Published by Elsevier Science Ltd.
12th European Conference on Earthquake Engineering
Paper Reference 653 (quote when citing this paper)

EFFECT OF ANALYSIS COMPLEXITY ON THE CALCULATED DUCTILITY DEMAND OF R/C BRIDGE PIERS

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ABSTRACT
A detailed parametric analysis of different bridge structures is carried out, to highlight the potential effect of analysis and modelling assumptions on the calculated ductility demand of reinforced concrete (R/C) bridge piers. Through a comprehensive approach for dealing with spatial variability, site effects and soil-structure-interaction phenomena within the context of inelastic dynamic analysis of bridge structures, 20 alternative bridge structures that vary in terms of structural type (fundamental period, symmetry, regularity, abutment conditions, pier-to-deck connections), dimensions (span and overall length), as well as ground motion characteristics (earthquake frequency content and direction of excitation) are examined. It is concluded that the ductility demand calculated when ignoring the coupling of the above phenomena can, under certain circumstances, underestimate the actual conditions.

Keywords: Bridges: Spatial variability: site effects: soil-structure interaction: Inelastic dynamic analysis; Reinforced concrete members.

INTRODUCTION
Capacity design is a well-established approach that aims at a controllable and hierarchically developed damage control. Its importance has been highlighted during recent earthquakes (Loma Prieta, 1989; Northridge, 1994; Kobe, 1995; Taiwan, 1999; Turkey, 1999) where it was shown that the design seismic forces may well be exceeded, and strength alone cannot ensure good seismic performance. Extensive research has been carried out, therefore, towards the identification of the optimal strength hierarchy within the structure and the subsequent selection, design and detailing of plastic hinges in pre-defined locations that would allow damage control and collapse prevention. The key parameters in this approach are the reliable estimation of the ductility demand and supply whose relative magnitude is crucial for the evaluation of the force redistribution and has to be assessed in advance. Nevertheless, a number of uncertainties related to the characteristics of the incident earthquake motion and the response of the foundation-soil system exist, directly affecting the calculated ductility demand, thus raising questions regarding the numerical accuracy of the capacity design procedure.

Along these lines, it was considered of particular interest to attempt to quantify the sensitivity of the inelastic dynamic response of bridges to three key simplifying assumptions made for