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NON-LINEAR ANALYSIS OF GEOSINTETICAL REINFORCED SOIL STABILITY

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Summary. *In this paper is presented the nonlinear analysis of landslide soil reinforced by geosintetical mesh and retained by reinforced concrete pile. The paper point out the advantage of using the geosynthetic, in soil stability problem. Also, is presented the consideration regarding the anchorage length of geosintetic, out of the sliding plane.*

1 INTRODUCTION

The computational of lateral earth pressure against retaining walls is such an important problem of soil mechanics.

The classical way to retain a soil mass is by installing a vertical wall made of reinforced concrete pile that are being driven into the ground.

In this paper is presented the nonlinear analysis of landslide soil reinforced by geosintetical mesh and retained by reinforced concrete pile. Four constitutive models were used for this analysis: reinforced concrete for pile, Drucker-Prager for soil, viscoelastic material model for polymer geogrid and nonlinear contact between soil and geosintetic.

The paper point out the advantage of using the geosintetic, in soil stability problem. Also, is presented the consideration regarding the anchorage length of geosintetic, out of the sliding plane.

2 CONSIDERATION REGARDIND THE ANALYSIS

The 7 m high retaining wall was analyzed in two steps. In the first step the FEM analyses for unreinforced soil stability was performed. The finite elements model is presented in Figure 1. The contact between reinforced concrete pile and soil was simulating by a contact surface.

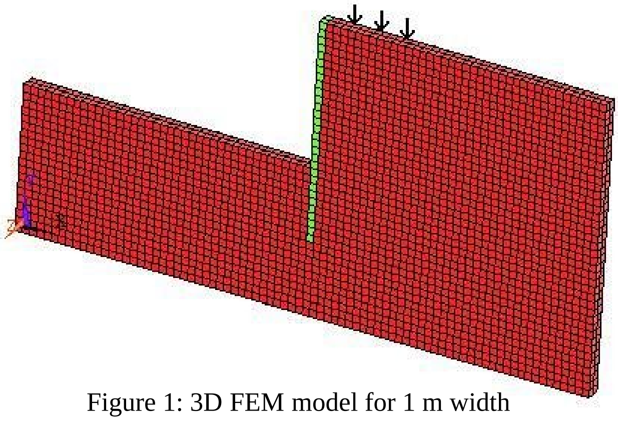

Figure 1: 3D FEM model for 1 m width

In the second analysis the soil is reinforced by geosintetical mesh. The geosinthetics have significant axial stiffness but very low resistance to bending and compression. Viscoelastic constitutive model with large deformation was considered for geosintetical elements.

3 CONSTITUTIVE LOW OF SOIL

The foundation soil is a sanding clay. Its behavior was modeled using the plastification criterion Druker – Prager.

The equivalent stress for Drucker-Prager is:

$$\sigma_e = 3\gamma\sigma_m + [\frac{1}{2}\{s\}^T[M]\{s\}]^{\frac{1}{2}} \tag{1}$$

where:

$$\sigma_m = \frac{1}{3}(\sigma_x + \sigma_y + \sigma_z) \tag{2}$$

σ_m - the mean hydrostatic stress;

$\{s\}$ - the deviatoric stress;

γ - the material constant.

This is a modification of the von Mises yield criterion that accounts for the influence of the hydrostatic stress component: the higher the hydrostatic stress (confirmed pressure) the higher the yield strength. γ is a material constant which is given as:

$$\gamma = \frac{2\sin\phi}{\sqrt{3}(3-\sin\phi)} \tag{3}$$

where:

ϕ - the input angle of internal friction.

The material yield parameter is defined as:

$$\sigma_y = \frac{6\,c\ \cos\phi}{\sqrt{3}\ (3-\sin\phi)} \tag{4}$$

c - the input cohesion value.

The yield criterion is then:

$$F = 3\gamma\sigma_m + [\frac{1}{2}\{s\}^T[M]\{s\}]^{\frac{1}{2}} - \sigma_y \tag{5}$$

This yield surface is a circular cone with the material parameters chosen such that corresponds to the outer aspics of the hexagonal Mohr-Coulomb yield surface. In figure 2 is presented the Drucker-Prager yield surface in deviatoric plan.

$$\left\{\frac{\partial F}{\partial \sigma}\right\} = \gamma\,[\ 1\ \ 1\ \ 1\ \ 0\ \ 0\ \ 0\ ]^T + \frac{1}{[\frac{1}{2}\{s\}^T[M]\{s\}]^{\frac{1}{2}}}\{s\} \tag{6}$$

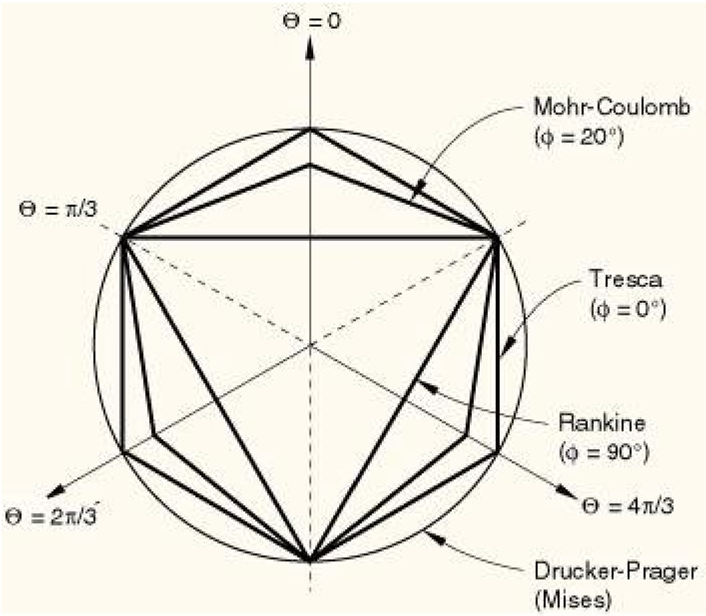

Figure 2: Drucker-Prager yield surface in deviatoric plane

$\left\{\frac{\partial Q}{\partial \sigma}\right\}$ is similar, however γ is evaluated using $\phi_f = \phi$, the flow rule is associated and plastic straining occurs normal to the yield surface and there will be a volumetric expansion of the material with plastic strains. If ϕ_f is less than ϕ there will be less volumetric expansion and if ϕ_f is zero , there will be no volumetric expansion.

The equivalent stress plastic parameter is defined as:

$$\hat{\sigma}_e^{pl} = \sqrt{3}(\sigma_y - 3\beta\sigma_m) \tag{7}$$

In Figure 3 is presented deformed shape of retained wall for unreinforced soil.

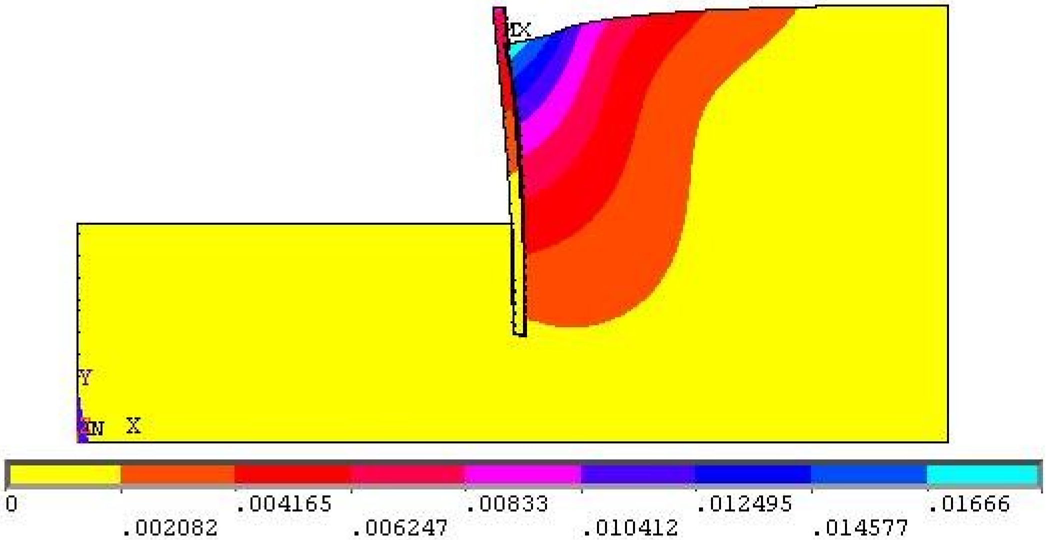

Figure 3: Deformed shape (m) - unreinforced soil

4 CONCLUSIONS

- Special attention should be paid to modeling of soil to obtain reasonable solutions we conduct numerical analysis in geotechnical engineering.
- The paper point out the advantage of using the geosintetic, in soil stability problem.
- Consideration regarding the anchorage length of geosintetic, out of the sliding plane tended is presented.
- Many factors include uncertain initial conditions with large spatial variations of soil properties and complex geological configuration. From this aspect, the measurements from laboratory model tests are very important for calibration the FEM model.

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