SYNOPSIS

The stability of weirs on permeable foundations against piping is governed by the well established theory of flotation gradients. In the application of this theory only horizontal surfaces subjected to upward efflux of seepage are considered. The material of the porous medium is supposed to be granular whose submerged weight contributes to stability. The use of filters to ensure stability in virtue of their weight is also conceived. However, in the design of head retaining structures such as levees or foundation trenches, the problem is more complex for the following reasons viz :

(i) The efflux of seepage takes place across inclined surfaces

(ii) Not only the submerged weight but also frictional resistance of the porous medium, and cohesion in the case of clayey soils play a part.

The objective of the present investigations, therefore, are :

(i) To evolve a generalised theory of exit gradients analytically, taking into account the effects of (a) friction (b) cohesion and (c) lateral confinement.

(ii) To experimentally verify the validity of the theoretical derivations in regard to the generalised theory of exit gradients by conducting investigations in transparent perspex models filled with different porous media and subjected to upward flow and tested under different inclinations and pressure heads, and

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(iii) To check experimentally the limits of applicability of Darcy's law and examine whether the flownet theory is valid or not in the high velocity regions in the vicinity of exit surfaces.

The studies have led to a number of interesting results, some of the principal ones being that :

(i) Slopes comprising of granular sands fail by the sliding of the particles along the slope.

(ii) Slopes consisting of sand and a little admixture of clay fail in lumps and the governing criterion of failure is by flotation.

(iii) Lateral confinement of granular media, together with a layer of gravel filter on top, increases the factor of safety considerably; the stabilising force being provided by frictional resistance, and

(iv) The flownet theory is valid for all practical purposes, since the extent of the regions in which the Darcy's law ceases to hold good are relatively small.

The agreement between the theoretical and experimental results are borne out and the results obtained help to clarify the mechanism of failure and furnish rational design criteria for the problems considered.

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