ABSTRACT

The current master thesis has been elaborated as a part of the post-graduate program of the department of civil engineering of the Aristotle University of Thessaloniki, entitled 'Earthquake Resistant Design of Structures'. The subject-matter of the thesis is the assessment of strictly frame structural system, according to the Greek code of practice 'Strengthening and Repair of Buildings' (February 2004). The assessment is established by both elastic and inelastic analysis, using performance base criterion the 'Life and occupants means safety' level.

The buildings analyzed are imaginary structures, designed according to the old Greek Earthquake Resistant Code (Royal Ordinance of the year 1959). The structure's design, which has been subject of an older paper, was made using an earthquake factor of 6%. The models analyzed are a 2-storey, a 4-storey and a 9-storey structure with an identical ground plan. It is well known that because of the huge reconstruction that took place during the 60's and the 70's in Greece, the majority of the biggest and well known city centers all over the country are full of buildings similar to those that this paper deals with. Due to the structure's symmetrical plan, the three dimensional model is simplified to a 2 dimensional frame according to the direction of analysis.

In order to evaluate the effective stiffness of the frames according to the Greek codes requests, a linear analysis is performed, assuming that the elements maintain only 25% of the actual pre cracked stiffness. Further to that, pre elastic analysis is being applied in order to check the conditions that the code demands to allow the use of the elastic static analysis. As long as the above conditions are fulfilled, the assessment using the elastic static analysis is being performed according to the two methodologies that the code suggests: using the entire (q) and the topic (m) behavior factor.

Furthermore, the inelastic static analysis (Pushover) takes place. In order to carry out the analysis correctly, there are some critical points that need special attention, given that the requested conditions for the use are being held. The critical points that needs special attention are the selection of the appropriate distribution of the seismic loads which are being enforced on each level of the structure's diaphragms, the correct evaluation of the target displacement where the assessment is being done, and the appropriate selection of the models through which the non linear behavior of the elements is being described. Concerning the first point the selected distributions are the ones that refer to the fist mode and the uniform. Regarding the second point, the target displacement is being evaluated through out the exact methodology that the Greek code contains. Last, the model used to describe the non linear behavior of the elements is the plastic hinges, because it is the model most capable to depict the building damages in both topic and entire level. The law describing aforementioned plastic hinges is critical for the analysis. Therefore, the available plastic rotation of each element has been evaluated by using three different methodologies: a) using already available formulas for calculating the rotation at yield (θ_y) and at failure (θ_u) b) through the curvatures at yield ($(1/r)_y$) and at failure ($(1/r)_u$) and an appropriate length of the plastic hinge which are all provided by the code through formulas, c) through the analytical evaluation of the curvatures at yield and at failure by using a computer

program (algorithm) that calculates the non linear response of a reinforced concrete cross-sections called 'RCCOLA'.

Resuming the thesis assesses the Greek code of practice 'Strengthening and Repair of Buildings' (February 2004) on the frame structural systems' vulnerability with an emphasis on the calculation of the law describing the plastic hinges.