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FIRE SAFETY AND DISABLED EGRESS WITHIN THE FRAME WORK OF LEGISLATIONS

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Atakan ALTAN

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ETHICAL STATEMENT

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- All information, documents, assessments and results have been presented in accordance with scientific ethical conduct and moral rules,
- All material used in this thesis that are not original to this work have been fully cited and referenced,
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Atakan ALTAN

04/01/2023

MEANS OF EGRESS FOR PEOPLE WITH DISABLITIES IN EDUCATIONAL FACILITIES
(Ms.C. Thesis)

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GAZİ UNIVERSITY
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ABSTRACT

The disabled population are vital contributors to our society; it has become a core symbol of modern civilized society that the disabled can participate in social life equally, integrate into society, and achieve self-value. Several nations' legal systems regarding disability discrimination, construction, and workplace safety create a problem to the evacuation of individuals with disabilities. This legal gap still exists, putting members of our society—especially those who have sensory or mobility issues—at danger of being prevented from leaving a building or becoming trapped within during an evacuation. In this context, researches were made to ensure the safety of the disabled during egress, fire safety, and the emergency evacuation and safety of the disabled individuals were discussed by conducting literature research on the emergency evacuation of the disabled, means of egress and safety of people with disabilities in Turkey, the United States and the United Kingdom. As a result of the examination, fire and disability legislations of our country, the United States of America and England were analyzed within the scope of fire safety measures and evacuation of the disabled. In conclusion, by examining both the fire regulations and disabled regulations of the three countries, it was suggested to eliminate the difference between fire and disabled regulations, to inform people about safe evacuation measures in case of emergencies and to include disabled people in evacuation drills.

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MEVZUAT ÇALIŞMALARI ÇERÇEVESİNDE YANGIN GÜVENLİĞİ VE ENGELLİ ÇIKIŞI
(Yüksek Lisans Tezi)

Atakan ALTAN

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ÖZET

Engelli nüfus, toplumumuza hayati katkı sağlayan unsurlardır; engellilerin toplumsal hayata eşit olarak katılabilmeleri, toplumla bütünleşebilmeleri ve özdeğerlerini kazanabilmeleri modern uygar toplumun temel bir simgesi haline gelmiştir. Engelli ayrımcılığı, inşaat ve işyeri güvenliği ile ilgili birçok ülkenin yasal sistemleri, engelli bireylerin tahliyesi için bir sorun yaratmaktadır. Bu yasal boşluk, toplumumuzun üyelerini, özellikle de duyusal veya hareket sorunları olan kişileri, bir binadan çıkmaları veya bir tahliye sırasında içeride mahsur kalma tehlikesiyle karşı karşıya bırakarakmaktadır. Bu kapsamda engellilerin acil tahliyesi, çıkış yolları ve güvenlikleri ile ilgili konularına ilişkin literatür araştırması yapılarak, engellilerin acil çıkış esnasında güvenliği, yangın güvenliği ve acil durum tahliyesi ve güvenliğinin sağlanmasına yönelik araştırmalar yapılmış ve tartışılmıştır. Türkiye, Amerika Birleşik Devletleri ve Birleşik Krallık'ta engelliler. Yapılan inceleme sonucunda yangın güvenlik önlemleri ve engellilerin tahliyesi kapsamında ülkemiz, Amerika Birleşik Devletleri ve Birleşik Krallık yangın ve engelli mevzuatı incelenmiştir. Sonuç olarak, üç ülkenin hem yangın yönetmeliği hem de engelli yönetmeliği incelenerek, yangın ve engelli yönetmeliği arasındaki farkın ortadan kaldırılması, acil durumlarda güvenli tahliye önlemleri konusunda halkın bilgilendirilmesi ve tahliye tatbikatlarına engellilerin de dahil edilmesi önerilmiştir.

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SYMBOLS AND ABBREVATIONS

The symbols and abbreviations used in this study are presented below along with their explanations.

Symbols	**Explanation**
C	Celsius
cm	Centimeter
h	Hour
Kw	Kilowatt
M	Meter
m²	Square Meter
mm	Millimeter

Abbreviations	**Explanation**
ADA	Americans with Disability Act
BR	British Regulations
BS	British Standards
DDA	Disability Discrimination Act
EN	European Standards
IBC	International Building Code
ICC	International Code Council
N/A	Not Applicable
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
TS	Turkish Standards
TSE	Turkish Standards Institute
UL	Unlimited

1. INTRODUCTION

The disabled people appeared along with the birth of humankind. Disability is part of being human. Almost everyone will encounter impairment at some point in their lives, whether it is due to birth defects, an accident, or just aging. The limitations that many people with disabilities have could be overcome with the use of suitable equipment and services.

The field of emergency management is responsible for the preparation and response to hazards, such as fires, which require special planning procedures for the disabled population. Fires generate scenarios that make evacuation difficult for those with disabilities. Professionals should consider how to communicate with the blind or deaf, how to assist those who are physically challenged, and how to include anyone who could become immobilized during an emergency in the plan, according to Logli (2009).

Designing and incorporating an emergency management exercise that addresses the needs of the disabled people that will allow emergency response personnel to identify and mitigate against any inaccuracies or complications that might exist in an evacuation plan. Integrating the disabled population in to the evacuation plan will also result in better utilization of resources during emergencies. Not only will emergency responders be better equipped to handle an emergency evacuation, but person with disabilities can also be ready to leave a facility.

An accessible means of egress for disabled population to evacuate a building should be implemented before an emergency evacuation occurs to an existing multi-level building.

Research Problem

Maintaining human dignity throughout the crisis management cycle is critical for the impaired population. An event such as fire evacuation requires preparation for the protection of all. In particular, members of the disabled population are susceptible to injury. This fact underscores how crucial it is to develop a safe method of escape and remove any barriers that might delay the prompt evacuation of the handicapped population.

Is it possible to improve the means of egress features of architectural projects when generated in accordance with universal design regulations?

Aim of the Thesis

The goal of this study is to solve Turkey's issues with general building fire safety issues and issues with handicapped people's egress during emergency evacuations. Turkey complies with fire regulations are applied in universal design principles and is developing; however, most of these regulations and principles are ignored during implementation. The fire escape and accessibility regulations are applied during the design of the buildings.

Methodology

This study compared the laws and regulations in Turkey, the United States of America, and the United Kingdom on accessible exits for individuals with impairments. Means of egress and disability regulations were reviewed for each country under a separate title. Both disability regulations and means of egress regulations were compared with two tables (Table 5.1 – 5.2).

A review of literature revealed existing egress standards, but identified a gap in regulations for evacuation of the people with disabilities for each country. The goal of this research was to examine how the chosen nations' disability rules, methods of egress, and means of egress for individuals with disabilities were handled. Therefore, a comparative approach was chosen.

The purpose of comparative method is to look at a subject of study in relation to another; specifically for this research, the themes discovered were in regard to the means of egress of people with disabilities during fire evacuations as perceived by Turkey, United States of America and United Kingdom. Structured analysis of the regulation of each country revealed similarities that appeared within each regulation.

Limitations

Only general accessibility requirements, means of egress and their components sections of the regulations of Turkey, United States of Amerika and United Kingdom were analyzed.

Passive and active fire protection systems, and specific requirements for building types are not included in this thesis study.

Topic Overview

A comprehensive computerized literature search was conducted on the topic of fire safety and means of egress in educational buildings for people with disabilities was carried out utilizing; EBSCO Open Dissertation, ProQuest Digital Dissertations and Google Scholar.

It was necessary to do a search using keywords, topic headings, search engine terms, and search engine phrases for mobility challenged, hearing impaired, and visually impaired, as well as accessibility standards and universal design standards. As far as the publishing date, there was no constraint. This specific subject was not included in the literature review on fire safety and disabled egress within the frame work of legislations.

2. ACCESSIBILITY FOR PEOPLE WITH DISABILITIES

For each disabled group classified according to Enginoz (2015), the reason and general definition of disability is as follows:

Temporary Physical Disorders: Those with fractures in their body, pregnant women, those who have constant or periodic difficulties in their movements due to their illness, patients who have undergone a surgery. Efficacy Disorders: This group includes patients with heart and chest diseases other than visual and hearing impairments and patients with neurological disorders and people with body sizes and weights in the dwarfism and very obesity spectrum. Movement Disorders: They are semi-mobile or cannot move. People with walking, climbing, turning difficulties and limited mobility are in the semi-active group. Those who use crutches, walking sticks, walking devices, prostheses and orthopedic shoes are also included in this group. The group of those who cannot move is the people who have to use a wheelchair. Handicapped Disorders: People with disabilities that have completely or partially lost manual skills in one or both hands. Visual Disorders: People with visual disturbances ranging from color blindness to blindness in one or both eyes. Hearing Disorders: Those with total or partial hearing disorders. Aging: Individuals with one or more of some of the disorders described above as signs of aging (Enginöz, 2015).

Developments in modern technologies, communication and globalization that cause changes in our daily lives have spread the concept of accessibility to a wide scale. It has gained importance in many areas such as culture, informatics, transportation, sports, job description (International Disability Alliance, 2010). Accessibility means that people with impairments can travel to all kinds of built environment from their home and benefit from all the services of the building without any help or with partial assistance in their daily life just like other healthy individuals (Enginöz, 2015). An individual's handicap is directly proportionate to the restrictions he or she has in everyday life. According to Scherrer (2001), "In an accessible context, a person with any impairment is not considered impaired. A healthy individual has a disability at an inconvenient location." Accessibility is, to provide the ability of interrelated actions in daily life to continue without hesitation. Furthermore, accessibility is critical in allowing people with disabilities to live autonomous lives without being hindered by their conduct in society (Enginöz, 2015).

People want to be able to carry out daily activities that everyone can do without assistance, in order to prove themselves in the social environment they are in at every stage of their lives and to show that they can live as an independent individual. Nowadays, various legal arrangements and standards in international platforms and in Turkey are trying to bring equal opportunities in order to enable people to act as independent individuals in the society and to not have any difficulties with accessibility. The core principles declaration on equal opportunity for people with disabilities has been included in Resolution 48/96, which was approved by the UN General Assembly on December 20, 1993. According to United Nations General Assembly regulations, policies on basic problems such as education, health, employment, social security, involvement in social - cultural life, and access to all resources as an independent individual have been developed, paving the way for the improvement of the living conditions of the disabled, benefiting from social developments, and access to all resources as an independent individual.

The "Americans with Disabilities Act" is one of the most successful policies for impaired people (ADA, 1990). This guideline comprises of legislative restrictions that prohibit discrimination against people in public and commercial areas, particularly in the workplace. The ADA Guidelines for Accessible Design serve as a guide that establishes the minimal standards for individuals with disabilities' access to public areas, accommodations, and commercial facilities.

Building Regulations: Document M is another resource that development practitioners should examine when implementing universal design principles (Building Regulations, 2020). This guidebook gives information on how to create and implement development initiatives to help people with disabilities participate equally in social and economic life. While this guidance is based on best practices and successful implementations of universal design throughout the world, it is not intended to be prescriptive. It is founded on the reality that the hurdles that people with disabilities experience differ between developing nations and within countries. It is also founded on the fact that each development project is unique and has its own set of problems, whether local or global, that may prohibit it from adopting all universal design principles to the letter.

2.1. Universal Design in Architecture

Universal Design is a concept that strives to make the built environment more accessible to society's different citizens. In the area of architecture, the notion of universal design has its origins. In the 1950s, the notion of universal design began to take shape. The term "barrier-free" planning was popular at the time. The phrase "accessible design" was considered in the 1970s. This was partly due to European and American pressure for people with impairments to be included into their communities.

Universal Design was offered as a viable alternative to barrier-free methods to disability access in the mid-1980s. The Worldesign Congress approved a resolution in 1987 declaring that designers should include disability and age in their work (Fletcher, 2002). The approach to universal design entailed beginning with the demands of the building's users. Current research shows that Universal Design is the strongest and most equitable method to design for the most people (Hamraie, 2007). Design studies on Universal Design, focus on evaluating individual designs, pushing designers to be more accessible, and claiming that Universal Design would result in improved execution of the ADA standards, according to Hamraie (2007).

A team of architects, product designers, engineers, and environmental experts under the direction of Ronald Mace of North Carolina State University created the fundamentals of Universal Design in 1997 (NCSU). The concepts might be used to the creation of places, activities, and communications. According to NCSU's Center for Universal Design, the following elements may be used to evaluate current designs, have an impact on the creative process, and inform both developers and customers about the characteristics of more usable products and environments.

- Equal Utilization: The design should be helpful and marketable to people with a wide variety of skills. All users should be able to utilize the same interface, which should be identical where possible and equal when not, and should not be separated or stigmatized. All users should be able to access confidentiality, security, and safety options. All users should find the design appealing.
- Flexibility in Use: The layout takes into account individual preferences and skills. The design should support the user's accuracy and precision, be speed-responsive, and allow

for flexion and extension access and usage. Users should also be able to select their preferred mode of operation.

- Easy and Uncomplicated to Use: Despite of the person's skill, ability, language skills, or current attention level, the design should be easy to use. Any superfluous complication should be removed. The importance of the information should be prioritized. During and after the activity is finished, effective prompting and feedback should be offered.
- Perceptible Information: Despite of the patient's perceptual ability or the surroundings, the design efficiently communicates the pertinent information to them. For redundant display of vital information, several modalities (pictorial, verbal, tactile) should be employed, and enough contrast between key information and its surrounds should be supplied.
- Inaccuracy Tolerance: The design decreases the dangers and negative consequences of errors or accidental action. The arrangement of the components should reduce risks and errors to the greatest extent possible. Hazardous materials should be removed, separated, or insulated, and the most often utilized elements should be the most accessible.
- Low Physical Effort: The design makes it possible to operate in a productive, pleasant, and fatigue-free manner. Users should be able to remain in a neutral posture, and operating forces should be appropriate. Repeated activities and prolonged physical exertion should be avoided.
- Strategy and Use of Dimension and Space: In terms of size and space for accessibility, range, operation, and usage, individuals of any stature or mobility are catered for. Important items should have a path of view that is not obstructed for any seated or standing user. The size of the hand and grip should be variable. Ample room should be made available for the usage of assistive technology or personal help.

For each principle, a set of implications was developed, outlining the essential aspects that must be present in a design that corresponds to the concept under consideration, the goal was to express universal design in a comprehensive way, according to Story (2000), the principle of universal design and its accompanying rules were intended to do just that. As the writers saw it, the fundamentals of Universal Design extended to all design disciplines, including architecture, product design and communication design (Story, Mueller, Mace, 1998). By guiding the design process, permitting a methodical evaluation of concepts, and aiding in the education of both parties (designers and users), the principles were developed to help

developers and users grasp the features of more advantageous design solutions (Mueller, 1997).

To describe a concept that incorporates human variability, Norms of Universal Design is an effort to express a notion that can be used across all design disciplines. Although the guidelines are helpful, they can be understood as just a starting point for the universal design method (Story et al., 1998). Any architecture challenge, according to Story (2000), can be effectively solved by several solutions. Choosing the best interface approach necessitates an appreciation of and negotiation of the inescapable compromises between accessibility and usability. At all stages of the design process, users must be solicited for feedback. In order to guarantee that the demands of a broad range of possible users are satisfied, it is important to engage actual users in project assessment during the execution (Story, 2000).

2.2. Disability Regulations for Accessibility in Buildings

2.2.1. Disability regulations in Turkey

Only healthy people were considered as users in most of the buildings that are built in cities. Disabled people, who are constitute an important role in social life, had to enter and use the building by the help of other people and had to live and work on the ground floors due to the buildings without elevators.

An accessible building is both a basic human right and a vital characteristic of the built environment. All citizens should have the same right to live, work and entertain. It is unfair for the people with disabilities that the buildings are only built according to the standard characteristics of a healthy person. Access to all facilities should be easy for people with restricted mobility who use strollers, walking sticks, wheelchairs, people with chronic diseases as well as who carry heavy loads. Everyone in a society should be able to live independently (Municipality of Cankaya, 2011).

The first legislative enactment on accessibility concepts for the disabled in Turkey was in 1997 under the statue of Zoning Law numbered 3194 Annex-1 which comprise of; “It is mandatory to comply with the related standards of Institute of Turkish Standards (TSE) to render accessible and habitable environment in urban zoning plans, infrastructures and

buildings for people with disabilities." (Zoning Law Annex-1, 1997). In 1999, new regulations and laws were introduced with the amendments made to the Development Law with the decree numbered 572 (Zoning Law Annex-1, 1997). Due to these regulations, arrangements have been made regarding the buildings for disabled people, and it is aimed to establish the accessibility of street, avenue, square, roads and urban public transportation systems for the disabled and the elderly according to the standards of Institute of Turkish Standards (Enginöz, 2015). In accordance with Gümüş (2007), making the built environment suitable for the disabled people is a process that includes making legal regulations, adopting the necessity of these regulations, applying them correctly and properly, increasing the knowledge and awareness of the society and the disabled, and following what needs to be done. The concept of the disabled, accessibility and the standards of the Turkish Standards Institute regarding the disabled were mentioned for the first time in the regulations. The municipalities in Turkey are obliged to comply with the legislation and standards regarding the disabled, to implement them and to take necessary precautions which are not included (Gümüş, 2007). On the other hand, according to Enginöz (2015), the regulations play a crucial part in the design process, directing the designer's actions at a given point and pushing him or her to consider in terms of handicapped individuals. Reducing accessibility to a special entry or vertical circulation plan intended for individuals with disabilities to enter a building or area is not the right course of action. These approaches both isolate disabled people in the society by separating from others, and also increases the cost of construction and management (Enginöz, 2015). People with disabilities should not be separated from the rest of the population in terms of space planning. Gümüş (2007) argues that design awareness of environment and demand is a requirement within the context of fundamental human rights and freedoms.

In Turkey, serious problems are encountered during implementation of regulations in city planning and in buildings. Usually, continuous and integrated practices that complies with standards or regulations cannot be obtained, and legal regulations and standards about disabled people are tried to meet by constructing ramps considering only people with walking disabilities among the disabled categories. According to Enginöz (2015), it should be aimed not only to deal with regulations or legal sanctions, but also to address design decisions that consider all individuals that make up the society. It should be ensured that the public awareness is preferred to choose equally accessible designs not only for people with disabilities but also for everyone. When designing the built environment, architects and

designers should also consider the issue of making accessible and equitable design (Ergenoğlu, 2013). The succession of the purpose of laws and other regulations are only possible by their implementation (Gümüş, 2007).

TS 9111 covers the architectural regulations that can be made in buildings where disabled people will use (Gümüş, 2007). According to TS 9111, the goal of the standard is to ensure the independent mobility of individuals with impairments within buildings. A large part of the standard includes design criteria for how to design a building and its immediate surroundings for disabled people who are using wheelchairs (Enginöz, 2013).

Disability, according to TS 9111, is the loss of physical, mental, spiritual, emotional, or social abilities to varying degrees as a result of any congenital or subsequent illness or accident. It also refers to people who need special physical and technical regulations in buildings and open areas in order to act independently (TS 9111, 2011).

Handicapped, temporarily disabled, elderly, pregnant women, strollers, children, people who are carrying items and loads, large and obese people, very tall or very short people are people with mobility restrictions in compliance with TS 9111 (2011). Within the scope of the "Law on the Disabled", numbered 5378, the mobility restrictions of people must be eliminated by all kinds of accessible arrangements made in the built environment in which the building and its immediate surroundings are included, and will make the mobility of everyone in this group possible, comfortable and easier (Law on the Disabled, 2005).

Everyone has the right to access anywhere and benefit from any service they want (Law on the Disabled, 2005). According to TS 9111 (2011) any type of building that allows people with any disabilities and the users of a structure and its immediate vicinity to enter and exit without assistance and easily under normal conditions of use, to walk around and to benefit from all the services provided here and considered accessible (TS 9111, 2011). The design's primary goal is to make all structures and the surroundings around them accessible to those with impairments and restricted mobility. The requirements in this standard should be followed beginning with the design process in order to achieve this purpose (Enginöz, 2015). According to "Basic Accessibility (4.2)" article in TS 9111 (2011), families and organizations with handicapped person should feel secure and comfortable accessing, utilizing and evacuating a building. Requirements for these conditions are;

- Car parks close to the main entrance,
- Accessible roads that connect to entrance
- Short distances,
- Even entrance and exit for outdoor access,
- Simple and useful plans,
- Stepless and barrier-free walking area on the floors,
- Simple access to the reception desk, lifts and handicapped lavatories,
- Detectable and prominent emergency evacuation routes for use in emergency situations,
- Safe and spacious elevators that can be used in emergencies,
- Special evacuation chair with safe ladders and ladder slide, which is comfortable and easy to use, helps evacuation and rescue in emergency situations and provides convenience,
- Walkways furnished with anti-slip material,
- Laying the surface coating of the surfaces that are likely to get wer with high friction coefficient material,
- Door apertures that are required and easy to use, as well as enough room to open and close the doors with a wheelchair,
- Suitable maneuvering areas,
- Control buttons and switches should be at a suitable height, location, and color, and should be simple to use,
- Sufficient illumination,
- Sufficient optic contrast on walls, floors, doors and markings,
- Information that can communicate through two or more emotions,
- Good acoustics,
- Sound amplifying systems.

It is also important for mentally disabled people that the above-mentioned uses and equipment are simple and easy to understand (TS 9111, 2011). Everyone in the building should use the same route, same entrance and the same equipment. This ensures the principle of equal use and equality for all (Savut, 2007). Simple recognition of the entry point, no steps or obstacles, vast openings, low necessary strength to function, better lighting and visual contrast, using the same route for both horizontal and vertical circulation, no steps or barriers, adequate maneuvering spaces, broad door passages, secure stairs, providing

recreation opportunities for disabled people, fairness in the utilization of toilets and other basic sanitation, equal exit and evacuation paths, design for emergencies (TS 9111, 2011).

Building Entrance:

The net width of the accessible route must be at least 90 cm. if there are protrusions on the route that narrows the passage, the passage width may decrease to 81.5 cm, provided that the length of these protrusions does not exceeds 61 cm (TS 9111, 2011). It is required that wheelchair users have access to passageways of 150 x 150 cm at reasonable intervals not exceeding 60 meters if an accessible path's gross width is less than 150 cm., the T-junction of two corridors can be acceptable crossing area (TS 9111, 2011). According to "Head Openings (4.3.4.)" article of the TS 9111 (2011) standard, the net height at the head of all circulation routes must be at least 220 cm. To notify visually challenged people, a barrier should be installed if the vertical height is less than 220 cm in an area close to an accessible route.

A special edge arrangement is not required for level differences up to 6 mm in accessible routes. Level differences between 6 mm and 13 mm can be arranged so that the slope does not exceed 1:2. A ramp should be designed appropriately for elevation differences over 13 mm (TS 9111, 2011). According to TS 9111 (2011), the slope should not be steeper than 1:20 (5%) on an accessible route. If the slope of the accessible surface exceeds 5%, it should be arranged as a ramp or curb ramp. In the accessible route, the transverse slope should not exceed 1:50 anywhere. The transverse slope for rainwater drainage should be assumed to be 2% (TS 9111, 2011). Transverse inclines cause the front wheels of a wheelchair to change direction and make the movement of the wheelchair difficult. Therefore, the lowest possible inclination should be used on ramps.

Building entrances should use various materials, colors, and lighting to make it simpler to recognize the doorway. A weather-protected landing should be placed, and the building entrance should be constructed of a solid, non-slip, matte substance to make it comfortable and secure from the elements. The landings in front of the entrance doors should be at least 150 x150 cm in size to allow the wheelchair users to maneuver (TS 9111, 2011). According to the article "Entrance Ramps (4.5.1)" in TS 9111 (2011), if ramps are used at entrances, the slope of the ramp should be maximum 1:12 (8%) if the level difference is 15 cm or less,

if the level difference is between 16 cm – 50 cm, maximum slope should be 1:14 (7%), there should be a maximum slope of 1:16 (6%) when the level difference is between 51 cm and 100 cm, whereas 1:20 (5%) ramps should be utilized when the level difference is greater than 100 cm. Ideally, the building entry ramp should have a net width of at least 90 cm and 100 cm in public buildings. Whenever a ramp's horizontal length exceeds 15 cm, guardrails should be installed on both sides. Ramps should have a flat, hard and non-slip surface, there should not be any drainage grates on it, at the start and at the end (TS 9111).

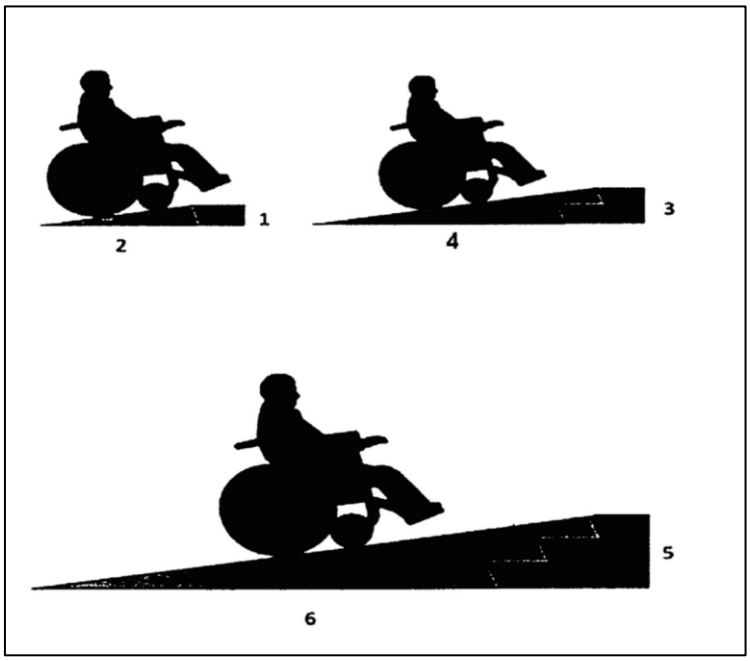


Figure 2.1. Ramps within Circulation Paths (1 - 15 cm-max. 16 cm / 2 - 300 cm / 3 - 30 cm 4 - 600 cm / 5 - 45 cm / 6 - 900 cm)

According to the “Entrance Doors (4.5.2.)” article in TS 9111 (2011), the doors should not form a plane line with the nearby walls at the entrance. Sensor lighting should be preferred at the entrance doors. The overall primary entryway width should not be less than 150cm in width, with one of the wings being at least 100 cm in double-winged doors. If a threshold needs to be created, its height should not be greater than 13 mm. In case windshield is installed at the entrance, a suitable and sufficient space should be provided. External doors should be made to be opened without any difficulty, the force to be applied to open the door should be maximum 37.8 kN. Usage of revolving doors should be avoided. If there is a revolving door, there must be a hinged or photocell door in addition. The building must have at least one accessible ground-floor entrance that is available to the general public. This

entrance cannot be a loading or a service entrance. However, if a facility's only entry is a utility entrance, this access has to be accessible (TS 9111).

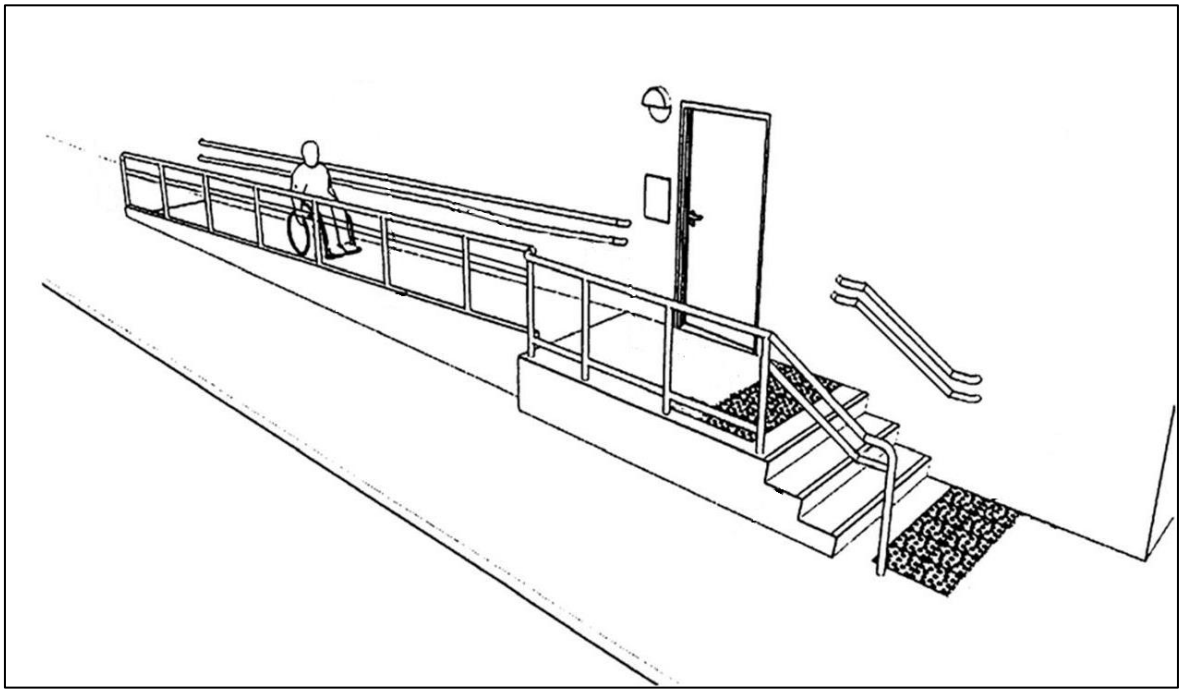


Figure 2.2. Accessible Entrance

Because the entrances also function as emergency exits, it is preferable if all entries are accessible. If the entry is not accessible, a suitable directional sign identifying the location of the next accessible entrance should be offered. Buildings must have accessible entrances as many as required by the legislation and standards regarding the fire regulations. In addition to the main entrance, each independent entrances of other sections within the building must be accessible (TS 9111, 2011).

Doors:

Internal doors must have a minimum net width of 90 cm when opened 90 degrees, while doors that are independent components of the buildings must have a minimum net width of 100 cm, according the article "Doors (4.6.2)" of the TS 9111 (2011) standard. The doors must have a minimum clear height of 210 cm. Thresholds should be avoided. Adjusting the level differences by beveling the floor covering instead of the threshold should be preferred. If making a threshold could not be avoided, the threshold height cannot exceed 13 mm. The

opening axis of the doors should be as perpendicular to the corridors as possible for easy opening. The door assembly should be recognizable and usable for both sides.

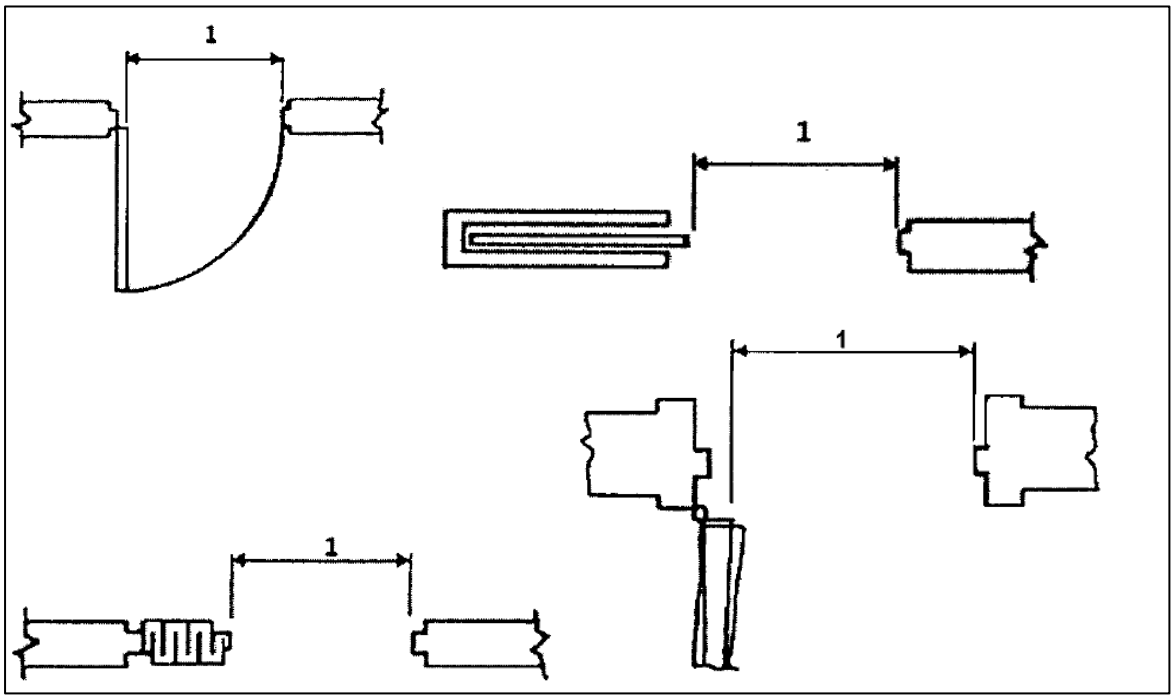


Figure 2.3. Door widths

In case of using self-closing mechanism for doors other than automatic doors, it is recommended that this hardware can delay the closing of the door. This issue is especially important for frequently used doors in order to extend the maneuver time for people with wheelchairs when entering through the door. Using swinging, spring and revolving doors should be avoided because they are not suitable for the use of disabled (TS 9111, 2011).

According to the “Doors (4.6.2)” article of the TS 9111 (2011) standard, a suitable maneuver area should be built in front of each door. If the door apertures do not allow for wheelchair maneuvering, doors operated by an accessible control button should be employed. These doors must be self-closing and equipped with a photocell.

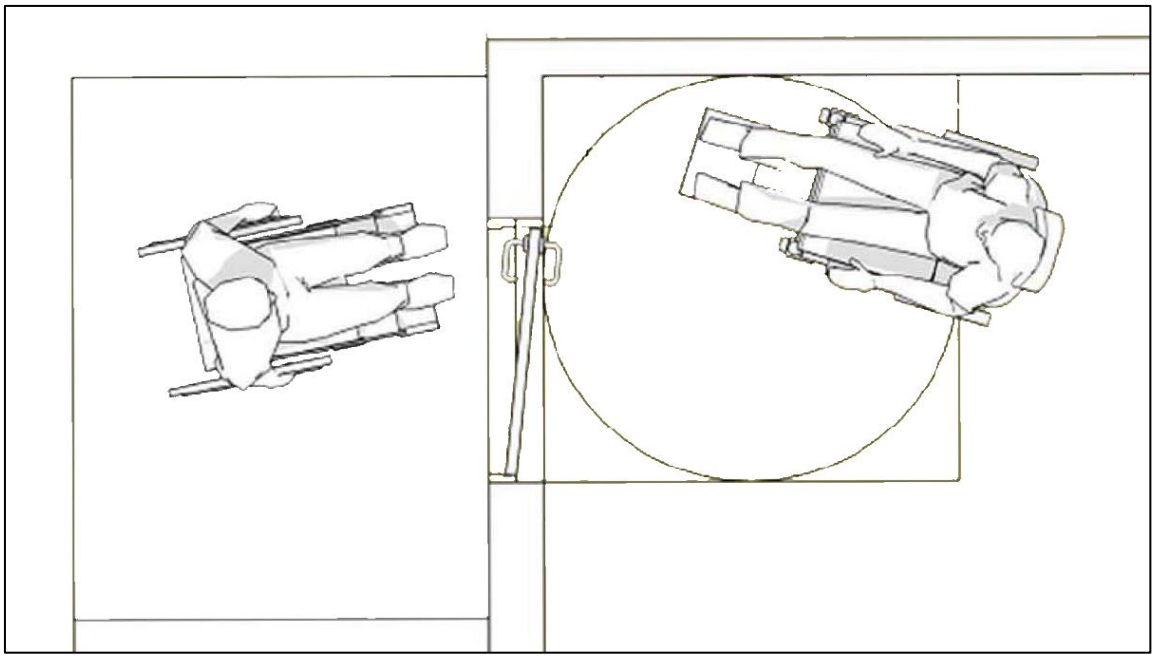


Figure 2.4. Maneuver area in front of doors

Vertical and Horizontal Circulation:

As in the entrances, the interior of the buildings should be hard, stable and non-slip materials. The materials chosen as floor coverings should not have a perforated and rough surface that will obstruct the movement of wheelchairs. The floor coating should prevent users from having an accident because of the wetted floor while cleaning process (TS 9111, 2011). The properties of some materials may vary due to external factors such as weather conditions, temperature, humidity, and intensity of use. When choosing the material, these factors should be taken in to consideration, and materials suitable for the purpose of use of the area, the environment and the slope should be selected (Savut, 2007). Carpets must be firmly fastened to the floor if they are utilized. The texture and weaving direction of the carpet should be arranged so that neither the wheelchairs nor the visually impaired individuals can interfere with their movements. Carpet thickness should not exceed 13 mm (TS 9111, 2011). According to TS9111 (2011), sound reflective surfaces on the floor help visually impaired people to find their way. When necessary, floors should be covered with suitable noise and vibration insulations.

According to the article “Circulation Areas (4.7.1)” in the “Regulation of Buildings (4.7)” section of the TS 9111 (2011) standard, level differences between the entrance hall, elevator access and entrance should be avoided. The unobstructed clear opening of the corridors

inside the buildings should be at least 90 cm in width and the height from the finished floor surface should be at least 220 cm. In this region, there should be no horizontal or vertical obstructions. This height should also be kept beneath stair cases in the halls. Handles should be placed at two different heights, one at 70 cm from the completed floor surface and the other at 90 cm from the finished floor. Both handrails should be mounted on the wall in the circulation areas (TS 9111, 2011).

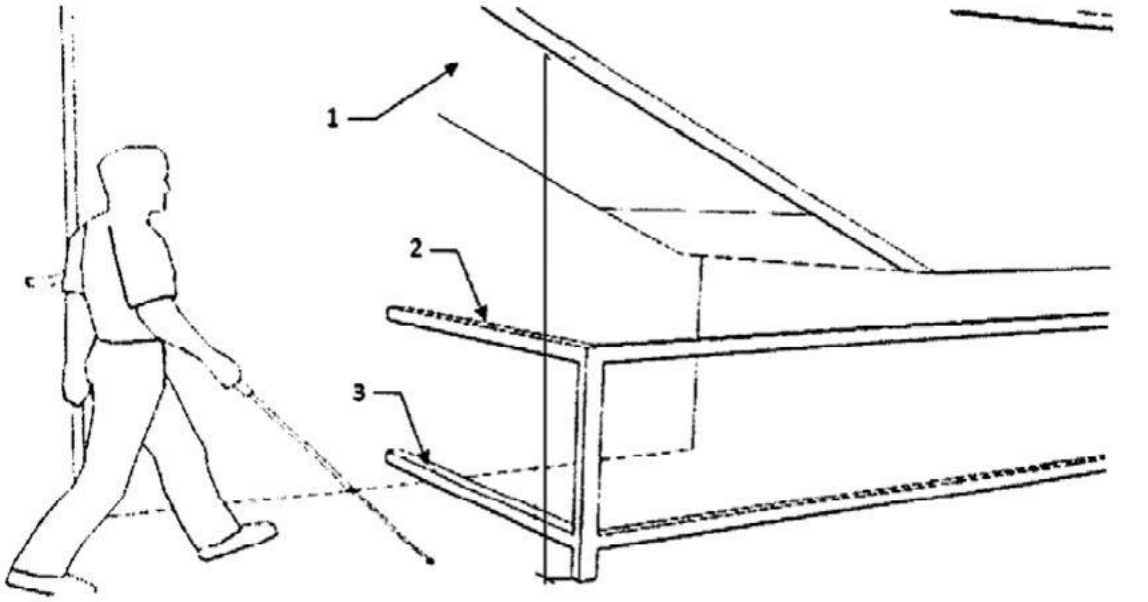


Figure 2.5. Overhead space under stairs in hallways (1 – min. 220 cm net height 2 – guardrail / 3 – guardrail that can be felt with white cane)

Features of elevators other than cabin dimensions must comply with the requirements of TS EN 81-70 standard. The door of the elevator should be minimum 90 cm and the dimensions of the elevator car should not be less than 150 cm in depth and 120 cm in width. An emergency power supply must be provided against power failure (TS 9111, 2011). An unobstructed and accessible route should be planned from the entrance of the building to elevators. According to TS 9111 (2001) standard, the level differences on this route shall be arranged appropriately and if the use of steps and stairs cannot be avoided, an accessible ramp in appropriate size should be provided as an alternative. Landings of appropriate width should be arranged in front of the elevators. Elevator call buttons should be set between 90 and 137 cm in height, ideally around 110 cm. There should be an additional stair next to the elevators and ramps. Additional arrangements should be made for the disabled people in

buildings with escalators. Spiral staircases should be avoided, if not an alternative accessible staircase must be designed (TS 9111, 2011).

The steps must be vertical to the way of traveling of the circulation route, as per the TS 9111 code, to allow visually impaired individuals to approach the staircases from the sides. If the positioning of stairs is not available, the start of the stair shall be marked reliably and clearly with appropriate materials and equipment. The starting and last steps of the staircase, as well as landings, should have visual contrast. Preferably, 4 – 5 cm thick visual warning tape should be placed at the end of each step in same width of the stairs. The perceivable warning surface should be located at the beginning and at the end of the stair. 60 cm long sensible stimulating surface should be placed in the direction of the stair, ending 30 cm before the first step of the stair (TS 9111, 2011). When the perceptible stimulating surface is used at the top and bottom steps, it reduces the visual perception of the first and last steps in the stairwell. Therefore, a visual contrast should be made between the stairs and floor material (Savuy, 2007). Other properties of perceptible stimulating surfaces must comply with the related standards.

According to the article “Circulation Areas (4.7.1)” in the “Regulation of Buildings (4.7)” section of TS 9111 (2011) standard, steps should be proportional to each other in terms of depth and height in staircase design. the step depth should be at least 28 cm. If there is no additional arrangement for the disabled people, the step height should be maximum 16 cm. In other situations, step height shall be maximum 18 cm. The steps should be made of non-slipping, hard and matte materials, and should not catch the eye with reflections or glare when illuminated with natural or artificial light. Anti-slip details or strips shall be placed at the end of each step. These stripes should contrast with the color of the steps, preferably yellow (TS 9111, 2011).

Both the top and bottom of the steps must have landings. Additionally, every 8 to 10 stairs, intermediate resting areas should be carved into staircases. Commonly used stairs and landing widths cannot be less than 120 cm in residential buildings and 150 cm in public buildings. The length of the start and end of landings of the stairs cannot be less than 150 cm and their width less than the width of the stair. This space must be at least 150cm × 150cm if a door opens to a landing (TS 9111, 2011). There should be a preference for

different-colored stair landings for people with impaired eyesight, according to Olguntürk (2007).

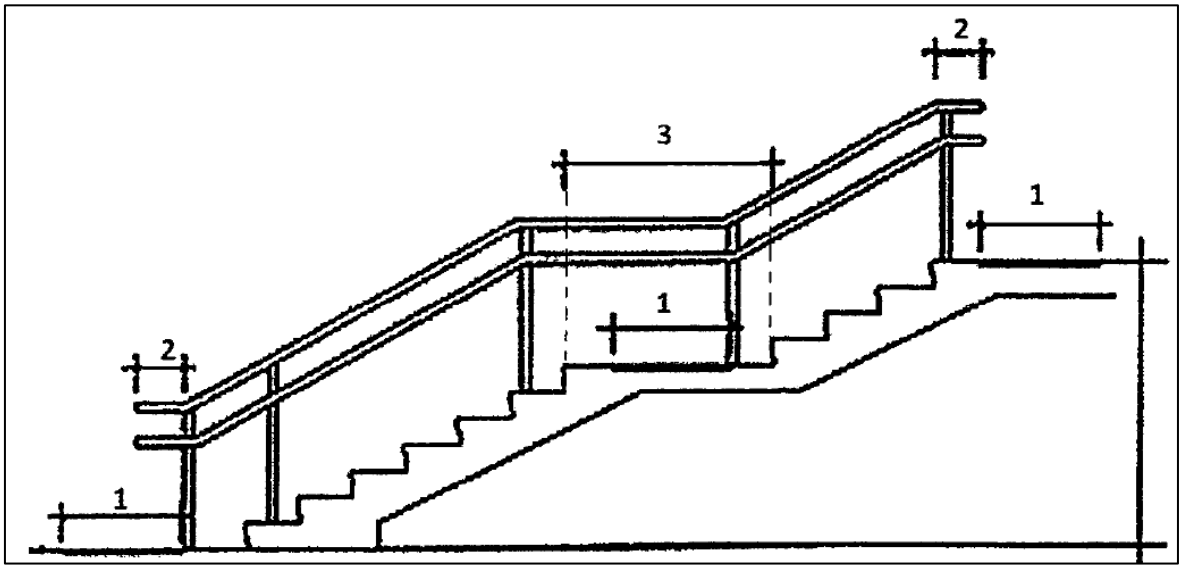


Figure 2.6. Stair Dimensions (1 – 60 cm long sensible stimulating surface / 2 – 30 cm
3 – min. 120 cm)

Handrails must be installed on both edges of the steps if the stairway includes gaps on both ends, and on one edge if the gap is on one side, in accordance with the TS 9111 (2011) regulation. If the staircase has a wall on one or both sides, railings must be installed on the wall. A handrail must be installed in the center of steps that are 300 cm wide or wider. Handrails should be easy to grasp (TS 9111, 2011). Handrails must be fixed to the wall or floor in such a way that they can safely carry and transmit loads. Two handrails at 70 cm and 90 cm in height should be designed on the railing. The handrails must continue at least 30 cm before the start of the stair and at least 30 cm from the end of the stair. The end of the railing extension should be curved downwards in the shape of a half-moon (TS 9111, 2011).

According to the article “Circulation Areas (4.7.1)” in the “Regulation of Building (4.7)” section of the TS 9111 (2011) standard, the distance between the wall and the handrail should not be less than 4 cm. In case of protrusions and roughness’s on the adjacent wall or other surfaces of the railing, the distance between the wall and the handrail should not be less than 6 cm net. The grip surface of the handrail should be seamless and continuous. It should not be interrupted by a guardrail post or other obstacles. The handrails can be shaped in different ways so that they can be easily held. Circular handrails are recommended for better grip. The handrails should have a thickness of 32 mm to 40 mm (TS 9111, 2011). To be easily

recognized by individuals with limited eyesight, the color of the handrail should be selected to contrast with the neighboring surroundings. In buildings open to public use, information about the stairs should be added on the handrails written with Braille Alphabet (Olguntürk, 2007).

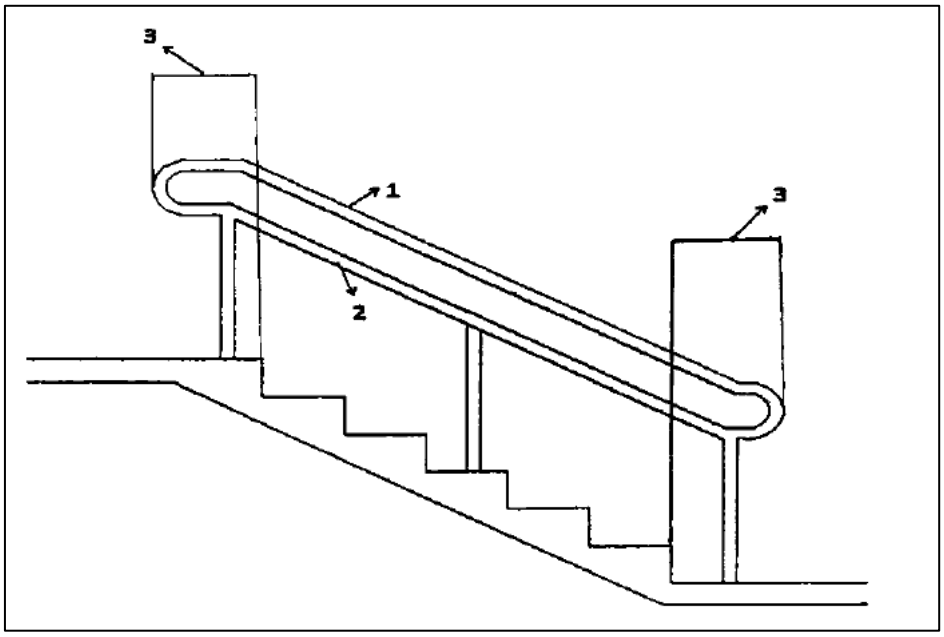


Figure 2.7. Handrail and Guardrail Dimensions

According to Gümüş (2007), apart from stairs and elevators, a stairlift or vertical platform system that is located on the stairs can be used for vertical circulation. The issue to be considered in using of these vertical circulation systems should be the choice of location, determination of the starting and ending points (Gümüş, 2007).

Markings:

According to the article “Markings (4.8)” of the TS 9111 (2011) standard, signs must be legible and understandable for everyone. Signs must be positioned at a suitable height so that they are clearly visible, legible, and well-lit. Written material should be accompanied by symbols to facilitate understanding for people with mental disabilities. Signage should be manufactured of materials that are long-lasting and simple to replace, clean, and maintain. Usage of too many signages must be avoided. At the entry door, illuminated instructional signs must be placed where it can be seen clearly. The door latch must include signage on

both sides. On the latch side, communication systems have to be installed, ideally 100–120 cm above the final surface.

Direction signs should be positioned in accessible places inside the building, so that they may be inspected in a relaxed and comfortable manner. In facilities that are open to public use, there should be a sign that shows the routing plan right after the main entrance. Directional signages should lead people to respective departments and should be in places where direction choices can be made and should form a reasonable routing sequence to different points of the route at the starting point. These should not be very frequent, but should be repeated whenever there is a possibility of changing direction. Every area of a facility should have signage pointing the way to the restrooms. Instructive signage identifying each access and exit point in stairwells should be included. Each elevator entry on either floor must have a floor number on each side of the outer frame.

Signs should be placed so that people can clearly see them while sitting, standing or walking. Signs should be non-glare and well lit. it should not be placed behind glass against reflections. Signs can be artificially illuminated.

2.2.2. Disability regulations in United States of America

Between 40 and 50 million Americans have a disability, according to the Institute of Medicine. As the new generation approaches an elderly age, when the risk of impairment is at its peak, this number is anticipated to increase significantly over the course of the next 30 years.

As a sizable minority, Americans with disabilities account for around one-fifth of the community, with more than half of those over the age of eighty. The United States has a long history with its handicapped population, and significant progress has been achieved in the previous century to improve the conditions of handicapped people via laws that grants protections and privileges to them. The Americans with Impairments Act (ADA), a key anti-discrimination statute, protects people with disabilities in society and at work.

According to the Social Security Advisory Board (2003), qualifying users were referred to be "totally and permanently crippled" when the federal government first started funding

state-run disability assistance programs. In 1956, the Disability Insurance Program expanded this criterion to include the incapacity to participate in any significant gainful activity owing to any physiological function that can be determined medically or mental disability that is either expected to culminate in mortality or has a lengthy and infinite existence (Security Advisory Board, 2003). Critics stated that the terminology confined the idea of impairment to a certain vocation, and that as time passed, more comprehensive definitions emerged (Donoghue, 2003). In the U.S.A., the current political, medical, and social consensus on impairment is that it includes limitations that hinder someone from doing basic daily duties physically or psychologically, as well as the belief that one has such a condition (Francis & Silvers, 2016).

Handicapped regulation was limited at the federal level in the 18th and 19th centuries, with John Adams' legislation for the assistance of ill and handicapped seafarers in the 18th centuries, passed in 1798, being a significant measure at the time. Several states approved Eugenic Sterilization Laws in the early 1900s, allowing governments to compel sterilization on people with mental illnesses (Charlton, 1998). According to Charlton (1998), the legality of such law was affirmed by the Supreme Court in the 1927 case Buck v Bell, and the Federal Sterilization Legislation of 1978 prohibited similar legislation over half a century later. Following the First World War, the Rehabilitation Programs, which was treating and supporting healing troops with educational services, ushered a new era of disability protection laws in the 1900s (Charlton, 1998). When Franklin D. Roosevelt, a physically challenged person, was elected president and the Social Security Act was passed in the 1930s, significant progress has been made in the disability community (Burkhauser & Daly, 2002).

The civil rights movement and advancements toward handicapped equality happened at the same time in the second part of the 20th century (Charlton, 1998). As a result of a research study on the barriers to building access for individuals with limited mobility reported by the American National Standards Institute in 1961, the Architectural Barriers Act was introduced in 1968, as well as several states passed fair ease of access legislation in the 1970s, per the Charlton (1998). The Intellectual Disabilities Institutions and Community Mental Health Facilities Construction Act, Medicaid, and other laws passed in the 1960s provided funding for treatment and set up national councils, advocacy organizations, and avenues for higher education for people with disabilities (Burkhauser & Daly, 2002).

Numerous important anti-discrimination laws were passed in the 1970s. One of these was the "Ugly Law" repeal, which permitted law enforcement to charge someone with a crime just for possessing a definable impairment. The 1980s saw the adoption of several laws, including the Fair Housing Amendments Act, Technology-Related Assistance for Individuals with Disabilities Act, Civil Rights of Institutionalized People Act (CRIOA), and the Air Carrier Access Act (Burkhauser & Daly, 2002).

The 1990-approved Americans with Disabilities Act (ADA) was built upon by further pieces of legislation, such as the Communications Act and the Transport to Work and Employment Benefits Enhancement Act (TWWIIA). Burkhauser & Daly at the millennium's turn, the Supreme Court heard significant opinions upholding federally specified disability rights (Wilson, 2017).

The Americans with Disabilities Act (ADA) prohibits discrimination based on disability in all public contexts, particularly employment, education, public transportation, and all governmental and non-governmental businesses open to the public (ADA, 2010). The Civil Rights Act of 1964 outlawed discrimination against persons on the basis of their gender identity as well as their ethnicity, religion, gender identity, nationality, and other characteristics. This law gives people with disabilities the same anti-discrimination protection as that law. In addition, unlike the Civil Rights Act, the ADA mandates that public spaces be accessible and that covered companies provide reasonable accommodations for workers with disabilities (US Department of Justice, 2009).

The Americans with Disabilities Act (ADA) mandates that public institutions design and build structures, or portions of institutions, that are freely accessible to and used by people with disabilities, provided that work starts after January 26, 1992.

A site's fixed or built-in elements are covered by the 2010 Guidelines, as well as the 1991 Criteria. Notes, appendices and illustrations in the 1991 and 2010 guidelines describe or illustrate the legislation's objectives except as otherwise indicated; they do not reflect legally binding obligations (ADA, 2010).

Individuals with disabilities can access locations, facilities, buildings, and features with ADA's scope and technical standards. The Americans with Disabilities Act of 1990 requires

that, to the extent necessary by national regulation, requirements must follow throughout the planning and construction of sites, infrastructures, buildings, and other aspects. Existing facilities are not protected by the ADA unless they are modified by a covered entity. The dimensions and anthropometric measurements of adults were utilized to develop the product's technical specifications. The Americans with Disabilities Act also includes technical specifications for drinking fountains, toilets, sinks, and tables and desks depending on children's anthropometric measurements (ADA, 2010).

Calculations of ratios or percentages are used to estimate the required number of features or facilities, according to ADA (2010). To calculate the proper size of an element or facility, rounding down numbers less than one-half is acceptable when using ratios or percentages. Mobility elements are required in common use spaces in residential complexes that do not service residential housing units. Workplaces must be designed and built so that people with disabilities may approach, enter, and leave them. This includes the locations and elements inside employee work zones. However, even while rooms that are generally used by personnel for work do not have to be totally accessible, they should be built with non-required turning spaces and accessible elements. Employees with impairments are entitled for special adjustments in the workplace underneath the Americans with Disabilities Act (ADA) (2010), which may involve adjustments to facility space.

Building Entrance:

From accessible parking areas, passenger pickup areas, roads, paths, and mass transport hubs to the accessible facility or institution doorway they support, at least one accessible route must be established on the property (ADA, 2010). When making changes to historical sites that qualify, the Americans with Disabilities Act of 2010 stipulates that only one accessible route between a site point of entry and an accessible entrance may be used. There must be an accessible pathway connecting each site entrance point to an accessible building door or entry. All bus stations must be on accessible routes and service the same accessible entry or entrances from site arrival points including such bus stations that are close to each other. Furthermore, each of the property's handicapped-accessible entrances must be served by as long as the sole method of access between the site arrival points and buildings or facility entrances is a car road that does not allow for pedestrian access, an accessible path is not

(ADA, 2010). Accessible public entrances must account for a minimum of 60% of all public entrances (IBC, 2018).

The ADA (2010) requires that accessible pathways incorporate at minimum one of the following criteria, entrances, ramps, curb ramps without flaring edges, elevators, and platform lifts. Additionally, the pedestrian surface must have a slope of no more than 1:20. An accessible route must adhere to the relevant requirements in all respects (ADA, 2010).

Doors:

Turnstiles, rotating gates, and spinning doors are not considered to be a component of an accessible path according to the ADA (2010). At least 815 mm of clear space must be available for doors. Clear apertures are used in winging door entrances to measure the separation between the door's surface and the stop when the door is opened 90 degrees. Openings need to be 915 mm wide if they are deeper than 610 mm. Projections which are less than 865 mm above the finished floor but would still fit inside the requisite clear opening width are not allowed. There can be no more than 100 millimeters projected into the 865 mm to 2030 mm clear opening width above the completed floor or ground (ADA, 2010).

The latch side stop can obtrude up to 16 mm into the required clear width when modifying an existing structure. Doorstops and closers need to be placed at least 1980 millimeters above the completed floor (ADA, 2010).

The needed latch or hinge side clearance, as well as the required maneuvering clearance, must encompass the whole width of the doorway. There is no mandate for the clearance beyond the latch when it comes to hospital patient room entry doors. The table below displays the swinging door and gate's maneuvering clearance.

Table 2.1. Manual Swinging Door and Gate Clearance

Usage Type		Clearance for Minimum Maneuvering	
Direction of Approach	Side of the Door or Gate	Perpendicular to Doorway	Parallel to Doorway
Frontal Approach	Pull	1525 mm	455 mm
Frontal Approach	Push	1220 mm	0 mm
On The Hinged Angle	Pull	1525 mm	915 mm
On The Hinged Angle	Pull	1370 mm	1065 mm
On The Hinged Angle	Push	1065 mm	560 mm
On The Latching End	Pull	1220 mm	610 mm
On The Latching End	Push	1065 mm	610 mm

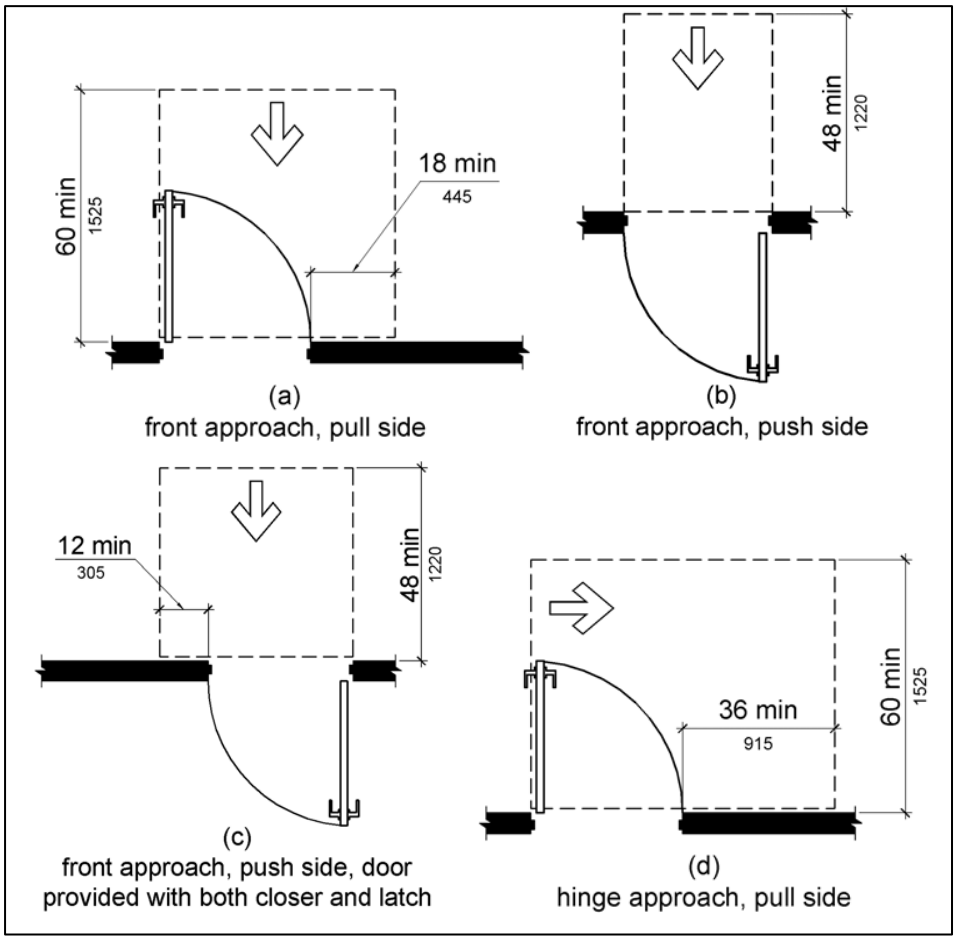


Figure 2.8. Clearance Maneuvering at Manual Swinging Doors and Gates

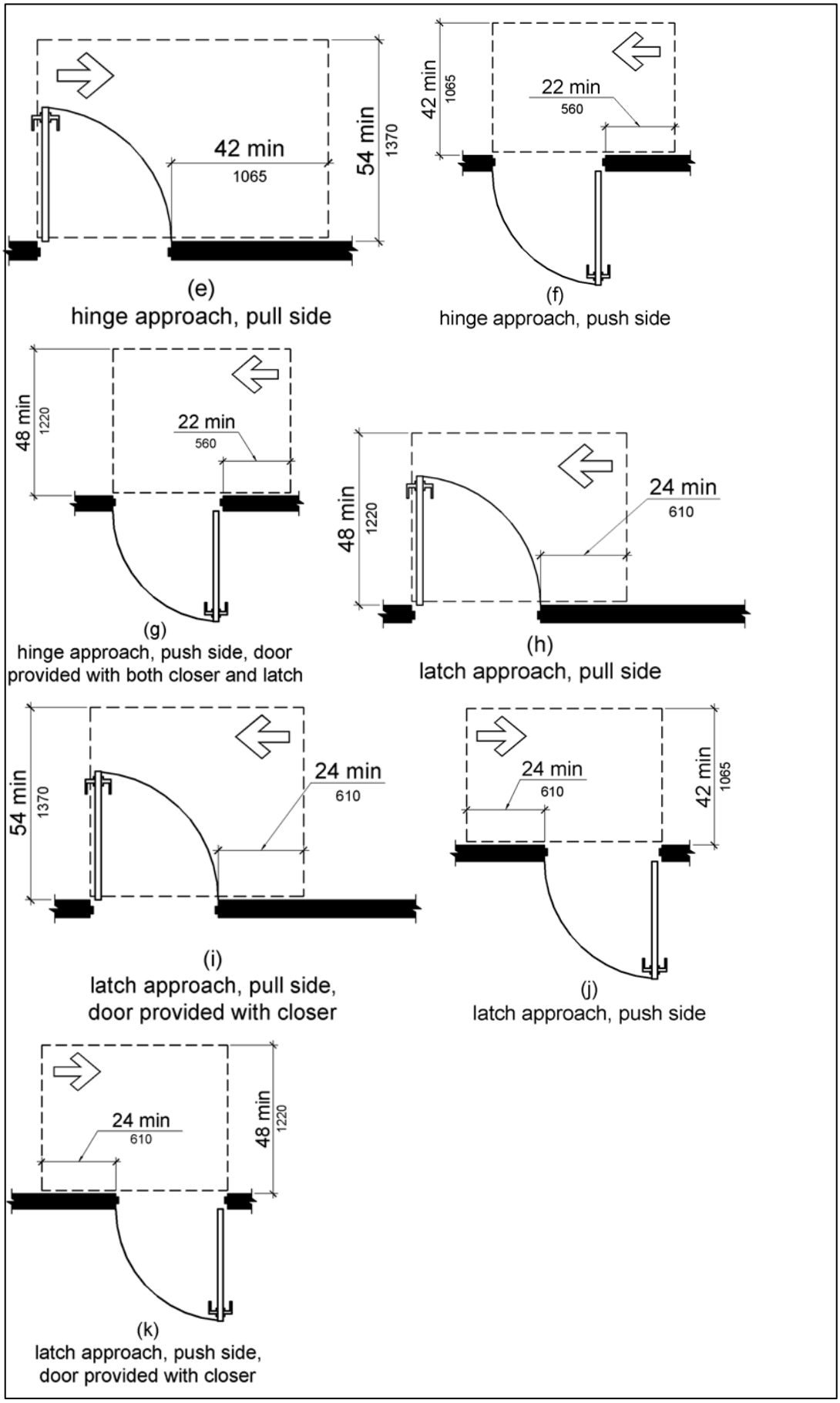


Figure 2.8. Clearance Maneuvering at Manual Swinging Doors and Gates (Continuation)

For apertures that are smaller than 915 mm broad without gateways, doors, sliding doors, or foldable entryways, maneuvering clearances must adhere to the chart beneath.

Table 2.2. For Manual Sliding Doors, Manual Folding Doors, And Doorways Without Doors or Gates, There Are Clearances.

	Clearance for Minimum Maneuvering	
Direction of Approach	Perpendicular to Doorway	Parallel to Doorway
Frontal Approach	1220 mm	0 mm
From side	1065 mm	0 mm
From pocket/hinge side	1065 mm	560 mm
From stop/latch side	1065 mm	610 mm

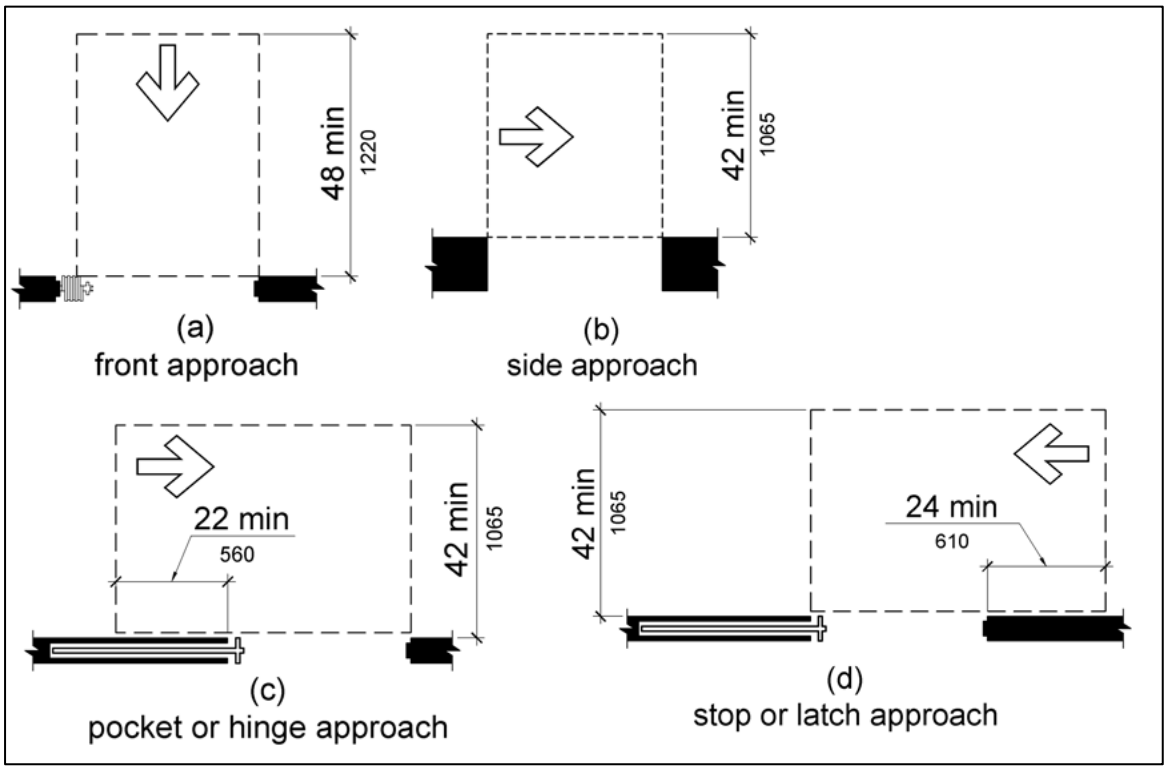


Figure 2.9. Doorway Clearances without any Doors or Gates, Manually Controlled Sliding Doors, and Manual Folded Doors

According to the ADA (2010), forward approach maneuvering allowances must be made whenever any obstruction extends beyond the face of a door or gate by more than 205mm when measured perpendicularly and is within 455mm of the latch side. If the thickness of the wall or the positioning of casework and other immovable features near to the entryway, a door can be recessed. This requirement must be followed whenever doors are recessed.

Thresholds at entrances, if supplied, must be no more than 13 mm high. Dual hinged or pivoted entrances or gateways must be separated by at least of 1220 mm including the size of the entry doors or gateways.

Handles, levers, latches, and locking on all functioning parts of gateways and doorways must all be usable with one hand and not necessitate a firm grip, a squeeze, or a wrist twist. The maximum effort needed to use the components should be 22.2 N. The operational components of these equipment must be minimum 865 mm and not exceed mor than 1220 mm in height from the finished flooring. There must be visible and accessible working hardware on both sides of the sliding doors when they are fully opened (ADA, 2010). According to the ADA (2010), a door or grille's lock that only engages at the top or bottom rails can be utilized in any position. Barrier walls and fences that surround hot tubs, spas, and swimming pools may have self-latching mechanisms if they are not auto locking and may be opened with a key, an electronic opener, or an incorporated combination lock from a maximum height of 1370mm above the completed floor surface.

Door equipment must be functional with a clenched fist or a loosened hold that supports the broadest variety of users, based on the American Disability Association (2010). Hardware that requires several consecutive actions is not advised as it requires more dexterity and coordination.

Doors and gates must be able to move from a 90-degree open position to a 12-degree closed position in at least five seconds when using closers. It is necessary to tune the spring hinges on doors and gates so that they move from a 70-degree open position to a closed position in at least 1.5 seconds (ADA, 2010).

In contrast to the initial effort needed to overcome the door's resistance, the ADA (2010) defines force applied as the constant pressure needed to completely open a door. This definition excludes the forces required to disengage other door-closing mechanisms or retract bolts.

On the push side of swinging doors and gates, a smooth surface that is as wide as the door or gate, and is within the height of 255 mm from the finished floor is required. Parts

connecting horizontally or vertically on these surfaces must be within 1.6 mm of one another's plane (ADA, 2010).

In doors, gates, and sidelights close to the doors or gates, there must be at least one glass panel within the 1090 mm above the finished floor that allows a sight through the panels (ADA, 2010).

Clear Width (404.3.1) of the ADA (2010) specifies that main entrance doors must have at least 815 mm clear opening in both power-on and off modes of operation. In order to establish the least required clear width for automatically controlled door systems in entrances, all wings should be in their open position. Swinging or sliding doors and gates must have a clear break out aperture of at least 815 mm in panic mode if they are being used as an escape route and do not have backup power available

Vertical and Horizontal Circulation:

According to the Americans with Disabilities Act of 2010, multi-story facilities and institutions must provide at least one accessible walkway on every story and mezzanine area. Every location and feature that is put on a floor level that isn't served by an accessible route must be in complete compliance. Mezzanine may refer to a level change rather than a floor. There must be an accessible walkway between all mezzanine floors in any construction. All common use areas must serve accessible housing units if residents have access to them, unless access is restricted to residents of specific dwelling units (ADA, 2010).

For new installations, it is essential to establish an accessible passage between the levels served by the elevator or staircase, and structural changes are required for installation (ADA, 2010).

Accessible pathways must follow general circulation routes closely or adjacent to them in order to be successful. The accessible route must follow the primary corridor of circulation. This means that pedestrian traffic patterns, such as sidewalks and clearly defined pedestrian lanes, must be accessible or have a nearby accessible option. Furthermore, accessible vertical internal flow should be located near stairwells and elevators rather than towards the back of the structure (ADA, 2010).

It is essential that the floor and ground surfaces are sturdy, solid, and slip resistant, as per the ADA (2010) standard's article "Walking Surface (403)." A sturdy surface means that is unaffected by contaminants or applied force and returns to its original shape once the contaminant or force is removed. Surfaces should be able to withstand the deformation brought on by bumps or moving objects. To provide safe walking, a slip-resistant surface must provide enough frictional resistance to walking forces (ADA, 2010).

The carpeting or carpet tile has to be equipped with either a strong cushioned pad or no cushioned pad at all. The pile height is limited to 13 mm. In addition, it must have trim throughout its length and be secured to the floor (ADA, 2010). The force necessary to use a wheelchair efficiently can increase due to the carpets and mats that are permanently connected to a surface. A sturdy backing, cushion, or pad must be employed if one is utilized. Carpet pad should be avoided whenever possible since the soft cushioning increases roll resistance (ADA, 2010). No sphere larger than 13 mm in diameter is allowed to enter through gaps in the ground or other floor surfaces. Elongated apertures must have a long dimension that is parallel to the main direction of movement.

According to the ADA, elevation fluctuations in level of up to 6.4 mm in height are permissible (2010). Level fluctuations in elevation between 6.4 mm and 13 mm must always be straightened out with a gradient of no more than 1:2. A 13 mm vertical and 6.4 mm beveled level shift conceivable. The overall elevation difference, however, must not exceed 13 mm.

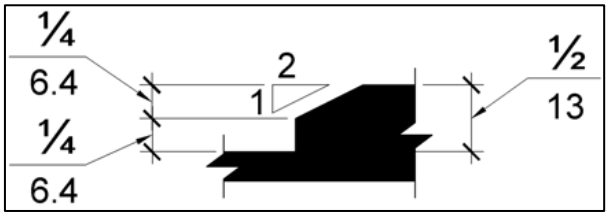


Figure 2.10. Beveled Change in Level

Ramp courses must have a maximum running slope of 1:12. Ramps must have the lowest feasible running gradient and, where practical, be reinforced by stepping to allow the greatest possible range of users. Ramp run's transverse slope cannot be higher than 1:48. (ADA, 2010).

According to the ADA, a ramp's clear width and, if railings are present, the clear space between handrails, must be at least 915 mm (2010). A maximum rise of 760 mm is required for every ramp run. Each ramp run requires landing platforms at the start and finish. Ramp runs that do not have smooth landings during direction changes may produce a complex slope that does not meet the necessary requirements. The direction of a ramp that is curved or round in addition, curvilinear ramps with short radii might produce complex cross slopes and, as a result, they may not fulfill the accessibility standard for mobility and door operations. Therefore; a flat landing at the accessible entry is required (ADA, 2010).

A landing platform's unobstructed width needs to be minimum equal to the width of the broadest portion of the ramp leading to the landings. The landing needs to be at least 1525 mm wide. For ramps that switch directions between runs at landing platforms, a clean width of landing platform of 1525 mm by 1525 mm is necessary. Maneuvering clearance is necessary whenever entrances are positioned near to a ramp landing (ADA, 2010).

The riser heights and tread depths of all steps on a set of steps must be constant, according to the “Stairways (504)” item in ADA (2010). Risers must be at least 100 mm height and no more than 180 mm high. Treads must be at least 280 mm deep. The use of open risers is not allowed. The tread surface must be sturdy, firm, and non-slip. Visual conflict on nosings or at the leading edges of treads without nosings must be resolved to make stair treads more visible to people with weak eyesight.

The tread's leading edge must have a maximum radius of 13 mm. Nosings that extend over risers must have a curved or beveled bottom edge. Risers can have a maximum slope of 30 degrees from vertical under the tread. The maximum allowed protrusion of the nosing above the tread below is 38 mm. In moist climates, stairway steps and platforms must be designed to avoid water accumulation (ADA, 2010).

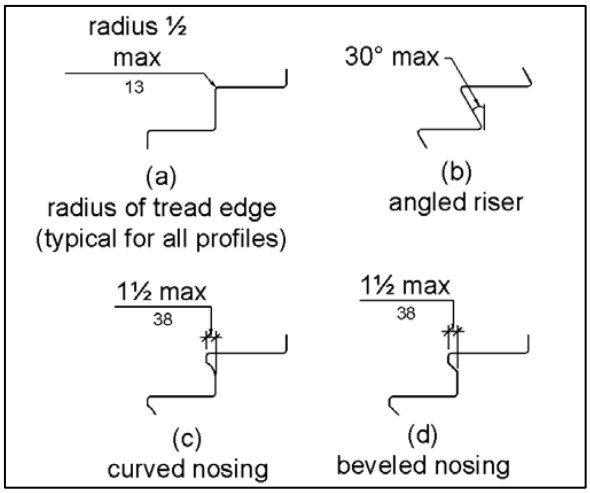


Figure 2.11. Stair Nosings

Handrails are required on ramps with an elevation of more than 150 mm and on certain staircases. Railing is not necessary on a walkway with a slope of less than 1:20. (ADA, 2010). Handrails must be installed on both ends of ramps and steps. Each stair flight and ramp run must have an uninterrupted railing that runs the entire distance of it. The vertical height of the handrails must be at minimum 865 mm and no more than 965 mm above the walking surface, stepping edge, and ramp surface. There must be a constant height between the handrail and the walking surface, staircase nosings, or ramp surface.

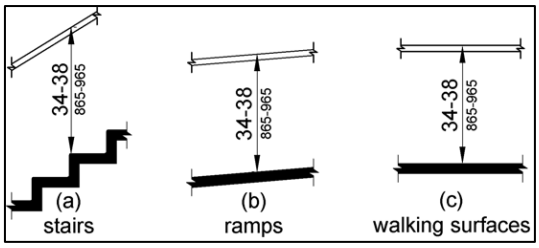


Figure 2.12. Handrail Height

According to ADA (2010), the distance between the handrail gripping surfaces and the neighboring surface must be at least 38 mm. Handrails must have uninterrupted grasping surfaces that are free from impediments on the top and sides. No more than 20% of the stair railing sections' length may be limited. When possible, horizontal extensions must extend at least 38 mm below the handrail's grabbing surface (ADA, 2010). In the event that someone loses their footing or falls, having a constant gripping surface that allows them to reach outward or downward to hold onto a railing might be helpful (ADA, 2010).

Handrail gripping surfaces must continue beyond stair flights and ramp runs in the same direction. For the horizontal handrails, the length between the top and bottom of a ramp run must be at most 305 mm. A nearby ramp run's wall, guard, or landing surface must have a continuous railing (ADA, 2010).

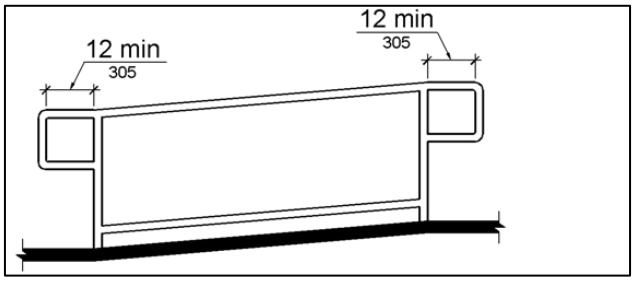


Figure 2.13. Ramp Handrail Extensions on the Top and Bottom

In staircases, handrails must extend horizontally above the landing for a minimum of 305 millimeters, starting at the top of the first riser nose. Ending an extension requires reaching a wall, guard, or landing surface (ADA, 2010)

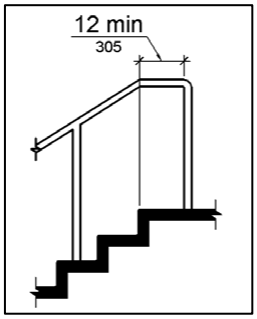


Figure 2.14. Extension of the Top Railing at the Stairs

The Americans with Disabilities Act of 2010 mandates clearances on pedestrian pathways. There must be a minimum clear width of 915 millimeters on walking surfaces. Accessible routes making 180-degree turns must have a minimum clear width of 1065 millimeters when approaching and 1065 millimeters when departing each U-turn around an element less than 1220 millimeters wide.

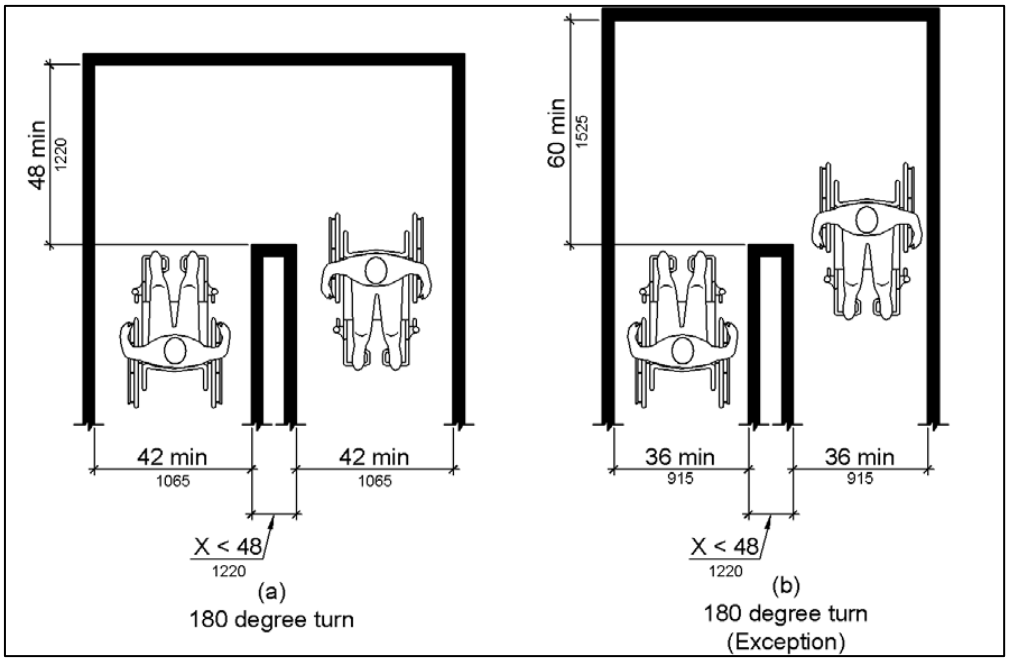


Figure 2.15. Width Clearance at Turns

On an accessible approach with a standard width of no more than 1525 mm, crossing points must be provided at periods of no more than 61 meters. A passing space should be at least 1525 mm by 1525 mm in size, as well as a T-shaped intersection of two routes with the base and arms extending 1220 mm or beyond the intersection. The T-shaped turning space arms must have a minimum width of 915 mm. Each T arm must be clear of impediments for at least 305 mm at all sides, and the floor must be clear of any obstacles for at least 610 mm. At the end of the corridor, the spacing must provide for knee and toe clearance (ADA, 2010).

The ADA (2010) defines toe clearances as the vacant space beneath an item that is 230 mm or less above the final floor or surface. The maximum toe clearance underneath a component should be 635 mm. The toe clearance is defined as a space that is more than 150 mm above the knee clearance and 230 mm above the finished floor or ground. Foot height shall exceed 430 mm underneath an item where required as part of a clean floor space. A minimum of 760 mm of wide toe clearance is required. (ADA, 2010).

The zone under an object that is between 230 mm and 685 mm above the completed floor or surface is referred to as a leg clear area. If a clean floor space under a component is required, it shall be 205 mm deep at 685 mm above the finished floor or ground and 280 mm deep at 230 mm above the finished floor or ground. Knee clearance should be allowed to decrease

by 25 mm for every 150 mm between 230 mm and 685 mm above the finished floor (ADA, 2010).

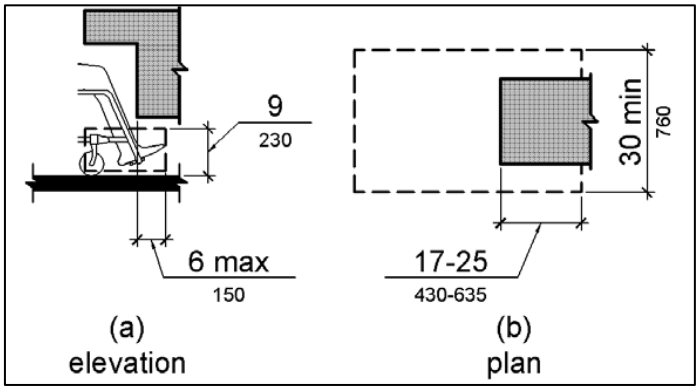


Figure 2.16. Clearance Zone of the Toes and Knees

Unless otherwise specified, unobstructed floor space must be provided in front of or parallel to an element, according to the ADA (2010). An accessible walkway or alternative clear floor space must be on an entire unblocked side of the open area. If the depth reaches 610 mm, front approach alcoves must be at least 915 mm broad. If the depth reaches 380 mm, parallel approach alcoves must be at least 1525 mm wide.

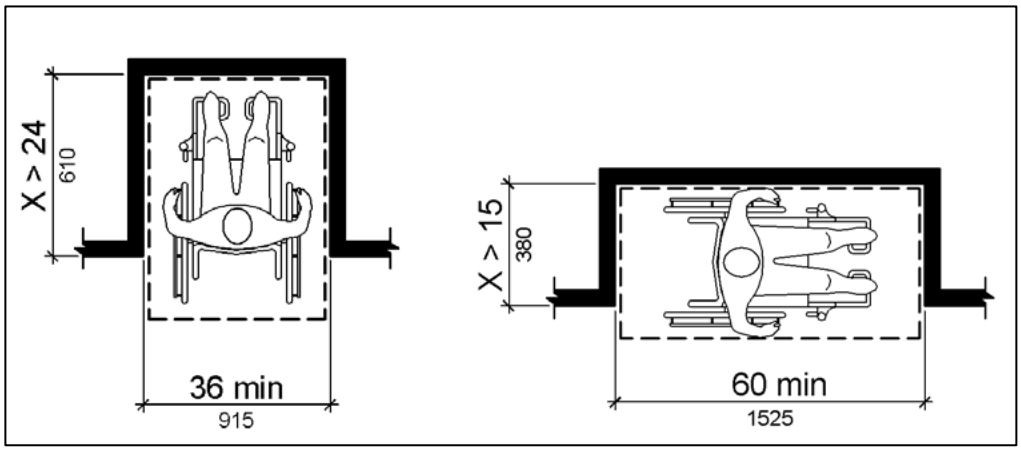


Figure 2.17. Maneuvering Clearance in an Alcove

When using a walking stick, a person has adequate time to identify the object with the walking stick before physical contact occurs. Components on circulation routes, including operational objects, must meet the protruding object criteria. Objects should have exterior parts which are no higher than 100 mm horizontally and no higher than 2030 mm above the completed floor in order to be compatible with the ADA (2010).

A 305 mm overhang at a height limit of 685 mm and a 2030 mm overhanging at a total elevation of 2030 mm above the completed floor or ground are required for items placed on top stand-alone columns or beams. The bottom border of signs or other obstructions placed between pillars or beams shall be 685 mm or 2030 mm higher than the finished floor or ground, whichever is greater (ADA, 2010).

According to ADA (2010), a circulatory route's overhead clearance must be at minimum 2030 mm high. Railings or other impediments must be installed when the maximum clearance is less than 2030 mm high. At least 685 mm must separate the guardrail or barrier's leading edge from the completed floor or ground. At least 1980 mm must separate door closers and stops from the finished floor or ground.

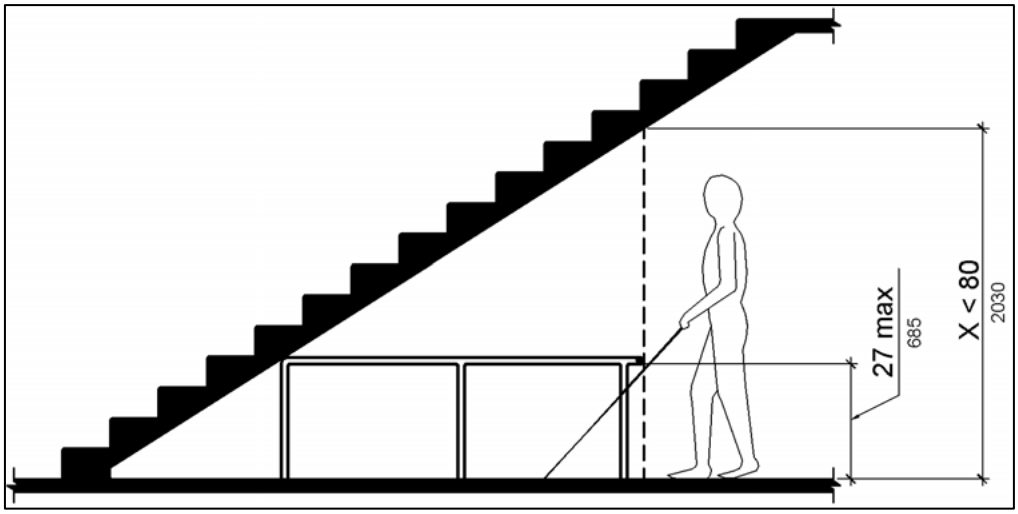


Figure 2.18. Amount of Vertical Space Required Under Stairs

As per the item “Elevators” in ADA (2010), passenger elevators must meet the requirements that are defined in ASME A17.1, and elevator operation must be automated. Elevator call buttons or keypads must be raised or flush with the wall if supplied. Hallway call buttons can be installed into already-existing elevators. Call pushbuttons and keypads must always be placed where frontal approach is unhindered, between 380 mm and 1220 mm above the completed floor surface. It is possible to place call keys and keypads as tall as 1370 mm above the floor surface, determined from the uppermost functional segment's midline. The smallest dimension of call buttons must be 19 mm (ADA, 2010).

The floor surface in front of elevator call controls must be clear of obstacles such as ash cans, plants, as well as other ornamental objects that prevent people in wheelchairs and

others from using the call buttons, as per the Americans with Disabilities Act (2010). The height of the clear floor area is described as an unoccupied zone between both the flooring and 2030 mm above the floor surface. Ashtrays that are recessed also should not be positioned near elevator call keys so that people with visual impairments do not come into touch with them and their contents when reaching for the call buttons.

There should be a visible and audible notice at each elevator door indicating the kind of car responding to a call as well as the direction in which the car is moving. In-car indications, if supplied, must be readable from the floor near the call pushbutton. Apparent signal fixtures must be placed at least 1830 mm in height of the finished floor surface. Measured along the element's vertical axis, the viewable signal components must be at least 64 mm in size. Indicators beside the hallway call button must be legible (ADA, 2010).

The ADA (2010) article "Audible Signals (407.2.2.3.)" states that audible indicators must ring once in the ascending direction and twice in the descending direction, or comprise voiced annunciators indicating the direction of elevator car passage. The frequency range of audible transmissions must be 1500 Hz. At least a frequency of 300 Hz and at most frequency of 3000 Hz is required for spoken annunciators. Audible and vocal annunciators must be at least 10 decibels above ambient, but no higher than 80 decibels as detected at the hall call button (ADA, 2010).

Floor numbers must be shown in both tactile and braille characters on both corners of elevator hoist way entrances. Tactile figures must be at least 51 mm tall. At the main entry level, both jambs must have a tactile star (ADA, 2010).

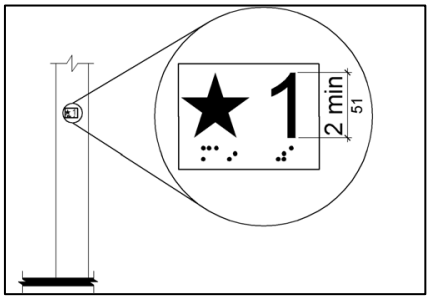


Figure 2.19. Floor Markings on the Jambs of Elevator Hoistway Entrances

Elevator doors must open and close horizontally. The use of car gates is not authorized. The elevator hoistway and car doors must operate automatically. Re-opening devices that

suspend and reopen elevator doors if they are blocked by something or someone are required. Physical touch is not required to trigger the mechanism; nevertheless, contact is permitted before the door reverses. At least 20 seconds must pass before the door-opening mechanisms stop working (ADA, 2010).

Elevator cars must have a clear width size of 1065 mm in width and 1370 cm in length, under ADA (2010) item "Elevator Cars (408.4)". In addition, automotive doors must be situated at the vehicle's narrower ends and have a clear width of 815 millimeters in order to be compatible. Each vehicle must have a self-leveling device that levels it with landings with an accuracy of 13 millimeters and maintains that level. Cars having a clear width of 1295 mm can also have a clear depth of 1295 mm if all of the doors are at least 915 mm wide. Existing elevator cars having a net clear area of 1.4 m2, a plain depth of 1370 mm, and a clear width of 915 mm may also be allowed (ADA, 2010).

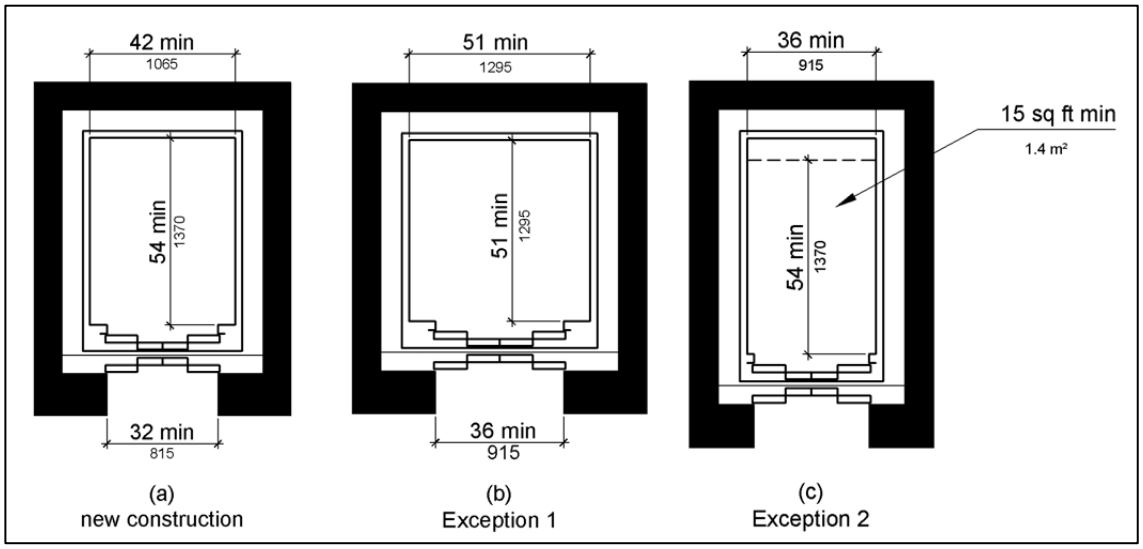


Figure 2.20. Elevator Car Dimensions

The ground and elevator floors must be sturdy, hard, and non-slip. To be adequately glued, the rug or carpet tile must include a strong cushion, pad, or backing. The mat or carpet tile must be flat looped, patterned looped, plain trim piled, or level cut/uncut pile in order to have a pattern. Maximum height of the pile should be13 mm.

According to the ADA (2010), Short-distance vertical transit is possible using sloped stairway chairlifts and vertical platform elevators. Since an accessible path necessitates a height clearance of 2030 mm, elevators should be chosen with caution because it is possible that they are not mutually suited for people in wheelchairs and those who are standing. In

new construction, an elevator that does not have a vertical clearance of 2030 mm cannot be considered as an accessible route (ADA, 2010).

Platform lifts must be operable by the user and must allow for unaided access and departure. The platform's floor surface must be sturdy, solid, and slip resistant, with a maximum carpet or carpet tile height of 13 mm. The platform's clear floor must be at least 760 mm by 1220 mm. (ADA, 2010).

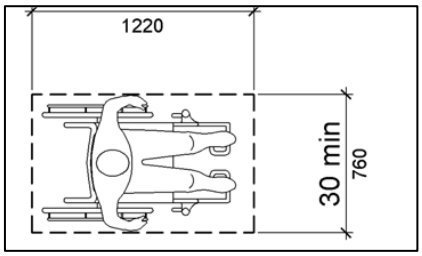


Figure 2.21. Clear Floor or Ground Space

A maximum of 32 mm must separate the platform sill from the runway edge. Platform elevators need to have gates or doors that work electrically. Doors need to be left open for at least 20 seconds. Exit gates and apertures must be at least 815 mm wide. The minimum clear width for side doors and gates is 1065 mm. Self-closing manually controlled doors are permitted on platform lifts with more than two landing platforms and doors on opposing sides.

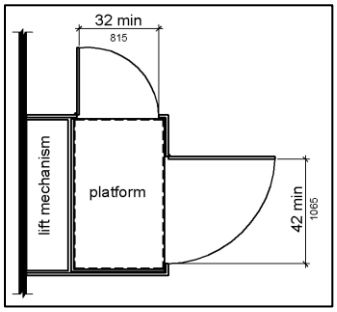


Figure 2.22. Doors and Gates of Platform Lifts

Markings:

Following the "Signs (703)" item in the ADA (2010), two markers with visual elements and one with tactile characters must be given. Swollen characters must be rendered in braille. Sharp or abrasive edges should be avoided on signs intended to be read by touch. Raised

characters must be at least 0.8 mm above their backdrop. All characters must be capitalized. The font should be sans serif. Italic, oblique, script, extremely ornamental, or other unique characters are not permitted (ADA, 2010).

Braille should be placed underneath the matching text. Raised borders and ornamental elements must be separated by 9.5 mm, as well as Braille and other tactile characters. On elevator vehicle controls, separated by 4.8 millimeters, braille can be placed right below or next to the appropriate raised text or symbols (ADA, 2010).

The ADA (2010) mandates that tactile lettering on signage may not rise more than 1525 mm above the completed flooring when calculated from the base of the highest tactile characters and may not rise lower than 1220 mm when measured from the bottom of the lowest tactile characters.

If one is provided, a tactile signal must be present on the door's latch side. A tactile sign must be placed on the active leaf of a double door. A tactile warning must be positioned to the right of the right entry in the event of a double door with two active wings. Signage must be posted on the next adjacent wall where there is no accessible solid area on the latch side of a single door or the right side of a double door. For signage that employ tactile characters, there must be 455 millimeters square of unoccupied floor area between both the closed position and the 45-degree open position (ADA, 2010).

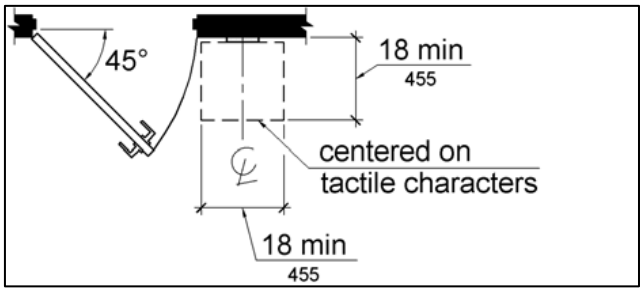


Figure 2.23. Location of Tactile Signs at Doors

The environment in which the characters are set must have a non-glare finish. Characters must stand out against their surroundings by being light against a saturated background or dark against a bright base (ADA, 2010). Signages are more readable for individuals with low sight, per the ADA (2010), when characters contrast as much as possible with their backgrounds. The consistency of the letters and their base hues and patterns, surface

reflectivity, illumination effects, and the consistency of the writing and its backdrop colors and textures are some of the factors that impact how easily the writing may be distinguished from its background (ADA, 2010).

As per the ADA (2010) item "Visual Characters (703.5)," graphical letters must be placed 1015 mm high of the completed floor. The stroke thickness of the capital latter "I" must be 10% of the character's height at least and 30% of the character's height maximum.

The surface height of a pictogram must be at least 150 mm. Braille and tactile characters are not permitted in the pictogram box. Both the backdrop and the pictograms must not reflect light. Pictograms must stand out from their surroundings by utilizing either a bright pictogram on a saturated backdrop or a darker pictogram on a bright background. Pictograms must have a written description exactly under the pictogram field (ADA, 2010).

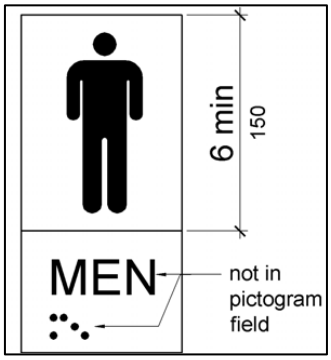


Figure 2.24. Pictogram Field

Handicap indicators' backgrounds must have a non-glare texture. Accessibility indicators must either appear bright on a dark surface or dark on a light surface in order to stand out from their environment (ADA, 2010).

Figure 2.25. Universal Emblem of Accessibility and Emblem of Access for Hearing Impaired

For observable warnings, a surface of truncated domes must be provided. The truncated dome diameter of a detectable warning surface should be between 23 mm and 36 mm, the top diameter shall be 50% to 65% of the maximum diameter, and the height must be 5.1 mm. To provide a visible warning surface, truncated domes should be spaced 41 millimeters apart from center to center, with 17 millimeters between the nearest adjoining domes on a square grid. The detectable warning surface must contrast with the surrounding walking surface in some way, either bright on saturated or vice versa. Surfaces at platform boarding borders must be 610 mm wide and extend the whole length of the platform's common usage zones to be considered notifiable warning surfaces (ADA, 2010).

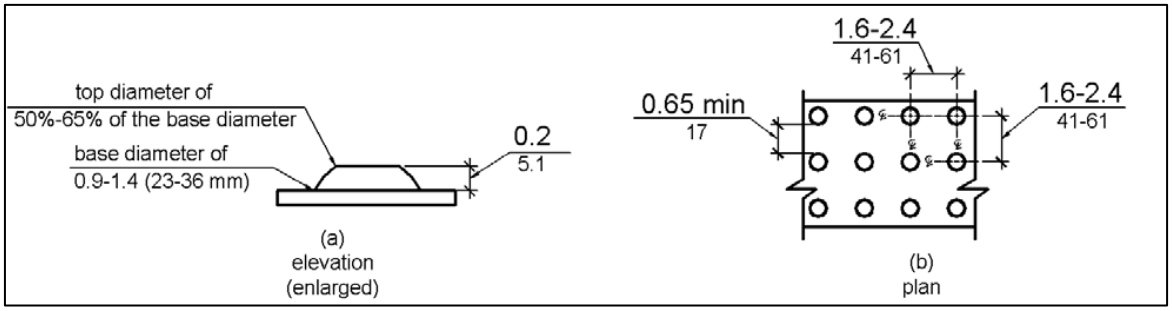


Figure 2.26. Size and Spacing of Truncated Domes

2.2.3. Disability regulations in United Kingdom

In accordance with the 2018/19 Family Welfare Survey (2020), 14.1 million people in the United Kingdom have an impairment, making up 8% of children, 19% of the employed population, and 45% of individuals over the age of retirement. Politicians and scientists classified individuals with mental or physical impairments as "feeble minded" in the early 1990s. There was no welfare system to help handicapped individuals, and the UK just established legislation making discrimination against disabled people unlawful 20 years ago (Versa, 2016).

The Disability Discrimination Act makes it illegal for businesses to segregate in employment, access to products, facilities, and services, land management, purchase or rental, and education (DDA, 2005). Businesses must make "reasonable modifications" to their policies, processes, or physical aspects of their facilities to avoid indirect discrimination (DDA, 2005).

Equality Act 2010 has superseded the Disability Discrimination Act (DDA) since 2010. This law still protects disabled people from discrimination, but it now covers those who are discriminated against because of their age, gender transition, marriage, pregnancy, race, religion, sex, or sexual orientation (Equality Act, 2010).

In terms of the Equality Act (2010), an individual has an impairment if they suffer from a physical or psychological handicap that significantly and permanently impairs their capability to carry out their regular chores (Equality Act, 2010).

Discrimination based on disability has been illegal in England for over 20 years. Since October 2004, the legislation has also compelled individuals in charge of public facilities to make every effort to make those structures as accessible as possible (Versa, 2016).

Since 1999, all businesses in the United Kingdom have been required to enhance their facilities so that wheelchair users may access them easily, and since 2004, they have also been compelled to adjust physical aspects. The architecture of a building, the degree of disruption created by adding ramps and access doors, and a range of other factors all influence the modifications that must be done. All new public buildings in the UK must fulfill wheelchair accessibility criteria; owners of older buildings who refuse to make necessary structural upgrades may be fined and face legal actions. The fundamental accessibility requirements for constructions are outlined in the Building Regulations (2020).

The "Building Regulations (2020)" control architectural development and construction in England and Wales. These laws include a variety of rules for achieving certain objectives, including health and welfare, emission reduction, water quality control, and the welfare and efficiency of those who reside within or near facilities (Designing for Accessibility, 2004). Part M of the Building Regulations describes the minimal conditions that must be met by law for all building occupants, including those who have impairments, to enter and use the structure. Since they were first introduced in 1985, the scope of access laws has undergone numerous modifications and additions (Building Regulations, 2020). Part M used to be concerned with “access for disabled people,” but today the need is simply, access and usage, access to extensions, and sanitary convenience in building expansions (Designing for Accessibility, 2004).

Architectural standards are backed up by "Approved Documents," which offer the regulations' useful guidance. While their usage is not required – and standards can be satisfied in other ways, according to Design for Accessibility (2004) – Approved Documents are regarded as a benchmark by local authorities.

The Building Regulations (2020) describe the regulatory advice for building access and usage. The Ministry of Communities, Housing, and Local Government issues these guidelines. It’s part of a set of authorized papers provided by the government to ensure consistency in the building sector. In a nutshell, Building Regulations (2020), Part M establishes the baseline for all structures' accessibility. Building Regulations (2020) only apply to all structures in England. It is a judicial obligation.

British Standard 8300 specifies the best practices for creating a welcoming and inclusive environment. BS 8300 is divided into two sections: BS 8300-1 for the facilities and BS 8300-2 for the outside settings (access roads and parking lots). The British Standards Institute (BSI) produced these rules. Construction and building are among the many industries for which they create regulatory standards. To replace BS 8300:2009, BS 8300-1 and BS 8300-2 were issued in 2018.

In conclusion, BS 8300 provides the most practical approaches for promoting inclusion and accessibility, whereas Building Regulations (2020) lay the groundwork for accessibility.

In contrast to Building Regulations (2020), BS 8300 (2018) accorporates the entire United Kingdom. BS 8300 can be used to a broad variety of public buildings. BS 8300 is not a legally binding standard. The minimal accessibility criterion is exceeded by complying with this standard.

When it comes to building accessibility requirements, the table below highlights the major changes between Building Regulations (2020) and BS 8300 (2018);

Table 2.3. Difference Between Building Regulations and BS 8300

	Building Regulations	BS 8300
Published By	Government – Ministry of Communities, Housing & Local Government	British Standard Institute
Legal Requirement	Yes	Not always
Applies in	England	The UK
Applies to	Private dwellings and public buildings	Shared access, public and residential structures

Building Entrance:

According to British Standard (BS) 8300 (2018), the entryway to a facility may frequently be an obstruction to access if not properly built (BS 8300, 2018). As per the Building Regulations, the access path should be safe and simple for everyone, such as the elderly, disabled, and individuals using a wheelchair (2020). It should have the smallest gradient and be step-free as much as is practical. The approach road must be either level, slightly sloped, or ramped as necessary. A tiered approach can be utilized on steeply sloping plots to allow most people to approach the building, and all exterior portions of the approach path have an appropriate ground surface (Building Regulations, 2020). With passageways clear of obstacles to a height of 2.1m, the floor width of the approach from the site's perimeter and designated handicapped parking spaces to the main doors, a staff entrance, or an accessible auxiliary entrance must be at least 1.5m (Building Regulations, 2020). The slope is either not more than 1:60 or less than 1:20 throughout the ramp’s length, with leveled landings provided for each 50 cm increase in the access, and a cross-fall slope of no more than 1:40 in all cases (Building Regulations, 2020).

The surface of a ramp must be solid and durable, with undulations no more than 3 mm beneath a 1m straight edge for formless materials. Where various instruments are used throughout the access path, they must have equivalent frictional properties (Building Regulations, 2020). As per Building Regulations, there must be no more than a 5mm difference in elevation at connections between paving units, and junctions shall be sealed flush (or recessed if necessary) or unfilled and no broader than 5mm (2020).

The path to the main door (or alternate accessible entry) should be properly marked and well illuminated. A building's entry door should be simple to use and lit to reduce the difference between exterior and inside illumination levels (BS 8300, 2018). Any entry door should be physically distinct from its surroundings, well illuminated, and properly labeled. Mirrored surfaces should not be used, and the frames for glass doors should be different from the surrounding window frames (BS 8300, 2018). Unless there are automatic doors that are accessible, the entry should have some type of protection from weather, such as a shade or entrance that is recessed, to provide cover for individuals who must wait before entering a building (BS 8300, 2018).

If necessary, a ramp should be built to the building's entrance. A ramping approach should not be longer than 10 m for slopes up to 1:15 (percentage 6) and no more than 5 m for gradients up to 1:12 (percentage 8). (Building Regulations, 2020). A ramp's minimum clear width should be 90 cm. A starting and finishing landing, as well as a middle landing platform in between distinct flights and at every change of direction, should be included in every ramp flight. All landings should be at least 120 cm long and as broad as ramp flights. Door swings should be kept away from landings (Building Regulations, 2020).

The welcome area should be both conveniently accessible and user-friendly because it serves as the building's initial point of contact with its resources and activities. Welcoming areas are frequently found at building main entrances, on independent floor levels or portions of floor levels when a property has been partitioned and rented, at both, and at none. In all cases, guests who are a stranger with the building's layout must be able to rectify themselves, determine their desired destination, and find their way there (BS 8300, 2018). A welcome or shop counter in a service building must be easily accessible and at a reasonable height for a wheelchair user or seated person, according to the Building Regulations (2020). Any wheelchair accessible part on the receiving side should likewise be height decreased (Building Regulations, 2020). Reception points should be instantly visible and navigable from any access to any component of the structure, and they should be easily recognized by blind or partially sighted people (BS 8300, 2018). Front desk locations should be situated in such a manner that a hard of hearing or deaf person's ability to lip reading is not impaired, according to British Standards - 8300 (2018). Patterned backgrounds should never be used as a backdrop for reception desks. It is necessary to specify the availability of induction loops (BS 8300, 2018). In the absence of a clear reception point, directional information around

the entrance point or points should be provided to identify the facilities available and their position. If an information point is placed elsewhere, it should be properly labeled (BS 8300, 2018).

Doors:

A building's primary common entrance door must have width of 775 mm at least (Building Regulations, 2020). The threshold of an entrance should be smooth, and water should be dispersed using appropriate means such as external grades and/or the use of a minimally invasive culvert, according to BS 8300 (2018). If a larger threshold is necessary in exceptional circumstances, it must have one or more upstands, with a total height of at most 15 mm. The threshold should have the fewest upstands and slopes feasible if it is raised. Any upstand with exposed edges that are longer than 5 mm has to have them rounded or chamfered (BS 8300, 2018). Wheelchairs must not be hampered by the ground surface or entry flooring (Building Regulations, 2020).

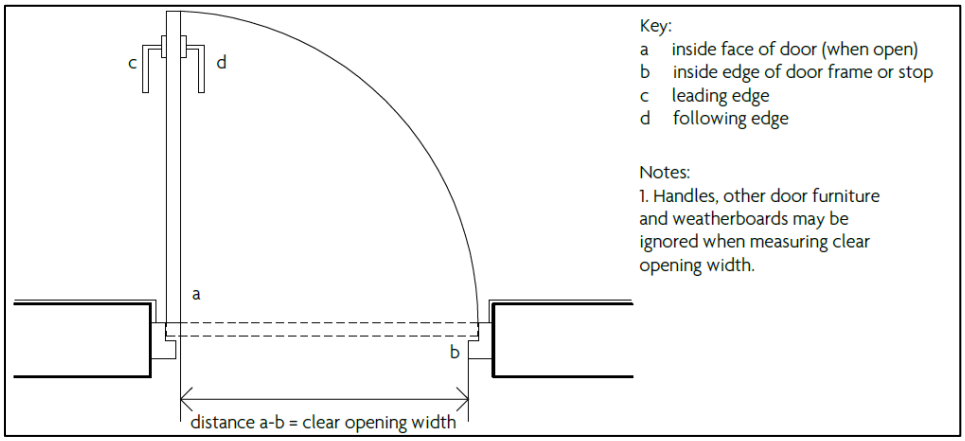


Figure 2.27. External and Internal Door Clear Opening Width Measurement

A buildings entrance door should be accessible for everyone, even though the doors are meant to be closed while not in use. Using an automated door closing device to a single leafed door, according to BS 8300 (2018), might pose considerable challenges for a wide range of people, including youngsters. If the power required to open doors exceeds the abilities of the individuals who are using wheelchairs and those who are feeble, they won't be able to move alone. Individuals may be thrown off balance if the door closing device's force is too powerful or its pace is too quick. Doors with regulated door closing mechanisms

and independent functioning should be fitted, whether they are hinged or pivoted (single or double swing) (BS 8300, 2018).

According to the Building Regulations (2020), the most practicable option for the majority of people is an electric operated door solution that may be activated either manually or automatically by a detector. An automated sliding door design is especially advantageous since it eliminates the hazards related with automatic swing doors and may be used to shorten the length of any entry lobby (The Building Regulations, 2020).

While using revolving doors, wheelchair users, individuals with ambulant motor disabilities, blind or low vision people, individuals with assistance dogs, sensory/neurological processing difficulties, people with young children as well as baby strollers, and people carrying large suitcases or objects face unique challenges (BS 8300, 2018). Significant rotating doors, which are becoming increasingly common in major enterprises, give more space in each compartment and move slowly, but they still represent a risk and a barrier to many disabled users. As a result of these considerations, automatic door systems that do not need user group segmentation are recommended (BS 8300, 2018).

According to BS 8300, an accessible door must always be available for usage when a revolving door is intended for building entry. The accessible door must be placed directly across from the rotating door (2018). The accessible entryway may be powered or motorized, swing, slide, or fold. It should be easily recognizable (BS 8300, 2018).

An interior lobby must be accessible for a wheelchair user, who is with or without a helper, or an individual who is pushing a baby stroller to walk clear of an entrance before opening the second door, according to Building Regulations (2020). The design of a lobby can allow an outdoor entrance to have a self-closing mechanism with a minimum requirement of strength than would otherwise be possible (Building Regulations, 2020). Based on how the entrance is established, a handicapped person might have to be able to go to a safe distance from one door swing to push open the next door or rotate their wheelchair to bring it open (BS 8300, 2018). Additionally, there must be enough room for someone to help a wheelchair user open a door and maneuver their wheelchair inside. Lobby doors with just one wing should be avoided at all costs. The length of a lobby with double doors must be at least as long as the projection of the doors, or the doors plus 157 cm if the doors swing into the

lobby. The proportions of the lobby should be free of any items that protrude into the lobby (2018, BS 8300).

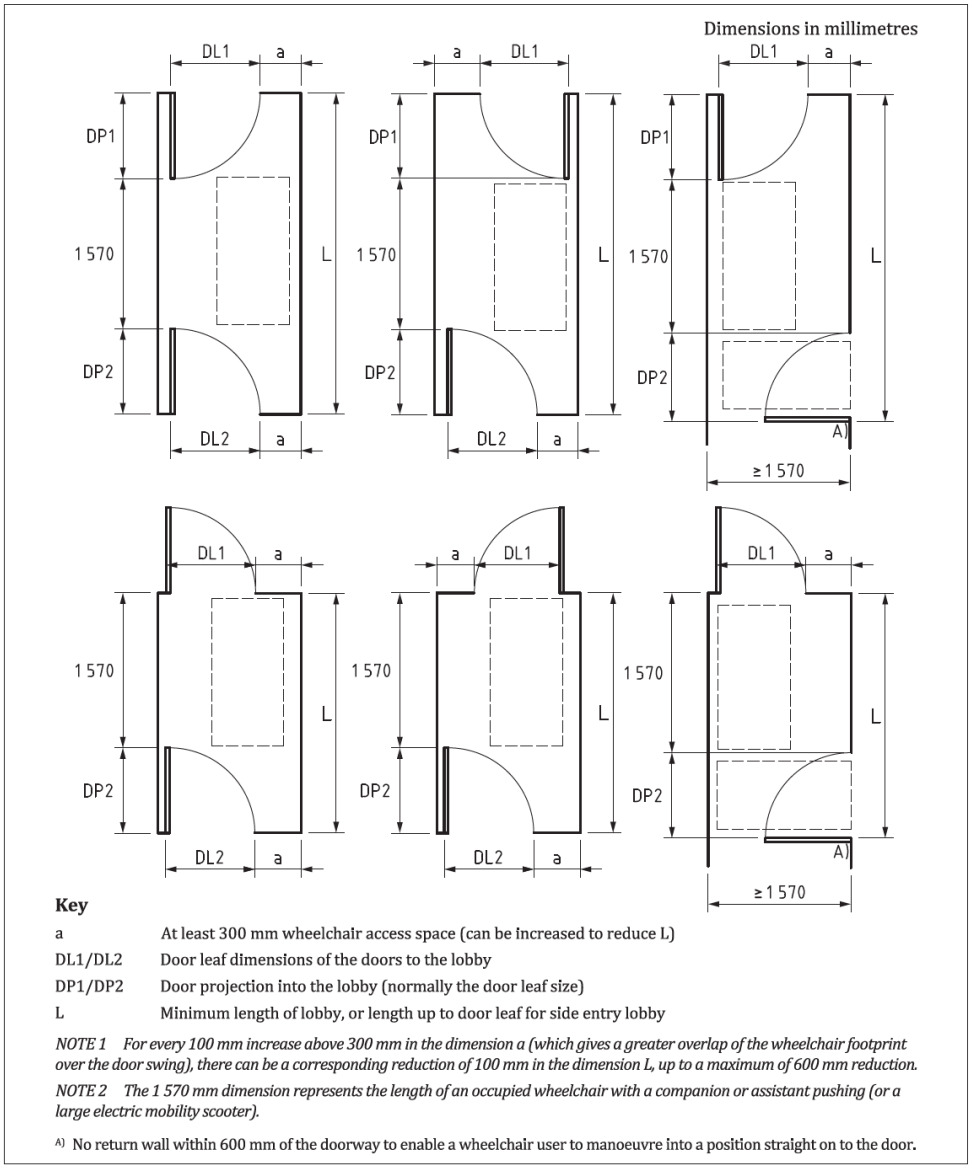


Figure 2.28. Minimum Dimensions for Single Leaf Doors in Lobbies

Vertical and Horizontal Circulation:

Vents, columns, and other full-length components within a foyer must not extend over than 100 mm into the accessible way, as per BS 8300 (2018). If such projections must be used, a guardrail or other hazard protection that stands out from the backdrop must be installed to allow individuals who are blind or partially sighted to pass through (BS 8300, 2018). The goal should be to avoid distracting reflections from glass while reducing possible risks from

local obstacles within the lobby. Rainwater from footwear or wheelchair wheels should not enter the structure, since this might provide a slipping danger (Building Regulations, 2020).

To allow individuals to utilize a facility freely, circulation pathways must allow for simple mobility while also providing a feeling of place and orientation. British Standards 8300 stipulates that halls and corridors need to have enough room to provide for simple access to units and, if necessary, to perform a U-turn (2018). Doors across corridors, as well as doors opening from rooms into hallways, must be accessible (BS 8300, 2018). Individuals pushing strollers, carrying bags, or using crutches must be capable of passing others on the access way if hallways and tunnels are wide enough (Building Regulations, 2020). The minimal area required for two people using a wheelchair to cross one another in a hallway is 180 cm (BS 8300, 2018). A corridor must have a floor width of at least 180 cm or, if less, crossing spaces that are 180 cm wide and at least 180 cm long at appropriate intervals, per the British Standards (2018). Surface width of a corridor must be at least 120 cm, excepting impediments that persist over a short distance (BS 8300, 2018).

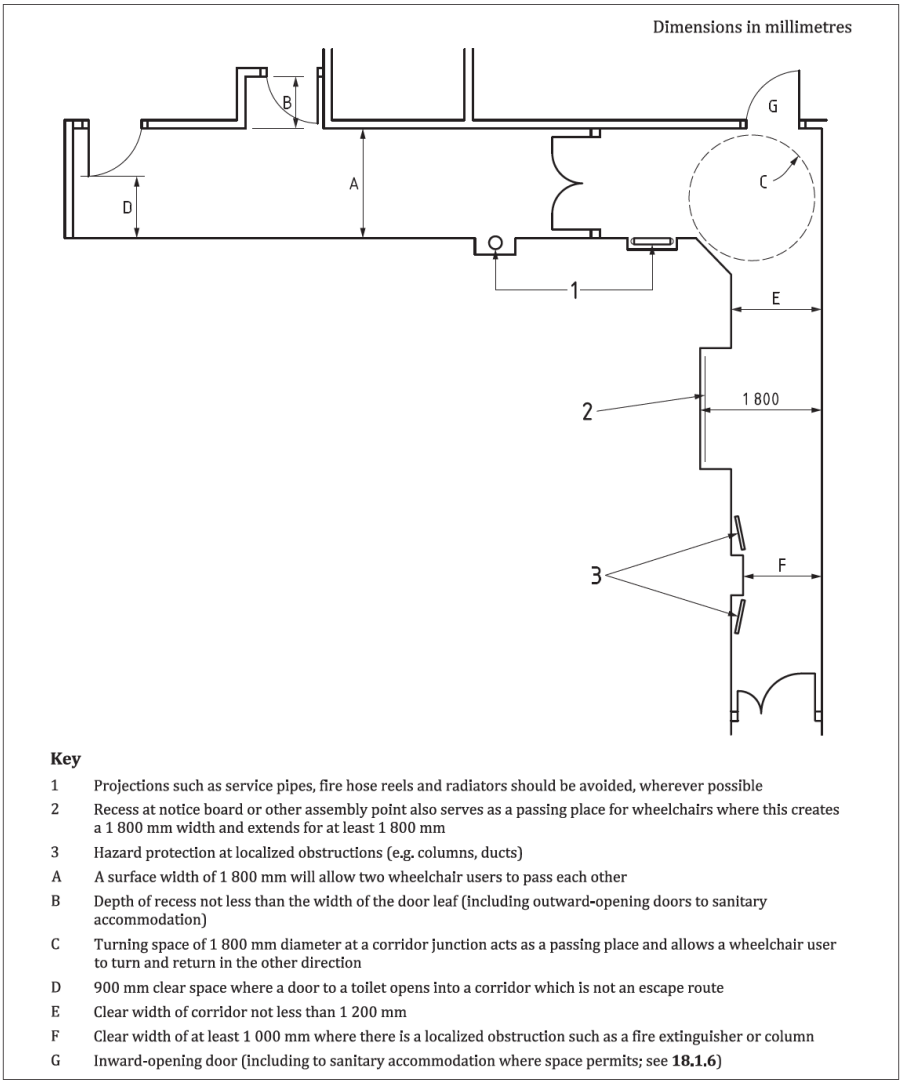


Figure 2.29. Corridors Dimensions and Space Allowance

The floor finishes should be chosen with care (BS 8300, 2018). Optical contrasts among the ceilings and walls, as well as the floor and the wall, should be present to allow people with vision impairments to grasp the scale of a volume they've entered or navigate their way around it (Building Regulations, 2020). Floor finishes should be complemented by natural and artificial illumination that is well-designed. Columns, heaters, and fire hoses cannot extend into the hallways, or if they do, a mechanism to guide people around them must be provided, such as an optically different guard rail (Building Regulations, 2020). With the exception of small utilities like small storage rooms and secure duct closets, any door facing a hallway that is a primary access route or a means of egress route, should be recessed so it does not swing into the hallway area when fully open. The larger wing of a sequence of double doorways with unequal width wings must be on the same side of the hallway

throughout the length of the passageway on a major access pathway or a means of escape route (Building Regulations, 2020).

Building Regulations (2020) permit a stepped approach with a uniform rise of 150-175 mm and a minimum going of 280 mm if a step-free access to any building entry is not feasible. Steps should have appropriate tread nosings. A climb of more than 180 cm between landings is not permitted on any given trip. Every flight must have a clear width of at least 90 cm (Building Regulations, 2020). Every stair must have a top, bottom, and, if needed, middle landing, which must be at least 90 cm long and as wide as the stairs. A railing is required on any stairway with three or more risers. The handrail must extend 30 cm beyond the top and bottom of the noses and be 85-100 cm above the flight's pitch line (Building Regulations, 2020).

Lifting devices are a necessary amenity for many individuals, including the disabled and the elderly, as well as those carrying baggage or pushing children in pushchairs. A public elevator, according to the "Lifts and Stairs" part of the "Building Regulations," is the most efficient way for a large number of people to move through the floors of a building (2020). At least one conventional passenger elevator must be constructed in multi-story buildings (BS 8300, 2018). If a lift is provided, it must be accessible to wheelchair users. If a lift access is not feasible, a decent stair can suffice. A standard passenger elevator should service all levels, including those below ground level (BS 8300, 2018).

According to the Building Regulations (2020), a vertical lifting platform, while not comparable to an elevator, can be suggested as another option to provide access for people with limited movement skills in cases where a passenger elevator cannot be accommodated in existing structures or in exceptional cases for new construction with limitations (Building Regulations, 2020). In exceptional cases, it may be permissible to install a wheelchair platform chairlift in an existing structure, providing that doing so does not violate the rules for means of egress (BS 8300, 2018).

At each floor level, an appropriate lift must have a clear landing that is at least 150 cm long and 150 cm broad right in front of the lift entrance. There must be an 80 cm minimum clear opening width for the entrances. Elevator sizes should be chosen to account for the predicted frequency of lift usage as well as the demands of disabled users (BS 8300, 2018). The

elevator car must be at least 140 cm deep and 100 cm wide on the inside (Building Regulations, 2020). It is possible to employ elevators with opposing doors (dual-entry elevators) to save wheelchair users from having to back out of the lift or do a U-turn in the lift vehicle (BS 8300, 2018).

Table 2.4. Dimensions of An Elevator Car with A Single Entrance or Two Opposing Entrances at A Minimum

Dimensions of the smallest car *	Users accommodated
110 cm wide x 140 cm deep	One person on a wheelchair, either electrically powered or manually, and one person escorting them. There is insufficient room for a wheelchair user to maneuver comfortably.
200 cm wide x 140 cm deep	One wheelchair user and a handful of other individuals. There is enough space for wheelchair users and those who use mobility assistance to rotate 180°.
* All dimensions are taken in relation to the car's structural walls, with any cosmetic finishes having a maximum thickness of 15 mm.	

There should be a tactile indicator for each floor on the landing platforms and next to the elevator call button. The lift must be equipped with a signaling system that makes it clear when it is in response to a landing request. There must be a five-second pause once the elevator doors have fully expanded before they begin to close. A door activation key that uses appropriate electrical equipment can be used to bypass the system as long as the elevator door is entirely open for at least three seconds (Building Regulations, 2020). If the elevator serves more than three stories, to indicate the level reached, visible and auditory signs should be used. The landing and automobile controls must be 400 mm or more from the inside of the front wall and 90 to 120 cm above the finished floor (Building Regulations, 2020). BS EN 81-70 must be met by all elevators.

Conventional passenger lifts used to remove handicapped individuals in an emergency should comply with the applicable BS 9999 guidelines. When emergency respond elevators

are used for evacuation, the requirements of BS EN 81-72 and BS 9999 standards must be complied (BS 8300, 2018).

According to BS 8300, vertical lifting platforms must include an emergency communication system as well as easily available and unambiguous operating instructions (2018). When passengers are waiting, the lifting platform should provide aural and visual information indicating that the platform has reached at their floor, as well as the floor it has arrived at when using the platform. Consider utilizing transition ramps to access vertical lifting platforms. The floor level and the lifting platform floor should be fully leveled whenever feasible. The floor of the lifting platform should be properly separated from the landing (BS 8300, 2018).

The vertical rising platforms dimension should be at least 110 cm wide and 140 cm deep whenever possible. In severe instances, existing structures' minimum clear dimensions may be 140 cm deep and 90 cm wide (BS 8300, 2018). Doors with apertures at 90° to each other must have a minimum effective clear of 80 cm for lifting platforms 90 cm wide or wider, and at least 90 cm for lifting platforms 110 cm wide or bigger. Doors should be visibly distinct from the neighboring surface (Building Regulations, 2020).

A chairlift enables an individual using a wheelchair to easily ascend and descend from the stairs while remaining sitting in their wheelchair. A stairlift platform with a unique function may be more appropriate for usage in limited places (Building Regulations, 2020). Building Regulations (2020) state that accessible platforms stairlifts are only intended for people in wheelchairs and should only be considered for adaptations and restoration projects if building a standard passenger lift or a lifting platform is not feasible. Step-lifts that move up the string of a step are available. Installing them is not a good idea if they interfere with other people's ability to safely utilize the stairs (Building Regulations, 2020). These stairlifts are only appropriate when the users can be trained how to correctly utilize them (BS, 2018).

From the elevator lobby, each visual cue and the lift call controls should be clearly visible. Each elevator lobby must have a sign displaying the level number on the wall opposite all elevator landing doors (BS 8300, 2018).

According to BS 8300 (2018), when climbing stairs, people with limited mobility, particularly those with limited lower body movement, are more vulnerable to tripping to the nosings and stumbling as a consequence. Furthermore, people who are partially blind may feel insecure while gazing through exposed steps, and assistance dogs may refuse to advance. Some neurological disorders make it difficult to step across open treads and judge gaps. (2018, BS 8300).

The height of steps and stairs must be between 15 and 18 cm, and the depth should be between 30 and 45 cm. Each stride in a flight should rise and fall in the same manner. Where feasible, the ascend and descend of each tread should be constant over a staircase sequence. Curved risers should be avoided at all costs (BS 8300, 2018). If at all feasible, a step should not overlap the one below it. If there is an overlapping, the noising must not extend more than 25 mm over the tread underneath. (BS 8300, 2018) According to BS 8300, treads and risers must be firm and opaque (2018). It is important to build riser profiles such that those who drag their legs when ascending will not trip. Whenever there are more than 40 steps in a sequence, there must be least a 30° shift in orientation among flights of steps. Longer flights increase the danger and severity of injuries when fallen. It is preferable for a stair to consist of straight steps, with any changes in direction occurring on the landing. (2018, BS 8300) Mobility-impaired people should not use spiral stairs since it might be difficult to get the measurements needed to determine whether the staircase is appropriate for them. They can, however, be permitted under BS 8300 (2018) if the needs of certain employees in a workplace are meet (BS 8300, 2018).

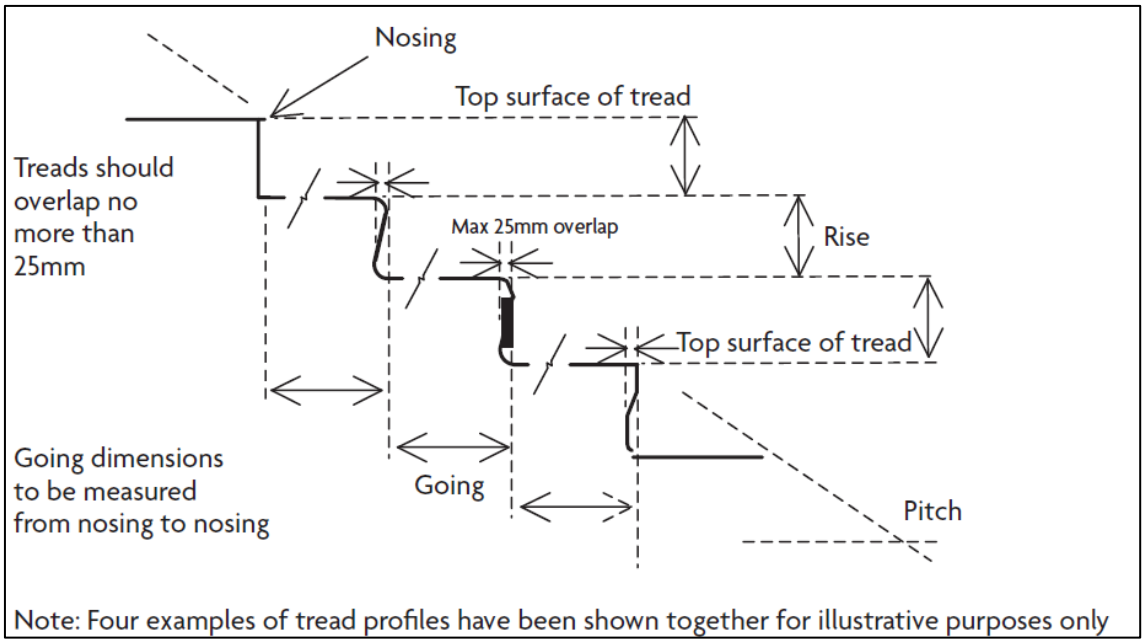


Figure 2.30. Measuring Rise and Going

Architects must strike a balance between maximizing the number of stairs between landing platforms to reduce the number of potential accident hazard spots and minimizing the number of stairs between stairheads to create more consistent resting points in accordance with BS 8300 (2018) when deciding on the type of risers in a flight. The first flight of stairs on stepped access routes should have no more than 20 risers, and following flights should, where feasible, have the same number of risers. While the latter approach is more likely to help those who are partly or completely blind, this one is more likely to help people who have restricted mobility (BS 8300, 2018).

Singular stairs should be abstained since they provide a substantial trip hazard even when highlighted with visual contrast. Thus, if the difference in elevation is lower than 30cm, the difference should be handled only by a ramp. If there is a change in elevation that is exceeding 30 cm, a step and a ramp must be provided (BS 8300, 2018).

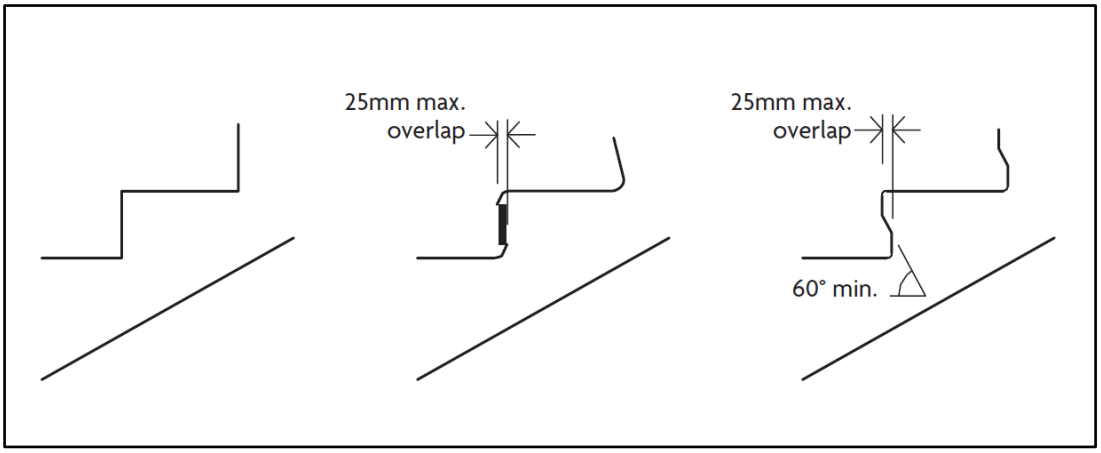


Figure 2.31. Examples of Suitable Tread Profiles

According to British Standard (2018), the width of a staircase between enclosed strings, walls, upstands, or balustrades must be at least 120 cm, and the distance between two handrails on either side of the staircase must be at least 100 cm. To guarantee that all individuals have access to a railing, the stairway must be split into two extra channels if the space among handrails is greater than 2 meters. These lanes must have a minimum separation of one meter and a maximum distance of 2 meters between handrails (BS 8300, 2018).

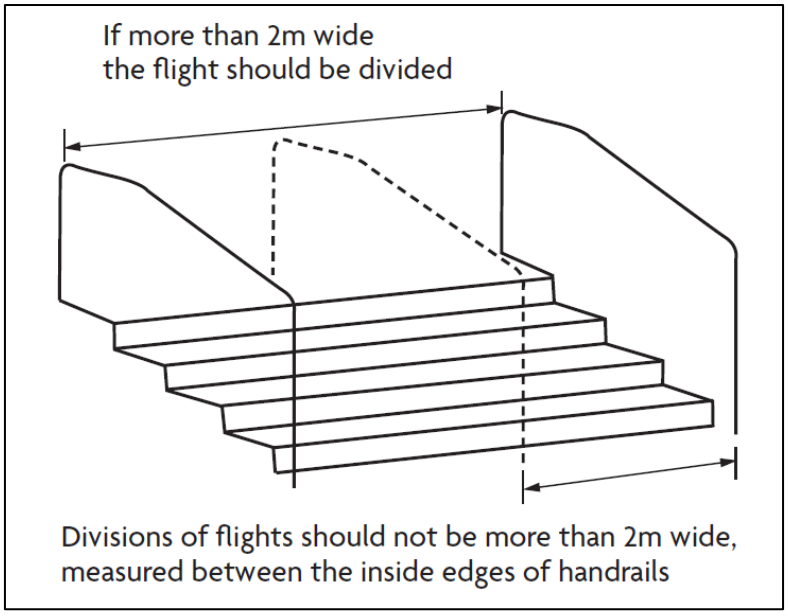


Figure 2.32. Dividing Flights

Each nosing must be made of a permanently contrasting continuous and durable material that runs the length of the staircase on both the tread and the riser to assist those who have lost their capacity to sight in estimating the size of the staircase and recognizing individual

steps (BS 8300, 2018). Between 50 and 65 millimeters wide from the tread's front edge, and 30 to 55 millimeters wide from the tip of the riser, this contrasting material should be significantly distinct from the rest of the tread and riser (BS 8300, 2018). Installing a warning sign at the top of an inside staircase is not allowed since there is presently no interior warning sign that is not a trip hazard when used close to ground surfaces with different frictional resistance characteristics (Building Regulations, 2020). According to Building Regulations (2020), designers should be mindful of the possible danger of placing a step immediately in front of an access path. For people with restricted mobility, a step of at least 30 cm is recommended (Building Regulations, 2020).

Every set of steps ought to include a smooth landing at the top and bottom. No door or gate swing must interfere with its length, which must be at least equal to that of the flight's surface width (BS 8300, 2018). If the staircases have more than 36 steps in each level, at least one direction change should be provided between stairs (Building regulations, 2020). The allowed number of steps for service stairs and staircases among landings in small enterprises with confined architectural elements should be 12 and 16, respectively (Building Regulations, 2020).

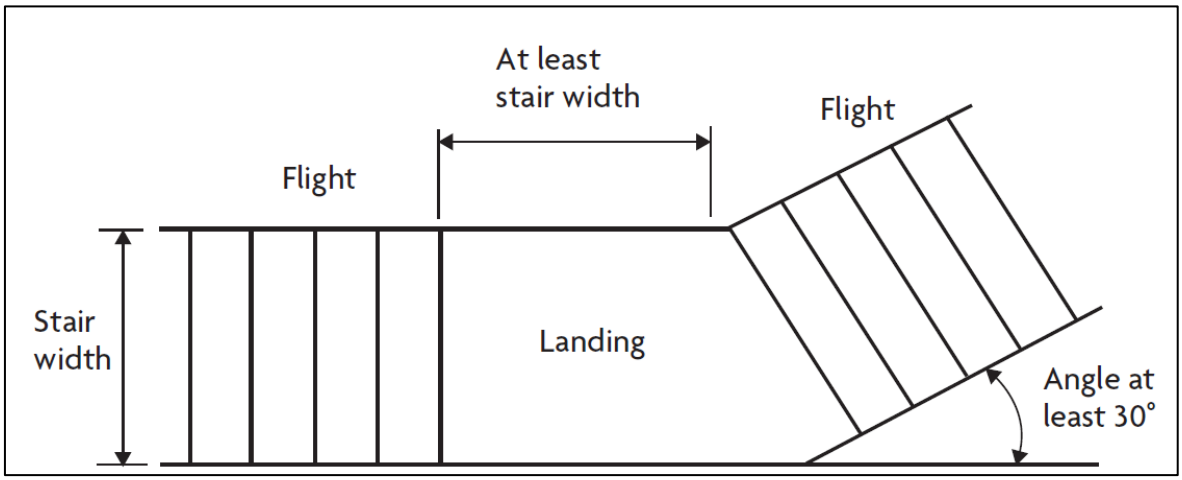


Figure 2.33. Direction Change in Set of Stairs

According to Building Regulations (2020), each landing platform shall have an unobstructed length of at least 120 cm. Doors should not be allowed to swing over landing zones (building Regulations, 2020).

It's crucial that stair and stair surface materials be both simple to maintain and as slip-resistant as is required (BS 8300, 2018). BS 8300 (2018) advises that when utilizing various materials for stair treads and platforms, attention should be given to verify that their frictional qualities are equivalent in order to reduce the danger of tripping. Stair steps should not be carpeted with deep pile carpet. Glare should be minimized by avoiding the use of bright, polished surface materials. People who have visual impairments or partially sighted, as well as those who have sensory/neurological processing problems, may be misled by highly patterned surface finishes (BS 8300, 2018).

There must be an alternative method of accessibility in the event that there is an inevitability of a variation in elevation along a circulation path, such as a slope or ramp or, if there isn't enough space to accommodate a ramp, a non-enclosed vertical lifting platform (BS 8300, 2018). The slopes and the distances between landings are the two most important considerations when designing sloping or ramped circulation pathways. A wheelchair user might not be capable to use it if the incline is too steep or the individual flights are too long. The identical situation would probably provide difficulties for a partner pushing a wheelchair user (BS 8300, 2018). If the gradient is excessively high, a person who is using a wheelchair, may fall forwards when descending, or may flip over backwards when climbing. On a steep hill, control and braking are also challenging. Excessive cross-fall slopes complicate ramp handling even more (BS 8300, 2018).

It is vital to note that ramps are not always safe or practical for people with ambulant disability. People who have difficulty in walking and have limited mobility may find ascending a ramp more challenging than ascending a step. If the inclination is modest and the elevation is no more than what two risers can offer, steps should be supplied in additional to a ramp (Building Regulations, 2020).

According to BS 8300 (2018), buildings should be constructed to eliminate the requirement for ramps or slopes on internal circulation routes as much as possible. A ramp should also have platforms at the top and bottom that are at least 150 cm in length and free of any swing of doors or other impediments for every 50 cm rise in height (BS 8300, 2018). The slope's surface should be clearly distinct from the landing platforms. It is important that where ramps are needed, they must easily apparent and should be located near to the steps (BS 8300,

2018). The ramps should be easily visible or well-marked (Building Regulations, 2020). There is no need to utilize steps if the difference in level is less than 30 cm (BS 8300, 2018).

There must be a minimum slope of 1:20 to 1:12 and a maximum distance between landings for a ramp to comply with Building Regulations (2020). According to the table below, the inclination of a ramp flight should not be steeper than it is;

Table 2.5. Maximum Permissible Relationship Between the Going, Gradient, And Rise of Ramps

Ramp rise in 10 mm increments mm	Preferred approach		Max. permissible approach	
	Preferred slope, 1/n	Going up the ramp at the desired slope, m	Max. allowable ramp gradient, 1/n	Going of ramp at max. permissible gradient, m
150	20	3000	12	2000
160	20	3200	12	2000
170	20	3400	12.47	2119
180	20	3600	12.54	2257
190	20	3800	12.63	2399
200	20	4000	12.73	2545
210	20	4200	12.83	2695
220	20	4400	12.95	2850
230	20	4600	13.08	3009
240	20	4800	13.22	3174
250	20	5000	13.38	3344
260	20	5200	13.53	3519
270	20	5400	13.70	3700
280	20	5600	13.88	3887
290	20	5800	14.07	4080
300	20	6000	14.27	4280
310	20	6200	14.47	4486
320	20	6400	14.69	4700
330	20	6600	14.91	4920
340	20	6800	15.14	5148
350	20	7000	15.38	5384
360	20	7200	15.63	5627
370	20	7400	15.89	5879
380	20	7600	16.15	6139
390	20	7800	16.43	6408
400	20	8000	16.71	6685
410	20	8200	17.00	6972
420	20	8400	17.30	7268
430	20	8600	17.61	7573
440	20	8800	17.93	7888
450	20	9000	18.25	8214

Table 2.5. Maximum Permissible Relationship Between the Going, Gradient, And Rise of Ramps (Continuation)

Ramp rise in 10 mm increments mm	Preferred approach		Max. permissible approach	
	Preferred slope, 1/n	Going up the ramp at the desired slope, m	Max. allowable ramp gradient, 1/n	Going of ramp at max. permissible gradient, m
460	20	9200	18.59	8549
470	20	9400	18.93	8896
480	20	9600	19.28	9253
490	20	9800	19.63	9621
500	20	10000	20.00	10000

The Building Regulations (2020) state that a floor surface with a slope of 1:20 or more must be built as a ramp. The figure below depicts the link between a ramp's gradient and its distance between landings;

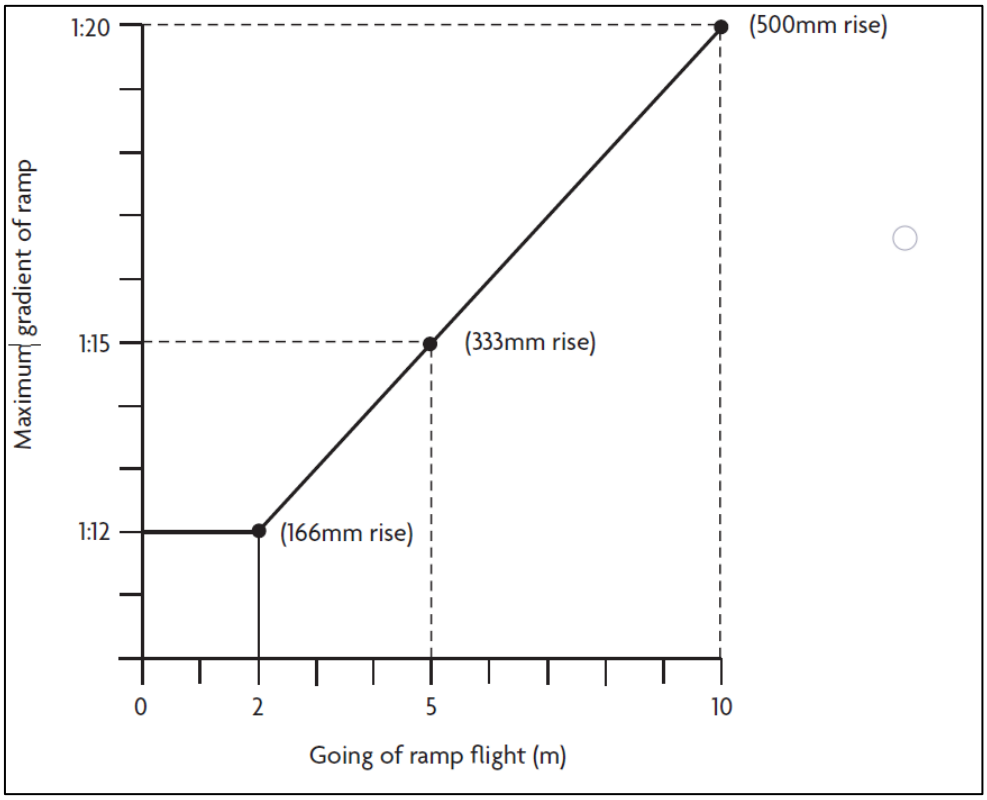


Figure 2.34. Relationship of Ramp Slope to the Going of a Flight

At the start and finish of the ramp, landing platforms should be constructed. They must minimally be as wide as the ramp, and the landing platforms must be at least 150 cm in length and clear of any obstructions such as swings of doors (Building Regulations, 2020). In a straight-line series of flights, any midlevel landing should be at least 150 cm in length and free of any swing of door or other obstruction (BS 8300, 2018). As per BS 8300 (2018),

it's important to keep the ramp width constant throughout a quarter or half-turn landing. Intermediate landings at least 180 cm broad and 180 cm in length should be provided as crossing areas when there is no direct distinct view from one end of the ramp to the other, or if there are three or more ramps. A landing platform should not be transverse unless it is in a wet region, in which case it may have a minor cross-fall slope of no more than 1:50 to help the drainage of surface water (BS 8300, 2018).

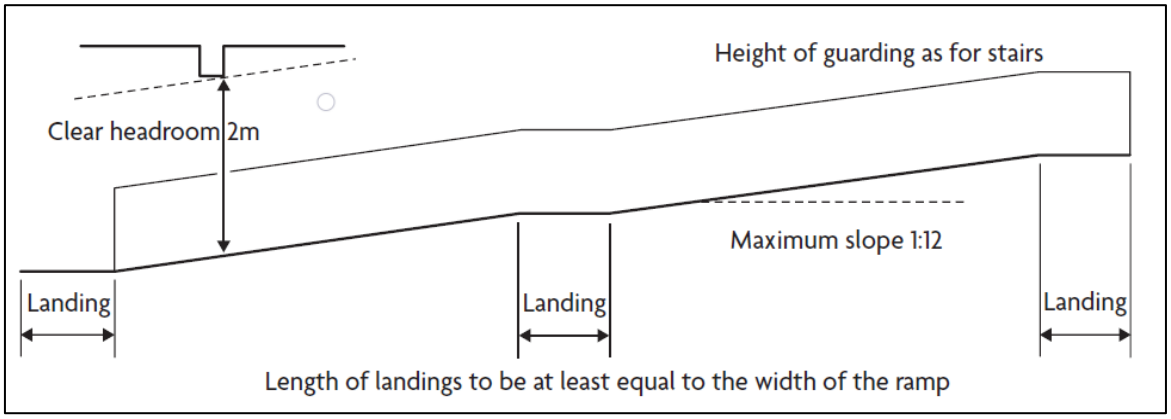


Figure 2.35. Ramp Design

At each open edge of a gradient, an unceasing upstand at least 10 cm high should be provided (BS 8300, 2018). Along with any protection, each ramp or landing must have a curb on the open side that is at least 10 cm high and clearly contrasting with the ramp or landing (Building Regulations, 2020). If solid guarding or transparent guarding with a constant bottom rail 10 cm above the ramp surface is provided, no separate upstand is necessary (BS 8300, 2018). The upstand is meant to keep a person in a wheelchair from sliding down the ramp's side and can also aid with walking stick detection. Added support might be provided via a permanent design feature (BS 8300, 2018).

When employing different materials for a ramp's flights and landings, more care should always be made to avoid accidents (BS 8300, 2018). A ramp's surface must not be made of deep pile carpeting. The use of tactile warning surfaces at the start and finish of ramps is not recommended. Glossy surfaces must be avoided (Building Regulations, 2020).

Portable ramps may only be utilized in extreme instances for existing structures. They should be suitably positioned, their existence noted, and an alternate path given and guarded so that they are not a danger to the people passing by (BS 8300, 2018). Mobile ramps should have

a surface wideness of at least as broad as the actual width of the doorway being a drainable, served, slip-resistant floor, and a 10 cm high upstand to keep wheelchair tires from straying off the edge (BS 8300, 2018).

According to the Building Regulations (2020), railings that are easy to grasp, comfortable to touch, and, ideally, provide adequate forearm support are necessary to assist people who have physical difficulties navigating level changes. Handrails should be mounted securely and placed farther away from the wall to reduce collisions with finger grasps. People with ambulant mobility impairments may be weaker on one side than the other, therefore they need a handrail on either side of the stairway, ramp, or step to help them (BS 8300, 2018). Wheelchair riders often do not require the use of railings while navigating a ramp. On long, steep ramps, handrails, on the other hand, can assist wheelchair users in keeping their balance in slick conditions (BS 8300, 2018).

A railing needs to be built on both edges of a ramp or staircase for the whole of the ramp or staircase (BS 8300, 2018). Handrails should be built at a height that is appropriate for all facility users, and they must reach safely further than the start and finish of a staircase or a ramp to give both support and information about a change in elevation (Building Regulations, 2020). The handrail's upper portion ought to be 90 to 100 cm above the pitch line of the ramp or staircase, and 90 to 110 cm above the landing pad (BS 8300, 2018). Installing a second handrail on staircases should be considered in some building types, for people with small statures and particularly in schools, use by children (Building Regulations, 2020). The handrail may be utilized as the top rail of the balustrading and as part of the guarding because it is 110 cm above the landings (BS 8300, 2018). Additionally, the handrail might be self-contained but reinforced by the guardrail (BS 8300, 2018).

As per BS 8300 (2018), a secondary railing should be installed in public buildings where appropriate guarding is provided, such as a wall or glazing barrier. There should be a 60-cm gap between secondary guardrail and ramp surface or stairway pitch line (BS 8300, 2018). A stepped entrance, staircase, or set of steps must have a railing that runs horizontally at minimum 30 cm further than the top and bottom nosings, but it cannot intersect the access path (Building Regulations, 2020). Handrails should be visually distinct from the background against which they are visible, without being too reflecting. Surfaces on railings should be non-icing and resistant to slipping; in locations requiring little maintenance or

resistance to vandalism, metals with weak heat conductivity may be suitable (Building Regulations, 2020).

A non - circular railing with a wide horizontal surface is simpler to grasp and gives greater hand and forearm assistance than a circular railing (BS 8300, 2018). A handrail should be simple to hold, with no sharp edges, while yet providing enough resistance to hand slipping (BS 8300, 2018). Building Regulations (2020) stipulates that railing profiles must have at least 15 mm-round edges and be non-circular, 50 mm broad, and between 32 and 50 mm in diameter. The distance between the handrails and any adjoining wall surfaces should be between 50 and 75 millimeters (Building Regulations, 2020). No more than 50mm of the ramp's or stairway's surface width should be visible on its inner face, and the handrail shall have at least 50mm of clearance from its underside (Building Regulations, 2020).

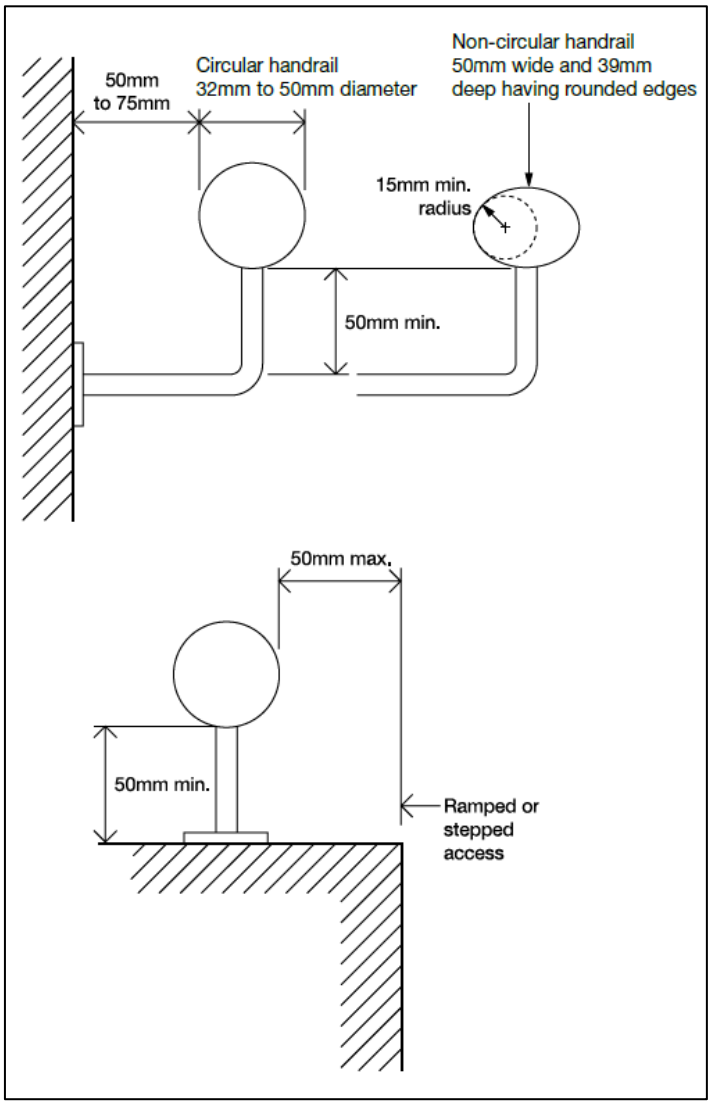


Figure 2.36. Handrail Design

According to BS 8300 (2018), using wheelchairs on escalators and moving walkways might result in unsafe circumstances that cannot be avoided by machine design. Most handicapped individuals, particularly wheelchair users and people with assistance dogs, prefer to travel vertically using traditional passenger lifts. If an escalator or moving walkway is constructed, a visibly marked alternate accessible path should be nearby (BS 8300, 2018). Any escalator or moving walk's location and direction of movement should be clearly specified by a sign. At the start and at the finish of an escalator, if feasible, a visible, well illuminated non-restricted area of 2.5m minimum in length should be designed to guarantee that users may board and alight safely (BS 8300, 2018). The escalator surface should contrast optical with the approach, and audio cues or pre-recorded announcements should be used to indicate the escalator's start and terminus. For the safety of those who are blind or partially sighted, guardrails must be present at both the beginning and the end of any escalator or moving walkway that is part of a public access route. A non-reflective surface should be used on any protective side panels (BS 8300, 2018).

There should be guarding on any section of a floor that is appropriate and essential for safety, including an opening balcony, terrace, deck or roof and any other location to which people have access. There should also be guarding on a basement or similar immersed area close to a facility.

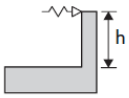
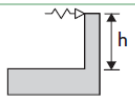
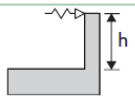
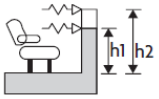
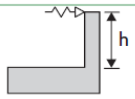
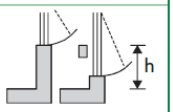
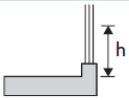
Building Category and Location		Height	
Single family dwellings	Stairs, landings, ramps, edges of internal floors	900mm for all elements	
	External balconies, including Juliette balconies and edges of roof	1100mm	
Factories and warehouses (light traffic)	Stairs, ramps	900mm	
	Landings and edges of floors	1100mm	
Residential, institutional, educational, office and public buildings	All locations	900mm for flights otherwise 1100mm	
Assembly	Within 530mm in front of fixed seating	800mm (h1)	
	All other locations	900mm for flights elsewhere 1100mm (h2)	
Retail	All locations	900mm for flights otherwise 1100mm	
Glazing in all buildings	At opening windows except roof windows in loft extensions, see Approved Document B1	800mm	
	At glazing to changes of levels to provide containment	Below 800mm	

Figure 2.37. Guarding Design According to Building Regulations Approved Document K

Whenever possible, guarding in buildings that may be utilized by kids under the age of five should be constructed such that no gap larger than a 100 mm globe may pass through it. Horizontal bars should also be eliminated in guarding to prevent youngsters from climbing up to it easily (Building Regulations, 2020).

Floor, wall, door, and ceiling surfaces, according to BS 8300 (2018), can help or hinder building utilization. People who are unable to react to visual cues or recognize sounds in an acoustical environment, such as those who are blind or partly sighted, partially or fully deaf and hard of hearing, and those who have sensory or neurological processing issues, may find it difficult to move around. Shiny surfaces and some patterns might be challenging for those who have sensory / neurological processing issues. A really high-resistance flooring, as a deep pile carpet, may unduly impede people in wheelchairs and others with mobility disabilities (BS 8300, 2018).

Because of glare difficulties and the perception that they are slippery despite having a slip-resistant surface, very shiny surfaces should be avoided (BS 8300, 2018). On any floor surface, large, repeating patterns with contrasting colors or that resemble staircases should be avoided. People who are blind or partially blind, as well as those who have neurological or organoleptic processing issues, may be deceived by strong patterns in floorings and perceive them as variations in elevation, as per BS 8300 (2018). A large visual difference at the door threshold or between floorings might be mistaken for a change in elevation or a void. This might cause worry or hesitation in movement, which can lead to falls (BS 8300, 2018).

2.3.4. Summary of accessibility regulations

In Turkey:

According to Gümüş (2007), the entire standard includes design criteria regarding how a suitable building and its immediate surroundings can be arranged for disabled people – especially disabled people using wheelchairs. Within the accessibility legislation for the disabled, local administrations carry out studies and practices regarding the suitability of the newly constructed buildings and open spaces for the disabled, although it is not sufficient and common (Gümüş, 2007). After the amendments in regulation, attention is paid to the project design phase regarding the suitability of the building built for the disabled, and regulations for orthopedically disabled people in open areas (Kılıç, 2013).

According to Gümüş (2007), the implementation of the legislation and the regulations made for the disabled are extremely inadequate and significantly problematic. Generally, compliance with standards, continuity and integrity are not provided in the regulations, these are limited to the construction of a ramp for orthopedically disabled people (Gümüş, 2007).

In United States of America:

Salmen (2011) asserts that the universal design movement has its beginnings in the US. The ADA gives the idea of accessibility a lot of weight. United States experience shows that effective implementation of accessibility rules and standards depends on education and

access to relevant material for individuals who have to build or execute the design (Salmen, 2001).

In contrast to universal design, accessibility is characterized by adherence to rules, guidelines, and specifications that specify the bare minimum of design required to accommodate individuals with impairments (Salmen, 2001).

According to Salmen (2011), there are three primary layers of teaching that influence the accessibility of the physical environment: legislation, laws, and norms. To address a social problem, legislation is created by a legislative body, such as the US Congress or a state legislature. The US Parliament created the ADA in an effort to combat discrimination against people with disabilities. The enforcement arm of a government body frequently creates regulations to carry out the legislation. Standards are technical standards that define conformity in a given subject area. Standards that have had a wide range of input throughout their creation are thought to be more reliable, reputable, and authoritative (Salmen, 2001).

Despite the ADA's numerous advantages, complete accessibility for individuals with disabilities has yet to be realized (Beasley and Davies, 2001). The United States of America's proclivity for using the law to change conduct has resulted in a variety of problems, and legislating universal design principles might be similarly unsuccessful.

According to Mazumdar and Geis (2011), in order to make educated decisions, designers must be familiar with the law's initial demands, court opinions, regulatory standards, and recommendations. They must also think about their professional, moral, and societal responsibilities.

The ADA, is a statute that protects people with disabilities. According to the ADA's civil rights provisions, everyone should have full access to commercially available goods and services, regardless of their ability. Design professionals and managers can get guidance from the Department of Justice's complying guidelines and advisory services on how to abide by the law's comprehensive civil rights requirements. As a result, designers and building owners face major challenges (Salmen, 2001).

In United Kingdom:

According to Smith (2006), the Disability Discrimination Act (DDA) is novel since it requires modifications to existing structures that, assuming no other substantial changes to the environment, even fire safety regulations would not generally need. According to Wood (2002), the Disability Discrimination Act of 1995's goal is to give handicapped individuals equitable access to goods, services, and facilities. The vast majority of providers are required by the Disability Discrimination Act to refrain from discriminating against users who have impairments. It already affects everyone who provides services to the public.

Part M of the building regulations addresses facility accessibility and usage. Building Regulations require that a newly or fully restored building be accessible, as well as have access to and use its facilities (Smith, 2006). According to Smith (2006), most forms of building work need builders and developers to verify that they conform with the Regulations.

The Building Regulations (2020) generally apply to all new constructions, expansions, and material alterations to existing structures. Some rules are applicable if a structure's usage is drastically altered. Building regulations do not apply to structures built before June 1, 1992.

3. NATIONAL AND INTERNATIONAL FIRE SAFETY AND MEANS OF EGRESS REGULATIONS

Fires and their consequences generally occur in the places and buildings where we work, live or where a large part of life continues. From the construction to the use of these structures, it is committed to the variables related to human awareness, economic and cultural development. The level reached in science and technology has also affected the design theories, construction methods and forms of use in buildings in the context of awareness, economic development, the importance and value given to human life. The desire to use products without any restrictions in the name of comfort and beauty, the point reached in technology; It has greatly increased the fire susceptibility of buildings (Bakırcı, 2016).

As per to Bakırcı (2016); the fire safety standards that architects and engineers must comply with are set at the lowest level in the regulations. However, these security criteria, namely minimums, may not always give the real answer to the problem encountered. Engineers and practitioners must anticipate existing risks and should be able to produce solutions within the framework of Fire Safety Criteria (Bakırcı, 2016).

The heat produced in the fire is transferred by conduction, transport and radiation. Conduction is the transfer of heat in solids, liquids and gases. Convection is a form of heat transfer specific to liquids and gases, as the medium also participates in the movement. Radiation is the transport of heat from a heat source to an item without the use of an intermediary medium.

According to Bakırcı (2016); there are differences in behavior and burning rate between indoor fires and outdoor fires. It is important to understand the development stages of indoor fires. The ceiling covering the space ensures the rapid return of the heat radiation to the surface of the combustibles. Walls can increase this effect, provided there is adequate ventilation. If there is enough flammable and airflow in an interior fire, ignition begins, and the fire grows, stagnates, and extinct.

The leading cause of death in a fire is smoke. According to studies, smoke inhalation often results in burns on two-thirds of patients, and more than half of deaths are directly related to carbon monoxide poisoning (Özdemir & Kır, 2018).

According to OSHA (Occupational Safety and Health Administration, 2020), a procedure of evacuation is divided into three impartial and distinct components: the process of escape, the exit, and the exit discharge. It must be a constant and unhindered path of travel from every spot inside a building or structure to a public way. In addition to the upward and downward circulations, an escape route must also contain the intermediate room spaces, doorways, hallways, corridors, passageways, balconies, ramps, stairs, enclosures, lobbies, escalators, horizontal exits, courts, and yards.

- Exit Access: A method of egress's component that grants access to an exit is called an exit access.
- Exit: The portion of an escape route that is structurally segregated from the remainder of the building or structure to offer a secure pathway to the exit discharge.
- Exit Discharge: The final discharge is the section of a route of egress that is between the termination of an escape and a public road.

All essential exits, routes to exit points, and passageways from exits into the street or open space must be preserved free of obstructions in the case of a fire and other incident (OSHA, 2020).

The Department of Fire and Rescue is responsible for making sure that the fire safety measures linked with the escape routes are both acceptable and practicable while taking into account the specifics of each unique situation.

As per to the Kılıç & Beceren; since the architectural design directly affects the active systems to be selected for the building, the need for mechanical systems is greatly reduced with a good definition of the passive systems of the building. If passive safety precautions are adequate, a fire will spread slowly, making it simpler to evacuate people and causing less damage overall (Klç & Beceren, 1999).

In fires, the majority of deaths and injuries are caused by the building not being designed in accordance with fire safety. Often the escape routes are not sufficient, leaving the building in smoke and creating undesirable results. Especially in buildings open to the public, precautions should be considered during the design phase of the buildings and should be handled first by architects regarding fire safety (Kılıç & Beceren, 1999).

The term "fire safety" refers to a group of actions intended to lessen the destruction brought on by fire. Fire safety techniques cover both methods for preventing the start of an uncontrolled fire and reducing its development and effects after it has already started.

The applications made to ensure fire safety in a building, the technology or human-based approaches and solutions have technical as well as administrative and legal aspects (Basdemir, Demirel, İseri, 2010). This dimension is one of the most important features that distinguishes fire safety studies and practices from other types of work and studies. In all developed countries, governments have undertaken the responsibility of ensuring the safety of their citizens against fire. Necessary arrangements for this are made through legislation and such regulations are an indicator of the level of civilization of those countries (Basdemir, Demirel, İseri, 2010).

One of the most important needs for the protection of persons and belongings in facilities throughout a fire is fire safety planning. Every building is at risk of fire, and since the spread of fire cannot be completely controlled, the situation needs to be handled cautiously. Fire protection in buildings requires an interdisciplinary study (Korkmaz, 2016).

3.1. Fire Safety and Means of Egress Regulations in Turkey

The occurrence of fire in buildings cannot be completely prevented, but possible losses can be minimized by taking the necessary measures to protect life and safety. High-rise buildings, which are rapidly increasing due to reasons such as population growth, rapid urbanization, and the needs of commercial and economic units in Turkey, have various consequences in social, cultural, economic and technical contexts (Kayacı, 2014). In this respect, scientific and technical developments in the field of building materials and technology, which is the subject of the building industry, accelerate the industry. According to Kayacı (2014), this circumstance leads to the invention and deployment of various ways in the area of building fire safety, as well as the necessity of specific challenges in terms of architecture and technology and their unique solutions.

According to the Istanbul Metropolitan Municipality Fire Department statistics, a total of 8,036 fires occurred in the first half of 2021 alone in the city of Istanbul. The failure to consider passive fire safety measures during the building's design phase and the inadequate

implementation of architectural fire safety measures are two of the main reasons for the loss of life and property in fires (Korkmaz, 2014).

According to Kayac (2014), the project's goals are to ensure the building's resistance to the effects of fire, provide escape and evacuation options in the event of a fire, lessen the spread of fire and smoke caused by the inadequate combustibility of the building material used for fire safety in Turkish constructions, and enhance the physical conditions of the existing structure. The regulations focused on the Regulation on the Protection of Buildings from Fire (BYKHY, 2019) provide a variety of components, such as the development of firefighting and emergency preparedness plans, to avoid property damage and loss of life in the event of a fire and to enable emergency responders to plan and carry out rescue efforts. When creating structures, architects and engineers should use these requirements as a guide (Kayaci, 2014).

According to Korkmaz (2016), passive fire safety measures are measures that have a specific function in the building and are designed during the architectural design process. These measures are;

- Limiting and eliminating the spread of flames and smoke containing hazardous gases, which cause the greatest loss of life in the structure;
- Preventing the spread of fire inside the structure outside the built-in impermeable areas;
- Designing exit routes (exit access, fire escape ladder, fire exit door, etc.) in a way that can be easily detected and evacuate users from the building safely,
- Choosing the right material (fire resistant, high ignition temperature, etc.),
- Keeping the building secure by safeguarding the structural system's load carrying capability during evacuation or extinguishment (Basdemir, Demirel, Seri, 2010).

On July 26, 2002, Turkey implemented the "Regulation on the Protection of Buildings from Fire" (BYKHY, 2019), which marked a significant advancement in the understanding of fire safety design. For the first time in Turkey, this rule embraced all types of structures, buildings, facilities, and companies utilized by public, private institutions, organizations, and individuals throughout the nation (Basdemir, Demirel, et, 2010). The 'Regulation on the Prevention of Public Buildings from Fire' and all fire protection rules and directives issued

by municipalities were removed with the introduction of BYKHY (2019) (Basdemir, Demirel, Seri, 2010).

Designing both new and existing facilities in compliance with the applicable clauses of the "Regulation on the Protection of Buildings from Fire" (BYKHY) is a practical way to lessen the possible harm from a fire threat (Simsek & Catkkas, 2020).

The objective of BYKHY (2019) is to reduce the possibility of fires occurring during the planning, development, operations, maintenance, and use of all different kinds of structures, facilities, and companies utilized by governmental institutions and organizations, private entities, and people. It also aims to put out any fire that could happen in any way by minimizing loss of life and property (BYKHY, 2019).

This regulation addresses the fire prevention and extinguishing measures that must be implemented in all types of structures, buildings, facilities, and indoor and outdoor businesses in Turkey in order to reduce the dangers that fire can pose in terms of life and property safety due to heat, smoke, toxic gas, suffocating gas, and panic. It covers the principles of building design, construction, use, maintenance, and operation, as well as actions to be taken on fixed and mobile facilities, including permanent or temporary, official or private, underground or above-ground construction on land and water, and their additions, alterations, and repairs (BYKHY, 2019). In BYKHY, information such as area, width and material, as well as the points that need to be protected and evaluated against fire are specified (Simsek & Catıkkas, 2020).

According to the BYKHY (2019), a building permit is not issued if the projects do not meet the conditions established in the regulation in terms of fire safety as well as legal rules. If it is determined that the buildings that are newly constructed or purpose of use has been changed with project modifications are not manufactured according to the principles stipulated in the fire code, the building will not be given a building occupancy permit or work permit until these deficiencies are eliminated (BYKHY, 2019). Turkish Standards are taken as basis by the designers for the issues where there is no sufficient provision in the regulation and for the protection of metro, marina, helipad, tunnel, stadium, airport and similar usage areas from fire, and in the absence of these standards, European Standards are taken as basis. In the matters that are not regulated in Turkish and European Standards,

internationally accepted standards can also be used. The written opinion of the Ministry of Public Works and Settlement and the Ministry of Interior will be the foundation for the application in the implementation of the regulations that are in dispute about the project and construction (BYKHY, 2019).

Building fire detection and extinguishment projects, according to BYKHY (2019), are planned independently from application projects. The production of emergency plans for levels with a surface area of more than 2000 m² occurs separately from the planning of the architecture. Evacuation projects can be shown in architectural discipline in other buildings. After the projects are licensed for use, the usage license is approved by the competent authorities and applied. In case changes or additions are deemed necessary by the municipality of fire department, it is obligatory to indicate which article of this Regulation is required for the requested change or addition. On matters that need to be interpreted, require clarification or are unclear, action and implementation are made after the opinion of the Ministry of Public Works and Settlement is taken.

Classification of Building Types:

In the Regulation on the Protection of Buildings from Fire (BYKHY, 2019), buildings are separated according to their intended use. In these buildings, the architect needs to transfer passive fire safety measures to the project correctly in buildings with high user density and requiring special design elements, health care buildings, educational facilities, buildings for accommodation and buildings where the population is 50 or more (Korkmaz, 2016). Correct implementation of passive fire safety measures in the projects will reduce the need for mechanical systems defined as active fire safety measures (Korkmaz, 2016).

According to BYKHY (2019), the following building types are classified based on their usage characteristics:

- Housings,
- Accommodation buildings,
- Institutional structures,
- Office buildings,
- Commercial structures,

- Industrial buildings,
- Gathering structures,
- Storage facilities,
- Highly dangerous places,
- Mixed-use buildings.

When there are areas of a structural system that are affected by two or more usage categories and these zones are not isolated from each other by an enclosure adequate for a higher risk category or it is not possible to implement separate protection measures as they are nested, the rules that require greater protection measures must be applied to the whole constructing (BYKHY, 2019).

According to BYKHY (2019), the danger class of a building or portion is defined by the facility's attributes and the type of the operations and activities performed in the building. If there are multiple danger classes of materials in different portions of a structure, the water and pump capacity is determined by the highest hazard classification of the building. When designing extinguishing systems and compartments in a structure or a portion of one, the following danger categories should be considered:

- Low-hazardous areas: These are the locations where minimal fire load or flammability materials are present, together with single compartment sections that are no greater than 126 m2 and at least 30 minutes of fire resistance.
- Medium hazardous areas: These are the areas where combustible materials with moderate fire load and flammability are present.
- High hazardous areas: These are the areas where there are materials with high fire load and flammability, which will cause the fire to spread and grow quickly.

Table 3.1. Medium hazard Usage Areas according to BYKHY

Medium Hazard Usage Area				
Usage Type	Medium Hazard -1	Medium Hazard -2	Medium Hazard -3	Medium Hazard -4
Glass and ceramic			Glass factories	
Chemicals	Cement works	Photograph laboratories	Paint workshops, soup factories	Wax and wax factories, paint shops
Engineering	Sheet metal production	Automobile factories, workshops	Electronics factory	
Food and drinks	Slaughterhouses	Bakeries, chocolate and beer factories	Animal feed mills, fruit drying, dehydrated vegetable and soup factories	Alcohol distillation facilities
Miscellaneous	Hospitals, hotels, residences, restaurants, libraries (except book storages), schools, offices	Physics laboratories, laundries, carparks, museums	Radio and television broadcasting houses	Cinemas, theaters, concert halls, tobacco factories
Paper			Binders, cardboard mills, paper mills, printing works and printing houses	Waste paper businesses
Tire and plastic			Cable factories, plastic casting and plastic goods (except foam plastic), rubber goods factories, synthetic fiver (except acrylic) factories, Vulcanization factories	Rope factories
Shops and offices	Computer data processing works		Large shops, shopping malls	Exhibition halls
Textile		Leather factories	Carpet factories (except rubber and foam plastic), fabric and garment factories, fiberboard factories, shoe factories, tricot (knitting), home textile (cloth) factories, mattress, mattress factories (except foam plastic), sewing and weaving workshops, wool and wool fabric workshops	Cotton spinning, flax and hemp preparation facilities
Wood and timber			Wood work factories, furniture factories (except foam plastics), furniture stores, armchairs, sofas and similar flooring (except plastic foam) workshops	Wood chipping mills, chipboard factories, plywood boards
If there are painting process and similar areas with high fire load in Medium Hazard-1 and Medium Hazard-2 usage areas, their usage areas are considered as Medium Hazard-3				

Table 3.2. High Hazard Usage Areas

High Hazard Usage Areas			
High Hazard - 1	High Hazard - 2	High Hazard - 3	High Hazard - 4
Fabric and linoleum factories, fabric and linoleum flooring manufacturing	Lighting flare factory	Cellulose nitrate factories	Fireworks factories
Paint, colorant (wood colorants and preservatives) and varnish factories	Plastic foam and sponge manufactures, rubber foam articles		
Manufactures of artificial rubber, resin, lampblack and turpentine	Tar distillation		
Sawdust mills and wood wool manufacturing	Bus depot, warehouse for loaded and unloaded trucks, wagons, buses,		

According to BYKHY (2019), in order for occupants to escape the building or be saved in another way in the event of a fire, the facility's load-bearing capacity must be maintained for a predetermined amount of time, the growth and spread of smoke and flames within building sections must be constricted, and the expansion of the fire to neighboring buildings must also be limited.

In residential buildings with a building height of more than 30.50 m and non-residential structures with a building height of more than 21.50 m, a maximum of three floors may be classified as a fire compartment, with the exception of the section with an atrium. (BYKHY, 2019).

Atrium partitions are only permitted in buildings with uses that include low and medium hazard classes. It is essential that the atrium area is at no point less than 90 m². According to BYKHY (2019), atrium spaces with an area of less than 90 m² must be surrounded by a smoke screen with a height of at least 45 cm on each floor and sprinklers should be installed. Smoke control must be done naturally or mechanically in the atriums (BYKHY, 2019). For the fire partitions to operate correctly, the fire resistance of the materials enclosing the compartment must be consistent at the joints, and there must be no openings between the sections that are not fire resistant (BYKHY, 2019).

Fire walls cannot have any cracks or openings. If breaches in the walls are unavoidable, doors and fixed light windows must be fire resistant for at least half as long as the fire wall's resistance. Self-closing and smoke-proof doors are a must. Such semi-strength chambers must be free of all flammable elements in their immediate surroundings. In order to prevent the passage of fire and smoke for at least the fire resistance time of the fire wall, BYKHY (2019) states that if water, electricity, heating, ventilation, or similar installations flow through the fire wall, the perimeter of the installations must be completely sealed off. Vertical installation shaft and chimney walls in high-rise structures, including those housing waste, communication, paperwork, and technological equipment, must be fire-resistant for at least 120 minutes, and doors must be smoke-proof for at least 90 minutes (BYKHY, 2019).

According to BYKHY (2019), all floors must be fire walls. Floor coverings should be made of at least normally flammable material, and in high-rise buildings, at least from hardly flammable materials. It is permissible to make heat insulation from easily flammable material on the floor, provided that it is covered with a layer of screed with a thickness of at least 2 cm. The material of the ceiling coverings and suspended ceilings of the buildings other than the detached houses in the detached order must be at least flammable or combustible. If water, electricity, heating, ventilation, or similar installations run through the floor, the perimeter of the installation must be sealed to prevent the passage of fire and smoke for at least the duration of the flooring's fire resistance period (BYKHY, 2019).

Exterior facades should be made of hardly flammable material in high-rise buildings and at least slightly flammable material in other buildings. As long as the floor offers fire resistance in a fashion that prevents the flames from spreading to the surrounding levels, the intersections of the facade components and the floors that do not have holes for the flames to pass through must be insulated (BYKHY, 2019). In order to prevent flames from spreading from one floor to the next, BYKHY (2019) advises either forming a surface surrounded by fire-resistant facade elements with a height of at least 100 cm vertically between the exposed areas of two floors, such as windows, or installing sprinklers at 2 m intervals inside the exterior wall to protect the facade (BYKHY, 2019).

According to BYKHY (2019), while constructing the roof of a building; the collapse of the roof, fire entry from the roof and the ignition of the roofing surface, the spread of fire under and inside the roof, the wind effects on the skylight, the fire passing from the skylight to the

building, the fire on the outer surface or layers of the roof covering, the possibility of spreading the fire inside the building and the formation of flame drops, passing the fire on the roofs of the adjacent buildings and roofs to the neighboring roof should be taken into consideration. Roofing materials must be B fire class roofing materials, the surface or insulation under roof coverings must be at least flammable or combustible. However, if non-combustible materials are used to cover the roof, at least typically flammable materials may be used on the roof covering's surface (BYKHY, 2019). According to BYKHY (2019), in high-rise buildings and adjacent structures, the floors on which the roofs sit must be of horizontal fire-breaking quality, and the roof carrier system and roof coverings must be made of non-combustible material.

In terms of safety against fire, easily flammable building materials are not allowed to be used in constructions. Easily flammable building materials can only be used by transforming them into a normally flammable material in a composite (BYKHY, 2019). Internal coatings and heat and sound insulations on the walls should be made of at least normally flammable materials, and slightly flammable materials in high-rise buildings and places such as cinemas, theaters, conference and wedding halls with a capacity of more than 100 people. Exterior coatings must be made of at least normally flammable material in buildings up to 2 floors, hardly flammable in buildings that do not belong to the high building class, and hardly flammable in high-rise buildings (BYKHY, 2019).

Table 3.3. Flammability Classification of Materials

Flammability Classes of Materials	
Flammability Class	Definition
A1	When a fire is completely formed, Class A1 materials do not contribute to combustion at any stage of the fire's development. This leads to the automatic assumption that the materials fully satisfy all of the requirements listed for the lower classes.
A2	It offers the standards established for class B in accordance with TS EN 13823. Additionally, these materials ought to provide a considerable contribution to the weight and development of the fire in the fully formed fire situation.
B	In addition to the criteria set for the C class, it provides more severe conditions
C	In addition to the criteria specified for class D, it provides more severe conditions. In addition, lateral flame spread should remain at a limited rate in the face of thermal attack with a single flame hood.
D	Materials that meet the criteria of class E and resist a small attack of flame for a long time without significant flame spread. In addition, it must withstand heat attack conditions with a single burning object that is adequately contained and produces limited heat.
E	Materials that briefly resist a small attack of flame without significant flame spread
F	Materials whose fire performance has not been determined and not classified as one of classes A1, A2, B, C, D, E
Additional Classifications for Smoke Generation	
s3	No limitation in terms of smoke production
s2	In addition to the increase rate of smoke production, total smoke production is also limited.
s1	Satisfying criteria heavier than s2
Additional Classifications for Combustion Drops/Particles	
d2	No limitation
d1	There should be no drops/particles near me for longer than a specified time
d0	No burning drops/particles should form

Table 3.4. A1 Flammability Class Materials

Materials with Flammability Class A1	
Materials	Notes
Expanded clay, expanded perlite and expanded vermiculite, mineral wool, cellular glass	
Concrete	Ready-mixed concrete and precast reinforced concrete prestressed and pre-compressed materials
Concrete (except for aggregates with integral thermal insulation, dense and light	Solids may include additives, pigments and other materials. Includes precast units
Gas (porous) concrete products	Units produced by combining water-based binders such as cement and/or lime with fines (silica materials, PFA, volatile kiln slag) and pore-generating substances. Includes precast units
Cement, fibrous cement and lime, blast furnace slag/powder fly ash (PFA) and mineral aggregates	
Iron, steel and stainless steel, copper and copper alloys, zinc and zinc alloys, aluminum and aluminum alloys, lead	Not in a completely separate form (shapeless)
Gypsum and gypsum-based plasters	May contain additives (retardants, fillers, fibers, pigments, hydrated, air and water retainers and plasticizers), dense aggregate or lightweight aggregates
Mortars with inorganic binders	Smoothing/plastering mortars and screeds based on one or more inorganic binders.
Clay materials	Includes units, bricks, tiles, floor tiles and fireplace units made of clay and other clayey materials, with or without sand, fuel or other preservatives
Calcium silicate units	Units made of lime and natural siliceous materials, may contain coloring pigments
Natural stone and slate units	Worked or untreated elements from natural stones or slates
Gypsum units	Includes units and blocks consisting of calcium sulfate and water, which are combined with aggregates, fillers, fibers and other additives and can be colored with pigments.
Cement mosaic	Covers mosaic tiles and cast-in-place flooring
Glass	Heat strengthened, chemically solidified, laminated and stranded glass
Glass ceramic	Glass ceramics containing crystal and residual glass
Ceramic	Covers powder pressed and extruded materials, sorted or unsorted

Table 3.5. Fire Resistance Periods According to Building Usage Classes as per the Fire Protection Code of Buildings

Building Use Classes		Fire Resistance Times of Building Elements (min)					
		Basement		Entrance or Upper Floors			
		Basement Depth (m)		Building Height (m)			
		More than 10 m	Less than 10 m	Less than 5m	Less than 21,50m	Less than 30,50m	More than 30,50m
1. Residences	a) One- and Two-Family Houses	---	30	30	60	---	---
	b) Apartments	90	60	30	60	90	120
2. Accommodation Buildings - no sprinkler system - with sprinkler system		 90 60	 60 60	 60 30	 60 60	 90 60	 not allowed 120
3. Institutional Buildings - no sprinkler system - with sprinkler system		 90 90	 60 60	 60 30	 60 60	 90 90	 not allowed 120
4. Office Buildings - no sprinkler system - with sprinkler system		 90 60	 60 60	 30 30	 60 30	 90 60	 not allowed 120
5. Commercial Buildings - no sprinkler system - with sprinkler system		 90 60	 60 60	 60 30	 60 30	 90 60	 not allowed 120
6. Industrial Buildings - no sprinkler system - with sprinkler system		 120 90	 90 60	 60 30	 90 60	 120 90	 not allowed 120
7. Buildings for Gathering - no sprinkler system - with sprinkler system		 90 60	 60 60	 60 30	 60 60	 90 60	 not allowed 120
8. Storage Facilities a) Warehouses - no sprinkler system - with sprinkler system		 120 90	 90 60	 60 30	 90 60	 120 90	 not allowed 120
b) Parking lot - open car parks - other parking lots		 --- 90	 --- 60	 15 30	 15 60	 15 90	 60 120

Occupancy Load Calculation:

The utilization class of the building, user load, floor space, path to the exit, and exit capacity are all taken into account while determining escape routes. Exit facilities must be provided

on each floor based on the user load and the longest escape distance (BYKHY, 2019). All levels, including basements, should have emergency escape stairs.

In buildings with different sections or floors designed for different types of uses or in which different uses are carried out at the same time, the requirements for the whole building or the whole floor are determined on the basis of the type of use with the most stringent means of egress requirements, or the requirements for each building section are determined separately (BYKHY, 2019). According to BYKHY (2019), while determining the user load of the level where they are placed, the floor areas of spaces such restrooms, dressing rooms, warehouses, employee canteens, hallways, and passageways that service other spaces but are not used at the same time as other spaces are taken into account.

According to BYKHY (2019), the values specified in the table below is used as the user load coefficient to be used in the necessary escape and panic calculations.

Table 3.6. User Load Factor

	Usage Areas		m²/person
1	Conference hall, multi-purpose halls, restaurant, concert halls, cinema and theater halls, etc.		1,5
2	Dance halls, bar, nightclubs and similar places	For sitting areas	1
		For standing areas	0,5
3	Passenger arrival and departure lounges of terminals		3
4	Classrooms, computer rooms, seminar rooms		1,5
5	Reception areas, waiting areas, atrium floor		3
6	Multi-purpose sports facilities		3
7	Supermarkets, department stores, shops		5
8	Art galleries, museums, workshops		5
9	Fitness centers, aerobics halls, reading rooms		5
10	Offices, association centers, public libraries		10
11	Student bedrooms		10
12	Packing places, factory production areas		10
13	Hospital bedrooms, nurse rooms		20
14	Kitchens, laundries		10
15	Hotel bedrooms		20
16	Hospital laboratories, pharmacies		20
17	Clinics, student labs		5
18	Warehouses, warehouses, engine rooms		30

Escape Routes:

According to BYKHY, any structure intended for human habitation must have adequate escape routes to allow inhabitants to immediately evacuate in the event of a fire or other emergency (2019). The design of escape routes and other safety measures indicates that the safety of life cannot depend on a single safeguard in the event of a fire or other calamity. Every facility should be constructed, outfitted, managed, and maintained in a specific way to protect occupants from the dangers of heat, smoke, or terror when leaving the building in the case of a fire or other calamity (BYKHY, 2019). Escape routes of type, quantity, location, and capacity should be designed in every building in accordance with the usage class, user load, fire protection level, construction, and height of the building, to enable a simple escape for all users (BYKHY, 2019).

Within each building, escape routes must be arranged and maintained so that they can be accessed freely and unhindered from all quarters once the building is put into use. No exit or door may have locks, bolts, or other similar hardware affixed in a way that restricts free exit from any structure. Locks are permitted in buildings that house mentally challenged, incarcerated, or recovered individuals, where authorized members of staff are constantly on duty, and where there are appropriate facilities to evacuate users in case of a fire or other emergency, according to BYKHY (2019).

Each exit should be readily visible, as should the road leading to it, so that any healthy user may quickly identify the direction from which to depart from any point (BYKHY, 2019). Any non-exit door or route leading to an exit must be designed or labelled such that it is not mistaken for the genuine exit. Precautions are taken to stop individuals from unintentionally entering dead-end sites or direct exits during a fire or other emergency (BYKHY, 2019).

According to BYKHY (2019), escape routes are the entire continuous and unhindered path from any place inside a structure to the street below. The phrase "means of escape" corresponds to all entrances and exits from rooms and other independent areas, hallways and similar pathways on each level, floor exits, stairs to the ground floor, roads leading to the building's last exit from the ground floor stairwells, and the last exit itself. Elevators are not considered to be means of escape.

The limitations listed in below table must be adhered to when measuring the distance between the furthest point in a useable area and the closest exit. It is acceptable if the direct evacuation route does not exceed two-thirds of the maximum allowable evacuation length on a level with a significant area divided into rooms, hallways, and other similar sub-sections. The furthest location for measuring the escape distance is 40 cm ahead of the space's surrounding walls (BYKHY, 2019). The capacity of exit doors, escape staircases, corridors, and other escape routes are computed using 50 cm width units for exit width. The table below shows the number of individuals going through the unit width based on the building usage classifications (BYKHY, 2019).

Table 3.7. Longest Egress Distances and Unit Widths to Exits

Usage Class	One-way maximum distance (m)		Two-way maximum distance (m)		Number of people per unit width				Dead end corridor maximum distance (m)	
									Corridors	
	No Sprinkler System	With Sprinkler System	No Sprinkler System	With Sprinkler System	Outwards Door Openings	Other doors and corridor doors	Egress Stairs	Ramp and Corridor	No Sprinkler System	With Sprinkler System
High Hazard Locations	10	20	20	35	50	40	30	50	10	20
Industrial Buildings	15	25	30	60	100	80	60	100	15	20
Dormitories	15	30	45	75	50	40	30	50	15	20
Stores, Shops, Markets	15	25	45	60	100	80	60	100	15	20
Office Buildings	15	30	45	75	100	80	60	100	15	20
Parking lots and Warehouses	15	25	45	60	100	80	60	100	15	20
School and Education Buildings	15	30	45	75	100	80	60	100	15	20
Buildings for Gathering	15	25	45	60	100	80	60	100	15	20
Hospitals, Nursing Homes	15	25	30	45	30	30	15	30	15	20
Hotels, Hostels	15	20	30	45	50	40	30	50	15	20
Apartments	15	30	30	75	50	40	30	50	15	20

Egress distances cannot be greater than the values specified according to the usage class.

According to BYKHY (2019), the values in "Table 3.7" are used as the user load coefficient for the exit capacity and escape distance in existing structures to be used in the necessary escape and panic calculations. If the circulation stairs of the building are protected, if the shafts are protected, and if easily flammable and combustible materials are not used and are not present on the floors, the escape distances given can be increased by 1/2 (BYKHY, 2019).

According to BYKHY, the overall exit width must be more than the sum of the width of the unit times the quantity of users divided by the sum of the users in all of the floor's usage zones, multiplied by 0.5 m. (2019). There must be no exit doors, escape staircases, or other escape routes that are narrower than the estimated values and 80 cm wide, and the width of an emergency exit must not be less than 100 cm if the total number of users exceeds 50. Unless employed as a hallway and hall servicing the building's areas, the escape path must be less than 110 cm wide. Stairs wider than 200 cm should be split into sections of no less than 100 cm and no more than 160 cm with railings (BYKHY, 2019). The height of the escape route corridor must be less than 210 cm. When two egress routes are necessary, each egress route must be broad enough to support at least half of the total user load. Clear widths are used to measure widths. For enough clearance on egress stairs and emergency exit doors;

- When calculating the clear width for escape stairs, 80 mm of the protrusion of the handrail is included in the clear width.
- At the exit door, when the wing surface is opened 90 degrees, the clear width of a single-leaf door is the space between the door frame or light protrusion. A single-leaf exit door's clear width cannot be less than 80 cm or greater than 120 cm. The clear width of a double-winged door is the distance between the leaf surfaces when both leaves are open 90 degrees.

Every exit and access routes should be kept free of barriers to allow for easy usage whenever required, according to BYKHY (2019). Alternatively, their positions should be indicated with signs. There should be direct access to one or more exits for each user within a building or its floors without requiring them to pass through any shared spaces or rooms with other users (BYKHY, 2019).

Fire Safety Halls:

The purpose of fire safety halls is to block smoke from reaching the escape stairs, to be utilized by extinguishing and rescue professionals, and to keep the injured and incapacitated safe, if needed, until assistance arrives. It is crucial that the hallways be constructed so that people may travel freely via the escape route (BYKHY, 2019). The fire protection halls must be separated from other areas by a smoke-proof door that can endure a fire for at least 90 minutes and a fire-resistant wall that can sustain a fire for at least 120 minutes. No combustible materials could be used on the walls, ceiling, or flooring of these areas. According to BYKHY (2019); the floor area of fire safety halls cannot be less than 3 m², more than 6 m² and the size in the escape direction cannot be less than 1.8 m. The area of the fire safety hall to be constructed in front of the emergency elevators cannot be less than 6 m², more than 10 m² and any dimension of it cannot be less than 2 m. The sloop of the floor should not exceed 1/200 from the elevator hall to the exit door (BYKHY, 2019).

Unless otherwise noted, escape stairs are reached by a fire safety hall or a hall, corridor, or lobby isolated from the public areas by a door, according to BYKHY (2019). In buildings with an evacuation elevator and an elevation greater than 51.50 m, a fire safety hall must be put in front of the egress steps. The emergency elevator must be opened to the safety hall in front of the fire escape. The building's administrator and management are in charge of maintaining the fire safety halls unoccupied (BYKHY, 2019).

According to BYKHY (2019), the fire resistance times of protected corridors or halls serving as escape routes in a building must comply with the periods specified in "Table 3.5.". Similar to exit doors opening to escape stairs, emergency exits opening to internal means of evacuation corridors or passages must be fire proof and should have automatic self-closing mechanisms. Level differences of less than four steps on the floor along the means of egress routes must be connected with ramps with a maximum slope of 10%. The floor surface of these ramps must be covered with anti-slip material (BYKHY, 2019).

Vertical Fire-Escape:

According to BYKHY (2019), escape stairs are often used stairs in the building that may be used in fire and other emergency circumstances. It is impossible to plan emergency escape

stairs separately from the other elements of escape routes because they are a part of the escape routes used in evacuations during fires and other emergencies. The escape staircases must have a smoke and fire-resistant wall that lasts at least 90 minutes between them and the rest of the structure, and their walls, ceilings, and floor surfaces cannot be coated with flammable materials.

In order to ensure that everyone on that floor level leaves regardless of where the fire originates, BYKHY (2019) suggests that escape pathways and escape staircases be built side by side. Egress routes cannot be established next to each other. The entrance to the escape stairs and the landing must be at the same level. It is not possible to reach the escape stair by passing the general stairs. In determining the location of the escape stair slots, the furthest escape distance and user loads are taken into account (BYKHY, 2019). The position of the stairs is chosen in such a way that individuals within the building may safely evacuate to the outside. The escape steps should be continuous from the beginning to the end (BYKHY, 2019).

At least half of the escape stairs must be large enough and plentiful enough to lead outside the building. The distance between the drop point and the external open area, if the escape stairway serves more than one floor, should not exceed 10 m if it descends to a circulation zone with a visible and unobstructed exit at ground level (BYKHY, 2019). In structures with a sprinkler system, this distance can be maximum of 15 m. The outdoor area must be clearly visible from the point where the escape stair descended and must be directly accessible in a safe manner. It is imperative that the exit door is wide enough to meet requirements of the user load from the interior escape stairs (BYKHY, 2019).

In the escape stairs, a landing must be arranged at each floor level with no more than 17 steps and not less than 4 steps (BYKHY, 2019). Balanced escape staircases are not authorized in buildings taller than 15.50 meters or with more than 100 inhabitants per level. The landing's minimum width and length cannot be less than the width of the staircase. It is critical that the step surfaces made of a non-slip substance (BYKHY, 2019). Doors to means of egress landings should never be placed so that they limit more than one-third of the escape path.

According to BYKHY (2019), the clear height on stairs should be at least 210 cm above the step and the difference in elevation between the landings should be at most 300 cm. In any escape staircase, the riser height cannot be more than 175 mm and the step depth cannot be less than 250 mm (BYKHY, 2019). On stairs that are allowed to be used for escape, the narrowest step width in the staircase cannot be less than 100 cm in residential buildings and 125 cm in other structures. Each escape stair must have a wall, railing or handrail on both sides. There cannot be any electrical and mechanical shaft covers that can be opened, combi boiler, air conditioning outdoor unit, counter and similar devices cannot be placed in the means of egress staircase and fire safety halls (BYKHY, 2019).

If the applicable standards are met, an outdoor open escape staircase may be utilized in place of an indoor escape stair. It is not necessary for the external escape ladder to be in a protected housing (BYKHY, 2019). Within 3 m of any section of the open exterior escape stair, horizontally from the sides and vertically from the bottom, there cannot be any wall opening, such as doors and windows, that is less protected than the characteristics of the external egress stair. Outside open egress staircases are not authorized in buildings taller than 21.50 meters (BYKHY, 2019).

External emergency egress stairs, which are situated outside the building and have constrained, challenging, and unsafe circumstances, provide hazardous situations in terms of life safety, as claimed by Avlar and Yldrm (2020). It is well known that accidents happened as a result of the risks on these staircases. The physical characteristics of the outdoor escape stairs should be examined in order to offer a simple and quick evacuation from buildings in the case of a fire or other disaster, while not jeopardizing life safety (Avlar & Yldrm, 2020).

According to the data obtained as a result of their study, Avlar & Yıldırım (2020) developed solutions to eliminate or reduce the risks that may occur due to possible safety hazards in the external escape stairs. There are differences in the rules regarding external escape ladders in the examined laws, standards and regulations. For this reason, it is recommended to review the differences in the rules first and to eliminate these rules in a way that will prevent incomplete or faulty applications, taking into account the building risk class, user profile and occupant population (Avlar & Yıldırım, 2020).

Circular stairs, if built of non-combustible material and at least 100 cm wide, can serve as a necessary evacuation from any level, mezzanine, or balcony if the user load does not exceed 25 people. (BYKHY, 2019). It is prohibited to utilize circular stairs as a method of egress exit if they do not adhere to the relevant rules. Circular stairs cannot exceed 9.50 m. in height. The step width cannot be less than 250 mm when it is 50 cm or more away from the staircase's center. Riser height is limited to 175 mm. The height of the head clearance cannot be less than 2.50 m. (BYKHY, 2019).

According to BYKHY (2019), the slope of interior and exterior escape ramps cannot be steeper than 10%. Escape ramps should be straight-armed and directional changes must only made with the landings. However, escape ramps with a slope in any part of the ramp is not more than 1/12, can be designed as curved ramps. All means of egress ramps must have horizontal landings at the start and end of the levels and, if necessary, at intermediate levels. A horizontal landing must be arranged at each door used for entering and exiting the escape ramps. The width of the ramp should be the minimum length and breadth of the landing. However, the maximum landing length for a straight-armed ramp is one meter (BYKHY, 2019).

It is obligatory to construct walls, railings or handrails in accordance with the requirements regarding escape ramps and stairs (BYKHY, 2019). The use of anti-slip surface coatings is essential for all means of egress ramps. In compliance with the ventilation standards for means of egress stairs, escape ramps must be ventilated. Vehicle ramps that can be reached directly outside the building by descending or ascending a floor and with a slope of not more than 10% are considered as escape ramps (BYKHY, 2019).

All protected means of egress staircases must be naturally or mechanically ventilated or pressurized. For lighting and ventilation requirements, escape staircases and usage areas cannot share the same light or duct space (BYKHY, 2019).

According to BYKHY (2019), every means of egress stairway serving a building's basement must meet all of the standards for escape stairs. With the exception of certain circumstances for homes, a fire safety hall must be provided for the access to the stairs in the basement levels if the standard floor staircase extends and serves to the basement or if the staircase serves more than 4 floors, including the basement floors (BYKHY, 2019). In the event of an

emergency, the basement stairs should be physically divided from the ground-level landing by a door or similar obstruction, or there should be enough clearly visible guiding signage supplied (BYKHY, 2019).

According to BYKHY (2019), elevator systems must conform with the "Elevator Regulation (95/16/AT)" issued in the Official Gazette on 31/1/2007, number 26420, and 18/11/2008, number 27058. Elevators must be designed and built-in conformity with the "Elevator Maintenance and Operation Regulation." Elevator shaft and engine room must be made of fire resistant and non-combustible material for at least 60 minutes. More than 3 elevator cabins cannot be arranged in the same shaft. If 4 elevator cabins are arranged, they must be separated in groups of two with a material resistant to fire for 60 minutes (BYKHY, 2019).

There must be a ventilation and smoke removal chimney at least 0.1 m² in the elevator shaft, 0.025 times the area of the well, or the wells should be pressurized. The elevators, which also serve the basement floors at the same time, must be accessed through a protected corridor or fire safety hall in the basement floors. Elevator doors cannot be opened directly to usage areas except corridors, halls and similar areas (BYKHY, 2019). Elevators in high-rise buildings and public buildings must adhere to the following guidelines:

- Elevators must be capable of automatically returning to the emergency exit floor and waiting with the doors open, regardless of their direction, without opening their doors when they receive a fire alarm warning. However, elevators must also have an electrical system that can be used by authorities when necessary.
- If a fire alarm warning is received, no floor or corridor calls should be accepted by the elevators.
- In high-rise structures located in the first- and second-degree earthquake zones, the elevators should have a device and a program that will not move, open their doors, and go to the nearest floor where the elevators can stop during an earthquake by receiving a warning from the earthquake sensor.

Elevator doors in structures with a building height greater than 51.50 meters must be fireproof and smokeproof for at least 30 minutes and for 60 minutes (BYKHY, 2019).

According to BYKHY (2019), an emergency elevator must be installed to ensure that firefighting teams and the equipment they use within a building are transported quickly to the upper and lower floors within a reasonable safety measure, to carry out necessary rescue operations, and to evacuate disabled people. Under normal circumstances, the elevator can also be utilized by the building's tenants. But emergency workers are given charge of the elevator in the event of a fire or other emergency (BYKHY, 2019). At least one elevator must be set up as an emergency elevator in buildings taller than 51.50 meters so that it may be used in an emergency (BYKHY, 2019).

On each level, a fire safety hall of less than 6 m², more than 10 m², and not less than 2 m in either direction shall be built in front of the emergency elevators to enable access to the means of egress stairs. The emergency elevator must have a cabin with a minimum area of 1.8 m², a speed from the ground level of at least 1 minute, and a connection to an emergency generator that will turn on automatically in the case of a power loss and keep it running for 60 minutes. The emergency elevators' electrical equipment and cables must be fire resistant for at least 60 minutes. The emergency elevator's machine room must be separate, and the elevator shaft must be pressurized (BYKHY, 2019).

If there is a use in the existing building that requires an additional exit requirement or the necessity of rearranging the escape stairs, an additional exit or escape staircase must be made for the entire building by the building owner or floor owners. When additional exit or escape stairs are required in existing buildings, joint solutions can be produced with the neighboring parcel or building, provided that consent is obtained and no additional floors are built (BYKHY, 2019).

According to BYKHY (2019), windows that are open to the secured external zone, at a height of no more than 4 m from the outer floor, and have an openable sash width and a height of at least 70 cm can be regarded as escape routes in existing structures, provided that there are no more than 25 users on the first floor. In the existing buildings, provided that the number of users on the floor does not exceed 50 people, the exits with the following features are considered as the second escape route;

- Access to escape stairs through a window in structures with a maximum height of 30.50 m if, window parapet level should not be higher than 80 cm from floor level, the clean

opening-closing part of the window should be at least 70/140 cm in size, making steps to reach the parapet level, if the materials used in the window passage are fire-resistant for at least 30 minutes and the standards are satisfied, it is acceptable.

- Access to the evacuation staircase through a room is permitted as long as the room's door is self-closing and latching and the total distance from the room's doorway to the evacuation stair does not exceed 9 m. If the walls and door of this room are fire resistant for at least 60 minutes and the door is smoke-proof, the escape distance is measured to the door.
- The second escape route may be utilized in place of the other staircase if the ground level can be accessed by a stair and a window with an opening side of at least 50 cm and an opening area of at least 0.4 m2.
- The exit can be regarded as a sufficient emergency exit regardless of the floor's height if there are fewer than 25 users of the first floor and there is a one-way escape distance from the furthest point of the used area to the floor's exit door. This is true as long as the staircase serving this floor is independent from the ground floor and the entrance is arranged separately.

Egress Doors:

Unless otherwise indicated, all structures must have at least two exits. The number of exits cannot be fewer than the total number of exits. Unless otherwise specified, there must be at least two exits in high-risk areas when 25 people are surpassed and at least one exit in every other building if 50 people are exceeded. If the population reaches 500 people, there must be at least three exits, and if the population surpasses 1000 people, there must be at least four exits. The exits should be as widely apart as feasible, according to BYKHY (2019). If 2 exits are required in undivided spaces, the distance between the exits cannot be less than 1/2 of the diagonal distance if there is no sprinkler system, and 1/3 of the diagonal distance if there is a sprinkler system. In building usage classes where exit distances are taken from the door, the distance between 2 escape stairs in a corridor cannot be less than half of the corridor length in buildings without sprinkler system and 1/3 of the corridor length in structures with sprinkler system (BYKHY, 2019).

Egress doors must have a clear width of at least 80 cm and a height of at least 200 cm. On egress doors, there shouldn't be a threshold. It is not permissible to use turnstiles or spinning

doors as emergency exits (BYKHY, 2019). Emergency exit door wings must not impede the movement of users. Exit doors must open in the direction of egress in places with a user load of more than 50 people. Doors leading to the escape path should be physically unlocked, not kept locked (BYKHY, 2019).

Emergency escape staircase and fire safety hall doors must be smoke-proof and fire resistant for at least 60 minutes if it serves less than 4 floors, and at least 90 minutes if it serves basements and more than 4 floors. Emergency doors should have self-closing mechanisms and be designed so that firemen or cops may enter from the outside if necessary (BYKHY, 2019).

The unobstructed width of a single-leaf door is defined by BYKHY (2019) as the space between the door frame and any light projection when the door is opened 90 degrees. A single-leaf exit door's clear width cannot be less than 80 cm or wider than 120 cm. When both wings are opened 90 degrees in a two-wing door, the clean width is the space between the leaf surfaces (BYKHY, 2019). If there are more than 100 persons on a floor, the escape stairs, escape corridor, and fire safety hall doors are situated such that they may be opened in the direction of the means of evacuation without using a door handle. All escape route doors opening from steps to a secure location at ground level. It is essential that the doors are designed in such a way that they can be opened with a maximum force of 110 N (BYKHY, 2019).

Boiler rooms, storage tanks, controls, chimneys, bunkers, car parks, kitchens, roofs, elevators, thunder safety systems, transformers, and generators are examples of sections in a structure where combustible materials are not permitted. These places must be cleaned at regular intervals, and the building owner or manager is obliged to provide the maintenance of these areas (BYKHY, 2019).

Lighting and Markings:

According to BYKHY (2019), on the means of egress routes, it is essential that the necessary lighting is provided for the users to escape. If the lighting units used for emergency lighting and guidance are selected as non-illuminating when normal lighting is present, they must be installed in such a way that they are automatically activated when the normal means of egress

route lighting is interrupted. All escape routes and stairs must be illuminated. When using escape routes, lighting on escape routes must be continuous throughout the building or structure. Lighting must be given by a lighting installation that is linked to the building's or structure's main lighting system, and natural lighting is not deemed adequate (BYKHY, 2019).

All buildings with more than one exit should give emergency instructions so that people may readily access the exits. Emergency exit signs must be installed to protect the building's exits for evacuating in case of emergency and to indicate the intended route outside the facility at each location (BYKHY, 2019).

According to BYKHY (2019), directional signs should be in white on a green background, it must contain symbols conforming to the standards and the words "EXIT" for exits to be used in normal times, and "EMERGENCY EXIT" for exits to be used in emergency exits. For directional signs lighted from the outside or the side, the distance should be 100 times the sign size, and for emergency guidance units with signs illuminated from the interior and behind, the distance should be 200 times the sign size. Direction signs should be added as necessary for access from points farther than this distance (BYKHY, 2019).

Directional signage should be positioned 200 cm to 240 cm above the finished floor surface. Other than directional signs, no other non-illuminated signs or things that would make it difficult to decide which way to flee should be put on the means of egress routes. Direction signs must be visible from all access points on the escape route, both in normal lighting and emergency lighting situations (BYKHY, 2019).

Informing the residents of all parts of a building about fire or other emergency situations is carried out with sound and light warning devices. Where the fire warning button is mandatory, the warning system is also mandatory (BYKHY, 2019).

Evacuation warnings must made both audible and visual, with the exceptions stated below;

- In locations where there are not expected to be any hearing-impaired people present, it is not necessary to employ a light warning device.

- Only light warning devices are allowed to be used if they are foreseen for buildings for healthcare purposes.

Evacuation warning systems must be activated throughout the entire structure, with the following exceptions;

- In buildings that cannot be evacuated completely due to their structure, warning systems are activated only in the areas that were or will be affected by the fire at the beginning. In such a case, the warning system is installed in such a way that it is activated gradually in other areas so that the building can be evacuated regularly.
- In buildings where individuals cannot leave on their own owing to old age, physical or mental handicap, or other similar reasons, only the people responsible for their care and evacuation from the building are permitted to provide fire warnings.

At an elevation of 150 cm above the floor, the noise level of all installed auditory alarm systems must be at least 15 dBA higher than the average ambient noise intensity. Showers, bathrooms, and sleeping areas must all have sound levels of at least 75 dBA (BYKHY, 2019).

3.2. Fire Safety and Means of Egress Regulations in United States of America

In the United States, standards are created through a private, voluntary process that is headed by business with involvement from the government. As a result, a substantial number of private sector standards development organizations produce and disseminate standards using the consensus technique. These groups often represent various economic sectors, such as the automobile, electronics, fire protection, and so on. The United States takes a different approach to standards than the majority of other countries, which typically have a single national standards agency that is frequently endorsed by and funded by the government (Wogalter, Dejoy & Laughery, 1999).

The main organizations in charge of creating codes are the International Code Council (ICC), which creates architectural, fire, and mechanical codes, and the National Fire Protection Association (NFPA), which creates electrical and life safety rules (Hirschiler, 2017).

Building fire has only recently been the subject of intensive investigation since World War II. To date, however, there have been extraordinary developments in the field of fire research,

notably in the field of fire modeling in recent years. As a result, the fire research community has become increasingly interested in creating performance requirements for building fire safety that are based on science and engineering (Tanaka, 1991). The risk of fires has increased as huge complex buildings and high-rise structures have been built more often recently. There are more deaths and property losses as a result of the lengthier evacuation times for larger structures and the complexity of the firefighting equipment needed to put out the fires (Woo & Hwang, 2014).

New changes in codes result from disasters. Fire and building rules were altered as a result of the Triangle Shirtwaist Factory fire in 1911, particularly with relation to ways of exit. The Coconut Grove fire in 1942 altered specifications for building supplies and egress. The Beverly Hills Supper Club fire in 1977 altered how building standards were written regarding fire sprinklers in nightclubs and other gathering places (Ballonco, 2001). Following the 1993 terrorist assault in the basement of the World Trade Center, changes were made, including better illumination for escape stairs, communications, evacuation protocols, and measures to help the disabled (Pauls, 2001). (Gold, 2001). The World Trade Center Twin Towers assault and subsequent collapse on September 11, 2001, have increased focus on safety in tall structure design, instruction, and code modifications. The Cook County office building fire in Chicago in 2003 that killed six people prompted the installation of automatic door unlocking in stairwells of tall buildings (Ballonco, 2003). The nightclub fire in 2003 in Warwick Rhode Island, killing total of 112 people, has created a review of thresholds for automatic fire sprinkler protection, interior finishes and decorations, egress and exiting arrangements, application of code requirements, inspections and permits, general admission seating, and the education of crowd managers. All of these incidences, and others resulting in changes, have affected The National Fire Protection Association's (NFPA) Life Safety Code (NFPA, 2020).

The International Building Code (IBC) was created to outline the minimal specifications required to ensure rational levels of protection, healthcare, and community wellbeing through structural strength, methods of escape routes facilities, consistency, hygiene, sufficient illumination and ventilation, energy efficiency, and safety to life and property from fire, explosion, and other dangers, as well as to provide fire fighters and rescue personnel with a rational reference (IBC, 2020).

The consensus standard generation process used to develop NSPA rules, standards, suggested practices, and recommendations, including the document supplied below, has received approval from the American National Standard Institute. To reach an agreement on fire and other safety-related concerns, volunteers with varied backgrounds and interests are brought together through this procedure. However, the NFPA does not independently analyze, evaluate, or support the veracity of any data or any conclusions in NFPA Standards. Instead, it oversees the procedure and develops rules to promote equity in the formation of consensus (NFPA, 2018).

Classification of Building Types:

The NFPA classifies buildings and structures depending on the kind of construction they have, which can be one of the essential construction types known as Type I, Type II, Type III, Type IV, or Type V, and which has a fire resistance rating that is not less than those specified in Table 3.8. below. When more than one kind of construction is employed in a single structure, the entire structure must be categorized as that construction type and must adhere to its standards (NFPA, 2018).

Table 3.8. Rating of Type I through Type V Construction for Fire Resistance (hr)

	Type I		Type II			Type III		Type IV	Type V	
	442	332	222	111	000	211	200	2HH	111	000
Exterior Bearing Walls	4	3	2	1	0	2	2	2	1	0
Interior Bearing Walls	4	3	2	1	0	1	0	2	1	0
Columns	4	3	2	1	0	1	0	H	1	0
Beams, Girders, Trusses, and Arches	4	3	2	1	0	1	0	H	1	0
Floor-Ceiling Assemblies	2	2	2	1	0	1	0	H	1	0
Roof-Ceiling Assemblies	2	1,50	1	1	0	1	0	H	1	0
Interior Nonbearing Walls	0	0	0	0	0	0	0	0	0	0
Exterior Nonbearing Walls	0	0	0	0	0	0	0	0	0	0

NFPA (2018) states that the fire barriers, structural components, walls, arches, floors, and roofs of Type I and Type II buildings must be made of authorized non - flammable or limited-combustible materials. To be classified as Type III construction, a structure must have outer walls, structural elements that are portions of external walls, fire walls, inner internal structures, walls, arches, floors, and roofs that are entirely or partially composed of wood with smaller dimensions than those required for Type IV construction, or that are made of approved fire-resistant components.

Type IV structures are those that are allowed to have noncombustible or limited-combustible fire walls, external walls, internal bearing walls, and structural components that are a part of those walls, according to NFPA (2018). Without any unnoticed voids, floors, roofs, arches, and other interior structural elements can all be made of solid or laminated wood.

Constructions that fall under the Type V classification include structural components, walls, arches, floors, and roofs that are totally or substantially composed of wood or another allowed material.

Occupancy Load Calculations:

Occupancy classification is critical in establishing design elements, occupant safety standards, particularly those relating to building constraints, evacuation routes, fire protection systems, and interior finishes. The criteria used to categorize buildings and structures into use groups and occupancies are described in Chapter 3 of the International Building Code (IBC), "Occupancy Classification and Use."

The official description of the main function of a building, structure, or component thereof is its occupancy classification. According to IBC Chapter 3, buildings are categorized into one or more of the occupancy categories depending on the kinds of risks and hazards that are commonly connected to the building's intended use for its people (2020). Any area, room, or place planned to be utilized for many purposes at different times must meet any legal criteria connected to such probable multifunctional usage. When a structure is designed for an unlisted purpose, it must be classified in the occupation that best fits its fire safety and relative threat (IBC, 2020).

According to IBC (2020), there are 10 occupancy classifications. These are;

1. Assembly: Groups A-1, A-2, A-3, A-4, and A-5: The phrase describes the usage of a building or structure, or a portion of one, for public meetings for events like civic, social, or religious gatherings, for recreation, the consumption of food and beverages, or while waiting for a bus or other kind of transportation.
2. Business: Group B: When a building or structure, is used for office-related, specialized, or service-type operations like bookkeeping, we say that the space is occupied.
3. Educational: Group E: When six or more people are simultaneously using a facility or area of a building for educational purposes through the 12th grade, that usage is referred to as occupancy.
4. Factory and Industrial: Groups F-1 and F-2: A building, structure, or facility may be occupied when it is being used for activities other than Group H hazardous or Group S storage, such as assembling, dismantling, fabricating, finishing, manufacturing, packaging, repair, or processing.
5. High Hazard: Groups H-1, H-2, H-3, H-4 and H-5: When a building or structure, is used for activities like the manufacturing, processing, generating, or storage of commodities in amounts larger than those permitted in control zones, this is referred to as occupancy.
6. Institutional: Groups I-1, I-2, I-3 and I-4: Occupation is defined as the use of a building or structure, or a section of it, when care or supervision is provided to people who can or cannot survive without physical support, where people are held for legal or correctional reasons, or where the inhabitants' freedom is constrained.
7. Mercantile: Group M: Occupancy is the term used to describe the use of a building or structure, or a section of it, for the exhibition and sale of products, as well as the stock of commodities, wares, or merchandise incidental to such operations and accessible to the public.
8. Residential: Groups R-1, R-2, R-3 and R-4: Occupancy refers to the use of a building or structure, or a section of it, for sleeping purposes when not designated as an Institutional Group I or governed by the International Residential Code.
9. Storage: Groups S-1 and S-2: Using a building or structure, or a section of it, for storage is an employment that is not classified as hazardous.
10. Utility and miscellaneous: Group U: Buildings and structures of an accessory nature, as

well as other buildings not specifically categorized in any occupancies, are built, furnished, and maintained in accordance with IBC standards, taking into account the fire and life danger inherent in their use.

In accordance with the IBC (2020), occupancy classes include subordinate uses with comparable risks and hazards for building occupants. Use includes, but is not limited to, the functional names given in the descriptions of the occupation groups. Certain usage could call for certain restrictions and controls. The specifications for building size, story count, and building height must be used separately. Each portion of a structure divided by one or more fire barriers is regarded as a separate building for the purposes of determining area limitations, height restrictions, and the type of construction. Construction methods, occupancy classifications, and the presence or absence of an automatic sprinkler system throughout the building all have an impact on a building's height and number of floors.

Table 3.9. Allowable Building Height Above Graded Plane

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION									
	SPRINKLER	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
A, B, E, F, M, S, U	NO	UL	48.76 m	19.81 m	16.76 m	19.81 m	16.76 m	19.81 m	15.24 m	12.19 m
	YES	UL	54.86 m	25.90 m	22.86 m	25.90 m	22.86 m	25.90 m	21.33 m	18.28 m
H-1, H-2, H-3, H-5	NO	UL	48.76 m	19.81 m	16.76 m	19.81 m	16.76 m	19.81 m	15.24 m	12.19 m
	YES	UL								
H-4	NO	UL	48.76 m	19.81 m	16.76 m	19.81 m	16.76 m	19.81 m	15.24 m	12.19 m
	YES	UL	54.86 m	25.90 m	22.86 m	25.90 m	22.86 m	25.90 m	21.33 m	18.28 m
I-1, I-3	NO	UL	48.76 m	19.81 m	16.76 m	19.81 m	16.76 m	19.81 m	15.24 m	12.19 m
	YES	UL	54.86 m	25.90 m	22.86 m	25.90 m	22.86 m	25.90 m	21.33 m	18.28 m
I-1, I-2	NO	UL	48.76 m	19.81 m	16.76 m	19.81 m	16.76 m	19.81 m	15.24 m	12.19 m
	YES	UL	54.86 m	25.90 m						

Table 3.9. Allowable Building Height Above Graded Plane (Continuation)

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION									
	SPRINKLER	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
I-4	NO	UL	48.76 m	19.81 m	16.76 m	19.81 m	16.76 m	19.81 m	15.24 m	12.19 m
	YES	UL	54.86 m	25.90 m	22.86 m	25.90 m	22.86 m	25.90 m	21.33 m	18.28 m
R	NO	UL	48.76 m	19.81 m	16.76 m	19.81 m	16.76 m	19.81 m	15.24 m	12.19 m
	YES	UL	54.86 m	25.90 m	22.86 m	25.90 m	22.86 m	25.90 m	21.33 m	18.28 m

Mezzanines do not increase the size or number of storeys of the structure. When determining the fire area, the mezzanine area is taken into consideration. The mezzanine floor building must have a minimum clear height of 2.13 meters above and below it. A room or area cannot have more than one-third of its combined size in floor space taken up by a mezzanine or mezzanines. The floor area of the room in which the mezzanine is created cannot be determined by using the enclosed area of the space. The floor size of the room cannot be taken into account when determining the permitted mezzanine area.

Under IBC, platforms for large machines are not treated as a part of the floor (2020). Building space and floor count are influenced by equipment platforms. Any mezzanine that contains an equipment platform is not allowed, and any walkways, stairs, alternating tread devices, or ladders that lead to an equipment platform are also not allowed to be used to exit the building. The size of the equipment platform is not included when estimating the fire area (IBC, 2020).

Table 3.10. Allowable Numbers of Stories Above Grade Plate

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION									
	SPRINKLER	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
A-1	NO	UL	5	3	2	3	2	3	2	1
	YES	UL	6	4	3	4	3	4	3	2
A-2	NO	UL	11	3	2	3	2	3	2	1
	YES	UL	12	4	3	4	3	4	3	2
A-3	NO	UL	11	3	2	3	2	3	2	1
	YES	UL	12	4	3	4	3	4	3	2
A-4	NO	UL	11	3	2	3	2	3	2	1
	YES	UL	12	4	3	4	3	4	3	2
A-5	NO	UL	UL	UL	UL	UL	UL	UL	UL	UL
	YES	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NO	UL	11	5	3	5	3	5	3	2
	YES	UL	12	6	4	6	4	6	4	3
E	NO	UL	5	3	2	3	2	3	1	1
	YES	UL	6	4	3	4	3	4	2	2
F-1	NO	UL	11	4	2	3	2	4	2	1
	YES	UL	12	5	3	4	3	5	3	2
F-2	NO	UL	11	5	3	4	3	5	3	2
	YES	UL	12	6	4	5	4	6	4	3
H-1		1	1	1	1	1	1	1	1	NP
H-2	NO	UL	3	2	1	2	1	2	1	1
	YES									
H-3	NO	UL	6	4	2	4	2	4	2	1
	YES									
H-4	NO	UL	7	5	3	5	3	5	3	2
	YES	UL	8	6	4	6	4	6	4	3
H-5		4	4	3	3	3	3	3	3	2
I-1 Condition 1	NO	UL	9	4	3	4	3	4	3	2
	YES	UL	10	5	4	5	4	5	4	3
I-1 Condition 2	NO	UL	9	4	3	4	3	4	3	2
	YES	UL	10	5						
I-2	NO	UL	4	2	1	1	NP	1	1	NP
	YES	UL	5	3						
I-3	NO	UL	4	2	1	2	1	2	2	1
	YES	UL	5	3	2	3	2	3	3	2
I-4	NO	UL	5	3	2	3	2	3	1	1
	YES	UL	6	4	3	4	3	4	2	2
M	NO	UL	11	4	2	4	2	4	3	1
	YES	UL	12	5	3	5	3	5	4	2
R-1	NO	UL	11	4	4	4	4	4	3	2
	YES	UL	12	5	5	5	5	5	4	3
R-2	NO	UL	11	4	4	4	4	4	3	2
	YES	UL	12	5	5	5	5	5	4	3

Table 3.10. Allowable Numbers of Stories Above Grade Plate (Continuation)

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION									
	SPRINKLER	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
R-3	NO	UL	11	4	4	4	4	4	3	3
	YES	UL	12	5	5	5	5	5	4	4
R-4	NO	UL	11	4	4	4	4	4	3	2
	YES	UL	12	5	5	5	5	5	4	3
S-1	NO	UL	11	4	2	3	2	4	3	1
	YES	UL	12	5	3	4	3	5	4	2
S-2	NO	UL	11	5	3	4	3	4	4	2
	YES	UL	12	6	4	5	4	5	5	3
U	NO	UL	5	4	2	3	2	4	2	1
	YES	UL	6	5	3	4	3	5	3	2

The IBC states that when determining a building's floor size, various elements are taken into account, including the building's design, occupant classification, whether an automated sprinkler system is installed throughout the entire structure, and the amount of the building that faces a public road or open space (2018). When determining a building's total legal floor area, portions of basements are excluded if their combined size does not go above the limit for one-story above grade construction (IBC, 2018).

Table 3.11. Allowable Area Factor in Square Meter

OCCUPANCY CLASSIFICATION	NOTES	TYPE OF CONSTRUCTION (m^2)								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HY	A	B
I-1	NS	UL	5109	1765	9292	1532	929	1672	975	418
	S1	UL	20438	7060	3716	6131	3716	6689	3901	1672
	SM	UL	15329	5295	2787	4505	2787	5016	2926	1254
I-2	NS	UL	UL	1393	1021	1114	NP	1114	882	NP
	S1	UL	UL	5574	4087	4459	NP	4459	3530	NP
	SM	UL	UL	4180	3065	3344	NP	3344	2740	NP
I-3	NS	UL	UL	1393	929	975	696	1114	696	464
	S1	UL	UL	4180	3716	3901	2787	4459	2787	1858
	SM	UL	UL	4180	2787	2926	2090	3344	2090	1393
I-4	NS	UL	5620	2461	1207	2183	1207	2369	1718	836
	S1	UL	11241	9847	4830	8732	4830	9476	6874	3344
	SM	UL	16954	7385	3623	6549	3623	7107	5156	2508

Table 3.11. Allowable Area Factor in Square Meter (Continuation)

OCCUPANCY CLASSIFICATION	NOTES	TYPE OF CONSTRUCTION (m^2)								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HY	A	B
M	NS	UL	UL	1997	1161	1718	1161	1904	1300	836
	S1	UL	UL	7989	4645	6874	4645	7618	5202	3344
	SM	UL	UL	5992	3483	5156	3483	5713	3901	2508
R-1	NS	UL	UL	2229	1486	2229	1486	1904	1114	650
	S13									
	S1	UL	UL	8918	5945	8918	5945	7618	4459	2601
	SM	UL	UL	6689	4459	6689	4459	5713	3344	1950
R-2	NS	UL	UL	2229	1486	2229	1486	1904	1114	650
	S13									
	S1	UL	UL	8918	5945	8918	5945	7618	4459	2601
	SM	UL	UL	6689	4459	6689	4459	5713	3344	1950
R-3	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S13 S1									
	SM									
R-4	NS	UL	UL	2229	1486	2229	1486	1904	1114	650
	S13									
	S1	UL	UL	8918	5945	8918	5945	7618	4459	2601
	SM	UL	UL	6689	4459	6689	4459	5713	3344	1950
S-1	NS	UL	4460	2415	1625	2415	1625	2369	1300	836
	S1	UL	17837	9661	6503	9661	6503	9476	5202	3344
	SM	UL	13378	7246	4877	7246	4877	7107	3901	2508
S-2	NS	UL	7339	3623	2415	3623	2415	3576	1950	1254
	S1	UL	29357	14492	9661	14492	9661	14307	7803	5016
	SM	UL	22018	10869	7246	10869	7246	10730	5852	3716
U	NS	UL	3298	1765	789	1300	789	1672	836	510
	S1	UL	13192	7060	3158	5202	3158	6689	3344	2043
	SM	UL	9894	5295	2369	3901	2369	5016	2508	1532

According to NFPA 101, Life Safety Code (2018), the occupancy of a building or structure, or a part of a building or structure, is classified as follows;

- Assembly Occupancy: A building that is occupied by a meeting of 50 or more people for conversation, worship, enjoyment, eating, drinking, entertainment, waiting for a bus or train, or other similar activities, or used as a specific entertainment venue, irrespective of the number of people there.
- Educational Occupancy: A location where six or more persons are present for educational purposes from kindergarten through grade 12 for at least four hours each day or for at least 12 hours each week.
- Health Care Occupancy: An establishment where four or more patients are receiving medical treatment or other care at the same time on an inpatient basis. These patients typically lack the capacity to protect themselves owing to advanced age, physical or mental disabilities, or external security measures.
- Ambulatory Health Care Occupancy: An establishment that offers treatment for patients that prevents them from acting to protect themselves in an emergency without help from others, anesthesia that prevents them from acting to protect themselves in an emergency without help from others, patients who require emergency or urgent treatment because their injury or disease is severe enough to prohibit them from acting to defend themselves in an emergency while serving four or more patients simultaneously
- Detention and Correctional Occupancy: A space used to contain one or more people with varying levels of security or constraints, where the inmates are typically unable to defend themselves due to security mechanisms outside of their control.
- Residential Occupancy: A place of business that offers overnight rooms for uses other than medical, remand, or penal needs.
- Residential Board and Care Occupancy: A location where four or more individuals who are not blood or marriage relatives of the owners or operators are housed, fed, and given personal care services.
- Mercantile Occupancy: A place of business where goods are sold and displayed.
- Business Occupancy: A location that is utilized for non-mercantile commercial purposes.
- Industrial Occupancy: A place of business where goods are produced or where procedures like processing, assembling, mixing, packing, finishing, decorating, or repair are carried out.

- Storage Occupancy: A space that is occupied largely for the purpose of storing, protecting, or housing items, merchandise, products, or automobiles.
- Multiple Occupancy: A structure or building with two or more different occupancy classifications.
- Mixed Occupancy: A situation where there are several occupants sharing one space.
- Separated Occupancy: A building with several occupants where fire barriers divide the spaces.

According to "Chapter 6, Classification of Occupancy and Hazard of Contents" of the NFPA 101 (2018), where there is a dispute about the appropriate classification in a particular circumstance, the authority having jurisdiction must make a decision.

According to NFPA 101, risks of contents in a building include the relative risk of a fire starting and spreading, the risk of smoke or gases being formed, the risk of an explosion, or any other incident that might endanger the lives and safety of the structure's occupants (2018). Prior to submitting it for review and approval to the appropriate authorities, the registered design expert or owner will classify the contents' risk based on their nature and the procedures or activities carried out in the building.

When variable levels of content risk exist in various parts of a structure, the NFPA 101 (2018) states that the most hazardous contents must decide the classification unless hazardous regions are covered or separated. There are three levels of danger for every building or structure's contents: low, average, and high.

When more exits are required in addition to those already present, the additional exits must be broad enough and large enough such that even if one were to be lost, the remaining ones could still offer at least half of the required capacity (NFPA, 2018). The result of multiplying the permitted floor space for a certain use by the designated occupant load factor for that use, as shown in table 3.12, must be less than the maximum number of people that a building or a portion of a building can accommodate. Calculations must be done by applying the gross space estimate to the gross area of the portion of the facility dedicated to the purpose for which the gross area estimate is indicated as well as the total area figure to the net area of the portion of the building dedicated to the purpose for which the net area figure is indicated when both gross and net area statistics are provided for the same occupancy.

Table 3.12. Occupant Load Factor

Occupant Load Factor			
Use	m²/person	Use	m²/person
Assembly use		Shops, laboratories, vocational rooms	4.6 net
Concentrated use, without fixed seating	0.65 net	Health Care Use	
Less concentrated use, without fixed seating	1.4 net	Inpatient treatment departments	22.3
Bench-type seating	1 person/455 linear mm	Sleeping departments	11.1
Fixed seating	Use number of fixed seats	Industrial Use	
Kitchens	9.3	General and high hazard industrial	9.3
Library stack areas	9.3	Special-purpose industrials	NA
Library reading rooms	4.6 net	Mercantile Use	
Swimming pools	4.6 (water surface)	Sales area on street floor	2.8
Swimming pool decks	2.8	Sales area on two or more street floors	3.7
Exercise rooms with equipment	4.6	Sales area on floor below street floor	2.8
Stages	1.4 net	Sales area on floors above street floor	5.6
Business Use (other than below)	14	Mall structures	Per factor applicable to use of space
Concentrated business use	4.6	Residential Use	
Collaboration rooms/spaces < 41.8 m²	2.8	Hotels and dormitories	18.6
Collaboration rooms/spaces > 41.8 m²	1.4	Apartment buildings	18.6
Day-care use	3.3 net	Storage Use	
Educational use	1.9 net	In storage occupancies	NA
Classrooms	1.9 net	In mercantile occupancies	27.9
		Other storage occupancies	46.5

Escape Routes:

The IBC's "Means of Egress" Chapter 10 provides guidelines for creating the main strategy for safeguarding people in buildings by enabling quick relocating or evacuation of building inhabitants. This chapter provides a fundamental approach that combines prescriptive and

performance language to help determine a safe departure mechanism for all occupancies. It provides design standards as well as guidelines for individual components, and it covers every area of the egress system. The specifications specify the quantity, arrangement, size, and protection of components for methods of escape. Functional and operational qualities that will allow components to be used safely without specialized training and effort are provided.

The IBC (2020) address the protection of vertical openings, interior finishes, fire suppression and detection systems, among many others, as well as other sections that have an effect on life safety collaborate with the criteria for means of escape protection.

A method of escape is defined by the International Building Code (IBC) as a continuous and unimpeded access to an open roadway from any location inside a building or structure (IBC, 2020). All three elements of the means of egress system must adhere to the requirements for exit access, exit, and exit discharge in addition to the basic standards outlined in IBC.

IBC (2020), "Chapter 10: Means of Egress," states that the means of egress must have a ceiling height that is at minimum 2286 mm above the completed floor. Materials used in the means of egress must be firmly affixed to the floor and have a non-slip surface. Sloped surfaces must be utilized where the methods of egress have elevation variations of less than 305 mm. Ramps must be utilized if the slope is larger than 1/20 slopped (5% slope). The ramps must include handrails or flooring finish materials that contrast with the nearby floor finish components when the elevation difference is 152 mm or more.

The passageway for egress along a building component that is not a part of an escape route may not be blocked. With the exception of improvements allowed by the IBC, obstacles cannot be placed in the minimum width or necessary capacity of a means of egress component. During an evacuation journey, the minimum breadth or needed capacity of a means of egress system cannot be reduced. With the exception of elevators utilized as accessible means of escape, escalators, and moving decks cannot be used as part of a necessary evacuation from any other portion of the structure.

According to the 2018 edition of the NFPA 101, Life Safety Code, the corridors used as exit access and service areas with more than 30 people must be segregated from other portions

of the building by walls with a minimum fire resistance rating of one hour. As long as the occupancy classification doesn't change, existing structures are immune from this requirement.

The separating construction must be at least 1-hour fire resistant if an exit needs to be maintained apart from other areas of the structure and connects three stories or less. Unless one of the following situations happens, the separation at the exit linking four or more storeys must have a minimum 2-hour fire resistant rating.

- Existing escape stair enclosures in low-rise structures must be at least 1-hour fire resistant.
- Existing buildings must have automatic sprinkler systems installed throughout that are approved and overseen (NFPA, 2018).

In accordance with NFPA 101 (2018), the minimum 2-hour fire resistance-rated separator must be reinforced by a structure with a least 2-hour fire resistance rating made of a combination of non-combustible and limited-combustible elements. Structural components, or sections of them, must fulfill the minimum necessary fire resistance rating when supporting egress components that either enter fire resistance rated assemblies or are installed inside fire resistance rated wall assemblies.

Because the separation needs to be smooth, fire door assemblies with door closers are required. Unless one of the following requirements is satisfied, openings in exit enclosures must be restricted to door assemblies leading to heavily trafficked areas, corridors, and door assemblies for leaving the enclosure.

- Vestibules that divide typically vacant spaces from an exit enclosure are acceptable as long as they are protected from adjacent spaces by at least a smoke barrier and any necessary corridor walls and opening protectives.
- Openings in escape pathways in mall buildings.
- In Type I and Type II structures, fire protection-rated door assemblies to generally vacant building service equipment support areas are permitted, as long as the area is segregated from the escape enclosure by fire barriers.

- Existing fire protection rated door assemblies to interstitial spaces are permitted in Type I or Type II buildings as long as the area is isolated from the escape barrier, utilized only for the distribution of conduits, ducts, and pipes, and has no storage.

A continuous protected transit channel from an exit discharge must be provided by an exit enclosure. Any limitations on the usage of the exit enclosure shall not prohibit it from serving as an exit and, if designated, as an area refuge (NFPA, 2018).

According to NFPA 101, the means of escape must be built and maintained to give headroom and must be no lower than 228 cm (2018). Projections from the ceiling must provide headroom of at least 200 cm, with a tolerance of -19 mm, above finished floor, with the exception of existing structures, where the ceiling height cannot be lower than 2135 mm from the surface and projections from the ceiling must be at least 2030 mm nominal above the floor.

Any room or area must have a minimum ceiling height of 2030 mm for the remaining area and a minimum ceiling height of at least two-thirds of the total area. Headroom must be measured vertically above a plane parallel to and perpendicular to the largest front protrusion of the stair tread on stairs and stair landings, and it cannot be less than 2030 mm.

The NFPA (2018) states that walking surfaces must be leveled. A walking surface's slope cannot be more than 1 in 20 in the direction of travel. Under reasonably foreseeable circumstances, all egress-related walking materials must be non-slip. Walking surfaces can only rise or fall more than 6.3 mm suddenly. Elevation increases greater than 6.3 mm but less than 13 mm in height can be beveled with a slope of 1 in 2. Elevation changes greater than 13 mm in height must be treated as level changes and must be performed using a ramp or step.

When the height exceeds 535 mm, level changes in the means of egress must be done by an approved means of escape. Where a ramp is utilized, it must be clear where it is and where it is located on any pathways that have ramped sections. If a stair is used, the tread depth must be less than 330 mm. Each step's existence and placement must be immediately obvious. Any system or device put in place to monitor or record egress activities as well as any alarm put in place to deter inappropriate use of egress must be constructed and installed

in such a way that it cannot hinder or prohibit escape in an emergency, even in the case of failure.

In the case of a fire or other emergency, always remove any obstructions or restrictions that would prohibit full use of the exits. The exits, their entrance, egress, or sight should not be obstructed by furniture, decorations, or other things (NFPA, 2018). The means of egress cannot be divided into parts that are attached to specific rooms, flats, or other inhabited locations by fences, obstacles, or gates. If the competent authority determines that any furniture or other moveable obstructions are impeding the needed way of movement, it may order their removal as well as the erection of railings or other long-term obstacles to prevent encroachment (NFPA, 2018). Mirrors cannot in any way obstruct the exit direction on exit doors or close to any exit.

According to NFPA 101 (2018), any necessary escape capacity from a balcony or mezzanine that goes through the room below must be added to the room's required egress capacity.

To establish the breadth of the means of escape, the narrowest point of the egress component under consideration must be measured in the open. Less than 114 mm on either side, projects inside the means of egress may not have a height larger than 965 mm. If a guard includes stair and landing railings, these missiles may be at a height of 1065 mm or below (NFPA, 2018). Any egress means must be at least 915 mm wide. The width of an exit access that serves a maximum of six people and has a maximum length of 15 meters must meet both of the following requirements:

- The width cannot be less than 455 mm at or below 965 mm in height, and it cannot be less than 710 mm above 965 mm in height.
- It must be possible to offer a width without relocating permanent walls of at least 915 mm for new exit access and 710 mm for existing exit access.

According to the NFPA (2018), a single exit access cannot have a width capacity that is less than the necessary width of the exit it leads to. If there are many exits, each access path to an exit must be wide enough for the amount of people it can hold (NFPA, 2018).

Any balcony, mezzanine, storey, or portion thereof must have a minimum of two exit points. There must be at least 3 ways of exit in buildings with more than 500 but fewer than 1000 occupants, and at least 4 means of egress in buildings with more than 1000 occupants. The number of escape routes at each level must be determined using the passenger load of each story taken into account separately if the required number of ways of egress is not reduced in the direction of egress movement (NFPA, 2018).

The location of exits and how exit access is set up must be done in accordance with NFPA 101 (2018) so that exits are always easily accessible. Continuous hallways, aisles, or corridors should be kept in excellent condition and should be built such that each user may access at least two exits via alternative pathways if exits are not readily accessible from an open floor area. At least two permitted exits must provide access to exit access corridors (NFPA, 2018). Corridors should provide access to the exit without passing through any other rooms, with the exception of hallways, lobbies, and other places that may be exposed to the corridor. Open floor layouts may be accessed from hallways without needing to be rated for fire protection (NFPA, 2018).

Exits, exit entrances, and exit discharges that are required from a structure or a section of it must be strategically located and maintained separate from one another to lessen the possibility that more than one might be blocked by a single fire or other emergency. When two exits, exit entrances, or exit discharges are required, they must be positioned such that they are at least half the structure's or area's maximum overall diagonal dimension, as measured by drawing a straight line between the exits' closest edges (NFPA, 2018). The minimum separation distance between two exits, exit accesses, or exit discharges in buildings that are entirely protected by an approved supervised automatic sprinkler system cannot be less than one-third the length of the maximum overall diagonal dimension of the building or area to be serviced. A building must have at least two exits, exit entrances, or exit discharges that are intended to meet the minimum separation distance criteria (NFPA, 2018).

Exit access from adjacent or separating rooms or locations may be permitted if they are accessories to the area being served. Foyers, lobbies, and reception areas built to accommodate corridors cannot be considered intermediary spaces. Kitchens, storage rooms, bathrooms, closets, bedrooms, or other comparable areas, or other rooms or locations

susceptible to locking, cannot be used as an exit (NFPA, 2018). Design and placement of escape doors and access must make them easy to identify. Drapes or hangings cannot be positioned over exit doors or in a way that hides or blocks any exit (NFPA, 2018).

NFPA 101 (2018) states that any outside balcony, porch, gallery, or roof that complies with the standards may be used for escape access. The balcony, porch, gallery, or other similar area's long side must be at least 50% open and constructed in a way that discourages smoke buildup. Similar to how it is required for corridors, external exit access balconies must be kept separate from the interior of the building by walls and opening protectives, unless they are provided with at least two remote stairways that can be accessed without any occupants passing through an unprotected opening to approach one of the stairs, or unless dead ends on the outer exit access do not exceed 6100 mm. There should be no dead ends in the outside exit access.

The NFPA (2018) states that the following rules must be used when measuring the trip distance to an exit on the ground or another walking surface:

- Starting from the furthest location susceptible to occupation, along the midline of the natural course of travel,
- With a 305 mm clearance from any obstacles or impediments, curve around them.
- Ending in the middle of the doorway or another starting place for the escape.

The travel distance must be calculated from the furthest point subject to occupancy to the leading nosing of the stair landing at the in-question floor level when outside stairs that are not separated from the building are allowed as necessary escapes. When open stairways or ramps are permitted to be used as a route to reach exits, the distance must also take into consideration how long it will take to use the stairway or ramp and how long it will take to go from the end of the stairway or ramp to an outer door or other exit. If any portion of an outside exit is situated less than 3050 mm from any exposed building entrance, as is authorized for outdoor staircases, the travel distance to the exit shall take into consideration the distance to the finished ground level. Measurements must be made in the plane of the tread nosing if stairs are involved (NFPA, 2018).

Exits must come to an immediate end at either an outside exit discharge or a public route. Yards, courts, open spaces, or other areas of the exit discharges must have the proper width and size so that all occupants may access a public route securely (NFPA, 2018). Exits may be allowed to discharge into internal building areas if the following requirements are met;

- It is not permitted for any level of discharge to have more than 50% of the required capacity and more than 50% of the requisite number of exit stairs for generally occupied areas on each floor.
- Each level of discharge should either discharge to the completed ground level or shall discharge to the finished ground level and offer access to the finished ground level via ramps or steps to the finished ground level.
- The internal exit discharge must be clearly marked by exit signs and have an open, unimpeded path from the point of discharge to the building's outside.
- A fire barrier with a fire resistance rating that fulfills the criteria for the enclosure of exits must be placed between the level of discharge or the component of the level discharge used for internal exit discharge and the non-sprinklered part of the floor in order to protect it.
- The interior exit discharge area should be located in a vestibule or foyer. If the building cannot be deeper than 3050 mm or longer than 9.1 m from the building's exterior, fire barriers with a minimum 1-hour fire resistance rating are required to separate the foyer from the rest of the level of discharge; however, wired glass in steel frames that are currently in place may still be used.
- When a level of discharge is protected, levels below that level in an atrium may be allowed to be open to that level;
- The whole area on the level of discharge must be enclosed in construction that has a fire resistance rating at least equivalent to that required for the exit enclosure in order to keep it separate from the areas below.

When approved by the authority with jurisdiction, escape routes can be authorized to dispense to rooftops, other parts of buildings, or an adjacent building if the roof/ceiling elements framework has a rating for fire resistance not less than that necessary for the exit enclosure and there is a continuous and safe means of egress from the roof available (NFPA, 2018).

Fire Safety Halls:

In order to create a system that satisfies the concept of a smokeproof enclosure, a suitable design methodology must be applied, according to NFPA 101 (2018). The stair enclosure can be pressurized and given natural ventilation, allowing for the construction of the smokeproof enclosure. A smokeproof enclosure's barriers must be able to survive a fire for two hours from its highest point to the level of the exit discharge.

Any vestibule that is used needs to be housed inside a two-hour certified smokeproof enclosure. When the component of the stairs below is separated from the stairway enclosure at the level of exit discharge by barriers having a 1-hour fire resistance rating, it is not possible to expect a smokeproof enclosure made up of an enclosed stair servicing levels below the level of exit discharge to comply (NFPA, 2018).

NFPA 101 (2018) states that if a vestibule is present, the entrance leading into it needs to have a fire door assembly that is authorized and has a least 1.5-hour fire protection rating. A minimum 20-minute fire protection rating is required for the fire door assembly that connects the vestibule to the smokeproof enclosure. A smoke detector must be activated within 3050 mm of the vestibule door opening in order for the door leaves to close automatically or self-closing.

Vestibules must be at least 1120 mm wide and 1830 mm in the direction of travel. The ceiling of the vestibule should not be higher than 510 mm above the vestibule entry so as to operate as a smoke and heat trap and to produce an upward-moving air column. If the engineering design and field tests permit it, the height may be lowered.

According to NFPA, every smokeproof enclosure must exhaust smoke onto a public way, an evacuation corridor, or a yard or court with easy access to a public way (2018). These escape routes may not have any openings other than the door leading to the outside yard, court, or public way and the entrance to the smokeproof enclosure. The escape path and the remainder of the building must be separated by a 2-hour fire resistance rating. The smokeproof enclosure may be permitted to discharge into interior building spaces if all of the following criteria are met:

- The discharge from the smokeproof enclosure must go to an outside exit that is freely accessible and easily recognizable from the discharge from the smokeproof enclosure.
- An approved, closely-monitored automatic sprinkler system must be installed across the whole structure.
- No more than 50% of the required number and capacity of smokeproof enclosures may be discharged through interior building areas.

An outdoor balcony or a vestibule must be used to enter the smokeproof enclosure (NFPA, 2018).

A minimum of one additional exit and a maximum of 50% of the required number and capacity of non-horizontal exits must be included in every fire compartment that qualifies for credit in conjunction with a horizontal exit. Any fire compartment that doesn't have an outside escape has to be handled like a portion of the adjacent compartment that does. Every horizontal exit allowed must be set up so that there are always open routes of transit connecting either side of the exit to stairwells or other exits that reach outside the structure. A horizontal exit's doors must be unlocked from the egress side if either side is occupied. At least 0.28 m2 of free floor space must be provided for each person on the floor area on either side of a horizontal exit in order for both floor areas to accommodate their occupants (NFPA, 2018).

Fire barriers must fulfill the following standards in order to be used to separate buildings or locations with horizontal exits: (1) they must have a minimum 2-hour fire resistance rating; and (2) they must offer a continuous separation to the finished ground level.

To reduce air leakage, door leaves in horizontal exits must be built and configured properly. Other than authorized existing door assemblies, all fire door assemblies in horizontal exits must close automatically or self-closing (NFPA, 2018).

Vertical Fire Escape

New stairs must follow the table below in compliance with the NFPA 101 (2018). Existing stairs may be kept in use as long as they satisfy the requirements listed in table 3.14 for

existing stairs. Steps that are close to areas where industrial equipment can be accessed are exempt from the standards for both new and old staircases.

Table 3.13. Dimensional Criteria for New Stairs

Dimensional Criteria	
Feature	mm
minimum width	varies
maximum height of risers	180
minimum height of risers	100
minimum tread depth	200
minimum headroom	2030
maximum height between landings	3660
landing	varies

Table 3.14. Dimensional Criteria for Existing Stairs

Dimensional Criteria	
Feature	mm
minimum width clear of all obstructions, except projections not more than 114 mm at or below handrail height on each side	915
maximum height of risers	205
minimum tread depth	230
minimum headroom	2030
maximum height between landings	3660
landing	varies

The minimum stair width is 915 mm, clear of all impediments, with the exception of projections no higher than 114 mm at or below railing height on each side, if the total occupant load of all the levels served by the stair is less than 50. (NFPA, 2018). Steps used by more than 50 persons must have a minimum width that complies with Table 3.13. This includes projections on each side of the staircase that are no wider than 114 mm at railing height or less.

According to NFPA 101 (2018), while assessing the stair width for downhill egress travel, the total number of individuals from levels above the level where the width is examined must be taken into consideration. When calculating the stair width for upward egress travel, the number of individuals from levels under the level where the width is anticipated must be taken into consideration. Doors must have a minimum clear width of 1420 mm to exit stairways (NFPA, 2018).

If the tread depth is at least 280 mm at a point 305 mm from the tread's narrowest end and the lowest radius is at least twice the stair width, curved staircases may be used as a part of an escape route. Existing curved stairs may be used as a part of an escape route as long as the lowest radius is at least twice as wide as the stairway and the tread depth is at least 255 millimeters at a location 305 millimeters from the tread's narrower end (NFPA, 2018).

Each stair acting as a necessary route of egress must be a fixed, permanent structure. Each stair, platform, and landing must adhere to the NFPA's Type I or Type II construction requirements and must be composed completely of non-combustible material, with the exception of railings and pre-existing stairs.

The width of the stairs and intermediate landings cannot narrow as they ascend or descend. When measured in the direction of travel, every landing in new construction must have a size that is at least as broad as the stairs. Landings do not need to extend more than 1220 mm in the direction of travel if the stair is straight (NFPA, 2018).

The landings and stair steps must be sturdy and without any holes. The treads and landings of the stairs must be free of any protrusions or lips that might trip stair users. Within a single stairway, surface traction must be constant on both stair treads and landings. When new stair risers are not vertical, they can slope under the tread at an inclination of no more than 30 degrees as long as the nosing sticks out no more than 38 mm (NFPA, 2018). The maximum tread and landing slope is 21 mm/m (a slope of 1 in 48).

The vertical distance between the tread nosings should be used to determine the riser height, per NFPA 101. (2018). The depth of a tread must be gauged between the vertical planes of the tread's initial projection of succeeding treads, horizontally, and at a right angle to the tread's leading edge. Slopes higher than 20 degrees, however, are not permitted on surfaces

with bevels or circular treads (a slope of 1 in 2.75). The horizontal dimensions of such beveling or rounding at tread nosings should not exceed 13 mm (NFPA, 2018).

Ramps and staircases must have handrails on both sides. For both new and existing staircases, handrails must be installed within 760 mm of all necessary escape widths, and within 1120 mm of all required egress widths for existing stairs.

When installing new intermediate railings, there must be 510 mm of open space between each handrail. The route's natural flow must provide the required egress width. A railing is not necessary if the curb separating a sidewalk from a motorway has a single step or a ramp (NFPA, 2018).

Existing ramps, stairs, steps inside apartments and guest rooms, must all have railings on just one side. Guards and handrails must be installed on each flight of steps. At landings on stair turns, handrails must continue from one level to the next. Guards, handrails, and the hardware used to attach them to guards, balusters, or walls must not have any projections that might grab on loose clothing. Guard holes must be designed such that slack clothing cannot jam in. The leading edge of the stair treads must be at a right angle to at least one handrail on conventional stairs (NFPA, 2018).

The leading edge of the tread must be measured vertically from the top of the rail to the handrail, which must be 865 mm or higher above the tread surface, in accordance with the NFPA 101 (2018). Furthermore, when measured vertically from the leading edge of the tread to the top of the rail, handrails connected to a guard may, when necessary, climb above 965 mm but not above 1065 mm. Existing necessary handrails shall rise up to a maximum height of 965 mm, or at least 760 mm, above the tread (NFPA, 2018).

New handrails must be built with a minimum distance of 57 mm between them and the wall on which they are fixed. One of the following elements must be present on handrails:

- A sphere having a 32-to-51-millimeter outer diameter and a circular cross section.
- A non-circular shape with a perimeter of at least 100 mm and a maximum cross-sectional dimension of 57 mm, provided the edges that may be grasped have a radius of at least 3.2 mm.

The full length of new handrails must be constantly graspable. If both of the following conditions are satisfied, handrail brackets or balusters affixed to the bottom surface of the railing are not regarded as obstructions to grip ability.

- Within 38 mm of the handrail's bottom, they do not extend horizontally over its side. Additionally, for every additional 13 mm in handrail perimeter size above 100 mm, the vertical clearance dimension of 38 mm is decreased by 3.2 mm.
- They have edges with radiuses that are at least 0.25 mm in diameter.

New handrail ends must either be terminated at posts or returned to the wall or floor.

New handrails that are not continuous across flights in buildings other than residential units should continue to slope downward for at least one tread beyond the bottom riser and shall extend horizontally at the appropriate height for at least 305 mm beyond the top riser (NFPA, 2018). The top and bottom risers must be exactly above the handrails in residential buildings, and the handrails themselves must be installed to be at least as high as those locations.

Guardrails must not be higher than 1065 mm, unless one of the following circumstances applies: Existing guards throughout residential properties may be no shorter than 915 mm high and existing guards on existing staircases may not be higher than 760 mm.

In addition, the following requirements must be met:

- The riser, tread, and bottom portion of the guardrail on the open side of a stair must be large enough to block passage of a 150 mm diameter sphere through the triangular opening.
- All open guards, other than those for which approval has already been granted, should be provided with intermediate rails or with an ornamental arrangement preventing the passage of a sphere of 100 mm diameter through any of them.

Any interior staircase used as a means of escape or as a part of an exit should be enclosed. Only then may an exit be enclosed on the story of exit discharge if a two-story exit enclosure connects it with an adjacent story in an existing building, provided that at least half of the number and capacity of exits on that story are independent of such enclosures (NFPA, 2018).

According to NFPA 101 (2018), facility enclosure walls within 3050 mm horizontally of nonrated walls or unprotected openings shall be constructed as required for stairway enclosures, including opening protectives, when the exterior of a stairway, other than an existing stairway, is enclosed by nonrated walls or unprotected openings and the walls or openings are exposed by other parts of the building at an angle of less than 180 degrees. Construction must climb vertically from finished ground level to 3050 mm above top stair landing, or if it is lower, to roofline (NFPA, 2018). When openings have a minimum fire protection value of 3/4 hours, the separation that extends 3050 mm from the stairs must have a fire resistance rating of no more than one hour. Any usage of the open area inside the exit enclosure must not have the potential to obstruct egress (NFPA, 2018).

Enclosed stairs serving multiple stories must comply with the followings;

- Each floor landing on the stairs must have specific signs inside the enclosure that identifies the floor level.
- The top and bottom of the stair enclosure must be identified by signs.
- The identity of the stair enclosure must be stated on the signs.
- The signs must be placed inside the stair enclosure and must specify the floor level and exit discharge direction.
- The top of the signage cannot be more than 2135 mm higher than the bottom of the signage, which must be at least 1220 mm above the floor landing.
- The signage must be stenciled or painted on the wall, or it must be on a separate sign securely affixed to the wall.
- The stairway identification must be shown at the top of the sign in no less than 25 mm high writing.
- Stairways that do not allow for roof access must be labeled with "NO ROOF ACCESS."
- Floor level numerals must be at least 125 mm high and placed below the stairway identification. Mezzanine levels must start with the letter "M," whereas basement levels must start with the letter "B" or another approved identifying letter.
- The sign must display the lower and higher termini of the stairs in 25 mm-high letters or digits.

At each floor level landing, there must be appropriate signage with directional directions if ascending an enclosed stair is necessary to reach the level of exit discharge (NFPA, 2018).

With the consent of the governing body, outdoor stairs can be permitted to lead to rooftops of other parts of the building or an adjacent building if the building is fire resistant and there is a continuous and safe method to escape from the roof. Construction of outdoor steps must be done without including any features that would make them unsafe for people who are terrified of heights. Except for previously allowed existing steps, outside stairs higher than 11 m above completed ground level must have an opaque visible impediment that is at least 1220 mm high (NFPA, 2018).

Outside staircases must be isolated from the inside of the structure, under NFPA 101 (2018), by construction that meets the standards for fire resistance for enclosed stairs with fixed or self-closing opening protectives, with the exception of the following:

- An outdoor stair leading to a balcony with an exterior exit and two separate exterior ramps may be left unsecured.
- Existing outdoor stairs that service three or fewer neighboring stories, including the story where the exit discharges, can be left uncovered when a second exit is located far away.
- Outside steps in buildings that are already in use and fully protected by automatic sprinklers that have been approved and are under supervision may be left unprotected.

The following requirements for ramp construction are outlined in NFPA 101 (2018):

- All ramps that serve as required means of escape must be made of fixed, permanent constructions.
- The ramp floor and landings must be solid and free of holes, and ramps made of fire-retardant-treated wood aren't allowed to be taller than 760 mm, have an area larger than 277 m2, or take up more than 50% of the space in a room.

Landings are required at the top, bottom, and the door exits that open onto the ramp. No steeper than 1 in 48 can be applied to the landing's slope. Every landing needs to be at least as wide as the ramp (NFPA, 2018).

Table 3.15. Dimension for New Ramps

Dimensions of New Ramps	
Feature	Dimensional Criteria
Minimum width clear of all obstruction	1120 mm
Maximum slope	1 in 12
Maximum cross slope	1 in 48
Maximum rise for a single ramp run	760 mm

Every landing must be longer than 1525 mm in the travel direction. The only time the direction of travel may be adjusted is during landings. The width of ramps and intermediate landings must remain constant in the direction of egress movement (NFPA, 2018). Curbs, walls, railings, or other protruding structures are required on ramps and landings with drop-offs to stop people from wandering down the edge of the ramp. The height of a curb or barrier cannot be less than 100mm (NFPA, 2018).

Outside ramps should be designed to remove any obstacles that would prevent those with a fear of heights from using them. Outside ramps must have an opaque sight blockage that is more than 11 m above the finished ground level and at least 1220 mm height (NFPA, 2018). It is necessary to build outside landings and ramps to lessen the quantity of water that gathers on them.

A separate escape path needs to be created from other areas of the structure, per NFPA 101 (2018). A building that has an authorized, monitored automatic sprinkler system installed throughout can have a fire window put in the partition. A stair enclosure must also meet the minimal fire safety standards for a discharge escape route from it. Unless the exit route additionally serves residents on other levels in addition to residents on the level of exit discharge, the width of an exit passageway should be proportioned to meet the full necessary capacity of all exits that discharge via it (NFPA, 2018). Any exit corridor that an exit stair discharges into or that acts as a horizontal transfer within an exit stair system must have a minimum width that is at least two thirds the width of the exit stair while it is being built. The surface must be firm and impenetrable (NFPA, 2018).

It is possible to use straight-run fire escape stairs with a platform that continues in the same direction or return-platform fire escape stairs with overlapping runs. Either kind may be built independently of buildings and connected by walkways, parallel to buildings, at right angles to buildings, or any combination of these. The least amount of window and door openings are permitted around fire escape stairs, and each opening must be secured by an authorized fire door or fire window assembly if it is situated in the following locations:

- Horizontally, 4570 mm or less from any platform, balcony, or staircase that is a part of the fire escape stair.
- Within two storeys or 7320 mm of any platform or walkway connecting any level to the fire escape stair, or within three stories or 11 m of any balcony, platform, walkway, or staircase that is a part of the fire escape stair.
- Within 3050 millimeters (measured vertically) of any balcony, platform, or walkway up above; or within 3050 millimeters (measured vertically) of any stair tread surface.
- When a court is served by a fire escape stair, the court's smallest dimension cannot be greater than one-third of the height of the fire escape stair's highest platform, measured from the finished ground level.
- When facing a fire escape stair that serves an alcove, the alcove's width or depth must not be greater than one-third or one-fourth of the stairway's height to the uppermost platform, as measured from the finished ground level.

A fire escape stair cannot be lower than 205 mm from the floor or higher than 455 mm from a windowsill, and it must be immediately accessible from a balcony, landing, or platform (NFPA, 2018). Stairs for fire escapes must adhere to Table 3.16. Building fire escape stairs requires the use of non-combustible materials.

When using windows to access a fire escape stair, the windows must be set up and kept in a way that makes it simple to open. Storm windows with screens that prevent easy access to the fire escape stairway are not allowed (NFPA, 2018). In any circumstance where the roof is useable or offers a spot for safe shelter, fire escape stairs must reach the roof.

Table 3.16. Fire Escape Stair Dimensions

Fire Escape Stairs		
Feature	Serving More Than 10 Occupants	Serving 10 or Fewer Occupants
Minimum widths	560 mm clear between rails	455 mm clear between rails
Minimum horizontal dimensions of any landing or platform	560 mm clear	455 mm clear
Maximum riser height	230 mm	305 mm
Minimum tread, exclusive of nosing	230 mm	150 mm
Minimum nosing or projection	25 mm	No requirement
Tread construction	Flat metal bars on edge or square bars secured against turning, spaced 32 mm maximum on centers	Flat metal bars on edge or square bars secured against turning, spaced 32 mm maximum on centers
Winders	None	Permitted subject capacity penalty
Risers	None	No requirement
Spiral	None	Permitted subject capacity penalty
Maximum height between landings	3660 mm	No requirement
Minimum headroom	2030 mm	2030 mm
Access to escape	Door or casement windows 610 mm x 1980 mm; or double hung windows, 760 mm x 915 mm clear opening	Windows providing a clear opening at least 510 mm in width, 610 mm in height and 0.53 m² in area
Level of access opening	Not over 305 mm above floor; steps if higher	Not over 305 mm above floor; steps if higher
Discharge to the finished ground level	Swinging stair section permitted if approved by authority having jurisdiction	Swinging stair, or ladder if approved by authority having jurisdiction
Capacity	13 mm per person, if access by door; 25 mm per person, if access by climbing over windowsill	10 people; if winders or ladder from bottom balcony, 5 people; if both, 1 person

According to NFPA 101 (2018), the maximum capacity of the emergency exits for any story, balcony, tier, or other occupied space must be adequate for the occupant load present, unless the authority with jurisdiction may allow to define the occupant load as the number of people for whom established means of escape routes are adequate, provided that precautions are

taken to prevent occupancy by a larger number of people, or the egress capacity has previously been established.

Egress Doors:

NFPA (2018) states that every door opening and every main entry that must function as an exit must be planned and built with a clear and straight path of egress in mind. Windows that may be mistaken for door openings due to their physical structure, design, or the materials used in their construction should be out of reach for occupants by obstacles or railings (NFPA, 2018).

The following measurements for door assemblies' clear width are required by the NFPA 101 (2018):

- The measurement must be made between the face of the door leaf and the stop of the frame, which is where the door opening is the narrowest.
- Swinging door assemblies need to have the door leaf open 90 degrees in order to be measured.
- For any existing door assembly, the measurement must be performed with the door entirely open.
- As long as they are positioned between 865 and 1220 mm above the floor and are designed to house panic hardware or fire exit hardware, projections of no more than 100 mm into the door opening width on the hinge side are not considered to reduce clear width.
- Projections that rise more than 2030 mm above the ground are not regarded as reducing clear width.

Door openings in means of egress must be less than 81 cm in clear width, excluding any of the following circumstances;

- When two door leaves are offered, each door leaf shall offer an aperture with a minimum clear width of 810 mm.
- Exit access door assemblies serving rooms under 6.5 m2 that are exempt from the need to be accessible to individuals with severe mobility impairments must have a door leaf width of less than 61 cm.

- For openings serving structures or areas of structures that are not required to be accessible to individuals with severe mobility limitations, door leaf widths of 710 mm are permitted.
- The width of an existing door leaf in an existing building cannot be less than 710 mm.
- When just one door assembly is used to depart a staircase that must be at least 1420 mm wide, the clear width of the door opening cannot be less than two-thirds the minimum width of the steps (NFPA, 2018).

According to NFPA, the level of the floor surfaces along each side of a door opening cannot differ by more than 13 mm (2018). The height of the floor surface must be maintained on both sides of the door apertures for a distance that is at least 915 mm and at least as wide as the broadest leaf in installations other than those that are already in place. Door aperture thresholds must be higher than 13 mm. Raised thresholds and floor level adjustments more than 6.3 mm must have beveled surfaces with a slope of no more than 1 in 2. (NFPA, 2018).

If the door opening discharges to the exterior, an outdoor balcony, or an outside exit access, the floor level outside the door opening may be one step lower than the interior level in existing structures, but it may not be higher than 205 mm (NFPA, 2018). An existing door assembly at the top of a stair can open directly at the stair if the door leaf does not swing over the stair and the door opening serves an area with less than 50 persons. For serving seldom used portions, the floor level may be lower than the door opening, but not by more than 205 mm.

Side-hinged or pivoted-swinging door leaves must swing in the direction of egress travel when serving a space with an occupant load of 50 or more, unless the door opening serves a single dwelling unit that opens straight into an escape enclosure or a high-hazard contents area.

Unless the door opening offers access to a stair in an existing building, any door leaf in a means of egress cannot be less than half the minimum width of an aisle, a corridor, a passageway, or a landing unobstructed throughout its span (NFPA, 2018). A door leaf in a means of egress may not stretch fully open over the necessary width of an aisle, a corridor, a tunnel, or a landing if it does not contain a certified self-closing mechanism. Surface-mounted latch release hardware has to be installed on the door leaf, however the maximum 180 mm projection restriction needs to be relaxed.

The pressures necessary to physically open each door leaf in an escape route must not be greater than 67 N to release the latch, 133 N to begin the leaf moving, and 67 N to open the leaf to the lowest allowable width, according to NFPA 101 (2018).

When the building is inhabited, door leaves must be set up so they may be easily opened from the egress side. If locks are present, opening them from the egress side must not require a key, a tool, specialized knowledge, or additional effort (NFPA, 2018). The egress side of external door assemblies may have key-operated locks if all of the following conditions are met.

- There must be a clearly visible, sturdy notification on or near the door leaf that says "THIS DOOR TO REMAIN UNLOCKED WHEN THE BUILDING IS OCCUPIED" in letters no less than 25 mm high on a contrasting background.
- The locking mechanism is of a kind that may easily be identified as locked.
- When the building is locked, anyone within has quick access to a key.

If the equipment for the escape routes occupant release of the electronic lock is attached to the door leaf, if it has an apparent operation procedure and is simple to operate in the path of egress under all illumination conditions, if it can be controlled with one hand in the manner of escape routes, or if any mixture of these circumstances hold true, then door assemblies in the escape route may be permitted to be fitted with approved electrical locking systems (NFPA, 2018).

When a building's fire alarm system is activated, each stair enclosure door assembly with more than four stories must either prohibit re-entry from the stair enclosure or have an automatic release that unlocks all stair enclosure door assemblies to permit re-entry (NFPA, 2018).

NFPA 101 (2018) states that as long as all of the following requirements are satisfied, door assemblies on stair enclosures may be built with hardware that forbids re-entry into the building's interior.

- The distance between storeys where it is possible to leave the stair cage and reach another exit cannot be greater than four stories;

- Where this is practicable, there must be no more than two levels separating the tales.
- The stair enclosure's top level or adjacent-to-top story must allow re-entry and offer access to an alternative exit.
- Door assemblies allowing re-entry must include signs indicating their use on the stair side of the door leaf.
- On the stair side of door assemblies that do not permit re-entry, there must be a sign indicating the closest door opening that does, in either direction of travel.

The building's roof door assembly must be maintained closed or open if a stair enclosure provides access to the roof (NFPA, 2018). Every latch or other fastening device on a door leaf should have a release mechanism that is simple to use and clearly visible in all lighting circumstances. Any latch's release mechanism must be placed between 865 and 1220 millimeters above the completed floor, but not below. Existing security measures cannot be installed higher than 1525 mm above the completed floor, excluding automated latching systems (NFPA, 2018).

Residential occupancies may place items on the egress door assemblies from individual dwelling units and guest rooms as long as they can be controlled from the inside without the need for a key or other instrument and are mounted at a height of no more than 1220 mm above the completed floor (NFPA, 2018). Existing security devices must be mounted no higher than 1525 mm above the completed floor and may have two additional releasing actions.

Devices that obstruct or are designed to limit the free use of the leaf for escape cannot be coupled with any door assembly that requires panic hardware or fire exit hardware (NFPA, 2018).

According to NFPA (2018), each door leaf in a pair that is required for a mode of egress must include a releasing device that is independent of which leaf releases first. If the door leaf fitted with the automated flush bolts lacks a doorknob or surface-mounted hardware on the egress side of the door and unlatching of any leaf does not take more than one action, approved automatic flush bolts may be utilized and configured (NFPA, 2018).

On door assemblies serving low- and average-hazard contents in buildings with an approved, monitored automated fire detection system or a sprinkler system throughout, approved delayed-egress electrical locking systems may be installed.

When installing panic or fire escape hardware on a side-hinged or pivoted-swinging door assembly, the following standards must be met, according to the NFPA 101 (2018):

- It must have a push pad or cross bar as its main component, with the push pad or cross bar's actuation portion's length being at least half as long as the door leaf.
- It must be mounted 865 to 1220 millimeters above the completed floor.
- A horizontal force of no more than 66N must be used to activate the cross bar, push pad, and latches.

Revolving door assemblies must adhere to the following requirements, whether or not they are employed as a method of egress;

- Unless they are already-existing spinning doors that have been granted approval by the authority with jurisdiction, revolving door wings must be able to book-fold or breakout for egress.
- Unless they are permitted by existing revolving door assemblies, the parallel egress pathways created when spinning door wings are compressed into the book-fold position must have an aggregate width of 915 mm.
- It is forbidden to utilize revolving door assemblies within 3050 mm of the bottom or top of escalators or steps.
- Between escalators or stairs and the revolving door assembly, there must be a dispersion space that is acceptable to the authority with jurisdiction.
- Within 3050 mm of each rotating door assembly, there must be a side-hinged swinging door assembly that adheres to the same wall.

If each of the following requirements is satisfied, revolving door assemblies may be used as an escape route:

- Revolving door openings are only eligible for up to 50% of the necessary egress capacity.
- A rotating door assembly must be given an egress capacity based on the clear opening width provided when folded into a book-fold position if the diameter is at least 2745. Each spinning door opening cannot be credited with a capacity of more than 50 people.

- The rotating door wings must be able to fold like a book when a force of no more than 580 N is applied to them within 75 mm of the outer edge.

Revolving door assemblies that aren't utilized for egress must be subjected to a collapse force of no more than 800 N at a point 1015 mm above the floor and 75 mm from the outer edge of the outer wing stile (NFPA, 2018).

Turnstiles or similar devices that limit traffic to one direction or are used to collect tolls or entry fees are not allowed to be installed in a fashion that prevents any necessary means of exit, according to NFPA 101. (2018). Upon approval by the relevant authorities, each turnstile must be credited with a capacity of 50 persons, provided that it complies with all of the conditions set out below;

- After being manually freed by a nearby worker, they freewheel in the direction of egress movement. They also freewheel when the primary power is switched off.
- They are only granted credit for up to 50% of the necessary egress width.
- Its height cannot exceed 990 mm, and their clear width must be less than 420 mm.

If all of the following conditions are satisfied, security access turnstiles that physically restrict movement in the direction of egress may be permitted to be classified as a component of means of exit:

- The building is totally guarded by an approved, monitored automatic sprinkler system, and each security entry turnstile lane arrangement has a minimum clear passage width of 560 mm.
- Every security access turnstile lane design with a clear route width of less than 810 mm must have an egress capacity of 50 individuals.
- Any security access turnstile lane configuration with a clear width of 810 mm or more can have its egress capacity estimated.
- Each secured physical barrier should automatically retract or swing to an unobstructed open posture in the direction of egress in each of the following situations: The physical barrier remains in the open position until it is manually reset when a fire-protective signaling system is activated if a power loss occurs in the turnstile or any other component of the access control system that secures the physical barrier and withstands activation by

a generally accessible and well-indicated manual release device for at least 30 seconds after remaining in the open position.

Turnstiles with a height more than 990 mm must adhere to the specifications for revolving door assemblies. Turnstiles must have a minimum clear width of 560 mm at heights above 990 mm and 420 mm at heights below 990 mm whether they are within or giving access to essential exits (NFPA, 2018).

If all of the following criteria are satisfied, special-purpose horizontally sliding accordion or folding door assemblies may be used as a method of egress:

- The door leaf may be easily opened and closed from either side without the need for specific skills or effort.
- To open the door leaf, a force of no more than 67 N must be exerted in the direction of egress to the working device.
- The force necessary to open or close the door leaf in the direction of travel must not be more than 67 N, and it must not be more than 133 N to start the leaf moving.
- If the door opening is a special purpose horizontally sliding accordion or folding exit access door assembly serving a space with less than fifty inhabitants, the door leaf can only be opened with a force of 222 N when a force of 1100 N is applied perpendicularly to the leaf next to the operating device.
- If necessary, the door assembly conforms with the fire protection rating and, when rated, is self-closing or automatically closes using.

Lighting and Marking:

NFPA 101 states that when contrasting markings are applied to stairs, they must include a continuous strip as a coating on, or as a material integral with, the whole width of each tread or landing nosing (2018). A horizontal measurement taken from the leading vertical edge of the nosing can be used to calculate the width of the marking strip that must be present on every nosing. The marking strip's width must be between 255 and 51 mm (NFPA, 2018). If new contrast marking is supplied for stairway handrails, it must be applied to, or include, at least the top surface of each handrail and extend the whole length of each handrail. It has a

13 mm minimum width. Where railings or handrail extensions bend or round corners, there must be a gap in the stripe of no more than 100 mm (NFPA, 2018).

The exit stair treads must be painted on, coated with, or made of a marking stripe whose material matches that of the step nosing. The marking stripe must be installed at the leading edge of the step and extend over its whole width. The marking stripe must also comply with the following requirements:

- The marking stripe can't be more than 13 mm from each step's leading edge and can't go over the step's vertical face by more than 13 mm.
- The marking stripe's horizontal width must be at least 25 mm and no more than 51 mm.
- It is not acceptable to apply marking stripes to the surface using adhesive-backed tapes.
- Every step along the exit enclosure must have a marking stripe that is the same size and position throughout.

A robust, continuous marking stripe must be applied to all handrails and railing extensions. The marking stripe must be applied to the top surface of the handrail or made of a material that is integrated with the handrail's top surface, and it must span the whole length of the handrail, including extensions (NFPA, 2018). Where railings or handrail extensions bend or curve corners, there may be a gap in the marking stipe of no more than 100 mm. The requirement that the marking stripe have a minimum horizontal width of 25 mm does not apply to highlighting stripes. On each handrail in the exit enclosure, the marking stipe's dimensions and location must be same and constant (NFPA, 2018).

A solid and continuous perimeter demarcation marking stripe on the floor, the walls, or a combination of the two is required for stair landings, escape corridors, and other floor surfaces inside the exit enclosure, according to NFPA 101 (2018). The marking stripe's horizontal width must be at least 25 mm and no more than 51 mm, with interruptions no longer than 100 mm apart (NFPA, 2018). The exit enclosure must have perimeter demarcation markings that are the same size and placed consistently throughout. It is prohibited to employ surface-applied marking stripes made of adhesive-backed tapes (NFPA, 2018).

The marks on the leading edge of landings must be within 51 millimeters of the perimeter floor demarcation lines, which must be installed within 100 millimeters of the wall. They must proceed via all doors' floors. They are not permitted to extend in front of exit doors that passengers must pass through to complete the egress path, such as those that lead out of an escape enclosure (NFPA, 2018). The bottom border of the demarcation line for perimeter walls should be no higher than 100 mm above the completed floor when positioned on the wall. They must descend vertically to the floor within 51 mm of the edge of the step or landing at either the top or bottom of the steps. There is no realistic way to represent the journey other than by drawing a line on the ground as they must vertically drop to the floor before rising above it (NFPA, 2018). The wall line must either continue over a door's face or change to the floor and cross it in front of the door when a door interrupts it.

The demarcation of a perimeter wall should not extend in front of escape enclosure doors via which an occupant shall complete the egress path. In cases where a wall-mounted demarcation line changes to a floor-mounted demarcation line or vice versa, the wall-mounted demarcation line should descend vertically to the floor to meet a commensurate extension of the floor-mounted demarcation line, resulting in a continuous marking (NFPA, 2018).

In order to identify barriers in the escape enclosure that are at or below 1980 mm in height and that protrude more than 100 mm into the egress channel, at least 25 mm broad markers made of equal bands of black and bright material must be utilized. The alternate bands must likewise be 51 mm wide, 45 degrees angled, and have a maximum width.

According to NFPA 101, all doors servicing the escape enclosure that swing out from the enclosure in the direction of egress movement must be displayed with the emergency exit emblem with a bright backdrop (2018). The height of the emergency escape sign, which must be horizontally centered on the door and no higher than 455 mm above the completed floor at its highest point, must be at least 100 mm (NFPA, 2018).

Except for primary external exit doors which are clearly visible as exits, all other exits should be marked with an authorized sign which shall be clearly visible from all exit access directions. When the continuation of the egress path is not evident, the horizontal portions

of the egress path within an exit enclosure must be designated by authorized exit or directed departure signs. The following requirements must be fulfilled for tactile signs:

- Tactile signage must be installed at each exit door that needs one.
- "EXIT" must be visible on tactile signs.

Access to an exit or path therefrom must be indicated by suitable, conspicuously placed signs where it is not immediately evident to the occupants. No location in an exit access corridor may be farther from the nearest sign than the rated viewing distance or 30 meters, whichever is less, when installing new signs. Every sign that is necessary must be placed in a prominent place, be a recognizable size, color, and style, and contrast with other signs, interior finishes, or other decorations. No equipment, furnishings, or decorations that reduce a sign's visibility are allowed. No sign, exhibit, or other object in or close to the mandatory exit sign that may compete with it is allowed to be brightly lighted for anything other than departure reasons (NFPA, 2018).

3.3. Fire Safety and Means of Egress Regulations in United Kingdom

When party walls, rights of light, drainage, and other relevant laws were created in London in 1189, building control in England officially started. Around the same time, requirements were applied to fire-resistant buildings and basic fire escape routes (Stephenson, 2000).

The first comprehensive building Act entered the statute book following the London fire. This contained guidelines for the hiring of surveyors who had the responsibility of verifying that the rules were followed.

Stephenson (2000) claims that in 1774, a consolidating act led to the appointment of district surveyors in London and established a scale of payments for their services. This piece of law was in effect for an additional 70 years until the London Building Act took effect in 1845. (Stephenson, 2000).

The government released "Proposals for a Building Bill" as a consultative paper in August 1972 and sent it to several groups. Building businesses, industrial industries, and

professional interests were all given the chance to share their opinions with the Department of the Environment.

The Future of Building Control in England and Wales was the title of a command paper published by the Secretary of State in February 1981. This document included a comprehensive list of suggestions for updating the building codes and the mechanism of control. Wider exemptions and new appeals procedures were outlined, along with the notion that designs may be certified as conforming with building standards by appropriately competent individuals practicing in the private sector (Stephenson, 2000).

A new Act to alter the legislation pertaining to the supervision of construction work, the building regulations, cleanliness of buildings, and building control was created by the Department of Environment based on the premise for totally rewriting the building regulations.

Sadly, according to Stephenson (2000), these criteria were tied to some highly contentious housing legislation that had a very difficult time passing both chambers of Parliament. A general election also got in the way. The Housing and Building Control Act of 1984 did not become a law until June 1984.

The 1984 Act included legislation that made it possible to:

- Supervise plans and construction projects other than through local authorities;
- Exempt and relax some procedural requirements for public bodies;
- Provide for approved documents that serve as guidelines for building regulations;
- Obtain private certification of building regulation compliance.

However, the building control-related provisions of the 1984 Act were only in effect for a brief period of time. On December 1st, a new legislation that took on the role of the drastic alterations for private certificates was adopted.

There have been a number of legislative developments since the 1985 creation of the building regulations;

- The Building (Inner London) Regulations 1985
- The Building (Disabled People) Regulations 1987
- The Fire Safety and Safety at Places of Sport Act 1987
- The Water Act 1989
- The Water Act 1991
- Water Consolidation (Consequential Provisions) Act 1991
- The Construction Production Regulations 1991
- The Building Regulations 1991
- The Building Regulations (Amendment) 1992 - 1999

These changes are meant to make it very clear that facilities for the fire service and access must be adequate.

In response to these requirements, a new Approved document for Part B (2000) was published, and it comprises instructions on the first installation of fire alarm and detection systems in all relevant buildings (Stephenson, 2000).

All fire safety laws in England and Wales are covered under the "Regulatory Reform (Fire Safety) Order 2005," which was developed to simplify the then-existing legal requirements. These regulations apply to all sites used for non-domestic activity, with a few minor exceptions. Due of the almost 20,000 business fires that occur in the UK each year, these laws are crucial obligations that should be followed seriously (Home Office Statistical Bulletin, 2021). Every company must have a "Responsible Person" assigned to them whose responsibility it is to ensure that certain responsibilities are met and that steps are made to both avoid fires and prevent harm or death if a fire does occur.

The Regulatory Reform (Fire Safety) Order of 2005 (RRFSO) places a duty on the person in charge of non-domestic properties to ensure the safety of everyone who enters the property, whether they are occupants or guests.

Numerous publications that provide instructions on how to adhere to the Building Regulations 2010 for England have received the Secretary of State's approval. These recognized official papers provide direction on all of the regulations' technical specifics. Construction workers are responsible for ensuring that the Building Regulations are adhered

to. The approved papers offer important information on numerous strategies to achieve compliance with English law, even though it is ultimately up to the courts to decide whether those criteria have been met (Building Regulations Part B, 2020).

Although authorized papers cover frequent building conditions, adherence to their instructions does not ensure compliance with the rules' criteria since they are not able to account for all situations, changes, and innovations. Those who are in charge of complying with the regulations must decide for themselves whether adhering to the instructions in the authorized papers is likely to satisfy those criteria in the specifics of their case (Building Regulations Part B, 2020).

Building Regulations Part B (2020) is divided into two volumes, Volume 1 focusing entirely on homes, including apartment buildings, and Volume 2 covering all other types of structures. The following objectives of the Building Regulations are to:

- Ensure that there are enough methods of alarm sounding and means of escape for people in the event of a fire;
- Prevent the spread of fire over interior building linings.
- The structure must be constructed so that, in the case of a fire, the structure doesn't fall down too soon, adjacent buildings are sufficiently separated from one another and from one another within structures, where necessary, automatic fire suppression is offered and cavities are protected from the smoke and fire's undetected spread.
- Limit the likelihood that a fire may spread to external walls and roofs as well as from one structure to another.
- Make sure the fire department has enough access to buildings' facilities and equipment so that firemen can save the lives of everyone inside and around them.

Each facet is offered advice separately, even though many are intricately related. It is best to view the material as a complete. It is important to understand the connections between various criteria and how they are interdependent. It is crucial to pay particular attention to situations in which the guideline is only partially applied since this might negatively affect other requirements (Building Regulations Part B, 2020).

The goal of the building codes is to offer individuals a sufficient level of fire safety. For the protection of property, including the building itself, extra measures are usually required (Building Regulations Part B, 2020).

Classification of Building Types:

Building types are broken down into many purpose categories, each of which corresponds to a distinct level of risk. A purpose group may be relevant to both the entire structure and a specific building compartment, and it should be linked to the building's or compartment's primary function (Building Regulations Part B, 2020). When a structure or space has several uses, it is reasonable to give each one its own purpose group. Each principal use that is distinct from the others and does not serve an additional purpose should be placed in its own purpose category. The stricter guidelines should be used when it is unclear which purpose group is best.

Table 3.17. Groups for Classifying Purposes

Title	Group	Purpose for which the building or compartment of a building is intended to be used
Residential (Dwellings)	1(a)	Flat
	1(b)	A home that has a livable story with a floor level at least 4.5 meters above ground and up to 18 meters above ground
	1(c)	A home having at least one livable floor that is 4.5 meters or more above the ground.
Residential (Institutional)	2(a)	A facility like a hospital, a house, a school, or another one where people stay overnight. The structure may be used for any of the following: Living quarters for, or lodging for the treatment, care, or maintenance of, either; individuals under the age of five; people with disabilities resulting from disease, old age, or other physical or mental infirmity.
Residential (Other)	2(b)	Any additional residential function not already mentioned, including a hotel, boarding house, residential college, dorm, or hostel.
Office	3	Offices or locations utilized for any of the aforementioned activities, under their management; Clerical labor (includes writing, accounting, sorting, filing, typing, duplicating, machine calculating, sketching, and editorial preparation of material for publishing) (including banking and building society work), Interactions (including postal, telegraph and radio communications), Audio or visual media such as radio, television, or movies.

Table 3.17. Groups for Classifying Purposes (Continuation)

Title	Group	Purpose for which the building or compartment of a building is intended to be used
Shop and Commercial	4	Stores or sites that provide one or more of the following purposes: (including selling food or drink to the public for immediate consumption, retail by auction, self-selection and over-the- counter wholesale trading, the business of lending books or periodical for gain, the business of a barber or hairdresser, and the rental of storage space to the public). Locations where items can be dropped off or picked up by the general public in connection with their rental, repair, or other care
Assembly and Recreation	5	Bingo halls, public broadcasting, recording, and film studios; casinos; dancing halls; or any other location used for gathering, amusement, or relaxation, Law courts, Places of worship, Crematoria, Public libraries, Non-residential day centers, Clinics, Amusement parks and arcades, Museums and art galleries; non-residential clubs; theaters, cinemas, and concert halls, Educational institutions; dancing schools; gymnasia; swimming pool structures; riding schools; skating rinks; and sports pavilions and stadiums
Industrial	6	Factories and other locations used for any of the following: producing electricity; slaughtering cattle; manufacturing, repairing, cleaning, washing, disassembling, modifying, or processing any item.
Storage and Other Non-residential	7(a)	Place (other than those mentioned under 7(b)) for the storage or deposit of goods and materials or, any structure outside of purpose groups 1 to 6
	7(b)	Only automobiles, motorbikes, and passenger or light goods vehicles that weigh little more than 2500 kg gross are permitted and accommodated in parking lots.

In order to have adequate provisions for fire detection alert and sufficient escape routes in the case of a fire that can be used safely and effectively at all relevant times from the building to a place of safety outside, the building must be planned and built in accordance with the Building Regulations (2020). (Building Regulations Part B, 2020).

Every building must have systems in place for spotting fires and sounding the alarm. In most buildings, people can smell or see a fire, therefore further measures are frequently not necessary. In certain small buildings or institutions, it may be simple to raise the alarm. In order to choose the best course of action, warnings must be heard and comprehended throughout the premises (Building Regulations Part B, 2020).

A fire alarm system that uses electricity must be provided, with the exception of a few little buildings or areas. In specific situations, a fire detection system must raise the alarm. The

precise specification must adhere to the building's fire strategy. Residences (institutional) and residences (other) must have automatic fire detection and alarms. Non-residential areas where a fire might start in an empty section of the structure and obstruct egress must have an automatic fire detection and alarm system installed. Anywhere automatic fire protection mechanisms, such as pressure differential systems or door releases, are necessary, automated fire detection is essential (Building Regulations Part B, 2020). The proper installation, upkeep, and planning must go into fire detection and alarm systems. For fire detection and alarm systems, a design, installation, and commissioning certificate is required. The quality, trustworthiness, and safety of fire prevention products and services may be ensured by third-party certification programs.

Occupancy Load Calculation:

When planning the building, user number should be kept in mind. If the number is unclear, floor space considerations should be applied. One of the following best describes the number of persons in a room, level, building, or building component: the largest group of people it can hold. The area of a room or storey is multiplied by the floor space factor listed in Table 3.18 to determine how many people are housed in a structure that isn't a residence.

When measuring area, counters and display units must be taken into account. Remove all stair enclosures, lifts, restrooms, and other building structural elements (Building Regulations Part B, 2020).

Table 3.18. Floor Space Factor

Type of Accommodation	Floor Space Factor (m^2/person)
1. Standing spectator spaces, as well as bar areas (within 2m of serving point) comparable refreshment areas	0.3
2. Amusement arcades, assembly halls (including general-purpose meeting places), bingo halls, clubs, crush halls, dance floors or halls, venues for pop concerts and similar events, and bar sections without permanent seating	0.5
3. Queuing area or concourse	0.7
4. Committee room, common room, conference room, dining room, licensed betting office (public space), lounge or bar (save as specified in (1) above, meeting room, reading room, restaurant, staff room, or waiting room	1.0
5. Exhibition Hall or studio (film, radio, television, recording)	1.5
6. Skating rink	2.0
7. Shop sales area	2.0
8. Art gallery, dormitory, factory production area, museum or workshop	5.0
9. Office	6.0
10. Kitchen or library	7.0
11. bedroom or study-bedroom	8.0
12. Bed-sitting room, billiards or snooker room or hall	10.0
13. Storage and warehousing	30.0
14. Car park	Two person per parking space

Escape Routes:

All types of structures are required to provide an exit at any point on a floor by the Building Regulations (2020). In general, anyone confronted with a fire within a building may turn away from it and safely escape. The rules for small premises may be utilized in place of the regulations if a small shop, office, industrial, storage, or other similar property fulfills both of the following conditions: no story has an area bigger than 280 m2, and there are no more than two storeys above ground.

The number of inhabitants in the room, tier, or storey as well as the distance restrictions to the nearest exit listed in Table 3.19 determine how many escape routes and exits must be provided.

If more than one stair is required for a vertical escape, more than one stair must be accessible from every area on every floor of a multi-story building. If the other stair is available, a space may be in a dead end. In mixed-use buildings, separate exits must be provided from any floors or sections of floors used for living, gathering, or recreational purposes.

Table 3.19. Limitations on Travel Distance

Purpose Group	Use of the Premises or Part of the Premises		Maximum Travel Distance Where Travel is Possible in:	
			One Direction Only (m)	More than One Direction (m)
2(a)	Residential (institutional)		9	18
2(b)	Residential (other) a. In bedrooms b. In bedroom corridors c. Elsewhere		9	18
			9	35
			18	35
3	Office		18	45
4	Shop and commercial		18	45
5	Assembly and recreation: a. Buildings primarily for disabled people b. Areas with seating in rows c. Elsewhere		9	18
			15	32
			18	45
6	Industrial	Normal hazard	25	45
		Higher hazard	12	25
7	Storage and other non-residential	Normal hazard	25	45
		Higher hazard	12	25
2-7	Place of special fire hazard		9	18
2-7	Plant room or roof-top plant: a. Distance within the room b. Escape route not in open air (overall travel distance) c. Escape route in open air (overall travel distance)		9	35
			18	45
			60	100

According to the Building Regulations (2020), one of the following is acceptable for the single escape route:

- Areas of a floor that can be reached by a storey exit while staying within the parameters for travel distance in a single direction stated in Table 3.19., provided that, in this case, no room has more than 60 people in it, including bars and places of gathering and no room in a "residential (institutional)" building contains more than 30 people in this scenario.
- A floor with no more than 60 occupants, provided the restrictions on one-way travel distance are met.

The diagram below explains how to calculate trip distance from a dead end in an open story structure.

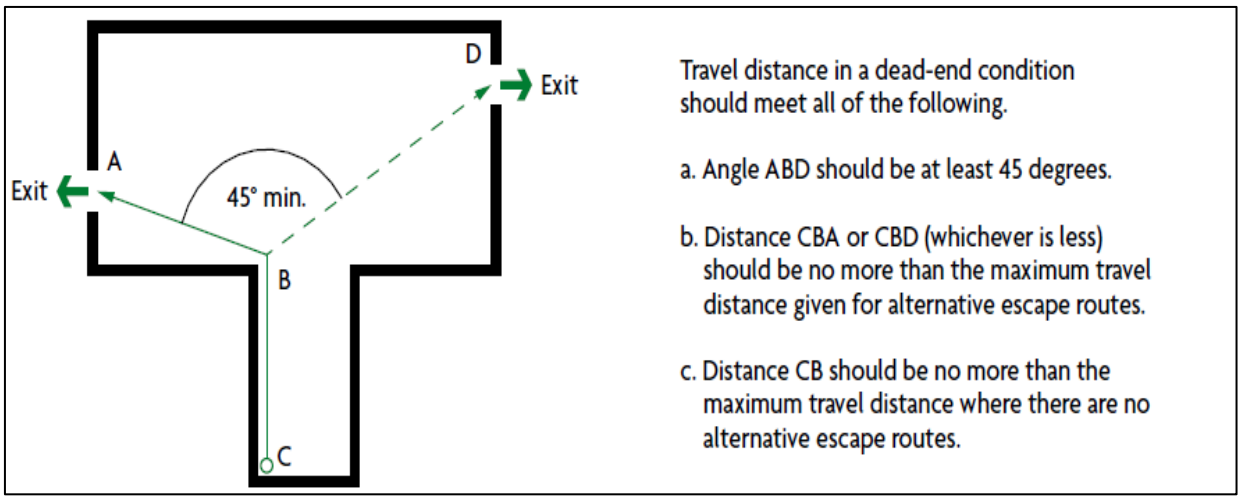


Figure 3.1. Travel Distance in Dead-end Condition

According to the Building Regulations (2020), methods of limiting access to the building or specific areas of it shall not compromise fire safety protocols. Even though it can be fair to close some exits beyond usual business hours, protocols for safely evacuating persons who are trapped within the building must be kept up.

The term "journey distance" is used by the Building Regulations (2020) to describe the shortest route. If there is permanent seating or other fixed obstacles, the shortest path is along the center line of the seat ways and passageways. If there are stairs involved, the pitch line on the center line of travel is the quickest route.

Table 3.20. displays the bare minimum of escape routes and exits from a room or floor for various population sizes. This figure is likely to rise as a result of the necessity to keep track of journey distance and other practical concerns (Building Regulations Part B, 2020).

Table 3.20. Minimum Number of escape Routes and Exits from a Room, Tier or Storey

Maximum Number of People	Minimum Number of Escape Routes/Exits
60	1
600	2
More than 600	3

Alternative escape routes need to adhere to one of the following:

- There is at least a 45-degree angle between them.
- Despite being separated by a fire-resistant architectural element, they face each other in orientations that are fewer than 45 degrees apart.

A room within the house might be at danger if a fire starts in the access room. Only if each and every one of the following conditions are satisfied may such an agreement be permitted;

- For residential (institutional) constructions, the number of people in the inner room is limited to 30; for other purpose groups, it is limited to 60.
- This is not a bedroom.
- The inner chamber is accessed directly from the entrance room rather than through a corridor.
- The travel distance from any location in the inner room to the access room exits does not exceed the distance stated in Table 3.19; the escape route from the inner room does not pass via more than one access room.
- The access chamber is handled by the same person and does not pose a particular fire risk.

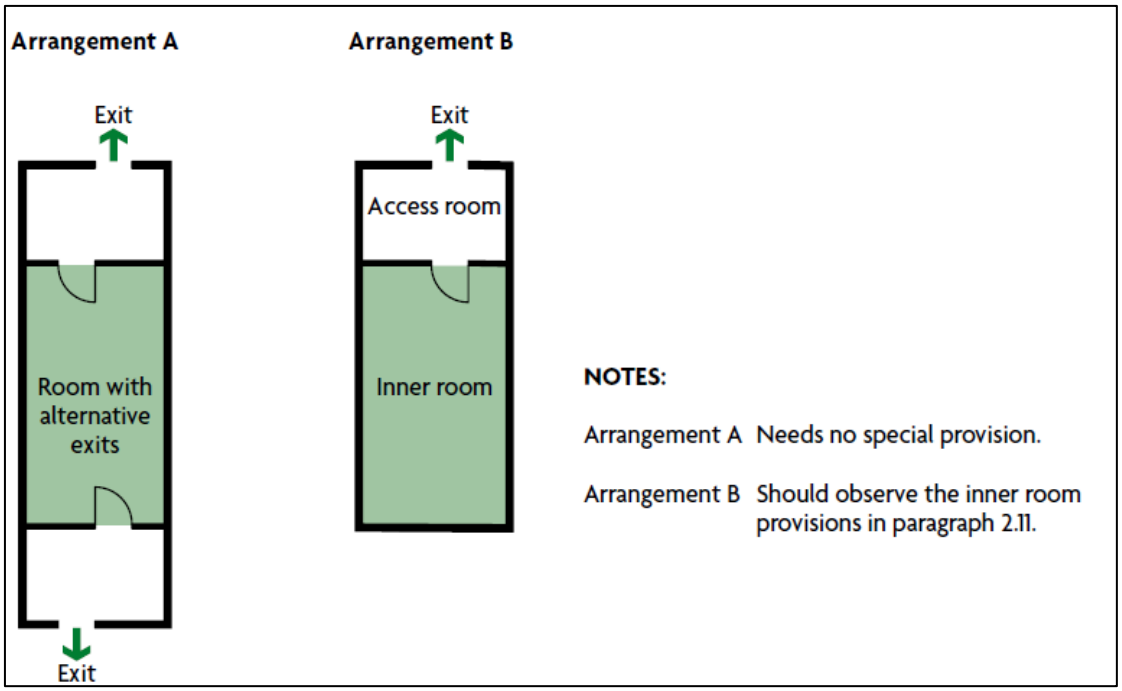


Figure 3.2. Inner Room and Access Room

The Building Regulations (2020) provide that if a central core has more than one exit, each exit on a different floor must be accessible via a separate elevator hall, shared lobby, or split corridor.

An alternate escape route must not pass within 4.5 m of an opening between floors, such as one for an escalator, or the movement must be in the opposite direction as the opening.

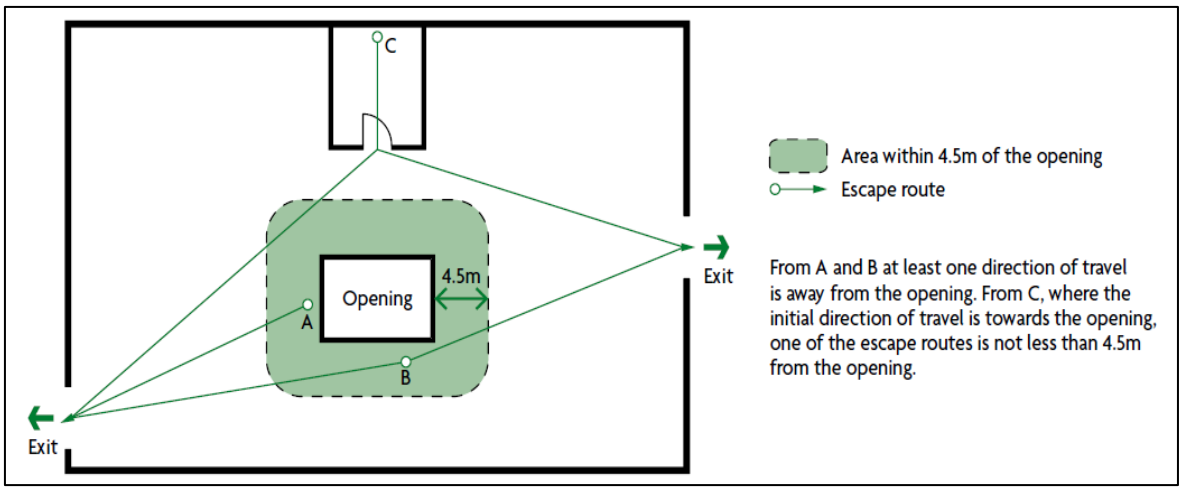


Figure 3.3. Open Connections

If a story includes more than one escape stair, it must be designed so that passing through one stair does not require passing through another. However, it can be acceptable to enter another stairway through the secure lobby of one. To prevent overuse from leaving them inoperable, self-closing fire doors that service protected stairways that are a part of crucial circulation routes must be fitted with an autonomous release mechanism. Otherwise, the stair and any associated escape path shouldn't be part of the primary circulation channel across various levels of the structure (Building Regulations Part B, 2020).

Both of the following apply if a story incorporates places for eating food and/or drink that are not the primary function of the structure;

- Except for interior rooms that satisfy the criteria, each space must have at least two escape routes.
- Those escape routes must go directly from a kitchen or another high-fire-risk area to a story exit.

According to the Building Regulations (2020), two of the following conditions must be satisfied when a storey is divided into zones of independent ownership or tenancy: An adequate automated fire detection and alarm system must be implemented throughout the story if a common corridor or circulation area is on the escape route.

The width of emergency exits and doors must adhere to the requirements in Table 3.21. The occupancy number guidelines should be used to establish an estimation if it is unclear how many individuals can utilize the escape route and exit at once (Building Regulations Part B, 2020).

Table 3.21. Exit and Escape Route Widths

Maximum Number of People	Minimum Width (mm)
60	750
110	850
220	1050
More than 220	5 per person

Where there are numerous escapes from a floor, fire may prohibit one from being utilized. Because the remaining exits must be broad enough to accommodate all people, the largest exit must be subtracted when utilizing Table 3.21. Stairs must be at least as wide as the nearest story exit. While certain staircases are not discounted since they are available for other levels, storey entrances onto them are (Building Regulations Part B, 2020).

The last exit must be large enough to accommodate the maximum flow rate required to evacuate people from the ground floor stair and story exit if the ground floor lobby doubles as both the last exit and the final departure (Building Regulations Part B, 2020).

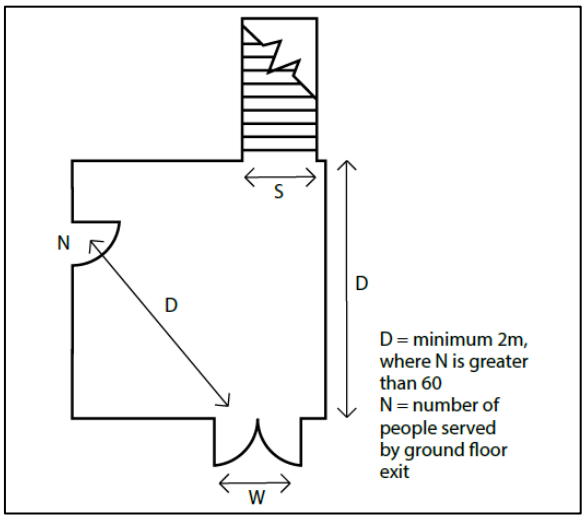


Figure 3.4. Merging Flows at Final Exit

This can be calculated using the following formula;

W = ((N/2.5) + (60S))/80
Where;
W is the width of final exit in meters
N is the number of people served by ground floor
S is the stair width in meters

Building Regulations Part B mandates that if there are more than 60 individuals (N) entering the lobby from the ground floor, there must be at least 2 meters (m) between the bottom of the stairway or story exit and the final departure (2020). If that minimum distance cannot be met, the ultimate exit width (W) must be at least the width of the stair plus the width of the story exit.

Fire Safety Halls:

A shielded passage should be used as part of the methods of escape in any of the following situations:

- Any corridor that serves bedrooms,
- Any dead-end corridor (excluding recesses and expansions no deeper than 2m, as illustrated in Figures 3.5. and 3.6.),
- Any corridor shared by two or more occupancies.

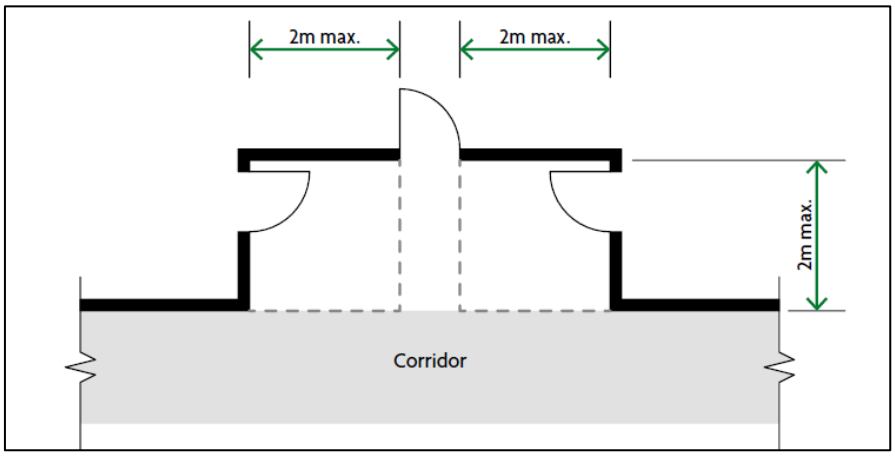


Figure 3.5. Recesses off Corridors

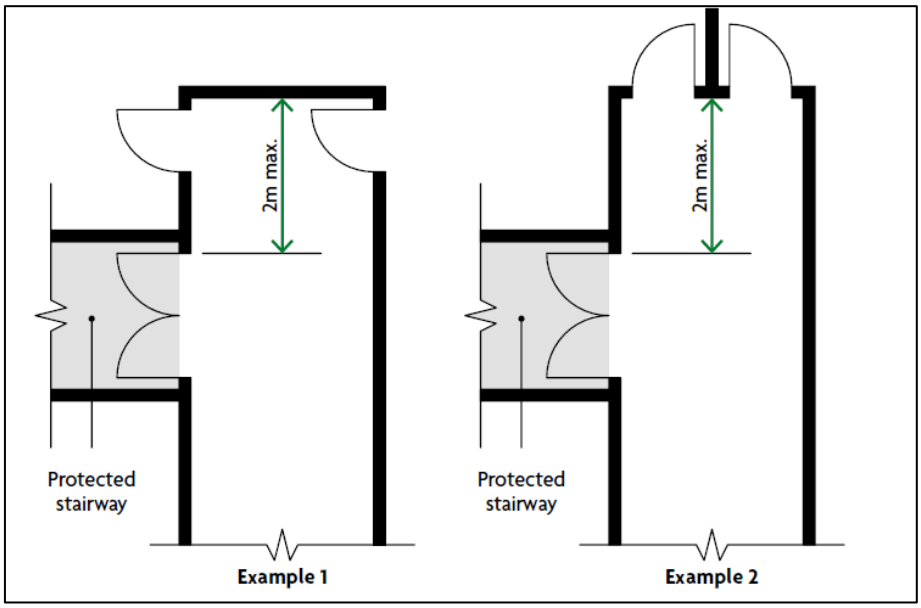


Figure 3.6. Corridor Expansion Beyond a Safe Stairway

The enclosing partitions should extend to a suspended ceiling or the soffit of the structural level above if a hallway is used for escape but is not a protected corridor. Openings into rooms from the corridor should also have doors fitted if fire door sets are not required. Although an open design cannot stop smoke from spreading, it can help residents spot a fire before it spreads (Building Regulations Part B, 2020).

The location of the fire doorsets and any screens should be about halfway between the two-level exits. While considering the corridor's architecture and any possible fire threats, they must guard the passage from smoke (Building Regulations Part B, 2020).

If there is a hollow above the enclosures leading to a hallway in a building other than a residence (for instance, because the enclosures are not carried to the top floor's underside of the roof covering), the danger of smoke escaping the enclosure should be decreased using one of the following techniques:

- Option 1: Install cavity barriers around the enclosure's edge and across the passageway
- Option 2: Dividing the storey along the corridor's division line using construction that is fire resistant.
- Option 3 - Enclosing the hollow on the bottom side by a compartment, structure, or independent component's fire-resistant ceiling. Any cavity above this division must have cavity barriers on the storey and corridor division lines.

Any door that might potentially let smoke out of the division needs to have a self-closing device fitted.

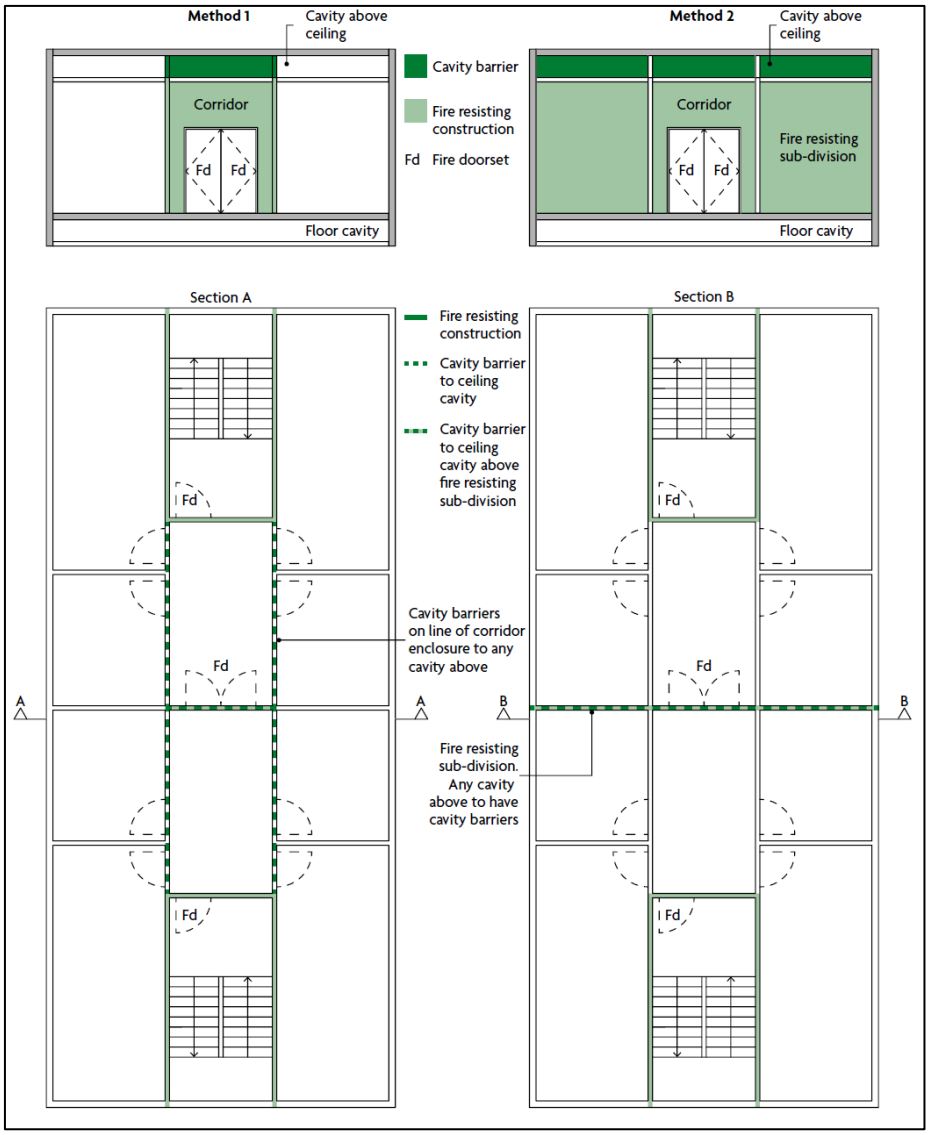


Figure 3.7. Division of Corridors

Self-closing fire doorsets are required to be installed, according to the Building Regulations (2020), between any area of a corridor that offers two directions of evacuation and continues past one storey exit and another, as well as any dead ends of passageways longer than 4.5 meters where access to a location from which substitute emergency exits are available (along with any associated screens).

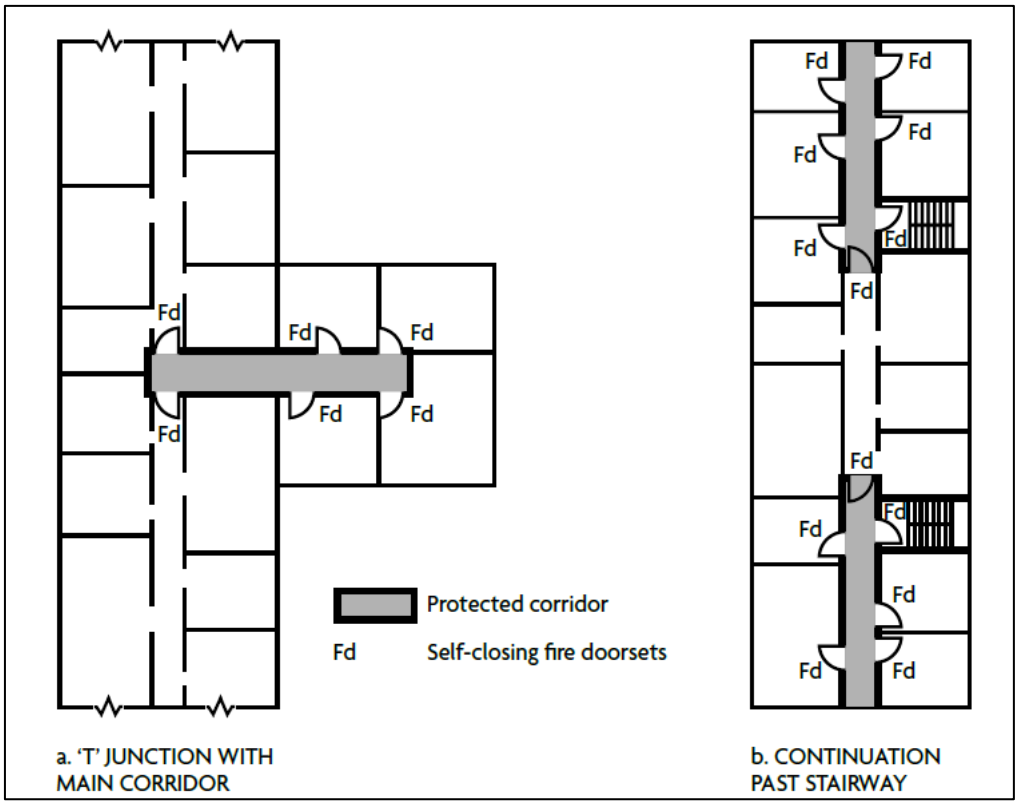


Figure 3.8. Dead-end Corridors

Vertical Fire Escape:

According to the Building Regulations (2020), due to the distance constraints on horizontal transit, the majority of people should be able to freely move through a protected escape route or final exit. Consider establishing a distinct escape route from the sections of various usage, or other efficient ways to safeguard shared escape routes, if a structure has storeys or portions of storeys used for diverse purpose groups.

In the following circumstances, a single escape stair may service a building (or a portion of a building);

- When separate escape routes from locations in various purpose categories are not required.
- From a basement with one permitted escape route.
- In tiny spaces, provided the requirements are met.
- From a structure with no floors higher than 11 meters above ground level.

- An office structure with no more than five stories above ground, with a floor level higher than 11 meters above ground level on each story, and with travel distances between any two points on any given storey that do not exceed the lengths listed in Table 3.19.
- A factory with no more than two low-risk buildings or one normal-risk building per floor above ground level, as long as the travel distance between each location on each floor does not exceed the lengths listed in Table 3.19. for escape in a single direction.
- Buildings for processing plants that can hold a maximum of 10 people.

According to the Building Regulations (2020), the width of escape stairs must meet each of the standards stated below;

- It should have a minimum width equal to all exits leading to the stairs.
- It must be at least as wide as the minimums listed in Table 3.22.
- On the route to the last exit, it shouldn't diminish at any moment.
- In steps taller than 30m, it shouldn't be more than 1400mm, unless a central railing is supplied. When determining stair capacity, the width of each side of a central railing should be taken into account individually. In public buildings, a central railing must be installed if the steps are more than 3000mm broad.

Table 3.22. Minimum Widths of Escape Stairs

Situation of Stair	Maximum Number of People Served	Minimum Stair Width (mm)
1a. In a residential building	150	1000
1b. In an assembly and recreation building and serving an area used for assembly purpose	220	1100
1c. In any other building and serving an area with an occupancy of more than 50	Over 220	See Table 3.23.
2. Any stair not described above	50	800

The breadth depends on the escape strategy and the number of accessible steps. Regardless of the escape strategy, it should be recognized that if there are two or more stairs available, only one may be usable in the event of a fire. Each stair should be discounted in turn to

ensure that the capacity of the remaining stairs is sufficient. Buildings with or without sprinkler systems are affected by this (Building Regulations Part B, 2020).

The Building Regulations state that the width of the escape stairs must take into consideration the number of persons using them at once to evacuate all storeys (2020). Construction of the stairways below is required to allow for simultaneous evacuation;

- All stairwells serving basements.
- All stairwells serving open-plan structures.
- All stairwells serving residential or assembly and recreation buildings.

Table 3.23. Stairway Capacity for Basements and Simultaneous Building Evacuation

No. of Floors Served	Maximum Number of people Served by a Stair of Width								
	1000mm	1100mm	1200mm	1300mm	1400mm	1500mm	1600mm	1700mm	1800mm
1	150	220	240	260	280	300	320	340	360
2	190	260	285	310	335	360	385	410	435
3	230	300	330	360	390	420	450	480	510
4	270	340	375	410	445	480	515	550	585
5	310	380	420	460	500	540	580	620	660
6	350	420	465	510	555	600	645	690	735
7	390	460	510	560	610	660	710	760	810
8	430	500	555	610	665	720	775	830	885
9	470	540	600	660	720	780	840	900	960
10	510	580	645	710	775	840	905	970	1035

In Table 3.23., the following calculations can be used to determine the capacity of staircases 1100mm wide or wider:

- $P = 200W + 50 (W – 0,3).(N – 1)$
- $W = P + 15N – 15 / 150 + 50N$

Where;

- P is the number of people that can be served
- W is the width of the stair in meters
- N is the number of storeys served.

Phased evacuation is not permitted in all types of structures, according to the Building Regulations (2020), however it may be useful for escape staircases in tall buildings. It necessitates the provision and upkeep of supporting infrastructure like fire detection and alarm systems.

People with limited mobility and those who are on the story that is being impacted by the fire the most are the first to be evacuated during a staged evacuation. If further evacuation is required, it is carried out two floors at a time to minimize interruption in huge structures (Building Regulations Part B, 2020).

In structures taller than 30 meters, phased evacuation increases the risk that evacuees would obstruct firefighters' access to and use of the facility. By speaking with the fire and rescue services about unique management techniques, this issue may be resolved. Physical measures, such as eliminating a stair, may need to be adopted in very tall structures, which are normally over 45 meters tall.

Building Regulations Part B (2020) specifies the specifications that must be met by any building (or component of a building) intended for phased evacuation:

- Except for the top floor, where staircases should be reached via a protected lobby or protected corridor, each story's elevators must be accessed through a protected lobby.
- A compartment floor should be present on each floor.
- If a building has a story with a floor that is higher than 30 meters from the ground, an automatic sprinkler system needs to be fitted throughout.
- The structure has to have a suitable fire warning system installed.
- An internal voice communication system should allow a control point at the entrance level of the fire and rescue service and a fire warden on each floor to speak with one another.

Table 3.24. Minimum Stairway Width for Phased Evacuations

Maximum Number of People in any Storey	Stair Width (mm)
100	1000
120	1100
130	1200
140	1300
150	1400
160	1500
170	1600
180	1700
190	1800

Table 3.24 assumes a phased evacuation with the fire floor as the first stop and no more than two floors at a time after that. If a central railing is not present, the maximum width for stairs with a rise of more than 30 meters is 1400 mm.

The Building Regulations (2020) state that every interior escape stairway must be a protected staircase inside of a fire-resistant enclosure. If a protected staircase extends past, recedes into, or forms an internal angle with a nearby exterior wall of the building, there must be at least 1800mm between the exposed portion of the building enclosure and the unprotected portion of the stair enclosure.

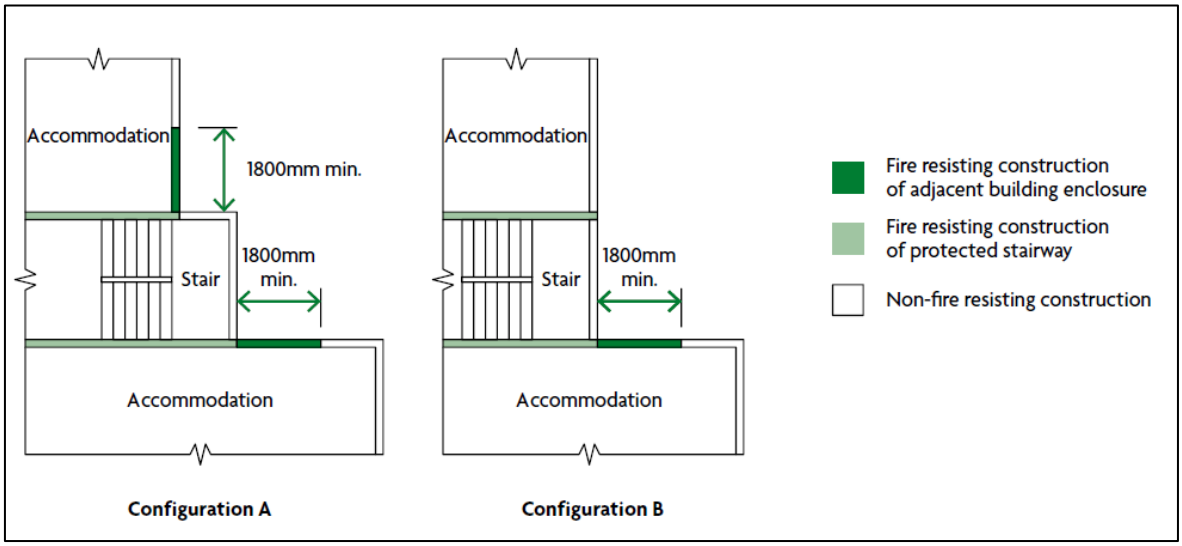


Figure 3.9. External Protection to Protected Stairways

If a level or portion of the building has several escape routes, some of those may mount an outside escape stair provided the following requirements are met:

- When a building group is engaged in "assembly and leisure," the route is not intended for use by the general public.
- In the case of a group of "residential" buildings, the route only provides access to staff housing or offices.
- Every area of every storey has at least one internal escape stair.

Any outside escape stairs should adhere to the following specifications:

- The only exception to this requirement, assuming it is the only entrance onto the landing, is a single exit door from the building to the top level of a downward-leading outdoor stair. Doors leading to the stairway have to have self-closing mechanisms and be fireproof.
- The following zones, as measured from the flights and landings of the outer stair, require the construction of external walls using fire-resistant materials: 1100mm above the top landing of the steps, 1800mm above and horizontally, and 9m below.
- Any building component (including doors) located within 1800 mm of the escape route from the bottom of the stairway to a place of safety must be built with fire resistance in mind. This does not apply if there are additional escape routes from the exterior escape stair's bottom.
- For stairs higher than 6 meters, weather protection is necessary. Protection shouldn't involve total enclosure, but it should stop snow or ice from building up.
- Glass should be secured and fire resistant in terms of integrity in portions of construction that resist fire, although insulation is not required.

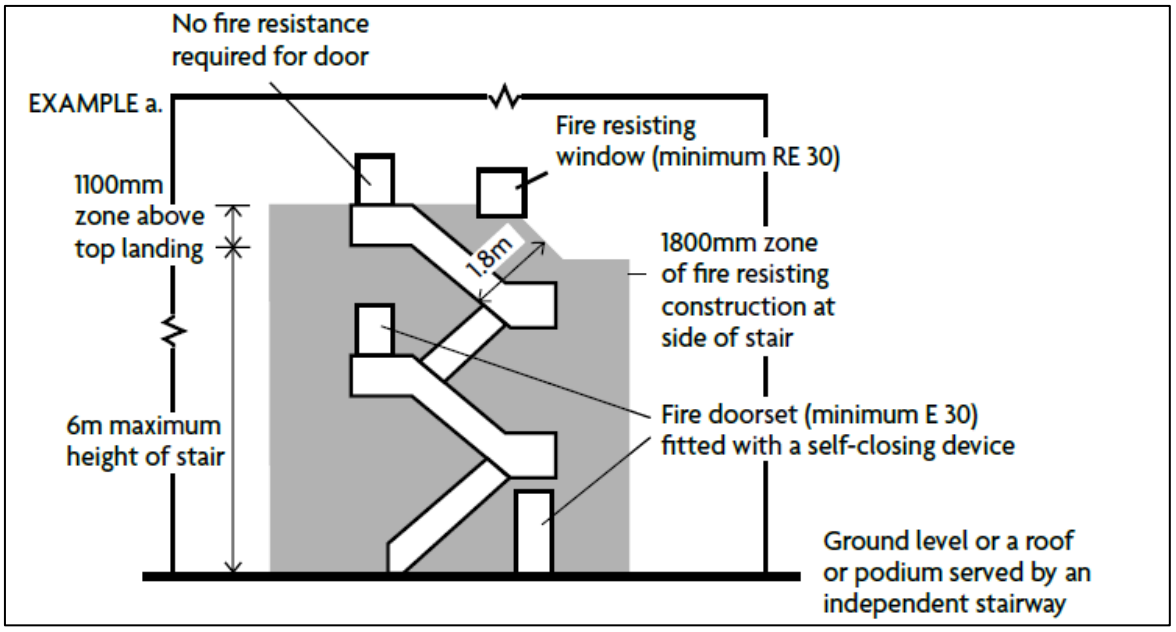


Figure 3.10: Fire Resistance of Areas Near to External Stairs

Egress Doors:

To prevent unnecessary delays for persons trying to flee, doors should be easily operable. According to the Building Regulations, doors on evacuation routes should, in general, either not be provided with a lock, latch, or bolt fastening, or only be installed with basic fastening (2020). When areas are unoccupied, doors may be equipped with equipment that enables them to be locked.

In places like hotel rooms, locks that are key controlled from the outside and manually unlocked from the inside may be placed. If a locked door is operated by a password or combination keypad, swipe or proximity card, biometric data, etc., a security mechanism override should be accessible from the side approached by people running. Electric powered locks shall return to the unlocked state if the fire detection and warning system is activated, if there is a power loss or system malfunction, and if the security mechanism override is activated.

In areas of assembly and storage in commercial buildings, doors on evacuation routes from spaces with more than 60 people shall either not be provided with locks, latches, or bolts, or fitted with emergency fastenings, according to the Building Regulations (2020). In non-residential buildings, certain last emergency exits include security locks that are only

activated when the facility is empty. These locks may be required, but management procedures must emphasize their proper use.

Any entryway or exit's door must be opened as soon as it is practical to do so along the evacuation path. If more than 60 people are expected to utilize the doors during a fire or if there is a highly severe fire threat with the potential for rapid fire growth, such as with some industrial activities, the doors should always be hanging open in the line of escape (Building Regulations, 2020).

Every exit door along an escape route must swing open clear of any change in floor level other than a threshold or single step in the doorway, be hung open at least 90 degrees, and not obstruct any escape path across a landing (Building Regulations, 2020). Any door that opens into a corridor or stairwell should be recessed to prevent its swing from encroaching on the effective width.

Doors along evacuation routes that separate corridors must have viewing panels and must swing both directions, under the Building Regulations (2020). Turnstiles, automatic doors, and revolving doors shouldn't block escape routes unless they are fully automated gates of the required size with a safety mechanism system that permits outward opening from any open position, have a supervised safety mechanism system to open the gates in the event of a power outage, or are immediately next to non-automatic swing doors of the required width (Building Regulations, 2020).

The minimum width of a final exit should match the minimum width of the escape route it serves. The last exit shouldn't provide any challenges for those with disabilities. Where there aren't any steps leading to the exit, there should be a level threshold and, if necessary, a ramp.

Lighting and Marking:

According to the Building Regulations (2020), people must be able to swiftly leave the area around the building. Direct access to a street, corridor, promenade, or open space is required. The exit from the building needs to be clearly marked and, if required, guarded. Every doorway or other exit providing access to a means of egress, other from those in regular use, should be visibly marked with an exit sign (Building Regulations, 2020).

Final exit points ought to be easily seen and recognized. There should be enough artificial lighting along all evacuation routes. In the event that the main electricity power supply fails, the pathways listed in the table below should be lighted by escape lights. The power supply for any other part of the escape route should not be connected to the circuit where the lighting for the escape steps is located (Building Regulations, 2020).

Table 3.25. Provision for Escape Lighting

Use of the Building or Part of the Building	Areas Requiring Escape Lighting
Residential	All common escape routes
Office, industrial, storage and other non-residential	Underground or windowless accommodation Stairs Internal corridors more than 30m long Open-plan areas of more than 60m²
Shop and commercial, and car parks	Underground or windowless accommodation Stairs Internal corridors more than 30m long Open-plan areas of more than 60m²
Assembly and recreation	All escape routes Accommodation except for that which is open on one side to view sport or entertainment during normal daylight hours
Any purpose group	All toilet accommodation with a minimum floor area of 8m² Electricity and generator rooms Switch rooms/battery rooms for emergency Lighting system Emergency control rooms

3.4. Summary of Means of Egress Regulations

In Turkey:

Buildings are always under danger of catching fire, which may lead to the destruction of both people and property. Although there is a chance that a fire will break out in a structure, steps can be done to stop it from happening and reduce the damage (Simsek & Catkkas, 2020).

According to Simsek & Catıkkas (2020), the measures to be taken against fire in building should include a process that starts at the design stage and ends with the implementation stage. It is necessary to incorporate criteria like the materials used in the design phase and

the ideal breadth and distance for ways of egress given the user load. Issues including proper material assembly, coating materials, and building in line with the design come to the forefront during the application phase. During construction phase, these measures should be considered as part of the building cost. In this way, life and property safety can be reached to higher standards (Simsek & Catıkkas, 2020).

The Regulation on the Protection of Buildings from Fire (BYKHY) is a manual for designing fire-safe buildings, according to Simsek & Catkkas (2020). However, it is not adequately understood by many architects. When the existing structures were examined, it was seen that means of egress stairs and escape routes were designed inappropriate for the conditions, no precautions were taken against the smoke, which is the main cause of death in fires, and coating materials that emit toxic gas when burned were used (Simsek & Catıkkas, 2020).

According to Simsek and Catıkkas (2020), occupancy permits are given even if the buildings are not designed for fire due to the absence of fire-related laws. These sanctions should be revised and fire related articles should not be limited to regulations. It is necessary to make detailed and careful examinations during the controls (Simsek & Catıkkas, 2020).

In United States of America:

In contrast to the majority of other nations, the United States of America has a fundamentally distinct procedure for developing codes and standards and subsequent legislation. It is run through a consensus-building process by private, non-profit businesses. The main organizations in charge of creating codes are the International Code Council (ICC), which creates building, fire, and mechanical codes, and the National Fire Protection Association (NFPA), which creates electrical and life safety rules (Hirschler, 2017). Each state in the US has adopted one or more model building codes. Both the International Building Code (IBC) and the National Fire Protection Association's (NFPA) 101 "Life Safety Code" are ratified by all 50 states. To serve as the foundation for building compliance, each State customizes and modifies the model codes. The adoption procedure might take several years. Some cities, like New York City, have their own construction regulations (City of New York, 2014). Other pertinent codes and standards, such as the international fire code and several referenced standards, that have an influence on construction, fire protection system design, maintenance, and fire-fighting operations must also be complied with (Barber, 2017).

In United Kingdom:

In the past, prescriptive legislation has been used to provide for fire safety. This might be viewed as the conventional strategy for fire safety. The entirely prescriptive approach to fire safety has altered when test methods for evaluating the performance of fire defense items have become available and demand that the items of fire defense fulfill a performance criteria. In addition, there has been a change from prescriptive to functional in recent years, which means that what is advised may be shown to produce acceptable fire safety. This acknowledges the demand for fire safety that is both affordable and multifaceted. In order to do this, it is required to identify both the activity's goal and the level of fire safety that is desired. In this regard, official legislation has a propensity to be a little vague, at least in the United Kingdom. Therefore, although typically striving for the degree of danger to be as low as practically feasible, the Health and Safety legislation acknowledges risk levels that are either inconsequential or unacceptable.

As performance-based design approaches substitute or supplement compliance to prescriptive standards, fire protection legislation is evolving (Spinardi, 2016). The capacity of regulators to effectively oversee fire safety is nonetheless called into serious question by this change in regulatory practice.

The prescriptive rules offer fire protection elements that are simple to apply and approve for many different types of structures. These guidelines seek to strengthen the fire safety of buildings in a reasonable, cost-effective way in accordance with the danger of fire. The primary organization in charge of implementing all fire-safety laws is the fire authority. They concentrate their efforts and inspections on locations with the greatest danger.

4. MEANS OF EGRESS OF PEOPLE WITH DISABILITIES

4.1. Means of Egress of Disabled People in Turkey

In recent years, Turkey has begun to give importance to issues such as the disabled and their rights. The researchers state that ideal solutions should be those that facilitate the evacuation of everyone in the building, not just those who have traditionally been identified as disabled. While seeking solutions to these, the fact that an acceptable solution for one may be an obstacle for others should not be ignored. Ideally, the chosen solution should benefit more than one group, or at least not compromise the security of another group.

The resources provide a number of options for evacuating people with disabilities to a safe location. Refuge areas, safe elevators, "responsible friend" systems are among the most applied. One of the most applied fire safety measures in large buildings with disabled people is the creation of waiting and shelter areas inside the building. In this option, disabled people are not required to evacuate the building during the fire; People with disabilities are taken to a protected area and then evacuated from there. The fire safety halls required in the "Regulation on the Protection of Buildings from Fire"(BYKHY, 2019) are, in a way, shelters for the disabled.

The usage of evacuation elevators is another choice in high-rise structures. Such elevators must be built with an emergency exit in case of a fire and other disaster. These elevators should take users to the secure security hall since they are powered by a reliable source.

A third option is the development of special evacuation plans for people with disabilities. With the “responsible friend” system, one or more people who are responsible for reporting the disabled person or his/her position in an emergency are determined. In some cases, a list of people who may be difficult to evacuate is also prepared to be given to firefighters responding to fires.

Access to buildings with disabled people has been solved with the use of elevators and ramps. Changes such as raising the characters on elevator buttons for the visually impaired or using Braille characters are facilitated by the use of simple signage and picture signs for the hearing impaired as well as the hearing impaired.

The words "safe areas," "assembly areas," "rescue areas," or "refuge areas," which are also known as "evacuation waiting spaces," refer to a readily accessible place that is segregated from other portions of the building by walls constructed of fire-resistant material and fire doors that keep out fire and smoke. The bunker area must offer the same protection and have the same fire resistance characteristics as a fire escape. Fire safety halls and stairwells can also be used as shelter areas in buildings. In such cases, the stairwell area must have a sufficiently large area so that it is not blocked by the disabled waiting there, including wheelchair users. Some researchers state that a refuge should have a direct connection to an exit route, such as a stairwell or elevator. Where firefighters plan emergency elevators to evacuate people in the building, the elevator lobby should be designed to be at least 6 square meters to serve as a refuge. In this case, if it is necessary to leave the floor, you will be protected while waiting to use the elevators. If this area does not lead directly to a stairwell or elevator, it should at least be close to a stairwell or elevator to allow rescue personnel easy access to these people.

4.2. Means of Egress of Disabled People in United States of America

In locations accessible to individuals with significant mobility impairment that are not inside of existing structures, NFPA 101 (2018) states that there should be more than two accessible escape points. Less than one accessible place of refuge or one accessible exit with an accessible pathway to an exit discharge should be made available within the permitted travel distance (NFPA 101, 2018). Buildings or portions of buildings with a single exit restriction may have one accessible exit. Traffic may be allowed for the distances designated as common channels of travel along the accessible ways of egress for exit access.

When two accessible means of egress are required, the distance between the exits serving those means of egress must be at least half the building's maximum overall diagonal dimension. The distance between the emergency exits or exit access doors' nearest corners should be determined linearly (NFPA 101, 2018). There should be a continuous accessible path from every accessible inhabited space to a public way or a place of refuge.

According to NFPA 101, an accessible escape route must either include a place of refuge inside an extended story-level landing or be reachable from a location of safety (2018). A smoke barrier must have a 1-hour fire resistance rating or a horizontal outlet that discharges

to a place of refuge in order to be designated a component of an accessible means of escape. There must be at least one elevator on every accessible level that is four storeys or more above or below the floor of the exit discharge.

Platform lifts may be utilized as a part of an accessible mode of egress when allowed as a component of a required accessible route. Standby power is necessary for platform lifts, thus it must be provided (IBC, 2020).

Any mandated location of refuge should have an accessible method of exit from the space it serves. The allowable travel distance from any accessible space to a safety area must be further than the length from the occupancy's permissible exit to the place of refuge. Every location of refuge that is necessary must have easy access to a set of stairs or an elevator (IBC, 2020).

According to the IBC (2020), each area of refuge should be constructed to provide one wheelchair place measuring 762 mm by 1219 mm for every 200 individuals or portion thereof, depending on the population capacity of the space of shelter and locations served by the zone of refuge. The minimum width or necessary capacity of the exit pathways should not be reduced by these wheelchair zones. In a designated place of refuge, there cannot be more than one wheelchair space immediately adjacent to a necessary wheelchair space. A two-way communication system must be installed at refuge areas.

4.3. Means of Egress of Disabled People in United Kingdom

Building Regulations (2020) states that refuges are a crucial component of the management plan and provide comparatively secure spaces for individuals to wait for just a little time. The following requirements must be met by refuges: Every protected stairway that provides a means of egress from that floor must be equipped with refuges; these refuges do not need to be inside the stair enclosure, but they must enable direct access to the stair; the number of refuge spaces does not need to be equal to the potential number of wheelchair users in the building. During the evacuation process, more than one individual may occupy a single shelter.

Refuges ought to be wheelchair accessible and at least 90 cm by 140 cm in size. When positioned in a protected stairwell, protected lobby, or protected corridor, they shouldn't reduce the space available for escape or obstruct the movement of those trying to flee. The provision of an emergency voice communication system for refuges is necessary.

Clearly marked refuges and evacuation lifts are required. Protected lobbies and protected stairways must also have a blue sign that reads, "Refuge - keep clear," in addition to fire safety signage.

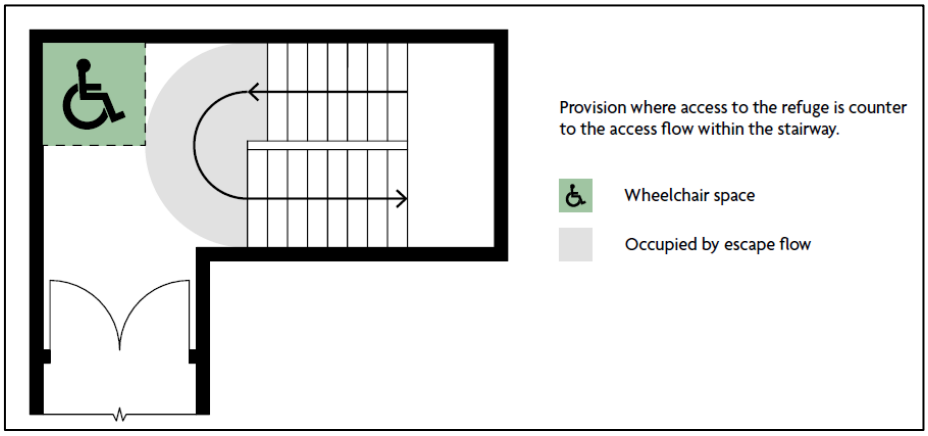


Figure 4.1. Refuge Formed in a Protected Stairway

5. COMPARISON OF NATIONAL AND INTERNATIONAL REGULATIONS

A well-designed building's passive systems can lessen the requirement for mechanical systems since the architectural design directly influences the active systems that should be chosen for the structure. Both building costs and fire safety are reduced. If the passive safety measures are appropriate, the fire will spread slowly, making it simpler to evacuate people and causing less damage overall.

As a result of the studies and researches, the current disability regulations and fire safety regulations used in Turkey, the United States of America and the United Kingdom have been examined within the framework of this thesis, and the findings are given in the tables below.

When the tables below are examined, it is seen that there is a contradiction in the dimensions given in the Disabled Regulations and Means of Escape Regulations of the three countries.

Table 5.1. Comparison of National and International Disability Regulations

ITEM	IN TURKEY (TS 9111, 2011)	IN UNTED STATES OF AMERICA (ADA, 2010)	IN UNITED KINGDOM (BS 8300, 2018)	NOTES
Circulation Area				
Width	min. 90 cm	min. 91.5 cm	min. 120 cm	
Height	min. 220 cm	min. 203 cm	min. 210 cm	
Slope	max 5% transverse 2%	max 5% transverse 2%	max 8%	
Toe/Knee Clearance Zone				
Depth	N/A	min. 43 cm max. 63.5 cm	min. 50 cm	There is no information about Toe/Knee Clearance Zone in the Turkish Standard of 9111
Width	N/A	min. 76 cm	min. 50 cm	
Height	N/A	min. 23 cm max. 68.5 cm	min. 70 cm	
Ramps				
Length	max. 900 cm	N/A	max. 10 m	• In ADA, ramp lengths are determined by the end elevation of the ramp. • Only in Turkish Standard of 9111 there are restrictions of slope that can be use according to the rise of ramps.
Width	min. 100 cm	min. 91.5 cm	min. 150 cm	
Height	N/A	each ramp run max. 76 cm	max. 50 cm	
Slope	if; h<15cm, max 8% if; 16<h<50 cm, max 7% if; 51<h<100 cm, max 6% if; 100 cm < h, max 5%	max 8% transverse 2%	max. 8%	
Doors				
Height	min. 210 cm	min. 198 cm	min. 200 cm	
Width	min. 90 cm	min. 91.5 cm	min. 85 cm	
Maneuvering Area				
Length	min. 150 cm	min. 152 cm	min. 150 cm	There is no defined slope for maneuvering area in Turkish Standard of 9111
Width	min. 150 cm	min. 152 cm	min. 150 cm	
Height	min. 220 cm	min. 203 cm	min. 210 cm	
Area	min. 2.25 m²	min. 2.31 m²	min. 2.25 m²	
Slope	N/A	max. 2%	max 5%	

Table 5.1. Comparison of National and International Disability Regulations (Continuation)

ITEM	IN TURKEY (TS 9111, 2011)	IN UNTED STATES OF AMERICA (ADA, 2010)	IN UNITED KINGDOM (BS 8300, 2018)	NOTES
Handrails				
Length	min. +30 cm from the end of the stairs	min. +30 cm from the end of the stairs	min. +30 cm from the end of the stairs	
Height	70 cm for handrail 90 cm for guardrail	min. 86.5 cm max. 96.5 cm	min. 90 cm max. 100 cm	
Width	min. 32 mm max. 40 mm	max. 57 mm	min. 32 mm max. 50 mm	
Steps				
Depth	min. 28 cm	min. 28 cm	min. 30 cm max. 45 cm	
Width	min. 120 cm	min. 91.5 cm	min. 120 cm	
Height	max. 18 cm	min. 10 cm max. 18 cm	min. 15 cm max. 18 cm	
Landings				
Length	min. 150 cm	min. 152 cm	At least stair width	
Width	min. 120 cm	as wide as ramp or stair, min. 91.5 cm	min. 120 cm	
Area	min. 1.8 m²	min. 1.38 m²	N/A	
Slope	N/A	max. 2%	max. 5%	
Parapets				
Height	Between 60 cm - 80 cm	min. 76.2 cm	min. 80 cm	
Elevators				
Length	min. 150 cm	min. 173 cm	min. 140 cm	
Width	min. 120 cm	min. 106.5 cm	min. 110 cm	
Height	N/A	N/A	min. 200 cm	
Area	min. 1.8 m²	min. 1.45 m²	min. 1.54 m²	
Platforms				There is no information about Disabled Platforms in Turkish Standard of 9111. Necessary dimensions and power requirements are in a different Turkish Standard
Length	N/A	min. 122 cm	min. 140 cm	
Width	N/A	min. 76 cm	min. 90 cm	
Height	N/A	N/A	N/A	
Area	N/A	min. 0.92 m²	min. 1.26 m²	

Table 5.2. Comparison of National and International Means of Egress Regulations

ITEM	IN TURKEY (BYKHY, 2019)	IN UNTED STATES OF AMERICA (NFPA, 2018) (IBC, 2018)	IN UNITED KINGDOM (Building Regulations, 2020)	NOTES
Corridors				
Length	N/A	N/A	max. 25 m (Table 3.19)	
Width	min. 90 cm	min. 91.5 cm	min. 75 cm (refer to Table 3.21.)	
Height	min. 210 cm	min. 203 cm	min. 210 cm	
Slope	N/A	max 5%	max 8%	
Fire Resistance Rating	60 min. (Refer to Table 3.5.)	min. 60 minutes	min. 60 minutes	
Means of Egress Routes				
Length	10 m	Depending on the Occupancy Load (Table 3.12)	max. 25 m (Table 3.19)	
Width	min. 110 cm	min. 91.5 cm	min. 75 cm (refer to Table 3.21.)	
Height	min. 210 cm	min. 228 cm	min. 210 cm	
Slope	N/A	mx 5%	max. 5%	
Fire Resistance Rating	60 min. (Refer to Table 3.5.)	min. 60 minutes	min. 60 minutes	
Fire Safety Halls				
Length	min. 180 cm	min. 122 cm	min. 140 cm	
Width	Same as stair width	min. 76 cm	min. 90 cm	
Height	min. 210 cm	min. 228 cm	min. 210 cm	
Area	min. 3 m² max. 6 m ²	min. 0.92 m²	min. 1.26 m²	
Fire Resistance Rating	120 min.	min. 60 minutes	min. 60 minutes	
Ramps				BYKHY does not define maximum ramp length and maximum slope of an egress ramp can be 10%
Length	N/A	N/A	max. 10 m	
Width	min. 100 cm	min. 112 cm	min. 150 cm	
Height	N/A	each ramp run max. 76 cm	max. 50 cm	
Slope	max 10%	max 8% transverse 2%	max. 8%	

Table 5.2. Comparison of National and International Means of Egress Regulations (Continuation)

ITEM	IN TURKEY (BYKHY, 2019)	IN UNTED STATES OF AMERICA (NFPA, 2018)	IN UNITED KINGDOM (Building Regulations, 2020)	NOTES
Doors				There is difference between the width given in the Disability Regulations for all three countries
Height	min. 210 cm	min. 198 cm	min. 200 cm	
Width	min. 80 cm max. 120 cm	min. 81.5 cm	min. 85 cm	
Fire Resistance Rating	min. 90 minutes	Depending on the Building Type	Depending on the Building Type	
Handrails				
Length	min. +30 cm from the end of the stairs	min. +30 cm from the end of the stairs	min. +30 cm from the end of the stairs	
Height	70 cm for handrail 90 cm for guardrail	min. 86.5 cm max. 96.5 cm	min. 90 cm max. 100 cm	
Width	min. 32 mm max. 40 mm	max. 57 mm	min. 32 mm max. 50 mm	
Steps				
Depth	min. 25 cm	min. 28 cm	min. 30 cm max. 45 cm	
Width	min. 110 cm	min. 91.5 cm	min. 120 cm	
Height	max. 17.5 cm	min. 10 cm max. 18 cm	min. 15 cm max. 18 cm	
Landings				
Length	min. 180 cm	min. 152 cm	At least stair width	
Width	min. 110 cm	as wide as ramp or stair, min. 91.5 cm	min. 120 cm	
Area	min. 1.98 m²	min. 1.38 m²	N/A	
Slope	N/A	max. 2%	N/A	

6. CONCLUSION AND SUGESTIONS

Although it is hard to plan for every scenario that can arise in every kind of emergency, it is still necessary to be as prepared as you can. One approach to do this is to take into account the opinions of various individuals and organizations, including senior management, human resources, and workers with disabilities, as well as first responders, other companies, surrounding residents, and other interested parties. Early involvement of these parties will aid in everyone's understanding of the evacuation procedures as well as the difficulties that companies, building owners and managers, and individuals with disabilities, encounter.

A sufficient number of exits should be given when constructing escape routes from the building, they should be shielded from fire and smoke, and the staircase and elevator sections should be designed in a way that stops a fire from spreading to another floor. The general layout, building height, population, number of residents, and planning of exits from the building should all be taken into consideration. In addition to the stairs and fire escapes, all evacuation routes must be built in a fire-resistant and secure manner to ensure fire safety.

In order to contain the growth and spread of the fire, the structure must include both horizontal and vertical components. The intended use of the structure should come first when considering fire safety measures in architectural design.

When we examine the concept of accessibility in the architectural design process, we may address a number of major inputs that have a big influence on the design. The first of these is to consider the dimensions and standards determined to meet the physical needs in the building to be designed and the spaces that will create it, in a way that will be suitable for everyone. The projects and practices to be carried out in order to ensure that a barrier-free, accessible life is seen as an indispensable need by our society is promising for the future, but when we look at how much of the legal regulations are implemented throughout our country, the importance given to the subject by the architect or designer, and the expectations of the end users, it is seen that there is a long way to go.

In architectural and design schools, accessibility, barrier-free design, universal design, design for everyone, and the eradication of the scarcity of professionals with this expertise must all be prioritized. Recently, courses in design and architecture education that include

the ideas of accessibility, barrier-free design, universal design, and design for everyone have begun to be taught in our nation in response to the needs of the departments of the higher education institutions. However, if these courses are transferred to students either theoretically or practically, they are generally seen as a utopian idea or as a specialized design under elective vocational courses. For this reason, by seeking new methods to reverse this low interest in design and architecture schools, especially in architectural design studios, a design process that includes the concepts of accessibility and barrier-free space can be preferred in studio work. The knowledge gained during the education process can be supported with undergraduate and graduate scientific studies, competitions and activities.

Visitors face the risk of being left behind when everyone else flees if they utilize a passenger elevator to enter a part of the building that does not have a horizontal evacuation path. It may be argued that because the current legislative framework does not provide adequate protection in these situations, people with disabilities are put in great danger each time they enter a multi-story building.

The research shows that a more comprehensive strategy has to be adopted by government regulators, workplace managers, and facility managers to overcome the gap in regulation. This strategy must take into account workplace management controls, human behavioral factors, and a building's structural characteristics.

To narrow this gap, legislative reforms must be implemented. Wherever risk may be lessened, consideration must be given to providing everyone with accessible exits while taking an all-inclusive approach. This involves lowering the risk of injury to building occupants as well as the danger to people in charge of delivering safe structures and workplaces.

It is necessary to develop strategies for improving the social and behavioral components of an inclusive approach to accessible methods of egress. This covers management procedures, occupant fire drills, and consideration for the usage of evacuation lifts and shelter places.

When we look at the literature review made during this study, it is seen that fire drills are not carried out in Turkey today and how to evacuate disabled people in an emergency is not programmed. Fire escape drills need to be conducted more frequently to educate building

users. Including disabled people in fire drills will reduce the stress they will experience in emergency situations and facilitate their evacuation.

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