Short Communications

Considerations of Establishment of Steady State in Constant Head Permeability Test

by

D.R. Phatak*

Introduction

The constant head permeability test is normally conducted for medium to coarse grained soils, which permit significant seepage through it. Most of the standards through out the world stipulate and is also the recommendation of Indian standards that measurement of discharge through constant head permeameter will be recorded after the establishment of steady state (ISI-1976). Incidentally to the knowledge of the writer there is no literature regarding conditions and parameters govering time required for steady state condition in constant head permeability test. Latelier and Leutheusser (1976) have studied the parameters governing establishment of steady state flow in laminar pipe flow problem. It was shown by them that theoretically the time for complete establishment of flow in pipe is infinite, however it was experimentally demonstrated by them that for a pipe of 6.4 mm. diameter, the time for 99 per cent establishment of steady state flow is around 16 seconds. It was also demonstrated by them that time required for establishment of steady state is inversely proportional to the diameter of pipe (Latelier and Leutheusser, 1976).

For soils, whose pore size is much smaller, it was expected by the writer of this note that time for establishment of steady state for soils would be significant. The writer of the article, therefore conducted experiments on time required for steady state flow in constant head permeability test and will show in this note that it is a reckonable parameter.

Experimental Details

Clean granular sand passing 1.19 mm. sieve and retained on 0.6 mm. size was chosen for study. The permeameter suggested by I.S. 2720 (part XVII)—1976 was employed for this study. The dry sand was deposited in the permeameter by drizzling. The permeameter was then flooded with distilled water and vibrated so as to exclude air from the pores of the sand and to obtain desired void ratios. The top is then fitted and apparatus immersed in water for a day. After this, the apparatus immediately attached to the air intake tube arrangement for imposition of fixed hydraulic gradient. The test is repeated with different void ratios. The sand was

* Civil Engineering Department, College of Engineering, Pune (M.S.), India 411037.

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subjected to a hydraulic gradient of 0.75 at the three different void ratios as per test standards recommended by Indian standards specifications. The measurement of discharge was taken after every 5 minutes by weight and graph was plotted between time in minutes and discharge in cc/min and which is shown in Fig. 1. The experimental observations obtained exhibited considerable scatter and each of the data points shown in Figure 1 represents the average of several repeated tests.

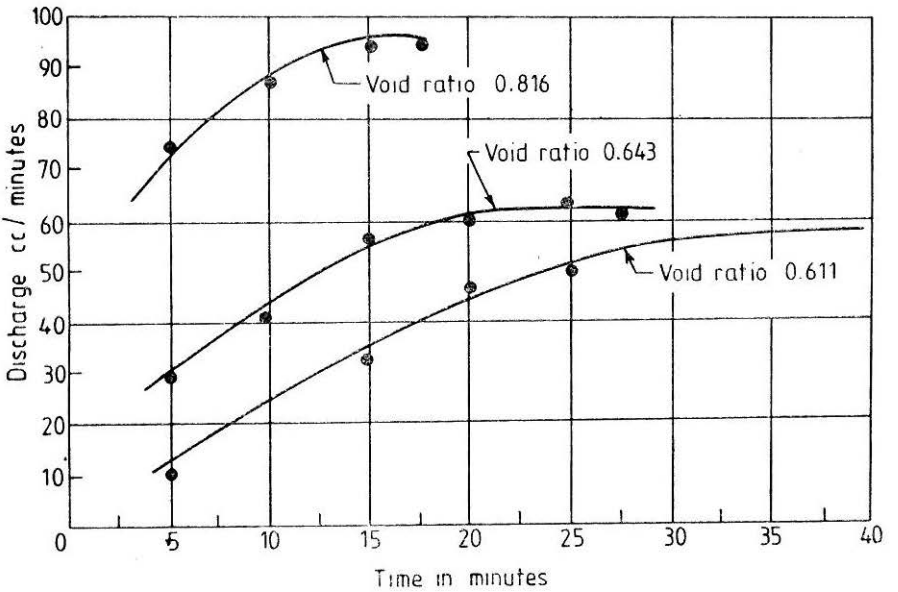

FIGURE 1 Relationship between discharge and time

Conclusions

Study of Fig. 1 will lead to following conclusions :

(1) For sands of this size i.e. 0.6 to 1.19 mm immersion for a day coupled with vibration under submergence is sufficient for permeability sand to guarantee exclusion of air prior to testing and therefore it may be concluded that reckonable time is required for the establishment of steady state flow and it is expected by the writer of this note that for medium to fine grained sands, this factor will become very significant.

(2) It appears that for the same soil having lesser void ratios, steady state establishment takes longer time as compared to the time required for steady state establishment for higher void ratios. This may be due to lesser pore diameter attributed to lesser void ratios.

In any case the problem of time for steady state establishment of flow in constant head permeability test warrants further attention.

References

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