International Conference on Contemporary Iran on Civil Engineering
Architecture and Urban Development
Iran Tehran - August 16, 2017

Submiting of the Equations and Boundary Conditions for the Optimum Calculation of the Shape of the Bending Stiffness Function of the Wall in the Symmetrical Wall-Frame Structural Systems to Reduce the End Displacements of the Tall Buildings

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Abstract

One of the most important objectives in the selection of structural form in tall buildings is to create the proper stiffness against lateral loads. Obviously, the goal should be met cheaply and economically as far as possible. One of the appropriate structural forms is wall-frame system. When a wall-frame structure is set under a lateral load, different shape of free displacement of frames and walls causes the horizontal interaction between them through slabs of the floor, therefore, the distribution of the load at the height of each of the frame and wall system can separately be very different from the distribution of the load of system. Horizontal interaction between the frame and the wall increases the lateral stiffness of structure and reduces walls' moment. On the other side, performance of the shear wall is like a bending cantilever beam and performance of the frame a shear cantilever beam and deformities of free end of the bending cantilever beam (wall) increase by increasing the height, thus the stability of bending stiffness of the wall can increase the displacements in the top level of the structure. In the article, by considering bending stiffness of the wall as a function of the wall height, the differential equation governing the displacement of the structure under the external uniform distributed load with considering the interaction effect of wall and frame are formed, then by using the calculus of variations method, the equations and the necessary boundary conditions for the determination of this function are introduced so that the maximum displacement is minimized at highest level of structure.

Key words: wall-frame, interaction, bending stiffness, the calculus of variations, displacement.

1. Introduction

One of the main objectives and principles in selecting structural forms, in addition to ability of bearing the vertical and lateral loads, is the ability to control the deformations induced by lateral forces. Obviously, in meeting the above objectives, the costs should be