

POST INSTALLED REBAR

Eurocode 2 design method for rebar anchoring system for use with EPOBAR and EPOBAR+ resins

CHARACTERISTICS

EPOBAR

- EPOXY acrylate resin
- Fast cure time
- Storage time 18 months
- Usable in wet environments
- Cartridge compatible with standard injection gun

EPOBAR+

- Vinylester resin
- Fast cure time
- Storage time 18 months
- Usable in wet environments
- Cartridge compatible with standard injection gun

APPLICATION

- Post-installed rebars applications

MECHANICAL CHARACTERISTICS OF REBARS

Nominal steel rebar Ø	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Sections [cm ²]	0,503	0,785	1,13	1,54	2,01	3,14	4,91	8,04
Min. resistances to failure [kN]	Fe E400	21,13	32,97	47,46	64,68	84,42	131,88	206,22
	Fe E500	25,90	40,43	58,20	79,31	103,52	161,71	252,87
Ultimate limit load N _{Rd} [kN]	Fe E500	21,85	34,15	49,17	66,93	87,42	136,59	213,43

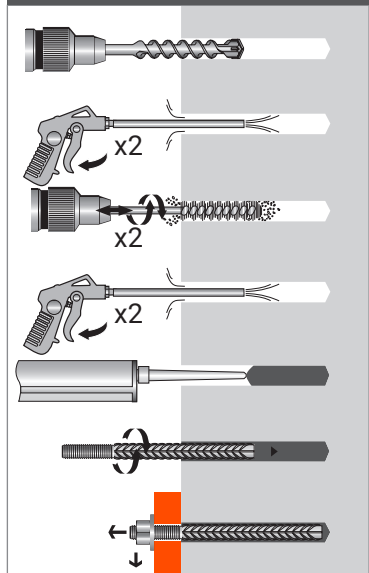
The mechanical characteristics of the high adhesion rebars are defined in the NFA 35-016 and NFA 35-017 standards.

SETTING TIME

TEMPERATURE	MAX. TIME FOR INSTALLATION	CURING TIME*
5°C ▶ 9°C	22 min.	250 min.
10°C ▶ 19°C	11 min.	190 min.
20°C ▶ 29°C	6 min.	110 min.
30°C ▶ 39°C	3 min.	65 min.
40°C	3 min.	50 min.

* double the curing time in wet concrete

INSTALLATION



* PREMIUM CLEANING:

- 2 blowing with compressed air
- 2 brushing with brushed fitted on a drilling machine
- 2 blowing with compressed air

SIZING RULES FOR STEEL REINFORCEMENT FIXINGS FOR CONCRETE ACCORDING TO EUROCODE 2 REGULATIONS

The basic anchorage length $L_{b,rd}$ [mm] for the ultimate limit load for rebar F_{Rd} [N] is given by following equation:

$$L_{b,rd} = \frac{F_{Rd}}{\pi \cdot \varnothing \cdot \eta_1 \cdot \eta_2 \cdot f_{bd}}$$

The design anchorage length L_{bd} [mm] is determined as follow:

$$L_{bd} = L_{b,rd} \cdot \alpha_2 \cdot \alpha_5$$

- F_{Rd} : Design ultimate load [N]
 f_{bd} : Design value of the bond strength [N/mm²]
 $\varnothing$: Rebar diameter [mm]
 η_1 : depends on bond conditions - $\eta_1 = 1$ ("good bond" conditions). See § 8.4.2 (EN 1992-1-1)
 η_2 : depends on rebar diameter - $\eta_2 = 1$ for $\varnothing_{rebar} \leq 32$ mm

with α_2 : **Influence of concrete minimum cover**

$$\alpha_2 = 1 - 0,15 (C_d - \varnothing_{rebar}) / \varnothing_{rebar} \geq 0,7$$

$$C_d = \min \left(C ; C_1 ; \frac{a}{2} \right)$$

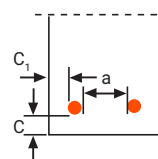
with α_5 : **Influence of the confinement by transverse pressure**

The factor α_5 take into account of the effect of the pressure transverse to the plane of splitting along the design length.

$$\alpha_5 = 1 - 0,04 \cdot p \geq 0,7$$

where p is the transverse pressure at the ultimate limit state along L_{bd} in MPa

Concrete class	f_{ck} [MPa]	f_{bd} [MPa]
C20/25	20	2,3
C25/30	25	2,7
C30/37	30	3,0
C35/45	35	3,4
C40/50	40	3,7
C45/55	45	4,0
C50/60	50	4,3



p [MPa]	α_5
3	0,88
5	0,8
7	0,72



EUROCODE 2 TABLE FOR STRAIGHT REBAR ANCHORING



HAMMER DRILLING (Ø8 -> Ø32)
HAMMER DRILLING WITH DUST FREE DRILL BIT (Ø12 -> Ø25)



CRACKED AND NON-CRACKED CONCRETE – C40/50

Rebar size [mm]	Drilling Ø d ₀ [mm]	Length of anchor L _{bd} [mm]	Ultimate limit load <u>without</u> influence of center distance and/or edge ⁽¹⁾ (α ₂ = 0,7) [daN]	Ultimate limit load <u>with</u> influence of center distance and/or edge ⁽²⁾ (α ₂ = 1) [daN]	Number of sealings per cartridge ⁽³⁾ 410 ml
8	10	100	1328	930	120,8
		130	1727	1209	93,0
		164	2185	1530	73,5
		235	-	2185	51,4
10	12	100	1661	1162	98,9
		150	2491	1744	65,9
		206	3415	2391	48,1
		294	-	3415	33,7
12	15	120	2391	1674	44,8
		280	5579	3906	19,2
		247	4917	3442	21,8
		353	-	4917	15,2
14	18	140	3255	2278	24,3
		200	4650	3255	17,0
		288	6693	4685	11,8
		411	-	6693	8,3
16	20	160	4251	2976	18,9
		260	6908	4836	11,6
		329	8742	6119	9,2
		470	-	8742	6,4
20	25	200	6642	4650	9,7
		300	9963	6974	6,4
		411	13659	9561	4,7
		588	-	13659	3,3
25	30	250	10378	7265	4,4
		380	15775	11043	2,9
		514	21342	14939	2,1
		734	-	21342	1,5
28	35	280	13019	9113	3,5
		400	18598	13019	2,5
		576	26775	18743	1,7
		823	-	26775	1,2
32	40	320	17004	11903	2,4
		450	23912	16738	1,7
		658	34956	24469	1,1
		900	-	33477	0,8

⁽¹⁾ Absence of edge distances greater than or equal to 7.Ø

⁽²⁾ Presence of edge distances and/or centre distances less than 7.Ø

⁽³⁾ The number of fixings per cartridge is calculated taking into account an increasing by 20% the real volume of sealing.

$$1,2 \times (d_0^2 - \varnothing_{\text{rebar}}^2) \times \pi \times L_{bd} / 4$$



EUROCODE 2 TABLE FOR STRAIGHT REBAR ANCHORING



HAMMER DRILLING (Ø8 -> Ø32)
HAMMER DRILLING WITH DUST FREE DRILL BIT (Ø12 -> Ø25)
DIAMOND CORE DRILLING WITH ROUGHENING TOOL (Ø8 -> Ø32⁽⁴⁾)



CRACKED AND NON-CRACKED CONCRETE – C40/50

Rebar size [mm]	Drilling Ø d ₀ [mm]	Length of anchor L _{bd} [mm]	Ultimate limit load <u>without</u> influence of center distance and/or edge ⁽¹⁾	Ultimate limit load <u>with</u> influence of center distance and/or edge ⁽²⁾	Number of sealings per cartridge ⁽³⁾	
			(α ₂ = 0,7) [daN]	(α ₂ = 1) [daN]	410 ml	825 ml
8	10	100	1328	930	120,8	243,2
		130	1727	1209	93,0	187,0
		164	2185	1530	73,5	147,8
		235	-	2185	51,4	103,5
10	12	100	1661	1162	98,9	198,9
		150	2491	1744	65,9	132,6
		206	3415	2391	48,1	96,7
		294	-	3415	33,7	67,7
12	15	120	2391	1674	44,8	90,1
		190	3786	2650	28,3	56,9
		247	4917	3442	21,8	43,8
		353	-	4917	15,2	30,7
14	18	140	3255	2278	24,3	48,8
		210	4882	3417	16,2	32,6
		288	6693	4685	11,8	23,8
		411	-	6693	8,3	16,6
16	20	176	4676	3273	17,2	34,5
		250	6642	4650	12,1	24,3
		329	8742	6119	9,2	18,5
		470	-	8742	6,4	12,9
20	25	220	7306	5115	8,8	17,7
		310	10295	7207	6,2	12,5
		411	13659	9561	4,7	9,5
		588	-	13659	3,3	6,6
25	30	300	12454	8718	3,6	7,3
		400	16606	11624	2,7	5,5
		514	21343	14940	2,1	4,3
		734	-	21343	1,5	3,0
28	35	336	15623	10936	2,9	5,9
		450	20923	14646	2,2	4,4
		576	26775	18743	1,7	3,4
		823	-	26775	1,2	2,4
32	40	416	22105	15474	1,8	3,7
		540	28694	20086	1,4	2,8
		658	34956	24469	1,1	2,3
		900	-	33477	0,8	1,7
32 ⁽⁴⁾	40	416	20313	14219	1,8	3,7
		540	26368	18457	1,4	2,8
		716	34956	24469	1,1	2,1
		900	-	30762	0,8	1,7

⁽¹⁾ Absence of edge distances greater than or equal to 7.Ø

⁽²⁾ Presence of edge distances and/or centre distances less than 7.Ø

⁽³⁾ The number of fixings per cartridge is calculated taking into account an increasing by 20% the real volume of sealing: $1,2 \times (d_0^2 - \varnothing_{rebar}^2) \times \pi \times L_{bd} / 4$

⁽⁴⁾ For diamond core drilling

POST INSTALLED REBAR

Vario design method for rebar anchoring system for use with EPOBAR and EPOBAR+ resins

CHARACTERISTICS

EPOBAR

- EPOXY acrylate resin
- Fast cure time
- Storage time 18 months
- Usable in wet environments
- Cartridge compatible with standard injection gun

EPOBAR+

- Vinyl ester resin
- Fast cure time
- Storage time 18 months
- Usable in wet environments
- Performance in diamond drilling
- Cartridge compatible with standard injection gun

MECHANICAL CHARACTERISTICS OF REBARS

Nominal steel rebar Ø		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Sections	[cm ²]	0,503	0,785	1,13	1,54	2,01	3,14	4,91	8,04
Min. resistances to failure	[kN]	Fe E400	21,13	32,97	47,46	64,68	84,42	131,88	206,22
		Fe E500	25,90	40,43	58,20	79,31	103,52	161,71	252,87
Ultimate limit load N _{Rd}	[kN]	Fe E500	21,85	34,15	49,17	66,93	87,42	136,59	213,43

The mechanical characteristics of the high adhesion rebars are defined in the NFA 35-016 and NFA 35-017 standards.

SIZING RULES FOR STEEL REINFORCEMENT FIXINGS FOR CONCRETE USING THE VARIO DESIGN METHOD

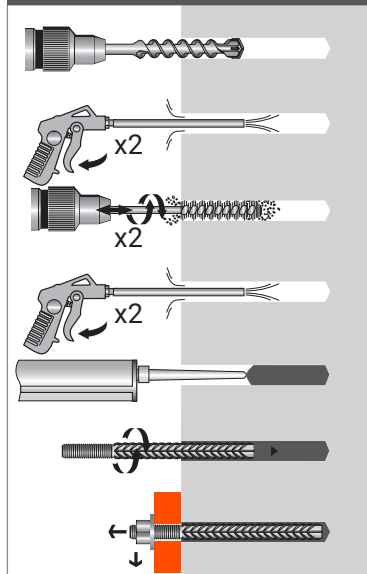
The VARIO adhesion design calculation can be used to determine the anchoring lengths in the case of application with large edge or spacing distances between bars, using the adhesive bond strength.

Tensile tests are generally performed on site to validate the steel failure of the rebar.

APPLICATION

- Post-installed rebars applications

INSTALLATION



* PREMIUM CLEANING:

- 2 blowing with compressed air
- 2 brushing with brushed fitted on a drilling machine
- 2 blowing with compressed air

CALCULATION METHOD

- **The Anchorage Length L_{bd}** shall be maximum embedment between Design anchorage length and Minimum anchorage length:

$$L_{bd} = \max[L_{b,rqd} ; L_{b,min}] \quad [\text{mm}] \quad (1)$$

- a) The design anchorage length $L_{b,rqd}$ is determined by the following equation:

$$L_{b,rqd} = (d_s/4) \cdot (\sigma_{sd}/f_{bd}) \quad [\text{mm}] \quad (1a)$$

with: σ_{sd} : Yield stress in bars [N/mm²]

d_s : Rebar diameter [mm]

f_{bd} : Design bond strength determined according to (2).

- b) $L_{b,min}$ is minimum anchorage length given in the ETA

- **The Design bond strength f_{bd}** shall be minimum bond strength:

$$f_{bd} = \min(f_{bd,sp} ; f_{bd,p}) \quad [\text{N/mm}^2] \quad (2)$$

- a) Bond strength for splitting resistance $f_{bd,sp}$ shall be determined by the equation:

$$f_{bd,sp} = f_{bd,pi} / \alpha_2 \quad [\text{N/mm}^2] \quad (2a)$$

with: $f_{bd,pi}$: Design bond strength [N/mm²] given in the ETA

α_2 factor takes account of the large cover and spacing depending on spacing rebars

S	7.d _s	8.d _s	9.d _s	10.d _s	12.d _s	15.d _s	18.d _s	20.d _s
α_2	0,70	0,63	0,58	0,53	0,47	0,38	0,33	0,29

- b) Bond strength for pull out resistance $f_{bd,p}$ shall be determined by the Equation :

$$f_{bd,p} = \tau_{RK,unc} / \gamma_{Mc} \quad [\text{N/mm}^2] \quad (2b)$$

with: $\tau_{RK,unc}$ and γ_{Mc} issue from ETA according to ETAG 001 Part5.



EPOBAR

VARIO DESIGN METHOD FOR STRAIGHT REBAR ANCHORING

Rebar Fe E500 size [mm]	Hole Ø [mm]	Design resistance in Tensile N _{Rd} [kN]	Spacing S [mm]	Length of anchorage L _{bd} [mm]						
				C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8	10	21,87	56	265	226	203	179	165	152	142
			64	240	204	184	162	149	138	128
			72	220	188	169	149	137	127	118
			80	201	171	154	136	125	115	109
			96	178	151	136	120	111	109	109
			120	143	129	121	113	109	109	109
			144	137	129	121	113	109	109	109
			≥160	137	129	121	113	109	109	109
10	12	34,13	70	331	282	253	224	206	190	177
			80	299	255	229	202	186	172	160
			90	275	234	211	186	171	158	147
			100	250	213	192	169	156	144	136
			120	222	189	170	150	138	136	136
			150	179	161	151	141	136	136	136
			180	172	161	151	141	136	136	136
			≥200	172	161	151	141	136	136	136
12	15	49,13	84	397	338	304	268	247	228	212
			96	359	306	275	243	223	206	192
			108	330	281	253	223	205	190	176
			120	300	256	230	203	187	173	163
			144	266	227	204	180	165	163	163
			180	215	194	181	169	163	163	163
			216	206	194	181	169	163	163	163
			≥240	206	194	181	169	163	163	163
14	18	66,96	98	463	395	355	313	288	266	248
			112	419	357	322	284	261	241	224
			126	385	328	295	261	239	222	206
			140	351	299	269	237	218	202	190
			168	311	265	238	210	201	195	190
			210	254	239	223	209	201	195	190
			252	254	239	223	209	201	195	190
			≥280	254	239	223	209	201	195	190
16	20	87,39	112	529	451	406	358	329	304	283
			128	479	408	367	324	298	275	256
			144	440	375	337	298	273	253	235
			160	401	341	307	271	249	236	229
			192	355	303	272	252	244	236	229
			240	307	289	269	252	244	236	229
			288	307	289	269	252	244	236	229
			≥320	307	289	269	252	244	236	229
20	25	136,52	140	661	563	507	447	411	380	354
			160	599	510	459	405	372	344	354
			180	550	468	422	372	345	334	354
			200	501	427	384	357	345	334	354
			240	444	409	381	357	345	334	354
			300	435	409	381	357	345	334	354
			360	435	409	381	357	345	334	354
			≥400	435	409	381	357	345	334	354
25	32	213,48	175	827	705	634	560	514	476	442
			200	827	705	634	560	514	476	442
			225	827	705	634	560	514	476	442
			250	827	705	634	560	514	476	442
			300	827	705	634	560	514	476	442
			375	827	705	634	560	514	476	442
			450	827	705	634	560	514	476	442
			≥500	827	705	634	560	514	476	442
32	40	349,57	224	1058	902	811	716	658	609	566
			256	1058	902	811	716	658	609	566
			288	1058	902	811	716	658	609	566
			320	1058	902	811	716	658	609	566
			384	1058	902	811	716	658	609	566
			480	1058	902	811	716	658	609	566
			576	1058	902	811	716	658	609	566
			≥640	1058	902	811	716	658	609	566



VARIO DESIGN METHOD FOR STRAIGHT REBAR ANCHORING

Rebar Fe E500 size [mm]	Hole Ø [mm]	Design resistance in Tensile N _{Rd} [kN]	Spacing S [mm]	Length of anchorage L _{bd} [mm]						
				C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8	10	21,87	56	265	226	203	179	165	152	142
			64	240	204	184	162	149	138	128
			72	220	188	169	149	137	127	118
			80	201	171	154	136	125	115	109
			96	178	151	136	120	111	109	109
			120	143	122	110	109	109	109	109
			144	124	109	109	109	109	109	109
			≥160	111	109	109	109	109	109	109
10	12	34,13	70	331	282	253	224	206	190	177
			80	299	255	229	202	186	172	160
			90	275	234	211	186	171	158	147
			100	250	213	192	169	156	144	136
			120	222	189	170	150	138	136	136
			150	179	153	137	136	136	136	136
			180	155	136	136	136	136	136	136
			≥200	139	136	136	136	136	136	136
12	15	49,13	84	397	338	304	268	247	228	212
			96	359	306	275	243	223	206	192
			108	330	281	253	223	205	190	176
			120	300	256	230	203	187	173	163
			144	266	227	204	180	165	163	163
			180	215	183	165	163	163	163	163
			216	186	163	163	163	163	163	163
			≥240	167	163	163	163	163	163	163
14	18	66,96	98	463	395	355	313	288	266	248
			112	419	357	322	284	261	241	224
			126	385	328	295	261	239	222	206
			140	351	299	269	237	218	202	190
			168	311	265	238	210	193	190	190
			210	251	214	192	190	190	190	190
			252	217	190	190	190	190	190	190
			≥280	195	190	190	190	190	190	190
16	20	87,39	112	529	451	406	358	329	304	283
			128	479	408	367	324	298	275	256
			144	440	375	337	298	273	253	235
			160	401	341	307	271	249	230	218
			192	355	303	272	240	221	218	218
			240	287	244	220	218	218	218	218
			288	248	218	218	218	218	218	218
			≥320	222	218	218	218	218	218	218
20	25	136,52	140	661	563	507	447	411	380	354
			160	599	510	459	405	372	344	320
			180	550	468	422	372	342	316	294
			200	501	427	384	339	311	288	272
			240	444	378	340	300	276	272	272
			300	358	305	275	272	272	272	272
			360	310	286	274	272	272	272	272
			≥400	296	286	274	272	272	272	272
25	32	213,48	175	827	705	634	560	514	476	442
			200	749	638	574	507	466	431	401
			225	688	586	527	465	428	395	368
			250	627	534	480	424	390	360	342
			300	555	473	426	376	355	348	342
			375	448	393	377	362	355	348	342
			450	408	393	377	362	355	348	342
			≥500	408	393	377	362	355	348	342
32	40	349,57	224	1058	902	811	716	658	609	566
			256	958	816	735	648	596	551	515
			288	880	750	675	595	547	524	515
			320	802	683	615	546	534	524	515
			384	710	605	567	546	534	524	515
			480	614	592	567	546	534	524	515
			576	614	592	567	546	534	524	515
			≥640	614	592	567	546	534	524	515