**DESIGN INSPIRATION**

The first of its kind, this tower incorporates a perimeter, column-free, four-story helical super-diagrid system to resist gravity and high seismic loads. Originally inspired by the ‘guqin’ – an ancient Chinese stringed instrument with strings laid over a bridge – the exterior wall is strung between the strong diagrid frames. The building has the characteristics of a Chinese paper lantern with folds changing around the building perimeter.

This landmark tower leverages a perimeter diagrid system acting in combination with other structural systems, in order to introduce full-height area and other shared interior spaces that are filled with natural lighting. Being a non-prescriptive structural system, careful attention was paid to the behavior of the structure, and enhanced analysis and design efforts were not avoided. Currently pursuing LEED® Gold certification, the tower stands as a prominent icon in Beijing’s skyline.

**LOAD PATHS AND STABILITY**

With the unique diagrid system, lateral loads are transferred from the building base along helical load paths, without relying on diagonal ties or the building core. The exoskeletal diagrid frame system on the perimeter acts in tandem with concrete walls at the building core to provide a dual gravity and lateral load resisting system with multiple continuous and redundant load paths. Global buckling stability afforded by the three-dimensional form of the diagrid made it possible to introduce large and fluidly scaling atria at building ends.

Collected buckling analysis were performed to confirm that the diagrid members would yield before the lateral or global buckling occur. To ensure stability of the diagrid frame at the atria level, the sales buckling loads related to major wind events were in plane sheath buckling members were introduced to act as a fail-safe backup system for the diagrid/steel stubs.

**NODE DEVELOPMENT AND TESTING**

The integrity of the diagrid structural system relies on the performance of the welded nodes. The diagrid nodes were reinforced, and consist of two horizontal steel plates in line with the perimeter beam flanges, one vertical shear plate centered on the node work point, and vertical surplus plates between the horizontal flange plates aligned with the diagrid tension and shear forces of the tower. Extensive buckling analyses were performed for representative diagrid nodes and reduced scale tests (cyclic and monotonic tests) were performed at the China Academy of Building Research (CABR) testing. The tests confirmed the validity of the node design and the parameters of yielding concrete and concrete-filled tube thickness at the nodes to ensure that eventual failure occurred beyond the nodes.

**FAILSAFE STUB COLUMN EXTENSIONS**

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**SUSPENDED INTERMEDIATE FLOORS AND FAILSAFE STUB COLUMN EXTENSIONS**

With nodes occurring every two floors, intermediate floors were suspended from nodal floors above to avoid loading diagrid members between nodes. It thus increasing the efficiency of the structure. In an overall concept of structural and design, floor slabs that eliminate the obtrusive transceivers above the diagrid structural system allows for a natural double-exterior columnless system that mitigates Beijing’s climate extremes.

**PROJECT CREDITS**

Architect and Structural Engineer: Skidmore, Owings & Merrill LLP (SOM)

Local Design Institute: Beijing Institute of Architectural Design

General Contractor: China Construction Third Engineering Bureau Co., Ltd.

Client: China Poly Real Estate Company Limited

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