

## AD 527:

# Hybrid connections with bolts and welds

SCI's Advisory service occasionally receives questions about connections where load is to be shared between bolts and welds. This AD explains the code requirements and why hybrid connections are generally not recommended.

So-called hybrid connections, where load might be shared between bolts and welds are covered by clause 3.9.3 of BS EN 1993-1-8. The clause permits Category C bolts (non-slip at ULS) to share load with welds, provided the final tightening of the bolts is carried out after welding is complete.

Non-preloaded bolts transfer load in shear and bearing. The bearing deformation and the movement in clearance holes mean that if this category of fixing were used in a hybrid connection, all the load would actually be carried by the welds, since the welds prevent movement. The same principle applies for hybrid connections

using Category B bolts, as these are assumed to slip between SLS and ULS.

Using Category C bolts, preloaded after completion of the welding, precludes slip, so it can be assumed that the welds and Category C bolts share the load.

SCI is not aware of any guidance on how the force might be shared between the bolts and welds. The situation is unlikely to be simple as it will depend on the stress distribution through the connection, which will be affected by the arrangement of bolts and welds. Owens and Cheal<sup>1</sup> point out that the strength and stiffness of fillet welds vary substantially with the direction of the applied load. A second comment is that an elastic analysis based on a single value of weld stiffness cannot be accurate; the limited ductility of the weld precludes the use of simple plastic

analysis. It may be possible to undertake a finite element analysis (FEA) of a hybrid connection, though SCI's experience is that FEA is often not straightforward.

The guidance on hybrid connections is not new – identical guidance is given in clause 6.1.1 of BS 5950, but SCI's advice is that hybrid connections should not be adopted without very careful consideration of the force distribution within the connection.

<sup>1</sup> Owens, Graham W.; and Cheal, Brian D. 1989. *Structural steelwork connections*, Butterworth & Co. Ltd, London, UK

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## New and revised codes and standards

From BSI Updates February 2024

### BRITISH STANDARDS UNDER REVIEW

#### BS EN 1011-3:2018

Welding. Recommendations for welding of metallic materials. Arc welding of stainless steels.

#### BS EN 1011-6:2018

Welding. Recommendation for welding of metallic materials. Laser beam welding.

#### BS EN 1365-3:2000

Fire resistance tests for loadbearing elements. Beams.

#### BS EN 1365-4:1999

Fire resistance tests for loadbearing elements. Columns.

#### BS EN 10058:2018

Hot rolled flat steel bars and steel wide flats for general purposes. Dimensions and tolerances on shape and dimensions.

#### BS EN 10164:2018

Steel products with improved deformation properties perpendicular to the surface of the product. Technical delivery conditions.

#### BS EN 15804:2012+A2:2019

Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products.

#### BS EN ISO 2553:2019

Welding and allied processes. Symbolic representation on drawings. Welded joints.

#### BS ISO 1891:2009

Fasteners. Terminology.

#### BS ISO 5952:2019

Steel sheet, hot-rolled, of structural quality with improved atmospheric corrosion resistance.

### BRITISH STANDARDS WITHDRAWN

#### BS EN ISO 15611:2003

Specification and qualification of welding procedures for metallic materials. Qualification based on previous welding experience.

### CEN EUROPEAN STANDARDS

#### EN ISO 15611:2024

Specification and qualification of welding procedures for metallic materials. Qualification based on previous welding experience.

### DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT

#### 24/30482380 DC

BS EN ISO 14344 Welding consumables. Procurement of filler materials and fluxes. *Comments for the above document are required by 17 March, 2024*

#### 24/30482425 DC

BS EN ISO 544 Welding consumables. Technical delivery conditions for filler materials and fluxes. Type of product, dimensions, tolerances and markings. *Comments for the above document are required by 19 March, 2024*

### ISO PUBLICATIONS

#### ISO 14373:2024

Resistance welding. Procedure for spot welding of uncoated and coated low-carbon steels.

### NEW WORK STARTED

#### EN ISO 8502-5

Preparation of steel substrates before application of paints and related products. Tests for the assessment of surface cleanliness. Measurement of chloride on steel surfaces prepared for painting (ion detection tube method).

#### EN ISO 11126-10

Preparation of steel substrates before application of paints and related products. Specifications for non-metallic blast-cleaning abrasives. Almandite garnet.

#### EN ISO 18203

Steel. Determination of the thickness of surface-hardened layers.

#### EN ISO 29481-1

Building information models. Information delivery manual. Methodology and format.

#### EN ISO 29481-2

Building information models. Information delivery manual. Interaction framework.

### PUBLISHED DOCUMENTS

#### PD GEN/TS 19102:2023

Design of tensioned membrane structures.

### UPDATED BRITISH STANDARDS

#### BS 8000-0:2014+A1:2024

Workmanship on construction sites. Introduction and general principles