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Abstract

ANALYSIS OF TUBE-IN-TUBE STRUCTURES COUPLED WITH OUTRIGGER AND TRUSS BELTS

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The thesis mainly consists of two parts. The first is concerned with the analysis of shear lag residing in a single framed-tube structure; and the second focuses on the tube-in-tube structure system coupled with outrigger and belt trusses.

Framed tube structures act primarily like cantilever box beams. However, due to flexural and shear flexibilities of the frame members, the basic beam bending action of the framed tubes is complicated by the occurrence of shear lag, which will affect the stress distributions in the frame panels to a large extent, and thus reduce the lateral stiffness of the structure. To appreciate the effect of shear lag phenomenon in this kind of structures, a parametric study through the use of finite element method is carried out. Unlike previous studies in which continuous models were employed, a set of discrete models are used throughout the whole analysis. The results reveal that the degree of shear lag effect in an individual web or flange is primarily dependent on the ratio of its own width to the height.

Noting that few detailed studies have been taken on the applications of outrigger and truss belt in framed tube structures, the author carries out an analysis to find out what role each structural element plays in such a structure. A comparison between the tube structures with and without belt truss is made. These results show that with the adoption of belt truss along its height, which combines the internal and external tubes to act together and also engage all the perimeter columns to resist lateral load, great reduction in drift displacement can be achieved when the belt is placed at its optimum location which is usually near the mid-height of the building as the results reveal. Further study on the results shows that when the configuration of external

tube is fixed, it is not an effective method to improve the lateral stiffness by increasing the thickness of the internal tube when the thickness approaches to some large value. Also it is found that the increase in lateral stiffness is not significant when the number of truss belts exceeds three.