Geophysical Research Abstracts
Vol. 14, EGU2012-13779, 2012
EGU General Assembly 2012

Advance in prediction of soil slope instabilities

C. Sigarán-Loría (1,2), R. Hack (1), and J.D. Nieuwenhuis (2)
(1) ITC, ESA, Enschede, Netherlands (sigaran@itc.nl), (2) TU Delft, Netherlands

Six generic soils (clays and sands) were systematically modeled with plane-strain finite elements (FE) at varying heights and inclinations. A dataset was generated in order to develop predictive relations of soil slope instabilities, in terms of co-seismic displacements (u), under strong motions with a linear multiple regression. For simplicity, the seismic loads are monochromatic artificial sinusoidal functions at four frequencies: 1, 2, 4, and 6 Hz, and the slope failure criterion used corresponds to near 10% Cartesian shear strains along a continuous region comparable to a slip surface.

The generated dataset comprises variables from the slope geometry and site conditions: height, H, inclination, i, shear wave velocity from the upper 30 m, v_{s30}, site period, T_s; as well as the input strong motion: yield acceleration, a_y (equal to peak ground acceleration, *PGA* in this research), frequency, f; and in some cases moment magnitude, M, and Arias intensity, I_a, assumed from empirical correlations. Different datasets or scenarios were created: "Magnitude-independent", "Magnitude-dependent", and "Soil-dependent", and the data was statistically explored and analyzed with varying mathematical forms. Qualitative relations show that the permanent deformations are highly related to the soil class for the clay slopes, but not for the sand slopes. Furthermore, the slope height does not constrain the variability in the co-seismic displacements. The input frequency decreases the variability of the co-seismic displacements for the "Magnitude-dependent" and "Soil-dependent" datasets.

The empirical models were developed with two and three predictors. For the sands it was not possible because they could not satisfy the constrains from the statistical method. For the clays, the best models with the smallest errors coincided with the simple general form of multiple regression with three predictors (e.g. near 0.16 and 0.21 standard error, S.E. and 0.75 and 0.55 R^2 for the "M-independent" and "M-dependent" datasets correspondingly). From the models with two predictors, a 2^{nd}-order polynom gave the best performance but with a not-significant parameter. The best models with both predictors significant have slightly larger error and smaller R^2, e.g. 0.15 S.E., 44% R^2 with a_y and i. The predictive models obtained with the three scenarios from the clay slopes provide well-constrained predictions but low R^2, suggesting the predictors are "not complete", most likely in relation to the simplicity used in the strong motion characterization. Nevertheless, the findings from this work demonstrate the potential from analytical methods in developing more precise predictions as well as the importance on treating different different ground types.