

West Gate Bridge Strengthening Project - The Strengthening of Bolted Splices and the use of Torshear Type Bolts

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Summary

The West Gate Steel Bridge (WGB) was completed in 1978 and is distinct from other bridges of similar type and vintage in that it makes extensive use of bolted rather than welded connections. The main girder comprises trapezoidal box sections joined at 53 locations across the bridge using high-strength friction grip (HSFG) bolted plate splices on the bottom flange and webs.

All bolted connections originally employed a proprietary waisted shank bolt and during the recent strengthening works, a total of 84 cell splices were upgraded to meet modern code requirements. Torshear Type Bolts (TSBs) to JSS-II-09 (often confusingly known as Tension Control Bolts) were chosen as the replacement bolt type. By the close of the project, approximately 450,000 new bolts had been installed, 96% of which were TSBs. This report describes the findings of several tests carried out over a 30-month period to verify bolt performance.

Keywords: Bridge, Torshear Bolts, Slip Critical, HSFG, TCB, Zinc Silicate Paint, Bolt Preload, relaxation, strengthening.

1. Introduction

TSBs were used in many strengthening details for the WGB strengthening project. Their use on the transverse splices is the subject of this paper, although wider lessons apply. With the main exception of the deck plates, HSFG (Slip Critical) connections were employed at the majority of plated connections within the trapezoidal box girder. These include such locations as the web-to-diaphragm or bottom flange connections as well as single- or double-shear inter-plate splices in both the box perimeter and internal webs and diaphragms.

The 2011 strengthening works replaced many of the existing bolts with predominately Grade S10T Torshear Type Bolts (TSBs) or Grade 10.9 hexagon bolts.

1.1 Existing Gilbert Roberts bolts

All existing bolts connecting box girder components were exclusively 7/8" (22.2mm) diameter waisted shank high strength friction grip bolts (a patented system developed by Sir Gilbert Roberts), commonly referred to as GR bolts (Figure 1). They were supplied with steel having mechanical properties at least equal to BS 970 EN 16V and corresponding nuts and washers of steel to BS 970 ENBR.