



ENGINEERING BASICS

Madavi Engineering Team
Apr 2023



فهرست مطالب

معرفی انکرهای مکانیکی و شیمیایی HILTI

▪ کاربرد انکر (anchor)

▪ کاربرد ریبار (rebar)

چگونه از FTM محصولات مهندسی استفاده کنیم؟

آشنایی با بخش ویژگی‌های محصول FTM

بتن ترک خورده / ترک نخورده

آئین‌نامه‌ها، دستورالعمل‌ها و گواهی‌ها

تاییدیه لرزه‌ای

انواع انکرهای هیلتی

از لحاظ نوع انکر

- انکرهای مکانیکی

1. انبساطی (Expansion)

2. اصطکاکی (Friction)

3. زیرچاکی (Under-cut)

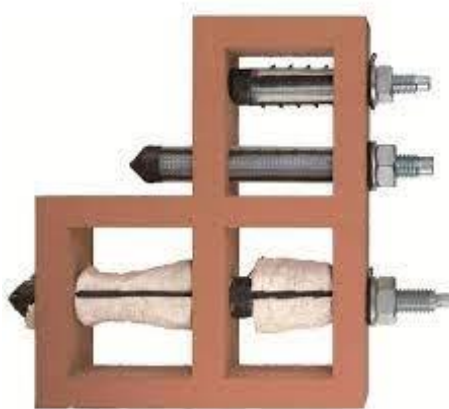
4. پیچی (Screw)

- انکرهای شیمیایی

1. پیوستگی (Bonding)

2. قفل شدگی (Keying)

- ترکیبی



کاربردهای انکرهای هیلتی

از لحاظ درجه اهمیت

- کاربردهای سازه‌ای
- کاربردهای غیر سازه‌ای

از لحاظ نوع اتصال

- اتصال بتن به بتن (ریبار – rebar)
- اتصال سازه فلزی به بتنی توسط بیس پلیت (انکر – anchor)

کاربردهای سازه‌ای



Steel jacking



Concrete jacking



Base plate



Bracing



Structural retrofitting



Overlaying

کاربردهای غیر سازه‌ای



MEP installation



Elevator structure



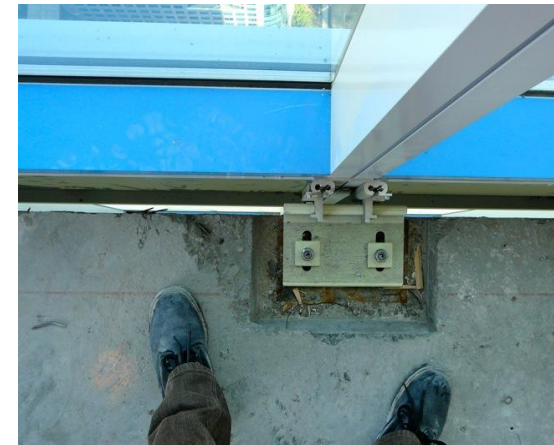
Wall post / wall tie



Equipment fixing



Suspended ceiling



Façade attachment

HST3 Expansion anchor

Ultimate-performance expansion anchor for cracked concrete and seismic

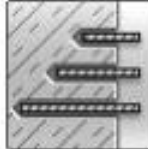
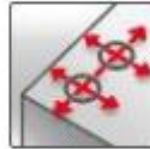
Anchor version		Benefits
	HST3 HST3-R (M8-M24)	- Ultimate resistance for reduced member thickness, short spacing and edge distances - Suitable for non-cracked and cracked concrete C 12/15 to C 80/95* - Highly reliable and safe anchor for structural seismic design with ETA C1/C2 assessment
	HST3 DN HST3-R DN (M8-M16)	- Longer embedment depth option to get higher resistance, closer distance to the edge or smaller spacing. - Full design flexibility with variable embedment depth and edge & spacing
	HST3 BW HST3-R BW (M8-M24)	- Faster and reliable installation thanks to approved non-cleaning and adaptive torquing tool. - Dome-nut version is available with adaptive tool qualification - Product and length identification mark facilitates quality control and inspection

بخش‌های مهم FTM

انکرهای مکانیکی

بخش‌های مهم FTM

انکرهای مکانیکی

Base material		Load conditions				
						
Concrete (non-cracked)	Concrete (cracked)	Static/ quasi-static	Seismic ETA-C1/C2	Fire resistance	Variable embedment depth	Small edge distance and spacing
Installation conditions			Other information			
						
Hammer drilled holes (with no cleaning)	Diamond drilled holes	Hollow drill- bit drilling	Impact wrench with adaptative torque module (M8-M16)	European Technical Assessment	CE conformity	PROFIS Engineering design software
						Corrosion resistance

Static and quasi-static loading (for a single anchor)

- All data in this section applies to:
- Correct setting (See setting instruction)
 - No edge distance and spacing influence
 - Steel failure
 - Minimum base material thickness
 - Concrete C 20/25, $f_{ck,cyl} = 20 \text{ N/mm}^2$ (EN 1992-4 design)

Effective anchorage depth for static

Anchor size		M8	M10	M12	M16	M20	M24
Approved variable embedment depth range ^{a)}	$h_{ef,min} - h_{ef,max}$ [mm]	47-90	40-100	50-125	65-160	101-180	125
Effective anchorage depth ^{b)}	h_{ef} [mm]	47	40 60	50 70	65 85	101	125

a) Variable embedment depth approved by ETA-98/0001 of 2021-05-04;
b) Standard embedment depth used for calculations of values below. For other embedment depths PROFIS Engineering can be used

Characteristic resistance

Anchor size				M8	M10		M12		M16		M20	M24
Non-cracked concrete												
Tension	HST3 (-BW, -DN)	N _{Rk}	[kN]	12,0	12,4	22,0	17,4	25,0	25,8	38,6	49,9	60,0
	HST3-R (-BW, -DN)			12,0	12,4	22,0	17,4	25,0	25,8	38,6	49,9	60,0
Shear	HST3 (-BW, -DN)	V _{Rk}	[kN]	13,8	21,9	23,6	34,0	35,4	54,5	55,3	83,9	94,0
	HST3-R (-BW, -DN)			15,7	25,6	25,3	31,1	36,7	48,6	63,6	97,2	115,0
Cracked concrete												
Tension	HST3 (-BW, -DN)	N _{Rk}	[kN]	8,0	8,7	15,0	12,2	20,0	18,0	27,0	35,0	40,0
	HST3-R (-BW, -DN)			8,5	8,7	15,0	12,2	20,0	18,0	27,0	35,0	40,0
Shear	HST3 (-BW, -DN)	V _{Rk}	[kN]	13,8	21,9	23,6	33,8	35,4	54,5	55,3	83,9	94,0
	HST3-R (-BW, -DN)			15,7	23,3	25,3	31,1	36,7	48,6	63,6	97,2	115,0

Design resistance

Anchor size				M8	M10		M12		M16		M20	M24
Non-cracked concrete												
Tension	HST3 (-BW, -DN)	N _{Rd}	[kN]	8,0	8,3	14,7	11,6	16,7	17,2	25,7	33,3	40,0
	HST3-R (-BW, -DN)			8,0	8,3	14,7	11,6	16,7	17,2	25,7	33,3	40,0
Shear	HST3 (-BW, -DN)	V _{Rd}	[kN]	11,0	17,5	18,9	27,2	28,3	43,6	44,2	67,1	62,7
	HST3-R (-BW, -DN)			12,6	20,5	20,2	24,9	29,4	38,9	50,9	77,8	88,5
Cracked concrete												
Tension	HST3 (-BW, -DN)	N _{Rd}	[kN]	5,3	5,8	10,0	8,1	13,3	12,0	18,0	23,3	26,7
	HST3-R (-BW, -DN)			5,7	5,8	10,0	8,1	13,3	12,0	18,0	23,3	26,7
Shear	HST3 (-BW, -DN)	V _{Rd}	[kN]	11,0	15,5	18,9	22,6	28,3	41,0	44,2	67,1	62,7
	HST3-R (-BW, -DN)			12,6	15,5	20,2	22,6	29,4	38,9	50,9	74,6	80,2

شرایط بارگذاری

فرضیات

محدوده عمق کاشت

مقاومت طراحی

بتن ترک نخورده/بتن ترک خورده

بخش‌های مهم FTM

انکرهای مکانیکی

Recommended loads^{a)}

Anchor size				M8	M10		M12		M16		M20	M24
Non-cracked concrete												
Tension	HST3 (-BW, -DN)	N _{Rec}	[kN]	5,7	5,9	10,5	8,3	11,9	12,3	18,4	23,8	28,6
	HST3-R (-BW, -DN)			5,7	5,9	10,5	8,3	11,9	12,3	18,4	23,8	28,6
Shear	HST3 (-BW, -DN)	V _{Rec}	[kN]	7,9	12,5	13,5	19,4	20,2	31,1	31,6	47,9	44,8
	HST3-R (-BW, -DN)			9,0	14,6	14,5	17,8	21,0	27,8	36,3	55,5	63,2
Cracked concrete												
Tension	HST3 (-BW, -DN)	N _{Rec}	[kN]	3,8	4,1	7,1	5,8	9,5	8,6	12,9	16,6	19,0
	HST3-R (-BW, -DN)			4,0	4,1	7,1	5,8	9,5	8,6	12,9	16,6	19,0
Shear	HST3 (-BW, -DN)	V _{Rec}	[kN]	7,9	11,1	13,5	16,1	20,2	29,3	31,6	47,9	44,8
	HST3-R (-BW, -DN)			9,0	11,1	14,5	16,1	21,0	27,8	36,3	53,3	57,3

a) With overall partial safety factor for action $\gamma = 1,4$. The partial safety factors for action depend on the type of loading and shall be taken from national regulations

بخش‌های مهم FTM

انکرهای مکانیکی

بار توصیه شده

بتن ترک نخورده/بتن ترک خورده

Design resistance

Anchor size				M8	M10	M12	M16	M20	M24			
Fire Exposure R30												
Tension	HST3 (-BW, -DN)	N _{Rd,fi}	[kN]	0,9	1,5	2,4	2,3	5,0	4,4	7,1	9,1	12,6
	HST3-R (-BW, -DN)			1,9	1,8	3,0	3,2	5,0	4,7	7,1	9,1	12,6
Shear	HST3 (-BW, -DN)	V _{Rd,fi}	[kN]	0,9	1,5	2,4	2,3	5,2	4,4	9,7	15,2	21,9
	HST3-R (-BW, -DN)			4,9	4,7	11,8	8,9	17,1	16,9	31,9	37,0	62,8
Fire Exposure R120												
Tension	HST3 (-BW, -DN)	N _{Rd,fi}	[kN]	0,6	0,8	0,9	0,8	1,3	1,5	2,4	3,8	5,4
	HST3-R (-BW, -DN)			1,5	1,5	2,4	2,5	4,0	3,8	5,6	7,3	10,1
Shear	HST3 (-BW, -DN)	V _{Rd,fi}	[kN]	0,6	0,8	0,9	0,8	1,3	1,5	2,4	3,8	5,4
	HST3-R (-BW, -DN)			1,7	2,0	3,3	3,3	4,8	6,2	9,0	14,1	20,3

For more information about different failure modes and fire resistance times please see the full ETA-98/0001 report

مقاومت طراحی در شرایط حریق

نیم ساعت و دو ساعت حریق

Materials

Mechanical properties

Anchor size			M8	M10	M12	M16	M20	M24
Nominal tensile strength	HST3 (-BW, -DN)	$f_{uk,thread}$ [N/mm ²]	800	800	800	720	700	530
	HST3-R (-BW, -DN)		720	710	710	650	650	650
Yield strength	HST3 (-BW, -DN)	$f_{yk,thread}$ [N/mm ²]	640	640	640	576	560	450
	HST3-R (-BW, -DN)		576	568	568	520	520	500
Stressed cross-section	A_s	[mm ²]	36,6	58,0	84,3	157	245	353
Moment of resistance	W	[mm ³]	31,2	62,3	109	277	541	935
Characteristic bending resistance	HST3 (-BW, -DN)	$M^0_{Rk,s}$ [Nm]	30	60	105	240	457	595
	HST3-R (-BW, -DN)		27	53	93	216	425	730

بخش‌های مهم FTM

انکرهای مکانیکی
مشخصات مصالح (گرید فولاد)

Material quality

Part		Material
Expansion sleeve	HST3 (-BW, -DN)	M10, M16: Galvanized or Stainless steel M8, M12, M20, M24: Stainless steel
	HST3-R (-BW, -DN)	Stainless steel A4
Bolt	HST3 (-BW, -DN)	Carbon steel, galvanized, coated (transparent)
	HST3-R (-BW, -DN)	Stainless steel A4, cone coated (transparent)
Washer	HST3 (-BW, -DN)	Galvanized
	HST3-R (-BW, -DN)	Stainless steel A4
Hexagon nut	HST3 (-BW)	Strength class 8
	HST3-R (-BW)	Stainless steel A4, coated
Dome nut	HST3 DN	Galvanized
	HST3-R DN	Stainless steel A4, coated

نوع پوشش در برابر خوردگی
برای بخش‌های مختلف

بخش‌های مهم FTM

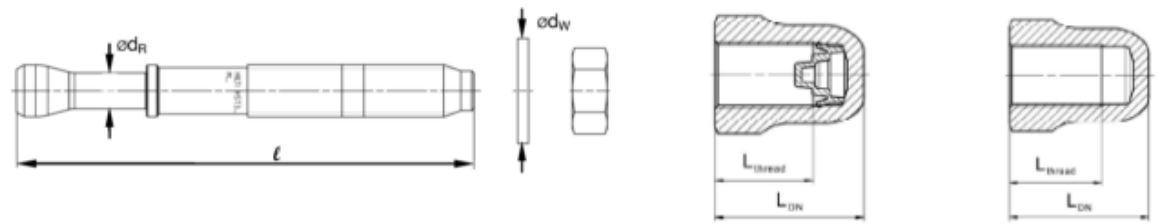
انکرهای مکانیکی

ابعاد انکر

جزئیات نصب انکرها

Anchor dimensions

Anchor size			M8	M10	M12	M16	M20	M24
Maximum length of anchor	$\ell_{max} \leq$	[mm]	260	280	350	475	450	500
Shaft diameter at the cone	d_R	[mm]	5,60	6,94	8,22	11,00	14,62	17,4
Length of expansion sleeve	ℓ_s	[mm]	13,6	16,0	20,0	25,0	28,3	36,0
Diameter of washer	$d_w \geq$	[mm]	15,57	19,48	23,48	29,48	36,38	43,38
Length of dome nut thread	$L_{thread} \geq$	[mm]	13,3	16,8	17,8	22,3	-	-
Length of dome nut	$L_{DN} \geq$	[mm]	18,1	21,9	24,0	29,5	-	-



Setting details

Anchor size			M8	M10	M12	M16	M20	M24
Nominal diameter of drill bit	d_o	[mm]	8	10	12	16	20	24
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45	10,45	12,5	16,5	20,55	24,55
Effective embedment depth	$h_{ef,1}$	[mm]	-	40-59	50-69	65-84	-	-
	$h_{ef,2}$	[mm]	47-90	60-100	70-125	85-160	101-180	125
Drill hole depth ^{1) 3)}	$h_{1,1} \geq$	[mm]	-	$h_{ef}+13$	$h_{ef}+18$	$h_{ef}+21$	-	-
	$h_{1,2} \geq$	[mm]	$h_{ef}+12$	$h_{ef}+13$	$h_{ef}+18$	$h_{ef}+21$	$h_{ef}+23$	151
Nominal embedment depth	$h_{nom,1}$	[mm]	-	$h_{ef}+8$	$h_{ef}+10$	$h_{ef}+13$	-	-
	$h_{nom,2}$	[mm]	$h_{ef}+7$	$h_{ef}+8$	$h_{ef}+10$	$h_{ef}+13$	$h_{ef}+15$	143
Maximum diameter of clearance hole in the fixture ²⁾	d_f	[mm]	9	12	14	18	22	26
Torque moment	T_{inst}	[Nm]	20	45	60	110	180	300
Maximum thickness of fixture	$t_{fix,max}$	[mm]	195	220	270	370	310	330
Width across	SW	[mm]	13	17	19	24	30	36

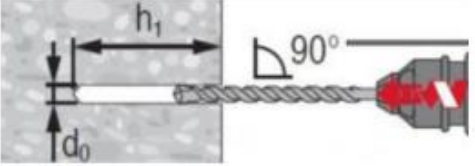
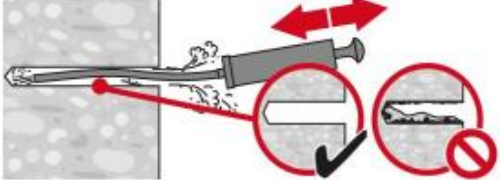
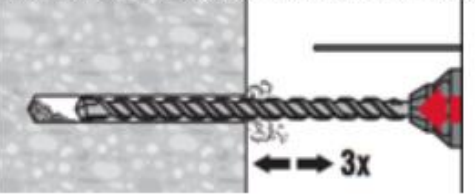
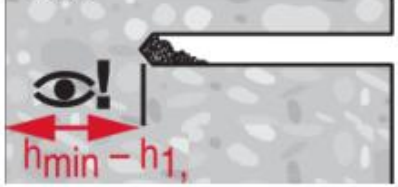
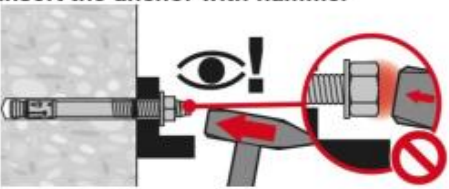
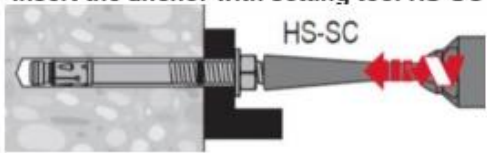
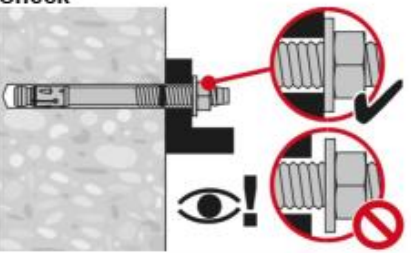
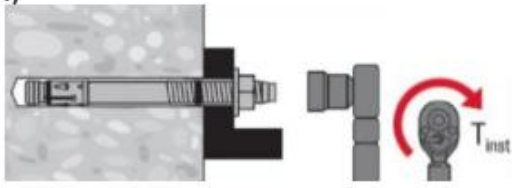
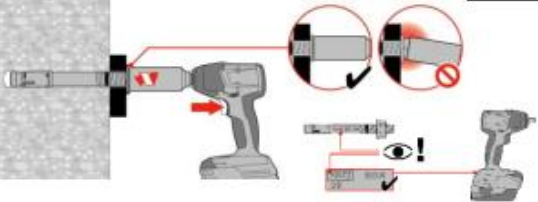
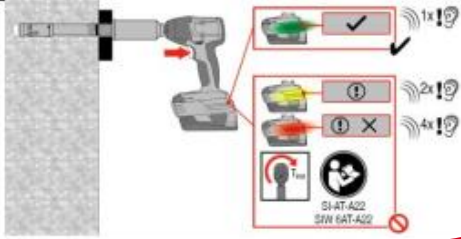
Setting parameters of HST3 (-BW, -DN) / HST3-R (-BW, -DN) for M8 and M10*								
Anchor Size		M8			M10			
Concrete class		C20/25 to C50/60 ^{a)} C55/67 to C80/95 ^{b)}		C12/15 ^{b)} C16/20 ^{b)}	C20/25 to C50/60 ^{a)}	C20/25 to C50/60 ^{a)} C55/67 to C80/95 ^{b)}		C12/15 ^{b)} C16/20 ^{b)}
Effective anchorage depth	h_{ef} [mm]	47		47	40	60		60
Minimum base material thickness	h_{min} [mm]	80	100	100	80	100	120	120
Minimum spacing in non-cracked concrete	s_{min} [mm]	35	35	35	50	40	40	70
	for $c \geq$ [mm]	70	55	65	65	90	75	90
Minimum spacing in cracked concrete	s_{min} [mm]	35	35	35	40	40	40	45
	for $c \geq$ [mm]	55	40	55	50	70	55	85
Minimum edge distance in non-cracked concrete	c_{min} [mm]	45	40	50	50	60	50	80
	for $s \geq$ [mm]	110	80	80	95	130	110	120
Minimum edge distance in cracked concrete	c_{min} [mm]	40	40	40	45	50	45	70
	for $s \geq$ [mm]	70	35	75	55	90	65	120
Critical spacing for splitting failure and concrete cone failure	$s_{cr,sp}$ [mm]	141		188	168	180		240
	$s_{cr,N}$ [mm]	141		141	120	180		180
Critical edge distance for splitting failure and concrete cone failure	$c_{cr,sp}$ [mm]	71		94	84	90		120
	$c_{cr,N}$ [mm]	71		71	60	90		90

بخش‌های مهم FTM

انکرهای مکانیکی

فواصل بحرانی/فواصل حداقل

فواصل انکرها از هم/فواصل انکرها از لبه

Setting instruction for HST3 (-BW, -DN) / HST3-R (-BW, -DN) ^{a)}	
Hammer drilling (M8, M10, M12, M16, M20, M24)	
1. Drill the hole (+12 mm for non-cleaned holes)	2a. Clean the hole
	
2bi. Move the drill bit in & out (non-cleaned hole)	2bii. Check
	
3a. Insert the anchor with hammer	3b. Insert the anchor with setting tool HS-SC
	
4. Check	5a. Torque with calibrated torque wrench (M8-M24)
	
5b. Torque with impact wrench with Adaptive torque module (M8-M16) ^{b)}	
	

بخش‌های مهم FTM

انکرهای مکانیکی

روش اجرا

نوع کاربرد
انکر با استفاده از راد

انواع راد

HIT-HY 200-R V3 injection mortar
Anchor design (EN 1992-4) / Rods and Sleeves / Concrete

Injection mortar system		Benefits
	Hilti HIT-HY 200-R V3 500 ml foil pack (also available as 330 ml foil pack)	- SafeSet technology: Simplified method of borehole preparation using either Hilti hollow drill bit for hammer drilling or Roughening tool for diamond cored applications
	Anchor rod: HAS-U HAS-U HDG HAS-U A4 HAS-U HCR (M8-M30)	- Suitable for uncracked and cracked concrete C 20/25 to C 50/60
	Internally threaded sleeve: HIS-N HIS-RN (M8-M20)	- ETA Approved for seismic performance category C1, C2 ^{a)}
	Anchor rod: HIT-Z HIT-Z-F HIT-Z-R (M8-M20)	- Maximum load performance in cracked concrete and uncracked concrete
	Anchor rod: HAS-D (M12-M20)	- High corrosion / corrosion resistance ^{b)}
		- Small edge distance and anchor spacing possible
		- Manual cleaning for borehole diameter up to 20mm and $h_{ef} \leq 10d$ for uncracked concrete only
		- 100 years service lifetime resistance

HIT-HY 200-R V3 injection mortar

Anchor design (EN 1992-4) / Rebar elements / Concrete

Injection mortar system

Benefits

- SafeSet technology: Simplified method of borehole preparation using either Hilti hollow drill bit for hammer drilling or Roughening tool for diamond cored applications
- Assessed following the EAD 330499-00-0601.
- ETA seismic approval C1
- Suitable for cracked and uncracked concrete C 12/15 to C 50/60
- Suitable for dry and water saturated concrete
- In service temperature range up to 120°C short term / 72°C long term
- Large diameter applications

Hilti HIT-HY 200-R V3

330 ml foil pack (also available as 500 ml foil pack)

Rebar B500 B (φ8 - φ32)

نوع کاربرد

انکر با استفاده از آرماتور

HIT-HY 200-R V3 injection mortar

Rebar design (EN 1992-1-1, EOTA TR 069) / Rebar elements / Concrete

Injection mortar system

Benefits

- SafeSet technology: Simplified method of borehole preparation using either Hilti hollow drill bit for hammer drilling or Roughening tool for diamond cored applications
- HY 200-R V3 version is formulated for best handling and cure time specifically for rebar applications
- Suitable for concrete C 12/15 to C 50/60
- Suitable for dry and water saturated concrete
- For rebar diameters up to 40 mm for static design acc. to EN 1992-1-1
- Non corrosive to rebar elements
- Good load capacity at elevated temperatures
- Suitable for embedment length up to 1000 mm
- Suitable for applications down to -10 °C

Hilti HIT-HY 200-R V3

330 ml foil pack (also available as 500 ml foil pack)

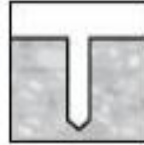
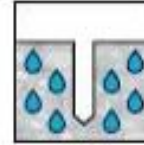
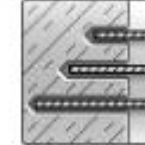
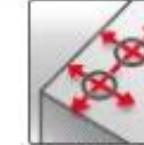
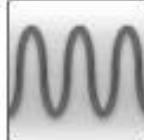
Rebar (φ8 - φ40)

نوع کاربرد

ریبار با استفاده از آرماتور

بخش‌های مهم FTM

انکرهای شیمیایی

Base material				Installation conditions				
								
Concrete (uncracked)	Concrete (cracked)	Dry concrete	Wet concrete	Hilti SafeSet technology	Diamond drilled holes ^{c)}	Hammer drilled holes	Variable embedment depth	Small edge distance and spacing
Load conditions			Other information					
								
Static/quasi-static	Seismic, ETA-C1, C2 ^{a)}	Fatigue ETA ^{d)}	European Technical Assessment	100 Years Design Life	CE conformity	Corrosion resistance ^{b)}	High corrosion resistance ^{b)}	PROFIS Engineering design Software

All data in this section applies to:

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Steel failure
- Minimum base material thickness
- Embedment depth, as specified in the table
- Anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube} = 25 \text{ N/mm}^2$
- in-service temperature range I
(min. base material temp. -40°C , max. long/short term base material temp.: $+24^\circ\text{C}/40^\circ\text{C}$)
- Short term loading. For long term loading please apply $\psi_{sus} = 0.74$.

شرایط بارگذاری

فرضیات

بخش‌های مهم FTM

انکرهای شیمیایی

For hammer drilled holes, hammer drilled holes with Hilti hollow drill bit:

Embedment depth ¹⁾ and base material thickness

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
HAS-U									
Embedment depth	h_{ef} [mm]	80	90	110	125	170	210	240	270
Base material thickness	h [mm]	110	120	140	160	220	270	300	340
HIS-N									
Embedment depth	h_{ef} [mm]	90	110	125	170	205	-	-	-
Base material thickness	h [mm]	120	150	170	230	270	-	-	-
HIT-Z									
Embedment depth	h_{ef} [mm]	70	90	110	145	180	-	-	-
Base material thickness	h [mm]	130	150	170	245	280	-	-	-
HAS-D									
Embedment depth	h_{ef} [mm]	-	-	100	125	170	-	-	-
Base material thickness	h [mm]	-	-	130	160	220	-	-	-

عمق موثر/حداقل ضخامت بتن

Design resistance				M8	M10	M12	M16	M20	M24	M27	M30
Anchor size											
Uncracked concrete											
Tension	HAS-U 5.8	N _{Rd}	[kN]	12,2	19,3	28,1	45,8	72,7	99,8	121,9	145,5
	HAS-U 8.8			19,5	28,0	37,8	45,8	72,7	99,8	121,9	145,5
	HAS-U A4			13,7	21,7	31,6	45,8	72,7	99,8	80,2	98,1
	HAS-U HCR			19,5	28,0	37,8	45,8	72,7	99,8	121,9	145,5
	HIS-N 8.8			16,7	30,7	44,7	72,7	77,3	-	-	-
	HIT-Z ^{a)}			16,0	25,3	33,3	57,3	79,2	-	-	-
	HAS-D			-	-	32,8	45,8	72,7	-	-	-
Shear	HAS-U 5.8	V _{Rd}	[kN]	8,8	13,9	20,2	37,7	58,8	84,7	110,2	134,6
	HAS-U 8.8			11,7	18,6	27,0	50,2	78,4	113,0	146,9	179,5
	HAS-U A4			8,2	13,0	18,9	35,2	55,0	79,2	48,2	58,9
	HAS-U HCR			11,7	18,6	27,0	50,2	78,4	70,6	91,8	112,2
	HIS-N 8.8			10,4	18,4	27,2	50,4	46,4	-	-	-
	HIT-Z ^{a)}			9,6	15,2	21,6	38,4	58,4	-	-	-
	HAS-D			-	-	27,2	50,4	119,2	-	-	-
Cracked concrete											
Tension	HAS-U 5.8	N _{Rd}	[kN]	10,0	14,1	23,5	32,1	50,9	69,9	85,4	101,8
	HAS-U 8.8			10,0	14,1	23,5	32,1	50,9	69,9	85,4	101,8
	HAS-U A4			10,0	14,1	23,5	32,1	50,9	69,9	80,2	98,1
	HAS-U HCR			10,0	14,1	23,5	32,1	50,9	69,9	85,4	101,8
	HIS-N 8.8			16,5	26,5	32,1	50,9	67,4	-	-	-
	HIT-Z ^{a)}			13,4	19,6	26,5	40,1	55,4	-	-	-
	HAS-D			-	-	22,9	32,1	50,9	-	-	-
Shear	HAS-U 5.8	V _{Rd}	[kN]	8,8	13,9	20,2	37,7	58,8	84,7	110,2	134,6
	HAS-U 8.8			11,7	18,6	27,0	50,2	78,4	113,0	146,9	179,5
	HAS-U A4			8,2	13,0	18,9	35,2	55,0	79,2	48,2	58,9
	HAS-U HCR			11,7	18,6	27,0	50,2	78,4	70,6	91,8	112,2
	HIS-N 8.8			10,4	18,4	27,2	50,4	46,4	-	-	-
	HIT-Z ^{a)}			9,6	15,2	21,6	38,4	58,4	-	-	-
	HAS-D			-	-	27,2	50,4	101,8	-	-	-

بخش‌های مهم FTM

انکرهای شیمیایی

مقاومت طراحی

بتن ترک نخورده/بتن ترک خورده

Mechanical properties for HAS-U

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal tensile strength	HAS-U 5.8	f_{uk} [N/mm ²]	500	500	500	500	500	500	-	-
	HAS-U 8.8 (HDG)		800	800	800	800	800	800	800	800
	AM 8.8 (HDG)		700	700	700	700	700	700	500	500
	HAS-U A4		800	800	800	800	800	700	-	-
Yield strength	HAS-U HCR	f_{yk} [N/mm ²]	440	440	440	440	400	400	-	-
	HAS-U 5.8		640	640	640	640	640	640	640	640
	HAS-U 8.8 (HDG)		450	450	450	450	450	450	210	210
	AM 8.8 (HDG)		640	640	640	640	640	400	-	-
Stressed cross-section	HAS-U	A_s [mm ²]	36,6	58,0	84,3	157	245	353	459	561
Moment of resistance	HAS-U	W [mm ³]	31,2	62,3	109	277	541	935	1387	1874

Setting information

Installation temperature:

- 10 °C to +40 °C (for HAS-U, HAS-D, HIS-N)
- +5 °C to +40 °C (for HIT-Z, HIT-Z-D)

In service temperature range

Hilti HIT-HY 200-R V3 injection mortar with anchor rod HAS-U / HIS-(R)N may be applied in the temperature ranges given below. An elevated base material temperature leads to a reduction of the design bond resistance.

Temperature in the base material

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +80 °C	+50 °C	+80 °C
Temperature range III	-40 °C to +120 °C	+72 °C	+120 °C

بخش‌های مهم FTM

انکرهای شیمیایی

مشخصات مصالح (گرید فولاد) رادها

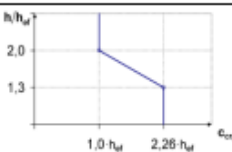
محدوده‌های دمایی نصب

Curing and working time

Temperature of the base material	HIT-HY 200-R V3	
	Maximum working time	Minimum curing time
T_{BM}	t_{work}	t_{cure}
$-10^{\circ}\text{C} < T_{BM} \leq -5^{\circ}\text{C}$ a)	3 h	20 h
$-5^{\circ}\text{C} < T_{BM} \leq 0^{\circ}\text{C}$ a)	1,5 h	8 h
$0^{\circ}\text{C} < T_{BM} \leq 5^{\circ}\text{C}$ a)	45 min	4 h
$5^{\circ}\text{C} < T_{BM} \leq 10^{\circ}\text{C}$	30 min	2,5 h
$10^{\circ}\text{C} < T_{BM} \leq 20^{\circ}\text{C}$	15 min	1,5 h
$20^{\circ}\text{C} < T_{BM} \leq 30^{\circ}\text{C}$	9 min	1 h
$30^{\circ}\text{C} < T_{BM} \leq 40^{\circ}\text{C}$	6 min	1 h

a) Installation of HIT-Z, HIT-Z-D only in range $+5^{\circ}\text{C}$ to $+40^{\circ}\text{C}$

Setting details for HAS II

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	22	28	30	35
Effective embedment depth (= drill hole depth) ^{a)}	$h_{ef,min} = h_0$	[mm]	60	60	70	80	90	96	108	120
	$h_{ef,max} = h_0$	[mm]	160	200	240	320	400	480	540	600
Minimum base material thickness	h_{min}	[mm]	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$			$h_{ef} + 2 d_0$				
Maximum diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22	26	30	33
Thickness of Hilti filling set	h_{fs}	[mm]	-	-	-	11	13	15	-	-
Effective fixture thickness with Hilti filling set	$t_{fix,eff}$	[mm]	$t_{fix} - h_{fs}$							
Maximum torque moment ^{b)}	T_{max}	[Nm]	10	20	40	80	150	200	270	300
Minimum spacing	s_{min}	[mm]	40	50	60	75	90	115	120	140
Minimum edge distance	c_{min}	[mm]	40	45	45	50	55	60	75	80
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2 C_{cr,sp}$							
Critical edge distance for splitting failure ^{c)}	$C_{cr,sp}$	[mm]	$1,0 \cdot h_{ef}$		for $h / h_{ef} \geq 2,00$					
			$4,6 h_{ef} - 1,8 h$		for $2,0 > h / h_{ef} > 1,3$					
			$2,26 h_{ef}$		for $h / h_{ef} \leq 1,3$					
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	$2 C_{cr,N}$							
Critical edge distance for concrete cone failure	$C_{cr,N}$	[mm]	$1,5 h_{ef}$							

بخش‌های مهم FTM

انکرهای شیمیایی

زمان کارپذیری/زمان گیرش

عمق کاشت حداقل/حداکثر

حداقل ضخامت مورد نیاز بتن

حداکثر گشتاور نصب مهره

فواصل بحرانی/فواصل حداقل

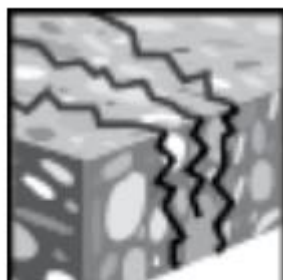
فواصل انکرها از هم/فواصل انکرها از لبه

بخش ویژگی‌های محصول FTM

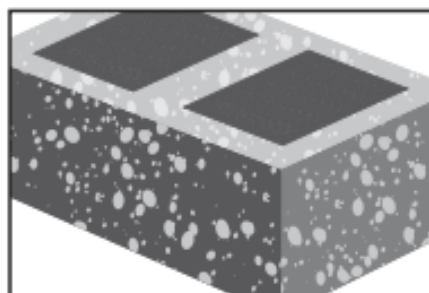
مصالح پایه (Base material)



Concrete
(uncracked)



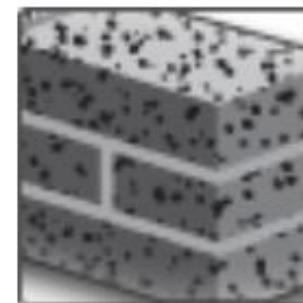
Concrete
(cracked)



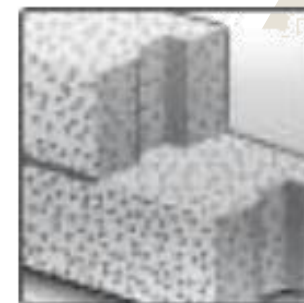
Grout-filled
concrete masonry



Hollow core
slabs



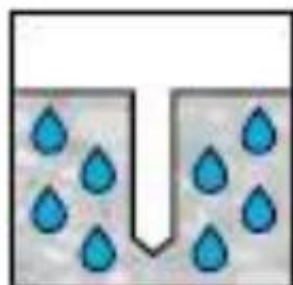
Solid brick



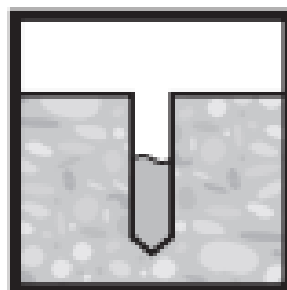
Autoclaved
aerated
concrete



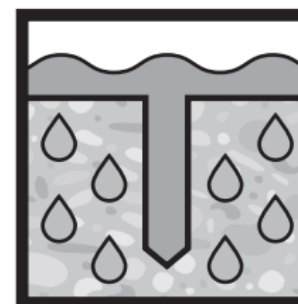
Dry concrete



Wet concrete



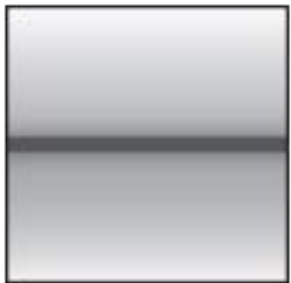
Water-filled
holes



Submerged
(underwater)

بخش ویژگی‌های محصول FTM

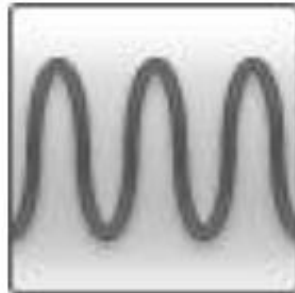
شرایط بارگذاری (Load condition)



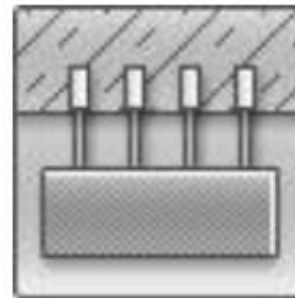
Static/
quasi-static



Seismic



Fatigue
ETA^{d)}



Redundant
fastening



Fire
resistance

100
YEARS

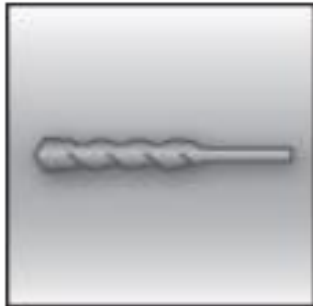
Working life
100 years,

بخش ویژگی‌های محصول FTM

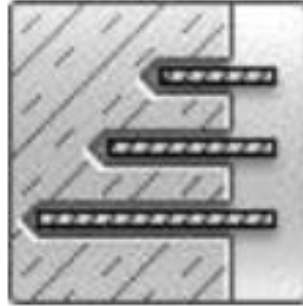
شرایط نصب (Installation condition)



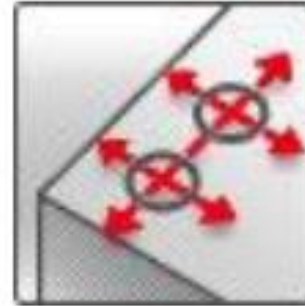
Diamond
drilled holes
c)



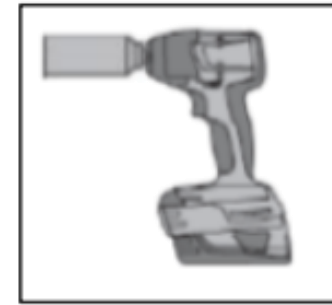
Hammer
drilled holes



Variable
embedment
depth



Small edge
distance
and
spacing



Impact wrench
with adaptative
torque module
(M8-M16)



Hilti
SafeSet
technology

بخش ویژگی‌های محصول FTM

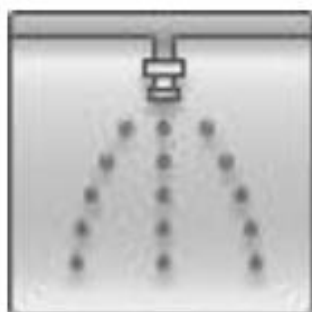
سایر اطلاعات (Other information)



Corrosion
resistance^{b)}



High
corrosion
resistance^{b)}



Sprinkler
approved



European
Technical
Assessment



CE
conformity

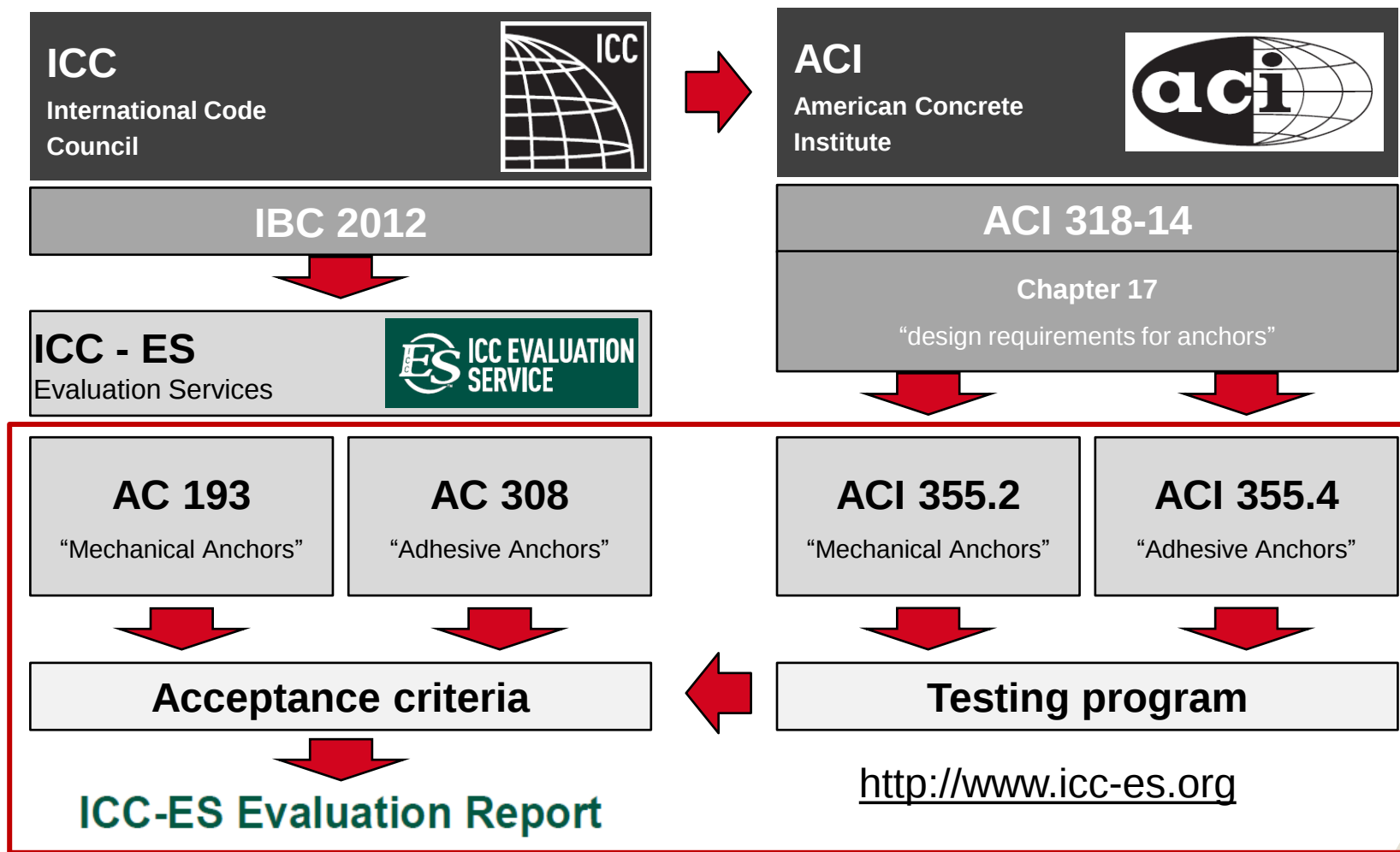


PROFIS
Engineering
design
Software



DIBt
Approval
Reusability

آشنایی با پروسه تست و تاییدیه آمریکا



آشنایی با پروسه تست و تاییدیه اروپا

	 Static loads	 Seismic loads 
Action	Load definition	EN 1991-1 (Eurocode 1) EN 1998-1:2004 (Eurocode 8)
Anchor resistance	Qualification (Testing)	ETAG 001 ETAG 001, Annex E
	Technical data (Approval)	European Technical Approval: ETA
	Design Method	ETAG 001, Annex C EOTA 029 EOTA TR045

مقایسه ضوابط و پروسه ارزیابی لرزه ای

		 US	 Europe
Action Anchor resistance	Load definition	(ASCE 7)	(Euro code 8)
	Qualification ("testing")	ACI 355.4 with ICC-ES AC193/AC308	ETAG 001, Annex E
	Technical data ("approval")	↓ ICC-ES Evaluation Service Report: ESR	↓ European Technical Approval: ETA
	Design method	↓ ACI 318-14 chapter 17	↓ EOTA TR045

THANK YOU

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