PERFORMANCE EVALUATION OF DAMAGED STEEL MOMENT FRAMES UNDER MAINSHOCK-AFTERSHOCK EARTHQUAKE SEQUENCES WITH CONSIDERING THE PLASTIC HINGES MODIFICATION FACTORS

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Mainshock–aftershock sequences ground motions are characterized by the repetition of medium-strong earthquake ground motions and separated by short intervals of time. There is a time gap between mainshock and aftershock for most seismic sequences. After the excitation of the mainshock, the vibration of the structure will cease gradually due to damping. In most cases, the components may have the residual displacement, begins to move when the aftershock presents.

There have been several investigations aimed at studying the effects of seismic sequences on the response of structures. All of those studies could be categorized in two groups. The first group of those researches has been focused on the nonlinear response of single degree of freedom (SDOF) systems such as Mahin (1980), Hatzigeorgiou (2009), etc. The other one studied the responses of multiple degree of freedom (MDOF) systems such as Li and Ellingwood (2007), Ruiz-Garcia et al. (2008), etc. Recorded or artificial sequence-types ground motions were used in the above studies.

In the all past studies main shock–aftershock sequences were modeled by back-to-back identical accelerograms. Unfortunately, the number of mainshock–aftershock ground motions in the databases is limited in comparison with the single mainshock ground motions. Moreover, the general moment-rotation relations of the structural elements during the sequence of main shock-aftershock were constant. However, it is necessary to propose a proper method to simulate the mainshock–aftershock sequences. Therefore, a more realistic procedure will be taken herein to model the main shock–aftershock sequences.

This paper presents results of an aimed study to evaluate the effects of aftershocks in steel moment frames buildings. For this purpose, a 15-story 2D special steel moment frame considered.

In order to evaluate the structural behaviors of steel moment frames under mainshock–aftershock sequences, the frame elements are modeled by series of moment–rotation relations that take brittle fracture of the elements under mainshock–aftershock sequences (FEMA 355c). In this method for every damage state has been considered a proper moment-rotation. Each plastic hinge behavior has been saved the effect of the initial excitation, and the responses of the structure are more realistic than the responses of structure under mainshock-aftershock sequence. At first, the nonlinear behavior of the intact structure was evaluated under mainshock ground motions. Then depends on the level of damage in each element, the suitable damaged hinges were assigned. This procedure is illustrated in Figure 1 as below.

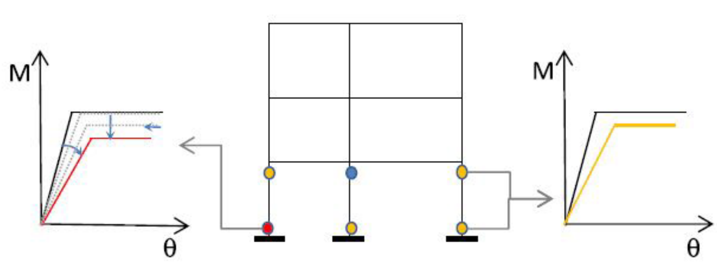

Figure 1. The proposal method (plastic hinges modification factors) for seismic performance of the building under sequence of mainshock-aftershock (Di-ludovico et al., 2013)

Next, after assigning the damaged behaviors of each element the performance of the damaged structure is evaluated. Nonlinear dynamic analysis (nonlinear time history analysis) is utilized for this purpose. The results indicated that the effects of aftershock on structural damages are significant.

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