REGIONE PUGLIA

COMUNE DI ACCADIA

COMPLETAMENTO DISSESTO IDROGEOLOGICO CENTRO URBANO VIA PERTINI

FINANZIAMENTO

P.O.R. Puglia 2014/2020 - Asse V - Azione 5.1 - "Interventi di riduzione del rischio idrogeologico e di erosione costiera". Programma di interventi cantierabili ai sensi della DGR n. 511 del 19.04.2016

Progetto N. 17328
Ottobre 2017

Progetto	**BONIFICA DISSESTO**
Fase Progettuale	PROGETTO ESECUTIVO
Localizzazione	ACCADIA - Via Pertini
Committente	COMUNE DI ACCADIA
Responsabile Unico del Procedimento	DOTT. ING. GIUSEPPE CELA

Progettista Raggruppamento temporaneo di professionisti

CAPOGRUPPO

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Dott.Geol. Michele ROSSI

rev.	data	aggiornamento	redatto	verificato	approvato
00	Ottobre 2017	Emissione	Bruschini	Bartocci	Balducci

Verifica terre rinforzate
Fascicolo dei calcoli

scala

tav. **GEOTB**

17328 – GEOTB – PE – 00 – --

COMUNE DI ACCADIA (FG)

PROGETTO INTERVENTO DI COMPLETAMENTO DISSESTO IDROGEOLOGICO CENTRO URBANO VIA PERTINI

VERIFICA TERRE RINFORZATE - FASCICOLO DEI CALCOLI

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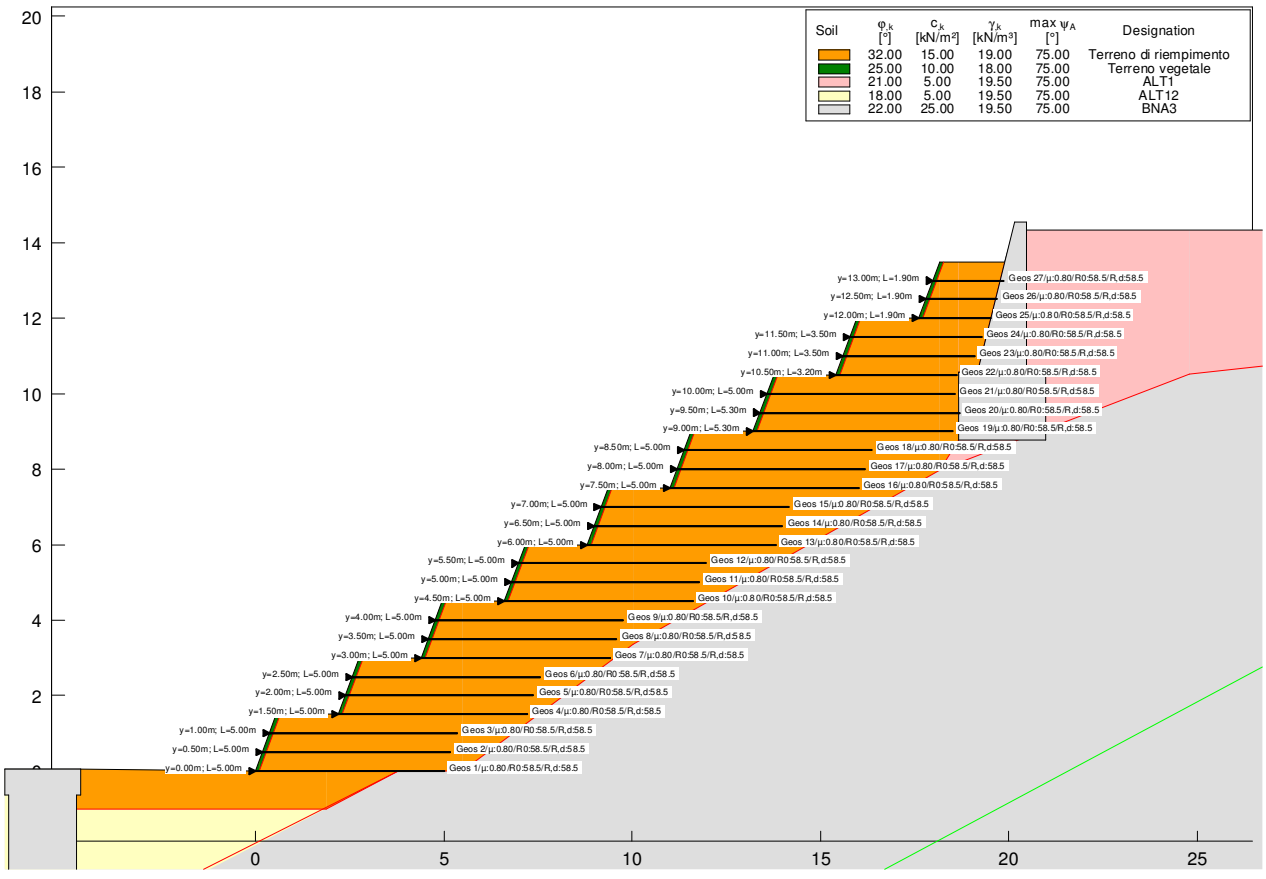
SEZIONE 2

PROGETTO: ACCADIA
CONFIGURAZIONE STRUTTURALE
SEZIONE 2

Geosintetici di rinforzo				
Strato n°	Tipo	Tamm	Lungh.	Spaz.
[-]	[-]	[kN/m]	[m]	[m]
1-6	Fortrac 110/25-20/30 MPT	58,53	5.50	0.50
7-12	Fortrac 110/25-20/30 MPT	58,53	5.00	0.50
13-18	Fortrac 110/25-20/30 MPT	58,53	5.00	0.50
19-20	Fortrac 110/25-20/30 MPT	58,53	5.30	0.50
21	Fortrac 110/25-20/30 MPT	58,53	5.00	0.50
22	Fortrac 110/25-20/30 MPT	58,53	3.20	0.50
23-24	Fortrac 110/25-20/30 MPT	58,53	3.50	0.50
25-27	Fortrac 110/25-20/30 MPT	58,53	1.90	0.50



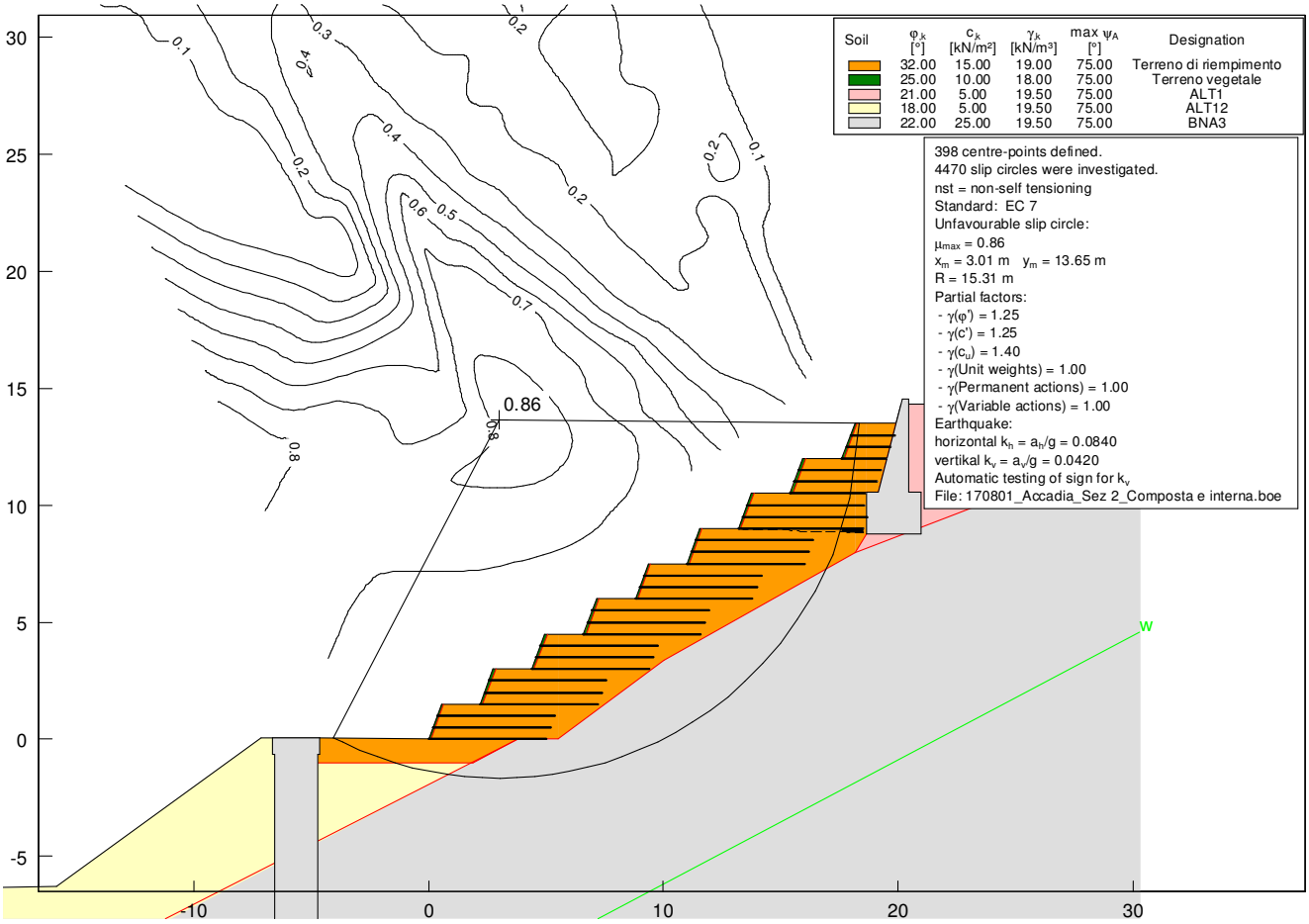
PROGETTO: ACCADIA
VERIFICA DI STABILITÀ INTERNA E COMPOSTA
SEZIONE 2

NTC2008
Combinazione:
A2+M2+R2

$E_d \leq (R/\gamma_R)$
$\gamma_R = 1{,}1$ (tab. 6.8.I NTC2008)
→ $R/E_d \geq 1{,}1$ → $F_S \geq 1{,}1$.

μ: grado di utilizzo del sistema
$\mu = 1/F_S = 0{,}86$

→$F_S = 1{,}16 \geq 1{,}10$



Slope stability analysis to EC 7
using circular slip surfaces

Datei: 170801_Accadia_Sez 2_Composta e interna.boe

Parameter list
phi [°] = friction angle
c [kN/m²] = cohesion
gamma [kN/m³] = unit weight
Max. psi(A) [°] = angle between slip direction of failure mechanism and the tension member
μ [-] = utilisation factor
xm,ym [m] = x and y values of slip circle centre-point
rad [m] = slip circle radius

Partial factors: (GEO-3)
- gam(phi)= 1.25
- gam(c') = 1.25
- gam(cu) = 1.40
- gam(Unit weights) = 1.00
- gam(Permanent actions) = 1.00
- gam(Variable actions) = 1.00

Movement direction of slip body to the Left

Coordinates of surface points

No. [-]	x [m]	y [m]
1	-40.000	-16.247
2	-22.291	-9.046
3	-18.422	-6.377
4	-15.871	-6.270
5	-7.148	0.060
6	-4.641	0.060
7	0.000	0.000
8	0.546	1.500
9	2.200	1.500
10	2.746	3.000
11	4.400	3.000
12	4.946	4.500
13	6.600	4.500
14	7.146	6.000
15	8.800	6.000
16	9.346	7.500
17	11.000	7.500
18	11.546	9.000
19	13.200	9.000
20	13.746	10.500
21	15.400	10.500
22	15.946	12.000
23	17.600	12.000
24	18.146	13.500
25	19.890	13.500
26	20.115	14.339
27	30.334	14.339

Characteristic soil properties

Soil [-]	phi,k [°]	c,k [kN/m²]	gamma,k [kN/m³]	max psi(A) [°]	drained	Designation
1	32.00	15.00	19.00	75.00	ja	Terreno di riempimento
2	25.00	10.00	18.00	75.00	ja	Terreno vegetale
3	21.00	5.00	19.50	75.00	ja	ALT1
4	18.00	5.00	19.50	75.00	ja	ALT12
5	22.00	25.00	19.50	75.00	ja	BNA3

Design soil properties

Soil [-]	phi,d [°]	c,d [kN/m²]	gamma,d [kN/m³]	drained	Designation
1	26.56	12.00	19.00	ja	Terreno di riempimento
2	20.46	8.00	18.00	ja	Terreno vegetale
3	17.07	4.00	19.50	ja	ALT1

4	14.57	4.00	19.50	ja	ALT12
5	17.91	20.00	19.50	ja	BNA3

Coordinates of layers and soil numbers

No. [-]	x(left) [m]	y(left) [m]	x(right) [m]	y(right) [m]	Soil no.
1	0.000	0.000	0.100	0.000	2
2	0.100	0.000	0.652	1.500	2
3	2.200	1.500	2.300	1.500	2
4	2.300	1.500	2.852	3.000	2
5	4.400	3.000	4.500	3.000	2
6	4.500	3.000	5.052	4.500	2
7	6.600	4.500	6.700	4.500	2
8	6.700	4.500	7.252	6.000	2
9	8.800	6.000	8.900	6.000	2
10	8.900	6.000	9.452	7.500	2
11	11.000	7.500	11.100	7.500	2
12	11.100	7.500	11.652	9.000	2
13	13.200	9.000	13.300	9.000	2
14	13.300	9.000	13.852	10.500	2
15	15.400	10.500	15.500	10.500	2
16	15.500	10.500	16.052	12.000	2
17	17.600	12.000	17.700	12.000	2
18	17.700	12.000	18.252	13.500	2
19	0.100	0.000	5.500	0.000	1
20	5.500	0.000	10.031	3.359	1
21	10.031	3.359	18.159	7.988	1
22	18.159	7.988	18.655	8.762	1
23	18.655	10.562	19.155	10.562	1
24	19.155	10.562	19.890	13.500	1
25	18.159	7.988	24.790	10.524	3
26	24.790	10.524	30.370	11.060	3
27	-40.000	-21.251	-26.335	-15.662	4
28	-4.741	-1.000	1.877	-1.000	1
29	1.877	-1.000	3.801	0.000	1
30	-26.335	-15.662	3.801	0.000	4
31	-40.000	-40.000	30.334	-40.000	5

Coordinates of pwp polygon course

No. [-]	x [m]	y [m]
1	-40.000	-25.672
2	-30.726	-22.102
3	-5.138	-14.376
4	30.280	4.595

Geosynthetics
Adhesive force f calculated with:
$f = \mu \cdot \tan(\varphi) \cdot \sigma'$
μ [-] = reduction factor for friction between ground and geosynthetics
sigma' [kN/m²] = effekive Spannung
R0 [kN/m] = design force at connection
L0 [m] = fold-back length
R,d [kN/m] = acceptable design force

Nr. [-]	x1 [m]	y1 [m]	x2 [m]	y2 [m]	μ [-]	R0 [kN/m]	R,d [kN/m]
1	0.00	0.00	5.00	0.00	0.800	58.53	58.53
2	0.18	0.50	5.18	0.50	0.800	58.53	58.53
3	0.36	1.00	5.36	1.00	0.800	58.53	58.53
4	2.20	1.50	7.20	1.50	0.800	58.53	58.53
5	2.38	2.00	7.38	2.00	0.800	58.53	58.53
6	2.56	2.50	7.56	2.50	0.800	58.53	58.53
7	4.40	3.00	9.40	3.00	0.800	58.53	58.53
8	4.58	3.50	9.58	3.50	0.800	58.53	58.53
9	4.76	4.00	9.76	4.00	0.800	58.53	58.53
10	6.60	4.50	11.60	4.50	0.800	58.53	58.53
11	6.78	5.00	11.78	5.00	0.800	58.53	58.53
12	6.96	5.50	11.96	5.50	0.800	58.53	58.53
13	8.80	6.00	13.80	6.00	0.800	58.53	58.53

14	8.98	6.50	13.98	6.50	0.800	58.53	58.53
15	9.16	7.00	14.16	7.00	0.800	58.53	58.53
16	11.00	7.50	16.00	7.50	0.800	58.53	58.53
17	11.18	8.00	16.18	8.00	0.800	58.53	58.53
18	11.36	8.50	16.36	8.50	0.800	58.53	58.53
19	13.20	9.00	18.50	9.00	0.800	58.53	58.53
20	13.38	9.50	18.68	9.50	0.800	58.53	58.53
21	13.56	10.00	18.56	10.00	0.800	58.53	58.53
22	15.40	10.50	18.60	10.50	0.800	58.53	58.53
23	15.58	11.00	19.08	11.00	0.800	58.53	58.53
24	15.76	11.50	19.26	11.50	0.800	58.53	58.53
25	17.60	12.00	19.50	12.00	0.800	58.53	58.53
26	17.78	12.50	19.68	12.50	0.800	58.53	58.53
27	17.96	13.00	19.86	13.00	0.800	58.53	58.53

Structural element 1

No. [-]	x [m]	y [m]
1	-6.64	0.06
2	-4.64	0.06
3	-4.64	-0.64
4	-4.74	-0.64
5	-4.74	-11.94
6	-6.54	-11.94
7	-6.54	-0.64
8	-6.64	-0.64

Structural element 2

No. [-]	x [m]	y [m]
1	20.16	14.56
2	20.46	14.56
3	20.46	10.56
4	20.96	10.56
5	20.96	8.76
6	18.66	8.76
7	18.66	10.56
8	19.16	10.56

Earthquake
horizontal kh = ah/g = 0.0840
vertical kv = av/g = 0.0420
Automatic testing of sign for kv
kv (governing) = -0.0420
(ah = horizontal seismic acceleration in m/s²)
(av = vertical seismic acceleration in m/s²)
(g = gravitational acceleration = 9.81 m/s²)

Water level in front of slope left [m] = -20.00
Water level in front of slope right [m] = -20.00

Gamma water [kN/m³] = 10.000

Calculation with consideration of passive earth pressure wedge

Slip circle no. 308
μ = 0.8568 = [M(Gi) + M(S)] / [M(Ti) + M(R)]
xm = 3.0089
ym = 13.6454
Radius = 15.3123
Numerator = 15555.6701
Denominator = 18156.3182
M(Ti) = 18156.3182
M(R) = 0.0000
M(Gi) = 13882.5064
M(S) = 1673.1638

Slice values

x = x (slice toe)
y = y (slice toe)
b = slice width
phi = friction angle
c = cohesion
PWP = pore water press. coeff.
tet = inclination of slice
g = weight
n = normal force
t = tangential force
FAi/FA0i/Rsi = see Equations (7) and (8) in DIN 4084:2009
pw = pore water pressure
pw(con) = excess pwp due to consolidation
wv = vertical water pressure
pst = permanent loads and footing
pv = live loads
fakpv = factor for live loads
So No. = soil number

Nr.	x [m]	y [m]	b [m]	phi,d [°]	c,d [kN/m²]	PWD [-]	tet [°]	g,k [kN/m]	n [kN/m]	t [kN/m]	FAi [kN/m]	FA0i [kN/m]	Rsi [kN/m]	pw [kN/m]	pw(kon) [kN/m]	wv [kN/m]	pst,d [kN/m]	pv,d [kN/m]	fakpv [-]	Bo-Nr. [-]
1	-3.668	-0.135	0.745	26.6	12.0	0.00	25.9	2.6	3.8	14.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	28
2	-2.922	-0.472	0.745	26.6	12.0	0.00	22.8	7.2	9.9	16.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	28
3	-2.177	-0.762	0.745	26.6	12.0	0.00	19.8	11.2	14.7	18.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	28
4	-1.432	-1.009	0.745	14.6	4.0	0.00	16.9	14.6	17.0	7.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	30
5	-0.686	-1.214	0.745	14.6	4.0	0.00	14.0	17.4	19.8	8.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	30
6	0.059	-1.380	0.745	14.6	4.0	0.00	11.1	21.9	24.3	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	30
7	0.804	-1.507	0.745	14.6	4.0	0.00	8.3	42.8	46.6	15.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	30
8	1.550	-1.597	0.745	17.9	20.0	0.00	5.5	44.1	47.4	30.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
9	2.295	-1.650	0.745	17.9	20.0	0.00	2.7	48.4	51.2	31.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
10	3.041	-1.667	0.745	17.9	20.0	0.00	-0.1	66.6	69.3	37.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
11	3.786	-1.647	0.745	17.9	20.0	0.00	-2.9	66.4	68.3	36.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
12	4.531	-1.591	0.745	17.9	20.0	0.00	-5.7	70.5	71.9	37.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
13	5.277	-1.498	0.745	17.9	20.0	0.00	-8.5	85.5	86.5	42.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
14	6.022	-1.368	0.745	17.9	20.0	0.00	-11.3	83.8	84.3	41.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
15	6.767	-1.199	0.745	17.9	20.0	0.00	-14.2	87.8	88.2	42.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
16	7.513	-0.990	0.745	17.9	20.0	0.00	-17.1	99.9	100.4	46.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
17	8.258	-0.739	0.745	17.9	20.0	0.00	-20.0	96.5	97.2	45.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
18	9.003	-0.445	0.745	17.9	20.0	0.00	-23.0	100.1	101.4	47.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
19	9.749	-0.104	0.745	17.9	20.0	0.00	-26.1	108.9	111.3	50.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
20	10.494	0.287	0.745	17.9	20.0	0.00	-29.3	103.4	106.9	49.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
21	11.240	0.733	0.745	17.9	20.0	0.00	-32.5	106.2	111.5	51.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
22	11.985	1.240	0.745	17.9	20.0	0.00	-35.9	111.1	119.0	53.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
23	12.730	1.815	0.745	17.9	20.0	0.00	-39.4	102.9	113.1	52.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
24	13.476	2.469	0.745	17.9	20.0	0.00	-43.1	104.1	118.0	54.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
25	14.221	3.217	0.745	17.9	20.0	0.00	-47.1	104.1	122.7	56.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
26	14.966	4.081	0.745	17.9	20.0	0.00	-51.3	91.7	113.6	54.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
27	15.712	5.095	0.745	17.9	20.0	0.00	-56.1	89.0	117.7	57.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
28	16.457	6.323	0.745	17.9	20.0	0.00	-61.4	80.7	116.5	58.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
29	17.203	7.900	0.745	26.6	12.0	0.00	-68.0	58.1	78.3	50.7	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	21
30	17.948	10.285	0.745	26.6	12.0	0.00	-77.3	37.6	61.5	44.8	0.0	0.0	0.0							

0.0 0.0 0.0 0.0 0.0 1 21

2064.9

0.0 0.0 0.0 0.0 0.0

Geosynthetic 1
x1 = 0.000 m
y1 = 0.000 m
x2 = 5.000 m
y2 = 0.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 2
x1 = 0.182 m
y1 = 0.500 m
x2 = 5.182 m
y2 = 0.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 3
x1 = 0.364 m
y1 = 1.000 m
x2 = 5.364 m
y2 = 1.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 4
x1 = 2.200 m
y1 = 1.500 m
x2 = 7.200 m
y2 = 1.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 5
x1 = 2.382 m
y1 = 2.000 m
x2 = 7.382 m
y2 = 2.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 6
x1 = 2.564 m
y1 = 2.500 m
x2 = 7.564 m
y2 = 2.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 7
x1 = 4.400 m
y1 = 3.000 m
x2 = 9.400 m
y2 = 3.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 8

x1 = 4.582 m
y1 = 3.500 m
x2 = 9.582 m
y2 = 3.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 9
x1 = 4.764 m
y1 = 4.000 m
x2 = 9.764 m
y2 = 4.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 10
x1 = 6.600 m
y1 = 4.500 m
x2 = 11.600 m
y2 = 4.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 11
x1 = 6.782 m
y1 = 5.000 m
x2 = 11.782 m
y2 = 5.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 12
x1 = 6.964 m
y1 = 5.500 m
x2 = 11.964 m
y2 = 5.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 13
x1 = 8.800 m
y1 = 6.000 m
x2 = 13.800 m
y2 = 6.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 14
x1 = 8.982 m
y1 = 6.500 m
x2 = 13.982 m
y2 = 6.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 15
x1 = 9.164 m
y1 = 7.000 m
x2 = 14.164 m
y2 = 7.000 m
μ = 0.800
R0 = 58.530 kN/m

```
R,d = 58.530 kN/m

Geosynthetic 16
x1 = 11.000 m
y1 = 7.500 m
x2 = 16.000 m
y2 = 7.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 17
x1 = 11.182 m
y1 = 8.000 m
x2 = 16.182 m
y2 = 8.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 18
x1 = 11.364 m
y1 = 8.500 m
x2 = 16.364 m
y2 = 8.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 19
x1 = 13.200 m
y1 = 9.000 m
x2 = 18.500 m
y2 = 9.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 67.96 °
Limit psi(A) = 75.00 °
Geosynthetic is self-tensioning (DIN 4084:2009 7.2.3.4).
Activated force = 55.196 kN/m
Bonded length = 0.90 m
F(AL) = 196.29 kN/m
F(AR) = 55.20 kN/m

Geosynthetic 20
x1 = 13.382 m
y1 = 9.500 m
x2 = 18.682 m
y2 = 9.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 77.32 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

Geosynthetic 21
x1 = 13.564 m
y1 = 10.000 m
x2 = 18.564 m
y2 = 10.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 77.32 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
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```
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

Geosynthetic 22
x1 = 15.400 m
y1 = 10.500 m
x2 = 18.600 m
y2 = 10.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 77.32 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

Geosynthetic 23
x1 = 15.582 m
y1 = 11.000 m
x2 = 19.082 m
y2 = 11.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 77.32 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

Geosynthetic 24
x1 = 15.764 m
y1 = 11.500 m
x2 = 19.264 m
y2 = 11.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 77.32 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

Geosynthetic 25
x1 = 17.600 m
y1 = 12.000 m
x2 = 19.500 m
y2 = 12.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 77.32 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

Geosynthetic 26
x1 = 17.782 m
y1 = 12.500 m
x2 = 19.682 m
y2 = 12.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 77.32 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

Geosynthetic 27
x1 = 17.964 m
```

```
y1 = 13.000 m
x2 = 19.864 m
y2 = 13.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 77.32 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)
```

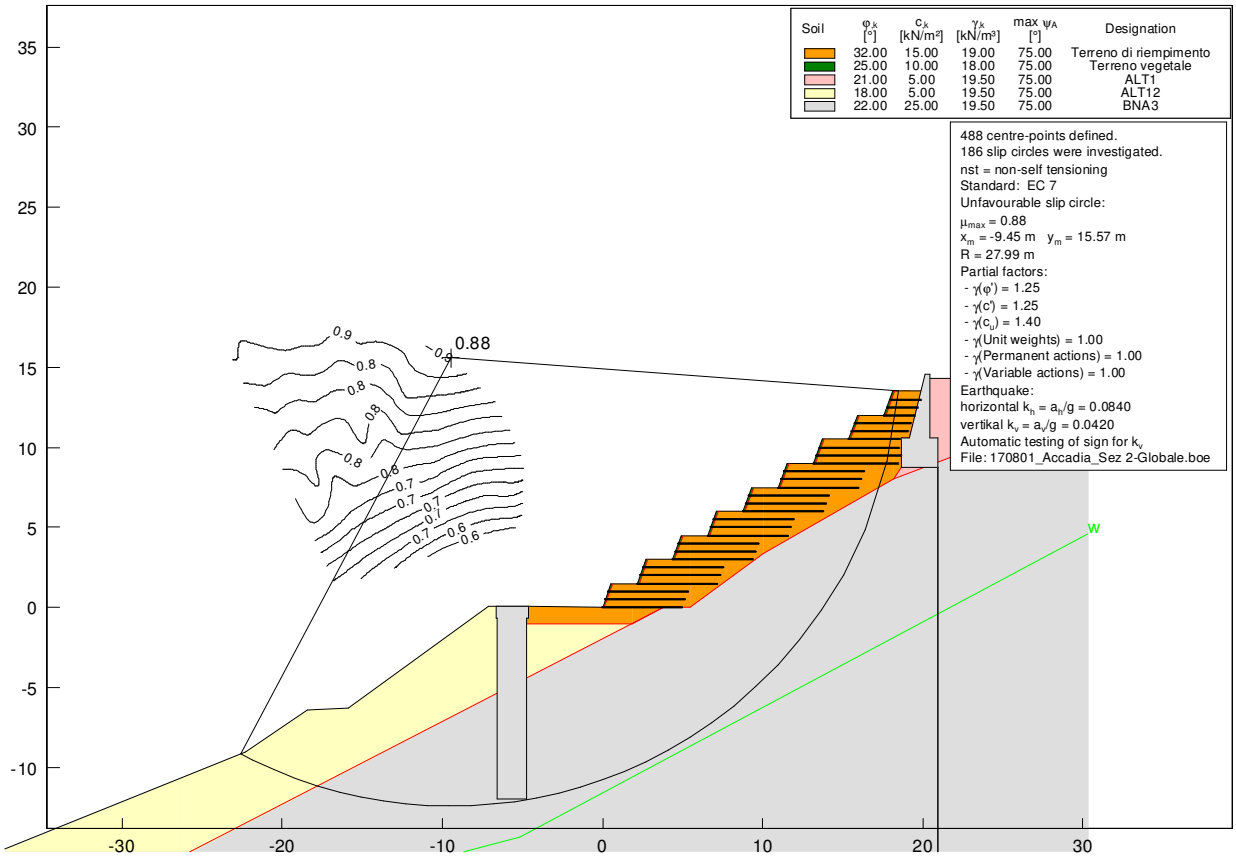
PROGETTO: ACCADIA
VERIFICA DI STABILITÀ SEZIONE 2
Verifica di stabilità globale

NTC2008
Combinazione:
A2+M2+R2

$E_d \leq (R/\gamma_R)$
$\gamma_R = 1{,}1$ (tab. 6.8.I NTC2008)
→ $R/E_d \geq 1{,}1$ → $F_S \geq 1{,}1$.

μ: grado di utilizzo del sistema
$\mu = 1/F_S = 0{,}88$

→ $F_S = 1{,}14 \geq 1{,}10$



Slope stability analysis to EC 7
using circular slip surfaces

Datei: 170801_Accadia_Sez 2-Globale.boe

Parameter list
phi [°] = friction angle
c [kN/m²] = cohesion
gamma [kN/m³] = unit weight
Max. psi(A) [°] = angle between slip direction of failure mechanism and the tension member
μ [-] = utilisation factor
xm,ym [m] = x and y values of slip circle centre-point
rad [m] = slip circle radius

Partial factors: (GEO-3)
- gam(phi)= 1.25
- gam(c') = 1.25
- gam(cu) = 1.40
- gam(Unit weights) = 1.00
- gam(Permanent actions) = 1.00
- gam(Variable actions) = 1.00

Movement direction of slip body to the Left

Coordinates of surface points

No. [-]	x [m]	y [m]
1	-40.000	-16.247
2	-22.291	-9.046
3	-18.422	-6.377
4	-15.871	-6.270
5	-7.148	0.060
6	-4.641	0.060
7	0.000	0.000
8	0.546	1.500
9	2.200	1.500
10	2.746	3.000
11	4.400	3.000
12	4.946	4.500
13	6.600	4.500
14	7.146	6.000
15	8.800	6.000
16	9.346	7.500
17	11.000	7.500
18	11.546	9.000
19	13.200	9.000
20	13.746	10.500
21	15.400	10.500
22	15.946	12.000
23	17.600	12.000
24	18.146	13.500
25	19.890	13.500
26	20.115	14.339
27	30.334	14.339

Characteristic soil properties

Soil [-]	phi,k [°]	c,k [kN/m²]	gamma,k [kN/m³]	max psi(A) [°]	drained	Designation
1	32.00	15.00	19.00	75.00	ja	Terreno di riempimento
2	25.00	10.00	18.00	75.00	ja	Terreno vegetale
3	21.00	5.00	19.50	75.00	ja	ALT1
4	18.00	5.00	19.50	75.00	ja	ALT12
5	22.00	25.00	19.50	75.00	ja	BNA3

Design soil properties

Soil [-]	phi,d [°]	c,d [kN/m²]	gamma,d [kN/m³]	drained	Designation
1	26.56	12.00	19.00	ja	Terreno di riempimento
2	20.46	8.00	18.00	ja	Terreno vegetale
3	17.07	4.00	19.50	ja	ALT1

4	14.57	4.00	19.50	ja	ALT12
5	17.91	20.00	19.50	ja	BNA3

Coordinates of layers and soil numbers

No. [-]	x(left) [m]	y(left) [m]	x(right) [m]	y(right) [m]	Soil no.
1	0.000	0.000	0.100	0.000	2
2	0.100	0.000	0.652	1.500	2
3	2.200	1.500	2.300	1.500	2
4	2.300	1.500	2.852	3.000	2
5	4.400	3.000	4.500	3.000	2
6	4.500	3.000	5.052	4.500	2
7	6.600	4.500	6.700	4.500	2
8	6.700	4.500	7.252	6.000	2
9	8.800	6.000	8.900	6.000	2
10	8.900	6.000	9.452	7.500	2
11	11.000	7.500	11.100	7.500	2
12	11.100	7.500	11.652	9.000	2
13	13.200	9.000	13.300	9.000	2
14	13.300	9.000	13.852	10.500	2
15	15.400	10.500	15.500	10.500	2
16	15.500	10.500	16.052	12.000	2
17	17.600	12.000	17.700	12.000	2
18	17.700	12.000	18.252	13.500	2
19	0.100	0.000	5.500	0.000	1
20	5.500	0.000	10.031	3.359	1
21	10.031	3.359	18.159	7.988	1
22	18.159	7.988	18.655	8.762	1
23	18.655	10.562	19.155	10.562	1
24	19.155	10.562	19.890	13.500	1
25	18.159	7.988	24.790	10.524	3
26	24.790	10.524	30.370	11.060	3
27	-40.000	-21.251	-26.335	-15.662	4
28	-4.741	-1.000	1.877	-1.000	1
29	1.877	-1.000	3.801	0.000	1
30	-26.335	-15.662	3.801	0.000	4
31	-40.000	-40.000	30.334	-40.000	5

Coordinates of pwp polygon course

No. [-]	x [m]	y [m]
1	-40.000	-25.672
2	-30.726	-22.102
3	-5.138	-14.376
4	30.280	4.595

Geosynthetics
Adhesive force f calculated with:
$f = \mu \cdot \tan(\varphi) \cdot \sigma'$
μ [-] = reduction factor for friction between ground and geosynthetics
sigma' [kN/m²] = effekive Spannung
R0 [kN/m] = design force at connection
L0 [m] = fold-back length
R,d [kN/m] = acceptable design force

Nr. [-]	x1 [m]	y1 [m]	x2 [m]	y2 [m]	μ [-]	R0 [kN/m]	R,d [kN/m]
1	0.00	0.00	5.00	0.00	0.800	58.53	58.53
2	0.18	0.50	5.18	0.50	0.800	58.53	58.53
3	0.36	1.00	5.36	1.00	0.800	58.53	58.53
4	2.20	1.50	7.20	1.50	0.800	58.53	58.53
5	2.38	2.00	7.38	2.00	0.800	58.53	58.53
6	2.56	2.50	7.56	2.50	0.800	58.53	58.53
7	4.40	3.00	9.40	3.00	0.800	58.53	58.53
8	4.58	3.50	9.58	3.50	0.800	58.53	58.53
9	4.76	4.00	9.76	4.00	0.800	58.53	58.53
10	6.60	4.50	11.60	4.50	0.800	58.53	58.53
11	6.78	5.00	11.78	5.00	0.800	58.53	58.53
12	6.96	5.50	11.96	5.50	0.800	58.53	58.53
13	8.80	6.00	13.80	6.00	0.800	58.53	58.53

14	8.98	6.50	13.98	6.50	0.800	58.53	58.53
15	9.16	7.00	14.16	7.00	0.800	58.53	58.53
16	11.00	7.50	16.00	7.50	0.800	58.53	58.53
17	11.18	8.00	16.18	8.00	0.800	58.53	58.53
18	11.36	8.50	16.36	8.50	0.800	58.53	58.53
19	13.20	9.00	18.50	9.00	0.800	58.53	58.53
20	13.38	9.50	18.68	9.50	0.800	58.53	58.53
21	13.56	10.00	18.56	10.00	0.800	58.53	58.53
22	15.40	10.50	18.60	10.50	0.800	58.53	58.53
23	15.58	11.00	19.08	11.00	0.800	58.53	58.53
24	15.76	11.50	19.26	11.50	0.800	58.53	58.53
25	17.60	12.00	19.50	12.00	0.800	58.53	58.53
26	17.78	12.50	19.68	12.50	0.800	58.53	58.53
27	17.96	13.00	19.86	13.00	0.800	58.53	58.53

Structural element 1

No. [-]	x [m]	y [m]
1	-6.64	0.06
2	-4.64	0.06
3	-4.64	-0.64
4	-4.74	-0.64
5	-4.74	-11.94
6	-6.54	-11.94
7	-6.54	-0.64
8	-6.64	-0.64

Structural element 2

No. [-]	x [m]	y [m]
1	20.16	14.56
2	20.46	14.56
3	20.46	10.56
4	20.96	10.56
5	20.96	8.76
6	18.66	8.76
7	18.66	10.56
8	19.16	10.56

Structural element 3

No. [-]	x [m]	y [m]
1	20.96	8.76
2	20.96	-40.00

Earthquake
horizontal kh = ah/g = 0.0840
vertical kv = av/g = 0.0420
Automatic testing of sign for kv
kv (governing) = -0.0420
(ah = horizontal seismic acceleration in m/s²)
(av = vertical seismic acceleration in m/s²)
(g = gravitational acceleration = 9.81 m/s²)

Water level in front of slope left [m] = -20.00
Water level in front of slope right [m] = -20.00

Gamma water [kN/m³] = 10.000

Calculation with consideration of passive earth pressure wedge

Slip circle no. 221
μ = 0.8823 = [M(Gi) + M(S)] / [M(Ti) + M(R)]
xm = -9.4499
ym = 15.5744
Radius = 27.9908
Numerator = 84525.1582
Denominator = 95800.9981

M(Ti) = 95800.9981
M(R) = 0.0000
M(Gi) = 72932.6447
M(S) = 11592.5135

Slice values
x = x (slice toe)
y = y (slice toe)
b = slice width
phi = friction angle
c = cohesion
PWP = pore water press. coeff.
tet = inclination of slice
g = weight
n = normal force
t = tangential force
FAi/FA0i/Rsi = see Equations (7) and (8) in DIN 4084:2009
pw = pore water pressure
pw(con) = excess pwp due to consolidation
wv = vertical water pressure
pst = permanent loads and footing
pv = live loads
fakpv = factor for live loads
So No. = soil number

Nr.	x	y	b	phi,d	c,d	PWD	tet	g,k	n	t	FAi	FA0i	Rsi	pw	pw(kon)	wv	pst,d	pv,d	fakpv	Bo-Nr.
	[m]	[m]	[m]	[°]	[kN/m²]	[-]	[°]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]	[-]
1	-21.877	-9.506	1.367	14.6	4.0	0.00	26.4	19.9	26.1	13.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	30
2	-20.510	-10.139	1.367	14.6	4.0	0.00	23.3	61.9	77.9	26.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	30
3	-19.142	-10.685	1.367	14.6	4.0	0.00	20.3	101.6	123.3	38.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	30
4	-17.775	-11.150	1.367	14.6	4.0	0.00	17.3	128.0	150.4	45.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	30
5	-16.407	-11.538	1.367	17.9	20.0	0.00	14.4	139.9	162.4	82.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
6	-15.040	-11.853	1.367	17.9	20.0	0.00	11.5	165.0	186.2	89.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
7	-13.672	-12.096	1.367	17.9	20.0	0.00	8.7	197.9	218.1	99.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
8	-12.305	-12.270	1.367	17.9	20.0	0.00	5.9	229.0	247.1	108.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
9	-10.937	-12.377	1.367	17.9	20.0	0.00	3.0	258.3	273.7	116.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
10	-9.570	-12.416	1.367	17.9	20.0	0.00	0.2	285.8	298.2	123.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
11	-8.202	-12.389	1.367	17.9	20.0	0.00	-2.6	311.6	320.9	130.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
12	-6.835	-12.294	1.367	17.9	20.0	0.00	-5.4	329.4	335.8	135.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
13	-5.467	-12.132	1.367	17.9	20.0	0.00	-8.2	325.1	328.8	132.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
14	-4.100	-11.900	1.367	17.9	20.0	0.00	-11.0	318.0	319.8	129.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
15	-2.732	-11.598	1.367	17.9	20.0	0.00	-13.9	309.5	310.3	126.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
16	-1.365	-11.223	1.367	17.9	20.0	0.00	-16.8	299.1	299.7	123.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	31
17	0.003	-10.772	1.367	17.9	20.0	0.00	-19.7	286.7	288.0	119.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
18	1.370	-10.240	1.367	17.9	20.0	0.00	-22.7	311.4	314.2	128.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
19	2.738	-9.624	1.367	17.9	20.0	0.00	-25.8	333.2	338.9	136.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
20	4.105	-8.915	1.367	17.9	20.0	0.00	-29.0	315.7	324.7	132.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
21	5.473	-8.107	1.367	17.9	20.0	0.00	-32.2	333.1	347.8	139.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
22	6.840	-7.188	1.367	17.9	20.0	0.00	-35.6	326.0	347.0	140.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
23	8.208	-6.144	1.367	17.9	20.0	0.00	-39.1	321.1	350.1	141.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
24	9.575	-4.957	1.367	17.9	20.0	0.00	-42.8	329.1	369.8	149.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
25	10.943	-3.599	1.367	17.9	20.0	0.00	-46.8	293.5	342.6	141.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31
26	12.310	-2.032	1.367	17.9	20.0	0.00	-51.0	291.2	356.7	147.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	31

```
          27   13.678   -0.193   1.367   17.9   20.0   0.00  -55.7    276.4    360.5    150.8      0.0      0.0      0.0
0.0       0.0      0.0      0.0      0.0    1    31
          28   15.045    2.029   1.367   17.9   20.0   0.00  -61.1    223.0    316.7    139.7      0.0      0.0      0.0
0.0       0.0      0.0      0.0      0.0    1    31
          29   16.413    4.869   1.367   17.9   20.0   0.00  -67.5    186.7    301.2    139.7      0.0      0.0      0.0
0.0       0.0      0.0      0.0      0.0    1    31
          30   17.780    9.093   1.367   26.6   12.0   0.00  -76.6     88.0    138.8     94.2      0.0      0.0      0.0
0.0       0.0      0.0      0.0      0.0    1    21
          ------------------------------------------------------------------------------------------------------------------
-------------------------------------------------
                                                                                                    7395.2
0.0       0.0      0.0      0.0      0.0
```

Geosynthetic 1
x1 = 0.000 m
y1 = 0.000 m
x2 = 5.000 m
y2 = 0.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 2
x1 = 0.182 m
y1 = 0.500 m
x2 = 5.182 m
y2 = 0.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 3
x1 = 0.364 m
y1 = 1.000 m
x2 = 5.364 m
y2 = 1.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 4
x1 = 2.200 m
y1 = 1.500 m
x2 = 7.200 m
y2 = 1.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 5
x1 = 2.382 m
y1 = 2.000 m
x2 = 7.382 m
y2 = 2.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 6
x1 = 2.564 m
y1 = 2.500 m
x2 = 7.564 m
y2 = 2.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 7
x1 = 4.400 m
y1 = 3.000 m
x2 = 9.400 m
y2 = 3.000 m

μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 8
x1 = 4.582 m
y1 = 3.500 m
x2 = 9.582 m
y2 = 3.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 9
x1 = 4.764 m
y1 = 4.000 m
x2 = 9.764 m
y2 = 4.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 10
x1 = 6.600 m
y1 = 4.500 m
x2 = 11.600 m
y2 = 4.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 11
x1 = 6.782 m
y1 = 5.000 m
x2 = 11.782 m
y2 = 5.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 12
x1 = 6.964 m
y1 = 5.500 m
x2 = 11.964 m
y2 = 5.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 13
x1 = 8.800 m
y1 = 6.000 m
x2 = 13.800 m
y2 = 6.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 14
x1 = 8.982 m
y1 = 6.500 m
x2 = 13.982 m
y2 = 6.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 15
x1 = 9.164 m

```
y1 = 7.000 m
x2 = 14.164 m
y2 = 7.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 16
x1 = 11.000 m
y1 = 7.500 m
x2 = 16.000 m
y2 = 7.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 17
x1 = 11.182 m
y1 = 8.000 m
x2 = 16.182 m
y2 = 8.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 18
x1 = 11.364 m
y1 = 8.500 m
x2 = 16.364 m
y2 = 8.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 19
x1 = 13.200 m
y1 = 9.000 m
x2 = 18.500 m
y2 = 9.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 76.61 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

Geosynthetic 20
x1 = 13.382 m
y1 = 9.500 m
x2 = 18.682 m
y2 = 9.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 76.61 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

Geosynthetic 21
x1 = 13.564 m
y1 = 10.000 m
x2 = 18.564 m
y2 = 10.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 76.61 °
```

```
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

Geosynthetic 22
x1 = 15.400 m
y1 = 10.500 m
x2 = 18.600 m
y2 = 10.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 76.61 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

Geosynthetic 23
x1 = 15.582 m
y1 = 11.000 m
x2 = 19.082 m
y2 = 11.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 76.61 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

Geosynthetic 24
x1 = 15.764 m
y1 = 11.500 m
x2 = 19.264 m
y2 = 11.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 76.61 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

Geosynthetic 25
x1 = 17.600 m
y1 = 12.000 m
x2 = 19.500 m
y2 = 12.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 76.61 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

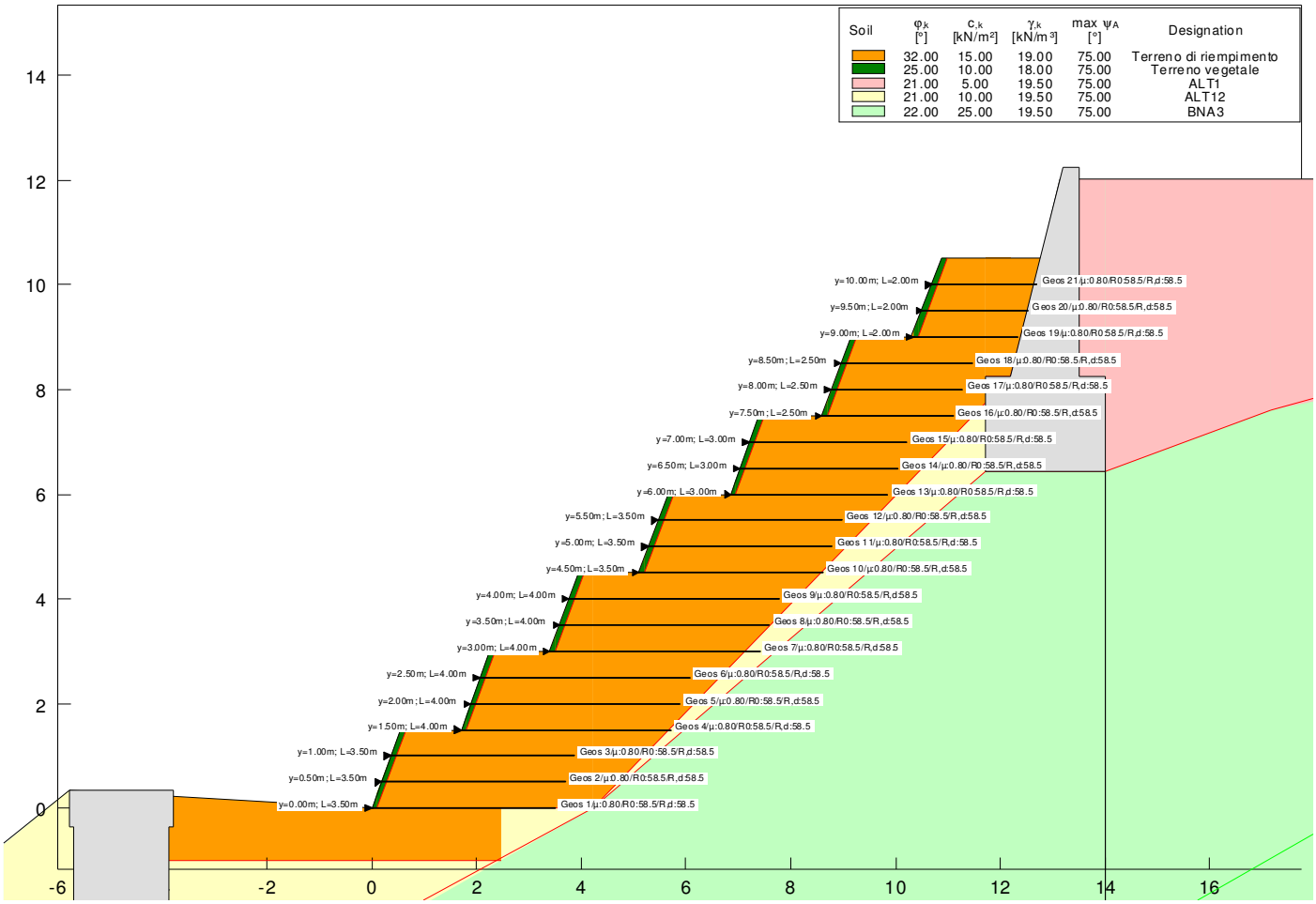
Geosynthetic 26
x1 = 17.782 m
y1 = 12.500 m
x2 = 19.682 m
y2 = 12.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 76.61 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)
```

```
Geosynthetic 27
x1 = 17.964 m
y1 = 13.000 m
x2 = 19.864 m
y2 = 13.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 76.61 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)
```

SEZIONE4

PROGETTO: ACCADIA
CONFIGURAZIONE STRUTTURALE
SEZIONE 4

Geosintetici di rinforzo				
Strato n°	Tipo	Tamm	Lungh.	Spaz.
[-]	[-]	[kN/m]	[m]	[m]
1-3	Fortrac 110/25-20/30 MPT	58,53	3.50	0.50
4-9	Fortrac 110/25-20/30 MPT	58,53	4.00	0.50
10-12	Fortrac 110/25-20/30 MPT	58,53	3.50	0.50
13-15	Fortrac 110/25-20/30 MPT	58,53	3.00	0.50
16-18	Fortrac 110/25-20/30 MPT	58,53	2.50	0.50
19-21	Fortrac 110/25-20/30 MPT	58,53	2.00	0.50



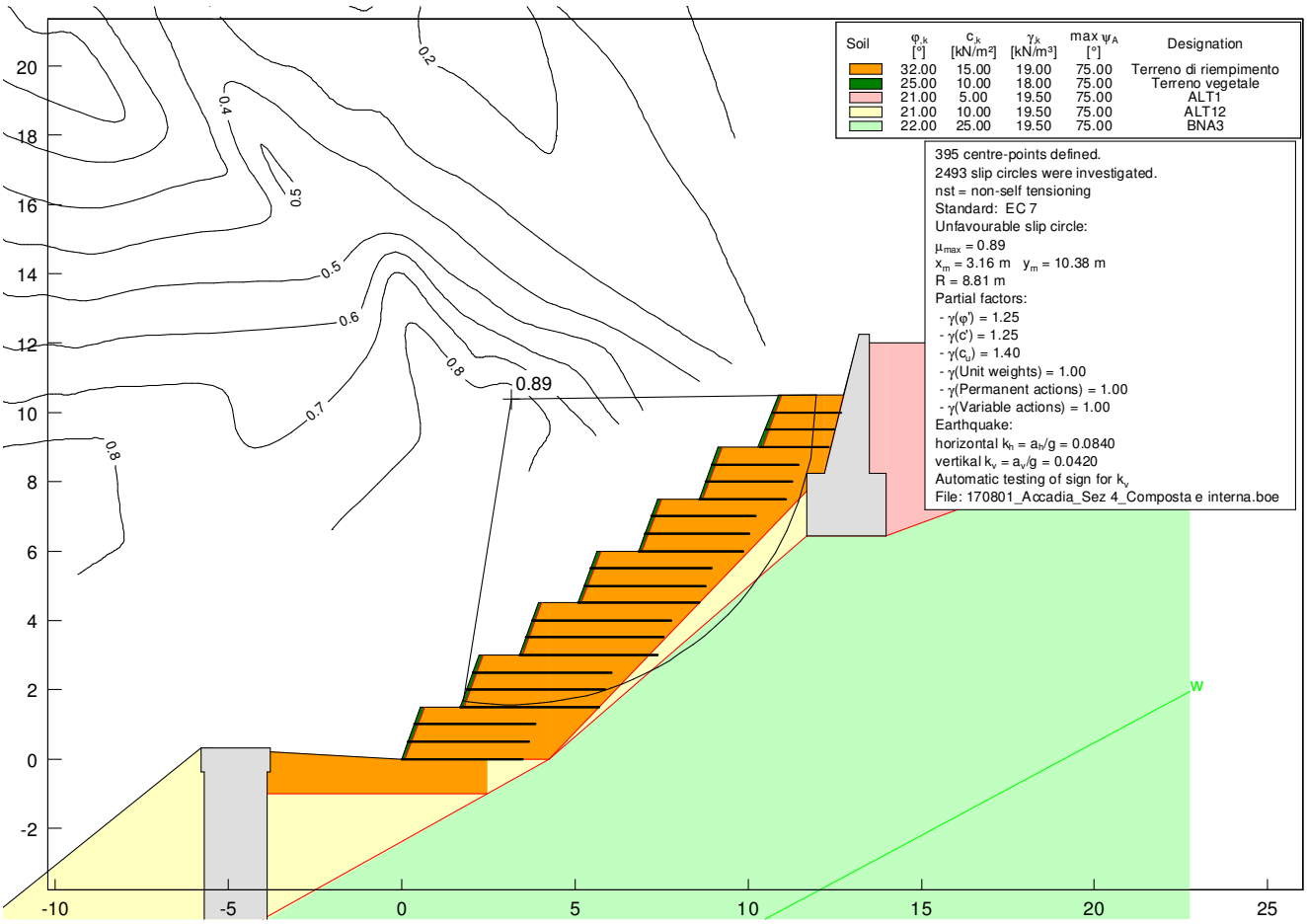
PROGETTO: ACCADIA
VERIFICA DI STABILITÀ INTERNA E COMPOSTA
SEZIONE 4

NTC2008
Combinazione:
A2+M2+R2

$E_d \leq (R/\gamma_R)$
$\gamma_R = 1,1$ (tab. 6.8.I NTC2008)
→ $R/E_d \geq 1,1$ → $F_S \geq 1,1$.

μ: grado di utilizzo del sistema
$\mu = 1/F_S = 0,89$

→$F_S = 1,12 \geq 1,10$



Slope stability analysis to EC 7
using circular slip surfaces

Datei: 170801_Accadia_Sez 4_Composta e interna.boe

Parameter list
phi [°] = friction angle
c [kN/m²] = cohesion
gamma [kN/m³] = unit weight
Max. psi(A) [°] = angle between slip direction of failure mechanism and the tension member
μ [-] = utilisation factor
xm,ym [m] = x and y values of slip circle centre-point
rad [m] = slip circle radius

Partial factors: (GEO-3)
- gam(phi)= 1.25
- gam(c') = 1.25
- gam(cu) = 1.40
- gam(Unit weights) = 1.00
- gam(Permanent actions) = 1.00
- gam(Variable actions) = 1.00

Movement direction of slip body to the Left

Coordinates of surface points

No. [-]	x [m]	y [m]
1	-40.000	-17.345
2	-18.446	-8.074
3	-15.806	-7.816
4	-5.789	0.335
5	-5.789	0.335
6	0.000	0.000
7	0.546	1.500
8	1.700	1.500
9	2.246	3.000
10	3.400	3.000
11	3.946	4.500
12	5.100	4.500
13	5.646	6.000
14	6.846	6.000
15	7.392	7.500
16	8.592	7.500
17	9.138	9.000
18	10.292	9.000
19	10.884	10.500
20	12.764	10.500
21	13.144	12.022
22	22.762	12.022

Characteristic soil properties

Soil [-]	phi,k [°]	c,k [kN/m²]	gamma,k [kN/m³]	max psi(A) [°]	drained	Designation
1	32.00	15.00	19.00	75.00	ja	Terreno di riempimento
2	25.00	10.00	18.00	75.00	ja	Terreno vegetale
3	21.00	5.00	19.50	75.00	ja	ALT1
4	21.00	10.00	19.50	75.00	ja	ALT12
5	22.00	25.00	19.50	75.00	ja	BNA3

Design soil properties

Soil [-]	phi,d [°]	c,d [kN/m²]	gamma,d [kN/m³]	drained	Designation
1	26.56	12.00	19.00	ja	Terreno di riempimento
2	20.46	8.00	18.00	ja	Terreno vegetale
3	17.07	4.00	19.50	ja	ALT1
4	17.07	8.00	19.50	ja	ALT12
5	17.91	20.00	19.50	ja	BNA3

Coordinates of layers and soil numbers

No.	x(left)	y(left)	x(right)	y(right)	Soil no.

[-]	[m]	[m]	[m]	[m]	
1	0.000	0.000	0.100	0.000	2
2	0.100	0.000	0.652	1.500	2
3	1.700	1.500	1.800	1.500	2
4	1.800	1.500	2.352	3.000	2
5	3.400	3.000	3.500	3.000	2
6	3.500	3.000	4.052	4.500	2
7	5.100	4.500	5.200	4.500	2
8	5.200	4.500	5.752	6.000	2
9	6.846	6.000	6.946	6.000	2
10	6.946	6.000	7.498	7.500	2
11	8.592	7.500	8.692	7.500	2
12	8.692	7.500	9.244	9.000	2
13	10.338	9.000	10.438	9.000	2
14	10.438	9.000	10.990	10.500	2
15	0.100	0.000	4.239	0.000	1
16	-3.889	-1.000	2.476	-1.000	1
17	4.239	0.000	11.700	7.743	1
18	11.700	8.243	12.200	8.243	1
19	12.200	8.243	12.764	10.500	1
20	-40.000	-22.718	-15.254	-11.057	4
21	-15.254	-11.057	4.239	0.000	4
22	4.239	0.000	11.700	6.443	4
23	11.700	6.443	14.000	6.443	3
24	14.000	6.443	17.172	7.612	3
25	17.172	7.612	22.762	8.832	3
26	-40.000	-40.000	22.762	-40.000	5

Coordinates of pwp polygon course

No.	x	y
[-]	[m]	[m]
1	-40.000	-27.268
2	-11.593	-16.727
3	22.762	1.961

Geosynthetics
Adhesive force f calculated with:
$f = \mu \cdot \tan(\varphi) \cdot \sigma'$
μ [-] = reduction factor for friction between ground and geosynthetics
sigma' [kN/m²] = effekive Spannung
R0 [kN/m] = design force at connection
L0 [m] = fold-back length
R,d [kN/m] = acceptable design force

Nr.	x1	y1	x2	y2	μ	R0	R,d
[-]	[m]	[m]	[m]	[m]	[-]	[kN/m]	[kN/m]
1	0.00	0.00	3.50	0.00	0.800	58.53	58.53
2	0.18	0.50	3.68	0.50	0.800	58.53	58.53
3	0.36	1.00	3.86	1.00	0.800	58.53	58.53
4	1.70	1.50	5.70	1.50	0.800	58.53	58.53
5	1.88	2.00	5.88	2.00	0.800	58.53	58.53
6	2.06	2.50	6.06	2.50	0.800	58.53	58.53
7	3.40	3.00	7.40	3.00	0.800	58.53	58.53
8	3.58	3.50	7.58	3.50	0.800	58.53	58.53
9	3.76	4.00	7.76	4.00	0.800	58.53	58.53
10	5.10	4.50	8.60	4.50	0.800	58.53	58.53
11	5.28	5.00	8.78	5.00	0.800	58.53	58.53
12	5.46	5.50	8.96	5.50	0.800	58.53	58.53
13	6.85	6.00	9.85	6.00	0.800	58.53	58.53
14	7.03	6.50	10.03	6.50	0.800	58.53	58.53
15	7.21	7.00	10.21	7.00	0.800	58.53	58.53
16	8.59	7.50	11.09	7.50	0.800	58.53	58.53
17	8.77	8.00	11.27	8.00	0.800	58.53	58.53
18	8.96	8.50	11.46	8.50	0.800	58.53	58.53
19	10.34	9.00	12.34	9.00	0.800	58.53	58.53
20	10.52	9.50	12.52	9.50	0.800	58.53	58.53
21	10.70	10.00	12.70	10.00	0.800	58.53	58.53

Structural element 1

No. [-]	x [m]	y [m]
1	-5.79	0.34
2	-3.79	0.34
3	-3.79	-0.37
4	-3.89	-0.37
5	-3.89	-11.67
6	-5.69	-11.67
7	-5.69	-0.37
8	-5.79	-0.37

Structural element 2

No. [-]	x [m]	y [m]
1	13.20	12.24
2	13.50	12.24
3	13.50	8.24
4	14.00	8.24
5	14.00	6.44
6	11.70	6.44
7	11.70	8.24
8	12.20	8.24

Earthquake
horizontal kh = ah/g = 0.0840
vertical kv = av/g = 0.0420
Automatic testing of sign for kv
kv (governing) = -0.0420
(ah = horizontal seismic acceleration in m/s²)
(av = vertical seismic acceleration in m/s²)
(g = gravitational acceleration = 9.81 m/s²)

Water level in front of slope left [m] = -20.00
Water level in front of slope right [m] = -20.00

Gamma water [kN/m³] = 10.000

Calculation with consideration of passive earth pressure wedge

Slip circle no. 202
μ = 0.8865 = [M(Gi) + M(S)] / [M(Ti) + M(R)]
xm = 3.1645
ym = 10.3777
Radius = 8.8114
Numerator = 3279.8794
Denominator = 3699.9687
M(Ti) = 3699.9687
M(R) = 0.0000
M(Gi) = 3002.4360
M(S) = 277.4434

Slice values
x = x (slice toe)
y = y (slice toe)
b = slice width
phi = friction angle
c = cohesion
PWP = pore water press. coeff.
tet = inclination of slice
g = weight
n = normal force
t = tangential force
FAi/FA0i/Rsi = see Equations (7) and (8) in DIN 4084:2009
pw = pore water pressure
pw(con) = excess pwp due to consolidation
wv = vertical water pressure
pst = permanent loads and footing
pv = live loads
fakpv = factor for live loads

So No. = soil number

Nr.	x	y	b	phi,d	c,d	PWD	tet	g,k	n	t	FAi	FA0i	Rsi	pw	pw(kon)	wv	pst,d	pv,d	fakpv	Bo-Nr.
	[m]	[m]	[m]	[°]	[kN/m²]	[-]	[°]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]	[-]
1	1.935	1.653	0.340	26.6	12.0	0.00	8.0	3.1	3.5	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	15
2	2.275	1.611	0.340	26.6	12.0	0.00	5.8	8.9	9.8	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	15
3	2.616	1.583	0.340	26.6	12.0	0.00	3.6	9.2	9.8	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	15
4	2.956	1.569	0.340	26.6	12.0	0.00	1.4	9.3	9.7	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	15
5	3.297	1.567	0.340	26.6	12.0	0.00	-0.9	9.3	9.6	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	15
6	3.637	1.579	0.340	26.6	12.0	0.00	-3.1	13.3	13.6	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	15
7	3.977	1.604	0.340	26.6	12.0	0.00	-5.3	18.7	18.8	13.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	15
8	4.318	1.642	0.340	26.6	12.0	0.00	-7.5	18.5	18.4	13.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	17
9	4.658	1.694	0.340	26.6	12.0	0.00	-9.8	18.1	17.8	12.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	17
10	4.998	1.759	0.340	26.6	12.0	0.00	-12.0	17.7	17.3	12.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	17
11	5.339	1.839	0.340	26.6	12.0	0.00	-14.3	21.4	20.6	14.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	17
12	5.679	1.933	0.340	26.6	12.0	0.00	-16.6	26.2	25.2	16.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	17
13	6.019	2.042	0.340	26.6	12.0	0.00	-18.9	25.6	24.5	16.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	17
14	6.360	2.166	0.340	17.1	8.0	0.00	-21.3	24.8	25.1	10.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	22
15	6.700	2.307	0.340	17.1	8.0	0.00	-23.7	23.9	24.3	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	22
16	7.041	2.465	0.340	17.1	8.0	0.00	-26.1	26.3	26.9	10.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	22
17	7.381	2.641	0.340	17.9	20.0	0.00	-28.6	31.2	32.1	17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
18	7.721	2.836	0.340	17.9	20.0	0.00	-31.1	30.3	31.4	16.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
19	8.062	3.053	0.340	17.9	20.0	0.00	-33.8	28.9	30.4	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
20	8.402	3.292	0.340	17.9	20.0	0.00	-36.5	27.4	29.3	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
21	8.742	3.557	0.340	17.9	20.0	0.00	-39.3	28.3	30.8	17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
22	9.083	3.850	0.340	17.9	20.0	0.00	-42.2	32.4	36.2	19.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
23	9.423	4.175	0.340	17.9	20.0	0.00	-45.3	31.4	36.1	19.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
24	9.763	4.539	0.340	17.9	20.0	0.00	-48.5	29.1	34.5	18.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
25	10.104	4.948	0.340	17.9	20.0	0.00	-52.0	26.4	32.7	18.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
26	10.444	5.413	0.340	17.1	8.0	0.00	-55.7	25.7	34.0	13.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	22
27	10.785	5.953	0.340	17.1	8.0	0.00	-59.9	27.8	39.3	15.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	22
28	11.125	6.600	0.340	17.1	8.0	0.00	-64.6	25.3	39.1	16.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	22
29	11.465	7.422	0.340	17.1	8.0	0.00	-70.4	19.9	35.1	15.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	22
30	11.806	8.654	0.340	26.6	12.0	0.00	-78.7	11.9	19.7	16.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	18
								650.3						0.0	0.0	0.0	0.0	0.0		

Geosynthetic 1
x1 = 0.000 m
y1 = 0.000 m
x2 = 3.500 m
y2 = 0.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 2
x1 = 0.182 m
y1 = 0.500 m

x2 = 3.682 m
y2 = 0.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 3
x1 = 0.364 m
y1 = 1.000 m
x2 = 3.864 m
y2 = 1.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 4
x1 = 1.700 m
y1 = 1.500 m
x2 = 5.700 m
y2 = 1.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 5
x1 = 1.882 m
y1 = 2.000 m
x2 = 5.882 m
y2 = 2.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 6
x1 = 2.064 m
y1 = 2.500 m
x2 = 6.064 m
y2 = 2.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 7
x1 = 3.400 m
y1 = 3.000 m
x2 = 7.400 m
y2 = 3.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 8
x1 = 3.582 m
y1 = 3.500 m
x2 = 7.582 m
y2 = 3.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 9
x1 = 3.764 m
y1 = 4.000 m
x2 = 7.764 m
y2 = 4.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 10
x1 = 5.100 m
y1 = 4.500 m
x2 = 8.600 m
y2 = 4.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 11
x1 = 5.282 m
y1 = 5.000 m
x2 = 8.782 m
y2 = 5.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 12
x1 = 5.464 m
y1 = 5.500 m
x2 = 8.964 m
y2 = 5.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 13
x1 = 6.850 m
y1 = 6.000 m
x2 = 9.850 m
y2 = 6.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 14
x1 = 7.031 m
y1 = 6.500 m
x2 = 10.031 m
y2 = 6.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 15
x1 = 7.211 m
y1 = 7.000 m
x2 = 10.211 m
y2 = 7.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 16
x1 = 8.592 m
y1 = 7.500 m
x2 = 11.092 m
y2 = 7.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 17
x1 = 8.774 m
y1 = 8.000 m
x2 = 11.274 m
y2 = 8.000 m
μ = 0.800

```
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 18
x1 = 8.956 m
y1 = 8.500 m
x2 = 11.456 m
y2 = 8.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 19
x1 = 10.338 m
y1 = 9.000 m
x2 = 12.338 m
y2 = 9.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 78.72 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

Geosynthetic 20
x1 = 10.520 m
y1 = 9.500 m
x2 = 12.520 m
y2 = 9.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 78.72 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)

Geosynthetic 21
x1 = 10.702 m
y1 = 10.000 m
x2 = 12.702 m
y2 = 10.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 78.72 °
Limit psi(A) = 75.00 °
Geosynthetic is not self-tensioning nach DIN 4084:2009
Geosynthetic therefore makes no impact (DIN 4084:2009 7.2.3.4)
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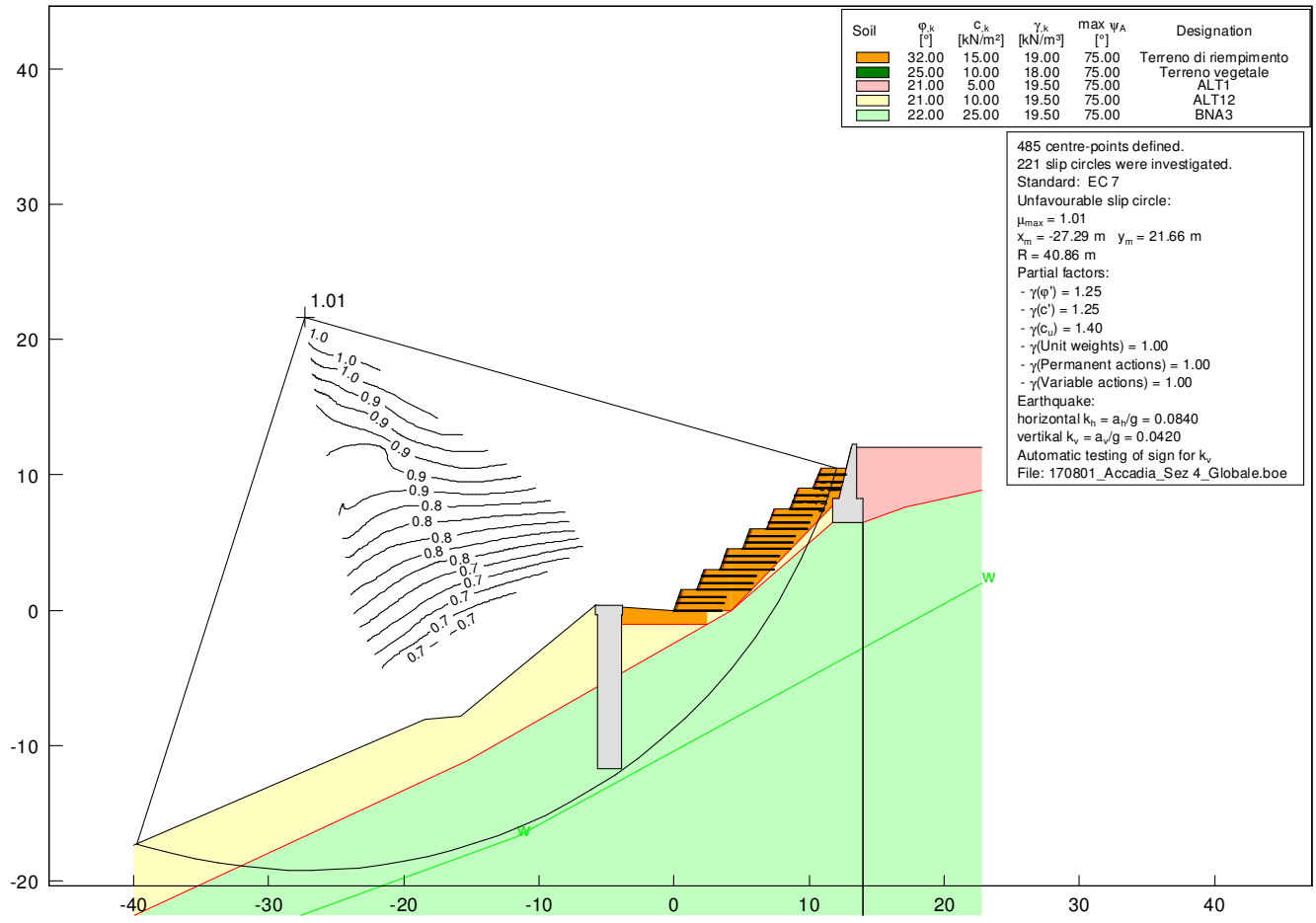
PROGETTO: ACCADIA
VERIFICA DI STABILITÀ SEZIONE 4
Verifica di stabilità globale

NTC2008
Combinazione:
A2+M2+R2

$E_d \leq (R/\gamma_R)$
$\gamma_R = 1{,}1$ (tab. 6.8.I NTC2008)
→ $R/E_d \geq 1{,}1$ → $F_S \geq 1{,}1$.

μ: grado di utilizzo del sistema
$\mu = 1/F_S = 1{,}01$

→ $F_S = 0{,}99 < 1{,}10$



Slope stability analysis to EC 7

using circular slip surfaces

Datei: 170801_Accadia_Sez 4_Globale.boe

Parameter list
phi [°] = friction angle
c [kN/m²] = cohesion
gamma [kN/m³] = unit weight
Max. psi(A) [°] = angle between slip direction of failure mechanism and the tension member
μ [-] = utilisation factor
xm,ym [m] = x and y values of slip circle centre-point
rad [m] = slip circle radius

Partial factors: (GEO-3)
- gam(phi)= 1.25
- gam(c') = 1.25
- gam(cu) = 1.40
- gam(Unit weights) = 1.00
- gam(Permanent actions) = 1.00
- gam(Variable actions) = 1.00

Movement direction of slip body to the Left

Coordinates of surface points

No. [-]	x [m]	y [m]
1	-40.000	-17.345
2	-18.446	-8.074
3	-15.806	-7.816
4	-5.789	0.335
5	-5.789	0.335
6	0.000	0.000
7	0.546	1.500
8	1.700	1.500
9	2.246	3.000
10	3.400	3.000
11	3.946	4.500
12	5.100	4.500
13	5.646	6.000
14	6.846	6.000
15	7.392	7.500
16	8.592	7.500
17	9.138	9.000
18	10.292	9.000
19	10.884	10.500
20	12.764	10.500
21	13.144	12.022
22	22.762	12.022

Characteristic soil properties

Soil [-]	phi,k [°]	c,k [kN/m²]	gamma,k [kN/m³]	max psi(A) [°]	drained	Designation
1	32.00	15.00	19.00	75.00	ja	Terreno di riempimento
2	25.00	10.00	18.00	75.00	ja	Terreno vegetale
3	21.00	5.00	19.50	75.00	ja	ALT1
4	21.00	10.00	19.50	75.00	ja	ALT12
5	22.00	25.00	19.50	75.00	ja	BNA3

Design soil properties

Soil [-]	phi,d [°]	c,d [kN/m²]	gamma,d [kN/m³]	drained	Designation
1	26.56	12.00	19.00	ja	Terreno di riempimento
2	20.46	8.00	18.00	ja	Terreno vegetale
3	17.07	4.00	19.50	ja	ALT1
4	17.07	8.00	19.50	ja	ALT12
5	17.91	20.00	19.50	ja	BNA3

Coordinates of layers and soil numbers

No. [-]	x(left) [m]	y(left) [m]	x(right) [m]	y(right) [m]	Soil no.

1	0.000	0.000	0.100	0.000	2
2	0.100	0.000	0.652	1.500	2
3	1.700	1.500	1.800	1.500	2
4	1.800	1.500	2.352	3.000	2
5	3.400	3.000	3.500	3.000	2
6	3.500	3.000	4.052	4.500	2
7	5.100	4.500	5.200	4.500	2
8	5.200	4.500	5.752	6.000	2
9	6.846	6.000	6.946	6.000	2
10	6.946	6.000	7.498	7.500	2
11	8.592	7.500	8.692	7.500	2
12	8.692	7.500	9.244	9.000	2
13	10.338	9.000	10.438	9.000	2
14	10.438	9.000	10.990	10.500	2
15	0.100	0.000	4.239	0.000	1
16	-3.889	-1.000	2.476	-1.000	1
17	4.239	0.000	11.700	7.743	1
18	11.700	8.243	12.200	8.243	1
19	12.200	8.243	12.764	10.500	1
20	-40.000	-22.718	-15.254	-11.057	4
21	-15.254	-11.057	4.239	0.000	4
22	4.239	0.000	11.700	6.443	4
23	11.700	6.443	14.000	6.443	3
24	14.000	6.443	17.172	7.612	3
25	17.172	7.612	22.762	8.832	3
26	-40.000	-40.000	22.762	-40.000	5

Coordinates of pwp polygon course

No. [-]	x [m]	y [m]
1	-40.000	-27.268
2	-11.593	-16.727
3	22.762	1.961

Geosynthetics
Adhesive force f calculated with:
$f = \mu \cdot \tan(\varphi) \cdot \sigma'$
μ [-] = reduction factor for friction between ground and geosynthetics
sigma' [kN/m²] = effekive Spannung
R0 [kN/m] = design force at connection
L0 [m] = fold-back length
R,d [kN/m] = acceptable design force

Nr. [-]	x1 [m]	y1 [m]	x2 [m]	y2 [m]	μ [-]	R0 [kN/m]	R,d [kN/m]
1	0.00	0.00	3.50	0.00	0.800	58.53	58.53
2	0.18	0.50	3.68	0.50	0.800	58.53	58.53
3	0.36	1.00	3.86	1.00	0.800	58.53	58.53
4	1.70	1.50	5.70	1.50	0.800	58.53	58.53
5	1.88	2.00	5.88	2.00	0.800	58.53	58.53
6	2.06	2.50	6.06	2.50	0.800	58.53	58.53
7	3.40	3.00	7.40	3.00	0.800	58.53	58.53
8	3.58	3.50	7.58	3.50	0.800	58.53	58.53
9	3.76	4.00	7.76	4.00	0.800	58.53	58.53
10	5.10	4.50	8.60	4.50	0.800	58.53	58.53
11	5.28	5.00	8.78	5.00	0.800	58.53	58.53
12	5.46	5.50	8.96	5.50	0.800	58.53	58.53
13	6.85	6.00	9.85	6.00	0.800	58.53	58.53
14	7.03	6.50	10.03	6.50	0.800	58.53	58.53
15	7.21	7.00	10.21	7.00	0.800	58.53	58.53
16	8.59	7.50	11.09	7.50	0.800	58.53	58.53
17	8.77	8.00	11.27	8.00	0.800	58.53	58.53
18	8.96	8.50	11.46	8.50	0.800	58.53	58.53
19	10.34	9.00	12.34	9.00	0.800	58.53	58.53
20	10.52	9.50	12.52	9.50	0.800	58.53	58.53
21	10.70	10.00	12.70	10.00	0.800	58.53	58.53

Structural element 1

No.	x	y

[-]	[m]	[m]
1	-5.79	0.34
2	-3.79	0.34
3	-3.79	-0.37
4	-3.89	-0.37
5	-3.89	-11.67
6	-5.69	-11.67
7	-5.69	-0.37
8	-5.79	-0.37

Structural element 2

No.	x	y
[-]	[m]	[m]
1	13.20	12.24
2	13.50	12.24
3	13.50	8.24
4	14.00	8.24
5	14.00	6.44
6	11.70	6.44
7	11.70	8.24
8	12.20	8.24

Structural element 3

No.	x	y
[-]	[m]	[m]
1	14.00	6.44
2	14.00	-40.00

Earthquake
horizontal kh = ah/g = 0.0840
vertical kv = av/g = 0.0420
Automatic testing of sign for kv
kv (governing) = -0.0420
(ah = horizontal seismic acceleration in m/s²)
(av = vertical seismic acceleration in m/s²)
(g = gravitational acceleration = 9.81 m/s²)

Water level in front of slope left [m] = -20.00
Water level in front of slope right [m] = -20.00

Gamma water [kN/m³] = 10.000

Calculation with consideration of passive earth pressure wedge

Slip circle no. 334
μ = 1.0134 = [M(Gi) + M(S)] / [M(Ti) + M(R)]
xm = -27.2939
ym = 21.6592
Radius = 40.8602
Numerator = 158007.6159
Denominator = 155925.9346
M(Ti) = 155925.9346
M(R) = 0.0000
M(Gi) = 136932.9903
M(S) = 21074.6256

Slice values
x = x (slice toe)
y = y (slice toe)
b = slice width
phi = friction angle
c = cohesion
PWP = pore water press. coeff.
tet = inclination of slice
g = weight
n = normal force
t = tangential force
FAi/FA0i/Rsi = see Equations (7) and (8) in DIN 4084:2009
pw = pore water pressure

pw(con) = excess pwp due to consolidation
wv = vertical water pressure
pst = permanent loads and footing
pv = live loads
fakpv = factor for live loads
So No. = soil number

Nr.	x	y	b	phi,d	c,d	PWD	tet	g,k	n	t	FAi	FA0i	Rsi	pw	pw(kon)	wv	pst,d	pv,d	fakpv	Bo-Nr.
	[m]	[m]	[m]	[°]	[kN/m²]	[-]	[°]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]	[-]
1	-38.912	-17.514	1.726	17.1	8.0	0.00	16.5	21.5	25.7	23.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	20
2	-37.186	-17.986	1.726	17.1	8.0	0.00	14.0	62.3	72.6	37.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	20
3	-35.460	-18.377	1.726	17.1	8.0	0.00	11.5	100.5	114.1	50.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	20
4	-33.733	-18.690	1.726	17.1	8.0	0.00	9.1	136.0	151.0	61.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	20
5	-32.007	-18.928	1.726	17.1	8.0	0.00	6.6	169.0	184.0	70.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	20
6	-30.281	-19.092	1.726	17.9	20.0	0.00	4.2	199.5	213.6	104.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	26
7	-28.555	-19.182	1.726	17.9	20.0	0.00	1.8	227.6	239.6	112.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	26
8	-26.828	-19.198	1.726	17.9	20.0	0.00	-0.7	253.1	262.8	119.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	26
9	-25.102	-19.142	1.726	17.9	20.0	0.00	-3.1	276.2	283.2	125.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	26
10	-23.376	-19.013	1.726	17.9	20.0	0.00	-5.5	296.9	301.2	131.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	26
11	-21.649	-18.809	1.726	17.9	20.0	0.00	-7.9	315.0	316.9	135.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	26
12	-19.923	-18.531	1.726	17.9	20.0	0.00	-10.4	330.6	330.4	139.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	26
13	-18.197	-18.175	1.726	17.9	20.0	0.00	-12.9	340.9	339.0	142.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	26
14	-16.471	-17.741	1.726	17.9	20.0	0.00	-15.4	331.9	329.1	139.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	26
15	-14.744	-17.226	1.726	17.9	20.0	0.00	-17.9	345.9	342.5	143.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	26
16	-13.018	-16.626	1.726	17.9	20.0	0.00	-20.4	372.9	369.6	152.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
17	-11.292	-15.937	1.726	17.9	20.0	0.00	-23.1	397.0	394.6	160.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
18	-9.566	-15.155	1.726	17.9	20.0	0.00	-25.7	418.0	417.5	168.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
19	-7.839	-14.272	1.726	17.9	20.0	0.00	-28.4	435.6	438.4	175.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
20	-6.113	-13.283	1.726	17.9	20.0	0.00	-31.2	449.5	457.0	181.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
21	-4.387	-12.176	1.726	17.9	20.0	0.00	-34.1	418.4	430.9	173.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
22	-2.660	-10.941	1.726	17.9	20.0	0.00	-37.1	372.5	389.9	160.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
23	-0.934	-9.561	1.726	17.9	20.0	0.00	-40.2	322.8	344.8	146.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
24	0.792	-8.018	1.726	17.9	20.0	0.00	-43.4	318.2	348.5	148.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
25	2.518	-6.283	1.726	17.9	20.0	0.00	-46.9	309.9	349.9	150.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
26	4.245	-4.319	1.726	17.9	20.0	0.00	-50.5	293.0	343.6	149.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
27	5.971	-2.069	1.726	17.9	20.0	0.00	-54.5	268.0	329.5	147.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
28	7.697	0.560	1.726	17.9	20.0	0.00	-58.9	230.2	301.1	140.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
29	9.423	3.732	1.726	17.9	20.0	0.00	-64.0	174.2	247.6	127.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	26
30	11.150	7.816	1.726	26.6	12.0	0.00	-70.2	88.0	112.5	81.6	43.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	17
								8275.2												

Geosynthetic 1
x1 = 0.000 m
y1 = 0.000 m
x2 = 3.500 m
y2 = 0.000 m
μ = 0.800
R0 = 58.530 kN/m

```
R,d = 58.530 kN/m

Geosynthetic 2
x1 = 0.182 m
y1 = 0.500 m
x2 = 3.682 m
y2 = 0.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 3
x1 = 0.364 m
y1 = 1.000 m
x2 = 3.864 m
y2 = 1.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 4
x1 = 1.700 m
y1 = 1.500 m
x2 = 5.700 m
y2 = 1.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 5
x1 = 1.882 m
y1 = 2.000 m
x2 = 5.882 m
y2 = 2.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 6
x1 = 2.064 m
y1 = 2.500 m
x2 = 6.064 m
y2 = 2.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 7
x1 = 3.400 m
y1 = 3.000 m
x2 = 7.400 m
y2 = 3.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 8
x1 = 3.582 m
y1 = 3.500 m
x2 = 7.582 m
y2 = 3.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 9
x1 = 3.764 m
y1 = 4.000 m
x2 = 7.764 m
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y2 = 4.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 10
x1 = 5.100 m
y1 = 4.500 m
x2 = 8.600 m
y2 = 4.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 11
x1 = 5.282 m
y1 = 5.000 m
x2 = 8.782 m
y2 = 5.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 12
x1 = 5.464 m
y1 = 5.500 m
x2 = 8.964 m
y2 = 5.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 13
x1 = 6.850 m
y1 = 6.000 m
x2 = 9.850 m
y2 = 6.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 14
x1 = 7.031 m
y1 = 6.500 m
x2 = 10.031 m
y2 = 6.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 15
x1 = 7.211 m
y1 = 7.000 m
x2 = 10.211 m
y2 = 7.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m

Geosynthetic 16
x1 = 8.592 m
y1 = 7.500 m
x2 = 11.092 m
y2 = 7.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 70.20 °
Limit psi(A) = 75.00 °

```
Geosynthetic is self-tensioning (DIN 4084:2009 7.2.3.4).
Activated force = 2.615 kN/m
Bonded length = 0.06 m
F(AL) = 117.85 kN/m
F(AR) = 2.61 kN/m

Geosynthetic 17
x1 = 8.774 m
y1 = 8.000 m
x2 = 11.274 m
y2 = 8.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 70.20 °
Limit psi(A) = 75.00 °
Geosynthetic is self-tensioning (DIN 4084:2009 7.2.3.4).
Activated force = 2.217 kN/m
Bonded length = 0.06 m
F(AL) = 106.89 kN/m
F(AR) = 2.22 kN/m

Geosynthetic 18
x1 = 8.956 m
y1 = 8.500 m
x2 = 11.456 m
y2 = 8.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 70.20 °
Limit psi(A) = 75.00 °
Geosynthetic is self-tensioning (DIN 4084:2009 7.2.3.4).
Activated force = 2.025 kN/m
Bonded length = 0.07 m
F(AL) = 94.32 kN/m
F(AR) = 2.03 kN/m

Geosynthetic 19
x1 = 10.338 m
y1 = 9.000 m
x2 = 12.338 m
y2 = 9.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 70.20 °
Limit psi(A) = 75.00 °
Geosynthetic is self-tensioning (DIN 4084:2009 7.2.3.4).
Activated force = 17.829 kN/m
Bonded length = 0.78 m
F(AL) = 80.36 kN/m
F(AR) = 17.83 kN/m

Geosynthetic 20
x1 = 10.520 m
y1 = 9.500 m
x2 = 12.520 m
y2 = 9.500 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 70.20 °
Limit psi(A) = 75.00 °
Geosynthetic is self-tensioning (DIN 4084:2009 7.2.3.4).
Activated force = 12.112 kN/m
Bonded length = 0.80 m
F(AL) = 73.97 kN/m
F(AR) = 12.11 kN/m
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Geosynthetic 21
x1 = 10.702 m
y1 = 10.000 m
x2 = 12.702 m
y2 = 10.000 m
μ = 0.800
R0 = 58.530 kN/m
R,d = 58.530 kN/m
Work. psi(A) = 70.20 °
Limit psi(A) = 75.00 °
Geosynthetic is self-tensioning (DIN 4084:2009 7.2.3.4).
Activated force = 6.166 kN/m
Bonded length = 0.83 m
F(AL) = 66.64 kN/m
F(AR) = 6.17 kN/m
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