Strength of HSC Slender Columns - A Method of Analysis

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ABSTRACT

A method is presented for the strength analysis of HSC columns subjected to eccentric loading. The method is based on a stability analysis of pin-ended columns using the exact sinusoidal equation for the deflected shape of the column. The degradation in the column stiffness as the load increases, representing the basic characteristic of inelastic response of columns, is considered subject to equilibrium conditions, compatibility requirements, and constitutive relationships for the concrete and reinforcement. The tension stiffening effect was taking into consideration. The column integrity is limited by either material or instability mode of failure. The method was applied to a wide range of experimental data. The predicted ultimate behavior shows excellent correlation with the test results. The mean of the predicted-to-experimental ultimate load ratio was 0.94, with a coefficient of variation of 10.8%.

INTRODUCTION

Utilization of high-strength concrete, HSC in reinforced concrete columns reduces the column proportions heightening the adverse effects of the slenderness on the column capacity. Significance of the slenderness effects in HSC columns caused concern on the applicability of current building codes requirements for design of HSC slender columns. The methods available in literature for the strength analysis of slender columns are generally based on a simplified nonlinear analysis approximating the column deflection to a sine wave function with either constant [1-3] or variable [3-5] wavelength. The feasible influence of the confinement of concrete core on the column response [6], including deformation and strength, was disregarded. Commonly, the available methods adopt stress-strain models for unconfined concrete. Probabilistic analyses of the modeling errors of various methods for strength analysis of slender columns [7] indicated that the modeling errors are sensitive to the adopted concrete stress-strain relationship.

Based on extensive investigation of the response of HSC columns, Légeron and Paultre [8] developed a stress-strain model for confined high-strength concrete, which considers the effects of concrete strength, and transverse and longitudinal reinforcement parameters on the significance of confinement. The strength of confined concrete is determined based on an effective confinement pressure that depends on the stress of transverse reinforcement at peak strength of concrete, and on the configuration of restrained concrete core. Results of nonlinear finite

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