WATERTIGHTNESS - OKTAGON®-PLUS

Watertightness pursuant to DIN 1048, Section 5

The following test certificate – M 0372/2013 – from MPA Bautest GmbH, attests to the watertightness of "OKTAGON®-PLUS", the formwork tie-rod system produced by us, pursuant to DIN in an installed state.

1. We point out quite explicitly that the surrounding concrete exerts a significant influence on the watertightness of the formwork tie rod. Great attention must therefore be placed on ensuring proper installation and the necessary concrete compaction in the vicinity of the tie rod. Our guarantee extends to the functionality of the product only, and does not cover either installation or processing.

This test certificate must not be passed on without this written advice!

Professor Dr.-Ing. Harald Sipple
Sworn expert in
concrete engineering; concrete building components and structures
publicly appointed by the IHK Regensburg

Fichtelgebirgstr. 15 - 93173 Wenzenbach - Tel 09407 3484 - Fax 09407 - 959692

5 November 2013

Nevoga GmbH
Znaimerstr. 4
83395 Freilassing

Re: Formwork spacer 'Oktagon-Plus'
- Here: Test of suitability for water-impermeable concrete structures pursuant to the WU Guideline [1].
My ref. 936/13.

Dear Sir or Madam,

The formwork spacer 'Oktagon-Plus' made by Nevoga GmbH, Freilassing, is a product used for creating watertight tie rods in the perimeter walls of so-called white tanks, in the sense of the relevant WU Guideline [1].

It is a plastic-based system, which is cut to size prior to delivery to the construction site and installed in accordance with the conventional and familiar rules of the trade in panel or beam formwork systems. Leakage is prevented by external profiling or ribbing of the plastic tubing. A sealing cap is provided to protect against water infiltration, which in this system is not fixed with adhesive but knocked into place by hand following stripping of the formwork.

The company Nevoga GmbH instructed the undersigned to test the

Watertightness of the 'Oktagon-Plus' system

and to verify this by means of a test certificate.

The test routine was coordinated with the client. As agreed, the tests were performed by the laboratory Kiwa MPA Bautest GmbH in Garching by Munich; see Annex for test certificate.

Performance of the test was oriented towards practice. Therefore, the concrete normally used for the white tank in structural engineering in accordance with the WU Guideline [1] Section 6.1 was used for creating the test objects, i.e. a common concrete of strength class C 25/30 with an equivalent water-cement value of w/zeq 0.60. To maintain a tolerance of Δw/zeq 0.05 as is common on construction sites, a w/zeq value 0.55 was selected.
See the attached test certificate (page 3 thereof) for further characteristic data relating to the concrete.

The test was performed at a water pressure of 5 bar over a period of 72 hours on the basis of DIN 1048, Section 5, with concrete of an age of 28 days. Cubes with a side length of 20 cm were produced to serve as test objects. Since the system is installed centrally in this test object, the concrete cover over the tie rod is only 8 cm, resulting in unfavourable conditions as regards stress from water pressure.

These unfavourable conditions were deliberately chosen in order to test the suitability of the system under such conditions.

Seepage test:
In both test objects, the water penetration depth reached as far as the first stop-anchor ring of the tied rod, approx. 40 mm beneath the surface of the concrete. It should be noted that the system cone already penetrates approx. 15 mm into the concrete.

Water infiltration test:
In this respect, both tie rods were watertight.

Result:
It is hereby verified that the 'Oktagon-Plus' system from Nevoga GmbH is suitable for the construction of so-called white tanks when subjected to due and proper professional installation in concrete in accordance with the WU Guideline [1].
Particular care should be taken at the site to ensure careful compaction of the concrete, additional compaction in the case of high-situated tie rods, and adequate subsequent treatment.

Prof. Dr.-Ing. H. Sipple
[1]... Water-Impermeable Concrete Structures Guideline ('WU Guideline). German Board for Reinforced Concrete, 11.2003.

Encl: Kiwa MPA Bautest GmbH test certificate No.. M 0372 / 2013 from 28.10.2013.

(Kiwa Logo)

Test Report

Assignment No.

M 0372 / 2013

Client

Nevoga GmbH
Znaimerstrasse 4
83395 Freilassing

Assignment date:	6 August 2013-11-22
Test material:	Plastic spacers 'Oktagon-Plus', incl. plugs
Assignment:	Determination of water penetration depth of concrete samples with embedded plastic spacers in accordance with DIN 1048, Section 5
Test duration:	11 September – 17 October 2013
Test performed by:	Kiwa MPA Bautest GmbH, Munich
Test period:	September/October 2013

Garching, 4 November 2013-11-22 br/gr

pp.

(Unterschrift)

Sigfried Bräuer
- Deputy head of test centre -

pp.

(Unterschrift)

Peter Grüner
- Testing officer -

(Stempel)
KIWA MPA Bautest
Kiwa

This test report comprises 7 pages and 1 annex.
The test results refer to the test material submitted. The sample material has been consumed.

Opinions and interpretations of the test centre are marked in *italics* pursuant to DIN EN ISO /IEC 10 025 item 5.10.5.

Bautest logo
Kiwa MPA Bautest GmbH
Gutenbergstrasse 25
85748 Garching
Tel. 089 329880-0, Fax 329880-40

1 General

Kiwa MPA Bautest GmbH received the assignment to determine the water penetration resistance of concrete samples with embedded 'Oktagon-Plus' plastic spacers from Nevoga GmbH, represented by Mr Ostermeier.

For this purpose, 'Oktagon-Plus' plastic spacers with plugs were supplied on 6 August 2013, see Fig.1.

All samples, sample preparations and tests were conducted by personnel and equipment of our laboratory in Garching.

Fig. 1: Oktagon-Plus spacer, condition as supplied.

2 Performance of test

The concrete sample objects (2 sample objects, cubes with a side length of 20 cm) were produced on 11 September 2013, with the following concrete formulation:

Concrete of strength class C 25/35 (0/16mm, F3), suitable for exposure class XC4:

- Cement CEM II/B-S 42.5:	295 kg/m³
- Fly ash:	65 kg/m³
- W/B value	0.55
- Concrete compressive strength 28 d:	approx. 42 N/mm²

One plastic spacer was placed in the middle of each sample cube and embedded in the concrete.

Storage of the samples was for 24 hours at approx. 20°C in the moulds (covered with foil). After stripping, the side of the samples exposed to water pressure was roughened over a circular area of approx. 10 cm in diameter. They were then placed in water at approx. 20°C and kept there up to testing at a concrete age of 28 days.

Prior to installation in the test apparatus, the face cones injected onto the spacers were broken at the intended position and removed by the client, and the embedded plastic spacer was sealed at one end with a sealing plug (sealing plugs were knocked into place), see Figs. 2 and 3.

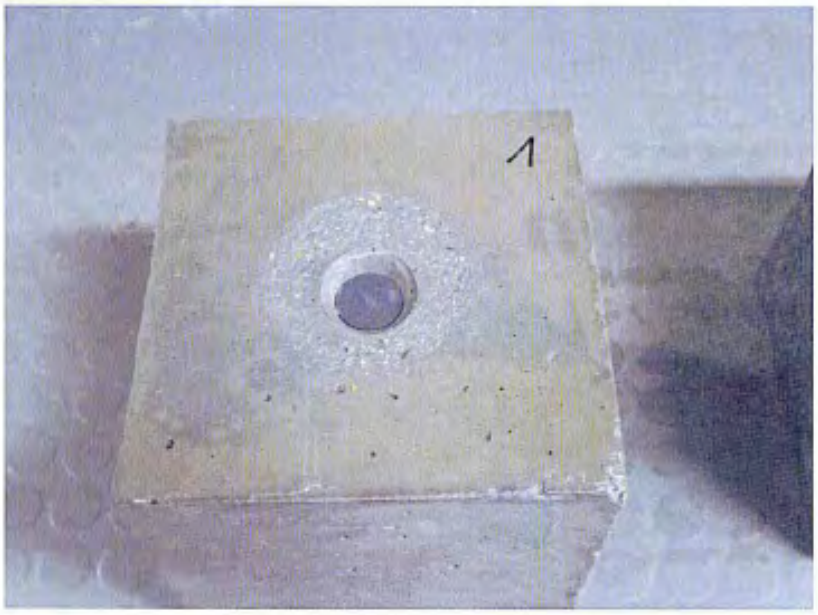

Fig. 1: Sample 1 with plug

Fig 2: Sample 2 with plug

The test-ready samples were installed in the test apparatus in such a way that the envisaged water pressure could impact on the roughened test surfaces and in turn on the sealed spacers.

The test was conducted in accordance with DIN 1048-5, during which the test objects were exposed to a water pressure of 5 bar.

- Test duration: 14 October to 17 October 2013

The test objects were then split in the direction of the sample height and the water penetration depth measured at the cross-section of the split samples, see Figs 4 and 5.

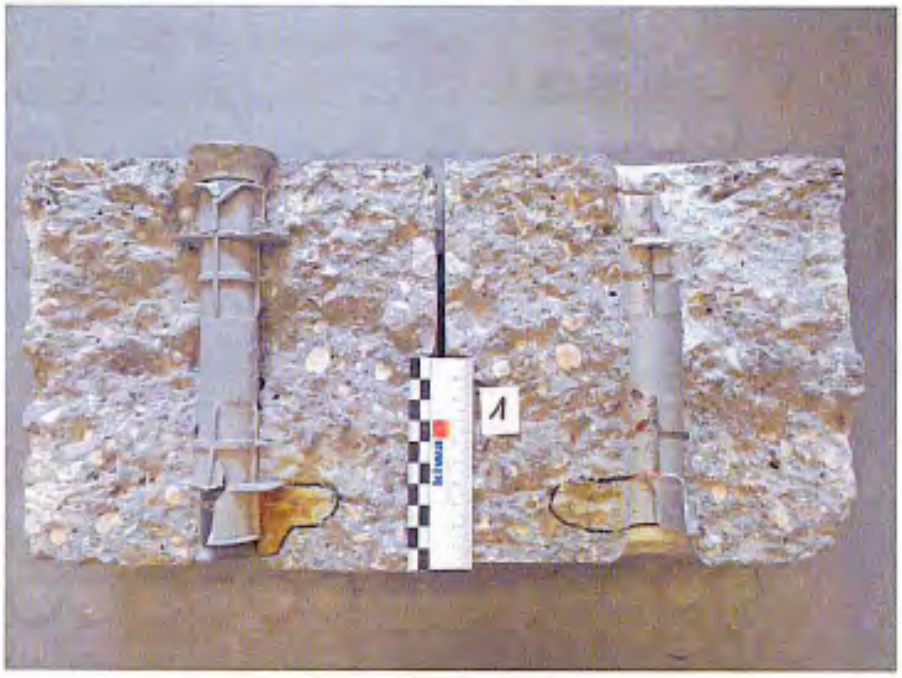

Fig. 4: Water penetration depth of the split test object – test object I

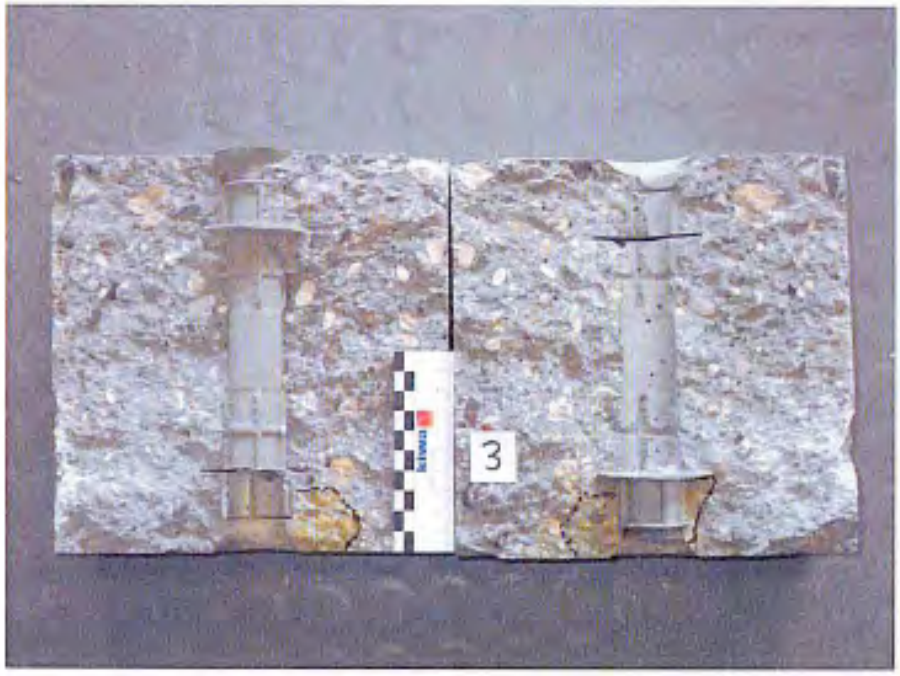

Fig. 5: Water penetration depth of the split test object – test object II

3 Test results

Following splitting of the test object, a water penetration depth up to the first ring of the 'Oktagon-Plus' plastic spacers was established in these samples.

Beyond this point, no further traces of moisture could be detected in either sample.

Garching, 4 November 2013

Photo 1: Oktagon-Plus' plastic spacer with sealing plug

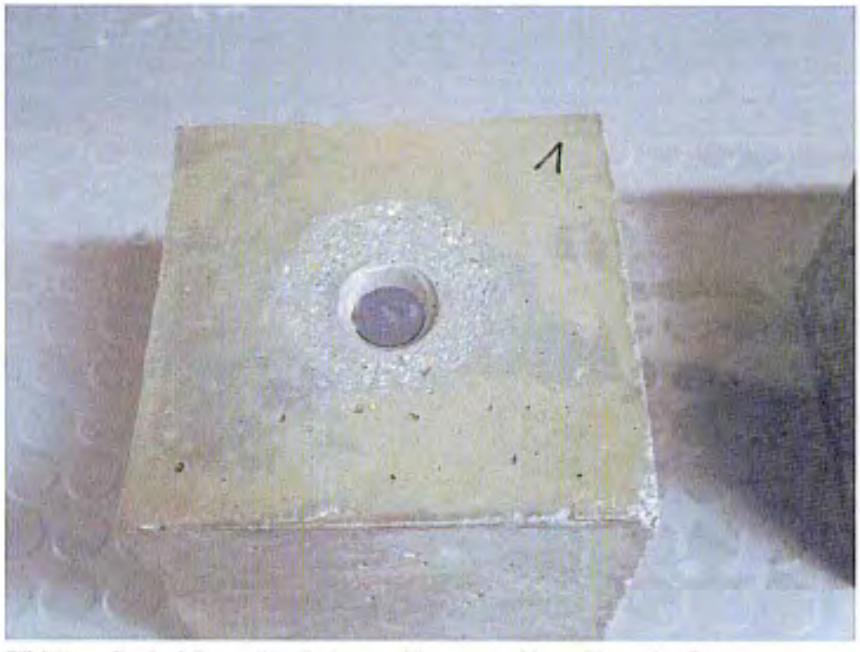

Photo 2: Test object 1 with inserted sealing plug

Photo 3: Test object 2 with inserted sealing plug

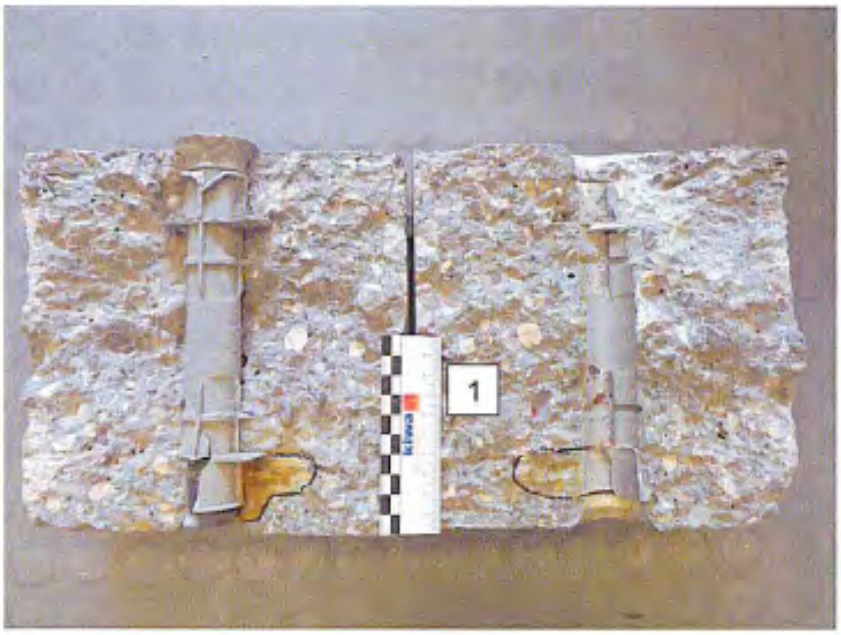

Photo 4: Test object 1: water penetration depth of 40 mm

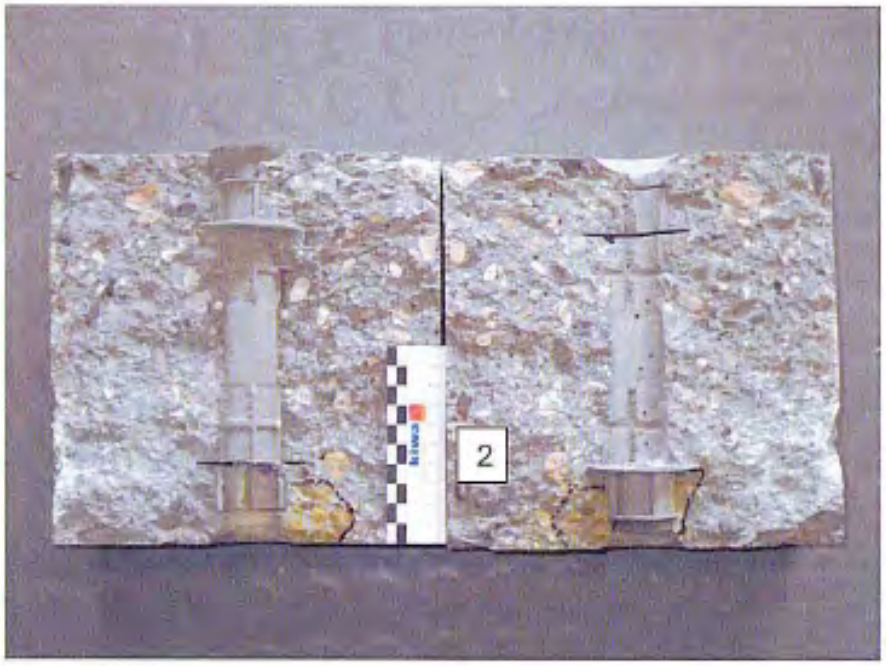

Photo 5: Test object 2: water penetration depth of 40 mm