Desirable Geometrical Configurations of The Web/Flange Splices for Enhancing the Frictional Slip Resistance of an I-Girder

Ryo Sakura, Takashi Yamaguchi

Osaka City University, Osaka, Japan

Contact: sakura@brdg.civil.eng.osaka-cu.ac.jp

Abstract

The present study focuses on the major slip behavior of high-strength frictional bolted connections in an I-girder. Bolted girder connections resist the applied bending moment through the cooperation of flange and web resistances. Flange and web splices are individually designed following practical design codes, such as Eurocode 3 and the Japanese Specifications for Highway Bridges. In the present study, FEA of various cross-sectional dimensions of the web splice in girder bolted connections, having various bolt arrangements of the web splice, and various number of bolts in the flange and web splices have been conducted to quantitatively evaluate the cooperative slip behavior of the girder connections. It has been found that the frictional force of the web splice was small compared to the design resistance. Moreover, as the bolt spacing of the web splice increased and the number of bolt rows of the web splice decreased, the ratio of the frictional force to the design slip resistance increased.

Keywords: girder bolted connections; high-strength frictional bolted joints; slip limit state; cooperative resistance mechanism

1 Introduction

Flange and web splices of girder connections are designed separately, following general design codes such as Eurocode 3 [1], Japanese Specifications for Highway Bridges [2], and the AISC Steel Construction Manual [3]. The ultimate and slip resistance of web splice is obtained by determining the ultimate and slip strength of the bolt is farthest from the center of gravity. This is because the implementation of the simplified design procedure and the web splices of the beam and girder connections are generally evaluated using the instantaneous center (IC) of the rotation method [4,5].

However, actual girder connections resist the applied bending moment through the cooperation of flange and web resistances [6,7] (herein cooperative resistance mechanism). Moreover, the slip resistance of the girder bolted connections is attributed to the flange and several web bolts [8,9]. Although the American Association of State Highway and Transportation Officials (AASHTO) LRFD Bridge Design Specifications [10] include the cooperative resistance mechanism; due to the lack of data on the influences of the various structural parameters, the details of the cooperative resistance mechanism are not clear.

It was found that the cooperative resistance mechanism had a significant effect on the slip limit states. Furthermore, clarifying the cooperative resistance mechanism enhances the slip resistance and reduces the number of bolts in bolted girder connections.

https://doi.org/10.2749/nanjing.2022.0592
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