

Future Building - Carbon for Bridges, Roofs and Facades

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Summary

The properties of Carbon Fibre Reinforced Polymers (CFRPs), very high strength, light weight, zero corrosion and no fatigue can fully be exploited for cable structures. The ideal structures for CFRP cables are highly pre-tensioned cable systems that are loaded orthogonally to their cable axes. High performance structures, such as stress-ribbon bridges, long-span roofs and facades made of CFRP can already be built economically today. In order to prove this point, CFRP prototype structures, a stress-ribbon bridge and a small spoked wheel cable roof built at the Technische Universität Berlin, are presented. First, however, cable structures, CFRP materials and existing CFRP cable structures are introduced in general.

Keywords: lightweight; bridges; roofs; CFRP; cables.

1. Introduction

A cable structure can be defined as structures in which a cable or a system of cables is used as the primary load-bearing structural element [1]. The materials for cables have evolved from natural fibres in ancient times to wrought iron and finally to high-strength steel today [2].

A milestone in the development of cable structures is the Munich Olympic Stadium roof completed in 1972, which shows that the structural ideal of “leicht und weit” can be realised by using cables [3]. Due to their ability of achieving long spans with minimal use of material while expressing lightness and elegance at the same time, cable structures are modern. Their structural forms are many and varied.

Reviewing the history of cable structures, it can be found that the development of cable materials promoted the development of new structural types. The availability of high-strength steel cables allows not only the construction of long-span cable structures, such as modern suspension and cable-stayed bridges, but also the reality of cable structures with new forms, such as cable roofs and facades. Carbon Fibre Reinforced Polymer (CFRP) is a new advanced composite material with advantages of high strength, lightweight, no corrosion and high fatigue resistance, which makes it suitable to be made into cables and potentially replace steel cables. [4]

2. CFRP and CFRP Cables

2.1 Carbon Fibre Reinforced Polymer

Carbon Fibre Reinforced Polymer, abbreviated to CFRP, is a non-metal composite material with