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A METHODOLOGY FOR DERIVATION OF SEISMIC FRAGILITY CURVES FOR BRIDGES WITH THE AID OF ADVANCED ANALYSIS TOOLS

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SUMMARY

Advanced inelastic analysis tools developed by the authors that include, among others, modal pushover analysis based on appropriately selected monitoring points for drawing the pushover curves and utilising the popular demand and capacity spectra approach, and time history analysis accounting for the influence of spatial variability of earthquake ground motion on both straight and curved bridges, are briefly presented. These tools are then used in the frame of a methodology for analytically deriving fragility curves for different types of bridges; two such case studies are presented herein, involving two different types of actual bridges.

1. INTRODUCTION

Within the framework of a major research programme in Greece ('ASProGe: Seismic Protection of Bridges') coordinated by the Laboratory of Concrete and Masonry Structures of the Aristotle University of Thessaloniki, the need arose for deriving seismic fragility curves for all types of bridges commonly found in the motorway system of Greece; these bridges can be considered as representative of current seismic design practice in Southern Europe. The ensuing fragility curves will be used, among other applications, as part of the seismic risk management system of the bridges along the 680km long Egnatia Motorway in Northern Greece (some of which are instrumented within the framework of the ASProGe project).

Several methods are currently being tested for producing fragility curves for a total of ten different types of concrete bridges, identified as the most common ones in Egnatia. The analysis of these bridges is carried out using advanced inelastic tools developed by the authors, which include, among others:

- Modal pushover analysis based on appropriately selected monitoring points for drawing the pushover curves, and the popular demand and capacity spectra approach.
- Time history analysis accounting for the influence of spatial variability of earthquake ground motion on both straight and curved bridges, as well as of soil-foundation-superstructure interaction.

The paper gives an overview of both the key features of the aforementioned advanced analysis tools and of the method used for deriving fragility curves; the latter are drawn assuming a lognormal distribution, and constructing the basic relationship between intensity of ground motion and bridge damage state using either pushover analysis or dynamic time history analysis. Damage state threshold values for the fragility curves are defined differently in bridges with yielding piers (of the column type), and bridges with elastomeric bearings and non-yielding piers of the wall type. Two examples of fragility curves will be presented, one for each of the aforementioned types (Krystallopigi Bridge and Lissos Bridge, respectively).

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