Methods Of Protection Of The Exterior Walls Of The Exploited Buildings From Moistening With Grunt Moisture

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Abstract : It is necessary to ensure reliable protection of underground structures from moisture of barrier structures and underground parts of buildings. Hydroisolization of underground parts of buildings is one of the most laborious and responsible processes. Hydroisolation in the construction of buildings and structures is an average value of construction and installation work from 0,1 to 0,5%, but at the same time, 3 percent of the total labor costs that go to the restoration of the building. Repair of gidroisolytics is a complex, expensive and no less effective process. Therefore, it is necessary to ensure that the building is suitable for long-term durability, taking into account all the negative effects on the gidroisolization of underground parts of the building. In the following years, the results of research aimed at studying the technical condition of buildings and structures, as well as the archive data collected during the period of their exploitation, show that the technical condition of most of the previously constructed buildings deteriorated, there were violations in their Sokol parts. In this article, the traditional methods of protecting the walls of the building from the front moisture can not be a reliable barrier to the penetration of grunt moisture into the wall thickness, and the question of its new look is raised.

Keywords: extremely crumbly grinds, crumbly, electroosmotic, protector.

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1. INTRODUCTION.

High humidity in the walls is a problem for very used (exploited) buildings. Especially this problem is very important for the basement and Sokol walls, which work under the most unfavorable conditions, when the grunt is in direct contact with moisture. The practice of exploitation of buildings showed that when horizontal hydroisolation between the foundation and the external walls loses its protective properties, when the external wall is moistened with grunt moisture, the quality of exploitation of the buildings, their durability and long-term durability is significantly reduced. The most common methods of gidroisolation (paint, glue, Mastic) also lose the ability to prevent moisture penetration into the outer wall thickness after 10-12 years. As a protection of the outer walls from the foundation, which is moistened from the grounding moisture, layers of gidroisolation with a cement mixture with various moisturizing or gidrophobic additives are used, and this layer also loses its (gidroisolation) properties over time. [1] (Fig-1).

***Fig-1**. The outer wall is moistened with Grunt moisture*

Horizontal and vertical hydroisolation during the operation of the premises leads to the fact that the layers are not long-lived, or the damage is caused by the capillary absorption of ground water and the wetting of the lower parts of the walls. In this case, the height of moisture rise for capillary systems is determined by the following formula:

$$H_K = 4\sigma / g \cdot \rho \cdot d. \quad (1)$$

Here σ - surface tension of water ($\sigma = 72{,}5 \cdot 10^{-3} n/m$);

d– Minimum diameter of capillary (for building materials $d = 2 \cdot 10^{-3} m$);

ρ - Density of water ($\rho = 10^3 kg/m^3$);

g - Free fall acceleration ($g = 9{,}81 m/\sec^2$).

In practice, the rise of moisture in the capillary through the walls reaches a height of 0,5 m. If the wall material contains chloride salts with high hygroscopicity, then this moisture rises to a height of 3-4 meters, and sometimes to a height of 5-6 meters. The consequences of such humidification are a decrease in the quality of heat protection of external walls, contamination and deterioration of room decoration, the appearance of salt stains on the facade of the building, as well as mold and fungus on the inner surface of the moistened outer wall (Fig-2). This condition can lead to the fact that people who are forced to live and work in such buildings are infected with a number of serious diseases [2].

***Fig-2**. Mold and fungus on the inner surface of the damp outer wall*

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It should be noted that the results of research conducted abroad (in particular, Germany, Norway and Finland) show that the mortality rate due to diseases caused by these phenomena has increased from the level of mortality caused by road traffic accidents [3]. In addition to unfavorable hygienic conditions, an increase in moisture in the external barrier structures leads to the fact that the external barrier accelerates the breakdown of structures. This leads to a significant increase in operational costs.

2. THE MAIN PART.

The removal of moisture from the dampened walls of buildings consists of two stages:

- drying walls and foundations;
- Recovery of gidroisoliasis.

It is very difficult and expensive to restore horizontal gidroizoly of external walls by conventional mechanical methods. Covering the inner surfaces of the rooms with roll (die) materials will only temporarily improve the hygienic condition of the room. However, such a layer, as a rule, the external barrier contributes to the accumulation of moisture in the structures. Because it makes it difficult for moisture to come out through the inner layers of the structure, and therefore after such repair, the humidity in the room increases. In particular, the restoration of the gidroisolyation of exploited residential buildings is a very difficult process. In order to protect the structure from the effects of grunt moisture, it is necessary to restore both the gidroizolyation on the vertical surface of the foundation touching the grunt, and the horizontal gidroizolyation between the foundation and the wall [4]. In this case, the latest method (measure) it will be necessary to disassemble the walls of the building to the foundation and restore the new layer of gidroisolation, and then rebuild (restore) the walls. Alternatively, an alternative is hydrolysation-that is, the injection of wet walls in the thickness of the material (the injection material is impregnated into the wall through injection holes, which are located in one or two rows). Their capillary is to reduce water permeability. However, such materials are quite expensive and for their use require drilling a large number of holes in the walls. This in turn can lead to an additional penetration of moisture into the wall thickness. Thus, traditional methods of protection can not be a reliable barrier to the penetration of grunt moisture into the wall thickness. It is determined that 75% of all moisture that rises through the wall construction comes from the influence of electroosomatic forces. Electroosomatic forces are the electric field of the Earth, the electrochemical microelements of materials, the thermal insulation layer, the friction forces formed on the surface of the facade of the building under the influence of wind, as well as many other factors, which are formed as a result of the electric field formed in the construction of the building. Therefore, in order to prevent the foundation from getting wet from the grunt moisture, it is necessary to remove the natural electric field formed in the wall construction or change its direction. According to this idea, it is based on one of the methods of combating the walls of the exploited buildings by preventing the foundation from getting wet with grunt moisture, that is, the so-called electroosmotic method. It should also be noted that at the opening of the phenomenon of electroosmosis – the movement of fluid through capillaries and microwaves to the opposite side when applying an external electric field – in 1808 year the Russian researcher, Professor of the Moscow University F.F.Opened by Reyss. During the time of the former Soviet Union (50-60-ies of the XX century), various technologies of building construction appeared, using the phenomenon of electroosmos. These technologies were based on the idea that there was a difference in the natural potentials between different parts of the structures in the body of the structure, which were directly soaked with the help of galvanic elements, or the creation of an electric field. However, despite the fact that a number of positive results were achieved in the drying of the dampened structure using the electroosmos method, this method was not widely used in our country. The fact that many organizations and scientific institutions were closed in connection with the subsequent restructuring process, which began in the 80-ies of the last century, almost stopped Research in this direction. In Europe, from the 90-ies, the electroosmos method was recognized as the most effective method of combating moisture. Despite all the above difficulties, the method of drying the walls using the phenomenon of electrothermos has gained new priority developments in Russia. The technical solutions of this method, which received the status of invention, provided for the destruction of the natural electric field at the bottom of the outer walls, which causes the electroosmatic movement of moisture from the grunt to the construction (zero potential method) [4]. The destruction of the natural electric field is carried out by the creation of an electric system consisting of a series of horizontal steel sterjens attached to the walls in a zero potential zone with a certain step and directed in the direction of the incline (at an angle of α>600 relative to the horizon). With the elimination of the difference in potentials, the electroosomatic movement of moisture in the wall stops. As an example, in 1825-1836, active electroosomatic drying works were carried out during the reconstruction of the building for the purpose of placing the 1st Marine Cadet Corps in the building built in Kronstadt. The first floor was built in arkali g'isht construction on the shrub Foundation. The walls are 1,5 meters thick, the gidroisolation layer of the building is broken, there are no basements. The height of the capillary rise of moisture in the walls of the first floor is 2-2,5 meters. In the moisture zone, the humidity of the brick walls was 20-22%, that is, it was in a state completely saturated with moisture. The work was conducted in three stages, each for three months. 900 anode electrodes were placed on the walls of the building, 48 independent power schemes were formed. 50 cathode electrodes are placed both inside and outside the building on the ground (Fig-3).

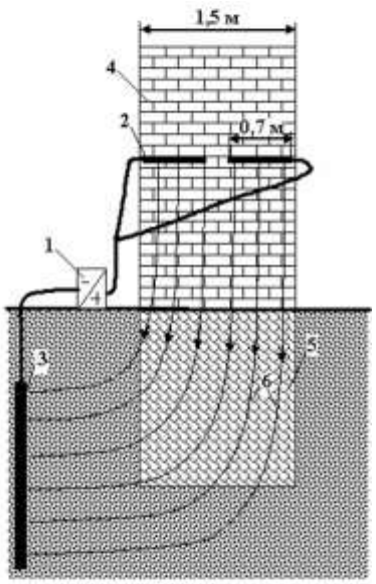

Fig-3. *Schemes for installation of anodes and cathodes: 1-constant current source; 2-electrodes (anodes); 3-electrodes (cathodes);*

4-drying wall; 5-the foundation of the Bush; 6-electric current line.

One of the main problems with the use of electrical voltages up to 200 watts is the intensive melting of anode electrodes, which occurs in accordance with the following law:

$$G = D_{\text{E}} \cdot I_{\text{A}} \cdot t \qquad (2)$$

here: G - mass loss of material, kg;

I_A – anode current, A;

D_E- electrochemical equivalent mass of metal, kg/(A·hours);

t – Time, hours.

In order to reduce the solubility of anode electrodes in the cement mixture, the mixture is filled with the addition of graphite powder, which is used to the gap between the anode electrode and the brick. Graphite has an electronic conductivity, like metal. Therefore, at the boundary of contact of these materials there will be no chemical reactions, and in places of contact with graphite, steel anode will not melt.

In addition, the mass of the electrochemical equivalent of graphite $(D_{\text{E}} = 0{,}91 \cdot 10^{-5})$ it is twice as small as the mass of the electrochemical equivalent $(D_{\text{E}} = 1{,}04 \cdot 10^{-3}, kg/(A \cdot hours))$.

Before drying the control samples of the brick, its absolute weight moisture was determined. G'ish absolute weight moisture content of the wall according to the measurement results in 10 times $W_A = 21\%$ equal to. The size of the wall g'isht in this humidity is 300 m3. At the first stage, the electroosmotic device was connected to a power source with a voltage of 150-160 V. Three months later, the electroosmotic drying device was transferred to the gidroisolation mode, that is, to the state of regulation of the voltage of 6-12 watts, which is automatically controlled. Three months later, the electroosmotic drying device was transferred to the gidroisolation mode, that is, to the state of regulation of the voltage of 6-12 watts, which is automatically controlled. The essence of the protector method is to install an electric field on the lower part of the wall, dependent on the sign of the natural electric field, which provokes the electroosomatic forces acting on the body of the moisture movement from the construction to the grunt. Unlike the zero-potential method, the upper ends of the steel sterols are connected by a conductor connected to each other and embedded in the ground, that is, they are connected to the protector-anode electrode, which generates electrical conductive forces. The resulting elektrosmos dries the wall on the border of a number of metal sterjenes and the Earth's surface. The use of these methods of electrostatic drying of external walls under the influence of electroosomatic forces ensures the cessation of the rise of ground waters along the wall and subsequent natural drying from one and a half to two years. The zero potential method can be used in practice when the groundwater levels are located below the 1-floor threshold level by 1,0 meters, or when the 1-floor threshold levels are located above the level of the leveled land by 0,5 meters. If the 1-th floor threshold level is located at an altitude of less than 0,5 meters above the leveled ground level, it is necessary to insulate the upper part of the side surface of the foundation to a depth that prevents the walls from getting wet with grunt moisture due to the capillary forces on the foundation. For electroosomatic systems, stergens can be made from steel fittings with a diameter of 10-12 mm. Sterjenes must be placed through the entire thickness of the wall into the holes drilled with the necessary slope to the wall. The horizontal row along the length of the sterjens should be placed with a step no more than the height of the otmostka area of their upper ends, the height of the step between them should not exceed 0,7 m, and at the same time the height of the step should not be less than 0,5 m. Steel sterjenes must be protected from the facade side of the outer walls of the buildings by a layer of barrier. However, if the building is adjacent to any structure or sutures, it is necessary to install electrostatic systems from the interior of the room. The protector method of electroosomatic drying should be applied when the level of groundwater is less than 1,0 meters above the level of the leveled ground and the walls of old buildings, which are used in unfavorable conditions, are strongly moistened. Protectors should be buried at a distance of at least 2 meters from the building and deeper than the freezing level of the ground. When applying the method of protector, it is necessary to use a complete protektor consisting of magnesium anodes, which are placed in a dusty activator place in cotton bags. Protectors are installed vertically into the pit dug on the foundation, and the Layer-Layer is filled with a grunt, densifying. The connecting wires between the protector and the connection wires are placed in a trench with a depth of not less than 25 centimeters. At present, German specialists have developed another method of electrostatic drying of external walls – with the help of galvanic elements and are practically applicable. The essence of this method is to use a current of current, which arises due to chemical reactions that occur around special short-circuited galvanic elements in the wet wall and grunt, and therefore formed as a result. These elements are charged from the protons lying on the grunt and serve as the cause of the spontaneous formation of the current, which provides the movement of moisture in the wall. Given that any two metals with different normal electrode potentials give a certain different electron potentials, galvanic elements for electroosmatic drying can be made from those metals. The best galvanic elements that form the maximum and stable current flow through the year are magnesium, magnesium-lithium, copper and coal-resins. In Galvanic space, the electrodes are placed on the sides of the inner part of the wall, and in the most humid environment (on the ground under the building or below the freezing zone) their active part is the protector. The distance between the electrodes is about 500 mm, the voltage given to the wall should not exceed 40-60 volts. Vine power 3-5 Ampere. Drying with a put Vine lasts no more than 2-3 weeks. During this time, due to the difference in the created potentials, the movement of negatively charged ions moves towards the positive potential electrode (Protector), which is installed on the ground. In this case, along with the dissolved salts of moisture, astasekin moves from the wall thickness to the grunt. After that, the constant maintenance of the electric field prevents moisture from moving in the wall thickness and keeps it outside the external walls and foundation. Currently, the research methodology developed by the German company Drymatec is known and widely used in practice [4]. According to this method, when working on a particular object, the moisture content of the external wall material is determined first of all using a microwave hygrometer. This allows you to measure the humidity of the walls up to 30 cm thick and thus understand how moisture is distributed in the construction. In addition, taking into account the plan of the room under study, the conditions of its operation and the materials of the external walls, the characteristics of the special device (developed by the company "Drymatec") are determined. This provides the potential for electrodes installed on the walls of the drying room and the grunt, and the scheme for laying the device and electrodes is drawn up. The device is constantly switched on, it first performs the drying of the walls, and then creates an electronic barrier to keep the foundation from grunt moisture. On average, a month later the walls of the room will be dry. After that, it will only be necessary to monitor the condition of the external walls with instruments (instrument). The method "Drymatec" was successfully used to dry the basement walls of the building of the Russian State Museum of Benue in the city of St. Petersburg. This method is relevant not only for the problems of damply stretched walls, but also for old, capital renovated buildings and parts of new buildings.

3. CONCLUSION.

In conclusion, it should be noted that today there are no local research methods that are equipped with equipment and have been tested on certain objects for a long time. The Commonwealth of Independent States studies carried out on managed facilities are mainly of Soviet era and have been used in several facilities, including in two residential buildings of the Moscow railway. This study, conducted by Drymatec for a three-year period, proved the effectiveness of the electroosomatic drying method (for three-year observations on these buildings, the moisture content of the damp wall decreased to a value close to equilibrium) [6], although this method did not adopt a wide industrial application in our country. In this regard, the study of studies of German, Finnish and Norwegian specialists in the field of drying barrier structures of buildings by electroosmotic methods, which included drying with the help of galvanic elements, is of particular importance for those who are engaged in research on this subject. The problem of wetting the walls should be solved by using all the accumulated experience, using the latest materials and technologies. This will enable us to develop local science-based techniques with appropriate equipment in the near future. This makes it possible to analyze the moisture content of the walls in the process of moisture.

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