



## Design and Study of Super Suspend Curtain Wall Support Structure of Shanghai Tower

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### Abstract

A unique flexible suspend curtain wall support structure (CWSS) was ultimately developed to suit exterior curtain wall system of Shanghai Tower. Its characteristics of away from main structure, twisted geometry, heavy weight, high suspension height, weak & nonuniform support stiffness lead to complicated cooperation properties with main structure, and created a number of unprecedented challenge for the analysis and design. Structural system and joint details have undergone repeated rounds of analysis, proof and optimization. Especially, By means of cooperative analysis of integrated model including CWSS and main structure, the properties of cooperative work of CWSS under horizontal and vertical loads, vertical seismic response, mechanical properties of CWSS in construction were analyzed in detail. These work ensured the successful implementation of the project construction. The actual installation and construction have proved the reliability of the design of this system.

**Keywords:** suspend curtain wall support structure; structure selection; connection design; cooperative work analysis; vertical seismic response analysis; construction simulation analysis

### 1 Project profile

The Shanghai Tower is located in Shanghai Lujiazui financial district, a total construction area of 580000m<sup>2</sup>. The structure height is 580m and the total height of the building is 632m. The project adopts the independent double-skin curtain wall system in the super high-rise firstly. The exterior curtain wall system, away from the main structure twisting and shrinking, is the significant feature of the building known from other high-rise buildings and one of the design difficulties as well.

#### 1.1 Architectural features of exterior curtain wall

The interior curtain wall is cylindrical arrangement along the floor border (Fig.2).The plan shape of

Curtain wall is an equilateral triangle, whose three corners are chamfered (Fig.2). In the vertical direction, it twist around the cylinder and shrink upward floor-by-floor, with the standard segment co-rotating 120° and shrinkage of 55%, thereby causing the interior and exterior walls spatially separated. The entire exterior curtain wall system area reaches 140,000 m<sup>2</sup>, which is divided into nine independent regions by the MEP floor in the vertical direction (9th zone is the tower crown). An atrium space which range 12 to 15 floors, height of 55~66m, is generated between the interior and exterior walls (Fig.3). This design can make full use of the amenity floor as a "sky lobby" that can provide restaurants, banks, shops and other basic services for people at 12 to 15 floor connected by the sky lobby.