

C H A P T E R - I V

SCOPE AND OBJECTIVES

4.0 General:

The clear understanding of the mechanical behaviour and failure phenomenon is a prime requirement for analysis and design of structures on rock. Rock could be considered a time independent material in the sense that its formation occurs over a large scale of time. If the material produced is ideal it should produce homogeneous strain on the application of stresses whence it behaves as a perfect continuum. While in reality the rock which is produced under the prevailing environmental conditions should develop necessarily the imperfections both in microscopic and macroscopic realm. Most of the research work appears to be revolving round the theoretical concepts, either elastic, quasi-elastic or quasi-plastic since it has not yet been possible to conceive the probable mechanism of failure. The basic deficiency experienced in all the failure theories is that the starting of the failure can not be identified. In case of igneous rocks it can be hypothesized that stresses get locked during the process of formation. These internal stresses are relieved at a null point corresponding to the balance of internal stresses with external stresses from which point the process of failure commences. To investigate the mechanical behaviour of rock diametral compression of discs and annuli has been accepted as a convenient alternative to the direct testing of rock materials by many

research workers owing to its simplicity both in experiment and theory. However the basic requirement of a test is the transmission of diametral load to the disc and annuli, so as to conform with theory which would involve the development of an ideal grip.

4.1 Scope:

To conduct an engineering analysis of any structure the twin fundamental requirements are to have a failure criterion and a constitutive relationship of structural materials which should be valid against observed phenomenon. The scope of the present investigation is to explore theoretically and verify experimentally the mechanism of failure with a goal to contribute towards the mathematical framework for analysis of structures constituted in rock materials.

4.2 Objectives:

The principal objectives of present investigation are categorised in to theoretical and experimental and are presented as below:

4.2.1 Theoretical:

4.2.1.1 Primary objectives:

- (I) To evolve the physical model for the mechanics of failure of a rock material.
- (II) To establish a failure criterion for a rock material.
- (III) To formulate constitutive relationship for a rock material.

4.2.1.2 Secondary objectives:

- (I) To determine the value of pre-stress in a rock material.
- (II) To determine the value of tensile stress for a rock material.
- (III) To derive various engineering parameters for a rock material.

4.2.2 Experimental:

4.2.2.1 Primary objectives:

- (I) To investigate the validity of Brazil Test.
- (II) To analyse the behaviour of a disc and annuli under diametral loading.
- (III) To observe the initiation and propagation of cracks.

4.2.2.2 Secondary objectives:

- (I) To develop grips for stress distribution conforming to the theoretical requirements.
- (II) To develop techniques for sample preparation.
- (III) To standardize the method of testing for disc and annuli.

4.3 Methodology:

The methodology for accomplishing the objectives consists of three steps:

- (I) Critical appraisal
- (II) Theoretical developments
- (III) Experimental investigations

4.3.1 A critical appraisal:

A critical appraisal of various theoretical treatments developed from early times to recent times are presented in previous chapters. Most of the theoretical treatments are the adoptions of classical failure theories for materials to failure in rock materials. While theoretical relations have been employed for analysis their experimental verifications are not provided. It is therefore imperative to weigh the various theoretical considerations against the experimental investigations.

4.3.2 Theoretical developments:

Theoretical developments for the present investigation stem from the roots of classical Griffith theory for brittle materials. Failure criteria for rock materials as reviewed by Hoek (1980) are the extensions of Griffith with an attempt to verify against experiments. One of the principal lacuna in these extensions is the non-consideration of the value of 'locked stresses' in a rock material. The present investigation proposes to establish a failure criterion which incorporates the influence of 'locked stresses'. One of the principal requirement for theoretical analysis is a material stress-strain law. A mathematically simple constitutive relationship for rock materials is proposed to be developed and validated against experimental observations.

4.3.3 Experimental investigations:

A critical review of various experimental techniques utilized for investigating the failure in rock

materials presented in previous chapters emphasise that the method of testing must necessarily be interpretable. Among the various experimental setups Brazil tests on disc and annuli are not only simple but also interpretable against theoretical derivations. However it is absolutely essential that testing should fulfill the theoretical requirements of load applications. This will necessarily require development of test specimen grip which can produce theoretical loading on the specimen. To understand the mechanism of failure it is not only necessary to record magnitudes of load but also displacements but more significant is to observe events leading to fracture of the sample. The present investigation proposes to conduct the investigations on carefully prepared specimens with a goal to acquire as much data as possible.

4.4 Concluding remarks:

In the context of scope and objectives outlined in this chapter and following the general methodology it is proposed to present the theoretical developments accomplished against the experimental observations in subsequent chapters.