CUTTING OF A PLATE BY A WEDGE

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Abstract

The energy-dissipating behaviour of structures is a major interest among structural engineers concerned with the design of vehicles of all sorts against collisions. The main objective of this thesis has been to study the way in which energy is absorbed by a metal plate during the process of cutting by a wedge.

A large number of quasi-static experiments have been conducted for mild-steel plates of four different thicknesses under several tests conditions involving different angles *etc*. Having treated the problem as one of *plastic flow* instead of plastic flow together with *fracture* (which is the usual assumption found in the literature), a simple empirical relationship based on dimensional analysis has been obtained between the energy absorbed and the cutting length and the thickness. It turns out that the various tests conditions make relatively little difference to the energy absorbed.

Various investigations have also been made into the *mechanisms* of the cutting process. These include strain measurements, geometrical surveys of the deformed surface, a study of frictional effects, a brief description of the kinematics of the cutting process, and an investigation of the size of the plastic deformation zone.

A theoretical model has been proposed which incorporates the major experimental observations. In this model, the whole deforming surface is divided into two regions: *tip* and *wake*. The tip region involves a steady-state plastic straining pattern which produces a doubly-curved surface. In the wake region, there is *bending* about a moving hinge as well as a *twisting* distortion: both of these absorb equally significant amounts of energy. The effect of friction in this problem has been taken into account: typically it absorbs about 2/3 of the total energy.