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# European Technical Assessment

**ETA-20/0842**  
of 13.11.2020

General part

## Technical Assessment Body issuing the European Technical Assessment

Österreichisches Institut für Bautechnik (OIB)  
Austrian Institute of Construction Engineering

## Trade name of the construction product

Ferbox Re-bend connection 1-C and 2-C

## Product family to which the construction product belongs

Re-bend connection

## Manufacturer

H-Bau Technik GmbH  
Am Güterbahnhof 20  
79771 Klettgau  
Germany

## Manufacturing plant

H-Bau Technik GmbH  
Am Güterbahnhof 20  
79771 Klettgau  
Germany

## This European Technical Assessment contains

22 pages including Annexes 1 to 9, which form an integral part of this assessment.  
Annex 10 contains confidential information and is not included in the European Technical Assessment when that assessment is publicly disseminated.

## This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of

EAD 160031-00-0301,  
European Assessment Document, "Re-bend  
connection".

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## Remarks

Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and should be identified as such.

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## Specific parts

### 1. Technical description of the product

#### 1.1 General

This European Technical Assessment – ETA – applies to the

### **Ferbox Re-bend connection 1-C and 2-C.**

The Ferbox Re-bend connection 1-C and 2-C consists of bent ribbed reinforcing steel bars in a casing of galvanized steel sheet, see Annex 1. 1-C has 1 casing, 2-C has 2 casings. The casing has a profiled backside that provides the interface between the two concrete members to be connected, see Annex 2. The ribbed reinforcing bars protrudes from the profiled backside of the casing. The casing is closed to a tight box with a cover of the same steel sheet as the casing or of plastic material.

#### 1.2 Components

The Ferbox Re-bend connection 1-C and 2-C consists of the following components:

- ribbed reinforcing steel bars
- casing
- cover

The ribbed reinforcing steel bars have nominal diameters,  $d_s$ , from 8 mm up to 14 mm. Distances of the ribbed reinforcing steel bars are in the range from  $l_4 = 75$  mm to  $l_4 = 300$  .

Bending of the ribbed reinforcing steel bars is made by a specific mandrel diameter for Ferbox Re-bend connection 1-C and 2-C. Mandrel diameter is  $d_{BR} = 6 \cdot d_s$ . The position of the offset of the bent steel bars is ensured by the casing.

The casing is made of galvanised steel sheet in DX51D, DX53D, or DX54D.

The steel sheet of the casing has a nominal thickness of  $t = 0.50$  mm. Depth of the casing with cover,  $F$ , is:

- $F = 30$  mm for ribbed reinforcing steel bars with the nominal diameter up to  $d_s = 10$  mm
- $F = 40$  mm for ribbed reinforcing steel bars with the nominal diameter  $d_s = 12$  mm and upwards

The cover is made of same steel sheet as the casing or of plastic material.

### 2. Specification of the intended use in accordance with the applicable European Assessment Document (hereinafter EAD)

#### 2.1 Intended use

The Ferbox Re-bend connection 1-C and 2-C is used for the connection of concrete members (e.g. slabs), which are concreted in subsequent stages.

The Ferbox Re-bend connection 1-C and 2-C is attached to the formwork of the first construction stage. After concreting, the cover is removed and the ribbed reinforcing steel bars are re-bend with a re-bending tool. The offset of the steel bar due to the re-bending is limited. The formwork of the next construction stage is then installed and concreted with the re-bent bars.

The Ferbox Re-bend connection 1-C and 2-C is subjected to static and quasi static actions only.

## **2.2 Assumptions**

### **2.2.1 General**

Concerning product packaging, transport, storage, maintenance, replacement, and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on transport, storage, maintenance, replacement, and repair of the product as he considers necessary.

### **2.2.2 Recommendations on packaging, transport, and storage**

During transportation and storage the Ferbox Re-bend connection 1-C and 2-C shall be handled with care. The Ferbox Re-bend connection 1-C and 2-C shall be protected during transport and storage against any damage. Depending on weather conditions, the re-bend connection shall be covered if necessary.

### **2.2.3 Design**

The European Technical Assessment only applies to the assessment of the Ferbox Re-bend connection 1-C and 2-C. Verification of stability of the works is not subject to the European Technical Assessment.

The following conditions shall be observed:

- Design of the Ferbox Re-bend connection 1-C and 2-C is carried under the responsibility of an engineer experienced in reinforced concrete. The specifications of Annex 1 to Annex 9 are considered.
- The Ferbox Re-bend connection 1-C and 2-C is installed correctly.

The manufacturer has to ensure that all necessary information concerning planning and installation is made known to those who are responsible for planning and execution of structures with the Ferbox Re-bend connection 1-C and 2-C.

### **2.2.4 Installation**

#### **2.2.4.1 General**

It is assumed that the Ferbox Re-bend connection 1-C and 2-C will be installed according to the manufacturer's instructions or – in absence of such instructions – according to the usual practice of the building professionals. An installation procedure to be applied in absence of standards and regulations in force at the place of use is given in Annex 7.

For each structure, an assembly plan is to be drawn up that contains the order in which the individual Re-bend connection are installed and the name of the individual Re-bend connection. The assembly plan shall be available at the construction site.

The casing with the protruding ribbed reinforced steel bars is fastened to the shuttering of the first construction stage. After concreting the first construction stage, the cover of the casing is removed and the ribbed reinforcing steel bars are re-bended by means of a suitable tool (re-bending tool).

## **2.3 Assumed working life**

The European Technical Assessment is based on an assumed working life of the composite wall of 50 years, provided that the Ferbox Re-bend connection 1-C and 2-C is subject to appropriate installation, use, and maintenance, see Clause 2.2.

The real working life may in normal use conditions be considerably longer without major degradation affecting the basic requirements for construction works<sup>1</sup>.

The indications given as to the working life of the Ferbox Re-bend connection 1-C and 2-C cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by the Technical Assessment Body, but are regarded only as a means for selecting the appropriate products in relation to the expected economically reasonable working life of the works.

### 3. Performance of the product and references to the methods used for its assessment

#### 3.1 Essential characteristics

The performance of the Ferbox Re-bend connection 1-C and 2-C for the essential characteristics is given in Table 1.

Table 1: Essential characteristics and performances of the Ferbox Re-bend connection 1-C and 2-C and the ribbed reinforcing steel bars

No	Essential characteristic	Product performance
<b>Basic requirement for construction works<sup>2</sup> 1: Mechanical resistance and stability</b>		
<b>Ferbox Re-bend connection 1-C and 2-C</b>		
1	Shape	See Annex 5.
2	Dimensions	See Annex 5.
3	Mandrel diameter	See Annex 5.
4	Load bearing capacity – Shear force perpendicular to the joint	See Annex 5.
5	Load bearing capacity – Shear force along the joint	See Annex 5.
6	Tightness of the casing during concreting	See Annex 5.
7	Material of the casing	See Annex 5.
8	Resistance to corrosion	See Annex 5.
<b>Ribbed reinforcing steel bars</b>		
9	Nominal diameter of the ribbed reinforcing steel bars	See Annex 6.
10	Mass per metre	See Annex 6.
11	Yield strength $R_e$	See Annex 6.
12	Tensile strength $R_m$	See Annex 6.
13	Percentage total elongation at maximum force $A_{gt}$	See Annex 6.
14	Ratio tensile strength to yield strength $R_m / R_e$	See Annex 6.
15	Bendability	See Annex 6.
16	Relative rib area $f_R$	See Annex 6.
17	Rib spacing $c$	See Annex 6.
18	Rib inclination $\beta$	See Annex 6.
19	Rib height $h$	See Annex 6.

<sup>1</sup> The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works are subject, as well as on the particular conditions of design, execution, use, and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than the working life indicated above.

<sup>2</sup> Basic requirement for construction works as defined in Annex I of Regulation (EU) № 305/2011.

№	Essential characteristic	Product performance
<b>Basic requirement for construction works 2: Safety in case of fire</b>		
<b>20</b>	Reaction to fire	See Clause 3.2.

### 3.2 Performance of the product – Reaction to fire

Regarding reaction to fire, the performance of components made of steel or galvanized steel sheet is Class A1 without testing. The performance of plastic cover is class F.

### 3.3 Assessment methods

The assessment of the essential characteristics in Clause 3.1 of the Ferbox Re-bend connection 1-C and 2-C for the intended use and in relation to the requirements for mechanical resistance and stability, and for safety in case of fire in the sense of the basic requirements for construction works № 1 and 2 of Regulation (EU) № 305/2011 has been made in accordance with the European Assessment Document EAD 160031-00-0301<sup>3</sup> “Re-bend connection”.

### 3.4 Identification

The European Technical Assessment for the Ferbox Re-bend connection 1-C and 2-C is issued on the basis of agreed data<sup>4</sup> that identifies the product that has been assessed. Changes to materials, to composition or characteristics of the product, or to the production process could result in these deposited data being incorrect and should be immediately notified to Österreichisches Institut für Bautechnik before the changes are introduced. Österreichisches Institut für Bautechnik will decide whether or not such changes affect the European Technical Assessment, and, if so, whether further assessment or alterations to the European Technical Assessment are considered necessary.

By the accompanying documentation the Ferbox Re-bend connection 1-C and 2-C shall be clearly identifiable at delivery.

## 4. Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

### 4.1 System of assessment and verification of constancy of performance

According to Commission Decision 1997/597/EC, the system of assessment and verification of constancy of performance to be applied to the Ferbox Re-bend connection 1-C and 2-C is System 1+. System 1+ is detailed in Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014, Annex, point 1.1, and provides for the following items.

(a) The manufacturer shall carry out:

- (i) factory production control;
- (ii) further testing of samples taken at the manufacturing plant by the manufacturer in accordance with the prescribed test plan<sup>5</sup>.

<sup>3</sup> Standards and other documents referred to in the European Technical Assessment are listed in Annex 9.

<sup>4</sup> The technical file of the European Technical Assessment is deposited at Österreichisches Institut für Bautechnik.

<sup>5</sup> The prescribed test plan has been deposited with Österreichisches Institut für Bautechnik and is handed over only to the notified product certification body involved in the procedure for the assessment and verification of constancy of performance. The prescribed test plan is also referred to as control plan.



- (b) The notified product certification body shall decide on the issuing, restriction, suspension or withdrawal of the certificate of constancy of performance of the construction product on the basis of the outcome of the following assessments and verifications carried out by that body:
  - (i) an assessment of the performance of the construction product carried out on the basis of testing (including sampling), calculation, tabulated values or descriptive documentation of the product;
  - (ii) initial inspection of the manufacturing plant and of factory production control;
  - (iii) continuing surveillance, assessment and evaluation of factory production control;
  - (iv) audit-testing of samples taken by the notified product certification body at the manufacturing plant or at the manufacturer's storage facilities.

#### **4.2 AVCP for construction products for which a European Technical Assessment has been issued**

Notified bodies undertaking tasks under System 1+ shall consider the European Technical Assessment issued for the construction product in question as the assessment of the performance of that product. Notified bodies shall therefore not undertake the tasks referred to in Clause 4.1, point (b) (i).

### **5. Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD**

#### **5.1 Tasks for the manufacturer**

##### **5.1.1 Factory production control**

In the manufacturing plant the manufacturer shall establish and continuously maintain a factory production control. All procedures and specification adopted by the manufacturer shall be documented in a systematic manner. The factory production control shall ensure the constancy of performances of the Ferbox Re-bend connection 1-C and 2-C with regard to the essential characteristics.

The manufacturer shall only use raw materials supplied with the relevant inspection documents as laid down in the test plan. The incoming raw materials shall be subject to controls by the manufacturer before acceptance. Check of incoming materials shall include control of inspection documents presented by the manufacturer of the raw materials.

The results of factory production control shall be recorded and evaluated. The records shall be presented to the notified product certification body involved in continuous surveillance and shall be kept at least for ten years after the product has been placed on the market. On request, the record shall be presented to Österreichisches Institut für Bautechnik.

If test results are unsatisfactory, the manufacturer shall immediately implement measures to eliminate the defects. Products or components that are not in conformity with the requirements shall be removed. After elimination of the defects, the respective test – if verification is required for technical reasons – shall be repeated immediately.

##### **5.1.2 Declaration of performance**

The manufacturer is responsible for preparing the declaration of performance. When all the criteria of the assessment and verification of constancy of performance are met, including the certificate of constancy of performance of the construction product issued by the notified product certification body, the manufacturer shall draw up a declaration of performance.

#### **5.2 Tasks for the notified product certification body**

##### **5.2.1 Initial inspection of the manufacturing plant and of factory production control**

The notified product certification body shall verify the ability of the manufacturer for a continuous and orderly manufacturing of the Ferbox Re-bend connection 1-C and 2-C according to this

European Technical Assessment. In particular the following items shall be appropriately considered.

- Personnel and equipment;
- the suitability of the factory production control established by the manufacturer;
- full implementation of the control plan.

#### 5.2.2 Continuing surveillance, assessment, and evaluation of factory production control

The notified product certification body shall visit the factory at least once a year for routine inspection. In particular the following items shall be appropriately considered.

- The manufacturing process including personnel and equipment;
- the factory production control;
- the implementation of the control plan.

The results of continuous surveillance shall be made available on demand by the notified product certification body to Österreichisches Institut für Bautechnik. When the provisions of the European Technical Assessment and the test plan are no longer fulfilled, the certificate of constancy of performance of the construction product shall be withdrawn.

#### 5.2.3 Audit – testing of samples taken by the notified product certification body at the manufacturing plant or at the manufacturer's storage facilities

During surveillance inspections the notified product certification body takes samples of components of the Ferbox Re-bend connection 1-C and 2-C for independent testing.

Issued in Vienna on 13<sup>th</sup> November 2020  
by Österreichisches Institut für Bautechnik

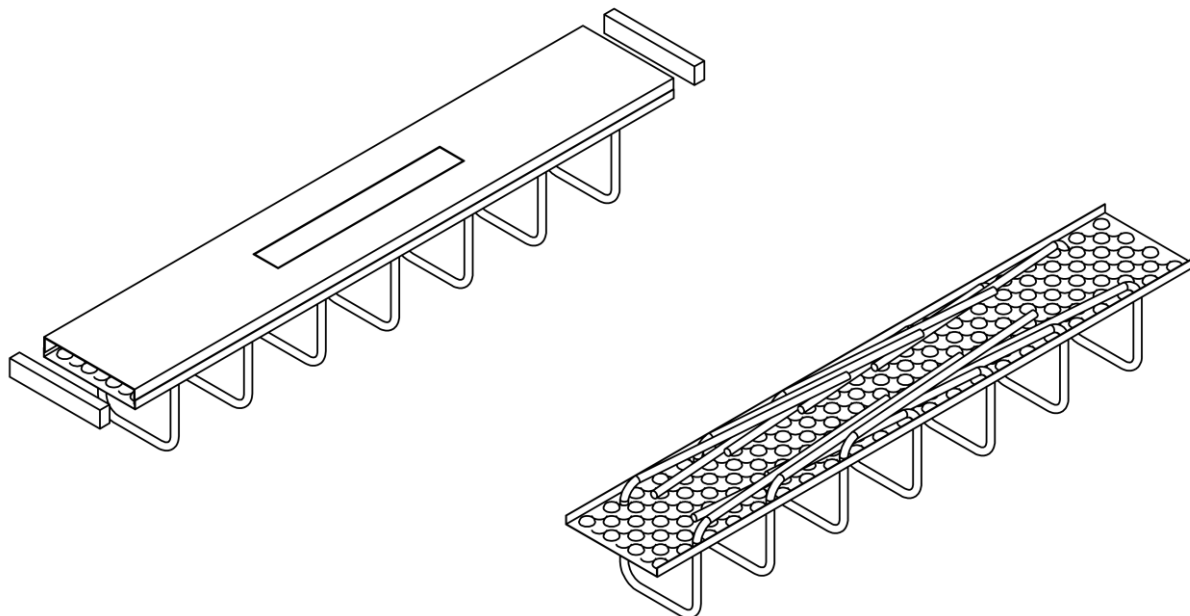
The original document is signed by

Rainer Mikulits  
Managing Director



### Shape and components

1-C:



2-C:

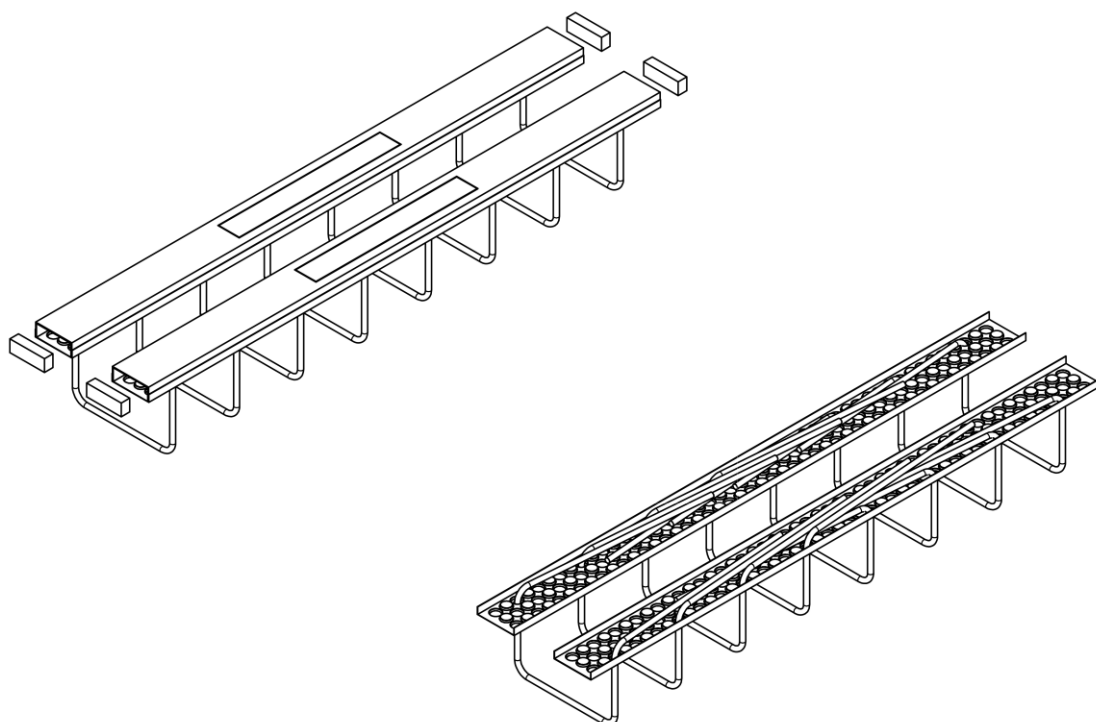


Figure 1: Ferbox Re-bend connection 1-C and 2-C – Shape and components



**Ferbox Re-bend connection 1-C and 2-C**

Shape and components

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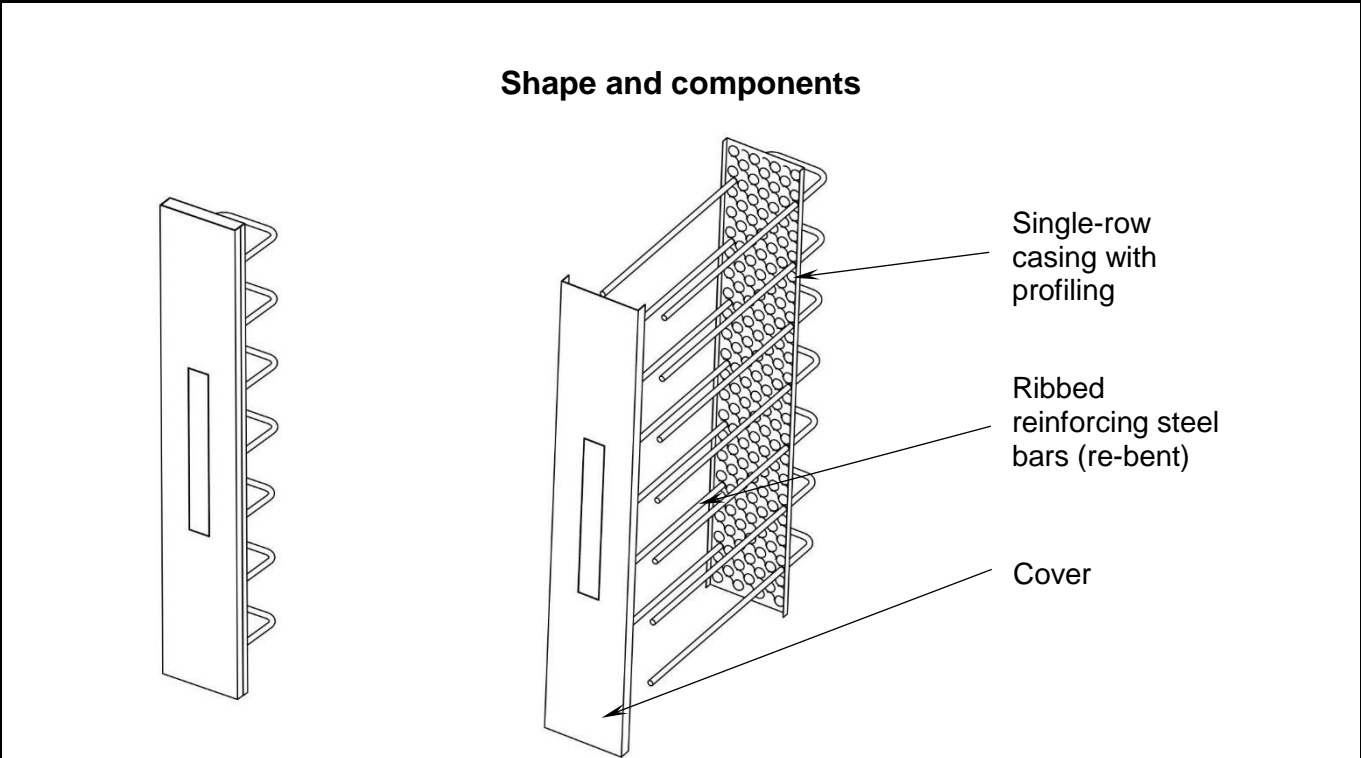


Figure 2: Ferbox Re-bend connection 1-C – Shape and components

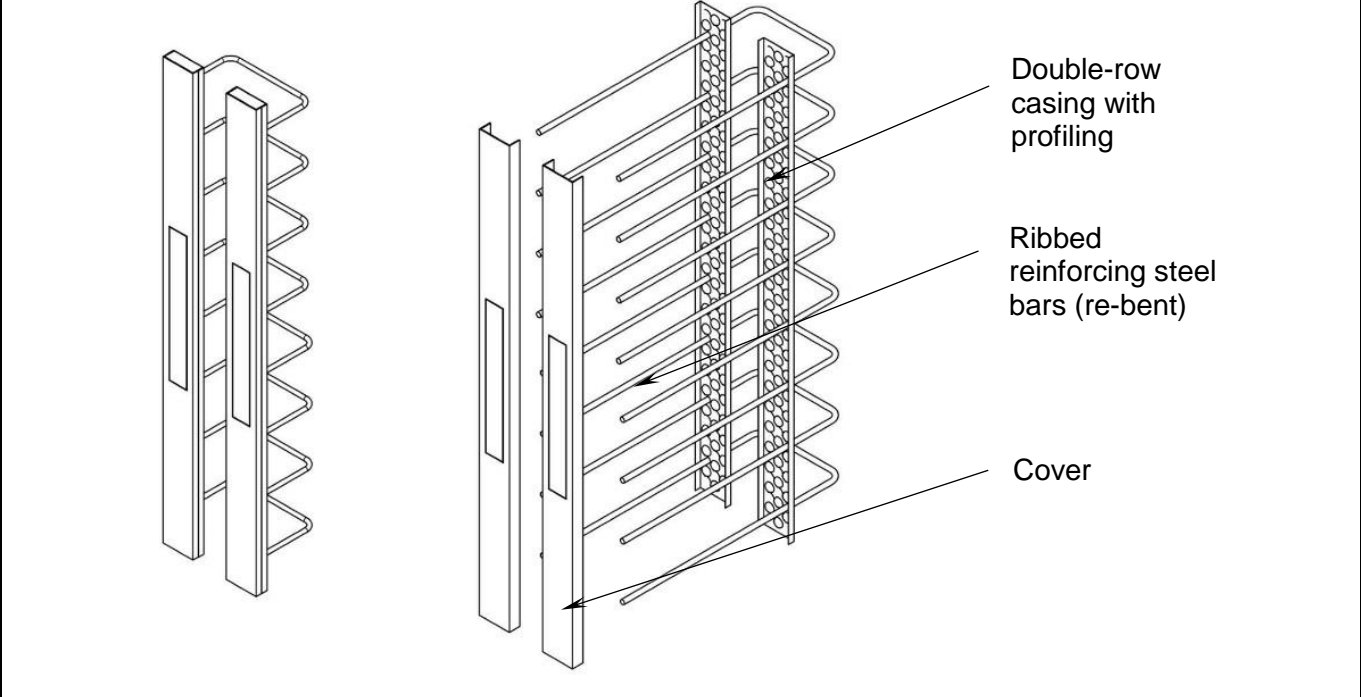
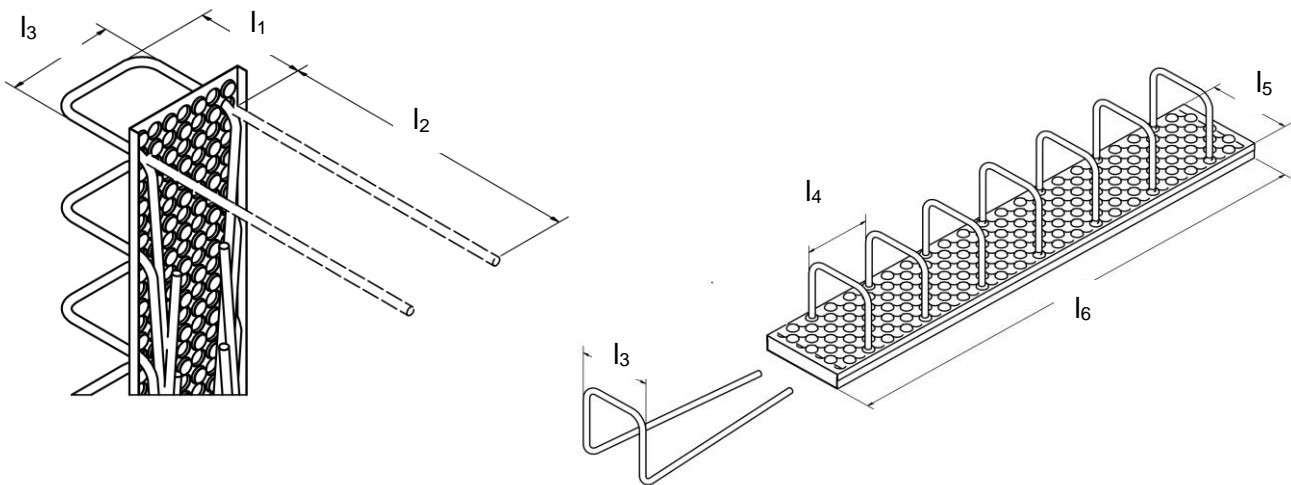


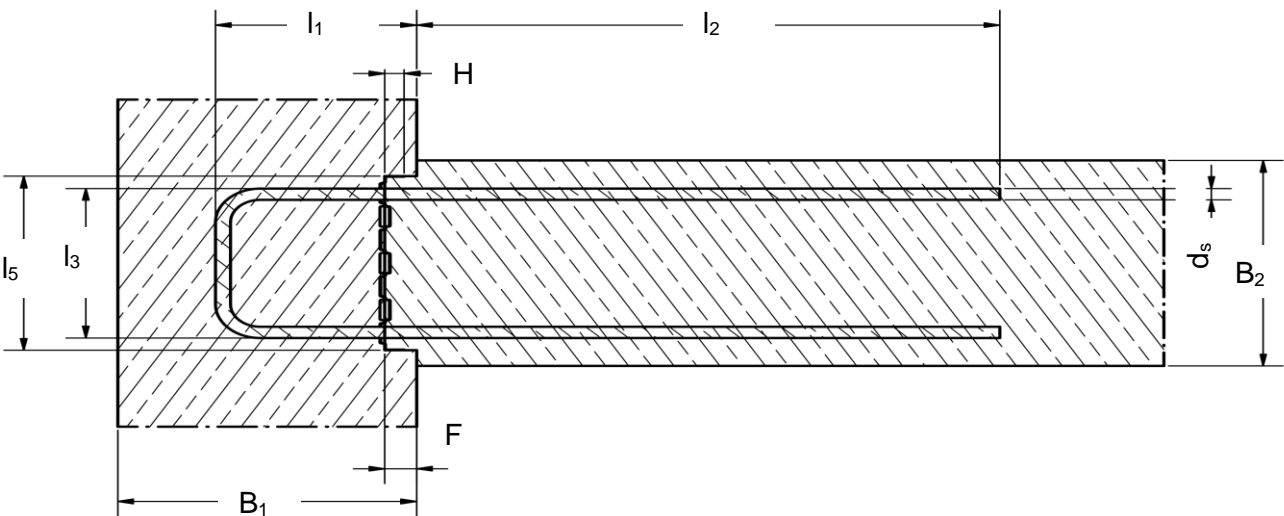
Figure 3: Ferbox Re-bend connection 2-C – Shape and components

### Dimensions and installation



$l_1, l_2$ ...Protruding lengths of ribbed reinforcing steel bar, project specific for anchorage of steel bars  
 $l_3$ .....Width of ribbed reinforcing steel bar,  $l_3 = 85\text{--}260\text{ mm}$

$l_4$ ....Centre distance of ribbed reinforcing steel bars,  $l_4 = 75\text{ mm to }300\text{ mm}$   
 $l_5$ ....Width of casing, see Annex 4  
 $l_6$ ....Length of casing,  $l_6 \leq 1.25\text{ m}$



$d_s$ ....Nominal diameter of ribbed reinforcing steel bar  
 $H$ ....Height of the casing  
 $F$ ....Height of the casing with cover  
 $B_1$ ....Thickness of the structural element 1  
 $B_2$ ....Thickness of the structural element 2

Figure 4: Dimensions and installation of the Ferbox Re-bend connection 1-C



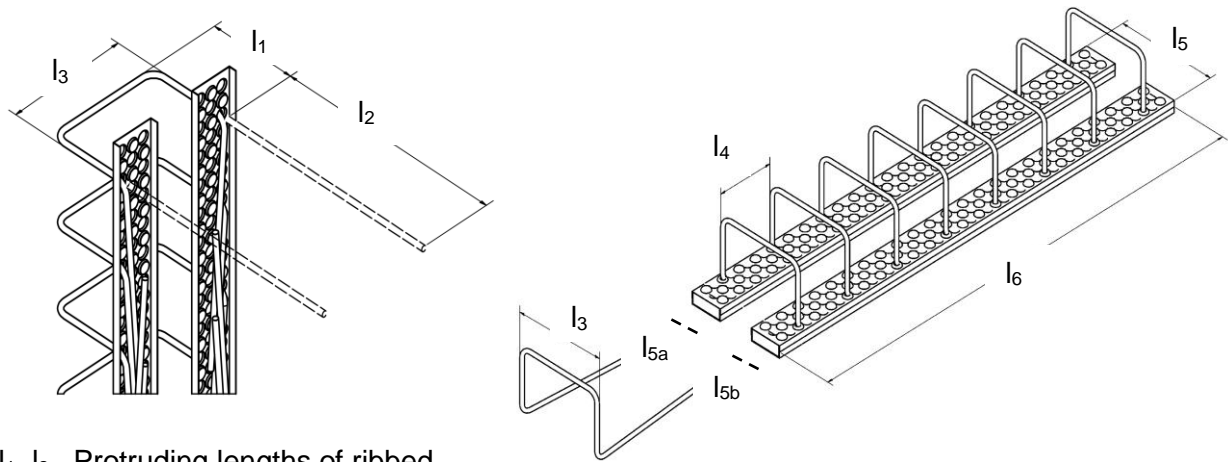
**Ferbox Re-bend connection 1-C and 2-C**

Dimensions and installation

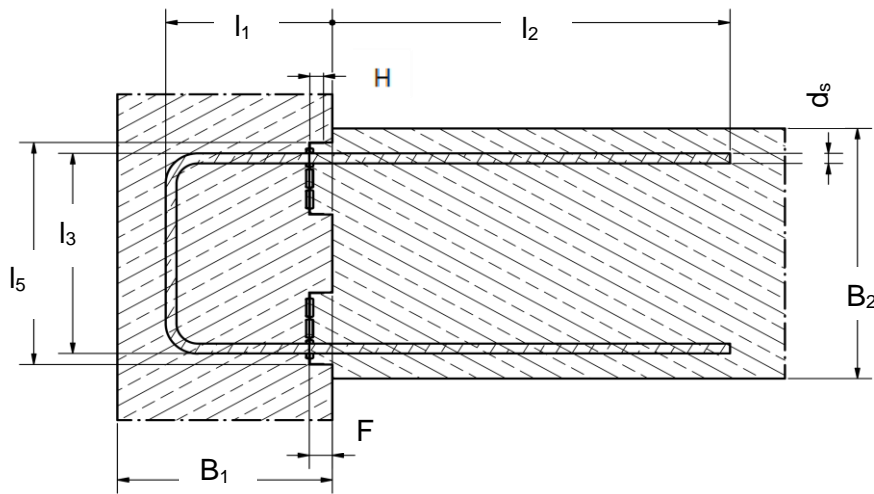
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### Dimensions and installation




- $l_1, l_2$ ...Protruding lengths of ribbed reinforcing steel bar, project specific for anchorage of steel bars
- $l_3$ .....Width of ribbed reinforcing steel bar,  $l_3 = 125-450$  mm
- $l_4$ ....Centre distance of ribbed reinforcing steel bars,  $l_4 = 75$  mm to 300 mm
- $l_5, l_{5a}, l_{5b}$ ....Width of casing, see Annex 4
- $l_6$ ....Length of casing,  $l_6 \leq 1.25$  m



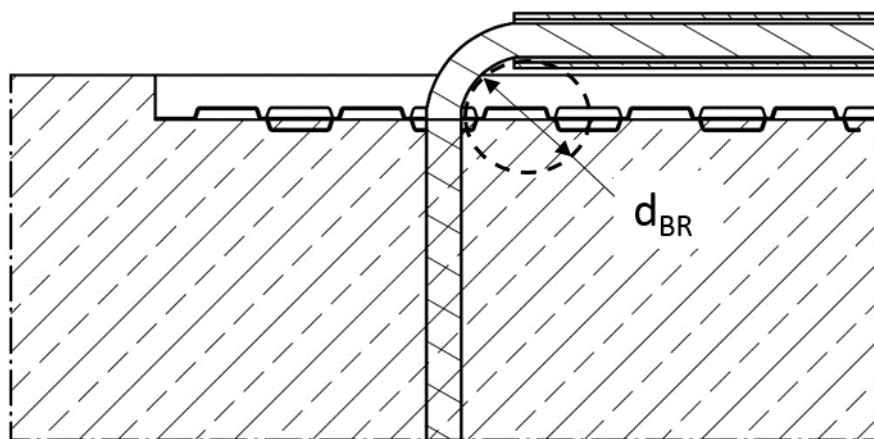
- $d_s$ ....Nominal diameter of ribbed reinforcing steel bar
- H.....Height of the casing
- F.....Height of the casing with cover
- $B_1$ ....Thickness of the structural element 1
- $B_2$ ....Thickness of the structural element 2

Figure 5: Dimensions and installation of the Ferbox Re-bend connection 2-C

	Ferbox Re-bend connection 1-C and 2-C	<b>Annex 2</b> Page 2 of 2 of European Technical Assessment ETA-20/0842 of 13.11.2020
	Dimensions and installation	

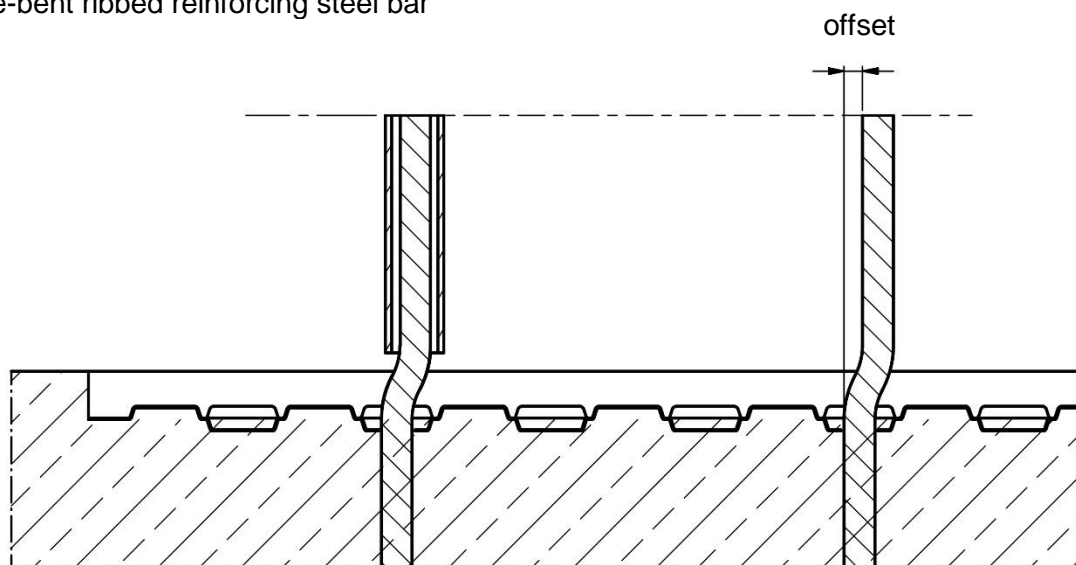
### Installation of the ribbed reinforcing steel bars

#### 1. Re-bending of the ribbed reinforcing steel bar with re-bending tool



$d_{BR}$ ...Mandrel diameter,  $d_{BR} = 6 \cdot d_s$

#### 2. Re-bent ribbed reinforcing steel bar

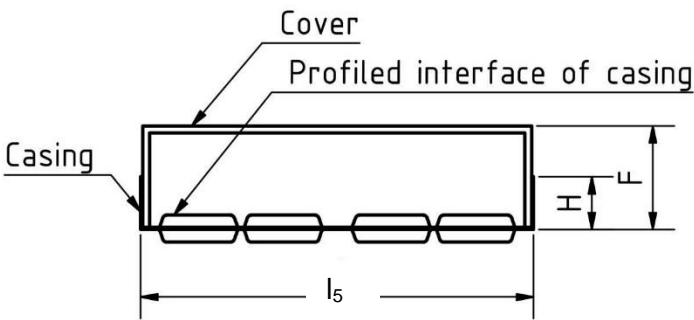


Offset  $\leq d_s/3$  in mm

Figure 6: Installation of the ribbed reinforcing steel bars

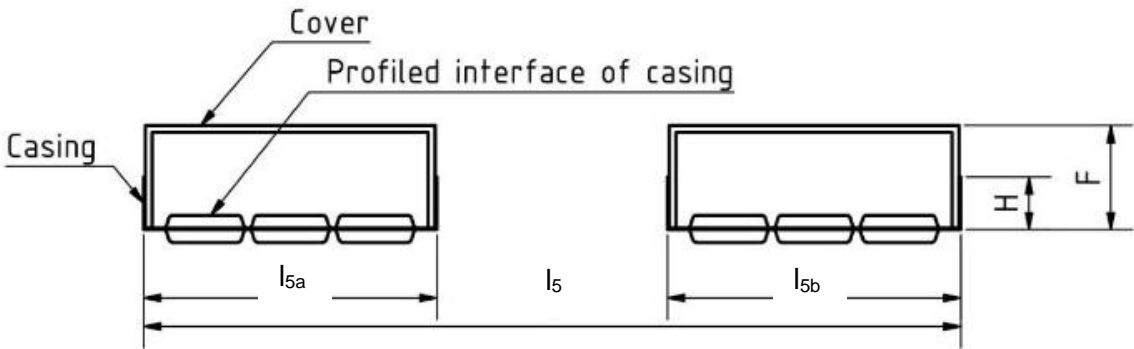


### Dimensions of the casing



#### FERBOX 1-C

- Width of casing  
 $l_5 = 110 \text{ to } 285 \text{ mm}$
- Height of casing  $H = 10\text{--}20 \text{ mm}$
- Height of casing with cover  $F = 30\text{--}40 \text{ mm}$



#### FERBOX 2-C

- Width of casing  
 $125 \text{ mm} \leq l_5 \leq 475 \text{ mm}$   
 $l_{5a} = 60\text{--}85 \text{ mm}$   
 $l_{5b} = 60\text{--}85 \text{ mm}$
- Height of casing  $H = 10\text{--}20 \text{ mm}$
- Height of casing with cover  $F = 30\text{--}40 \text{ mm}$

Figure 7: Dimensions of the casing


	Ferbox Re-bend connection 1-C and 2-C	<b>Annex 4</b> Page 1 of 1 of European Technical Assessment ETA-20/0842 of 13.11.2020
	Dimensions of the casing	

Table 2: Essential characteristics of the Ferbox Re-bend connection 1-C and 2-C

BRCW <sup>1)</sup>	Essential characteristic	Assessment method	Level, class, or description
1	<b>Shape</b>		
	- 1-C	–	See Annex 1, Figure 2
	- 2-C	–	See Annex 1, Figure 3
	<b>Dimensions</b>		
	- 1-C	–	See Annex 2, Figure 4 and Annex 4, Figure 7
	- 2-C	–	See Annex 2, Figure 5 and Annex 4, Figure 7
	<b>Mandrel diameter d<sub>BR</sub></b>		
	- 1-C	–	6 · d <sub>s</sub> See Annex 3
	- 2-C	–	6 · d <sub>s</sub> See Annex 3
	<b>Load bearing capacity – Shear force perpendicular to the joint</b>	EAD 160031-00-0301, EN 1992-1-1	See Annex 8, Figure 9, and Table 4
	<b>Load bearing capacity – Shear force along the joint</b>	EAD 160031-00-0301, EN 1992-1-1	See Annex 8, Figure 9, and Table 4
	<b>Tightness of the casing during concreting</b>	EAD 160031-00-0301	Satisfactory
	<b>Material of the casing</b>		
	- galvanised steel sheet casing	EN 10346	DX51D+Z100-M-A-C DX53D+Z100-M-A-C DX54D+Z100-M-A-C
	<b>Resistance to corrosion</b>		
	- minimum mass of zinc coating: - DX51D + Z100-M-A-C - DX53D + Z100-M-A-C - DX54D + Z100-M-A-C	EN 10346	100 g/m <sup>2</sup>
1) Basic requirement for construction works.			

**Ferbox Re-bend connection 1-C and 2-C**
 Essential characteristics of the  
 Ferbox Re-bend connection 1-C and 2-C

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Table 3: Essential characteristics of the ribbed reinforcing steel bars

BRCW	Essential characteristic	Assessment method	Level, class, or description
1	<b>Nominal diameter <math>d_s</math></b>	EN 10080, Clause 7.3.1	8.0 to 14 mm
	<b>Mass per metre</b> , nominal Tolerances mass per metre: For $d_s \leq 8$ mm For $d_s > 8$ mm:	EN 10080, Clause 7.3.2  EN 1992-1-1, Annex C	0.395 kg/m to 1.21 kg/m  $\pm 6.0 \%$ $\pm 4.5 \%$
	<b>Strength properties of ribbed reinforcing steel B500B, <math>d_s = 8</math> mm, 10 mm, 12 mm, 14 mm</b>		
	<b>Yield strength <math>R_e</math> <sup>1) 2)</sup></b>	EN ISO 15630-1 EN 10080, EN 1992-1-1, Annex C	$\geq 500$ N/mm <sup>2</sup>
	<b>Tensile strength <math>R_m</math> <sup>2)</sup></b>		$\geq 550$ N/mm <sup>2</sup>
	<b>Percentage total elongation at maximum force <math>A_{gt}</math> <sup>3)</sup></b>		$\geq 5.0 \%$
	<b>Ratio tensile strength to yield strength <math>R_m / R_e</math> <sup>3)</sup></b>		$\geq 1.08$
	<b>Bendability</b>	Re-bend test acc. to EN 15630-1	Satisfactory
	<b>Relative rib area <math>f_R</math> <sup>2)</sup></b>	EN ISO 15630-1, EN 1992-1-1 Annex C	$d_s = 8$ mm $d_s = 10$ mm $d_s = 12$ mm } $\geq 0.040$
			$d_s = 14$ mm $\geq 0.056$
	<b>Rib spacing <math>c</math></b>	EN ISO 15630-1, EN 10080 (Table 7)	$0.4 \cdot d_s$ to $1.2 \cdot d_s$
	<b>Rib inclination <math>\beta</math></b>	EN ISO 15630-1, EN 10080 (Table 7)	$35^\circ$ to $75^\circ$
	<b>Rib height <math>a</math></b>	EN ISO 15630-1, EN 10080 (Table 7)	$0.03 \cdot d_s$ to $0.15 \cdot d_s$
<sup>1)</sup> Yield strength is reduced to 80 % of the nominal value, i.e. $f_{yk} = 0.8 \cdot 500 = 400$ N/mm <sup>2</sup> , because of decrease of strength during cold bending. <sup>2)</sup> 5 % fractile <sup>3)</sup> 10 % fractile			

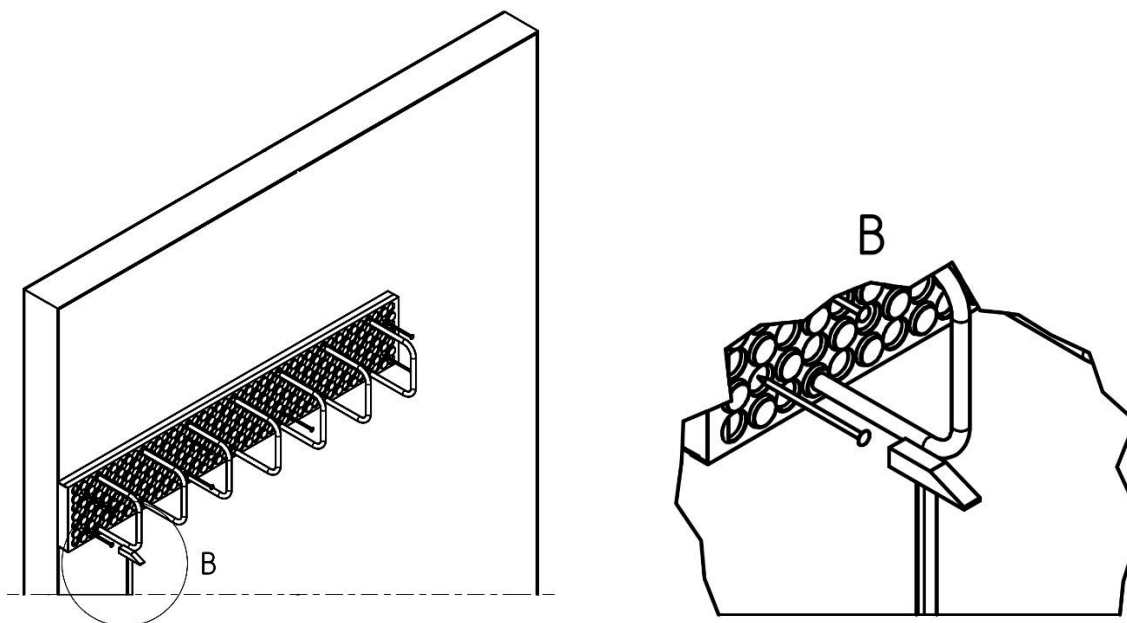
**Ferbox Re-bend connection 1-C and 2-C**

Essential characteristics of the ribbed reinforcing steel bars

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### Installation procedure

#### 1. Fastening of casing to the shuttering of the 1<sup>st</sup> construction stage



#### 2. Concreting of the 1<sup>st</sup> construction stage

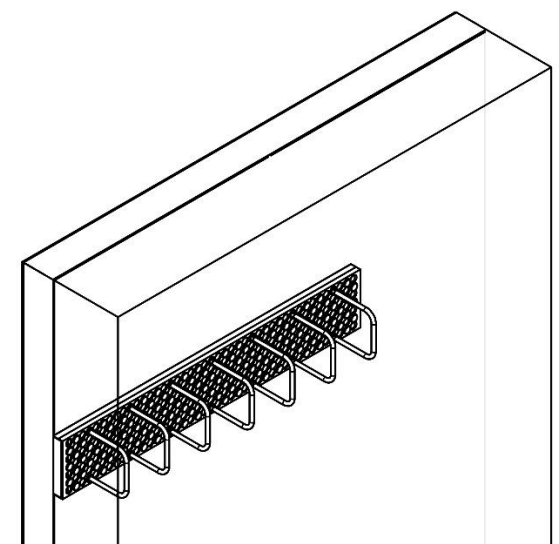


Figure 8: Installation procedure



**Ferbox Re-bend connection 1-C and 2-C**

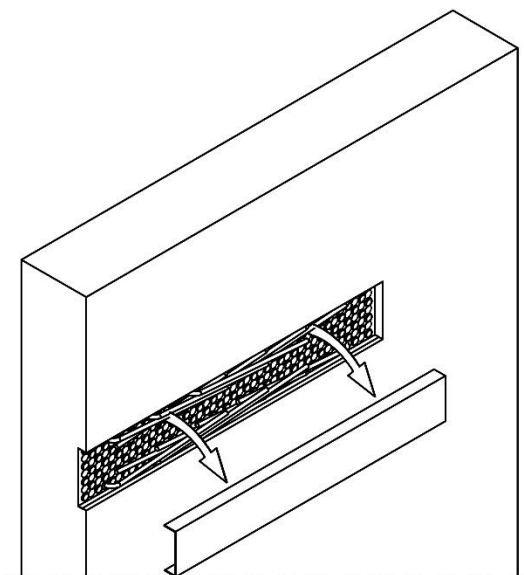
Installation procedure

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### Installation procedure

#### 3. Striking the shuttering and removing of the cover



#### 4. Re-bending of ribbed reinforcing steel bars

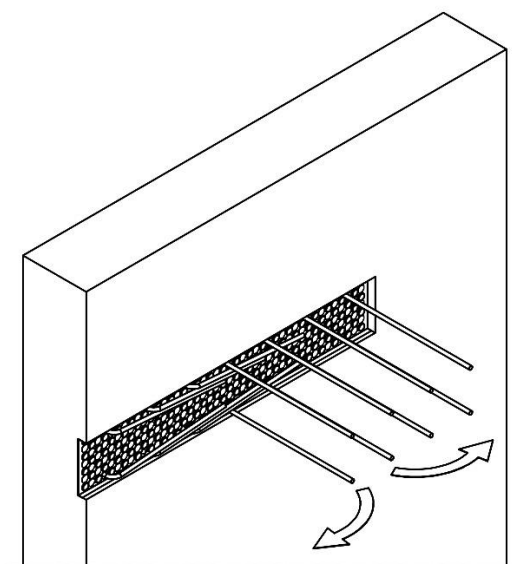


Figure 8: Installation procedure - continuation



**Ferbox Re-bend connection 1-C and 2-C**

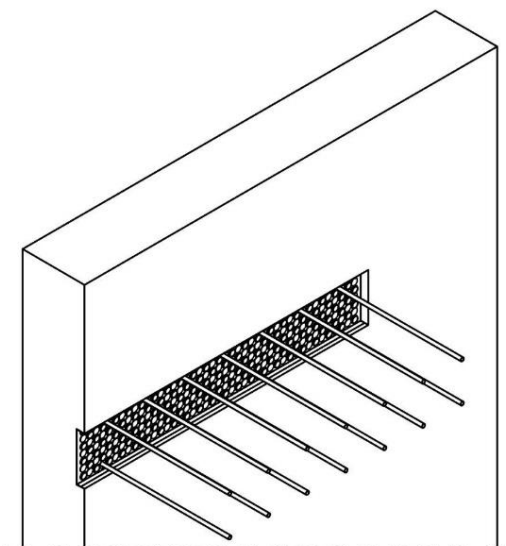
Installation procedure

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### Installation procedure

#### 5. Completed re-bent ribbed reinforcing steel bars



#### 6. Final state

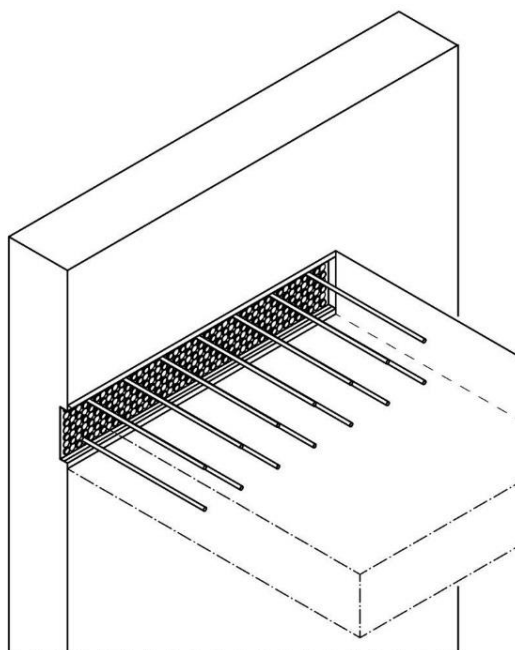
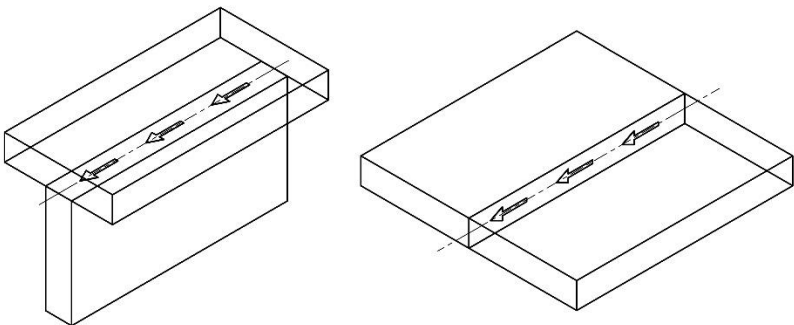
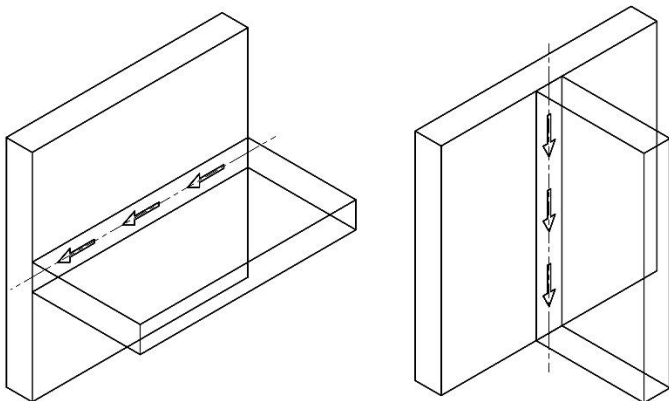


Figure 8: Installation procedure - continuation

**Assessment of load bearing capacity**

Shear force along the joint



Shear force perpendicular to the joint

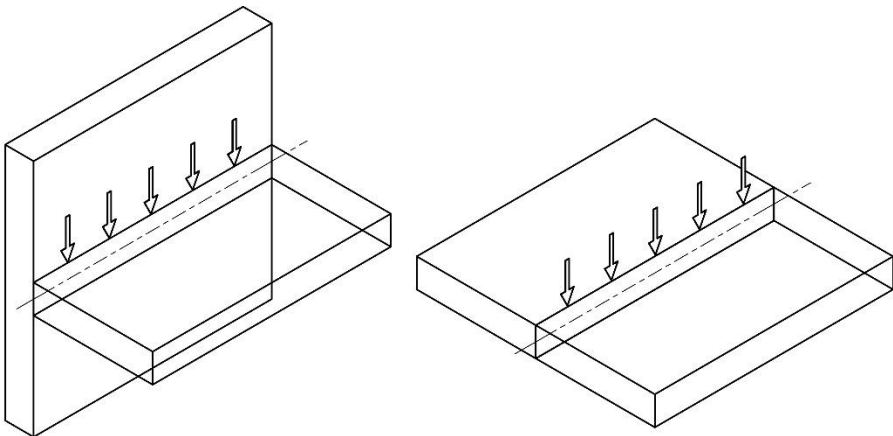


Figure 9: Assessment of load bearing capacity – connections



**Ferbox Re-bend connection 1-C and 2-C**

Assessment of load bearing capacity

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### Assessment of load bearing capacity

Table 4: Assessment of load bearing capacity - Factors for shear force

–	Factor of adhesion $c$	Factor of friction $\mu$
Loading perpendicular to the joint		
Without vertical shear reinforcement and with ribbed reinforcing steel bars up to nominal diameter $d_s = 14$ mm, indented interface	0.5	0.9
With vertical shear reinforcement and with ribbed reinforcing steel bars up to nominal diameter $d_s = 12$ mm, indented interface	0.5	0.9
Loading along the joint		
With ribbed reinforcing steel bars up to nominal diameter $d_s \leq 12$ mm, indented interface	0.5	0.9
With ribbed reinforcing steel for bars nominal diameter $d_s = 14$ mm and width of casing $l_s \geq 30$ cm, rough interface	0.4	0.7

Assumptions:

1) Slabs with shear reinforcement

The permitted inclination angle of shear reinforcement is  $\alpha = 90^\circ$ .

2) Re-bend ribbed reinforcing steel bars

Re-bend ribbed reinforcing steel bars may be exploited only up to 80 % of the yield strength.

3) Concrete cover of the re-bend reinforcing steel bars

Concrete cover of the re-bend reinforcing steel bars for shear force along the joint shall be at least:

$$c_{\min, b} = \max \begin{cases} 3 \cdot d_s - 10 \text{ mm} \\ 20 \text{ mm} \\ \text{maximum aggregate size } d_g - 10 \text{ mm. For } d_g > 32 \text{ mm } d_g - 5 \text{ mm} \end{cases}$$

and  $\Delta c_{\text{dev}} \geq 10 \text{ mm}$ .

Concrete cover of the re-bend reinforcing steel bars for shear force perpendicular to the joint shall be at least as per EN 1992-1-1.

Concrete cover due to environmental conditions is to be considered.

Concrete cover according to standards and regulations on force at the place of use is observed.

4) In the case of combined loading both in perpendicular and longitudinal direction, the verification can be made individually per direction.

5) Reduction of the design value of maximum shear force to  $0.3 \cdot V_{Rd, \max}$ . Where  $V_{Rd, \max}$  is the design value of maximum shear force, limited by crushing of the compression strut.



**Ferbox Re-bend connection 1-C and 2-C**

Assessment of load bearing capacity

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### Reference documents

EN 1992-1-1 (12.2004) + AC (01.2008) + AC (11.2010) + A1 (12.2014)	Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings
EN 10346 (07.2015)	Continuously hot-dip coated steel flat products for cold forming
EN 10080 (05.2005)	Steel for the reinforcement of concrete – Weldable reinforcing steel – General
EN ISO 15630-1 (10.2010)	Steel for the reinforcement and prestressing of concrete – Test methods – Part 1: Reinforcing bars, wire rod and wire
EN 10204 (2004)	Metallic products – Types of inspection documents
EAD 160031-00-0301 1997/597/EC	European Assessment Document “Re-bend connection”  Commission Decision of 14 July 1997 on the procedure for attesting the conformity of construction products pursuant to Article 20(2) of Council Directive 89/106/EEC as regards reinforcing and prestressing steel for concrete, Official Journal L 240, 2.9.1997, p. 4-7.
305/2011	Regulation (EU) № 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC, OJ L 88 of 4.4.2011, p. 5, amended by Commission Delegated Regulation (EU) No 568/2014 of 18 February 2014, OJ L 157 of 27.05.2014, p. 76 and Commission Delegated Regulation (EU) № 574/2014 of 21 February 2014, OJ L 159 of 28.05.2014, p. 41.
568/2014	Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014 amending Annex V to Regulation (EU) № 305/2011 of the European Parliament and of the Council as regards the assessment and verification of the performance of construction products, OJ L 157 of 27.5.2014, p. 76.
96/603/EC	Commission Decision of 4 October 1996 establishing the list of products belonging to Classes A ‘No contribution to fire’ provided for in Decision 94/611/EC implementing Article 20 of Council Directive 89/106/EEC on construction products, OJ L 267 of 19.10.1996, p.23, as amended by Commission Decision of 26 September 2000, OJ L 258, 12.10.2000, p. 36 and amended by Commission Decision of 6 June 2003, OJ L 144, 12.06.2003, p. 9.



**Ferbox Re-bend connection 1-C and 2-C**

Reference documents

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