

Public-law institution jointly founded by the federal states and the Federation

European Technical Assessment Body  
for construction products



## European Technical Assessment

## ETA-24/0780 of 20 November 2025

English translation prepared by DIBt - Original version in German language

### General Part

Technical Assessment Body issuing the European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

Rebar connection with injection system  
Selkent SEL-V+

Product family  
to which the construction product belongs

Systems for post-installed rebar connections with mortar

Manufacturer

Selkent Fastenings Ltd.  
Osprey House  
New Mill Road  
BR5 3QJ ORPINGTON, LONDON  
GROSSBRITANNIEN

Manufacturing plant

Werk Selkent

This European Technical Assessment contains

24 pages including 3 annexes which form an integral part of this assessment

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

EAD 330087-01-0601, Edition 06/2021

This version replaces

ETA-24/0780 issued on 4 February 2025

The European Technical Assessment is issued by the Technical Assessment Body in its official language. Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and shall be identified as such.

Communication of this European Technical Assessment, including transmission by electronic means, shall be in full. However, partial reproduction may only be made with the written consent of the issuing Technical Assessment Body. Any partial reproduction shall be identified as such.

This European Technical Assessment may be withdrawn by the issuing Technical Assessment Body, in particular pursuant to information by the Commission in accordance with Article 25(3) of Regulation (EU) No 305/2011.

## Specific Part

### 1 Technical description of the product

The subject of this European Technical Assessment is the post-installed connection, by anchoring or overlap connection joint, of reinforcing bars (rebars) in existing structures made of normal weight concrete, using the "Rebar connection with injection system Selkent SEL-V+" in accordance with the regulations for reinforced concrete construction.

Reinforcing bars made of steel with a diameter  $\phi$  from 8 to 28 mm or the Selkent rebar anchor FRA or FRA HCR of sizes M12 to M24 according to Annex A and injection mortar Selkent SEL-V+ are used for rebar connections. The rebar is placed into a drilled hole filled with injection mortar and is anchored via the bond between rebar, injection mortar and concrete.

The product description is given in Annex A.

### 2 Specification of the intended use in accordance with the applicable European assessment Document

The performances given in Section 3 are only valid if the rebar connection is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the rebar connections of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right 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 Mechanical resistance and stability (BWR 1)

| Essential characteristic  | Performance             |
|---|-------------------------|
| Characteristic resistance under static and quasi-static loading | See Annex C1 and C2     |
| Characteristic resistance under seismic loading                 | No performance assessed |

#### 3.2 Safety in case of fire (BWR 2)

| Essential characteristic | Performance         |
|--------------------------|---------------------|
| Reaction to fire         | Class A1            |
| Resistance to fire       | See Annex C2 and C3 |

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

In accordance with European Assessment Document EAD No. 330087-01-0601, the applicable European legal act is: [96/582/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 European Assessment Document**

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 20 November 2025 by Deutsches Institut für Bautechnik

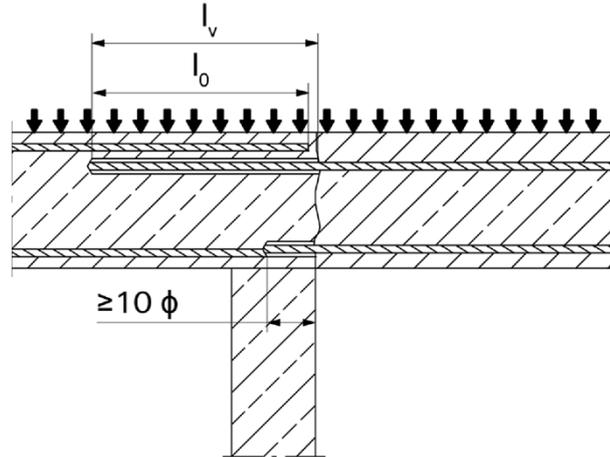
Dipl.-Ing. Beatrix Wittstock  
Head of Section

*beglaubigt:*  
Baderschneider

## Installation conditions and application examples reinforcing bars, part 1

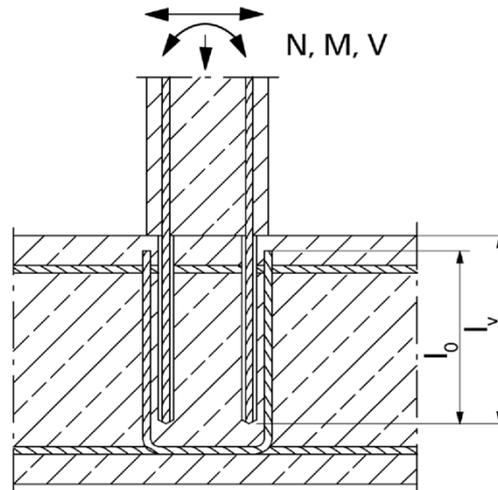
**Figure A1.1:**

Overlap joint with existing reinforcement for rebar connections of slabs and beams



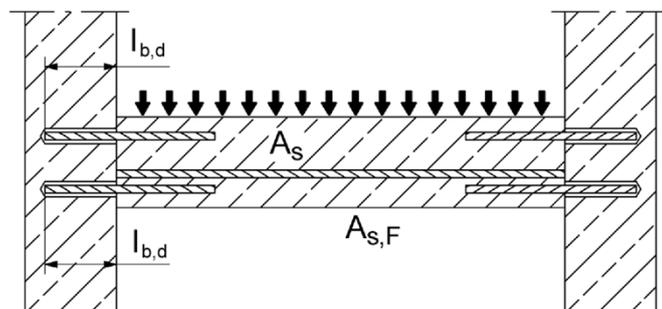
**Figure A1.2:**

Overlap joint with existing reinforcement at a foundation of a column or wall where the rebar is stressed



**Figure A1.3:**

End anchoring of slabs or beams (e.g. designed as simply supported)



Figures not to scale

Rebar connection with injection system Selkent SEL-V+

**Product description**

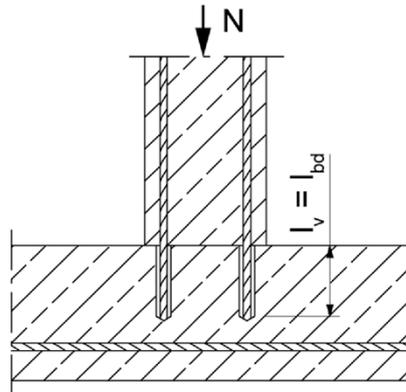
Installation conditions and application examples reinforcing bars, part 1

**Annex A1**

## Installation conditions and application examples reinforcing bars, part 2

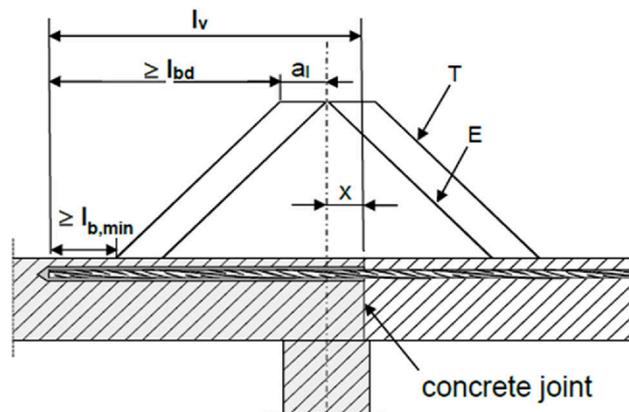
**Figure A2.1:**

Rebar connection for stressed primarily in compression



**Figure A2.2:**

Anchoring of reinforcement to cover the enveloped line of acting tensile force in the bending member



(only post-installed rebar is plotted)

**Key to Figure**

- T Acting tensile force
- E Envelope of  $M_{ed} / z + N_{ed}$  (see EN 1992-1-1:2011)
- x Distance between the theoretical point of support and concrete joint

**Note to figure A1.1 to A1.3 and figure A2.1 to A2.2**

In the figures no traverse reinforcement is plotted, the traverse reinforcement as required by EN 1992-1-1:2011 shall be present.

The shear transfer between old and new concrete shall be designed according to EN 1992-1-1:2011. Preparation of joints according to **Annex B3** of this document

Figures not to scale

Rebar connection with injection system Selkent SEL-V+

**Product description**

Installation conditions and application examples reinforcing bars, part 2

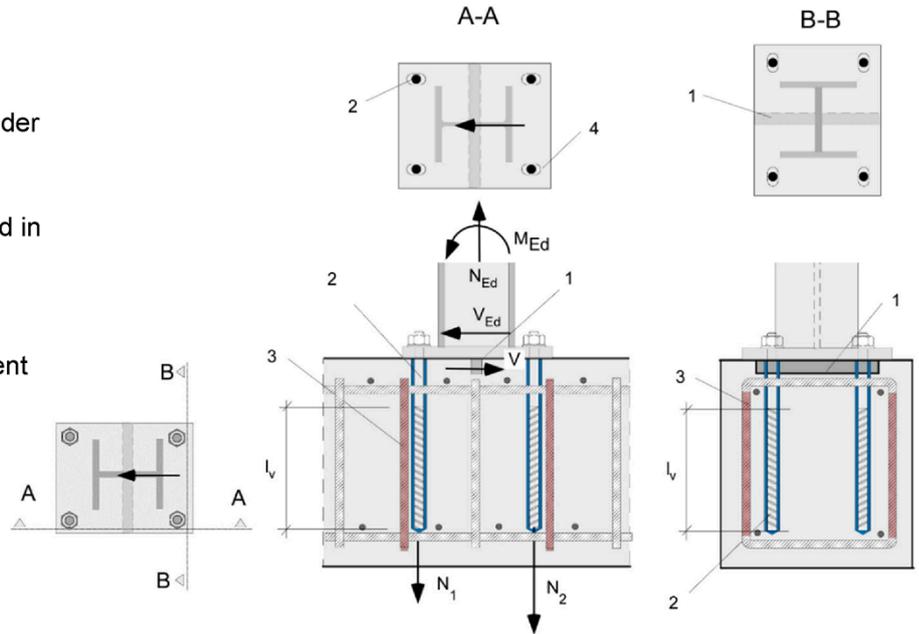
**Annex A2**

## Installation conditions and application examples Selkent rebar anchor FRA

**Figure A3.1:**

Lap to a foundation of a column under bending.

1. Shear lug (or fastener loaded in shear)
2. Selkent rebar anchor FRA (tension only)
3. Existing stirrup / reinforcement for overlap (lap splice)
4. Slotted hole

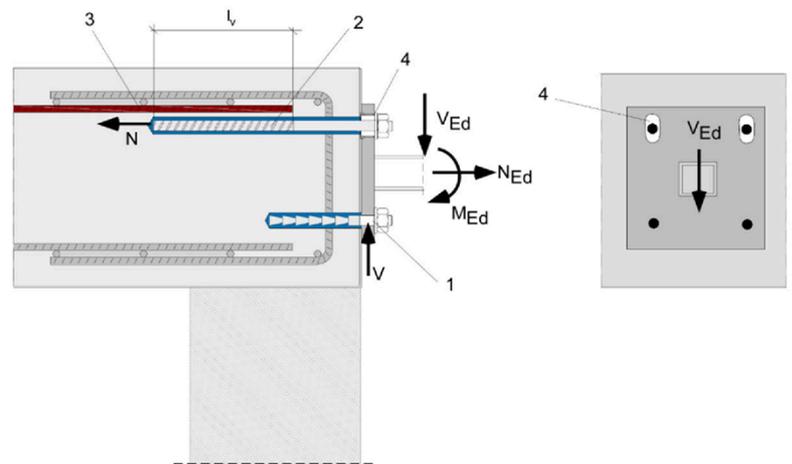


**Figure A3.2:**

Lap of the anchoring of guardrail posts or anchoring of cantilevered building components.

In the anchor plate, the drill holes for the Selkent rebar anchors FRA have to be designed as slotted holes with axial direction to the shear force.

1. Fastener for shear load transfer
2. Selkent rebar anchor FRA (tension only)
3. Existing stirrup / reinforcement for overlap (lap splice)
4. Slotted hole



The required transverse reinforcement acc. to EN 1992-1-1:2011 is not shown in the figures. **The Selkent rebar anchor FRA may be only used for axial tensile force.** The tensile force must be transferred by lap to the existing reinforcement of the building. The transfer of the shear force has to be ensured by suitable measure, e.g. by means of shear force or anchors with European Technical Assessment (ETA).

Figures not to scale

Rebar connection with injection system Selkent SEL-V+

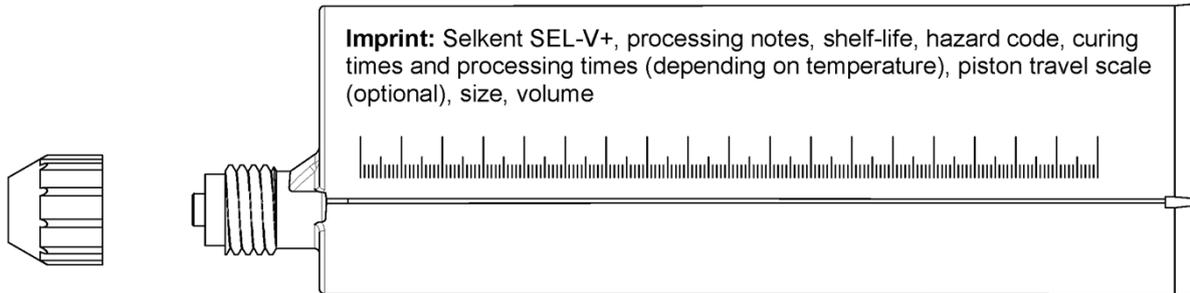
**Product description**

Installation conditions and application examples Selkent rebar anchors FRA

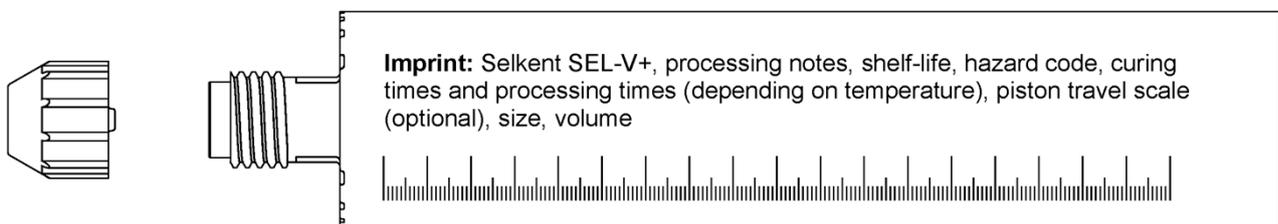
**Annex A3**

## Overview system components

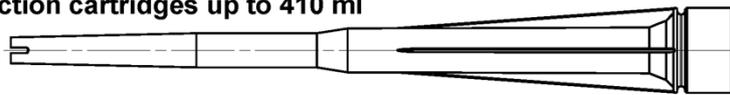
### Injection cartridge (shuttle cartridge) with sealing cap; Sizes: 360 ml, 825 ml



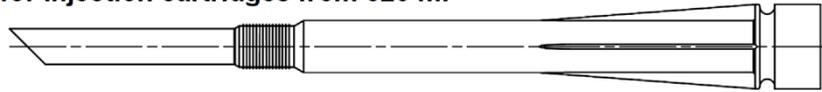
### Injection cartridge (coaxial cartridge) with sealing cap; Sizes: 300 ml, 380 ml, 400 ml, 410 ml



### Static mixer Selkent SEL-V+ for injection cartridges up to 410 ml



### Static mixer Selkent SEL-V+ for injection cartridges from 825 ml



### Injection adapter and extension tube Ø 9 for static mixer Selkent SEL-V+ for injection cartridges up to 410 ml

### Injection adapter and extension tube Ø 9 or Ø 15 for static mixer Selkent SEL-V+ for injection cartridges from 825 ml



### Reinforcing bar (rebar) Sizes: Ø8, Ø10, Ø12, Ø14, Ø16, Ø20, Ø25, Ø28



### Selkent rebar anchor FRA / FRA HCR Sizes: M12, M16, M20, M24



### Selkent Blow out pump



### Compressed-air cleaning tool with compressed-air nozzle



Figures not to scale

### Rebar connection with injection system Selkent SEL-V+

#### Product description

Overview system components; Injection mortar, static mixer, injection adapter, reinforcing bar, Selkent rebar anchor FRA, cleaning tools

## Annex A4

## Properties of reinforcing bars (rebar)

Figure A5.1:



- The minimum value of related rib area  $f_{R,min}$  according to EN 1992-1-1:2011
- The maximum outer rebar diameter over the ribs shall be:
  - The nominal diameter of the bar with rib  $\phi + 2 \cdot h$  ( $h \leq 0,07 \cdot \phi$ )
  - ( $\phi$ : Nominal diameter of the bar;  $h_{rib}$  = rib height of the bar)

Table A5.1: Installation conditions for rebars

| Nominal diameter of the bar          |           | $\phi$ | 8 <sup>1)</sup>              |    | 10 <sup>1)</sup> |    | 12 <sup>1)</sup> |    | 14           | 16 | 20 | 25 <sup>1)</sup> |    | 28 |
|--------------------------------------|-----------|--------|------------------------------|----|------------------|----|------------------|----|--------------|----|----|------------------|----|----|
| Nominal drill hole diameter          | $d_0$     | [mm]   | 10                           | 12 | 12               | 14 | 14               | 16 | 18           | 20 | 25 | 30               | 35 | 35 |
| Drill hole depth                     | $h_0$     |        | $h_0 = l_v$                  |    |                  |    |                  |    |              |    |    |                  |    |    |
| Effective embedment depth            | $l_v$     |        | acc. to static calculation   |    |                  |    |                  |    |              |    |    |                  |    |    |
| Minimum thickness of concrete member | $h_{min}$ |        | $l_v + 30$<br>( $\geq 100$ ) |    |                  |    |                  |    | $l_v + 2d_0$ |    |    |                  |    |    |

<sup>1)</sup> Both drill hole diameters can be used

Table A5.2: Materials of rebars

| Designation                                  | Reinforcing bar (rebar)   |
|--|---|
| Reinforcing bar<br>EN 1992-1-1:2011, Annex C | Bars and de-coiled rods class B or C with<br>$f_{yk}$ and $k$ according to NDP or NCI of EN 1992-1-1/NA<br>$f_{uk} = f_{tk} = k \cdot f_{yk}$ |

Figures not to scale

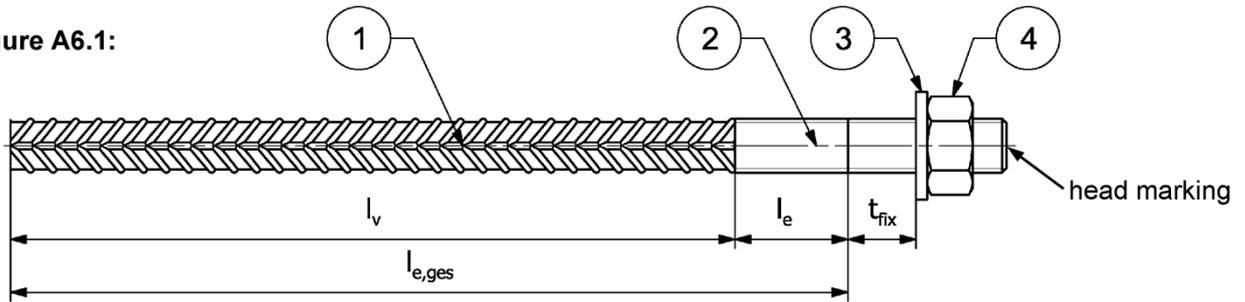
Rebar connection with injection system Selkent SEL-V+

**Product description**  
Properties and materials of reinforcing bars (rebar)

**Annex A5**

## Properties of Selkent rebar anchors FRA

Figure A6.1:



Head marking e.g.: FRA (for stainless steel)

FRA HCR (for high corrosion-resistant steel)

Table A6.1: Installation conditions for Selkent rebar anchors FRA

| Thread diameter   |                           | M12 <sup>2)</sup>               | M16          | M20 | M24 <sup>2)</sup> |
|---|---------------------------|---------------------------------|--------------|-----|-------------------|
| Nominal diameter  | $\phi$ [mm]               | 12                              | 16           | 20  | 25                |
| Nominal drill bit diameter                                      | $d_0$ [mm]                | 14   16                         | 20           | 25  | 30   35           |
| Drill hole depth ( $h_0 = l_{e,ges}$ )                          | $l_{e,ges}$ [mm]          | $l_v + l_e$                     |              |     |                   |
| Effective embedment depth                                       | $l_v$ [mm]                | according to static calculation |              |     |                   |
| Distance concrete surface to welded joint                       | $l_e$ [mm]                | 100                             |              |     |                   |
| Maximum Diameter of clearance hole in the fixture <sup>1)</sup> | Pre-positioned $d_f$ [mm] | 14                              | 18           | 22  | 26                |
|   | Push through $d_f$ [mm]   | 16   18                         | 22           | 26  | 32   40           |
| Minimum thickness of concrete member                            | $h_{min}$ [mm]            | $h_0+30$                        | $h_0 + 2d_0$ |     |                   |
| Maximum torque moment for attachment of the fixture             | $\max T_{inst}$ [Nm]      | 50                              | 100          | 150 | 150               |

<sup>1)</sup> For bigger clearance holes in the fixture see EN 1992-4:2018

<sup>2)</sup> Both drill bit diameters can be used

Table A6.2: Materials of Selkent rebar anchors FRA

| Part | Description                           | Materials  |   |
|------|---------------------------------------|--|---|
|      |                                       | FRA<br>Corrosion resistance class CRC III<br>acc. to EN 1993-1-4:2006+A1:2015  | FRA HCR<br>Corrosion resistance class CRC V<br>acc. to EN 1993-1-4: 2006+A1:2015                                      |
| 1    | Reinforcing bar                       | Bars and de-coiled rods class B or C with $f_{yk}$ and $k$ according to NDP or NCI of EN 1992-1-1:NA; $f_{uk} = f_{tk} = k \cdot f_{yk}$ ; ( $f_{yk} = 500 \text{ N/mm}^2$ ) |   |
| 2    | Round bar with partial or full thread | Stainless steel,<br>strength class 80,<br>according to EN 10088-1: 2023  | High corrosion-resistant steel,<br>strength class 80,<br>according to EN 10088-1: 2023                                |
| 3    | Washer<br>ISO 7089:2000               | Stainless steel,<br>according to EN 10088-1: 2023  | High corrosion-resistant steel,<br>according to EN 10088-1: 2023  |
| 4    | Hexagon nut                           | Stainless steel,<br>strength class 80,<br>acc. to EN ISO 3506-2:2020,<br>according to EN 10088-1: 2023   | High corrosion-resistant steel,<br>strength class 80,<br>acc. to EN ISO 3506-2:2020,<br>according to EN 10088-1: 2023 |

Figures not to scale

Rebar connection with injection system Selkent SEL-V+

**Product description**  
Properties and materials of Selkent rebar anchors FRA

**Annex A6**

| <b>Specifications of intended use part 1</b>   |                     |  |                                 |   |   |
|--|---------------------|--|---------------------------------|---|---|
| <b>Table B1.1: Overview use and performance categories</b>   |                     |  |                                 |   |   |
| Anchorages subject to  |                     | <b>Selkent SEL-V+ with ...</b>   |                                 |   |   |
|  |                     | Reinforcing bar<br> |                                 | Selkent rebar anchor FRA<br> |   |
| Hammer drilling or compressed air drilling with standard drill bit<br>  |                     | all sizes  |                                 |   |   |
| Hammer drilling with hollow drill bit<br><br>(fischer "FHD", Heller "Duster Expert", Bosch "Speed Clean", Hilti "TE-CD, TE-YD") |                     | Nominal drill bit diameter ( $d_0$ )<br>12 mm to 35 mm   |                                 |   |   |
| Use category I1  | dry or wet concrete | all sizes  |                                 |   |   |
| Characteristic resistance under static and quasi static loading, in  | uncracked concrete  | all sizes  | Tables:<br>C1.1<br>C1.2<br>C1.3 | all sizes   | Tables:<br>C1.1<br>C1.2<br>C1.3<br>C2.1<br>C2.2 |
|  | cracked concrete    |  |                                 |   |   |
| Characteristic resistance under seismic loading  |                     | -1)  |                                 | -1)   |   |
| Installation direction   |                     | D3 (downward and horizontal and upwards (e.g. overhead))   |                                 |   |   |
| Installation temperature   |                     | $T_{i,min} = 0\text{ °C}$ to $T_{i,max} = +40\text{ °C}$   |                                 |   |   |
| Service temperature  | Temperature range   | -40 °C to +80 °C   |                                 | (max. short term temperature +80 °C;<br>max long term temperature +50 °C)                                       |   |
| Resistance to fire   |                     | all sizes  | Annex C3                        | all sizes   | Table C2.3                                      |
| 1) No performance assessed   |                     |  |                                 |   |   |
| Rebar connection with injection system Selkent SEL-V+  |                     |  |                                 |   | <b>Annex B1</b>                                 |
| Intended use<br>Specifications part 1  |                     |  |                                 |   |   |

## Specifications of intended use part 2

### Anchorage subject to:

- Static and quasi-static loading: reinforcing bar (rebar) size 8 mm to 28 mm; FRA M12 to M24
- Resistance to fire: reinforcing bar (rebar) size 8 mm to 28 mm; FRA M12 to M24

### Base materials:

- Compacted reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013+A2:2021
- Concrete strength classes C12/15 to C50/60 according to EN 206:2013+ A2:2021
- Maximum chloride content of 0,40 % (CL 0.40) related to the cement content according to EN 206:2013+A2:2021
- Non-carbonated concrete

Note: In case of a carbonated surface of the existing concrete structure the carbonated layer shall be removed in the area of the post-installed rebar connection with a diameter of  $\phi + 60$  mm prior to the installation of the new rebar. The depth of concrete to be removed shall correspond to at least the minimum concrete cover in accordance with EN 1992-1-1:2011. The foregoing may be neglected if building components are new and not carbonated and if building components are in dry conditions.

### Use conditions (Environmental conditions) for Selkent rebar anchors FRA

- For all conditions according to EN1993-1-4:2006+A1:2015 corresponding to corrosion resistance classes to **Annex A6 Table A6.2**.

### Design:

- The structural design according to EN 1992-1-1:2011, EN 1992-1-2:2011 and **Annex B3** and **B4** are conducted under responsibility of a designer experienced in the field of anchorages and concrete works.
- Verifiable calculation notes and drawings are prepared taking account of the forces to be transmitted.
- The actual position of the reinforcement in the existing structure shall be determined on the basis of the construction documentation and taken into account when designing.

### Installation:

- The installation of post-installed rebar respectively Selkent rebar anchor FRA shall be done only by suitable trained installer and under Supervision on site; the conditions under which an installer may be considered as suitable trained and the conditions for Supervision on site are up to the Member States in which the installation is done.
- Check the position of the existing rebars (if the position of existing rebars is not known, it shall be determined using a rebar detector suitable for this purpose as well as on the basis of the construction documentation and then marked on the building component for the overlap joint).

Rebar connection with injection system Selkent SEL-V+

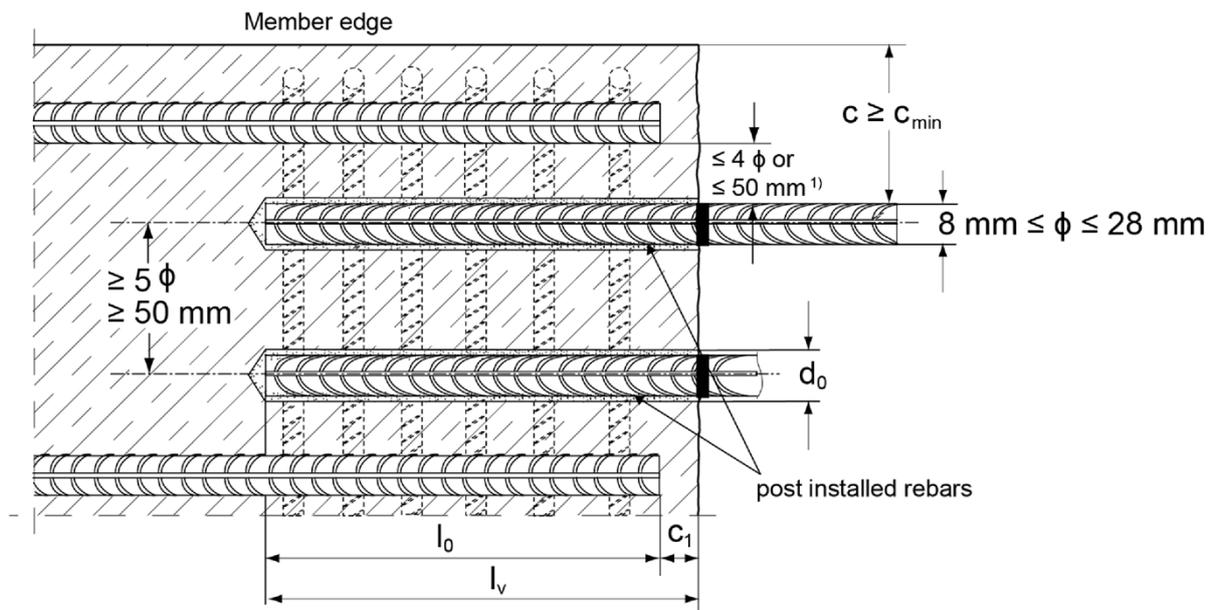
**Intended use**  
Specifications part 2

**Annex B2**

## General construction rules for post-installed rebars

**Figure B3.1:**

- Only tension forces in the axis of the rebar may be transmitted.
- The transfer of shear forces between new concrete and existing structure shall be designed additionally according to EN 1992-1-1:2011.
- The joints for concreting must be roughened to at least such an extent that aggregate protrude.



<sup>1)</sup> If the clear distance between lapped bars exceeds  $4 \phi$  or 50 mm then the lap length shall be increased by the difference between the clear bar distance and the smaller  $4 \phi$  or 50 mm.

- $c$  concrete cover of post-installed rebar  
 $c_1$  concrete cover at end-face of existing rebar  
 $c_{min}$  minimum concrete cover according to **Table B5.1** and to EN 1992-1-1:2011, Section 4.4.1.2  
 $\phi$  nominal diameter of reinforcing bar  
 $l_0$  lap length, according to EN 1992-1-1:2011 for static loading  
 $l_v$  effective embedment depth,  $\geq l_0 + c_1$   
 $d_0$  nominal drill bit diameter, see **Annex B6**

Figures not to scale

Rebar connection with injection system Selkent SEL-V+

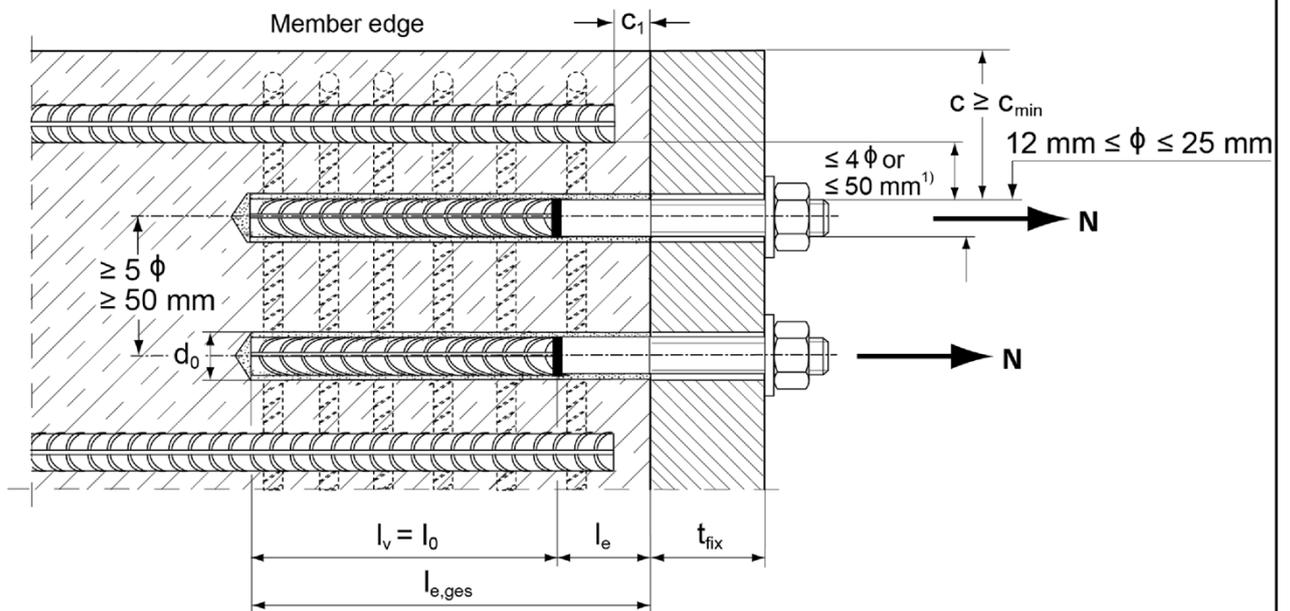
**Intended use**  
General construction rules for post-installed rebars

**Annex B3**

## General construction rules for post-installed Selkent rebar anchors FRA

Figure B4.1:

- Only tension forces in the axis of the Selkent rebar anchor FRA may be transmitted.
- The tension force must be transferred via an overlap joint to the reinforcement in the building part.
- The transmission of the shear load shall be ensured by appropriate additional measures, e.g. by shear lugs or by anchors with a European Technical Assessment (ETA).
- In the anchor plate, the holes for the Selkent rebar anchors FRA shall be executed as slotted holes with the axis in the direction of the shear force.
- The length of the bonded-in thread may not be accounted as anchorage.



<sup>1)</sup> If the clear distance between lapped bars exceeds  $4\phi$  or  $50\text{ mm}$  then the lap length shall be increased by the difference between the clear bar distance and the smaller  $4\phi$  or  $50\text{ mm}$ .

|                    |  |
|--------------------|--|
| c                  | concrete cover of post-installed Selkent rebar anchor FRA                                      |
| $c_1$              | concrete cover at end-face of existing rebar   |
| $c_{\min}$         | minimum concrete cover according to <b>Table B5.1</b> and to EN 1992-1-1:2011, Section 4.4.1.2 |
| $\phi$             | nominal diameter of reinforcing bar  |
| $l_0$              | lap length, according to EN 1992-1-1:2011, Section 8.7.3                                       |
| $l_{e,\text{ges}}$ | overall embedment depth, $\geq l_0 + l_e$  |
| $d_0$              | nominal drill bit diameter, see <b>Annex B6</b>  |
| $l_e$              | length of the bonded in threaded part  |
| $t_{\text{fix}}$   | thickness of the fixture   |
| $l_v$              | effective embedment depth  |

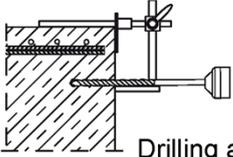
Figures not to scale

Rebar connection with injection system Selkent SEL-V+

**Intended use**

General construction rules for post-installed Selkent rebar anchors FRA

**Annex B4**

| Drilling method   | nominal diameter of reinforcing bar $\phi$ [mm] | Minimum concrete cover $c_{min}$ |                                |  |
|---|---|----------------------------------|--------------------------------|---|
|   |   | Without drilling aid [mm]        | With drilling aid [mm]         |   |
| Hammer drilling with standard drill bit or hollow drill bit | < 25  | 30 mm + 0,06 $l_v \geq 2 \phi$   | 30 mm + 0,02 $l_v \geq 2 \phi$ |   |
|   | $\geq 25$                                       | 40 mm + 0,06 $l_v \geq 2 \phi$   | 40 mm + 0,02 $l_v \geq 2 \phi$ |   |
| Compressed air drilling                                     | < 25  | 50 mm + 0,08 $l_v$               | 50 mm + 0,02 $l_v$             |   |
|   | $\geq 25$                                       | 60 mm + 0,08 $l_v \geq 2 \phi$   | 60 mm + 0,02 $l_v \geq 2 \phi$ |   |

<sup>1)</sup> See Annex B3, figure B3.1 and Annex B4, figure B4.1

Note: The minimum concrete cover as specified in EN 1992-1-1:2011 must be observed.

**Table B5.2: Dispensers and cartridge sizes corresponding to maximum embedment depth  $l_{v,max}$**

| reinforcing bars (rebar) | Selkent rebar anchor FRA | Manual dispenser                 | Accu and pneumatic dispenser (small) | Accu and pneumatic dispenser (large) |
|--------------------------|--------------------------|----------------------------------|--------------------------------------|--------------------------------------|
|                          |                          | Cartridge size                   |                                      |                                      |
|                          |                          | < 500 ml                         |                                      | > 500 ml                             |
| $\phi$ [mm]              | thread [-]               | $l_{v,max} / l_{e,ges,max}$ [mm] |                                      | $l_{v,max} / l_{e,ges,max}$ [mm]     |
| 8                        | ---                      | 1000                             | 1000                                 | 1800                                 |
| 10                       | ---                      |                                  | 1200                                 |                                      |
| 12                       | FRA M12<br>FRA HCR M12   |                                  |                                      |                                      |
| 14                       | ---                      |                                  | 1300                                 |                                      |
| 16                       | FRA M16<br>FRA HCR M16   | 700                              |                                      | 1000                                 |
| 20                       | FRA M20<br>FRA HCR M20   |                                  | 700                                  |                                      |
| 25                       | FRA M24<br>FRA HCR M24   |                                  |                                      |                                      |
| 28                       | ---                      |                                  |                                      |                                      |

**Table B5.3: Conditions for use static mixer without an extension tube**

| Nominal drill hole diameter | $d_0$       | [mm] | 10   | 12           | 14 | 16         | 18         | 20         | 24         | 25         | 30         | 35         |
|-----------------------------|-------------|------|--|--------------|----|------------|------------|------------|------------|------------|------------|------------|
|                             |             |      | Drill hole depth $h_0$ by using injection cartridges | up to 410 ml |    | $\leq 90$  |            | $\leq 120$ | $\leq 140$ | $\leq 150$ | $\leq 160$ | $\leq 190$ |
|                             | from 825 ml | -    | -  | $\leq 90$    |    | $\leq 160$ | $\leq 180$ | $\leq 190$ | $\leq 220$ |            | $\leq 250$ |            |

Rebar connection with injection system Selkent SEL-V+

**Intended use**  
Minimum concrete cover;  
dispenser and cartridge sizes corresponding to maximum embedment depth

**Annex B5**

**Table B6.1: Working times  $t_{work}$  and curing times  $t_{cure}$**

| Temperature in the anchorage base [°C] | Maximum working time <sup>1)</sup><br>$t_{work}$<br><b>Selkent SEL-V+</b> | Minimum curing time <sup>2)</sup><br>$t_{cure}$<br><b>Selkent SEL-V+</b> |
|--|---|--|
| 0 to 5 <sup>3)</sup>                   | 13 min  | 3 h  |
| > 5 to 10 <sup>3)</sup>                | 9 min   | 90 min   |
| > 10 to 20                             | 5 min   | 60 min   |
| > 20 to 30                             | 4 min   | 45 min   |
| > 30 to 40 <sup>4)</sup>               | 2 min   | 35 min   |

1) Maximum time from the beginning of the injection to rebar / Selkent rebar anchor FRA setting and positioning.

2) For wet concrete the curing time must be doubled.

3) If the temperature in the concrete falls below 10 °C the cartridge must be warmed up to +15 °C.

4) If the temperature in the concrete exceeds 30 °C the cartridge must be cooled down to +15 °C up to 20 °C.

**Table B6.2: Installation tools for drilling and cleaning the bore hole and injection of the mortar**

| reinforcing bars (rebar)<br>$\phi$ [mm] | Selkent rebar anchor FRA<br>Designation            | Drilling and cleaning                    |  |                                    |   | Injection                          |                               |
|---|--|--|--|------------------------------------|---|------------------------------------|-------------------------------|
|   |  | Nominal drill bit diameter<br>$d_0$ [mm] | Diameter of cutting edge<br>$d_{cut}$ [mm] | Steel brush diameter<br>$d_b$ [mm] | Diameter of compressed air nozzle<br>[mm] | Diameter of extension tube<br>[mm] | Injection adapter<br>[colour] |
| 8 <sup>1)</sup>                         | ---  | 10                                       | $\leq 10,50$                               | 11,0                               | ---                                       | 9                                  | ---                           |
|   |  | 12                                       | $\leq 12,50$                               | 12,5                               |   |                                    | nature                        |
| 10 <sup>1)</sup>                        | ---  | 12                                       | $\leq 12,50$                               | 12,5                               | 11  | 9                                  | blue                          |
|   |  | 14                                       | $\leq 14,50$                               | 15                                 |   |                                    | red                           |
| 12 <sup>1)</sup>                        | FRA M12 <sup>1)</sup><br>FRA HCR M12 <sup>1)</sup> | 14                                       | $\leq 14,50$                               | 15                                 | 15  | 9 or 15                            | yellow                        |
|   |  | 16                                       | $\leq 16,50$                               | 17                                 |   |                                    | green                         |
| 14                                      | ---  | 18                                       | $\leq 18,50$                               | 19                                 | 19  | 9 or 15                            | black                         |
| 16                                      | FRA M16<br>FRA HCR M16                             | 20                                       | $\leq 20,55$                               | 21,5                               |   |                                    | grey                          |
| 20                                      | FRA M20<br>FRA HCR M20                             | 25                                       | $\leq 25,55$                               | 26,5                               | 28  | 9 or 15                            | brown                         |
| 25 <sup>1)</sup>                        | FRA M24 <sup>1)</sup><br>FRA HCR M24 <sup>1)</sup> | 30                                       | $\leq 30,55$                               | 32                                 |   |                                    | brown                         |
|   |  | 35                                       | $\leq 35,70$                               | 37                                 | brown                                     |                                    |                               |
| 28                                      | ---  | 35                                       | $\leq 35,70$                               | 37                                 | 28  | 9 or 15                            | brown                         |

1) Both drill bit diameters can be used.

Rebar connection with injection system Selkent SEL-V+

**Intended use**

Working times and curing times;  
Installation tools for drilling and cleaning the bore hole and injection of the mortar

**Annex B6**

## Safety regulations



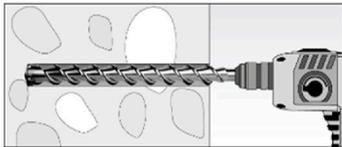
Review the Safety Data Sheet (SDS) before use for proper and safe handling!  
Wear well-fitting protective goggles and protective gloves when working with mortar Selkent SEL-V+.  
Important: Observe the instructions for use provided with each cartridge.

## Installation instruction part 1; Installation with Selkent SEL-V+

### Hole drilling

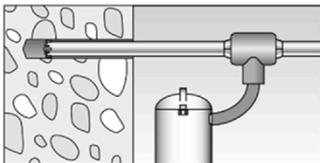
Note: Before drilling, remove carbonized concrete; clean contact areas (see **Annex B2**)  
In case of aborted drill holes the drill hole shall be filled with mortar.

#### 1a Hammer drilling or compressed air drilling



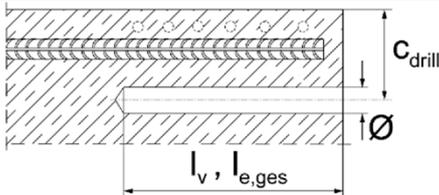
Drill the hole to the required embedment depth using a hammer drill with carbide drill bit set in rotation hammer mode or a pneumatic drill.  
Drill bit sizes see **Table B6.2**.

#### 1b Hammer drilling with hollow drill bit

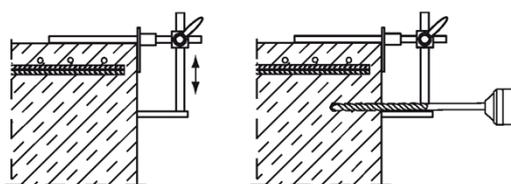


Drill the hole to the required embedment depth using a hammer drill with hollow drill bit in rotation hammer mode.  
Dust extraction conditions see drill hole cleaning **Annex B8**.  
Drill bit sizes see **Table B6.2**.

2



Measure and control concrete cover  $c$   
( $c_{\text{drill}} = c + \varnothing / 2$ )  
Drill parallel to surface edge and to existing rebar.  
Where applicable use drilling aid.



For holes  $l_v > 20$  cm use drilling aid.  
Three different options can be considered:

- A) drilling aid
- B) Slat or spirit level
- C) Visual check

Minimum concrete cover  $c_{\text{min}}$  see **Table B5.1**.

Rebar connection with injection system Selkent SEL-V+

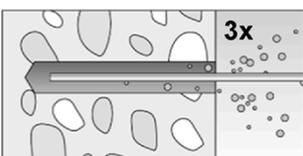
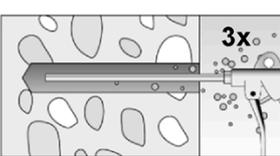
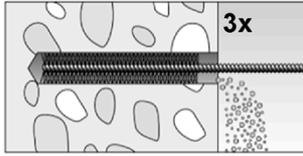
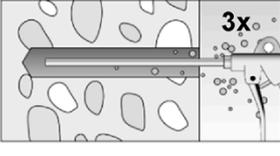
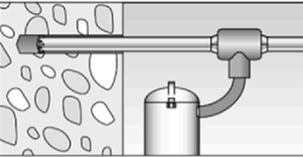
#### Intended use

Safety regulations; Installation instruction part 1, hole drilling

**Annex B7**

## Installation instruction part 2; Installation with Selkent SEL-V+

### Drill hole cleaning

|  |   |  |   |  |
|--|---|--|---|--|
|  |   | <b>Hammer or compressed air drilling</b>   |   |    |
| 3a   |    | Clean the drill hole:<br>For $d_0 < 18$ mm and depths $l_v$ resp.<br>$l_{e,ges} \leq 12 \cdot \phi$<br>blow out the hole three times by hand.  |   | For $d_0 > 18$ mm and depths $l_v$ resp.<br>$l_{e,ges} > 12 \cdot \phi$ blow out the hole three times with oil-free compressed air ( $p \geq 6$ bar). Use suitable compressed-air nozzle (see <b>Table B6.2</b> ). |
|  |    | Brush drill hole three times; for drill hole diameters $d_0 \geq 30$ mm attach brush to a power tool and brush hole with a speed of max. 550 revolutions per minute. For deep holes a brush extension is mandatory. Use suitable brushes (see <b>Table B6.2</b> ).   |   |  |
|  |   | Clean the drill hole:<br>For $d_0 < 18$ mm and depths $l_v$ resp.<br>$l_{e,ges} \leq 12 \cdot \phi$<br>blow out the hole three times by hand.  |  | For $d_0 > 18$ mm and depths $l_v$ resp.<br>$l_{e,ges} > 12 \cdot \phi$ blow out the hole three times with oil-free compressed air ( $p \geq 6$ bar) Use suitable compressed-air nozzle (see <b>Table B6.2</b> ).  |
|  |   | <b>Hammer drilling with hollow drill bit</b>   |   |    |
| 3b   |  | Use a suitable dust extraction system, e. g. fischer FVC 35 M or a comparable dust extraction system with equivalent performance data. Drill the hole with hollow drill bit. The dust extraction system has to extract the drill dust nonstop during the drilling process and must be adjusted to maximum power. No further drill hole cleaning necessary. |   |  |
| Rebar connection with injection system Selkent SEL-V+                |   |  |   | Annex B8   |
| Intended use<br>Installation instruction part 2, drill hole cleaning |   |  |   |  |

**Installation instruction part 3; Installation with Selkent SEL-V+**

reinforcing bars (rebar) / Selkent rebar anchor FRA and cartridge preparation

|          |  |  |
|----------|--|--|
| <p>4</p> |  | <p>Before use, make asure that the rebar or the Selkent rebar anchor FRA is dry and free of oil or other residue.<br/>Mark the embedment depth <math>l_v</math> (e.g. with tape)<br/>Insert rebar in borehole, to verify drill hole depth and setting depth <math>l_v</math> resp. <math>l_{e,ges}</math>.</p> |
| <p>5</p> |  | <p>Twist off the sealing cap<br/>Twist on the static mixer (the spiral in the static mixer must be clearly visible).</p>   |
| <p>6</p> |  | <p>Place the cartridge into a suitable dispenser.</p>  |
| <p>7</p> |  | <p>Press out approximately 10 cm of mortar until the resin is permanently grey in colour. Mortar which is not grey in colour will not cure and must be disposed.</p>   |

Rebar connection with injection system Selkent SEL-V+

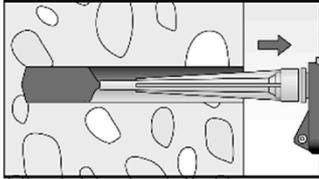
**Intended use**  
Installation instruction part 3,  
reinforcing bars (rebar) / Selkent rebar anchor FRA and cartridge preparation

**Annex B9**

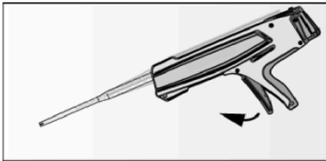
### Installation instruction part 4; Installation with Selkent SEL-V+

#### Injection of the mortar without extension tube

8a



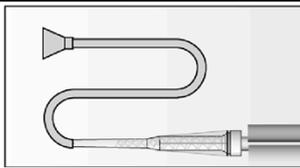
Inject the mortar from the back of the hole towards the front and slowly withdraw the static mixer step by step with each trigger pull. Avoid bubbles. Fill holes approximately 2/3 full, to ensure that the annular gap between the rebar and the concrete will be completely filled with adhesive over the entire embedment length. The conditions for mortar injection without extension tube can be found in **Table B5.3**.



After injecting, release the dispenser. This will prevent further mortar discharge from the static mixer.

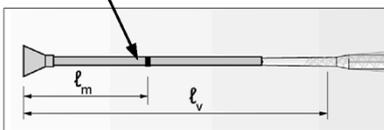
#### Injection of the mortar with extension tube

8b



Assemble static mixer, extension tube and appropriate injection adapter (see **Table B6.2**).

Mortar level mark



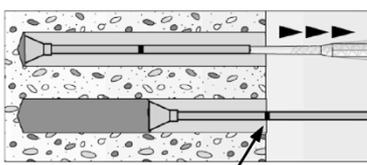
Mark the required mortar level  $l_m$  and embedment depth  $l_v$  resp.  $l_{e,ges}$  with tape or marker on the injection extension tube.

a) Estimation:

$$l_m = \frac{1}{3} \cdot l_v \text{ resp. } l_m = \frac{1}{3} \cdot l_{e,ges} \text{ [mm]}$$

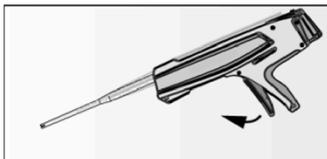
b) Precise equation for optimum mortar volume:

$$l_m = l_v \text{ resp. } l_{e,ges} \left( \left( 1,2 \cdot \frac{d_s^2}{d_0^2} - 0,2 \right) \right) \text{ [mm]}$$



Mortar level mark

Insert injection adapter to back of the hole. Begin injection allowing the pressure of the injected adhesive mortar to push the injection adapter towards the front of the hole. Do not actively pull out! Fill holes approximately 2/3 full, to ensure that the annular gap between the rebar and the concrete will be completely filled with adhesive over the embedment length. When using an injection adapter continue injection until the mortar level mark  $l_m$  becomes visible. Maximum embedment depth see **Table B5.2**.



After injecting, release the dispenser. This will prevent further mortar discharge from static mixer.

Rebar connection with injection system Selkent SEL-V+

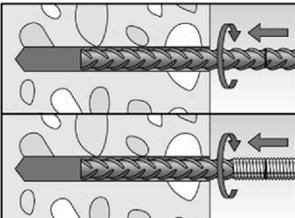
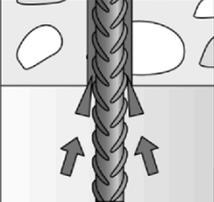
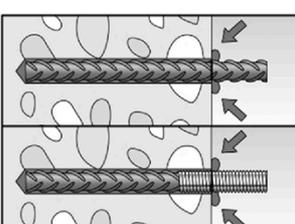
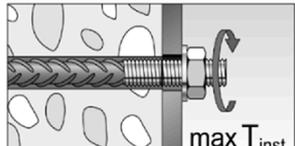
**Intended use**

Installation instruction part 4, mortar injection

**Annex B10**

### Installation instruction part 5; Installation with Selkent SEL-V+

#### Insert rebar / Selkent rebar anchor FRA

|           |   |  |
|-----------|---|--|
| <p>9</p>  |    | <p>Insert the rebar / Selkent rebar anchor FRA slowly twisted into the borehole until the embedment mark is reached.<br/>Recommendation:<br/>Rotation back and forth of the reinforcement bar or the Selkent rebar anchor FRA makes pushing easy.</p>  |
| <p>10</p> |    | <p>For overhead installation, support the rebar / Selkent rebar anchor FRA and secure it from falling till mortar started to harden, e.g. using wedges.</p>  |
| <p>11</p> |   | <p>After installing the rebar or Selkent rebar anchor FRA the annular gap must be completely filled with mortar.</p> <p>Proper installation</p> <ul style="list-style-type: none"> <li>• Desired embedment depth is reached <math>l_v</math>, resp. <math>l_{e,ges}</math>:<br/>embedment mark at concrete surface</li> <li>• Excess mortar flows out of the borehole after the rebar has been fully inserted up to the embedment mark.</li> </ul> |
| <p>12</p> |  | <p>Observe the working time "<math>t_{work}</math>" (see Table B6.1), which varies according to temperature of base material. Minor adjustments to the rebar / Selkent rebar anchor FRA position may be performed during the working time</p> <p>Full load may be applied only after the curing time "<math>t_{cure}</math>" has elapsed (see Table B6.1).</p>   |
| <p>13</p> |  | <p>Mounting the fixture for Selkent rebar anchor FRA,<br/><math>\max T_{inst}</math> see Table A6.1.</p>   |

Rebar connection with injection system Selkent SEL-V+

**Intended use**

Installation instruction part 5, insert rebar / Selkent rebar anchor FRA

**Annex B11**

### Minimum anchorage length and minimum lap length

The minimum anchorage length  $l_{b,min}$  and the minimum lap length  $l_{0,min}$  according to EN 1992-1-1:2011 shall be multiplied by the relevant amplification factor  $\alpha_{lb}$  according to **Table C1.1**.

**Table C1.1:** Amplification factor  $\alpha_{lb}$  related to concrete strength class and drilling method

| Hammer drilling, hollow drilling and compressed air drilling |                                    |        |        |        |        |        |        |        |        |
|--|------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Rebar / Selkent<br>rebar anchor FRA                          | Amplification factor $\alpha_{lb}$ |        |        |        |        |        |        |        |        |
|  | Concrete strength class            |        |        |        |        |        |        |        |        |
| $\phi$ [mm]  | C12/15                             | C16/20 | C20/25 | C25/30 | C30/37 | C35/45 | C40/50 | C45/55 | C50/60 |
| 8 to 25  | 1,0                                |        |        |        |        | 1,1    |        | 1,2    |        |
| 28   | 1,0                                |        |        |        |        |        |        |        |        |

**Table C1.2:** Bond efficiency factor  $k_b$  related to concrete strength class and drilling method

| Hammer drilling, hollow drilling and compressed air drilling |                              |        |        |        |        |        |        |        |        |
|--|------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Rebar / Selkent<br>rebar anchor FRA                          | Bond efficiency factor $k_b$ |        |        |        |        |        |        |        |        |
|  | Concrete strength class      |        |        |        |        |        |        |        |        |
| $\phi$ [mm]  | C12/15                       | C16/20 | C20/25 | C25/30 | C30/37 | C35/45 | C40/50 | C45/55 | C50/60 |
| 8 to 25  | 1,00                         |        |        |        |        |        |        |        |        |
| 28   | 1,00                         |        |        |        |        | 0,91   | 0,84   | 0,84   |        |

**Table C1.3:** Design values of the bond strength  $f_{bd,PIR}$  in N/mm<sup>2</sup> related to concrete strength class and drilling method for good bond conditions

$$f_{bd,PIR} = k_b \cdot f_{bd}$$

$f_{bd}$ : Design value of the bond strength in N/mm<sup>2</sup> considering the concrete strength classes and the rebar diameter for good bond condition (for all other bond conditions multiply the values by  $\eta_1 = 0,7$ )  
and recommended partial factor  $\gamma_c = 1,5$  according to EN 1992-1-1: 2011

$k_b$ : Bond efficiency factor according to **Table C1.2**

### Hammer drilling, hollow drilling and compressed air drilling

| Rebar / Selkent<br>rebar anchor FRA | Bond strength $f_{bd,PIR}$ [N/mm <sup>2</sup> ] |        |        |        |        |        |        |        |        |
|-------------------------------------|---|--------|--------|--------|--------|--------|--------|--------|--------|
|                                     | Concrete strength class                         |        |        |        |        |        |        |        |        |
| $\phi$ [mm]                         | C12/15  | C16/20 | C20/25 | C25/30 | C30/37 | C35/45 | C40/50 | C45/55 | C50/60 |
| 8 to 25                             | 1,6   | 2,0    | 2,3    | 2,7    | 3,0    | 3,4    | 3,7    | 4,0    | 4,3    |
| 28                                  | 1,6   | 2,0    | 2,3    | 2,7    | 3,0    | 3,4    | 3,4    | 3,4    | 3,7    |

Rebar connection with injection system Selkent SEL-V+

#### Performance

Amplification factor  $\alpha_{lb}$ , bond efficiency factor  $k_b$ ,  
design values of the bond strength  $f_{bd,PIR}$

**Annex C1**

| <b>Table C2.1: Characteristic tensile yield strength for rebar part of Selkent rebar anchors FRA</b>   |                      |                      |      |       |       |                 |      |
|--|----------------------|----------------------|------|-------|-------|-----------------|------|
| Selkent rebar anchor FRA / FRA HCR   |                      |                      | M12  | M16   | M20   | M24             |      |
| <b>Characteristic tensile yield strength for rebar part</b>  |                      |                      |      |       |       |                 |      |
| Rebar diameter   | $\phi$               | [mm]                 | 12   | 16    | 20    | 25              |      |
| Characteristic tensile yield strength for rebar  | $f_{yk}$             | [N/mm <sup>2</sup> ] | 500  | 500   | 500   | 500             |      |
| Partial factor for rebar part  | $\gamma_{Ms,N}^{1)}$ | [-]                  | 1,15 |       |       |                 |      |
| 1) In absence of national regulations  |                      |                      |      |       |       |                 |      |
| <b>Table C2.2: Characteristic resistance to steel failure under tension loading of Selkent rebar anchors FRA</b>   |                      |                      |      |       |       |                 |      |
| Selkent rebar anchor FRA / FRA HCR   |                      |                      | M12  | M16   | M20   | M24             |      |
| <b>Characteristic resistance to steel failure under tension loading</b>  |                      |                      |      |       |       |                 |      |
| Characteristic resistance  | $N_{Rk,s}$           | [kN]                 | 62,0 | 111,0 | 173,0 | 236,5           |      |
| <b>Partial factor</b>  |                      |                      |      |       |       |                 |      |
| Partial factor   | $\gamma_{Ms,N}^{1)}$ | [-]                  | 1,40 |       |       |                 |      |
| 1) In absence of national regulations  |                      |                      |      |       |       |                 |      |
| <b>Table C2.3: Characteristics resistance to steel failure of Selkent rebar anchors FRA under fire exposure R30 to R120</b>                                  |                      |                      |      |       |       |                 |      |
| Selkent rebar anchor FRA / FRA HCR   |                      |                      | M12  | M16   | M20   | M24             |      |
| Characteristic resistance to steel failure under fire exposure   | R30                  | $N_{Rk,s,fi}$        | [kN] | 2,5   | 4,7   | 7,4             | 10,6 |
|  | R60                  |                      |      | 2,1   | 3,9   | 6,1             | 8,8  |
|  | R90                  |                      |      | 1,7   | 3,1   | 4,9             | 7,1  |
|  | R120                 |                      |      | 1,3   | 2,5   | 3,9             | 5,6  |
| Rebar connection with injection system Selkent SEL-V+  |                      |                      |      |       |       |                 |      |
| <b>Performance</b><br>Characteristic tensile yield strength for rebar part of FRA;<br>Characteristic resistance to steel failure of Selkent rebar anchor FRA |                      |                      |      |       |       | <b>Annex C2</b> |      |

### Design value of the ultimate bond strength $f_{bd,fi}$ at increased temperature for concrete strength classes C12/15 to C50/60 (all drilling methods)

The design value of the bond strength  $f_{bd,fi}$  at increased temperature has to be calculated by the following equation:

$$f_{bd,fi} = k_{fi}(\theta) \cdot f_{bd,PIR} \cdot \frac{\gamma_c}{\gamma_{m,fi}}$$

If:  $\theta > 74 \text{ °C}$   $k_{fi}(\theta) = \frac{24,308 \cdot e^{-0,012 \cdot \theta}}{f_{bd,PIR} \cdot 4,3} \leq 1,0$

If:  $\theta > \theta_{max} (317 \text{ °C})$   $k_{fi}(\theta) = 0$

$f_{bd,fi}$  = Design value of the ultimate bond strength at increased temperature in N/mm<sup>2</sup>

$\theta$  = Temperature in °C in the mortar layer

$k_{fi}(\theta)$  = Reduction factor at increased temperature

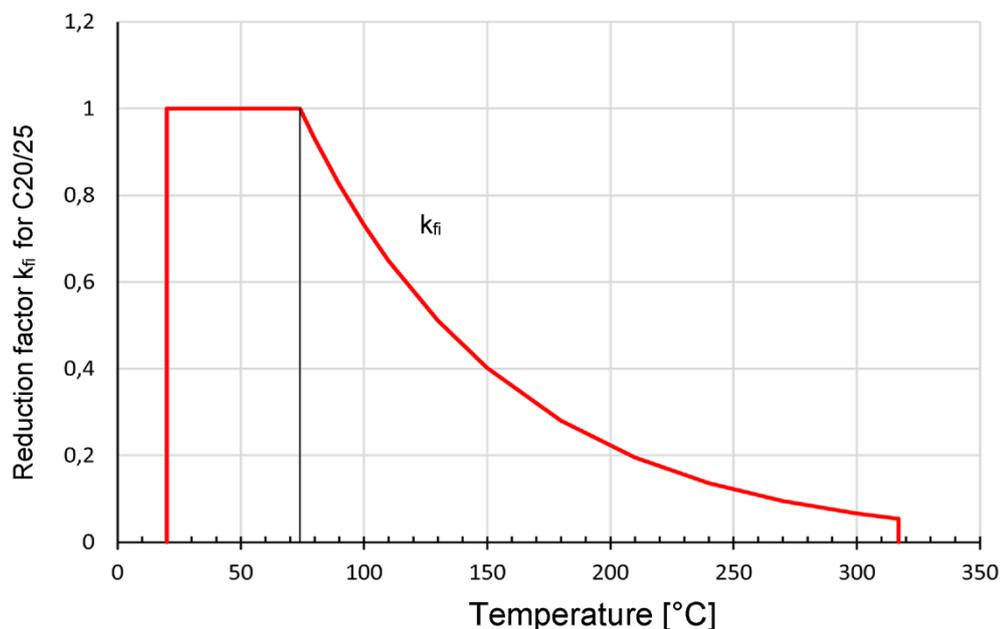
$f_{bd,PIR}$  = Design value of the bond strength in N/mm<sup>2</sup> in cold condition according to **Table C1.3** considering the concrete strength classes, the rebar diameter, the drilling method and the bond conditions according to EN 1992-1-1:2011

$\gamma_c$  = 1,5 recommended partial factor according to EN 1992-1-1:2011

$\gamma_{m,fi}$  = 1,0 recommended partial factor according to EN 1992-1-2:2011

For evidence at increased temperature the anchorage length shall be calculated according to EN 1992-1-1:2011 Equation 8.3 using the temperature-dependent ultimate design value of bond strength  $f_{bd,fi}$ .

**Figure C3.1:** Example graph of reduction factor  $k_{fi}(\theta)$  for concrete class C20/25 for good bond conditions



Rebar connection with injection system Selkent SEL-V+

**Performance**  
Design value of bond strength  $f_{bd,fi}$  at increased temperature

**Annex C3**