1 INTRODUCTION

Settlement analysis is one of the two most important types of analysis made by soils engineer in order to estimate the total magnitude of settlements and rates of settlement of structures founded on compressible strata. The classical theory of consolidation propounded by Terzaghi (73, 1923) inspite of its highly idealised assumptions, still forms the basis of analysis in settlement and stability problems with refinements being sought from time to time by the theories as put forth by Skempton-Bjerrum (63, 1957), the stress path concepts of Lambe (40, 1964) and the use of decision theory as advocated by Folayan et al (21, 1970).

The correlation, though poor in many cases, brought about by Terzaghi's theory is acceptable once it is realised that the consolidation parameters are greatly affected by sampling operations, Rutledge (11, 1944) and the conditions of the consolidometer tests, Leonard-Ramiah (45, 1959) and Crawford (14, 1964). Further, a rational method of predicting in-situ $m_v$ and $C_v$ values is still (1971) a problem involving many considerations.

Nevertheless, the deviations exhibited by the classical theory has lead to extensive research on rheological behaviour of soil system to take into account the time effects, Taylor Merchant (72, 1940), Ishii (29, 1951), Goldstein (43, 1952), Gibson-Lo (22, 1960),
Walils (77, 1962), Leonard-Girault (44, 1961), Davis (15, 1965), and Barden (4, 6, 1965, 1969). These studies help reveal many aspects of consolidation process and thereby provide a better approach towards the problem of settlement analysis.

The deviations exhibited by the classical theory when analysed for the soil systems reveal the need of directing the attempts towards the pursuit of knowledge on complex nature of soil water systems. To initiate such a study, consolidation testing programme would be required to be undertaken on soil systems having varying size fractions, unbalanced electrical charges and void ratios.

The black cotton soils encountered in Western, Central and Southern parts of India are cohesive in nature and being a predominant type of soil available in these areas, it is often necessary to build structures on such deposits. Hence the need for investigating the consolidation characteristics of the soil hardly requires any emphasis. Black cotton soil from Baroda region is selected for the study and from this soil, sand, silt, five micron and two micron clay fractions are separated. Further from sodium bentonite samples, five micron and two micron fractions are also separated to obtain varied electroviscous systems.
The present investigations aims at revealing the role of adsorbed water layers in governing the mechanism involved in the process of consolidation of varied soil systems. Conventional size new consolidometer and large size consolidometer units are designed and developed, specially for this study programme, to obtain respectively the records of pore pressure at the base and for the first time of isochrones in the consolidating systems.

Experimental results obtained from both the consolidometers units are analysed in the light of size fractions, unbalanced electrical charges and void ratios reflecting thereby the involved mechanism of the adsorbed water layers in the soil systems. Further, an approach has been made for the possible quantitative assessment of electro-viscous characteristics of a consolidating system and thereby to help establishing the much desired interrelationship of the consolidation process and shear failures in soil systems.

A physical model, developed from the experimental analysis, is transformed into a rheological model and a theory is formulated. The proposed rheological theory is applied to the varied soil systems tested in this investigation and is checked for its performance with the existing (1971) consolidation theories.