RECOSTAL
BY DYWIDAG

RECOSTAL®
Reinforcement Technologies

Screw connection for reinforced concrete structures
RECOSTAL® Coupler

Key profiled continuity system RECOSTAL® Starter Pack

RECOSTAL
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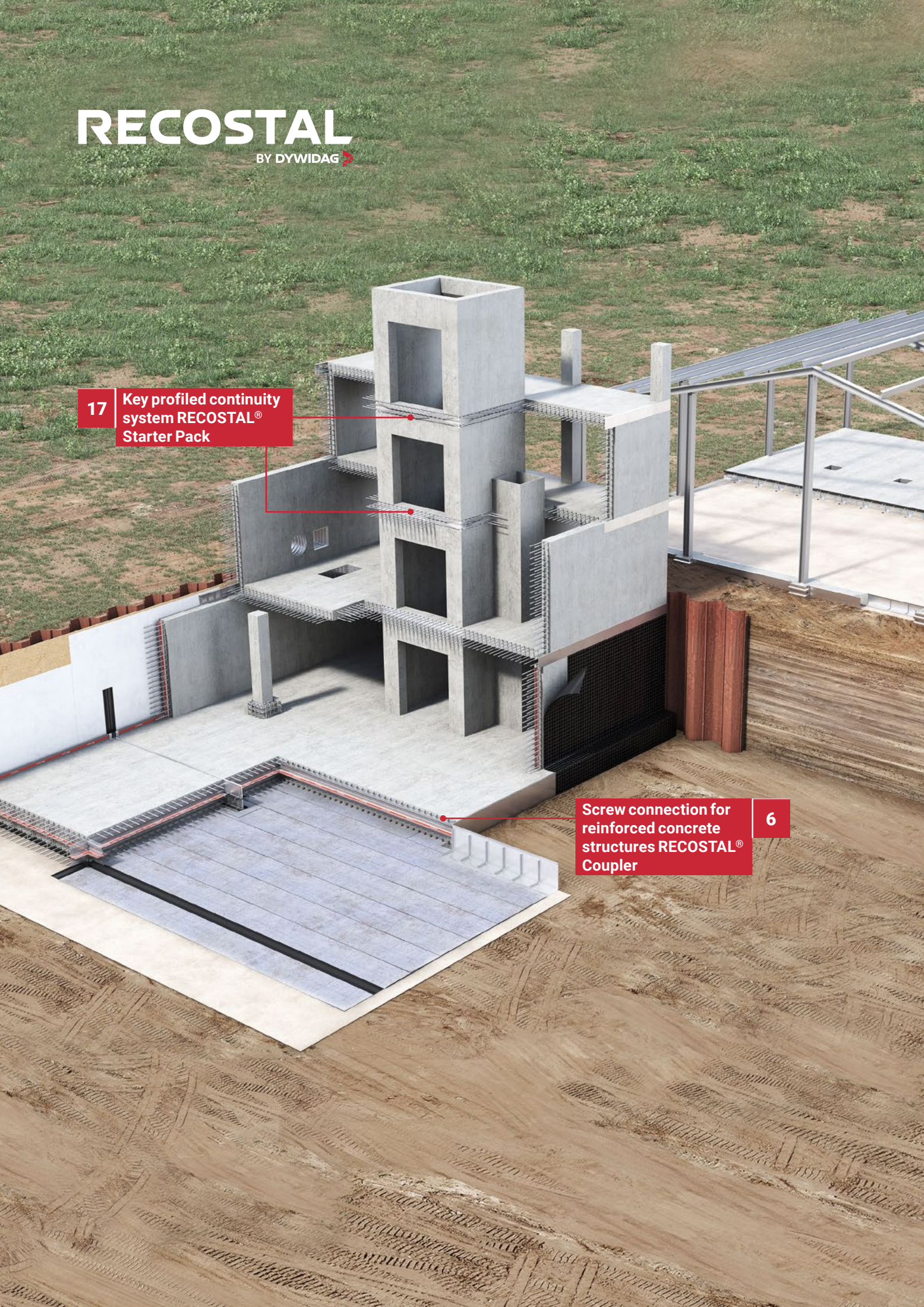

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Supporting infrastructure by making it safe and strong has been our story since 1865.

We've grown to 1,500+ employees and 25 licensees in 50+ countries.

From the steel in our first reinforced bridge in 1903, to remote robots scanning stay cable health - we help extend the lifespan of the world's new and aging infrastructure.

Private and public asset owners, engineers, and construction companies use our technology for projects across sectors like bridges, buildings, ground stabilization, wind towers, and tunnels. Projects include The Golden Gate Bridge, Panama Canal, Kap Shui Mun Bridge, and Freedom Tower.

The needs of infrastructure have changed - and so have we. Our roots? Bridges, one of the most complex civil structures, which require safety and strength in all kinds of demanding environments. Although we were founded as a concrete company, that changed in the early 20th century when we found our focus as a multi-sector civil construction project (and maintenance) sub-contractor.

For over 100 years, the main product the construction industry thinks of after hearing DYWIDAG, is our threadbar - likely found in a significant amount of the infrastructure in your city.

DYWIDAG is a well-known company for geotechnics and post tensioning. But there's more: DYWIDAG Form tie systems, sealing technologies CONTEC®, lost formwork and reinforcement technologies RECOSTAL® which are one business unit called DYWIDAG Concrete Technologies.

Our technologies are widely recognized for highly secure systems. Our main production is in Poland and Germany. Products carry approvals to international quality standards. The coating of the metal waterstops consists of highly swelling bentonite.

Our timeline:

1865 Dyckerhoff & Widmann AG (DYWIDAG) founded a small concrete construction company.

1950 DYWIDAG starts license business for construction systems with bridge post-tensioning at its core.

1979 DYWIDAG SYSTEMS INTERNATIONAL (DSI) founded to expand international business. Invests in R&D and a second global segment: geotechnics.

2006 DSI enters the European concrete accessories market by making acquisitions in France and Germany: Arteon, Technique Beton, Mandelli-Setra, CONTEC®.

2011 Private equity investor Triton becomes the new shareholder of DSI.

2016 Development of construction activities in Middle East & Asia, including new joint ventures in Qatar and India.

2018 Alpin Technik and Datum Group acquired to empower DSI's robotics and monitoring.

2018 Concrete accessories created as a Business Unit within DYWIDAG.

2019 DSI acquires PARTEC.

2020 DSI rebrands as DYWIDAG.

2021 DY.CO launched as a new Pan-European Business Unit of DYWIDAG.

2023 DY.CO rebrands as DYWIDAG Concrete Technologies.

DYWIDAG CONCRETE TECHNOLOGIES

- 40+ years of experience
- Resellers in 40+ countries
- Tailor-made products
- Quality and safety orientation
- Made in Europe

Applications

- Commercial Buildings
- Residential Construction
- Civil Engineering
- Precast Concrete Elements
- Structural Repair

Customers

- General Contractors
- Distributors
- Applicators

Our product brands

RECOSTAL® Reinforcement Technologies

RECOSTAL® Lost Formwork Technologies

CONTEC® Sealing Technologies

DYWIDAG® Surface Sealing Technologies

DYWIDAG Form Ties Systems

End markets

Construction
Commercial buildings/ Residential/ Non-residential/ Hospital/ Datacenter

Agriculture
Biogas plants/ Silage storage

Industrial
Production/ Warehouse

Power
Nuclear power plant/ Hydroelectric power plant

Infrastructure
Tunnels/ Bridges

RECOSTAL® Coupler

Threaded splice connection for reinforced concrete structures

With the new RECOSTAL® Coupler rebar connection, DYWIDAG Concrete Technologies is expanding its product portfolio in the field of RECOSTAL® reinforcement technology.

RECOSTAL® Coupler threaded connections offer an optimal and secure connection in reinforced concrete construction where reinforcement steel needs to be spliced. RECOSTAL® Coupler connection is available in sizes: 12 mm - 28 mm according to DIBt approval and 12 mm - 25 mm according to CARES approval (other sizes on request).

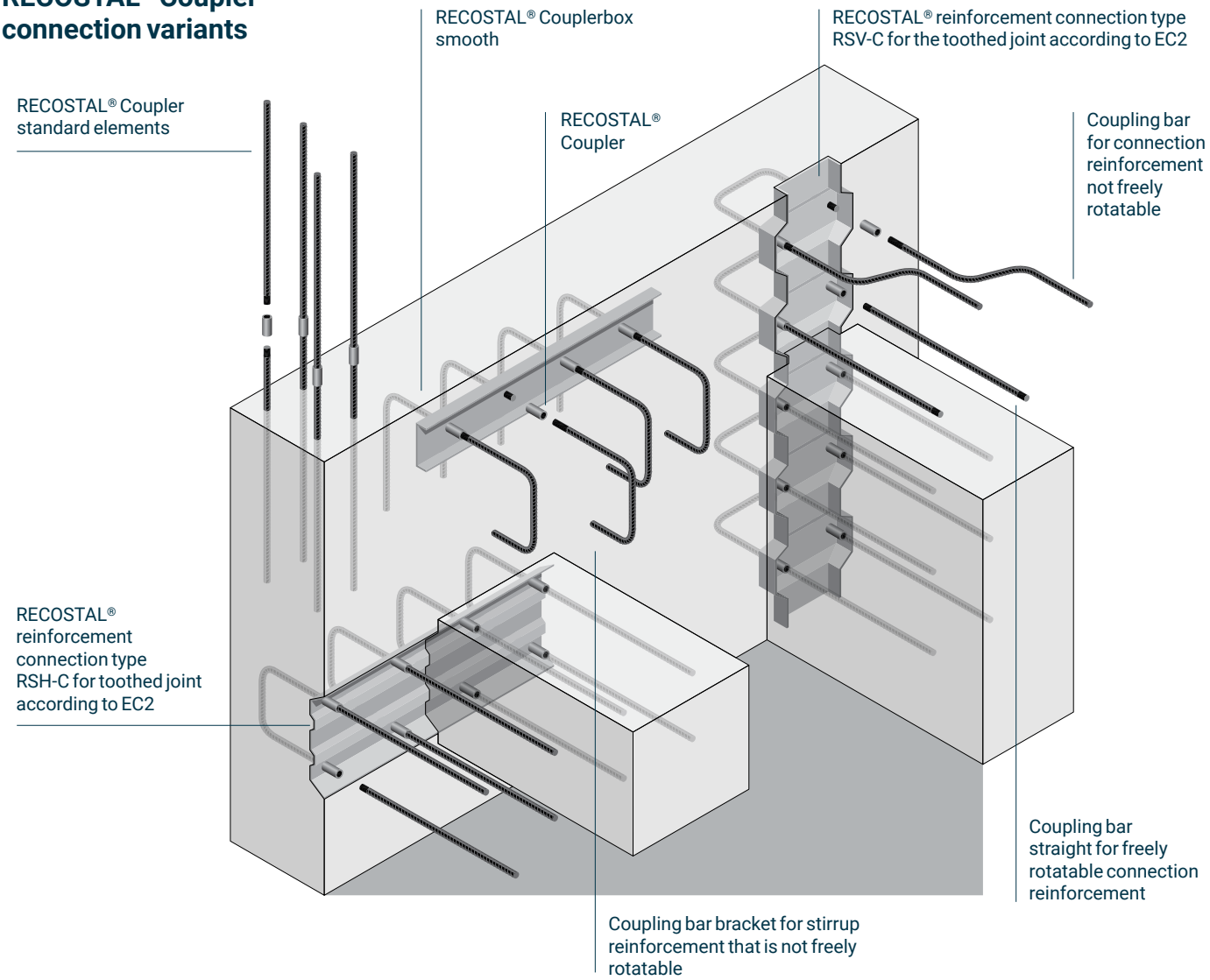
For this purpose, the reinforcing bars can be ordered bespoke to specification directly via our manufacturing facilities. RECOSTAL® Couplers can be used in combination with many products from the DYWIDAG Concrete Technologies portfolio, such as the RECOSTAL® Couplerbox, providing maximum design flexibility for engineers and contractors.

RECOSTAL® Coupler connections can save time and costs, ensures a secure connection and helps conserve resources by saving reinforcement steel.

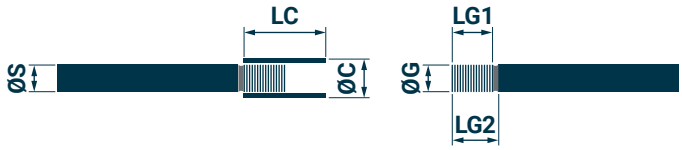
The Benefits

- High fatigue strengths for use in bridges, among other applications
- 100% power transmission
- General technical approval: abG, CARES, ETA
- Extensive combination possibilities with RECOSTAL® formwork systems
- Efficient and economical
- Less planning effort
- Conservation of resources
- Design flexibility

RECOSTAL® Coupler connection variants



RECOSTAL® Coupler screw connection



Product	Coupling bar ØS	Ø Coupler [1]		Thread coupling bar			Tightening moment M
		Ø Outside ØC	Length coupler LC	Length thread LG1	Shell length LG2	Ø Outside ØG	
Abbreviation	mm	mm	mm	mm	mm	mm	Nm
RC	12	19	35	18.5	19	12.38	60
	14	22	40	21.5	22.5	14.5	80
	16	25	45	24	25	16.5	80
	20	30	55	29	30	20.55	160
	25	38	65	34.5	35.5	25.55	230
	28	42	70	37	38	28.55	300

1) Dimensions for standard screw connection.

Coupling bars

Type	Form	Explanation
SG		Straight bar
SW		Angled bar
SB		Bent bar
SK		Swan necked bar

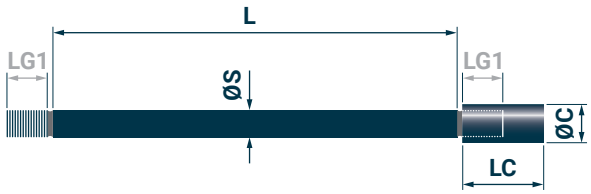
Connection Variants

Abbreviation	Connection options	Explanation
M		Simple thread / bar
MM		Simple thread / simple thread
F		Single thread with coupler/ bar
FM		Simple thread with coupler/ simple thread
FF		Single thread with coupler/ single thread with coupler
FX		Double thread length with coupler/ bar
FXM		Double thread length with coupler/ single thread
FXF		Double thread length with coupler/ single thread with coupler
FFX		Double thread length with coupler/ double thread length with coupler

"M" = Male thread, "F" = Female thread with coupler. "X" for bars that are not freely rotatable.

Bars that are not freely rotatable have a double thread length (2 x LG1) at the socket end

RECOSTAL® RC-SG coupling bar straight

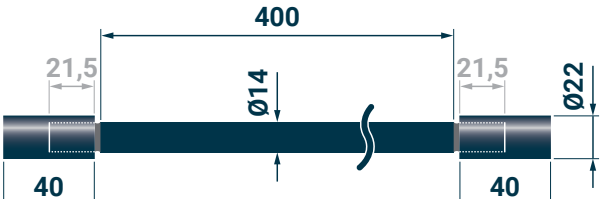


Example here: RECOSTAL® RC...-SG...

Ø Coupling bar ØS	Type	Length coupling bar [1]	Connection variant bar freely rotatable	Coupler Length LC	Ø Outside Ø C
mm	Abbreviation	mm	Abbreviation	mm	mm
12	SG Straight Bar	400	M, MM, F, FM, FF	35	19
		600			
		730			
		960			
		1,350			
14		400		40	22
		600			
		730			
		960			
		1,350			
16		400		45	25
		590			
		840			
		1,160			
		1,650			
20		400	Connection variant Bar not freely rotatable	55	30
		730			
		1,040			
		1,450			
		1,890			
25		400	FX, FXM, FXF, FFX	65	38
		910			
		1,290			
		1,800			
		2,360			
28		400		70	42
		1,020			
		1,450			
		2,020			
		2,640			

1) Standard dimensions, other dimensions on request.

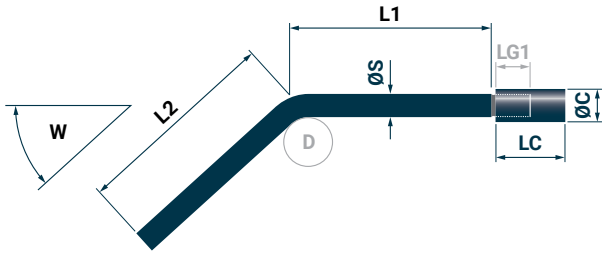
Example of a complete article description



RECOSTAL® RC | 14 | SG | 400 | FF

- RECOSTAL® Coupler
- Ø Coupling bar = 14 mm
- Type Straight bar
- Length Coupling bar L = 400 mm
- Connections: Female/Female, both sides single thread

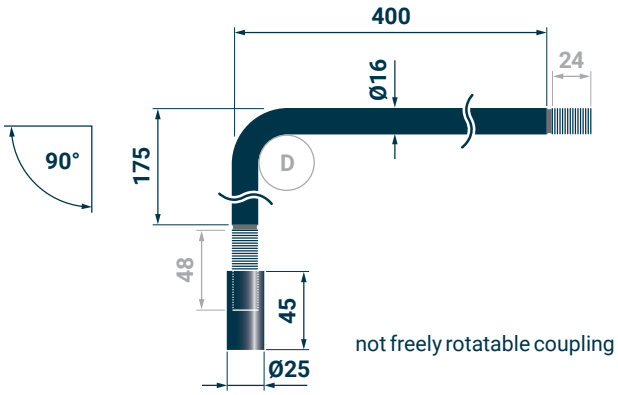
RECOSTAL® RC-SW coupling bar angled



Example here: RECOSTAL® RC...-SW...F-...

Ø Coupling bar ØS	Type	Length coupling bar L1	Connection end for L1	Length coupling bar L2	Connection end for L2	Bend angle W	Coupler	
							Length LC	Ø Outside ØC
mm	Abbreviation	mm	Abbreviation	mm	Abbreviation	°	mm	mm
12	SW (Angled bar)	freely selectable	M F FX	freely selectable	M F FX	freely selectable	35	19
14							40	22
16							45	25
20							55	30
25							65	38
28							70	42

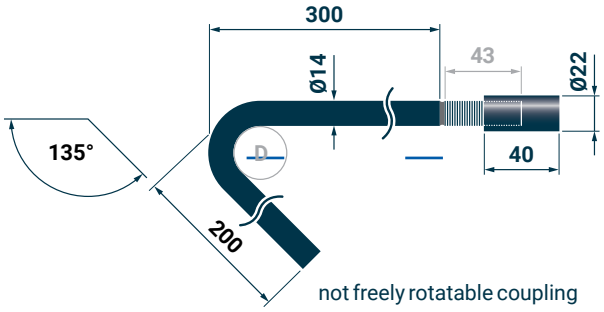
Example of a complete article description



not freely rotatable coupling

RECOSTAL® RC | 16 | SW | 400 | M | 175 | FX | W90

- RECOSTAL® Coupler
- Ø Coupling bar = 16 mm
- Type Angled bar
- Length of Coupling bar L1 = 400 mm
- Connection end L1: Male
- Length of coupling bar L2 = 175 mm
- Connection end L2: Female, X = double thread length
- Angle 90°

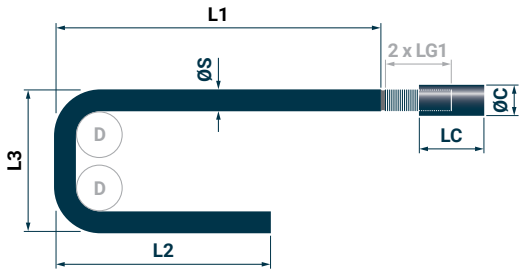


not freely rotatable coupling

RECOSTAL® RC | 14 | SW | 300 | FX | 200 | W135

- RECOSTAL® Coupler
- Ø Coupling bar = 14 mm
- Type Angled bar
- Length of coupling bar L1 = 300 mm
- Connection end L1: Female, X = double thread length
- Length of coupling bar L2 = 200 mm (neutral connection end)
- Angle 135°

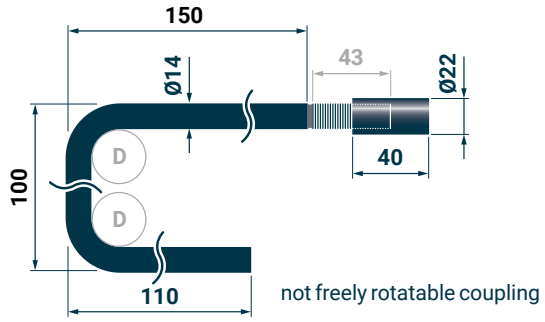
RECOSTAL® RC-SB coupling bar bent



Example here: RECOSTAL® RC...-SB... FX-...

Ø Coupling bar ØS	Type	Length coupling bar L1	Connection end for L1	Length coupling bar L2	Connection end for L2	Length Coupling bar L3	Coupler	
							Length LC	Ø Outside ØC
mm	Abbreviation	mm	Abbreviation	mm	Abbreviation	mm	mm	mm
12	SB (Bent bar)	freely selectable	M F FX	freely selectable	M F FX	freely selectable	35	19
14							40	22
16							45	25
20							55	30
25							65	38
28							70	42

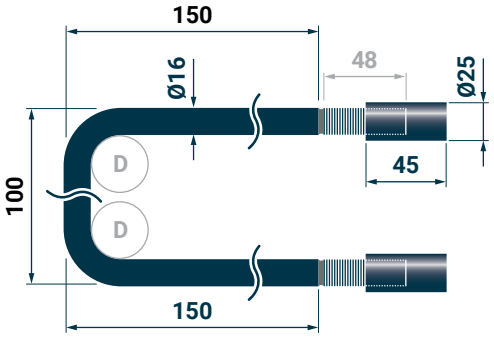
Example of a complete article description



not freely rotatable coupling

RECOSTAL® RC | 14 | SB | 150 | FX | 110 | 100

- RECOSTAL® RC: RECOSTAL® Coupler
- 14: Ø Coupling bar = 14 mm
- SB: Type Bent bar
- 150: Length of coupling bar L1 = 150 mm
- FX: Connection end L1: Female, X = double thread length
- 110: Length of coupling bar L2 = 110 mm (neutral connection end)
- 100: Length of coupling bar L2 = 100 mm

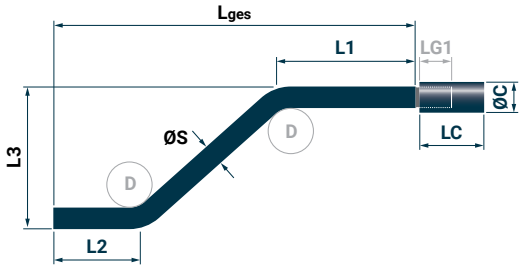


not freely rotatable coupling

RECOSTAL® RC | 16 | SB | 150 | FX | 150 | FX | 100

- RECOSTAL® RC: RECOSTAL® Coupler
- 16: Ø Coupling bar = 16 mm
- SB: Type Bent bar
- 150: Length of coupling bar L1 = 150 mm
- FX: Connection end L1: Female, X = double thread length
- 150: Length of coupling bar L2 = 150 mm
- FX: Connection end L2: Female, X = double thread length
- 100: Length of coupling bar L3 = 100 mm

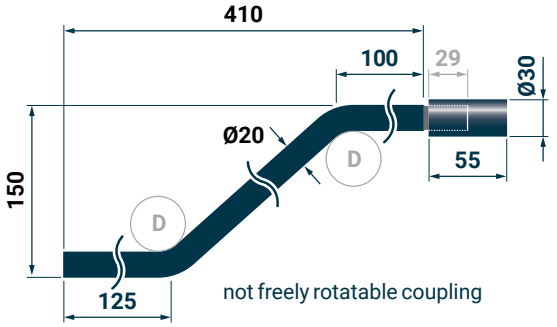
RECOSTAL® RC-SK coupling bar swan necked



Example here: RECOSTAL® RC...-SW...F-...

Ø Coupling bar ØS	Type	Length coupling bar L1	Connection end for L1	Length coupling bar L2	Connection end for L2	Total length L_{ges}	Length Coupling bar L3	Coupler	
								Length LC	Ø Outside ØC
mm	Abbreviation	mm	Abbreviation	mm	Abbreviation	mm	mm	mm	mm
12	SK (Swan necked)	freely selectable	M F FX	freely selectable	M F FX	freely selectable	freely selectable	35	19
14								40	22
16								45	25
20								55	30
25								65	38
28								70	42

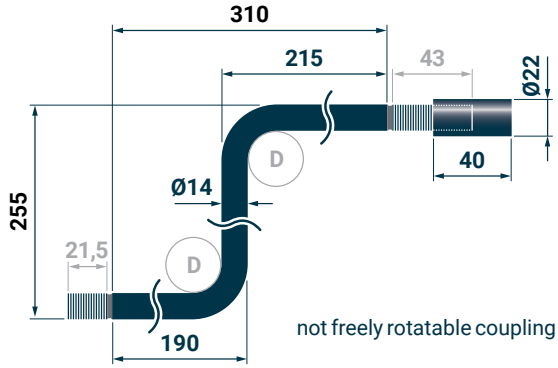
Example of a complete article description



not freely rotatable coupling

RECOSTAL® RC | 20 | SK | 100 | F | 125 | 150 | 410

- RECOSTAL® Coupler
- Ø Coupling bar = 20 mm
- Type Swan Necked bar
- Length of coupling bar L1 = 100 mm
- Connection end L1: Female
- Length of coupling bar L2 = 125 mm (neutral connection end)
- Length of coupling bar L3 = 150 mm
- Length Total L_{ges} = 410 mm



not freely rotatable coupling

RECOSTAL® RC | 14 | SK | 215 | FX | 190 | M | 255 | 310

- RECOSTAL® Coupler
- Ø Coupling bar = 14 mm
- Type Swan Necked bar
- Length of coupling bar L1 = 215 mm
- Connection end L1: Female, X = double thread length
- Length of coupling bar L2 = 190 mm
- Connection end L2: Male
- Length of coupling bar L3 = 255 mm
- Length Total L_{ges} = 310 mm

RECOSTAL® Coupler accessories

Mounting bracket for single bars for variable fixing of RECOSTAL® Couplers to the formwork by means of nails.

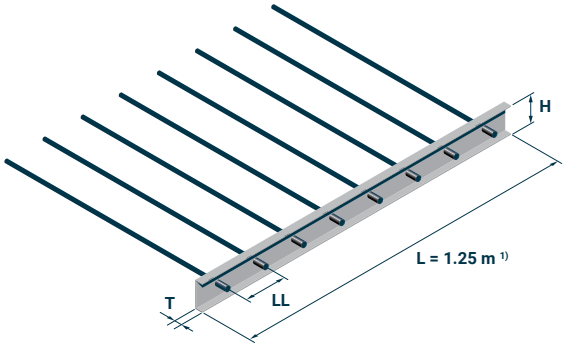
Torque wrench for diameter 10 - 40 mm. Torque up to 400 Nm.

Mounting bar for fastening several RECOSTAL® Couplers to the formwork by means of nails. Hole spacing is freely selectable.

More accessories, e.g. caps, are available upon request.

RECOSTAL® Couplerboxes

RECOSTAL® Couplerbox smooth



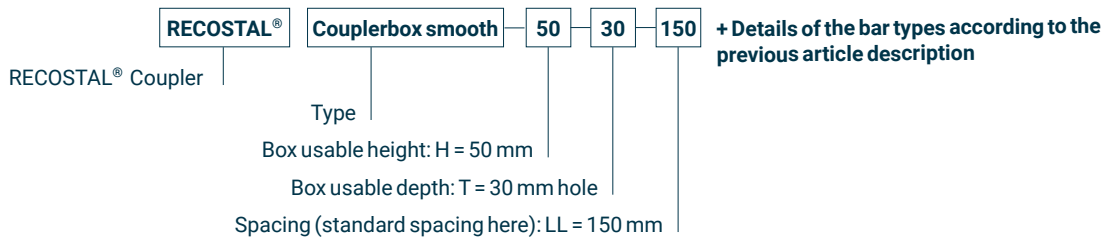
Example here with RC-SG (straight coupling bars)

Type	Box- usable height 1) H	Box- usable depth T	Hole Spacing 1) LL	Bar Forms	Connection variant bar freely rotatable
	mm	mm	mm	Abbreviation	Abbreviation
Couplerbox smooth	50 or 80	30 or 40	150 or 200	SG (Straight bar) SW (Angled bar) SB (Bent bar) SK (Swan necked bar)	M MM F FM FF

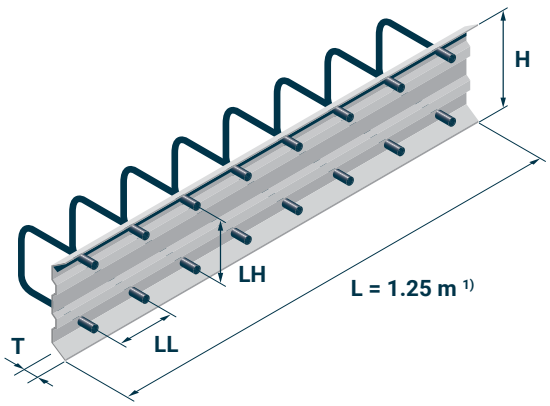
Connection variant bar not freely rotatable
Abbreviation
FX FXM FXF FFX

1) Standard dimensions, other dimensions on request.

Example of a complete article description



RECOSTAL® Couplerbox RSH-C toothed according to EC2



Example here with RC-SB (Bent coupling bars)

Type	Box- usable height 1) H	Box- usable depth T	Hole Spacing 1) LL	Box-usable height (depending on LH) H
	cm	mm	mm	mm
RSH-C	10	35 or 40	150 or 200	130
	11			140
	12			150
	14			170
	16			190
	18			210
	20			230
	22			250

1) Standard dimensions, other dimensions on request.

Example of a complete article description

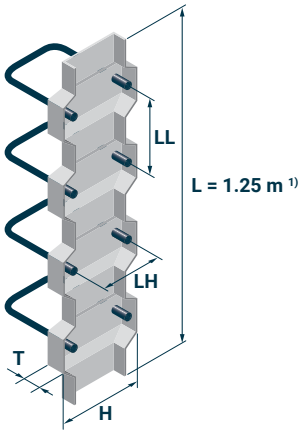
RECOSTAL® | RSH-C | 12 | 40 | 200

- RECOSTAL® Coupler
- Type
- Hole spacing height LH = 12 cm
- Box usable depth T = 40 mm hole
- Spacing length (standard spacing here): LL = 200 mm

+ Details of the bar types according to the previous article description

RECOSTAL® Couplerbox RSH-C toothed according to EC2

RECOSTAL® Couplerbox RSV-C toothed according to EC2



Type	Hole spacing height 1) LH	Box- usable depth T	Hole Spacing length 1) LL	Box- usable height (depending on LH) H
	cm	mm	mm	mm
RSV-C	8	40	150	110
	11			140
	14			170
	18			210

1) Standard dimensions, other dimensions on request.

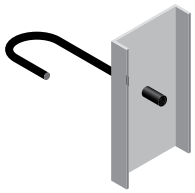
Example of a complete article description

RECOSTAL® | RSV-C | 14 | 40 | 150

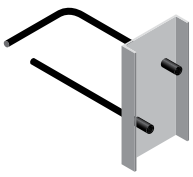
+ Details of the bar types according to the previous article description

RECOSTAL® Coupler
Type
Hole spacing height LH = 14 cm
Box usable depth T = 40 mm hole
Spacing length (standard spacing here): LL = 150 mm

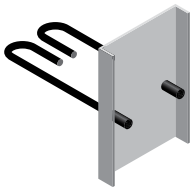
Special Solutions



SHQ-C



SRG-C



S2H-C

Further special solutions on request.

RECOSTAL® shuttering elements with RECOSTAL® Coupler screw connection

Conventional formation of the connection reinforcement.
Fresh concrete composite waterproofing must be advanced far into the next concreting section!

Solution: RECOSTAL® shuttering elements with RECOSTAL® Coupler for optimal installation on fresh concrete composite waterproofing with flow protection for safe backflow protection.

- Can be combined with all RECOSTAL® shell elements
- Prefabricated flow protection
- Optimal for use in the application of fresh concrete composite systems
- Free working space in the next concreting section
- Conservation of resources
- Ready-to-install self-supporting shell elements with coupling bars
- Joint category “toothed” according to EC2

RECOSTAL® Starter Pack

Highest bearing capacity due to key profiled boxes
Highest joint category according to Eurocode 2

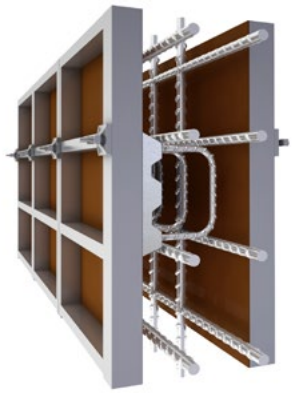
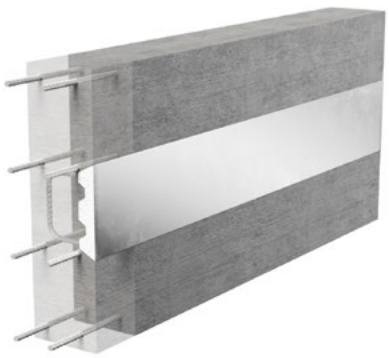
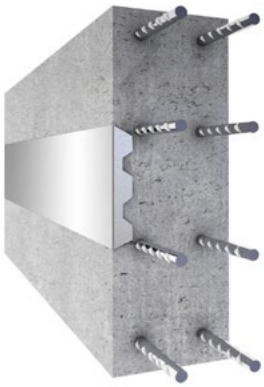
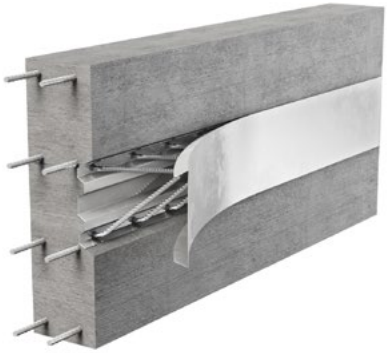
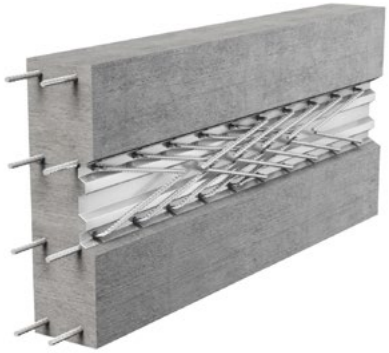
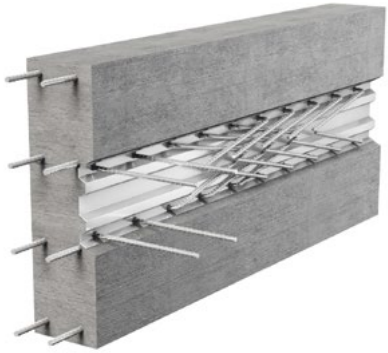
The main advantages of RECOSTAL® Starter Pack is the strong and robust box with high dimensional stability and a trapezoidal profile, which guarantees the highest bearing capacity according to Eurocode 2. Joint category “key profiled” according to DIN EN 1992-1-1/NA. RECOSTAL® Starter Pack meets the requirements of the DBV Bulletin.

RECOSTAL® Starter Pack ensures time-saving installation of secure connections between steel reinforced concrete construction parts that are created with different pour sequences. Therefore, floor slabs, walls or staircases can be installed subsequently with rigid connections corresponding to the highest joint category “key profiled“.

The large variety of shapes offers the perfect connection for many different design situations. The standard range includes starter packs with 8, 10, 12, 14 and 16 mm diameter and 1.25 m unit lengths. Unit lengths exceeding 1.25 m, special types for specific solutions and the combination with waterproofing systems as well as solutions for entire projects are possible on request.

The benefits

- Strong, robust galvanised sheet metal starter packs, dimensionally stable
- Cost and time effective installation, starter packs are simply nailed to the formwork
- Easy removal of the sheet metal covers due to their special design
- Trapezoidally profiled box for excellent bond
- Various possible combinations provide a solution for all common installation details

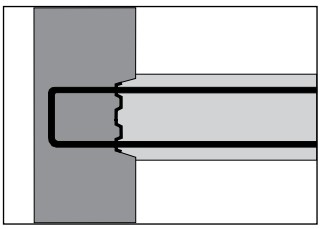







Structural design

RECOSTAL® Starter Pack type RSH and type RSV

Type RSH

Type RSV



Joint category“key profiled” according to DIN EN 1992-1-1/NA

DIN EN 1992-1-1/NA § 2.8.2: Planning Principles

The type of joint must be specified in the starter pack drawings

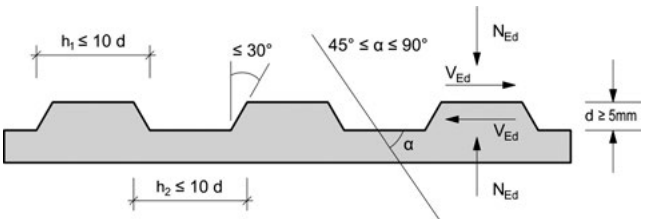
DIN EN 1992-1-1/NA § 6.2.5: Transfer of Shear Forces in Joints

EC 2 divides the type of joint surface into 4 categories. Trapezoidally profiled construction joints represent the highest category with regard to the transfer of shear forces.

Type of surface according to EC 2 § 6.2.5 (2)	Roughness coefficient c [1)]	Friction coefficient μ	Strength reduction coefficient [3)]
key profiled joint	0.5	0.9	0.7
rough joint	0.4 [2)]	0.7	0.5
smooth joint	0.2 [2)]	0.6	0.2
very smooth joint	0	0.5	0 [4)]

1) In case of dynamic or fatigue loading, concrete bond (adhesion) should not be taken into consideration (c = 0).
2) Where tension occurs perpendicular to the joint due to strain, c = 0.
3) For concrete classes ≥ C55/67 the stated values are to be multiplied by factor (1.1 - f_{ck} / 500) with f_{ck} in [N/mm²] .
4) The friction proportion in Expression 6.25 may be allowed up to the limit of $\mu \cdot \sigma_N \leq 0.1\ f_{cd}$ for very smooth joints.

Geometry of key profiled joints according to EC 2: RECOSTAL® Starter Packs meet the EC 2 requirements for the highest category “key profiled“.



Starter Pack Requirements according to DBV Bulletin

Starter packs without key profiled surfaces are to be classified as “rough”, “smooth” or “very smooth” by means of analysis. Starter packs that are not categorized should always be classified as joint category “very smooth”.

Concrete Cover for Starter Packs according to DBV Bulletin

For sheet steel starter packs that remain inside the construction, the concrete cover should be determined referring to the most unfavorable section according to DIN EN 1992-1-1, Paragraph 4.4 with Table 4.4DE. The allowance for deviations Δc_{dev} for the sheet steel of the box may be reduced by 5 mm.

Reduced Bar Tension

According to DIN EN 1992-1-1, 8.3 (NA.5), the reinforcement surrounding sections of rebending, while exposed to predominantly static loading close to the limit of the bearing capacity, has to be determined with no more than 80 % of the otherwise permissible values of the calculated stress-strain curve of the reinforcing steel according to DIN EN 1992-1-1, Fig. 3.8. The design value of the anchorage length $l_{b,rqd}$ for this type of starter pack may, according to DIN EN 1992-1-1, 8.4.3 GL (8.3), also be determined with the reduced rated value of the bar tension $f_{yd,red} = 0.8\ f_{yk} / \gamma_s$.

Shear Force Longitudinal to the Construction Joint

[R1] Exp. 6.25: Design value of the shear capacity

Total bearing capacity = bearing contact area [concrete] + [friction] +[reinforcement] ≤ max. bearing capacity

$V_{Rdi} = c \cdot f_{ctd} + \mu \cdot \sigma_N + V_{Rdi,s} \leq V_{Rdi,max}$ [N/mm²]

Where

$f_{ctd} = \alpha_{ct} \cdot f_{ctk;0,05} / \gamma_c$ (with $\alpha_{ct} = 0.85$ and $\gamma_c = 1.5$ according to 3.1.6 (2) P);

$\sigma_N < 0.6\ f_{cd}$ (positive for stress and negative for tension);

$V_{Rdi,s} = \rho \cdot f_{yd,red}\ (1.2\mu \cdot \sin\alpha + \cos\alpha)$ where $\rho = A_s / A_i$ and

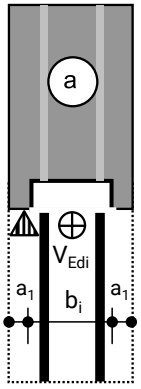
$f_{yd,red} = 400$ [N/mm²] / γ_s (0.8 f_{yk} at bending);

$V_{Rdi,max} = 0.5 \cdot v \cdot f_{cd}$ (no reduction to 0.3 $V_{Rd\ i,max}$)

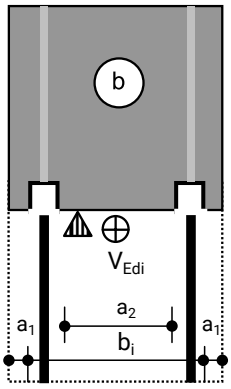
Table 1. Classification of joint surfaces according to [R1], 6.2.5

Type of surface according to EC 2 § 6.2.5 (2)	Roughness coefficient c [1]	Friction coefficient μ	Strength reduction coefficient V [3]
key profiled joint	0.5	0.9	0.7
rough joint	0.4 [2]	0.7	0.5
smooth joint	0.2 [2]	0.6	0.2
very smooth joint	0	0.5	0 [4]

1) In case of dynamic or fatigue loading, the concrete bond (adhesion) should not be taken into consideration (c = 0).
2) Where tension occurs perpendicular to the joint due to impact, c = 0.
3) For concrete classes ≥ C55/67, the stated values are to be multiplied by the factor (1.1 - f_{ck} / 500) with f_{ck} in [N/mm²].
4) The friction proportion in Expression 6.25 may be allowed for up to the limit of $\mu \cdot \sigma_N \leq 0.1\ f_{cd}$.



a1 < 50 mm



$a_1 < 50$ mm
$a_2 \geq 50$ mm where surface finish is according to DIN EN 1992-1-1, 6.2.5

Like a_2 $a_1 \geq 50$ mm may be taken into account for bi; however, in this case, only the slighter roughness of the starter pack box or the construction joint surface should be considered for bi. Alternatively, the individual width of the construction joint surface area or the starter pack box with their respective surface roughness for bi may be allowed for.

Shear Force Transverse to the Construction Joint

[R1] Exp. (6.2): Shear resistance without shear reinforcement, including reduction by applying roughness coefficient c

$V_{Rd,c} = (c / 0.5) \cdot [0.15 / \gamma_c \cdot k \cdot (100\rho_1 \cdot f_{ck})^{1/3} + 0.12\sigma_{cp}] \cdot b_w \cdot d$

where $k = 1 + \sqrt{(200/d\ [mm])} \leq 2.0$ and c according to Table 1

[R1] Exp. (6.8): Shear resistance with shear reinforcement

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

where $z = 0.9\ d$ and/or $z \leq d - c_{v,i} - 30$ mm and $f_{ywd} = f_{yk} / \gamma_s$

Maximum acceptable shear with shear reinforcement (very smooth joint not permissible): [R1] Exp. (6.9) for 90° bar reinforcement, reduced to 30% in sections of rebending

$V_{Ed} \leq 0.30 \cdot V_{Rd,max} = 0.30 \cdot b_w \cdot z \cdot v_1 \cdot f_{cd} / (\cot\theta + \tan\theta)$

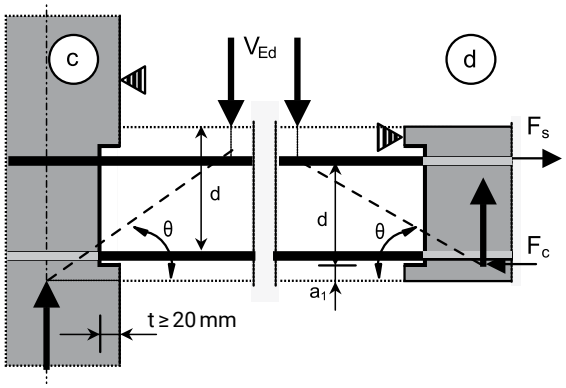
with $v_1 = 0.75 \cdot (1.1 - f_{ck} / 500) \leq 0.75$

[R1] Exp. (6.7aDE): Reduction of the strut inclination, calculated with reduction to $\theta \leq 45°$ in the area $l_e = 0.5\ l_e \cdot \cot\theta \cdot d$ on either side of the joint $1.0 \leq \cot\theta \leq [(1.2 + 1.4\sigma_{cd} / f_{cd})] / [(1 - V_{Rd,cc} / V_{ed})] < 3.0$

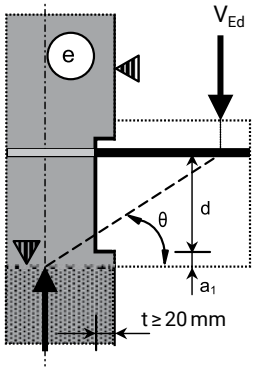
where [R1]] Exp. (6.7bDE):

$V_{Rd,cc} = 0.48 \cdot c \cdot f_{ck}^{1/3} \cdot (1 - 1.2\sigma_{cd} / f_{cd}) \cdot b_w \cdot z$ with c according to Table; $\sigma_{cd} = N_{Ed} / Ac > 0$ as compressive strength!

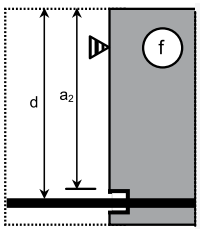
Please note: The longitudinal reinforcement to be considered in Exp. (6.2) is, according to the structural design, the one that is exposed to tensile loads (e.g. c, d or e). Fig. d and e show the effective depth d to be reduced by a_1 due to the difficult concrete pour conditions of $a_1 < 50$ mm in the stress area.



Wall to floor slab



Floor slab to floor slab



$a_2 \geq 50$ mm where surface roughness according to DIN EN 1992-1-1, 6.2.5 (see Table 1)

Edge of concrete pour area,
[R1] DIN EN 1992-1-1 with DIN EN 1992-1-1/NA

RECOSTAL® RSH

RECOSTAL® RSH with trapezoidal profile for transverse stresses.

It meets the requirements of DIN EN 1992-1-1 for the highest surface category “key profiled“ in the case of transverse loads. RECOSTAL® Starter Packs type RSH meet the requirements of the DBV Bulletin “Rückbiegen von Betonstahl und Anforderungen an Verwahrkästen nach Eurocode 2”.

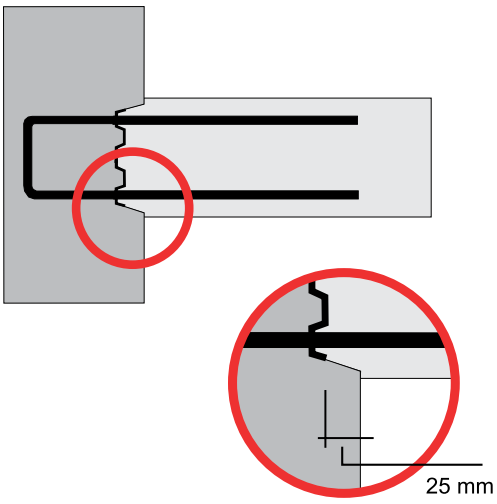
[“Rebending of reinforcement steel and requirements for continuity strips according to Eurocode 2”] (issue January 2011) for the highest joint category “key profiled” in the case of transverse stresses. No national approval required!

Technical Data

- Trapezoidally profiled starter packs, joint category “key profiled“ according to DIN EN 1992-1-1, highest shear force bearing capacity
- Concrete reinforcement steel B500B,B500C, B550B according to DIN 488, Ø = 8 mm – 16 mm
- Diameter of bending rolls dbr ≥ 6 Ds in the section of rebending
- 8 standard profiles, bar widths 10 cm – 22 cm, smaller or larger bar widths on request
- Standard unit length L= 1.25 m, fixed lengths up to 2.20 m on request

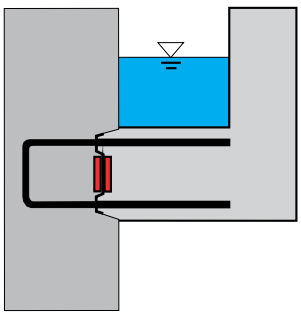
Increased Corrosion Protection

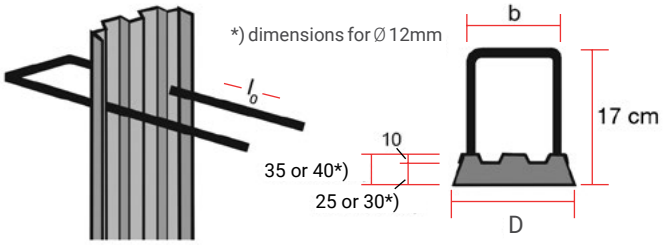
RECOSTAL® Starter Pack type RSH is installed with a planned 25 mm recess.

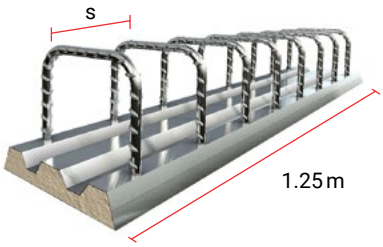


RSH active Construction Joint Sealing

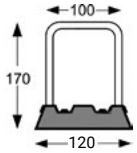
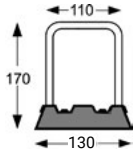
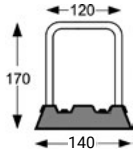
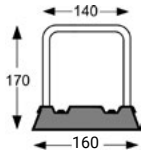
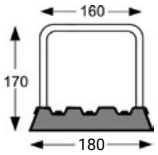
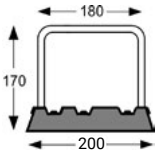
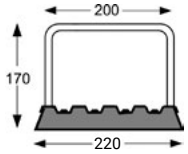
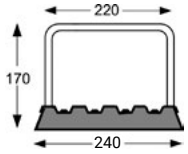
RECOSTAL® Starter Pack type RSH active is with active Waterproofing. It can be manufactured with an active bentonite coating on both sides for the application in construction joints exposed to water.





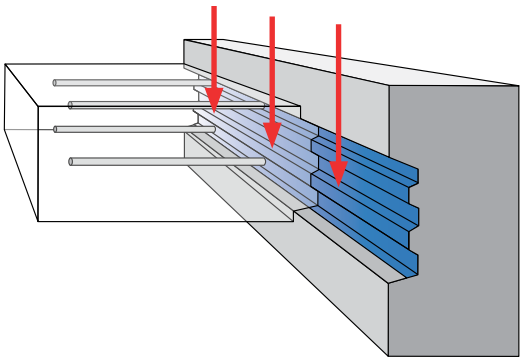


Reinforcement steel: B500B, B500C, B550B

Standard	Type	Ø (mm)/s (cm)	Lap length l_0 (cm)	Bar height h (cm)	Bar width b (cm)	Box width D (cm)
	RSH 10	8/15	32	17	10	12
		8/20	32	17	10	12
		10/15	39	17	10	12
		10/20	39	17	10	12
		12/15	46	17	10	12
		12/20	46	17	10	12
	RSH 11	8/15	32	17	11	13
		8/20	32	17	11	13
		10/15	39	17	11	13
		10/20	39	17	11	13
		12/15	46	17	11	13
		12/20	46	17	11	13
	RSH 12	8/15	32	17	12	14
		8/20	32	17	12	14
		10/15	39	17	12	14
		10/20	39	17	12	14
		12/15	46	17	12	14
		12/20	46	17	12	14
	RSH 14	8/15	32	17	14	16
		8/20	32	17	14	16
		10/15	39	17	14	16
		10/20	39	17	14	16
		12/15	46	17	14	16
		12/20	46	17	14	16
	RSH 16	8/15	32	17	16	18
		8/20	32	17	16	18
		10/15	39	17	16	18
		10/20	39	17	16	18
		12/15	46	17	16	18
		12/20	46	17	16	18
	RSH 18	8/15	32	17	18	20
		8/20	32	17	18	20
		10/15	39	17	18	20
		10/20	39	17	18	20
		12/15	46	17	18	20
		12/20	46	17	18	20
	RSH 20	8/15	32	17	20	22
		8/20	32	17	20	22
		10/15	39	17	20	22
		10/20	39	17	20	22
		12/15	46	17	20	22
		12/20	46	17	20	22
	RSH 22	8/15	32	17	22	24
		8/20	32	17	22	24
		10/15	39	17	22	24
		10/20	39	17	22	24
		12/15	46	17	22	24
		12/20	46	17	22	24

Other sizes on request

Shear Force Transverse to the Construction Joint



Highest joint category “key profiled”

Determination according to:

- DIN EN 1992-1-1/NA
- DBV-Bulletin “Rückbiegen…nach Eurocode 2”
  [“Rebending… according to Eurocode 2”], January 2011

Determination Example - Acceptable Shear Force

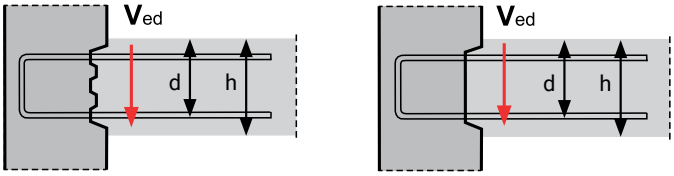
Acceptable shear force without shear reinforcement, including reduction by applying roughness coefficient c: $V_{Rd,c} = (c /0.5) \cdot [C_{Rd,c} \cdot k \cdot (100\rho_1 \cdot f_{ck})^{1/3} + k_1 \cdot \sigma_{cp}] \cdot b_w \cdot d$ (6.2.a)

Values	Definition
h = 20 cm	Height of the construction part
d = 17 cm	Effective depth
b_w = 1.0 m	1m width of section
C20/25	Tab. 3.1 > f_{ck} = 20 N/mm²
c = 0.5	6.2.5 (2) > key profiled metal base
$C_{Rd,c} = 0.15/\gamma_c = 0.10$	(NA, 6.2.2(1)), Y_c = 1.5
k = 1 +√(200/170) = 2.08	k = 1 +√(200/d [mm]) ≤ 2.0
ρ1 = 7.54/(100 x 17) = $4.435 \cdot 10^{-3}$	(A sl/b_w · d) ≤ 0.02 determined with Ø 12/15 cm = 7.54 cm²/m, single
K1 = 0.12	NA, 6.2.2 (1)
σ_{cp} = 0	No compressive stress in the concrete from axial loading or prestressing

$V_{Rd,ct} = (0.5/0.5) \cdot [0.10 \cdot 2.0 \cdot (100 \cdot 4.435 \cdot 10^{-3} \cdot 20)^{1/3} + 0] \cdot 1.0 \cdot 0.17 \cdot 10^3$
$= 70.4$ kN/m

Please note:
If anchorage and lap lengths are reduced, the bearing values have to be reduced accordingly.

Shear Force Bearing Capacity (kN/m)



Shear force bearing capacity (kN/m) of slab to steel reinforced concrete wall connections without shear reinforcement depending on the joint category and the steel cross section, if starter packs are used.

The values given in the table are subject to the application of the entire anchorage and lap lengths required according to EC 2.

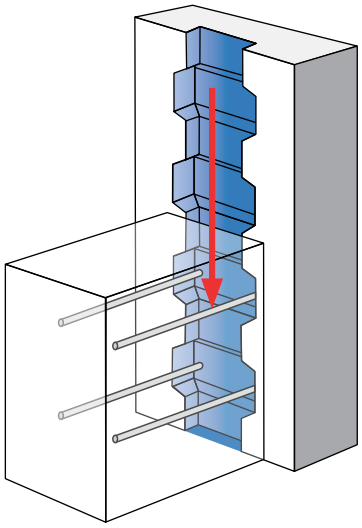
- Tabular values $V_{Rd,c}$ in kN/m
- All values have been determined for $\sigma_{cp} = 0$

Effective depth d (cm)	Type	Ø Bar diameter/ centers	Joint category key profiled $V_{Rd,c,kp}$			Joint category smooth $V_{Rd,c,smooth}$		
			C 20/25	C 25/30	C 30/37	C 20/25	C 25/30	C 30/37
11	RSH 10	Ø 8/15	40.18	43.28	45.99	16.07	17.31	18.40
		Ø 10/15	46.64	50.24	53.39	18.66	20.10	21.36
		Ø 12/15	52.65	56.72	60.27	21.06	22.69	24.11
12	RSH 11	Ø 8/15	42.58	45.86	48.74	17.03	18.35	19.50
		Ø 10/15	49.42	53.24	56.57	19.77	21.29	22.63
		Ø 12/15	55.79	60.11	63.87	22.32	24.04	25.55
13	RSH 12	Ø 8/15	44.91	48.38	51.41	17.96	19.35	20.56
		Ø 10/15	52.13	56.16	59.68	20.85	22.46	23.87
		Ø 12/15	58.86	63.40	67.37	23.54	25.36	26.95
15	RSH 14	Ø 8/15	49.41	53.22	56.56	19.76	21.29	22.62
		Ø 10/15	57.35	61.78	65.65	22.94	24.71	26.26
		Ø 12/15	64.75	69.75	74.12	25.90	27.90	29.65
17	RSH 16	Ø 8/15	53.71	57.85	61.50	21.48	23.14	24.60
		Ø 10/15	62.34	67.16	71.36	24.94	26.86	28.55
		Ø 12/15	70.38	75.82	80.57	28.15	30.33	32.23
19	RSH 18	Ø 8/15	57.84	62.31	66.21	23.14	24.92	26.48
		Ø 10/15	67.14	72.33	76.86	26.86	28.93	30.74
		Ø 12/15	75.80	81.65	86.77	30.32	32.66	34.71
21	RSH 20	Ø 8/15	61.09	65.8	69.93	24.43	26.32	27.97
		Ø 10/15	70.91	76.38	81.17	28.36	30.55	32.47
		Ø 12/15	80.05	86.23	91.64	32.02	34.49	36.66
23	RSH 22	Ø 8/15	63.48	68.38	72.67	25.39	27.35	29.07
		Ø 10/15	73.69	79.38	84.35	29.47	31.75	33.74
		Ø 12/15	83.19	89.61	95.23	33.28	35.85	38.09

Please note:
If anchorage and lap lengths are reduced, the bearing values have to be reduced accordingly.

RECOSTAL® RSV

RECOSTAL® RSV with trapezoidal profile for longitudinal stresses.



Shear Force Longitudinal to the Construction Joint

Highest joint category “key profiled”

Determination Example - Shear Capacity

Total bearing capacity =
bearing contact area [concrete] + [friction] + [reinforcement] ≤ max. bearing capacity

Example: concrete C 20/25

Values	Definition
b = 17 cm	Shear force area
$\sigma_N = 0$	Nominal compressive stress vertical to the joint N_{Ed} = design value of the applied axial force or prestressing which can act together with the shear force.
c = 0.5	c according to DIN EN 1992-1-1, 6.2.5(2) (key profiled)
μ = 0.9	μ according to DIN EN 1992-1-1, 6.2.5(2) (key profiled)
$f_{ctd} = \alpha_{ct} \cdot f_{ctk;0.05} / \gamma_c$ $= 0.85 \cdot 1.5/1.5$ $= 0.85$	Design value of the axial tensile strength of concrete with $f_{ctk;0.05} = 1.5$ N/mm² according to DIN EN 1992-1-1, Table 3.1 and $\gamma_c = 1.5$ for concrete according to DIN EN 1992-1-1, Table 2.1
	$\alpha_{ct} = 0.85$ according to DIN EN 1992-1-1 / NA 3.1.6 (2)P
Asl = Ø10/15 double = 5.24 x 2 = 10.48 cm²/m	Cross section of the reinforcement transverse to the joint, double
$f_{yd,red} = 0.8 \cdot 500/1.15$ $= 348$ N/mm²	Design value of the reinforcement steel yield strength with $f_{yk} = 500$ N/mm² according to DIN EN 1992-1-1 / NA 3.2.2(3P) $\gamma_c = 1.15$; reduced steel tension 80 % f_{yd} according to DIN EN 1992-1-1 / NA 8.3 (5)P
α = 90°	Angle of the reinforcement transverse to the joint
v = 0.7	v according to DIN EN 1992-1-1 / NA 6.2.2(6)
$f_{cd} = \alpha_{cc} \cdot f_{ck} / \gamma_c$ $= 0.85 \cdot 20/1.5$ $= 11.33$ N/mm²	Design value of the characteristic cylinder strength with $f_{ck} = 20$ N/mm² according to DIN EN 1992-1-1, Tab.3.1 and $\alpha_{cc} = 0.85$ according to DIN EN 1992-1-1, NA 3.1.6(1)P and $\gamma_c = 1.5$ according to DIN EN 1992-1-1 Tab.2.1N

Bearing Contact Area Concrete

$V_{Rdi,c} = (c \cdot f_{ctd}) = (0.5 \cdot 0.85)$
$= 0.425$ N/mm²

Bearing Contact Area Friction

$V_{Rd,\mu} = (\mu \cdot \sigma_N) = (0.9 \text{ x } 0)$
$= 0$

Bearing Contact Area - Reinforcement

$V_{Rd,sy} = \rho \cdot f_{yd} \cdot (1.2\mu \cdot \sin\alpha + \cos\alpha)$
$= 10.48/(17 \cdot 100) \cdot 348 \cdot (1.2 \cdot 0.9 \cdot \sin 90° + \cos 90°)$
$= 2.32$ N/mm²

Factor 1.2 according to DIN EN 1992-1-1, NA 6.2.5

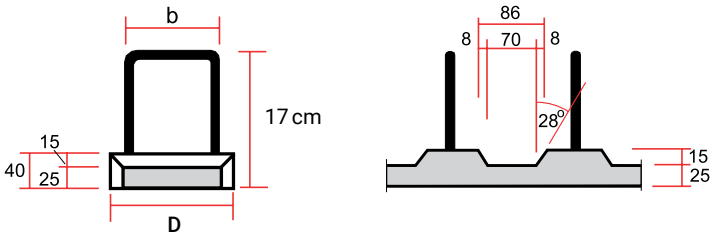
Total Bearing Capacity

$V_{Rdi} = V_{Rdi,c} + V_{Rd,sy} < V_{Rdi,max}$
$> V_{Ed}$

The values stated apply to full length anchorage and lap lengths; if the lengths are reduced, the bearing values have to be reduced accordingly.

$V_{Rdi,max} = 0.5 \cdot v \cdot f_{cd}$
$= 0.5 \cdot 0.7 \cdot 11.33 = 3.97$ N/mm²
$\hat{=} 3.97 \cdot 10^3 \cdot 0.17 = 674.9$ kN/m

$V_{Rdi} = (0.425 + 2.32) \cdot 10^3 \cdot 0.17$
$= 466.65$ kN/m = applicable
$< V_{Rdi,max} = 674.9$ kN/m



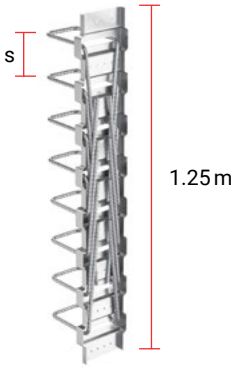
Standard	Type	Ø (mm)/s (cm)	Lap length l_0 (cm)	Bar height h (cm)	Bar width b (cm)	Box width D (cm)
	RSV 8	8/15	32	17	8	11
		10/15	39	17	8	11
	RSV 11	8/15	32	17	11	14
		10/15	39	17	11	14
		12/15	46	17	11	14
	RSV 14	8/15	32	17	14	17
		10/15	39	17	14	17
		12/15	46	17	14	17
	RSV 18	8/15	32	17	18	21
		10/15	39	17	18	21
		12/15	46	17	18	21

Table of the Bearing Capacity Applicable for the Shear Force Stress Longitudinal to the Starter Pack

The values given in the table are subject to the anchorage and lap lengths required according to DIN EN 1992-1-1.

- Tabular values in kN/m
- All values have been determined for $\sigma_{Nd} = 0$

Determination according to:

- DIN EN 1992-1-1 § 6.2.5 (6.25)
- DBV Bulletin “Rückbiegen von ...“ [Rebending...] (Issue 2011)
- Type of surface “key profiled”

Taken as:

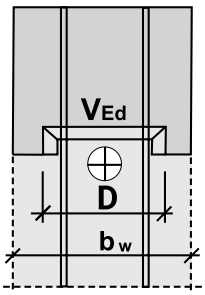
$\sigma_N = 0$; $45° \leq \alpha \leq 90°$

Applicable:

max. $V_{ed} < V_{Rd,i} < V_{Rd,i}$ max

e. G. RSV 8 - 8/15 cm,

max. V_{ed} = 298.56 kN/m = applicable

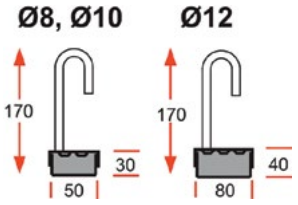


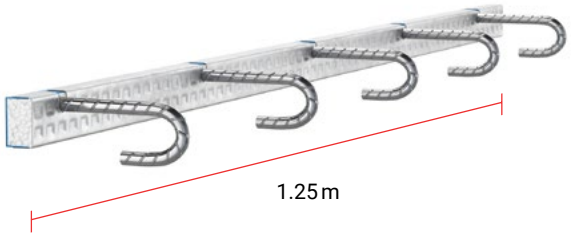
Shear force area D (mm)	Type	Ø (mm)/ s (cm)	Joint category key profiled (kp)					
			C 20/25		C 25/30		C 30/37	
			$V_{Rd,i}$	$V_{Rd,i\ max}$	$V_{Rd,i}$	$V_{Rd,i\ max}$	$V_{Rd,i}$	$V_{Rd,i\ max}$
110	RSV 8	8/15	298.56	436.21	307.91	545.55	314.13	654.5
		10/15	440.63	436.21	449.98	545.55	456.20	654.5
140	RSV 11	8/15	311.31	555.17	323.21	694.33	331.12	833.00
		10/15	453.38	555.17	465.28	694.33	473.19	833.00
		12/15	626.27	555.17	638.17	694.33	646.08	833.00
170	RSV 14	8/15	324.06	674.90	338.51	843.12	348.12	1011.50
		10/15	466.65	674.90	480.58	843.12	490.19	1011.50
		12/15	639.02	674.90	653.47	843.12	663.07	1011.50
210	RSV 18	8/15	341.06	832.76	358.91	1041.50	370.78	1249.50
		10/15	483.13	832.76	500.98	1041.50	512.85	1249.50
		12/15	656.02	832.76	673.87	1041.50	685.73	1249.50

Please note:
If anchorage and lap lengths are reduced, the bearing values have to be reduced accordingly.

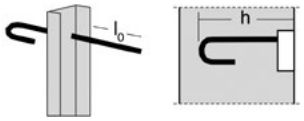
RECOSTAL® VHQ

RECOSTAL® Single Bar VHQ

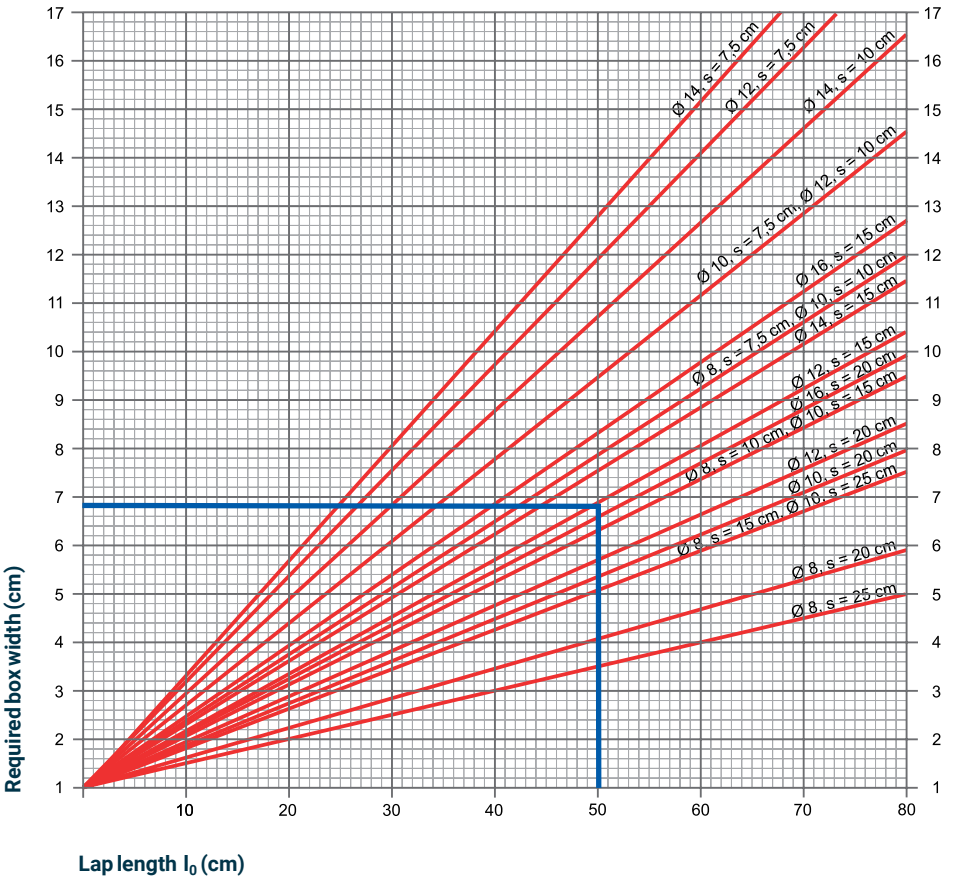




Reinforcement steel: B500B, B500C, B550B

Standard	Type	Ø (mm)/s (cm)	Lap length l_0 (cm)	Centers-s (cm)
	VHQ	8/15	32	15
		8/20	32	20
		8/25	32	25
		10/15	39	15
		10/20	39	20
		10/25	39	25
		12/15	46	15
		12/20	46	20
		12/25	46	25

Graph for the Determination of the Production-Related required Box Widths and Max. Producible l_0-Lengths



Notes:

b: Production-related required box width for single bars. In case of double bar starter packs, the respective value has to be doubled.

Example:

Type SB (double bar starter pack)
Ø 12, s = 15 cm, l_0 = 50 cm
▶ required box width: 2 x 6.8 = 14 cm

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RSH S2G

RSH SKB

RSH SKG

RSH SKG-v

RSH SRG

RSH SKB-v

RSH S2v

RSH S2G-v

RSH SB

RSH SWQ

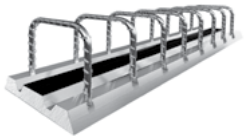
RSH SHQ

RSH SWv

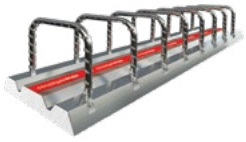
RSH S2H

RSH SK2H

RSH SKR



RSH bitum*

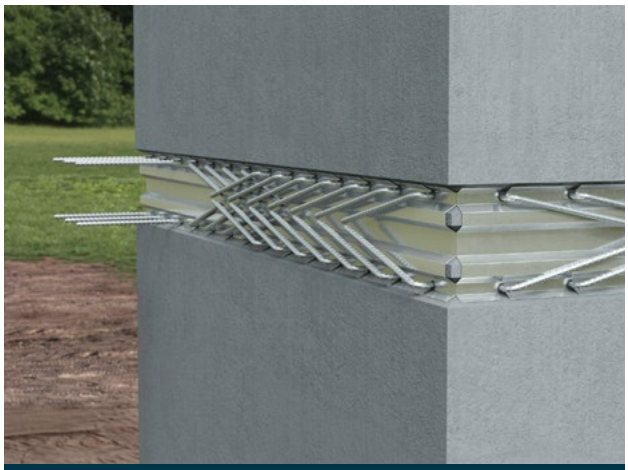


RSH activ

*This type is not available in Germany

RECOSTAL®
Reinforcement Technologies

RECOSTAL® Coupler



RECOSTAL® Starter Packs

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