# CARES Technical Approval Report TA7 5028

Issue 3



RFA-TECH

## Sheartech®
### Punching Shear Stud System

Assessment of the RFA-TECH Sheartech® Punching Shear Stud System and Quality System for Production

TECHNICAL APPROVAL 5028

UKAS PRODUCT CERTIFICATION 0002

Validate with the CARES Cloud App

# Product

**RFA-TECH Sheartech®**
**Punching Shear**
**Stud System**

**Product approval held by:**

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## 1 Product Summary

The Sheartech® Punching Shear Stud System comprises short lengths of deformed reinforcement with end anchorages provided by enlarged heads at both ends and is used to provide shear reinforcement to resist punching failure. The Sheartech double-headed shear studs are welded to carrier/spacer rails ensuring their correct spacing and allowing them to be supported by the top flexural reinforcement.

### 1.1 Scope of Application

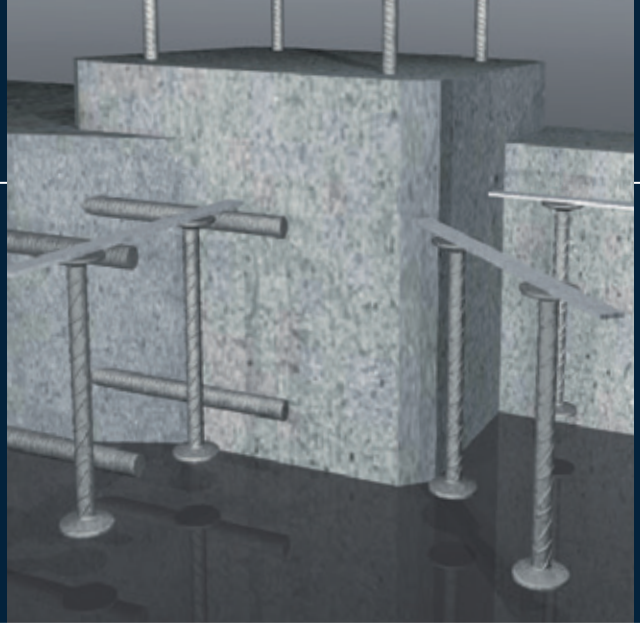
The Sheartech® Punching Shear Stud System has been evaluated for use in statically loaded reinforced concrete slabs designed for shear in accordance with Eurocode 2 and its UK National Annex.

### 1.2 Design Considerations

Eurocode 2 describes shear reinforcement in terms of links or bent-up bars. For punching, shear reinforcement is arranged in layers or perimeters around the column in which all the elements, e.g. the legs of links are equidistant from the column faces. Where proprietary products are used for punching shear, Eurocode 2 calls for $V_{Rd,cs}$ , the combined shear resistance of the concrete and shear reinforcement, to be determined by testing.

In the view of CARES, the basis of design and detailing, adopted for a shear reinforcement system other than links or bent-up bars, should be similar to that of the code, with amendments made only to take account of particular features of the system in question.

The performance of the system should be experimentally validated against a design method, and the test results should show that the system functions essentially as designed and gives resistances at least equal to the calculated characteristic resistances. Deviations from the code in relation to detailing requirements and/or other limits require experimental validation.







In the view of CARES, double headed shear studs that have been experimentally validated for punching shear may also be used for linear shear in slabs in which the flexural reinforcement complies with clause 9.3.1 of Eurocode 2. The slab edges should contain longitudinal and transverse reinforcement arranged as shown in Figure 9.8 of the code. Additionally, the spacing of the U bars should comply with the requirements of clause 9.3.2 of Eurocode 2 for shear reinforcement. The minimum distance to the slab edge from the stud centreline should not be less than 4.5$\phi$ where $\phi$ is the stud diameter.

The code contains various detailing requirements, particularly in relation to the spacing of the elements of shear reinforcement and various limits on for example the concrete compressive strength, which may be taken into account in design for shear in slabs.

## 1.3 Conclusion

It is the opinion of CARES that RFA-TECH's Sheartech® Punching Shear Stud System is satisfactory for use within the limits stated in paragraph 1.1 when applied and used in accordance with Eurocode 2 and the manufacturer's design guidance and the requirements of this certificate.

L. Brankley
Chief Executive Officer
March 2023

# 2 Technical Specification

## 2.1 General

The RFA-TECH Sheartech® Punching Shear System double-headed stud is formed from reinforcing steel bar with a characteristic yield strength of 500 N/mm$^2$. The ends are enlarged by a hot forging process to three times the diameter of the shaft to securely anchor the stud in the slab. RFA-TECH manufacture the double-headed studs from BS4449 Grade B500C, in diameters from 10mm to 25mm. The full range of shear studs is available in 5mm increments to ensure the correct placement of studs in the slab is respected.

The RFA-TECH Sheartech® double-headed studs are supplied to site factory welded to the carrier rails at predetermined spacings. Fixing of RFA-TECH Sheartech® rails is carried out once all slab reinforcement and accessories have been placed with installation of RFA-TECH Sheartech® rails usually carried out from above. The rails are positioned on the top layer reinforcement bars (T1) so that the tops of the upper heads are at the level of the top surfaces of the T1 bars. The stud lengths are such that the bottoms of their lower heads are at the level of the undersides of the B1 bars. Where rails run parallel to the T1 bars an additional spacing device is available where required to ensure rails sit on this top reinforcement layer.

# 3 Product Performance and Characteristics

## 3.1 Material Properties

The RFA-TECH Sheartech® double-headed shear stud is formed from reinforcing steel complying with BS4449 Grade B500C. The carrier rail used is formed from mild steel S275JR to BS EN 10025.

## 3.2 Production Processes

The RFA-TECH Sheartech® Punching Shear System is made from double-headed shear studs with heads formed to three times the shaft diameter giving a cross sectional area ratio of 9:1 between head and shaft to give an effective anchorage in the concrete. The studs are welded to a carrier rail in a BS EN ISO 9001:2000 approved factory environment.

## 3.3 Design Method and Detailing Requirements

In the punching shear tests made as a part of the process leading to this approval, the studs were arranged as in designs to Eurocode 2, with all the studs at a perimeter being equidistant from the columns. The approval thus applies to stud reinforcement designed and detailed to EC2.

Although the performance available from a single stud is in principle independent of the design method adopted, there are significant differences between designs to EC2 and designs to BS8110, particularly in relation to the plan arrangement of shear reinforcement.

There should be no obstacle to using EC2 to design shear reinforcement for a slab where the flexural reinforcement is designed to BS8110.

The design and detailing of this system of shear reinforcement for punching to BS8110 is a possibility but is neither substantiated or discredited by the tests made in relation to this approval. It should be noted that BS8110 requires the circumferential spacing of the shear reinforcement in all layers to be not more than 1.5d.

Designing for punching to EC2 but arranging the studs in square or rectangular perimeters or in a grid is another possibility, but it requires interpretation of the actual arrangement of the shear reinforcement as an equivalent one with the studs in layers, in which all of the studs are sensibly equidistant from the column. If the number of studs varies between such layers it is also necessary to have a method of defining a single number of studs per layer - a safe assumption would be the minimum. CARES is not aware of any proven method of making the interpretation required.

Studs may be used as reinforcement for linear shear in slabs provided compression longitudinal reinforcement is not included in the flexural resistance calculation. The shear reinforcement should be designed in accordance with Section 6.2.3 of Eurocode 2. The placement of studs within the depth of the slab should be as described in Section 4.1 of this Technical Approval. The maximum longitudinal and transverse spacings of the studs should respectively be in accordance with requirements of clauses 9.3.2 (4) and 9.3.2(5) of Eurocode 2. The maximum diameter of studs used for linear shear should not exceed $\phi_{max} = 16\sqrt{d/200}$.

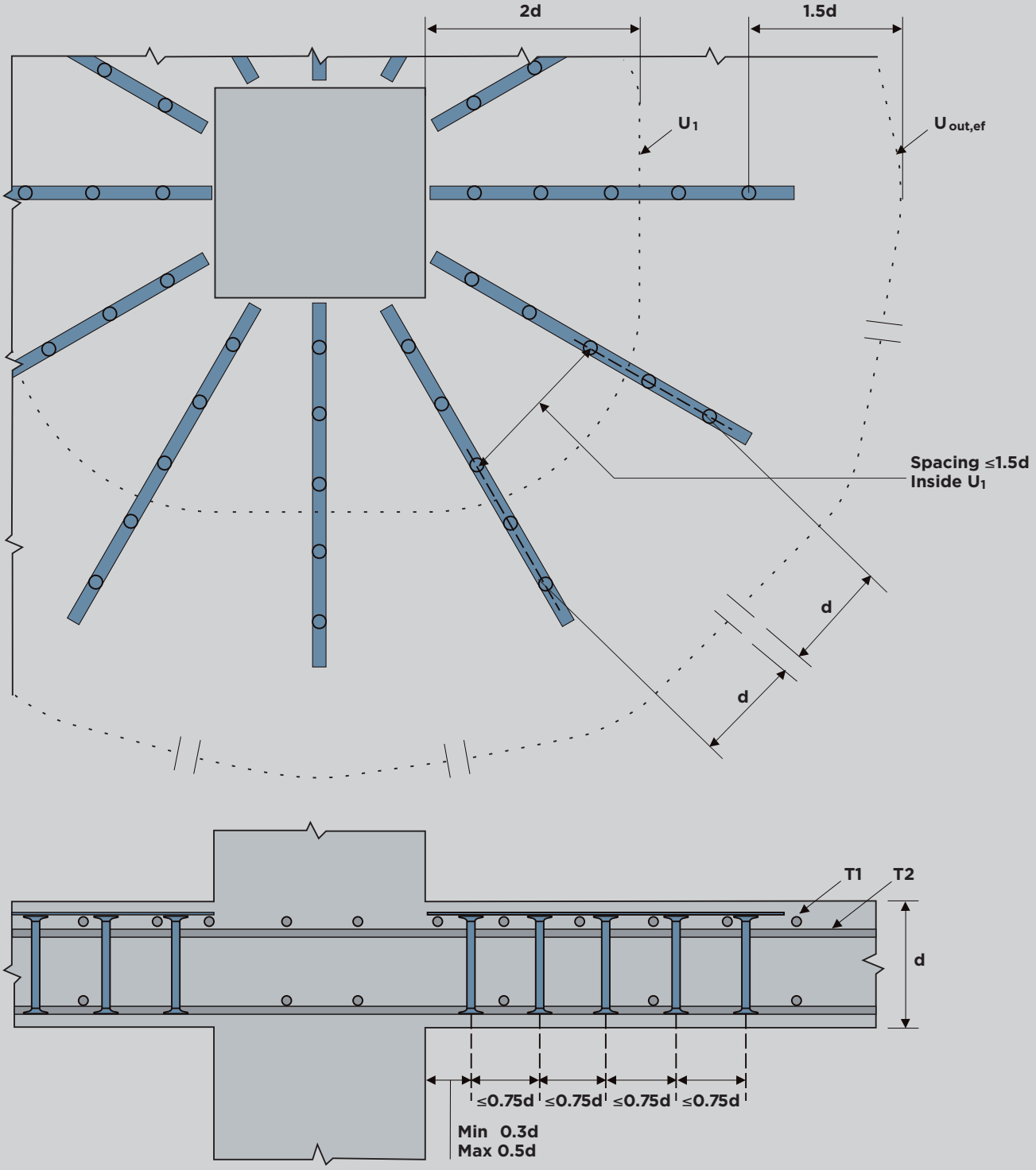



**Figure 1 - Detailing requirements**

# 4 Installation

## 4.1 Placement of the Studs

In most applications the RFA-TECH Sheartech® rails are placed after the main reinforcement. They are inserted from above and the rails sit on, and are fixed to, the upper (T1) main bars, so that the tops of the upper heads are at the level of the top surfaces of the T1 bars. The stud lengths are such that the bottoms of their lower heads are at the level of the undersides of the B1 bars. Where rails are required to be installed in parallel with the upper T1 main bars the use of a horizontal support may be necessary.

**Figure 2 - Placement of Sheartech® rails**

**Figure 3 - Rail Spacing Device**

Alternatively the stud rails may be 'bottom fixed' and placed before the main reinforcement, with the upper faces of the rails at the level of the undersides of the B1 bars and the studs projecting upwards. When placed in this manner the rails should be supported by a proprietary spacing device to ensure respect of cover to the underside of slab. Where units are fixed in this manner care should be taken to ensure the stability of the RFA-TECH Sheartech® rails when placing the upper reinforcement.

i) At the tension face of the slab the cover to the studs should be equal to that to the outer reinforcement and

ii) At the compression face the cover to the studs should be not more than d/6.

This generally makes it convenient to use stud lengths equal to the overall depth of the slab minus the sum of the top and bottom covers to the horizontal reinforcement (bars T1 and B1).

## 4.2 Storage

RFA-TECH Sheartech® rails are delivered to site stacked on pallets, banded with steel and then shrink wrapped. The order schedules / rail details are attached to the pallet along with pallet numbering if the delivery is one of multiple pallets. It is suggested that pallets are stored in the area of application where possible and schedules are retained at the earliest opportunity for records and to assist in identification of material if required. Although the product is fabricated from steel and robust in nature it is good practice to store the product away from an area where damage may occur.

## 5 Safety Considerations

RFA-TECH Sheartech® rails are easily placed on site and are a low weight product. General PPE precautions should be taken in line with general steel fixing such as the wearing of gloves and eye protection. Care should be taken when cutting steel banding from pallets and eye protection is recommended for this process.

## 6 Product Testing and Evaluation

The RFA-TECH Sheartech® Punching Shear System has undergone independent structural testing at Cambridge University to demonstrate compliance with the requirements of Eurocode 2 and also compliance with the requirements of Cares Appendix TA7 ‘Quality and Operations Schedule for the Technical Approval of Stud Shear Reinforcing System for Flat Slabs’.

## 7 Quality Assurance

RFA-TECH’s BS EN ISO 9001 quality management system monitors the production of the Sheartech double-headed shear studs and Sheartech® Punching Shear Stud System components to ensure that materials and product remain within the limits of this technical approval.

CARES: Quality Management System Certificate No 5028.

# 8 Building Regulations

## 8.1 The Building Regulations (England and Wales)

### Structure, Approved Document A

RFA-TECH Sheartech® Punching Shear System, when used in EC2 based designs using the data contained within this technical approval, satisfy the relevant requirements of The Building Regulations (England and Wales), Approved Document A.

### Materials and Workmanship, Approved Document

This technical approval gives assurance that the RFA-TECH Sheartech® Punching Shear System comply with the material requirements of EC2.

## 8.2 The Building Regulations (Northern Ireland)

### Materials and Workmanship

This technical approval gives assurance that RFA-TECH Sheartech® Punching Shear System comply with the material requirements of EC2 by virtue of regulation *23, Deemed to satisfy provisions regarding the fitness of materials and workmanship.*

## 8.3 The Building Standards (Scotland)

### Fitness of Materials

This technical approval gives assurance that RFA-TECH Sheartech® Punching Shear System comply with the material requirements of EC2 by virtue of *Clause 0.8*.

### Structure

RFA-TECH Sheartech® Punching Shear System, when used in EC2 based designs using the data contained within this technical approval, satisfy the requirements of *The Building Standards (Scotland) clause 1.*

# 9 References


- Eurocode 2 : Design of concrete structures - Part 1-1: General rules and rules for buildings, BSEN 1992-1-1:2004.
- UK National Annex “NA to BSEN 1992-1-1:2004” published by BSI 2005.
- BS8110: Part 1: 1997 (Revised 2007): Structural Use of Concrete, Code of Practice for Design and Construction.
- CARES Appendix TA7 Quality and Operations Schedule for the Technical Approval of Stud Shear Reinforcing Systems for Flat Slabs.

# 10 Conditions

1. The quality of the materials and method of manufacture have been examined by CARES and found to be satisfactory. This technical approval will remain valid provided that:

   a. The product design and specification are unchanged.
   b. The materials, method of manufacture and location are unchanged.
   c. The manufacturer complies with CARES regulations for technical approvals.
   d. The manufacturer holds a valid CARES Certificate of Product Assessment.
   e. The product is installed and used as described in this report.

2. CARES make no representation as to the presence or absence of patent rights subsisting in the product and/or the legal right of RFA-TECH to market the product.

3. Any references to standards, codes or legislation are those which are in force at the date of this certificate.

4. Any recommendations relating to the safe use of this product are the minimum standards required when the product is used. These requirements do not purport to satisfy the requirements of the Health and Safety at Work act 1974 or any other relevant safety legislation.

5. CARES does not accept any responsibility for any loss or injury arising as a direct or indirect result of the use of this product.

6. This Technical Approval Report should be read in conjunction with CARES Certificate of Product Assessment No 5028. Confirmation that this technical approval is current can be obtained from CARES.

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