



# Navigating the EC2 punching shear specification? The 'quality' answer is CARES approved

*What makes a construction project successful? In short, the delivery of a high-quality building, within the given time and cost limitations. A key point to success is certainly the good connection between the parties involved – ranging from the client, through to the engineers, contractors and suppliers of construction products. Gerhard Bumes of Max Frank reports on how this quality aspect can be assured in the case of punching shear solutions. This is achieved by complying with current design Codes, in particular Eurocode 2 and the UK National Annex, and quality products approved by CARES.*

**D**espite London clearly being the centre of business activity, other cities increase their attractiveness with developments as well. Birmingham's Eastside is an area of thriving growth, with the advantage of being close to the city and well connected in terms of infrastructure.

Unite the Union decided to build a £35 million complex at Birmingham Science Park, to be used as offices, hotel, and a conference centre for up to 1000 delegates. The new buildings form part of the existing Holt Court, which prior to the development consisted of four office buildings grouped around a landscaped courtyard. The most southerly building was demolished in order for this development to commence. The site was formerly an area of 18th and 19th Century domestic and small-scale industrial buildings, whose expansion was supported by the construction of the canal in 1790. Despite the redevelopment, much of the original street pattern remains (see Figures 1 and 2).

The seven-storey hotel was designed as a flat-slab concrete frame. This method of construction is widely used nowadays, for its

speed and efficiency. However, the challenge arising with this method is the issue of punching shear around the columns – that is, the danger of having the columns punching through the slabs.

An industry-acknowledged solution for this is the use of double-headed studs on rails, eg, Max Frank Shearail (see Figure 3). These are placed around the columns within the reinforcement fabric, to increase the shear resistance of the slab. With the support of proprietary design software, the design and detailing of the punching shear solution was a quick process. In difficult cases, the technical team provide the project engineer with timely design support. The output of the software can easily be integrated into structural drawings (see Figure 4).

The software is supported with CPDs and workshops at the engineer's premises, discussing various design cases. This is important, as there is more and more confusion in the market regarding the underlying design standards for punching shear and CE marking in particular. To understand this in more detail, a principal view on Eurocode 2 is helpful.

Figure 1: Architect's illustration of the development.  
(Image: Consarc Design Group.)

**EC2 – bigger picture**

Eurocode 2, or officially known as BS EN 1992-1-1<sup>(1)</sup>, is a widely used Standard nowadays. Not only in the public sector but also in the private sector, it has replaced BS 8110<sup>(2)</sup> to a great extent.

As a Eurocode, one might think that BS EN 1992-1-1 unifies the design approach across Europe. However, this is not the case. The Eurocode, and further Standards that need to be used in conjunction with it, eg, BS EN 13670<sup>(3)</sup>, incorporate the history and requirements in different markets. Country-specific adjustments are therefore made in National Annexes, which mainly define nationally determined parameters.

An example of this is the permissible yield strength of reinforcement. In addition to these parameters, further documents that provide country-specific background information are referenced. The *National Structural Concrete Specification for Building Construction*<sup>(4)</sup>, also known as NSCS 4, is such a document. It is referred to in the National Annex of BS EN 13670 as ‘non-contradictory complementary information’.

**Punching shear reinforcement**

An appreciation of this background is essential in understanding the requirements for specific building products, eg, punching shear reinforcement. As a structural component, they need to be designed and specified by the structural engineer. EC2 and the National Annex define the design rules; however, they do not ensure the quality of the product used.

Therefore, the above mentioned NSCS 4 makes a clear statement: “All punching shear reinforcement system manufacturers shall hold a valid Technical Approval certificate issued by CARES”. This ensures the quality of the product used by providing complete traceability of the reinforcement steel and quality control of the manufacturing process. However, a design according to EC2 consequentially requires the usage of a CARES-approved punching shear system, which finally ensures the quality of the building.

**CE mark**

The request for CE-marked products is becoming increasingly popular. CE marks are mandatory for products covered by a harmonised European Standard (hEN). Punching shear reinforcement is currently not covered by a hEN, therefore CE marking is not mandatory. However, it can be achieved voluntarily based on a European Assessment Document (EAD).

Figure 2: Architect’s illustration of new Unite office. (Image: Consarc Design Group.)

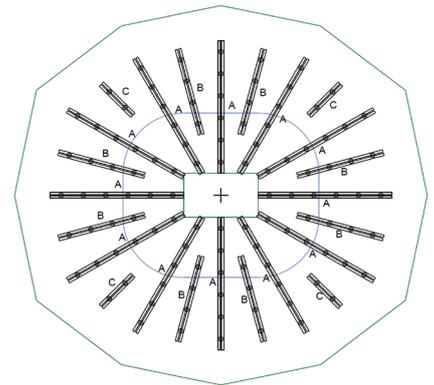
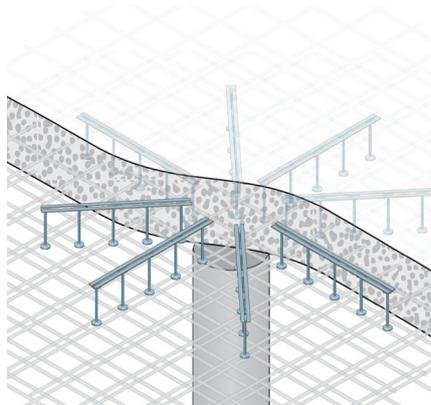


Figure 3 (above left): Max Frank Shearail double-headed pins preventing local shear failure around columns. (Image: Max Frank.)

Figure 4 (above): Shearail rail layouts can be integrated via DXF output of the Max Frank software into engineering drawings. (Image: Max Frank.)

Nevertheless, the CE mark in this case is still not a *quality* mark, but only states *conformity* with the EAD. It therefore cannot replace a CARES approval; furthermore, in reality, none of the CE-marked punching shear products comply with CARES requirements. Therefore, a design in compliance with EC2 and the respective UK National Annex must not only rely on a CE-marked product but also needs to consider the usage of CARES-approved systems.

**CARES and BBA approved**

Max Frank Shearail punching shear reinforcement is the only system available on the market that holds both BBA and CARES



Figure 5: Based on site-layout drawings, Shearail is quick and easy to install. (Photo: Max Frank.)



Figure 6: Shearail in place on-site. (Photo: Max Frank.)

approval<sup>(5,6)</sup>, demonstrating the technical benefit of the product.

For Northfield Construction – the contractor erecting the concrete frame in Birmingham for Unite – the use of Shearail was a clear benefit. “The engineer’s specification allowed us to save a considerable amount of time. Shearail is much easier to place than traditional ‘bob and hook’ reinforcement. The installation drawings are easy to understand, the product is clearly labelled and we therefore can ensure that no mistakes in installation are made,” as Northfield’s contracts manager Mick Galligan points out (see Figures 5 and 6).

The products used on this project ranged from 10 to 20mm pins in variable length; bigger-sized 25mm pins are available, but were not required. The product is manufactured in the UK under CARES surveillance to ensure its quality. However, as this case study shows, the ultimate success

and quality of a construction project comes from the successful collaboration between all parties involved. ■

**References:**

1. BRITISH STANDARDS INSTITUTION, BS EN 1992-1-1. *Eurocode 2: Design of concrete structures. General rules and rules for buildings*. BSI, London, 2004+A1:2014.
2. BRITISH STANDARDS INSTITUTION, BS 8110. *Structural use of concrete. Code of practice for design and construction*. BSI, London, 1985, withdrawn.
3. BRITISH STANDARDS INSTITUTION, BS EN 13670. *Execution of concrete structures*. BSI, London, 2009.
4. CONSTRUCT. *National Structural Concrete Specification for Building Construction – Fourth edition complying with BS EN 13670:2009*. The Concrete Centre, Blackwater, 2010.
5. BRITISH BOARD OF AGRÉMENT, BBA Agrément Certificate 14/5112. *Max Frank Ltd reinforcement systems – Shearail punching shear reinforcement system*. Watford, April 2014.
6. UK CERTIFICATION AUTHORITY FOR REINFORCING STEELS, CARES Certificate 5043. *Max Frank punching shear reinforcement system for use in accordance with Technical Approval Report TA7 – 5043*. Kent, January 2016.