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Independent Technical Evaluation

fischer FHY M10 / M12 anchor used in precast pre-stressed hollow core slabs for seismic applications (category C1)

Name of the product:
FHY

Type of product:
Hollow-ceiling wedge anchor

Product owner:
fischerwerke GmbH & Co. KG

Validity:
5 years

Production plant:
Germany / Czech Republic

Technical Assessment bases on:
Z-21.1-1711, IEA report 18_046-1 and additional test for seismic applications for Cat. C1

Date: Stuttgart, March 28, 2019
Number of pages: 8

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Independent Technical Assessment

1 Introduction and scope

The fischerwerke GmbH & Co. KG wants to qualify the FHY anchor for seismic applications (use category C1) in accordance to EAD 330232-00-0601. However, this application is not covered by the current EAD the company asked for an independent technical evaluation of the anchor performance.

The seismic characteristic resistances shall be valid for the sizes FHY M10 and FHY M12 as well as for all material versions (gvz- and A4- Version). Therefore, seismic tests for category C1 at the laboratory fischerwerke [R1] and the supervision of the IWB and FAST³Solution [R2] were performed to qualify the anchors for category C1. The tests and the evaluation are done in accordance with the current state of the art, especially in accordance with EAD 330232-00-0601[5] and Technical Report EOTA TR 045 [4] and 049 [7].

2 Literature

[1] Prüfbericht-Nr. : S 06-2019, FHY M10 nach Seismic C1 in der Hohldecke - Ergebniszusammenstellung der überwachten Versuche, fischerwerke GmbH & Co. KG , 27.02.2019.

[2] 18_046-1, Evaluation Report Assessment for fischer FHY M12 anchor precast pre-stressed hollow core slabs, IEA GmbH & Co. KG, Stuttgart 2018-06-08.

[3] Z-21.1-1711, Allgemeine bauaufsichtliche Zulassung vom 24.01.2017 , Zulassungsgegenstand: fischer Hohldeckenanker FHY.

[4] EOTA Technical Report 045. Design of metal anchors for use In concrete under seismic actions, Edition February 2013

[5] EAD 330232-00-0601, Mechanical fasteners for use in concrete, EOTA Brussels.

[6] EAD 330747-00-0601, Fasteners for use in concrete for redundant non-structural systems, EOTA Brussels.

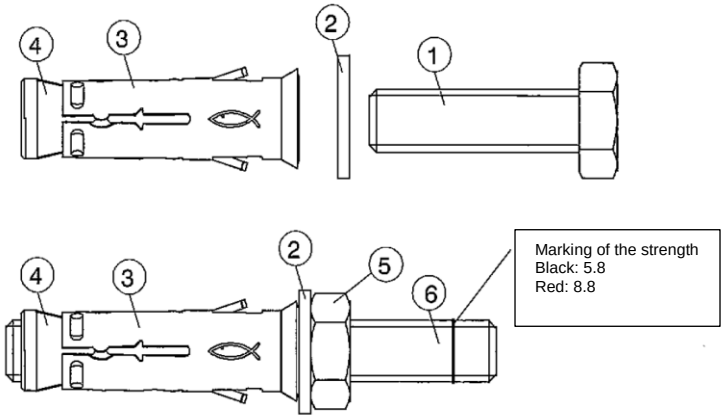
[7] EOTA Technical Report 049. EOTA Technical Report 045. Design of metal anchors for use In concrete under seismic actions, Edition August 2016

[8] 18-086-1 Evaluation Report, Assessment of the fischer EA II drop in anchor with an embedment depth h_{ef} = 25 mm for Option 7 as single anchor use, IEA GmbH & Co. KG, 22.1.2018.

3 Description of the product

3.1 Description

The fischer FHY M10 anchor is available with a hexagonal screw or a threaded bolt with hexagonal nut. For both types a washer is used between sleeve and screw or nut respectively. The functional part exists of an expansion sleeve and an expansion cone. The expansion cone is pulled into the sleeve if the torque moment is applied on the screw or nut. A drawing of the used product is given in Figure 3.1.



Legend:

1 = Hexagonal screw
2 = Washer
3 = Anchor sleeve
4 = Anchor cone
5 = Hexagonal nut
6 = threaded bolt

Figure 3.1: Description of the product.

3.2 Installation of the anchors

The installation of the anchor must be done with a calibrated torque wrench. The installation torque moment is given in Table 3.1. The installation torque moment shall be applied to the hexagon nut of the threaded bolt or on the hexagon screw.

Typ	**Dimension**	**Material Version**	**FHY M10**	**FHY M12**
Nominal drill bit diameter	[mm]	gvz + A4	16	18
Maximum cutting diameter	≤ [mm]	gvz + A4	16,50	18,50
Bore hole depth	h_1 ≥ [mm]	gvz + A4	60	65
Length of the screw [1)]	min. l_s ≥ [mm]	gvz + A4	54 + t_{fix}	57 + t_{fix}
Length of the bolt	min. l_B ≥ [mm]	gvz + A4	77 + t_{fix}	83 + t_{fix}
Hole diameter in the fixture	d_f ≤ [mm]	gvz + A4	12	14
Distance to the prestressed reinforcement	Sp ≥ [mm]	gvz + A4	50	50
Installation torque moment	T_{inst} = [Nm]	gvz	20	30
		A4	40	x

Table 3.1: Installation parameters for the FHY anchors

The anchor is properly anchored and shall only be loaded if the installation torque moment can be applied without problems. Installed anchor can be checked at any time by applying the installation torque moment again.

The required installation torque according to the MPII was applied in the seismic C1 tests.

3.3 Parts and materials

The different parts of the anchors shown in figure 3.1 are made of the materials given in table 3.2. The anchors are galvanized according to EN 4042 with a thickness of the layer of at least 5 μm.

Part	Nomenclature	Material	Surface treatment
1	Hexagonal screw	Steel DIN EN ISO 898-1:2013, Strength class 4.8, 5.8 or 8.8 (M10 and M12)	Galvanised acc. DIN EN IS 4042:2001 ≥ 5μm
2	Washer	Cold treaded steel DIN EN 10139:2016	
3	Sleeve	Cold treaded steel DIN EN 10139:2016	
4	Cone	Steel DIN EN 10277-3:2008	
5	Hexagonal nut	Steel DIN EN ISO 898-1:2013, Strength class 4.8, 5.8 or 8.8 (M10 and M12)	
6	Threaded bolt	Steel DIN EN ISO 898-1:2013, Strength class 4.8, 5.8 or 8.8 (M10 and M12)	

Table 3.2: Materials used for the FHY anchors.

4 Performance of the product

4.1 Characteristic resistances

In the following Table 4-1 the characteristic resistances for seismic actions are summarized. The values are valid under the condition that the concrete remains uncracked due to the prestressing.

Anchor FHY for precast pre-stressed hollow core slabs in redundant systems				**FHY M10 (gvz / A4)**	**FHY M12 (gvz / A4)**
				h_{nom}	**h_{nom}**
Embedment depth in concrete		h_{nom}	[mm]	**40**	**40**
Web thickness of the core slab				**≥ 30 mm**	**≥ 30 mm**
Seismic steel failure for Tension- and Shear resistance for seismic category 1					
Characteristic resistance (seismic)		$N_{Rk,s,seis}$	[kN]	13,9	13,9
		$V_{Rk,s,seis}$	[kN]	6,9	6,9
Seismic factor		$\alpha_{N,seis}$	-	1,0	
Seismic factor		$\alpha_{N,seis}$	-	1,0	
Seismic Pullout seismic category 1					
Characteristic resistance in cracked concrete C45/55 (seismic)		$N_{Rk,p,seis}$	[kN]	3,75	3,75
		$V_{Rk,p,seis}$	[kN]	3,75	3,75
		including $\alpha_{N,seis}$ = 1,0			
Pull out	edge distance	$c_{cr,N}$	[mm]	> 150 mm	
	spacing	$s_{cr,N}$	[mm]	> 300 mm	
Seismic factor		$\alpha_{N,seis}$	-	1,0	
Seismic Concrete cone failure and splitting failure seismic category 1					
Effective anchorage depth		h_{ef}	[mm]	30	30
Factor for	non-cracked	k_{cr}	-	11	
Concrete cone	edge distance	$c_{cr,N}$	[mm]	> 150 mm	
	spacing	$s_{cr,N}$	[mm]	> 300 mm	
Seismic factor		$\alpha_{N,seis}$	-	1,0	
Seismic design factors					
Seismic factor considering hole clearance **with** hole clearance		α_{gap}	-	0,5	
Seismic factor considering hole clearance **without** hole clearance				1,0	
Seismic factor considering group effects		α_{eq}	-	0,5	

Table 4.1: Characteristic resistances for seismic actions (Cat. C1).

4.2 Displacements

The following displacements were observed after the seismic tests. For this reason the mean displacements $\delta_{N,seis}$ and $\delta_{V,seis}$ should be considered for the construction design under seismic actions.

Anchor FHY			**FHY M10**
			h_{nom} $h_{web} \geq 30$ mm
Embedment depth in concrete	**h_{nom} [mm]**		**40**
Mean displacement under seismic actions for Cat. C1	$\delta_{N,seis}$	[mm]	2,7
	$\delta_{V,seis}$	[mm]	2,6

Table 4.2: Characteristic resistances for seismic actions (Cat. C1).

For the design for quasi static actions the displacement for short term and long term loading shall be considered.

5 Summary and conclusion

The fischerwerke GmbH & Co. KG qualified the anchor FHY M10 and M12 for seismic applications in pre-stressed hollow core slabs pre-stressed hollow core slabs. The anchors were tested according to the provision of EAD 330232-00-0601 [G2] for seismic category C1 in pre-stressed hollow core slabs.

The anchors FHY M10 and M12 are assessed in the evaluation report [R3] for redundant systems in pre-stressed hollow core slabs. Additional seismic tests were performed under the supervision of the experts stuff. The seismic tests with the anchor FHY M10 are summarized in [R1].

The seismic characteristic resistance evaluated is valid for the sizes FHY M10 and M12 as well as for all material versions (gvz- and A4- Version) and larger embedment depths, if the characteristic resistance is limited to the values of FHY M10.

The results under pulsating tension loading show that the anchors will fulfill the criteria with $\alpha_{seis,N,C1}$ = 1,0. Under alternating shear loading the criteria is fulfilled for $\alpha_{seis,V,C1}$ = 1,0. The conditions of redundant systems must be fulfilled and the seismic performance is given in the table 4.1.