# Mechanical Analysis of Central Buckle Region of Long Span Suspension Bridge

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## Abstract

A central buckle is generally set in the middle of long-span suspension bridge to improve the structure mechanical performance. With a large number and sophisticated composition of steel plates, the mechanical behaviour of central buckle region is obscure. In this paper, a shell-beam hybrid finite element model of a 428m main span self-anchored suspension bridge was established, and the mechanical characteristics of central buckle region were analysed. The result shows that the normal stress of steel plates in central buckle region is mainly dependent on by dead loads, the effect caused by live loads only accounts for approximately 15% of that caused by dead loads; axial force of central buckle is mainly transmitted to the diaphragms and webs of the girder.

**Keywords:** bridge engineering; long-span suspension bridge; finite element model; central buckle; force transmission.

## 1 Introduction

Suspenders in classical suspension bridges are generally vertical arranged. However, the structure cannot provide effective longitudinal constraint between cables and girders, and the relative displacement between cables and beams may cause large bending stresses in suspenders, which will probably lead to the fatigue failure of short suspenders [1]. After the Tacoma bridge accident in 1940, bridge engineering experts has spent great effort on improving the dynamic performance of suspension bridges. Studies have shown that, setting central buckle connections in the middle of large span is an effective way to limit the relative longitudinal movement between cables and girders and improve the stiffness of suspension bridge. And since central buckles were used in new Tacoma bridge in 1950, three configurations of central buckles have been invented: 1, rigid central buckle; 2, flexible central buckle, 3, cable-beam connection [2]. In the United States and European countries, rigid central buckles are more popular in construction of suspension bridges, and in contrast, flexible central buckles are used more in Japan. In China, Sidu River Bridge, Runyang Yangtze River Bridge, Aizhai Bridge, the second Dongting Lake Bridge, and Baling River Bridge were all designed with a central buckle, among which the central buckle of Runyang Yangtze River Bridge was used for the first time in China [3]. Recently, the central connection between cables and beams in the main span has been widely used in suspension bridges, becoming a development trend of suspension bridge structure.

Up to now, related research of central buckle is ongoing. Hu Tengfei et al. studied the influence of the central buckle on the modal characteristics of Aizhai Bridge by using finite element analysis and dynamic testing methods [4]. Wang Hao et al. studied the influence of the central buckle on the

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