**FOUNDATION WITH FAILING TENSION ZONE v 1.2**

*Name of program:* ***Foundation***

The program computes for a rectangular foundation submitted to several vertical forces **Ni** acting in yN, zN and moments **My**, **Mz** ( fig. 1) the soil pressure in consideration of failing tension stresses in the gap between soil and foundation. The dimensions of the foundation are defined by the Length **Ly**, width **Lz** and thickness **tf**. If **tf** > 0, the own weight acting in the center is calculated as **Ly**\***Lz**\***tf**\***25,** with **25** [kN/m**3**] being the specific weight of reinforced concrete and displayed as **Gf** (see fig. 7 of the example). Otherwise, if **tf** is input or accepted as default value ***0***, the net weight

is neglected and can be taken into account by the input of **Ni** “manually”. In a first calculation the program checks the criterion (Mz/(N\*Ly))**2** + (My/(N\*Lz))**2** <=1/9, which means that the open gap is **less** than 50% of the rectangle. If it applies, the stresses now are determined “normally” ( + and - ) for all four points of the contour. Then a new contour is created by the neutral axis (and those parts of the foundation being under pressure.

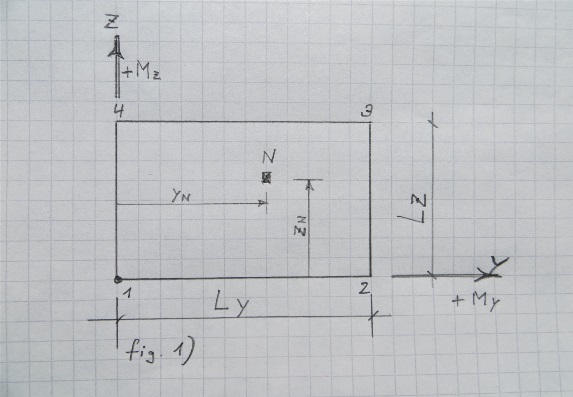
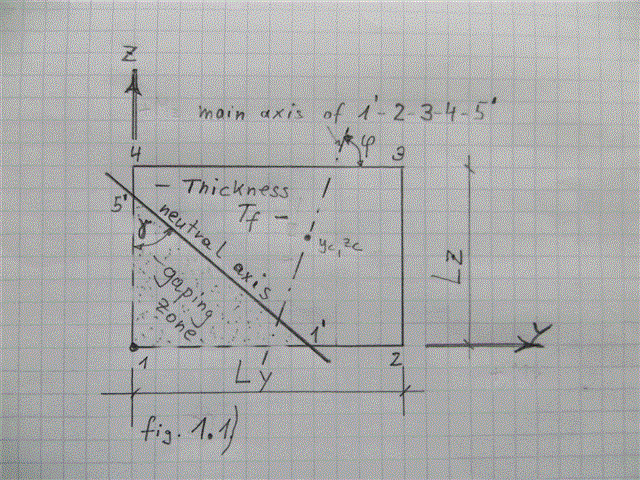
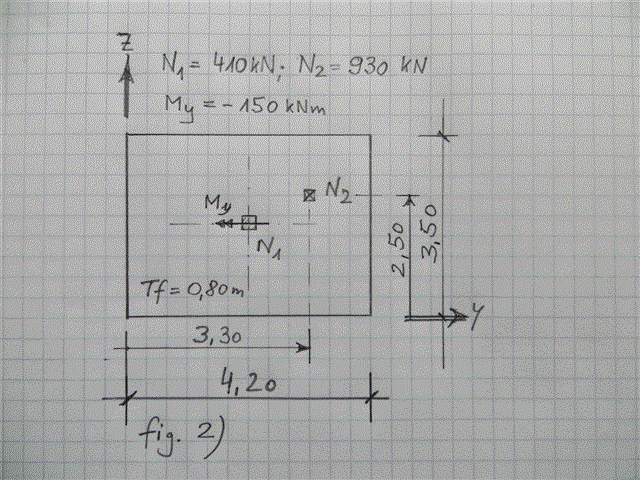
 

fig. 1) - Moments positive as indicated! fig. 1.1) - Basis for iterations

Internally the program calculates the points on the contour, where the stresses change sign (=0 In fig. 1.1 this area is defined by the points 1**’**-2-3-4-5**’,** where1’ and 5’ are the intersection of the neutral axis and the contact area. With new section properties A,p (= A,pressure), Iy, Iz, Iyz the next calculation is performed. This procedure is continued until max is **less** then **10-4**. Each iteration is depicted by the area A,p of the contour under pressure, its centre of gravity yc, zc, moments of inertia and the main axis of the contour. Pressing the “Enter”-key now shows the stresses min and max for the current iteration (fig.9). The line 1 ’- 5’ ( neutral axis in fig 1.1) is part of the new contour to be consulted for the next iteration. After the last iteration (,max < 1**E**-4, as a rule 3 – 6 iterations ) the final result is displayed as the amount of the stresses in every point of the contour, the equation of the neutral axis and the quantities of min and max, the last of which should be near 0 (fig. 10). Pressing “Enter” now depicts the graph with the area being under pressure, centre of gravity and both axes (main and neutral ). The procedure of the execution of the program is explained by the following example:

***EXAMPLE:***  fig. 2)

A rectangular foundation with Ly = 4.2 m, Lz = 3.5 m, tf = 0.8 m bears two vertical loads N1 = 410 kN (in the centre yN1, zN1 as default of the rectangle ), N2 = 930 kN in (3.3, 2.5) and a moment My = -150 kNm ( fig. 2 ). Calculate the soil pressure for this load case.

To start the program, press the Mem-key, then touch the User-field and select “**FOUNDATION**” and press “Enter”. Then start **FoundGap**, OK. Continue the input:

***PROMPT*** > ***INPUT***

Ly = 4.2 , Lz = 3.5 tf = .8 (Default: 0)

Gf = -294 kN

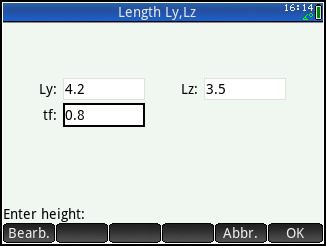
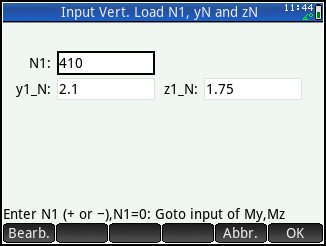
N1 = 410 , y,N1 = 2.1 ( = yc as default ) , z,N1 = 1.75 ( = zc as default )

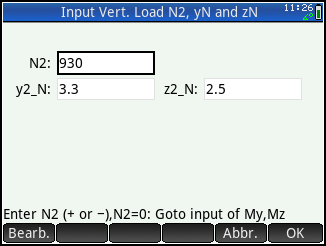
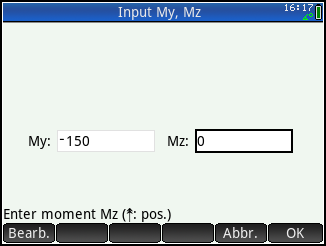
N2 = 930 , y,N2 = 3.3 , z,N2 = 2.5

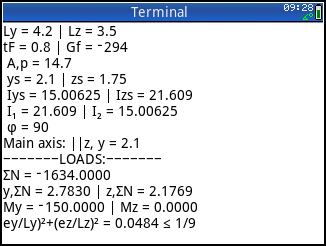
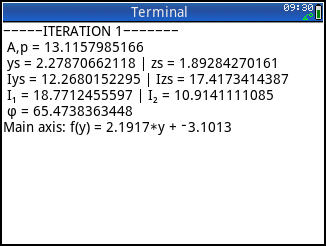
N3 = 0 ( to conclude the input of vertical loads, leave N3 = 0 in the display and press OK to start the input of My, Mz):

My = -150 Mz = 0

An excerpt of the inputs and total result is depicted in fig. 3) - fig. 11):

 fig. 3)  fig. 4)

 fig. 5)  fig. 6)

 fig. 7  fig. 8)

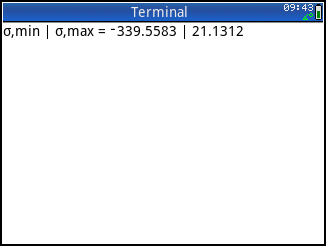
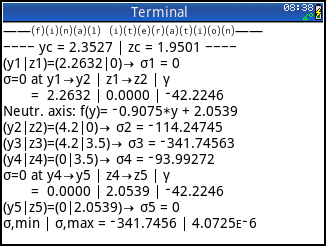
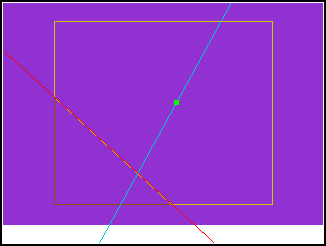
 fig.9)  fig. 10)  fig. 11)

Fig. 10) displays the final result after the fourth iteration (max = 4E-6) showing the centre (yc,zc) of the contact area in the first line, fig. 11) depicts the neutral line (red), the main axis (lightblue), the centre of the contour being under soil pressure (yc,zc) as a green point .

**HINTS and WARNING**

Regardless of the input as negative or positive value, Ni is assumed to act **downward** onto the foundation!

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