ABSTRACT

The title of this dissertation is : *Nonlinear ground response analysis (1D) at existing soil profiles of Thessaloniki's coastland by studying liquefaction potential and the assessment of permanent displacements, according to the 475 years earthquake scenario.*

The present dissertation consists of ten chapters that are separated into two parts. Their structure and content are the following :

Part 1 : Bibliographic review relative to liquefaction phenomenon studies and the liquefaction hazard assessment.

Chapter 1, provides general definitions and descriptions of the liquefaction phenomenon and of the shear stress – shear strain curves at liquefiable soils.

Chapter 2, provides criteria of liquefaction potential, as well as the main points included in codes (EC8 - Part5, EAK2000) and NCEER-97 dispositions, relative to liquefiable soils. Finally, this chapter presents laboratory data relative to liquefaction studies and proposes improved criteria about the liquefaction potential of soils.

Chapter 3, reports prevalent in situ tests that are used for liquefaction resistance assessment such as: Standard Penetration Test, Cone Penetration Test and Becker Penetration Test.

Chapter 4, spells out general methods that are used for liquefaction hazard estimation as they are proposed by NCEER-97 and EC8 - Part 5. These methods are based on stress (developing shear stressess due to cyclic loading and cyclic shear resistance of soils) estimation.

Chapter 5, summarizes methods that are used for liquefaction hazard estimation, on a basis of shear strains estimation or energy and geological criteria (such as magnitude

M, epicentral distance R, Arias intensity). The latter are expounded from field records or laboratory tests.

Part 2 : Seismic ground response analysis (1D) of Thessaloniki's coastland.

Chapter 6, describes the seismotectonic, geologic and geotechnic characteristics of Tessaloniki's area, and then presents a map of the sites of this study and some typical soil profiles of Thessaloniki's coastland. Moreover, this chapter provides the accelerograms that are used for the nonlinear ground response analysis and finally presents epistemic studies of liquefaction potential at Tessaloniki's area which have been already elaborated.

Chapter 7, presents the computer code CYCLIC 1D which uses the nonlinear method and constitutes the basic tool of the earhquake response analysis that follows. Then, an equal example is given, and finally a comparison (differences) between the results of nonlinear analysis (using computer code CYCLIC 1D) and the results of equivalent linear analysis (using computer code EERA) is presented. The last paragraph of this chapter describes problems that immerge by using equivalent linear analysis.

In chapter 8, a preliminary study of liquefaction potential at Thessaloniki's coastland is attempted, by using simplified – analytical methods (specifically the proposed methods from EC8 and NCEER-97 that are described in chapter 4). This study is based on SPT and CPT data that are available in some sites. Finally, a settlement estimation is attempted, using the semi – empirical method proposed by Ishihara & Yoshimine (1992).

Chapter 9, presents the final results of the nonlinear analysis (computer code CYCLIC 1D). These results concern the spatial distribution of peak horizontal ground acceleration (PGA), velocity (PGV), displacement (PGD) and permanent horizontal ground displacemet at the free surface and a depth of 3,00 m, as well as the spatial distribution of peak developing shear stresses and stains at a depth of 3,00 m. Further more, the final results concern the spatial distribution of spots that liquefaction occures, thickness and top of the liquefied soil layers. Finally, this chapter presents the resultant normalized elastic response spectrums of acceleration at the free surface

as a result of statistics, as well as some comparative results between nonlinear analysis and equivalent linear analysis.

Finally, chapter 10 provides with the final conclusions.