Cost sensitivity analysis in bridges design

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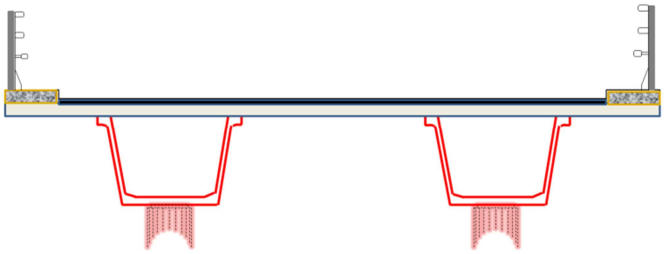
ABSTRACT

The application of metaheuristic techniques enables optimizing structures for economic aspects, greenhouse effects, energy consumption and other life cycle impacts [1-4]. Structural designs obtained with the application of the heuristic algorithms vary according to the above mentioned objectives and with the values of the parameters determined by the boundary conditions of structures and materials. The featured paper presents the cost optimization of prestressed concrete (PC) precast road bridges. The beam has a U-shape cross-section (Fig.1). The deck has a span of 35 m and 12 m in width. The Simulated Annealing algorithm (SA) [5] is used for obtaining the cross-section transverse geometric dimensions, the concrete class and the active and passive reinforcement amounts. Our example is defined by 59 discrete design variables. SA algorithm requires the calibration of the initial temperature, the number of variables modified in each iteration, the length of the Markov chains and the cooling coefficient. It all is subject to the Spanish Structural Concrete Code EHE. The overall objective is to determine whether the structural design is influenced by the unit prices. Hence, different economic scenarios are presented where the concrete and steel unit prices vary. The results show that the application of heuristic techniques delivers structural designs that adapt to the variation of unit prices, in order to reduce the overall cost of the resulting structural design. In this study, an increment in the steel price leads to a reduction in the steel amount, increasing the concrete amount, and vice versa.

Fig. 1. PC precast road bridge cross-section.



REFERENCES

[1] J.V. Martí, F. González-Vidosa, V. Yepes and J. Alcalá. *Design of prestressed concrete precast road bridges with hybrid simulated annealing*, Engineering Structures, 2013, 48, 342-352.
[2] J.V. Martí, V. Yepes, F. González-Vidosa (2015). *Memetic algorithm approach to designing of precast-prestressed concrete road bridges with steel fiber-reinforcement*. Journal of Structural Engineering ASCE, 2015, 141(2): 04014114.
[3] J.V. Martí, V. Yepes, F. González-Vidosa, A. Luz. *Diseño automático de tableros óptimos de puentes de carretera de vigas artesa prefabricadas mediante algoritmos meméticos híbridos.* R.I.M.N.I., 2014, 30(3), 145-154.
[4] P. Zastrow, F. Molina-Moreno, T. Garcia-Segura, J. V. Marti and V. Yepes. *Life cycle assessment of cost-optimized buttress earth-retaining walls: A parametric study.* Journal of Cleaner Production 2016, In Press October 2016. http://dx.doi.org/10.1016/j.jclepro.2016.10.085
[5] S. Kirkpatrick, CD Gelatt, MP Vecchi, *Optimization by simulated annealing*. Science 1983, 220(4598):671-80.