



## **Sensitivity analysis for the influence of soil properties on slope stability**

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Soil properties are a major factor in slope stability. However, for natural slopes they are difficult to be measured for a full profile. Commonly, calculations are based on the 'Factor of Safety' (FOS) which expresses the slope conditions as unstable (e.g.  $\leq 1$ ), marginal (e.g.  $1 < \text{FOS} < 1.5$ ) and stable (e.g.  $> 1.5$ ) with only minor consideration of direct soil properties. A simple formula is sometimes used based on the friction angle and the slope angle. The result gives approximations only for the slope stability. A formula created originally by Skempton and DeLory (1957), modified by Jibson et al. (2000) and Miles and Keefer (2001), considers the cohesion, unit weight, slope angle, internal friction angle, the thickness of the moving mass and the position of the ground water table within the moving mass. Within this study, a sensitivity analysis was performed to show the influences of the different values of these properties.

To obtain the possible range of these properties, a database was created. Due to the lack or non-accessibility of data of recent measurements for natural slopes, most of the data were compiled from literature including manuals. These data were complemented by few analysis data from soils taken from natural slopes. However, the precise descriptions helped in building seven classes for the soils based on their plasticity, because the classification based on sand, silt, clay and so forth is inadequate for these studies. These classes are similar according to German DIN 18300 for geological engineering. The spread of the obtained data for each class gives a good overview for the range of possible values for the soil properties.

The results of the sensitivity analysis show, that e.g. the ground water level is of minor

importance for shallow slopes, whilst the internal friction angle is very important. The cohesion is very important within a certain range of the mean values of cohesion and all other properties, but nearly unimportant within a range of minimum and maximum values.

These differences are demonstrated for slopes in areas around Bonn and the Swabian Alb, Germany on a regional basis. The comparison with mapped landslides result in good correlation. Thus it can be concluded, that this method is suitable for calculating prone areas for landslides without knowing the precise soil property data.