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Strength of Cold-Formed Sigma Section Subjected to Bending Moment Using Direct Strength Method

A Thesis submitted in the Partial Fulfillment for the Requirement of the Degree of Master of Science in civil engineering (Structural)

Submitted by

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STATEMENT

This dissertation is submitted to the faculty of Engineering at Ain Shams University for getting MSc. Degree in Civil Engineering (Structural Department).
The work included in this thesis was carried out by the researcher in the Department of Structural Engineering, Ain Shams University.
No part of this thesis was submitted for a degree or a qualification at any other institution or university.

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ABSTRACT

Using sigma cold-formed steel sections is continuously increasing in industrial buildings due to their light weight. The sigma sections are characterized by their web stiffeners which increase their buckling strength over the conventional C-section and bring the shear center closer to the C.G of the section. This thesis answered the question of whether using the sigma section, as an alternative to the C-section subjected to bending moment, is feasible or not. A comparison was carried out between the sigma and C sections. The results demonstrated the superiority of the sigma section over the C-section, especially when the web local or distortional buckling is the governing failure mode. In addition, due to the lack of investigations for the behavior of sigma beams, the Direct Strength Method hypothesized that the sigma beam is not a prequalified beam for the Direct Strength Method implementation; consequently, conservative safety factors must be used in the design. In the current study, the behavior of sigma beams is investigated by studying the relation between the nominal flexural capacity (Mn.) and critical buckling moment (M_{cr}.); therefore, a more economical design can be achieved.

Furthermore, this thesis proposed a simple design approach for designing cold-formed sigma section subjected to bending moment using the Direct Strength Method (DSM). A wide parametric study was carried out using a wide range of dimensional parameters. The proposed equations can calculate the critical local and distortional buckling moments without the need of using specific software that might complicate the design process.

KEYWORDS

Direct Strength Method, Sigma section, ABAQUS, Cold-formed steel sections, CUFSM, Finite strip analysis, Finite element analysis.

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