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Technical assessment institute for construction
products and methods:

Deutsches Institut für Bautechnik (DIBt)
German Centre of Competence for Construction
(National and Federal State approved statutory public body)

National Technical Approval

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Applicant:

Leviat GmbH
Liebigstraße 14
40764 Langenfeld,
Germany

Approved product:

Halfen HEK Precast coupler for connection of precast concrete elements

The object named above is herewith granted a National Technical Approval (*allgemeine bauaufsichtliche Zulassung*)/general construction technique permit (*allgemeine Bauartgenehmigung*).
This approval contains seven pages and 18 annexes.
This National Technical Approval/general construction technique permit replaces National Technical Approval/General Construction Technique permit no. 21.8-2086 of 30th March 2023.
The object of approval was first granted a National Technical Approval on 30th January 2018.

I GENERAL PROVISIONS

- 1 This National Technical Approval confirms the usability and applicability of the aforementioned construction product in accordance with the Building Codes of the federal states (*Landesbauordnungen*).
- 2 A National Technical Approval does not replace any permits, approvals and certificates legally required for the execution of construction projects.
- 3 This National Technical Approval is granted without prejudice to the rights of third parties, in particular private property rights.
- 4 Notwithstanding further provisions in the 'Special Provisions', copies of this approval must be made available to the user and installer of the object concerned. The user and installer of the product must be informed that this approval must be made available at the place of use or place of application. Copies of the National Technical Approval must be made available to the respective authorities on request.
- 5 This National Technical Approval must only be reproduced in its entirety. Reproduction in extracts requires consent from the DIBt. Texts and drawings in promotional material must not contradict this approval. Translations of the national technical approval must include a disclaimer as follows "This translation of the original German version has not been verified by the Deutsches Institut für Bautechnik" (Vom Deutschen Institut für Bautechnik nicht geprüfte Übersetzung der deutschen Originalfassung).
- 6 This National Technical Approval may be revoked at any time. The specifications contained therein may be subsequently amended and changed, especially if new technical findings makes this necessary.
- 7 This National Technical Approval is based on the information and documents provided by the applicant. Alterations to this basis are not covered by this approval, and the DIBt informed without delay.

II SPECIAL PROVISIONS

1 Subject and intended use

1.1 Object of approval and application

The object of this approval is the Halfen HEK Precast coupler. It consists of a symmetrically bent steel bracket (type HEK3-T, type HEK3-L, type HEK2 T-100, HEK2 L-100, HEK2 T-150, HEK2 L-150 and HEK2 U-150), a serrated plate insert (only for HEK2 T-150) as well as a square counter plate (with washer for the HEK3-L/-T) and an adjustment washer (applies only to the HEK2 U-150) made in hot-dipped galvanized or stainless steel.

Halfen HEK Precast couplers are used for anchoring in concrete.

1.2 Field of use and application

This approval covers the planning, design calculation, and the method of connecting concrete elements using Halfen HEK Precast couplers.

The HEK is cast surface-flush in a precast concrete element with an installation access hole. The serrated plate insert, counter plate or adjustment washer as well as the screw are inserted in the installation access hole. The HEK is used in combination with an anchor (e.g. threaded socket or an anchor channel) in a second precast concrete element to provide a force-locked connection.

An example of an installed Halfen HEK3 Precast coupler is shown in annex 1, annex 2 shows an installed HEK2 Precast coupler.

The Halfen HEK Precast coupler may be used for connections under static and quasi-static loads in reinforced or unreinforced normal weight concrete with a minimum strength class of C20/25 and a maximum strength class of C50/60 in accordance with DIN EN 206-1:2001-07 'Concrete; Part 1: Definition, properties, production and conformity'.

The precast coupler can only be used in installations as illustrated in annex 12.

The precast coupler can be used in cracked and non-cracked concrete.

The hot-dipped galvanized, steel precast coupler can only be used in dry internal environments, e.g. in residential, offices, schools, hospitals, commercial sales structures – with the exception of wet rooms.

The stainless steel precast coupler may be used as specified in corrosion resistance class CRC III in accordance with DIN EN 1993-1-4:2015-10 in conjunction with DIN 1993-1-4/NA:2017-01

If all steel parts of the precast coupler in the joint and installation access hole are subsequently fully sealed using grout in accordance with DAfStb guideline 'Manufacture and use of cement-bound concrete and mortar' (Herstellung und Verwendung von zementgebundenem Vergussbeton und Vergussmörtel) (Publ. issue July 2019), then the concrete cover and exposure class is regulated in accordance with DIN EN 1992-1-1:2011-01 as well as DIN EN 1992-1-1/NA:2013-04.

The bolt, washer, threaded socket anchor or anchor channel are not covered by this approval.

2 Provisions for the construction product

2.1 Properties and composition

The Halfen HEK Precast coupler (Steel brackets HEK3-T, HEK3-L, HEK2 T-100, HEK2 L-100, HEK2 T-150, HEK2 L-150 and HEK2 U-150 including the serrated plate, the square counter plate, the washers) must comply with the specifications and drawings provided in the annexes.

The material characteristics, dimensions and tolerances of the precast coupler not specified in this approval must comply with the specifications as deposited with the DIBt, the certification body and the third party monitoring body.

2.2 Identification

All packaging, delivery or shipping documents for the Halfen HEK Precast coupler (steel brackets HEK3-T, HEK3-L, HEK2 T-100, HEK2 L-100, HEK2 T-150, HEK2 L-150 or HEK2 U-150 and the serrated plate, counter plate and adjusting washer) must be marked by the manufacturer with the national conformity mark (Ü-Zeichen) in accordance with the Conformity Marking Ordinances (Übereinstimmungs-zeichen-Verordnungen) of the federal states. The identifying mark, the approval number and the complete designation of the precast coupler must also be specified.

The identification mark may only be applied if the requirements stated in Section 2.3 'Confirmation of conformity' are met.

Each precast coupler must be marked in accordance with Annex 10.

2.3 Confirmation of conformity

2.3.1 General

Confirmation of the conformity of the precast coupler with the provisions of this National Technical Approval for each manufacturing plant with a manufacturer's declaration of conformity based on in-house factory production control and a certificate of conformity issued by a recognized certification body and regular third-party monitoring, must be confirmed by a recognized inspection body in accordance with the following provisions:

For the issue of a certificate of conformity and third-party monitoring including required product testing, the manufacturer of the precast coupler must use an approved inspection body and an approved certification body.

The manufacturer must mark the precast coupler with the national conformity mark (Ü-Zeichen) stating the intended use.

The certification body must forward a copy of the issued certificate of conformity to the DIBt.

A copy of the initial type-testing evaluation report must also be sent to the DIBt.

Factory production control

2.3.2

Each manufacturing plant must set up and implement an in-house, factory production control. Factory production control is understood as the continuous internal monitoring of the production process, implemented by the manufacturer, to ensure the products manufactured by them are in conformity with the provisions of this national technical approval.

The extent, type and frequency of factory production control is determined by the inspection plan deposited with the German Centre of Competence for Construction (Deutsches Institut für Bautechnik) and the third-party certification body.

The results of the factory production control must be documented and evaluated.

These records must include at minimum the following:

- designation of the construction product, raw material and the components
- method of test or inspection
- production date, test date of the construction product, raw material or components
- results of the inspection and tests, and evaluation against the requirements
- signature of the person responsible for in-house factory production control

The records must be kept for at least five years and be submitted to the inspection body responsible for third-party inspection. On request, these records must be made available to the German Centre of Competence for Construction (Deutsches Institut für Bautechnik) and to the responsible supreme building authority (oberste Bauaufsichtsbehörde).

In case of unsatisfactory test results the manufacturer must take immediate action to resolve the deficiency. Construction products which do not comply with the requirements must be handled in a manner to ensure they cannot be mistaken for products complying with the requirements. After a problem has been resolved, the respective test must be repeated immediately, as far as this is technically feasible and necessary to verify that the deficiency has been eliminated.

2.3.3 Third party monitoring

Factory production control systems must be regularly inspected, at least once a year by a third party body, for each manufacturing plant where the precast coupler is manufactured.

Independent (third party) inspection must include an initial test of the precast coupler and samples taken for random inspections. The respective approved inspection body is responsible for taking samples and testing.

The extent, type and frequency of third-party control is as recorded in the inspection plan deposited with the German Centre of Competence for Construction (Deutsches Institut für Bautechnik) and the third-party monitoring authority.

The results of the certification and third-party control must be kept for at least five years. On request, they must be made available by the appointed certification or inspection body to the German Centre of Competence for Construction (Deutsches Institut für Bautechnik) and to the responsible supreme building authority (obersten Bauaufsichtsbehörde)..

3 Provisions for planning, design and execution

3.1 Planning

Precast connections must be designed in accordance with standard engineering practice. Verifiable calculations and design drawings must be prepared, taking the loads to be anchored into account. The design drawings must include the exact positions of the precast coupler as well as information on the approved bolts.

For design purposes, the Halfen HEK Precast coupler is the equivalent of an anchor plate with two welded bolt fasteners .

The allowable load (actions) directions are taken from the information in annexes 3 to 9 respectively for types HEK3-T; HEK3-L; HEK2 T-100; HEK2 L-100; HEK2 T-150; HEK2 L-150 and HEK2 U-150. The minimum values for edge distances, axial-spacings and concrete component thickness, the dimensions of the installation recess as well as the effective characteristic values of the precast connectors can be found in Annex 12, Table 9.

3.2 Design

3.2.1 General

The precast coupler must be designed in accordance with DIN EN 1992-4:2019-04: 'Eurocode 2 - Design of concrete structures - Part 4: Design of fastenings for use in concrete', taking the following notes and information into account.

This design calculation verifies that the immediate local transmission into the concrete has been provided. Further transmission of the loads to be anchored into the element must be verified separately.

Additional loads which may occur in the precast coupler, in the connected element or in the element in which the precast coupler is anchored due to restrained deformations (e.g. due to temperature fluctuations) must be taken into consideration.

Eccentric configuration of the bolt in relation to the precast coupler is allowable and does not have to be considered separately in the design of the precast coupler.

The load-bearing capacities of the precast elements and the anchor elements in the second precast concrete element (e.g. anchor with threaded socket and bolt) are not subject of this approval and must be separately verified.

3.2.2 Design in accordance with DIN EN 1992-4:2019-04

The characteristic values for verifications in accordance with DIN EN 1992-4:2019-04 are provided in the tables in annexes 13 and 16.

The information and illustration for projection surfaces in annexes 13 to 17 must be observed for verification of concrete failure.

3.2.3 Additional reinforcement in accordance with DIN EN 1992-4:2019-04

If additional reinforcement is present, verification for concrete pry-out/blow-out failure or concrete edge failure under tensile or shear stress is not required.

The design guidelines specified in DIN EN 1992-4:2019-04, section 7.2.1.2 or section 7.2.2.2, apply for additional reinforcement.

Annex 18 must also be taken into account when detailing the reinforcement.

3.3 Execution

3.3.1 General

The precast coupler must be installed in accordance with the design drawings specified in Section 3.1.

The user of this construction method, respectively the building company responsible for the construction must submit a declaration of conformity in accordance with §§ 16 a Para. 5, 21 Para. 2 MBO to confirm that the construction method complies with this general type approval.

3.3.2 Installation of the precast coupler in the precast concrete element

The precast coupler must be installed in accordance with the manufacturer's installation instructions and the specifications in annex 12. The required installation access holes must be ensured by installing recess formers. These are removed after the concrete has been poured and cured.

The precast coupler must be suitably fixed to the formwork to ensure it remains in place when installing the reinforcement, and pouring and compacting the concrete.

The serrated area of the precast couplers (see annexes 3 to 6 and 8) must be protected against contamination by concrete.

When pouring the concrete, it must be ensured that the concrete is compacted with particular care around the edges of the precast coupler.

3.3.3 Connecting with the second precast element

The precast coupler must be installed as specified in the assembly instructions supplied by the manufacturer.

The counter plate of the precast connector is inserted into the installation recess with the bolt, it must rest fully on the serrated surface of the precast connector, engage in said serration and is locked in place by tightening the bolt

If type HEK2 T-150 (bent steel bracket) is used, the serrated plate insert must be inserted in the square recess in the steel bracket (precast coupler) first.

If type HEK2 U-150 is used, an adjusting washer is used instead of a counter plate. This adjusting washer must be placed in the circular recess (precast coupler) in the steel bracket.

If an expansion joint is required between the precast elements, a spacer must be used under the precast coupler in accordance with annex 1 and 2 (e.g. with a suitable shim).

The torque moments for the bolts as specified in annex 12, table 8, must be observed.

3.3.4 Inspection of execution

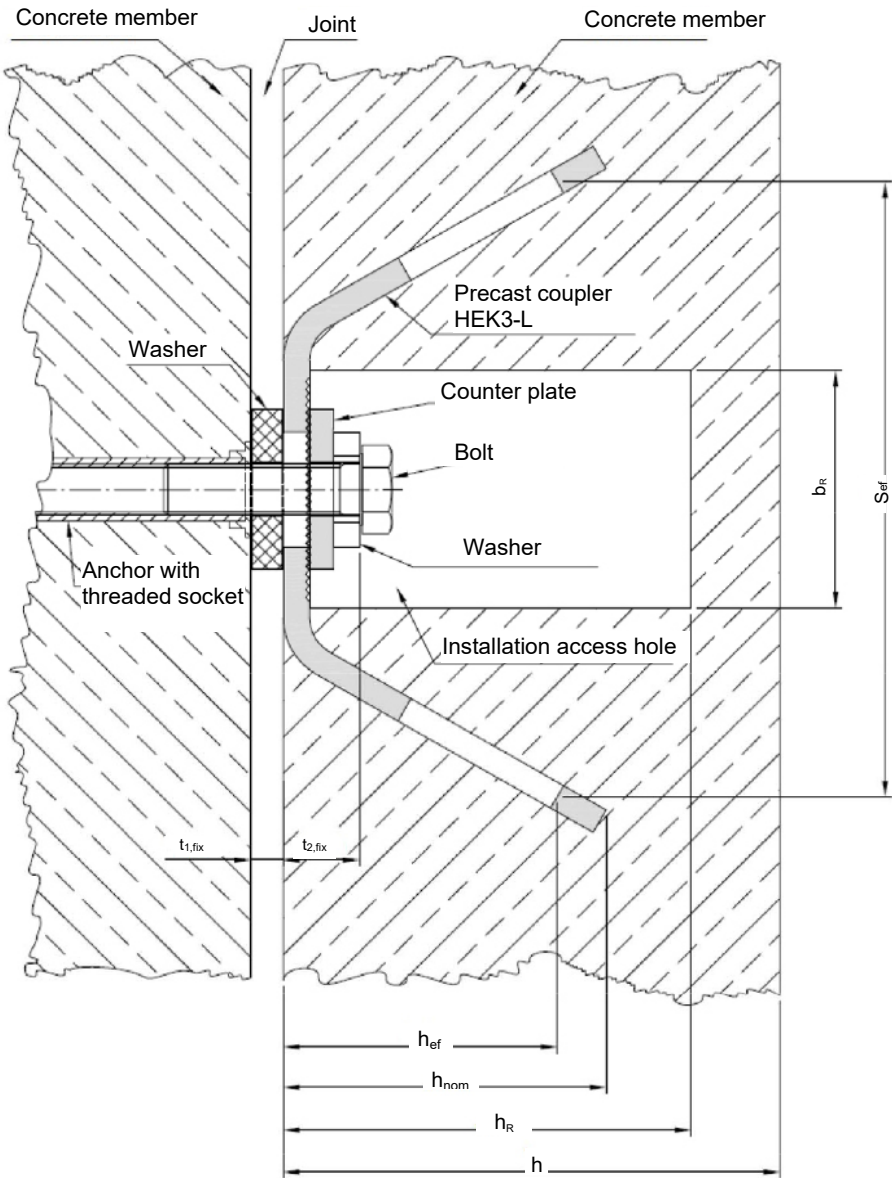
During installation of the precast coupler and the assembly of the connection, the designated contractor or site manager appointed by the contractor or a competent representative of the site manager must be present at the construction site. They must ensure that work is carried out as specified and document the installation and assembly. They must check the position of the precast coupler and any optional additional reinforcement.

The records must be available at the construction site during the construction period and must be available for inspection on request. As with the delivery documents, they must be kept by the company for a minimum of 5 years after completion of the project.

Section Head
Beatrix Wittstock

Compiled by
Oliver Tempel

HALFEN HEK3 Precast coupler

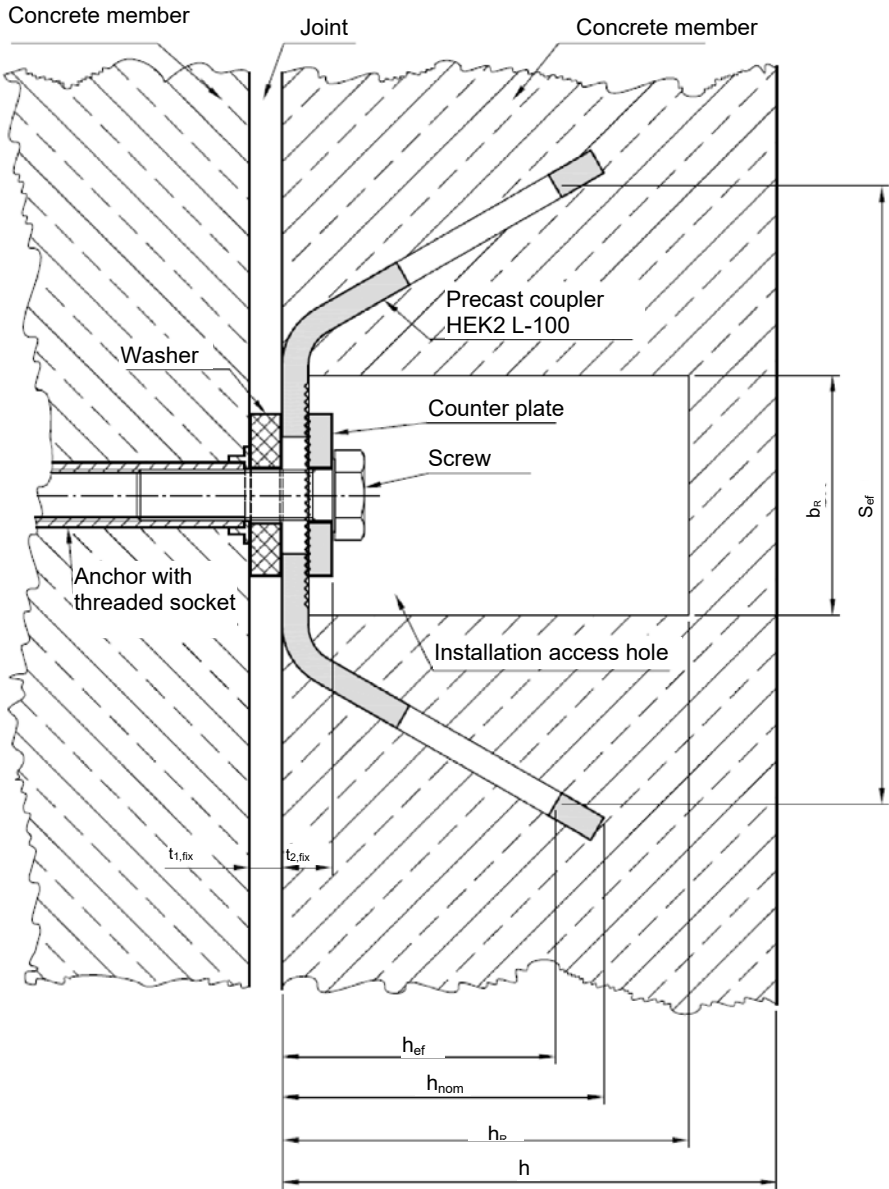


- h = thickness of concrete member
- h_R = height of installation access hole
- h_{nom} = embedment depth
- h_{ef} = effective anchorage depth
- t_{1,fix} = thickness of washer in joint
- t_{2,fix} = clamping thickness of precast coupler with counter plate or adjustment washers
- s_{ef} = effective spacing of the coupler legs
- b_R = width of installation access hole

HALFEN HEK Precast coupler for connection of precast concrete elements	Annex 1
Product description Installed condition HEK3	

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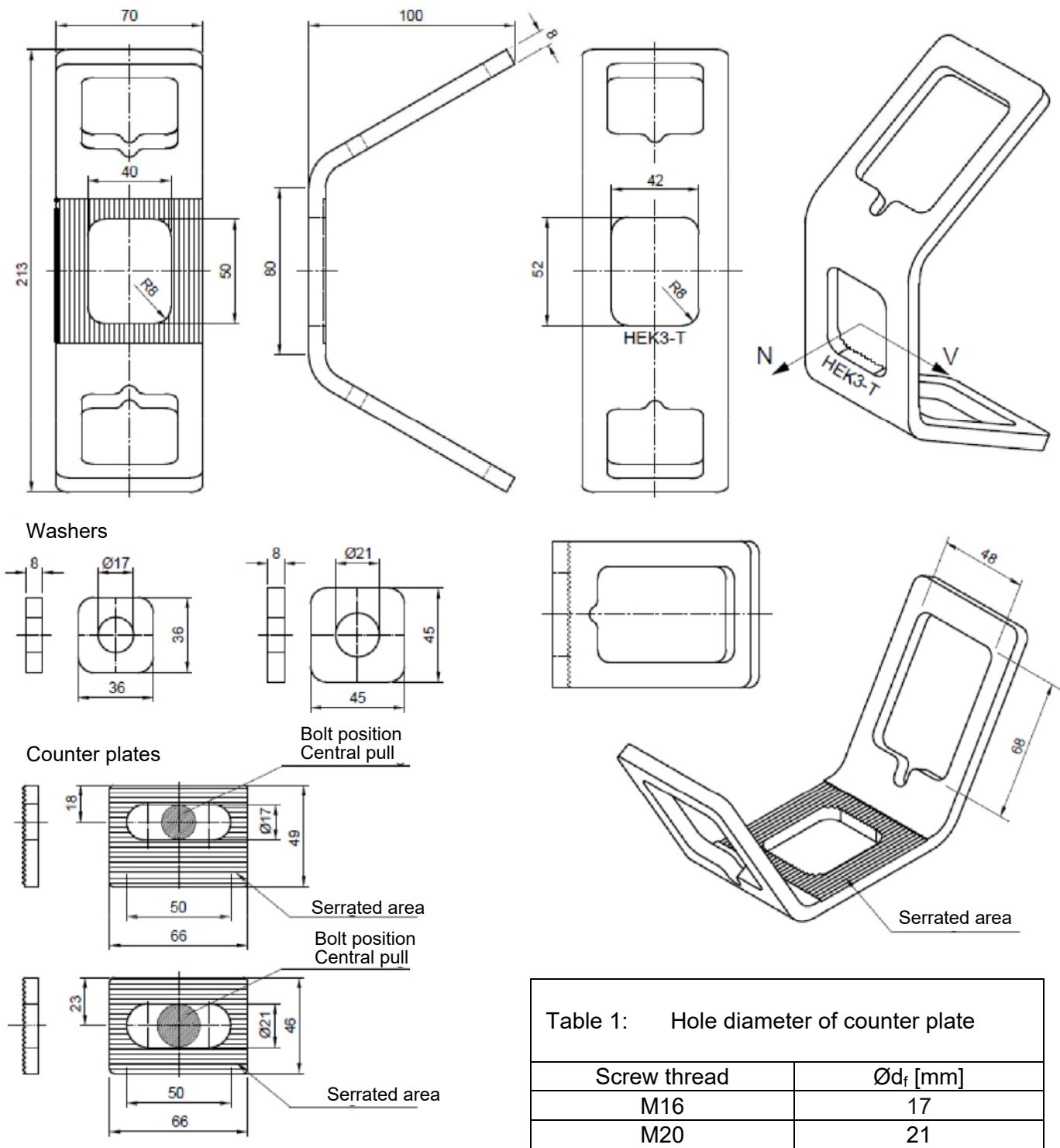
HALFEN HEK2 Precast coupler



- h = thickness of concrete member
- h_R = height of installation access hole
- h_{nom} = embedment depth
- h_{ef} = effective anchorage depth
- $t_{1,fix}$ = thickness of washer in joint
- $t_{2,fix}$ = clamping thickness of precast coupler with counter plate or adjustment washers
- s_{ef} = effective spacing of the coupler legs
- b_R = width of installation access hole

HALFEN HEK Precast coupler for connection of precast concrete elements	
Product description Installed condition HEK2	Annex 2

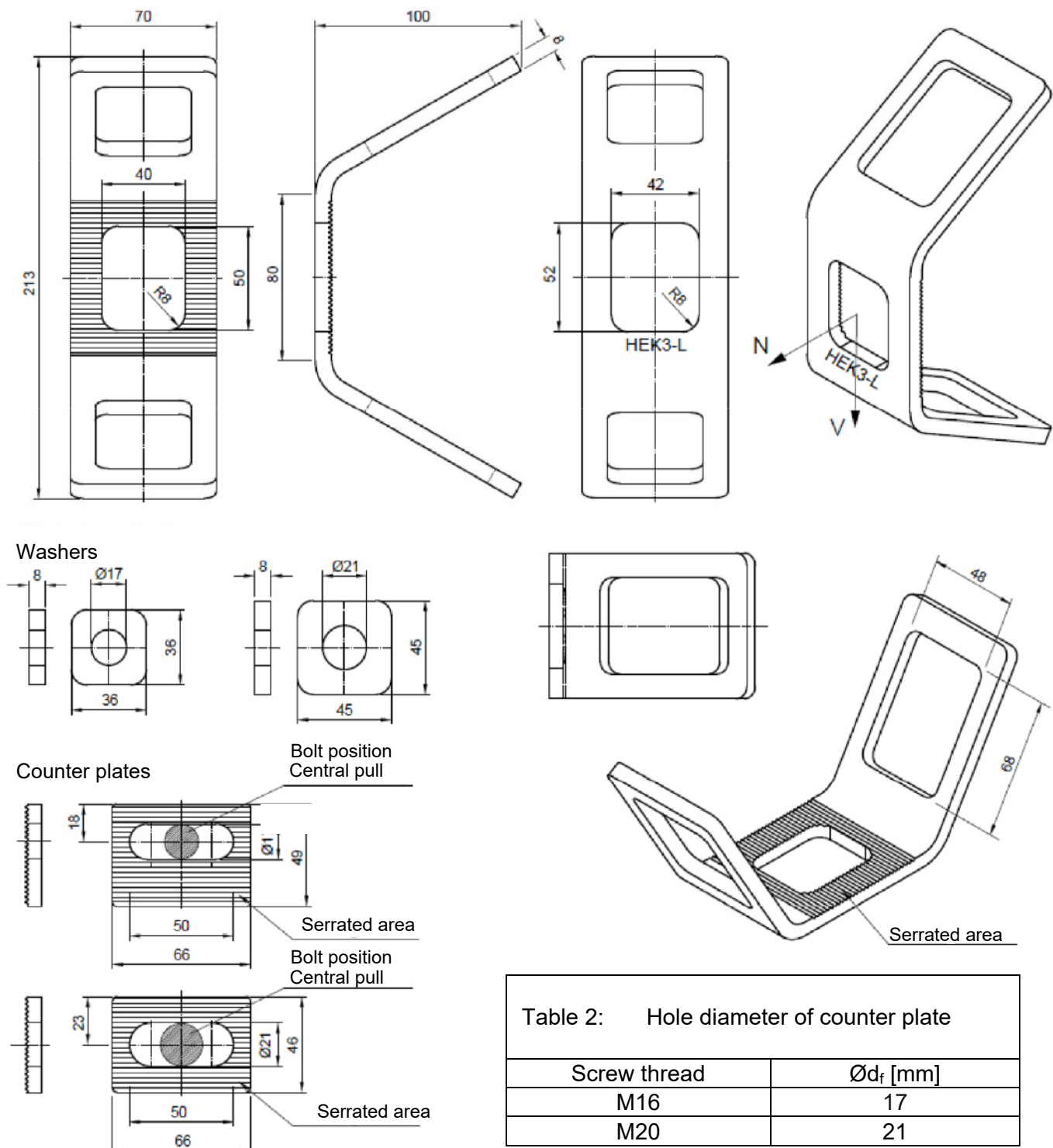
Precast coupler HEK3-T (with counter plate and washer)



The clamping thickness of the precast coupler with the counter plate and washer is $t_{2,fix} = 22$ mm.
 The serrated area can also be on the back of the precast coupler.

HALFEN HEK Precast coupler for connection of precast concrete elements	Annex 3
Product description Dimensions, designations and directions of action; type HEK3-T	

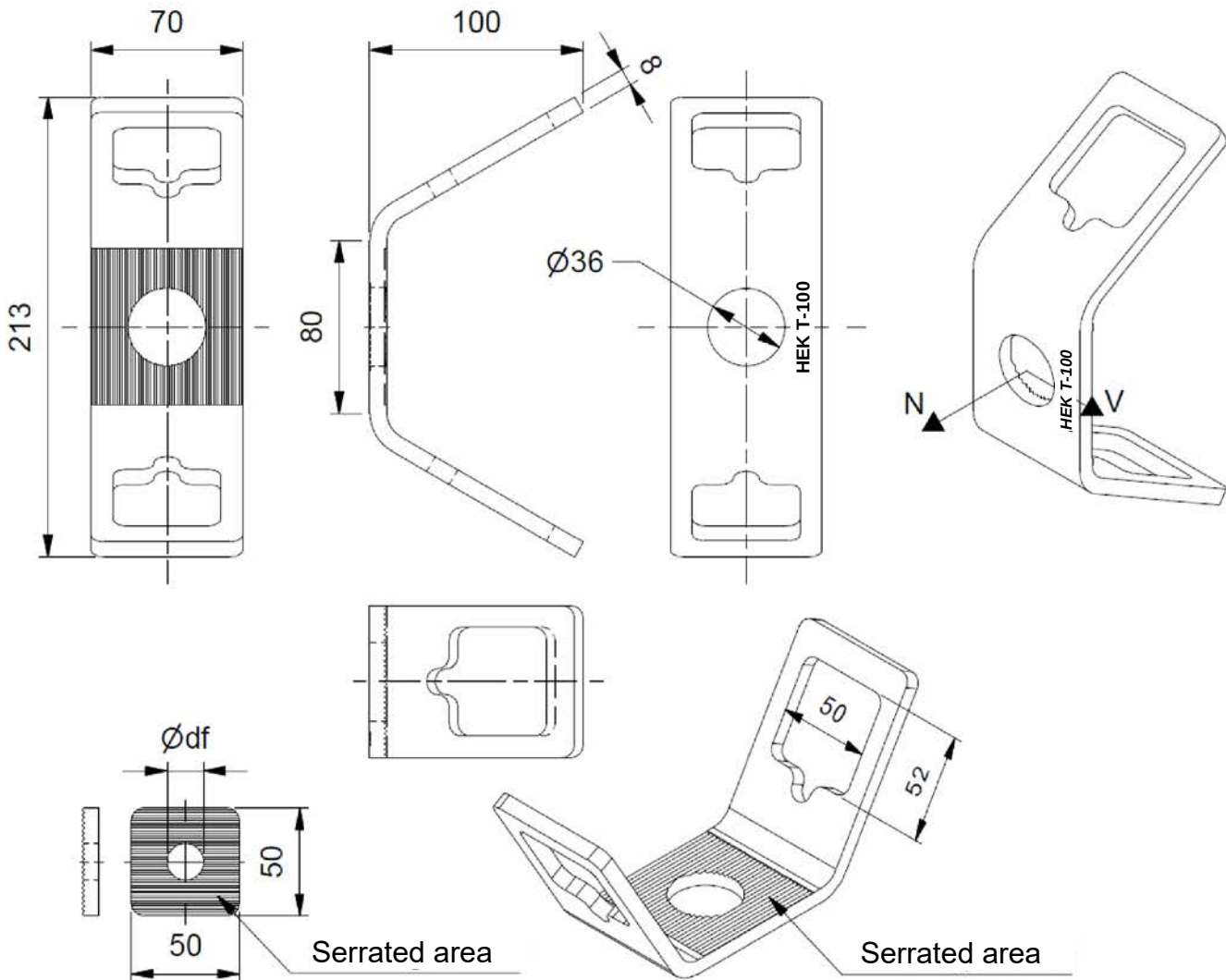
Precast coupler HEK3-L (with counter plate and washer)



The clamping thickness of the precast coupler with the counter plate is $t_{2,fix} = 22$ mm. The serrated area can also be on the back of the precast coupler.

HALFEN HEK Precast coupler for connection of precast concrete elements	Annex 4
Product description Dimensions, designations and directions of action of type HEK3-L	

Precast coupler HEK2 T-100 (with counter plate and washer)



The clamping thickness of the precast coupler with the counter plate is $t_{2,fix} = 14\text{ mm}$.
 The serrated area can also be on the back of the precast coupler.

Table 3: Hole diameter of counter plate

Screw thread	Ød _f [mm]
M16	17
M20	21
M24	25

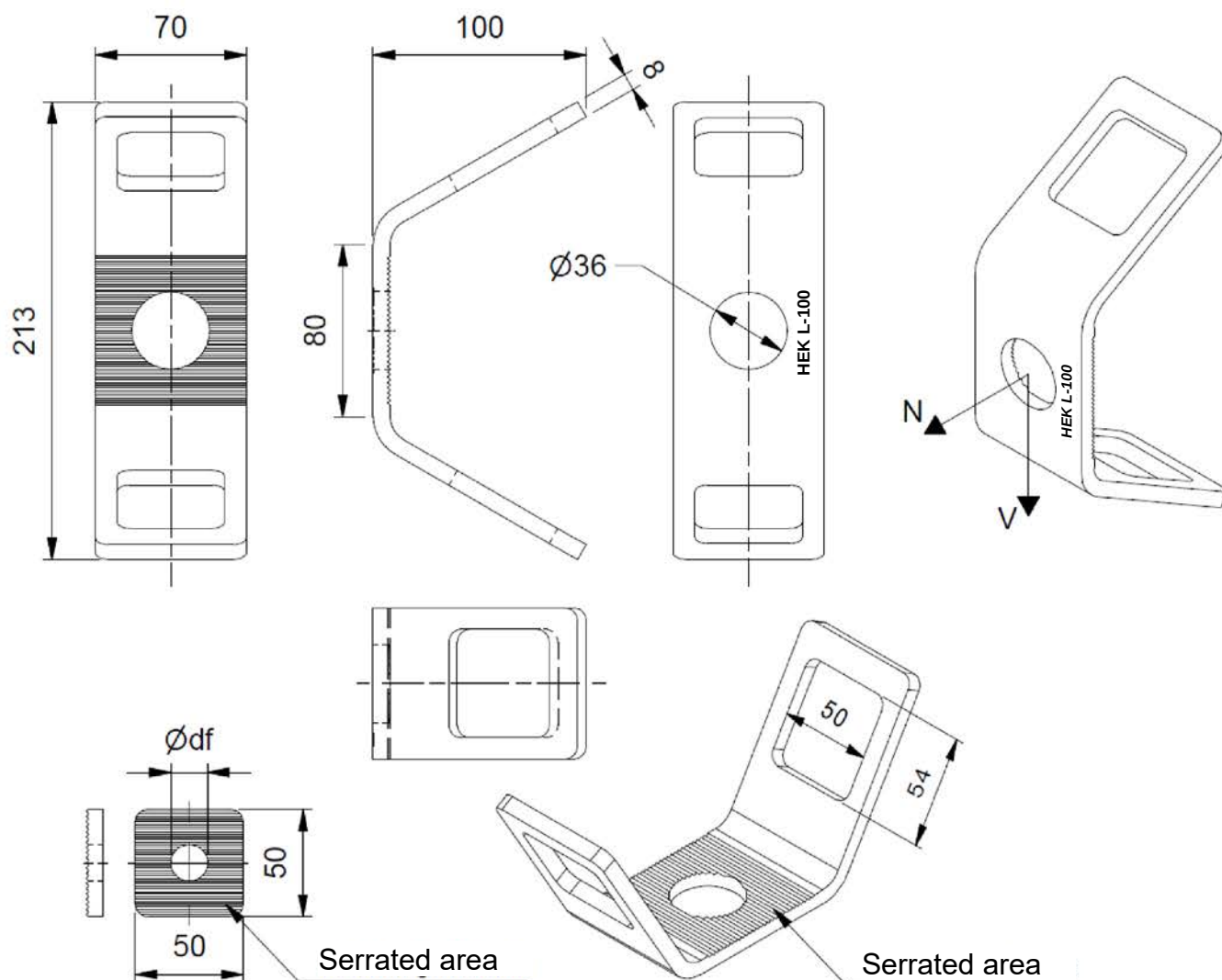
HALFEN HEK Precast coupler for connection of precast concrete elemenets

Product description
 Dimensions, designations and directions of action of type HEK2 T-100

Annex 5

Note: This translation of the original German version has not been verified by the Deutsches Institut für Bautechnik.

Precast coupler HEK2 L-100 (with counter plate)



The clamping thickness of the precast coupler with the counter plate is $t_{2,fix} = 14 \text{ mm}$. The serrated area can also be on the back of the precast coupler.

Table 4: Hole diameter of the counter plate

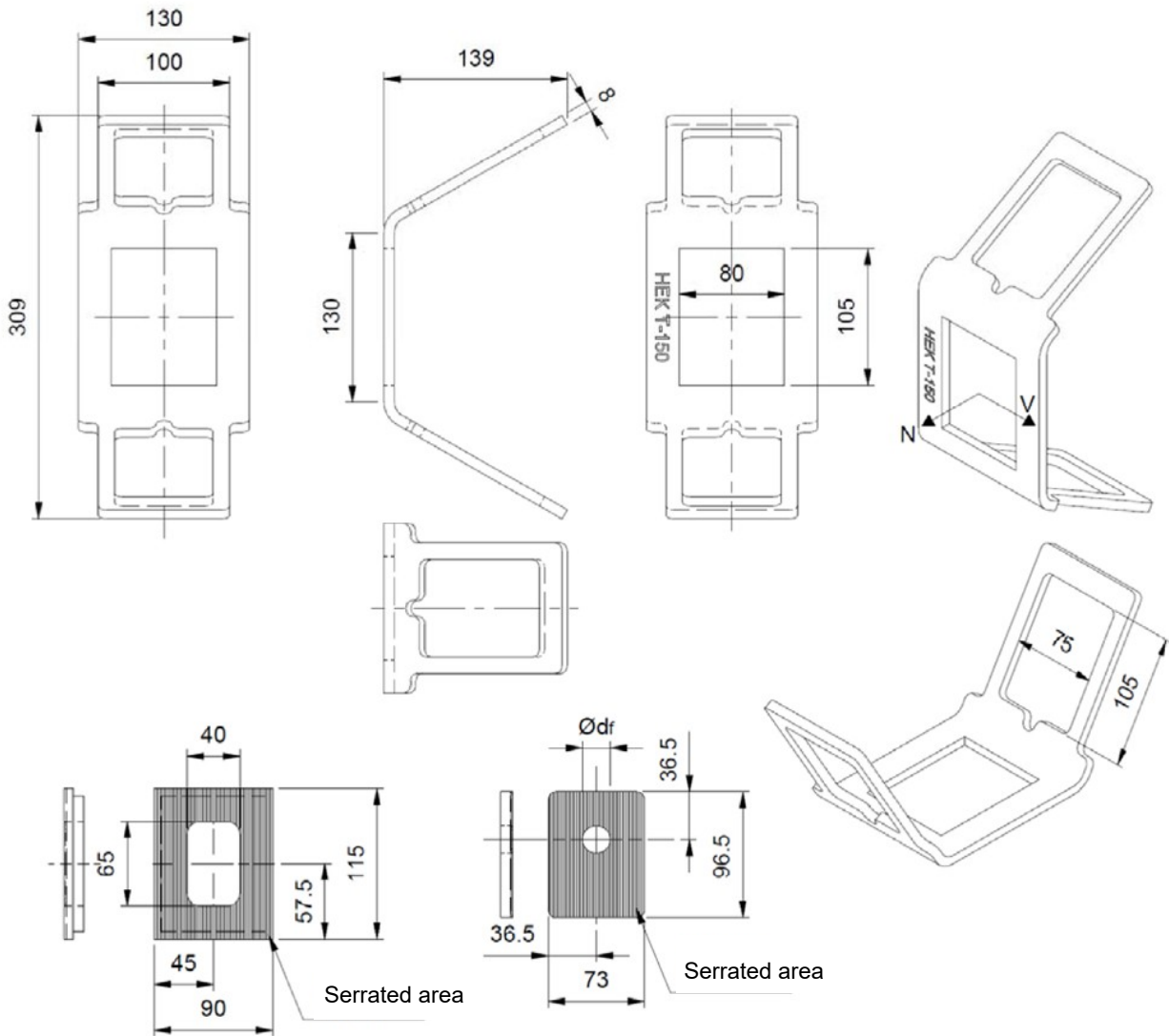
Screw thread	Ød _f [mm]
M16	17
M20	21
M24	25

HALFEN HEK Precast coupler for connection of precast concrete elements

Product description
Dimensions, designations and directions of action of type HEK2 L-100

Annex 6

Precast coupler HEK2 T-150 (with serrated plate insert and counter plate)



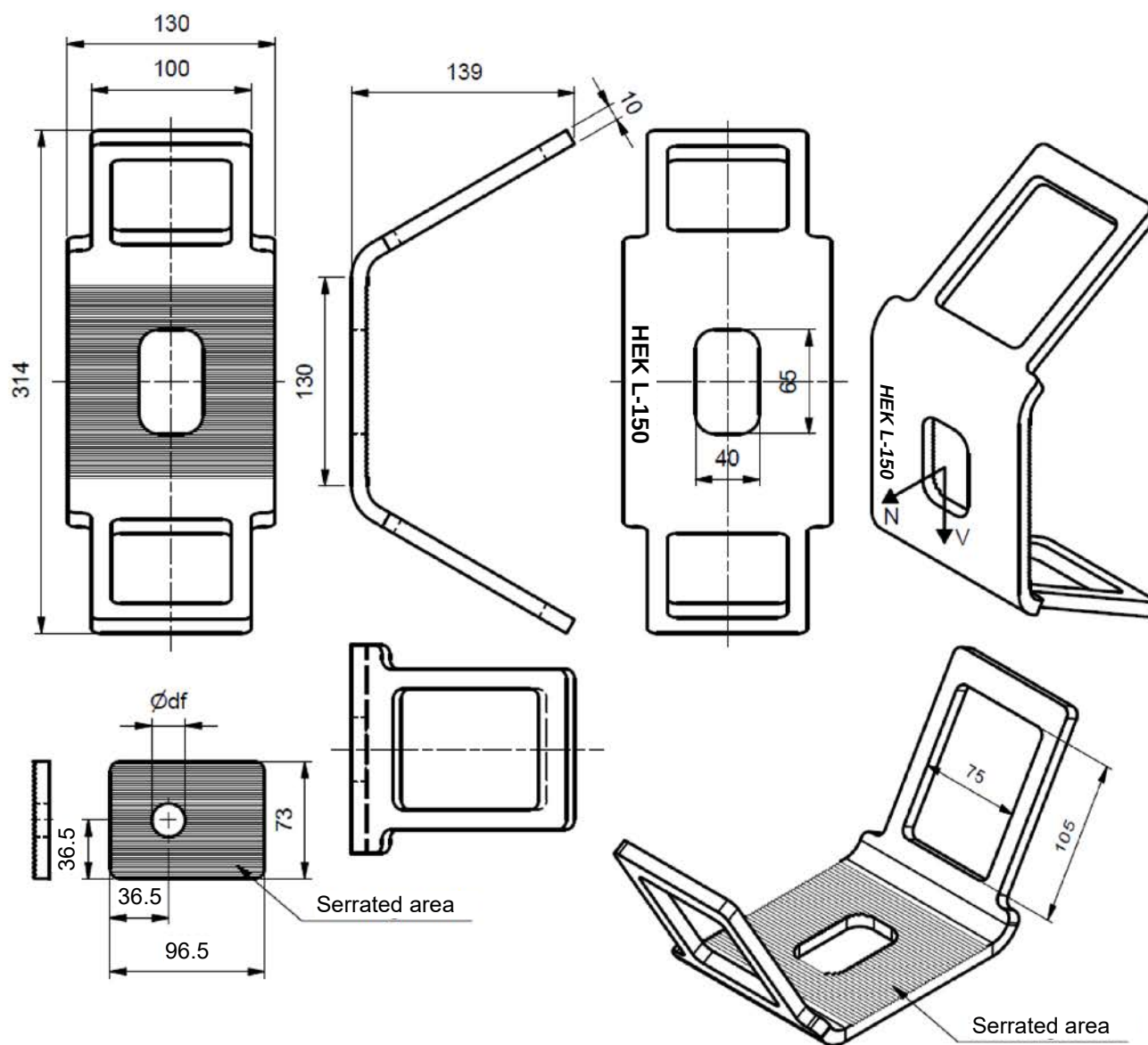
The clamping thickness of the precast coupler with the counter plate is $t_{2,fix} = 23\text{ mm}$.
 The serrated area can also be on the back of the precast coupler.

Table 5: Hole diameter of counter plate

Screw thread	Ød _f [mm]
M20	21
M24	25
M30	31

HALFEN HEK Precast coupler for connection of precast concrete elements	Annex 7
Product description Dimensions, designations and directions of action of type HEK2 T-150	

Precast coupler HEK2 L-150 (with counter plate)



The clamping thickness of the precast coupler with the counter plate is $t_{2,fix} = 18 \text{ mm}$. The serrated area can also be on the back of the precast coupler.

Table 6: Hole diameter of counter plate

Screw thread	Ød _f [mm]
M20	21
M24	25
M30	31

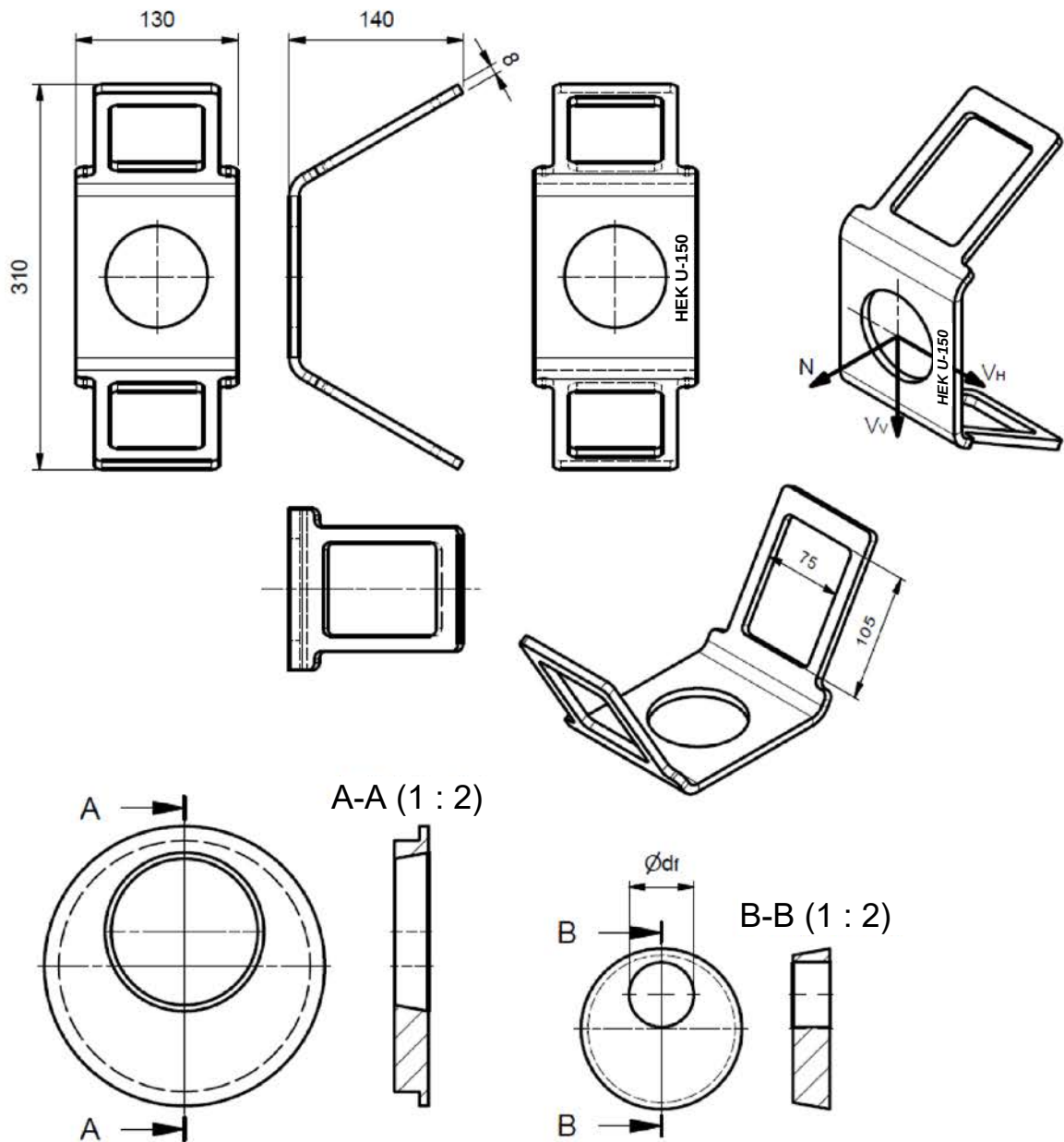
HALFEN HEK Precast coupler for connection of precast concrete elements

Annex 8

Product description

Dimensions, designations and directions of action; type HEK2 L-150

Precast coupler HEK2 U-150 (with adjusting washer)



The clamping thickness of the precast coupler with the adjusting washer is $t_{2,fix} = 12 \text{ mm}$.

Table 5: Hole diameter of adjusting washer

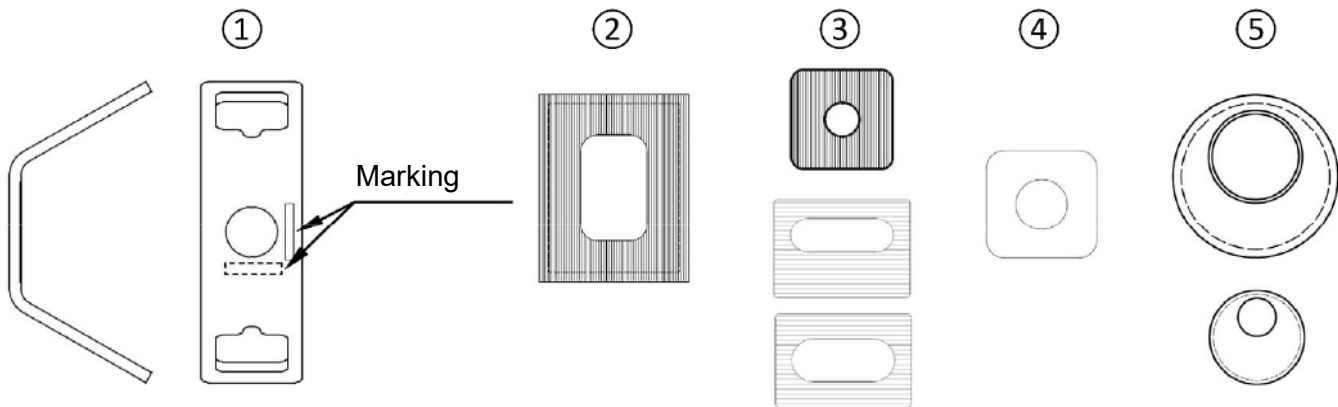
Screw thread	$\text{Ød}_f \text{ [mm]}$
M20	21
M24	25
M30	31

HALFEN HEK Precast coupler for connection of precast concrete elements

Product description
Dimensions, designations and directions of action; type HEK2 U-150

Annex 9

Precast coupler



Marking:
e.g.: HEK L-100
HEK: Article designation
L-100: Size

Table 8: Designations and materials of precast couplers, counter plates, washer and adjusting washers			
Part	Component	Material 1 Precast coupler, hot-dip galvanised (HDG)	Material 2 Precast coupler made of stainless steel (A4)
1	Precast coupler	Steel 1.0038 (S235JR) in accordance with DIN EN 10025-2:2019-10, hot-dip galvanised ¹⁾	Stainless steel 1.4162 / 1.4362 / 1.4401 / 1.4404 / 1.4571 with $f_{yk} \geq 240 \text{ N/mm}^2$ / $f_{uk} \geq 500 \text{ N/mm}^2$ in accordance with Z-30.3-6 i.e. DIN EN 10088-2:2014-12
2	Serrated plate insert	Steel 1.0038 (S235JR) in accordance with DIN EN 10025-2:2019-10, hot-dip galvanised ¹⁾	
3	Counter plate	Steel 1.0038 (S235JR) in accordance with DIN EN 10025-2:2019-10, hot-dip galvanised ¹⁾ or mechanically plated ²⁾	
4	Washer	Steel 1.0038 (S235JR) in accordance with DIN EN 10025-2:2019-10, f hot-dip galvanised ¹⁾ or mechanically plated ²⁾	
5	Adjusting washer, two-piece	Steel 1.0577 (S355J2) in accordance with DIN EN 10025-2:2019-10, hot-dip galvanised ¹⁾	

1) Galvanized layer thickness $\geq 45 \text{ }\mu\text{m}$ in accordance with DIN EN ISO 1461:2022-12
2) Galvanized layer thickness $\geq 50 \text{ }\mu\text{m}$ in accordance with DIN EN ISO 12683:2005-02

HALFEN HEK Precast coupler for connection of precast concrete elements		Annex 10
Product description Marking and materials		

Table 9: Designation and materials of fasteners, washer and additional reinforcement (not included as the subject of approval)

Component	Material for use with precast couplers in accordance with Table 8, material 1	Material for use with precast couplers in accordance with Table 8, material 2
Screw	Steel in accordance with DIN EN ISO 898-1:2013-05, galvanised ¹⁾ , strength class 4.6, 5.6 or 8.8	Stainless steel 1.4401 / 1.4404 / 1.4571 / 1.4362 / 1.4578 / 1.4062 / 1.4162 / 1.4662 / 1.4439 / 1.4462 / 1.4539 / 1.4565 / 1.4529 / 1.4547 in accordance with DIN EN ISO 3506-1:2020-08, strength class A4-50, A4-70 or A4-80
Washer or split washer for installation with joint	Steel in accordance with DIN EN 10025-2:2019-10, galvanised ¹⁾	Stainless steel 1.4401 / 1.4404 / 1.4571 / 1.4362 / 1.4578 / 1.4062 / 1.4162 / 1.4662 / 1.4439 / 1.4462 / 1.4539 / 1.4565 / 1.4529 / 1.4547 in accordance with DIN EN 10088-1:2014-12
Additional reinforcement	B500A or B500B	Stainless reinforcing steel B500NR i.e. B500A or B500B in compliance with concrete cover c_{nom} in accordance with DIN EN 1992-1-1:2011-01 in conjunction with DIN EN 1992-1-1/NA:2013-04
	Position / dimensions in accordance with DIN EN 1992-4:2019-04	

¹⁾ Galvanized layer thickness of $\geq 5 \mu\text{m}$ in accordance with DIN EN ISO 4042:2022-11 or DIN EN ISO 2081:2018-7

HALFEN HEK Precast coupler for connection of precast concrete elements

Product description
Materials

Annex 11

Table 10: Installation parameters

Screw thread	d	[mm]	M16	M20	M24	M30
Torque (HEK2)	T _{inst}	[Nm]	30	50	90	180
Torque (HEK3)	T _{inst}	[Nm]	70 ¹⁾ /100 ²⁾	90 ¹⁾ /125 ²⁾	-	-
Hole diameter in washer or split washer for installation with joint in accordance with annex 1 i.e. 2	Ød _{f1,fix}	[mm]	17	21	25	31

¹⁾Applies for applications using the T-FIXX

²⁾Applies for applications using 1988/1980-P

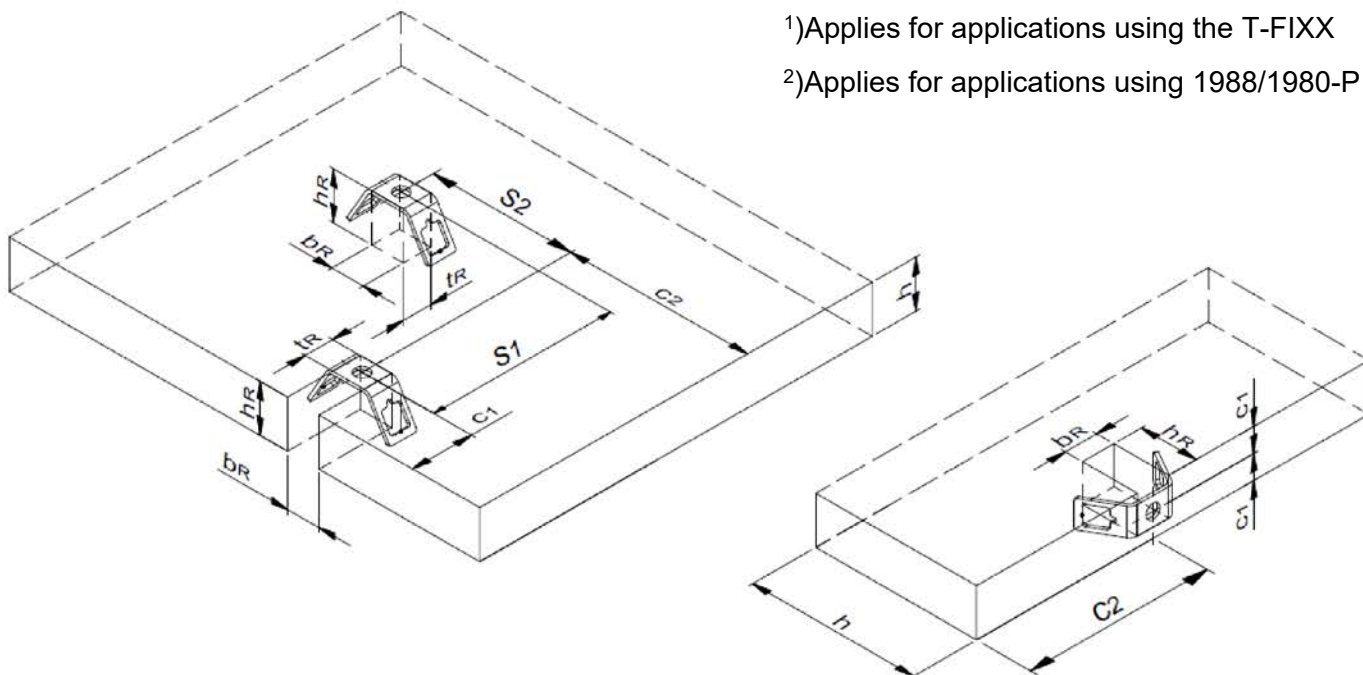


Table 11: Minimum values for edge distances and spacings and element thickness, dimensions of installation access hole, applicable characteristic values of precast couplers

			HEK2 T/L-100 HEK3-T/L	HEK2 T-150 HEK2 L-150 HEK2 U-150
Minimum edge distances	C _{1,min}	[mm]	50	75
	C _{2,min}	[mm]	225	321
Minimum spacing	S _{1,min}	[mm]	250	360
	S _{2,min}	[mm]	450	642
Minimum thickness of concrete member	h _{min}	[mm]	100	150
Maximum height of installation access hole	h _{R,max}	[mm]	125	175
Width of installation access hole	b _R	[mm]	74	120
Depth of installation access hole at precast coupler	t _R	[mm]	72	130
Effective anchorage depth of precast coupler	h _{ef}	[mm]	83	120
Effective distance between the sides of precast coupler	S _{ef}	[mm]	200	282

HALFEN HEK Precast coupler for connection of precast concrete elements

Installation parameters and position in precast concrete member

Annex 12

Table 12: Characteristic resistances under tensile stress

			HEK2 T/L-100 HEK3-T/L	HEK2 T/L-150 HEK2 U-150
Steel fracture of precast coupler				
Characteristic resistance	$N_{RK,S}$	[kN]	40.4	76.3
Characteristic resistance			62,6 (M16)	-
Central pull, HEK3-T/L in acc. with annex 3 and 4			69,9 (M20)	-
Associated partial safety factor	γ_{Ms}	[-]	1.84	1.84
Concrete cone failure				
Factor k_1 for consideration of anchor mechanism in cracked and uncracked concrete	$k_{1,cr}$	[-]	7.13	7.13
	$k_{1,ucr}$	[-]	9.99	9.99
Characteristic spacing	$s_{cr,N}$	[mm]	250	360
Characteristic edge distance	$c_{cr,N}$	[mm]	125	180
Existing projection area of idealised concrete cone failure after deduction of projected area of installation access hole	$A_{c,N}$	[mm ²]	See Fig. 1	See Fig. 1
Partial safety factor	γ_{Mc}	[-]	1.50	1.50
Pull-out of precast coupler				
Characteristic resistance	$N_{RK,p}$	[kN]	not applicable	not applicable
Failure through splitting of concrete				
Characteristic spacing	$s_{cr,sp}$	[mm]	250	360
Characteristic edge distance	$c_{cr,sp}$	[mm]	125	180
Factor for consideration of member thickness	$\psi_{h,sp}$	[-]	Eq. ¹⁾	Eq. ¹⁾
Partial safety factor	γ_{Msp}	[-]	1.50	1.50
¹⁾ $\psi_{h,sp} = \left(\frac{h}{2 \cdot h_{ef}} \right)^{2/3} \leq \max \left\{ 1; \left(\frac{h_{ef} + 1.5 \cdot c_1}{2 \cdot h_{ef}} \right)^{2/3} \right\} \leq 2$ In case of several element edges, (such as a precast coupler on one element corner or in a small element), the smallest edge distance c_1 must be applied.				
Failure through local concrete blow-out failure				
Factor k_5 for consideration of anchor mechanism in cracked and uncracked concrete	$k_{5,cr}$	[-]	6.71	6.71
	$k_{5,ucr}$	[-]	9.37	9.37
Load-transferring contact area of one side of the precast coupler	A_h	[mm ²]	400	600
Existing projection area of idealised concrete cone failure after deduction of projected area of installation access hole	$A_{c,Nb}$	[mm ²]	See Fig. 2	See Fig. 2
Partial safety factor	γ_{Mc}	[-]	1.50	1.50

HALFEN HEK Precast coupler for connection of precast concrete elements

Characteristic resistances under tensile stress

Annex 13

Table 12 (continued): Characteristic resistances under tensile stress

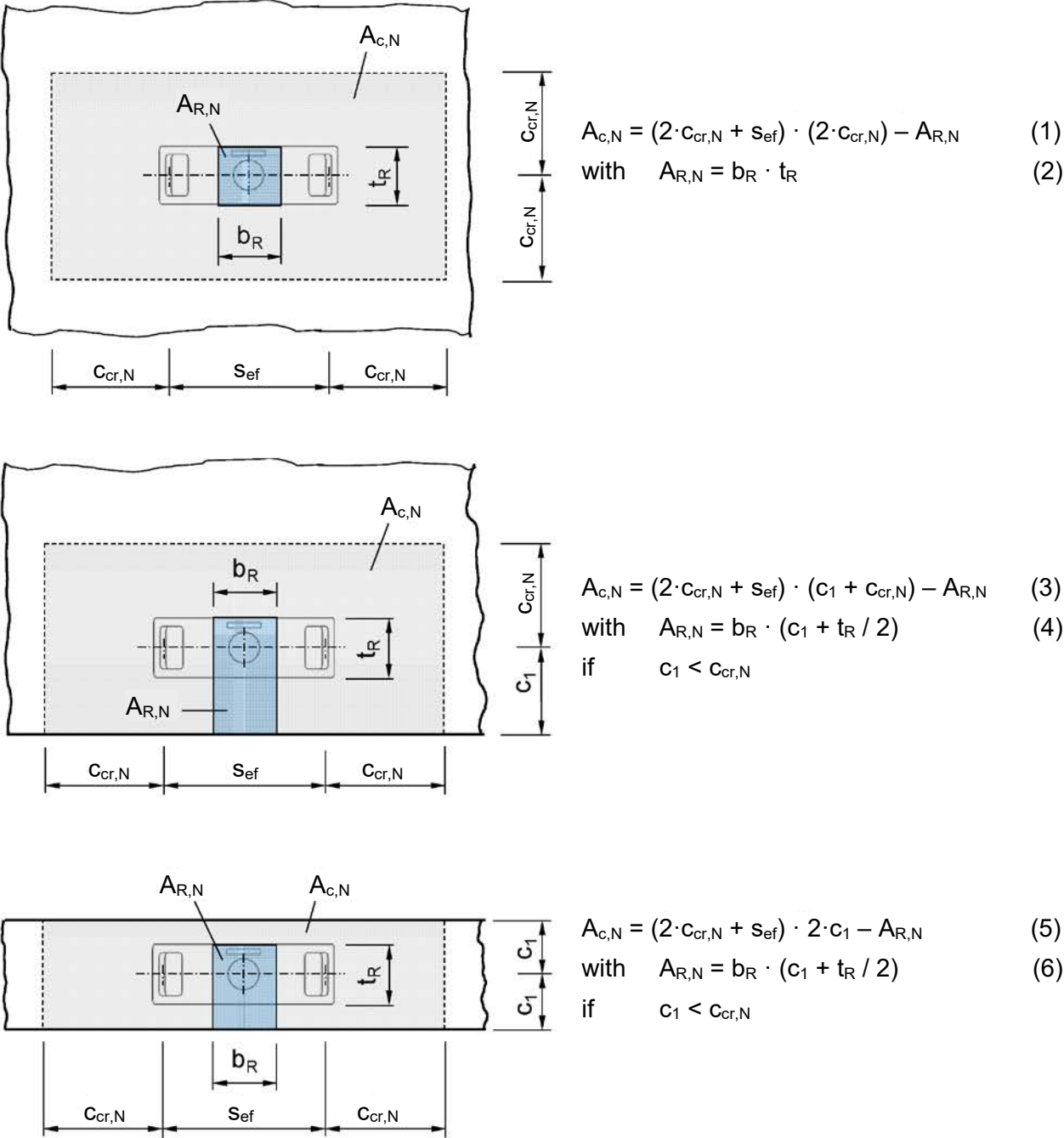


Fig. 1: Examples for existing projected areas $A_{c,N}$ of an idealised concrete cone failure as well as projected areas of installation access hole $A_{R,N}$ for different positions of the precast coupler under central tensile stress

HALFEN HEK Precast coupler for connection of precast concrete elements

Characteristic resistances under tensile stress

Annex 14

Table 12 (continued): Characteristic resistances under tensile stress

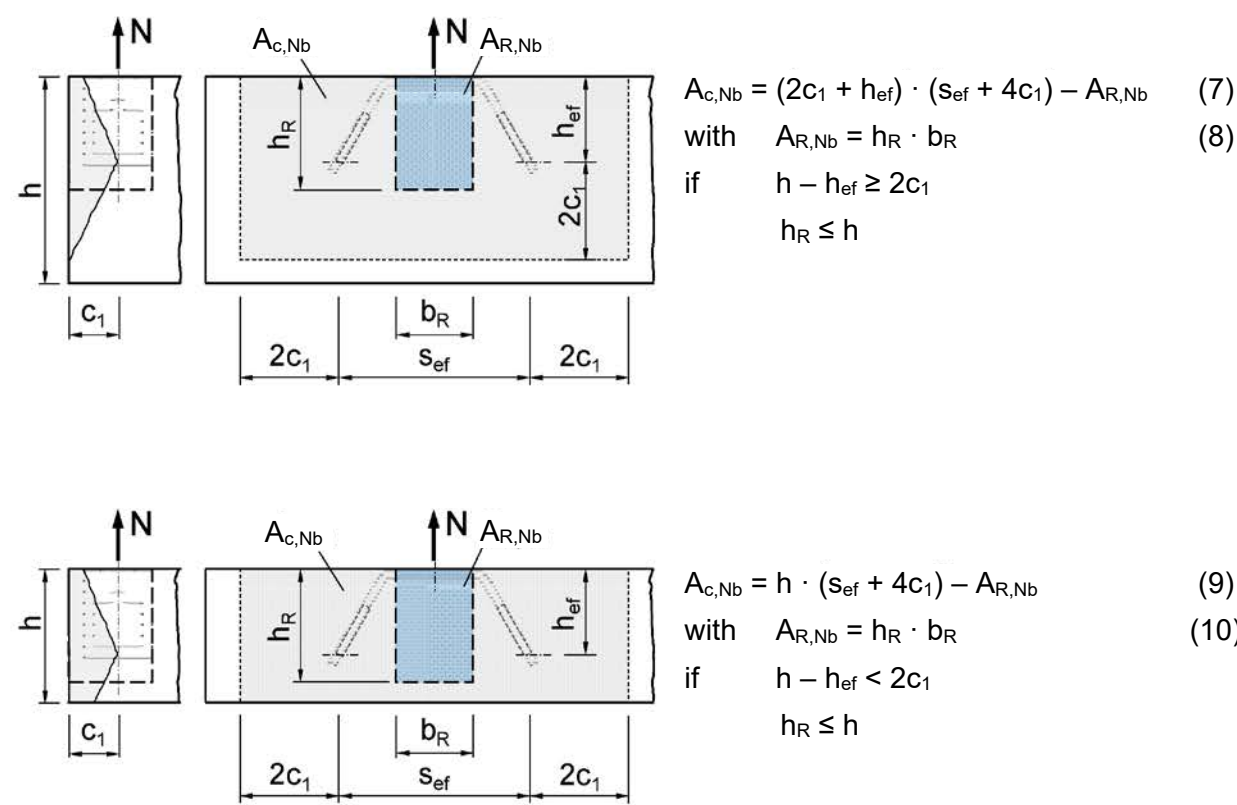


Fig. 2: Examples for existing projected areas $A_{c,Nb}$ of an idealised concrete cone failure as well as projected areas of installation access hole $A_{R,Nb}$ for different positions of the precast coupler in the event of local concrete blow-out failure.

HALFEN HEK Precast coupler for connection of precast concrete elements	Annex 15
Characteristic resistances under tensile stress	

Note: This translation of the original German version has not been verified by the Deutsches Institut für Bautechnik.

Table 13: Characteristic resistances under shear stress

			HEK2 T/L-100 HEK3-T/L	HEK2 T-150 HEK2 L-150 HEK2 U-150
Steel fracture of precast coupler				
Factor k_7	k_7	[-]	1.0	1.0
Characteristic resistance	$V_{Rk,s}^0$	[kN]	43.2 / 40,9 ²⁾	62.1
Associated partial safety factor	γ_{Ms}	[-]	1.53	1.53
Concrete pry-out failure on non-load side				
Factor k_8	k_8	[-]	1.0	1.0
Partial safety factor	γ_{Mc}	[-]	1.50	1.50
Concrete edge failure ¹⁾				
Effective anchor length under shear stress	l_f	[mm]	83	120
Effective outer diameter	d_{nom}	[mm]	60	60
Factor k_9 for consideration of anchor mechanism in cracked and uncracked concrete	$k_{9,cr}$	[-]	1.34	1.34
	$k_{9,ucr}$	[-]	1.87	1.87
Existing projection area of an idealized concrete cone failure after deduction of projected area of installation access hole	$A_{c,v}$	[mm ²]	See Fig. 3	See Fig. 3
Partial safety factor	γ_{Mc}	[-]	1.50	1.50
¹⁾ With precast couplers with more than one element edge, verification is only required for the edge distance c_1 in the direction of shear stress. ²⁾ only applies to HEK3-T/L				

HALFEN HEK Precast coupler for connection of precast concrete elements

Characteristic resistances under shear stress

Annex 16

Table 13 (continued): Characteristic resistances under shear stress

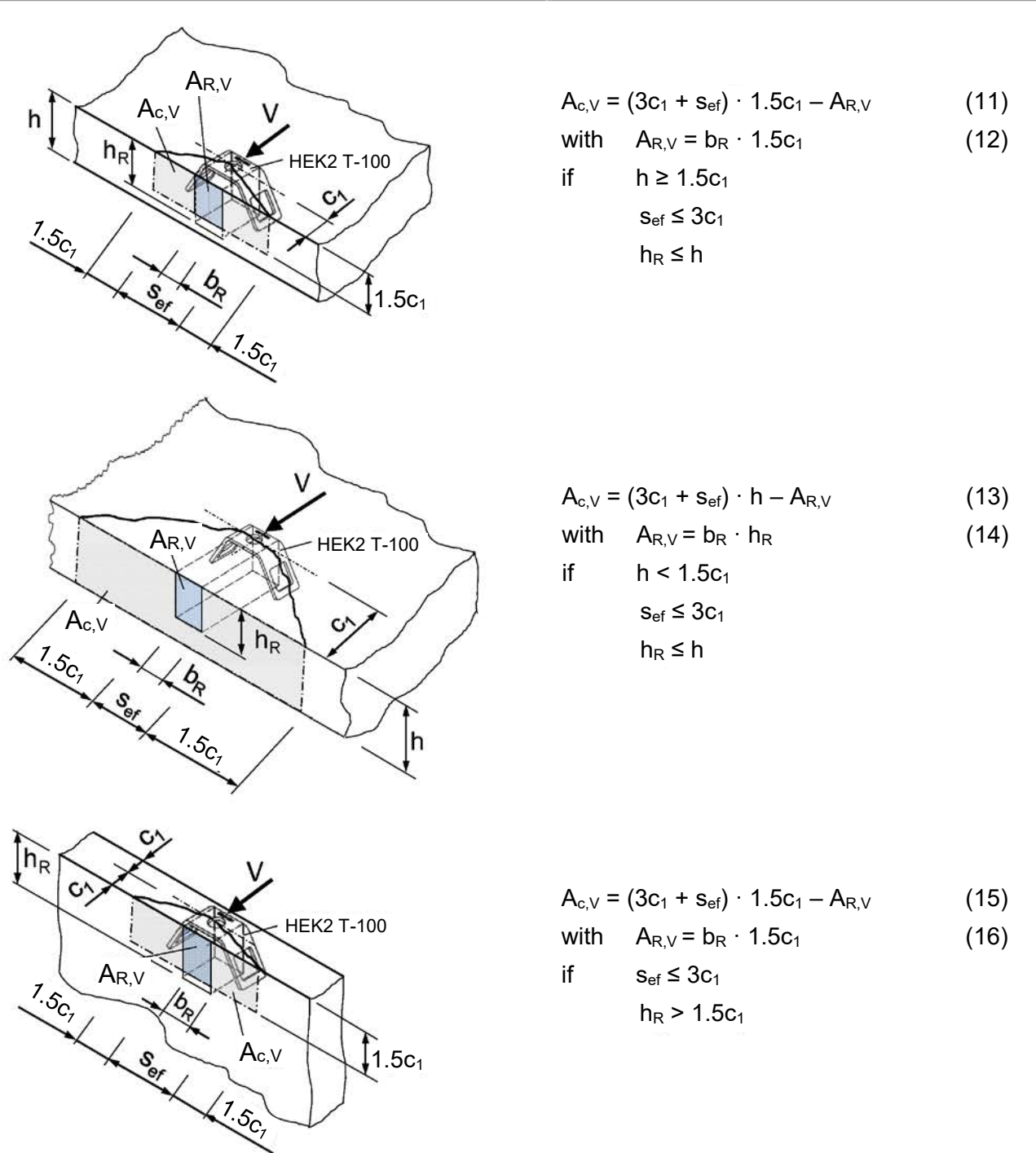
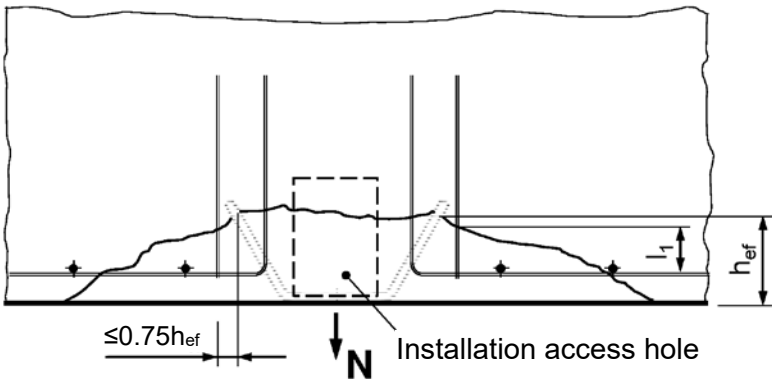


Fig. 3: Examples for existing projected areas $A_{c,V}$ of the idealised concrete cone failure as well as projected areas of installation access hole $A_{R,V}$ for different positions of the precast coupler HEK2 T-100 and HEK3-T under shear stress

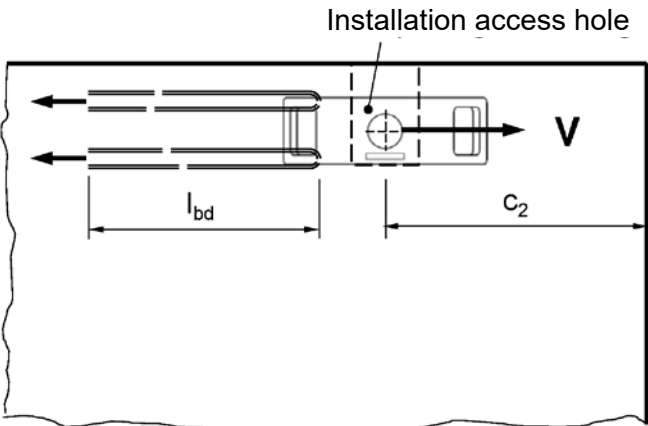
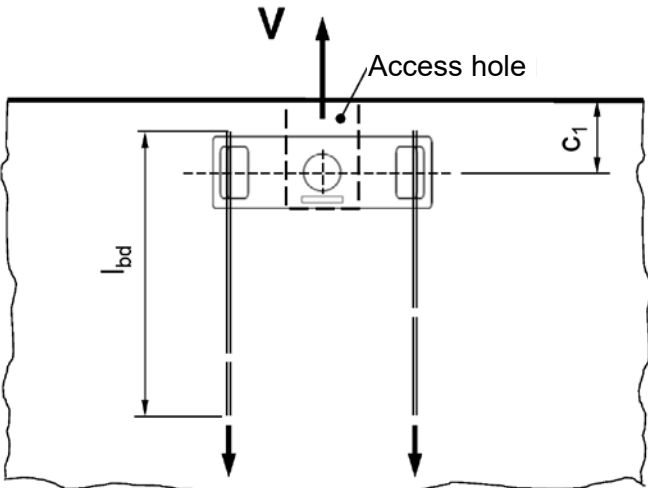
HALFEN HEK Precast coupler for connection of precast concrete elements	Annex 17
Characteristic resistances under shear stress	

Note: This translation of the original German version has not been verified by the Deutsches Institut für Bautechnik.

Additional reinforcement under tensile stress



Additional reinforcement in case of shear stress



Design value of anchor length l_{bd} in accordance with DIN EN 1992-1-1:2011-01 in conjunction with DIN EN 1992-1-1/NA:2013-04

HALFEN HEK Precast coupler for connection of precast concrete elements	Annex 18
Detailing of additional reinforcement	