An Experimental Study of Self-anchored Combined CFRP Cables

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Abstract

Carbon Fiber Reinforced Polymer (CFRP) is an advanced material known for its lightweight, high strength, corrosion resistance, and fatigue durability, making it an ideal choice for cables in structural engineering. However, being an anisotropic material, CFRP faces challenges in anchoring due to its lower transverse mechanical properties compared to its tensile strength. In response to this issue, this paper designs and tests a self-anchored combined CFRP cable with variations in anchorage type, joint type, and CFRP plate thickness. The results reveal that interface shear stress causes delamination failure in the anchorage, leading to lower-than-expected load-bearing capacity. Through improved design and processing methods, interface damage in the anchorage is reduced, enhancing load-bearing capacity and achieving an ideal failure mode of cable body rupture.

Keywords: Carbon fiber reinforced polymer (CFRP); cable; anchorage; Self-anchored.

1 Introduction

Carbon Fiber Reinforced Polymer (CFRP) is composed of carbon fibers embedded within a polymer matrix, showcasing notable attributes including lightweight characteristics, elevated tensile strength, resistance to fatigue, and corrosion resilience. These attributes make it a promising solution to address challenges encountered by traditional steel cables, including significant self-weight, susceptibility to corrosion, and fatigue issues. However, CFRP is an anisotropic material, exhibiting lower transverse mechanical properties compared to its longitudinal tensile strength. Consequently, anchoring and connecting the CFRP cables have presented formidable challenges in past engineering practices [1-3].

In addressing this challenge, researchers have put forth diverse anchoring solutions, systematically classified according to anchoring mechanisms, including mechanical-type anchorages, bonded-type anchorages, composite-type anchorages, and self-anchored systems. The first three types achieve anchoring through force transmission on the surface, but due to the relatively low shear strength of CFRP, their efficiency is often compromised, and their structures tend to be intricate. Self-anchored systems, on the other hand, efficiently convert cable tension into pressure on the anchoring ring, resulting in a simpler and more effective structure. Leveraging the principles of self-anchoring, we have introduced a novel self-anchored CFRP cable system, as illustrated in Figure 1 [4].

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