науковими здобутками. Дане стажування відкриває більше можливостей для роботи над сучасними науковими проектами та підвищенні рівня підготовки вітчизняних фахівців шляхом удосконалення існуючих курсів.

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MODERN METHODS OF MASONRY STRUCTURES STRENGTHENING

One of the urgent issues of reconstruction and restoration of existing stone buildings is to ensure their structural reliability and durability. Unlike reinforced concrete structures, in which cracking is prevented by reinforcement, masonry is very sensitive to tensile and shear stresses.

As a result, the most common type of damage to stone buildings is cracking. This process, firstly, has a negative impact on the comfort of residents, users, tenants, etc. Secondly, it can be both a consequence and a cause of the emergency condition of the structure as a whole or its separate part. In addition, cracks, even safe ones, reduce the commercial value of the object, deteriorating its appearance and interior.

The consequences of such destructions are especially noticeable in historic buildings with a rich relief of facades and valuable interior decoration of the walls, containing frescoes, gilding and other elements of interior decoration.

Recently, due to the widespread construction of new facilities near old stone buildings and structures, the formation of cracks in their masonry is accelerating. In such cases, the most dangerous for an architectural monument is the close proximity to the sites of zero cycle work, causing the inevitable change in the stress-strain state of the foundations. There are known facts when in the process of construction of ditches in the immediate vicinity of existing facilities, the latter not only cracked, but also collapsed.

Among the traditional methods of strengthening stone structures, the most common are steel and reinforced concrete clips, metal belts and overlays, masonry, etc. Most of them are time-consuming to implement, expensive, and in relation to historic buildings, some are not applicable for aesthetic reasons. Therefore, new technologies and materials are increasingly used to repair and strengthen stone structures. These include, in particular, composites in the form of lamellae, mats and nets, made of hydrocarbons, aramids and fiberglass, the

strength of which often exceeds the strength of steel. Therefore, they are used to strengthen not only stone but also reinforced concrete and even metal structures as surface reinforcement. The connection of such materials with the reinforced structure is usually carried out using epoxy glue. The commercial name of such an amplification system abroad is known as FRP (Fiber Reinforced Polymers). This system, however, has a number of disadvantages.

The noted shortcomings can be avoided if instead of glue to use special plaster solutions from inorganic mineral materials with the modified polymeric additives. The amplification technology is as follows. On the surface of a stone laying cleared of plaster and pollution after its moistening the layer of gluing plaster solution 3 mm thick in which the reinforcing grid from composite materials is sunk is put. Then a protective plaster layer 8–10 mm thick is applied, the surface of which is subjected to finishing. If necessary, a second mesh can be sunk into the protective layer, providing increased reinforcement strength.

This reinforcement system is known as FRCM (Fiber Reinforced Cementitious Matrix), and one of its variants is the Ruredilx Mech system. This system uses carbon fiber nets with the following mechanical properties: tensile strength - 4800 MPa; modulus of elasticity - 240 GPa; deformation at break - 1,8%.

The undoubted advantages of this method of reinforcement include its versatility and the possibility of application for any shape and outline of reinforced structures.

In engineering practice, it has been widely used to strengthen stone buildings and structures exposed to dynamic influences, such as traffic, technological equipment and seismic.

Another equally effective way to strengthen stone structures, which has become widespread in European countries in recent years, is reinforcement using spiral ties and anchor joints. The method is based on the use of spiral Brutt profili rods embedded in a special Brutt Saver Powder solution. The solution is placed in pre-cut in the seams of the masonry cracks or holes drilled in its body.

According to experts, the method of strengthening with spiral connections allows you to preserve the original appearance of old buildings. It can be used as one of the newest innovative means of strengthening of a brick facing in multilayered walls.

In conclusion, it should be noted that many years of experience in the operation of stone structures, reinforced by these methods, confirmed their high reliability and efficiency. Thus, the expediency of their introduction into the practice of repair, reconstruction and restoration of stone buildings is indisputable.

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UNIQUE MASONRY STRUCTURES

Stone has been used in the architecture of many buildings for centuries. This timeless building material still remains a wonderful, durable choice for homes and buildings. If you are building or renovating a house, consider adding a few architectural elements to the design. Be inspired by some of our favorite elements of stone architecture from around the world.

Angkor Wat Temple. Cambodia. This temple was built during the reign of Suryavarman II, which took place in 1112-1152. Along the perimeter of the territory of Angkor Wat is surrounded by a 4.5-meter wall. Its total length is more than 3.5 km - the smaller side of the rectangle formed by the walls - 802 meters, and the largest - 1025. 30 meters separates the wall from the ditches filled with water, their width - 190 meters.

Machu Picchu. Spain. The city was founded by the Inca ruler Pachakutek in 1440, and functioned until 1532. The city is located on top of a mountain range at an altitude of 2057 meters above the valley of the Urubamba River in modern Peru.

Temples of Tamil Nadu. All temples were built 1000-1200 years ago. Every column in the temple, several human heights, is made of a single piece of stone, and it is made in the form of some mythical creature. And there are hundreds of such columns in any temple, and hundreds of huge statues from huge boulders, and they are all carved out of stone.

Brihadeswarar Temple. The central temple consists of two parts. The first is located in a low building, the second in a high. There is a staircase leading to each part. Inside are two small rooms, without a single window measuring 5 by 5 meters, 4 meters high. The floor, walls and ceiling are made of large stone blocks. No paint or plaster. The total height of the temple is 65.4 meters. The top is crowned with a monolithic stone weighing 80 tons. It is said that this stone was taken from a distance of 6 km.

Mausoleum of Theodoric. Ravenna. Italy. Built in 520 from Istrian limestone on two ten-sided tiers, crowned by a ten-meter dome carved from solid 300-ton stone.

Pyramid of Kukulkan. Mexico. The base of the pyramid is a square, each side of which is 55.5 meters and its height is 25 meters. The pyramid consists of 9 ledges. There is a staircase on each side from the foot of the pyramid to the top. Each of them consists of 91 steps, if you add them all and take into account the upper platform, you get exactly 365 steps.

All of them are the unique landmarks of our civilization.