

FERBOX® REBEND CONNECTIONS

STAINLESS STEEL REINFORCEMENT

For reinforcing and connecting
concrete components





OUR CONVICTION: FORWARD CONSTRUCTING.

Not just to reflect the current state of building technology, but always to be a decisive step ahead – this is our promise. This is why we constantly achieve pioneering work in all product areas. Our employees consistently use their extensive practical experience and creativity to benefit our customers. Through regular collaborative dialogue with our target groups, we develop today the products which are needed tomorrow. With our dynamics we set consistently milestones in building technology – yesterday, today and tomorrow. This is what we mean by Forward Constructing.

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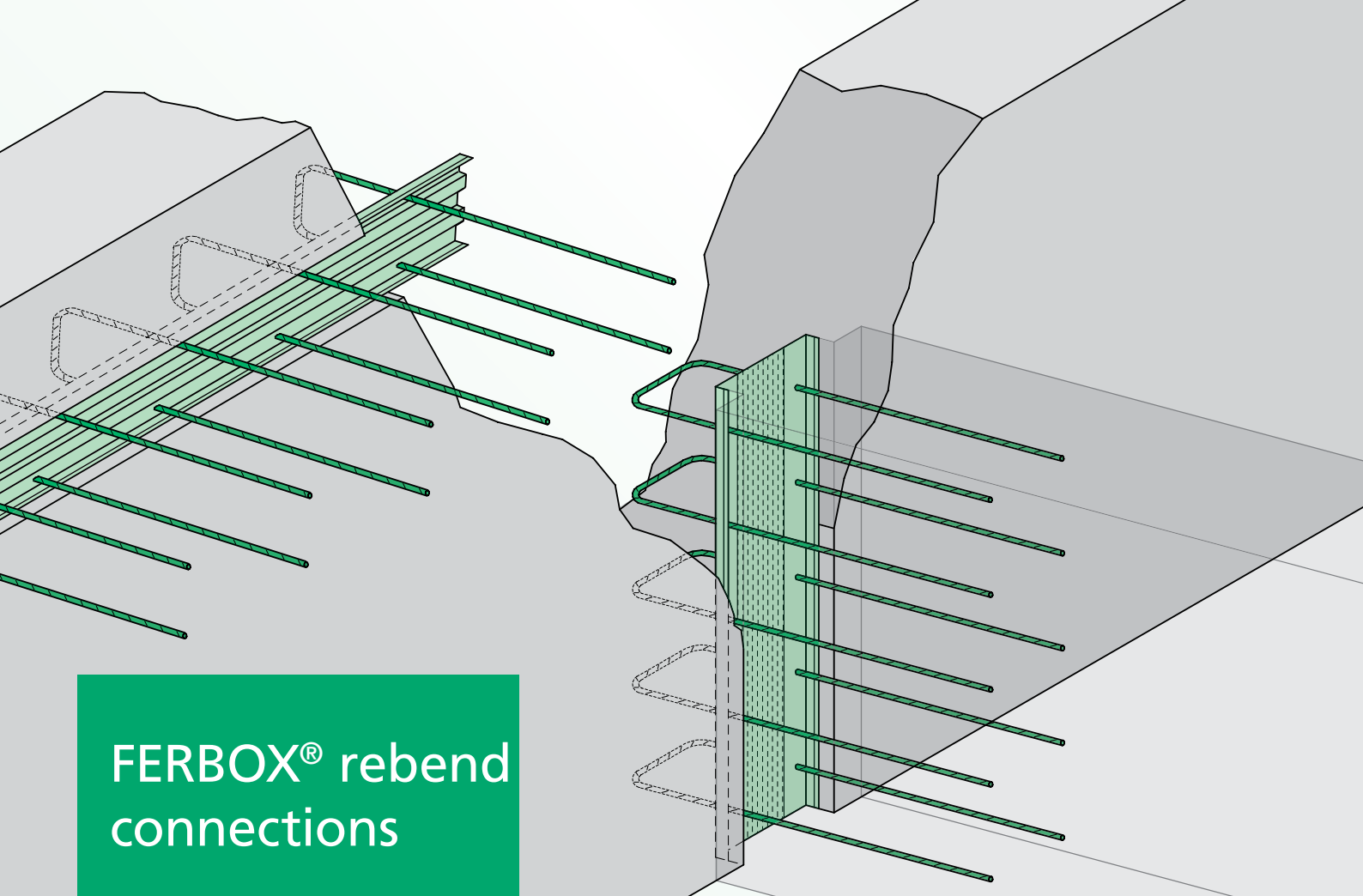
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Service & Contact

We are always there for you.
We will be wherever you are.



FERBOX® rebend connections

FOR THE BEST CONNECTIONS

THE PRODUCT

The FERBOX® rebend connection for simply and securely connecting reinforced concrete components of various designs and/or concreted sections.

A wide range of standard and special types are available for various applications. The consistent quality standard of FERBOX® is ensured through constant in-house and external monitoring.

BENEFITS

- Quick and cost-effective to install
- Type test in accordance with DIN EN 1992-1-1 and the DBV bulletin (January 2011)
- Many different versions
- Flashing box with smooth or toothed surface profile
- Dimensionally stable plastic cover can be removed quickly, easily and safely

APPLICATION AREA

FERBOX® rebend connections ensure simple, non-positive connection of reinforced concrete components that are concreted in different construction phases.

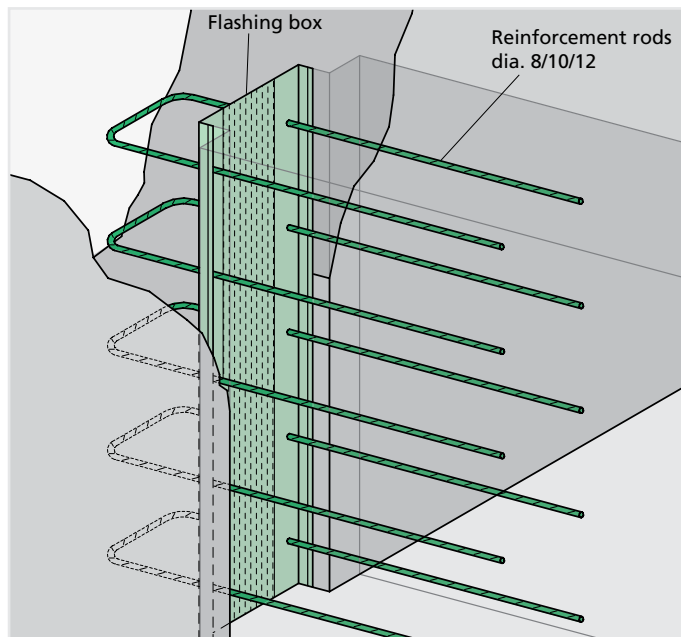
This enables walls, ceilings, corbels or staircases, for example, to be fabricated retrospectively in several concreted sections.



TECHNICAL INFORMATION

GENERAL

- FERBOX® standard rebend connections are type-tested and meet all requirements of DIN EN 1992-1-1
- All FERBOX® rebend connections are manufactured in accordance with the DBV bulletin "Reverse bending of reinforcing steel and requirements for flashing boxes", and therefore do not require technical approval
- Standard reinforcement rods dia. 8/10/12 B500B
- Special reinforcement rods dia. 6/14 B500B
- The required minimum concrete cover for the remaining flashing box is ensured by the short underlying side walls
- Plastic cover as standard, sheet metal cover available on request
- Standard length: 1.25 m, shorter or longer lengths available on request



INSTALLATION INSTRUCTIONS

- Attach the FERBOX® rebend connection in the correct position on the formwork:
 - Attach it to the formwork using nails or steel covers and magnets
 - Attach it to the reinforcements using tie wire
- After the first concreted section, the plastic covers and the polystyrene stoppers at the ends must be removed
- Reverse bend the reinforcement rods using a reverse bending tool (see the DBV bulletin "Reverse bending of reinforcing steel and requirements for flashing boxes")
- Do not treat the flashing box remaining in the joint with formwork release oil
- Remove any concrete debris
- Reinforce and concrete the next section

INSTALLATION INSTRUCTIONS FOR ROUND FORMWORK

Depending on the formwork radius, several cuts with uniform spacing are made using an abrasive cutter on the side walls on both sides of the flashing box. This can be performed at the factory on request.

This enables the flashing box to be adapted to the round formwork as a traverse.

Care must be taken to ensure that the inner reinforcement rods are not damaged.

ANCHORAGE AND JOINTS IN ACCORDANCE WITH DIN EN 1992-1-1/DIN EN 1992-1-1 NA

LAP LENGTH AND ANCHORAGE LENGTH

In accordance with DIN EN 1992-1-1 and the DBV bulletin, the reinforcement may only be utilised up to 80% for rebend connections in the ULS. Due to the 20% reduction in steel stress, the anchorage length can also be reduced by 20%.

BASE LENGTH OF THE ANCHORAGE $l_{b,reqd}$

$$l_{b,reqd} = \frac{d_s}{4} \cdot \frac{\sigma_{sd}}{f_{bd}}$$

- d_s Rod diameter
- σ_{sd} Steel stress, reduced by 20% in accordance with DBV bulletin
→ $\sigma_{sd} \leq 500/1.15 \cdot 0.8 = 348 \text{ N/mm}^2$
- f_{bd} Bond stress in accordance with DIN EN 1992-1-1 NA

Base length of the anchorage $l_{b,reqd}$ [mm] $\sigma_{sd} = 348 \text{ N/mm}^2$				
Concrete strength	Condition of the bond	Rod diameter d_s [mm]		
		8	10	12
C20/25	good	302	378	454
C25/30	good	258	322	387
C30/37	good	232	290	348

ANCHORAGE LENGTH h

$$l_{bd} = \alpha_1 \cdot \alpha_5 \cdot b_{reqd}$$

- $\alpha_1 = 1.0$ for straight rod ends
- $\alpha_1 = 0.7$ hooks/winding hooks in accordance with EC2
- $\alpha_5 = 1.0$ for indirect support
- $\alpha_5 = 0.7$ for direct support

LAP LENGTH $l_{\bar{u}}$

$$l_0 = l_{bd} \cdot \alpha_6$$

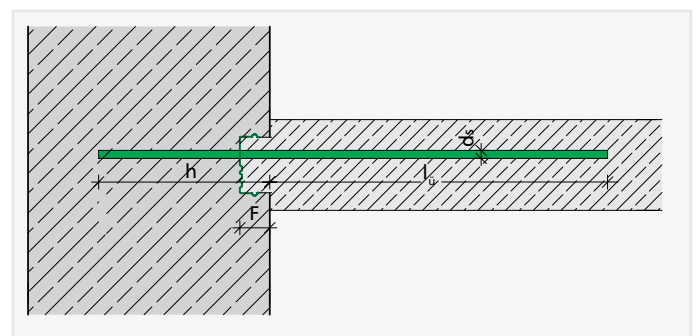
- $\alpha_6 = 1.0$ for $d_s < 16 \text{ mm}$, $a \geq 8 d_s$, $c_1 \geq 4 d_s$ and percentage of lapped bars in one section $\geq 33\%$ in accordance with DIN EN 1992-1-1 NA
- $\alpha_6 = 1.4$ for $d_s < 16 \text{ mm}$, $a \leq 8 d_s$, $c_1 \geq 4 d_s$ and percentage of lapped bars in one section $\geq 33\%$ e.g. for $d_s = 12 \text{ mm}$, $e = 100 \text{ mm}$, because $a^* > 8 d_s$

* a = Clearance for the reinforcement

STANDARD LAP LENGTH $l_{\bar{u}}$ AND ANCHORAGE LENGTH h FOR FERBOX®

dia. d_s/e	$l_{\bar{u}}$ standard	h [mm]
dia. 8/25	320	170
dia. 8/20		
dia. 8/15		
dia. 8/10		
dia. 10/25	390	170
dia. 10/20		
dia. 10/15		
dia. 10/10		
dia. 12/25	460	170
dia. 12/20		
dia. 12/15		
dia. 12/10		

* with $\alpha_6 = 1.4$



CALCULATION INFORMATION IN ACCORDANCE WITH THE DBV BULLETIN

a
 $a_1 < 50 \text{ mm}$

b
 $a_1 < 50 \text{ mm}$
 $a_2 \geq 50 \text{ mm}$ mit Oberflächenbeschaffenheit nach DIN EN 1992-1-1, 6.2.5

$a_1 \geq 50 \text{ mm}$ darf wie a_2 auf b_1 angerechnet werden, dabei ist aber nur die geringere Oberflächenrauigkeit von Verwahrkasten oder Betonierfuge für b_1 zu berücksichtigen. Alternativ darf die Einzelbreite von Betonierfugenfläche oder Verwahrkasten mit der jeweiligen Oberflächenrauigkeit für b_1 berücksichtigt werden.

Schubkraft längs zur Betonierfuge:

[R1] Gl. 6.25: Bemessungswert der Schubtragfähigkeit
Gesamtragfähigkeit = Traganteile [Beton] + [Reibung] + [Verbundbewehrung] ≤ Maximaltragfähigkeit

$$V_{Rd1} = c \cdot f_{ctd} + \mu \cdot \sigma_s + V_{Rd1,s} \leq V_{Rd1,max} \text{ [N/mm}^2\text{]}$$

Dabei ist

$$f_{ctd} = \alpha_{ct} \cdot f_{ctk,0,05} / \gamma_c \text{ (mit } \alpha_{ct} = 0,85 \text{ und } \gamma_c = 1,5 \text{ nach 3.1.6 (2)P);}$$

$$\sigma_s < 0,6 f_{ctd} \text{ (positiv für Druck und negativ für Zug);}$$

$$V_{Rd1,s} = \rho \cdot f_{yd,red} (1,2\mu \cdot \sin \alpha + \cos \alpha) \text{ mit } \rho = A_s / A_1 \text{ und}$$

$$f_{yd,red} = 400 \text{ [N/mm}^2\text{]} / \gamma_s \text{ (0,8} f_{yk} \text{ an der Rückbiegestelle);}$$

$$V_{Rd1,max} = 0,5 \cdot v \cdot f_{ctd} \text{ (keine Abminderung auf 0,3 } V_{Rd1,max}\text{)}$$

Tabelle 1. Einteilung von Fugenoberflächen nach [R1], 6.2.5
Table 1. Classification of surfaces according to [R1], 6.2.5.

Fugenoberfläche	c ¹⁾	μ	v ³⁾
verzahnt	0,50	0,9	0,70
rau	0,40 ²⁾	0,7	0,50
glatt	0,20 ²⁾	0,6	0,20
sehr glatt	0	0,5	0 ⁴⁾

¹⁾ Bei dynamischer oder Ermüdungsbeanspruchung darf der Betonverbund (Adhäsion) nicht berücksichtigt werden ($c = 0$).
²⁾ Wenn infolge Einwirkungen rechtwinklig zur Fuge Zug entsteht, ist $c = 0$ zu setzen.
³⁾ Für Betonfestigkeitsklassen $\geq C55/67$ sind die Werte mit dem Faktor $(1,1 - f_{ck} / 500)$ mit f_{ck} in [N/mm²] zu multiplizieren.
⁴⁾ Der Reibungsanteil in Gl. 6.25 darf für sehr glatte Fugen bis zur Grenze $\mu \cdot \sigma_s \leq 0,1 f_{ctd}$ ausgenutzt werden.

c Wand - Decke

d Decke - Decke

e

f

$t \geq 20 \text{ mm}$

$a_2 \geq 50 \text{ mm}$ mit Oberflächenrauigkeit nach DIN EN 1992-1-1, 6.2.5 (siehe Tabelle 1)

Querkraft quer zur Betonierfuge:

[R1] Gl. (6.2): Querkraftwiderstand ohne Querkraftbewehrung mit Abminderung über Rauigkeitsbeiwert c

$$V_{Rd,c} = (c / 0,5) \cdot [0,15 / \gamma_c \cdot k \cdot (100 \rho \cdot f_{ck})^{1/3} + 0,12 \alpha_{cp}] \cdot b_w \cdot d$$

mit

$$k = 1 + \sqrt{\frac{200}{d \text{ [mm]}}} \leq 2,0 \text{ und } c \text{ nach Tabelle 1}$$

[R1] Gl. (6.8): Querkraftwiderstand mit Querkraftbewehrung:

$$V_{Rd,s} = (A_{sw} / s) \cdot f_{ywd} \cdot z \cdot \cot \theta$$

mit $z = 0,9 d$ bzw. $z \leq d - c_{v1} - 30 \text{ mm}$ und $f_{ywd} = f_{yk} / \gamma_s$

Maximale aufnehmbare Querkraft mit Querkraftbewehrung (sehr glatte Fuge unzulässig):

[R1] Gl. (6.9) für 90°-Bügelbewehrung, im Bereich der Rückbiegestelle Begrenzung auf 30 %

$$V_{Ed} \leq 0,30 \cdot V_{Rd,max} = 0,30 \cdot b_w \cdot z \cdot v_1 \cdot f_{ctd} / (\cot \theta + \tan \theta)$$

mit $v_1 = 0,75 \cdot (1,1 - f_{ck} / 500) \leq 0,75$

[R1] Gl. (6.7aDE): Begrenzung der Druckstrebenneigung: aber mit Begrenzung auf $\theta \leq 45^\circ$ im Bereich

$$i_s = 0,5 \cdot \cot \theta \cdot d \text{ beiderseits der Fuge:}$$

$$1,0 \leq \cot \theta \leq \frac{1,2 + 1,4 \sigma_{ct} / f_{ctd}}{1 - V_{Rd,00} / V_{Ed}} \leq 3,0$$

mit [R1] Gl. (6.7bDE):

$$V_{Rd,cc} = 0,48 \cdot c \cdot f_{ck}^{1/3} \cdot (1 - 1,2 \alpha_{ct} / f_{ctd}) \cdot b_w \cdot z$$

mit c nach Tabelle 1;

$$\sigma_{ct} = N_{Ed} / A_c > 0 \text{ als Druckspannung!}$$

Hinweise:
Die anzurechnende Längsbewehrung in Gl. (6.2) ist die nach statischem System auf der Zugseite liegende (z. B. c, d oder e). Im Bild d und e ist die um a_1 zu verringerte Nutzhöhe d wegen der Betonierschwierigkeiten bei $a_1 < 50 \text{ mm}$ in der Druckzone dargestellt.

▼ Betonierabschnittsgrenze, [R1] DIN EN 1992-1-1 mit DIN EN 1992-1-1/NA

Source: DBV bulletin "Reverse bending of reinforcing steel and requirements for flashing boxes", January 2011
Figure 8: Dimensioning in the ultimate limit state – cross-section values

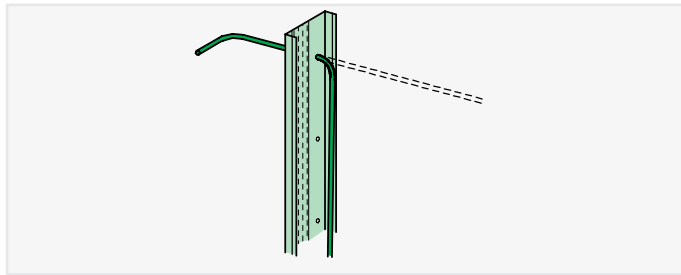
STANDARD ELEMENTS AND APPLICATION

In addition to a range of single-row and double-row standard types with a length of 1.25 m, designs with custom stirrup shapes and dimensions and custom element lengths are available. See page 26.

FERBOX® TYPE E

Single-row attachment
e.g. of concrete walls ≥ 80 mm to a concrete wall or concrete column

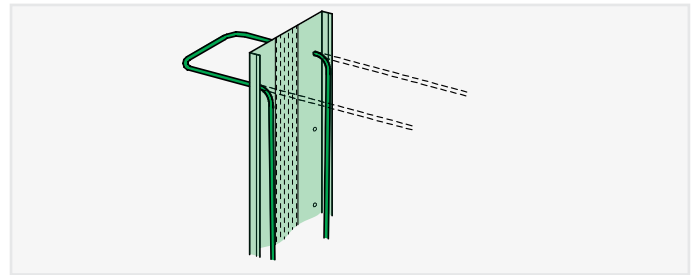
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FERBOX® TYPE B

Double-row attachment
e.g. of vertical or horizontal concrete components

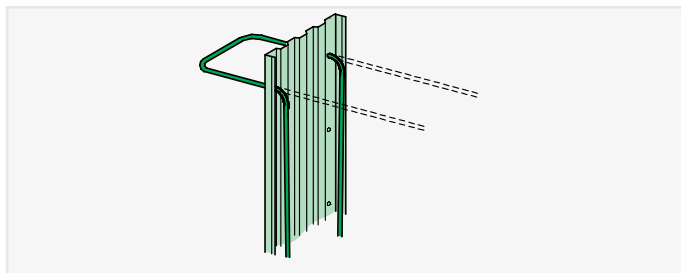
see page 10



FERBOX® TYPE BQ

Double-row attachment with horizontal teeth
e.g. of horizontal concrete components

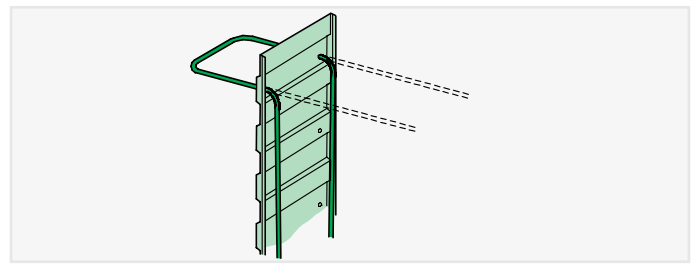
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FERBOX® TYPE BL

Double-row attachment with vertical teeth
e.g. of vertical concrete components

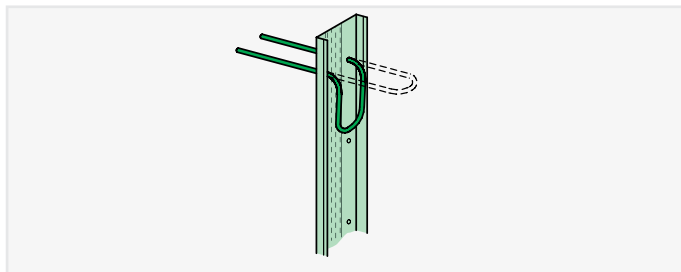
see page 12



FERBOX® TYPE F

Double-row attachment
e.g. for connecting fully prefabricated walls

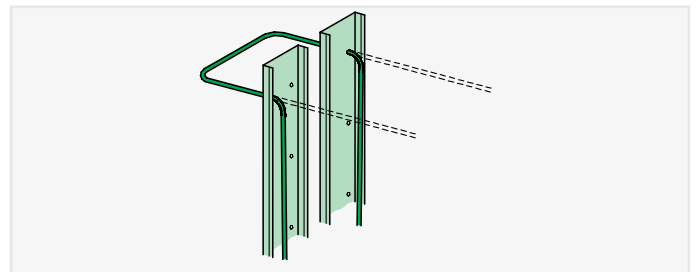
see page 13



FERBOX® TYPE D

Double-row attachment
e.g. of components $d \geq 270$ mm

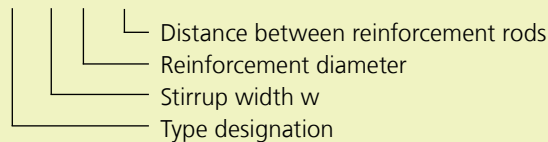
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FERBOX® TYPE DESIGNATION

Definition using type designation, diameter and division.

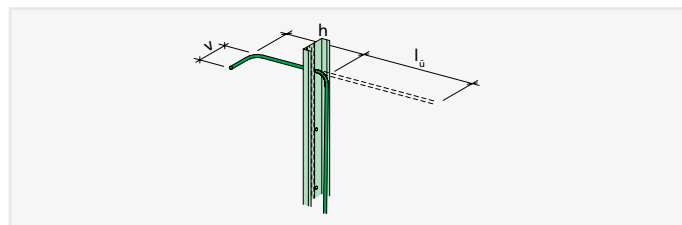
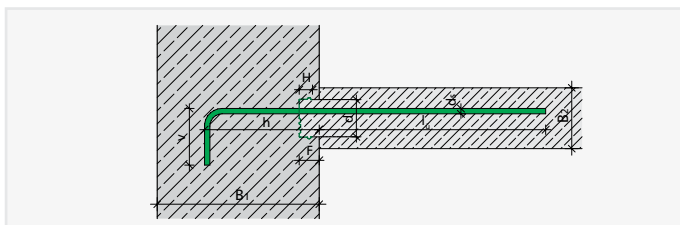
Example order: FERBOX® type B 9 - 8 - 15



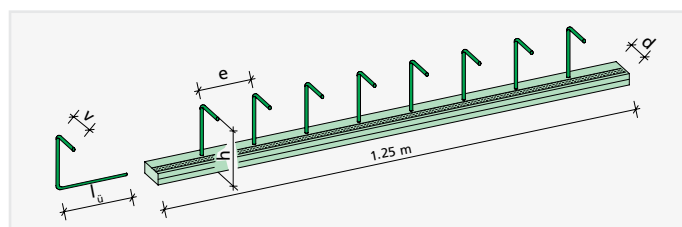
FERBOX® TYPE E

SINGLE-ROW ATTACHMENT

TECHNICAL DATA



- Joint category: Smooth
- Reinforcement rods made from B500B
- Bending roller diameter $d_{BR} = 6 ds$
- Construction and dimensioning in accordance with the DBV bulletin*
- Length: 1.25 m
- Deviating dimensions as special type S5 (see page 27)



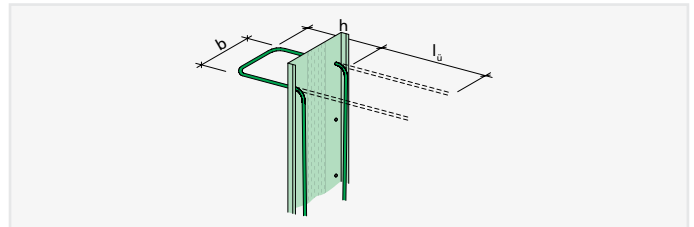
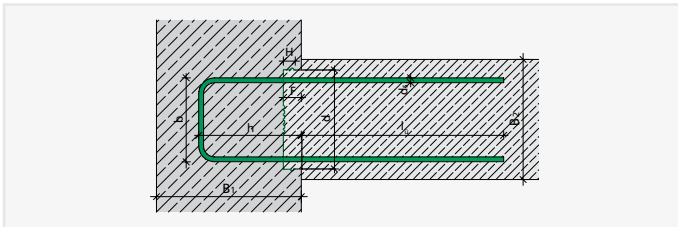
Type E	Hook length v [mm]	Anchorage length l_d /dia. [mm]	Distance between stirrups e [mm]	Stirrup height h [mm]	Flashing box width d [mm]	Box height H [mm]	Depth of box + cover F [mm]	Component thickness B1** [mm]	Component thickness B2** [mm]
E 8-10	72	320 / 8	100	170	50	21	30	≥ 200	≥ 85
E 8-15			150						
E 8-20			200						
E 8-25			250						
E 10-10	90	390 / 10	100	170	85	21	30	≥ 200	≥ 85
E 10-15			150						
E 10-20			200						
E 10-25			250						
E 12-10	110	460 / 12	100	170	85	21	40	≥ 200	≥ 115
E 12-15			150						
E 12-20			200						
E 12-25			250						

* DBV bulletin "Reverse bending of reinforcing steel and requirements for flashing boxes", January 2011
 ** Assuming a concrete coverage of $c_{,30}$

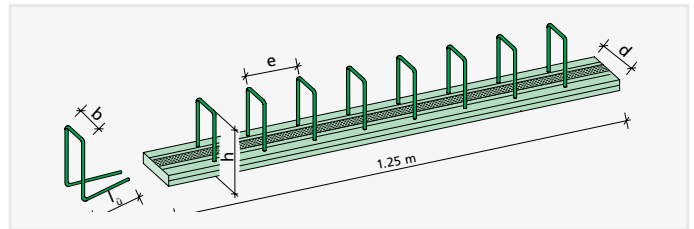
FERBOX® TYPE B

DOUBLE-ROW ATTACHMENT

TECHNICAL DATA



- Joint category: Smooth
- Reinforcement rods made from B500B
- Bending roller diameter $d_{BR} = 6 ds$
- Construction and dimensioning in accordance with the DBV bulletin*
- Length: 1.25 m
- Deviating dimensions as special type A0 (see page 26)



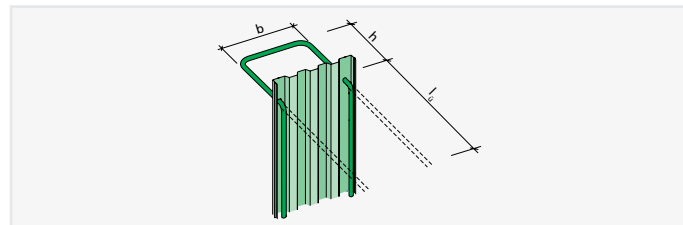
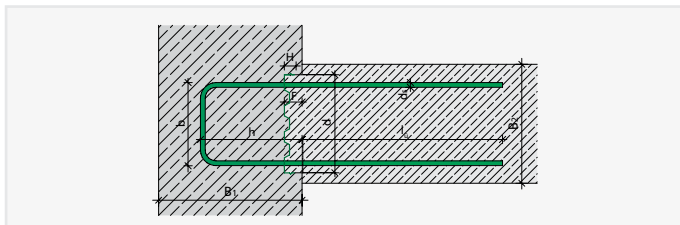
Type B	Stirrup width w [mm]	Anchorage length l_u /dia. [mm]	Distance between stirrups e [mm]	Stirrup height h [mm]	Flashing box width d [mm]	Box height H [mm]	Depth of box + cover F [mm]	Component thickness B1** [mm]	Component thickness B2** [mm]
B 9-8-15	90	320 / 8	150	170	115	21	30	≥ 200	≥ 150
B 9-8-20		320 / 8	200						
B 9-10-15		390 / 10	150						
B 9-10-20		390 / 10	200						
B 9-12-15		430 / 12	150						
B 9-12-20		460 / 12	200						
B 12-8-15	120	320 / 8	150	170	145	21	30	≥ 200	≥ 180
B 12-8-20		320 / 8	200						
B 12-10-15		390 / 10	150						
B 12-10-20		390 / 10	200						
B 12-12-15		460 / 12	150						
B 12-12-20		460 / 12	200						
B 14-8-15	140	320 / 8	150	170	165	21	30	≥ 200	≥ 200
B 14-8-20		320 / 8	200						
B 14-10-15		390 / 10	150						
B 14-10-20		390 / 10	200						
B 14-12-15		460 / 12	150						
B 14-12-20		460 / 12	200						
B 16-8-15	160	320 / 8	150	170	185	21	30	≥ 200	≥ 220
B 16-8-20		320 / 8	200						
B 16-10-15		390 / 10	150						
B 16-10-20		390 / 10	200						
B 16-12-15		460 / 12	150						
B 16-12-20		460 / 12	200						
B 18-8-15	180	320 / 8	150	170	205	21	30	≥ 200	≥ 240
B 18-8-20		320 / 8	200						
B 18-10-15		390 / 10	150						
B 18-10-20		390 / 10	200						
B 18-12-15		460 / 12	150						
B 18-12-20		460 / 12	200						
B 20-8-15	200	320 / 8	150	170	225	21	30	≥ 200	≥ 260
B 20-8-20		320 / 8	200						
B 20-10-15		390 / 10	150						
B 20-10-20		390 / 10	200						
B 20-12-15		460 / 12	150						
B 20-12-20		460 / 12	200						

* DBV bulletin "Reverse bending of reinforcing steel and requirements for flashing boxes", January 2011
 ** Assuming a concrete coverage of $c_s 30$

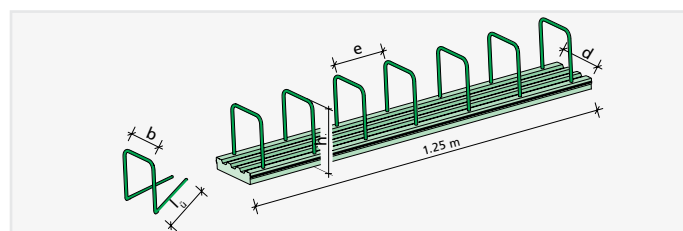
FERBOX® TYPE BQ

DOUBLE-ROW ATTACHMENT

TECHNICAL DATA



- Joint with horizontal teeth in accordance with EC2
- Reinforcement rods made from B500B
- Bending roller diameter $d_{BR} = 6 ds$
- Construction and dimensioning in accordance with the DBV bulletin*
- Length: 1.25 m
- Deviating dimensions as special type A0-Q (see page 26)



Type BQ	Stirrup width w [mm]	Anchorage length l_v /dia. [mm]	Distance between stirrups e [mm]	Stirrup height h [mm]	Flashing box width d [mm]	Box height H [mm]	Depth of box + cover F [mm]	Component thickness B1** [mm]	Component thickness B2** [mm]
BQ 9-8-15	90	320 / 8	150	170	115	21	40	≥ 200	≥ 150
BQ 9-8-20		320 / 8	200				40		
BQ 9-10-15		390 / 10	150				40		
BQ 9-10-20		390 / 10	200				40		
BQ 9-12-15		430 / 12	150				50		
BQ 9-12-20		460 / 12	200				50		
BQ 12-8-15	120	320 / 8	150	170	145	21	40	≥ 200	≥ 180
BQ 12-8-20		320 / 8	200				40		
BQ 12-10-15		390 / 10	150				40		
BQ 12-10-20		390 / 10	200				40		
BQ 12-12-15		460 / 12	150				50		
BQ 12-12-20		460 / 12	200				50		
BQ 14-8-15	140	320 / 8	150	170	165	21	40	≥ 200	≥ 200
BQ 14-8-20		320 / 8	200				40		
BQ 14-10-15		390 / 10	150				40		
BQ 14-10-20		390 / 10	200				40		
BQ 14-12-15		460 / 12	150				50		
BQ 14-12-20		460 / 12	200				50		
BQ 16-8-15	160	320 / 8	150	170	185	21	40	≥ 200	≥ 220
BQ 16-8-20		320 / 8	200				40		
BQ 16-10-15		390 / 10	150				40		
BQ 16-10-20		390 / 10	200				40		
BQ 16-12-15		460 / 12	150				50		
BQ 16-12-20		460 / 12	200				50		
BQ 18-8-15	180	320 / 8	150	170	205	21	40	≥ 200	≥ 240
BQ 18-8-20		320 / 8	200				40		
BQ 18-10-15		390 / 10	150				40		
BQ 18-10-20		390 / 10	200				40		
BQ 18-12-15		460 / 12	150				50		
BQ 18-12-20		460 / 12	200				50		
BQ 20-8-15	200	320 / 8	150	170	225	21	40	≥ 200	≥ 260
BQ 20-8-20		320 / 8	200				40		
BQ 20-10-15		390 / 10	150				40		
BQ 20-10-20		390 / 10	200				40		
BQ 20-12-15		460 / 12	150				50		
BQ 20-12-20		460 / 12	200				50		

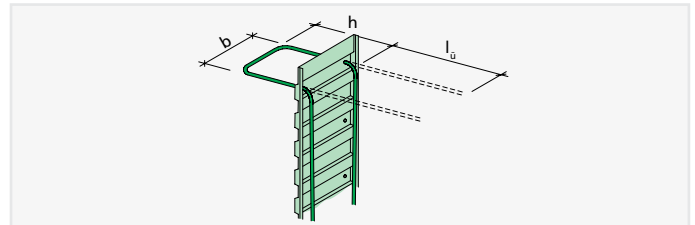
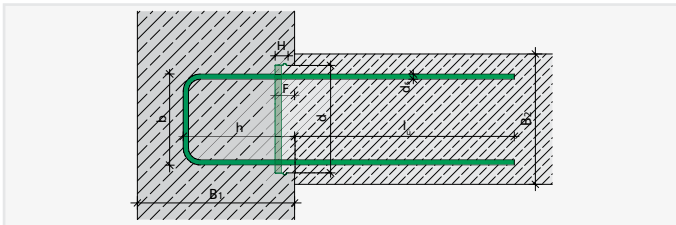
* DBV bulletin "Reverse bending of reinforcing steel and requirements for flashing boxes", January 2011

** Assuming a concrete coverage of $c_s 30$

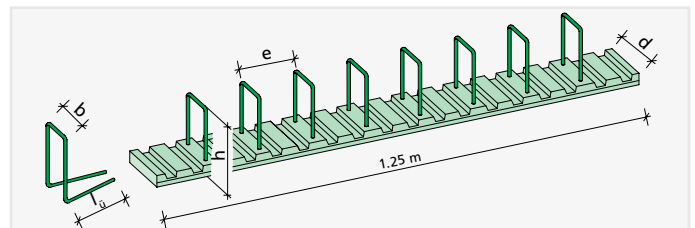
FERBOX® TYPE BL

DOUBLE-ROW ATTACHMENT

TECHNICAL DATA



- Shear key in the longitudinal direction
- Joint category: Toothed
- Reinforcement rods made from B500B
- Bending roller diameter $d_{BR} = 6 \times ds$
- Construction and dimensioning in accordance with the DBV bulletin*
- Length: 1.25 m
- Deviating dimensions as special type A0 L (see page 26)



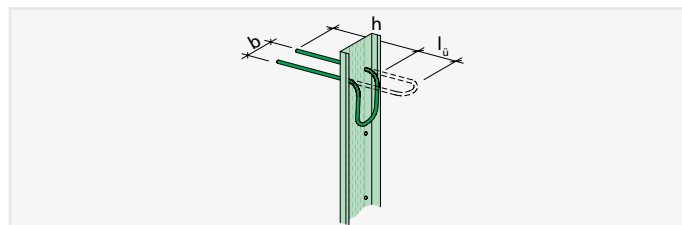
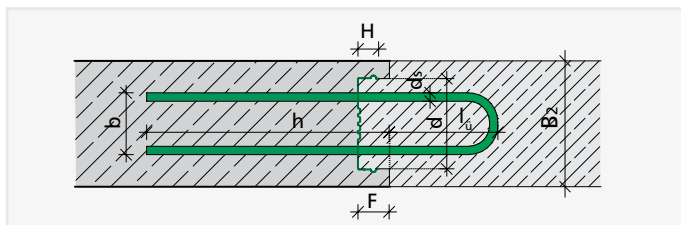
Type BL	Stirrup width w [mm]	Anchorage length l_u /dia. [mm]	Distance between stirrups e [mm]	Stirrup height h [mm]	Flashing box width d [mm]	Box height H [mm]	Depth of box + cover F [mm]	Component thickness B1** [mm]	Component thickness B2** [mm]
BL 9-8-15 BL 9-8-20 BL 9-10-15 BL 9-10-20	90	320 / 8 320 / 8 390 / 10 390 / 10	150 200 150 200	170	115	28	40 40 40 40	≥ 200	≥ 150
BL 12-8-15 BL 12-8-20 BL 12-10-15 BL 12-10-20 BL 12-12-15 BL 12-12-20	120	320 / 8 320 / 8 390 / 10 390 / 10 460 / 12 460 / 12	150 200 150 200 150 200	170	145	28	40 40 40 40 50 50	≥ 200	≥ 180
BL 14-8-15 BL 14-8-20 BL 14-10-15 BL 14-10-20 BL 14-12-15 BL 14-12-20	140	320 / 8 320 / 8 390 / 10 390 / 10 460 / 12 460 / 12	150 200 150 200 150 200	170	165	28	40 40 40 40 50 50	≥ 200	≥ 200
BL 16-8-15 BL 16-8-20 BL 16-10-15 BL 16-10-20 BL 16-12-15 BL 16-12-20	160	320 / 8 320 / 8 390 / 10 390 / 10 460 / 12 460 / 12	150 200 150 200 150 200	170	185	28	40 40 40 40 50 50	≥ 200	≥ 220
BL 18-8-15 BL 18-8-20 BL 18-10-15 BL 18-10-20 BL 18-12-15 BL 18-12-20	180	320 / 8 320 / 8 390 / 10 390 / 10 460 / 12 460 / 12	150 200 150 200 150 200	170	205	28	40 40 40 40 50 50	≥ 200	≥ 240
BL 20-8-15 BL 20-8-20 BL 20-10-15 BL 20-10-20 BL 20-12-15 BL 20-12-20	200	320 / 8 320 / 8 390 / 10 390 / 10 460 / 12 460 / 12	150 200 150 200 150 200	170	225	28	40 40 40 40 50 50	≥ 200	≥ 260

* DBV bulletin "Reverse bending of reinforcing steel and requirements for flashing boxes", January 2011
 ** Assuming a concrete coverage of $c_s 30$

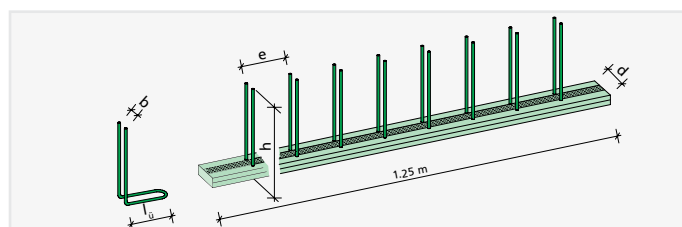
FERBOX® TYPE F

DOUBLE-ROW ATTACHMENT

TECHNICAL DATA



- Special attachment for fully prefabricated walls
- Joint category: Smooth
- Reinforcement rods made from B500B
- Construction and dimensioning in accordance with the DBV bulletin*
- Length: 1.25 m
- Deviating dimensions as special type A2 (see page 26)



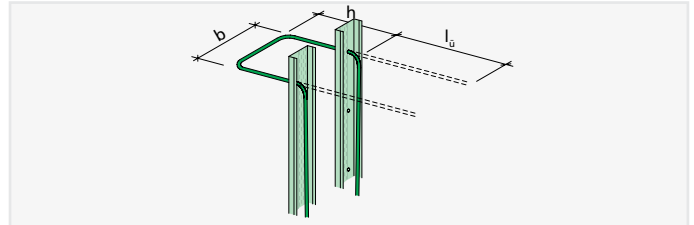
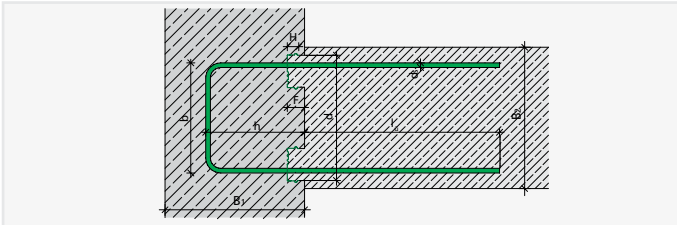
Type F	Stirrup width w [mm]	Stirrup height l _v /dia. [mm]	Distance between stirrups e [mm]	Anchorage length h [mm]	Flashing box width d [mm]	Box height H [mm]	Depth of box + cover F [mm]	Component thickness B2** [mm]
F 8-15	60	83 / 8	150	330	85	21	30	≥ 120
F 8-20			200					
F 8-25			250					
F 10-15	60	83 / 10	150	400	85	21	30	≥ 120
F 10-20			200					
F 10-25			250					

* DBV bulletin "Reverse bending of reinforcing steel and requirements for flashing boxes", January 2011
 ** Assuming a concrete coverage of c_v 30

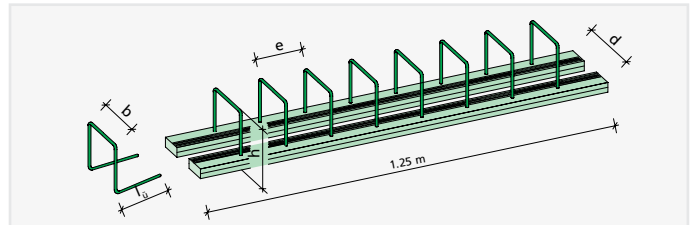
FERBOX® TYPE D

DOUBLE-ROW ATTACHMENT

TECHNICAL DATA



- Joint category: Smooth
- Reinforcement rods made from B500B
- Bending roller diameter $d_{BR} = 6 \times d_s$
- Construction and dimensioning in accordance with the DBV bulletin*
- Length: 1.25 m
- Deviating dimensions as special type D (see page 26)



Type D	Stirrup width w [mm]	Anchorage length l_a /dia. [mm]	Distance between stirrups e [mm]	Stirrup height h [mm]	Flashing box width d [mm]	Box height H [mm]	Depth of box + cover F [mm]	Component thickness B1** [mm]	Component thickness B2** [mm]
D 24- 8-15 D 24- 8-20	240	320 / 8	150 200	170	265	21	30	≥ 200	≥ 300
D 24-10-15 D 24-10-20	240	390 / 10	150 200	170	265	21	30	≥ 200	≥ 300
D 24-12-15 D 24-12-20	240	460 / 12	150 200	170	265	21	40	≥ 200	≥ 300

* DBV bulletin "Reverse bending of reinforcing steel and requirements for flashing boxes", January 2011
 ** Assuming a concrete coverage of $c_s 30$

FERBOX® TYPE B CASE a

SHEARING FORCE PARALLEL TO THE JOINT

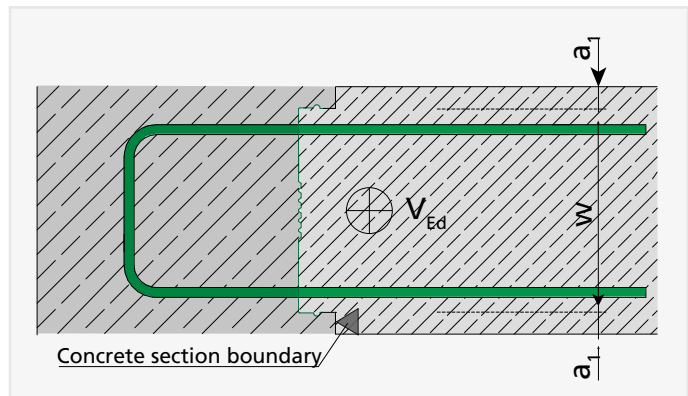
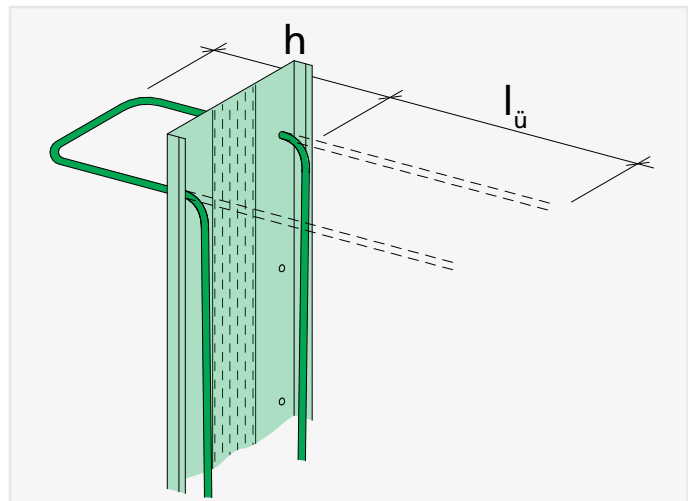
DESIGN VALUES IN ACCORDANCE WITH THE TYPE TEST

max. v_{Ed} [kN/m]						
C20/25	Type B9	Type B12	Type B14	Type B16	Type B18	Type B20
dia. 8/25	87.4	92.7	96.2	99.7	103.2	106.7
dia. 8/20	104.2	109.5	113.0	116.5	120.0	123.5
dia. 8/15	130.3	137.5	141.0	144.5	148.0	151.5
dia. 8/10	130.3	164.3	187.0	200.5	204.0	207.5
dia. 10/25	104.2	109.5	113.0	116.5	120.0	123.5
dia. 10/20	125.2	130.5	134.0	137.5	141.0	144.5
dia. 10/15	130.3	164.3	169.0	172.5	176.0	179.5
dia. 10/10	-	164.3	187.0	209.7	232.3	249.6
dia. 12/25	113.8	119.1	122.6	126.1	129.6	133.1
dia. 12/20	130.3	142.5	146.0	149.5	153.0	156.5
dia. 12/15	-	164.3	185.0	188.5	192.0	195.5
dia. 12/10	-	-	187.0	209.7	232.3	255.0

C25/30	Type B9	Type B12	Type B14	Type B16	Type B18	Type B20
dia. 8/25	101.4	107.5	111.6	115.7	119.7	123.8
dia. 8/20	120.9	127.0	131.1	135.2	139.2	143.3
dia. 8/15	153.4	159.5	163.6	167.7	171.7	175.8
dia. 8/10	162.9	205.4	228.6	232.7	236.8	240.8
dia. 10/25	120.9	127.0	131.1	135.2	139.2	143.3
dia. 10/20	145.3	151.4	155.5	159.5	163.6	167.7
dia. 10/15	162.9	192.0	196.1	200.2	204.2	208.3
dia. 10/10	-	205.4	233.8	262.1	285.5	289.6
dia. 12/25	132.1	138.2	142.2	146.3	150.4	154.4
dia. 12/20	159.2	165.3	169.4	173.5	177.5	181.6
dia. 12/15	-	205.4	214.7	218.8	222.8	226.9
dia. 12/10	-	-	233.8	262.1	290.4	317.4

C30/37	Type B9	Type B12	Type B14	Type B16	Type B18	Type B20
dia. 8/25	114.5	121.4	126.0	130.6	135.2	139.8
dia. 8/20	136.5	143.4	148.0	152.6	157.2	161.8
dia. 8/15	173.3	180.1	184.7	189.3	193.9	198.5
dia. 8/10	195.5	246.5	258.2	262.8	267.4	271.9
dia. 10/25	136.5	143.4	148.0	152.6	157.2	161.8
dia. 10/20	164.1	171.0	175.6	180.2	184.8	189.4
dia. 10/15	195.5	216.9	221.5	226.0	230.6	235.2
dia. 10/10	-	246.5	280.5	314.5	322.4	327.0
dia. 12/25	149.1	156.0	160.6	165.2	169.8	174.4
dia. 12/20	179.8	186.7	191.3	195.9	200.5	205.1
dia. 12/15	-	237.8	242.4	247.0	251.6	256.2
dia. 12/10	-	-	280.5	314.5	348.5	358.5

Assumptions: Load-bearing capacity of the joint in accordance with case a, DBV bulletin "Reverse bending" – see page 7
 $a_1 \leq 5 \text{ cm}$ $s_{cd} = s_{Nd} = 0$



The values in the table apply to type B elements on page 10 with:

- $h = 170 \text{ mm}$
- dia. 8 $l_u = 320 \text{ mm}$
- dia. 10 $l_u = 390 \text{ mm}$
- dia. 12 $l_u = 460 \text{ mm}$

FERBOX® TYPE BL CASE a

SHEARING FORCE PARALLEL TO THE JOINT

DESIGN VALUES IN ACCORDANCE WITH THE TYPE TEST

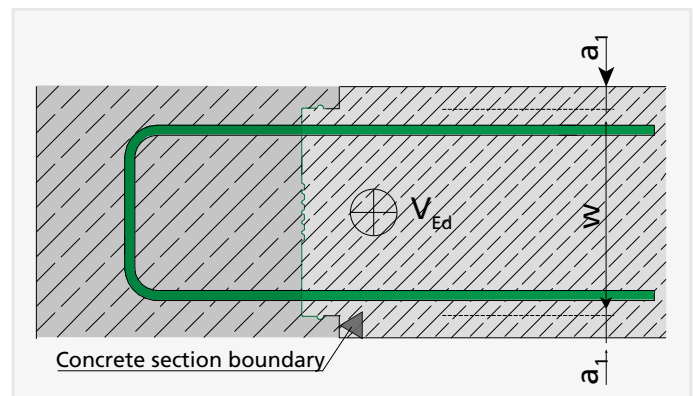
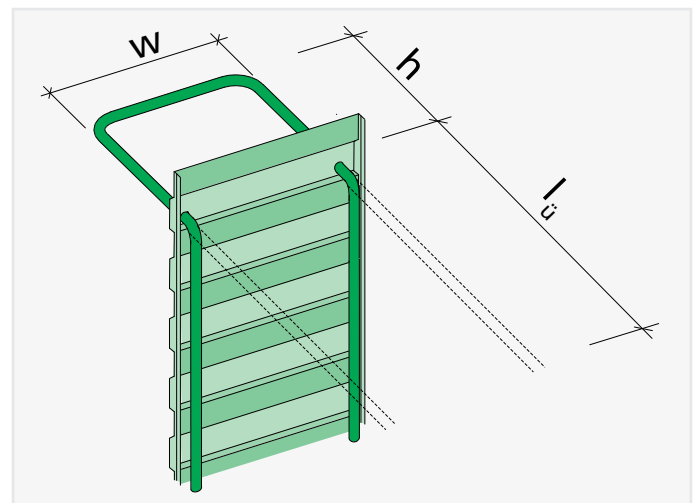
max. v_{Ed} [kN/m]						
C20/25	Type BL9	Type BL12	Type BL14	Type BL16	Type BL18	Type BL20
dia. 8/25	144.1	157.2	166.0	174.7	183.5	192.3
dia. 8/20	167.5	180.6	189.4	198.2	206.9	215.7
dia. 8/15	206.5	219.6	228.4	237.2	245.9	254.7
dia. 8/10	284.5	297.7	306.4	315.2	324.0	332.7
dia. 10/25	167.5	180.6	189.4	198.2	206.9	215.7
dia. 10/20	196.7	209.9	218.7	227.4	236.2	245.0
dia. 10/15	245.5	258.7	267.4	276.2	285.0	293.7
dia. 10/10	-	356.2	365.0	373.7	382.5	391.3
dia. 12/25	180.1	193.2	202.0	210.8	219.5	228.3
dia. 12/20	212.5	225.6	234.4	243.2	251.9	260.7
dia. 12/15	-	279.7	288.4	297.2	306.0	314.7
dia. 12/10	-	-	396.5	405.3	414.0	422.8

C25/30	Type BL9	Type BL12	Type BL14	Type BL16	Type BL18	Type BL20
dia. 8/25	167.2	182.4	192.6	202.8	213.0	223.1
dia. 8/20	194.3	209.6	219.8	229.9	240.1	250.3
dia. 8/15	239.6	254.9	265.0	275.2	285.4	295.6
dia. 8/10	330.2	345.4	355.6	365.8	375.9	386.1
dia. 10/25	194.3	209.6	219.8	229.9	240.1	250.3
dia. 10/20	228.3	243.6	253.7	263.9	274.1	284.2
dia. 10/15	284.9	300.1	310.3	320.5	330.7	340.8
dia. 10/10	-	413.3	423.5	433.7	443.9	454.0
dia. 12/25	209.0	224.2	234.4	244.6	254.7	264.9
dia. 12/20	246.6	261.8	272.0	282.2	292.4	302.5
dia. 12/15	-	324.5	334.7	344.9	355.1	365.2
dia. 12/10	-	-	460.1	470.3	480.4	490.6

C30/37	Type BL9	Type BL12	Type BL14	Type BL16	Type BL18	Type BL20
dia. 8/25	188.8	206.0	217.5	229.0	240.5	252.0
dia. 8/20	219.4	236.7	248.2	259.7	271.2	282.6
dia. 8/15	270.6	287.8	299.3	310.8	322.3	333.8
dia. 8/10	372.8	390.1	401.6	413.0	424.5	436.0
dia. 10/25	219.4	236.7	248.2	259.7	271.2	282.6
dia. 10/20	257.8	275.0	286.5	298.0	309.5	321.0
dia. 10/15	321.7	338.9	350.4	361.9	373.4	384.9
dia. 10/10	-	466.8	478.3	489.7	501.2	512.7
dia. 12/25	236.0	253.2	264.7	276.2	287.7	299.2
dia. 12/20	278.4	295.7	307.2	318.7	330.1	341.6
dia. 12/15	-	366.5	378.0	389.4	400.9	412.4
dia. 12/10	-	-	519.5	531.0	542.5	554.0

Assumptions: Load-bearing capacity of the joint in accordance with case a, DBV bulletin "Reverse bending" – see page 7
 $a_1 \leq 5 \text{ cm}$ $s_{cd} = s_{Nd} = 0$

toothed in accordance with EC2



The values in the table apply to type BL elements on page 12 with:
 $h = 170 \text{ mm}$
 dia. 8 $l_u = 320 \text{ mm}$
 dia. 10 $l_u = 390 \text{ mm}$
 dia. 12 $l_u = 460 \text{ mm}$

The information in the type test must be taken into account.

Higher design values are possible with greater anchorage and lap lengths. Please contact our Application technology team:
 Phone: +49 7742 9215-30
 Fax: +49 7742 9215-319
 E-mail: technik@h-bau.de

FERBOX® TYPE B CASE c

SHEARING FORCE VERTICAL TO THE JOINT WITHOUT LATERAL FORCE REINFORCEMENT

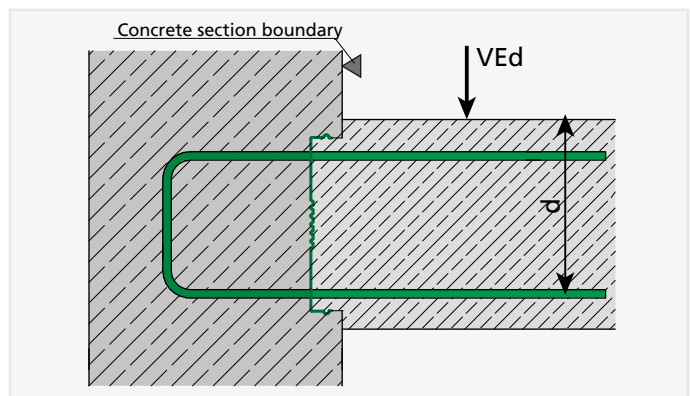
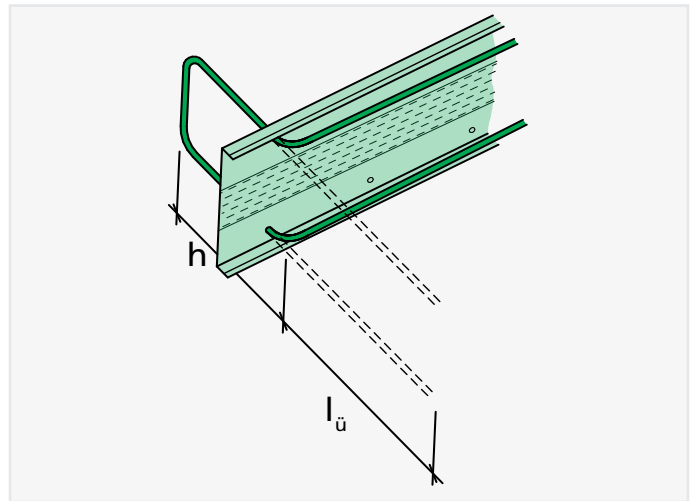
DESIGN VALUES IN ACCORDANCE WITH THE TYPE TEST

Maximum lateral force load-bearing capacity of the connection without lateral force reinforcement in the ceiling: max. v_{Ed} [kN/m]									
C20/25	Type B 9, 12, 14, 16, 18, 20								
	d [mm]								
	120	140	160	180	200	220	240	260	280
dia. 8/25	49.4	53.0	56.5	60.1	62.9	62.9	62.9	62.9	62.9
dia. 8/20	49.4	53.0	56.5	60.1	63.6	65.8	67.9	70.0	72.1
dia. 8/15	49.4	53.0	56.5	60.1	63.6	65.8	67.9	70.0	72.1
dia. 8/10	-	53.0	56.5	60.1	63.6	65.8	67.9	70.0	72.1
dia. 10/25	49.4	53.0	56.5	60.1	63.6	65.8	67.9	70.0	72.1
dia. 10/20	49.4	53.0	56.5	60.1	63.6	65.8	67.9	70.0	72.1
dia. 10/15	49.4	53.0	56.5	60.1	63.6	65.8	67.9	70.0	72.1
dia. 10/10	-	-	56.5	60.1	63.6	65.8	67.9	70.0	72.1
dia. 12/25	53.1	62.0	65.9	69.4	73.0	75.2	77.3	79.4	81.5
dia. 12/20	53.1	62.0	65.9	69.4	73.0	75.2	77.3	79.4	81.5
dia. 12/15	-	62.0	65.9	69.4	73.0	75.2	77.3	79.4	81.5
dia. 12/10	-	-	68.5	71.0	73.5	75.2	77.3	79.4	81.5

C25/30	Type B 9, 12, 14, 16, 18, 20								
	d [mm]								
	120	140	160	180	200	220	240	260	280
dia. 8/25	56.5	60.4	62.9	62.9	62.9	62.9	62.9	62.9	62.9
dia. 8/20	56.5	60.4	64.4	68.3	72.3	74.7	77.1	78.7	78.7
dia. 8/15	56.5	60.4	64.4	68.3	72.3	74.7	77.1	79.5	81.8
dia. 8/10	-	60.4	64.4	68.3	72.3	74.7	77.1	79.5	81.8
dia. 10/25	56.5	60.4	64.4	68.3	72.3	74.7	77.1	79.5	81.8
dia. 10/20	56.5	60.4	64.4	68.3	72.3	74.7	77.1	79.5	81.8
dia. 10/15	56.5	60.4	64.4	68.3	72.3	74.7	77.1	79.5	81.8
dia. 10/10	-	-	64.4	68.3	72.3	74.7	77.1	79.5	81.8
dia. 12/25	59.4	69.3	75.3	79.2	83.2	85.6	88.0	90.4	92.7
dia. 12/20	59.4	69.3	75.3	79.2	83.2	85.6	88.0	90.4	92.7
dia. 12/15	-	69.3	75.3	79.2	83.2	85.6	88.0	90.4	92.7
dia. 12/10	-	-	76.9	79.7	83.2	85.6	88.0	90.4	92.7

C30/37	Type B 9, 12, 14, 16, 18, 20								
	d [mm]								
	120	140	160	180	200	220	240	260	280
dia. 8/25	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9
dia. 8/20	62.9	67.3	71.6	76.0	78.7	78.7	78.7	78.7	78.7
dia. 8/15	62.9	67.3	71.6	76.0	80.3	83.0	85.6	88.2	90.7
dia. 8/10	-	67.3	71.6	76.0	80.3	83.0	85.6	88.2	90.7
dia. 10/25	62.9	67.3	71.6	76.0	80.3	83.0	85.6	88.2	90.7
dia. 10/20	62.9	67.3	71.6	76.0	80.3	83.0	85.6	88.2	90.7
dia. 10/15	62.9	67.3	71.6	76.0	80.3	83.0	85.6	88.2	90.7
dia. 10/10	-	-	71.6	76.0	80.3	83.0	85.6	88.2	90.7
dia. 12/25	65.1	75.9	83.9	88.3	92.6	95.3	97.9	100.5	103.0
dia. 12/20	65.1	75.9	83.9	88.3	92.6	95.3	97.9	100.5	103.0
dia. 12/15	-	75.9	83.9	88.3	92.6	95.3	97.9	100.5	103.0
dia. 12/10	-	-	84.7	88.3	92.6	95.3	97.9	100.5	103.0

Assumptions: Load-bearing capacity of the joint in accordance with case c, DBV bulletin "Reverse bending" – see page 7
 $s_{cd} = 0$



The values in the table apply to type B elements on page 10 with:
 $h = 170 \text{ mm}$
 dia. 8 $l_u = 320 \text{ mm}$
 dia. 10 $l_u = 390 \text{ mm}$
 dia. 12 $l_u = 460 \text{ mm}$

The information in the type test must be taken into account.

FERBOX® TYPE BQ CASE c

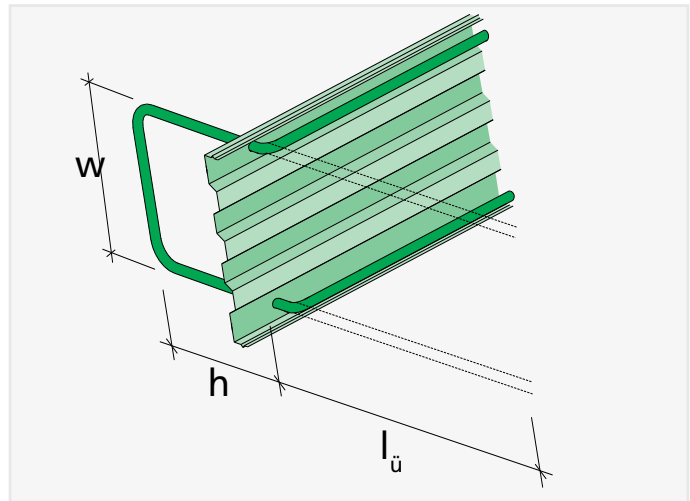
SHEARING FORCE VERTICAL TO THE JOINT WITHOUT LATERAL FORCE REINFORCEMENT

DESIGN VALUES IN ACCORDANCE WITH THE TYPE TEST

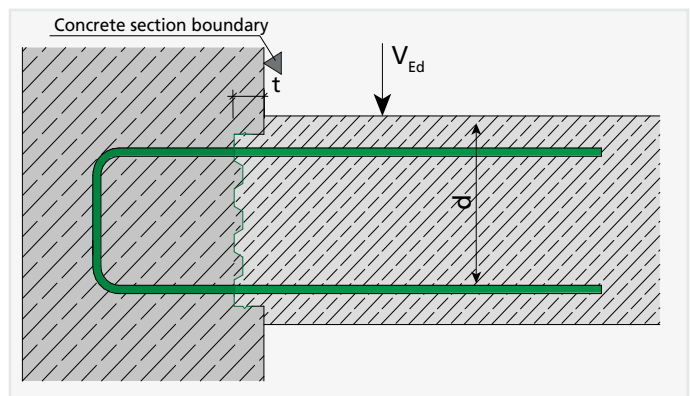
toothed in accordance with EC2

Maximum lateral force load-bearing capacity of the connection without lateral force reinforcement in the ceiling: max. v_{Ed} [kN/m]									
C20/25	Type BQ 9, 12, 14, 16, 18, 20								
	d [mm]								
	120	140	160	180	200	220	240	260	280
dia. 8/25	53.1	62.0	62.9	62.9	62.9	62.9	62.9	62.9	62.9
dia. 8/20	53.1	62.0	70.8	78.7	78.7	78.7	78.7	78.7	78.7
dia. 8/15	53.1	62.0	70.8	79.7	88.5	94.0	99.4	104.7	104.9
dia. 8/10	-	62.0	70.8	79.7	88.5	94.0	99.4	104.7	109.8
dia. 10/25	53.1	62.0	70.8	79.7	88.5	94.0	95.6	95.6	95.6
dia. 10/20	53.1	62.0	70.8	79.7	88.5	94.0	99.4	104.7	109.8
dia. 10/15	53.1	62.0	70.8	79.7	88.5	94.0	99.4	104.7	109.8
dia. 10/10	-	-	70.8	79.7	88.5	94.0	99.4	104.7	109.8
dia. 12/25	53.1	62.0	70.8	79.7	88.5	94.0	99.4	104.7	109.8
dia. 12/20	53.1	62.0	70.8	79.7	88.5	94.0	99.4	104.7	109.8
dia. 12/15	55.8	62.0	70.8	79.7	88.5	94.0	99.4	104.7	109.8
dia. 12/10	-	-	77.4	83.7	89.8	94.0	99.4	104.7	109.8

Assumptions: Load-bearing capacity of the joint in accordance with case c, DBV bulletin "Reverse bending" – see page 7
 $s_{cd} = 0$



C25/30	Type BQ 9, 12, 14, 16, 18, 20								
	d [mm]								
	120	140	160	180	200	220	240	260	280
dia. 8/25	59.4	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9
dia. 8/20	59.4	69.3	78.7	78.7	78.7	78.7	78.7	78.7	78.7
dia. 8/15	59.4	69.3	79.2	89.1	99.0	104.9	104.9	104.9	104.9
dia. 8/10	-	69.3	79.2	89.1	99.0	105.1	111.1	117.0	122.8
dia. 10/25	59.4	69.3	79.2	89.1	98.3	98.3	98.3	98.3	98.3
dia. 10/20	59.4	69.3	79.2	89.1	99.0	105.1	111.1	117.0	122.8
dia. 10/15	59.4	69.3	79.2	89.1	99.0	105.1	111.1	117.0	122.8
dia. 10/10	-	-	79.2	89.1	99.0	105.1	111.1	117.0	122.8
dia. 12/25	59.4	69.3	79.2	89.1	99.0	105.1	111.1	117.0	122.8
dia. 12/20	59.4	69.3	79.2	89.1	99.0	105.1	111.1	117.0	122.8
dia. 12/15	60.1	69.3	79.2	89.1	99.0	105.1	111.1	117.0	122.8
dia. 12/10	-	-	83.4	90.2	99.0	105.1	111.1	117.0	122.8



C30/37	Type BQ 9, 12, 14, 16, 18, 20								
	d [mm]								
	120	140	160	180	200	220	240	260	280
dia. 8/25	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9
dia. 8/20	65.1	75.9	78.7	78.7	78.7	78.7	78.7	78.7	78.7
dia. 8/15	65.1	75.9	86.8	97.6	104.9	104.9	104.9	104.9	104.9
dia. 8/10	-	75.9	86.8	97.6	108.4	115.1	121.7	128.2	134.5
dia. 10/25	65.1	75.9	86.8	97.6	98.3	98.3	98.3	98.3	98.3
dia. 10/20	65.1	75.9	86.8	97.6	108.4	115.1	121.7	122.9	122.9
dia. 10/15	65.1	75.9	86.8	97.6	108.4	115.1	121.7	128.2	134.5
dia. 10/10	-	-	86.8	97.6	108.4	115.1	121.7	128.2	134.5
dia. 12/25	65.1	75.9	86.8	97.6	108.4	115.1	121.7	128.2	134.5
dia. 12/20	65.1	75.9	86.8	97.6	108.4	115.1	121.7	128.2	134.5
dia. 12/15	65.1	75.9	86.8	97.6	108.4	115.1	121.7	128.2	134.5
dia. 12/10	-	-	88.6	97.6	108.4	115.1	121.7	128.2	134.5

The values in the table apply to type BQ elements on page 11 with:
 $h = 170 \text{ mm}$
 dia. 8 $l_u = 320 \text{ mm}$
 dia. 10 $l_u = 390 \text{ mm}$
 dia. 12 $l_u = 460 \text{ mm}$

The information in the type test must be taken into account.

FERBOX® TYPE B, BQ CASE c

SHEARING FORCE VERTICAL TO THE JOINT WITH LATERAL FORCE REINFORCEMENT

DESIGN VALUES IN ACCORDANCE WITH THE TYPE TEST

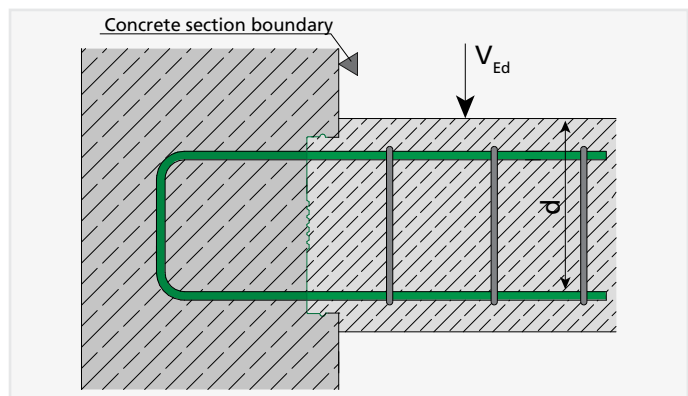
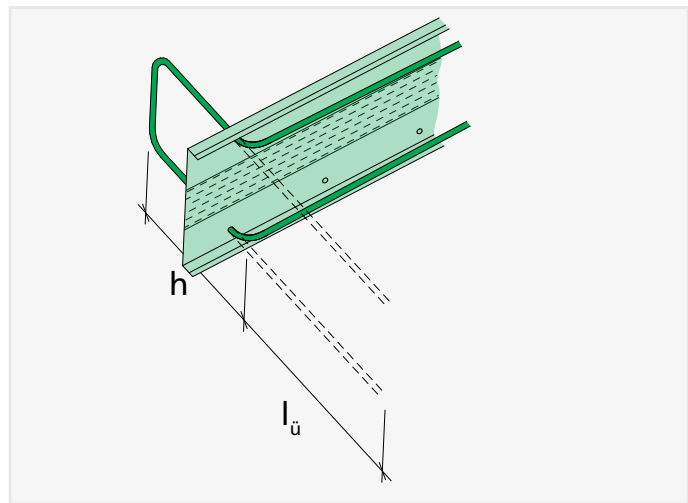
Joint smooth or toothed in accordance with EC2

Maximum lateral force load-bearing capacity of the connection with lateral force reinforcement in the ceiling: max. v_{Ed} [kN/m]									
C20/25	Type B, BQ 9, 12, 14, 16, 18, 20								
	d [mm]								
	120	140	160	180	200	220	240	260	280
dia. 8/25	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
dia. 8/20	82.9	87.4	87.4	87.4	87.4	87.4	87.4	87.4	87.4
dia. 8/15	82.9	108.4	116.6	116.6	116.6	116.6	116.6	116.6	116.6
dia. 8/10	-	108.4	133.9	159.4	174.8	174.8	174.8	174.8	174.8
dia. 10/25	82.9	108.4	109.3	109.3	109.3	109.3	109.3	109.3	109.3
dia. 10/20	82.9	108.4	133.9	136.6	136.6	136.6	136.6	136.6	136.6
dia. 10/15	82.9	108.4	133.9	159.4	182.1	182.1	182.1	182.1	182.1
dia. 10/10	-	-	133.9	159.4	184.9	210.4	235.9	261.4	273.2
dia. 12/25	82.9	108.4	133.9	157.4	157.4	157.4	157.4	157.4	157.4
dia. 12/20	82.9	108.4	133.9	159.4	184.9	196.7	196.7	196.7	196.7
dia. 12/15	82.9	108.4	133.9	159.4	184.9	210.4	235.9	261.4	262.3
dia. 12/10	-	-	133.9	159.4	184.9	210.4	235.9	261.4	286.9

C25/30	Type B, BQ 9, 12, 14, 16, 18, 20								
	d [mm]								
	120	140	160	180	200	220	240	260	280
dia. 8/25	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
dia. 8/20	87.4	87.4	87.4	87.4	87.4	87.4	87.4	87.4	87.4
dia. 8/15	103.6	116.6	116.6	116.6	116.6	116.6	116.6	116.6	116.6
dia. 8/10	-	135.5	167.3	174.8	174.8	174.8	174.8	174.8	174.8
dia. 10/25	103.6	109.3	109.3	109.3	109.3	109.3	109.3	109.3	109.3
dia. 10/20	103.6	135.5	136.6	136.6	136.6	136.6	136.6	136.6	136.6
dia. 10/15	103.6	135.5	167.3	182.1	182.1	182.1	182.1	182.1	182.1
dia. 10/10	-	-	167.3	199.2	231.1	263.0	273.2	273.2	273.2
dia. 12/25	103.6	135.5	157.4	157.4	157.4	157.4	157.4	157.4	157.4
dia. 12/20	103.6	135.5	167.3	196.7	196.7	196.7	196.7	196.7	196.7
dia. 12/15	103.6	135.5	167.3	199.2	231.1	262.3	262.3	262.3	262.3
dia. 12/10	-	-	167.3	199.2	231.1	263.0	294.8	326.7	333.6

C30/37	Type B, BQ 9, 12, 14, 16, 18, 20								
	d [mm]								
	120	140	160	180	200	220	240	260	280
dia. 8/25	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
dia. 8/20	87.4	87.4	87.4	87.4	87.4	87.4	87.4	87.4	87.4
dia. 8/15	116.6	116.6	116.6	116.6	116.6	116.6	116.6	116.6	116.6
dia. 8/10	-	162.6	174.8	174.8	174.8	174.8	174.8	174.8	174.8
dia. 10/25	124.3	109.3	109.3	109.3	109.3	109.3	109.3	109.3	109.3
dia. 10/20	124.3	136.6	136.6	136.6	136.6	136.6	136.6	136.6	136.6
dia. 10/15	124.3	162.6	182.1	182.1	182.1	182.1	182.1	182.1	182.1
dia. 10/10	-	-	200.8	239.1	273.2	273.2	273.2	273.2	273.2
dia. 12/25	124.3	157.4	157.4	157.4	157.4	157.4	157.4	157.4	157.4
dia. 12/20	124.3	162.6	196.7	196.7	196.7	196.7	196.7	196.7	196.7
dia. 12/15	124.3	162.6	200.8	239.1	262.3	262.3	262.3	262.3	262.3
dia. 12/10	-	-	200.8	239.1	277.3	315.6	353.8	376.7	376.7

Assumptions: Load-bearing capacity of the joint in accordance with case c, DBV bulletin "Reverse bending" – see page 7
 $s_{cd} = 0$



The values in the table apply to type B elements on page 10 with:
 $h = 170 \text{ mm}$
 dia. 8 $l_u = 320 \text{ mm}$
 dia. 10 $l_u = 390 \text{ mm}$
 dia. 12 $l_u = 460 \text{ mm}$

The information in the type test must be taken into account.

FERBOX® TYPE B CASE e

SHEARING FORCE VERTICAL TO THE JOINT WITHOUT LATERAL FORCE REINFORCEMENT

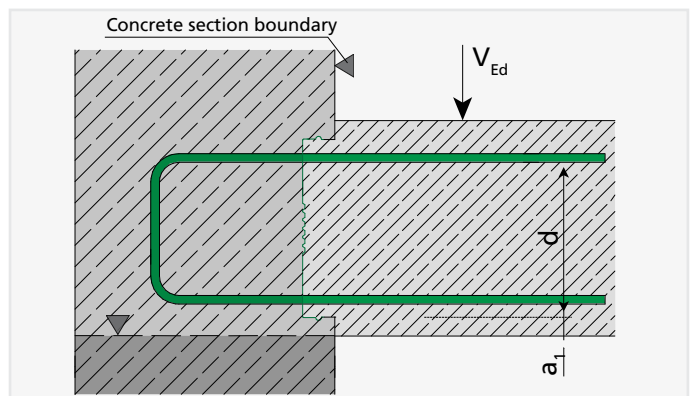
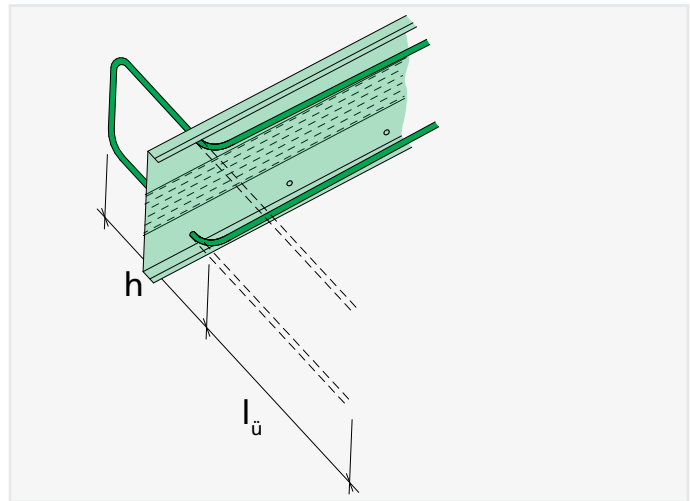
DESIGN VALUES IN ACCORDANCE WITH THE TYPE TEST

Maximum lateral force load-bearing capacity of the connection without lateral force reinforcement in the ceiling: max. v_{Ed} [kN/m]						
C20/25	Type B 9, 12, 14, 16, 18, 20					
	d [mm]					
	100	120	140	160	180	200
dia. 8/25	44.3	49.4	53.0	56.5	56.7	56.7
dia. 8/20	44.3	49.4	53.0	56.5	60.1	63.6
dia. 8/15	44.3	49.4	53.0	56.5	60.1	63.6
dia. 8/10	44.3	49.4	53.0	56.5	60.1	63.6
dia. 10/25	44.3	49.4	53.0	56.5	60.1	63.6
dia. 10/20	44.3	49.4	53.0	56.5	60.1	63.6
dia. 10/15	44.3	49.4	53.0	56.5	60.1	63.6
dia. 10/10	-	50.8	53.2	56.5	60.1	63.6
dia. 12/25	44.3	53.1	62.0	65.9	69.4	73.0
dia. 12/20	44.9	53.1	62.0	65.9	69.4	73.0
dia. 12/15	-	55.8	62.0	65.9	69.4	73.0
dia. 12/10	-	-	65.9	68.5	71.0	73.5

C25/30	Type B 9, 12, 14, 16, 18, 20					
	d [mm]					
	100	120	140	160	180	200
dia. 8/25	49.5	56.5	60.4	64.4	65.8	65.8
dia. 8/20	49.5	56.5	60.4	64.4	68.3	72.3
dia. 8/15	49.5	56.5	60.4	64.4	68.3	72.3
dia. 8/10	49.5	56.5	60.4	64.4	68.3	72.3
dia. 10/25	49.5	56.5	60.4	64.4	68.3	72.3
dia. 10/20	49.5	56.5	60.4	64.4	68.3	72.3
dia. 10/15	49.5	56.5	60.4	64.4	68.3	72.3
dia. 10/10	-	57.1	60.4	64.4	68.3	72.3
dia. 12/25	49.5	59.4	69.3	75.3	79.2	83.2
dia. 12/20	49.5	59.4	69.3	75.3	79.2	83.2
dia. 12/15	-	60.1	69.3	75.3	79.2	83.2
dia. 12/10	-	-	74.1	76.9	79.7	83.2

C30/37	Type B 9, 12, 14, 16, 18, 20					
	d [mm]					
	100	120	140	160	180	200
dia. 8/25	54.2	62.9	67.3	69.9	69.9	69.9
dia. 8/20	54.2	62.9	67.3	71.6	76.0	80.3
dia. 8/15	54.2	62.9	67.3	71.6	76.0	80.3
dia. 8/10	54.2	62.9	67.3	71.6	76.0	80.3
dia. 10/25	54.2	62.9	67.3	71.6	76.0	80.3
dia. 10/20	54.2	62.9	67.3	71.6	76.0	80.3
dia. 10/15	54.2	62.9	67.3	71.6	76.0	80.3
dia. 10/10	-	62.9	67.3	71.6	76.0	80.3
dia. 12/25	54.2	65.1	75.9	83.9	88.3	92.6
dia. 12/20	54.2	65.1	75.9	83.9	88.3	92.6
dia. 12/15	-	65.1	75.9	83.9	88.3	92.6
dia. 12/10	-	-	81.0	84.7	88.3	92.6

Assumptions: Load-bearing capacity of the joint in accordance with case e, DBV bulletin "Reverse bending" – see page 7
 $s_{cd} = 0$



The values in the table apply to type B elements on page 10 with:
 $h = 170 \text{ mm}$
 dia. 8 $l_u = 320 \text{ mm}$
 dia. 10 $l_u = 390 \text{ mm}$
 dia. 12 $l_u = 460 \text{ mm}$

The information in the type test must be taken into account. The existing reverse bending movement covers a clamping torque of $m_{Ed} = v_{Ed} \cdot z$. For greater torques, it is necessary to separately prove that the tensile force is covered.

FERBOX® TYPE BQ CASE e

SHEARING FORCE VERTICAL TO THE JOINT WITHOUT LATERAL FORCE REINFORCEMENT

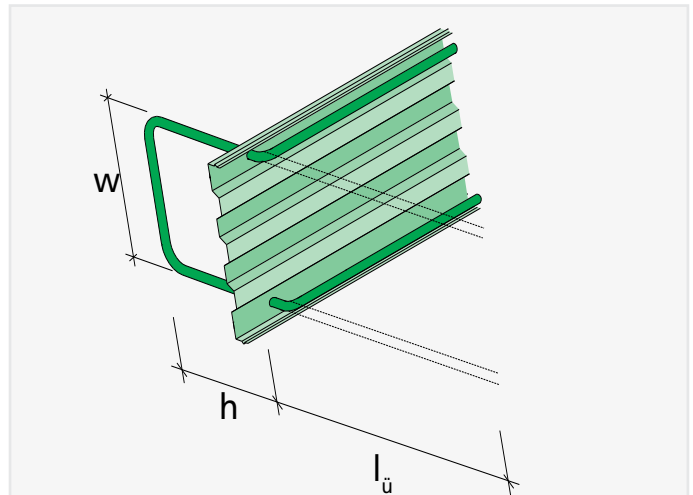
DESIGN VALUES IN ACCORDANCE WITH THE TYPE TEST

toothed in accordance with EC2

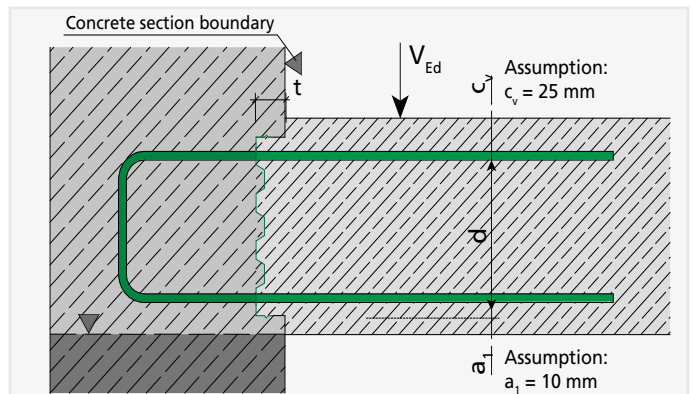
Maximum lateral force load-bearing capacity of the connection without lateral force reinforcement in the ceiling: max. v_{Ed} [kN/m]						
C20/25	Type BQ 9, 12, 14, 16, 18, 20					
	d [mm]					
	100	120	140	160	180	200
dia. 8/25	44.3	53.1	56.7	56.7	56.7	56.7
dia. 8/20	44.3	53.1	62.0	70.8	70.8	70.8
dia. 8/15	44.3	53.1	62.0	70.8	79.7	88.5
dia. 8/10	44.3	53.1	62.0	70.8	79.7	88.5
dia. 10/25	44.3	53.1	62.0	70.8	70.8	70.8
dia. 10/20	44.3	53.1	62.0	70.8	79.7	88.5
dia. 10/15	44.3	53.1	62.0	70.8	79.7	88.5
dia. 10/10	-	56.6	62.7	70.8	79.7	88.5
dia. 12/25	44.3	53.1	62.0	70.8	79.7	85.0
dia. 12/20	44.9	53.1	62.0	70.8	79.7	88.5
dia. 12/15	-	55.8	62.0	70.8	79.7	88.5
dia. 12/10	-	-	70.8	77.4	83.7	89.8

Assumptions: Load-bearing capacity of the joint in accordance with case e, DBV bulletin "Reverse bending" – see page 7

$s_{cd} =$



C25/30	Type BQ 9, 12, 14, 16, 18, 20					
	d [mm]					
	100	120	140	160	180	200
dia. 8/25	49.5	59.4	65.8	65.8	65.8	65.8
dia. 8/20	49.5	59.4	69.3	79.2	82.2	82.2
dia. 8/15	49.5	59.4	69.3	79.2	89.1	99.0
dia. 8/10	49.5	59.4	69.3	79.2	89.1	99.0
dia. 10/25	49.5	59.4	69.3	79.2	82.2	82.2
dia. 10/20	49.5	59.4	69.3	79.2	89.1	99.0
dia. 10/15	49.5	59.4	69.3	79.2	89.1	99.0
dia. 10/10	-	60.9	69.3	79.2	89.1	99.0
dia. 12/25	49.5	59.4	69.3	79.2	89.1	98.6
dia. 12/20	49.5	59.4	69.3	79.2	89.1	99.0
dia. 12/15	-	60.1	69.3	79.2	89.1	99.0
dia. 12/10	-	-	76.3	83.4	90.2	99.0



C30/37	Type BQ 9, 12, 14, 16, 18, 20					
	d [mm]					
	100	120	140	160	180	200
dia. 8/25	54.2	65.1	69.9	69.9	69.9	69.9
dia. 8/20	54.2	65.1	75.9	86.8	87.4	87.4
dia. 8/15	54.2	65.1	75.9	86.8	97.6	108.4
dia. 8/10	54.2	65.1	75.9	86.8	97.6	108.4
dia. 10/25	54.2	65.1	75.9	86.8	92.8	92.8
dia. 10/20	54.2	65.1	75.9	86.8	97.6	108.4
dia. 10/15	54.2	65.1	75.9	86.8	97.6	108.4
dia. 10/10	-	65.1	75.9	86.8	97.6	108.4
dia. 12/25	54.2	65.1	75.9	86.8	97.6	108.4
dia. 12/20	54.2	65.1	75.9	86.8	97.6	108.4
dia. 12/15	-	65.1	75.9	86.8	97.6	108.4
dia. 12/10	-	-	81.0	88.6	97.6	108.4

The values in the table apply to type BQ elements on page 11 with:

- h = 170 mm
- dia. 8 l_u = 320 mm
- dia. 10 l_u = 390 mm
- dia. 12 l_u = 460 mm

The information in the type test must be taken into account. The existing reverse bending movement covers a clamping torque of $m_{Ed} = v_{Ed} \cdot z$. For greater torques, it is necessary to separately prove that the tensile force is covered.

FERBOX® TYPE B, BQ CASE e

SHEARING FORCE VERTICAL TO THE JOINT WITH LATERAL FORCE REINFORCEMENT

DESIGN VALUES IN ACCORDANCE WITH THE TYPE TEST

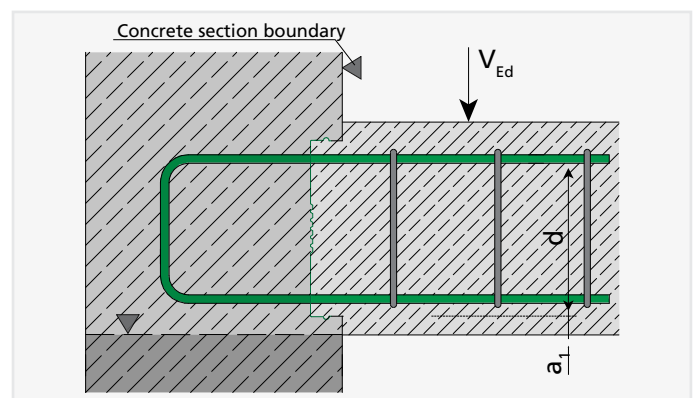
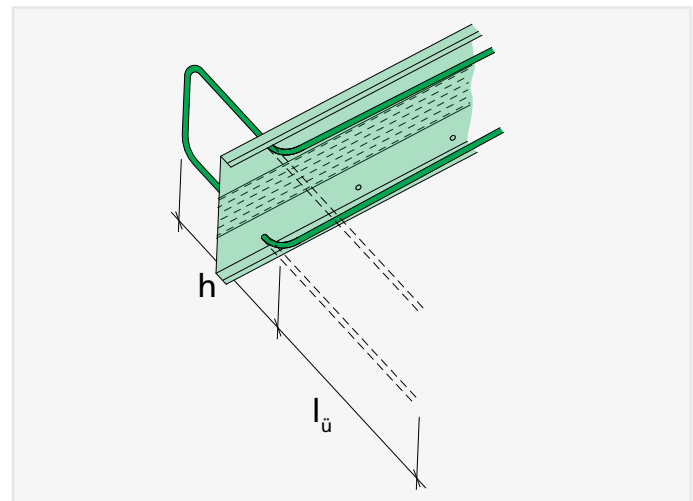
Joint smooth or toothed in accordance with EC2

Maximum lateral force load-bearing capacity of the connection with lateral force reinforcement in the ceiling: max. v_{Ed} [kN/m]						
C20/25	Type B, BQ 9, 12, 14, 16, 18, 20					
	d [mm]					
	100	120	140	160	180	200
dia. 8/25	56.7	56.7	56.7	56.7	56.7	56.7
dia. 8/20	70.8	70.8	70.8	70.8	70.8	70.8
dia. 8/15	73.3	94.4	94.4	94.4	94.4	94.4
dia. 8/10	73.3	98.8	124.3	141.7	141.7	141.7
dia. 10/25	70.8	70.8	70.8	70.8	70.8	70.8
dia. 10/20	73.3	88.5	88.5	88.5	88.5	88.5
dia. 10/15	73.3	98.8	118.1	118.1	118.1	118.1
dia. 10/10	-	98.8	124.3	149.8	175.3	177.1
dia. 12/25	73.3	85.0	85.0	85.0	85.0	85.0
dia. 12/20	73.3	98.8	106.2	106.2	106.2	106.2
dia. 12/15	-	98.8	124.3	141.7	141.7	141.7
dia. 12/10	-	-	124.3	149.8	175.3	200.8

Assumptions: Load-bearing capacity of the joint in accordance with case e, DBV bulletin "Reverse bending" – see page 7
 $s_{cd} = 0$

C25/30	Type B, BQ 9, 12, 14, 16, 18, 20					
	d [mm]					
	100	120	140	160	180	200
dia. 8/25	65.8	65.8	65.8	65.8	65.8	65.8
dia. 8/20	82.2	82.2	82.2	82.2	82.2	82.2
dia. 8/15	91.6	109.6	109.6	109.6	109.6	109.6
dia. 8/10	91.6	123.5	155.4	164.4	164.4	164.4
dia. 10/25	82.2	82.2	82.2	82.2	82.2	82.2
dia. 10/20	91.6	102.7	102.7	102.7	102.7	102.7
dia. 10/15	91.6	123.5	137.0	137.0	137.0	137.0
dia. 10/10	-	123.5	155.4	187.3	205.5	205.5
dia. 12/25	91.6	98.6	98.6	98.6	98.6	98.6
dia. 12/20	91.6	123.3	123.3	123.3	123.3	123.3
dia. 12/15	-	123.5	155.4	164.4	164.4	164.4
dia. 12/10	-	-	155.4	187.3	219.1	246.6

C30/37	Type B, BQ 9, 12, 14, 16, 18, 20					
	d [mm]					
	100	120	140	160	180	200
dia. 8/25	69.9	69.9	69.9	69.9	69.9	69.9
dia. 8/20	87.4	87.4	87.4	87.4	87.4	87.4
dia. 8/15	110.0	116.6	116.6	116.6	116.6	116.6
dia. 8/10	110.0	148.2	174.8	174.8	174.8	174.8
dia. 10/25	92.8	92.8	92.8	92.8	92.8	92.8
dia. 10/20	110.0	116.0	116.0	116.0	116.0	116.0
dia. 10/15	110.0	148.2	154.7	154.7	154.7	154.7
dia. 10/10	-	148.2	186.5	224.7	232.0	232.0
dia. 12/25	110.0	111.4	111.4	111.4	111.4	111.4
dia. 12/20	110.0	139.2	139.2	139.2	139.2	139.2
dia. 12/15	-	148.2	185.6	185.6	185.6	185.6
dia. 12/10	-	-	186.5	224.7	263.0	278.4



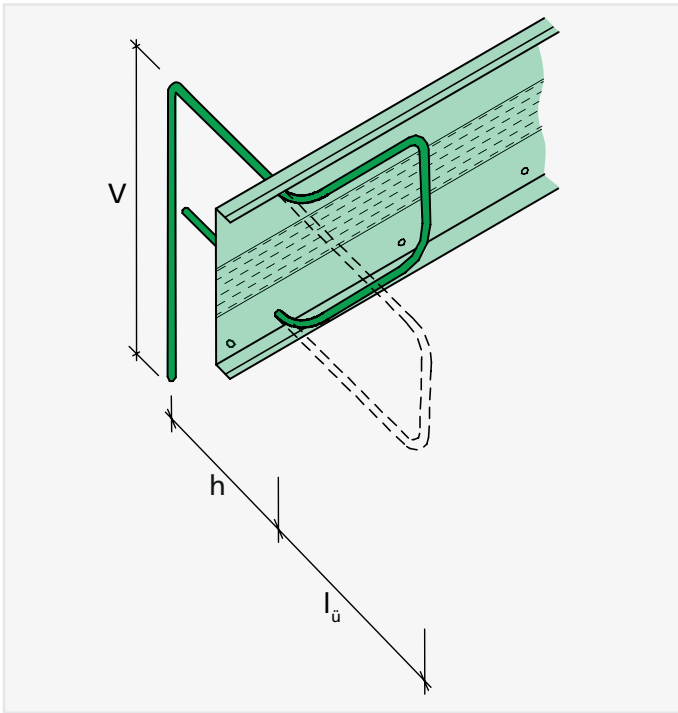
The values in the table apply to type B elements on page 10 with:
 $h = 170 \text{ mm}$
 dia. 8 $l_u = 320 \text{ mm}$
 dia. 10 $l_u = 390 \text{ mm}$
 dia. 12 $l_u = 460 \text{ mm}$

The information in the type test must be taken into account. The existing reverse bending movement covers a clamping torque of $m_{Ed} = v_{Ed} \cdot z$. For greater torques, it is necessary to separately prove that the tensile force is covered.

FERBOX® TYPE A3 SPECIAL CASE: CORBEL

SHEARING FORCE VERTICAL TO THE JOINT

DESIGN VALUES IN ACCORDANCE WITH THE TYPE TEST

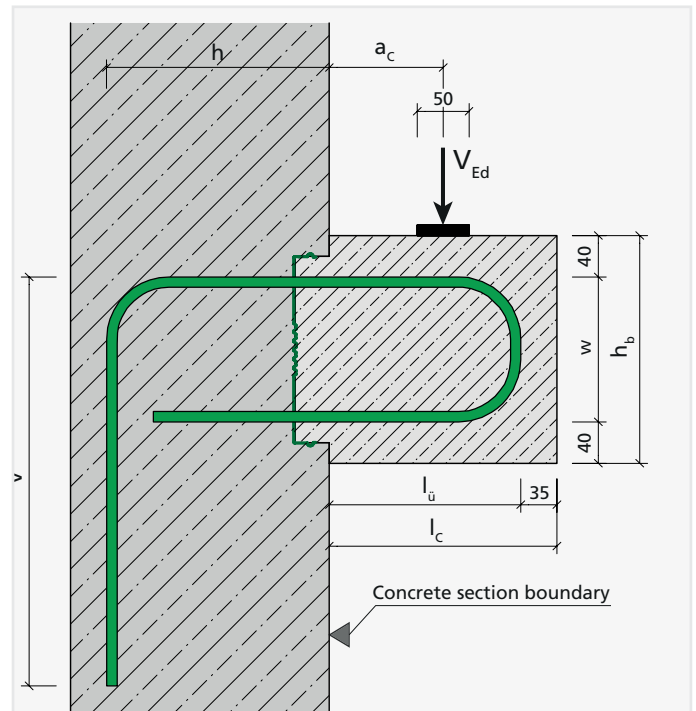


Joint smooth or toothed in accordance with EC2

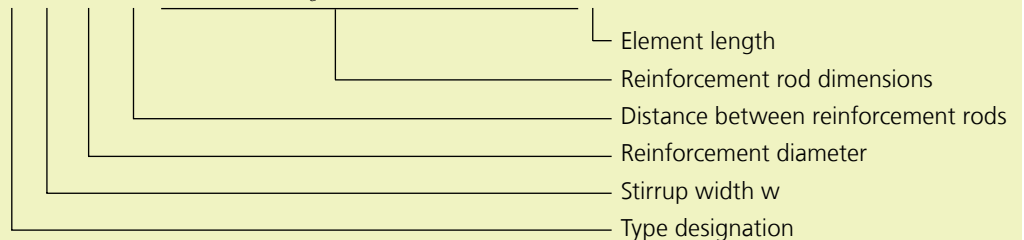
Comment:

For $V_{Rd,2} < V_{Ed} \leq V_{Rd,1}$, closed vertical stirrups must be arranged for stirrup forces of $0.7 \cdot V_{Ed}$ in total.
 For $V_{Ed} \leq V_{Rd,2}$, no additional vertical stirrups are required.

The following lengths are specified for v:
 for $d_s = 8 \text{ mm} \rightarrow v = 320 \text{ mm}$
 for $d_s = 10 \text{ mm} \rightarrow v = 390 \text{ mm}$
 for $d_s = 12 \text{ mm} \rightarrow v = 460 \text{ mm}$



Example order: FERBOX® type A3/18 – 10 – 15, h = 170 mm, $l_u = 390 \text{ mm}$, v = 390 mm, l = 1.25 m



FERBOX® TYPE A3 SPECIAL CASE: CORBEL

SHEARING FORCE VERTICAL TO THE JOINT

DESIGN VALUES IN ACCORDANCE WITH THE TYPE TEST

Maximum lateral force load-bearing capacity of the connection: max. v_{Ed} [kN/m]												
C20/25	$h_b = 180$ mm $l_c = 180$ mm $a_c = 90$ mm		$h_b = 200$ mm $l_c = 200$ mm $a_c = 100$ mm		$h_b = 220$ mm $l_c = 220$ mm $a_c = 110$ mm		$h_b = 250$ mm $l_c = 250$ mm $a_c = 130$ mm		$h_b = 280$ mm $l_c = 280$ mm $a_c = 150$ mm		$h_b = 300$ mm $l_c = 300$ mm $a_c = 160$ mm	
	$V_{Rd,1}$	$V_{Rd,2}$	$V_{Rd,1}$	$V_{Rd,2}$	$V_{Rd,1}$	$V_{Rd,2}$	$V_{Rd,1}$	$V_{Rd,2}$	$V_{Rd,1}$	$V_{Rd,2}$	$V_{Rd,1}$	$V_{Rd,2}$
dia. 8/20	42.5	42.5	51.0	51.0	59.5	59.5	67.4	67.4	75.0	75.0	81.4	81.4
dia. 8/15	55.6	48.0	66.9	56.9	78.1	65.7	88.6	79.0	98.8	90.9	107.3	96.3
dia. 8/10	75.7	48.0	97.0	56.9	113.5	65.7	129.3	79.0	144.5	90.9	157.0	96.3
dia. 10/20	51.9	47.6	62.4	56.4	73.0	65.3	82.9	78.6	92.5	90.6	102.7	96.0
dia. 10/15	67.6	47.6	81.5	56.4	95.4	65.3	108.6	78.6	121.3	90.6	134.9	96.0
dia. 12/20	-	-	-	-	86.0	64.9	97.9	78.1	109.4	90.3	121.6	95.8
dia. 12/15	-	-	-	-	111.9	64.9	127.8	78.1	143.1	90.3	159.1	95.8

C25/30	$V_{Rd,1}$	$V_{Rd,2}$	$V_{Rd,1}$	$V_{Rd,2}$	$V_{Rd,1}$	$V_{Rd,2}$	$V_{Rd,1}$	$V_{Rd,2}$	$V_{Rd,1}$	$V_{Rd,2}$	$V_{Rd,1}$	$V_{Rd,2}$
dia. 8/20	49.5	49.5	59.4	59.4	69.3	69.3	78.4	78.4	87.3	87.3	90.1	90.1
dia. 8/15	64.9	53.7	78.0	63.6	91.1	73.5	103.2	88.4	115.1	101.6	118.9	107.7
dia. 8/10	94.0	53.7	113.4	63.6	132.6	73.5	150.9	88.4	168.6	101.6	174.6	107.7
dia. 10/20	60.5	53.2	72.8	63.1	85.1	73.0	96.5	87.9	107.7	101.3	119.6	107.4
dia. 10/15	78.9	53.2	95.2	63.1	111.4	73.0	126.7	87.9	141.4	101.3	157.2	107.4
dia. 12/20	-	-	85.6	62.6	100.3	72.5	114.1	87.4	127.4	101.0	141.6	107.1
dia. 12/15	-	-	111.5	62.6	130.8	72.5	149.2	87.4	166.9	101.0	185.6	107.1

C30/37	$V_{Rd,1}$	$V_{Rd,2}$	$V_{Rd,1}$	$V_{Rd,2}$	$V_{Rd,1}$	$V_{Rd,2}$	$V_{Rd,1}$	$V_{Rd,2}$	$V_{Rd,1}$	$V_{Rd,2}$	$V_{Rd,1}$	$V_{Rd,2}$
dia. 8/20	56.1	56.1	67.3	67.3	78.5	78.5	86.3	86.3	88.2	88.2	90.6	90.6
dia. 8/15	73.6	58.8	88.4	69.7	103.2	80.5	113.6	96.8	116.5	111.3	119.7	118.0
dia. 8/10	106.8	58.8	128.7	69.7	150.6	80.5	166.5	96.8	171.3	111.3	176.4	118.0
dia. 10/20	68.6	58.3	82.5	69.1	96.4	80.0	109.3	96.2	121.9	111.0	135.4	117.6
dia. 10/15	89.6	58.3	108.0	69.1	126.3	80.0	143.6	96.2	160.3	111.0	178.1	117.6
dia. 12/20	-	-	97.1	68.6	113.7	79.4	129.2	95.7	144.3	110.6	160.4	117.3
dia. 12/15	-	-	126.6	68.6	148.4	79.4	169.2	95.7	189.3	110.6	210.5	117.3

The information in the type test must be taken into account.

SPECIAL TYPES AND APPLICATIONS

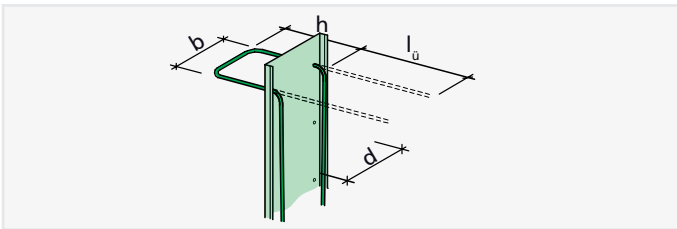
A total of 14 special types are available with the appropriate stirrup shapes.

The dimensions of the stirrups and lengths of the elements are restricted by production conditions and the (freely selectable) box width. See the table on page 28 for more information.

TYPE OVERVIEW AND APPLICATION

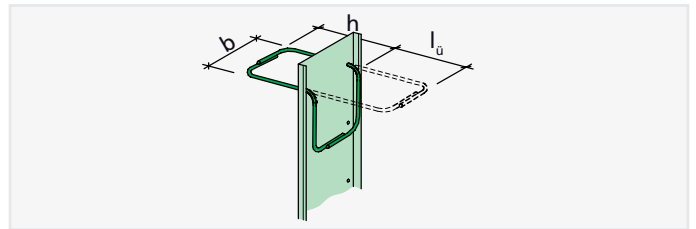
FERBOX® TYPE A0/... A0Q/... A0L/...

Double-row attachment, e.g. of a concrete wall/ceiling to a concrete wall.



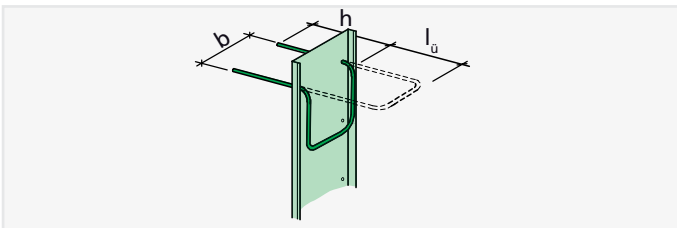
FERBOX® TYPE A1/... A1Q/... A1L/...

Double-row attachment, e.g. of a corbel to a concrete wall.



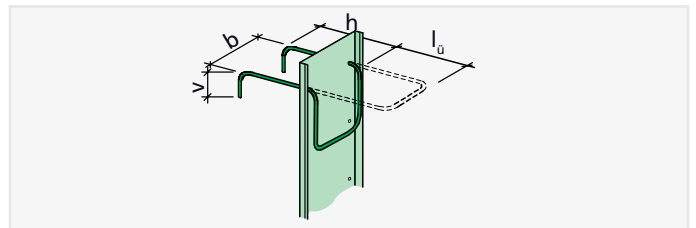
FERBOX® TYPE A2/... A2Q/... A2L/...

Double-row attachment, e.g. of a corbel to a concrete wall.



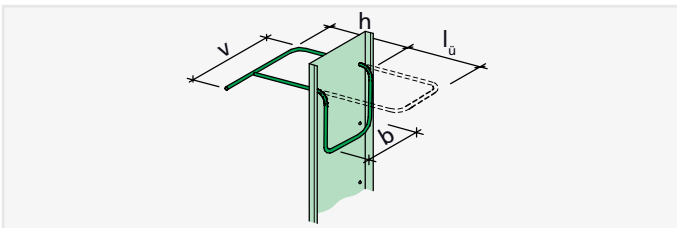
FERBOX® TYPE A2V/... A2VQ/... A2VL/...

Double-row attachment, e.g. of a corbel to a concrete wall with a greater anchorage length.



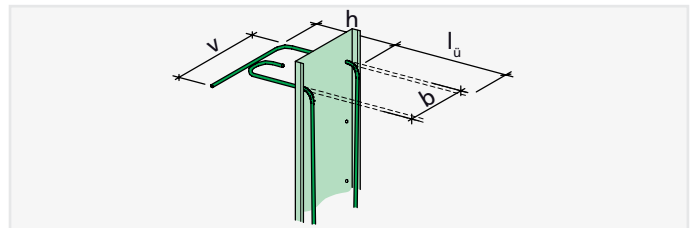
FERBOX® TYPE A3/... A3Q/... A3L/...

Double-row attachment, e.g. of a corbel to a concrete wall.



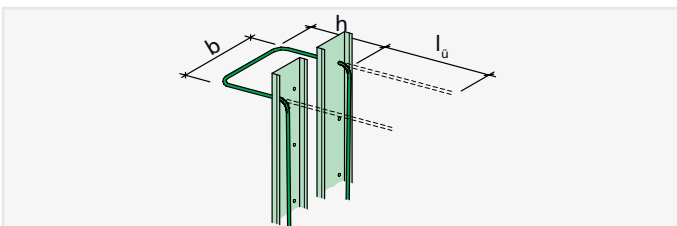
FERBOX® TYPE R3/... R3Q/... R3L/...

Double-row attachment, e.g. of a rigid ceiling attachment.



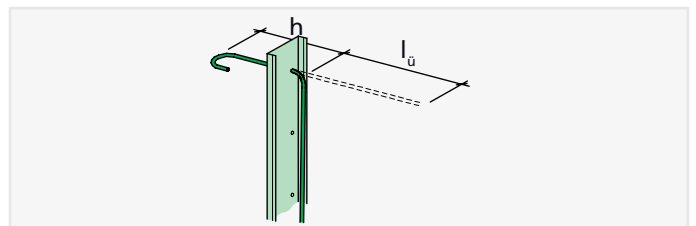
FERBOX® TYPE D

Double-row attachment, e.g. of concrete walls ≥ 270 mm to a concrete wall.



FERBOX® TYPE S1

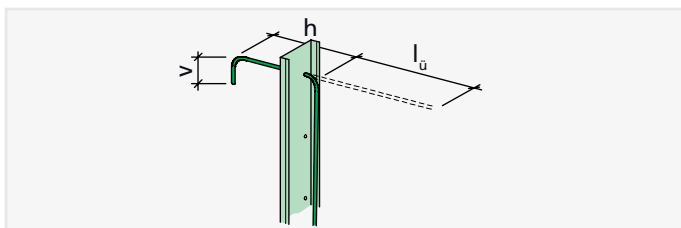
Single-row attachment, e.g. of a concrete wall to a concrete wall or concrete column.



SPECIAL TYPES AND APPLICATIONS

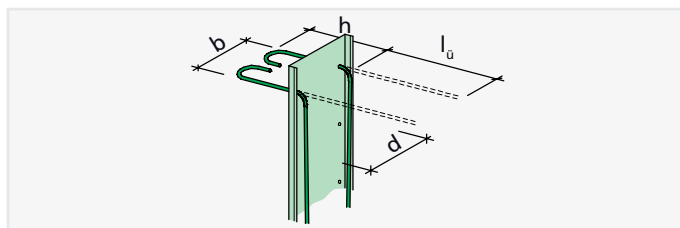
FERBOX® TYPE S2

Single-row attachment, e.g. of a concrete wall to a concrete wall or concrete column



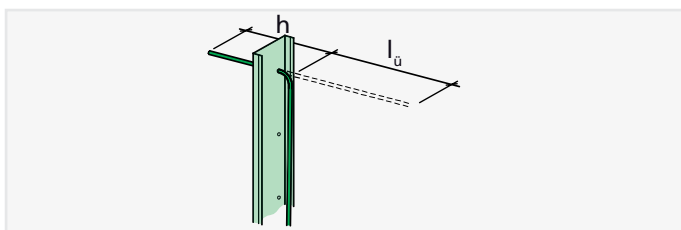
FERBOX® TYPE S3/... S3Q/... S3L/...

Double-row attachment, e.g. of a concrete wall/ceiling to a concrete wall



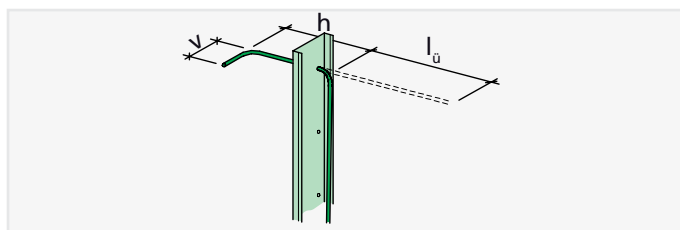
FERBOX® TYPE S4

Single-row lap joint on both sides, e.g. wall-to-wall



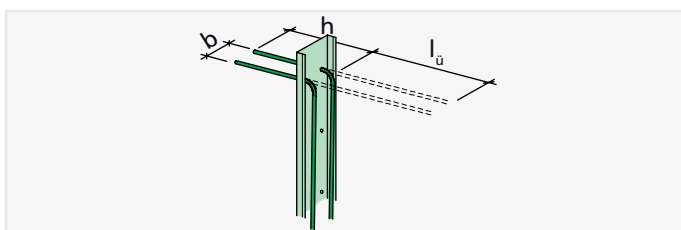
FERBOX® TYPE S5

Single-row attachment, e.g. of concrete walls ≥ 80 mm to a concrete wall or concrete column



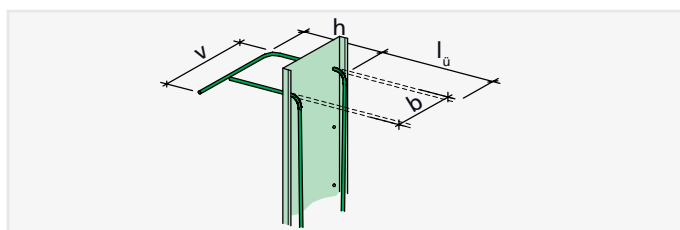
FERBOX® TYPE S6/... S6Q/... S6L/...

Double-row lap joint on both sides, e.g. wall-to-wall

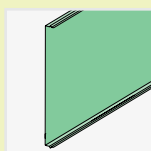


FERBOX® TYPE S45/... S45Q/... S45L/...

Double-row attachment, e.g. of a rigid ceiling attachment.

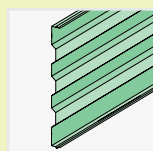


ALL DOUBLE-ROW TYPES ARE AVAILABLE IN THE FOLLOWING DESIGNS:



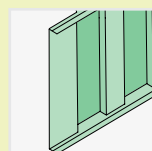
Smooth

e.g. A0/...



With horizontal teeth

e.g. A0Q/...



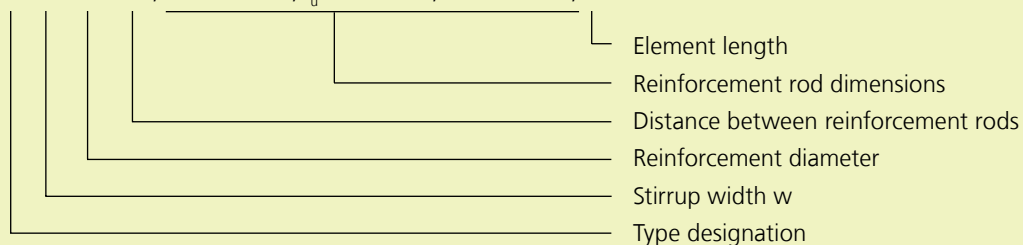
With vertical teeth

e.g. A0L/...

FERBOX® SPECIAL TYPE DESIGNATION

Definition of special types using type designation, diameter, division and reinforcement rod dimensions.

Example order: FERBOX® type A3/18 – 10 – 15, $h = 120$ mm, $l_u = 140$ mm, $v = 300$ mm, $l = 1.00$ m



MAXIMUM LAP LENGTHS FOR SPECIAL TYPES

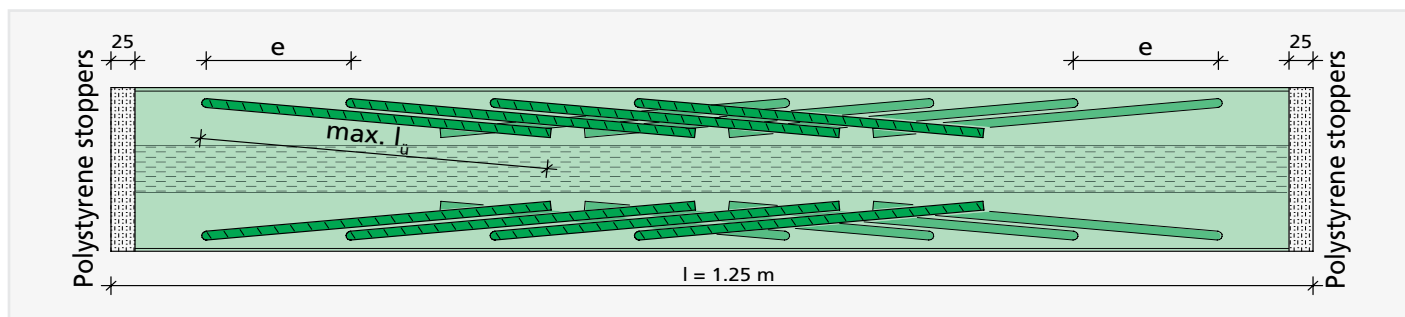
Box [mm]	Rod dia. [mm]	Clearance [mm]	max. l_0 [mm] for special type		
			S1, S2, S4, S5, D	S3, S6, A0, R3	A1, A2, A2V, A3
55	8	100	320	-	-
		150	470	-	-
		200	600	-	-
	10	100	280	-	-
		150	400	-	-
		200	500	-	-
85	8	100	590	-	70
		150	650	300	120
		200	600	320	170
	10	100	490	-	-
		150	600	300	120
		200	600	320	170
	12	100	460	-	-
		150	600	-	-
		200	600	-	-
115	8	100	-	340	140
		150	-	600	250
		200	-	600	320
	10	100	-	320	90
		150	-	550	150
		200	-	460	200
	12	100	-	-	-
		150	-	430	130
		200	-	460	180
145	8	100	-	500	230
		150	-	600	320
		200	-	600	320
	10	100	-	380	180
		150	-	600	310
		200	-	600	320
	12	100	-	400	130
		150	-	600	220
		200	-	600	280

Box [mm]	Rod dia. [mm]	Clearance [mm]	max. l_0 [mm] for special type		
			S1, S2, S4, S5, D	S3, S6, A0, R3	A1, A2, A2V, A3
165	8	100	-	600	310
		150	-	600	320
		200	-	600	320
	10	100	-	460	240
		150	-	600	320
		200	-	600	320
12	100	-	430	180	
	150	-	600	310	
	200	-	600	320	
185	8	100	-	600	320
		150	-	600	320
		200	-	600	320
	10	100	-	550	310
		150	-	600	320
		200	-	600	320
	12	100	-	480	240
		150	-	600	320
		200	-	600	320
205	8	100	-	600	320
		150	-	600	320
		200	-	600	320
	10	100	-	600	320
		150	-	600	320
		200	-	600	320
	12	100	-	550	300
		150	-	600	320
		200	-	600	320
225	8	100	-	600	320
		150	-	600	320
		200	-	600	320
	10	100	-	600	320
		150	-	600	320
		200	-	600	320
	12	100	-	600	320
		150	-	600	320
		200	-	600	320

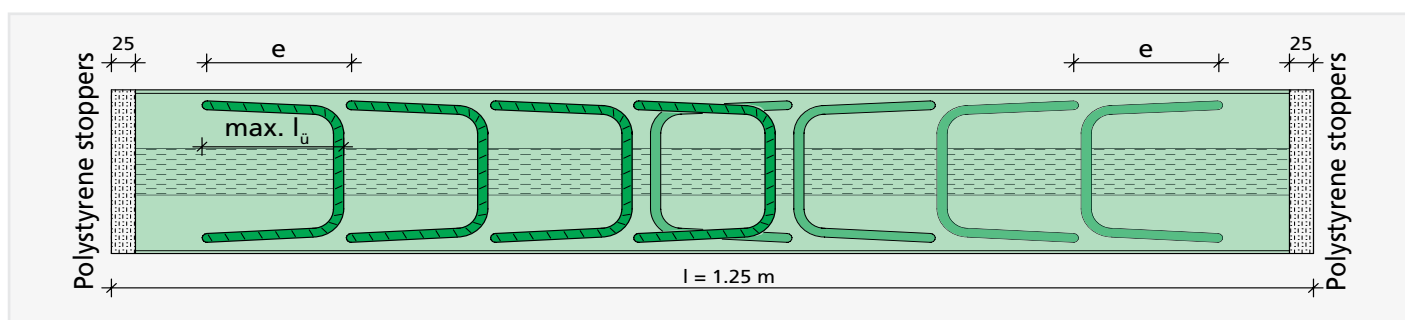
Max. l_0 for clearance of $e = 250$ mm available on request
* for conically bent reinforcement rods of the types A1, A2, A2V, A3

MAXIMUM LAP LENGTHS FOR SPECIAL TYPES

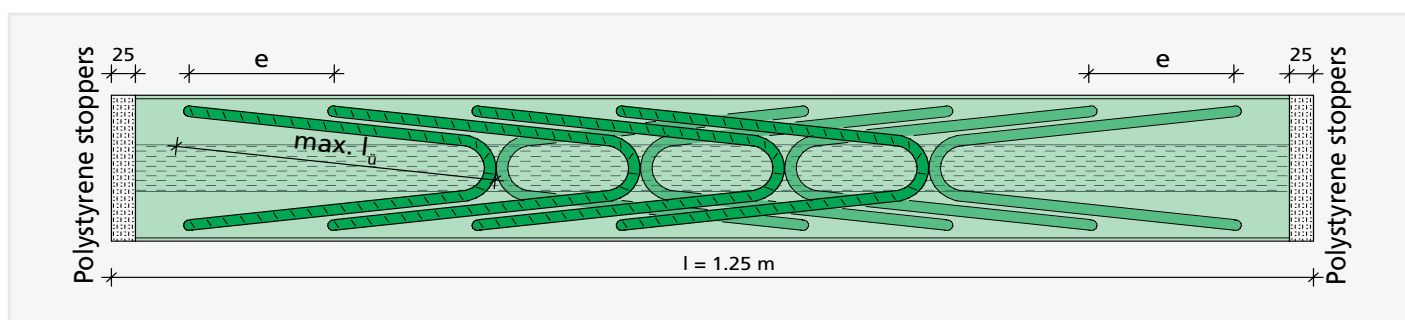
REINFORCEMENT ROD ARRANGEMENT AND MAX. LAP LENGTH $l_{\bar{u}}$



Type B, E, S1, S2, S3, S4, S5, S6, A0, R3, D



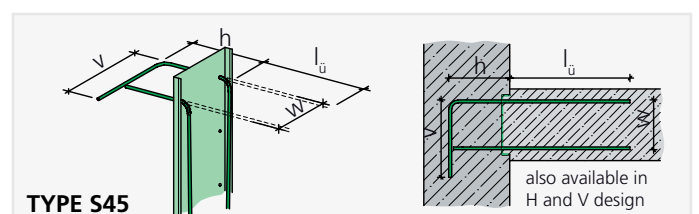
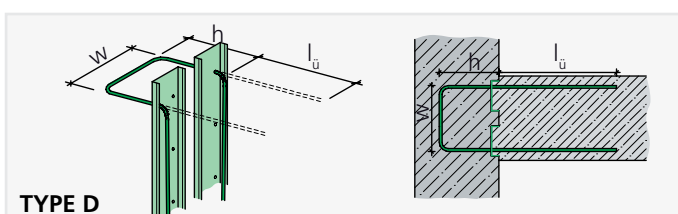
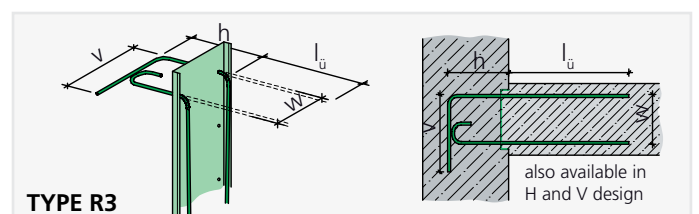
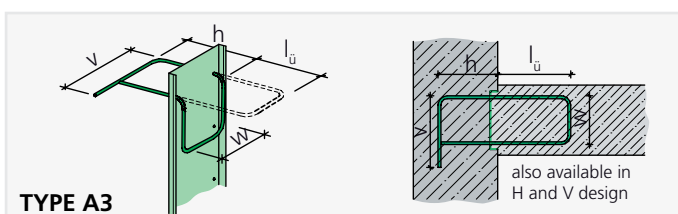
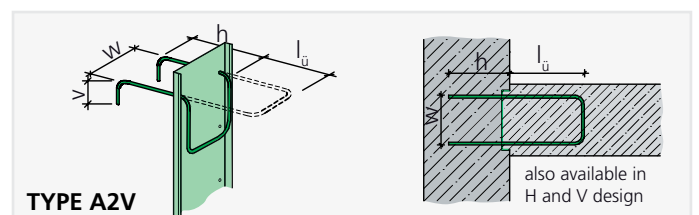
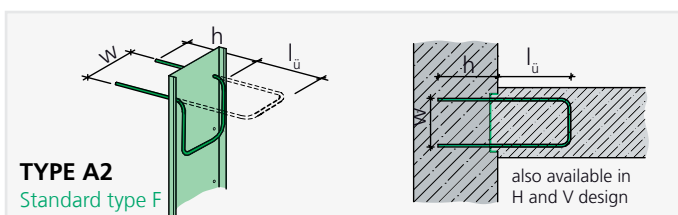
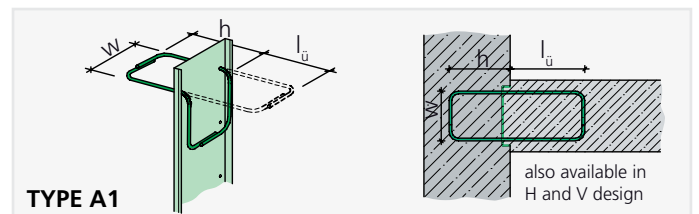
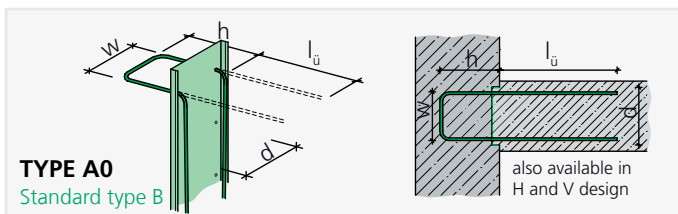
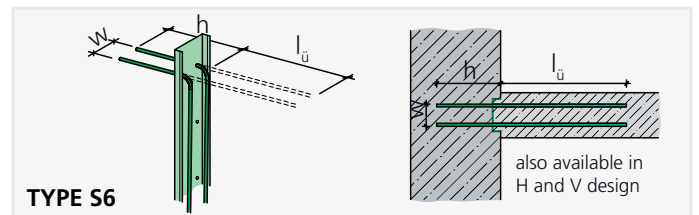
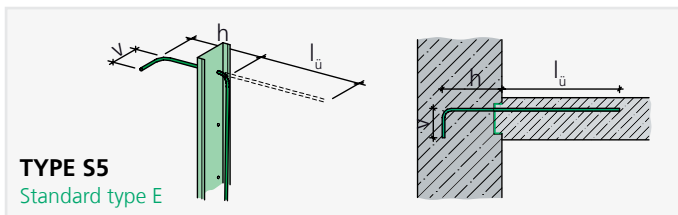
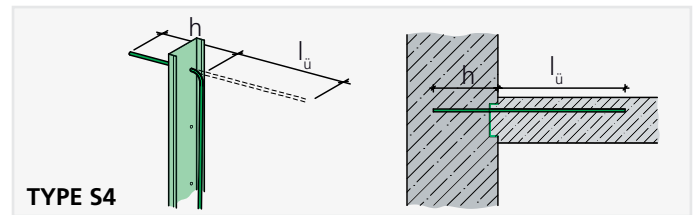
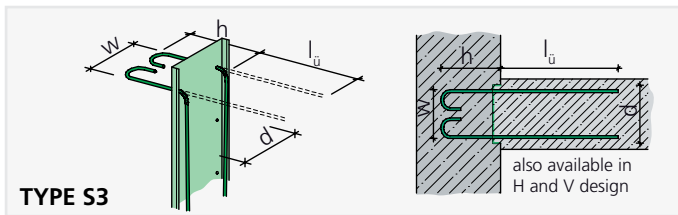
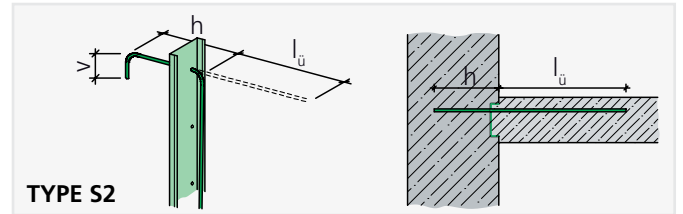
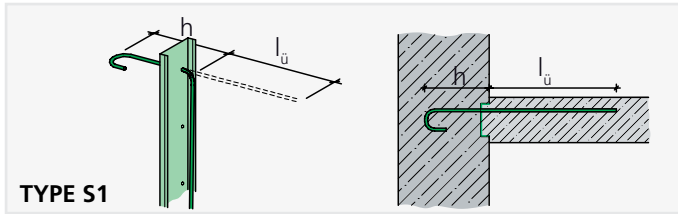
Type F, A1, A2, A2V, A3 bent normally



Type A1, A2, A2V, A3 bent conically

ORDER FORM

OVERVIEW OF FERBOX® SPECIAL AND STANDARD TYPES



ORDER FORM

By fax to
+49 (0) 77 42 / 92 15-90

1. CONSTRUCTION PROJECT: _____

2. OFFER TO:

Company stamp	Company _____
	Contact _____
	Telephone _____ Fax _____
	E-mail _____
	Street address _____
	Postcode, town/city _____

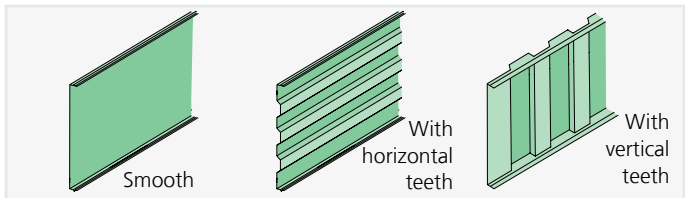
3. PROJECT PHASE: Costing _____
 Requirements construction company: _____

4. DESIGN:

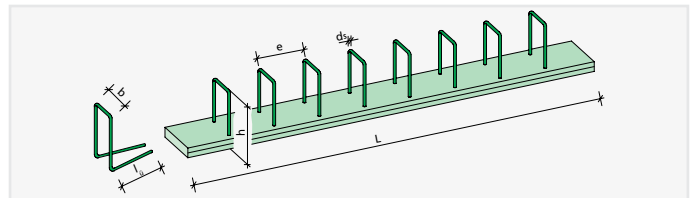
Item	Type	Box design			Reinforcement [mm]		Dimensions [mm]				Quantity [Pcs]	
		Smooth	With horizontal teeth	With vertical teeth	d_s	e	w	h	l_u^*	v		L

* Observe the max. lap lengths – see page 28

BOX DESIGN:

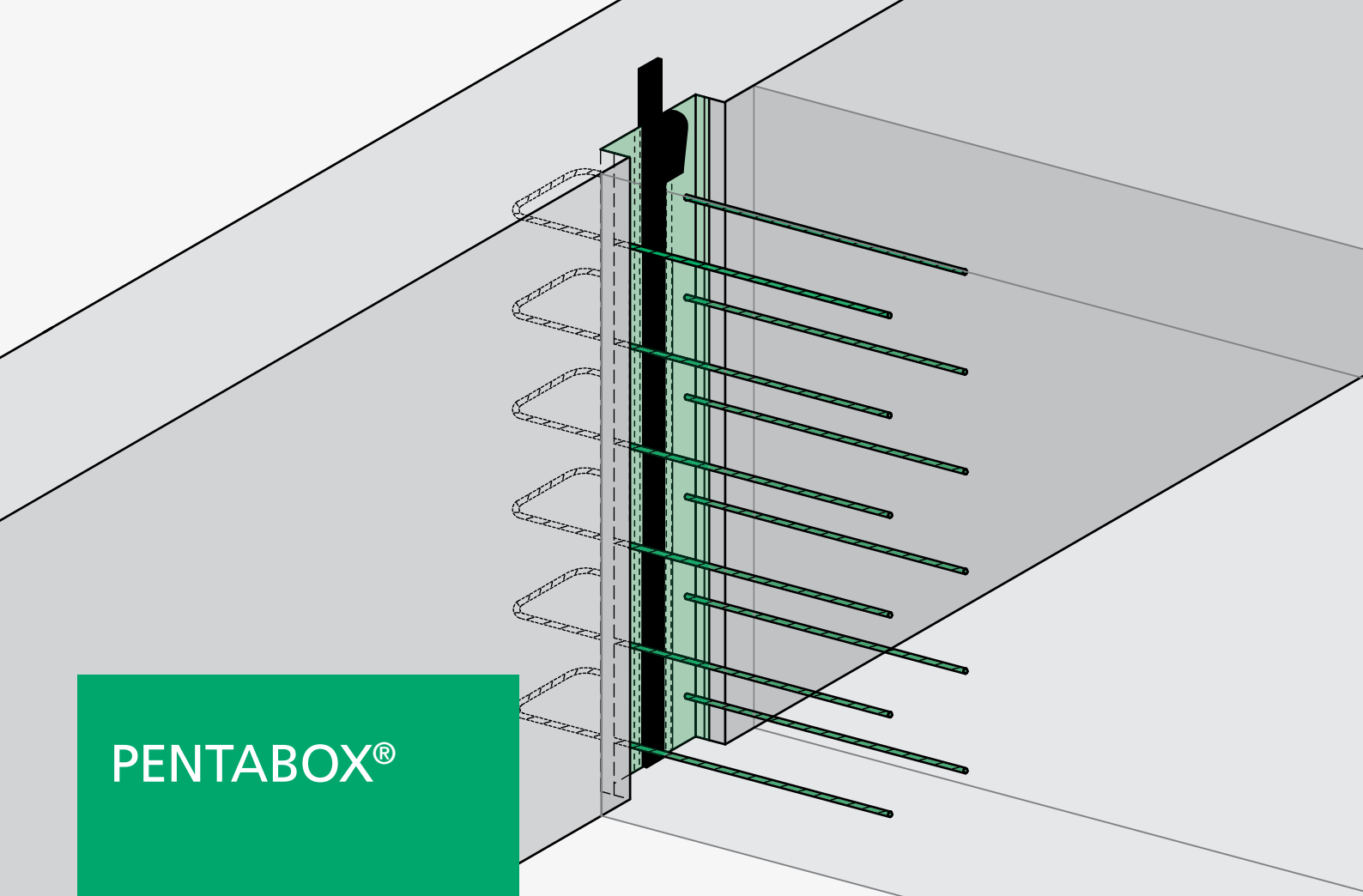


SYSTEM DIAGRAM:



Example order: FERBOX® type A3/18 – 10 – 15, $h = 120$ mm, $l_u = 140$ mm, $v = 300$ mm, $l = 1.00$ m

_____	Element length
_____	Reinforcement rod dimensions
_____	Distance between reinforcement rods
_____	Reinforcement diameter
_____	Stirrup width w
_____	Type designation



PENTABOX®

REBEND CONNECTION FOR WATERTIGHT CONSTRUCTION JOINTS

TECHNICAL INFORMATION

PENTABOX® is a FERBOX® reinforcement attachment supplemented by the PENTAFLEX® coating, offering the maximum possible protection against leaks in the joint area compared to conventional rebend connections.

The FERBOX® types are coated on both sides with PENTAFLEX® at the factory in order to prevent ingress of water along the flashing box. This also enables water-impervious rebend connections to be easily fabricated.

PENTABOX® rebend connections can be connected together using the PENTAFLEX® strip protruding on both sides.

TYPES AND DIMENSIONS

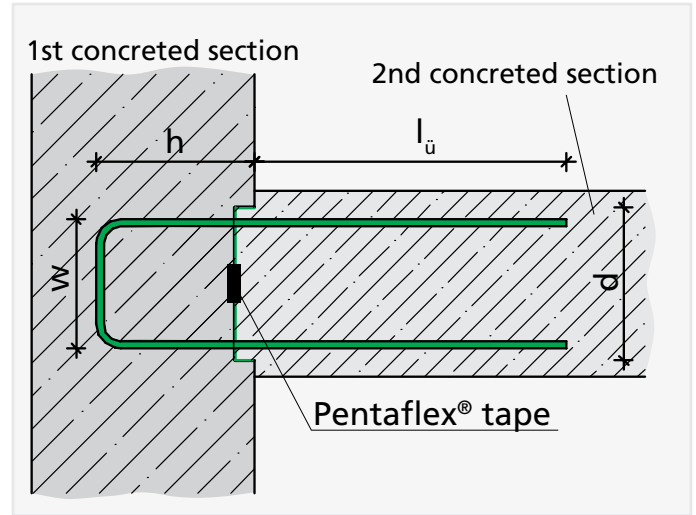
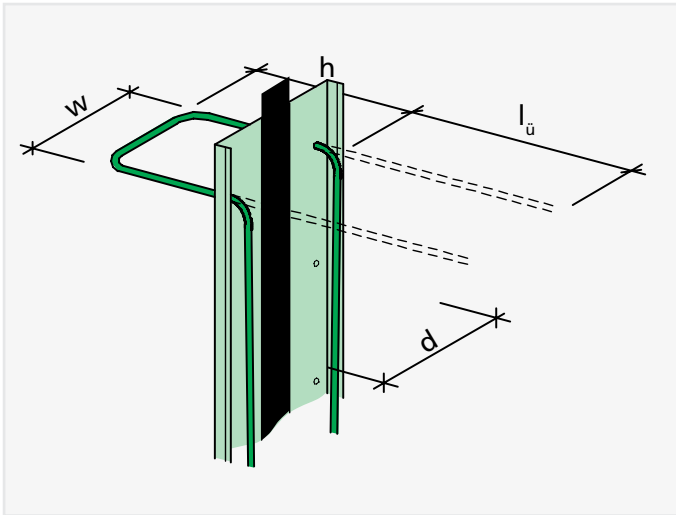
- Standard type based on the FERBOX® type B
- Special types with box widths of 115 mm or more available on request
- The dimensions of the flashing box the and reinforcement density can be found on page 10

APPLICATION AREAS

PENTABOX® can be used for all components that come into contact with water. The application areas are wall and ceiling attachments and light shaft attachments.



TECHNICAL INFORMATION



INSTALLATION INSTRUCTIONS

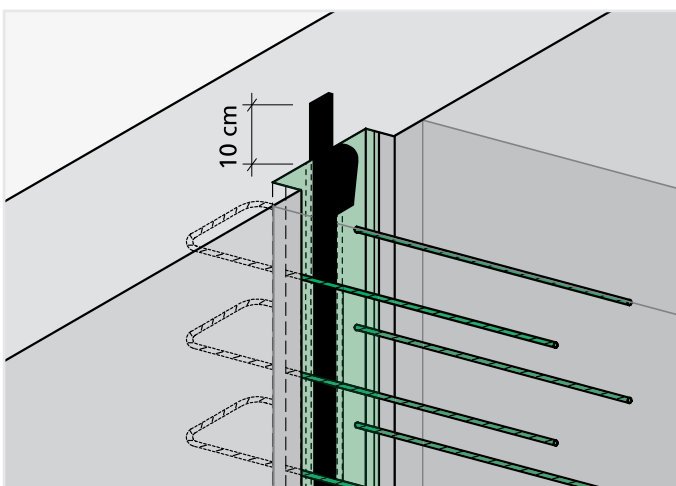
- Attach the PENTABOX® rebind connection immovably in the correct position on the formwork by:
 - Nailing it onto the wooden formwork
 - Welding or connecting it to the existing reinforcement
- Place the next PENTABOX® flush against it and attach it to the formwork
- Connect the protruding PENTAFLEX® strip together (remove the film and stick the strip together)
- Peel the protective film off the PENTAFLEX® strip, then lay the reinforcement for the first wall section, place the formwork and pour the concrete
- Then remove the plastic cover using a hammer
- Remove the polystyrene stoppers from the ends of the box
- Reverse bend the reinforcement rods using a reverse bending pipe (in accordance with the DBV bulletin "Reverse bending of reinforcing steel and requirements for flashing boxes") with an inner diameter that is only slightly larger than the rod diameter

- Insert the pipe up to the start of the bend and move the reinforcement rod into the correct position by bending it towards the reverse bending point in stages, changing grip each time. Avoid bending it back and forth
- Do not treat the flashing box remaining in the joint with formwork release oil
- Remove any concrete debris
- Connect the protruding PENTAFLEX® strip together (remove the film and stick the strip together)
- Peel the protective film off the PENTAFLEX® strip, then lay the reinforcement for the second wall section, place the formwork and pour the concrete

INSTALLATION ON ROUND FORMWORK

Depending on the formwork radius, several cuts with uniform spacing are made using an abrasive cutter on the side walls on both sides of the flashing box. The manufacturer can perform this at the factory on request.

This enables the flashing box to be adapted to the round formwork.



Important:

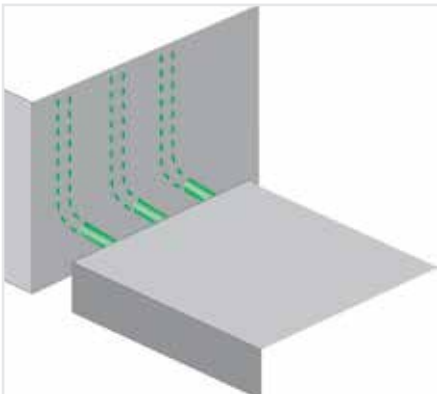
Care must be taken to ensure that the inner reinforcement rods and the PENTAFLEX® strip are not damaged.



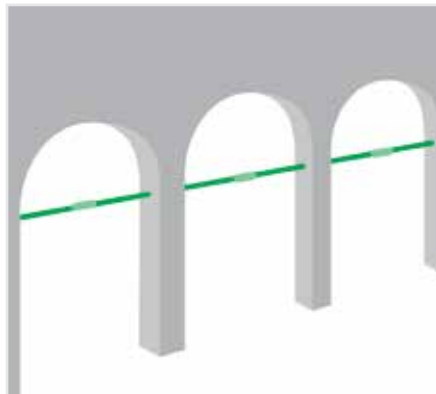
Stainless steel reinforcement

STAINLESS STEEL
AND HIGH-STRENGTH
ANCHORING STEEL

STEEL FOR CRITICAL AREAS IN REINFORCED CONCRETE CONSTRUCTIONS



RIPINOX® stainless steel reinforcement



STAIFIX® anchoring prestressing steel



STAIFIX® accessories



STAINLESS STEEL WELDED WIRE MESH



BENEFITS

- No risk of corrosion if cracks form in the concrete

MATERIAL

- Stainless steel material no. 1.4571 and material no. 1.4401

DELIVERY

- Standard sizes available ex stock
- Special meshes in accordance with order information (also available in small quantities)

DIMENSIONS

Type	Quality	Dimensions [mm]	Mesh size [mm]	Rod diameter [mm]	Reinforcement cross-section [cm ² /m]	Weight [kg/pc]
50/3	V4A 1.4571	5000 x 2150	50 x 50	3	1.41	24.10
100/4	V4A 1.4571	5000 x 2150	100 x 100	4	1.26	22.62
100/5	V4A 1.4401	5000 x 2150	100 x 100	5	1.96	33.93
100/6	V4A 1.4401	5000 x 2150	100 x 100	6	2.83	50.03
150/6	V4A 1.4401	5000 x 2150	150 x 150	6	1.88	34.06
100/8	V4A 1.4401	5000 x 2150	100 x 100	8	5.02	90.26
150/8	V4A 1.4401	5000 x 2150	150 x 150	8	3.35	61.46

Special meshes with different dimensions are available on request.

APPLICATION AREAS

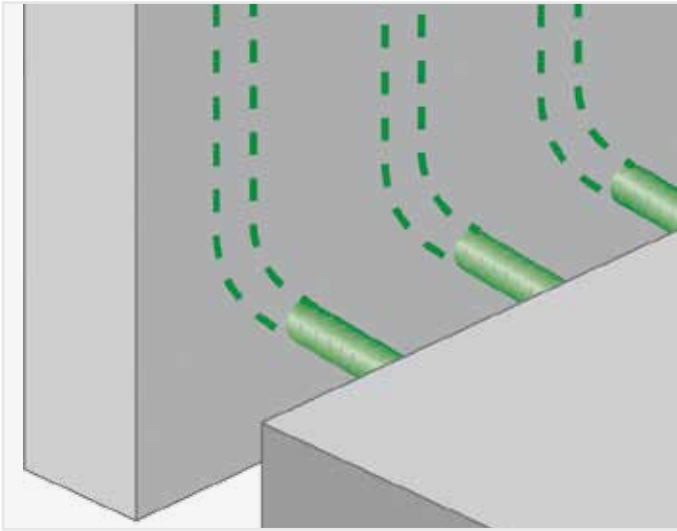
Stainless steel welded wire mesh is used for any applications that require concrete components with particularly highly resistant reinforcement:

- Components that are particularly at risk of corrosion
- Components that do not produce magnetic fields
- Reduced minimum concrete cover

RIPINOX®

STAINLESS STEEL REBAR

APPLICATION PRINCIPLE



BENEFITS

- No risk of rust if cracks form in the concrete

MATERIAL

- Stainless steel material no. 1.4571 and material no. 1.4362

APPROVAL

- RIPINOX® material no. 1.4571 is approved by the building authorities for diameters between 6 and 14 mm
- RIPINOX® material no. 1.4362 is approved by the building authorities for diameters between 6 and 12 mm
- Larger diameters are available without approval with factory certification

ANTIMAGNETIC (MATERIAL NO. 1.4571)

- Extensive range of applications thanks to anti-magnetic properties

APPLICATION

- For all types of anchorage and connections
- For all types of connection reinforcement that run through insulation

APPLICATION AREAS

RIPINOX® stainless steel rebars are used for any applications that require reinforcement with particularly high resistance to external factors:

- Components that are particularly at risk of corrosion
- Components that do not produce magnetic fields
- Reduced minimum concrete cover

NOTES

- RIPINOX® is available threaded on request
- RIPINOX® is weldable. Workers responsible for processing this material require relevant certification
- RIPINOX® can be supplied in other diameters on request

TECHNICAL CHARACTERISTICS

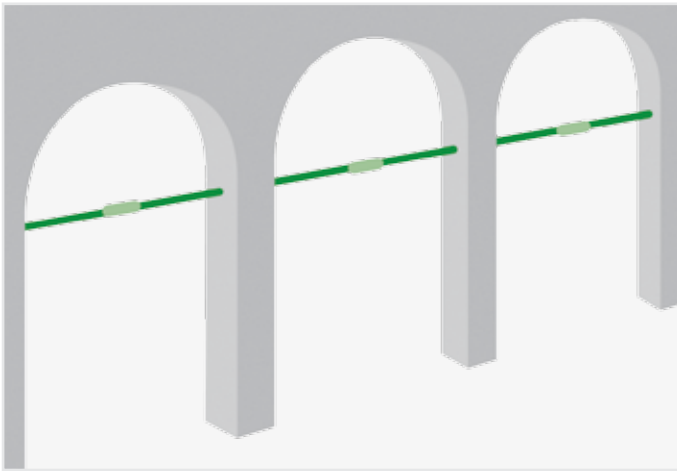
Material no. 1.4571 dia. [mm]	6	8	10	12	14
Weight per metre in length [kg/m]	0.22	0.40	0.62	0.89	1.21
Rod cross-section A [mm ²]	28.3	50.3	78.5	113.0	154.0
Tensile strength f_u [N/mm ²]	550	550	550	550	550
Yield point f_{yk} [N/mm ²]	500	500	500	500	500
Elongation at break ϵ_{10} [%]	15-30				
Thread	M6	M8	M10	M12	M14
Stress cross-section (thread) A_c [mm ²]	20.1	33.6	58.0	84.3	115.0
Tensile resistance (thread) Z_{Rd} [kN]	8.0	13.4	23.2	33.7	46.0

Material no. 1.4362 dia. [mm]	6	8	10	12
Weight per metre in length [kg/m]	0.22	0.40	0.62	0.89
Rod cross-section A [mm ²]	28.3	50.3	78.5	113.0
Tensile strength f_u [N/mm ²]	800	800	800	800
Yield point f_{yk} [N/mm ²]	700	700	700	700
Elongation at break ϵ_{10} [%]	15-30			
Thread	M6	M8	M10	M12
Stress cross-section (thread) A_c [mm ²]	20.1	33.6	58.0	84.3
Tensile resistance (thread) Z_{Rd} [kN]	11.7	19.6	33.7	49.0

STAIFIX® & DUPLEX®

HIGH-STRENGTH, CORROSION-RESISTANT STEEL REBAR/SMOOTH STEEL

APPLICATION PRINCIPLE



BENEFITS

- High-strength, corrosion-resistant smooth steel for anchorage and connection reinforcement
- Available in ribbed or smooth design
- Hot-rolled steel with natural toughness as a result of the hot rolling process and excellent characteristics
- Especially high tensile strength for tendons and anchors (can be prestressed)
- Especially high shear strength
- High notch impact strength
- High tensile strength and notch impact strength at temperatures below zero
- High fatigue strength (for components subject to cyclic stress)
- High corrosion resistance (resistant to aggressive atmospheric and ground conditions)

STAIFIX® TECHNICAL CHARACTERISTICS (STEEL REBAR)

STAINLESS STEEL MATERIAL NO. 1.4429

STAIFIX® ribbed dia. [mm]	16	20	25	28	30	32	40	
Weight per metre in length [kg/m]	1.61	2.51	3.93	4.93	5.66	6.43	10.05	
Rod cross-section A_s [mm ²]	201	314	491	616	707	804	1257	
Tensile strength f_u [N/mm ²]	930	900	850	800	790	790	790	
Yield point f_{yk} [N/mm ²]	800	790	700	630	630	630	600	
Elongation at break ϵ_{10} [%]	15-30							
Thread M, cut	M16	M20	–	–	–	–	–	–
Stress cross-section (thread) A_G [mm ²]	157	245	–	–	–	–	–	–
Tensile resistance (thread) Z_{Rd} [kN]	106.2	160.4	–	–	–	–	–	–
Thread M, rolled	M16	M20	M24	M27	M30	M33	M39	M42
Stress cross-section (thread) A_G [mm ²]	157	245	353	459	561	694	976	1120
Tensile resistance (thread) Z_{Rd} [kN]	106.2	160.4	218.2	267.1	322.3	398.7	560.8	623.3

- STAIFIX® is supplied in fixed lengths
- STAIFIX® is available threaded on request
- STAIFIX® special shapes can be manufactured in accordance with drawings

THE FOLLOWING APPLIES TO STAIFIX® AND DUPLEX® STEEL REBARS:

The tensile resistance is derived from the smaller of these two values:

$$Z_{Rd} \text{ thread} = A_G \times f_u / (1.25 \times \gamma_m)$$

$$Z_{Rd} \text{ rod} = A_s \times f_{yk} / (1.1 \times \gamma_m)$$

A_G = thread stress cross-section [mm²]

f_u = tensile strength [N/mm²]

γ_m = safety factor 1.1

STAIFIX® & DUPLEX®

HIGH-STRENGTH, CORROSION-RESISTANT STEEL REBAR

DUPLEX® TECHNICAL CHARACTERISTICS (SMOOTH STEEL)

STAINLESS STEEL MATERIAL NO. 1.4462

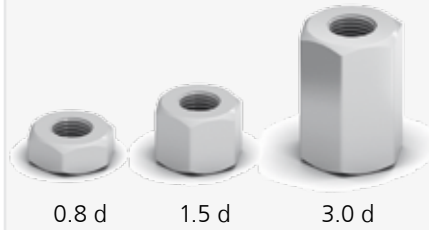
DUPLEX® smooth dia. [mm]	10	12	14	16	18	20	22	25	30	35	42	52		
Weight per metre in length [kg/m]	0.61	0.88	1.20	1.57	1.96	2.45	2.97	3.83	5.51	7.50	10.80	16.60		
Rod cross-section A_s [mm ²]	78.5	113	154	201	255	314	380	491	707	962	1385	2123		
Tensile strength f_u [N/mm ²]	900	900	900	900	900	900	900	900	900	850	800	750		
Yield point f_{yk} [N/mm ²]	700	700	700	700	700	700	700	700	700	650	600	550		
Elongation at break ϵ_{10} [%]	15-35													
Thread M, cut	M10	M12	M14	M16	M18	M20	M22	-	-	-	-	-	-	
Stress cross-section (thread) A_G [mm ²]	58.0	84.3	115	157	192	245	303	-	-	-	-	-	-	
Tensile resistance (thread) Z_{Rd} n[kN]	38.0	55.2	75.3	102.8	125.7	160.4	198.3	-	-	-	-	-	-	
Thread M, rolled	-	-	-	M16	M18	M20	M22	M24	M24	M27	M30	M36	M42	M52
Stress cross-section (thread) A_G [mm ²]	-	-	-	157	192	245	303	353	353	459	561	817	1120	1760
Tensile resistance (thread) Z_{Rd} [kN]	-	-	-	102.8	125.7	160.4	198.3	219.8	231.1	284.1	367.2	505.1	651.6	960.0

STAIFIX® & DUPLEX® ACCESSORIES

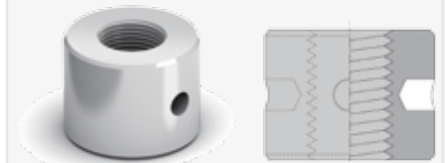
STAIFIX® ACCESSORIES

All STAIFIX® accessories are available in various sizes and dimensions.

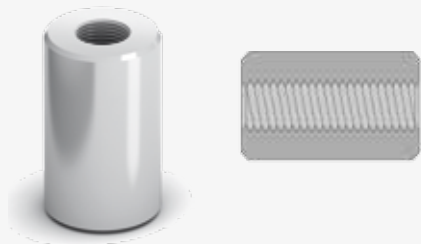
STAIFIX® NUT



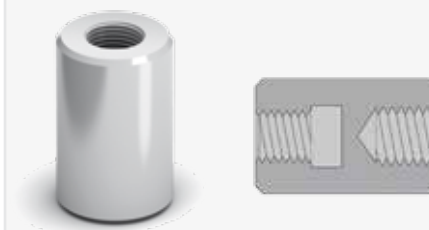
STAIFIX® ROUND NUT



STAIFIX® COUPLING



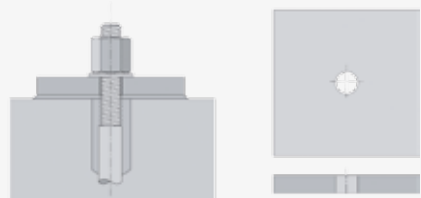
STAIFIX® SPECIAL COUPLING



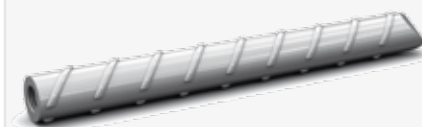
STAIFIX® TURNBUCKLE



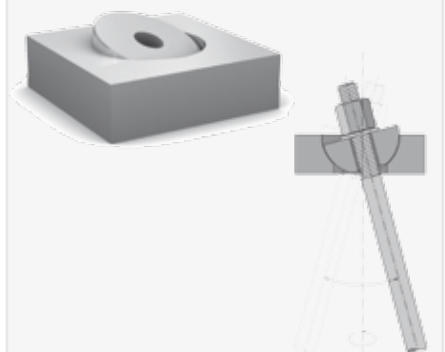
STAIFIX® ANCHOR PLATE



STAIFIX® DOWEL

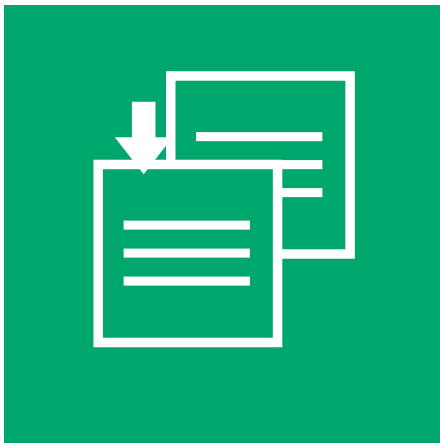


STAIFIX® BALL JOINT



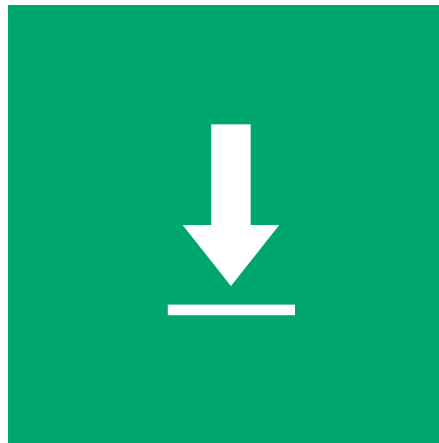
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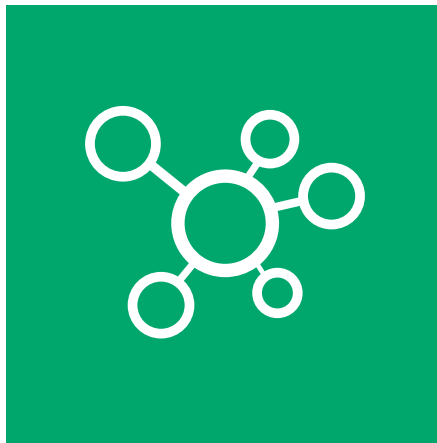
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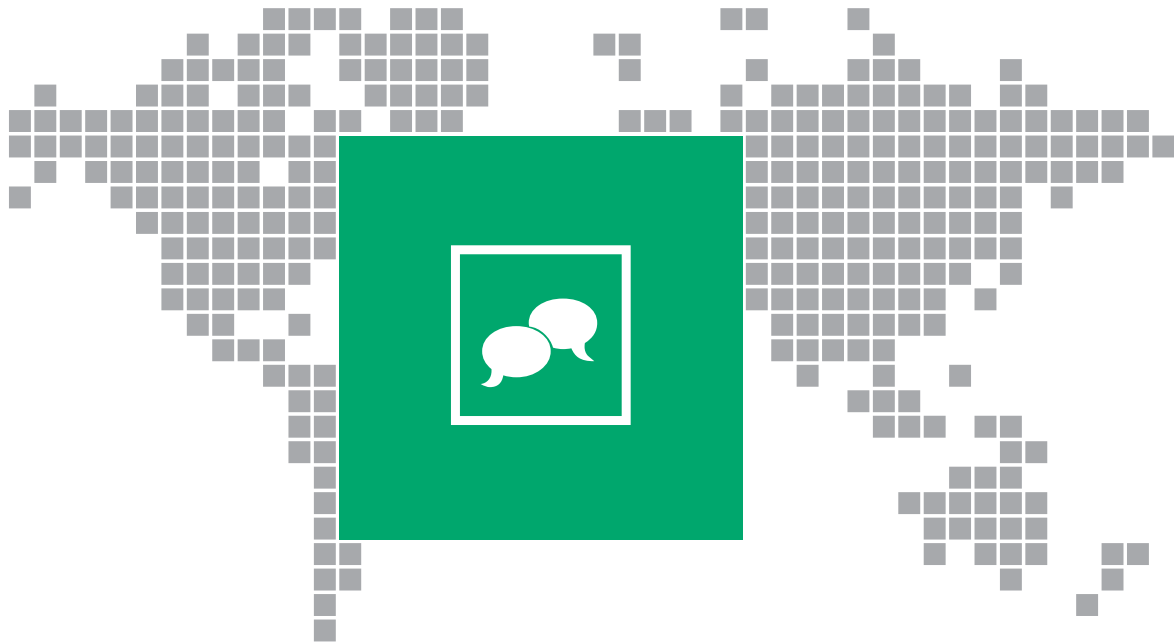
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