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Institute of Building Materials, Concrete Construction and Fire Protection | Braunschweig Civil Engineering Materials Testing Institute

Expert Opinion

– Translation –

Document number:	(2101/150/18) – CM dated 27/06/2018
Client:	Hilti Entwicklungsgesellschaft mbH Hiltistr. 6 86916 Kaufering
Order date:	15/05/2018
Order ref:	Gregor.Giessmann@hilti.com
Order received:	15/05/2018
Subject:	Assessment of the fire behaviour of Hilti HVZ / HVZ R / HVZ HCR adhesive anchors installed and loaded in solid structural elements (reinforced concrete), when exposed to fire in accordance with DIN 4102-2 : 1977-09, Fire Behaviour of Building Components
Basis for assessment:	See Section 1

This expert opinion comprises 5 pages including cover sheet and 2 annexes.

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Notified body (0761-CPR) - Approved as a civil engineering testing, inspection and certifying body as well as notified as a civil engineering testing and certifying body.

Contents

1 General

An expert opinion on the Hilti HVZ / HVZ R / HVZ HCR adhesive anchors combined with solid structural elements (reinforced concrete) under exposure to fire on one side was commissioned in writing by Hilti Entwicklungsgesellschaft mbH, Kaufering on 15/05/2018.

The documents serving as basis for the expert opinion for the constructions to be assessed are listed below:

[1] DIN 4102-2 : 1977-09, Fire Behaviour of Building Components,

[2] Test Report No. (3357/0550-1) dated 17/04/2001, issued by MPA Braunschweig,

[3] Technical Data Sheets for Hilti HVZ / HVZ R / HVZ HCR Adhesive Anchors, from Hilti Entwicklungsgesellschaft mbH, Kaufering,

[4] ETA-03/0032 dated 27/08/2015 for Hilti HVZ / HVZ R / HVZ HCR adhesive anchors, issued by DIBt, Berlin

The assessment for the Hilti HVZ / HVZ R / HVZ HCR adhesive anchors was conducted on the basis of the fire tests carried out when installed in solid structural elements (reinforced concrete) in accordance with DIN 4102-2 : 1977-09. Existing technical regulations and technical specifications, which regulate above all mechanical fasteners for cracked concrete combined with reinforced concrete elements when exposed to fire in accordance with DIN 4102-2 : 1977-09, currently provide no complete design concept for these fastening systems combined with reinforced concrete elements. According to Hilti Entwicklungsgesellschaft mbH, Kaufering, there is currently no complete construction supervisory authority certificate (e.g. ETA) for Hilti HVZ / HVZ R / HVZ HCR adhesive anchors combined with reinforced concrete grounds that lays down the regulations to be met by the execution described here in the event of fire.

2 Description of the constructions

Hilti HVZ / HVZ R / HVZ HCR adhesive anchors are special anchors (see Annex 1). The loads are applied via the shaft of the anchor rod and the mortar into the anchoring base.

Hilti HVZ / HVZ R / HVZ HCR adhesive anchors are made of electro-galvanized or stainless steel.

According to the client, the related technical specifications for Hilti HVZ / HVZ R / HVZ HCR adhesive anchors installed in reinforced concrete grounds and loaded mainly with dead loads – for the normal purpose of use – can be taken from the respective technical data sheets (e.g. installation instructions) of Hilti GmbH Kaufering.

The fire-safety-related assessment is limited to mainly static (dead) loads combined with reinforced concrete elements, which also have to be certified for a fire load according to the standard temperature/time curve (ETK).

The following table and the annexes summarize the design data (from the manufacturer) for the Hilti HVZ / HVZ R / HVZ HCR adhesive anchor. Further information on Hilti HVZ / HVZ R / HVZ HCR adhesive anchors can be taken from the technical data sheets (e.g. installation instructions) and approvals of Hilti Entwicklungsgesellschaft mbH, Kaufering.

Table 1: Hilti HVZ / HVZ R / HVZ HCR adhesive anchor

Hilti HVZ HCR adhesive anchor	**Dimension (tensile stress cross section A_s [mm²])**			
Dimension of anchor rod	M10 (58.00)	M12 (84.30)	M16 (157.00)	M20 (247.00)
Hilti HVZ / HVZ R / HVZ HCR adhesive anchors with nut and washer combined with HVU TZ mortar capsule	M10 to M20			

For a more detailed description of the construction, reference is made to Annex 1 and the technical data sheets for Hilti HVZ / HVZ R / HVZ HCR adhesive anchors of Hilti Entwicklungsgesellschaft mbH, Kaufering.

3 Fire-safety-related assessment of Hilti HVZ / HVZ R / HVZ HCR adhesive anchors combined with solid structural elements (reinforced concrete)

The subject matter of this fire-safety-related assessment is the load-bearing behaviour of Hilti HVZ / HVZ R / HVZ HCR adhesive anchors combined with reinforced concrete grounds (strength classes C20/25 to C50/60), when exposed to fire in accordance with DIN 4102-2 : 1977-09.

If smaller loads apply for the normal purpose of use according to the technical documents [3] and [4] of Hilti Entwicklungsgesellschaft mbH, Kaufering, these shall be binding. Independent of the fire-safety-related assessment, the suitability of the anchors has to be attested for the ground and application, also for the cold as-installed state.

With regard to the load-bearing behaviour under exposure to fire, steel failure and ground failure can be distinguished.

For the anchors assessed here, the failure of the Hilti HVZ / HVZ R / HVZ HCR adhesive anchors (steel failure) was decisive. In terms of fire safety, it may be assumed with sufficient reliability that a failure of the ground examined here will not be decisive in case of fire.

The centre distance to be applied for the Hilti HVZ / HVZ R / HVZ HCR adhesive anchors under exposure to fire is the distance that excludes a failure of the ground, which means the steel failure of the fastening system will be decisive. Moreover, the centre distances have to comply at least with the distances required for the cold as-installed state as per technical documents [3] and [4] of Hilti Entwicklungsgesellschaft mbH, Kaufering. Further parameters (geometry, moisture, formwork spalling, eccentricity, position in the structural element and other influencing variables) have to be considered separately, if required.

The load-bearing behaviour (steel failure) under exposure to fire of the systems described above was determined on the basis of the fire tests conducted in solid structural elements (reinforced concrete).

$F_{fire(t)}$ $\Rightarrow$ design value for Hilti HVZ / HVZ R / HVZ HCR adhesive anchors

The load on the anchors can be applied as centric tensile load (N), shear load (V) or as a combination of both (oblique tension).

The design proposal for Hilti HVZ / HVZ R / HVZ HCR adhesive anchors under tensile load and exposure to fire on one side in accordance with DIN 4102-2 : 1977-09 can be taken from Annex 2.

4 Special notes

4.1 This Expert Opinion is no substitute for the building authority certificate (abP, abZ, ETA).

4.2 This Expert Opinion applies only to Hilti HVZ / HVZ R / HVZ HCR adhesive anchors combined with solid structural elements (reinforced concrete), taking the constraints of the technical documents [3] and [4] of Hilti Entwicklungsgesellschaft mbH, Kaufering (Germany) into account.

4.3 The assessment of the Hilti HVZ / HVZ R / HVZ HCR adhesive anchors refers to the fastener combined with reinforced concrete elements under exposure to fire on one side according to the standard temperature/time curve (ETK).

4.4 The validity of this Expert Opinion ends on 27/06/2023.

4.5 The validity of this Expert Opinion can be extended upon request and as a function of the state of the art.

This document is the translated version of Expert Opinion No. 2101/150/18 – CM dated 27/06/2018. The legally binding text is the aforementioned German Expert Opinion.

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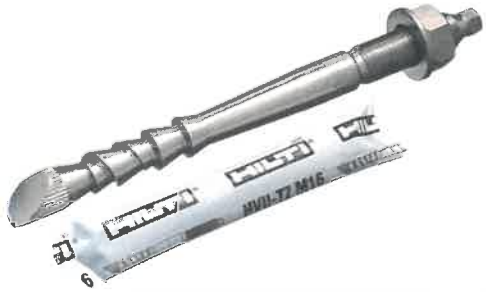
Braunschweig, dated 20/07/2018

Technical data of the Hilti HVZ HCR adhesive anchor

Anchor type	
	**Hilti HVZ HCR adhesive anchor** For cracked and non-cracked concrete (C 20/25 to C 50/60)

Material characteristics

Component	Material data
Anchor rod HAS TZ	Electro-galvanized steel, (strength class 8.8 (HAS-TZ)), or stainless steel EN10088 (strength class 80 (HCR-TZ) or 70 (HAS RTZ))
Nut	
Washer	
Mortar capsule HVU TZ	2-component mortar with aggregate

Installation parameters for Hilti HVZ HCR adhesive anchor

			M10x75	M12x95	M16x105	M16x125	M20x170
Nominal diameter of drill bit	d_o	[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	$h_1 \geq$	[mm]	90	110	125	145	195
Minimum base material thickness	h_{min}	[mm]	150	190	210	250	340
Diameter of clearance hole in the fixture	d_f	[mm]	12	14	18	18	22
Torque moment	T_{inst}	[Nm]	40	50	90	90	150

Curing time

Temperature in the anchoring base	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 a dry anchoring base only. In case of a wet anchoring base, the curing time must be doubled.

Design proposal for loaded Hilti HVZ / HVZ R / HVZ HCR adhesive anchors under fire exposure on one side, in accordance with the standard temperature/time curve (ETK)

Table 2: Design proposal for Hilti HVZ adhesive anchor in reinforced concrete ground (strength classes C20/25 to C50/60)

Designation	**Maximum load under exposure to fire in accordance with the standard temperature/time curve (ETK) for Hilti HVZ adhesive anchors**			
Size	**M10**	**M12**	**M16**	**M20**
Minimum embedment depth [mm]	75	95	105	170
Fire resistance [min]	**Max. $F_{fire}(t)$ [kN]**			
30	2.94	4.27	7.96	9.00
60	2.03	2.95	5.49	9.00
90	1.12	1.62	3.02	4.76
120	0.66	0.96	1.79	2.82

1) It is to be checked, whether the admissible cold loads are decisive. Fixtures may have to be additionally certified.

Table 2: Design proposal for Hilti HVZ R / HVZ HCR adhesive anchors in reinforced concrete grounds (strength classes C20/25 to C50/60)

Designation	**Maximum load under exposure to fire in accordance with the standard temperature/time curve (ETK) for Hilti HVZ R / HVZ HCR adhesive anchors**			
Size	**M10**	**M12**	**M16**	**M20**
Minimum embedment depth [mm]	75	95	105	170
Fire resistance [min]	**Max. $F_{fire}(t)$ [kN]**			
30	4.72	6.86	9.45	9.45
60	3.31	4.80	8.95	9.00
90	1.89	2.75	5.12	8.06
120	1.19	1.72	3.21	5.05

1) It is to be checked, whether the admissible cold loads are decisive. Fixtures may have to be additionally certified.