Test Report

Initial Test of Earth Mortar for Plastering corresponding to, Abrasion and Adsorption Test according to DIN 18947:2013-08

Project:	Estonia_Materialpruefung
Project-No:	14080
Client:	Mikk Luht Tegevjuht/CEO Saviukumaja OÜ Mooste Mõis/Mooste Manor Põlva maakond 64616 Estonia
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This report consists of 24 pages in total.

Project-No: 14080 Initial Test corresponding to, Abrasion and Absorption Test according to DIN 18947:2013-08

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1 Aims and Objectives

The client seeks the provision of essential services to the self-monitoring in the initial type testing of earth plasters according to DIN 18947: 2013-08: "Lehmputzmörtel - Begriffe, Anforderungen, Prüfverfahren", Chapter 9.1.2 for the earth plaster that under this test report prefixed with the abbreviations are referred to:

- 14080_BC Manufacturer description: "Base Coat"

Documented in this report tests include the following testing services:

Tests / Materials	14080_BC
Particle size group	x
Measure of shrinkage	x
Density	x
Compressive strength	x
Bending tensile strength	x
Adhesion strength	x
Abrasion strength	x
Water vapour adsorption	x
Fire behaviour*	(x)

*The classification of fire behaviour occurs in pure mineral products and products with organic content ≤ 1 mass or volume percent (higher value relevant) in the building material class A1. For larger organic content the signatories will made no A2 or B1-examination and classification, but classified the product into the building material class B2.

Table 1: Overview of commissioned tests for base coat

Based on the calculated density of the earth plaster occurs the determination of the thermal conductivity. In this context, the water vapour diffusion resistance is also given. Under the contract, there should be no calculation of CO_2-equivalent characteristic value.

In addition abrasion tests on 11 different colour finish plasters have to be done according to [DIN 18947:2013]. The testing samples with a surface area of 30 * 30 cm (base gypsum fibre boards) and covered with primer were delivered by the client.

Also the facultative adsorption test regarding DIN 18947 will be done for base coat plaster with top layer of one selected finish plaster on top.

The tests were carried out in the laboratory of Ziegert | Seiler Ingenieure GmbH, Schlesische Straße 26, Staircase A, 10997 Berlin, Germany.

2 Abrasion Test of colour finish plasters and one base coat

2.1 Requirements

For this optional test requirements defined in Appendix A.1 of [DIN 18947:2013] have to be applied, where earth mortars for plastering are divided into two strength classes. Table 2 shows the requirements for earth plasters at a glance.

Strength class	Abraded material in g
S I	≤ 1.5
S II	≤ 0.7

Table 2: Strength classes related to abraded material of earth plaster corresponding to [DIN 18947:2013]

Within the contract tested colour finish plasters are applied in not more than 2 mm thickness and are for this reason thinner than ordinary earth plasters. As finish plasters they are directly affected by normal use of rooms, too. That's why such finish plasters should comply with higher requirements of strength class S II.

2.2 Test Procedure

Test was done according to requirements defined in Appendix A.1 of [DIN 18947:2013] with the difference that all finish plasters were applied on gypsum fibre boards and covered with primer by the client. The abrasion of the base coat was tested on samples produced for adsorption test (see) and covered with primer by the contractor. Needed three tests for every finish plaster and for the base coat were made displaced from another on one test sample.

2.3 Results

Following Table 3 shows the results of eleven finish plasters which were tested in the context of the contract.

No	Sample	Abraded Material in g			Mean Value in g	Strength Class
		1	2	3		
1	14080_FP_Orange	0,74	1,08	0,62	0,81	S I
2	14080_FP_Yellow	0,09	0,15	0,08	0,11	S II
3	14080_FP_Brown	0,28	0,15	0,16	0,20	S II
4	14080_FP_Dark_Red	0,12	0,13	0,10	0,12	S II
5	14080_FP_Blue	0,18	0,20	0,24	0,21	S II
6	14080_FP_White	0,10	0,17	0,15	0,14	S II
7	14080_FP_Green	0,06	0,06	0,07	0,06	S II
8	14080_FP_Mustard	0,04	0,04	0,09	0,06	S II
9	14080_FP_Red	0,11	0,04	0,05	0,07	S II
10	14080_FP_Lilac	0,07	0,08	0,05	0,07	S II
11	14080_FP_Grey	0,03	0,03	0,06	0,04	S II

Table 3: Results of Abrasion Test of colour finish plasters and corresponding strength class according to [DIN 18947:2013]

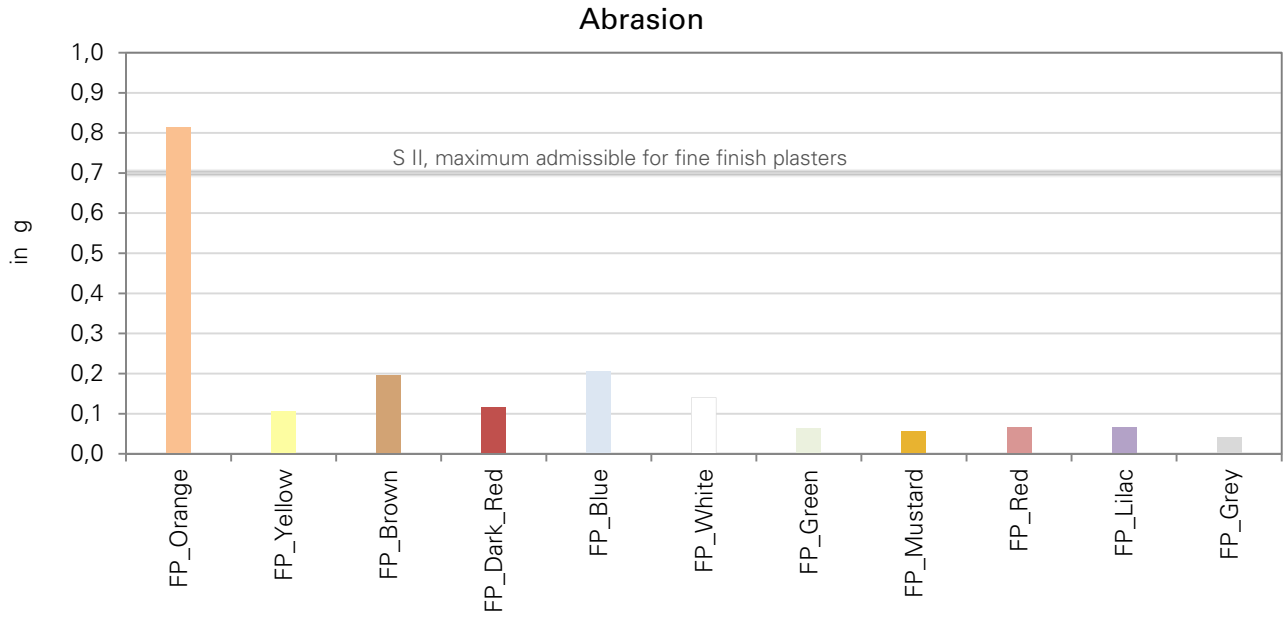

Figure 1: Results of Abrasion Test of colour finish plasters in relation to requirements

All but one tested plaster pass the abrasion test and could be correlate to strength class S II. The orange finish plaster showed such a high abrasion, that it had to be ranged in strength class S I. It's recommended to check, if primer was also applied on this test sample.

The average abrasion of the base coat was 0.14 g. The plaster could therefore be classified in S II. Single values are included in

Appendix 1.

3 Obligatory Tests for Base coat plaster regarding DIN 18947

The obligatory tests for base coat plaster 14080_BC were done corresponding to DIN 18947:2013-08: „Lehmputzmörtel - Begriffe, Anforderungen, Prüfverfahren". For evaluating the results requirements defined in the standard were taken as a basis.

All test protocols containing single values and avarages are included in

Appendix 1.

3.1 Particle Size Group/Oversize Particles

3.1.1 Requirements

The particle size group according to [DIN 18947:2013] denotes the aggregates by lower and upper sieve size, in which single grains may stay left on upper sieve (oversize particles) and some may pass the lower sieve (undersize particles).

According to Chapter 5.2.4 [DIN 18947:2013] the oversize particles have to be smaller than minimum thickness of application which is specified by the producer of the earth plaster.

3.1.2 Testing Procedure

Determination of particle size group, oversize particles and oversize particles dimension is done for the base coat 14080_BC by wet sieving according to [DIN EN 1015-1:2007], the denotation according to [DIN EN 13139:2011].

3.1.3 Results

Results of the determination of particle size group and oversize particles are summarized in

Description	14080_BC
Minimum thickness of application defined by producer in mm	not specified
Lower sieve size (d) - undersize particle in mm	0
Upper sieve size (D) - oversize particle in mm	2
Maximum grain diameter of oversize particles in mm	<4
Particle Size Group d/D according to [DIN EN 13139:2011]	**0/2**

Table 4: Summary of results for determination of particle size group and oversize particles

The measured oversize particle was smaller than specified by the manufacturer.

To fulfil requirements of [DIN 18947:2013] minimum thickness of application for the base coat 14080_BC has to be bigger than measured grain diameter of the oversize particles. That's why application thickness should be 4 mm minimum.

3.2 Linear Measure of Shrinkage

3.2.1 Requirements

The determination of linear measure of shrinkage for earth mortars for plastering has to be done according to [DIN 18947:2013] on three prisms, which are made in plastic stage corresponding to Chapter 8.3. The linear

measure of shrinkage for earthen plasters should be less than 2 %. Fibre containing earth plasters and thin finish earth plasters can have measure of shrinkage up to 3 % and fibre containing thin finish plasters up to 4 %.

3.2.2 Testing Procedure

The formwork of the three prisms made in plastic stage were stripped after 7 days and before the test samples stored another 7 days in the climate chamber (product - Vötsch VC^3 0018) by 23 °C and 50 % air humidity up to constant mass. The linear measure of shrinkage was determined by measuring the length of the prisms in the half of the height and put it into relation to the initial length (internal dimensions of the formwork).

3.2.3 Results

The measure of shrinkage of the base coat 14080_BC was 2.4 %, which is lower than maximum admissible for earth plasters containing fibres and meets the requirements of [DIN 18947:2013].

3.3 Density

3.3.1 Requirements

Requirements for this test are defined in [DIN 18947:2013].

3.3.2 Testing Procedure

For measuring the density the prisms of 14080_BC were stored under 23 °C and 50 % air humidity up to constant mass first. Than dimensions were measured with calliper and prisms were weighted. Density has to be determined by putting prisms masses in relation to outer volumes. Single values are used for calculating the average which is used for classification earth plaster into density classes.

3.3.3 Results

The average density of the base coat 14080_BC was 1.68 kg/dm^3 so that the earth plaster could be classified into density class 1.8.

Based on the measured density the thermal conductivity can be assigned for the earth mortar (see Table 5) according to [DIN 4108-4:2013]. Independently from density water vapour diffusion resistance factor can be given with μ= 5/10 corresponding to [DIN 18947:2013]. The water vapour diffusion resistance factor was not tested corresponding to [DIN EN ISO 12572:2001].

Properties	14080_BC
Density in kg/dm³*	1.7
Thermal conductivity λ in W/m·K	0.91
Water vapour diffusion resistance factor μ	5/10

*rounded up on 0,1 kg/dm³

Table 5: Assignment of thermal conductivity based on density and designation of water vapour diffusion resistance factor

3.4 Bending Tensile Strength

3.4.1 Requirements

For this test requirements corresponding to [DIN 18947:2013] apply. Though earth plasters are divided into two strength classes. Table 6 shows the requirements at a glance.

Strength class	Compressive Strength in N/mm²	Bending tensile Strength in N/mm²	Adhesion Strength in N/mm²
S I	>1.0	≥ 0.3	≥ 0.05
S II	> 1.5	≥ 0.7	≥ 0.10

Table 6: Strength classes of earth mortar for plastering corresponding to [DIN 18947:2013]

3.4.2 Testing Procedure

Testing of prisms was done with the material testing machine type Zwick/Röll Z010 14 days after production. While the last 7 days before testing the prisms were stored under standard clime (23 °C/50 % air humidity) up to constant mass.

During the test load speed (in N/s) was adapted to strength properties that way that failure happpens at minimum 30 up to maximum 90 seconds according to [DIN 18947:2013].

3.4.3 Results

The average bending tensile strength of the base coat 14080_BC was 0.9 N/mm². In relation to bending tensile strength the tested earth plaster can be classified into strength class S II. Test Results of compressive strength (Chapter 3.5) and adhesion strength (Chapter 3.6) may have an influence on the classification. That's why final evaluation for the earth plaster will be done in Chapter 5.

3.5 Compressive Strength

3.5.1 Requirements

For this test requirements corresponding to [DIN 18947:2013] apply. Classification to strength classes will be done analogue to specification under 3.4.1.

3.5.2 Testing Procedure

The compressive strength of the prisms conditioned under standard clime (23 °C/50 % air humidity) was tested with material testing machine type Zwick/Röll Z010. Number of samples was doubled because both pieces of the bending tensile strength test were used. The minimum number of three samples was guaranteed that way.

During the test load speed (in N/s) was adapted to strength properties that way that failure happpens at minimum 30 up to maximum 90 seconds according to [DIN 18947:2013].

3.5.3 Results

The average compressive strength of the base coat 14080_BC was 2.5 N/mm² which allows classification into strength class S II.

3.6 Adhesion Strength

3.6.1 Requirements

For this test requirements corresponding to [DIN 18947:2013] apply. Diameter of test samples was 50 mm corresponding to [DIN EN 1015-12].

Classification to strength classes will be done analogue to specification under 3.4.1.

3.6.2 Testing Procedure

The earth plaster was prepared in plastic stage and applied on concrete slaps according to [DIN 18947:2013]. Test was done with the adhesion tester of the company Dynatest (Type: DTEpico 500 dc) after 14 days of storing the samples while the last 7 days before the test under standard clime (23 °C/50 % air humidity).

3.6.3 Results

The average adhesion strength was 0.11 N/mm² which leads to classification in strength class S II.

3.7 Fire Behaviour / Building Material Class

Previously regulations used for testing earth plasters such as the [TM 04, 2011] or the [DVL, 2009] allowed the classification in building material classes without testing just in relation to measured density. Now the

classification in the building material class A1 according to [DIN 18947: 2013] without examination is only possible for pure mineral earth plasters or earth plasters containing organic aggregates, which accounts for less than 1% of mass or volume.

3.7.1 Requirements

The determination of fire behaviour has to occur after [DIN 18947: 2013] pursuant to [4102-1 DIN: 1998]. Thus earth plaster without organic aggregates can be classified in building materials class A1. Earth plasters with a content of ≤ 1% of the mass or volume of homogeneously distributed organic aggregates according to [DIN 4102-4: 1994] can also be classified in the building materials class A1, the larger value is decisive. Required for all other earth plasters A2 or B1-tests to determine the fire behaviour are not due under the contract, so that a classification in the building material class B2 is made for this.

3.7.2 Testing Procedure

The classification of purely mineral earth plaster can be done without prior examination. For earth plaster with low fibre content, the mass and volume increase upon mixing of homogeneously distributed organic aggregates is compared to the measured values of fibre loose mortar ingredients.

3.7.3 Results

According to the manufacturer's instructions the tested earth plaster 14080_BC contains 10% straw, so that it is classified in accordance with the contract in building material class B2 (combustible materials - normally flammable).

4 Facultative Absorption Test regarding DIN 18947

The ability of building materials to adsorb and store water vapour from the ambient air in a given time period is called water vapour adsorption or sorption. If room air humidity is falling the stored water released again (desorption). Open plaster surfaces can thus act as a buffer for the room air humidity. The sorption properties of earth plasters are an important climatic quality.

4.1 Requirements

The determination of water vapour adsorption of earth plasters is carried out according to the requirements of Appendix A.2 of [DIN 18947: 2013]. The earth plaster shall be categorized according to their water vapour adsorption in water adsorption classes. The class limits defined here are listed in Table 7 below. Earth plasters should meet or exceed the requirements of water adsorption class WS I. The water adsorption class WS I is applied such that the adsorption capacity of conventional mineral plasters is about to be exceeded. The minimum values of the adsorption class WS II are approximately 45%, the minimum values of the WS III

about 90% higher than the WS I, which stand out clearly thus earth plasters according conventional mineral building materials.

Water vapour adsorption class	Water adsorption in g/m² after				
	0,5 Hours	1 Hour	3 Hours	6 Hours	12 Hours
WS I	≥ 3,5	≥ 7,0	≥ 13,5	≥ 20,0	≥ 35,0
WS II	≥ 5,0	≥ 10,0	≥ 20,0	≥ 30,0	≥ 47,5
WS III	≥ 6,5	≥ 13,0	≥ 26,5	≥ 40,0	≥ 60,0

Table 7: Water adsorption classes of earth plasters corresponding to Appendix A.2 [DIN 18947:2013]

4.2 Testing Procedure

For the examination of water vapour adsorption three test surfaces of the plaster prepared in plastic stage were incorporated in sheet steel boxes with internal dimensions 50 x 20 x 1.5 cm. To achieve the specified sample thickness also for the colour finish plaster it was applied above the dried base coat layer (1.5 cm). The surrounding joint formed during the drying process, attributable to shrinkage processes was sealed in a second step, so that the adsorption occurred only on the surface. Cellulose ether was applied on the dried surfaces, as provided by the manufacturer.

The specimens were stored under standard conditions of 23 ° C / 50% relative humidity in air to constant weight in the climate chamber (type Vötsch VC3 0018). For the test, the relative humidity was raised to 80% relative humidity and samples weighed at given intervals.

4.3 Results

The results of sorption are summarized and presented in a comparative graphically in Table 8 and Figure 2. Listed are averages of three test samples. The single values of the measurements are included in the Appendix 1.

Sorption class / Samples	Measuring interval in h					
	0	0,5	1	3	6	12
	Minimum and Mean Values (cumulative) in g/m²					
WS I	0.0	3.5	7.0	13.5	20.0	35.0
WS II	0.0	5.0	10.0	20.0	30.0	47,5
WS III	0.0	6.5	13.0	26.5	40.0	60.0
Mean Values of 14080_BC	0.0	13.0	20.5	41.0	60.0	78.5
Mean Values of 14080_BC_FP	0.0	8.5	13.5	28.0	46.0	69.5

Table 8: Results of Water vapour adsorption rounded to 0.5 in comparison to the classes of earth plasters by [DIN 18947: 2013]

Both the base coat 14080_BC and the construction of an additional fine plaster 14080_BC_FP over-stride at each measurement, the minimum values of the WS III according to Appendix A.2 [DIN 18947: 2013] and can therefore be classified in the WS III.

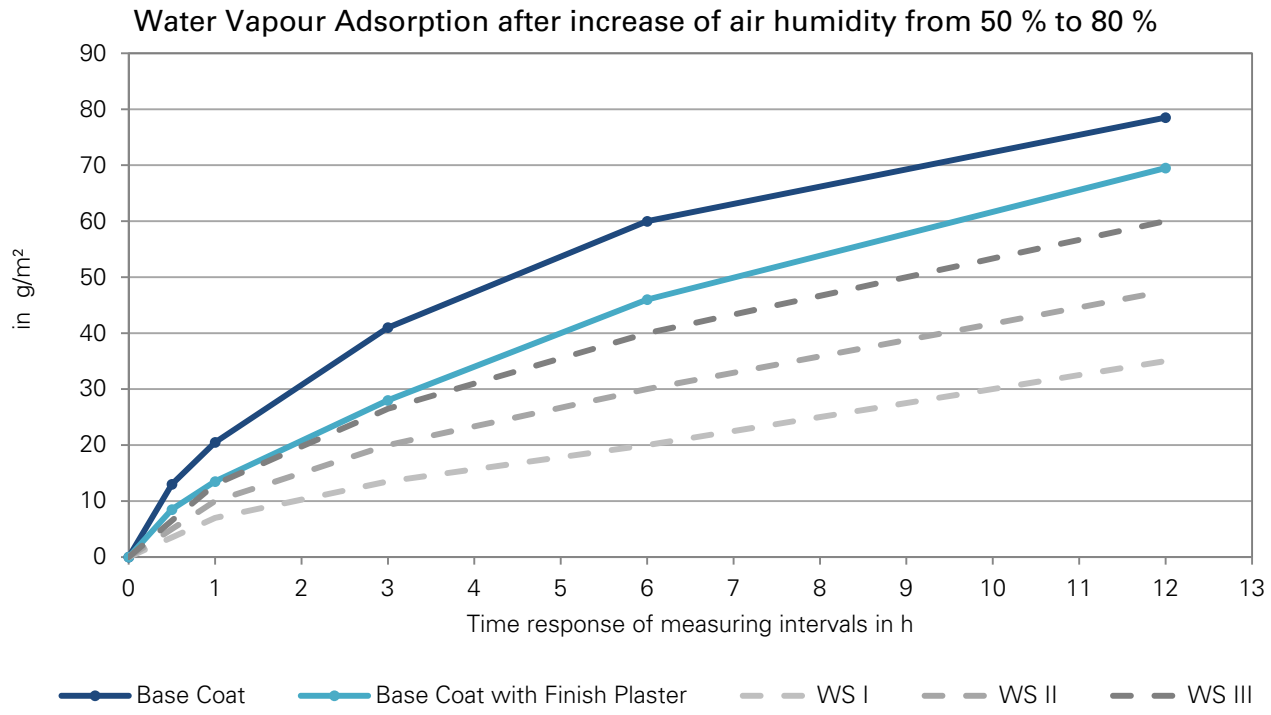

Figure 2: Results overview of investigated plasters in relation to the adsorption classes in Appendix A.2 [DIN 18947: 2013]

Compared to the sorption samples made alone from base coat water vapour sorption of combined construction with finish plaster is lower at the beginning of the test, as evidenced by the flatter curve.
Since the beginning of the test the upper layers are effective, means that the finish plaster has not such a big adsorption capacity.

In relation to conventional plasters like machine compliant gypsum plaster, lime plaster or lime cement plaster the adsorption capability of the tested base coat as single layer and also in combination with a finish plaster is much quicker and of greater extent (see Figure 3), which is typical for earth plasters.

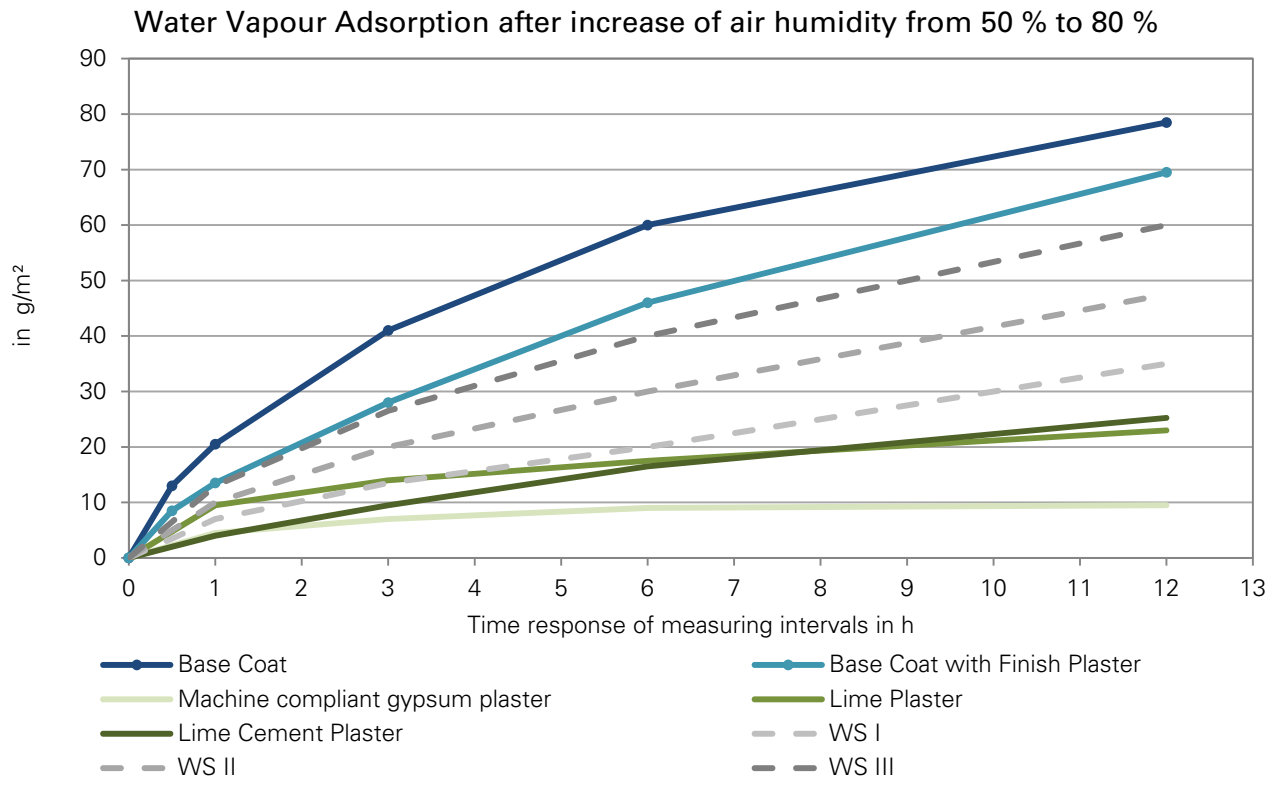

Figure 3: Results overview of investigated plasters in relation to the adsorption classes in Appendix A.2 [DIN 18947: 2013] and conventional plasters

5 Summary of Results

The results obtained in the above tests (Chapter 3 and 4) are summarized in the following table.

Properties	14080_BC	14080_BC_FP
Particle size group	0/2	/
Measure of shrinkage in %	2.4	/
Density class	1.8	/
Thermal conductivity λ in W/m·K	0.,91	/
Dampfdiffusionswiderstandsfaktor μ	5/10	/
Bending tensile strength in N/mm²	0.9	/
Compressive strength in N/mm²	2.5	/
Adhesion strength in N/mm²	0.11	/
Abrasion in g	0.14	/

Properties	14080_BC	14080_BC_FP
Strength class	S II	/
Water vapour adsorption class	WS III	WS III
Builidng material class	B2	/

Figure 4: Overview of results

6 Recommendation for Declaration

On the product data sheet of the earth plaster 14080_BC the manufacturer has to declare the following information according to Chapter 11 of [DIN 18947: 2013]. The declaration recommendations made here are made with the principle that the values are reliably maintained like specified in the pre-mentioned standard.

The declaration recommendations below made by the signatories are issued on the basis of the experimental results and to the best of our knowledge. These recommendations are to be checked by the manufacturer and, if necessary, taking into account possible adapt from the manufacturing process resulting fluctuations.

The determination of abrasion for the base coat, CO_2-equivalent characteristic value, concentration of natural radionuclides and the activity concentration index are optional according to [DIN 18947: 2013] and were not performed under the contract. That's why no values are specified for these properties here.

For the investigated earth plaster listed below declarations are recommended:

14080_BC Manufacturer description: "Base Coat"

a)	Kind of earth plaster:	earth plaster, dry
b)	Particle size group, oversize particles:	0/2, < 4 mm
c)	Fibres:	straw, up to 15 mm
d)	Minimum and maximum application thickness:	4 up to 15 mm
e)	Density class:	1.8
f)	Measure of shrinkage:	< 3.0 %
g)	Strength class:	S II
h)	Bending tensile strength:	0.7 N/mm²
i)	Compressive strength:	2.0 N/mm²
j)	Adhesion strength:	0.10 N/mm²
k)	Water vapour diffusion resistance factor:	5/10
l)	Thermal conductivity:	0.91 W/m·K
m)	Building material class:	B2
n)	Abrasion:	0.20
o)	Water vapour adsorption class:	WS III

The recommended declaration of particle size , oversize particles and indirectly also for minimum application thickness departed from manufaturer's instructions. The Manufacturer should check delivery notes for aggregates or of used clayey soil, if bigger oversize particles as measured here are possible. If so the manufacturer has to adapt declared values in accordance with bigger oversize particles.

The value obtained for the adhesion strength of the base coat is slightly above the required minimum of strength class S II. To ensure the classification in the strength class S II securely we recommend the manufacturer to make the mix of the base coat fatter and thus the adhesion of the clay plaster to increase. If no recipe adjustment will be done and the strength class S II will be declared, there are only little reserves for material or manufacturing-related fluctuations, so that for the clay plaster adhesive strengths below the minimum required value of the strength class could occur.

In addition to being declared values the manufacturer has also to provide information on the following points according to [DIN 18947: 2013]:

- Added substances to clayey soil, suitable for use as building material (Page 4 of the standard)
- Delivery and especially higher moisture contents (see 5.2.1 of the standard)
- Maximum storage time and storage conditions (see 5.2.2 of the standard)
- Minimum thicknesses (see 5.2.4 of the standard.)
- If necessary, necessary treatment equipment and method (s. 5.3 of the standard),
- Treatment and tempering of clay to improve workability if minimum times must be observed (see 5.3 of the standard.)
- Details of the required amount of water to adjust the consistency of processing (see 5.4 of the standard.) and
- If necessary, necessary strengthening of the surface to achieve a sufficiently low abrasion (5.5.8 of the standard), here: cellulose ether primer

7 Designations

The earth plaster 14080_BC is to describe in the following order in accordance with Chapter 6 of [DIN 18947 2013]: Lehmputzmörtel - DIN main number - Symbols with upper sieve size and fibre reinforcement / mineral - Strength class – density class.

Thus obtained for the tested earth plaster the data summarized results in Chapter 5 and submitted declaration recommendations in Chapter 6 the following notation:

Lehmputzmörtel – DIN 18947 – LPM 0/2 f – S II – 1,8

8 Information to Delivery Note

According to Chapter 10 of [DIN 18947: 2013] the delivery note for earth plasters produced in the factory has to contain name of the company, its mark, quantity and description of the delivered earth plaster and also information to delivery form. In addition to that also the day of delivery and the recipient have to be named.

9 Further Recommendations

The properties of the earth plaster are to monitor in the context of the factory production control according to Chapter 9.1.3 [DIN 18947: 2013]. Here are earth plasters for each 400 t at an annual production ≤ 1 600 t or 4 times a year with an annual production> 1600 t to test related to oversize, density, measure of shrinkage and compressive strength.

If changes are made to the recipes, thus losing the results of this report for the new formulas validation and it is to perform a new initial type-testing for the earth plaster.

10 Lists

10.1 Literature

[DIN 4102-1:1998] Deutsches Institut für Normung (Hrsg.): DIN 4102-1:1998-05 Brandverhalten von Baustoffen und Bauteilen- Teil 1: Baustoffe; Begriffe, Anforderungen und Prüfungen, Ausgabe: Mai 1998

[DIN 4102-4:1994] Deutsches Institut für Normung (Hrsg.): DIN 4102-4:1994-03 Brandverhalten von Baustoffen und Bauteilen- Teil 4: Zusammenstellung und Anwendung klassifizierter Baustoffe, Bauteile und Sonderbauteile, Ausgabe: März 1994

[DIN 4108-4:2013] Deutsches Institut für Normung (Hrsg.): DIN 4108-4:2013-02 Wärmeschutz und Energie-Einsparung in Gebäuden- Teil 4: Wärme- und feuchteschutztechnische Bemessungswerte, Ausgabe: Februar 2013

[DIN 18947:2013] Deutsches Institut für Normung (Hrsg.): DIN 18947:2013-08: Lehmputzmörtel - Begriffe, Anforderungen, Prüfverfahren, Ausgabe: August 2013

[DIN EN 1015-1:2007] Deutsches Institut für Normung (Hrsg.): DIN EN 1015-1:2007-05 Prüfverfahren für Mörtel für Mauerwerk- Teil 1: Bestimmung der Korngrößenverteilung (durch Siebanalyse), Ausgabe: Mai 2007

[DIN EN 13139:2011] Deutsches Institut für Normung (Hrsg.): DIN EN 13139:2011-03 Gesteinskörnungen für Mörtel, Ausgabe: März 2011

[DVL, 2009] Dachverband Lehm e.V. (Hrsg.): Lehmbau Regeln, 3., überarbeitete Auflage, Vieweg+Teubner / GWV Fachverlage GmbH, Wiesbaden 2009

[TM 01, 2008] Dachverband Lehm e.V. (Hrsg.): Anforderungen an Lehmputze. Technische Merkblätter Lehmbau TM 01, Eigenverlag des DVL, Weimar 2008

[TM 04, 2011] Dachverband Lehm e.V. (Hrsg.): Lehm-Putzmörtel, Begriffe, Baustoffe, Anforderungen, Prüfverfahren. Technisches Merkblatt TM 04, Eigenverlag des DVL, Weimar 2011

10.2 Tables

10.3 Figures

11 Formal Aspects

11.1 Copyright

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11.2 Scale

This report consists of 18 pages of text including cover page and table of contents and 6 pages of appendixes including cover page thus, the document amounts to 24 pages in total.

Berlin, 5. November 2014

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Project:	Estonia_Materialpruefung
Project-No:	14080
Client:	Mikk Luht Tegevjuht/CEO Saviukumaja OÜ Mooste Mõis/Mooste Manor Põlva maakond 64616 Estonia

APPENDIX

Appendix 1: printouts of test results

Sample Characterisation

Project: 14080_Estonia_Materialprüfung

Sample	Manufacture's labelling	Date of sample arriving	Amount	Describtion
14080_BC	Base coat	26.09.2014	15 kg	dark red, crushed straw (approx. up to 15 mm)
14080_FP	Fine finish clay plaster	08.10.2014	5 kg	yellow, fine, no fibres visible
Primer	Cellulose Ether	08.10.2014	5 g	white, fine powder

Measure of shrinkage, Density, Compressive and Bending Tensile Strength according to DIN 18947:2013-08, DIN EN 1015-10 and DIN EN 1015-11

Material							
Sample No		1		2		3	
Date of Production		09.10.2014					
Consistency		plastic					
Slump	mm	172*173, 171*172					
Storing in formwork	Days	7					
Storing stripped out	Days	7					
Date of Test		22.10.2014					
Days after Production	Days	14					
Test Temperature /Humidity	°C / %	23/50					
Storing under Test Climate	h	168					
Length (with Moisture of Production)	mm	160,0		160,0		160,0	
Length (with balancing humidity)	mm	156,2		156,1		156,2	
Should value be used for calculating the average?		☑		☑		☑	
Measure of Shrinkage	%	2,4		2,4		2,4	
Measure of Shrinkage (Average)	**%**	**2,4**					
Standard Deviation	%	0,04					
Deviation from the Average	%	1		2		1	
Width (with balancing humidity)	mm	37,9		37,6		38,4	
Height (with balancing humidity)	mm	38,8		39,0		38,6	
Mass (with balancing humidity)	g	389,4		384,7		388,0	
Volume	cm³	229,70		228,91		231,53	
Should value be used for calculating the average?		☑		☑		☑	
Density (single values/ with balancing humidity)	kg/dm³	1,70		1,68		1,68	
Density (average/ with balancing humidity)	**kg/dm³**	**1,68**					
Standard Deviation	kg/dm³	0,01					
Deviation from the Average	%	1		0		0	
Breaking Load Bending Tensile Strength	N	386		308		337	
Should value be used for calculating the average?		☑		☑		☑	
Bending Tensile Strength f (single values)	N/mm²	1,0		0,8		0,9	
Bending Tensile Strength f (Average	**N/mm²**	**0,9**					
Standard Deviation	N/mm²	0,1					
Deviation from the Average	%	12		10		2	
Half of the prism		1_a	1_b	2_a	2_b	3_a	3_b
Breaking Load Compression Test F	N	3710	3720	3710	3680	3710	3830
Compression Area	mm²	1516		1504		1536	
Should value be used for calculating the average?		☑	☑	☑	☑	☑	☑
Compressive Strength (Single Values)	N/mm²	2,4	2,5	2,5	2,4	2,4	2,5
Compressive Strength (Average)	**N/mm²**	**2,5**					
Standard Deviation	N/mm²	0,0					
Deviation from the Average	%	0	0	1	0	2	2

Oversize Particle according to DIN 18947:2013-08

Projekt: 14080_Estonia_Materialprüfung

		Oversize dry											
Sample	Full Sample Mass (dry)	8 mm		4 mm		2 mm		1 mm		0,5 mm		Particle Size Group	Oversize Particle
	in g	in g	in %	in g	in %	in g	in %	in g	in %	in g	in %		in mm
14080_BC	154	0	0	0	0	4	2	/	/	/	/	0/2	<4

Determination of Abrasion and Adhesion corresponding to DIN 18947:2013-08

Project: 14080_Estonia_Materialprüfung
Date of testing: 04.11.2014 and 05.11.2014

Adhesion Strength Test

Sample	Adhesion value in kN	Φ Area of Fracture in mm	Adhesion strength, absolute in N/mm²	Note Adhesion Fraction: Fracture between mortar and subsoil Cohesion Fraction: Frature in mortar or subsoil
14080_BC_ 1	0,18	49,4	0,09	adhesion fraction
14080_BC_ 2	0,28	49,3	0,15	adhesion fraction
14080_BC_ 3	0,17	50,0	0,09	adhesion fraction
14080_BC_ 4	0,18	50,0	0,09	adhesion fraction
14080_BC_ 5	0,16	50,0	0,08	adhesion fraction
		Mean Value:	0,11	
		Correspondig Strength Class:	SII	

Sample	Abraded Material in g
14080_BC_ 6	0,19
14080_BC_ 7	0,10
14080_BC_ 8	0,12
Mean Value:	0,14
Strength Class:	SII

Determination of Water Vapour Adsorption according to DIN 18947:2013-08, Appendix A.2

Project: 14080_Estonia_Materialprüfung

Base Coat

Water vapour adsorption						
	Measuring interval in h					
Sample	0	0,5	1	3	6	12
14080_BC_I	0,00	1,20	1,95	4,02	5,97	7,96
14080_BC_II	0,00	1,45	2,04	4,22	5,93	7,70
14080_BC_III	0,00	1,28	2,16	4,11	6,14	7,88
Mean Value (per 0,1 m²)	0	1,31	2,05	4,12	6,01	7,85
Mean Value (per 1,0 m²) in g/m²	0,0	13,0	20,5	41,0	60,0	78,5

Base Coat with Finish Plaster

Water vapour adsorption						
	Measuring interval in h					
Sample	0	0,5	1	3	6	12
14080_BC_FP_I	0,00	1,05	1,36	2,70	4,41	6,58
14080_BC_FP_II	0,00	0,77	1,11	2,75	4,44	6,90
14080_BC_FP_III	0,00	0,72	1,59	2,97	4,91	7,37
Mean Value (per 0,1 m²)	0,00	0,85	1,35	2,81	4,59	6,95
Mean Value (per 1,0 m²) in g/m²	0,0	8,5	13,5	28,0	46,0	69,5