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SHAPE OPTIMIZATION OF COLD-FORMED STEEL SECTIONS USING DMS ALGORITHM

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Cold-formed steel sections (CFS) have been used extensively in buildings as structural members. Despite having a thickness of approximately 1 2 mm and typical section depths between 75-300 mm, CFS sections have considerable strength. One of the most attractive features of CFS is that they may be fabricated from plane steel sheets to nearly any shape of open cross-section. Therefore, the finding of optimal shapes for CFS is a problem of great interest, not only by getting the minimization of weight but also satisfying strength (safety) constraints. Since CFS members are usually thin-walled, they are subject to different buckling phenomena, including local buckling, distortional buckling, and global buckling. The goal of this work is to identify the cross-sections that maximize the capacity of a member with a given length, cross-section perimeter, and sheet thickness. Instead of the minimum weight for a given cross-section shape, this work explores the topology more freely, and from the manufacturer's viewpoint: what is the maximum strength for a given amount of steel?

A key and challenging task in the optimization process is to compute the buckling strength of candidate designs with complex cross-sections. Using the Direct Strength Method (DSM), adopted by AISI, the nominal strength Pn for arbitrary geometry CFS is given by the minimum between two strengths (local/global – Pnle; distortional – Pnd), which are calculated using the elastic critical loads (local – Pcrl; distortional – Pcrd; global – Pcre) and the yielding load (Py). The computation of these critical loads for an arbitrary CFS is made using the open source software CUFSM. In this paper, the authors explore the coupling of optimization algorithms with DSM and CUFSM for the design of CFS. The optimization problem is solved using the Direct MultiSearch (DMS) method to maximize both strengths (Pnle and Pnd) as objectives.