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Risk Analysis of the Reference Object and the Range of the Integrated Rescue System

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Abstract

Safety needs are in the second place in Maslow's hierarchy of needs. This means that a sense of security is not only very important for us, but also necessary. The priority of feeling safe is reflected in everyday activities. From ordinary work to great life decisions. This is the reason why in today's modern world great emphasis is placed on various security measures. however, the modern world is based on freedom, and since it is impossible to create a completely safe world without restrictions on freedom, there are sometimes situations where it is necessary to intervene quickly with some units of the integrated rescue system.
This article focuses on the analyzes of the danger of the congress center, which serves as a cultural center in the city of Zlin where people meet for freedom and entertainment, which can be disrupted.
In the paper is used FMEA analysis (Failure Mode and Effects Analysis) and method of modeling for creation of map of city of Zlin and integrated rescue system.

Keywords: FMEA Analysis; Integrated Rescue System; Reference Object.

1. Introduction

In this article in today's world, prevention is very important, which is doubly true when it comes to averting a terrorist attack or a crime. The intention is to stop the attacker before he reaches his target, which can result in mass loss of life, damage to infrastructure, etc.

Most of these targets are places with a high number of people and places with high attractiveness for the attacker. Criteria such as the presence of the police, a large number of important people, openness to the public, the quality of security staff, the presence of the media, etc. can increase the attractiveness of a given place Kalvach (2016).

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If an attack occurs, it is a necessary part to have a quality integrated rescue system that can be in place as quickly as possible and help the persons concerned at a given moment. The article aims to present a safety analysis of the Zlín Congress Center – its location, surroundings, and surrounding buildings, individual floors, and layout of the reference object, for the calculation of the FMEA analysis. The result of the FMEA analysis is expected to define the three biggest risks for the specified reference object. The analysis counts on various types of attacks, which evaluates and subsequently visualizes the availability of individual integrated rescue systems.

2. Reference Object

The Zlín Congress Center has been in Zlín for the public since September 29, 2010. The complex was established on the plots of former Masaryk schools in the center of the city of Zlín. The basic orientation of the individual buildings is based on the original location of no longer existing school buildings and thus respects the existing monument to Tomáš Garrigue Masaryk. The congress center consists of a central building – the Bohuslav Martinů Philharmonic, where various cultural, social and other events are held, which are attended by a large number of people.

For FMEA analysis, it is necessary to understand the concept, layout and surroundings of the building. Therefore, it is important to deal with the description of individual floors for a clearer idea. The central building is connected to underground garages and restaurants, which serve the public only during events. From the underground garage is the entrance to the immediately adjacent building of the university center – Tomas Bata University (TBU). The central building and garages have 2 underground floors and 3 above-ground floors.

The building has a non-flammable construction system. On the underground floor is located technically facilities (air conditioning engine room, cooling, exchanger station, transformer station, substations, stable fire extinguishing equipment, rooms and garages. On the above ground floor is a large hall for 550 visitors, a small hall for 80 visitors, facilities for performers, more social spaces and an entrance area for visitors with a cash register and a cloakroom. On the 2nd floor (above-ground floor) there is a balcony for 150 visitors as part of the auditorium of the concert hall, offices, warehouses and sanitary facilities, and on the third floor is a balcony for 150 visitors. On the fourth floor, there is a space for overhead and storage space and on the roof of the building a diesel generator with a tank with a capacity of 500 liters of diesel.

Garages are connected to the central building of the Congress Center. The garages are located on the 1st and 2nd floors of the Congress Center building, and are intended for visitors to the Congress Center, but also the public. The capacity of the garages is 57 parking spaces for the 1st floor and 46 parking spaces for the 2nd floor.

2.1. Location of the reference object

The congress center is located in the very center of the city of Zlín (76,000 inhabitants), between Štefánikova and Gahurova streets, close to a public transport stop. The congress center is surrounded by two green spaces. The first of them is Comenius Park, which is located behind the library building between Tomáš Bata Street and Štefánikova Street, and another green area is Gahurův Prospekt in a view under the House of Arts on Tomáš Garrigue Masaryk Square.

The passages of the park lead to the adjacent Prior department store on Náměstí práce. Furthermore, in close proximity, the Congress Center is adjacent to the Tomas Bata University Library (U13), with which it also shares a common courtyard.

However, the buildings are at a sufficient distance from each other, when in the event of a fire, it is not possible to hit the other of the buildings. There is also a newly built faculty of humanities at Tomas Bata University in the vicinity, where a large number of students and staff gather daily. Furthermore, the Congress Center is located near the student dormitories, which are situated north of the building. To the south of the Congress Center is the Roman Catholic Church of St. Filip and Jakub, Municipal Theater, Library.

On the north side, there is the Tomas Bata Memorial – the House of Arts, and on the east side is the already mentioned Prior department store and the Moskva Hotel – the former Social House. The building of the Congress Center is located next to the Gahurova and Štefánikova roads with very heavy traffic. To the south, within a range of 498 m, there is the Dřevnice River, but the Zlín Congress Center is not located in a flood area.

2.2. Description of the reference object

In the basement, there is an underground car park for 107 cars (Fig.1). In this part, there is one member of the security, who performs regular inspections of the entire area around the premises every hour. By radio, this employee is connected to the person of the city police, who is located on the first floor. Parking spaces are distributed for both the public and employees. Employee positions are divided for employees of the Bohuslav Martinů Philharmonic and employees of the University Center. The whole building is under camera surveillance.

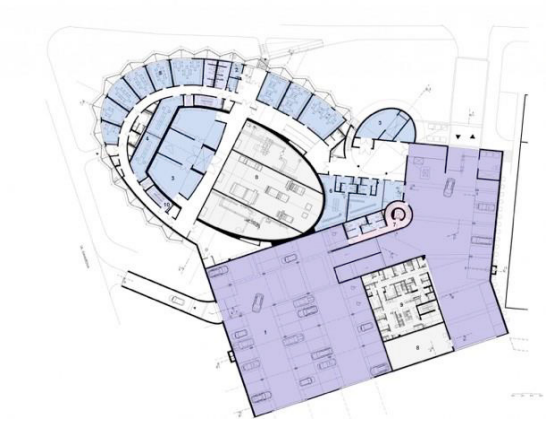

Fig. 1. Underground.

Figure number 2 shows, that there are two entrances on the first floor. One entrance, located on the side of Štefánikova Street, is for employees only. Only 16 people have the so-called general key from the whole complex, one of them is Mgr. Petr Jordán – head of the department, Petr Zikmund – technical administration of the building or, for example, a city police officer, who has a glass office right at the entrance to the building and whose job is permanent supervision of the building.

It has a recording of all cameras in the area, and since it sits right at the entrance, it also has a personal overview of each person who walks through the door of the building. Furthermore, on the first floor, there is an information center, entrance, cloakroom, and lounge. ZLIN (2021)

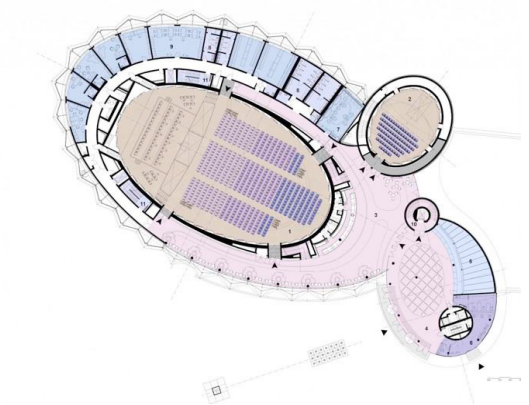

Fig. 2. First floor.

On the second floor (Fig. 3) there is a restaurant, which is open only if the event takes place in the Zlín Congress Center or if the landlord rents a restaurant. The restaurant is no longer operated separately, as it used to be in the past. This also reduced the risk of fire. Because all appliances in the restaurant are switched on only for a limited time and always only under the control of a specific employee.

Immediately after the event, all appliances are switched off, both to save energy and due to the possible risk of fire. It is necessary to add that the appliances are always handled under the supervision of a trained person and the appliances do not operate in the absence of supervisors.

There are also several offices on this floor, each of these offices has a large window, with the possibility of opening, but it must be added that the whole building is lined with a luxfer wall, which prevents noise from Štefánikova busy street, but also has the task of protecting the whole building for example before vandalism etc.

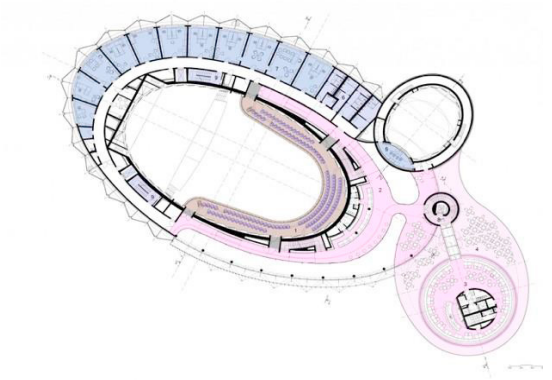

Fig. 3. Second floor.

On the third floor, there is a recording studio of the Bohuslav Martinů Philharmonic, rooms for directing, but also a foyer for the public. And as on every floor, there are also escape and operating stairs and toilets. The plan and deployment are described in Figure 4 ZLIN (2021).

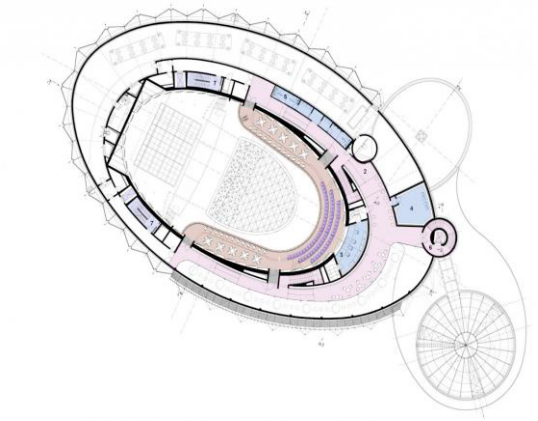

Fig. 4. Third floor.

2.3. 2.3. Crime of the City of Zlín

The location of the Zlín Congress Center is not dangerous in terms of crime. The crime of the city of Zlín is doing well in comparison with other municipal cities. According to the crime map, the city of Zlín has a crime index of only 13.2. In comparison with Prague, which has a crime index of 155.4, or Olomouc, which has an index of 24.6, we can say about Zlín that it is a relatively safe location, however, the safety of the building can not be underestimated.

3. Risk Analysis of the Zlín Congress Center

A congress center is a place where a large number of people meet every day who can become potential victims. Therefore, all risks that may occur and that endanger human health and lives must be addressed here. After a personal consultation with the building manager, Mr. Petr Zikmund, I learned that all possible risks that could occur in the premises of the Cultural and University Center are provided from the beginning and employees are regularly trained against possible, but even so small possible occurrence ZLIN (2021).

Failure Mode and Effects Analysis (FMEA analysis) is used to determine the degree of risk of the reference object against individual security risks. For the needs of FMEA analysis, it is important to focus on individual forms of attack and evaluate the degree of probability, detectability and severity on a scale of 1-10 (Tab. 1; Tab. 2) BERNATIK (2013).

1. Fire – The Zlín Congress Center has a diesel unit located on the roof, which is used to power air conditioning, which air-conditioning the premises in summer and heats them in winter. This diesel unit stores 500 liters of diesel, which creates a fire risk. Due to external intervention, long-term high temperatures in the summer months or technical faults, the diesel unit could ignite.
2. Terrorist attack – Zlín, as such, is not one of the most important cities in relation to other cities in the Czech Republic. It is a small, modern, regional town. On the other hand, a few very famous events a year take place in Zlín, which increase their significance, such as the Zlín Film Festival and the Barum Rally, where the center of Zlín and the surrounding area is open to visitors from all over the world.
3. Truck raid – a truck raid into the Zlín Congress Center would be fatal for visitors who would surround the courtyard of the Zlín Congress Festival during the Zlín Film Festival. There is nothing to prevent the passage in the immediate vicinity of the building. Only a deceleration retarder, which could be used at high speed (a long Gahur street could be used to gain high speed), would rather serve as a retarder. However, the penetration into the building itself would not be possible with a truck, as the front part of the building is bordered from 3 meters by a black metal structure, which would prevent the truck from passing.
4. Driving a car – seemingly similar to driving a truck, but has a completely different impact. As already mentioned above, the metal structure of the Congress Center starts from 3 m, so the passage of the running car would not be stopped and the car could penetrate into the premises of the building itself. In this case, there would be more injured people outside the building.
5. Explosive – the month of November, when Christmas events are held, and the month of May, when the Zlín Film Festival takes place, a large number of people gather in the Congress Center Zlín and its surroundings. A potential attacker who would hide a bag with a bomb could walk into the premises of the building, as there is no personal search in these events. During these months, it would only be enough to leave the bomb in front of the object, the bomb placed in this way would cause a great loss of life.
6. Sagittarius – the main entrance of the Congress Center is not guarded, at the beginning of the concert, when visitors arrive, the perpetrator in the hall with locker rooms could do great damage to lives, the average attendance at the event is over 700 visitors. It would also be possible to carry a short firearm under a jacket or shirt if the attacker had a ticket for the event and started firing inside, which would cause even greater damage. A long firearm (such as a shotgun) could only be used on entry, as it would be difficult to hide after storing bags and coats.
7. Food poisoning – can occur as a result of food spoilage or intentional poisoning of raw materials. At this risk, it would be possible to pump up the stomachs of people who ate food and if the damage could be minimal. However, the reputation of the Zlín Congress Center would be damaged.
8. Mass brawl – at all events of the Zlín Congress Center, the consumption of alcohol is allowed, which can arouse aggressive behavior in people. As already mentioned — the Congress Center is mainly used to gather more people, which together with alcohol can have a bad impact.
9. Theft – during the planned breaks at events, there is a sudden large number of visitors around the restaurant and refreshments, which can lead to deconcentration of service and therefore theft. As cash or in the form of expensive bottles of alcohol. Theft can also occur during the supply of the Zlín Congress Center.
10. Burglary – as part of exhibitions and openings in the Zlín Congress Center, there are works of art in the building. Alarms and camera systems are used against burglary. The camera systems are connected to the city

police, which is located on Tomáš Bata Street. The building is guarded by a security guard who bypasses the building every hour.

11. Vandalism – there are no residential buildings in the area, only high school and university dormitories. In the vicinity, there are only buildings that are uninhabited overnight - T. Bata Business Academy, TBU Faculty of Humanities, Prior. Therefore, the vandal would not be disturbed and at the same time environments such as clubs and bars are close enough where young people, as a risk group of people who are more prone to vandalism, occur in the evening Brzybohaty (1999), Bennet (2018).

Table 1 FMEA analysis.

		RPN			
ID	Risk	P	O	Z	ΣRPN
1	Fire	2	8	5	80
2	Terrorist attack (car, gun, lorry)	3	6	9	81
3	Food poisoning	4	9	8	288
4	Mass brawl	5	6	4	120
5	Theft	6	8	6	252
6	Burglary	5	7	7	245
7	Vandalism	9	8	5	360

Table 2 Classification of values.

Values	Classification	
Probability.	1=Low	10 = High
Detectability	1=high	10 = undetectable before occurrence
Severenity	1=low	10 = high

The surroundings of the Zlín Congress Center are busy. Immediately after the building is the busy Štefánikova Street, which leads to Vizovice, and from the east side is Gahurova Street, which leads from the South Slopes to the House of Arts, Grammar School and Language School and the Police of the Czech Republic – Zlín Regional Office.

Gahurova Street in front of the Congress Center is slowed down by a retarder located directly in front of the building. Štefánikova street is very busy, there is also a trolleybus stop, where the connections of trolleybuses number 3,8,4,11,9,2,13,12 and 1 and buses number 33 (Medical school), 31 (Jaroslavice) stop, 36 (Velíková), 32 (Kudlov), 38 (Baťa Hospital), 34 (Lešná), 70 (Baťa Hospital), 35 (Velíková), 90 (Lužkovice) and 820765 (Luhačovice) ZLIN (2021).

Employees, the public and visitors to the Congress Center have parking directly in the underground garages of the building, or they can park in front of the adjacent Prior shopping center, where there is a parking lot for 70 cars. The journey of each of the Integrated Rescued System units to the Zlín Congress Center is possible within 10 minutes. The closest is the Police of the Czech Republic – district department on T. Bati 44 class with a travel time of 2 minutes.

Also nearby are the Regional Police Headquarters of the Czech Republic (J. A. Bati 5637), the Territorial Department of the Police of the Czech Republic (T. G. Masaryk Square), the Zlín Municipal Police Service (Santražiny 3312) and the Municipal Police Service (Okružní 4699).

We have a double type of fire rescue in Zlín. The professional fire brigade is located at 213 Přílucká Street and the Voluntary Fire Brigade at 103 Švermova Street. If necessary, the Emergency Medical Service will contact the service in Zlín, located at 602 Váchy Street or 434 Peroutkovo nábřeží. In the picture below (Fig. 5) are seen units of the integrated rescue system and the distance from the Congress center of Zlín.

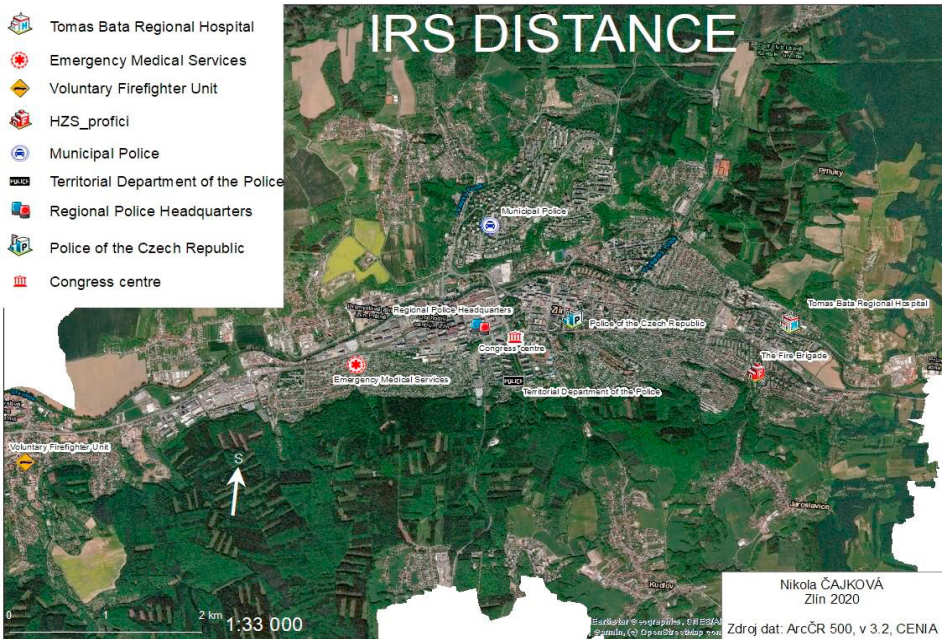

Fig. 5. IRS distance map.

4. Methods

In this paper were used 2 methods. The first method, FMEA analysis, was used to assess the risks that may occur and to classify them. A table is created in the work, which shows the point representation of individual risks. The second method is a modeling method, which was used to create a map composition that shows the city of Zlín and the deployment of an integrated rescue system in it. Lorenc (2013).

5. Conclusion

This article aimed to perform security analyzes of the Zlín Congress Center building. First, the location of the building, the surrounding streets, the lining building, and the individual entrances to the building were assessed. Detailed documentation was linked to each floor of the Zlín Congress Center, both in an illustrative form and in a detailed description of the individual floors. After a thorough description of the building, the location of the building itself, the location of the city of Zlín, in which the building is located, and the associated crime rate of the city were evaluated.

The article described the availability of the nearest integrated rescue system units with the time of their arrival to the premises and the category of the building, while after evaluating the aspects, the risks threatening the building were assessed.

The results of the FMEA analysis show that the biggest risks in the reference object are vandalism, food poisoning, theft. Future work would focus on a more detailed analysis with subsequent proposals for security, evacuation of people and deployment of an integrated rescue system. The scope of the article was also not enough to describe individual possible scenarios and visualize the damage of individual terrorist attacks, which would make the arrival of the integrated rescue system impossible or difficult.

6. Discussion

The results of the FMEA analysis show that the biggest risks are vandalism, food poisoning and theft. Due to the

fact that the reference object is guarded through events only by the organizers, who also check tickets for individual events, it would be appropriate to apply rotary turnstiles with RFID codes.

Rotary turnstiles with RFID codes would be connected to a database that would store information about visiors and could also be connected to the IRS, which would have an online number of people in the building and at the same time would store brief information about visitors.

Acknowledgments

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