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THE EFFECT OF THE DISPROPORTIONATE EFFECTIVE MOMENT OF INERTIA CAUSED BY CRACKS ON THE SEISMIC RESPONSE OF THE CONCRETE BUILDING

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Concrete buildings during its service life suffer from cracks which occur due to several reasons like creeps, temperature, cyclic loading (fatigue), shrinkage, exposing to chemical material and others. These cracks affect the response of the buildings to the external loads and especially the seismic response, because the effective moment of inertia for the building's elements decrease after cracking. Codes like UBC97, ACI318-14, and eurocode have provided formulas and structural details to estimate and control cracking procedure, and also give an estimate to the effective moment of the inertia for the cracked sections. To claim this factor, we can use values like those mentioned in ACI318-14, 0.7 Ig for columns and 0.35 Ig for beams, but we know that columns and beams in any building do not resist the same bending moment and shear force, so it is more logical to have a special effective moment of inertia for each element, and to claim it we will use the formulas in Table 5.5(b) from the ACI318-14 code.

Table 5. 5(b) -Alternative moments of inertia for elastic analysis at factored load (ACI Committee, ACI 318-14).

Member	Alternative value of *I* for elastic analysis		
	Minimum	***I***	**Maximum**
Columns and walls	0.35 I_g	$(0.8+25\frac{A_{st}}{A_g})(1-\frac{M_u}{P_u h}-0.5\frac{P_u}{P_0})$	0.875 I_g
Beams, Flat plates and flat slabs	0.25 I_g	$(0.1+25\rho)(1.2-0.2\frac{b_w}{d})$	0.5 I_g

Notes: For continuous flexural members, *I* shall be permitted to be taken as the average of values obtained for the critical positive and negative moment sections. *Pu* and *Mu* shall be calculated from the load combination under consideration, or the combination of *Pu* and *Mu* that produces the least value of *I*.

The purpose of these study is to have an accurate response of the structure due to the seismic load and to prevent a failure which occur due to underestimation of the whole response of buildings.

We have made five models for five buildings by using ETABS. In the five models we have used a frame system to resist the lateral load, in the first step we have analyzed the five models using the effective moment of inertia from the ACI318-14 codes 0.7 Ig for columns and 0.35 Ig for beams, then according to the axial force and bending moments in columns, and the reinforcement ratio in beams, we calculated the effective moment of inertia separately for each member and assigned it to the models, then we analyzed the five models again, we did this many times until we had a response without a big difference from the previous one, then we have compared the two case of response for the five models.

We have found a difference in bending moment and shear force, but this difference mostly does not essentially affect the design procedure; therefor, we can ignore it and take design according to the effective moment of inertia as 0.7 Ig for columns and 0.35 Ig for beams from the ACI318-14 or the Iranian code 4th edition. On the other hand, the most significant and considerable difference was in the story drift, so it should be considered especially in places where we have nearby buildings and a collision can happen, and in the very important building which should stay in service during the crisis, like the hospitals and emergency centers. Lastly we recommend to make at least one stage of analysing using the formulas in Table 5.5(b) to calculate the effective moment of inertia, to have a closer story drift's results from the real one, and to make sure that a collapse will not happen due to underestimating the story drifts.

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