# Application of the yield design theory to the stability analysis of reinforced soil structures

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Most engineering design methods developed for reinforced soil structures are derived from classical stability analyses of homogeneous earthworks, such as slopes, embankments or retaining structures, where it is generally made use of failure surfaces, across which the resisting contribution of both the soil and the reinforcing inclusions should be accounted for. In this context, the yield design theory provides a consistent mechanical framework for dealing with the stability of such reinforced geotechnical structures in a rational and efficient way. The practical implementation of this theory relies upon two possible ways of modelling a reinforced soil.

In a first approach, called *"mixed modelling"* approach, the reinforcing inclusions are treated as one dimensional structural elements embedded in the soil regarded as a three dimensional continuum. This model may easily be incorporated into the upper bound kinematic method of yield design, either for "flexible" inclusions resisting to axial tensile forces only, or for "rigid" inclusions (such as large diameter piles) where the shear and bending resistance must also be taken into account.

On the other hand, in the case of soil reinforcement techniques involving a large number of regularly distributed inclusions, the use of a *homogenization* procedure appears to be an attractive alternative way to the mixed modelling approach, for performing the stability analysis of reinforced soil structures. According to this method, the composite reinforced soil may be regarded as a macroscopically homogeneous continuum, exhibiting anisotropic strength properties due to the preferential orientations of the linear reinforcements placed in the soil mass.

The implementation of both methods will be illustrated on some typical examples.

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His main research area concerns the application of homogenization methods and related upscaling techniques to the simulation and design of reinforced geotechnical structures and the development of associated engineering-oriented computational methods. He is co-author of several textbooks and more than 100 scientific papers in international refereed journals.