HVZ (HVU-TZ + HAS-TZ) adhesive anchor system

Mortar system		Benefits
	Hilti HVU-TZ foil capsule	- suitable for cracked and non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete
	HAS-TZ HAS-R-TZ HAS-HCR-TZ rod	

Concrete | Tensile zone | Fire resistance | Fatigue | Shock | A4 316 Corrosion resistance | HCR highMo High corrosion resistance | European Technical Approval | CE conformity

European Technical Approval | CE conformity | PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-03/0032 / 2013-06-04
Approval for shockproof fastenings in civil defence installations	Federal Office for Cicil Protection, Bern	BZS D 09-602 / 2009-10-28
Fatigue loading	DIBt, Berlin	Z-21.3-1692 / 2013-07-19
Fire test report ZTV-Tunnel	IBMB, Braunschweig	UB 3357/0550-2 / 2001-06-26
Fire test report	IBMB, Brunswick	UB 3357/0550-1 / 2001-04-17
Assessment report (fire)	warringtonfire	WF 327804/B / 2013-07-10

a) All data given in this section according ETA-03/0032, issue 2013-06-04.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- Embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +50°C/80°C)
- Installation temperature range 0°C to +40°C

Embedment depth and base material thickness for the basic loading data.
Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M10x75	M12x95	M16x105	M16x125	M20x170
Embedment depth [mm]	75	95	105	125	170
Base material thickness [mm]	150	190	210	250	340

Mean ultimate resistance a): concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HVZ

	Data according ETA-03/0032, issue 2013-06-04				
Anchor size	**M10x75**	**M12x95**	**M16x105**	**M16x125**	**M20x170**
Non cracked concrete					
Tensile $N_{Ru,m}$ HVZ [kN]	*36,8*	*53,3*	72,4	94,1	149,2
Shear $V_{Ru,m}$ HVZ [kN]	*18,9*	*28,4*	*53,6*	*53,6*	*92,4*
Cracked concrete					
Tensile $N_{Ru,m}$ HVZ [kN]	31,2	44,4	51,6	67,1	106,4
Shear $V_{Ru,m}$ HVZ [kN]	*18,9*	*28,4*	*53,6*	*53,6*	*92,4*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HVZ

	Data according ETA-03/0032, issue 2013-06-04				
Anchor size	**M10x75**	**M12x95**	**M16x105**	**M16x125**	**M20x170**
Non cracked concrete					
Tensile N_{Rk} HVZ [kN]	32,8	40,0	54,3	70,6	111,9
Shear V_{Rk} HVZ [kN]	*18,0*	*27,0*	*51,0*	*51,0*	*88,0*
Cracked concrete					
Tensile N_{Rk} HVZ [kN]	23,4	33,3	38,7	50,3	79,8
Shear V_{Rk} HVZ [kN]	*18,0*	*27,0*	*51,0*	*51,0*	*88,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HVZ

	Data according ETA-03/0032, issue 2013-06-04				
Anchor size	**M10x75**	**M12x95**	**M16x105**	**M16x125**	**M20x170**
Non cracked concrete					
Tensile N_{Rd} HVZ [kN]	21,9	26,7	36,2	47,1	74,6
Shear V_{Rd} HVZ [kN]	14,4	21,6	40,8	40,8	70,4
Cracked concrete					
Tensile N_{Rd} HVZ [kN]	15,6	22,2	25,8	33,5	53,2
Shear V_{Rd} HVZ [kN]	14,4	21,6	40,8	40,8	70,4

Recommended loads a): concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HVZ

	Data according ETA-03/0032, issue 2013-06-04				
Anchor size	**M10x75**	**M12x95**	**M16x105**	**M16x125**	**M20x170**
Non cracked concrete					
Tensile N_{rec} HVZ [kN]	15,6	19,0	25,9	33,6	53,3
Shear V_{rec} HVZ [kN]	10,3	15,4	29,1	29,1	50,3
Cracked concrete					
Tensile N_{rec} HVZ [kN]	11,1	15,9	18,4	24,0	38,0
Shear V_{rec} HVZ [kN]	10,3	15,4	29,1	29,1	50,3

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

Service temperature range

Hilti HVZ adhesive anchor with anchor rod HAS-TZ may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HAS-TZ

			Data according ETA-03/0032, issue 2013-06-04				
Anchor size			M10x75	M12x95	M16x105	M16x125	M20x170
Nominal tensile strength f_{uk}	HAS-(R) (HCR)TZ	[N/mm²]	800				
Yield strength f_{yk}	HAS-(R) (HCR)TZ	[N/mm²]	640				
Stressed cross-section A_s	tension	[mm²]	44,2	63,6	113	113	227
	shear	[mm²]	50,3	73,9	141	141	245
Moment of resistance W	HAS-(R) (HCR)TZ	[mm³]	50,3	89,6	236	236	541

Material quality

Part	Material
HAS-TZ	carbon steel strength class 8.8
HAS-R-TZ	stainless steel 1.4401 and 1.4571
HAS-HCR-TZ	high corrosion resistance steel 1.4529 and 1.4547

Anchor dimensions

Anchor size		M10x75	M12x95	M16x105	M16x125	M20x170
Anchor embedment depth	[mm]	75	95	105	125	170

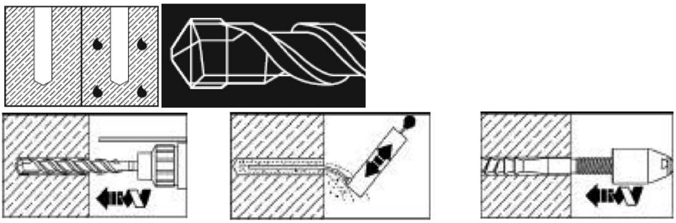
Setting

installation equipment

Anchor size	M10x75	M12x95	M16x105	M16x125	M20x170
Rotary hammer	TE 1 – TE 30		TE 1 – TE 60		TE 30 – TE 80
Tools	Setting tools				

Setting instruction

Dry and water-saturated concrete, hammer drilling



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

For technical data for anchors in diamond drilled holes please contact the Hilti Technical advisory service.

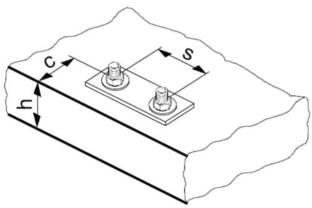
Curing time for general conditions

Data according ETA-03/0032, issue 2013-06-04	
Temperature of the base material	**Curing time before anchor can be fully loaded t_{cure}**
≥ 20 °C	20 min
10 °C to 20 °C	30 min
0 °C to 10 °C	60 min

These data are valid for dry concrete only. In wet concrete the curing time must be doubled.

Setting details

			Data according ETA-03/0032, issue 2013-06-04				
Anchor size			**M10x75**	**M12x95**	**M16x105**	**M16x125**	**M20x170**
Nominal diameter of drill bit	d_0	[mm]	12	14	18	18	25
Diameter of element	d	[mm]	10	12	16	16	20
Effective anchorage depth	h_{ef}	[mm]	75	95	105	125	170
Drill hole depth	h_1	[mm]	90	110	125	145	195
Minimum base material thickness	h_{min} [a]	[mm]	150	190	210	250	340
Diameter of clearance hole in the fixture	d_f	[mm]	12	14	18	18	22
Cracked concrete							
Minimum spacing	s_{min}	[mm]	50	60	70	70	80
Minimum edge distance	c_{min}	[mm]	50	60	70	70	80
Non cracked concrete							
Minimum spacing	s_{min}	[mm]	50	60	70	70	80
Minimum edge distance	c_{min}	[mm]	50	70	85	85	80
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$				
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	$1{,}5\ h_{ef}$				
Critical spacing for concrete cone failure	$s_{cr,N}$		$2\ c_{cr,N}$				
Critical edge distance for concrete cone failure	$c_{cr,N}$ [b]		$1{,}5\ h_{ef}$				
Torque moment [c]	T_{max}	[Nm]	40	50	90	90	150



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) h: base material thickness ($h \geq h_{min}$)

b) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

c) This is the maximum recommended torque moment to avoid splitting failure during installation for anchors with minimum spacing and/or edge distance.

Simplified design method

Simplified version of the design method according ETAG 001, Annex C. Design resistance according data given in ETA-03/0032, issue 2013-06-04.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, Annex C. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

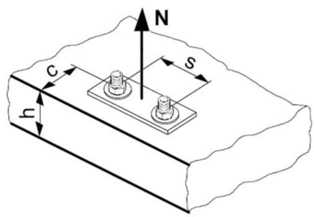
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{h,p}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

	Data according ETA-03/0032, issue 2013-06-04				
Anchor size	**M10x75**	**M12x95**	**M16x105**	**M16x125**	**M20x170**
$N_{Rd,s}$ HAS-TZ, HAS-R-TZ, HAS-HCR-TZ [kN]	23,3	34,0	60,0	60,0	121,3

Design combined pull-out and concrete cone resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{h,p}$

	Data according ETA-03/0032, issue 2013-06-04				
Anchor size	**M10x75**	**M12x95**	**M16x105**	**M16x125**	**M20x170**
Embedment depth h_{ef} [mm]	75	95	105	125	170
Non cracked concrete					
$N^0_{Rd,p}$ Temperature range I [kN]	21,9	26,7	36,2	47,1	74,6
Cracked concrete					
$N^0_{Rd,p}$ Temperature range I [kN]	15,6	22,2	25,8	33,5	53,2

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$

Design splitting resistance [a] $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{h,N} \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{re,N}$

	Data according ETA-03/0032, issue 2013-06-04				
Anchor size	**M10x75**	**M12x95**	**M16x105**	**M16x125**	**M20x170**
$N^0_{Rd,c}$ Non cracked concrete [kN]	21,9	31,2	36,2	47,1	74,6
$N^0_{Rd,c}$ Cracked concrete [kN]	15,6	22,2	25,8	33,5	53,2

a) Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0.1}$ [a]	1	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = h_{ef}/h_{ef,typ}$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance [a]

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance.

Influence of anchor spacing [a]

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$$

Influence of reinforcement

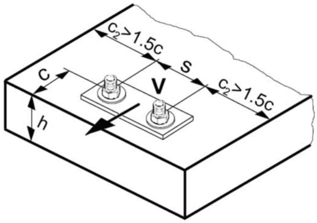
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N}$ = 0,5 + h_{ef}/200mm ≤ 1	0,7 [a)]	0,75 [a)]	0,8 [a)]	0,85 [a)]	0,9 [a)]	0,95 [a)]	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor f_{re} = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot$ lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

			Data according ETA-03/0032, issue 2013-06-04				
Anchor size			M10x75	M12x95	M16x105	M16x125	M20x170
$V_{Rd,s}$	HAS-TZ	[kN]	14,4	21,6	40,8	40,8	70,4
$V_{Rd,s}$	HAS-R-TZ HAS-HCR-TZ	[kN]	16,0	24,0	44,8	44,8	78,4

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

k = 1 for h_{ef} < 60 mm
k = 2 for h_{ef} ≥ 60 mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance [a)] $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4$

		Non-cracked concrete					Cracked concrete				
Anchor size		M10x 75	M12x 95	M16x 105	M16x 125	M20x 170	M10x 75	M12x 95	M16x 105	M16x 125	M20x 170
$V^0_{Rd,c}$	[kN]	3,7	6,7	9,9	10,3	11,0	2,7	3,8	5,3	5,5	7,9

a) For anchor groups only the anchors close to the edge must be considered.

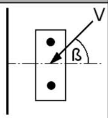
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
f_B = $(f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \frac{1}{\sqrt{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{2/3} \leq 1$	0,22	0,34	0,45	0,54	0,63	0,71	0,79	0,86	0,93	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Combined tension and shear loading

For combined tension and shear loading see section "Anchor Design".