APPLYING VALUE ANALYSIS IN DESIGN OF ISOLATED STRUCTURES

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ABSTRACT

In an optimal seismic design, structural performance should be in a balance with other variables which form the design space. In practice, such a balance can be achieved by using the value analysis in which cost-benefit analysis methods are often applied to assess the value. To develop regulations by which the optimal performance is directly obtained by the value analysis, study structuralsystems from the cost-benefit point of view is essential. In the present research by employing the value analysis, the optimal performance of the isolation system for low-rise frame structures is studied. Firstly, a design framework is proposed in which the main design variables in cost-benefit analysis of structures are taken into account. Then, using this framework indifferent case studies, the optimal performance of the isolated structures is identified under different design situations. In each case, besides the isolated structures, the same structures with fixed bases are analysed. The results show how the optimal performance varies with respect to variation in occupancy type, design life period, and also economic environment. One of the main results shows that the use of the seismic isolation is not justifiable for structures with residential occupancy.

INTRODUCTION

The cost-benefit analysis is an efficient tool for the value assessment in a structural design problem. In the recent years, various frameworks have been proposed to evaluate the performance of a structural design under seismic loads from cost or cost-benefit point of view (e.g., Wen and Kang, 2001, Sanchez-Silva and Rackwitz, 2004, Goda and Hong, 2005, Taflanidis and Beck, 2009). Despite the general similarities between the existing frameworks, most of them are merely based on cost analysis methods and role of benefit as the inherent part of the value analysis has not been considered. Moreover, in the carried out studies, comprehensive approaches are not often applied to account for all the influential variables in cost-benefit analysis. For instance, the effect of the design life span and economic environment as the important variables in cost-benefit analysis has been considered in only few studies (Wen and Kang, 2001, Sanchez-Silva and Rackwitz, 2004).

The use of value analysis becomes more important in relation to design of structural systems such as base isolation. In base isolation technique, performance of structure is significantly improved, but cost of construction increases in comparison with cost of conventional systems. To find the optimal performance for isolation system, different cost aspects such as construction and life cycle costs should be integrated into a cost-benefit analysis. However, only few of studies have considered the cost-benefit issues related to the analysis and design of isolation system (e.g., Goda and Hong, 2010). On the other hand, the aim in the existing method for design of isolated structures is to provide a high-level of the structural performance (Naeim and Kelly, 1999), while the high performance level may not be necessarily the optimal solution for the design of isolated structures from the value-based point of view.