European Technical Assessment

ETA-13/0136
of 20 March 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	JORDAHL punching reinforcement JDA
Product family to which the construction product belongs	Double headed studs as punching reinforcement for flat slabs and footings
Manufacturer	JORDAHL GmbH Nobelstraße 51 12057 Berlin DEUTSCHLAND
Manufacturing plant	JORDAHL Herstellwerke
This European Technical Assessment contains	20 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 160003-00-0301
This version replaces	ETA-13/0136 issued on 27 March 2013

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Specific Part

1 Technical description of the product

The JDA double headed studs are made of weldable structural steel or ribbed reinforcement bars with nominal characteristic yield strength of 500 MPa. The mechanical properties of the steel comply with the requirement according to EN 1992-1-1, Annex C.

They have a head at both ends with a diameter of three times the shaft diameter.

The diameters of the shafts are 10, 12, 14, 16, 18 and 20 mm for studs with smooth shafts and

10, 12, 14, 16, 20 and 25 mm for studs with ribbed bars.

The studs are assembled to form reinforcement elements comprising at least two studs (see Annex A1). The studs are tack welded or clamped at one end to a non-structural steel rail or steel bars (reinforcing bars or round bars) for securing the position of the double headed studs when pouring the concrete. For use in semi-prefabricated slabs only, steel rails in connection with special plastic locks are used to secure the placement during casting. All studs of one of those reinforcement element shall have the same diameter.

The bars used to secure the stud's position during casting (assembling bars or -rails) are made of weldable reinforcing steel or structural steel (smooth steel bars) with $d_s = 6$ mm to $d_s = 10$ mm and the rails are made of structural steel with a thickness of minimum $t = 3$ mm. The material for the structural steel (bars or rails) shall be No. 1.0037 or 1.0045 acc. to EN 10025-2 or non-corrosive steel No. 1.4401, 1.4404, 1.4439, 1.4571 acc. to EN 10088-5 or DD11 No. 1.0332 acc. To EN 10111. The material of the plastic locks for use in semi-prefabricated slabs is specified within the technical documentation deposited with Deutsches Institut für Bautechnik.

The detailed 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 Product 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 Product 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
Increasing factor for punching shear resistance	$k_{pu,sl} = 1{,}96$ $k_{pu,fo} = 1{,}50$
characteristic fatigue strength for $N = 2 \cdot 10^6$ load cycles	$\Delta\sigma_{Rsk,n=2\cdot10^6} = 70$ MPa

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. 160003-00-0301 the applicable European legal act is: [97/597/EC(EU)].

The system(s) to be applied is (are): [1+]

In addition, with regard to reaction to fire for products covered by this EAD the applicable European legal act is: [2001/596/EC(EU)]

The system to be applied is: [4]

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD
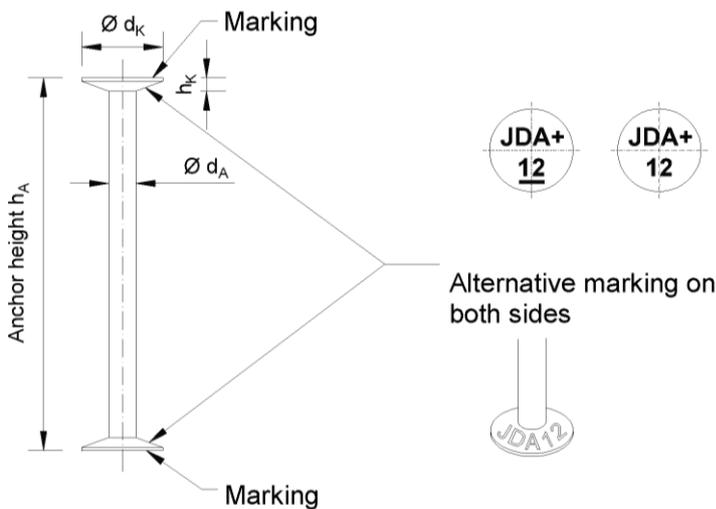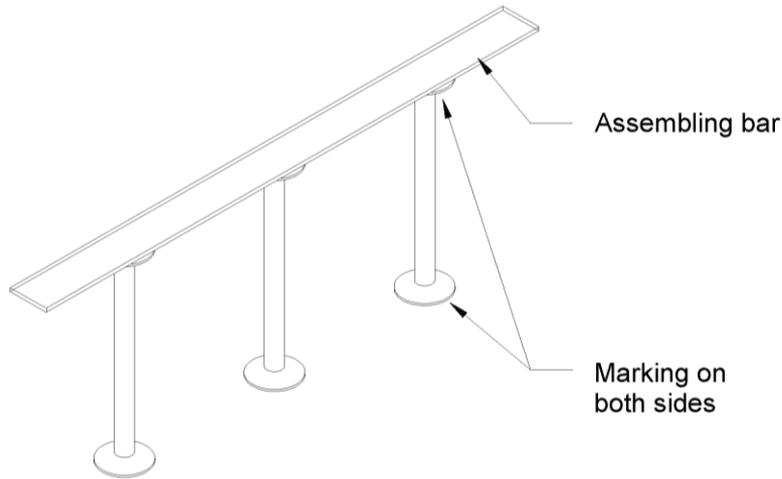
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 20 March 2018 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow   *beglaubigt:*
Head of Department   Schüler

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JORDAHL double headed stud elements with smooth shaft

Assembling bar

Marking on
both sides

Ø d_K

Marking

h_K

Anchor height h_A

Ø d_A

JDA: symbol of manufacturing
plant

12: example for
double headed stud
d_A = 12 mm

JDA+
12

JDA+
12

Alternative marking on
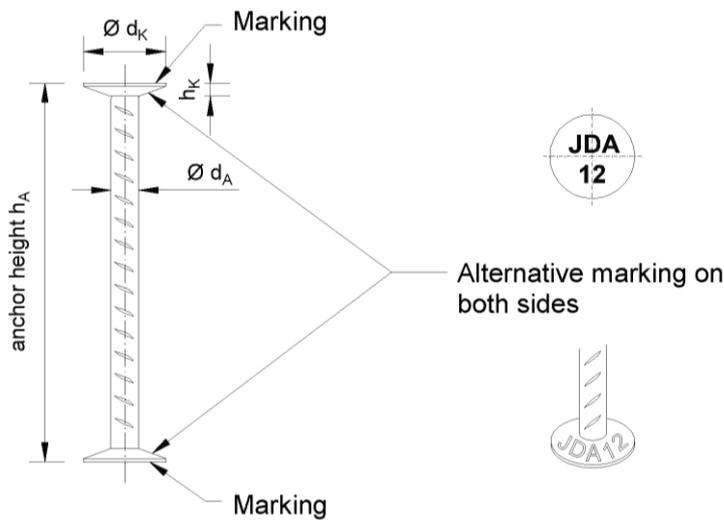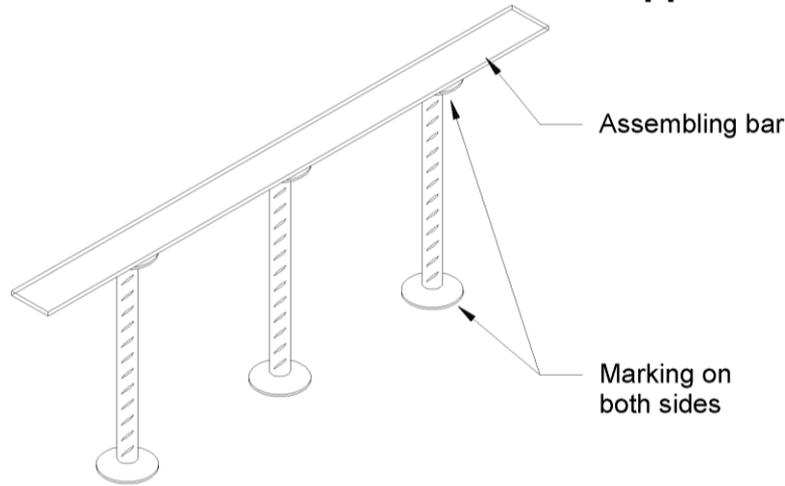both sides

JDA12

Marking

Anchor diameter d_A [mm]	Head diameter d_K [mm]	Head height min. h_K [mm]	Anchor cross section A [mm²]	Characteristic value for yield strength f_{yk} [MPa]	Anchor height $h_A \leq 300$ mm [mm]
10	30	5	79		
12	36	6	113		h_A =
14	42	7	154		slab thickness - upper and
16	48	7	201	500	lower concrete cover
18	54	8	254		
20	60	9	314		

JORDAHL punching shear reinforcement JDA

Product description
JDA stud dimensions and types

Annex A1

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JORDAHL double headed stud elements with ripped shaft

Assembling bar

Marking on
both sides

Ø d_K

Marking

h_K

Ø d_A

anchor height h_A

JDA: symbol of manufacturing
plant

12: example for
double headed stud
d_A = 12 mm

JDA
12

Alternative marking on
both sides

JDA12

Marking

Anchor diameter d_A [mm]	Head diameter d_K [mm]	Head height min. h_K [mm]	Anchor cross section A [mm²]	Characteristic value for yield strength f_{yk} [MPa]	Anchor height h_A [mm]
10	30	5	79		
12	36	6	113		h_A =
14	42	7	154		slab thickness - upper and
16	48	7	201	500	lower concrete cover
20	60	9	314		
25	75	12	491		

JORDAHL punching shear reinforcement JDA

Product description
JDA stud dimensions and types

Annex A2

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Version with flat steel to provide stability
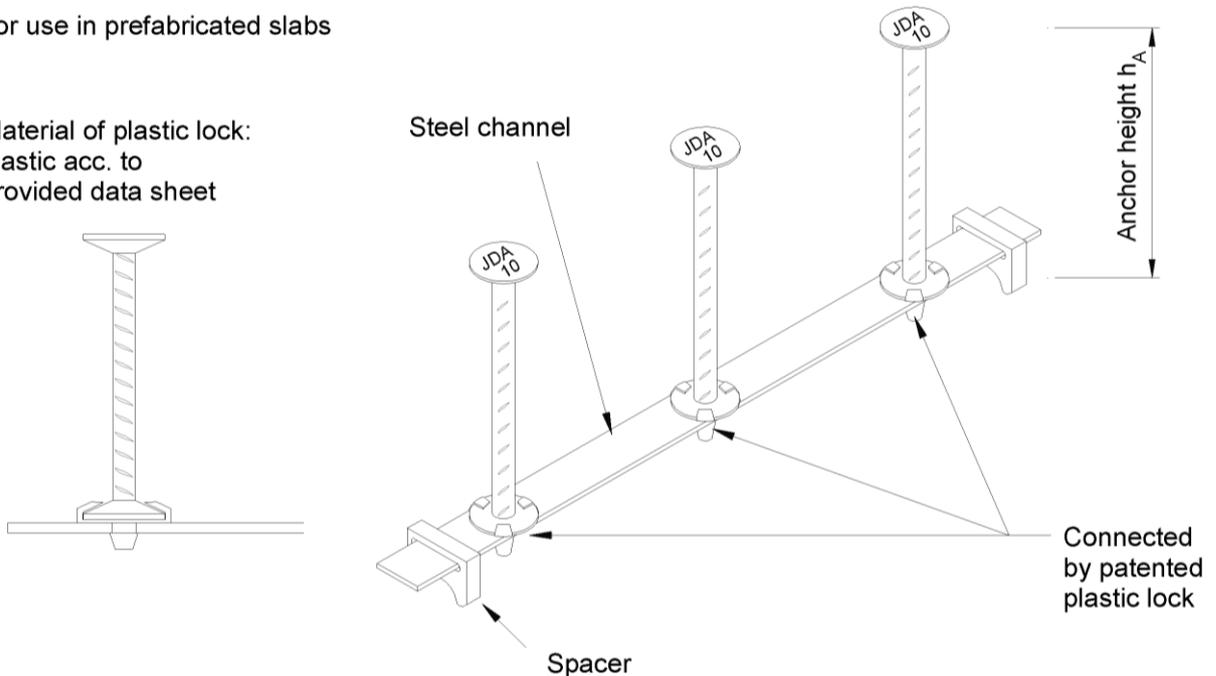
For use in-situ concrete

Flat steel to provide stability
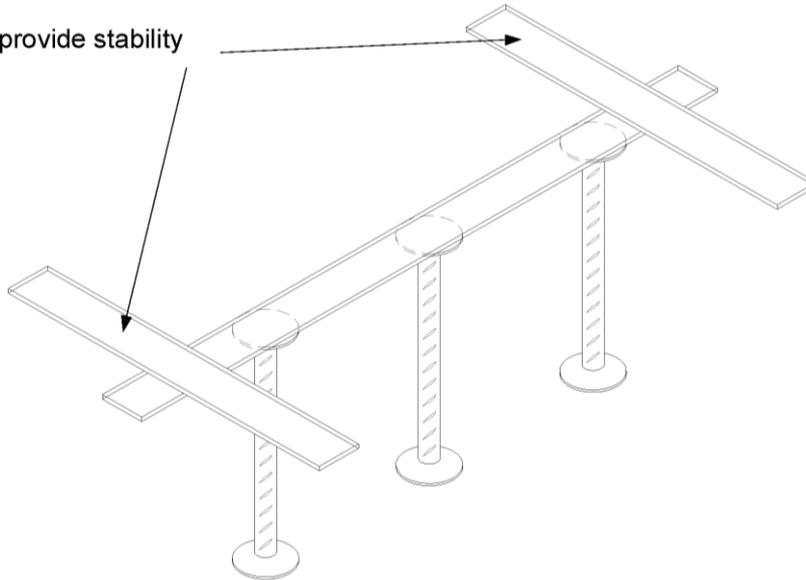
FT-KL version with patented plastic lock

For use in prefabricated slabs

Material of plastic lock:
plastic acc. to
provided data sheet

Steel channel

JDA 10

JDA 10

JDA 10

Anchor height h_A

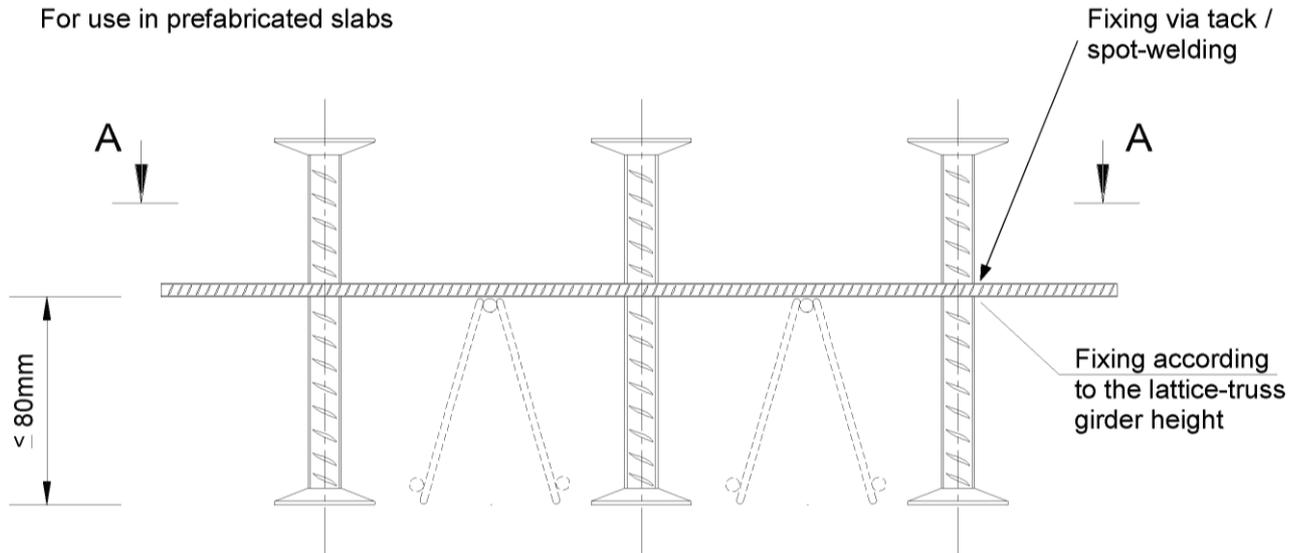Connected
by patented
plastic lock

Spacer

JORDAHL punching shear reinforcement JDA	
Product description For use in-situ concrete and For use in prefabricated slabs	Annex A3

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DIBt

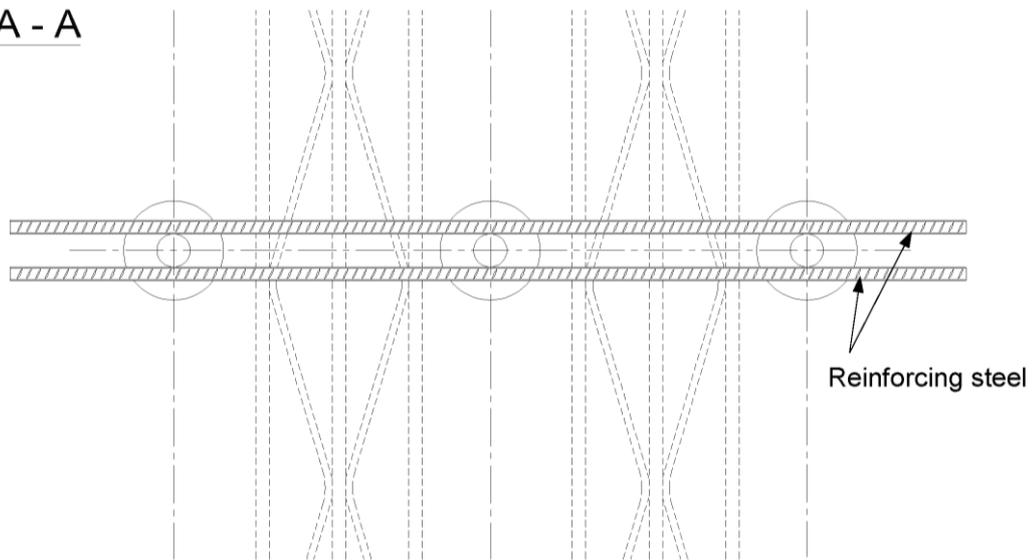## Punching shear reinforcement with double headed studs
Version with attached positional stabilisation

For use in prefabricated slabs

Fixing via tack /
spot-welding

A   A

< 80mm

Fixing according
to the lattice-truss
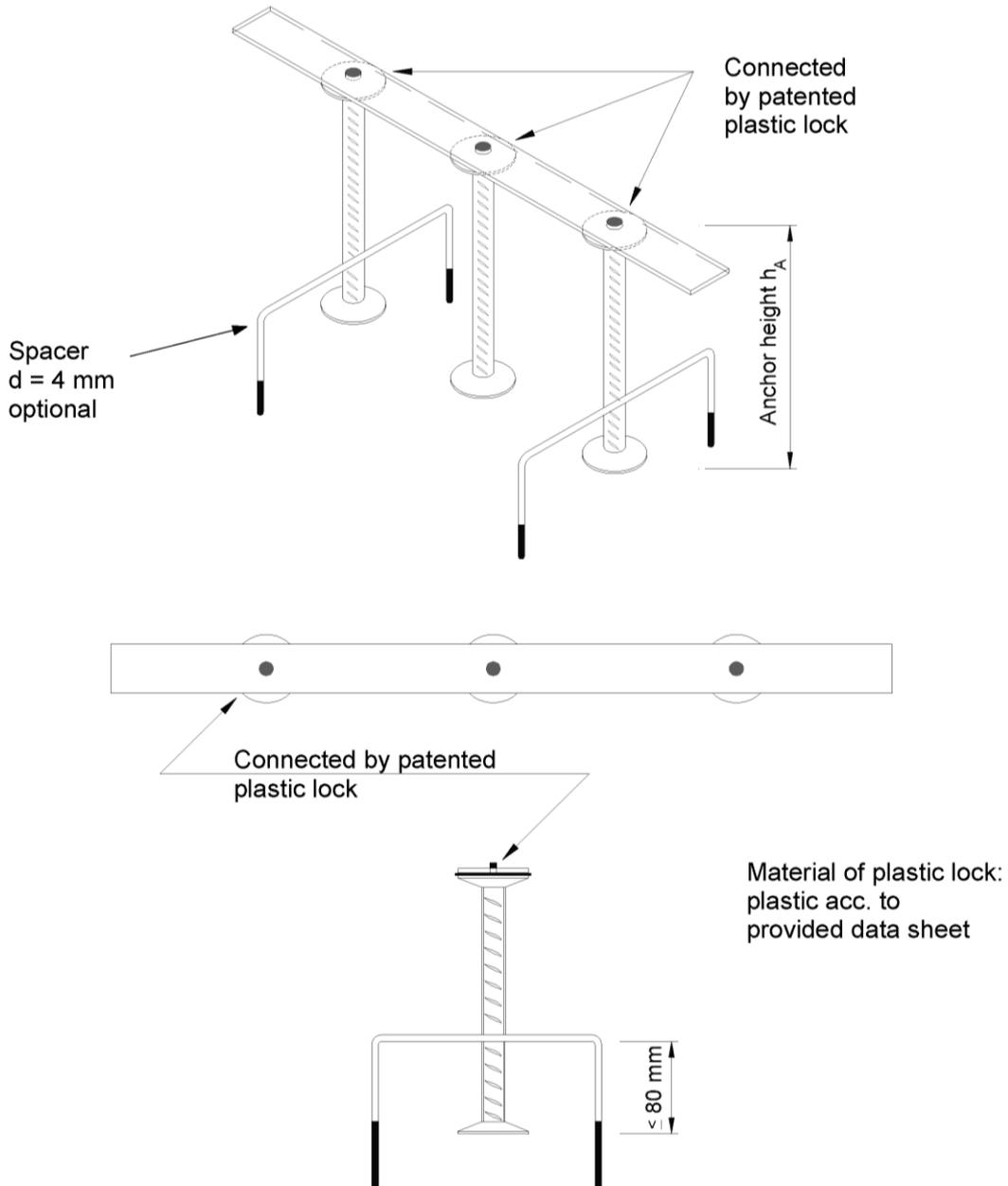girder height

Section A - A

Reinforcing steel

JORDAHL punching shear reinforcement JDA

Product description
Version with attached positional stabilisation for use in prefabricated slabs

Annex A4

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Punching shear reinforcement with double headed studs
Version FT with patented plastic lock

For use in prefabricated slabs

Connected by patented plastic lock

Anchor height h_A

Spacer
d = 4 mm
optional

Connected by patented
plastic lock

Material of plastic lock:
plastic acc. to
provided data sheet

< 80 mm

JORDAHL punching shear reinforcement JDA	
Product description FT version in prefabricated slabs	Annex A5

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Specification of intended of use

Double headed anchors are used to increase the puncture resistance of flat slabs, reinforced concrete slabs or footings and ground slabs under static, quasi-static and fatigue-relevant load.
Double headed anchors are arranged next to columns or concentrated single loads.
The design of the punching shear resistance of flat slabs, reinforced concrete slabs or footings and ground slabs is done in accordance with EOTA TR 060.
Double headed studs can also be used for semi-prefabricated slabs also in combination with lattice girders when the respective ETAs or national guidelines are observed.
Double headed studs installed as shear reinforcement are also effective as interface reinforcement between precast and in-situ concrete.
The intended use covers the following specifications:

- flat slabs, reinforced concrete slabs or footings and ground slabs made of reinforced normal weight concrete of strength class C20/25 to C50/60 according to EN 206-1:2013
- flat slabs, reinforced concrete slabs or footings and ground slabs with a minimum height of h = 180 mm
- flat slabs, reinforced concrete slabs or footings and ground slabs with a maximum effective depth of d = 300 mm (only for double headed studs with smooth shafts)
- double headed anchors as reinforcing elements of the same diameter and type (ribbed or smooth) in punching area around supports or concentrated single load
- reinforcement elements with double headed studs installed in an upright (rail at the bottom of the slab) or hanging position
- reinforcement elements with double headed studs positioned so that the double headed bolts are perpendicular to the surface of the flat ceilings, reinforced concrete slabs or footings and ground slabs
- reinforcement elements with double headed studs directed radially towards the column of high concentrated load and distributed evenly in the critical punching area
- reinforcement elements with double headed studs positioned such that the upper heads of the studs reach at least to the outside of the uppermost layer of the flexural reinforcement
- reinforcement elements with double headed studs positioned such that the lower heads of the studs reach at least to the outside of the lowest layer of the flexural reinforcement
- reinforcement elements with double headed studs positioned such that the concrete cover complies with the provisions according to EN 1992-1-1
- reinforcement elements with double headed studs positioned so that the minimum and maximum distances between the double headed studs on an element and between the elements as arranged around a column or concentrated load area shall comply with the requirements of Annexes B3 to B8
- The provisions are kept on site with an accuracy of 0.1h (h = height of the slab)

Installation

- When installed correctly, the reinforcement elements have sufficient robustness to withstand usual actions before concreting.

- In case the studs are intended for use in prefabricated slabs there are no requirements in terms of before mentioned robustness if there are other possibilities to ensure a safe transport and positioning.

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Packing, transport and storage:

Special considerations shall be given to the transportation of the prefabricated elements to avoid any damage to the anchorage of the headed studs in the precast slab. When storing and transporting precast elements, the height of the double headed stud elements has to be considered. Higher spacers are required when stacking the precast elements.

Positioning and transportation when used in semi-prefabricated slabs
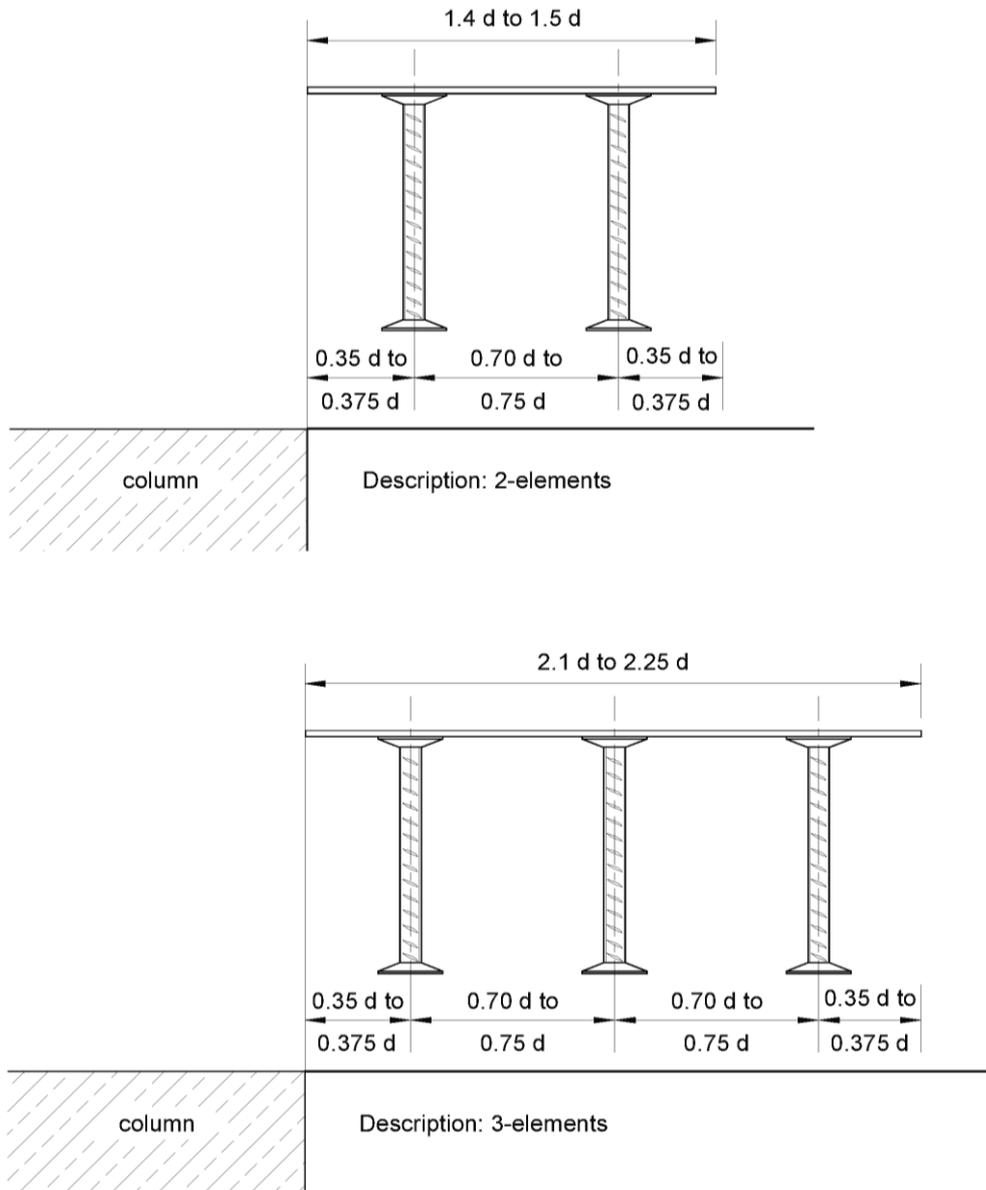
Higher spacers required
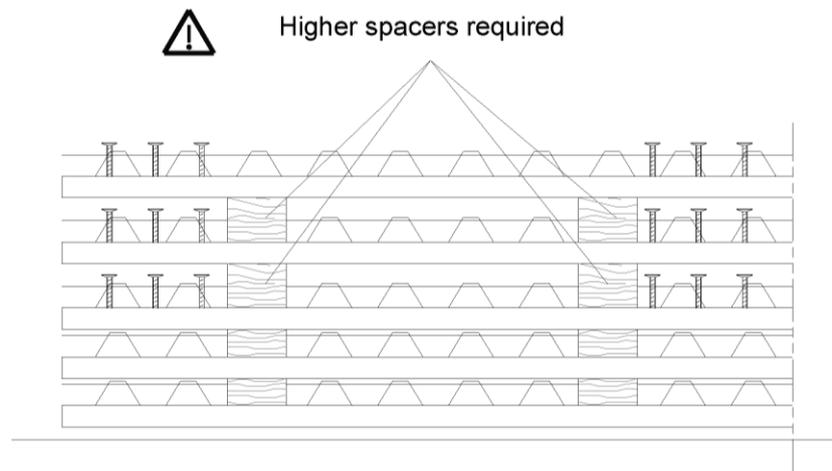
JORDAHL punching shear reinforcement JDA	
Intended use Specification	Annex B2

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Design of the JDA standard elements

1.4 d to 1.5 d

| 0.35 d to 0.375 d | 0.70 d to 0.75 d | 0.35 d to 0.375 d |

column   Description: 2-elements

2.1 d to 2.25 d

| 0.35 d to 0.375 d | 0.70 d to 0.75 d | 0.70 d to 0.75 d | 0.35 d to 0.375 d |

column   Description: 3-elements

The symmetric overlap of the assembling bar is used to ensure correct spacing of the elements from the column. Furthermore, it ensures the right radial spacing between two adjacent stud elements.

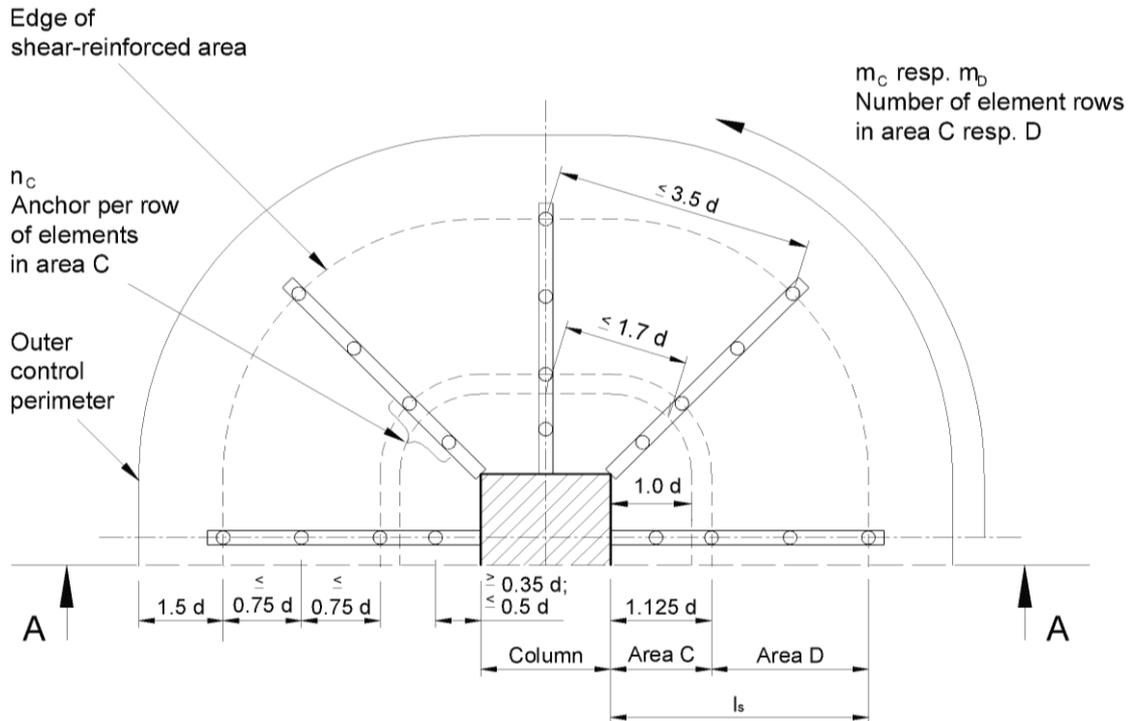| JORDAHL punching shear reinforcement JDA	
Intended use Standard system arrangement	Annex B3

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Principle arrangement of the JDA studs in slabs
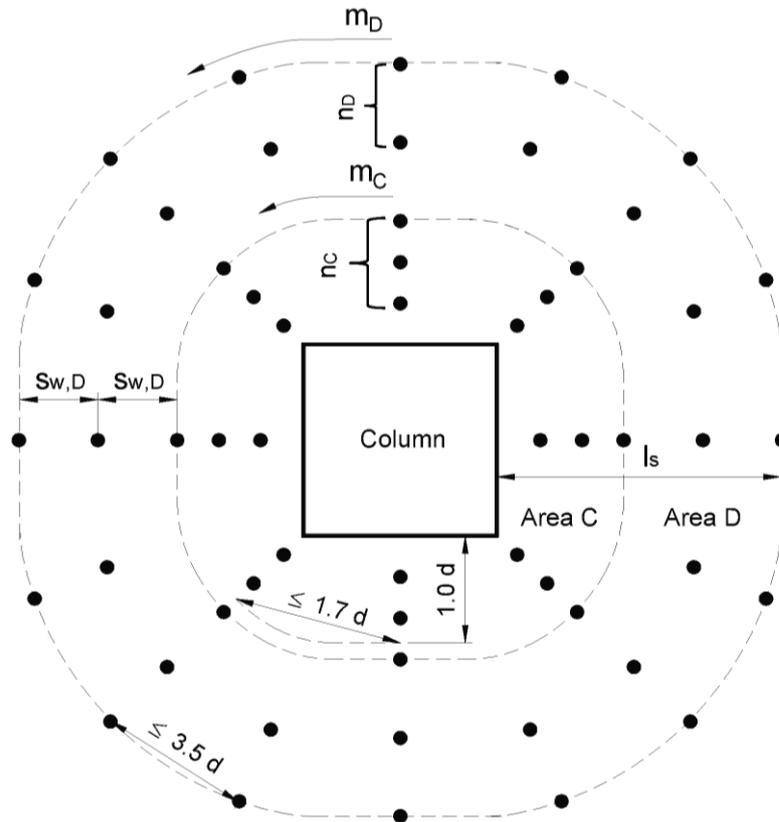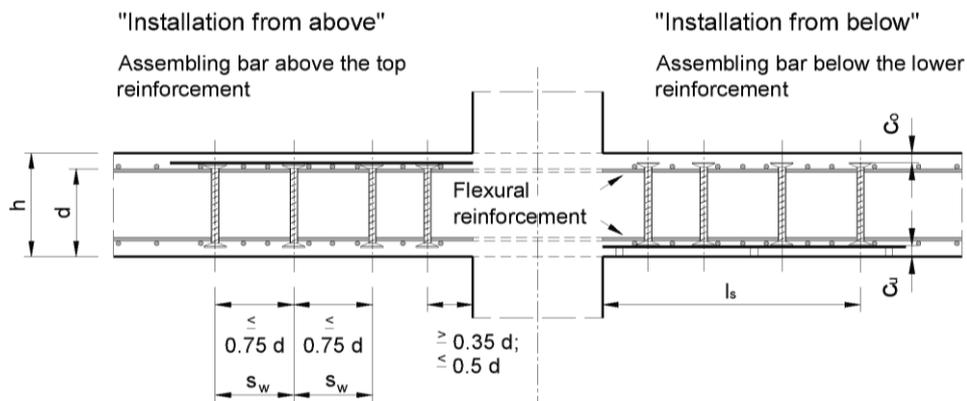

m_C	number of elements (rows) in area C
m_D	number of elements (rows) in area D
n_C	number of studs of each element (row) in area C
n_D	number of studs of each element (row) in area D
$s_{w,D}$	radial spacing in area D

JORDAHL punching shear reinforcement JDA

Intended use
Principle arrangement of JDA studs in slabs

Annex B4

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Arrangement of punching shear reinforcement using continuous elements in slabs

Edge of
shear-reinforced area

m_C resp. m_D
Number of element rows
in area C resp. D

n_C
Anchor per row
of elements
in area C

Outer
control
perimeter

$\leq 3.5\ d$

$\leq 1.7\ d$

$1.0\ d$

$\geq 0.35\ d;$
$\leq 0.5\ d$

A

1.5 d | $\leq$ 0.75 d | $\leq$ 0.75 d

1.125 d

A

Column | Area C | Area D

l_s

Section A-A

"Installation from above"

Assembling bar above the top
reinforcement

"Installation from below"

Assembling bar below the lower
reinforcement

Flexural
reinforcement

c_o

h d

$\leq$ 0.75 d | $\leq$ 0.75 d

s_w | s_w

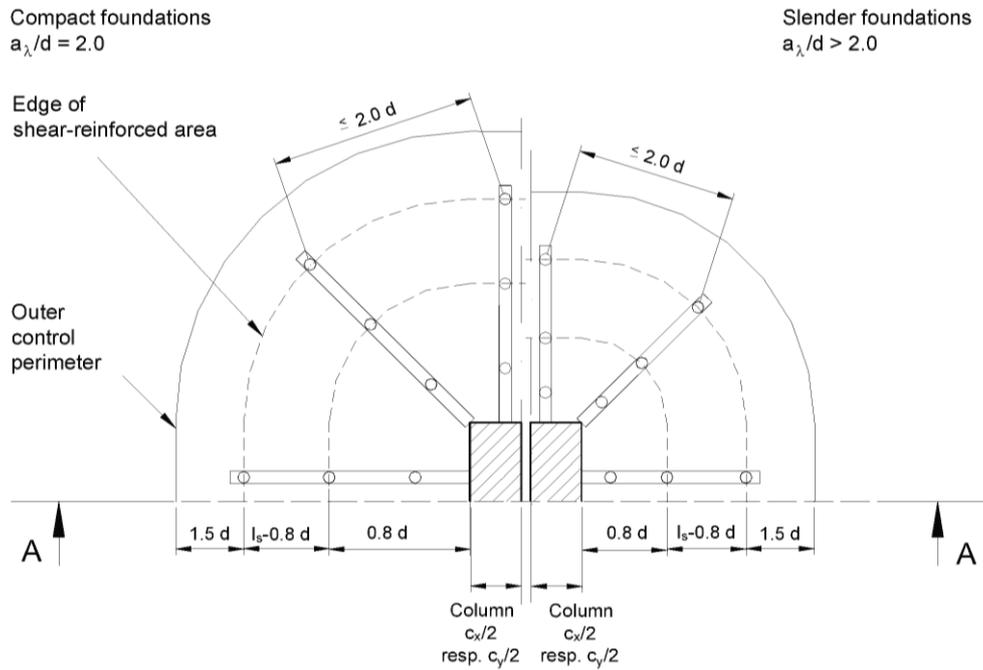$\geq 0.35\ d;$
$\leq 0.5\ d$

l_s

c_u

Concrete cover c_o resp. c_u acc. to EN1992-1-1 : 2004 + AC : 2010, section 4.4

JORDAHL punching shear reinforcement JDA

Intended use
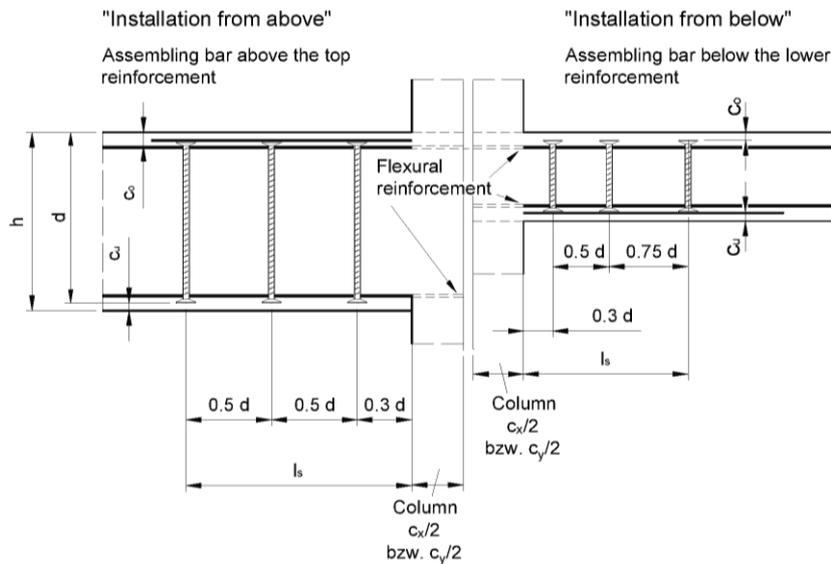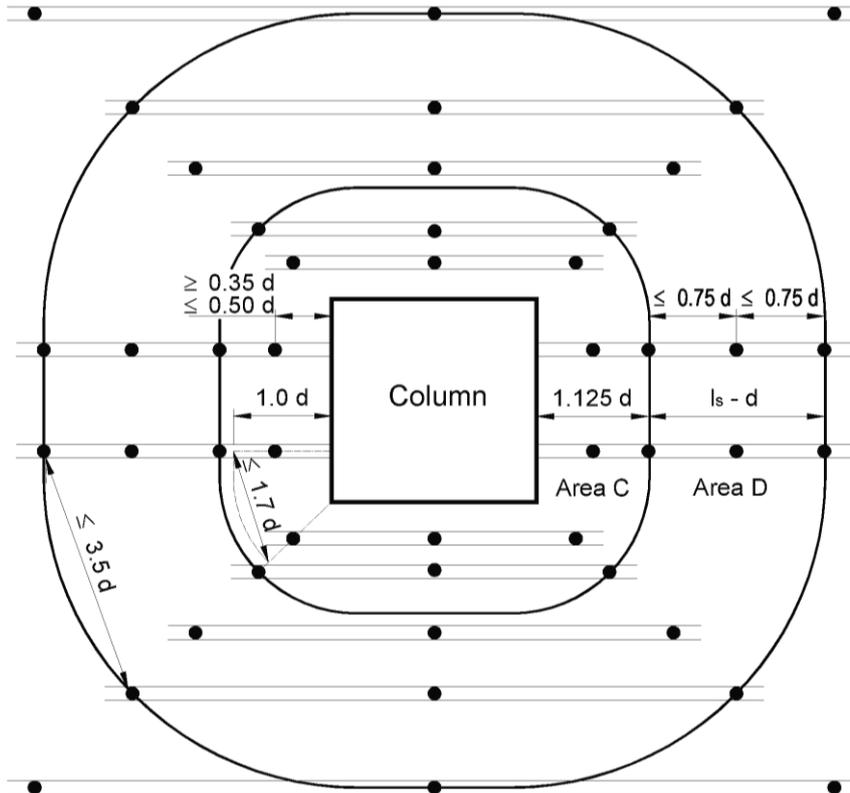Arrangement of punching shear reinforcement with continuous elements in slabs

Annex B5

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Arrangement of punching shear reinforcement using continuous elements in footings and ground slabs

Compact foundations
$a_\lambda/d = 2.0$

Slender foundations
$a_\lambda/d > 2.0$

Edge of shear-reinforced area

$\leq 2.0\,d$

$\leq 2.0\,d$

Outer control perimeter

A

1.5 d | l_s-0.8 d | 0.8 d

0.8 d | l_s-0.8 d | 1.5 d

A

Column
$c_x/2$
resp. $c_y/2$

Column
$c_x/2$
resp. $c_y/2$

Section A-A

"Installation from above"

Assembling bar above the top reinforcement

"Installation from below"

Assembling bar below the lower reinforcement

h

d

c_o

c_o

Flexural reinforcement

c_o

c_u

0.5 d | 0.75 d

0.3 d

l_s

0.5 d | 0.5 d | 0.3 d

l_s

Column
$c_x/2$
bzw. $c_y/2$

Column
$c_x/2$
bzw. $c_y/2$

Concrete cover c_o resp. c_u acc. to EN1992-1-1 : 2004 + AC : 2010, section 4.4

JORDAHL punching shear reinforcement JDA

Intended use
Arrangement of punching shear reinforcement in footings and ground slabs

Annex B6

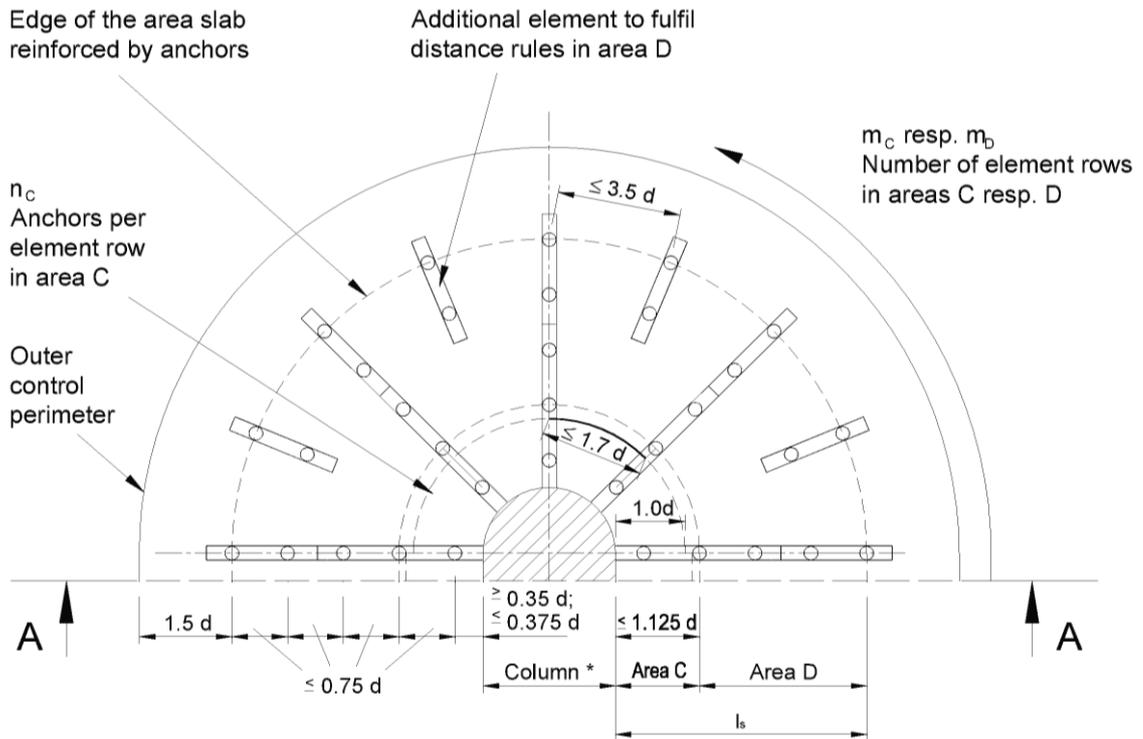## Orthogonal arrangement of punching shear reinforcement in slabs

$\geq 0.35\ d$
$\leq 0.50\ d$

$\leq 0.75\ d \leq 0.75\ d$

$1.0\ d$

Column

$1.125\ d$

$l_s - d$

$\leq 1.7\ d$

$\leq 3.5\ d$

Area C

Area D
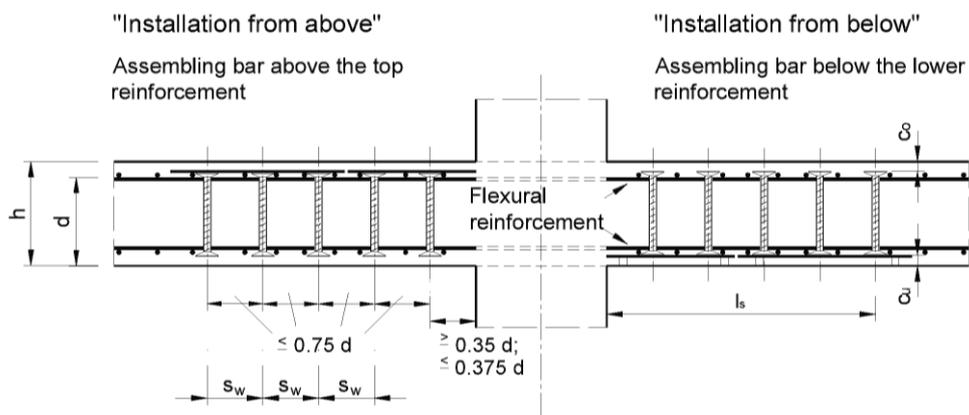
JORDAHL punching shear reinforcement JDA

Intended use
Parallel arrangement of punching shear reinforcement

Annex B7

Arrangement of punching shear reinforcement using shared standard elements in slabs

Edge of the area slab reinforced by anchors

Additional element to fulfil distance rules in area D

m_C resp. m_D
Number of element rows in areas C resp. D

n_C
Anchors per element row in area C

Outer control perimeter

≤ 3.5 d

≤ 1.7 d

1.0 d

A

1.5 d

≥ 0.35 d;
≤ 0.375 d

≤ 1.125 d

A

≤ 0.75 d

Column *

Area C

Area D

l_s

Section A-A

"Installation from above"

Assembling bar above the top reinforcement

"Installation from below"

Assembling bar below the lower reinforcement

h

d

Flexural reinforcement

l_s

≤ 0.75 d

s_w s_w s_w

≥ 0.35 d;
≤ 0.375 d

* Combination of shared standard elements analogous to rectangular columns

JORDAHL punching shear reinforcement JDA

Intended use
Arrangement for shared standard elements in slabs

Annex B8

Defining the critical perimeter u_1 and outermost perimeter u_{out}

1. Critical perimeter u_1

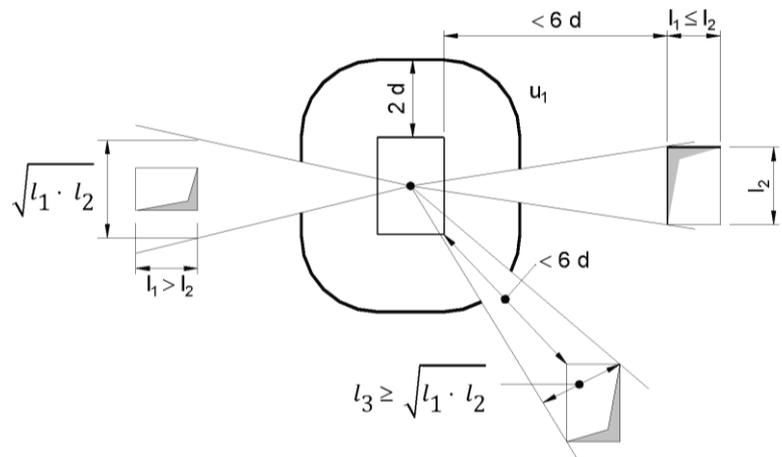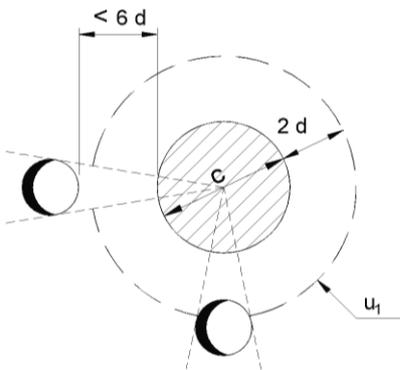a) Loaded areas (columns) are 6 d or more than 6 d of openings or slab free edges
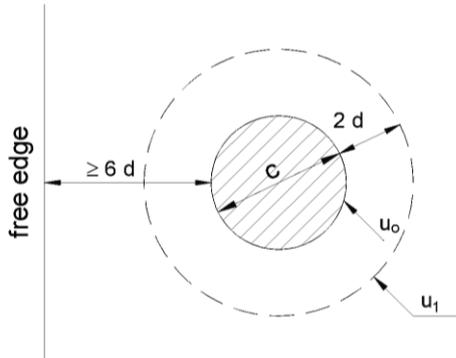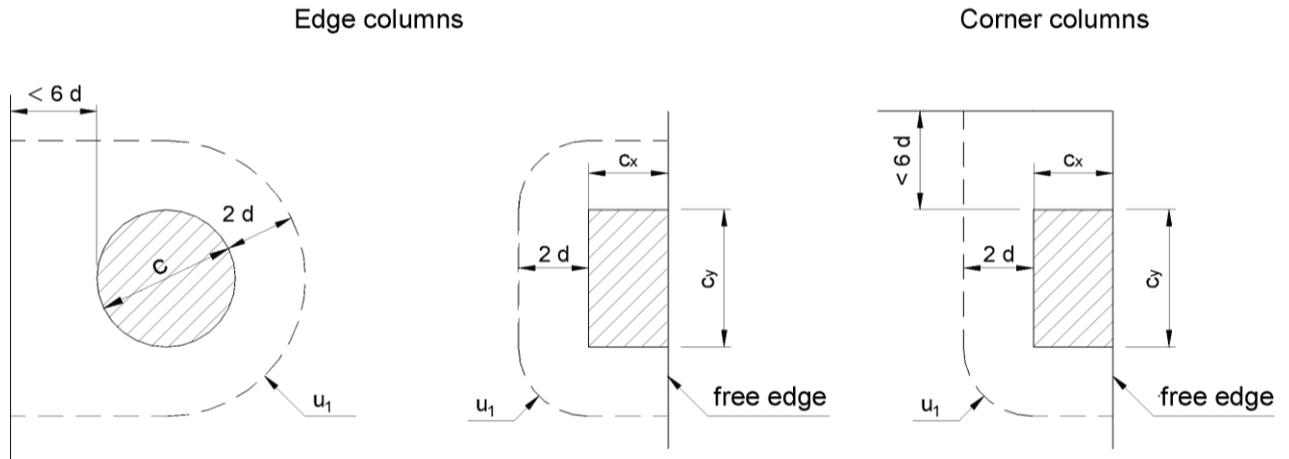
$$u_1 = \pi\,(c + 4\,d)$$
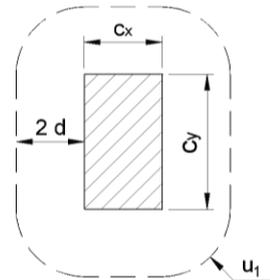
$$u_1 = 2\,(c_x + c_y) + 4\,d\,\pi$$

b) Loaded areas (columns) are less than 6 d from openings (voids) in the slab.

$$\sqrt{l_1 \cdot l_2}$$

$$l_3 \geq \sqrt{l_1 \cdot l_2}$$

JORDAHL punching shear reinforcement JDA	
Critical perimeter u_1 and outermost perimeter u_{out}	Annex C1

c) Loaded areas (columns) at distances less than 6 d from free edges
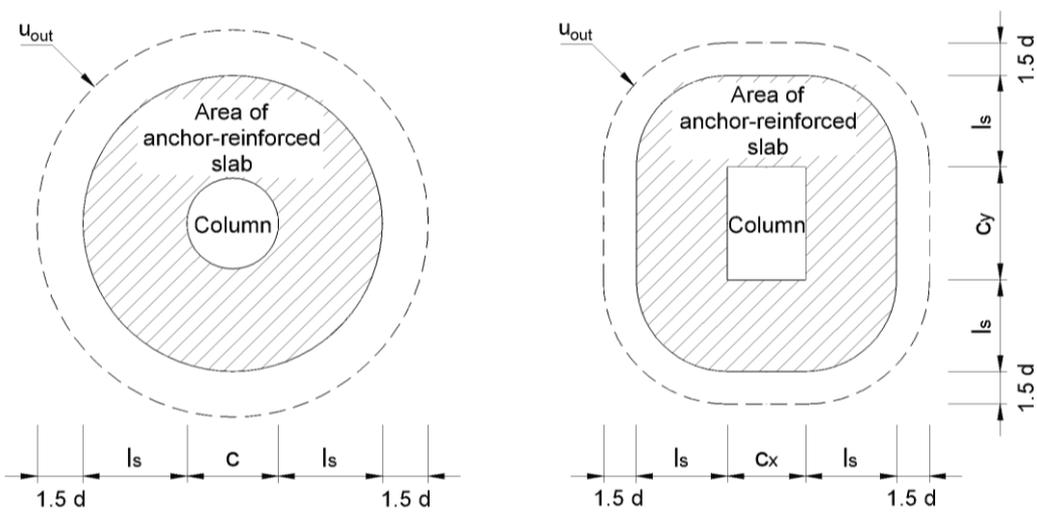
Edge columns

Corner columns

2. Outermost perimeter u_{out}

a) Loaded areas (columns) are more than 6 d from openings or slab free edges
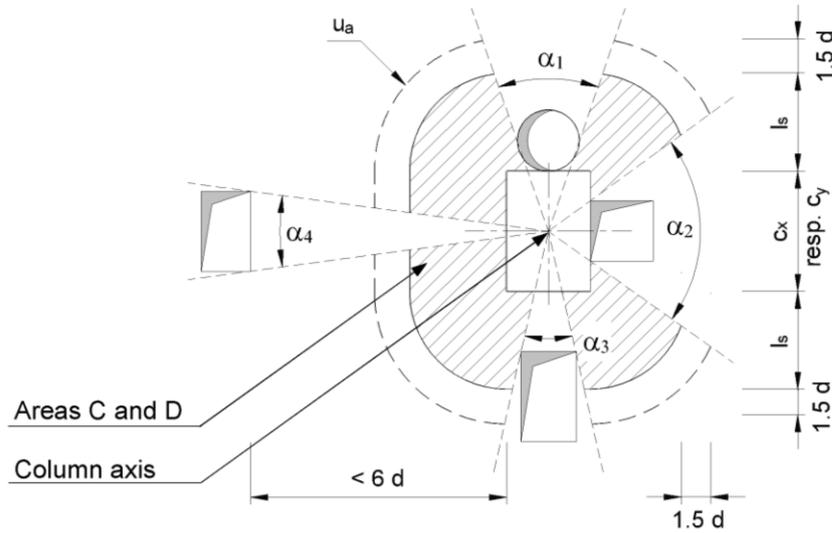
Circular column
$$u_{out} = \pi \, (2 \, l_s + c + 3 \, d)$$

Rectangular column
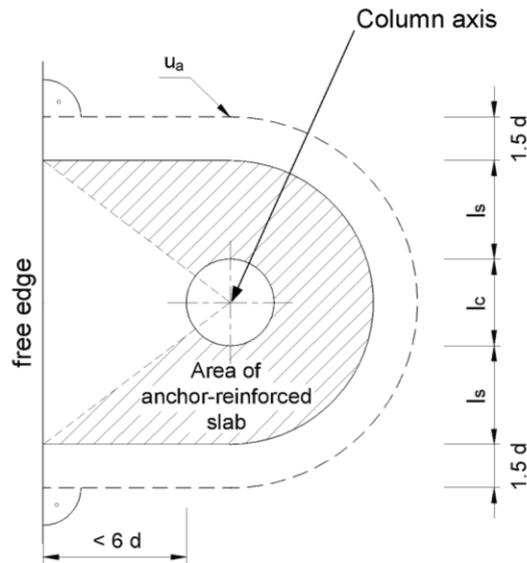$$u_{out} = 2 \, (c_x + c_y) + \pi \, (2 \, l_s + 3 \, d)$$

JORDAHL punching shear reinforcement JDA	
Critical perimeter u_1 and outermost perimeter u_{out}	Annex C2

b) Loaded areas (columns) are less than 6 d from opening in the slab

c) Loaded areas (columns) are less than 6 d from free edges

JORDAHL punching shear reinforcement JDA

Critical perimeter u_1 and outermost perimeter u_{out}

Annex C3