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-12/0454 of 1 September 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	HALFEN HDB shear rail
Product family to which the construction product belongs	Double headed studs as punching reinforcement
Manufacturer	HALFEN GmbH Liebigstraße 14 40764 Langenfeld DEUTSCHLAND
Manufacturing plant	HALFEN GmbH Otto-Brünner-Straße 3 06556 Artern DEUTSCHLAND Halfen-Produkcja Sp. zo.o. ul. Kolejowa 18a 63-460 Nowe Skalmierzyce POLEN
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, Edition 05/2018
This version replaces	ETA-12/0454 issued on 18 December 2017

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Specific Part

1 Technical description of the product

The Halfen HDB double headed studs with ribbed shafts are made of weldable ribbed reinforcement bars with a nominal characteristic yield strength of 500 MPa, the Halfen HDB-G double headed studs with smooth shafts are made of weldable, structural steel with a nominal characteristic yield strength of 500 MPa. The mechanical properties of the steel fulfill the requirement according to EN 1992-1-1:2004 + AC:2010, 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 of at least two studs (see Annex A1). The studs are tack welded or clamped at one end to a non-structural steel rail or reinforcing bars for securing the position of the double headed studs when pouring the concrete. All studs of one of those reinforcement element shall have the same diameter.

To secure the position of the studs during casting, bars of weldable reinforcing steel d_s = 6 mm to d_s = 10 mm or rails made of structural steel (S235JR according to EN 10025-2:2019) or non-corrosive steel (No. 1.4401, 1.4404, 1.4571 according to EN 10088-5:2009) or DD11 (No. 1.0332 according to EN 10111:2008) are used.

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+]

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.

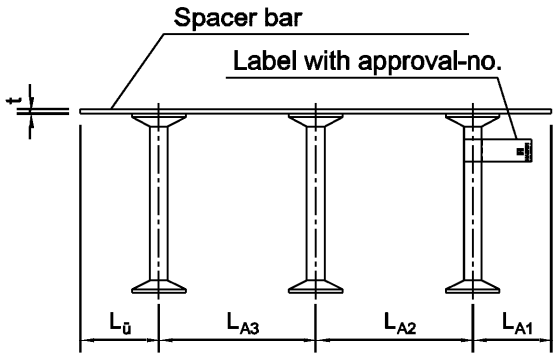
Issued in Berlin on 1 September 2020 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

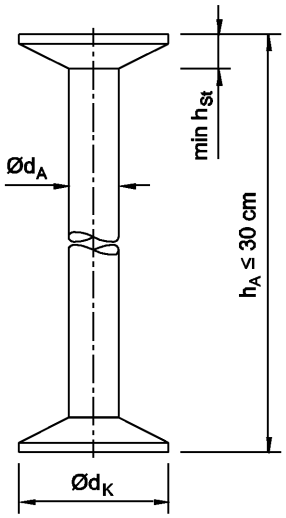
beglaubigt:
Schüler

Deutsches Institut für Bautechnik DIBt

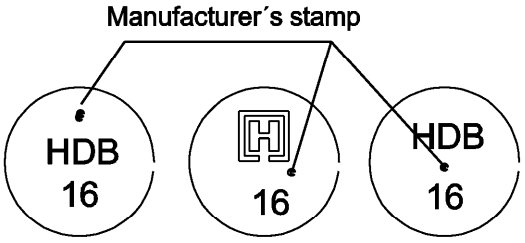
HDB - G - Double Headed Stud - Elements



HDB - G stud dimensions



HDB - G studs identification on both (heads/ends) e.g.



Material: reinforcement steel with a characteristic yield strength of $f_{yk} \geq 500$ MPa acc. to EN 1992-1-1, annex C and provided data sheet

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

HALFEN HDB double headed studs for punching shear reinforcements

Product description
HDB-G stud dimensions and types

Annex A1

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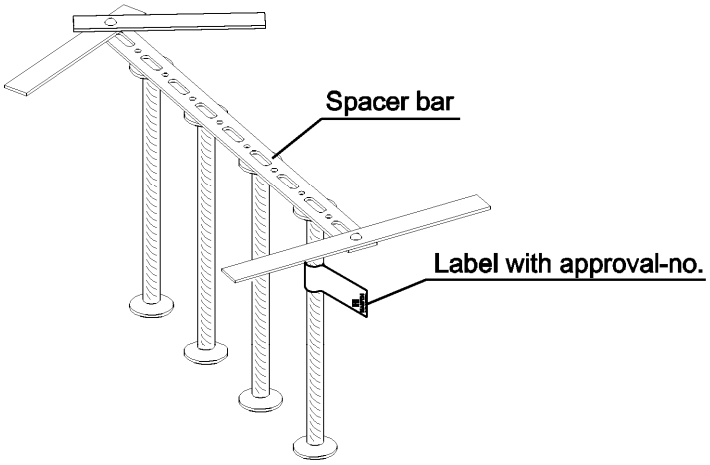
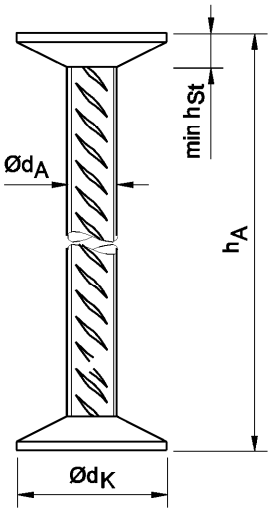
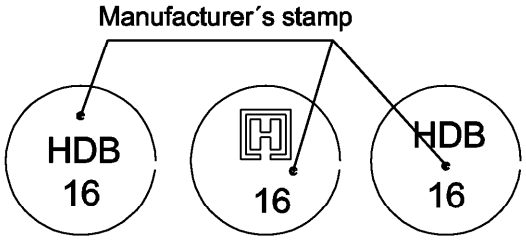
HDB - Double-Headed Stud - Elements



HDB stud dimensions



HDB studs identification on both (heads/ends) e.g.



Material: reinforcement steel with a characteristic yield strength of $f_{yk} \geq 500$ MPa
acc. to EN 1992-1-1, annex C
and provided data sheet

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

HALFEN HDB double headed studs for punching shear reinforcements	Annex A2
Product description HDB stud dimensions and types	

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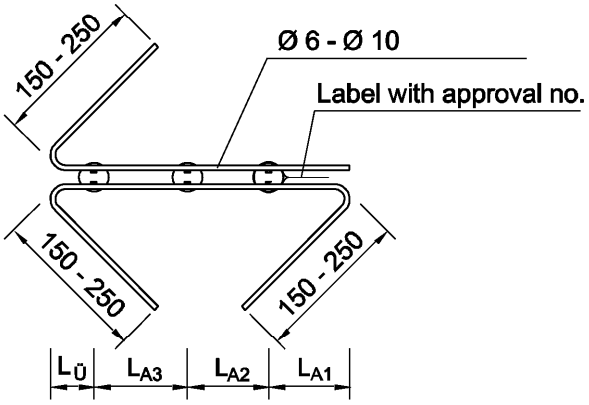
Spacer bars from reinforcement bars or round bars

- with bent off endings

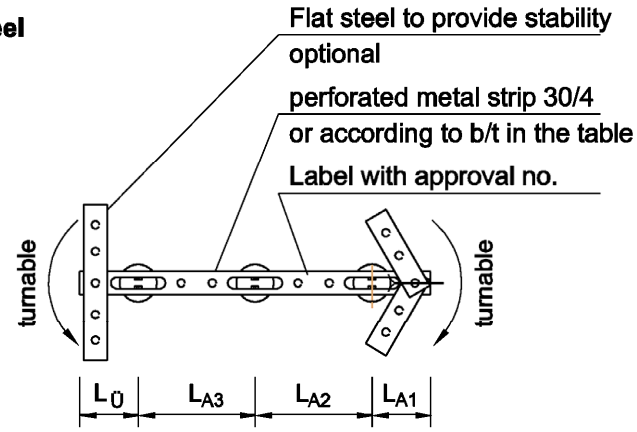


Example:
Label with approval no.

Material: Reinforcement steel (acc.to EN 1992-1-1 Annex C and provided data sheet)
Round bars: A4 = 1.4571/ 1.4401/ 1.4404 (acc. to EN 10088-5:2009)
S 235 JR = 1.0038 (acc.to EN10025-2:2004)

Spacer bar from flat steel

- with turnable flat steel



Stud -Ø Ø d_A	b	t
10, 12	30	3
14, 16	40	3
18, 20	60	3
[mm]		

Material: A4 = 1.4571/ 1.4401/ 1.4404 (acc. to EN 10088-5:2009)
S 235 JR = 1.0038 (acc.to EN10025-2:2004)
DD11 = 1.0332 (acc. to EN10111:2008)

HALFEN HDB double headed studs for punching shear reinforcements	Annex A3
Product description Spacer bars for HDB shear rails	

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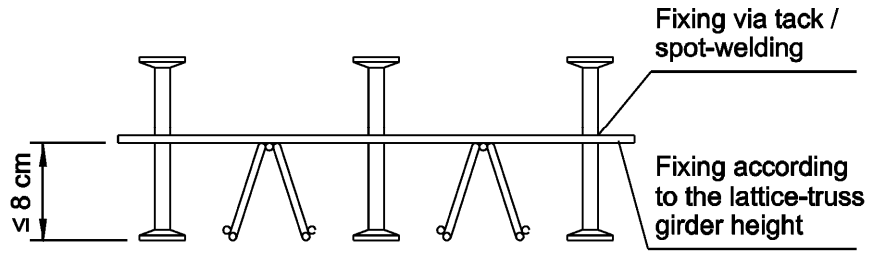
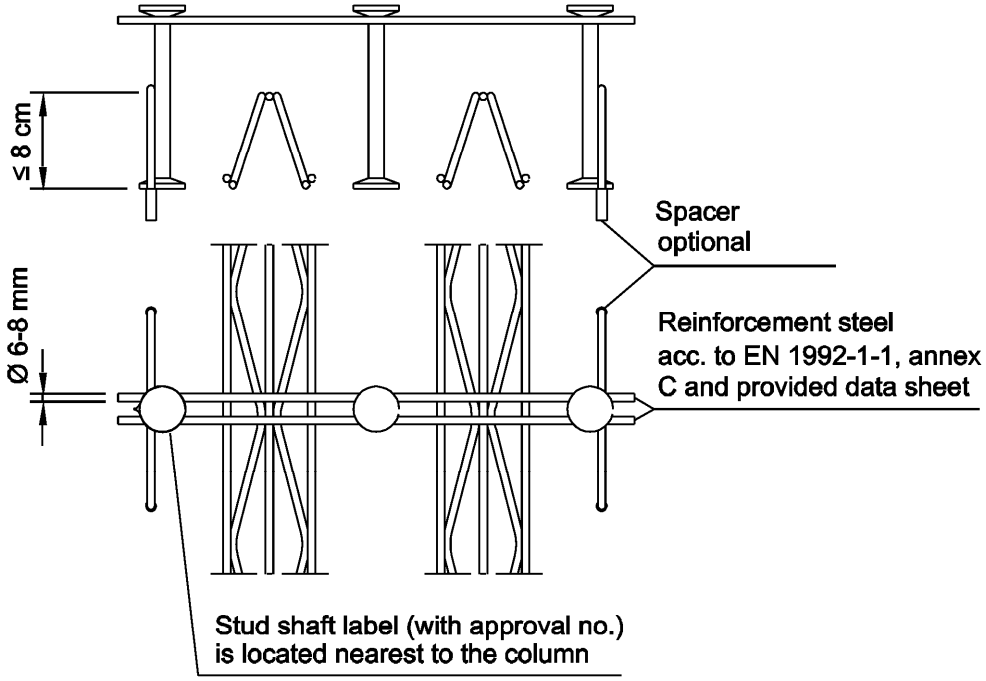
HDB - G - reinforcing elements for precast elements
Types with spot-welded positioning-elements

Positioning of the HDB - reinforcing elements on top of the lattice-truss girder



Fixing the HDB - reinforcing elements using spacers



HALFEN HDB double headed studs for punching shear reinforcements	Annex A4
Product description HDB shear rail for precast elements (spot-welded positioning elements)	

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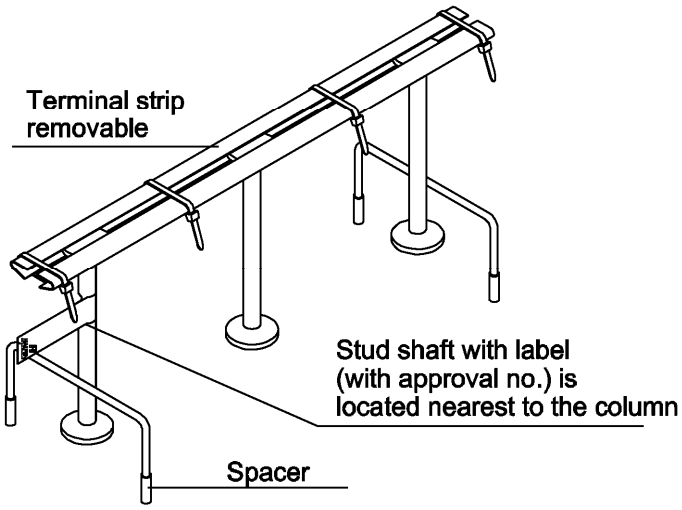
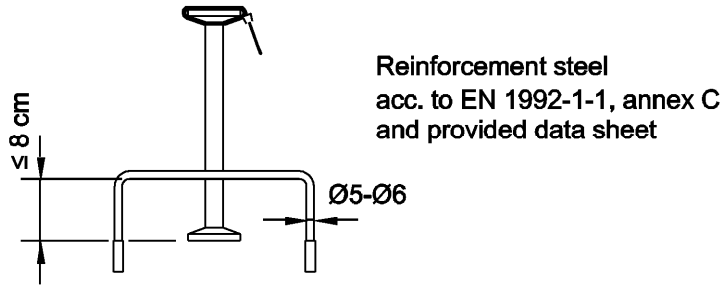
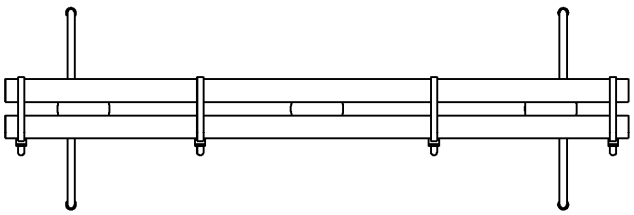
HDB (-G) - reinforcing elements for precast elements
Type with removable positioning-elements







HALFEN HDB double headed studs for punching shear reinforcements	Annex A5
Product description HDB shear rail for precast elements (removable assembly-elements)	

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Specifications of intend of use

The reinforcement elements with double headed studs are intended to be used for the increase of the punching shear resistance of flat slabs or footings and ground slabs under static, quasi-static and fatigue loading. The reinforcement elements with double headed studs are located adjacent to columns or high concentrated loads. The design of the punching shear resistance of flat slabs or footings and ground slabs is done in accordance with EOTA TR 060.
The intended use covers the following specifications:

- flat slabs or footings and ground slabs made of reinforced normal weight concrete of strength class C20/25 to C50/60 according to EN 206-1:2000
- flat slabs or footings and ground slabs with a minimum height of h = 180 mm
- flat slabs or footings and ground slabs with a maximum effective depth of d = 300 mm (only for double headed studs with smooth shafts)
- reinforcement elements with double headed studs of the same diameter and type (ripped or smooth) in the punching area around a column or high concentrated 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 such that the double headed studs are perpendicular to the surface of flat slabs or footings and ground slabs
- reinforcement elements with double headed studs directed radially towards the column or 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 such that the minimum and maximum distances between the double headed studs on an element and between the elements as arranged around a column or area of high concentrated load complies with the provisions according to Annex B3 to B8
- The provisions are kept on site with an accuracy of 0,1h (h height of the slab)

HALFEN HDB double headed studs for punching shear reinforcements	Annex B1
Intended use Specifications	

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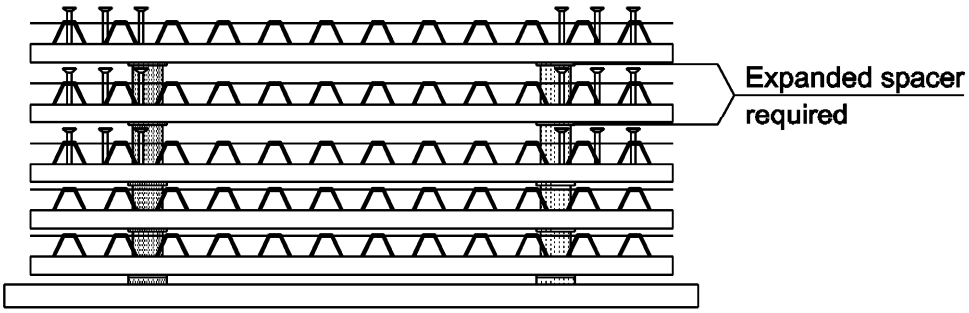
Installation:

- 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.

Packaging, 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.



HALFEN HDB double headed studs for punching shear reinforcements	Annex B2
Intended use Specifications	

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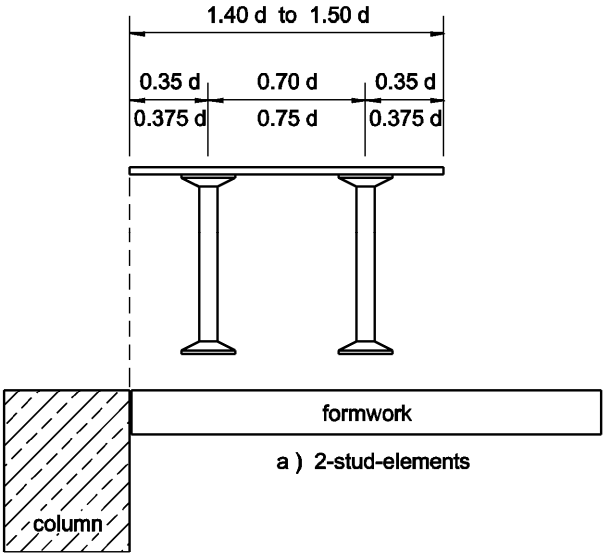
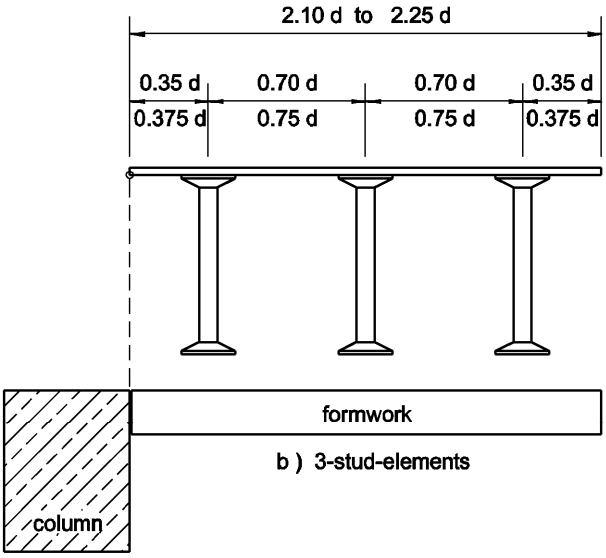
Design of the HDB (-G) - system elements

The symmetric overlap of the spacer 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.



a) 2-stud-elements



b) 3-stud-elements

HALFEN HDB double headed studs for punching shear reinforcements	Annex B3
Intended use Standard system arrangement	

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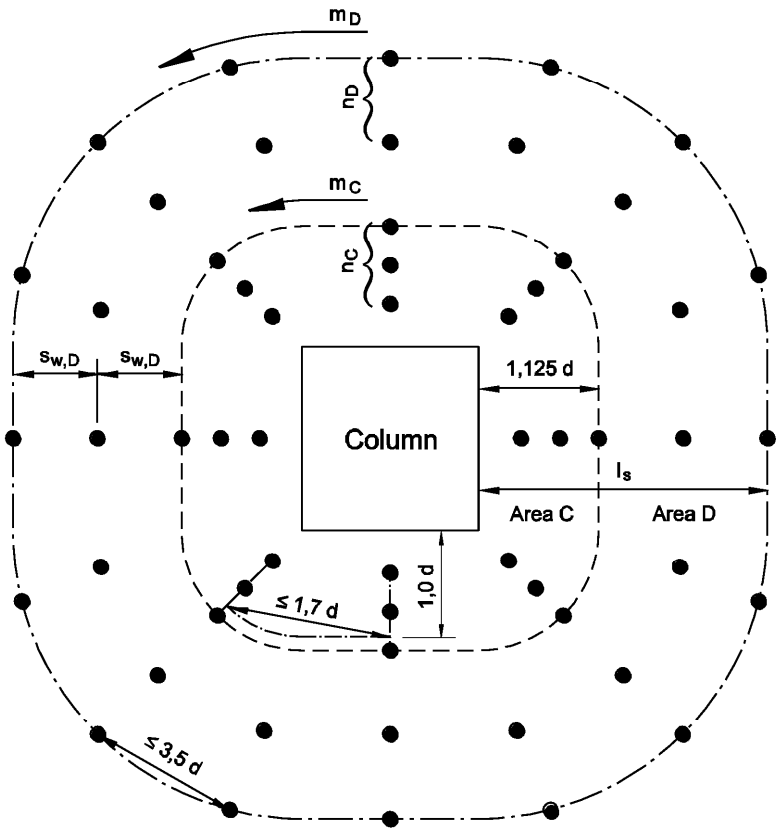
Principle arrangement of the HDB (-G) - studs in slabs



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

HALFEN HDB double headed studs for punching shear reinforcements	Annex B4
Intended use Principle arrangement of HDB studds in slabs	

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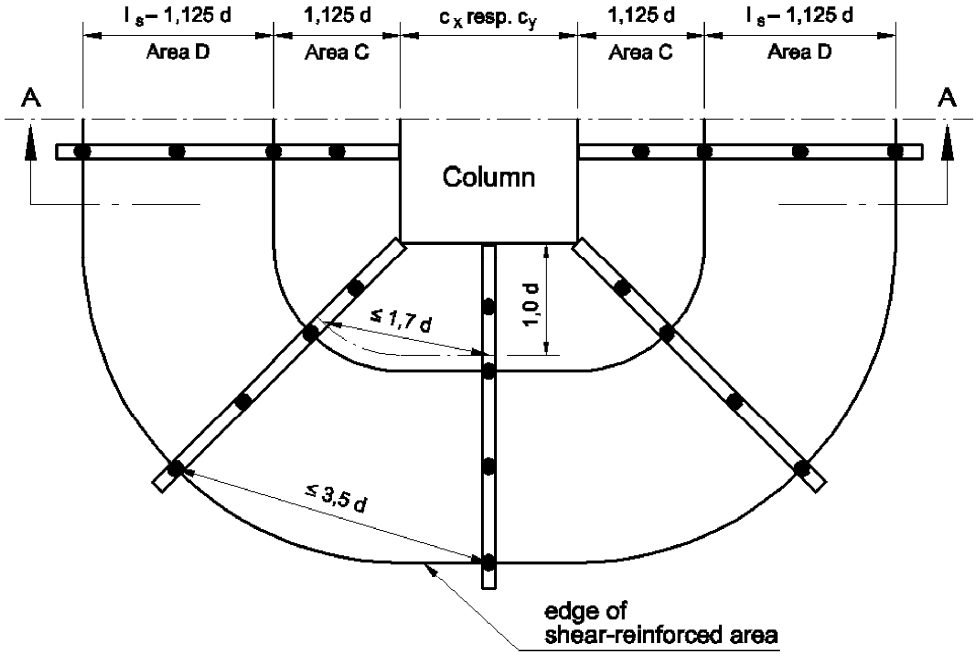
Placing the punching shear reinforcement using complete elements in slabs

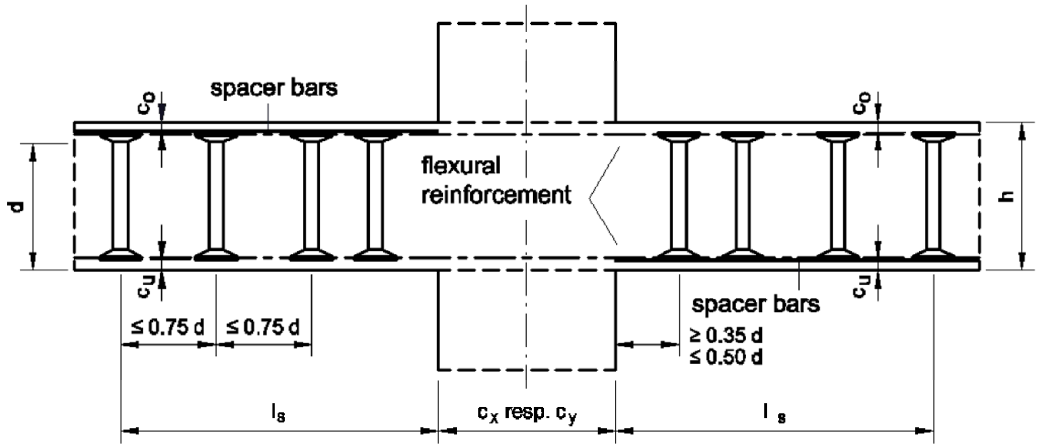
Plan view



Section A - A

Installation after placing the top and bottom reinforcement layers

Reverse installation; spacer bars are under the lower layer of reinforcement



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

HALFEN HDB double headed studs for punching shear reinforcements	Annex B5
Intended use Arrangements for HDB complete elements in slabs	

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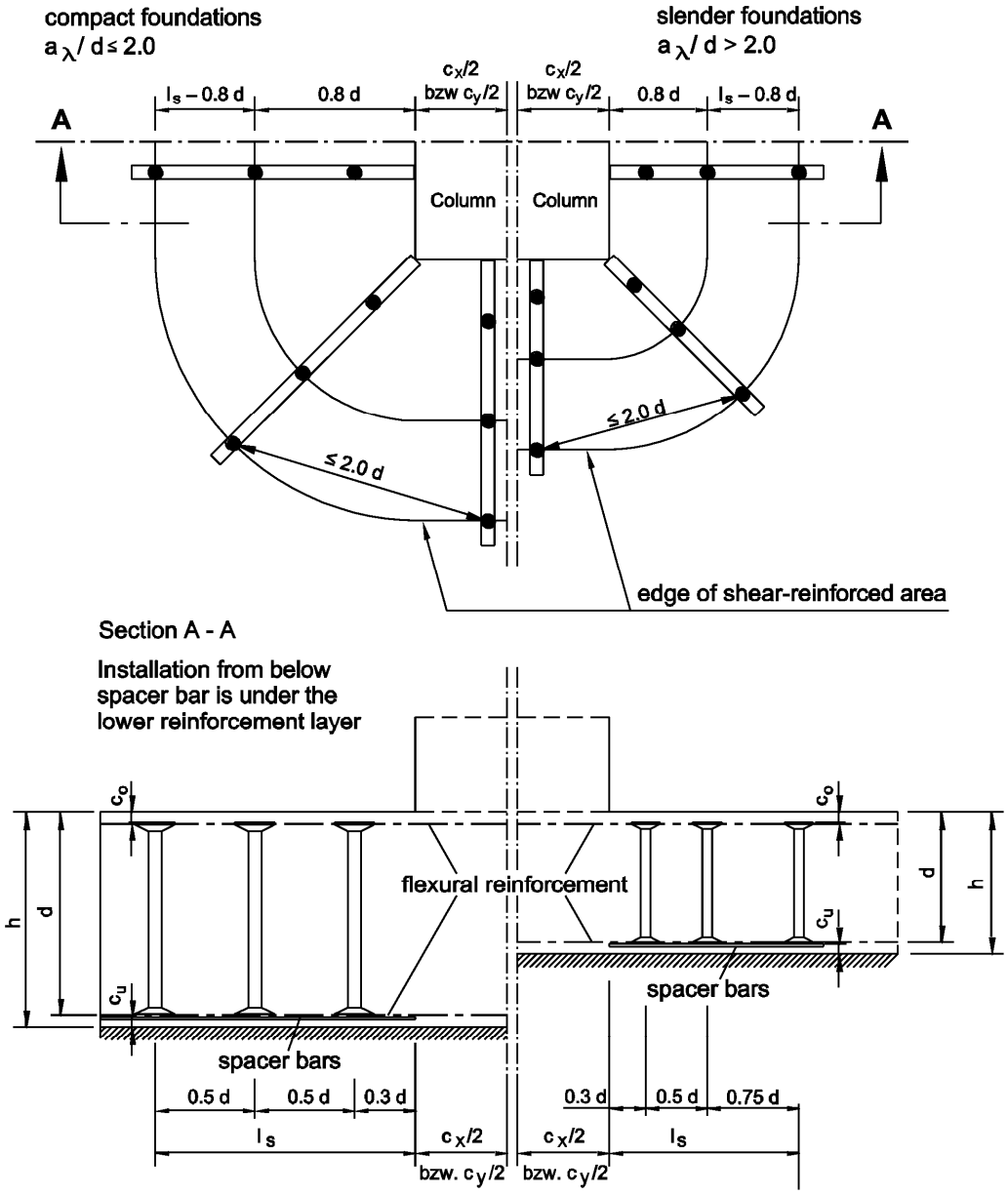
Arrangement of punching shear reinforcement using complete elements in footings and ground slabs

Plan view



Section A - A

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

HALFEN HDB double headed studs for punching shear reinforcements	Annex B6
Intended use Arrangements for HDB complete elements in footings and ground slabs	

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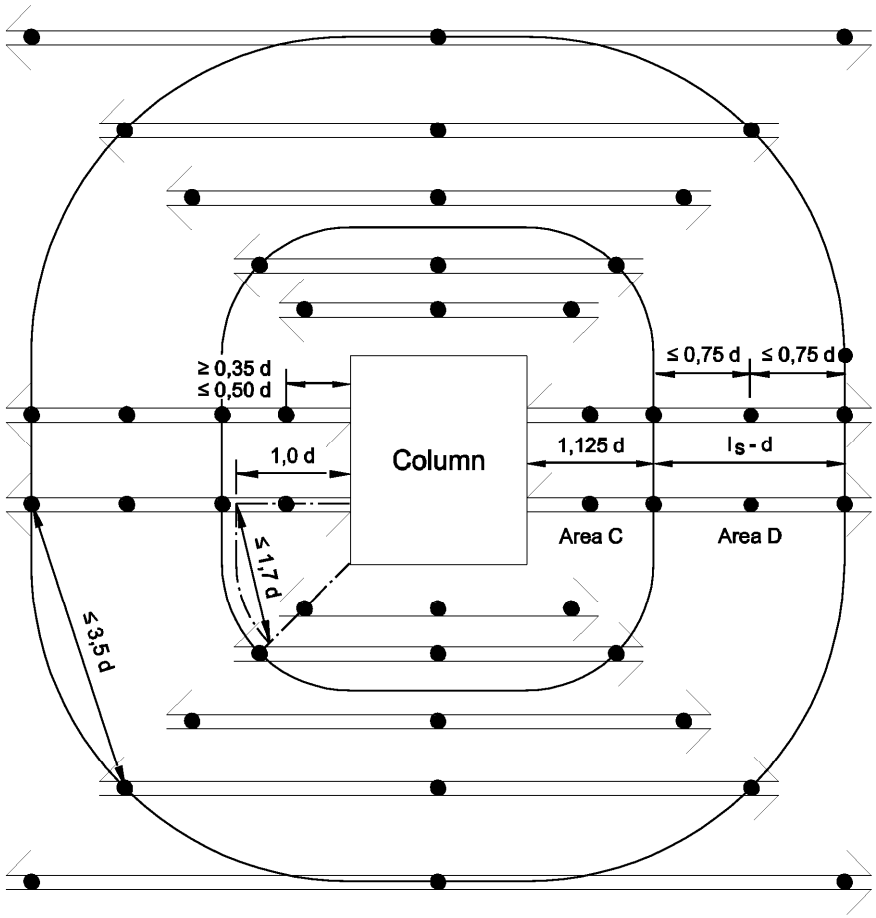
Orthogonal arrangement of punching shear reinforcement in slabs



HALFEN HDB double headed studs for punching shear reinforcements	Annex B7
Intended use HDB parallel arrangement in slabs	

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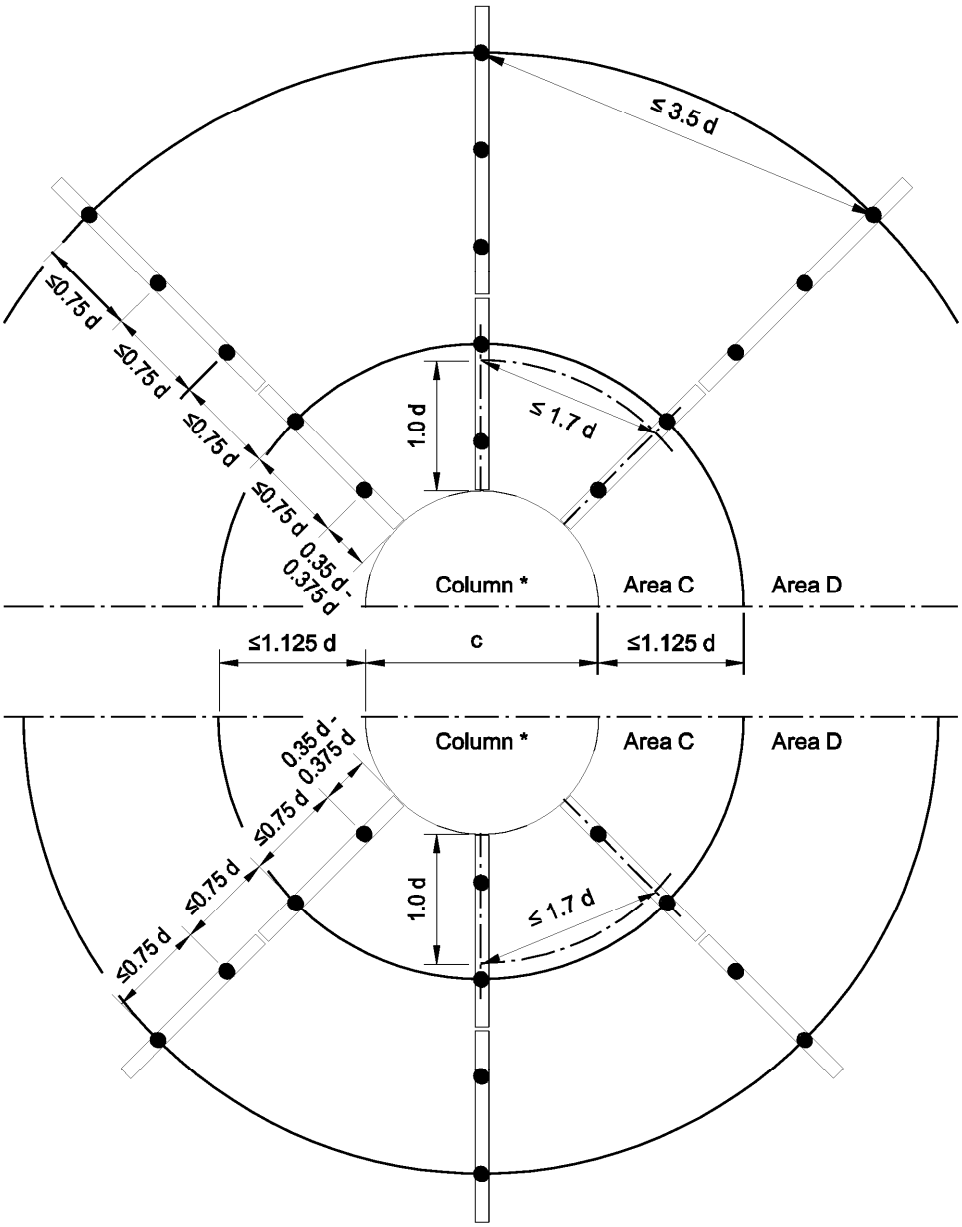
Placing the punching shear reinforcement with 2- or 3- stud standard-elements in slabs



* For combination of 2- or 3- stud elements in similar on rectangular columns

HALFEN HDB double headed studs for punching shear reinforcements	Annex B8
Intended use HDB arrangement for 2- and 3- stud standard-elements in slabs	

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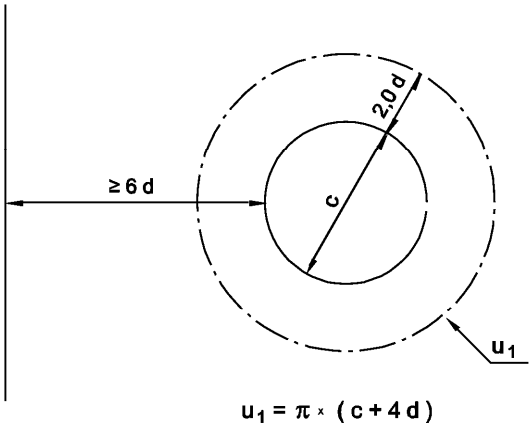
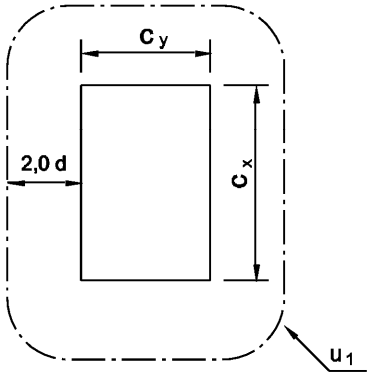
Defining the critical perimeters u_1 and u_{out}

1. Critical perimeter u_1

a) Loaded areas (columns) are more than 6 d from openings or slab free edges

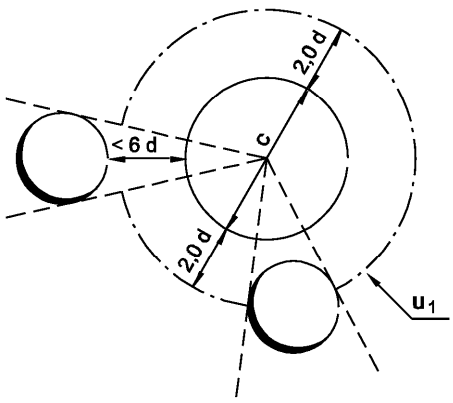


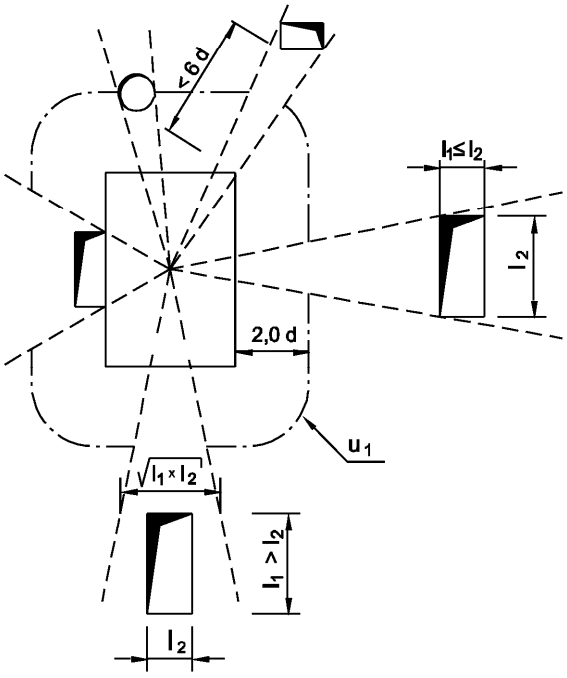
$u_1 = \pi \times (c + 4\,d)$



$u_1 = 2 \times (c_x + c_y) + 4\,d \times \pi$

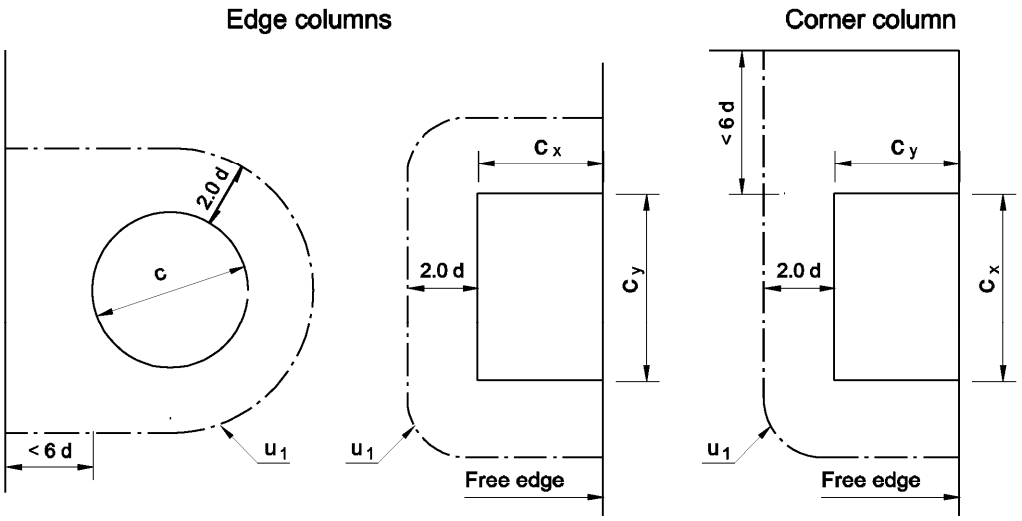
b) Loaded areas (columns) are less than 6d from openings (voids) in the slab.





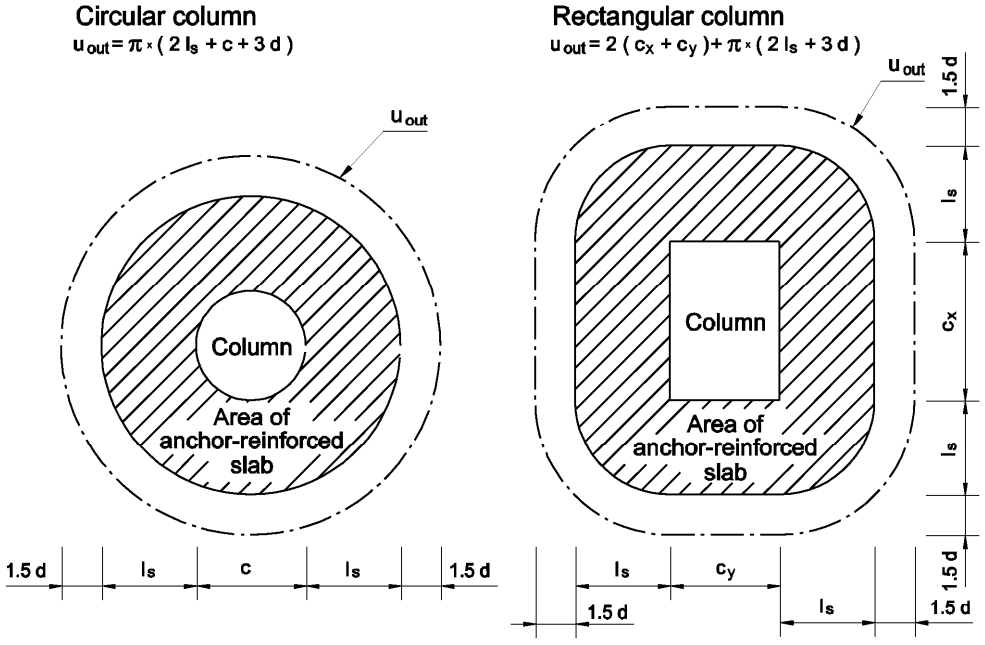
HALFEN HDB double headed studs for punching shear reinforcements	Annex C1
Critical perimeter u_1 and outermost perimeter u_{out}	

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



2. Outermost perimeter u_{out}

a) Loaded areas (columns) are more than 6 d from openings or slab free edges



HALFEN HDB double headed studs for punching shear reinforcement	Annex C2
Critical perimeter u_1 and outermost perimeter u_{out}	

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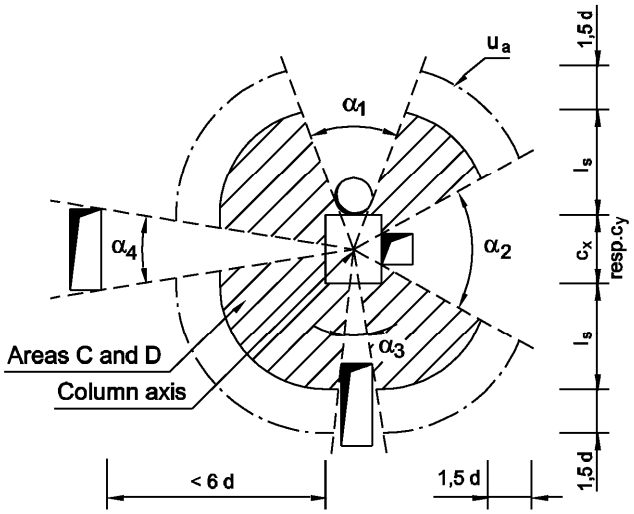
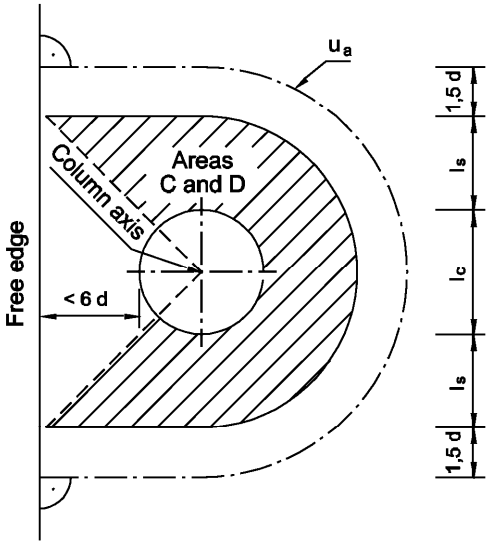
a) Loaded areas (columns) are less than 6 d from opening in the slab



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



HALFEN HDB double headed studs for punching shear reinforcements	Annex C3
Critical perimeter u_1 and outermost perimeter u_{out}	