Patch Plate Strengthening of Steel Box Member by Frictional High-Strength Bolts/Studs

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Abstract

An analytical study was conducted to examine the differences in design and reinforcement effectiveness in patch plate reinforcement using high-strength bolts and studs. High-strength stud bolts, which were recently developed in Japan, allow for one-sided installation. From the obtained analytical results, it was found that the yield load of the high-strength stud bolt was 13% higher than that of the high-strength bolt because of the absence of cross-sectional defects in the main plate, and the rate of increase in slip load twice as large. In addition, it was shown that the thickness of the patch plate could be reduced by 11 mm, and the ratio of the load transmitted to the patch plate was also higher. It has been concluded that the usage of high-strength studs reinforcement is desired from the viewpoint of mechanical rationality and economical aspects.

Keywords: High-strength bolt/ stud bolt; Patch plate; Reinforcement; Load transfer

1 Introduction

In Japan, patch plate reinforcement of steel members has been adopted in recent years to improve the seismic resistance of steel structures and increase their load-bearing capacity. The reinforcement patch plates are connected to the structures through high strength bolted friction joints generally. HTB is in accordance with the Japanese Industrial Standards (JIS B 1186) which is based on International Organization for Standardization (ISO). When using high-strength bolted reinforcement in closed section members of arch and truss bridges, handholes are required and high-strength stud bolts has been proposed to ease their installation.

The cross-sectional view of the patch plate reinforcement using high-strength stud is shown in Figure 1. High-strength stud bolts have been developed in recent years and have not yet been standardized. Studs are attached to existing members by welding, so that no bolt holes are drilled in the main plate. As a result, it can be installed from the external side of the cross-section. On the other hand, high-strength bolts require bolt hole drilling and hand-holes. Since the cross-sectional area of the existing member will be reduced, its bearing capacity is reduced and the patch plate thickness is increased [1].

However, few studies have focused on high-strength stud reinforcement, and so far, detailed comparisons between high-strength stud

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