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Seismic Response Reduction of Steel MRF Using SMA Equipped Innovated Low-damage Column Foundation Connection

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Abstract

Connections in MRFs are the most important members and seismic behaviour is affected by function of beam column connections as well as column foundation connections. If the connections are able to provide the required ductility and efficiency against the seismic excitation, the seismic capacity of the MRF performed by these connections will be affected. SMAs have recently been used as a tool to dissipate energy in structures. So far, using of them for column foundation connections has been applied much less. In this paper, SMAs have been introduced and an innovated column foundation connection equipped with SMA has been suggested. Micro and macro behaviour of the connection has been studied and it was applied in sample MRF. Seismic response of the MRF under different earthquakes by equipping the connection with steels/SMAs bars have been studied and compared. Finally, results indicated that MRF with this connection showed proper seismic performance.

Keywords: Seismic Performance; Low-damage Column; Foundation Connections; Steel MRF; NiTi SMA.

1. Introduction

One of the resistant structures against lateral loads is moment resistant frame (MRF) in which the beams and columns form a moment frame through a fixed support in connections. Connections are the most important members in MRFs. Because of this importance, recently many researchers focused their investigation on beam to column connection and behaviour of MRFs. Experimental results of three Reduced Beam Section Tubular TW-RBS connections under cyclic loading have been conducted [1]. The load transfer mechanism and load-bearing capacity of cast steel joints for H-shaped beam to square tube column connection based on the deformation compatibility theory are studied [2]. The optimum design of planar frames with semi-rigid connections by standard sections from (AISC) table has been Studied [3]. Steel bolted connection and bolts satiation on connection plate for high strength steel connections built up with high strength bolts have been investigated [4].

The performance and ductility capacity of the connections in bending structures are the most crucial factors governing the seismic capacity of these structures. In addition to beam-column connections, the method of connecting the columns to foundations is of great importance in tolerating lateral loads by the MRFs. Different ways of connecting column to foundation brings about different performance of MRFs. Since the connecting method of column to foundation was decided by the designer, one can decide on frame performance selection. This issue can be the basis for offering a controlled connection method, the schematic of which has been shown in Figure 1. If the above mentioned connection has an unlimited rotational stiffness, it will function like a restraining connection; if it lacks a rotational stiffness, it will perform like a hinged connection and in the aforementioned scope, it will show appropriate performance under rotational and seismic loadings if it applies appropriate materials. The dynamic performance of the

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