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Designated according to Article 29 of Regulation (EU) No 305/2011

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European Technical Assessment ETA 23/0895 of 19/12/2023

I General Part

Technical Assessment Body issuing the ETA	**Eurofins Expert Services Oy**
Trade name of the construction product	**ARBOX® Plus**
Product family to which the construction product belongs	RE-BEND connection
Manufacturer	**Peikko Group Corporation** **P.O.Box 104, 15101 Lahti, Finland**
Manufacturing plant	Peikko Manufacturing Plants (Annex N)
This European Technical Assessment contains	32 pages including 24 Annexes, which form an integral part of this assessment and a separate Annex N.
This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of	EAD 160031-00-0301 RE-BEND connection

II Specific Part

1 Technical description of the product

The re-bend connection ARBOX® Plus from Peikko Group Corporation is a construction product for the friction-locked connection of two concrete components and consists of the following components:

- Casing with the nominal thickness of 0.5 mm made of profiled galvanized steel sheet with upstand on both sides
- Cover made of galvanized steel sheet with upstand on both sides
- B500B reinforcing steel

The casing is provided with holes through which reinforcing steel bent at 90° are inserted in the form of bars or stirrups. On the front side, the rebars lie flat in the box. On the back side, the rebars stick out. The front side is covered. The cover and the casing are fixed with adhesive tape at the end and the middle of the re-bend connection. The adhesive tape wraps around the casing and the cover.

Arbox® Plus re-bend connection is available in different models. The models differ in the length and width of the casing and the length, width and height of the cover, as well as in the number, diameter, length and bending shapes of the reinforcing bars. The shapes and dimensions are presented in Annex 2 and Annex 3.

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 the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

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

Intended uses

The re-bend connection ARBOX® Plus is a construction product for the friction locked connection of two reinforced concrete components. The product can be used for connecting components with loads perpendicular to the product (e.g. slab-wall connection) as well as with loads along the product (e.g. wall-wall connection).

The reinforced concrete components are produced in two concreting sections. The product is therefore first fixed with the cover side to the formwork of the component of the first concreting section. After stripping the formwork of the first concreting section, the cover is removed and the reinforcing bars, which have been bent by 90°, are bent back with a rebending tool. After bending the bars back, the offset distance of the reinforcing steel bars must be equal or less than 1/3 d_s. Subsequently, the component of the second concreting section can be friction-locked to the building component of the first concreting section by means of the re-bend rebars.

The product is intended for the load transfer of static and quasi-static loads.

Working life/durability

The product is intended for a lifetime of the structure of 50 years when installed in the works provided that the is subject to appropriate installation. These provisions are based upon the current state of the art and the available knowledge and experience.

The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[1].

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

Design

Design of the Arbox® Plus connections as carried out under the responsibility of an engineer experienced in the field of structural design and concrete structure.

The dimensioning and design of the Arbox® Plus connections shall be done according to the EN 1992-1-1:2004.

This European technical approval is based on the assumption that all plans needed have been made correctly according to the regulations valid on the building site.

[1] The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the 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 referred to above.

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

Table 1. Basic requirements for construction works and essential characteristics

Basic requirement and essential characteristics	Performance
BWR 1. Mechanical resistance and stability	
Shape	Clause 3.1
Dimensions	Clause 3.1
Mandrel diameter	Clause 3.1
Load bearing capacity – Shear force perpendicular to the joint	Clause 3.1
Load bearing capacity – Shear force along the joint	Clause 3.1
Tightness of the casing during concreting	Clause 3.1
Material of the casing	Clause 3.1
Resistance to corrosion	Clause 3.1
Nominal diameter	Clause 3.1
Mass per metre	Clause 3.1
Yield strength, R_e	Clause 3.1
Tensile strength, R_m	Clause 3.1
Percentage total elongation at maximum force, A_{gt}	Clause 3.1
Ratio tensile strength to yield strength, R_m / R_e	Clause 3.1
Bendability	Clause 3.1
Relative rib area, f_R	Clause 3.1
Rib spacing, c	Clause 3.1
Rib inclination, β	Clause 3.1
Rib height, h	Clause 3.1
BWR 2. Safety in case of fire	
Reaction to fire	Clause 3.2

3.1 Mechanical resistance and stability, BWR 1

Shape

There are two different types of the re-bend connection:

- single-row casings (e.g. A–shape, Annex 2)
- double-row casings, which are installed parallel and spaced apart. Both casings are usually connected by reinforcing bars (e.g. A 2–shape, Annex 2)

All shapes are presented in Annex 2

Dimensions

The dimensions are presented in Annex 3.

Mandrel diameter

The mandrel diameters are presented in Table 2 of Annex 1.

Load bearing capacity – Shear force perpendicular to the joint

The Load bearing capacity – Shear force perpendicular to the joint is presented in Table 2 of Annex 1.

Load bearing capacity – Shear force along the joint

The Load bearing capacity – Shear force along the joint is presented in Table 2 of Annex 1.

Tightness of the casing during concreting

The tightness of the casing during concreting is presented in Table 2 of Annex 1.

Material of the casing

The Material of the casing is presented in Table 2 of Annex 1.

Resistance to corrosion

The resistance to corrosion is presented in Table 2 of Annex 1.

Nominal diameter

The nominal diameters is presented in Table 2 of Annex 1.

Mass per metre

The mass per metre is presented in Table 2 of Annex 1.

Yield strength, R_e

The yield strength, R_e is presented in Table 2 of Annex 1.

Tensile strength, R_m

The tensile strength, R_m is presented in Table 2 of Annex 1.

Percentage total elongation at maximum force, A_{gt}

The Percentage total elongation at maximum force, A_{gt} is presented in Table 2 of Annex 1.

Ratio tensile strength to yield strength, R_m / R_e

The ratio tensile strength to yield strength, R_m / R_e is presented in Table 2 of Annex 1.

Bendability

The bendability is presented in Table 2 of Annex 1.

Relative rib area, f_R

The relative rib area f_R is presented in Table 2 of Annex 1.

Rib spacing, c

The Rib spacing c is presented in Table 2 of Annex 1.

Rib inclination, β

The Rib inclination β is presented in Table 2 of Annex 1.

Rib height, h

The Rib height, h is presented in Table 2 of Annex 1.

3.2 Safety in case of fire, BWR 2

3.2.1 Reaction to fire

The Arbox® plus connections are considered to satisfy the requirements for performance Class A1.

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

For the products covered by this EAD the applicable European legal act is: 97/597/EC

The system to be applied is: **1+**

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

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Eurofins Expert Services.

Issued in Espoo on December 19, 2023
by Eurofins Expert Services Oy

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ANNEX 1. ESSENTIAL CHARACTERISTICS

Table 2. Essential characteristics.

Basic requirement and essential characteristics	Performance
Shape	See Annex 2
Dimensions	See Annex 3
Mandrel diameter	Mandrel diameter, $d_{BR} \geq 6 \cdot d_s$
Load bearing capacity – Shear force perpendicular to the joint	Without shear reinforcement, c = 0.5
	With shear reinforcement, c = 0.5
Load bearing capacity – Shear force along the joint	c = 0.4 and μ = 0.7
Tightness of the casing during concreting	Satisfactory
Material of the casing	DX51D+Z-100MA acc. EN 10346
Resistance to corrosion	Minimum mass of zinc coating ≥ 100g/m^2 acc. EN 10346
Ribbed reinforcing steel B500B acc. EN 10080	
Nominal diameter	d_s =8 mm, 10 mm and 12 mm, and 14 mm acc. EN 10080
Mass per metre	0.395 kg/m – 1.208 kg/m acc. EN 10080 with following tolerances: d_s = 8 mm: ±6 % d_s > 8 mm: ±4.5 % acc. EN 1992-1-1
Yield strength, R_e	≥ 500 MPa acc. EN 10080
Tensile strength, R_m	≥ 540 MPa acc. EN 10080
Percentage total elongation at maximum force, A_{gt}	≥ 5% acc. EN 10080
Ratio tensile strength to yield strength, R_m / R_e	≥ 1.08 acc. EN 10080
Bendability	Satisfactory, acc. EN 10080
Relative rib area, f_R	for d_s = 8 mm, 10 mm and 12 mm, $f_R \geq 0.040$ for d_s = 14 mm, $f_R \geq 0.056$ acc. EN 10080 acc. EN 10080
Rib spacing, c	$0.4 \cdot d_s$ - $1.2 \cdot d_s$ acc. EN 10080
Rib inclination, β	35° - 75° acc. EN 10080
Rib height, h	$0.03 \cdot d_s$ - $0.015 \cdot d_s$ acc. EN 10080

Restrictions:

- Normal concrete of strength classes C20/25 to C35/45
- Tensile stress of the reinforcing steel bars of the connection elements should be calculated. The stress, anchorage and overlap lengths must be verified according to EN 1992-1-1. The yield strength of the reinforcing steel of the re-bend connection is reduced to a maximum of 80% of the nominal yield strength of reinforcing steel due to the cold bending of the reinforcement.
- After bending the reinforcing steel bars back, the offset distance of the bars must be equal or less than 1/3 d_s.

In addition, design shear load perpendicular to the joint for structural members with shear reinforcement:

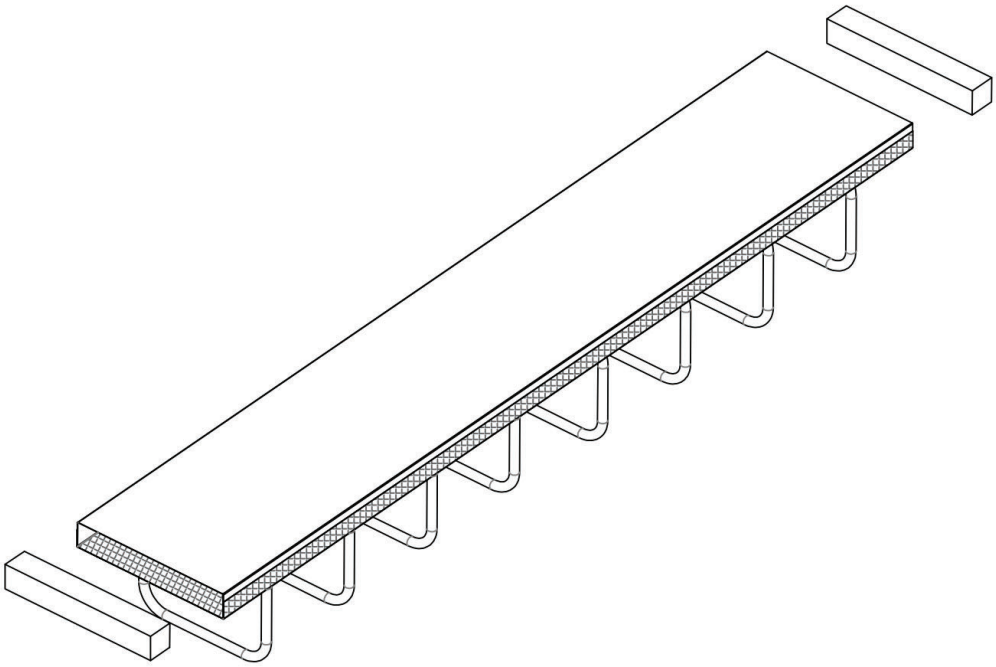
- Maximum utilization of the compression strut load-bearing capacity: $0.3 \cdot V_{Rd,max}$

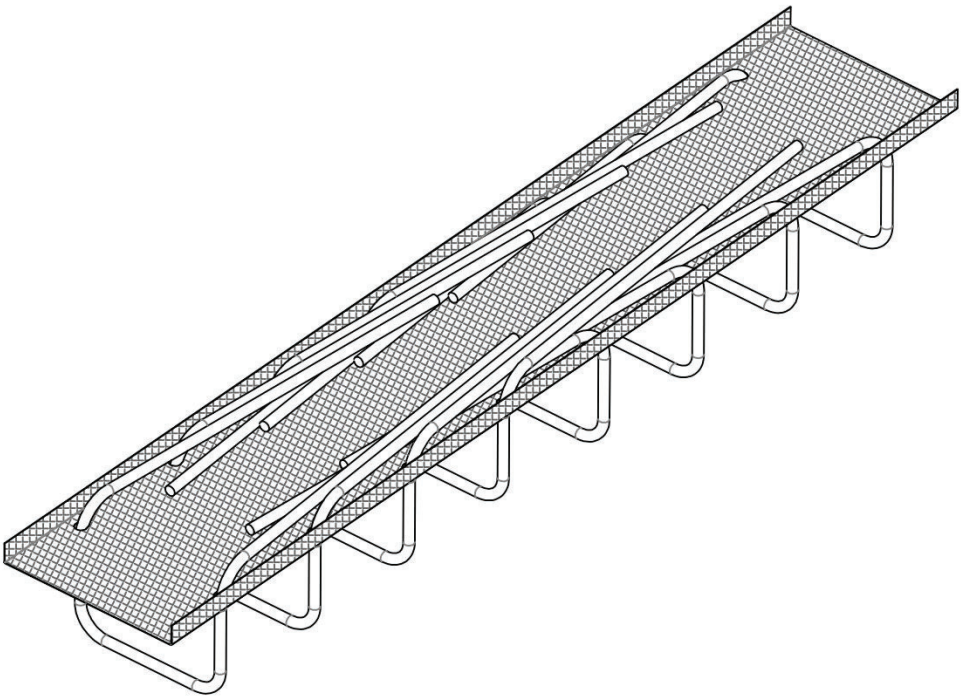
- Angle of inclination of the shear reinforcement: 90°
- Compression strut inclination angle: 1.0 ≤ cot θ ≤ 2.5
- Calculation of the inner lever arm: z = 0.9·d according to EN 1992-1-1, but not higher than

$$z_{max} = \begin{cases} d - c_{nom} - 30\ mm \\ d - 2 \cdot c_{nom}) \end{cases}$$

ANNEX 2. SHAPE AND COMPONENTS

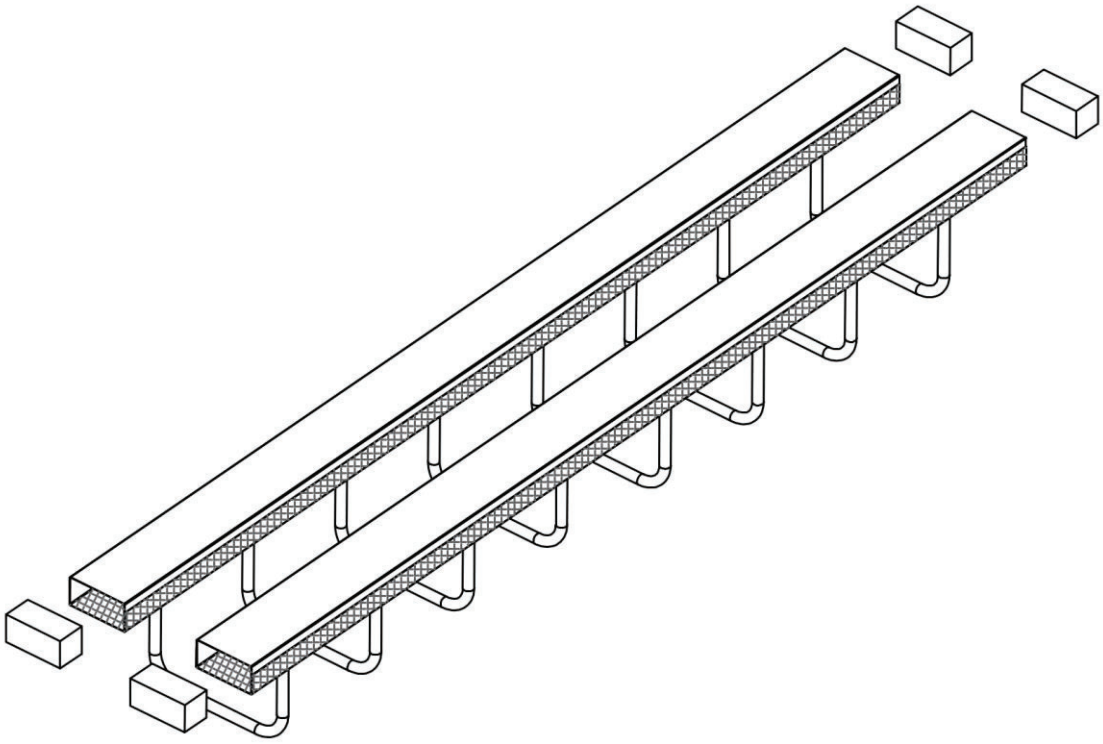
- **A-Shape (single row casing) -**

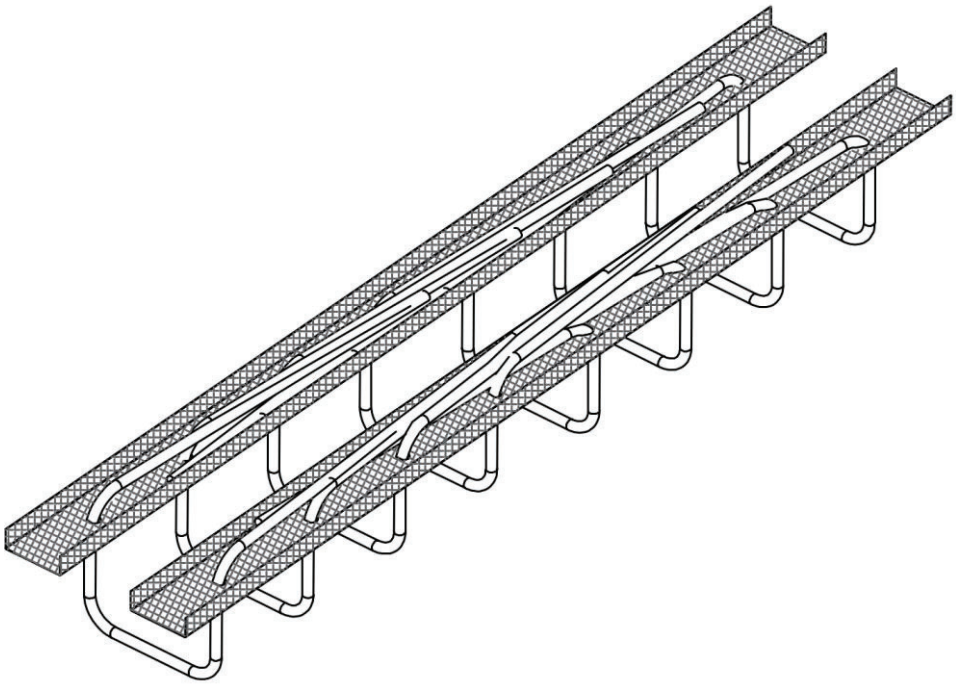




Shape and components

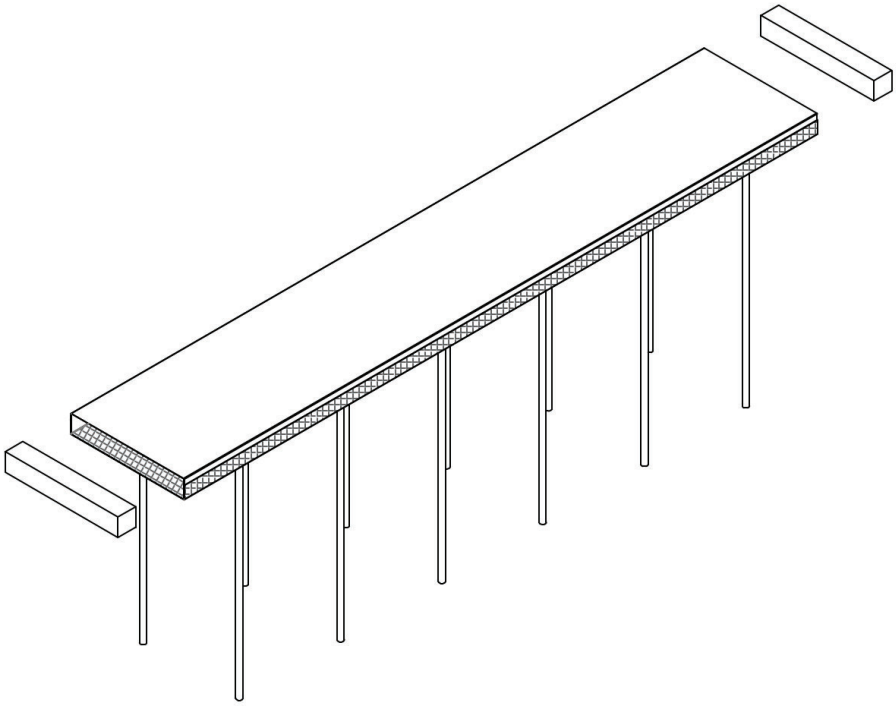
- **A 2-Shape (double row casing) -**

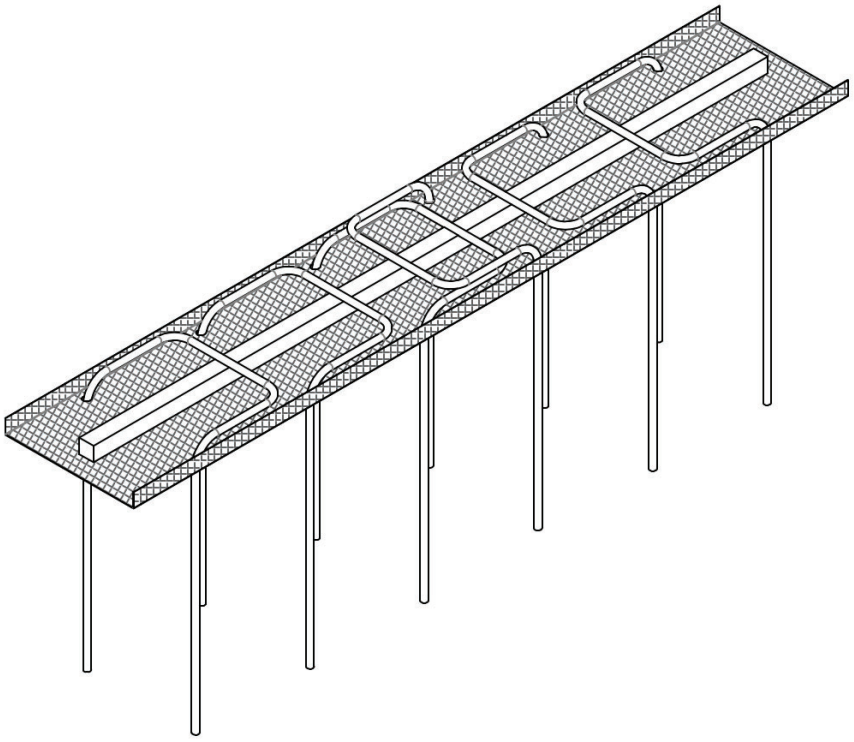




Shape and components

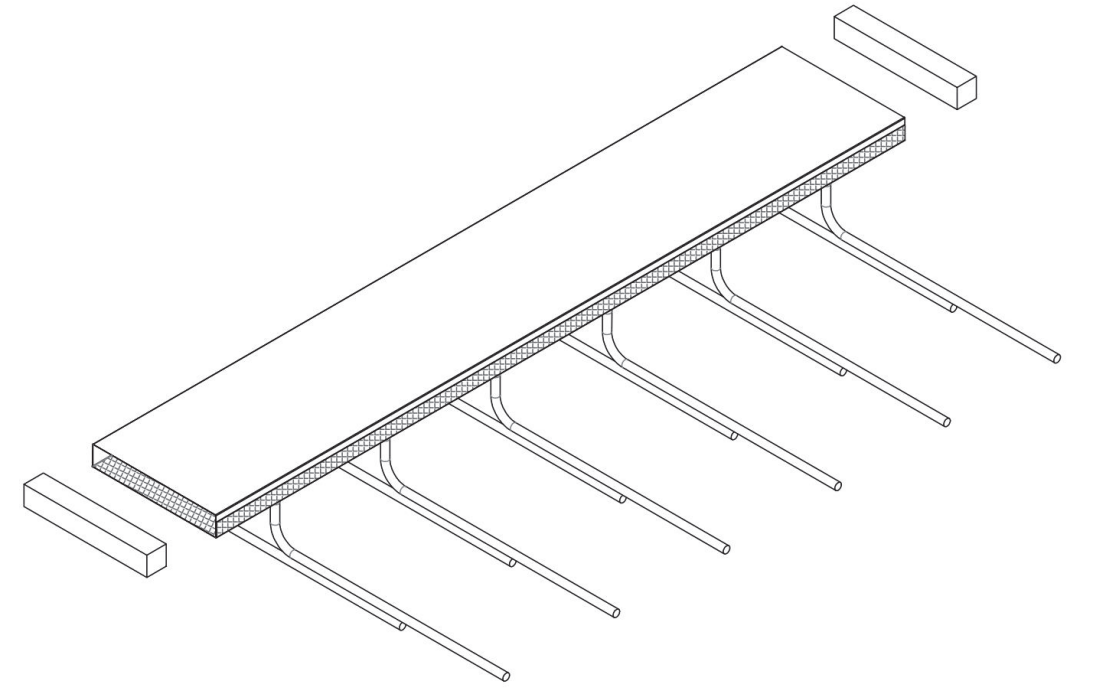
- **K-Shape** -

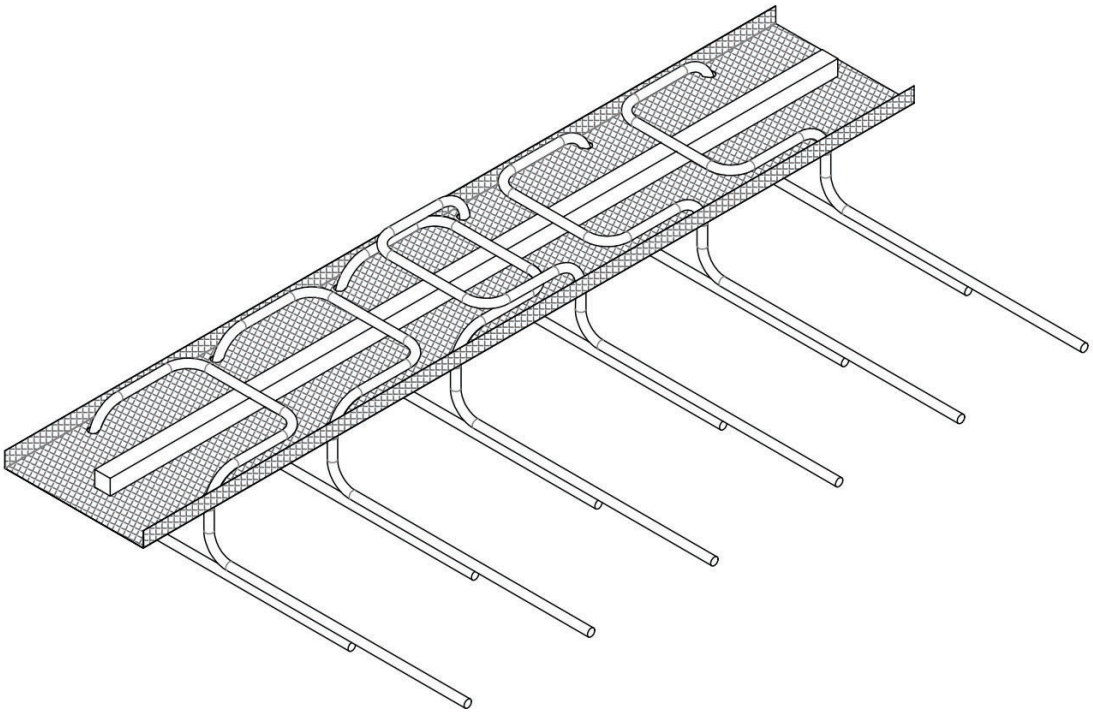




Shape and components

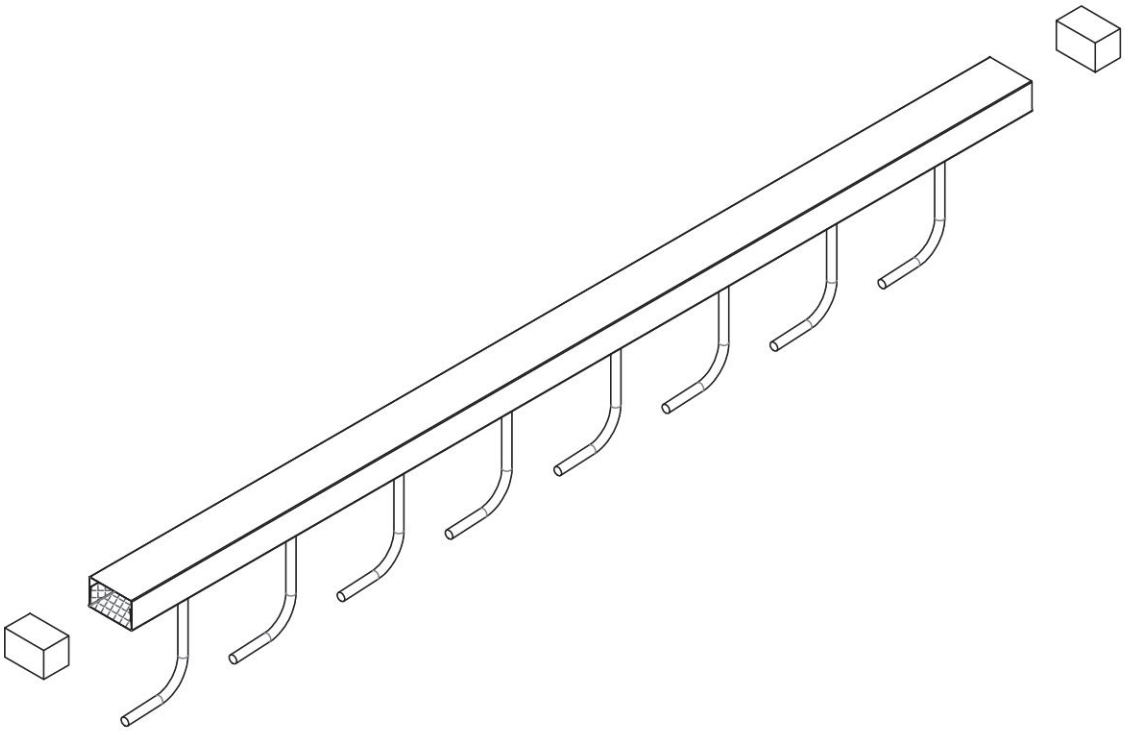
- **C-Shape** -

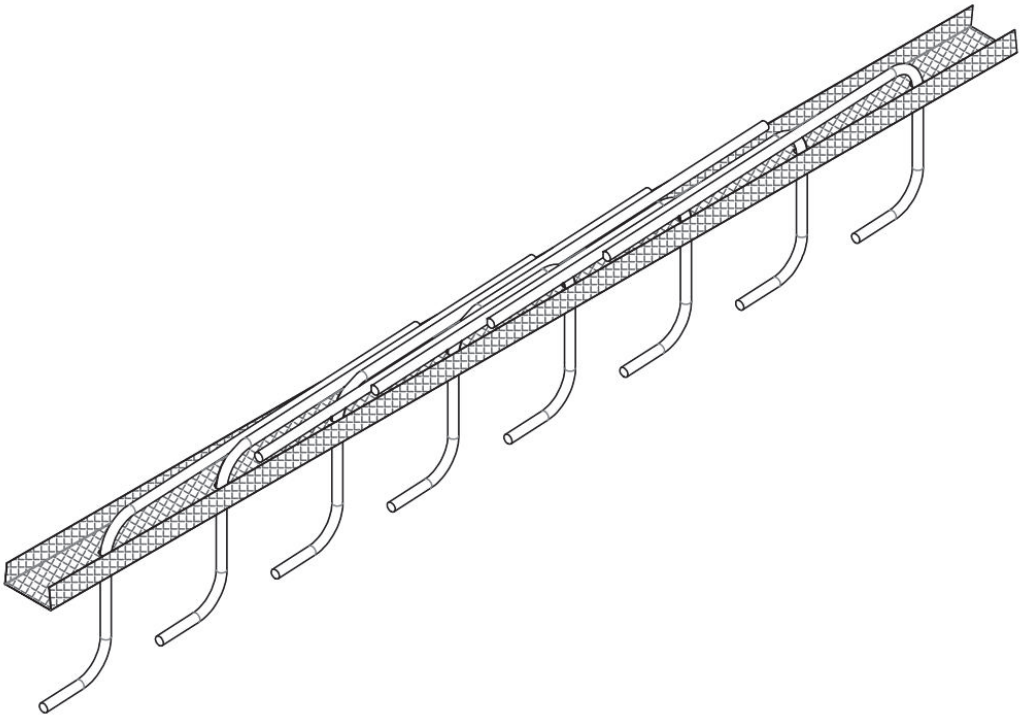




Shape and components

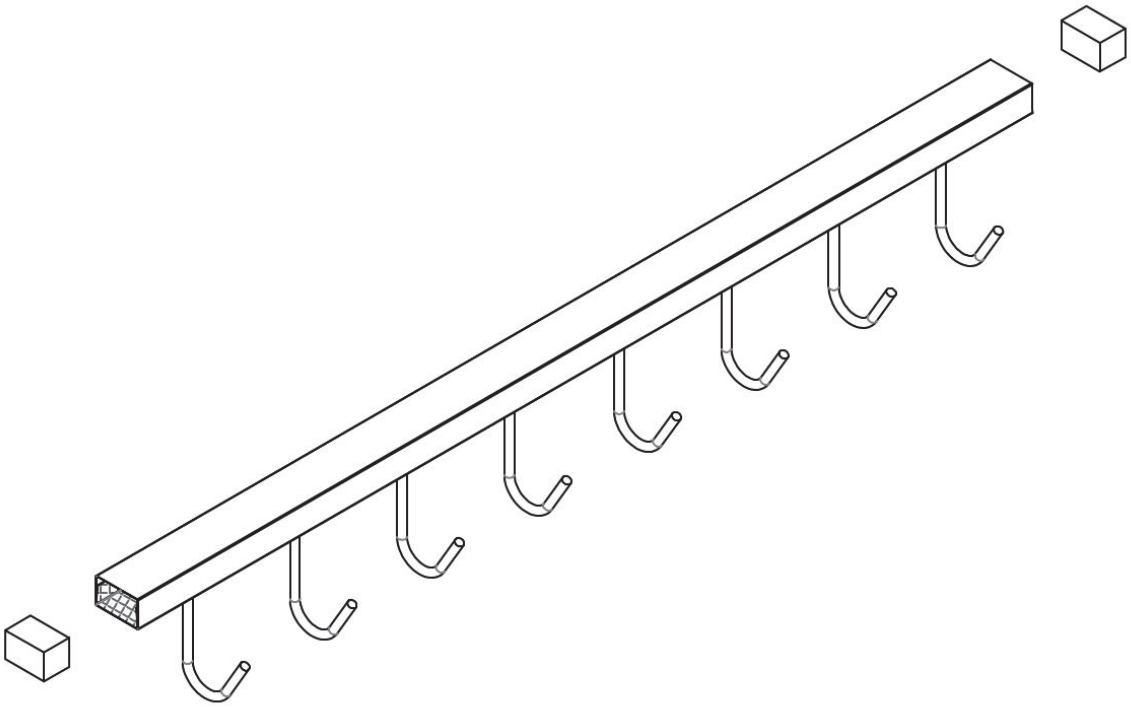
- **L-Shape** -

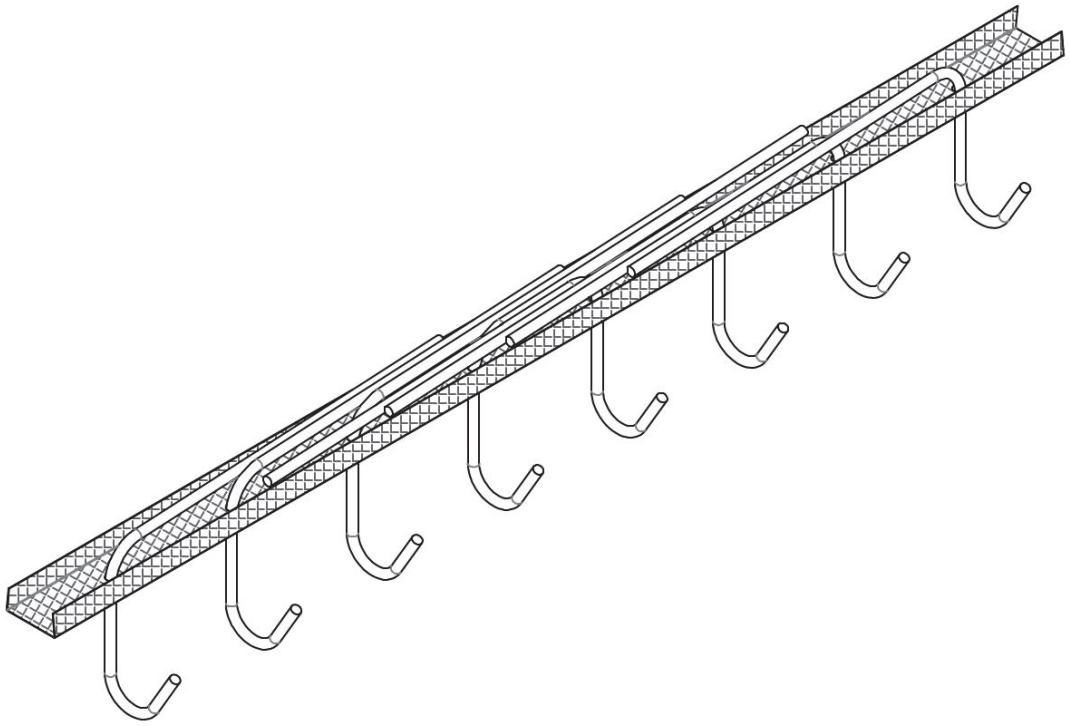




Shape and components

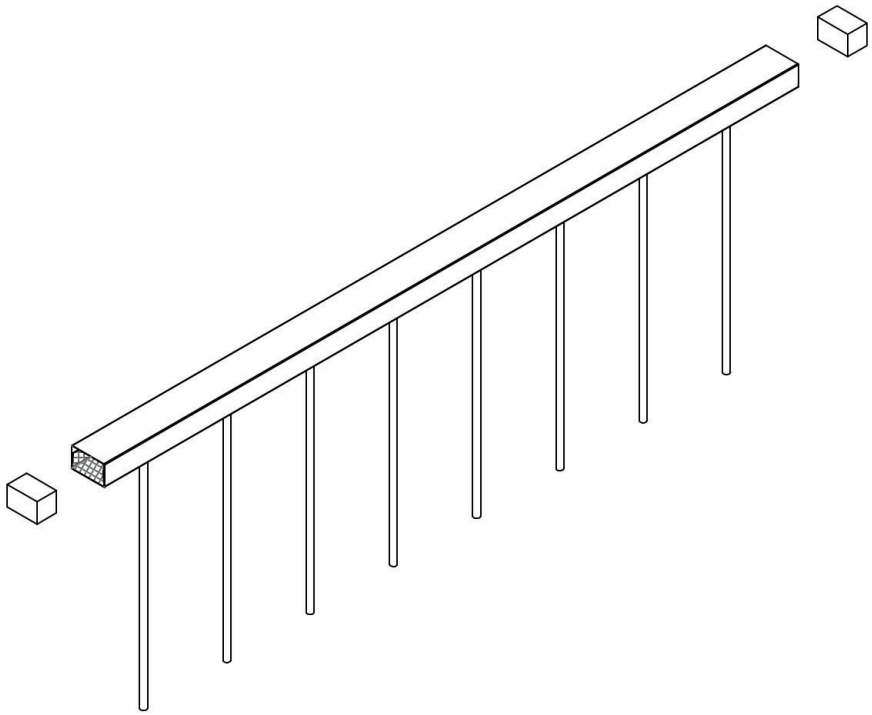
- **J-Shape** -

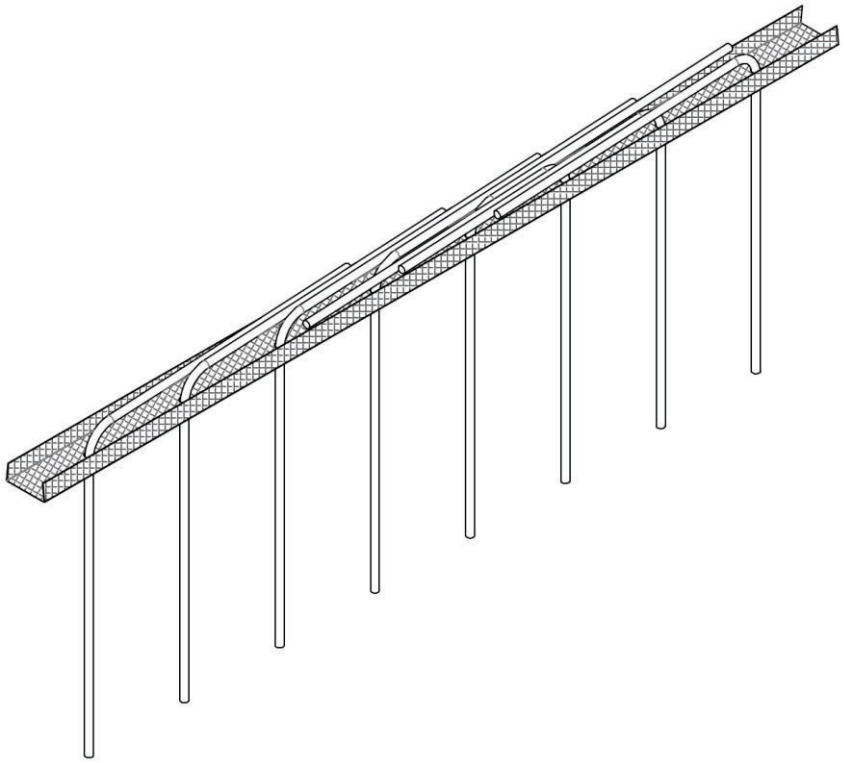




Shape and components

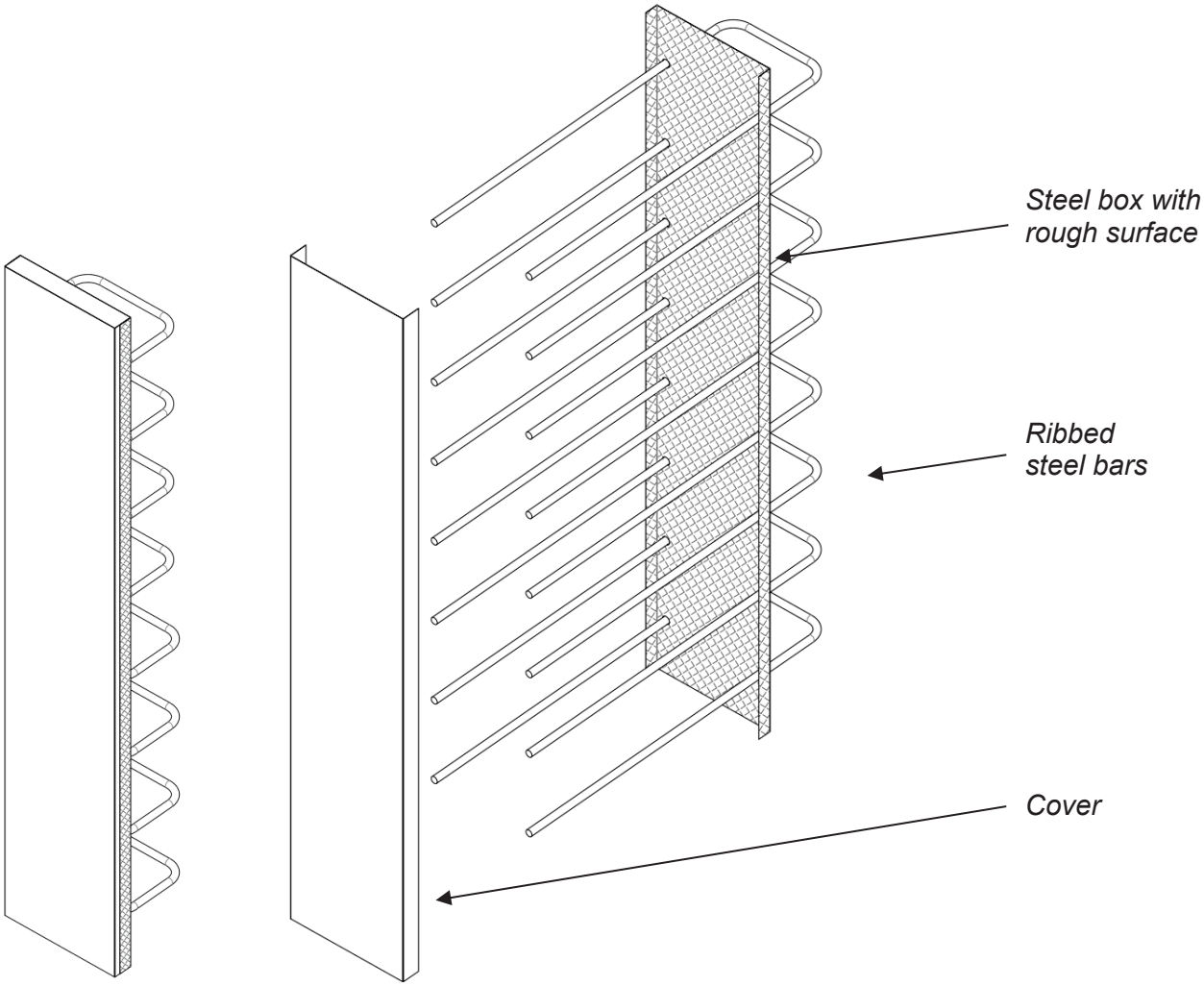
- **I-Shape** -





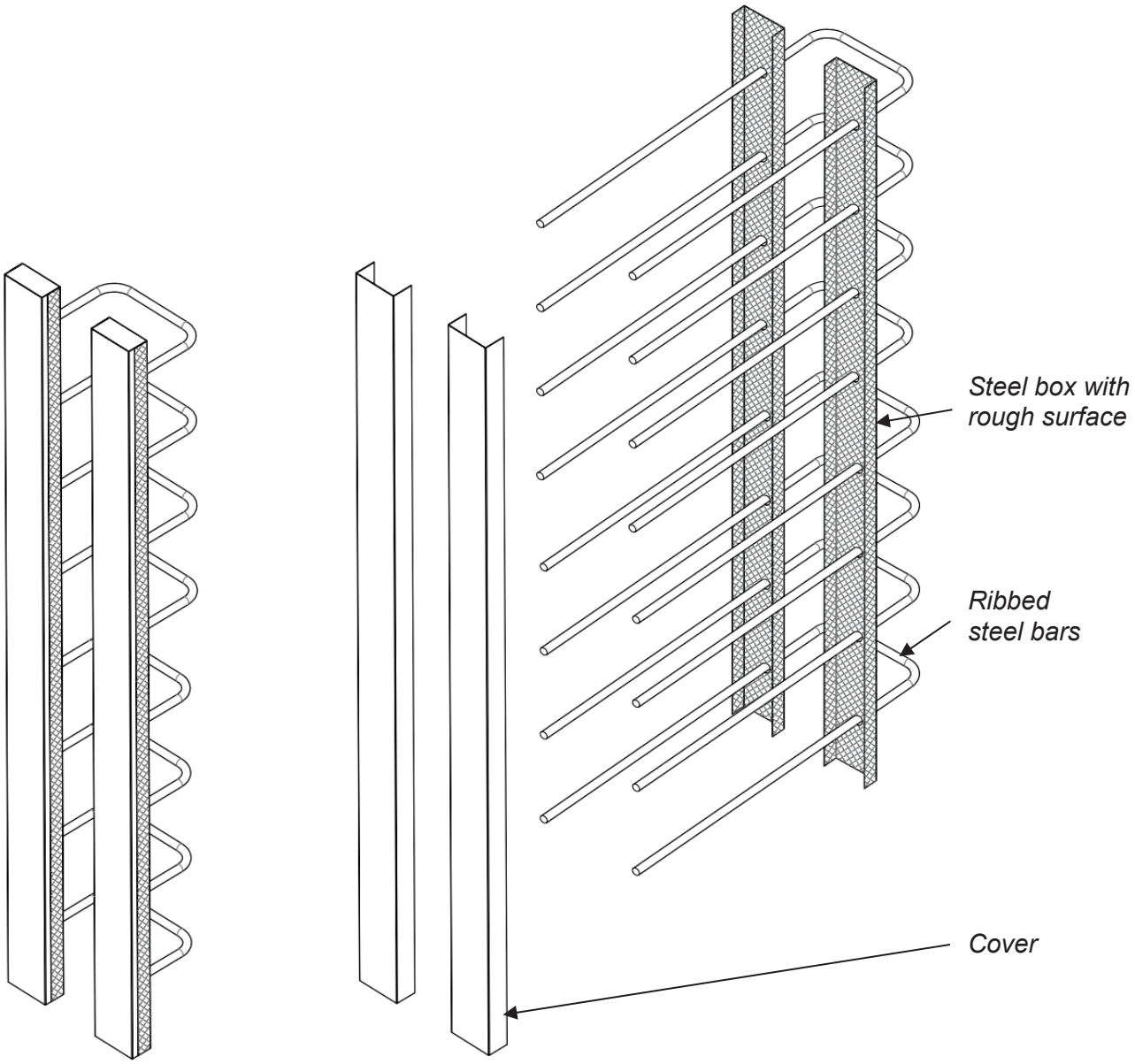
Shape and components

A - Shape after bending of rebars (single row casing)



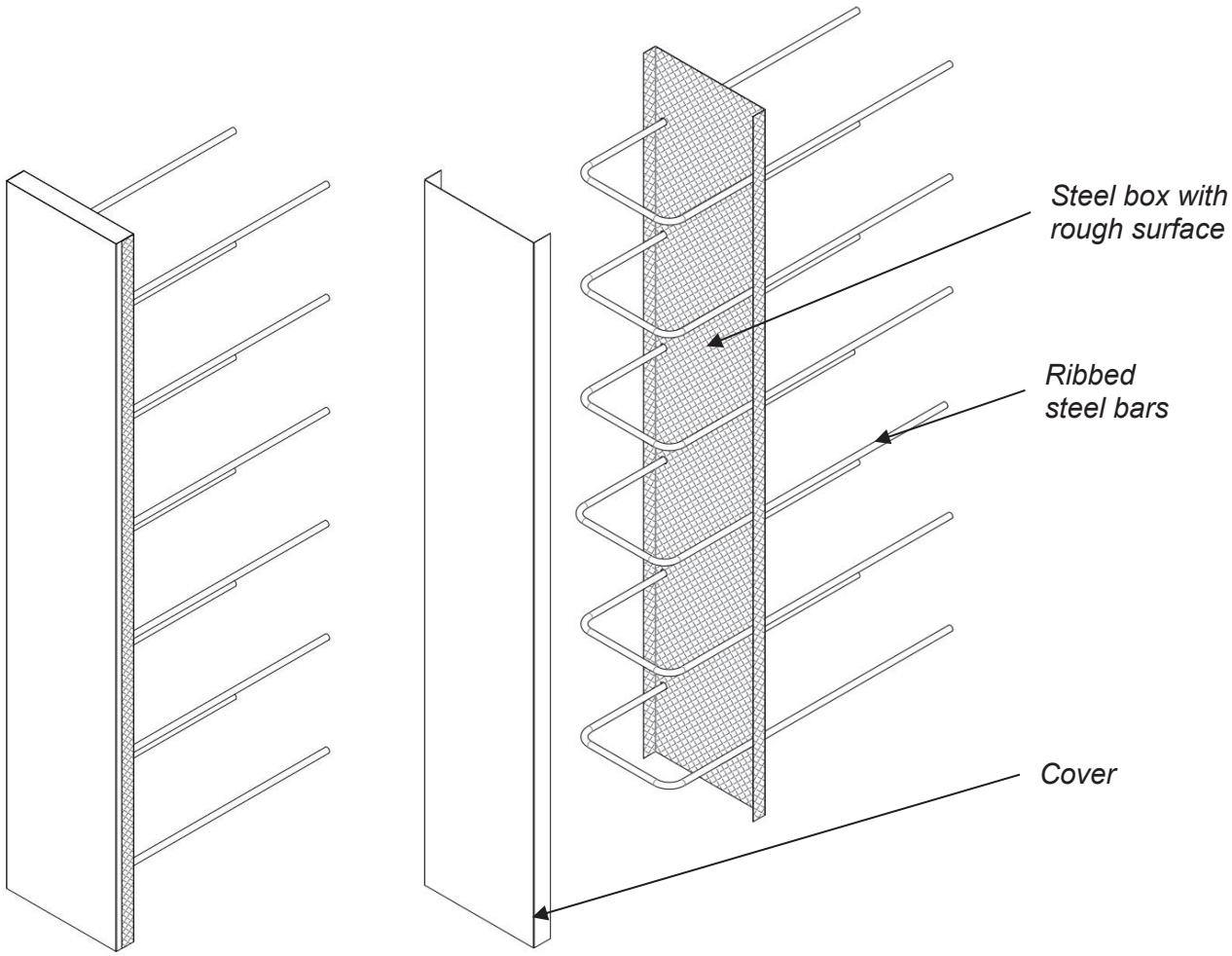
Shape and components

A 2 - Shape after bending of rebars (double row casing)



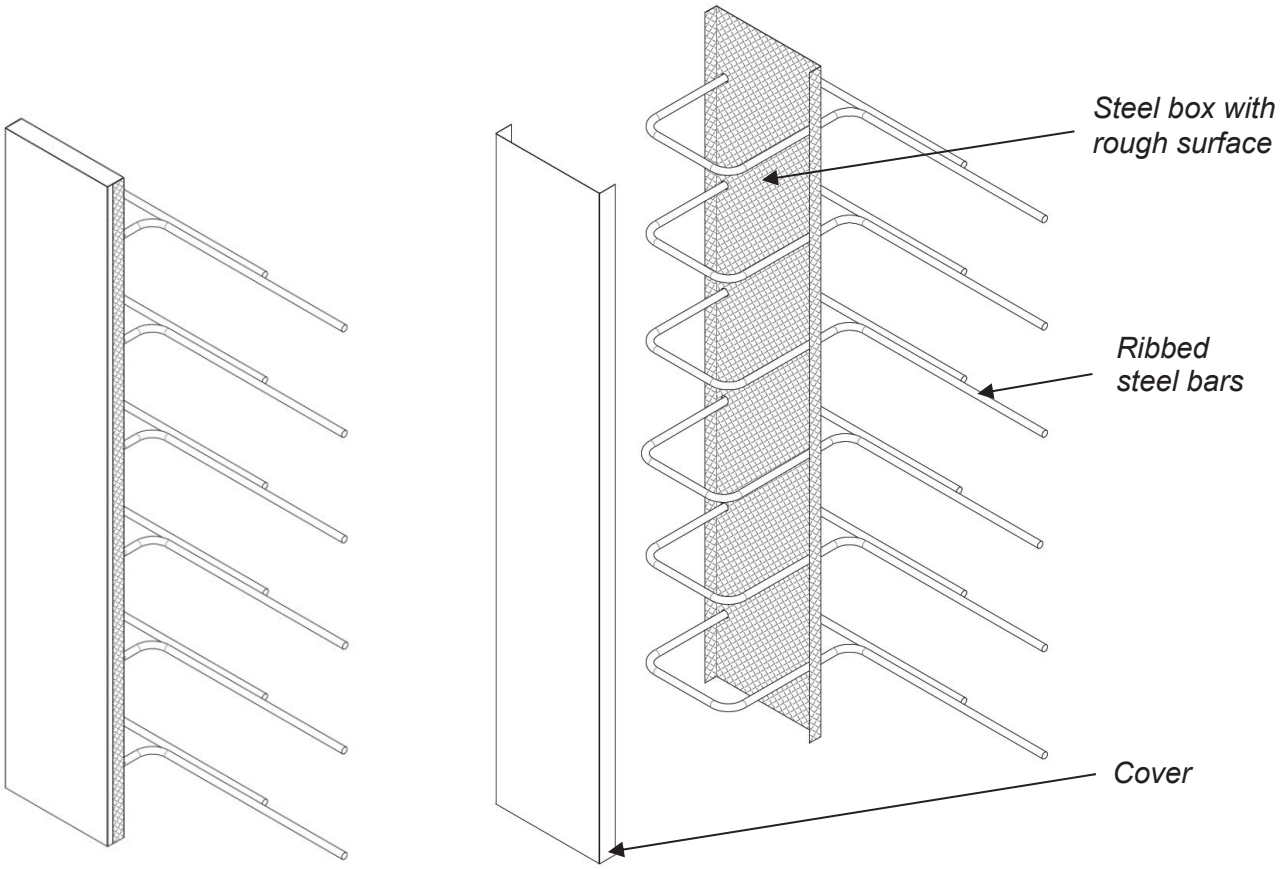
Shape and components

K - Shape after bending of rebars



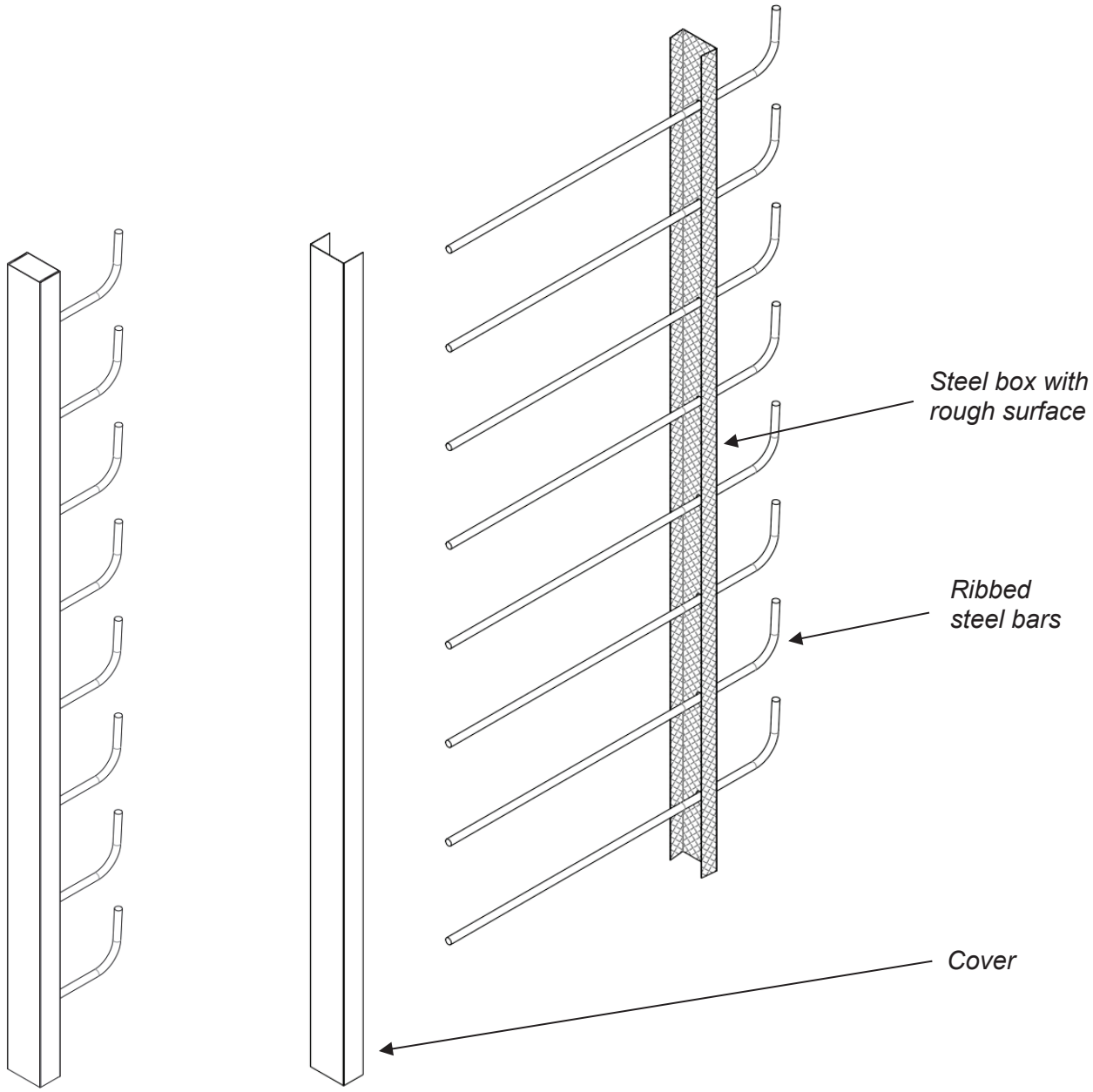
Shape and components

C - Shape after bending of rebars



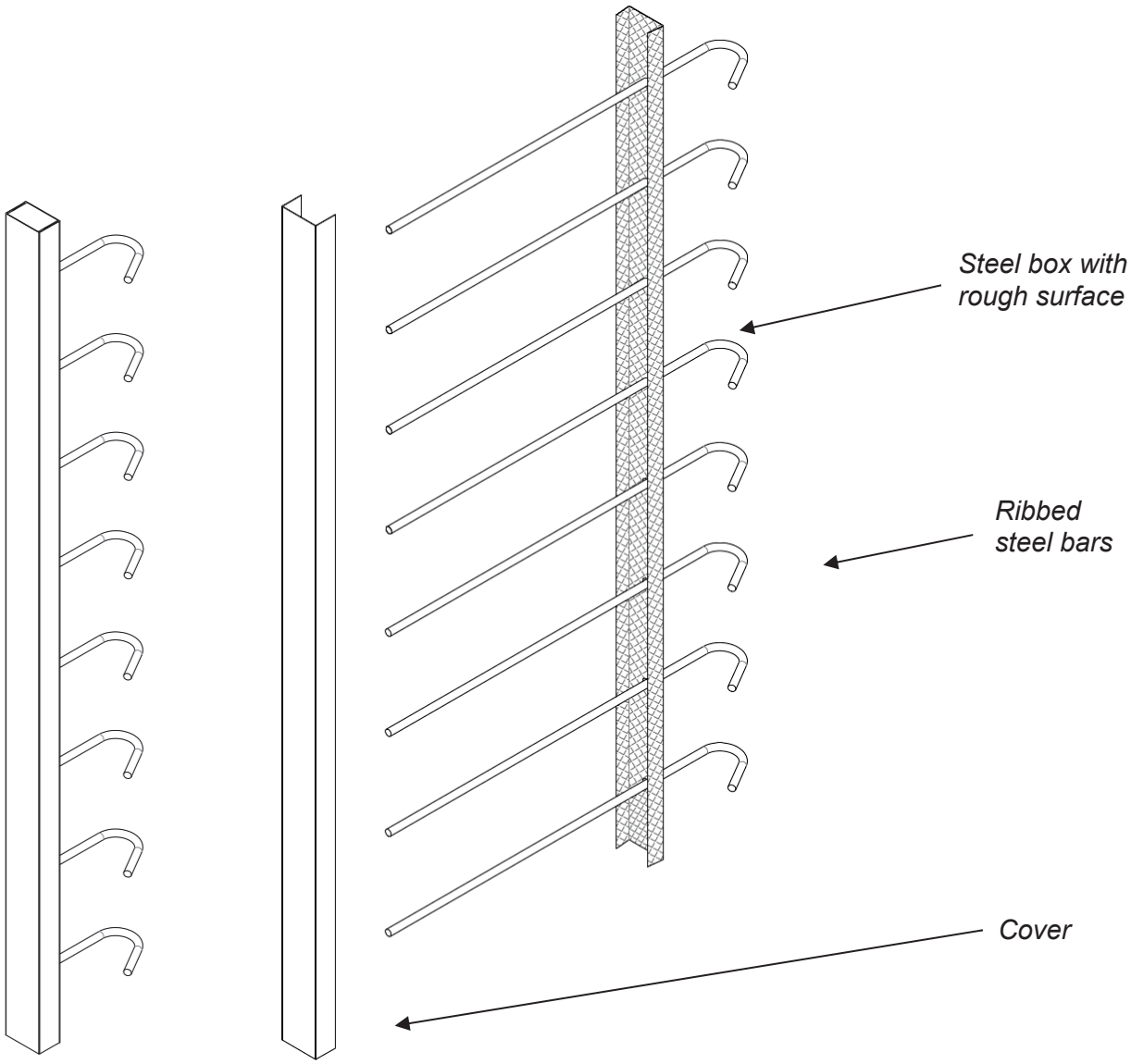
Shape and components

L - Shape after bending of rebars



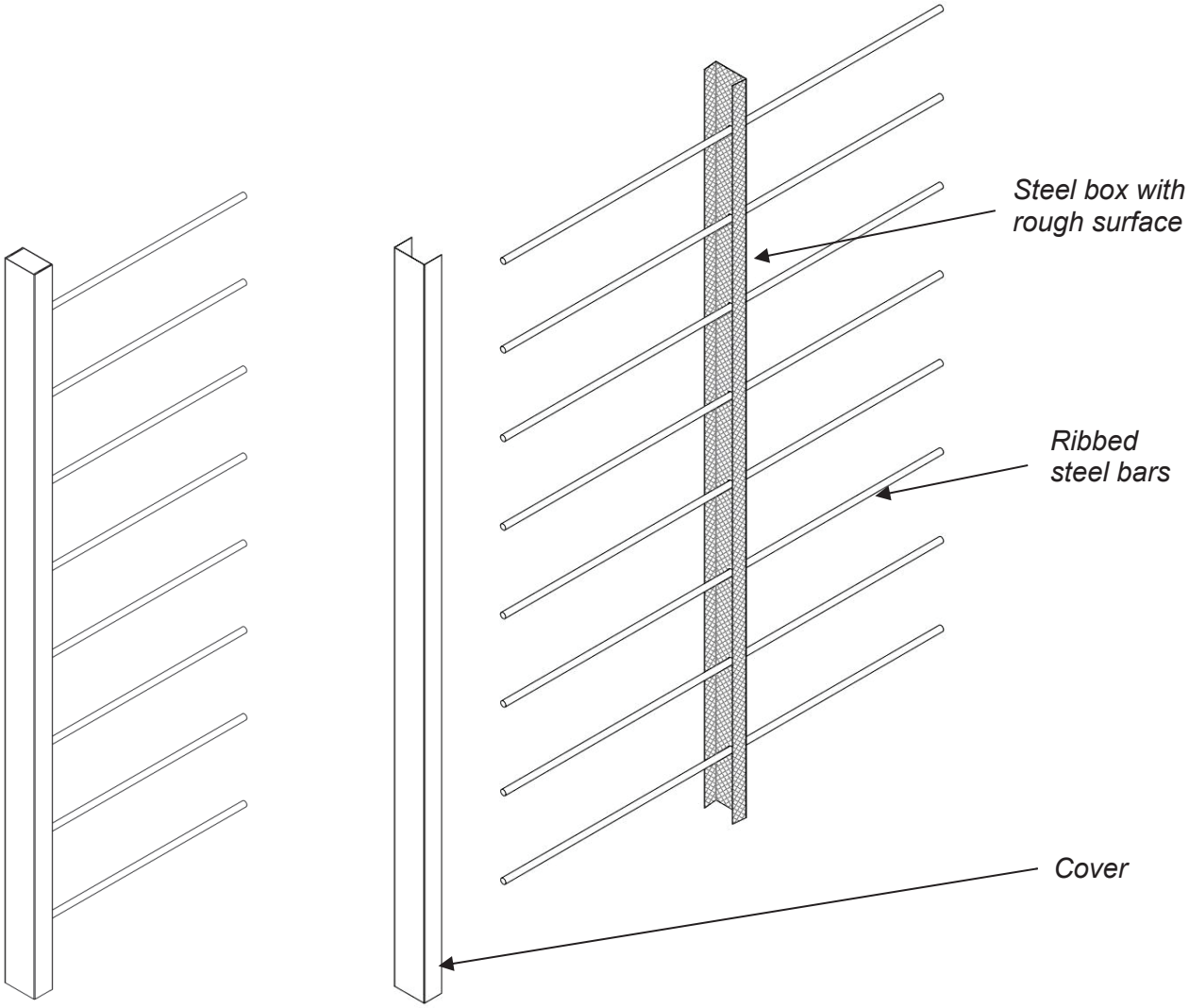
Shape and components

J - Shape after bending of rebars



Shape and components

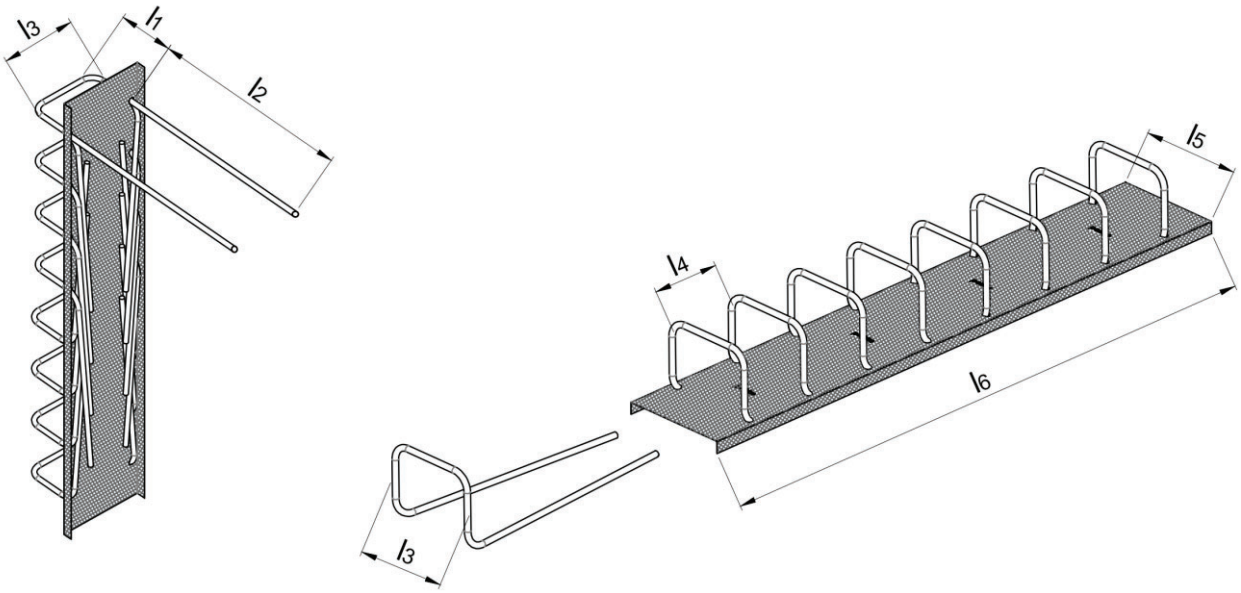
I - Shape after bending of rebars

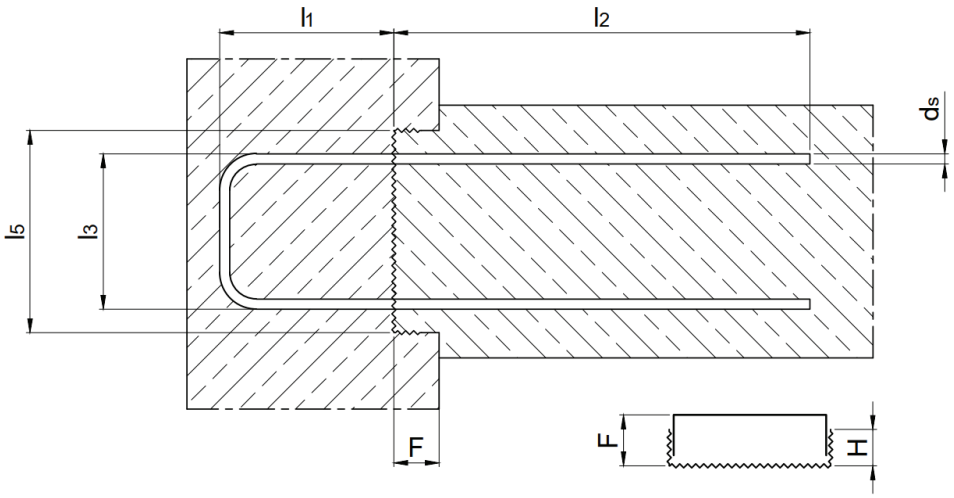


ANNEX 3. DIMENSIONS

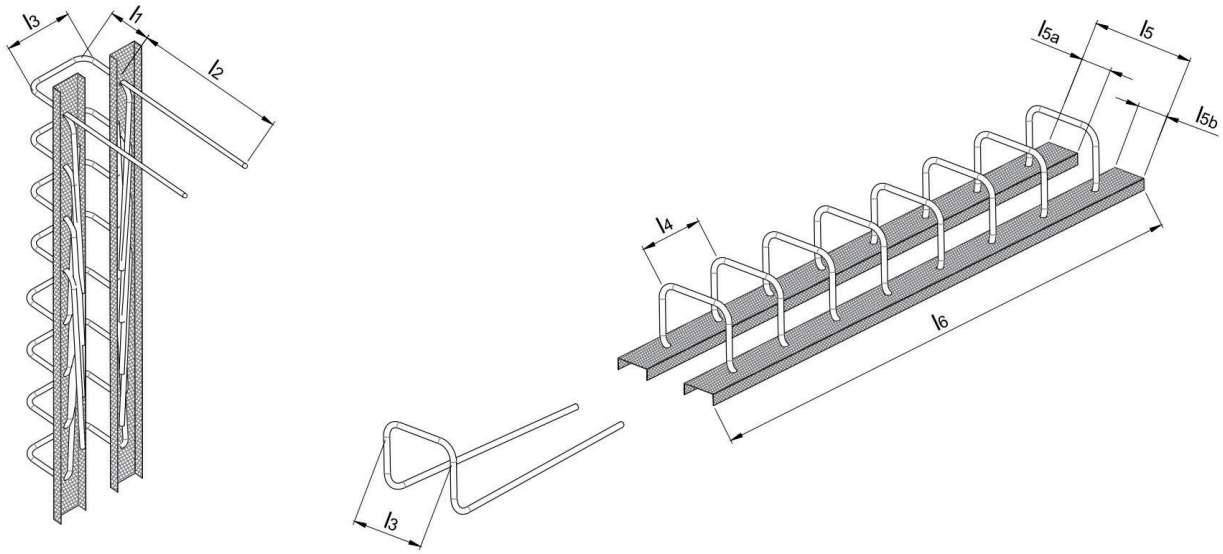
Dimensions and installation (A, K, C)

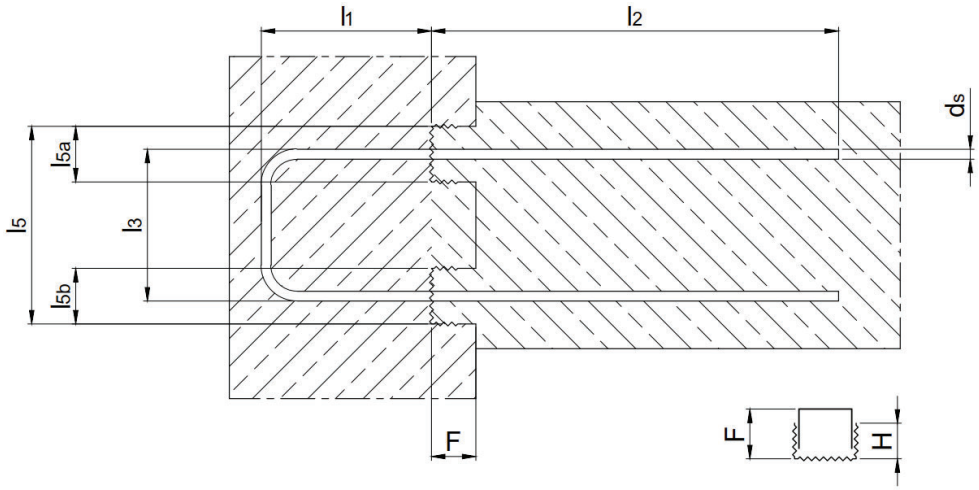
A-Shape



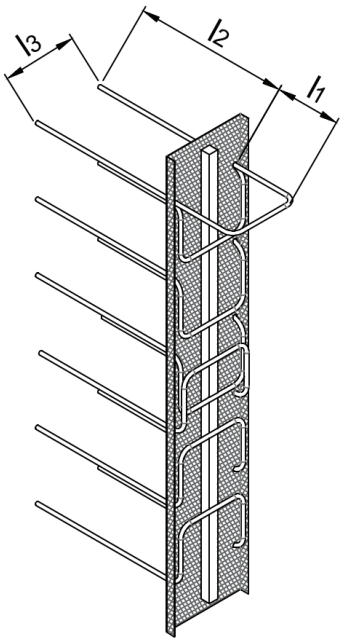


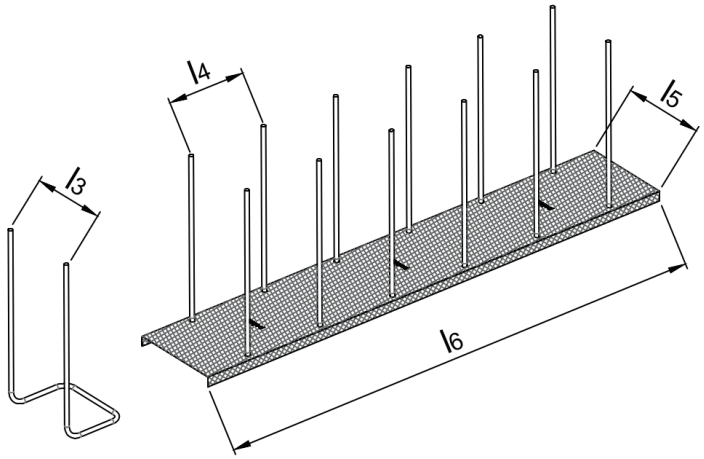
A 2-shape

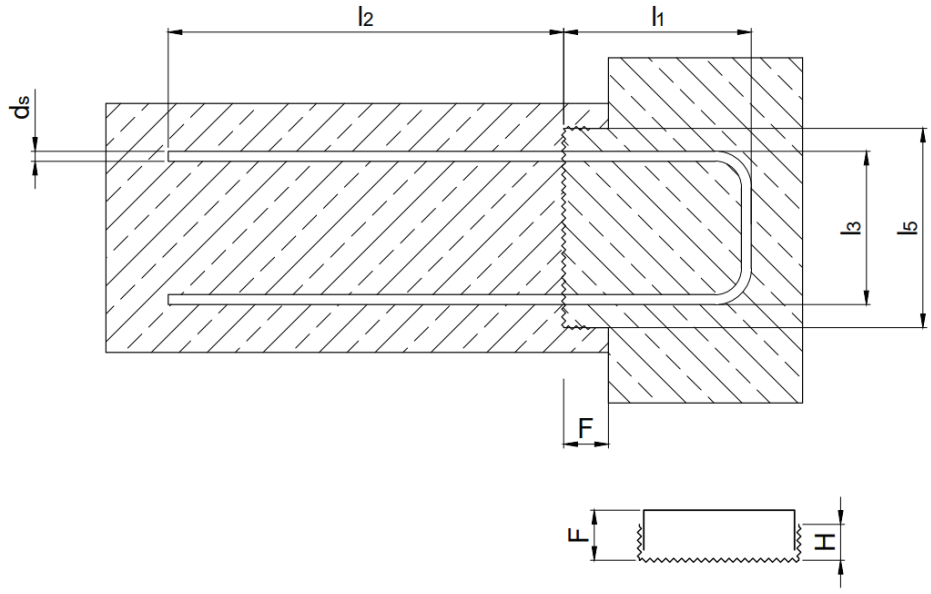




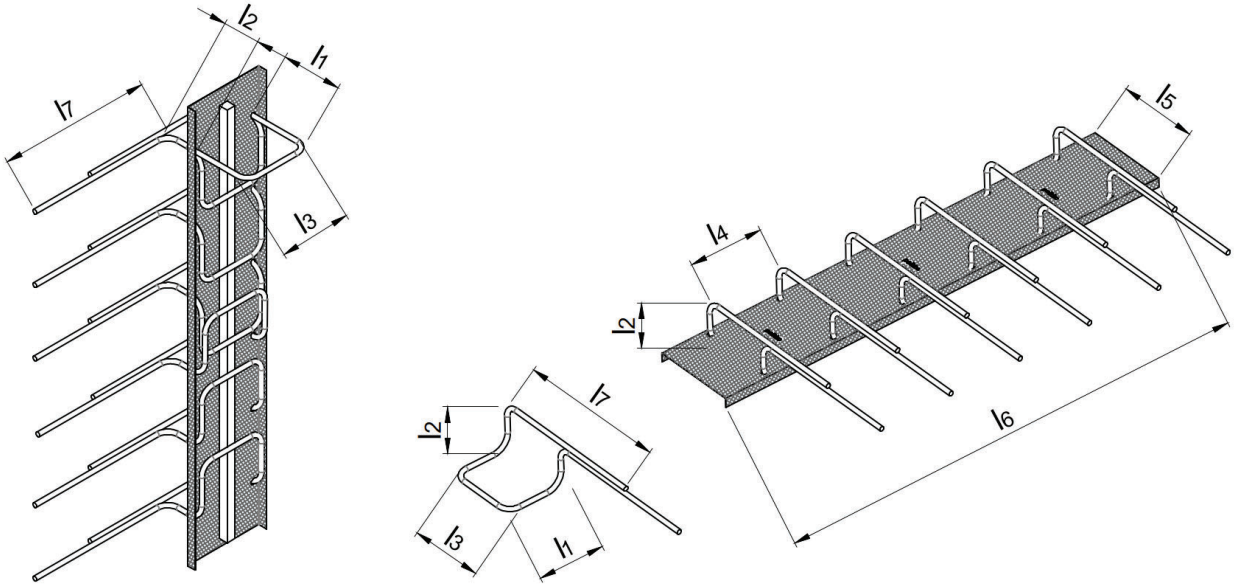
K-Shape

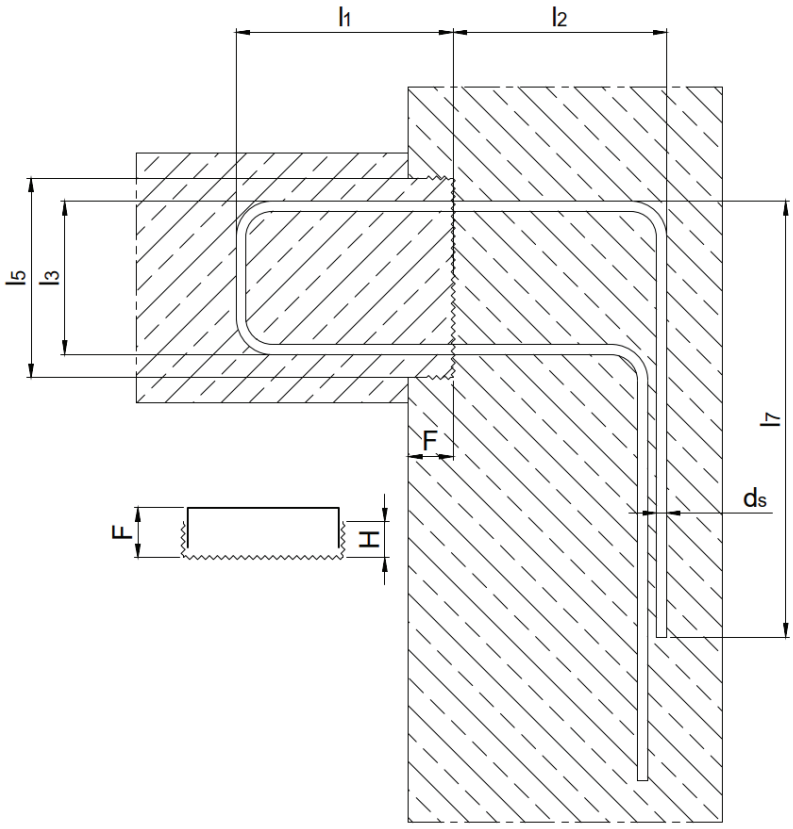






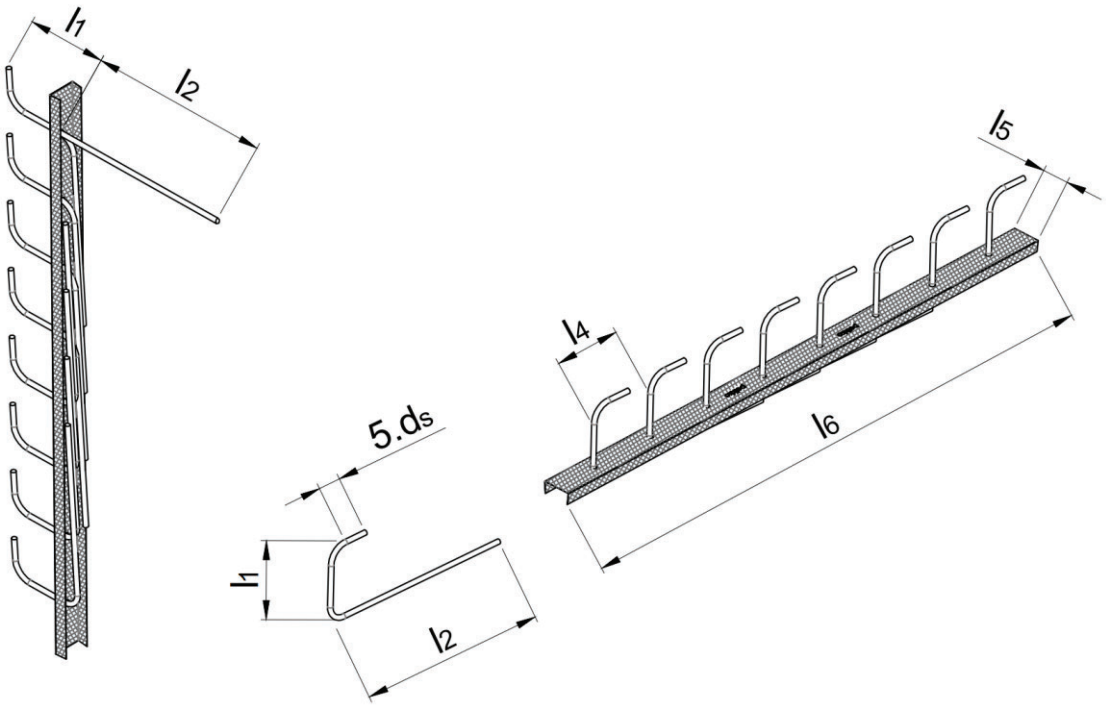
C-Shape

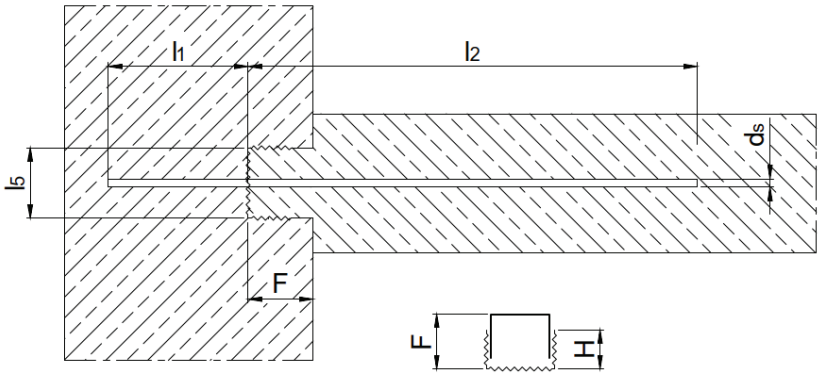


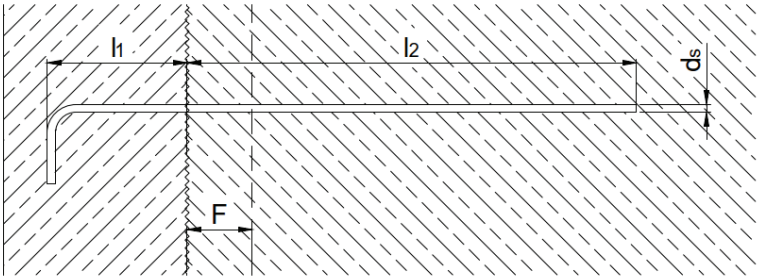


Dimensions and installation (L, I, J)

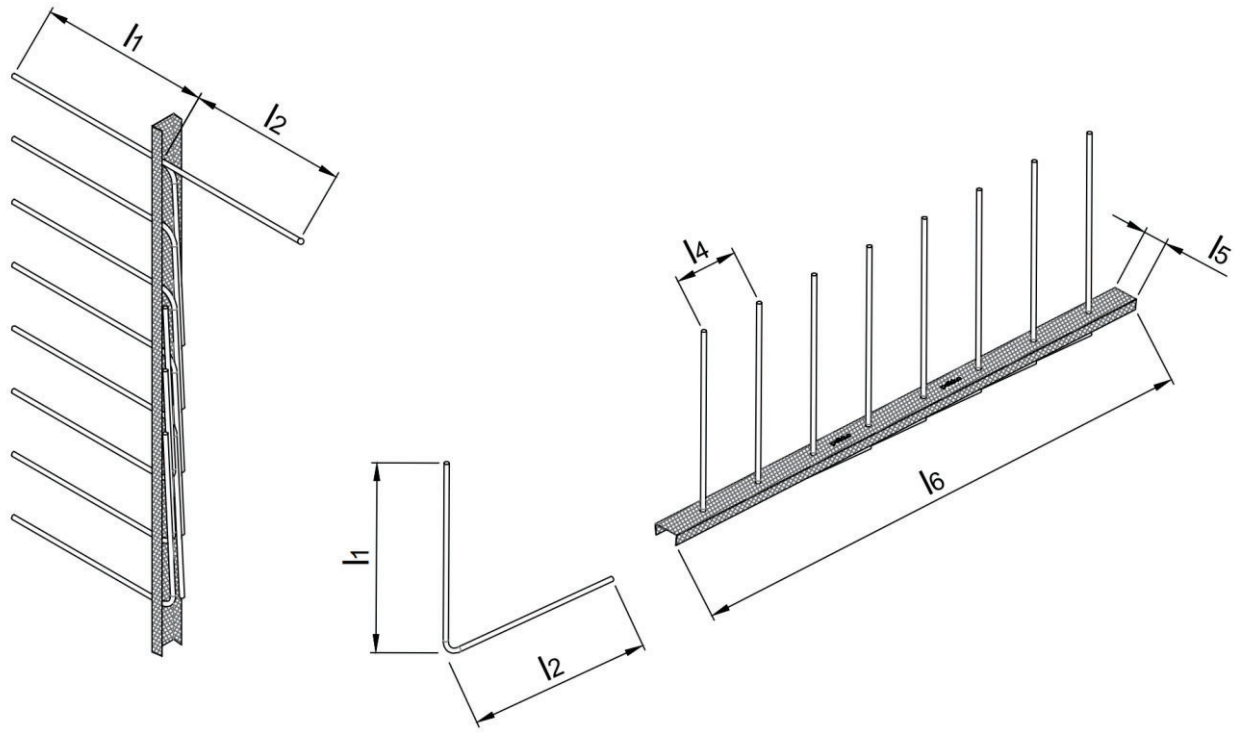
L-Shape

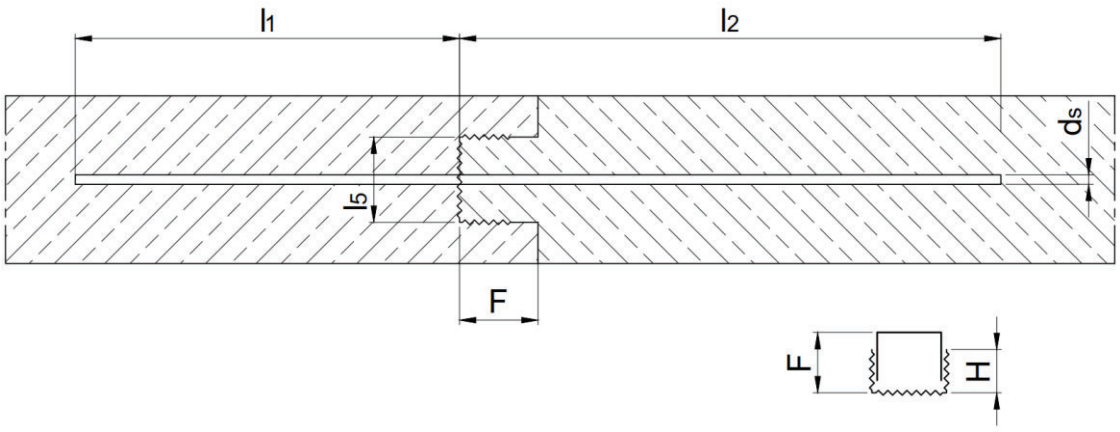




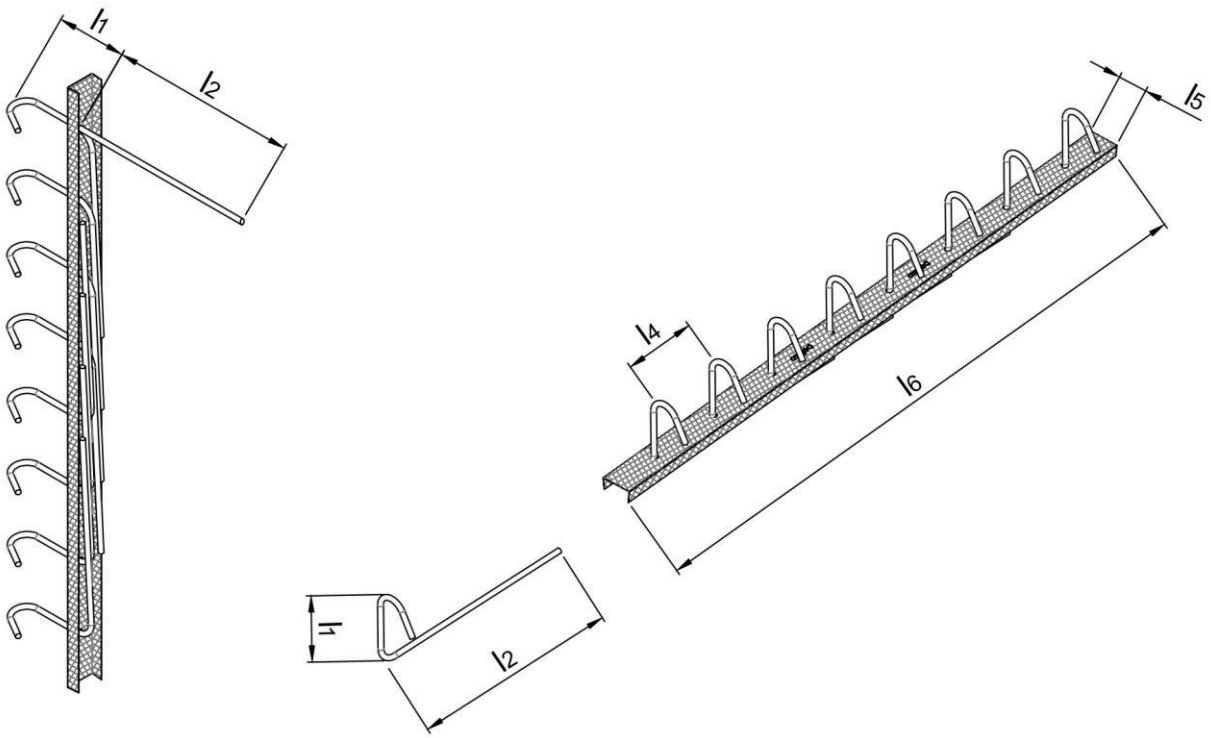


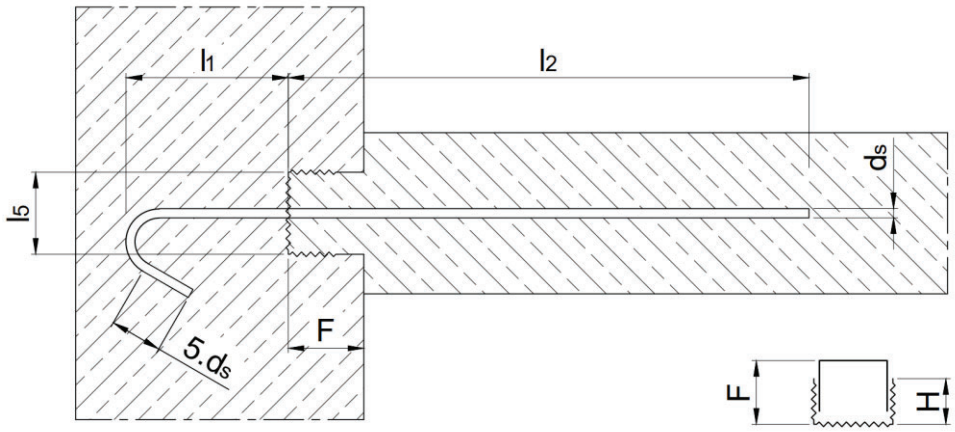
I-Shape





J-Shape





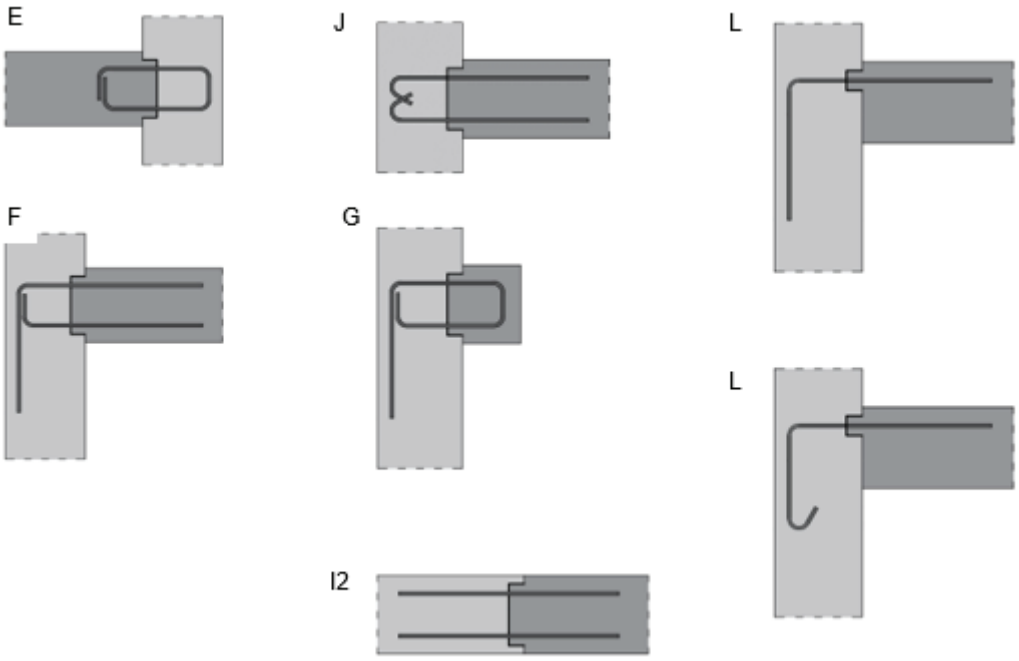
Dimensions and installation

Hook length[1]	-	l_1	-	Project specific[1]
Lap length[1]	-	l_2	-	Project specific[1]
Rebar width	-	l_3	-	60 mm - 260 mm (single row casings)
				90 mm - 450 mm (double row casings)
Rebar spacing	-	l_4	-	100 mm - 300 mm
Box width	-	l_5	-	85 mm - 285 mm (single row casings)
				115 mm - 475 mm (double row casings)
	-	l_{5a}	-	45 mm - 75 mm
	-	l_{5b}	-	45 mm - 75 mm
Fixed length of the box	-	l_6	-	≤ 1250 mm
Anchorage length	-	l_7	-	Project specific[1]
Diamater of the ribbed steel bar	-	d_s	-	8, 10, 12 and 14 mm
Height of the box	-	H	-	25 mm
Total height	-	F	-	36 mm - 50 mm

The reinforcing bars of the re-bend connection elements may be concreted in the first concreting step with a maximum length of d_s from the beginning of the bending. If necessary, tha manufacturer has to adjust the box heights F to the diameter of the reinforcement.

[1] The anchorage and overlap lengths of the reinforced steel bars can be calculated project-specific according to the structural requirements on the basis of EN 1992-1-1.

Additional possible bending shapes and modifications of rebars

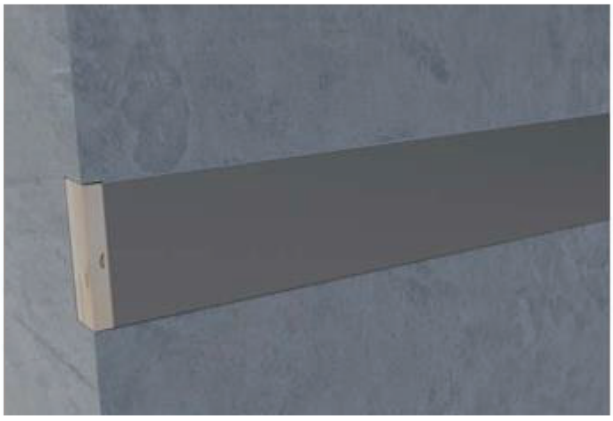


ANNEX 4. INSTALLATION MANUAL

Installing ARBOX® Joint Reinforcement

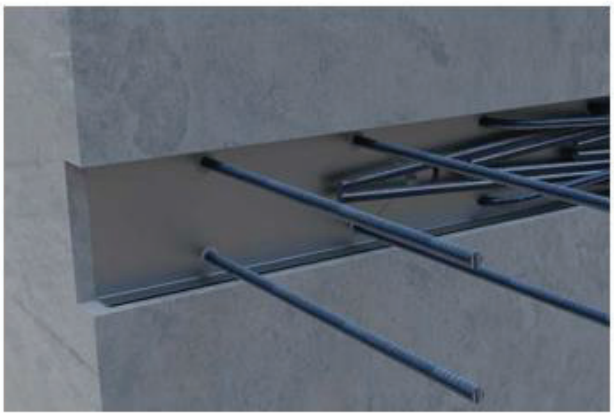
Before casting, fix the ARBOX® Joint Reinforcement in the planned position by nailing it onto the wooden formwork or connecting it to the existing reinforcement.

Pour concrete into the formwork.
When the formwork is removed. The ARBOX® steel cover is revealed.



Remove the ARBOX® steel cover by cutting the tapes that secure it. Then place the claw of a hammer at one end and pull it away to expose the pre-bent bars.

Straighten the bars using an appropriate re-bending tool (e.g. pipe with internal diameter not greater than 2× nominal bar diameter). Bars must only be straightened once.



In case of models ARBOX® K and C. it is necessary to remove the polystyrene block after hooks are straightened.

Remove concrete debris. Once the bars are straightened and aligned. They are ready for overlapping with the element reinforcement. Overlapping length is length l_0.