Coefficient of Consolidation for Soil – That Elusive Quantity

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ABSTRACT

Although it is accepted that the coefficient of consolidation for soil is not a true property, but reflects the net effect of permeability and compressibility, it is a very useful parameter in day to day design. Design calculations make extensive use of elastic solutions for consolidation, such as beneath a shallow foundation or around a driven pile, but an important consideration is how to measure or estimate an appropriate coefficient of consolidation to use in those solutions. Typically the quantity is determined either from laboratory oedometer tests (generally then referred to as c_v) or from field dissipation tests using a piezocone or piezoball penetrometer (generally then referred to as c_h). Since the latter form of test includes a mix of stress paths, for some of which the soil has a stiffness associated with unloading, and others of which involve plastic compression, the magnitude of c_h for a given soil is typically 3 to 5 times the value of c_v from virgin compression in laboratory tests. The paper explores the relationship between c_v and c_h for a variety of boundary value problems, within the confines of soil modelled as Modified Cam Clay, for both isotropic and anisotropic permeability. Problems range among: simulated oedometer testing, field dissipation testing and both pore pressure and settlement response of a shallow foundation. These cover different strain conditions, for example one-dimensional consolidation or more general axisymmetric or three-dimensional conditions, and also problems that are essentially stress controlled (e.g. oedometer testing), deformation controlled (e.g. radial consolidation around a pile) or a mixture of the two (e.g. beneath a shallow foundation). Results of finite element analysis of this range of problems are presented and compared with classical solutions based on elastic soil response. The results are used to develop guidelines for different classes of problem, comparing the relevant coefficient of consolidation against a benchmark c_v value associated with virgin compression in an oedometer. The normalised values of consolidation coefficient are expressed as functions of fundamental soil parameters used within Modified Cam Clay.