Deutsches Institut für Bautechnik

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment ETA-03/0041 of 16 May 2020

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	Nelson 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	Stanley Engineered Fastening Avdel UK Ltd. 43 Hardwick, Grange WARRINGTON, WA1 4 RF GROSSBRITANNIEN
Manufacturing plant	Nelson Herstellwerke
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-03/0041 issued on 14 May 2018

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Specific Part

1 Technical description of the product

The Nelson 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 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 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 under tension and shear load (static and quasi-static loads)	See Annex C1 to C2
Displacements (static and quasi-static loads)	See Annex C1 to C2
Durability	See Annex B1

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. 330084-00-0601, 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 16 May 2020 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Müller

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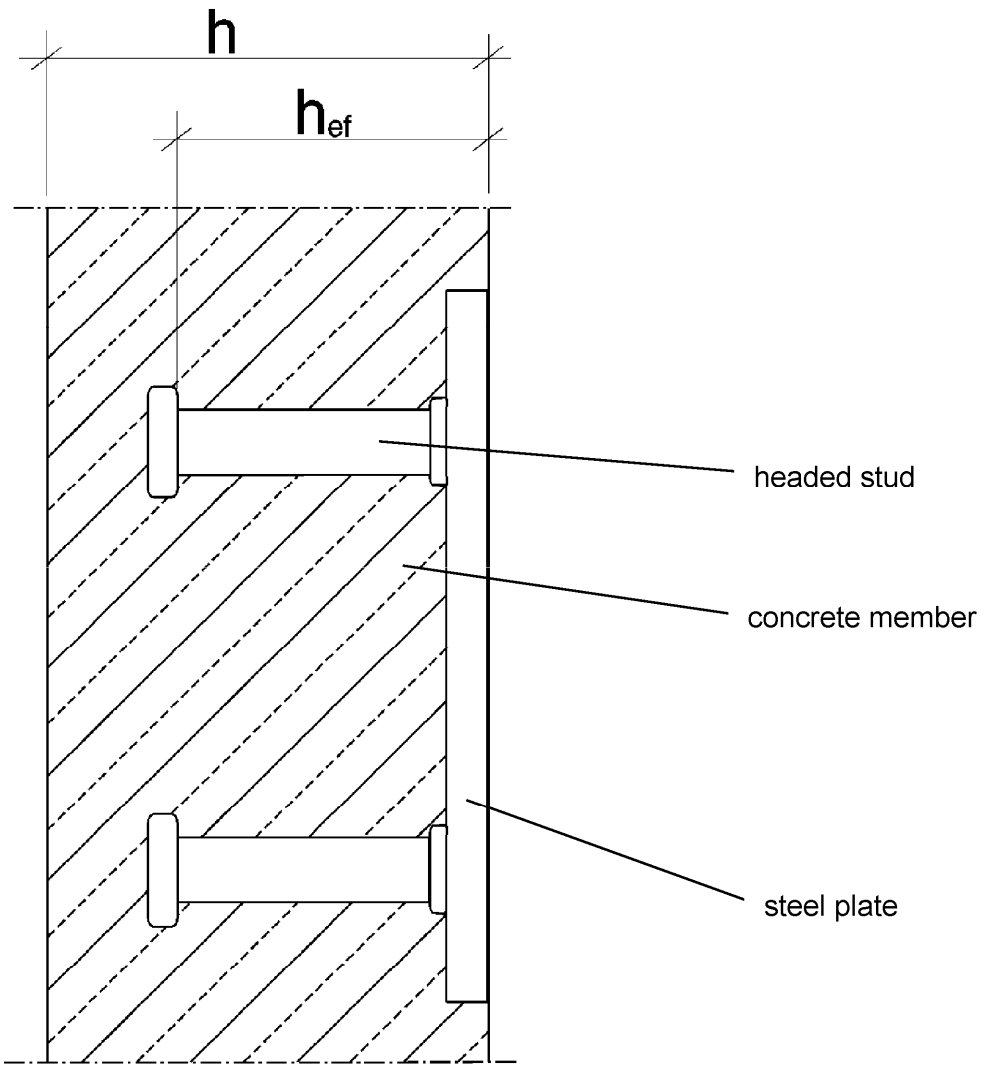

h_{ef} = effective anchorage depth

h = thickness of concrete member

Steel plate with cast-in Nelson headed studs made of steel and stainless steel	**Annex A1**
Product description Installed condition	

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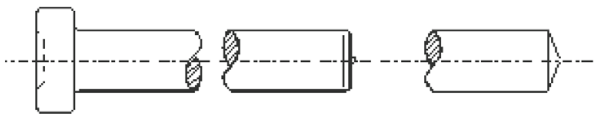
Marking:

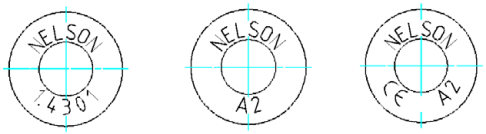


Form A Form B

Steel

Marking:
Manufacturer = Nelson or N

Stainless steel



Marking:
Manufacturer = Nelson
Stainless steel = 1.4301/1.4303 or A2

Table A1: Dimensions

Headed stud type	Shaft ∅ d [mm]	Head ∅ d_h [mm]	Nominal length		thickness of the head t_h [mm]
			min h_n [mm]	max h_n [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	25	40	75	525	12

Steel plate with cast-in Nelson headed studs made of steel and stainless steel	Annex A2
Product description Marking and dimensions	

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Table A2: Materials steel

Part	Denomination	Material	Mechanical properties	Intended Use
1	Headed stud according to EN ISO 13918:2018 Type: SD1	S235J2+C450 or S355 acc. EN10025:2005 (conforms to material group 1 according to EN ISO 13918:2018 and ISO/TR 15608)	$f_{uk} \geq 450$ N/mm², $f_{yk} \geq 350$ N/mm²	Steel plate 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 N/mm², f_{yk} = 225 N/mm²	
		S355JO; S355J2 according to EN 10025:2005	f_{uk} = 510-680 N/mm², f_{yk} = 345 N/mm²	

Table A3: Materials stainless steel

Part	Denomination	Material	Mechanical properties	Intended Use
1	Headed stud according to EN ISO 13918:2018 Type:SD3	Stainless steel 1.4301; 1.4303 according to EN 10088:2005	$f_{uk} \geq 540$-780 N/mm², $f_{yk} \geq 350$ N/mm²	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 are e.g. permanent, alternating immersion in seawater or the splash zone of sea water, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plant or road tunnels where de-icing materials are used).
2	Steel plate	Stainless steel 1.4571; 1.4401 according to EN 10088:2005	f_{uk} = 530-680 N/mm², f_{yk} = 220 N/mm²	

Steel plate with cast-in Nelson headed studs made of steel and stainless steel	Annex A3
Product description Materials	

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Specification of intended use

Steel plate with Nelson cast-in headed studs subject to:

- Static and quasi-static loads in tension or shear or a combination of tension and shear loads.

Base materials:

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

Use conditions:

- in concrete components subject to dry internal conditions.
  (steel plates and headed studs according to Annex A3, Table A2).
- in concrete components subject to external atmospheric exposure (including industrial and marine environment) or exposure in permantly damp internal condition, if no particular aggressive conditions exists. Such particular aggressive conditions are, e.g. permanent or alternate immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. desulphurization plants or road tunnels, where de-icing materials are used).
  (steel plates and headed studs according to Annex A3, Table A3).

Design:

- Steel plates with cast-in anchors will be designed unter the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account to the loads to be anchored. The position of the headed studs is indicated in the design drawings (e.g. position of the headed studs relative to the reinforcement or to supports).
- For static and quasi-static loading the steel plate with cast-in anchors are designed in accordance to CEN/TS 1992-4-1:2009 and CEN/TS 1992-4-2:2009.
- It is generally assumed that the concrete is cracked and that the occuring splitting forces are resisted by reinforcement. The required cross section of the minimum reinforcement is determined according to CEN/TS 1992-4-2 section 6.2.6.2b.

Installation:

Welding of the headed studs to the steel plate:

- Steel plates, on which headed studs will be welded, consist of the material S235JR, S235J0, S235J2, S355J0 or S355J2 according to Annex A3, Table A2.
- Steel plates in stainless steel consist of material 1.4571 or 1.4401 according to Annex A3, Table A3.
- Headed studs shall be welded to the steel plate by means of drawn arc stud welding with ceramic ferrule or shielding gas in accordance to EN ISO 14555.

Steel plate with cast-in Nelson headed studs made of steel and stainless steel	Annex B1
Specifications Intended use	

- Level of quality requirements corresponds to EN ISO 3834-3.
- In structures acted upon by tensile forces in the thickness direction of the steel plate, possibly not homogenous structure of the steel plate (e.g. lamellar tearing / lamellar imperfections) in the direction of the thickness are taken into account (EN 1993-1-10).
- 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 qualification for arc stud welding according to EN ISO 14555.

Placing steel plates into concrete:

- The installation of headed studs is carried out by appropriately qualified personal under the supervision of the person responsible for the technical matters on site.
- Use of the product only as supplied by the manufacturer without exchanging the components.
- It is assumed that the product will be installed according to the manufacturer's instructions given in Annex B4, B5 and B6.
- The steel plate with welded-on anchors are fixed on the formwork, on the 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 studs must be properly compacted.
- In case of large fixtures (steel plate > 400 mm x 400 mm) vent openings are provided, specified in the design drawings.

Steel plate with cast-in Nelson headed studs made of steel and stainless steel	Annex B2
Specifications Intended use	

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Table B1: Installation parameters for headed studs made of steel and stainless steel

Nominal size (mm)		10	13	16	19	22	25
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
characteristic spacing	s_{cr} [mm]	3 h_{ef}					
characteristic edge distance	c_{cr} [mm]	1.5 h_{ef}					
minimum thickness of concrete member	h_{min} [mm]	h_{ef} + t_h + c_{nom}[1)]					
[1)] c_{nom} = required concrete cover according to national regulations							

Arrangement of headed studs

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

Steel plate with cast-in Nelson headed studs made of steel and stainless steel	Annex B3
Intended use Installation parameters and arrangement of the headed studs	

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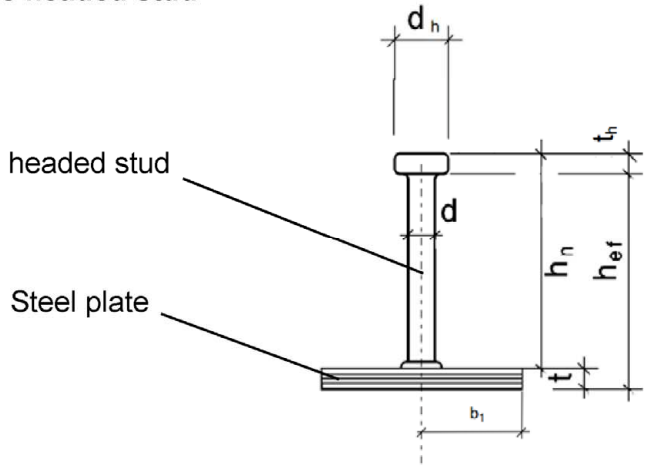
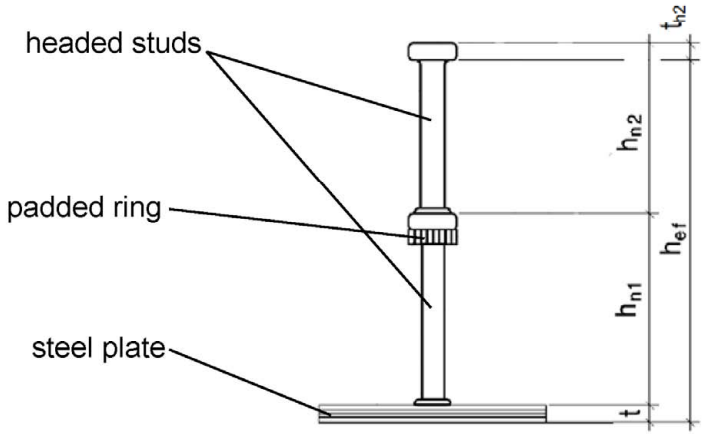
Fig. 1: Single headed stud



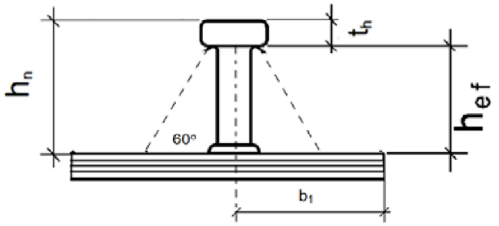
$h_{ef} = h_n - t_h + t$

Fig. 2: Double headed stud



$h_{ef} = h_{n1} + h_{n2} - t_{h2} + t$

Fig. 3: Short headed stud



$h_{ef} = h_n - t_h$

if the theoretic cone meets the steel plate at angle of ~ 60° or $t \geq 0.2\ h_n$

d = diameter of shaft
d_h = diameter of head
h_{ef} = effective anchorage depth
h_n = nominal length of the headed stud (after welding)
t_h = thickness of the head
t = thickness of the steel plate

Steel plate with cast-in Nelson headed studs made of steel and stainless steel	Annex B4
Intended use Details of the construction product and effective anchorage depth	

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Installation instruction

1 Welding headed studs on the steel plate:

- Confect the steel plate according to the design drawings (material see table A2 or table A3 in Annex A3).
- Weld headed studs to the steel plate as shown in figure 1.
- Position the headed studs according to the design drawings.
- Use drawn arc stud welding process 783 according to EN ISO 4063 with ceramic ferrule or shielding gas in accordance to EN ISO 14555.

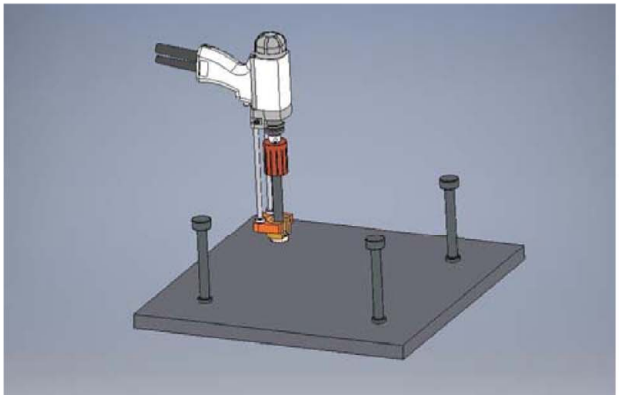

Fig. 1: stud welding

2 Installation:

2 a) Fixing the steel plate to the reinforcement:

- Fix the steel plate with the headed studs directly to the reinforcement or mounting bar by wire binding as shown in figure 2.
- Fix the steel plate in a way that the plate does not move during placing and compacting the concrete.
- Orient the surface-flush of the steel plate to the assumed surface of the concrete member.

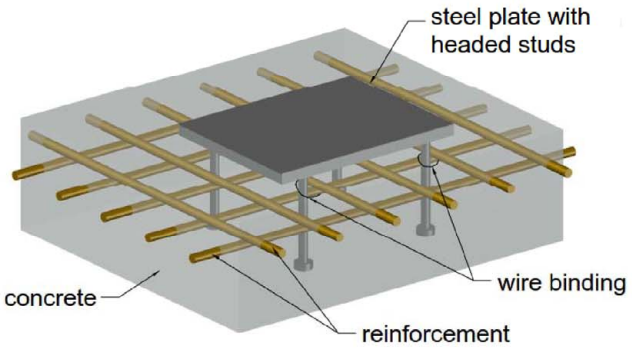

Fig. 2: steel plate fixed to the reinforcement

Steel plate with cast-in Nelson headed studs made of steel and stainless steel	Annex B5
Intended use Installation instructions	

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2 b) Fixing the steel plate to the formwork:

- Fix the steel plate with the headed studs directly to the formwork by nails, screws or wire binding as shown in figure 3.
- Control close contact between steel plate and formwork.
- Fix the steel plate in a way that the plate does not move during placing and compacting the concrete.

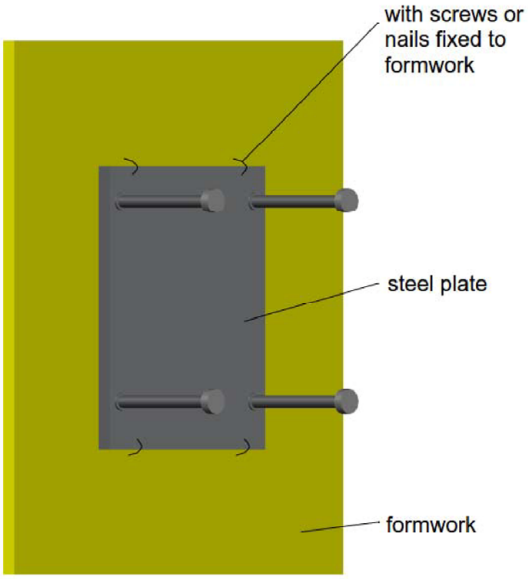

Fig. 3: steel plate fixed to the formwork

3 Placing and and compacting the concrete:

- Compact the concrete properly around the steel plate and headed studs.

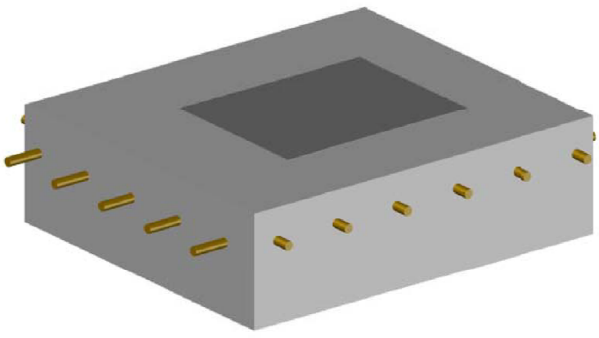

Fig. 4: steel plate in finished concrete member

Steel plate with cast-in Nelson headed studs made of steel and stainless steel	Annex B6
Intended use Installation instructions	

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Table C1: Characteristic resistance of headed studs made of steel and stainless steel due to tensile load

Headed stud – nominal size			**10**	**13**	**16**	**19**	**22**	**25**
Steel failure for headed studs made of steel								
Characteristic resistance		$N_{Rk,s}$ [kN]	35	60	90	128	171	221
Partial safety factor		γ_{Ms} 1)	1.54					
Steel failure for headed studs made of stainless steel								
Characteristic resistance		$N_{Rk,s}$ [kN]	42	72	109	153	205	265
Partial safety factor		γ_{Ms} 1)	1.85					
Pull-out failure								
Characteristic resistance		$N_{Rk,p}$ [kN]	30	50	90	78	85	115
Increasing factors ψ for the characteristic resistance		C25/30 C30/37 C35/45 C40/50 C45/55 C50/60	1.20 1.48 1.80 2.00 2.20 2.40					
Partial safety factor		γ_{Mp} 1)	1.5					
Concrete cone failure and splitting								
Effective anchorage depth		h_{ef} [mm]	$h_n - k + t^{2)}$					
factor to take into account the influence of load transfer mechanisms	cracked concrete	k_{cr} [-]	8.5					
	uncracked concrete	k_{ucr} [-]	11.9					
Characteristic spacing		$s_{cr,N} = s_{cr,sp}$ 3) [mm]	3 h_{ef}					
Characteristic edge distance		$c_{cr,N} = c_{cr,sp}$ 3) [mm]	1.5 h_{ef}					
Partial safety factor		γ_{Mc} 1)	1.5					
Blow-out failure								
Partial safety factor		γ_{Mcb} 1)	1.5					

1) **In absence of other national regulations**
2) **For simple headed studs (for double headed studs resp. short studs see Fig. 2 resp. 3 in Annex B4)**
3) **Reinforcement resists the splitting forces and limits the crack width to $w_k \leq 0{,}3$ mm**

Table C2: Displacement due to tensile load

Headed stud – nominal size	**10**	**13**	**16**	**19**	**22**	**25**
Displacements δ_{N0} 1) to 0.7 mm under following loads in [kN]	14	20	25	30	35	45
1) The indicated displacements are valid for short term loading, the displacements can be increased under long term loading ($\delta_{N\infty}$) to 1.8 mm.						

Steel plate with cast-in Nelson headed studs made of steel and stainless steel	**Annex C1**
Performances Characteristic resistances and displacements due to tensile load	

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Table C3: Characteristic resistance of headed studs made of steel and stainless steel due to shear load

Headed stud – nominal size		**10**	**13**	**16**	**19**	**22**	**25**
Steel failure for headed studs made of steel							
Characteristic resistance	$V_{Rk,s}$ [kN]	21	36	54	77	103	133
Partial safety factor	γ_{Ms} 1)	1.28					
Steel failure for headed studs made of stainless steel							
Characteristic resistance	$V_{Rk,s}$ [kN]	25	43	65	92	123	159
Partial safety factor	γ_{Ms} 1)	1.54					
Concrete pry-out failure							
Factor according to CEN/TS 1992-4-2:2009, section 6.3.4	k_3 2)	2.0					
Partial safety factor	γ_{Mcp} 1)	1.5					
Concrete edge failure							
Effective length of the headed stud	$l_f = h_{ef}$ [mm]	$h_n - k + t$ 3)					
Effective outside diameter	$d_{nom} = d_1$ [mm]	10	13	16	19	22	25
Partial safety factor	γ_{Mc} 1)	1.5					

1) In absence of other national regulations

2) In case of supplementary reinforcement the factor k_3 shall be multiplied with 0.75

3) For simple headed studs (for double headed studs resp. short headed studs see Fig. 2 resp. 3 in Annex B4)

Table C4: Displacements due to shear load

Headed stud – nominal size	**10**	**13**	**16**	**19**	**22**	**25**
Displacements δ_{V0} 1) to 1.5 mm under following loads in [kN]	15	20	30	45	60	75

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

Table C5: Combined tension and shear load

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

Steel plate with cast-in Nelson headed studs made of steel and stainless steel	**Annex C2**
Performances Characteristic resistances and displacements due to shear load	