STABILITY AND BEHAVIOR OF INHOMOGENEOUS CONCRETE COLUMNS

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Abstract

Stability calculations are critical in structural design can cause significant damage to structural column members. Stability analysis in solid mechanics began with Euler's solution of buckling of an elastic column (Euler, 1744). Most basic linear elastic problems of structural stability were solved by the end of the 19th century, although further solutions have been appearing as new structural types were being introduced. In this research, critical load or stability of inhomogeneous orthotropic reinforced concrete columns have been investigated. Due to the numerous outputs obtained, software package have been written in Matlab and analysis on data and drawing related charts have been done.

Keywords: Concrete columns, Inhomogeneous, Stability, Buckling Load

1. INTRODUCTION

Most structural failures are the result of an error made by one of the people involved in the great number of steps between the original idea and the completion of the final structure. For reinforced concrete construction, mainly inadequate column designs and over-weight structures are the cause of fatal building failure and related human victims.

Buckling, also known as structural instability, may be classified into two categories:1, bifurcation buckling and 2, limit load buckling. In bifurcation buckling, the deflection under compressive load changes from one direction to a different direction (e.g., from axial shortening to lateral deflection). The load at which the bifurcation occurs in the load-deflection space is called the critical buckling load or simply critical load. In limit load buckling, the structure attains a maximum load without any previous bifurcation, i.e., with only a single mode of deflection.

The buckling load of stocky columns must be determined by taking into consideration the inelastic behavior, (Euler, 1744).

$$P = \pi^2 EI / kL^2 \quad (1)$$

Where E is the modulus of elasticity of the column member representing the material property, I is the area moment of inertia of the cross-section, k is the column effective length factor, whose value depends on the conditions of end support of the column and L is the length of the column.

In this research, critical load or stability of inhomogeneous reinforced concrete columns have been investigated. To do this, sensitivity analysis of critical loads to various parameters such as E, I and L have been investigated. In this study, studying has been done on a set of concrete columns with and without inhomogeneous properties. The column section is generally square or rectangular, but circular and polygonal columns are used in special cases. Consider now columns of square cross sections.

2. MATERIAL PROPERTIES

2.1. CONCRETE STRENGTH

Material properties affect the critical value of the buckling loads. Concrete strength is counted as one of the important parameters for the material properties in reinforced concrete structure design. The material modeling of reinforced concrete consisting generally of three phases: cement mortar, aggregate grains and reinforcing steel bars, is a strong compromise between the structural phenomena and available material parameters. In structural analysis, reinforced concrete materials are modeled as a macroscopically homogeneous material with response influences by each of the phases. Stress-strain curves are an extremely important graphical measure of a material's mechanical properties, (Fig. 1).