THE OPTIMAL DESIGN OF MULTI-STOREY FRAMES USING MATHEMATICAL PROGRAMMING

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Abstract

Although much research has been done on the analysis of multi storey, unbraced steel frames, the methods of design have not reached a similar stage of development. In particular, the methods of optimal structural design still have many shortcomings.

The present work is concerned with two applications of mathematical programming to the optimal design of frames.

Previous studies have usually treated the minimum weight elastic design of frames subject to limitations on stresses and deflections as a constrained, nonlinear problem. The first part of the present work describes how to convert the constrained problem into a series of unconstrained ones, with significant computational and practical benefits. A standard minimisation technique is used, and apart frame the analysis subroutines, little extra programming is required. But the size of frame which can be tackled is limited

The major part of the present work deals with the use of dynamic programming in the optimal plastic design of multi-storey frames. This formulation essentially breaks the problem down into a number of more manageable designs of single-storey frames. The same standard minimisation technique can be used to find the minimum cost of a given storey. Realistic nonlinear cost functions can represented, and the programming is very straightforward. The main difficulty with this approach is that the computational effort increases exponentially with the number of bays, and the present work discusses a way of solving this problem. Further extensions to the approach are made so that secondary can be included.