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

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It is essential to rehabilitate the existing structures due to many reasons including the retrofitting of damaged structures under the earthquakes or the need for strengthening or retrofitting undamaged structures designed based on the previous building codes, upgrading due to mistakes in the construction process.

In some countries, steel bracing systems have been used for the rehabilitation of non-ductile RC buildings. Said and Nehdi (2008) proposed beam-column connection rehabilitation technique using local steel brace members. The technique of using steel elements, called steel props and curbs in beam-column connections is usable for local and global strengthening of RC frames. Cyclic behaviour of the damaged weak exterior RC beam-column connection retrofitted using this technique was studied by Sharbatdar et al. (2012) experimentally. The main idea of this technique was using a stiff member which acts as a resistant arm. So it decreases the forces and damages in panel zone consequently.

Emami and et al. (2014) and Khalili and et al. (2014) made numerical work on abilities of the steel props and curb method at strengthening of RC frame and investigated the global behaviour of the strengthened frames by this method.

In this paper, the steel gusset plates and curbs method for strengthening of RC frames is suggested and the capability using of this method at developing behaviour of a RC frames is investigated. The steel curbs are erected at top end of the columns and at both end of beams and every gusset plates are located between the curbs of beam and columns. At this research the impact of number and dimensions of gusset plates at every side of connection are studied. Figure 1 indicates the strengthening method of frame with steel gusset plate and curbs.

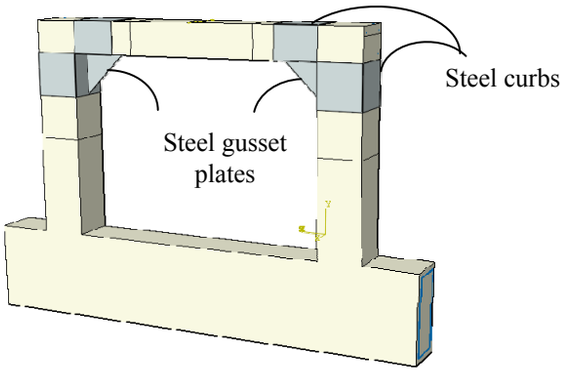
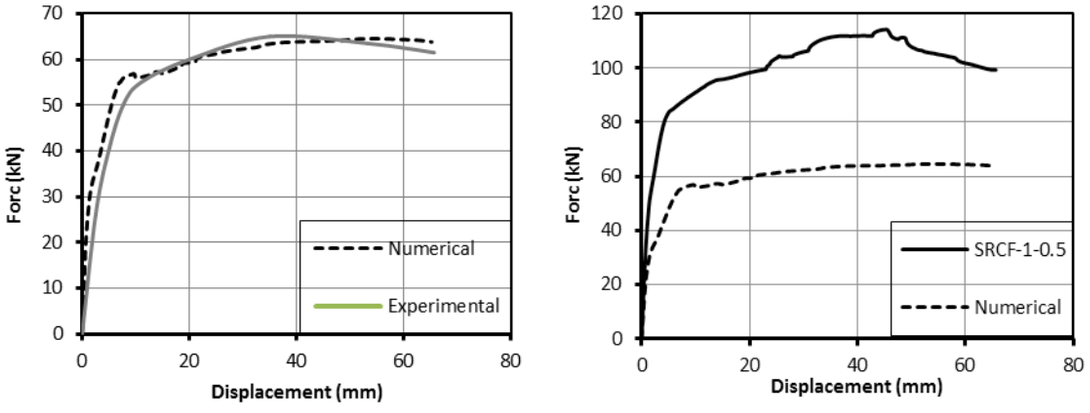


Figure 1. Strengthening method of frame

For verifying performance of elements and behavior of models in program (ABAQUS-2010), an ordinary RC frame which has been tested in structural lab of Semnan University, by Hemmati (2013) were used. After modelling and verifying performance of the model, local and global behaviour of these frames was investigated; displacement, ultimate strength, ductility factor and reduction factor of frames were calculated and studied. Figure 2.a present Force-Displacement diagrams for ordinary (tested in lab and finite element model), and Figure 2.b shows SRCF (strengthened with steel gusset plate and curbs) frame's response against verified ordinary frames.



a) Verification of numerical model b) Numerical ordinary and SRCF frames

Figure 2. Comparsion of Force-displacement diagrams of ordinary and SRCF frames

Results were indicated that adding of a steel gusset plates and curbs to every side of frame cause to the stresses at panel zone were decreased and plastic hinges formed at vicinity of steel curb and outside of panel zone and the maximum strength, rigidity and energy absorption of strengthened frames were increased about of twice relative to ordinary frame but the ductility factor decreased. When the gusset plate dimensions (as number, thickness and length) and length of curbs increases, the maximum strength, rigidity and energy absorption will increase and ductility decrease. The length of steel curbs and gusset plate relative to other investigated parameters had more impact at behaviour of strengthened frames.

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