Strength and Plastic Deformation Capacity of H-shaped Beam-Columns

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Summary

One of the authors has proposed *WF*, the new limitation of plate slenderness ratio, which considers stress distribution within H-shaped beams and coupled instability of web and flanges and has succeeded in evaluation for ultimate strength and plastic deformation capacity of H-shaped beams with *WF*. This study is intended to examine whether *WF* can also be adapted for evaluating the performance of H-shaped beam-columns and to develop evaluation method of it. As a result, this study found that ultimate strength and plastic deformation capacity of H-shaped beam-columns can be evaluated with equation (2) and equation (4) , (5) , respectively.

Keywords: beam-column, plate slenderness ratio, local buckling, ultimate strength, plastic deformation capacity

1. Introduction

Plate slenderness ratio (width-thickness ratio or depth-thickness ratio) of web and flanges is one of the factors determining ultimate strength and plastic deformation capacity of H-shaped steel beam-columns. Hitherto, many experimental and analytical studies have been reported aimed to reveal the relationship between local buckling behavior and plate slenderness ratio. Based on the results of them, various plate slenderness ratio limitations are set in the standard and the recommendations by the Architectural Institute of Japan. However, they did not precisely consider coupled local buckling of web and flanges. For example, the limitation on plate slenderness ratio of web and flanges are set separately in Design Standard for Steel Structures in Japan[1]. In Recommendation for limit state design of steel structures[2], plate slenderness ratio of web and flanges are classified into three ranks according to plastic deformation capacity. Evaluation formula for classification is set using correlation curves between plate slenderness ratios of web and flanges in the range where plate slenderness ratio of web is small. In contrast, limitation on plate slenderness ratio of web is separately set in the range where plate slenderness ratio of web is large.

To the problem that an interaction between web and flanges is not accurately considered in plate slenderness ratio limitations, one of the authors has proposed normalized slenderness ratio *WF* [3], [4]. It is a new evaluation indicator for H-shaped beams based on theoretical analysis of elastic coupled local buckling and considers stress distribution within beams and coupled instability of web and flanges. Ultimate strength and plastic deformation capacity of beams is organized with *WF*, and evaluation formulas for them are proposed regardless of steel materials in a previous study[5]. As a result, usability of beams exceeding the plate slenderness ratio limitation in the Standard[1] is shown.

This study is intended to examine if the evaluation method for H-shaped beams can be applied to the behavior of beam-columns. Ultimate strength and plastic deformation capacity of beam-columns are derived by numerical analysis and the influence of axial force on them is considered. Based on the results, new evaluation method for ultimate strength and plastic deformation capacity of H-shaped beam-columns considering axial force with *WF* is proposed.

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