

Finite element techniques to calculate axial shortenings of composite columns

Author: Narayan Baidya

Email: n.baidya@student.unimelb.edu.au

Supervisors : Prof. P. Mendis, Dr. L. Zhang and Dr. M. Sofi

Department: Infrastructure Engineering



THE UNIVERSITY OF
MELBOURNE



Abstract: In tall concrete building, shortenings in composite columns (concrete-filled circular steel tubes) and core accumulate with respect to height. Such shortenings occur due to elastic shortening, temperature, and time-dependent deformations caused by creep and shrinkage. To predict composite column shortening, existing analytical procedure do not consider any restraint caused by frame action. Thus, the focus of this paper is to exploit the Finite element structural analysis program ETABS, which in turn will compute the actual restrained composite column shortenings. An example of the procedure using ETABS program, to calculate axial shortening of composite columns of a tall building, is presented.

Introduction

Axial shortening can potentially cause problems to other infrastructure of buildings including ventilation, water and sewerage pipes, and heating systems, along with potential structural problems to facades, beams and slabs joining the columns. Also, the detrimental effects escalate with geometric complexity of the structure and non-vertical load paths.

Methodology

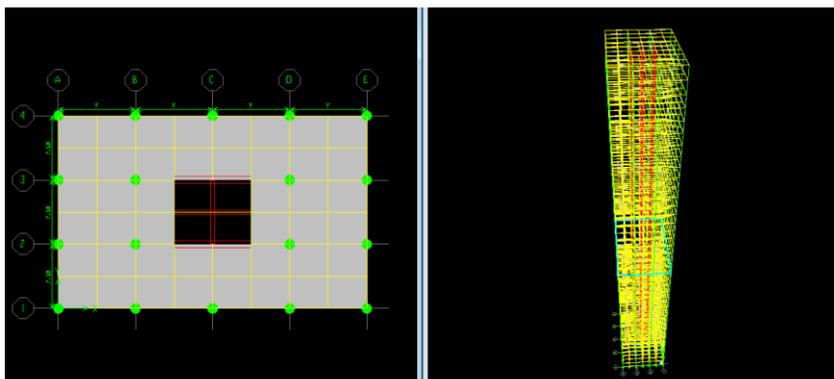
The main objective of this research is to develop a load time-history based analytical procedure for evaluating the differential shortening of composite columns and core in high rise buildings. The procedure captures the impact of construction sequence combined with the time varying values of elastic modulus, creep and shrinkage models of concrete.

Discussion

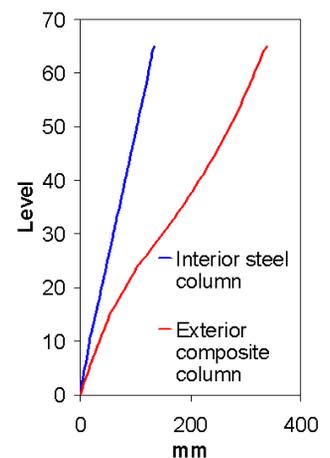
The combination of compression only elements, time varying elastic modulus of reinforced concrete and time history analysis are used to formulate the real staged construction procedure and to capture load migrations during and after the construction. This load migration has a significant post-construction impact on the axial shortening due to creep and other factors.

Conclusion

The proposed procedure is general enough to be applicable to all composite column high rise buildings to predict axial and differential shortenings between vertical elements. This will enable appropriate action to be undertaken at the planning and design stages to mitigate the adverse effects.



Using ETABS, plan and elevation of a tall building



Differential shortening between exterior and interior columns