

STRENGTHENING AND EARTHQUAKE RESISTANT DESIGN OF AN EIGHT-STORIED  
REINFORCED-CONCRETE APARTMENT BUILDING

by  
B.Simeonov<sup>I</sup>

During the construction of an eight-storied reinforced-concrete apartment building, it was observed that the strength of the concrete used in the first three stories is considerably smaller than the design strength of the concrete.

In order to define the resistant capacity of the structure to dead and seismic loads, a limit analysis was carried out on reinforced-concrete building frames and the possible positions of plastic hinges in case of earthquake was examined.

It was observed that in many joints, first plastic hinges are formed in the cross-sections of the columns and that the ratio between the axial force in the columns to the bearing capacity of the concrete sections is high for the lower stories.

For definition of the structural dynamic response analysis, bilinear story diagrams were used with three variants of the elastic stiffness, for the originally designed building.

The dynamic analysis was done for El Centro earthquake of May 18, 1940, the N-S component and Port Hueneme earthquake, 1957, N-S component.

Also, the influence of the change in stiffness upon the response of the structure to the above-mentioned earthquakes is discussed.

The results obtained show concentration of plastic deformations into the lower stories of the building for the three stiffness variants.

In order to improve the strength and ductility of the columns and to transfer the plastic hinges from columns to beams, the columns of the three lower stories of the building were strengthened with cover of new concrete and reinforcement.

The dynamic analysis of the strengthened structure gave better behaviour to the mentioned earthquakes.

The method of strengthening applied to this building enabled simple and economical repair together with the other work in the building.

In this way the basic architectural system was preserved and complete stability of the members, joints and structure to actual earthquakes achieved.

---

<sup>I</sup> Associate Professor, Building Section, IZIIS, University "Kiril & Metodij", Skopje, Yugoslavia.