

National technical approval

Egcodorn[®] N & Q

Z-15.7-301 | 15.08.2022 | English

Egcodorn[®] shear force dowel N & Q according to DIN 1045-1 and Eurocode 2

Tested by: DIBt, Berlin

Note: This is a translation of the German original document not examined by DIBt, Berlin.

This is a translation of the German original document not examined by Deutsches Institut für Bautechnik (DIBt).

General Technical Approval

Deutsches Institut für Bautechnik
[German institute for building construction
technology]

Approval and authorization body for building products and types

A public law institution jointly funded by the German
Federal Government and the federal states
Member of the EOTA, UEAtc and WFTAO

Date:

13 July 2022

Reference number:

I 27-1.15.7-16/22

Approval number:

Z-15.7-301

Validity period:

From: 15 August 2022

End: 15 August 2027

Applicant:

Max Frank GmbH & Co. KG
Mitterweg 1
94339 Leiblging

Object of approval:

Egcodorn shear force dowel
Egcodorn shear force dowel N and Q for connection between reinforced concrete parts

The above-mentioned object of approval is herewith granted the *allgemeine bauaufsichtliche Zulassung* [national technical approval]. This national technical approval comprises nine pages and 17 annexes. The product was initially granted national technical approval on 14 August 2017.

I GENERAL STIPULATIONS

- 1 With the national technical approval, the usability and/or applicability of the object of approval in the sense of the *Landesbauordnungen* [building regulations of the Federal states] is verified.
- 2 The national technical approval does not replace the legally required approvals, consents, and certificates for the execution of construction projects.
- 3 The national technical approval is granted without prejudice to any third-party rights, in particular property rights.
- 4 Without prejudice to the further regulations in the “Specific stipulations” section, the producer, and distributors of the object of approval shall hand out copies of the national technical approval to the user and/or operator of the object of approval and shall inform them about the fact that the national technical approval has to be present at the location of use. On request, the responsible authorities are to be provided with copies of the national technical approval.
- 5 The national technical approval may only be copied in its entirety. An extract publication is subject to the approval of *Deutsches Institut für Bautechnik*. Texts and drawings of advertising material must not contradict the national technical approval. Translations of the national technical approval must contain the note “*Vom Deutschen Institut für Bautechnik nicht geprüfte Übersetzung der deutschen Originalfassung*” [Translation of the German original document which has not been examined by *Deutsches Institut für Bautechnik*].
- 6 The national technical approval is granted in a revocable manner. The stipulations of the national technical approval may be supplemented and modified subsequently, particularly if this is required due to new technical knowledge.
- 7 The national technical approval refers to the information provided and documents submitted by the applicant. A change in these basic principles is not covered by this notice and shall be disclosed to *Deutsches Institut für Bautechnik* without delay.

II SPECIFIC STIPULATIONS

1 Object of approval and area of application

1.1 Subject of approval and area of application

Subject of approval is the MAX FRANK Egcodorn.

It is a connection element between construction components made of reinforced concrete according to DIN EN 1992-1-1 and is used for the planned transmission of shear forces.

The Egcodorn consists of a dowel element and the related sleeve element.

The introduction into the concrete can be done by means of an anchor element, as well as directly.

The respective types are uniquely defined by letters:

- With the Egcodorn N, the sleeve is the round counterpart of the dowel so that only movements in the direction of the longitudinal axis of the dowel are possible.
- With the Egcodorn Q, the sleeve is rectangular so that an additional relocation capability vertically to the longitudinal axis of the dowel is possible.
- The type W describes the formation of the anchor elements. The W stands for the short version with cross-welded bars.
- The type S stands for the version with one anchor element. This means that the dowel can be set directly in concrete with or without a sleeve.

The anchor element consists of a front plate with two differently bent loop brackets.

The Egcodorns are standardized in the types 40, 50, 70, 95, 100, 120, 150, 170, 210, 300, 350 and 400, each in regularly relocatable N-version and in cross-relocatable Q-version.

1.2 Object of approval and scope of application

Object of approval is the design, dimensioning, and execution of reinforced concrete components with MAX FRANK Egcodorn as shear force connection (see appendix 1).

The Egcodorn may be used as a flush connection element between reinforced concrete construction components which meet the requirements on the bending limitation according to DIN EN 1992-1-1, section 7.4.2, under mainly static load (see appendix 1).

The use is restricted to standard concrete of strength class C20/25 up to C50/60.

The admissible environmental conditions depend on the exposure classes (DIN EN 1992-1-1, table 4.1) as well as on the corrosion resistance classes of the types of steel according to DIN EN 1993-1-4, see appendix A.

The joint width between the components to be connected may amount to up to 80 mm.

2 Stipulations for the construction product

2.1 Characteristics and composition

2.1.1 Construction material

The following construction material is to be used:

for the anchor element	<u>Front plate:</u> Stainless steel corrosion resistance class III or IV in the material quality S235 to S460 and <u>Loop bracket:</u> B500NR with a nominal diameter of ≤ 14 mm of the material number 1.4362, 1.4482, 1.4571 or 1.4462 according to the respective national technical approval as well as stainless bar steel with the material number 1.4362, butt welded to B500 according to the submitted data sheet
for the bearing dowel part	tempering steel of material number 1.7227 or 1.7225 according to DIN EN 10083-3 as well as characteristics in accordance with the submitted data sheet
dowel coating	stainless steel corrosion resistance class III or IV of the material class S235, sealant in accordance with the submitted data sheet

2.1.2 Dimensions

The dimensions of the “Egcodorns” are specified in the annexes 6, 9 and 10. The installation of the “Egcodorns” in areas which are exclusively subject to tensile load is excluded.

The dimensions of the sleeves are specified in appendices 4 and 5.

2.2 Production, packing, transport, storage, and labelling

2.2.1 Production

The Egcodorn is to be manufactured ex works.

For the welding connections between stainless steel and reinforced steel, flash butt welding, resistance butt welding or friction welding procedures are to be applied.

Before or after welding, the even loops are bent and, subsequently, the 3D-bends are produced. With the loop brackets, the bending roller diameter may not undercut the fourfold bar diameter. The distance between the welding seam and the start of the bending roller must amount to a minimum of $2 \cdot d_s$.

The load distribution washer is to be connected constructively with the loop brackets by means of welding points. The dowel and the sleeve are fixed at the anchor element in order to secure the position.

The crossbars at the Egcodorn “type W” are to be welded in a shear-protected manner, the stipulations of DIN EN ISO 17660-1 apply.

For welding a recognized WPS-welding instruction according to DIN EN ISO 15609-1 must be available and must be observed by the welding personnel.

The manufacturer of the weld must be able to submit a welding certificate in accordance with DIN EN 1090-1, table B.1. The welders must have valid welder qualification certificates according to DIN EN ISO 9606-1.

The welding company is obliged to ensure that the welding work fulfils the quality requirements for the construction product, if applicable by means of work samples.

The surface must be clean and smooth, discoloration is to be removed.

2.2.2 Packing, transport, and storage

Packing, transport, and storage must be carried out in such a way that the reinforcement elements are not damaged.

2.2.3 Labelling

Every packaging unit of the “Egcodorn” is to be labelled with the German conformity mark (*Ü-Zeichen*) in accordance with the respective *Übereinstimmungszeichen-Verordnungen* [regulations regarding the conformity mark] of the Federal States.

The labels may only be applied if the requirements according to section 2.3 “Conformity verification” are met. Furthermore, the label shall contain the following information as a minimum requirement:

- Designation of the object of approval
- Type designation

The manufacturer shall attach installation instructions to every delivery.

2.3 Conformity verification

2.3.1 General

The construction product’s conformity with the stipulations of the present national technical approval is to be confirmed for every manufactured good by means of a conformity certificate based on a factory-owned production test as well as regular external supervision, including an initial inspection of the construction product, in accordance with the following stipulations.

For the granting of the conformity verification and the external inspection, including the product checks executed in the framework of this inspection, the manufacturer of the construction product shall commission a recognized certification body for the certification of the shear force dowels as well as a recognized supervising body for the supervision of the shear force dowels.

The manufacturer shall issue the declaration that a conformity certificate has been granted by means of labelling the construction products with the conformity mark (*Ü-Zeichen*), indicating the intended use.

The *Deutsches Institut für Bautechnik* shall be notified immediately by the certification body by means of submitting a copy of the conformity certificate issued by them as well as a copy of the initial inspection report.

2.3.2 Factory-owned production test

In every manufacturer’s factory, a factory-owned production test is to be set up and implemented. The factory-owned production test is the continuous supervision of the production by the manufacturer by means of which the latter ensures that the construction products manufactured by them comply with the stipulations of this national technical approval.

The factory-owned production test shall include the measures described in the attached test schedule and listed in the following as the minimum requirements. The test schedule is submitted to *Deutsches Institut für Bautechnik* and the commissioned supervising body:

- Examination of the raw material and the components:

For the Egcodorn, only such construction material may be used for which the conformity verification has been obtained in accordance with the applicable standards and approvals.

For reinforced steel, DIN 488-1 is valid and the characteristics in accordance with the attached data sheet apply.

For reinforced stainless steel with a nominal diameter of 6mm to 14mm, the corresponding national technical approvals apply. For stainless steel bar, in accordance with the attached datasheet of material number 1.4362 (see section 2.1.1), the mechanical characteristics are to be verified by means of an acceptance test certificate 3.1 according to DIN EN 10204.

For stainless steel, the national technical approval no. Z-30.3-6 applies.

For the material types 1.7227 and 1.7225, the mechanical characteristics in accordance with the datasheet, submitted to *Deutsches Institut für Bautechnik* and to the external supervising body, are to be verified by means of an acceptance test certificate 3.1 according to DIN EN 10204.

For the material of the sealant, the characteristics in accordance with the submitted datasheet are to be verified by means of an acceptance test certificate 3.1 according to DIN EN 10204.

- Verifications and tests to be implemented at the finished construction product:

The component dimensions of the MAX FRANK “Egcodorns” are to be examined in accordance with the test schedule and to be compared to the requirements of the test schedule submitted to *Deutsches Institut für Bautechnik* and to the external supervising body. The surface quality is to be examined and to be compared to the requirements.

The results of the factory-owned production test are to be recorded and evaluated. Apart from the records listed in the test schedule, the records must contain the following information:

- Designation of the construction product and/or the raw material and individual parts
- Type of test or examination
- Date of manufacture and of the test of the construction product and/or its raw material or individual parts
- Result of the tests and examination and, if applicable, comparison with the requirements
- Signature of the person responsible for the factory-owned production test.

The records are to be stored for a minimum period of five years and are to be submitted to the supervising body commissioned with the external supervision. On request, they are to be provided to *Deutsches Institut für Bautechnik* and the responsible supreme construction supervising body.

In the event of insufficient test results, the manufacturer shall immediately initiate the corresponding measures to rectify the defect. Construction products which do not comply with the requirements are to be handled in a manner which excludes any confusion with complying products. Upon rectification of the defect, if technically possible and required for verifying the rectification of the defect, the respective test is to be repeated.

2.3.3 External supervision

In every production facility, the factory-owned production test is to be regularly checked by an external supervising body, as a minimum requirement twice a year.

In the framework of the external supervision, an initial test of the Egcodorns must be carried out.

The following must be tested here:

- Regular surface treatment of the pre-material
- Regular execution of the welding seams for all “Egcodorn” types
- Compliance with the dimensions in accordance with the approval for the “Egcodorn” types as well as measures for ensuring the compliance with the prescribed dimensions.

Furthermore, samples for sampling testing are to be taken and to be examined according to the testing schedule. The sampling and tests are subject to the respective acknowledged supervising body. The values of the raw material are to be checked in accordance with the data sheet.

The certification and external supervision results are to be stored for a minimum period of five years. On request, they are to be submitted to *Deutsches Institut für Bautechnik* and the supreme construction supervising body by the certification body and/or the supervising body.

3 Specifications regarding the design and dimensions

The following applies to the design and dimensioning of the structural system produced with the type of construction DIN EN 1992-1-1, unless otherwise specified below, always applies together with DIN EN 1992-1-1/NA.

3.1 Specifications regarding the design

The transmission (distribution and absorption) of the forces, transmitted from the “Egcodorn” to the subsequent components, must be verified for each individual case.

The transmissible shear forces are only applicable to the indicated joint widths. If the calculated joint widths are exceeded and cannot be excluded, the transmissible shear forces of the next greater joint width are to be applied or the transmissible shear forces determined through linear interpolation.

The “Egcodorn N” can exclusively take up longitudinal relocations along the dowel axis.

The “Egcodorn Q” can take up both longitudinal as well as horizontal transverse relocations along the dowel axis.

“Egcodorns” may only be installed into slabs with straight edges. In all other cases, for every “Egcodorn”, a suitable relocation capability is to be verified.

When installing the “Egcodorns” across a corner, suitable relocation abilities are to be verified.

The longitudinal reinforcement A_{sy} at the edge of the slabs may be determined assuming a continuous edge beam with span widths according to the spaces between the dowels.

When using the Egcodorn in wall applications, the shear forces can be transmitted by the anchor body of the Type W or directly.

For slabs and walls with type W anchor head, stirrup reinforcement according to d_x in Annex 15 is required (see also Annex 16).

For dowel supports without anchor elements, the structural reinforcement shall be inserted in accordance with appendix 17.

3.2 Specifications regarding the dimensions

The application is restricted to reinforced concrete components made of standard concrete of the strength classes C20/25 up to C50/60. For the concrete strengths \geq C20/25, the nominal resistance values are indicated in annex 12, tables 11 and 12 for two anchor elements and in annex 13, tables 13 and 14 for one anchor element. This is applicable to all dowels in good compound systems for all previously indicated concrete strength classes.

The verification of the proof in the serviceability is not provided hereby.

3.2.1 Verifications in ultimate limit state

3.2.1.1 Steel failure

The nominal load capacity values for the dowel cross-section and the anchor elements are indicated in annex 11, tables 7 and 8, depending on the joint width. As calculated joint widths, $z = 10\text{mm}$, $z = 20\text{mm}$, $z = 30\text{mm}$, $z = 40\text{mm}$, $z = 50\text{mm}$, $z = 60\text{mm}$, $z = 70\text{mm}$ or $z = 80\text{mm}$ shall be applied. Intermediate values may be directly interpolated. The diameter of the anchor element stirrup is to be selected in accordance with annex 11, table 9, while the diameter of the cap stirrup is to be selected according to annex 11, table 10. The cap stirrup can be omitted with slab thicknesses greater than or equal to h_k according to annex 6 and 9. Tables 7 and 8 from annex 11 refer to dowels with two anchor elements.

3.2.1.2 Punching verification

The punching verification according to DIN EN 1992-1-1, section 6.2 and 6.4, together with DIN EN 1992-1-1/NA, NCI on 6.2 and 6.4 applies. The critical circular section is to be determined in accordance with annex 15. For verification purposes, concrete strengths up to C50/60 may be applied.

3.2.1.3 Concrete edge failure

The concrete edge failure verification is considered fulfilled, in the case of application with two anchor elements, where the regulations of this national technical approval are observed.

When storing the dowel without an anchor element (application with an anchor element), the concrete edge failure is relevant and is to be designed according to annex 13.

3.2.1.4 Consideration of friction forces

The existing friction forces are taken into consideration in the tables in annexes 11, 12 and 13. When determining the reinforcement to be provided at the construction site, it is not necessary for the friction forces to be considered.

3.2.2 Verification of the serviceability limits

3.2.2.1 Limitation of crack widths

The crack width verification of the slab edge beams is to be implemented in accordance with DIN EN 1992-1-1, section 7.3, taking into consideration the respective section of DIN EN 1992-1-1/NA.

If, in the wall, transverse tension occurs in the direction of the shear force dowel load and if the crack width in the direction of the shear force dowel load is not reduced to $w_k \leq 0.2\text{mm}$, the load capacity of the dowel is to be reduced by 1/3.

3.2.2.2 Limitation of deformation

The “Egcodorn” may be used as shear force coherent connection element between the steel concrete components which comply with the requirements of the bending limitation according to DIN EN 1992-1-1, 7.4.2, taking into consideration DIN EN 1992-1-1/NA, NCI on 7.4.2 (2).

3.2.3 Constructive design

3.2.3.1 Factory design

The surface of the sleeve and dowel shall be treated at the factory in order to minimize the friction. On the construction site, the surface may not be changed in a way that the finish roughness is increased.

The edges of the sleeve opening must be burr-free.

3.2.3.2 Construction-side design

The minimum thickness of components h_{\min} according to annexes 6 or 9 are to be complied with. The alignment of the minimum reinforcement in the punching cone is stipulated in annex 15. The relation of the slab thickness to the Egcodorn diameter $h/D_k \geq 7$ is to be complied with. The relation of the diameters of the longitudinal bars and brackets $d_{sy} / d_{sx,1} \geq 1$ is to be complied with.

The cap stirrup according to annex 9, table 4, is to be aligned within a distance of 20mm from the end of the shear force dowel and/or within a distance of 80mm from the end of the sleeve.

3.3 Fire resistance

The proof of usability in components for which requirements are made with regard to the fire resistance duration is not regulated by this general technical approval /general type approval.

3.4 Implementation specifications

The following must be observed in the execution of the structural systems produced with the construction type:

When installing the “Egcodorns”, the minimum distances $h_{min}/2$ of the upper and lower edges of the components to be connected towards the centre of the dowel may not be exceeded.

It is to be thoroughly ensured that no angle deviations occur between adjacent “Egcodorns”.

For wall bearing of the mandrel without anchor body, a bearing length of min. 5Dk must be maintained.

In order to confirm the conformity of the type of construction, the contractor shall submit a declaration of conformity with the general type approval covered by this notice in accordance with §§ 16a Para. 5 in conjunction with 21 Para. 2 MBO.

In the present national technical approval, the following standards, approvals, and references are referred to:

- DIN 488-1:2009-08 Concrete steel – part 1: types of steel, characteristics, labelling
- DIN EN 1090-1:2012-02 Execution of steel structures and aluminum structures.
Part 1: Method of verification of conformity for load bearing members.
German version: EN 1090-1:2009 + A1:2011
- DIN EN 1992-1-1:2011-01 Eurocode 2: dimensioning and construction of reinforced concrete and pre-stressed concrete supporting structures – Part 1-1: General dimensioning rules and rules for structural engineering; German version EN 1992-1-1:2004+AC:2010 and
- DIN EN 1992-1-1/NA:2013-04 National annex – nationally stipulated parameters – Eurocode 2: dimensioning and construction of reinforced concrete and pre-stressed concrete supporting structures – part 1-1: General dimensioning regulations and regulations for structural engineering
- DIN EN 1993-1-4:2015-10 Eurocode 3: Design of steel structures - Part 1-4.
Part 1-4: General design rules and supplementary rules for the application of stainless steels; German version: EN 1993-1-4:2006 + A1:2015
- DIN EN 1993-1-4/NA:2017-01 National Annex - Nationally determined parameters - Eurocode 3: Design of steel structures - Part 1-4:
General design rules and supplementary rules for the application of stainless steels
- DIN EN 10083-3:2007-01 Tempering steels – part 3: technical terms of conditions for alloyed steels; German version EN 10083-3:2006
- DIN EN 10204-1:2005-01 Metallic products – type of test certificates; German version EN 10204:2004
- DIN EN 10152:2009-07 Electrolytically cold-rolled flat steel products for cold forming ; technical delivery conditions; German version EN 10152:2003
- DIN EN ISO 9606-1:2013-12 Qualification testing of welders. Fusion welding. 1: Steels. German version EN ISO 9606-1:2013

- DIN EN ISO 15609-1:2005-01 Specification and qualification of welding procedures for metallic materials - Welding procedure specifications - Part 1: Arc welding
welding (ISO 15609-1:2004), German version
EN ISO 15609-1:2004
- DIN EN ISO 17660-1:2006:12 Welding – welding of concrete steel – part 1: supporting welding connections (ISO 17660-1:2006), German version DIN EN ISO 17660-1:2006-12
- Approval no. Z-30.3-6 Products, connection equipment and components made of stainless steel, dated 20 April 2022

The data sheet is submitted to *Deutsches Institut für Bautechnik* and the body commissioned with the external supervision.

Beatrix Wittstock
[Head of department]

Certified
[Schüler]

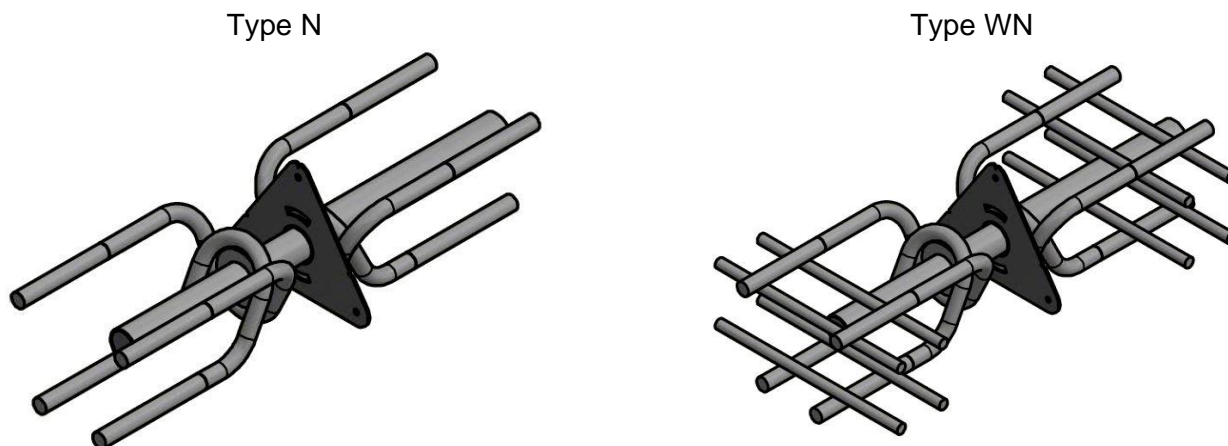


Fig. 1: Three-dimensional illustration of the Egcodorn types with two anchor elements

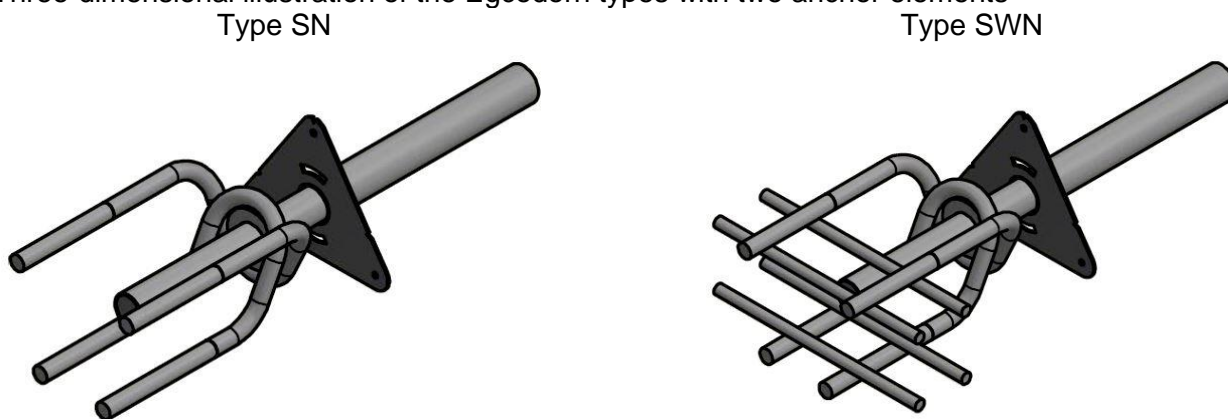


Fig. 2: Three-dimensional illustration of the Egcodorn types with anchor element and sleeve

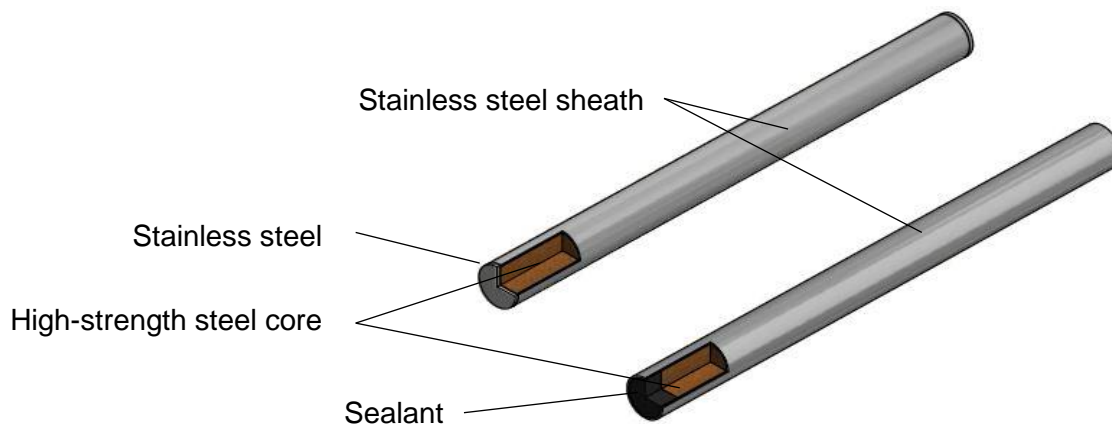


Fig. 3: Variants of the Egcodübel core-sheath system

Egcodorn shear force dowel
 Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts

Shear force dowel - dowel

Annex 1

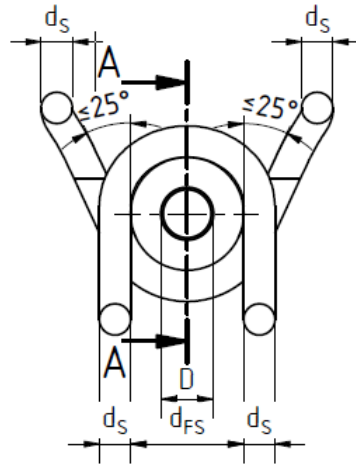
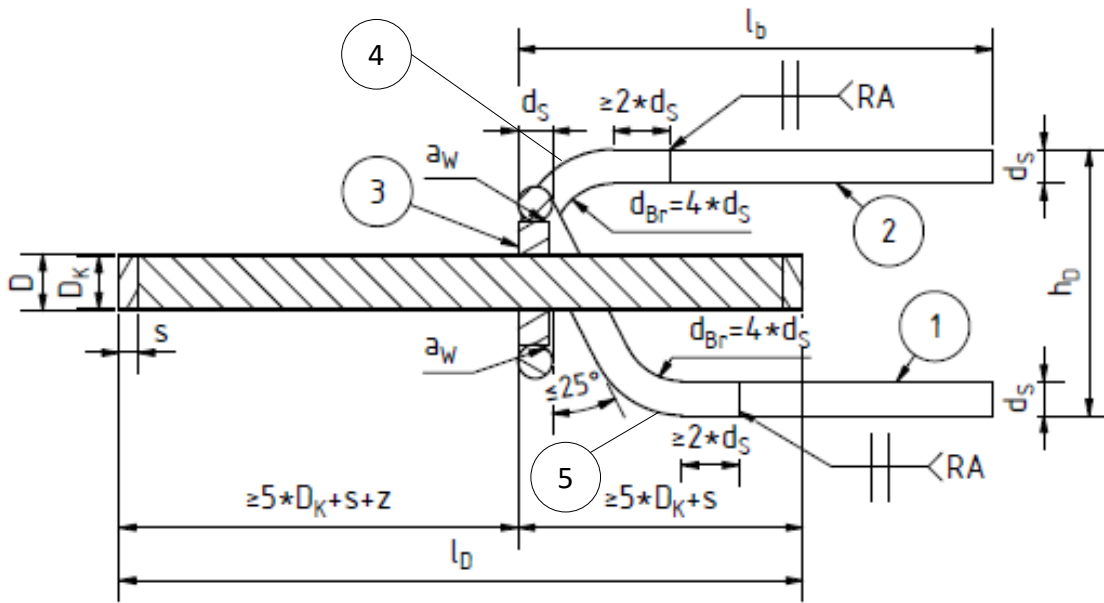


Fig. 4: Egcodorn type N – view of dowel



- ① Loop stirrup; bending into the slabs
- ② Loop stirrup; lateral bending
- ③ Load distribution washer
- ④ Length from the beginning of the bend to the butt weld ≥ 100 mm
- ⑤ Length from the top edge of the stirrup to the butt weld ≥ 100 mm

$s = 10$ mm Sealant
 $s = 1$ mm Stainless steel

Fig. 5: Egcodorn type N – dowel section A-A

Egcodorn shear force dowel
 Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts

Shear force dowel - dowel

Annex 2

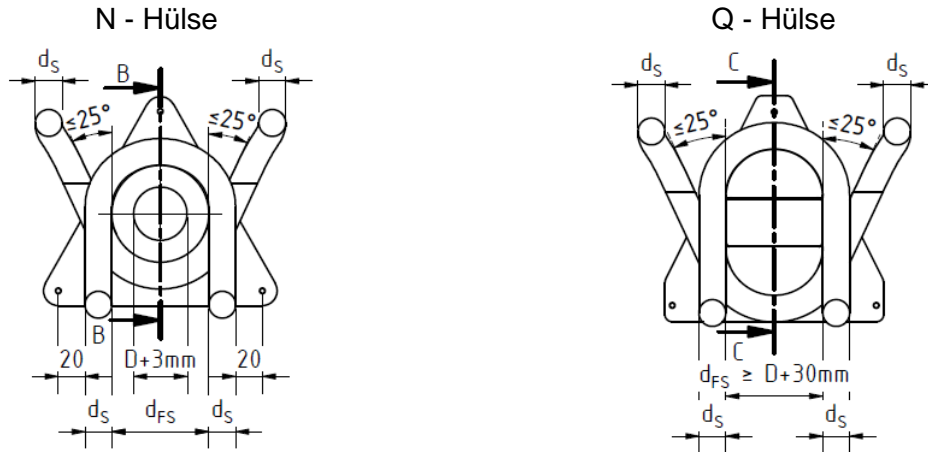


Fig. 6: Egcodorn types N and Q – view of sleeve

- ① Loop stirrup; bending into the slab
- ② Loop stirrup; lateral bending
- ③ Load distribution washer
- ④ Length from the beginning of the bend to the butt weld ≥ 100 mm
- ⑤ Length from the top edge of the bracket to the butt weld ≥ 100 mm

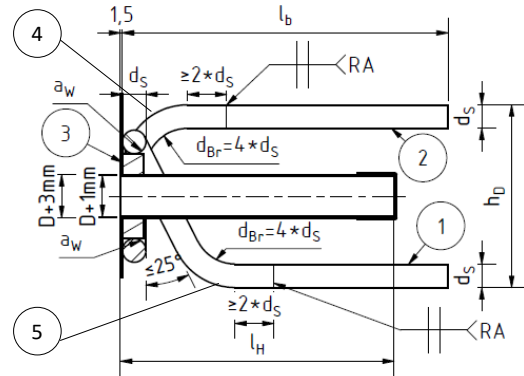


Fig. 7: Egcodorn type N – sleeve section B-B

- ① Loop stirrup; bending into the slab
- ② Loop stirrup; lateral bending
- ③ Load distribution washer
- ④ Length from the beginning of the bend to the butt weld ≥ 100 mm
- ⑤ Length from the top edge of the bracket to the butt weld ≥ 100 mm

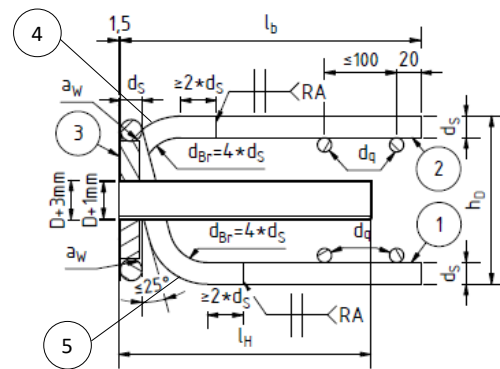
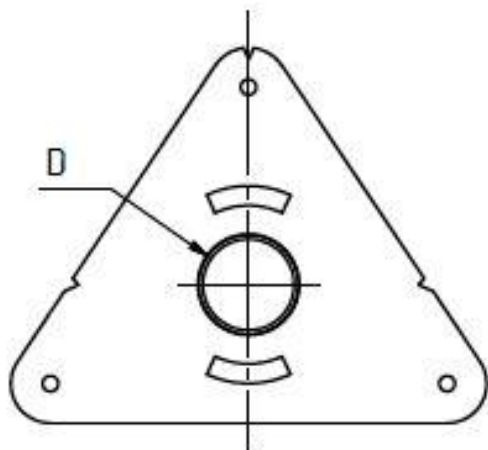
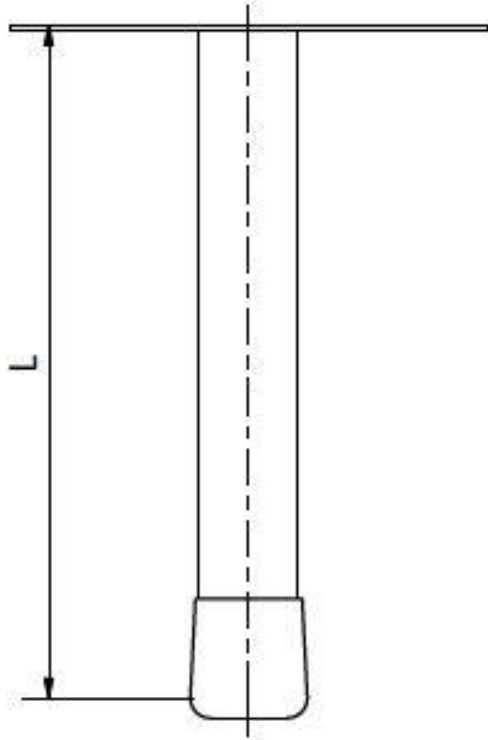


Fig. 8: Egcodorn type Q – sleeve section C-C

Egcodorn shear force dowel
 Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts

Components and dimensions - general

Annex 3



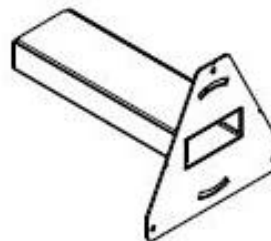
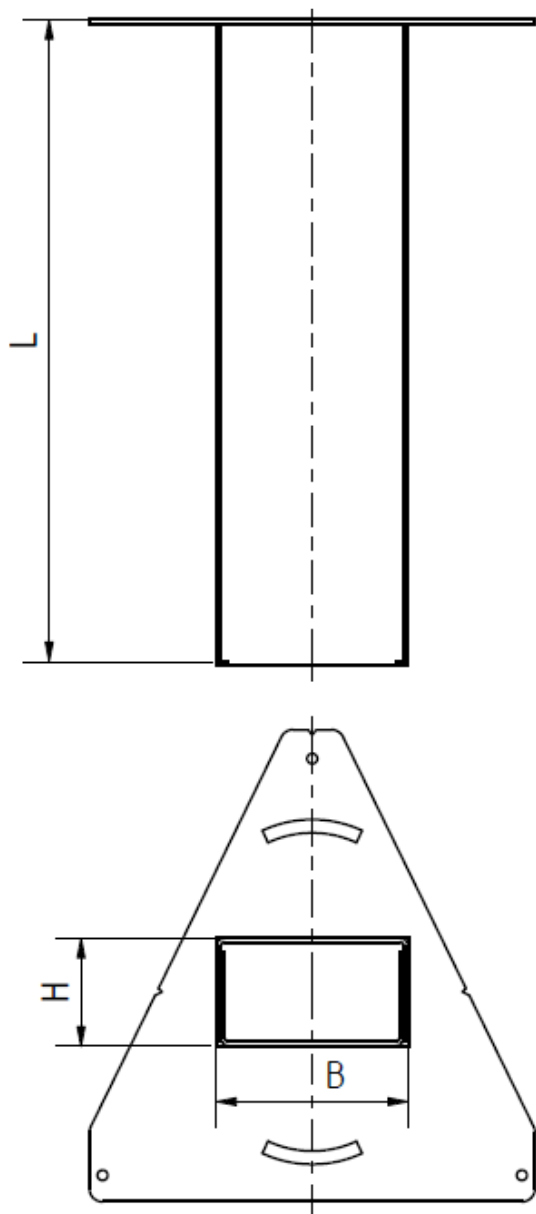
D [mm]	L [mm]	D ^{Sleeve} [mm]
22	170	25
24	180	27
27	195	30
30	210	33
32	220	35
34	230	37
37	245	40
40	260	43
42	270	45
52	320	55

Fig. 9: N-sleeve for application with SN – type (one-sided anchor element)

Egcodorn shear force dowel
 Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts

Components and dimensions - general

Annex 4



D [mm]	L [mm]	B [mm]	H [mm]
22	170	56	25
24	180	60	27
27	195	60	30
30	210	64	33
32	220	65	35
34	230	68	37
37	245	73	41
40	260	76	44
42	270	78	46
52	320	88	56

Fig. 10: Q-sleeve for application with SQ – type (one-sided anchor element)

Egcodorn shear force dowel
 Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts

Components and dimensions - general

Annex 5

Components and dimensions - general

D_k = diameter of dowel core

D = external diameter including protective tube = $D_k + 2\text{mm}$

$l_{D,max}$ = external dowel length = $2 \cdot (5 \cdot D_k + s) + z$ (min and max values arise from the joint width)

z = calculated joint width

d_s = reinforcing steel diameter anchor body

d_{Br} = bending roller diameter, loop stirrup = $4 \cdot d_s$

d_{Fs} = load distribution washer diameter = $4 \cdot d_s$

α = bending angle $\leq 25^\circ$

h_D = depth of the anchor element (minimum value from geometric requirements)

l_b = anchorage length in the slab

h_k = slab depth from which cap stirrups can be omitted

h_{min} = minimum slab depth

l_c = column width for the punching shear verification

l_D = dowel length (depending on the joint width)

Table 1 Egcodorn N/Q dimensions

Egcodorn	[-]	40	50	70	95	100	120	150	170	210	300	350	400
D_k	[mm]	20	22	25	28	30	32	35	38	40	42	50	50
D	[mm]	22	24	27	30	32	34	37	40	42	44	52	52
$l_{D,max}$	[mm]	300	320	350	380	400	420	450	480	500	520	600	600
$l_{D,min}$	[mm]	250	270	300	330	350	370	400	430	450	470	550	550
h_D	[mm]	80	100	120	140	140	170	170	200	200	240	240	240
h_k	[mm]	220	240	260	290	300	320	340	370	380	400	410	440

Table 2 Anchor body N/Q dimensions

Anchor body	[-]	8	10	12	14	16	20	25	28 ²⁾
d_s	[mm]	8	10	12	14	16	20	25	28
d_{Fs}	[mm]	32	40	48	56	64	80	100	100
d_{Br}	[mm]	32	40	48	56	64	80	100	100
l_b	[mm]	185	235	280	330	375	470	585	1030
h_{min}	[mm]	108	120	132	144	156	180	210	210
$l_c^{1)}$	[mm]	100	100	100	115	130	165	210	210
$h_{D,min}$	[mm]	48	60	72	84	96	120	150	150

¹⁾ support width calculated for the punching verification [mm]

²⁾ Butt-welded bar \varnothing 28/25/28

Egcodorn shear force dowel
 Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts

Components and dimensions - general

Annex 6

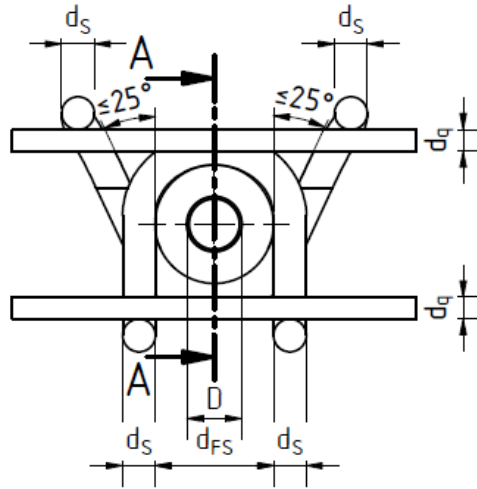
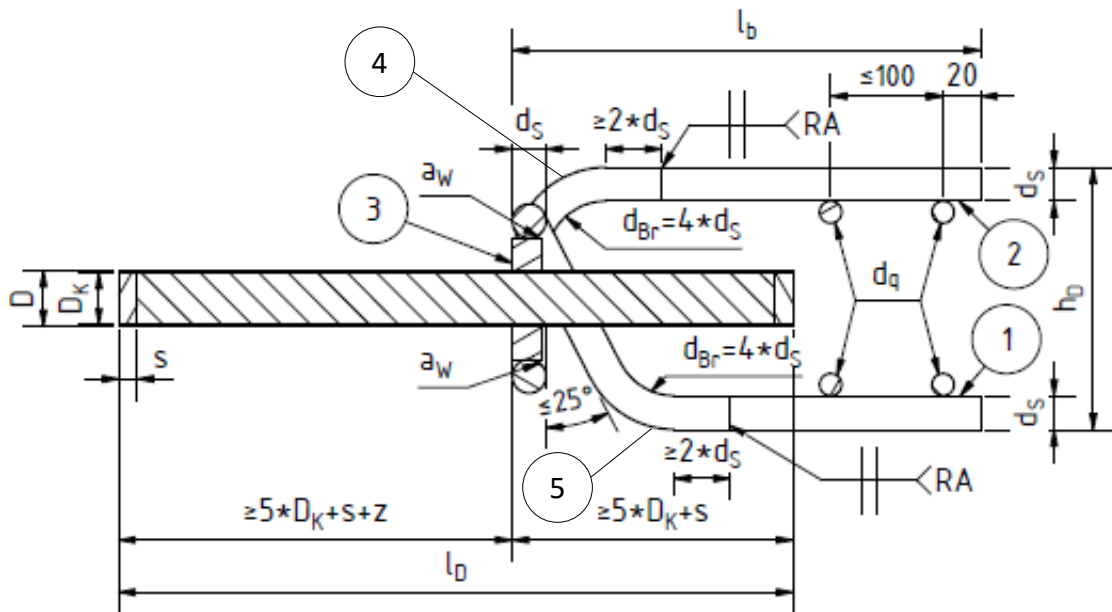


Fig. 11: Egcodorn type W – view of dowel



- ① Loop stirrup; bending into the slab s = 10 mm rubber seal
- ② Loop stirrup; lateral bending s = 1 mm stainless steel seal
- ③ Load distribution washer
- ④ Length from the beginning of the bend to the butt weld ≥ 100 mm
- ⑤ Length from the top edge of the stirrup to the butt weld ≥ 100 mm

Fig. 12: Egcodorn type W – dowel section A-A

Egcodorn shear force dowel Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts	Annex 7
Shear force dowel type W - dowel	

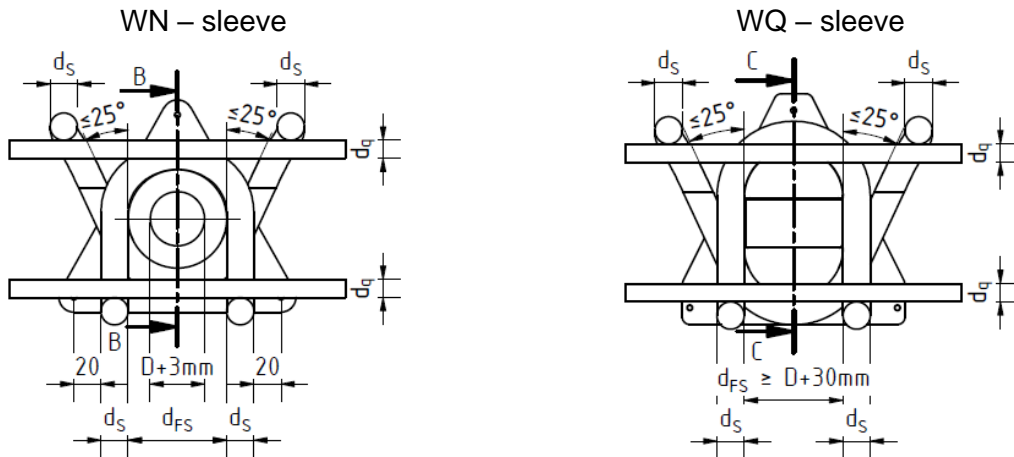


Fig. 13: Egcodorn type WN and WQ – view of sleeve

- ① Loop stirrup; bending into the slab
- ② Loop stirrup; lateral bending
- ③ Load distribution washer
- ④ Length from the beginning of the bend to the butt weld ≥ 100 mm
- ⑤ Length from the top edge of the bracket to the butt weld ≥ 100 mm

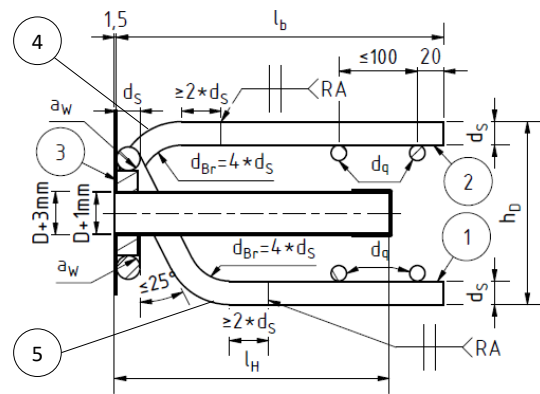


Fig. 14: Egcodorn type WN – sleeve section B-B

- ① Loop stirrup; bending into the slab
- ② Loop stirrup; lateral bending
- ③ Load distribution washer
- ④ Length from the beginning of the bend to the butt weld ≥ 100 mm
- ⑤ Length from the top edge of the bracket to the butt weld ≥ 100 mm

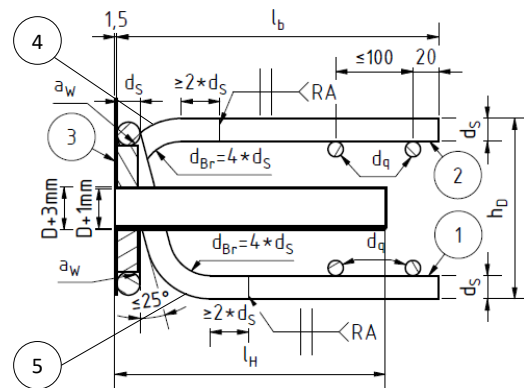


Fig. 15: Egcodorn type WQ – sleeve section C-C

Egcodorn shear force dowel
 Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts

Shear force dowel type W - sleeves

Annex 8

Components and dimensions – general

D_k = diameter of dowel core

D = external diameter including protective tube = $D_k + 2 \text{ mm}$

l_D = external dowel length = $2 \cdot (5 \cdot D_k + s) + z$ (min and max values arise from the joint width)

z = calculated joint width

d_s = reinforcing steel diameter anchor body

d_{Br} = bending roller diameter, loop stirrup = $4 \cdot d_s$

d_{Fs} = load distribution washer diameter = $4 \cdot d_s$

α = bending angle $\leq 25^\circ$

h_D = depth of the anchor element (minimum value from geometric requirements)

l_b = anchorage length in the slab

h_k = slab depth from which cap stirrups can be omitted

h_{min} = minimum slab depth

l_c = column width for the punching shear verification

l_D = dowel length (depending on the joint width)

Table 3 Egcodorn WN/WQ dimensions

Egcodorn	[-]	40	50	70	95	100	120	150	170	210	300	350
D_k	[mm]	20	22	25	28	30	32	35	38	40	42	50
D	[mm]	22	24	27	30	32	34	37	40	42	44	52
$l_{D,max}$	[mm]	300	320	350	380	400	420	450	480	500	520	600
$l_{D,min}$	[mm]	250	270	300	330	350	370	400	430	450	470	550
h_D	[mm]	80	100	120	140	140	170	170	200	200	240	240
h_k	[mm]	220	240	260	290	300	320	340	370	380	400	410

Table 4 Anchor body WN/WQ dimensions

Anchor body	[-]	10	12	14	16	20	25
d_s	[mm]	10	12	14	16	20	25
d_{Fs}	[mm]	40	48	56	64	80	100
d_{Br}	[mm]	40	48	56	64	80	100
l_b	[mm]	156	187	218	250	312	390
h_{min}	[mm]	120	132	144	156	180	210
$l_c^{1)}$	[mm]	100	100	115	130	165	210
$h_{D,min}$	[mm]	60	72	84	96	120	150

¹⁾ support width calculated for the punching verification [mm]

Egcodorn shear force dowel
 Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts

Components and dimensions – general type W

Annex 9

Components and dimensions – standard types

D = external diameter dowel including protective tube (coat) = $D_k + 2$ mm

d_s = concrete steel diameter

l_b = anchorage length in the slab

l_c = column width for the punching shear verification

Table 5 Egcodorn N/Q dimensions – standard types

Egcodorn N / Q	[-]	40	50	70	95	100	120	150	170	210	300	350	400
D	[mm]	22	24	27	30	32	34	37	40	42	44	52	52
h_D	[mm]	80	100	120	140	140	170	170	200	200	240	240	240
d_s	[mm]	10	12	14	16	16	20	20	25	25	25	25	28 ²⁾
l_b	[mm]	235	280	330	375	375	470	470	585	585	585	585	1030
$l_c^{1)}$	[mm]	100	100	115	130	130	165	165	210	210	210	210	210

Table 6 Egcodorn N/Q dimensions – standard types

Egcodorn WN / WQ	[-]	40	50	70	95	100	120	150	170	210	300	350
D	[mm]	22	24	27	30	32	34	37	40	42	44	52
h_D	[mm]	80	100	120	140	140	170	170	200	200	240	240
d_s	[mm]	10	12	14	16	16	20	20	25	25	25	25
l_b	[mm]	156	187	218	250	250	312	312	390	390	390	390
$l_c^{1)}$	[mm]	100	100	115	130	130	165	165	210	210	210	210

1) support width calculated for the punching verification [mm]

2) Butt-welded bar \varnothing 28/25/28

Egcodorn shear force dowel
 Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts

Components and dimensions – standard types

Annex 10

Dimensioning tables Egcodorn N/Q and type WN/WQ

Table 1 steel load capacity dowel $V_{Rd,s,0,90}$ [kN] (slab to slab)

z	Diameter of dowel core D [mm]										
[mm]	22	24	27	30	32	34	37	40	42	44	52
10	92,4	113,9	150,3	191,7	222,0	254,6	307,7	365,8	407,4	451,1	-
20	73,4	93,0	126,6	165,2	193,6	224,4	274,6	329,9	369,5	411,3	-
30	54,5	72,2	102,9	138,7	165,3	194,1	241,5	293,9	331,6	371,6	-
40	40,9	54,5	79,9	112,2	136,9	163,8	208,4	258,0	293,8	331,9	-
50	32,7	43,6	63,9	89,8	110,5	134,1	175,3	222,0	255,9	292,1	-
60	27,3	36,3	53,3	74,8	92,0	111,7	146,2	187,1	218,2	252,4	411,7
70	23,4	31,1	45,7	64,1	78,9	95,8	125,3	160,3	187,0	216,5	364,4
80	20,5	27,2	40,0	56,1	69,0	83,8	109,6	140,3	163,6	189,4	319,6

Table 2 steel load capacity dowel $V_{Rd,s,0,81}$ [kN] (slab to slab)

z	Diameter of dowel core D [mm]										
[mm]	22	24	27	30	32	34	37	40	42	44	52
10	83,1	102,5	135,2	172,5	199,8	229,2	277,0	329,3	366,6	406,0	-
20	66,1	83,7	113,9	148,6	174,3	201,9	247,2	296,9	332,6	370,2	-
30	49,1	65,0	92,6	124,8	148,7	174,7	217,3	264,5	298,5	334,4	-
40	36,8	49,0	71,9	100,9	123,2	147,4	187,5	232,2	264,4	298,7	-
50	29,5	39,2	57,5	80,8	99,4	120,6	157,7	199,8	230,3	262,9	-
60	24,5	32,7	47,9	67,4	82,8	100,5	131,5	168,4	196,4	227,1	370,6
70	21,0	28,0	41,1	57,7	71,0	86,2	112,8	144,3	168,3	194,8	328,0
80	18,4	24,5	36,0	50,5	62,1	75,4	98,7	126,3	147,3	170,5	287,6

Table 3 Anchor element diameter d_s [mm]

z	Diameter of dowel core D [mm]										
[mm]	22	24	27	30	32	34	37	40	42	44	52
10	14	14	16	20	20	25	25	28	28	28	-
20	12	14	16	20	20	20	25	25	28	28	-
30	10	12	14	16	20	20	25	25	25	28	-
40	10	12	14	16	16	20	20	25	25	28	-
50	8	10	12	14	16	16	20	25	25	25	-
60	8	10	12	12	14	16	20	20	25	25	28
70	8	10	10	12	14	14	16	20	20	25	28
80	8	8	10	12	12	14	16	20	20	20	28

Table 4 Cap stirrup diameter \emptyset [mm]

z	Diameter of dowel core D [mm]										
[mm]	22	24	27	30	32	34	37	40	42	44	52
10	6	6	6	6	6	8	8	8	8	8	-
20	6	6	6	6	8	8	8	8	10	10	-
30	6	6	6	8	8	8	8	10	10	10	-
40	6	6	6	6	8	8	8	10	10	10	-
50	6	6	6	6	8	8	8	10	10	10	-
60	6	6	6	6	8	8	8	10	10	10	10
70	6	6	6	6	6	8	8	8	10	10	10
80	6	6	6	6	6	8	8	8	10	10	10

z calculated joint width [mm]
D external diameter of the dowel, including protective coating [mm]
 $V_{Rd,s,0,90}$ shear force resistance, longitudinal or transverse relocation [kN]
 $V_{Rd,s,0,81}$ shear force resistance, longitudinal and transverse relocation [kN]

Egcodorn shear force dowel
Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts

Dimensioning tables general

Annex 11

Dimensioning tables, standard types Egcodorn N/Q and WN/WQ

Table 5: Connection load capacity $V_{Rd,0,90}$ [kN] for application with two anchor elements

Type	Dowel diameter D	Loop stirrup d_s	Cap stirrup \varnothing	V_{Rd} [kN] longitudinally or laterally for joint width z [mm]							
				10	20	30	40	50	60	70	80
[-]	[mm]	[mm]	[mm]								
40	22	10	6	62,0	58,9	54,5	40,9	32,7	27,3	23,4	20,5
50	24	12	6	89,4	85,3	72,2	54,5	43,6	36,3	31,1	27,2
70	27	14	6	122,3	117,4	102,9	79,9	63,9	53,3	45,7	40,0
95	30	16	6	154,7	149,1	138,7	112,2	89,8	74,8	64,1	56,1
100	32	16	6	155,8	150,6	145,7	136,9	110,5	92,0	78,9	69,0
120	34	20	8	241,5	224,4	194,1	163,8	134,1	111,7	95,8	83,8
150	37	20	8	243,8	236,8	230,3	208,4	175,3	146,2	125,3	109,6
170	40	25	8	365,8	329,9	293,9	258,0	222,0	187,1	160,3	140,3
210	42	25	10	380,3	369,5	331,6	293,8	255,9	218,2	187,0	163,6
300	44	25	10	382,1	373,0	364,4	331,9	292,1	252,4	216,5	189,4
350	52	25	10	388,0	380,2	372,7	365,6	358,7	352,0	345,6	319,6
400	52	28/25/28	10	486,7	476,9	467,6	458,6	449,9	411,7	364,4	319,6

Table 6: Connection load capacity $V_{Rd,0,81}$ [kN] for application with two anchor elements

Type	Dowel diameter D	Loop stirrup d_s	Cap stirrup \varnothing	V_{Rd} [kN] longitudinally or laterally for joint width z [mm]							
				10	20	30	40	50	60	70	80
[-]	[mm]	[mm]	[mm]								
40	22	10	6	62,0	58,9	49,1	36,8	29,5	24,5	21,0	18,4
50	24	12	6	89,4	83,7	65,0	49,0	39,2	32,7	28,0	24,5
70	27	14	6	122,3	113,9	92,6	71,9	57,5	47,9	41,1	36,0
95	30	16	6	154,7	148,6	124,8	100,9	80,8	67,4	57,7	50,5
100	32	16	6	155,8	150,6	145,7	123,2	99,4	82,8	71,0	62,1
120	34	20	8	229,2	201,9	174,7	147,4	120,6	100,5	86,2	75,4
150	37	20	8	243,8	236,8	217,3	187,5	157,7	131,5	112,8	98,7
170	40	25	8	329,3	296,9	264,5	232,2	199,8	168,4	144,3	126,3
210	42	25	10	366,6	332,6	298,5	264,4	230,3	196,4	168,3	147,3
300	44	25	10	382,1	370,2	334,4	298,7	262,9	227,1	194,8	170,5
350	52	25	10	388,0	380,2	372,7	365,6	358,7	352,0	328,0	287,6
400	52	28/25/28	10	486,7	476,9	467,6	455,7	413,2	370,6	328,0	287,6

- z calculated joint width [mm]
- D external diameter of the dowel, including protective coat [mm]
- d_s Diameter of reinforcing steel anchor body
- \varnothing Diameter of reinforcing steel cap stirrup
- $V_{Rd,0,90}$ shear force resistance, longitudinal or transverse relocation [kN]
- $V_{Rd,s,0,81}$ shear force resistance, longitudinal and transverse relocation [kN]

Egcodorn shear force dowel
 Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts

Dimensioning tables standard types with two anchor elements

Annex 12

Dimensioning tables, standard types Egcodorn SN / SQ und SWN / SWQ

Table 7: Connection load capacity $V_{Rd,0,90}$ [kN] for application with an anchor element

Type	Dowel diameter D	Loop stirrup d_s	Cap stirrup \varnothing	V_{Rd} [kN] longitudinally or laterally for joint width z [mm]							
				10	20	30	40	50	60	70	80
40	22	10	6	41,2	32,9	27,4	23,5	20,5	18,2	16,4	14,9
50	24	12	6	51,4	41,6	34,9	30,1	26,4	23,6	21,3	19,4
70	27	14	6	68,8	56,6	48,1	41,8	37,0	33,1	30,0	27,4
95	30	16	6	86,3	74,2	63,7	55,8	49,6	44,7	40,6	37,3
100	32	16	6	98,3	87,4	75,4	66,4	59,3	53,5	48,8	44,8
120	34	20	8	111,1	101,7	88,3	78,0	69,9	63,3	57,8	53,2
150	37	20	8	131,8	125,4	109,7	97,5	87,7	79,8	73,1	67,5
170	40	25	8	154,2	151,7	133,6	119,4	107,9	98,5	90,5	83,8
210	42	25	10	170,2	167,5	151,0	135,4	122,7	112,2	103,3	95,8
300	44	25	10	186,9	184,1	169,5	152,5	138,5	126,9	117,1	108,7
350	52	25	10	261,6	258,3	255,0	232,0	212,7	196,4	182,4	170,2

Table 8: Connection load capacity $V_{Rd,0,81}$ [kN] for application with an anchor element

Type	Dowel diameter D	Loop stirrup d_s	Cap stirrup \varnothing	V_{Rd} [kN] longitudinally or laterally for joint width z [mm]							
				10	20	30	40	50	60	70	80
40	22	10	6	37,1	29,6	24,7	21,1	18,5	16,4	14,8	13,4
50	24	12	6	46,2	37,4	31,4	27,1	23,8	21,2	19,1	17,4
70	27	14	6	61,9	51,0	43,3	37,6	33,3	29,8	27,0	24,7
95	30	16	6	80,0	66,8	57,3	50,2	44,7	40,2	36,6	33,5
100	32	16	6	93,4	78,6	67,9	59,7	53,3	48,2	43,9	40,3
120	34	20	8	107,9	91,5	79,5	70,2	62,9	57,0	52,0	47,9
150	37	20	8	131,7	112,8	98,7	87,7	79,0	71,8	65,8	60,7
170	40	25	8	154,2	136,5	120,3	107,5	97,1	88,6	81,5	75,4
210	42	25	10	170,2	153,6	135,9	121,8	110,4	101,0	93,0	86,2
300	44	25	10	186,9	171,8	152,6	137,2	124,7	114,2	105,4	97,8
350	52	25	10	261,6	255,1	229,7	208,8	191,4	176,7	164,1	153,2

- z calculated joint width [mm]
D external diameter of the dowel, including protective coat [mm]
 d_s Diameter of reinforcing steel anchor body
 \varnothing Diameter of reinforcing steel cap stirrup
 $V_{Rd,0,90}$ shear force resistance, longitudinal or transverse relocation [kN]
 $V_{Rd,s,0,81}$ shear force resistance, longitudinal and transverse relocation [kN]

Egcodorn shear force dowel
Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts

Dimensioning tables standard types with an anchor element

Annex 13

Dimensioning aids, punching verification

Table 9: erf. a_s for formation of adjacent punching cones without overlapping

max d_s	h	erf. $a_{s,x} = \text{erf. } a_{s,y} [\text{cm}^2/\text{m}]$												
		existing V_{Ed} [kN]												
[mm]	[mm]	20	30	40	50	60	70	80	90	100	110	120	130	140
12	160	1,4	4,7	11,2	21,9	-	-	-	-	-	-	-	-	-
14	180	0,7	2,3	5,5	10,7	18,6	-	-	-	-	-	-	-	-
16	200	0,4	1,2	3,0	5,8	10,0	15,8	23,7	-	-	-	-	-	-
20	220	0,2	0,8	1,8	3,5	6,1	9,7	14,4	20,5	28,2	-	-	-	-
20	240	0,1	0,4	1,0	2,0	3,5	5,5	8,3	11,8	16,2	21,5	27,9	35,5	
25	260	0,1	0,3	0,7	1,4	2,4	3,9	5,8	8,2	11,3	15,0	19,5	24,7	30,9
25	280	0,1	0,2	0,5	0,9	1,6	2,6	3,9	5,5	7,6	10,1	13,1	16,6	20,8
28	300	0,0	0,1	0,4	0,7	1,2	1,9	2,8	4,0	5,5	7,4	9,6	12,2	15,2
28	320	0,0	0,1	0,3	0,5	0,9	1,4	2,0	2,9	3,9	5,2	6,8	8,7	10,8
28	340	0,0	0,1	0,2	0,4	0,6	1,0	1,5	2,1	2,9	3,8	5,0	6,3	7,9
28	360	0,0	0,1	0,1	0,3	0,5	0,7	1,1	1,6	2,1	2,8	3,7	4,7	5,9
28	380	0,0	0,0	0,1	0,2	0,3	0,6	0,8	1,2	1,6	2,2	2,8	3,6	4,4
28	400	0,0	0,0	0,1	0,2	0,3	0,4	0,6	0,9	1,2	1,7	2,2	2,7	3,4
28	450	0,0	0,0	0,0	0,1	0,1	0,2	0,4	0,5	0,7	0,9	1,2	1,5	1,9
28	500	0,0	0,0	0,0	0,1	0,1	0,1	0,2	0,3	0,4	0,5	0,7	0,9	1,1
28	550	0,0	0,0	0,0	0,0	0,1	0,1	0,1	0,2	0,3	0,3	0,4	0,6	0,7
28	600	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,1	0,2	0,2	0,3	0,4	0,5

Table 10: erf. a_s for formation of adjacent punching cones without overlapping

max d_s	h	erf. $a_{s,x} = \text{erf. } a_{s,y} [\text{cm}^2/\text{m}]$												
		existing V_{Ed} [kN]												
[mm]	[mm]	50	100	150	200	250	300	350	400	450	500	550	600	650
12	160	21,9	-											
14	180	10,7	-											
16	200	5,8	-											
20	220	3,5	28,2											
20	240	2,0	16,2											
25	260	1,4	11,3	38,0										
25	280	0,9	7,6	25,5										
28	300	0,7	5,5	18,7	44,3									
28	320	0,5	3,9	13,3	31,5									
28	340	0,4	2,9	9,7	23,0	44,9								
28	360	0,3	2,1	7,2	17,1	33,4	57,7							
28	380	0,2	1,6	5,5	12,9	25,3	43,7							
28	400	0,2	1,2	4,2	10,0	19,5	33,6	53,4						
28	450	0,1	0,7	2,3	5,5	10,7	18,5	29,4	43,9	62,6				
28	500	0,1	0,4	1,4	3,2	6,3	10,9	17,4	25,9	36,9	50,7	67,5	87,6	
28	550	0,0	0,3	0,9	2,0	4,0	6,8	10,8	16,2	23,0	31,6	42,1	54,6	69,4
28	600	0,0	0,2	0,6	1,3	2,6	4,4	7,1	10,5	15,0	20,6	27,4	35,6	45,2

d_s diameter of the longitudinal reinforcement [mm]
 h plate thickness [mm]
 existing V_{Ed} impacting shear force [kN]

Egcodorn shear force dowel
 Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts

Dimensioning aids, punching verification

Annex 14

Minimum slab thickness and lateral distance to the edge

Table 11:

Egcodorn	[-]	40	50	70	95	100	120	150	170	210	300	350	400
$h_{min} = 7 \cdot D_k$	[mm]	140	160	180	200	210	230	250	270	280	300	350	350
a_r	[mm]	70	80	90	100	105	115	125	135	140	150	175	175
$a_{r1} = 0,75 \cdot h_{min}$	[mm]	110	120	140	150	160	170	190	200	210	230	260	260

h_{min} minimum slab thickness
 a_r distance to the edge into the direction of load
 a_{r1} lateral distance to the edge

Minimum reinforcement in the punching cone

Table 12:

Egcodorn	[-]	40	50	70	95	100	120	150	170	210	300	350	400
min n_x	[-]	4	4	4	4	4	4	4	4	4	4	4	4
min $d_x^{(1)}$	[mm]	10	10	10	12	12	14	14	16	16	20	20	20
max $s_x^{(1)}$	[mm]	30	30	30	50	50	70	70	90	90	100	100	100

- 1) or equivalent degree of reinforcement in the punching cone
 2) The constructive regulations of DIN EN 1992-1-1 regarding the bar distances are to be complied with for greater diameters than indicated in line 3.

min n_x minimum number, u-bar reinforcement at slab edge
 min d_x minimum diameter, u-bar reinforcement at slab edge
 max s_x maximum clearance at min d_x

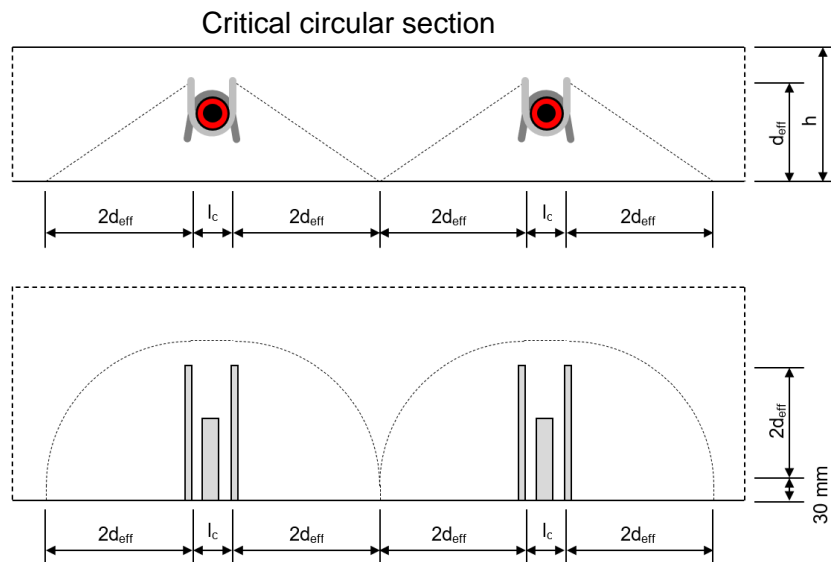


Fig. 16: Critical circular section

h slab thickness [mm]
 d_{eff} usable effective depth
 l_c calculated support width according to annex 6 or annex 9

Egcodorn shear force dowel
 Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts

Punching verification

Annex 15

Layout of a constructive stirrup reinforcement in the wall (with anchor element)

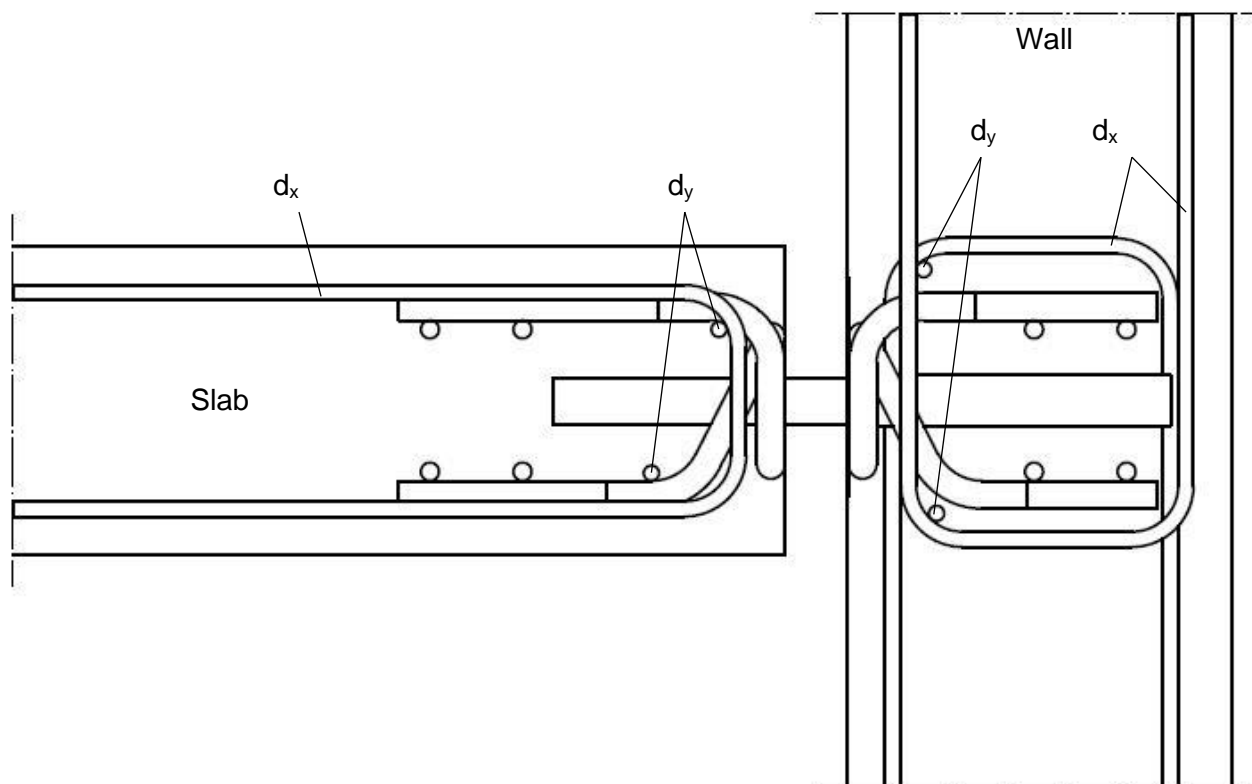


Fig. 17: Wall installation with two anchor elements

- d_x Diameter of u-bar reinforcement in x-direction according to annex 15
- d_y Diameter of reinforcement in y-direction

Wall side

- n_x One bar in x-direction on every dowel side
- n_y One bar in y-direction, top and bottom

Slab side

- n_x Number in x-direction according to annex 15 and punching shear verification
- n_y Number in y-direction and punching shear verification

The statically required wall and slab reinforcement is not represented.

Egcodorn shear force dowel
 Egcodorn N and Q – shear force dowel for connection between reinforced concrete parts

Wall installation

Annex 16

Layout of a constructive stirrup reinforcement in the wall (without anchor element)

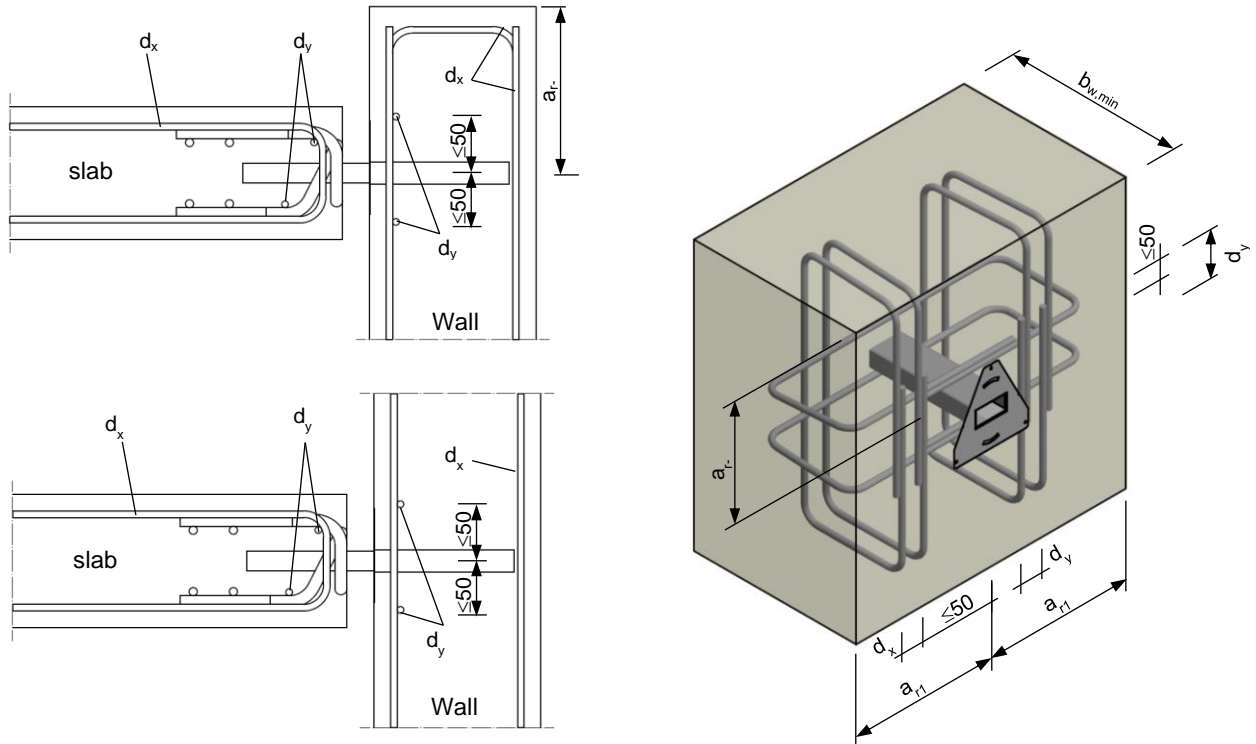


Fig. 18: Wall installation with an anchor element in the slab

Table 13:

Egcdorn	[-]	40	50	70	95	100	120	150	170	210	300	350	400
$d_x^{1)}$	[mm]	10	12	12	12	12	14	14	16	16	20	20	25
n_x	[-]	4	4	4	4	4	4	4	4	4	4	4	4
d_y	10	12	12	12	12	14	14	14	16	16	20	20	25
$n_y^{1)}$	[-]	2	2	2	2	2	2	2	2	2	2	2	2
a_r	[mm]	195	200	205	210	215	220	225	230	235	240	300	350
a_{r1}	[mm]	450	500	550	600	650	700	750	800	850	900	900	1000

¹⁾ Distance to the sleeve ≤ 50 mm

- d_x Diameter of reinforcement in x-direction
- d_y Diameter of reinforcement in y-direction
- a_r Minimum distance against the direction of load

Wall side

- n_x Two bars in x-direction on every dowel side (4 bars)
- n_y One bar in y-direction, top and bottom

Slab side

- n_x Number in x-direction according to annex 15 and punching shear verification
- n_y Number in y-direction and punching shear verification statically required wall and slab

Egcdorn shear force dowel
 Egcdorn N and Q – shear force dowel for connection between reinforced concrete parts

Wall installation

Annex 17