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On the quantification of brushlayer's effect on slopes stability

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Among the methods that can be used to stabilize natural and man-made slopes, the ones which make use of vegetation have gained an increasing relevance, especially in the case of shallow slipping depth. Soil bioengineering, which groups such techniques in particular, is nowadays considered able to combine safety constrains and environmental conservation needs. Vegetation, in fact, improves the stability of slopes via mechanical reinforcement and via soil moisture depletion and, at the same time, plays an important environmental role.

One of the most common techniques used in slope stabilisation works by soil bioengineering approach, is live cuttings brushlayering. In fact, the live cut stems and branches provide an immediate reinforcement, which will be increased by the development of adventitious roots along the whole length of the imbedded stems. Adventitious roots exert a double action: on one hand, they prevent stems from slipping out and on the other hand, they reinforce the portion of the soil that they explore. Plants growing from brushleyers, moreover, decrease the soil water content by means of suction and transpiration phenomena.

In spite of the widespread use of this technique, little research has been done to quantify its effect on slope stability. The aim of this work is to contribute to fill such gap, presenting a simple scheme for the evaluation of the Safety Factor for a slope reinforced by means of brushlayers.

The proposed model is based on the limit equilibrium principle and considers both the effect of stems and the root reinforcement. The method accounts for geotechnical soil properties (cohesion, friction angle, unit weight of soil), soil saturation, slope steepness and brushleyer design parameters (number of stems per meter, length and diameter of stems, distance between brushlayers). The outcome of the model consists in the value of the Safety Factor for a given slope, respect to soil depth.

The method has been implemented for Purple Willow (Salix purpurea L.), for which some measurements have been carried out. Pull-out resistance of stems and tensile strength of the roots were measured by laboratory tests, whereas adventitious root distribution has been determined in the field. The results in terms of Safety Factor for the case of the infinite slope are presented.