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COMPARISON AND EVALUATION OF MOMENT FRAME FREQUENCY AND RESPONSE ACCURACY UNDER CHARACTERISTIC MATRICES BASED ON CLASSICAL AND MODIFIED SHAPE FUNCTIONS

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Abstract

Stiffness, mass and more accurate frequency estimation are the key parameters in calculating, designing and obtaining base shear forces in structures. In this study, first, the experimentally available natural frequencies of a five-story moment frame were compared with the results of two numerical methods, i.e., the natural frequency obtained from the mass and stiffness values of classical shape functions and those obtained from the proposed modified shape functions. The frequencies are also compared under four damage scenarios. Matlab software is used, in this step. The results showed that the moment frame frequency results from the modified stiffness and mass matrices of real shape functions had approximately less than one percent error compared with the experimental data, whereas the error of frequencies using stiffness and mass matrices from classical shape functions was up to six percent compared with the experimental data. Next, five-story intact frame was modeled in SAP2000 in order to implement nonlinear dynamic analysis and compare the base shear and displacements. Seven seismic records were applied to the frame, and its base shear and displacement values were compared with the two frequencies obtained in the previous section from the classical and modified stiffness and mass matrices. According to the findings, the base shear of the frame under the modified mass and stiffness matrices was 21-36% lower than that under the classical matrices, depending on the seismic records. Moreover, the modified model had a 17–26% lower displacement than the classical model. In short in this article, a modified theoretical and computational method is presented to achieve a more accurate frequency of the frame element. Fortunately, by using this method, we reached more accurate results and closer to the results extracted from an experimental work.

Key words: natural frequency, nonlinear dynamic analysis, mass and stiffness, shape functions, steel moment frame

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