Company:		Page:	1
Address:		Specifier:	
Phone | Fax:	|	E-mail:	
Design:	Rebar - 11 Jan 2024	Date:	11.01.2024
Rebar application:			

Specifier's comments:

1. Input data

General

Design method	EN 1992-1-1:2004 + AC:2010
Consider the effect of ΔF_{td}	yes
Verification of interface shear	no
Consider compression reinforcement for CSD	no
Application type	Beam to wall
Continuous in X	yes
Loading type	Static
Design for yield	no
Design working life	50 years

Product

Mortar	**HIT-RE 500 V4**
Item number	2287557 HIT-RE 500 V4 (adhesive)
UK Technical Assessment	UKTA-0836-22/6577
Issued	28. 03. 2023
Installation	Hammer drilling (HD), Installation Condition: Dry Concrete
Drilling direction	Drilling aid is used (this improves the angle of drilling)

Material and Geometry

Existing concrete	C40/50, f_{ck} = 40 N/mm²
New concrete	C40/50, f_{ck} = 40 N/mm²
Joint roughness	Rough
Interface between new and old concrete	Rectangular cross section, width = 850 mm, height = 2,000 mm
Length of existing concrete	1,200 mm
Temperature	During installation: from 5°C to 20°C; During service: 20 °C / 20 °C (short / long term)
Concrete reinforcement	Wide

Post-installed rebar

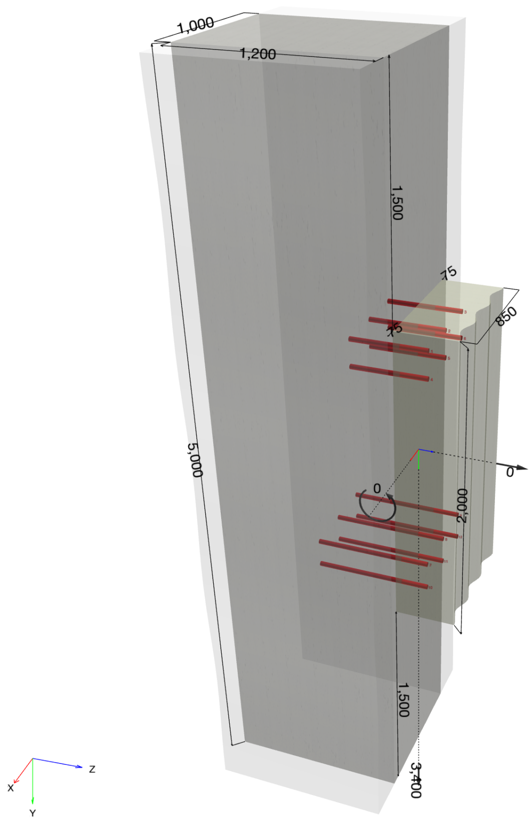
Company:		Page:	2
Address:		Specifier:	
Phone | Fax:	|	E-mail:	
Design:	Rebar - 11 Jan 2024	Date:	11.01.2024
Rebar application:			

	Diameter	**Coordinate Y**	**Bond**	**f_{yk}**	**Drilling length (l_v)**
Top layer 1	32mm	855 mm	Good	500.00 N/mm²	320 mm
Top layer 2	32mm	675 mm	Good	500.00 N/mm²	320 mm
Bottom layer 1	32mm	-835 mm	Good	500.00 N/mm²	584 mm
Bottom layer 2	32mm	-655 mm	Good	500.00 N/mm²	584 mm

Company:		Page:	3
Address:		Specifier:	
Phone | Fax:	|	E-mail:	
Design:	Rebar - 11 Jan 2024	Date:	11.01.2024
Rebar application:			

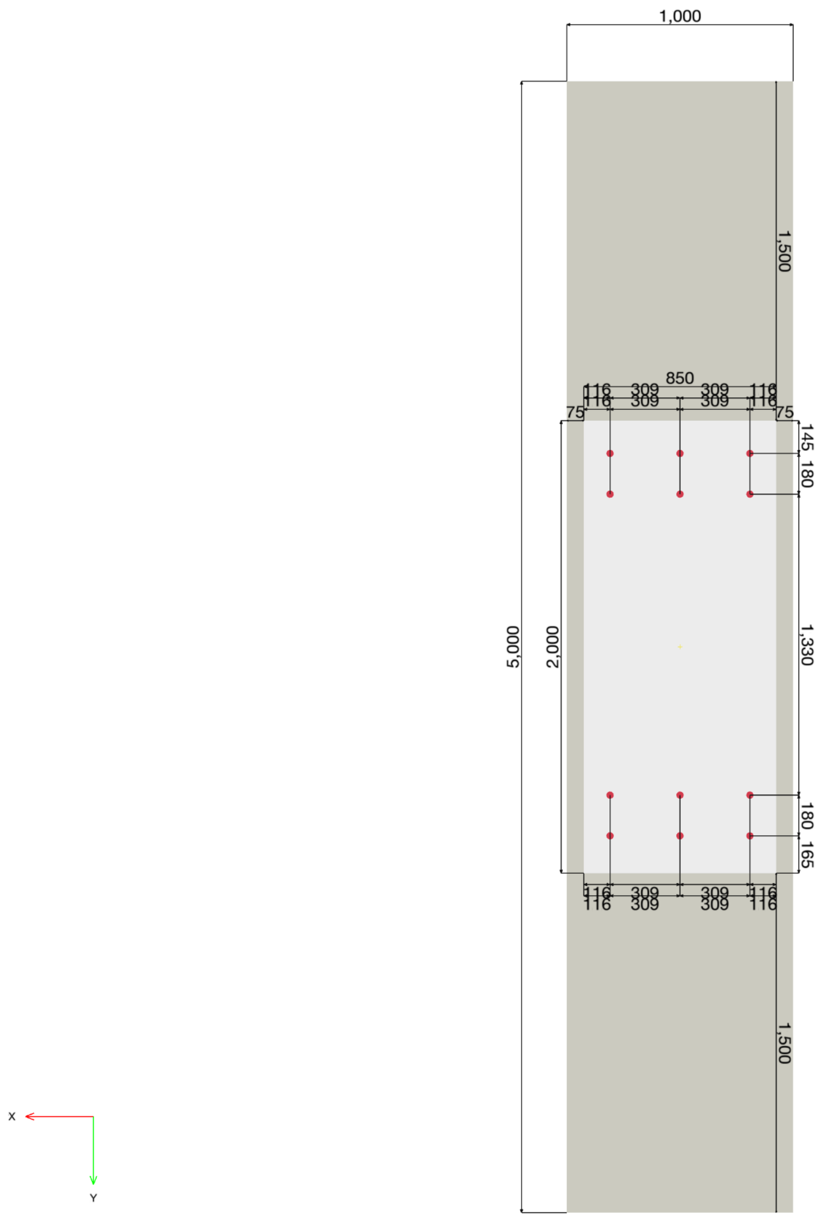
1.1. Geometry & Loading

Geometrical dimensions in [mm]. Loading values in [kN, kNm]



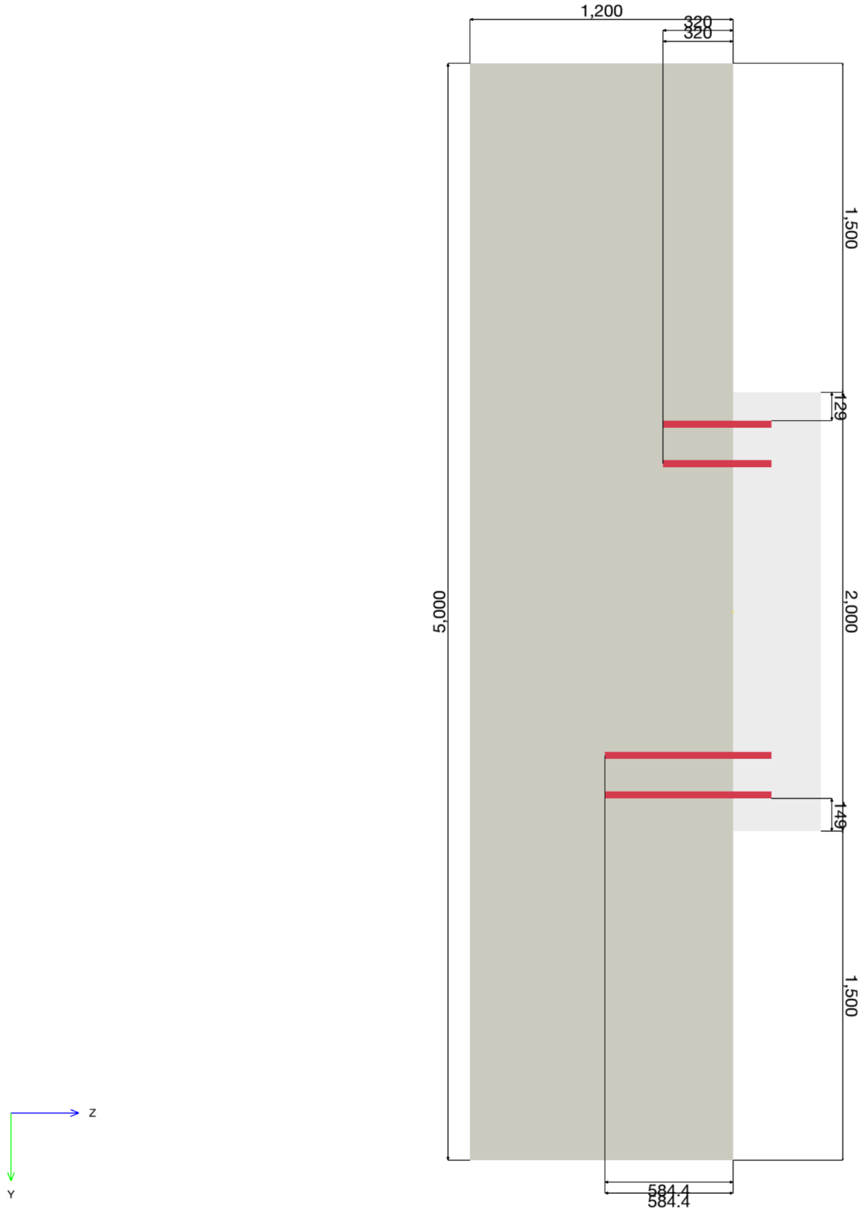
Company:		Page:	4
Address:		Specifier:	
Phone | Fax:	|	E-mail:	
Design:	Rebar - 11 Jan 2024	Date:	11.01.2024
Rebar application:			

1.2. Cross section view



Company:		Page:	5
Address:		Specifier:	
Phone | Fax:	|	E-mail:	
Design:	Rebar - 11 Jan 2024	Date:	11.01.2024
Rebar application:			

1.3. Side section view



2. Loads

2.1. Load combination and Geometry

LC	Load type	V_y [kN]	N [kN]	M_x [kNm]	Design Method	Max drill length l_v [mm]	Max. Utilization [%]
Combination 1	Static	3,400.000	0.000	0.000	EN1992-1-1	584.377	89

3. Overview of results

3.1. References

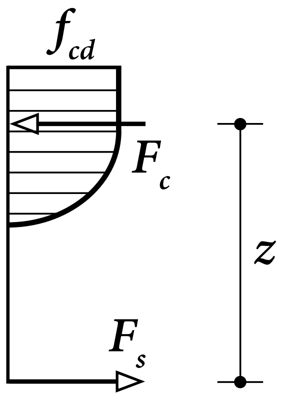
[1] EN 1992-1-1:2011 (01/2011): Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings

3.2. Cross-section verification

Description	Variable	Value
Post-Installed Rebar diameter	ϕ	32 mm
Reinforcement yield strength, post installed	f_{yk}	500.00 N/mm²
Concrete compressive strength, existing	f_{ck}	40.00 N/mm²
Concrete compressive strength, new	f_{ck}	40.00 N/mm²
Member height	h	2,000 mm
Member width	b	850 mm

The determination of the load bearing capacity of the reinforced concrete member is performed assuming the Bernoulli Hypothesis ("plane sections remain plane").

For the (compressed) concrete the following stress-strain relationship (parabola-rectangle diagram) is used.



$\sigma_c = f_{cd} \cdot \left[1 - \left(1 - \frac{\varepsilon_c}{\varepsilon_{c2}}\right)^n\right] \; for \; 0 \leq \varepsilon_c \leq \varepsilon_{c2}$ [1] Eq. (3.17)

$\sigma_c = f_{cd} \; for \; \varepsilon_{c2} \leq \varepsilon_c \leq \varepsilon_{cu2}$ [1] Eq. (3.18)

$f_{cd} = \frac{\alpha_{cc} \cdot f_{ck}}{\gamma_c}$ [1] (3.15)

The design stress-strain diagram for reinforcing steel (in tension and compression) is assumed to be bi-linear with a horizontal top branch.

f_{yd}	$= \frac{f_{yk}}{\gamma_s}$	design yield stress
ε_{yd}	$= \frac{f_{yd}}{E_s}$	design strain at yielding of steel reinforcement
ε_{ud}		design ultimate strain for steel reinforcement

f_{ck} [N/mm²]	α_{cc} [-]	γ_c [-]	f_{cd} [N/mm²]	ε_{c2} [-]	ε_{cu2} [-]
40.00	0.850	1.500	22.67	0.002	0.0035

f_{yk} [N/mm²]	γ_s [-]	f_{yd} [N/mm²]	E_s [N/mm²]	ε_{yd} [-]	ε_{ud} [-]
500.00	1.150	434.78	200,000.00	0.002	0.020

Additional tension force due to shear load

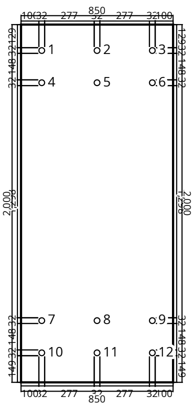
$\Delta F_{td} = F_{Ed} = |V_{Ed}| \cdot \frac{a_l}{z}$ [1] Eq. 9.3 and Section 9.2.1.3 (2)

$a_l = \frac{z \cdot (\cot\Theta - \cot\alpha)}{2}$ [1] Eq. 9.2

V_{Ed} [kN]	Θ [°]	$\cot\Theta$ [-]	α [°]	$\cot\alpha$ [-]	z [mm]
-3,400.000	42.5	1.091	90.0	0.000	1,571

a_l [mm]	$\frac{a_l}{z}$ [-]	ΔF_{td} [kN]
857	0.546	1,855.224

Rebar arrangement and diameter at the interface; see figure below



Resulting rebar forces

Force (+Tension, -Compression)

Layer BottomLayer1 contains rebars 10-12
Layer BottomLayer2 contains rebars 7-9
Layer TopLayer1 contains rebars 1-3
Layer TopLayer2 contains rebars 4-6

Layer	Tension Force [kN]	Additional tension force due to shear load (ΔF_{td}) [kN]	Total Force [kN]
TopLayer1	-	-	-
TopLayer2	-	-	-
BottomLayer2	-	927.612	927.612
BottomLayer1	-	927.612	927.612

max. concrete compressive strain:	0.000 ‰
max. concrete compressive stress:	0.00 N/mm²
resulting tension force in (x/y) = (0.000/0.000):	0.000 kN
resulting compression force in (x/y) = (0.000/0.000):	0.000 kN
inner lever arm z =	- mm

4. Rebar design in tension ([1] Section 8.4 , 8.7)

4.1. Steel verification and anchorage length determination

Input

Description	Variable	Value
Characteristic concrete compressive strength, existing	f_{ck}	40.00 N/mm²
Characteristic concrete tensile strength (5%-fractile), existing	$f_{ctk;0.05}$	2.456 N/mm²
Partial material safety factor	γ_c	1.500
Coefficient for long-term effects on the tensile strength	α_{ct}	1.000
Design concrete tensile strength, existing	f_{ctd}	1.637 N/mm²
Rebar diameter, Post-installed	ϕ	32.000 mm
Reinforcement yield strength	f_{yk}	500.000 N/mm²
Partial material safety factor	γ_s	1.150
Shape of rebar influence ([1] Table 8.2)	α_1	1.000
Concrete cover influence ([1] Table 8.2)	α_2	0.700
Transverse pressure influence ([1] Table 8.2)		
Transverse pressure	p	0.00 N/mm²
	α_5	1.000

Governing loading situation

The results presented in the following are valid for the governing loading situation:

The design is performed based on the results of the cross-section analysis (incl. additional tension forces due to shear loads)

Installation/Drill length results

$$l_v \quad \geq l_{bd}$$

Layer BottomLayer1 contains rebars 10-12
Layer BottomLayer2 contains rebars 7-9
Layer TopLayer1 contains rebars 1-3
Layer TopLayer2 contains rebars 4-6

Layer	ϕ [mm]	l_{bd} [mm]	l_v [mm]
BottomLayer1	32	584	584
BottomLayer2	32	584	584
TopLayer1	32	320	320
TopLayer2	32	320	320

Steel verification

$$F_{Ed} \quad \leq F_{yd} = \frac{A_s \cdot f_{yk}}{\gamma_s}$$

Layer	F_{Ed} [kN]	ϕ [mm]	γ_s [-]	A_s [mm²]	F_{yd} [kN]	Utilisation [%]	Status
Post-Installed BottomLayer1	309.204	32	1.150	804	349.673	89	Ok
Post-Installed BottomLayer2	309.204	32	1.150	804	349.673	89	Ok
Post-Installed TopLayer1	0.000	32	1.150	804	349.673	0	Ok
Post-Installed TopLayer2	0.000	32	1.150	804	349.673	0	Ok

Anchorage length

l_{bd}	$= \alpha_1 \cdot \alpha_2 \cdot \alpha_3 \cdot \alpha_4 \cdot \alpha_5 \cdot l_{b,rqd} \geq l_{b,min}$	[1] Eq. (8.4)
$l_{b,rqd}$	$= \frac{\phi}{4} \cdot \frac{\sigma_{sd}}{f_{bd}}$	[1] Eq. (8.3)
$l_{b,min}$	$= max\left(0.3 \cdot l_{b,rqd}, 10 \cdot \phi, 100mm\right)$	[1] Eq. (8.6)
σ_{sd}	$= \frac{F_{Ed}}{A_s}$	
f_{bd}	$= 2.25 \cdot \eta_1 \cdot \eta_2 \cdot f_{ctd}$	[1] Eq. (8.2)
η_1	$= 1.0$ for good bond conditions	[1] Section 8.4.2 (2)
η_1	$= 0.7$ for all other cases	
η_2	$= 1.0$ for rebars with $\phi \leq 32mm$	[1] Section 8.4.2 (2)
η_2	$= \frac{(132-\phi)}{100}$ for rebars with $\phi > 32mm$	
f_{ctd}	$= \frac{\alpha_{ct} \cdot f_{ctk;0.05}}{\gamma_c}$	[1] Eq. (3.16)
$f_{ctk;0.05}$	$= 0.7 \cdot f_{ctm} = 0.7 \cdot 0.3 \cdot f_{ck}^{\frac{2}{3}}$	[1] Table (3.1)

Post-installed rebars

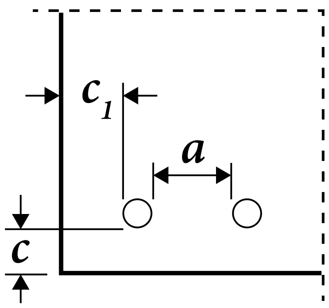
In case of post-installed rebars, use $f_{bd,PIR}$ in [1] Eq. (8.3)

$f_{bd,PIR}$	$= k_b \cdot f_{bd}$
k_b	bond efficiency factor from UKTA-0836-22/6577
$l_{0,min}$	$= \alpha_{lb} \cdot l_{0,min}$
α_{lb}	amplification factor from UKTA-0836-22/6577

Influencing factor (α_i) equations

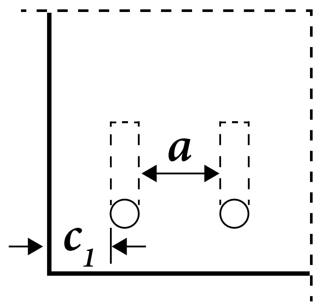
Concrete cover

$0.70 \leq \alpha_2$	$= 1 - 0.15 \cdot \frac{(c_d - \phi)}{\phi} \leq 1.00$	[1] Table 8.2



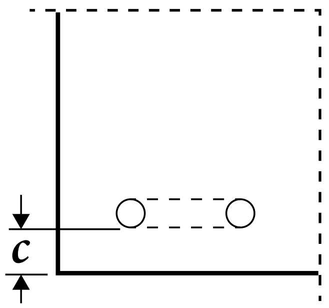
Straight bars

$c_d = min\left(\frac{a}{2}, c_1, c\right)$



Bent or hooked bars

$c_d = min\left(c_1, c\right)$



Looped bars

$c_d = c$

Transverse pressure

$0.7 \le \alpha_5 \quad = 1 - 0.04 \cdot p \le 1.00$ [1] Table 8.2

Combination limit

$\alpha_{2,3,5} \quad = max\left(\alpha_2 \cdot \alpha_3 \cdot \alpha_5; 0.7\right)$ [1] Eq. (8.5)

Layer	F_{Ed} [kN]	ϕ [mm]	A_s [mm²]	σ_{sd} [N/mm²]	η_1 [-]	η_2 [-]	f_{ctd} [N/mm²]
Post-Installed BottomLayer1	309.204	32	804	384.46	1.000	1.000	1.637
Post-Installed BottomLayer2	309.204	32	804	384.46	1.000	1.000	1.637
Post-Installed TopLayer1	0.000	32	804	0.00	1.000	1.000	1.637
Post-Installed TopLayer2	0.000	32	804	0.00	1.000	1.000	1.637

Layer	k_b [-]	f_{bd} [N/mm²]	$f_{bd,PIR}$ [N/mm²]	α_{lb} [-]	$l_{b,rqd}$ [mm]	$l_{b,min}$ [mm]	c_d [mm]
Post-Installed BottomLayer1	1.000	3.68	3.68	1.000	835	320	139
Post-Installed BottomLayer2	1.000	3.68	3.68	1.000	835	320	139
Post-Installed TopLayer1	1.000	3.68	3.68	1.000	0	320	139
Post-Installed TopLayer2	1.000	3.68	3.68	1.000	0	320	139

Layer	α_1 [-]	α_2 [-]	α_3 [-]
Post-Installed BottomLayer1	1.000	0.700	1.000
Post-Installed BottomLayer2	1.000	0.700	1.000
Post-Installed TopLayer1	1.000	1.000	1.000
Post-Installed TopLayer2	1.000	1.000	1.000

Layer	α_4 [-]	p [N/mm²]	α_5 [-]	$\alpha_{2,3,5}$ [-]	l_{bd} [mm]
Post-Installed BottomLayer1	1.000	0.00	1.000	0.700	584
Post-Installed BottomLayer2	1.000	0.00	1.000	0.700	584
Post-Installed TopLayer1	1.000	0.00	1.000	1.000	320
Post-Installed TopLayer2	1.000	0.00	1.000	1.000	320

5. Warnings

This design exclusively considers the load transfer with post-installed rebars at the interface between new and existing concrete.

Load distribution to the rebars is done assuming that cross-sections remain plane after bending.

The joint surfaces for concreting must be roughened at least to such an extent that aggregates protrude.

The accessory list in this report is for the information of the user only. All the relevant installation conditions (drilling, cleaning, setting) must be done in accordance with the relevant UKTA and product IFUs.

If the design is carried out assuming a simply supported connection a check for partial fixity may be required, acc. to EN1992-1-1.

No shear check verification was selected by the user, the verification was not performed in PROFIS Engineering.

Interface meets the design criteria!

6. Installation data

Mortar: HIT-RE 500 V4 + Rebar

Item number: 2287557 HIT-RE 500 V4 (adhesive)

Reinforcement yield strength f_{yk}: 500.00 N/mm²

Drilling method: Hammer drilling (HD) (Drilling aid is used)

Hole type: Dry Concrete

Installation temperature: from 5°C to 20°C

Roughness: Rough

Top layer 1

- Rebar diameter: 32mm
- Number of bars: 3
- Top cover: 129 mm
- Drill length, l_v: 320 mm
- Drill diameter, d_0: 40 mm
- Hole cleaning: Compressed air without brushing or Cleaning with the air nozzle

Top layer 2

- Rebar diameter: 32mm
- Number of bars: 3
- Top cover: 148 mm
- Drill length, l_v: 320 mm
- Drill diameter, d_0: 40 mm
- Hole cleaning: Compressed air without brushing or Cleaning with the air nozzle

Bottom layer 1

- Rebar diameter: 32mm
- Number of bars: 3
- Bottom cover: 149 mm
- Drill length, l_v: 584 mm
- Drill diameter, d_0: 40 mm
- Hole cleaning: Compressed air without brushing or Cleaning with the air nozzle

Bottom layer 2

Rebar diameter: 32mm

Number of bars: 3

Bottom cover: 148 mm

Drill length, l_v: 584 mm

Drill diameter, d_0: 40 mm

Hole cleaning: Compressed air without brushing or Cleaning with the air nozzle

6.1. Working time and curing time 1) 2)

Temperature in the base material T	Maximum working time t_{work}	Initial curing time $t_{cure,ini}$	Minimum curing time t_{cure}
-5 °C to -1 °C	2 hours	2 days	7 days
0 °C to 4 °C	2 hours	1 days	2 days
5 °C to 9 °C	2 hours	16 hours	1 days
10 °C to 14 °C	1.5 hours	12 hours	16 hours
15 °C to 19 °C	1 hours	8 hours	16 hours
20 °C to 24 °C	30 min	4 hours	7 hours
25 °C to 29 °C	20 min	3.5 hours	6 hours
30 °C to 34 °C	15 min	3 hours	5 hours
35 °C to 39 °C	12 min	2 hours	4.5 hours
40 °C	10 min	2 hours	4 hours

1) The curing time data are valid for dry base material only. In wet base material the curing times must be doubled.
2) The minimum temperature of the foil pack is +5°C.

7. Remarks; Your cooperation duties

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