

Tóth Péter László¹, Pántya Péter²

PREPARING PROTECTION PROFESSIONALS AND THE POPULATION FOR BASIC KNOWLEDGE OF BUILDING SAFETY

<https://doi.org/10.30583/2021-1-2-084>

Absztrakt

A körülöttünk lévő veszélyek palettája széles. Ezek között speciális területet képeznek az épületek, épületszerkezetek okozta veszélyek. Az ezzel kapcsolatos ismeretek a védelmi szakemberek és az épület használói számára egyaránt hasznosak lehetnek. A szerzők ebben a cikkben a védelmi szakemberek felkészítésének magyarországi lehetőségére és fontosságára hívják fel a figyelmet. Példákkal illusztrálják, hogy az épületek és épületszerkezetek-ozokta veszélyek megfelelő ismeretek birtokában sok esetben könnyen észlelhetők és figyelembe vehetők, illetve a károsodásokból milyen következtetések vonhatók le az okokra vonatkozóan.

Kulcsszavak: Felkészítés, épület, építmény, veszély, alapvető követelmények, hatások

Abstract

The range of dangers around us is wide. Among these, the dangers caused by buildings and building structures form a special area. Knowledge of this can be useful for both security professionals and building users. In this article, the authors draw attention to the possibility and importance of training safety professionals in Hungary. Examples illustrate how hazards from buildings and building structures can in many cases be easily detected and taken into account with the right knowledge, and what conclusions can be drawn from the damage as to the causes.

Keywords: Training, building, structure, danger, basic requirements, effects

¹ University of Public Service, Doctoral Schools of Military Engineering, doctoral student; Chief scientific officer of ÉMI LLC, e-mail: ptoth@emi.hu, ORCID: 0000-0003-3516-5318

² University of Public Service, associate professor, e-mail: pantya.peter@uni-nke.hu, ORCID: [0000-0003-2732-2766](https://orcid.org/0000-0003-2732-2766)

1. Introduction

Our built environment largely determines our lives, as we spend a significant portion of it in or near buildings.

The buildings provide the conditions necessary for daily living and working. However, our buildings not only protect against various environmental impacts, but can sometimes endanger those living in or around them in different ways.

Builders, users and operators of buildings typically know very little about the hazards that often occur during the construction, use and demolition of buildings, which are often easily eliminated or at least perceived. There are also many dangers for rescuers or those standing on defensive and working in or around buildings that are damaged or exposed to special effects.

At the same time, organizations of national defense, law enforcement, and thus disaster management (where there are a wide range of related official powers) have or use a large-scale but mixed real estate portfolio. Knowledge of buildings could therefore also be applied during operation and maintenance. It can also be a great result if at least the knowledge gained during the preparation helps to identify the problem, so that the right specialist can be involved in time.

The aim of the authors and this paper is to identify the need and the various possibilities / barriers of the proposed training in Hungary - on the basis of the relevant literature and own practical and educational experience.

Another question arises as to how the different levels of professional knowledge required for buildings could be passed on to professionals working in the field of national defense and law enforcement, especially in the field of disaster management, but even to the wider public.

Traditional preparation materials and lectures prepared in a comprehensible way, compiled according to the specific needs of the target groups, can be advantageously used for the transfer of knowledge, but the question arises as to what modern solutions can be used to make the preparation for this knowledge more effective. Let us first examine the topic of building security in a larger context.

2. Interpretation of security, safety, challenges in the XXI century

Researchers have already formulated the basic premise that *“One of the important drivers of the creation and development of human societies has been the recognition of the need for common defense against threats. With the development of societies, the number of sources of danger endangering human lives and material property has gradually increased, their types and destructive effects have become more complex.”*³.

The Commission of the European Communities *“does not limit the concept of security to the security of the territory of a State or to the security of specific systems but includes the external and internal security of the State itself and its inhabitants. The concept accordingly focuses on human security (freedom from deprivation and fear, freedom to act independently), i.e., it focuses on the security of the citizen, and thus on the security of the state.”*⁴

According to the sectoral security approach, the basic areas of security are public security, economic, social, political, environmental and military security. In the future, due to the topic of the study, environmental safety will be of paramount importance to us.

*„Environmental safety is of paramount importance for disaster prevention, its core areas are environmental and nature protection, health protection, industrial safety, transport safety and disaster management. Environmental safety analyzes and helps to protect the natural environment and people's lives and material assets in a unified system”*⁵.

In terms of environmental security, we face global environmental and civilization challenges. *„Rapid changes in the natural environment and climate can become a source of conflict today. Disruption of the global environmental balance (ozone depletion, deforestation, greenhouse effect, water, air and land pollution, biodiversity) poses a threat*

³ Júlia Hornyacsek: A polgári védelem alapjai 1. Zrínyi Miklós Nemzetvédelmi Egyetem, Budapest, 2009. pp 7.

⁴ Solana Javier: Challenges for the 21st Century. Lecture SACLANT symposium: Lisbon 03. 09.1998.

⁵ Júlia Hornyacsek: A polgári védelem alapjai 1. Zrínyi Miklós Nemzet-védelmi Egyetem, Budapest, 2009. p. 10.

not only to individual countries but to the world as a whole."⁶. Construction is one of the most energy-intensive sectors, but also one of the biggest polluters. Operating our built environment accounts for 40% of total energy consumption in Europe ⁷.

It is in the national interest in Hungary for our buildings to be durable, low energy and safe. In contrast in reality building users and operators often face energy wastage, low quality of materials and workmanship and, in many cases, real hazards. Some of the dangers often remain hidden: they cause slow health damage or only occur in the event of some extraordinary effect.

In the case of critical infrastructure, the issue under consideration raises its importance for critical systems from another point of view, since due to the deterioration of a building, the unusability of a given structure, even temporary, may result in the loss or restriction.⁸ Elements of the critical infrastructures often contains complex and special engineering solutions and systems, therefore the authors of this article consider them outside of the scope.

For those working in individual structures, thinking about the condition of the structure can also be part of the workplace safety culture.⁹

In the next section, we review the general requirements that should be met for all of our buildings.

⁶ Júlia Hornyacsek: A polgári védelem alapjai 1. Zrínyi Miklós Nemzetvédelmi Egyetem 2009. p. 15.

⁷ National Building Energy Strategy, Hungary (Nemzeti Épületenergetikai Stratégia). 2015.

https://ec.europa.eu/energy/sites/ener/files/documents/EU%C3%81T_164_2_2105_Nemzeti%20%C3%89p%C3%BCletenergetikai%20Strat%C3%A9gia%20150225%20pdf.pdf, (download date: February 4, 2021) p. 10.

⁸ Tünde Bonnyai: A lakosságfelkészítés lehetséges módszertana a létfontosságú rendszerek és létesítmények védelmének rendszerében. Hadmérnök. Vol. VIII issue 2013/3 pp. 58-73. http://hadmernok.hu/133_07_bonnyait.pdf, downloaded on 10.12.2020.

⁹ Gabryelewicz, I.; Krupa, P.; Sadłowska-Wrzesinska, J.: Online measurement of work safety culture - statement of research, 4TH International Conference on Computing and Solutions in Manufacturing Engineering 2016 - COSME'16, Volume 94, Published 2017, DOI: 10.1051/mateconf/20179406008

3. General requirements for buildings

Below, we first review the basic legal requirements for buildings and their construction. According to the 50. § of the Government Decree No. 253/1997. (XII. 20.) (on the Hungarian national settlement planning and construction requirements, hereinafter OTÉK), the constructions must comply with basic requirements of the aspects below and with the expectations detailed in the planning program as per the intended purpose:

- mechanical resistance and stability,
- safety in case of fire,
- hygiene, health and the environment,
- safety and accessibility in use,
- protection against noise and vibration,
- energy economy and heat retention,
- life and property protection, as well as
- sustainable use of natural resources.

The essential requirements listed above can be met by applying the relevant Hungarian national standard or by another solution ensuring at least equivalent fulfillment of the requirements. It is a basic rule that the structures meet the safety requirements of the Hungarian national standards during their planned or estimated service life, in particular the requirements of stability and mechanical resistance, as well as proper and safe use, and provide protection against damage caused by expected effects during the intended use of the structure and withstand the expected loads and effects. Below we briefly present the basic requirements (in connection with the security of buildings) and the main specific requirements (according to § 50-57 of the OTÉK, in a very abbreviated form¹⁰).

Stability, mechanical resistance

The building and its parts and structures (including mechanical systems) must be designed and implemented in such a way that the expected loads and effects occurring during construction and use do not

¹⁰ For each of the essential requirements described, it is proposed to take into account the more detailed explanation given in the cited legal position.

lead to, among other things, complete or partial collapse of the building and its structures and do not lead to impermissible deformation of the building and its structures.”¹¹

Safety in case of fire

The building and its parts must be constructed in a way that, in the event of a fire, their stability is maintained for the prescribed time. The generation and spread of fire and smoke are limited, the occupants can leave the structure within the prescribed time or the possibility of their rescue must be technically ensured, the operation of the rescue units must be manageable and safe.¹²

Hygiene, health and the environment

The building and its parts must be constructed in a way that the building material, building structure, built-in equipment and piping are selected and installed as not to endanger the hygiene of the environment. Also, important health of users by among others the generation and emission of toxic gases, by emitting dangerous radiation by sedimentation of biological pests, by harmful noise and vibration, by the formation or retention of harmful moisture.¹³

Safety and accessibility in use

The building must provide safe conditions for its intended use and must not cause accidents, injuries such as slipping, falling (while moving), tripping, falling down, colliding, etc. ¹⁴

Protection against noise and vibration

The building and its parts and structures must be dimensioned and implemented so that it can withstand the noise and vibration effects from its surroundings (e.g. seismic and traffic vibration effects) to the prescribed extent or dampen it to a certain extent.

Energy economy and heat retention

The building must be designed and constructed in such a way as to minimize the energy consumption required for its intended and safe

¹¹ OTÉK 51. §

¹² OTÉK 52. §

¹³ OTÉK 53. §

¹⁴ OTÉK 54. §

use. The possibility of using energy from renewable sources must be considered in the planning program in all cases.¹⁵

Property protection

It must be ensured during the planning, implementation and maintenance of the buildings that the assets placed (stored) as predestined are safe in the manner specified in the planning program.¹⁶

Sustainable use of natural resources

Sustainability aspects (healthy indoor environment, rationalization of energy and water use, use of renewable energy sources, use of locally produced, natural or recycled building materials, reduction of pollution, and application of a life-cycle approach) must be pursued during designing, implementation and demolition.¹⁷

Protection of buildings against certain effects

Quoted directly from OTÉK: „*The building and its parts must be protected against chemical, corrosion and biological effects endangering stability, mechanical resistance and proper use, as well as against the harmful effects of water, moisture (groundwater, soil moisture, soil vapor, rainwater, service water, steam, etc.). [...] The protection of the structure against lightning, electrostatic charging and leakage currents must be ensured in accordance with its purpose.*”¹⁸

Overall, we can say, that the requirements are diversified, they cover many professional fields, and, in many cases, they are difficult to coordinate.

4. Classification of hazards related to the different aspects of buildings

Different approaches and classifications of building hazards are possible. Our classifications, detailed in very different respects below,

¹⁵ OTÉK 56. §

¹⁶ OTÉK 56/A.§

¹⁷ OTÉK 56/B.§

¹⁸ OTÉK 57. §

show how diverse the area under study is. Hazards can occur during the life cycle of a building:

- during construction,
- during use,
- during renovation,
- during demolition.

Hazards according to the place of origin:

- in the building,
- in the surrounding of the building.

Hazards in buildings by origin:

- incorrect design,
- incorrect construction,
- malfunction,
- extraordinary effects, environmental changes,
- previous damages (e.g, war damage),
- unprofessional restructuring,
- vandalism,
- natural aging of structures,
- unsuitable or poor construction product,
- construction product or structure containing / emitting dangerous substances,
- change of function,
- other unknown or ignored circumstances.

Main building structures or systems associated with the hazards:

- structures,
- enclosure structures,
- industrial structures,
- plumbing,
- building- electricity.

Classification of hazards by consequences:

- imminent danger of accident or death,
- risk of accident or death in the event of an emergency,
- causes damage to health in the long run,
- material damage.

In addition to the considerations listed above, there may be other issues involved in identifying and assessing hazards. It is very common that the hazards occur simultaneously connected to one another. Failure of building structures can result in damage to or destruction of additional structures. Rapid detection and repair of faults and damage in buildings can prevent chain reactions, resulting in significant financial savings and the prevention of additional hazards. Building diagnostics knowledge can play a big role¹⁹.

5. Examples of common hazards

The following examples illustrate some of the features from the actual practice that risks related to buildings in many cases can be clearly identified.²⁰

5.1. Structural hazards

Usually easily recognizable signs (deformations, cracks) indicate the onset or impending structural failure. Early detection of these can make it possible to eliminate danger and preserve lives and property.

Vertical cracks on the masonry piers of buildings can predict near and progressive ruination. In such cases, rapid intervention is required (static inspection and strutting, in critical cases, evacuation of the building, part of the building, diversion of pedestrian traffic, etc). It can be especially dangerous if there is traffic with strong vibrations close to the building.

¹⁹ József Bajza: Szemrevételezéses épületdiagnosztika. Terc Kiadó, Budapest 2003.

²⁰ Therefore, the purpose of this chapter is only to present the identifiable nature of some of the characteristic hazards, and not a broad and thorough overview.



*Figure 1: Vertical crack in the masonry pier of a multi-storey building
(Made by: Péter Tóth)*

Figure 2 shows cracks from a typical settlement. The location and direction of the cracks in many cases show the mechanism of settlement. Several other suggestive examples of structural defects were described by Sarolta M. Zöldi ²¹.

On the Figure 3 the deformation of the upper part of the firewall shows the weakening of the masonry. In the event of an extreme impact (e.g, stormy wind, earthquake), the upper part of the masonry may fall, causing immediate danger and further damage to the building structure (e.g., damage to the floor slab).

²¹ Sarolta M. Zöldi: Tartószerkezetek hibái. Műszaki Könyvkiadó, Budapest, 1979.



*Figure 2: Inclined crack in the load-bearing wall structure of a one-storey building. Cracks result from settlement. The supported corner of the building sank, presumably due to a drainage fault.
(Made by: Péter Tóth)*



Figure 3: Significant deformation of the firewall (Made by: Péter Tóth)

A heavily fungus-infected roof structure can also be a structural problem. The fungus-infected, rotten wood can easily be identified, i.e., by means of a screwdriver (intact wood is solid). In the vicinity of leaking, it may also be appropriate to inspect covered wooden slabs. Common faults are the surrounding of furrow (roof pitch), chimneys, antennas, and scuttles etc., firewall line. Unfortunately, effective fungal and fire protection is rarely made on the wood used.²²



Figure 4: Heavily rotten wooden roof structure (Made by: Péter Tóth)

Without excavation involving major destruction, many structural defects can only be identified during construction. The prefabricated prestressed beams of the E-beam reinforced concrete slab shown in Figure 5 were placed on an incorrectly positioned and weak lintel.

²² Iveta Mitterova, Martin Zachar, Eva Ružinská, Andrea Majlingova: Ignitability of Unprotected and Retardant Protected Samples of Spruce Wood, August 2014 Advanced Materials Research 1001:330-335, DOI: 10.4028/www.scientific.net/AMR.1001.330, p. 330



Figure 5: Incorrect slab design (Made by: Péter Tóth)

The additional tin structures of roofing shown in Figure 1 are worn out and need to be replaced. Replacement can prevent serious damage to the roof structure and wooden floor support elements.



Figure 6: Worn out zinc sheet valley (Made by: Péter Tóth)

5.2. Fire hazards

In many cases, great practice is required to identify fire hazards. In many cases, however, the hazards can be identified based on a few simple considerations relating building structures similar to those below:

- The fire resistance of structures with fire resistance performance (e.g, walls, ceilings) may disappear at the site of breakthroughs, pipe penetrations. The fire resistance performance of the applied solutions must be verified.
- The protection of combustible façade thermal insulation is always necessary from fire protection aspect. This is most often solved with a thin, mesh-reinforced back putty. The details and breakthroughs of the thermal insulation system must be carefully designed in accordance with fire protection aspects. Incorrect details and subsequent breakthroughs result in non-compliance of the system from the point of view of fire protection (refer to Figure 7 and 8).
- Combustible thermal insulation for cavity façades must not be installed in Hungary at any building height.



Figure 7: Due to the installation of air conditioning equipment, the façade thermal insulation system was broken through, and the seal was solved with PUR foam. (Made by: Péter Tóth)



Figure 8: Due to a retrofitted shutter cabinet, the contractors cut out the part of the façade thermal insulation system above the window (window-head). As a result, the fire protection characteristics of the thermal insulation system are radically worse than those of a certified system. (Made by: Péter Tóth)

The safety of the up-to-date buildings are depending highly on the operational safety of the so-called *active fire protection systems* (fire detection and alarming systems, automatic fire suppression systems, heat and smoke vent systems etc.) which contains sophisticated electronic components too. Their possible design or operational deficiencies are also barely noticeable to experts, even so the knowledge about the main operational principles and the reliability of the systems (and the necessary maintenance) could be useful for the target groups.

The fire safety of a building can also be strongly influenced by the way it is used (the so-called human factor) as follows:

- Improperly stored building materials, waste and junk cause a fire hazard.
- Fire doors and windows do not fill their role when fixed in open position.
- The number of persons in the rooms must be determined in accordance with the escape possibilities and the design of the structures. In many cases (e.g, kindergarten graduation) there are far more people than allowed in the rooms hosting the event.

5.3. Health hazards

The materials used in our buildings are often harmful to health. Wet, fungal structures also mean health hazard. Emission of hazardous materials from building materials (and furniture) can often only be determined by laboratory testing. Some common health hazards are highlighted below.

Wet to touch nitrous stains indicate active mechanical failure or absorbed moisture. The thermal properties of wet walls deteriorate, the settling fungi can cause allergies and other diseases in the long run and can spread to other structures (e.g, parquet flooring) (refer to Figure 9).



Figure 9: Wall structure sodden due to mechanical failure (Made by: Péter Tóth)

Condensation, mold in wall corners, on the inner surface of inhomogeneous wall structures indicate high humidity and cold bridge building structures. The settling fungi can cause allergies and other diseases in the long run (refer to Figure 10).

Many building materials contain volatile hazardous components (e.g, formaldehyde). The number of controlled ingredients is relatively small compared to the number of potentially hazardous compounds. Block-boards, OSB sheets, paints, adhesives, plastic foams emit such

materials to varying degrees. Great efforts are currently being made in the European Union to limit these emissions, to label products and to inform buyers / designers. Concentrations of hazardous substances can be effectively reduced by adequate ventilation.



Figure 10: Mold due to cold bridge wall structure (Made by: Péter Tóth)

Toxic substances are also released into the air during the combustion of building materials. These include flame retardant plastics, plastic foams, fiberboards, block-boards, wood treated with wood preservatives, pallets etc. Their destruction by fire or use for heating is not allowed. Toxicity of fumes released from building materials in fire events is usually underestimated²³.

In buildings, built between 1960 and 1980, various versions of asbestos insulations were favored, primarily as fire protection (refer to Figure 11). The carcinogenic effect of fibers spilled from asbestos insulation is known. In most cases the presence of asbestos insulations can be identified visually (Figure 11.). Proper removal or isolation of detected asbestos is required.

23 S. Doroudiani, B. Doroudiani, Z. Doroudiani, 9 - Materials that release toxic fumes during fire, Ed.: F. Pacheco-Torgal, S. Jalali, A. Fucic, In Woodhead Publishing Series in Civil and Structural Engineering, Toxicity of Building Materials, Woodhead Publishing, 2012 pp 241-282, ISBN 9780857091222



Figure 11: Sprayed asbestos fire protection (Made by: Péter Tóth)

Roof slate coverings made with asbestos fibers were preferred because of their advantageous properties and durability. The release of fibers from the worn coverings into the environment is continuous, but higher exposure is mostly expected during the drilling and cutting of the elements, i.e., during transformation. Asbestos slate is to be treated as hazardous waste and can only be demolished with special precautions.

5.4. Errors that endanger safety in use



Figure 12: Incomplete, poorly maintained handrail in a nightclub (Made by: Péter Tóth)

During use, building structures often contribute to the formation of accidents, causing slippage, tripping and collisions. Covers with sharp or pointed parts can cause injury. Dropping elements that are not properly secured can also be dangerous.

Due to the missing elements of the handrail shown in Figure 12, it posed a danger to visitors to the nightclub in several ways. There was a risk of falling due to missing handrail inserts and injury due to sharp corners.

The balcony handrail inserts shown in Figure 13 is made of a single-layer tempered glass. It falls into small pieces on a hard hit, but it cannot provide the protection against falling out.



Figure 13: Balcony handrail insert made of tempered glass (Made by: Péter Tóth)

The falling elements of the roof posed an immediate danger to life in the courtyard of the educational building shown in Figure 14. In addition, aged, deteriorated roof coverings can cause the destruction of protected structures.

It would be useful to provide basic knowledge to staff using and operating buildings concerning the cases such as those described in this article.



Figure 14: Frozen plain tile covering (Made by: Péter Tóth)

6. Practical implementation of building preparation

From the above, it can be seen that there are countless types of hazards and hazards associated with buildings, so not only professionals need to be aware of them.

There are few examples and possibilities for similar trainings, so in this chapter we summarize the main aspects of theoretical preparation related to buildings.

Several experts pointed out that despite the successful transfer of information, *“the biggest dilemma is not to compile professional content or solve organizational and technical issues, to organize the staff, but to arouse the professional interest of the human community to be protected, and the ‘follow-up’ of changes”*. Surveys show that broad sections of the population do not want to take an active part in preparation tasks. The reason is not to be found in dismissive behavior but in human brain activity. Namely: the human brain almost automatically “pushes out” unlikely events that seem distant in time, especially negative effects, from its conscious base, approx. within 15-30 days.”²⁴

²⁴ György Potóczki: Vannak-e továbbfejlesztési lehetőségek a katasztrófákat megelőző időszak lakosságfelkészítési tevékenységében? Hadmérnök Vol. VI. /2. p. 325

The short but *exemplary and engaging training* advocated in this article would be important and useful in the long run for all concerned. Potóczki further elaborates on the examined problem area as follows:

„Most people do not even recognize their own risk involvement or consider protection to be the sole responsibility of a law enforcement and / or administrative organization, despite legal obligations. Yet almost any preparation would also require the personal involvement skill of those involved. It can be proved that in unstable socio-economic conditions, the population's need for self-defense (food supply, etc.) increases almost automatically)”²⁵

The above quotation points out that it is not enough to pass on knowledge in lectures, but also to publish it in an easily accessible printed or Internet interface, in an understandable and searchable form. There are also obstacles to providing the necessary financial resources for the preparation and the time frame of the participants (teachers and students). It would be desirable to design the national (in-house and public information) system of training of security professionals and the population in a way that it could cover also the training on various topics.

Tools for disseminating knowledge and preparation

The traditional means and methods of preparing the population are as follows:

- lectures,
- presentations,
- open days,
- leaflets,
- tenders,
- events,
- Internet /media.

In our case, it would be desirable to transfer the knowledge through online or contact lectures and to record it in a retrievable way. The content should cover at least the hazards associated with construction, use, repair – reconstruction and dismantling, as well as knowledge of the basic diagnostic possibilities.

²⁵ Potóczki p. 325

In the field of defense, the above knowledge transfers could take place in a more targeted way; in addition, the members of the staff are naturally more motivated to participate in education and training, as they have an employment relationship with the owner and operator of the building.^{26 27}

Learning and knowledge gathering has been changed. For the new generations, the instructor is not the only "source of knowledge". Adapting to this in knowledge transfer, new forms need to be applied. Such new forms could be targeted electronic, mobile phone or web-based distance learning opportunities²⁸, but even virtual-augmented reality^{29 30}.

Summary conclusions

The article addresses one of the challenges of environmental safety, the dangers associated with buildings, the need and opportunities to prepare for them by examples in Hungary.

The lessons learned from some of the practical examples presented are that in the future it would be important for defense professionals, but also for the general public, to have access to this knowledge: either by inviting them to stand-alone training or by building on existing training systems. In addition to traditional forms, VR-AR platforms, apps,

²⁶ Tünde Bonnyai: A kritikus infrastruktúra védelem elemzése a lakosságfelkészítés tükrében. Doctoral (PhD) Dissertation 2014. https://www.uni-nke.hu/document/uni-nke-hu/Bonnyai-Tunde_Doktori-ertekezes_2018.pdf, downloaded on 10.12.2020.

²⁷ Tomasz Zwęgliński: Effectiveness of E-Learning in Safety and Security. Community Awareness Raising and Resilience Building, January 2017, In book: Security and Law Publisher: Verlag Dr. Kovac GMBH Fachverlag für Wissenschaftliche Literatur

²⁸ Charles R. Graham, Kursat Cagiltay, Joni Craner, Byung-Ro Lim, Thomas M. Duffy: Teaching in a Web Based Distance Learning Environment: An Evaluation Summary Based on Four Courses. CRLT Technical Report No. 13-00. Indiana University, 2000.

²⁹ Mehmet Kesima, Yasin Ozarslan: Augmented reality in education: current technologies and the potential for education. Procedia - Social and Behavioral Sciences Vol. 47, 2012. pp. 297 – 302

³⁰ Hornyacsek Júlia, Kovács Gergely: A kiterjesztett valóság alapú szemüveg alkalmazásának kihívásai a védelmi szférában a műszaki szakfeladatok ellátása során, In: László Földi: Szemelvények a katonai műszaki tudományok eredményeiből I., Budapest, Hungary: Ludovika Egyetemi Kiadó (2021) 275 p. pp. 147-166., 20 p.

and similar devices could convey this knowledge well. They have a high level of motivation, so they would also increase their willingness to learn.

The training proposed in the article could increase the number and effectiveness of professionals (not experts!) who can be involved in defense in the event of specific disasters or accidents. In the field of building knowledge, it may also be desirable to train professionals who come into contact with buildings at some level of disaster management or other law enforcement agencies as part of their work, their construction, operation, demolition, or rescue, remediation, and remediation problems in emergency situations.

According to the conclusions of this article the trained professionals (or commoners) will move more confidently in the built environment and will be able to identify the easily recognizable hazards.

Both professional and volunteer or other staff may be involved in this circle. Of course, the target groups need to be provided with special knowledge, with content that affects them. However, this is the subject of a subsequent research.

References

József Bajza: Szemrevételezéses épületdiagnosztika. Terc Kiadó, Budapest 2003.

Tünde Bonnyai: A lakosságfelkészítés lehetséges módszertana a létfontosságú rendszerek és létesítmények védelmének rendszerében. Hadmérnök. Vol. VIII issue 2013/3 pp. 58-73. http://hadmernok.hu/133_07_bonnyait.pdf, downloaded on 10.12.2020.

Tünde Bonnyai: A kritikus infrastruktúra védelem elemzése a lakosságfelkészítés tükrében. Doctoral (PhD) Dissertation 2014. https://www.uni-nke.hu/document/uni-nke-hu/Bonnyai-Tunde_Doktori-ertekezes_2018.pdf , downloaded on 10.12.2020.

S. Doroudiani, B. Doroudiani, Z. Doroudiani, 9 - Materials that release toxic fumes during fire, Ed.:F. Pacheco-Torgal, S. Jalali, A. Fucic, In Woodhead Publishing Series in Civil and Structural Engineering, Toxicity of Building Materials, Woodhead Publishing, 2012. pp. 241-282, ISBN 9780857091222

Júlia Hornyacsek: A polgári védelem alapjai 1. Zrínyi Miklós Nemzetvédelmi Egyetem 2009. p. 15.

Gabryelewicz, I.; Krupa, P.; Sadłowska-Wrzesinska, J.: Online measurement of work safety culture - statement of research, 4TH International Conference on Computing and Solutions in Manufacturing Engineering 2016 - COSME'16, Volume 94, Published 2017. DOI: 10.1051/ma-tecconf/20179406008, p.1

Charles R. Graham, Kursat Cagiltay, Joni Craner, Byung-Ro Lim, Thomas M. Duffy: Teaching in a Web Based Distance Learning Environment: An Evaluation Summary Based on Four Courses. CRLT Technical Report No. 13-00. Indiana University, 2000.

Mehmet Kesima, Yasin Ozarslan: Augmented reality in education: current technologies and the potential for education. Procedia - Social and Behavioral Sciences Vol. 47, 2012. pp. 297 – 302

Sarolta Mentésné Zöldi: Tartószerkezetek hibái. Műszaki Könyvkiadó, Budapest, 1979.

Iveta Mitterova, Martin Zachar, Eva Ružinská, Andrea Majlingova: Ignitability of Unprotected and Retardant Protected Samples of Spruce Wood, August 2014 Advanced Materials Research 1001:330-335, DOI: 10.4028/www.scientific.net/AMR.1001.330, p.330.

National Building Energy Strategy, Hungary (Nemzeti Épületenergetikai Stratégia) 2015.

https://ec.europa.eu/energy/sites/ener/files/documents/EU%C3%81T_164_2_2105_Nemzeti%20%C3%89p%C3%BClet-energetikai%20Strat%C3%A9gia%20150225%20pdf.pdf,
(downloaded on 02.04.2021)

György Potóczki: Vannak-e továbbfejlesztési lehetőségek a katasztrófákat megelőző időszak lakosságfelkészítési tevékenységében? Hadmérnök Vol. VI. issue 2. p. 325.

Solana Javier: Challenges for the 21st Century. Lecture SACLANT symposium: Lisbon 03. 09.1998

Tomasz Zwęgliński: Effectiveness of E-Learning in Safety and Security. Community Awareness Raising and Resilience Building, January 2017, In book: Security and Law Publisher: Verlag Dr. Kovac GMBH Fachverlag für Wissenschaftliche Literatur

Government Decree 253/1997. (XII. 20.) on the national requirements regarding town planning and construction

Júlia Hornyacsek, Gergely Kovács: A kiterjesztett valóság alapú szemüveg alkalmazásának kihívásai a védelmi szférában a műszaki szakfeladatok ellátása során, In: László Földi: Szemelvények a katonai műszaki tudományok eredményeiből I., Budapest, Hungary: Ludovika Egyetemi Kiadó (2021) 275 p. pp. 147-166., 20 p.