FEM AND EXPERIMENTAL ANALYSIS OF COLUMNS WITH DIFFERENT STRENGTHS ALONG THE HEIGHT

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ABSTRACT

For a better efficiency in the use of the concrete, it is used concrete of higher strength to the compression in columns and concrete of lower strength in beams and slabs. Considering the constructive method traditionally adopted for buildings in Brazil, the region of the column that crosses the level of the pavement is shaped by the use of the same material that is uses on beams and slabs. The use of concrete with different strengths and behaviours in the same column creates doubt regarding its structural design. Since this region is confined by the floor (in the case of flat slabs) and partially confined (in the case of beams and slab), it can be considered that the region can gain more or less resistance respectively.

It was made several scale models to verify the confinement of columns by beams and slabs with different strengths between elements. It was expected that the lack of strength on the beams and the slabs were compensated by the confinement at this region but the results has shown that the rupture occurred in high-strength concrete immediately above the slab level. This result shows that there is a risk in the procedure currently adopted by the constructors in Brazil and by the Brazilian code ABNT NBR6118: 2014 that does not set a minimum of plastic strain uniformity in high strength concrete columns nor the aggravating factors generated by the variation of the concrete strength between column and beams/slabs.

It was performed a Finite Element Analysis with proper representation of the nonlinearity of the reinforced concrete and its damage criteria of the scale models using the software Abaqus. It was used solid elements to represent the concrete and truss elements to represent the reinforcement bars. As the concrete is in the multiaxial stress state, it was represented using the Drucker-Prager strength hypothesis. For the steel rebars it was uses an elastoplastic hypothesis. The results shown at the FEM has the same results (strains) found in the scale models, validating the experimental data.

One possibility for the rupture above the slab is due to the fact that this concrete is more fragile and have not been able to adapt plastically, thus generating a concentration of stress and premature rupture. Muttoni (2017) has shown the importance of considering the brittle of the concrete, especially when it has higher strengths.

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