BUCKLING LOAD OF PINED-PINED INHOMOGENEOUSE CONCRETE COLUMN

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ABSTRACT

Concrete is a non-homogeneous and anisotropic material. Modeling the mechanical behavior of Reinforced Concrete (RC) is still one of the most difficult challenges in the field of structural engineering. There are some factors which cause the mechanical factors of concrete in right dimension are not uniform and isotropic in high columns. In this research, critical load or stability of inhomogeneous reinforced concrete columns have been investigated and to complete this research, exact solving method, approximate solving method which include different methods of energy and exact finite element approach have been used.

Keywords: Concrete columns, Inhomogeneous, Stability, Buckling Load

1. INTRODUCTION

Columns are structural members in buildings carrying roof and floor loads to the foundations. Most columns are termed short columns and fail when the material reaches its ultimate capacity under the applied loads and moments. The limit loads for columns, having major importance to a building's safety, are considered stability limits. Thus, a designer must evaluate the critical load limits. In reality, some of the design parameters in structural analysis may be disregarded which can lead to uncertainties. Slender columns buckle and the additional moments caused by deflection must be taken into account in design.

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

$$P = \pi^2 EI/kL^2 \tag{1}$$

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.

The column slenderness is defined as L/r, where $r=h/12^{0.5}$ and h=side of the square cross section = 150mm. In numerical calculations, we consider f'_c=250 kg/cm^2. The column is reinforced symmetrically by eight axial steel bars and the steel ratio ρ=0.01 and 0.03. The cover of concrete bars is such that the axial bar centers are about 50 mm from the surface. Furthermore, E_s=2e6 kg/cm^2 and f_y=4000 kg/cm^2.

2. MODULUS OF ELASTICITY

Material properties can be defined through concrete strength and modulus of elasticity as proposed in different national building codes through various formulas for the same values of concrete strength. Modulus of elasticity of concrete is frequently expressed in terms of compressive strength, (Eq. 2).

$$E_0 = 0.1347 W_c^{1.5}\sqrt{f'_c}\left(\frac{kg}{cm^2} - ACI318\right) \tag{2}$$

This modulus relates to the kind of concrete, concrete age and speed in loading, concrete properties and mixing percent and more importantly relates to definition of concrete elasticity modulus. According to Eq. 2, the two factors, compressive strength and weight, have relations with elasticity modulus. In concreting, by being careful about how to compact the concrete and its completion, the concrete will have much compressive strength.

3. INHOMOGENEOUS FORMULATION OF COLUMN BY ENERGY METHOD

Euler's equation is given from solving of a differentiating of deformation curves and in some parts it is a little complex and we should use approximation equations based on system energy. Elasticity modulus, E, is defined by ACI-318 as Eq. 2,

$$W_{cx} = (1 - \xi(1 - K_w))W_{c0} \tag{3}$$

Where W_c and W_{c0} are the density of concrete and W_{cx} is the inhomogeneous formulation of the density. Inhomogeneous formulations of the compression strength, f'_{cx}, and elasticity modulus, E_x, are represented as:

$$f'_{cx} = (1 - \xi(1 - K_w))f'_{c0} \tag{4}$$