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Expert Opinion

Investigations of HASIT Fixit 222 Aerogel WDP sample plaster

Property:	Trausnitz Castle HASIT Fixit Aerogel WDP Landshut sample plaster surfaces
Client:	HASIT Trockenmörtel GmbH Landshuter Str. 30 85356 Freising
Contractor:	IGS Institut für Gebäudeanalyse und Sanierungsplanung München GmbH Glückaufstraße 12 83734 Hausham
Processor:	Dipl.-Ing Rolf Kaiser Bernd Backhaus, Civil Engineer

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Project: 03021 G03

IGS was commissioned by HASIT to carry out structural investigations on the two plaster sample areas in the cellar area of Trausnitz Castle in Landshut. Investigations were carried out on moisture and salt loads of the plasters and, in addition, climate measurements were carried out to assess possible condensation processes on the plaster surfaces in the summer phase.

In the initial investigation cycle in 2021, after approximately 3 years of exposure, 20 material samples from the aforementioned plaster system were taken from a total of 6 locations using core drilling in the area of the sample surfaces. These samples were analyzed in the laboratory for moisture content and the presence of construction-damaging salts.

Additionally, climate measurements were conducted from June 23, 2021, to October 6, 2021, to check the extent of condensation processes on the plaster surfaces during the summer phase (summer condensate) and their effects on the moisture load of the plasters.

The results of these investigations are presented in the investigation report G02 by IGS dated October 27, 2021.

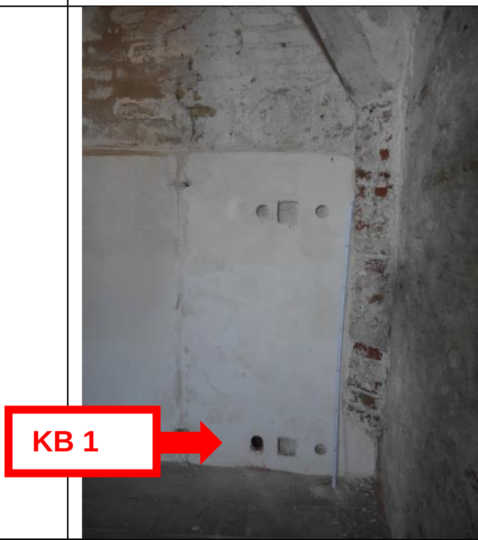
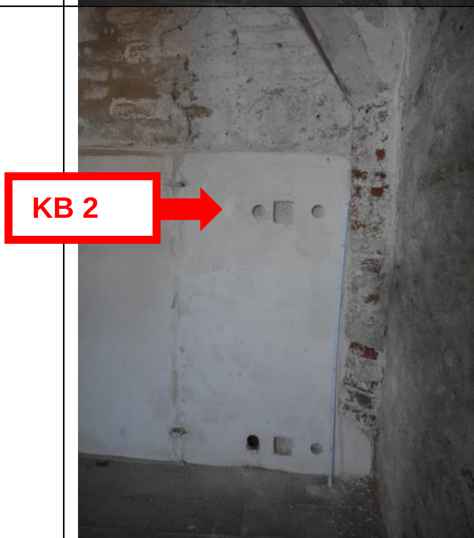
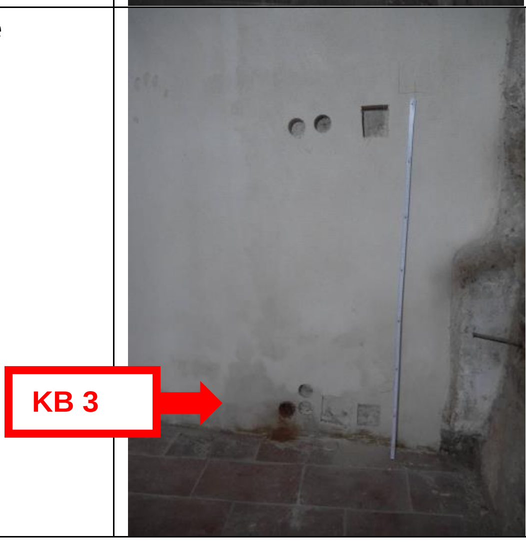
At the client's request, further investigations were conducted after now approximately 5 years of exposure of the plaster samples to examine and evaluate the effects of moisture and salt damage on the historical building substance on the plaster surfaces after a 5-year exposure period.

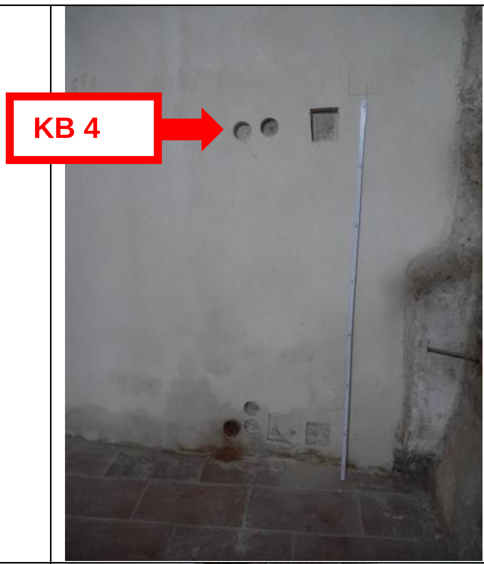
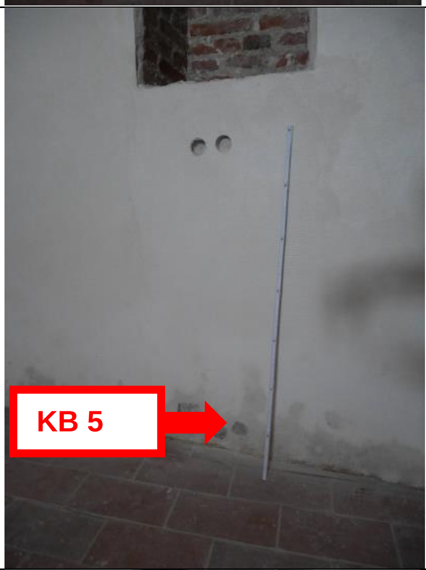
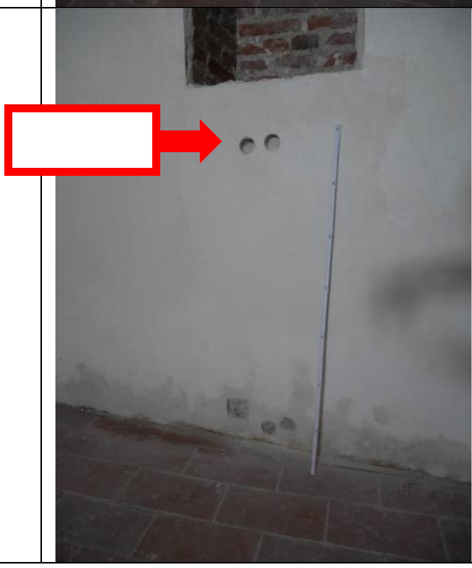
1. <u>Investigations into moisture and salt loads</u>

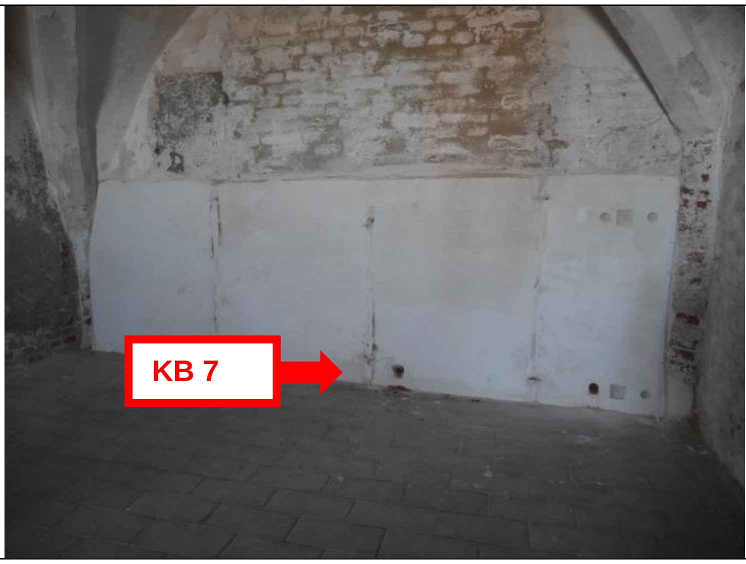
On 16.06.2021, a total of 20 material samples of the above-mentioned plaster system were taken at 6 locations by means of core drilling in the area of the sample surfaces of the above-mentioned project and examined laboratory for the moisture content and the content of structurally damaging salts.

On September 20, 2023, comparable material samples of the plaster system mentioned above and the masonry beneath it were once again taken immediately next to the sampling sites from 2021 through core drilling. These samples were again analyzed for moisture content and the presence of harmful building salts.

Documentation of sampling:

Sample no.	Location / altitude	Photo documentation
KB 1	Upper room, sample surface on the right edge Height: 0,16 m	
KB 2	Upper room, sample surface on the right edge Height: 1.35 m	
KB 3	Lower room, sample surface on the right edge Height: 0.16 m	

KB 4	Lower room, sample surface on the right edge Height: 1.35 m	
KB 5	Lower room, sample area in the middle (under wall niche) Height: 0,10 m	
KB 6	Lower room, sample area in the middle (under wall niche) Height: 1.35 m	

KB 7	Upper room, central sample area Height: 0.12 m	

The results of our laboratory tests are presented in the following tables. For comparison, the values from the current investigations as well as the values from the previous investigations in 2021 are presented.

Exposure to moisture:

To determine the exposure to moisture, the sample material was weighed and the material moisture content was determined using the Darr method.

Results:

Sample type	Sample no.	Removal height above top edge of floor [m]	Material	Material moisture % 2023	degree of damp-ness 2023	Material moisture % 2021
KB	1/0.5	0.16	Lime plaster, finishing plaster	7,33	23	1.64
KB	1/0.8	0.16	Render/finishing plaster boundary layer	-	-	5.00
KB	1/4	0.16	Render (aerogel)	38,87	22	35,95
KB	1/6	0.16	Solid brick	13,84	96	-
KB	2/0.5	1.35	Lime plaster, finishing plaster	9,94	25	4.19
KB	2/0.8	1.35	Render/finishing plaster boundary layer	-	-	7.17
KB	2/4	1.35	Render (aerogel)	29,29	16	24,07
KB	3/0,5	0.16	Lime plaster, finishing plaster	18,62	58	12.74
KB	3/3	0.16	Render (aerogel)	47,11	24	51.55
KB	3/6	0.16	Solid brick	13,89	86	-
KB	4/0.5	1.35	Lime plaster, finishing plaster	5,67	28	3.46
KB	4/4	1.35	Render (aerogel)	16,12	9	14,17
KB	5/0,5	0,10	Lime plaster, finishing plaster	20,74	59	23,58
KB	5/3	0.10	Render (aerogel)	35,67	77	33,20
KB	6/0,5	1.35	Lime plaster, finishing plaster	9,25	28	4,59
KB	6/5	1.35	Render (aerogel)	16,10	7	18,64
KB	7/5	0,12	Render (aerogel)	45,25	25	-
KB	7/13	0,12	Solid brick	14,20	92	-

KB = core drilling, the number after the slash indicates the extraction depth.

Exposure to structurally damaging salts:

To determine the salt load, an aqueous extract was made from a defined amount of building material. The content of the water-soluble anions chloride, nitrate, and sulfate in this solution was determined using ion chromatographic analysis technique. For comparable material samples, the values from the studies in 2021 and 2023 are presented together.

Sample no.	Removal height above top edge of floor [m]	Material	Salt load [wt. %] BS = assessment level						
			Chloride	BS	Nitrate	BS	Sulphate	BS	Year of sampling
1/0.5	0.16	Lime plaster, finishing plaster	0.160	I	0.034	I	0.111	I	2021
			0,205	II	0,035	I	0,632	II	2023
1/4	0,16	Render (aerogel)	0,485	II	0,083	I	0,945	II	2021
			0,176	I	0,091	I	0,185	I	2023
1/6	0,16	Solid brick	0,116	I	0,032	I	0,070	I	2023
2/0,5	1,35	Lime plaster, finishing plaster	0,493	II	0,399	III	0,253	I	2021
			0,266	II	0,233	II	0,483	I	2023
2/4	1,36	Render (aerogel)	1,116	III	1,303	III	0,402	I	2021
			0,323	II	0,330	III	0,274	I	2023
3/0,5	0,16	Lime plaster, finishing plaster	0,064	I	0,000	I	0,040	I	2021
			0,041	I	0,000	I	0,000	I	2023
3/3	0,16	Render (aerogel)	0,092	I	0,100	II	0,052	I	2021
			0,065	I	0,034	I	0,146	I	2023
3/6	0,16	Solid brick	0,000	I	0,000	I	0,053	I	2023
4/0,5	1,35	Lime plaster, finishing plaster	0,626	III	0,205	II	0,112	I	2021
			0,614	III	0,276	II	0,094	I	2023
4/4	1,35	Render (aerogel)	2,302	III	0,874	III	0,147	I	2021
			1,610	III	0,709	III	0,211	I	2023
5/0,5	0,10	Lime plaster, finishing plaster	0,035	I	0,000	I	0,000	I	2021
			0,030	I	0,000	I	0,000	I	2023
5/3	0,10	Render (aerogel)	0,038	I	0,000	I	0,000	I	2021
			0,029	I	0,000	I	0,024	I	2023
6/0,5	1,35	Lime plaster, finishing plaster	0,828	III	0,247	II	0,137	I	2021
			0,676	III	0,325	III	0,152	I	2023

6/5	1,35	Render (aerogel)	2,550	III	1,169	III	0,256	I	2021
			1,577	III	0,802	III	0,261	I	2023
7/5	0,12	Render (aerogel)	0,117	I	0,000	I	0,281	I	2023
7/13	0,12	Solid brick	0,075	I	0,000	I	0,034	I	2023

Assessment table for damage-causing effect according to WTA leaflet 4-5-99/D, Table 8:

Assessment level		wt. % chloride	wt. % nitrate	wt. % sulphate
I	low	< 0.2	< 0.1	< 0.5
II	medium	0.2 - 0.5	0.1 - 0.3	0.5 - 1.5
III	high	< 0.5 Evaluation	< 0.3	< 1.5

2. Evaluation of the results

The examined substrates of the plasters—brick masonry—show extreme moisture loads with moisture levels near complete saturation of the building material. The high to extreme moisture loads of the plaster layers, partly observed, are due to moisture ingress from the substrate (soil-contacting exterior wall). Additional moisture entries through condensation have been ruled out by earlier dew point analyses.

Comparing the current moisture loads of the aerogel insulation plaster with those from 2021, no significant changes are detectable. Currently, the top plaster layers often show significantly higher loads than in 2021.

The investigations of the moisture loads of the aerogel plaster layers, based on current studies, once again demonstrate that the plaster has a very high water absorption capacity and exhibits high capillary suction. From the studies and the moisture distribution of the plaster layers, it can be inferred that the aerogel insulation plaster used as base plaster can absorb moisture from the substrate without damage and transport it to the room-side component surfaces.

The investigations into construction-damaging salts again often show high to extreme concentrations of chlorides and nitrates in the plaster layers, with comparable concentrations occurring in all plaster layers.

The distribution of salt load indicates that a "transport" of the dissolved salts through the individual plaster layers towards the component surfaces occurs. Surprisingly, after about 5 years of service life of the plaster samples, no destructive damages in the form of delaminations on the component surfaces due to the high to extreme salt loads are evident.

During the investigations, it was notable that despite the high moisture load of the plaster, there were apparently no signs of mold infestation. Considering the climatic conditions during the summer phase with very high relative humidities consistently over 90%, the plaster material can be deemed inhibitive for mold growth or "mold-resistant."

During the sampling of material, it was again noted that the aerogel insulation plaster could be easily and without major mechanical impact detached from the substrate. With gentle manual and especially non-destructive action, the plaster material could be completely removed from the substrate. In terms of application of the plaster on historic building fabric, this is positively regarded and evaluated.

It is also worth mentioning that due to the applied layer thicknesses of up to 50 mm—which presumably can be applied without problems—an evening out of irregularities in the plaster substrate can occur, and larger deviations in alignment of the substrate with the plaster layer can be compensated.

Dipl.-Ing Rolf Kaiser