ABSTRACT

The aim of the post-graduate thesis presented here, is the assessment of the seismic performance of an old industrial building. The structure is located at New Ionia in Athens and is being upgraded in order to accommodate the office needs of the organization "Athens 2004". In this context, a brand new underground parking lot is constructed by deepening the existed foundations of the old structure, adding an extra level to the otherwise one- floor typical industrial building.

At first, an approximate evaluation of the reinforcement of the old concrete members of the building is carried out, according to older Greek codes of the time constructed. Accordingly, the design of the new concrete members of the underground floor is being made, according to the regulations mandated by the contemporary Greek Antiseismic Code. The reasons for the incapability to use equivalent 2-D frames in this case are explained, and thus making the use of 3-D mathematical models, analyzed exclusively with SAP 2000, a one-way path for now and on. Furthermore, the assessment of the seismic performance of the building is carried out, using the standard elastic dynamic eigenvector analysis procedure mandated by the Greek Seismic Code and the static nonlinear (pushover) analysis procedure as given by FEMA 356. In this procedure, the selected structural performance level was life safety, for a design earthquake with probability of exceedance 10% in 50 years. The analyses lead to the conclusion that the original structure's seismic performance is very poor and inadequate in respect to the Greek seismic code and FEMA's demands.

In the light of the above, a solution for the amelioration of the seismic performance of the structure is proposed, mainly aiming at the increase of its stiffness and strength by introducing X steel bracings at the main floor and the roof. To evaluate these strengthening measures a series of different kinds of analyses are taking place; standard elastic dynamic eigenvector analysis, static nonlinear (pushover) analysis, and different dynamic linear and nonlinear (time history) analyses for two seismic horizontal components of the ATHENS 1999 earthquake. The results were astonishingly improved compared to the original building, as far as its capability to sustain lateral seismic forces is concerned. The seismic performance of the improved structure goes well beyond the life safety criteria given by FEMA 356. Moreover, it is proved that the steel bracings undertake the major part of the seismic lateral forces induced at each analysis contacted and by exhibiting nonlinear behavior during an earthquake, they absorb large amounts of seismic energy, reducing the stress of the older concrete elements, while they can be readily replaced post-seismically.