CHAPTER I

INTRODUCTION

1.1 GENERAL

The term 'jointed rock' refers to the rock mass with discontinuities. The mechanical behaviour of jointed rock therefore depends on the properties of the discontinuities rather than on the strength of the parent rock. The extension of the classical concepts without incorporating the characteristics of the discontinuities is irrational. It is therefore imperative to commence the delineation of the characteristics of the discontinuities. A number of investigations on jointed rock indicate that 'dilation' is the characteristic phenomenon observed in jointed rock. For the interaction analysis incorporation of 'dilation' in the constitutive relationship is necessarily essential. The current approach is to evolve and develop a joint element which realistically reflect the characteristics of the discontinuities.

1.2 MECHANICAL BEHAVIOUR OF JOINTED ROCKS

The classical concept of friction is not directly applicable to sliding of rock blocks over pre-existing joints since there is no dilation or volume change when two rigid bodies slide, whereas in sliding of rock blocks over joints, volume change is involved due to presence of asperities on the sliding surfaces. This phenomenon is called 'dilation,' 'dilatation' or 'dilatancy.' This is the fundamental aspect in which the mechanical behaviour of jointed rock differs from that of an intact rock. The term dilatancy is also used to indicate thicknening of a joint, that is an increase in the separation of two blocks.

It has been observed that a dilatant joint tested in conventional direct shear apparatus indicate a lower friction angle due to dilation as compared to one tested under constant normal deformation. This leads to the adjustment of friction angle obtained from conventional direct shear test. However dilation also affects deformation normal to the joint plane. Therefore a stress strain analysis conducted after merely adjusting the friction angle would not give realistic behaviour. It is therefore necessary to conduct further research on the mechanical behaviour of jointed rock to be able to account for dilatancy in the analysis.

1.3 CONSTITUTIVE MODELS

A constitutive law represents a mathematical model that describes behaviour of a material. In other words, it is a mathematical model that can permit reproduction of the observed behaviour of a system.

The current constitutive models can be divided into two major catagories : elasticity models and plasticity models. The simplest model used has been the piecewise linear elastic law, often simulated by using mathematical functions such as parabola, hyperbola, splines etc. Higher order nonlinear elasticity models have been proposed on the basis of hyper-elasticity approaches as Cauchy and Green elastic materials. Classical plasticity models include those based on Von Mises, Mohr Coulomb and Drucker-Prager criteria. However, none of these models reflect the realistic behaviour of a media. It is therefore necessary to develop a simple and realistic constitutive model for rock joint, incorporating the dilation phenomena such that it can be easily implemented through Finite Element Method.

1.4 JOINT ELEMENTS

Special 'Joint' or 'interface' elements have been used in Finite Element Analysis to characterise joints in rocks and interfaces or junctions between structures and geologic masses. Many research workers have provided different types of joint elements. Non-linear elasticity and plasticity models have been proposed to define constitutive behaviour of joint elements. Constitutive behaviour of joints has often been expressed by defining stiffness characteristics in shear, normal and rotational modes.

1.5 APPLICATIONS

The basic objective behind development of a joint element is to provide a constitutive relationship amneable to numerical and computational methods. There are varieties of engineering situations like underground openings, stability of slopes, interfaces between structures and geologic media etc. where rock structure interaction analysis has been attempted using Finite Element Method. The efficacy and efficiency of a joint element, however, depend on the realistic predictions of the practical cases.

1.6 CONCLUDING REMARKS

Thus, there is a need to understand the mechanical behaviour of jointed rock from fundamental considerations rather than adopting or extending the available systems of analysis. Investigation from first principles might provide more generalized criterion for understanding the mechanical behaviour of jointed rocks.