MODELING OF MOISTURE TRANSFER IN THE MATERIALS OF ENCLOSING STRUCTURES IN THE CONDITIONS OF THE REPUBLIC OF TAJIKISTAN

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Abstract. *The main result of the conducted research is the establishment of the fact of variability of the vapor permeability coefficient of material layers in multilayer external walls during the year in accordance with the change in the relative humidity of air in the pores of materials during operational influences and testing of fragments of external walls in natural and laboratory conditions, it was established that the relative humidity of air in the pores of material layers of external walls varies throughout the year in the range from 20 to 100%.*

Key words*: Durability, efficiency, heat protection, enclosing structure, humidity, condition.*

1. Introduction

The durability and efficiency of thermal protection of the enclosing structures largely depend on their moisture state. Protection against waterlogging of the structure is provided in accordance with the current ISS-II-3-79"Thermal protection of buildings": timely removal of moisture from the structure, preventing the accumulation of moisture in the structure during the year of operation. One of the defining characteristics for ensuring the required moisture condition of the enclosing structures is the vapor permeability coefficient of the materials used. Existing engineering methods for determining the moisture state of a structure use a constant value of the vapor permeability coefficient and do not take into account its change from the operating mode. However, it is known that the values of the vapor permeability coefficient of materials largely depend on their moisture content. Numerous studies of the exterior walls indicate a wide range of operational moisture content of the materials used. However, the operational moisture content of materials according to ISS-II-3-79 is reduced to two values A and B.

Thus, at the present time, at the stage of designing fences with various design solutions, there are no methods for assessing the actual operational moisture content of the materials used. In connection with this, an urgent task is to study the regularities of changes in the vapor permeability of materials under operating conditions and the development on this basis of calculation methods for determining the moisture state of enclosing structures.

2. The purpose of the work is to establish the patterns of change in the vapor permeability of materials from their moisture content and to develop on this basis a method for assessing the moisture state of multilayer enclosing structures, while establishing the range of values of the operational moisture content of material layers for various design solutions of external walls and to develop a method and installation for experimental studies of the vapor permeability of materials at different relative air humidity in isothermal and non-isothermal conditions.

According to the studies of P.S. Khuzhaev, T.R. Kholmuratov, R.G. Abdulloyev and a number of other scientists, vapor permeability is a complex process due to the emergence of various mechanisms of moisture transfer with an increase in the sorption moisture content of the material. In the sorption zone of material moistening, in parallel with vapor diffusion, the processes of film movement of moisture, capillary flow, thermal gradient transfer, and others can occur.

Therefore, in reality, the experimental coefficient μ of materials is a combination or sum of the mechanisms of moisture release in the sorption zone of moisture.

3. Materials and methods

Comparative analysis of existing methods for determining the vapor permeability of materials made it possible to reveal the absence of a comprehensive taking into account a number of operational impacts:

- change in material moisture;
- mutual arrangement of layers of materials relative to each other;
- the presence of a temperature gradient over the sample cross section;
- the influence of wind influences on the facades of buildings.

Thus, there is a need to create experimental and computational methods for determining the vapor permeability of the condensing structures, taking into account their constructive features and operational effects. A study of the temperature and humidity conditions of operation of various structural types of external walls was carried out. The experimental study was carried out both on a full-scale stand and in laboratory conditions using a climatic chamber with "warm" and "cold" compartments.

4. Results

A full-scale stand is a wall of an existing operating building.

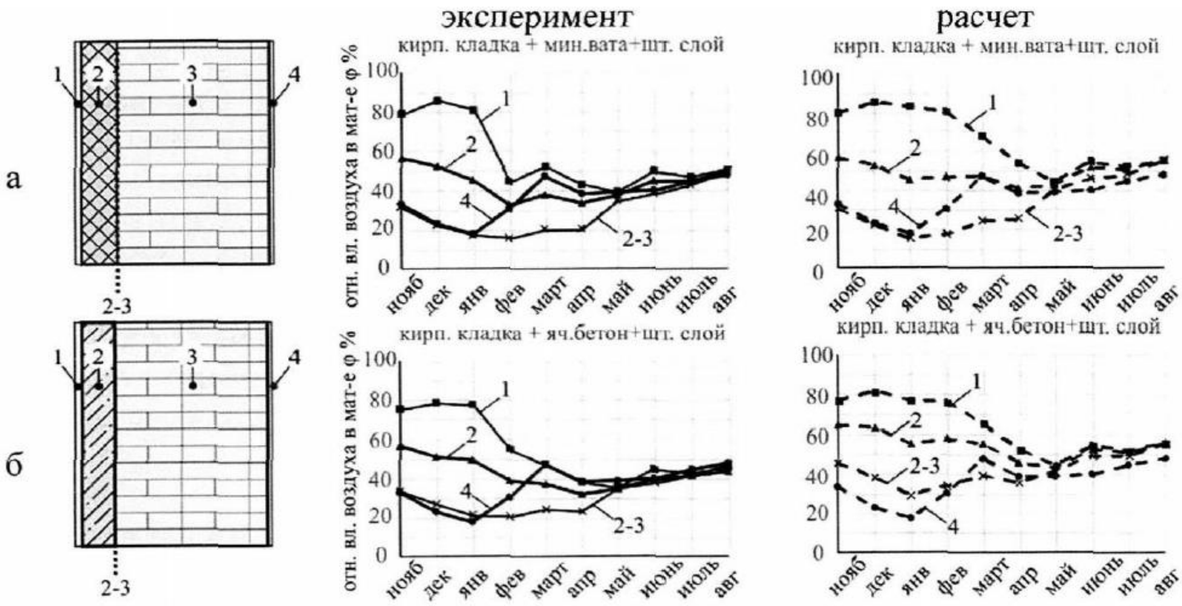

Figure 1. Experimental and calculated values of the relative air humidity along the sections of the structures of a full-scale stand from November to August in Kazan, a, b and c - a structure with a heat-insulating layer of min. cotton wool, aerated concrete and expanded polystyrene, respectively

The inner structural layer 640 mm thick is made of silicate bricks, the outer layer is made according to the "wet facade" type using three types of insulation: expanded polystyrene with a density of 8.6 kg / m ', mineral wool with a density of 95.8 kg / m', cellular concrete with a density 422 kg / m 'and outer plaster layer. In various sections of these structures, through the holes drilled from the ends of the material samples, DTG-2.0 sensors were installed and automatically every 15 minutes readings of the temperature and relative humidity of the air in material pores using the Terem-3.2 measuring complex.

The calculated distributions of the relative air humidity over the sections of the fences were obtained according to the well-known formula f = (e / E) • 100%, in which the actual partial pressure of water vapor (e. Pa) was determined through the resistance to vapor permeation of the outer wall layers (Kp, m ^ h-Pa / mg), and the saturation pressure (V, Pa) - according to the calculated values of temperatures in the same sections. Average monthly values of relative air humidity over the cross-section of structures are shown in Figure 1. It can be seen that under operating conditions, the actual values of the relative air humidity throughout the year are in the range from 20 to 85%.

5. Conclusions. In a climatic chamber with "warm" and "cold" compartments, an experimental determination of the temperature and relative humidity of air in the most common types of external wall structures was carried out. To measure the indicators of temperature, relative humidity and heat fluxes in the sections of the tested fragments, the sensors of the measuring complexes ITP MG 4.03-10 "Potok" and "Terem-3.2" were installed;

To install the sensors of the complex (DTG-2.0), holes were pre-drilled along the diameter of the sensors (8 mm) to different depths inside the fragment. Holes were drilled from the ends of the fragments to exclude their influence on the processes of mass transfer. The processing of the received data was carried out on a computer with the subsequent output of the resulting tables and graphs. During the month in the climatic chamber the values of temperatures and relative humidity of the air, typical for January conditions in Dushanbe, were maintained. Average values of temperature and relative humidity in the "warm" and "cold" compartments of the climatic chamber: f "= 79%, f ^ = 41%, 1 ^ = - 1 3 ° C, C = 17 ° C.

The main result of the conducted research is the establishment of the fact of variability of the vapor permeability coefficient of material layers in multilayer external walls during the year in accordance with the change in the relative humidity of air in the pores of materials during operational influences and testing of fragments of external walls in natural and laboratory conditions, it was established that the relative humidity of air in the pores of material layers of external walls varies throughout the year in the range from 20 to 100%.

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