BUILDING COMMON GROUND

MAX FRANK®

# Test Report

## Spacers cast concrete

**M 0190 / 2015 | 31.04.2015 | english**

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

Tested by: Kiwa, Garching

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kiwa
Partner for progress

# Test report

Client

Max Frank GmbH & Co. KG
Mitterweg 1
94339 Leiblfing

Order-no.:

M 0190 / 2015


| | | |
|---|---|---|
| Order date | : | 01.July 2015 |
| Test material | : | Single Spacer with plastic holder AB 50 HVF |
| 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.<br>Examination after thermal cycling |
| Testing period | : | 07. July – 28. August 2015 |
| Tested by | : | Kiwa GmbH, NL München |
| Test period | : | July 2015 – August 2015 |

Garching, 31. August 2054
ma/mz

p.p.

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

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- person respensible -



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- Photos

# 1 General

Kiwa GmbH was contracted by Max Frank GmbH, represented by Mr. Ostermeier and Mr. Lindner, determine the concrete samples with built in spacers AB 50 HVF 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 June delivered by Mr. Ostermeier.

All samplings and testings where performed by employes 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 7. July 2015, according to the following concrete formula:

Concrete strength class C 30/37 (0/16 mm, F3)

- Cement CEM II/A-LL 42,5
- Number of varities: 15342100
- Exposure classes: XD1, XF2

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.

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 opplied 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 di-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. There after 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 tock 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 termal 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: 05. August to 28. August 2015

# 3 Test results

## 3.1 Examination water penetration

After cleavage, it was found that the samples have an average water penetration of about 0,3 cm. The maximum allowed penetration depth of 5 cm was not exceeded.

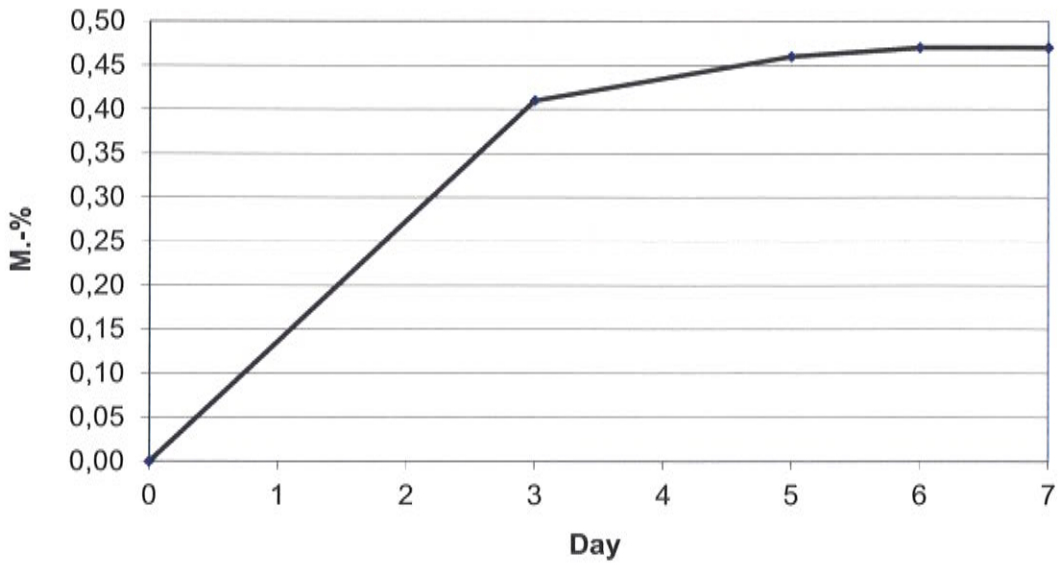
## 3.2 Total amount of scaled material by the frost-thaw stress

### 3.2.1 Fluid absorption by capillary suction

| Test Nr. | Mass of solution absorbed in M .-% after | | | |
|---|---|---|---|---|
| | 3 days | 5 days | 6 days | 7 days |
| 1 | 0,36 | 0,38 | 0,39 | 0,39 |
| 2 | 0,36 | 0,43 | 0,44 | 0,44 |
| 3 | 0,52 | 0,57 | 0,57 | 0,58 |
| MW | 0,41 | 0,46 | 0,47 | 0,47 |
| SA | 0,09 | 0,10 | 0,09 | 0,44 |

MW = average, SA = standard deviation

**Fluid absorption by capillary suction**

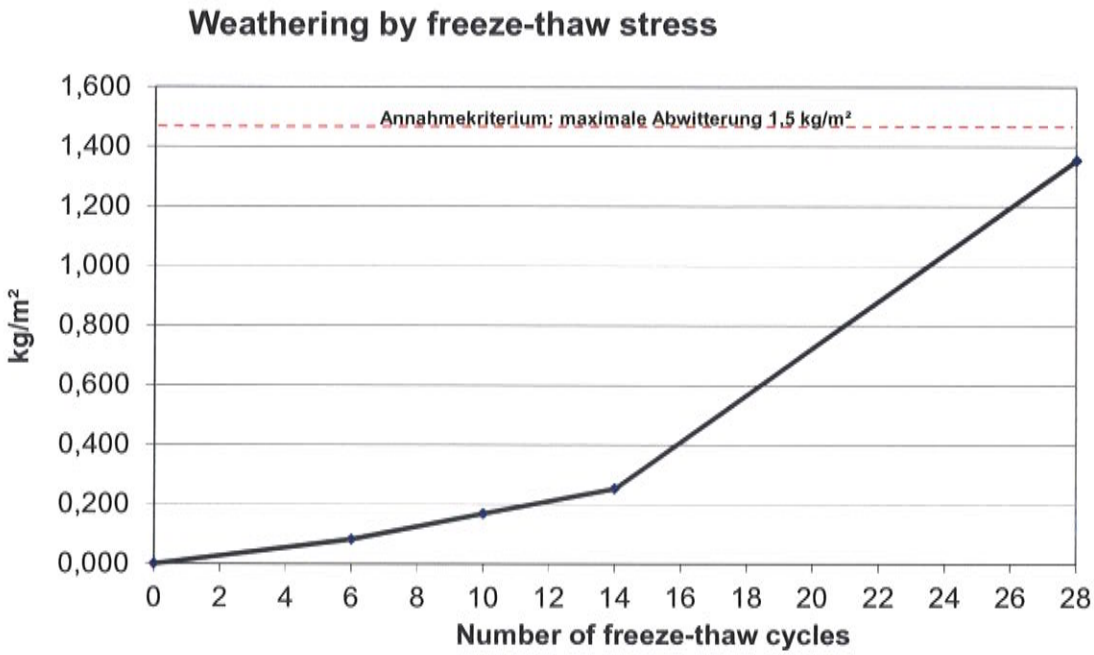



### 3.2.2 Total amount of scaled material by the frost-thaw stress

Beginning of the freeze-thaw cycles: 14. August 2015
The end of the freeze-thaw cycles: 28. August 2015

| Test Nr. | Test area [m²] | Total mass of the dried scaled material related according to the test area in kg/m² | | | |
|---|---|---|---|---|---|
| | | 6 Zyklen | 10 Zyklen | 14 Zyklen | 28 Zyklen |
| 1 | 0,225 | 0,113 | 0,208 | 0,313 | 1,465 |
| 2 | 0,0225 | 0,071 | 0,149 | 0,213 | 1,728 |
| 3 | 0,0225 | 0,064 | 0,151 | 0,232 | 0,869 |
| MW | - | 0,083 | 0,169 | 0,253 | 1,354 |
| SA | - | 0,03 | 0,03 | 0,05 | 0,44 |

MW = average, SA = standard deviation



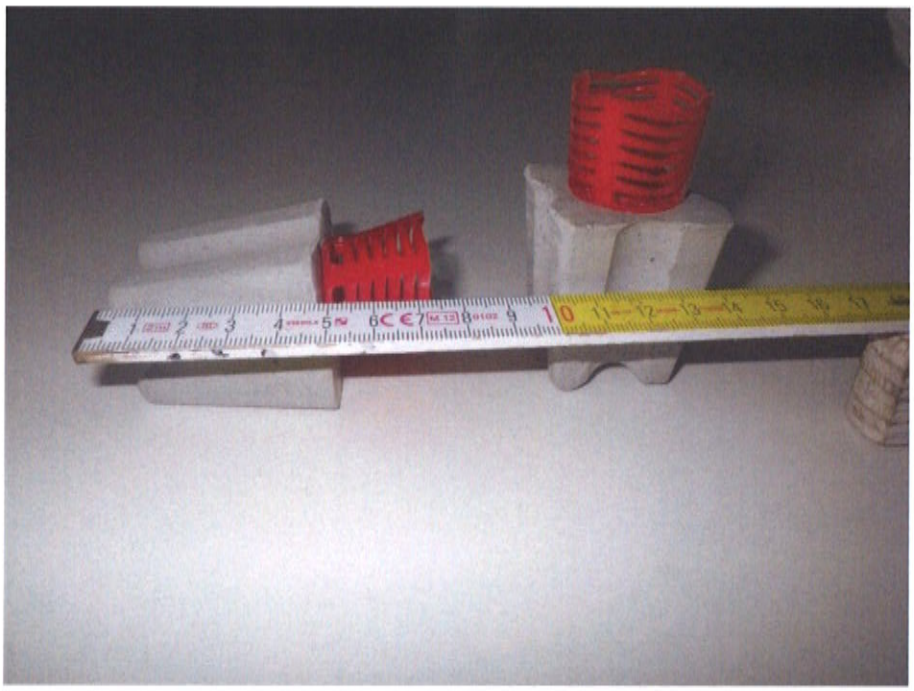

### 3.3 Temperatur cycling

After ten thermal shocks no cracks or cracks or spallings at the vicinity of the indirect un-cast spacers of the concrete surfaces were detected (see photos).

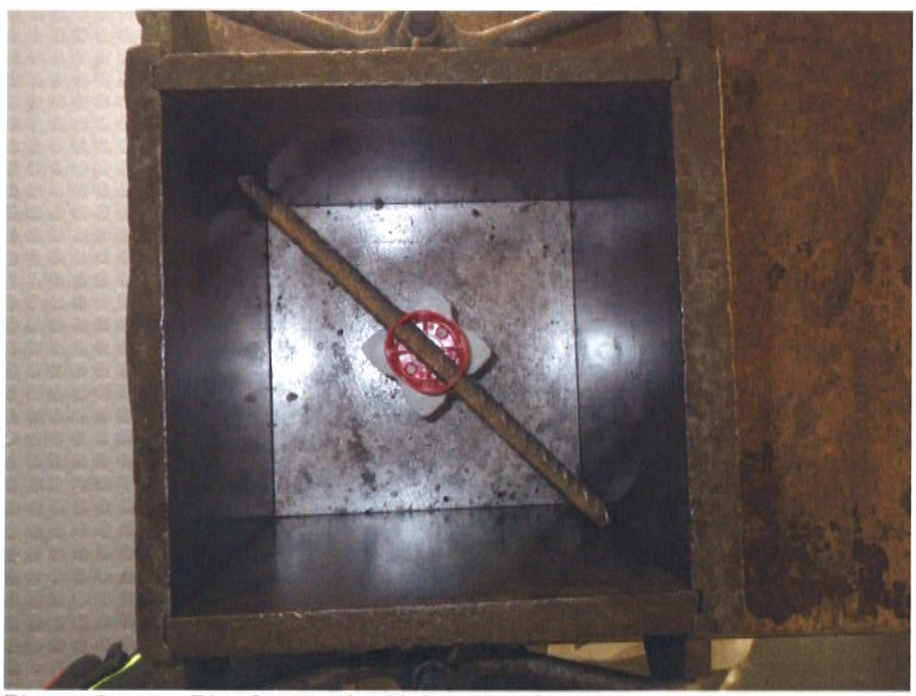
## 4 Summery

An audited spacers AB 50 HVF no discernible damage ( spalling, cracks or the like ) could be observed

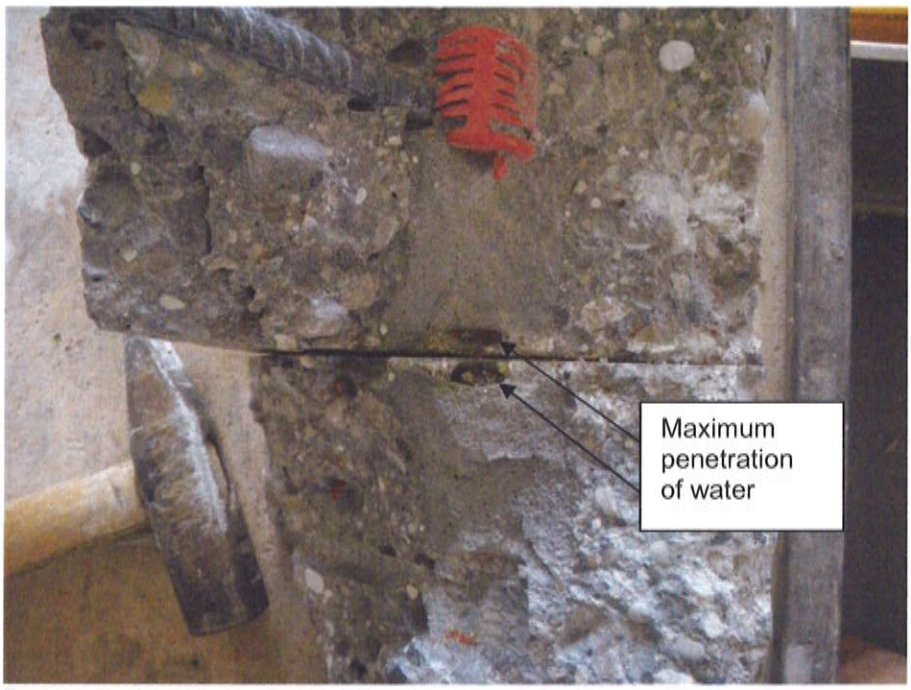
Garching, 31. August 2015



Picture 1: Spacer used

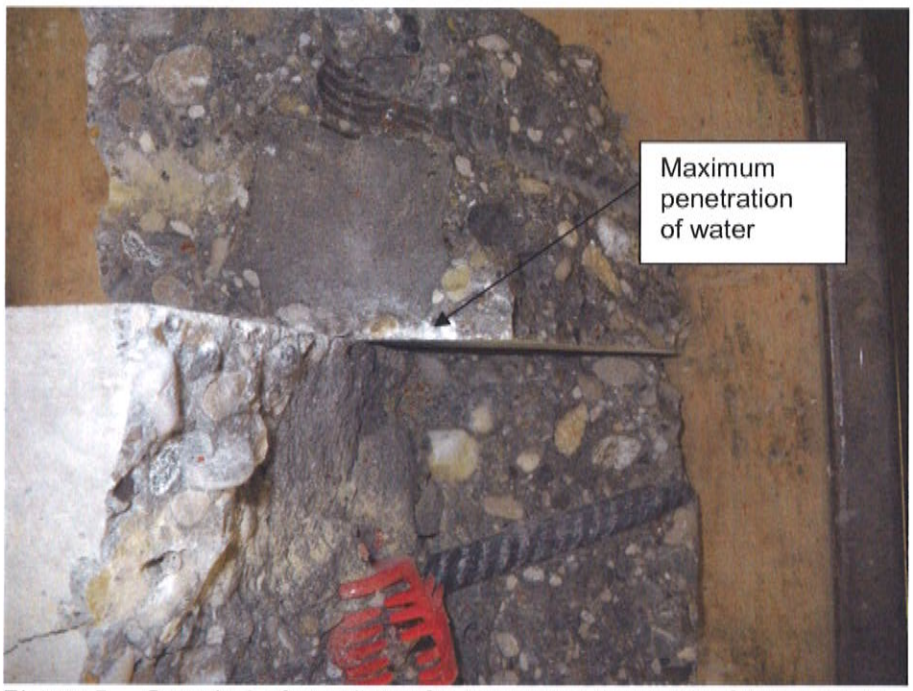


Picture 2: Dice formwork with integrated spacer




Picture 3: Sample 1 after splitting for measuring the depth of water penetration 5 mm


Picture 4: after splitting for measuring the water penetration depth 2 mm




Picture 5 Sample 3 after splitting for measuring the depth of water 3 mm

Picture 6: Sample 4 after 28 freeze thaw resistance, strong abgewitterte surface. No damage to the spacers.

Picture 7: after 28 freeze thaw resistance, strong abgewitterte surface. No damage to the spacer regonizable

Picture 8: Test 6 after 28 freeze thaw resistance , strong abgewitterte surface. No damage to the spacer recognizable.