



Sensitivity Analysis and Optimization of Coupling Trusses under Wind Stiffness Constraints for Multi-Petal Supertall Buildings

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Abstract

The multi-petal tower is a favorable alternative type for supertall buildings because of its distinctive appearance and high wind-resistant performance. The coupling trusses are the important member to connect tower petals to form a stable structural system. The selection of its location and material distribution are of great research value. In this paper, the characteristics and application scenarios of various sensitivity analysis methods are compared. And the incremental sensitivity analysis method is selected to assist determining about the optimal arrangement of the coupling trusses of multi-petal tower under the wind stiffness constraint quickly and efficiently. Based on the sensitivity rank of each coupling truss, the cross section of coupling trusses is optimized. The structural cost of coupling trusses is effectively reduced at the cost of tiny stiffness reduction, which provides an efficient and simple optimization method and application case for similar engineering optimization needs.

Keywords: multi-petal supertall building; coupling truss; incremental sensitivity analysis method; wind stiffness constraint; structural optimization.

1 Introduction

In recent years, the proposal of the multi-petal supertall tower reflects the innovation and optimization of the supertall building shape, which makes the appearance of the building look slender and light, and the vertical members concentrated in the triangular corner can provide greater

stiffness for the structure, and the transparent space in the middle of the tower petals can allow the wind to pass freely, reducing the vibration response brought by the wind load to the structure (Figure 1)^[1].

The structure system of multi-petal supertall tower is complex, which is a good carrier for studying the design of supertall building wind resistance. In this