SYNOPSIS

Plasticity is that behaviour of solid bodies in which they deform permanently under the external loads. This theory concerns itself with the situation in which the loads are sufficiently large so that measurable amount of permanent deformation occurs. Plasticity theory has two aspects. In one case there are metal forming process such as forging, extrusion, drawing, rolling etc. in which case the material can be assumed perfectly plastic and in the other case there are series of problems involving small plastic strains of the order of elastic strains which are of much theoretical importance. This work will be concerned mainly with the second type of problems i.e., elastic-plastic problems where the plastic strains are of the same order of magnitude as the elastic strains.

Plasticity theory has important application in engineering and physics. The resolution of many questions relating to the strength of various kinds of machines and structures is based on the inferences drawn from the plasticity theory. The study of the strength and similar other properties of materials is based on the results of plasticity theory, since plastic

deformation precedes fracture. In recent years this theory is employed successfully into the mechanism of pressure in rocks, a matter of considerable interest for mining industry.

The problem of propagation of plastic waves in different media is of great interest in the field of dynamic plasticity. In this work we are mainly concerned with the propagation of shock waves in solids which is one of the main topics considered to-day in dynamic plasticity. The rate sensitivity and work-hardening of the plastic material is also considered in the present work. Von Mises' plasticity condition is used throughout this work. A general review of the subject and a historical back ground is given in Chapter I.

In the Chapter II, the propagation of torsional waves in a elastic-plastic circular cylinder is considered. An exact solution is derived for the elastic-plastic waves when a twist is suddenly applied at the end of the circular cylinder. The expressions for the resulting particle displacements and stress components in both elastic and plastic regions are obtained. It is found that for a fiven twist waves a particular wave length are generated and propagate through the medium, the wave length increasing with increase in twist.

In Chapter III, propagation of coupled dilatational and shearing waves in a particular rheological model which is elasto-plastic is studied when the medium is either incompressible or compressible. The case when the waves become uncoupled are also considered and it is seen that the effect of uncoupling

enhances the shearing wave velocity but reduces the dilatational wave velocity compared to that of the coupled waves. With the same elasto-plastic model propagation of two coupled shearing waves in torsion is also investigated. The effect of uncoupling in this case gives one shearing wave in each case whose velocity remains unchanged.

The Chapter IV deals with the propagation of stress waves in a rate sensitive and work-hardening plastic medium. The infinite medium considered is elastic/viscoplastic/plastic medium, i.e. we assume the body under consideration possesses elastic, viscoplastic and plastic inviscid properties. This gives a general constitutive equation in which instantaneous plastic properties are coupled and the non-instantaneous properties are also present. From this model we can get as special cases the classical Prandtl-Reuss constitutive equations of plasticity, the constitutive equations of Hohenemser and Prager for an elastic/viscoplastic body and finally the constitutive equations for an elastic body. The propagation of stress waves in the elastic/viscoplastic/plastic medium is studied for three separate cases, namely, spherical waves, cylindrical waves and plane waves in a half space. The stress, strain and velocity components are obtained in each case along the characteristics and numerical results are presented to give the stress, strain and velocity components (for a mild steel), and contour and their graphs are drawn in each case.

In Chapter V, the propagation of shock waves in soils, which has application in constructing and agricultural engineering is discussed. The Hencky-Ilyushin constitutive equations are used to investigate both pure-compression and shear-compression perturbations under Huber-Von Mises' plasticity conditions for soils. As a special case the propagation of shock waves in sandy soils is considered and the velocity of propagation is found to coincide with the compression characteristic.

The Chapter VI contains two parts. In one part exially symmetric torsional problems are considered. Perturbation of the lateral surface of cylindrical bars of circular cross-section subjected to torsion is analysed in two cases. In the first case the torsion does not afflict the cylindricity of the bar and in the second case the cross-section remains circular but diameter varies along the axis of symmetry of the bar. In the other part of this chapter we consider the propagation of a longitudinal pulse along the axis of the cylinder of variable cross-section. It is observed that the damping is predominant due to plasticity of the material of the cylinder.

Finally in the last chapter longitudinal stress pulse in a rigid plastic bar of variable cross-section is considered. The stress and the velocity is obtained.