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ABSTRACTS
PART II

THE EFFICIENCY OF THE OPTIMIZATION TECHNIQUES IN THE ECONOMIC DESIGN OF STEEL STRUCTURES

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Single- and multiobjective optimization techniques are good tools for finding the best results of the design problem. The developed computer code contains seven various type multiobjective and five singleobjective optimization techniques [1,2]. See Table 1.

The efficiency of the computer code is shown on the design of singlebay plane frame, with I-cross section with continuously increasing web height, taking account 3 objective functions and 35 inequality constraints. Constraints: static stresses, local web and flange buckling, lateral buckling for the compressed flange, elastic lateral buckling at the eaves points both in columns and rafters. Displacements of the frame, size constraints. In this case the Hillclimb method was the most efficient, it could find more quickly the optima, using FEM subprograms for stress and displacement calculations at different topology.

The second application is the design of a welded, stiffened box girder as a main girder of an overhead travelling crane with 4 objectives and 16 inequality constraints. Constraints: stresses, web and flange buckling due to main loading and total loading, fatigue constraints on weldments, deflection of the girder, size constraints. There is a possibility of using higher strength steels. The Complex method could find quickly the global optima of the multiobjective optimization problem.

The third application is the design of a spindle-bearing system with 3 objectives and 10 inequality constraints. Constraints: radial displacement, radial rigidity, eigenfrequency, size constraints. The Flexible Tolerance method was very efficient in finding the optimum using the finite strip method, but it needed more computation time.

The fourth application is the design of cellular plates with 3 objectives and 14 inequality constraints. Constraints: normal stress at coverplates, shear constraints at stiffeners, deflection, local buckling and size constraints. There is a possibility of using higher strength steels. The Direct-Random Search technique was very useful in this case. It usually gives global optimum for the structure.

In these cases the optimization techniques had different efficiencies, one or two is better to use for that problem than the others, regarding the singleobjective optimization techniques. At the multiobjective optimization techniques the main difference is, what kind of Pareto optima can be found and how close is it to the ideal solution.

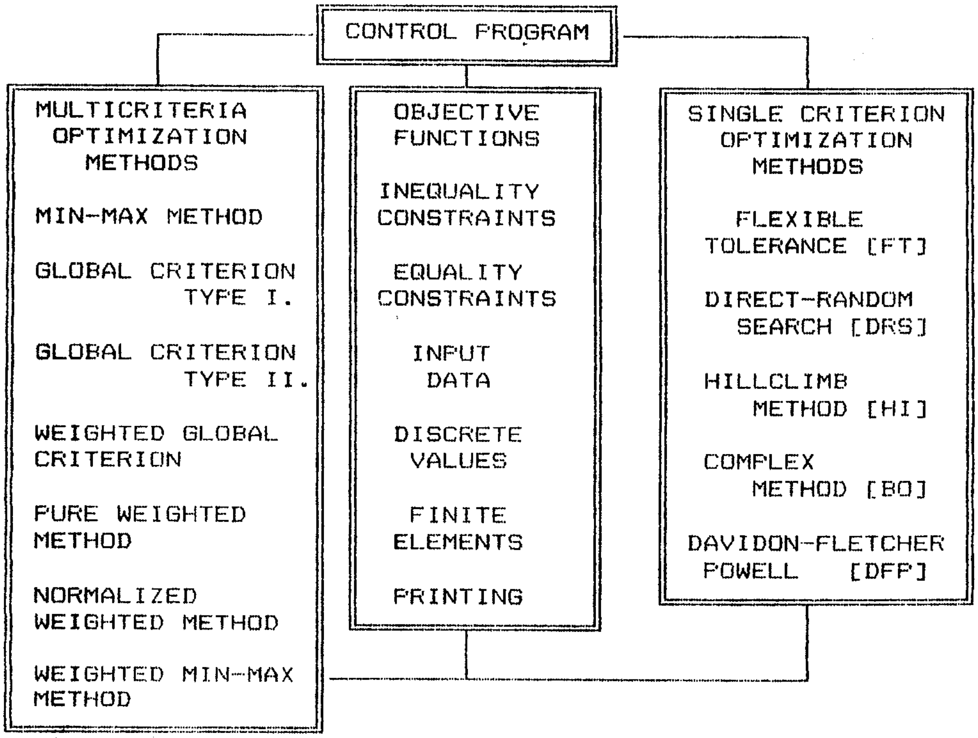

Table 1.

The program system was made in MS FORTRAN on PC/AT compatible computer. If we write the programs for example in C language , at that case the Complex method was quicker than the Hillclimb, but in FORTRAN the Hillclimb was the quickest one, but usually gave local optimum.

References

[1] Jarmai,K.: Single- and multicriteria optimization as a tool of decision support system. Computers in Industry, 1989. Vol.11. No.3. p.249-266.

[2] Jarmai,K.: Design of economic stiffened box girders, experiments for the local buckling interaction. Publications of the University of Miskolc, Series C. Mechanical Engineering, 1990. Vol.43. p.107-126.