HALFEN HSD SHEAR DOWEL SYSTEM

TECHNICAL PRODUCT INFORMATION

HALFEN HSD SHEAR DOWEL SYSTEM

CONCRETE

HSD 08-E

Acc. to DIN 1045-1

Officially approved
Z-15.7-253

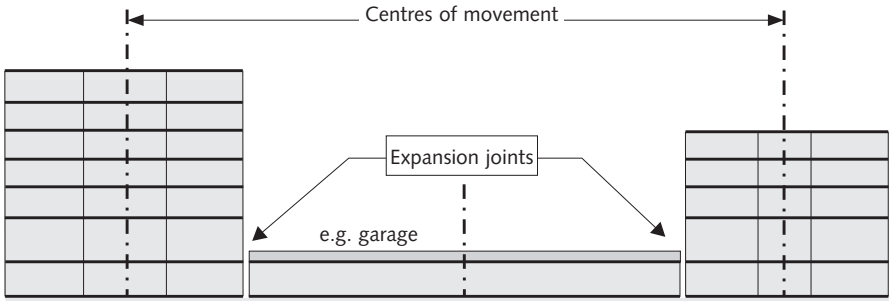
HALFEN

YOUR BEST CONNECTIONS

Expansion joints to prevent constraint stresses

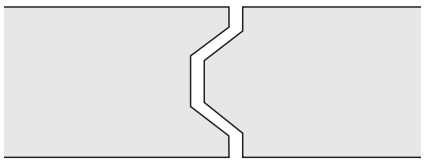
The effects of
- Shrinkage
- Temperature
- Creep
- Subsidence

require constructive measures in large supporting frameworks.
Movement joints prevent the uncontrolled formation of cracks and the subsequent damage that arises from this as a result of leakage and corrosion.



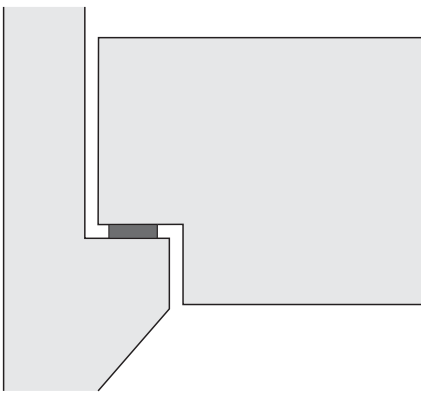
Problems with conventional solutions

Example 1, floor or ceiling slabs:



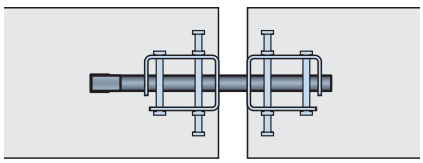
Conventional shear keying of a floor slab: Expensive and probe to damage.

Example 2, beam connection:

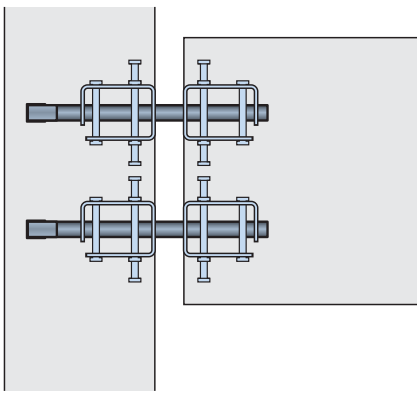


Disadvantageous: Movable support on the console; higher formwork and reinforcement outlay, poor use of the space in the area of the thrust bearing.

The solution: The HALFEN HSD Shear dowel system



Economically and technically flawless: Implementation using HALFEN shear dowel



Movable support with the HALFEN heavy-duty shear dowel; support consoles are unnecessary. Valuable gain of space! Planning outlay is reduced!

Advantages of the HALFEN shear dowel system:

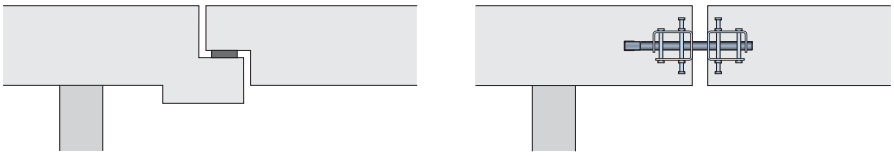
- Simple geometry of the formation of the joint.
- Simple formwork and installation time saving.
- Simple guidance of the reinforcement.
- Gain in space through avoidance of double supports (see page 3).
- Cost saving and gain in space through staged erection of the construction elements (see page 3).
- Approved by the German Construction Supervisory Board DIBt, Approval No. Z-15.7-253.
- User-friendly HSD Dimensioning Software available in the Internet (→ www.halfen.com → Software/CAD).
- Fire-resistance classification F120 designable with fire protection pads (see page 5).

Application

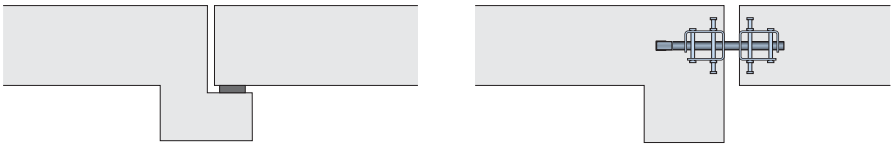
Conventional joint design	Joints with HALFEN shear dowel

a) Application area for HALFEN CRET heavy-duty shear dowels → see pages 6 - 13.

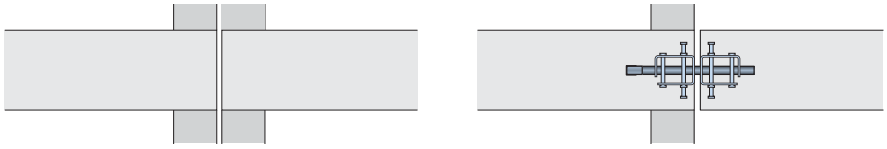
Flat slab (vertical section)



Slab connection with console (vertical section)

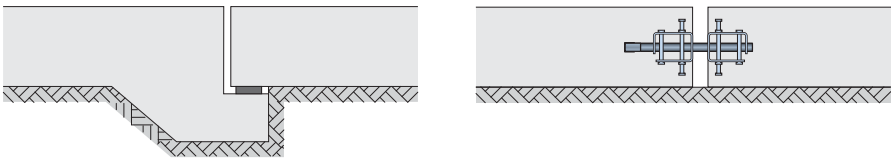


Double column replaced by a single column (vertical section)

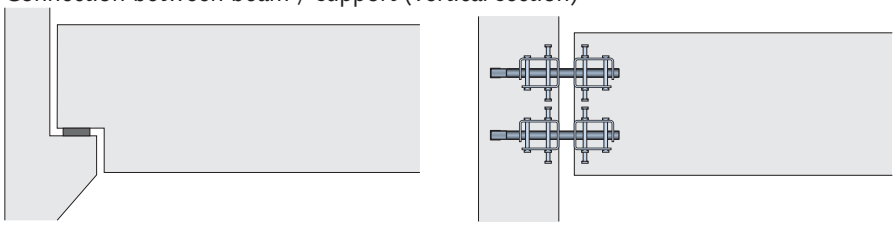


Connection of a supporting wall (horizontal section)

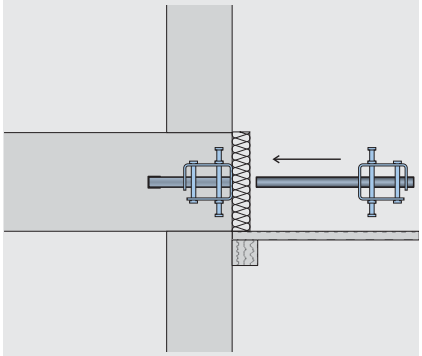
Expansion joint in floor slab (vertical section)



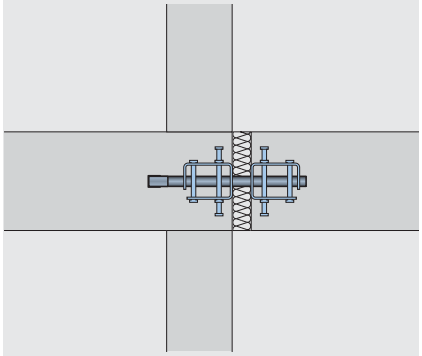
Connection between beam / support (vertical section)



Construction phases:



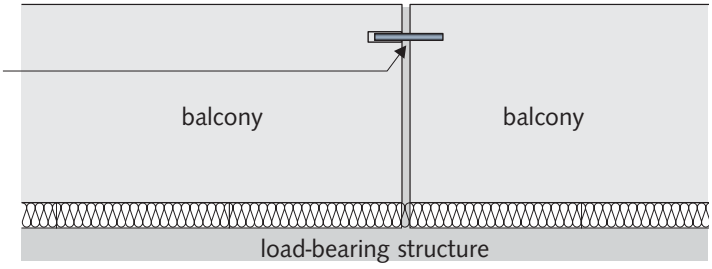
Following the first concrete work section, the formwork is set and the HSD-CRET dowel element is positioned.



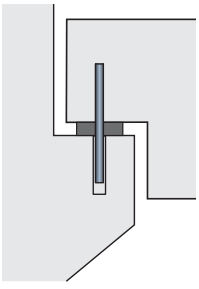
Final state of construction element using the HALFEN HSD shear dowel.

b) Application area for HALFEN single shear dowels → see pages 14 - 18

Expansion joint with HALFEN single shear dowel between 2 freely projecting balcony slabs (top view)



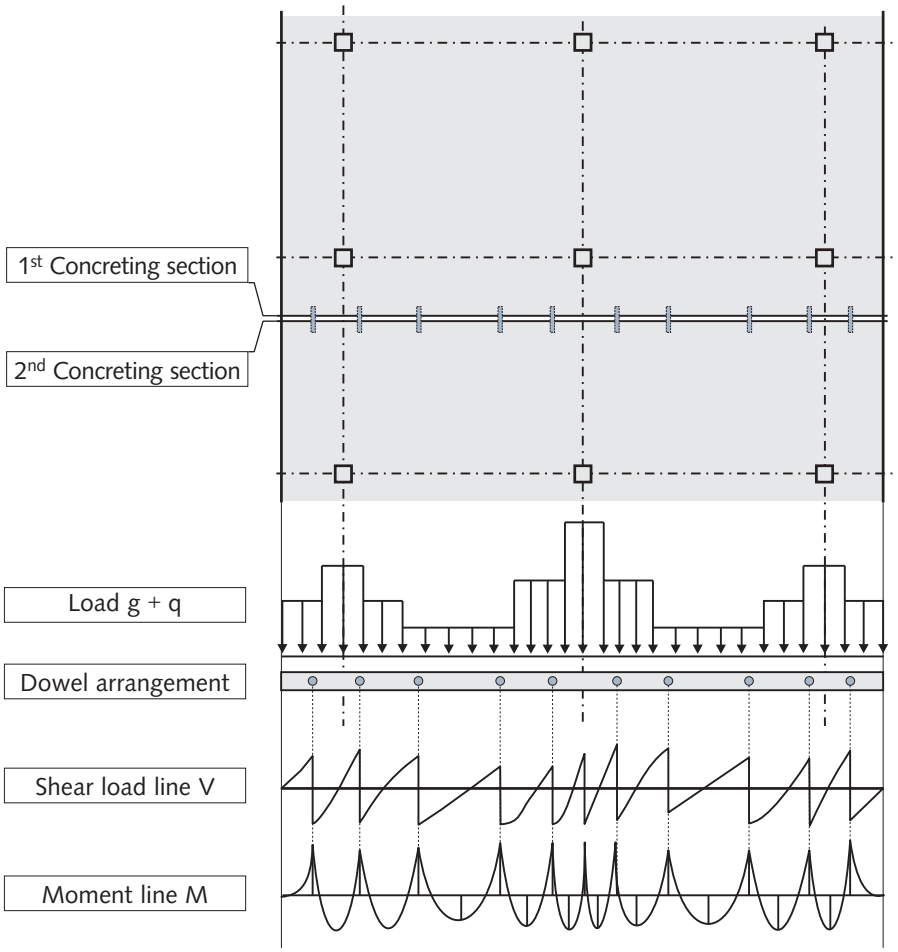
Dowelling at the support of a pre-cast reinforced concrete beam on a console.



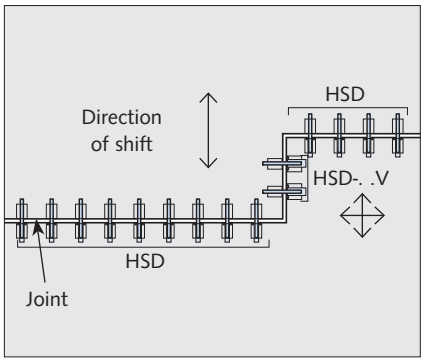
Expansion joints to prevent constraint stresses

For flat slabs, it is advisable to arrange the dowels at different spacings according to the different shear load concentrations. The value and the distribution of the shear load to be transmitted can be determined by an finite elements slab calculation.
The static model of a continuous beam is suitable for the dimensioning of the edge of the slab. Shear and bending moments will be used for the dimensioning of the reinforcement across and along the edge. It must thereby be noted that, as a result of the proof of the punching shear load capacity, transverse and longitudinal reinforcement is also required in the load introduction area of the dowel, which could be decisive against those from the continuous beam calculation. With large dowel spacings, the continuous beam calculation is normally the decisive value for the longitudinal reinforcement.

Dimensioning of the joint width f
f = calculated joint width + safety supplement (approx. 1cm)



Arrangement of the shear dowel - Examples

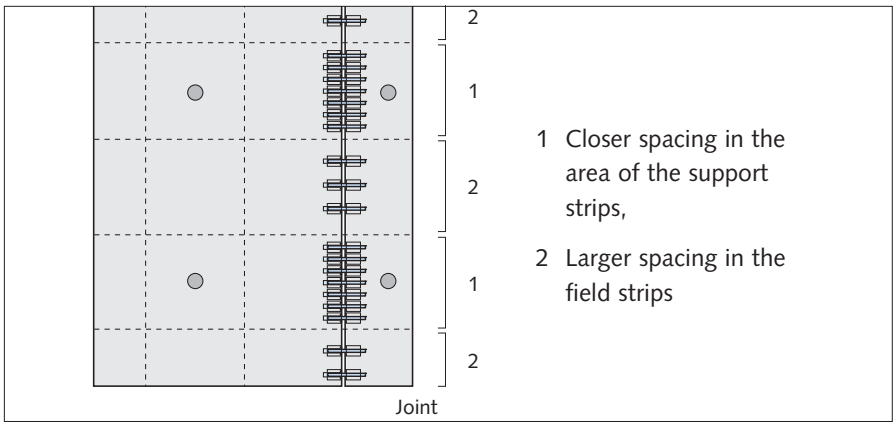


Angled joint run

Shifting direction of the shear dowels:

HSD ↕ = longitudinal movement

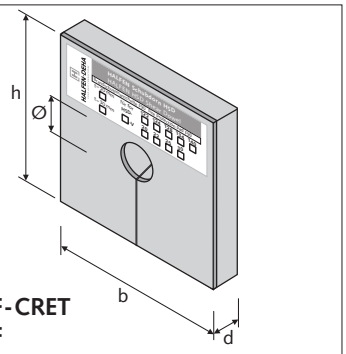
HSD-. .V ✥ = longitudinal and transverse movement



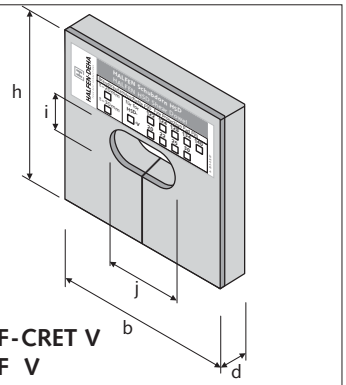
Flat slab joint; dowel arrangement corresponding to the support model for the slab

HSD-F fire protection pad

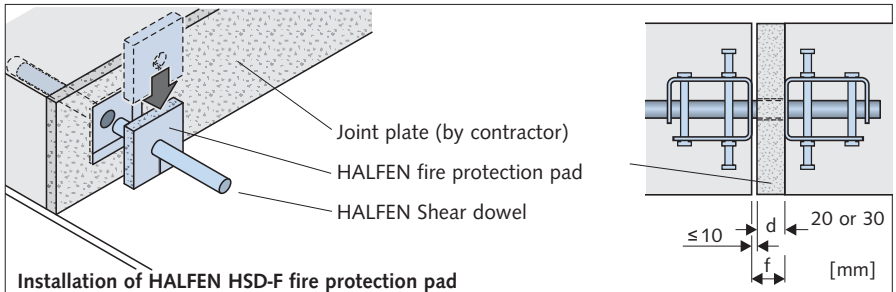
If fire-protection is required for components according to DIN 4102 T.2, we recommend to install the HALFEN HSD shear dowels with fire protection pads.
The fire protection pad can be supplied 20 mm (d = 20) and 30 mm (d = 30) thick. For larger joint widths, a combination of fire protection pads is possible.
The Fire-resistance classification F120 (longitudinal movement) or F90 (longitudinal and transverse movement) is confirmed by the MFPA Leipzig.



HSD-F-CRET
HSD-F
for shear dowels HSD,longitudinal movement



HSD-F-CRET V
HSD-F V
for shear dowels HSD, longitudinal and transverse movement



Installation of HALFEN HSD-F fire protection pad
Note: The HSD-F fire protection pad consists of a material that will produce foam in case of a fire and will tightly seal the joint.

Ordering example:

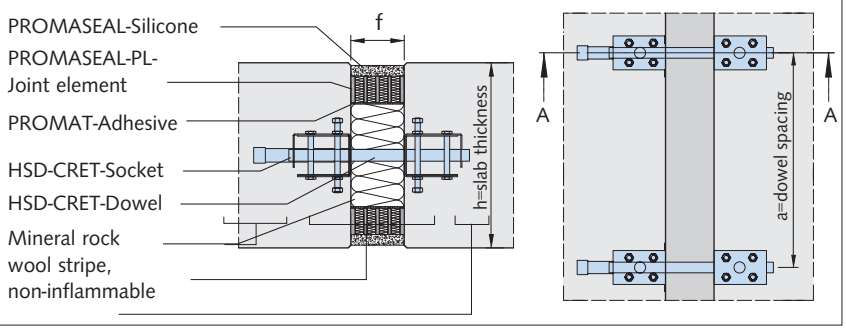
HSD-F - CRET 124 V - 30

Fire protection pad
Matching dowel type
Thickness d [mm]

Fire protection pad selection

matching the HALFEN HSD shear dowel -	Item name d = 20 ⇒ f ≤ 30 d = 30 ⇒ f ≤ 40	h / b	Ø or i	j
Heavy-duty dowel, longitudinal movement				
CRET 122	**HSD-F-CRET 122 -**d	120 / 120	23	
CRET 124	**HSD-F-CRET 124 -**d	130 / 130	25	
CRET 128	**HSD-F-CRET 128 -**d	140 / 140	29	
CRET 134	**HSD-F-CRET 134 -**d	160 / 180	35	
CRET 140	**HSD-F-CRET 140 -**d	180 / 220	41	
Single dowel, longitudinal movement				
Set 20	**HSD-F 20 -**d	110 / 110	21	
Set 22	**HSD-F 22 -**d	110 / 110	23	
Set 25	**HSD-F 25 -**d	110 / 110	26	
Set 30	**HSD-F 30 -**d	110 / 110	31	
Heavy-duty dowel, longitudinal and transverse movement				
CRET-122 V	**HSD-F-CRET 122 V -**d	120 / 120	23	46
CRET-124 V	**HSD-F-CRET 124 V -**d	130 / 130	25	50
CRET-128 V	**HSD-F-CRET 128 V -**d	140 / 140	29	58
CRET-134 V	**HSD-F-CRET 134 V -**d	160 / 180	35	70
CRET-140 V	**HSD-F-CRET 140 V -**d	180 / 220	41	82
Single dowel, longitudinal and transverse movement				
Set 20 V	**HSD-F 20 V -**d	110 / 160	21	42
Set 22 V	**HSD-F 22 V -**d	110 / 160	23	46
Set 25 V	**HSD-F 25 V -**d	110 / 160	26	52
Set 30 V	**HSD-F 30 V -**d	110 / 160	31	62

For requirements -enclosure of space- according DIN EN 1366-4 in combination with DIN EN 1363-1, we recommend to use the joint element **PROMASEAL-PL** (see fig.).
For the combination of HALFEN shear dowel with PROMASEAL-PL the enclosing design function and the fire-resistance classification F90 is confirmed by the MFPA Leipzig.

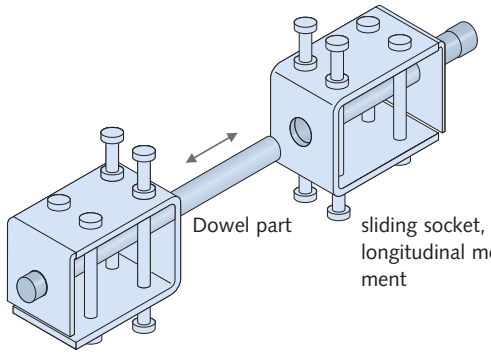


HALFEN HSD SHEAR DOWEL SYSTEM

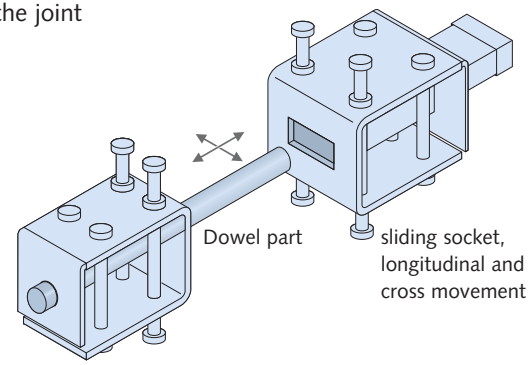
Heavy-duty shear dowels

Product description

HSD-CRET heavy-duty shear dowel
consisting of dowel part and sliding socket,
single-axis movement - along the dowel axis



HSD-CRET V heavy-duty shear dowel
consisting of dowel part and sliding socket,
two-axis movement – along the dowel axis and parallel to the joint



HALFEN HSD-CRET heavy-duty shear dowels allow a sliding movement in the direction of the dowel axis. The dowels are normally used to transfer shear loads in any direction. A high load capacity is effectuated by the load distribution body.
If lateral movements must be considered, the HALFEN HSD-CRET V heavy-duty shear dowel is used, which allows also lateral movement. In this case, the shear load will only be transferred in one direction.

Technical data

Dowel diameter and minimum component thickness

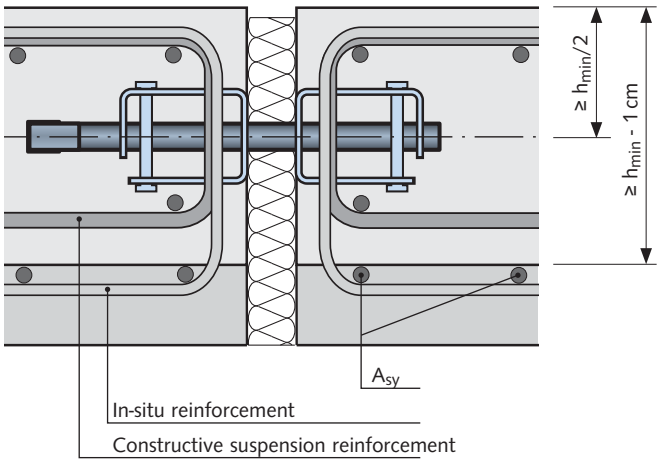
HSD-	HSD-	Dowel diameter [mm]	Minimum component thickness h_{min} [cm]
CRET 122	**CRET 122 V**	22	18
CRET 124	**CRET 124 V**	24	20
CRET 128	**CRET 128 V**	28	24
CRET 134	**CRET 134 V**	34	30
CRET 140	**CRET 140 V**	40	35

Materials

- Dowel: stainless steel S 690 (grade 1.4462)
- Load distribution body and sliding socket: Stainless steel S 275 (grade 1.4404)
- Fixing rod: Stainless steel, strength class 70 (grade 1.4401)

All materials correspond to at least the corrosion-resistance class III.

Installation in semi-prefabricated slabs

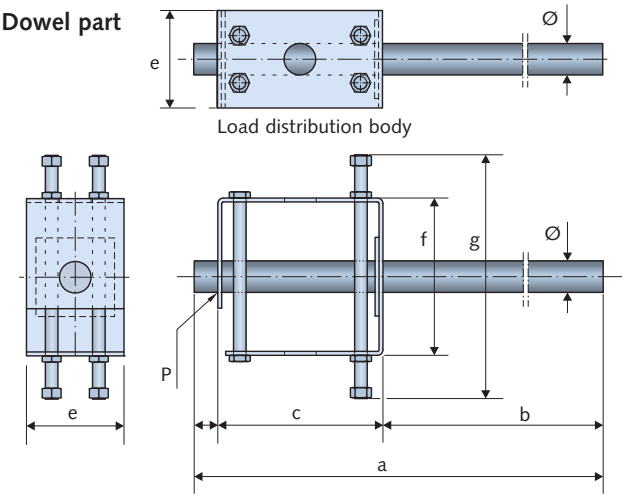


Recommendation:

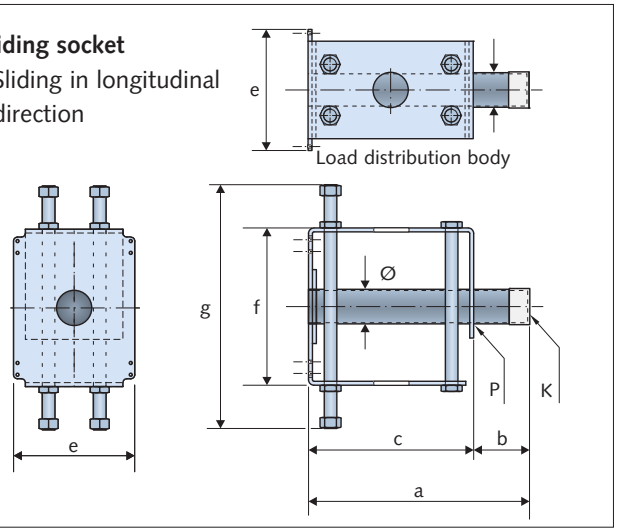
- Insertion of constructive suspension reinforcement in the semi-prefabricated slab (dimensioning for VRd/3).
- Thickness of the in-situ cast concrete = hmin – 1 cm.
- Dimension between the shear dowel axis and upper edge of the in-situ cast concrete = hmin/2.
- With a sufficient thickness of the in-situ cast concrete, the reinforcement Asy can also be placed outside the semi-prefabricated slab.
- In-situ reinforcement (Asx and Asy top) is to be arranged according to the tables on pages 11 and 12 and/or the approval.

Type selection

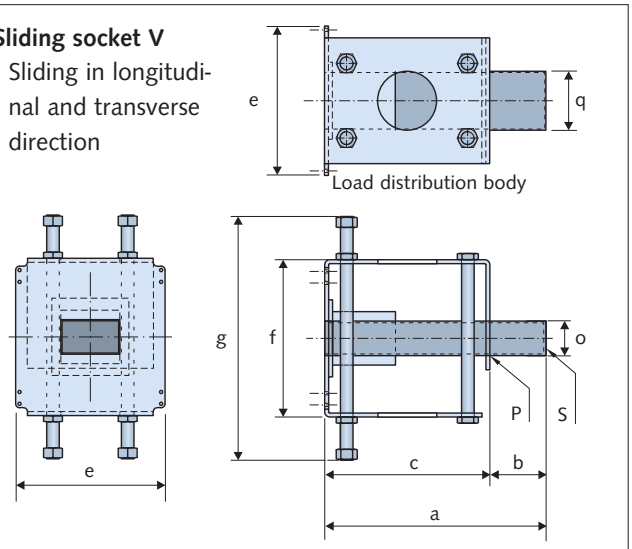
Dowel part



Sliding socket
- Sliding in longitudinal direction



Sliding socket V
- Sliding in longitudinal and transverse direction



Ordering example:

HALFEN heavy-duty shear dowel — **HSD-CRET 124 V**
Load range
V = Transverse and longitudinal movement

P = Spot welding
K = PE pipe protection cap
S = Sheet metal cover

Dimensions [mm]

	HSD-CRET 122 HSD-CRET 122 V			HSD-CRET 124 HSD-CRET 124 V			HSD-CRET 128 HSD-CRET 128 V			HSD-CRET 134 HSD-CRET 134 V			HSD-CRET 140 HSD-CRET 140 V		
	Dowel part	Socket	Socket V	Dowel part	Socket	Socket V	Dowel part	Socket	Socket V	Dowel part	Socket	Socket V	Dowel part	Socket	Socket V
a	302	180	181,5	341	192	193,5	388	215	217	450	246	248	520	280	281,5
b	180	72	73,5	192	59	60,5	215	60	62	246	66	68	280	70	71,5
c	108	108	108	133	133	133	155	155	155	180	180	180	210	210	210
d	14	–	–	16	–	–	18	–	–	24	–	–	30	–	–
e	70	100	125	76	106	133	88	118	146	106	136	168	124	154	190
f	80	80	80	90	90	90	110	110	110	160	160	160	200	200	200
g	140	140	140	160	160	160	200	200	200	260	260	260	310	310	310
Ø	22	25,4	–	24	28	–	28	32	–	34	38	–	40	44	–
o	–	–	26	–	–	28	–	–	32	–	–	38	–	–	44
q	–	–	50	–	–	55	–	–	60	–	–	70	–	–	75

Dimensioning

$V_{Rd} = \min (V_{Rd,s(Dorn)}; V_{Rd,c}; V_{Rd,ct})$

$V_{Rd,s}$ Design value of the resistance of the steel load-bearing capacity
$V_{Rd,c}$ Design value of the resistance against concrete edge failure
$V_{Rd,ct}$ Design value of the resistance against punching failure

A dowel can be selected from these tables, no further proofs are required.

The values quoted for the maximum dimensioning resistance V_{Rd} only apply for an arrangement of the junction reinforcement according to the tables on page 11.

Relevant dimensioning resistances V_{Rd} [kN] HSD-CRET shear dowels with longitudinal movement ①

Shear dowel	Component thickness [mm]	C20/25 Joint width [mm]					C30/37 Joint width [mm]					C40/50 Joint width [mm]				
		20	30	40	50	60	20	30	40	50	60	20	30	40	50	60
HSD-CRET 122	180	45.0	45.0	45.0	40.1	33.4	55.8	55.8	50.1	40.1	33.4	65.1	65.1	50.1	40.1	33.4
	200	61.9	61.9	50.1	40.1	33.4	76.8	66.4	50.1	40.1	33.4	85.6	66.4	50.1	40.1	33.4
	220	79.2	66.4	50.1	40.1	33.4	85.6	66.4	50.1	40.1	33.4	85.6	66.4	50.1	40.1	33.4
	240	85.6	66.4	50.1	40.1	33.4	85.6	66.4	50.1	40.1	33.4	85.6	66.4	50.1	40.1	33.4
	250	85.6	66.4	50.1	40.1	33.4	85.6	66.4	50.1	40.1	33.4	85.6	66.4	50.1	40.1	33.4
HSD-CRET 124	200	62.0	62.0	62.0	52.0	43.4	77.0	77.0	65.0	52.0	43.4	89.7	84.8	65.0	52.0	43.4
	220	79.4	79.4	65.0	52.0	43.4	98.2	84.8	65.0	52.0	43.4	105.7	84.8	65.0	52.0	43.4
	240	95.4	84.8	65.0	52.0	43.4	105.7	84.8	65.0	52.0	43.4	105.7	84.8	65.0	52.0	43.4
	250	99.1	84.8	65.0	52.0	43.4	105.7	84.8	65.0	52.0	43.4	105.7	84.8	65.0	52.0	43.4
	260	105.7	84.8	65.0	52.0	43.4	105.7	84.8	65.0	52.0	43.4	105.7	84.8	65.0	52.0	43.4
	280	105.7	84.8	65.0	52.0	43.4	105.7	84.8	65.0	52.0	43.4	105.7	84.8	65.0	52.0	43.4
HSD-CRET 128	240	98.8	98.8	98.8	82.6	68.8	123.1	123.1	103.2	82.6	68.8	144.0	127.6	103.2	82.6	68.8
	250	120.8	120.8	103.2	82.6	68.8	149.9	127.6	103.2	82.6	68.8	151.9	127.6	103.2	82.6	68.8
	260	125.0	125.0	103.2	82.6	68.8	151.9	127.6	103.2	82.6	68.8	151.9	127.6	103.2	82.6	68.8
	280	133.4	127.6	103.2	82.6	68.8	151.9	127.6	103.2	82.6	68.8	151.9	127.6	103.2	82.6	68.8
	300	144.0	127.6	103.2	82.6	68.8	151.9	127.6	103.2	82.6	68.8	151.9	127.6	103.2	82.6	68.8
	320	145.3	127.6	103.2	82.6	68.8	151.9	127.6	103.2	82.6	68.8	151.9	127.6	103.2	82.6	68.8
	340	151.9	127.6	103.2	82.6	68.8	151.9	127.6	103.2	82.6	68.8	151.9	127.6	103.2	82.6	68.8
HSD-CRET 134	300	184.5	184.5	177.5	147.9	123.3	226.8	207.1	177.5	147.9	123.3	236.7	207.1	177.5	147.9	123.3
	320	187.3	187.3	177.5	147.9	123.3	234.5	207.1	177.5	147.9	123.3	236.7	207.1	177.5	147.9	123.3
	340	198.3	198.3	177.5	147.9	123.3	236.7	207.1	177.5	147.9	123.3	236.7	207.1	177.5	147.9	123.3
	350	203.8	203.8	177.5	147.9	123.3	236.7	207.1	177.5	147.9	123.3	236.7	207.1	177.5	147.9	123.3
	360	209.2	207.1	177.5	147.9	123.3	236.7	207.1	177.5	147.9	123.3	236.7	207.1	177.5	147.9	123.3
HSD-CRET 140	350	214.6	214.6	214.6	214.6	200.7	270.3	270.3	270.3	235.5	200.7	309.4	305.1	270.3	235.5	200.7
	360	220.1	220.1	220.1	220.1	200.7	277.3	277.3	270.3	235.5	200.7	326.9	305.1	270.3	235.5	200.7
	380	230.8	230.8	230.8	230.8	200.7	291.4	291.4	270.3	235.5	200.7	339.9	305.1	270.3	235.5	200.7
	400	241.5	241.5	241.5	235.5	200.7	305.2	305.1	270.3	235.5	200.7	339.9	305.1	270.3	235.5	200.7
	450	267.6	267.6	267.6	235.5	200.7	339.2	305.1	270.3	235.5	200.7	339.9	305.1	270.3	235.5	200.7
HSD-CRET 140 ②	350	259.2	259.2	259.2	235.5	200.7	321.9	305.1	270.3	235.5	200.7	339.9	305.1	270.3	235.5	200.7
	360	266.2	266.2	266.2	235.5	200.7	331.7	305.1	270.3	235.5	200.7	339.9	305.1	270.3	235.5	200.7
	380	280.2	280.2	270.3	235.5	200.7	339.9	305.1	270.3	235.5	200.7	339.9	305.1	270.3	235.5	200.7
	400	293.9	293.9	270.3	235.5	200.7	339.9	305.1	270.3	235.5	200.7	339.9	305.1	270.3	235.5	200.7
	450	327.4	305.1	270.3	235.5	200.7	339.9	305.1	270.3	235.5	200.7	339.9	305.1	270.3	235.5	200.7
		339.9	305.1	270.3	235.5	200.7	339.9	305.1	270.3	235.5	200.7	339.9	305.1	270.3	235.5	200.7

① Load-bearing capacities for concrete strengths C25/30 and C35/40 can be interpolated. ② Values apply for increased reinforcement according to the table on page 11

= steel load-bearing capacity decisive
= Concrete edge failure decisive
= Punching failure decisive

Dimensioning

The values quoted for maximum design resistance V_{Rd} only apply for an arrangement of the junction reinforcement according to the tables on page 12.

Relevant design resistances V_{Rd} [kN] HSD-CRET V shear dowels with longitudinal and transverse movement ①

Shear dowel	Component thickness [mm]	C20/25 Joint width [mm]					C30/37 Joint width [mm]					C40/50 Joint width [mm]				
		20	30	40	50	60	20	30	40	50	60	20	30	40	50	60
HSD-CRET 122 V	180	37.6	37.6	37.6	36.1	30.1	46.5	46.5	45.1	36.1	30.1	54.1	54.1	45.1	36.1	30.1
	200	50.5	50.5	45.1	36.1	30.1	62.4	59.8	45.1	36.1	30.1	72.5	59.8	45.1	36.1	30.1
	220	65.3	59.8	45.1	36.1	30.1	77.0	59.8	45.1	36.1	30.1	77.0	59.8	45.1	36.1	30.1
	240	70.5	59.8	45.1	36.1	30.1	77.0	59.8	45.1	36.1	30.1	77.0	59.8	45.1	36.1	30.1
	250	73.0	59.8	45.1	36.1	30.1	77.0	59.8	45.1	36.1	30.1	77.0	59.8	45.1	36.1	30.1
HSD-CRET 124 V	200	52.4	52.4	52.4	46.8	39.0	64.8	64.8	58.5	46.8	39.0	75.4	75.4	58.5	46.8	39.0
	220	65.4	65.4	58.5	46.8	39.0	80.7	76.3	58.5	46.8	39.0	93.7	76.3	58.5	46.8	39.0
	240	70.6	70.6	58.5	46.8	39.0	87.4	76.3	58.5	46.8	39.0	95.1	76.3	58.5	46.8	39.0
	250	84.3	76.3	58.5	46.8	39.0	95.1	76.3	58.5	46.8	39.0	95.1	76.3	58.5	46.8	39.0
	260	87.6	76.3	58.5	46.8	39.0	95.1	76.3	58.5	46.8	39.0	95.1	76.3	58.5	46.8	39.0
	280	95.1	76.3	58.5	46.8	39.0	95.1	76.3	58.5	46.8	39.0	95.1	76.3	58.5	46.8	39.0
HSD-CRET 128 V	240	81.5	81.5	81.5	74.4	62.0	101.3	101.3	92.9	74.4	62.0	118.2	114.8	92.9	74.4	62.0
	250	84.9	84.9	84.9	74.4	62.0	105.7	105.7	92.9	74.4	62.0	123.5	114.8	92.9	74.4	62.0
	260	88.3	88.3	88.3	74.4	62.0	110.0	110.0	92.9	74.4	62.0	128.7	114.8	92.9	74.4	62.0
	280	111.6	111.6	92.9	74.4	62.0	136.8	114.8	92.9	74.4	62.0	136.8	114.8	92.9	74.4	62.0
	300	119.2	114.8	92.9	74.4	62.0	136.8	114.8	92.9	74.4	62.0	136.8	114.8	92.9	74.4	62.0
	320	121.5	114.8	92.9	74.4	62.0	136.8	114.8	92.9	74.4	62.0	136.8	114.8	92.9	74.4	62.0
	340	128.8	114.8	92.9	74.4	62.0	136.8	114.8	92.9	74.4	62.0	136.8	114.8	92.9	74.4	62.0
HSD-CRET 134 V	300	155.1	155.1	155.1	133.1	110.9	193.7	186.4	159.8	133.1	110.9	213.1	186.4	159.8	133.1	110.9
	320	157.7	157.7	157.7	133.1	110.9	197.1	186.4	159.8	133.1	110.9	213.1	186.4	159.8	133.1	110.9
	340	167.8	167.8	159.8	133.1	110.9	210.2	186.4	159.8	133.1	110.9	213.1	186.4	159.8	133.1	110.9
	350	172.8	172.8	159.8	133.1	110.9	213.1	186.4	159.8	133.1	110.9	213.1	186.4	159.8	133.1	110.9
	360	177.7	177.7	159.8	133.1	110.9	213.1	186.4	159.8	133.1	110.9	213.1	186.4	159.8	133.1	110.9
HSD-CRET 140 V	350	182.5	182.5	182.5	182.5	180.7	229.6	229.6	229.6	211.9	180.7	270.3	270.3	243.3	211.9	180.7
	360	187.5	187.5	187.5	187.5	180.7	236.0	236.0	236.0	211.9	180.7	278.0	274.6	243.3	211.9	180.7
	380	197.4	197.4	197.4	197.4	180.7	248.8	248.8	243.3	211.9	180.7	293.4	274.6	243.3	211.9	180.7
	400	207.1	207.1	207.1	207.1	180.7	261.4	261.4	243.3	211.9	180.7	305.9	274.6	243.3	211.9	180.7
	450	230.8	230.8	230.8	211.9	180.7	292.3	274.6	243.3	211.9	180.7	305.9	274.6	243.3	211.9	180.7
HSD-CRET 140 V ②	380	233.9	233.9	233.9	211.9	180.7	291.2	274.6	243.3	211.9	180.7	305.9	274.6	243.3	211.9	180.7
	400	246.5	246.5	243.3	211.9	180.7	305.9	274.6	243.3	211.9	180.7	305.9	274.6	243.3	211.9	180.7
	450	277.1	274.6	243.3	211.9	180.7	305.9	274.6	243.3	211.9	180.7	305.9	274.6	243.3	211.9	180.7
		305.9	274.6	243.3	211.9	180.7	305.9	274.6	243.3	211.9	180.7	305.9	274.6	243.3	211.9	180.7

① Load-bearing capacities for concrete strengths C25/30 and C35/40 can be interpolated. ② Values apply for increased reinforcement according to the table on page 12

= steel load-bearing capacity decisive
= Concrete edge failure decisive
= Punching failure decisive

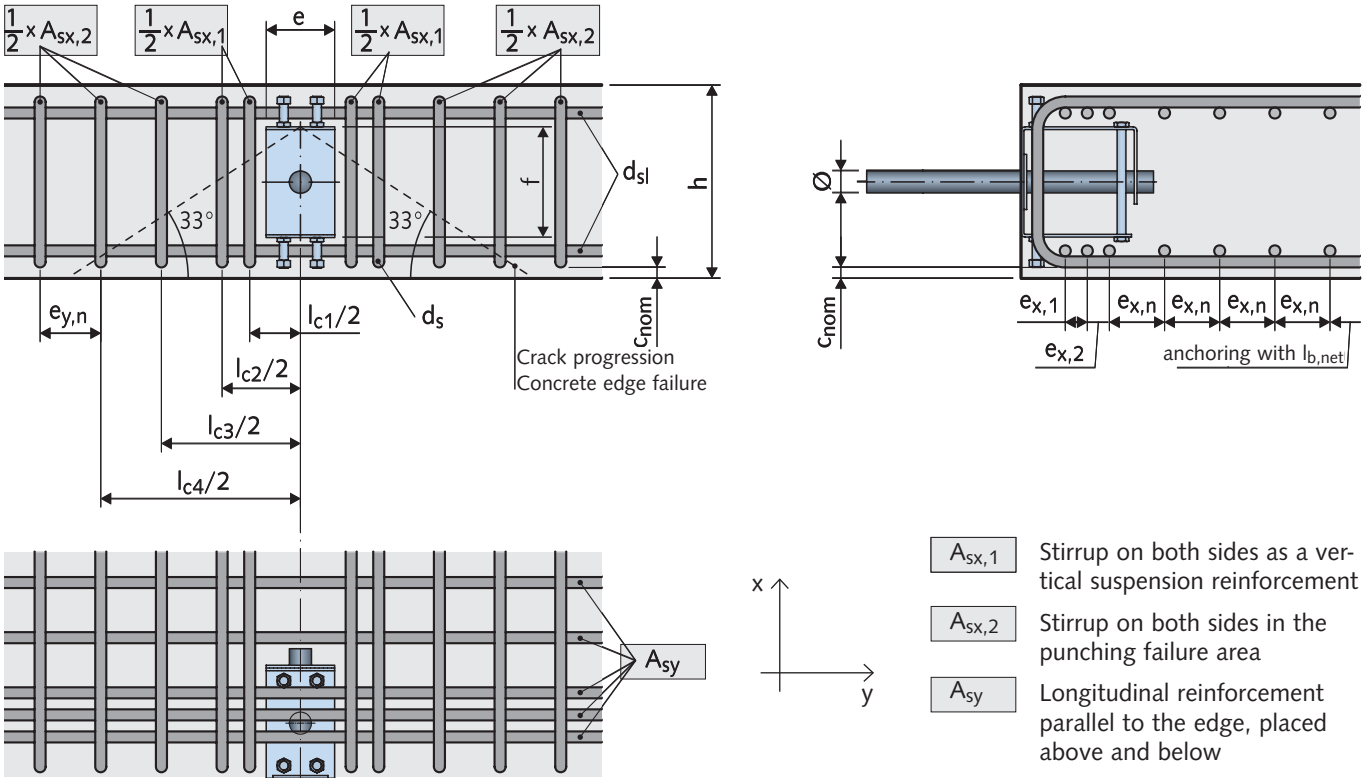
A separate proof of the load-bearing capacity of the concrete (punching shear failure and concrete edge failure) is to be carried out:

- in case of deviating reinforcement in the punching cone
- If the dowel spacings are below the critical minimum limit
- when using for larger slab thicknesses

Dimensioning of the joint width f

f = calculated joint width + safety supplement (approx. 1cm)

In-situ reinforcement



$A_{sx,1}$	Stirrup on both sides as a vertical suspension reinforcement
$A_{sx,2}$	Stirrup on both sides in the punching failure area
A_{sy}	Longitudinal reinforcement parallel to the edge, placed above and below

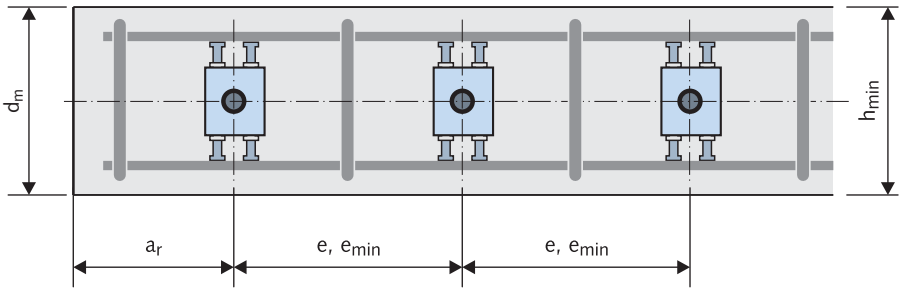
Installation dimensions

Minimum spacings

HSD-CRET-	HSD-CRET-	Dowel diameter [mm]	Minimum component thickness h_{min} [cm]	Critical dowel spacing ① $e = 3 \times d_m + l_{c1}$ [cm]	Minimum dowel spacing $e_{min} = 1{,}5 \times h_{min}$ [cm]	Minimum edge distance $a_r = 0{,}75 \times h_{min}$ [cm]
122	122 V	22	18	54	27	14
124	124 V	24	20	60	30	15
128	128 V	28	24	73	36	18
134	134 V	34	30	91	45	23
140	140 V	40	35	108	53	26

In order to obtain a linear support, it is recommended that the centre spacing of the dowels should not be above the limit of 5 × h.

① If the dowel spacings are below the applicable table value for the critical dowel spacing, a separate punching load proof according to DIN 1045-1 is to be carried out.



e = centre spacing between the dowels

e_{min} = minimum dowel spacing

a_r = minimum edge spacing

d_m = average static height

In-situ reinforcement

Heavy-duty shear dowels HSD-CRET longitudinal movement

Type	Component thickness [mm]	c_{nom} [mm]	Reinforcement spacings [mm]								In-situ reinforcement		
			$l_{c1}/2$	$l_{c2}/2$	$l_{c3}/2$	$l_{c4}/2$	$e_{y,n}$	$e_{x,1}$	$e_{x,2}$	$e_{x,n}$	$A_{sx,1}$	$A_{sx,2}$	A_{sy} ③
HSD-CRET 122	180	25	55	87	137	187	–	50	–	–	4 Ø 12	4 Ø 12	2 Ø 12
	200			89	139	189					4 Ø 14	4 Ø 14	2 Ø 14
	220	30		91	141	191	150				4 Ø 16	4 Ø 16	2 Ø 16
	240	25		89	139	189	150		50		6 Ø 14	4 Ø 14	3 Ø 14
	250												
HSD-CRET 124	200	25	60	94	144	194	–	50	–	–	4 Ø 14	4 Ø 14	2 Ø 14
	220	30		96	146	196					4 Ø 16	4 Ø 16	2 Ø 16
	240	25		94	144	194	150		100		6 Ø 14	4 Ø 14	3 Ø 14
	250												
	260	30		96	146	196				150	6 Ø 16	4 Ø 16	3 Ø 16
	280												
HSD-CRET 128	240	25	65	99	149	199	70	50	100	–	6 Ø 14	6 Ø 14	3 Ø 14
	250	30		101	151	201				120	6 Ø 16	6 Ø 16	4 Ø 16
	260									150			
	280											8 Ø 16	
	300	25		99	149	199			50	100	8 Ø 14	6 Ø 14	5 Ø 14
	320	25		115	165	215				150			
	340	30									8 Ø 16	8 Ø 16	5 Ø 16
HSD-CRET 134	300	30	75	111	161	211	50	50	50	70	8 Ø 16	8 Ø 16	6 Ø 16
	320			125	175	225	70					6 Ø 16	7 Ø 16
	340												
	350											8 Ø 16	
	360												8 Ø 16
HSD-CRET 140	350	30	85	135	185	235	70	50	50	70	8 Ø 16	8 Ø 16	7 Ø 16
	360												8 Ø 16
	380											10 Ø 16	
	400												
	450											12 Ø 16	9 Ø 16
HSD-CRET 140 ②	350	30	85	135	185	235	70	50	50	70	8 Ø 20	8 Ø 20	7 Ø 20
	360												
	380												8 Ø 20
	400											10 Ø 20	
	450											12 Ø 20	9 Ø 20
		35	90	140	190	240					8 Ø 25	12 Ø 25	9 Ø 25

② Increased reinforcement for higher load-bearing capacity according to table on page 8

③ In-situ reinforcement A_{sy} placed above and below

Heavy-duty shear dowels

In-situ reinforcement

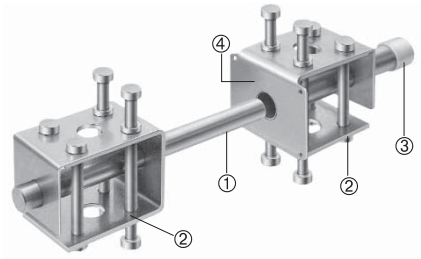
Heavy-duty shear dowels HSD-CRET V longitudinal and transverse movement

Type	Component thickness [mm]	c_{nom} [mm]	Reinforcement spacings [mm]								In-situ reinforcement		
			$l_{c1}/2$	$l_{c2}/2$	$l_{c3}/2$	$l_{c4}/2$	$e_{y,n}$	$e_{x,1}$	$e_{x,2}$	$e_{x,n}$	$A_{sx,1}$	$A_{sx,2}$	A_{sy} ③
HSD-CRET 122 V	180	25	65	97	147	197	–	–	–	–	4 Ø 12	4 Ø 12	1 Ø 12
	200		70	104	154	204					4 Ø 14	4 Ø 14	1 Ø 14
	220	30		106	156	206	150				4 Ø 16	4 Ø 16	1 Ø 16
	240											6 Ø 14	
	250												
HSD-CRET 124 V	200	25	70	104	154	204	–	–	–	–	4 Ø 14	4 Ø 14	1 Ø 14
	220	30	75	111	161	211					4 Ø 16	4 Ø 16	1 Ø 16
	240											6 Ø 16	
	250	25	70	104	154	204	150	50			6 Ø 14	4 Ø 14	2 Ø 14
	260												
	280	30	75	111	161	211					6 Ø 16	4 Ø 16	2 Ø 16
HSD-CRET 128 V	240	25	80	114	164	214	70	50	–	–	6 Ø 14	6 Ø 14	2 Ø 14
	250												
	260												
	280	30		116	166	216	100				6 Ø 16	6 Ø 16	2 Ø 16
	300												
	320			130	180	230							
	340												
HSD-CRET 134 V	300	30	90	126	176	226	70	50	50	120	8 Ø 16	6 Ø 16	5 Ø 16
	320			140	190	240						8 Ø 16	
	340												
	350												
	360												
HSD-CRET 140 V	350	30	100	150	200	250	70	50	50	100	8 Ø 16	8 Ø 16	6 Ø 16
	360												
	380											10 Ø 16	
	400												7 Ø 16
	450											12 Ø 16	
HSD-CRET 140 V ②	380	30	105	155	205	255	70	50	50	100	8 Ø 20	8 Ø 20	6 Ø 20
	400											10 Ø 20	7 Ø 20
	450											12 Ø 20	
		35			190	240					8 Ø 25	12 Ø 25	7 Ø 25

② Increased reinforcement for higher load-bearing capacity according to the table on page 9

③ In-situ reinforcement A_{sy} placed above and below

Assembly instructions for HALFEN HSD-CRET heavy-duty shear dowels



① Dowel
② Load distribution body
③ Sliding socket
④ Nail plate for the fixation of the socket to the formwork


HSD-CRET sliding sockets nailed onto the formwork

First concreting section

The sliding sockets are fixed to the formwork by nailing (Illustrations 1 and 2); in doing this, it must be ensured that the sockets are exactly aligned in the sliding direction.
The label applied over the opening in the socket protects the socket against the entry of concrete, and must therefore not be removed.
The in-situ junction and suspension reinforcement is to be installed according to the information from the static calculations and the reinforcement plan.

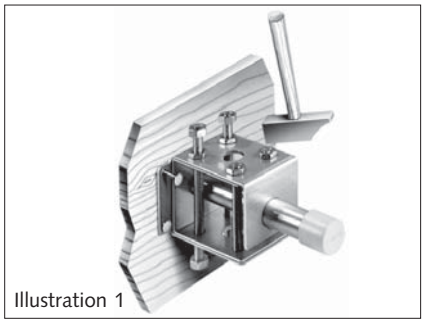


Illustration 1

Second concreting section

After removing the formwork from the first concreting section, the filling material is placed into the joint (Illustration 3). The joint width specified in the plan must be complied with exactly.
A recess in the filling material has to be provided so that the dowels can be inserted into the sockets. The required joint reinforcement is to be installed according to the data from the static plan and the reinforcement plans. The use of the shear dowels without additional measures for environmental conditions according to DIN 1045–1 is permissible.
In the case of environmental conditions with higher requirements on corrosion protection, the dowels and the sliding sockets are to be well coated with a corrosion protection compound, e.g. on a petroleum basis. If a higher fire resistance duration is specified in the reinforcement plan, non-inflammable material must be used as filling material in the joints (e.g. mineral fibre with a relative density of approx. 110 kg/m3 according to DIN 4102 T 4).
If there are fire protection requirements on the construction components according to DIN 4102 T.2, we recommend the installation of the HALFEN HSD shear dowels with fire protection pad (see page 5).

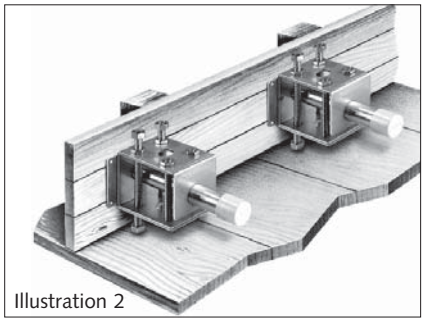


Illustration 2

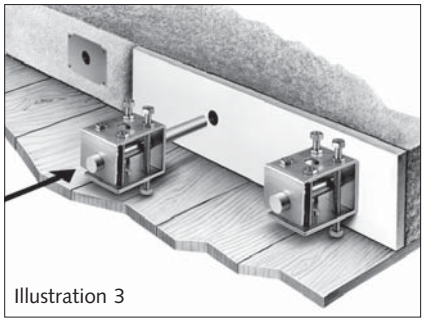
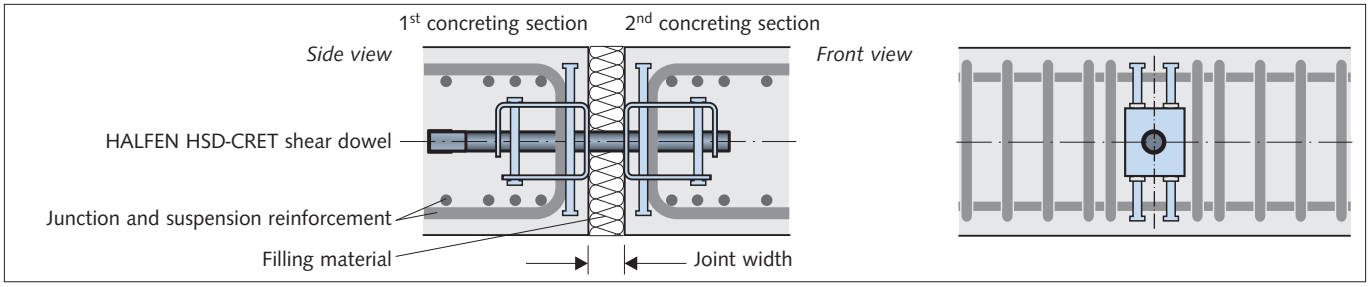


Illustration 3

Additional and suspension reinforcement (by contractor)



HALFEN HSD SHEAR DOWEL SYSTEM

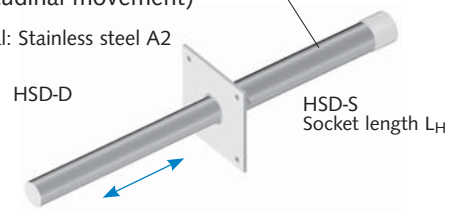
Single shear dowels

Product description

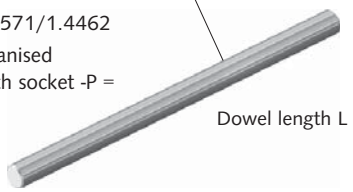
HALFEN Single shear dowels HSD allow sliding in the direction of the member axis. The dowels are normally used to transmit shear loads in any direction.
If lateral movements have to be taken into account, the HSD-SV sockets are used, which permit a sideways movement, i.e. the shear load will only be transmitted in one direction.

Note: HALFEN single shear dowls HSD are not subject to a technical approval!

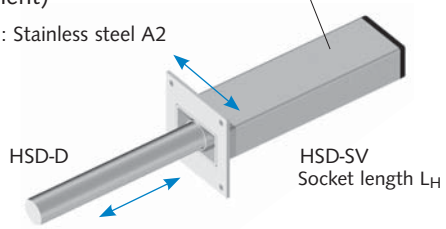
Socket HSD-S
(longitudinal movement)
Material: Stainless steel A2



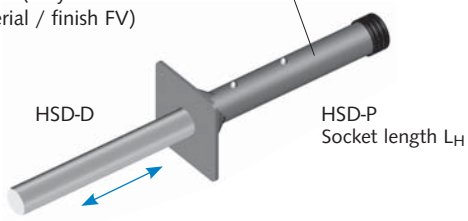
Single shear dowel HSD-D
Material / finish:
A4 = Stainless steel grade 1.4571/1.4462
FV = Steel S355, hot-dip galvanised
(only in combination with socket -P = plastic)



Socket HSD-SV
(longitudinal and transverse movement)
Material: Stainless steel A2



Socket HSD-P
(longitudinal movement)
Material: Plastic (only in combination with dowel in material / finish FV)



Dimensions of single shear dowels and sockets

Dowel type	Single shear dowel		Sliding sockets HSD-P, -S		Sliding sockets HSD-SV	
	Dowel Ø [mm]	Dowel length L [mm]	Socket length L_H [mm]	Nail plate width/height [mm]	Socket length L_H [mm]	Nail plate width/height [mm]
HSD-D 20	20	300	160	70/70	180	80/80
HSD-D 22	22	300	160	70/70	180	80/80
HSD-D 25	25	300	160	70/70	180	80/80
HSD-D 30	30	350	185	80/80	205	100/80

Ordering examples:

- Dowel: **HSD-D 22 -A4**
  - HALFEN shear dowel
  - Diameter [mm]
  - A4 = Stainless steel A4 material
- Sliding socket: **HSD-SV 22**
  - HALFEN sliding socket
  - S = Stainless steel A2
  - SV = ditto, transverse and longitudinal movement
  - P = Plastic
  - for dowel diameter [mm]
- Set (Dowel + sliding socket) **HSD-SET 22 V -A4**
  - HALFEN shear dowel set
  - with dowel diameter [mm]
  - V = Socket transverse and longitudinal movement
  - A4 = Dowel stainless steel A4, Socket S/SV = stainless steel A2

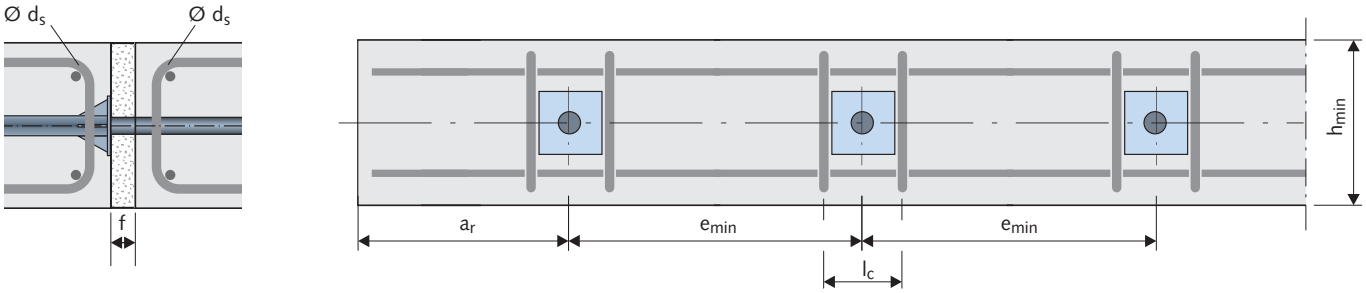
Single shear dowels

Dimensioning

Minimum spacing, Element thickness, Stirrup spacing

Dowel Ø [mm]	Socket	Stirrup Ø d_s [mm]	Component thickness h_{min} [mm]	Stirrup spacing l_c [mm]	Required dowel spacing e_{min} [mm]	Edge distance a_r [mm]
20	HSD-S + HSD-P	10	160	60	310	160
22		10	160	60	350	175
25		12	175	70	410	200
30		14	210	90	560	240
20	HSD-SV	10	160	80	310	160
22		10	160	90	350	175
25		12	175	100	410	200
30		14	210	110	560	240

l_c = Distance of the first stirrup from the dowel
h_{min} = Minimum component thickness
e_{min} = Minimum centre spacing between the single dowels
a_r = Minimum edge distance



Dimensioning for non-reinforced concrete

Design resistances HSD-D in non-reinforced concrete according to volume 346, DAfStb (German association for reinforced concrete construction)

Steel load-bearing capacity: $V_{Rd,s} = f_\mu \times 1{,}25 \times (f_{yk}/\gamma_{MS}) \times W / (f+Ø)$

Concrete load-bearing capacity: $V_{Rd,c} = 0{,}4 \times f_{ck} \times Ø^{2,1} / (333+12{,}2 \times f)$

$0{,}4 = (\alpha \times \gamma_{MW}) / 3$

with:

f_μ = 0,9 Reductions factor due to friction [-]
f_{yk} = Yielding point [N/mm²]
f_{ck} = characteristic cylinder resistance to pressure of the concrete [N/mm²]
f = Joint width [mm]
Ø = Shear dowel diameter [mm]
W = Section modulus [mm³]
γ_{MS} = Material safety factor for steel [-]

- HALFEN Single shear dowels HSD-D require no official approval.
- α = 0,85 (consideration of the long-term effects)
- γ_{MW} = 1,425 (average value from γ_G = 1,35 and γ_Q = 1,5)
- Minimum edge distance to the dowel axis $a_r = 8 \times Ø$ (in all directions)
- Minimum axial distance $e = 16 \times Ø$

Dimensioning resistances $V_{Rd.s}$ and $V_{Rd.c}$ [kN] for non-reinforced concrete

Dowel type	Concrete grade	Dowel-Ø [mm]	Minimum component thickness [mm]	Design resistances [kN] for joint width f [mm] 10	20	30	40
HSD-D 20	≥ C20/25	20	320	9.5	7.1	5.7	4.8
HSD-D 22		22	350	11.6	9.0	7.3	6.1
HSD-D 25		25	400	15.2	12.0	9.9	8.4
HSD-D 30		30	480	22.2	17.5	14.5	12.3

Dimensioning for reinforced concrete

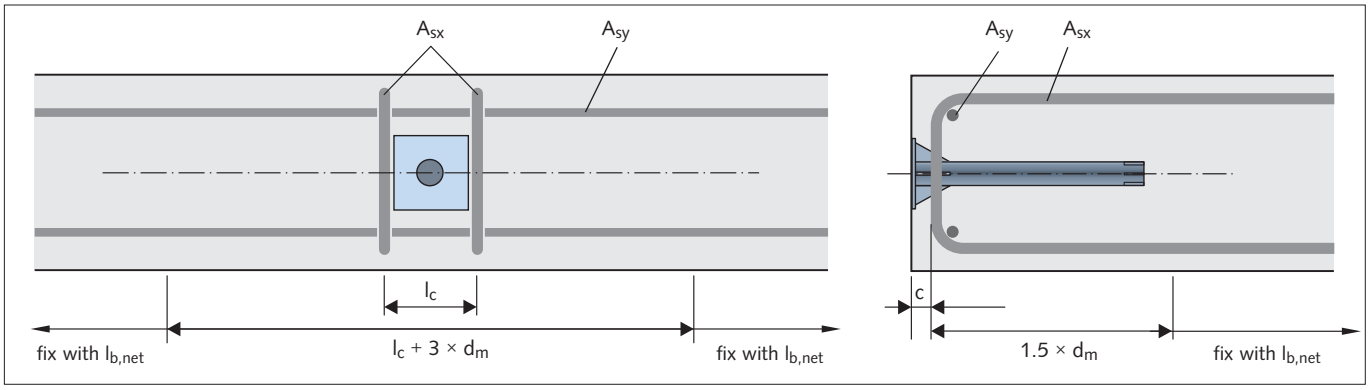
Design resistances HSD-D in reinforced concrete according to volume 346, DAfStb (German association for reinforced concrete construction)

$$V_{Rd} = \min (V_{Rd,s}; V_{Rd,c})$$

Required certifications:
Certification against punching failure $V_{Rd,ct}$
(acc. to DIN 1045-1)
Certification against concrete edge failure $V_{Rd,ce}$
(acc. to volume 346, DAfStb)
Nachweis der Stahltragfähigkeit $V_{Rd,s}$
Steel load-bearing capacity:

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

$V_{Rd,s}$ Dimensioning resistance of the steel load-bearing capacity
$V_{Rd,c}$ Dimensioning resistance of the concrete load-bearing capacity
mit:
f_μ = Reduction factor due to friction [-]
f_{yk} = Yielding point [N/mm²]
f = Joint width [mm]
Ø = Shear dowel diameter [mm]
W = Section modulus [mm³]
γ_{MS} = Material safety factor for steel [-]



Proof of the steel load-bearing capacity

Design resistances $V_{Rd,s}$ for HSD-S and HSD-P -longitudinal movement - **for reinforced concrete**

Dowel type	Dowel-Ø [mm]	Design resistances $V_{Rd,s}$ [kN] for joint width f [mm]			
		10 mm	20 mm	30 mm	40 mm
HSD-D 20	20	14.3	9.5	7.1	5.7
HSD-D 22	22	18.1	12.2	9.3	7.4
HSD-D 25	25	24.8	17.1	13.1	10.6
HSD-D 30	30	38.5	27.5	21.4	17.5
taking account of friction ($f\mu$ = 0,9)					

Design resistances $V_{Rd,s}$ for HSD-SV -longitudinal and transverse movement- **for reinforced concrete**

Dowel type	Dowel-Ø [mm]	Design resistances $V_{Rd,s}$ [kN] for joint width f [mm]			
		10 mm	20 mm	30 mm	40 mm
HSD-D 20	20	12.8	8.6	6.4	5.1
HSD-D 22	22	16.3	11.0	8.3	6.7
HSD-D 25	25	22.3	15.4	11.8	9.5
HSD-D 30	30	34.6	24.7	19.2	15.7
taking account of friction ($f\mu$ = 0,81)					

Single shear dowels

Dimensioning for reinforced concrete

Proof of the concrete load-bearing capacity

The design resistance for the concrete load-bearing capacity is the smallest dimensioning resistance from the concrete edge failure and punching failure proofs:

Asx = Rear suspension reinforcement
Asy = Longitudinal reinforcement
lc = Distance of the first stirrup to the dowel

Dimensioning resistances $V_{Rd,c}$ for HSD-S and HSD-P -longitudinal movement -

Dowel type	Component thickness h [mm]	c_{nom} [mm]	Design resistances $V_{Rd,c}$ [kN] ≥ C20/25	In-situ reinforcement A_{sx}	In-situ reinforcement A_{sy}	Centre spacing l_c [mm]
HSD-D 20	≥160	30	14.2	2 Ø 10	2 Ø 10	60
	≥180		15.8			
HSD-D 22	≥160	30	14.2	2 Ø 10	2 Ø 10	60
	≥180		15.8			
	≥200		17.3			
	≥220		18.9			
	≥240		20.4			
HSD-D 25	≥180	30	20.5	2 Ø12	2 Ø12	70
	≥200		22.4			
	≥220		24.3			
	≥240		26.2			
	≥260		28.0			
HSD-D 30	≥220	30	29.3	2 Ø 14	2 Ø 14	90
	≥240		31.5			
	≥260		33.7			
	≥280		35.9			
	≥300		38.1			
	≥320		40.2			

taking account of friction (f_μ = 1,0)

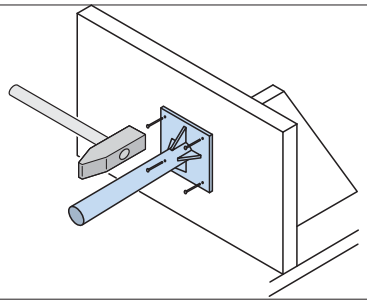
Dimensioning resistances $V_{Rd,c}$ for HSD-SV -longitudinal and transverse movement-

Dowel type	Component thickness h [mm]	c_{nom} [mm]	Design resistances $V_{Rd,c}$ [kN] ≥ C20/25	In-situ reinforcement A_{sx}	In-situ reinforcement A_{sy}	Centre spacing l_c [mm]
HSD-D 20	≥160	30	[5]	2 Ø 10	2 Ø 10	80
	≥180		13.0			
HSD-D 22	≥160	30	[5]	2 Ø 10	2 Ø 10	90
	≥180		12.5			
	≥200		13.9			
	≥220		15.3			
	≥240		16.7			
HSD-D 25	≥180	30	[5]	2 Ø12	2 Ø12	100
	≥200		18.0			
	≥220		19.8			
	≥240		21.5			
	≥260		23.2			
HSD-D 30	≥220	30	24.6	2 Ø 14	2 Ø 14	110
	≥240		26.7			
	≥260		28.7			
	≥280		30.7			
	≥300		32.7			
	≥320		34.7			

taking account of friction (f_μ = 0,9) [5] No rear suspension stirrup in the break-out cone

Assembly instructions for HSD single shear dowels

1

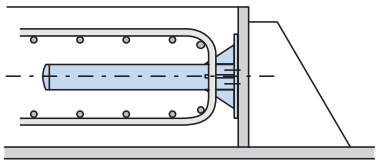


1. Fixing to the formwork

Nail the socket onto the formwork according to the specified position. Important: The socket must be aligned exactly in the direction of slide.

NOTE: Do not remove the label. This protects the socket from the penetration of fresh concrete.

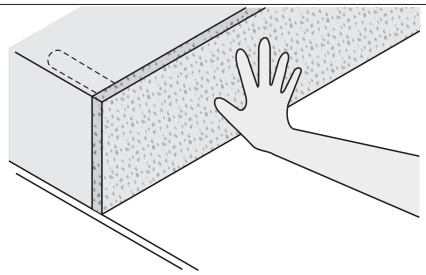
2



2. Reinforcement

Laying of the in-situ joint and rear suspension reinforcement, as well as the component reinforcement, in the 1st concreting-section.

3, 4



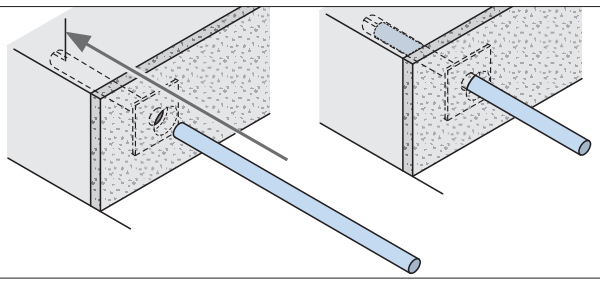
3. Protective label

The protective label can be removed from the socket after the concreting and the removal of the formwork.

4. Joint material

Application of the joint material. The positions of the shear dowel sockets are to be exactly marked where necessary.

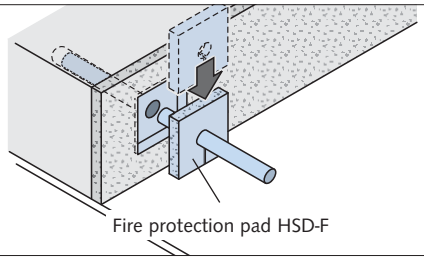
5a



5. a) Shear dowel

The dowel that matches the socket is now inserted through the joint material and is pushed into the socket up to the stop (safety plug).

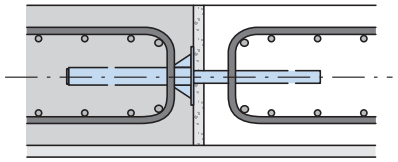
5b



5. b) Shear dowel

In the case of fire protection requirements according to DIN 4102, a recess is to be provided in the joint material for the HALFEN fire protection pad.

6



6. Concreting

Positioning of the reinforcement (by contractor) and concreting the 2nd concreting -section.

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