Seismic response of bridges under asynchronous excitation: Implications for practical design according to Eurocode 8

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ABSTRACT

The paper aims to evaluate the way existing codes and guidelines treat the effect of asynchronous earthquake ground motion during the seismic design of bridges, and to discuss alternative solutions for cases wherein existing provisions do not lead to satisfactory results. The evaluation of current provisions and simplified methods is performed through comparison with a more refined approach whereas an effort is made to quantitatively assess the relative importance of various design and analysis assumptions that have to be made when spatial variability of ground motion is taken into consideration, based on the study of the dynamic response of 27 different bridges. It is concluded that, despite the complexity of the problem, there are specific cases where recent code provisions can be safely and easily applied in practice, while in other cases ignoring the effect of asynchronous excitation or performing simplified calculations can significantly underestimate the actual seismic demand.

Keywords: bridges, seismic design, earthquakes, ground motion, spatial variability

1. Introduction

From all the parameters that define the non-linear dynamic response of complex structures such as bridges, the input motion has by far the highest level of uncertainty. The last two decades different approaches, methodologies and tools have been developed 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. The extensive work on predicting or producing refined response spectra, as well as the large data of actual ground motions recorded on different soil and seismotechtonic conditions that are currently available, are a precious source of information that has allowed a better understanding of both the characteristics of seismic motion and its implications on the earthquake performance of bridges. Additionally, the increasingly enhanced capabilities now available for inelastic dynamic analysis, provide a very good estimate of the expected response of

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