A CRITICAL REVIEW OF THE ROLE OF SPATIAL VARIABILITY OF GROUND MOTION, SITE CONDITIONS, AND SOIL-STRUCTURE INTERACTION, IN BRIDGE ENGINEERING

Kyriazis PITILAKIS [1], Anastasios SEXTOS [2], and Andreas Kappos [3]

[1] Professor, Department of Civil Engineering, Aristotle University Thessaloniki, Greece, pitilakis@geo.civil.auth.gr
[2] Civil Engineer, MSc-DIC, Ph.D., Department of Civil Engineering, Aristotle University Thessaloniki, Greece, asextos@geo.civil.auth.gr
[3] Professor, Department of Civil Engineering, Aristotle University Thessaloniki, Greece, ajkap@civil.auth.gr

ABSTRACT: The objective of this paper is to critically evaluate the importance of common assumptions made during seismic design of bridges that are related to the asynchronous character of ground motion, local soil conditions and soil-structure-foundation interaction. To this effect, an extensive parametric analysis scheme is applied, and relevant results from these analyses, as well as from the literature are compared and discussed. It is concluded that although significant effort has been put in shedding some light on the above complicated and multiparametric phenomena, there is still a lot to be learnt towards a more rational, efficient and safe design of R/C bridges.
Keywords: Spatial variability, site effects, soil-structure interaction, R/C bridges

INTRODUCTION

As major bridge design projects aim at a safe performance under unfavourable geological, seismotectonic and geotechnical conditions, the need typically arises for advanced design capabilities and enhanced know-how that would allow for dealing with complex problems that are not covered by modern seismic codes. Moreover, the importance of such structures, in view of the high socioeconomic cost that a potential structural failure entails, calls for consideration and proper treatment of a number of uncertainties involved in the determination of the dynamic response under earthquake loading. To this end, it is of particular interest to focus on the importance of the simplifying assumptions typically made during seismic design, either when following code provisions or even during advanced dynamic analyses of bridge structures. Bearing in mind that to date significant research effort has already shed some light on the above phenomena and that important aspects of the dynamic bridge response have been thoroughly examined, it is often the case that the conclusions drawn are very much case dependent and, under certain circumstances they even appear contradictory, thus hampering the development of a definitive methodology for estimating the dynamic response of a bridge under earthquake loading. Such assumptions often refer to the spatial and temporal variation of ground excitation among the pier supports, the characterization of the underlying soil profile, as well as the interaction of the overall soil-foundation system with the structure. The extensive use of such simplifying assumptions in practical design, not only results in the oversimplification of the phenomenon studied, but also in the perpetuation of certain misconceptions and fallacies regarding the dynamic behaviour of bridges; some of them are discussed in the following.