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EFFECT OF SOIL-STRUCTURE INTERACTION AND SPATIAL VARIABILITY OF GROUND MOTION ON IRREGULAR BRIDGES: THE CASE OF THE KRYSTALLOPIGI BRIDGE

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SUMMARY

This study focuses on the assessment of the curved, 638m long, twelve-span Krystallopigi bridge, which is currently under construction as part of the EGNATIA highway in northern Greece. An effort is made to investigate the potential influence of spatial variability of earthquake ground motion on curved bridges (as opposed to straight ones). It is shown that the structural performance of the particular curved bridge under earthquake loading is strongly affected by (a) the accuracy in modeling the properties of the incoming seismic wave field and the foundation subsoil and (b) the curvature and overall irregularity parameters.

INTRODUCTION

From all the parameters that define the non-linear dynamic response of complex structures like bridges, the input motion has by far the highest level of uncertainty. The last three decades, different approaches, methodologies and tools have been utilized to deal with this uncertainty and put it in a framework that can be quantified and thus uniformly interpreted by the practicing engineers and the scientific community. Along theses lines, the extensive use of refined response spectra worldwide is currently the primer tool for defining the input earthquake ground motion independently of the type of analysis that is to be used (i.e. equivalent static, response spectrum) while it is also used within the context of (spectrum compatible) accelerograms generation and time history analysis. Despite the fact that nowadays seismic design of important bridges is increasingly performed using dynamic analysis in the time domain, using natural or artificially generated earthquake records identical for all bridge supports, the question still arises whether such decision making process is still valid for extended structures. In particular for the case of bridges (especially long ones), it is clear that earthquake ground motion may significantly differ among the support points, in terms of amplitude, frequency content and arrival time, inducing under certain circumstances significant forces and deformations that would not develop if the assumption of synchronous excitation was adopted (Hao [1], Shinozuka & Deodatis [2], Zerva [3]). These spatial and temporal variations of seismic motion can be primarily attributed to four (a-d) factors (Der Kiureghian & Keshishian [4], Zerva [3]):

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