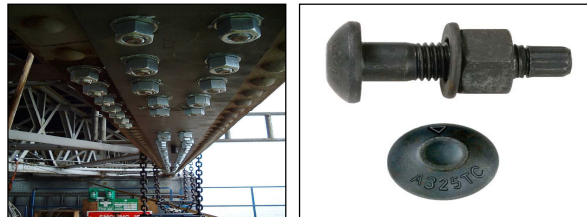


Case Study – Tension Control Bolts - TCB®

The Problem

Rivet replacement traditionally occurs during strengthening/repair or maintenance jobs typically on railway infrastructure such as bridges. As many of these structures are of historical importance it is important that any replacements mimic the appearance of rivets as closely as possible.

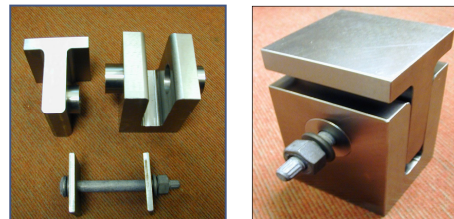


Although Tension Control Bolts are manufactured to a close tolerance fit, they also offer clamping through the preloading of the shank during the installation process, thus mimicking the features of traditional rivets. However, there was little published information available regarding their performance in tension (friction) and shear simultaneously.

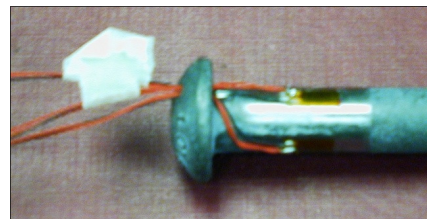
An experimental investigation was undertaken to test the performance of Tension Control Bolts under dual loading and in-service conditions.

The Tests

A test rig was designed containing non faying surfaces to represent on site conditions where age/corrosion may lead to a loss of contact between components.



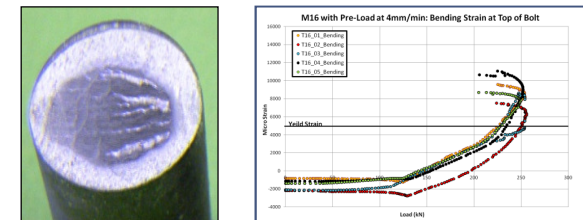
Strain gauges were fitted to the surface of the bolt at the rivet head in order to monitor its behaviour during installation and testing.



Three different diameter bolts 16mm, 20mm and 22mm were tested in tension and under shear at strain rates of 1mm/min, 4mm/min and 16 mm/min both with and without pre-load.

The Results

The fracture surfaces of the bolts which were consistent throughout the testing showed that the rig failed the bolts correctly with clean shear failures



The tensile strain produced as a result of the pre-loading is lost at approximately 70% of the maximum achievable load.

As shown in the table below, the state of preload in the Tension Control Bolts appears to have no effect on the shear strength. The experimental shear strength was found to be approximately twice the published values.

Bolt	M16	M20	M22
Average Pre-Load (kN)	123.4	217.1	243.6
Theoretical Failure Load (kN)⁽¹⁾	126	196	242
Actual Failure Load (kN)	253	418	512
%age Difference	4.5	-11.5	-5.3

1. Adapted from Table C3 Tension Control Bolts, Grade S10T, in Friction Grip Connections published by The Steel Construction Institute