


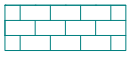
Pile verification

Input data

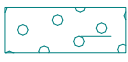
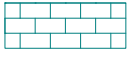
Project

Date : 11/2/2005

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	C_{ef} [kPa]	γ [kN/m ³]	γ_{su} [kN/m ³]
1	Soil No. 1		29.00	8.00	19.00	9.00
2	Soil No. 2		37.00	40.00	19.00	9.00

All soils are considered as cohesionless for at rest pressure analysis.

No.	Name	Pattern	E_{oed} [MPa]	E_{def} [MPa]	γ_{sat} [kN/m ³]	γ_s [kN/m ³]	n [-]
1	Soil No. 1		24.00	-	19.00	-	-
2	Soil No. 2		1220.00	-	19.00	-	-

Soil parameters

Soil No. 1

Unit weight : $\gamma = 19.00$ kN/m³
 Angle of internal friction : $\varphi_{ef} = 29.00$ °
 Cohesion of soil : $C_{ef} = 8.00$ kPa
 Poisson's ratio : $\nu = 0.35$
 Oedometric modulus : $E_{oed} = 24.00$ MPa
 Saturated unit weight : $\gamma_{sat} = 19.00$ kN/m³

Soil No. 2

Unit weight : $\gamma = 19.00$ kN/m³
 Angle of internal friction : $\varphi_{ef} = 37.00$ °
 Cohesion of soil : $C_{ef} = 40.00$ kPa
 Poisson's ratio : $\nu = 0.35$
 Oedometric modulus : $E_{oed} = 1220.00$ MPa
 Saturated unit weight : $\gamma_{sat} = 19.00$ kN/m³

Geometry of structure

Pile geometry

Pile profile: circular

Dimensions

Diameter $d = 1.30$ m

Length $l = 8.00$ m

Location

Off ground height $h = 1.00$ m

Depth of finished grade $h_z = 2.00$ m

Technology

Piles with excavation of soil from a bore hole

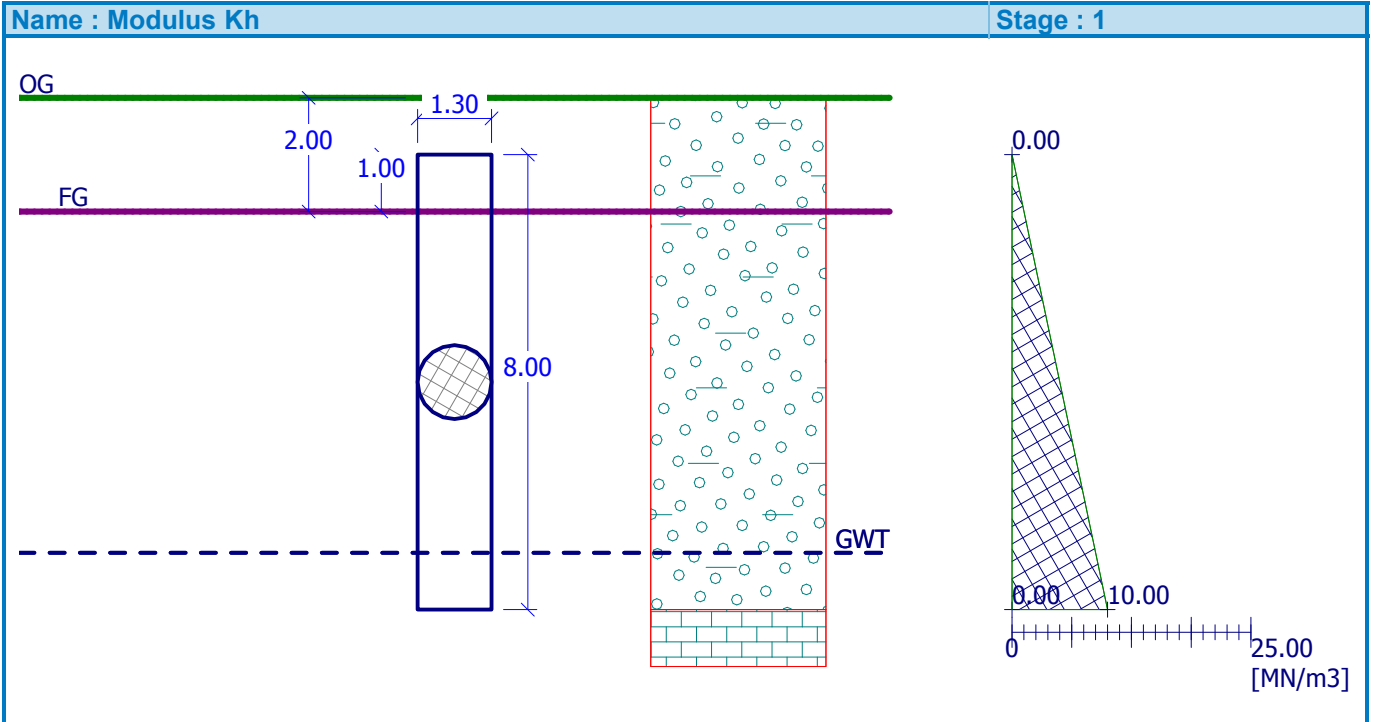
Pile type: continuous flight auger pile

Heel resistance reduction = 0.80

Skin resistance reduction = 0.60

Distribution of modulus of subsoil reaction

Depth [m]	Kh [MN/m ³]
0.00	0.00
8.00	10.00



Material of structure

Analysis of concrete structures carried out according to the standard EN 1992 1-1 (EC2).

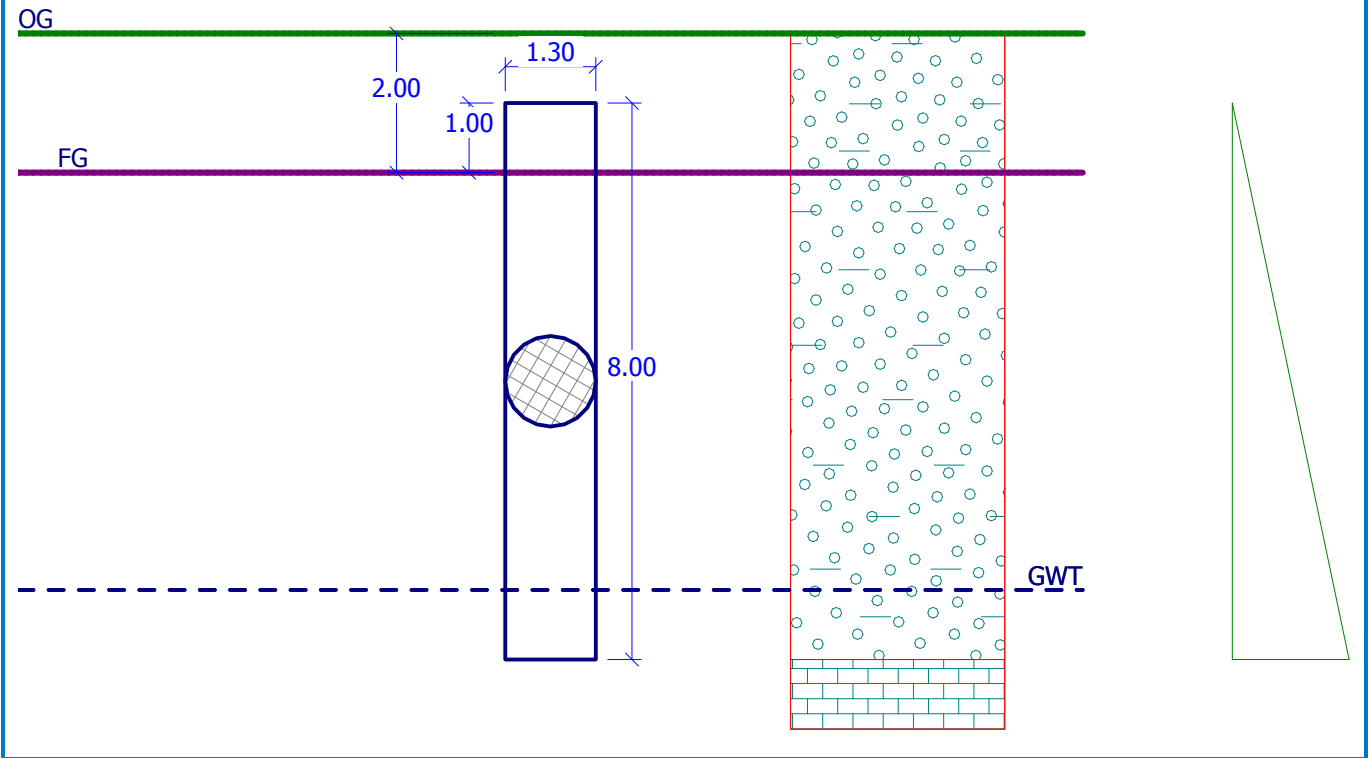
Concrete : C 20/25
 Cylinder compressive strength $f_{ck} = 20.00$ MPa
 Tensile strength $f_{ct} = 2.20$ MPa
 Elasticity modulus $E_{cm} = 29000.00$ MPa
 Longitudinal steel : B500
 Yield strength $f_{yk} = 500.00$ MPa
 Elasticity modulus $E = 200000.00$ MPa

Geological profile and assigned soils

No.	Layer [m]	Assigned soil	Pattern
1	9.00	Soil No. 1	
2	-	Soil No. 2	

Name : Profile and assignment

Stage : 1



Load

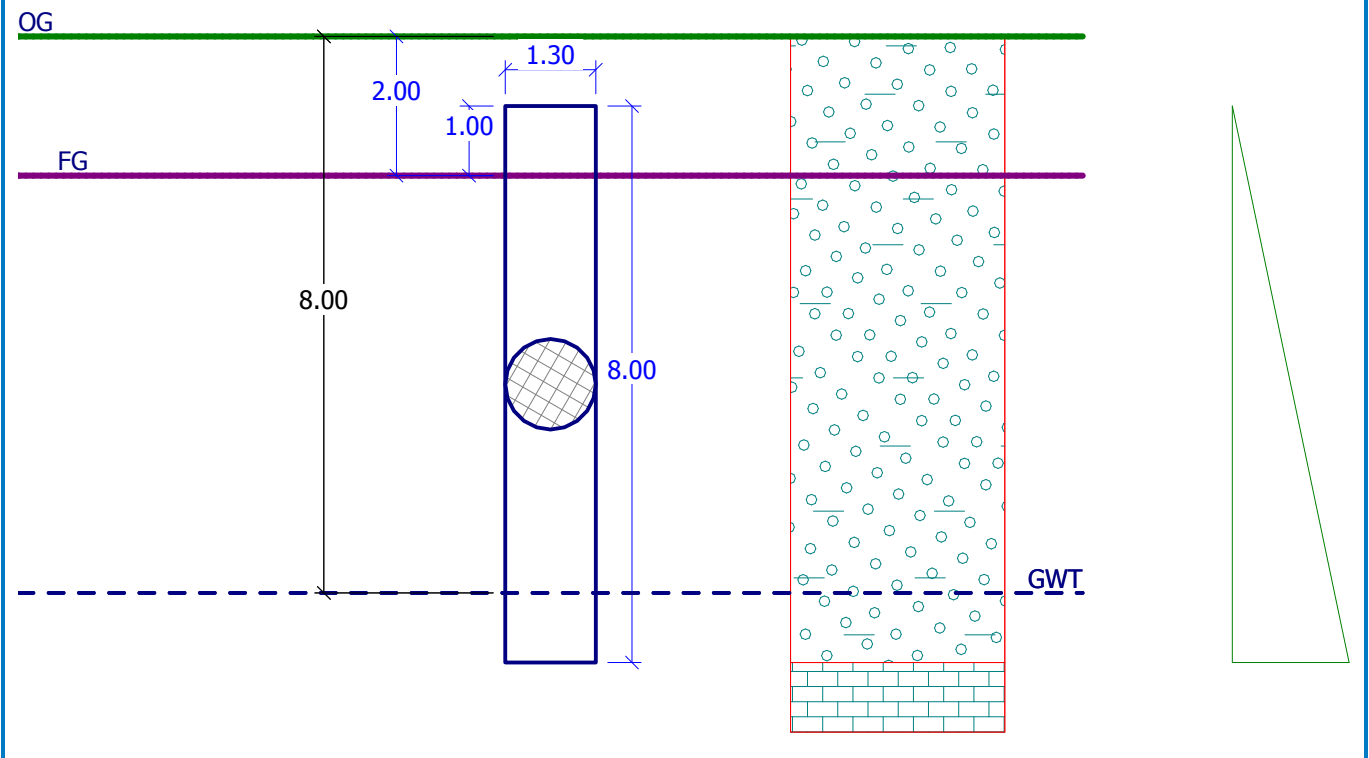
No.	Load		Name	Type	N [kN]	M _x [kNm]	M _y [kNm]	H _x [kN]	H _y [kN]
	new	change							
1	YES		Load No. 1	Design	1200.00	50.00	14.00	0.00	120.00

Ground water table

The ground water table is at a depth of 8.00 m from the original terrain.

Name : GWT + subsoil

Stage : 1



Analysis settings

Analysis carried out without reduction of input data.

Verification No. 1

Input data to compute pile horizontal bearing capacity

Analysis carried out with automatic selection of the most unfavourable load cases.
Horizontal bearing capacity verified in the direction of maximum load effect.

Distributions of internal forces and displacement of pile

Pile displacements and internal forces distributions:

Dist. [m]	Modulus k [MN/m ³]	Displacement [mm]	Rotat. [mRad]	Stress [kPa]	Shear Force [kN]	Moment [kNm]
0.00	0.00	-22.21	3.76	5.55	-120.00	50.00
0.40	0.50	-20.71	3.75	10.36	-117.21	97.44
0.40	0.50	-20.71	3.75	10.36	-117.21	97.44
0.80	1.00	-19.21	3.75	19.21	-109.43	142.74
0.80	1.00	-19.21	3.75	19.21	-109.43	142.74
1.20	1.50	-17.71	3.75	26.56	-97.43	184.08
1.20	1.50	-17.71	3.75	26.56	-97.43	184.08
1.60	2.00	-16.21	3.75	32.42	-81.99	219.92
1.60	2.00	-16.21	3.75	32.42	-81.99	219.92
2.00	2.50	-14.71	3.74	36.78	-63.90	249.04
2.00	2.50	-14.71	3.74	36.78	-63.90	249.04
2.40	3.00	-13.21	3.74	39.64	-43.94	270.54
2.40	3.00	-13.21	3.74	39.64	-43.94	270.54
2.80	3.50	-11.72	3.74	41.02	-22.87	283.82
2.80	3.50	-11.72	3.74	41.02	-22.87	283.82

Dist. [m]	Modulus k [MN/m ³]	Displacement [mm]	Rotat. [mRad]	Stress [kPa]	Shear Force [kN]	Moment [kNm]
3.20	4.00	-10.23	3.73	40.90	-1.47	288.59
3.20	4.00	-10.23	3.73	40.90	-1.47	288.59
3.60	4.50	-8.73	3.73	39.30	19.47	284.88
3.60	4.50	-8.73	3.73	39.30	19.47	284.88
4.00	5.00	-7.24	3.72	36.21	39.20	273.02
4.00	5.00	-7.24	3.72	36.21	39.20	273.02
4.40	5.50	-5.75	3.72	31.64	56.94	253.65
4.40	5.50	-5.75	3.72	31.64	56.94	253.65
4.80	6.00	-4.27	3.72	25.59	71.92	227.73
4.80	6.00	-4.27	3.72	25.59	71.92	227.73
5.20	6.50	-2.78	3.71	18.06	83.36	196.52
5.20	6.50	-2.78	3.71	18.06	83.36	196.52
5.60	7.00	-1.29	3.71	9.05	90.51	161.57
5.60	7.00	-1.29	3.71	9.05	90.51	161.57
6.00	7.50	0.19	3.71	-1.44	92.59	124.76
6.00	7.50	0.19	3.71	-1.44	92.59	124.76
6.40	8.00	1.68	3.71	-13.40	88.82	88.28
6.40	8.00	1.68	3.71	-13.40	88.82	88.28
6.80	8.50	3.16	3.71	-26.85	78.45	54.61
6.80	8.50	3.16	3.71	-26.85	78.45	54.61
7.20	9.00	4.64	3.71	-41.78	60.71	26.55
7.20	9.00	4.64	3.71	-41.78	60.71	26.55
7.60	9.50	6.12	3.71	-58.19	34.81	7.21
7.60	9.50	6.12	3.71	-58.19	34.81	7.21
8.00	10.00	7.61	3.71	-74.18	-0.00	-0.00

Maximum internal force and deformation :

Pile head displacement = -22.2 mm
 Max. pile displacement = 22.2 mm
 Max. shear force = 120.00 kN
 Maximum moment = 288.59 kNm

Dimensioning of reinforcement:

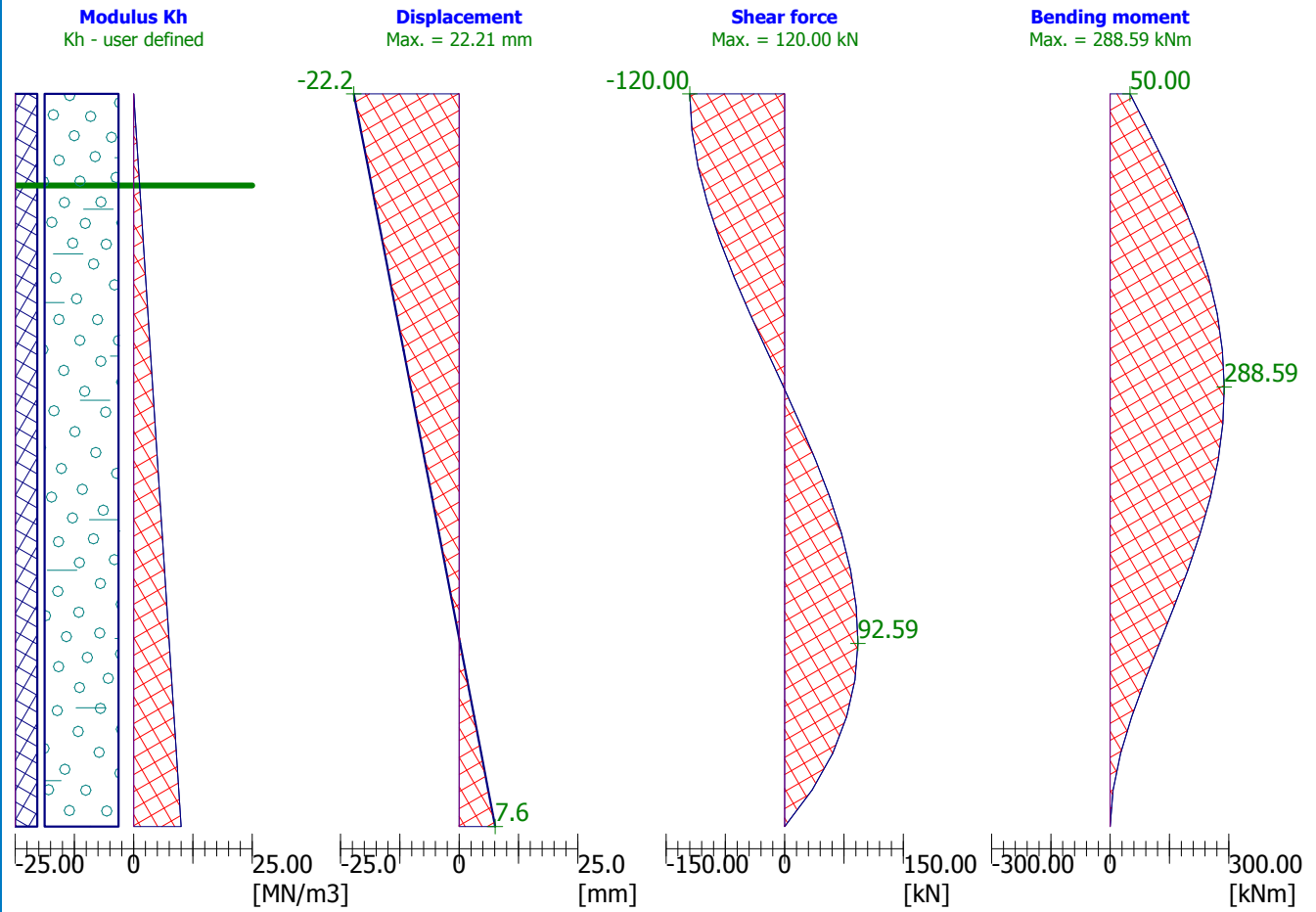
Reinforcement - 6 pc bars 9.5 mm; covering 40.0 mm

Reinforcement ratio $\rho = 0.021 \% < 0.130 \% = \rho_{\min}$

Cross-section is NOT ACCEPTABLE; increase reinforcement ratio.

Name : Horizontal cap.

Stage : 1; Verification : 1



Verification No. 1

Input data

Maximum displacement 25.0 mm
Coeff. of increase of limit skin friction due to technology 1
Depth of influence zone is post-computed.

Load transfer curve

No.	Load [kN]	Settlement [mm]
1	0.00	0.0
2	1457.23	0.9
3	2914.47	4.5
4	4371.70	7.3
5	5828.93	10.1
6	7286.16	13.0
7	8743.40	15.8
8	10200.63	18.6
9	11657.86	21.4
10	13115.09	24.3
11	13483.46	25.0

Loading Q = 1200.00 kN yields pile settlement 0.7 mm

Shear - deformation dependence at a depth of 4.00m

No.	Displacemer [mm]	Shear [kPa]
1	0.0	0.00
2	0.7	2.51
3	4.2	14.99
4	6.8	24.20
5	9.5	33.75
6	12.2	43.32
7	14.9	52.84
8	17.6	62.37
9	20.2	71.91
10	22.9	81.47
11	25.0	88.85

Analysis for load F = 1457.23 kN

x [m]	Norm. force [kN]	Rel. norm. [-]	Shear [kN]	Rel. shear [-]
0.00	1457.23	1.00	0.00	0.00
1.00	1457.23	1.00	0.00	0.00
1.70	1454.42	1.00	2.81	0.00
2.40	1451.70	1.00	5.53	0.00
3.10	1449.08	0.99	8.16	0.01
3.80	1446.54	0.99	10.69	0.01
4.50	1444.10	0.99	13.13	0.01
5.20	1441.76	0.99	15.48	0.01
5.90	1439.50	0.99	17.73	0.01
6.60	1437.34	0.99	19.89	0.01
7.30	1435.27	0.98	21.96	0.02
8.00	1413.58	0.97	43.65	0.03

Analysis for load F = 2914.47 kN

x [m]	Norm. force [kN]	Rel. norm. [-]	Shear [kN]	Rel. shear [-]
0.00	2914.47	1.00	0.00	0.00
1.00	2914.47	1.00	0.00	0.00
1.70	2898.87	0.99	15.60	0.01
2.40	2883.46	0.99	31.01	0.01
3.10	2868.23	0.98	46.23	0.02
3.80	2853.19	0.98	61.28	0.02
4.50	2838.33	0.97	76.13	0.03
5.20	2823.66	0.97	90.81	0.03
5.90	2809.16	0.96	105.30	0.04
6.60	2794.85	0.96	119.62	0.04
7.30	2780.72	0.95	133.75	0.05
8.00	2627.68	0.90	286.78	0.10

Analysis for load F = 4371.70 kN

x [m]	Norm. force [kN]	Rel. norm. [-]	Shear [kN]	Rel. shear [-]
0.00	4371.70	1.00	0.00	0.00
1.00	4371.70	1.00	0.00	0.00
1.70	4346.58	0.99	25.11	0.01
2.40	4321.75	0.99	49.95	0.01
3.10	4297.19	0.98	74.50	0.02
3.80	4272.91	0.98	98.78	0.02
4.50	4248.91	0.97	122.79	0.03
5.20	4225.18	0.97	146.52	0.03
5.90	4201.72	0.96	169.98	0.04
6.60	4178.53	0.96	193.16	0.04
7.30	4155.62	0.95	216.08	0.05
8.00	3907.21	0.89	464.49	0.11

Analysis for load F = 5828.93 kN

x [m]	Norm. force [kN]	Rel. norm. [-]	Shear [kN]	Rel. shear [-]
0.00	5828.93	1.00	0.00	0.00
1.00	5828.93	1.00	0.00	0.00
1.70	5793.96	0.99	34.97	0.01
2.40	5759.37	0.99	69.56	0.01
3.10	5725.14	0.98	103.79	0.02
3.80	5691.29	0.98	137.64	0.02
4.50	5657.80	0.97	171.13	0.03
5.20	5624.68	0.96	204.25	0.04
5.90	5591.92	0.96	237.01	0.04
6.60	5559.52	0.95	269.41	0.05
7.30	5527.48	0.95	301.45	0.05
8.00	5279.17	0.91	549.76	0.09

Analysis for load F = 7286.16 kN

x [m]	Norm. force [kN]	Rel. norm. [-]	Shear [kN]	Rel. shear [-]
0.00	7286.16	1.00	0.00	0.00
1.00	7286.16	1.00	0.00	0.00
1.70	7251.89	1.00	34.27	0.00
2.40	7207.52	0.99	78.65	0.01
3.10	7163.61	0.98	122.56	0.02
3.80	7120.16	0.98	166.00	0.02
4.50	7077.17	0.97	208.99	0.03
5.20	7034.64	0.97	251.52	0.03
5.90	6992.56	0.96	293.60	0.04
6.60	6950.94	0.95	335.23	0.05
7.30	6909.76	0.95	376.40	0.05
8.00	6658.69	0.91	627.47	0.09

Analysis for load F = 8743.40 kN

x [m]	Norm. force [kN]	Rel. norm. [-]	Shear [kN]	Rel. shear [-]
0.00	8743.40	1.00	0.00	0.00
1.00	8743.40	1.00	0.00	0.00
1.70	8708.90	1.00	34.50	0.00
2.40	8654.79	0.99	88.61	0.01
3.10	8601.24	0.98	142.16	0.02
3.80	8548.24	0.98	195.16	0.02
4.50	8495.80	0.97	247.60	0.03
5.20	8443.90	0.97	299.49	0.03
5.90	8392.55	0.96	350.84	0.04
6.60	8341.74	0.95	401.65	0.05
7.30	8291.48	0.95	451.92	0.05
8.00	8038.58	0.92	704.81	0.08

Analysis for load F = 10200.63 kN

x [m]	Norm. force [kN]	Rel. norm. [-]	Shear [kN]	Rel. shear [-]
0.00	10200.63	1.00	0.00	0.00
1.00	10200.63	1.00	0.00	0.00
1.70	10165.94	1.00	34.69	0.00
2.40	10109.35	0.99	91.28	0.01
3.10	10046.14	0.98	154.49	0.02
3.80	9983.58	0.98	217.05	0.02
4.50	9921.66	0.97	278.96	0.03
5.20	9860.39	0.97	340.24	0.03
5.90	9799.75	0.96	400.87	0.04
6.60	9739.75	0.95	460.88	0.05
7.30	9680.38	0.95	520.25	0.05
8.00	9425.99	0.92	774.64	0.08

Analysis for load F = 11657.86 kN

x [m]	Norm. force [kN]	Rel. norm. [-]	Shear [kN]	Rel. shear [-]
0.00	11657.86	1.00	0.00	0.00
1.00	11657.86	1.00	0.00	0.00
1.70	11623.02	1.00	34.84	0.00
2.40	11566.18	0.99	91.68	0.01
3.10	11493.32	0.99	164.54	0.01
3.80	11421.20	0.98	236.66	0.02
4.50	11349.82	0.97	308.04	0.03
5.20	11279.17	0.97	378.69	0.03
5.90	11209.25	0.96	448.61	0.04
6.60	11140.06	0.96	517.80	0.04
7.30	11071.58	0.95	586.28	0.05
8.00	10816.03	0.93	841.83	0.07

Analysis for load F = 13115.09 kN

x [m]	Norm. force [kN]	Rel. norm. [-]	Shear [kN]	Rel. shear [-]
0.00	13115.09	1.00	0.00	0.00
1.00	13115.09	1.00	0.00	0.00
1.70	13080.14	1.00	34.96	0.00
2.40	13023.10	0.99	91.99	0.01
3.10	12940.57	0.99	174.53	0.01
3.80	12858.86	0.98	256.23	0.02
4.50	12777.99	0.97	337.10	0.03
5.20	12697.95	0.97	417.15	0.03
5.90	12618.72	0.96	496.37	0.04
6.60	12540.31	0.96	574.78	0.04
7.30	12462.71	0.95	652.38	0.05
8.00	12206.23	0.93	908.86	0.07

Analysis for load F = 14572.33 kN

x [m]	Norm. force [kN]	Rel. norm. [-]	Shear [kN]	Rel. shear [-]
0.00	14572.33	1.00	0.00	0.00
1.00	14572.33	1.00	0.00	0.00
1.70	14537.25	1.00	35.08	0.00
2.40	14480.01	0.99	92.32	0.01
3.10	14400.60	0.99	171.73	0.01
3.80	14309.26	0.98	263.06	0.02
4.50	14218.85	0.98	353.47	0.02
5.20	14129.36	0.97	442.96	0.03
5.90	14040.79	0.96	531.54	0.04
6.60	13953.12	0.96	619.21	0.04
7.30	13866.35	0.95	705.97	0.05
8.00	13608.91	0.93	963.42	0.07

Name : Vert. cap. (springs)

Stage : 1; Verification : 1

