SYNOPSIS

The classical Terzaghi theory of one dimensional consolidation represents an over simplification of the exact mechanical behaviour of clays. Experimental observations reflect the characteristics of clay mineral, pore fluid and soil skeleton. The stress strain relationship is inelastic, time-dependent, nonlinear and non quasi static in nature. The principle objective of successive workers has been to discover an appropriate stress strain time relationship. Most approaches are inappropriate particularly for the material exhibiting appreciable strains. The Lagranian Mathematical treatment of McNabb (1960) is seen to be promising for a realistic approach.

Parikh and Verma (1970) established a differential equation: $\frac{\partial e}{\partial T} = \frac{\partial^2 e}{\partial Z^2} \pm P \frac{\partial e}{\partial Z}$ based on Lagranian mathematical scheme from fundamental considerations. The stress strain time relationships for clay mineral, pore fluid and soil skeleton are accounted in the quantity P. The equation has a form identical to the differential equation for the non-steady one dimensional flow of heat through moving media against the Terzaghi classical concept of heat flow through isotropic bodies. In the above theoretical background the present work investigates the influence of various physiochemical factors

on the consolidation characteristics of clays. Taking P as a constant, a solution of the differential equation is obtained by Laplace Transform Technique. A Fortran programme on IBM-1402 is used to compute theoretical relationships. Isochrones and the theoretical relationship between the average degree of consolidation and time factor are presented.

The present work investigates experimentally the influence of mineral type, degree of saturation, fabric structure, stress history and drainage path on the consolidation characteristic of clay. A series of consolidation tests are conducted for each of the factors (i) mineral types, samples of kaolinitic, illitic and montmorillonitic clays (ii) degree of saturation, samples at moisture contents drier, nearer and wetter of proctor OMC (iii) fabric structure, samples in which dispersed and flocculent structures are developed (iv) stress history, samples under loading and unloading cycles, also under various stress increment ratio, and (v) drainage path, samples taken at vertical, horizontal and inclined orientations, also samples of various depths are tested in Oedometers. Conventional Casagrande and hydraulically pressurized Rowe type of Oedometers are used for the experimental work. A system consisting of electric transducers, scanner, digital voltmeter and printer is employed for the measurements.

The experimental data from a variety of tests performed during this investigations are analysed and discussed from fundamental considerations. Montmorillonitic clays of expanding lattice type exhibit distinct consolidation characteristics compared to illitic and kaolinitic clays of nonexpanding lattice types. The distinctive behaviour of Bentonite can be attributed to the predominant repulsive potential in clay – water system and rigid plastic nature of the oriented water. Consolidation characteristics of flocculated clays edge to face configuration and dispersed clays – face to face configuration are contrarary to each other. A comprehensive picture of process of deformation can be had by visualising that it consists of two distinct phenomenae. One is the sliding and lifting of plate shaped particles leading to breakage of link bonds pressing out the pore water which is a predominant phenomenon in dispersed clays. Another is the breaking up of link the bonds at edge to edge or edge to face proximity. This preceeds the first phenomenens   particularly in well developed flocculated clays. Clays compacted near to or drier to OMC are similarly different in characteristics to saturated clays while clays of wetter of OMC behave almost identically to saturated clays. The explanation lies in the fact that at dry side of OMC, water thirst prevails, at wet side of OMC air is in occuluded state

and at OMC air ceases to flow out. Consolidation characteristics of kaolinite clays alter with progressive cycles of loading and unloading depending on the mode of load application. The phenomenal changes occuring in energy levels of clay water system as a result of loading and unloading cycles govern the process of deformation. Consolidation phenomenon in kaolinite tends to become predominantly of primary nature with higher intensity of loading. The guiding point is that at lower load intensity, physico-chemical forces predominate, the influence of which is obscured under higher intensity of loading. Vertically or inclined or horizontally oriented kaolinite clay samples indicate no appreciable distinction in the consolidation characteristics. The argument to explain the ineffect on the consolidation characteristics is that the effect of drainage length and interfacial grip gets mutually nullified. Thicker samples exhibit primary consolidation behaviour of Terzaghi conception. The significant point is that the dominating self weight generate pore water pressure and the consolidation proceeds fundamentally as hydrodynamic lag.

The proposed theory is seen to agree adequately into experimental observations. It is suggested that it will be worthwhile to obtain the solution of the differential equation taking P as some function of t. The testification of

the proposed theory against isochrones is a further step.
Conventional Casagrande set up provides a simple and accurate
enough arrangement even for research studies. The hydraulically
pressurised Rowe type set up is particularly better suited
for pressure measurements and drainage control. The measurements
                pore
of local deformations and pore pressures within the clay bed
employing radiographical techniques are worth a pursuit. The
clue to consolidation response is contained in nature of clay
lattice structure, interaction in clay water system and link
formations at various contacts.