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Summary letter reference: CT/345425 Issue 3
Date: 20th October 2014
Page 1 of 6

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Summary letter for determining the contribution of protection system to the fire resistance of concrete slab members

To ensure the reinforced concrete solid slabs in buildings have the required fire resistance ability, the slab thickness and the thickness of concrete cover to the rebars must not be less than a certain level in accordance with EN 1992-1 Part 2. In the cases where the thickness of slab or concrete cover in existing reinforced concrete slab is deficient, it is possible to improve the fire resistance by applying intumescent paint system to the soffit of the slab. This letter presents a summary of the assessment of an intumescent coating system known as 'HENSOTHERM 820 KS' to fire protect structural concrete slabs in accordance with EN 13381-3:2015 for periods of fire resistance up to 240 minutes.

In accordance with section 5.7.2 in BS EN 1992-1 part 2, the required minimum slab thicknesses of reinforced concrete solid slabs are presented in Table 1. Generally when the overall slab thickness is equal or greater than those values, the integrity and insulation performance of the slab is deemed to be satisfied; while when the concrete cover over the rebar is deficient it is necessary to improve the protection to meet appropriate load bearing capacity.

Table 1. The required minimum slab thicknesses of reinforced concrete solid slabs according to section 5.7.2 in BS EN 1992-1 part 2.

Fire resistance period, minutes	Required minimum concrete cover in accordance with BS EN 1992-1 part 2, mm	Required minimum slab thickness in accordance with BS EN 1992-1 part 2, mm
EI 30	10	60
EI 60	20	80
EI 90	30	100
EI 120	40	120
EI 180	55	150
EI 240	65	175

The required dry film thickness (DFT) of 'HENSOTHERM 820 KS' to remedy the concrete cover deficiency is summarised in the tables below using linear interpolation avoiding non-conservative predictions against depth inside concrete slab along vertical axis at which steel reinforcing bars are positioned, with a predefined failure temperature of 500°C of the reinforcing bars. It is understood that the temperature distribution (where the rebar location is concerned) can be affected by the actual thickness of the reinforced concrete slab, however this variation is considered limited given the overall insulation performance will be met by the minimum required slab thickness. Therefore this variation has not been taken into account in this letter.

The data in the tables is based on the tests reports WF nos. 328732 and 330451 and assessment report 339814 Issue 2, with the following limits of applicability.

- 1) The concrete cover prior to application of protection should meet the requirement in BS EN1992-1 Part 1.
- 2) The load ratio of the slab in fire condition should be not greater than 0.6.
- 3) Consult Rudolf Hensel GmbH for the requirements of preparation of the concrete base prior to application of 'HENSOTHERM 820 KS'.
- 4) The results presented in this letter are based on the fire protection system tested in horizontal orientation on concrete slabs. Therefore, following the EN 13381-3:2015 Clause 15, the results are applicable to all concrete slabs and walls with fire exposure from one side only, in both horizontal and vertical orientation
- 5) Other limits of applicability in EN 13381-3:2015 (e.g. Clause 15)

Table 2. Required 'HENSOTHERM 820 KS' dry film thickness to improve fire resistance of the reinforced concrete slab for the period of 30 minutes.

30 minutes fire resistance period	
Depth of the reinforcing bar inside concrete slab along vertical axis, mm	Required 'HENSOTHERM 820 KS' dry film thickness for the 500°C design reinforcing bar temperature, mm
< 10	0.420
≥ 10	No protection required

Table 3. Required 'HENSOTHERM 820 KS' dry film thickness to improve fire resistance of the reinforced concrete slab for the period of 60 minutes.

60 minutes fire resistance period	
Depth of the reinforcing bar inside concrete slab along vertical axis, mm	Required 'HENSOTHERM 820 KS' dry film thickness for the 500°C design reinforcing bar temperature, mm
0	0.744
1	0.684
2	0.623
3	0.563
4	0.502
5	0.442
Between 6 and 20	0.420
≥ 20	No protection required

Table 4. Required 'HENSOTHERM 820 KS' dry film thickness to improve fire resistance of the reinforced concrete slab for the period of 90 minutes.

90 minutes fire resistance period	
Depth of the reinforcing bar inside concrete slab along vertical axis, mm	Required 'HENSOTHERM 820 KS' dry film thickness for the 500°C design reinforcing bar temperature, mm
0	1.043
1	0.991
2	0.939
3	0.887
4	0.834
5	0.782
6	0.730
7	0.678
8	0.626
9	0.574
10	0.522
11	0.469
Between 12 and 30	0.420
≥ 30	No protection required

Table 5. Required 'HENSOTHERM 820 KS' dry film thickness to improve fire resistance of the reinforced concrete slab for the period of 120 minutes.

120 minutes fire resistance period	
Depth of the reinforcing bar inside concrete slab along vertical axis, mm	Required 'HENSOTHERM 820 KS' dry film thickness for the 500°C design reinforcing bar temperature, mm
0	1.293
1	1.240
2	1.187
3	1.134
4	1.080
5	1.027
6	0.974
7	0.921
8	0.867
9	0.814
10	0.761
11	0.708
12	0.654
13	0.601
14	0.548
15	0.495
16	0.441
Between 17 and 40	0.420
≥ 40	No protection required

Table 6. Required 'HENSOTHERM 820 KS' dry film thickness to improve fire resistance of the reinforced concrete slab for the period of 150 minutes.

150 minutes fire resistance period	
Depth of the reinforcing bar inside concrete slab along vertical axis, mm	Required 'HENSOTHERM 820 KS' dry film thickness for the 500°C design reinforcing bar temperature, mm
0	1.560
1	1.496
2	1.431
3	1.367
4	1.303
5	1.238
6	1.174
7	1.109
8	1.045
9	0.981
10	0.916
11	0.852
12	0.788
13	0.723
14	0.659
15	0.594
16	0.530
17	0.466
Between 18 and 48	0.420
≥ 48	No protection required

Table 7. Required 'HENSOTHERM 820 KS' dry film thickness to improve fire resistance of the reinforced concrete slab for the period of 180 minutes.

180 minutes fire resistance period	
Depth of the reinforcing bar inside concrete slab along vertical axis, mm	Required 'HENSOTHERM 820 KS' dry film thickness for the 500°C design reinforcing bar temperature, mm
4	1.646
5	1.589
6	1.531
7	1.473
8	1.415
9	1.357
10	1.299
11	1.241
12	1.183
13	1.125
14	1.067
15	1.009
16	0.951
17	0.893
18	0.835
19	0.777
20	0.719
21	0.662
22	0.604
23	0.546
24	0.488
25	0.430
Between 26 and 55	0.420
≥ 55	No protection required

Table 8. Required 'HENSOTHERM 820 KS' dry film thickness to improve fire resistance of the reinforced concrete slab for the period of 240 minutes.

240 minutes fire resistance period	
Depth of the reinforcing bar inside concrete slab along vertical axis, mm	Required 'HENSOTHERM 820 KS' dry film thickness for the 500°C design reinforcing bar temperature, mm
12	1.687
13	1.639
14	1.591
15	1.543
16	1.495
17	1.447
18	1.399
19	1.351
20	1.303
21	1.255
22	1.207
23	1.159
24	1.111
25	1.063
26	1.015
27	0.966
28	0.918
29	0.870
30	0.822
31	0.774
32	0.726
33	0.678
34	0.630
35	0.582
36	0.534
37	0.486
38	0.438
Between 39 and 65	0.420
≥ 65	No protection required

We trust that the information presented in this letter will be useful to you.

Yours sincerely



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11th November 2016: Issue 2 – inclusion of table for 150 minutes.

24th August 2018: Issue 3 – editorial changes and addition of the statement allowing application of results to walls with fire exposure from one side only.

This assessment represents our opinion as to the performance likely to be demonstrated on a test in accordance with prEN 13381-3:2012, 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.

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