Available online at www.CivileJournal.org

Civil Engineering Journal

Vol. 5, No. 7, July, 2019

Non-linear Analysis of Slender High Strength Concrete Column

Ernesto Fenollosa [a*], Iván Cabrera [a], Verónica Llopis [b], Adolfo Alonso [a]

[a] *Tenure Professor, Ph.D., Department of Continuum Mechanics and Theory of Structures, Universitat Politècnica de València, Cno. de Vera s/n, Valencia 46022, Spain.*

[b] *Professor, Ph.D., Department of Continuum Mechanics and Theory of Structures, Universitat Politècnica de València, Cno. de Vera s/n, Valencia 46022, Spain.*

Received 25 April 2019; Accepted 02 July 2019

Abstract

This article shows the influence of axial force eccentricity on high strength concrete columns design. The behavior of columns made of normal, middle and high strength concrete with slenderness values between 20 and 60 under an eccentric axial force has been studied. Structural analysis has been developed by means of software which considers both geometrical and mechanical non-linearity. The sequence of points defined by increasing values of axial force and bending moment produced by eccentricity has been represented on the cross-section interaction diagram until failure for each tested column. Then, diagrams depicting the relationship between failure axial force and column's slenderness have been drawn. The loss of bearing capacity of the member for normal and middle strength columns when compared with the bearing capacity of their cross-section is more noticeable as axial force eccentricity assumes higher values. However, this situation reverses for high strength columns with high slenderness values. On the basis of results obtained, the accuracy level for the moment magnifier method was checked. Despite the good concordance in most of the cases, it was verified that the moment magnifier method leads to excessively tight results for high strength concrete columns with high slenderness values. In these specific cases, a coefficient which amends the column rigidity is proposed so as to obtain safer values.

Keywords: Columns; Axial Force; High Strength Concrete; Non-linear Analysis; Moment Magnifier Method.

1. Introduction

Reinforced concrete rigid frames are the most widely employed structural system. They are composed by columns and beams. Columns are the structural elements whose prevailing internal force is an axial load which can be combined with one or two bending moments around two orthogonal axis.

Since the mid-twentieth century they have been targeted in many researches whose results, after being contrasted with pilot testing, have led to several calculation methods. In the case of short columns whose strength depends only on the bearing capacity of their section, we should mention the method proposed by Bresler [1] and more recently Hsu [2].

Gradual technological development has enabled the production of concretes with a higher strength to compression stress. The use of columns made of high strength concrete (HSC) in high-rise buildings reduces their section and increases the available space around them. The reduction of the cross section caused by the use of high strength concrete leads to slender columns whose bearing capacity is basically conditioned by their length. Therefore, a thorough analysis of second order effects derived from both the P-δ effect and the materials mechanic non-linearity is required.

* Corresponding author: efenollo@mes.upv.es

http://dx.doi.org/10.28991/cej-2019-03091343