TECHNISCHE UNIVERSITÄT MÜNCHEN
Prüfamt für Verkehrswegebau

München, 12.10.2017
Re-GÜ 02/17

TECHNISCHE UNIVERSITÄT MÜNCHEN
Institute for Road, Railway and Airfield Constructions

REPORT GÜ 02/17

Quality Supervision 2nd Half-year 2017
Pull-Out Tests and on Dowels
(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 doupt the German version is valid.

1. GENERAL

For the quality routine tests 2nd half-year 2017, 10 dowels with nominal diameter of 25 mm and nominal length of 500 mm were taken from the current production of the company Brentzel and sent to *Prüfamt für Verkehrswegebau der TU München*. 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 light-coloured dots. They are apparently round, without any burr and damages. On one face side the dowels are brushed with anticorrosion paint (without coating).

3. COATING THICKNESS

The thickness of the plastic coating of the dowels was checked with a magnetic layer thickness meter (minitest F 100). 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] as well as length of the dowels [mm]

No.	top	centrically	bottom	length
	[µm]			**[mm]**
1	418	474	532	500
2	410	478	524	500
3	436	427	508	500
4	415	460	480	499
5	426	462	489	500
6	414	438	532	500
7	418	494	518	500
8	381	442	500	499
9	378	490	457	500
10	370	412	470	500
Mittel	**406.6**	**457.7**	**501.0**	**499.8**

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 on three dowels (No.3, No.8, No.10). Within the test, the face side of the dowel ("above" side with anticorrosion paint, see table 1) was inside the concrete block. The concrete blocks from C30/37 had an age of 23 – 24 hours at the time of the tests; the compressive strength of the concrete was about 15.5 N/mm², which was determined by a concrete test hammer.

The displacement measurements were 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. See appendix 8 for pictures of the dowels after test execution.

Table 2: Pull-out forces in the test and requirements.

Pull-out forces [kN] at 0.25 mm displacement				
	No. 3	No. 8	No. 10	Required value (see App. 7)
1st loading	7.8	9.2	9.6	≤ 18
5th loading	4.0	4.2	4.5	≤ 12

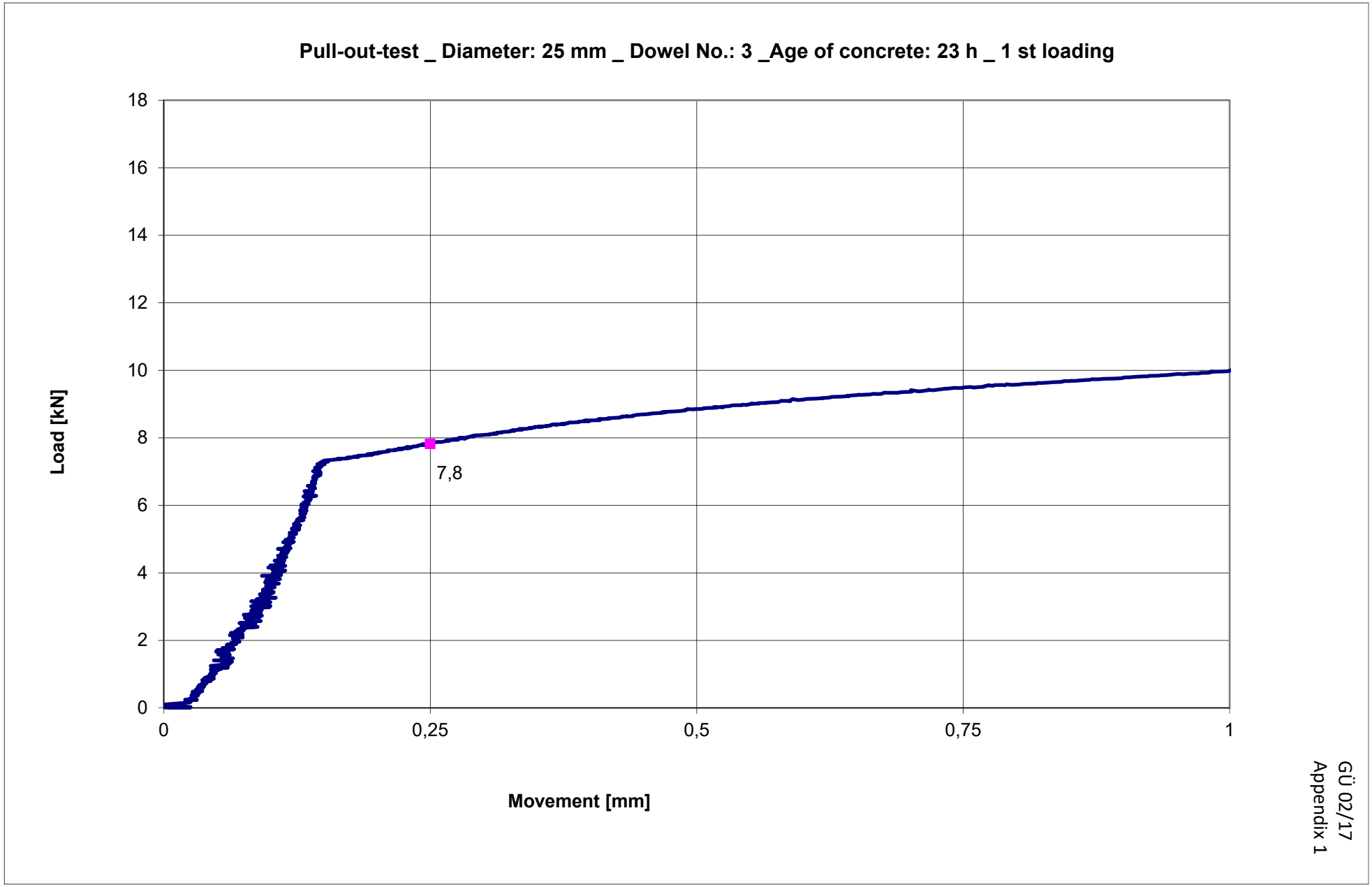
After the test the dowels were pulled-out completely. No damages of the coating or noteworthy separations from the steel were observed.

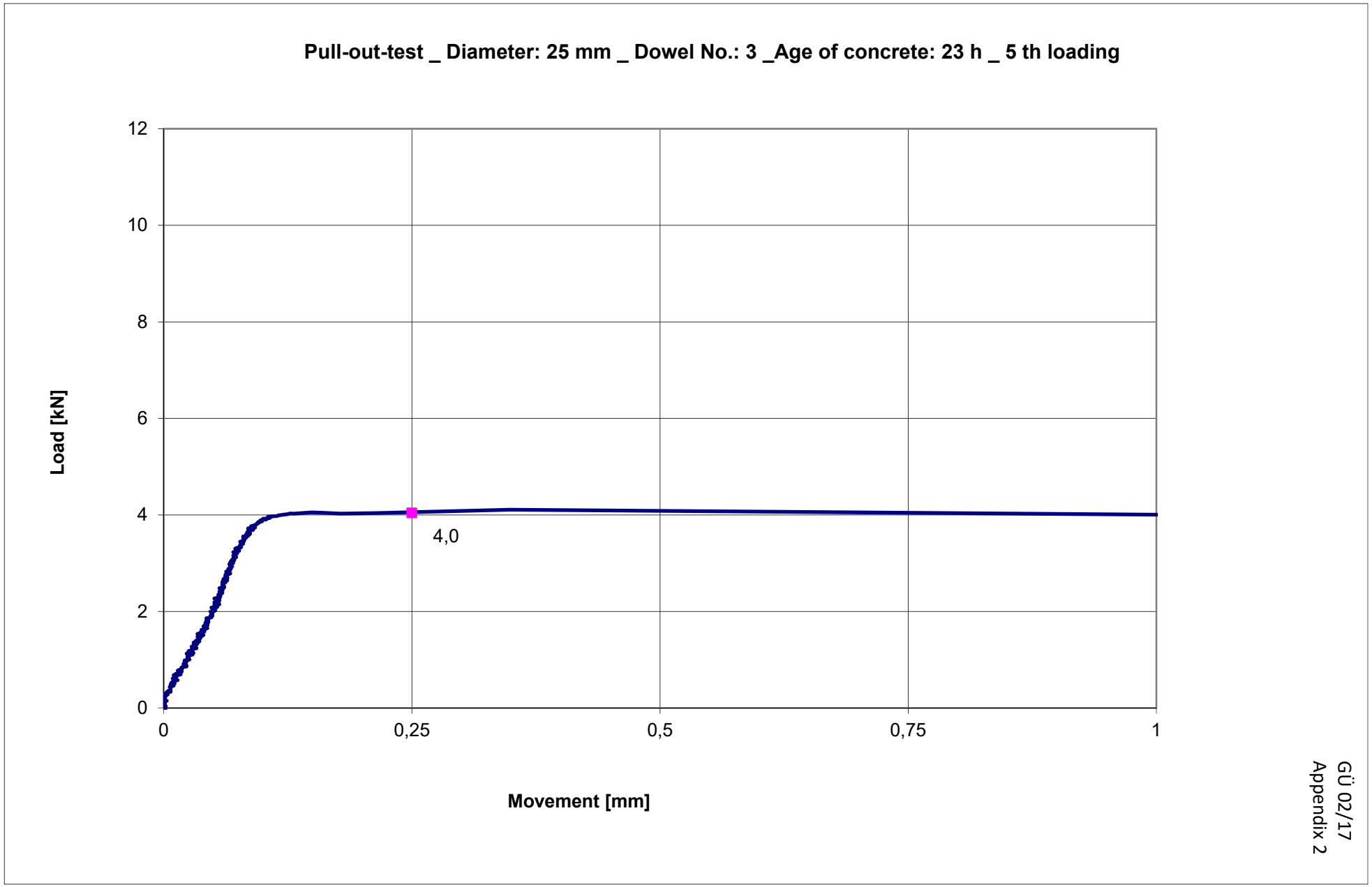
The required values of a maximum permissible pull-out force (perm. $F_{max} \leq 18$ kN in 1st loading; perm. $F_{max} \leq 12$ kN in 5th loading) at related displacement of 0.25 mm are met by all tested dowels.

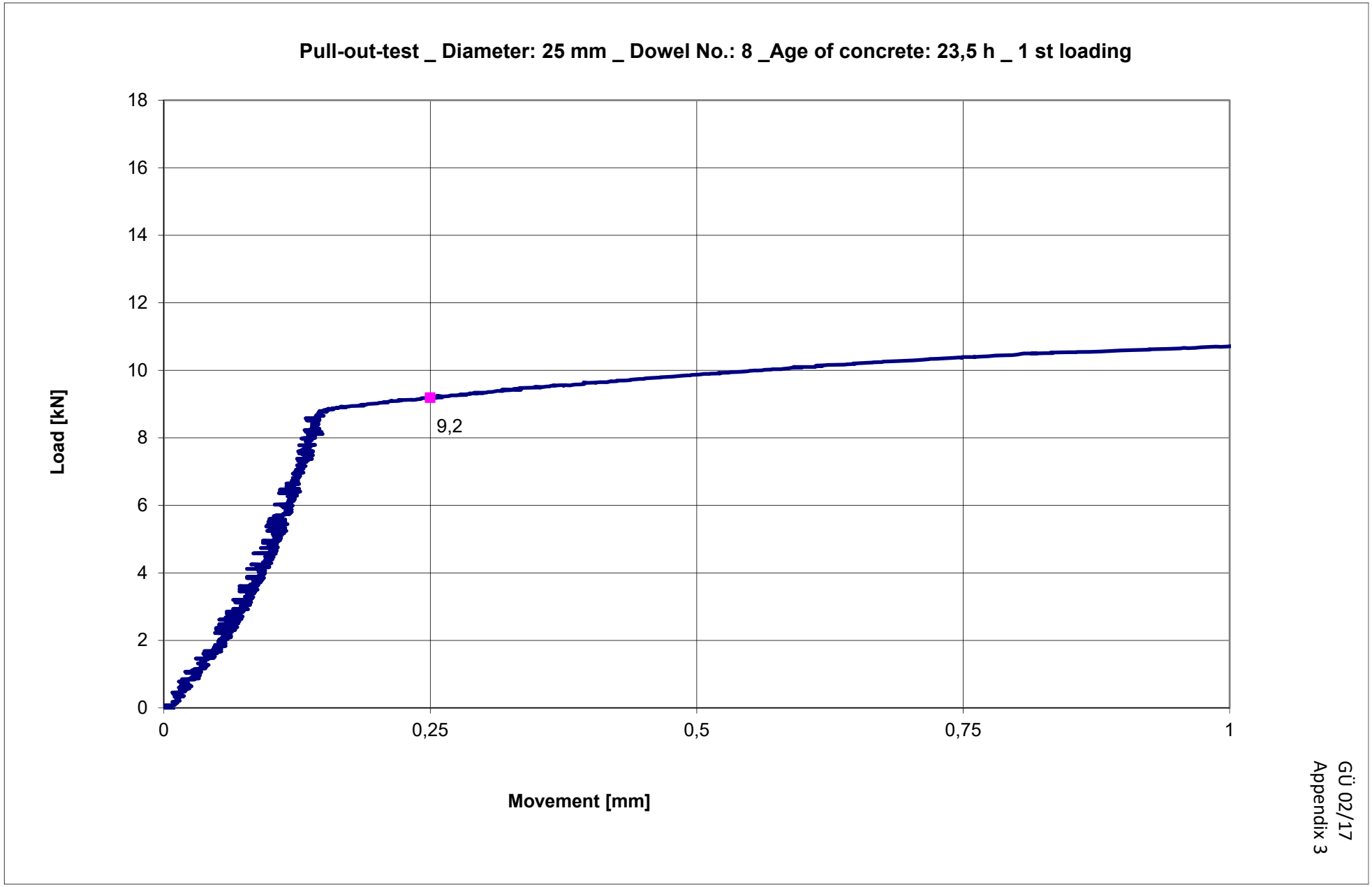
For performing the tests
and analysis of the results:

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

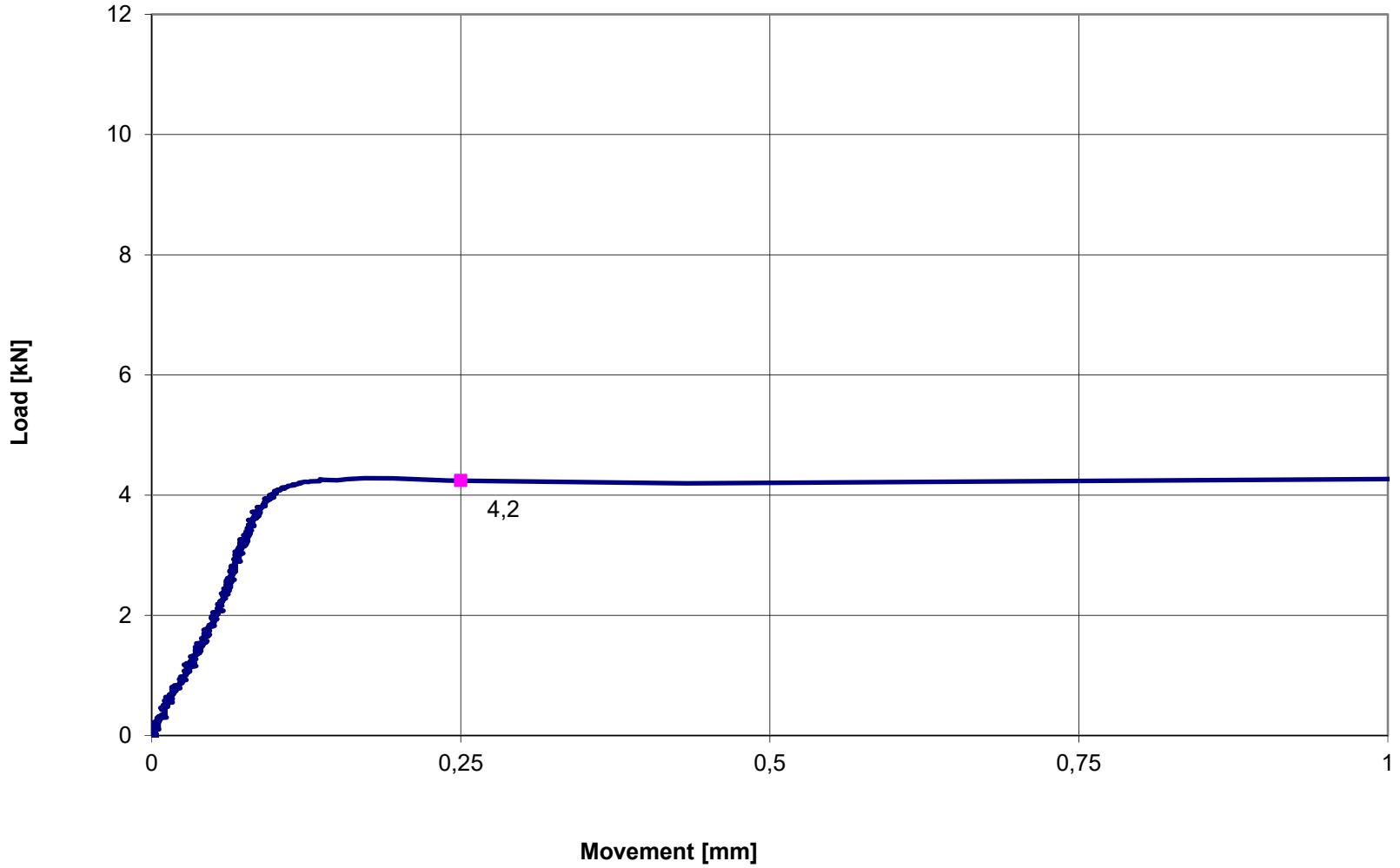
(Dr.-Ing. C. Simon)

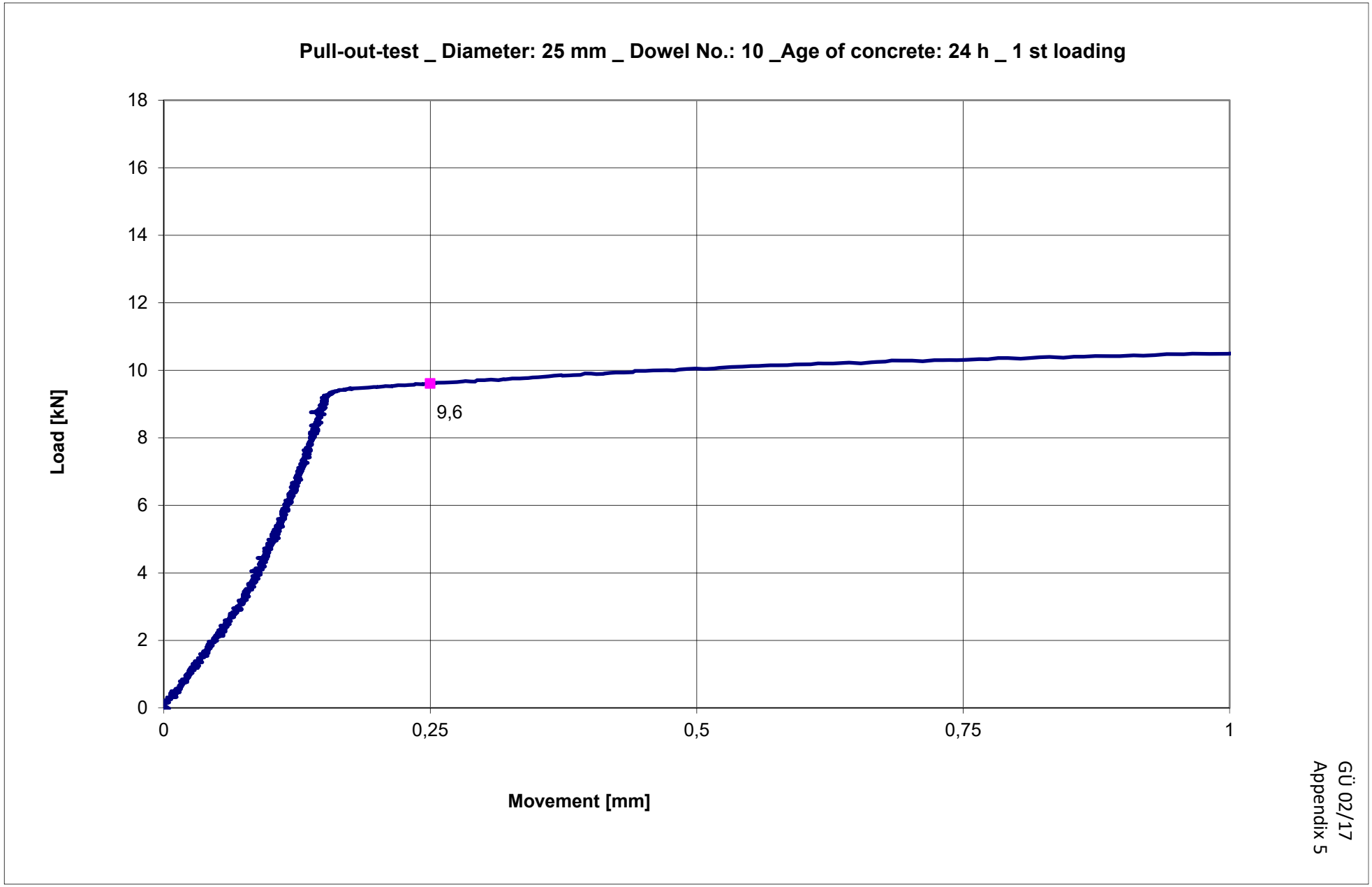

Pull-out-test _ Diameter: 25 mm _ Dowel No.: 3 _Age of concrete: 23 h _ 1 st loading
Load [kN]
18
16
14
12
10
8
6
4
2
0
7,8
0
0,25
0,5
0,75
1
Movement [mm]


Pull-out-test _ Diameter: 25 mm _ Dowel No.: 3 _Age of concrete: 23 h _ 5 th loading
Load [kN]
12
10
8
6
4
2
0
4,0
0
0,25
0,5
0,75
1
Movement [mm]

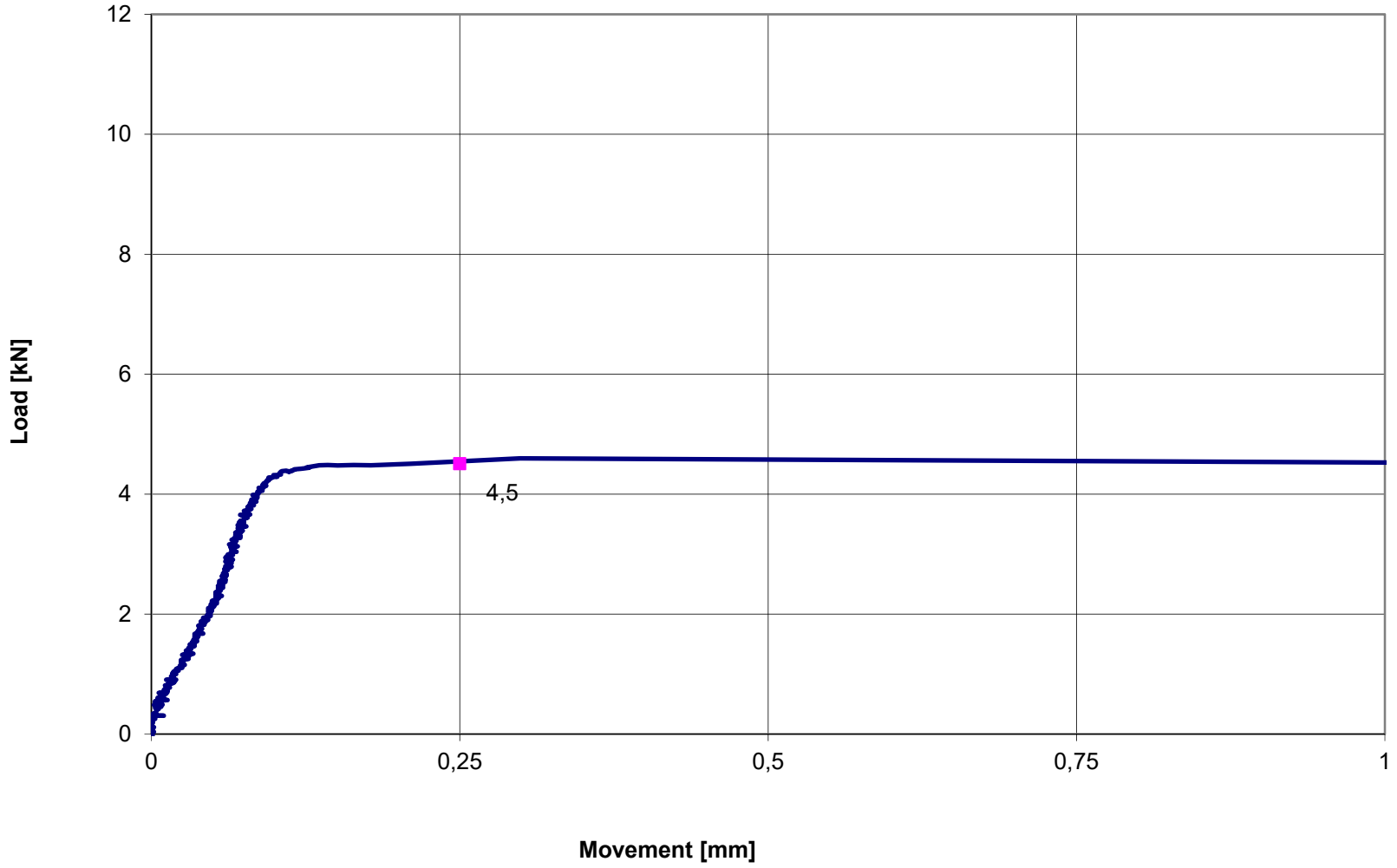

Pull-out-test _ Diameter: 25 mm _ Dowel No.: 8 _Age of concrete: 23,5 h _ 1 st loading
Load [kN]
18
16
14
12
10
8
6
4
2
0
9,2
0
0,25
0,5
0,75
1
Movement [mm]

Pull-out-test _ Diameter: 25 mm _ Dowel No.: 8 _Age of concrete: 23,5 h _ 5 th loading




Pull-out-test _ Diameter: 25 mm _ Dowel No.: 10 _Age of concrete: 24 h _ 1 st loading
Load [kN]
18
16
14
12
10
8
6
4
2
0
9,6
0
0,25
0,5
0,75
1
Movement [mm]

Pull-out-test _ Diameter: 25 mm _ Dowel No.: 10 _Age of concrete: 24 h _ 5 th loading



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Appendix 6

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.3, 8 and 10 without damage or delamination of coating.

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