FOUNDATION WITH FAILING TENSION ZONE

Name of program: ***Foundation*** **V 1.03**

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 **Gf** acting in the center is calculated as **Ly*Lz*Tf*25,** with **25** [kN/m^3] being the specific weight of reinforced concrete. 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 gaping zone 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 ($\sigma=0$) and those parts of the foundation being under pressure.

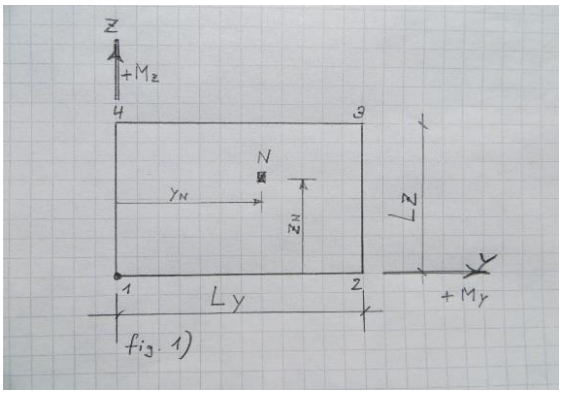


fig. 1) - Moments positive as indicated!

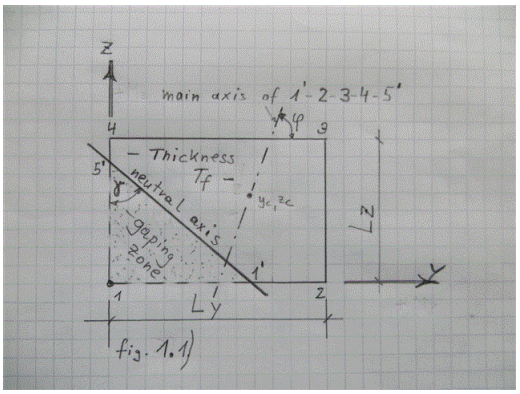
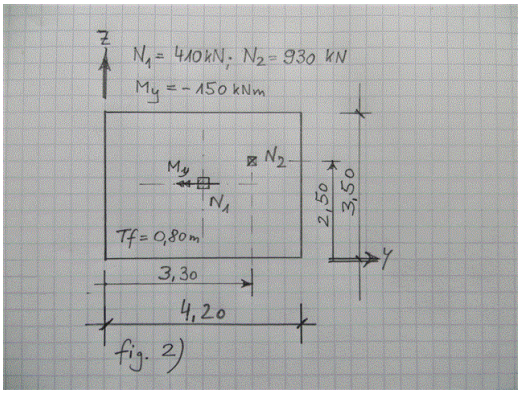


fig. 1.1) - Basis for iterations

In fig. 1.1 this area is defined by the points 1'-2-3-4-5'. With new section properties A,p (= A,pressure), Iy, Iz, Iyz the next calculation is performed. This procedure is continued until $\sigma_{,max}$ is **less** then $\mathbf{10^{-4}}$.

Each iteration is depicted by the area A,p of the contour under pressure, its center yc, zc and the points of the contour and its stresses σ. If there is a change of sign between $\sigma(i)$ and $\sigma(i+1)$ an additional line shows the coordinates y(i ➤ i+1) and z(i ➤ i+1) where $\sigma = 0$ and the angle γ of the neutral axis. At last the quantities of $\sigma_{,min}$ and $\sigma_{,max}$ are indicated. After the last iteration (as a rule 3 – 6 iterations) the program shows the equations of the main- and neutral axis. On page 1.2 the graph of the last calculation is depicted, page 1.3 shows the results of the recent iteration as a spreadsheet. 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 (yN1, zN1 as default in the center of the rectangle), N2 = 930 kN in (3.3, 2.5) and a Moment My = -150 kNm (fig. 2). Find the maximum (negative) soil pressure .

To start the program, go on page 1.1, press the var -key and select **found().** 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, enter Ni = 0)

My = -150 Mz = 0

An excerpt of the total result is depicted in fig. 3) - fig. 8):

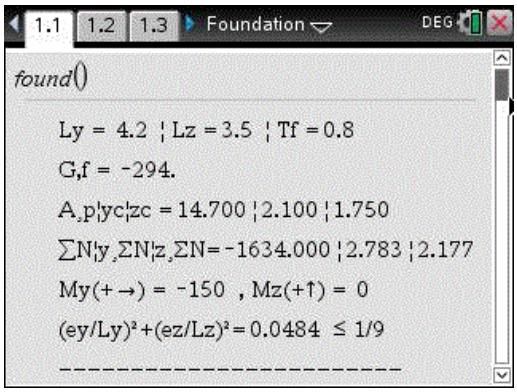


fig. 3)

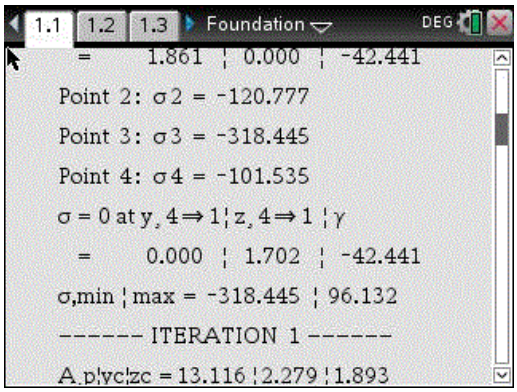


fig. 4)

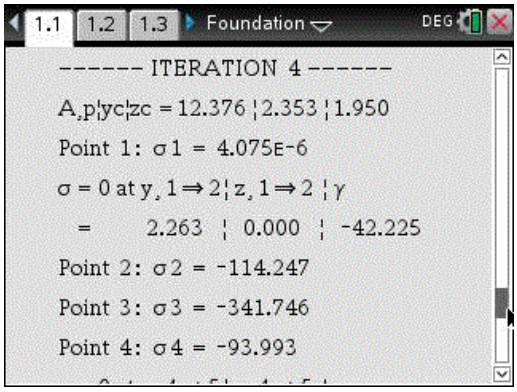


fig. 5)

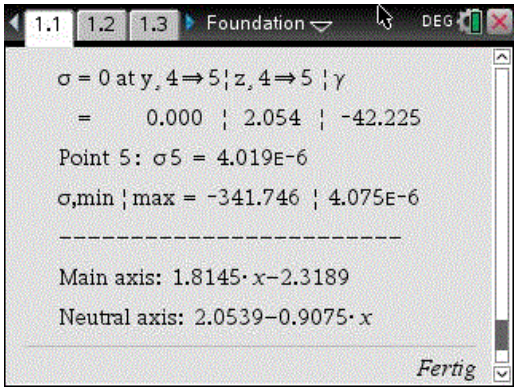


fig. 6)

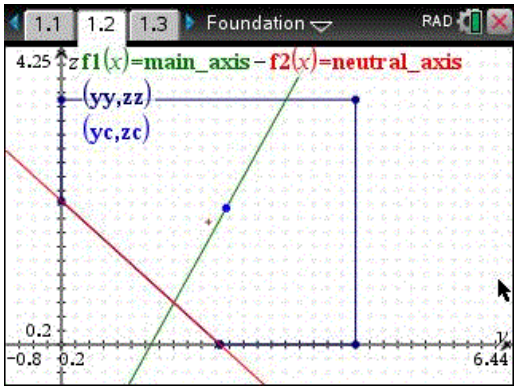


fig. 7

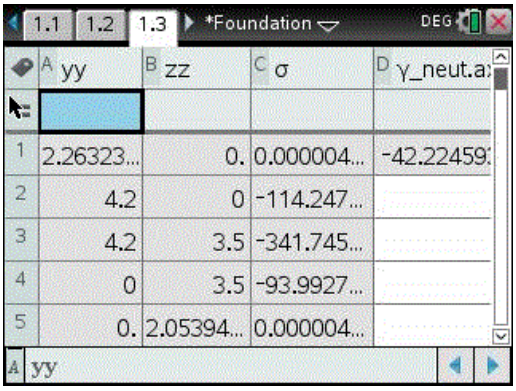


fig. 8)

Fig. 7) depicts the neutral line (red), the main axis (green), the center (yc,zc) as a blue point, a **+** marks the center of the foundation.

HINTS and WARNINGS

There must be at least one vertical force Ni, which may be input positive or negative.

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