General comments

The assignment aims to study several components of the engineering behaviour of soils and its impact in practice. In Part 1, we re-explore the fitting of the elastic coefficients from the experimental data set provided under the assignments tab. Part 2 requires the design of a soil anchor by modelling the soil anchor pull-out in finite element softwa ... signment should be written and presented in a professional manner. To do so, not c ... e given, but you should include methodology and a discussion of the logic followed to ... es any assumption made and why.

Part 1: 30 poi

Download the data files ... ab for an isoptropic pressure experiment and drained triaxial tests of Fine sand.

I. [**5 Points**] For the isotropic pressure experiment, plot the volumetric strain ε_v, void ratio e, and solid fraction ϕ all against pressure p, which should be displayed in both natural and log-scale.

II. [**5 Points**] For the drained triaxial tests, plot the triaxial shear stress q against axial strain $\varepsilon_a = \varepsilon_1$, and plot volumetric strain ε_v against axial strain ε_1.

III. [**20 Points**] Determine the elastic constants of a continuum granular elastic and a linear elastic materials.

Part 2: 70 points

In this part, we will design the pull-out capacity of a plate anchored in fine sand. As an initial starting point for the design, your boss asks you to analyse a simple vertical anchor in a vertical pull-out scenario with no dynamic effects. The site in question is shown in Figure 1. The site is composed of fine sand, where the elastic properties were determined from Part 1. The soil anchor is embedded 4 m in the sand and has a base of 2 m. Note that you should take care to prescribe realistic boundary conditions for a corresponding finite element model in OptumGE.

I. [**35 Points**] Assuming elastic medium:

(a) [**15 Points**] Apply different loads f on the plate anchor and calculate the corresponding displacement u. Using these results, plot the load f versus displacement u for the anchor pull-out. Furthermore, determine the global stiffness $\frac{\partial f}{\partial u}$ at $u = 0$.

(b) [**10 Points**] Comment on the applicability of the elastic model to determine pull-out capacity.

(c) [**10 Points**] Show and discuss how your results would change if the elastic constants are actually 10 times larger than their original value.

II. [**35 Points**] Now, choose a Drucker-Prager model, which you should justify, and perform the following:

(a) [**15 Points**] Plot the load f versus displacement u for the anchor pull-out and compare the global stiffness $\frac{\partial f}{\partial u}$ at $u = 0$ to the elastic model results.

(b) [**10 Points**] Determine the required force for pull-out and display the failure mechanism.

(c) [**10**] Show and discuss how your results would change if the elastic constants are actually 10 times larger than their original value.

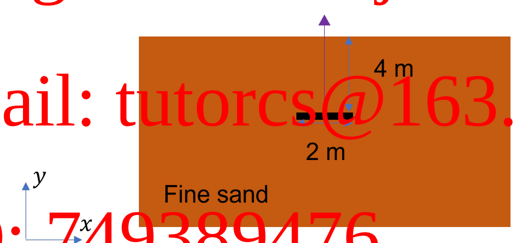

Figure 1: An illustration of the geotechnical site, where the soil anchor will be used. The anchor is subject to a force f.