GGU Software

Program Details

ARTICLE NUMBER
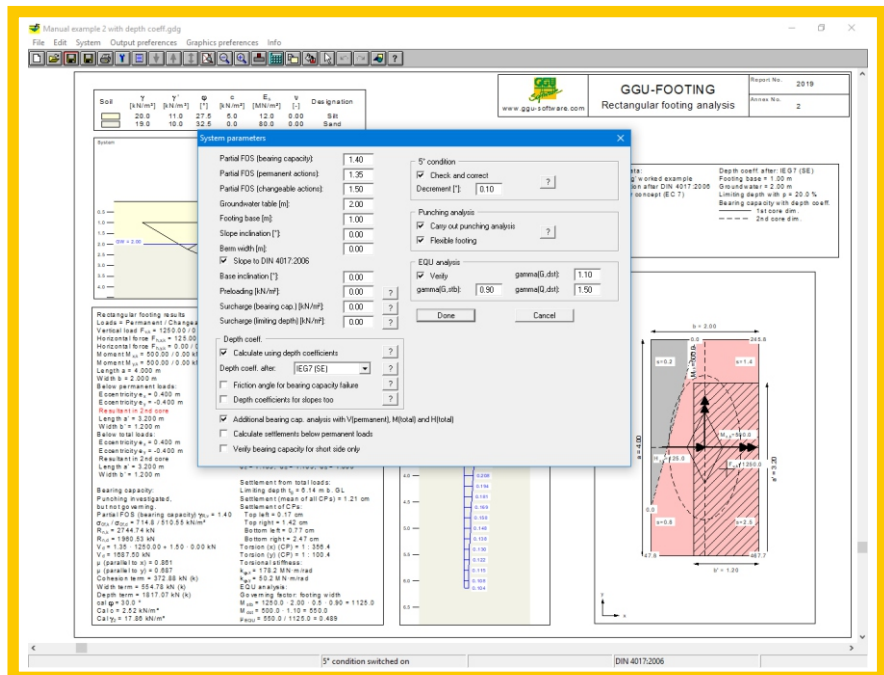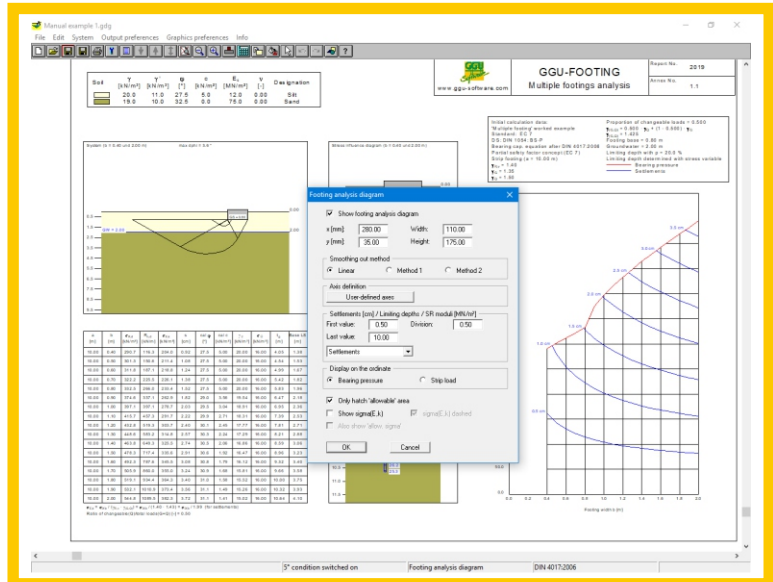ggu-01-102

OPERATING SYSTEM
Windows 7/8/10

Description

GGU-FOOTING – *Analysis of bearing capacity according to DIN 4017 and of settlement according to DIN 4019.*

Capabilities:
- *Choice of analysis using either partial safety factors to DIN 1054:2010 or EC 7 or global safety factors (DIN 1054 old)*
- *Bearing capacity equations to DIN 4017 (2006/old), Terzaghi, Meyerhoff, Hansen or Vesic can be selected*
- *Analysis of multiple footings of a single type (variation of footing width)*
- *Analysis of single rectangular footings or single circular/annular footings*
- *System input and visualisation using absolute heights*
- *Soil properties can be selected from an expandable database of common soils*
- *Consideration of multiple horizons and determination of mean governing soil properties using a logarithmic spiral*
- *Tests the "5° condition", and corrects through iterative reduction of shear friction angles that are above the current mean*
- *Punching analysis for flexible and rigid footings (DIN 4017)*
- *Determination of torsional stiffnesses*
- *Settlement analysis at the characteristic point (DIN 4019)*
- *Sliding safety analysis adopting user-defined angles possible*
- *Consideration of berms and slope inclinations*
- *Consideration of footing base inclinations*
- *Consideration of pre-loading for settlement analysis*
- *Consideration of kappa correction coefficients (DIN 4019)*
- *Creation of a footing analysis diagram with (acceptable) bearing pressure or allowable soil pressure and a set of curves with the resulting settlements as wll as modulus of subgrade reaction contours*
- *Footing plan view (pad footing) with forces, kernel widths, settlements etc.*
- *Presentation of analysis results as tables*
- *Footing export to the GGU-STABILITY program (slope stability analyses)*
- *Presentation of system geometry*
- *Presentation of stress distribution*
- *Presentation of soil properties, general information on your analysis data, adopted*

standard, program name and version displayed in legends
- *Freely definable positioning and sizing of graphical elements and legends*
- *Print or copy screen sections, e.g. for transfer to a word processor*
- *Integrated Mini-CAD system for additional annotation of graphics*

GGU-Software
www.ggu-software.com

GGU-FOOTING
Circular footing analysis

	Report No.	2018
	Annex No.	3

Initial calculation data:
'Circular footing' worked example
Bearing cap. equation after DIN 4017:2006
Partial safety factor concept (EC 7)
$\gamma_{R,v} = 1.40$
$\gamma_G = 1.35$
$\gamma_Q = 1.50$
EQU limit state:
$\gamma_{G,dst} = 1.10$
$\gamma_{G,stb} = 0.90$
$\gamma_{Q,dst} = 1.50$
Footing base = 0.80 m
Groundwater = 2.00 m
Limiting depth with p = 20.0 %
——— 1st core dim.
– – – – 2nd core dim.

Plan view

a' = 2.33
129.9
$M_{y,k}$=500.0
D = 3.50
11.1 kN/m²
s = 0.4 cm
$F_{v,k}$=1250.0
$H_{x,k}$=125.0
Equivalent area
248.7 kN/m²
s = 1.8 cm
b' = 2.94
D = 3.50

Stress influence diagram for footing centre

FB = 0.80
a = 3.50
GW = 2.00

0.00
1.000
0.963
0.836
0.706
0.606
0.534
0.479
0.436
0.401
0.370
0.343
0.319
0.297
0.277
0.259
0.242
0.227
0.212
0.199
0.187
0.175
0.165
0.155
0.146
0.138
0.130
0.123
2.00

0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5

System

max dphi = 3.9 °

Soil	γ [kN/m³]	γ' [kN/m³]	φ [°]	c [kN/m²]	E_s [MN/m²]	ν [-]	Designation
	20.0	11.0	27.5	5.0	12.0	0.00	Silt
	19.0	10.0	32.5	0.0	80.0	0.00	Sand

D = 3.50
GS = 0.80
Silt 2.00
0.00
Sand
GW = 2.00

0.5
1.5
2.5
3.5
4.5
5.5
6.5
7.5
8.5

Circular footing results
Loads = Permanent / Changeable
Vertical load $F_{v,k}$ = 1250.00 / 0.00 kN
Horizontal force $F_{h,x,k}$ = 125.00 / 0.00 kN
Horizontal force $F_{h,y,k}$ = 0.00 / 0.00 kN
Moment $M_{x,k}$ = 500.00 / 0.00 kN·m
Moment $M_{y,k}$ = 0.00 / 0.00 kN·m
Diameter D = 3.500 m
Below permanent loads:
Eccentricity e_x = 0.000 m
Eccentricity e_y = -0.400 m
Resultant in 1st core (= 0.438 m)
a' = 2.329 m
b' = 2.939 m
Below total loads:
Eccentricity e_x = 0.000 m
Eccentricity e_y = -0.400 m
Resultant in 1st core (= 0.438 m)
a' = 2.329 m
b' = 2.939 m

Bearing capacity:
Punching investigated,
but not governing.
Partial FOS (bearing capacity) $\gamma_{R,v}$ = 1.40
$\sigma_{0r,k} / \sigma_{0r,d}$ = 712.0 / 508.55 kN/m²
$R_{n,k}$ = 4873.91 kN
$R_{n,d}$ = 3481.36 kN
V_d = 1.35 · 1250.00 + 1.50 · 0.00 kN
V_d = 1687.50 kN
μ (parallel to y) = 0.485
μ (parallel to x) = 0.445
Cohesion term = 337.57 kN (k)
Width term = 1683.76 kN (k)
Depth term = 2852.58 kN (k)

cal φ = 31.3 °
Cal c = 1.20 kN/m²
Cal γ_2 = 14.37 kN/m³
Cal σ_{li} = 16.00 kN/m²
Base of log. spiral = 4.67 m b. GL
Length log. spiral = 15.91 m
Area of log. spiral = 32.21 m²
Bearing capacity coeff. (x):
N_{c0} = 33.70; N_{d0} = 21.55; N_{b0} = 12.53
Shape coeff. (x):
v_c = 1.433; v_d = 1.413; v_b = 0.762
Gradient coeff. (x):
i_c = 0.852; i_d = 0.859; i_b = 0.773
Bearing capacity coeff. (y):
N_{c0} = 33.61; N_{d0} = 21.47; N_{b0} = 12.47
Shape coeff. (y):
v_c = 1.432; v_d = 1.412; v_b = 0.762
Gradient coeff. (y):
i_c = 0.852; i_d = 0.859; i_b = 0.773

Settlement from total loads:
Limiting depth t_g = 5.99 m b. GL
Settlement (mean of all CPs) = 1.13 cm
Settlement of CPs:
Top = 0.44 cm
Bottom = 1.81 cm
Torsion (x) (CP) = 1 : 214.8
Torsional stiffness:
$k_{\varphi,x}$ = 107.4 MN·m/rad
EQU analysis:
M_{stb} = 1250.0 · 3.50 · 0.5 · 0.90 = 1968.8
M_{dst} = 500.0 · 1.10 = 550.0
μ_{EQU} = 550.0 / 1968.8 = 0.279