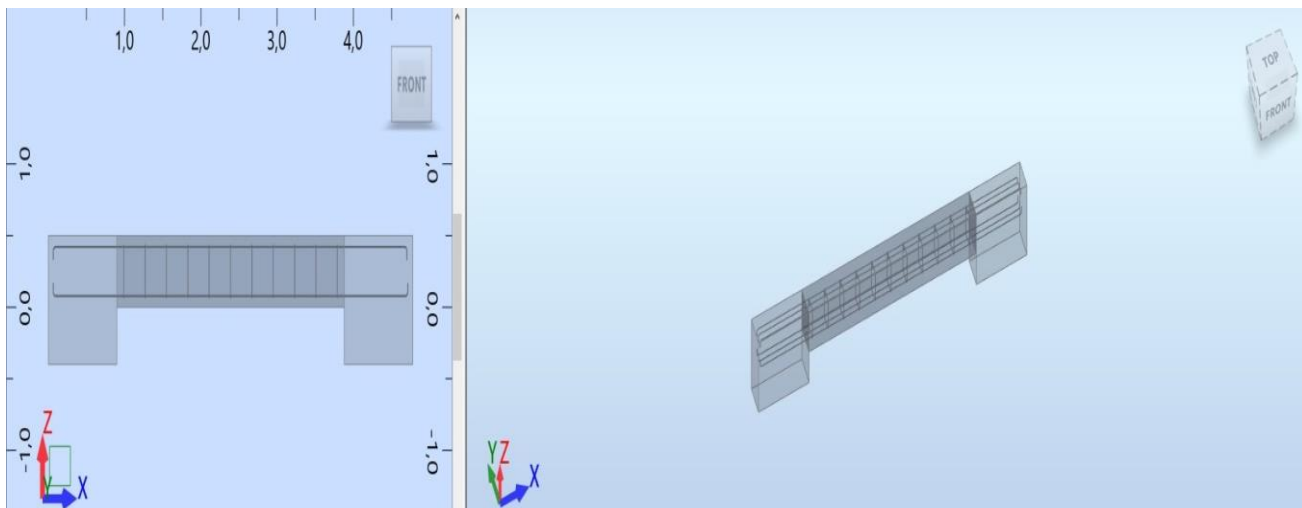
Transversal reinforcement:

- main (B500C)
 - stirrups 11 $\phi 10$ $l = 1,22$
 $e = 1*0,09 + 10*0,28$ (m)

3 Material survey:

- Concrete volume = 0,72 (m3)
- Formwork = 5,97 (m2)
- Steel B500C
 - Total weight = 33,81 (kG)
 - Density = 47,16 (kG/m3)
 - Average diameter = 11,4 (mm)
 - Survey according to diameters:

Diameter (mm)	Length (m)	Weight (kG)	Number (No.)	Total weight (kG)
10	1,22	0,75	11	8,25
12	4,79	4,26	6	25,54



ΔΟΚΟΣ 2

1 Level:

- Name : Level ±0,00
- Reference level : 0,00 (m)
- Maximum cracking : 0,30 (mm)
- Exposure : XC2
- Concrete creep coefficient : $\phi_{\pi} = 1,40$
- Cement class : N
- Concrete age (loading moment) : 90 (days)
- Concrete age : 5 (years)
- Concrete age after erecting a structure : 365 (years)
- Structure class : S1
- Fire resistance class : no requirements
- FFB Recommendations 7.4.3(7) : 0,00

2 Beam: Beam17 elements: 1

Number of identical

2.1 Material properties:

- Concrete : C25/30 $f_{ck} = 25,00$ (MPa)
 Rectangular stress distribution [3.1.7(3)]
 Density : 2501,36 (kG/m³)
 Aggregate size : 20,0 (mm)
- Longitudinal reinforcement: B500C $f_{yk} = 500,00$ (MPa)
 Horizontal branch of the stress-strain diagram
 Ductility class : C
- Transversal reinforcement: B500C $f_{yk} = 500,00$ (MPa)
 Horizontal branch of the stress-strain diagram
 Ductility class : C
- Additional reinforcement: B500C $f_{yk} = 500,00$ (MPa)
 Horizontal branch of the stress-strain diagram

2.2 Geometry:

2.2.1	Span	Position	L supp. (m)	L (m)	R supp. (m)
	P1	Span 0,90	2,98	0,90	
	Span length: $L_o = 3,88$ (m)				
	Section from 0,00 to 2,98 (m)				
	30,0 x 50,0 (cm)				
	without left slab				
	without right slab				

2.3 Calculation options:

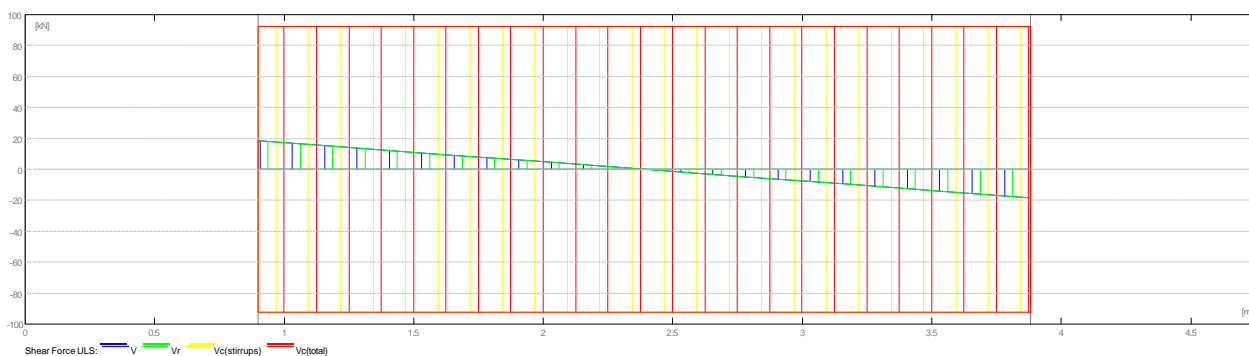
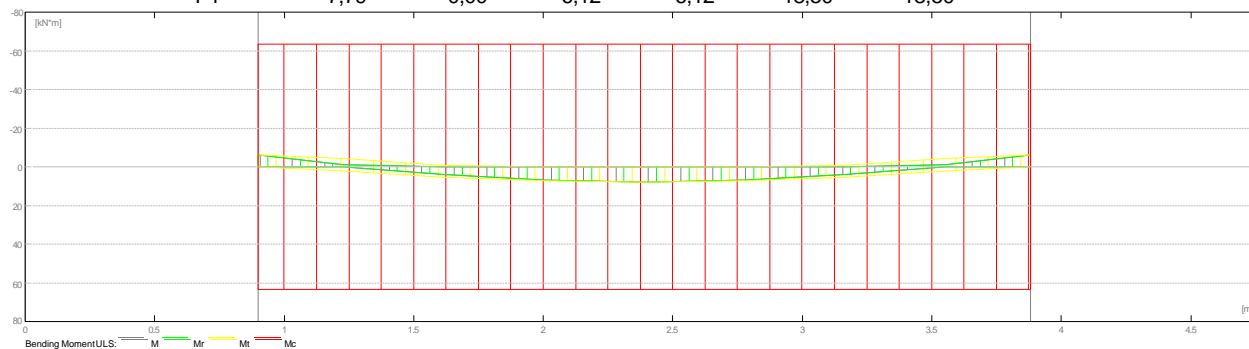
- Regulation of combinations : EN 1990:2002
- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast beam : no
- Cover :
 - : bottom c = 6,0 (cm)
 - : side c1= 6,0 (cm)
 - : top c2= 6,0 (cm)
- Cover deviations : Cdev = 1,0(cm), Cdur = 0,0(cm)
- Coefficient $\beta_2 = 0.50$: long-term or cyclic load
- Method of shear calculations : strut inclination

2.4 Calculation results:

The "Freeze Reinforcement" option is switched on. The distribution of reinforcing bars has not been modified.

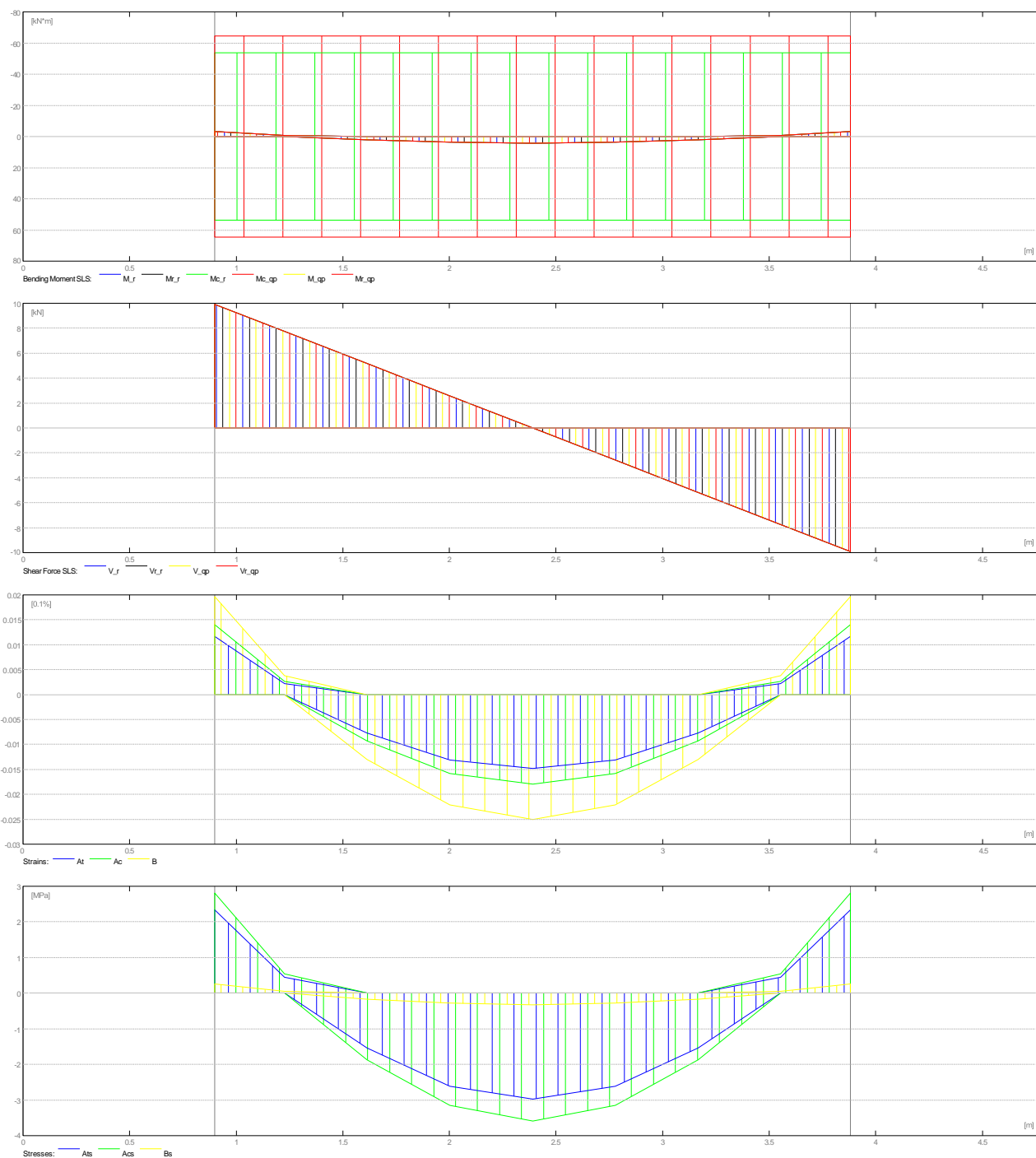
2.4.1 Internal forces in ULS

Span	Mt max. (kN*m)	Mt min. (kN*m)	MI (kN*m)	Mr (kN*m)	Ql (kN)	Qr (kN)
P1	7,79	-0,00	-6,12	-6,12	18,50	-18,50



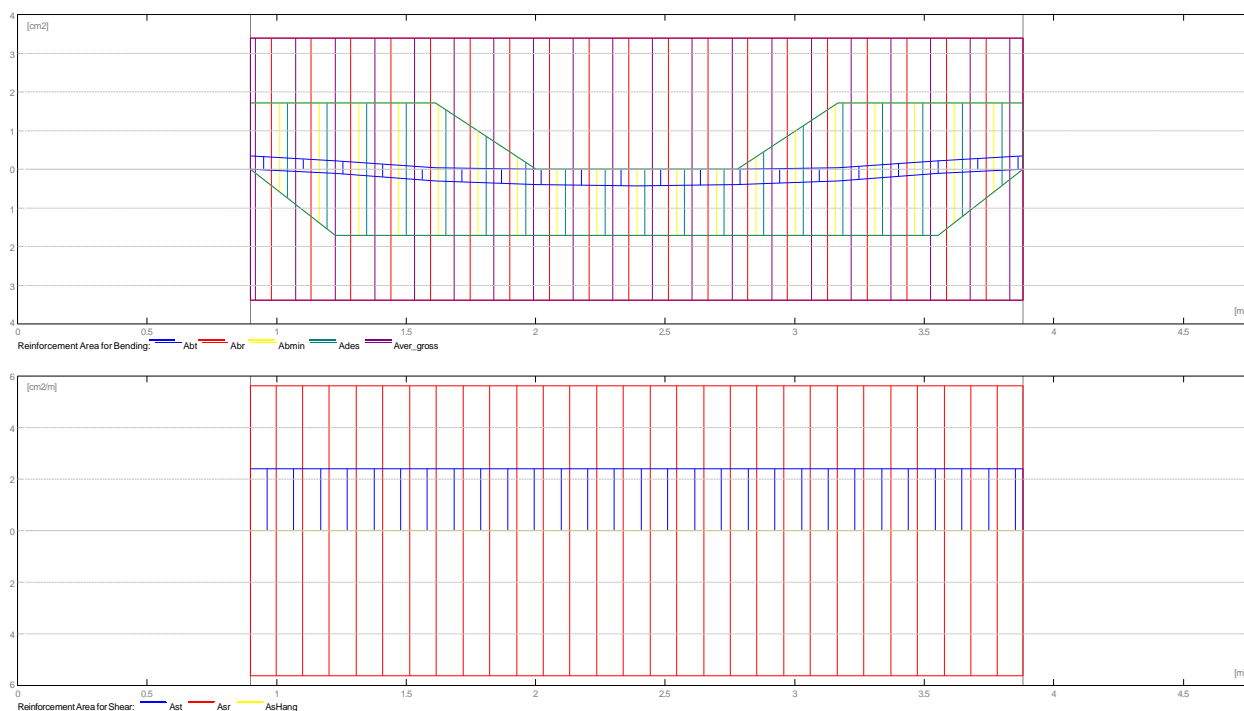
2.4.2 Internal forces in SLS

Span	Mt max. (kN*m)	Mt min. (kN*m)	MI (kN*m)	Mr (kN*m)	Ql (kN)	Qr (kN)
P1	4,18	0,00	-3,28	-3,28	9,92	-9,92



2.4.3 Required reinforcement area

Span	Span (cm ²)		Left support (cm ²)		Right support (cm ²)	
	bottom	top	bottom	top	bottom	top
P1	0,43	0,00	0,00	0,34	0,00	0,34



2.4.4 Deflection and cracking

wt(QP) Total due to quasi-permanent combination

wt(QP)dop Allowable due to quasi-permanent combination

Dwt(QP) Deflection increment from the quasi-permanent load combination after erecting a structure.

Dwt(QP)dop Admissible deflection increment from the quasi-permanent load combination after erecting a structure.

wk - width of perpendicular cracks

Span	wt(QP) (cm)	wt(QP)dop (cm)	Dwt(QP) (cm)	Dwt(QP)dop (cm)	wk (mm)
P1	0,0	1,6	-0,0	0,8	0,0

2.5 Theoretical results - detailed results:

2.5.1 P1 : Span from 0,90 to 3,88 (m)

Abscissa (m)	ULS		SLS		A bottom (cm ²)	A top (cm ²)
	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)		
0,90	0,00	-6,12	0,00	-3,28	0,00	0,34
1,23	2,11	-4,24	0,00	-0,63	0,11	0,21
1,61	5,51	-0,61	2,17	0,00	0,30	0,03
2,00	7,34	-0,00	3,68	0,00	0,40	0,00
2,39	7,79	0,00	4,18	0,00	0,43	0,00
2,78	7,34	-0,00	3,68	0,00	0,40	0,00
3,17	5,51	-0,61	2,17	0,00	0,30	0,03
3,55	2,11	-4,24	0,00	-0,63	0,11	0,21
3,88	0,00	-6,12	0,00	-3,28	0,00	0,34

Abscissa (m)	ULS		SLS	afp (mm)
	V max. (kN)	V max. (kN)		
0,90	18,50	9,92	0,0	
1,23	14,45	7,75	0,0	
1,61	9,64	5,17	0,0	
2,00	4,82	2,58	0,0	

2,39	-0,00	-0,00	0,0
2,78	-4,82	-2,58	0,0
3,17	-9,64	-5,17	0,0
3,55	-14,45	-7,75	0,0
3,88	-18,50	-9,92	0,0

2.6 Reinforcement:

2.6.1 P1 : Span from 0,90 to 3,88 (m)

Longitudinal reinforcement:

- bottom (B500C)
3 $\phi 12$ $l = 4,80$ from 0,06 to 4,72
- support (B500C)
3 $\phi 12$ $l = 4,79$ from 0,06 to 4,71

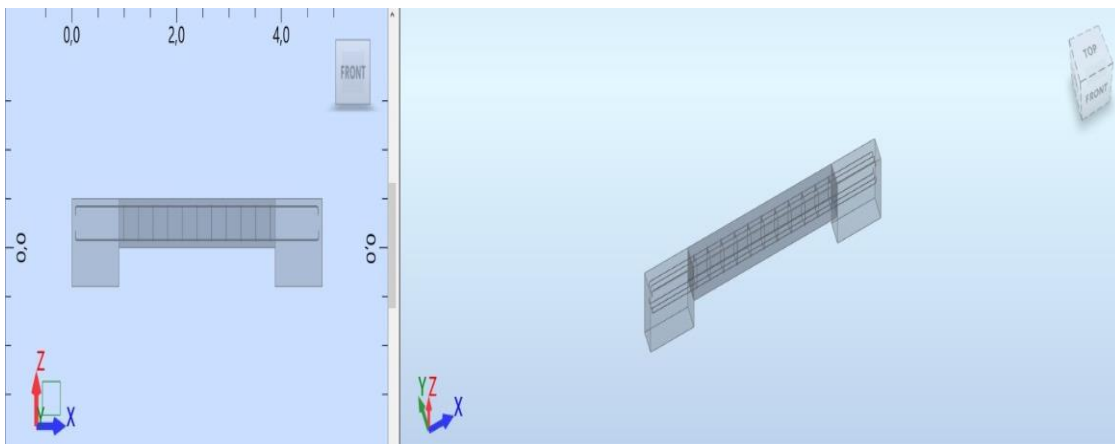
Transversal reinforcement:

- main (B500C)
stirrups 11 $\phi 10$ $l = 1,22$
 $e = 1*0,09 + 10*0,28$ (m)

3 Material survey:

- Concrete volume = 0,72 (m3)
- Formwork = 5,97 (m2)
- Steel B500C
 - Total weight = 33,81 (kG)
 - Density = 47,16 (kG/m3)
 - Average diameter = 11,4 (mm)
 - Survey according to diameters:

Diameter (mm)	Length (m)	Weight (kG)	Number (No.)	Total weight (kG)
10	1,22	0,75	11	8,25
12	4,79	4,26	6	25,54



ΔΟΚΟΣ ΤΡΙΑ

1 Level:

- Name : Level $\pm 0,00$
- Reference level : 0,00 (m)
- Maximum cracking : 0,30 (mm)
- Exposure : XC2
- Concrete creep coefficient : $\phi_{\pi} = 1,40$
- Cement class : N
- Concrete age (loading moment) : 90 (days)
- Concrete age : 5 (years)
- Concrete age after erecting a structure : 365 (years)
- Structure class : S1
- Fire resistance class : no requirements
- FFB Recommendations 7.4.3(7) : 0,00

2 Beam: Beam17 elements: 1

Number of identical

2.1 Material properties:

- Concrete : C25/30 $f_{ck} = 25,00$ (MPa)
 Rectangular stress distribution [3.1.7(3)]
 Density : 2501,36 (kG/m³)
 Aggregate size : 20,0 (mm)
- Longitudinal reinforcement: : B500C $f_{yk} = 500,00$ (MPa)
 Horizontal branch of the stress-strain diagram
 Ductility class : C
- Transversal reinforcement: : B500C $f_{yk} = 500,00$ (MPa)
 Horizontal branch of the stress-strain diagram
 Ductility class : C
- Additional reinforcement: : B500C $f_{yk} = 500,00$ (MPa)
 Horizontal branch of the stress-strain diagram

2.2 Geometry:

2.2.1	Span	Position	L supp. (m)	L (m)	R supp. (m)
	P1	Span 0,90	2,98	0,90	
	Span length: $L_o = 3,88$ (m)				
	Section from 0,00 to 2,98 (m)				
	30,0 x 50,0 (cm)				
	without left slab				
	without right slab				

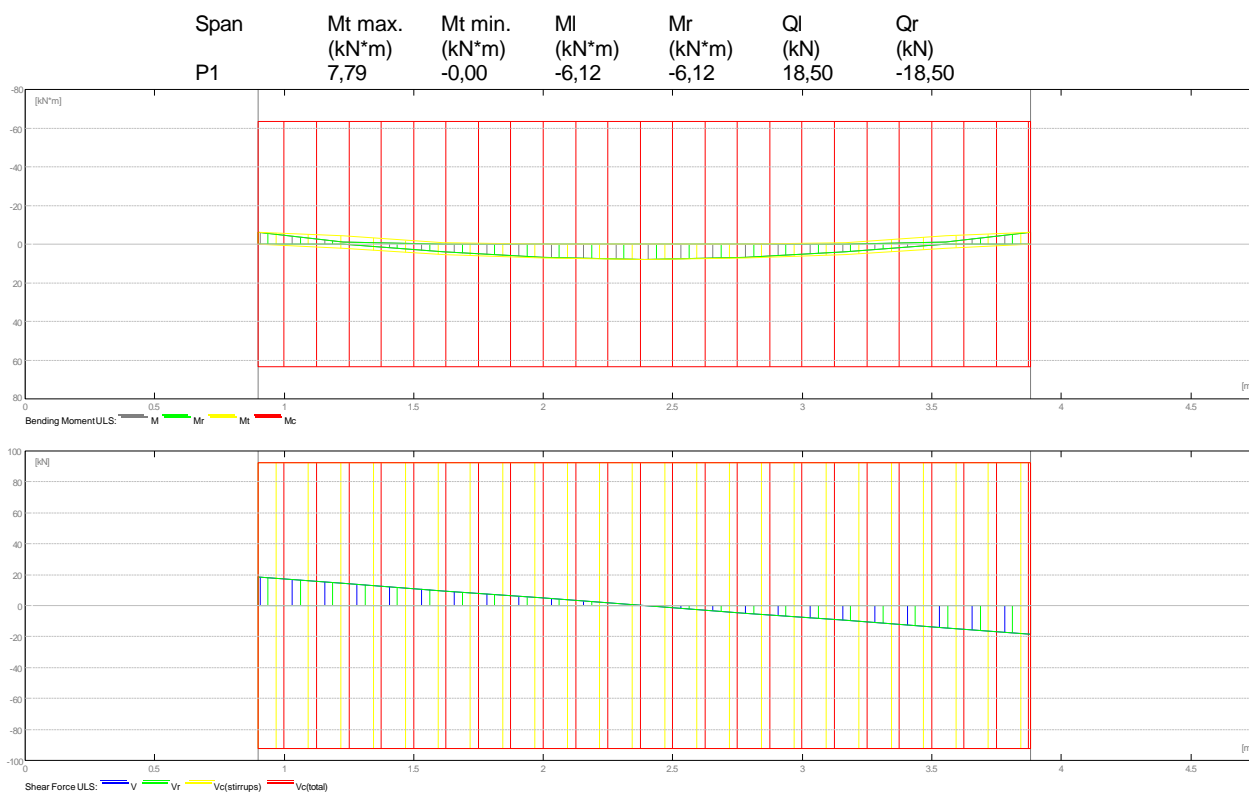
2.3 Calculation options:

- Regulation of combinations : EN 1990:2002
- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast beam : no
- Cover :
 - : bottom $c = 6,0$ (cm)
 - : side $c1 = 6,0$ (cm)
 - : top $c2 = 6,0$ (cm)
- Cover deviations : $C_{dev} = 1,0$ (cm), $C_{dur} = 0,0$ (cm)
- Coefficient $\beta_2 = 0.50$: long-term or cyclic load
- Method of shear calculations : strut inclination

2.4 Calculation results:

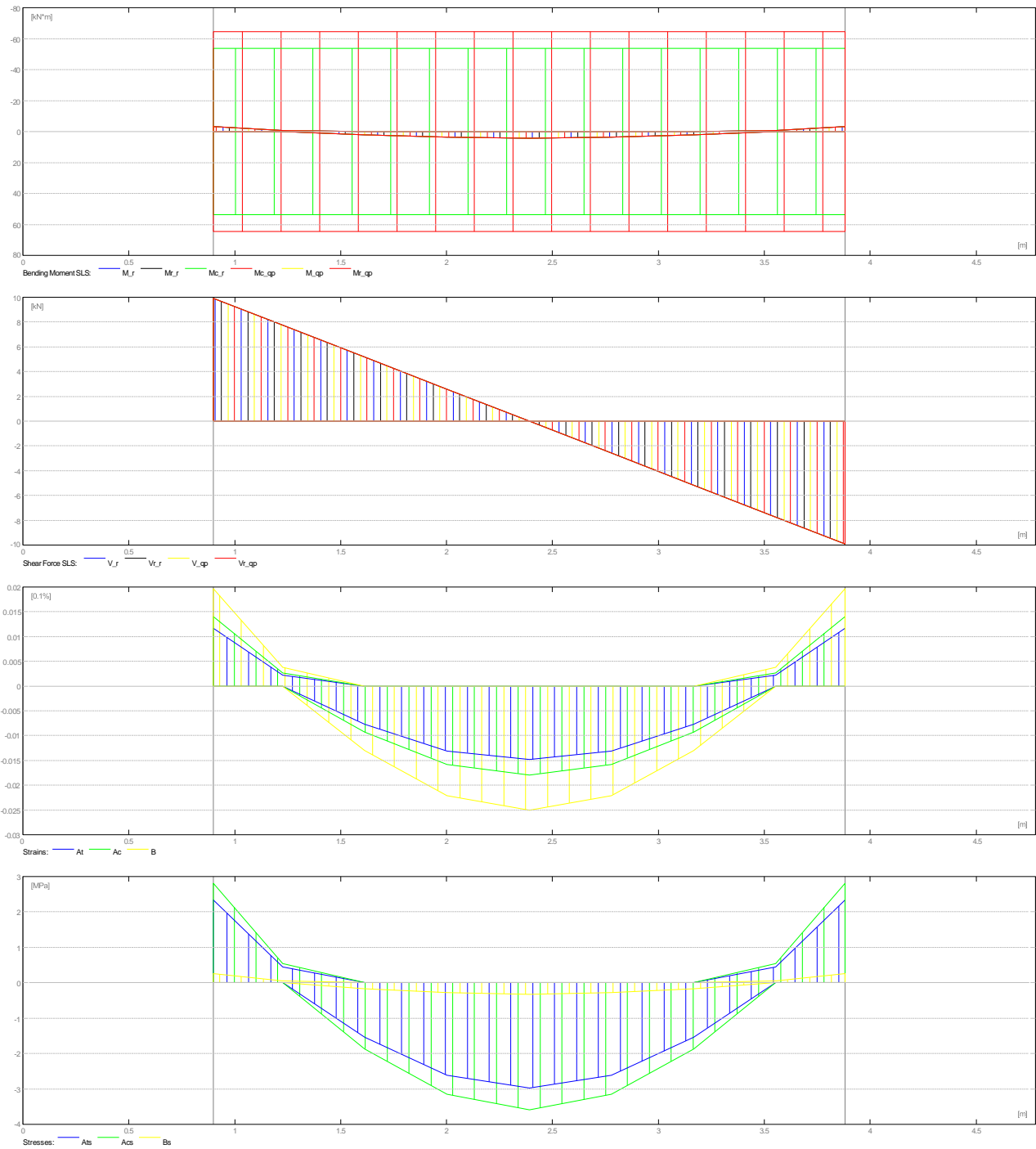
The "Freeze Reinforcement" option is switched on. The distribution of reinforcing bars has not been modified.

2.4.1 Internal forces in ULS



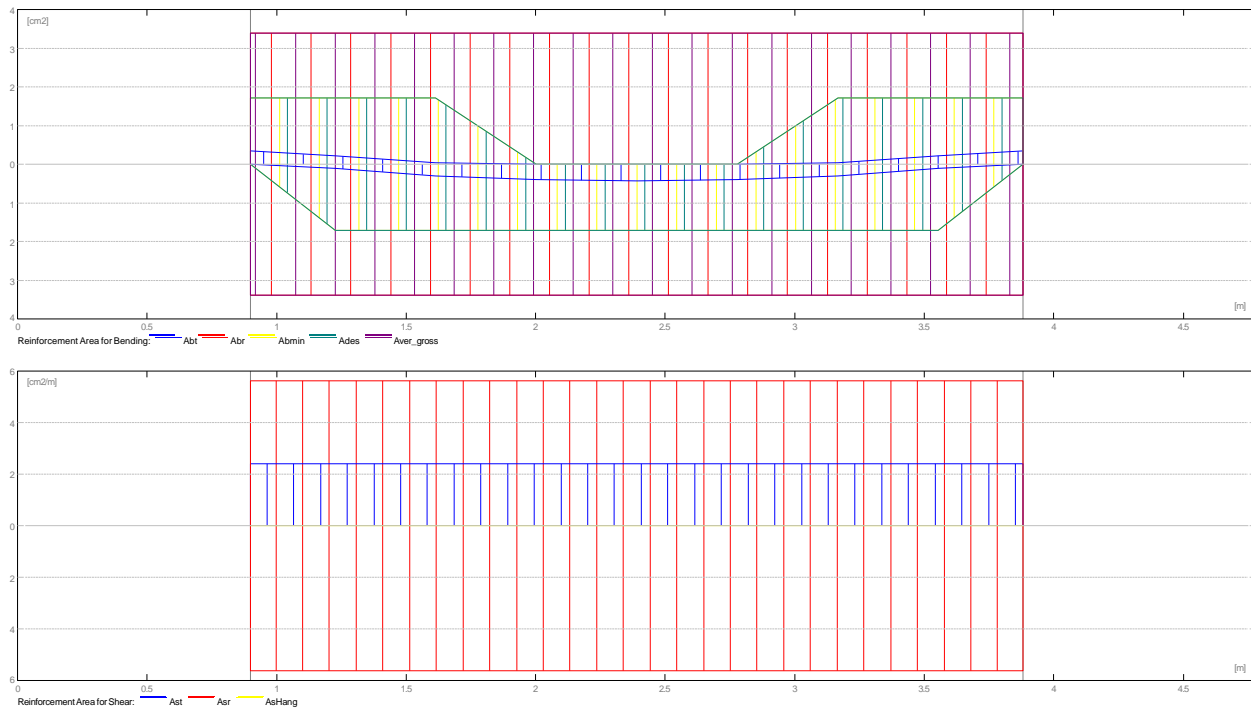
2.4.2 Internal forces in SLS

Span	Mt max. (kN*m)	Mt min. (kN*m)	MI (kN*m)	Mr (kN*m)	Ql (kN)	Qr (kN)
P1	4,18	0,00	-3,28	-3,28	9,92	-9,92



2.4.3 Required reinforcement area

Span	Span (cm ²)		Left support (cm ²)		Right support (cm ²)	
	bottom	top	bottom	top	bottom	top
P1	0,43	0,00	0,00	0,34	0,00	0,34



2.4.4 Deflection and cracking

wt(QP) Total due to quasi-permanent combination

wt(QP)dop Allowable due to quasi-permanent combination

Dwt(QP) Deflection increment from the quasi-permanent load combination after erecting a structure.

Dwt(QP)dop Admissible deflection increment from the quasi-permanent load combination after erecting a structure.

wk - width of perpendicular cracks

Span	wt(QP) (cm)	wt(QP)dop (cm)	Dwt(QP) (cm)	Dwt(QP)dop (cm)	wk (mm)
P1	0,0	1,6	-0,0	0,8	0,0

2.5 Theoretical results - detailed results:

2.5.1 P1 : Span from 0,90 to 3,88 (m)

Abscissa (m)	ULS		SLS		A bottom (cm²)	A top (cm²)
	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)		
0,90	0,00	-6,12	0,00	-3,28	0,00	0,34
1,23	2,11	-4,24	0,00	-0,63	0,11	0,21
1,61	5,51	-0,61	2,17	0,00	0,30	0,03
2,00	7,34	-0,00	3,68	0,00	0,40	0,00
2,39	7,79	0,00	4,18	0,00	0,43	0,00
2,78	7,34	-0,00	3,68	0,00	0,40	0,00
3,17	5,51	-0,61	2,17	0,00	0,30	0,03
3,55	2,11	-4,24	0,00	-0,63	0,11	0,21
3,88	0,00	-6,12	0,00	-3,28	0,00	0,34

Abscissa (m)	ULS		SLS	afp (mm)
	V max. (kN)	V max. (kN)		
0,90	18,50	9,92	0,0	
1,23	14,45	7,75	0,0	
1,61	9,64	5,17	0,0	
2,00	4,82	2,58	0,0	

2,39	-0,00	-0,00	0,0
2,78	-4,82	-2,58	0,0
3,17	-9,64	-5,17	0,0
3,55	-14,45	-7,75	0,0
3,88	-18,50	-9,92	0,0

2.6 Reinforcement:

2.6.1 P1 : Span from 0,90 to 3,88 (m)

Longitudinal reinforcement:

- bottom (B500C)
3 $\phi 12$ $l = 4,80$ from 0,06 to 4,72
- support (B500C)
3 $\phi 12$ $l = 4,79$ from 0,06 to 4,71

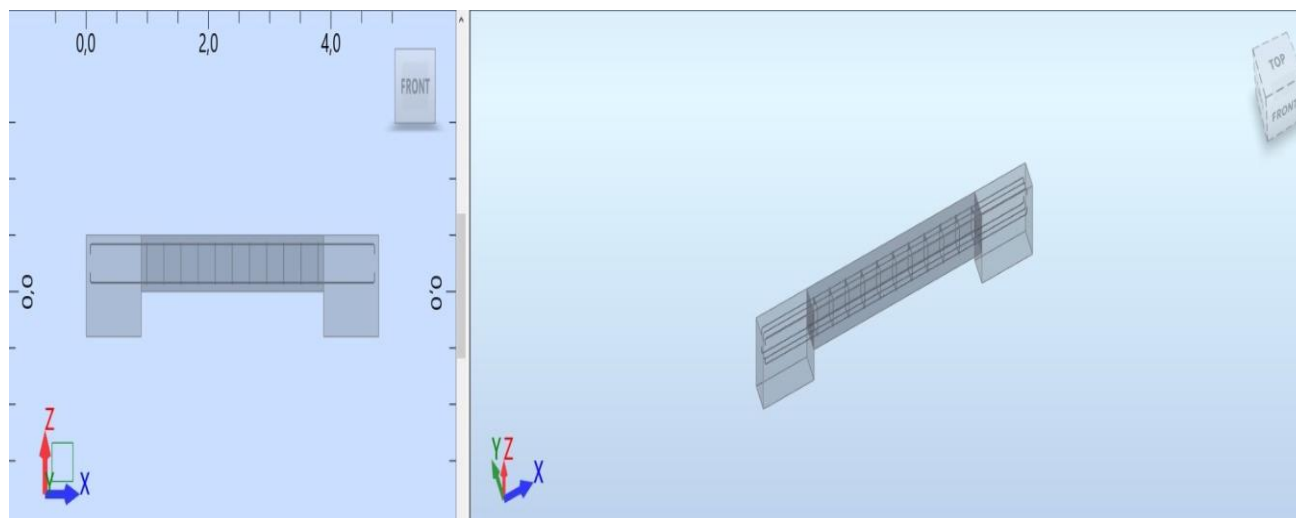
Transversal reinforcement:

- main (B500C)
stirrups 11 $\phi 10$ $l = 1,22$
 $e = 1*0,09 + 10*0,28$ (m)

3 Material survey:

- Concrete volume = 0,72 (m3)
- Formwork = 5,97 (m2)
- Steel B500C
 - Total weight = 33,81 (kG)
 - Density = 47,16 (kG/m3)
 - Average diameter = 11,4 (mm)
 - Survey according to diameters:

Diameter (mm)	Length (m)	Weight (kG)	Number (No.)	Total weight (kG)
10	1,22	0,75	11	8,25
12	4,79	4,26	6	25,54



ΔΟΚΟΣ ΤΕΣΣΕΡΑ ΚΑΙ ΠΕΝΤΕ

1 Level:

- Name : Level ±0,00
- Reference level : 0,00 (m)
- Maximum cracking : 0,30 (mm)
- Exposure : XC2
- Concrete creep coefficient : $\phi_{\pi} = 1,40$
- Cement class : N
- Concrete age (loading moment) : 90 (days)
- Concrete age : 5 (years)
- Concrete age after erecting a structure : 365 (years)
- Structure class : S1
- Fire resistance class : no requirements
- FFB Recommendations 7.4.3(7) : 0,00

2 Beam: Beam19...20 elements: 1

Number of identical

2.1 Material properties:

- Concrete : C25/30 $f_{ck} = 25,00$ (MPa)
 Rectangular stress distribution [3.1.7(3)]
 Density : 2501,36 (kg/m³)
 Aggregate size : 20,0 (mm)
- Longitudinal reinforcement: B500C $f_{yk} = 500,00$ (MPa)
 Horizontal branch of the stress-strain diagram
 Ductility class : C
- Transversal reinforcement: B500C $f_{yk} = 500,00$ (MPa)
 Horizontal branch of the stress-strain diagram
 Ductility class : C
- Additional reinforcement: B500C $f_{yk} = 500,00$ (MPa)
 Horizontal branch of the stress-strain diagram

2.2 Geometry:

2.2.1	Span	Position	L supp. (m)	L (m)	R supp. (m)
	P1	Span 1,35	2,82	0,90	
	Span length: $L_o = 3,94$ (m)				
	Section from 0,00 to 2,82 (m)				
	30,0 x 50,0 (cm)				
	without left slab				
	without right slab				
2.2.2	Span	Position	L supp. (m)	L (m)	R supp. (m)

P2 Span 0,90 2,84 1,30

Span length: $L_0 = 3,94$ (m)

Section from 0,00 to 2,84 (m)

30,0 x 50,0 (cm)

without left slab

without right slab

2.3 Calculation options:

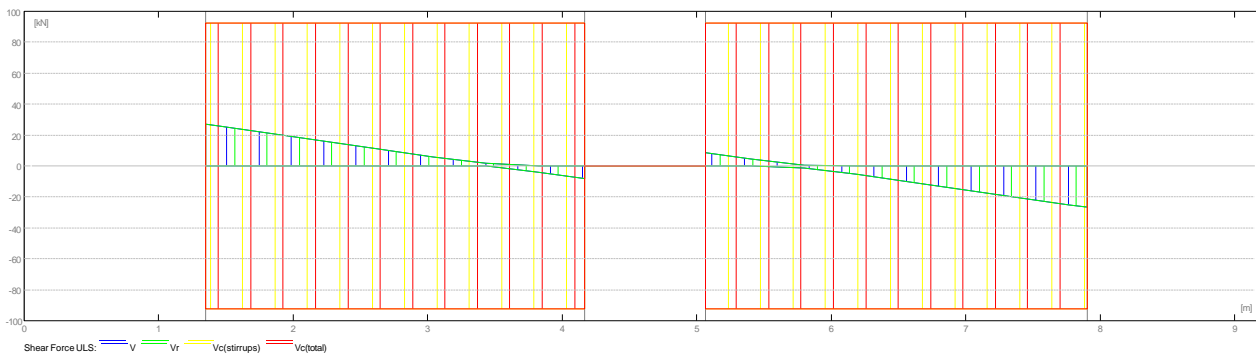
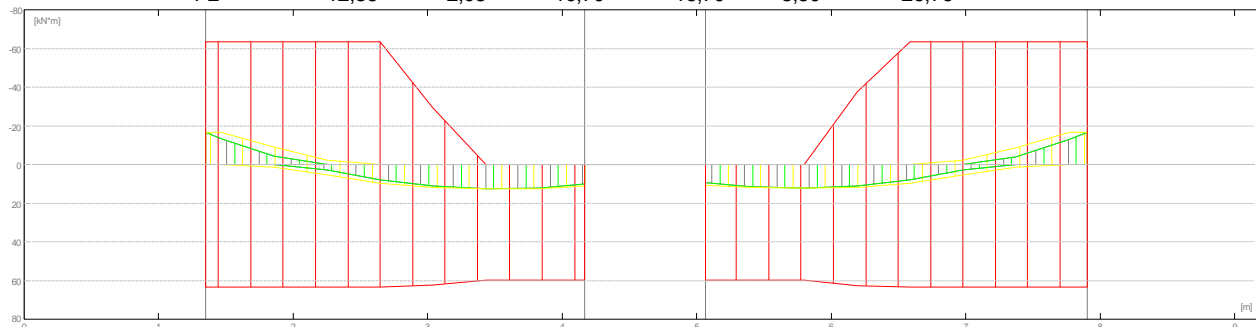
- Regulation of combinations : EN 1990:2002
- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast beam : no
- Cover :
 - : bottom $c = 6,0$ (cm)
 - : side $c_1 = 6,0$ (cm)
 - : top $c_2 = 6,0$ (cm)
- Cover deviations : Cdev = 1,0(cm), Cdur = 0,0(cm)
- Coefficient $\beta_2 = 0.50$: long-term or cyclic load
- Method of shear calculations : strut inclination

2.4 Calculation results:

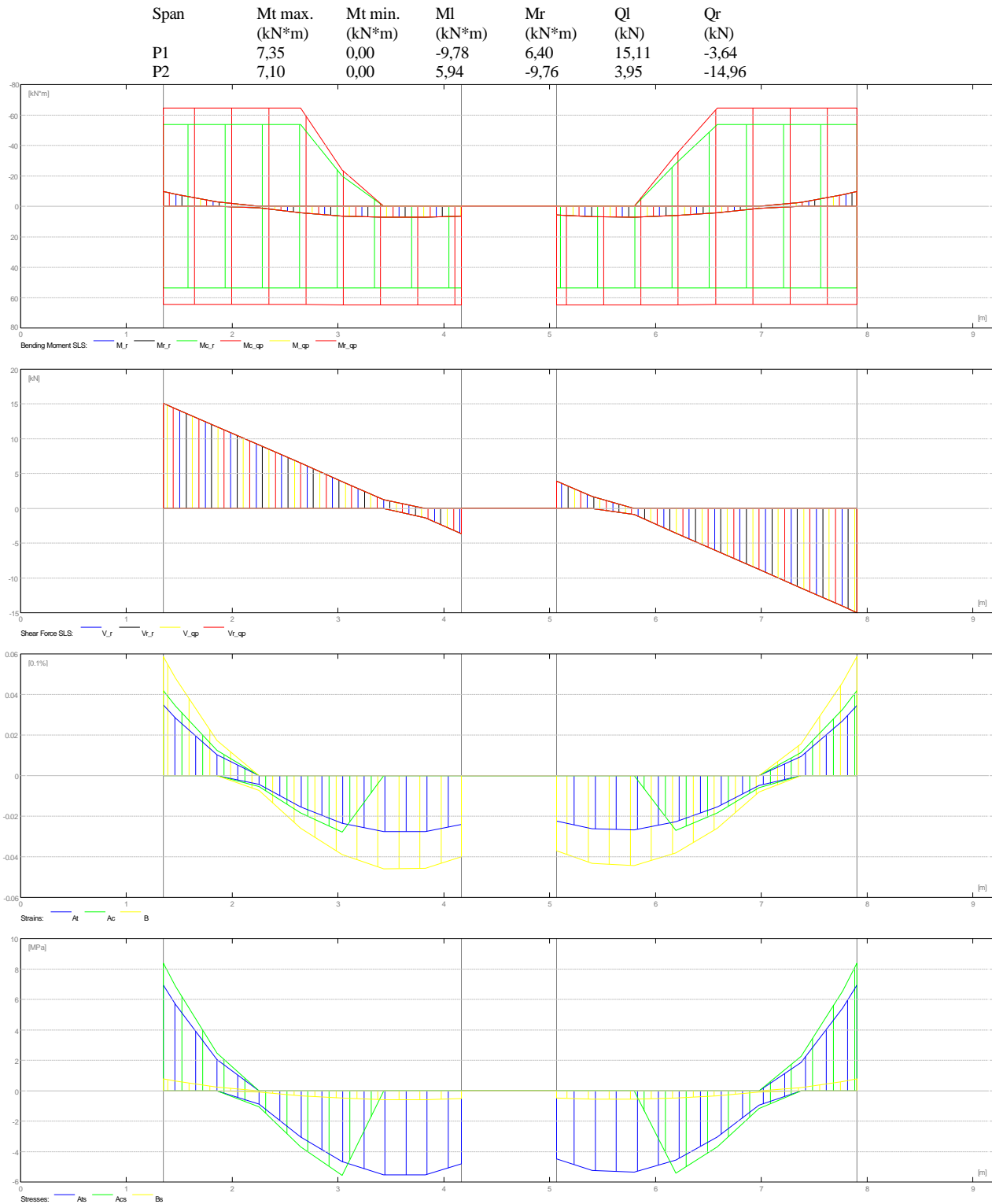
The "Freeze Reinforcement" option is switched on. The distribution of reinforcing bars has not been modified.

2.4.1 Internal forces in ULS

Span	Mt max. (kN*m)	Mt min. (kN*m)	MI (kN*m)	Mr (kN*m)	Ql (kN)	Qr (kN)
P1	12,71	-2,27	-16,61	11,31	26,92	-8,04
P2	12,35	-2,08	10,70	-16,70	8,50	-26,76

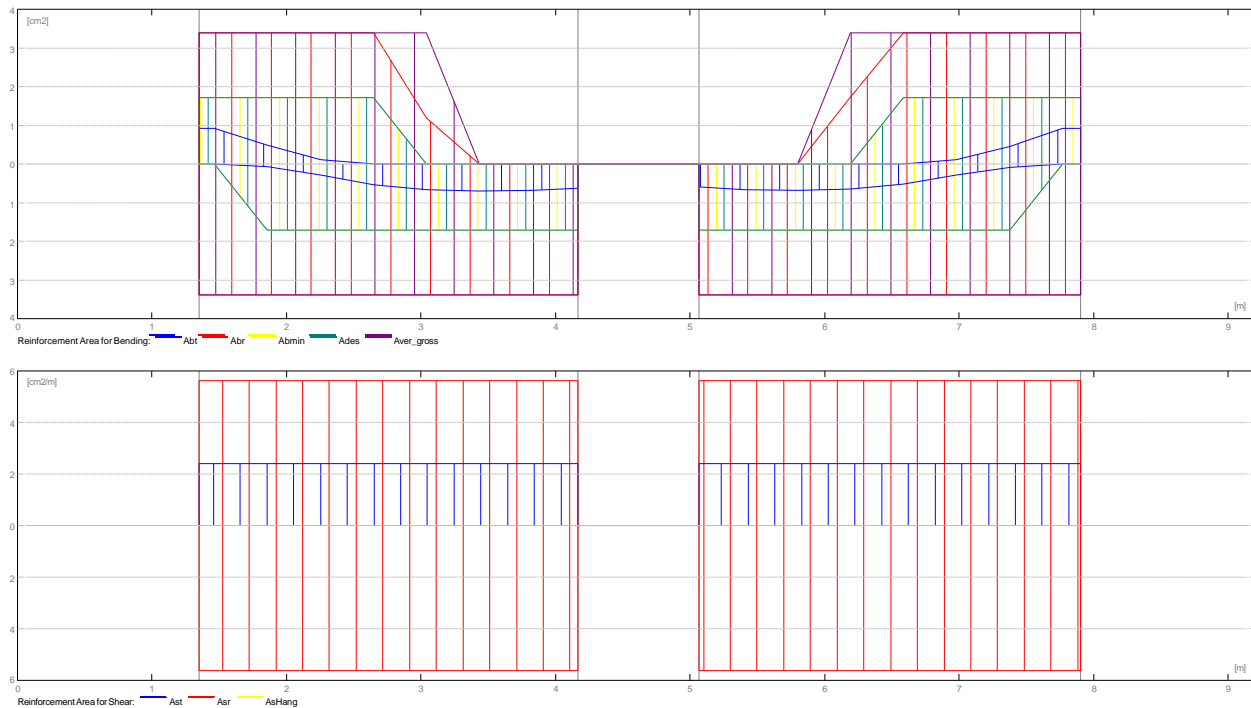


2.4.2 Internal forces in SLS



2.4.3 Required reinforcement area

Span	Span (cm ²)		Left support (cm ²)		Right support (cm ²)	
	bottom	top	bottom	top	bottom	top
P1	0,70	0,00	0,00	0,92	0,62	0,00
P2	0,68	0,00	0,59	0,00	0,00	0,92



2.4.4 Deflection and cracking

wt(QP) Total due to quasi-permanent combination

wt(QP)dop Allowable due to quasi-permanent combination

Dwt(QP) Deflection increment from the quasi-permanent load combination after erecting a structure.

Dwt(QP)dop Admissible deflection increment from the quasi-permanent load combination after erecting a structure.

wk - width of perpendicular cracks

Span	wt(QP) (cm)	wt(QP)dop (cm)	Dwt(QP) (cm)	Dwt(QP)dop (cm)	wk (mm)
P1	0,0	1,6	0,0	0,8	0,0
P2	0,0	1,6	0,0	0,8	0,0

2.5 Theoretical results - detailed results:

2.5.1 P1 : Span from 1,35 to 4,17 (m)

Abscissa (m)	ULS		SLS		A bottom (cm²)	A top (cm²)
	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)		
1,35	0,00	-16,61	0,00	-9,78	0,00	0,92
1,46	0,00	-16,61	0,00	-8,01	0,00	0,92
1,86	1,44	-9,03	0,00	-2,87	0,08	0,48
2,25	5,49	-2,27	1,24	0,00	0,28	0,12
2,65	9,73	-0,03	4,31	0,00	0,54	0,00
3,04	12,04	-0,00	6,34	0,00	0,66	0,00
3,43	12,71	-0,00	7,35	0,00	0,70	0,00
3,83	12,45	-0,00	7,32	0,00	0,69	0,00
4,17	11,31	-0,00	6,40	0,00	0,62	0,00

Abscissa (m)	ULS		afp (mm)
	V max. (kN)	V max. (kN)	
1,35	26,92	15,11	0,0
1,46	25,51	14,35	0,0
1,86	20,62	11,73	0,0

2,25	15,73	9,11	0,0
2,65	10,83	6,48	0,0
3,04	5,94	3,86	0,0
3,43	1,97	1,23	0,0
3,83	-3,84	-1,39	0,0
4,17	-8,04	-3,64	0,0

2.5.2 P2 : Span from 5,07 to 7,91 (m)

Abscissa (m)	ULS		SLS		A bottom (cm ²)	A top (cm ²)
	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)		
5,07	10,70	-0,00	5,94	0,00	0,59	0,00
5,40	11,99	-0,00	6,95	0,00	0,66	0,00
5,80	12,35	-0,00	7,10	0,00	0,68	0,00
6,19	11,77	-0,00	6,22	0,00	0,65	0,00
6,59	9,64	-0,03	4,31	0,00	0,53	0,00
6,98	5,58	-2,08	1,36	0,00	0,29	0,11
7,37	1,53	-8,57	0,00	-2,62	0,08	0,46
7,77	0,00	-16,70	0,00	-7,64	0,00	0,92
7,91	0,00	-16,70	0,00	-9,76	0,00	0,92

Abscissa (m)	ULS		afp (mm)
	V max. (kN)	V max. (kN)	
5,07	8,50	3,95	0,0
5,40	4,31	1,70	0,0
5,80	-1,54	-0,93	0,0
6,19	-5,48	-3,55	0,0
6,59	-10,37	-6,17	0,0
6,98	-15,27	-8,80	0,0
7,37	-20,16	-11,42	0,0
7,77	-25,05	-14,05	0,0
7,91	-26,76	-14,96	0,0

2.6 Reinforcement:**2.6.1 P1 : Span from 1,35 to 4,17 (m)****Longitudinal reinforcement:**

- bottom (B500C)
3 $\phi 12$ $l = 9,23$ from 0,06 to 9,15
- assembling (top) (B500C)
2 $\phi 12$ $l = 4,53$ from 2,35 to 6,88
- support (B500C)
3 $\phi 12$ $l = 3,24$ from 0,06 to 3,23

Transversal reinforcement:

- main (B500C)
stirrups 11 $\phi 10$ $l = 1,22$
 $e = 1*0,01 + 10*0,28$ (m)

2.6.2 P2 : Span from 5,07 to 7,91 (m)**Longitudinal reinforcement:**

- support (B500C)
3 $\phi 12$ $l = 3,24$ from 5,91 to 9,08

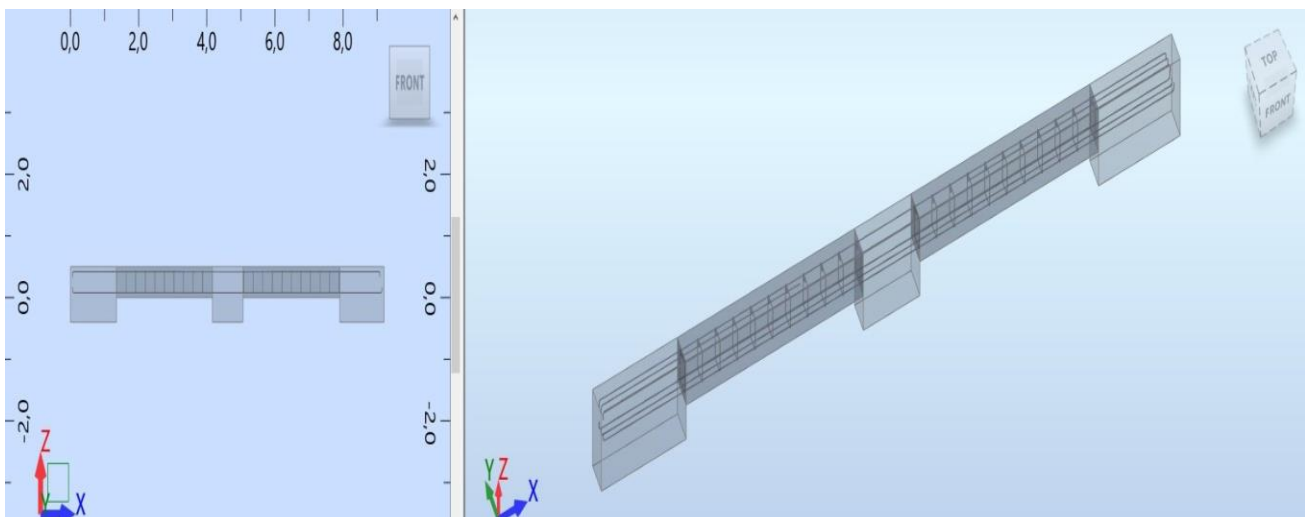
Transversal reinforcement:

- main (B500C)
stirrups 11 $\phi 10$ $l = 1,22$
 $e = 1*0,02 + 10*0,28$ (m)

3 Material survey:

- Concrete volume = 1,38 (m3)
- Formwork = 11,20 (m2)
- Steel B500C
 - Total weight = 66,40 (kG)
 - Density = 48,09 (kG/m3)
 - Average diameter = 11,4 (mm)
 - Survey according to diameters:

Diameter (mm)	Length (m)	Weight (kG)	Number (No.)	Total weight (kG)
10	1,22	0,75	22	16,49
12	3,24	2,88	6	17,27
12	4,53	4,03	2	8,05
12	9,23	8,19	3	24,58



ΔΟΚΟΙ ΕΞΙ ΚΑΙ ΕΠΤΑ

1 Level:

- Name : Level ±0,00
- Reference level : 0,00 (m)
- Maximum cracking : 0,30 (mm)
- Exposure : XC2
- Concrete creep coefficient : $\phi_{\pi} = 1,40$
- Cement class : N
- Concrete age (loading moment) : 90 (days)
- Concrete age : 5 (years)
- Concrete age after erecting a structure : 365 (years)
- Structure class : S1
- Fire resistance class : no requirements
- FFB Recommendations 7.4.3(7) : 0,00

2 Beam: Beam21...22 elements: 1

Number of identical

2.1 Material properties:

- Concrete : C25/30 $f_{ck} = 25,00$ (MPa)
 Rectangular stress distribution [3.1.7(3)]
 Density : 2501,36 (kG/m³)
 Aggregate size : 20,0 (mm)
- Longitudinal reinforcement: : B500C $f_{yk} = 500,00$ (MPa)
 Horizontal branch of the stress-strain diagram
 Ductility class : C
- Transversal reinforcement: : B500C $f_{yk} = 500,00$ (MPa)
 Horizontal branch of the stress-strain diagram
 Ductility class : C
- Additional reinforcement: : B500C $f_{yk} = 500,00$ (MPa)
 Horizontal branch of the stress-strain diagram

2.2 Geometry:

2.2.1	Span	Position	L supp. (m)	L (m)	R supp. (m)
	P1	Span 1,35	2,82	0,90	
	Span length: $L_o = 3,94$ (m)				
	Section from 0,00 to 2,82 (m)				
	30,0 x 50,0 (cm)				
	without left slab				
	without right slab				

2.2.2	Span	Position	L supp. (m)	L (m)	R supp. (m)
	P2	Span 0,90	2,82	1,35	
	Span length: $L_0 = 3,94$ (m)				
	Section from 0,00 to 2,82 (m)				
	30,0 x 50,0 (cm)				
	without left slab				
	without right slab				

2.3 Calculation options:

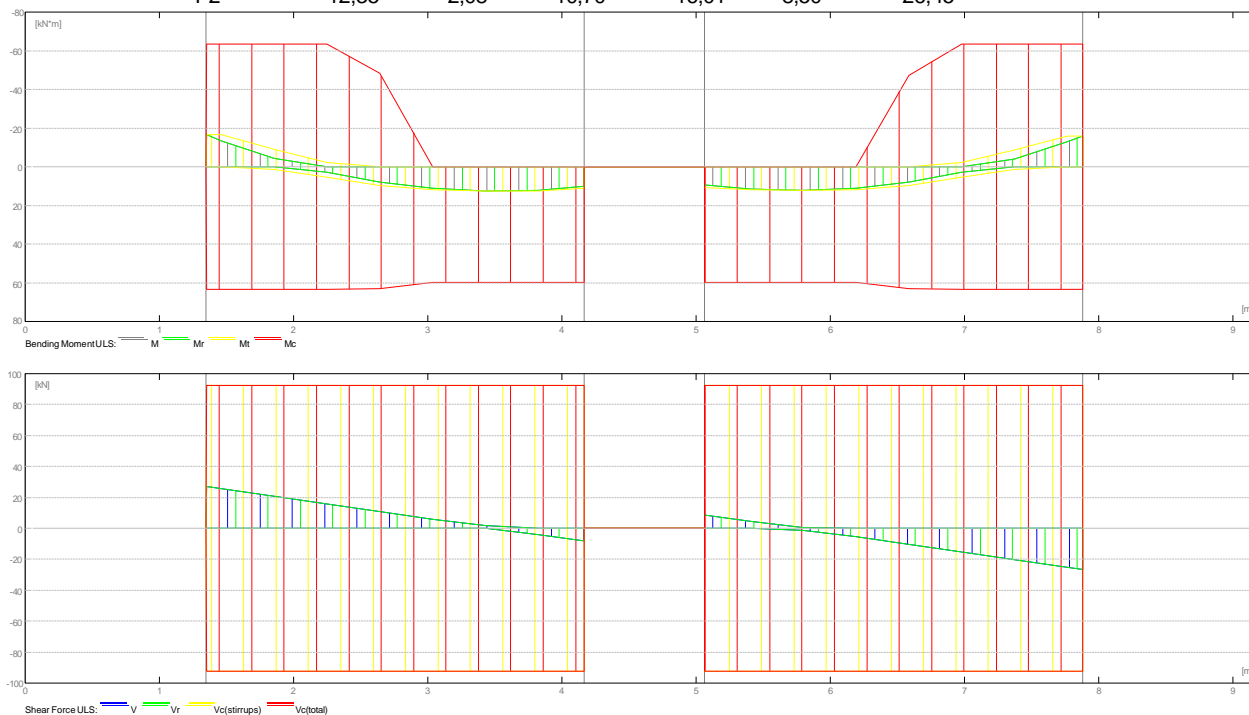
- Regulation of combinations : EN 1990:2002
- Calculations according to : EN 1992-1-1:2004/A1:2014
- Seismic dispositions : No requirements
- Precast beam : no
- Cover :
 - bottom $c = 6,0$ (cm)
 - side $c1 = 6,0$ (cm)
 - top $c2 = 6,0$ (cm)
- Cover deviations : Cdev = 1,0(cm), Cdur = 0,0(cm)
- Coefficient $\beta_2 = 0.50$: long-term or cyclic load
- Method of shear calculations : strut inclination

2.4 Calculation results:

The "Freeze Reinforcement" option is switched on. The distribution of reinforcing bars has not been modified.

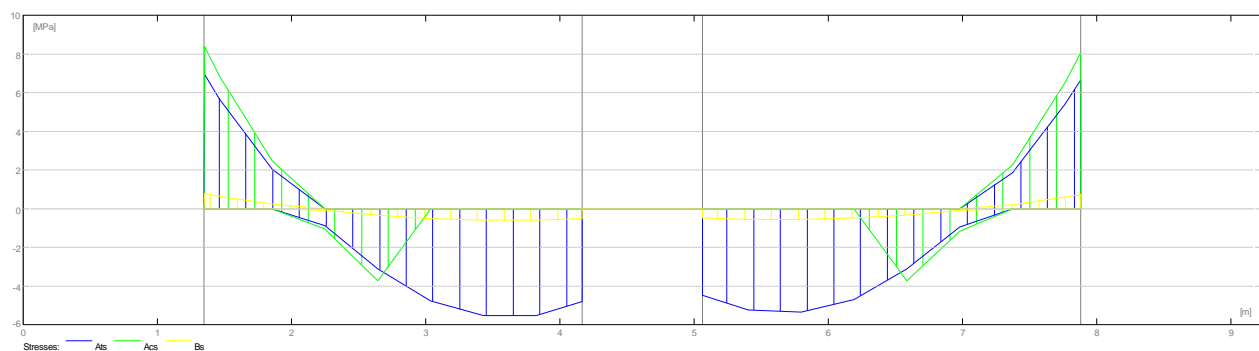
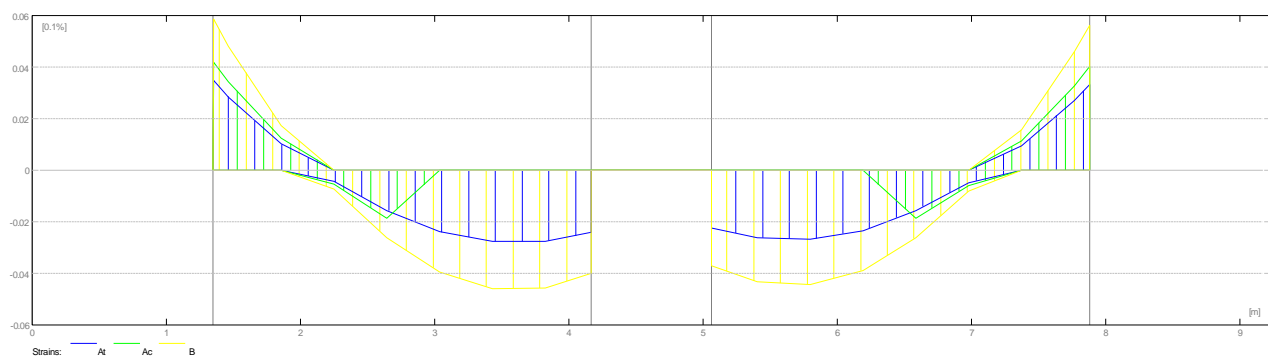
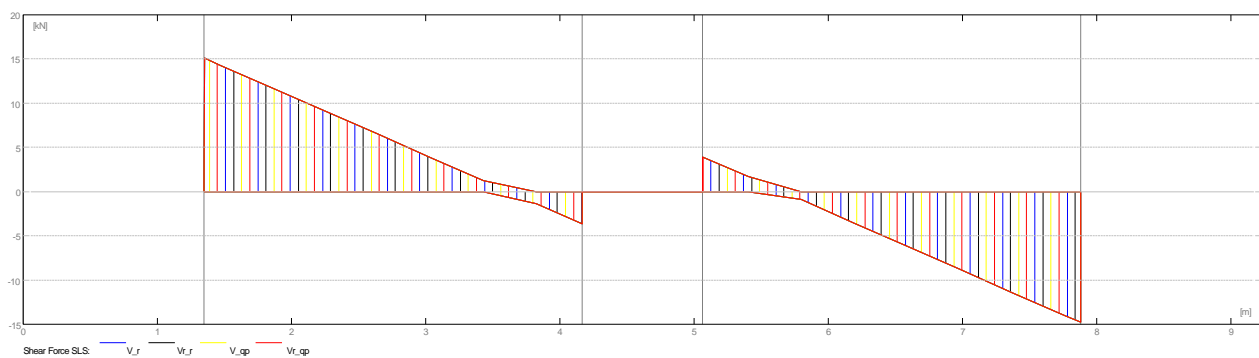
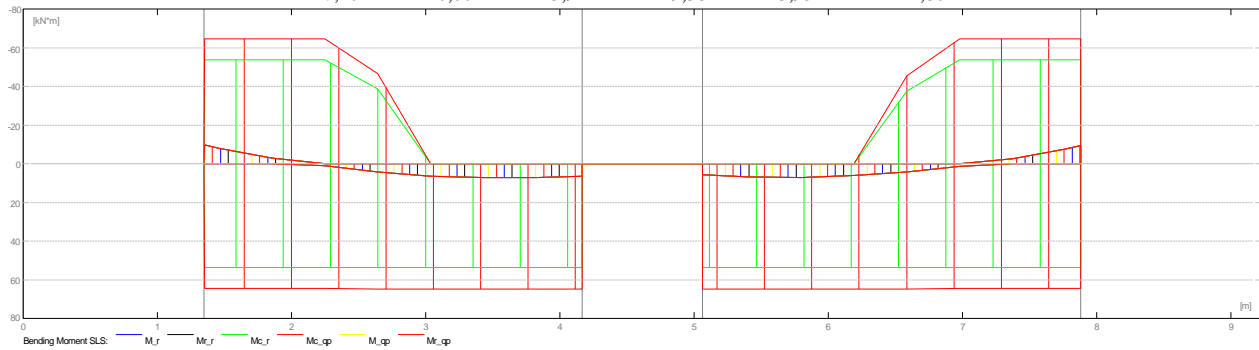
2.4.1 Internal forces in ULS

Span	Mt max. (kN*m)	Mt min. (kN*m)	MI (kN*m)	Mr (kN*m)	QI (kN)	Qr (kN)
P1	12,71	-2,27	-16,61	11,31	26,92	-8,04
P2	12,35	-2,08	10,70	-16,01	8,50	-26,45



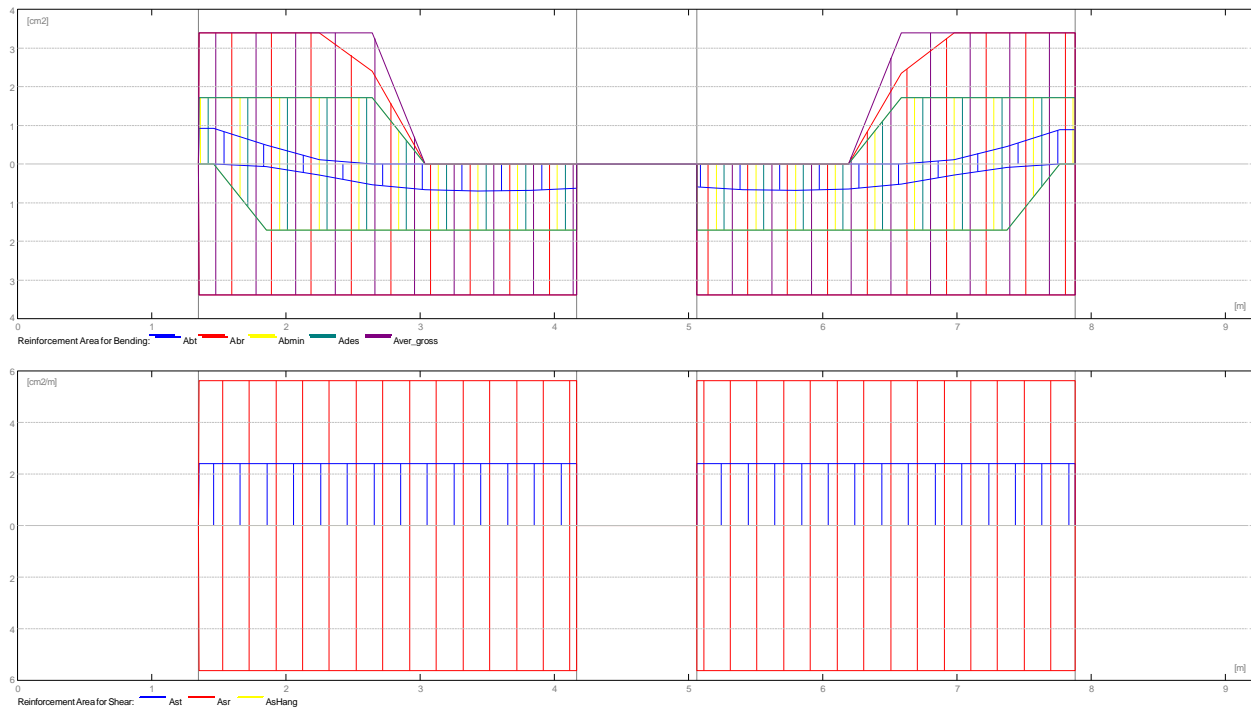
2.4.2 Internal forces in SLS

Span	Mt max. (kN*m)	Mt min. (kN*m)	MI (kN*m)	Mr (kN*m)	QI (kN)	Qr (kN)
P1	7,35	0,00	-9,78	6,40	15,11	-3,64
P2	7,10	0,00	5,94	-9,38	3,95	-14,80



2.4.3 Required reinforcement area

Span	Span (cm ²)		Left support (cm ²)		Right support (cm ²)	
	bottom	top	bottom	top	bottom	top
P1	0,70	0,00	0,00	0,92	0,62	0,00
P2	0,68	0,00	0,59	0,00	0,00	0,88



2.4.4 Deflection and cracking

wt(QP) Total due to quasi-permanent combination

wt(QP)dop Allowable due to quasi-permanent combination

Dwt(QP) Deflection increment from the quasi-permanent load combination after erecting a structure.

Dwt(QP)dop Admissible deflection increment from the quasi-permanent load combination after erecting a structure.

wk - width of perpendicular cracks

Span	wt(QP) (cm)	wt(QP)dop (cm)	Dwt(QP) (cm)	Dwt(QP)dop (cm)	wk (mm)
P1	0,0	1,6	0,0	0,8	0,0
P2	0,0	1,6	0,0	0,8	0,0

2.5 Theoretical results - detailed results:

2.5.1 P1 : Span from 1,35 to 4,17 (m)

Abscissa (m)	ULS		SLS		A bottom (cm²)	A top (cm²)
	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)		
1,35	0,00	-16,61	0,00	-9,78	0,00	0,92
1,46	0,00	-16,61	0,00	-8,01	0,00	0,92
1,86	1,44	-9,03	0,00	-2,87	0,08	0,48
2,25	5,49	-2,27	1,24	0,00	0,28	0,12
2,65	9,73	-0,03	4,31	0,00	0,54	0,00
3,04	12,04	-0,00	6,34	0,00	0,66	0,00
3,43	12,71	-0,00	7,35	0,00	0,70	0,00
3,83	12,45	-0,00	7,32	0,00	0,69	0,00
4,17	11,31	-0,00	6,40	0,00	0,62	0,00

Abscissa (m)	ULS		afp (mm)
	V max. (kN)	V max. (kN)	
1,35	26,92	15,11	0,0
1,46	25,51	14,35	0,0
1,86	20,62	11,73	0,0

2,25	15,73	9,11	0,0
2,65	10,83	6,48	0,0
3,04	5,94	3,86	0,0
3,43	1,97	1,23	0,0
3,83	-3,84	-1,39	0,0
4,17	-8,04	-3,64	0,0

2.5.2 P2 : Span from 5,07 to 7,88 (m)

Abscissa (m)	ULS		SLS		A bottom (cm ²)	A top (cm ²)
	M max. (kN*m)	M min. (kN*m)	M max. (kN*m)	M min. (kN*m)		
5,07	10,70	-0,00	5,94	0,00	0,59	0,00
5,40	11,99	-0,00	6,95	0,00	0,66	0,00
5,80	12,35	-0,00	7,10	0,00	0,68	0,00
6,19	11,77	-0,00	6,22	0,00	0,65	0,00
6,59	9,64	-0,03	4,31	0,00	0,53	0,00
6,98	5,58	-2,08	1,36	0,00	0,29	0,11
7,37	1,53	-8,57	0,00	-2,62	0,08	0,46
7,77	0,00	-16,01	0,00	-7,64	0,00	0,88
7,88	0,00	-16,01	0,00	-9,38	0,00	0,88

Abscissa (m)	ULS		afp (mm)
	V max. (kN)	V max. (kN)	
5,07	8,50	3,95	0,0
5,40	4,31	1,70	0,0
5,80	-1,54	-0,93	0,0
6,19	-5,48	-3,55	0,0
6,59	-10,37	-6,17	0,0
6,98	-15,27	-8,80	0,0
7,37	-20,16	-11,42	0,0
7,77	-25,05	-14,05	0,0
7,88	-26,45	-14,80	0,0

2.6 Reinforcement:**2.6.1 P1 : Span from 1,35 to 4,17 (m)****Longitudinal reinforcement:**

- bottom (B500C)
3 $\phi 12$ $l = 9,25$ from 0,06 to 9,17
- assembling (top) (B500C)
2 $\phi 12$ $l = 4,53$ from 2,35 to 6,88
- support (B500C)
3 $\phi 12$ $l = 3,04$ from 0,06 to 3,03

Transversal reinforcement:

- main (B500C)
stirrups 11 $\phi 10$ $l = 1,22$
 $e = 1*0,01 + 10*0,28$ (m)

2.6.2 P2 : Span from 5,07 to 7,88 (m)**Longitudinal reinforcement:**

- support (B500C)
3 $\phi 12$ $l = 3,04$ from 6,21 to 9,18

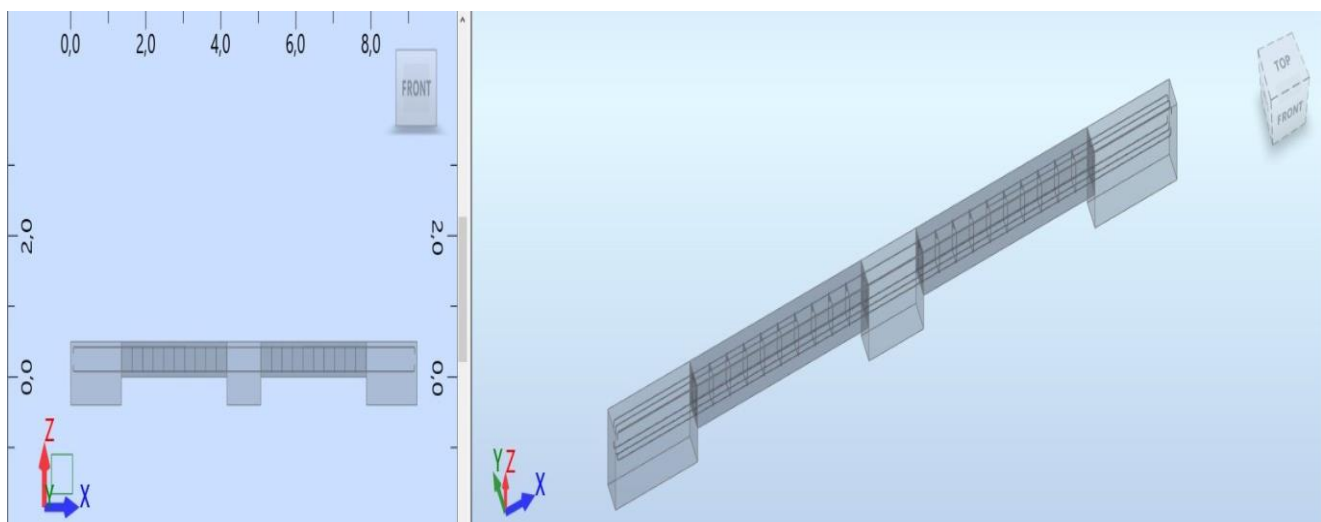
Transversal reinforcement:

- main (B500C)
stirrups 11 $\phi 10$ $l = 1,22$
 $e = 1*0,01 + 10*0,28$ (m)

3 Material survey:

- Concrete volume = 1,38 (m3)
- Formwork = 11,22 (m2)
- Steel B500C
 - Total weight = 65,40 (kG)
 - Density = 47,24 (kG/m3)
 - Average diameter = 11,3 (mm)
 - Survey according to diameters:

Diameter (mm)	Length (m)	Weight (kG)	Number (No.)	Total weight (kG)
10	1,22	0,75	22	16,49
12	3,04	2,70	6	16,21
12	4,53	4,03	2	8,05
12	9,25	8,22	3	24,65



ΚΥΡΙΑΚΟΣ Ι. ΑΠΟΣΤΟΛΟΠΟΥΛΟΣ
 ΔΙΠΛΩΜΑΤΟΥΧΟΣ ΠΟΛΙΤΙΚΟΣ ΜΗΧΑΝΙΚΟΣ Α.Π.Θ.
 ΑΡΙΣΤΟΤΕΛΕΙΟΥ ΠΑΝΕΠΙΣΤΗΜΙΟΥ ΘΕΣΣΑΛΟΝΙΚΗΣ
 Μέλος Τ.Ε.Ε. Αριθ. Μητρώου 152923
 Α.Φ.Μ. 164738694 ΔΟΥ ΧΑΝΙΩΝ
 ΣΜΥΡΝΗΣ 11 ΧΑΝΙΑ 73100
 ΤΗΛ. 2821046796-2821096623-6934539294

Ελέγχθηκε – Θεωρήθηκε

Η Προϊσταμένη Δ/σης
 Τεχνικών Υπηρεσιών & Περ/ντος

ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
 ΔΗΜΟΣ ΡΗΓΑΣ ΦΕΡΑΙΟΥ

ΚΑΤΣΙΟΥΡΑ ΑΠΟΣΤΟΛΙΑ
 ΠΟΛ/ΚΟΣ. ΜΗΧ/ΚΟΣ Π.Ε.