THE PLASTIC DESIGN OF VIERENDEEL TRUSSES

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Abstract

Strength, stiffness and stability are the acknowledged objectives of any design method in structural engineering. Considerations of economy however, dictate the ultimate choice of design which is safe and which also satisfies particular requirements on other aspects.

With the introduction of the plastic theory, it has been possible to design structures constructed of ductile material, which were more economical than others designed by the orthodox methods. The light weight of the structures so designed, is achieved, not at their expense of their safety, but through a clear and logical understanding of their behaviour under the applied loads.

The application of this theory to a particular type of construction should, however, be preceded by investigations whose aim would be to envisage and overcome a factor, such as instability, which might endanger the safety of the structure.

This research is concerned with studying the plastic behaviour Vierendeel trusses having regard to the possibility of obtaining safe, economical designs by the plastic theory. It is divided into two parts.

Part 1 is devoted to investigating the plastic behaviour of Vierendeel trusses when conditions of instability do not arise. It includes studying the effects of varying the height and the panel length as well as using sloping chords on the plastic design of this structure. Tests were performed on small-scale models of different types of trusses fabricated from $\frac{1}{4}$" x $\frac{1}{4}$" mild steel sections. This part is concluded with a chapter in which the minimum weight design of Vierendeel trusses is examined.

The effect of instability on the plastic design of Vierendeel trusses is discussed in Part II. This factor of major importance in plastically designed structures since their stability deteriorates with the formation of plastic hinges. In addition to the theoretical investigations, whose aim was to place limitations upon the capability of members to developing plastic hinges at their ends, tests were performed on both small and large-scale trusses with a view to

checking the applicability of these theoretical deductions to the plastic design of Vierendeel trusses.

General conclusions are then drawn from which recommendations for the design of Vierendeel trusses are possible.