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Assessing Fire Safety Measures in 14 Buildings in Samsun

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Abstract

Fire is one of the most important discoveries that have emerged for various reasons throughout human history. However, it has also been an essential source of risks and hazards for life and property. The most important thing that should be done to prevent the heat from becoming a conflagration is to check the fire from occurring. Therefore, fire safety is gaining importance. In doing so, attention should be given mainly to fire safety measures in buildings. Within this context, this study aims at evaluating fire safety precautions of 14 selected buildings in Samsun province, Turkey. The study discussed and sought to propose a holistic fire safety approach with the consideration of regulations and legislation in Turkey. In doing so, the buildings were evaluated within the framework of 28 criteria, and some findings were revealed. As a result of the study, it has been determined that the precautions taken concerning fire safety measures are sufficient in many aspects of some buildings. Still, in some buildings, there are serious inadequacies. It has been demonstrated that fire safety measures should be considered holistically, and appropriate solutions should be made in all buildings, and new methods should be developed for this.

Keywords: Fire, Fire Safety, Fire Prevention

1. Introduction

Human beings have been living and shaping their lives in a built environment both physically and socially since its existence. With the development of both the spiritual and social aspects of humans, the buildings in which he lives have also gradually developed. At the same time, the risks and dangers that have arisen have increased.

Fire is one of humankind's exceptional discoveries but can also be a severe jeopardy initiator in accidents (Url-1). Fires caused by various reasons in buildings pose a significant risk to life and property safety (Demirel et al., 2017). Since fire is the result of the combination of oxygen, combustible material, an ignition source (Şimşek, 2018), it can occur wherever these three components are all together. The most critical issues of fire protection in buildings are life safety, the security of the structure, and fire prevention (Beyhan, 2015).

The fire caused by the combustion out of control has been one of the essential dangers since the past. For this reason, fighting fires is significant in terms of life and property safety. One of the most critical tasks to ensure the safety of life and property is to take measures against fires in buildings that we live in. The primary target for fire safety in buildings is to prevent ignition, limit the fire in cases where it cannot be prevented, and remove the users in the fire area safely through escape routes (Url-2).

Preventing a fire outbreak is safer than dealing with the consequences (Muro, 2019). However, to avoid material and moral damage caused by fires, it is vital to design the buildings we live safely against fire. For this reason, fire safety in buildings is one of the priority issues that need to be addressed on a personal, local, and central scale. So, fire risks need to be realistically identified and developed methods (Alkoç and Yılmaz, 2018).

The measures to be taken regarding fire safety in structures and the compulsory circumstances are compiled in two main sections. These are passive and active fire safety measures. Passive fire safety is a measure that has a specific function in the building. It is designed during the architectural project process (such as escape routes of the building, fire ladders, installation shafts, pump room, fire compartments, etc.) (Korkmaz, 2016). Besides, the fire insulation of vertical and horizontal openings used in mechanical and electrical installations in partition walls is passive protective measures. Active fire safety consists of measures such as fire cabinets, sprinkler systems, gas extinguishing systems, smoke evacuation systems, stair pressurization, detection, and warning systems (Demirel et al., 2017). Fire protection

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and safety can be highly provided in the buildings where these precautions are taken (Bahaeldeen, 2015). Proper management will also ensure active and passive fire protection measures that are well-maintained and appropriate for the risk (Brinson, 2017).

In this context, the present paper reports a case study of fire safety analysis of 14 different buildings in Samsun, Turkey. The study discussed and aimed to propose a holistic fire safety approach with the consideration of regulations and legislation in Turkey. In doing so, the buildings were evaluated within the framework of 28 criteria, and some findings were revealed. As a result of the study, it has been shown that the precautions taken concerning fire safety measures are sufficient in many aspects of some buildings. Still, in some buildings, there are serious inadequacies. It has been demonstrated that fire safety measures should be considered holistically, and appropriate solutions should be made in all structures, and new methods should be developed for this.

2. Fire Safety Regulations in Turkey and Developed Countries

In many countries worldwide, detailed statistics, reports, and studies on fires and causes of fires in various countries are continuously published by related institutions and organizations (Günaydın, 2013). One of those prominent statistics is World Fire Statistics, prepared by the Center of Fire Statistics (CFS) of the International Association of Fire and Rescue Services (CTIF). Its latest report is the 24th report with data on calls, fires, and losses provided from 59 countries that have supplied data for one or more of the five years in 2013-2017. According to the report, the highest call rates relative to population are found in the USA, France, and Japan. The highest fire rates relative to the population are located in Cyprus, Israel, and Suriname. The highest fire death rates relative to the population are found in Belarus, Russia, and Ukraine. The highest fire death rates per 100 fires are located in Belarus, Taiwan, and Latvia (Url-3). In the report, except for the estimated annual number of deaths, there is no data on Turkey. In Turkey, the number of fires only in some provinces is published. No organization collects and reports fire statistics throughout the country (Kılıç, 2018). In their study, Bekem et al. (2011) stated that 929.165 of fires occurred in Turkey, and a total of 3237 people lost their lives between 1998-2008 (Bekem Kara, 2018). The damage caused by building fires to the economy is relatively high in developed countries. This damage is $ 17 billion annually in the U.S., 3 billion euros in Germany, 1.9 billion euros in the U.K., 1.4 billion Turkish Liras (nearly 240 million dollars) in Turkey (Selamet, 2017).

In all developed countries, states have the responsibility to ensure the safety of their citizens against fire. For this purpose, the necessary regulations are made through the legislation, and such rules indicate the civilization levels of those countries (Başdemir et al., 2013; Demirel and Konur, 2006; Başdemir and Demirel, 2010). Many states have put forward many regulations after big fires, or others like Italy have increased their importance to existing rules after such events (Özgünler, 2018). Some developed countries, especially the USA and Canada, are revising and regulating building regulations according to fire resistance (Eren, 2002).

The National Fire Protection Association (NFPA) was founded in 1896 in the United States. It sets and publishes the laws of fire that must be complied with within the United States and the standards of fire safety standards. It is the most reputable and widely used resource in the world (Bahaeldeen, 2015). NFPA codes, guides, and standards include, in principle, the design, implementation, material, and system quality standards, maintenance, and operation training rules of any subject that directly or indirectly concern fire safety. Each NFPA code, guide, and the standard is reviewed and renewed (if necessary) in a three or 4-year cycle.

In the 16th century, fire protection issues began to gain importance in most European countries, especially in England (Serteser and Karakoyun, 2017). The EN Eurocodes, as part of the European Union's aim, to remove technical barriers to trade, help to standardize design rules within Europe (Östman, 2013). The EN Eurocodes includes ten standards (EN 1990 - 1999) covering various subjects related to construction. Each of the codes (except EN 1990) is divided into several parts covering specific aspects. There are 58 EN Eurocode parts distributed in the ten Eurocodes (EN 1990 – 1999). All EN Eurocodes relating to materials have Part 1-1, which covers the design of buildings and other civil engineering structures and a Part 1-2 for fire design (Url-4). Therefore, it is also possible to design systems or components for the desired behavior in the case of fire, based on tabular values and simplified or general calculation methods, and to optimize the design of fire protection (Östman, 2013).

The history of fire protection measures on Turkey's national scale is very recent (Serteser and Karakoyun, 2017). In particular, studies on the fire safety of buildings have been made regarding British regulation and NFPA (Başdemir and Demirel, 2010). In 1986, for the first time by the Istanbul Technical University on behalf of the Istanbul Metropolitan Municipality, the Fire Protection Regulation was prepared by approaching this subject scientifically (Eren, 2002). The Regulation on the Protection of Buildings from Fire (BYKHY) was first organized jointly by the Ministry of Interior and the Ministry of Public Works and Settlement on 08.10.1999 and put into force on 12.06.2002 (Serteser and Karakoyun, 2017; Kaboğlu, 2017; Basdemir et al., 2013). Other regulations issued after the adoption of BYKHY were abolished (Başdemir and Demirel, 2010). For the first time, all kinds of structures, facilities, and enterprises are included in this Regulation throughout the country (Demirel and Konur, 2006). After 2002, in 2007, 2009 and most recently, in 2015, various amendments were made to the Regulation. In particular, there has been almost no change since the 2007 regulation. (Kaboğlu, 2017). The difference of this Regulation from the rules in Europe, especially in the U.K., specializes in fire, is that it does not recognize fire engineering methods and can produce no solutions with these methods (Selamet, 2017). Although much progress has been achieved regarding fire safety in developed countries, Turkey's measures could not go beyond the limited scope of the regulations (Serteser and Karakoyun, 2017).

3. Methodology

Samsun is a city where essential struggles against fires have been made and but also fires have increased with the population. As seen in Figure 1, Samsun province is on Turkey's north side (MEU, 2015). Samsun, situated between the deltas where Yeşilırmak and Kızılırmak rivers are poured into the Black Sea, has an area of 9.083 km² (Bodur, 2019). Different societies have governed the city since history. The town, which was burned and destroyed by the Phrygian attacks in 1200s BC, was also burned in the Ottomans and Genoese (Url-5). In the 1869 Great Samsun fire, the population was around 18,000 (Erler, 2000), 415 houses were burned (Url-6). The fire of 1869 was formed by spreading barrels in a shop selling petroleum products by taking fire (Altaylı, 1967).

According to the Samsun Metropolitan Municipality Fire Department, Samsun has confronted 2145 fires in 2016, 2646 fires in 2017, and 1800 fires in 2018. Of the fires in 2018, 148 were workplace fires, and 503 were residential fires. The fires in Samsun are mostly caused by electricity, chimney, gas, and electrical devices. Most fires occur in districts such as Atakum, İlkadım, and Bafra, where the population is higher (Samsun İtfaiyesi, 2018). Accordingly, since an average of 12 workplace fires and 42 residential fires occur in Samsun every month, fire is a significant hazard according to the population.

1	OMU Central (New) Library
2	OMU Faculty of Fine Arts
3	OMU State Conservatory
4	OMU Faculty of Architecture
5	OMU Foundation College
6	Atakum Youth Center
7	Medıcana International Samsun Hospital
8	Samsun Liv Hospital
9	Gloria Tibi Hotel
10	Hampton by Hilton Samsun Hotel
11	Hilas Thermal Resort & SPA Hotel
12	Yesilyurt Shopping Mall
13	Samsun Branch Chamber of Architects
14	Köksal Business Center

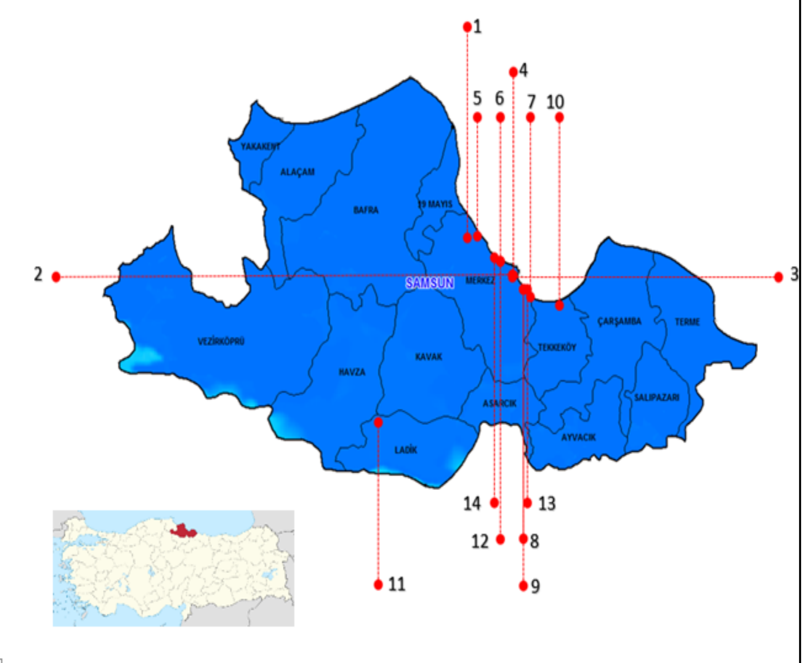
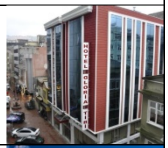
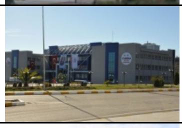


Figure 1. The locations of selected buildings in Samsun

This research aims to discuss and propose a holistic fire safety approach and limited to the evaluation of 14 buildings located in the center of Samsun, Turkey, by the random selection method. The sample consists of 4 faculty and service buildings of Ondokuz Mayıs University (OMU), four hotels, two hospitals, one college, one youth center, the building of Chamber of Architects, and one shopping center. Each building is open to the public and used continuously. In the event of a fire, severe damage to life and property may occur in these buildings. Therefore, the selected buildings are featured in terms of fire safety and were found worthy of examination. Table 1 shows some information about the sample buildings. As can be seen from the table, the buildings in the sample were built in different years and consist of 3, 4, 5, 6, 7, and 9 floors.

Table 1 Information Related to Selected Buildings

	Year	Floors	Height (m)	Photos		Year	Floors	Height (m)	Photos
OMU Central (New) Library	2018	4	20		Samsun Liv Hospital	2016	7	25	
OMU Faculty of Fine Arts	1976	3	12		Gloria Tibi Hotel	2012	5	16	
OMU State Conservatory	2000	3	15		Hampton by Hilton Samsun Hotel	2015	5	25	
OMU Faculty of Architecture	1965	3	12		Hilas Thermal Resort & SPA Hotel	2018	6	22	
OMU Foundation College	2005	5	20		Yesilyurt Shopping Mall	2006	4	18	
Atakum Youth Center	2015	3	20		Samsun Branch Chamber of Architects	2012	7	22	
Medıcana International Samsun Hospital	2011	9	32		Köksal Business Center	2018	4	12	

In doing so, the buildings have been analyzed under 28 criteria. These 28 criteria established within the study's scope have been put forward by using national and international laws and regulations related to fire safety directly or indirectly in line with the data obtained from the previous scientific studies and literature. These criteria include passive and active measures that must be introduced to be successful in fire fighting. On the other hand, the steps to be taken against the risks that may arise during the buildings' usage stages (fire safety supervision, presence of fire safety team, etc.) are included in the selected criteria. Accordingly, the criteria were established to enable the evaluation of buildings in terms of audit, escape routes, fire access, compartmentalization, design, fire crew presence, building materials, floor and façade strength, active and passive measures general fire safety. The highest score that can be reached in 28 criteria is 140. Then, the building's total score was calculated, and a comparison was made between the buildings. Thus, the buildings' fire safety, analysis related to each criterion, and fire safety measures between buildings were crosschecked. Following the determination of the sampling area and the development of standards, a field study was initiated. According to the results obtained from the evaluation and analysis of the buildings within the determined criteria framework, it was determined to what degree fire safety was taken into consideration in the selected facilities.

The fieldwork of the research was carried out by architecture and interior architecture students. As a result of the analysis carried out on architectural projects and on-site, each criterion was scored from 1 to 5 (1: Very bad, 2: Bad, 3. Medium, 4. Good, 5. Very good). Also, each criterion's status in terms of the fire has been evaluated in two scales, positive and negative. For instance, in the field analysis, the presence of warning signs in the criterion of "warning signs in terms of fire safety" was evaluated as positive in terms of fire, and moderate (3: medium) regarding adequacy. Scoring with the general adequacy of fire measures was determined by evaluating all criteria resulting from field studies. The differences between the scoring were based on analysis and judgments made in the field and emerged from the differences between them after the buildings were examined. In other words, together with evaluating a criterion as positive or negative in general, the differences between each building were included in the study's scope, and the study was detailed. Thus, the analysis of each criterion and fire safety measures between buildings could be compared. As a result, together with the evaluation and analysis of the buildings within the determined criteria framework, it was determined to what extent fire safety criteria were taken into account.

4. Findings

The buildings were analyzed separately based on each criterion through their architectural plans and on-site examinations in fire safety. Table 2 shows the results of the analysis performed within the framework of the evaluation criteria established. Criteria found to be positive and sufficient due to field studies, and on-site examinations were marked with an "√" sign, and criteria found to be negative and inadequate were marked with a "-" sign. In the bottom line of the table, each building's total score, which is the result of the evaluation of all criteria and the observation made in the field, is shown.

Table 2 The Adequacy of Criteria Constituting the Sample (√: sufficient, -: unsufficient)

		OMU Central (New) Library	**OMU Faculty of Fine Arts**	**OMU State Conservatory**	**OMU Faculty of Architecture**	**OMU Foundation College**	**Atakum Youth Center**	**Medıcana International Samsun Hospital**	**Samsun Liv Hospital**	**Gloria Tibi Hotel**	**Hampton by Hilton Samsun Hotel**	**Hilas Thermal Resort & SPA Hotel**	**Yesilyurt Shopping Mall**	**Samsun Branch Chamber of Architects**	**Köksal Business Center**
1	**Building fire safety supervision**	√	-	-	-	√	-	√	√	-	√	√	√	-	√
2	**Fire ladder qualification**	√	√	-	-	√	√	√	√	-	√	√	-	√	√
3	**Fire ladder compliance with regulations**	√	√	-	-	√	√	√	√	-	√	√	√	√	√
4	**Fire safety hall in building**	√	√	-	-	√	√	√	√	-	√	√	√	-	√
5	**Safe escape routes in the building**	√	√	-	√	√	√	√	√	-	√	√	√	√	√
6	**Escape distance in building corridors**	√	√	√	√	√	√	√	√	-	√	√	√	√	-
7	**Water supply connection to the building in case of fire**	√	-	-	-	√	√	√	√	-	√	-	√	-	√
8	**Fire compartments**	-	-	-	-	√	√	√	-	√	√	√	√	√	√
9	**Doors to be used as fire resistant**	√	√	-	-	√	√	√	√	√	√	√	√	-	√
10	**Water supply in the building in case of fire**	√	-	√	-	-	√	√	√	-	√	√	√	√	√
11	**Effects of building geometry or size of windows on fire safety**	√	-	-	√	-	-	√	-	√	√	√	-	-	√
12	**Sprinkler system**	√	-	√	-	√	√	√	√	-	√	-	√	-	√
13	**Maintaining high air pressure in some places to prevent smoke**	√	-	-	-	-	√	√	√	-	-	-	-	-	√
14	**Warning signs in terms of fire safety**	√	√	√	-	√	-	-	√	√	√	√	√	√	-
15	**Audible warning system for fire**	√	√	√	-	√	√	√	√	√	√	√	√	√	√
16	**The evacuation plan of the building**	√	√	-	-	√	√	√	√	-	√	√	-	√	√
17	**Portable extinguishing systems**	√	√	√	√	√	√	√	√	√	-	√	√	√	√
18	**Existence of fire safety team in the building**	√	-	-	-	√	-	√	-	-	√	-	-	√	-
19	**Existence of flammable materials**	-	-	-	-	√	√	-	√	-	√	-	-	-	√
20	**Connection of the fire truck with the building in order to intervene**	√	-	-	√	√	√	√	√	-	√	√	√	√	√
21	**Presence of water resources in the environment during fire fighting**	√	√	-	-	-	√	√	-	√	-	√	√	√	-
22	**Compliance of materials used with fire safety**	-	-	-	√	-	√	√	√	-	-	√	-	-	√
23	**Compatibility of building flooring with fire safety**	-	√	-	√	√	√	√	√	√	√	√	√	√	-
24	**Compatibility of building walls with fire safety**	√	√	-	√	√	√	√	√	-	√	√	√	√	√
25	**Compatibility of building facade with fire safety**	√	-	-	√	-	-	√	√	√	√	√	√	-	√
26	**General adequacy of passive fire safety measures**	√	-	-	-	-	√	√	√	-	√	√	√	√	√
27	**General adequacy of active fire safety measures**	√	-	√	-	√	√	√	√	-	√	√	√	√	√
28	**General adequacy of fire safety measures of the building**	√	-	√	-	√	√	√	√	√	√	√	√	√	√
Total scores (out of 140 points)		114	114	75	60	61	110	106	124	120	90	124	129	104	97

Accordingly, it is seen that the measures taken against fire vary according to each criterion and building. While some criteria were adequate and positive in most buildings, some criteria were insufficient in most buildings. It is seen that enough precautions are taken in most of the buildings in the criteria of; (3) fire ladder compliance with regulations, (5) safe escape routes in the building, (6) escape distance in building corridors, (9) doors to be used as fire-resistant, (14) warning signs in terms of fire safety, (15) audible warning system for fire safety, (17) portable extinguishing systems, (20) connection of the fire truck with the building in order to intervene, (23) compatibility of building flooring with fire safety, (24) compatibility of building the walls with fire safety. However, it is difficult to say that enough precautions are taken in many buildings in the criteria of; (7) water supply connection to the building in case of fire, (11) effects of building geometry or size of windows on fire safety, (13) maintaining high air pressure in some places to prevent smoke emission, (18) existence of fire safety team in the building, (19) existence of flammable materials, (22) compliance of materials used with fire safety.

When the fire safety measures are examined on a building basis, it is seen that there are significant differences. Accordingly, the buildings with the lowest scores are OMU Conservatory Building (60 points), OMU Faculty of Architecture Building (61 points), OMU Fine Arts Building (75 points), Gloria Tibi Hotel (90 points), Samsun Chamber of Architects Building (97 points). The highest-rated buildings are Liv Hospital (120 points), Samsun Private Medicana Hospital (124 points), Hampton By Hilton Samsun Hotel (124 points). The fire safety measures of hospital buildings are higher and close to each other. However, the fact that the buildings have the same utilization does not generally reveal that the fire safety measures taken are close to each other. OMU Conservatory and OMU Architecture Faculty Building received 1 point on 14 criteria out of 28, which means there are no fire safety measures on these criteria. The buildings which scored 5 points mostly are Samsun Private Medicana Hospital Building (16 criteria), Hilas Thermal Resort Hotel Building (17 criteria), Hampton by Hilton Samsun Hotel Building (20 criteria), and Köksal Business Center (21 criteria). It shows that fire safety measures are taken in these buildings in an excellent manner.

When the fire precautions are evaluated according to the construction date of the buildings, it is seen that the buildings with high scores are newly built. One of the two highest-rated buildings has been in use since 2011 (Samsun Private Medicana Hospital), and the other (Hampton By Hilton Samsun Hotel) was opened for use in 2015. Accordingly, when fire measures are evaluated according to the construction dates of the buildings, it is seen that the buildings with high scores are recent. After analyzing all other criteria in the field, the buildings were evaluated in terms of active and passive measures and general fire efficiency in the last three criteria. Regarding the buildings' scores, the general fire efficiency and the active and passive measures taken in all buildings are presented as a percentage. Accordingly, active fire safety measures taken in all buildings were found to be 74.29% sufficient, passive fire safety measures 72.86% sufficient. According to the analysis results, all buildings' general fire efficiency was considered sufficient to be 71.43%.

5. Discussion

In this study, 14 different buildings constructed and started to be used on other dates within Samsun's borders were analyzed in terms of fire safety. The 28 criteria used in the study were determined on how to be taken into consideration in the design and use stage. On the other hand, the current of the reviews on fire safety was questioned through these criteria. The evaluations of the buildings examined based on the information obtained from the requirements' analysis are explained below.

Kılıç (2003) states that education plays an essential role in taking measures against fire. That intervention by an untrained person may accelerate the fire instead of extinguishing it (Kılıç, 2003). In most of the buildings examined within this research scope, there are no fire safety teams as a significant deficiency. In buildings such as OMU New Library Building with fire safety teams, it is seen that the team is inadequate due to the quitting of some people. Thus, it is essential to have a safety team in terms of coordination of works such as evacuation, escape, and rescue in case of a fire.

The level of fire safety in a building is achieved either by allowing people to escape or by protecting them in-place with safe enough containment of the fire and preventing structural collapse (Östman et al., 2017). Looking for appropriate human behavior can be achieved a higher level of fire safety (Silva and Rodrigues, 2012). The safe evacuation of building occupants in case of fire is a crucial requirement for preserving human life in building (Laban et al., 2015). The fire evacuation plan is a reliable plan that must be prepared to remove the people in the building from the risky area during the fire and intervene quickly (Muro, 2019). The evacuation plan is defined as a document that comprises the instructions and procedures to be followed by all personnel within a building related to operations designed to ensure an orderly evacuation, total or partial, of the areas considered at risk (Silva and Rodrigues, 2012). When it comes to the analyzed buildings, there is nothing to talk about an adequate and systematic fire evacuation plan. The fire brigade intervention is easy as the buildings are located in a discrete order. On the other hand, afforestation and green areas in the vicinity do not prevent fire intervention. So, in the event of a fire, there is no situation in terms of the ease of intervention of the fire truck, which may cause negativity concerning the connections of the buildings to the environment.

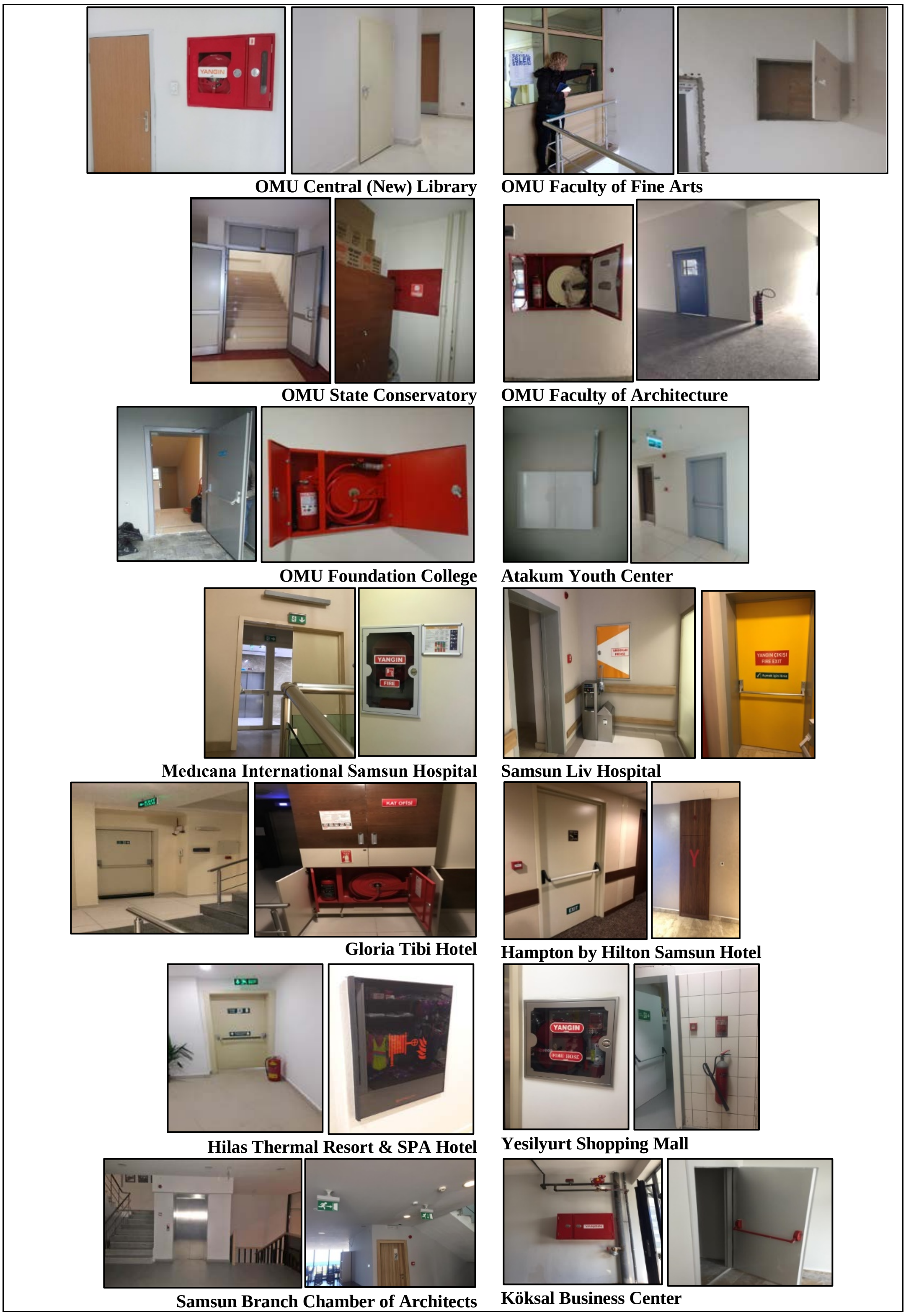


Figure 2. Photos from inside of the buildings

Fire doors and fire cabinets are shown in Figure 2. While fire doors and fire cabinets are remarkable and visible in some buildings, they are not appropriately placed in some buildings. As seen in Figure 2, the buildings have fire cabinets and fire extinguishers. Some buildings have water reservoirs, and some do not. Although fire fighting is comfortable, there are no water sources around the buildings except the sea.

Fire ladders must be usable during a fire. The selected buildings have fire escape stairs, which are generally sufficient. The fire escape stairs in the buildings are made of both steel and reinforced concrete. It is seen that fire ladders are used for garbage transportation in the buildings. It is observed that the doors of the fire escape stairs to the outside cannot adequately fulfill this task. The escape routes are adequate and appropriate following fire protection and regulations, but some buildings are designed to be narrower than they should be. Besides, most buildings do not have a fire safety hall, which creates a safe escape environment in case of fire. Fire doors are assessed for two characteristics: their ability to resist the passage of fire as fire control doors and their ability to restrict smoke selection as smoke control doors (Malhotra, 1993). In the selected buildings, fire doors are sufficient against fire in terms of their dimensions and the material they are formed regarding the standards such as TS EN 1634-3, which is a method for testing the smoke under the specified test conditions.

When a fire starts, it produces heat, smoke, and other toxic products (Malhotra, 1993). As most of the deaths and injuries and material damage are caused by smoke, materials' choice should be given importance in buildings (Kılıç, 2003). Building materials and many other products can be divided into combustible and non-combustible (Malhotra, 1993). When looking at the 14 buildings, they have materials that accelerate the spread of fire. However, it does not seem possible to say that adequate measures have been taken in case of fire.

The bearing systems of the buildings are reinforced concrete and thus fire-resistant. Coating materials other than the structural design are generally not fire-resistant. Floors are usually fire-safe, but there may be a risk of slipping during the escape. The paints used on the interior walls are water-based plastic paint and are generally fire-resistant. Sheathing material was used in some building facades. The sheathing is not suitable for handling and triggering a fire and threatens fire safety. In the fire in the building, flames emerge from the windows and attack the external wall surfaces (Malhotra, 1993). The analyzed structures do not have a façade system that prevents the spread of smoke in the transition of fire from one floor to another floor or from one area to another.

According to Walls (2001), one method of controlling the spread of fire is to separate different parts of a building into fire cells (Walls, 2001). Şimşek and Akıncıtürk (2016) attributed the lack of fire compartments to one of the main reasons for the occurrence of fire or the increase in losses in buildings (Şimşek and Akıncıtürk, 2016). In 14 facilities, there are no fire compartments that prevent the spread of fire. Although compartments are not imperative in the fire regulation for the selected buildings, this situation harms the spread of smoke in a fire. Besides, smoke detectors are located in buildings, but they seem insufficient to prevent the spread of smoke, as the only function of smoke detectors is to send a signal to the fire safety panel in the event of a fire.

The overall adequacy ratio of the average fire safety measures of all the buildings was 71.43%. Although less adequate in older buildings, active fire safety measures can generally be appropriate, with 74.29%. It can be said that the facilities are in good condition with a percentage of 72.86% in terms of passive fire safety measures. Since passive fire safety measures aim to save people enough time during a fire, these measures need to be made much better in all buildings. According to the study results, it was revealed that fire precautions were given importance in facilities, but some issues needed to be improved.

6. Conclusions

The material and moral losses will inevitably increase due to the fire in a country like Turkey, together with the risks posed by unplanned urbanization. Hence, fire protection and fire safety in buildings become more important. Although there is not a sufficient level, Turkey is getting to expand the scope of the fight against fire and becoming more responsive. In this context, the new buildings sought to be designed and constructed appropriately to the fire risk.

It is of utmost importance that the people who will use the buildings obtain sufficient information about the fire safety system during the buildings' use phase. It should be noted that the vast majority of life and property losses are due to a lack of information. Since the lack of education related to fires is a concern for all society segments, a roadmap including all stakeholders related to fire safety is required.

The holistic handling of fire safety in buildings is directly related to the extent to which active and passive safety measures have been addressed and implemented at all stages from design to use. Routine checks of the entire system should be carried out at regular intervals, even if all precautions have been taken. In case of need, repair, maintenance, and renewal of the parts that are not working should be done on time. Fire statistics should be made with fire brigade coordination throughout the country. This information should be combined with international data such as World Fire Statistics. National standards and regulations should be revised primarily in passive measures, which can meet different needs with international standards and regulations.

In this study, a comprehensive fire safety assessment is carried out by examining the fire safety measures from the design to 14 buildings in Samsun. In general, there are deficiencies in fire safety in the selected facilities. It can be concluded that these deficiencies were mostly due to the design process and the lack of implementation and supervision. However, it is possible to correct the existing adverse conditions within the framework of laws, regulations, and scientific researches.

This study, which provides a sample assessment of the extent to which fire safety measures are used in buildings, should be supported by other studies. In this sense, this study shows a strong result in the improvement and corrective activities to be carried out in the future. All kinds of thoughts on this subject should be taken into consideration to prevent the loss of life and property that may occur in fires involving severe risks. Firefighting will only be successful if a comprehensive fire safety management and strategy is implemented.

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