

European Technical Approval ETA-10/0388

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung <i>Trade name</i>	Bewehrungsanschluss mit Upat Verbundmörtel UPM 44 <i>Rebar connection with Upat injection mortar UPM 44</i>
Zulassungsinhaber <i>Holder of approval</i>	Upat Vertriebs GmbH Otto-Hahn Straße 15 79211 Denzlingen DEUTSCHLAND
Zulassungsgegenstand und Verwendungszweck <i>Generic type and use of construction product</i>	Nachträglich eingemörtelter Bewehrungsanschluss mit Upat Verbundmörtel UPM 44 <i>Post-installed rebar connection with Upat injection mortar UPM 44</i>
Geltungsdauer: <i>Validity:</i>	vom <i>from</i> bis <i>to</i>
Herstellwerk <i>Manufacturing plant</i>	fischerwerke
	26 June 2013 26 June 2018

Diese Zulassung umfasst
This Approval contains

23 Seiten einschließlich 13 Anhänge
23 pages including 13 annexes

Diese Zulassung ersetzt
This Approval replaces

ETA-10/0388 mit Geltungsdauer vom 20.10.2010 bis 19.01.2014
ETA-10/0388 with validity from 20.10.2010 to 19.01.2014

I LEGAL BASES AND GENERAL CONDITIONS

- 1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:
 - Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products¹, modified by Council Directive 93/68/EEC² and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council³;
 - *Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998⁴, as amended by Article 2 of the law of 8 November 2011⁵;*
 - Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC⁶;
 - Guideline for European technical approval of "Metal anchors for use in concrete - Part 5: Bonded anchors", ETAG 001-05.
- 2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.
- 3 This European technical approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European technical approval.
- 4 This European technical approval may be withdrawn by Deutsches Institut für Bautechnik, in particular pursuant to information by the Commission according to Article 5(1) of Council Directive 89/106/EEC.
- 5 Reproduction of this European technical approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of Deutsches Institut für Bautechnik. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European technical approval.
- 6 The European technical approval is issued by the approval body in its official language. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

¹ Official Journal of the European Communities L 40, 11 February 1989, p. 12
² Official Journal of the European Communities L 220, 30 August 1993, p. 1
³ Official Journal of the European Union L 284, 31 October 2003, p. 25
⁴ *Bundesgesetzblatt Teil I 1998*, p. 812
⁵ *Bundesgesetzblatt Teil I 2011*, p. 2178
⁶ Official Journal of the European Communities L 17, 20 January 1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of the construction product and intended use

1.1 Definition of the product

The subject of this approval 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 injection mortar UPM 44 in accordance with the regulations for reinforced concrete construction.

Reinforcing bars made of steel with a diameter d_s from 8 to 28 mm according to Annex 6 or the rebar anchor FRA sizes 12, 16 and 20 according to Annex 7 and injection mortar UPM 44 are used for rebar connections. The steel element is placed into a drilled hole filled with injection mortar and is anchored via the bond between embedded element, injection mortar and concrete.

1.2 Intended use

The rebar connection may be used in normal weight concrete of a minimum grade of C12/15 and maximum grade C50/60 according to EN 206-1:2000. It may be used in non-carbonated concrete with the allowable chloride content in concrete of 0.40% (CL 0.40) related to the cement content according to EN 206-1.

Rebar connections with reinforcing bars and rebar anchor FRA may be used for predominantly static loads.

The fire resistance of post-installed rebar connections is not covered by this European technical approval. Fatigue, dynamic or seismic loading of post-installed rebar connections are not covered by this European technical approval.

Rebar connections may only be carried out in a manner, which is also possible with cast-in straight reinforcing bars, e.g. those in the following applications (see Annexes 2 and 3):

- an overlap joint with existing reinforcement in a building component (Figures 1 and 2),
- anchoring of the reinforcement at a slab or beam support, (e.g. according to Figure 3: end support of a slab, designed simply supported, as well as an appropriate general reinforcement for restraint forces),
- anchoring of reinforcement of building components stressed primarily in compression (Figure 4),
- anchoring of reinforcement to cover the envelope line of tensile force in the bending member (Figure 5).

The post-installed rebar connections may be used in the temperature range of -40 °C to $+80\text{ °C}$ (max short term temperature $+80\text{ °C}$ and max long term temperature $+50\text{ °C}$).

This European technical approval covers anchoring in bore holes made with hammer drilling or compressed air drilling. The post-installed rebar connection may be installed in dry or wet concrete. It must not be installed in flooded holes.

Rebar connections with the rebar anchor FRA may be used for the transmission of tensile forces in the direction of the bar axis only. The transmission of shear forces has to be ensured by appropriate measures. Examples for the application are given in Annex 4, Figure 6 to Figure 8.

- The rebar anchor FRA made of stainless steel may be used in structures subject to dry internal conditions and also in structures subject to external atmospheric exposure (including industrial and marine environment), or exposure to permanently damp internal conditions, if no particular aggressive conditions exist. Such particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

- The rebar anchor FRA C made of high corrosion resistant steel 1.4529 may be used in structures subject to dry internal conditions and also in structures subject to external atmospheric exposure, in permanently damp internal conditions or in other particular aggressive conditions. Such particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

The provisions made in this European technical approval are based on an assumed working life of the post-installed rebar connection of 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.

2 Characteristics of the product and methods of verification

2.1 Characteristics of the product

The post-installed rebar connection corresponds to the drawings and provisions given in the Annexes. The characteristic material values, dimensions and tolerances not indicated in the Annexes shall correspond to the respective values laid down in the technical documentation⁷ of this European technical approval.

The two components of the injection mortar are delivered in unmixed condition in shuttle cartridges or in coaxial cartridges according to Annex 1. Each cartridge is marked with the identifying mark "UPM 44" with the processing notes, shelf-life, hazard code, curing time (depending on temperature).

The rebar shall comply with the specifications given in Annex 6. The rebar anchor FRA shall comply with the specifications given in Annex 7. Each rebar anchor FRA with connecting thread made of stainless steel is marked with works symbol and the letters "FRA" according to Annex 7. Each rebar anchor FRA with connecting thread made of high corrosion resistant steel 1.4529 is marked with works symbol and the letters "FRA C" according to Annex 7.

2.2 Methods of verification

The assessment of fitness of the post-installed rebar connection for the intended use in relation to the requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 has been made in accordance with the "Guideline for European technical approval of Metal Anchors for Use in Concrete", Part 1 "Anchors in general" and Part 5 "Bonded anchors" and EOTA Technical Report TR 023 "Assessment of post-installed rebar connections"⁸.

⁷ The technical documentation of this European technical approval is deposited at the Deutsches Institut für Bautechnik and, as far as relevant for the tasks of the approved bodies involved in the attestation of conformity procedure, is handed over to the approved bodies.

⁸ The Technical Report TR 023 "Assessment of post-installed rebar connections" is published on EOTA website www.EOTA.eu.

In addition to the specific clauses relating to dangerous substances contained in this European technical approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

3 Evaluation and attestation of conformity and CE marking

3.1 System of attestation of conformity

According to the Decision 96/582/EC of the European Commission⁹ system 2(i) (referred to as System 1) of the attestation of conformity applies.

This system of attestation of conformity is defined as follows:

System 1: Certification of the conformity of the product by an approved certification body on the basis of:

- (a) Tasks for the manufacturer:
 - (1) factory production control;
 - (2) further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan;
- (b) Tasks for the approved body:
 - (3) initial type-testing of the product;
 - (4) initial inspection of factory and of factory production control;
 - (5) continuous surveillance, assessment and approval of factory production control.

Note: Approved bodies are also referred to as "notified bodies".

3.2 Responsibilities

3.2.1 Tasks for the manufacturer

3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European technical approval.

The manufacturer may only use initial/raw/constituent materials stated in the technical documentation of this European technical approval.

The factory production control shall be in accordance with the control plan which is part of the technical documentation of this European technical approval. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited with Deutsches Institut für Bautechnik.¹⁰

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

⁹ Official Journal of the European Communities L 254 of 08.10.1996

¹⁰ The control plan is a confidential part of the European technical approval and only handed over to the approved body involved in the procedure of attestation of conformity. See section 3.2.2.

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3.2.1.2 Other tasks for the manufacturer

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in the field of anchors in order to undertake the actions laid down in section 3.2.2 For this purpose, the control plan referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of this European technical approval.

3.2.2 Tasks for the approved bodies

The approved body shall perform the

- initial type-testing of the product,
- initial inspection of factory and of factory production control,
- continuous surveillance, assessment and approval of factory production control,

in accordance with the provisions laid down in the control plan.

The approved body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the product stating the conformity with the provisions of this European technical approval.

In cases where the provisions of the European technical approval and its control plan are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform Deutsches Institut für Bautechnik without delay.

3.3 CE marking

The CE marking shall be affixed on each packaging of the injection mortar. The letters "CE" shall be followed by the identification number of the approved certification body, where relevant, and be accompanied by the following additional information:

- the name and address of the holder of the approval (legal entity responsible for the manufacture),
- the last two digits of the year in which the CE marking was affixed,
- the number of the EC certificate of conformity for the product,
- the number of the European technical approval,
- the number of the guideline for European technical approval.

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

The European technical approval is issued for the product on the basis of agreed data/information, deposited with Deutsches Institut für Bautechnik, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to Deutsches Institut für Bautechnik before the changes are introduced. Deutsches Institut für Bautechnik will decide whether or not such changes affect the approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the approval shall be necessary.

4.2 Drafting

Rebar connections must be designed in keeping with good engineering practice. Considering the loads to be anchored, design calculations and design drawings must be produced which can be checked. At least the following items must be stated in the design drawings:

- grade of concrete strength,
- diameter, drilling technique, concrete cover, spacing and embedment depth of the rebar,
- length ℓ_v and length for markings ℓ_m on the injection extension according to Annex 8,
- Use of a drill guide for anchorages close to the edge (see Annex 10),
- kind of preparation of the joint between building component being connected including the diameter and thickness of concrete layer that has to be removed.

4.3 Design

4.3.1 General

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.

The design of post-installed rebar connections according to Annexes 2 and 3 and determination of the internal section forces to be transferred in the construction joint shall be verified in accordance with EN 1992-1-1:2004. When ascertaining the tensile force in the rebar, allowance shall be made for the statically effective height of the bonded-in reinforcement.

The rebar anchor FRA according to Annex 7 shall be designed for the welded-on reinforcement steel B500 B. The length of the bonded-in shaft made of stainless steel may not be accounted as anchorage.

The verification of the immediate local force transfer to the concrete has been provided.

The verification of the transfer of the loads to be anchored to the building component shall be provided.

The spacing between post-installed rebars respectively rebar anchor FRA shall be greater than the minimum of $5 d_s$ and 50 mm (see Annex 5).

4.3.2 Determination of the basic anchorage length

The required basic anchorage length $\ell_{b,rqd}$ shall be determined in accordance with EN 1992-1-1, Section 8.4.3:

$$\ell_{b,rqd} = (d_s / 4) (\sigma_{sd} / f_{bd})$$

with: d_s = diameter of the rebar

σ_{sd} = calculated design stress of the rebar

f_{bd} = design value of bond strength according to Annex 10, Table 7

in consideration of the coefficient related to the quality of bond conditions and of the coefficient related to the bar diameter and of the drilling technique

4.3.3 Determination of the design anchorage length

The required design anchorage length ℓ_{bd} shall be determined in accordance with EN 1992-1-1, Section 8.4.4:

$$\ell_{bd} = \alpha_1 \cdot \alpha_2 \cdot \alpha_3 \cdot \alpha_4 \cdot \alpha_5 \ell_{b,rqd} \geq \ell_{b,min}$$

with: $\ell_{b,rqd}$ = according to section 4.3.2

α_1 = 1.0 for straight bars

α_2 = 0.7...1.0 calculated acc. to EN 1992-1-1, Table 8.2

α_3 = 1.0 because of no transverse reinforcement

α_4 = 1.0 because of no welded transverse reinforcement

α_5 = 0.7...1.0 for influence of transverse pressure acc. to EN 1992-1-1, Table 8.2

$$\begin{aligned} \ell_{b,\min} &= \text{minimum anchorage length acc. to EN 1992-1-1} \\ &= 1.5 \max \{0.3 \ell_{b,\text{reqd}}, 10d_s, 100 \text{ mm}\} \text{ under tension} \\ &= 1.5 \max \{0.6 \ell_{b,\text{reqd}}, 10d_s, 100 \text{ mm}\} \text{ under compression} \end{aligned}$$

The maximum permissible anchorage depth is given in Annex 8 in relation to the dispenser to be used.

4.3.4 Overlap joints

The required design lap length ℓ_0 shall be determined in accordance with EN 1992-1-1, Section 8.7.3:

$$\ell_0 = \alpha_1 \cdot \alpha_2 \cdot \alpha_3 \cdot \alpha_5 \cdot \alpha_6 \ell_{b,\text{reqd}} \geq \ell_{0,\min}$$

with: $\ell_{b,\text{reqd}}$ = according to Section 4.3.2

$$\alpha_1 = 1.0 \text{ for straight bars}$$

$$\alpha_2 = 0.7 \dots 1.0 \text{ calculated acc. to EN 1992-1-1, Table 8.2}$$

$$\alpha_3 = 1.0 \text{ because of no transverse reinforcement}$$

$$\alpha_5 = 0.7 \dots 1.0 \text{ for influence of transverse pressure acc. to EN 1992-1-1, Table 8.2}$$

$$\alpha_6 = 1.0 \dots 1.5 \text{ for influence of percentage of lapped bars relative to the total cross-section area acc. to EN 1992-1-1, Table 8.3}$$

$$\ell_{0,\min} = \text{minimum lap length acc. to EN 1992-1-1}$$

$$= 1.5 \max \{0.3 \cdot \alpha_6 \ell_{b,\text{reqd}}, 15d_s, 200 \text{ mm}\}$$

The maximum permissible anchorage depth is given in Annex 8 in relation to the dispenser and the bar diameter to be used.

4.3.5 Embedment depth for overlap joints

Overlap joint for rebars:

For calculation of the effective embedment depth of overlap joints the concrete cover at end-face of bonded-in rebar c_1 shall be considered (see Annex 5, Figure 9):

$$\ell_v \geq \ell_0 + c_1$$

with: ℓ_0 = required lap length acc. to Section 4.3.4 and to EN 1992-1-1

c_1 = concrete cover at end-face of bonded-in rebar (see Annex 5, Figure 9)

If the clear distance between the overlapping rebars is greater than $4 d_s$ the lap length shall be enlarged by the difference between the clear distance and $4 d_s$.

Overlap joint for rebar anchor FRA (C):

The effective embedment depth is the same like the lap length $\ell_v = \ell_0$ (see Annex 5, Figure 10).

The total embedment depth $\ell_{e,\text{ges}}$ shall be determined as follows (see Annex 5, Figure 10):

$$\ell_{e,\text{ges}} \geq \ell_0 + \ell_e$$

with: ℓ_0 = required lap length acc. to Section 4.3.4 and to EN 1992-1-1

ℓ_e = length of the embedded threaded ($\ell_e > c_1$ see also Annex 7),

If the clear distance between overlapping rods exceeds $4 d_s$, the overlap length shall be increased by the difference between the actual clear distance and $4 d_s$.

4.3.6 Concrete cover

The concrete cover required for bonded-in rebars and rebar anchor FRA is shown in Annex 10, Table 8, in relation to the drilling method and the hole tolerance.

Furthermore the minimum concrete cover given in EN 1992-1-1, Section 4.4.1.2 shall be observed.

4.3.7 Transverse reinforcement

The requirements of transverse reinforcement in the area of the post-installed rebar connection or of the rebar anchor FRA connection shall comply with EN 1992-1-1, Section 8.7.4.

4.3.8 Connection joint

The transfer of shear forces between new concrete and existing structure shall be designed according to EN 1992-1-1. The joints for concreting must be roughened to at least such an extent that aggregate protrude.

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 $d_s + 60$ 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 for the respective environmental conditions in accordance with EN 1992-1-1.

The foregoing may be neglected if building components are new and not carbonated and if building components are in dry conditions.

4.4 Installation

The fitness for use of the post-installed rebar connection can only be assumed if the rebar respectively the rebar anchor FRA is installed as follows:

- the installation of post-installed rebar respectively 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,
- use of the injection system only as supplied by the manufacturer without exchanging the components of the Injection system,
- installation in accordance with the manufacturer's specifications and drawings using the tools indicated in the technical documentation of this European technical approval,
- checks before rebar installation to ensure that the strength class of the concrete in which the post-installed rebar connection is to be placed is in the range given and is not lower than that of the concrete to which the characteristic loads apply,
- check of concrete being well compacted, e.g. without significant voids,
- 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),
- keeping the anchorage depth as specified in the design drawings,
- keeping of concrete cover and spacing as specified in the design drawings,
- positioning of the drill holes without damaging the reinforcement,
- in case of aborted drill hole the drill hole shall be filled with mortar,
- the post-installed rebar connection must not be installed in flooded holes,
- the drilling and cleaning of the hole and the installation shall be performed only with the equipment specified by the manufacturer according to the manufacturer's installation instructions (see Annex 9), it shall be ensured that this equipment is available on site and it is used,
- during curing of the injection mortar the temperature of the building component must not be less than 0 °C and no more than +40 °C; observing the curing time given in Annex 8.

5 Recommendations concerning packaging, transport and storage

5.1 Responsibility of the manufacturer

It is in the responsibility of the manufacturer to ensure that the information on the specific conditions according to sections 1 and 2 including Annexes referred to and section 4 is given to those who are concerned. This information may be made by reproduction of the respective parts of the European technical approval. In addition all installation data shall be shown clearly on the package and/or on an enclosed instruction sheet, preferably using illustration(s).

The minimum data required are:

- drill bit diameter,
- diameter of rebar,
- admissible service temperature range,
- curing time of the injection mortar,
- Installation instructions including cleaning of the drill hole,
- reference to any special installation equipment needed,
- identification of the manufacturing batch,

All data shall be presented in a clear and explicit form.

5.2 Packaging, transport and storage

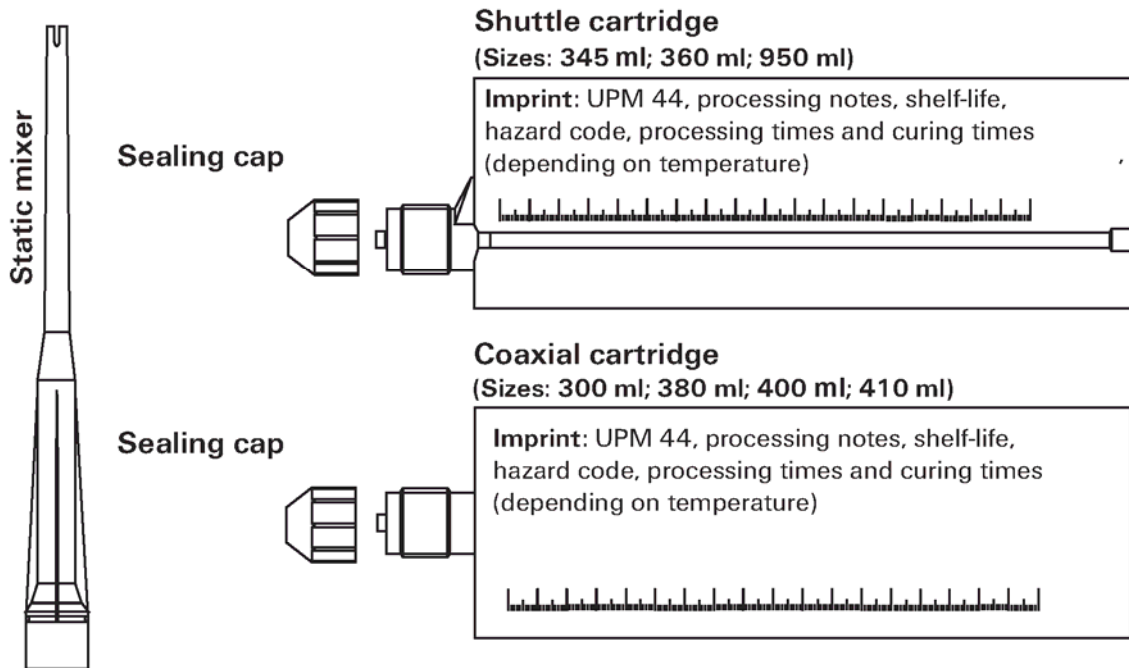
The mortar cartridges shall be protected against sun radiation and shall be stored according to the manufacture's installation instructions in dry condition at temperatures of at least +5 °C to not more than +25 °C.

Mortar cartridges with expired shelf life must no longer be used.

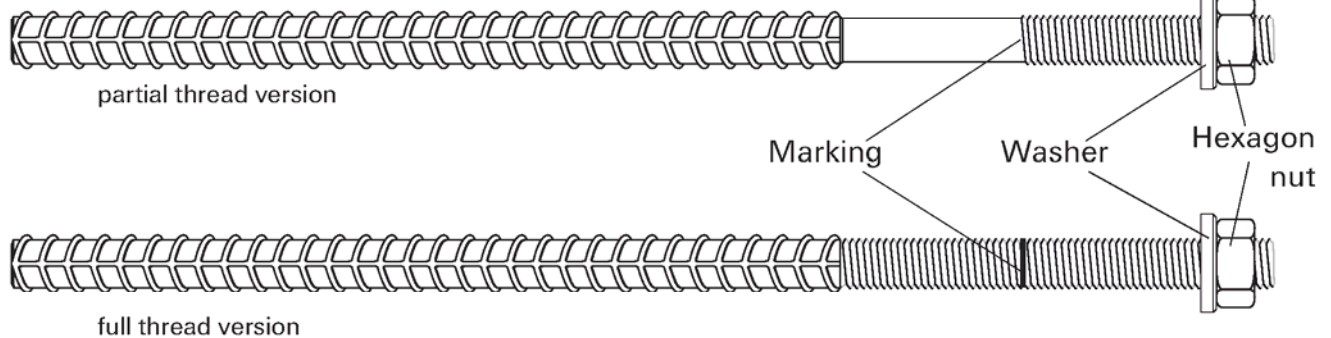
Uwe Bender
Head of Department

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- Standard concrete C12/15 - C50/60 according to EN 206-1.
- Reinforcement bar, $d_s = 8 \text{ mm} - 28 \text{ mm}$ (properties see Annex 6).
- Rebar anchor FRA 12, FRA 16, FRA 20 (properties see Annex 7).
- Injection mortar UPM 44.
- Method for drilling and cleaning the drill hole and injection of the mortar.



Rebar anchor FRA 12, 16, 20



Intended use:

Installation in dry and wet concrete. It must not be installed in flooded holes.

Temperature range:

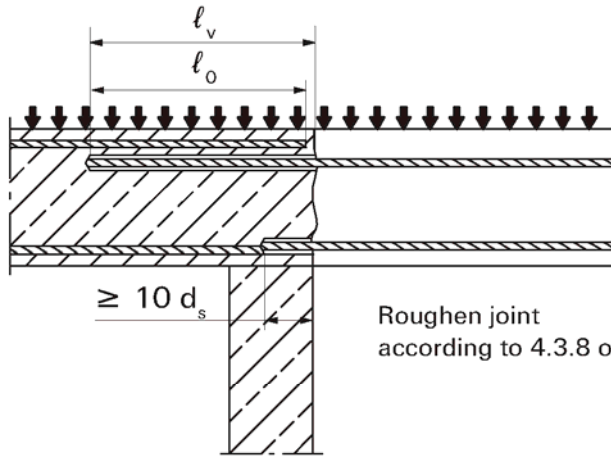
-40°C to + 80°C (max. long term temperature +50°C and max. short term temperature +80°C)

Rebar connection with Upat injection mortar UPM 44

Product
Intended use

Annex 1

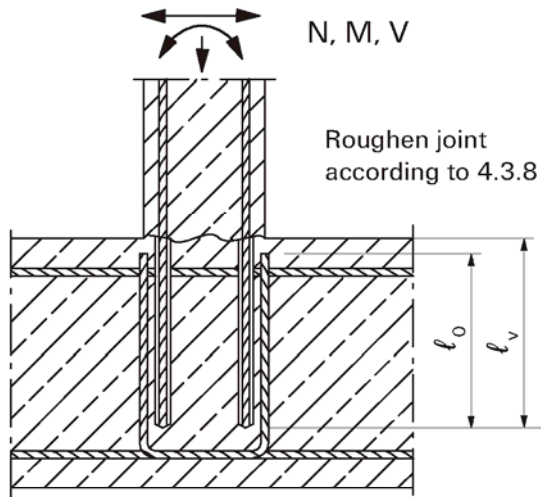
Figure 1



Reinforcement lap for rebar connections of slabs and beams

Roughen joint according to 4.3.8 of this approval

Figure 2



Roughen joint according to 4.3.8 of this approval

Reinforcement lap of a column or a wall under bending stress to a foundation.

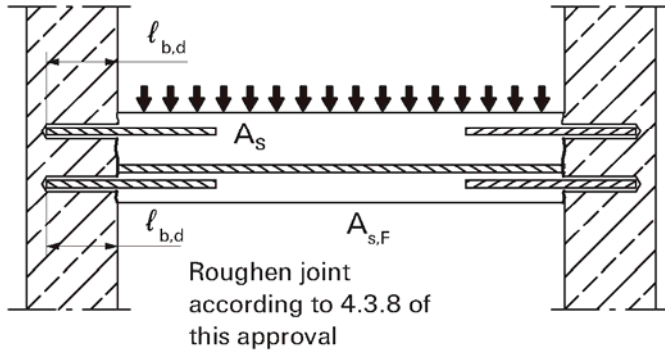
The required transverse reinforcement according to EN 1992-1-1 is not shown in the figures.

Rebar connection with Upat injection mortar UPM 44

Examples of use for reinforcement bars
Laps

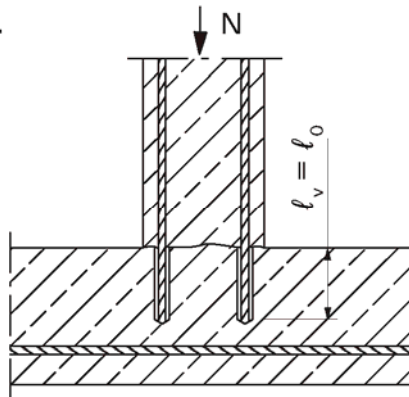
Annex 2

Figure 3



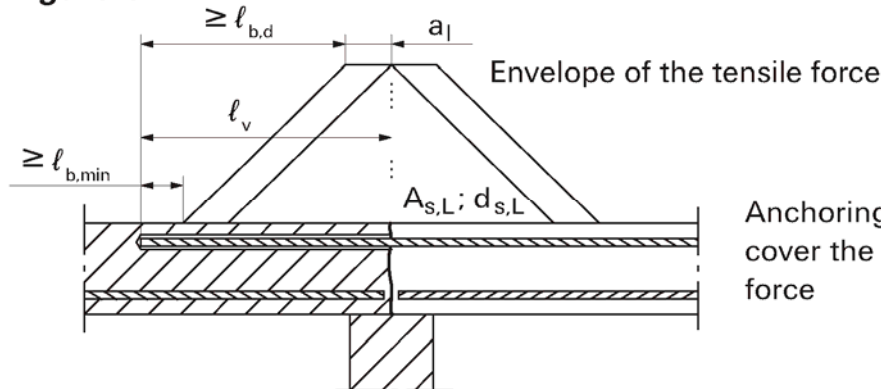
End anchoring of slabs or beams which have been designed as simply supported

Figure 4



Rebar connection of building members under predominant pressure

Figure 5



Anchoring of reinforcement to cover the envelope of the tensile force

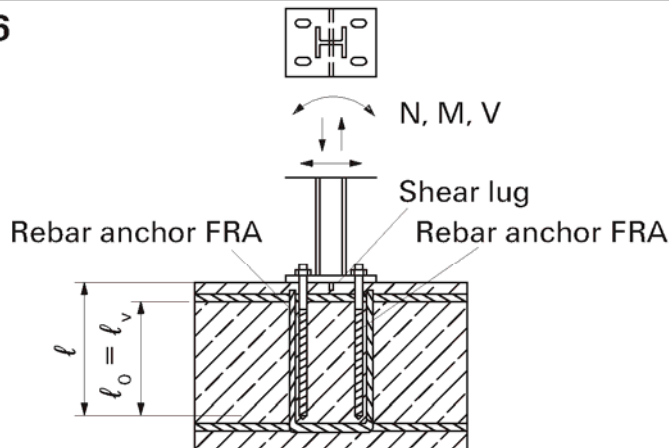
The required transverse reinforcement according to EN 1992-1-1 is not shown in the figures.

Rebar connection with Upat injection mortar UPM 44

Examples of use for reinforcement bars
Anchorages

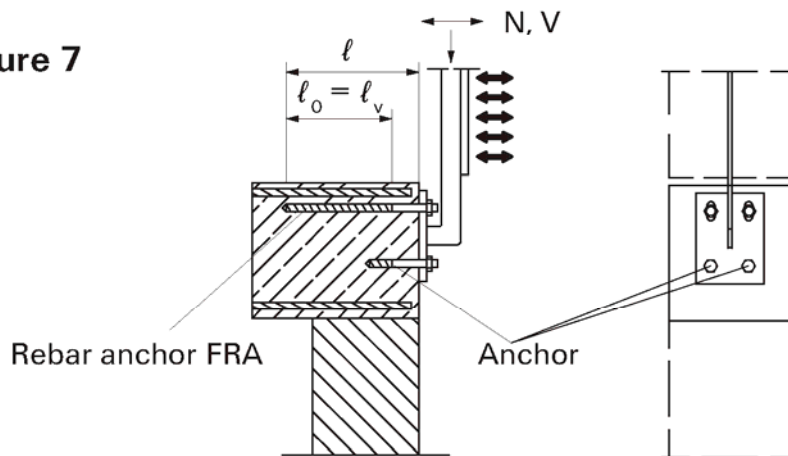
Annex 3

Figure 6



Lap to a foundation of
a column under bending

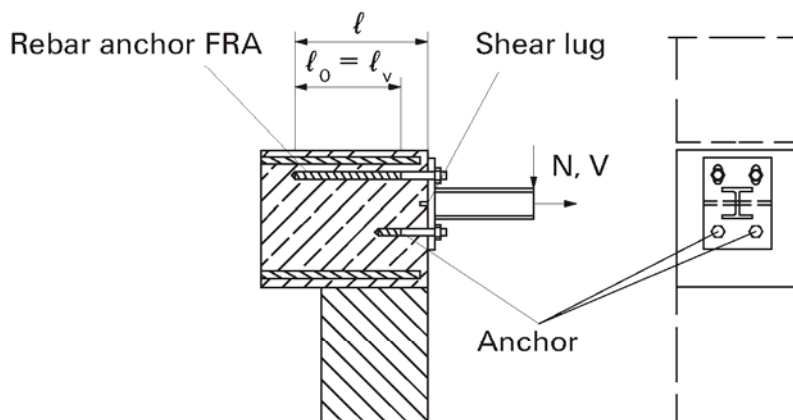
Figure 7



Lap for the anchoring of
guardrail posts

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

Figure 8



Lap of the anchoring of
cantilevered building
components

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

The required transverse reinforcement according to EN 1992-1-1 is not shown in the figures.

The rebar anchor FRA may be only used for axial tensile loads.

The tensile force must be transferred by a lap to the existing reinforcement of the building.

The transfer of the shear loads has to be ensured by suitable measure, e.g.

by means of shear lugs or anchors with an European Technical Approval (ETA).

Rebar connection with Upat injection mortar UPM 44

Examples of use for rebar anchors FRA
Laps

Annex 4

Figure 9: Setting instruction rebar

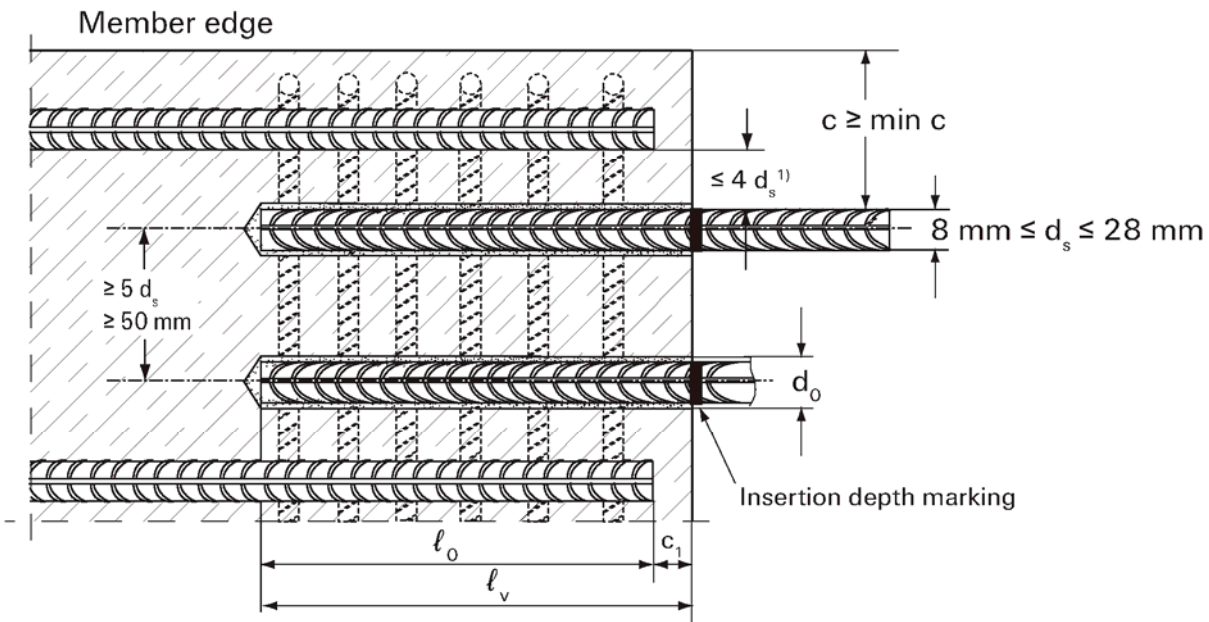
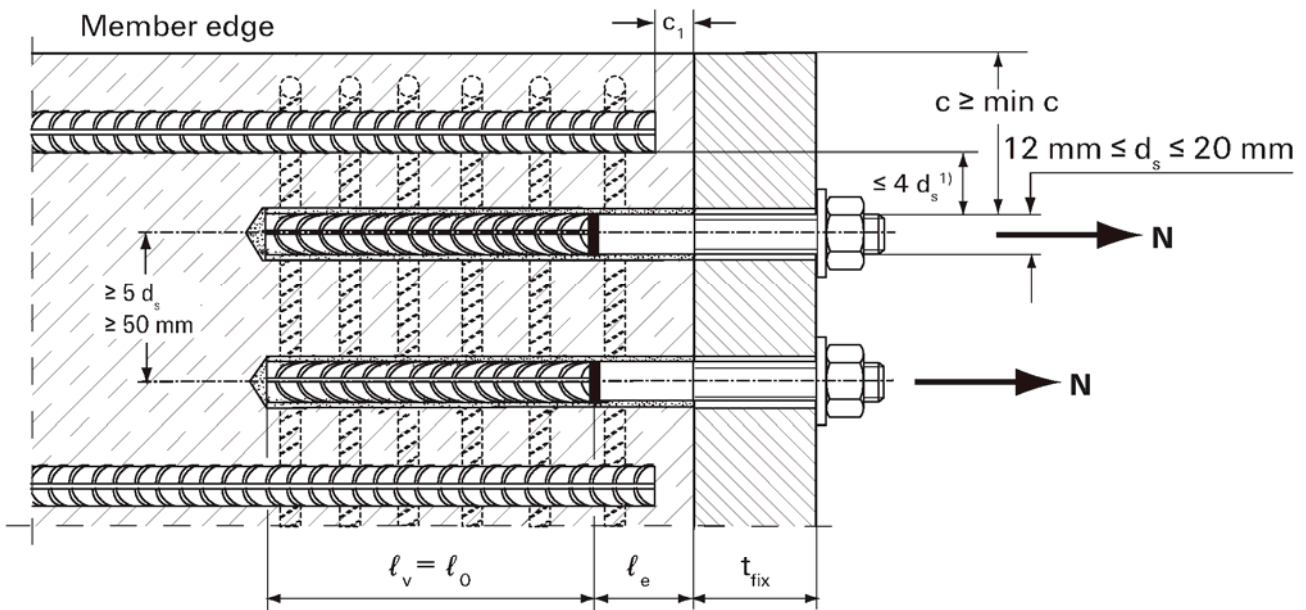


Figure 10: Setting instruction rebar anchor FRA



¹⁾ If the clear distance between lapped bars exceeds $4d_s$, then the lap length shall be increased by the difference between the clear bar distance and $4d_s$.

c concrete cover of bonded-in bar
 $\min c$ minimum concrete cover according to Section 4.3.6 of this approval
 c_1 concrete cover at end-face of bonded-in bar
 d_s diameter of bonded-in bar
 l_0 lap length

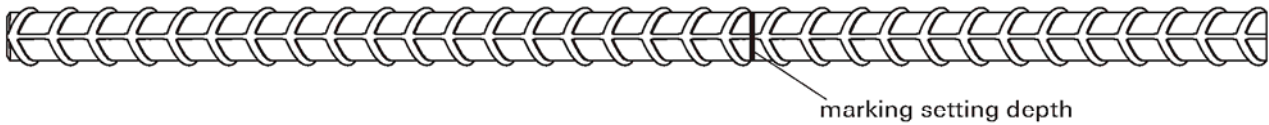
l_v effective embedment depth
 l_e length of the smooth shaft
 d_0 nominal drill bit diameter, see table 4, annex 8
 t_{fix} minimum thickness of fixture

Rebar connection with Upat injection mortar UPM 44

General instruction rules

Annex 5

Figure 11: Properties of reinforcing bars „rebars“



Properties of reinforcement: Refer to EN 1992-1-1 Annex C, Table C.1 and C.2N,

Produkt form		Non-zinc-plated bars and de-coiled rod	
Class		B	C
Characteristic yield strength f_{yk} or $f_{0,2k}$ [MPa]		400 to 600	
Minimum value of $k = (f_t/f_y)_k$		$\geq 1,08$	$\geq 1,15$ < 1,35
Characteristic strain at maximum force, ϵ_{uk} [%]		$\geq 5,0$	$\geq 7,5$
Bendability		Bend / Rebend test	
Maximum deviation from nominal mass (individual bar) [%]	Nominal bar size [mm] ≤ 8	$\pm 6,0$	
	> 8	$\pm 4,5$	
Bond: Minimum relative rib area, $f_{R,min}$ (determination according to EN 15630)	Nominal bar size [mm] 8 to 12	0,040	
	> 12	0,056	

Rip hight h:

The rip hight h must be:

$$0,05 \cdot d \leq h \leq 0,07 \cdot d$$

d = nominal bar size

Rebar connection with Upat injection mortar UPM 44

Properties of rebars

Annex 6

Figure 12: Properties of rebar anchor FRA / FRA C

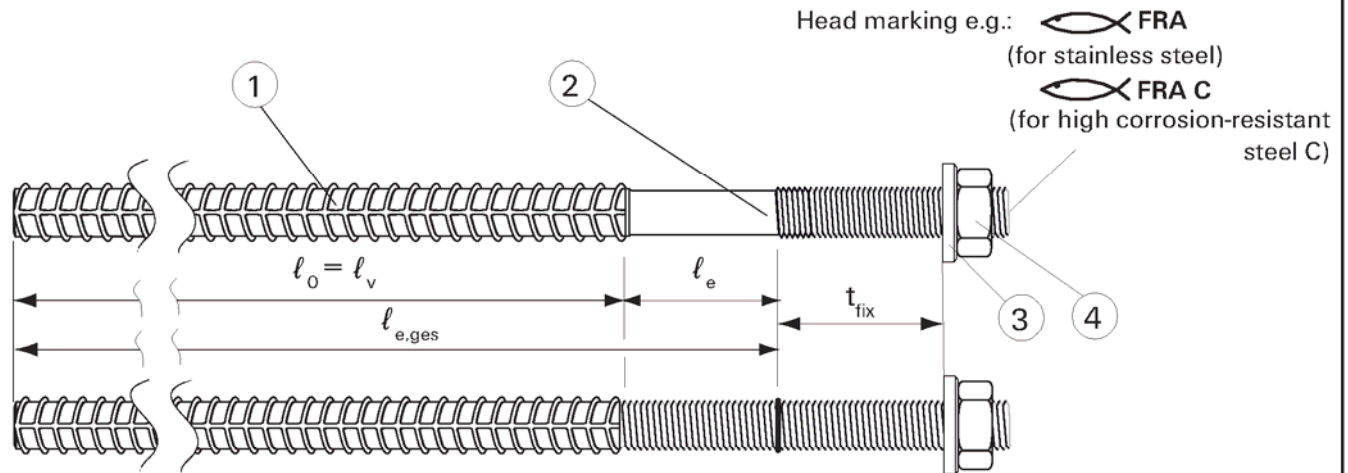


Table 1: Dimensions of rebar anchor FRA and FRA C

Size	FRA 12/l _{e,ges} M12-t _{fix}	FRA 16/l _{e,ges} M16-t _{fix}	FRA 20/l _{e,ges} M20-t _{fix}
Threaded diameter [mm]	12	16	20
Wrench size [mm]	19	24	30
Total embedment depth l _{e,ges} [mm]	l ₀ + l _e		
Effective embedment depth l _v [mm]	according to statical calculation		
Length of smooth shaft or cast-in thread l _e [mm]	100		
Minimum thickness of fixture t _{fix} [mm]	5		
Maximum thickness of fixture t _{fix} [mm]	3000		

Table 2: Materials of rebar anchor FRA and FRA C

Part	Description	Materials	
		FRA	FRA C
1	Reinforcing bar	Non-zinc-plated reinforcement bar acc. to EN 1992-1-1	
2	Round bar with partial or full thread	stainless steel according to EN 10088	high corrosion-resistant steel
3	Washer	stainless steel according to EN 10088	high corrosion-resistant steel
4	Hexagon nut	strength class 80 EN ISO 3506	strength class 80 EN ISO 3506

Rebar connection with Upat injection mortar UPM 44

Properties of FRA
Materials FRA

Annex 7

Table 3: Maximum permissible processing times and minimum curing times

Base material temperature [°C]	Minimum curing time ¹⁾ [minutes] UPM 44	mortar temperature [°C]	Max. processing time ³⁾ [minutes] UPM 44
±0 to +5	180	+ 5	13
>+5 to +10	90	+ 10	9
>+10 to +20	60	+ 20	5
>+20 to +30	45	+ 30	4
>+30 to +40	35	+ 40	2 ²⁾

³⁾ Maximum time from the beginning of injection to rebar setting and positioning.

¹⁾ For wet concrete the curing time must be doubled.

²⁾ If temperatures exceed 30°C, cool the cartridges to +15°C....+20°C

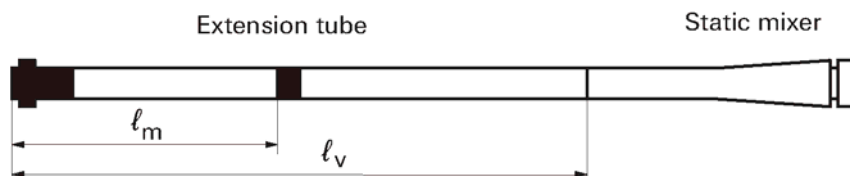
Table 4: Maximum permissible setting depths

Bar diameter d_s [mm]	Nominal drill diameter d_0 [mm]	Diameter of cutting edge d_{cut} [mm]	maximum permissible setting depth l_v [mm]		
			cartridge		pneumatic dispenser (large)
			< 500 ml	≥ 500 ml	
			manual dispenser	Accu and pneumatic dispenser (small)	
8	12	≤ 12,50	1000	1000	1800
10	14	≤ 14,50		1200	
12/FRA 12	16	≤ 16,50		1500	
14	18	≤ 18,50		1300	
16/FRA 16	20	≤ 20,55	700	1000	2000
20/FRA 20	25	≤ 25,55		700	
25	30	≤ 30,55	500	700	
28	35	≤ 35,70		500	700

Table 5: Maximum installation torque for rebar anchor FRA

Rebar anchor FRA	Installation torque T_{inst} [Nm]
FRA 12/ $l_{e,ges}$ M12 - t_{fix}	50
FRA 16/ $l_{e,ges}$ M16 - t_{fix}	100
FRA 20/ $l_{e,ges}$ M20 - t_{fix}	150

Marking length l_m as factor of the setting depth l_v



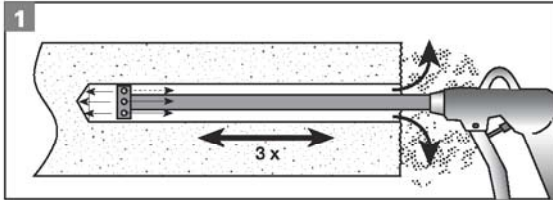
l_v planned setting depth = drill hole depth = minimum length of the extension tube
 l_m length from the end of the injection adapter to the marking on the extension tube

Rebar connection with Upat injection mortar UPM 44

Curing times and processing times
Setting depths
Installation torque FRA

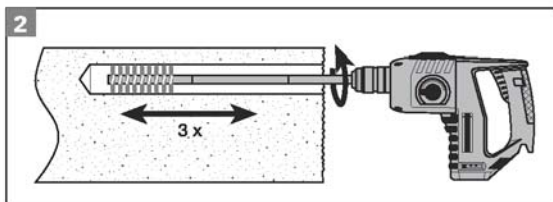
Annex 8

Drill hole with hammer drill or pneumatic drill. Do not use diamant core bit.



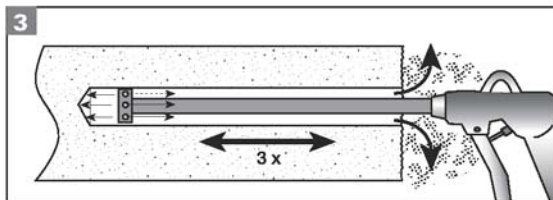
Blowing out the drill hole

Blow out the drill hole 3 times from the base of the hole with the corresponding cleaning nozzle (oil-free compressed air ≥ 6 bar).



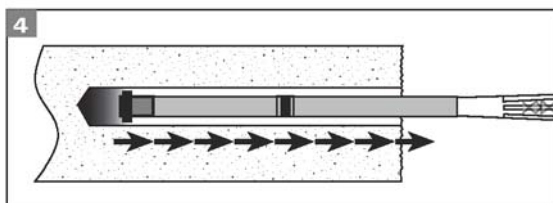
Brushing out the drill hole

Attach the extension with corresponding stainless steel brush to the power drill. Brush out the drill hole 3 times.



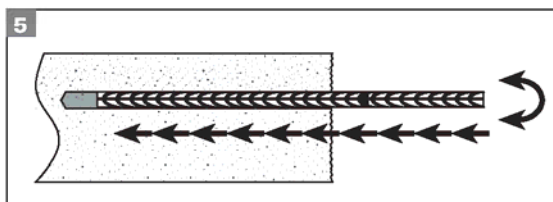
Blowing out the drill hole (control)

Blow out the drill hole 3 times, starting from the top of the hole with corresponding cleaning nozzle (oil-free compressed air ≥ 6 bar).



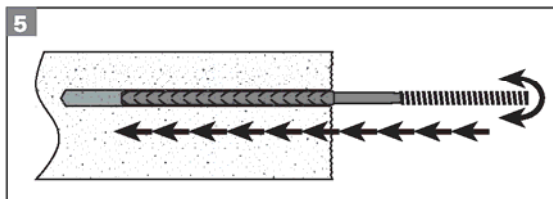
Filling the drill hole

Place mortar cartridge in dispenser. Attach static mixer, extension tube and injection adapter. Slowly withdraw the dispenser - following the pressure build-up - during filling.



Inserting reinforcement bar

Using a turning movement, push the rebar or rebar anchor FRA vigorously into the filled hole up to the insertion depth marking. Excess mortar has to exit from the drill hole surface. Wait for the specified curing time.



The rebar may only be loaded after full curing!

Rebar connection with Upat injection mortar UPM 44

Installing instructions

Annex 9

Table 6: Installing equipment

Rebar diameter d_s [mm]	Drill hole diameter d_o [mm]	Cleaning nozzle diameter [mm]	Extension tube diameter [mm]	Colour of injection adapter and brush
8	12	11	9 ¹⁾	white
10	14			blue
12	16			red
14	18	15	9 ¹⁾ or 15	yellow
16	20			green
20	25			black
25	30	28	9 ¹⁾ or 15	gray
28	35			brown

¹⁾ Observe the max. filling depth for the 9mm extension tube.

Table 7: Design values of the ultimate bond resistance

Ultimate bond resistance	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
f_{bd} [N/mm ²]	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3

Note: The values given in Table 7 are valid for „good bond conditions“ as described in EN 1992-1-1. For all other conditions multiply the values by 0,7.

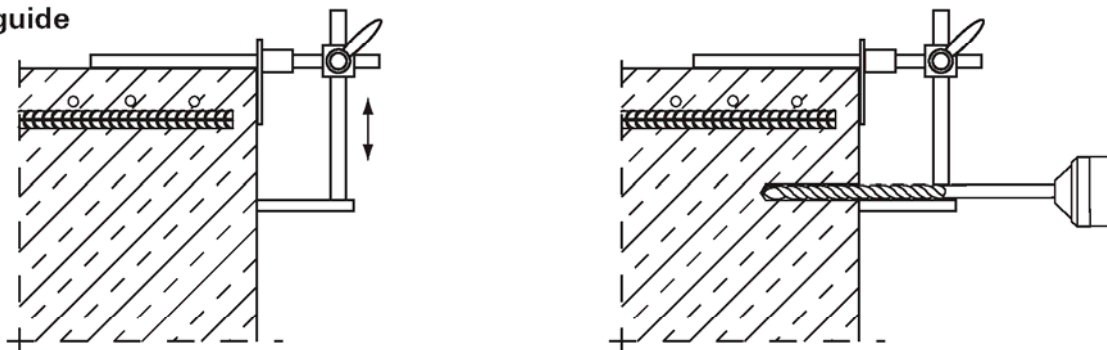
Table 8: Minimum concrete cover min c ¹⁾ depending of the drilling method and the drilling tolerance

Drilling method	Bar diameter d_s [mm]	Minimum concrete cover min c	
		without drill guide [mm]	with drill guide [mm]
Electro hammer drilling	≤ 20 mm	30 mm + 0,06 l_v	30 mm + 0,02 $l_v \geq 2 d_s$
	≥ 25 mm	40 mm + 0,06 l_v	40 mm + 0,02 $l_v \geq 2 d_s$
Pneumatic hammer drilling	≤ 20 mm	50 mm + 0,08 l_v	50 mm + 0,02 l_v
	≥ 25 mm	60 mm + 0,08 l_v	60 mm + 0,02 l_v

¹⁾ see Annex 5, Figures 9 and 10

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

Drill guide



Rebar connection with Upat injection mortar UPM 44

Installing equipment
Design values
Concrete cover

Annex 10

Tabelle 9: Values for pre-calculation of anchoring with Upat UPM 44.
Example for C20/25, good bond conditions, Rebar yield strength 500 N/mm².

Rebar Ø [mm]	$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 1,0$			$\alpha_2 \text{ or } \alpha_5 = 0,7 \quad \alpha_1 = \alpha_3 = \alpha_4 = 1,0$		
	Anchorage length $l_{b,D}$ [mm]	Design value N_{Rd} [kN]	Mortar volume [ml]	Anchorage length $l_{b,D}$ [mm]	Design value N_{Rd} [kN]	Mortar volume [ml]
8	170	9,8	13	170	14,1	13
8	170	9,8	13	200	16,5	15
8	200	11,6	15	-	-	-
8	320	18,5	24	-	-	-
8	378	21,9	29	265	21,9	20
10	213	15,4	19	213	22,0	19
10	200	14,5	18	200	20,6	18
10	300	21,7	27	300	31,0	27
10	400	28,9	36	-	-	-
10	473	34,2	43	331	34,2	30
12	255	22,1	27	255	31,6	27
12	240	20,8	25	240	29,7	25
12	360	31,2	38	360	44,6	38
12	480	41,6	51	-	-	-
12	567	49,2	60	397	49,2	42
14	298	30,1	36	298	43,0	36
14	280	28,3	34	280	40,5	34
14	420	42,5	51	420	60,7	51
14	560	56,7	68	-	-	-
14	662	66,9	80	463	66,9	56
16	340	39,3	46	340	56,2	46
16	320	37,0	43	320	52,9	43
16	480	55,5	65	480	79,3	65
16	640	74,0	87	-	-	-
16	756	87,4	103	529	87,4	72
20	425	61,5	90	425	87,8	90
20	400	57,8	85	400	82,6	85
20	600	86,7	127	600	123,9	127
20	800	115,6	170	-	-	-
20	945	136,6	200	662	136,6	140
25	532	96,0	138	532	137,2	138
25	500	90,3	130	500	129,0	130
25	750	135,5	194	750	193,5	194
25	1000	180,6	259	-	-	-
25	1181	213,4	306	827	213,4	214
28	595	120,5	247	595	172,1	247
28	600	121,4	249	600	173,4	249
28	840	170,0	349	840	242,8	349
28	1120	226,6	466	-	-	-
28	1323	267,7	550	926	267,7	385

The design value is valid for „good bond conditions“ as described in EN 1992-1-1. For all other conditions multiply the value by 0,7.

Rebar connection with Upat injection mortar UPM 44

Values for pre-calculation of anchoring with Upat UPM 44
Example for C20/25 ($f_{b,d} = 2,3 \text{ N/mm}^2$), good bond conditions,
Rebar yield strength 500 N/mm²

Annex 11

Tabelle 10: Values for pre-calculation of overlap joins with Upat UPM 44.
Example for C20/25, good bond conditions, Rebar yield strength 500 N/mm²

Rebar Ø [mm]	$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_5 = \alpha_6 = 1,0$			$\alpha_2 \text{ or } \alpha_5 = 0,7 \quad \alpha_1 = \alpha_3 = \alpha_6 = 1,0$		
	Lap length l_0 [mm]	Design value N_{Rd} [kN]	Mortar volume [ml]	Lap length l_0 [mm]	Design value N_{Rd} [kN]	Mortar volume [ml]
8	300	17,3	23	300	24,8	23
8	320	18,5	24	-	-	-
8	-	-	-	-	-	-
8	-	-	-	-	-	-
8	378	21,9	29	265	21,9	20
10	300	21,7	27	300	31,0	27
10	300	21,7	27	300	31,0	27
10	400	28,9	36	-	-	-
10	-	-	-	-	-	-
10	473	34,2	43	331	34,2	30
12	300	26,0	32	300	37,2	32
12	240	20,8	25	240	29,7	25
12	360	31,2	38	360	44,6	38
12	480	41,6	51	-	-	-
12	567	49,2	60	397	49,2	42
14	315	31,9	38	315	45,5	38
14	280	28,3	34	280	40,5	34
14	420	42,5	51	420	60,7	51
14	560	56,7	68	-	-	-
14	662	66,9	80	463	66,9	56
16	360	41,6	49	360	59,5	49
16	320	37,0	43	320	52,9	43
16	480	55,5	65	480	79,3	65
16	640	74,0	87	-	-	-
16	756	87,4	103	529	87,4	72
20	450	65,0	95	450	92,9	95
20	400	57,8	85	400	82,6	85
20	600	86,7	127	600	123,9	127
20	800	115,6	170	-	-	-
20	945	136,6	200	662	136,6	140
25	563	101,6	146	563	145,2	146
25	500	90,3	130	500	129,0	130
25	750	135,5	194	750	193,5	194
25	1000	180,6	259	-	-	-
25	1182	213,4	306	827	213,4	214
28	630	127,5	262	630	182,1	262
28	600	121,4	249	600	173,4	249
28	840	170,0	349	840	242,8	349
28	1120	226,6	466	-	-	-
28	1323	267,7	550	926	267,7	385

The design value is valid for „good bond conditions“ as described in EN 1992-1-1. For all other conditions multiply the value by 0,7.

Rebar connection with Upat injection mortar UPM 44

Values for pre-calculation of overlap joins with Upat UPM 44
Example for C20/25 ($f_{b,d} = 2,3 \text{ N/mm}^2$), good bond conditions,
Rebar yield strength 500 N/mm²

Annex 12

Table 11: Marking length ℓ_m as factor of setting depth ℓ_v resp. $\ell_{e,ges}$

Drill hole depth = setting depth ℓ_v [mm]	Marking length ℓ_m [mm]							
	Bar diameter d_s [mm]							
	8	10	12/ FRA12	14	16/ FRA16	20/ FRA20	25	28
	Nominal drill diameter d_0 [mm]							
	12 mm	14 mm	16 mm	18 mm	20 mm	25 mm	30 mm	35 mm
80	25							
100	35	40						
120	40	50	55					
140	45	60	65	75				
160	55	65	75	85	90			
180	60	75	85	95	100			
200	65	80	95	105	115	115		
220	75	90	105	115	125	125		
240	80	100	115	125	135	135		
250	85	105	120	130	140	140	160	
260	85	105	125	135	150	150	165	
280	95	115	135	145	160	160	175	160
300	100	125	140	160	170	170	190	170
320	105	130	150	170	180	180	205	180
340	115	140	160	180	195	195	215	195
350	115	145	165	185	200	200	220	200
360	120	150	170	190	205	205	230	205
380	125	155	180	200	215	215	240	215
400	135	165	190	210	225	225	255	225
420	140	175	200	220	240	240	265	240
450	150	185	215	235	255	255	285	255
500	165	205	235	265	285	285	315	285
550	185	225	260	290	310	310	350	310
600	200	245	285	315	340	340	380	340
650	215	270	310	340	370	370	410	370
700	235	290	330	370	400	400	445	400
750	250	310	355	395	425	425	475	425
800	265	330	380	420	455	455	505	455
850	285	350	405	445	485	485	540	485
900	300	370	425	475	510	510	570	510
950	315	390	450	500	540	540	600	540
1000	335	410	475	525	570	570	635	570
1100	365	455	520	580	625	625	695	625
1200	400	495	570	630	680	680	760	680
1300	435	535	615	685	740	740	825	740
1400	465	575	665	735	795	795	885	795
1500	500	620	710	790	850	850	950	850
1600	535	660	760	840	910	910	1015	910
1700	565	700	805	895	965	965	1075	965
1800	600	740	855	945	1020	1020	1140	1020
1900							1205	1080
2000							1265	1135

Rebar connection with Upat injection mortar UPM 44

Marking length

Annex 13