



Study on system extension and mechanical performance of outer convex spoke tensile structure

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Summary

Spoke tensile structure developed from bicycle wheel spokes based on spoke wheel principle, this system with beautiful shape and reasonable force is often used for large-span space structure. According to different roof shapes, the spoke tensile structure is divided into inner concave-shaped and outer convex-shaped. Outer convex structures were proposed for a simplified theoretical calculation method to analyze the structure stress characteristics. Spoke tensile structures arrangement is flexible, through study on the outer convex structural system extension means, the structural forms is varied and expanded, and ultimately get dozens of forms such architecture. Meanwhile, the structural members display architectural beauty, and achieve the perfect combination of architecture and structures. Outer convex structural system mechanical performance were theoretical derivation and numerical computation, and then study the force nature of such forms.

Keywords: outer convex spoke tensile structure; spoke wheel principle; large-span space structure; form-finding analysis; system extension.

1. Introduction

Spoke tensile structure is proposed based on spoke wheel principle, This structural system has the characteristics of tensile structure, while overcoming the shortcomings that system is complex, power transmission is not direct and easy to form mechanism^{[1][2]}. This structure roof is usually covered with membrane, which has light weight and beautiful appearance, while studies have shown that, as the span increases, the cost increase is not large, it has a great advantage in long-span spatial structures. The structural system is mainly used in stadium, gymnasium and other large public buildings that accommodate 3 to 10 million.

2. Structural system constitutes and mechanical properties

2.1 Structural system constitutes

Spoke tensile structural system can be divided into outer convex-shaped and inner concave-shaped by roofing shape category^{[3][4]}. Two internal tensile rings of outer convex Spoke tensile structure are linked by flying column, and there is an external compression ring, the external compression ring and the tensile rings are connected by radial cable truss, the up and down strings of radial cable trusses are connected by slings; while inner concave spoke tensile structure has a internal tensile