Assessment Report

Project **21810 – condensed version**

Assessment of resistance under fire exposure of the Friulsider Injection System KEM HYBRID

Employer **Friulsider S.p.A.**
Via Trieste 1
33048 San Giavanni al Natisone (UD) ITALY

Date **9.2.2018**

Pages **10**

Author

INGENIEURBÜRO THIELE
TRAGWERKSPLANUNG GMBH

UNTERER SOMMERWALDWEG 1 66953 PIRMASENS
TRAGWERK@INGENIEURBUEROTHIELE.DE TEL. 06331 55470

Table of contents

1 General information

Friulsider S.p.A. authorized the evaluation of the fire resistance of the Friulsider Injection System KEM HYBRID for axial tension and shear loads. The evaluation in [1] is based on tests that were conducted by the Technical University Kaiserslautern under fire exposure according to DIN EN 1363-1:2012 [3] and Technical Report 020 [2]. The test results are summarized in test report 17027MR15552 [4].

This evaluation is only valid for one-sided fire exposure.

2 Reference documents

[1] Gutachten 21737 vom 1.8.2017, Ingenieurbüro Thiele GmbH, deposited by the signee

[2] Evaluation of Anchorages in Concrete Concerning Resistance to Fire, EOTA TR 020, Edition May 2004

[3] Feuerwiderstandsprüfungen – Teil 1: Allgemeine Anforderungen, DIN EN 1363-1; Edition Oktober 2012

[4] Test Report 17027MR15552, TU Kaiserslautern, June 2017, deposited by the signee

[5] Test Report 15025CT15541, TU Kaiserslautern, December 2016, deposited by the signee

[6] Guideline for European technical approval of metal anchors for use in concrete, ETAG ETAG 001, Edition April 2013

[7] European Technical Approval ETA-16/0957: Friulsider Injection System KEM HYBRID, EOTA, DIBt, 11. April 2017

[8] C. Thiele, M. Reichert: “Qualifikation von Verbunddübeln im Brandfall”, TU Kaiserslautern, DIBt, June 2017

3 Product description

The Friulsider KEM HYBRID adhesive is a bonded anchor system consisting of a plastic cartridge containing the injection mortar and a steel part.

The injection system KEM HYBRID is designed for the use in concrete according to the European Technical Assessment ETA-16/0957[7].

4 Scope of evaluation

The present evaluation of fire resistance for Friulsider Injection System KEM HYBRID in concrete is assessed with respect to its fire resistance properties for anchor applications in walls and ceilings. The tests which this evaluation refers to, are executed with vertical arranged anchors and axial load application. Furthermore, the anchors were exposed to the standard temperature-time curve (ETK) [3]. In the tests a fixture according to TR020 was used, therefore the following fire resistances cover only anchors protected from fire by attachments similar to the fixture according to TR020 [2].

The assessment of steel failure and concrete cone failure is carried out in dependence on TR020 [2]. Additionally the failure type pullout failure is assessed as explained in below.

a. Steel failure:
   Steel failure is assessed according to TR020 [2]. In some cases several anchor size is assessed together

b. Pullout failure:
   Pullout failure is assessed by the current state of scientific knowledge according to the research report “Qualifikation von Verbunddübeln im Brandfall” [7]. A combination of thermal simulation and assessment of test results was used.

c. Concrete cone failure:
   Concrete cone failure is assessed according to TR020 [2].

The fire resistances given in chapter 5 covers axial loads and shear loads as well.

5 Summary

Table 5-1 to Table 5-4 show the fire resistances for the use of Friulsider Injection System KEM HYBRID for use in **cracked** and **uncracked concrete**. The given fire resistances covers axial and shear loads.

The listed fire resistances are valid for single anchors with an edge distance of more than $c_{cr}=2\ h_{ef}$ and a spacing to the adjacent anchor of $s= 2\ c_{cr}= 4\ h_{ef.}$ Edge distance and spacing distances have to be chosen so that steel – or pullout failure is decisive.

The values below are valid for the use of carbon steel (minimum grade 5.8 acc. to ISO 898-1), stainless steel (acc. to EN 10088, minimum grade 70 acc. to ISO 3506) or high corrosion resistant steel (HCR acc. to EN 10088, minimum grade 70 acc. to ISO 3506) anchor rods.

For the values highlighted in grey steel failure was decisive.

*Table 5-1: Summary of the characteristic resistances for **uncracked** concrete, M8-M16*

Anchorage depth h_{ef}	Anchor size	Maximum tension laod $N_{Rk,fi(t)}$ [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
60	M8	0,71	0,56	0,14	0,14
65		0,71	0,56	0,29	0,15
70		0,71	0,56	0,41	0,16
75		0,71	0,56	0,41	0,24
80		0,71	0,56	0,41	0,33
85		0,71	0,56	0,41	0,33
90		0,71	0,56	0,41	0,33
60	M10	1,42	0,58	0,17	0,17
65		1,42	0,95	0,18	0,18
70		1,42	1,11	0,34	0,20
75		1,42	1,11	0,60	0,21
80		1,42	1,11	0,79	0,28
85		1,42	1,11	0,79	0,52
90		1,42	1,11	0,79	0,63
95		1,42	1,11	0,79	0,63
100		1,42	1,11	0,79	0,63
70	M12	3,03	1,15	0,24	0,24
75		3,03	1,71	0,40	0,25
80		3,03	2,28	0,72	0,27
85		3,03	2,28	1,12	0,32
90		3,03	2,28	1,60	0,61
95		3,03	2,28	1,60	0,96
100		3,03	2,28	1,60	1,18
105		3,03	2,28	1,60	1,18
110		3,03	2,28	1,60	1,18
80	M16	5,65	1,66	0,36	0,36
85		5,65	2,41	0,58	0,38
90		5,65	3,34	1,02	0,41
95		5,65	4,24	1,55	0,43
100		5,65	4,24	2,21	0,83
105		5,65	4,24	2,98	1,29
110		5,65	4,24	2,98	1,86
115		5,65	4,24	2,98	2,20
120		5,65	4,24	2,98	2,20
125		5,65	4,24	2,98	2,20

*Table 5-2: Summary of the characteristic resistance for **uncracked** concrete, M20-M30*

Anchorage depth h_{ef}	Anchor size	Maximum tension laod $N_{Rk,fi(t)}$ [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
90	M20	8,82	2,45	0,51	0,51
95		8,82	3,42	0,90	0,54
100		8,82	4,60	1,47	0,57
105		8,82	6,01	2,15	0,64
110		8,82	6,62	2,98	1,15
115		8,82	6,62	3,98	1,75
120		8,82	6,62	4,66	2,46
125		8,82	6,62	4,66	3,30
130		8,82	6,62	4,66	3,43
135		8,82	6,62	4,66	3,43
140		8,82	6,62	4,66	3,43
95	M24	12,71	2,52	0,64	0,64
100		12,71	3,54	0,73	0,68
105		12,71	4,76	1,35	0,71
110		12,71	6,23	2,07	0,75
115		12,71	7,97	2,93	0,95
120		12,71	9,53	3,96	1,59
125		12,71	9,53	5,18	2,32
130		12,71	9,53	6,61	3,19
135		12,71	9,53	6,71	4,20
140		12,71	9,53	6,71	4,94
145		12,71	9,53	6,71	4,94
150		12,71	9,53	6,71	4,94
108	M27	16,52	5,27	1,43	0,82
115		16,52	6,85	2,21	0,88
120		16,52	8,72	3,15	0,92
125		16,52	10,87	4,24	1,62
130		16,52	12,39	5,52	2,40
135		16,52	12,39	7,02	3,32
140		16,52	12,39	8,72	4,39
145		16,52	12,39	8,72	5,66
150		16,52	12,39	8,72	6,43
155		16,52	12,39	8,72	6,43
160		16,52	12,39	8,72	6,43
120	M30	20,20	7,62	2,42	1,02
125		20,20	9,62	3,41	1,06
130		20,20	11,91	4,58	1,68
135		20,20	14,53	5,94	2,52
140		20,20	15,15	7,53	3,50
145		20,20	15,15	9,37	4,63
150		20,20	15,15	10,66	5,95
155		20,20	15,15	10,66	7,46
160		20,20	15,15	10,66	7,85
165		20,20	15,15	10,66	7,85
170		20,20	15,15	10,66	7,85

*Table 5-3: Summary of the characteristic resistance for **cracked** concrete, M8-M16*

Anchorage depth h_{ef}	Anchor size	Maximum tension laod $N_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
60	M8	0,71	0,56	0,10	0,10
65		0,71	0,56	0,22	0,11
70		0,71	0,56	0,37	0,12
75		0,71	0,56	0,41	0,18
80		0,71	0,56	0,41	0,32
85		0,71	0,56	0,41	0,33
90		0,71	0,56	0,41	0,33
60	M10	1,42	0,44	0,13	0,13
65		1,42	0,71	0,14	0,14
70		1,42	1,07	0,25	0,15
75		1,42	1,11	0,45	0,16
80		1,42	1,11	0,70	0,21
85		1,42	1,11	0,79	0,39
90		1,42	1,11	0,79	0,61
95		1,42	1,11	0,79	0,63
100		1,42	1,11	0,79	0,63
70	M12	3,03	0,86	0,18	0,18
75		3,03	1,28	0,30	0,19
80		3,03	1,82	0,54	0,20
85		3,03	2,28	0,84	0,24
90		3,03	2,28	1,22	0,46
95		3,03	2,28	1,60	0,72
100		3,03	2,28	1,60	1,04
105		3,03	2,28	1,60	1,18
110		3,03	2,28	1,60	1,18
80	M16	5,65	1,25	0,27	0,27
85		5,65	1,81	0,44	0,29
90		5,65	2,50	0,76	0,31
95		5,65	3,36	1,16	0,32
100		5,65	4,24	1,65	0,62
105		5,65	4,24	2,26	0,97
110		5,65	4,24	2,98	1,39
115		5,65	4,24	2,98	1,90
120		5,65	4,24	2,98	2,20
125		5,65	4,24	2,98	2,20

*Table 5-4: Summary of the characteristic resistance for **cracked** concrete, M20-M30*

Anchorage depth h_{ef}	Anchor size	Maximum tension laod $N_{Rk,fi(t)}$, [kN] depending on the fire resistance time			
		30	60	90	120
[mm]	[mm]	[min]	[min]	[min]	[min]
90	M20	8,82	1,84	0,38	0,38
95		8,82	2,56	0,67	0,40
100		8,82	3,45	1,10	0,42
105		8,82	4,51	1,61	0,48
110		8,82	5,77	2,24	0,86
115		8,82	6,62	2,99	1,31
120		8,82	6,62	3,89	1,84
125		8,82	6,62	4,66	2,47
130		8,82	6,62	4,66	3,23
135		8,82	6,62	4,66	3,43
140		8,82	6,62	4,66	3,43
95	M24	10,16	1,89	0,48	0,48
100		12,48	2,66	0,54	0,51
105		12,71	3,57	1,01	0,53
110		12,71	4,67	1,55	0,56
115		12,71	5,98	2,20	0,71
120		12,71	7,49	2,97	1,19
125		12,71	9,25	3,89	1,74
130		12,71	9,53	4,96	2,39
135		12,71	9,53	6,22	3,15
140		12,71	9,53	6,71	4,05
145		12,71	9,53	6,71	4,94
150		12,71	9,53	6,71	4,94
108	M27	16,52	3,95	1,07	0,62
115		16,52	5,13	1,66	0,66
120		16,52	6,54	2,36	0,69
125		16,52	8,15	3,18	1,22
130		16,52	9,99	4,14	1,80
135		16,52	12,09	5,26	2,49
140		16,52	12,39	6,58	3,29
145		16,52	12,39	8,10	4,24
150		16,52	12,39	8,72	5,32
155		16,52	12,39	8,72	6,43
160		16,52	12,39	8,72	6,43
120	M30	20,20	5,72	1,81	0,76
125		20,20	7,21	2,56	0,80
130		20,20	8,93	3,43	1,26
135		20,20	10,90	4,46	1,89
140		20,20	13,13	5,65	2,62
145		20,20	15,15	7,03	3,47
150		20,20	15,15	8,61	4,46
155		20,20	15,15	10,41	5,59
160		20,20	15,15	10,66	6,90
165		20,20	15,15	10,66	7,85
170		20,20	15,15	10,66	7,85

Pirmasens, 9.2.2018

C. Thiele

Jun.-Prof. Dr.-Ing. Catherina Thiele

M. Reichert

Dipl.-Ing. Marie Reichert