BAUTECHNISCHE VERSUCHSANSTALT
at the HTL RANKWEIL
Akkreditierte Prüf- und Inspektionsstelle
DEPARTMENT FOR BUILDING MATERIALS AND COMPONENTS

NEGRELLISTRASSE 50
A-6830 RANKWEIL

TEL +43 5522 44004
FAX +43 5522 44004 89
E-MAIL va-baustoffe@htl-rankweil.at

TEST-REPORT

Testing of water tightness of anchor fastenings in composite specimens
on the basis of
EN 12390-8:2019 (issue 01.06.2019)
Testing hardened concrete – Part 8: Depth of penetration of water under pressure
with
water pressure of 5 bar for a test duration of 3 days

Adhesive anchoring system Hilti HIT-RE 500 V4
and stainless steel A4 anchor rods M12x160 mm

description of order

Ordering party	Hilti AG
Address of ordering party	Feldkircherstr. 100 FL-9494 Schaan Principality of Liechtenstein
Date of order Order No.	21.12.2020
Test material	• six composite specimens*) • Hilti HIT-RE 500 V4 • Stainless steel A4 anchor rods M12x160 mm
Receipt of test material	21.12.2020*), 15.01.2021

Test Report No.	301/20b
Date of issue	31.03.2021
This report consists of:	Text 9 pages

1. MISCELLANEOUS

The *Hilti AG* contracted the Testing Laboratory at the HTL Rankweil (Bautechnische Versuchsanstalt an der HTL Rankweil) to conduct tests to verify the water tightness of an adhesive anchor fastening system in composite specimens on the basis of EN 12390-8:2019 (issue 01.06.2019).

The Testing Laboratory at the HTL Rankweil is part of an educational institution and owned by the Republic of Austria. The Testing Laboratory is accredited according to EN ISO/IEC 17025:2017 by the Federal Ministry for Digital and Economic Affairs.

All used testing devices are calibrated with traceability to national or international reference standards.

2. TEST SAMPLES

The testing program comprised tests on six composite specimens with dimensions of approx. 300x300x235 mm. The composite specimens consist of 6 layers, i.e. – beginning from the top surface – (1) ceramic tiles with thickness of approx. 7 mm, (2) tile cement with thickness of approx. 3 mm, (3) sealing with thickness of approx. 2 mm, (4) screed with thickness of 65 mm, (5) sealing with thickness of 3-4 mm, and (6) concrete with height of 150 mm. The different layers are shown in Figure 1.

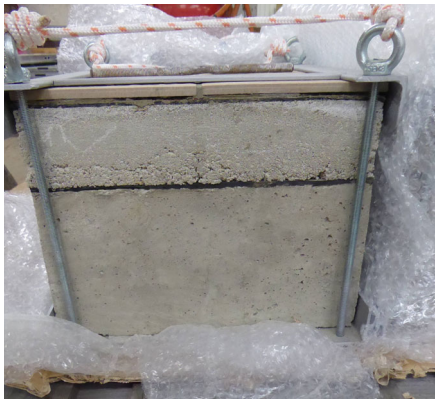


Figure 1. Lateral surface of a composite specimen with six layers.

The composite specimens were delivered by the ordering party to the Testing Laboratory at the HTL Rankweil on 21.12.2020.

The stainless steel A4 anchor rods M12x160 mm and the injection mortar Hilti HIT-RE 500 V4 are shown in Figure 2. These components were delivered by the ordering party to the Testing Laboratory at the HTL Rankweil on 15.01.2021.

Figure 2. Injection mortar Hilti HIT-RE 500 V4 (left) and anchor rods M12x160 mm (right).

The article number of the injection mortar was #2287557 and the batch numbers of component A and component B were 9014250 and 9115373, respectively.

3. PREPARATION OF THE TEST SAMPLES

3.1 Composite specimens

On 15.01.2021 (specimen no. 20.301 01) and on 18.01.2021 (specimens no. 20.301 02-06) the composite specimens were cut wet to the dimensions of 200x200x235 mm, in order to be able to testing the specimens in the water pressure test stand. The cutting surfaces were defined in such a way, that the crossing joint of the four ceramic tiles on the top surface of the composite specimens still remained in the centre of the surface-area. In Figure 3, the composite specimens are depicted after wet cutting.

Figure 3. Composite specimens after wet cutting with dimensions of 200x200x235 mm.

3.2 Setting the anchor rods

The boreholes / the anchor rods were positioned in the centre of the composite specimens, i.e. in / near the crossing joint of the ceramic tiles. The Hilti HEX 14/40 SPX diamond drill bit with a diameter of 14 mm was used for producing the boreholes in the ceramic tiles (diamond drilling procedure), whereas the Hilti TE-CX 14 drill bit with a medium cutting diameter of 14,33 mm was used for hammer drilling in the screed, sealing, and concrete. The borehole depth h_{nom} amounted to approx. 65 mm, hence, an embedment of the anchor rod in the concrete of 60 mm was achieved (schematically shown in Figure 4).

Figure 4. Definition of the borehole depth.

After drilling the boreholes were cleaned according to the borehole cleaning procedure described in ETA-20/0540 (issued on 27.11.2020), i.e. blowing 2 times from the back of the hole over the whole length with compressed air (6 bar), brushing 2 times with a steel brush in a twist motion, blowing again with compressed air 2 times.

Before the installation of the anchor rods, in agreement with the ordering party, the anchor rods were cleaned with a break cleaner (Liqui Moly GmbH), in order to degrease and remove any impurities (oil, dust, chips etc.).

The static mixer Hilti HIT-RE-M was tightly attached to the foil pack manifold. The 500 ml foil pack was inserted in the foil pack holder, which in turn was put into the mechanical dispenser Hilti HDM 500. The first 4 strokes were discarded.

Then, the boreholes were filled with the injection mortar starting at the back of the borehole. With each trigger pull the mixer was slowly withdrawn. The boreholes were filled up to approximately 2/3 of the height, and then, the anchor rods were set to the required embedment depth.

The ambient air temperature was 19°C. The anchors were installed on 28.01.2021.

After curing, the excess mortar was removed very carefully.

No fixture was attached and no tightening torque was applied.

4. WATER TIGHTNESS TESTS – 5 BAR FOR 3 DAYS

The water tightness tests were conducted on the basis of EN 12390-8:2019 (issue 01.06.2019).

The specimens were placed in a testing apparatus that is usually used for testing the water penetration depth according to ONR 23303:2010 resp. EN 12390-8:2019.

As with the tests described in the test report 301/20a issued on 31.03.2021, the ceramic tiles and the tile cement layers were removed very carefully by tapping with a hammer. The tested surfaces of the modified composite specimens with the internal numbers 20.301 02, 20.301 03, and 20.301 04 are shown in Figure 5.

Figure 5. Surfaces of specimens no. 20.301 02 (left), 20.301 03 (middle), and 20.301 04 (right) after removing the ceramic tiles and the tile cement layers.

The specimens were installed in the testing apparatus without any air inclusion (shown in Figure 6).

Figure 6. Installation of the specimens in the testing apparatus.

These specimens were exposed to a water pressure of 5 bar. More precisely, a circle with 100 mm in diameter with the anchor in its centre was exposed to the respective water pressure.

After a period of 3 days, the specimens were splitted along the axis of the anchor rods and the fracture surface was investigated visually for water penetration in the screed and in the concrete. The visual inspection was done by two members of the Testing Laboratory at the HTL Rankweil.

5. RESULTS OF THE WATER TIGHTNESS TESTS

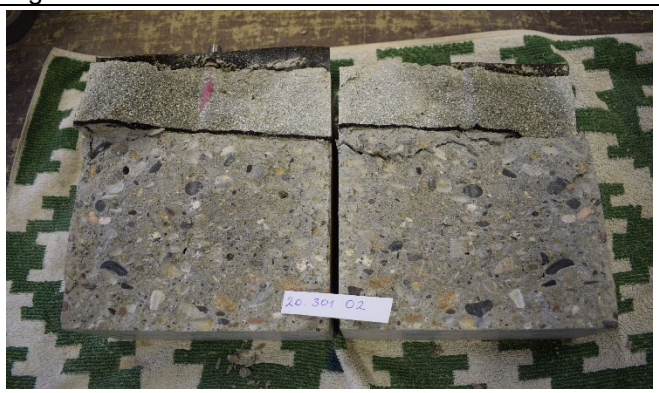
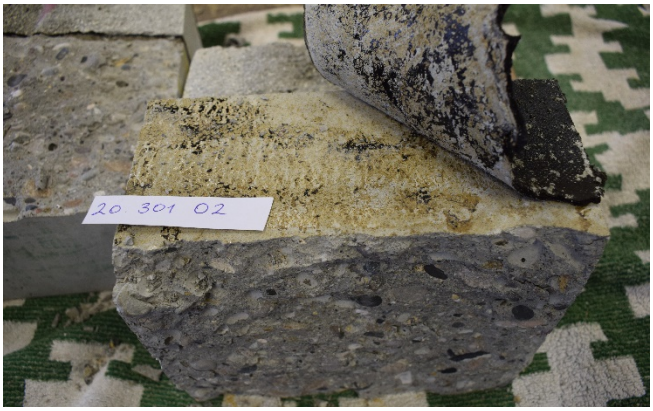
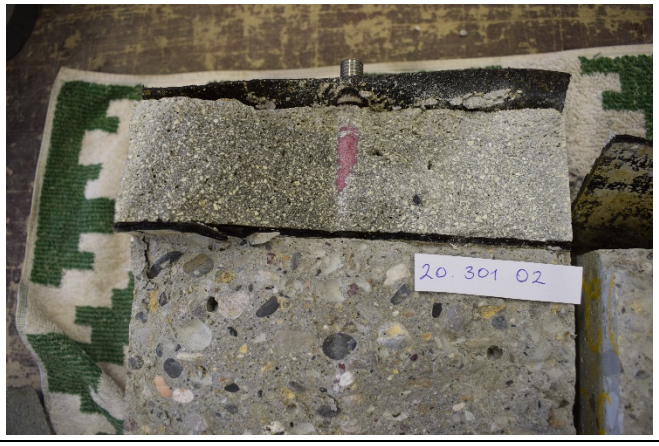
After 3 days of testing and before turning off the water pressure, the following observations were made (shown in Figure 7):

- specimen no. 20.301 02: crack formation in the screed
- specimen no. 20.301 03: crack formation in the screed and water outlet in that area
- specimen no. 20.301 04: crack formation in the screed and water outlet in that area

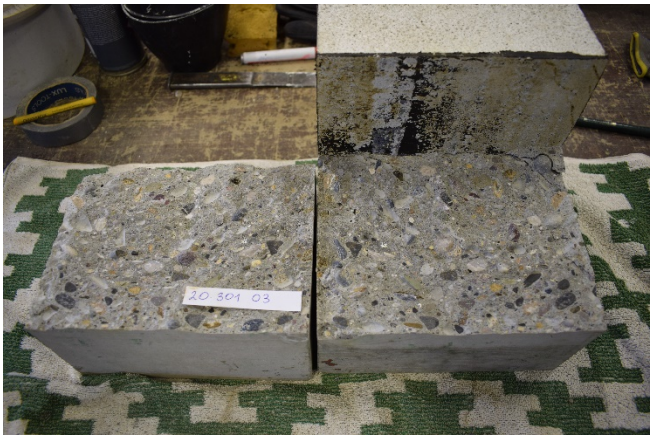
Figure 7. Specimens no. 20.301 02 (left), 20.301 03 (middle), and 20.301 04 (right).

The results of the water penetration tests performed with 5 bar and the evaluation of the tests are given in the following table.

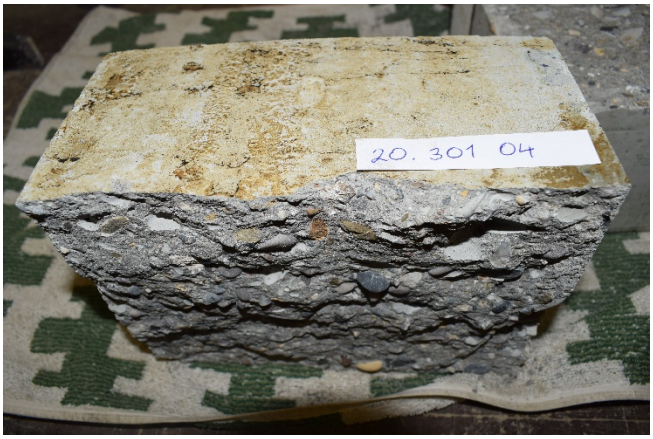
Table 1. Results of the water penetration tests – 5 bar for 3 days.

Specimen no.	Figure	Evaluation
20.301 02	  	• no water penetration in the concrete • water penetration in the screed

Continue of Table 1.

Specimen no.	Figure	Evaluation
20.301 03	  	• no water penetration in the concrete • water penetration in the screed

Continue of Table 1.

Specimen no.	Figure	Evaluation
20.301 04	   	• no water penetration in the concrete • water penetration in the screed

Since all tests showed a water penetration in the screed, the mass water content of the screed was determined on small pieces with penetrated water. The pieces were dried "softly" at a temperature of 50°C for a duration of about 48 hours. The results are shown in Table 2.

Table 2. Screed with penetrated water - mass water content.

Specimen no.	**20.301 02**	**20.301 03**	**20.301 04**
Mass water content	6,1 M-%	5,9 M-%	5,3 M-%

On specimen no. 20.301 05 (see test report 301/20a issued on 31.03.2021), the mass water content of a "dry" region of the screed was determined. The mass water content amounted to 1,4 M-%. Hence, an increase in the mass water content of 4,8 M-% (specimen no. 20.301 02), 4,6 M-% (specimen no. 20.301 03), and 3,9 M-% (specimen no. 20.301 04) was determined.

6. SUMMARY

Table 3 shows a summary of the results.

Table 3. Summary – test results.

Laboratory no.	anchor rod size	drilling direction	injection mortar	Evaluation of **water penetration** in the **concrete**
20.301 02	M12x160	90°	HIT-RE 500 V4	passed
20.301 03				passed
20.301 04				passed

Decision rule according to EN ISO/IEC 17025, in agreement with the ordering party:

Evaluation of the results on the basis of the **water penetration** in the **concrete**
Declaration of conformity according EN 12390-8:2019 (issue 01.06.2019):
See Table 3.

Rankweil, 31.03.2021

Dipl.-Ing. Dr. techn. M. Drexel
Deputy head of the department
Authorised person

Dipl.-Ing. W. Wechner
Head of the department
Authorised person