BUILDING COMMON GROUND

MAX FRANK®

General Technical Approval

Egcodorn® DND

for non-predominantly static loads for connections between reinforced concrete components

Z-15.7-266 | 10.10.2023

issued by: DIBt Deutsches Institut für Bautechnik, Berlin

NOTE:
This is a translation of the German original document by MAX FRANK Group – not examined by DIBt.

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DIBt

General Technical Approval / General type approval

Approval and authorization body for building products and types

Date: 10.10.2023

Reference number: I 27-1.15.7-11/23

Approval number:
Z-15.7-266

Validity period
From: **31 October 2023**
To: **31 October 2028**

Applicant:
Max Frank GmbH & Co. KG
Mitterweg 1
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Subject of approval:
"Egcodorn DND" for non-predominantly static loads for connections between reinforced concrete components

The building authority approval for the above mentioned subject of approval is hereby generally granted.
This general technical approval comprises nine pages and 13 annexes.
The product was initially granted national technical approval on 30 October 2008.

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I GENERAL STIPULATIONS

1 This document shall verify the usability and/or applicability of the subject of approval as defined by the state building codes ("Landesbauordnungen").

2 This document shall not substitute the permissions, consents and certifications required by law for the execution of construction projects.

3 This document is granted regardless of the rights of third parties, including but not limited to private property rights.

4 The manufacturers and distributors of the subject of approval shall provide copies of this document to the users of the subject of approval and they shall point out that the general technical approval has to be available at the application site, regardless of further regulations in the "Special Provisions". Copies of the general technical approval must be provided upon request to the involved authorities.

5 This document may only be copied in full. A publication in extracts requires the consent of the German Institute for Civil Engineering (DIBt). Texts and drawings of advertising brochures must not conflict with the general technical approval. Translations of the general technical approval shall contain the note "Translation of the German original document not examined by DIBt".

6 This document will be issued with the option of revocation. The provisions of the general technical approval may be amended or modified, especially when this becomes necessary due to new technical knowledge.

7 This document refers to the information given by the proposer and the submitted documents. A modification of this foundations is not registered in the general technical approval and must be revealed to the German Institute for Civil Engineering immediately.

II SPECIAL PROVISIONS

1 Subject matter and scope of use and application

1.1 Subject of approval and area of application

The subject of approval is the Max Frank "Egcodorn DND" (see Annex 1). It is a connecting element between reinforced concrete components in accordance with DIN EN 1992-1-1 and is used for the planned transmission of shear forces.
The "Egcodorn DND" consists of a dowel and a corresponding sleeve, both fitted with a trapezoidal sheet welded to the front plate for additional anchoring in the concrete component.
The approval is granted for the "Egcodorn DND" types DND 40, 50, 70, 95, 100, 120, 150, 210, 300 and 350.

1.2 Subject of authorisation and scope of application

The subject of the authorisation is the planning, dimensioning and execution of concrete components with the Max Frank "Egcodorn DND".
The "Egcodorn DND" may be used as a form-locked connecting element between reinforced concrete components which fulfil the conditions of the restriction on deflection according to DIN EN 1992-1-1, chapter 7.4.2 considering DIN EN 1992-1-1/NA, NCI for 7.4.2(2), under not predominantly static load. The installation of the "Egcodorn DND" in areas exclusively subject to tensile load is excluded.
The application is limited to normal concrete of strength classes C20/25 to C50/60.

The permissible 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 steels used in conformity with DIN EN 1993-1-4, Annex A.
The joint width between the components to be connected must not exceed maximal 60 mm.

2 Provisions for the building product

2.1 Characteristics and composition

2.1.1. Construction materials

The following construction materials shall be used:

For the anchoring body:	Front plate: stainless steel with material number 1.4571 or 1.4401 according to DIN EN 1993-1-4 in conjunction with DIN EN 1993-1-4/NA at least corrosion resistance class III and at least strength S275 and Trapezoidal sheet: stainless steel with material number 1.4301 (corrosion resistance class II) or 1.4571 or 1.4401 (corrosion resistance class III) according to DIN EN 1993-1-4 in conjunction with DIN EN 1993-1-4/NA and at least strength S275
For the load-bearing dowel:	Tempering steel with material number 1.7227 or 1.7225 according to DIN EN 10083-3 and with characteristics according to the deposited data sheet

Protective pipe:	Stainless steel with material number 1.4401 or 1.4571 (corrosion resistance class III) with material grade S235, plug according to the deposited data sheet
Sleeve lining:	According to the specifications deposited with the DIBt and the external inspection body

2.1.2. Dimensions

The dimensions of the "Egcodorn DND" are defined in annex 3. The minimum dimensions of the components to be connected and the edge and axle distances when utilising the design resistances defined in the annexes 7 to 10 must correspond to the table in annex 4.

2.2. Manufacture, packaging, transport, stocking and labelling

2.2.1 Manufacture

For the welding process, the specifications according to the data sheet deposited with the DIBt and the external inspection body shall apply.

The surfaces must be clean and smooth, any discolouration must be removed.

2.2.2 Packaging, transport and stocking

Packaging, transport and stocking have to be carried out that way to keep the connecting element undamaged.

2.2.3 Labelling

Each packing unit of the "Egcodorn DND" shall be labelled by the manufacturer with the German Mark of Conformity [Ü-Zeichen] in accordance with the provisions for the marks of conformity of the federal states.

The labelling shall only be carried out if the prerequisites as defined in chapter 2.3 "Certification of Conformity" are met. In addition, the labelling shall contain the following details:

- the designation of the subject to approval
- type designation.

The manufacturer shall enclose an installation instruction with each delivery.

2.3. Certification of conformity

2.3.1. General

The confirmation of conformity of the construction product with the provisions of this document shall be given for each manufacturing plant with a declaration of conformity of the manufacturer on the basis of a plant production control and a certificate of conformity from a recognised certification body and regular external inspections including an initial inspection of the construction product of a recognised inspection body in accordance with the following provisions.

With regard to the granting of the certification of conformity and for the external inspection including the product tests to be performed, the manufacturer shall employ a certification body approved for the certification of shear force dowels as well as an inspection body approved for the inspection of shear force dowels.

The manufacturer shall declare that the certification of conformity is granted by labelling the construction products with the German Mark of Conformity (Ü-sign) with reference to the intended purpose.

The certification body shall provide the DIBt with a copy of the certificate of conformity issued by it.

The DIBt must also be provided with an copy of the initial test report.

2.3.2. Plant production control

A plant production control shall be set up and executed in each manufacturing plant. Plant production control refers to the continuous monitoring of production to be carried out by the manufacturer which ensures that the manufactured building products meet the requirements of this general technical approval.
The inspection plan deposited with Deutsches Institut für Bautechnik and the external inspection body is decisive for the scope, type and frequency of the factory production control.
The results of the factory production control must be recorded and analysed. In addition to the records specified in the test plan, the records must contain at least the following information:

- Check of the starting materials and the component parts:

  Only construction materials with certification of conformity according to the applicable standards and approvals may be used for "Egcodorn DND".
  For stainless steel, the general approval by the building authorities no. Z-30.3-6 shall apply.
  For the materials 1.7225 and 1.7227, the mechanical properties according to the data sheet deposited with the DIBt and the external inspection body shall be proven by way of an acceptance test certificate 3.1 according to DIN EN 10204.

- Inspections and tests to be performed on the finished construction product

  The component dimensions of the Max Frank "Egcodorn DND" must be checked and compared with the requirements as per the inspection plan deposited with the DIBt and the external inspection body for each component. The surface condition must be checked and compared with the requirements.

The results of the plant production control shall be recorded. The records shall at least contain the following details:

- denomination of the building product and/or the starting material and of the component parts
- type of the control or check
- date of manufacture and of the check of the building product and/or starting material or the component parts
- result of the controls and checks and, if applicable, comparison with the requirements
- signature of the person in charge of the plant production control.

If the check result is insufficient, the manufacturer shall immediately take the appropriate measures to rectify the defect. Construction products which do not meet the requirements shall be handled so as to exclude any mix-up with the compliant ones.
After rectification of a defect, the check in question shall be repeated directly – as far as technically possible and required for proof of the rectification of defects.
The records shall be recorded, evaluated and kept for at least five years. Upon request, they shall be provided to the DIBt.

2.3.3. Initial inspection of the construction product

Within the scope of the test, the following shall be verified:

- proper surface treatment of the primary material
- proper execution of the weld seams for all "Egcodorn DND" classes

- compliance with the dimensions according to the approval for the "Egcodorn DND" classes as well as means to ensure dimensional accuracy.

2.3.4. External inspections

In each manufacturing plant, the plant production control shall be checked by means of an external inspection on a regular basis, but at least twice a year.
Within the scope of the external inspection, an initial inspection of the "Egcodorn DND" shall be carried out, including but not limited to the weld seams and the surfaces. In addition, samples for sample inspections shall be taken and inspected according to the inspection plan. The values of the primary material shall be checked in accordance with the data sheet.
The approved inspection body shall be responsible for the sampling and the inspections.
The results of the certification and external inspections shall be kept for at least five years. Upon request, they shall be provided to the DIBt and the supreme building control authority by the certification and/or inspection body.

3 Provisions for design, dimensioning and execution

The following information refers exclusively to the verification of the fatigue resistance.
Unless otherwise specified below, DIN EN 1992-1-1 always applies together with DIN EN 1992-1-1/NA for the planning and design of the structural system produced with the type of construction.

3.1 Planning

The transmission of the forces transmitted by the "Egcodorn DND" to the adjacent components shall be certified for each individual case.
The transmittable shear forces shall only apply for the indicated joint widths. If a possible exceeding of the calculated joint widths cannot be excluded, the transmittable shear forces of the next larger joint width shall be applied.
Shear force dowels of the "Egcodorn DND" type may only be installed in components with straight edges. In all other cases, a sufficient movability must be proven for each "Egcodorn DND".
When installing "Egcodorn" across a corner, a sufficient movability must be proven.
The longitudinal reinforcement A_{sy} at the panel edge can be determined assuming a continuous edge girder – with spans corresponding to the distances of the dowels. In doing so, the distributor reinforcement as shown in the annexes 5 and 6 can be applied.

3.2 Dimensioning

The use is limited to standard concrete of the strength classes C20/25 to C50/60.
The design resistances are specified in the annexes 7 to 10 and shall apply for dowels in areas with good bonding conditions which have an axle distance greater than $e_{crit} = 3 \cdot d_m + l_c$ and which are installed with an on-site reinforcement of the specified diameters. The arrangement of this on-site reinforcement is defined in the annexes 5 and 6 and shall apply for a nominal dimension of the concrete cover of 30 mm.
This shall not be deemed a proof of serviceability.

3.2.1 Proof against fatigue

3.2.1.1 Fatigue

The verification of fatigue resistance according to DIN EN 1992-1-1, chapter 6.8 shall be deemed to be fulfilled when the specifications in this approval are complied with.

The design values of the shear force bearing capacity $V_{Rd,S,o}$ and/or $V_{Rd,c}$ as well as the design values of the bearable shear load ranges $\Delta V_{Rd,S}$ and/or $\Delta V_{Rd,c}$ are specified in the tables in the annexes 7 to 10.

For the design values of the shear force bearing capacity, the value from the tables for the design values of the steel bearing capacity $V_{Rd,S,o}$ (annex 7) or the value from the tables for the design values of the concrete bearing capacity $V_{Rd,c}$ (annexes 8 to 10) shall be decisive – whichever is smaller. At the same time, the design values of the shear force bearing capacity shall apply under not predominantly static load as upper threshold values which already contain a possible shear load range.

3.2.1.2 Steel failure

The verification of the resistance against steel failure shall be deemed fulfilled when the specifications detailed in this approval are complied with. The design values of the bearing capacity for the dowel sections and the anchoring bodies $V_{Rd,S,o}$ are indicated in annex 7 depending on the joint width. The maximum design values of the shear load range $\Delta V_{Rd,S}$ are indicated in annex 7 depending on the joint width. A calculated joint width of $20 \leq f \leq 60$mm shall be applied.

3.2.1.3 Punching shear verification and concrete edge failure

The verification of the resistance against punching shear and concrete edge failure shall be deemed fulfilled when the specifications detailed in this approval are complied with. The design values of the concrete bearing capacity $V_{Rd,c}$ and the maximum design values of the shear force amplitudes $\Delta V_{Rd,c}$ are indicated in the annexes 8 to 10.

The verifications shall only be deemed fulfilled when the potential punching shear or concrete edge failure cones can be completely developed. The geometries of the failure parts are depicted in the annexes 5 and 6.

DIN EN 1992-1-1, chapter 6.4.5, paragraph (NA.6) shall be taken into consideration.

The reinforcement A_{sy} parallel to the joint must be anchored with l_{bd} (see annexes 5 and 6) and/or at the panel corners using slip-in brackets with the same section.

The brackets $A_{sx,1}$ must be anchored with l_{bd} according to annexes 5 and 6.

The position of the hanging reinforcement $A_{sx,1}$ and the shear reinforcement A_{sy} is defined in the annexes 5 and 6.

3.2.2 Verification of the serviceability limit state

3.2.2.1 Limitation of the crack widths

The crack width verification of the panel edge girder shall be carried out according to DIN EN 1992-1-1, chapter 7.3, taking into consideration the respective chapters of DIN EN 1992-1-1/NA.

3.2.2.2 Limitation of the deformation

The "Egcodorn DND" may be used as shear force-locked connecting element between reinforced concrete components which fulfil the conditions of the restriction on deflection under predominantly static load according to DIN EN 1992-1-1, chapter 7.4.2, under consideration of DIN EN 1992-1-1/NA:2011-01, NCI to 7.4.2 (2).

3.2.3 Structural design

3.2.3.1 Factory-made design

The surfaces of sleeve and dowel are treated at the factory to minimise friction. No modifications to the surface may be made by the customer.

The edges of the sleeve opening must be free of burrs.

3.2.3.2 On-site design

The minimum component thickness h_{min} according to the table in annex 4 must be complied with.

The first two suspension brackets of the reinforcement $A_{sx,1}$ must be attached directly to the trapezoidal sheet of the shear force dowel.

The clear distance between the suspension brackets $A_{sx,1}$ next to the dowel is:

H ≤ 300mm $s_1 \geq 20mm \geq d_s$

$s_2 \geq 50 - d_s\,mm \geq d_s$

h > 300mm $s_{1,2} \geq 50 - d_s\,mm \geq d_s$

(s_1 and s_2 according to annexes 5 and 6)

The number of suspension brackets $A_{sx,1}$ in the calculated breaking cone $2 \leq n_{bracket}$ must be complied with.

The diameter of the suspension reinforcement is:

$d_s \leq 16mm$ for h < 30cm

$d_s \leq 20mm$ for 30cm ≤ h < 35cm

$d_s \leq 25mm$ for 35cm ≤ h

The ratio of the slab thickness h to "Egcodorn DND" diameter D (see annex 3) must not be below the value h/D = 7.

The ratio of the diameters of longitudinal bars $d_s(A_{sy,1})$ and brackets $d_s(A_{sx,1})$ must not be below the value $d_s(A_{sy,1})/d_s(A_{sx,1}) = 1$.

3.3 Fire resistance

This approval does not provide evidence for the usability of the "Egcodorn DND" in components subjected to fire endurance requirements.

3.4 Provisions for the execution

When installing "Egcodorn DND", the minimum distances $h_{min}/2$ of the upper and the lower edges of the connected components to the centre of the dowel must be complied with.

Particular care must be taken to ensure that no angle deviations occur between adjacent "Egcodorn DND" shear force dowels.

The user of the type of construction or the company carrying out the construction work must submit a declaration of conformity in accordance with §§ 16 a Para. 5, 21 Para. 2 MBO to confirm that the type of construction complies with this general type approval.

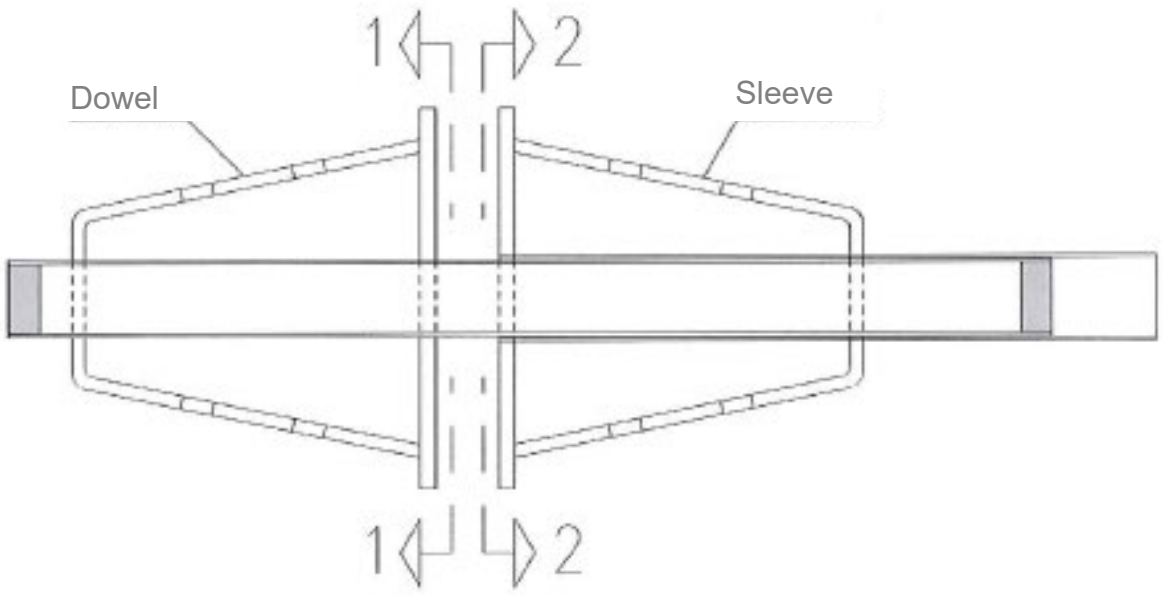
The following standards, approvals and references are referred to in this general technical approval:

- DIN EN 1090-2:2018-09	Execution of steel structures and aluminium structures - Part 2: Technical requirements for steel structures; German version EN 1090-2:2018
- DIN EN 1992-1-1:2011-01	Eurocode 2: Design of concrete structures – Part 1-1: General rules for buildings; German version EN 1992-1-1:2004 + AC:2010 and
- DIN EN 1992-1-1/NA:2013-04	National annex – nationally determined parameters – Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings
- DIN EN 1993-1-1:2010-12	Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings; German version EN 1993-1-1:2005 + AC:2009
- DIN EN 10204:2005-01	Metallic products - Types of inspection documents; German version EN 10204:2004
- DIN EN 10083-3:2007-01	Steels for quenching and tempering - Part 3: Technical delivery conditions for alloy steels; German version EN 10083-3:2006
- DIN EN ISO 9606-1:2013-12	Qualification testing of welders - Fusion welding - Part 1: Steels (ISO 9606-1:2012, including Cor 1:2012); German version EN ISO 9606-1:2013

- The data sheet is deposited with the DIBt and the commissioned external inspection body.
- The inspection plan is deposited with the DIBt and the commissioned external inspection body.

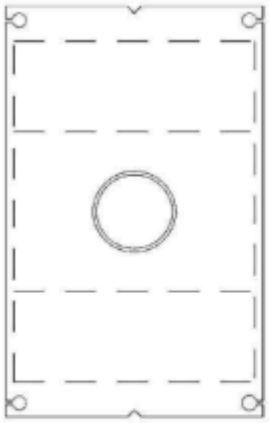
Dipl.-Ing. Beatrix Wittstock
Referatsleiter/in

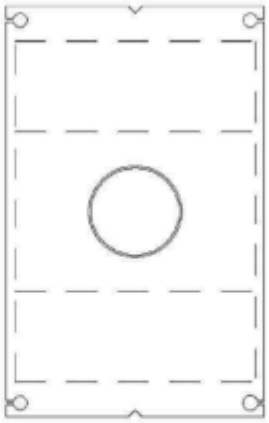
Certified
Schüler



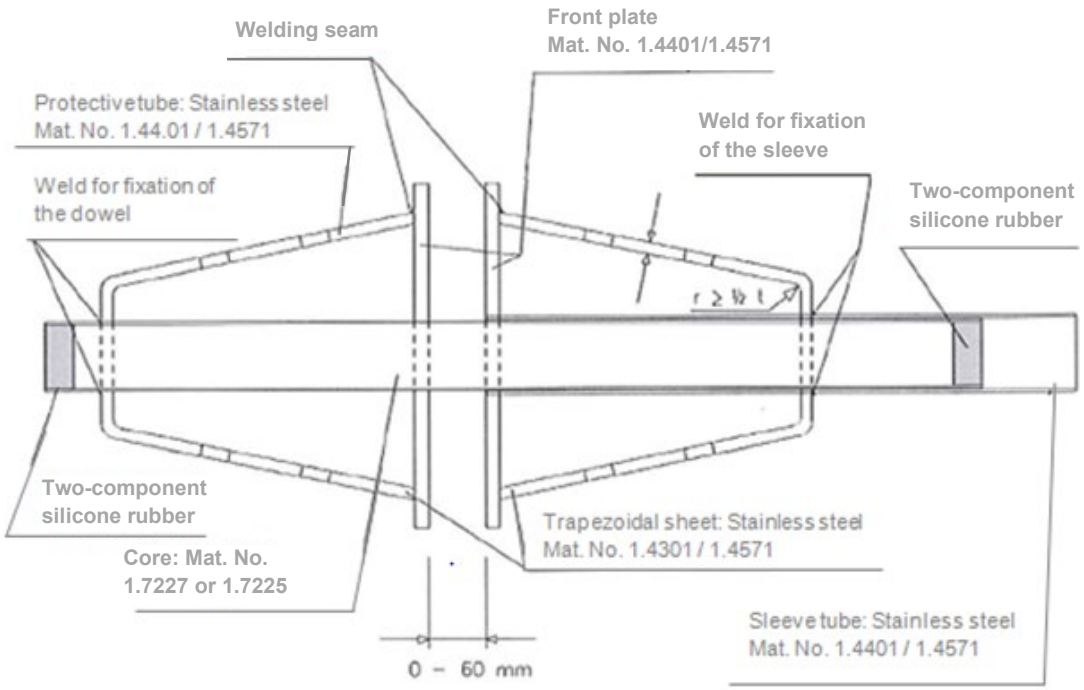
Section 1-1

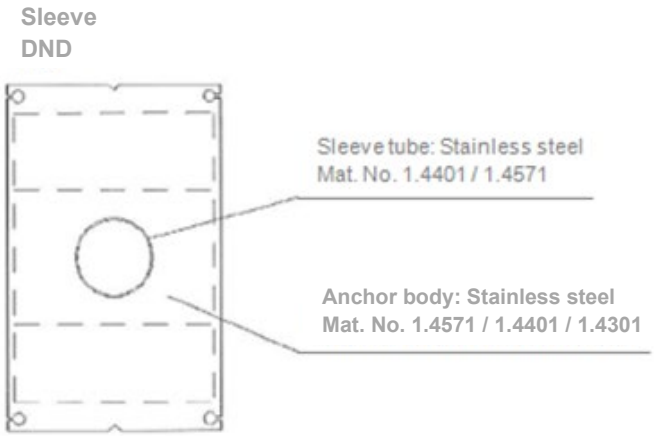
Section 2-2



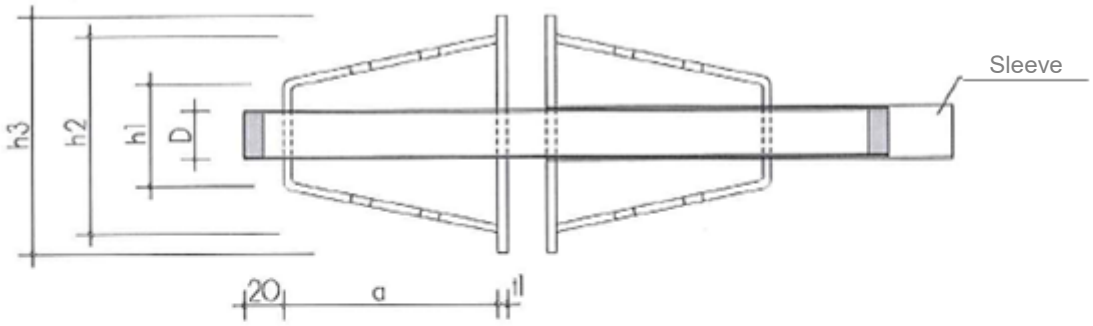


Egcodorn DND for non-predominantly static loads for connection between reinforced concrete components	Annex 1
System overview	

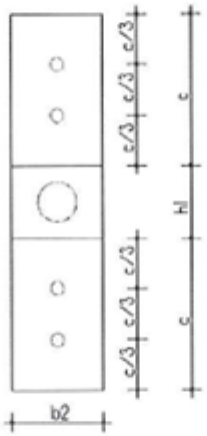


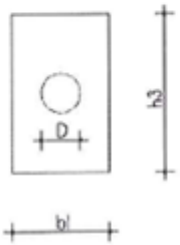


Egcodorn DND for non-predominantly static loads for connection between reinforced concrete components	Annex 2
Construction materials	

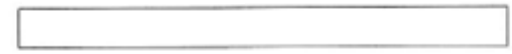


Rear sheet – t2 Front panel – t1





Dowel



LD (without protective tube)

Dowel type	Dowel core diameter [mm]	D [mm]	L_D [mm]	a [mm]	h_1 [mm]	h_2 [mm]	h_3 [mm]	c [mm]	t_1 [mm]	b_1 [mm]	t_2 [mm]	b_2 [mm]
DND-40	20	22	290	100	50	100	120	104	4	75	4	65
DND-50	22	24	310	110	55	100	120	113	5	75	4	70
DND-70	25	27	340	125	60	110	130	129	6	85	5	80
DND-95	28	30	380	140	70	130	150	144	8	90	6	85
DND-100	30	32	400	150	80	150	170	155	8	95	6	90
DND-120	30	32	420	160	90	170	190	157	8	105	6	105
DND-150	35	37	450	175	100	190	210	182	10	110	8	105
DND-170	38	40	480	190	110	210	230	198	10	125	8	115
DND-210	40	42	500	200	120	230	250	209	10	140	8	130
DND-300	50	52	600	250	120	250	280	260	12	165	10	160
DND-350	50	52	600	250	120	290	320	266	12	185	10	170

Egcodorn DND for non-predominantly static loads for connection between reinforced concrete components

Dimensions dowel and sleeve

Annex 3

Longitudinally movable types DND

	Axle distance of the hanger reinforcement l_c	Minimum thickness of the components being connected h_{min}	Minimum edge distance in the direction of stress $a_{R1} = 0.5 \cdot h_{min}$	Required axle distance $e = 3.0 \cdot d_m + l_c$	Minimum axle distance $e_{min} = 1.5 \cdot h_{min}$	Lateral minimum edge distance $a_r = 0.75 \cdot h_{min}$
Dowel type	**[cm]**	**[cm]**	**[cm]**	**[cm]**	**[cm]**	**[cm]**
DND-40	7.7	16.0	8.0	43.7	24.0	12.0
DND-50	8.4	16.0	8.0	43.8	24.0	12.0
DND-70	9.4	18.0	9.0	50.8	27.0	13.5
DND-95	10.1	20.0	10.0	56.9	30.0	15.0
DND-100	11.0	22.0	11.0	63.8	33.0	16.5
DND-120	12.1	24.0	12.0	70.3	36.0	18.0
DND-150	12.5	26.0	13.0	75.5	39.0	19.5
DND-170	14.0	28.0	14.0	83.0	42.0	21.0
DND-210	15.5	30.0	15.0	89.0	45.0	22.5
DND-300	18.5	32.0	16.0	98.0	48.0	24.0
DND-350	19.5	35.0	17.5	108.0	52.2	26.3

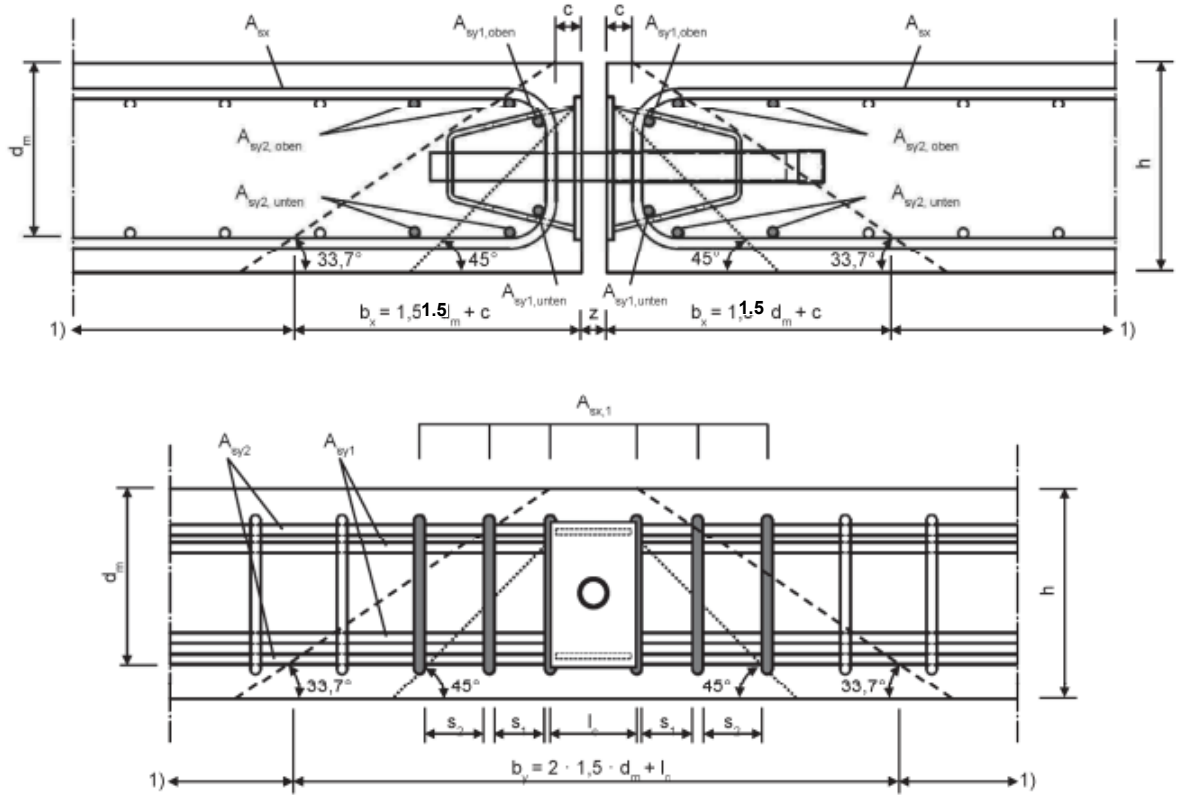
e minimum dowel axle distance without mutual interference of the individual dowels. The dimensioning tables on pages 10 to 15 may be applied without further verification.

a_r lateral minimum distance at right angles to the direction of stress

d_m medium static effective height

e_{min} minimum distance for the verification of concrete edge failure. The verification of the shear load bearing capacity and/or punching shear shall be carried out according to DIN EN 1992 under static and non-static loads.

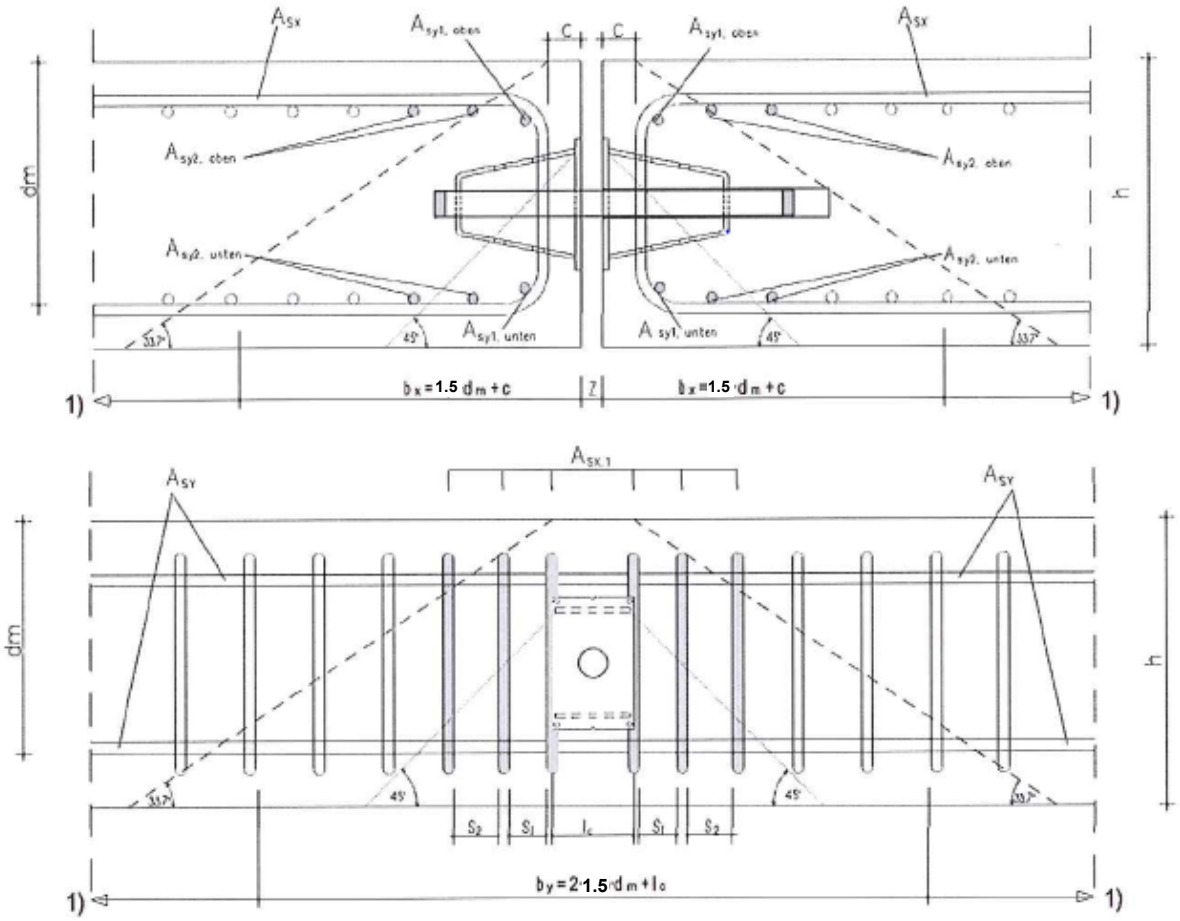
Reinforcement configuration for component thickness h = h_{min}



1) Anchoring length l_{bd} (DIN EN 1992-1-1) of the bracket limb of A_{SX} from the point of interception of the broken concrete part under 33.7° with the bracket limb according to DIN EN 1992-1-1 under consideration of DIN EN 1992-1-1/NA, NCI to 8.4.4 (1)

Egcodorn DND for non-predominantly static loads for connection between reinforced concrete components	Annex 5
Reinforcement configuration for component thickness h = h_{min}	

Reinforcement configuration for component thickness h > h_{min}



..... Concrete edge failure
— — — Punching shear

1) Anchoring length l_{bd} (DIN EN 1992-1-1) of the bracket limb of A_{SX} from the point of interception of the broken concrete part under 33.7° with the bracket limb according to DIN EN 1992-1-1 under consideration of DIN EN 1992-1-1/NA, NCI to 8.4.4 (1)

Egcodorn DND for non-predominantly static loads for connection between reinforced concrete components	Annex 6
Reinforcement configuration for component thickness h > h_{min}	

Dimensioning value of the steel shear force bearing capacity $V_{Rd,S,o}$ for the verification of failure resistance depending on the joint width z

z ≤	[mm]	20	30	40	50	60
$V_{Rd,s}$ [kN]	DND-40	23.7	22.7	21.7	20.9	19.4
	DND-50	28.0	26.9	25.9	25.0	24.1
	DND-70	39.6	38.2	36.9	35.7	34.6
	DND-95	53.2	51.5	49.9	48.5	47.1
	DND-100	57.1	55.4	53.8	52.3	50.9
	DND-120	66.0	64.1	62.4	60.7	59.2
	DND-150	85.0	82.8	80.8	78.8	76.9
	DND-170	100.0	97.6	95.4	93.2	91.1
	DND-210	116.1	113.5	110.9	108.5	106.2
	DND-300	162.7	159.7	156.8	154.1	151.4
	DND-350	192.1	188.5	185.1	181.8	178.6

Dimensioning value of the steel shear force load range $\Delta V_{Rd,S}$ for the verification of failure resistance depending on the joint width z

z ≤	[mm]	20	30	40	50	60
$\Delta V_{Rd,s}$ [kN]	DND-40	9.3	8.9	8.5	7.1	5.9
	DND-50	10.2	9.8	9.4	9.1	7.9
	DND-70	15.0	14.4	13.9	13.5	11.5
	DND-95	19.3	18.7	18.1	17.6	16.1
	DND-100	20.7	20.1	19.5	19.0	18.5
	DND-120	24.7	24.0	23.4	22.8	22.2
	DND-150	33.0	32.2	31.4	30.6	29.9
	DND-170	36.7.	35.8	35.0	34.2	33.5
	DND-210	42.1	41.2	40.2	39.4	38.5
	DND-300	65.9	64.7	63.5	62.4	61.3
	DND-350	70.6	69.3	68.0	66.8	65.6

DND 40 Component thickness	$V_{Rd,c}$ 1)	$\Delta V_{Rd,c}$ 3)	A_{Sx}	A_{Sy} (upper and lower layer respetively)	
h			A_{Sx1}	A_{Sy1}	A_{Sy2}
[mm]	[kN]	[kN]	[-]	[-]	[-]
160	23.7 2)	9.3 2)	4 ø 10	1 ø 10	2 ø 10
180	23.7 2)	9.3 2)	4 ø 8	1 ø 8	2 ø 8
200	23.7 2)	9.3 2)	4 ø 8	1 ø 8	2 ø 8
220	23.7 2)	9.3 2)	4 ø 8	1 ø 8	2 ø 8
240	23.7 2)	9.3 2)	4 ø 8	1 ø 8	2 ø 8

DND 50 Component thickness	$V_{Rd,c}$ 1)	$\Delta V_{Rd,c}$ 3)	A_{Sx}	A_{Sy} (upper and lower layer respetively)	
h			A_{Sx1}	A_{Sy1}	A_{Sy2}
[mm]	[kN]	[kN]	[-]	[-]	[-]
160	28.1 2)	10.2 2)	4 ø 10	1 ø 10	2 ø 10
180	28.1 2)	10.2 2)	4 ø 10	1 ø 10	2 ø 10
200	28.1 2)	10.2 2)	4 ø 10	1 ø 10	2 ø 10
220	28.1 2)	10.2 2)	4 ø 10	1 ø 10	2 ø 10
240	28.1 2)	10.2 2)	4 ø 10	1 ø 10	2 ø 10

DND 70 Component thickness	$V_{Rd,c}$ 1)	$\Delta V_{Rd,c}$ 3)	A_{Sx}	A_{Sy} (upper and lower layer respetively)	
h			A_{Sx1}	A_{Sy1}	A_{Sy2}
[mm]	[kN]	[kN]	[-]	[-]	[-]
180	39.6 2)	15.0 2)	4 ø 12	1 ø 12	2 ø 12
200	39.6 2)	15.0 2)	4 ø 12	1 ø 12	2 ø 12
220	39.6 2)	15.0 2)	4 ø 12	1 ø 12	2 ø 12
240	39.6 2)	15.0 2)	4 ø 10	1 ø 10	2 ø 10
260	39.6 2)	15.0 2)	4 ø 10	1 ø 10	2 ø 10

DND 95 Component thickness	$V_{Rd,c}$ 1)	$\Delta V_{Rd,c}$ 3)	A_{Sx}	A_{Sy} (upper and lower layer respetively)	
h			A_{Sx1}	A_{Sy1}	A_{Sy2}
[mm]	[kN]	[kN]	[-]	[-]	[-]
200	53.2 2)	19.3 2)	4 ø 14	1 ø 14	2 ø 14
220	53.2 2)	19.3 2)	4 ø 14	1 ø 14	2 ø 14
240	53.2 2)	19.3 2)	4 ø 12	1 ø 12	2 ø 12
260	53.2 2)	19.3 2)	4 ø 12	1 ø 12	2 ø 12
280	53.2 2)	19.3 2)	4 ø 12	1 ø 12	2 ø 12

1) Dimensioning values of the concrete bearing capacity valid for an axle distance $e \geq 3 \cdot d_m + l_c$ dimensioning to the upper threshold value of the connection bearing capacity (static)

2) Dimensioning values of the steel bearing capacity $V_{Rd,S}$ or $\Delta V_{Rd,S}$ for joint widths ≤ 20 mm annexes 8 and 9 are decisive

3) Dimensioning values of the concrete bearing capacity valid for an axle distance $e \geq 3 \cdot d_m + l_c$ dimensioning to the threshold force amplitude of the connection (dynamic)

DND 100 Component thickness	$V_{Rd,c}$ 1)	$\Delta V_{Rd,c}$ 3)	A_{Sx}	A_{Sy} (upper and lower layer respetively)	
h			A_{Sx1}	A_{Sy1}	A_{Sy2}
[mm]	[kN]	[kN]	[-]	[-]	[-]
220	57.1 2)	20.8 2)	6 ø 12	1 ø 12	2 ø 12
240	57.1 2)	20.8 2)	4 ø 12	1 ø 12	2 ø 12
260	57.1 2)	20.8 2)	4 ø 12	1 ø 12	2 ø 12
280	57.1 2)	20.8 2)	4 ø 12	1 ø 12	2 ø 12
300	57.1 2)	20.8 2)	4 ø 12	1 ø 12	2 ø 12

DND 120 Component thickness	$V_{Rd,c}$ 1)	$\Delta V_{Rd,c}$ 3)	A_{Sx}	A_{Sy} (upper and lower layer respetively)	
h			A_{Sx1}	A_{Sy1}	A_{Sy2}
[mm]	[kN]	[kN]	[-]	[-]	[-]
240	66.0 2)	24.8 2)	4 ø 14	1 ø 14	2 ø 14
260	66.0 2)	24.8 2)	4 ø 12	1 ø 12	2 ø 12
280	66.0 2)	24.8 2)	4 ø 12	1 ø 12	2 ø 12
300	66.0 2)	24.8 2)	4 ø 12	1 ø 12	2 ø 12
320	66.0 2)	24.8 2)	4 ø 12	1 ø 12	2 ø 12

DND 150 Component thickness	$V_{Rd,c}$ 1)	$\Delta V_{Rd,c}$ 3)	A_{Sx}	A_{Sy} (upper and lower layer respetively)	
h			A_{Sx1}	A_{Sy1}	A_{Sy2}
[mm]	[kN]	[kN]	[-]	[-]	[-]
260	85.1 2)	33.1 2)	6 ø 14	1 ø 14	2 ø 14
280	85.1 2)	33.1 2)	4 ø 14	1 ø 14	2 ø 14
300	85.1 2)	33.1 2)	4 ø 14	1 ø 14	2 ø 14
320	85.1 2)	33.1 2)	4 ø 14	1 ø 14	2 ø 14
340	85.1 2)	33.1 2)	4 ø 14	1 ø 14	2 ø 14

DND 170 Component thickness	$V_{Rd,c}$ 1)	$\Delta V_{Rd,c}$ 3)	A_{Sx}	A_{Sy} (upper and lower layer respetively)	
h			A_{Sx1}	A_{Sy1}	A_{Sy2}
[mm]	[kN]	[kN]	[-]	[-]	[-]
280	100.1 2)	37.7 2)	6 ø 12	1 ø 12	2 ø 12
300	100.1 2)	37.7 2)	6 ø 12	1 ø 12	2 ø 12
320	100.1 2)	37.7 2)	6 ø 12	1 ø 12	2 ø 12
340	100.1 2)	37.7 2)	6 ø 12	1 ø 12	2 ø 12
360	100.1 2)	37.7 2)	6 ø 12	1 ø 12	2 ø 12

1) Dimensioning values of the concrete bearing capacity valid for an axle distance $e \geq 3 \cdot d_m + l_c$ dimensioning to the upper threshold value of the connection bearing capacity (static)

2) Dimensioning values of the steel bearing capacity $V_{Rd,S}$ or $\Delta V_{Rd,S}$ for joint widths ≤ 20 mm annexes 8 and 9 are decisive

3) Dimensioning values of the concrete bearing capacity valid for an axle distance $e \geq 3 \cdot d_m + l_c$ dimensioning to the threshold force amplitude of the connection (dynamic)

DND 210 Component thickness	$V_{Rd,c}$ 1)	$\Delta V_{Rd,c}$ 3)	A_{Sx}	A_{Sy} (upper and lower layer respetively)	
h			A_{Sx1}	A_{Sy1}	A_{Sy2}
[mm]	[kN]	[kN]	[-]	[-]	[-]
300	116.1 2)	42.8 2)	6 ø 14	1 ø 14	2 ø 14
350	116.1 2)	42.8 2)	6 ø 14	1 ø 14	2 ø 14
400	116.1 2)	42.8 2)	6 ø 14	1 ø 14	2 ø 14
450	116.1 2)	42.8 2)	6 ø 14	1 ø 14	2 ø 14
500	116.1 2)	42.8 2)	6 ø 14	1 ø 14	2 ø 14

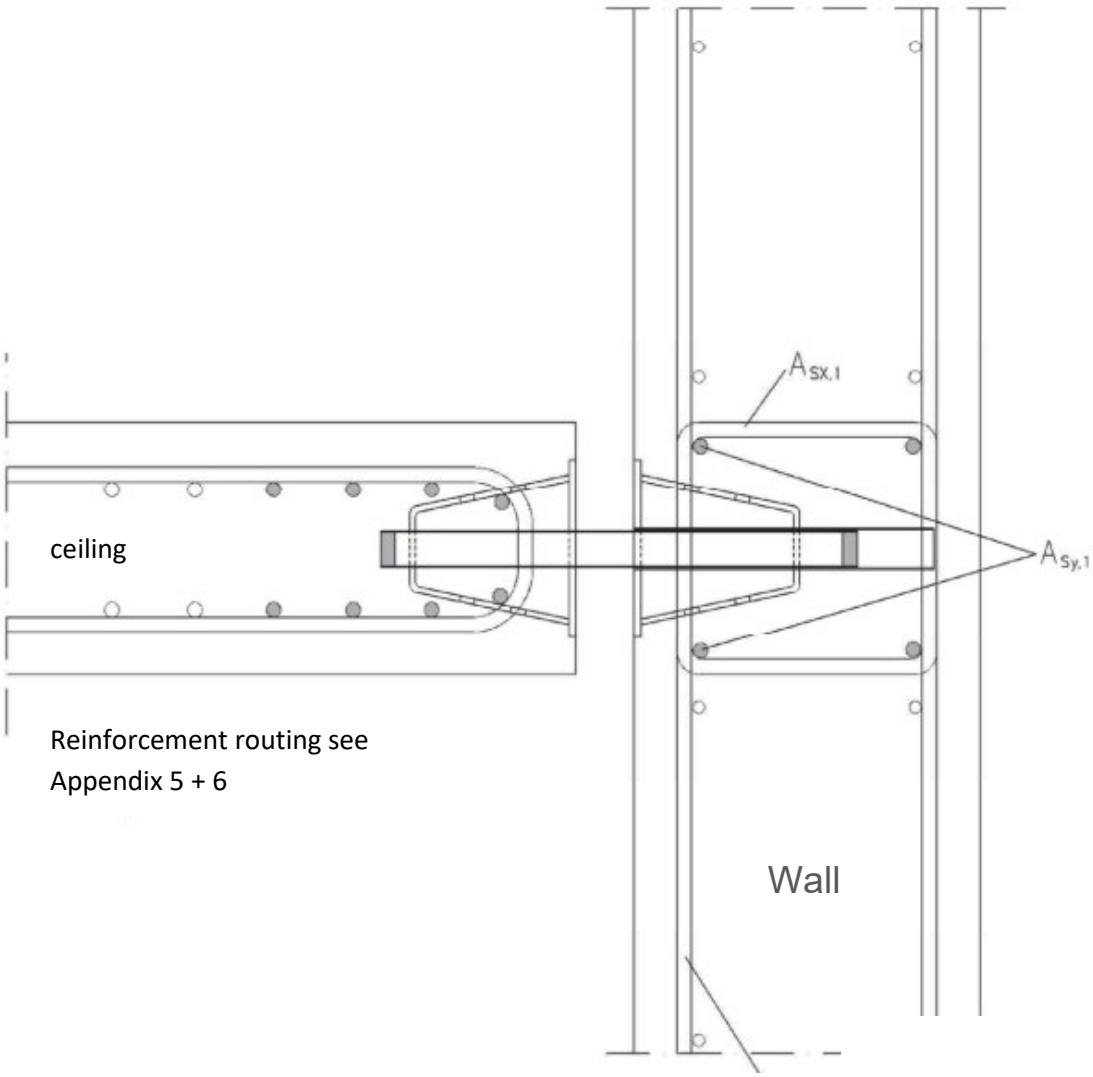
DND 300 Component thickness	$V_{Rd,c}$ 1)	$\Delta V_{Rd,c}$ 3)	A_{Sx}	A_{Sy} (upper and lower layer respetively)	
h			A_{Sx1}	A_{Sy1}	A_{Sy2}
[mm]	[kN]	[kN]	[-]	[-]	[-]
320	162.8 2)	66.0 2)	6 ø 20	1 ø 20	2 ø 20
350	162.8 2)	66.0 2)	6 ø 20	1 ø 20	2 ø 20
400	162.8 2)	66.0 2)	6 ø 16	1 ø 16	2 ø 16
450	162.8 2)	66.0 2)	6 ø 16	1 ø 16	2 ø 16
500	162.8 2)	66.0 2)	6 ø 16	1 ø 16	2 ø 16

DND 350 Component thickness	$V_{Rd,c}$ 1)	$\Delta V_{Rd,c}$ 3)	A_{Sx}	A_{Sy} (upper and lower layer respetively)	
h			A_{Sx1}	A_{Sy1}	A_{Sy2}
[mm]	[kN]	[kN]	[-]	[-]	[-]
350	192.1 2)	70.6 2)	6 ø 20	1 ø 20	2 ø 20
400	192.1 2)	70.6 2)	6 ø 20	1 ø 20	2 ø 20
450	192.1 2)	70.6 2)	6 ø 16	1 ø 16	2 ø 16
500	192.1 2)	70.6 2)	6 ø 16	1 ø 16	2 ø 16
550	192.1 2)	70.6 2)	6 ø 16	1 ø 16	2 ø 16

1) Dimensioning values of the concrete bearing capacity valid for an axle distance $e \geq 3 \cdot d_m + l_c$ dimensioning to the upper threshold value of the connection bearing capacity (static)

2) Dimensioning values of the steel bearing capacity $V_{Rd,S}$ or $\Delta V_{Rd,S}$ for joint widths ≤ 20 mm annexes 8 and 9 are decisive

3) Dimensioning values of the concrete bearing capacity valid for an axle distance $e \geq 3 \cdot d_m + l_c$ dimensioning to the threshold force amplitude of the connection (dynamic)



Egcodorn DND for non-predominantly static loads for connection between reinforced concrete components	Annex 11
Connection panel / wall	

Dimensioning example

Given: Concrete: ≥ C20/25
Concrete reinforcing steel: B500B
Slab thickness: h = 300mm
Concrete cover: c_{nom} = 30mm
Joint width: z ≤ 40mm

Loads: Maximum value of the non-static shear force applied: V_{Ed} = 80.0kN
Maximum value of the shear force load range applied: ΔV_{Ed} = 31.0kN

Selected: DND150; axle distance e ≥ 75.5cm (no mutual interference of the dowels)
+ 4 brackets Ø 14 as edge banding A_{Sx1} + 3 Ø 14 as longitudinal reinforcement A_{Sy}

1 Analysis of the steel bearing capacity

Maximum value of the shear force	Shear force load range
$V_{Rd,S}$ = 80.8kN (see table below)	$\Delta V_{Rd,S}$ = 31.4kN (see table in annex 13)
Proof:	Proof:
$\eta_S = \frac{80.0}{80.8} = 0.99 \le 1.00$	$\eta_S = \frac{31.0}{31.4} = 0.99 \le 1.00$

z ≤	[mm]	20	30	40	50	60
$V_{Rd,s}$ [kN]	DND-40	23.7	22.7	21.7	20.9	19.4
	DND-50	28.0	26.9	25.9	25.0	24.1
	DND-70	39.6	38.2	36.9	35.7	34.6
	DND-95	53.2	51.5	49.9	48.5	47.1
	DND-100	57.1	55.4	53.8	52.3	50.9
	DND-120	66.0	64.1	62.4	60.7	59.2
	DND-150	85.0	82.8	80.8	78.8	76.9
	DND-170	100.0	97.6	95.4	93.2	91.1
	DND-210	116.1	113.5	110.9	108.5	106.2
	DND-300	162.7	159.7	156.8	154.1	151.4
	DND-350	192.1	188.5	185.1	181.8	178.6

z ≤	[mm]	20	30	40	50	60
$\Delta V_{Rd,s}$ [kN]	DND-40	9.3	8.9	8.5	7.1	5.9
	DND-50	10.2	9.8	9.4	9.1	7.9
	DND-70	15.0	14.4	13.9	13.5	11.5
	DND-95	19.3	18.7	18.1	17.6	16.1
	DND-100	20.7	20.1	19.5	19.0	18.5
	DND-120	24.7	24.0	23.4	22.8	22.2
	DND-150	33.0	32.2	31.4	30.6	29.9
	DND-170	36.7	35.8	35.0	34.2	33.5
	DND-210	42.1	41.2	40.2	39.4	38.5
	DND-300	65.9	64.7	63.5	62.4	61.3
	DND-350	70.6	69.3	68.0	66.8	65.6

2. Analysis of the concrete bearing capacity

Maximum value of the shear force	Shear force load range
$V_{Rd,c}$ = 85.1kN (see table below)	$\Delta V_{Rd,c}$ = 33.1kN (see table below)
Proof:	Proof:
$\eta_S = \frac{80.0}{85.1} = 0.94 \leq 1.00$	$\eta_S = \frac{31.0}{33.1} = 0.94 \leq 1.00$

DND 150 Component thickness	$V_{Rd,c}$ [1)]	$\Delta V_{Rd,c}$ [3)]	A_{Sx}	A_{Sy} (upper and lower layer respetively)	
h			A_{Sx1}	A_{Sy1}	A_{Sy2}
[mm]	[kN]	[kN]	[-]	[-]	[-]
260	85.1 [2)]	33.1 [2)]	6 ø 14	1 ø 14	2 ø 14
280	85.1 [2)]	33.1 [2)]	4 ø 14	1 ø 14	2 ø 14
300	85.1 [2)]	33.1 [2)]	4 ø 14	1 ø 14	2 ø 14
320	85.1 [2)]	33.1 [2)]	4 ø 14	1 ø 14	2 ø 14
340	85.1 [2)]	33.1 [2)]	4 ø 14	1 ø 14	2 ø 14

Footnotes 1 to 3 following annexes 8 to 10.

3. Structural measures

The on-site reinforcement must be anchored on the outside of the punching cone and/or spliced with the reinforcement of the adjacent component.

The load transmission is to be verified in the adjacent component.