ABSTRACT

The objective of this thesis, submitted in partial fulfillment of the requirements for the MSc degree of the Graduate studies program "Earthquake Resistant Design of Structures" was the assessment of a standard type school building (type B-A), by applying draft no.1 of the Greek Structural Intervention Code (ΚΑΝ.ΕΠΕ.). The building is made of cast in place reinforced concrete, consisting of a ground floor and two stores and its structural design follows the older Greek building codes (1954, 1959) and the construction practices and considerations that were valid during the '70s.

The goal of this assessment was the "life safety and property protection of the occupants, with a 10% probability of exceedance of the seismic action in a period of 50 years" (Β1-β1, as it is provided by the ΚΑΝ.ΕΠΕ.), which coincides with the goal of the 2000 Greek Seismic code (ΕΑΚ2000) for new buildings.

For the assessment of the building's bearing capacity the following two methods were applied, whose general principles, conditions and application rules are defined by the ΚΑΝ.ΕΠΕ.:

1. The Elastic Static analysis
2. The Inelastic Static analysis

The Elastic Static analysis with the q-factor method is implemented using the ETABS v.8.4.9. computer program and the computational tool e-tools, which makes easier the conducting of the required checks. Although the conditions provided by the ΚΑΝ.ΕΠΕ for the application of the Elastic Static analysis are not met, an attempt was made to apply it by deviation in this particular case. The intention of this application is to draw certain conclusions relevant to the bearing capacity of the building as well as to assess the validity of the conditions set by the Code. However, the results of the preliminary analysis, which was carried out for q=1.0 with the consideration that the structural elements bear 25% of the non cracked cross-sections' flexural stiffness, indicate that any further attempt to assess the building with the Elastic Static analysis (main analysis with q>1) is in vain, since it was made clear that, for the design seismic action, extensive inefficiencies are to be expected especially in the vertical elements.

As a second attempt, the Inelastic Static analysis was applied, using the ETABS v.8.4.9. computer program and a 3D-model. The analyses of the building were carried out for two load cases ("modal distribution" – "uniform distribution") while the seismic loads were applied on the two main directions of the building (100% in the one direction and 30% in the other, successively for the two directions). Additionally, two groups of analyses were carried out (A and B). In the first group (A) an attempt was made to take into consideration the prevailing form of failure (flexural or shear), during the simulation of the inelastic behaviour of the frame elements, which was conducted according to the method provided by the ΚΑΝ.ΕΠΕ, while in the second group of analyses (B) it was assumed that in all the frame elements the flexural failure precedes the shear failure.

The definition of the inelastic behaviour law of the elements was based on the analytical equations of ΚΑΝ.ΕΠΕ. The check of the general safety inequality of the building was done in terms of rotations (based on the developing and available plastic rotations of the frame elements), which are used to examine the flexural failure, and in terms of forces (comparing the developing shear forces with the corresponding resistances of the elements), which are used to check the possibility of shear failure.

During the elaboration of this thesis certain questions ensued concerning certain provisions of the ΚΑΝ.ΕΠΕ. The most important of these questions are pointed out with the purpose of improving the text of the ΚΑΝ.ΕΠΕ which is under formation.

Eventually the application of the Inelastic Static analysis, although its results are evidently more favourable, confirms in general the estimation of the preliminary elastic analysis, resulting in the conclusion that the bearing capacity of the building falls short of the required bearing capacity levels that were set by the goal of the assessment.