FLEXIBLE TANK FOUNDATION ON ELASTIC SATURATED SOIL

In this document, the settlement of a flexible tank founded on elastic saturated soil is studied. It is verified that the settlement at the centre of the tank, under homogeneous, isotropic soil conditions, is calculated correctly in PLAXIS.

Used version:

- PLAXIS 2D - Version 2018.0
- PLAXIS 3D - Version 2018.0

Geometry: A circular tank with radius R equal to 23.35 m is founded on elastic saturated soil. The tank imposes vertical stress Δq = 263.3 kN/m^2 at the soil surface. In PLAXIS 2D an axisymmetric model is used and the vertical stress is represented with a *Line load* AA'. The right and bottom boundaries are set at a distance 5R from the axis of symmetry (left boundary) and top surface respectively. Geometry lines are used to generate a soil cluster for mesh refinement up to 4 m below the tank. The default boundary conditions are applied. Figure 1 illustrates the model geometry in PLAXIS 2D.

In PLAXIS 3D one-quarter of the geometry is modelled and a *Surface load* is used to impose the vertical stress. The same distance as in PLAXIS 2D (5R) is selected for the boundaries. The default boundary conditions are applied. The model geometry in PLAXIS 3D is presented in Figure 2.

Materials: The soil is modelled as *Linear elastic* and nearly incompressible (ν' = 0.499), under fully saturated conditions. The *Undrained C* drainage type is used. The adopted material parameters are:

Soil: Linear elastic Undrained C γ = 0 kN/m^3 E_u = 95.8 $\times$ 10^3 kN/m^2 ν_u = 0.499

Meshing: The *Medium* option is selected for the *Element distribution*. The soil cluster beneath the tank is locally refined with a *Coarseness factor* of 0.5. Figures 1 and 2 illustrate the generated mesh in PLAXIS 2D and PLAXIS 3D respectively.

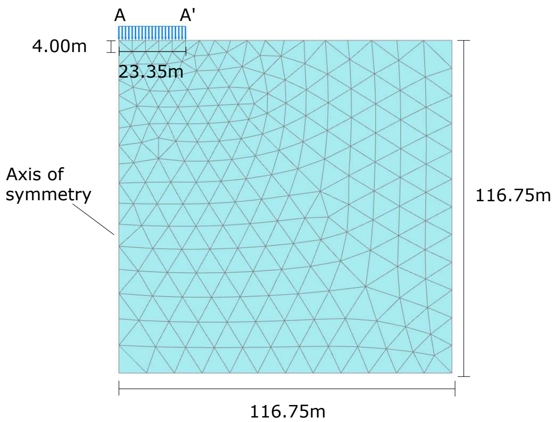

Figure 1 Model geometry and generated mesh (PLAXIS 2D)

Calculations: In the Initial phase, zero initial stresses are generated (γ = 0 kN/m^3). The load is activated in a separate phase (Phase 1). A *Plastic analysis* is performed with the default numerical control parameters.

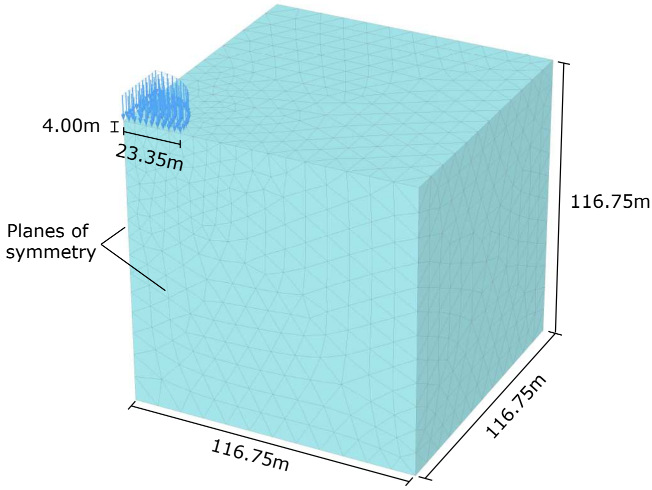

Figure 2 Model geometry and generated mesh (PLAXIS 3D)

Output: The vertical settlement of the surface (u_y), at the centre of the tank, is 74.21 mm and 75.60 mm in PLAXIS 2D and PLAXIS 3D respectively. The vertical displacement shadings are presented in Figures 3 and 4.

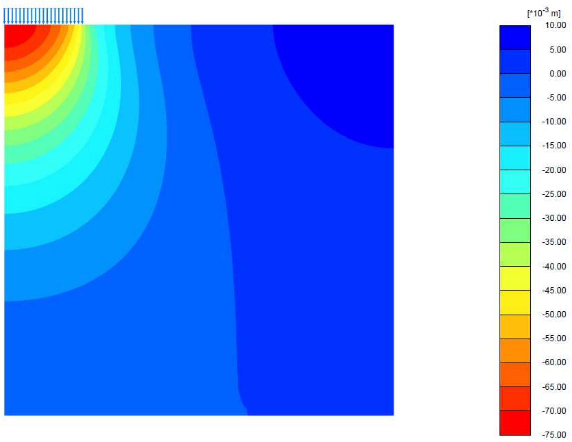

Figure 3 Vertical displacements (PLAXIS 2D)

Verification: The settlement at the centre of the tank is given by Lancellota (2008):

$$u_y = \frac{\Delta q R I_p}{E}$$

where I_p is the influence coefficient, which can be determined based on Figure 5.

The settlement at the centre of the tank is:

$$u_y = \frac{263.3 \cdot 23.35 \cdot 1.16}{95.8 \cdot 1000} = 0.07444 \text{ m} = 74.44 \text{ mm}$$

The analytically obtained settlement and the computed values in PLAXIS 2D and PLAXIS

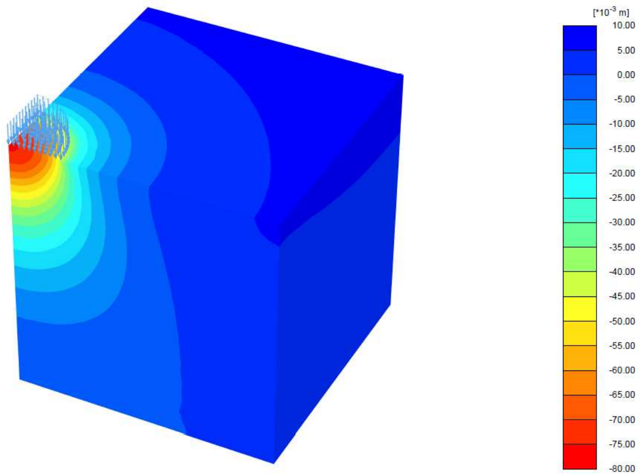

Figure 4 Vertical displacements (PLAXIS 3D)

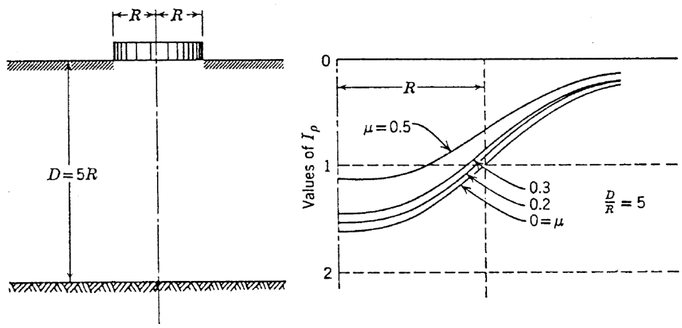

Figure 5 Influence coefficient I_p, for settlement under uniform load, over circular area (Terzaghi, 1948)

3D are compared in Table 1. It is concluded that the numerical results are in good agreement with the analytical solution.

Table 1 Comparison between analytical solution and PLAXIS results regarding the settlement at the centre of the tank

Settlement at the centre of the tank (mm)			Error	
Lancellota	PLAXIS 2D	PLAXIS 3D	PLAXIS 2D	PLAXIS 3D
74.44	74.21	75.60	0.3%	1.6%

REFERENCES

[1] Lancellota, R. (2008). Geotechnical engineering. Balkema.

[2] Terzaghi, K. (1948). Theoretical soil mechanics.