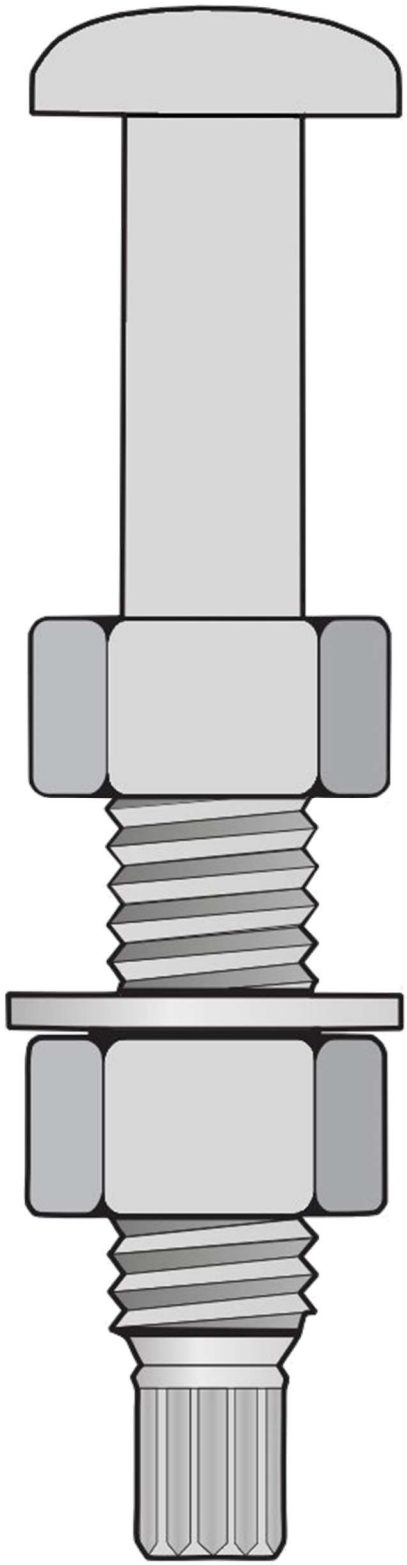
TCB Shear Stud

TCB Shear Studs have been designed as a dual purpose fixing. The high strength preloaded bolting assemblies are manufactured in accordance with EN 14399-1 but also need to meet the requirements of a shear connector in accordance with EN 1994-1-1.



Technical Requirements

- The high strength bolting assemblies meet the specifications of EN 14399-1 for preloaded bolting including the minimum preload
- Initially conceived for use on composite bridge repairs where use of welded shear studs would not be conducive with the original wrought iron
- Manufactured to order as a bespoke solution; need to allow 2/3 weeks for delivery.
- Manufactured from a standard property class 10.9 TC bolt where the highly ductile base material lends itself to longitudinal forces that are imparted

Benefits

- Single solution fastener
- Ideal for composite structures
- Uniquely conforms to standards for preloaded bolting assemblies & welded shear studs
- Can be used on wrought / cast iron structures
- No on-site welding required
- Dome head readily accepts concrete
- Used in composite bridge design mitigating longitudinal forces
- Large under-head surface reduces up-lift

Design Resistance

Testing in accordance with BS EN 1994-1-1 Annex B.2 was carried out on M20 TCB Shear Studs at the School of Mechanical, Aerospace and Civil Engineering (MACE), University of Manchester. A test jig was manufactured (with 8 TCB shear studs) in accordance with Annex B of BS EN 1994-1-1:2004. The average compressive strength of concrete cube at time of testing was 35.61 MPa and the value for cylinders was 29.85 MPa thus the expected failure load was calculated to be 702.6kN.

A comparison between the expected failure load and the actual failure load from the testing is shown in table 1.

Table 1 – Comparison between the design resistance load obtained from testing and the value calculated from Eurocode 4

Test No.	Failure Load (kN)	Standard Deviation from mean value	Experimental value for the design resistance: P_{Rd} (kN)	Eurocode 4 value for the design resistance: P_{Rd} (kN)
1	1,569.48	0.76 %	128.85	87.82
2	1,431.67	8.09 %		
3	1,671.97	7.34 %		
Mean	1,557.71			

BS EN 1994-1-1 specifies that if the values obtained from three tests on identical specimens do not have a deviation of more than 10% from the mean value, the design resistance of the connectors can be determined as follows:

* P_{Rk} = minimum failure load divided by the number of connectors and reduced by 10%
* $P_{Rd} = P_{Rk}/\gamma_v$, (γ_v = 1.25, safety factor)

It can be observed that the design resistance load obtained from push tests performed on specimens using TCB shear studs was nearly 1.5 times higher than the design resistance load obtained from the calculations in accordance with BS EN 1994-1-1:2004 for welded shear studs.

Table 2 – Summary of the results obtained from the testing

Test No.	Failure Load (kN)	Type of failure	Shear resistance per connector (kN)	Ultimate slip value just before failure (mm)
1	1569.48	Concrete crushing/bolt failure	143.52	7.79
2	1431.67	Concrete crushing	157.39	5.28
3	1671.97	Bolt failure	172.26	8.31

The tabulated results above show that the calculations proposed in BS EN 1994-1-8 are very conservative and that the TCB shear studs perform better than welded shear studs of similar dimensions when used in composite construction.

TCB shear studs deliver a significant improvement over traditional welded shear studs and provide a viable alternative in situations where on-site welding is not an option.