



# Life-Cycle Cost Analysis of Super Long-Span Cable-Stayed Bridges with Steel or CFRP Cables

Yue Liu

*Institut für Bauingenieurwesen, Technische Universität Berlin, Berlin, Germany*

Guangli Du

*Danish Building Research Institute, Aalborg University, Copenhagen, Denmark*

Contact: [gdu@sbi.aau.dk](mailto:gdu@sbi.aau.dk)

## Abstract

Concrete and steel are conventional construction materials for bridges. To achieve longer span and longer life expectancy, bridge engineers are urged to seek the novel material and new technology. Carbon Fibre Reinforced Polymer (CFRP) is a promising composite material attracting increasing attention in civil engineering. CFRP has advantages in high strength, light weight, durability, anti-corrosion performance and low maintenance, which make it suitable for cables in super long cable supported bridges. This paper intends to compare the Life-Cycle Cost (LCC) of a super long-span cable-stayed bridge using CFRP cables with the same bridge using conventional steel cables. The result indicates that, although the super long CFRP cable-stayed bridge shows a higher initial cost, its overall cost from the whole life-cycle perspective is more favourable comparing to the conventional steel ones.

**Keywords:** life-cycle-cost; long span; cable-stayed bridge; CFRP; steel.

## 1 Introduction

The history of bridge is a history of bridge structural materials. The advent of new material usually promotes the development of bridges. For example, the appearance of high-strength steel in the 20<sup>th</sup> century has greatly promoted the progress of the bridge engineering. This progress not only reflects the increase of the bridge span but also the appearance of new structural forms like modern cable-stayed bridges [1].

Carbon Fibre Reinforced Polymer (CFRP) is a new high performance composite material. The mechanical properties of CFRP, such as the tensile strength, the self-weight, and the fatigue performance, are superior to those of the high-strength steel. This makes CFRP possess great

potential to replace steel cables in cable bridges [1].

Because of the relatively higher unit price, CFRP cables are regarded to be cost-effective only in long-span or super long-span cable bridges. As early as 1987, Urs Meier studied the feasibility of building a CFRP cable-stayed bridge with a main span of 8400 m crossing the Strait of Gibraltar [2]. From then on, some other researchers have also investigated the CFRP cable-stayed bridges [3] [4] [5]. However, most researches only focus on the mechanical behaviours of CFRP cable-stayed bridges while their economies, especially from the life-cycle perspective, are still lack of study.

For this reason, this paper studies the Life-Cycle Cost (LCC) of a super long-span cable-stayed