Slipping Behavior and Relaxation Characteristics of Thin-Walled GFRP High-Strength Bolted Friction Joints for Sound Barriers on Bridge Viaducts

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Abstract

This study aimed to clarify the performance of high-strength bolted joints for thin-walled glass-fiber-reinforced polymer (GFRP) members by conducting slip tests and long-term relaxation tests. The parameters of the slip test were the FRP surface treatment, bolt axial force, and bolt hole diameter. Relaxation characteristics might also be affected by variations in fiber content based on differences in production lots. Hence, samples from different production lots were taken. However, in these tests, the influence of all parameters was relatively minimal. One year after tightening, the axial force reduction gradually subsided and tended toward convergence. However, because it is difficult to determine convergence based on temperature changes, long-term measurements will continue. In the slip tests, the highest slip coefficient was obtained when the GFRP was coated with fluoroplastic and the connecting plates were treated with phosphate. This study proposes a design slip coefficient for GFRP high-strength bolted friction joints.

Keywords: GFRP; high-strength bolted friction joints; slipping behavior; relaxation.

1 Introduction

Glass-fiber-reinforced polymer (GFRP) has excellent material properties such as corrosion resistance, high strength and light weight. Moreover, laminated structures made from GFRP can be easily molded to form single parts. This reduces cost and simplifies manufacturing processes [1]. This has the advantage of simplifying the structure of bridge appendages such as GFRP wall railings, which are complex structures with many components. Therefore, the number of components can be reduced and workability improved, which has led to its application to bridge appendages. High-strength bolted friction joints, which have a proven track record in steel structures and are highly reliable, are commonly used.

However, in GFRP members with these joints, creep deformation occurs after a certain period of time owing to the viscoelastic behavior of the matrix resin after axial force is introduced. Therefore, the bolt axial force may be reduced to a greater extent than that in general steel.

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