Designing anchors with HIT-RE 500 V3 using core drilled holes with large annular gap
Revised July 26, 2021

Hilti has published technical data for the Hilti HIT-RE 500 V3 adhesive anchoring system which can be used for post-installed threaded rod installations for anchor design in accordance with ACI 318 Chapter 17 and CSA A23.3 Annex D. Current published information is based on testing in accordance with ACI 355.4 and ICC-ES Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements, (AC308) and can be found in ESR-3814 and in section 3.2.3 of the Hilti North American Product Technical Guide Volume 2: Anchor Fastening Technical Guide, Edition 21 (PTG Ed. 21). The published values in ESR-3814 and the PTG Ed. 21 correspond to testing performed in accordance with the published Instructions for Use (IFU).

Hilti has performed additional testing in diamond core drilled holes with a core bit diameter, d_o, of 1.5 * d_a (d_a is the nominal threaded rod diameter) in accordance with ACI 355.4 and AC308. The design information presented in the tables below is based on this additional testing and the technical data in the tables is intended to be used in conjunction with a full anchor design in accordance with ACI 318 Chapter 17 or CSA A23.3 Annex D. See ESR-3814 and the PTG Ed. 21 for more design information for additional information that may be needed for a full design calculation. No testing has been performed in hammer drilled holes, however, using the assumptions below is expected to represent a conservative approach.

Hilti, Inc.
7250 Dallas Parkway, Suite 1000
Plano, TX 75024

1-800-879-8000
www.hilti.com

Table 1—Bond strength design information for HIT-RE 500 V3 with fractional threaded rods in holes core drilled with a diamond core bit in accordance with ACI 318 Chapter 17[1]

DESIGN INFORMATION			Symbol	Units	Nominal rod diameter (in.)						
					3/8	1/2	5/8	3/4	7/8	1	1-1/4
Maximum nominal core bit diameter			d_o	in.	9/16	3/4	7/8	1-1/8	1-1/4	1-1/2	1-7/8
Minimum embedment			$h_{ef,min}$	in.	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	5
Maximum embedment			$h_{ef,max}$	in.	7-1/2	10	12-1/2	15	17-1/2	20	25
Minimum member thickness			h_{min}	in.	h_{ef} + 1-1/4		h_{ef} + $2d_0$[7]				
Critical edge distance-splitting (for uncracked concrete)			c_{ac}	-	See Section 4.1.10 of ESR-3814						
Min. edge distance[6]			c_{min}	in	5d; or see Section 4.1.9 of this ESR-3814 for design with reduced minimum edge distances						
Min. anchor spacing[6]			s_{min}	in	1-7/8	2-1/2	3-1/8	3-3/4	4-3/8	5	6-1/4
Effectiveness factor for uncracked concrete			$k_{c,uncr}$	-	24						
Strength reduction factor for tension, concrete failure modes, Condition B[5]			ϕ	-	0.65						
Strength reduction factor for shear, concrete failure modes, Condition B[5]			ϕ	-	0.70						
Dry concrete & water saturated concrete	Temperature range A[2]	Characteristic bond strength in uncracked concrete – Short term load conditions[4]	$\tau_{k,uncr}$	psi	1,550	1,550	1,550	1,550	1,550	1,550	1,550
		Characteristic bond strength in uncracked concrete – Sustained load conditions[3]	$\tau_{k,uncr}$	psi	480	480	480	480	480	480	480
	Temperature range B[2]	Characteristic bond strength in uncracked concrete – Short term load conditions[4]	$\tau_{k,uncr}$	psi	730	730	730	730	730	730	730
		Characteristic bond strength in uncracked concrete – Sustained load conditions[3]	$\tau_{k,uncr}$	psi	230	230	230	230	230	230	230
	Anchor Category		-	-	2	2	3	3	3	3	3
	Strength Reduction factor		ϕ_d, ϕ_{ws}	-	0.55	0.55	0.45	0.45	0.45	0.45	0.45

For SI: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Bond strength values correspond to concrete compressive strength f'c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.25}$ for uncracked concrete [For SI: $(f'_c / 17.2)^{0.25}$]. See Section 4.1.4 of this ESR-3814 for bond strength determination.
[2] Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°C), Maximum long term temperature = 110°F (43°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
[3] Characteristic bond strength values are for sustained load combinations including dead and live loads.
[4] Characteristic bond strength values are for load combinations consisting of short term loads only, such as wind and seismic
[5] Values provided for post-installed anchors under Condition B without supplementary reinforcement.
[6] For installations with 1-3/4-inch edge distance, refer to Section 4.1.9 of ESR-3814 for spacing and maximum torque requirements.
[7] d_0 = hole diameter.

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Table 2—Bond strength design information for HIT-RE 500 V3 with fractional threaded rods in holes core drilled with a diamond core bit in accordance with CSA A23.3 Annex D[1]

DESIGN INFORMATION			Symbol	Units	Nominal rod diameter (in.)						
					3/8	1/2	5/8	3/4	7/8	1	1-1/4
Maximum nominal core bit diameter			d_o	in.	9/16	3/4	7/8	1-1/8	1-1/4	1-1/2	1-7/8
Minimum embedment			$h_{ef,min}$	mm	60	70	79	89	89	102	127
Maximum embedment			$h_{ef,max}$	mm	191	254	318	381	445	508	635
Minimum member thickness			h_{min}	mm	h_{ef} + 30		h_{ef} + $2d_0$[7]				
Critical edge distance-splitting (for uncracked concrete)			c_{ac}	-	See Section 4.1.10 of ESR-3814						
Min. edge distance[6]			c_{min}	mm	5d; or see Section 4.1.9 of ESR-3814 for design with reduced minimum edge distances						
Min. anchor spacing[6]			s_{min}	mm	48	64	79	95	111	127	159
Effectiveness factor for uncracked concrete			$k_{c,uncr}$	-	10						
Concrete material resistance factor			ϕ	-	0.65						
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]			R	-	1.00						
Dry concrete & water saturated concrete	Temperature range A[2]	Characteristic bond strength in uncracked concrete – Short term load conditions[4]	$\tau_{k,uncr}$	MPa	10.7	10.7	10.7	10.7	10.7	10.7	10.7
		Characteristic bond strength in uncracked concrete – Sustained load conditions[3]	$\tau_{k,uncr}$	MPa	3.3	3.3	3.3	3.3	3.3	3.3	3.3
	Temperature range B[2]	Characteristic bond strength in uncracked concrete – Short term load conditions[4]	$\tau_{k,uncr}$	MPa	5.0	5.0	5.0	5.0	5.0	5.0	5.0
		Characteristic bond strength in uncracked concrete – Sustained load conditions[3]	$\tau_{k,uncr}$	MPa	1.6	1.6	1.6	1.6	1.6	1.6	1.6
	Anchor Category		-	-	2	2	3	3	3	3	3
	Resistance modification factor for bond failure modes		R_d, R_{ws}	-	0.85	0.85	0.75	0.75	0.75	0.75	0.75

For SI: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.25}$ for uncracked concrete [For SI: $(f'_c / 17.2)^{0.25}$]. See Section 4.1.4 of ESR-3814 for bond strength determination.

[2] Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°C), Maximum long term temperature = 110°F (43°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time. Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short term loads only, such as wind and seismic, bond strengths may be increased by 320%.

[3] Characteristic bond strength values are for sustained load combinations including dead and live loads.

[4] Characteristic bond strength values are for load combinations consisting of short term loads only, such as wind and seismic

[5] Values provided for post-installed anchors under Condition B without supplementary reinforcement as defined in CSA A23.3 D.5.3.

[6] For installations with 1-3/4-inch edge distance, refer to Section 4.1.9 of ESR-3814 for spacing and maximum torque requirements.

[7] d_0 = hole diameter.

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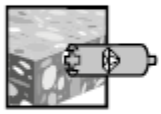
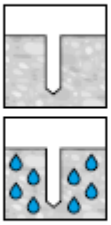
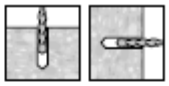
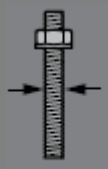
Supplemental instructions for use:

The following is intended to be a supplement to the attached Instructions for Use (IFU) for Hilti HIT-RE 500 V3 for core drilling with large annular gap as described above.

1. The following table is intended to supplement the instructions on page 5 of the attached IFU for holes drilled with a large annular gap. Refer to the instructions on the indicated page of the attached IFU for the condition indicated below.

Drilling method/concrete condition	Hole condition	Hole diameter	Embedment	Installation direction	IFU page
		7/16" ... 1 7/8"	2 3/8" ...10" 60...250 mm		
		7/16" ... 1 7/8"	2 3/8" ...25" 60...640 mm		
					

2. The following installation equipment should be used in lieu of the table shown on page 12.

Ø 	HAS 	 HIT-RB	 HIT-SZ	HIT-DL 
do [inch]	d [inch]	[inch]	[inch]	[inch]
9/16	3/8	9/16	9/16	9/16
3/4	1/2	3/4	3/4	3/4
7/8	5/8	7/8	7/8	7/8
1-1/8	3/4	1-1/8	1-1/8	1
1-1/4	7/8	1-1/4	1-1/4	1
1-1/2	1	1-1/2	1-1/2	1-3/8
1-7/8	1-1/4	1-7/8[1]	1-7/8[2]	1-3/8

[1] HIT-RB 1-7/8 brush is a special order item. Contact Hilti for more details.
[2] HIT-SZ 1-7/8 piston plug is a special order item. Contact Hilti for more details.

Please feel free to contact our Engineering Technical Services department for more information or any questions.

Hilti Engineering Technical Services – United States
(877) 749-6337 toll free

Hilti Engineering Technical Services – Canada
(800) 363-4458 toll free

Hilti, Inc.
7250 Dallas Parkway, Suite 1000
Plano, TX 75024

1-800-879-8000
www.hilti.com

hnatechnicalservices@hilti.com

CATechnicalServices@hilti.com

Hilti, Inc.
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Plano, TX 75024

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www.hilti.com