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Experimental investigation of the static load bearing capacity of a FRP-strengthened tubular T-joint under brace axial compressive loading

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Abstract

This paper presents the results of an experimental research program conducted on a FRP strengthened steel tubular T-joint made of Circular Hollow Sections. The specimen was reinforced by uni-directional glass fibers impregnated with vinyl ester resin and wrapped all around the intersection of the members and the adjacent areas. Axial compression in shape of displacement controlled non-linear static loading acting on the brace member and consequently on the chord face at the intersection was selected for the monotonic loading regime. The load–displacement was recorded during the experiments. Results of this study have been compared with a formerly conducted experiment on a FRP-strengthened tubular T-joint to evaluate how the joint geometry affects the FRP efficacy on the improvement of joint static capacity. Assessment of the relative studies confirms that the FRP wrapping has significant influence on the ultimate load capacity of the connections and can highly improve the connection behavior. In addition, it was found that joint's geometry plays a significant role on the FRP effectiveness.

Keywords: Tubular connection, FRP-strengthening, Experimental specimen, Static load bearing capacity, Geometrical parameters.

1. INTRODUCTION

Onshore and offshore tubular structures are made from tubular joints which are fabricated from steel circular hollow sections. For instance, Bridges, and platform jackets are examples of their industrial application. Typically, the hollow section members are connected using but-welding technic to manufacture the so-called tubular joints. The most common simple connection is T shaped joint which is made from circular tube members (brace and chord) connected perpendicularly. Generally, the connection between these members is tried to be configured without any stiffening or reinforcing element as possible. A great interest has always been toward reinforcing tubular joints in the form of structural rehabilitation and upgrade. Metallic-based methods such as welding doubler plates, collar plates, internal/external ring-stiffeners or increasing the thickness of the main member at the joint intersection have shown to be effective in reinforcing these structures [1–10].

The static capacity of circular hollow section X-joints, strengthened with collar plates, under brace compression was experimentally and numerically investigated by Nassiraei et al. [11]. They observed that the collar plate could increase both of the initial stiffness and ultimate strength of the X-joints. Some researchers specifically carried out studies on the SCF parameter in CHSs. Shao [12] studied the effect of collar-plate reinforcement on the static strength of tubular T-joints under axial loading, through experimental test and finite element (FE) simulation. Based on the parametric study, it was found that the static strength could be greatly improved by increasing the collar-plate thickness to chord wall thickness ratio and the collar-plate length to brace diameter ratio. Parametric equations were also developed in this study.

On the other hand, cementitious-based schemes such as full member grouting or grouting the annulus of concentric members have also shown to be efficient [13,14].