

Approval body for construction products  
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and  
Laender Governments



## European Technical Assessment

**ETA-12/0454**  
**of 18 December 2017**

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. z o.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 160003-01-0301

This version replaces

ETA-12/0454 issued on 18 December 2012

**European Technical Assessment**

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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 for fill 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 figure 1). 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 stud's during casting, bars of weldable reinforcing steel  $d_s = 6$  mm to  $d_s = 10$  mm or rails made of structural steel with a nominal characteristic yield strength of 235 MPa (S235JR acc. to EN 10025-2) or non-corrosive steel (No. 1.4401, 1.4404, 1.4571 acc. to EN 10088-5) 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	$\Delta\sigma_{Rsk,n=2 \cdot 10^6} = 70$ 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. 160003-01-0301 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**

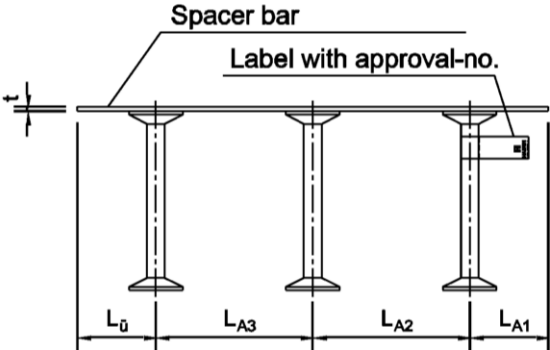
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 18 December 2017 by Deutsches Institut für Bautechnik

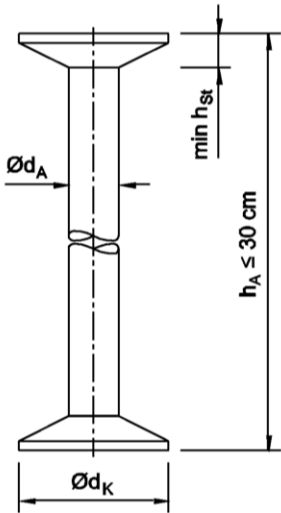
BD Dipl.-Ing. Andreas Kummerow  
Head of Department

*beglaubigt:*  
Schüler

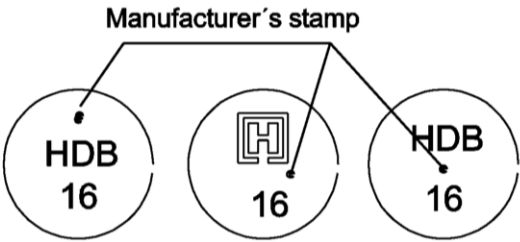
HDB - G - Double Headed Stud - Elements



HDB - G stud dimensions



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



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

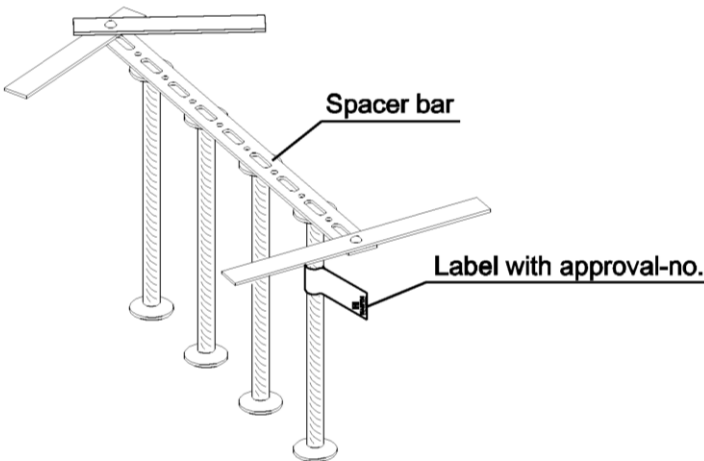
Stud-Ø $d_A$ [mm]	Head-Ø $d_K$ [mm]	Head thickness $\min h_{st}$ [mm]	Stud section $A_{S DKA}$ [mm <sup>2</sup> ]	Characteristic value for yield strength $f_{yk}$ [MPa]	Anchor height $h_A \leq 300\text{ mm}$
10	30	5	79	500	$h_A =$ slab thickness - upper and lower concrete cover
12	36	6	113		
14	42	7	154		
16	48	8	201		
18	54	9	254		
20	60	10	314		

HALFEN HDB double headed studs for punching shear reinforcements

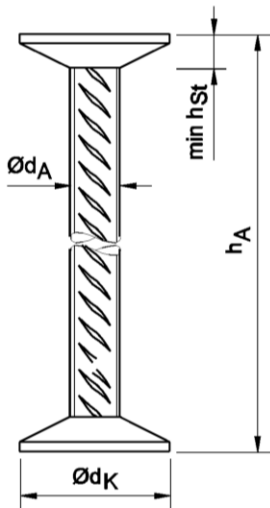
Product description  
HDB-G stud dimensions and types

Annex A1

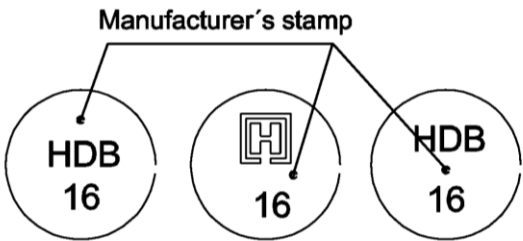
HDB - Double-Headed Stud - Elements



HDB stud dimensions



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



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

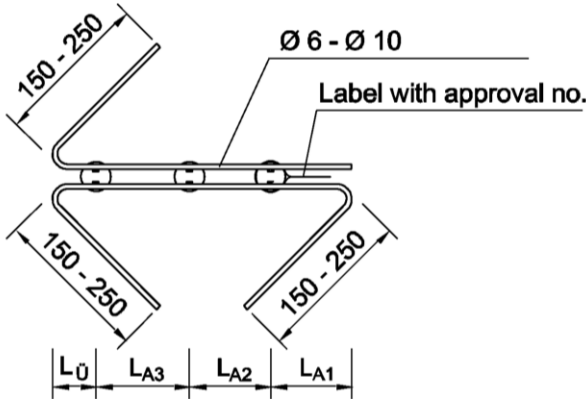
Stud-Ø $d_A$ [mm]	Head-Ø $d_K$ [mm]	Head thickness $\min h_{St}$ [mm]	Stud section $A_{S DKA}$ [mm <sup>2</sup> ]	Characteristic value for yield strength $f_{yk}$ [MPa]	Anchor height $h_A$ [mm]
10	30	5	79	500	$h_A =$ slab thickness - upper and lower concrete cover
12	36	6	113		
14	42	7	154		
16	48	7	201		
20	60	9	314		
25	75	12	491		

HALFEN HDB double headed studs for punching shear reinforcements

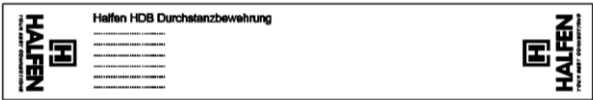
Product description  
HDB stud dimensions and types

Annex A2

**Spacer bars from reinforcement bars or round bars**  
**- with bent off endings**



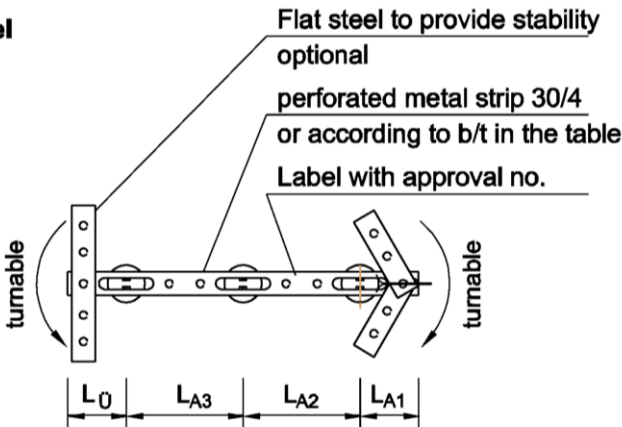
Example:  
Label with  
approval no.



**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 <sub>A</sub>	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)

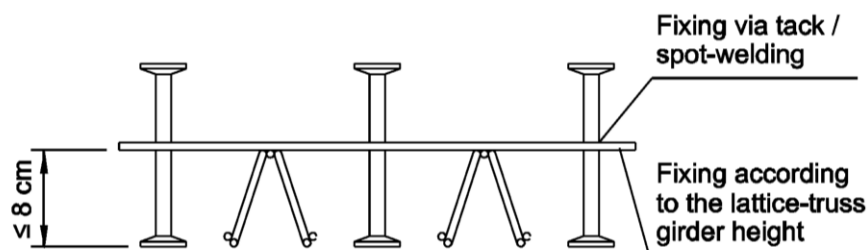
HALFEN HDB double headed studs for punching shear reinforcements

Product description  
Spacer bars for HDB shear rails

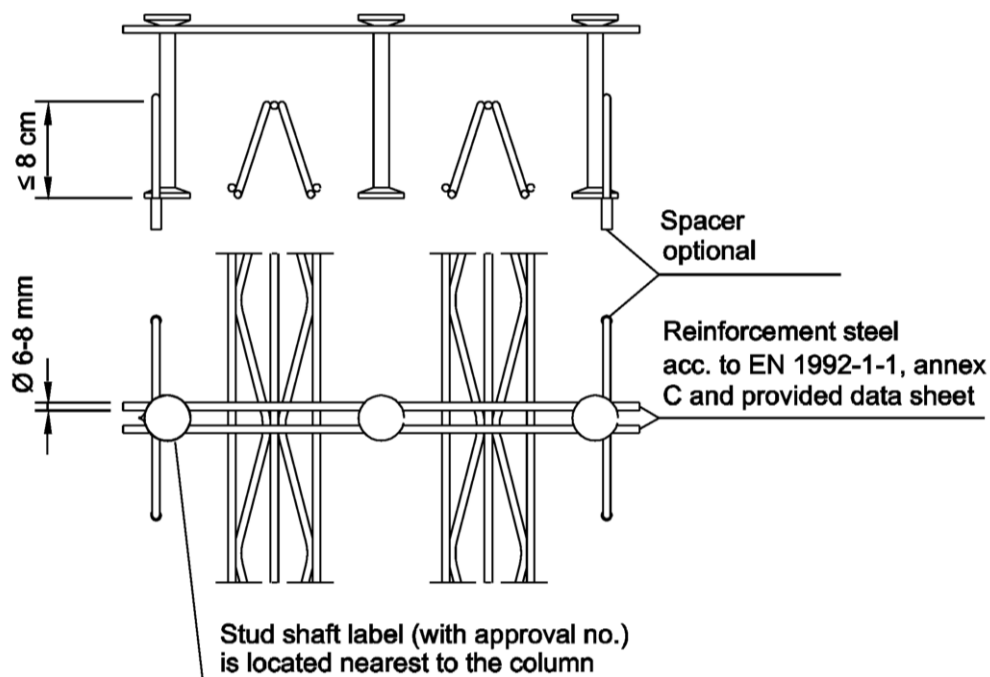
Annex A3

## 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



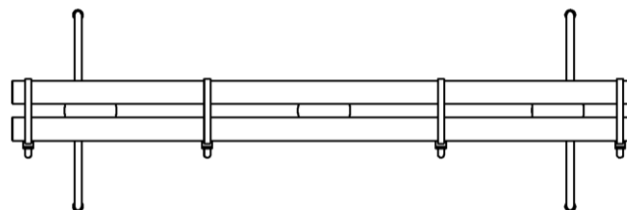
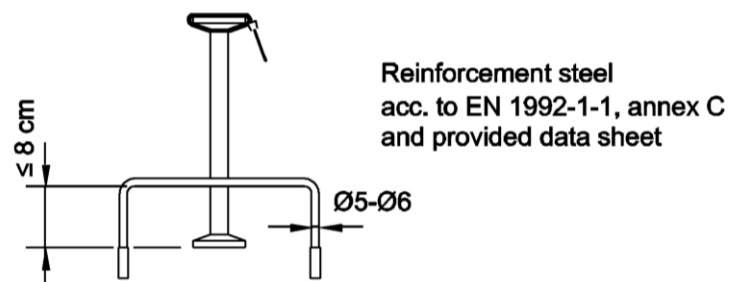
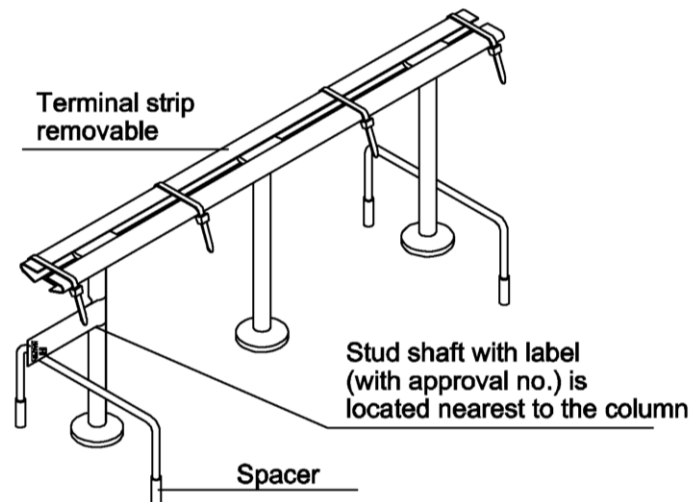
HALFEN HDB double headed studs for punching shear reinforcements

Product description  
HDB shear rail for precast elements (spot-welded positioning elements)

Annex A4



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



HALFEN HDB double headed studs for punching shear reinforcements

Product description  
HDB shear rail for precast elements (removable assembly-elements)

Annex A5

## 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 206-1:2013
- flat slabs or footings and ground slabs with a minimum height of  $h = 180 \text{ mm}$
- flat slabs or footings and ground slabs with a maximum effective depth of  $d = 300 \text{ mm}$  (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

Intended use  
Specifications

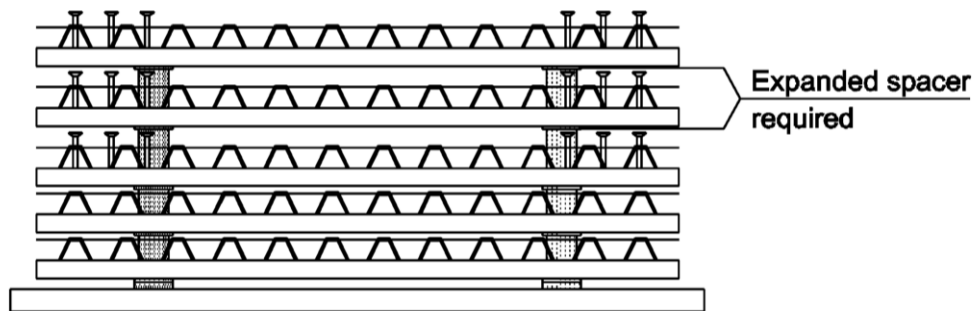
Annex B1

### 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.



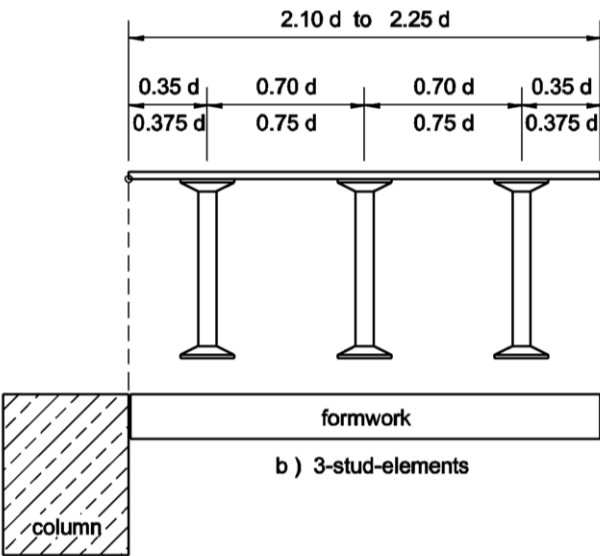
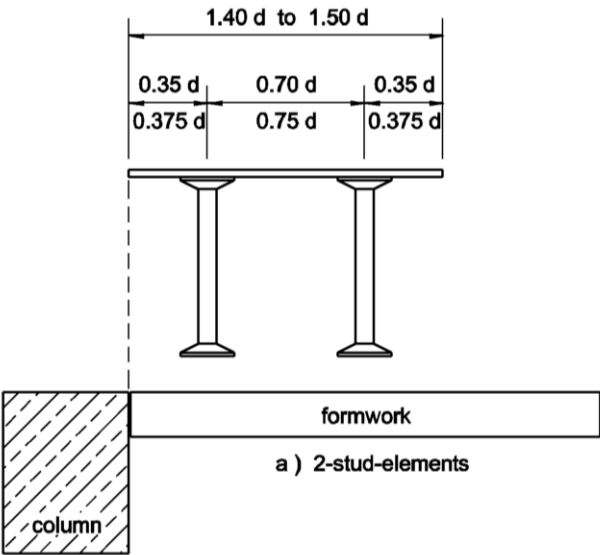
HALFEN HDB double headed studs for punching shear reinforcements

Intended use  
Specifications

Annex B2

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.

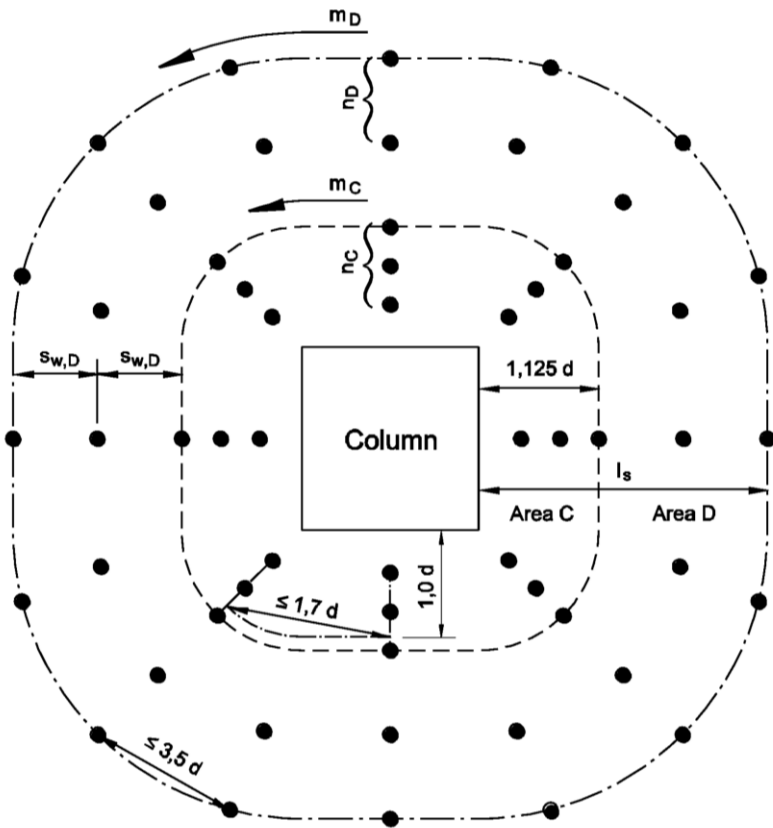


HALFEN HDB double headed studs for punching shear reinforcements

Intended use  
Standard system arrangement

Annex B3

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



- m<sub>C</sub> number of elements (rows) in area C
- m<sub>D</sub> number of elements (rows) in area D
- n<sub>C</sub> number of studs of each element (row) in area C
- n<sub>D</sub> number of studs of each element (row) in area D
- s<sub>w,D</sub> radial spacing in area D

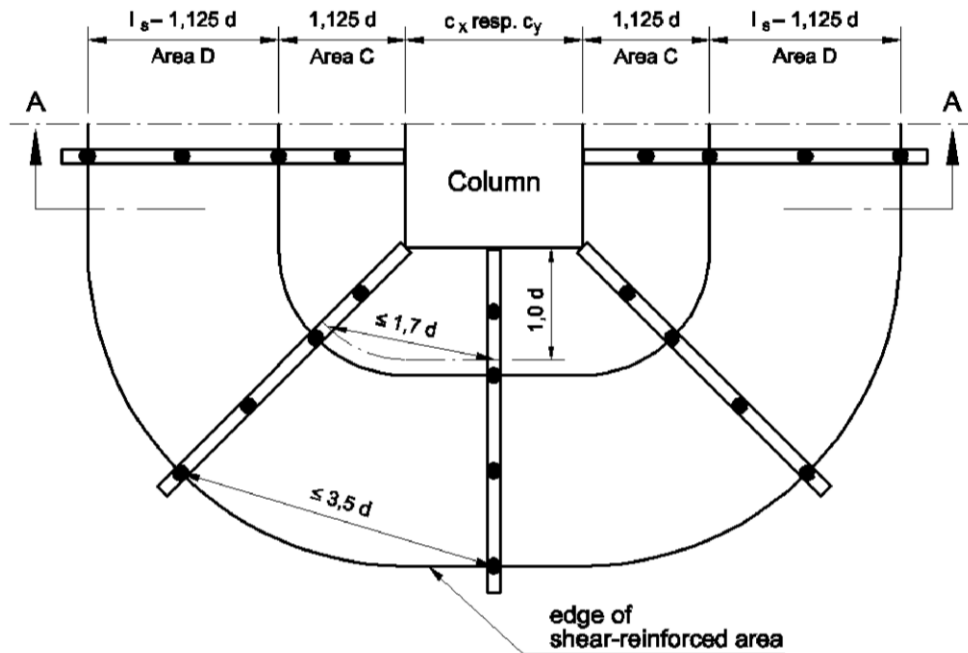
HALFEN HDB double headed studs for punching shear reinforcements

Intended use  
Principle arrangement of HDB studs in slabs

Annex B4

### Placing the punching shear reinforcement using complete elements in slabs

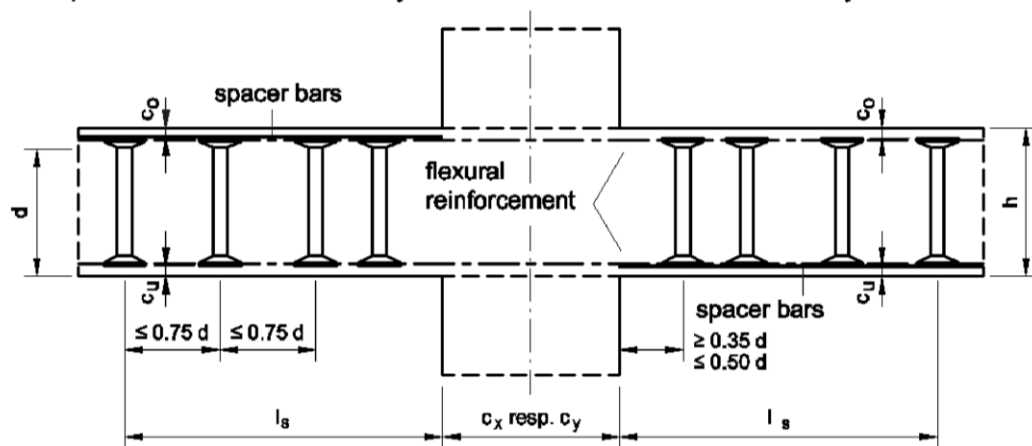
### Plan view



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.  $c_{ij}$  acc. to EN1992-1-1 : 2004 + AC : 2010, section 4.4

## HALFEN HDB double headed studs for punching shear reinforcements

Intended use  
Arrangements for HDB complete elements in slabs

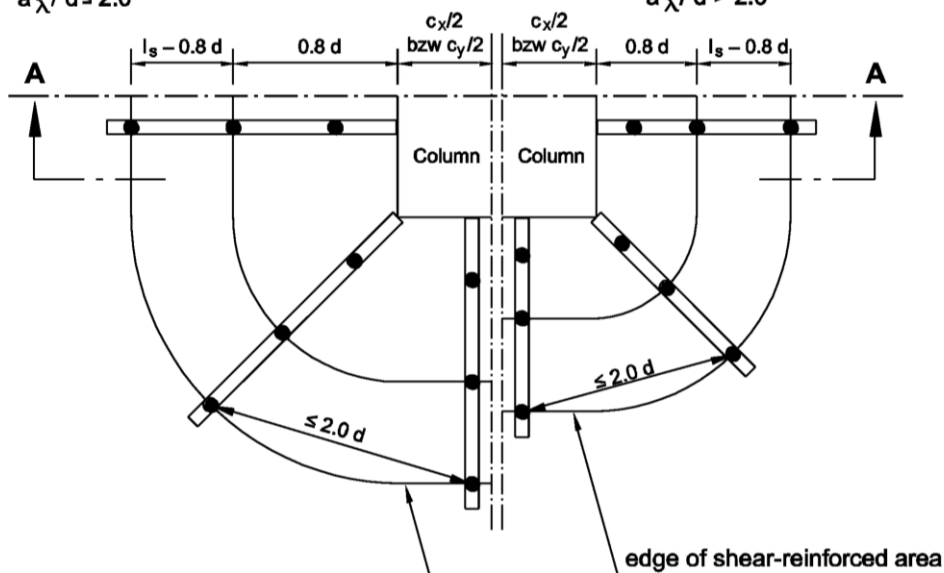
Annex B5

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

Plan view

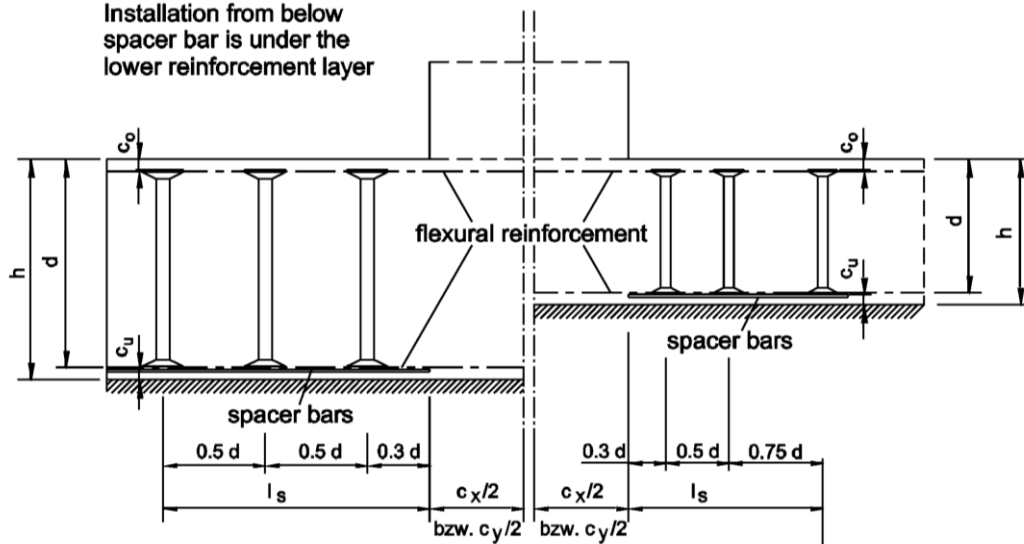
compact foundations  
 $a_{\lambda}/d \leq 2.0$

slender foundations  
 $a_{\lambda}/d > 2.0$



Section A - A

Installation from below  
spacer bar is under the  
lower reinforcement layer



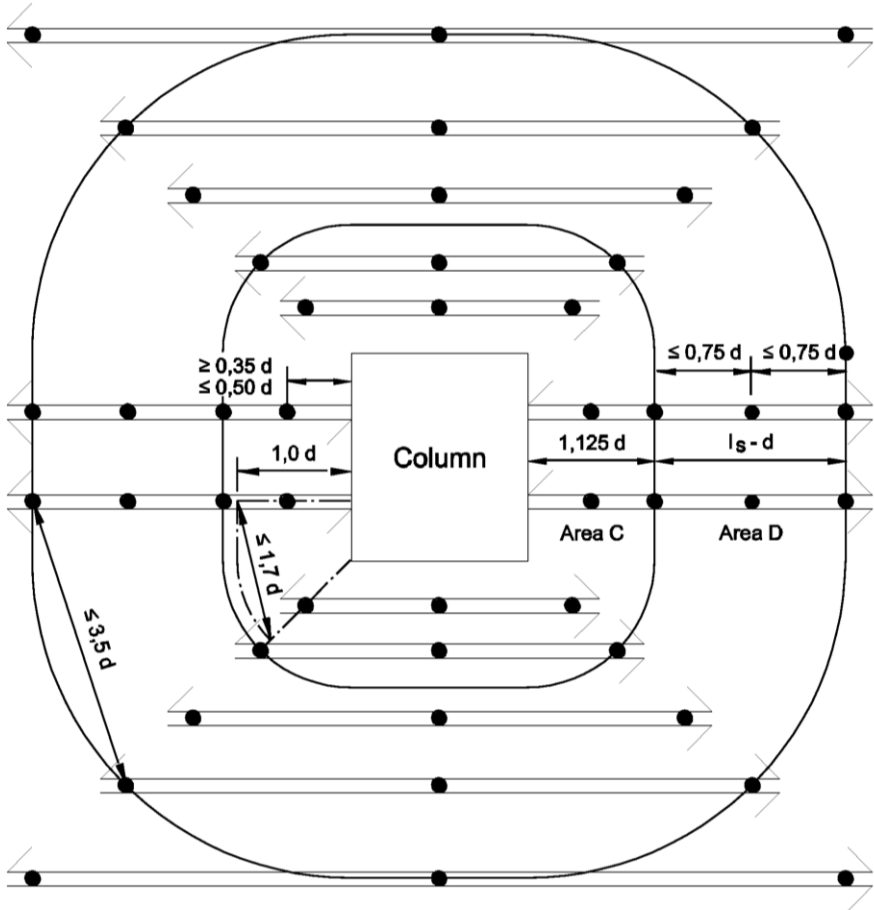
Concrete cover  $c_o$  resp.  $c_u$  acc. to EN1992-1-1 : 2004 + AC : 2010, section 4.4

HALFEN HDB double headed studs for punching shear reinforcements

Intended use  
Arrangements for HDB complete elements in footings and ground slabs

Annex B6

Orthogonal arrangement of punching shear reinforcement  
in slabs



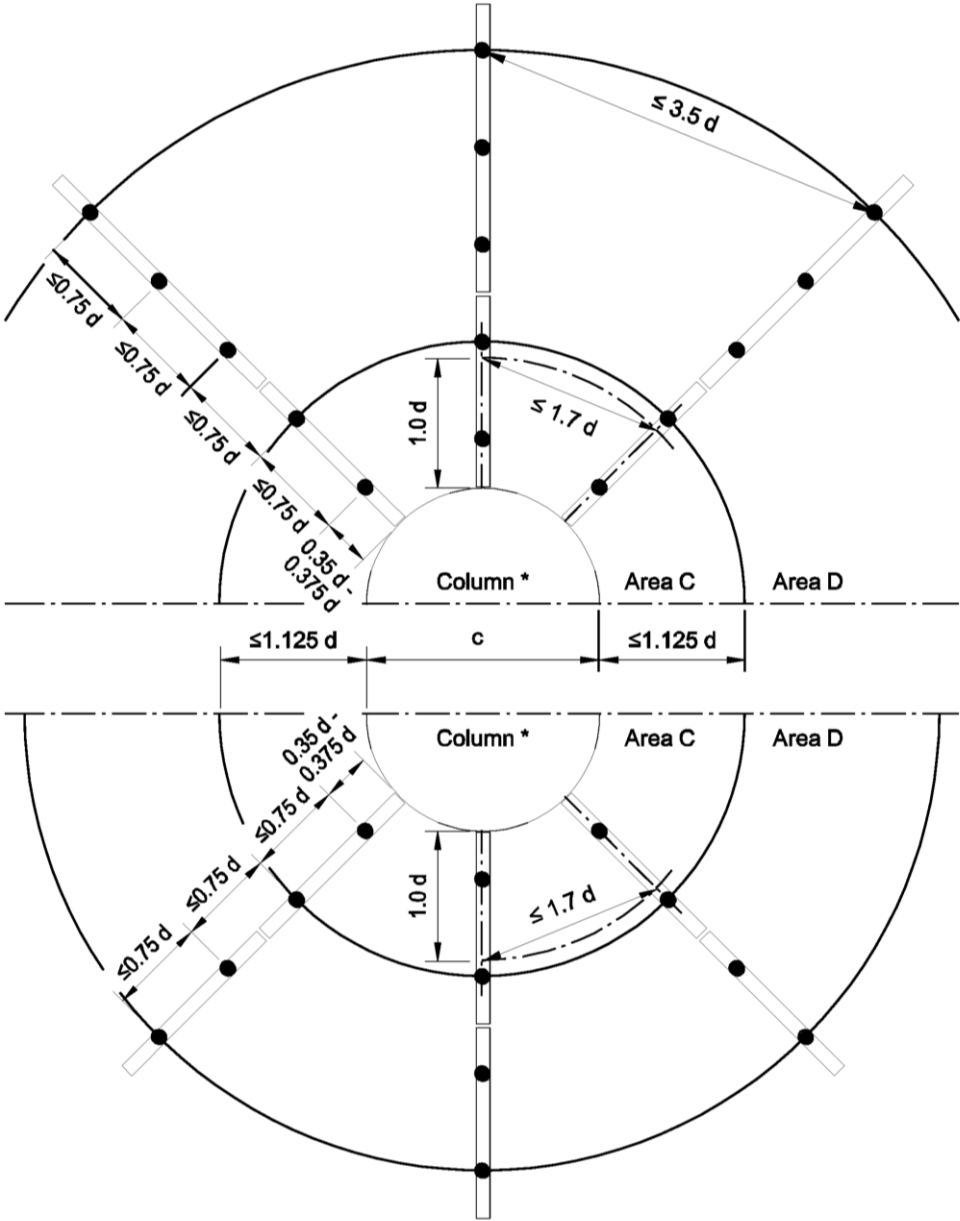
HALFEN HDB double headed studs for punching shear reinforcements

Intended use  
HDB parallel arrangement in slabs

Annex B7



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

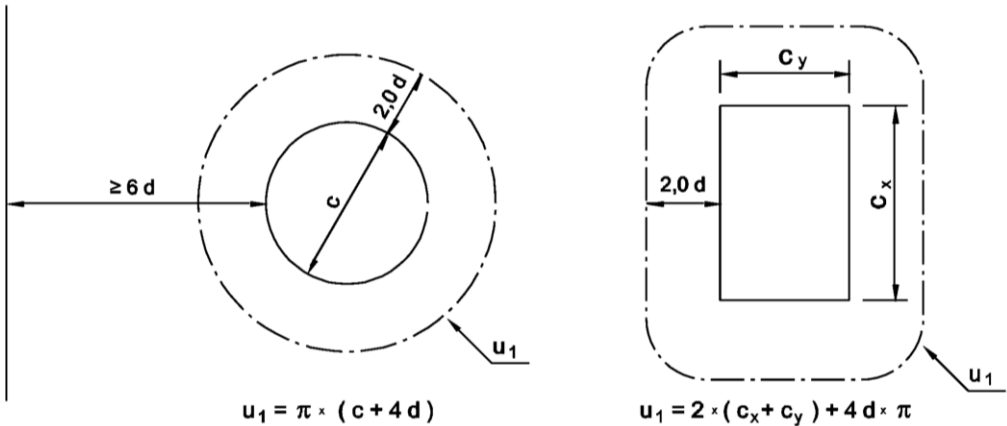
Intended use  
HDB arrangement for 2- and 3- stud standard-elements in slabs

Annex B8

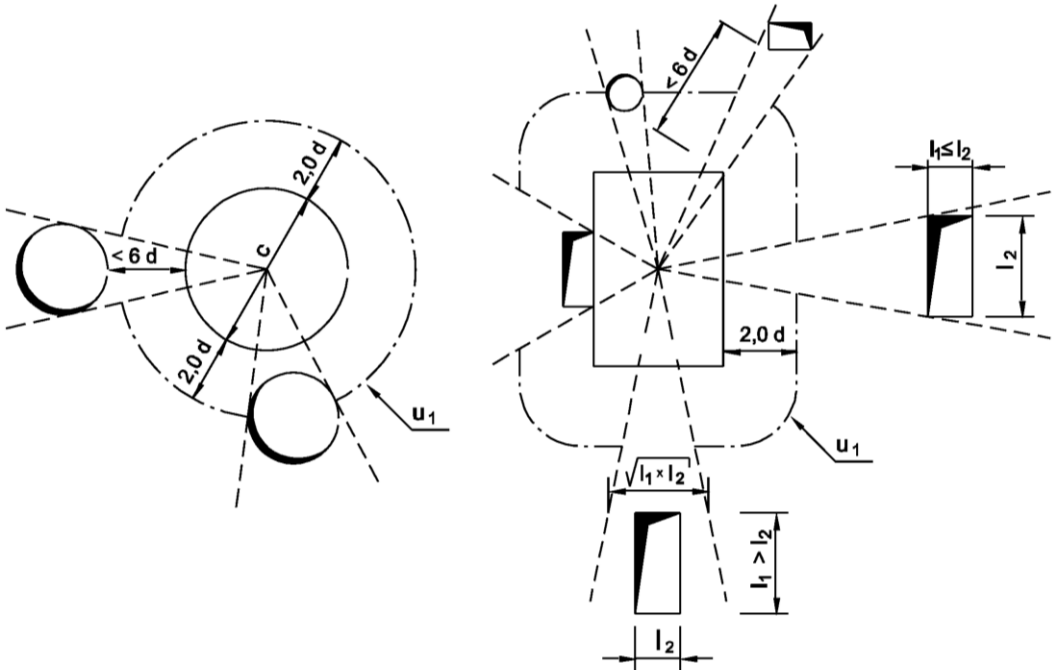
Defining the critical perimeters  $u_1$  and  $u_{out}$

1. Critical perimeter  $u_1$

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



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

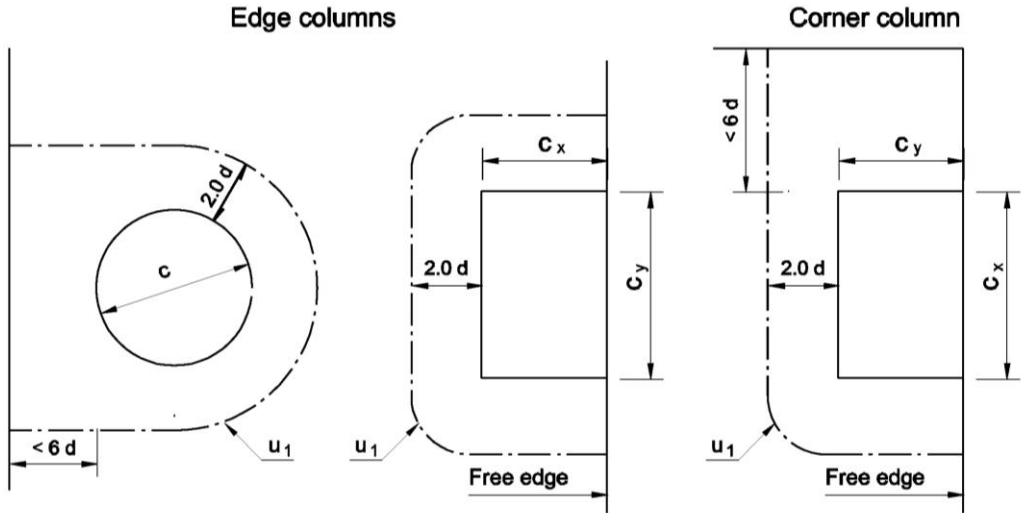


HALFEN HDB double headed studs for punching shear reinforcements

Critical perimeter  $u_1$  and outermost perimeter  $u_{out}$

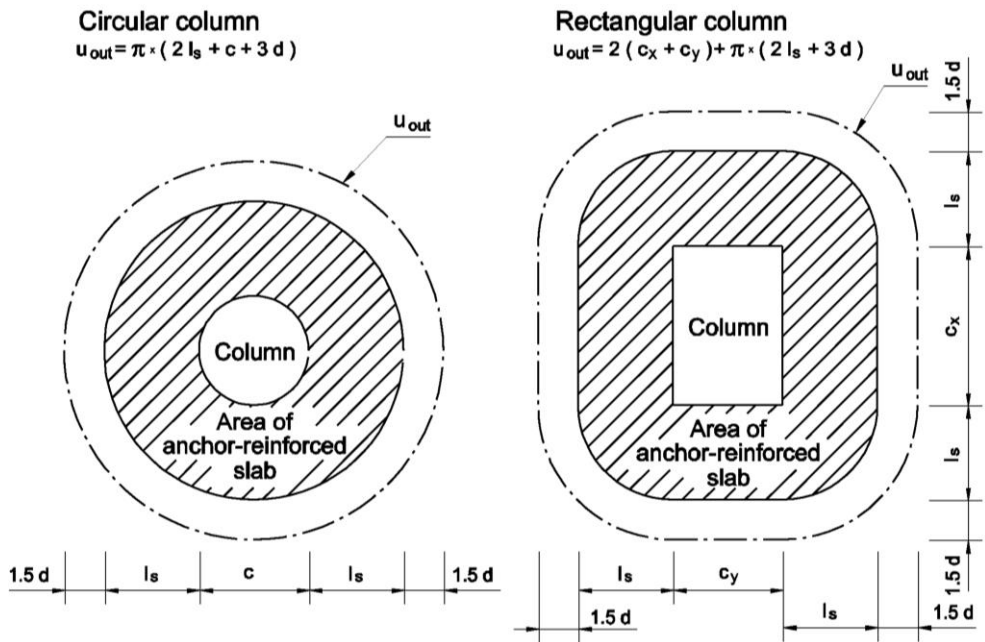
Annex C1

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

Critical perimeter  $u_1$  and outermost perimeter  $u_{out}$

Annex C2

