INVESTIGATION OF INCLUSIVE DESIGN PRINCIPLES, APPLICATIONS AND A CASE STUDY IN ÇANKAYA UNIVERSITY, ANKARA

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ABSTRACT

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Inclusive design is a set of principles that were developed during the middle of the past century with the aim to provide equal accessibility, opportunity and usability for all users' groups for the built environment. The concept was developed in the United Kingdom with a few similar principles for the same aim around the world. Inclusive design takes into consideration the diversity in users' capabilities in order to provide the smoothest experience for everyone. There are seven main principles for inclusive design, which are equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance of error, low physical effort, and size and space for approach and use. The main aim of the research is to analyze the Balgat campus of Çankaya University, Ankara, in accordance to inclusive design principles and to propose modifications that enables the built environment to achieve the inclusive design criteria. The study used a qualitative analysis method to identify six key areas within the campus, which are entrance and main lobby, circulation and corridors, service areas (cafeteria), library, studios and toilets. Four user groups using the campus were identified; elderly, users with disabilities, international and exchange students, and national students. The analysis of the current design status shows that the majority of the areas on campus do not comply with inclusive design principles. Design models for the entrance, lobby and corridors are provided, as well as design suggestions and recommendations for the six areas, which increased the conformity of the campus with the seven inclusive design principles.

Keywords: inclusive design, university campus, qualitative analysis, design models

ÖZ

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Kapsayıcı tasarım, tüm kullanıcı gruplarının yapılı çevre için eşit erişilebilirlik, fırsat ve kullanılabilirlik sağlamak amacıyla geçen yüzyılın ortalarında geliştirilen bir dizi prensiptir. Konsept, İngiltere'de aynı amaç için birkaç benzer prensip ile Birleşik Krallık'ta geliştirilmiştir. Kapsayıcı tasarım, herkes için en yumuşak deneyimi sağlamak için kullanıcıların yeteneklerindeki çeşitliliği dikkate alır. Kapsayıcı tasarım için adil kullanım, kullanım esnekliği, basit ve sezgisel kullanım, algılanabilir bilgiler, hata toleransı, düşük fiziksel çaba ve yaklaşım ve kullanım için boyut ve alan olan yedi ana ilke vardır. Araştırmanın temel amacı, Ankara'daki Çankaya Üniversitesi'nin eski kampüsünü kapsayıcı tasarım ilkelerine göre analiz etmek ve yapılı çevrenin kapsayıcı tasarım kriterlerine ulaşmasını sağlayan değişiklikleri önermektir. Çalışmada, kampüs içinde giriş ve ana lobi, dolaşım ve koridorlar, servis alanları (kafeterya), kütüphane, stüdyolar ve tuvaletler olmak üzere altı kilit alan tanımlamak için nitel bir analiz yöntemi kullanılmıştır. Kampüsü kullanan dört kullanıcı grubu tanımlandı; yaşlılar, engelli kullanıcılar, uluslararası ve değişim öğrencileri ve ulusal öğrenciler. Mevcut tasarım durumunun analizi, kampüsteki alanların çoğunun kapsayıcı tasarım ilkelerine uymadığını göstermektedir. Giriş, lobi ve koridorlar için tasarım modelleri ile altı alan için tasarım önerileri ve öneriler sunuldu; bu da kampüsün yedi kapsayıcı tasarım ilkesine uygunluğunu arttırdı.

Anahtar Kelimeler: kapsayıcı tasarım, üniversite kampüsü, nitel analiz, tasarım modelleri

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I would to thank my dear husband and my family for their patience and support throughout my study journey.

This work is dedicated to my beloved country Libya and I pray to God to enable me to apply my knowledge to benefit it and its people for development and peace.

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CHAPTER 1

INTRODUCTION

With the aim to provide an equal accessibility and opportunity for all users in the physical environment, several design principles emerged in different countries, where they differ in their origins and approaches (Persson, Ahmad, Yngling, & Culliksen, 2015). There are three main principles that have addressed considering the capabilities and needs of all user types during the design of the physical environment. The first concept was defined in the United Kingdom in 2000 under the term "Inclusive Design", which applies to environments that satisfy the largest share of the space users. The concept of inclusive design extends beyond disability and elderly to look for all groups that are not usually considered in the design. Other concepts such as; "Universal Design" and "Design for All" have been started in the United States following the Vietnam war in order to take into consideration the needs of all user groups and provide an equivalent experience of the physical environment to all of them (Design and Architecture Norway, 2011). Nonetheless, the three terms describe similar concepts that their application achieve a physical environment usable by all user groups (Ormerod & Newton, 2005). The term "inclusive design" is used in this research as a unified term to describe the concept and due to its description of a design that "includes" all user groups.

The main reason to assess and apply the inclusive design principles is to understand the diversity of the population who are using or intended to use the physical environment. Furthermore, the considerations of the inclusive design are innovative that different criteria can be emerged such as the body size of the users (Pritchard, 2014). There are seven specific design principles that are identified in the assessment and application of inclusive design into the physical environment: equitable use, flexibility in use, simple and intuitive, perceptible information, tolerance for error, low physical effort, and size and space for approach and use. These principles are applied in different manners depending on the needs and diversity of user groups of a certain built environment (Ormerod & Newton, 2005).

The inclusive design is a significant concept as there is often a variety of user groups that need to be considered, which implies complexity in the design consideration. The designer shall have an extensive user expertise, knowledge of possible solutions and ability to predict the interaction with the different design elements in order to provide the most efficient inclusive design (Heylighen, Van der Linden, & Van Steenwinkel, 2017). Furthermore, the ability to collect data about the ~~space~~ users and the usage patterns is key in order to be able to provide or modify a design to satisfy the inclusive design principles. A literature survey showed variety of instruments that can be used ~~in order~~ to collect user data ranging from technological tools, governmental data to questionnaires, surveys and quizzes (Gray, Zimmerman, & Rimmer, 2012). Therefore, in this research, the inclusive design principles are researched and applied to an educational setting for evaluation and recommendation purposes. The tools, measures, and structure of the research are discussed in Chapter 2 of the thesis.

1.1 Inclusive Design and Research Significance

The concept of inclusive design is defined as design guidelines emerged in 1950s under several terms in different parts of the world, including the United States, the United Kingdom, Scandinavian countries and Japan with the aim to increase the participation of the passively/ unintentionally excluded population with the current design practices and technologies (Brown & Robert, 2009; Clarkson & Coleman, 2015; Hanna, 2005). The concept ~~is~~ targets mainly ageing and disabled users through understanding their needs, and in order to increase their interaction with the built environment in an accessible manner. Although targeting 100% of the population is challenging, studies show that the implementation of inclusive design principles has several benefits for users and facility owners. Users ~~obviously~~ benefit from the increased accessibility and flexibility to the facility and being able to use its services. Additionally, it was suggested that inclusive design has economic benefits for facility owners with a reasonable cost (Halbach & Fuglerud, 2016; Maisel & Ranahan, 2017).

The current research investigates the implementation extent of inclusive design principles in Balgat Campus of Çankaya University, which was built as a high school in the 1980s and then used as the university campus upon its establishment in 1997. The analysis shows

that some of the design principles were considered during the development; however, further enhancements can be incorporated to increase its accessibility and flexibility for users with special needs. The implementation of inclusive design has the potential to increase user satisfaction, as well as boost economic returns up to 30% (Perry, 2017; Maisel, et al., 2017). The investigation carried out in this study identifies the issues that are hindering the inclusivity of the case study facility. Moreover, design suggestions and recommendations are provided for further development.

1.2 Aim of the Study and Research Questions

The main aim of the research is to analyze the Balgat campus of Çankaya University, Ankara, according to the inclusive design principles and to propose modifications that enables the built environment to achieve inclusive design criteria. The analysis was performed through an assessment process of the inclusive design principles. Thereafter, proposals from the various applications and the innovative suggestions found in the literature are used to enhance the current design. In order to achieve the main aim of the study, the following objectives are set:

1. Understanding the concept of inclusive design in detail through a comprehensive review of the main design principles.
2. Studying the development of inclusive design and its principles.
3. Reviewing applications of inclusive design in order to grasp the most efficient solutions that were adopted by experienced designers.
4. Reviewing the literature for applications of inclusive design principles in educational environments.
5. Collecting data of the users of the Balgat Campus of Çankaya University to classify the different user groups and understanding their needs.
6. Performing an architectural analysis of the current campus design elements and assessing the extent of inclusive design principles' implementation.
7. Recommending solutions for the case study campus in order to increase its conformity with inclusive design principles.

There are several questions that are developed through the course of the study. Nonetheless, the main questions that need to be answered by this research is: what is the current compliance status of the Balgat campus of Çankaya university with inclusive design

principles? How can inclusive design be achieved in order to account for the majority of the user groups?

Therefore, it is necessary to develop ~~to~~ answers to the main questions of the research using secondary questions. The secondary questions are as follows:

Q1: What are the principles of inclusive design that are applied in the built environment?

Q2: How are the inclusive design principles applied in the built environment and specifically in the educational context?

Q3: What are the different user groups that are available in the old campus of Çankaya university?

Q4: How can the current design be enhanced using inclusive design principles?

1.3 Structure of the Thesis

The first chapter of this thesis focused on introducing the concept of inclusive design. Moreover, the main aim, research questions, and objectives are identified. The second chapter is the ~~a~~ literature review of the inclusive design concept development and history, in addition to understanding the principles of inclusive design. Furthermore, applications of inclusive design principles are studied in order to understand their practical deployments and the extent of which they were used to enhance the experience of the various user groups. The chapter researches the application of the inclusive design principles in educational contexts. The research performs an in-depth study of the different design elements and the way inclusive design principles are implemented into each one of them. The main aim of the literature study is to survey the inclusive design ideas that could be implemented into the case study.

The third chapter provides the research design and methodology that are used for the assessment of the case study and the development of the models and recommendations. The fourth chapter includes the case study of the thesis, which is the application of the inclusive design principles into the Çankaya university, Balgat campus. The chapter starts by previewing the collected data about the different user groups that are available at the campus, then moving to an architectural analysis of the campus design elements and evaluating its conformity to inclusive design principles. The fifth chapter provides design

suggestions by the researcher through three-dimensional (3D) models and recommendations for the key areas within the campus. Moreover, a post-design assessment is carried out to measure the conformity of the key areas to inclusive design principles after the research. Based on the results of the case study, the conclusions of the study are provided in the sixth chapter; answering the research questions and reviewing the results.

CHAPTER 2

LITERATURE REVIEW

It is imperative to understand the inclusive design based on its history, principles and applications. Therefore, this chapter provides a thorough review of the literature on the origins of the basics, in addition to an understanding of the seven inclusive design principles that were developed. Moreover, applications of inclusive design principles to different environmental elements are presented.

2.1 History and Definition of Inclusive Design

This section explains the attention to the principles of inclusive design. It started when designers began to realize that the built environment experience is similar for all users. It was noticed that many space users cannot use essential elements of the interior and exterior, including stairs, light switches, and restrooms. Therefore, the designers desire to include the widest range of user groups into experiencing their designs, as well as abolishing disparity in environment experience between them, defined the term inclusive design (Hamraie, 2016). Several disability rights movement legislations have been based in the United States between the 1970s and 1990s, which forced professionals in several sectors to reconsider their work practices and standards. Such movement drew the attention of the architects to rethink their standards and design to ensure that there is no discrimination in the user's experience between any of the user groups (Hanna, 2005).

The first attempts to consider and establish inclusive design principles on the global level were in Japan, United States, and Europe in the 1950s. The research and innovative approaches towards and easy and smooth use for all users evolved into applying seven main principles; equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size and space in approach and use (Brown & Roberts, 2009). Nonetheless, the discussions about designs that can fit different types of users were only insights and visions towards the main aim. The inclusive design

principles were note defined and became clear until 1990s, as more research and applications on the subject commenced. The main objectives were identified as facilitating usage based on the social needs for aging, disabled, and diversity (Clarkson & Coleman, 2015).

Inclusive design in the United Kingdom started by addressing the challenges that ~~face~~ the elderly face in using the current urban environments through researches, conferences, exhibitions, and design proposals. The early exhibitions/ conferences conducted in the middle and late 1980s were focused on designed ideas that considers the senior user group. Nonetheless, in the 1990s the concept was improved to include other special user groups, including the disabled (Clarkson & Coleman, 2015). As the concept of inclusive design got wider, a general definition was provided as the practice of understanding the population's diversity and responding to it by taking informed design decisions. The significance of the concept emerges from its benefits to mitigate business risks and providing competitive advantage for the design as it becomes simpler (Waller, Bradley, Hosking, & Clarkson, 2015). Based on the geographic origin of the concept and the main focus, several terms have emerged describing as illustrated in Figure 2.1 and narrated as follows (Clarkson & Coleman, 2015):

- Inclusive design: Originated in the UK and the focus is on the ageing users. It is mostly driven by the market and the private sector based on business and design decisions.
- Universal design: Originated in Japan and further adopted and developed in the US with focus on the disabled user groups. It is driven by both the private and public sectors.
- Design for all: Originated by the Nordic countries and adopted by the EU countries later on, focusing on the disabled user groups. It is mainly driven by the public sector through legislations.

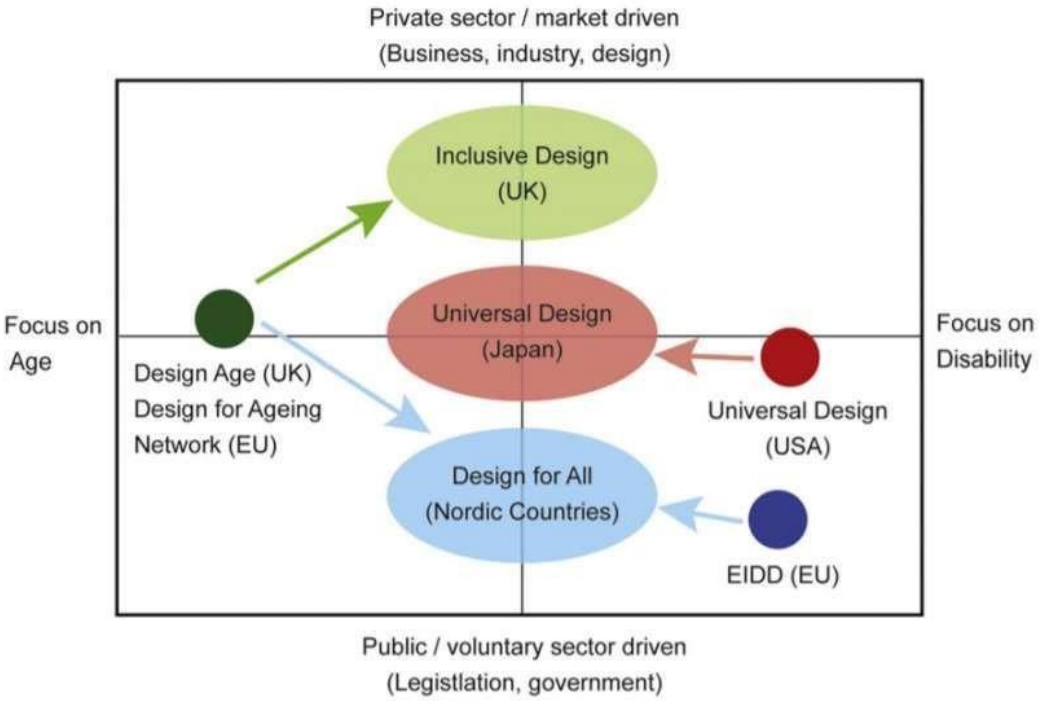

Figure 2.1: The origins and influence of the different ideas of inclusive design, universal design and design-for-all (Clarkson & Coleman, 2015)

In spite of the difference in origins and influences of each concept, it can be said that three of them have similar, if not the same, objectives and vision (Van der Linden, Dong, & Heylighen, 2016). The term of inclusive design is used in this research to represent the three terms in order to avoid confusion and provide consistency. There are two drivers of inclusive design concepts that have been responsible for its development, expansion and adoption by many countries and designers; policies imposed by legislations and business opportunities foreseen by the private sector. The concept influenced several aspects and design disciplines, including products, architecture and products (Van der Linden, Dong, & Heylighen, 2016).

The initiation of inclusive design commences through understanding the different user groups within the society that would potentially interact with the environment in different manners. Figure 2.2 shows the division of the working population in US based on the difficulty level of their impairments. Therefore, it is illustrated by the response to the diversity of the user groups as a portfolio is developed understanding these difficulties,

defining the targeted beneficiaries from the developed design, and making design decisions based on this information to enhance the success of the design. As shown in Figure 2.2, it cannot be possible to include 100% of the population in the design, as some severe difficulty cases need special products that attends to the specific needs of these users (Waller, Bradley, Hosking, & Clarkson, 2015). Figure 2.3 provides a more detailed survey of the elderly user groups in the UK, where loss of consciousness (LOC) and hearing impairments form the majority and the most severance rate amongst the surveyed group (Clarkson & Coleman, 2015).

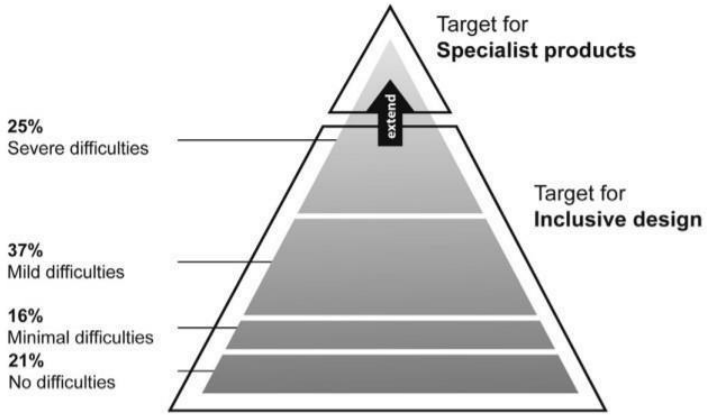

Figure 2.2: The response of inclusive design to the population pyramid (Waller, Bradley, Hosking, & Clarkson, 2015)

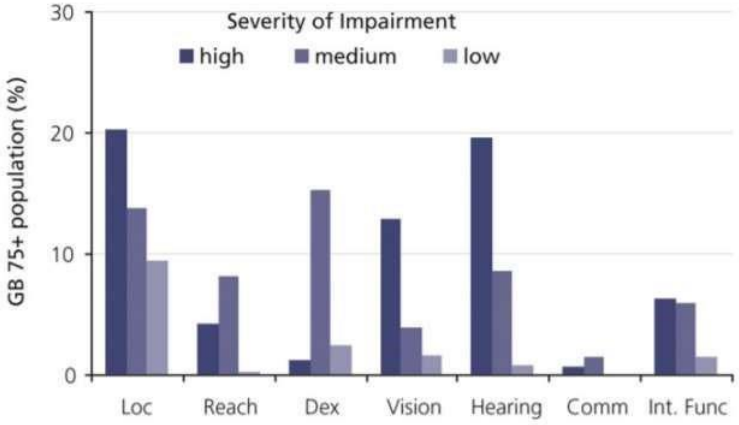

Figure 2.3: Impairments faced by old user groups as per a survey in UK (Clarkson & Coleman, 2015)

2.2 Principles of Inclusive Design

Inclusive design has basic principles that define its success in designing and implementing the concept, which are based on the objectives of a useful design that can be marketed to diverse users with different abilities, flexible to include the widest range of users, easy to comprehend by the users regardless of their background and skills, easy to be communicated, ability to reduce accidents, enabling usage with minimum effort, and provides enough space for a comfortable and efficient use (Barnes, 2011). The following sections review the seven principles of inclusive design through definitions, insights and selected examples for a better understanding.

2.2.1 Principle 1: Equitable Use

Equitable use concept is defined through the ability of the design to useful to different user groups with diverse abilities and the easiness of marketing the design to them (Watchorn, Larkin, Hitch, & Ang, 2014). These two characteristics needs to be provided by the design while maintaining the required privacy, security and safety levels, regardless of the users' impairments or personal variations (Helvacioglu & Karamanoglu, 2012). Benefits of implementing this principle are the consideration of the variety of the user, which makes it easier to communicate during the sales process. Moreover, equitable use considers the different conditions that may impose hazards on the health of the users, increasing its safety and security. Generally, this principle increases the attractiveness of the design to the widest range of users (Abubakar, Adam, & Ghafar, 2016).

Furthermore, researchers believe that the equitable use principle provides justice within the design, as it considers the needs and the variations of the population. Although such an objective might seem hard to achieve, the resonance provided by some inclusive design solutions simplifies the task. For instance, both user groups with wheelchairs and prams can benefit from providing a curb cuts and ramps. Therefore, fairness in inclusive design does not necessarily mean that all users should have the same experience in the environment, rather than providing a design that takes into account their limitations, understanding them and providing tools that can enhance the different experiences with maximized benefits (Bianchin & Heylighen, 2017). Figure 2.4 shows the way an automatic sliding door design provides equitable use for users with carts and wheelchairs.

Figure 2.4: Equitable use principle provided by automatic sliding doors (Baker, 2017)

2.2.2 Principle 2: Flexibility in Use

Flexibility in use principle represents the complexity of functioning the design according to the limitations of the various types of users. One way of providing flexibility in use is to give multiple means of representation, action and engagement (Dinmore, 2013). Therefore, this principle is defined as the ability of the design to accommodate the widest range of preferences and abilities. Such a principle can be implemented through giving options for the usage method (Figure 2.5), accommodating right and left-handed users, considering low accuracy and precision individuals (Figure 2.6), and enabling the design to adapt to the pace of the user (Story, Mueller, & Mace, 1998).

Figure 2.5: Options for usage method illustrated by providing an access using stairs and ramp (Stairs for the Wheels, 2018)

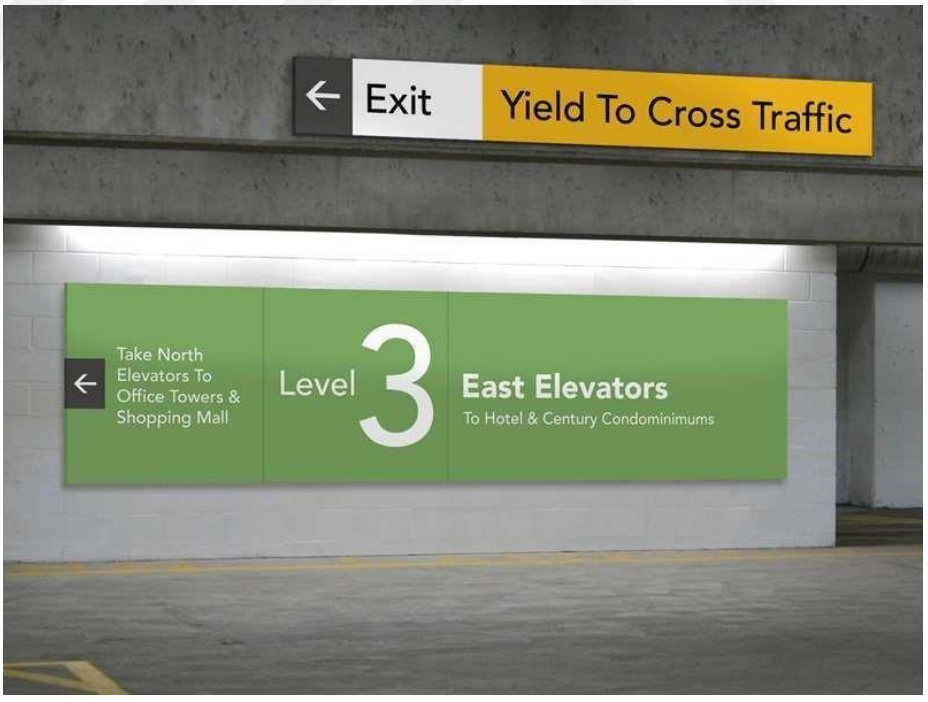

Figure 2.6: Providing distinctive signage in order to consider users with low accuracy and precision (Davies Associates, Inc, 2016)

2.2.3 Principle 3: Simple and Intuitive Use

Simplicity and considering the different user expectations are one of the most significant principles of inclusive design. It mainly deals with eliminating complexity where it is unnecessary, providing a consistent design throughout the environment, allowing for difference knowledge and skills, prioritizing elements based on their importance, and looking for feedback for further enhancement (Story, Mueller, & Mace, 1998). Operating a design element through a simple human interaction, such as pushing or turning, allows the user to utilize it without having to think about a way for operation for a long time, which is an example of removing complexity. Furthermore, using different languages on signage and instructions allows people from international background to use the environment using their available language skill (Boduroglu, 2014). Figure 2.7 show an emergency button design that uses a simple push movement for activation, as well as providing button title in English and braille to accommodate users with sight impairments.

Figure 2.7: Emergency button design with simple use and accounting for different skills and user conditions (Ymgerman, 2018)

2.2.4 Principle 4: Perceptible Information

The perceptible information principle is concerned with the communication aspect of the design, as it is necessary for the design elements to provide information to the user in an effective manner, regardless of the environment's condition or the sensory ability of the user (Story, Mueller, & Mace, 1998). The key in this principle is to provide more than one representation of the information, e.g. verbal and pictorial, maximizing the legibility of the information, differentiating information based on their priority, importance or type, and providing more than one technique to suite the variety in sensory abilities (Boduroglu, 2014). Figure 2.8 shows a toilet signage with amplified gender specification signs, allowing the distinguish of gender designation.

Figure 2.8: Toilet signage communicating gender designation with extra-large symbol exaggeration (Eytan, 2016)

2.2.5 Principle 5: Tolerance of Error

The tolerance of error principle states that the inclusive design shall minimize or eliminate hazards during the usage of the element, as well as the results of accidents through unintended action (Story, Mueller, & Mace, 1998). There are a few recommendations to achieve the goals of this principle, where elements can be arranged according to their risk probability and impact, and then corrective design decisions are taken for shielding, isolation or elimination. Moreover, adequate warnings, safety features in case of failure, and discouragement of usage of the elements during certain health conditions shall be imposed depending on the risk analysis carried out (Boduroglu, 2014). Figure 2.9 shows an example of the implementation of the fifth principle. The presented water tab is equipped with a changing color lighting, warning users when the water is hot in order to avoid any burning hazards.

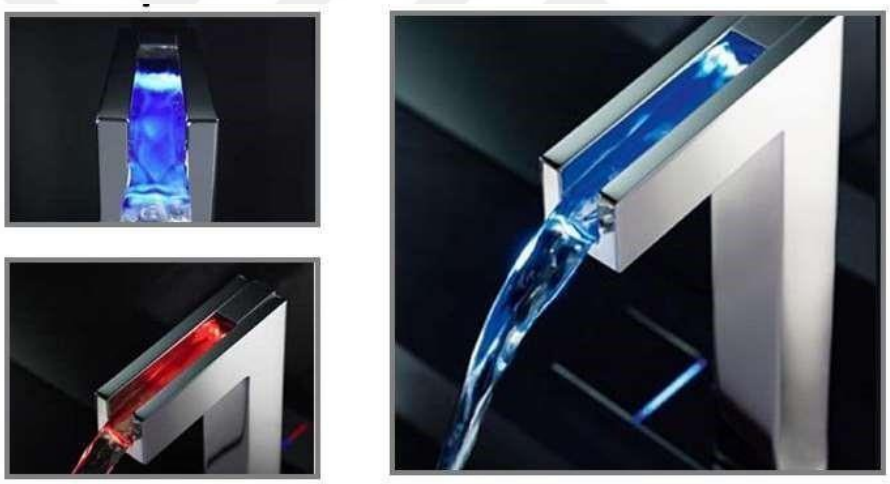

Figure 2.9: Water tab design implementing the principle of tolerance of error, which is equipped with hot water warning through colored lighting (McCoy, 2013)

2.2.6 Principle 6: Low Physical Effort

The sixth principle of inclusive design aims for a design that reduces fatigue during usage through comfortable and efficient use (Story, Mueller, & Mace, 1998). The recommendations to achieve the goals of this principle, includes the design for reasonable force to operate the design element, allowing the user to maintain his or her neutral body position, and minimizing unnecessary repetitive action and continuous physical effort

(Boduroglu, 2014). As shown in Figure 2.10, kitchen counter and equipment can be designed in a special way for disabled facilities allowing the users to maintain their wheelchair position. The depth of the counter and the equipment used take into consideration minimizing the physical effort required to work in the kitchen.

Figure 2.10: Kitchen counter allows wheelchair users to maintain their neutral position for low physical effort (McCoy, 2013)

2.2.7 Principle 7: Size and Space for Approach and Use

The last principle for an inclusive design requires the element to provide an approachable, reachable size and space, allowing the users to manipulate around it, despite their body size, mobility and posture (Story, Mueller, & Mace, 1998). Several recommendations are provided to achieve a size and space for approach and use through maintaining the visibility of the important elements for seated and standing users, keeping all design elements reachable regardless of body neutral position, adjusting the grip size to suite variations, and allowing for space in case any assistance is required. As shown in Figure 2.11, the dimensions and the height of the ticketing gate is adjusted to fit universal size wheelchairs, while the user is able to verify his ticket through a reachable machine.

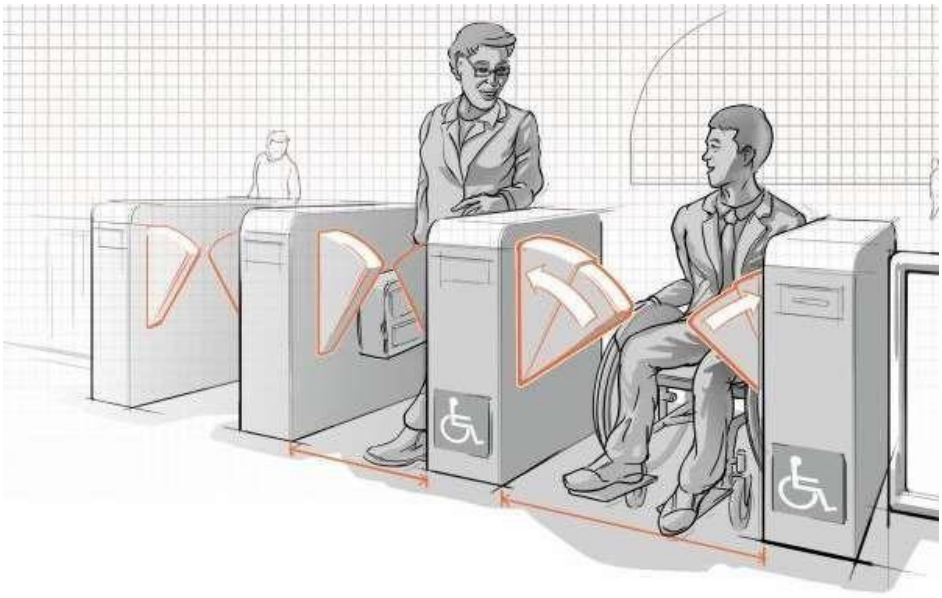

Figure 2.11: Ticketing gate design that provides the suitable size and space for disabled users (Baker, 2017)

2.3 Applications of Inclusive Design

There are several aspects to consider when thinking of inclusive design, especially that the discipline is relatively new, and its principles have only got defined within the past twenty years. There are many challenges to consider advocating for the concept, as designers are facing questions from clients and organizations of its added-value and shortfalls (Heylighen A. , 2008). Therefore, this section focuses on the challenges and limitations of the subject, followed by the benefits that can be achieved from implementation on the micro and macro levels. Moreover, the question about the added costs due inclusive design adoption is answered, along with the planning processes that are recommended whilst considering its implementation in the built environment.

2.3.1 Challenges and Limitations

Most of the sources that studied the need and feasibility of inclusive design have seen that the main challenge is the lack of awareness and knowledge about it. It is challenging to make clients understand the importance of implementing inclusive design principles in achieving sustainability of the built environment, as it either adds cost or it hinders some of the requirements that are desired by the owner. However, inclusive design has been

proven more cost effective than implementing specific measures for certain individual cases (Lynne, 2014). The same challenge extends to professionals and companies due to the perception that inclusive design is a specific design area that is chosen and implemented by choice, rather than a need to design for everyone in the society. The constant encouragement of adopting inclusive design principles in the built environment is mainly driven through legislations, which provides specific recommendations for specific design elements. Nonetheless, it is seen that inclusive design shall be assessed on a case by case basis, where the majority of the population is considered (Bechmann, 2013). A discussion on the challenges facing inclusive design implementation states that there is no specific knowledge of the required practices that need to be implemented in order to consider a design inclusive. It is not that inclusive design is not defined, it is the problem that there are no transparent requirements that make its implementation a knowledge that can be taught and duplicated (Heylighen A. , 2008).

The challenges during the implementation of inclusive design are divided into challenges in predicting the needs of the users, challenges in design solutions and challenges faced in acquiring the feedback required for enhancement for current designs.

Understanding the needs of all the users is the most challenging tasks in implementing inclusive design, as there is a wide spectrum of variations between the users' perceptions and skills, even if they were categorized under the same user group. However, designer can turn such challenges into opportunities, in test of their creativity and ability to find solutions to serve the widest part possible of the population (Dalton, 2016).

2.3.2 Benefits of Inclusive Design

The existence of the concept of inclusive design is based on achieving benefits for the society, especially for the groups who are excluded with conventional design methods. Bechmann (2013) provided five principles presented by the UK Commission for Architecture and the Built Environment that shows the benefits from adopting inclusive design (Bechmann, 2013):

1. Inclusive design puts people at the center when discussing the design process, which shows that the concept is driven by the needs of the population.
2. The concept takes into considerations that difference and diversity of human circumstances.

3. It Gives people choice rather than providing a single design option.
4. The flexibility offered by an inclusive design can give more purpose to the design element
5. Inclusive design allows everyone to use and enjoy the built environment.

Increasing the accessibility of the design is another benefit of implementing inclusive design. The ability to experience seamless transition throughout the built environment is a criterion that makes it more favorable for the users that can achieve it. The scale of implementing the concept would automatically define the lifestyle of people affected by it. If inclusive design is implemented on several built environments within a city, that makes the city inhabitants more satisfied and more socially involved, while ignoring the subject makes it more hostile to live and more socially fragile. Therefore, greater accessibility facilitated through inclusive design would eventually mean a better social value for the city (Bannert & Elnokaly, 2013).

Waller, et al. (2015) states the greatest three benefits of inclusive design are simplicity and risk mitigation, and the ageing population. The ability to figure out the needs of the majority of the population and then design for it allows the design to be preferred by the widest number of people, which is a competitive advantage against conventional designs that considers the able part of the population. Furthermore, inclusive design prioritizes the safety features of the design elements, which reduces costs of customer support, reduces warranty costs, avoids lawsuits, and increases the satisfaction of the users. Finally, statistics show that the number of the aging population increase, as the population grows, which increases the percentage of the excluded users year by year. Thus, implementing inclusive design allows designers, companies and governments to avoid several problems that can emerge in the future (Waller, Bradley, Hosking, & Clarkson, 2015).

2.3.3 Costs and Affordability

There are two views on the costs associated with implementing inclusive design; the cost of excluding part of the population from the built environment and its impact on their activities and behavior, including lost purchases due to accessibility issues, and the costs of achieving accessibility in an existing building versus designing it inclusively (Perry, 2017; Maisel, et al., 2017). The chairman of the Construction Industry Council in the UK believes

that there are no added costs by adopting inclusive design strategies. Moreover, the reduced costs of healthcare and social care make up for any additional features that may be added to adopt inclusive design in any aspect. There are economic impacts that occur due to excluding more than 80% of the disabled population from making purchases, participating in social activities, and participating in the workplace (Perry, 2017). An increase of 30% is expected in sales and economic activities through the adoption of inclusive design.
Therefore, inclusive design assures the efficiency of utilizing society's human capital, as well as economic efficiency (Maisel, Steinfeld, Basnak, Smith, & Tauke, 2017).

Furthermore, Maisel and Ranahan state that considering an inclusive design from the conception of the built environment should not add any budget provisions. Nonetheless, if an existing is to be redesigned for more accessibility, additional costs are expected, especially with specialized contractors on board (Maisel & Ranahan, 2017). However, understanding the extent and the scope of the needed inclusive design is essential in order to be able to estimate the associated costs. Through studying the user profile and the population excluded from using the built environment, designers and engineers should be able to define the elements that need to be incorporated. Thus, calculating costs is a more achievable task (Halbach & Fuglerud, 2016).

2.3.4 Planning

For an effective inclusive design implementation, it is essential to understand the purpose and requirements of the seven principles of the concept. Such a comprehension allows for a proper design solution that can fit the needs of the population, as well as achieve a specific plan with clear objectives. As shown in Figure 2.12, the overlapping of the seven inclusive design principles uncovers seven objectives of inclusive design during the planning stage: adaptability, power to choose, user friendly interface, wayfinding clues, human scale, proximity and safety. Through understanding those objectives, designers can target the different systems within the built environment based on more specific requirements (Bjork, et al., 2013).

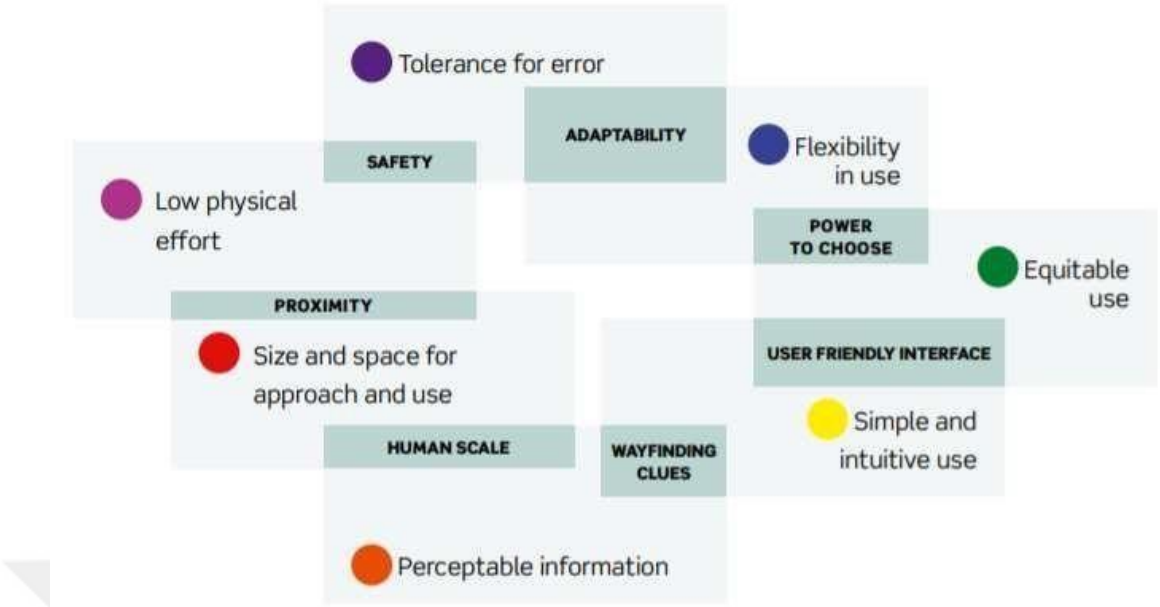

Figure 2.12: Design objectives for planning through the overlapping of inclusive design principles (Bjork, et al., 2013)

Planning in inclusive design should ensure that human is the core interest in the design process. Through understanding the basic and high-level needs of the individuals in the society, designers are able to categorize the design criteria into useful, usable, sustainable and desirable. The achievement of these needs during the design process is through collaboration between the users, design and implementation stakeholders from different disciplines, as shown in Figure 2.13 (Bjork, et al., 2013). During planning for the implementation process, there are five key areas, where users interface with the interior built environment; circulation system, entrances and exits, wayfinding system, products and services acquisition, and public amenities. Each of these systems has different strategies to handle, as shown in Figure 2.14 (Anous, 2015).

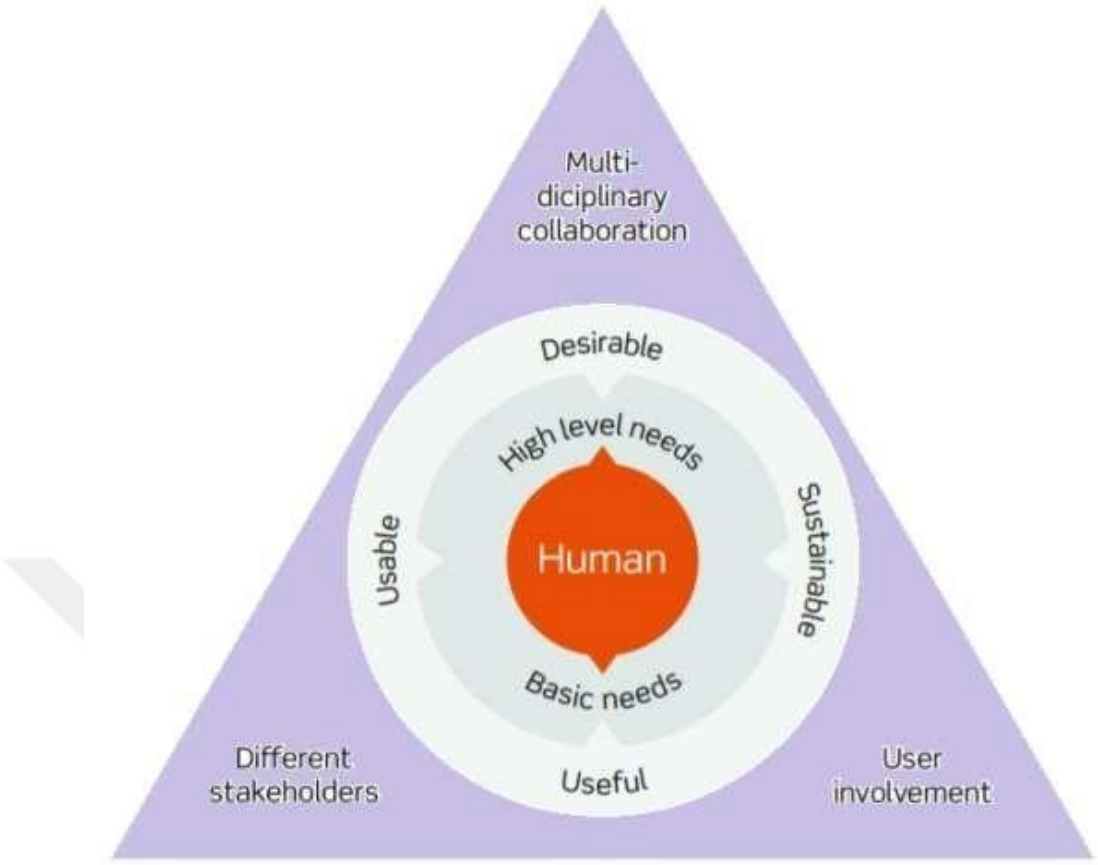

Figure 2.13: Planning and design process framework for inclusive design (Bjork, et al., 2013)

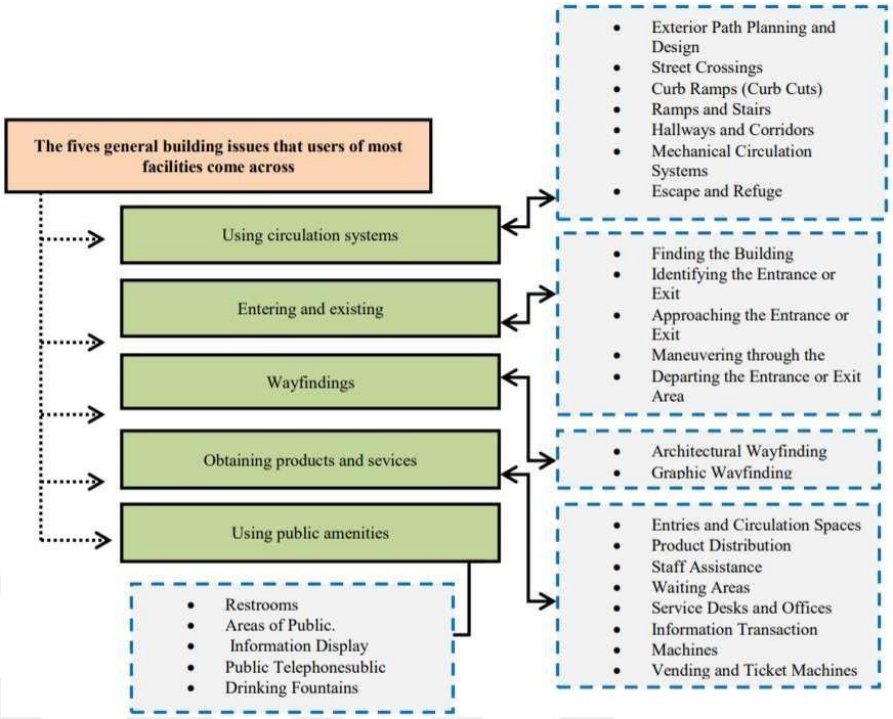

Figure 2.14: Design areas to be considered during the planning phase of inclusive design (Anous, 2015)

The conventional design wheel can be used as a planning tool during the inclusive design process, as shown in Figure 2.15. Managing the design process is the core of the wheel, where the goals are defined, and a common understanding is created. Exploring the potential of the design through observations and data is the first strep. Then, work starts within the creation process, where the design ideas simulated based on the needs of the users. The concept of the design is then developed, and prototypes or renders are presented. Thereafter, the evaluation of the created design occurs through a set of criteria and group of experts. The design can be tested on users in order to understand the percentage of excluded users from the built environment. Once evidence is available, a business case is built in the management process and the design can be executed (Waller, Bradley, Hosking, & Clarkson, 2015).

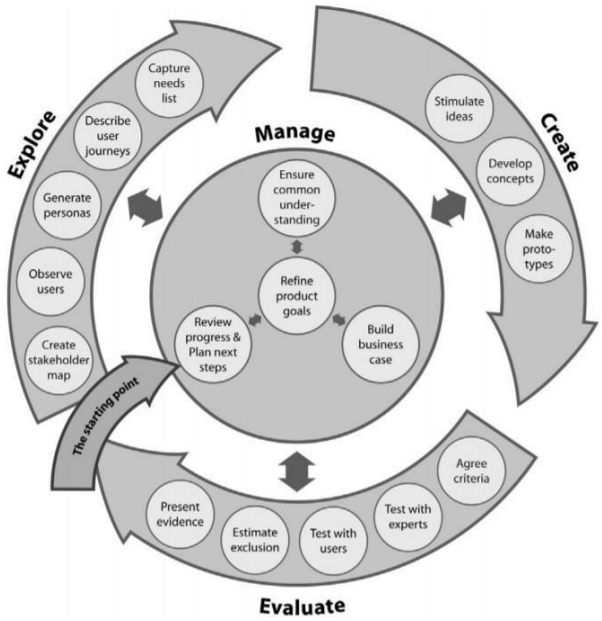

Figure 2.15: Design planning and execution illustrated via the Design Wheel (Waller, Bradley, Hosking, & Clarkson, 2015) – Design process wheel is a tool used in inclusive design for planning and control during design and execution (narration in previous paragraph)

2.4 Application in Inclusive Design to Educational Environments

Educational environments are considered sensitive as they impact the psychological status of the students, as well as their academic achievements. Factors such as lighting, ventilation, acoustic, circulation system, accessibility and technology are all physical environment factors that has been identified to have this impact. Therefore, governments and legislation bodies work on issuing guidelines and reports on these impacts and provide recommendations for more efficient and accessible educational environments (Wall, 2016). This section provides a review of studies and reports issued in the literature, which include analyses of inclusive design principles in educational environments, or present cases that implemented the concept completely or partially. The aim of this review is to understand the implementation of inclusive design principles in educational environments and its possible extent.

A Swedish study examined the building process of the educational environment in order to suite students with concentration challenges (i.e. ADHD, Down's syndrome and autism). The people affected by such difficulties are known to be more sensitive to their

environment, when compared with other types of users. Therefore, it is important to rethink the design processes and the considerations that are implemented in the physical environment, in order to allow them to participate in the educational and social activities. The study considered the physical environmental factors, in additional to social, pedagogical and individual factors that has the potential to impose an impact on the targeted subjects' experience. The results of the research, which is constructed through two case studies, show that the physical environment had a great impact on the abilities of the students. Background noise, direct sun lighting, high number of students in the classroom, increased number of doors and windows, had a negative impact, which indicates that the acoustic design is one of the factors to consider during the inclusive design process (Tufvesson & Tufvesson, 2009).

Consideration for different disabilities requires different arrangements and design strategies. In a study that researched inclusive design with attention to the deaf users in an educational environment, the author emphasized that developing an inclusive education is part of providing an inclusive design (Abdel-Maksoud, 2016). Therefore, the focus of the study was on gathering and classroom areas, where users interact and communicate. The study shows that space and color are the two most influential factors in enhancing the inclusivity of the design for the deaf. Cases with wide circulation systems, comfortable gathering areas and color-coded plains, signs and tools were presented as a successful tool in tackling these challenges. Blue and green colors were found to impose more comfort on the hearing-impaired individuals. Moreover, the author mentions that the circulation system and the size of space should allow for free movement, as well as the use of reflective surfaces with low-glare for better wayfinding clues (Abdel-Maksoud, 2016), as shown in Figure 2.16.

Figure 2.16: Use of space and size with reflective surfaces with low-glare for an inclusive design for the deaf - entrance and social area (Abdel-Maksoud, 2016)

Disability in movement and mobility is another challenge that causes the exclusion of part of the population. People with such issues are often using wheelchairs to move from one place to another. Therefore, it is essential for the inclusive design to provide ramps at the stairs and cuts at the curbs in order to facilitate their movement. Moreover, safety features are added, such as handrails on both sides and non-slippery finishing, to provide movement assistant and prevent any accidents (Chiwandire & Vincent, 2017). An evaluation of the specific issue on four university campuses in Botswana showed that some of these features were provided in 53% of the studied cases, Figure 2.17, while the remaining cases faced issues with one or more feature (Fidzani, et al., 2013). Entrances are significant as sufficiently wide gates should be provided through a double or a sliding door. For wheelchair users, there should be no barriers placed in pathways, or in front of entrances and ramps. The height of counters (administrative) and amenities (kitchen and toilets) shall be adjusted to allow the wheelchair users to use them without having to adjust their body position. Furnitures should also allow wheelchair users to use them with providing the suitable heights and undercounter space. Finally, vertical transportation and parking spaces shall be provided with extra spacing in order to allow for the universal wheelchair size (Armah & Kwantwi-Barima, 2016).

Figure 2.17: Good ramp example with handrails on both sides and floor is finished with non-slippery material (Fidzani, et al., 2013)

Another good example of inclusive design implementation is the case of Aalto University, Finland, where several considerations were given to the excluded part of the population. The model of the university encourages social involvement and responsibility towards social values. The study defined disability as the gap between the demands from the environment and the individual capabilities of the users. Therefore, bridging the gap would mean implementing changes to the environment that would approximate the capabilities of the users, while strengthening the users' abilities to use the environment efficiently. Several examples were provided by the authors of inclusive spaces. As shown in Figure 2.18, a social space is provided with plenty of movement space, which gives it flexibility and the suitable size for maneuvering. Figure 2.19 shows a classroom setting with several levels, where the stairs are equipped with adjustable panels that serve as a ramp. Figure 2.20 shows a side ramp at the campus with non-slippery material finish and handrails on both sides. Finally, the stairs at the main lobby on campus in equipped with a stair lift, Figure 2.21, allowing people with mobility issues to use it for vertical transportation. The considerations of inclusive design are unlimited; however, the main goal is to include the widest range of the users in order to achieve a smooth educational environment for everyone (Raike, Ahlava, Akytta, & Tuomi, 2016).

Figure 2.18: Study and social space at Aalto University providing flexibility and freedom of movement (Raike, Ahlava, Akytta, & Tuomi, 2016)

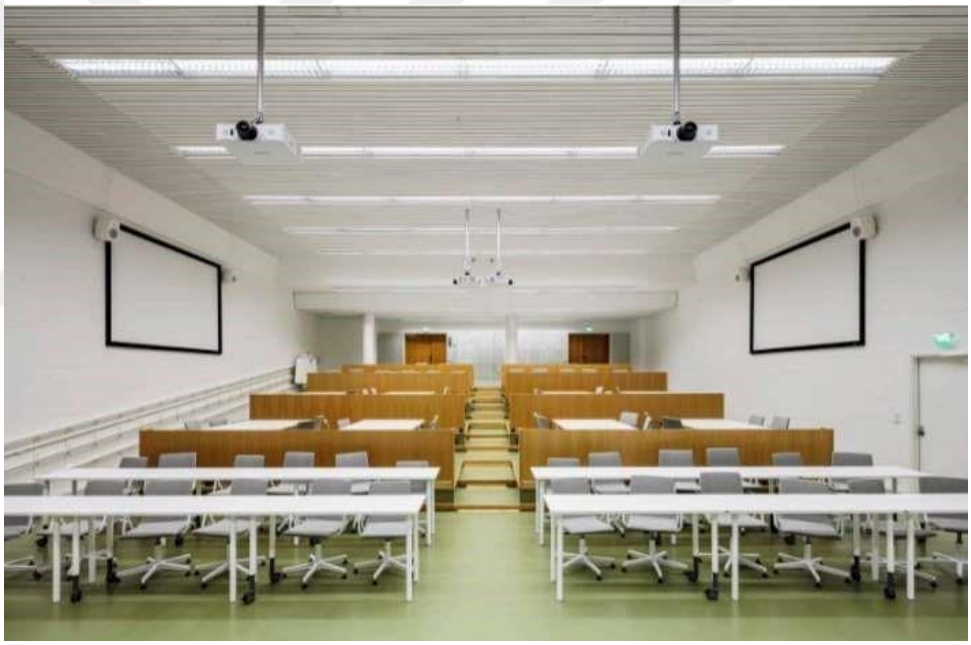

Figure 2.19: Classroom and workshop setting at Aalto University – Stairs are equipped with ramp panels (Raike, Ahlava, Akytta, & Tuomi, 2016)

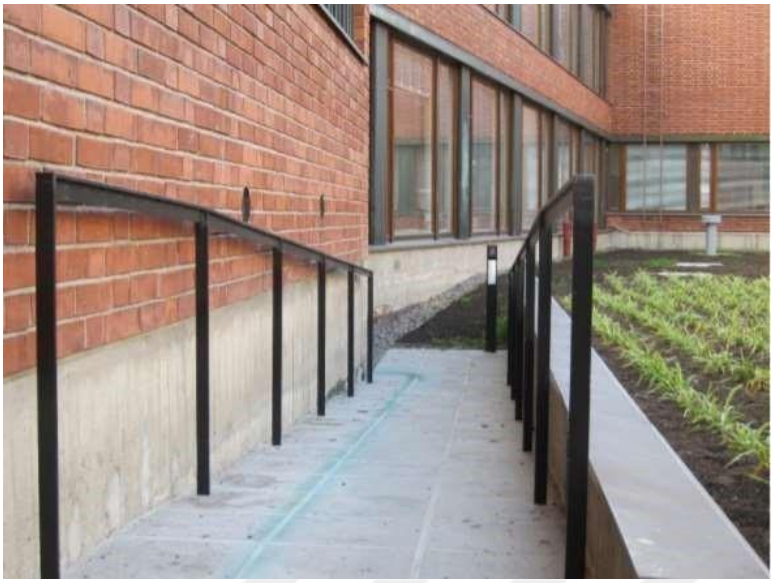

Figure 2.20: Side ramp with non-slippery finish and handrails on both sides at Aalto University campus (Raike, Ahlava, Akytta, & Tuomi, 2016)

Figure 2.21: Stair lift at Aalto University to increase vertical accessibility (Raike, Ahlava, Akytta, & Tuomi, 2016)

Another guideline for inclusive design in educational environments is the UK's Department of Education and Employment's Building Bulletin 94. The guideline provides the aim of inclusive design in the educational environment, its scope, targeted users, significance of

inclusive design, and a review of the most important spaces that need to be considered for a complete inclusive design on campus. Firstly, the bulletin discusses the overall layout of the educational facility, where distances between buildings, access areas, circulation width, noise, furnishing and number of students are all factors to be considered when designing a school layout. The guideline emphasizes the importance of the wayfinding system into providing easy movement between the different parts on campus. Adequate signage, considering the different user groups, are important factors for the sense of inclusion for all built environment users. Horizontal movement, doors and vertical movement components all have minimum specifications in the guideline in order to ensure that users with special needs can access all facilities without assistance. Safety, fire, thermal comfort and acoustic measures are also taken into consideration, as important parts of a complete inclusive design (Hrekow, Clark, & Gathorne-Hardy, 2001).

The guideline provides recommendations and specifications for certain essential parts of the educational environment. In classrooms, it is necessary to have plenty of space in order to achieve flexibility and adaptability according to the several activities performed. Also, the furniture design and layout are important parts of the classroom to reinforce variety in learning. Library facilities contains also of shelving, which could be unreachable for a lot of users. Therefore, an efficient shelving system, as well as adequate spacing between shelves, should be considered during the design. Entrances are another critical point within the built environment that should have flushed edges to facilitate wheelchair movement. The bulletin recommends automated doors for easier access for all users. Designated toilets for disabled with plenty of space and grab bars are essential. Signage to the toilets should be clear and distinguished, while it is recommended to have non-reflective and slipresistance flooring to avoid glare confusion and accidents (Hrekow, Clark, & GathorneHardy, 2001).

2.5 Chapter Summary

The main aim of inclusive design is to ensure the suitability of the built environment for usage for the maximum percentage of the population. Increasing accessibility has several benefits, including economic and social benefits. There are seven basic principles that need to be incorporated for an inclusive design; equitable use, flexibility in use, simple and

intuitive use, perceptible information, tolerance of error, low physical effort, and size and space for approach and use. There are recommendations and design suggestions that were found in the literature in order to comply with each of these principles. The main challenge for the implementation of inclusive design is the awareness amongst designers and clients towards it. There is a perception that implementing inclusive design would increase the costs of building. However, it was argued by a few advocates of the concept that the inclusion of a wider percentage of the population can increase the accessibility of a larger number, hence more economic rewards on the long run. In implementing inclusive design in educational environments, it is essential to focus on solutions that facilitate the accessibility of all user groups to all the areas of the built environment. Moreover, technologies using innovative solutions can be beneficial in several parts of the campus.

CHAPTER 3

METHODOLOGY

The following chapter provides the main research strategy and concepts that are used in this research in order to understand inclusive design principles and apply them to the case study. A qualitative research method is used, which is reviewed for its advantages and disadvantages. The architectural analysis design and research designs are presented.

3.1 Qualitative Research

The selection of the research method mainly depends on the research question that is targeted in the study, as well as the nature of the research. Qualitative research methods are found to be used in complex research that contains more details required to answer the research question. The emphasis level in qualitative research is known to be more than its counterpart for the quantitative research, which is used to understand the nature of a phenomenon rather than looking into details. In quantitative research, a margin of error can be estimated or specified; however, qualitative research breaks down the subelements of the main element targeted by study and understand their compliance with a certain standard or quality level. It is rare for the qualitative research contain numerical data. Instead, the qualitative research depends on understanding the standard qualities by the field experts, study subjects and the researchers, and the perceived compliance of each quality criterion (Erbil & Akinciturk, 2010).

In architecture, qualitative research is used for researches that require assessment of the built environment. Designers seek information back from the environment in order to be able to enhance it and increase its usage efficiency. Several qualitative methods can be used for the evaluation of the built environment, including; observation of user behavior, analysis of design elements for specific quality criteria, review of model examples against a case study, POE assessment (post-occupancy evaluation), and Performance data

collection and evaluation. Accuracy in acquiring information and understanding the qualities that need to be observed are key skills that need to be monitored during a qualitative methodology implementation. The use of qualitative research methodologies ensures that the study provides accurate and reliable information about the built environment at lower costs. Therefore, in architectural studies, qualitative research is an essential source of data and solutions that can be used for design enhancements and quality reference (Fross, Winnicka-Jaslowska, Guminska, Masly, & Sitek, 2015).

Fross and Sempruch (2015) defined the steps of a qualitative architectural research and the benefits that yields from adopting such a methodology. The qualitative research starts by understanding the different sources of information that can be used to acquire the knowledge needed about the built environment and the users. Moreover, standards, guidelines and experts' recommendations are used to establish the quality criteria that are assessed in the built environment. The next step would be planning, programming and designing the enhanced elements within the building in preparation for construction. After the project execution, additional data is supplied to the original data for further efficiency and verification of the design decisions that were made initially. Generally, there are three main points that are recognized through using qualitative research in architecture (Fross & Sempruch, 2015):

- Design solution and built environment qualities are enhanced through the knowledge acquired from existing building assessments.
- Two qualities are targeted by the qualitative research; functionality and quality enhancement, and user satisfaction.
- Qualitative research is successful in defining the priorities of the design, which impacts the success of the design and the project.

3.2 Compliance Analysis

Assessing an existing built environment for compliance is a common methodology in researches that aim for enhancements in one or several architectural qualities. The level of the analysis or the assessment accuracy mainly depends on the maturity of the quality standards that are used in the analysis process. For instance, sustainability standards and processes are considered one of the most developed concepts in architectural evaluation. Therefore, several criteria, assessment systems and quality requirements are developed

based on the geographic location, built environment functionality and the level of compliance targeted by the designer. Based on that, a compliance analysis commences by defining the quality system or standard that the built environment is evaluated against, which contains the set of criteria that are used in the assessment process. Thereafter, the criteria and their importance are determined, if not an equal weight distribution is used. Finally, the assessment is conducted based on users', experts' or researchers' expertise (Akadiri, Chinyio, & Olomolaiye, 2012).

In studies related to compliance analysis of the built environment against the principles of inclusive design, researches have used the seven principles that were developed through design and architectural research through a narrative explanation of the compliance between a certain case study and its ability to provide maximized usage for the majority of the users. Three main criteria were considered in a Nigerian study with a museum case; approachability, accessibility and usability. The first two criteria are concerned with the user travel on the horizontal and vertical levels, while the usability criterion is concerned with more specific design characteristics that enables each user group to benefit from the facility (Ibem, Oni, Umoren, & Ejiga, 2017).

3.3 Research Design

The study develops by understanding the concept of inclusive design and the main principles that need to be applied in order to achieve a fully compliant system. Thus, the literature review performed in the second chapter allows the researcher to form a comprehensive understanding that leads to compiling a set of requirements and criteria. Moreover, the application of the inclusive design concepts in the different types of built environment enables the research to be consistent with the findings of other research in the literature. The applications on educational environment contexts aims mainly to establish specific measures and techniques that are used in different case studies to comply with the inclusive design principles through specific design elements.

Subsequently, the user groups' needs were evaluated through a data collection method. The data of the old campus of Çankaya University were obtained through university data of students and staff. The main groups that were expected to be found and confirmed by the survey are people with different types of disabilities and cultural groups, e.g. exchange

student, that can have difficulties in using the campus efficiently due to cultural and social differences, e.g. language barrier.

Thereafter, a compliance analysis was conducted through a field survey of the different design elements within the campus environment. The analysis is performed based on space (lobby, main entrance, stairs, library, toilets, studio, cafeteria) and design element. After the building data were collected, a compliance analysis with the principles of inclusive design was carried out in order to assess conformity of the status quo with these principles, as well as the needs of the diverse user groups. Subsequently, models, specific enhancement guidelines and recommendations were provided for spaces and design elements in order to ensure the compliance with inclusive design principles.

CHAPTER 4
CASE STUDY INVESTIGATION AND ANALYSIS

The case study of Çankaya University, Balgat Campus is adopted to assess compliance with inclusive design principles and recommendations. The Balgat Campus is the first facility built as a high school campus in the 1980s, then transformed to be the campus for the university in 1997. A new campus is built in 2011, which was granted awards for architectural design. Nonetheless, the old campus is operational and can be used more efficiently. As a first step to understand the needs of the interior built environment users. After a review with the faculty and university administration, the users that might have differences using the campus:

- Elderly (including some administrative staff and faculty members)
- Users with disabilities
- International and exchange students
- National students

Moreover, the researcher performed a field survey of various areas of the campus, such as entrances, circulation, toilets, studios. Each of the areas are tested for compliance with the seven principles of inclusive design and recommendations to improve the designs are suggested in the next chapter.

4.1 Current Design Status and Compliance with Inclusive Design Principles

For conformity with inclusive design principles, six areas of the built environment are analyzed based on the checklist provided by Story, Mueller and Mace (1998). The areas analyzed are shown in Figure 4.1, which were chosen to cover the most important areas that are used daily by the user, as per the recommendation of Anous (2015). The author recommends focusing on circulation system, entrances and exits, wayfinding system, products and services acquisition areas (the place where services are provided), and public amenities, as the most areas that witness user interface with the built environment.

Therefore, the areas included in the analysis are (Figure 4.1):

- Entrance and main lobby (a)
- Circulation and corridors (b)
- Cafeteria (c)
- Library (d)
- Studio (e)
- Toilets (f)

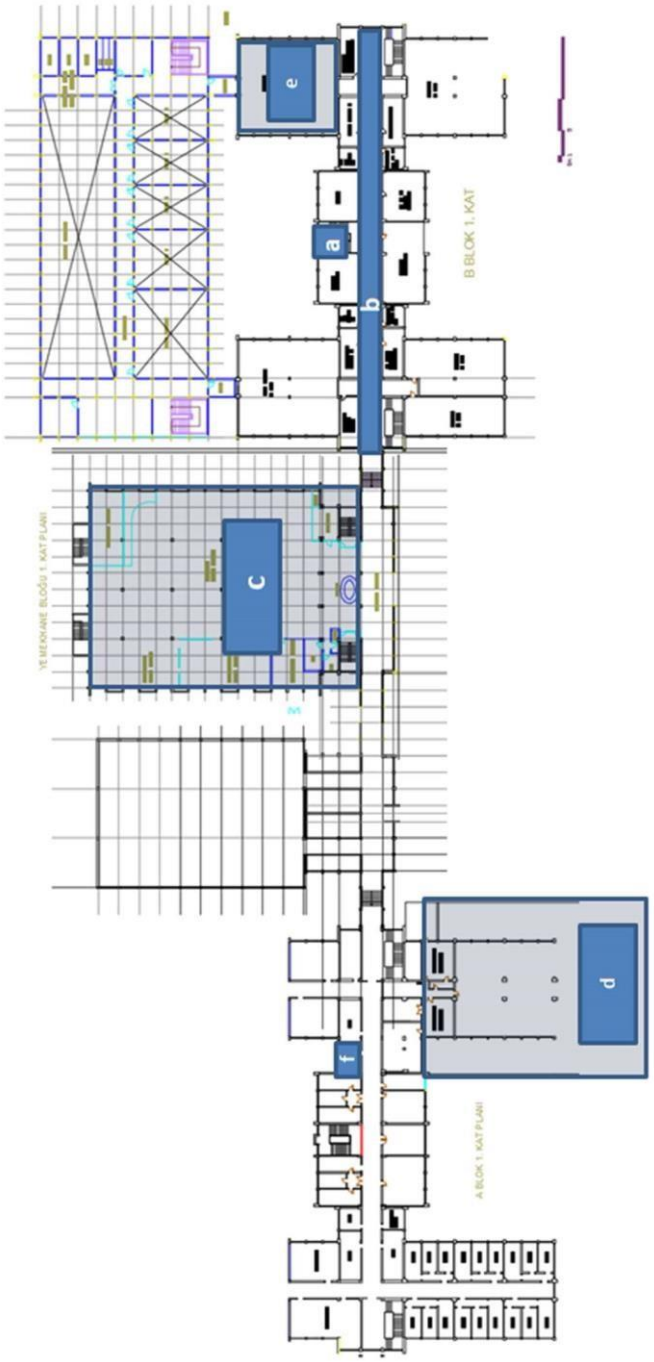

Figure 4.1: Balgat campus plan with the analyzed areas specified (Çankaya University records and modified by the researcher)

4.1.1 Entrance and Lobby

The first area to be analyzed is the main entrance and lobby of the campus. The main entrance is accessed through two double doors that opens outwards. Most of the time, one wing of one of the doors is used. The entrance is designed as a vestibule with double set of

doors, creating an isolated area, as shown in Figure 4.2. The vestibule and interior floor level are not flushed/ not leveled with the exterior floor level. The main lobby has two columns at 3 meters from the entrance. The lobby is lighted during the day with natural light entering from the windows at the eastern façade side. The lobby leads to corridors on the right and the left sides, which act as the horizontal circulation mechanisms for the campus, as shown in Figure 4.3.

Based on the description provided for the area, it is observed that equitable use is not provided for all users. Users with wheelchairs or ones experiencing weaknesses due to aging will suffer to pull or push the main door twice, which makes it difficult and not appealing to the excluded population. Moreover, a vestibule with push door imposes a hazard of confinement between the two sets of doors, shall they manage to open one door and fail to open another door.

Since the area is an entrance and a lobby, no high privacy level is expected. However, safety features are only provided through fire extinguishers mounted on the wall. No emergency buttons or clear emergency exit signs are provided for the disabled users.

Figure 4.2: The main entrance to the campus – outside and inside views

Figure 4.3: The main lobby following the main entrance of the campus

The main entrance and lobby are not compliant with the flexibility in use principle, as there is not much choice of method through providing the unflushed entrance, the door type or the elements of the lobby. There is no issue with left or right-handed users as the section can be used by both. There are no considerations for user's accuracy, precision or pace.

The space does not provide simplicity of use. The overall design has a few unnecessary complexities that can be eliminated, such as the threshold at the entrance and the vestibule design. The sole language used in the space is the Turkish language, while users can use other languages, such as English, German, Arabic and Braille. There is no apparent prioritization of information, while actually the space lacks directional signs that could assist the users to navigate from the lobby in and out. This leads to incompliance with the fourth principle of inclusive design: Perceptible information.

The swinging entrance doors impose a hazard on disabled users as they move to the neutral position with a damper, while the double set of doors require repetitive actions that can be eliminated. The door design requires physical effort for pushing or pulling with a force that cannot be borne by everyone. Therefore, the tolerance for error and low physical effort principles are not satisfied, as indicated in Table 4.1. There is clear line of sight from the outside and the inside, with a reasonable space for the lobby area. However, there is no assistance calling button provided or an information desk that can be used in case of emergencies. Based on that, the seventh principle (size and space for approach and use) is

partially satisfied. As shown in Table 4.1, six out of the seven inclusive design principles are not satisfied in the entrance, which would require many design changes.

Table 4.1: Compliance of entrance and lobby areas with the inclusive design principles.

Inclusive Design Principles	Compliance	Reason
Equitable Use	N	Push doors are not easy to use by wheelchair users; blind users would face challenge to find main directions
Flexibility in Use	N	The choice of vestibule design considers healthy users; few options are provided for different user categories
Simple and Intuitive	N	Design is conventional and addresses needs of healthy users
Perceptible Information	N	Main signages are provided in local language; no directional and informational tools are provided for deaf and blind users
Tolerance of Error	N	Safety features are limited to fire extinguishers and sensors; emergency and assistant buttons are not provided
Low Physical Effort	N	Push doors require effort from the disabled
Size and Space for Approach and Use	Y	Sufficient space is available for movement and maneuvering

Y = Yes, N= No, P= Partially

4.1.2 Circulation and Corridors

The second space analyzed is the circulation areas and corridors (Figure 4.1). The first issue found with these elements is that they extend on two different levels connected with a staircase of 3-meter-wide (Figure 4.4). There are no provisions for blind or wheelchair users, while navigation can also be considered difficult for the elderly. As shown in Figure 4.5 the second level corridor extend on one floor level and its entrance is through a doublewing door that is constantly open. There is a clear issue with communication with the users, as no adequate signage is provided for directions. Minimal signage is provided at the entrances of the departments. Similar to the ground level, there are no tools to be used by disabled users, especially with visual and hearing impairments. The connection between the two floors is carried out through staircases ~~stairs~~, where no elevators are provided, which makes vertical navigation impossible for wheelchair users and the elderly aged (Figure 4.6).

Figure 4.4: A section of the corridor in the ground level extending on two floor levels (Location in Figure 4.1)

Figure 4.5: Second floor corridor with no tools for inclusive design (Location in Figure 4.1)

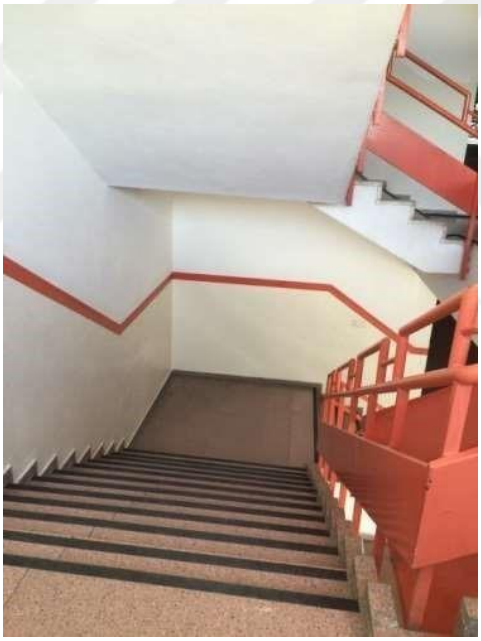

Figure 4.6: Stairs connecting the ground and first floor (Location in Figure 4.1)

When applying an assessment of the principles of inclusive design, the circulation and corridor spaces do not provide equitable use, flexibility, simplicity or perceptible information for foreign and blind users. It is considered dangerous for disabled and ageing users to navigate through the campus with hazards of falling on the many stairs provided in the environment. Navigating through the campus definitely requires a significant physical effort, especially on the stairs, where no railing or only a single railing is provided.

The corridor size is considered adequate; however, the stairs connecting the two floors are does not have the suitable size to implement inclusive design solutions, as they are narrow for traffic and connect the floors through multiple landing points. As summarized in Table 4.2, six out of the seven inclusive design principles are not satisfied by corridors and the circulation system in the Balgat campus.

Table 4.2: Compliance of circulation and corridor areas with inclusive design principles

Inclusive Design Principles	Compliance	Reason
Equitable Use	N	Aged and disabled cannot move from one level to another
Flexibility in Use	N	Vertical transportation has limited options (Stairs only)
Simple and Intuitive	N	Design is conventional and addresses needs of healthy users
Perceptible Information	N	no directional and informational tools are provided for the disabled
Tolerance of Error	N	Handrails are not provided; no apparent safety considerations
Low Physical Effort	N	Vertical movement between levels is majorly hindered by the onlystair option
Size and Space for Approach and Use	Y	Sufficient space is available for movement and maneuvering

Y = Yes, N= No, P= Partially

4.1.3 Cafeteria

The cafeteria area (location in Figure 4.1) is accessed through stairs with single side railing. No access provisions are provided for users with mobility issues (Figure 4.7). Nonetheless, the cafeteria area is spacious and allows free movement, but due to placing the tables close to each other, maneuvering between tables is considered difficult, as not enough spacing is provided between them (Figure 4.8). By assessing the inclusive design principles, the area is comfortable for use to a certain extent. The accessibility for all types of users remains the main issue through locating the cafeteria on the first floor. Therefore, there is no equality

or flexibility, which results into incompliance with the principles of equality in use and flexibility in use. Tools that can make the space usage simple and intuitive were also not found, as the heights of the counters and tables, as well as other amenities are designed for normal people and not considering people with wheelchairs or sight impairment.

While the lack of signage in the space remains an issue across campus, this issue is also witnessed in the cafeteria area. There are no signages that could guide people towards the entrances and exits, in addition to the different parts of the cafeteria. The fifth and sixth principles, tolerance of error and low physical effort do not seem to be thought of during the design of the space. The food counters, tables, chairs and service counters require having normal physical abilities and lacking them may cause some accidents to occur. While the overall space achieves an approachable size, it can be enhanced by a more efficient layout. By spreading the tables and allowing for more space, which is available, the overall layout can allow for more approachable size. As shown in Table 4.3, the cafeteria area does not comply with five of the seven inclusive design principles, while complying partially with flexibility in use and fully with size and space for approach and use.

Figure 4.7: Stairs leading to entrance cafeteria area (Location in Figure 4.1)

Figure 4.8: Floor area of the entrance cafeteria (Location in Figure 4.1)

Table 4.3: Compliance of cafeteria areas with inclusive design principles

Inclusive Design Principles	Compliance	Reason
Equitable Use	N	Accessibility to area is limited through location
Flexibility in Use	P	No options for usage are provided in area; partial flexibility is provided with movable furniture
Simple and Intuitive	N	Design is conventional and addresses needs of healthy users
Perceptible Information	N	no directional and informational tools are provided for the disabled
Tolerance of Error	N	No apparent safety considerations other than fire extinguishers; floor is slippery in a food a beverage area
Low Physical Effort	N	Counter heights and furniture options do not consider all user categories
Size and Space for Approach and Use	Y	Sufficient space is available for movement and maneuvering

Y = Yes, N= No, P= Partially

4.1.4 Library

The library, location marked in Figure 4.1, is also included in the inclusive design analysis of the campus. The two main issues that need to be analyzed in this case are the mobility of the users and the shelving used in the space. There are no provisions for disabled users on campus, including the library. As shown in Figure 4.9, navigating through the ground floor of the library is difficult due to narrow pass ways. Moreover, the spacing between the shelves is considered inadequate, especially during pressure hours, as shown in Figure 4.9. The shelves may seem reachable for users who are able to use their feet; however, wheelchair users are provided with no tools to reach them. Assistance buttons can be supplied at the shelves' area in case users need help from the front desk. As shown in Figures 4.9 and 4.10, the spacings between the study tables are not sufficient for free movement of the users. Blind, deaf and ageing users are expected to struggle during navigation and usage, especially that the first floor is only accessible through stairs.

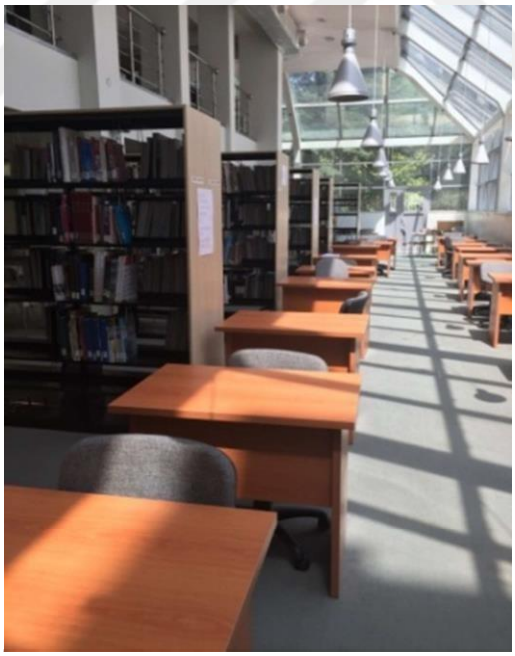

Figure 4.9: Library atrium with limited passage space (Location marked in Figure 4.1)

Considering the seven principles of inclusive design, equitable use is not implemented in the library, as people using wheelchairs would find it difficult to maneuver the floor plan

with crowded table layout. Moreover, a part of the library is placed on an elevated floor, which cannot be accessible by those users. Flexibility can be available, as furniture is movable. However, the current layout and design of the library has no flexibility to accommodate users with special needs, such as the ones with sight impairment and hearing impairment. There are no applied safety features within the library that can allow for tolerance of error. For instance, a chair placed by mistake in the corridor can be a clear tripping hazard, left picture in Figure 4.10, while this can be enhanced through placing tables and chairs away for pass ways between the shelves. There are a few signs that can lead users to the different parts around the library. Nonetheless, users speaking other languages or using braille are not accommodated. As shown in Table 4.4, the library only complies partially with the perceptible information principle, while not complying with the other six principles.

Figure 4.10: High shelves and limited passage cases at the library (Location marked in Figure 4.1)

Table 4.4: Compliance of library with inclusive design principles

Inclusive Design Principles	Compliance	Reason
Equitable Use	N	The current design does not allow aged and disabled users to navigate and use library smoothly
Flexibility in Use	N	Options of furniture, tools and circulation to first floor do not consider aged or disabled users
Simple and Intuitive	N	Design is conventional and addresses needs of healthy users
Perceptible Information	P	informational tools are not provided for the disabled and foreign users
Tolerance of Error	N	No apparent safety considerations other than fire extinguishers
Low Physical Effort	N	Shelve heights and furniture options do not consider all user categories
Size and Space for Approach and Use	N	Spaces between shelves and furniture do not allow for smooth movement and maneuvering

Y = Yes, N= No, P= Partially

4.1.5 Studio

The design studios in the campus, location in Figure 4.1 and a picture is provided in Figure 4.11, are spacious and has a large size (approximately 9 x 15 meters) to accommodate a large number of students. The design is simple, where workshop tables are provided, and windows are located on more than one side providing natural lighting during daytime. However, spacing between workstations is limited imposing mobility issues and hazardous navigation. The design does not seem to incorporate the some of the inclusive design principles, as the disabled users are expected to face several issues; no braille tools and no hearing aids. Therefore, the equality principle is not satisfied. The flexibility in use

principle; however, can be accommodated through having a large space with movable furniture.

Figure 4.11: Studio space at the case study campus (Location marked in Figure 4.1)

No adequate information is provided within the space, which is required to communicate with different types students. Users with sight and hearing impairments need special tools to be able to communicate with instructors and other users within the space. Moreover, there are no provisions for disabled users suffering from visual and hearing issues. It is expected that the disabled would require a higher physical effort working within the space, as table heights are not adjustable. The fixed height of the current working stations is 80 cm. Wheelchair users would require having stations that can be adjusted according to their comfort and wheelchair design.

The layout is not clear is working stations are moved to hinder movement within the space. Thus, there are no tools for tolerance for error, as furniture can hinder movement and cause accidents. Safety features, such as first aid kits and fire extinguishers, were not found within the space. Finally, the inclusive design principles are not fully considered during the design of the studios, where many tools and concepts can be implemented to enhance the majority of the users' experiences. As shown in Table 4.5, three of the inclusive design principles

are implemented, while major enhancements need to be implemented to satisfy the other four.

Table 4.5: Compliance of studio with inclusive design principles

Inclusive Design Principles	Compliance	Reason
Equitable Use	N	The current design does not allow aged and disabled users to use the furniture and tools smoothly
Flexibility in Use	Y	Movable furniture provides flexibility; space allows for inclusive tool addition
Simple and Intuitive	Y	Design is conventional but space allows for simplicity with the addition of functional tools
Perceptible Information	N	No apparent informational tools
Tolerance of Error	N	No apparent safety considerations other than fire extinguishers
Low Physical Effort	N	Tables and chairs require special measures from excluded users
Size and Space for Approach and Use	Y	Space allow for smooth movement and maneuvering

Y = Yes, N= No, P= Partially

4.1.6 Toilets

It is important to state that a few toilets across campus are designed for the needs of the disabled and ageing users, location marked in Figure 4.1. As shown in Figure 4.12, bars are provided around the toilet seat at 75 com height and the space of the toilet is suitable for maneuvering with a wheelchair, with 1.5 meters to 2 meters width between the walls, toilet seat and the sink. The sink and mirror design allow users to use them efficiently with a dent in the sink and a downward tilt in the mirror. However, there is no clear signage indicating the designation of the toilet to the disabled. Other required features can be added to increase the safety of the space, such as emergency callout buttons in the toilet seat and sink areas.

Furthermore, the blind users need floor indicators to navigate through the toilet, similar to the whole campus, as they are expected to suffer within the current design. It can be concluded that the seven principles of inclusive design are partially applied to the space, as shown in Table 4.6, while further enhancements would increase its ability to include the maximum proportion of the population.

Figure 4.12: Toilets for the disabled at campus (Location marked in Figure 4.1) Table

4.6: Compliance of studio with inclusive design principles

Inclusive Design Principles	Compliance	Reason
Equitable Use	Y	Includes normal, aged and disabled users
Flexibility in Use	Y	Design allows more than mode of usage
Simple and Intuitive	Y	Mechanical items (side bars, grab bars, etc.) are universal and easy to use
Perceptible Information	Y	Toilets are marked; material of different elements is distinguished
Tolerance of Error	P	Space and grab bars reduce accident risks; emergency and assistance buttons are important in this area; opening mechanism is needed from the outside
Low Physical Effort	Y	Shape and height of sink and toilet seat allow for usage without extra effort
Size and Space for Approach and Use	Y	Space allow for smooth movement and maneuvering

Y = Yes, N= No, P= Partially

4.1.7 Compliance Matrix

Based on the compliance analysis performed through this section, Table 4.7 represents a compliance matrix with the seven principles of inclusive design for the six studied elements of Çankaya University campus. Five of the six building sections provide plenty of space to maneuver, except for the library, where tables are occupying most of the space preventing the ability to move freely for wheelchair users, the elderly and possibly users with disabilities. Moreover, the toilets analyzed in this study represents the most complaint space with four out of the seven principles. Nonetheless, there is a room for more enhancements in terms of information presented in the space and the safety features that accounts for

tolerance for error. Guidelines and recommendations are provided in the fifth chapter (Section 5.4) for each of the incompliances indicated in Table 4.1.

Table 4.7: Compliance of different elements within the Çankaya University campus with inclusive design principles

Inclusive Design Principles	MainEntrance andLobby	Circulationand Corridors	Cafeteria	Library	Studio	Toilets
Equitable Use	N	N	N	N	N	Y
Flexibility in Use	N	N	P	N	Y	Y
Simple and Intuitive	N	N	N	N	Y	Y
Perceptible Information	N	N	N	P	N	Y
Tolerance of Error	N	N	N	N	N	P
Low Physical Effort	N	N	N	N	N	Y
Size and Space for Approach and Use	Y	Y	Y	N	Y	Y

Y = Yes, N= No, P= Partially

CHAPTER 5

DESIGN SUGGESTIONS AND PROPOSED MODELS

The suggested design changes are justified through the lack of the majority of inclusive design principles in different areas within campus. As per the recommendations of Anous (2015), entrances, exits, circulation system and wayfinding system are the most areas that should be focused on during the implementation of inclusive design principles. Therefore, three models for an entrance, lobby area and corridors in Balgat campus are addressed for changes. The main finishing materials are to be ceramic tiles for flooring and paint for walls and ceilings. However, the changes that are suggested addresses the features that can be added or modified within the targeted areas to increase their inclusivity for more users; elderly, disabled and students with different cultural backgrounds.

The main changes were adding tools for better wayfinding in the main areas of the campus through multilingual signages and technological tools that can assist users with disabilities to navigate the built environment. Tactile tools are added to the floor to provide guidance and directions for users with sight impairments. Adding the information desk contributes into providing a personal assistance for the users during the operation hours. Moreover, safety features are increased within the environment through using non-slippery material on ramps and handrails on the different sides of corridors, stairs and ramps. Visual panels are added to confined areas such as the vestibule in order to prevent accidents. Additionally, automated sliding doors enable all users to access the built environment without needing the pulling or pushing mechanisms.

The proposed models are based on the actual dimensions of the campus environment as shown in Figure 4.1, which allows for an actual implementation of the proposed changes. Further design recommendations and suggestions are presented in the last section (section 5.4), which addresses each of the six areas researched in this study.

5.1 Model 1: Entrance

The first model developed is for the entrance at block B of the campus. As shown in Figure 5.1, a ramp[1] is added before the sliding door within an inclination of 1:12. The width of the ramp is 3 meters and the inclination distance is 1.5 meters. Non-slip material is added at the ramp through bands of fiber fabric on top of the ceramic floor finish. The entrance doors were changed to automated sliding door at each end of the vestibule. As shown in Figure 5.2, tactile markings for blind users with warning stops are added at each door. The tactile markings continue inside the building, while glass panels for high visibility (2.2×1 meters) from the outside and the inside of the building are installed, as shown in Figure 5.3. Figure 5.4 illustrates a section in the entrance model with double sliding doors, and vision panels placed at the external and internal elevations.

Figure 5.1: Entrance model – Front view

[1] A ramp was added to the entrance during the execution of this research. Ramp did not include nonslippery material as suggested by the study.

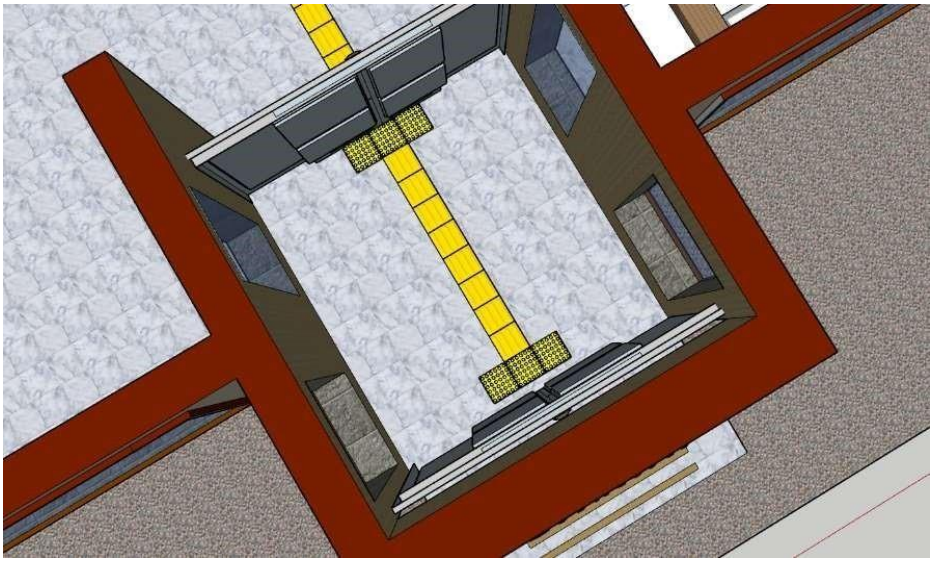

Figure 5.2: Top view of entrance model

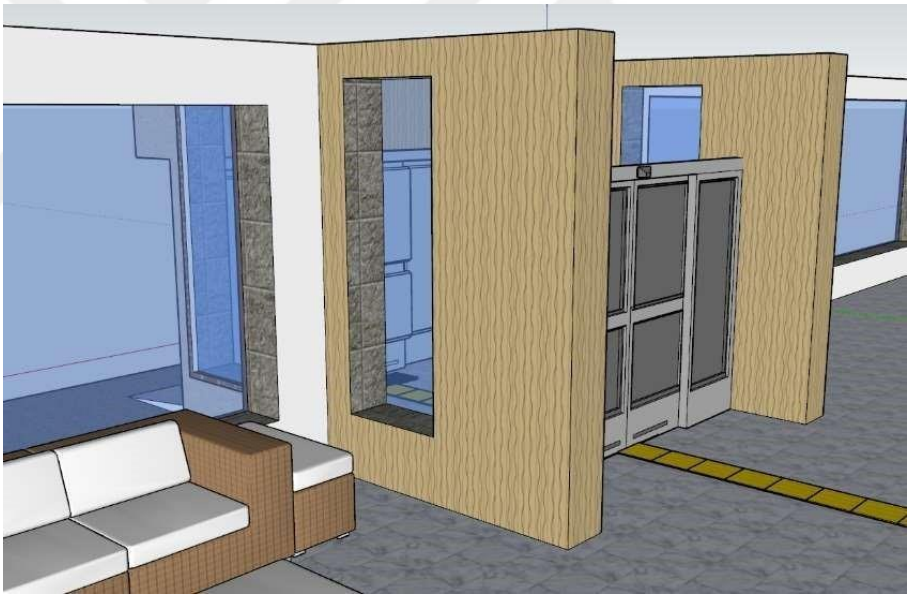

Figure 5.3: Entrance model – Back view

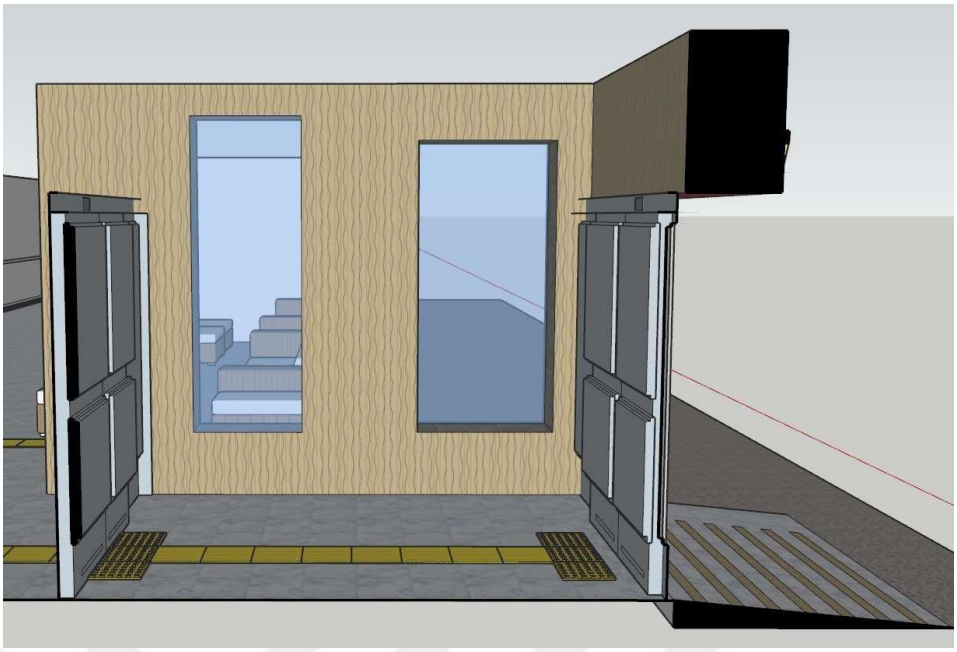

Figure 5.4: Section for the entrance area

5.2 Model 2: Lobby

The second model developed is for the lobby area, which is adjacent to the entrance targeted by the first model. As shown in Figure 5.5, a reception area/ desk is added for information and assistance. In order to increase the wayfinding tools, which are currently missing in the building to a certain extent[2], and to enable accessibility for all targeted users, main internal directional signages are added at the columns, a global map for the building is added, and a tablet is added at the global map area for blind users. Moreover, a wall-mounted bar is added for support and guidance, in addition to tactile warnings for users with visual impairments.

[2] During the execution of the current research, wayfinding tools were provided on campus.

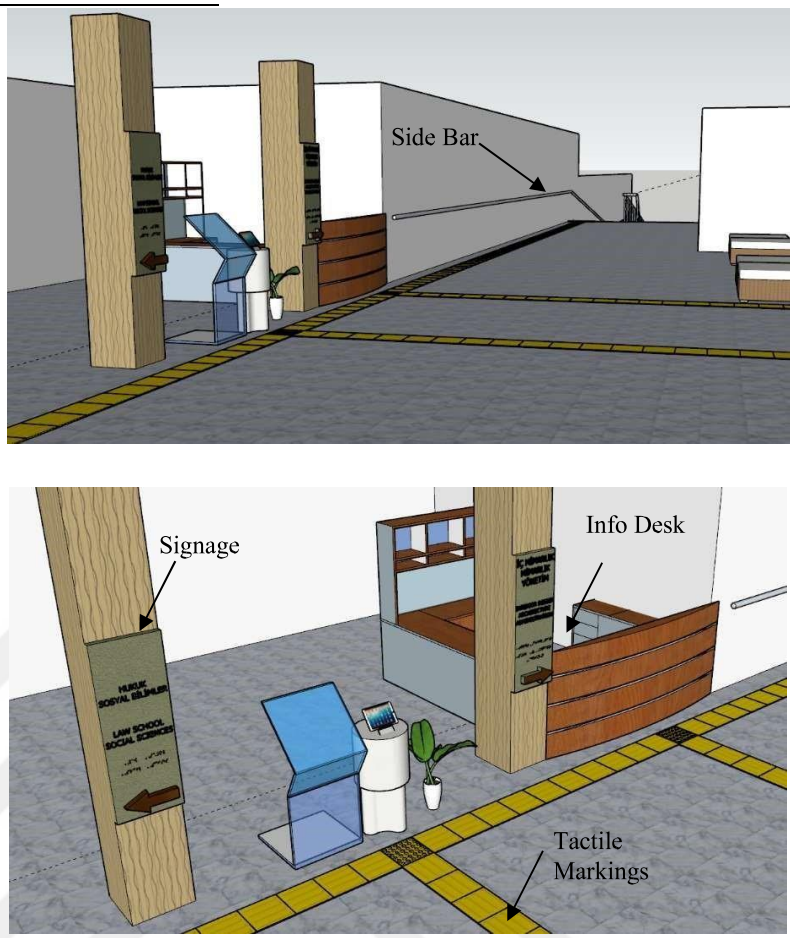

Figure 5.5: Model for the lobby at the main entrance

Figure 5.6 shows the main signages added to the lobby area. The main purpose of adding those signs is to empower the perceptible information principle of an inclusive design. The signages contain Turkish language for national users, English language for international users and braille for blind users. The inclusion of braille in the main directional signages also aims to empower the equitable use principle of an inclusive design. A tablet is provided beside the global map for sight and hearing disabled users, which also aims for an equitable use and perceptible information. Figure 5.7 shows an overhead perspective for the lobby area model, where a reception area, as well as the several wayfinding tools are placed (see section in Figure 5.8). The tactile markings extend from the entrance to the reception area, the waiting area and throughout the facility.

Figure 5.6: Main informational and directional tools at the main entrance lobby

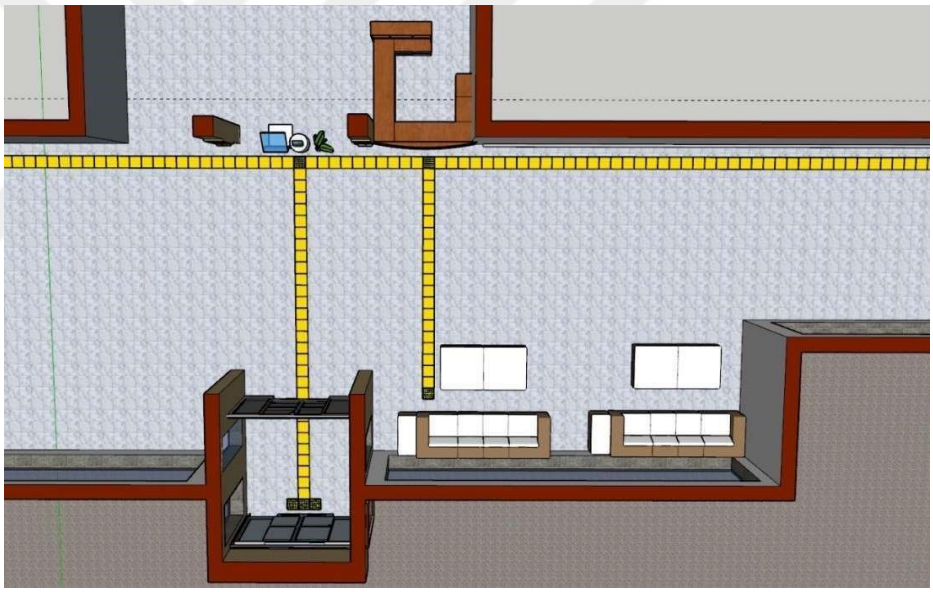

Figure 5.7: Overhead perspective for the lobby area model

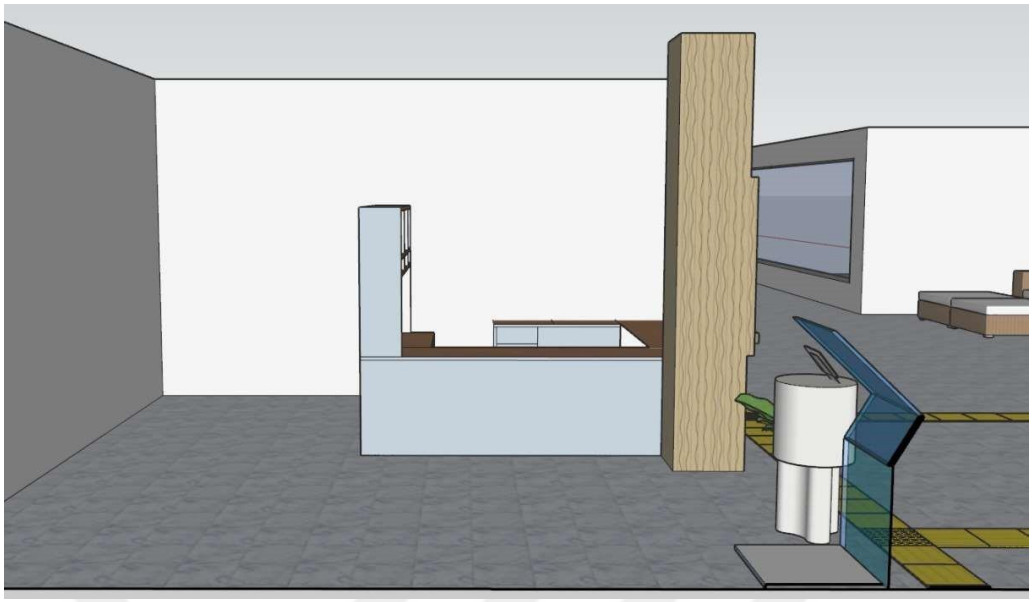

Figure 5.8: A section at the reception area showing the wayfinding tools

5.3 Model 3: Corridor

The third model is developed for the corridor and circulation area of the campus. One of the most problematic sections of the corridors is the part with a stair connection. As a solution to this issue, the 3-meter stair is divided equally into a ramp and stairs with support bars on each side, as shown in Figure 5.9. An overhead perspective is provided in Figure 5.10 for more clarity.

The design of the stair area at the corridor, as presented in Figure 5.9, empowers accessibility for currently excluded users. A ramp is added with an inclination of 1:12 (width 1.5 meters) and length (24 meters) for wheelchair users, elderly and sight disabled users, which provides equitable use and flexibility and choice for the users. The ramp contains non-slip material (fiber fabric bands) and tactile markings. Such measures increase the safety features of the circulation system for more tolerance of error and equitable use for users with sight impairments. Aluminum handrails are added in both sides of the ramp and the stairs allowing for right and left-handed users at 1-meter height. Through the implementation of this flexible design, the users have choice for the use and enhances the safety feature of the circulation.

Figure 5.9: Elevated corridor solution for the case study

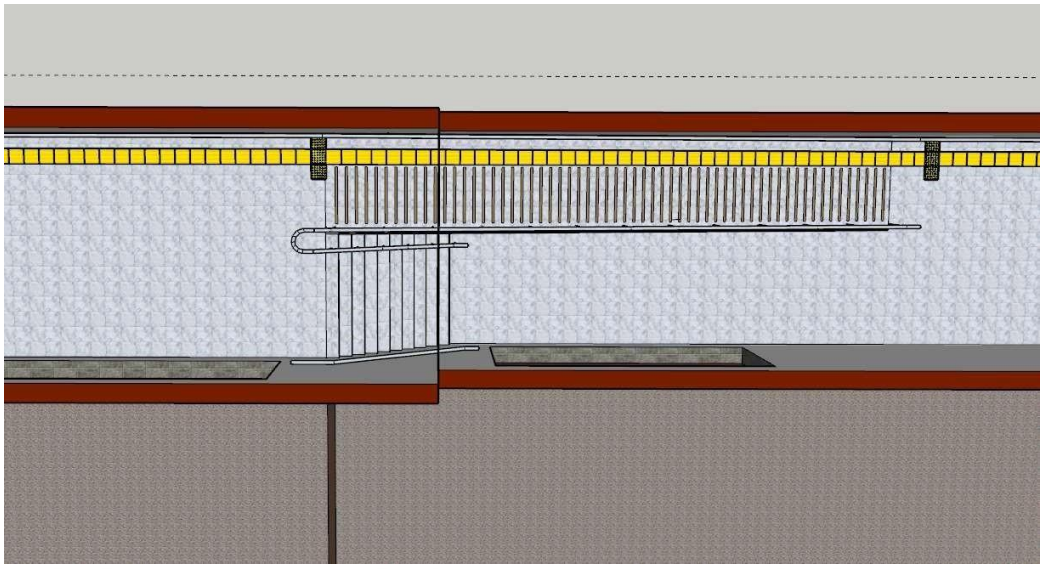

Figure 5.10: Overhead perspective for the corridor model

5.4 Guidelines and Recommendations

There are several recommendations that are suggested through the analysis and the proposed models of this research. The first group of guidelines are general for the facility, which mainly require the implementation of inclusive design principles on the case study campus in order to allow all users to have equal experiences. There should be consideration for security and safety features, reducing the protentional accidents and hazards around the campus. Revision of the communication and wayfinding tools and systems around the campus is considered a requirement due to the many issues faced throughout the different spaces. The following sections provide guidelines and recommendations for each of the six areas discussed in the study, where some of them were implemented through the proposed models.

5.4.1 Entrance and Lobby

The vestibule design is recommended to be changed with a single layer entrance, while environmental control can be achieved through over gate ventilators. An alternative solution would be changing the manual double doors into an automated sliding door in order to increase the accessibility to the lobby space. External and internal floor levels shall be flushed with a gentle inclination easing access for wheelchair users.

Lobby area should contain the main directional signages of the building facilitating navigation around the campus. Textured marking shall extend from the outside environment to the lobby area, leading blind users to the walking path. Seating areas can be provided in order to increase the social factor around the main entrance. Emergency buttons need to be provided, as well as a front desk for immediate assistance.

5.4.2 Circulation and Corridors

Textured markings are required for blind users' guidance. Stairs between the different levels on the ground floor shall be modified to include a ramp with double railing for the ramp and the stairs. Directional signage should be provided along the corridors. Vertical transport means shall be provided, such as elevators, in order to enable the disabled and ageing users to use the campus, as it is currently not usable.

5.4.3 Service Areas (Cafeteria)

Accessibility to service areas, especially the ones located on the second floor, needs to be enhanced through vertical transportation (elevators). More consideration has to be made for disabled and elderly user groups with tactile markings, vocal technologies and layout redesign to allow free movement between different parts of the service area. Signages need to be provided to direct users to the different parts around the cafeteria.

Safety features, such as fire exist signs and non-slippery floor is recommended to take into account errors by the users.

5.4.4 Library

More space shall be allowed between tables and shelves in order to allow free movement. Technologies and consideration shall be made for the sight and hearing disabled users. Shelve height shall be lowered in order to allow users with wheelchairs to reach the books and periodical without assistance. Emergency and assistance call buttons are recommended to be added around the library. Shelves in the second floor are inaccessible to disabled and ageing user groups. Thus, vertical transportation is required.

5.4.5 Classrooms and Studios

Classroom and studio layouts shall allow for enough space between stations in order for wheelchair users to move freely around them. Educational tools and technologies for the blind and the deaf need to be added.

5.4.6 Toilets

Emergency buttons need to be added near the toilet seat and the sink. Entrance door shall be automatically operated with emergency open button.

5.5 Post-Study Compliance

Further to the models and the recommendations that were provided following the analysis for the key six areas within the campus, an analysis is carried out to measure the impact of the research input on the compliance extent towards the principles of inclusive design. For the entrance and lobby area, equitable use is provided through taking into account the different user groups that are using the environment. Sliding entrance doors, tactile markings, side bars and the several wayfinding and information tools allow blind, deaf, old users, as well as users with wheelchairs to access the space and use the different parts of it. Flexibility in use is provided through the variety of tools that are provided within the proposed design. For instance, the wayfinding tools provided at the lobby area allow the different users to choose between visual or interactive tools. Additionally, an information desk is provided in order to accommodate any users that find difficulty in using the provided tools.

The principle of simple and intuitive is met through providing tools that the users are familiar with, such as tactile markings and braille, which are used worldwide to provide direction for visually impaired users. The use of tablets allows users to interact with technology that they are aware of. The principle of perceptible information is illustrated through the signage languages that are provided in two languages and braille. Tolerance of error was taken into account through providing safety features into the design. The visual panels at the entrance, which provide visual accessibility from the outside and the inside, in addition to non-slippery material at the entrance ramp, are all feature that intend to increase safety and minimize accidents and the impacts of human error. Providing sliding

entrance doors, information desk and a tablet are all measures that aim to reduce the physical effort by the users and their interaction with the environment. The size and space for flexibility and use is provided in all of the six key spaces by the original design, except for the library.

In circulation spaces and corridors, the biggest challenge were the elevated areas with stairs, which limited the movement of several user groups. The proposed design allowed a provision for a ramp that changes the circulation for the blind, the old and the wheelchair users. Such a change targets providing an equitable use for all users, as well as the tactile markings that continued from the lobby area throughout the facility.

Moreover, the ramp design provides flexibility and choice for the user to use the stairs or the ramp, as well as providing side bars on both sides to accommodate for righthanded and left-handed users.

The users do not have to get familiar with the new design. Ramps are used universally in all environments and globally to facilitate movement to and within the facility. Therefore, the proposed design is a simple solution and using it falls within the intuitive capabilities of the users. The design provided for the corridor was performed on a section which did not have any intersections or direction change. Thus, the signages provided at the entrance satisfy the need for perceptible information. The safety of the circulation space is taken into consideration in the proposal through providing a reasonable inclination for the ramp (1:12), non-slippery material at the ramp and the stairs, and side bars on both sides. Low physical effort is expected to use the proposed design, in addition to the size and space provided by the original design. Nonetheless, circulation through the different levels on campus requires providing vertical transportation to facilitate movement for many group users, which is a point addressed in the recommendations. The implementation of this point affects the principles of equitable use, flexibility in use, simple and intuitive, tolerance for error, and low physical effort.

In the cafeteria space, there are several inclusive design principles that can be met through providing vertical transportation through lifts to the space, including equitable use, flexibility in use, simple and intuitive and low physical effort. As per the recommendations and the suggestions, perceptible information can be provided through providing the necessary signage in Turkish, English and braille, while tolerance for error can be provided

through finishing the floor with non-slippery material. The library space has a similar case, in addition to the issue of providing lifts between the different levels of the facility. More space needs to be provided between table and between shelves to allow users' movement. Furthermore, tools are required to increase accessibility of the wheelchair users, blind users and old user to use the high shelves, as stated by the design suggestions.

In the studios, more technological tools are required to provide an equitable use, perceptible information, tolerance for error and low physical effort for wheelchair users, the blind users, the deaf users and the old users. The suggestions provided by the study include adjustable tables and universal educational tools. For the toilets, emergency call buttons and emergency door automation buttons are suggested to increase the tolerance for error in the space. The rest of the inclusive design principles are met according to the analysis performed in the fourth chapter. Table 5.1 provides a summary of the compliance of the six spaces with the seven inclusive design principles through the status quo of the design, the design models or the design suggestions and recommendations.

Table 5.1: Compliance of the six key spaces within the Çankaya University campus with inclusive design principles after design models and design suggestions

Inclusive Design Principles	MainEntrance andLobby	Circulationand Corridors	Cafeteria	Library	Studio	Toilets
Equitable Use	M	M^R	R	R	R	O
Flexibility in Use	M	M^R	R	R	O	O
Simple and Intuitive	M	M^R	R	R	O	O
Perceptible Information	M	M	R	R	R	O
Tolerance of Error	M	M^R	R	R	R	R
Low Physical Effort	M	M^R	R	R	R	O
Size and Space for Approach and Use	O	O	O	R	O	O

O = Originally met by the status quo design
M = Met through proposed model design
R = Met through recommendations

CHAPTER 6

CONCLUSION

This chapter provides the final conclusions of the research and future research opportunities. Based on the performed literature review, architectural analysis of the case study and designed models, a comprehensive idea was formed of the inclusive design principles and their application in the built environment. Moreover, the case study analysis shows opportunity for inclusive design implementation, as they are humbly considered within the current design.

Inclusive design aims to include the majority of the user population into experiencing the built environment without hindrance. The concept started in the mid-1900s in several countries, including the United States, the United Kingdom, Scandinavian countries and Japan. Each of these regions developed a different understanding of inclusive design, as well as different terms to describe it. The differences between the different terms mainly emerge from the driver behind it (public or private sector) and the user group they focus on. It is estimated that 25% of the population suffer from severe disabilities that does not allow them to use the conventional design implemented within the built environment.
Therefore, experts have identified seven principles for inclusive design:

1. Equitable use
2. Flexibility in use
3. Simple and intuitive use
4. Perceptible information
5. Tolerance for error
6. Low physical effort
7. Size and space for approach and use

The main challenge in implementing inclusive design is the awareness of its importance amongst designers and legislators. The misconception that inclusive design would impose additional costs without a return remains the main reason behind refraining or ignoring the concept by the designers and clients. It was shown through the current study that implementing inclusive design principles would increase the accessibility to a big part of

the population, which would increase sales and profitability to cover any apparent additional costs. Moreover, implementing inclusive design reduces health and safety risks, and increase user satisfaction, which increases the attractiveness of the built environment and save unexpected costs from accidents and safety failures.

The main aim of the current study is to analyze the old campus of Çankaya University, Ankara, according to inclusive design principles and propose modifications that enables the built environment to achieve inclusive design criteria. Thus, a qualitative methodology is selected through using a compliance analysis of the case study. Six areas were analyzed for conformity with inclusive design principles; main entrance and lobby, corridors, cafeteria, library, studios, and toilets. The compliance matrix provided in Table 4.1 shows that the majority of the areas do not comply or comply partially with inclusive design principles. Furthermore, three design models for an entrance, the adjacent lobby and a corridor were provided, with considerations for national users, international users, disabled users and ageing users. General and specific recommendations were provided, which mainly address the accessibility issue of the facility.

In the entrance area and lobby, the first issue observed is the need for a slight inclination at the threshold of the entrance to facilitate access for wheelchair users and to prevent tripping hazards. Moreover, the current vestibule design requires effort through pushing or pulling a manual door with a damper, which does not support the principles of ease of use and equitable use. As shown in the first model proposed in section 5.1, an inclination was added to the threshold with bands of textile non-slippery material. Furthermore, the vestibule manual doors are substituted with automated sliding doors, which does not require the user to make an effort to access the facility. Also, vision panels were provided on the internal and external elevations of the vestibule to allow visual accessibility.

In the lobby area, there were no wayfinding tools for directions within the facility. Through the proposed model in section 5.2, several wayfinding tools were provided for the different user types. A directional zone is provided with signages with the Turkish and English language. To allow an equitable user and perceptible information for visually impaired users, braille is provided at each directional signage. A global map is placed at the lobby area, along with a tablet that allows users to interact with the global map and get more information about the facility. Additionally, a reception area is placed beside the

wayfinding zone for further assistance and directions. Tactile markings extend from the entrance to the wayfinding zone and the reception area to allow blind users to navigate through the area. A waiting/ rest area is provided in the lobby to allow users to rest and socialize.

The corridors of the case study campus are generally three meter wide. The main issue for an inclusive design in the zone is the elevated corridors with stairs, which does not allow movement for the wheelchair users and impose safety hazards and difficulty on other user groups, such as the blind and the elderly. Through the model proposed in section 5.3, the corridor is divided equally at the stair area for stairs and a ramp with 1:12 inclination. Such a modification allows excluded user groups to navigate through the facility easily and safely. Anti-slippery textile bands are added at the ramp to prevent slipping accidents. Furthermore, hand bars are provided along the corridors for guidance and support. The hand bars are added to the both sides of the stairs and the ramps for a more flexible usage. Also, the tactile markings continue throughout the circulation system to include the visually impaired user groups.

For the cafeteria area, and other elevated facilities on the first floor, there is an accessibility issues due to the availability of a single vertical transportation mean, which are stairs. Therefore, it is recommended to install lifts at a few locations to allow better accessibility for other user groups. Moreover, the layout of the cafeteria shall be modified to allow for more movement space between tables. In the library, more space between tables and shelves shall be provided, accessibility to higher shelves can be facilitated through a mechanism and a lift shall be provided for accessibility for the first floor. Tactile markings and assistance button should also be provided in order to include users with visual impairments and to increase the safety features of the area.

A compliance analysis is performed after providing the design models and recommendations, which showed the possibility of complying with every inclusive design principle within the current environment. In future research, it is recommended that user satisfaction and environmental performance indicators are surveyed for the current design status. Thereafter, the recommendations can be implemented fully or partially in order to understand the impact of inclusive design principles' implementation on these factors. As shown in the framework for qualitative research framework, the construction of the

proposed models and the feedback from the environment and the users are the missing steps in the current research. However, the diagnosis, analysis and proposed solutions within this study facilitates the next steps.

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