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European Technical Assessment

ETA-16/0967 of 13/01/2017

General Part

Technical Assessment Body issuing the European Technical Assessment	Instytut Techniki Budowlanej
Trade name of the construction product	ResAC-16 for rebar connections
Product family to which the construction product belongs	Post-installed rebar connections with ResAC-16 injection mortar
Manufacturer	S&P Clever Reinforcement Company AG Seewernstrasse 127 CH-6423 Seewen Switzerland
Manufacturing plant	Plant in France
This European Technical Assessment contains	17 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	Guideline for European Technical Approval ETAG 001, Edition April 2013 "Metal anchors for use in concrete – Part 1: Anchors in general and Part 5: Bonded anchors", used as European Assessment Document (EAD)

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Specific Part

1 Technical description of the product

The subject of the assessment are the post-installed connections, by anchoring or overlap connection joint, of steel reinforcing bars (rebars) in existing structures made of normal weight concrete, using injection mortar ResAC-16 in accordance with the regulations for reinforced concrete construction.

Steel reinforcing bars of diameter from 8 to 32 mm and ResAC-16 injection mortar are used for the post-installed rebar connections. The reinforcing bar is placed into a drilled hole previously filled with injection mortar and is anchored by the bond between embedded element, injection mortar and concrete.

The product description is given in Annexes A1 to A4.

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

The performances given in Section 3 are only valid if the post-installed connections are used in compliance with the specifications and conditions given in Annexes B1 to B6.

The performances given in this European Technical Assessment are based on an assumed working life of the rebar connection of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer or the Technical Assessment Body, 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 Performance of the product

3.1.1 Mechanical resistance and stability (BWR 1)

The essential characteristic are detailed in Annexes C1 to C3.

3.1.2 Safety in case of fire (BWR 2)

No performance assessed.

3.1.3 Hygiene, health and the environment (BWR 3)

Regarding the dangerous substances contained in this European Technical Assessment, there may be 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 Regulation, these requirements need also to be complied with, when and where they apply.

3.1.4 Safety in use (BWR 4)

For basic requirement Safety in use the same criteria are valid as for Basic Requirement Mechanical resistance and stability (BR 1).

3.1.5 Sustainable use of natural resources (BWR 7)

No performance assessed.

3.2 Methods used for the assessment

The assessment of fitness of the post-installed connections for declared intended use in relation to the requirements for mechanical resistance and stability and safety in use in the sense of the Basic Requirements 1 and 4 has been made in accordance with the ETAG 001 *"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*".

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

According to Decision 96/582/EC of the European Commission the system of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) given in the following table applies.

Product	Intended use	Level or class	System
Metal anchors for use in concrete	For fixing and/or supporting to concrete structural elements (which contributes to the stability of the works) or heavy units	–	1

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document (EAD)

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Instytut Techniki Budowlanej.

For type testing the results of the tests performed as part of the assessment for the European Technical Assessment shall be used unless there are changes in the production line or plant. In such cases the necessary type testing has to be agreed between Instytut Techniki Budowlanej and the notified body.

Issued in Warsaw on 13/01/2017 by Instytut Techniki Budowlanej

Marcin M. Kruk, PhD
Director of ITB

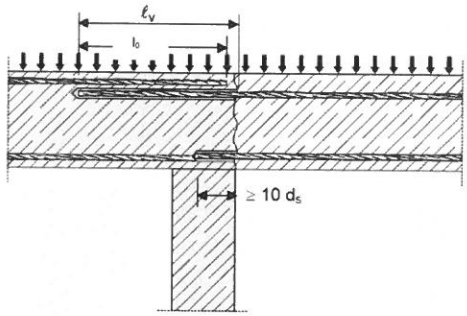


Figure 1: Overlap joint for rebar connections of slabs and beams

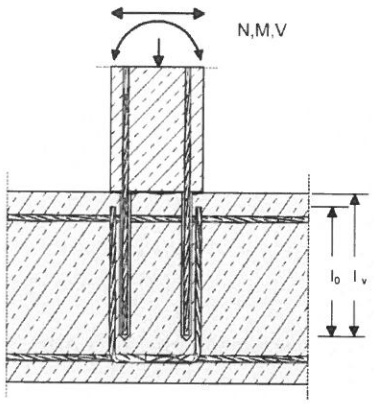


Figure 2: Overlap joint at a foundation of a column or wall where the rebars are stressed in tension

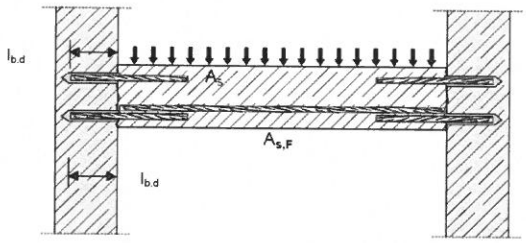


Figure 3: End anchoring of slabs or beams, designed as simply supported

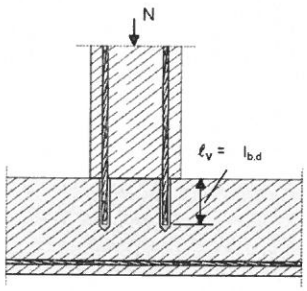


Figure 4: Rebar connection for components stressed primarily in compression. The rebars are stressed in compression

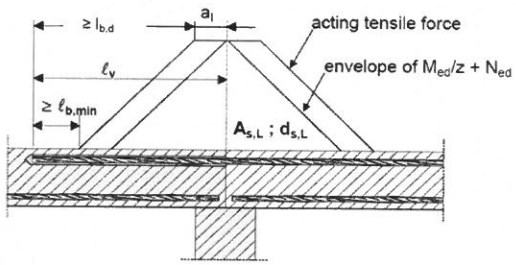


Figure 5: Anchoring of reinforcement to cover the line of acting tensile force

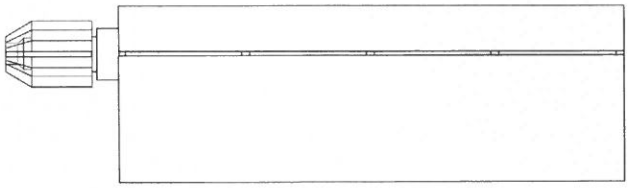
Note to Figure 1 to 5:

In the Figures no transverse reinforcement is plotted, the transverse reinforcement as required by EC 2 shall be present.

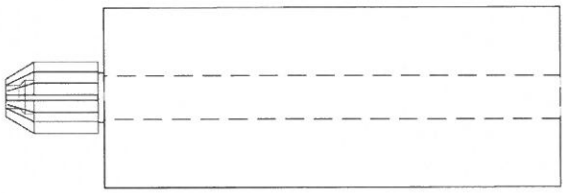
The shear transfer between old and new concrete shall be designed according to EC 2.

ResAC-16 for rebar connections	**Annex A1** of European Technical Assessment ETA-16/0967
Use of the product	

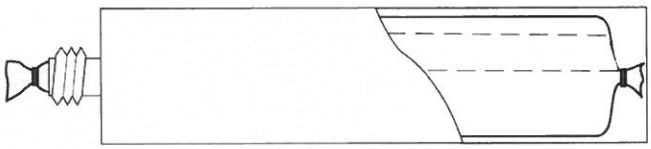
a) side by side cartridge: 345 and 825 ml



b) coaxial cartridge: 280 and 380 ml



c) two part foil capsule in the cartridge: 300 ml



Marking of the cartridges:
- identifying mark of the producer
- trade name of the product
- charge code number
- expiration date
- curing time and open time

ResAC-16 for rebar connections	**Annex A2** of European Technical Assessment ETA-16/0967
Product description	

Table A1: Rebars

Designation	Rebars
Rebars according to EN 1992-1-1, Annex C, Table C.1 and C.2N	Bars and de-coiled rods Class B or C Minimum relative rib area, $f_{R,min}$, according to EN 1992-1-1 The rib height h: $h \leq 0{,}07 \cdot Ø$

Table A2: Injection mortar

Designation	Composition
ResAC-16 (injection mortar)	Bonding agent: styrene free methacrylate Hardener: dibenzoyl peroxide

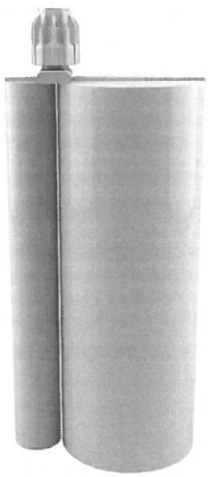
a) 280 ml

b) 300 ml

c) 345 ml

d) 380 ml

e) 825 ml



Storage temperature of the cartridge: +5°C to +25°C

ResAC-16 **for rebar connections**	**Annex A4** of European Technical Assessment ETA-16/0967
Cartridge types and sizes	

SPECIFICATION OF INTENDED USE

Anchorages subject to:

Static and quasi-static loads.

Base material:

- Reinforced or unreinforced normal weight concrete of strength class C12/15 at minimum to C50/60 at maximum according to EN 206-1.
- Maximum chloride content of 0,20% (Cl 0,20) related to the cement content according to EN 206-1.
- Non-carbonated concrete.

  Note: In case of a carbonated surface of the existing concrete structure the carbonate 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 according to EN 1992-1-1.

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

Temperature range:

The products may be used in the following temperature range:

- -40°C to +52°C (max. short term temperature +62°C and max. long term temperature +50°C).

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions.
- Structures subject to external atmospheric exposure including industrial and marine environment.
- Structures subject to permanently damp internal conditions if no particular aggressive conditions exist.

  Note: 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).

Design:

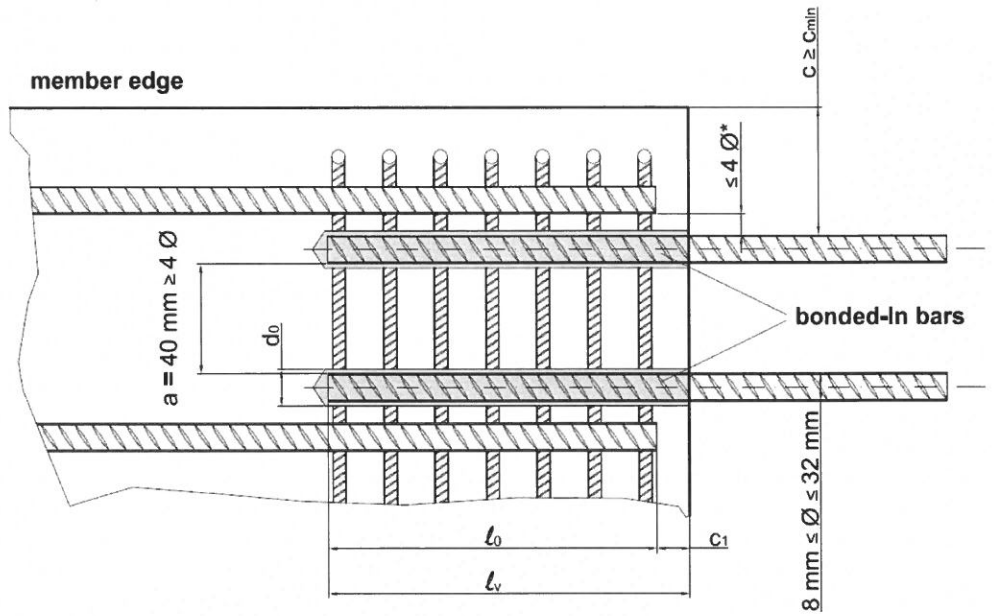
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking into account of the forces to be transmitted.
- Design according to EN 1992-1-1 and Annex B2.
- The actual position of the reinforcement in the existing structure shall be determined on the basis of the construction documentation and taken into account when designing.

Installation:

- Dry or wet concrete (use category 1).
- It must not be installed in flooded holes.
- Hole drilling by hammer drilling.
- Installation of the post-installed rebars shall be done only by suitable trained installer and under supervision on the site.
- 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).

General design rules of construction for post-installed rebars

- 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.
- The joints for concreting must be roughened to at least such an extended that aggregate protrude.



* If the clear distance between overlapping rebars is greater than 4·Ø the overlap length shall be enlarged by the difference between the clear distance and 4·Ø.

l_0 – lap length acc. to EN 1992-1-1, clause 8.7.3
l_v – effective embedment depth; $l_v \geq l_0 + c_1$
c – concrete cover of post-installed rebar
c_{min} – minimum concrete cover acc. to Annex B3 and EN 1992-1-1, clause 4.4.1.2.
c_1 – concrete cover at end-face of existing rebar
d_0 – nominal drill bit diameter acc. to Annex B3
Ø – rebar diameter (d_s)

ResAC-16 for rebar connections	Annex B2 of European Technical Assessment ETA-16/0967
Intended use. General construction rules for post-installed rebars	

Table B1: Installation data – hammer drilling

Rebar diameter [mm]	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Drill bit diameter [mm]	12	14	16	18	20	25	30	35	40
Brush diameter [mm]	17	20	30	30	30	35	32	37	42
Minimum anchorage length $l_{b,min}$ [mm]	115	145	170	200	230	285	355	600	685
Minimum anchorage length $l_{o,min}$ - overlap joint [mm]	200	200	200	210	240	300	375	630	720
Maximum embedment depth $l_{v,max}$ [mm]	400	500	600	700	800	1000*	1000*	1000*	1000*

*** from diameter 20 to 32 mm all installation over 600 mm depth has to be done with a cartridge stored at +20°C**

Note:

- for ∅8 to ∅25: $l_{b,min}$ and $l_{0,min}$ according to EN 1992-1-1 (8.6 and 8.7) and (8.11)
- for ∅28 to ∅32:
  $l_{b,min} = 1,5 \times \max \{0,3 \times l_{b,rqd}; 10\varnothing; 100 \text{ mm}\}$
  $l_{o,min} = 1,5 \times \max \{0,3 \times \alpha_6 \times l_{b,rqd}; 15\varnothing; 200 \text{ mm}\}$
  with: yield stress for rebar 500 N/mm^2; $\gamma_M = 1,15$; $\alpha_6 = 1,0$; concrete C20/25 and $f_{bd} = 2,3$ N/mm^2 (good bond conditions)

Minimum concrete cover (see Annex B2):

$c_{min} = 30 \text{ mm} + 0,06 \cdot l_v \geq 2 \cdot Ø$ for $Ø < 25$ mm
$c_{min} = 40 \text{ mm} + 0,06 \cdot l_v \geq 2 \cdot Ø$ for $Ø \geq 25$ mm
The minimum concrete cover according to EN 1992-1-1 shall be observed.

Minimum clear spacing between two post-installed rebars:

$a = 40 \text{ mm} \geq 4 \cdot Ø$

Table B2: Processing time and minimum curing time

Mortar temperature [C°]	Concrete temperature [C°]	Processing time	Minimum curing time
+5	-5 to -1	15 min.	9 h
+5	0 to +4	12 min.	4 h
+5	+5 to +9	9 min.	1.5 h
+10	+10 to +19	4 min.	60 min.
+20	+20 to +29	1 min.	30 min.
+30	+30 and above	<1 min.	20 min.

After the minimum curing time the blue colored injection mortar changed into grey. The curing color proof is working above +5°C.

ResAC-16 for rebar connections	Annex B3 of European Technical Assessment ETA-16/0967
Installation data, processing time and curing time	

a) mixing nozzle no. 1 (for 825 ml)

b) mixing nozzle no. 2 (for all other cartridges)

c) mixing nozzle extension

d) brushes

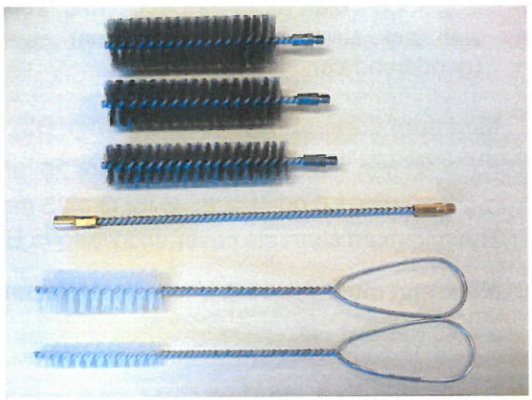


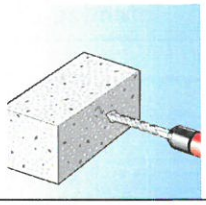
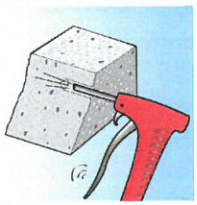
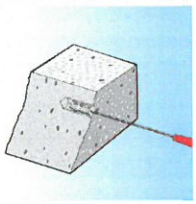
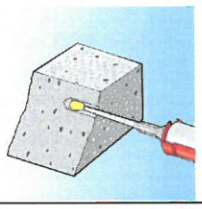
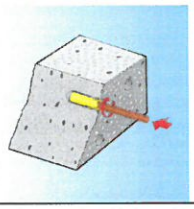
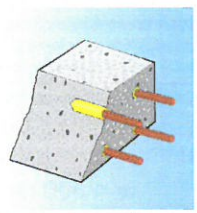
Table B3: Brushes for cleaning the drilled holes (steel or nylon wires)

Rebar diameter [mm]		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Type of the brush		nylon wires						steel wires		
Nominal drill bit diameter	[mm]	12	14	16	18	20	25	30	35	40
Brush head diameter	[mm]	17	20	30	30	30	35	32	37	42
Brush head length	[mm]	90	90	130	130	130	130	130	130	130

ResAC-16 for rebar connections	**Annex B4** of European Technical Assessment ETA-16/0967
Tools for installation (1)	

Table B4: Mortar cartridges and dispensing tools

Dispensing tool	Cartridge	Intended use
 ResAC-16 – *Manual gun*	280 and 300 ml	lv < 300 mm Ø8 to Ø20
 ResAC-16 – *Manual gun*	345 ml	lv < 300 mm Ø8 to Ø20
 ResAC-16 – *Manual gun*	380 ml	lv < 300 mm Ø8 to Ø20
 ResAC-16 – *Pneumatic gun*	380 ml	lv ≥ 300 mm Ø8 to Ø32
 ResAC-16 – *Manual gun*	825 ml	lv < 300 mm Ø8 to Ø20

1		Drill the hole with the correct diameter and depth (Annex B3, Table B1) using a rotary hammer drilling tool. Check the perpendicularity of the hole during the drilling operation.
2	 	Clean the hole from drilling dust: the hole shall be cleaned by at least 2 blowing operations (with the compressed air – min. 6 bar)) and following by at least 2 brushing operations and following again by at least 2 blowing operations. Before brushing check if the brush diameter is sufficient (according to Annex B4, Table B3).
3		Insert the cartridge with mixing nozzle into the appropriate pump. Before starting to use the cartridge, eject a first part of the product, being sure that the two components are completely mixed. The complete mixing is reached only after that the product, obtained by mixing the two component, comes out from the mixer with an uniform color.
4		Fill the drilled hole uniformly starting from the drilled hole bottom, filling the drill hole with a quantity of the injection mortar corresponding to 2/3 of the drill hole depth. Insert immediately the rebar (rebar should be marked with the embedment depth mark) slowly, with a slight twisting motion and remove excess of injection mortar around the rebar.
5		The curing time according to Annex B4, Table B3 shall be taken into account.
6		Start with the loading phase.

ResAC-16 **for rebar connections**	**Annex B6** of European Technical Assessment ETA-16/0967
Installation instruction	

Table C1: Design values of the ultimate bond resistance f_{bd} according to EN 1992-1-1 for hammer drilling

Rebar diameter [mm]	Ultimate bond resistance f_{bd}[1] [N/mm²]								
	C12/15	C16/20	20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Ø8	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,30
Ø10	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,30
Ø12	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,30
Ø14	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,00
Ø16	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,00
Ø20	1,60	2,00	2,30	2,70	3,00	3,40	3,40	3,40	3,70
Ø25	1,60	2,00	2,30	2,70	3,00	3,40	3,40	3,40	3,70
Ø28	1,60	2,00	2,30	2,70	3,00	3,40	3,40	3,40	3,40
Ø32	1,60	2,00	2,30	2,70	3,00	3,00	3,00	3,40	3,40

[1] The values given are valid for good bond condition according to EN 1992-1-1.
For all other bond conditions multiply the value by 0,7.

Values for calculation of anchoring rebars connections
Examples for anchorage length[1] ($f_{y,k}$ = 500 N/mm^2; concrete C20/25; f_{bd} = 2,3 N/mm^2)

Rebar Ø	$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 1,0$			$\alpha_1 = \alpha_3 = \alpha_4 = 1,0$ and α_2 or $\alpha_5 = 0,7$		
	Anchorage length l_{bd}[1]	Tension load	Mortar volume V	Anchorage length l_{bd}[1]	Tension load	Mortar volume V
[mm]	[mm]	[kN]	[ml]	[mm]	[kN]	[ml]
8	115	6,6	9	115	9,5	9
	200	11,6	15	200	16,5	15
	280	16,2	21	-	-	-
	360	20,8	27	-	-	-
	380	21,9	29	265	21,9	20
10	145	10,5	13	145	15,0	13
	200	14,5	18	200	20,6	18
	300	21,7	27	300	31,0	27
	400	28,9	36	-	-	-
	475	34,1	43	330	34,1	30
12	170	14,7	18	170	21,1	18
	240	20,8	25	240	29,7	25
	360	31,2	38	360	44,6	38
	480	41,6	51	-	-	-
	500	43,4	53	-	-	-
	570	49,1	60	400	49,1	42
14	200	20,2	24	200	28,9	24
	280	28,3	34	280	40,5	34
	420	42,5	51	420	60,7	51
	560	56,6	68	-	-	-
	665	67,0	80	465	67,0	56
16	230	26,6	31	230	38,0	31
	320	37,0	43	320	52,9	43
	480	55,5	65	480	79,3	65
	640	74,0	87	-	-	-
	760	87,4	103	530	87,4	72
20	285	41,2	60	285	58,8	60
	400	57,8	85	400	82,6	85
	600	86,7	127	600	123,9	127
	800	115,6	170	-	-	-
	945	136,5	200	662	136,5	140
25	355	64,1	92	355	91,6	92
	500	90,3	130	500	129,0	130
	750	135,5	194	750	193,5	194
	1000	180,6	259	830	213,3	215
28	600	121,4	249	600	173,4	249
	840	169,9	349	840	242,8	349
	1000	202,3	416	930	267,7	387
32	685	158,4	372	685	226,3	372
	700	161,9	380	700	231,2	380
	1000	231,2	543	1000	330,3	543

The given values are valid for good bond condition according to EN 1992-1-1. For all other bond condition the values for tension load shall be multiplied by 0,7. The mortar volume V can be calculated using the equation: $V = l_{bd} \cdot \pi \cdot (d_0^2 - d^2) / (4 \cdot 0,85)$ with the nominal hole diameter.

ResAC-16 for rebar connections	**Annex C2** of European Technical Assessment ETA-16/0967
Design values for anchoring connections	

Values for calculation of overlap joint connections

Examples for the lap splice length[1] ($f_{y,k}$ = 500 N/mm²; concrete C20/25; f_{bd} = 2,3 N/mm²)

Rebar Ø	$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_5 = \alpha_6 = 1,0$			$\alpha_1 = \alpha_3 = \alpha_6 = 1,0$ and α_2 or $\alpha_5 = 0,7$		
	Lap splice length l_0[1]	Tension load	Mortar volume V	Lap splice length l_0[1]	Tension load	Mortar volume V
[mm]	[mm]	[kN]	[ml]	[mm]	[kN]	[ml]
8	200	11,6	15	200	16,5	15
	280	16,2	21	-	-	-
	360	20,8	27	-	-	-
	380	21,9	29	265	21,9	20
10	200	14,5	18	200	20,6	18
	300	21,7	27	300	31,0	27
	400	28,9	36	-	-	-
	475	34,1	43	330	34,1	30
12	200	17,3	21	200	24,8	21
	240	20,8	25	240	29,7	25
	360	31,2	38	360	44,6	38
	480	41,6	51	-	-	-
	500	43,4	53	-	-	-
	570	49,1	60	400	49,1	42
14	210	21,2	25	210	30,3	25
	280	28,3	34	280	40,5	34
	420	42,5	51	420	60,7	51
	560	56,6	68	-	-	-
	665	67,0	80	465	67,0	56
16	240	27,7	33	240	39,6	33
	320	37,0	43	320	52,9	43
	480	55,5	65	480	79,3	65
	640	74,0	87	-	-	-
	760	87,4	103	530	87,4	72
20	300	43,3	64	300	61,9	64
	400	57,8	85	400	82,6	85
	600	86,7	127	600	123,9	127
	800	115,6	170	-	-	-
	945	136,5	200	662	136,5	140
25	375	67,7	97	375	96,8	97
	500	90,3	130	500	129,0	130
	750	135,5	194	750	193,5	194
	1000	180,6	259	830	213,3	215
28	630	127,5	262	630	182,1	262
	840	169,9	349	840	242,8	349
	1000	202,3	416	930	267,7	387
32	720	166,5	391	720	237,8	391
	900	208,1	489	900	297,3	489
	1000	231,2	543	1000	330,3	543

The given values are valid for good bond condition according to EN 1992-1-1. For all other bond condition the values for tension load shall be multiplied by 0,7. The mortar volume V can be calculated using the equation: $V = l_{bd} \cdot \pi \cdot (d_0^2 - d^2) / (4 \cdot 0,85)$ with the nominal hole diameter.