

Determining the fire risk for shopping centre

Adam MALATINSKÝ, Martin HROMADA

Department of Security Engineering, Faculty of Applied Informatics,
Tomas Bata University in Zlín
Nad Stráněmi 4511, 760 05 Zlín, Czech Republic
E-mail: a_malatinsky@utb.cz, hromada@utb.cz

Abstract

Fire threats are currently a pervasive problem for various industries. The article proposes specific criteria related to fire protection to determine the resulting fire risk based on which activities are proposed to increase preventive protection. Specifically, in this article, fire safety is addressed for a shopping centre.

Keywords

Fire Safety, Fire risk, Fire protection, Fire criteria

Introduction

The article deals with determining the fire risk of shopping centre shops. In the first chapter, the article describes the primary fire threats and other threats that may arise due to the primary threats. The next chapter deals with the characteristics of the criteria determined for individual shops in the shopping centre. Each criterion is described, and a certain number of points is also assigned. For clarity, at the end of the chapter, there is a table with the minimum and the maximum number of points for individual criteria. The last chapter deals with the resulting degree of risk. Each resulting degree of risk is characterized and assigned design activities to increase preventive protection. The last part of the chapter describes the basic process of evaluating the resulting fire risk.

1. Fire threats

The primary fire threats related not only to the shopping centre's shops include fire, explosion, and leakage of hazardous substances. [1] Fire occurs in the presence of these three quantities - oxidizing agent (oxygen, peroxide), combustible (fuel) and combustion initiator (temperature, spark). As part of fire protection, hazardous substances can cause an explosion and possible fire in the building. [2] The individual types of dangerous substances are divided into appropriate classes according to their nature. The classes of flammable substances are explosives and preparations, gases, flammable liquids, flammable solids, self-igniting substances, substances causing flammable substances in contact with water, oxidizing substances, organic peroxides, toxic substances, infectious substances, radioactive material, corrosive substances and other dangerous substances and articles. [3] These significant threats can cause other accidents at work, damage to machinery and equipment, flooding, power outages, elevated air temperatures, toxic smoke generation or disorientation. Therefore, it is essential to increase resilience as a

precaution and thus prevent the emergence of significant threats that could cause further threats. [4] [5] [6]

2. Criteria

This chapter deals with individual criteria for determining the fire risk for individual shops in the shopping centre. The total number of criteria for each shop is 14. A certain number of points is allocated according to the given situation in each criterion. The criteria for determining the fire risk include:

- number of persons
- shop area,
- type of shop,
- time mode of the shop,
- working week,
- holiday,
- number of floors,
- fire protection system,
- elements of the fire protection system,
- emergency exit,
- space,
- presence of a private security service,
- presence of fire patrol,
- statistics.

Criterion 1 – Number of persons

Within this criterion, it is a matter of determining the average number of persons in the shop in 1 day. The following table shows the average number of people in 1 day and the assigned point value.

Table 1 – Criterion 1 [author]

The average number of people in the shop in 1 day	Number of points	The average number of people in shop the in 1 day	Number of points
up to 50	1	301 – 400	6
51 – 100	2	401 – 500	7
101 – 150	3	501 – 700	8
151 – 200	4	701 – 1 000	9
201 - 300	5	over 1 000	10

Criterion 2 – Shop area

Within this criterion, it is a question of determining the total area of the shop (the warehouse area is also included in the total area of the shop). The following table shows the total area of the shop and the assigned point value.

Table 2 – Criterion 2 [author]

Shop area [m ²]	Number of points	Shop area [m ²]	Number of points
up to 50	1	501 – 700	5
51 – 100	2	701 – 1000	6
101 – 300	3	over 1000	7
301 – 500	4		

Criterion 3 – Type of shop

This criterion determines the type of shop according to the goods or services offered. The following table shows the type of shop and the point value assigned to it.

Table 3 – Criterion 3 [author]

Type of shop	Number of points
Footwear, toys, flowers, drugstores and cosmetics, pharmacy, jewellery and books	1
Grocery without bakery, fashion, sports, household	2
Grocery with bakery, restaurant	3
Electronics	4
Entertainment and services*	5

* A point value of 5 is assigned to the services if it is a service where it comes with electronics to a greater extent. Otherwise, a point value of services (for example, hairdressers, and so on) is assigned. There is less contact with electronics, and a point value is assigned 2.

Criterion 4 – Time mode of shop

This criterion only determines whether the working hours of the shops are non-stop. If not, the assigned point value is 1. If it is, the assigned point value is 3.

Criterion 5 – Working week

The working week criterion determines when the shop is open. If it is open from Monday to Friday, the assigned point value is 1. If it is open from Monday to Saturday, the assigned point value is 2. If it is open from Monday to Sunday, the assigned point value is 3.

Criterion 6 – Holiday

This criterion determines whether a holiday occurs in a given period (this predicts an increased number of people during the holidays or the day before if the holiday is closed). If there is no holiday in the given period, a point value of 1 is assigned. If there is a public holiday or non-working day during the given period, a point value of 2 is assigned. For Easter holidays, a point value of 3 is assigned, and for Christmas holidays, a point value of 4 is assigned.

Criterion 7 – Number of floors

Within this criterion is determining the number of floors in a given shop. If the number of floors is 1, a point value is assigned to 1. If the shop has two floors, the assigned point value is 2. If it has three or more floors, the assigned point value is 3.

Criterion 8 – Fire protection system

This criterion determines whether there is a fire protection system in the given shop. If so, the assigned point value is 1. If not, the assigned point value is 5.

Criterion 9 – Elements of the fire protection system

The criterion determines whether the elements of the fire protection system cover the entire area of the shop or only partially. For total traffic coverage, the assigned point value is 1. If only partially covered traffic, the assigned point value is 3. If no elements of the fire protection system are in the shop, the assigned point value is 4. If criterion 8 is assigned a point value of 5, a point value of 4 is automatically assigned to this criterion.

Criterion 10 – Emergency exit

This criterion determines where the escape route is located. If there is an escape exit directly in the shop, the assigned point value is 1. If it is located next to the shop, the assigned point value is 2. If it is out of the shop, the assigned point value is 3.

Criterion 11 – Space

The criterion determines where the shop is located. If the traffic is located in a corridor (it is not bounded by walls), it is assigned a point value of 1. Otherwise, it is assigned a point value of 2.

Criterion 12 – Presence of a private security service

This criterion determines the presence of a private security service. If a private security member continuously operates, the assigned point value is 1. If a private security member is occasionally in the shop for checking purposes, a point value of 2 is assigned. If a private security member does not come into the shop, the assigned point value is 3.

Criterion 13 – Presence of fire patrol

If there is a fire patrol in the shopping centre, a point value of 1 is assigned. Otherwise, a point value of 3 is assigned.

Criterion 14 – Statistics

This criterion determines the frequency of breaches of fire safety. If there is no security breach, a point value of 1 is assigned. If an exceptional security breach occurs, a point value of 3 is assigned. If there is a more frequent security breach, a point value of 5 is assigned.

Table 4 clearly shows the maximum and minimum point values for the individual criteria.

Table 4 – Point values for the individual criteria [author]

Criterion number	Minimum point value	Maximum point value	Criterion number	Minimum point value	Maximum point value
1	1	10	8	1	5
2	1	7	9	1	4
3	1	5	10	1	3
4	1	3	11	1	2
5	1	3	12	1	3
6	1	4	13	1	3
7	1	3	14	1	5

The total minimum value is 14 points. The total maximum value is 60 points.

3. The resulting degree of risk

Based on the sum of all points from the criteria, the resulting degree of risk within the fire protection is evaluated. The total number of resulting risk levels within the fire protection is 4. Table 5 shows the degree of risk and the number of points from the criteria assigned to them.

Table 5 – The resulting degree of risk [author]

The resulting degree of risk		Number of points
I.	Low risk	14 – 25
II.	Medium risk	26 – 37
III.	Increased risk	38 – 49
IV.	High risk	50 - 60

Each resulting level of risk determines the activity of the fire patrol, control of elements of the fire protection system, control of the private security service and control of state authorities.

I - Low risk

There is a low risk of disruption in fire protection. A breach of security is only expected in very exceptional situations. There are proposed in the shop: the presence of a fire patrol once a week, the inspection of the fire alarm system once a week, the inspection of the private security service once a day, and the inspection of the fire protection authorities once a year.

II – Medium risk

This is a medium risk of disruption in fire protection. A security breach is expected in less frequent situations. There are proposed in the shop: the presence of a fire patrol three times a week, the inspection of the fire alarm system twice a week, the inspection of the private security service twice a day, and the inspection of the fire protection authorities twice a year.

III – Increased risk

There is an increased risk of disruption in fire protection. A security breach is expected in more frequent situations. There are proposed in the shop: the presence of a fire patrol once a day, the inspection of the fire alarm system four times a week, the inspection of the private security service three times a day, and the inspection of the fire protection authorities three times a year.

IV – High risk

There is a high risk of disruption in fire protection. A security breach is expected in more frequent situations. There are proposed in the shop: the presence of a fire patrol twice a day, the inspection of the fire alarm system once a day, the inspection of the private security service four times a day, and the inspection of the fire protection authorities four times a year.

Table 6 provides an overview of fire protection activities for each condition.

Table 6 – Proposal of activities for individual degrees of risk [author]

Degree of risk	Fire patrol	Inspection of the fire alarm system	Inspection of the private security service	Fire protection authorities
I	Once a week	Once a week	Once a day	Once a year
II	Three times a week	Twice a week	Twice a day	Twice a year
III	Once a day	Four times a week	Three times a day	Three times a year
IV	Twice a day	Once a day	Four times a day	Four times a year

For risk levels III and IV, increasing the number of fire extinguishers in the shop is also necessary.

For the first month, shop managers should be in charge of counting people in the plant and evaluating the average number of people in 1 day. This evaluation would be made on the penultimate day of the month. The resulting balances would be proposed for individual shops in the shopping centre on the last day of the month. Based on this proposal, the current level of risk for a given shop would apply from the first day of the month to the following month. The total point value of the criteria with the resulting risk status would change based on changes through the individual criteria. The point values of the criteria would change most often, where the average number of people per day would change, the shop would change or expand the type of goods, or if there were holidays in the following month or if the statistics on the number of fire protection violations would change.

Conclusion

The article dealt with determining the fire risk of the shopping centre shops. In the first chapter, the article described the primary fire threats and other threats that may arise due to the primary threats. The next chapter dealt with the characteristics of the criteria determined for individual shops in the shopping centre. Each criterion was described, and a number of points were also assigned. For clarity, at the end of the chapter, there was a table with the minimum and the maximum number of points for each criterion. The last chapter dealt with the resulting degree of risk. Each resulting degree of risk was characterized and assigned design activities to increase preventive protection. The last part of the chapter described the basic process of evaluating the resulting fire risk. These criteria, after some adjustment, would also be appropriate for other fire risk assessment institutions. The criteria would be modified according to the type of institution and its means.

Acknowledgments

This research was based on the support of the Internal Grant Agency of Tomas Bata University in Zlín, IGA/CebiaTech/2022/004 and The Department of Security Engineering, Faculty of Applied Informatics.

References

- [1] Hazardous substances: Healthy working lives [online]. Available from: <https://www.healthyworkinglives.scot/workplace-guidance/safety/hazardous-substances/Pages/common-hazards.aspx>
- [2] Fire and explosion: Controlling risk together [online]. Available from: <https://www.hseni.gov.uk/topic/fire-and-explosion>
- [3] NEVRKLA, Jakub and team. Soft targets: Identification, hazards and protection [online]. Zlín: Soft Targets Protection Institute, z.ú., 2019. ISBN 978-80-270-7066-4. (in Czech)
- [4] LUKÁŠ, Luděk. Theory of security I. Zlín: VeRBuM, 2017. ISBN 978-80-87500-89-7 (in Czech)
- [5] Act no. 314/2001 Z. z. Act for fire protection: Acts for people [online]. 2001, 2001 Available from: <https://www.zakonypreludi.sk/zz/2001-314> (in Slovak)
- [6] Decree no. 121/2002 Z. z. Decree of the Ministry of the Interior of the Slovak republic on fire prevention: Acts for people [online]. 2002 Available from: <https://www.zakonypreludi.sk/zz/2002-121#f2738114> (in Slovak)