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Root reinforcement in shallow soil covers: an interpretation model based on congruent displacements

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In the region of Campania, shallow covers of pyroclastic soils are very widespread even on very steep slopes, where they are susceptible to landslides, evolving into mud-flows. The high landslide risk has solicited studies about all the factors influencing the stability of this cover. This includes analysis and experimentation of the role of vegetation.

In the literature some models may be found to describe root reinforcement in soil. Root reinforcement depends on the tensile action in roots and failure mechanisms of the soil-root system that limits the tensile value within roots. There are three different types of failure mechanism: tensile failure of the root, sliding at the interface between soil and root, and yielding of the soil in contact with the root. Existing models include all the described failure mechanisms of the soil-root system but are weak as regards the determination of the tensile action in roots. This aspect has been improved with the present work.

Referring to an infinite slope in which shear strain is concentrated in the shear zone at the base of the sliding mass, we developed a new model based on congruent displacements between the root and the soil inside the shear zone. It is thus possible to obtain the increase in length of the root and the tensile force inside it, once its elastic modulus is known. The results may then be extended to a distribution of roots by means of the root density, that expresses the ratio between the area occupied by the roots and that of the soil volume that contains them. Reinforcement is considered a linear function of root density for low values of this parameter.

An application is presented, showing that, according to this model, root action varies with the strain in the shear zone and becomes important only when the shear strain is

large. At large strains the contribution of the root system to slope stability is less than that calculated with previous models but it may be considerable if we allow for root density. In general, the contribution to slope stability is appreciable in the case of the herbaceous vegetation and negligible for trees.