



Evaluation of the Libraries of Tehran University of Medical Sciences in Terms of Fire Based on the Selection of the National Building Regulations (2019)

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ABSTRACT

Background: Library buildings are prone to fire due to the type of the stored materials. Evaluation of safety systems in these places is essential to the prevention of possible detriment educational research resources. The present study aimed to assess the status of the libraries of Tehran city Universities of Medical Sciences in the case of fire based on the National Building Regulation selection in 2019.

Methods: This practical, descriptive survey was conducted on 36 faculty libraries of TUMS in Tehran, Iran. Data were collected using a checklist and via observations and interviews. Data analysis was performed in SPSS version 23 using descriptive statistics and tables.

Results: The general status of the building structures in 44.5% and the fire detection, alarm, and extinguishing equipment in 68% of the studied libraries was unsuitable in the case of fire based on the National Building Regulations. On the other hand, 85% of the libraries had unfit safety signs.

Conclusion: According to the results, the building structure of some of the libraries was dilapidated, and lack of proper fire alarm and extinguishing equipment increases the risk of fire in these libraries.

1. Introduction

Historically, libraries and archives play a key role in the preservation of human literatures and have often accommodated a wide variety of resources, ranging from books and multimedia materials to computer files. Library buildings are prone to fire due to the type of the stored

Materials, and the arrangement of libraries is also a potential hazard [1].

Considering that university libraries support education and research in the community and are critically involved in national development, evaluation of the safety systems in these places is essential to the prevention of possible detriments and educational and research resources used by



students, professors, and researchers in the long run [2].

Fire is an incident that threatens libraries, which causes irreparable damage to the library collection if safety principles are not observed to prevent the incident. Fire is assumed to be a central issue that adversely affects safety, health, and environment, and its prevention and control are particularly important [3].

According to the statistics of the National Fire Association of the United States, 182 fires occur on average in the libraries of this country each year [1]. In 2015, the largest university library of Russia caught fire, and more than 2,000 square meters of library space containing one million copies of history books were destroyed. According to the investigations, electrical short circuit was the cause of the accident [4]. The observance of safety principles in libraries is a requirement of the law, including the National Fire Association Standard 909, which guides the protection of libraries and museums [5]. It is important from a humanitarian perspective priority, while it is also a priority for the preservation of funds and resources. Given the central role of university and college libraries in the provision of the required information of faculty members and students and the importance of their safety for the presence of the clients, the current research is considered pivotal for the universities in question.

An important requirement in the design and operation of library buildings is to ensure fire safety. For this purpose, it is essential for the buildings to be designed and operated properly, so that the life and financial safety of citizens would be guaranteed rationally and in accordance with the use of the building in the case of fire [6]. Furthermore, the prediction and use of fire detection and suppression systems and equipment to become aware of fire in the early stages, so that people could be rescued and evacuate the scene promptly, and the crisis center would be fought by the discovery the exact location of the incident and extinguishing the fire. The proper use of such equipment could reduce the problems caused by fire incidents.

Numerous rules and regulations have been globally set to prevent and preclude fires. In Iran, a set of technical, executive, and legal criteria must be observed in the design, supervision, and execution of construction operations, including demolition, renovation, building development, major repairs, change of use, and operation of the building to ensure the safety, interest, appropriate provision, comfort, health, and economic efficiency of individuals and the community [7]. These standards are known as the National Building Regulations and are available in 22 volumes. The third volume of the series of National Building Regulations deals with the protection of buildings against fire. Some of the important costs associated with inattention to safety principles include life and financial costs due to accidents, rework costs, and waste of time. The proper observance of

safety principles could significantly decrease the mentioned costs, as well as the current safety costs and prevention costs [8].

With this background, the proper observance and implementation of the rules and regulations in construction processes and the necessity of equipping and securing buildings against fire are inevitable due to the legal obligations in this regard. The present study aimed to assess the status of the libraries of Tehran University of Medical Sciences (TUMS) in the case of fire based on the National Building Regulations in 2019.

2. Materials and Methods

This practical, descriptive survey was conducted on 36 libraries of the medical universities in Tehran, Iran, including TUMS, Iran University of Medical Sciences, Shahid Beheshti University of Medical Sciences, AJA University of Medical Sciences, Baqiyatallah University of Medical Sciences, University of Social Welfare and Rehabilitation Sciences, and Shahed University.

Due to security issues and lack of cooperation, the libraries of the schools of dentistry, nursing, and aerospace and surface medicine of AJA University of Medical Sciences were excluded from the sample population. In addition, the schools of medicine and new technologies of Iran University of Medical Sciences the schools of health and environmental safety and medicine of Shahid Beheshti University of Medical Sciences were excluded due to the lack of an independent library. Research center libraries, research institutes, and hospital libraries were not surveyed in the present study.

Data were collected using a checklist inspired by topics 3, 13, 14, 17, 21, and 22 of the National Building Regulations and specialized checklists of Tehran Fire Department and Municipality Safety Services to evaluate the safety status of the selected libraries [9-14]. The cases of the study were prepared and adjusted based on the condition of the building structure, fire detection, alarms, extinguishing equipment, and safety signs and guidance with 14 components and 83 questions. Eventually, the checklist compiled by the researcher was completed by observing and interviewing an individual who was familiar with the technical affairs of the building in the selected university libraries.

Data analysis was performed in SPSS version 23, and the obtained results were presented in statistical tables using descriptive statistics (percentage and mean).

3. Results and Discussion

The checklist was completed in 100% of the studied university libraries ($n = 36$). Table 1 shows the frequency distribution of the sample population and status of the completed checklists in the selected universities.

Table 1: Frequency distribution of libraries and status of completed checklists by university and in alphabetical order

Row	Name of the universities in Tehran	Number of libraries studied	Number of completed checklists
1	Social welfare and rehabilitation sciences	1	1
2	Islamic republic of iran army (AJA)	1	1
3	Iran	9	9
4	Baqiyatallah	2	2
5	Tehran	11	11
6	Shahid beheshti	9	9
7	Shahed	3	3
Total		36	36

The building structure of the selected libraries was assessed based on eight components, including the structure type (library skeleton), proportionality of the library design to the use of the building, distance of the library from fire stations and accessibility to fire trucks, library floor in the building, condition of the gas piping system, heating systems, electrical installations, and building exits and fire escapes. Table 2 shows the frequency distribution and general status of each component in the studied libraries.

According to the information in Table 2, the structure type of 47.2% of the libraries (n = 17) was concrete, while 52.8% of the libraries (n = 19) were made of steel. Since concrete skeletons are more resistant to fire compared to metal skeletons and have more than one hour of resistance against fire as well, concrete skeletons are preferred over other construction materials [7]. Furthermore, the data in Table 2 demonstrated that the design of 55.6% libraries (n = 20) was proportionate to the use of the building, while it was inappropriate in 44.4% of the cases (n = 16).

According to the findings, the distance of the libraries from fire stations and accessibility to fire trucks was appropriate in 73.6% of the cases and inappropriate in 26.4% of the cases. The analysis of the research findings indicated that 41.7% of the studied libraries were on the ground floor, and 58.3% were on the other floors in the building. The location of a library on non-ground floors is contrary to the criteria of educational and cumulative occupations and reduces the safety factor of libraries against fire as in the case of fire, it is difficult for the staff to leave the place; therefore, these libraries are more vulnerable to fire.

In the present study, the condition of the building gas piping system was considered proper in 81.7% of the cases, while it was inappropriate in 18.3%. Furthermore, 65.3% of the studied libraries had a proper heating system, while 34.7% had inefficient heating systems. The status of the electrical installations of the studied libraries was considered appropriate in 64.4% of the cases, while it was inappropriate in 35.6%. In addition, the condition of the library exits and fire escape routes was considered appropriate in half of the studied libraries. Based on the National Building Regulations, the building structure of the selected libraries in the case of fire was appropriate in 55.5% of the cases (n = 20) and inappropriate in 44.5% (n = 16).

In the survey of the status of fire detection, alarms, and extinguishing equipment of the libraries in the present study, we evaluated the four components of maintenance, inspection availability, installation location, and appearance of fire detection, alarms, and extinguishing equipment. Table 3 shows the frequency distribution and general status of these components in the libraries. According to the findings, the status of the maintenance and inspection of fire detection, alarms, and extinguishing equipment was appropriate in 27.8% of the cases, while it was inappropriate in 72.2%. Moreover, the status of fire detection, alarms, and extinguishing equipment in the library buildings was considered efficient in 29.9% of the studied libraries and inefficient in 70.1%. The location of fire detection, alarms, and extinguishing equipment was considered proper in 37.2% and unsuitable in 62.8% of the cases. Furthermore, the appearance of the fire detection, alarms, and extinguishing equipment of the libraries was appropriate in 33.3% and unsuitable in 66.7% of the cases. In general, the condition of all the fire detection, alarms, and extinguishing equipment against fire was appropriate in 32.1% of the libraries (n = 12) and inappropriate in 67.9% (n = 24) based on the National Building Regulations.

In the current research, the assessment of the status of using safety signs and signals by the selected libraries against fire was carried out based on two components of the status and location of the safety signals. Table 4 shows the frequency distribution and general status of these components in the studied libraries. According to the obtained results, the status of the safety signs and signals was appropriate in 12.2% of the libraries and inappropriate in 87.8%. In addition, the physical location of the safety signs was appropriate in 17.6% of the cases and inappropriate in 82.4%. In general, the status of using fire safety signs and signals in the selected libraries was suitable in 14.9% of the cases and unsuitable in 85.1% based on National Building Regulations.

According to the findings of the current research, the building skeleton of 47.2% of the libraries (n = 17) was concrete, which is safer in the case of fire compared to steel structures. This is consistent with the findings of Mir Hosseini and Mirakbari (2009), who investigated the safety status against library fires in the Islamic Azad University of Region 8 (Iran).

Table 2: Status of building structure of selected libraries in case of fire based on national building regulations

Row	Components studied	Situation	Abundance	Percentage
1	Library building skeleton type	Appropriate (Concrete)	17	47.2
		inappropriate (steel)	19	52.8
		Total	36	100
2	Proportion of library design with its type of use	Appropriate	20	55.6
		inappropriate	16	44.4
		Total	36	100
3	The location of the library to fire stations, and its accessibility to fire trucks	Appropriate	26	73.6
		inappropriate	10	26.4
		Total	36	100
4	library location floor in the building	Appropriate (ground floor)	15	41.7
		inappropriate (non-ground floor)	21	58.3
		Total	36	100
5	The condition of the gas piping system	Appropriate	29	81.7
		inappropriate	7	18.3
		Total	36	100
6	The condition of the heating systems	Appropriate	24	65.3
		inappropriate	12	34.7
		Total	36	100
7	The condition of the electrical installations	Appropriate	23	64.4
		inappropriate	13	35.6
		Total	36	100
8	The condition of the ways to get out of the building and escape from the fire	Appropriate	18	50
		inappropriate	18	50
		Total	36	100
Total		Appropriate	20	55.5
		inappropriate	16	44.5
		Total	36	100

According to the mentioned study, 26% of the libraries ($n = 8$) had a concrete structure [5]. On the other hand, these findings are inconsistent with the study conducted by Kyani khuzestani and Keikha (2015), which aimed to perform a comparative comparison of the fire safety standards in the libraries of Zabul University and Zabul University of Medical Sciences (Iran). Their findings indicated that 100% of the surveyed libraries had steel structures, and none had a concrete structure [15].

According to the results of the present study, 55.6% of the libraries were located in a building with library use, which increased the safety factor. This is in line with the findings of Kyani khuzestani and Keikha (2015) [15], while inconsistent with the findings of Mir Hosseini and Mirakbari (2009) [5]. Another research in this regard was performed by Olanrewaju *et al.* (2012) to investigate the causes of disasters and their prevention by determining the preparedness of the staff of Ilorin State Public Library in Nigeria; according to the mentioned study, the library was built in a non-library space [16].

In the current research, approximately 73% of the studied libraries had access to a minimum of one fire station within the maximum distance of five minutes. This is in congruence with the results obtained by Mir Hosseini and Mirakbari (2009) and Kyani khuzestani and Keikha (2015) [5, 15]. Furthermore, the study by Isa *et al.* (2016) aimed to perform a spatial analysis of the fire stations in the metropolitan area of Kano (Nigeria), and their findings indicated that firefighting was only fully performed in the old town of Kano, while it was extremely infrequent in the other parts of the

metropolis, and the response time was reported to be above the standard (five minutes) [17].

The results of the present study regarding the height of the library buildings indicated that 72.2% of the libraries ($n = 26$) had adequate space for firefighting vehicles, which is consistent with the findings of Shukri and Bozorgi (2012), who evaluated the issues of the preservation, maintenance, and restoration of paper materials in Iranian libraries. According to their findings, 60% of the studied libraries ($n = 3$) had access to the building in the case of fire [18], which is in contrast to the findings of Mir Hosseini and Chizari (2010). The mentioned authors performed a comparative assessment of the safety status of the public libraries affiliated to the Cultural and Art Organization of the Municipality and the public libraries of Iran. According to their findings, 73.4% of the studied libraries ($n = 80$) had no access to the library building in the case of fire [19].

With regard to the condition of the building gas piping system in the case of fire, our findings indicated that the status was appropriate in 81.7% of the libraries ($n=29$), which is in line with the findings of Olanrewaju *et al.* (2012)[16]. According to the results of the present study, 58.3% of the libraries ($n = 21$) were located on the ground floor of the building, and the main doors of their entrances and exits did not open to a public road, which contradicted the criteria of cumulative occupations and reduced the safety factor of the libraries against fire as it will be more difficult for the staff to leave the building in the case of fire, and the buildings become more vulnerable to fire; this is consistent with the findings of Mir Hosseini and Mirakbari (2009) [5].

Table 3: General status of fire detection, alarms, and extinguishing equipment in studied libraries in case of fire based on national building regulations

Row	Components studied	Status	Frequency	Percent
1	The status of maintenance and inspection of fire detection, alarm, and extinguishing equipment	Appropriate	10	27.8
		Inappropriate	26	72.2
		Total	36	100
2	The status of fire detection, alarm, and extinguishing equipment in the library building	Appropriate	11	29.9
		Inappropriate	25	70.1
		Total	36	100
3	The location of fire detection, alarm and extinguishing equipment	Appropriate	13	37.2
		Inappropriate	23	62.8
		Total	36	100
4	The appearance of fire detection, alarm, and extinguishing equipment of the libraries	Appropriate	12	33.3
		Inappropriate	24	66.7
		Total	36	100
Total		Appropriate	12	32.1
		Inappropriate	24	67.9
		Total	36	100

The findings of the current research demonstrated that the condition of the heating systems was appropriate in 65.3% of the libraries, which is in line with the findings of Eskandarian and Eftekhari Jaliseh (2015), who performed a case study of the security of the central library of Rahyar Educational Complex (Tehran, Iran) against earthquake and fire [20]. Furthermore, this finding is consistent with the study conducted by Cheshmeh Sohrabi *et al.* (2010) which investigated the design standards of the central university libraries in Isfahan (Iran) [21], as well as the findings of Olanrewaju *et al.* (2012) [16].

In the present study, the status of the electrical installations was considered appropriate in 64.4% of the libraries (n=23), which is in congruence with the findings of Mir Hosseini and Chizari (2010) [19], Kiani Khuzastani and Keikha (2015) [15], and Olanrewaju *et al.* (2012) [16], while contradictory to the findings of Mir Hosseini and Mirakbari (2009) and the research by Zabihi faridian and Bashiri (2018) [5, 22]. The mentioned study aimed to investigate the safety status of the libraries affiliated to the Agricultural Research, Education, and Extension Organization [22]. The obtained results of the present study indicated that 38.9% of the library buildings (n = 14) had an emergency exit route, which is consistent with the findings of Ayoung *et al.* (2016) regarding the preparedness of the polytechnic libraries in Ghana against natural disasters [23]. However, the finding is inconsistent with the studies by Olanrewaju *et al.* (2012) and Zabihi faridian and Bashiri (2018) [16, 22].

Regarding the condition of fire detection, alarms, and extinguishing equipment, our findings demonstrated that

only in 27.8% of the libraries (n = 10), the person in charge of the building maintenance monitored and inspected the fire protection equipment every three months, which is consistent with the findings of Ayoung *et al.* (2016) and Olanrewaju *et al.* (2012) [16, 23] and inconsistent with the study by Mir Hosseini and Chizari (2010) [19]. With respect to the existence of fire detection and alarm equipment, the results of the present study showed that 72.2% of the universities (n= 26) had no central fire alarm systems, which is in congruence with the findings of Zabihi faridian and Bashiri (2018). The mentioned research demonstrated that 86% of the studied libraries (n = 84) were not equipped with any fire alarm systems [22]. According to the current research, the installation of fire detection, alarms, and firefighting equipment was inappropriate in 62.8% of the libraries (n = 23), which is in line with the findings of Eskandarian and Eftekhari Jaliseh (2015) [20]. Furthermore, our study demonstrated that the availability of fire detection, alarms, and extinguishing equipment was appropriate in 66.7% of the studied libraries (n = 24); no studies have assessed this parameter so far.

Regarding the status of fire safety signs and signals in the studied libraries, our findings indicated that 87.8% of the studied libraries (n=32) had a favorable status in terms of the presence of safety signs and signals, while the status was unfavorable in 82.4% (n=30). This is in line with the findings of Eskandarian and Eftekhari Jaliseh (2015) [20], as well as the studies conducted by Cheshmeh Sohrabi *et al.* (2010) [21], Mir Hosseini and Mirakbari (2009) [5], Kiani Khuzastani and Keikha (2015) [15], and Olanrewaju *et al.* (2012) [16].

Table 4: General status of using fire safety signs in studied libraries based on national building regulations

Row	Components studied	Status	Frequency	Percent
1	Status of safety signs and guidance in the library	Appropriate	4	12.2
		Inappropriate	32	87.8
		Total	36	100
2	Appearance of library safety signs and guidance	Appropriate	6	17.6
		Inappropriate	30	82.4
		Total	36	100
Total		Appropriate	5	14.9
		Inappropriate	31	85.1
		Total	36	100

4. Conclusion

According to the results, almost half of the selected libraries had an unfavorable status in terms of the building structure in the case of fire. Furthermore, the general condition of the fire detection, alarms, and extinguishing equipment of most of the libraries (n=24) was unsatisfactory, which reduced their efficiency in the case of hazard. With regard to the status of fire safety guidance and signs, most of the libraries (n=31) did not have appropriate fire caution signs. Due to the inadequacy of the library building and lack of proper safety equipment in some of the studied libraries, the status was considered insecure in the case of fire. In the field of safety, the smallest flaws could lead to a major disaster. Therefore, it is highly recommended that the expert opinions regarding building safety be incorporated as advice in the studied libraries in order to continuously improve and control their safety against fire.

Authors' Contributions

F.D.N., and S.J.G.H.M., concept creation, study design, overall planning; S.J.G.H.M., and S.E.: project supervision; F.D.N., and S.E., data collection; F.D.N., and S.E., contribution to the drafting of the final manuscript. All the authors read and approved the final manuscript for publication.

Conflicts of Interest

The Authors declare that there is no conflict of interest.

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