Erosion behaviour of gap-graded soils due to upward flow

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A laboratory study aiming at the evaluation of the suffusion behaviour of coarse gap-graded soils is presented. Six granular gap-graded soils missing the medium-to-coarse sand fraction have been examined. Four soils have no fines, one has 5% of non-plastic fines, and one has 5% of clayey fines (with plasticity index of about 14%). The use of available methods to assess internal stability of soils suggests that the majority of the selected soils are susceptible to suffusion. Testing has been carried out in the Upward Flow (UF) seepage test. A cylindrical seepage cell is used to impose vertical flow, from the bottom to the top, along a soil specimen with 200 mm-diameter and 150 mm-thick. During an UF test, the hydraulic gradient in the specimen is slowly increased in steps. The observation of the erosion behaviour at the top surface of specimen, together with the evolution of the discharge flow rate, allows determining the hydraulic gradients causing initiation of erosion on top of the specimen and development of suffusion in the soil. Some tests have been conducted with a low friction sheet placed in the inner surface of the test cell, to evaluate the influence of the cell wall roughness in the soil erosion behaviour. A ‘sand boiling’ phenomenon has been observed in soils exhibiting suffusion, resulting in the deposition of the finer particles at the specimen surface. Laboratory testing on soils with no fines clearly shows that the higher the fine sand content the higher the amount of material deposited on the specimen top, but the gradients associated to initiation of suffusion and development of 'sand boiling' also increase. Whenever high hydraulic gradients are not likely to occur, the gap-graded soil with 5% of plastic fines should be more resistant to initiation and development of suffusion than the gap-graded soil with 5% of clayey fines.