DESIGN OPTIMIZATION OF STRUCTURAL STEELWORK

Design optimization of steel frame structures according to the British codes of practice using a genetic algorithm

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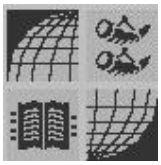

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ABSTRACT

Keywords: Design Optimization, Steel Frames, BS 5950, Genetic Algorithm, Stability

This thesis deals with the design optimization of 2D and 3D steel frame structures.

A computer code based on the direct method for the stability analysis of 2D steel frame structures has been developed and verified. This code is then used to compare the values of the effective buckling length of columns with those determined from the charts presented in BS 5950.

The versatility of GAs in dealing with discrete design optimization is demonstrated. Modifications to GA are implemented to improve its performance. It is shown that the choice of parameters in a GA can considerably affect its robustness and speed of convergence. A technique is developed to deal with a case when the number of catalogue cross sections does not fit into a string keeping the probability of selection equal for all sections.

Investigation of the maximum ratio of the effective buckling length when using the finite element approach and that by the BS 5905 approach is carried out. Three anti-optimization problems have been formulated to identify the position of the column and the cross sections of framework members at the maximum ratio.

Applications to design optimisation of 2D and 3D steel structures are presented. In order to consider realistic steelwork design problems, a GA has been linked to a system of structural design rules (British Standards BS 5950 and BS 6399), interacting with a finite element analysis package ANSYS. A steelwork optimization problem is considered as a selection of the optimum set of practical cross sections from a catalogue (British Standard BS 4, BS 4848). The design criteria of the codes of practice and other practical designer's considerations are reflected in the formulation of the optimization problem.

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