Research on Methods to Increase the Strength and Flame of Reinforced Concrete Structures

K. R. Berdiev
Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan, doctor of technical sciences (PhD) professor, colonel-general

I. U. Madjidov
National University of the Republic of Uzbekistan doctor of technical sciences, professor

ANNOTATION

This article's text examines the challenges surrounding improving methods for raising the fire resistance of reinforced concrete structures, as well as the present state of the art in the field of methods and tools for boosting concrete building fire resistance. The difficulty of selecting, creating, and implementing approaches and tools for assessing the durability of reinforced concrete structures while taking thin-layer, fire-resistant glass coatings into account.

Because of the use of thin-layer flammable embossing coatings, it was determined that evaluating the heating capabilities of reinforced concrete structures during a fire was critical. The creation of a method for assessing the qualities of thin-layer coatings formed on swelling reinforced concrete structures caused by fire, as well as the refractive efficiency of thin-layer fire-resistant coatings on concrete structures. A determination of the fire-resistance efficiency of reinforced concrete structures and the ideal thickness of thin-layer fire-resistant coatings was also made based on the research findings.

KEYWORDS: *Concrete, reinforced concrete structures, fire, metal, thin layer, geometric dimensions, coating, porosity.*

Introduction: Large-scale research is now being conducted all over the world to find scientific and technical solutions to fire safety challenges. In this regard, much consideration is given to the use of various efficient fire protection strategies for various reinforced concrete and building structures, such as the treatment of structures and materials with compositions, thermal insulation, flammable varnish, and other materials. According to an analysis of significant fires around the world, the rapid collapse of primary structures of buildings under the influence of temperature also creates specific obstacles in the coordination of emergency rescue operations.

A range of procedures and tools are available to improve the fire resistance of concrete structures and prevent explosive concrete damage. Several types of poor fire protection are employed in construction, including concreting, plaster coatings, screen and surface coatings, and thin-layer inflatable coatings. Each of the listed reinforced concrete constructions' fire safety methods has its own set of benefits and drawbacks.

In our country, there is a need to accelerate scientific research into the effective use of fire and heat protection building materials, such as metal, wood, and reinforced concrete structures with heat-resistant lacquer-paint materials to increase their fire resistance, extend the time of construction structures to fire damage, organize rescue operations, and rescue people. In this regard, the country

has set goals such as "ensuring that people live in an environmentally safe environment, ensuring fire safety, and ensuring production localization." The development of fire-retardant coating compositions and the development of technology for processing coatings on buildings to strengthen the fire resistance and heat protection of building structures and materials are critical in this regard.

Material and method: Experiments were carried out on boosting the strength and fire resistance of reinforced concrete structures using innovative compositions based on local mineral raw elements such as wollastonite, vermiculite, and silicates, which improve the fire safety of buildings and structures.

Increase the thickness of the protective layer through research: The purpose of using the approach of increasing the thickness of the protective layer in reinforced concrete structures to increase their fire resistance was to investigate the potential of improving the fire resistance of reinforced concrete structures to the necessary levels (from 100 to 120 minutes).

However, there are various flaws in the process of strengthening the structure's fire resistance, including the danger of explosive concrete disintegration. The high degree of durability of the contact relationship between the protective structure of the concrete coating and the surface of the reinforced concrete plays a negative role in this case, because such strength does not prevent the development of internal cracks from this surface to the reinforced concrete. Because this form of fire protection not only expands the geometric dimensions of the structure's load-bearing sections, but also makes them significantly heavier, this circumstance is not always true for multi-story buildings.

For this sort of fire protection, the concrete surface must also be strengthened, and the installation of formwork for various types of structures considerably extends the time it takes to remove solid concrete from the formwork, requiring more time to restore technological holes.

Surface and plaster layers: Using this method to strengthen the fire resistance of reinforced concrete structures, as well as the usage of slab surfaces and screens, as well as leaf surfaces, allows reinforced concrete structures to be fire resistant for 180-240 minutes. It is preferable to utilize these materials to safeguard less complex constructions from fire (mainly in increasing the fire resistance of curtains).

The advantage of this method is the technological compatibility of mechanical attaching to structures; it is not affected by the condition of the previously mentioned layers, and the fact that the structure's surface has a non-dense connection to it does not obstruct water flow.

However, there are several drawbacks to using sheet and plate surfaces and screens, particularly for layers with a large surface area that require fire protection, the complexity of sealing, and high levels of vapor permeability (which can lead to changes in the properties of flammability).

The fire protection leaves are composed of metal fasteners, which must also be protected from the effects of high temperatures. Additional equipment, such as lights and video surveillance, cannot be installed on top of this sort of fire protection. The fundamental problem of fibrous flammable layers is their oleophilicity, which means that they can absorb flammable liquids and vapors from oils. In the air of various industrial plants, we encounter vapors of highly flammable liquids and highly flammable dusts, which have the ability to be adsorbed on the fibers of flammable coatings, and the accumulation of such substances occurs over time. These flammable coatings act as a source of flame spread and reduce their flammability efficiency in the case of a fire. Because their composition is based on a hydraulic type alloy, it is currently recommended to bring lightweight plaster layers to more sophisticated refractory kinds. The chemical makeup of such coatings can protect reinforced concrete structures from the impacts of fire for up to four hours.

It also necessitates that the processing of transportation tunnels, environmental structures, and those

with high humidity nitrogen and carbon oxides be considered to operate under extreme temperature variations. The following are the advantages of this type of fire protection over the previously considered types: sufficient mechanical and contact strength, longevity, ability to apply on complex shaped surfaces, ability to paint with hydrophobic, decorative, and other compositions, resistance to atmospheric, water, anti-icing reagents, and cleaning solutions, additional equipment (lighting, surveillance, etc.) can serve as a substrate for.

Research results and discussion: to high-rise structures' shortcomings, such as the application of protective chemicals to their surfaces and, as a result, their fire-retardant characteristics, excessive application of coatings to proper surfaces, resulting in extra load on the building's load-bearing bodies and an increase in the quantity of labor necessary to apply these coatings. Coatings of this type have a density of 500-1000 kg/m^2.

Application of inflatable thin-layer coatings as fire protection of concrete: Inflatable fire-resistant coatings are typically designed to increase the fire resistance of metal structures. In the 90s of the twentieth century, such coatings began to be used as fire protection of wood and materials based on it. Inflatable fire-resistant coatings increase the thickness of the initial layer by 10-50 times when heated. The effectiveness of such coatings is determined by the fact that the application of a thin layer, for example, 1-2 mm, is sufficient to protect the surface. When exposed to fire temperature, the coating forms a porous layer several centimeters thick. Insufficient research has been conducted for reinforced concrete structures, which requires the development of research in this area. This porous layer covers the protected surface, fills holes and cracks, insulates the flame and makes it difficult to heat the building surface. The coefficient of expansion of the coating depends not only on the natural properties of the material, but also on its heating conditions (maximum temperature and rate of rise). The cause of swelling and porosity is the release of water vapor or gas at high temperatures. When a porous layer is formed, the binder softens, and when the foaming substance breaks down, non-combustible vapors and gases are released. The coating begins to swell, the temperature range being 160-350°C. Today, the development of the building complex with tall and unique buildings has led to the need to increase the fire resistance limits of not only metal but also reinforced concrete structures.

Much work is known to evaluate the fire-resistance effectiveness of various inflatable coatings against metal structures . Research aimed at improving the fire resistance of reinforced concrete structures shows the need to conduct research using thin film inflatable coatings, as well as to improve the resistance of fire-resistant concrete with thin-layer inflatable coatings. Based on these assumptions, the aim of the work was to study the possibility of increasing the fire resistance of reinforced concrete structures using thin-layer fire-resistant embossed coatings.

Conclusion and suggestions: The situation in the field of methods and tools to increase the fire resistance of concrete structures was analyzed. The issue of selection, development and implementation of methods and tools for assessing the durability of reinforced concrete structures, taking into account the use of thin-layer, fire-resistant, glazed coatings was considered. Considering the use of thin-layer flammable embossed coatings, it was found necessary to study the heating properties of reinforced concrete structures during a fire. The properties of the formation of thin-layer coatings of reinforced concrete structures swollen under the influence of fire were studied. A method for evaluating the fire-resistance efficiency of thin-layer fire-retardant coatings of concrete building structures has been developed. The fire-resistance efficiency applied to reinforced concrete structures and the optimal thickness of thin-layer fire-resistant coatings were evaluated.

References:

1. Lykov A.V. Theoretical Foundations of Construction Thermophysics. Minsk: Publishing House of the Academy of Sciences of Belarus, 1961. – p.519
2. Leonovich A.A. Fire protection efficiency of phosphorus-containing flame retardants depending on the chemical nature of the nitrogen-containing component // Chemical Industry. 2003. V. 80, № 2. – P. 8
3. Khayrullina E.R. Fire-resistant bloating coatings with increased corrosion resistance // Proceedings of the 59th scientific-practical conference of students, graduate students and young scientists of USPTU. - Ufa: Publishing house of USPTU., 2008. – P. 158–159.
4. Lapushkin M.P Influence of inorganic flame retardants on the fire protection efficiency of compositions of intumescent type / MP Lapushkin, P.A. Feshchenko, R.A. Vakhitov // Paint and varnish materials and their application. – 2007.– № 1–2.– P.48–54.
5. Instruction No. 004-B-I-U Installation and operation of coating on concrete and reinforced concrete supporting and enclosing structures on the basis of fire retardant composition "Monolit". - Moscow: NPO Association Krilak. - 2002. – p.18.
6. Yakovlev A.I., Roitman V.M., Meshalkin E.A. Method for assessing the resistance of building structures to explosive loss of integrity in fire / A.I. Yakovlev, V.M. Roitman, E.A. Meshalkin // Proceedings of VNIIPO: Fire resistance of building structures. MOSCOW: VNIIPO, 1978. - №39, p.55-84.