IMPROVEMENT OF SEISMIC CONTROL OF CABLE - STAYED BRIDGE USING SIMULTANEOUS ANALYSIS OF COST AND LOSS

VahidAKHOONDZADE NOGHABI
M.Sc student, University of Tehran, Tehran, Iran
akhoondzade@ut.ac.ir

KhosrowBARGI
Professor, University of Tehran , Tehran , Iran
kbargi@ut.ac.ir

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ABSTRACT

In cable-stayed bridges, passive seismic control is usually performed by using bearingdevices in the place where deck and pylons connect to each other. However, owners usually refuse to use more expensive bearing devices despite their superior seismic behavior.In Mashhad cable-stayed bridge as a case study located in Iran, Pot Bearing device has been used which is not very effective in seismic behavior. While, Elastomeric Bearing Pads or Lead Rubber Bearings are more effective in absorbing earthquake's energy due to higher damping. Thus, the use of Pot Bearing was probably because of the lower costs compared to Lead Rubber Bearing.So in this paper, we are going to thoroughly compare the use of different bearingdevices in Mashhad bridge using simultaneous analysis of the construction costs and losses due to earthquake.Indeed, if economically justified, this paper tries to improve the passive seismic control device of the Mashhad bridge from its current Pot Bearing to another type. The economic justification is studied using seismic risk assessment process alongside simultaneous analysis of costs and losses. To achieve this purpose, it is necessary to design and control the bridge for seismic behavior with three aforementioned different bearing devices. Then, the seismic risk assessment process is performed for each cases. The final results of seismic risk assessment process are achieved as Total Loss Ratio curves. Then, the proposed Cost-Loss-Benefit (CLB) method will compare the three cases by defining Benefit Ratio (BR) as a profitability measure. The final results indicatethat both of the alternative cases increase the costs and decrease the losses compared to the existing Pot Bearings. However, simultaneously considering the costs and losses, the BR coefficient reveals the profitability of the use of Lead Rubber Bearings in Mashhad cable-stayed bridge.

INTRODUCTION

The bridges as an important means of transportation, must remain relatively undamaged for emergency disaster relief. Howbeit, about cable-stayed bridges as a good option for long spans, intense damages are reported during the Chi-Chi earthquake (Chang et al. 2004). Their Long spans and low damping could be the cause of their vulnerability and so some researchers focus on seismic risk assessment of this type of bridges (Casciati et al. 2008, Pang et al. 2013).

Seismic risk assessment is usually performed in two sections; vulnerability assessment in the form of fragility curves and loss assessment in the form of Expected Annual Loss (EAL) estimation (Mander et al. 2007). In order to apply the uncertainty of demand in seismic risk assessment, different methods such as Capacity Spectrum Method by Olmos et al. (2012), Time History Analysis by Pang et al. (2013), or Incremental Dynamic Analysis by Mander et al. (2007) are generally used.

However, one of the applications of seismic vulnerability or risk assessment is comparing different design schemes according to their fragility curves or seismic loss (Shinozuka et al. 2002, Kim et al. 2008).