TECHNISCHE UNIVERSITÄT MÜNCHEN
Prüfamt für Verkehrswegebau

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TECHNICAL UNIVERSITY of MUNICH
Institute for Road, Railway and Airfield Constructions

REPORT GÜ 03/2024

Quality Supervision 2nd Half-year 2024
Pull-Out Tests at Dowels for Concrete Roads
(Fa. Brentzel, Fischbach)

Dieser Bericht ist die englische Fassung des Originalberichtes in deutscher Sprache. Im Zweifel hat die deutsche Fassung Gültigkeit.
This is the English version of the original report in German language. In doubt the German version is valid.

1. GENERAL

For quality routine tests in 2nd half-year 2024, ten dowels with nominal diameter of 25 mm and nominal length of 500 mm were taken from the current production of company Otto Brentzel – Stahlverarbeitung e.K., Hauptstraße 61, 67693 Fischbach, Germany, and sent to *Institute for Road, Railway and Airfield Construction of Technical University of Munich*. The coating thickness should be checked and pull-out tests in accordance with appendix 7 should be performed.

2. STATUS

The dowels show a grey coating with white-coloured dots. They are apparently round, without any burr and damages. On one face side the dowels are brushed with anticorrosion paint (instead of plastic coating).

3. COATING THICKNESS

The thickness of the plastic coating of the dowels was checked with a magnetic layer thickness meter (Salu Tron 06). The values specified in the table 1 were determined. The lengths of the dowels are as well listed in table 1.

Table 1: Thickness of the plastic coating [µm] and length of the dowels [mm]

No.	top	centrically	bottom	length
	[µm]			**[mm]**
1	330	432	507	500
2	328	378	448	500
3	359	376	477	500
4	335	444	500	500
5	346	432	467	500
6	338	430	508	500
7	341	437	464	500
8	323	434	467	500
9	311	452	485	500
10	362	415	445	500
Mean	**337.3**	**423.0**	**476.8**	**500**

Hence the minimum thickness of the plastic coating of 0.3 mm required as per „TL Beton-StB 07“ is met.

4. PULL-OUT TESTS

The pull-out tests were executed according to appendix 7 at three dowels (No.2, No.6, No.9). For this test, the face side of the dowel named “above” (face side with anticorrosion paint instead of coating, see table 1) was inside the concrete block and dowel was embedded in concrete on half length. The concrete blocks from C30/37 had an age of 23 – 25 hours at the time of test execution. The compressive strength of the concrete at the time of test execution was mean 19.2 N/mm², which was determined by a concrete test hammer.

Measurement of pull-out deflection was performed between dowel and concrete face. The test results are shown in app. 1 to 6. The pull-out forces (1st and 5th loading) at a related displacement of 0.25 mm are listed in table 2.

Table 2: Pull-out forces in the test and required maximum values

Pull-out forces [kN] at 0.25 mm displacement				
	Dowel No. 2	Dowel No. 6	Dowel No. 9	Required value (see App. 7)
1st loading	9.7	8.2	7.6	≤ 18
5th loading	4.4	2.7	3.1	≤ 12

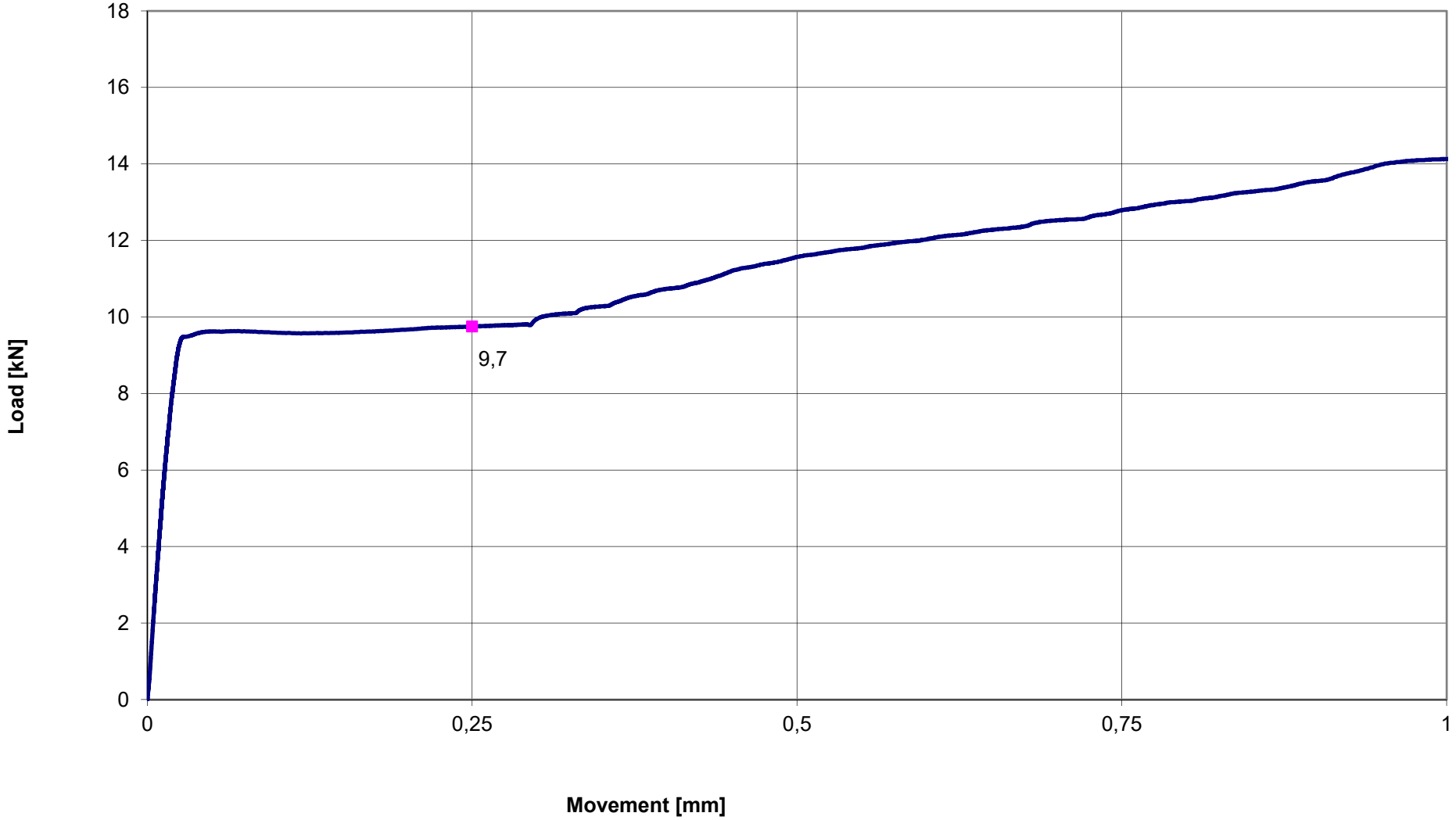
After 5th loading the dowels were pulled-out completely. The three tested dowels did not show any damages of the coating or separations of the coating from the steel. Appendix 8 shows pictures of the dowels after test execution.

The required values of a maximum permissible pull-out force (perm. $F_{max} \leq 18$ kN in 1st loading; perm. $F_{max} \leq 12$ kN in 5th loading) at related displacement of 0.25 mm are met by all tested dowels.

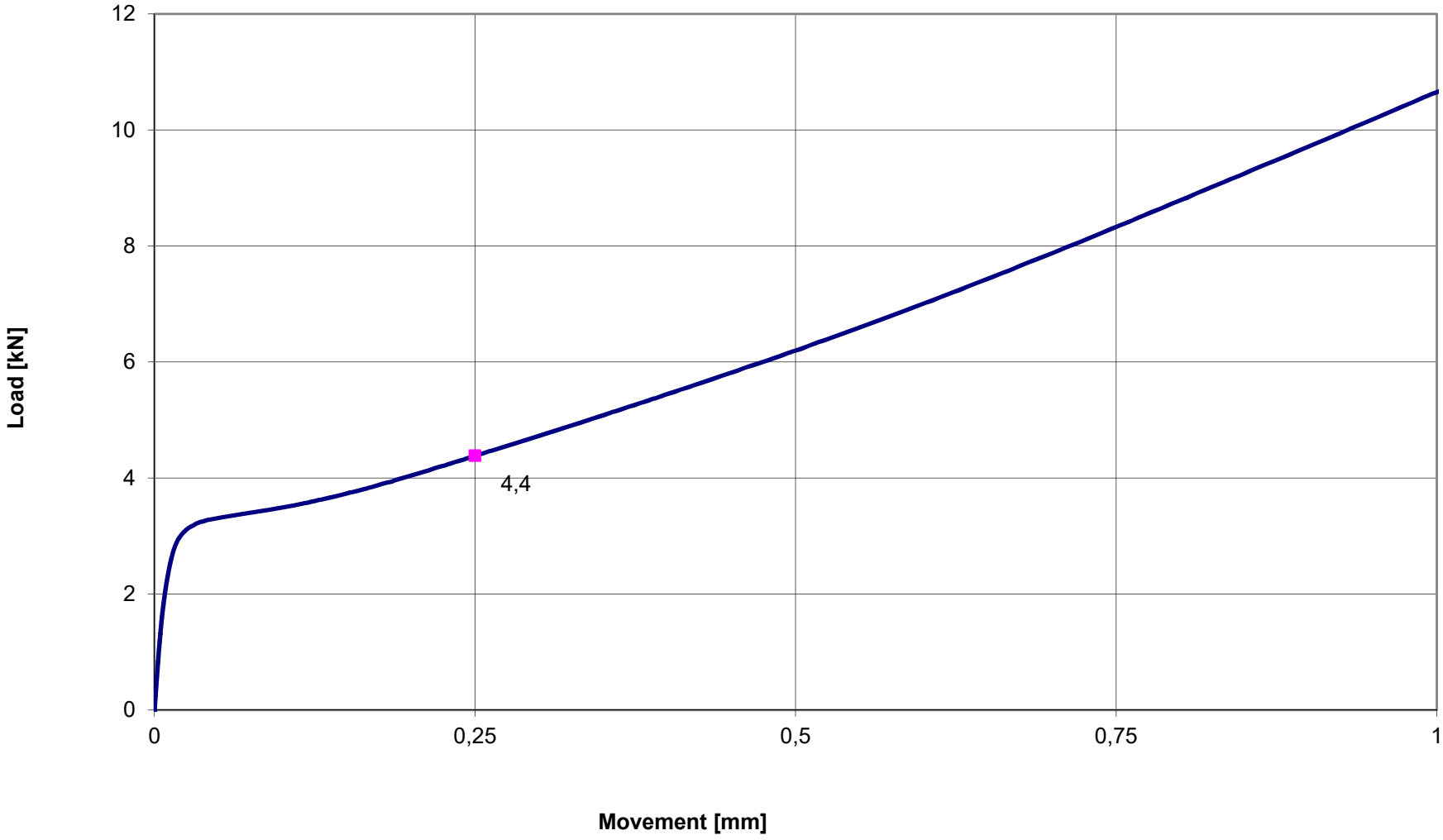
For performing the tests
and analysis of the results:

(Dr.-Ing. S. Freudenstein)
Univ.-Prof.

(Dr.-Ing. C. Simon)


Pull-out-test _ Diameter: 25 mm _ Dowel No.: 2 _Age of concrete: 23 h _ 1 st loading
Load [kN]
18
16
14
12
10
8
6
4
2
0
9,7
0
0,25
0,5
0,75
1
Movement [mm]

Pull-out-test _ Diameter: 25 mm _ Dowel No.: 2 _Age of concrete: 23 h _ 5 th loading



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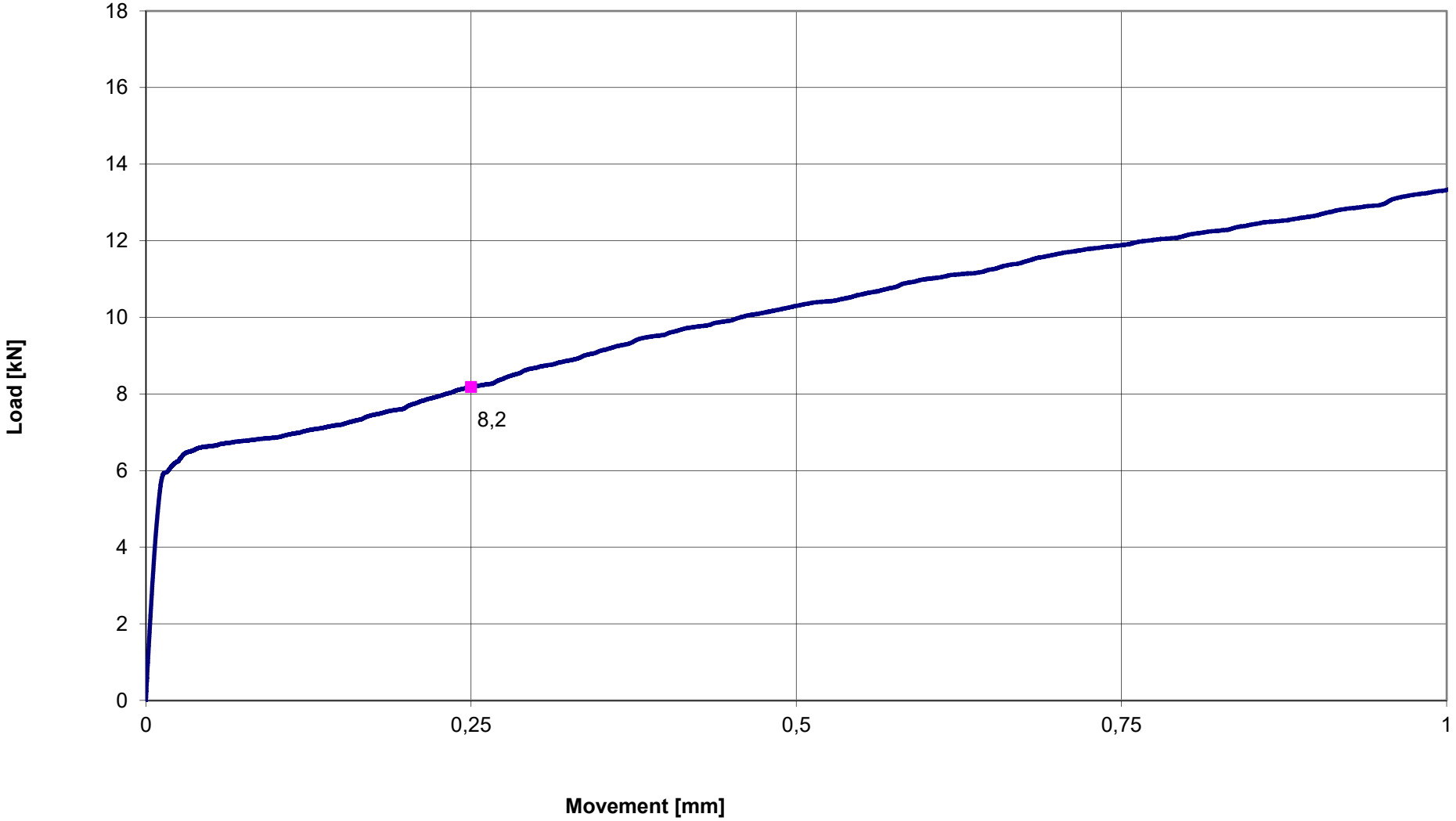
Appendix 2

Pull-out-test _ Diameter: 25 mm _ Dowel No.: 6 _Age of concrete: 24 h _ 1 st loading



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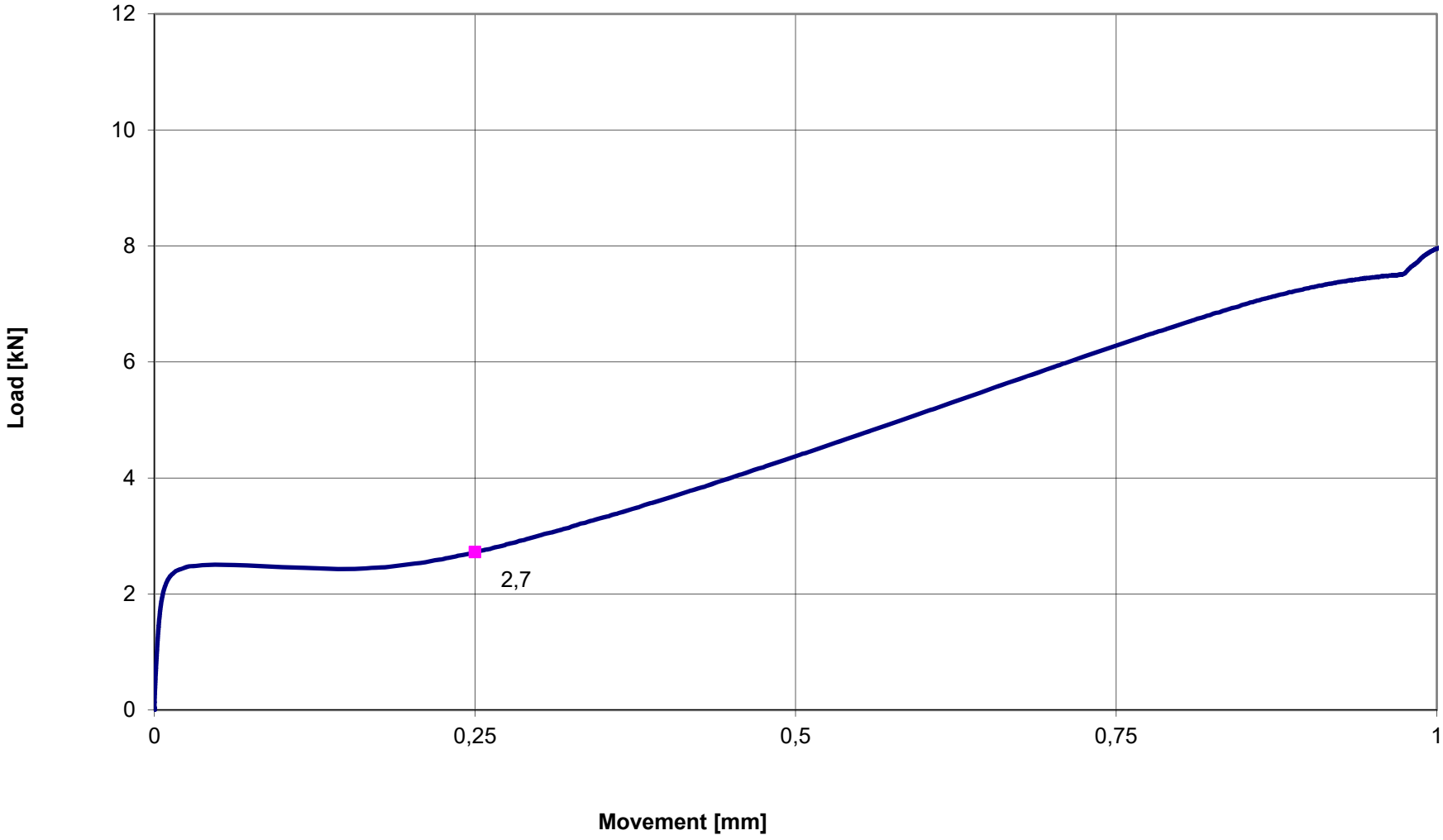
Appendix 3

Pull-out-test _ Diameter: 25 mm _ Dowel No.: 6 _Age of concrete: 24 h _ 5 th loading



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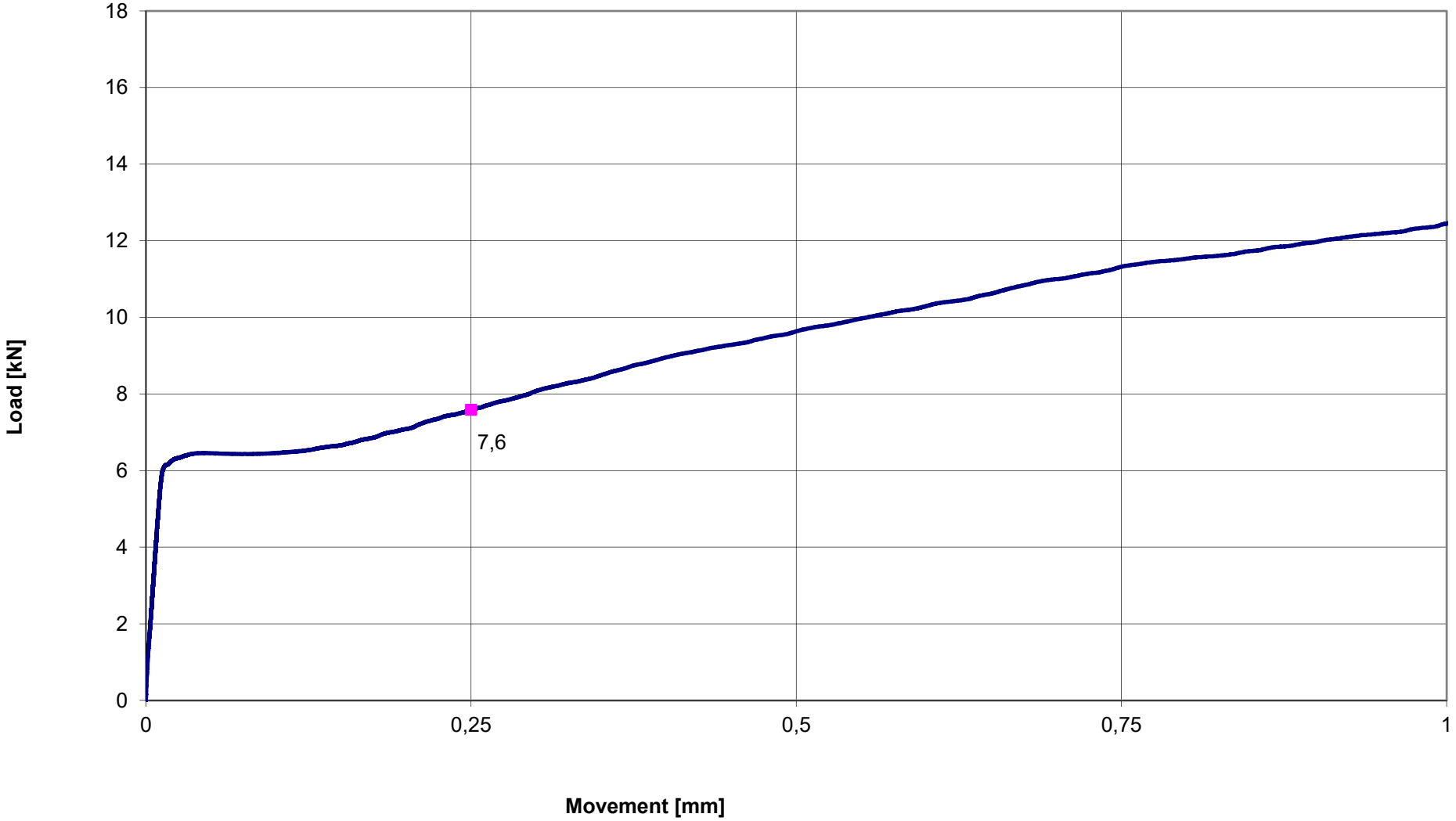
Appendix 4

Pull-out-test _ Diameter: 25 mm _ Dowel No.: 9 _Age of concrete: 25 h _ 1 st loading



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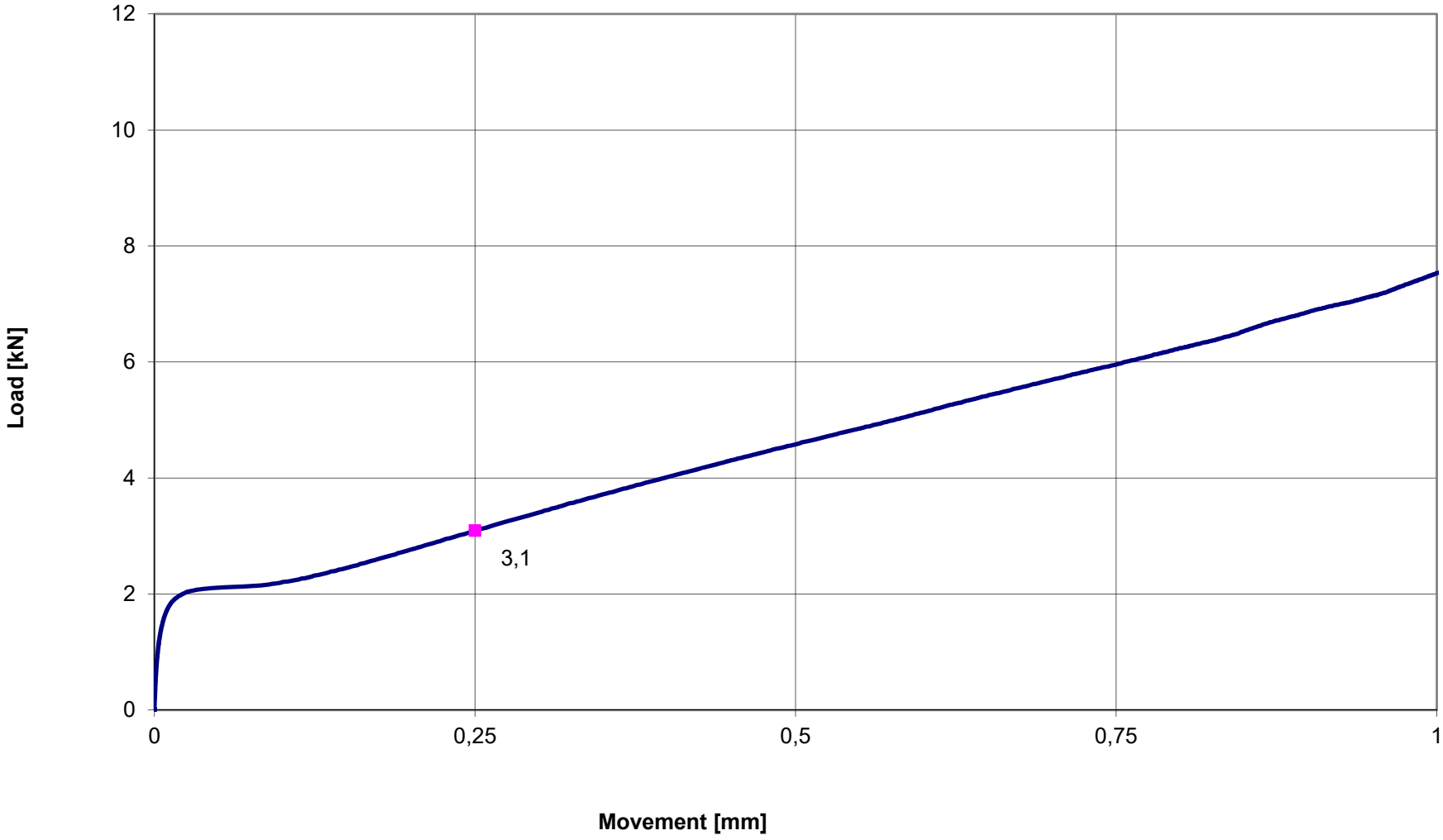
Appendix 5

Pull-out-test _ Diameter: 25 mm _ Dowel No.: 9 _Age of concrete: 25 h _ 5 th loading



Pull-out test on dowels for concrete roads and requirements

(Release: April 2014)

1. Specimen

At least 10 specimens of investigated dowel have to be sent by the manufacturer for testing. For execution of pull-out tests 3 specimen of this batch will be chosen randomly. Thickness of coating of all 10 dowels has to be determined in the centre of the steel bar, and at both endings (10 mm away from end surface) and has to be reported. (Note: According to TL Beton StB-07 a minimum thickness of coating of 0.3 mm is demanded.) Length of all 10 dowels has to be measured and reported.

The three chosen dowels have to be concreted centric and vertical in concrete blocks of size 20 x 20 x 30 cm (concrete quality: C30/37) up to half length of the dowel (= 25 cm at dowel length 50 cm) with the uncoated end surface inside the concrete block.

Pull-out test has to be executed at an age of concrete of 23 to 25 hours. Compression strength of the concrete at age of test execution has to be controlled by a rebound hammer and documented.

2. Test execution
    a. Pull-out test No.1

The concrete block is fixed in the test rig. At ambient temperature, the concreted dowel has to be loaded by a centric tensile load in dowel axle (loading velocity: 13 kN/min) up to adhesion break and ongoing up to a maximum deflection of 5 mm. Load and related deflection has to be recorded.

Requirement of first loading: At a deflection of 0.25 mm the maximum load is $P_{max} \leq 18$ kN.

    b. Repetition of loading

Afterwards, the dowel has to be pushed back into the concrete block to primary position with equal loading velocity and pull-out test has to be repeated four more times. The fifth loading has to be recorded again.

Requirement of fifth loading: At a deflection of 0.25 mm the maximum load is $P_{max} \leq 12$ kN.

    c. Final loading

Finally, the dowel has to be completely pulled off the concrete block. By this, no damage to the coating (abrasion, delamination) shall occur.

Picture 1: Tested dowels No. 2, No. 6 and No. 9 without damage or delamination of coating.

Picture 2: View of opposite side of lateral surface of dowels after test execution without damage of coating.