A coupled plasticity – erosion model for geomaterials

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ABSTRACT

For the assessment of the load bearing capacity of in-service sewer pipes, the support from the surrounding soil is of vital importance. In ideal circumstances, soil pressure counteracts the deformation of a sewer pipe under vertical loading conditions. However, due to water infiltration, soil erosion may occur around the pipe, resulting in soil volume loss and possible subsidence. This may have a severe effect on the collapse strength of the sewer pipe [1]. This work presents an elasto-plastic soil model that accounts for the effect of soil erosion. The proposed yield criterion describes frictional sliding and compaction of the soil. The model is based on the three-invariant cap model presented in [2], whereby some adaptations are made to account for both plastic contraction and dilation [3]. The erosion process is driven by ground water flow, which is simulated by coupling the mechanics model to a flow model based on Darcy's law [4]. The soil model and the erosion model are calibrated using experimental data reported in [5] and [6], respectively. The final case-study presented shows that the combined soil plasticity-erosion model is able to realistically describe the process of soil erosion around an in-situ sewer pipe system. Future work will focus upon incorporating the effect of fracture of the concrete sewer pipe in the model.

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