Hilti HIT-RE 500 post-installed rebars

Injection mortar system		Benefits
	Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- suitable for non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - under water application - large diameter applications - high corrosion resistant - long working time at elevated temperatures - odourless epoxy
	Static mixer	
	Rebar	

Concrete	Fire resistance	European Technical Approval	DIBt approval	Drinking water appoved	Corossion tested	PROFIS Rebar design software

Service temperature range

Temperature range: -40℃ to +80℃ (max. long term t emperature +50℃, max. short term temperature +80℃) .

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval	DIBt, Berlin	ETA-08/0105 / 2008-07-30
European technical approval	DIBt, Berlin	ETA-04/0027 / 2009-05-20
DIBt approval	DIBt, Berlin	Z-21.8-1790 / 2009-03-16
Fire test report	IBMB Braunschweig	3357/0550-5 / 2002-07-30
Assessment report (fire)	Warringtonfire	WF 166402 / 2007-10-26

Materials

Reinforcmenent bars according to EC2 Annex C Table C.1 and C.2N.

Properties of reinforcement

Product form		Bars and de-coiled rods	
Class		B	C
Characteristic yield strength f_{yk} or $f_{0,2k}$ (MPa)		400 to 600	
Minimum value of $k = (f_t/f_y)_k$		≥ 1,08	≥ 1,15 < 1,35
Characteristic strain at maximum force, ε_{uk} (%)		≥ 5,0	≥ 7,5
Bendability		Bend / Rebend test	
Maximum deviation from nominal mass (individual bar) (%)	Nominal bar size (mm) ≤ 8 > 8	 ± 6,0 ± 4,5	
Bond: Minimum relative rib area, $f_{R,min}$	Nominal bar size (mm) 8 to 12 > 12	 0,040 0,056	

Setting details

For detailed information on installation see instruction for use given with the package of the product.

Curing time for general conditions

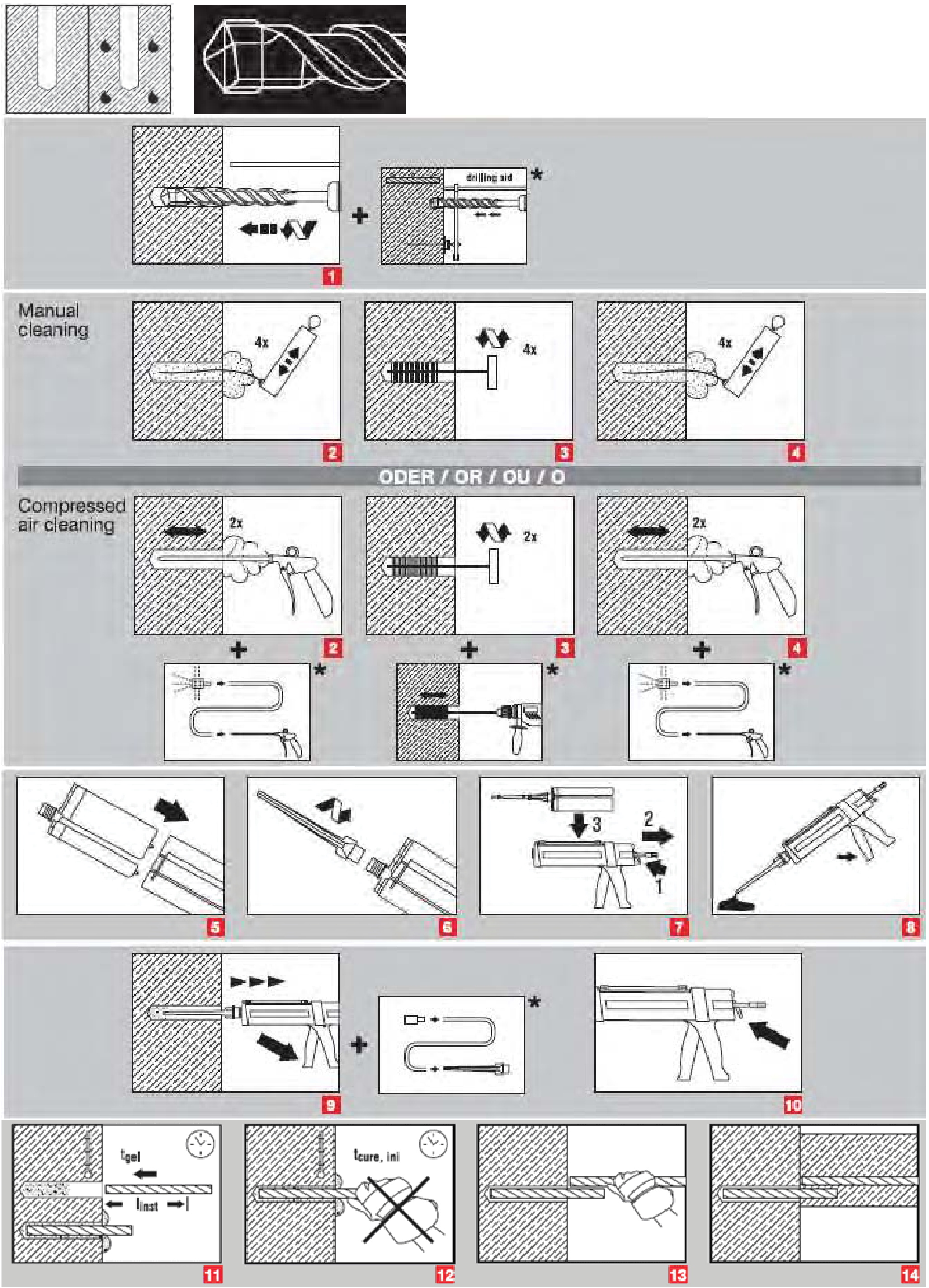
Data according ETA-08/0105, issue 2008-06-30			
Temperature of the base material	**Working time in which rebar can be inserted and adjusted t_{gel}**	**Initial curing time $t_{cure,ini}$**	**Curing time before rebar can be fully loaded t_{cure}**
5 °C ≤ T_{BM} < 10 °C	2 h	18 h	72 h
10 °C ≤ T_{BM} < 15 °C	90 min	12 h	48 h
15 °C ≤ T_{BM} < 20 °C	30 min	9 h	24 h
20 °C ≤ T_{BM} < 25 °C	20 min	6 h	12 h
25 °C ≤ T_{BM} < 30 °C	20 min	5 h	12 h
30 °C ≤ T_{BM} < 40 °C	12 min	4 h	8 h
T_{BM} = 40 °C	12 min	4 h	4 h

For dry concrete curing times may be reduced according to the following table. For installation temperatures below +5 °C all load values have to be reduced according to the load reduction factors given below.

Curing time for dry concrete

Additional Hilti technical data				
Temperature of the base material	**Working time in which rebar can be inserted and adjusted t_{gel}**	**Initial curing time $t_{cure,ini}$**	**Reduced curing time before rebar can be fully loaded t_{cure}**	**Load reduction factor**
T_{BM} = -5 °C	4 h	36 h	72 h	0,6
T_{BM} = 0 °C	3 h	25 h	50 h	0,7
T_{BM} = 5 °C	2 ½ h	18 h	36 h	1
T_{BM} = 10 °C	2 h	12 h	24 h	1
T_{BM} = 15 °C	1 ½ h	9 h	18 h	1
T_{BM} = 20 °C	30 min	6 h	12 h	1
T_{BM} = 30 °C	20 min	4 h	8 h	1
T_{BM} = 40 °C	12 min	2 h	4 h	1

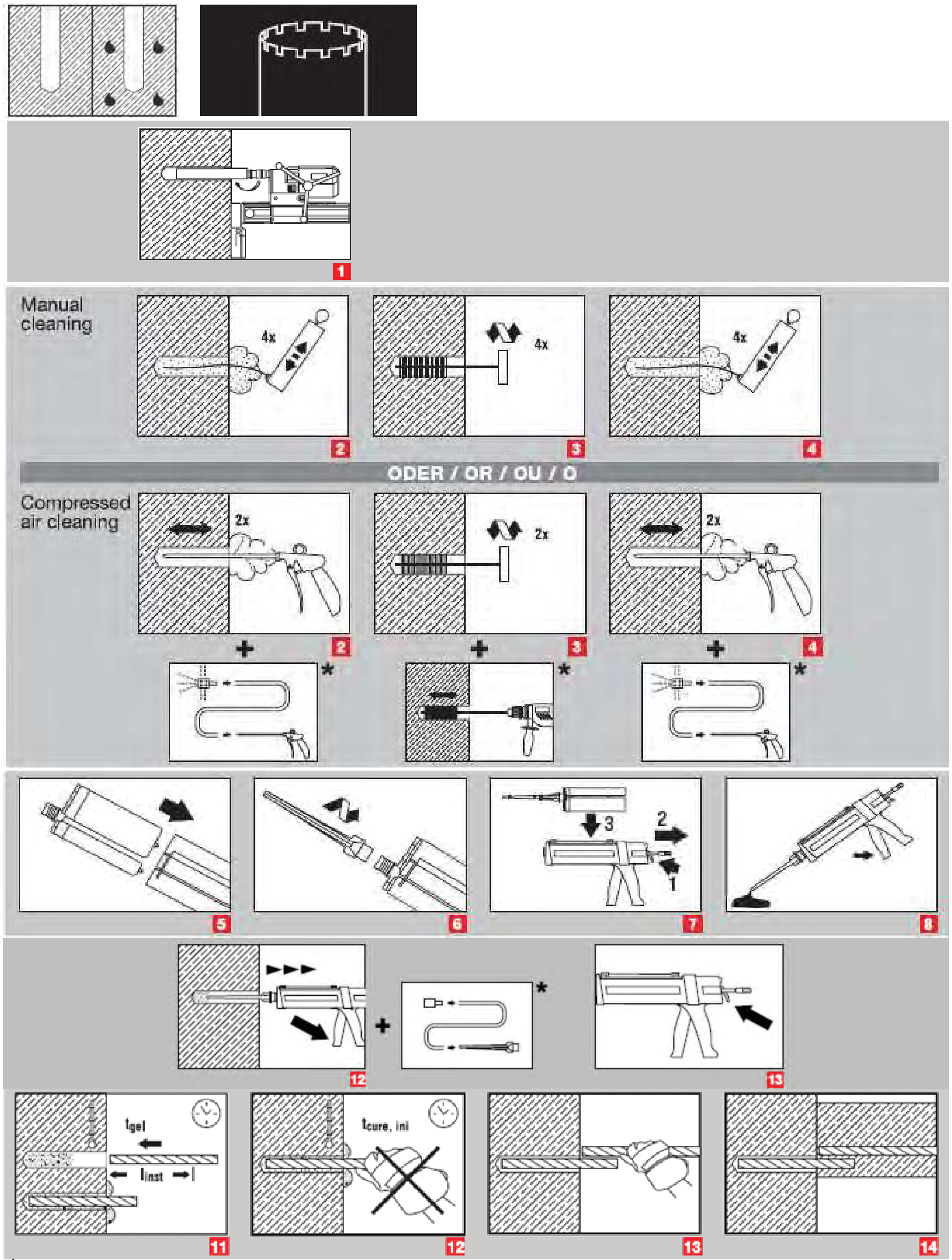
Dry and water-saturated concrete, hammer drilling



a)

a) Note: Manual cleaning for element sizes d ≤ 16mm and embedment depth h_{ef} ≤ 20 d only!

Dry and water-saturated concrete, diamond coring drilling; Hilti technical information only



[a] Note: Manual cleaning for element sizes d ≤ 16mm and embedment depth h_{ef} ≤ 20 d only!

Fitness for use

Some creep tests have been conducted in accordance with ETAG guideline 001 part 5 and TR 023 in the following conditions : in dry environnement at 50 °C during 90 days.
These tests show an excellent behaviour of the post-installed connection made with HIT-RE 500: low displacements with long term stability, failure load after exposure above reference load.

Resistance to chemical substances

Categories	Chemical substances	resistant	Non resistant
Alkaline products	Drilling dust slurry pH = 12,6	+	
	Potassium hydroxide solution (10%) pH = 14	+	
Acids	Acetic acid (10%)		+
	Nitric acid (10%)		+
	Hydrochloric acid (10%)		+
	Sulfuric acid (10%)		+
Solvents	Benzyl alcohol		+
	Ethanol		+
	Ethyl acetate		+
	Methyl ethyl keton (MEK)		+
	Trichlor ethylene		+
	Xylol (mixture)	+	
Products from job site	Concrete plasticizer	+	
	Diesel	+	
	Engine oil	+	
	Petrol	+	
	Oil for form work	+	
Environnement	Sslt water	+	
	De-mineralised water	+	
	Sulphurous atmosphere (80 cycles)	+	

Electrical Conductivity

HIT-RE 500 in the hardened state **does not conduct electrically**. Its electric resistivity is $66 \cdot 10^{12}$ Ω.m (DIN IEC 93 – 12.93). It is adapted well to realize electrically insulating anchorings (ex: railway applications, subway).

Drilling diameters

Rebar (mm)	Drill bit diameters d_0 [mm]			
	Hammer drill (HD)	Compressed air drill (CA)	Diamond coring	
			Wet (DD)	Dry (PCC)
8	12 (10 [a)])	-	12 (10 [a)])	-
10	14 (12 [a)])	-	14 (12 [a)])	-
12	16 (14 [a)])	17	16 (14 [a)])	-
14	18	17	18	-
16	20	20	20	-
18	22	22	22	-
20	25	26	25	-
22	28	28	28	-
24	32	32	32	35
25	32	32	32	35
26	35	35	35	35
28	35	35	35	35
30	37	35	37	35
32	40	40	40	47
34	45	42	42	47
36	45	45	47	47
40	55	57	52	52

a) Max. installation length I = 250 mm.

Basic design data for rebar design according to rebar ETA

Bond strength in N/mm² according to ETA 08/0105 for good bond conditions for hammer drilling, compressed air drilling, dry diamond core drilling

Rebar (mm)	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 - 32	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
34	1,6	2,0	2,3	2,6	2,9	3,3	3,6	3,9	4,2
36	1,5	1,9	2,2	2,6	2,9	3,3	3,6	3,8	4,1
40	1,5	1,8	2,1	2,5	2,8	3,1	3,4	3,7	4,0

Bond strength in N/mm² according to ETA 08/0105 for good bond conditions for wet diamond core drilling

Rebar (mm)	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 - 25	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
26 - 32	1,6	2,0	2,3	2,7	2,7	2,7	2,7	2,7	2,7
34	1,6	2,0	2,3	2,6	2,6	2,6	2,6	2,6	2,6
36	1,5	1,9	2,2	2,6	2,6	2,6	2,6	2,6	2,6
40	1,5	1,8	2,1	2,5	2,5	2,5	2,5	2,5	2,5

Pullout design bond strength for Hit Rebar design

Design bond strength in N/mm² according to ETA 04/0027 (values in table are design values, $f_{bd,po} = \tau_{Rk}/\gamma_{Mp}$

<table>
<tr><td colspan="16">Hammer or compressed air drilling.
Water saturated, water filled or submerged hole.
Uncracked concrete C20/25.</td></tr>
<tr><td rowspan="3">temperature range</td><td colspan="15">Bar diameter</td></tr>
<tr><td colspan="13">Data according to ETA 04/0027</td><td colspan="2">Hilti tech data</td></tr>
<tr><td>8</td><td>10</td><td>12</td><td>14</td><td>16</td><td>20</td><td>22</td><td>24</td><td>25</td><td>26</td><td>28</td><td>30</td><td>32</td><td>36</td><td>40</td></tr>
<tr><td>I: 40℃/24℃</td><td colspan="3">7,1</td><td colspan="3">6,7</td><td colspan="7">6,2</td><td>5,2</td><td>4,8</td></tr>
<tr><td>II: 58℃/35℃</td><td colspan="4">5,7</td><td colspan="6">5,2</td><td colspan="3">4,8</td><td>4,3</td><td>3,8</td></tr>
<tr><td>III: 70℃/43℃</td><td colspan="5">3,3</td><td colspan="5">3,1</td><td colspan="3">2,9</td><td colspan="2">2,4</td></tr>
</table>

Increasing factor in non-cracked concrete: $f_{B,p}=(f_{cck}/25)^{0,1}$ (f_{cck}: characteristic compressive strength on cube)

Additional Hilti Technical Data:

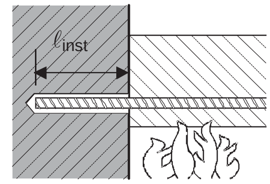
If the concrete is dry (not in contact with water before/during installation and curing), the pullout design bond strength may be increased by 20%.

If the hole was produced by wet diamond coring, the pullout design bond strength has to be reduced by 30%.

Reduction factor for splitting with large concrete cover: δ = 0,306 (Hilti additional data)

Fire Resistance according to DIBt Z-21.8-1790

a) fire situation “anchorage”



Maximum force in rebar in conjunction with HIT-RE 500 as a function of embedment depth for the fire resistance classes F30 to F180 (yield strength f_{yk} = 500 N/mm²) according EC2[a].

Bar ∅	Drill hole ∅	Max. $F_{s,T}$	ℓ_{inst}	Fire resistance of bar in [kN]				
[mm]	[mm]	[kN]	[mm]	R30	R60	R90	R120	R180
8	10	16,19	80	2,4	1,0	0,5	0,3	0
			95	3,9	1,7	0,3	0,6	0,1
			115	7,3	3,1	1,7	1,1	0,4
			150	16,2	8,2	4,6	3,1	1,4
			180		16,2	10,0	6,7	2,9
			205			16,2	12,4	5,1
			220				16,2	7,0
			265					16,2
10	12	25,29	100	5,7	2,5	1,3	0,8	0,2
			120	10,7	4,4	2,5	1,7	0,7
			140	17,6	7,8	4,4	3,0	1,3
			165	25,3	15,1	8,5	5,8	2,6
			195		25,3	17,6	12,2	5,1
			220			25,3	20,7	8,7
			235				25,3	11,8
			280					25,3
12	16	36,42	120	12,8	5,3	3,0	2,0	0,8
			150	25,2	12,2	6,9	4,7	2,1
			180	36,4	24,3	15,0	10,1	4,4
			210		36,2	27,4	20,6	8,5
			235			36,4	31,0	14,2
			250				36,4	19,1
			295					36,4
14	18	49,58	140	24,6	10,9	6,1	4,2	1,9
			170	39,1	23,5	13,5	9,2	4,1
			195	49,6	35,6	24,7	17,1	7,2
			225		49,6	39,2	31,3	13,5
			250			49,6	43,4	22,3
			265				49,6	29,5
			310					49,6
16	20	64,75	160	39,2	21,3	11,9	8,1	3,6
			190	55,8	37,9	25,5	17,3	7,3
			210	64,8	49,0	36,5	27,5	11,3
			240		64,8	53,1	44,1	20,9
			265			64,8	57,9	33,7
			280				64,8	42,0
			325					64,8

Bar ∅	Drill hole ∅	Max. $F_{s,T}$	ℓ_{inst}					
[mm]	**[mm]**	**[kN]**	**[mm]**	**R30**	**R60**	**R90**	**R120**	**R180**
20	**25**	**101,18**	200	76,6	54,3	38,7	27,5	11,4
			240	101,2	82,0	66,4	55,1	26,1
			270		101,2	87,1	75,9	45,6
			295			101,2	93,2	62,9
			310				101,2	73,2
			355					101,2
25	**30**	**158,09**	250	139,0	111,1	91,6	77,6	39,9
			275	158,1	132,7	113,2	99,2	61,3
			305		158,1	139,1	125,1	87,2
			330			158,1	146,7	108,8
			345				158,1	121,8
			390					158,1
28	**35**	**198.3**	280	184,7	153,4	131,6	115,9	73,5
			295	198,3	168,0	146,1	130,4	88,0
			330		198,3	180,0	164,3	121,9
			350			198,3	183,6	141,2
			370				198,3	160,6
			410					198,3
32	**40**	**259,02**	320	255,3	219,6	194,7	176,7	128,2
			325	259,0	225,1	200,2	182,2	133,8
			360		259,0	238,9	220,9	172,5
			380			259,0	243,1	194,6
			395				259,0	211,2
			440					259,0
40	**47**	**404,71**	400	404,7	385,1	353,9	331,5	270,9
			415		404,7	374,6	352,2	291,6
			440			404,7	386,8	326,2
			455				404,7	346,9
			500					404,7

[a] For tables according the standards to DIN 1045-1988, NF-ENV 1991-2-2(EC2), Österreichische Norm B 4700-2000, British-, Singapore- and Australian Standards see Warringtonfire report WF 166402 or/and IBMB Braunschweig report No 3357/0550-5.

b) fire situation parallel

Max. bond stress, τ_T , depending on actual clear concrete cover for classifying the fire resistance.
It must be verified that the actual force in the bar during a fire, $F_{s,T}$, can be taken up by the bar connection of the selected length, ℓ_{inst}. Note: Cold design for ULS is mandatory.

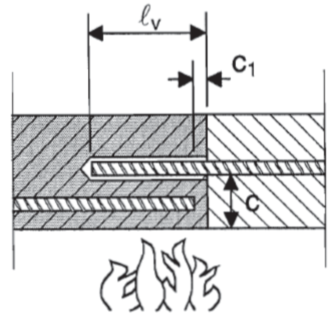
$F_{s,T} \leq (\ell_{inst} - c_f) \cdot \phi \cdot \pi \cdot \tau_T$ where: $(\ell_{inst} - c_f) \geq \ell_s$;

ℓ_s = lap length

ϕ = nominal diameter of bar

$\ell_{inst} - c_f$ = selected overlap joint length; this must be at least ℓ_s,
but may not be assumed to be more than 80 ϕ

τ_T = bond stress when exposed to fire



Critical temperature-dependent bond stress, τ_c, concerning "overlap joint" for Hilti HIT-RE 500 injection adhesive in relation to fire resistance class and required minimum concrete coverage c.

<table>
<tr><th rowspan="2">Clear concrete cover c
[mm]</th><th colspan="5">Max. bond stress, τ_c [N/mm²]</th></tr>
<tr><th>R30</th><th>R60</th><th>R90</th><th>R120</th><th>R180</th></tr>
<tr><td>30</td><td>0,7</td><td>0</td><td rowspan="5">0</td><td rowspan="7">0</td><td rowspan="12">0</td></tr>
<tr><td>35</td><td>0,8</td><td>0,4</td></tr>
<tr><td>40</td><td>0,9</td><td>0,5</td></tr>
<tr><td>45</td><td>1,0</td><td>0,5</td></tr>
<tr><td>50</td><td>1,2</td><td>0,6</td></tr>
<tr><td>55</td><td>1,4</td><td>0,7</td><td>0,5</td></tr>
<tr><td>60</td><td>1,6</td><td>0,8</td><td>0,5</td></tr>
<tr><td>65</td><td>1,9</td><td>0,9</td><td>0,6</td><td>0,4</td></tr>
<tr><td>70</td><td rowspan="22">2,2</td><td>1,0</td><td>0,7</td><td>0,5</td></tr>
<tr><td>75</td><td>1,2</td><td>0,7</td><td>0,5</td></tr>
<tr><td>80</td><td>1,4</td><td>0,8</td><td>0,6</td></tr>
<tr><td>85</td><td>1,5</td><td>0,9</td><td>0,7</td></tr>
<tr><td>90</td><td>1,7</td><td>1,1</td><td>0,8</td><td>0,5</td></tr>
<tr><td>95</td><td>2,0</td><td>1,2</td><td>0,9</td><td>0,5</td></tr>
<tr><td>100</td><td rowspan="16">2,2</td><td>1,4</td><td>1,0</td><td>0,6</td></tr>
<tr><td>105</td><td>1,6</td><td>1,1</td><td>0,6</td></tr>
<tr><td>110</td><td>1,7</td><td>1,2</td><td>0,7</td></tr>
<tr><td>115</td><td>2,0</td><td>1,4</td><td>0,7</td></tr>
<tr><td>120</td><td rowspan="12">2,2</td><td>1,6</td><td>0,8</td></tr>
<tr><td>125</td><td>1,7</td><td>0,9</td></tr>
<tr><td>130</td><td>2,0</td><td>1,0</td></tr>
<tr><td>135</td><td rowspan="9">2,2</td><td>1,1</td></tr>
<tr><td>140</td><td>1,2</td></tr>
<tr><td>145</td><td>1,3</td></tr>
<tr><td>150</td><td>1,4</td></tr>
<tr><td>155</td><td>1,6</td></tr>
<tr><td>160</td><td>1,7</td></tr>
<tr><td>165</td><td>1,9</td></tr>
<tr><td>170</td><td>2,1</td></tr>
<tr><td>175</td><td>2,2</td></tr>
</table>

Minimum anchorage length

According to ETA-08/0105, issue 2008-06-30, the minimum anchorage length shall be increased by factor 1,5 for wet diamond core drilling. For all the other given drilling methods the factor is 1,0.

Minimum anchorage and lap lengths for C20/25; maximum hole lengths (ETA 08/0105)

Rebar		Hammer drilling, Compressed air drilling, Dry diamond coring drilling		Wet diamond coring drilling		
Diameter d_s [mm]	$f_{y,k}$ [N/mm²]	$l_{b,min}$* [mm]	$l_{0,min}$ * [mm]	$l_{b,min}$* [mm]	$l_{0,min}$ * [mm]	l_{max} [mm]
8	500	113	200	170	300	1000
10	500	142	200	213	300	1000
12	500	170	200	255	300	1200
14	500	198	210	298	315	1400
16	500	227	240	340	360	1600
18	500	255	270	383	405	1800
20	500	284	300	425	450	2000
22	500	312	330	468	495	2200
24	500	340	360	510	540	2400
25	500	354	375	532	563	2500
26	500	369	390	553	585	2600
28	500	397	420	595	630	2800
30	500	425	450	638	675	3000
32	500	454	480	681	720	3200
34	500	492	510	738	765	3200
36	500	532	540	797	810	3200
40	500	616	621	925	932	3200

* $l_{b,min}$ (8.6) and $l_{0,min}$ (8.11) are calculated for good bond conditions with maximum utilisation of rebar yield strength f_{yk} = 500 N/mm² and $\alpha_6 = 1,0$