SOME ASPECTS OF THE PLASTIC THEORY OF STRUCTURES, WITH SPECIAL REFERENCE TO TRANSVERSLEY LOADED BENTS AND GRIDS

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Abstract

This dissertation contains an investigation into certain aspects of the behaviour of general structures. General structures are defined as one dimensional continua acted on by two or more generalised stresses associated with non-zero generalised strains. Transversely loaded bents and grids are used as specific examples where detailed explanation is given.

For a rigid-plastic stress-strain relation an attempt is made to systematise the hinge pattern at the initiation of flow in general structures; the systematisation is extended for a grid type structure where the effect of a change in one particular physical parameter is studied. Certain simplifications in the numerical computation methods for grids can be introduced as a result of this systematisation. An introductory survey to a problem in minimum weight design is also given. A large deflexion rigid-plastic analysis is given for a simple idealised grid, and experimental results are presented to show the significance of this analysis.

The behaviour of certain transversely loaded bents is studied with a perfectly elastic, perfectly plastic stress strain relation, and it is shown that, in general, limit conditions can only be attained at infinitely large deflexions. The concepts of behaviour noted are shown to be true for general structures. The relevance of this phenomenon is discussed in relation to the design problem in real structures, and a technique by which deflexion estimation can be made is proposed. Tests carried out on simple bents support some of the concepts introduced and show that, in simple cases, reasonably accurate deflexions computations can be made.