Exova Warringtonfire
Holmesfield Road
Warrington
WA1 2DS
United Kingdom

T : +44 (0) 1925 655 116
F : +44 (0) 1925 655 419
E : warrington@exova.com
W: www.exova.com

Testing. Advising. Assuring.

Title:

The Fire Performance of Various Types Of Chemical Anchor Fixing Systems for Use in Concrete Structures

WF Assessment Report No:

401715 Issue 2

Prepared for:

Hilti Entwicklungsgesellschaft mbH

Hiltistrasse 6
86916 Kaufering
Germany

Date:

11th September 2018

TABLE OF CONTENTS

Executive Summary

Objective	This report provides a considered opinion regarding the fire performance of various types of chemical anchor fixing systems for use in concrete structures, if subjected to tests utilising the general principles of BS 476: Part 20: 1987.
Report Sponsor	Hilti Entwicklungsgesellschaft mbH
Address	Hiltistrasse 6 86916 Kaufering Germany
Summary of Conclusions	Should the recommendations given in this report be followed, it can be concluded that Hilti anchor systems, as detailed in this report, should be capable of supporting the loads detailed in the tables within this report, for periods of up to 240 minutes, when fixed into structural concrete (or other materials specifically detailed within this report), if subjected to the heating conditions of BS 476: Part 20: 1987
Valid until	1st October 2023

This report may only be reproduced in full. Extracts or abridgements of reports shall not be published without permission of Bodycote warringtonfire.

Introduction

This report provides a considered opinion regarding the fire performance of various types of chemical anchor fixing systems for use in concrete structures, when subjected to tests utilising the general principles of BS 476: Part 20: 1987.

The report considers the test procedures and subsequent data obtained from tests conducted at the Institut Für Baustoffe Massivbau und Brandschutz, Technische Universität Braunschweig (IBMB), Germany, tests conducted at MFPA Leipzig GmbH, Baulicher Brandschutz, Hans Weigel Strasse 2b, 04 379 Leipzig and the general principles of BS 476: Part 20: 1987.

The performance tables included within this assessment have been collated from various test reports. For full details of the test configuration and results the specific report should be utilised.

FTSG

The data referred to in the supporting data section has been considered for the purpose of this appraisal which has been prepared in accordance with the Fire Test Study Group Resolution No. 82: 2001.

Assumptions

It is assumed that the concrete elements into which the various types of rebar are installed will be constructed in accordance with BS 8110: Part 2: 1985 and have a minimum compressive strength of 25 N/mm².

The fire performance rating of the fixing systems is assumed to apply to reinforced concrete elements which have been designed to give at least the same period of fire resistance as that for the injection system.

The injection systems are assumed to be installed correctly and in accordance with Hilti Entwicklungsgesellschaft mbH installation instructions.

Proposals

It is proposed to provide various types of Hilti anchor fixing systems, into structural grade concrete (or other materials specifically detailed within this report), which are supporting a load and are capable of providing this support whilst being subjected to the heating conditions of BS 476: Part 20: 1987, for periods ranging from 30 up to 240 minutes. An index of the proposed anchors is provided below:

Index

List of Basic Evidence

Chemical Fixings – With Threaded Rods				
Fixings	**Report**		**Fixings**	**Report**
HIT-HY 200-A with threaded rod (HIT-V(- R); HIT-Z(-R),	IBMB 3501/676/12		HIT-RE 500-SD	MFPA GS3.2/13-122-1
HIT-HY 200-R with threaded rod (HIT-V(- R); HIT-Z(-R), B500	IBMB 3501/676/12		HIT-HY270	PB 3.2/14-179-1
HIT-RE 500- V3	GS 32/15-361-4		HIT-HVU2	ETA 16/0515

Chemical Fixings – With Post Installed Reinforced Bars (rebar)				
Fixings	**Report**		**Fixings**	**Report**
HIT-HY 150-MAX-Rebar	GS 3.2/10-51-1		HIT-RE 500 Rebar	IBMB 3357/0550
HIT-HY 200-A Rebar	DiBt Z-21.8-1947		HIT-RE 500-SD Rebar	MFPA GS 3.2/09-122
HIT-HY 200-R Rebar	DiBt Z-21.8-1948		HIT-CT-1	ETA 11/0390

Assessed Performance

There is not currently a British Standard relating to the testing of chemical anchors under fire conditions and therefore a number of test reports, primarily conducted to the DIN standard fire curve, have been cited in support of this appraisal. All of the cited evidence has been conducted utilising the heating conditions specified in DIN 4102-2 or EN 1363-1, both of which are based upon the ISO 834 heating curve, which is also the basis for the heating conditions given in BS 476: Part 20 1987.

The heating conditions to which the tested anchors were subjected would therefore be expected to be similar to those of a BS 476: Part 20 test, the results of these tests would therefore be expected to be comparable with those that would be achieved if the anchors were subjected to the heating conditions of BS 476: Part 20: 1987.

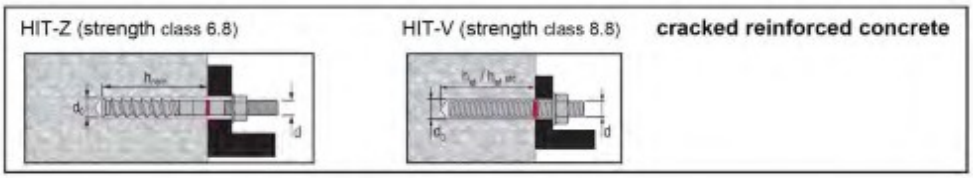
The following sections give a brief descriptions of each anchor system tested and its associated performance:

1) Chemical Systems- With Threaded Rods

HIT-HY 200-A with threaded rod (HIT-V(-R); HIT-Z(-R), B500-B

The Hilti HIT-HY 200-A anchors, were subjected to tests utilising the heating conditions of DIN EN 1363-1, as reported under the reference IBMB 3501/676/12. The performance ratings given in this report are as follows

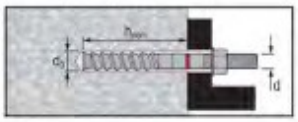
The fire resistance in cracked reinforced concrete of HY200-A- anchors is detailed in the tables below:



anchoring depth [mm]	Anchor rod dimension	fire resistance time [minutes] as a function of maximum loading [kN] in a fire (centric tensile load)			
		30	60	90	120
h_{ef}/h_{nom}	-	$N_{Rd,fi}$ [1]			
60	M8	0,52	0,17	0,11	0,08
65		0,70	0,22	0,13	0,10
70		0,94	0,28	0,16	0,12
80		1,64	0,45	0,24	0,17
100		2,10	1,14	0,55	0,35
110		2,10	1,50	0,81	0,49
120		2,10	1,50	0,90	0,50
160		2.10	1,50	0,90	0,50
60	M10	0,55	0,19	0,13	0,10
70		0,97	0,30	0,18	0,14
80		1,67	0,48	0,27	0,20
90		2,75	0,75	0,40	0,28
100		3,40	1,18	0,59	0,39
125		3,40	2,40	1,40	0,90
150		3,40	2,40	1,40	0,90
200		3,40	2,40	1,40	0,90
60	M12	0,58	0,21	0,14	0,11
70		1,01	0,33	0,20	0,16
80		1,69	0,50	0,30	0,22
85		2,15	0,63	0,36	0,26
90		2,72	0,78	0,43	0,31
95		3,43	0,96	0,51	0,36
100		4,29	1,19	0,62	0,42
110		4,90	1,80	0,89	0,59
120		4,90	2,66	1,29	0,82
150		4,90	3,50	2,00	1,30
240		4,90	3,50	2,00	1,30

[1] see also sector 3.1

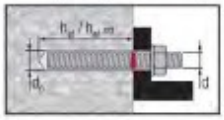
HIT-Z (strength class 6.8) HIT-V (strength class 8.8) **cracked reinforced concrete**



anchoring depth [mm]	Anchor rod dimension	fire resistance time [minutes] as a function of maximum loading [kN] in a fire (centric tensile load)			
		30	**60**	**90**	**120**
h_{ef}/h_{nom}	-	$N_{Rd,fi}$ [1]			
80	M16	1,74	0,55	0,33	0,25
95		3,37	0,99	0,55	0,40
105		5,07	1,46	0,78	0,54
110		6,18	1,76	0,92	0,63
120		9,09	2,55	1,29	0,86
130		10,50	3,63	1,80	1,16
135		10,50	4,34	2,13	1,35
145		10,50	6,07	2,95	1,83
160		10,50	7,90	4,69	2,85
180		10,50	7,90	5,20	3,90
200		10,50	7,90	5,20	3,90
220		10,50	7,90	5,20	3,90
320		10,50	7,90	5,20	3,90
90	M20	2,84	0,87	0,51	0,38
100		4,22	1,24	0,70	0,51
120		8,94	2,51	1,31	0,89
130		12,61	3,51	1,79	1,18
140		16,40	4,85	2,43	1,57
150		16,40	6,61	3,28	2,08
160		16,40	8,95	4,40	2,75
170		16,40	12,01	5,85	3,61
180		16,40	12,30	7,70	4,72
200		16,40	12,30	8,20	6,10
400		16,40	12,30	8,20	6,10

[1] see also sector 3.1

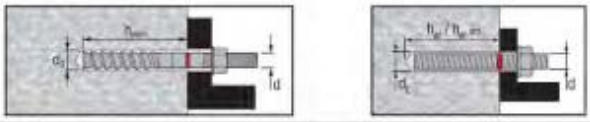
HIT-V (strength class 8.8) **cracked reinforced concrete**



anchoring depth [mm]	Anchor rod dimension	fire resistance time [minutes] as a function of maximum loading [kN] in a fire (centric tensile load)			
		30	**60**	**90**	**120**
h_{ef}/h_{nom}	-	$N_{Rd,fi(t)}$ [1)]			
110	M24	7,36	2,02	1,09	0,77
120		10,25	2,80	1,46	1,00
145		22,25	6,04	3,02	1,94
155		23,60	8,04	3,99	2,53
170		23,60	12,12	5,98	3,73
180		23,60	15,79	7,76	4,80
190		23,60	17,70	9,99	6,15
205		23,60	17,70	11,80	8,80
215		23,60	17,70	11,80	8,80
480		23,60	17,70	11,80	8,80
120	M27	12,97	3,53	1,89	1,31
135		20,55	5,56	2,86	1,92
160		30,90	11,25	5,62	3,58
175		30,90	16,67	8,29	5,19
190		30,90	23,10	12,01	7,44
205		30,90	23,10	15,30	10,56
215		30,90	23,10	15,30	11,50
230		30,90	23,10	15,30	11,50
540		30,90	23,10	15,30	11,50
135	M30	18,06	4,72	2,39	1,59
150		27,32	7,13	3,55	2,28
180		37,60	15,27	7,53	4,68
195		37,60	21,77	10,70	6,60
210		37,60	28,10	14,96	9,20
250		37,60	28,10	18,70	14,00
600		37,60	28,10	18,70	14,00

[1)] see also sector 3.1

HIT-Z-R (strength class A4-70) HIT-V-R (strength class A4-70) **cracked reinforced concrete**



anchoring depth [mm]	Anchor rod dimension	fire resistance time [minutes] as a function of maximum loading [kN] in a fire (centric tensile load)			
		30	**60**	**90**	**120**
h_{ef}/h_{nom}	-	$N_{Rd,fi(t)}$ [1]			
80	M16	1,74	0,55	0,33	0,25
95		3,37	0,99	0,55	0,40
105		5,07	1,46	0,78	0,54
110		6,18	1,76	0,92	0,63
120		9,09	2,55	1,29	0,86
130		13,20	3,63	1,80	1,16
135		16,04	4,34	2,13	1,35
145		20,10	6,07	2,95	1,83
160		20,10	9,86	4,69	2,85
180		20,10	14,60	8,43	5,01
200		20,10	14,60	9,10	6,30
220		20,10	14,60	9,10	6,30
320		20,10	14,60	9,10	6,30
90	M20	2,84	0,87	0,51	0,38
100		4,22	1,24	0,70	0,51
120		8,94	2,51	1,31	0,89
130		12,61	3,51	1,79	1,18
140		17,61	4,85	2,43	1,57
150		24,21	6,61	3,28	2,08
160		31,40	8,95	4,40	2,75
170		31,40	12,01	5,85	3,61
180		31,40	16,01	7,70	4,72
200		31,40	22,80	13,15	7,90
400		31,40	22,80	14,20	9,90

[1] see also sector 3.1

HIT-Z-R (strength class A4-70) HIT-V-R (strength class A4-70) **cracked reinforced concrete**

anchoring depth [mm]	Anchor rod dimension	fire resistance time [minutes] as a function of maximum loading [kN] in a fire (centric tensile load)			
		30	**60**	**90**	**120**
h_{ef}/h_{nom}	-	$N_{Rd,fi}$ [1]			
110	M24	7,36	2,02	1,09	0,77
120		10,25	2,80	1,46	1,00
145		22,25	6,04	3,02	1,94
155		29,68	8,04	3,99	2,53
170		44,38	12,12	5,98	3,73
180		45,20	15,79	7,76	4,80
190		45,20	20,48	9,99	6,15
205		45,20	29,88	14,45	8,83
215		45,20	32,80	18,34	11,12
480		45,20	32,80	20,50	14,30
120	M27	12,97	3,53	1,89	1,31
135		20,55	5,56	2,86	1,92
160		30,90	11,25	5,62	3,58
175		30,90	16,67	8,29	5,19
190		30,90	23,10	12,01	7,44
205		30,90	23,10	15,30	10,56
215		30,90	23,10	15,30	11,50
230		30,90	23,10	15,30	11,50
540		30,90	23,10	15,30	11,50
135	M30	18,06	4,72	2,39	1,59
150		27,32	7,13	3,55	2,28
180		58,28	15,27	7,53	4,68
195		71,90	21,77	10,70	6,60
210		71,90	30,66	14,96	9,20
250		71,90	52,20	32,50	21,08
600		71,90	52,20	32,50	22,70

[1] see also sector 3.1

HIT – RE 500-V3

The Hilti HIT-RE 500-V3 anchors, were subjected to tests utilising the heating conditions of DIN EN 1363-1, as reported under the reference MFPA Leipzig GmbH GS 3.2. The performance ratings given in this report are as follows

Table A2.1 *Characteristic pull-out resistance for M8 to M12 if electrogalvanized steel (5.8 and 8.8) is used as anchor*

Characteristic resistance against pull-out (kN)					
Size	**Embedment depth h_{ef} [mm]**	**R30**	**R60**	**R90**	**R120**
8	60	1.21	0.00	0.00	0.00
	65	1.63	0.01	0.00	0.00
	70	2.07	0.33	0.00	0.00
	80	3.03	1.05	0.00	0.00
	100	5.09	2.76	1.39	0.51
	120	11.00	4.71	3.10	1.97
	160	30.93	13.35	7.08	5.62
10	60	1.14	0.00	0.00	0.00
	70	2.17	0.02	0.00	0.00
	80	3.35	0.90	0.00	0.00
	90	4.57	1.87	0.42	0.00
	100	5.86	2.95	1.29	0.20
	125	12.19	5.96	3.93	2.49
	150	26.91	9.25	6.96	5.27
	200	60.01	35.69	19.86	11.62
12	70	2.19	0.00	0.00	0.00
	80	3.53	0.61	0.00	0.00
	85	4.24	1.17	0.00	0.00
	90	4.97	1.72	0.01	0.00
	95	5.72	2.36	0.53	0.00
	100	6.47	2.99	1.05	0.00
	110	8.05	4.33	2.18	0.76
	120	9.69	5.79	3.45	1.84
	150	26.61	10.40	7.69	5.68
	240	98.15	67.64	46.45	30.49

Table A2.2 *Characteristic pull-out resistance for M16 to M24 if electrogalvanized steel (5.8 and 8.8) is used as anchor*

Characteristic resistance against pull-out (kN)					
Size	**Embedment depth h_{ef} [mm]**	**R30**	**R60**	**R90**	**R120**
16	80	3.63	0.00	0.00	0.00
	95	6.41	1.91	0.00	0.00
	105	8.42	3.55	0.92	0.00
	110	9.44	4.41	1.64	0.00
	120	11.53	6.24	3.17	1.16
	130	13.67	8.10	4.88	2.61
	135	14.74	9.12	5.75	3.41
	145	18.32	11.12	7.61	5.07
	160	31.38	14.28	10.51	7.79
	320	201.83	158.38	128.12	103.60
20	90	5.65	0.15	0.00	0.00
	100	7.99	2.03	0.00	0.00
	120	12.94	6.14	2.44	0.00
	130	15.59	8.41	4.39	1.70
	140	18.27	10.80	6.54	3.57
	150	20.99	13.26	8.79	5.60
	160	25.42	15.83	11.14	7.78
	170	35.95	18.47	13.58	10.05
	180	47.46	21.13	16.10	12.41
	200	71.81	27.07	21.28	17.35
	400	343.33	284.48	245.00	213.05
24	95	6.20	0.00	0.00	0.00
	110	10.24	2.66	0.00	0.00
	120	13.09	4.97	0.75	0.00
	145	20.82	11.48	6.44	3.00
	155	24.03	14.35	9.00	5.28
	170	28.90	18.79	13.05	9.01
	180	33.55	21.89	15.92	11.66
	190	45.21	25.04	18.84	14.45
	205	65.96	29.88	23.41	18.74
	215	80.31	33.14	26.56	21.73
	480	511.01	433.53	384.45	345.69

Table A2.3 *Characteristic pull-out resistance for M27 and M30 if electrogalvanized steel (5.8 and 8.8) is used as anchor*

Characteristic resistance against pull-out (kN)					
Size	**Embedment depth h_{ef} [mm]**	**R30**	**R60**	**R90**	**R120**
27	110	11.09	2.18	0.00	0.00
	120	14.35	4.73	0.00	0.00
	135	19.41	8.94	3.50	0.00
	160	28.35	16.73	10.39	6.03
	175	33.88	21.76	15.01	10.24
	190	44.94	26.99	19.86	14.80
	205	67.95	32.38	24.93	19.58
	215	83.87	36.02	28.37	22.68
	540	679.10	585.29	526.83	481.26
30	120	13.90	3.25	0.00	0.00
	135	19.32	7.55	1.70	0.00
	150	24.98	12.31	5.85	1.53
	180	37.08	22.88	15.31	10.11
	195	43.27	28.56	20.54	14.95
	210	60.52	34.45	25.99	20.09
	600	847.98	733.54	665.54	613.79

Table A3.1 Characteristic pull-out resistance for M8 to M12 if stainless steel (A4) is used as anchor

Characteristic resistance against pull-out (kN)					
Size	**Embedment depth h_{ef} [mm]**	**R30**	**R60**	**R90**	**R120**
8	60	1.66	0.20	0.00	0.00
	65	2.12	0.45	0.00	0.00
	70	2.57	0.77	0.00	0.00
	80	3.57	1.55	0.46	0.00
	100	9.18	3.31	1.89	0.96
	120	18.46	5.31	3.66	2.48
	160	39.59	19.78	8.48	6.18
10	60	1.82	0.02	0.00	0.00
	70	2.95	0.70	0.00	0.00
	80	4.19	1.62	0.33	0.00
	90	5.55	2.69	1.13	0.15
	100	9.72	3.82	2.07	0.92
	125	24.06	6.93	4.82	3.30
	150	40.41	17.28	7.92	6.16
	200	74.63	48.02	29.83	17.18
12	70	3.26	0.56	0.00	0.00
	80	4.70	1.62	0.08	0.00
	85	5.47	2.21	0.54	0.00
	90	6.23	2.85	1.02	0.00
	95	7.24	3.50	1.52	0.31
	100	9.61	4.20	2.09	0.77
	110	15.75	5.62	3.34	1.78
	120	22.62	7.12	4.66	2.94
	150	45.66	18.52	9.04	6.93
	240	119.74	87.28	63.51	45.14

Table A3.2 Characteristic pull-out resistance for M16 to M24 if stainless steel (A4) is used as anchor

Characteristic resistance against pull-out (kN)					
Size	**Embedment depth h_{ef} [mm]**	**R30**	**R60**	**R90**	**R120**
16	80	5.47	1.40	0.00	0.00
	95	8.50	3.76	1.26	0.00
	105	11.71	5.55	2.71	0.88
	110	15.46	6.50	3.50	1.51
	120	23.94	8.44	5.18	2.96
	130	33.32	10.47	7.03	4.54
	135	38.22	11.51	7.96	5.44
	145	48.40	15.23	9.92	7.20
	160	64.25	27.10	12.98	10.04
	320	240.40	196.47	163.69	136.49
20	90	8.47	2.76	0.01	0.00
	100	11.06	4.78	1.47	0.00
	120	23.30	9.33	5.33	2.58
	130	34.28	11.80	7.48	4.48
	140	46.23	14.39	9.83	6.60
	150	58.83	17.62	12.27	8.78
	160	71.83	26.28	14.80	11.13
	170	85.12	36.70	17.39	13.56
	180	98.59	48.03	21.00	16.07
	200	125.85	72.49	39.93	21.32
	400	402.03	345.52	304.34	269.93
24	95	10.21	2.99	0.00	0.00
	110	14.76	6.60	2.42	0.00
	120	18.65	9.31	4.60	1.61
	145	49.59	16.71	11.05	7.19
	155	64.21	19.85	13.93	9.82
	170	87.26	30.91	18.45	13.92
	180	103.10	43.19	21.55	16.84
	190	119.18	56.54	25.26	19.86
	205	143.59	78.10	40.69	24.50
	215	159.98	93.17	53.21	28.63
	480	599.14	528.53	479.05	438.18

Table A3.3 Characteristic pull-out resistance for M27 and M30 if stainless steel (A4) is used as anchor

Characteristic resistance against pull-out (kN)					
Size	**Embedment depth h_{ef} [mm]**	**R30**	**R60**	**R90**	**R120**
27	110	16.36	6.81	2.03	0.00
	120	20.04	9.85	4.47	1.06
	135	37.56	14.59	8.57	4.52
	160	77.50	23.29	16.43	11.59
	175	103.65	36.53	21.52	16.29
	190	130.60	58.01	26.81	21.20
	205	158.00	81.71	39.94	26.41
	215	176.41	98.45	53.58	29.96
	540	782.37	699.43	642.39	595.70
30	120	20.67	9.14	3.38	0.05
	135	31.88	14.22	7.69	3.41
	150	55.91	19.76	12.53	7.61
	180	111.52	35.42	23.37	17.48
	195	141.24	57.94	29.22	22.94
	210	171.49	83.41	38.57	28.68
	600	978.98	881.50	817.03	765.10

HIT-RE 500/HAS-R, HIT-RE 500/HIS-R

The Hilti HIT-RE 500 (-R) series of anchors, were subjected to tests utilising the heating conditions of DIN EN 1363-1, as reported under the reference IBMB 3565/4595. The performance ratings given in this report are as follows:

Anchor Reference	Anchor Size	Maximum tensile load (kN) for requested fire resistance duration (mins)			
		30	60	90	120
HIT-RE 500/HAS -R & HIT-RE 500/HIS –R & HIT-RE500/HAS-ER/HAS-HCR & HIT-RE 500/HIS-RN	M8	2.42	1.88	1.34	1.07
	M10	3.84	2.98	2.12	1.69
	M12	6.5	5.5	4.5	4.0
	M16	12.1	10.24	8.37	7.44
	M20	18.88	15.98	13.07	11.61
	M24	27.21	23.02	18.83	16.73
	M27	35.38	29.93	24.48	21.75
	M30	43.24	36.58	29.92	26.59
	M33	53.49	45.25	37.01	32.89
	M36	70.68	59.79	48.9	43.46
	M39	75.23	63.64	52.05	46.26

HIT-RE 500-SD
HIT-RE 500-SD, HIT-V(-R), HAS-E(-R) HIS-N(R

The Hilti HIT-RE 500-SD with threaded rod HIT-V(-R) and HAS-E(R) series of anchors, were subjected to tests utilising the heating conditions of DIN EN 1363-1, as reported under the reference MFPA GS3.2/13-122-1. The performance ratings given in this report are as follows:

Table A 2.1: Characteristic values for anchor failure mode (steel- or bond failure mode) for centric tensile loads of Hilti HIT-RE 500-SD injectable adhesive with HIT-V-5.8(F) and HIT-V-8.8(F) threaded rods on exposure to fire. Anchor sizes M8 to M16.

Nominal diameter of thread	Nominal diameter of hole	Anchorage depth	Characteristic tensile loads $F_{R,k,p,fi(t)}$ [2)] and $F_{R,k,s,fi(t)}$ [3)] depending on fire resistance time [1)] (galvanized / hot-dip galvanized steel, 5.8 u. 8.8 grade)			
HIT-V-...	d_0	h_{ef}	t=30	t=60	t=90	t=120
[mm]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
M8	10	40	0,47	0,12	0,00	0,00
		50	0,75	0,28	0,00	0,00
		60	1,12	0,48	0,13	0,00
		70	1,62	0,74	0,29	0,12
		80	2,30	1,08	0,50	0,28
		90		1,26	0,73	0,46
		160				
M10	12	40	0,52	0,15	0	0
		50	0,82	0,35		
		60	1,23	0,60	0,16	0,00
		70	1,78	0,93	0,37	0,15
		80	2,52	1,35	0,63	0,35
		90	3,53	1,90	0,96	0,59
		100	3,7	2,00	1,15	0,73
		200				
M12	14	48	0,75	0,30	0	0
		60	1,24	0,60	0,16	
		70	1,79	0,94	0,37	0,12
		80	2,54	1,36	0,63	0,28
		90	3,55	1,92	0,97	0,48
		100	4,91	2,63	1,40	0,72
		110	5,35	2,91	1,68	1,04
		120				1,06
		240				
M16	18	64	1,56	0,74	0,24	0,02
		80	2,78	1,41	0,65	0,32
		90	3,88	1,98	1,00	0,55
		100	5,37	2,72	1,45	0,84
		110	7,38	3,67	2,01	1,20
		120	10,00	4,91	2,73	1,66
		130		5,42	3,12	1,97
		320				

1) It must be checked whether the permissible cold loads given in the tables in ETA-07/0260 may be applied.
2) $F_{R,k,p,fi(t)}$: characteristic resistance value on exposure to fire for pull-out failure mode.
3) $F_{R,k,s,fi(t)}$: characteristic resistance value on exposure to fire for steel failure mode (gray background)
Note: Interpolation of intermediate values is permissible. Extrapolation is not permissible.

Table A 3.1: Characteristic values for anchor failure mode (steel- or bond failure mode) for centric tensile loads of Hilti HIT-RE 500-SD injectable adhesive with HIT-V-R and HIT-V-HCR threaded rods on exposure to fire. Anchor sizes M8 to M12.

Nominal diameter of thread	Nominal diameter of hole	Anchorage depth	Characteristic tensile loads $F_{R,k,p,fi(t)}$ [2] and $F_{R,k,s,fi(t)}$ [3] depending on fire resistance time [1] (stainless- and high corrosion-resistant steel)			
HIT-V_R HIT-V-HCR	d_0	h_{ef}	t=30	t=60	t=90	t=120
[mm]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
M8	10	40	0,49	0,12	0,00	0,00
		50	0,79	0,28		
		60	1,18	0,48	0,13	
		70	1,71	0,74	0,29	0,12
		80	2,42	1,08	0,50	0,28
		90		1,52	0,77	0,47
		100		1,88	1,11	0,72
		110			1,34	1,03
		120				1,07
		160				
M10	12	40	0,54	0,15	0,00	0,00
		50	0,85	0,35		
		60	1,28	0,60	0,16	
		70	1,85	0,93	0,37	0,15
		80	2,62	1,35	0,63	0,35
		90	3,84	1,90	0,96	0,59
		100		2,61	1,39	0,90
		110		2,98	1,93	1,28
		120			2,12	1,69
		200				
M12	14	48	0,75	0,36	0,00	0,00
		60	1,24	0,72	0,19	
		70	1,79	1,11	0,44	0,18
		80	2,54	1,62	0,76	0,42
		90	3,55	2,28	1,16	0,71
		100	4,91	3,13	1,67	1,08
		110	6,50	4,24	2,32	1,54
		120		5,50	3,16	2,13
		130			4,22	2,87
		140			4,50	3,80
		150				4,00
		240				

1) It must be checked whether the permissible cold loads given in the tables in ETA-07/0260 may be applied.
2) $F_{R,k,p,fi(t)}$: characteristic resistance value on exposure to fire for pull-out failure mode.
3) $F_{R,k,s,fi(t)}$: characteristic resistance value on exposure to fire for steel failure mode (gray background)
Note: Interpolation of intermediate values is permissible. Extrapolation is not permissible.

Table A 3.2: Characteristic values for anchor failure mode (steel- or bond failure mode) for centric tensile loads of Hilti HIT-RE 500-SD injectable adhesive with HIT-V-R and HIT-V-HCR threaded rods on exposure to fire. Anchor sizes M16 to M24.

Nominal diameter of thread	Nominal diameter of hole	Anchorage depth	Characteristic tensile loads $F_{R,k,p,fi(t)}$ [2] und $F_{R,k,s,fi(t)}$ [3] depending on fire resistance time [1] (stainless- and high corrosion-resistant steel)			
HIT-V_R HIT-V-HCR	d_0	h_{ef}	t=30	t=60	t=90	t=120
[mm]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
M16	18	64	1,63	1,14	0,37	0,04
		80	2,90	1,48	1,01	0,55
		90	4,05	2,16	1,54	0,94
		100	5,60	3,04	2,22	1,43
		110	7,69	4,18	3,10	2,05
		120	10,51	5,65	4,21	2,84
		130	12,10	7,56	5,62	3,82
		140		10,03	7,43	5,07
		150		10,24	8,37	6,64
		160			8,37	7,44
		320				
M20	24	80	3,28	1,76	0,96	0,53
		90	4,59	2,47	1,47	0,90
		100	6,35	3,40	2,11	1,36
		110	8,72	4,59	2,94	1,95
		120	11,91	6,14	4,00	2,69
		130	15,51	8,15	5,34	3,63
		140	18,88	10,74	7,06	4,81
		150		14,10	9,25	6,31
		160		15,98	12,04	8,19
		170			13,07	10,56
		180				11,61
		400				
M24	28	96	6,05	3,58	2,18	1,38
		120	13,02	7,39	4,80	3,23
		130	16,94	9,81	6,41	4,36
		140	20,87	12,93	8,47	5,78
		150	24,80	16,98	11,10	7,57
		160	27,21	22,21	14,45	9,83
		170		23,02	18,72	12,68
		180		23,02	18,83	16,27
		480				16,73

1) It must be checked whether the permissible cold loads given in the tables in ETA-07/0260 may be applied.
2) $F_{R,k,p,fi(t)}$: characteristic resistance value on exposure to fire for pull-out failure mode.
3) $F_{R,k,s,fi(t)}$: characteristic resistance value on exposure to fire for steel failure mode (gray background)
Note: Interpolation of intermediate values is permissible. Extrapolation is not permissible.

Table A 3.3: Characteristic values (characteristic values for anchor failure mode (steel- or bond failure mode for centric tensile loads of Hilti HIT-RE 500-SD injectable adhesive with HIT-V-R and HIT-V-HCR threaded rod on exposure to fire. Anchor sizes M27 to M30.

Nominal diameter of thread	Nominal diameter of hole	Anchorage depth	Characteristic tensile loads $F_{R,k,p,fi(t)}$ [2] und $F_{R,k,s,fi(t)}$ [3] depending on fire resistance time [1] (stainless- and high corrosion-resistant steel)			
HIT-V_R HIT-V-HCR	d_0	h_{ef}	t=30	t=60	t=90	t=120
[mm]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
M27	30	108	8,46	3,58	1,95	1,19
		120	12,37	5,10	2,84	1,77
		130	16,10	6,77	3,80	2,39
		140	19,84	8,92	5,02	3,16
		150	23,57	11,71	6,57	4,14
		160	27,30	15,33	8,55	5,38
		170	31,03	19,06	11,08	6,94
		180	34,76	22,79	14,31	8,91
		190	35,38	26,52	18,04	11,40
		200		29,93	21,77	14,53
		210			24,48	17,99
		220				21,44
		230				21,75
		480				
M30	35	120	12,72	5,24	2,92	1,99
		130	16,55	6,96	3,90	2,69
		140	20,39	9,17	5,15	3,56
		150	24,22	12,04	6,75	4,67
		160	28,06	15,75	8,79	6,06
		170	31,89	19,59	11,39	7,82
		180	35,73	23,43	14,71	10,03
		190	39,57	27,26	18,54	12,83
		200	43,24	31,10	22,38	16,36
		210		34,93	26,22	20,25
		220		36,58	29,92	24,13
		230				26,59
		600				

1) It must be checked whether the permissible cold loads given in the tables in ETA-07/0260 may be applied.
2)$F_{R,k,p,fi(t)}$: characteristic resistance value on exposure to fire for pull-out failure mode.
3)$F_{R,k,s,fi(t)}$: characteristic resistance value on exposure to fire for steel failure mode (gray background)
Note: Interpolation of intermediate values is permissible. Extrapolation is not permissible.

Table A 4.1: Characteristic values for centric tensile loads of Hilti HIT-RE 500-SD injectable adhesive with HIT-N internal threaded galvanized steel sleeves (5.8 or 8.8 grade)[4] on exposure to fire

Nominal diameter of thread	Nominal diameter of hole	Anchorage depth	Characteristic tensile loads $F_{R,k,s,fi(t)}$ depending on fire resistance time [1)4)] (galvanized steel)			
HIT-N	d_0	h_{ef}	t=30	t=60	t=90	t=120
[mm]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
M8	14	90	2,30	1,26	0,73	0,46
M10	18	110	3,70	2,00	1,15	0,73
M12	22	125	5,35	2,91	1,68	1,06
M16	28	170	10,00	5,42	3,12	1,97
M20	32	205	15,60	8,46	4,87	3,08

1) It must be checked whether the permissible cold loads given in the tables in ETA-07/0260 may be applied.
4) The values were taken from [4]

Tabelle A 4.2: Characteristic values for centric tensile loads of Hilti HIT-RE 500-SD injectable adhesive with HIS-RN internal threaded steinless steel sleeves (material 1.4401; 1.4404; 1.4571) [5] on exposure to fire

Nominal diameter of thread	Nominal diameter of hole	Anchorage depth	Characteristic tensile loads $F_{R,k,s,fi(t)}$ depending on fire resistance time (stainless- and high corrosion-resistant steel)[1)5)]			
HIT-RN	d_0	h_{ef}	t=30	t=60	t=90	t=120
[mm]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
M8	14	90	2,42	1,88	1,34	1,07
M10	18	110	3,84	2,98	2,12	1,69
M12	22	125	6,50	5,50	4,50	4,00
M16	28	170	12,10	10,24	8,37	7,44
M20	32	205	18,88	15,98	13,07	11,61

1) It must be checked whether the permissible cold loads given in the tables in ETA-07/0260 may be applied.
5) The values were taken from [3].

HVU2

The Hilti HVU2 with threaded rod HAS series of anchors, were subjected to tests utilising the heating conditions of DIN EN 1363-1, as reported under the reference ETA 16/0515. The performance ratings given in this report are as follows:

*Table 5-1: Summary of the characteristic resistance for **non-cracked** concrete, HAS, carbon steel (strength class higher than 5.8)*

Anchorage depth h_{ef}	Anchor diameter	Maximum tension laod $N_{Rd,fi(t)}$ depending on the fire resistance time			
		30 min	60 min	90 min	120 min
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
80	8	1,83	1,39	0,58	0,28
90	10	2,90	2,20	0,97	0,47
110	12	4,22	3,20	2,19	1,31
125	16	7,85	5,97	3,98	2,22
170	20	12,25	9,31	6,37	4,41
210	24	17,65	13,41	9,18	6,35
240	27	22,95	17,44	11,93	8,26
270	30	28,05	21,32	14,59	10,10

*Table 5-2: Summary of the characteristic resistance for **non-cracked** concrete, HAS, stainless steel (strength class 70)*

Anchorage depth h_{ef}	Anchor diameter	Maximum tension laod $N_{Rd,fi(t)}$ depending on the fire resistance time			
		30 min	60 min	90 min	120 min
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
80	8	4,19	1,51	0,58	0,28
90	10	6,64	2,33	0,97	0,47
110	12	9,65	4,88	2,49	1,31
125	16	17,08	7,40	3,98	2,22
170	20	28,05	19,67	11,29	7,11
210	24	40,42	28,35	16,27	10,24
240	27	52,56	36,86	21,16	13,31
270	30	64,23	45,05	25,86	16,27

*Table 5-3: Summary of the characteristic resistance for **cracked** concrete, HAS, carbon steel (strength class higher than 5.8)*

Anchorage depth h_{ef}	Anchor diameter	Maximum tension laod $N_{Rd,fi(t)}$ depending on the fire resistance time			
		30 min	60 min	90 min	120 min
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
80	8	0,00	0,00	0,00	0,00
90	10	2,90	1,75	0,73	0,35
110	12	4,22	3,20	1,87	0,99
125	16	7,85	5,55	2,98	1,66
170	20	12,25	9,31	6,37	4,41
210	24	17,65	13,41	9,18	6,35
240	27	22,95	17,44	11,93	8,26
270	30	28,05	21,32	14,59	10,10

*Table 5-4: Summary of the characteristic resistance for **cracked** concrete, HAS, stainless steel (strength class 70)*

Anchorage depth h_{ef}	Anchor diameter	Maximum tension laod $N_{Rd,fi(t)}$ depending on the fire resistance time			
		30 min	60 min	90 min	120 min
[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
80	8	0,00	0,00	0,00	0,00
90	10	4,98	1,75	0,73	0,35
110	12	8,97	3,66	1,87	0,99
125	16	12,81	5,55	2,98	1,66
170	20	28,05	16,28	10,14	6,89
210	24	40,42	28,35	16,27	10,24
240	27	52,56	36,86	21,16	13,31
270	30	64,23	45,05	25,86	16,27

*Table 5-5: Summary of the characteristic resistance for **non-cracked** concrete, HIS-N, carbon steel*

Anchorage depth h_{ef}	outer diameter of the sleeve	Anchor diameter	Maximum tension laod $N_{Rd,fi(t)}$ depending on the fire resistance time			
			30 min	60 min	90 min	120 min
[mm]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
90	12,5	8	1,83	1,39	0,85	0,43
110	16,5	10	2,90	2,20	1,51	1,02
125	20,5	12	4,22	3,20	2,19	1,52
170	25,4	16	7,85	5,97	4,08	2,83
205	27,6	20	12,25	9,31	6,37	4,41

*Table 5-6: Summary of the characteristic resistance for **non-cracked** concrete, HIS-N, stainless steel*

Anchorage depth h_{ef}	outer diameter of the sleeve	Anchor diameter	Maximum tension laod $N_{Rd,fi(t)}$ depending on the fire resistance time			
			30 min	60 min	90 min	120 min
[mm]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
90	12,5	8	4,19	2,18	0,85	0,43
110	16,5	10	6,64	4,47	2,04	1,02
125	20,5	12	9,65	6,77	3,35	1,75
170	25,4	16	17,98	12,61	7,24	4,55
205	27,6	20	28,05	19,67	11,29	7,11

*Table 5-7: Summary of the characteristic resistance for **cracked** concrete, HIS-N, carbon steel*

Anchorage depth h_{ef}	outer diameter of the sleeve	Anchor diameter	Maximum tension laod $N_{Rd,fi(t)}$ depending on the fire resistance time			
			30 min	60 min	90 min	120 min
[mm]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
90	12,5	8	1,83	1,39	0,64	0,33
110	16,5	10	2,90	2,20	1,51	0,76
125	20,5	12	4,22	3,20	2,19	1,31
170	25,4	16	7,85	5,97	4,08	2,83
205	27,6	20	12,25	9,31	6,37	4,41

*Table 5-8: Summary of the characteristic resistance for **cracked** concrete, HIS-N, stainless steel*

Anchorage depth h_{ef}	outer diameter of the sleeve	Anchor diameter	Maximum tension laod $N_{Rd,fi(t)}$ depending on the fire resistance time			
			30 min	60 min	90 min	120 min
[mm]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]
90	12,5	8	4,19	1,63	0,64	0,33
110	16,5	10	6,64	3,35	1,53	0,76
125	20,5	12	9,65	5,12	2,51	1,31
170	25,4	16	17,98	12,61	7,24	4,55
205	27,6	20	28,05	19,67	11,29	7,11

HY270

The Hilti HIT-HY270 anchors, were subjected to tests utilising the heating conditions of DIN EN 1363-1, as reported under the reference MFPA Leipzig GmbH PB 3.2/14-179-1. The performance ratings given in this report are as follows

Table 1: Results of the tensile loading tests with Hilti HIT-HY 270, h_{ef} = 80 mm

Material	Anchor type	Size	Depth of embedment [mm]	Tensile load [kN]	Failure time [min : s]	Cause of failure	Test date
HLZ	HIT-V	M8 (SC 16)	80	0,5	55:03	Pull out	24/10/2006
HLZ	HIT-V	M8 (SC 16)	80	1,0	48:03	Pull out	24/10/2006
HLZ	HIT-V	M8 (SC 16)	80	1,5	38:21	Pull out	24/10/2006
HLZ	HIT-V	M12 (SC 22)	80	0,2	98:00	Pull out	15/12/2006
HLZ	HIT-V	M12 (SC 22)	80	0,4	73:48	Pull out	15/12/2006
HLZ	HIT-V	M12 (SC 22)	80	0,5	51:21	Pull out	24/10/2006
HLZ	HIT-V	M12 (SC 22)	80	1,0	43:03	Pull out	24/10/2006
HLZ	HIT-V	M12 (SC 22)	80	1,5	39:18	Pull out	24/10/2006
HLZ	HIT-IC	M8 (SC 16)	80	0,5	73:18	IG Pull out	24/11/2006
HLZ	HIT-IC	M12 (SC 22)	80	1,0	52:12	IG Pull out	24/11/2006
HLZ	HIT-V	M12 (SC 22)	80	0,2	110:00	Pull out	11/01/2007
KSL	HIT-V	M12 (SC 22)	80	0,5	57:10	Pull out	26/10/2006
KSL	HIT-V	M8 (SC 16)	80	0,5	68:20	Pull out	26/10/2006
KSL	HIT-IC	M8 (SC 16)	80	0,5	86:45	IG Pull out	23/11/2006
KSL	HIT-V	M12 (SC 22)	80	1,0	50:00	Pull out	26/10/2006
KSL	HIT-V	M8 (SC 16)	80	1,0	55:30	Pull out	26/10/2006
KSL	HIT-IC	M12 (SC 22)	80	1,0	57:00	IG Pull out	23/11/2006
KSL	HIT-V	M8 (SC 16)	80	1,5	36:40	Pull out	26/10/2006

Material	Anchor type	Size	Depth of embedment [mm]	Tensile load [kN]	Failure time [min : s]	Cause of failure	Test date
KSL	HIT-V	M12 (SC 22)	80	1,5	46:40	Pull out	26/10/2006
KSV	HIT-IC	M8 (SC 16)	80	0,5	75:30	IG Pull out	30/11/2006
KSV	HIT-V	M12 (SC 22)	80	0,5	83:00	Pull out	30/11/2006
KSV	HIT-V	M8 (SC 16)	80	0,5	83:40	Pull out	30/11/2006
KSV	HIT-IC	M12 (SC 22)	80	0,5	83:55	IG Pull out	30/11/2006
MZ	HIT-IC	M12 (SC 22)	80	0,5	136:55	IG Pull out	1/12/2006
MZ	HIT-V	M12 (SC 22)	80	0,5	71:40	Pull out	1/12/2006
MZ	HIT-V	M8 (SC 16)	80	0,5	73:00	Pull out	1/12/2006
MZ	HIT-IC	M8 (SC 16)	80	0,5	87:10	IG Pull out	1/12/2006
PB	HIT-V	M8 (SC 16)	80	0,5	60:30	Pull out	29/11/2006
PB	HIT-V	M12 (SC 22)	80	0,5	56:30	Pull out	29/11/2006
PB	HIT-IC	M8 (SC 16)	80	0,5	56:30	IG Pull out	29/11/2006
PB	HIT-IC	M12 (SC 22)	80	0,5	51:35	IG Pull out	29/11/2006
ZD	HIT-V	M6 (SC 12)	80	2,0	20:48	Pull out	02/04/2007
ZD	HIT-V	M6 (SC 12)	80	1,0	31:54	Thread	02/04/2007
ZD	HIT-V	M6 (SC 12)	80	0,4	68:06	Pull out	02/04/2007

Table 2: Results of the tensile loading tests with Hilti HIT-HY 270, h_{ef} = 130 mm, M6

Material	Anchor type	Size	Depth of embedment [mm]	Tensile load [kN]	Failure time [min : s]	Cause of failure	Test date
ZD	HIT-V	M6 (SC 12)	130	1,3	37:00	Thread	02/04/2007
ZD	HIT-V	M6 (SC 12)	130	0,7	36:28	Thread	02/04/2007
ZD	HIT-V	M6 (SC 12)	130	0,4	20:18	Shear	02/04/2007

Table 3: Results of the tensile loading tests with Hilti HIT-HY 270, h_{ef} = 130 mm, M8

Material	Anchor type	Size	Depth of embedment [mm]	Tensile load [kN]	Failure time [min : s]	Cause of failure	Test date
HLZ	HIT-V	M8 (SC 16)	130	0,5	128:24	Steel breakage	24/11/2006
HLZ	HIT-V	M8 (SC 16)	130	0,65	112:48	Steel breakage	15/12/2006
HLZ	HIT-V	M8 (SC 16)	130	0,8	97:51	Steel breakage	15/12/2006
HLZ	HIT-V	M8 (SC 16)	130	1,0	69:54	Thread	24/11/2006
HLZ	HIT-V	M8 (SC 16)	130	2,4	42:18	Thread	11/01/2007
KSL	HIT-V	M8 (SC 16)	130	0,5	130:24	Steel breakage	23/11/2006
KSL	HIT-V	M8 (SC 16)	130	1,0	70:57	Thread	23/11/2006
PB	HIT-V	M8 (SC 16)	130	0,4	156:48	Pull out	13/12/2006
PB	HIT-V	M8 (SC 16)	130	0,8	96:45	Steel breakage	13/12/2006
PB	HIT-V	M8 (SC 16)	130	1,0	55:25	Steel breakage	29/11/2006
MZ	HIT-V	M8 (SC 16)	130	1,0	70:15	Thread	1/12/2006

Table 4: Results of the tensile loading tests with Hilti HIT-HY 270, h_{ef} = 130 mm, M12

Material	Anchor type	Size	Depth of embedment [mm]	Tensile load [kN]	Failure time [min : s]	Cause of failure	Test date
HLZ	HIT-V	M12 (SC 22)	130	1,0	129:06	Pull out	24/11/2006
HLZ	HIT-V	M12 (SC 22)	130	1,5	112:15	Thread	24/11/2006
HLZ	HIT-V	M12 (SC 22)	130	2,5	83:42	Steel breakage	15/12/2006
HLZ	HIT-V	M12 (SC 22)	130	5,0	53:42	Thread	11/01/2007
HLZ	HIT-V	M12 (SC 22)	130	3,0	65:15	Pull out	11/01/2007
HLZ	HIT-IC	M12 (SC 22)	130	1,0	154:50	Pull out	11/01/2007
HLZ	HIT-IC	M12 (SC 22)	130	2,0	113:45	Pull out	11/01/2007
KSL	HIT-V	M12 (SC 22)	130	1,0	147:54	Pull out	23/11/2006
KSL	HIT-V	M12 (SC 22)	130	1,5	116:48	Steel breakage	23/11/2006
KSV	HIT-V	M12 (SC 22)	130	1,0	155:10	Thread	8/11/2006
MZ	HIT-V	M12 (SC 22)	130	1,0	143:25	Thread	1/12/2006

Material	Anchor type	Size	Depth of embedment [mm]	Tensile load [kN]	Failure time [min : s]	Cause of failure	Test date
PB	HIT-V	M12 (SC 22)	130	1,0	114:50	Pull out	29/11/2006
PB	HIT-V	M12 (SC 22)	130	1,5	50:33	Pull out	13/12/2006
PB	HIT-V	M12 (SC 22)	130	2,5	55:15	Thread	13/12/2006
PB	HIT-V	M12 (SC 22)	130	3,0	44:42	PB-break out	13/12/2006
PB	HIT-V	M12 (SC 22)	130	1,9	129:45	Pull out and PB-break out	16/01/2007
PB	HIT-V	M12 (SC 22)	130	1,5	50:30	Pull out and PB-break out	16/01/2007
PB	HIT-V	M12 (SC 22)	130	1,2	120:12	Pull out	16/01/2007
PB	HIT-V	M12 (SC 22)	130	0,8	180:02	No failure	16/01/2007

2) Chemical Systems- With Post Installed Reinforced Bars(Rebar)

HIT-RE 500 The following tables load tables for the HIT-RE 500 system, following national design codes are taken from the reports referenced IBMB 3357/0550-5:

BS 8110: 1-1997 Maximum connection force of rebar concerning 'Anchoring' as per BS 8110: 1-1997 during exposure to fire for bar diameters of 8 to 40 mm in relation to anchorage depth and a fire resistance time of 30 to 240 minutes.

Maximum Rebar Force for HIT-RE 500 Injection System

Nominal rebar dia mm	Drill hole dia mm	Max Force of rebar kN	Anchorage depth of rebar	Maximum force of rebar in conjunction with injection system for fire resistance period kN					
			mm	30 mins	60 mins	90 mins	120 mins	180 mins	240 mins
8	10	15.73	65 80 95 115 150 180 205 220 265 305	1.38 2.35 3.87 7.30 15.73	0.57 1.02 1.68 3.07 8.15 15.73	0.19 0.47 0.88 1.71 4.59 9.99 15.73	0.05 0.26 0.55 1.14 3.14 6.75 12.38 15.73	- - 0.12 0.44 1.41 2.94 5.08 6.95 15.73	- - - 0.18 0.80 1.70 2.86 3.82 8.57 15.73
10	12	24.58	80 100 120 140 165 195 220 235 280 320	2.94 5.68 10.66 17.57 24.58	1.27 2.45 4.44 7.76 15.06 24.58	0.59 1.31 2.48 4.38 8.50 17.63 24.58	0.33 0.85 1.68 2.99 5.79 12.18 20.66 24.58	- 0.24 0.68 1.33 2.58 5.12 8.69 11.80 24.58	- - 0.31 0.73 1.50 2.93 4.78 6.30 13.86 24.58
12	16	35.39	95 120 145 175 210 230 250 290 330	5.80 12.79 23.16 35.39	2.52 5.33 10.68 22.22 35.39	1.32 2.97 6.02 13.20 27.38 35.39	0.83 2.01 4.12 8.94 20.65 28.94 35.39	0.18 0.82 1.84 3.93 8.47 12.80 19.13 35.39	- 0.37 1.03 2.26 4.74 6.90 9.89 19.70 35.39
14	18	48.17	110 140 170 190 225 245 260 305 345	10.92 24.60 39.12 48.17	4.65 10.87 23.50 33.18 48.17	2.55 6.13 13.55 22.27 39.20 48.17	1.70 4.19 9.20 15.10 31.34 41.02 48.17	0.61 1.86 4.07 6.43 13.48 20.20 27.07 48.17	0.20 1.03 2.37 3.69 7.34 10.56 13.75 29.66 48.17
16	20	62.92	130 160 190 205 240 260 275 320 360	22.59 39.17 55.76 62.92	9.42 21.33 37.92 46.21 62.92	5.30 11.95 25.45 33.74 53.10 62.92	3.61 8.15 17.25 24.76 44.12 55.17 62.92	1.56 3.65 7.35 10.16 20.88 30.94 39.23 62.92	0.80 2.11 4.22 5.73 11.04 15.72 20.36 42.08 62.92

Minimum yield strength of rebar 460 N/mm^2.
Intermediate values may be obtained by linear interpolation. No extrapolation allowed

Maximum Rebar Force for HIT-RE 500 Injection System

Nominal rebar dia mm	Drill hole dia mm	Max force of rebar kN	Anchorage depth of rebar mm	Maximum force of rebar in conjunction with injection system for fire resistance period kN					
				30 mins	60 mins	90 mins	120 mins	180 mins	240 mins
20	25	98.31	160 200 235 265 290 305 350 390	48.97 76.61 98.31	26.67 54.31 78.50 98.31	14.93 38.73 62.92 83.65 98.31	10.18 24.50 51.69 72.42 89.70 98.31	4.56 11.42 23.60 42.13 59.41 69.77 98.31	2.64 6.48 12.60 21.43 32.83 42.23 73.33 98.31
25	30	153.61	200 250 270 300 325 340 385 425	95.77 138.95 153.61	67.89 111.09 128.37 153.61	48.41 91.60 108.88 134.80 153.61	31.37 77.57 94.85 120.77 142.37 153.61	14.27 39.86 56.98 82.90 104.50 117.45 153.61	8.10 20.61 29.19 48.55 70.07 83.02 121.90 153.61
28	35	192.68	225 250 290 325 345 360 405 445	131.45 155.64 192.68	100.23 124.42 163.12 192.68	78.41 102.60 141.30 175.17 192.68	62.69 86.88 125.58 159.45 178.80 192.68	26.95 44.64 83.17 117.04 136.39 150.90 192.68	14.69 23.08 45.95 78.47 97.83 112.34 155.88 192.68
32	40	251.67	255 280 320 350 375 390 435 475	183.40 211.05 251.67	147.72 175.37 219.60 251.67	122.78 150.43 194.66 227.84 251.67	104.82 132.47 176.70 209.87 237.52 251.67	56.35 83.99 128.23 161.40 189.05 205.63 251.67	28.80 44.34 84.15 117.33 144.98 161.56 211.33 251.67
36	44	318.52	290 320 350 380 400 420 465 500	248.97 287.19 318.52	209.73 247.05 284.37 318.52	181.67 218.99 256.32 293.64 318.52	161.46 198.79 236.11 273.43 298.31 318.52	106.93 144.25 181.58 218.90 243.78 268.66 318.52	59.10 94.67 132.00 169.32 194.20 219.08 275.06 318.52
40	47	393.23	320 350 375 410 430 445 490 530	319.10 360.57 393.23	274.50 315.97 350.53 393.23	243.33 284.80 319.35 367.73 393.23	220.87 262.34 296.90 345.28 372.93 393.23	160.28 201.75 236.31 284.69 312.33 333.07 393.23	105.19 146.66 181.22 229.60 257.25 277.98 340.18 393.23

Minimum yield strength of rebar 460 N/mm^2.

Intermediate values may be obtained by linear interpolation. No extrapolation allowed

DIN 1045

Maximum connection force of rebar concerning 'Anchoring' as per DIN 1045: 1988 during exposure to fire for bar diameters of 8 to 40 mm in relation to anchorage depth and a fire resistance time of 30 to 240 minutes.

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500 (yielding point f_{yk} = 500 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
8	10	14.36	65	1.38	0.57	0.19	0.05	0	0
			80	2.35	1.02	0.47	0.26	0	0
			95	3.87	1.68	0.88	0.55	0.12	0
			115	7.30	3.07	1.71	1.14	0.44	0.18
			145	14.36	7.12	4.01	2.74	1.23	0.69
			175		14.36	8.80	5.96	2.62	1.52
			200			14.36	11.00	4.57	2.59
			215				14.36	6.27	3.48
			260					14.36	7.86
			300						14.36
10	12	22.44	80	2.94	1.27	0.59	0.33	0	0
			100	5.68	2.45	1.31	0.85	0.24	0
			120	10.66	4.44	2.48	1.68	0.68	0.31
			140	17.57	7.76	4.38	2.99	1.33	0.73
			155	22.44	11.66	6.55	4.47	2.01	1.15
			190		22.44	15.91	10.78	4.59	2.64
			210			22.44	17.21	7.06	3.95
			230				22.44	10.66	5.75
			270					22.44	11.68
			310						22.44
12	16	32.31	95	5.80	2.52	1.32	0.83	0.18	0
			120	12.79	5.33	2.97	2.01	0.82	0.37
			145	23.16	10.68	6.02	4.12	1.84	1.03
			170	32.31	20.15	11.61	7.88	3.49	2.03
			200		32.31	23.24	16.50	6.85	3.89
			225			32.31	26.87	11.55	6.29
			240				32.31	15.66	8.28
			285					32.31	18.10
			325						32.31
14	18	43.98	110	10.92	4.65	2.55	1.70	0.61	0.20
			140	24.60	10.87	6.13	4.19	1.86	1.03
			170	39.12	23.50	13.55	9.20	4.07	2.37
			185	43.98	30.76	19.85	13.36	5.75	3.32
			215		43.98	34.36	26.51	10.97	6.08
			235			43.98	36.18	16.52	8.82
			255				43.98	24.65	12.60
			295					43.98	25.00
			335						43.98
16	20	57.45	130	22.59	9.42	5.30	3.61	1.56	0.80
			160	39.17	21.33	11.95	8.15	3.65	2.11
			195	57.45	40.69	28.22	19.49	8.20	4.68
			230		57.45	47.57	38.59	17.06	9.20
			250			57.45	49.65	25.51	13.19
			265				57.45	33.70	17.14
			310					57.45	36.55
			350						57.45

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500 (yielding point f_{yk} = 500 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
20	25	89.76	160	48.97	26.67	14.93	10.18	4.56	2.64
			200	76.61	54.31	38.73	27.50	11.42	6.48
			220	89.76	68.14	52.55	41.32	17.38	9.56
			255		89.76	76.74	65.51	35.22	18.00
			275			89.76	79.34	49.04	25.45
			295				89.76	62.86	35.72
			335					89.76	62.96
			375						89.76
25	30	140.25	200	95.77	67.89	48.41	34.37	14.27	8.10
			250	138.96	111.09	91.60	77.57	39.86	20.61
			255	140.25	115.41	95.92	81.89	44.02	22.50
			285		140.25	121.84	107.81	69.94	37.71
			310			140.25	129.41	91.54	57.11
			325				140.25	104.50	70.07
			370					140.25	108.94
			410						140.25
32	40	229.79	255	183.40	147.72	122.78	104.82	56.35	28.80
			275	205.52	169.84	144.90	126.94	78.46	40.71
			300	229.79	197.48	172.54	154.58	106.11	62.15
			330		229.79	205.72	187.76	139.28	95.21
			355			229.79	215.40	166.93	122.86
			370				229.79	183.52	139.45
			415					229.79	189.21
			455						229.79
36	44	290.82	290	249.87	209.73	181.67	161.46	106.93	59.10
			305	268.53	228.39	200.33	180.13	125.59	76.01
			325	290.82	253.27	225.21	205.01	150.47	100.89
			360		290.82	268.76	248.55	194.02	144.44
			380			290.82	273.43	218.90	169.32
			395				290.82	237.56	187.98
			440					290.82	243.96
			480						290.82
40	47	359.04	320	319.10	274.50	243.33	220.87	160.28	105.19
			335	339.84	295.24	264.06	241.61	181.02	125.93
			350	359.04	315.97	284.80	262.34	201.75	146.66
			385		359.04	333.18	310.72	250.13	195.04
			405			359.04	338.37	277.78	222.69
			420				359.04	298.51	243.42
			465					359.04	305.63
			505						359.04

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

DIN 1045 & Eurocode 2

Maximum connection force of rebar concerning 'Anchoring' as per DIN 1045: 2001 and Eurocode 2: 1992 during exposure to fire for bar diameters of 8 to 40 mm in relation to anchorage depth and a fire resistance time of 30 to 240 minutes.

Nenn-durch-messer	Bohrloch-durch-messer	Maximale Stab-kraft	Ver-ankerungs-tiefe	Maximale Stabkraft in Verbindung mit Hilti HIT-RE 500 (Streckgrenze f_{yk} = 500 N/mm²) in Abhängigkeit von der Feuerwiderstandsdauer					
Ø	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
8	10	16.19	65	1.38	0.57	0.19	0.05	0	0
			80	2.35	1.02	0.47	0.26	0	0
			95	3.87	1.68	0.88	0.55	0.12	0
			115	7.30	3.07	1.71	1.14	0.44	0.18
			150	16.19	8.15	4.59	3.14	1.41	0.80
			180		16.19	9.99	6.75	2.94	1.70
			205			16.19	12.38	5.08	2.86
			220				16.19	6.95	3.82
			265					16.19	8.57
			305						16.19
10	12	25.29	80	2.94	1.27	0.59	0.33	0	0
			100	5.68	2.45	1.31	0.85	0.24	0
			120	10.66	4.44	2.48	1.68	0.68	0.31
			140	17.57	7.76	4.38	2.99	1.33	0.73
			165	25.29	15.06	8.50	5.79	2.58	1.50
			195		25.29	17.63	12.18	5.12	2.93
			220			25.29	20.66	8.69	4.78
			235				25.29	11.80	6.30
			280					25.29	13.86
			320						25.29
12	16	36.42	95	5.80	2.52	1.32	0.83	0.18	0
			120	12.79	5.33	2.97	2.01	0.82	0.37
			145	23.16	10.68	6.02	4.12	1.84	1.03
			180	36.42	24.29	14.99	10.12	4.41	2.55
			210		36.42	27.38	20.65	8.47	4.74
			235			36.42	31.01	14.16	7.56
			250				36.42	19.13	9.89
			295					36.42	21.43
			335						36.42
14	18	49.58	110	10.92	4.65	2.55	1.70	0.61	0.20
			140	24.60	10.87	6.13	4.19	1.86	1.03
			170	39.12	23.50	13.55	9.20	4.07	2.37
			195	49.58	35.60	24.69	17.05	7.17	4.10
			225		49.58	39.20	31.34	13.48	7.34
			250			49.58	43.44	22.32	11.54
			265				49.58	29.49	15.00
			310					49.58	31.98
			350						49.58
16	20	64.75	130	22.59	9.42	5.30	3.61	1.56	0.80
			160	39.17	21.33	11.95	8.15	3.65	2.11
			190	55.76	37.92	25.45	17.25	7.35	4.22
			210	64.75	48.98	36.51	27.53	11.29	6.32
			240		64.75	53.10	44.12	20.88	11.04
			265			64.75	57.94	33.70	17.14
			280				64.75	42.00	22.17
			325					64.75	44.84
			365						64.75

Hinweis : Zwischenwerte dürfen linear interpoliert werden. Eine Extrapolation ist nicht erlaubt.

Nenn-durch-messer	Bohrloch-durch-messer	Maximale Stab-kraft	Ver-ankerungs-tiefe	Maximale Stabkraft in Verbindung mit Hilti HIT-RE 500 (Streckgrenze f_{yk} = 500 N/mm²) in Abhängigkeit von der Feuerwiderstandsdauer					
Ø	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
20	25	101.18	160	48.97	26.67	14.93	10.18	4.56	2.64
			200	76.61	54.31	38.73	27.50	11.42	6.48
			240	101.18	81.96	66.37	55.15	26.10	13.80
			270		101.18	87.11	75.88	45.58	23.36
			295			101.18	93.16	62.86	35.72
			310				101.18	73.23	45.69
			355					101.18	76.79
			395						101.18
25	30	158.09	200	95.77	67.89	48.41	34.37	14.27	8.10
			250	138.96	111.09	91.60	77.57	39.86	20.61
			275	158.09	132.69	113.20	99.17	61.30	31.81
			305		158.09	139.12	125.09	87.22	52.79
			330			158.09	146.69	108.82	74.39
			345				158.09	121.77	87.34
			390					158.09	126.22
			430						158.09
32	40	259.02	255	183.40	147.72	122.78	104.82	56.35	28.80
			275	205.52	169.84	144.90	126.94	78.46	40.71
			325	259.02	225.13	200.19	182.23	133.75	89.68
			360		259.02	238.89	220.93	172.46	128.39
			380			259.02	243.05	194.58	150.51
			395				259.02	211.16	167.09
			440					259.02	216.86
			480						259.02
36	44	327.82	290	249.87	209.73	181.67	161.46	106.93	59.10
			325	293.41	253.27	225.21	205.01	150.47	100.89
			355	327.82	290.59	262.54	242.33	187.80	138.22
			385		327.82	299.86	279.65	225.12	175.54
			410			327.82	310.75	256.22	206.64
			425				327.82	274.88	225.30
			470					327.82	281.28
			510						327.82
40	47	404.71	320	319.10	274.50	243.33	220.87	160.28	105.19
			355	367.48	322.88	291.71	269.25	208.66	153.57
			385	404.71	364.35	333.18	310.72	250.13	195.04
			415		404.71	374.64	352.19	291.60	236.51
			440			404.71	386.75	326.16	271.07
			455				404.71	346.89	291.80
			500					404.71	354.01
			540						404.71

Hinweis : Zwischenwerte dürfen linear interpoliert werden. Eine Extrapolation ist nicht erlaubt.

Eurocode 2

Maximum connection force of rebar concerning 'Anchoring' as per Eurocode 2: 1992 during exposure to fire for bar diameters of 8 to 40 mm in relation to anchorage depth and a fire resistance time of 30 to 240 minutes.

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500 (yielding point f_{yk} = 500 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
8	10	16.19	65	1.38	0.57	0.19	0.05	0	0
			80	2.35	1.02	0.47	0.26	0	0
			95	3.87	1.68	0.88	0.55	0.12	0
			115	7.30	3.07	1.71	1.14	0.44	0.18
			150	16.19	8.15	4.59	3.14	1.41	0.80
			180		16.19	9.99	6.75	2.94	1.70
			205			16.19	12.38	5.08	2.86
			220				16.19	6.95	3.82
			265					16.19	8.57
			305						16.19
10	12	25.29	80	2.94	1.27	0.59	0.33	0	0
			100	5.68	2.45	1.31	0.85	0.24	0
			120	10.66	4.44	2.48	1.68	0.68	0.31
			140	17.57	7.76	4.38	2.99	1.33	0.73
			165	25.29	15.06	8.50	5.79	2.58	1.50
			195		25.29	17.63	12.18	5.12	2.93
			220			25.29	20.66	8.69	4.78
			235				25.29	11.80	6.30
			280					25.29	13.86
			320						25.29
12	16	36.42	95	5.80	2.52	1.32	0.83	0.18	0
			120	12.79	5.33	2.97	2.01	0.82	0.37
			145	23.16	10.68	6.02	4.12	1.84	1.03
			180	36.42	24.29	14.99	10.12	4.41	2.55
			210		36.42	27.38	20.65	8.47	4.74
			235			36.42	31.01	14.16	7.56
			250				36.42	19.13	9.89
			295					36.42	21.43
			335						36.42
14	18	49.58	110	10.92	4.65	2.55	1.70	0.61	0.20
			140	24.60	10.87	6.13	4.19	1.86	1.03
			170	39.12	23.50	13.55	9.20	4.07	2.37
			195	49.58	35.60	24.69	17.05	7.17	4.10
			225		49.58	39.20	31.34	13.48	7.34
			250			49.58	43.44	22.32	11.54
			265				49.58	29.49	15.00
			310					49.58	31.98
			350						49.58
16	20	64.75	130	22.59	9.42	5.30	3.61	1.56	0.80
			160	39.17	21.33	11.95	8.15	3.65	2.11
			190	55.76	37.92	25.45	17.25	7.35	4.22
			210	64.75	48.98	36.51	27.53	11.29	6.32
			240		64.75	53.10	44.12	20.88	11.04
			265			64.75	57.94	33.70	17.14
			280				64.75	42.00	22.17
			325					64.75	44.84
			365						64.75

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500 (yielding point f_{yk} = 500 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
20	25	101.18	160	48.97	26.67	14.93	10.18	4.56	2.64
			200	76.61	54.31	38.73	27.50	11.42	6.48
			240	101.18	81.96	66.37	55.15	26.10	13.80
			270		101.18	87.11	75.88	45.58	23.36
			295			101.18	93.16	62.86	35.72
			310				101.18	73.23	45.69
			355					101.18	76.79
			395						101.18
25	30	158.09	200	95.77	67.89	48.41	34.37	14.27	8.10
			250	138.96	111.09	91.60	77.57	39.86	20.61
			275	158.09	132.69	113.20	99.17	61.30	31.81
			305		158.09	139.12	125.09	87.22	52.79
			330			158.09	146.69	108.82	74.39
			345				158.09	121.77	87.34
			390					158.09	126.22
			430						158.09
32	40	259.02	255	183.40	147.72	122.78	104.82	56.35	28.80
			275	205.52	169.84	144.90	126.94	78.46	40.71
			325	259.02	225.13	200.19	182.23	133.75	89.68
			360		259.02	238.89	220.93	172.46	128.39
			380			259.02	243.05	194.58	150.51
			395				259.02	211.16	167.09
			440					259.02	216.86
			480						259.02
36	44	327.82	290	249.87	209.73	181.67	161.46	106.93	59.10
			325	293.41	253.27	225.21	205.01	150.47	100.89
			355	327.82	290.59	262.54	242.33	187.80	138.22
			385		327.82	299.86	279.65	225.12	175.54
			410			327.82	310.75	256.22	206.64
			425				327.82	274.88	225.30
			470					327.82	281.28
			510						327.82
40	47	404.71	320	319.10	274.50	243.33	220.87	160.28	105.19
			355	367.48	322.88	291.71	269.25	208.66	153.57
			385	404.71	364.35	333.18	310.72	250.13	195.04
			415		404.71	374.64	352.19	291.60	236.51
			440			404.71	386.75	326.16	271.07
			455				404.71	346.89	291.80
			500					404.71	354.01
			540						404.71

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

NF-ENV 1991-2-2: 1955-02

Maximum connection force of rebar concerning 'Anchoring' as per NF-ENV 1991-2-2: 1955-02 during exposure to fire for bar diameters of 8 to 40 mm in relation to anchorage depth and a fire resistance time of 30 to 240 minutes.

Diamètre nominal du fer HA	Diamètre de forage	Force maximale de barre	Longueur de scellement	Force maximale de barre pour Hilti HIT-RE 500 (limite d'étirage f_{yk} = 500 N/mm²) en fonction des classes de résistance au feu					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	daN	daN	daN	daN	daN	daN
8	10	1619	65	138	57	19	5	0	0
			80	235	102	47	26	0	0
			95	387	168	88	55	12	0
			115	730	307	171	114	44	18
			150	1619	815	459	314	141	80
			180		1619	999	675	294	170
			205			1619	1238	508	286
			220				1619	695	382
			265					1619	857
			305						1619
10	12	2529	80	294	127	59	33	0	0
			100	568	245	131	85	24	0
			120	1066	444	248	168	68	31
			140	1757	776	438	299	133	73
			165	2529	1506	850	579	258	150
			195		2529	1763	1218	512	293
			220			2529	2066	869	478
			235				2529	1180	630
			280					2529	1386
			320						2529
12	16	3642	95	580	252	132	83	18	0
			120	1279	533	297	201	82	37
			145	2316	1068	602	412	184	103
			180	3642	2429	1499	1012	441	255
			210		3642	2738	2065	847	474
			235			3642	3101	1416	756
			250				3642	1913	989
			295					3642	2143
			335						3642
14	18	4958	110	1092	465	255	170	61	20
			140	2460	1087	613	419	186	103
			170	3912	2350	1355	920	407	237
			195	4958	3560	2469	1705	717	410
			225		4958	3920	3134	1348	734
			250			4958	4344	2232	1154
			265				4958	2949	1500
			310					4958	3198
			350						4958
16	20	6475	130	2259	942	530	361	156	80
			160	3917	2133	1195	815	365	211
			190	5576	3792	2545	1725	735	422
			210	6475	4898	3651	2753	1129	632
			240		6475	5310	4412	2088	1104
			265			6475	5794	3370	1714
			280				6475	4200	2217
			325					6475	4484
			365						6475

Remarque : Les Valeurs intermédiaires peuvent être obtenues par interpolation linéaire. Extrapolation n'est pas permis.

Diamètre nominal du fer HA	Diamètre de forage	Force maximale de barre	Longueur de scellement	Force maximale de barre pour Hilti HIT-RE 500 (limite d'étirage f_{yk} = 500 N/mm²) en fonction des classes de résistance au feu					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	daN	daN	daN	daN	daN	daN
20	25	10118	160	4897	2667	1493	1018	456	264
			200	7661	5431	3873	2750	1142	648
			240	10118	8196	6637	5515	2610	1380
			270		10118	8711	7588	4558	2336
			295			10118	9316	6286	3572
			310				10118	7323	4569
			355					10118	7679
			395						10118
25	30	15809	200	9577	6789	4841	3437	1427	810
			250	13896	11109	9160	7757	3986	2061
			275	15809	13269	11320	9917	6130	3181
			305		15809	13912	12509	8722	5279
			330			15809	14669	10882	7439
			345				15809	12177	8734
			390					15809	12622
			430						15809
32	40	25902	255	18340	14772	12278	10482	5635	2880
			275	20552	16984	14490	12694	7846	4071
			325	25902	22513	20019	18223	13375	8968
			360		25902	23889	22093	17246	12839
			380			25902	24305	19458	15051
			395				25902	21116	16709
			440					25902	21686
			480						25902
36	44	32782	290	24987	20973	18167	16146	10693	5910
			325	29341	25327	22521	20501	15047	10089
			355	32782	29059	26254	24233	18780	13822
			385		32782	29986	27965	22512	17554
			410			32782	31075	25622	20664
			425				32782	27488	22530
			470					32782	28128
			510						32782
40	47	40471	320	31910	27450	24333	22087	16028	10519
			355	36748	32288	29171	26925	20866	15357
			385	40471	36435	33318	31072	25013	19504
			415		40471	37464	35219	29160	23651
			440			40471	38675	32616	27107
			455				40471	34689	29180
			500					40471	35401
			540						40471

Remarque : Les Valeurs intermédiaires peuvent être obtenues par interpolation linéaire. Extrapolation n'est pas permis.

B 4700 - 2000 Maximum connection force of rebar concerning 'Anchoring' as per BF 4700 - 2000 during exposure to fire for bar diameters of 8 to 40 mm in relation to anchorage depth and a fire resistance time of 30 to 240 minutes.

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500 (yielding point f_{yk} = 550 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
8	10	17.81	65	1.38	0.57	0.19	0.05	0	0
			80	2.35	1.02	0.47	0.26	0	0
			95	3.87	1.68	0.88	0.55	0.12	0
			115	7.30	3.07	1.71	1.14	0.44	0.18
			155	17.81	9.33	5.24	3.58	1.61	0.92
			190		17.81	12.73	8.63	3.67	2.11
			210			17.81	13.76	5.65	3.16
			225				17.81	7.70	4.20
			270					17.81	9.34
			310						17.81
10	12	27.82	80	2.94	1.27	0.59	0.33	0	0
			100	5.68	2.45	1.31	0.85	0.24	0
			120	10.66	4.44	2.48	1.68	0.68	0.31
			140	17.57	7.76	4.38	2.99	1.33	0.73
			170	27.82	16.79	9.68	6.57	2.91	1.69
			205		27.82	21.09	15.48	6.35	3.58
			225			27.82	22.39	9.63	5.25
			245				27.82	14.43	7.54
			285					27.82	15.08
			325						27.82
12	16	40.07	95	5.80	2.52	1.32	0.83	0.18	0
			120	12.79	5.33	2.97	2.01	0.82	0.37
			145	23.16	10.68	6.02	4.12	1.84	1.03
			190	40.07	28.44	19.09	12.94	5.51	3.17
			220		40.07	31.53	24.79	10.43	5.73
			245			40.07	35.16	17.31	9.05
			260				40.07	23.20	11.79
			305					40.07	25.34
			345						40.07
14	18	54.54	110	10.92	4.65	2.55	1.70	0.61	0.20
			140	24.60	10.87	6.13	4.19	1.86	1.03
			170	39.12	23.50	13.55	9.20	4.07	2.37
			205	54.54	40.44	29.53	21.67	8.89	5.01
			235		54.54	44.04	36.18	16.52	8.82
			260			54.54	48.28	27.07	13.75
			275				54.54	34.33	17.81
			320					54.54	36.82
			360						54.54
16	20	71.23	130	22.59	9.42	5.30	3.61	1.56	0.80
			160	39.17	21.33	11.95	8.15	3.65	2.11
			190	55.76	37.92	25.45	17.25	7.35	4.22
			220	71.23	54.51	42.04	33.06	13.90	7.64
			255		71.23	61.39	52.41	28.17	14.40
			275			71.23	63.47	39.23	20.36
			290				71.23	47.52	26.26
			335					71.23	50.37
			375						71.23

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500 (yielding point f_{yk} = 550 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
20	25	111.30	160	48.97	26.67	14.93	10.18	4.56	2.64
			200	76.61	54.31	38.73	27.50	11.42	6.48
			240	104.26	81.96	66.37	55.15	26.10	13.80
			255	111.30	92.33	76.74	65.51	35.22	18.00
			285		111.30	97.47	86.25	55.95	30.17
			305			111.30	100.07	69.77	42.23
			325				111.30	83.60	56.05
			370					111.30	87.15
			405						111.30
26	34	188.09	210	108.58	79.59	59.33	44.73	18.35	10.26
			260	153.51	124.52	104.25	89.66	50.27	25.54
			300	188.09	160.46	140.19	125.60	86.21	50.49
			335		188.09	171.64	157.05	117.66	81.85
			355			188.09	175.02	135.63	99.82
			370				188.09	149.11	113.30
			415					188.09	153.73
			455						188.09
30	38	250.42	240	156.39	122.94	99.56	82.72	39.16	20.69
			300	218.59	185.14	161.76	144.92	99.48	58.26
			335	250.42	221.43	198.05	181.21	135.76	94.45
			365		250.42	229.15	212.31	166.86	125.55
			390			250.42	238.23	192.78	151.47
			405				250.42	208.33	167.02
			450					250.42	213.67
			490						250.42
36	44	360.60	290	249.87	209.73	181.67	161.46	106.93	59.10
			360	336.96	296.81	268.76	248.55	194.02	144.44
			380	360.60	321.70	293.64	273.43	218.90	169.32
			415		360.60	337.18	316.97	262.44	212.86
			435			360.60	341.86	287.32	237.74
			455				360.60	312.20	262.62
			495					360.60	312.39
			535						360.60
40	47	445.19	320	319.10	274.50	243.33	220.87	160.28	105.19
			400	429.69	385.09	353.91	331.46	270.87	215.78
			415	445.19	405.82	374.64	352.19	291.60	236.51
			445		445.19	416.11	393.66	333.07	277.98
			470			445.19	428.22	367.63	312.54
			485				445.19	388.36	333.27
			530					445.19	395.48
			570						445.19

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

CP – 65: 1999

Maximum connection force of rebar concerning 'Anchoring' as per Singapore Standard CP – 65: 1999 during exposure to fire for bar diameters of 8 to 40 mm in relation to anchorage depth and a fire resistance time of 30 to 240 minutes.

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500 (yielding point f_{yk} = 460 Mpa) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
8	10	14.36	65	1.38	0.57	0.19	0.05	0	0
			80	2.35	1.02	0.47	0.26	0	0
			95	3.87	1.68	0.88	0.55	0.12	0
			115	7.30	3.07	1.71	1.14	0.44	0.18
			145	14.36	7.12	4.01	2.74	1.23	0.69
			175		14.36	8.80	5.96	2.62	1.52
			200			14.36	11.00	4.57	2.59
			215				14.36	6.27	3.48
			260					14.36	7.86
			300						14.36
10	12	22.44	80	2.94	1.27	0.59	0.33	0	0
			100	5.68	2.45	1.31	0.85	0.24	0
			120	10.66	4.44	2.48	1.68	0.68	0.31
			140	17.57	7.76	4.38	2.99	1.33	0.73
			155	22.44	11.66	6.55	4.47	2.01	1.15
			190		22.44	15.91	10.78	4.59	2.64
			210			22.44	17.21	7.06	3.95
			230				22.44	10.66	5.75
			270					22.44	11.68
			310						22.44
13	18	37.92	105	8.66	3.72	2.02	1.33	0.43	0.09
			130	18.35	7.65	4.31	2.94	1.27	0.65
			155	29.58	15.16	8.51	5.81	2.61	1.50
			175	37.92	24.07	14.30	9.68	4.25	2.47
			210		37.92	29.66	22.37	9.17	5.13
			230			37.92	31.35	13.86	7.48
			245				37.92	18.76	9.81
			290					37.92	21.34
			330						37.92
16	20	57.45	130	22.59	9.42	5.30	3.61	1.56	0.80
			160	39.17	21.33	11.95	8.15	3.65	2.11
			195	57.45	40.69	28.22	19.49	8.20	4.68
			230		57.45	47.57	38.59	17.06	9.20
			250			57.45	49.65	25.51	13.19
			265				57.45	33.70	17.14
			310					57.45	36.55
			350						57.45
20	25	89.76	160	48.97	26.67	14.93	10.18	4.56	2.64
			200	76.61	54.31	38.73	27.50	11.42	6.48
			220	89.76	68.14	52.55	41.32	17.38	9.56
			255		89.76	76.74	65.51	35.22	18.00
			275			89.76	79.34	49.04	25.45
			295				89.76	62.86	35.72
			335					89.76	62.96
			375						89.76

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500 (yielding point f_{yk} = 460 Mpa) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
22	28	108.61	175	65.27	40.74	24.20	16.38	7.20	4.18
			220	99.48	74.95	57.80	45.45	19.11	10.51
			235	108.61	86.35	69.21	56.86	25.96	13.86
			265		108.61	92.01	79.67	46.34	23.57
			290			108.61	98.67	65.35	36.11
			305				108.61	76.75	46.45
			350					108.61	80.66
			390						108.61
25	30	140.25	200	95.77	67.89	48.41	34.37	14.27	8.10
			250	138.96	111.09	91.60	77.57	39.86	20.61
			255	140.25	115.41	95.92	81.89	44.02	22.50
			285		140.25	121.84	107.81	69.94	37.71
			310			140.25	129.41	91.54	57.11
			325				140.25	104.50	70.07
			370					140.25	108.94
			410						140.25
28	35	175.93	225	131.45	100.23	78.41	62.69	26.96	14.69
			250	155.64	124.42	102.60	86.88	44.64	23.08
			275	175.93	148.61	126.79	111.07	68.65	35.62
			305		175.93	155.81	140.10	97.68	59.12
			330			175.93	164.29	121.87	83.31
			345				175.93	136.39	97.83
			390					175.93	141.37
			430						175.93
32	40	229.79	255	183.40	147.72	122.78	104.82	56.35	28.80
			280	211.05	175.37	150.43	132.47	83.99	44.34
			300	229.79	197.48	172.54	154.58	106.11	62.15
			330		229.79	205.72	187.76	139.28	95.21
			355			229.79	215.40	166.93	122.86
			370				229.79	183.52	139.45
			415					229.79	189.21
			455						229.79
40	47	359.04	320	319.10	274.50	243.33	220.87	160.28	105.19
			335	339.84	295.24	264.06	241.61	181.02	125.93
			350	359.04	315.97	284.80	262.34	201.75	146.66
			385		359.04	333.18	310.72	250.13	195.04
			405			359.04	338.37	277.78	222.69
			420				359.04	298.51	243.42
			465					359.04	305.63
			505						359.04

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

AS 3600: 2001 Maximum connection force of rebar concerning 'Anchoring' as per Australian Standard AS 3600: 2001 during exposure to fire for bar diameters of 8 to 40 mm in relation to anchorage depth and a fire resistance time of 30 to 240 minutes (yielding point fyk= 400 Mpa).

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500 (yielding point f_{yk} = 400 Mpa) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
8	10	12.87	65	1.38	0.57	0.19	0.05	0	0
			80	2.35	1.02	0.47	0.26	0	0
			95	3.87	1.68	0.88	0.55	0.12	0
			115	7.30	3.07	1.71	1.14	0.44	0.18
			140	12.87	6.21	3.50	2.39	1.06	0.59
			170		12.87	7.74	5.26	2.33	1.35
			195			12.87	9.74	4.10	2.34
			210				12.87	5.65	3.16
			255					12.87	7.20
			290						12.87
10	12	20.11	80	2.94	1.27	0.59	0.33	0	0
			100	5.68	2.45	1.31	0.85	0.24	0
			120	10.66	4.44	2.48	1.68	0.68	0.31
			140	17.57	7.76	4.38	2.99	1.33	0.73
			150	20.11	10.19	5.74	3.92	1.76	1.00
			180		20.11	12.49	8.43	3.67	2.13
			205			20.11	15.48	6.35	3.58
			220				20.11	8.69	4.78
			265					20.11	10.71
			305						20.11
12	16	28.95	95	5.80	2.52	1.32	0.83	0.18	0
			120	12.79	5.33	2.97	2.01	0.82	0.37
			145	23.16	10.68	6.02	4.12	1.84	1.03
			160	28.95	16.00	8.96	6.11	2.74	1.58
			195		28.95	21.16	14.62	6.15	3.51
			215			28.95	22.72	9.40	5.21
			235				28.95	14.16	7.56
			275					28.95	15.27
			315						28.95
16	20	51.47	130	22.59	9.42	5.30	3.61	1.56	0.80
			160	39.17	21.33	11.95	8.15	3.65	2.11
			185	51.47	35.16	22.69	15.26	6.58	3.80
			215		51.47	39.27	30.29	12.53	6.95
			240			51.47	44.12	20.88	11.04
			255				51.47	28.17	14.40
			300					51.47	31.07
			340						51.47
20	25	80.42	160	48.97	26.67	14.93	10.18	4.56	2.64
			200	76.61	54.31	38.73	27.50	11.42	6.48
			210	80.42	61.22	45.64	34.41	14.11	7.89
			240		80.42	66.37	55.15	26.10	13.80
			265			80.42	72.42	42.13	21.43
			280				80.42	52.49	27.71
			325					80.42	56.05
			365						80.42

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500 (yielding point f_{yk} = 400 Mpa) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
22	28	97.31	175	65.27	40.74	24.20	16.38	7.20	4.18
			200	84.27	59.74	42.60	30.25	12.56	7.13
			220	97.31	74.95	57.80	45.45	19.11	10.51
			250		97.31	80.61	68.26	35.07	18.13
			275			97.31	87.27	53.94	27.99
			290				97.31	65.35	36.11
			335					97.31	69.26
			375						97.31
25	30	125.66	200	95.77	67.89	48.41	34.37	14.27	8.10
			220	113.05	85.17	65.69	51.65	21.72	11.94
			235	125.66	98.13	78.64	64.61	29.50	15.76
			270		125.66	108.88	94.85	56.98	29.19
			290			125.66	112.13	74.26	41.04
			310				125.66	91.54	57.11
			350					125.66	91.66
			390						125.66
28	35	157.63	225	131.45	100.23	78.41	62.69	26.96	14.69
			240	145.96	114.74	92.92	77.20	36.55	19.31
			255	157.63	129.26	107.43	91.72	49.30	25.20
			285		157.63	136.46	120.75	78.33	42.24
			310			157.63	144.94	102.52	63.96
			325				157.63	117.04	78.47
			370					157.63	122.02
			410						157.63
32	40	205.89	255	183.40	147.72	122.78	104.82	56.35	28.80
			265	194.46	158.78	133.84	115.88	67.40	34.28
			280	205.89	175.37	150.43	132.47	83.99	44.34
			310		205.89	183.60	165.64	117.17	73.10
			335			205.89	193.29	144.81	100.74
			350				205.89	161.40	117.33
			395					205.89	167.09
			435						205.89
40	47	321.70	320	319.10	274.50	243.33	220.87	160.28	105.19
			325	321.70	281.41	250.24	227.79	167.19	112.11
			355		321.70	291.71	269.25	208.66	153.57
			380			321.70	303.81	243.22	188.13
			395				321.70	263.95	208.87
			440					321.70	271.07
			480						321.70

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

AS 3600: 2001 Maximum connection force of rebar concerning 'Anchoring' as per Australian Standard AS 3600: 2001 during exposure to fire for bar diameters of 8 to 40 mm in relation to anchorage depth and a fire resistance time of 30 to 240 minutes (yielding point fyk= 500 Mpa).

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500 (yielding point f_{yk} = 500 Mpa) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
8	10	16.08	65	1.38	0.57	0.19	0.05	0	0
			80	2.35	1.02	0.47	0.26	0	0
			95	3.87	1.68	0.88	0.55	0.12	0
			115	7.30	3.07	1.71	1.14	0.44	0.18
			150	16.08	8.15	4.59	3.14	1.41	0.80
			180		16.08	9.99	6.75	2.94	1.70
			205			16.08	12.38	5.08	2.86
			220				16.08	6.95	3.82
			265					16.08	8.57
			305						16.08
10	12	25.13	80	2.94	1.27	0.59	0.33	0	0
			100	5.68	2.45	1.31	0.85	0.24	0
			120	10.66	4.44	2.48	1.68	0.68	0.31
			140	17.57	7.76	4.38	2.99	1.33	0.73
			165	25.13	15.06	8.50	5.79	2.58	1.50
			195		25.13	17.63	12.18	5.12	2.93
			220			25.13	20.66	8.69	4.78
			235				25.13	11.80	6.30
			295					25.13	17.86
			320						25.13
12	16	36.19	95	5.80	2.52	1.32	0.83	0.18	0
			120	12.79	5.33	2.97	2.01	0.82	0.37
			145	23.16	10.68	6.02	4.12	1.84	1.03
			180	36.19	24.29	14.99	10.12	4.41	2.55
			210		36.19	27.38	20.65	8.47	4.74
			235			36.19	31.01	14.16	7.56
			250				36.19	19.13	9.89
			295					36.19	21.43
			335						36.19
16	20	64.34	130	22.59	9.42	5.30	3.61	1.56	0.80
			160	39.17	21.33	11.95	8.15	3.65	2.11
			190	55.76	37.92	25.45	17.25	7.35	4.22
			210	64.34	48.98	36.51	27.53	11.29	6.32
			240		64.34	53.10	44.12	20.88	11.04
			265			64.34	57.94	33.70	17.14
			280				64.34	42.00	22.17
			325					64.34	44.84
			365						64.34
20	25	100.53	160	48.97	26.67	14.93	10.18	4.56	2.64
			200	76.61	54.31	38.73	27.50	11.42	6.48
			235	100.53	78.50	62.92	51.69	23.60	12.60
			270		100.53	87.11	75.88	45.58	23.36
			290			100.53	89.70	59.41	32.83
			310				100.53	73.23	45.69
			350					100.53	73.33
			390						100.53

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

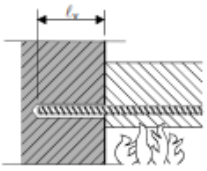
Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500 (yielding point f_{yk} = 500 Mpa) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
22	28	121.64	175	65.27	40.74	24.20	16.38	7.20	4.18
			220	99.48	74.95	57.80	45.45	19.11	10.51
			250	121.64	97.76	80.61	68.26	35.07	18.13
			285		121.64	107.22	94.87	61.55	33.19
			305			121.64	110.08	76.75	46.45
			325				121.64	91.96	61.66
			365					121.64	92.07
			405						121.64
25	30	157.08	200	95.77	67.89	48.41	34.37	14.27	8.10
			250	138.96	111.09	91.60	77.57	39.86	20.61
			275	157.08	132.69	113.20	99.17	61.30	31.81
			305		157.08	139.12	125.09	87.22	52.79
			330			157.08	146.69	108.82	74.39
			345				157.08	121.77	87.34
			390					157.08	126.22
			430						157.08
28	35	197.04	225	131.45	100.23	78.41	62.69	26.96	14.69
			250	155.64	124.42	102.60	86.88	44.64	23.08
			295	197.04	167.96	146.14	130.42	88.01	50.00
			330		197.04	180.00	164.29	121.87	83.31
			350			197.04	183.64	141.23	102.66
			365				197.04	155.74	117.18
			410					197.04	160.72
			450						197.04
32	40	257.36	255	183.40	147.72	122.78	104.82	56.35	28.80
			280	211.05	175.37	150.43	132.47	83.99	44.34
			325	257.36	225.13	200.19	182.23	133.75	89.68
			355		257.36	233.37	215.40	166.93	122.86
			380			257.36	243.05	194.58	150.51
			395				257.36	211.16	167.09
			440					257.36	216.86
			480						257.36
40	47	402.12	320	319.10	274.50	243.33	220.87	160.28	105.19
			350	360.57	315.97	284.80	262.34	201.75	146.66
			385	402.12	364.35	333.18	310.72	250.13	195.04
			415		402.12	374.64	352.19	291.60	236.51
			435			402.12	379.84	319.25	264.16
			455				402.12	346.89	291.80
			495					402.12	347.10
			535						402.12

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

HIT-HY 150 MAX rebar

The Hilti HIT-HY 200-A Rebar series of anchors, were subjected to tests utilising the heating conditions of DIN EN 1363-1, as reported under the reference GS 3.2/10-51-1. The performance ratings given in this report are as follows:

Table 1a: Design value for tensile loading $N_{Rd,fi}$ of verification in accordance with section 3.2.9 for classification in fire resistance ratings; rebar connection perpendicular to the component surface with the fire exposure in slabs and walls;



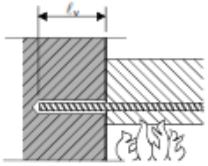
Rebar diameter	Embedment depth	Fire-resistance rating				
		R30	R60	R90	R120	R180
d_s	ℓ_v	$N_{Rd,fi(30)}$	$N_{Rd,fi(60)}$	$N_{Rd,fi(90)}$	$N_{Rd,fi(120)}$	$N_{Rd,fi(180)}$
mm	cm	kN	kN	kN	kN	kN
8	8	3,0	0,7	0,2	0,0	0,0
	12	7,0	2,2	1,3	0,7	0,2
	17	16,2	10,2	9,2	4,0	1,7
	21	16,2	16,2	16,2	11,0	7,5
	23	16,2	16,2	16,2	14,5	10,9
	25	16,2	16,2	16,2	16,2	14,5
	30	16,2	16,2	16,2	16,2	16,2
10	10	6,1	2,0	1,0	0,4	0,0
	15	19,3	9,3	7,1	2,2	1,0
	19	25,3	18,0	15,9	9,3	4,9
	23	25,3	25,3	24,7	18,1	13,7
	26	25,3	25,3	25,3	24,7	20,3
	28	25,3	25,3	25,3	25,3	24,7
	32	25,3	25,3	25,3	25,3	25,3
12	12	15,3	6,0	1,9	1,1	0,3
	18	31,0	19,0	17,8	8,5	7,0
	22	36,4	29,6	27,0	19,1	13,8
	26	36,4	36,4	36,4	29,7	24,4
	28	36,4	36,4	36,4	35,0	29,6
	30	36,4	36,4	36,4	36,4	34,9
	34	36,4	36,4	36,4	36,4	36,4

Intermediate values may be interpolated linearly. Extrapolating is not permitted.

Proof: $N_{Sd,fi} \leq N_{Rd,fi}$

Injection system Hilti HIT-HY 150-MAX for rebar connections	**Annex 3**
Fire protection, Proof in accordance with section 3.2.9, rebar connection perpendicular to the component surface with the fire exposure, rebar diameter d_s 8 mm to 12 mm	

Table 1b: Design value for tensile loading $N_{Rd,fi}$ of verification in accordance with section 3.2.9 for classification in fire resistance ratings; rebar connection perpendicular to the component surface with the fire exposure in slabs and walls



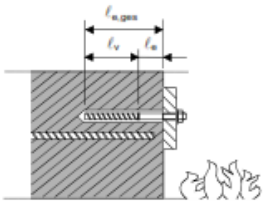
Rebar diameter	Embedment depth	Fire-resistance rating				
		R30	R60	R90	R120	R180
d_s	ℓ_x	$N_{Rd,fi(30)}$	$N_{Rd,fi(60)}$	$N_{Rd,fi(90)}$	$N_{Rd,fi(120)}$	$N_{Rd,fi(180)}$
mm	cm	kN	kN	kN	kN	kN
14	14	24,0	9,9	6,9	2,6	1,0
	21	45,0	31,4	28,5	25,7	13,0
	24	49,6	40,6	37,7	32,8	22,33
	28	49,6	49,6	49,6	40,7	34,6
	30	49,6	49,6	49,6	44,7	40,7
	33	49,6	49,6	49,6	49,6	49,6
	36	49,6	49,6	49,6	49,6	49,6
16	16	34,5	18,4	14,9	4,4	2,3
	24	62,6	46,4	43,0	37,7	25,5
	26	64,8	53,5	50,0	44,7	32,5
	30	64,8	64,8	57,0	51,7	49,6
	33	64,8	64,8	64,8	61,3	57,2
	36	64,8	64,8	64,1	64,8	64,8
	40	64,8	64,8	64,8	64,8	64,8
20	20	60,7	40,0	36,3	29,3	14,3
	25	78,3	62,5	58,3	51,3	36,3
	31	101,2	88,9	84,6	77,6	62,6
	35	101,2	101,2	101,2	94,2	80,2
	37	101,2	101,2	101,2	101,2	83,5
	39	101,2	101,2	101,2	101,2	97,8
	43	101,2	101,2	101,2	101,2	101,2
25	25	97,9	78,1	72,6	64,7	45,3
	28	126,5	94,6	89,4	81,2	61,8
	37	158,1	144,0	127,9	119,7	111,2
	41	158,1	158,1	150,0	141,8	123,2
	43	158,1	158,1	158,1	150,0	144,2
	45	158,1	158,1	158,1	158,1	155,2
	50	158,1	158,1	158,1	158,1	158,1

Intermediate values may be interpolated linearly. Extrapolating is not permitted.

Proof: $N_{Sd,fi} \leq N_{Rd,fi}$

Injection system Hilti HIT-HY 150-MAX for rebar connections	**Annex 4**
Fire protection, Proof in accordance with section 3.2.9, rebar connection perpendicular to the component surface with the fire exposure, rebar diameter d_s 14 mm to 25 mm	

Table 2: Design value for tensile loading $N_{Rd,fi}$ of verification in accordance with section 3.2.9 for classification in fire resistance ratings; rebar connection with tensile anchor HZA-R / HZA-HCR perpendicular to the component surface with the fire exposure in slabs and walls



Tensile anchor	Embedment depth	Fire-resistance rating				
		R30	R60	R90	R120	R180
	ℓ_v	$N_{Rd,fi(30)}$	$N_{Rd,fi(60)}$	$N_{Rd,fi(90)}$	$N_{Rd,fi(120)}$	$N_{Rd,fi(180)}$
	cm	kN	kN	kN	kN	kN
HZA-R / HZA-HCR M12 / t_{fix} d_s = 12 mm	12,0	5,2	1,7	1,1	0,8	0,4
	13,0	7,9	2,6	1,7	1,1	0,6
	13,5	9,2	3,0	2,0	1,3	0,7
	14,0	10,6	3,5	2,3	1,5	0,8
	15,5	14,5	4,7	3,1	2,0	1,1
	17,5	19,8	6,5	4,2	2,8	1,4
	19,5	25,1	8,2	5,0	3,0	1,8
	21,5	30,0	10,0	5,0	3,0	2,1
HZA-R / HZA-HCR M16 / t_{fix} d_s = 16 mm	16,0	21,1	7,0	4,5	3,0	1,5
	17,5	26,4	8,7	5,6	3,8	1,9
	18,5	29,9	9,8	6,4	4,3	2,1
	19,5	33,5	11,0	7,2	4,8	2,4
	20,5	37,0	12,1	7,5	5,2	2,6
	21,5	40,0	13,3	7,5	5,8	2,9
HZA-R / HZA-HCR M20 / t_{fix} d_s = 20 mm	20,0	44,0	14,5	9,4	6,3	3,1
	21,0	48,4	15,9	10,4	6,9	3,4
	22,0	52,8	17,4	11,3	7,6	3,8
	23,0	57,2	18,8	12,2	8,2	4,1
	24,0	60,0	20,2	13,2	8,8	4,4

Intermediate values may be interpolated linearly. Extrapolating is not permitted.

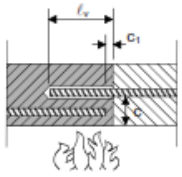
Proof:

$N_{Sd,fi} \leq N_{Rd,fi}$ and $N_{Sd,fi} \leq N_{Rd,fi,Gewinde}$

$N_{Rd,fi,Gewinde}$ according Annex 8, Table 5

Injection system Hilti HIT-HY 150-MAX for rebar connections	**Annex 5**
Fire protection, Proof in accordance with section 3.2.9, rebar connection with HZA-R / HZA-HCR perpendicular to the component surface with the fire exposure	

Table 3: Design value of the bond strength $f_{bd,fi}$ depending on existing concrete coverage for classification in fire resistance ratings; rebar connection parallel to the component surface with the fire exposure in slabs and walls



Fire-resistance rating					Concrete cover for bonded-in reinforcement c
R30	R60	R90	R120	R180	
Design value of the bond strength $f_{bd,fi}$					
N/mm²	N/mm²	N/mm²	N/mm²	N/mm²	mm
0,6	0,3	0,0	0,0	0,0	30
0,7	0,3	0,0	0,0	0,0	35
0,9	0,4	0,2	0,0	0,0	40
1,0	0,4	0,2	0,0	0,0	45
1,2	0,5	0,3	0,0	0,0	50
1,5	0,6	0,3	0,2	0,0	55
1,8	0,8	0,4	0,3	0,0	60
2,2	0,9	0,5	0,3	0,0	65
	1,0	0,5	0,3	0,0	70
	1,2	0,6	0,4	0,2	75
	1,5	0,7	0,5	0,3	80
	1,7	0,8	0,5	0,3	85
	2,0	1,0	0,6	0,3	90
	2,2	1,1	0,7	0,4	95
		1,3	0,8	0,4	100
		1,5	0,9	0,5	105
		1,7	1,1	0,5	110
		2,0	1,2	0,6	115
		2,2	1,4	0,6	120
			1,6	0,7	125
			1,9	0,8	130
			2,1	0,9	135
				2,3	200

Proof:

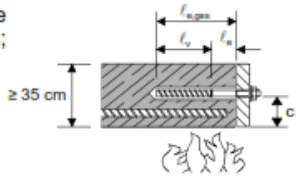
$N_{Sd,fi} \le (\ell_v - c_1) \cdot d_s \cdot \pi \cdot f_{bd,fi}$ with $(\ell_v - c_1) \ge \ell_s$, $\le 80\, d_s$

The following meanings apply:

- $N_{Sd,fi}$ design value of action under fire exposure
- ℓ_s lap length of overlap joint acc. to section 3.2.4
- d_s nominal diameter of the rebar
- $(\ell_v - c_1)$ selected lap length. This shall be set at a minimum of ℓ_s), and a maximum of $80 d_s$.

Injection system Hilti HIT-HY 150-MAX for rebar connections	Annex 6
Fire protection, rebar connection parallel to the component surface with the fire exposure	

Table 4: Design value of the bond strength $f_{bd,fi}$ depending on existing concrete coverage for classification in fire resistance ratings; rebar connection with tensile anchor HZA-R / HZA-HCR with the fire exposure from three sides in slabs and walls



Fire-resistance rating				Concrete coverage c for Tension anchor HZA-R / HZA-HCR
R30	R60	R90	R120	
Design value of the bond strength $f_{bd,fi}$				
N/mm²	N/mm²	N/mm²	N/mm²	mm
N/mm²	N/mm²	N/mm²	N/mm²	mm
0,0	0,0	0,0	0,0	< 20
0,2	0,0	0,0	0,0	20
0,4	0,0	0,0	0,0	25
0,6	0,0	0,0	0,0	30
0,7	0,2	0,0	0,0	35
0,9	0,3	0,0	0,0	40
1,0	0,4	0,0	0,0	45
1,1	0,5	0,2	0,0	50
	0,6	0,3	0,0	55
	0,8	0,4	0,1	60
	0,9	0,5	0,3	65
	1,0	0,5	0,4	70
	1,1	0,6	0,5	75
		0,7	0,7	80
		0,8	0,8	85
		0,9	0,9	90
		1,0	1,1	95
			1,1	100
			1,1	105
			1,1	110

Proof:

$N_{Sd,fi} \le \ell_v \cdot d_s \cdot \pi \cdot f_{bd,fi}$ and $N_{Sd,fi} \le N_{Rd,fi,Gewinde}$

with $\ell_s \le \ell_v \le 80\, d_s$,

$N_{Rd,fi,Gewinde}$ according Annex 8, Table 5

The data in Annex 7, Table 4 apply for concrete with a thickness of concrete slab of $h_{vorh} \ge 35$ cm. If the thickness of concrete slab falls below of this minimum thickness by 35 cm – h_{vorh}, this can be compensated by fire protection plates with a total thickness of at least 0,5 · (35 cm – h_{vorh}).

Explanation of notations and symbols see Annex 8

Injection system Hilti HIT-HY 150-MAX for rebar connections	**Annex 7**
Fire protection connection with HZA-R / HZA-HCR with the fire exposure from three sides	

The following definitions apply:

$N_{Sd,fi}$	design value of action under fire exposure
ℓ_s	lap length of overlap joint acc. to section 3.2.4
d_s	nominal diameter of the Tension anchor HZA-R(HCR)
ℓ_v	selected lap length. This shall be set at a minimum of ℓ_s and a maximum of 80 d_s.
ℓ_e	length of the smooth shaft of the Tension anchor HZA-R(HCR)
$\ell_{e,ges}$	total embedment depth
c	concrete coverage on the front side of the existing rebar
$f_{bd,fi}$	Design value of the bond strength under fire exposure
h_{vorh}	existing thickness of concrete slab

Table 5: Design value of the resistance for steel failure $N_{Rd,fi,Gewinde}$ depending on fire-resistance rating

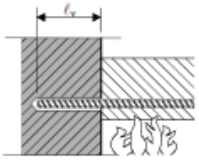
Tension anchor	Fire-resistance rating				
	R30	R60	R90	R120	R180
	kN	kN	kN	kN	kN
HZA-R / HZA-HCR M12	30,0	12,0	5,0	3,0	2,1
HZA-R / HZA-HCR M16	40,0	15,0	7,5	6,0	4,7
HZA-R / HZA-HCR M20	60,0	35,0	15,0	10,0	7,3

Injection system Hilti HIT-HY 150-MAX for rebar connections	**Annex 8**
Design value of the resistance for steel failure $N_{Rd,fi,Gewinde}$ depending on fire-resistance rating	

HIT-HY 200-A rebar

The Hilti HIT-HY 200-A Rebar series of anchors, were subjected to tests utilising the heating conditions of DIN EN 1363-1, as reported under the reference DiBt Z-21.8-1947. The performance ratings given in this report are as follows:

Table 1a: Design value for tensile loading $N_{Rd,fi}$ of verification in accordance with section 3.3 for classification in fire resistance ratings; rebar connection perpendicular to the component surface with the fire exposure in slabs and walls;



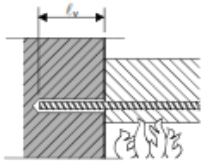
Rebar diameter	Embedment depth	Fire-resistance rating				
		R30	R60	R90	R120	R180
d_s	ℓ_v	$N_{Rd,fi(30)}$	$N_{Rd,fi(60)}$	$N_{Rd,fi(90)}$	$N_{Rd,fi(120)}$	$N_{Rd,fi(180)}$
mm	cm	kN	kN	kN	kN	kN
8	8	3,0	0,7	0,2	0,0	0,0
	12	7,0	2,2	1,3	0,7	0,2
	17	16,2	10,2	9,2	4,0	1,7
	21	16,2	16,2	16,2	11,0	7,5
	23	16,2	16,2	16,2	14,5	10,9
	25	16,2	16,2	16,2	16,2	14,5
	30	16,2	16,2	16,2	16,2	16,2
10	10	6,1	2,0	1,0	0,4	0,0
	15	19,3	9,3	7,1	2,2	1,0
	19	25,3	18,0	15,9	9,3	4,9
	23	25,3	25,3	24,7	18,1	13,7
	26	25,3	25,3	25,3	24,7	20,3
	28	25,3	25,3	25,3	25,3	24,7
	32	25,3	25,3	25,3	25,3	25,3
12	12	15,3	6,0	1,9	1,1	0,3
	18	31,0	19,0	17,8	8,5	7,0
	22	36,4	29,6	27,0	19,1	13,8
	26	36,4	36,4	36,4	29,7	24,4
	28	36,4	36,4	36,4	35,0	29,6
	30	36,4	36,4	36,4	36,4	34,9
	34	36,4	36,4	36,4	36,4	36,4
14	14	24,0	9,9	6,9	2,6	1,0
	21	45,0	31,4	28,5	25,7	13,0
	24	49,6	40,6	37,7	32,8	22,3
	28	49,6	49,6	49,6	40,7	34,6
	30	49,6	49,6	49,6	44,7	40,7
	33	49,6	49,6	49,6	49,6	49,6
	36	49,6	49,6	49,6	49,6	49,6

Intermediate values may be interpolated linearly. Extrapolating is not permitted.

Proof: $N_{Sd,fi} \leq N_{Rd,fi}$

Injection system Hilti HIT-HY 200-A for rebar connections	**Annex 3**
Fire protection, Proof in accordance with section 3.3, rebar connection perpendicular to the component surface with the fire exposure, rebar diameter d_s 8 mm to 14 mm	

Table 1b: Design value for tensile loading $N_{Rd,fi}$ of verification in accordance with section 3.3 for classification in fire resistance ratings; rebar connection perpendicular to the component surface with the fire exposure in slabs and walls



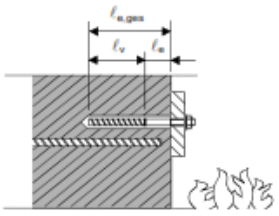
Rebar diameter	Embedment depth	Fire-resistance rating				
		R30	R60	R90	R120	R180
d_s	ℓ_v	$N_{Rd,fi(30)}$	$N_{Rd,fi(60)}$	$N_{Rd,fi(90)}$	$N_{Rd,fi(120)}$	$N_{Rd,fi(180)}$
mm	cm	kN	kN	kN	kN	kN
16	16	34,5	18,4	14,9	4,4	2,3
	24	62,6	46,4	43,0	37,7	25,5
	26	64,8	53,5	50,0	44,7	32,5
	30	64,8	64,8	57,0	51,7	49,6
	33	64,8	64,8	64,8	61,3	57,2
	36	64,8	64,8	64,1	64,8	64,8
	40	64,8	64,8	64,8	64,8	64,8
20	20	60,7	40,0	36,3	29,3	14,3
	25	78,3	62,5	58,3	51,3	36,3
	31	101,2	88,9	84,6	77,6	62,6
	35	101,2	101,2	101,2	94,2	80,2
	37	101,2	101,2	101,2	101,2	83,5
	39	101,2	101,2	101,2	101,2	97,8
	43	101,2	101,2	101,2	101,2	101,2
25	25	97,9	78,1	72,6	64,7	45,3
	28	126,5	94,6	89,4	81,2	61,8
	37	158,1	144,0	127,9	119,7	111,2
	41	158,1	158,1	150,0	141,8	123,2
	43	158,1	158,1	158,1	150,0	144,2
	45	158,1	158,1	158,1	158,1	155,2
	50	158,1	158,1	158,1	158,1	158,1
32	25	97,9	78,1	72,6	64,7	45,3
	28	126,5	94,6	89,4	81,2	61,8
	37	158,1	144,0	127,9	119,7	111,2
	41	158,1	158,1	150,0	141,8	123,2
	43	158,1	158,1	158,1	150,0	144,2
	45	158,1	158,1	158,1	158,1	155,2
	50	158,1	158,1	158,1	158,1	158,1

Intermediate values may be interpolated linearly. Extrapolating is not permitted.

Proof: $N_{Sd,fi} \leq N_{Rd,fi}$

Injection system Hilti HIT-HY 200-A for rebar connections	**Annex 4**
Fire protection, Proof in accordance with section 3.3, rebar connection perpendicular to the component surface with the fire exposure, rebar diameter d_s 16 mm to 32 mm	

Table 2: Design value for tensile loading $N_{Rd,fi}$ of verification in accordance with section 3.3 for classification in fire resistance ratings; rebar connection with tensile anchor HZA-R / HZA-HCR perpendicular to the component surface with the fire exposure in slabs and walls



Tensile anchor	Embedment depth	Fire-resistance rating				
		R30	R60	R90	R120	R180
	ℓ_v	$N_{Rd,fi(30)}$	$N_{Rd,fi(60)}$	$N_{Rd,fi(90)}$	$N_{Rd,fi(120)}$	$N_{Rd,fi(180)}$
	cm	kN	kN	kN	kN	kN
HZA-R / HZA-HCR M12 / t_{fix} d_s = 12 mm	12,0	5,2	1,7	1,1	0,8	0,4
	13,0	7,9	2,6	1,7	1,1	0,6
	13,5	9,2	3,0	2,0	1,3	0,7
	14,0	10,6	3,5	2,3	1,5	0,8
	15,5	14,5	4,7	3,1	2,0	1,1
	17,5	19,8	6,5	4,2	2,8	1,4
	19,5	25,1	8,2	5,0	3,0	1,8
	21,5	30,0	10,0	5,0	3,0	2,1
HZA-R / HZA-HCR M16 / t_{fix} d_s = 16 mm	16,0	21,1	7,0	4,5	3,0	1,5
	17,5	26,4	8,7	5,6	3,8	1,9
	18,5	29,9	9,8	6,4	4,3	2,1
	19,5	33,5	11,0	7,2	4,8	2,4
	20,5	37,0	12,1	7,5	5,2	2,6
	21,5	40,0	13,3	7,5	5,8	2,9
HZA-R / HZA-HCR M20 / t_{fix} d_s = 20 mm	20,0	44,0	14,5	9,4	6,3	3,1
	21,0	48,4	15,9	10,4	6,9	3,4
	22,0	52,8	17,4	11,3	7,6	3,8
	23,0	57,2	18,8	12,2	8,2	4,1
	24,0	60,0	20,2	13,2	8,8	4,4

Intermediate values may be interpolated linearly. Extrapolating is not permitted.

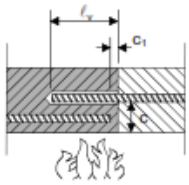
Proof:

$N_{Sd,fi} \leq N_{Rd,fi}$ and $N_{Sd,fi} \leq N_{Rd,fi,Gewinde}$

$N_{Rd,fi,Gewinde}$ according Annex 8, Table 5

Injection system Hilti HIT-HY 200-A for rebar connections	**Annex 5**
Fire protection, Proof in accordance with section 3.3, rebar connection with HZA-R / HZA-HCR perpendicular to the component surface with the fire exposure	

Table 3: Design value of the bond strength $f_{bd,fi}$ depending on existing concrete coverage for classification in fire resistance ratings; rebar connection parallel to the component surface with the fire exposure in slabs and walls



Fire-resistance rating					Concrete cover for bonded-in reinforcement c
R30	R60	R90	R120	R180	
Design value of the bond strength $f_{bd,fi}$					
N/mm²	N/mm²	N/mm²	N/mm²	N/mm²	mm
0,6	0,3	0,0	0,0	0,0	30
0,7	0,3	0,0	0,0	0,0	35
0,9	0,4	0,2	0,0	0,0	40
1,0	0,4	0,2	0,0	0,0	45
1,2	0,5	0,3	0,0	0,0	50
1,5	0,6	0,3	0,2	0,0	55
1,8	0,8	0,4	0,3	0,0	60
2,2	0,9	0,5	0,3	0,0	65
	1,0	0,5	0,3	0,0	70
	1,2	0,6	0,4	0,2	75
	1,5	0,7	0,5	0,3	80
	1,7	0,8	0,5	0,3	85
	2,0	1,0	0,6	0,3	90
	2,2	1,1	0,7	0,4	95
		1,3	0,8	0,4	100
		1,5	0,9	0,5	105
		1,7	1,1	0,5	110
		2,0	1,2	0,6	115
		2,2	1,4	0,6	120
			1,6	0,7	125
			1,9	0,8	130
			2,1	0,9	135
				2,3	200

Proof:

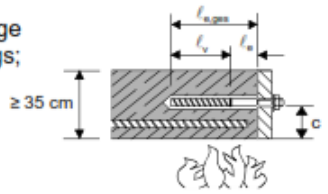
$N_{Sd,fi} \le (\ell_v - c_1) \cdot d_s \cdot \pi \cdot f_{bd,fi}$ with $(\ell_v - c_1) \ge \ell_s$, $\le 80\, d_s$

The following meanings apply:

$N_{Sd,fi}$ design value of action under fire exposure
ℓ_s lap length of overlap joint acc. to section 3.2.4
d_s nominal diameter of the rebar
$(\ell_v - c_1)$ selected lap length.
This shall be set at a minimum of ℓ_s),
and a maximum of $80d_s$.

Injection system Hilti HIT-HY 200-A for rebar connections	**Annex 6**
Fire protection, rebar connection parallel to the component surface with the fire exposure	

Table 4: Design value of the bond strength $f_{bd,fi}$ depending on existing concrete coverage for classification in fire resistance ratings; rebar connection with tensile anchor HZA-R / HZA-HCR with the fire exposure from three sides in slabs and walls



Fire-resistance rating				Concrete coverage c for Tension anchor HZA-R / HZA-HCR
R30	R60	R90	R120	
Design value of the bond strength $f_{bd,fi}$				
N/mm²	N/mm²	N/mm²	N/mm²	mm
N/mm²	N/mm²	N/mm²	N/mm²	mm
0,0	0,0	0,0	0,0	< 20
0,2	0,0	0,0	0,0	20
0,4	0,0	0,0	0,0	25
0,6	0,0	0,0	0,0	30
0,7	0,2	0,0	0,0	35
0,9	0,3	0,0	0,0	40
1,0	0,4	0,0	0,0	45
1,1	0,5	0,2	0,0	50
	0,6	0,3	0,0	55
	0,8	0,4	0,1	60
	0,9	0,5	0,3	65
	1,0	0,5	0,4	70
	1,1	0,6	0,5	75
		0,7	0,7	80
		0,8	0,8	85
		0,9	0,9	90
		1,0	1,1	95
			1,1	100
			1,1	105
			1,1	110

Proof:

$N_{Sd,fi} \le \ell_v \cdot d_s \cdot \pi \cdot f_{bd,fi}$ and $N_{Sd,fi} \le N_{Rd,fi,Gewinde}$

with $\ell_s \le \ell_v \le 80\ d_s$,

$N_{Rd,fi,Gewinde}$ according Annex 8, Table 5

The data in Annex 7, Table 4 apply for concrete with a thickness of concrete slab of $h_{vorh} \ge 35$ cm. If the thickness of concrete slab falls below of this minimum thickness by 35 cm – h_{vorh}, this can be compensated by fire protection plates with a total thickness of at least 0,5 · (35 cm – h_{vorh}).

Explanation of notations and symbols see Annex 8

Injection system Hilti HIT-HY 200-A for rebar connections	**Annex 7**
Fire protection connection with HZA-R / HZA-HCR with the fire exposure from three sides	

The following definitions apply:

$N_{Sd,fi}$	design value of action under fire exposure
ℓ_s	lap length of overlap joint acc. to section 3.2.4
d_s	nominal diameter of the Tension anchor HZA-R(HCR)
ℓ_v	selected lap length. This shall be set at a minimum of ℓ_s and a maximum of 80 d_s.
ℓ_e	length of the smooth shaft of the Tension anchor HZA-R(HCR)
$\ell_{e,ges}$	total embedment depth
c	concrete coverage on the front side of the existing rebar
$f_{bd,fi}$	Design value of the bond strength under fire exposure
h_{vorh}	existing thickness of concrete slab

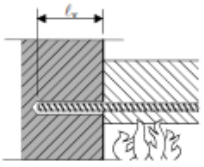
Table 5: Design value of the resistance for steel failure $N_{Rd,fi,Gewinde}$ depending on fire-resistance rating

Tension anchor	Fire-resistance rating				
	R30	R60	R90	R120	R180
	kN	kN	kN	kN	kN
HZA-R / HZA-HCR M12	30,0	12,0	5,0	3,0	2,1
HZA-R / HZA-HCR M16	40,0	15,0	7,5	6,0	4,7
HZA-R / HZA-HCR M20	60,0	35,0	15,0	10,0	7,3

HIT-HY 200-R rebar

The Hilti HIT-HY 200-R Rebar series of anchors, were subjected to tests utilising the heating conditions of DIN EN 1363-1, as reported under the reference DiBt Z-21.8-1948. The performance ratings given in this report are as follows:

Table 1a: Design value for tensile loading $N_{Rd,fi}$ of verification in accordance with section 3.3 for classification in fire resistance ratings; rebar connection perpendicular to the component surface with the fire exposure in slabs and walls;



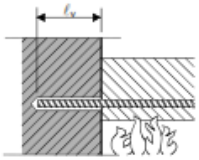
Rebar diameter	Embedment depth	Fire-resistance rating				
		R30	R60	R90	R120	R180
d_s	ℓ_v	$N_{Rd,fi(30)}$	$N_{Rd,fi(60)}$	$N_{Rd,fi(90)}$	$N_{Rd,fi(120)}$	$N_{Rd,fi(180)}$
mm	cm	kN	kN	kN	kN	kN
8	8	3,0	0,7	0,2	0,0	0,0
	12	7,0	2,2	1,3	0,7	0,2
	17	16,2	10,2	9,2	4,0	1,7
	21	16,2	16,2	16,2	11,0	7,5
	23	16,2	16,2	16,2	14,5	10,9
	25	16,2	16,2	16,2	16,2	14,5
	30	16,2	16,2	16,2	16,2	16,2
10	10	6,1	2,0	1,0	0,4	0,0
	15	19,3	9,3	7,1	2,2	1,0
	19	25,3	18,0	15,9	9,3	4,9
	23	25,3	25,3	24,7	18,1	13,7
	26	25,3	25,3	25,3	24,7	20,3
	28	25,3	25,3	25,3	25,3	24,7
	32	25,3	25,3	25,3	25,3	25,3
12	12	15,3	6,0	1,9	1,1	0,3
	18	31,0	19,0	17,8	8,5	7,0
	22	36,4	29,6	27,0	19,1	13,8
	26	36,4	36,4	36,4	29,7	24,4
	28	36,4	36,4	36,4	35,0	29,6
	30	36,4	36,4	36,4	36,4	34,9
	34	36,4	36,4	36,4	36,4	36,4
14	14	24,0	9,9	6,9	2,6	1,0
	21	45,0	31,4	28,5	25,7	13,0
	24	49,6	40,6	37,7	32,8	22,3
	28	49,6	49,6	49,6	40,7	34,6
	30	49,6	49,6	49,6	44,7	40,7
	33	49,6	49,6	49,6	49,6	49,6
	36	49,6	49,6	49,6	49,6	49,6

Intermediate values may be interpolated linearly. Extrapolating is not permitted.

Proof: $N_{Sd,fi} \leq N_{Rd,fi}$

Injection system Hilti HIT-HY 200-R for rebar connections	**Annex 3**
Fire protection, Proof in accordance with section 3.3, rebar connection perpendicular to the component surface with the fire exposure, rebar diameter d_s 8 mm to 14 mm	

Table 1b: Design value for tensile loading $N_{Rd,fi}$ of verification in accordance with section 3.3 for classification in fire resistance ratings; rebar connection perpendicular to the component surface with the fire exposure in slabs and walls



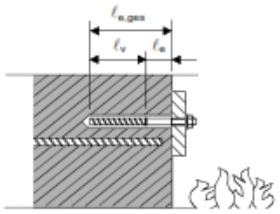
Rebar diameter	Embedment depth	Fire-resistance rating				
		R30	R60	R90	R120	R180
d_s	ℓ_v	$N_{Rd,fi(30)}$	$N_{Rd,fi(60)}$	$N_{Rd,fi(90)}$	$N_{Rd,fi(120)}$	$N_{Rd,fi(180)}$
mm	cm	kN	kN	kN	kN	kN
16	16	34,5	18,4	14,9	4,4	2,3
	24	62,6	46,4	43,0	37,7	25,5
	26	64,8	53,5	50,0	44,7	32,5
	30	64,8	64,8	57,0	51,7	49,6
	33	64,8	64,8	64,8	61,3	57,2
	36	64,8	64,8	64,1	64,8	64,8
	40	64,8	64,8	64,8	64,8	64,8
20	20	60,7	40,0	36,3	29,3	14,3
	25	78,3	62,5	58,3	51,3	36,3
	31	101,2	88,9	84,6	77,6	62,6
	35	101,2	101,2	101,2	94,2	80,2
	37	101,2	101,2	101,2	101,2	83,5
	39	101,2	101,2	101,2	101,2	97,8
	43	101,2	101,2	101,2	101,2	101,2
25	25	97,9	78,1	72,6	64,7	45,3
	28	126,5	94,6	89,4	81,2	61,8
	37	158,1	144,0	127,9	119,7	111,2
	41	158,1	158,1	150,0	141,8	123,2
	43	158,1	158,1	158,1	150,0	144,2
	45	158,1	158,1	158,1	158,1	155,2
	50	158,1	158,1	158,1	158,1	158,1
32	25	97,9	78,1	72,6	64,7	45,3
	28	126,5	94,6	89,4	81,2	61,8
	37	158,1	144,0	127,9	119,7	111,2
	41	158,1	158,1	150,0	141,8	123,2
	43	158,1	158,1	158,1	150,0	144,2
	45	158,1	158,1	158,1	158,1	155,2
	50	158,1	158,1	158,1	158,1	158,1

Intermediate values may be interpolated linearly. Extrapolating is not permitted.

Proof: $N_{Sd,fi} \leq N_{Rd,fi}$

Injection system Hilti HIT-HY 200-R for rebar connections	**Annex 4**
Fire protection, Proof in accordance with section 3.3, rebar connection perpendicular to the component surface with the fire exposure, rebar diameter d_s 16 mm to 32 mm	

Table 2: Design value for tensile loading $N_{Rd,fi}$ of verification in accordance with section 3.3 for classification in fire resistance ratings; rebar connection with tensile anchor HZA-R / HZA-HCR perpendicular to the component surface with the fire exposure in slabs and walls



Tensile anchor	Embedment depth	Fire-resistance rating				
		R30	R60	R90	R120	R180
	ℓ_v	$N_{Rd,fi(30)}$	$N_{Rd,fi(60)}$	$N_{Rd,fi(90)}$	$N_{Rd,fi(120)}$	$N_{Rd,fi(180)}$
	cm	kN	kN	kN	kN	kN
HZA-R / HZA-HCR M12 / t_{fix} d_s = 12 mm	12,0	5,2	1,7	1,1	0,8	0,4
	13,0	7,9	2,6	1,7	1,1	0,6
	13,5	9,2	3,0	2,0	1,3	0,7
	14,0	10,6	3,5	2,3	1,5	0,8
	15,5	14,5	4,7	3,1	2,0	1,1
	17,5	19,8	6,5	4,2	2,8	1,4
	19,5	25,1	8,2	5,0	3,0	1,8
	21,5	30,0	10,0	5,0	3,0	2,1
HZA-R / HZA-HCR M16 / t_{fix} d_s = 16 mm	16,0	21,1	7,0	4,5	3,0	1,5
	17,5	26,4	8,7	5,6	3,8	1,9
	18,5	29,9	9,8	6,4	4,3	2,1
	19,5	33,5	11,0	7,2	4,8	2,4
	20,5	37,0	12,1	7,5	5,2	2,6
	21,5	40,0	13,3	7,5	5,8	2,9
HZA-R / HZA-HCR M20 / t_{fix} d_s = 20 mm	20,0	44,0	14,5	9,4	6,3	3,1
	21,0	48,4	15,9	10,4	6,9	3,4
	22,0	52,8	17,4	11,3	7,6	3,8
	23,0	57,2	18,8	12,2	8,2	4,1
	24,0	60,0	20,2	13,2	8,8	4,4

Intermediate values may be interpolated linearly. Extrapolating is not permitted.

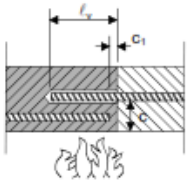
Proof:

$N_{Sd,fi} \leq N_{Rd,fi}$ and $N_{Sd,fi} \leq N_{Rd,fi,Gewinde}$

$N_{Rd,fi,Gewinde}$ according Annex 8, Table 5

Injection system Hilti HIT-HY 200-R for rebar connections	**Annex 5**
Fire protection, Proof in accordance with section 3.3, rebar connection with HZA-R / HZA-HCR perpendicular to the component surface with the fire exposure	

Table 3: Design value of the bond strength $f_{bd,fi}$ depending on existing concrete coverage for classification in fire resistance ratings; rebar connection parallel to the component surface with the fire exposure in slabs and walls



Fire-resistance rating					Concrete cover for bonded-in reinforcement c
R30	R60	R90	R120	R180	
Design value of the bond strength $f_{bd,fi}$					
N/mm²	N/mm²	N/mm²	N/mm²	N/mm²	mm
0,6	0,3	0,0	0,0	0,0	30
0,7	0,3	0,0	0,0	0,0	35
0,9	0,4	0,2	0,0	0,0	40
1,0	0,4	0,2	0,0	0,0	45
1,2	0,5	0,3	0,0	0,0	50
1,5	0,6	0,3	0,2	0,0	55
1,8	0,8	0,4	0,3	0,0	60
2,2	0,9	0,5	0,3	0,0	65
	1,0	0,5	0,3	0,0	70
	1,2	0,6	0,4	0,2	75
	1,5	0,7	0,5	0,3	80
	1,7	0,8	0,5	0,3	85
	2,0	1,0	0,6	0,3	90
	2,2	1,1	0,7	0,4	95
		1,3	0,8	0,4	100
		1,5	0,9	0,5	105
		1,7	1,1	0,5	110
		2,0	1,2	0,6	115
		2,2	1,4	0,6	120
			1,6	0,7	125
			1,9	0,8	130
			2,1	0,9	135
				2,3	200

Proof:

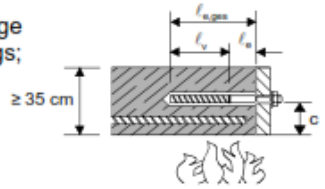
$N_{Sd,fi} \le (\ell_v - c_1) \cdot d_s \cdot \pi \cdot f_{bd,fi}$ with $(\ell_v - c_1) \ge \ell_s$, $\le 80\ d_s$

The following meanings apply:

- $N_{Sd,fi}$ design value of action under fire exposure
- ℓ_s lap length of overlap joint acc. to section 3.2.4
- d_s nominal diameter of the rebar
- $(\ell_v - c_1)$ selected lap length. This shall be set at a minimum of ℓ_s), and a maximum of $80d_s$.

Injection system Hilti HIT-HY 200-R for rebar connections	**Annex 6**
Fire protection, rebar connection parallel to the component surface with the fire exposure	

Table 4: Design value of the bond strength $f_{bd,fi}$ depending on existing concrete coverage for classification in fire resistance ratings; rebar connection with tensile anchor HZA-R / HZA-HCR with the fire exposure from three sides in slabs and walls



Fire-resistance rating				Concrete coverage c for Tension anchor HZA-R / HZA-HCR
R30	R60	R90	R120	
Design value of the bond strength $f_{bd,fi}$				
N/mm²	N/mm²	N/mm²	N/mm²	mm
N/mm²	N/mm²	N/mm²	N/mm²	mm
0,0	0,0	0,0	0,0	< 20
0,2	0,0	0,0	0,0	20
0,4	0,0	0,0	0,0	25
0,6	0,0	0,0	0,0	30
0,7	0,2	0,0	0,0	35
0,9	0,3	0,0	0,0	40
1,0	0,4	0,0	0,0	45
1,1	0,5	0,2	0,0	50
	0,6	0,3	0,0	55
	0,8	0,4	0,1	60
	0,9	0,5	0,3	65
	1,0	0,5	0,4	70
	1,1	0,6	0,5	75
		0,7	0,7	80
		0,8	0,8	85
		0,9	0,9	90
		1,0	1,1	95
			1,1	100
			1,1	105
			1,1	110

Proof:

$N_{Sd,fi} \le \ell_v \cdot d_s \cdot \pi \cdot f_{bd,fi}$ and $N_{Sd,fi} \le N_{Rd,fi,Gewinde}$

with $\ell_s \le \ell_v \le 80\ d_s$,

$N_{Rd,fi,Gewinde}$ according Annex 8, Table 5

The data in Annex 7, Table 4 apply for concrete with a thickness of concrete slab of $h_{vorh} \ge 35$ cm. If the thickness of concrete slab falls below of this minimum thickness by 35 cm – h_{vorh}, this can be compensated by fire protection plates with a total thickness of at least 0,5 · (35 cm – h_{vorh}).

Explanation of notations and symbols see Annex 8

Injection system Hilti HIT-HY 200-R for rebar connections	**Annex 7**
Fire protection connection with HZA-R / HZA-HCR with the fire exposure from three sides	

The following definitions apply:

$N_{Sd,fi}$	design value of action under fire exposure
ℓ_s	lap length of overlap joint acc. to section 3.2.4
d_s	nominal diameter of the Tension anchor HZA-R(HCR)
ℓ_v	selected lap length. This shall be set at a minimum of ℓ_s and a maximum of 80 d_s.
ℓ_e	length of the smooth shaft of the Tension anchor HZA-R(HCR)
$\ell_{e,ges}$	total embedment depth
c	concrete coverage on the front side of the existing rebar
$f_{bd,fi}$	Design value of the bond strength under fire exposure
h_{vorh}	existing thickness of concrete slab

Table 5: Design value of the resistance for steel failure $N_{Rd,fi,Gewinde}$ depending on fire-resistance rating

Tension anchor	Fire-resistance rating				
	R30	R60	R90	R120	R180
	kN	kN	kN	kN	kN
HZA-R / HZA-HCR M12	30,0	12,0	5,0	3,0	2,1
HZA-R / HZA-HCR M16	40,0	15,0	7,5	6,0	4,7
HZA-R / HZA-HCR M20	60,0	35,0	15,0	10,0	7,3

Injection system Hilti HIT-HY 200-R for rebar connections	**Annex 8**
Design value of the resistance for steel failure $N_{Rd,fi,Gewinde}$ depending on fire-resistance rating	

HIT-RE 500 SD rebar

The Hilti HIT-RE 500 SD Rebar series of anchors, were subjected to tests utilising the heating conditions of DIN EN 1363-1, as reported under the reference MFPA GS 3.2/09-122 The performance ratings given in this report are as follows:

Table 2:

Critical temperature dependent bond stress, $\tau_{cr,T}$ for Hilti HIT-RE 500-SD injection adhesive in relation to fire resistance times of 30 to 240 minutes and the required minimum concrete coverage, c

Concrete coverage	Critical, temperature-dependent bond stresses, $\tau_{crit,T}$, for Hilti HIT-RE 500-SD injection adhesive in relation to fire resistance class					
c	F30	F60	F90	F120	F180	F240
[mm]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]
10	0	0	0	0	0	0
20	0,49					
30	0,66					
40	0,89	0,48				
50	1,21	0,62				
60	1,63	0,80	0,51			
70	2,19	1,04	0,65	0,49		
80	2,96	1,35	0,83	0,61		
90	3,99	1,75	1,06	0,77	0,45	
100	5,38	2,26	1,36	0,97	0,55	
110	7,25	2,93	1,73	1,23	0,67	0,47
120	9,78	3,79	2,21	1,55	0,81	0,55
130	11,00	4,91	2,81	1,96	0,98	0,64
140		6,35	3,59	2,47	1,18	0,76
150		8,22	4,58	3,12	1,43	0,89
160		10,65	5,84	3,94	1,73	1,04
170		11,00	7,45	4,97	2,10	1,23
180			9,51	6,27	2,54	1,44
190			11,00	7,91	3,07	1,69
200				9,99	3,71	1,99
210	11,00	11,00	11,00	11,00	4,49	2,34
220					5,44	2,75
230					6,58	3,22
240					7,96	3,79
250					9,64	4,45
260					11,00	5,23
270						6,14
280						7,21
290						8,47
300						9,95
310						11,000

Table 3.1:

Maximum connecting force of rebar as per German Standard DIN 1045 – 1988 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 Minutes

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point $f_{y,k}$ = 500 N/mm²) as a function of fire resistance class					
Ø	d_0	$F_{s,Tk}$	ℓ	F30	F60	F90	F120	F180	F240
[mm]	[mm]	[kN]	[mm]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
8	10	14,36	65	1,38	0,57	0,19	0,05	0	0
			80	2,35	1,02	0,47	0,26	0	0
			95	3,87	1,68	0,88	0,55	0,12	0
			115	7,30	3,07	1,71	1,14	0,44	0,18
			145	14,36	7,12	4,01	2,74	1,23	0,69
			175		14,36	8,80	5,96	2,62	1,52
			200			14,36	11,00	4,57	2,59
			215				14,36	6,27	3,48
			260					14,36	7,86
			300						14,36
10	12	22,44	80	2,94	1,27	0,59	0,33	0	0
			100	5,68	2,45	1,31	0,85	0,24	0
			120	10,66	4,44	2,48	1,68	0,68	0,31
			140	17,57	7,76	4,38	2,99	1,33	0,73
			155	22,44	11,66	6,55	4,47	2,01	1,15
			190		22,44	15,91	10,78	4,59	2,64
			210			22,44	17,21	7,06	3,95
			230				22,44	10,66	5,75
			270					22,44	11,68
			310						22,44
12	16	32,31	95	5,80	2,52	1,32	0,83	0,18	0
			120	12,79	5,33	2,97	2,01	0,82	0,37
			145	23,16	10,68	6,02	4,12	1,84	1,03
			170	32,31	20,15	11,62	7,88	3,49	3,03
			200		32,31	23,24	16,50	6,85	3,89
			225			32,31	26,87	11,55	6,29
			240				32,31	15,66	8,28
			285					32,31	18,10
			325						32,31
14	18	43,98	110	10,92	4,65	2,55	1,70	0,61	0,20
			140	24,60	10,87	6,13	4,19	1,86	1,03
			170	39,12	23,50	13,55	9,20	4,07	2,37
			185	43,98	30,76	19,85	13,36	5,75	3,32
			215		43,98	34,36	26,51	10,97	6,08
			235			43,98	36,18	16,52	8,82
			255				43,98	24,65	12,60
			295					43,98	25,00
			335						43,98

Comments: Intermediate values may be optained by linear interpolation. Extrapolating is not permitted.

Table 3.2:

Maximum connecting force of rebar as per German Standard DIN 1045 – 1988 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 Minutes

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point $f_{y,k}$ = 500 N/mm²) as a function of fire resistance class					
Ø	d_0	$F_{s,Tx}$	ℓ	F30	F60	F90	F120	F180	F240
[mm]	[mm]	[kN]	[mm]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
16	20	57,45	130	22,59	9,42	5,30	3,61	1,56	0,80
			160	39,17	21,33	11,92	8,15	3,65	2,11
			195	57,45	40,69	28,22	19,49	8,20	4,68
			230		57,45	47,57	38,59	17,06	9,20
			250			57,45	49,65	25,51	13,19
			265				57,45	33,70	17,14
			310					57,45	36,55
			350						57,45
20	25	89,76	160	48,97	26,67	14,93	10,18	4,56	2,64
			200	76,61	54,31	38,73	27,50	11,42	6,48
			220	89,76	68,14	52,55	41,32	17,38	9,56
			255		89,76	76,74	65,51	35,22	18,00
			275			89,76	79,34	49,04	25,45
			295				89,76	62,86	35,72
			335					89,76	62,96
			375						89,76
25	30	140,25	200	95,77	67,89	48,41	34,37	14,27	8,10
			250	138,96	111,09	91,60	77,57	39,86	20,61
			255	140,25	115,41	95,92	81,89	44,02	22,50
			285		140,25	121,84	107,81	69,94	37,71
			310			140,25	129,41	91,54	57,11
			325				140,25	104,50	70,07
			370					140,25	108,94
			410						140,25
32	40	259,79	255	183,40	147,72	122,78	104,82	56,35	28,80
			275	205,52	169,84	144,90	126,94	78,46	40,71
			300	229,79	197,48	172,54	154,58	106,11	62,15
			330		229,79	205,72	187,76	139,28	95,21
			355			229,79	215,40	166,93	122,86
			370				229,79	138,52	139,45
			415					229,79	169,21
			455						229,79

Comments: Intermediate values may be optained by linear interpolation. Extrapolating is not permitted.

Table 3.3:

Maximum connecting force of rebar as per German Standard DIN 1045 – 1988 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 Minutes

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point $f_{y,k}$ = 500 N/mm²) as a function of fire resistance class					
Ø	d_0	$F_{s,Tk}$	ℓ	F30	F60	F90	F120	F180	F240
[mm]	[mm]	[kN]	[mm]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
36	44	290,82	290	249,87	209,73	181,67	161,46	106,93	59,10
			305	268,53	228,37	200,33	180,13	125,59	76,01
			325	290,82	253,27	225,21	205,01	150,47	100,89
			360		290,82	268,76	248,55	194,02	144,44
			380			290,82	273,43	218,90	169,32
			395				290,82	237,56	187,98
			440					290,82	243,96
			480						290,82
40	47	359,04	320	319,10	274,50	243,33	220,87	160,28	105,19
			335	339,84	295,24	264,06	241,61	181,02	125,83
			350	359,04	315,97	284,80	262,34	201,75	146,66
			385		359,04	333,18	310,72	250,13	195,04
			405			359,04	338,37	277,78	222,69
			420				359,04	298,51	243,42
			465					359,04	305,63
			505						359,04

Comments: Intermediate values may be oplained by linear interpolation. Extrapolating is not permitted.

Table 4.1:

Maximum connection force of rebar as per Eurocode 2 - 1992 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 minutes

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point $f_{y,k}$ = 500 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,f}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
8	10	16.19	65	1.38	0.57	0.19	0.05	0	0
			80	2.35	1.02	0.47	0.26	0	0
			95	3.87	1.68	0.88	0.55	0.12	0
			115	7.30	3.07	1.71	1.14	0.44	0.18
			150	16.19	8.15	4.59	3.14	1.41	0.80
			180		16.19	9.99	6.75	2.94	1.70
			205			16.19	12.38	5.08	2.86
			220				16.19	6.95	3.82
			265					16.19	8.57
			305						16.19
10	12	25.29	80	2.94	1.27	0.59	0.33	0	0
			100	5.68	2.45	1.31	0.85	0.24	0
			120	10.66	4.44	2.45	1.68	0.68	0.31
			140	17.57	7.76	4.36	2.99	1.33	0.73
			165	25.29	15.06	8.60	5.79	2.58	1.50
			195		25.29	17.63	12.18	5.12	2.93
			220			25.29	20.65	8.69	4.78
			235				25.29	11.80	6.30
			280					25.29	13.86
			320						25.29
12	16	36.42	95	5.80	2.52	1.32	0.63	0.18	0
			120	12.79	5.33	2.97	2.01	0.82	0.37
			145	23.16	10.68	6.02	4.12	1.84	1.03
			180	36.42	24.29	14.99	10.12	4.41	2.55
			210		36.42	27.38	20.65	8.47	4.74
			235			36.42	31.01	14.16	7.56
			250				36.42	19.13	9.89
			295					36.42	21.43
			335						36.42
14	18	49.58	110	10.92	4.65	2.55	1.70	0.81	0.20
			140	24.60	10.67	6.13	4.19	1.86	1.03
			170	39.12	23.50	13.55	9.20	4.07	2.37
			195	49.58	35.60	24.69	17.05	7.17	4.10
			225		49.58	39.20	31.34	13.48	7.34
			250			49.58	43.44	22.32	11.54
			265				49.58	29.49	15.00
			310					49.58	31.98
			350						49.58
16	20	64.75	130	22.59	9.42	5.30	3.61	1.56	0.80
			160	39.17	21.33	11.95	8.15	3.65	2.11
			190	55.76	37.92	25.45	17.25	7.35	4.22
			210	64.75	48.98	36.51	27.53	11.29	6.32
			240		64.75	53.10	44.12	20.88	11.04
			265			64.75	57.94	33.70	17.14
			280				64.75	42.00	22.17
			325					64.75	44.84
			365						64.75

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Table 4.2:

Maximum connection force of rebar as per Eurocode 2 - 1992 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 minutes

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point $f_{y,k}$ = 500 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
20	25	101.18	160	48.97	26.67	14.93	10.18	4.56	2.64
			200	76.61	54.31	38.73	27.50	11.42	6.48
			240	101.18	81.96	66.37	55.15	26.10	13.80
			270		101.18	87.11	75.88	45.58	23.36
			295			101.18	93.16	62.86	35.72
			310				101.18	73.23	45.69
			355					101.18	76.79
			395						101.18
25	30	158.09	200	95.77	67.89	48.41	34.37	14.27	8.10
			250	138.96	111.09	91.60	77.57	39.86	20.61
			275	158.09	132.89	113.20	99.17	61.30	31.81
			305		158.09	139.12	125.09	87.22	52.79
			330			158.09	146.69	108.82	74.39
			345				158.09	121.77	87.34
			390					158.09	126.22
			430						158.09
32	40	259.02	255	183.40	147.72	122.78	104.82	56.35	28.80
			275	205.52	169.84	144.90	126.94	78.46	40.71
			325	259.02	225.13	200.19	182.23	133.75	89.66
			360		259.02	238.89	220.93	172.46	128.39
			380			259.02	243.05	194.58	150.51
			395				259.02	211.16	167.09
			440					259.02	216.86
			480						259.02
36	44	327.82	290	249.87	209.73	181.67	161.46	106.93	59.10
			325	293.41	253.27	225.21	206.01	150.47	100.89
			355	327.82	290.59	262.54	242.33	187.80	138.22
			385		327.82	299.86	279.65	225.12	176.54
			410			327.82	310.75	256.22	206.64
			425				327.82	274.86	225.30
			470					327.82	261.28
			510						327.82
40	47	404.71	320	319.10	274.50	243.33	220.87	160.28	105.19
			355	367.48	322.88	291.71	269.25	208.66	153.57
			385	404.71	364.35	333.18	310.72	250.13	195.04
			415		404.71	374.64	352.19	291.60	236.51
			440			404.71	386.75	326.16	271.07
			455				404.71	346.89	291.80
			500					404.71	354.01
			540						404.71

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Table 5.1:

Force maximale de ou dans la barre selon NF-ENV 1991-2-2 : 1955-02 (Eurocode 2) sous tenue au feu pour l' ANCRAGE de barres d'armature en fonction des résistances au feu de 30 à 240 minutes

Diamètre nominal du fer HA	Diamètre de forage	Force maximale de barre	Longueur de scellement	Force maximale de barre pour Hilti HIT-RE 500-SD (limite d' étirage $f_{y,k}$ = 500 N/mm²) en fonction des classes de résistance au feu					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	daN	daN	daN	daN	daN	daN
8	10	1619	65	138	57	19	5	0	0
			80	235	102	47	26	0	0
			95	367	168	88	55	12	0
			115	730	307	171	114	44	18
			150	1619	815	459	314	141	80
			180		1619	999	675	294	170
			205			1619	1238	506	286
			220				1619	695	382
			265					1619	857
			305						1619
10	12	2529	80	294	127	59	33	0	0
			100	568	245	131	85	24	0
			120	1066	444	248	166	68	31
			140	1757	776	438	299	133	73
			165	2529	1506	850	579	258	150
			195		2529	1763	1218	512	293
			220			2529	2066	869	478
			235				2529	1180	630
			280					2529	1386
			320						2529
12	16	3642	95	580	252	132	83	18	0
			120	1279	533	297	201	82	37
			145	2316	1068	602	412	184	103
			180	3642	2429	1499	1012	441	255
			210		3642	2738	2065	847	474
			235			3642	3101	1416	756
			250				3642	1913	969
			295					3642	2143
			335						3642
14	18	4958	110	1092	465	255	170	61	20
			140	2460	1087	613	419	186	103
			170	3912	2350	1355	920	407	237
			195	4958	3560	2469	1705	717	410
			225		4958	3920	3134	1348	734
			250			4958	4344	2232	1154
			265				4958	2949	1500
			310					4958	3198
			350						4958
16	20	6475	130	2259	942	530	361	156	80
			160	3917	2133	1195	815	365	211
			190	5576	3792	2545	1725	735	422
			210	6475	4898	3651	2753	1129	632
			240		6475	5310	4412	2068	1104
			265			6475	5794	3370	1714
			280				6475	4200	2217
			325					6475	4484
			365						6475

Remarque : Les Valeurs intermédiaires peuvent être obtenues par interpolation linéaire. Extrapolation n'est pas permis.

Table 5.2:

Force maximale de ou dans la barre selon NF-ENV 1991-2-2 : 1955-02 (Eurocode 2) sous tenue au feu pour l' ANCRAGE de barres d'armature en fonction des résistances au feu de 30 à 240 minutes

Diamètre nominal du fer HA	Diamètre de forage	Force maximale de barre	Longueur de scellement	Force maximale de barre pour Hilti HIT-RE 500-SD (limite d' étirage $f_{y,k}$ = 500 N/mm²) en fonction des classes de résistance au feu					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	daN	daN	daN	daN	daN	daN
20	25	10118	160	4807	2667	1493	1018	456	264
			200	7661	5431	3873	2750	1142	648
			240	10118	8196	6637	5515	2610	1380
			270		10118	8711	7588	4558	2336
			295			10118	9316	6286	3572
			310				10118	7323	4569
			355					10118	7679
			395						10118
25	30	15809	200	9577	6789	4841	3437	1427	810
			250	13896	11109	9160	7757	3986	2061
			275	15809	13269	11320	9917	6130	3181
			305		15809	13912	12509	8722	5279
			330			15809	14669	10882	7439
			345				15809	12177	8734
			390					15809	12622
			430						15809
32	40	25902	255	18340	14772	12278	10482	5635	2880
			275	20552	16984	14490	12694	7846	4071
			325	25902	22513	20019	18223	13375	8968
			360		25902	23889	22093	17246	12839
			380			25902	24305	19458	15051
			395				25902	21116	16709
			440					25902	21686
			480						25902
36	44	32782	290	24967	20973	18167	16146	10693	5910
			325	29341	25327	22521	20501	15047	10089
			355	32782	29059	26254	24233	18780	13822
			385		32782	29988	27965	22512	17554
			410			32782	31075	25622	20604
			425				32782	27488	22530
			470					32782	26126
			510						32782
40	47	40471	320	31910	27450	24333	22087	16028	10519
			355	36748	32288	29171	26925	20866	15357
			385	40471	36435	33318	31072	25013	19504
			415		40471	37464	35219	29160	23651
			440			40471	38675	32516	27107
			455				40471	34689	29180
			500					40471	35401
			540						40471

Remarque : Les Valeurs intermédiaires peuvent être obtenues par interpolation linéaire. Extrapolation n'est pas permis.

Table 6.1:

Maximum connection force of rebar as per Austrian Standard B 4700 – 2000 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 Minutes

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point $f_{y,k}$ = 550 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
8	10	17.81	65	1.38	0.57	0.19	0.05	0	0
			80	2.35	1.02	0.47	0.26	0	0
			95	3.87	1.68	0.88	0.55	0.12	0
			115	7.30	3.07	1.71	1.14	0.44	0.18
			155	17.81	9.33	5.24	3.58	1.61	0.92
			190		17.81	12.73	8.63	3.67	2.11
			210			17.81	13.76	5.65	3.16
			225				17.81	7.70	4.20
			270					17.81	9.34
			310						17.81
10	12	27.82	80	2.94	1.27	0.59	0.33	0	0
			100	5.68	2.45	1.31	0.85	0.24	0
			120	10.66	4.44	2.48	1.68	0.68	0.31
			140	17.57	7.70	4.38	2.99	1.33	0.73
			170	27.82	15.79	9.68	6.67	2.91	1.69
			205		27.82	21.09	15.48	6.35	3.58
			225			27.82	22.39	9.63	5.25
			245				27.82	14.43	7.54
			285					27.82	15.08
			325						27.82
12	16	40.07	95	5.80	2.52	1.32	0.83	0.18	0
			120	12.79	5.33	2.97	2.01	0.82	0.37
			145	23.16	10.68	6.02	4.12	1.84	1.03
			190	40.07	28.44	19.09	12.94	5.51	3.17
			220		40.07	31.53	24.79	10.43	5.73
			245			40.07	35.16	17.31	9.05
			280				40.07	23.20	11.79
			305					40.07	25.34
			345						40.07
14	18	54.54	110	10.92	4.65	2.55	1.70	0.61	0.20
			140	24.60	10.87	6.13	4.19	1.86	1.03
			170	39.12	23.50	13.55	9.20	4.07	2.37
			205	54.54	40.44	29.53	21.67	8.89	5.01
			235		54.54	44.04	36.18	16.52	8.82
			260			54.54	48.28	27.07	13.75
			275				54.54	34.33	17.81
			320					54.54	36.82
			360						54.54
16	20	71.23	130	22.59	9.42	5.30	3.61	1.56	0.80
			160	39.17	21.33	11.95	8.15	3.65	2.11
			190	55.76	37.92	25.45	17.25	7.35	4.22
			220	71.23	54.51	42.04	33.06	13.90	7.64
			266		71.23	61.39	52.41	28.17	14.40
			275			71.23	63.47	39.23	20.36
			290				71.23	47.52	26.26
			335					71.23	50.37
			375						71.23

Comments: Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Table 6.2:

Maximum connection force of rebar as per Austrian Standard B 4700 – 2000 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 Minutes

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point $f_{y,k}$ = 550 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
20	25	111.30	160	48.97	26.67	14.93	10.18	4.56	2.64
			200	76.81	54.31	38.73	27.50	11.42	6.48
			240	104.26	81.96	66.37	55.15	26.10	13.80
			255	111.30	92.33	76.74	65.51	35.22	18.00
			285		111.30	97.47	86.25	55.95	30.17
			305			111.30	100.07	69.77	42.23
			325				111.30	83.60	56.05
			370					111.30	87.15
			405						111.30
26	34	188.09	210	108.58	79.59	59.33	44.73	18.35	10.26
			260	153.51	124.52	104.25	89.66	50.27	25.54
			300	188.09	160.46	140.19	125.60	86.21	50.49
			335		188.09	171.64	157.05	117.66	81.85
			355			188.09	175.02	135.63	99.82
			370				188.09	149.11	113.30
			415					188.09	153.73
			455						188.09
30	38	250.42	240	156.39	122.94	99.56	82.72	39.16	20.69
			300	218.59	185.14	161.76	144.92	99.48	56.20
			335	250.42	221.43	198.05	181.21	135.76	94.45
			365		250.42	229.15	212.31	166.86	125.55
			390			250.42	236.23	192.78	151.47
			405				250.42	208.33	167.02
			450					250.42	213.67
			490						250.42
36	44	360.60	290	249.87	209.73	181.67	161.46	106.93	59.10
			360	336.96	296.81	268.76	248.55	194.02	144.44
			380	360.60	321.70	293.64	273.43	218.90	169.32
			415		360.60	337.18	316.97	262.44	212.86
			435			360.60	341.88	287.32	237.74
			455				360.60	312.20	262.62
			495					360.60	312.39
			535						360.60
40	47	445.19	320	319.10	274.50	243.33	220.87	160.28	105.19
			400	429.69	385.09	353.91	331.46	270.87	215.78
			415	445.19	405.82	374.64	352.19	291.60	236.51
			445		445.19	416.11	393.66	333.07	277.98
			470			445.19	425.22	367.63	312.54
			485				445.19	388.36	333.27
			530					445.19	385.48
			570						445.19

Comments: Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Table 7.1:
Maximum connection force of rebar as per British Standard BS 8110 : 1 – 1997 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 Minutes

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point $f_{y,k}$ = 460 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
8	10	15.73	65	1.38	0.57	0.19	0.05	0	0
			80	2.35	1.02	0.47	0.26	0	0
			95	3.87	1.68	0.89	0.55	0.12	0
			110	7.30	3.07	1.71	1.14	0.44	0.18
			150	15.73	8.15	4.59	3.14	1.41	0.80
			180		15.73	9.99	6.75	2.94	1.70
			205			15.73	12.38	5.08	2.86
			220				15.73	6.95	3.82
			265					15.73	8.57
			305						15.73
10	12	24.58	80	2.94	1.27	0.59	0.33	0	0
			100	5.68	2.45	1.31	0.85	0.24	0
			120	10.66	4.44	2.48	1.68	0.68	0.31
			140	17.57	7.76	4.38	2.99	1.33	0.73
			165	24.58	15.06	8.50	5.79	2.58	1.50
			195		24.58	17.63	12.18	5.12	2.93
			220			24.58	20.66	8.69	4.78
			235				24.58	11.80	6.30
			260					24.58	13.86
			320						24.58
12	16	35.39	95	5.80	2.52	1.32	0.83	0.18	0
			120	12.79	5.33	2.97	2.01	0.82	0.37
			145	23.16	10.68	6.02	4.12	1.84	1.03
			175	35.39	22.22	13.20	8.94	3.93	2.28
			210		35.39	27.38	20.65	8.47	4.74
			230			35.39	26.94	12.80	6.90
			250				35.39	19.13	9.89
			290					35.39	19.70
			330						35.39
14	18	48.17	110	10.92	4.65	2.55	1.70	0.61	0.20
			140	24.60	10.87	6.13	4.19	1.86	1.03
			170	39.12	23.50	13.55	9.20	4.07	2.37
			190	48.17	33.18	22.27	15.10	6.43	3.69
			225		48.17	36.20	31.34	13.48	7.34
			245			48.17	41.02	20.20	10.56
			260				48.17	27.07	13.75
			305					48.17	29.56
			345						48.17
16	20	62.92	130	22.59	9.42	5.30	3.61	1.56	0.80
			160	39.17	21.33	11.95	8.15	3.65	2.11
			190	55.76	37.92	25.45	17.25	7.35	4.22
			205	62.92	46.21	33.74	24.76	10.16	5.73
			240		62.92	53.10	44.12	20.88	11.04
			260			62.92	55.17	30.94	15.72
			275				62.92	39.23	20.36
			320					62.92	42.08
			360						62.92

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Table 7.1:
Maximum connection force of rebar as per British Standard BS 8110 : 1 – 1997 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 Minutes

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point $f_{y,k}$ = 460 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
8	10	15.73	65	1.38	0.57	0.19	0.05	0	0
			80	2.35	1.02	0.47	0.26	0	0
			95	3.87	1.68	0.89	0.55	0.12	0
			115	7.30	3.07	1.71	1.14	0.44	0.18
			150	15.73	8.15	4.59	3.14	1.41	0.80
			180		15.73	9.99	6.75	2.94	1.70
			205			15.73	12.38	5.08	2.86
			220				15.73	6.95	3.82
			265					15.73	8.57
			305						15.73
10	12	24.58	80	2.94	1.27	0.59	0.33	0	0
			100	5.68	2.45	1.31	0.85	0.24	0
			120	10.66	4.44	2.48	1.68	0.68	0.31
			140	17.57	7.76	4.38	2.99	1.33	0.73
			165	24.58	15.06	8.50	5.79	2.58	1.50
			195		24.58	17.63	12.18	5.12	2.93
			220			24.58	20.66	8.69	4.78
			235				24.58	11.80	6.30
			280					24.58	13.86
			320						24.58
12	16	35.39	95	5.80	2.52	1.32	0.83	0.18	0
			120	12.79	5.33	2.97	2.01	0.82	0.37
			145	23.16	10.68	6.02	4.12	1.84	1.03
			175	35.39	22.22	13.20	8.94	3.93	2.28
			210		35.39	27.38	20.65	8.47	4.74
			230			35.39	26.94	12.80	6.90
			250				35.39	19.13	9.89
			290					35.39	19.70
			330						35.39
14	18	48.17	110	10.92	4.65	2.55	1.70	0.61	0.20
			140	24.60	10.87	6.13	4.19	1.86	1.03
			170	39.12	23.50	13.55	9.20	4.07	2.37
			190	48.17	33.18	22.27	15.10	6.43	3.69
			225		48.17	36.20	31.34	13.48	7.34
			245			48.17	41.02	20.20	10.56
			260				48.17	27.07	13.75
			305					48.17	29.56
			345						48.17
16	20	62.92	130	22.59	9.42	5.30	3.61	1.56	0.80
			160	39.17	21.33	11.95	8.15	3.65	2.11
			190	55.76	37.92	25.45	17.25	7.35	4.22
			205	62.92	46.21	33.74	24.76	10.16	5.73
			240		62.92	53.10	44.12	20.88	11.04
			260			62.92	55.17	30.94	15.72
			275				62.92	39.23	20.36
			320					62.92	42.08
			360						62.92

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Maximum connection force of rebar as per British Standard BS 8110 : 1 – 1997 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 Minutes

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point $f_{y,k}$ = 460 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,r}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
20	25	98.31	160	48.97	26.67	14.93	10.18	4.56	2.64
			200	75.61	54.31	38.73	27.50	11.42	6.48
			235	98.31	75.50	62.92	51.69	23.60	12.60
			265		98.31	83.65	72.42	42.13	21.43
			290			98.31	89.70	59.41	32.83
			305				98.31	69.77	42.23
			350					98.31	73.33
			390						98.31
25	30	153.61	200	95.77	67.89	48.41	34.37	14.27	8.10
			250	138.96	111.09	91.60	77.57	39.86	20.61
			270	153.61	126.37	108.88	94.85	56.98	29.19
			300		153.61	134.80	120.77	82.90	46.55
			325			153.61	142.37	104.50	70.07
			340				153.61	117.45	83.02
			385					153.61	121.90
			425						153.61
28	35	192.68	225	131.45	100.23	78.41	62.69	26.95	14.69
			250	155.84	124.42	102.80	86.98	44.64	23.08
			290	192.68	163.12	141.30	125.58	83.17	45.96
			325		192.68	175.17	159.45	117.04	78.47
			345			192.68	178.80	136.39	97.83
			360				192.68	150.90	112.34
			405					192.68	155.86
			445						192.68
32	40	251.67	255	183.40	147.72	122.78	104.82	56.35	28.80
			280	211.05	175.37	150.43	132.47	83.99	44.34
			320	251.67	219.60	194.66	176.70	128.23	84.15
			350		251.67	227.84	209.87	161.40	117.33
			375			251.67	237.52	189.05	144.98
			390				251.67	205.63	161.56
			435					251.67	211.33
			475						251.67
36	44	318.52	290	249.97	209.73	181.67	161.46	106.93	59.10
			320	287.19	247.05	219.99	198.79	144.25	94.67
			350	318.52	284.37	255.32	236.11	181.58	132.00
			390		318.52	293.64	273.43	218.90	169.32
			400			318.52	298.31	243.78	194.20
			420				318.52	268.66	219.08
			465					318.52	275.06
			500						318.52
40	47	393.23	320	319.10	274.50	243.33	220.87	160.28	105.19
			350	360.57	315.97	284.80	262.34	201.75	146.86
			375	393.23	350.53	319.35	296.90	236.31	181.22
			410		393.23	367.73	345.28	284.69	229.60
			430			393.23	372.93	312.33	257.25
			445				393.23	333.07	277.98
			490					393.23	340.18
			530						393.23

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Table 8.1:

Maximum connection force of rebar as per Singapore Standard CP - 65 : 1999 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 Minutes

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point $f_{y,k}$ = 460 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
8	10	14.36	65	1.38	0.67	0.19	0.05	0	0
			80	2.35	1.02	0.47	0.26	0	0
			95	3.87	1.68	0.68	0.55	0.12	0
			115	7.30	3.07	1.71	1.14	0.44	0.18
			145	14.36	7.12	4.01	2.74	1.23	0.69
			175		14.36	8.80	5.96	2.62	1.52
			200			14.36	11.00	4.57	2.59
			215				14.36	6.27	3.48
			260					14.36	7.86
			300						14.36
10	12	22.44	80	2.94	1.27	0.59	0.33	0	0
			100	5.68	2.45	1.31	0.85	0.24	0
			120	10.66	4.44	2.46	1.66	0.68	0.31
			140	17.57	7.76	4.36	2.99	1.33	0.73
			155	22.44	11.66	6.55	4.47	2.01	1.15
			190		22.44	15.91	10.78	4.59	2.64
			210			22.44	17.21	7.06	3.95
			230				22.44	10.66	5.75
			270					22.44	11.68
			310						22.44
13	18	37.92	105	6.66	3.72	2.02	1.33	0.43	0.09
			130	18.35	7.65	4.31	2.94	1.27	0.65
			155	29.56	15.16	8.51	5.81	2.61	1.50
			175	37.92	24.07	14.30	9.68	4.25	2.47
			210		37.92	29.66	22.37	9.17	5.13
			230			37.92	31.35	13.86	7.48
			245				37.92	18.76	9.81
			290					37.92	21.34
			330						37.92
16	20	57.45	130	22.59	9.42	5.30	3.61	1.56	0.80
			160	39.17	21.33	11.95	8.15	3.65	2.11
			195	57.45	40.69	28.22	19.49	8.20	4.68
			230		57.45	47.57	38.59	17.06	9.20
			250			57.45	49.65	25.51	13.18
			265				57.45	33.70	17.14
			310					57.45	36.55
			350						57.45
20	25	89.76	160	48.97	26.67	14.93	10.18	4.56	2.64
			200	76.61	54.31	38.73	27.50	11.42	6.48
			220	89.76	68.14	52.55	41.32	17.38	9.56
			255		89.76	76.74	65.51	35.22	18.00
			275			89.76	79.34	49.04	25.45
			295				89.76	62.86	35.72
			335					89.76	62.96
			375						89.76

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Table 8.2:

Maximum connection force of rebar as per Singapore Standard CP - 65 : 1999 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 Minutes

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point $f_{y,k}$ = 460 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
22	28	108.61	175	65.27	40.74	24.20	16.38	7.20	4.18
			220	99.46	74.95	57.80	45.45	19.11	10.51
			235	108.61	86.35	69.21	56.86	25.96	13.86
			265		108.61	92.01	79.67	46.34	23.57
			290			108.61	98.67	65.35	36.11
			305				108.61	76.75	46.45
			350					108.61	80.66
			390						108.61
25	30	140.25	200	95.77	67.89	48.41	34.37	14.27	8.10
			250	138.96	111.09	91.60	77.57	39.86	20.61
			255	140.25	115.41	95.92	81.89	44.02	22.50
			285		140.25	121.84	107.81	69.94	37.71
			310			140.25	129.41	91.54	57.11
			325				140.25	104.50	70.07
			370					140.25	108.94
			410						140.25
28	35	175.93	225	131.46	100.23	78.41	62.69	26.90	14.69
			250	155.64	124.42	102.60	86.88	44.64	23.06
			275	175.93	148.61	126.79	111.07	68.65	35.62
			305		175.93	155.81	140.10	97.68	59.12
			330			175.93	164.29	121.87	83.31
			345				175.93	136.39	97.83
			390					175.93	141.37
			430						175.93
32	40	229.79	255	183.40	147.72	122.78	104.82	56.35	28.60
			280	211.05	175.37	150.43	132.47	83.99	44.34
			300	229.79	197.48	172.54	154.58	106.11	62.15
			330		229.79	205.72	187.76	139.28	95.21
			355			229.79	215.40	166.93	122.86
			370				229.79	183.52	139.45
			415					229.79	189.21
			455						229.79
40	47	359.04	320	319.10	274.50	243.33	220.87	160.26	105.19
			335	339.84	295.24	264.06	241.61	181.02	125.93
			350	359.04	315.97	284.80	262.34	201.75	146.66
			385		359.04	333.18	310.72	250.13	195.04
			405			359.04	338.37	277.78	222.69
			420				359.04	298.51	243.42
			465					359.04	305.63
			505						359.04

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Table 9.1:

Maximum connection force of rebar as per Australian Standard AS 3600 - 2001 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 Minutes (yielding point f_{yk} = 400 Mpa)

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point $f_{y,k}$ = 400 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
8	10	12.87	65	1.38	0.57	0.19	0.05	0	0
			80	2.35	1.02	0.47	0.26	0	0
			95	3.87	1.68	0.88	0.55	0.12	0
			115	7.30	3.07	1.71	1.14	0.44	0.18
			140	12.87	6.21	3.50	2.39	1.06	0.59
			170		12.87	7.74	5.26	2.33	1.35
			195			12.87	9.74	4.10	2.34
			210				12.87	5.65	3.16
			255					12.87	7.20
			290						12.87
10	12	20.11	80	2.94	1.27	0.59	0.33	0	0
			100	5.68	2.45	1.31	0.85	0.24	0
			120	10.66	4.44	2.48	1.68	0.68	0.31
			140	17.57	7.76	4.38	2.99	1.33	0.73
			150	20.11	10.19	5.74	3.92	1.76	1.00
			180		20.11	12.49	8.43	3.67	2.13
			205			20.11	15.48	6.35	3.58
			220				20.11	8.69	4.78
			265					20.11	10.71
			305						20.11
12	16	28.95	95	5.80	2.52	1.32	0.83	0.18	0
			120	12.79	5.33	2.97	2.01	0.82	0.37
			145	23.16	10.68	6.02	4.12	1.84	1.03
			160	28.95	16.00	8.90	6.11	2.74	1.58
			195		28.95	21.16	14.62	6.15	3.51
			215			28.95	22.72	9.40	5.21
			235				28.95	14.16	7.56
			275					28.95	15.27
			315						28.95
16	20	51.47	130	22.59	9.42	5.30	3.61	1.56	0.80
			160	39.17	21.33	11.95	8.15	3.65	2.11
			185	51.47	35.16	22.99	15.26	6.58	3.80
			215		51.47	39.27	30.29	12.53	6.95
			240			51.47	44.12	20.88	11.04
			255				51.47	28.17	14.40
			300					51.47	31.07
			340						51.47
20	25	80.42	160	48.97	26.67	14.93	10.18	4.56	2.64
			200	79.61	54.31	38.73	27.50	11.42	6.48
			210	80.42	61.22	45.64	34.41	14.11	7.89
			240		80.42	66.37	55.15	26.10	13.80
			265			80.42	72.42	42.13	21.43
			280				80.42	52.49	27.71
			325					80.42	56.05
			365						80.42

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Table 9.2:

Maximum connection force of rebar as per Australian Standard AS 3600 - 2001 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 Minutes (yielding point f_{yk} = 400 Mpa)

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point f_{yk} = 500 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
22	28	97.31	175	65.27	40.74	24.20	16.38	7.20	4.18
			200	84.27	59.74	42.60	30.25	12.56	7.13
			220	97.31	74.95	57.80	45.45	19.11	10.51
			250		97.31	80.61	68.26	35.07	18.13
			275			97.31	87.27	53.94	27.99
			290				97.31	65.35	36.11
			335					97.31	69.26
			375						97.31
25	30	125.66	200	95.77	67.89	48.41	34.37	14.27	8.10
			220	113.05	85.17	65.69	51.65	21.72	11.94
			235	125.66	98.13	78.64	64.61	29.50	15.76
			270		125.66	106.88	94.85	56.98	29.19
			290			125.66	112.13	74.26	41.04
			310				125.66	91.54	57.11
			350					125.66	91.66
			390						125.66
28	35	157.63	225	131.45	100.23	78.41	62.69	26.96	14.69
			240	145.96	114.74	92.92	77.20	36.55	19.31
			255	157.63	129.26	107.43	91.72	49.30	25.20
			285		157.63	136.46	120.75	78.33	42.24
			310			157.63	144.94	102.52	63.96
			325				157.63	117.04	78.47
			370					157.63	122.02
			410						157.63
32	40	205.89	255	183.40	147.72	122.78	104.82	56.35	28.80
			265	194.46	156.78	133.84	115.88	67.40	34.28
			280	205.89	175.37	150.43	132.47	83.99	44.34
			310		205.89	183.60	165.64	117.17	73.10
			335			205.89	193.29	144.81	100.74
			350				205.89	161.40	117.33
			395					205.89	167.09
			435						205.89
40	47	321.70	320	319.10	274.50	243.33	220.87	160.28	105.19
			325	321.70	281.41	250.24	227.79	167.19	112.11
			355		321.70	291.71	269.25	208.66	153.57
			380			321.70	303.81	243.22	188.13
			395				321.70	263.95	208.87
			440					321.70	271.07
			480						321.70

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted

Table 10.1:

Maximum connection force of rebar as per Australian Standard AS 3600 - 2001 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 Minutes (yielding point f_{yk} = 500 Mpa)

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point $f_{y,k}$ = 500 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,t}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
8	10	16.08	55	1.38	0.57	0.19	0.05	0	0
			80	2.35	1.02	0.47	0.26	0	0
			95	3.87	1.68	0.88	0.55	0.12	0
			115	7.30	3.07	1.71	1.14	0.44	0.18
			150	16.08	8.16	4.59	3.14	1.41	0.80
			180		16.08	9.99	6.75	2.94	1.70
			205			16.08	12.38	5.08	2.85
			220				16.08	6.95	3.82
			265					16.08	8.57
			305						16.08
10	12	25.13	80	2.94	1.27	0.59	0.33	0	0
			100	5.68	2.45	1.31	0.85	0.24	0
			120	10.65	4.44	2.46	1.68	0.68	0.31
			140	17.57	7.76	4.36	2.99	1.33	0.73
			165	25.13	15.06	8.50	5.79	2.56	1.50
			195		25.13	17.53	12.18	5.12	2.93
			220			25.13	20.66	8.69	4.78
			235				25.13	11.60	6.30
			295					25.13	17.86
			320						25.13
12	16	36.19	95	5.80	2.52	1.32	0.83	0.18	0
			120	12.79	5.33	2.97	2.01	0.82	0.37
			145	23.16	10.68	6.02	4.12	1.84	1.03
			180	36.19	24.29	14.99	10.12	4.41	2.55
			210		36.19	27.38	20.65	8.47	4.74
			235			36.19	31.01	14.16	7.56
			250				36.19	19.13	9.89
			295					36.19	21.43
			335						36.19
16	20	64.34	130	22.59	9.42	5.30	3.61	1.56	0.80
			160	39.17	21.33	11.95	8.15	3.65	2.11
			190	55.76	37.92	25.45	17.25	7.35	4.22
			210	64.34	48.98	36.51	27.53	11.29	6.32
			240		64.34	53.10	44.12	20.88	11.04
			265			64.34	57.94	33.70	17.14
			280				64.34	42.00	22.17
			325					64.34	44.84
			385						64.34
20	25	100.53	150	48.97	26.67	14.93	10.18	4.56	2.64
			200	76.61	54.31	38.73	27.50	11.42	6.48
			235	100.53	78.50	52.92	51.69	23.60	12.60
			270		100.53	87.11	75.88	45.58	23.36
			290			100.53	89.70	59.41	32.83
			310				100.53	73.23	45.69
			350					100.53	73.33
			390						100.53

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

Maximum connection force of rebar as per Australian Standard AS 3600 - 2001 concerning ANCHORING during exposure to fire in relation to fire resistance times from 30 to 240 Minutes (yielding point f_{yk} = 500 Mpa)

Nominal rebar diameter	Drill hole diameter	Maximum force in rebar	Anchorage depth	Maximum force in rebar in conjunction with Hilti HIT-RE 500-SD (Yielding point $f_{y,k}$ = 500 N/mm²) as a function of fire resistance class					
dia.	D	$F_{s,T}$	L	F30	F60	F90	F120	F180	F240
mm	mm	kN	mm	kN	kN	kN	kN	kN	kN
22	28	121.64	175	65.27	40.74	24.20	16.38	7.20	4.18
			220	99.48	74.95	57.80	45.45	19.11	10.51
			250	121.64	97.76	80.61	68.26	35.07	18.13
			285		121.64	107.22	94.87	61.55	33.19
			305			121.64	110.08	76.75	46.45
			325				121.64	91.96	61.66
			365					121.64	92.07
			405						121.64
25	30	157.08	200	95.77	67.89	48.41	34.37	14.27	8.10
			250	138.96	111.09	91.60	77.57	39.86	20.61
			275	157.08	132.69	113.20	99.17	61.30	31.81
			305		157.08	139.12	125.09	87.22	52.79
			330			157.08	146.69	108.82	74.39
			345				157.08	121.77	87.34
			390					157.08	126.22
			430						157.08
28	35	197.04	225	131.45	100.23	78.41	62.69	26.96	14.69
			250	155.64	124.42	102.60	86.88	44.64	23.06
			295	197.04	167.96	146.14	130.42	88.01	50.00
			330		197.04	180.00	164.29	121.87	83.31
			350			197.04	183.64	141.23	102.66
			365				197.04	155.74	117.18
			410					197.04	160.72
			450						197.04
32	40	257.36	255	183.40	147.72	122.78	104.82	56.35	28.80
			280	211.05	175.37	150.43	132.47	83.99	44.34
			325	257.36	225.13	200.19	182.23	133.75	89.66
			355		257.36	233.37	215.40	166.93	122.86
			380			257.36	243.06	194.58	150.51
			395				257.36	211.16	167.09
			440					257.36	216.86
			480						257.36
40	47	402.12	320	319.10	274.50	243.33	220.87	160.28	105.19
			350	360.57	315.97	284.80	262.34	201.75	146.66
			385	402.12	364.35	333.18	310.72	250.13	195.04
			415		402.12	374.64	352.19	291.60	236.51
			435			402.12	379.84	319.25	264.16
			455				402.12	346.89	291.80
			495					402.12	347.10
			535						402.12

Comments : Intermediate values may be obtained by linear interpolation. Extrapolating is not permitted.

CT-1

The Hilti HIT-CT 1 Rebar series of anchors, were subjected to tests utilising the heating conditions of DIN EN 1363-1, as reported under the reference ETA 11/0390 The performance ratings given in this report are as follows:

Minimum anchorage length and minimum lap length

The minimum anchorage length $l_{b,min}$ and the minimum lap length $l_{0,min}$ according to EN 1992-1-1 shall be multiplied by the relevant amplification factor α_{lb} given in Table C1.

Table C1: Amplification factor α_{lb} for hammer drilling, hammer drilling with Hilti hollow drill bit TE-CD, TE-YD, compressed air drilling

Bar diameter	Units	Concrete class								
		C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8 to ϕ 25	[-]	1,0			1,2	1,4				

Table C2: Bond efficiency value k_b for hammer drilling, hammer drilling with Hilti hollow drill bit TE-CD, TE-YD, compressed air drilling

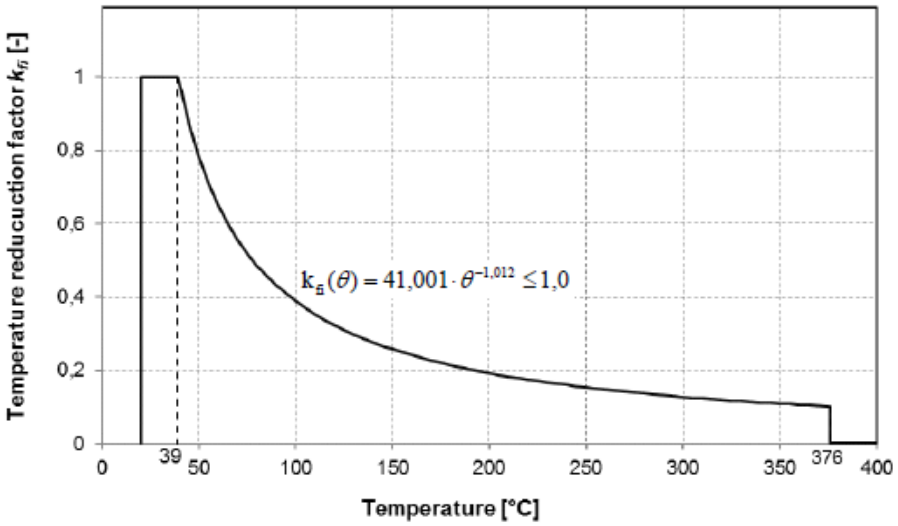
Bar diameter	Units	Concrete class								
		C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8 to ϕ 25	[-]	1,00	1,00	1,00	1,00	1,00	0,90	0,82	0,76	0,71

Table C3: Design values of the ultimate bond resistance f_{bd}[1)] in N/mm² for hammer drilling, hammer drilling with Hilti hollow drill bit TE-CD, TE-YD, compressed air drilling

Bar diameter	Units	Concrete class								
		C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8 to ϕ 25	[N/mm²]	1,6	2,0	2,3	2,7	3,0	3,0	3,0	3,0	3,0

1) According to EN 1992-1-1 for good bond conditions. For all other bond conditions multiply the values by 0,7.

Figure C1: Temperature reduction factor $k_{fi}(\theta)$ vs. temperature



The analytic equation that describes the variation of $k_{fi}(\theta)$ with temperature is given by the following function:

If $39°C \leq \theta \leq 376°C$: $k_{fi}(\theta) = 41{,}001 \times \theta^{-1{,}012} \leq 1.0 \quad \theta \; in \; °C$

If $\theta < 39°C$: $k_{fi}(\theta) = 1.0$

If $\theta > 376°C$: $k_{fi}(\theta) = 0.0$

The design value of ultimate bond strength $f_{bd,fi}$ under fire exposure is calculated according to following equation:

$$f_{bd,fi} = k_{fi}(\theta) \cdot f_{bd} \cdot \gamma_c / \gamma_{M,fi}$$

with:

$k_{fi}(\theta)$	… temperature reduction factor under fire exposure, see Figure C1
f_{bd}	… design values of the ultimate bond resistance according to Table C1
$\gamma_c = 1{,}5$	… recommended safety factor according to EN 1992-1-1
$\gamma_{M,fi}$	… safety factor according to EN 1992-1-2 under fire exposure

Conclusions

Hilti anchor systems, as detailed in this report, should be capable of supporting the loads detailed in the tables within this report, for periods of up to 240 minutes, when fixed into structural concrete (or other materials specifically detailed within this report), if subjected to the heating conditions of BS 476: Part 20: 1987.

This assessment represents our opinion as to the performance likely to be demonstrated on a test in accordance with BS 476: Part 20: 1987 on the basis of the evidence referred to above. We express no opinion as to whether that evidence, and/or this assessment, would be regarded by any Building Control authority as sufficient for that or any other purpose. This assessment is provided to the client for its own purposes and we cannot opine on whether it will be accepted by Building Control authorities or any other third parties for any purpose.

Validity

This assessment is issued on the basis of test data and information available at the time of issue. If contradictory evidence becomes available to EXOVA **warringtonfire** the assessment will be unconditionally withdrawn and Hilti Entwicklungsgesellschaft mbH will be notified in writing. Similarly the assessment is invalidated if the assessed construction is subsequently tested because actual test data is deemed to take precedence over an expressed opinion. The assessment is valid initially for a period of five years i.e. until 1st July 2018, after which time it is recommended that it be returned for re-appraisal.

The appraisal is only valid provided that no other modifications are made to the tested construction other than those described in this report.

Summary of Primary Supporting Data

The following tests were conducted by Institut Für Baustoffe Massivbau und Brandschutz, Technische Universität Braunschweig (IBMB), Germany and MFPA Leipzig GmbH, Baulicher Brandschutz, Hans Weiger Strasse 2b, 04 379 Leipsig on mechanical and chemical anchor systems as discussed in this report:

Chemical Fixings – With Threaded Rods				
Fixings	**Report**		**Fixings**	**Report**
HVA	IBMB 3333/0891		HIT-RE 500-SD	MFPA GS3.2/13-122-1
HVZ	IBMB 3357/0550		HIT-HY 200-A with threaded rod (HIT-V(-R); HIT-Z(-R), B500-B	IBMB 3501/676/12
HIT-HY 70	MFPA PB3.2/12-055-1		HIT-HY 200-R with threaded rod (HIT-V(-R); HIT-Z(-R), B500	IBMB 3501/676/12
HIT-HY 150-MAX	MFPA GS 3.2/09-121 A		HIT-RE 500	IBMB 3588/4825
HIT-HVU2	ETA 16/0515		HIT-HY270	PB 3.2/14-179-1

Chemical Fixings – With Post Installed Reinforced Bars (rebar)				
Fixings	**Report**		**Fixings**	**Report**
HIT-HY 150-MAX-Rebar	GS 3.2/10-51-1		HIT-RE 500 Rebar	IBMB 3357/0550
HIT-HY 200-A Rebar	DiBt Z-21.8-1947		HIT-RE 500-SD Rebar	MFPA GS 3.2/09-122
HIT-HY 200-R Rebar	DiBt Z-21.8-1948		HIT-CT-1	ETA 11/0390

Signatories

Responsible Officer

C Abbott* - Principle Certification Engineer

Approved

A Kearns* - Technical Manager

* For and on behalf of EXOVA **warringtonfire**.

Report Issued: 11th September 2018

Issue 2: 24th October 2018

The assessment report is not valid unless it incorporates the declaration duly signed by the applicant.

This copy has been produced from a .pdf format electronic file that has been provided by Exova Warringtonfire to the sponsor of the report and must only be reproduced in full. Extracts or abridgements of reports must not be published without permission of Exova Warringtonfire. The pdf copy supplied is the sole authentic version of this document. All pdf versions of this report bear authentic signatures of the responsible Exova Warringtonfire staff.