

Approval body for construction products  
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and  
Laender Governments



## European Technical Assessment

**ETA-03/0039**  
**of 5 June 2018**

English translation prepared by DIBt - Original version in German language

### General Part

Technical Assessment Body issuing the  
European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

KÖCO Headed Studs

Product family  
to which the construction product belongs

Headed studs cast-in and welded on steel plates made of  
steel and of stainless steel

Manufacturer

Köster & Co. GmbH  
Spreeler Weg 32  
58256 Ennepetal  
DEUTSCHLAND

Manufacturing plant

Herstellwerk 1

This European Technical Assessment  
contains

15 pages including 3 annexes which form an integral part  
of this assessment

This European Technical Assessment is  
issued in accordance with Regulation (EU)  
No 305/2011, on the basis of

EAD 330084-00-0601

This version replaces

ETA-03/0039 issued on 4 June 2013

**European Technical Assessment**

**ETA-03/0039**

English translation prepared by DIBt

**Page 2 of 15 | 5 June 2018**

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## Specific Part

### 1 Technical description of the product

The KÖCO-headed studs welded on steel plates consist of steel and stainless steel.

The headed studs have a diameter of the shaft of 10, 13, 16, 19, 22 and 25 mm. At one end a head is formed by upsetting. The other end is prepared for drawn arc stud welding with ceramic ferrule or shielding gas (method 783 according to EN ISO 4063:2002-02).

The steel plates with welded on headed studs are embedded surface-flush in the concrete.

The product description is given in Annex A.

### 2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the anchor channel is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor channel of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

### 3 Performance of the product and references to the methods used for its assessment

#### 3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load (static and quasi-static loading)	See Annex C1
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C2
Displacements (static and quasi-static loading)	See Annex C1 to C2

#### 3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1

### 4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with EAD No. 330084-01-0601, the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

**5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD**

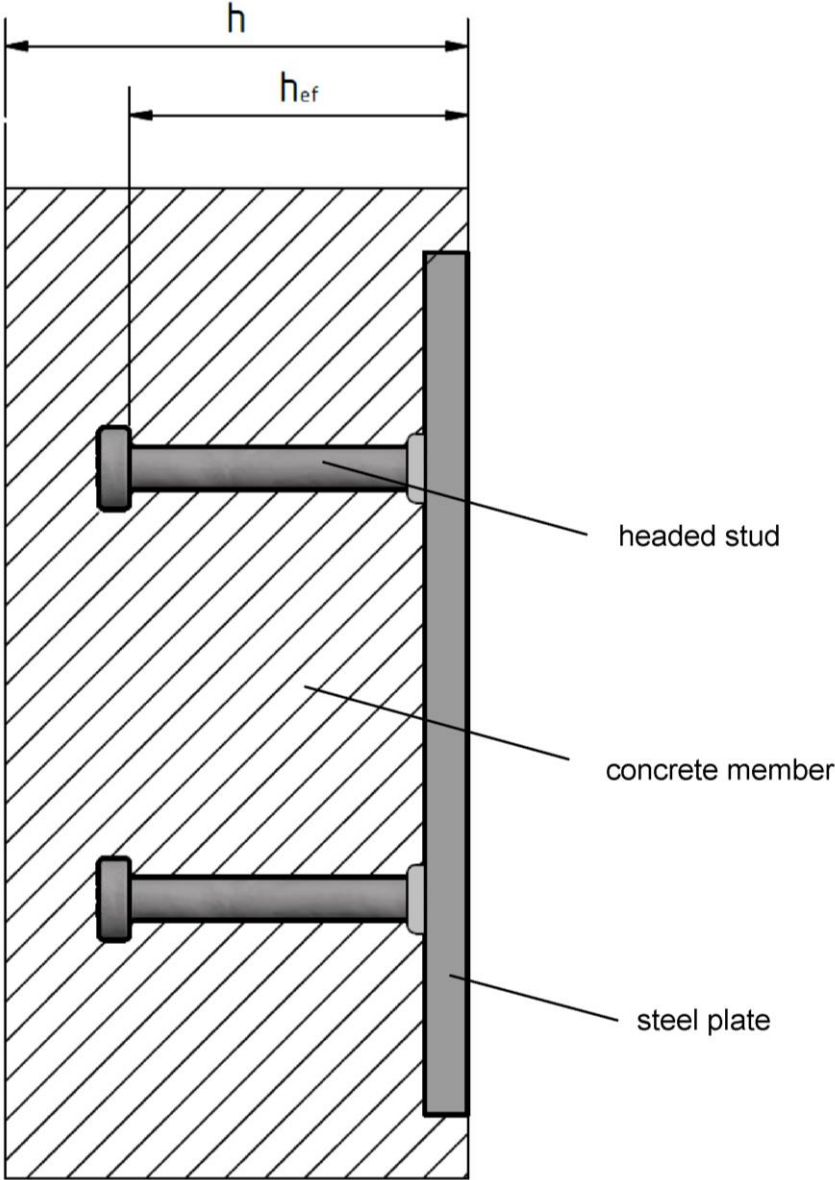
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 15 June 2018 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow  
Head of Department

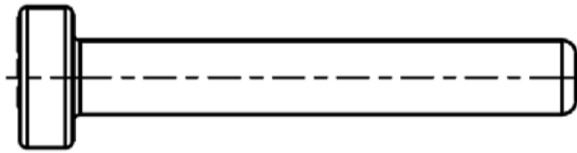
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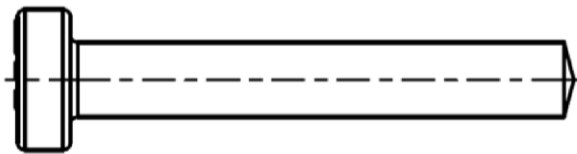


$h$  = thickness of concrete member  
 $h_{ef}$  = effective embedment depth

KÖCO-Headed Studs	Annex A1
Product description Installed condition	



Form A



Form B



Marking: e.g. KÖCO

KÖCO = Identifying mark of the producer  
without = material acc. to Table 2, Part 1



Marking: e.g. KÖCO

KÖCO = Identifying mark of the producer  
1.4301 or 1.4303 = material

**Table 1: Dimensions**

Headed stud type	Shaft Ø d [mm]	Head Ø d <sub>h</sub> [mm]	Nominal length		Thickness of head t <sub>h</sub> [mm]
			min h <sub>n</sub> [mm]	max h <sub>n</sub> [mm]	
10	10	19	50	200	7,1
13	13	25	50	400	8
16	16	32	50	525	8
19	19	32	75	525	10
22	22	35	75	525	10
25 <sup>1</sup>	25	40	75	525	12

<sup>1</sup> Headed stud size 25 only of material acc. To Table 2, Part 1

## KÖCO-Headed Studs

### Product description

Headed studs dimensions and marking

**Annex A2**

**Table 2: Material steel**

Part	Denomination	Material	Mechanical properties	Intended use
1	Headed stud SD1 acc. to EN ISO 13918:2018	Killed steel acc. to material group 1 ISO/TR 15608 within limits according to EN ISO 13918:2018 (e.g. S235J2+C470 according to EN 10025:2005)	$f_{uk} \geq 470 \text{ N/mm}^2$ $f_{yk} \geq 375 \text{ N/mm}^2$	Steel plates with welded on headed studs may only be used in structures subject to dry internal conditions
2	Steel plate	Steel S235JR; S235JO; S235J2 according to EN 10025:2005	$f_{uk} = 340 - 470 \text{ N/mm}^2$ $f_{yk} \geq 225 \text{ N/mm}^2$	
		S355JO; S355J2 according to EN 10025:2005	$f_{uk} = 510 - 680 \text{ N/mm}^2$ $f_{yk} \geq 350 \text{ N/mm}^2$	

**Table 3: Materials stainless steel**

Part	Denomination	Material	Mechanical properties	Intended use
1	Headed stud SD3 acc. to EN ISO 13918:2018	Stainless steel 1.4301; 1.4303, 1.4306, 1.4307, 1.4401, 1.4404, 1.4571, 1.4432, 1.4436, 1.4439 acc. to EN 10088:2005	$f_{uk} = 540 - 780 \text{ N/mm}^2$ $f_{yk} \geq 350 \text{ N/mm}^2$	Steel plates with welded on headed studs may also be used in structures subject to external atmospheric exposure (including industrial and marine environment), or exposure in permanently damp internal conditions, if no particular aggressive conditions exist. Such particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).
2	Steel plate	Stainless steel 1.4401, 1.4404, 1.4571, 1.4432, 1.4436, 1.4439 according to EN 10088:2005	$f_{uk} = 530 - 680 \text{ N/mm}^2$ $f_{yk} \geq 220 \text{ N/mm}^2$	

**KÖCO-Headed Studs**

**Product Description**  
Material

**Annex A3**



## Specifications of intended use

### Steel plate with cast-in anchors subject to:

- Static and quasi-static loads in tension and shear.

### Base materials:

- Reinforced normal weight concrete according to EN 206-1:2000.
- Strength classes C20/25 to C90/105 according to EN 206-1:2000.
- Cracked or uncracked concrete.

### Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (headed studs welded to steel plates according to Annex A3, Table 2 and 3)
- Structures subject to external atmospheric conditions (including industrial and marine environment) or exposure in permanently damp internal conditions, if no particular aggressive conditions (e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with chemical pollution e.g. desulphurization plants or road tunnels where de-icing materials are used) exist.  
(headed studs welded to steel plates according to Annex A3, Table 3)

### Design:

- Steel plate with cast-in anchors are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor channel and channel bolts are indicated on the design drawings (e.g. position of the anchor channel relative to the reinforcement or to supports).
- For static and quasi-static loading the steel plate with cast-in anchors are designed in accordance with CEN/TS 1992-4-2:2009.
- It is generally assumed that the concrete is cracked and that the occurring splitting forces are resisted by the reinforcement. The required cross section of the minimum reinforcement is determined according CEN/TS 1992-4-2:2009 section 6.2.6.2 b).

### Installation:

#### Welding of the headed studs to the steel plate

- Steel plates, on which headed studs made of steel will be welded, consist of the materials S235JR, S235JO, S235J2, S355JO and S355J2 according to Annex A3, Table 2 or
- Steel plates, on which headed studs made of stainless steel will be welded, consist of the materials 1.4401, 1.4404, 1.4571, 1.4432, 1.4436, 1.4439 according to Annex A3, Table 3.
- Headed studs shall be welded to the steel plate by means of drawn arc stud welding with ceramic ferrules or shielding gas in accordance with EN ISO 14555 and EN ISO 3834.
- Level of quality requirements corresponds to EN ISO 3834-3.
- Possibly not homogeneous structure of the steel plate (e.g. lamellar tearing/ lamellar imperfections) in the direction of the thickness are taken into account.
- Welding of the headed studs via arc stud welding may be performed in the manufacturing plant or on the construction site.
- For the welding of headed studs on the steel plate the executing company has a valid acceptance for arc stud welding according EN ISO 14555.

## KÖCO-Headed Studs

Intended use  
Specifications

Annex B1



Placing steel plates into concrete

- The installation of headed studs is carried out by appropriately qualified personnel under the supervision of the person responsible for the technical matters on site.
- Use of the product only as supplied by the manufacturer.
- Installation in accordance with the manufacturer's specifications given in Annexes B4, B5 and B6.
- The anchorages are fixed on the formwork, reinforcement or auxiliary construction such that no movement of the product will occur during the time of laying the reinforcement and of placing and compacting the concrete.
- The concrete under the head of the headed studs are properly compacted.
- For large fixtures (steel plate > 400 mm x 400 mm) and if air can accumulate under the plate during compaction vent openings are provided, specified in the design drawings.

**KÖCO-Headed Studs**

**Intended use**  
Specifications

**Annex B2**

**Table 4: Installation parameter for headed studs**

Nominal size (mm)		10	13	16	19	22	25 <sup>1)</sup>
anchorage depth	$\min h_{ef}$ [mm]	50	50	50	75	75	75
minimum spacing	$s_{min}$ [mm]	50	70	80	100	100	100
minimum edge distance	$c_{min}$ [mm]	50	50	50	70	70	100
minimum thickness of concrete member	$h_{min}$ [mm]	$h_{ef} + t_h + c_{nom}$ <sup>2)</sup>					

<sup>1)</sup> Headed stud size 25 only of material acc. to Table 2, Part 1

<sup>2)</sup>  $c_{nom}$  = required concrete cover according to national regulations

### Arrangement of the headed studs

Regulations for the arrangement of the headed studs on the plate are given in CEN/TS 1992-4-1:2009, section 1.2.3.

**KÖCO-Headed Studs**

**Intended use**  
Installation parameters

**Annex B3**

Fig.1: Simple headed stud

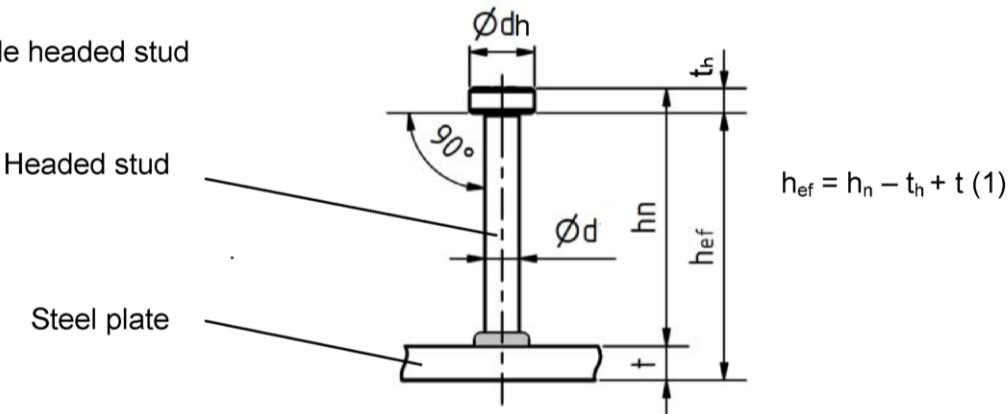


Fig.2: Double headed stud

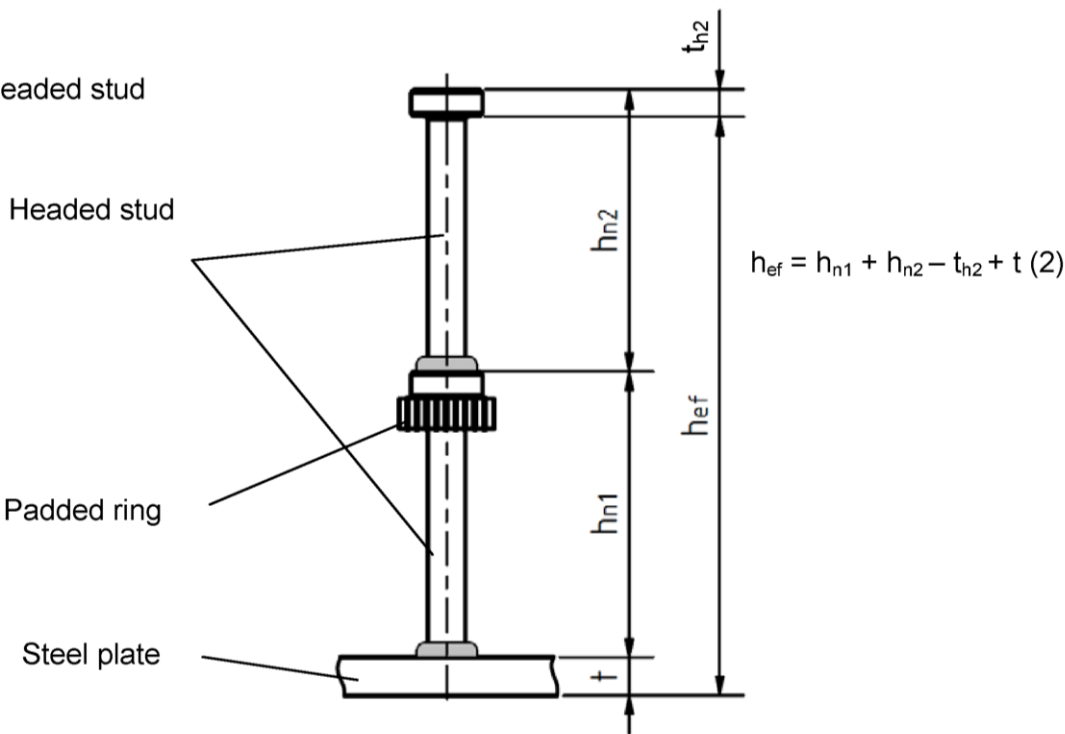
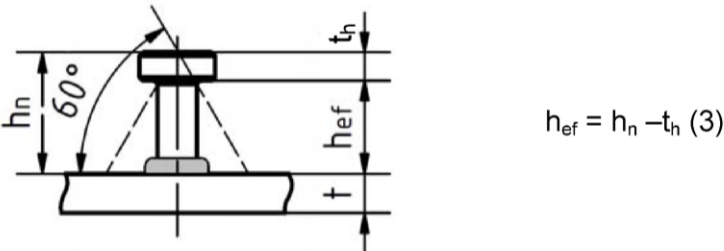


Fig.3: Short headed stud,  
if the theoretic cone meets  
the steel plate at an angle  
of  $\sim 60^\circ$  or  $t \geq 0,2 h_n$



$d$  = diameter of shaft  
 $d_h$  = diameter of head  
 $h_{ef}$  = effective embedment depth  
 $h_n$  = nominal length of stud  
 $t_h$  = thickness of the head  
 $t$  = thickness of the steel plate

**KÖCO-Headed Studs**

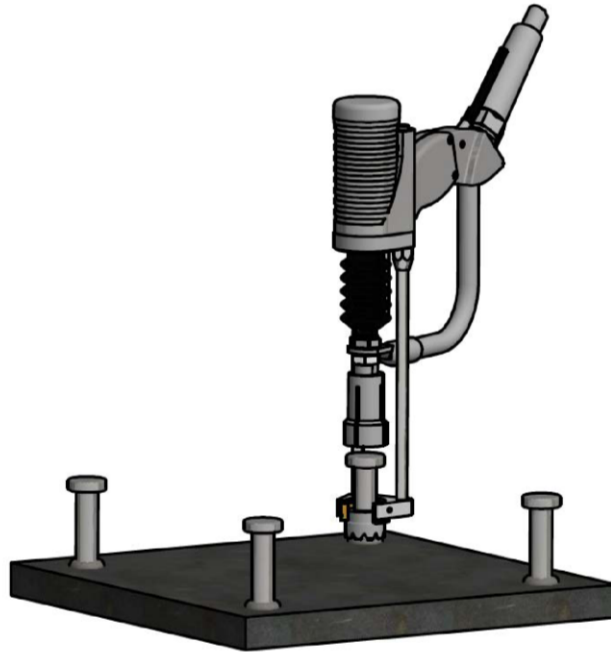
**Intended use**  
Effective embedment depth

**Annex B4**

## Installation instruction

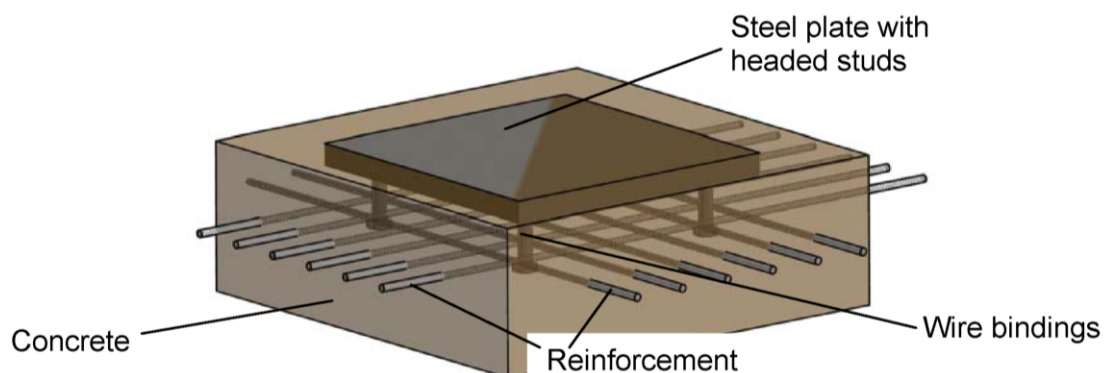
### 1 Welding headed studs to steel plate

- Confect steel plate (material S235JR, S235JO, S235J2, S355JO or S355J2) acc. design drawings,
- Weld headed studs to steel plate acc. method 783 of EN ISO 4063 and at position acc. to design drawings.



### 2 a Fixing steel plate to reinforcement

- Fix steel plate with headed studs directly to reinforcement or to mounting bar by wire binding,
- Fix in a way that steel plate does not move while pouring and compacting concrete,
- Orient steel plate surface-flush with the assumed concrete member.



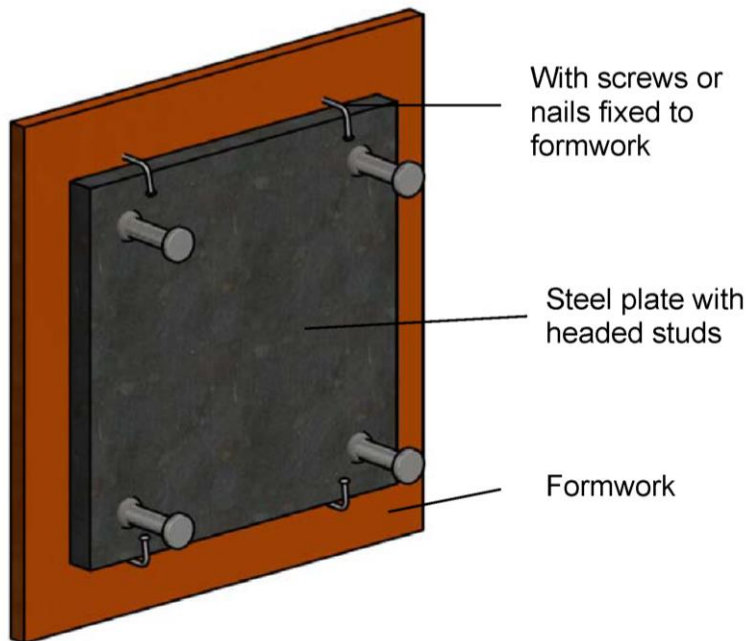
## KÖCO-Headed Studs

**Intended use**  
Installation instructions

**Annex B5**

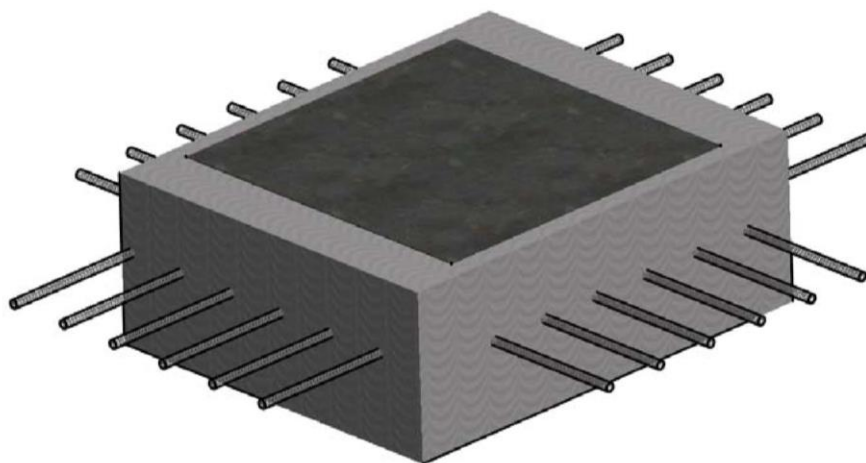
## 2 b Fixing steel plate to formwork

- Fix steel plate with headed studs directly to formwork by nails, screws or wire binding,
- Control close contact between steel plate and formwork;
- Fix in a way that steel plate does not move while pouring and compacting concrete.



## 3 Pouring concrete and compacting concrete

- Compact concrete properly around steel plate and headed studs.



### KÖCO-Headed Studs

**Intended use**  
Installation instructions

**Annex B6**

**Table 5: Characteristic resistances under tension load for headed studs of steel and stainless steel**

Headed stud – nominal size			10	13	16	19	22	25 <sup>2)</sup>
Steel failure for headed studs made of steel								
Characteristic resistance		N <sub>RK,s</sub> [kN]	37	62	94	133	179	231
Partial safety factor		γ <sub>Ms</sub> <sup>1)</sup>	1.5					
Steel failure for headed studs made of stainless steel								
Characteristic resistance		N <sub>RK,s</sub> [kN]	42	72	109	153	205	--
Partial safety factor		γ <sub>Ms</sub> <sup>1)</sup>	1.85					
Pull-out failure for cracked concrete								
Characteristic resistance		N <sub>RK,p</sub> [kN]	30	50	90	75	85	115
Increasing factors ψ for the characteristic resistance		C25/30	1.20					
		C30/37	1.48					
		C35/45	1.80					
		C40/50	2.00					
		C45/55	2.20					
		≥ C50/60	2.40					
Partial safety factor		γ <sub>Mp</sub> <sup>1)</sup>	1.5					
Concrete cone failure								
Effective anchorage depth		h <sub>ef</sub> [mm]	h <sub>n</sub> – t <sub>h</sub> + t <sup>3)</sup>					
factor to take into account the influence of load transfer mechanisms	cracked concrete	k <sub>cr</sub> [-]	8.5					
	uncracked concrete	k <sub>ucr</sub> [-]	11.9					
Characteristic spacing		s <sub>cr,N</sub> = s <sub>cr,sp</sub> <sup>4)</sup> [mm]	3h <sub>ef</sub>					
Characteristic edge distance		c <sub>cr,N</sub> = c <sub>cr,sp</sub> <sup>4)</sup> [mm]	1.5h <sub>ef</sub>					
Partial safety factor		γ <sub>Mc</sub> <sup>1)</sup>	1.5					
Blow-out failure								
Partial safety factor		γ <sub>Mcb</sub> <sup>1)</sup>	1.5					

<sup>1)</sup> In absence of other national regulations.

<sup>2)</sup> Headed stud size 25 only of material acc. to Table 2, Part 1

<sup>3)</sup> For simple headed studs (For doubled headed studs resp. short headed studs see Fig. 2 resp. 3, Annex B4)

<sup>4)</sup> Reinforcement resists the splitting forces and limits the crack width to  $w_w \leq 0.3$  mm.

**Table 6: Displacement under tensile load**

Headed stud – nominal size	10	13	16	19	22	25 <sup>2)</sup>
Displacements $\delta_{N0}$ <sup>1)</sup> to 0.7 mm under following loads in [kN]	14	20	25	30	35	45

<sup>1)</sup> The indicated displacements are valid for short term loading, the displacements  $\delta_{N\infty}$  can be increased under long term loading to 1.8 mm.

<sup>2)</sup> Headed stud size 25 only of material acc. to Table 2, Part 1

## KÖCO-Headed Studs

### Performance data

Characteristic resistances and displacements under tension load

Annex C1



**Table 7: Characteristic resistances under shear load for headed studs of steel and stainless steel**

Headed stud – nominal size		10	13	16	19	22	25 <sup>2)</sup>
Steel failure for headed studs made of steel							
Characteristic resistance	V <sub>Rk,s</sub> [kN]	22	37	57	80	107	138
Partial safety factor	γ <sub>Ms</sub> <sup>1)</sup>	1.25					
Steel failure for headed studs made of stainless steel							
Characteristic resistance	V <sub>Rk,s</sub> [kN]	25	43	65	92	123	--
Partial safety factor	γ <sub>Ms</sub> <sup>1)</sup>	1.54					
Concrete pry-out failure							
Factor in equation (32) according to CEN/TS 1992-4-2:2009, section 6.3.4 without tensile reinforcement	k <sub>3</sub> <sup>3)</sup>	2.0					
Partial safety factor	γ <sub>Mcp</sub> <sup>1)</sup>	1.5					
Concrete edge failure							
Effective length of the headed stud	l <sub>f</sub> = h <sub>ef</sub> [mm]	h <sub>n</sub> – t <sub>h</sub> + t <sup>4)</sup>					
Effective outside diameter	d <sub>nom</sub> = d [mm]	10	13	16	19	22	25
Partial safety factor	γ <sub>Mc</sub> <sup>1)</sup>	1.5					

<sup>1)</sup> In absence of other national regulations.

<sup>2)</sup> Headed stud size 25 only of material acc. to Table 2, Part 1

<sup>3)</sup> In case of supplementary reinforcement the factor  $k_3$  shall be multiplied with 0.75

<sup>4)</sup> For simple headed studs (For doubled headed studs resp. short headed studs see Fig. 2 resp. 3, Annex B4)

**Table 8: Displacements under shear load**

Headed stud – nominal size	10	13	16	19	22	25 <sup>2)</sup>
Displacements $\delta_{v0}$ <sup>1)</sup> to 1.5 mm under following loads in [kN]	15	20	30	45	60	75

<sup>1)</sup> The indicated displacements are valid for short term loading, the displacements  $\delta_{v\infty}$  can be increased under long term loading to 2.0 mm.

<sup>2)</sup> Headed stud size 25 only of material acc. to Table 2, Part 1

### Combined tension and shear load

The factor  $k_7$  is for combined tension and shear load according CEN/TS 1992-4-2:2009, section 6.4.1.3  $k_7 = \frac{2}{3}$ .

### KÖCO-Headed Studs

#### Performance data

Characteristic resistances and displacements under shear load, combined tension and shear load

### Annex C2