

## ABSTRACT

The theme of this project is the study of the dynamic behavior of a five-story building, with pilotis and pile-foundation, which is located in Lefkada and had serious damages during the earthquake of 14<sup>th</sup> August 2003.

In the first part of the project it is attempted to find out the causes of the damages of the building. For this reason a fixed-based model of the structure is created. Afterwards, a time history analysis, an elastic analysis with the response spectras of the seismic movement (damping 5%) and an analysis with the design spectra of "EAK2000" take place. From the comparison of the results of the above analysis, conclusions about the seismic behavior of the building during the earthquake of 14th August 2003 are drawn. In addition, given the asymmetry of the building, it is questioned how the angle of incidence of the seismic movement affects the response of the building.

In the second part of the project the effect of soil-structure-interaction is examined. For this reason the pile-foundation is modelled as elastic beams based on hooks in two directions, the stiffness of which is related to the type of the soil. The analysis of the new model are run based on the the seismic movement as it is estimated for various depths from the ground surface until the level, where the piles are fixed, in order to investigate the effect of the depth of the input of the model. The seismic movement at the place of the structure for different depths was estimated by means of two different programmes, cyberquake and cyclic, after the surface movement, where the hospital of the island is located, was deconvoluted to the bedrock. After the change in the dynamic characteristics of the building due to the soil-structure-interaction is examined, the results from the various analysis are compared. Afterwards the effect of the observed liquefaction in the seismic behavior of the building is examined. This phenomenon is taken into consideration in two steps. At first step it is included in the input, that is given to the analysis, which is calculated by means of the specialised for the liquefaction programme, cyclic. At second step, the reduced stiffness of the liquefiable soil-layer is taken into account by decreasing the value of the spring's constant. Finally, an analysis with imposition of constrained displacements along the piles takes place in order to achieve a more realistic resemblance of seismic movement that strikes the building. The displacements are related on the seismic movements of the various depths.

In the last chapter of the project the conclusions of the issues that where examined are summarised:

A. As far as the dynamic characteristics of the building and the causes f the observed damages are concerned, the twisting character of the oscillation of the structure is charateristic. As a result, the perimetric elements, especially the collumns, are more strained. The twisting ability of the building is attributed to the asymmetry of the building and the lack of sufficient walls. In addition the explosive clearage failures (short collumns) are imputed to the fact that the masonry infills at the ground storey are built only until the height of 2m above the pavement.

B. The angle of incidence of the seismic movement can differentiate the results of the analysis up to 30%.

C. The soil-structure interaction leads to 10% lower value of the period of the structure and 40% higher element forces in comparison with those of the fixed-based model. In addition, activation of the highest eigenvalues is observed.

D. If the seismic movement is taken uniform along the piles, the results from the analysis with the surface movement give up to 40% higher element forces compared to the corresponding forces from the analysis with the seismic movement of the depth -20m.

E. When the liquefaction is taken into account it is evident that while the peak ground acceleration is lower (for the seismic movement of the ground surface), the frequency content changes, so that the structure is affected unfavourably. Moreover, the reduction of the stiffness of the ground affects the element forces only when the liquefiable soil-layer is near the ground surface, where the piles bend.

Z. By the imposition of constrained displacements along the piles the structure is led to an intermediate situation in relation to the behavior of the structure for the uniform seismic movement of the surface and the uniform seismic movement of the depth -20m.