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Presentation of the Hazardous Environment in the Light of Firefighting Activity

The purpose of this article is to present the dangers facing firefighters during various interventions. It is a challenge for firefighters to deal with various hazards every day, be it firefighting, technical rescue, or even fire investigation. Intellectual readiness, professional knowledge, and a state of work are necessary to be able to handle a given situation effectively and professionally. In this article, the authors present both the hazards of firefighting work, with a brief overview of the consequences of climate change and technological development. To prepare the article, the authors processed several international and domestic literature and case studies, based on which the topic was presented extensively. At the end of the article, several accident prevention proposals and solutions related to the topic are mentioned. Based on these, the authors propose some development directions in the field of safety that may be suitable for more extensive protection against various threats.

Keywords: danger, climate change, firefighting, technical rescue, accident

Introduction

In Hungary, according to Section 23 (1) of Act XXXI of 1996 on fire protection, technical rescue and fire brigade (hereinafter: the Act), "the central management of fire protection and technical rescue and the activities of the fire brigade, except Section 24, shall be exercised by the Minister responsible for disaster protection, the head of the central disaster management body". The Director General of the National Directorate General for Disaster Management of the Ministry of the Interior (hereinafter: ND GDM) directs the activities of the professional fire brigades and controls the activities of the municipal fire brigade, the facility fire brigade

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and the voluntary fire brigade association performing firefighting and technical rescue tasks through the territorial body of the professional disaster management body.

During firefighting interventions, firefighters have to perform several different, in many cases dangerous tasks. According to Section 1 (2) of Act XCIII of 1993 on occupational safety and health, “those working in Hungary have the right to safe and healthy working conditions”. In addition, the employer is obliged to provide the stock with appropriate personal protective equipment and to review and inspect it regularly.

Climate change, which can be felt by many of us, will not make the lives of the firefighters intervening easier, as forest fires caused by drought or more frequent storm damage require more attention and preparation. However, the achievements of accelerated technical development in recent years have made everyday life easier, but they can also hold hidden dangers.

Environmental factors

Events (accidents, disasters, fires) that negatively affect people's daily lives can come from many sources. Disasters can also be grouped as follows:

- Natural disasters: rain, earthquake, ice, storm, etc.
- Artificial disasters: e.g. wars
- Sociological disasters: epidemics, explosions, nuclear activities³

Within these groups, it is mostly about recovering the damage caused by natural disasters. Frequent windstorms cut down trees, and demolish the tiles of houses, and in such cases, the help of firefighters is needed. The danger of an accident is also caused by the overhead cables on which the tree or the branch has fallen. Before starting work at the scene as a firefighter, it is essential to consult the energy supply company to disconnect the affected section to avoid electric shock. After that, the fallen tree or branch can be pruned professionally, during which it is necessary to comply with the rules of occupational safety.

Slippery surfaces caused by rain can also pose a risk, especially when working at heights. In such cases, it is important to protect against falling. Areas, where potholes and ditches due to road defects or soil conditions are filled with rainwater, are also additional risks. In such cases, an accident is more common in which the firefighter suffers an ankle injury after entering the pit during the intervention.

Due to the increase in the global average temperature, the weather in Hungary also differs from the previous, usual conditions. Drier periods have become more frequent, which has also led to an increase in the frequency and intensity of forest fires.⁴ As a result, the number and duration of interventions pose an increasing challenge to intervening firefighters, both physically and psychologically.

³ SZENDI 2011: 165.

⁴ RESTÁS 2020: 91–107.

Adequate heat protection, which is primarily provided by systematic personal protective equipment, is of paramount importance to firefighters in extinguishing fires. Additional protection includes proper distance and residence time, use of professional equipment, and communication with others at the scene.

During technical rescues, sudden events may occur that could be a source of danger to the life and physical integrity of the intervening firefighters. The special equipment they use is classified as dangerous machines such as a hydraulic rescue tool, a disc cutter, or a chainsaw, so their use requires certain professional knowledge. Accidental, incorrect movement can lead to accidents resulting in serious injury.

Regulation 34/2021 of the professional disaster management body on the provision of personal protective equipment to the personnel of the ND GDM contains the personal protective equipment required for the given jobs and tasks.

In the event of a fire or technical rescue, firefighters come into contact with the victims and face the bodies. Following a particular incident, the behaviour of the individuals involved may change relative to general behaviour, e.g. immobility, mental paralysis, aggression, etc.⁵ In such cases, firefighters must provide appropriate and professional assistance to the victims, avoiding any possible injury to themselves or others.

The sight of the dead can be psychologically stressful for some firefighters. Improper processing of these experiences in the future can lead to a condition, i.e. trauma, which has a negative effect on everyday life and causes an upset of physical and mental balance.⁶ In order to avoid this, achieving and maintaining one's mental health and well-being plays a particularly important role. Regular communication with other firefighters can help with this, since they have been and are going through similar events, so they understand the other person's problems. In addition, regular sports activities or even the clarity of different roles (leader, subordinate) within the workplace can be effective in dealing with stress.⁷

Finally, protection against biological, chemical, radiological and nuclear threats must be mentioned. In such situations, firefighters wear special protective clothing, thus ensuring isolation from the external environment. Due to the design of the gas-tight chemical protective clothing, picking up smaller objects becomes difficult. In addition, the view from the protective clothing becomes more limited, so the firefighter is under more pressure from a psychological point of view, which can affect the efficiency of performing the given activity. There is a certain amount of time available in the dress, so the stress caused by time constraints can have a negative effect on the mental state of the wearer of the dress, both in the short and long term. Finally, it is worth mentioning the process when the firefighter takes off the gas-tight chemical protective suit after the intervention. In such a case, it is necessary to remove the clothes professionally in order to avoid contamination. Mastering this process should be the subject of preliminary and repeated theoretical and practical training.⁸

⁵ RESTÁS 2016: 49–51.

⁶ KISS–SZ. MAKÓ 2015: 222.

⁷ JACOBSSON 2018.

⁸ PATITSA–CHALARIS 2016: 1761–1764.

Before starting any type of intervention and during the process, it is important that the firefighters pay attention to each other's personal protective equipment, i.e. it is necessary to check whether the other person has properly put on the protective clothing for the deployment. If communication and, as a result, harmony is established between teammates, the likelihood of accidents and injuries resulting from human inattention can be reduced.

For the sake of a brief look, it is worth mentioning the fire investigation and the dangers that occur in the process. Section 4 (f) of Act XXXI of 1996 on fire protection, technical rescue and fire brigade sets out the following: "An official activity aimed at discovering the time, place and cause of a fire to increase fire prevention knowledge and improve rescue intervention conditions."

For all this, a thorough inspection of the site is essential, during which the affected personnel must wear the specified personal protective equipment. The structural stability of a burned-out property is far from satisfactory, so it is necessary to pay more attention to the given building, as it cannot be ruled out that the fire inspector falls on e.g. a damaged beam. The risk of tripping in such cases is high, as the ruins can hide white spots that fall in the event of a step, causing injury to the ankles and feet. Finally, it is important to note that unknown gases and vapours can be released into the air in such cases, so the use of appropriate personal protective equipment and a thorough preventive assessment are important aspects before the examination (Figure 1).



Figure 1: Different dangers during interventions

Source: Drawing by Anna Veronika Grósz.

It must be emphasised that during the service, the firefighter must be in a working condition, i.e. his body must be free of alcohol and drugs that do not affect his ability to concentrate, as well as drugs, and he must be properly rested and healthy (e.g. fever-free).

Technical development

Thanks to the rapid technological development of recent years, several new devices and equipment have entered the market, which has posed a challenge to people both in terms of fire protection and firefighting. Examples are solar photovoltaic systems or the increasingly popular hybrid/electric vehicles.⁹ To ensure accident-free and efficient firefighting and technical rescue, a thorough, comprehensive study of the operating principles of these equipment (both in theory and in practice) is a necessary condition among firefighters today.

In case of solar-powered properties, special attention must be paid to firefighting if the roof structure and, if applicable, the solar system are ignited, as the owner of the property may not be connected to the mains. The following image is an excellent example of how much damage a burned solar cell can do to a building (Figure 2).



Figure 2: Roof structure damaged by solar panels

Source: FITZGERALD WEAVER 2019

Technical progress can also be seen in everyday transport, with cars and road transport vehicles being good examples, such as buses and trolleys. When extinguishing a fire caused by a breakdown or accident of a motor vehicle, especially if it can be started at an early stage, the source of the fire, i.e. the engine compartment or the battery, must be isolated. In this case, the intervention can be carried out more efficiently and the number of possible accidents can be reduced.

Finally, it is worth mentioning in general the smart devices that we all use every day. Today, most people have an Internet subscription, so we can access the wealth of information on the World Wide Web with several smart devices. Such devices include mobile phones, tablets, screens of all kind, etc. As a result of technological advances, we are increasingly relying on these devices, and even use them 24 hours a day compared to previous years.

The authors found it important to mention this description of the data because firefighters use smart devices both during the intervention and in their private lives. When working, it can be a source of danger for the user to rely too heavily on the device, taking her/his

⁹ PÁNTYA 2021: 287–296.

attention, thus ignoring his environment, which can even lead to an accident. Inside the fire stations, during rest periods, someone may use the phone while walking, moving so there is a risk of falling, stumbling and being injured. In summary, the opportunities offered by the technological advances that have largely shaped our world today will in any case have a positive effect on the effectiveness of firefighting interventions, but the risk of inattention due to convenience has increased, which is often worth noting.

Description of international cases

According to the NFPA (National Fire Protection Association, United States), in 2020, 64,875 firefighters in the United States were injured while on duty. The main causes of injuries during firefighting and technical rescue are shown in Figure 3.

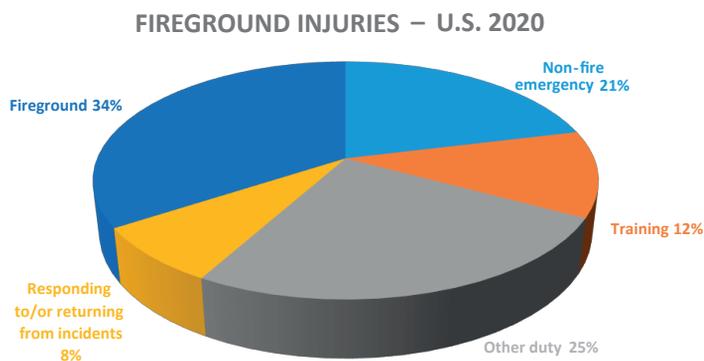


Figure 3: Causes of accidents during firefighting

Source: CAMPBELL–EVARTS 2021

Figure 3 shows that the majority of accidents occur during firefighting (34%). The non-fire emergency cases can connect to it with 21%. Most accidents are likely to occur during these cases, as there are a number of unexpected hazards that the firefighter cannot prepare for in all cases. This is followed by a series of accidents that do not fall into the categories shown on the chart. This may be the case when a firefighter stumbles at a fire station as a result of a bad move while in walking. The third most common type of accident is any type of intervention (e.g. technical rescue) where we cannot talk about extinguishing a fire. Unexpected events can also occur in such cases, such as a failure of professional firefighting equipment, which can easily lead to an accident.

In our opinion, the proportion of accidents that occurred during exercises and sports (12%) is low. By maintaining appropriate and regular theoretical and practical training, whether before a sport or a firefighter training, this ratio can be maintained or even reduced. The smallest number of accidents is responding to/or returning from incidents, which in many cases is the result of inattention.

Case report

In a U.S. city, on a Thursday morning, a neighbour noticed that the house next door was on fire, so he immediately called the firefighters. The fire department alerted two fire trucks, one of which was a ladder. After receiving several emergency calls, it was revealed that several people were stranded on the second floor, so the fire department sent a third fire truck and an emergency ambulance. Within four minutes, the first fire truck arrived, followed by the units that were later dismantled, bringing the total number of firefighters on-site to a total of 19.

Upon their arrival, the firefighters saw that several rooms were burning on the first floor. Two firefighters transmitted a hose line to the first floor living room, extinguishing the fire as they progressed. From the ladder fire truck, firefighters were looking for two people trapped on the second floor. The doors and windows in the house were open, but the strong southwest wind (24–40 km/h) quickly amplified the spread of flames.

A more intense fire due to the wind spread faster to the first floor, squeezing the occupants and two rescue personnel on the second floor, thus blocking the escape route. The two firefighters, who had previously extinguished the fire in the first floor living room, had to flee the burning house but suffered first-degree burns. To evacuate the people trapped upstairs, the outdoor units propped two fire ladders to the side of the house, to the window of one of the rooms.

However, the fire was already so widespread that the people inside could no longer approach the window in that room. Eventually, one of the firefighters trapped inside facing the flames helped one of the victims to the window, and then, he managed to reach the ladder.

A total of seven firefighters were injured in the fire. Of these, four, who were inside during the fire, suffered first-degree burns. They did not suffer any major injuries as they were professionally wearing the appropriate personal protective equipment that is required to be worn in exactly such cases. The two firefighters outside had a mild smoke poisoning as they did not wear a breathing apparatus. In addition, a civilian got smoke poisoning while fleeing the building.¹⁰

The incident described above shows the dangers firefighters face in their daily work. The example illustrates the importance of professional knowledge in this activity. As this work puts a special psychological burden on people, firefighters must acquire and then repeat the necessary knowledge from time to time during theoretical and practical training. In addition, the role of personal protective equipment in the work of firefighters was mentioned. Of course, it should not be forgotten that it is not enough just to wear personal protective equipment, but to check it regularly and, if necessary, review it to ensure that it can provide protection.

¹⁰ HAYNES–MOLIS 2016: 28–30.

Results

This article describes several hazards that firefighters are exposed to in their daily lives. The authors now describe a solution that can reduce the occurrence or extent of accidents and injuries in one of these dangerous situations.

For electric car fires, the Rosenbauer company offers a completely new solution to the problem that reaches the source of the fire in a safer and more efficient way. For electric and hybrid vehicles, this type of extinguishing system breaks through the bottom of the battery and then delivers the extinguishing agent through the gap (Figure 4). A lance is used for the breakthrough, for which the energy required is provided by a compressed air cylinder. The special feature of the system is that this solution is compatible with any type of vehicle, i.e. battery system. Of course, the most important thing to determine is whether a fire in a vehicle is caused by the battery. The extinguishing system has already been tested at several European fire brigades and in fires.¹¹

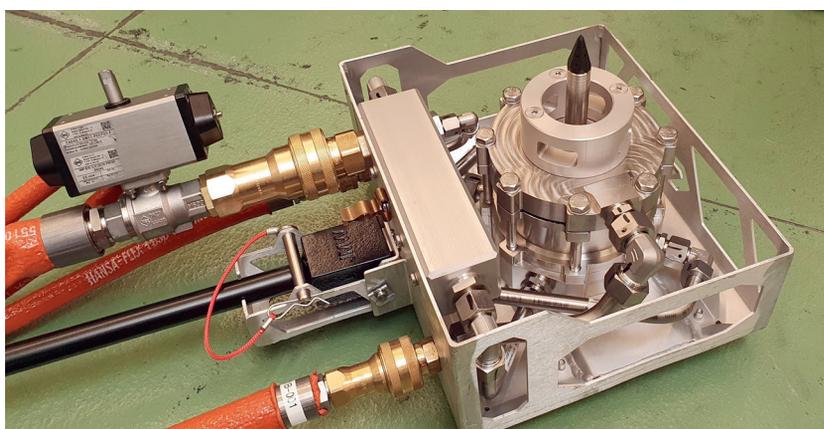


Figure 4: Rosenbauer extinguishing system

Source: Hesztia Kft. 2022: 57–58.

As a consequence of the changing environmental environment and the evolving digital world, education and training need to be constantly updated. Accordingly, it is strongly recommended to visit forums, workshops and exhibitions in the field of firefighting on these topics, so that the intervening firefighters are always able to carry out their activities with certain knowledge and training.

¹¹ Hesztia Kft. 2022: 57–58.

Conclusion

In this article, the authors present the daily hazards associated with firefighting, technical rescue and fire testing. There was also talk of climate change, which will not make it easier for firefighters to intervene shortly. The smart tools and solutions most used by the society of our time have been mentioned as they have posed and pose a different challenge to the fire brigade than in previous years. As a solution, the authors have introduced a new firefighting equipment that has been developed to extinguish electric cars, making them easier and safer to work with. The training that is important at all times has been identified as a recommendation, as it is necessary to know not only the equipment that is the subject of firefighting, but also the more modern firefighting technique itself, as the goal is always to minimise personal injury and property damage.

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