Elastic Local Buckling Strength of Stiffened Plate under Bending Shear Stress

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Summary

It is possible to increase the local buckling strength and improve the plastic deformation capacity of H-shaped beams by applying stiffeners to web plate with large width–thickness ratios. In this study, we consider the web plate the end of the beam to be a stiffened plate and examine the elastic buckling strength using the energy method. In addition, we discuss the fundamental buckling characteristics of the stiffened web plate and the effective stiffener shape for stiffening the end of web plate with large width–thickness ratios.

Keywords: stiffened plate; elastic buckling; beams; energy method; plate element; width-thickness ratio; local buckling

1. Introduction

According to the standards for steel structures in many countries, the width–thickness ratio of web plate is assumed large for thin-walled steel structures. In Japan, the division for the plate width–thickness ratio of H-shaped beams is given with respect to the plastic deformation capacity in general, which is only applicable to a limited region. However, by applying stiffeners to web plate with large web width–thickness ratios, the local buckling strength can be controlled and plastic deformation capacity of H-shaped beams improves. To date, many experimental and analytical studies aimed to reveal the relation between the buckling strength of H-shaped beams and stiffeners have been reported. Nevertheless, the results have not been incorporated in standard and technical specifications for steel structures. Furthermore, the relation between the number of stiffeners and buckling strength of H-shaped beams is not sufficiently clarified. Therefore, we looked at the local elastic buckling strength of a stiffened web plate under bending and shear stress. The buckling strength of the stiffened plate was studied using the energy method, and the basic buckling characteristics of the stiffened plate were subsequently discussed. In addition, we discussed the most effective stiffener shape for increasing the buckling strength of the web plate.

2. Elastic Buckling Analysis of Stiffened Plate

2.1 H-shaped Beam Model

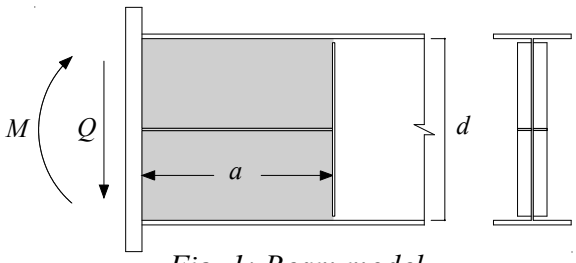

Fig. 1: Beam model

Figure. 1 shows the model for the H-shaped beam with a web having a large width–thickness ratio under bending and shear stress. We consider stiffened web plate to be stiffened plate with stiffeners attached to both sides of the web plate. The stiffeners have flexural and torsional rigidity for resisting the displacement and revolution of the joint lines.

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