Lyudmila Feskova
G.P. Ivanova, research supervisor
O.D. Shvets, language adviser
SHEI “National Mining University”, Dnipropetrovsk

Main Beam Parametrical Optimization of a Metal Frame Cage

Nowadays the theory of optimum design is one of the topical and developing sections in deformable solid body mechanics which is the base for design calculations of construction structures. Optimal design capabilities have increased substantially with the design computing practice introduction and efficient numerical methods, in particular the finite element method. Basic method equations are a linear equations system, which are introduced in the iteration procedure. Structure is characterized by a number of indicators: reliability, cost, weight, dimensions, design time, and others which can be in mutual contradiction. The solving problem difficulty is the lack of a priori information necessary to find the best embodiment. Therefore, it is advisable to build a design procedure so that at each subsequent design stage information is increased.The decrease in a material capacity of structures and improvement of their mechanical characteristics is one of the most important tasks of the optimum design.

As an example let us consider the main beam of a metal frame cage. Optimization of cross section sizes represents a nonlinear problem which can be solved with the Microsoft Excel Solver program ("Search for solutions"). The "Search for solutions" program is an additional superstructure of the tabular MS Excel processor which can solves either linear tasks or the linear tasks.When solving the problem of minimization of the double-T section sizes, the constructive and standard requirements are considered.

The stages of the problem solution are the following:

1. Initial parameters of the beam investigated are set.
2. Optimization of section parameters is implemented by means of the Microsoft Excel Solver program (Search for solutions).
3. Comparison and assessment of initial data with those obtained as a result of optimization.

This procedure leads to the reduction of beam weight by 9,74% and, respectively, a consumption of steel.

The received optimum section is checked on durability by normal tension. When carrying out optimization stages the requirements for general and local stability as well as constructive requirements are considered.

Optimal design of metal structures affects the reduction in material costs to manufacture it. Optimization stages was consisted of minimizing the I-beam cross section size and compare it with the original size.

The article shows how it is possible to reduce a consumption of steel when producing metal structures without violating any standard or constructive requirements.