

ZAŁĄCZNIK 1

Wyniki obliczeń osiadania fundamentów na podłożu wzmocnionym kolumnami DSM

Łącznie : 3 strony

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do projektowania bez ograniczeń
w specjalności konstrukcyjno-budowlanej



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Calculation of a foundation

Kind of treatment: Deep soil mixing

Single footing of 9.88 m² (2.60 m * 3.80 m) on 4 column(s)

Foundation level 1.60 m Foundation pressure 150.00 kN/m²

Reference area 2.47 m²

Calculation depth 20.00 m

Depth of column foot 6.50 m

Properties of installed material (below load level)

No.	Top l.	gamma	phi	c	Dia.	D	E	q	K
	[m]	[kN/m ³]	[°]	[kN/m ²]	[m]	[MN/m ²]	[MN/m ²]	[kN/m ²]	
2	1.60	19.00	37.50	0.00	1.00	90.0	1500.0	1200.0	1.00
3	1.90	19.00	37.50	0.00	1.00	90.0	1500.0	1200.0	1.00
4	2.20	19.00	37.50	0.00	1.00	90.0	1500.0	1200.0	1.00
5	5.00	19.00	37.50	0.00	1.00	90.0	1500.0	1200.0	1.00
6	5.40	19.00	37.50	0.00	1.00	90.0	1500.0	1200.0	1.00
7	6.00	19.00	37.50	0.00	1.00	90.0	1500.0	1200.0	1.00
8	6.50	19.00	37.50	0.00	0.00	90.0	1500.0	1200.0	1.00
9	20.00	19.00	37.50	0.00	0.00	90.0	1500.0	1200.0	1.00

Properties of soil layers (from ground level)

No.	Top l.	gamma	phi	c	ny	D	A-R	D-R	tau
	[m]	[kN/m ³]	[°]	[kN/m ²]		[MN/m ²]			[kN/m ²]
1	0.00	18.00	31.00	0.00	0.30	50.00	*****	1.80	0.00
2	1.60	18.00	31.00	0.00	0.30	50.00	3.14	1.80	0.00
3	1.90	19.00	38.00	0.00	0.30	130.00	3.14	0.69	0.00
4	2.20	18.50	33.00	0.00	0.30	50.00	3.14	1.80	0.00
5	5.00	19.00	38.00	0.00	0.30	130.00	3.14	0.69	0.00
6	5.40	18.50	33.00	0.00	0.30	80.00	3.14	1.12	0.00
7	6.00	20.00	39.00	0.00	0.30	175.00	3.14	0.51	0.00
8	6.50	20.00	39.00	0.00	0.30	175.00	*****	0.51	0.00
9	20.00	20.00	39.00	0.00	0.30	175.00	*****	0.51	0.00

Top l. = top level of layer

Dia. = column diameter

A-R = area ratio

D-R = ratio of constraint moduli

D = constrained modulus

E = Young's modulus

q = admissible stress at elastic deformation

K = mobilized coefficient of earth pressure

Soil improvement

(Relevant for column sections with plastic deformations only!)

The initial support of the columns is considered with K = 1

The proportional load on columns is approximated to $m = 1 - 1/n$

Mutual support of columns occurs at 49 % of this limited system only

No.	n0,0	n0,1	n0	d(A/AC)	n1,0	n1,1	n1	n1'	fd	fd'	n2	n2'
1												
2	1.80	1.44	1.62	5.32	1.57	1.31	1.44	1.25	1.01	1.00	1.44	1.25
3	0.69	0.69	0.69	99.00	0.69	1.00	0.85	0.85	1.04	1.00	0.85	0.85
4	1.80	1.44	1.62	5.32	1.57	1.31	1.44	1.25	1.20	1.00	1.44	1.25
5	0.69	0.69	0.69	99.00	0.69	1.00	0.85	0.85	1.44	1.00	0.85	0.85
6	1.12	1.12	1.12	34.25	1.12	1.12	1.12	1.04	1.53	1.00	1.12	1.04
7	0.51	0.51	0.51	99.00	0.51	1.00	0.76	0.76	1.65	1.00	0.76	0.76
8												

without depth factor
 (for failure analyses)

with depth factor
 (for settlement calculations)

No.	m1	phi1 [°]	c1 [kN/m2]	D1 [MN/m2]	m2	phi2 [°]	c2 [kN/m2]	D2 [MN/m2]
1			Layer above the load level!					
2	0.20	32.40	0.00	62.72	0.20	32.40	0.00	62.72
3	0.00	38.00	0.00	110.36	-0.18	38.09	0.00	110.36
4	0.20	33.95	0.00	62.72	0.20	33.95	0.00	62.72
5	0.00	38.00	0.00	110.36	-0.18	38.09	0.00	110.36
6	0.04	33.18	0.00	83.18	0.04	33.18	0.00	83.18
7	0.00	39.00	0.00	133.27	-0.31	39.46	0.00	133.27
8			Layer without columns!					

n0 = basic improvement factor (n0,0 for grid and n0,1 for isolated column)
 d(A/AC) = addition to the area ratio (due to column compressibility)
 n1 = amended improvement factor (column compressibility) (resp. n1,0 and n1,1)
 fd = depth factor (due to overburden constraint) (fd' = reduced fd)
 n2 = fd' x n1' (n1' resp. n2' = reduced n1 resp. n2)
 m1/2 = proportional load on columns)
 phi1/2 = friction angle of compound) attributable to n1' resp. n2'
 c1/2 = cohesion of compound)
 D1/2 = constr. modulus of compound)

Settlement
 at the 1.0-fold distance of the characteristic point

Depth [m]	Unlimited load area [cm]	Single foundation [cm]		Over- burden [kN/m2]	Found. pressure [kN/m2]	Pressure ratio
1.60	0.01	0.01 el.	40 %	28.8	150.0	5.21
1.90	0.01	0.01 el.	40 %	34.2	150.0	4.39
2.20	0.02	0.02 el.	40 %	39.9	149.8	3.76
2.70	0.02	0.02 el.	40 %	49.2	149.0	3.03
3.20	0.02	0.02 el.	40 %	58.4	147.2	2.52
3.70	0.02	0.02 el.	39 %	67.7	144.5	2.14
4.20	0.01	0.01 el.	38 %	76.9	140.8	1.83
4.70	0.01	0.01 el.	37 %	86.1	136.6	1.59
5.00	0.01	0.01 el.	36 %	91.7	133.8	1.46
5.40	0.01	0.01 el.	35 %	99.3	130.1	1.31
5.90	0.00	0.00 el.	34 %	108.5	125.3	1.15
6.00	0.01	0.01 el.	34 %	110.4	124.3	1.13
6.50	0.06	0.04		120.4	119.7	0.99
7.00	0.06	0.03		130.4	82.9	0.64
7.50	0.06	0.02		140.4	64.2	0.46
8.00	0.06	0.02		150.4	52.4	0.35
8.50	0.06	0.02		160.4	43.7	0.27
9.00	0.06	0.01		170.4	36.8	0.22
9.50	0.06	0.01		180.4	31.2	0.17
10.00	0.06	0.01		190.4	26.7	0.14
10.50	0.06	0.01		200.4	22.9	0.11
11.00	0.06	0.01		210.4	19.8	0.09
11.50	0.06	0.01		220.4	17.3	0.08
12.00	0.06	0.01		230.4	15.1	0.07
12.50	0.06	0.00		240.4	13.4	0.06
13.00	0.06	0.00		250.4	11.9	0.05
13.50	0.06	0.00		260.4	10.6	0.04
14.00	0.06	0.00		270.4	9.5	0.04
14.50	0.06	0.00		280.4	8.5	0.03
15.00	0.06	0.00		290.4	7.7	0.03
15.50	0.06	0.00		300.4	7.0	0.02
16.00	0.06	0.00		310.4	6.4	0.02
16.50	0.06	0.00		320.4	5.9	0.02
17.00	0.06	0.00		330.4	5.4	0.02
17.50	0.06	0.00		340.4	5.0	0.01
18.00	0.06	0.00		350.4	4.6	0.01
18.50	0.06	0.00		360.4	4.2	0.01
19.00	0.06	0.00		370.4	3.9	0.01
19.50	0.06	0.00		380.4	3.7	0.01

1.66 0.36
 (At elastic sections the load is carried by the columns only)

Additional settlement by lower punching 0.05 cm

Total settlement 0.41 cm