Finite Element Modeling of Cold-Formed Steel Members


Abstract
The study herein presented aims to better understand the behavior and resistance of Cold-Formed Steel Members based on a parametric Finite Element (FE) analysis. The study leads to an optimal performance of cold-formed steel member when submitted to a certain loading condition.

Key words: Finite Elements, Cold-Formed Steel, Stability

Introduction

Cold-Formed Steel (CFS) members are obtained by rolling at low temperatures to achieve a desired shape, allowing higher strength and stiffness. If compared to other materials such as timber or concrete, CFS is lighter, faster to erect and install, and has uniform quality. Therefore, the use of Cold-Formed Steel members in construction can be very cost-effective. The main purpose of this research was to introduce the student to the academic world while learning a new set of tools and skills through a parametric study of finite element models.

Results and Discussion

At a first stage, FE models were compared to compression experiments carried out at LABMEM (Laboratório Modelagem de Estruturas e Monitoração) – FEC – Unicamp of a CFS member with stiffeners. Based on the models previously developed, a clip CFS angle was studied in order to optimize the cross-section for maximum shear strength; the shear strength is parameterized per unit of weight (Vn/W) while still maintaining its fabrication feasibility.

The parametric analysis leads to a simple, yet efficient design while slight changes are made to its geometry in which stiffeners are added where the shear strength is maximized.

Figure 1. Buckled shape of model N38
When comparing the basic clip CFS angle depicted in Figure 1 to the clip CFS angle depicted in Figure 2, a 30% increase in shear strength per unit of weight was achieved.

Conclusions

The study conducted showed the importance of computer simulation in order to find the best configuration of an element by exploiting its mechanical and geometrical properties, thus, making the use of CFS very advantageous and cost-effective. The study also lead to important findings of great interest to industries that are looking for optimizing the strength of CFS members manufactured to resist shear loading.

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1Abaqus v6.14 software documentation, Dassault Systèmes Simulia Corp., Providence, RI, USA, 2014.