DEVELOPMENT OF SIMPLE METHOD FOR RECORD SELECTION IN STRUCTURAL COLLAPSE RISK ASSESSMENT

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Keywords: Record Selection, Epsilon, Collapse Assessment, Mean Annual Frequency

From the various intensity measures that may be applied for evaluation of the seismic risk of structures, the acceleration response spectrum, Sa(T), is the most famous (Baker and Cornell, 2005). As a key assumption in usual risk assessment procedures, like as PEER methodology, the structural response depends only upon the applied intensity measures, and not on any other properties of the ground motion. This required condition has termed "sufficiency" of used intensity measure. The limited "sufficiency" of Sa (T) has been emphasized in the recent researches and as a result, different methods have been proposed to modify the structural response analysis. In this paper, the problem has been re-defined and then the recent studies have been surveyed.

This paper is mainly focused on the spectral shape concern. It has been discussed how the spectral shape of a ground motion affects the structural nonlinear response. Epsilon, as a well known seismological parameter is introduced as a convenient indicator of spectral shape. Epsilon as an indicator on the spectral shape has significant influence in the structural collapse risk assessment. The epsilon is defined as a measure of the difference between the spectral acceleration of a record and the mean value obtained from a ground motion attenuation model for a given period (Baker and Cornell, 2006).

As a direct approach for the consideration of the spectral shape in the record selection, a target ε value, associated with a selected hazard level, is first obtained from the hazard disaggregation procedure, and then records with a closer epsilon value to the target value can be chosen. The major challenge in considering the spectral shape for the selection of records lies in the finding of different sets of ground motion records for each level of hazard for calculation of the MAF of a limit-state for a given structure. Due to the dependence of epsilon on period, it may not be practical to select different specific ground motion sets for any specified period (T1) corresponding to a given site with a particular hazard level.

A simple alternative has been proposed in the ATC63 project which could be used instead of the direct selection approach. In this approach, a general set of ground motion records could be used for assessment of the collapse fragility of any structure, without considering the spectral shape of the records. The resulting mean collapse capacity can then be adjusted to meet the hazard-related target epsilon value (Haselton and Deierlein, 2007). The major challenge of this method is that the objective structure shall be necessarily analyzed via a huge number of ground motions which is unfavorably time consuming task.

Another more straight-forward approach is defined in this paper for the mentioned issue. In this method, an efficient range of epsilons is proposed to select a limited number of ground motions for collapse risk assessment of the objective structure. A program has been provided in MATLAB that could find the best interval for epsilon for any stucture. The proposed efficient range depends on the structural major parameters, number of stories and ductility. Then a formula has been calculated with a regresssion between these epsilons and number of story and ductility to estimate the efficient epsilon. With these efficient ranges of epsilon the mean annual frequency of structures can be simply estimated. Figure 1 shows

mean annual frequency for a 2 stories structure,with period of 0.56s and ductility=10. This figure shows the validity of this simplfied method as well as the other two methods. The attenuation model in this paper is AS97 (Abrahamson and Silva, 1997) and all of the data buildings are in previous works (Haselton and Deierlein, 2007).

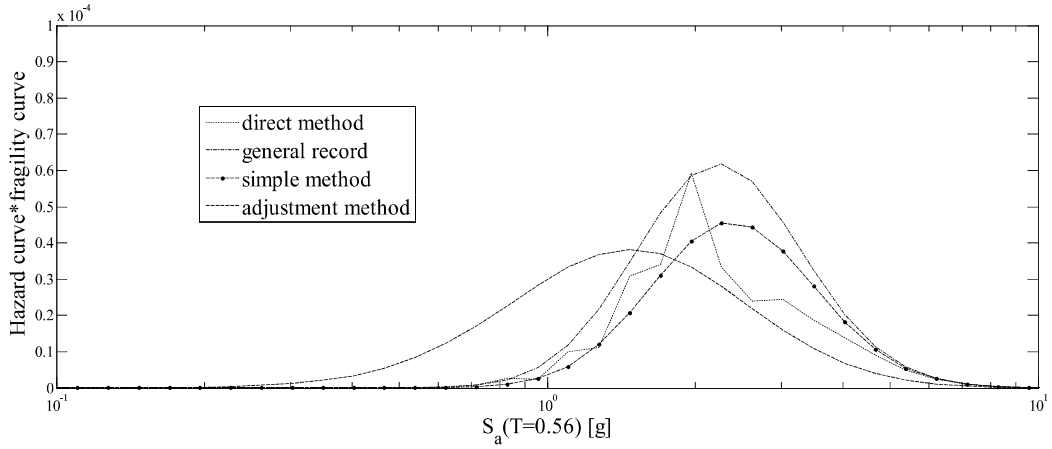

Figure 1. The effect of different approaches for the consideration of spectral shape in MAF analysis for 2-stories structure

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