Effect of external air temperature on buildings and structures and monuments

Mominjon Nabiyev*, Orif Salimov, Asadulla Khotamov, Tolqin Akhmedov, Khasan Nasriddinov, Ulugbek Abdurakhmanov, Rasuljon Raximov, Abbosbek Khalimov, and Azizbek Abobakirov

Fergana Polytechnical Institute, Fergana, Uzbekistan

Abstract. The article provides information about external factors affecting the migration of residential and public buildings and architectural monuments.

1 Introduction

Currently, the ecological changes observed in the world have a significant impact on the territory of Uzbekistan. In the last two years, i.e. in 2021, 2022, including 2023, an increase in temperature has been observed in the territory of Uzbekistan.

Various measures are being taken to maintain the normal climate of public and residential buildings in the territory of Uzbekistan and increase their positive impact on human health. In addition, various design solutions are offered to keep the building's microclimate in compliance with standard requirements. Among the project solutions, volume-planning solutions, constructive solutions of new types are used. In addition, various engineering systems and household appliances are used to ensure the modern microclimate in accordance with the standard requirements.

Creating comfortable conditions and a pleasant air environment for a person in the rooms of civil buildings is important for human health and increasing his creative activity.

2 Materials and methods

In the preparation and implementation of construction projects, materials and standards designed for a certain temperature range, precipitation, wind direction and geological factors - earthquakes, subsidence and groundwater levels are used. If any of these parameters change, structural elements of the building may be damaged. Examples of this include wind moving roof coverings, prolonged rain causing rising water levels and flooding.[1].

The energy of sunlight falling on the Earth's surface is called solar radiation. When the sun's rays reach the earth's surface through the atmosphere, complex processes take place. In the distance from the upper layers of the atmosphere to the earth's surface, a certain part of the solar radiation is absorbed in the atmosphere, the rest is scattered and changes quantitatively and spectrally. The rest of the solar radiation reaches the earth's surface. A

* Corresponding author: nabievmuminzon@gmail.com
certain part of the radiation scattered in the atmosphere will definitely fall back to the earth. Therefore, solar radiation falling on the earth's surface is considered to consist of the following components:

- Direct solar radiation.
- Scattered solar radiation.

Solar radiation is the energy of sunlight that reaches the earth's surface from the sun. Due to the great distance between the Earth and the Sun, solar radiation can be viewed as a bundle of parallel rays. After being scattered in the atmosphere and clouds, the part of the solar radiation that falls back to the horizontal surface of the earth from air molecules, clouds and dust particles is called scattered solar radiation. Solar radiation is measured in an actinometer device Fig. 1 and Fig. 2.

Fig. 1. Actinometer instrument.

Fig. 2. The process of obtaining results in the actinometer instrument.

Direct solar radiation and scattered solar radiation simultaneously falling on a horizontal surface add up to form solar radiation. Since the energy of radio waves found in the composition of sunlight is very low, they can be detected only with the help of special radio wave receiving devices. In general, the atmosphere and clouds together absorb about 15 percent of the energy of sunlight reaching the earth.
The energy of sunlight that falls on 1 m² of surface perpendicular to sunlight in 1 minute is called the intensity of solar radiation. Due to the change in the optical mass of the atmosphere through which the light passes, the spectral composition of the solar radiation also changes. Therefore, when the sun is close to the horizon, only short-wavelength rays reach the earth's surface in greater quantities.

The energy of rays with a long wavelength is less than the energy of rays with a short wavelength. Therefore, the intensity of direct solar radiation is very low in the morning or evening. In addition, when the sun is close to the horizon, the amount of insolation is very small due to the large angle of incidence of the sun's rays on the horizontal surface. The intensity of solar radiation on a surface facing the sun's rays increases as the sun rises above the horizon, and decreases in the afternoon. Since the clarity of the atmosphere changes during the day, the intensity of solar radiation does not change symmetrically compared to its value at noon. The radiation intensity reaches its maximum value at noon in the winter months. In warmer months, the intensity does not increase as lunchtime approaches, and sometimes the intensity may decrease during lunchtime. This is because the amount of water vapor and various dust particles in the atmosphere increases as noon approaches in the hot months of the year. As a result, due to the absorption and scattering of solar radiation, the solar radiation falling on the earth is reduced. In addition, during the day, the intensities of direct solar radiation on a vertical surface and on a horizontal surface differ from each other.

Solar radiation has different effects on the surface of building materials. For example, concrete absorbs 70% of solar radiation and heats up.

A temperature of +40°C and more, relative humidity below 50-55% is called a hot climate. The duration of the hot climate in summer is about 100 days. The average temperature of the hottest month can be +29...30°C and higher. Also, a dry hot climate is characterized by sudden changes in air temperature and relative humidity during the day, alternating heating and cooling of the earth's surface and building structures under the influence of intense solar radiation, dry winds and other negative factors.

The temperature of the surface of structures facing the sun is higher than the summer air temperature by +15...23°C, and sometimes up to +30...40°C. Therefore, when calculating constructions, structures directly affected by solar radiation and structures protected from solar radiation are considered separately.

The strength of brick walls to external loads, environmental temperature and humidity, the strength of the brick layer, the strength of the building mixture with the brick, the presence of reinforced concrete cores and anti-seismic belts, window and door tops depends on the strength of the connection with the walls.

Changes in temperature and humidity throughout the day have a serious impact on concrete and brickwork. As a result of the sudden warming of the air, the buildings heat up more, which causes discomfort for the residents. In that case, the solution would be to shade the windows, provide better ventilation and thermal insulation, but would significantly change the basic functions of the building.

Reinforced concrete is the most commonly used material. Nowadays, it is used more - in high-rise and skyscraper buildings. The creation of such strong structures is carried out by pouring liquid concrete into steel reinforcements installed in molds. However, humid and hot climates seriously affect the strength of such structures. Steel within the structure expands as a result of corrosion, which in turn causes the concrete to crack and reduce the strength of the structure. One of the main directions of modern climate research is to assess the impact of future climate change on various sectors of the economy and social sphere, as a result of adaptation to them, it will be possible to reduce negative consequences. This will require developing measures to adapt the construction industry to the observed climate change and assessing any weather indicators and climate risks. These risks are associated with the
occurrence and recurrence of various meteorological events, as well as climate change. They affect the size of the adaptation potential of the studied area.

When assessing the impact of climate change on the construction industry, it is necessary to take into account how the specialized climate indices for changing temperature characteristics will change. The reason for this is that the climate change observed in recent decades is manifested, first of all, in the change of the thermal regime. In addition, the choice of solutions for the design and operation of structures remains dependent on air temperature.

A changing climate has different effects on the structural stability of buildings. For example: when the temperature of the earth rises, the rate of evaporation is observed. As a result, precipitation in some regions will increase and precipitation in some regions will decrease.

Climate has a strong influence on the durability of buildings - their service life. Building type is determined and building materials are selected depending on climatic conditions. The service life of the building is determined by its ability to withstand the effects of the climate, i.e., the materials from which the building is made, cold and hot temperatures, high and low atmospheric humidity. With the passage of time, year after year, the air temperature is increasing sharply. Changes in air temperature have a significant impact on the condition of previously constructed buildings. The materials of these constructed buildings are formed as a result of changes in the temperature of hot and cold air. A rapid change in temperature is often accompanied by a drop in temperature. The temperature drop in the cold season, the temperature rise in the summer, and the increase in building humidity as a result of a lot of precipitation seriously affect not only the external part of the building, but also the microclimate inside the building and shorten the service life of the building. The reasons for the appearance of moisture in the building material are as follows:

1. Technological moisture in construction is moisture that is formed during the preparation of building materials and during the restoration of the building or equipment.
2. Moisture passing through the floor. This moisture moves from the soil to the walls by capillary action. Such moisture can rise up to 2-2.5 m above ground level in the wall. If it is well provided with a protective layer, the moisture of the soil will not affect the moisture condition of the walls.
3. Moisture passing through the atmosphere. This moisture, combined with wind from snow and rain, affects exterior barrier structures. In order to prevent this moisture effect, it is necessary to build a protective layer on the outer surface of the external barrier constructions from a material that does not transmit moisture or does not transmit moisture.
4. Humidity under the influence of operating environment. This moisture is formed during the use of the building, and it directly affects the walls and floors in the form of steam and water in the workshops of industrial buildings, in domestic service buildings. In order to prevent this effect of moisture, the surface of the wall and floor is protected with a layer of ceramic and glass tiles.
5. Hygroscopic moisture. The process of formation of condensing moisture is inextricably linked with the thermal physical state of external barriers. Condensation moisture is often the cause of increased humidity in external walls and building materials. It is necessary to take into account not only the periodic amplitudes of air temperature changes on a daily, monthly, annual basis, but also their frequency and intensity. [3]

Moisture exchange occurs as a result of constant air exchange between the building and the environment. As a result of the increase in moisture exchange, the thermal conductivity of structures decreases. The increase of humidity in the building is caused by the close location of the underground water level, a decrease in air temperature, rains that fall at a high wind speed. During wetting due to precipitation, the outer surface of the wall becomes wet and the moisture moves towards the inside of the wall. In places where underground water is close to the surface of the earth, rapid failure of walls, floors, basements and foundations is
observed. When the air temperature drops to 0°C in humid air temperatures, the building's barrier structures quickly become unusable. Under the influence of humidity, water vapor collected in the pores of materials condenses as a result of cold temperature and the water freezes. This, in turn, causes negative damage to the building. Sometimes, for these reasons, the internal walls of buildings also get wet. In areas with high temperature, it is not possible to stick flower wallpaper (wallpaper) on the interior walls of buildings, because they will fall off. Also, dry gypsum is not used, because it is observed that it quickly absorbs moisture.

In order to develop measures to ensure a satisfactory moisture regime, when calculating the moisture regime of buildings, it is necessary to take into account all sources of moisture in building structures. The atmosphere always contains water vapor, but its condensation occurs when there is an appropriate combination of air temperature and humidity, that is, when the air reaches a state of saturation. In other words, condensation occurs when the air temperature reaches the dew point. Indicators known in meteorology are used to determine the humidity regime. The degree of air saturation with water vapor is characterized by relative humidity. As the air temperature decreases, the relative humidity increases. If the inner surface of the wall cools and reaches a temperature below the dew point, the moisture in the room air condenses and settles on the cold surface. In dry climate zones, buildings become excessively dry in summer. This can happen even in the cold season in places where the absolute humidity of the outdoor air is low. Such air enters the room and heats up, and its relative humidity decreases. In this case, unfavorable conditions for a person arise. When breathing dry air, a person loses a lot of moisture. In addition, moisture evaporates through the pores of the skin. As a result of increased dehydration, dry mouth, thirst and fatigue are felt. The opposite is observed with high humidity. Evaporation of moisture in the human body is a complex process. Therefore, in order to reduce such climatic factors, it is necessary to apply special microclimate measures in buildings and their design. Depending on the climate, the temperature and humidity ratio of the outside and inside air, it is possible to observe the movement of water vapor through the wall. In some geographical areas, the movement of water vapor dominates in winter, that is, it moves out of the room, and in others, on the contrary, it moves inside. During the year, the outdoor temperature is rarely higher than the indoor temperature, which means that the direction of the heat flow to the outside prevails. Therefore, the annual course of the temperature and humidity regime should be taken into account when designing buildings. Also, it is necessary to take measures to prevent moisture condensation on the fences, the waterproofing layer should be placed closer to the wettest zone of the fence.

In order to prevent high humidity and salinity during repair work, it is recommended to carry out the sequence of works as follows:
- Cleaning the plaster layer damaged by moisture and salts;
- Cleaning the damaged layer of plaster and cleaning the seams to a depth of about 2 cm;
- Treatment of salts using a special preparation;
- Sprinkling cement mixture on the wall;
- Leveling with the help of the main layer of plaster in case of high amount of salts;
- Implementation of special repair plaster;
- Putting putty;
- Paint.

Open facades of buildings and structures are always exposed to the weather. Through rain, sulfur and carbon oxides in the air directly affect the facades of buildings and structures, as a result of which the construction materials of the structure gradually deteriorate. The appearance of buildings and structures should always be beautiful. Appearance of facades changes due to external influences. It is known that external facades in historical monuments are plastered with a mixture, covered with decorative material, and the wall can be made of the same material (ceramic materials, natural stone, etc.). Walls made of ceramic brick,
clinker or natural stone can be exposed, i.e. not watered, due to external influences, their color may change, they may become cloudy, salts may be released, and they may become polluted due to dust and pollen.

3 Discussion of experimental results

Transferring moisture prevention measures in buildings from one area to another, without taking into account the specific characteristics of the climate of this area, can lead to a decrease, not an increase in the strength of the structure, and will lead to a deterioration of comfort. Builders have many tools at their disposal to neutralize negative climate factors and use positive ones.

In accordance with the climatic and physical geographical conditions, the choice of the optimal option of the main parts of the building, surrounding structures, taking into account these conditions, the internal structure of the house is planned. It is necessary to study the climate of the area of the object to be built and choose building materials suitable for these conditions. Depending on the geographical location of the object under construction, the main and surrounding structures of the building should be selected. Factors such as solar radiation, temperature, relative humidity, and wind direction affecting building structures must also be taken into account. Engineering means of protection from adverse climate effects (ventilation, heating) are provided. In the design of the building, on the one hand, the durability of the building, on the other hand, it is important to create conditions for people. Also, the economic side of construction should not be neglected. [4-12]

In addition, the wall between the rooms of monuments is continued up between the roof arches, 70x80 cm to each wall. if the holes of the size are placed, they will serve for air circulation on the arches. [8].

The intermediate wall is made higher than the upper part of the arch of the cells, and its thickness is 10 cm. reinforced concrete was laid. [6]. The diameter between the concrete is 100 mm. 50 cm from the pipe. was cut from and placed upright. They are designed to allow air to enter the roof of the cells from above, and holes were placed for wind to enter from both ends of the common roof. Then, the mortar was made with bricks in a cement mixture. This method costs several times less than the old one. Also, since the upper part of the building was always dry and light, its life was guaranteed to be eternal [7-12]. The method used above is currently being used in other monuments as well.

4 Summary

All this requires measures to adapt to climate change. As the main adaptation measures, it is possible to apply the updating and improvement of the current regulatory and legal framework for the construction industry, making appropriate changes to the chapters on climate parameters of the regulatory documents used in the territory of Uzbekistan.

In order to eliminate the consequences of heat waves, it is necessary to install air conditioners in existing buildings and to use wind and solar panels that meet the requirements of the time, as well as to build buildings equipped with more effective internal climate control.

Builders and architects are working to make buildings more resilient to climate change by rethinking their design. For this purpose, they are planning to protect structures from negative effects and create green construction methods. The use of protective features, efficient materials and smart technologies can increase the stability and strength of the building.
It can be estimated that most of the damages that occur in historical monuments are caused by man-made effects and weather effects, harmful chemical elements in the atmosphere and the rise of groundwater level [5, 9-12]. Taking these factors into account when strengthening brick structures is of great importance in solving the problem.

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