VÉDELEM TUDOMÁNY
KATASZTRÓFAVÉDELMI ONLINE TUDOMÁNYOS FOLYÓIRAT

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THE ROLE OF FIRE PROTECTION TECHNICAL GUIDELINE IN THE PROTECTION AGAINST HEAT AND SMOKE SPREAD

Abstract

During the procedures of fire protection authorities and professional authorities, always brought to the fore the question of how and with what solution the level of safety required by law can be implemented. From 5 March 2015, there are more emphasis on the various engineering methods that help the engineering thinking and the development of design. As a result of this, the proven solutions that have been implemented and occurred several times are soon appear in the relevant Fire Protection Technical Guidelines, which support the work of designers and representatives of the authority, speed up and simplify official and professional procedures. The authors briefly, through the presentation of Protection against heat and smoke spread Fire Protection Technical Guidelines, show the numerous topics, where various technical solutions, different calculations, or conditions of particular implementations has been worked out. This proves that such a detailed elaboration of fire protection solutions, their appearance in a unified structure would not have been realized, if the system of Fire Protection Technical Guidelines had not been established.

Keywords: TvMI, engineering methods, solutions, Fire Protection Technical Guideline

TŰZVÉDELMI MŰSZAKI IRÁNYELV SZEREPE A HŐ ÉS FÜST ELLENI VÉDELEMBEN

Absztrakt

A tűzvédelmi hatósági és szakhatósági eljárások során mindig előtérbe kerül az a kérdés, hogy hogyan, milyen megoldással valósítható meg, teljesíthető a jogszabály által előírt biztonsági

szint. 2015. március 5-től nagyobb hangsúlyt kapnak a különböző mérnöki módszerek, amelyek segítik a mérnöki gondolkodást, a tervezés fejlődését. Ennek köszönhetően megvalósított és többször előfordult, bevált megoldások kis idő múlva megjelennek a vonatkozó Tűzvédelmi Műszaki Irányelvekben, amelyek támogatják a tervezők és a hatóság képviselőinek a munkáját, gyorsítják, egyszerűsítik a hatósági és szakhatósági eljárásokat. A szerzők röviden, a Hő és Füst elleni védelem Tűzvédelmi Műszaki Irányelven keresztül mutatják be, hogy milyen sokrétű témában vannak már kidolgozva műszaki megoldások, különböző számítások, vagy az egyes megvalósítások feltételei. Bizonyítva azt, hogy a tűzvédelmi megoldások ilyen részletes kidolgozása, egységes szerkezetben történő megjelenése nem valósult volna meg, ha nem jön létre a Tűzvédelmi Műszaki Irányelv rendszere.

Kulcsszavak: TvMI, mérnöki módszerek, megoldások, Tűzvédelmi Műszaki Irányelv

1. INTRODUCTION

On the 5th of March 2015, a new time began for fire professionals in the field of fire protection. On this day the amendment of the National Fire Regulations (hereinafter referred to as OTSZ) came into force, which was prepared on the basis of new aspects and expectations. The essence of the new structure is that the required safety level is included in the OTSZ, while its fulfilment is given by a national standard called Fire Protection Technical Guideline (hereinafter: TvMI) [1] [2]. It can be achieved with the technical solutions, calculation methods included in the TVMI or with the use of different solutions certified by the designer. A great advantage of this type of regulation is that the solutions are more understandable, they are more detailed, and they can appear in the guidelines soon at the same time as the technical progress. Their use is voluntary, other solutions can be used, which provides freedom for the designers. The Technical Commission for Fire Protection (hereinafter: the Commission) supervises the development and extension of the TvMIs. The task of it is to monitor the directions of the technical progresses, to analyse the Hungarian and international experiences in connection with the fire protection and, if necessary - but at least annually - to review the TvMIs and their content, and to amend them if it is necessary. The chairman of the Commission is the Chief Inspector of National

Directorate General for Disaster Management of the Ministry of the Interior (hereinafter: BM OKF). Its members are representatives delegated by 11 external organizations.

Another amendment of the OTSZ was published in 2019, which gave to the Commission and to the TvMI working groups a major task. All so far completed TvMIs had to be reviewed and modified in accordance with the changes in the OTSZ. In addition, two new directives had to be developed. Currently, 14 TvMIs have been developed, which can be downloaded free of charge from the website of BM OKF [2].

Most of the designers and experts use the solutions according to the TvMIs. The reason for this is that these solutions have already been proven and meet the level of requirements included in the OTSZ.

By describing some of the solutions of the TvMI, we would like to show how detailed some solutions are and at the same time to prove that their absence would incompletely affect fire protection planning.

2. ESTABLISHMENT AND CONVERSION OF HEAT AND SMOKE EXTRACTION SYSTEM

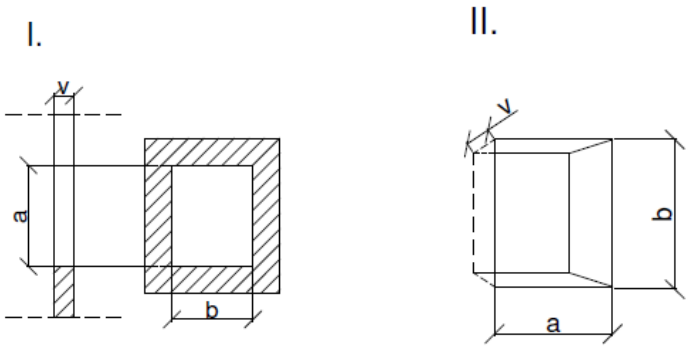
A few years ago, it was a common problem to find solutions for heat and smoke extraction in case of buildings. It is basic that during the installation of the natural heat and smoke extraction system in the new constructions, in addition to the requirements of the OTSZ, the provisions of the MSZ 12101 series of standards must also be observed. In such cases, systems tested as complete structures can be considered. On the other hand, in the existing building, we distinguish the designs based on the scope and extent of the transformation. In case of conversion, it is necessary to install a new heat and smoke extraction structure (for example a new escape route is formed and there are no windows and doors in the given area), then the systems examined as complete structures mentioned above can be developed [3].

In case an existing door and window is used for heat and smoke extraction or air replacement, the normative values included in the TvMI can also be taken into account. However, the actuator must be tested. In the case of the replacement of doors and windows in monument buildings, the manufactured door and window meets the requirements of the OTSZ for heat resistance. It can be placed in the existing opening and can also be used as a heat and smoke extractor with the tested actuator. If the normative values included in the TvMI are chosen, then the effective permeable surface is adequate. In case of converting an existing heat and smoke extraction structure, if the structure was manufactured before 2006, the solutions certified by the manufacturer can be used. Modifications to heat and smoke extraction structures manufactured after 2006 can only be carried out with a separate certification. The OTSZ amendment, (in force from 22 January 2020) not only allows the design of a heat and smoke extraction structure, but also let a permanently opened free opening designed for this purpose [2].

In this regard, the legislator had to record in the TvMI the design of the permanent opening that meets the expectations of the OTSZ [3] [4].

The following free openings can be considered as a heat and smoke extraction or air replacement surface (Figure 1):

a) which is perpendicular to the direction of flow and its smallest extension is larger than the direction of flow (at the thickness of the wall at the opening)
b) the size (length) of the opening in the direction of flow does not exceed 1 metre
c) whose size at the opening (in the case of an opening of less than 2 m^2) is not more than 1: 4, and
d) where the cross-section of the opening is not less than 0.5 m^2.



b > v	a > v
v ≤ 1 m	v ≤ 1 m
In case of opening sizes less than 2 m^2: b/a > 1/4, vagy a/b < 4	a/b > 1/4, or b/a < 4
a*b ≥ 0,5 m^2	a*b ≥ 0,5 m^2

Figure 1 - Development of free opening. Created by the Author.

It was important to mention that not all openings are responsible for the efficient extraction of heat and smoke. For this reason, a surface minimum, a depth maximum, and the aspect ratio to be observed have been determined. The values above were derived from the practical experience of the designers. From this it can be stated how important the knowledge and experience of the professionals are, which are the basis of the solutions included in many TvMIs [5] [6].

3. RELATIONSHIP BETWEEN HEAT AND SMOKE EXTRACTION AND EXTINGUISHING EQUIPMENT

It is an ongoing question for fire protection professionals, that in case of buildings, where sprinkler equipment and heat and smoke extraction are installed, which one should work sooner? A further question is whether these devices interact each other in such a way as to affect the achievement of the installation goals? According to the OTSZ the built-in fire alarm system must control the heat and smoke extraction. An exception is if the operation of the built-in extinguisher is restricted by the control of the fire control panel. For a long time there was no agreement on this issue, but a solution was reached during the elaboration of the TvMIs. So, the TvMI already includes a solution that in the case of a normal sprinkler system, the heat and smoke extraction system can be started automatically by the built-in fire alarm system. However, when using fast-response ESFR sprinklers, the automatic start of the fire alarm system is not appropriate [7] [8].

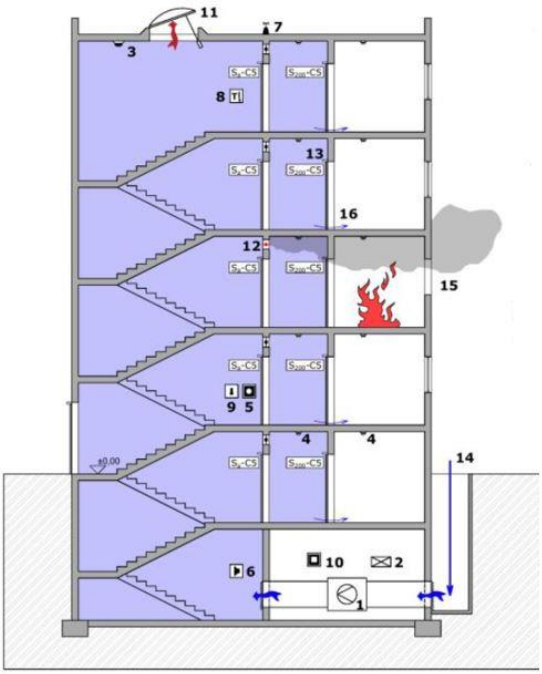
In such a room, an automatic start of the heat and smoke extractor is controlled by the fire alarm system and it limits the efficient operation of the ESFR system. Only manually operated heat and smoke extraction systems may be used in warehouses protected by the ESFR sprinkler. The manual start can be supplemented by a separate thermal release element built into the cupola (the release temperature is higher than the temperature in the sprinkler). This automatically opens the heat and smoke extraction surface in each cupola. However, the ESFR sprinkler system is not used in public areas, buildings or other rooms, where the automatic operation of the heat and smoke extraction is controlled by a fire alarm, which is required to ensure conditions of the evacuation.

In case of industrial buildings, the effect of the two systems on each other must be determined by taking into account the technology, the storage, the number of employees, the evacuation strategy and the firefighting. The freedom and responsibility of the designers also appears here. If the number of number of people and the evacuation strategy together take into account that the heat and smoke extraction system in the production room protected by the ESFR sprinkler does not start automatically, the heat and smoke extraction shall be started manually. If the heat

and smoke extractions are to operate automatically to ensure evacuation conditions, the ESFR sprinkler cannot be used [7] [8].

4. CREATION OF OVER PRESSURED SMOKELESS STAIRWELL

In order to operate the over pressured smokeless stairwell safety the fresh air should be provided primarily from the level closer to the ground (Figure 2).



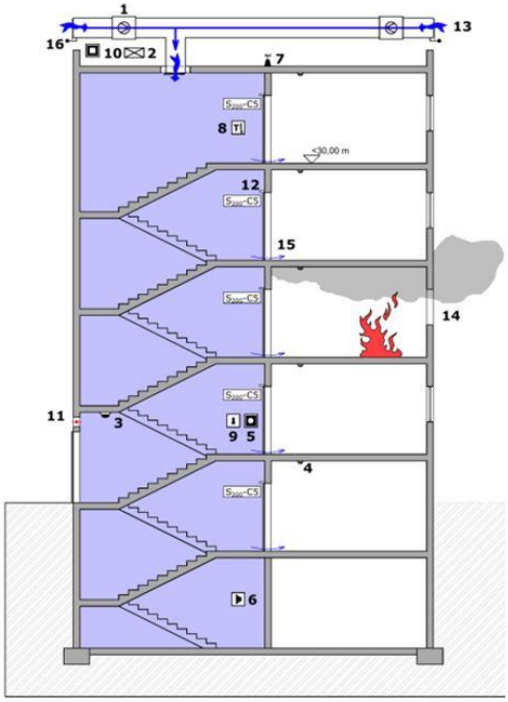
Legend:

1. blower ventilator
2. pressure regulator
3. differential pressure sensor.
4. smoke detector
5. fire alarm (manual call point)
6. fire alarm (sound and light alarm)
7. wind and temperature sensor
8. temperature sensor
9. ventilation key switch
10. overpressure relief cupola
11. weekly program
12. ventilation damper
13. automatic door closer
14. fresh air intake
15. outflow from a broken window
16. pressure loss

Figure 2 - Over pressured smokeless stairwell with overpressure relief cupola. Created by the Author.

If it is not feasible because of technical reasons, fresh air intake above the top level of the staircase can also be a good solution. The condition of it is that the air is taken from at least two different facades or roof surfaces of the building. The intake points must be at least 15 m apart and the switching between the air intake points must be controlled by the fire alarm system at

the signal of the air duct sensor located in the air ducts (Figure 3). Alternatively, it is acceptable to have a single supply ventilator on the roof in the common section of the 2 air duct branches and to place 1-1 flue gas control dampers in each branch. Of these, the one that opens to the section of the air duct farther from the smoke rise [3] [4] [5] [6].



Legend:

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5. fire alarm (manual call point)
6. fire alarm (sound and light alarm)
7. wind and temperature sensor
8. temperature sensor
9. ventilation key switch
10. weekly program
11. pressure relief damper
12. automatic door closer
13. fresh air intake
14. outflow form a broken window
15. pressure lost
16. heat and smoke detector to control reversible suction

Figure 3 - two-way fresh air intake on the rooftop in case of over pressured smokeless stairwell. Create by the Author.

It may be enough to provide a fresh air intake at the top of the over pressured smokeless stairwell, if the building has an automatic extinguishing and alarm system. If there are several smokeless stairwells located in at least two different fire sections, or there is a possibility to escape to the neighbour fire section at each level and there must be a distance of at least 50 metres between the stairwells in the neighbour fire section. The differential pressure values provided by the mechanical system of over pressured smokeless stairwells have not changed during the regulations of recent years. However, innovations have already appeared in terms of differential pressure as well as mechanical response time.

The machine of the smokeless stairwell shall create the appropriate pressure difference within 100 seconds of the activation of the system. Stairway machine has to respond to external influences (for example door opening, closing) that affect the stairwell pressure within 3 seconds. Stairway doors shall be so created so that they can normally be opened with a force not exceeding 100 N. In other cases, the door can be opened by a door actuator [3] [4] [5] [6].

The force required to close the door can be calculated using the following formula:

$$P_{max} = \frac{(100\ N \times X_{handle} - M_{closing})}{(0{,}5 \times SZ_{door} \times A_{door})}$$

where: P_{max}: maximum allowable overpressure
X_{handle} distance of the handle from the axis of the door
$M_{closing}$: torque of the closing structure
SZ_{door}: width of the door
A_{door}: surface of the door

5. ROOFING WITHOUT SIGNIFICANT FIRE RESISTANCE

88.§ (2) of the OTSZ contains the cases where it is not obligatory to provide heat and smoke extraction. Examples are industrial, agricultural or storage rooms whose roof or other structures do not have a high fire resistance. The TvMI contains which solutions and designs can be accepted.

The roofing or other structure closing the room from above shall not have significant fire resistance if:

a) the material of the roofing and structure is

- single-layer, non-insulated glass without safety foil, glass wire mesh without insert
- Material with a flash point below 150 °C, or
- aluminium sheet up to thickness of 1 mm (or thinner).

b) the roofing or structure defined in point (a) covers at least 50% of the floor area of the room and

c) the room does not have a suspended ceiling, insulation, cladding or other structure that prevents the heat of fire from reaching the structure referred to in point (a), and

d) there is no built-in fire extinguisher in the room, which operation would prevent the heating of the structure referred in the point a) closing the room from above.

It is important to mention that if the E 15 criterion is not met, in this case it does not mean that the structure or the cover does not have significant integrity to the fire resistance. This only proves that gaps are developed larger than 6 mm during a possible fire resistance test.

In the above, we have presented the solutions and designs that help the spread of various engineering methods and contribute to effective fire protection in Hungary. Finally, it can be stated that these solutions would not have taken place or would have taken significantly longer if the Fire Protection Technical Guidelines and the legal framework supporting them had not been established.

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[4] MSZ EN 12101-2 Smoke and heat control systems. Part 2: Specification for natural smoke and heat exhaust ventilators

[5] MSZ EN 12101-6 Smoke and heat control systems. Part 6: Specification for pressure differential systems. Kits

[6] MSZ EN 12101-7 Smoke and heat control systems. Part 7: Smoke duct sections

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