Abstract

The effect of internal erosion on the mechanical behaviour of soils was investigated experimentally, using sodium chloride grains as an analogue for erodible soil grains. With this technique, the loss of controlled quantities of finer particles could be simulated under more realistic hydro-mechanical conditions than in previous research, but within practical experimental time scales. Two experimental programs were undertaken. The first looked at general changes in volume and shear strength using a large diameter oedometer adapted to perform a punch test following salt dissolution. The second program investigated particular changes in volume and shear strength following salt dissolution using an adapted direct shear box

Previous studies have shown shear strength reductions following the loss of finer particles representing as little as 5 % of the total mass of the original soil. Findings here show shear strength can be largely unaffected if the erodible finer fraction (F) makes up less than a transition value (F_t) of approximately 10 – 15 % by mass of the original soil. This threshold represents F above which the coarser fabric is looser than at its minimum void ratio. As F increases further, finer particles increasingly hinder the coarser particles from achieving their densest packing, such that the coarser fabric remaining after finer particle loss is in a looser state than the original fabric, the remaining fabric reaching its maximum void ratio at a critical finer fraction (F_c) of approximately 25 – 35 %. For $F < F_c$, finer particle loss results in limited collapse of the coarser fabric and it was found that the state of this initial coarser fabric determines the shear behaviour of the soil following the loss of finer particles. The shear behaviour of initially dense specimens with $F < F_t$ remained similar to that of a dense soil following finer particle loss, whereas shear behaviour of initially dense specimens with $F_t < F < F_c$ approached that of a loose soil as F increased. Soils with higher internal filter ratios (D_{15c}/D_{85f}) were found to have higher values of F_t and F_c.

Soils with $F > F_c$, settled and weakened significantly following finer particle loss, reflecting the load-bearing role finer particles play in this case. This load bearing nature of the finer particles in soils with $F > F_c$ decreases the risk of internal erosion.