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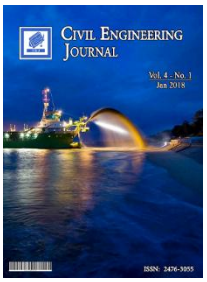

Cyclic Behavior of Bolted Extended End-Plate Moment Connections with Different Sizes of End Plate and Bolt Stiffened by a Rib Plate

Abbas Haghollahi [a], Reza Jannesar [a*]

[a] *Faculty of Civil Engineering, Shahid Rajaee Teacher Training University, Tehran, Iran.*

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Abstract

This paper presents a numerical study on the behavior of prequalified Bolted Extended End Plate (BEEP) moment connections when are affected by cyclic loading. Specimens were six four-bolt extended end-plate connections consist of H-shaped columns and I-shaped beams with different geometry as well as different end-plate size and bolt diameter; three of them were stiffened by a triangular rib plate welded to the top and bottom of the beam flanges, and others remained unstiffened. They were modeled in ABAQUS software and their cyclic behavior was evaluated using finite element analysis. Responses of specimens were examined by presenting their equivalent plastic strain, stress distribution, and moment-rotation hysteretic curves. Results revealed that with the increase of beam height and inertia moment in equal story drift rotations, the reduction of connection strength occurred earlier due to the occurrence of local buckling in the beam web and flange after subjecting to cyclic loading. By comparing moment-rotation hysteretic responses of specimens, it was found out that in unstiffened BEEP connections with thinner end-plate, the use of single vertical rib stiffener can slightly improve their cyclic behavior, but in connections with thicker end plate, it showed no considerable effect. It was concluded that the BEEP connections whose dimensions are not based on the tenth code of the Iranian national building regulations, cannot satisfy the criteria of AISC seismic provisions for both special and intermediate steel moment frames, although they experienced no local beam web and flange buckling.

Keywords: Bolted Extended End-Plate Connection; Unstiffened; Rib Stiffener; Steel Moment Frame; Finite Element Analysis.

1. Introduction

Nowadays, the use of bolted extended end-plate (BEEP) moment connections has become popular due to ease of fabrication, erection, and proper seismic performance. These connections are for connecting a beam to column or splicing two beams together. BEEP moment connections are included in the 2010 ANSI/AISC 358 [1], and seismic test results have shown them to be capable of providing considerable ductility and seismic resilience. These connections are prequalified moment connections in the AISC 358 standard [1] for special moment frames (SMFs). BEEP connections are classified in terms of relationship between the moment transmitted by the connection and their rotation in the plane of connection [2]. According to European Standard [3] and many other studies; it can be classified by its rotational stiffness, strength and ductility. There are three types of BEEP connections including four-bolt unstiffened, four-bolt stiffened, and the eight-bolt stiffened. "In stiffened connections, a triangular stiffener is welded between the outer surface of the beam flange and the extended portion of the end plate" [4]. This stiffener increases the strength and stiffness of the end plate, and reduces prying action and distributes flange forces among the bolt group.

The behavior of the prequalified BEEP connections has been investigated through many experimental and analytical studies. The earlier studies have shown that the ductility and energy dissipation of four-bolt unstiffened and stiffened extended end-plate connections can be improved if end plate, end plate stiffener and bolts are designed to

* Corresponding author: rezajannesar.srttu@gmail.com

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