NONLINEAR BEHAVIOR OF RC FRAMES STRENGTHENED WITH STEEL GUSSET PLATES AND CURBS

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ABSTRACT

One of the severe deficiencies in RC frame structures making it vulnerable against earthquakes isthe inadequate shear resistance of beam-column joints and low stiffness of frames. To improve the seismic performance of the structure, improving the performance of its joints is essential. A steel curb and gusset plate system is introduced at the beam–column connections to protect the joint panel zone from extensive damage and brittle shear mechanisms, while inverting the hierarchy of strength and stiffness within the beam-column subassemblies and forming a plastic hinge in the beam.

In this paper, the RC frames which were strengthened using this proposed method are investigated under monotonic lateral force using the numerical modelling. After verifying the models, local and global behavior of these frames, such as displacement, strength and ductility factor were studied. Analytical results show that maximum and ultimate lateral force of the strengthened frames has grown up to two times of the ordinary frame, averagely. According to the results, when the number of gusset plate increases, the strenght and stiffness of frames will increase remarkbaly but the ductility factor of frames will decrease relatively. The analytical results also demonstrated the effectiveness of the proposed solution for upgrading of RC frames andthe displacing ofplastic hinges to far from the beam-column joint.

INTRODUCTION

At recent decades, numerous earthquakes have caused severe damage or have led to collapse of old structures. Many existing reinforced concrete (RC) frame buildings were designed and constructed under the old seismic codes and regulations as those details are often not enough for proper seismic behavior, particularly in the beam–column connections,and or the lateral and horizontal displacement of them are not in safe rang.Therefore, these deficient frames often do not the capacity to resist under earthquakes and need to be strengthened. For this purpose, different approaches have been proposed by researchers.

Atfew recent years, adding steel braces to concrete moment resisting frames (MRFs),jacketing with thin plainconcrete or high performance fiber reinforced cementitious composites HPFRCC, flat and corrugated steel plate jacketing, attachment of steel plates, using of FRP composite materialas externally bonded sheets,have used for local and general retrofitting of deficient RC frames. Each of the preceding methods can be used for upgrading and improvingof linear and nonlinear behavior of RC frames such as rigidity, ultimate strength and ductility. Also many researchershave investigated these mentioned methods