

## **Abstract**

This master diploma thesis was worked out in the Laboratory of Soil Mechanics, Foundations and Geotechnical Earthquake Engineering at the Department of Civil Engineering of the Aristotle University of Thessaloniki.

The object of this project is to investigate the influence of several soil interventions to the seismic response of bridge piers. Specifically, the analysis will be executed initially on a pier of Krystallopigi Bridge and then parametrical analyses will be presented for four (4) different soil types, for two pier heights and for two seismic excitations (Lefkada, 2003 and Loma Prieta, Gilroy, 1989) with more emphasis on the Lefkada Earthquake.

After a brief introduction to the subject in the first chapter, numerical investigations of improved soil during seismic -or not seismic- excitations and experimental results based on the soil improvement are presented in chapter 2. In the next chapter, the basic principals of the soil improvement methods are presented while, more thoroughly, specific methods concerning soil stiffening, construction of either stiff or soft diaphragms, construction of soft layer and eventually soft caisson – which is a combination of soft diaphragms and soft layer - are presented.

In the 4<sup>th</sup> chapter, time history analyses were executed using the finite element program ANSYS, resulting in the response of soil and bridge pier separately. The purpose of this study, was to confirm whether the output of ANSYS was matching the theoretical solutions qualitatively. In addition to all these, in the 5<sup>th</sup> chapter, Krystallopigi Bridge is presented, emphasising on the pier geometry and the soil characteristics. A first transient analysis of the pier model in the lateral direction of the bridge is executed using the ANSYS finite element code.

The last chapter contains the investigation of the soil intervention effect on the pier response, in terms of acceleration. The analyses were initially run using the model of the specific pier of the Krystallopigi Bridge and then a parametrical study follows, using as parameters the soil type, the pier natural frequency and the seismic excitation. The purpose of these analyses was to demonstrate in which cases each intervention is better to be applied.

The conclusions of this study were that the soil stiffening intervention and that of stiff diaphragms unfavourable effect in the pier response and so it should be taken into serious consideration whether to apply these methods or not. The soft layer and soft caisson methods, decrease the pier response for every soil type. Finally, the construction of soft diaphragms, appears to have complicated behaviour, depending on the soil type and the pier height.