ABSTRACT

Jenkins, Ryan William. Ph.D., Purdue University, August 2015. Improving the Design of Slender, Concrete Columns. Major Professor: Robert J. Frosch.

With the greater availability and affordability of high-strength concrete, designers have been able to reduce concrete column cross-sections, leading to in an increase in the prevalence of slender columns in building construction. In spite of this trend, provisions for the design of slender columns have not changed significantly since the provisions were first introduced 1971. Improved understanding of as well as improved design provisions for slender, concrete columns can allow for further use while maintaining safety. The objective of this research is to better understand the behavior and limits of slender, concrete columns and, from the results, develop improved design procedures for incorporation into building codes. The research program consisted of experimental testing coupled with computational modeling. The experimental testing was designed to expand the boundaries of practical column design while maintaining realistic service conditions. Additionally, the columns tests were designed to simulate theoretical conditions, which correspond better to code provisions and simplified computational analysis. The columns were tested with equal end eccentricities, braced against sidesway, and used pinned-pinned loading conditions. A computational model was further developed from a previous study. It incorporated commonly assumed material properties, simple mechanics, and structural analysis. The results of the experimental tests were used to evaluate and calibrate the computational model. With increased confidence, the computational model was used to develop design methods through analysis and parametric evaluation. Based on the results, design equations and recommendations are recommended for the short-term and long-term loading of nonprestressed and prestressed, slender, concrete columns.