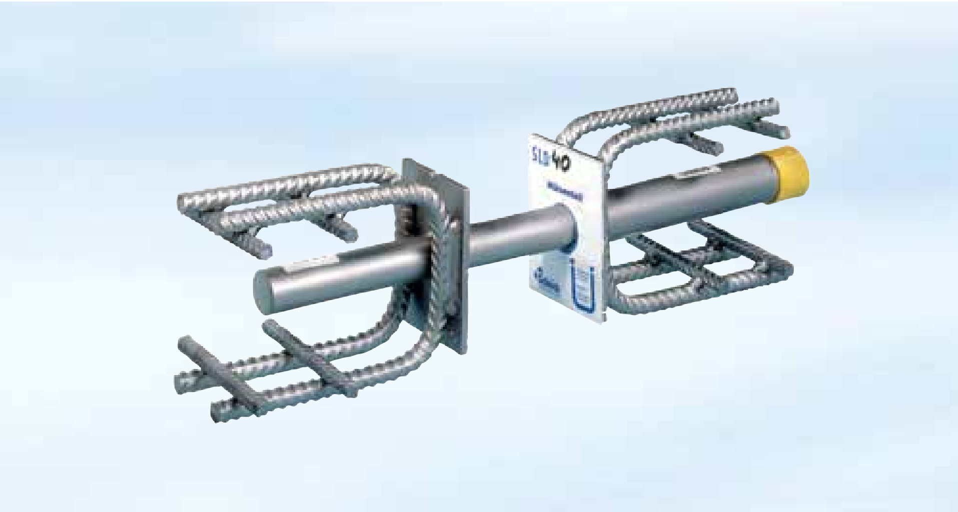
Schöck Dorn



Technical Information

November 2014

Telephone hotline for design support services
Tel. +45 86 22 93 93
Fax +45 86 22 93 96
E-mail: info@haucon.dk

Planning tools - downloads and requests
info@haucon.dk
www.schoeck.dk

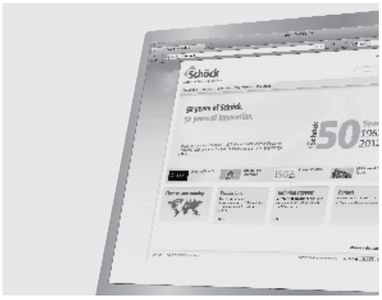
Schöck Dorn
Planning and advisory service

The engineers in the design support department at Schöck would gladly provide advice concerning static and structural matters and will suggest solutions with calculations and detailed drawings for you.

For this purpose, please send your planning documents (plan views, cross-sections, static information) specifying the construction project address to:

HauCon A/S
Lægårdsvej 19
DK-8520 Lystrup
Telefon: +45 86 22 93 93
Fax: +45 86 22 93 96

- Tel. +45 86 22 93 93
  Fax +45 86 22 93 96
  info@haucon.dk

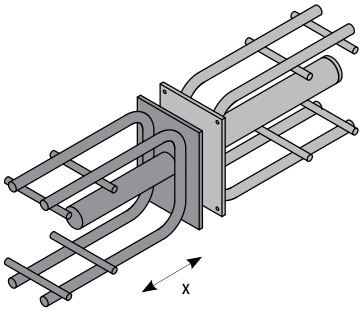


Schöck Dorn
Contents

Schöck Dorn
All types at a glance

Heavy duty dowel SLD

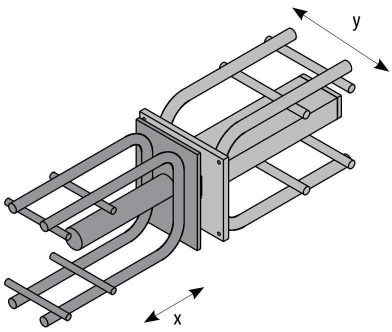
Schöck Dorn type SLD



- Heavy duty dowel for the transfer of large shear forces
- Movable in x-direction
- use of stainless steels
- material no. 1.4571, 1.4404, 1.4462, 1.4362
- Eurocode compliant

Page 9

Schöck Dorn type SLD Q

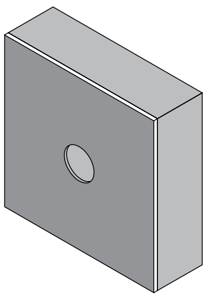


- Heavy duty dowel for the transfer of large shear forces
- Movable in x direction, in y direction ±15 mm
- use of stainless steels
- material no. 1.4571, 1.4404, 1.4462, 1.4362
- Eurocode compliant

Page 9

Accessories for heavy duty dowel SLD

Schöck fire protection collar SLD-BSM



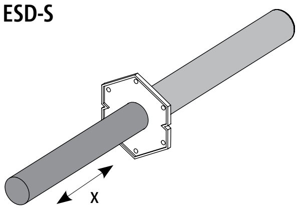
- Fire protection collar for classification of the whole connection as fire resistance class R 90 for 90 minutes

Page 46

Schöck Dorn
All types at a glance

Single shear dowel ESD

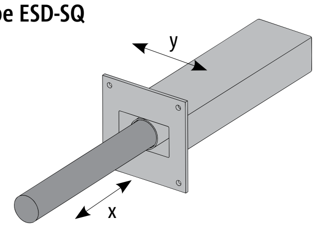
Schöck Dorn type ESD-S



- Single shear dowel for the transfer of shear forces
- Dowel made from stainless steel
- Material no. 1.4571, 1.4404, 1.4362
- Movable in x- direction

Page 35

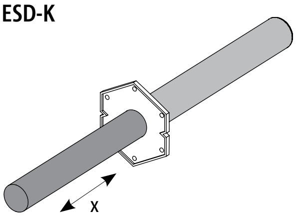
Schöck Dorn type ESD-SQ



- Single shear dowel for the transfer of shear forces
- Dowel and sleeve made from stainless steel
- Material no. 1.4571, 1.4404, 1.4362
- Movable in x- and y- directions

Page 35

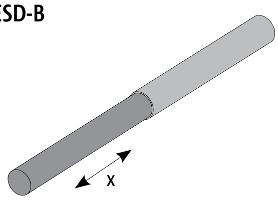
Schöck Dorn type ESD-K



- Single shear dowel for the transfer of shear forces
- Dowel made from galvanised or stainless steel S355
- Material no. 1.4571, 1.4404, 1.4362
- Plastic sleeve with fixing plate
- Movable in x- direction

Page 35

Schöck Dorn type ESD-B

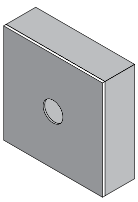


- Single shear dowel for the transfer of shear forces
- Dowel made from galvanised or stainless steel S355
- Material no. 1.4571, 1.4404, 1.4362
- With half sided plastic sleeve
- Movable in x- direction

Page 35

Accessories for single shear dowel ESD

Schöck fire protection collar ESD-BSM



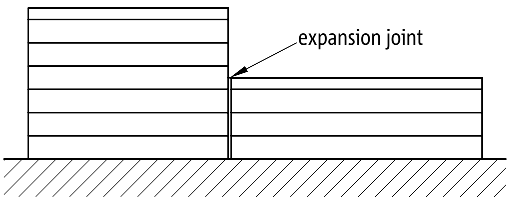
- Fire protection collar for classification of the whole connection as fire resistance class R 90 for 90 minutes

Page 46

Schöck Dorn
Design information for expansion joints

Planned expansion joints

Expansion joints are used in order to facilitate motions between parts of buildings. This prevents restraint stresses and therefore structural damage.

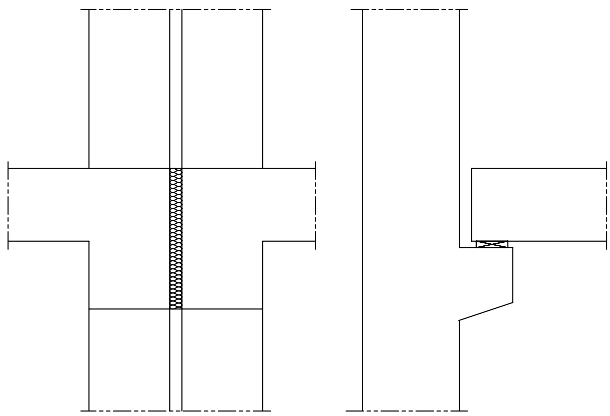


Restraint stresses can be caused by:

- Temperature expansion
- Shrinkage
- Swelling

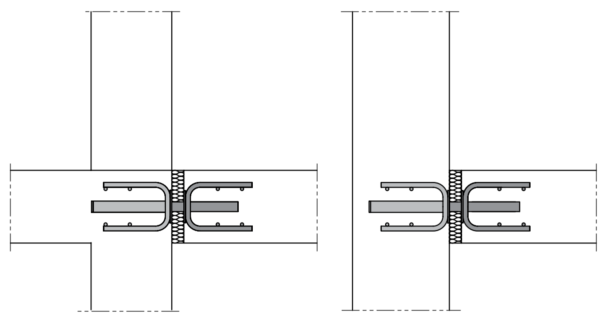
Conventional solutions - complicated and expensive

Floor slabs and beams, which are separated by the joint, must be supported in the joint area. Varying settlement effects of the building parts must be prevented as well. Traditionally, consoles with friction bearings or double load-bearing walls and supports in the building joints were used for this purpose. These solutions are difficult to reinforce and line. They also take up space that later presents an obstacle in extensions.



The solution – Schöck Dorns

The Schöck Dorns facilitate horizontal motion and the transfer of vertical loads. These systems have the following advantages:



- simpler formwork and reinforcement routing
- better utilisation of space due to lack of double supports and consoles
- creation possible in one or several construction stages
- static calculation according to BS EN 1992-1-1:2004
- free download of a user-friendly dimensioning program at www.schoeck.co.uk
- joints can be realised in fire resistance class R 90
- safe and maintenance-free connection thanks to high-quality stainless steels

Schöck Dorn
Design information for expansion joints

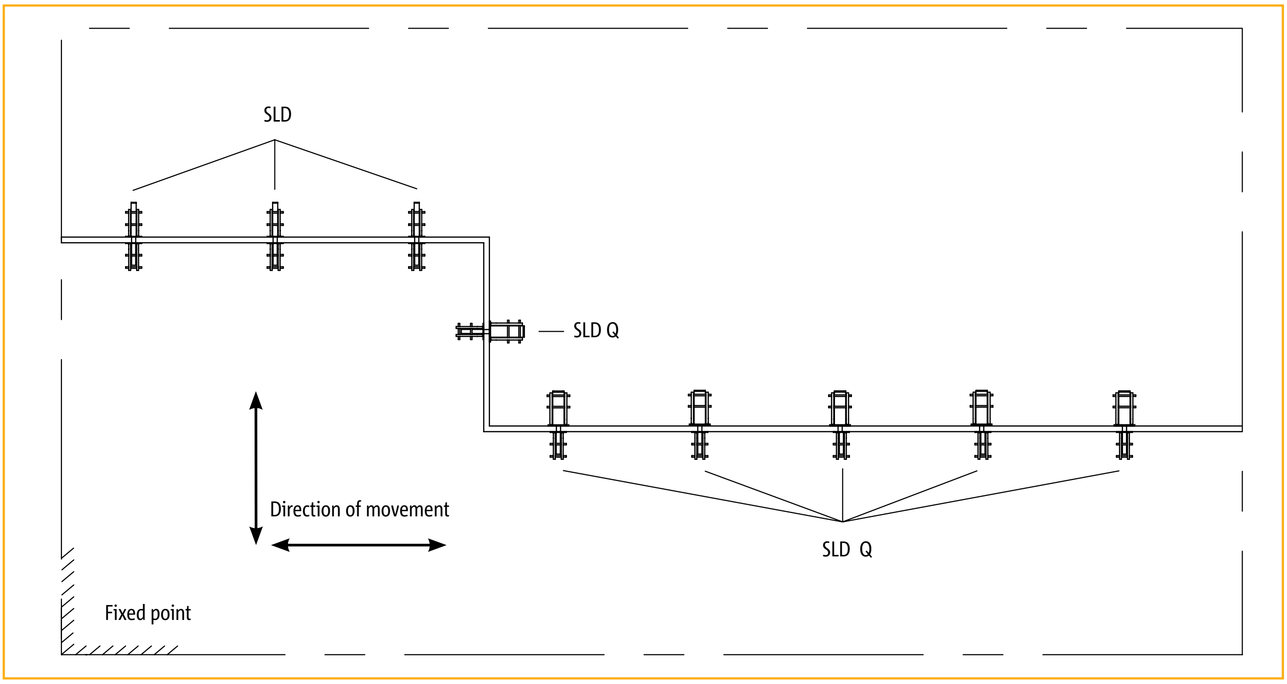
The right dowel

The Schöck Dorns include the SLD heavy-duty dowel and the ESD single shear dowel.

- The SLD heavy-duty dowel is particularly suitable for the connection of structurally important parts such as floor slabs. It features very high load-bearing capacities.
- The ESD single shear dowel is used to transmit forces in constructional joints with small loads. This includes, for example, joints between balcony slabs, roadway slabs and cantilever retaining walls.

Construction Advice

- If planned forces run in a longitudinal and vertical direction along the joint, they must be supported separately. For this purpose, dowels of the SLD Q or ESD SQ types that facilitate sideways motion are arranged along the entire joint. The dowels that support the planned longitudinal joint forces are placed at a right angle to the joint axis. This ensures that these dowels do not have to bear non-planned vertical loads.
- Planned expansion joints are utilised in order to prevent constraints in building parts. For this reason, each building part must be checked for the possible movement effects such as temperature changes, shrinkage, creep, swelling and building settlement along its longitudinal and transverse axis.
- For long expansion joints or expansion joints adjacent to building corners, dowels of the type SLD Q or ESD SQ moveable on two axes must be used.



Dowel choice for recessed corners or long expansion joints

Schöck Dorn

Design information for expansion joints

Calculation of the required joint width

It is always the maximum joint width that is important in dimensioning the shear force dowels. They are calculated from the initial joint width and the temperature and shrinkage expansion of the adjacent components. Creep effects must only be taken into consideration if permanent direct stresses are exerted on the component, for example due to pretensioning. The maximum joint width can be estimated based on the following equation:

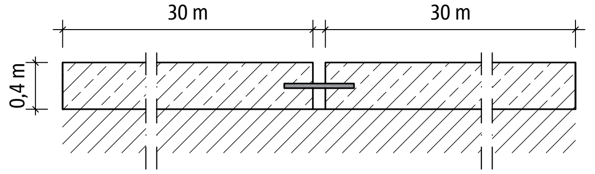
Joint width $f = 20 + L_{slab} \cdot (\Delta T \cdot \alpha_t + \varepsilon_{cd} + \varepsilon_{ca})$

with:

20 - recommended initial joint width [mm]
L_{slab} - effective component length for expansion
ΔT - maximum temperature change of the component after manufacture according to BS EN 1992-1-5
α_t - $10 \cdot 10^{-6}$ [1/K] according to BS EN 1992-1-1, Paragraph 3.1.3 (6)
ε_{cd} - drying shrinkage expansion according to BS EN 1992-1-1, Paragraph 3.1.4 (6)
ε_{ca} - shrinkage expansion according to BS EN 1992-1-1, Paragraph 3.1.4 (6)

Example:

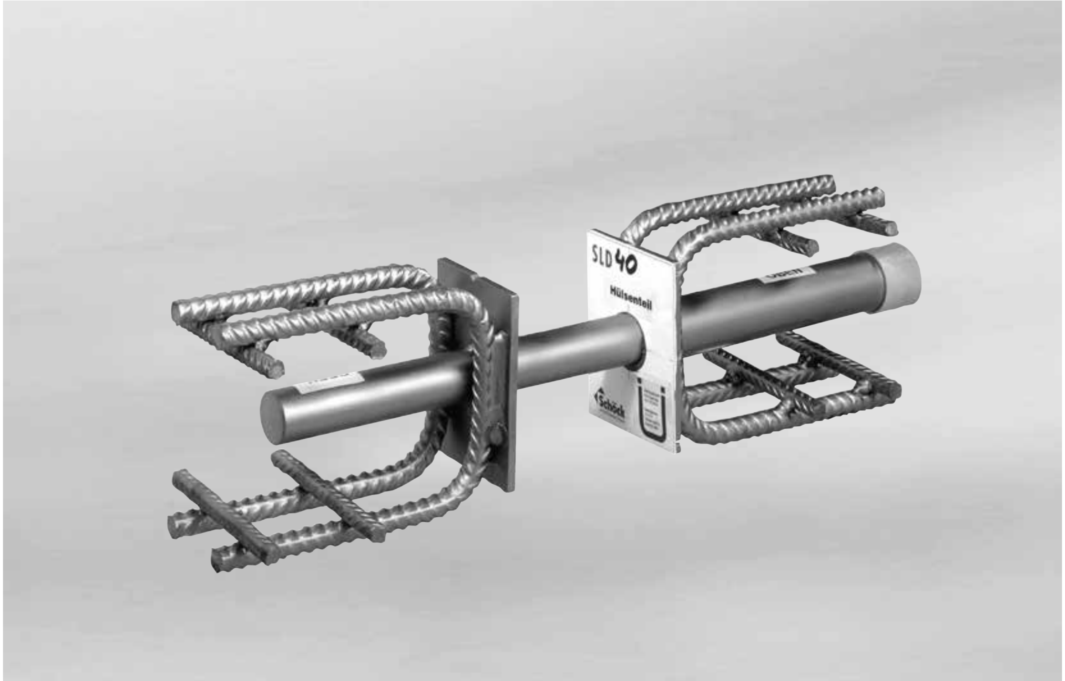
Connection of two floor slabs:
thickness 40 cm
concrete C20/25 with cement strength class 32.5 N
effective length up to the centre line of a 15m floor slab
humidity 60 %
temperature at component completion 10°C



Calculation according to BS EN 1992-1-1:
Δ_T = 37 – 10 = 27 K according to BS EN 1991-1-5
ε_{cd} = 0.049 % according to BS EN 1992-1-1, Paragraph 3.1.4 (6)
ε_{ca} = 0.0025 % according to BS EN 1992-1-1, Paragraph 3.1.4 (6)
f = 20 + 2 · 15.000 · (27 · 10 · 10–6 + 0.00049 + 0.000025) = 44 mm

The calculated shrinkage expansion values are average values with a variation coefficient of approx. 30%. For this reason, an additional safety margin of 0.5 to 1cm should be taken into account.

Schöck Dorn type SLD



Schöck Dorn type SLD

SLD

Contents **Page**

Schöck Dorn type SLD

Planned expansion joints

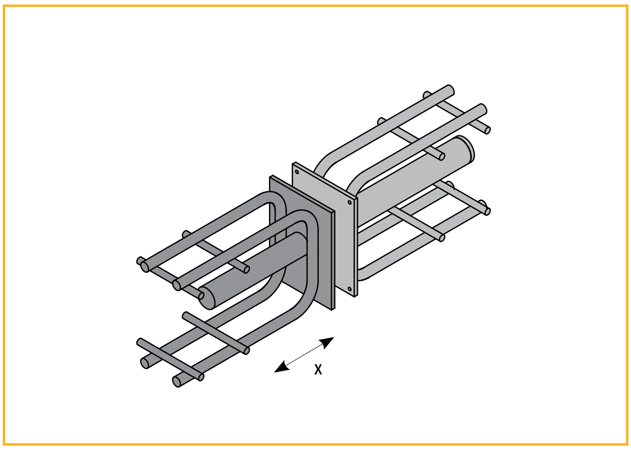
SLD

The SLD heavy-duty dowel

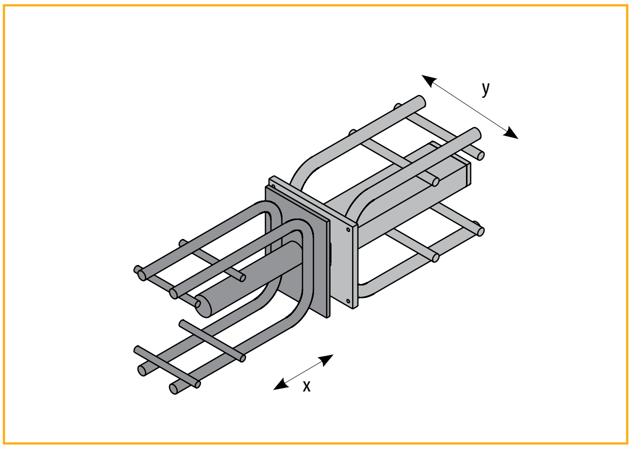
The SLD heavy-duty dowel consists of a sleeve part and a dowel part, which are set in concrete in the building parts adjacent to the joint. The dowel transfers loads from the one component i nto the sleeve and thus into the other component. The front panel and the welded links that have been welded on serve as the ideal anchors in the concrete here.

The sleeve of type SLD is round, which facilitates longitudinal movements in the direction of the x-axis, thus preventing restraint stresses due to the expansion of components. The forces can be transferred at perpendicular angles and across the dowel axis.

If movement of the y-axis is required, type SLD Q can be used. The sleeve of this dowel is rectangular, thus allowing for +15mm movement on the y-axis.



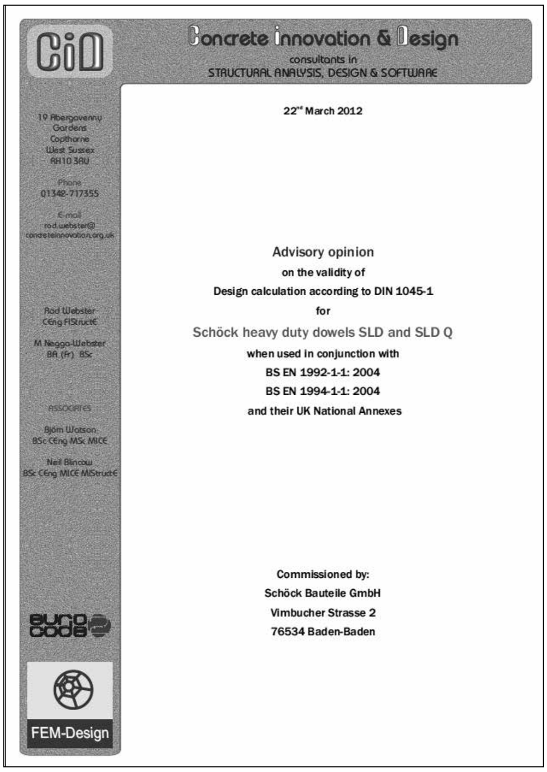
Schöck Dorn type SLD



Schöck Dorn type SLD Q

Specifications for dimensioning

- The static calculations to Eurocode 2 for Schöck dweil type SLD, when used in conjunction with BS EN 1992-1-1:2004 and its UK national Annex, have been approved by Mr. Rod Webster, the Concrete Innovation & Design, West Sussex.
- The calculations cover applications of the Schöck Dorn type SLD for strength C20/25 up to C50/60.
- Joint widths up to 60 mm can be realised with the Schöck Dorn type SLD.
- All dimensioning, reinforcement and geometry tables are based on a concrete cover of 3 cm.
- Dowel and sleeve consist of approved stainless steel.



CiD

Concrete Innovation & Design
consultants in
STRUCTURAL ANALYSIS, DESIGN & SOFTWARE

19 Abergavenny Gardens
Copthorne
West Sussex
RH10 3RU

Phone
01342-717355

E-mail
rod.webster@concreteinnovation.org.uk

Rod Webster
CEng FIStructE

M Neggo-Webster
BA (Fr) BSc

ASSOCIATES

Björn Watson
BSc CEng MSc MICE

Neil Blincow
BSc CEng MICE MIStructE

22nd March 2012

Advisory opinion
on the validity of
Design calculation according to DIN 1045-1
for
Schöck heavy duty dowels SLD and SLD Q
when used in conjunction with
BS EN 1992-1-1: 2004
BS EN 1994-1-1: 2004
and their UK National Annexes

Commissioned by:
Schöck Bauteile GmbH
Vimbucher Strasse 2
76534 Baden-Baden

FEM-Design

Schöck Dorn type SLD
Connection options

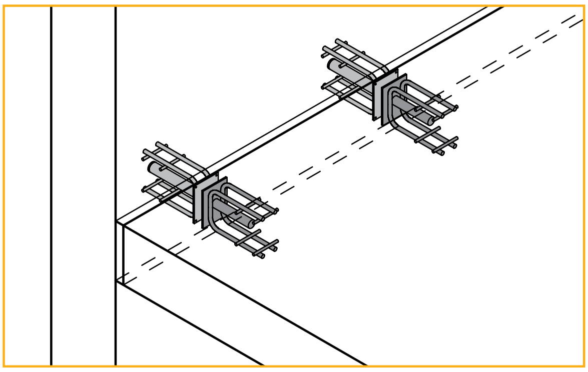


Figure 1: Connection between slab and wall

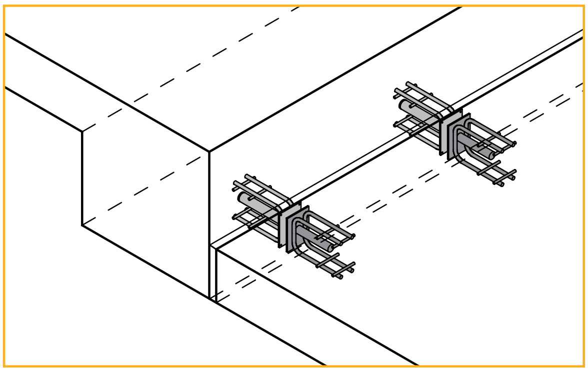


Figure 2: Connection between slab and downstand edge

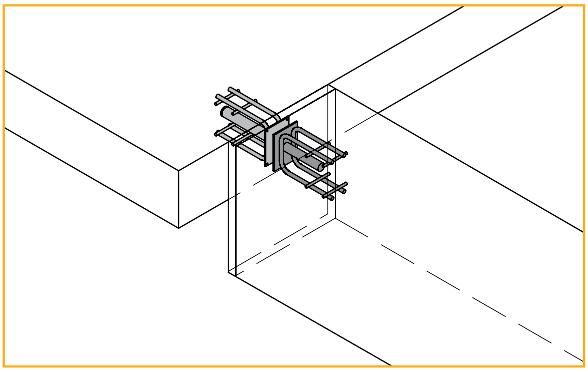


Figure 3: Connection between slab and beam face

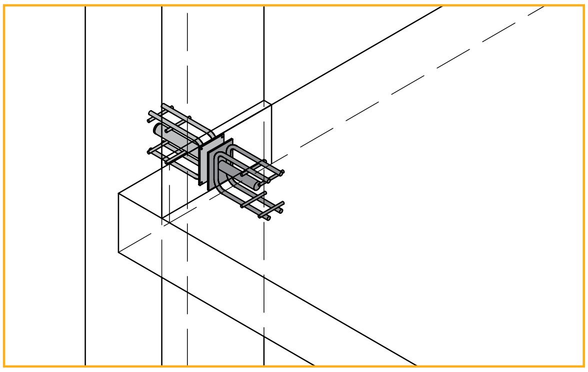


Figure 4: Connection between slab and support column

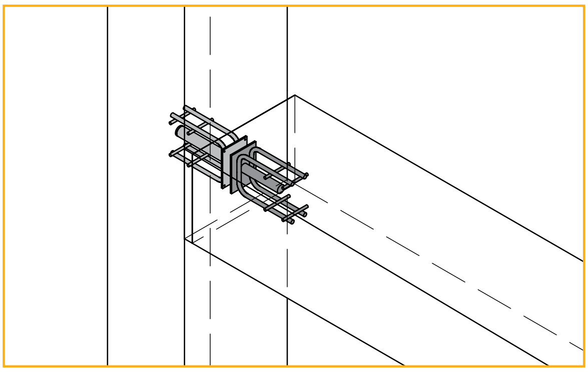


Figure 5: Connection between beam face and support column

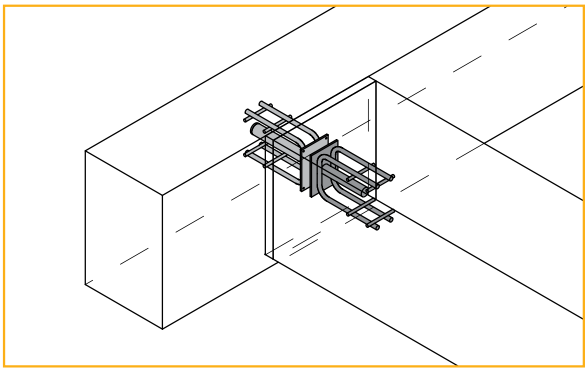


Figure 6: Connection between beam edge and beam face

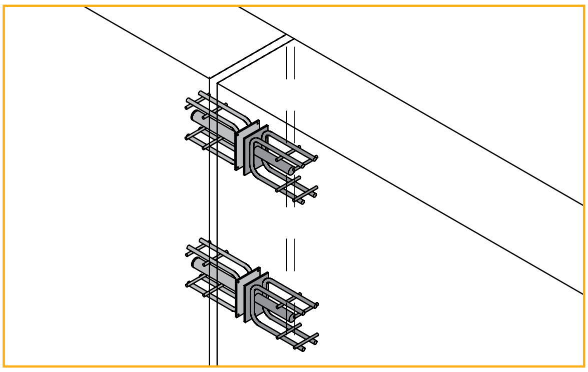


Figure 7: Connection between wall and wall (face to face)

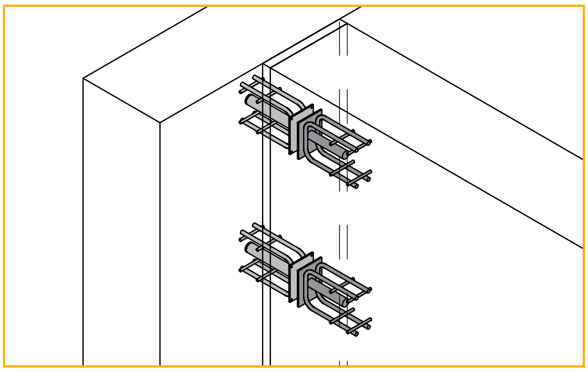
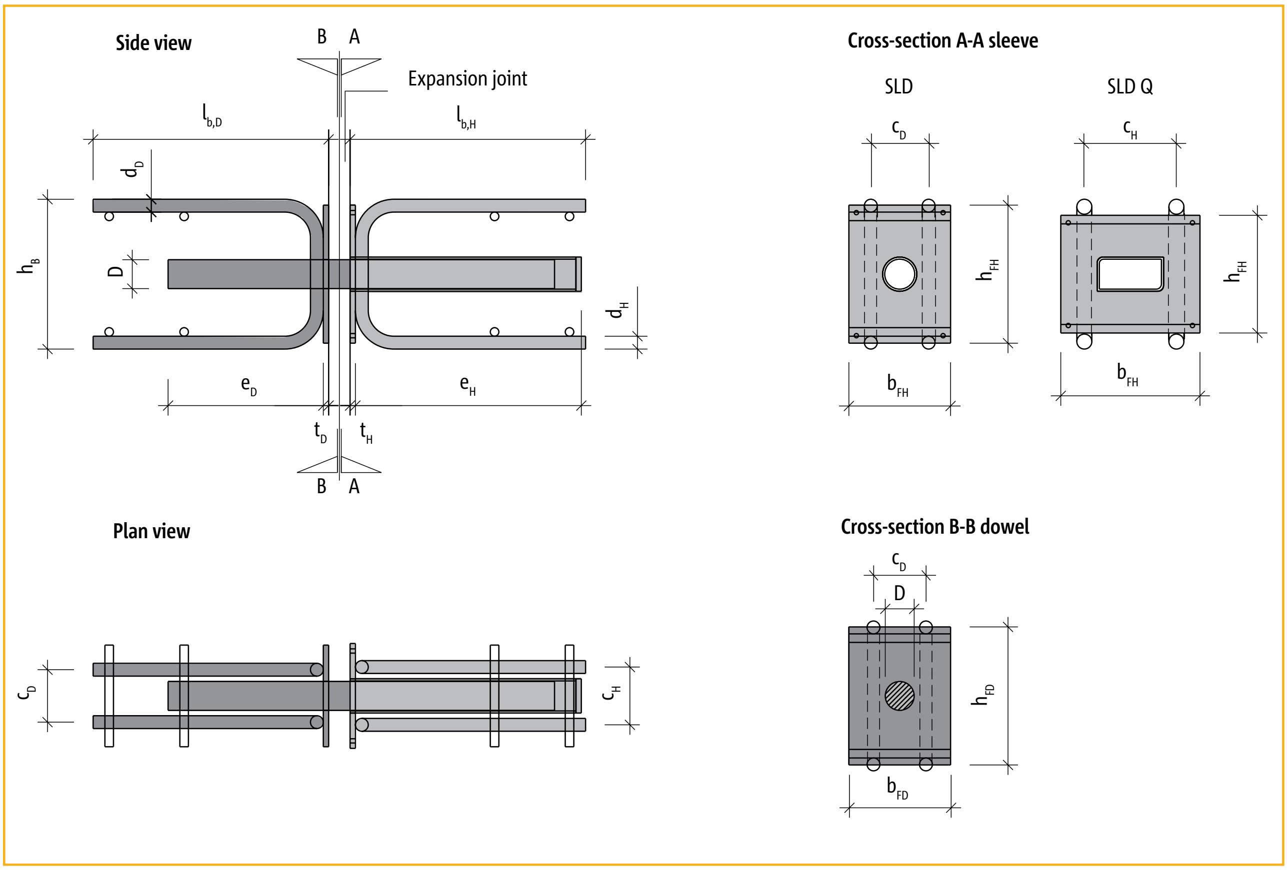


Figure 8: Connection between wall and wall (face to edge)

Schöck Dorn type SLD

Dimensions SLD 40 to SLD 80/ or SLD Q 40 to SLD Q 80

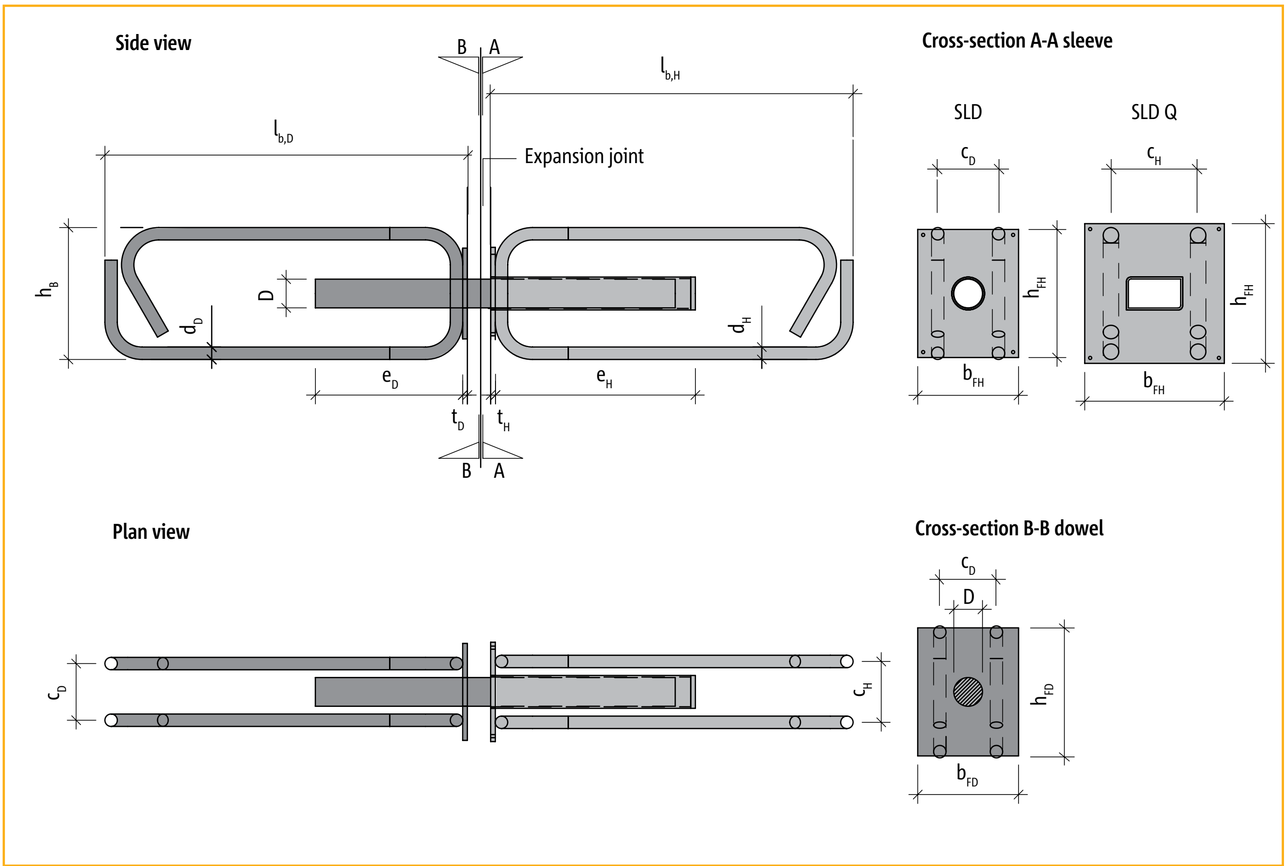


Dimensions [mm]			Schöck Dorn type SLD									
			40	Q 40	50	Q 50	60	Q 60	70	Q 70	80	Q 80
Dowel	ø Dowel	D	22		22		24		27		30	
	embedment depth	e_D	100		115		130		145		155	
	ø U-bar	d_D	10		10		12		12		14	
	U-bar length[1]	$l_{b,D}$	146		146		169		220		238	
	U-bar height[2]	h_B	100		100		120		140		180	
	U-bar spacing	c_D	42		42		46		49		54	
	Faceplate	t_D	4		4		4		5		6	
	Faceplate height	h_{FD}	85		87		117		129		144	
	Faceplate width	b_{FD}	65		85		85		95		110	
Sleeve	Sleeve length	e_H	165		180		195		211		221	
	ø U-bar	d_H	10		10	12	12		12	14	14	16
	U-bar length[1]	$l_{b,H}$	146	168	146	175	169	171	220	214	238	294
	U-bar spacing	c_H	45	80	45	80	48	83	53	86	61	97
	Faceplate	t_H	4	5	4	6	4	6	5	8	6	8
	Faceplate height	h_{FH}	85	95	87	95	117	110	129	110	144	130
	Faceplate width	b_{FH}	65	105	85	110	85	120	95	130	110	165

[1] Manufactory tolerances for bent bar length: ± 10 mm
[2] Manufactory tolerances for bent bar height: ± 5 mm

Schöck Dorn type SLD

Dimensions SLD 120/SLD 150 or SLD Q 120/SLD Q 150



Dimensions [mm]			Schöck Dorn type SLD			
			120	Q 120	150	Q 150
Dowel	ø Dowel	D	37		42	
	Embedment depth	e_D	190		230	
	ø U-bar	d_D	16		20	
	U-bar length[1]	$l_{b,D}$	457		458	
	U-bar height[2]	h_B	170		210	
	U-bar spacing	c_D	73		82	
	Faceplate	t_D	8		10	
	Faceplate height	h_{FD}	165		180	
	Faceplate width	b_{FD}	130		145	
Sleeve	Sleeve length	e_H	258	258	300	300
	ø U-bar	d_H	16	20	20	25
	U-bar length[1]	$l_{b,H}$	457	448	458	536
	U-bar spacing	c_H	75	110	85	120
	Faceplate	t_H	8	10	10	10
	Faceplate height	h_{FH}	165	180	180	210
	Faceplate width	b_{FH}	130	180	145	200

[1] Manufactory tolerances for bent bar length: ± 10 mm
[2] Manufactory tolerances for bent bar height: ± 5 mm

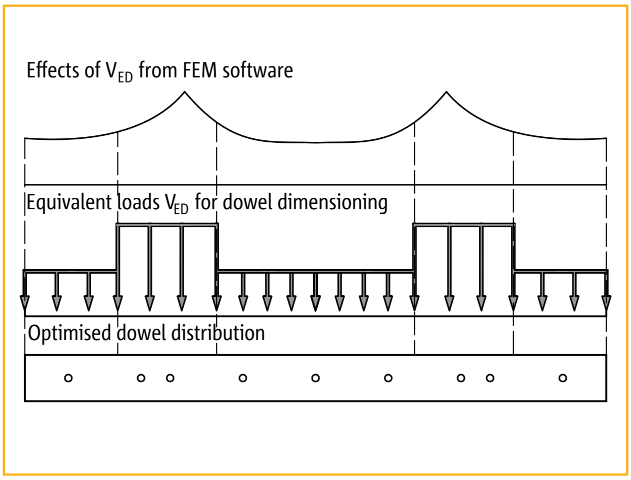
Schöck Dorn type SLD

Calculation of expansion joints

SLD

Influences and marginal conditions

- Determining the shear force distribution in the connected slab vertical to the expansion joint by means of FEM software or simplified structural models
- Defining the load v_{Ed} (kN/m) on the joint from the resulting shear forces
- Determining the expected maximum joint width (see page 8)
- Are shear force dowels with sideways motion capacity necessary? (see page 7)



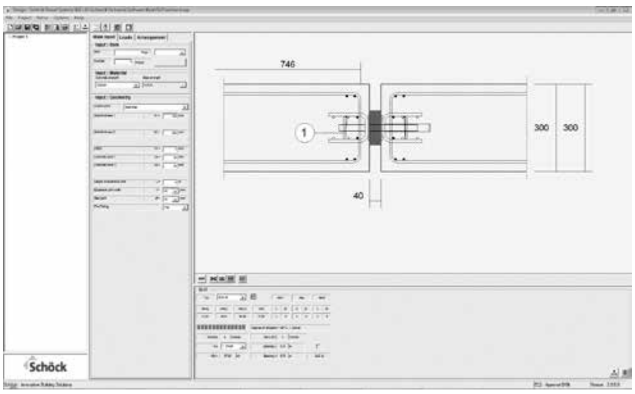
Dimensioning with design tables

- Checking minimum component dimensions and determining the shear force dowels that may be used (see page 16)
- Selecting dowel spacing e longer than the critical dowel spacing (see page 17)
- Calculating the load per dowel $V_{dowel} = v_{Ed} \cdot e$
- Dowel selection from design tables based on concrete quality, slab thickness, dowel type and maximum joint width (see pages 18-23)
- Optimising dowel spacing according to the design resistance $e = V_{Rd} / v_{Ed} < 5 \cdot$ plate thickness
- Determining the required edge reinforcement (see page 25)

Schöck Dorn type		SLD Q 40	SLD Q 50	SLD Q 60	SLD Q 70	SLD Q 80	SLD Q 120	SLD Q
Component thickness [mm]	Joint width [mm]	Design resistance V_{Rd} for concrete strength class C30/C37 [kN/dowel]						
160	20	35,5	45,4					
	30	35,5	45,4					
	40	33,9	45,1					
	50	27,1	36,1					
	60	22,6	30,1					
180	20	39,5	50,4	65,6				
	30	39,5	50,4	65,6				
	40	33,9	45,1	58,5				
	50	27,1	36,1	46,8				
	60	22,6	30,1	39,0				
200	20	43,4	55,3	71,4	78,4			
	30	43,4	55,3	71,4	78,4			
	40	33,9	45,1	58,5	78,4			
	50	27,1	36,1	46,8	66,7			
	60	22,6	30,1	39,0	55,6			
220	20	47,2	60,0	77,1	85,9			
	30	45,2	59,8	76,3	85,9			
	40	33,9	45,1	58,5	83,3			
	50	27,1	36,1	46,8	66,7			
	60	22,6	30,1	39,0	55,6			
250	20	52,8	66,8	85,3	96,6	146,5		
	30	45,2	59,8	76,3	96,6	136,8		
	40	33,9	45,1	58,5	83,3	113,3		
	50	27,1	36,1	46,8	66,7	91,5		
	60	22,6	30,1	39,0	55,6	76,2		
280	20	58,4	73,6	93,3	107,1	160,3		
	30	45,2	59,8	76,3	104,5	136,8		
	40	33,9	45,1	58,5	83,3	113,3		
	50	27,1	36,1	46,8	66,7	91,5		
	60	22,6	30,1	39,0	55,6	76,2		
	20	60,8	77,0	95,1	113,9	160,3	195,2	

Dimensioning with software

- Dimensioning software available for download free of charge at www.schoeck.co.uk (see page 26)
- Entering marginal conditions and loads
- Automatic calculation and graphical display of dowel and reinforcement
- Saving project and position
- Entering additional positions



Schöck Dorn type SLD
Design resistance steel $V_{Rd,s}$

Steel load-bearing capacity of the dowels in concrete

The steel load-bearing capacity of the dowel is of vital importance in components (such as walls, supports etc.) for which concrete failure due to concrete edge fracture or punching can be excluded. This value was determined from the load-bearing capacity of the welded links, weld seams, front plate and dowel.

Steel load capacity of dowel $V_{Rd,s}$ [kN]		Expansion joints f [mm]					
		10	20	30	40	50	60
SLD	40	85,0	67,6	50,2	37,6	30,1	25,1
	50	102,5	85,6	66,4	50,1	40,1	33,4
	60	126,6	105,7	84,8	65,0	52,0	43,4
	70	163,1	139,6	116,1	92,6	74,1	61,7
	80	204,3	178,2	152,0	125,9	101,6	84,7
	120	270,7	270,7	253,8	221,6	189,4	158,9
	150	372,0	372,0	341,9	305,3	268,7	232,2
SLD Q	40	76,5	60,8	45,2	33,9	27,1	22,6
	50	94,3	77,0	59,8	45,1	36,1	30,1
	60	113,9	95,1	76,3	58,5	46,8	39,0
	70	146,8	125,6	104,5	83,3	66,7	55,6
	80	183,8	160,3	136,8	113,3	91,5	76,2
	120	270,7	257,4	228,4	199,4	170,5	143,0
	150	372,0	340,6	307,7	274,8	241,9	209,0

Schöck Dorn type SLD

Geometrical minimum for dowel arrangement

Dimension in [mm]		Minimum member dimensions			Minimum dowel spacings[1)]		Minimum distance to edge[1)]
		slab thickness h_{min}	Wall thickness b_w	Beam width b_u	Horizontal $e_{h,min}$	Vertical $e_{v,min}$	Horizontal $e_{R,min}$
SLD	40	160	185	240	240	120	120
	50		200				
	60	180	215	270	270	140	135
	70	200	255	300	300	160	150
	80	240	275	360	360	200	180
	120	300	460 + c_{nom}	450	450	215	225
	150	350	460 + c_{nom}	530	530	235	265
SLD Q	40	160	200	240	240	120	120
	50		210				
	60	180	215	270	270	140	135
	70	200	250	300	300	160	150
	80	240	305 + c_{nom}	360	360	200	180
	120	300	460 + c_{nom}	450	450	215	225
	150	350	540 + c_{nom}	530	530	235	265

[1)] The minimum dowel spacings and edge spacings must be met in order to prevent mutual effects of the adjacent dowels.

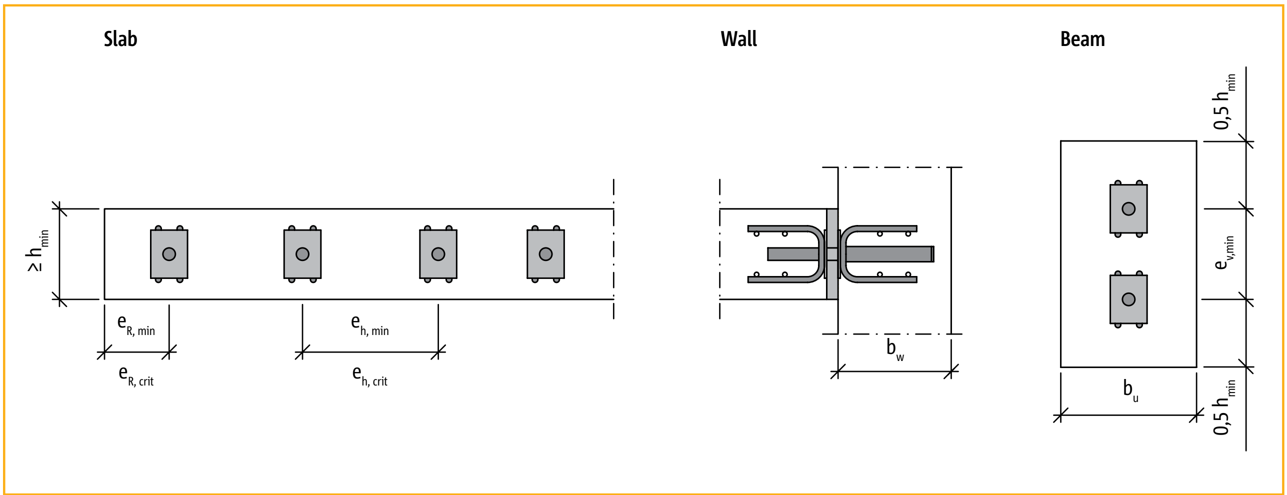


Figure 1: Minimum member dimensions and dowel spacings

Schöck Dorn type SLD

Critical dowel spacings

Critical dowel and edge spacings

Cross interference of the punching cone does not have to be taken into consideration if the criteria for critical edge and dowel spacing are met. The design tables on page 18-23 are based on these distances. If the spacing requirements are not met, an additional punching shear check taking into account the shortened control perimeter is required.

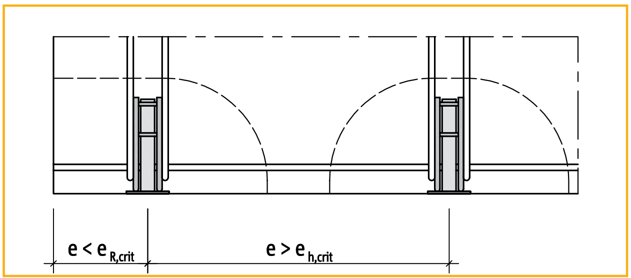


Figure 2: Round section with dowel spacing e > e_{crit}

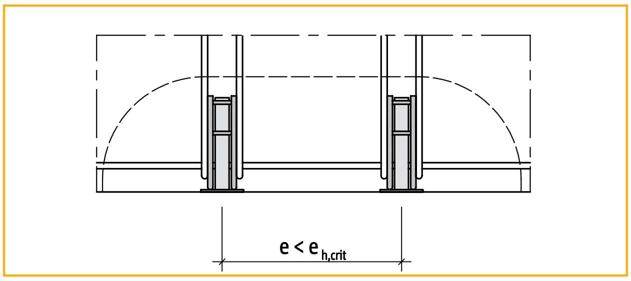


Figure 3: Round section with reduced dowel spacing

Critical dowel spacings $e_{h,crit}$ [mm]		Slab thickness [mm]							
		160	180	200	220	250	280	300	350
SLD	40	425	470	515	560	695	785	845	995
	50	420	470	515	560	690	780	840	990
	60	–	480	530	575	645	780	840	990
	70	–	–	550	595	660	730	850	1000
	80	–	–	–	–	700	765	810	925
	120	–	–	–	–	–	–	880	1030
	150	–	–	–	–	–	–	–	1035
SLD Q	40	455	500	545	590	725	815	875	1025
	50	455	500	545	590	725	815	875	1025
	60	–	515	565	610	675	815	875	1025
	70	–	–	585	630	695	765	885	1035
	80	–	–	–	–	730	795	840	955
	120	–	–	–	–	–	–	915	1065
	150	–	–	–	–	–	–	–	1075

Critical edge spacings $e_{R,crit}$ [mm]		Slab thickness [mm]							
		160	180	200	220	250	280	300	350
SLD	40	345	380	415	450	555	625	675	790
	50	340	380	415	450	555	625	670	790
	60	–	390	425	460	515	625	670	790
	70	–	–	440	475	530	580	675	795
	80	–	–	–	–	555	605	640	730
	120	–	–	–	–	–	–	685	805
	150	–	–	–	–	–	–	–	805
SLD Q	40	360	395	430	465	570	640	690	805
	50	360	395	430	465	570	640	690	805
	60	–	405	445	480	530	640	690	805
	70	–	–	455	495	545	600	695	815
	80	–	–	–	–	570	620	655	745
	120	–	–	–	–	–	–	705	825
	150	–	–	–	–	–	–	–	825

Schöck Dorn type SLD
Design table SLD for C20/25

SLD

Design resistance V_{Rd} = min [steel load-bearing capacity $V_{Rd,s}$, slab load-bearing capacity $V_{Rd,c}$, punching load capacity $V_{RD,ct}$]

The following design values were determined based on **BS EN 1992-1-1:2004**. The maximum load capacities listed here are only valid in combination with the reinforcement set-up according to the table (page 25) and in compliance with the critical dowel and edge spacings (page 17).

Schöck Dorn type		SLD 40	SLD 50	SLD 60	SLD 70	SLD 80	SLD 120	SLD 150
Component thickness [mm]	Joint width [mm]	Design resistance V_{Rd} for concrete strength class C20/C25 [kN/dowel]						
160	20	35,8	46,7					
	30	35,8	46,7					
	40	35,8	46,7					
	50	30,1	40,1					
	60	25,1	33,4					
180	20	39,1	50,8	64,3				
	30	39,1	50,8	64,3				
	40	37,6	50,1	64,3				
	50	30,1	40,1	52,0				
	60	25,1	33,4	43,4				
200	20	42,3	54,7	70,5	73,1			
	30	42,3	54,7	70,5	73,1			
	40	37,6	50,1	65,0	73,1			
	50	30,1	40,1	52,0	73,1			
	60	25,1	33,4	43,4	61,7			
220	20	45,5	58,6	75,1	81,8			
	30	45,5	58,6	75,1	81,8			
	40	37,6	50,1	65,0	81,8			
	50	30,1	40,1	52,0	74,1			
	60	25,1	33,4	43,4	61,7			
250	20	50,2	64,3	81,9	94,1	125,9		
	30	50,2	64,3	81,9	94,1	125,9		
	40	37,6	50,1	65,0	92,6	125,9		
	50	30,1	40,1	52,0	74,1	101,6		
	60	25,1	33,4	43,4	61,7	84,7		
280	20	54,8	69,9	88,6	102,8	139,7		
	30	50,2	66,4	84,8	102,8	139,7		
	40	37,6	50,1	65,0	92,6	125,9		
	50	30,1	40,1	52,0	74,1	101,6		
	60	25,1	33,4	43,4	61,7	84,7		
300	20	57,8	73,6	93,0	108,5	149,1	167,9	
	30	50,2	66,4	84,8	108,5	149,1	167,9	
	40	37,6	50,1	65,0	92,6	125,9	167,9	
	50	30,1	40,1	52,0	74,1	101,6	167,9	
	60	25,1	33,4	43,4	61,7	84,7	158,9	
350	20	63,2	80,3	101,1	117,6	172,9	201,6	232,6
	30	50,2	66,4	84,8	116,1	152,0	201,6	232,6
	40	37,6	50,1	65,0	92,6	125,9	201,6	232,6
	50	30,1	40,1	52,0	74,1	101,6	189,4	232,6
	60	25,1	33,4	43,4	61,7	84,7	158,9	232,2

Schöck Dorn type SLD

Design table SLD for C25/30

Design resistance V_{Rd} = min [steel load-bearing capacity $V_{Rd,s}$, slab load-bearing capacity $V_{Rd,c}$, punching load capacity $V_{RD,ct}$]

The following design values were determined based on **BS EN 1992-1-1:2004**. The maximum load capacities listed here are only valid in combination with the reinforcement set-up according to the table (page 25) and in compliance with the critical dowel and edge spacings (page 17).

Schöck Dorn type		SLD 40	SLD 50	SLD 60	SLD 70	SLD 80	SLD 120	SLD 150
Component thickness [mm]	Joint width [mm]	Design resistance V_{Rd} for concrete strength class C25/C30 [kN/dowel]						
160	20	40,4	52,3					
	30	40,4	52,3					
	40	37,6	50,1					
	50	30,1	40,1					
	60	25,1	33,4					
180	20	44,2	57,2	69,3				
	30	44,2	57,2	69,3				
	40	37,6	50,1	65,0				
	50	30,1	40,1	52,0				
	60	25,1	33,4	43,4				
200	20	47,9	61,8	79,3	78,8			
	30	47,9	61,8	79,3	78,8			
	40	37,6	50,1	65,0	78,8			
	50	30,1	40,1	52,0	74,1			
	60	25,1	33,4	43,4	61,7			
220	20	51,6	66,3	84,9	88,1			
	30	50,2	66,3	84,8	88,1			
	40	37,6	50,1	65,0	88,1			
	50	30,1	40,1	52,0	74,1			
	60	25,1	33,4	43,4	61,7			
250	20	57,0	72,9	92,7	102,4	135,6		
	30	50,2	66,4	84,8	102,4	135,6		
	40	37,6	50,1	65,0	92,6	125,9		
	50	30,1	40,1	52,0	74,1	101,6		
	60	25,1	33,4	43,4	61,7	84,7		
280	20	62,4	79,4	100,4	114,8	150,5		
	30	50,2	66,4	84,8	114,8	150,5		
	40	37,6	50,1	65,0	92,6	125,9		
	50	30,1	40,1	52,0	74,1	101,6		
	60	25,1	33,4	43,4	61,7	84,7		
300	20	65,9	83,7	105,5	123,4	160,6	180,9	
	30	50,2	66,4	84,8	116,1	152,0	180,9	
	40	37,6	50,1	65,0	92,6	125,9	180,9	
	50	30,1	40,1	52,0	74,1	101,6	180,9	
	60	25,1	33,4	43,4	61,7	84,7	158,9	
350	20	67,6	85,6	105,7	133,9	178,2	217,2	250,6
	30	50,2	66,4	84,8	116,1	152,0	217,2	250,6
	40	37,6	50,1	65,0	92,6	125,9	217,2	250,6
	50	30,1	40,1	52,0	74,1	101,6	189,4	250,6
	60	25,1	33,4	43,4	61,7	84,7	158,9	232,2

Schöck Dorn type SLD

Design table SLD for C30/37

Design resistance V_{Rd} = min [steel load-bearing capacity $V_{Rd,s}$, slab load-bearing capacity $V_{Rd,c}$, punching load capacity $V_{RD,ct}$]

The following design values were determined based on **BS EN 1992-1-1:2004.** The maximum load capacities listed here are only valid in combination with the reinforcement set-up according to the table (page 25) and in compliance with the critical dowel and edge spacings (page 17).

Schöck Dorn type		SLD 40	SLD 50	SLD 60	SLD 70	SLD 80	SLD 120	SLD 150
Component thickness [mm]	Joint width [mm]	Design resistance V_{Rd} for concrete strength class C30/C37 [kN/dowel]						
160	20	44,6	55,6					
	30	44,6	55,6					
	40	37,6	50,1					
	50	30,1	40,1					
	60	25,1	33,4					
180	20	48,9	63,1	73,6				
	30	48,9	63,1	73,6				
	40	37,6	50,1	65,0				
	50	30,1	40,1	52,0				
	60	25,1	33,4	43,4				
200	20	53,1	68,3	84,3	83,7			
	30	50,2	66,4	84,3	83,7			
	40	37,6	50,1	65,0	83,7			
	50	30,1	40,1	52,0	74,1			
	60	25,1	33,4	43,4	61,7			
220	20	57,2	73,4	93,8	93,6			
	30	50,2	66,4	84,8	93,6			
	40	37,6	50,1	65,0	92,6			
	50	30,1	40,1	52,0	74,1			
	60	25,1	33,4	43,4	61,7			
250	20	63,3	80,8	102,7	108,9	144,1		
	30	50,2	66,4	84,8	108,9	144,1		
	40	37,6	50,1	65,0	92,6	125,9		
	50	30,1	40,1	52,0	74,1	101,6		
	60	25,1	33,4	43,4	61,7	84,7		
280	20	67,6	85,6	105,7	122,0	160,0		
	30	50,2	66,4	84,8	116,1	152,0		
	40	37,6	50,1	65,0	92,6	125,9		
	50	30,1	40,1	52,0	74,1	101,6		
	60	25,1	33,4	43,4	61,7	84,7		
300	20	67,6	85,6	105,7	137,1	170,7	192,3	
	30	50,2	66,4	84,8	116,1	152,0	192,3	
	40	37,6	50,1	65,0	92,6	125,9	192,3	
	50	30,1	40,1	52,0	74,1	101,6	189,4	
	60	25,1	33,4	43,4	61,7	84,7	158,9	
350	20	67,6	85,6	105,7	139,6	178,2	230,8	266,3
	30	50,2	66,4	84,8	116,1	152,0	230,8	266,3
	40	37,6	50,1	65,0	92,6	125,9	221,6	266,3
	50	30,1	40,1	52,0	74,1	101,6	189,4	266,3
	60	25,1	33,4	43,4	61,7	84,7	158,9	232,2

Schöck Dorn type SLD Q

Design table SLD Q for C20/25

Design resistance V_{Rd} = min [steel load-bearing capacity $V_{Rd,s}$, slab load-bearing capacity $V_{Rd,c}$, punching load capacity $V_{RD,ct}$]

The following design values were determined based on **BS EN 1992-1-1:2004.** The maximum load capacities listed here are only valid in combination with the reinforcement set-up according to the table (page 25) and in compliance with the critical dowel and edge spacings (page 17).

Schöck Dorn type		SLD Q 40	SLD Q 50	SLD Q 60	SLD Q 70	SLD Q 80	SLD Q 120	SLD Q 150
Component thickness [mm]	Joint width [mm]	Design resistance V_{Rd} for concrete strength class C20/C25 [kN/dowel]						
160	20	28,6	36,8					
	30	28,6	36,8					
	40	28,6	36,8					
	50	27,1	36,1					
	60	22,6	30,1					
180	20	31,7	40,7	53,0				
	30	31,7	40,7	53,0				
	40	31,7	40,7	53,0				
	50	27,1	36,1	46,8				
	60	22,6	30,1	39,0				
200	20	34,7	44,4	57,5	63,0			
	30	34,7	44,4	57,5	63,0			
	40	33,9	44,4	57,5	63,0			
	50	27,1	36,1	46,8	63,0			
	60	22,6	30,1	39,0	55,6			
220	20	37,6	48,0	61,9	68,7			
	30	37,6	48,0	61,9	68,7			
	40	33,9	45,1	58,5	68,7			
	50	27,1	36,1	46,8	66,7			
	60	22,6	30,1	39,0	55,6			
250	20	41,9	53,3	68,2	77,0	124,2		
	30	41,9	53,3	68,2	77,0	124,2		
	40	33,9	45,1	58,5	77,0	113,3		
	50	27,1	36,1	46,8	66,7	91,5		
	60	22,6	30,1	39,0	55,6	76,2		
280	20	46,2	58,5	74,4	85,1	141,9		
	30	45,2	58,5	74,4	85,1	136,8		
	40	33,9	45,1	58,5	83,3	113,3		
	50	27,1	36,1	46,8	66,7	91,5		
	60	22,6	30,1	39,0	55,6	76,2		
300	20	49,0	61,9	78,4	90,3	151,3	156,5	
	30	45,2	59,8	76,3	90,3	136,8	156,5	
	40	33,9	45,1	58,5	83,3	113,3	156,5	
	50	27,1	36,1	46,8	66,7	91,5	156,5	
	60	22,6	30,1	39,0	55,6	76,2	143,0	
350	20	53,8	68,0	85,9	98,7	160,3	173,8	180,2
	30	45,2	59,8	76,3	98,7	136,8	173,8	180,2
	40	33,9	45,1	58,5	83,3	113,3	173,8	180,2
	50	27,1	36,1	46,8	66,7	91,5	170,5	180,2
	60	22,6	30,1	39,0	55,6	76,2	143,0	180,2

Schöck Dorn type SLD Q
Design table SLD Q for C25/30

SLD

Design resistance V_{Rd} = min [steel load-bearing capacityt $V_{Rd,s}$, slab load-bearing capacity $V_{Rd,c}$, punching load capacity $V_{RD,ct}$]

The following design values were determined based on **BS EN 1992-1-1:2004.** The maximum load capacities listed here are only valid in combination with the reinforcement set-up according to the table (page 25) and in compliance with the critical dowel and edge spacings (page 17).

Schöck Dorn type		SLD Q 40	SLD Q 50	SLD Q 60	SLD Q 70	SLD Q 80	SLD Q 120	SLD Q 150
Component thickness [mm]	Joint width [mm]	Design resistance V_{Rd} for concrete strength class C25/C30 [kN/dowel]						
160	20	32,2	41,3					
	30	32,2	41,3					
	40	32,2	41,3					
	50	27,1	36,1					
	60	22,6	30,1					
180	20	35,8	45,8	59,6				
	30	35,8	45,8	59,6				
	40	33,9	45,1	58,5				
	50	27,1	36,1	46,8				
	60	22,6	30,1	39,0				
200	20	39,3	50,1	64,8	71,1			
	30	39,3	50,1	64,8	71,1			
	40	33,9	45,1	58,5	71,1			
	50	27,1	36,1	46,8	66,7			
	60	22,6	30,1	39,0	55,6			
220	20	42,6	54,3	69,8	77,7			
	30	42,6	54,3	69,8	77,7			
	40	33,9	45,1	58,5	77,7			
	50	27,1	36,1	46,8	66,7			
	60	22,6	30,1	39,0	55,6			
250	20	47,6	60,4	77,1	87,2	137,9		
	30	45,2	59,8	76,3	87,2	136,8		
	40	33,9	45,1	58,5	83,3	113,3		
	50	27,1	36,1	46,8	66,7	91,5		
	60	22,6	30,1	39,0	55,6	76,2		
280	20	52,5	66,3	84,2	96,5	152,9		
	30	45,2	59,8	76,3	96,5	136,8		
	40	33,9	45,1	58,5	83,3	113,3		
	50	27,1	36,1	46,8	66,7	91,5		
	60	22,6	30,1	39,0	55,6	76,2		
300	20	55,7	70,3	88,9	102,6	160,3	176,7	
	30	45,2	59,8	76,3	102,6	136,8	176,7	
	40	33,9	45,1	58,5	83,3	113,3	176,7	
	50	27,1	36,1	46,8	66,7	91,5	170,5	
	60	22,6	30,1	39,0	55,6	76,2	143,0	
350	20	60,8	77,0	95,1	112,3	160,3	196,7	203,2
	30	45,2	59,8	76,3	104,5	136,8	196,7	203,2
	40	33,9	45,1	58,5	83,3	113,3	196,7	203,2
	50	27,1	36,1	46,8	66,7	91,5	170,5	203,2
	60	22,6	30,1	39,0	55,6	76,2	143,0	203,2

Schöck Dorn type SLD Q

Design table SLD Q for C30/37

Design resistance V_{Rd} = min [steel load-bearing capacity $V_{Rd,s}$, slab load-bearing capacity $V_{Rd,c}$, punching load capacity $V_{RD,ct}$]

The following design values were determined based on **BS EN 1992-1-1:2004.** The maximum load capacities listed here are only valid in combination with the reinforcement set-up according to the table (page 25) and in compliance with the critical dowel and edge spacings (page 17).

Schöck Dorn type		SLD Q 40	SLD Q 50	SLD Q 60	SLD Q 70	SLD Q 80	SLD Q 120	SLD Q 150
Component thickness [mm]	Joint width [mm]	Design resistance V_{Rd} for concrete strength class C30/C37 [kN/dowel]						
160	20	35,5	45,4					
	30	35,5	45,4					
	40	33,9	45,1					
	50	27,1	36,1					
	60	22,6	30,1					
180	20	39,5	50,4	65,6				
	30	39,5	50,4	65,6				
	40	33,9	45,1	58,5				
	50	27,1	36,1	46,8				
	60	22,6	30,1	39,0				
200	20	43,4	55,3	71,4	78,4			
	30	43,4	55,3	71,4	78,4			
	40	33,9	45,1	58,5	78,4			
	50	27,1	36,1	46,8	66,7			
	60	22,6	30,1	39,0	55,6			
220	20	47,2	60,0	77,1	85,9			
	30	45,2	59,8	76,3	85,9			
	40	33,9	45,1	58,5	83,3			
	50	27,1	36,1	46,8	66,7			
	60	22,6	30,1	39,0	55,6			
250	20	52,8	66,8	85,3	96,6	146,5		
	30	45,2	59,8	76,3	96,6	136,8		
	40	33,9	45,1	58,5	83,3	113,3		
	50	27,1	36,1	46,8	66,7	91,5		
	60	22,6	30,1	39,0	55,6	76,2		
280	20	58,4	73,6	93,3	107,1	160,3		
	30	45,2	59,8	76,3	104,5	136,8		
	40	33,9	45,1	58,5	83,3	113,3		
	50	27,1	36,1	46,8	66,7	91,5		
	60	22,6	30,1	39,0	55,6	76,2		
300	20	60,8	77,0	95,1	113,9	160,3	195,2	
	30	45,2	59,8	76,3	104,5	136,8	195,2	
	40	33,9	45,1	58,5	83,3	113,3	195,2	
	50	27,1	36,1	46,8	66,7	91,5	170,5	
	60	22,6	30,1	39,0	55,6	76,2	143,0	
350	20	60,8	77,0	95,1	124,9	160,3	217,7	224,3
	30	45,2	59,8	76,3	104,5	136,8	217,7	224,3
	40	33,9	45,1	58,5	83,3	113,3	199,4	224,3
	50	27,1	36,1	46,8	66,7	91,5	170,5	224,3
	60	22,6	30,1	39,0	55,6	76,2	143,0	209,0

Schöck Dorn type SLD
Installation information

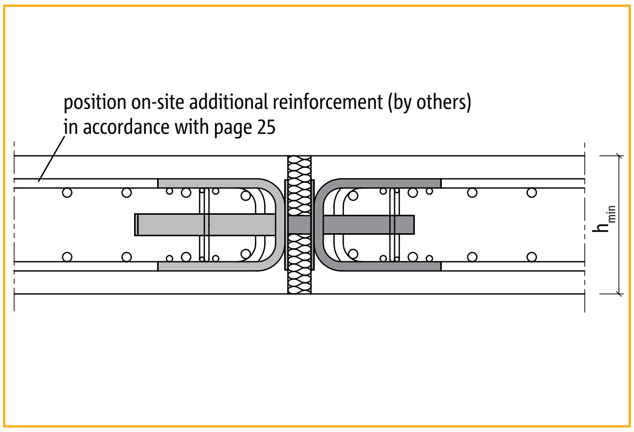


Figure 1: Installation for minimum slab thickness h_{min}

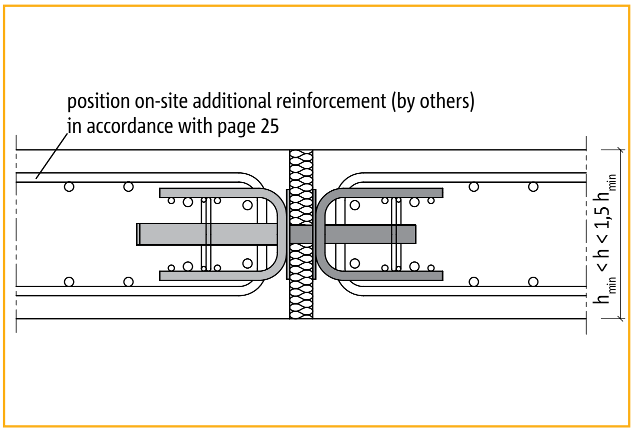


Figure 2: Installation for slab thickness $h_{min} < h < 1,5\ h_{min}$

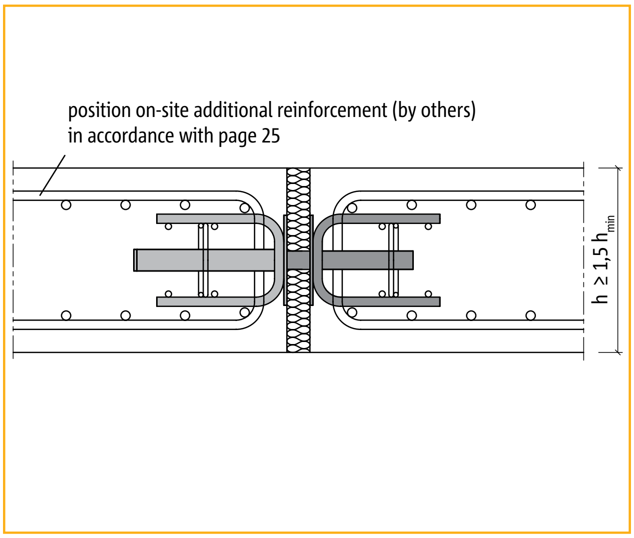


Figure 3: Installation for large slab thicknesses $h \geq 1,5\ h_{min}$ and generally for SLD120 and SLD 150

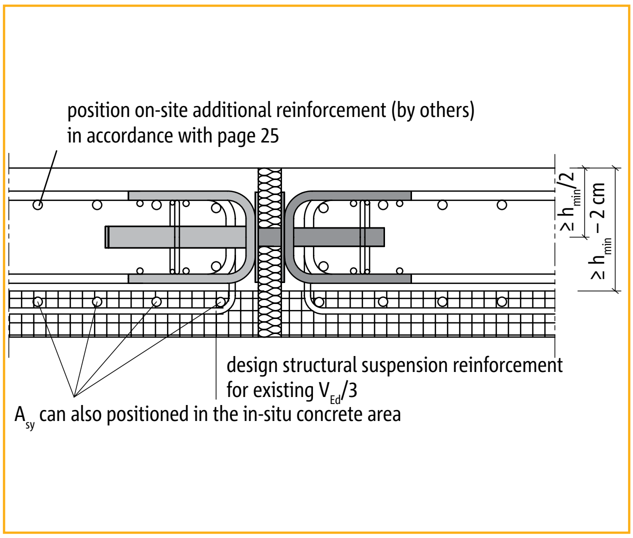


Figure 4: Installation for precast floor slabs

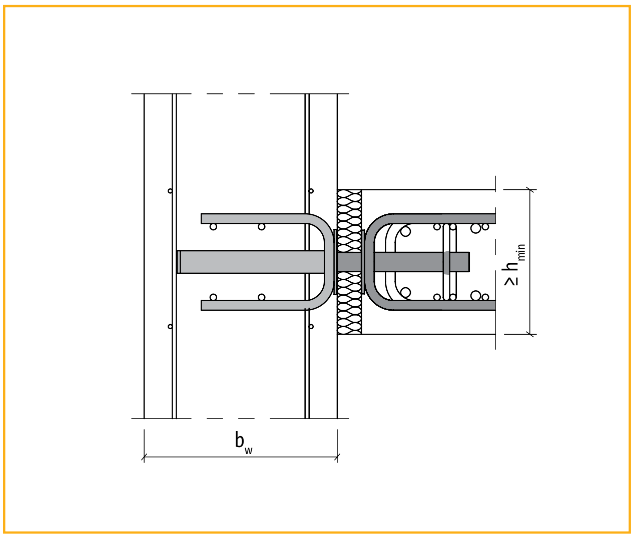


Figure 5: Connection of slab to wall

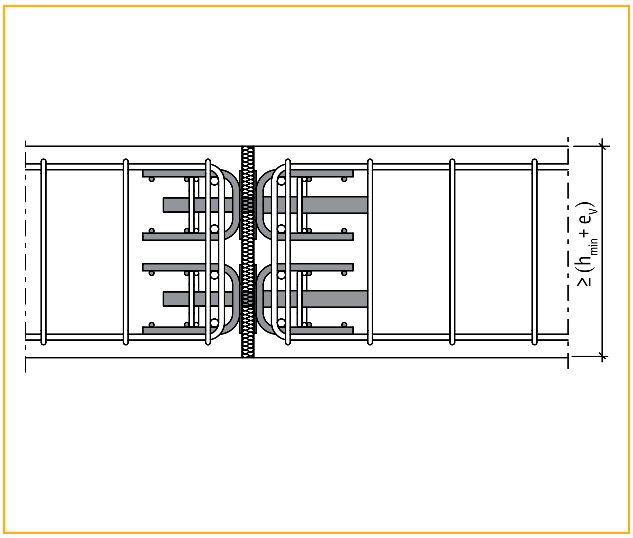


Figure 6: Beam joint configuration

Schöck Dorn type SLD
On-site reinforcement

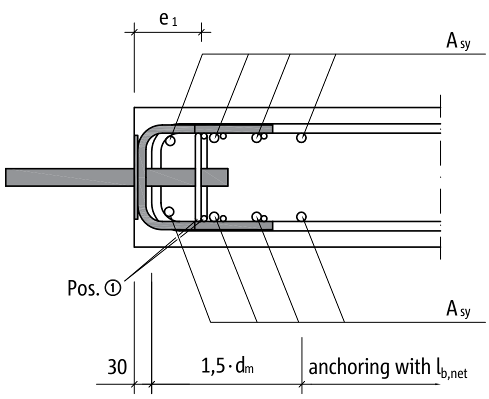
Reinforcement layout for slab connections

On-site reinforcement		A_{sx}	s_1 for slab thickness		s_i	A_{sy}	Pos. 1	e_1
			≤ 300 mm	> 300 mm				
SLD/ SLD Q	**40**	6 ø 10	30			3 ø 12	2 ø 6	65
	50	6 ø 12	32			3 ø 12	2 ø 6	80
	60	6 ø 14	34			3 ø 14	2 ø 8	95
	70	8 ø 12	32	50	50	3 ø 12	2 ø 8	105
	80	10 ø 16	36			3 ø 16	2 ø 8	115
	120	10 ø 16	-			4 ø 16	2 ø 10	150
	150	10 ø 20	-			4 ø 20	2 ø 12	185

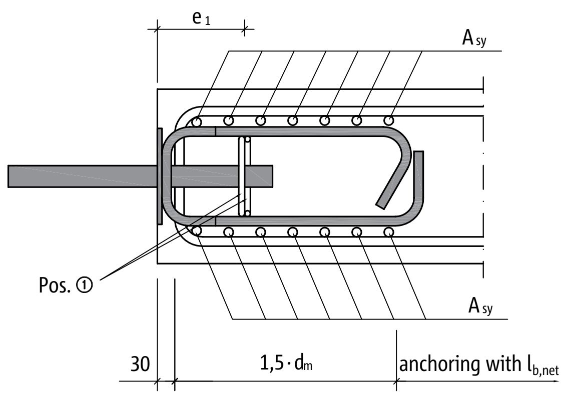
SLD

All dimensions in [mm]

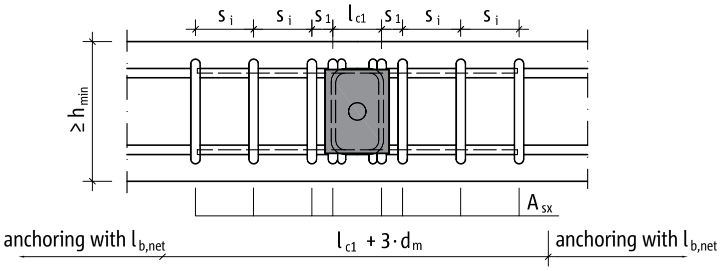
Cross-section SLD 40 - SLD 80:



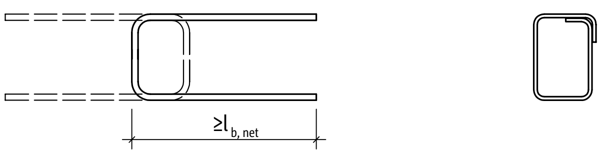
Cross-section SLD 120 - SLD 150:



Elevation:



Pos. ① : 2 U-bars, alternatively 1 closed hoop

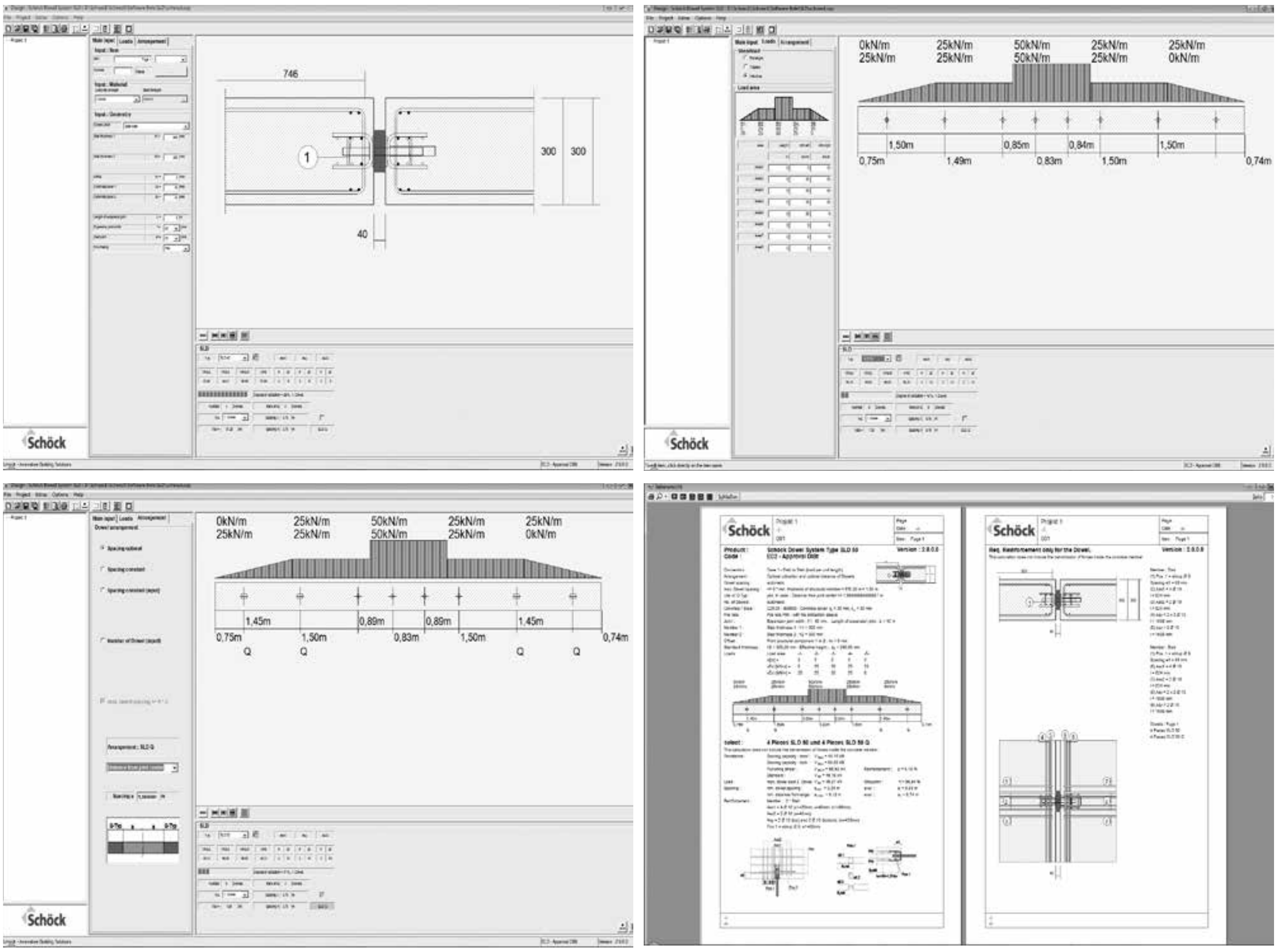


Schöck Dorn type SLD

Dimensioning program

- Easy and fast dimensioning of expansion joints with Schöck SLD heavy-duty dowels
- Dimensioning based on BS EN 1992-1-1:2004 and National Annex UK
- 9 different applications can be verified (slab-slab, slab-wall, slab-inner slab joist)
- Automatic calculation of dowel spacings and types
- Flexible load input for line loads, triangular loads or free loads
- Automatic calculation and graphic display of edge reinforcement

SLD



Requests and downloads

info@haucon.dk
www.schoeck.dk

Schöck Dorn type SLD

Punching shear proof

Proof of punching shear resistance must be provided:

- if the amount of reinforcement is reduced in comparison with the suggestions on page 25
- if the critical dowel or edge conditions are not met while complying with the conditions $e_{h,min} \le e_h < e_{h,crit}$ or $e_{R,min} \le e_R \le e_{R,crit}$

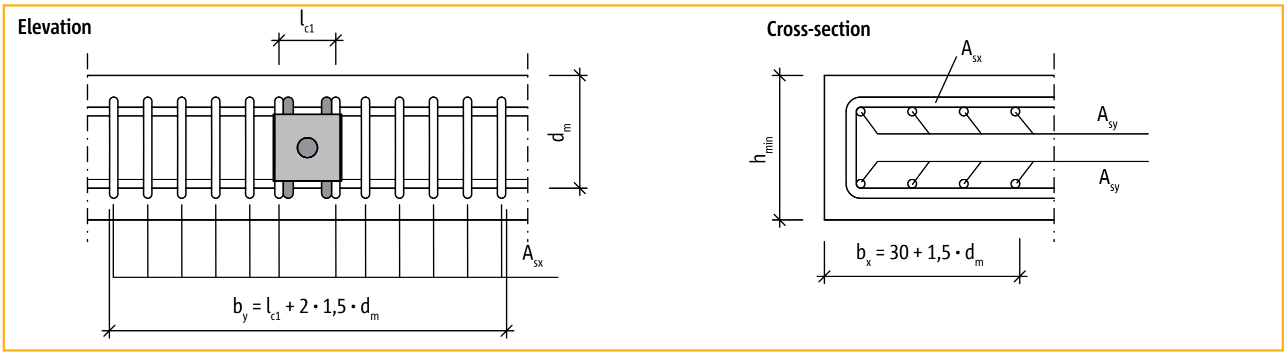


Figure 1: Effective lengths b_x and b_y and allowable reinforcement cross-section A_{sx} and A_{sy} for determination of the reinforcement grade ρ_l

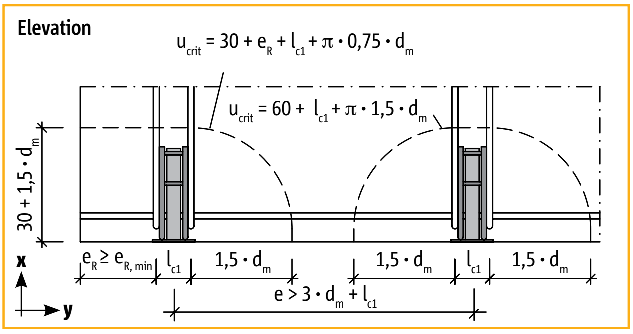


Figure 2: Critical circular section for dowel spacing $e > e_{crit}$

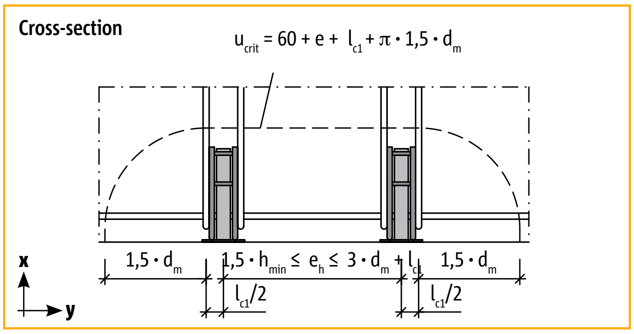


Figure 3: Critical circular section for reduced dowel spacing

$$V_{Rd,ct} \le 0{,}14 \cdot \eta_1 \cdot \kappa \cdot (100 \cdot \rho_l \cdot f_{ck})^{1/3} \cdot d_m \cdot \frac{u_{crit}}{\beta}$$

Legend:

η_1 = 1.0 for normal concrete

κ = $1 + \sqrt{\frac{200}{d_m}} \le 2{,}0$ with d_m in [mm]

ρ_l : mean longitudinal reinforcement value of the regarded round section with:

$$\rho_l = \sqrt{\rho_x \cdot \rho_y} \le \min \begin{cases} 0{,}5 \cdot \frac{f_{cd}}{f_{yd}} \\ 0{,}02 \end{cases} \qquad \rho_x = \frac{A_{sx}}{d_m \cdot b_y} \quad \text{with} \quad \rho_y = \frac{A_{sy}}{d_m \cdot b_x}$$

b_x : area of reinforcement A_{sy}
b_y : area of reinforcement A_{sx}

f_{ck} : characteristic cylinder strength of the concrete

d_m : mean statical effective height of the slab with $d_m = \frac{d_x + d_y}{2}$

u_{crit} : circumference of the critical round section

β : coefficient to take into account non-rotationally symmetric shear force distribution, here: $\beta = 1{,}4$

l_{c1} : axis spacing of the first two links A_{sx1} (see page 25)

Schöck Dorn type SLD

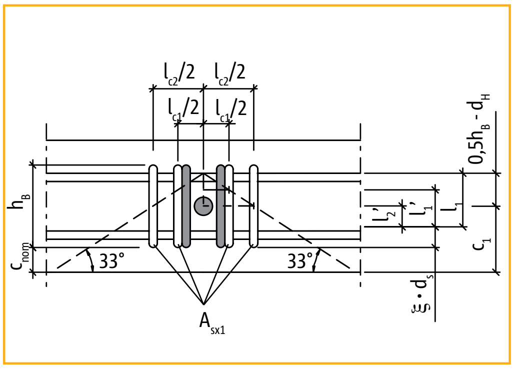
Slab load-bearing capacity according to approval Z-15.7-236

Proof of the slab bearing limit must be established:

- if the amount of reinforcement is reduced in comparison with the suggestions on page 25
- if the distances s_1, s_2, s_3 of the suspension reinforcement are exceeded, page 25

The slab design resistance is given by:

$$V_{Rd,c} = \Sigma V_{Rd,1i} + \Sigma V_{Rd,2i} \leq \Sigma A_{sx1} \cdot f_{yd}$$



$V_{Rd,1i}$ transferable force from hook bearing effect

$$V_{Rd,1i} = 0,357 \cdot \psi_i \cdot A_{sx1,i} \cdot f_{yk} \cdot \sqrt{f_{ck}/30} \,/\, \gamma_{MC}$$

ψ_i : Coefficient for taking account of the distance of the suspended reinforcement from the dowel
ψ_i: $1 - 0,2 \cdot [(l_{ci}/2)/c_1]$
$l_{ci}/2$: Axis separation of the suspension reinforcement $A_{sx1,2}$ from the dowel
l_{c1}: see page 25
c_1: Distance to edge measured from centre of dowel to the free edge

$A_{sx1,i}$: cross-section of a suspension reinforcement leg in the failure cone

f_{yk} : characteristic yield strength of the reinforcement: $f_{yk} = 500$ N/mm²

f_{ck} : characteristic cylindrical compressive strength of concrete

γ_{MC} : partial safety factor for concrete, $\gamma_{MC} = 1,5$

$V_{Rd,2i}$ transferable composite force

$$V_{Rd,2i} = \pi \cdot d_s \cdot l'_i \cdot f_{bd}$$

d_s : suspension reinforcement diameter [mm]

l_1 : suspension reinforcement leg lengths which can be applied
$l_1 = c_1 + (0,5 \cdot h_B - d_H) - \xi \cdot d_s - c_{nom}$
h_B, d_H: see pages 12 and 13
$c_1 = 0,5 \cdot h$
$\xi = 3,0$ for $d_s < 20$ mm
$\xi = 4,5$ for $d_s \geq 20$ mm
c_{nom}: concrete covering for suspension reinforcement ≥ 30 mm

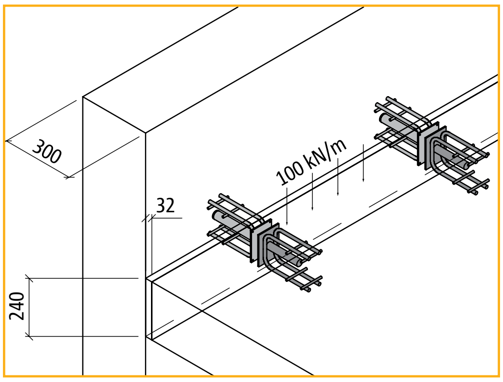
l'_i : effective anchoring length in failure cone
$l'_i = l_1 - (l_{ci}/2) \cdot \tan 33°$

f_{bd} : Design value of bond stress for reinforcing steel

f_{yd} : Design value of suspension reinforcement yield strength
$f_{yd} = f_{yk}/\gamma_s$ using the partial safety factor for reinforcing steel $\gamma_s = 1,15$

Schöck Dorn type SLD
Calculation example

Connection of a floor slab to a wall



Concrete	C 20/25
Slab thickness	$h = 240$ mm
Effective depth	$d_m = 194$ mm
Wall thickness	$b_W = 300$ mm
Concrete cover	$c_{nom,u} = c_{nom,o} = 30$ mm

Design value of shear force	$V_{Ed} = 100$ kN/m
Joint length	$l_f = 1{,}6$ m
Designed joint width	$f = 32$ mm
Start joint width	20 mm

The maximum joint opening must be determined by a structural design engineer. This value can be determined by taking into account deformations due to shrinkage, load and temperature changes.

The deciding factor for the design is the maximum joint opening f = 32 mm.

Calculation for Schöck Dorn SLD

Dorn type
Choice: Schöck Dorn SLD 80
$h_{min} = 240 \text{ mm} \leq 240 \text{ mm} = h_{exist}$
$V_{Rd,s} = 125{,}9$ kN for $f \leq 40$ mm

On-site reinforcement
Choice: according to page 25
req. wall thickness $b_W = 275 \text{ mm} \leq 300 \text{ mm} = \text{exist. } b_W$
(required wall thickness see page 16)

Checking dowel and edge spacing, see page 17

Dowel spacing
Choice: e = 400 mm
$400 \text{ mm} > 360 \text{ mm} = e_{min}$ √
$400 \text{ mm} < 670 \text{ mm} = e_{crit}$!

Distance to edge
Choice: $e_R = 600$ mm
$600 \text{ mm} > 240 \text{ mm} = e_{R,min}$ √
$600 \text{ mm} > 535 \text{ mm} = e_{R,crit}$ √

A punching shear proof and verification of the slab bearing limit are necessary.

Schöck Dorn type SLD

Calculation example

SLD

Punching shear proof

$$V_{Rd,ct} \leq 0{,}14 \cdot \eta_1 \cdot \kappa \cdot (100 \cdot \rho_l \cdot f_{ck})^{1/3} \cdot d_m \cdot \frac{u_{crit}}{\beta}$$

η_1 = 1,0 for normal concrete

$\kappa = 1 + \sqrt{\frac{200}{d_m}} = 1 + \sqrt{\frac{200}{194}} = 1 + 1{,}02 = 2{,}02 \leq 2{,}0!$

$\rho_l = \sqrt{\rho_x \cdot \rho_y}$

$\rho_x = \frac{A_{sx}}{d_m \cdot b_y}$ und $\rho_y = \frac{A_{sy}}{d_m \cdot b_x}$

$\sum A_{sx} = 2 \cdot [6 \cdot 2{,}01] + 2 \cdot [2 \cdot 1{,}13] = 28{,}64$ cm²
[2 • (6 ø 16 + 2 ø 12)]
$A_{sy} = 3 \cdot 2{,}01 = 6{,}03$ cm² (3 ø 16)
$b_x = 30 + 1{,}5 \cdot d_m = 30 + 1{,}5 \cdot 194 = 321$ mm
$b_y = 2 \cdot 1{,}5 \cdot d_m + l_{c1} + e = 3 \cdot 194 + 89 + 400 = 1.071$ mm

$$\rho_1 = \sqrt{\frac{28{,}64}{19{,}4 \cdot 107{,}1} \cdot \frac{6{,}03}{19{,}4 \cdot 32{,}1}}$$

$$= 0{,}012 \leq \min \begin{cases} \frac{0{,}5 \cdot 0{,}85 \cdot 20}{435 \cdot 1{,}5} \\ 0{,}02 \end{cases} = 0{,}0130$$

f_{ck} = 20 N/mm²
$u_{crit} = 60 + l_{c1} + \pi \cdot 1{,}5 \cdot d_m + e = 60 + 89 + \pi \cdot 1{,}5 \cdot 194 +$ 400 = 1.463,2 mm

$$V_{Rd,ct} = 0{,}14 \cdot 1{,}0 \cdot 2{,}0 \cdot (100 \cdot 0{,}012 \cdot 20)^{1/3} \cdot 0{,}194 \cdot \frac{1{,}4632}{1{,}4} = 163{,}74 \text{ kN}$$

Calculation of slab bearing limit

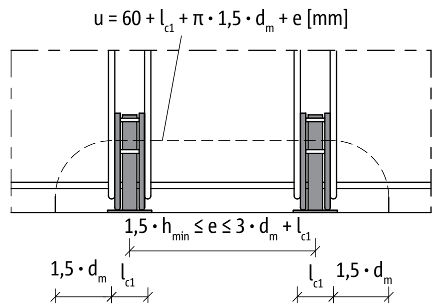
$$V_{Rd,c} = \sum V_{Rd,1i} + \sum V_{Rd,2i} \leq \sum A_{sx1} \cdot f_{yd}$$

$$V_{Rd,1i} = 0{,}357 \cdot \psi_i \cdot A_{sx1,i} \cdot f_{yk} \cdot \sqrt{f_{ck}/30} / \gamma_{MC}$$

$\psi_i = 1 - 0{,}2 \cdot [(l_{ci}/2)/c_1]$
$A_{sx1,i}$ = 2,01 cm²
f_{yk} = 500 N/mm²
f_{ck} = 20 N/mm²
$c_1 = 0{,}5 \cdot 240 = 120$ mm

l_{c1} = 89 mm
$\psi_1 = 1 - 0{,}2 \cdot [(89/2)/120] = 0{,}93$
$V_{Rd,11} = 0{,}357 \cdot 0{,}93 \cdot 2{,}01 \cdot 50{,}0 \cdot \sqrt{20/30} / 1{,}5 = 18{,}16$ kN

Allowable reinforcement cross-section A_{sx} and A_{sy} see page 25.
Linear connection, so the punching shear proof must be carried out for two adjacent dowels.



l_{c1} = Spacing of the innermost U-bars in the transverse direction A_{sx1} see page 25.

Schöck Dorn type SLD

Calculation example

l_{c2} $= l_{c1} + 2 \cdot s_1 = 89 + 2 \cdot 36 = 161$ mm
ψ_2 $= 1 - 0{,}2 \cdot [(161/2)/120] = 0{,}87$
$V_{Rd,12} = 0{,}357 \cdot 0{,}87 \cdot 2{,}01 \cdot 50{,}0 \cdot \sqrt{20/30} /1{,}5 = 16{,}99$ kN

l_{c3} $= l_{c2} + 2 \cdot s_2 = 161 + 2 \cdot 50 = 261$ mm
ψ_3 $= 1 - 0{,}2 \cdot [(261/2)/120] = 0{,}78$
$V_{Rd,13} = 0{,}357 \cdot 0{,}78 \cdot 2{,}01 \cdot 50{,}0 \cdot \sqrt{20/30} /1{,}5 = 15{,}23$ kN

The fourth U-bars lies outside the calculated failure cone and is therefore not taken into account.

$$V_{Rd,2i} = \pi \cdot d_s \cdot l'_i \cdot f_{bd}$$

d_s = 16 mm
f_{bd} = 2,3 N/mm² für C20/25
h_B = 180 mm (siehe Seite 12)
d_H = 14 mm (siehe Seite 12)
ξ = 3,0, da d_s = 16 mm < 20 mm
c_{nom} = 30 mm
$l_1 = c_1 + (0{,}5 \cdot h_B - d_H) - \xi \cdot d_s - c_{nom}$
$l_1 = 120 + (0{,}5 \cdot 180 - 14) - 3{,}0 \cdot 16 - 30 = 118$ mm
$l'_i = l_1 - (l_{c1}/2) \cdot \tan 33°$

$l'_1 = 118 - 89/2 \cdot \tan 33° = 89{,}1$ mm
$V_{Rd,21} = \pi \cdot 16 \cdot 89{,}1 \cdot 2{,}3 \cdot 10^{-3} = 10{,}30$ kN

$l'_2 = 118 - (161/2) \cdot \tan 33° = 65{,}72$ mm
$V_{Rd,22} = \pi \cdot 16 \cdot 65{,}72 \cdot 2{,}3 \cdot 10^{-3} = 7{,}60$ kN

$l'_3 = 118 - (261/2) \cdot \tan 33° = 33{,}25$ mm
$V_{Rd,23} = \pi \cdot 16 \cdot 33{,}25 \cdot 2{,}3 \cdot 10^{-3} = 3{,}84$ kN

$V_{Rd,c} = \sum V_{Rd,1i} + \sum V_{Rd,2i} \leq \sum A_{sx1} \cdot f_{yd}$
$V_{Rd,c} = 2 \cdot (18{,}16 + 16{,}99 + 15{,}23 + 10{,}30 + 7{,}60 + 3{,}84)$
$= 144{,}24 \text{ kN} \leq 6 \cdot 2{,}01 \cdot 43{,}5 = 524{,}6$ kN

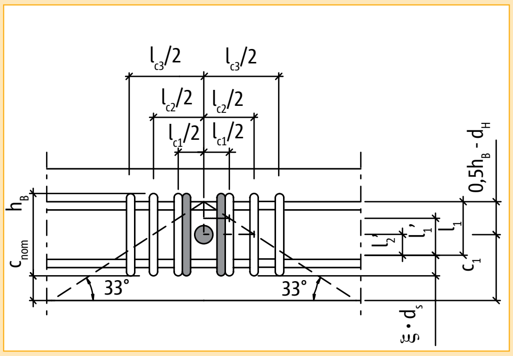
Proofs:

1) Punching shear
$V_{Rd,ct} = 163{,}74 \text{ kN} > V_{ed} = 100 \text{ kN/m} \cdot 1{,}60 \text{ m} = 160$ kN

2) Slab bearing limit
$V_{Rd,c} = 144{,}24 \text{ kN} > V_{ed} = (100 \text{ kN/m} \cdot 1{,}60 \text{ m}) : 2 = 80$ kN

3) Steel load-bearing capacity
$V_{Rd,s} = 125{,}4 \text{ kN} > V_{ed} = (100 \text{ kN/m} \cdot 1{,}60 \text{ m}) : 2 = 80$ kN

⇒ **The steel load-bearing capacity is the deciding factor for the maximum transferable shear force of the Schöck Dorn SLD 80.**



f_{bd} : Design value for the bond stress

d_s : Diameter of rear suspended reinforcement [mm]

l'_i : effective anchoring length

c_{nom} : Concrete covering of rear suspended reinforcement

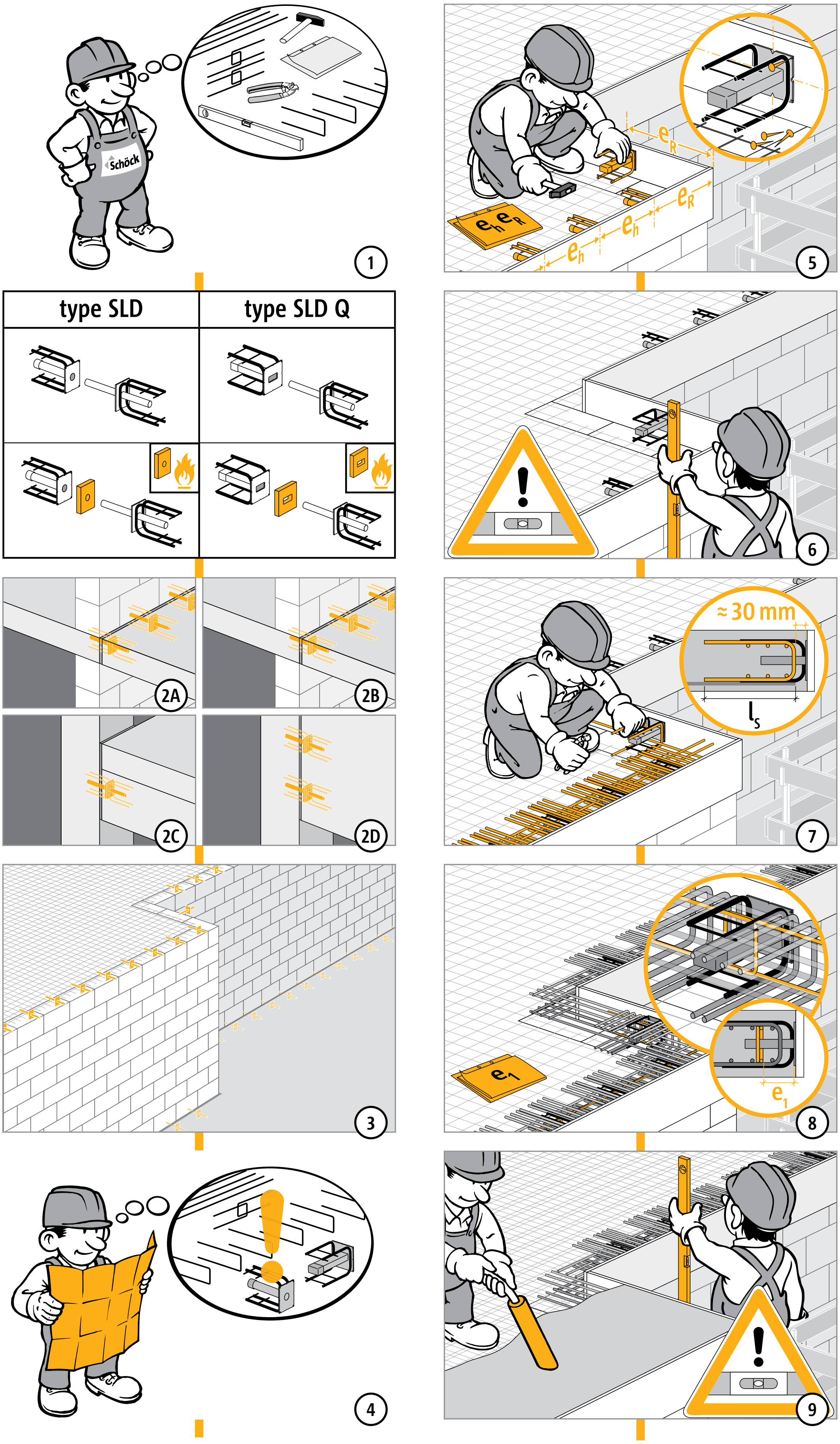
h : Slab thickness

f_{ck} : characteristic cylindrical compressive strength of the concrete

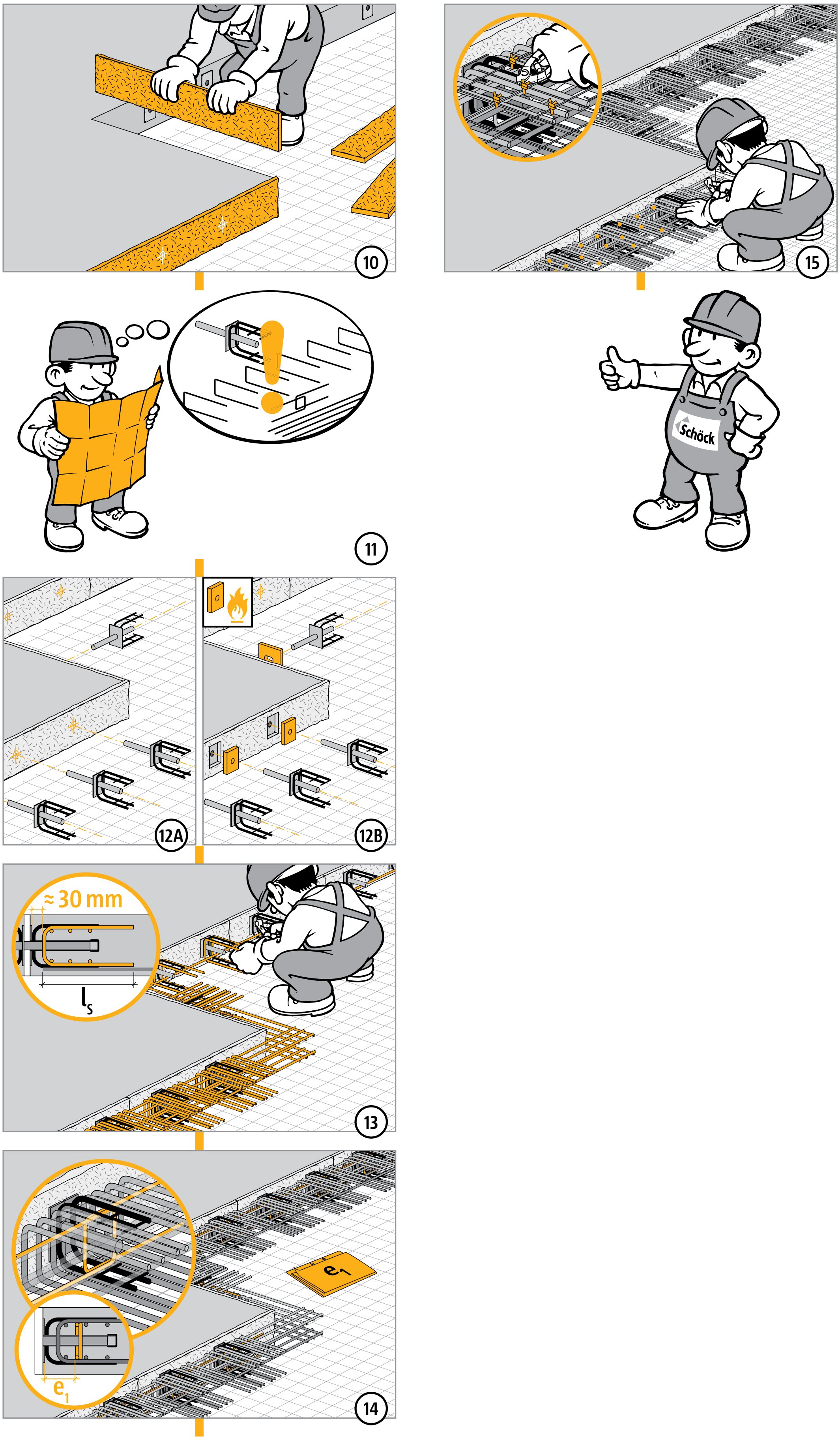
f_{yk} : Yield strength of the rear suspended reinforcement

Schöck Dorn type SLD

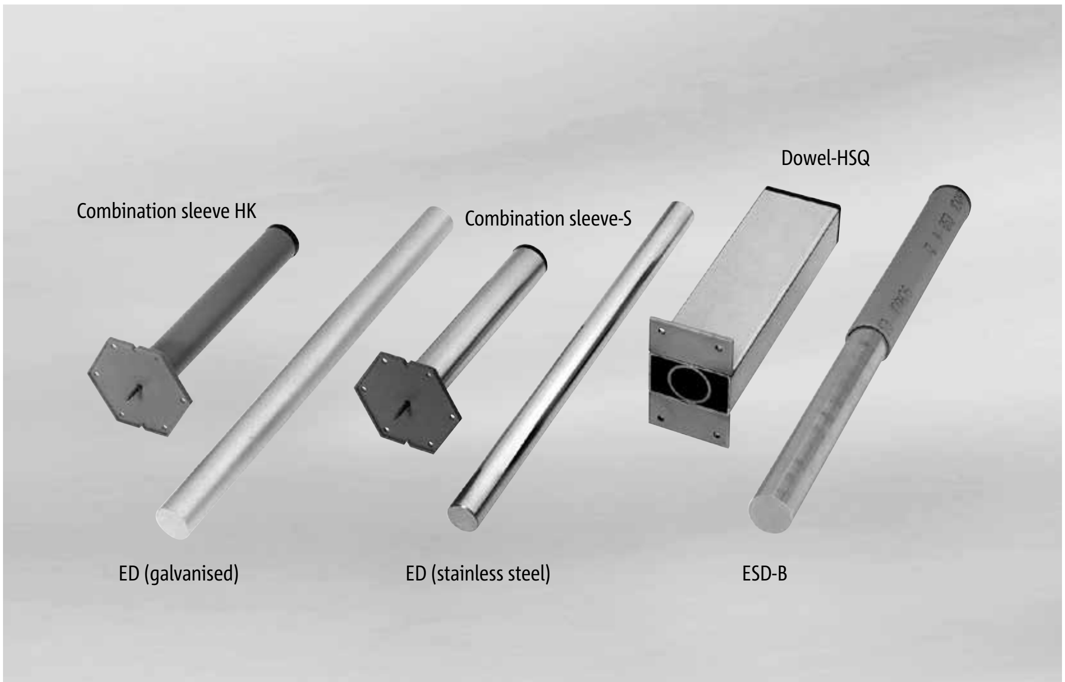
Installation instructions



Schöck Dorn type SLD
Installation instructions



Schöck Dorn type ESD



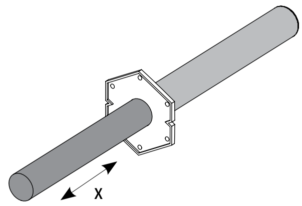
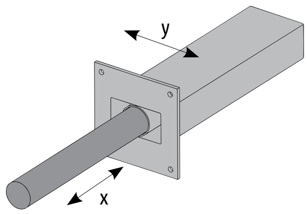
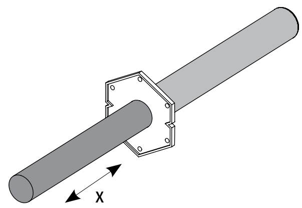
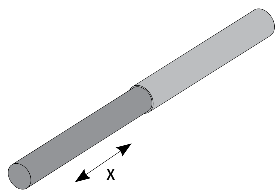
Schöck single shear dowel

Contents	**Page**

Schöck Dorn type ESD

types and product description

Dowels consist of dowel and sleeve

Description	Dowel
ESD-S d/L Single shear dowel (ED) made of stainless steel Including combination sleeve ESD HS made from stainless steel	
ESD-SQ d/L Single shear dowel (ED) made of stainless steel Including sleeve ESD- HSQ made from stainless steel movable in x und y directions	
ESD-K d/L-DM Single shear dowel (ED) made of stainless steel or galvanised Including combination sleeve ESD-HK made from plastic	
ESD-B d/L-DM Single shear dowel (ED) made of stainless steel or galvanised with half-sided plastic sleeve	

Abbreviations:

d Dowel diameter:
20, 22, 25 or 30 mm

L Dowel length:
300 mm for dowel diameter 20, 22, 25
350 mm for dowel diameter 30

DM Dowel material:
A4 for stainless steel
fv for galvanised

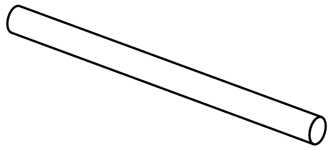
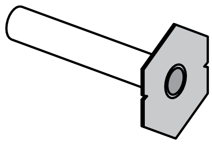
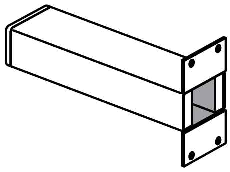
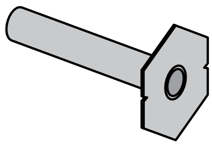
type designation in design documents
(Statics, Invitation to tender form, final drawings, order)

e.g.: **ESD-K 20/300-A4**

type of dowel
Material of sleeve & type
Dowel diameter
Dowel length
Dowel material

Schöck Dorn type ESD
types and product description

Each component can be supplied individually

Description	Component
ED d/L-DM Single shear dowel (ED) made of stainless steel or galvanised	
ESD-HS d/L Combination sleeve made of stainless steel	
ESD-HSQ d/L Combination sleeve made of stainless steel, movable in longitudinal and transverse directions	
ESD-HK d/L Combination sleeve made of plastic	

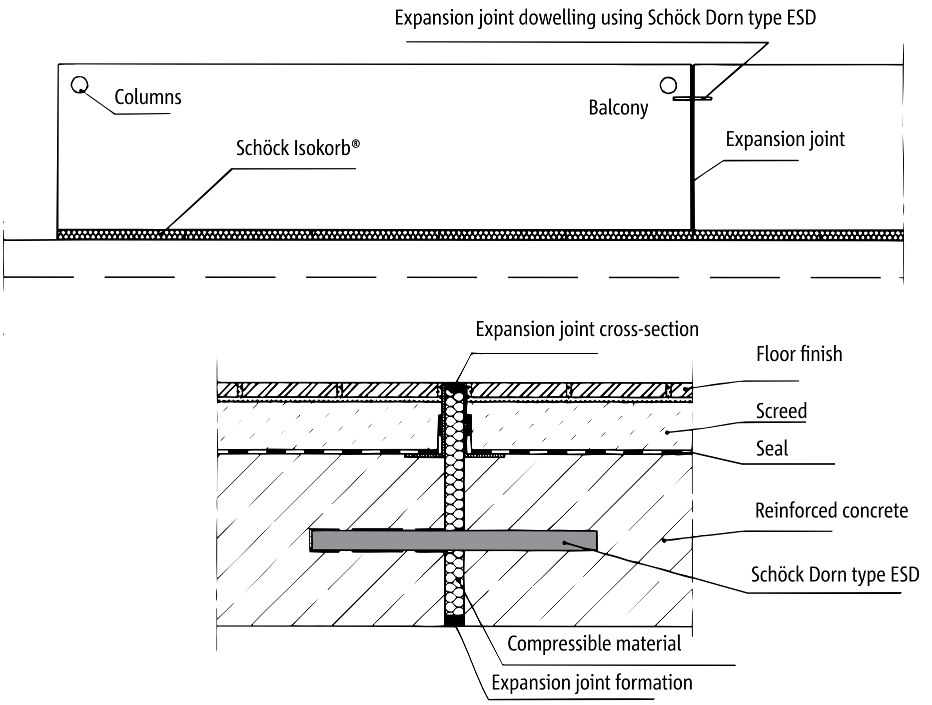
Abbreviations:

d Dowel diameter:
20, 22, 25 or 30 mm

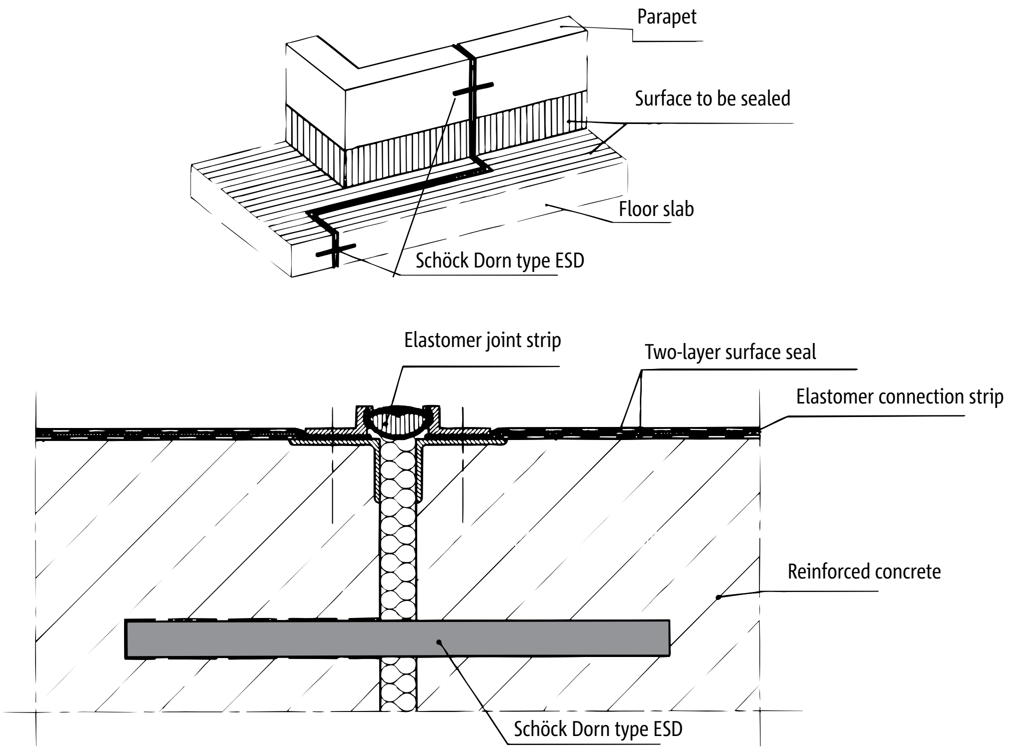
L Dowel length:
300 mm for dowel diameter 20, 22, 25
350 mm for dowel diameter 30

DM Dowel material:
A4 for stainless steel
fv for galvanised

Schöck Dorn type ESD
Application examples/building construction details



Expansion joint dowelling of concrete balconies



Expansion joint dowelling for parking levels and underground car parks

Schöck Dorn type ESD
Application examples/civil engineering details

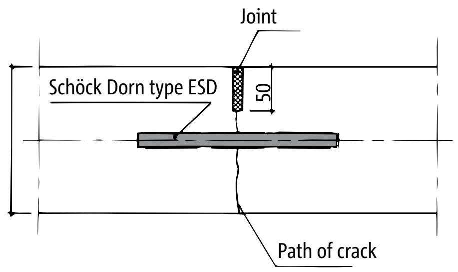


Figure 1: Dummy joint formation in concrete road surfaces

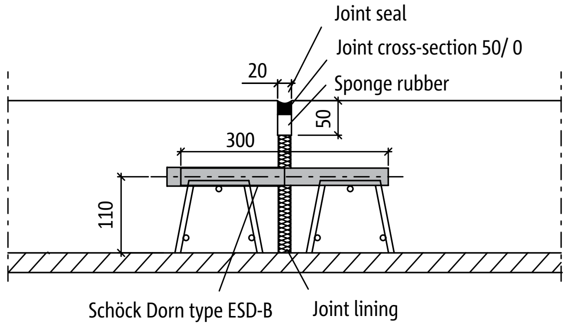


Figure 2: Expansion joint with dowel in concrete road surfaces

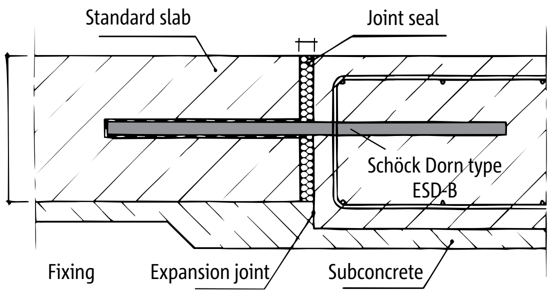


Figure 3: Connections for concrete carriageways to bridge structures (using approach slab construction)

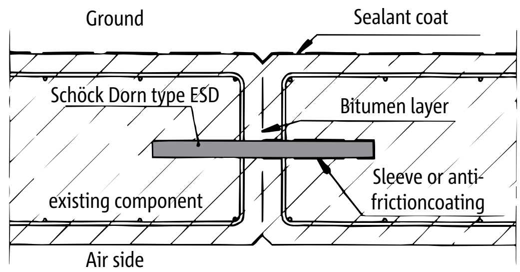


Figure 4: Supporting wall connections for smooth construction joints with dowels (also suitable for connections to existing components)

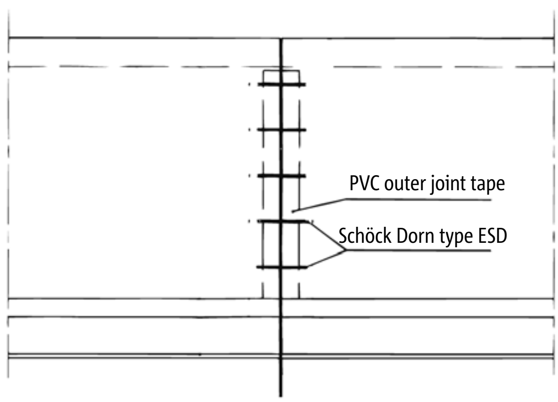


Figure 5: Retaining wall (Elevation)

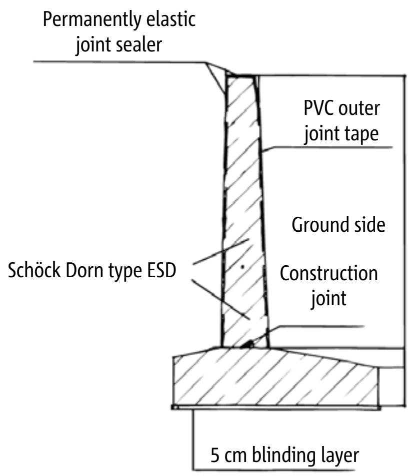
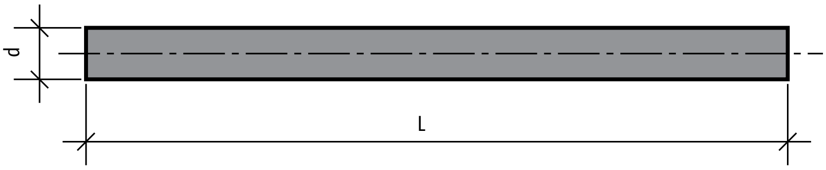


Figure 6: Retaining wall (Cross-section)

Schöck Dorn type ESD
Dimensions



Materials:
stainless steel 1.4571, 1.4404, 1.436
Steel S355 galvanised

other materials and
lengths on request

Figure 1: Single shear dowel also available in dowel ESD-S, SQ, K or B

Dimensions [mm]		Schöck Dorn type			
		ED-20/300-A4	ED-22/300-A4	ED-25/300-A4	ED-30/350-A4
		ED-20/300-fv	ED-22/300-fv	ED-25/300-fv	ED-30/350-fv
Dowel diameter	d	20	22	25	30
Dowel length	L	300	300	300	350

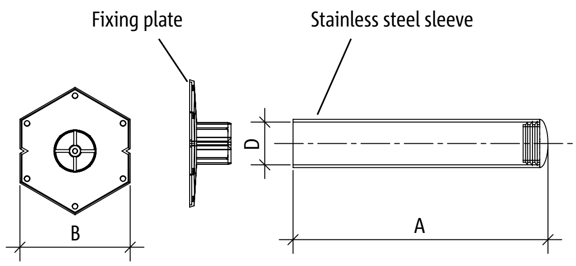


Figure 2: Combination sleeve ESD-HS made of stainless steel

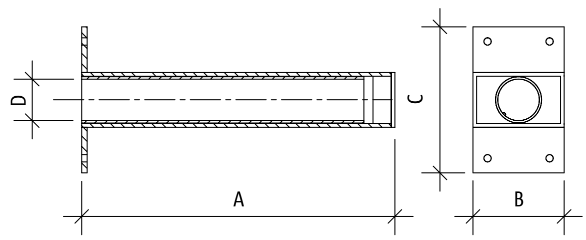


Figure 3: Sleeve ESD-HSQ made of stainless steel,movable in longitudinal and transverse directions

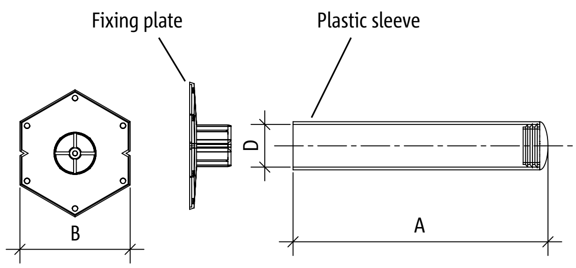


Figure 4: Combination sleeve ESD-HK made of plastic

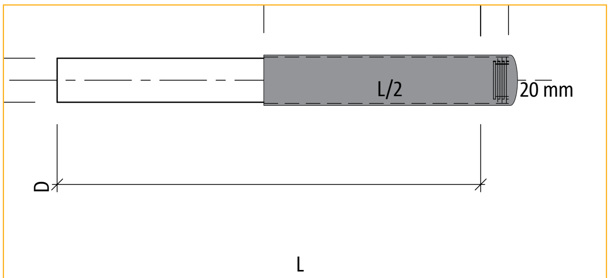


Figure 5: Single shear dowel ESD-B with half-sided plastic sleeve

Dimensions [mm]		Schöck Dorn type							
		ESD-HS ESD-HK	ESD-HSQ	ESD-HS ESD-HK	ESD-HSQ	ESD-HS ESD-HK	ESD-HSQ	ESD-HS ESD-HK	ESD-HSQ
		20/300		22/300		25/300		30/350	
Sleeve length	A	162	170	162	170	162	170	187	195
Fixing plate width	B	80	50	80	50	80	50	80	60
Fixing plate height	C	–	80	–	80	–	80	–	90
Inner diameter	D	21		23		26		31	

Schöck Dorn type ESD
Anti-corrosion protection/Movable in transverse direction

Anti-corrosion protection

In normal building construction and civil engineering, structures must be designed in such a way that they are serviceable for a minimum lifetime of 50 years. The following table gives the necessary materials for sample applications and the dowels supplied by Schöck.

Applications	Suitable materials	Suitable dowels
installed in dry interior rooms	S355	ESD-B -fv ESD-K -fv
Damp rooms, ambient air, proximity to seawater, structures with moderate loading of chloride and sulphur dioxide Conditions referred to corrosion resistance class III	stainless steels material no.: 1.4404 1.4571 1.4462, 1.4362	ESD-S ESD-SQ ESD-B -A4 ESD-K -A4 All SLD

Movable in transverse direction

Transverse movement in ESD-SQ sleeve [mm] depending on Dowel diameter
ø 20 : ±9,5
ø 22 : ±9,0
ø 25 : ±7,0
ø 30 : ±10,0

Schöck Dorn type ESD
Design/On-site reinforcement

ESD

Design resistances of single shear dowels in reinforced concrete:

Steel load-bearing capacity $V_{Rd,s}$

in accordance to BS EN 1993-1-1:2005

$V_{Rd,s} = f_{\mu} \cdot 1{,}25 \cdot (f_{yk} / \gamma_{MS}) \cdot W/(f + D/2)$

γ_{MS}	= 1,1	Partial safety factor for steel
f_{μ}	= 0,9	Reduction factor for taking account of resulting frictional forces
f_{yk}	= 355 N/mm²	Yield strength of steel

Concrete load-bearing capacity $V_{Rd,b}$ = min ($V_{Rd,c}$; $V_{Rd,ct}$)

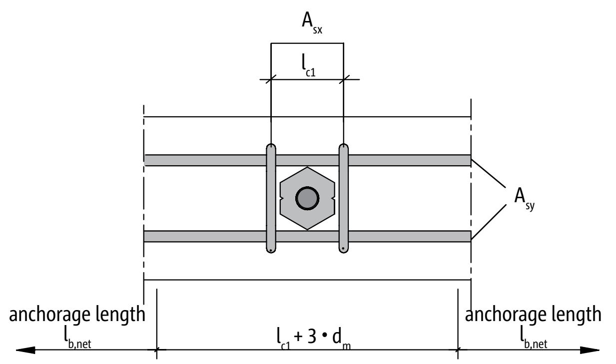
Slab bearing limit $V_{Rd,c}$
in accordance to the expert report on conversion of shear dowel connections.
Prof. Eligehausen (also see page 31)
$V_{Rd,c} = \sum V_{Rd,1i} + \sum V_{Rd,2i} \leq A_{sx} \cdot f_{yd}$

Punching bearing limit $V_{Rd,ct}$
in accordance to Schöck Dorn type SLD
$V_{Rd,ct} = 0{,}14 \cdot \eta_1 \cdot \kappa \cdot (100 \cdot \rho_l \cdot f_{ck})^{1/3} \cdot d_m \cdot u_{crit}/ß$

Key

- A_{sx} : U-bar
- A_{sy} : Longitudinal reinforcement
- l_{c1} : Spacing of the innermost U-bars in the transverse direction
- h_{min} : Minimum slab thickness
- e_{min} : Minimum dowel spacing
- e_R : Minimum edge distance

- W : Dowel section modulus
- f : Joint width
- D : Dowel diameter



Minimum component dimensions

Schöck Dorn type	Dowel diameter D [mm]	U-bar spacing l_{c1} [mm]	Slab thickness h_{min} [mm]	Dowel spacing e_{min} [mm]	Edge distance e_R [mm]
ESD 20	20	60	160	310	155
ESD 22	22	60	160	350	175
ESD 25	25	70	180	410	205
ESD 30	30	90	220	560	280

Schöck Dorn type ESD
Design/On-site reinforcement

Design resistances of the steel load-bearing capacity $V_{Rd,s}$

Schöck Dorn type	Dowel diameter [mm]	Joint width f [mm]			
		10	20	30	40
		$V_{Rd,s}$ [1] [kN]			
ESD 20	20	14,3	9,5	7,1	5,7
ESD 22	22	18,1	12,2	9,3	7,4
ESD 25	25	24,8	17,1	13,1	10,6
ESD 30	30	38,5	27,5	21,4	17,5

The factor f_{μ} = 0,9 is taken into account when determining the steel load-bearing capacity.

ESD

Design resistances of concrete load-bearing capacity $V_{Rd,b}$ taking the on-site reinforcement into account

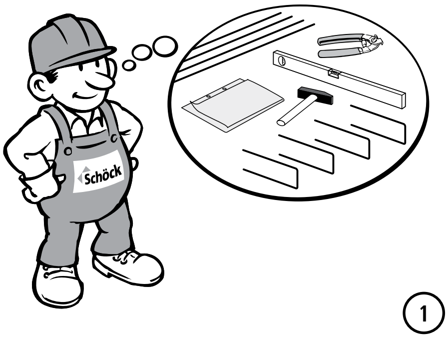
Schöck Dorn type	Slab thickness [mm]	$V_{Rd,b}$ [1] [kN] C20/25	On-site reinforcement		Distance l_{c1} [mm]
			ΣA_{sx}	ΣA_{sy}	
ESD 20	≥ 160	13,7	2 ø 10	2 ø 10	60
	≥ 180	14,3			
ESD 22	≥ 160	14,2	2 ø 10	2 ø 10	60
	≥ 180	15,8			
	≥ 200	17,2			
	≥ 220	18,0			
	≥ 240	18,1			
ESD 25	≥ 180	20,5	2 ø 12	2 ø 12	70
	≥ 200	22,4			
	≥ 220	23,6			
	≥ 240	24,6			
	≥ 260	24,8			
ESD 30	≥ 220	29,2	2 ø 14	2 ø 14	90
	≥ 240	31,5			
	≥ 260	33,7			
	≥ 280	35,8			
	≥ 300	38,0			
	≥ 320	38,5			

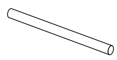
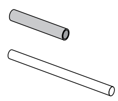
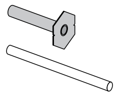
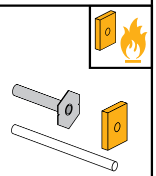
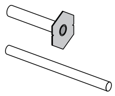
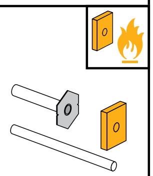
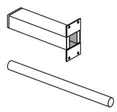
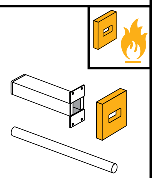
The factor f_{μ} = 0,9 is taken into account when determining the steel load-bearing capacity.

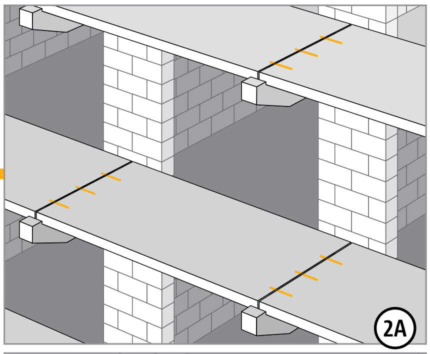
[1] The smaller value of $V_{Rd,s}$ and $V_{Rd,b}$ should be used.

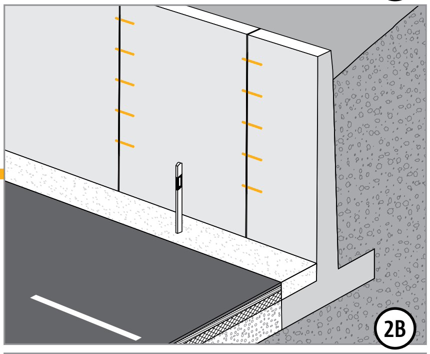
Schöck Dorn type ESD

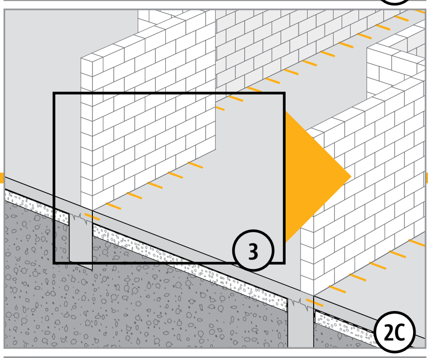
Installation instructions

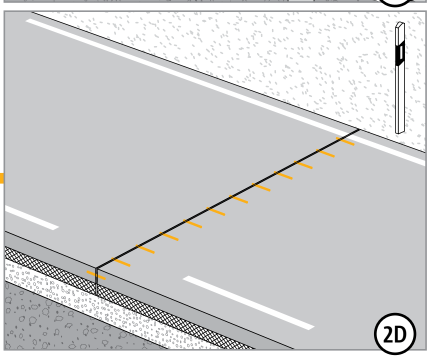


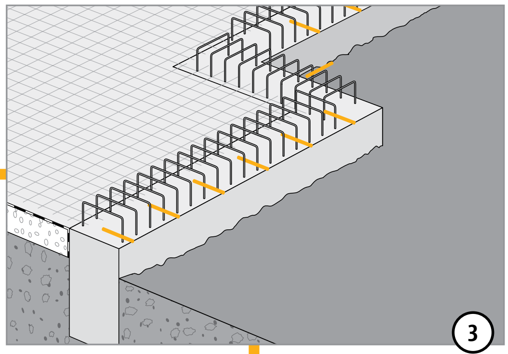
Type ED		
Type ESD-B		
Type ESD-K		
Type ESD-S		
Type ESD-SQ		

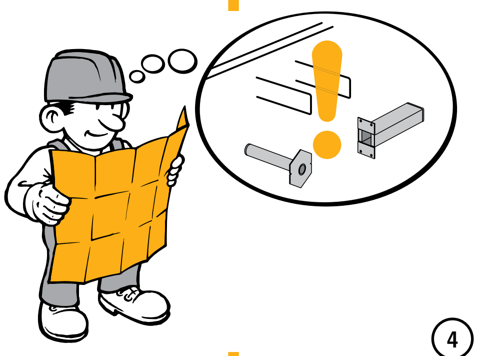




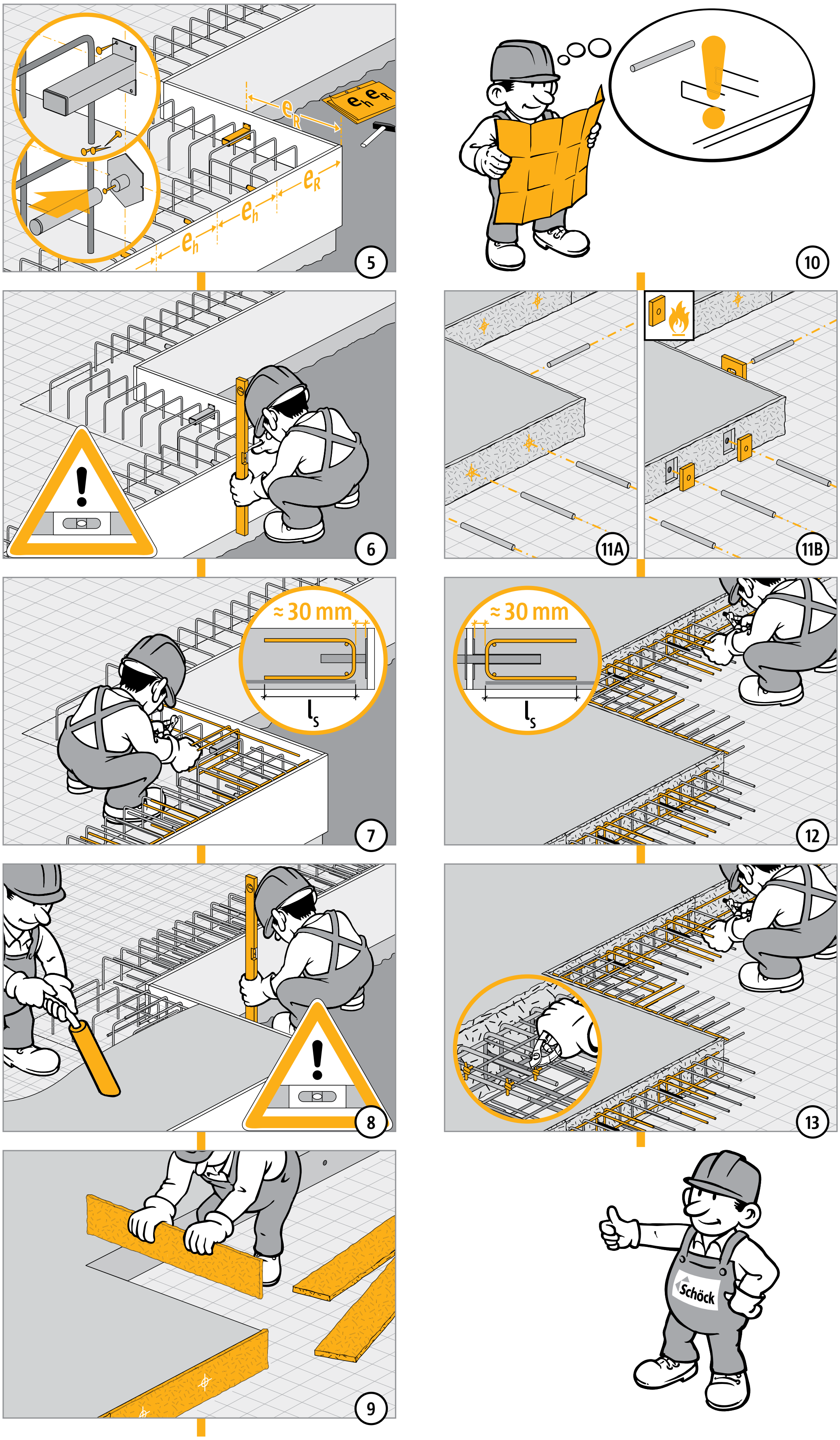








Schöck Dorn type ESD
Installation instructions

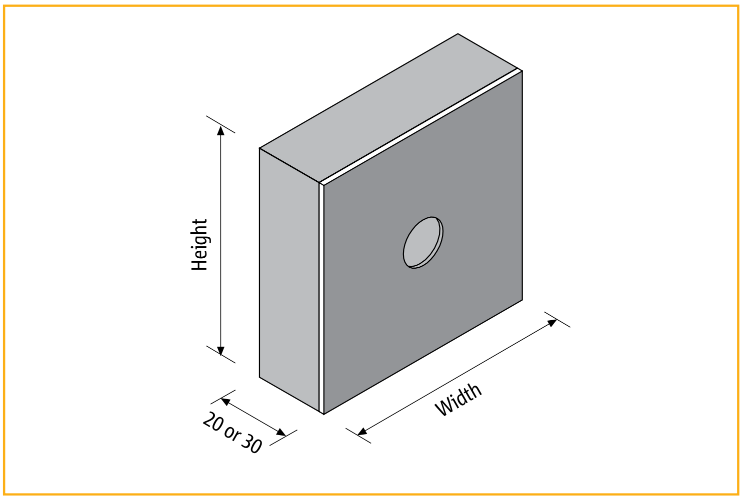


Schöck fire protection collar

R 90 system solution for SLD and ESD

Schöck Dorns in combination with the Schöck fire protection collar can fulfil high fire safety requirements in joints for the transfer of shear forces.

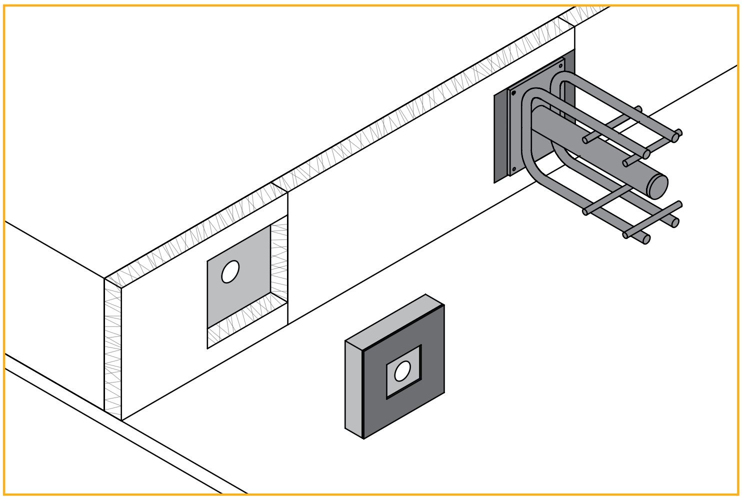
Classification according to fire resistance class R 90 (90 minutes) is confirmed by an expert's report from the Institute for Building Materials, Construction and Fire Protection of Braunschweig Technical University, Germany (iBMB).



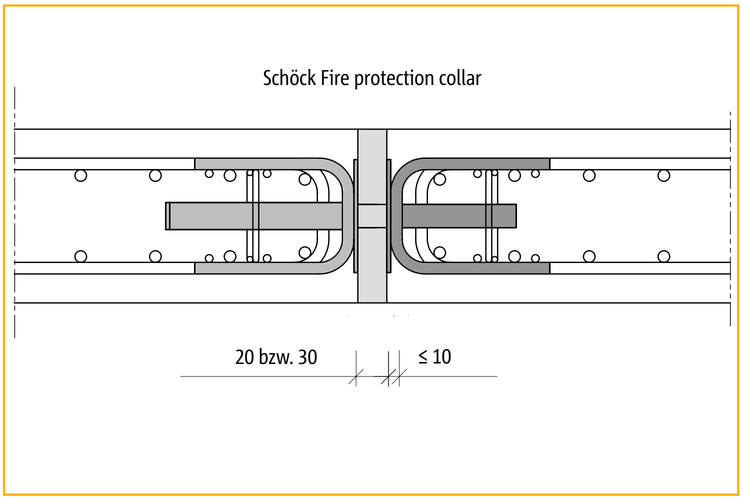
Design of the Schöck fire protection collar

Schöck fire protection collar

- The ideal complement for all Schöck Dorn for fire resistance class R 90 (90 minutes) requirements.
- Standard solutions for joint widths of 20 mm and 30 mm.
- Classification according to the fire resistance class R 90 (90 minutes) even with an air gap of up to 10 mm in the joint.
- R 90 even at the shell construction stage No additional structure required.
- Patented system



Expansion joint with Schöck fire protection collar using: Schöck Dorn type SLD



Connection layout cross-section using: Schöck Dorn type SLD

Schöck fire protection collar
Dimensions

Fire protection collar for SLD	Joint width f [mm]	Width [mm]	Height [mm]
SLD 40/50 BSM 20	20	120	120
SLD 40/50 BSM 30	30		
SLD 60 BSM 20	20	140	140
SLD 60 BSM 30	30		
SLD 70 BSM 20	20	160	160
SLD 70 BSM 30	30		
SLD 80 BSM 20	20	150	180
SLD 80 BSM 30	30		
SLD 120 BSM 20	20	170	210
SLD 120 BSM 30	30		
SLD 150 BSM 20	20	190	220
SLD 150 BSM 30	30		


Schöck fire protection collar SLD

Fire protection collar for SLD Q	Joint width f [mm]	Width [mm]	Height [mm]
SLD Q 40/50 BSM 20	20	160	150
SLD Q 40/50 BSM 30	30		
SLD Q 60 BSM 20	20	180	170
SLD Q 60 BSM 30	30		
SLD Q 70 BSM 20	20	190	170
SLD Q 70 BSM 30	30		
SLD Q 80 BSM 20	20	210	220
SLD Q 80 BSM 30	30		
SLD Q 120 BSM 20	20	230	250
SLD Q 120 BSM 30	30		
SLD Q 150 BSM 20	20	250	250
SLD Q 150 BSM 30	30		


Schöck fire protection collar SLD Q

Fire protection collar for ESD	Joint width f [mm]	Width [mm]	Height [mm]
ESD 20 BSM 20	20	100	100
ESD 20 BSM 30	30		
ESD 22 BSM 20	20	120	120
ESD 22 BSM 30	30		
ESD 25 BSM 20	20	105	105
ESD 25 BSM 30	30		
ESD 30 BSM 20	20	150	180
ESD 30 BSM 30	30		


Schöck fire protection collar ESD

Fire protection collar for ESD SQ	Joint width f [mm]	Width [mm]	Height [mm]
ESD SQ 20 BSM 20	20	130	100
ESD SQ 20 BSM 30	30		
ESD SQ 22 BSM 20	20	160	150
ESD SQ 22 BSM 30	30		
ESD SQ 25 BSM 20	20	135	105
ESD SQ 25 BSM 30	30		
ESD SQ 30 BSM 20	20	210	220
ESD SQ 30 BSM 30	30		


Schöck fire protection collar ESD SQ

Schöck fire protection collar with an report from the Institute for Building Materials, Construction and Fire Protection of Braunschweig Technical University, Germany (iBMB).

Schöck Dorn type SLD
Invitation to tender form

Tendering recommendation for Schöck Dorn type SLD

Position	Quantity	unit		unit price	Total price
1.			**Task: Expansion joints in reinforced concrete works expansion joint connection for the transfer of shear forces**		
1.1			Delivery and installation of a shear dowel for the transfer of shear forces around expansion joints. Implementation based on technical approval and support structure planner specifications. The manufactorer's technical documentation must be complied with.		
1.1.1			Schöck Dorn type SLD ______ Movable in direction of dowel axis		
1.1.2			Schöck Dorn type SLD Q ______ Movable in direction of dowel axis and longitudinal direction of joint		
1.2			R 90 system solution for Schöck Dorn type SLD. Supply Schöck Dorn R 90 fire protection collar with expert's report from Braunschweig Technical University and install in accordance with the manufacturer's instructions		
1.2.1			Schöck R 90 collar for dowel type SLD _______ expansion joint _______ mm (20 or 30 mm)		
1.2.2			Schöck R 90 collar for dowel type SLD Q _______ expansion joint _______ mm (20 or 30 mm)		

Schöck Dorn type ESD/ED
Invitation to tender form

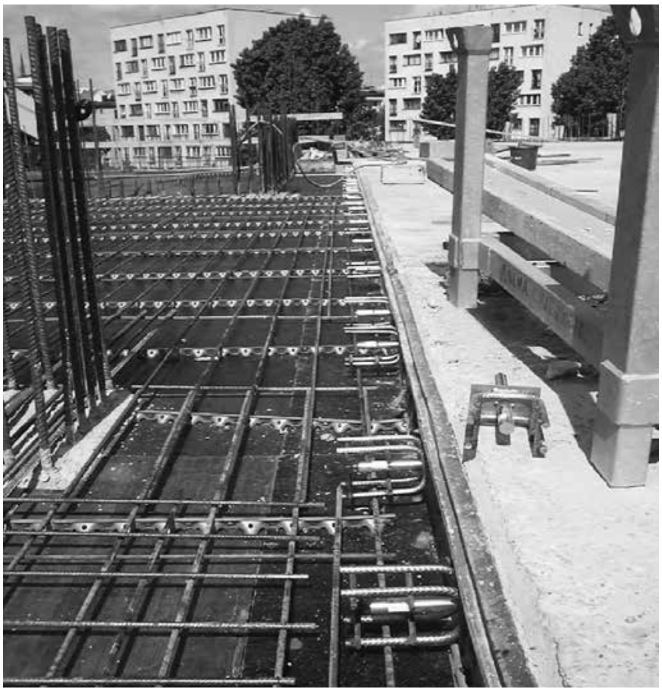
Tendering recommendation for Schöck Dorn type ESD/ED

Position	Quantity	unit		unit price	Total price
1.			**Task: Expansion joints in reinforced concrete works expansion joint connection for the transfer of shear forces**		
1.1			Delivery and installation of a shear dowel for the transfer of shear forces in expansion joints. Design and choice of the elements apply only to the Schöck Dorn type ESD system.		
1.1.1			Schöck Dorn type ESD-S ______ /______ Dowel made from stainless steel 1.436 including combination sleeve made of stainless steel with attachment plate		
1.1.2			Schöck Dorn type ESD-SQ ______ /______ Dowel made from stainless steel 1.436 including sleeve made of stainless steel which is movable in a transverse direction		
1.1.3			Schöck Dorn type ESD-K ______ /______ Dowel made from stainless steel 1.4362 including combination sleeve made of plastic with fixing plate		
1.1.4			Schöck Dorn type ESD-K ______ /______ Dowel made of steel S355, galvanised, including combination sleeve made of plastic with fixing plate		
1.1.5			Schöck Dorn type ESD-B ______ /______ Dowel made of stainless steel 1.4362 with half-sided plastic sleeve		
1.1.6			Schöck Dorn type ESD-B ______ /______ Dowel made of steel S355, galvanised, with half-sided plastic sleeve		
1.1.7			Schöck Dorn type ED ______ /______ Single dowel made of S355 galvanised		
1.1.8			Schöck Dorn type ED ______ /______ Single dowel made of stainless steel 1.4362		
1.2			R 90 system solution for Schöck Dorn type ESD. Supply Schöck Dorn R 90 fire protection collar with expert's report from Braunschweig Technical University and install in accordance with the manufacturer's instructions		
1.2.1			Schöck R 90 collar ESD _______ Joint width _______ mm (20 or 30 mm)		
1.2.2			Schöck R 90 collar ESD SQ _____ Joint width _______ mm (20 or 30 mm)		

Schöck Dorn
Reference projects

Pasaz Grunwaldzki, Wroclaw, Poland

Construction of a shopping centre with approx. 2000 m² floor area
Products: SLD and SLD Q
Client: Echo Investment SA.
Installation: May 07



ETO stadium, Györ, Hungary

New development of stand for Hungary's second largest football club.
Improved fire prevention requirements for the stand.
Products: SLD and SLD Q with fire protection collar
Client: QUESTOR Investment Group
Installation: August 07

Imprint

Published by: HauCon A/S
Lægårdsvej 19
DK-8520 Lystrup
Telefon: +45 86 22 93 93
Fax: +45 86 22 93 96
info@haucon.dk

Date of publication: Oktober 2014

Subject to technical changes
Date of publication: Oktober 2014

Distributed by

HauCon A/S
Lægårdsvej 19
DK-8520 Lystrup
Telefon: +45 86 22 93 93
Fax: +45 86 22 93 96
info@haucon.dk
www.haucon.dk

Innovative Building Solutions

801483/10.2014/DK/140676