Rectangular box column minimum cost design composed from cellular plates

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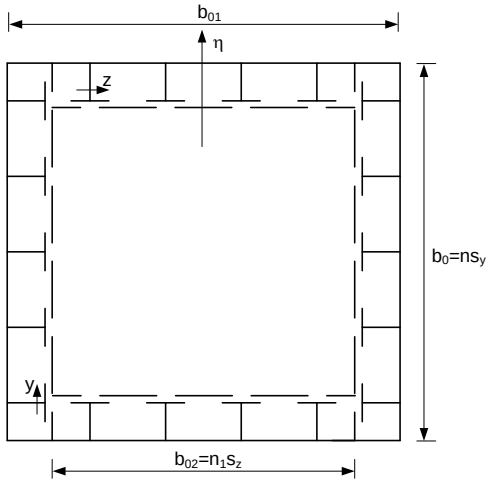
Abstract. A cantilever column is loaded by a compression force and a bending moment caused by a horizontal force. It can be derived that, in the case of uniaxial bending, the rectangular cross section is more economic than the square one. In the given numerical case, the plate thicknesses should be too large for fabrication. Therefore stiffened plates should be used. Thus, the aim of the present study is to elaborate the minimum cost design of a column with rectangular cross-section and cellular plate walls. Cellular plates are constructed from two plates and longitudinal stiffeners welded between them. Previous studies have shown that welded T-stiffeners are more economic than the halved rolled I-section stiffeners, thus, welded T-stiffeners are used.

Stress and horizontal deformation constraints are formulated. In the stress constraint the face plate buckling is avoided by using effective widths. Local buckling constraint is used for the web of T-stiffeners. Variables are as follows: heights of welded T-sections, thicknesses of stiffener webs, number of stiffeners in both directions, main dimensions of the rectangular box section, thicknesses of outer and inner face plates in smaller and larger walls. The cost function is formulated according to the fabrication sequence and consists of cost of material, welding and painting. The constrained function minimization is performed by using efficient mathematical optimization methods, the particle swarm optimization with some modifications and the response surface technology IOSO.

Keywords: structural optimization, minimum cost design, cellular plates, columns



Cross section of the column