

40-Year-old Bridge strengthened with Prestressed CFRP Laminates and Monitored by FBG Gauge

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Abstract. Prestress technology is the most efficient method to make use of the high strength of carbon fiber reinforced polymer in structure reinforcement. Jingang bridge, a simply supported reinforced concrete T-beam bridge, had served for over 40 years. The nondestructive investigation and service load test showed that long time employment and lots of cracks resulted in a severe degradation of the bridge. According to the calculation results of the normal section load-bearing capacity, a total of 60 m² prestressed CFRP plates were installed at the surfaces of the bridge to enhance its flexural strength, which was the first engineering application of strengthening an old bridge using prestressed FRP laminates in domestic. CFRP laminates were prestressed to 1000 MPa initial stress by a structural-base tensioner system and the permanent anchors were used to provide reliable anchorage. Controlled truckload tests were conducted to evaluate the effectiveness of prestressed CFRP plates when the bridge retrofit was completed. Several fiber bragg grating gauges were installed at the surface of CFRP plates and periodic measure was conducted to invest the long time behavior of the strengthening materials and bridge. The service load test showed that prestressed CFRP plates improved the bridge performance significantly under vehicle load. However, FBG monitoring result revealed that temperature variances could produce obvious stress level changes of the CFRP plates.

1. Introduction

Carbon fiber reinforced polymer (CFRP) composite laminate has been popularly used in structural strengthening of reinforced concrete (RC) members due to its outstanding durability and high strength–weight ratio. However, the method of external bonding the CFRP laminate to the concrete surface could not take advantage of the high strength of material. The technology of prestressing CFRP, which aim to make full use of material strength by stressing the laminates prior to bonding, was present as the resolution of traditional method. In this paper, the Jingang bridge situated in Hunan Province was strengthened with the prestressed CFRP plate technology.