Test Report

Single Spacer

M 0054 / 2016 | 07.05.2016 | english
Requirements according DBV-WU, T, CDF, Type FAHKS40

Tested by: Kiwa GmbH, Garching
Test report

Order no.: M 0054 / 2016
Page 1 / 14

Client
Max Frank GmbH & Co. KG
Mitterweg 1
94339 Leiblfing

Order date : 15. February 2016
Test material : Single Spacer FAH KS 40

Project : Determination of the water penetration on concrete specimens with built-in spacers according to DIN 1048, Part 5 freeze-thaw test according to DIN CEN / TS 12390-9 via CDF test methods. Examination after thermal cycling

Testing period : 01. April 2016 – 06. May 2016
Tested by : Kiwa GmbH, NL München
Test period : February 2016 – May 2016

Garching, 07. May 2016
ma/mz


Dipl.-Ing. (FH) Andreas Matzner
- Team Leader -

The test report contains 15 pages.
The test results relate to the presented sample materials. The sample materials is consumend.
A partial duplication or disclosure of the test report is permitted only with our written permission.
Opinions and interpretations of the inspection are identified in accordance with DIN EN ISO /IEC 17 025, point 5.10.5 italics.


Peter Maier
- person responsible -
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1 General

Kiwa GmbH was contracted by Max Frank GmbH, represented by Mr. Dipl.-Ing. (FH) Lindner, to determine the concrete samples with built-in spacers FAH KS 40 to water penetration, the freeze-thaw testing according to the CDF-method and the determine test after thermal cycling.

To this end, the spacers were delivered on February 2016 delivered by Mr. Lindner.

All samplings and testings were performed by employees of our laboratories in Garching.
2 Test methodology

The preparation of the concrete specimen (cube with an edge length of 20 and 15 cm) was performed at 18. March 2016, according to the following concrete formula:

Concrete strength class C 35/45 (0/16 mm, F3)
- Cement CEM II/A-LL 42,5
- Number of varieties: 17832204
- Exposure classes: XD3, XF3

In the center cube samples 1 each spacer was set in concreted.

The storage of the samples was carried out (in the forms covered with foil) for 24 hours at about 20°C. After removal of the forms a circular area with diameter fo about 10 cm at the center area of the testing side with the water pressure was roughenect. Subsequently to test a water storage of about 20°C.

The storage of specimens for the freeze-thaw testing according to the CDF process and testing of the thermal cycling was carried out according to the standard.
2.1 Examination water penetration

The test was carried out according to DIN 1048-5, whereby the specimens were applied 5 bar water pressure for 72 hours at the side of the spacer. Subsequently the test specimens were split in the direction of sample height and the depth of water was measured on the cross section of the cleaved sample.

2.2 Freez-thaw test according to CDF method

The determination of freeze-/deicing salt resistance with de-icing salts solution was performed according to DIN CEN / TS 12390-9 with CDF method (alternative method) at the surface of the concrete cube with spacers.

This test method determines the weathering amount of surfaces defined by a number of freeze-thaw cycles in the presence of a de-icing agent solution. As a de-icing agent solution a 3% sodium chloride solution was used.

Three days before the start of the pre-saturation with the test solution a lateral seal with aluminum foil with butyl rubber was applied. Thereafter the specimens were stored (seven days in the test solution) for capillary fluid acquisition seven days in the test solution.

Before starting the freeze / thaw cycles loosely adhering particles were removed from the test surface of the specimens by treatment in an ultrasonic bath.

It was followed by a stress on the specimen with 28 freeze / thaw cycles. The duration of one freeze-thaw cycle took 12 hours. The temperature variation corresponded to the requirements of DIN CEN / TS 12390-9, Figure 10 (temperatures between ± 20 °C.)
To determine the surface scaling loose components of the test areas was removed after every 6, 10, 14 and 28 freeze/thaw cycles by an ultrasonic bath. The weathered material was collected and filtered. After drying at 105 °C to constant mass, the mass of scaling was determined and related to the particular test plots.

2.3 Testing with thermal cycling

The test specimen with the cast spacers were subjected to a ten-time thermal cycling at temperatures between +60 °C and -10 °C. Therefore the dice surfaces were heated by radiant heat for about 8 hours at a temperature of +60 °C. Subsequently the cubes were stored for about 16 hours in a freezer at a temperature of -10 °C. After ten temperature changes the concrete surfaces were visually inspected and photographed.

Test period: 15. April to 29. April 2016
3 Test results
3.1 Examination water penetration

After cleavage, it was found that the samples have an average water penetration of about 0.7 cm. The maximum allowed penetration depth of 5 cm was not exceeded.

3.2 Total amount of scaled material by the frost-thaw stress
3.2.1 Fluid absorption by capillary suction

<table>
<thead>
<tr>
<th>Test Nr.</th>
<th>Mass of solution absorbed in M.-% after</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 days</td>
</tr>
<tr>
<td>1</td>
<td>0.40</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
</tr>
<tr>
<td>3</td>
<td>0.42</td>
</tr>
<tr>
<td>MW</td>
<td>0.41</td>
</tr>
<tr>
<td>SA</td>
<td>0.01</td>
</tr>
</tbody>
</table>

MW = average, SA = standard deviation
3.2.2 Total amount of scaled material by the frost-thaw stress

Beginning of the freeze-thaw cycles: 22. April 2016
The end of the freeze-thaw cycles: 06. May 2016

<table>
<thead>
<tr>
<th>Test Nr.</th>
<th>Test area [m²]</th>
<th>Total mass of the dried scaled material related according to the test area in kg/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6 Zyklen</td>
</tr>
<tr>
<td>1</td>
<td>0,0225</td>
<td>0,001</td>
</tr>
<tr>
<td>2</td>
<td>0,0225</td>
<td>0,003</td>
</tr>
<tr>
<td>3</td>
<td>0,0225</td>
<td>0,002</td>
</tr>
<tr>
<td>MW</td>
<td>-</td>
<td>0,002</td>
</tr>
<tr>
<td>SA</td>
<td>-</td>
<td>0,00</td>
</tr>
</tbody>
</table>

MW = average, SA = standard deviation
3.3 Temperatur cycling

After ten thermal shock no cracks or delamination could be observed on the concrete surfaces in the immediate vicinity of the cast-in spacers.

4 Summery

All requirements of the DBV data sheet "spacers" are met.

Garching, 06. May 2016
Picture 1: Spacer used

Picture 2: Side view of spacer
Picture 3: Sample 1 after splitting for measuring the depth of water penetration 7 mm

Picture 4: Sample 2 after splitting for measuring the water penetration depth 10 mm
Picture 5  Sample 3 after splitting for measuring the depth of water 3 mm

Maximum penetration of water
Picture 6: Sample 7 after 28 freeze-thaw resistance. Abgewitterte Surface, no damage on the spacers recognizable.

Picture 7: Sample 8 after 28 freeze-thaw resistance. Abgewitterte surface. No damage on the spacer recognizable.
Picture 8: Sample 9 after 28 freeze thaw resistance, abgewitterte surface. No damage on the spacer recognizable.