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**Technical authority granting approvals
and permits for construction products
and construction techniques**

Date:

Reference number:

11 Feb 2022

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National technical approval / General construction technique permit

Number:

Z-21.8-2035

Applicant:

Leviat GmbH

Liebigstraße 14

40764 Langenfeld, Germany

Validity

from: **1 January 2022**

to: **6 December 2024**

Subject of decision:

HALFEN HBT Rebend connection for the connection of reinforced concrete members

The subject named above is herewith granted a national technical approval (*allgemeine bauaufsichtliche Zulassung*)/general construction technique permit (*allgemeine Bauartgenehmigung*).

This decision contains six pages and five annexes.

This national technical approval / general construction technique permit replaces national technical approval / general construction technique permit no. Z-21.8-2035 of 3 December 2019. The subject concerned was granted the first national technical approval on 5 December 2014.

Translation authorised by DIBt

DIBt

I GENERAL PROVISIONS

- 1 This decision confirms the fitness for use and application of the subject concerned within the meaning of the Building Codes of the federal states (*Landesbauordnungen*).
- 2 This decision does not replace the permits, approvals and certificates required by law for carrying out construction projects.
- 3 This decision 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 decision shall be made available to the user and installer of the subject concerned. The user and installer of the subject concerned shall also be made aware that this decision must be made available at the place of use or place of application. Upon request, copies of the decision shall be provided to the authorities involved.
- 5 This decision shall be reproduced in full only. Partial publication requires the consent of DIBt. Texts and drawings in promotional material shall not contradict this decision. In the event of a discrepancy between the German original and this authorised translation, the German version shall prevail.
- 6 This decision may be revoked. The provisions contained herein may subsequently be supplemented and amended, in particular if this is required by new technical findings.
- 7 This decision is based on the information and documents provided by the applicant. Alterations to this basis are not covered by this decision and shall be notified to DIBt without delay.

II SPECIAL PROVISIONS

1 Subject concerned and field of use and application

1.1 Subject of approval and field of use

The subject of approval is the HALFEN HBT Rebend connection made of bent rebars of 8, 10 or 12 mm diameter made of reinforcing steel B500B or stainless steel B500°NR in a casing of galvanised steel.

The rebend connection is used for connecting reinforced concrete members.

1.2 Subject of the permit and field of application

The subject of the permit is the planning, design and execution of the HALFEN HBT Rebend connection for the connection of reinforced concrete members from different concreting sections.

The installed rebend connection is shown in Annex 1.

The reinforcing steel bars protrude from casings with a corrugated back which are concreted in with a sheet steel cover so they are flush with the surface.

The rebend connection may be applied for the connection of members under static, quasi-static as well as fatigue-relevant loading, in reinforced or unreinforced normal weight concrete with a minimum strength class of C20/25 in accordance with DIN EN 206-1:2001-07 'Concrete – Part 1: Specification, performance, production and conformity'.

2 Provisions for the construction product

2.1 Properties and composition

The components of the rebend connection shall correspond to the drawings and specifications given in the annexes.

The material characteristics, dimensions and tolerances which are not specified in this national technical approval shall comply with the specifications deposited with DIBt.

2.2 Manufacture and marking

2.2.1 Manufacture

The rebend connections and the casings shall be assembled at the factory.

2.2.2 Marking

Each delivery note shall be marked by the manufacturer with the national conformity mark (*Ü-Zeichen*) in accordance with the Conformity Marking Ordinances (*Übereinstimmungszeichen-Verordnungen*) of the federal states. The identifying mark of the manufacturing plant, the approval number and the complete designation shall also be indicated on the delivery note.

The mark shall only be applied if the requirements given in Section 2.3 are met.

Each rebend connection shall be marked in accordance with Annex 2.

2.3 Confirmation of conformity

2.3.1 General

The manufacturer shall confirm for each manufacturing plant that the rebend connection complies with the provisions of this national technical approval by way of a declaration of conformity based on factory production control and a certificate of conformity issued by a recognised certification body, as well as by way of regular external surveillance carried out by a recognised inspection body in accordance with the following provisions.

To grant the certificate of conformity and for external surveillance, including the associated product testing, the manufacturer of the rebend connection shall use a certification body and an inspection body recognised for these purposes.

The declaration of conformity shall be submitted by the manufacturer through marking of the rebend connection with the national conformity mark including statement of the intended use.

The certification body shall send a copy of the certificate of conformity issued by it to DIBt.

2.3.2 Factory production control

A factory production control system shall be set up and implemented in each manufacturing plant. Factory production control shall be understood to be continuous surveillance of production by the manufacturer to ensure that the manufactured construction products satisfy the provisions of this national technical approval.

Scope, type and frequency of factory production control shall be in accordance with the test plan deposited with DIBt and the external surveillance body.

The results of factory production control shall be recorded and evaluated. The records shall include at least the following information:

- designation of the construction product or the starting material and the components
- type of check or test
- date of manufacture and testing of the construction product or the starting material or the components
- results of checks and tests and, where applicable, comparison with the requirements
- signature of the person responsible for factory production control.

The records shall be kept for at least five years and submitted to the inspection body used for external surveillance. They shall be submitted to DIBt and the competent supreme building authority upon request.

If the test result is unsatisfactory, the manufacturer shall immediately take the necessary measures to resolve the defect. Construction products which do not meet the requirements shall be handled in such a way that they cannot be confused with compliant products. After the defect has been remedied, the relevant test shall be repeated immediately - where technically feasible and necessary to show that the defect has been eliminated.

2.3.3 External surveillance

The factory production control at each manufacturing plant shall be inspected regularly by means of external surveillance.

Within the framework of external surveillance, initial type-testing of the rebend connection and sample testing shall be carried out. Sampling and testing shall be the responsibility of the recognised inspection body.

Scope, type and frequency of factory production control shall be in accordance with the test plan deposited with DIBt and the external surveillance body.

The results of certification and external surveillance shall be kept for at least five years. They shall be presented by the certification or inspection body to DIBt and the competent supreme building authority upon request.

3 Provisions for planning, design and execution

3.1 Planning

The connections shall be planned by a qualified engineer in accordance with DIN EN 1992-1-1:2011-01 in conjunction with DIN EN 1992-1-1/NA:2013-04 as well as leaflet 'Rebending of reinforcing steel and requirements of protective boxes according to Eurocode 2' (*Rückbiegen von Betonstahl und Anforderungen an Verwahrkästen nach Eurocode 2*), January 2011, by the German Concrete and Construction Technology Association (DBV). Verifiable calculations and design drawings shall be prepared taking into account the loads to be transferred.

For fatigue-relevant loading, the bending roll diameter during the initial bending process shall be $\geq 15 \varnothing$ ($\varnothing$ = nominal bar diameter). The range of the steel stress shall not exceed 50 N/mm².

The design drawings shall contain precise information on the position, size or type and dimensions of the rebend connections (casings, rebend reinforcement).

For the detailing of concrete members to be connected in the joint area, the following information and additions shall be observed. For loads longitudinal to the joint, the information provided in Annex 5 shall apply additionally.

The allowance of the concrete cover Δc_{dev} in accordance with DIN EN 1992-1-1:2011-01 may be reduced by 5 mm for the casing sheet. The anchor and lap length of the rebend reinforcement may be calculated starting from the surface of the casings.

3.2 Design

The connections shall be designed in accordance with DIN EN 1992-1-1:2011-01 in conjunction with DIN EN 1992-1-1/NA:2013-04 taking into account Clause 5.3 of the DBV leaflet 'Rebending of reinforcing steel and requirements of protective boxes according to Eurocode 2', January 2011.

Deviating provisions included in this national technical approval / general construction technique permit shall be taken into account.

The load-bearing capacity of the rebend reinforcement provided by the rebend connection shall only be utilised up to 80%. For this reason, a reduced design yield strength $f_{yd,red}$ shall be applied:

$$f_{yd,red} = 0.8 \times f_{yk} / \gamma_s$$

When determining the shear resistances perpendicular and longitudinal to the construction joint, the supplementary provisions set out in Annexes 4 and 5 shall be observed.

In case of load combinations of shear loading perpendicular and longitudinal to the joint, the verification shall be carried out separately for each load direction.

The transfer of the loads to be anchored in the concrete members shall be verified.

3.3 Execution

3.3.1 General

The execution shall take into account the specifications on cold-rebending and casings set out in Clauses 3 and 5.4 of the DBV leaflet 'Rebending of reinforcing steel and requirements of protective boxes according to Eurocode 2', January 2011.

The installer of the construction technique or the executing company shall provide a declaration of conformity in accordance with Sections 16a(5) and 21(2) of the Model Building Code to confirm the conformity of the construction technique with this general construction technique permit.

3.3.2 Installation of rebend connection

The rebend connection shall be installed in accordance with the design drawings prepared in accordance with Section 3.1. The rebend connection shall be fixed to the formwork in such a way that it will remain in place during the laying of the reinforcement and the pouring and compacting of the concrete. The concrete shall be properly compacted in the area of the casings and the associated reinforcement. The casings shall be protected against concrete penetrating into the interior.

3.3.3 Rebending of the reinforcement in the connection position

After stripping the formwork, the sheet steel cover of the rebend connection shall be removed. Rebending shall only be permitted with suitable tools. The installation instructions of the manufacturer shall be observed.

The reinforcement may be rebent (cold-bending) at temperatures down to -5 °C.

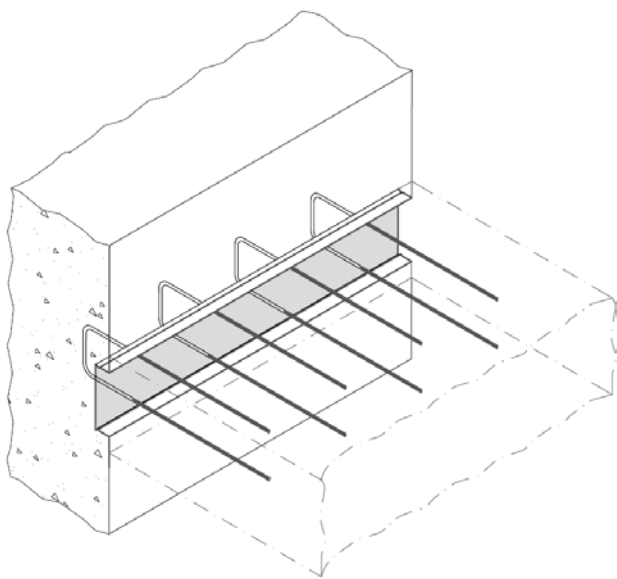
3.3.4 Inspection of execution

During the installation of the rebend connection, the contractor commissioned with the manufacture of the connection or the site manager assigned by them or a competent representative of the site manager shall be present at the construction site. They shall ensure that the work is executed properly. In particular, they shall check the execution and positioning.

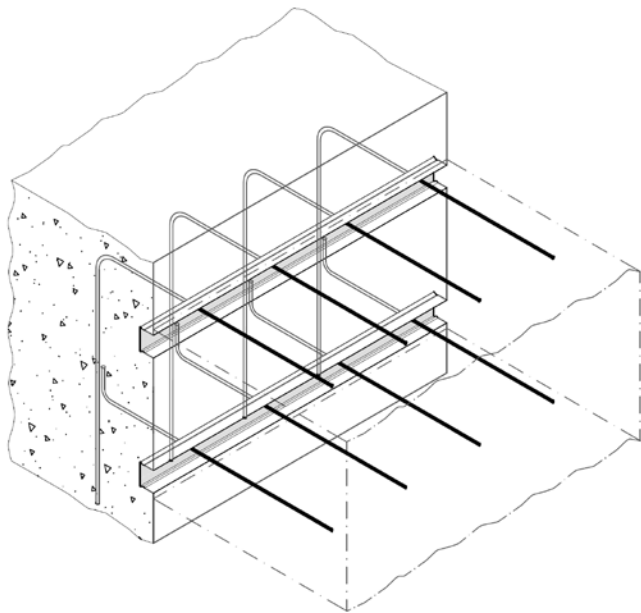
The records relating to this shall be available at the construction site during the construction period and shall be submitted to the inspection supervisor upon request. Like the delivery notes, they shall be kept by the contractor for a minimum of 5 years after completion of the project.

Beatrix Wittstock
Head of Section

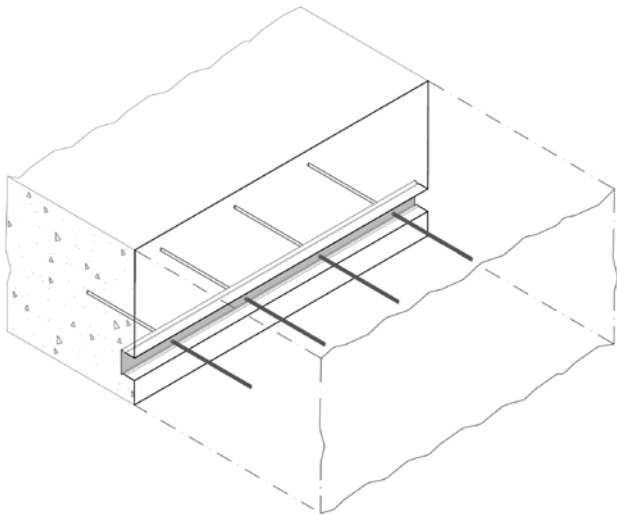
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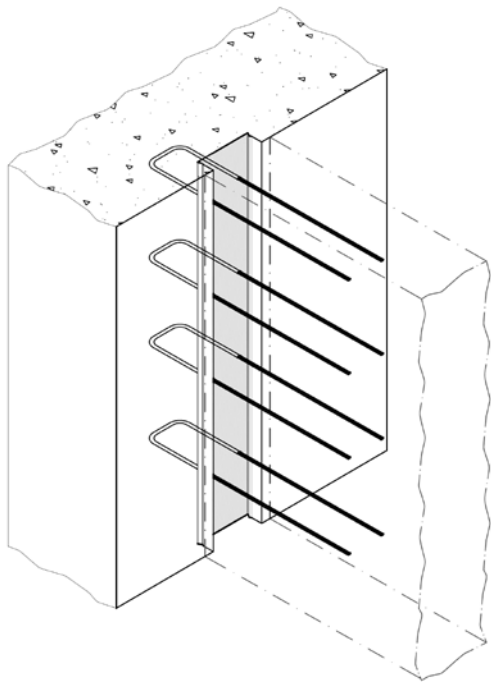
a) Floor/wall



b) Platform/wall



c) Floor/floor



d) Wall/wall

Figure 1: Application examples for the installation of HALFEN HBT Rebend connections

HALFEN HBT Rebend connection	Annex 1
Installed condition	

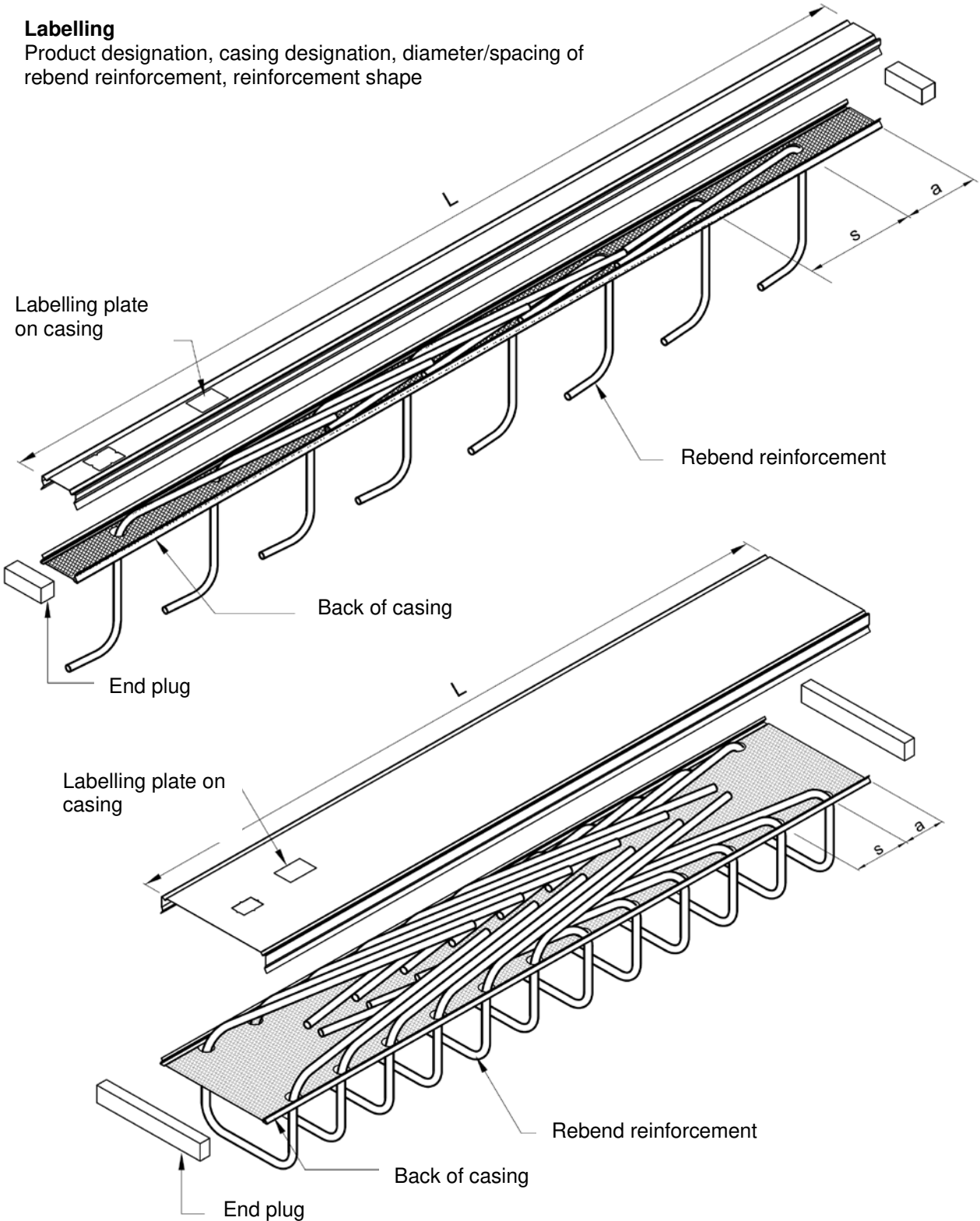


Figure 2: Setup of casing, rebend reinforcement (one or two layers)

HALFEN HBT Rebend connection

Product and designations

Annex 2

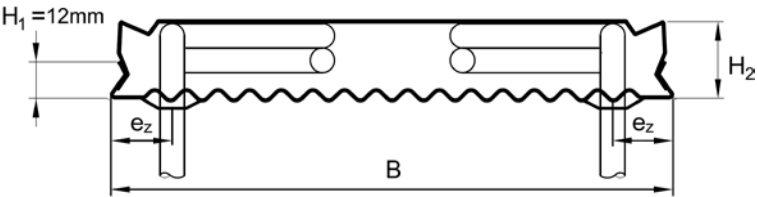


Figure 3: Cross-section of casing

Table 1: Rebend reinforcement

Material	B500B, B500NR
Bar diameter ϕ [mm]	8, 10, 12
Nominal spacing s [cm]	10, 15, 20, 25

Table 2: Casing

Casing designation HBT	55	80	85	120	150	190	220
No. of reinforcement layers	1	2	1	1; 2	2	2	2
Width casing back B [mm]	58	86	86	122	150	186	222
Distance reinforcement / casing edge e_z [mm]	21	18	21	21	21	21	21
Standard casing height H_2	$H_2 = 3 \cdot \phi$						
Material: sheet steel, galvanised, casing back corrugated							

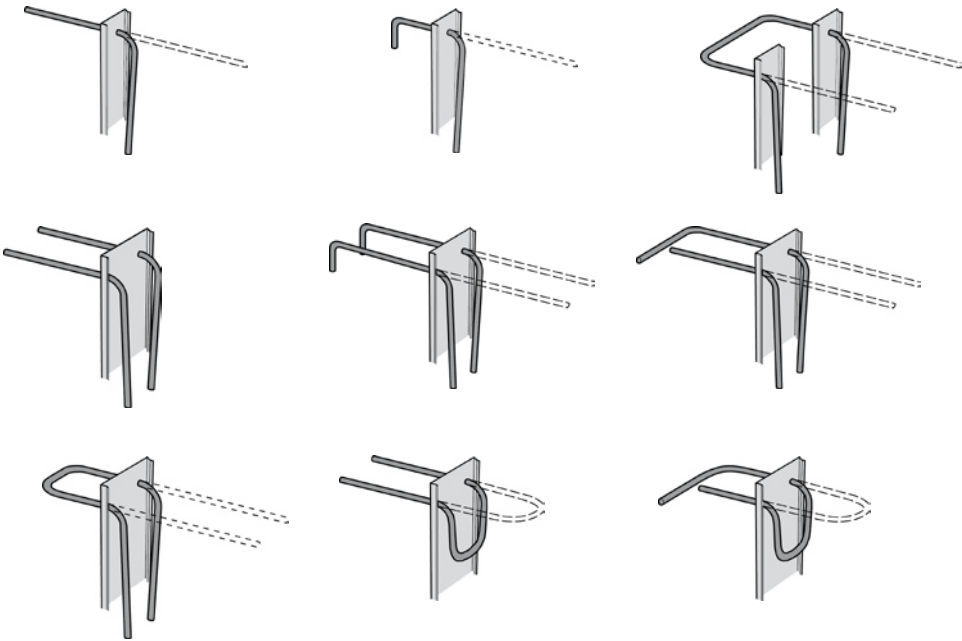
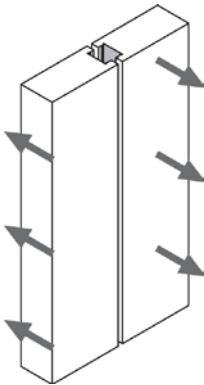


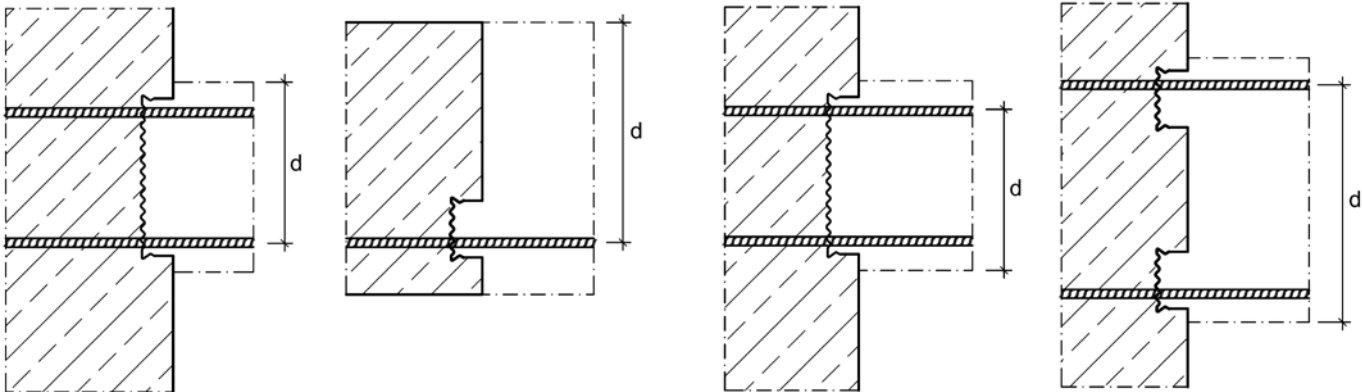
Figure 4: Variants of rebend reinforcement, examples

HALFEN HBT Rebend connection	Annex 3
Product and execution	

1. Design for shear loading perpendicular to the joint



Verification is carried out in accordance with DIN EN 1992-1-1:2011-01, Clause 6.2 and DIN EN 1992-1-1/NA:2013-04, in the same way as for monolithic members. The following supplementary provisions shall be observed.



a) Tension zone at bottom edge of member b) Tension zone at top edge of member

Figure 5: Position of reinforcement subject to loading and associated effective depth d

Design shear resistance without shear reinforcement: The decisive resistance $V_{Rd,c}$ for the verification results from DIN EN 1992-1-1:2011-01, Clause 6.2.2. A reduction of the reinforcement ratio ρ_l of the rebend connection is not required here (due to the reduced yield strength).

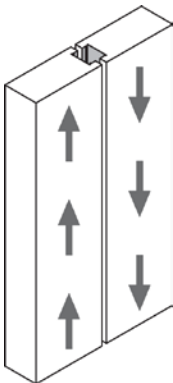
Design shear resistance with shear reinforcement: The decisive resistance for the verification is 30% of the design shear resistance $V_{Rd,max}$ resulting from DIN EN 1992-1-1:2011-01, Clause 6.2.3:

$$V_{Ed} \leq 0,3 \cdot V_{Rd,max}$$

The additional stress on the longitudinal reinforcement resulting from the shear force shall be verified using a strut angle of 45° ($\cot \theta = 1.0$). The required design shear reinforcement shall be determined using $\cot \theta = 1.0$.

HALFEN HBT Rebend connection	Annex 4
Design	

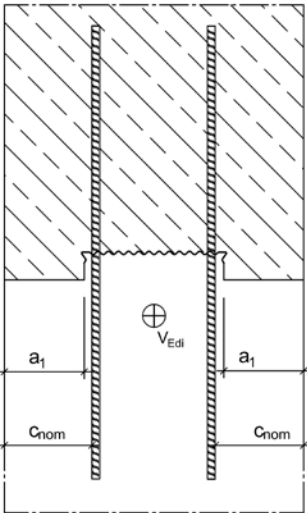
2. Design for shear loading along the longitudinal axis of the joint



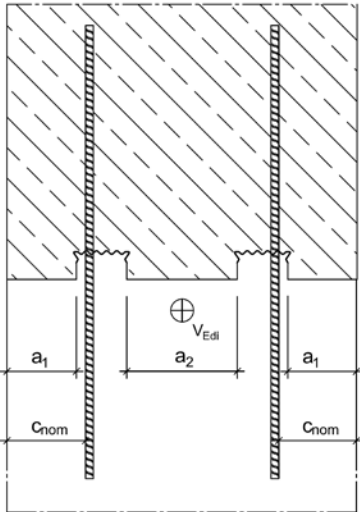
Verification is carried out in accordance with DIN EN 1992-1-1:2011-01, Clause 6.2.5 and DIN EN 1992-1-1/NA:2013-04. The following supplementary provisions shall be observed.

The coefficients for the determination of the design shear resistance are

- $c = 0.4$ standard, $c = 0$ for fatigue-relevant loading,
- $\mu = 0.7$,
- $v = 0.5$.



a) Single



b) Multiple

Figure 6: Execution variants, designations

If joint area a_2 between two casings is also to be used for the transfer of shear forces, the joint shall be rough or toothed in accordance with DIN EN 1992-1-1:2011-01. In addition, the contribution of the edge areas a_1 to the design resistance may be factored in provided that a_1 is ≥ 50 mm.

The concrete cover c_{nom} shall be designed in accordance with DIN EN 1992-1-1:2011-01. For the rebend reinforcement,
 $c_{nom} \geq \max \{3\phi, 30 \text{ mm, maximum nominal aggregate size } d_g\}$
shall also be adhered to.

HALFEN HBT Rebend connection	Annex 5
Design	