III-442 **LANDSLIDE POTENTIAL OF UNDERCUT CLAYEY SLOPES WITH SAND LENSES**

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Introduction

The presence of sand lenses in clay masses on slope with different shear strenght is the principal cause of landsliding occurring in areas environmentally disturbed by engineering activity. The study summarizes potential of landslide occurrence after major slope undercutting, using Extended Distinct Element Method (EDEM), developed at Earthquake Research Institute, University of Tokyo (1). The method already demonstrated its efficiency for assessing destruction process of continuous media exposed to large deformation and long distance material transport, typical for occurrence of large landslides and other kinds of major mass movements.

Simulation of landslide process

EDEM is a numerical method that assesses the behavior of a model assembled of large number of circular elements, attempting to simulate the actual behaviour of soil when exposed to external factors. In the model, soil is treated as: a) intergranular interaction by Voight-type pore springs, consisting of dashpot and elastic springs; and b) interaction of granular particles with filled-in material by an additional Voight spring of the same type. Such a modelling enables observation of discontinuous behaviour of media with increased force.

A case landslide model (Ubilci,near Belgrade), of length of 50m and height of 20m (Fig.1a,b) is analysed and presented. Defined are 1272 particle elements; parameters of analyzes are calculated according to Meguro and Hakuno(2).Influence of shear strength of clay landslide masses with sand lenses upon the landsliding potential is studied for two hypothetical, extreme conditions:

a) dry clay mass with cohesion (c=1.5*10**4 N/m**2), and
b) saturated clay mass (c=0.75*10**4 N/m**2).

Corresponding clay springs in shear direction are defined as Kps=6.4*10**7 N/m and Kps=6.4*10**5 N/m, respectively (Fig.3,4).

Influence of sand lens upon the landslide potential is studied by comparing behavior of the models of same geometry and geotechnical characteristics of clayey masses, but with and without (referent clay model, RCM) sand lens (Fig.5.). Irrespectively of the shear strength of clay, RCM model remains stable, with negligible interparticle displacement capacity (Fig.5,7.). Sand lenses intercalating clayey slopes generally cause slope instability, while for dry clay it is manifested as isolated slope mass movement concentrated at undercut surface (Fig.3.). In the case of saturated clays it might extend to general slope instability (Fig.4.).

Conclusion

Results presented indicate the following:

1) Shear strength of clay material analized within the presented limits does not pose landslide hazard if the natural slope is not disturbed (undercut) without an adequate protection. 2) Presence of sand lens generally might cause increased landslide potential

with magnitude of effects directly proportional to saturation degree. 3) Slope displacement of undercut slopes is increased in the case of presence of sand lens (Fig.6.). 4) EDEM modelling and analyzis technic might predict crack appearance and genesis, as well as the position of failure surface in undercut slope.

References

1) Iwashita,K. and Hakuno,M. : Granular Assembly Simulation for Dynamic Cliff Collaps due to earthquake, Proc. JSCE.No.380/I-7.1987.

2) Meguro.K. and Hakuno.M. :Fracture Analises of Concrete Structures by Granular Assembly Simulation. Bulletin of the ERI ,University of Tokyo. Vol.63. Part.4. 1988.

3) Meguro.K.and Hakuno.M.Fracture Analyses of Concrete Structures by the MDEM. Structural Eng./ Eartquake Eng.. Vol.6. No.2. pp.283-294 (Proc. of JSCE No.410). 1989

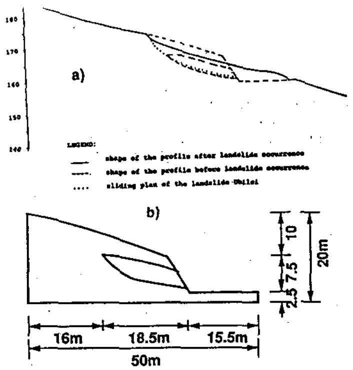


Fig.1. a) Profile of Ubilci before and after landslide occurrence, b) shape of model for EDEM simulation

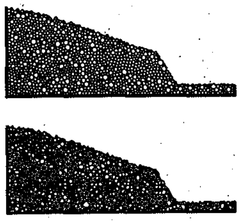


Fig.2. Model A and B, initial condition

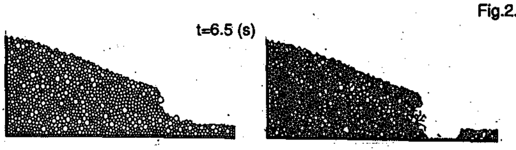
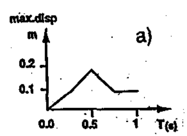
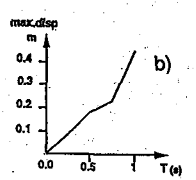


Fig.3. Final shape of model A





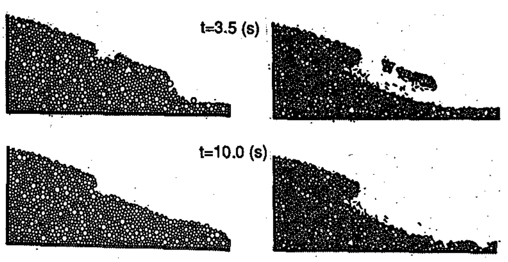


Fig.4. Final and intermediate shape of model B

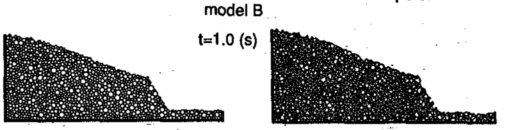


Fig.5. Shape of control model after 1s simulation