

THE EFFECT OF CLADDING ON TALL BUILDINGS

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Abstract

A major shortcoming of conventional tall building design is the failure to take any account of the effects of cladding. As a first approach to this topic, it is proposed that structural partitions be used to stiffen tall frames, which often satisfy strength requirements while lacking sufficient lateral stiffness. A survey of the static and dynamic behaviour is presented, and the design of a practical cladding is discussed.

Two chapters contain preparations required for the tall building studies. Plane stress finite elements are used to provide an analytical model of a panel, for use in a matrix method of analysis. A sparse matrix solution technique is then developed, for the analysis of tall structures.

The elastic behaviour of four sample structures (from 20 to 46 storeys) under wind load is examined. An approximate technique, the storey stiffness method, is developed to size panels for drift control purposes. The ensuing designs are then analysed by a matrix method, and the effectiveness of the storey stiffness method is indicated. The major cause of inconsistency, the lateral drift due to column axial deformations, is closely examined.

Clad frames are then subjected to a ground motion, and a dynamic analysis performed. The structure is modelled with elasto-plastic girders, and elastic-brittle panels, which fail at a deformation 3.0 times allowable. These cladding panels are seen to be overstrained in the upper third of most tall structures, because of a “whipping” effect. Finally, the problem is altered by the use of extremely stiff panels, and important behaviour characteristics are displayed.

Lastly, the panels themselves are discussed. Assemblage analyses favourably compare the unrealistic panels of the tall buildings analyses with the more practical panel installations. Panel materials are reviewed and light gauge corrugated sheeting emerges as the most practical choice. Relying exclusively on the work of previous researchers, the behaviour of

this material is discussed, and sample design charts are generated. Certain earlier findings need revision for tall building application, and areas for future research are outlined.