



TEST-REPORT

**PENETRATION OF WATER UNDER PRESSURE WITH 500 kPa
IN HARDENED CONCRETE OF STRENGTH CLASS C25/30**

**SAMPLES WITH ANCHOR ROD HAS-U 5.8 M12x160
INSTALLED WITH HILTI HIT-HY 200-A V3**

Test procedure on the basis of EN 12390-8:2019: Testing hardened concrete – Part 8: Depth of penetration of water under pressure

description of order

Ordering party	Hilti Entwicklungsgesellschaft mbH Development – Business Unit Anchors
Address of ordering party	Hiltistr. 6 86916 KAUFERING GERMANY
Date of order Order No.	April 28 th , 2021
Test material	HAS-U 5.8 M12x160 Hilti HIT-HY 200-A V3
Receipt of test material	June 29 th , 2021

Test Report No.	299/21
Date of issue	December 15 th , 2021
This report consists of:	Text 6 pages Appendix 1 1 page Appendix 2 1 page Appendix 3 1 page

1 MISCELLANEOUS

The Hilti Entwicklungsgesellschaft mbH contracted the Testing Laboratory at the HTL Rankweil (Bautechnische Versuchsanstalt an der HTL Rankweil) to conduct tests to determine the depth of penetration of water under pressure in hardened concrete, when anchor rods HAS-U 5.8 M12x160 are installed with the adhesive mortar Hilti HIT-HY 200-A V3.

The following test procedure was agreed between the ordering party and the Testing Laboratory:


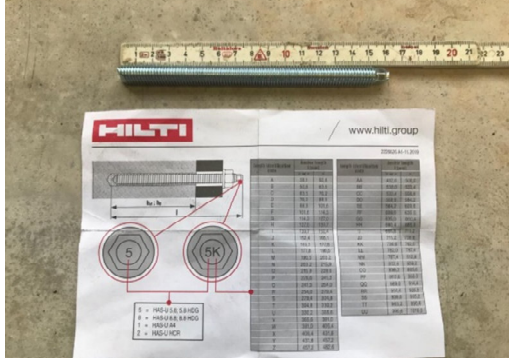
- casting of 5 concrete samples using C25/30 D_{max} 22, cubes with 200 mm edge length;
- casting of 3 concrete slabs from the same batch, with dimensions 200x200x120 mm;
- installation of the anchor rods HAS-U 5.8 M12x160 with Hilti HIT-HY 200-A V3 according to the instructions given by the ordering party;
- testing the samples on the basis of EN 12390-8:2019 respectively of ISO 1920-5:2018 by applying a water pressure with (500 ± 50) kPa for the duration of (72 ± 2) hours.

It was agreed upon, that the specimens, in which the anchors were installed, are not water-cured for the whole period between demolding and testing.

2 Test material

The test material, i.e. anchor rods HAS-U 5.8 M12x160 and adhesive mortar Hilti HIT-HY 200-A V3, are shown in Table 1.

Table 1. Test material, article number, lot number, date of sample receipt.

<p>Hilti HIT-HY 200-A V3</p> <p>Article no.: #2022697 Lot no.: 14677899 Receipt: June 29th, 2021</p> <p>Comp. A: 8018678 Comp. B: 8110042</p>	 <p>Remark: This samples were part of the QE production and therefore filled in the old HIT-HY 200-A foil design. Batch number and printing on the connector allowed an identification as HIT-HY 200-A V3.</p>
<p>HAS-U 5.8 M12x160</p> <p>Article no.: #2223823 Lot no.: 14611366 Receipt: June 29th, 2021</p>	

3 CONCRETE MIX DESIGN - CASTING OF CONCRETE SAMPLES

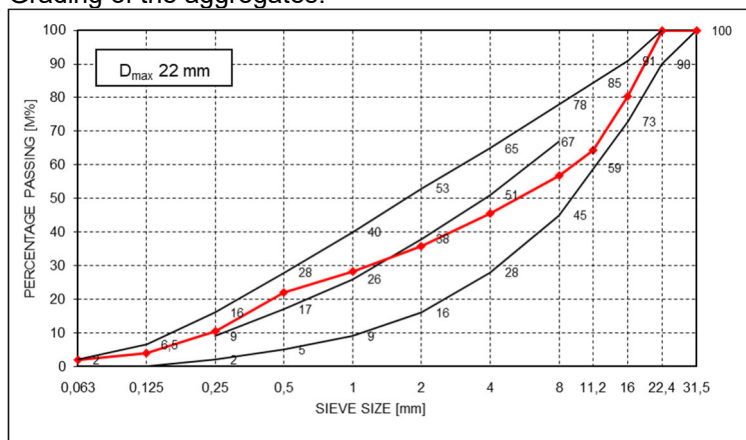
3.1 CONCRETE MIX DESIGN

Cement: 321 kg/m³ CEM II/A-LL 42,5 N, Holcim, Fluvio 4
Water: drinking water 170 kg/m³
W/C - ratio: 0,53

Aggregate - natural rounded gravel

0/4: 46%: 900 kg/m³ Zech-Kies GmbH
4/8: 9%: 179 kg/m³ Zech-Kies GmbH
8/16: 25%: 498 kg/m³ Zech-Kies GmbH
16/22: 20%: 398 kg/m³ Zech-Kies GmbH

Grading of the aggregates:



3.2 CASTING OF CONCRETE SPECIMENS

The concrete components were first mixed dry in a laboratory compulsory mixer. Then the mixing water was gradually added continuing the mixing for another 2 minutes. Afterwards, fresh concrete properties, i.e. concrete flow spread, density, and temperature, were determined (given in Table 2). In total, two concrete charges were casted. After filling the different moulds, the concrete was compacted with a vibrating table at 7500 R/min during at least 30 sec.

The density of the hardened concrete and the compressive strength at the date of setting the anchor rods (December 6th, 2021) are given in Appendix 3.

Table 2. Fresh concrete properties and fabricated specimens.

concrete charge no.	1	2
date of casting	18.10.2021	18.10.2021
concrete flow spread	44 cm	47 cm
density of fresh concrete	2449 kg/m ³	ND
temperature of fresh concrete	20,2 °C	20,2 °C
fabricated specimens		
5 cubes 200x200x200 mm	21.299 01-02	21.299 03-05
3 slabs 200x200x120 mm	21.299 06-07	21.299 08
3 cubes 150x150x150 mm	21.299 09-10	21.299 11

Storing and curing the specimens:

All samples were stored 24 hours within the mould at room temperature (20 ± 2) °C and the concrete surface was covered with plastic foil.

After demoulding, the specimens were stored as follow:

- cubes to test water-penetration of concrete with installed adhesive anchors and cubes to test the compressive strength
 - until the age of 7 days immersed in water at a temperature of $(20 \pm 2) ^\circ\text{C}$;
 - afterwards, at room temperature $(20 \pm 2) ^\circ\text{C}$ until installing the anchors and testing; in case of the compressive strength tests, until testing.
- slabs to test the water penetration: immersed in water until testing.

4 TEST PROCEDURE AND TEST RESULTS

4.1 SETTING THE ADHESIVE ANCHORS

USED ANCHORING SYSTEM

Adhesive Mortar: **Hilti HIT-HY 200-A V3**
Anchor rod: **HAS-U 5.8 M12x160**

SETTING DETAILS

Drill bit: TE-CX 14
Cutting diameter of used drill bit: $d_{\text{cut}} = 14,40 \text{ mm}$
Depth of borehole: 130 mm
installation depth: 125 mm
Rotary hammer drill: TE22
Borehole cleaning: dust removal with compressed air (6 bar), 2 times
brushing with steel-wire brush RB 14, 2 times
dust removal with compressed air (6 bar), 2 times

SETTING PROCEDURE

The hole was drilled vertically downwards in the centre of a casted surface perpendicular to the direction of casting. After cleaning, the diameter of the drilled holes was measured by means of calibrated steel cylinders of known diameter. The borehole depth was checked by using a calliper with a depth rod. The results are given in Table 3.

Table 3. Borehole and setting parameters.

specimen no	bore hole diameter	bore hole depth	depth of embedment
21.299 01	13,7 mm	$\geq 130 \text{ mm}$	125 mm
21.299 02	13,8 mm	$\geq 130 \text{ mm}$	125 mm
21.299 03	13,7 mm	$\geq 130 \text{ mm}$	125 mm
21.299 04	13,7 mm	$\geq 130 \text{ mm}$	125 mm
21.299 05	13,7 mm	$\geq 130 \text{ mm}$	125 mm

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

The borehole was filled with the injection mortar starting at the back of the borehole. With each trigger pull the mixer was slowly withdrawn. The borehole was filled up to approximately 2/3 of the height. Afterwards, the anchor rod was set to the required embedment depth, which was marked with an adhesive tape.

The ambient temperature at the time of setting was $\geq 20^\circ\text{C}$.

Five samples were prepared and setting was done on December 6th, 2021. After setting the anchors, the adhesive was allowed to cure for > 24 hours at ambient temperature $(20 \pm 2) ^\circ\text{C}$.

4.2 PENETRATION OF WATER UNDER PRESSURE 500 kPa SAMPLES WITHOUT ANCHOR RODS

Test procedure: EN 12390-8:2019, section 7
ISO 1920-5:2018, section 5.4

Deviation from the standard test method: none

Details of test:

date of start of testing: December 7th, 2021
end of testing: December 10th, 2021
age of concrete at start of testing: 50 days
compressive strength at setting the rods: 51,0 N/mm²
direction of application of water pressure: on bottom of the specimen perpendicular to the direction of casting
applied water pressure: **(500 ± 10) kPa** during (72 ± 2) h
specimens: slabs with 200x200x120 mm

TEST RESULTS – WATER PENETRATION

Table 4. Test results of water penetration in concrete slabs.

specimen no.	21.299 06	21.299 07	21.299 08
maximum depth of penetration mm	25 33	17 20	20 22
deviation of the water penetration from the acceptable one	none	none	None
leakage	none	none	None
opposite surface after testing	dry	dry	Dry
overall mean of maximum depth of water penetration	23 mm		
penetration front curve	see Appendix 1, Page 1		

4.3 PENETRATION OF WATER UNDER PRESSURE 500 kPa SAMPLES WITH **Hilti HIT-HY 200-A V3** AND **HAS-U 5.8 M12x160**

Test procedure: EN 12390-8:2019, section 7
ISO 1920-5:2018, section 5.4

Deviation from the standard test method:

- curing of the concrete cubes immersed in water only to the age of 7 days
- Installation of anchor rods

Details of test:

date of start of testing: December 7th, 2021
end of testing: December 10th, 2021
age of concrete at start of testing: 50 days
compressive strength at setting the rods: 51,0 N/mm²
direction of application of water pressure: on bottom of the specimen perpendicular to the direction of casting and parallel to the axis of the adhesive anchor
applied water pressure: **(500 ± 10) kPa** during (72 ± 2) h
exposed concrete area: the surface with the installed anchor was exposed to the water pressure; an area according to a circle with 100 mm diameter with the anchor in its centre was exposed to the water pressure
specimens: cubes with 200 mm edge length

TEST RESULTS – WATER PENETRATION

Table 5. Test results of water penetration in concrete cubes with installed anchor rods.

specimen no.	21.299 01	21.299 02	21.299 03	21.299 04	21.299 05
maximum depth of water penetration	35	42	41	37	54
penetration mm	35	40	37	38	53
deviation of the water penetration from the acceptable one	none	none	none	none	none
leakage	none	none	none	none	none
opposite surface after testing	dry	dry	dry	dry	Dry
overall mean of maximum depth of water penetration	41 mm				
penetration front curve	see Appendix 2, Page 1				

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

- Depth of water penetration:
expanded measurement uncertainty U (95% confidence level): ± 3 mm

Rankweil, December 15th, 2021



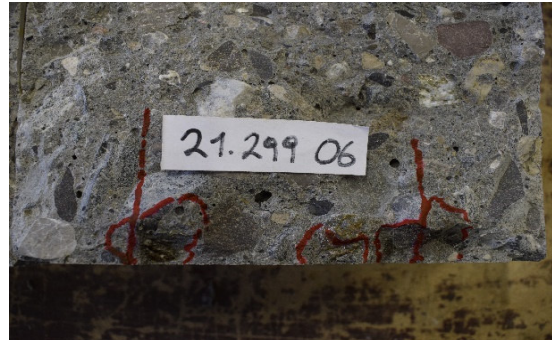
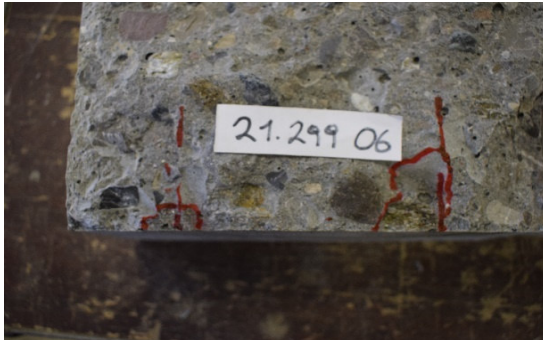
Dipl.-Ing. Dr. techn. M. Drexel
Deputy head of the department
Authorised person

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

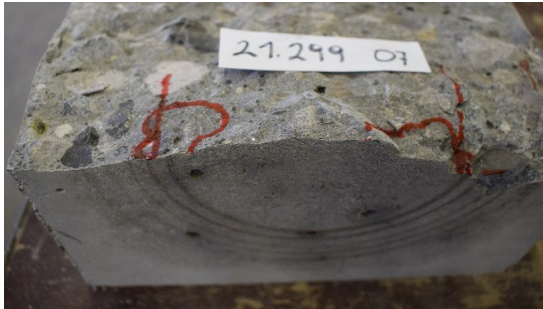
WATER PENETRATION CURVE

Concrete specimens 200x200x120 mm
Test procedure according to EN 12390-8

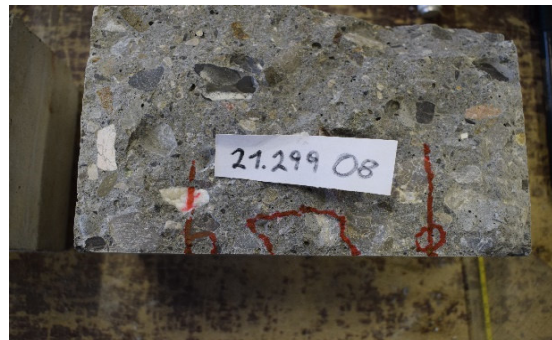
21.299 06



21.299 07



21.299 08



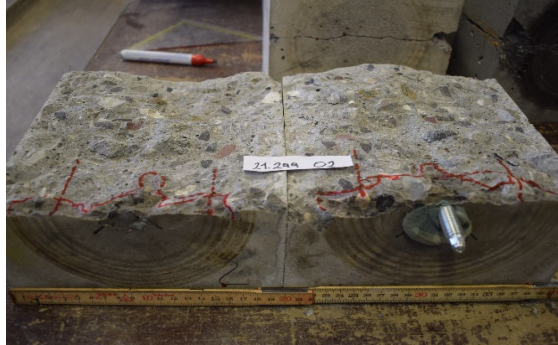
WATER PENETRATION CURVE

Concrete specimens 200x200x200 mm
with anchor rods HAS-U 5.8 M12x160 installed with Hilti HIT-HY 200-A V3

21.299 01



21.299 02



21.299 03



21.299 04



21.299 05



TEST REPORT
TESTING OF CONCRETE - COMPRESSIVE STRENGTH
ONR 23303:2010 (issue date: 01.09.2010) resp. EN 12390-3:2019

ORDERING PARTY Hilti Entwicklungsgesellschaft mbH
Hiltistraße 6, 86916 Kaufering, Germany

BASE MATERIAL specimens for testing the penetration of water under pressure

TEST SAMPLES 3 cubes with 15 cm edge length

INFORMATION GIVEN BY THE TESTING LABORATORY

CONCRETE:

C25/30 Dmax 22 F3

Mix design no. -
Casting plant VA-HTL Rankweil

Concrete-Mixture:

Aggregates:	Dmax 22	Admixtures:	none	Consistency (Flow table test):	see Table 2
Cement:	CEM II/A-LL 42,5 N	Cement content:	321 kg/m ³	Air content:	ND
Date of casting:	18.10.2021	w/c-ratio:	0,53	Concrete temperature:	see Table 2

TEST RESULTS:

Storage of specimens after receipt: according to ONR 23303:2010
Preparation of specimens: without any preparation
Surface conditions at testing: air-dry
Test procedure: according to ONR 23303:2010, chapter 9.1 and 9.2
and EN 12390-3:2019

Specimen No.	marks on the specimens		mass	length	width	height	ultimate load	bulk density ¹⁾	compr. strength
	no.	other marks	kg	mm	mm	mm	kN	kg/m ³	MPa
21.299 09	Bet71-9		8,122	150,4	149,9	149,8	1147	2405	50,89
21.299 10	Bet71-10		8,165	151,3	150,0	149,9	1155	2401	50,91
21.299 11	Bet72-11		8,141	150,8	149,9	150,0	1158	2400	51,23
date of testing	age at testing						mean value:	2400	51,0
06.12.2021	49 days						compressive strength (SI-units):	51,0 MPa	

¹⁾ calculated from measured values determined on specimens without preparation or conditioning

The authorized signatory declares, as the person responsible for testing, that the tests were carried out according to the reference test method given in ONR 23303:2010, with the exception of the specified deviations from the reference test method.

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

Expanded measurement uncertainty U (95 % confidence level): 3,8 %

Rankweil, December 15, 2021

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



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

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