EARTHQUAKE ENGINEERING AND STRUCTURAL DYNAMICS
Earthquake Engng Struct. Dyn. 2003; **32**:607–627 (DOI: 10.1002/eqe.241)

Inelastic dynamic analysis of RC bridges accounting for spatial variability of ground motion, site effects and soil–structure interaction phenomena. Part 1: Methodology and analytical tools

Anastasios G. Sextos[1,†], Kyriazis D. Pitilakis[1,*,‡] and Andreas J. Kappos[2]

[1] *Laboratory of Soil Mechanics and Foundation Engineering, Department of Civil Engineering, Aristotle University of Thessaloniki, Thessaloniki, GR-54006, Greece*
[2] *Laboratory of Reinforced Concrete, Department of Civil Engineering, Aristotle University of Thessaloniki, Thessaloniki, GR-54006, Greece*

SUMMARY

During strong ground motion it is expected that extended structures (such as bridges) are subjected to excitation that varies along their longitudinal axis in terms of arrival time, amplitude and frequency content, a fact primarily attributed to the wave passage effect, the loss of coherency and the role of local site conditions. Furthermore, the foundation interacts with the soil and the superstructure, thus significantly affecting the dynamic response of the bridge. A general methodology is therefore set up and implemented into a computer code for deriving sets of appropriately modified time histories and spring–dashpot coefficients at each support of a bridge with account for spatial variability, local site conditions and soil–foundation–superstructure interaction, for the purposes of inelastic dynamic analysis of RC bridges. In order to validate the methodology and code developed, each stage of the proposed procedure is verified using recorded data, finite-element analyses, alternative computer programs, previous research studies, and closed-form solutions wherever available. The results establish an adequate degree of confidence in the use of the proposed methodology and code in further parametric analyses and seismic design. Copyright © 2003 John Wiley & Sons, Ltd.

KEY WORDS: bridges; spatial variability; site effects; soil–structure interaction; seismic design

INTRODUCTION

Seismic design of important bridges is increasingly performed using dynamic analysis in the time domain, wherein the response of the structure to appropriately selected and scaled time histories is strongly dependent on three key simplifying assumptions that are often made: (i)

* Correspondence to: Kyriazis D. Pitilakis, Laboratory of Soil Mechanics and Foundation Engineering, Department of Civil Engineering, Aristotle University of Thessaloniki, Thessaloniki, GR-54006, Greece.
† E-mail: asextos@geo.civil.auth.gr
‡ E-mail: pitilakis@evripos.civil.auth.gr

Received 10 December 2001
Revised 20 June 2002
Accepted 30 July 2002