



# Analysis and Optimization of Single Cable Plane Prestressed Concrete Extradosed Cable-stayed Bridge

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## Abstract

Extradosed cable-stayed bridge has been used more and more in practical engineering because of its superior structural performance, good economic efficiency and good appearance. In this paper, taking a single cable plane prestressed concrete extradosed cable-stayed bridge as an engineering example, finite element analysis (FEA) is applied to complete the static analysis and stability analysis of the bridge during the construction stage, completed bridge stage and operation stage. In addition, the characteristics of stress distribution of the anchorage zone are analysed by using FEA software and the space finite element method. Finally, FEA software is used to output the cable force influence matrix, and the cable force adjustment and optimization are carried out based on the calculation principle of cable force optimization and combined with Matlab programming. The results can be used as reference for the design and construction of similar bridges.

**Keywords:** extradosed cable-stayed bridge; finite element analysis (FEA); global analysis; local analysis; adjustment and optimization of cable force.

## 1 Introduction

With the development of bridge technology, the type of bridge structure has gradually formed two obvious trends. One is the lightweight structure, which reduces the self-weight through the use of new materials and more rigorous calculation; One is the combination of bridge types, that is, the beams, arches and cables, etc. as the basic structure are combined with each other to form a more diversified composite bridge type [1]. Extradosed cable-stayed bridge is a relatively new cable-beam composite structural type, which is between continuous beam bridge and cable-stayed bridge [2]. As a transitional bridge type, it has been used more and more in engineering practice for its superior structural performance, good economic benefit and good aesthetic effect.

Extradosed cable-stayed bridge not only has the stress characteristics of the beam of continuous beam bridge, but also has the flexibility and spatial triangle stress of conventional cable-stayed bridge, but it is significantly different from them in cable arrangement, size and stress characteristic [3]. The vertical load of extradosed cable-stayed bridge is borne by the main girder and the cable. The form of its main girder is similar to that of continuous beam bridge, and its stiffness is less than that of continuous beam bridge with the same span. The number of stay cables is less than that of conventional stay cables, and the inclination angle is smaller. Its vertical component plays the role of elastic support, and its horizontal component plays the role of external prestress. The cable only plays a partial role in the overall resistance of the structure, and the proportion of bearing load is less than that of the main girder [4].