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MEASURES TO ENSURE FIRE SAFETY IN HOUSES FOR THE AGE AND DISABLED

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Abstract. The article is devoted to the problem of ensuring fire safety in nursing homes and disabled people. The documentation in the field of fire safety was analyzed, the building was also modeled, calculations were made, and the fire safety of the protected object was assessed. Based on the work carried out, recommendations were proposed to improve fire safety for the protected object.

Keywords: fire, fire risk, fire hazards, fire safety, nursing homes and disabled people

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Introduction

Socially vulnerable groups, such as the elderly and the disabled, are at great risk due to their physical or mental health. International studies show that risks increase with age, especially in fire situations. So, for people over 85 years of age, mortality more than three times the risk from fire than for the general population. And fire-related injuries are also more common in older adults 65 years and older. This higher risk is associated with the difficulty of responding to a fire and evacuating them from fire hazardous facilities. In addition, injuries experienced by the elderly tend to be more severe and are often complicated by other diseases [1, 2].

Based on the statistics conducted by Russian researchers in the field of analyzing the situation with fires and their consequences, over the past year, the indicators with the largest number of victims are socially vulnerable groups - they make up more than 2 500 people, in other words, about 40 % of the total number of victims affected by fires [3].

In the period 2005–2022 at least 19 major fires in nursing homes across Russia have been reported, with approximately three deaths for every third fire incident. One of the last major fires occurred on January 8, 2022 in a nursing home in Kuzbass, where four people died.

Factors that put older people at risk of fire include physical aspects such as deterioration in their physical health or vulnerability to trauma, mental aspects such as cognitive decline or social isolation and behavioral aspects. Other factors that contribute to an increased risk of fire-related injury include physiological changes such as thinning of the skin, reduced visual acuity, or the use of certain types of medications [4].

Currently, middle- and high-income countries, including Russia, are facing an increase in the number of elderly people, due in part to improvements in the quality of life of the population and better health care. In connection with which often there is a need to send an elderly person or a disabled person, someone who is more unable to take care of themselves, to a nursing home for care and daily needs. Of course, there are situations where an accident or incident can happen to a person, or his mental abilities can deteriorate and a fire emergency occurs. The safety of the nursing home resident, as well as facility staff, is a top concern. One a key component of a well thought out safety plan is a detailed fire safety strategy.

So, the relevance of the problem of ensuring fire safety for nursing homes and disabled people is obvious.

The aim of the work is to develop measures to ensure the fire safety of nursing homes and disabled people [5].

Research methods

The laws governing nursing homes are designed to reduce risks to the health and safety of the people living there. Of particular interest are documents regulating fire safety and life safety, namely: Federal Law № 69 «On Fire Safety»; Federal Law № 123 «Technical regulations on fire safety requirements»; Collection of codes of practice «Fire protection systems»; SP 59.13330.2016 «Accessibility of buildings and structures for people with limited mobility», etc.

Analyzing the regulatory documentation, one can highlight important information regarding nursing homes and the disabled, which will be of paramount importance in ensuring fire safety in these facilities.

So, according to the «technical regulations», for the buildings of specialized nursing homes and the disabled, a functional hazard class is assigned – F1.1.

Class F1.1 has its own characteristics, according to which buildings of this fire hazard class can be characterized as buildings with round-the-clock mass stay of the elderly. The description used for this category of people is people who have chronic diseases, feel certain difficulties in movement or orientation in space, as well as those who can be classified as disabled, who have completely or partially lost the ability to self-care.

Nursing homes, like most public and residential facilities, rely on standard fire safety and prevention measures to ensure that any emergency can be resolved as quickly as possible to reduce injury and death to residents and limit damage to the building itself. The main components of any successful fire safety plan are smoke and carbon monoxide detectors, fire extinguishers and fire suppression systems. Smoke and carbon dioxide detectors can provide rapid hazard detection before a major fire breaks out. Early detection with smoke detectors allows facility personnel to act quickly to get occupants out of hazardous areas to safety and contact emergency services for immediate intervention. It is worth noting that autonomous fire extinguishing systems provide an advantage in extinguishing a fire before the arrival of emergency services. In the event of a faulty smoke detector or a rapidly spreading fire preventing occupants from evacuating, in many cases the fire suppression system will be able to suppress the fire and clear an escape route from the building. Fire is unpredictable, and having a system that not only helps extinguish the fire, but also reduces smoke in the air, is more likely to save lives [6, 7].

It is important to note that for people in this category, also referred to as low-mobility groups of the population M1-M4, there are their own restrictions. So, using materials from the set of rules for groups with limited mobility, it is possible to identify certain requirements for the organization of space for such people, taking into account their physiological needs. This, in turn, affects the layout of the building of nursing homes and the disabled and affects the organization of the evacuation of people from the building in case of fire, and also affects the management of the fire extinguishing system [8].

To assess the fire hazard in the buildings of nursing homes for the elderly and disabled in the «Fenix +» program, a model of the object was built, where 33 people of different categories of mobility were placed. When modeling, the characteristic features of each group of people were taken into account in order to more accurately describe the movement of people during evacuation, which directly affected the travel time to evacuation exits.

Research results and their analysis

During the construction of the model, the following requirements of regulatory documents that apply to functional buildings were taken into account:

– an automatic fire alarm is used, which includes: a control and management panel, a light annunciator above the evacuation exits, fire smoke detectors for rooms and manual fire detectors on evacuation routes;

– a second type warning system is used;

– it is provided for the removal of combustion products in case of fire by an exhaust smoke ventilation system from the corridor.

The calculation of the individual fire risk was carried out using the methodology of calculated values from the order of the Russian Emergencies Ministry dated June 30, 2009, № 382 [9].

Of particular importance in the calculation is the time of blocking escape routes as a result of the spread of dangerous fire factors. Most of the time, these factors lead to to more victims. And in this case, where are the people at the facility with limited mobility, every second spent on evacuation is especially important [10].

So, the program simulated the scenario of the development of a fire in a residential area with two guests belonging to the M3 category. Evacuation of people is carried out through exits 1–3 directly to the outside, as shown in the figure.

So, according to the Methodology, the calculation of the minimum time of blocking the premises at the calculated points 1–3 was carried out. The calculation results are presented in the table.

Table

Time to reach the hazard value

Estimated points	By elevated temperature	By loss of visibility	By low oxygen content	For toxic combustion products
1	20,78	7,57	19,75	11,20
2	23,32	8,49	21,97	12,57
3	35,73	13,04	33,68	19,30

So, the minimum blocking time was identified by the criterion of «loss of visibility».

The calculated value of the individual fire risk was calculated according to the formula proposed by the Methodology:

$$Q_{В} = Q_{П} * (1 - К_{АП}) * Р_{ПР} * (1 - Р_{Э}) * (1 - К_{ПЗ}) = 0{,}525 * 10^{-6}.$$

According to the calculations, the value of the individual fire risk does not exceed the standard value established by Federal law № 123, equal to $1*10^{-6}$, that is, the safety condition is met.

Although nursing homes for the elderly and disabled are designed in accordance with regulatory requirements, but based on an analysis of the causes of death in fires of such facilities, circumstances were identified that indicate violations of the elementary requirements of the fire regime, such as:

– closing the doors of emergency exits;

– barred windows;

– congestion of evacuation routes;

– faulty fire alarm;

– lack of training and sluggishness of the personnel on duty during the evacuation [11, 12].

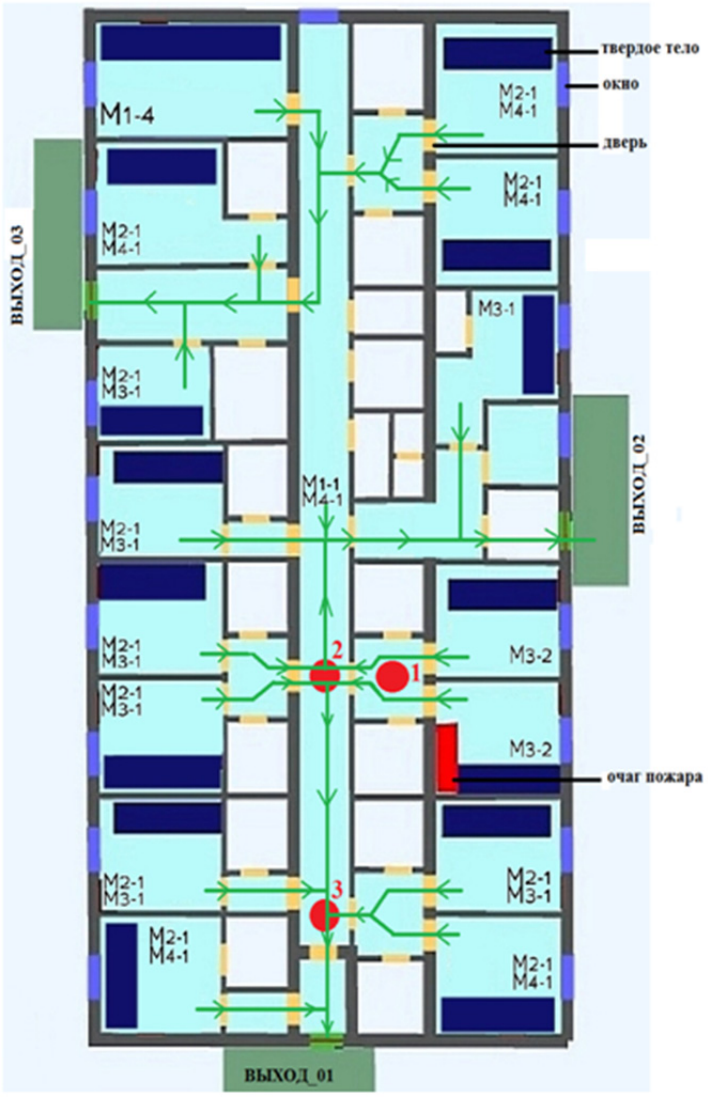

Fig. **Model of a nursing home for the elderly and disabled: top view**

Conclusion

So, in order to reduce the death rates in fires, it is necessary to ensure the implementation of not only constructive, space-planning and engineering solutions, but also organizational measures. Such as: the use of personal devices with light, sound effects or vibration, training of personnel in case of fire, installation of sprinkler systems, the use of non-combustible materials (steel, metal and concrete), the use of a system of supply and exhaust smoke control ventilation and the organization of additional evacuation routes or use of window openings for evacuation.

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