SUMMARY

The present dissertation was worked out in the laboratory of Soil Mechanics and Foundation‘s Engineering of Department of Civil Engineering of Aristotle University of Thessaloniki. The main objective of this dissertation was the investigation of the effect of the spatial variation of ground motion in the seismic response of bridges from reinforced concrete.

So far, the omission or partial evaluation of the phenomenon of the spatial variation of ground motion from all the codes, in combination with the possible unfavourable effect of this phenomenon in the structures which present high economic and social cost (eg. bridges, etc.), makes the specific field of research particularly interesting and worthy of further research. In the last decades, in the international bibliography, there are some guidelines for the detection and the research of the phenomenon, without however general conclusions can be exported.

In the second chapter, there is an analytic review of the state of the art in the spatial variation of ground motion in experimental and analytic section. The stages of the methodologies of evaluation of asynchronous motion in the seismic excitation of the structures and the empirical and semi-empirical models of the coherence functions are mentioned. The main conclusions that resulted from the previous work in the phenomenon of the spatial variation of ground motion are mentioned as well. Finally, there is a reference to cases of possible damages in bridges that it is probably because of the effect of asynchronous movement.

Three straight bridges of reinforced concrete with total length of span 152.4m, 292.6m and 459.0 m are analyzed. The three models of bridges present enough differentiations regarding the total length of span, the distances of the piers and their geometry.
The main alternative approaches of analysis on the state of the art and on the state of the practice of the spatial variation of ground motion are described.

Particular emphasis in the guidelines of EC8 with regard to the phenomenon is given. Also, the basic methodologies of simulation of seismic excitation are presented, (generation artificial accelerograms in point generation artificial accelerograms taken into account the spatial variation of ground motion etc.).

In the fifth chapter, the cases of seismic excitation and the types of parametric analyses are presented. The cases take into account the effect of the difference in arrival times of seismic waves at different locations, commonly known as the “wave passage”, loss of coherence of seismic waves due to multiple refractions and reflections as they propagate through the soil medium “incoherence effect”, as well as both the parameters. The effect of the different method of simulation on the phenomenon in the estimation of the largest displacements of spans and the internal forces in the base of the piers is studied. It is also studied the relative effect of loss of coherence, the wave passage effect and the local soil conditions. Also, they are investigated the cases where the seismic response of structure is dominated by the parameters estimated of each individual phenomenon. The guidelines of EC8 with regard to the spatial variation of ground motion are evaluated. In all the analyses SAP2000 ver.8.1.1 (CIS) is used. The artificial accelerograms are generated with ASINC (Sextos A., 2001) and SIMQKE-II (Vanmarcke et al.).

Finally, in the sixth chapter, there is a synopsis and evaluation of the results as well as apposition of conclusions. It is observed the unfavourable influence of asynchronous motion in bridges of relatively big length, as well as the differentiation of the seismic response of the structure. In bridges of relatively small length does not exist the effect of this phenomenon. Also, possible uncertainties of EC8 are located, regarding his proposals to the case. At the

end, further study of the phenomenon of spatial variation of ground motion and the effect of this in the oblong structures is recommended.

The investigation of the effect of spatial variation of ground motion in the seismic response of oblong structures, constitutes a field of study which is related with structures of vital importance for the society. For this reason, further research is imperative, aiming the achievement of designing safe and economical structures.