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LIGHT-WEIGHT DESIGN OF AN OVERHEAD CRANE'S GIRDER WITH A NON-SYMMETRIC BOX CROSS-SECTION

Goran V. Pavlović[1], Mile M. Savković[2], Radovan R. Bulatović[2], Nebojša B. Zdravković[2] and Goran Đ. Marković[2]

[1]*University of Niš, Faculty of Electronic Engineering, 18000 Niš, Serbia*
[2]*University of Kragujevac, Faculty of Mechanical and Civil Engineering in Kraljevo, 36000 Kraljevo, Serbia*

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ABSTRACT

The proper choice of material and geometric properties of the bridge crane main girder can significantly reduce its weight and production cost. This research presents the optimization of the weight of the double-beam bridge crane main girder with an asymmetric box-like cross-section. The strength analysis in characteristic points of the critical cross-section and the local stability of plates were conducted using Eurocodes [1]. This study aimed to prove that a proper choice of geometry for the cross-section plates and their additional design elements can have a meaningful impact on the main girder weight and, by that, on the overall weight of the double-beam bridge crane. The optimization procedure was done using Water Evaporation Optimization (WEO) algorithm [2], with the implementation of all necessary criteria and conditions which must be fulfilled. This study revealed that the application of the lightweight design philosophy to the steel structure of the bridge crane main girder could significantly reduce its weight, which is verified in the existing examples of double-beam bridge cranes.

Achieved savings in girder weight are between 24,43% and 34,73%, dependingly on the considered example. Also, the study showed the influence of the chosen material on the optimum weight and geometric parameters of the steel girder.

Depending on the studied example of the bridge crane and selected material, the WEO algorithm gave the same solution through simulations. The value of the objective function (optimum weight) had a slight deviation at the second decimal place, which is neglectable. The algorithm successfully avoided the trap of getting into the local minimum during the search.

In the end, it can be stated that the application of the WEO algorithm was successful in the considered engineering problem since it was the optimization of a complex steel structure with 11 variables and more than 20 constraint functions.

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