

A Study on Passive Fire Safety Measures in University Dormitories in Türkiye

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ABSTRACT

This study examines the critical issue of fire safety in student dormitories, a domain fraught with potential dangers due to the inexperienced nature of its occupants. The research focuses on a higher education dormitory building located in the city centre of Tokat, Türkiye, which was constructed as a model project, and assesses its compliance with the basic passive fire safety criteria specified in the Turkish Fire Code (BYKHY), the British Fire Code (British Standard), and the United States Code (NFPA 101- NFPA 5000). Through a meticulous analysis of 15 key criteria, the study provides insights into the building's adherence to fire safety standards in various regulatory frameworks. The findings indicate that the dormitory exhibits varying levels of compliance across different regions, emphasizing the necessity of tailoring fire safety measures to specific geographical contexts. In line with BYKHY, the dormitory demonstrates an 80% compliance rate, with a 20% non-compliance rate. However, when assessed against the British Standard, its compliance decreases to 40%, with a 20% non-compliance rate, and 40% of the criteria lack available information. Under NFPA regulations, the building achieves a 53% compliance rate, with a 14% non-compliance rate, and data is missing for 33% of the criteria. These findings underscore the importance of region-specific fire safety assessments and highlight the need for continuous monitoring and improvements to ensure the safety of dormitory occupants worldwide.

Keywords: Dormitory, Fire Safety, International Regulations, Türkiye Fire Regulation

1. INTRODUCTION

Fire poses a significant danger to people worldwide, spanning from the smallest residential structures to the largest industrial complexes. The severity of fire incidents can vary depending on the specific usage and classification of a building.

Student dormitories are "Student Housing Service Buildings". These buildings are opened with the aim of meeting the accommodation, nutrition, social, psychological needs of students, addressing their educational needs during the educational periods. They include student dormitories, student boarding houses, student apartments, and student studio apartments that provide services to secondary and higher education students.

The period when students attend university is exciting and important for both themselves and their parents. Living in a new place away from their home where they have been living with their families gives them freedom and new responsibilities. One of these important responsibilities is to consider fire safety while living on university campuses or in off-campus student houses and dormitories. In the US, NFPA and the Center for Campus Fire Safety are working together to raise awareness of fire hazards for college students living in residence halls. The Center for Campus Fire Safety was founded in 1999, and its mission is to improve fire and life safety at all colleges and universities by providing resources and educational programs for students in higher education, evaluating proposed changes in national legislation and standards as they relate to college and university infrastructure. When its work is examined, it can be said that it is an organization that can be an example for many countries in the world.

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In the context of student dormitories, the focus of this article is a category of buildings that demand rigorous fire safety measures. These dormitories accommodate young individuals who are leaving their homes for the first time and lack experience in safety precautions and fire prevention. Furthermore, the majority of these students are young people who play a pivotal role in shaping the future of their nations. Hence, it is imperative to implement more stringent and thorough safety measures in the architectural design and construction of student dormitory buildings.

The United States is one of the leading countries in the world in preparing and publishing fire statistics. The statistics concerning fires in student dormitories are indeed alarming. To illustrate, in the United States, a country known for its advanced fire safety measures, there were 4,100 fires reported in student dormitories between 2011 and 2015. These incidents resulted in an annual average of 35 civilian injuries and caused approximately \$14 million in direct property damage. In the statistical evaluations for the same period within the scope of the report, it was determined that the main cause of student dormitory building fires was caused by cooking equipment with a rate of 87%. The remaining 5% of student dormitory building fires are caused by intentional fires, 3% are caused by smoking, 2% are caused by fires due to the heating equipment, and 2% are caused by fires due to the electrical distribution and lighting equipment (Campbell, 2017).

Between 2018 and 2022, an estimated annual average of 3,331 structure fires in student dormitories in the United States were intervened in and extinguished each year. In these fires, 3 civilian death, 21 civilians were injured annually, resulting in material damage and loss of around 12 million dollars. The number of fatalities was two civilians over the five years, about three out of every four fires in these buildings started in the kitchen or cooking area. Cooking equipment was involved in about 9 out of every 10 fires. Unsupervised equipment was the most common cause of ignition in these fires. 88% of the fires were localized small fires and did not spread. Most fires occurred on Saturdays and Sundays. Fires occurred between 16:00 and midnight. There were a few fires between midnight and 8 am, but most of the injuries and property damage occurred during these hours. Between 2018 and 2022, the highest number of dormitory fires in the United States occurred in February, September and October, while the lowest number of fires occurred in June and July. (NFPA, 2024). However, it has been found that the biggest cause of fires is cooking equipment by approximately 90% (McGree, 2021).

When the literature on fire safety measures in dormitory buildings is examined, it is seen that the number of national publications is quite low and international publications are not at the expected rate. In the first of the national publications, the fire tragedy that occurred in Aladağ district of Adana on 29.11.2016, in which 12 people, including 11 female students and 1 staff member, lost their lives and 22 students were injured, was examined. In the article, the cause of the fire, the behaviors of dormitory students and staff during the fire were investigated and evaluated. In other parts of the research, the technical deficiencies and solutions that caused the fire and the high loss of life were explained (Altındaş, 2017). As can be understood from the tragedy of the fire in this article, all stakeholders involved in the design, construction, inspection and operation of student dormitory buildings have important duties. In addition, the technical aspects of fire safety should be given due importance by administrative units. It should be well known that fire precautions are for life safety, and the license and inspection procedures in this context should not be seen as bureaucratic obstacles to be overcome. In another national study, a student dormitory was evaluated with the L-type matrix method in terms of fire risk (Yemişçiöğlü and Şimşek, 2023). According to the results of the study, the highest level risks were determined as having locked fire doors, not keeping smoke-tight doors closed, having physical obstacles that make it difficult to use fire doors and not having a self-closing system. Another national study was conducted on evacuation simulations and fire precautions in student dormitory buildings. According to this research, in student dormitory buildings, the principles of the Turkish national fire code BYKHY can be supported, developed, and revised with project-specific performance-based solutions. In evacuations of dormitory buildings, it is important to assess risks through scenarios and develop rational and realistic fire safety measures that can respond to risks. Student dormitory building fires are a life safety issue that cannot be taken lightly; solutions should be found in this context (Yaman, 2021). Inal and Kaya (2017) conducted a study on the examination of dormitories within the scope of fire safety and a sample dormitory building in Yalova was analyzed in the research. According to another study, it is important that

school administrators fulfill their duties in this regard to ensure the continuity of fire safety measures in all educational buildings. The most important of these duties can be summarized as follows: Developing strategies for student evacuation, informing and training all staff on this matter, conducting evacuation drills at regular intervals, ensuring that fire protection systems related to active fire prevention measures are periodically inspected, tested, and maintained in accordance with relevant standards to maintain their performance. (Başdemir, 2022). The same measures apply to dormitory buildings.

The aim of the study by Arghami et al. (2016) from international research is to develop a fire safety checklist for fire safety inspections in dormitories. The first items of the checklist were extracted from official standards and regulations. The checklists developed for the research were used to examine the fire safety status of the dormitories of Zanzan University of Medical Sciences. According to the research conducted by Griffin, (2011), fire safety for boarding school students is a serious concern for dormitory managers, firefighters with firefighting responsibilities, local administrators, and parents. According to the study, fire safety training is provided to boarding school students in the United States, but it is not known how effective it is, because very little research has been conducted on this subject. For this reason, Griffin (2011) examined the safety behaviors of boarding students after the initial fire safety training and tried to determine whether trainers or managers with authority were effective in this regard. The same study also aimed to determine the impact of adding drill experimentation to traditional fire safety training. Another international paper is an empirical study of errors in dormitory fires. In another study conducted in the United States, fire safety in dormitory-like university residences was addressed. With this project, the causes of fires, fire training programs, fire detection and extinguishing studies were analyzed (Petruccelli, 2004). In the doctoral thesis conducted by Campagnola (2004), fire safety in university dormitories was analyzed.

In the study by Zhu and Zhu (2013), a SVM (Support Vector Machines) based fire prediction method was developed by combining the behavior of people in student dormitories and similar buildings with the fire event. The developed model was tested by simulation and found to be effective. According to this study, universities and higher education institutions continue to suffer injuries and loss of life due to fires occurring on university campuses. The research was conducted to help eliminate this negative situation. There are many factors that can lead to fires; some of these factors can be random and sudden, but often the relationship between them cannot be detected. In another study by Zhao and Song (2016), a simulation study was conducted on the emergency evacuation of a male student dormitory building. The study was conducted with Pathfinder 2011 evacuation simulation software. In the study, the parameters for determining the building models and the relevant personnel, the simulation results with the Steering model and different numbers of exits revealed that the time and number of evacuations have a linear relationship with each other. The results regarding the growth between the rate of change of evacuation time and the number of evacuations were also analyzed within the scope of the research. The study shows where and when high risks occur and aims to optimize evacuations. Rahouti et al. (2018). In their study, evacuation simulation with a performance-based approach for a high-rise multi-storey dormitory building for engineering students in Mons, Belgium, and case studies were conducted according to various scenarios.

The research by Zhang and Yu (2021) is an interdisciplinary study because they are computer engineers. A Bayesian network analysis model for fires in university dormitories is proposed. To analyze fire safety risks, expert knowledge and a large number of relevant documents are gathered, a relevant index system is established, and a model for fire risk analysis is constructed. To verify the accuracy of the model, validation is performed using relevant data from the last ten years. The variables were analyzed by backward reasoning to reveal the key situations of hidden dangers. According to the results of the analysis, it was found that the main influential causes of dormitory fires are unsafe human behaviors such as illegal use of electrical appliances and smoking. Therefore, the study concluded that the supervision of illegal electrical appliances in student dormitories should be strengthened and the management system should be improved to effectively prevent accidents.

The paper written by Zhu and Shi (2009), examines fire risks in dormitory environments using Fault Tree Analysis (FTA). This method in the research identifies potential causes of fires by categorizing them into basic

and intermediate events. FTA helps to assess critical factors such as human errors, equipment failures and environmental conditions that contribute to fire incidents. By emphasizing a systematic approach to risk reduction, the study aims to isolate key vulnerabilities and enable targeted safety interventions. It also aligns with broader fire safety research that uses similar risk assessment tools such as Bayesian Networks or Analytic Hierarchy Process to assess fire hazards in various environments such as commercial complexes or industrial facilities. In the study conducted by Lei et al. (2013), it was stated that the user density in student dormitories is high. It was emphasized that due to the function of the dormitory buildings, both the number of students and the number of guests are high and therefore the losses are high in disasters such as fire and earthquake. According to the research, corridor and exit widths in dormitory buildings are two important parameters that affect the evacuation of the building when these disasters occur. For this reason, in this study, the evacuation performance of the sample buildings is estimated using FDS + Evac software and the effect of corridor and exit widths is examined. Field research was also conducted using the simulated values. The effect of changing one of the two parameters mentioned above is also discussed. In the research, it was seen that the simulation and the real field experiment were compatible. According to the results of the research, it is seen that the evacuation time and evacuation distance are not proportional. It was determined that the appropriate dormitory exit width for the dormitory building in the study was 3 m. In another study, the evacuation of a student dormitory building was analyzed through experimentation and modeling. Video recordings of users' movements in the dormitory building were analyzed and data about the evacuation of the building were obtained. For example, pedestrian flow and crowd behavior were examined. In this study, the evacuation of the building was analyzed both by determining the real situation with field work and by simulation. These two analyses and observations were evaluated comparatively. The results were found to be close to each other. The “faster, slower” effect was also observed in the study (Lei et al. 2012).

Academic papers on fire safety in student residences often focus on building safety, fire prevention strategies and risk management. In this research, a high-education dormitory building in our country, designed as a standard project, has been analyzed according to significant passive fire safety criteria outlined in both national and international regulations. The study highlights the essential considerations that architects should bear in mind when designing fire-safe dormitories.

2. MATERIAL AND METHOD

2.1. Student Dormitory Building Analyzed Through Passive Fire Safety Measures

Passive fire safety measures that should be implemented during the architectural design and construction phases of student dormitories include the use of fire-resistant materials in the walls, floors, structural elements, and roofs of the dormitory buildings, compartmentalizing the building to contain fire and smoke in limited areas, using fire-rated doors and windows that can withstand fire for a specified period and are suitable for escape, ensuring clear and unobstructed means of egress, and so on. Below are 15 selected important measures from those described above that have been analyzed in the building outlined below.

The building examined in the research, as seen in Figure 1, is a standard design university student dormitory accommodating 1000 students in Tokat, Türkiye, consisting of three blocks named A, B, and C. Within the scope of the study, detailed analysis was conducted on Block A, as shown in Figure 2.



Figure 1. The analyzed university dormitory in Tokat, Türkiye



Figure 2. The analyzed university dormitory block A

Block A has a total construction area of 6,023.00 m². It consists of a basement floor, ground floor, and 4 standard floors, totaling 6 floors. It has a total of 96 rooms with a capacity of 262 beds.

The student dormitory building, which is the subject of this research, has been examined in terms of architectural design within the framework of the following 15 criteria related to passive fire safety measures. The analysis has been carried out in accordance with both national and international regulations.

2.2. Findings and Discussion Based on the Analyzed 15 Criteria

Criterion 1: Fire Compartments:

In accordance with the relevant regulations, Türkiye Regulation on Fire Protection (2009) (Binaların Yangından Korunması Hakkında Yönetmelik (BYKHY, 2009)) Article 24 (6) - Appendix 4, the maximum compartment area for accommodation facilities is 4000 m². The analyzed dormitory building meets this requirement as follows: the basement floor area is 974 m², the ground floor area is 981 m², and each of the 4 standard floors has an area of 1,017 m², all of which are in compliance with the regulations.

Criterion 2: Maximum Escape Route Distances:

According to BYKHY Article 31 - Appendix 5/B, the escape route may have a maximum distance of 75 meters as it is equipped with a sprinkler system and is bidirectional. In the examined dormitory building, as depicted in Figure 3, the distances are as follows: A to C: 26m, B to C: 23m, D to C: 22m, E to C: 35m, E to D: 32m, F to D: 15m, and they are in compliance with the regulations.

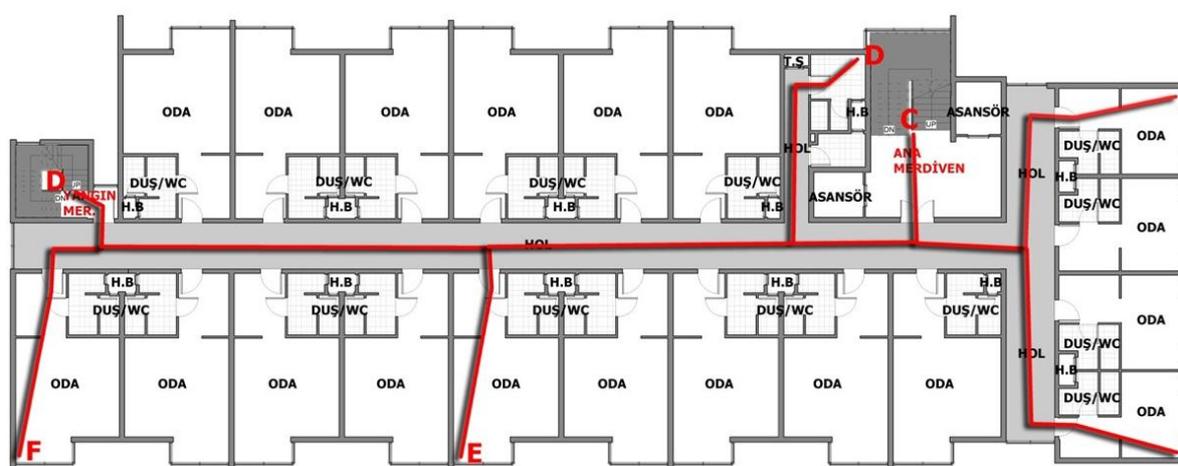


Figure 3. Escape distances in the examined dormitory building

Criterion 3: Escape Route Width:

According to BYKHY Article 33 (1), escape routes cannot have a width of less than 110 cm.

-In the dormitory building examined in the research, the escape routes also serve as corridors. The corridor widths have been designed at 2.30 meters, 2.20 meters, and 1.15 meters, which are in compliance with the regulations (Figure 4).

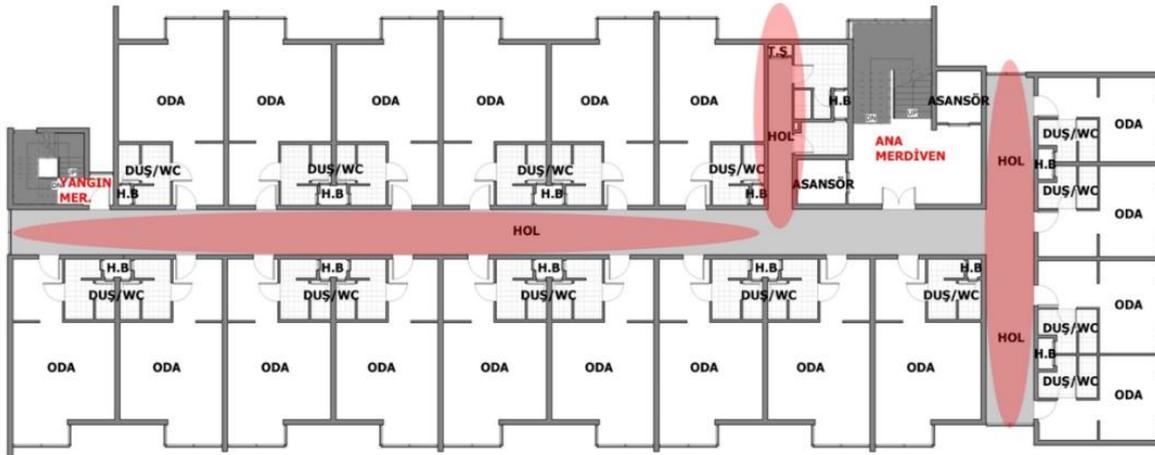


Figure 4. Escape routes in the examined dormitory building

Criterion 4: Number of Escape Routes:

According to BYKHY Article 39 (2), in high-risk areas with occupancy exceeding 25 people and in all spaces where occupancy exceeds 50 people, there must be a minimum of 2 exits. The examined dormitory building, as seen in Figure 5, has a study and reading hall with a capacity of more than 50 people and only one exit. This does not comply with national regulations.

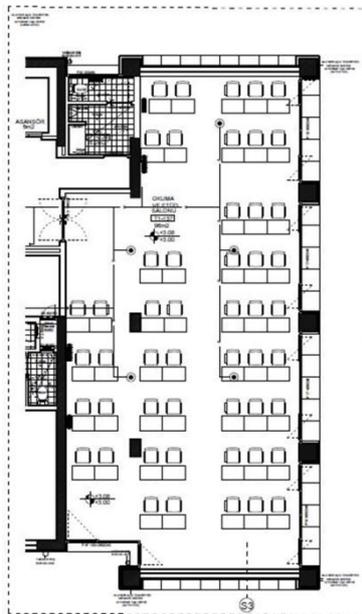


Figure 5. The plan of the study and reading hall at the dormitory

Criterion 5: Fire Safety Vestibule Dimensions:

According to BYKHY Article 34 (3), the floor area of fire safety vestibules cannot be less than 3 m², more than 6 m², and the dimension in the escape direction cannot be less than 1.8 m. In the examined dormitory

building, as shown in Figure 6, the fire safety vestibule has a floor area of 2.00 m² and is designed within the stairwell, with a dimension in the escape direction of 1.4 m, which does not comply with the regulations.

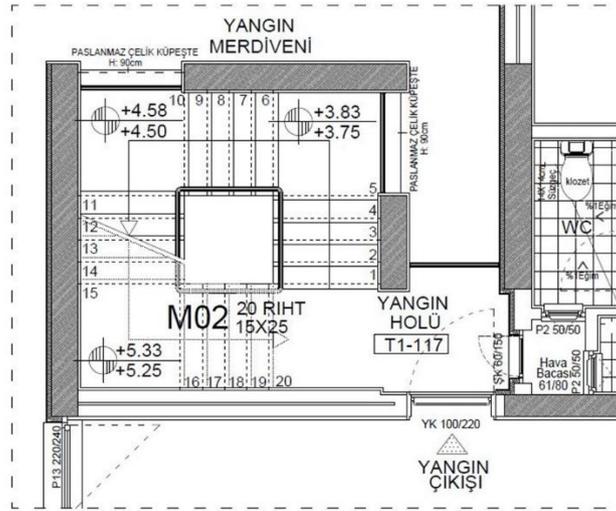


Figure 6. Examinated fire safety vestibule

Criterion 6: Dead-End Corridor Maximum Distance Dimensions:

As per BYKHY Appendix 5/B, the maximum distances for dead-end corridors should be a maximum of 15 meters if there is no sprinkler system, and a maximum of 20 meters if a sprinkler system is in place. The dead-end corridor dimensions in the dormitory building, as seen in Figure 7, are as follows:

- Dead-end corridor 1: 6.35 m
- Dead-end corridor 2: 8.00 m
- Dead-end corridor 3: 7.95 m

These dimensions are in compliance with the regulations.

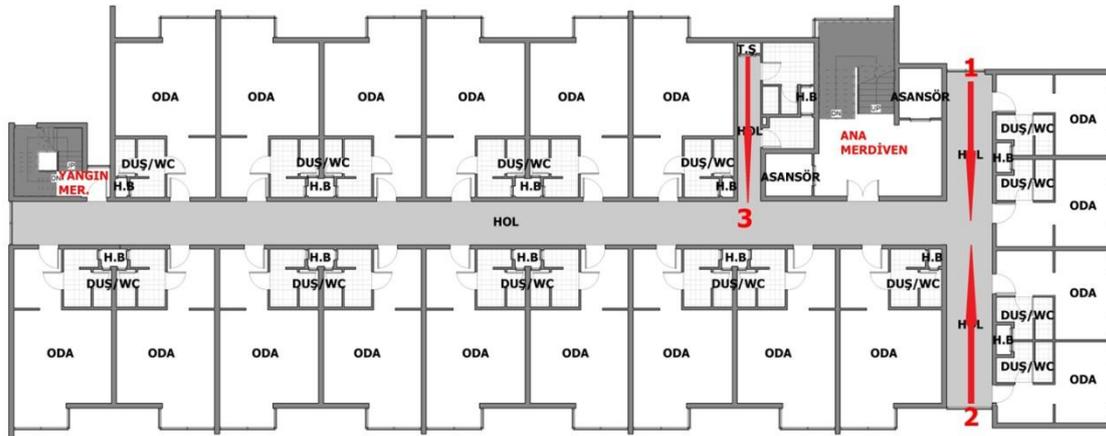


Figure 7. Floor plan of the analyzed dormitory building

Criterion 7: Distance between the Exit Point of the Fire Escape Staircase and the Outdoor Area:

According to BYKHY Appendix 5/B, the distance between the exit point of the escape staircase and the outdoor open area can be a maximum of 15 meters in buildings equipped with a sprinkler system. In the examined building, as seen in Figure 8, the fire escape staircase on the basement floor directly leads to the outdoor open area.

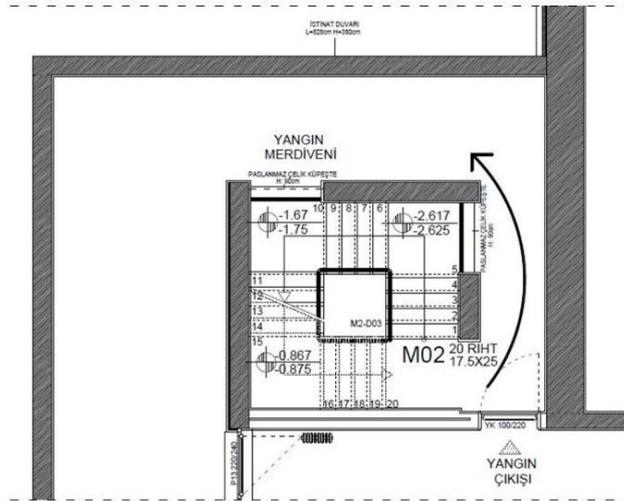


Figure 8. Fire escape staircase

Criterion 8: Fire Escape Staircase Features (Step Width in the Stair Shaft):

According to BYKHY Article 41 (8), in staircases allowed for escape, the minimum step width at the narrowest point in the stair shaft must not be less than 100 mm for residential buildings and 125 mm for other structures. The width of the fire escape staircase in the dormitory building is 250 mm and is compliant with the regulations.

Criterion 9: Fire Escape Staircase Features (Landing Arrangement):

As per BYKHY Article 41 (3), in escape staircases, landings are arranged at intervals that are not more than 17 steps and not less than 4 steps at each floor level. In the analyzed example, there are 5 steps and 1 landing in the fire escape staircase shaft, which has been designed in compliance with the regulations.

Criterion 10: Fire Escape Staircase Features (Stair Headroom Clearance):

As per BYKHY Article 41 (6), the headroom clearance should be at least 210 cm above the step, and the maximum level difference between landings should be 300 cm. In the analyzed example, as seen in Figure 9, the height in the escape staircase is 266 cm above the step. The level difference between landings is 300 cm, which complies with national regulations.

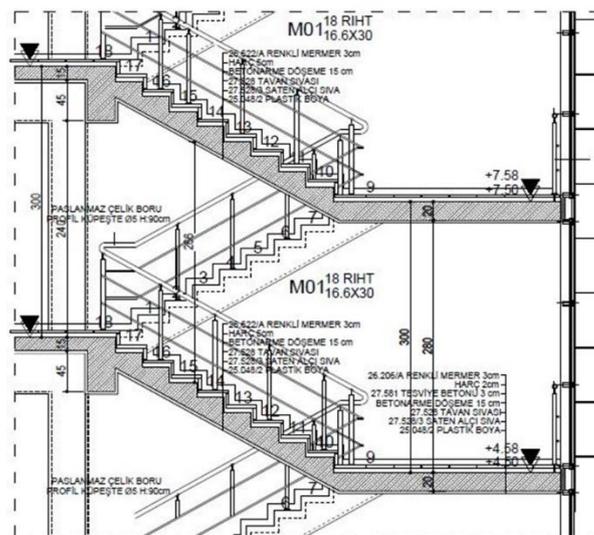


Figure 9. Landing height in the analyzed building's staircase

Criterion 11: Fire Escape Staircase Features (Riser Height and Tread Width):

According to BYKHY Article 41 (7), in any escape staircase, the riser height must be more than 175 mm, and the tread width must be at least 250 mm. In the examined dormitory building, the fire escape staircase has a riser height of 17.5 cm and a tread width of 25 cm, which is in compliance with the regulations.

Criterion 12: Escape Route Doors (Dimensions):

According to BYKHY Article 47 (4), the clear width of a single-leaf exit door must not be less than 80 cm and not more than 120 cm. Its height must not be less than 200 cm. Escape route doors should not have thresholds. Revolving doors and turnstiles cannot be used as exit doors.

In the examined building, the clear width of double-leaf exit doors is 160 cm, while single-leaf exit doors have a clear width of 90 cm and a height of 220 cm. There are no turnstiles or thresholds.

Criterion 13: Escape Route Doors (Opening Direction and Locking State):

According to BYKHY Article 47 (2), escape route doors should not obstruct the movement of users. Exit doors in spaces accommodating 50 or more people must open in the direction of escape. Escape route doors should be manually operable and not locked. The escape route doors in the examined building open in the direction of escape and are not locked.

Criterion 14: Emergency Wayfinding:

As per BYKHY Article 71 (1) - (4), wayfinding signs should be visible from every point and have a minimum sign height of 15 cm. The maximum visibility distance should be equal to 100 times the sign height for externally or edge-lit wayfinding signs and 200 times the sign height for emergency wayfinding units with internally and back-lit signs. The emergency way in the building has been appropriately implemented, and the lighting is integrated into the architectural design.

Criterion 15: Emergency Lighting System:

According to BYKHY Article 72 (3), emergency lighting must be provided for a minimum duration of 60 minutes in the event of a normal lighting failure. If the user load exceeds 200, the minimum duration for emergency operation should be 120 minutes. The emergency lighting in the examined dormitory building is not sufficient.

3. THE COMPARATIVE ANALYSIS OF THE EXAMINED DORMITORY BUILDING IN TERMS OF FIRE SAFETY REGULATIONS IN TÜRKIYE, THE UNITED KINGDOM AND THE UNITED STATES

As in all building types, passive fire safety measures in student dormitories include architectural and design applications. As another safety measure, active fire safety measures include all mechanical systems that contribute to passive fire safety measures in the project. Active fire safety measures include applications, systems and controls belonging to engineering disciplines (Rahardjo and Prihanton, 2020). This study was carried out in the context of passive fire safety measures. The legislation and criteria used as evaluation tools in the research are given in Table 1.

After a comprehensive analysis based on 15 criteria, the dormitory building reveals varying degrees of compliance with fire regulations in different regions. In line with Türkiye Fire Regulations (BYKHY), it achieves an 80% compliance rate, with only a 20% non-compliance rate. However, when assessed against British Fire Regulations (British Standard), its compliance drops to 60%, with a 33,3% non-compliance rate, and for 6,7% of the criteria, information is unavailable. Under United States Regulations (NFPA 101 - NFPA 5000), the building attains a 66,7% compliance rate, with a 26,6% non-compliance rate, and for 6,7% of the criteria, there is a lack of available data. These findings underscore the importance of region-specific fire safety assessments and the need for continuous monitoring and improvements to ensure the safety of occupants in such structures.

Table 1. The Comparative Analysis of The Examined Dormitory Building (BYKHY, 2009; BR (Building Regulations), 2010; Code, (2012))

CRITERIA	REGULATIONS IN TÜRKİYE BYKHY	REGULATIONS IN THE UNITED KINGDOM (BS) (BR)	REGULATIONS IN THE USA NFPA 101 - NFPA 5000
1-COMPARTMENT	Dormitory buildings must have a maximum compartment area of 4000 m ² .	In dormitory buildings, the maximum compartment area is 6000 m ² .	Dormitory buildings must have a maximum compartment area of 6000 m ² .
DORMITORY	+	+	+
2- MAXIMUM ESCAPE ROUTE DISTANCES	In buildings with two exits, the maximum distance for a sprinkler system should be 75 m.	In buildings with two exits, the maximum distance should be 45 m, while in buildings with a single exit, the maximum distance should be 18 m.	Without sprinklers: maximum of 45 m. With sprinklers: maximum of 60 m.
DORMITORY	+	+	+
3- ESCAPE ROUTE WIDTH	If escape routes are also used as corridors and halls, they cannot be less than 110 cm in width.	In spaces with a maximum occupancy of 60 people, the minimum width of escape routes should be 75 cm. For spaces with a maximum occupancy of 110 people, the minimum width should be 85 cm. If the occupancy is up to 220 people, the minimum width should be 105 cm. If the occupancy exceeds 220 people, then for every 5mm over 1050mm you can add another person.	The minimum width of any exit route, under any circumstances, cannot be less than 91 cm.
DORMITORY	+	+	+
4- NUMBER OF ESCAPE ROUTES	In high-risk areas with an occupancy exceeding 25 people and in all spaces where occupancy exceeds 50 people, there must be a minimum of 2 exits. If the occupancy exceeds 500 people, a minimum of 3 exits, and if it exceeds 1000 people, a minimum of 4 exits are mandatory.	In spaces with a maximum occupancy of 60 people, there should be 1 exit. For spaces with a maximum occupancy of 600 people, there should be 2 exits. In spaces with an occupancy exceeding 600 people, there should be 3 exits.	There must be no fewer than 2 escape routes on any floor or in any section. If the occupancy load is between 500 and 1000 people, there should be a minimum of 3 escape routes. If the occupancy load is 1000 people or more, there should be a minimum of 4 escape routes.
DORMITORY	-	+	-
5- FIRE SAFETY VESTIBULE DIMENSIONS	The base area of fire safety corridors must not be less than 3 m ² , not more than 6 m ² , and their dimension in the escape direction must not be less than 1.8 m.	There must be a protected lobby between a fire-risk area and an escape staircase. This lobby should have independent ventilation of at least 0.4 m ² or should be protected from smoke by a mechanical smoke control system.	Where a vestibule is provided, the doorway into vestibule shall be protected with an approved fire door assembly having a 1.5 hour fire protection rating, and the fire door assembly from the vestibule to smokeproof enclosure shall have not less than 20 minute fire protection rating. Doors shall be designed to minimize the air leakage and shall be self-closing or shall be automatic-closing by actuation of a smoke detector with in 10ft (3m) of the vestibule door
DORMITORY	-	-	-

6- DEAD-END CORRIDOR MAXIMUM DISTANCE DIMENSIONS	Dead-end corridor maximum distance should be 15 m if there is no sprinkler system; if there is a sprinkler system, it should be 20 m.	All dead-end corridors, except where protected by a pressurization system for escape stairways and corridors, shall be separated from other parts of the corridor by self-closing fire doors with a minimum length of 4.5 m. If these corridors: a) provide escape in two directions, b) provide access from one floor exit to another	Dead-end corridor maximum distance should be 6,1 m if there is no sprinkler system; if there is a sprinkler system, it should be 15 m.
DORMITORY	+	-	+
7- DISTANCE BETWEEN THE EXIT POINT OF THE FIRE ESCAPE STAIRCASE AND THE OUTDOOR AREA	If the escape staircase serves more than one floor, it cannot exceed 10 m. In buildings with a sprinkler system, this distance can be a maximum of 15 m.	Information regarding this criterion is not available.	Information regarding this criterion is not available.
DORMITORY	+	?	?
8- FIRE ESCAPE STAIRCASE FEATURES (STEP WIDTH IN THE STAIR SHAFT)	A minimum of 125 mm	A minimum of 27.9 cm	A minimum of 25 cm
DORMITORY	+	-	+
9- FIRE ESCAPE STAIRCASE FEATURES (LANDING ARRANGEMENT)	Escape stairs shall have landings in every floor level at least every 17 steps, and there shall be at least 4 steps between landings. The minimum width and length of the landing shall not be less than the width of the staircase.	Landing clear widths shall not be less than the stair width and shall be suitable for carrying objects	Landings must be provided where doors open onto stairways. Landings and intermediate landings shall continue at the same width without narrowing the escape route width. In new buildings, the width of all landings in the escape direction must be arranged so that it is not less than the width of the stairway. Exception: The landing length must be at least the minimum step width but must not exceed 122 cm..
DORMITORY	+	+	+
10- FIRE ESCAPE STAIRCASE FEATURES (STAIR HEADROOM CLEARANCE)	The stair headroom clearance must be a minimum of 210 cm above the step and the height difference between landings must be a maximum of 300 cm.	Staircases must be enclosed by walls or handrails, and the head clearance distance cannot be less than 2.0 meters. The level difference between floors shall not be less than 2000 mm.	The minimum headroom clearance in new and existing buildings is 203 cm. The height difference between landings should be a maximum of 3.7 m.
DORMITORY	+	+	+
11- FIRE ESCAPE STAIRCASE FEATURES (RISER HEIGHT AND TREAD WIDTH)	The step height cannot exceed 175 mm, and the step width cannot be less than 250 mm.	The step height cannot exceed 180 mm, and the step width cannot be less than 280 mm.	The step height cannot exceed 178 mm, and the step width cannot be less than 279 mm.
DORMITORY	+	-	-
12- ESCAPE ROUTE DOORS (DIMENSIONS)	The clear width of a single-wing exit door cannot be less than 80 cm and cannot exceed 120 cm. Its height must be at least 200 cm.	A standard 750mm width door may only be suitable for buildings with up to 60 people. Larger workplaces and those with a higher fire risk level are likely to need wider doors.	No door on an escape route can have a clear width of less than 81 cm. In places where double doors are required, at least one of the doors must provide this 81 cm clear width.
DORMITORY	+	+	+

13- ESCAPE ROUTE DOORS (OPENING DIRECTION AND LOCKING STATE)	In spaces with an occupancy of more than 50 people, exit doors must open in the escape direction. Exit route doors should be opened by hand and should not be locked.	In spaces with an occupancy of more than 60 people, exit route doors should open in the direction of escape and should not be locked.	The door's opening direction should be toward the exit direction in the following situations: a) Where the exit shaft is located, b) In areas serving high-risk areas, c) In rooms or areas with an occupancy of 50 or more.
DORMITORY	+	+	+
14- EMERGENCY WAYFINDING	In buildings with multiple exits, emergency wayfinding is conducted to ensure that users can easily access the exits. In case of an emergency, the locations of exits to be used for evacuation within the building and the planned exit routes from every point inside the building must be indicated to the building occupants through the placement of emergency exit signs.	Escape routes within the building should be clearly discernible, and emergency wayfinding should be implemented to ensure easy access to exit routes in case of an emergency.	Escape routes emergency wayfinding signs must be visible and emergency wayfinding signs must be in place.
DORMITORY	+	+	+
15- EMERGENCY LIGHTING SYSTEM	Emergency lighting must be provided for at least 60 minutes in case of normal lighting failure. In case the occupancy exceeds 200 people, the emergency operation time must be at least 120 minutes.	3-hour duration if evacuation is not immediate, or where early re-occupation may be required. 1-hour duration may be acceptable if evacuation is immediate and re-occupation is delayed until the system has recharged.	In the event of a power failure, emergency illumination must be provided for at least 90 minutes.
DORMITORY	-	-	-

4. DISCUSSION

The analysis of the student dormitory building in the context of 15 important criteria selected from national, some international regulations revealed both compliance and non-compliance with passive fire precautions. The following priorities were considered in selecting the criteria: passive fire protection measures, architectural relevance, and the possibility of measurement during architectural project and on-site inspections. These criteria may not determine whether the building is fully compliant with fire safety regulations, but they provide a result within the scope of this study. Other criteria can be examined in a separate study.

Although the dormitory meets most of the requirements set out in the Turkish Fire Protection Regulation (BYKHY) and international standards such as British Standard (BS) and United States fire (NFPA) codes, some critical deficiencies were identified.

One of the key deficiencies was the study and reading room, which had a capacity of over 50 people, but only one exit instead of the required two. This poses a significant safety risk in the event of a fire as it could prevent timely evacuation. Similarly, the dimensions of the fire safety hall do not meet the minimum requirements of the legislation. This has the consequence that during smoke control and fire containment, users are deprived of a place where they can safely wait for some time to escape.

Another major shortcoming was the emergency lighting system, which did not meet the required 60-minute uptime in the event of a power outage. This could seriously affect the safe evacuation of residents in the event of a fire. In addition, while the emergency guidance system was properly implemented, ensuring

visibility of exits, fire escape doors and staircases were mostly compliant, requiring constant maintenance to ensure optimal function.

When compared with fire safety regulations in the United Kingdom and the United States, it was observed that although Turkish regulations are in line with international standards in many respects, there are some significant differences. For example, UK and US standards allow larger fire compartments in dormitory buildings (6000 m² compared to Türkiye 4000 m²), which may affect the fire control strategy. In addition, differences in maximum escape route distances suggest that there are differences in the assessment of safe evacuation times in different regions.

In addition, in student dormitories falling into the category of accommodation buildings where the most passive human activity, sleeping, takes place, if fire safety measures are implemented in accordance with the regulations from the design stage of the structure, these fires will be survived with minimal loss. In this context, all stakeholders involved in the design, construction, inspection, and operation stages have important roles to play. Furthermore, administrative units should give due importance to the technical dimension of fire safety. It should be well understood that fire safety measures are aimed at protecting human lives, and in this context, the permits and inspections provided should not be seen as bureaucratic obstacles to overcome.

5. CONCLUSION AND RECOMMENDATIONS

This study presented a comprehensive assessment of the passive fire safety measures implemented in a university residence hall and analyzed their compliance with national and international fire safety standards. The findings show that although the building complies with several basic regulations, there are critical deficiencies that could pose significant safety risks during a fire emergency.

The dormitory complies with regulations on fire compartments, escape route distances, corridor widths, staircase dimensions, and door features, providing a basic level of fire safety. However, inadequacies in emergency lighting, fire safety hall dimensions, insufficient number of exits in the study and reading hall are important deficiencies that need to be corrected. This result shows the need for continuous inspection, evaluation and improvement to ensure maximum safety of students in case of fire.

Based on the findings of this study, the following immediate and long-term measures are recommended to improve fire safety measures in the analysed dormitory building:

The measures recommended for urgent improvement are as follows:

- **Renewal of the Emergency Lighting System:** The existing emergency lighting system should be renewed to provide at least 60 minutes of operation in the event of a power failure and 120 minutes of operation when the number of users exceeds 200.
- **Regular Maintenance of Fire Escape Routes and Doors:** Routine inspections and maintenance should be carried out to ensure that escape route doors are in working order, unobstructed, and comply with national and international standards.
- **Update Fire Safety Signs and Wayfinding Systems:** Although a wayfinding system is currently in place, additional checks should be carried out to ensure that all emergency exit signs are well lit and clearly visible from every point in the building.

The following measures are recommended for long-term improvement:

- **Increasing the number of exits in high-traffic areas:** Study and reading rooms should be modified to include at least one additional exit to comply with fire safety regulations and facilitate a faster evacuation process.

- Compliance with fire safety entrance hall dimensions: The entrance hall area should be redesigned to comply with the minimum required 3 m² area and 1.8 m escape direction dimension to ensure effective smoke control and safe exit.
- Reviewing and adapting international best practices: Considering the differences between Turkish and international fire safety regulations, a more detailed assessment should be conducted to determine whether adapting international standards would improve fire safety strategies in dormitory buildings.

Implementing these recommendations will help reduce fire risks in the dormitory building under review and increase the overall safety of residents.

Among the recommended emergency measures, ensuring that escape route doors are in working order, unobstructed, and compliant with national and international standards, and ensuring that all emergency exit signs are well-lit and clearly visible from every point in the building are easier to implement and significantly less costly than other criteria. Installing an emergency lighting system is more difficult to implement and more costly. Additional exit arrangements and fire safety hall design, which are long-term improvement tasks, are also costly but feasible. However, considering that they will prevent loss of life and property, it is clear that this is an invaluable investment. In this context, the cost and difficulty are insignificant compared to human life.

It is hoped that this study will contribute to future research and provide a more comprehensive fire safety strategy for student dormitories by focusing more on active fire safety measures such as sprinkler systems and smoke control mechanisms.

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