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INVESTIGATING THE EFFECT OF CHANGING PERFORMANCE OBJECTIVE ON RESILIENT STRUCTURES

Bahram MOHAMMADPOUR
Ph.D. Student, Urmia University, Urmia, Iran
ba.mohammadpour@gmail.com
Alireza MANAFPOUR
Assistant Professor, Department of Civil Engineering, Urmia University, Urmia, Iran
a.manafpour@urmia.ac.ir

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With the development of earthquake engineering science and the experiences gained from the previously occurred earthquakes and also the compilation of seismic and design codes, the concept of safe structures that are resistant against earthquakes has been partly determined. The codes have defined seismic demands and certain performance levels based on defined performance objectives. However, according to what was observed in recent earthquakes, the structures have not been able to show the expected performance during strong earthquakes (Un et al., 2015; Molina Hutt et al., 2015). This leads to numerous problems and financial damages and restoring to the pre-earthquake state would be time-consuming and costly (Han et al., 2016). Therefore by changing the performance objectives of the structures we might be able to design them in a way that they would be more resistant against earthquakes and bear less damage. This would also mean less structure repair time and cost and it would minimize the mental and physical injuries of the afflicted and would increase the general resilience of the buildings. In this study, concrete frames are designed under Design Basic Earthquake (DBE) and Maximum Considered Earthquake (MCE) spectral response acceleration. Then, according to the methodology of the research, the amount of losses caused by the earthquake is evaluated based on the FEMA p-58 method by the PACT software.

In this study, performance assessment of structure has been carried out using the nonlinear time history analysis and exploiting intensity-based assessment method. This method has been done according to the process presented in FEMA P-58 (ATC 58, 2012a & ATC 58, 2012b) and is performed using PACT (PACT) calculation tool.

Intensity-based assessments provide expression of a building's probable performance for a specified intensity of shaking at the building site. The specified shaking intensity is represented by a user-defined 5% damped elastic acceleration response spectrum (ATC 58, 2012b).

To assess the performance of a structure based on intensity, nonlinear time history analysis is done on the structures. To do this, a pair of ground motion records is selected based on the similarities of their response spectrum and the target response spectrum and then they are scaled. A nonlinear analysis is done on the structures to investigate the studied buildings' response to these scaled records; and finally the performance of the structure is calculated.

The nonlinear time history analysis is summarized in the following steps according to the process presented in FEMA P-58 (ATC 58, 2012b):

- Defining Earthquake Hazards
- Analyzing Building Response
- Inputting Response and Calculating Performance

The results of the study are presented in Figures 1 and 2.

The conclusions of this study are as follows:

The results indicate that changing performance objectives and upgrades will greatly reduce the amount of repair costs, repair time and damage (mortality) and increase the structural resilience. Therefore, the repair time of the structures is reduced and the structure recovery can be improved.

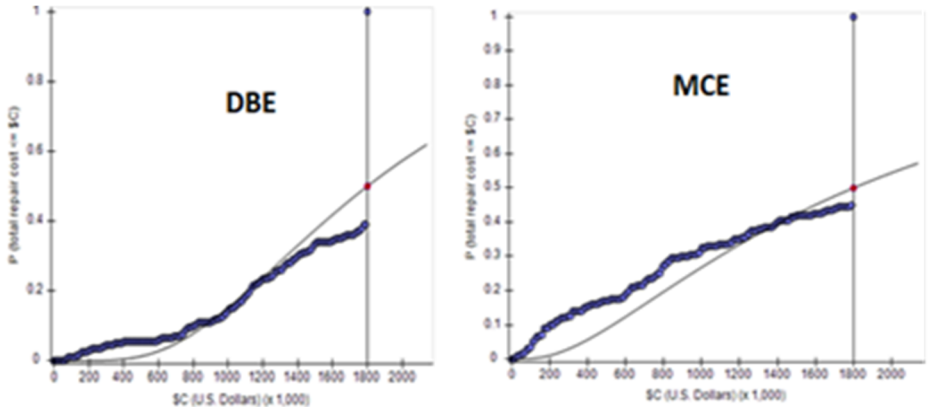

Figure 1. Comparing repair cost at two different levels of risk.

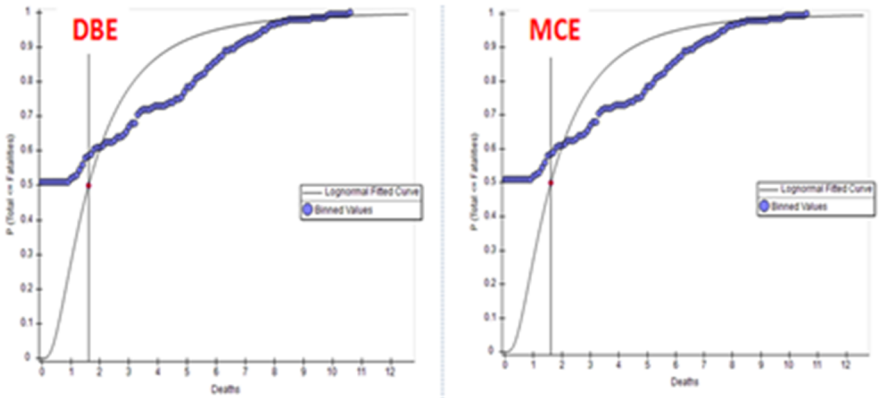

Figure 2. Comparing Casualties (deaths) at two different levels of risk.

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