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CONSIDERATIONS RELATED TO WATERPROOFING BRICK WALLS AFFECTED BY CAPILLARY MOISTURE AND CASE STUDY

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Abstract: One of the methods most applied in order to remove capillary moisture from old buildings brick walls is DryKit. Its efficiency has been proven over time, as a result of numerous objectives rehabilitated using mentioned technology. The paper presents some aspects related to specific features of the method, such as different types of ecological solutions used and their quantities necessary to inject the brick walls and a case study.

Key words: moisture, ecological solution, insulation, waterproofing.

1. INTRODUCTION

The decay of masonry, plaster and even paintwork or decoration is caused by the rise of water in construction materials through the capillary effect: a phenomenon which affects civil construction in general and a large part of our building heritage.

Even long ago this phenomenon was widely known, but construction workers considered it to be an unavoidable element of a building.

Rising humidity is caused by the presence of water in the soil and by the capillary action of construction material; it can be seen above all through the appearance of stains at the bottom of walls, with cracking paintwork and flaking plaster or fragments of construction materials (stone, brick, etc.).

Due to the low surface tension, the microscopic channels of the capillaries enable water to rise. If salts are dissolved in the soil or construction materials, it spreads even further upwards.

Besides the aesthetic damage, rising humidity increases the dispersal of heat from the inside of the building to the outside and also causes the internal relative humidity to rise, leading to sanitary and environmental problems [1].

The method described bellow is called DryKit and is an exclusive patented system for fighting rising humidity, which eliminates the problem for good.

This system acts on masonry through the formation of a chemical barrier consisting of water or solvent-based hydrophobic formula.

2. METHOD CHARACTERISTICS

2.1 Hydrophobic formulas used

According to this method the continuous chemical barrier which is guaranteed and unalterable in time can be obtained by use of different formulas (solutions), as described bellow.

- TRE 128 environmental friendly - specifically formulated siloxane microemulsion-based solvents in heteropolar hydrolysates for walls of any type of material or thickness to be applied by insertion of diffuser tube shaped made from pressed cellulose at a series of holes passing near, prepared at 15 cm from the floor.
- TRS 114 - formulated specifically based on polysiloxanes in aliphatic solvent, for walls of any material or thickness to be applied by insertion of diffuser tube shaped made from pressed cellulose at a series of holes passing near, prepared at 15 cm from the floor.
- TRX 118 - monomeric silane component formulation with high penetration of any masonry material or thickness to be applied as mentioned above.
- TRA 115 - silicone formulated in deionized water suitable for masonry or stone, for compact brick masonry with a thickness greater than 40-50 cm, to be applied as mentioned above.
- TRF 135 - formulated specifically based on modified polysiloxane solvents super rectified, for the treatment of frescoed walls, to be applied by insertion of speakers tubopress of cells at a series of holes almost loops, drawn 15 cm from the floor share

2.2 Conclusions for treated walls

The drying time of a treated wall may vary depending on the actual construction of the wall, weather conditions, the wall thickness, type of product formula used, water or solvent (tab. 1).

Table 1 Drying time of treated walls

Wall average drying time, when TRX 118 and TRA 115 was used		**Wall average drying time, when TRS 114, TRF 135 and TRE 128 was used**	
Wall thickness, [cm]	Time, [days]	Wall thickness, [cm]	Time, [days]
05	35	05	20
10	50	10	25
15	75	15	40
20	95	20	50
25	120	25	60
30	145	30	75
35	170	35	80
40	195	40	100
45	215	45	115
50	240	50	125
55	265	55	140
60	290	60	150
65	310	65	180
70	335	70	200
75	360	75	225
80	385	80	240
85	400	85	255
90	430	90	270

The required quantities of solutions used for waterproofing brick walls are according to tab. 2:

Table 2 Required quantities of waterproofing fluid

Wall thickness, [cm]	Required quantity, [l]
05	0.25
10	0.50
15	0.75
20	1.00
25	1.25
30	1.50
35	1.75
40	2.00
45	2.25
50	2.50
55	2.75
60	3.00
65	3.25
70	3.50
75	3.75
80	4.00
85	4.25
90	4.50
95	4.75
100	5.00

It is easy to observe the linear variation between required quantity of fluid and wall thickness, as well as between average drying time and wall thickness, for different formula used.

In addition, using this method, any rise of water is prevented by changing the wetting angle, which means reversal of concave meniscus to convex, respecting the law of Jurrin.

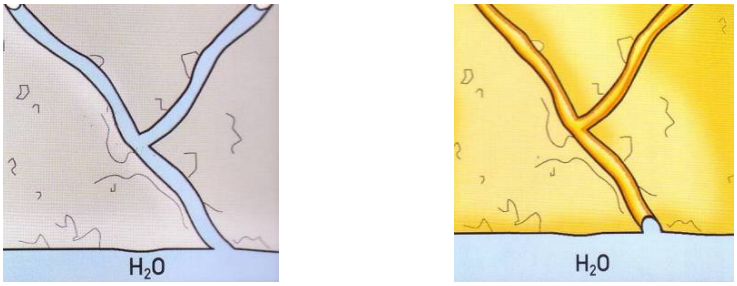

Fig. 1 Untreated wall (left side); treated wall (right side).

3. CASE STUDY – WATERPROOFING BRICK WALLS OF „BUNA VESTIRE" CHURCH FROM JINA VILLAGE, SIBIU COUNTY

Jina village is located in the southwestern county of Sibiu, on the boundary with the Alba County and part of the famous folkloric area The Edge of Sibiu, being representative of ports and related traditional grazing habits. The church was built in 1782 and painted by Vasile Munteanu of Laz in 1802. At the first visit on site we observed the moisture level in the walls.

Measurements have revealed high levels of moisture in the walls of the church, which exceeded 35% both in the exterior walls and interior. In time, this problem has caused degradation

of paintings, the emergence and persistence of mold odor and health hazard to the inhalation of harmful fungi. The humidity high in the walls was about 1.80 m.

Some suggestive images are presented below:

Fig. 2 Capillary moisture on exterior wall.

Fig. 3 Capillary moisture and efflorescence on exterior wall.

Fig. 4 Efflorescence and damaged paintings on interior wall.

Related to what we presented above and part of the technical expertise, measures of intervention on interior and exterior walls, in order to eliminate capillary moisture, were established.

DryKit technology was implemented as follow:

• **Rising dump barrier**:

- Execution of horizontal holes at 15 cm interspaced throughout the wall thickness but less than 5 cm, where tube shaped diffuser made from pressed cellulose will be inserted;

- TRE 128 ecological solution will be dose (product specifically designed for this kind of work that does not degrade the paintings and materials which came in contact with) depending on the thickness of the walls and ensure connection to diffusers, for scattering in the walls. Dispersion may take between 1 hour and 24 hours depending on the walls materials porosity and their capillary.

- In this way, a chemical barrier around (25-30) cm thickness will be achieved throughout the wall section.

• **Removing interior and exterior plaster throughout moisture height limits plus 50 cm**:

- If time allows, leave the walls to dry naturally (with deepening the joints between the bricks, in advance, by 2.5-3 cm depth). In depth, the drying process will have a speed about 2.5 cm/month;

- If it requires urgent restoration of plaster, the plaster will be aerated type using TRH 780 product or Der Por (mortar containing hydrophobic additive will be applied in a single layer directly on the wet wall), according to the recipe. At about three weeks from applying the plaster, the wall surface can be finished.

- To accelerate dehumidification it is possible to use, optionally, a specific electrical device over a period of approximately 25 days. After reaching a relative humidity of 10-12 % outer plaster can be made.

• **Collection and disposal of rainwater** through underground pipes (PVC type Ø 110 mm diameter) at the sewage collectors;

• **Execution of ventilation** around the church foundation perimeter, to a minimum depth of 1.2 m (knowing from the polls, that the foundation base is at -1.20 m deep)

- Neps foil will sit with the plugs into the foundation;

- This kind of measures provides balancing capillary pressure, reducing its value including to the church floor.

The technical specification was followed exactly and the results can be observed bellow:

Fig. 5 Collection and disposal of rainwater.

More suggestive images are presented as follow:

Fig. 6 Exterior wall waterproofed and ventilated foundation.

Fig. 7 Positive effect after applying DryKit method as described above.

4. CONCLUSIONS

As discussed in this article we may be said that the desired effects from the application of a method for remediation of walls affected by humidity (in this case is about DryKit) is maximum when the provisions are met, and the technological solutions are strictly follow.

REFERENCES

1. DryKit specifications and instructions (www.drykit.it, www.tecnored.it).

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