

*Valerii Pershakov, Doctor of Technical Sciences, Professor,
Andrii Bieliatynskyi, Doctor of Technical Sciences, Professor,
Evgenii Bakulin, Ph.D., Associate Professor,
Gregory Bolotov, Ph.D. in Architecture, Associate Professor,
Ivanna Martynenko, Assistant, Master
(National Aviation University, Ukraine)*

Problems of counteraction to fire danger and fire resistance of high-rise buildings

In this work the terms and designations, history of creation and development of high-rise building are considered. The trends of high-rise house building development are outlined. The reasons and consequences of the destruction of high-rise buildings from the effects of fire, as well as the analysis of the extinguishing of fires and rescuing people from high-rise buildings during a fire are considered.

Providing fire safety is an integral part of the state policy of any country for the protection of life and health of people, national wealth and the natural environment. Each fire has negative consequences both directly for the injured person and for society as a whole. The fires directly cause the destruction of material assets, create threats to the life and health of people, but most importantly - they cause significant, and sometimes irreparable damage to the environment.

At the end of the 20th century, about 7 million fires were registered annually, and nearly 70,000 people died. In fact, there are many more fires on the planet, but many fires (especially small ones) are not recorded for various reasons.

The Worldwide Fire Statistics Center, operating within the UN, annually publishes a comparative analysis of the costs associated with the elimination of the effects of fires in different countries around the world. World statistics show that over the past 10 years the number of fires has increased by almost three times, the number of buildings destroyed by fire is more than 8 times, and the dynamics of deaths of people in fires has a general tendency to increase. According to statistics, only for one day in Ukraine, on average, there are 110-120 fires, in which 5-7 people are killed, and 4-6 are injured of varying degrees of severity, each week the fires destroy or damage 600-700 buildings. World statistics show that direct damage from fires is on average 0.2-0.3% of the gross domestic product of the country concerned. According to world statistics, one perished in the fire accounts for 25-30 injured, who received burns and injuries of varying degrees. Losses for the treatment of people who suffered burn injuries in fires and require long and expensive treatment are about 21% of the total damage caused by fires.

Today, when humanity has entered the third millennium of its centuries-old history, fire safety remains relevant. Every five seconds there is a fire on the globe, and in Ukraine every 10 minutes. Within one day in Ukraine there are 120-140 fires, in which 6-7 deaths, injuries are 3-4 people; 32-36 buildings, 4-5 units of equipment are destroyed by fire. Daily losses from fires amount to about 500 thousand UAH.

Despite the significant achievements in the scientific and technical sphere, humanity has not yet found absolutely perfect means to provide fire safety. The problem of fires is global in its scale, affects not only national but also international interests. In a modern technological environment - financial, labor and material damage from fires become burdensome for the economies of the world.

In order to provide effective fire protection every year, each country allocates more and more money to basic research, maintenance of fire protection and fire prevention. Accordingly, fires and their consequences are causing significant damage to the entire world economy. Thus, from the point of view of social, economic and environmental losses of society from the consequences of fires, the problem of ensuring effective fire protection of the safety of people, material values and preservation of ecological environment of each country is actualized

The analysis of fire danger shows that in Ukraine there are more than 50 thousand fires every year, in which people die, and the material damage exceeds 20 million UAH. The losses are 20 times higher. To a large extent, such disturbing statistics are due to an increase in the fire risk of buildings and structures that are being reduced and exploited by changing production technology, increasing surface and density of buildings, changing traditional and material-intensive technologies, building houses for new advanced technologies with efficient building materials from wood, plastics, polymers, metal. The above materials are highly sensitive to the effects of high temperatures and fire.

As practice shows, the combustibility of used materials and the low limit of fire resistance of building structures are the main causes of considerable material damage and death of people during fires. Therefore, reducing the combustibility of materials and increasing the fire resistance of building structures is an actual scientific and technical problem, an integral part of the State Program for the provision of fire safety in Ukraine.

The growing number of fires and fire hazards of buildings and structures raises the need for special preventive measures. However, the development of effective measures largely depends on the correct assessment of the fire risk of materials and fire resistance of structures. To determine the nature of the material handling and design, assessments of the fire protection means used are fire and high-temperature tests.

In world practice, now the assessment of the fire hazard of building materials is studied in more than 200 methods. Worthy of note are the methods for assessing the combustibility of materials in developed countries: Britain, Germany, France, the USA and CIS countries. Unfortunately, with the general tendency to develop common estimates of the fire hazard of materials, there are significant differences and contradictions in their definition. Therefore, the assessment of materials for fire hazard is carried out in different countries in a variety of techniques, which causes serious controversy.

Fire resistance and its limit in the general plan characterize the accumulation and manifestation of dangerous fire factors. Estimation of fire resistance of building structures leads in two directions - it is experimental methods of evaluation of objects, designs of models, samples and design methods for assessing fire resistance of structures.

The development of the methodology of fire examinations of materials and structures is currently being addressed by several international research centers and test stations. Their work and research orientation is coordinated by the Working Group of the 15th International Building Council (GIB). In Western Europe, the following main organizations deal with the fire safety of buildings and structures: the European Committee for Standardization, the European Economic Community (EEC), the Committee for the Harmonization of Research (CHR).

Analysis of methods for assessing the fire resistance of structures showed that along with the advantages of recommended methods, they also have significant disadvantages: a significant scatter of data (20% and more), high cost, labor complexity, low efficiency in the accumulation and aggregation of data, etc. .

Due to the significant depreciation of fixed assets in the country, and therefore with the increasing number of man-made emergencies, the construction of structural safety systems is becoming increasingly important.

Statistics show that 80% of accidents occurring in the construction with the collapse of the bearing structures of the object arise as a result of human errors that are permitted in the design, construction and operation of a building or structure. These errors form the internal (object) risk of accidents, the magnitude of which depends on the duration of exploitation (resource) of the structure. In addition to man-caused factors (explosions, fires, transport accidents, cranes crash, local congestion of constructions, errors of designers, negligence of builders, etc.), there are also natural factors (seismic, the emergence of karst failures in the foundations of buildings, landslides, hurricanes, etc. .), through the influence of which the emergence of partial or complete destruction of the building.

The wear and damage of bearing structures or their connections and, consequently, the change in the strength, stiffness of the elements of the design schemes leads to a decrease in the structural safety of the structure. In the worst combination of negative circumstances, they result in a sudden refusal and progressive collapse.

At present, Ukraine has increasingly focused on solving this problem. But the main part of scientific publications is staged (representative) character. It is also known that taking into account and complying with all requirements of normative documents does not provide the necessary level of reliability of the building. The standards set only a minimum level of safe operation and durability of constructions, using a set of coefficients that are still empirical. In fact, these ratios provide at the design stage of their exploitation resources.

The onset of an emergency condition of a building or a building involves the presence of an external cause of man-made (an explosion, a fire, a terrorist act, etc.) or a natural-climatic nature (earthquake, hurricane, tsunami, landslide, village, etc.). The current norms do not provide for "protection" in the form of appropriate stock and reliability ratios, but there are no risk factors associated with the combined emergency effects of such "protection". However, recently, the number of combined emergency effects with increasingly difficult social and economic consequences has increased significantly. Therefore, a comprehensive assessment of the impact of emergency loads on building structures is a critical condition for choosing the best solutions for ensuring the survivability of buildings and structures.

The department of the reconstruction of the airports and highways of the Training Aviation Institute of the National Aviation University with the participation of the Academy of Civil Engineering of Ukraine and the Engineering Academy of Ukraine issued 3 parts of 4 monographs, under the general editorship of the doctor of sciences, of the professor V. M. Pershakov. Recommended for publication by the Scientific and Technical Council of the National Aviation University (Minutes No. 9 dated December 10, 2015).

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For scientific and engineering specialists, staff of research, design, construction organizations, as well as post-graduate students and students of construction higher education institutions and faculties.

The proposed monograph PROBLEMS OF FIRE FIGHTING DANGER AND THE FIRST CONSTRUCTION OF THE HIGH CONSTRUCTION is of a survey nature and will consist of four parts.

Part 1. Experience in design, construction and operation / 1 /. The terms and designations, history of creation and development of high-rise building and civil engineering are considered. The highest and most high-rise, high-rise and unique high-rise buildings in the world are listed. The tendencies of high-rise house building development are outlined:

Part 2. Causes and consequences of the destruction of high-rise buildings from the effects of fire / 2 /. The causes and consequences of the destruction of high-rise buildings from the effects of fire, as well as the analysis of the extinguishing of fires and rescuing people from high-rise buildings during the fire are considered. The review of publications and normative documents on the issues of fire and fire resistance of high-rise buildings is given.

Part 3. Constructive schemes and features of volume-spatial structures of high-rise buildings / 3 /. The review of publications on the world-wide experience in the construction of high-rise buildings is given. The evolution of constructive systems and schemes is considered: from the structures of elevated superficiality to ultra-high skyscrapers of the present day. The peculiarities of design of bulk-spatial structures and architectural-constructive solutions are described.

Part 4 (planned). Methods of calculation, design and experimental study of fire resistance of constructions of high-rise buildings. Peculiarities of methods of calculation, construction of frameworks of high-rise buildings with account of fire danger and fire resistance are described. The experimental researches, current recommendations and norms are given taking into account the counteraction of fire hazard and fire resistance of high-rise buildings. The problem was substantiated and the task of research on survivability, reliability, stability, seismic stability, safety, technical condition of structures of high-rise buildings frameworks was revealed.

Conclusions:

In general, the monograph is aimed at structuring existing approaches to solving the problems of counteraction to fire danger and fire resistance of high-rise buildings, the stability of buildings to progressive collapse, justified by the tendency to ensure the safety of construction objects for people and the environment. The

provision of safe operation of existing and existing high-rise buildings involves the ability to predict their behavior in the event of an emergency (partial loss of load-bearing capacity, fire, earthquake, etc.).

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