Introduction

1·1. Rock Mechanics

The subject "Rock Mechanics" is comparatively a new branch in engineering. Civil Engineers, Mining Engineers, Geologists and Geophysists are mainy associated with this subject because the problems pertaining to their fieid are being solved with the application of developed theories of Rock Mechanics. The First Conference of International Society of Rock Mechanics was held in 1966 in Lisbon. The Committee on Rock Mechanics of the Geological Society of America in 1964, and then Committee on Rock Mechanics of the National Academy of Sciences in 1966 came forward with the definition of Rock Mechanics. "Rock Mechanics is the theoretical and applied science of the behaviour of rock ; it is that branch of mechanics which is concerned with the response of rock to the force field of its environment".

Rock Mechanics may be taken as separate field of engineering and different from engineering geology. It not only deals with rock as an engineering materials but it also deals with changes in mechanical behaviour in rocks (such as stress, strain and movement in rocks) brought in due to engineering activities. It is also associated with design and stability of underground structures in rock.

Till the rock mass is continuous with no inherent defects, its property can be estimated with theories of engineering geology and mechanics. But when the rock mass is discontinuous having either inherent defects or the defects which are likely to develop due to engineering operations then the theories of Rock Mechanics are required to predict the behaviour of the rock mass. Since it deals with mechanics of discontinum media, it is also known as articulate, grain structure mechanics.

1·2. Rock Mechanics Problems

As in the field of Soil Mechanics where laws of Mechanics and Hydraulics are applied to soil and soil mass, in Rock Mechanics laws of Mechanics and hydraulic including theories of elasticity and plasticity are utilised for Rock and Rock Masses. In general, problems of rock mechanics may be classified in three categories.

(*a*) Problems of equilibrium or stability.

(*b*) Problems of Elastic and Plastic deformations.

(*c*) Drainage problems.

For problems of (*a*) and (*b*) types it is necessary to know about the load imposed, and magnitude and distribution of stresses induced in the rock mass by the load. Rock in itself may be homogeneous but when we consider about the rock mass over which we plan to make construction, may behave altogether in different manner due to its defects in the mass such as jointing, bedding planes, schistosity, fissures, cavities and other discontinuities. Henee, properties which are obtained on microscopic or macroscopic basis may not be true for megascopic scale. This problem of discontinuity makes the problem of estimation of distribution of stresses induced in the rock mass very difficult.

To estimate the stress distribution in the rock mass and other related problems, finite element method is being used. and the behaviour of rock mass is being predicted well. However, the results may not tally exactly with the nearest value.

To predict the behaviour of rock mass to the nearest value, "in-situ" tests are done. But these tests are very expensive. In such cases, modelling also is tried. Hence, in the rock mechanics great importance has been given to testing techniques which include laboratory as well as in situ testing. Modelling theories have also great importance.

1·3. Scope of Rock Mechanics

Although study of rock mechanics is necessary for mining engineers, geologists and geophysis, it has got more importance for civil engineers who are faced with problems relating to rock mass during different construction operations.

If a building is very tall its foundation may go deep for stability requirement. In such cases, the foundation may rest over a rock. To act as a good foundation support, bearing capacity of the rock should be within permissible limits. At the same time settlement criteria also should be such that there may not be uneven settlement of the building and for that, settlement properties of the rock mass is required. In case a building is very tall and constructed on reclamed land over the shallow sea, the uplift force acts on the foundation which goes into the sea bed. To make the building stable, the foundation has to be anchored to deep sound rock bed by anchor cables and for such operations knowledge of rock mechanics is essential.

One of the most important work for civil engineers is the construction of masonary or concrete dams, which are also known as gravity dams. A gravity dam has its foundation supported on deep excavation into the rock mass. In such a case the rock supporting the dam should have no fault zone and should be able to take stresses due to construction of the dam. At the same time, the rock strata should be such that upstream water may not seep through the foundation bed. For these details and proper design a knowledge of rock mechanics is essential.

When a cut is made into the rock mass such as mining shafts, tunnels, underground power houses then there is a stress relief in the surrounding rock mass which causes the development of tensile stress due to which cracks appear and subsequently there is rock fall into the opening. In such cases the opening has to be designed such that rock cracks may not appear excessively after the opening has been made. If at all cracks have appeared, then the rock may be made stable by adopting a suitable design of rock reinforcement or a concrete lining.

Knowlege of rock mechanics is essential for mining engineers geologists and geophysists also. For effective mining operations explosives are put for explosion, and then the mining operation is done. Knowlege of rock mechanics helps in effective selection of explosive material depending on rock properties. Rock mechanics also helps in selecting drilling bit materials so that effective drilling may be done at deeper depth such as for oil explorations etc.

1·4. Problems of Rock Mechanics

A few examples, discussed above, give an idea about the scope of rock mechanics in engineering practice. Based on the above discussions and looking at other engineering operations, some of the problems in rock mechanics associated with engineering activity may be summarised below.

Reaction of a particular rock when put to actual use, load carrying capacity of the rock at its surface and at different depths, shear strength of rock, dynamic properties of the rock, effect of earthquake on rock foundation system, elastic constants of rocks, effect of rock defects on its strength properties, time-dependent deformation (creep) in rock, laws of plastic flow, effect of anisotropy of rock on stress distribution, co-relation of laboratory results with rock-strength "in-situ", estimation of test method which will provide actual "in-situ" conditions and properties of rocks, mechanism of failure in rocks, estimation of rock-slope design factors and factor of safety to be used in design.

Although use of rock as construction materials also come in perview of rock mechanics, it is discussed in detail in books of road engineering and concrete technology. In this book general physical properties of rocks also have been discussed from which one can get an idea of its suitability for any engineering pupose.