



Evaluation of Local Buckling Strength of Square Hollow Section Member

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Summary

Elastic local buckling strength of square hollow section members under biaxial bending shear force and axial force is theoretically presented by considering coupled effects of plate elements. Simple approximate formulas for calculating the coupled local buckling strength corresponding to boundary conditions at both ends, shape and stress distribution with respect to the members are presented. By application of these formulas, it is shown that square hollow section members with large width–thickness ratio can be used from the viewpoint of buckling strength by considering coupled effects of plate elements and stress distribution in members.

Keywords: column; biaxial bending shear force; axial force; box section; square steel tube; plate element; elastic local buckling; coupled local buckling; energy method.

1. Introduction

Square hollow section members are used as columns of steel structures, and biaxial bending shear force and axial force act on columns by natural external force. Since local buckling (Photo 1) determines the elasto-plastic behavior of the members except for fracture, it is necessary to clarify the deformation behavior of the members under biaxial bending shear force and axial force governed by local buckling to accurately evaluate seismic capacities of buildings. To accomplish this, it is important to understand the local buckling characteristics of the members purely determined by member shapes and loading conditions in ideal states where imperfections were not initially present.

Although many studies have been conducted on square hollow section members (for example [1], [2]), few examine the detailed local buckling characteristics of the members. Even the elastic local buckling characteristics were not sufficiently understood. In a study [3] about elastic local buckling strength of square hollow section members, the buckling strength under bending shear interaction was computed using energy method. However, the boundary condition of the plate element along longitudinal edge was assumed to be simple or fixed support, in other words, coupled plate buckling was not considered in the literature [3]. Hence, the buckling strength under any stress conditions by biaxial bending shear force and axial force could not be theoretically derived.

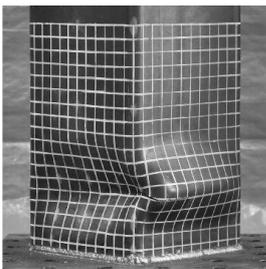


Photo 1: Local buckling of square hollow section member

To solve this problem, buckling analysis considering coupled effects of plate elements and complex stress conditions by bending, shear, and compression was conducted using energy method in a previous study [4]. Precise elastic local buckling strength was theoretically derived for square hollow section members under biaxial bending shear force and axial force. However, an evaluation method for buckling strength was not previously presented in the literature [4].

The purpose of this study is to present approximate formulas for elastic local buckling strength of square hollow section members under biaxial bending shear force and axial force. For this