Dr. C. Sachpazis, Civil / Geotechnical Engineer

PROJECT: "NEW STEAM BOILER U-5190 in HELPE Aspropyrgos Industrial Complex"

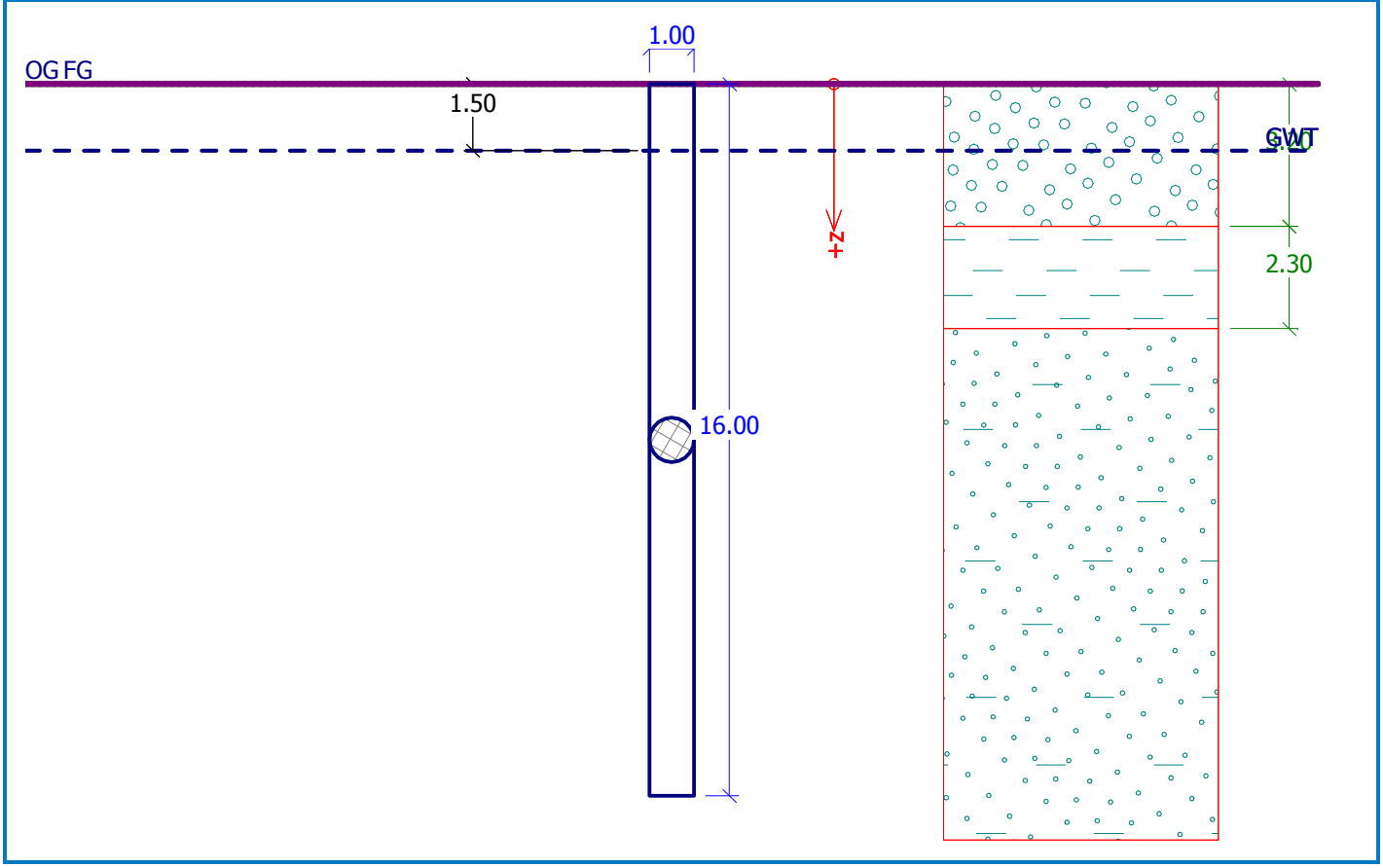
Pile Bearing Capacity Analysis / Verification

Input data

Project

Task : PROJECT: "NEW STEAM BOILER U-5190 in HELPE Aspropyrgos Industrial Complex"
Part : A-1
Descript. : The objective of this Analysis is the Pile allowable bearing Capacity Analysis % Calculations for the construction of the New Steam Boiler U-5190, in HELPE Aspropyrgos Industrial Complex.
Author : Dr. C. Sachpazis, Civil & Geotechnical Engineer
BEng (Hons) Civil Eng. UK, Dipl. Geol, M.Sc.Eng UK, Ph.D. NTUA (E.M.Π.), Post-Doc. UK, Gr.m.ICE.
Customer : HELLENIC PETROLEUM S.A.
Date : 09-Oct-13

Name : Project | **Stage : 1**



Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m^3]	γ_{su} [kN/m^3]
1	Poorly graded gravel (GP), medium dense		35.50	0.00	19.00	9.50
2	High plasticity clay (CH,CV,CE), consistency soft		27.00	0.00	18.00	9.00
3	Clayey sand (SC)		42.00	0.00	21.00	11.50

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

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No.	Name	Pattern	E_{oed} [MPa]	E_{def} [MPa]	γ_{sat} [kN/m³]	γ_s [kN/m³]	n [-]
1	Poorly graded gravel (GP), medium dense		161.00	-	19.50	-	-
2	High plasticity clay (CH,CV,CE), consistency soft		8.00	-	19.00	-	-
3	Clayey sand (SC)		40.00	-	21.50	-	-

Parameters of soils to compute modulus of subsoil reaction

No.	Name	Pattern	β
1	Poorly graded gravel (GP), medium dense		15.00
2	High plasticity clay (CH,CV,CE), consistency soft		10.00
3	Clayey sand (SC)		25.00

Soil parameters

Poorly graded gravel (GP), medium dense

Unit weight :	γ	=	19.00 kN/m³
Angle of internal friction :	φ_{ef}	=	35.50 °
Cohesion of soil :	c_{ef}	=	0.00 kPa
Poisson's ratio :	ν	=	0.20
Oedometric modulus :	E_{oed}	=	161.00 MPa
Saturated unit weight :	γ_{sat}	=	19.50 kN/m³
Angle of dispersion :	β	=	15.00 °

High plasticity clay (CH,CV,CE), consistency soft

Unit weight :	γ	=	18.00 kN/m³
Angle of internal friction :	φ_{ef}	=	27.00 °
Cohesion of soil :	c_{ef}	=	0.00 kPa
Poisson's ratio :	ν	=	0.42
Oedometric modulus :	E_{oed}	=	8.00 MPa
Saturated unit weight :	γ_{sat}	=	19.00 kN/m³
Angle of dispersion :	β	=	10.00 °

Clayey sand (SC)

Unit weight :	γ	=	21.00 kN/m³
Angle of internal friction :	φ_{ef}	=	42.00 °
Cohesion of soil :	c_{ef}	=	0.00 kPa
Poisson's ratio :	ν	=	0.35
Oedometric modulus :	E_{oed}	=	40.00 MPa
Saturated unit weight :	γ_{sat}	=	21.50 kN/m³
Angle of dispersion :	β	=	25.00 °

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Geometry of structure

Pile geometry

Pile profile: circular

Dimensions

Diameter d = 1.00 m
Length l = 16.00 m

Location

Off ground height h = 0.00 m
Depth of finished grade h_z = 0.00 m

Technology

Piles with excavation of soil from a bore hole
Pile type: bored with or without clayey suspension
Heel resistance reduction = 0.50
Skin resistance reduction = 0.60
Modulus of subsoil reaction assumed constant.

Material of structure

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

Concrete : C 40/50
Longitudinal steel : B500

Geological profile and assigned soils

No.	Layer [m]	Assigned soil	Pattern
1	3.20	Poorly graded gravel (GP), medium dense	
2	2.30	High plasticity clay (CH,CV,CE), consistency soft	
3	-	Clayey sand (SC)	

Assumed Loads

No.	Load new	Load change	Name	Type	N [kN]	M_x [kNm]	M_y [kNm]	H_x [kN]	H_y [kN]
1	YES		Load No. 1	Design	2842.00	500.00	250.00	100.00	50.00

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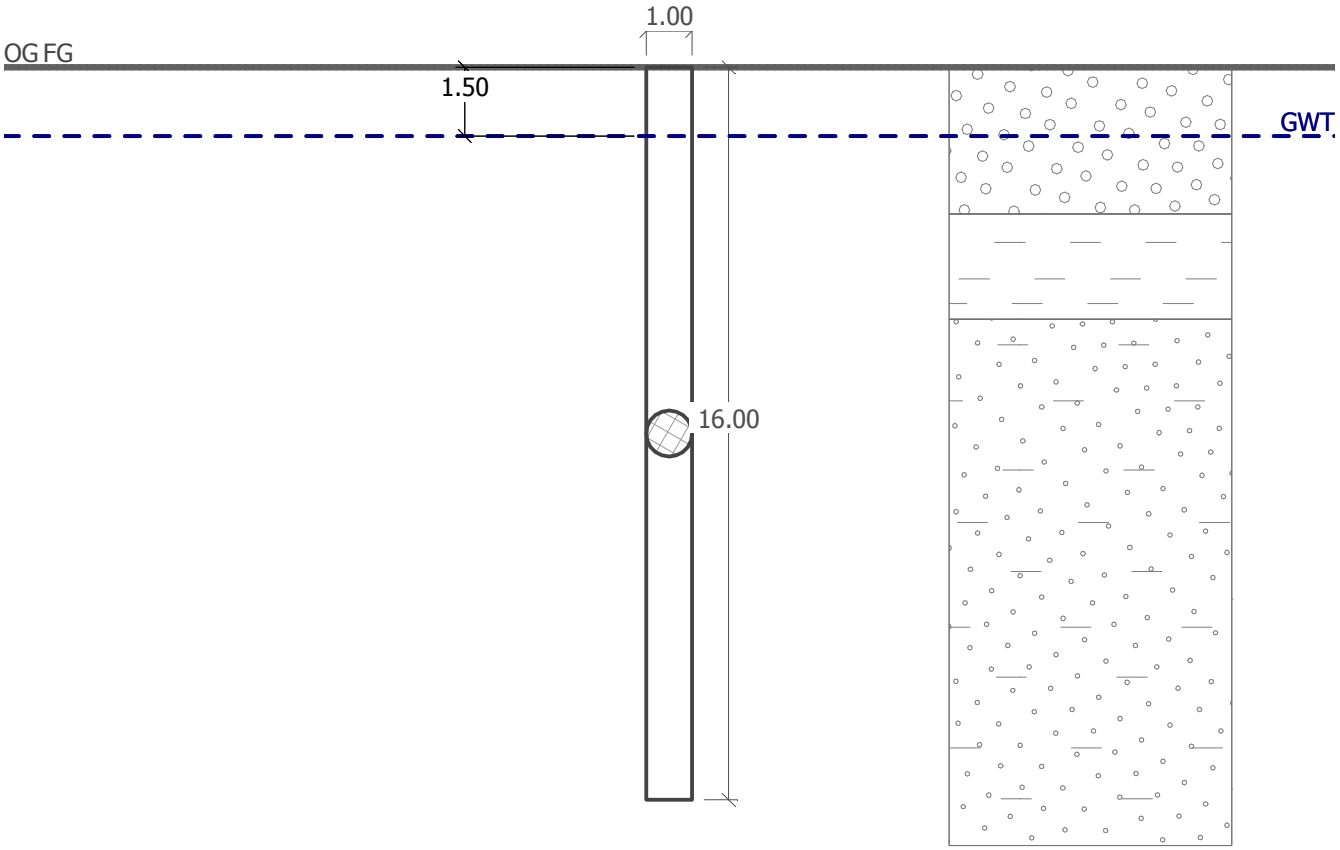
Ground water table

The ground water table is at a depth of 1.50 m below the original terrain elevation.

Name : GWT + subsoil | **Stage : 1**



Analysis settings

Analysis carried out without reduction of input data.

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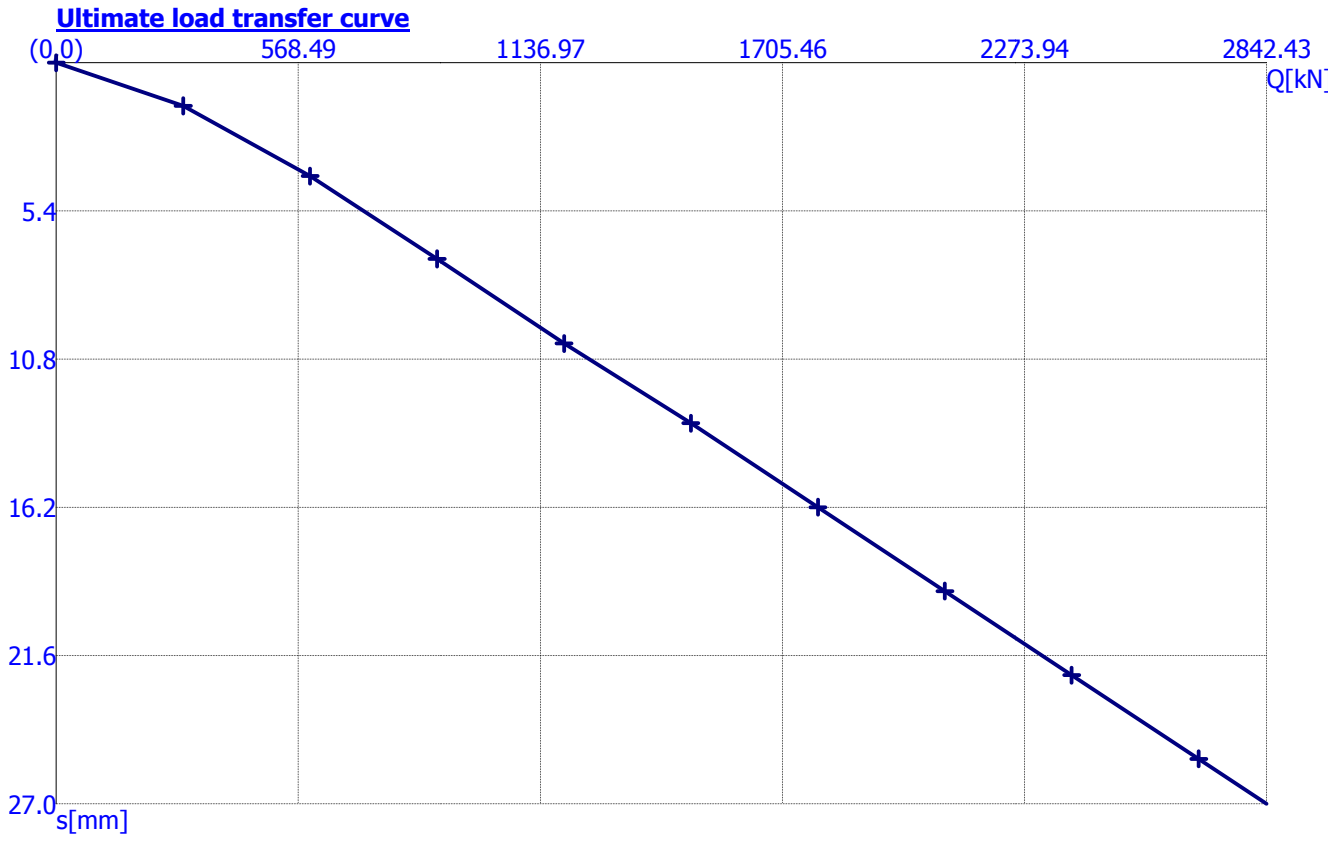
Name : Vert. cap. (springs) | **Stage : 1: Verification : 1**



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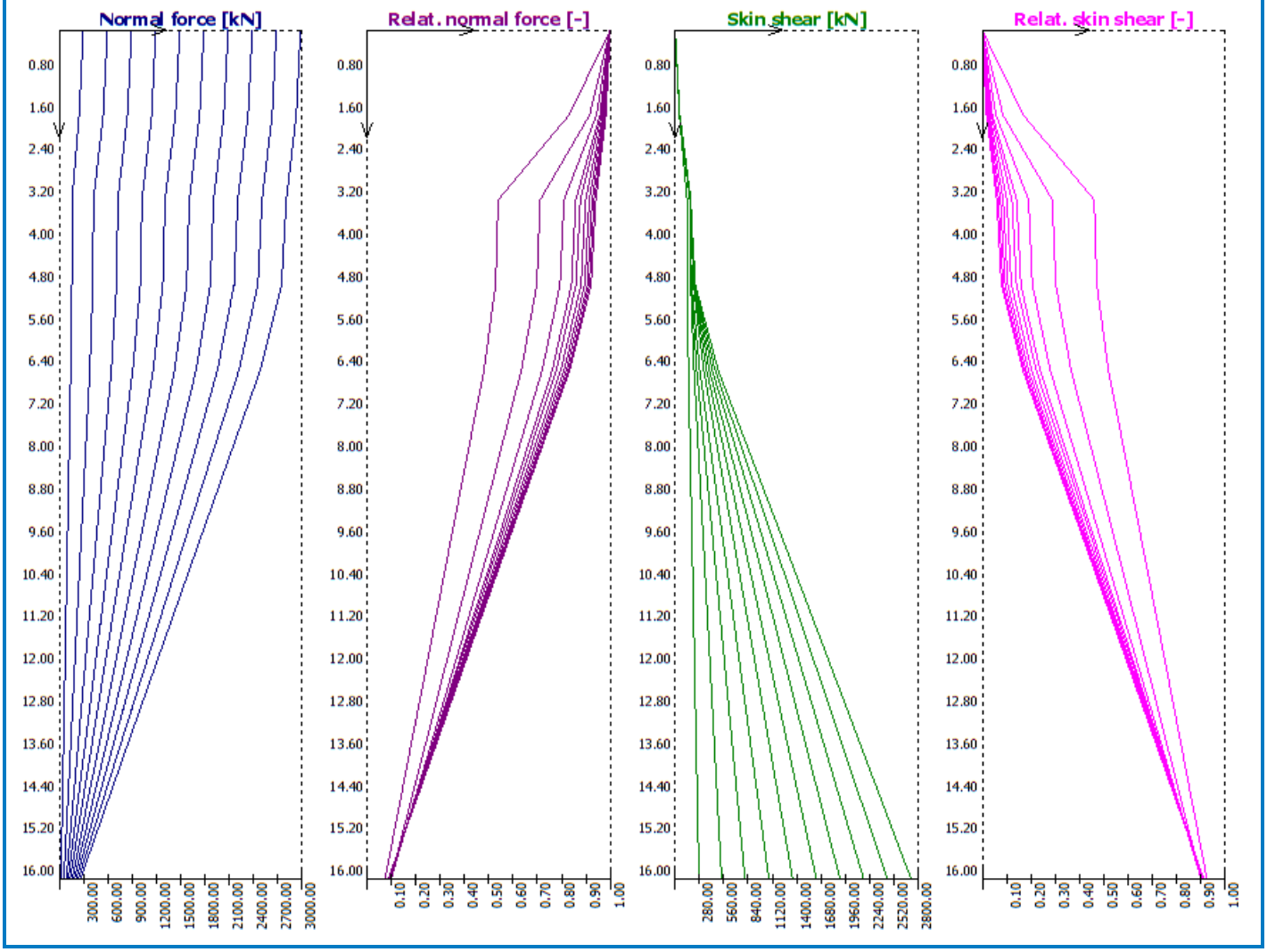

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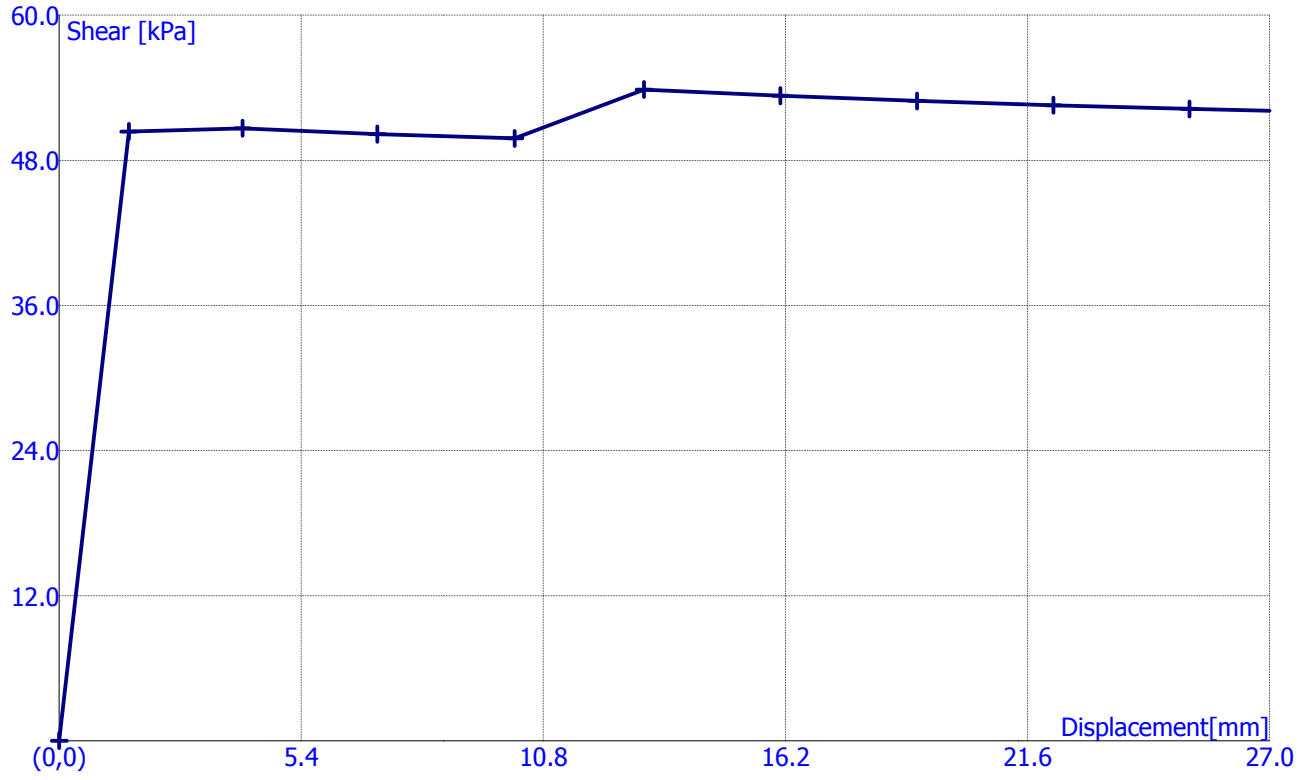
Verification No. 1

Name : Vert. cap. (springs)	Stage : 1: Verification : 1

Shear - deformation dependence (at a depth of 0.00m)



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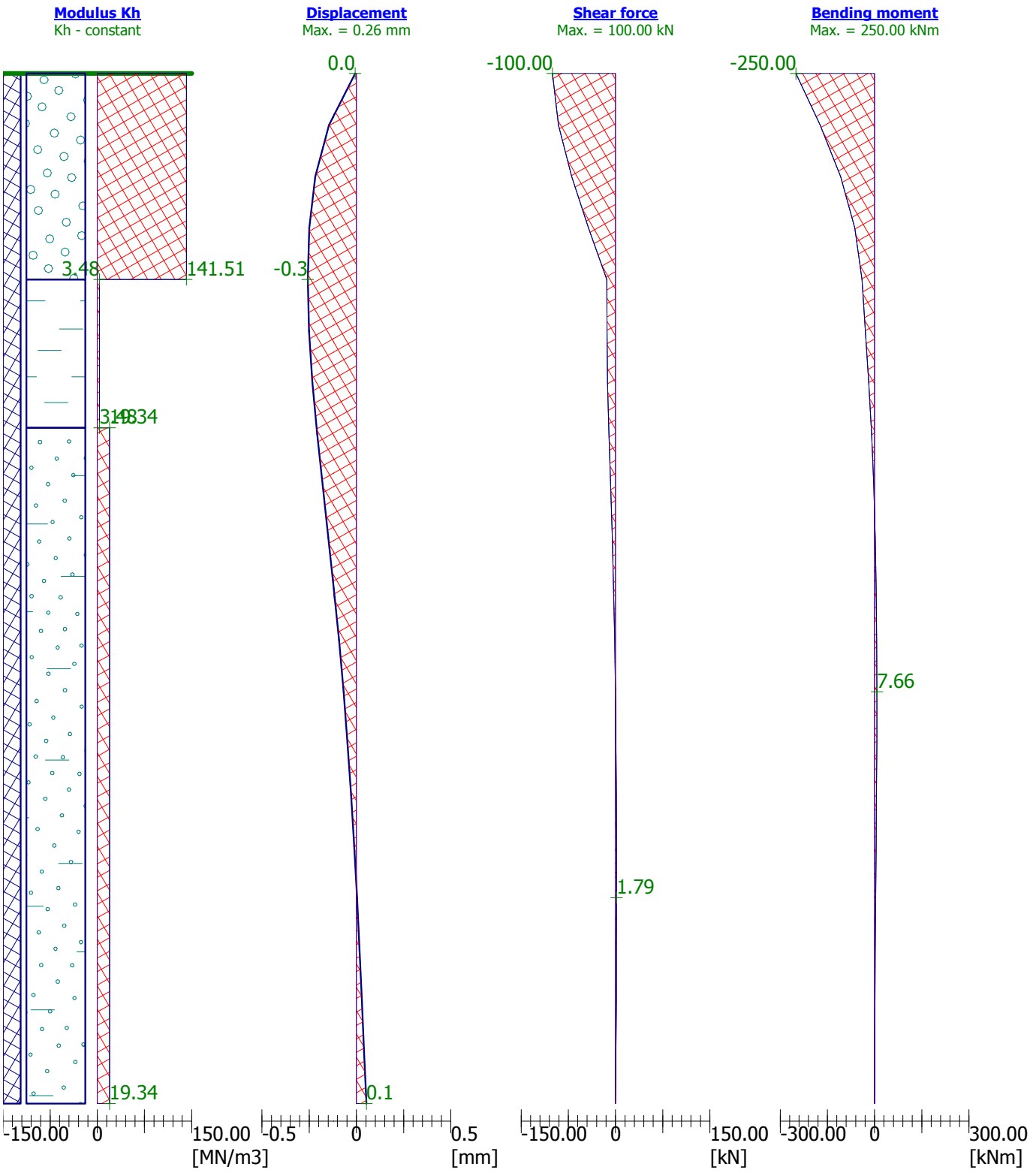
Verification No. 1

Name : Horizontal cap. | **Stage : 1; Verification : 1**



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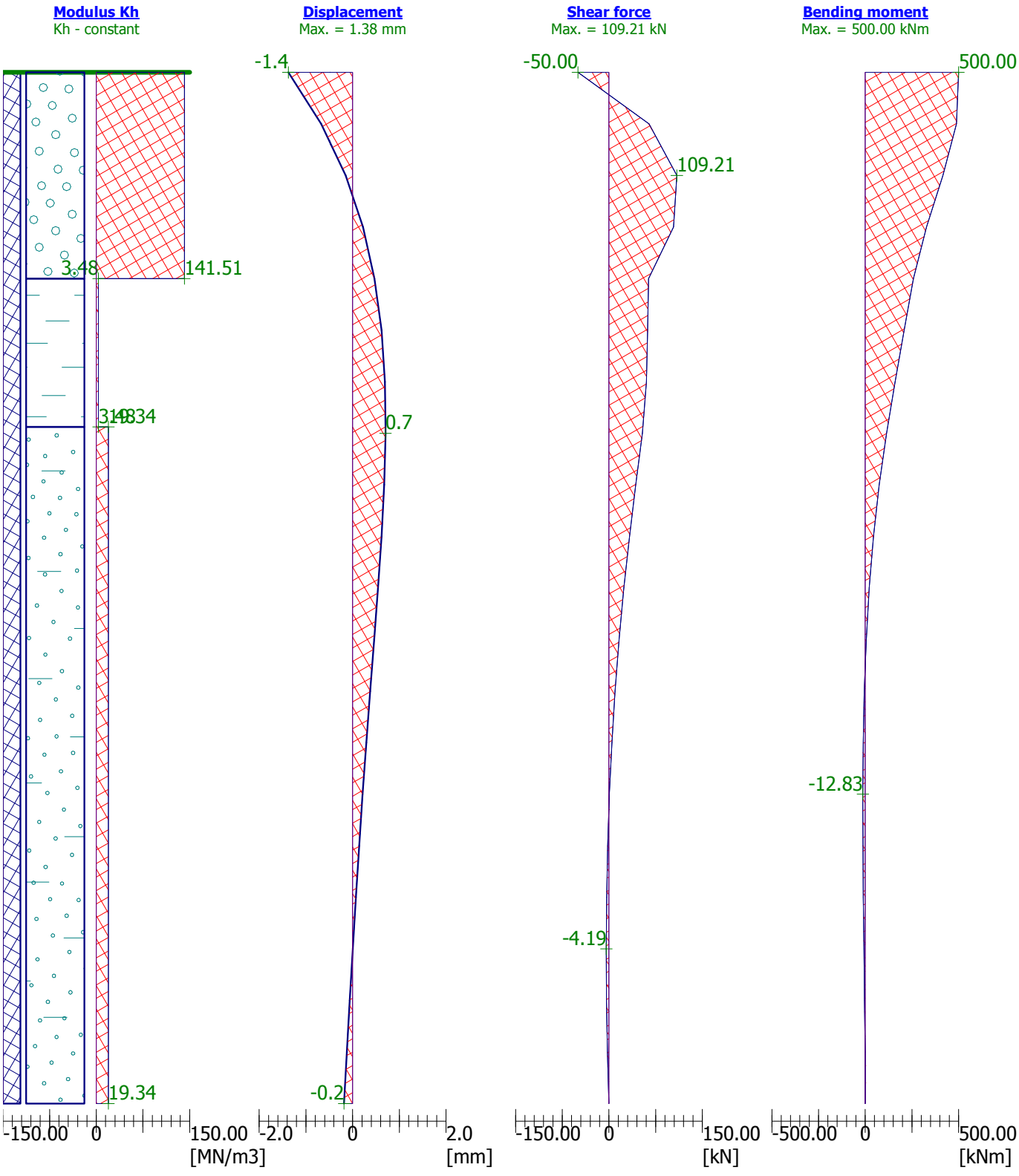
Verification No. 1

Name : Horiziontal cap. | **Stage : 1; Verification : 1**



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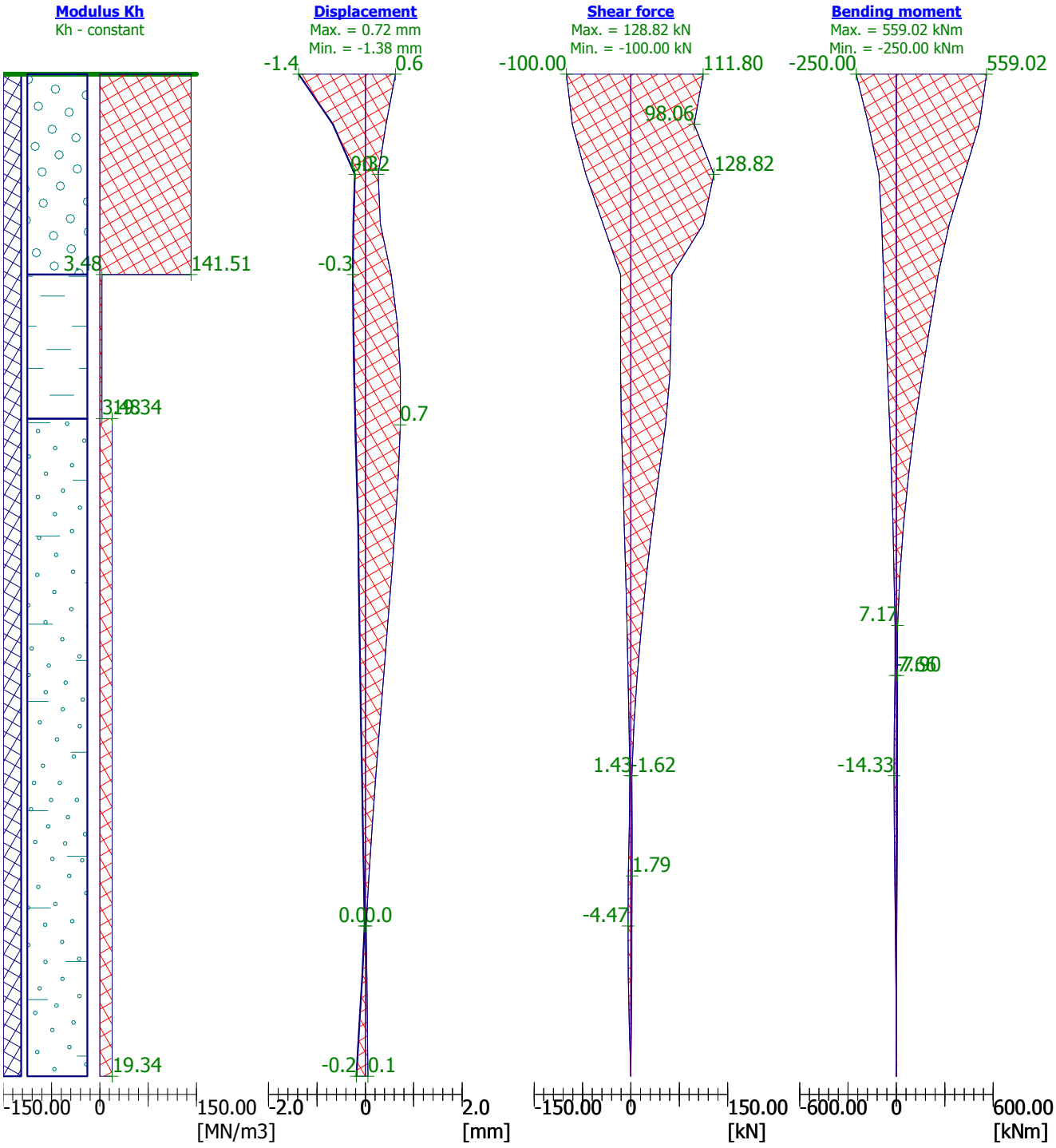
Verification No. 1

Name : Horizontal cap. | **Stage : 1; Verification : 1**



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Maximum internal force and deformation :

Max. pile displacement	=	1.4 mm
Max. shear force	=	128.82 kN
Maximum moment	=	559.02 kNm

Dimensioning of reinforcement:

Reinforcement - 6 pc bars 30.0 mm; Nominal covering 40.0 mm

Reinforcement ratio $\rho = 0.270\ \% > 0.182\ \% = \rho_{min}$

Load : N_{Ed} = -2842.00 kN (compression) ; M_{Ed} = 559.02 kNm
Bearing capacity : N_{Rd} = -14135.36 kN; M_{Rd} = 1791.43 kNm

Designed pile reinforcement is SATISFACTORY.

We are kindly remaining at your disposal for any further information and/or clarifications on telephone numbers: +30-210-5238127, +30-210-5711263, +30-210-5711898, Fax: +30-210-5711461, and Mobile phone: +30-6936425722, e-mail: costas@sachpazis.info & csachpazis@tee.gr, URL: http://www.geodomisi.com.

Yours Sincerely,

Athens, 09 October - 2013

On behalf of and for Geodomisi Ltd.

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