Optimization of Cold-formed Steel Sections using Genetic Algorithm
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Abstract

Most research done on optimization of cold-formed steel members focuses on a single cross-section with set conditions and steel yield strengths. How would this optimization look if different cold-formed cross-sections are compared. Furthermore, how would different cold-formed cross-sections with varying steel yield strength behave in a global optimization.

The aim is to study how to reach optimized cross-sections (profiles) for roof trusses in different steel strength classes using a genetic algorithm and create a library of the most optimized cross-sections for certain spans and applied loads.

The four selected cross-sections to be analysed are C-section, double back-to-back C-section, hollow square-section and hollow hexagon-section. These profiles can act as diagonals in a roof truss and the compressed diagonals will be analysed. As for the upper chord which is subjected to both compression and bending, only double back-to-back C-sections will be optimized. `Matlab` functions were generated to calculate the required parameters, buckling modes and capacities for the selected sections. These functions were connected to a genetic algorithm to find the most optimized dimensions for each section. Lastly the most optimized cross-sections with respect to smallest area were selected for different load and span length combination to create a library.

The results of the genetic algorithm showed that for the upper chord the higher the steel strength the smaller the area becomes but the section with higher steel strength have a lower utilization ratio. The diagonals which were divided into two groups and were analysed separately showed that the most optimized shape to use is a hollow square-section. However, the connection between the upper chord and the diagonals will not be feasible with closed cross-sections used as diagonals. The chosen cross-section shape is therefore C-section.

Keywords: steel, cold-formed, cross-section, optimization, genetic algorithm, roof truss, Eurocode 3.