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PITAK SIRIPHARPHUN : TIME-DEPENDENT ANALYSIS OF AXIAL SHORTENING OF CONCRETE COMPOSITE COLUMNS IN HIGH - RISE BUILDINGS WITH STAGE CONSTRUCTION. THESIS ADVISOR : PROF. PANITAN LUKKUNAPRASIT , Ph.D. 192 pp. ISBN 974-634-910-4

The behaviour of axial shortening of reinforced concrete and composite columns under sustained loading was studied , considering the instantaneous component and time dependent effects of creep and shrinkage in concrete. In the method of analysis the structure is modeled as a plane frame using prismatic beam elements which are assumed to be uncracked in the service condition. The embedded reinforcing steel and structural steel are assumed to be perfectly bonded with the concrete. Thus the steel stiffness can be obtained in terms of the nodal displacements of the concrete beam element. The time dependent stiffness property of the structure is synthesized by means of the direct stiffness method , using the age-adjusted effective modulus approach to model the time dependent behaviour of concrete , with the creep coefficient as recommended by the ACI Committee 209 used in the formulation. Incremental loading with stage construction is taken into accout in this study. The method is suitable for computing differential column shortenings which are significant and need to be taken into consideration in the design of high - rise buildings.

Free shortening analyses of a reinforced concrete column with varying reinforcement ratios of 1% , 2% , 5% and 8% yielded excellent agreement between the detailed method proposed and the force method developed by Beasley , whereas the approximate method gives rise to maximum discrepancies of about 10%-12% in the column shortening. In the approximate method , the stiffness matrices were evaluated at an average time in the time interval under consideration The steel reinforcement (or embedded structural steel) results in restraining effect , thereby reduces column shortening due to creep and shrinkage of concrete by about 20%-70% for reinforcement ratios of 1%-8%. The rate of decrease is not linear , being about 15%-20% at reinforcement ratios of 1%-2% and 5% at the maximum reinforcement ratio of 8%. The restraining effect of steel reinforcement leads to transfer of some of the internal force in the concrete to the reinforcing steel , thereby increasing the internal stress in the steel to about 2-3.5 times of the initial values.

In the case study of Baiyoke 2 tower , the maximum differential free column shortening was found to be 22.5 mm. However , when the frame interaction arising from the presence of the connecting beams was considered , the differential column shortening was significantly reduced by 20%.

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