ARCHITECTURE CIVIL ENGINEERING ENVIRONMENT
The Silesian University of Technology
No. 4/2023

doi: 10.2478/ACEE-2023-0047

ASSESSMENT OF DESIGN PRINCIPLES IN THE RESIDENTIAL BUILDINGS FOR DISABLED PERSONS: A CASE STUDY OF SOCIAL HOUSING IN NORTHERN CYPRUS

Ibtihal Alwi Al HINDWAN [a], Çilen ERÇİN [b]

[a] BA; Near East University, Faculty of Architecture, Near East Boulevard, ZIP: 99138, Nicosia, North Cyprus
ORCID: 0009-0007-8089-6052
E-mail address: *ibtihal.alhindwan@neu.edu.tr*

[b] Assist. Prof.; Near East University, Faculty of Architecture, Near East Boulevard, ZIP: 99138, Nicosia, North Cyprus
ORCID: 0000-0002-9799-1810
E-mail address: *cilen.ercin@neu.edu.tr*

Received: 1.08.2023; Revised:10.11.2023; Accepted: 16.12.2023

Abstract

All human beings in the world; no matter their race, culture, origin and religion have a right to live and access different environments with ease and comfort ability. This includes disabled persons with any type from all types of disability. Hence, we need to ensure that all the buildings that we need to access in our daily lives are designed to accommodate all. One of the most significant buildings that people spend most of their time in and their comfort being most important are residential buildings. Therefore, it is essential to ensure that residential homes incorporate inclusive design principles to accommodate all individuals, particularly those with special needs. This research paper examines residential spaces' design principles for disabled individuals in Northern Cyprus, focusing on Mağusa and Nicosia's social housing, to assess their suitability. The methodology combines qualitative and quantitative analyses. Qualitatively, it includes a literature review on design principles for disabled access and an overview of residential spaces. Quantitatively, it employs a structured questionnaire with three sections: demographics, accessibility, and housing features, using a 1–5 scale (1 being Very Poor, and 5 being Very Good). Approximately 160 questionnaires were distributed, with 147 used in the study. The findings reveal challenges with sidewalk accessibility and toilet design, indicating dissatisfaction with residential designs. Social housing in Famagusta and Nicosia also falls short of universal design standards for the disabled. Despite these issues, residents are relatively satisfied with the living room and kitchen spaces. Overall, the research concludes that Northern Cyprus residential designs inadequately address the special needs of disabled individuals, particularly regarding circulation spaces and overall quality.

Keywords: **Design, Design principles, Residential spaces, Disabled, Social housing, Northern Cyprus.**

1. INTRODUCTION

Users have different needs which are determined by the space they are in. The type of user this paper focuses on is the disabled persons and the space is the residential spaces. Since the disabled have their special needs, analysing the residential spaces where they spend most of their time is crucial and the focus here is on Northern Cyprus houses which makes it a study that has not been done before. Each space of the house should be designed in a manner that accommodates all, even the disabled. Hence, design is a significant factor in satisfying the user's needs.

Design can have multiple definitions and this can be determined by the particular field that the term is being defined from. Nevertheless, design can be generally defined as a process in which certain needs are being met [1]. It is a common and natural kind of human activity where it is just like a process of finding solutions to certain problems [2]. People think and imagine before they try to create any type of product

or service with their human skills. It is this power of humans imagining something that has not been created before that is called design [3]. It consists of two components and that includes the design object and subject. The two are different from each other since the subject of the design is the person who is responsible for the making or creating of the design. On the other hand, the object of the design is the thing that the subject designs [4]. It is from a teleological behaviour and this is a type of behaviour where one seeks to achieve a certain goal. Hence design is a process of achieving a certain objective, goal or purpose [5].

Design principles have a dual type of audience. They add to the existing knowledge over time [6]. To determine whether to use the design principles or not, the designer has to give it a thought since there is knowledge of a couple of design forms such as patterns [7], scenarios [8] or even heuristics [9] where they can be more or less of help according to the design issue at hand [10]. In this situation, the designer may decide to use their previous experience or knowledge and this is where the design principles come in [11]. Design principles set the standards that people can refer to when innovating or creating designs and even solve the problems of the future [12]. They are developed either from already existing knowledge or via experimentation or even observation [13]. They are a kind of rules or guidelines that can be deduced and reasoned out from either a certain experience or empirical data so as to create a successful solution. Hence, the critical issue or problem can be resolved by translating the principles of design into the features of the design [14, 15]. Architectural space is where architecture is always based. Architecture is the main root of creating space and this is formed by the interconnection of the objects [16]. Space is the sole creator of the environment where we build our relationships, do our various activities and even organise our lives [17]. It is a place where humans interact every single day of their life [18] which makes it very important in architecture [19]. It is in a space where we can understand how various objects can be placed and examine their shape and the interactions present between them [20]. Space can sometimes be defined as a pattern instead of an object although it has more objective properties like sound, colour, light and texture [21]. Even though space has various definitions, all of the meanings have one thing in common; the possibility that the user of the space grants themselves [22].

Disability is used to highlight the constraints that come about from a disease or an injury that someone has or even the emotional, mental and physical challenges that a person faces as a result of the barriers caused [23]. Due to the important sociological, policy, political, and economic ramifications of disability, there are many different definitions of it [24]. The International Classification of Functioning (ICF) explains that disability is a result of various functioning challenges such as barriers to participating in certain activities, impairments and limitations to performing daily life roles [25] as the result of a complex link or relationship between three factors together: the health condition of a person, their personal factors and external setting that define the individual's circumstances of living. Due to this complex relationship, different environmental settings may result in various effects on the person with a certain health problem. Some environments may have limitations that will act as a restriction to the performance of the person. Also, the other issue is that society sometimes limits the performance of the individual by either forming barriers (for example, buildings that are inaccessible) or the lack of production of facilitators (for example, assistive devices are not available) [26, 27].

Social housing is defined as housing whose main objective is to solve the problem of shortage of housing. It is normally constructed using funds from the public and its main target is to provide housing to the poorest lower-class population, people with hardly any income or none and lastly those with very low education levels [28]. It is a vital factor when it comes to the provision of social housing that it is affordable and the social houses make up 6% and more than 28 million of the houses [29]. The provision of social housing consists of a couple of factors that include; the renting of the social houses, their development, management and even their allocation [30]. The social housing is being funded by the public funds in the countries that are categorised as developing countries [31].

1.1. Aim of the Study

This paper aims to study design principles that have been taken into consideration in the design of residential spaces and significantly examine if disabled people have been catered for in the designs. Moreover, a critical study where the social housing that are located in Northern Cyprus specifically in the city of Famagusta and Nicosia is analysed by assessing the design criteria used and their relation to the comfort and ease of access of the disabled.

1.2. Limitation of the Study

There is an expectation of limitations in this study which is in the methodology of the ways of collecting data about the case studies discussed in the paper. This can be a result of not getting access to some of

Table 1.
Universal design principles [32]

Principles	Guidelines
1. Equity in Usage The design can be used by everyone with different abilities.	1. It provides the same type of means to all the users equivalently 2. It avoids stigmatising any user 3. Provides safety, security and privacy equally to all people 4. All the users that use the design find it to be appealing
2. Flexibility in Usage It takes into consideration the various preferences of the people and also their different capacities	1. Gives choices in the types of methods to be used 2. Gives access to both right or left-handed users 3. Promotes precision and accuracy of the user 4. It offers adaptation to the paces of the different users
3. Simplicity in Usage The usage of the design is very simple and easily understandable, despite the users' type of experience, level of knowledge and language ability.	1. Eliminates any complexity faced by the user 2. Always consistent with the expectations of the user 3. Accommodates different levels of language skills and literacy 4. Puts information in accordance with its consistency 5. It provides feedback that is effective during the task and even after completing it
4. Information is Perceptible It successfully conveys the information to the users, regardless of the settings of their surroundings.	1. Usage of various modes for presentation. For example, verbal and pictorial 2. It maximises the information's legibility 3. Gives a difference in the way elements can be described 4. It provides a sense of compatibility using various techniques that are used by individuals who have sensory problems
5. Tolerance of Error The design decreases the dangers and negative results of actions that are inadvertent or unintentional.	1. Provide warning when of danger and errors 2. Well arrange various elements to avoid errors 3. Provides features of fail safe 4. Discourage actions that are unconscious in the completion of tasks that need much attention
6. Low Level of Effort It can be utilized effectively, pleasantly, and with little effort.	1. Uses operating forces that are reasonable 2. Reduces sustained physical effort 3. Reduces actions that are repetitive 4. Allow users to have a position of the body that is neutral
7. Dimensions and Room for Use and Approach Irrespective of the type of posture, size or mobility of the person, adequate space and size are given to reach it, handle and use the design.	1. Provides variations in the hand and the size of the grip 2. Provide a clear line of sight to those seated and standing 3. Make the reach to any element easy for both the seated and standing 4. Provides sufficient space for those users who need assistance or assistive devices

the apartments of the case studies. Also, the other possible limitation might be the restricted time to prepare this paper; which is a semester only. This might affect the observation being made on the study not to be very vast and expanded and the paper not to have deeper detailed information.

2. LITERATURE REVIEW

2.1. Universal Design Principles

The term was first invented by the famous architect Ronald Mace who put the approach that an average user would have in designing into a challenge, he gave the foundation of the designs with more usability and accessibility to both environmental settings and products that people use. Hence, UD is the designing of environments and products so that they can be usable by everyone without any barriers, a design that can be used to the greatest extent possible without people needing to adapt to it or requiring a special design to suit their certain needs. Figure 1 shows the UD relation diagram [32]. Universal design encompasses individuals with various disabilities, including pregnant women, parents with strollers, elderly, children, and, most importantly, disabled individuals, which constitutes the primary focus of this study.

There are 7 types of principles of the universal design that are discussed in Table 1.

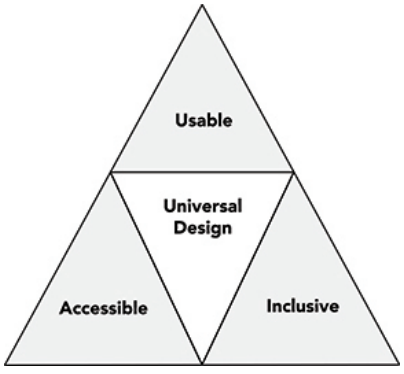


Figure 1.
UD relation diagram [32]

2.2. Disabled Persons

People with disabilities almost comprise a 15 percent estimation of the population of the world which calculates to 80 billion people in the world. Where 80 percent of disabled people are those that are living in developing countries and people that are in the dire form of poverty over present them [33, 34]. Around the world, at least one out of three adults suffer from a certain chronic illness and most of them are elderly people and from countries with high-income countries [35].

According to WHO, Disability has 3 dimensions (The term disability stands for all the following three; constraints of activity, impairments and limitations in participation).

1) Constraints in activity: These are the barriers that a person faces when trying to perform a certain task
2) Impairment: These are the problems that a person may have in their body structure or functioning
3) Limitations in participation: These are the problems an individual may face when trying to involve themselves in real-world situations and circumstances

Hence, the individuals that are considered to have a disability are the people that are traditionally considered disabled. These include the blind, deaf, wheelchair users, people with intellectual problems and lastly the ones who experience difficulties in conducting daily tasks because of a chronic disease they have mental problems or even old age issue [36].

Types of disability: There are nine major types of disability that most people have. They are mentioned as follows:

1. Disability of locomotion
2. Visual Impairment
3. Hearing Impairment
4. Language and speech form of disability
5. Intellectual type of Disability
6. Mental disease or disorder
7. Disability that is caused by chronic neurological problems
8. Disability that is as a result of disorders in the blood
9. Multiple Disabilities [37]

2.3. Residential Spaces Design for the Disabled

Residential space can be defined as an architecturally designed space where more than half of it is used by the people for dwelling purposes. It provides different functions like bedroom, living area, kitchen and bathroom. There are different types of residential spaces. For example, individual houses, apartments, duplexes, dormitories and hotels [38].

The general basics of design: The regulations of the buildings cover the construction of the building, design and furnishing for accessible housing together with their external spaces. The residential spaces should be usable by all without having any barriers. The users in these spaces should be independent and not require help from people. This applies to all users including wheelchair users, the visually impaired and blind, people with other types of disabilities, the elderly, children and those who are tall or short [39].

In the domain of design, it is crucial to take into account the accessibility of structures, internal flow, and the availability of services to guarantee their suitability for universal utilization [40]. The ADA Standards for Accessible Design, crafted in accordance with the Americans with Disabilities Act (ADA), serve as the foundational directives for accessibility standards. Their primary aim is to institute regulations that ensure access to spaces commonly used by disabled individuals within society [41]. Similarly, the United Nations document titled "Accessibility for the Disabled - A Design Manual for a Barrier-Free Environment" furnishes guidance to designers in the development of inclusive environments and spaces for both disabled individuals and the general population [42]. Therefore, these guidelines are employed to assess the case studies and ascertain their adherence to standard measurements and design principles.

In the residential space, the width of the turning place should be at least 150cm and the depth also be 150cm in each function. This applies to all the rooms except the small ones where the person using the wheelchair can easily move either forward or backward. Also, it applies specifically in front of the WC as shown in Figure 2, in front of the doors of the shaft of the lift and lastly, at the beginning and end of a ramp.

In the bedroom, a minimum of 1.50 m deep is required in front of the long side of a wheelchair

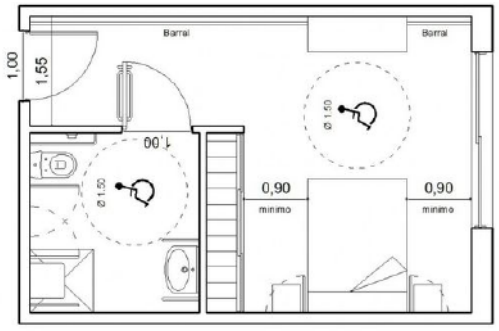


Figure 2.
Movement area in the WC and space requirement at the long side of a wheelchair user's bed [Edited by Author from Ref. 39]

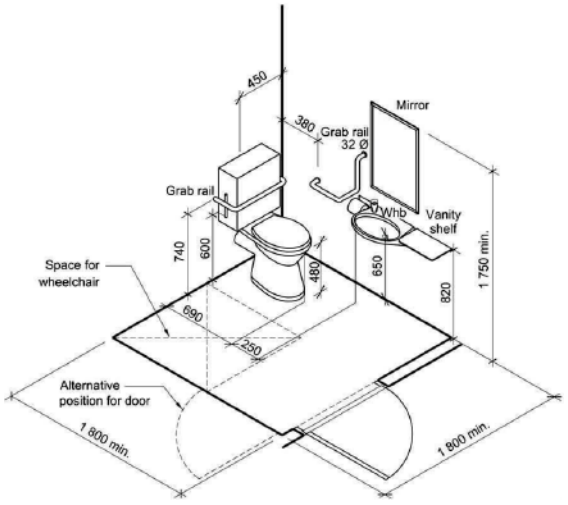


Figure 3.
Measurements of the WC from the front view Universal design principles [32]. [Edited by Author from Ref. 39]

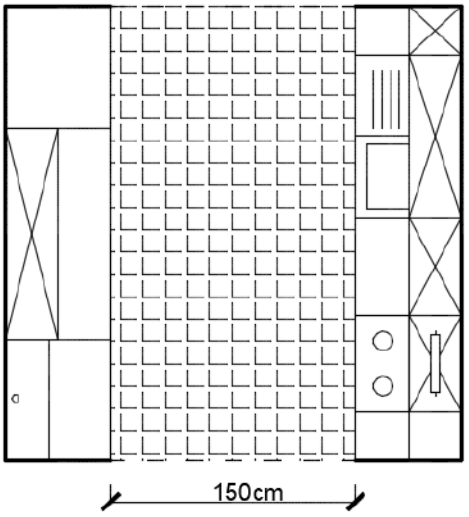


Figure 4.
Movement area in a double-space kitchen [Edited by Author from Ref. 39]

user's bed as shown in Figure 2 and in front of cupboards whereas also the measurements of the WC from the front view are shown in Figure 3.

In the kitchen, a minimum of 150 centimetres is required in the movement area in a double-spaces kitchen as shown in figure 4. Whereas the movement area in an L-shaped kitchen also requires a minimum of 150 centimetres as shown in Figure 5 below. In addition, a minimum of 150 cm is required in front of kitchen installations. Moreover, the Figure 6 shows the front view and the standard measurements of the kitchen.

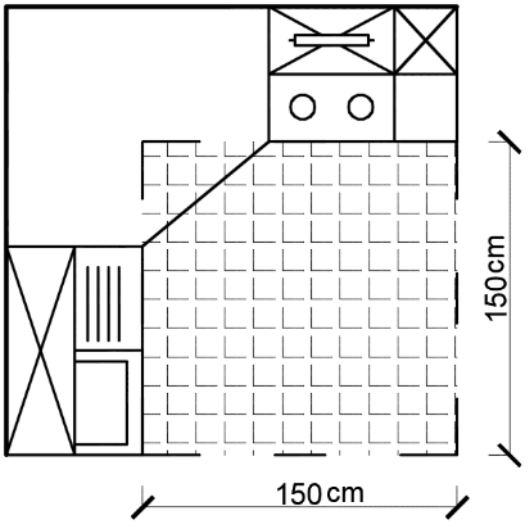


Figure 5.
Movement area in an L-layout kitchen [Edited by Author from Ref. 39]

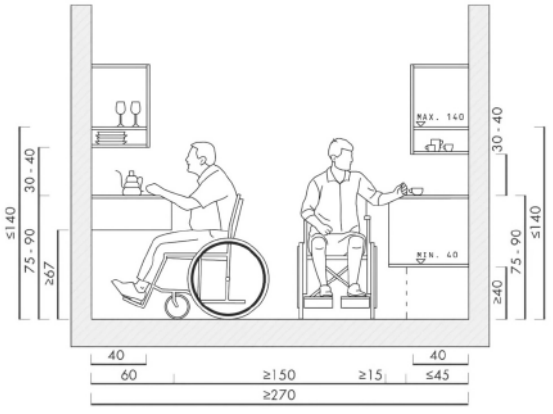


Figure 6.
Front view of the standard kitchen measurements [Edited by Author from Ref. 39]

Circulation space: A person using a wheelchair requires a minimum of 1.50 m^2 as shown in Figure 7 so as to make a turn of 180 degrees. This space area determines two factors; the area of movement and the size of the corridors and rooms in the house. This is because accessibility in the hallways is the most common arrangement in the residential housing. Therefore, there should be a straight corridor for easy accessibility and corners and angles should be avoided. Also, the entrance hall should have an area of at least 1.50 m^2 in width and 1.50 m^2 in length.

In the living rooms, sufficient space for the wheelchair users' movement is very vital. Also, there should be adequate space for a minimum of two other wheelchair users. For example, visitors who are disabled. The floor area of the living room that has a dining table such as the one shown in Figure 8 should have a minimum area of 22 mm^2 when the house is for one person, 24 mm^2 for approximate 2-4 individuals, 26 mm^2 for 5 persons and lastly 28 mm^2 for 7 people.

Every dwelling should have a garage or a car parking unit that is weather-protected. A movement area of the length 150 cm should be provided next to the car as shown in Figure 9.

All the rooms of a housing and the communal facilities must not have stairs or should have a lift as shown in Figure 10. The thresholds and stops at the door should not be designed and if necessary, they should not be more than 2 cm high.

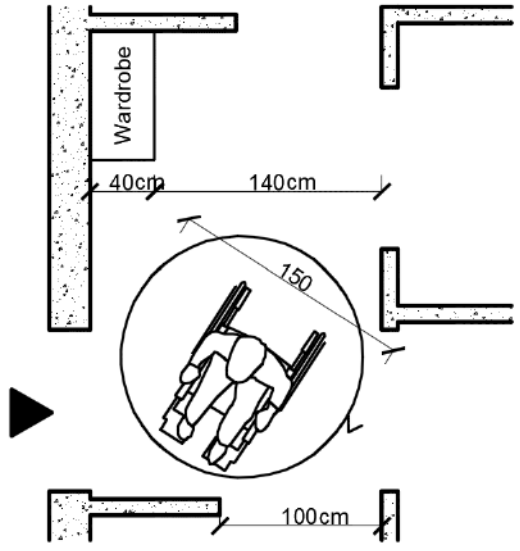


Figure 7.
The transverse layout of entrance area [Edited by Author from Ref. 39]

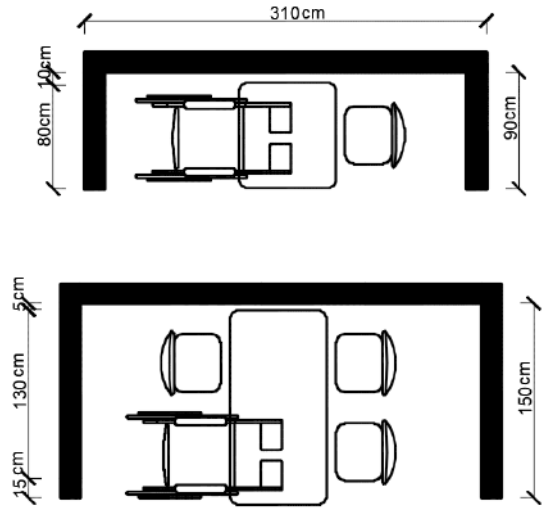


Figure 8.
Dining area layout for two or four people [Edited by Author from Ref. 39]

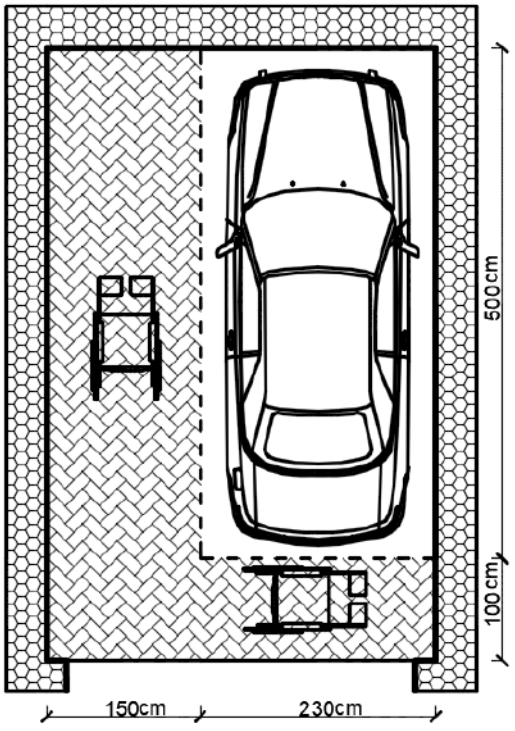


Figure 9.
Space requirement in a garage [Edited by Author from Ref. 39]

3. METHODOLOGY

The study will follow a qualitative and quantitative analysis. The qualitative analysis will be done in two phases: the literature review which will be followed by an overview study of the residential spaces and a case study. The literature review will analyse the definition of design, architectural space, disabled and the design

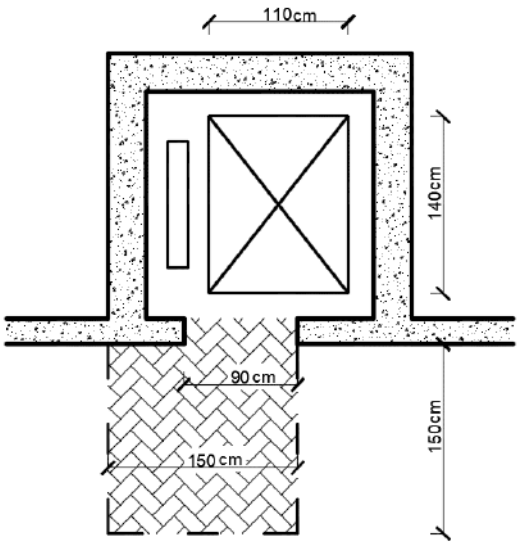


Figure 10.
Plan of the lift [Edited by Author from Ref. 39]

Table 2.
The size guidelines for flats that have only one person using a wheelchair (Area in m^2) (Author, 2022)

Name of the Spaces	1 person	2 people	3 people
Bedroom	16.0	24.0	16.0
Living area	20.0	20.0	22.0
Kitchen	8.0	9.0	9.0
Dining room	6.0	6.0	10.0
Bathroom	6.0	7.0	7.0
Spare room (washing machine)	1.0	1.0	1.0
Corridor	5.0	6.0	6.0
Total area	62.0	73.0	91

principles that need to be applied in an architectural space so that the disabled can easily access it. This paper employs a traditional literature review approach to provide a comprehensive overview and synthesis of existing knowledge and research findings related to universal design principles and their application in residential buildings for disabled individuals. The traditional literature review approach was chosen to collate and summarize information from various sources on the subject matter. This approach allows for a broader examination of the topic, including foundational concepts, principles, and real-world applications, rather than focusing on specific research questions or a particular selection process. The literature review topics and findings have significantly shaped the questionnaire which consisted of 40 questions by inspiring the inclusion of questions related to demographics, accessibility, and housing features. Drawing from the literature on disabled persons, demographic questions were integrated to capture participants' personal characteristics, allowing for subgroup analysis and tailored design recommendations. The emphasis on accessibility principles prompted questions on participants' perceptions of accessibility in their current residential spaces, the impact of specific features, and their overall satisfaction. Furthermore, housing feature questions were informed by universal design principles, seeking to assess the presence and influence of such features and gather input on enhancements. These questionnaire components aim to collect data essential for evaluating the state of residential spaces and guiding efforts toward greater inclusivity and accessibility in housing design. The questionnaire was administered online through Google Forms, chosen for its accessibility, cost-effectiveness, customization, data security, anonymity, and integration capabilities. It also facilitated collaboration, validation, and offered versatile export options. The research spanned approximately four months, utilizing questionnaires as efficient tools for structured data collection, enhancing research objectivity, and ensuring valuable feedback and reproducibility.

Subsequently, the research proceeds to examine the social housing case studies situated in Northern Cyprus, specifically in Mağusa and Nicosia. The selection of the location of the case studies is driven by the overarching aim of capturing the diversity present in the region, encompassing varying urban settings, population profiles, architectural trends, policies, and design challenges. Each case will undergo a thorough analysis to assess the suitability and alignment of accessibility and housing design features with the requirements of disabled individuals. This research on social housing for the disabled in Northern Cyprus takes a comprehensive approach, yielding significant societal benefits by addressing the housing requirements of marginalized groups, including disabled individuals. It scrutinizes the practical implementation of design principles in government-regulated social housing units, with a particular emphasis on catering to the accessibility needs of disabled residents. Utilizing real-world instances as illustrations, this study offers valuable insights into the application of universal design principles, informs housing policies, conducts comparative evaluations of diverse housing projects, and ultimately identifies pragmatic solutions and best practices for the benefit of architects, designers, and housing developers. The overarching goal is to enhance the overall well-being and quality of life for disabled individuals, meeting essential social needs and elevating housing standards.

In addition, the quantitative analysis will involve a structured questionnaire which highlights three different sections; demographics, accessibility and housing features. The demographics were highlighting the gender, age, education, location of residence, house typology and disability. Section 2 and 3 of the accessibility and design features had a scale of 1-5 starting with 1 (Very Poor) to 5 (Very Good). Approximately 160 questionnaires were distributed to different people of different ages and at different hours and days where 147 of the questionnaires were employed in this research study.

Case Studies

There are two case areas of social housing in two cities of Northern Cyprus that are observed and analysed to investigate if the design features meet the design criteria of the disabled. The two social housing evaluated are in Nicosia and Famagusta. The areas that the questionnaire was also distributed to the residents living there.

Case Study 1: Social Housing in Famagusta

The social housing is located in the city of Famagusta in Northern Cyprus. The house is located next to the "Ismet Inönü Bulvarı". The social houses are in a site that is next to a mosque and the street's traffic lights. Some of the social houses are situated facing the street whereas the others are on the back elevation of these social houses. There are four rows of these houses. All these houses have five stories. The ground floor of the houses is being used as shops. The ground floor was first planned to be a parking area but this changed during the construction of the building when the social housing ministry decided to make them shops instead of parking areas so as to create job opportunities for the social houses residents. The houses are designed to be next to each other and the parking area in the space that is between the blocks. The street view of the social housing is shown in Figure 11, whereas the cross view is in Figure 12, and lastly the front and rear views are in Figure 13 and 14 respectively.



Figure 11.
Street view [43]



Figure 12.
Cross view [43]



Figure 13.
Front view [43]



Figure 14.
Rear view [43]

Case Study 2: Social Housing in Nicosia

The social housing that are situated in Nicosia are in the street of Mehmet Ahmet Kucuk Caddesi Sosyal Konutlar. The social housing consists apartments of in a four-storey building. Some of the pictures of the social housing unit are shown in Figure 15 and 16.



Figure 15.
View from the location [43]



Figure 16.
View from the location [43]

4. FINDINGS AND DISCUSSION

The report on the demographics of the respondents that is shown in Table 3 reveals that 51.4% (74) of the respondents are male and 46.6% (70) of them are female. The majority of the respondents are in the age group of 18-30 years, 63.7% (93) of them are in this age gap. Also, the majority of the respondents live in Nicosia city, where we have 61.8% (84) of them residing here. Followed by Magusa 20.6% (28) of the respondents and lastly followed closely by Girne 17.6% (24) respondents. In addition, 66.4% (99) of the respondents live in the apartments. A greater number of the residents of the three different cities do not have a disability (86.3%), whereas a few are disabled (13.7%).

Table 3.
Demographics of respondents (Author, 2022)

	Frequency	Percentage
Gender		
Male	74	51.4
Female	70	46.6
Age		
18-30	93	63.7
31-40	26	17.8
41-50	13	8.9
51-60	7	4.8
61 +	7	4.8
Education		
Bachelor's degree	88	60.3
Master's degree	32	21.9
PhD or higher	26	17.8
Residence		
Nicosia	84	61.8
Girne	24	17.6
Mağusa	28	20.6
House Typology		
Bungalow	6	4.1
Semi-detached house	11	7.5
Apartment	99	66.4
Duplex	15	10.3
Others	17	11.6
Disability		
Yes	20	13.7
No	126	86.3
Someone to help if disabled		
Yes	39	33.9
No	76	66.1

The findings on the satisfaction or dissatisfaction with the accessibility features for universal use indicate that the residents of Northern Cyprus are most satisfied with the location of their house as 56 respondents rated it as (Good) and scored a satisfactory mean of 3.53 out of 5 as displayed in the table 4. Also, the residents are majorly satisfied with the distance from the car parking space to the house since it has a score of a satisfactory mean of 3.51 (Good). The feature that most of the respondents seem not satisfied with is the sidewalks that lead to the house. As majority of the respondents are not satisfied with the curb ramp of the sidewalks, scoring a mean of 3.05, which is followed closely by dissatisfaction with the maintenance of the sidewalks with a mean score of 3.10. Additionally, the width and the surface of the sidewalks that lead to the house is also the major issue the respondents are not satisfied with having a mean score of 3.14 and 3.16 respectively.

Table 4.
Satisfaction rating of the accessibility features of the residential spaces. Satisfaction Rate on a scale of 1 (Very Poor) to 5 (Very Good) (Author, 2022)

Accessibility features	Mean Quality	Remark
Location of house/accessibility	3.53	Good
Streets leading to the house	3.25	Fair
The width of the sidewalks leading to the house	3.14	Fair
The surface of the sidewalks leading to the house	3.16	Fair
Curb ramp of the sidewalks	3.05	Fair
Maintenance of the sidewalks	3.10	Fair
Lighting of the streets next to the house	3.27	Fair
Width of the parking space	3.23	Fair
Distance from the car parking space to the house	3.51	Good
Levelled approach to the entrance of the house	3.37	Fair
Ramp gradient to the entrance of the house	3.23	Fair

From the questions asked in the questionnaire about the accessibility challenges that are faced in the neighbourhood, three responses recorded the highest percentage and these are sidewalks (21.1%), ramps and stairs (19%) and streets (16.3%) respectively as shown in Figure 17.

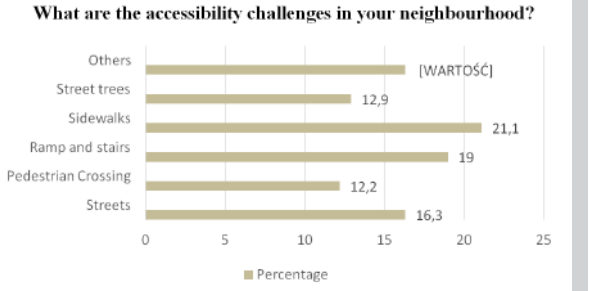


Figure 17.
Chart representation of the major accessibility challenges the residents face in their neighbourhood (Author, 2022)

The other findings are on the satisfaction rate of the residents on the design features of their houses as shown in table 5. The features that the residents were most satisfied with are the living room size, material, application, lighting and ventilation which had a mean score of 3.58. The other feature is the height of windows and doors with a score of a mean satisfaction of 3.52 (Good). All the other features had a fair rating but the feature that the respondents were most dissatisfied with was the space for turning wheelchairs in all the rooms such as the kitchen, living room and sitting room with a low mean score of 2.96. Also, the residents are not satisfied with the rent/cost of acquisition, lift and bathroom with a mean score of 3.01, 3.12 and 3.16 respectively. Lastly, the overall quality of the house had a mean score of 2.96 where most of the residents had a problem with house design features for the various functions; bedroom, living room, bathroom, and kitchen.

Table 5.
Satisfaction rating of the house design features of the residential spaces. Satisfaction Rate on a scale of 1 (Very Poor) to 5 (Very Good) (Author, 2022)

House design features	Mean Quality	Remark
Type of house	3.35	Fair
Building material	3.36	Fair
Width of doorways	3.38	Fair
Width of hallways	3.36	Fair
Height of windows and doors	3.52	Good
Space for turning of wheelchairs in all rooms (Kitchen, living room, Sitting room)	2.96	Fair
Bedroom (Size, Material, Application, lighting, ventilation etc.)	3.34	Fair
Bathroom (Size, Material, Application, lighting, ventilation etc.)	3.16	Fair
Bathroom layout	3.23	Fair
Kitchen (Size, Material, Application, lighting, ventilation etc.)	3.37	Fair
Living room (Size, Material, Application, lighting, ventilation)	3.58	Good
Lift	3.12	Fair
Handrails	3.26	Fair
Floor coverings	3.29	Fair
Height of switches, sockets and service controls	3.33	Fair
Natural lighting and ventilation	3.28	Fair
Rent/ Cost of acquisition	3.01	Fair
Overall quality of house for persons with disability	2.96	Fair

One of the questions in the questionnaire was about the functional space that the residents have the most problem with as shown in Figure 18. It is indicated that the residents have the most problems with the toilet leading with a percentage of 30.9. Followed closely by the kitchen with a percentage of 23. Hence these are the two spaces that have the most issues that the residents in North Cyprus are facing.

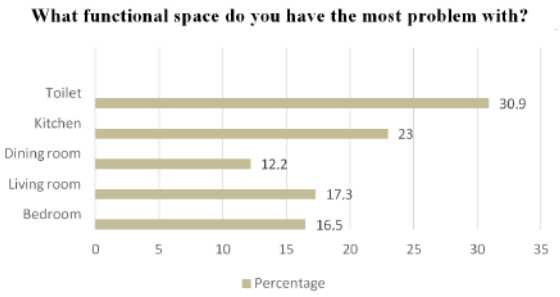


Figure 18.
Chart representation of the functional spaces that most of the residents have a problem with (Author, 2022)

4.1. Evaluation of Findings

The analysis involves scrutinizing the architectural floor plans of the two case studies in Magusa and Nicosia to determine whether the design principles catering to disabled users in residential buildings are fulfilled. Analysing architectural floor plans and design principles in disabled-friendly social housing serves multiple vital purposes. It allows for a meticulous examination of housing layouts and practical design implementation, including assessing accessibility elements such as doorways, hallways, ramps, and elevators crucial for disabled residents' mobility and comfort. Visual representations in floor plans help identify barriers and design challenges, aiding in understanding spatial flow. Comparisons across different housing units enable a comprehensive analysis of design variations while ensuring an objective assessment. Ultimately, this assessment empowers researchers to make informed recommendations for enhancing housing accessibility and inclusivity for disabled individuals.

4.2. Architectural Floor Plan of the Social Housing in Magusa

There are two flats in each storey in the social housing in Mağusa and each flat has an area of 85 square meters. The architectural floor plan of the two flats in each storey is shown in Figure 19.

4.2.1. Assessment of design principles in the flats for the disabled

Each function of the flat is analysed to see if the design is suitable for disabled people to access, move and use without any difficulties. This is done by examining if the design features and measurements fit the standard design principles and measurements of the design for the disabled.

The bathroom movement area should be at least

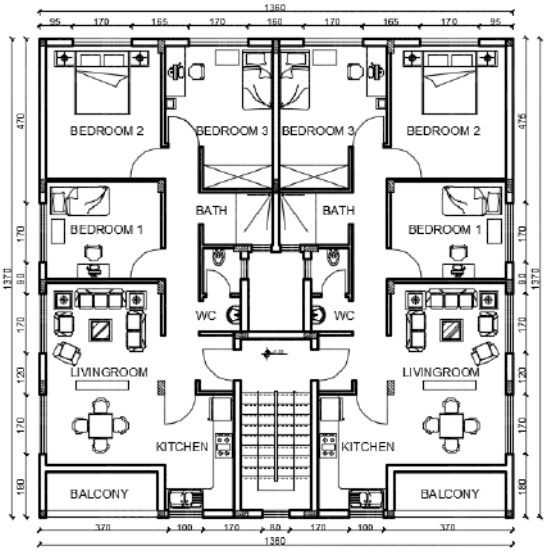


Figure 19.
The plan of the two flats each with 85m2 (Source: Edited by Author, 2022)

150 cm. In the social house, the bath movement area has a measurement of 95 cm as shown in Figure 20 which is not enough for the disabled. Also, the entry to the bathroom is small with a length of 90 cm which a wheelchair cannot pass through. This is also noticed in the questionnaire where the bathroom had one of the least satisfactory mean scores of 3.16.

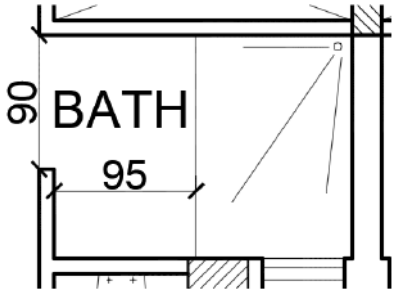


Figure 20.
Movement area by the bath (Source: Edited by Author, 2022)

In the WC catering for the disabled, there should be a movement area of a minimum of 150 cm in front of the WC and washbasin 30 cm next to the WC and 20 cm next to the washbasin. In this case, there is 80 cm space in front of the WC and washbasin which is not suitable for the disabled. This issue is faced by a big percentage of the residents of Northern Cyprus since the toilet is the functional space that most of its residents are challenged with, leading to a percentage

of 30.9. Nevertheless, the space next to the WC and washbasin has been well designed with 30 cm and 25cm respectively as shown in Figure 21.

The bedroom design suitable for the disabled should have at least 150 cm space requirement at the long side bed of a wheelchair user. But in this case, as seen in bedroom 1 in Figure 22, the size of the bed is just 80 cm which is not enough for the wheelchair and also bedroom 2 in Figure 23 highlights that there is just a space of 90 cm to the right and 80 cm to the left.

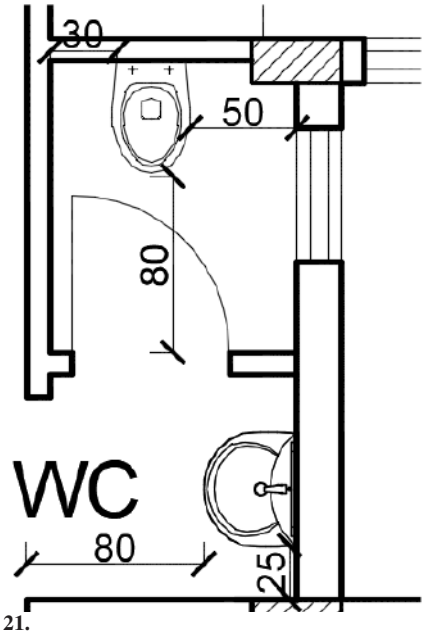


Figure 21.
The area of the movement next to the washbasin and WC (Source: Edited by Author, 2022)

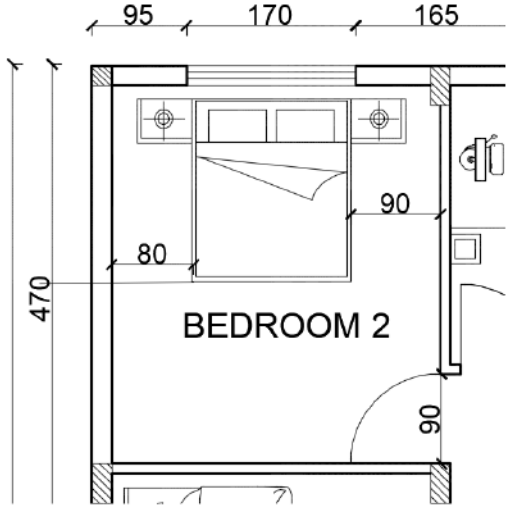


Figure 22.
Bedroom 1 space for a wheelchair user at the long side of the bed and door measurements (Source: Edited by Author, 2022)

Additionally, both doors are 90 cm which is not adequate for the passage of a wheelchair user. Moreover, the turning space is not suitable for the wheelchair. This is also recorded in the questionnaire where 52 respondents rate the bedroom size and layout as fair, 16 as poor and 14 as very poor.

The L-shaped layout kitchen accommodating disabled persons requires a movement area of at least 150cm, which has been considered in this case in the length of the kitchen which is 270 cm and even in the questionnaire, 53 respondents rated the kitchen as good and 20 very good. However, the width is 10 cm less than the standard requirement as it is 140 cm as shown in Figure 24 below.

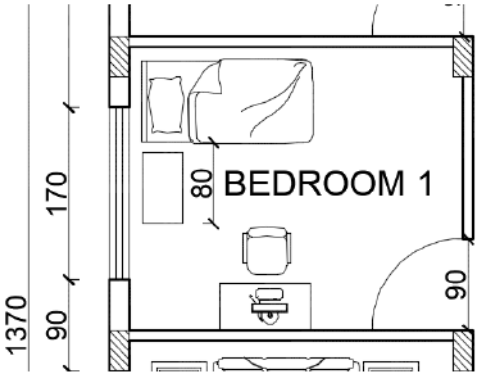


Figure 23.
Bedroom 2 space for a wheelchair user at the long side of the bed and door measurements (Source: Edited by Author, 2022)

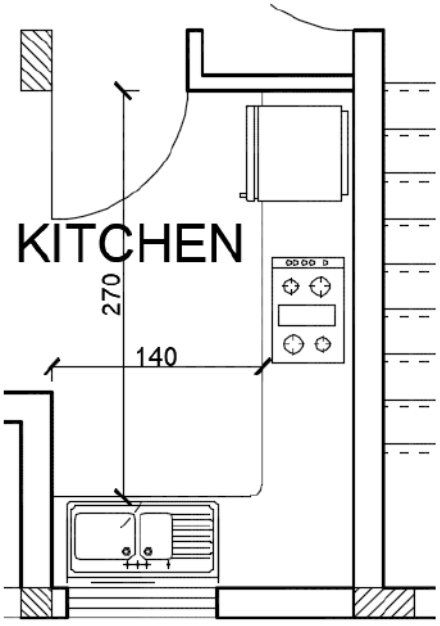


Figure 24.
The area of movement in the L-layout kitchen (Source: Edited by Author, 2022)

The circulation should be at least 150 cm so that wheelchair user can turn 1800, this is the size of the corridor suitable for the disabled. In this case, we can see in Figure 25 that the circulation is 100 cm which makes it difficult for easy circulation from different functions in the house for the disabled. This is a major problem since it is the house design feature with the lowest mean of 2.96 which in turn indicates that the houses in Northern Cyprus don't consider this factor in the design.

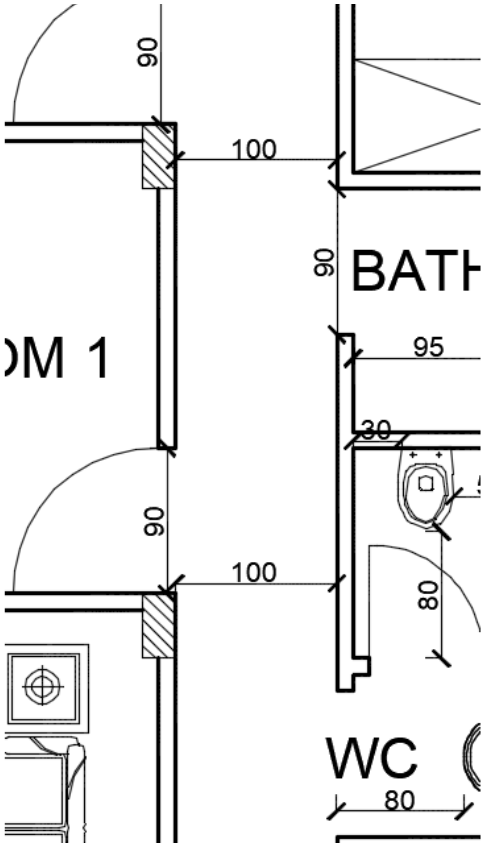


Figure 25
Circulation (Source: Edited by Author, 2022)

The dining area catering for the disabled should have a minimum area of 24 m^2 if it is a house for 2–4 people, and 28 m^2 for 5-6 people. In this dining room, it is way below standard as it has an area of only 6.4 m^2 as shown in Figure 26 making it an unsuitable design for the disabled.

In conclusion, the evaluation of social housing in Famagusta, Northern Cyprus, considering design principles for disabled individuals reveals significant shortcomings. Bathroom and toilet areas lack sufficient space for wheelchair users, leading to resident

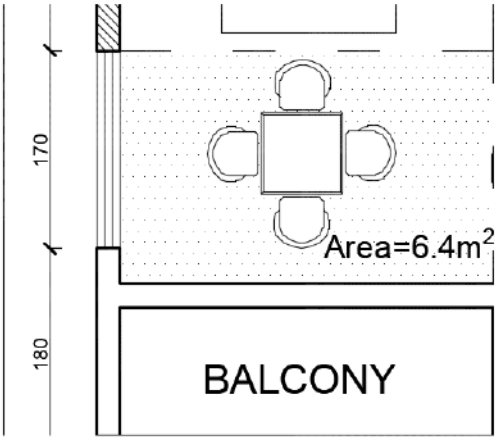


Figure 26.
Dining area (Source: Edited by Author, 2022)

dissatisfaction. Bedroom layouts also fall short of necessary space and accessibility standards. The kitchen, while somewhat accommodating, lacks the required width. Circulation space within the house is notably limited, hindering easy movement for disabled residents. Additionally, the dining area is much smaller than recommended for a disabled-friendly design. The absence of a lift further adds to the inaccessibility of the house for disabled individuals. Overall, this evaluation underscores significant design deficiencies in these social housing units concerning the needs of disabled persons.

4.3. Architectural Floor Plan of the Social Housing in Nicosia

The social house in Nicosia has two flats in each storey and each has an area of 60 m^2 as shown in the floor plan in Figure 27.

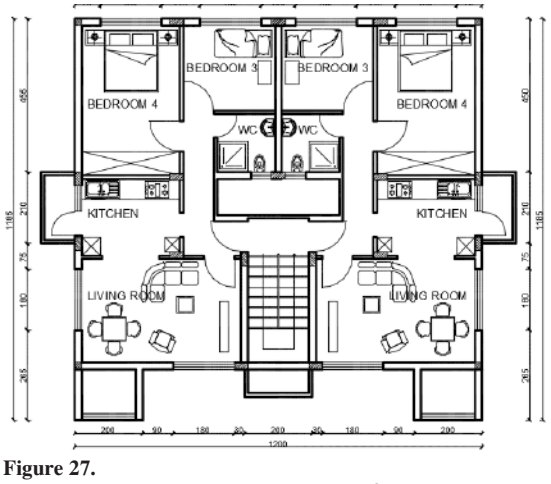


Figure 27.
The plan of the two flats each with 60 m^2 (Source: Edited by Author, 2022)

4.3.1. Assessment of design principles in the flats for the disabled

Similar to case study 1 (Social housing in Magusa), each function of the flat is analysed to see if the design is suitable for disabled people to access, move and use without any difficulties. This is done by examining if the design features and measurements of the social housing in Nicosia features and measurements fit the standard design principles and measurements of the design for the disabled.

The bathroom layout should be in the design of 150 cm in front of the WC and shower but the movement area in front of the shower and basin as shown in Figure 28 are 80 cm and 55 cm respectively which is not enough. This social housing bathroom layout design is not in the standard manner just like the one in Magusa and this is supported by the respondents since it is the function that most people have a problem with 43 respondents.

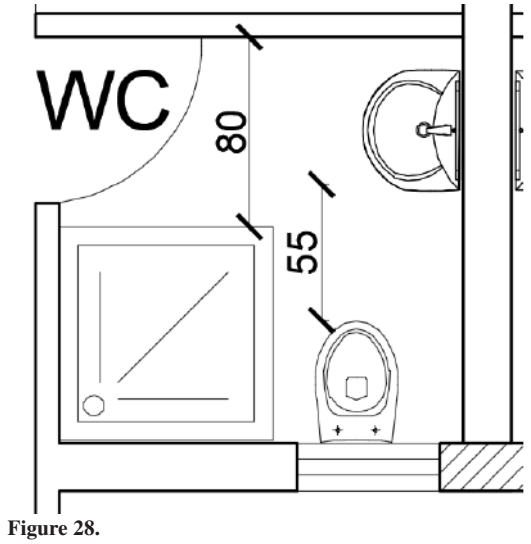


Figure 28.
The movement space in front of the shower and WC, and next to the washbasin (Source: Edited by Author, 2022)

The bedrooms here face the same issue as in the houses in Magusa. The door is not enough for the wheelchair to pass through, and neither is the area of the space alongside the bed as shown in Figure 29. With the overall respondents from the questionnaire rating their bedrooms as fair, this makes the bedroom designs not satisfactory for the comfort and ease of movement of wheelchair users.

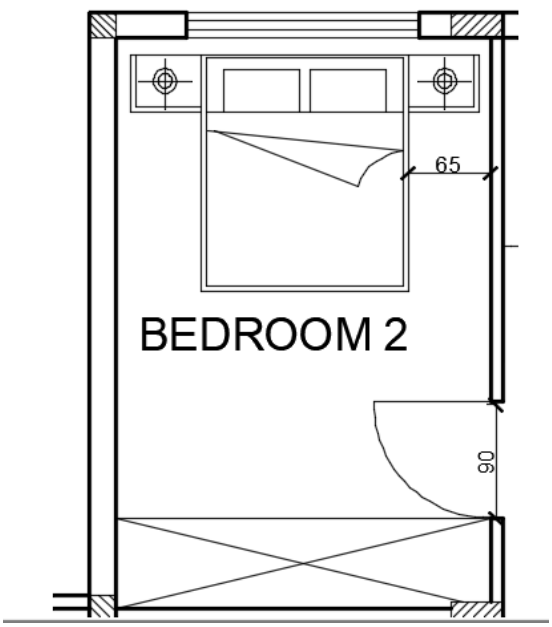


Figure 29.
The door size and space alongside the bed (Source: Edited by Author, 2022)

The kitchen as shown in Figure 30 does not meet the standards of the double space kitchen where it should have a movement area of at least 150 cm. This can be justified by the respondents who rated the kitchen as the second functional space that they have a major problem with.

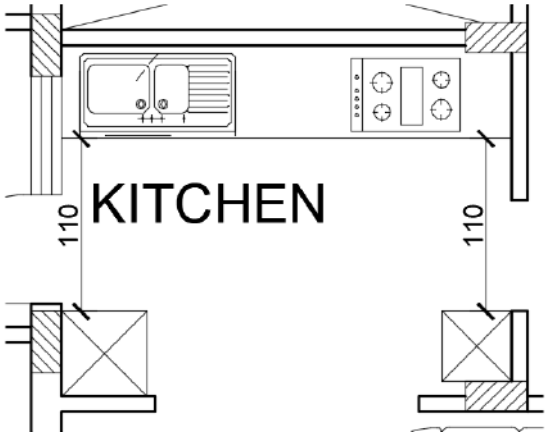


Figure 30.
The space in the kitchen (Source: Edited by Author, 2022)

The circulation in the house is not possible for a wheelchair user since it's only 90 cm as shown in Figure 31 where it should be at least 150 cm. The same problem was faced in the social housing in Magusa and the respondents since it's the feature that they were most unsatisfied with.

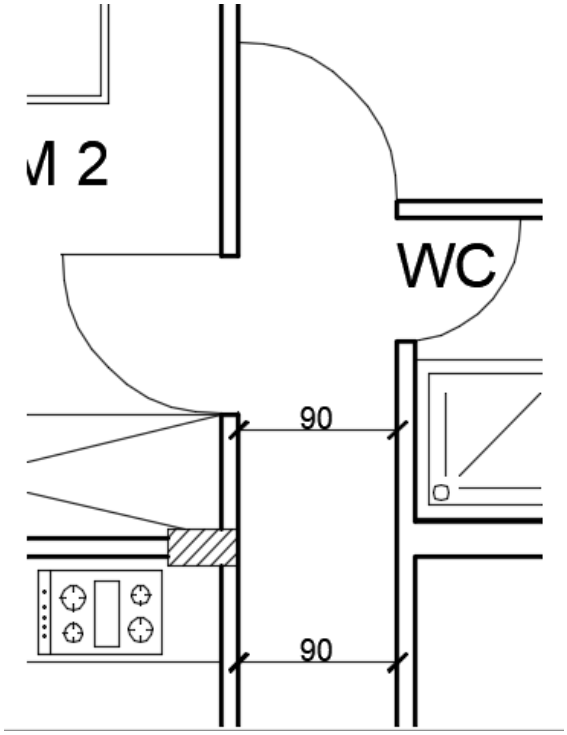


Figure 31.
Circulation (Source: Edited by Author, 2022)

The dining area space in this social house does not meet the standard area as it has a very small area as shown in Figure 32. This does not provide adequate movement areas for wheelchair users. This is also the same case in the housing in Magusa.

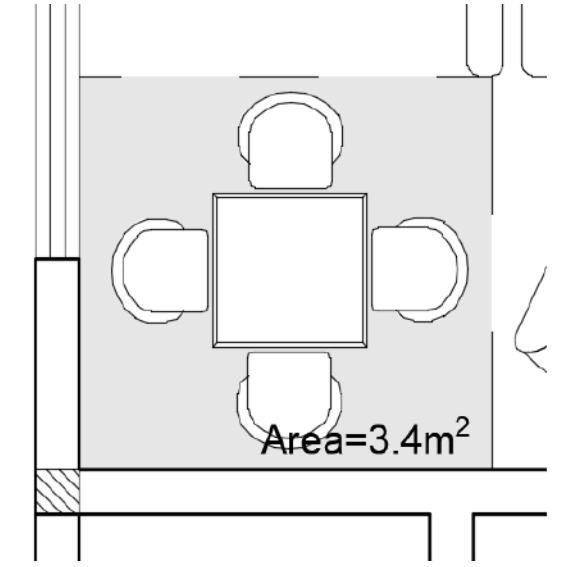


Figure 32.
The space of the dining area (Source: Edited by Author, 2022)

Consequently, the evaluation of social housing in Nicosia, Northern Cyprus, with regards to design principles for disabled individuals reveals several design deficiencies just as the one in Magusa. The bathroom layout lacks sufficient space in front of the WC and shower, falling short of standard requirements. Similarly, the bedrooms present issues with narrow doorways and inadequate space alongside the bed. The kitchen's layout does not meet the recommended double space criteria and is a major source of concern for residents. Circulation space within the house is insufficient for wheelchair users. Additionally, the dining area lacks the standard area required, hindering movement for wheelchair users. These findings underscore significant design flaws in this social housing unit concerning the needs of disabled individuals.

5. CONCLUSION

This research is set to assess the design principles for the residential spaces and examine if they are suitable for disabled persons since they have special needs. The disabled have their standard design and measurements of spaces that if not met can result in limitations such as barriers to moving around the house and performing daily life tasks. Hence, the analysis was done on the social housing in the two cities located in Northern Cyprus; Famagusta and Nicosia. Also, a questionnaire was distributed among the cities of Northern Cyprus so as to examine the resident's satisfaction with the design features of their houses and 147 residents responded. The findings of the questionnaire show that the sidewalks are the accessibility feature that most residents are having a problem with whereas the toilet is the house design feature that they are having most challenges with. This research also found that the major problem with the least satisfactory mean from all the design features of the house is the circulation in the various spaces which limits the wheelchair users from moving around efficiently. Also, the other feature with the least satisfaction of the residents was the overall quality of the house which means that most residents are not satisfied with the design of their residential spaces. This can also be elaborated by the two social housing that were examined since they did not meet the universal design features of the house thus not catering for the special needs of the disabled persons. The houses examined had the toilet as the smallest space with no adequate space for the wheelchair users and also did not enough circulation area. Moreover, a residential building lacking an elevator

is not inclusive for everyone, and the presence of a lift is considered one of the fundamental criteria of universal design. Nevertheless, the residents were most satisfied with the living room space as it had a fair and satisfactory mean. In addition, the kitchen also had gained the satisfaction of the users and can also be elaborated in the social housings that were examined since the kitchen was the space that had the most area and can be easily accessible by the disabled and they can easily move around to cater for their various needs.

The deficiencies in meeting design principles and accommodating disabled residents underscore the significance of further research and potential policy improvements. Enhancing the accessibility and inclusivity of residential spaces for disabled individuals is not only a matter of addressing their specific needs but also of promoting social equity and improved quality of life. This research serves as a valuable step towards recognizing and addressing the challenges faced by disabled individuals in housing design and paves the way for future advancements in universal design principles and accessibility standards in the context of social housing.

5.1. Recommendations

My recommendations are that other types of dwellings can also be examined in other parts of Northern Cyprus to analyse if they are designed in a suitable way to cater for the needs of the disabled. In addition, the planners, architects and designers should all ensure that all buildings are designed universally so that they can accommodate everyone without creating any limitations. They should also focus on each space of the houses individually and analyse every feature and how each design element can affect the user if not designed in a manner that satisfies their needs. Moreover, it is crucial for Cyprus to establish its own universal design principles.

ACKNOWLEDGEMENT

I extend my heartfelt gratitude to Assist. Prof. Dr. Çilen Erçin for her invaluable support and contributions to this article. Her insights and dedication have been instrumental in shaping its content. Thank you for being an essential part of this journey.

REFERENCES

[1] Razzouk, R., & Shute, V. (2012). What is design thinking and why is it important? *Review of educational research, 82*(3), 330–348.

[2] Braha, D., & Maimon, O. (1997). The design process: properties, paradigms, and structure. *IEEE Transactions on Systems, Man, and Cybernetics-Part A: Systems and Humans, 27*(2), 146–166.

[3] Ochoa, C. (2016). Virtual and augmented reality in education. Are we ready for a disruptive innovation in education? In ICERI2016 Proceedings (pp.2013-2022). IATED.

[4] J, Eekels. (2000). On the fundamentals of engineering design science: The geography of engineering design science Retrieved January 14, 2023, from Eekels, J. (2000). On the fundamentals of engineering design science: The geography of engineering design science. Part 1. *Journal of Engineering Design, 11*(4), 377–397.

[5] Ulrich, W. (1985). The way of inquiring systems. Journal of the Operational Research Society, 36(9), 873-876.

[6] Visser, W. (2009). Design: one, but in different forms. *Design studies, 30*(3), 187–223.

[7] Gamma, E., Helm, R., Johnson, R., Vlissides, J., & Patterns, D. (1995). Elements of Reusable Object-Oriented Software. Design Patterns.

[8] Carroll, J. M. (2016). Chapter 10 THEORIZING THE UNPRECEDENTED. In Theory development in the information sciences (pp. 185–203). University of Texas Press.

[9] Pearl, J. (1984). Heuristics: intelligent search strategies for computer problem solving. Addison-Wesley Longman Publishing Co., Inc..

[10] Purao, S., Storey, V. C., & Han, T. (2003). Improving analysis pattern reuse in conceptual design: Augmenting automated processes with supervised learning. *Information Systems Research, 14*(3), 269–290.

[11] Guindon, R., Krasner, H., & Curtis, B. (1987, December). Breakdowns and processes during the early activities of software design by professionals. In Empirical studies of programmers: Second Workshop, 65–82.

[12] Fu, K. K., Yang, M. C., & Wood, K. L. (2016). Design principles: Literature review, analysis, and future directions. *Journal of Mechanical Design, 138*(10), 101103.

[13] Gregor, S., Chandra Kruse, L., & Seidel, S. (2020). Research perspectives: the anatomy of a design principle. Association for Information Systems.

[14] Fu, K. K., Yang, M. C., & Wood, K. L. (2015, August). Design principles: The foundation of design. In International design engineering technical confer-

ences and computers and information in engineering conference (Vol. 57175, p. V007T06A034). American Society of Mechanical Engineers.

[15] Zhang, J., Gisca, O., Koivumäki, T., & Ahokangas, P. 1. Legitimacy challenges in the healthcare ecosystem: data management in the era of GDPR. In 15th Annual Conference of the EuroMed Academy of Business.

[16] Leopold, C. (2002). Architecture and Geometrical Space Conceptions.

[17] Thurston, T. (2022). Slavery: Annual Bibliographical Supplement (2021). Slavery & Abolition, 43(4), 841-987.

[18] Wijesooriya, N. (2018). Architecture, Space and Place: Finding Phenomenological Meaning. Research Paper, University of Cambridge. https://www.researchgate.net/publication/329359027_Architecture_space_and_Place_finding_phenomenological_ meaning.

[19] Baghchesaraei, A., & Baghchesaraei, O. R. (2015). Space definition in modern and innovative houses. *Indian Journal of Fundamental and Applied Life Sciences, 5*(S2), 266–269.

[20] Kant, I. (1781). 1934 Critique of Pure Reason. London: JM Dent & Sons Ltd.

[21] Erman, O. (2017). Analysis of the architectural space through the spatial neighbourhood concept. *Journal of the faculty of engineering and architecture, 32*(1), 165–176.

[22] Franz, G. (2005). An empirical approach to the experience of architectural space (Doctoral dissertation, Bauhaus-Universität Weimar, Germany).

[23] Altman, B. M. (2014). Definitions, concepts, and measures of disability. *Annals of epidemiology, 24*(1), 2–7.

[24] Savage, K. T., Singh, V., Patel, Z. S., Yannuzzi, C. A., McKenzie-Brown, A. M., Lowes, M. A., & Orenstein, L. A. (2021). Pain management in hidradenitis suppurativa and a proposed treatment algorithm. *Journal of the American Academy of Dermatology, 85*(1), 187–199.

[25] Kazou, K. (2017). Analysing the Definition of Disability in the UN Convention on the Rights of Persons with Disabilities: is it really based on a'Social Model'approach? International *Journal of Mental Health and Capacity Law*, (23), 25-48.

[26] World Health Organization. (2001). The World Health Report 2001: Mental health: new understanding, new hope.

[27] Bianquin, N., & Bulgarelli, D. (2017). 4 Conceptual Review of Disabilities. Play development in children with disabilities, 71-87.

[28] De Azevedo, N. J. D., Silva, J. J., & Silva, P. M. W. (2010). Definition of indicators for sustainable social housing: in search of a model. *International Journal for Housing Science & Its Applications, 34*(2).

[29] Adema, W., Plouin, M., & Fluchtmann, J. (2020). Social Housing: A Key Part of Past and Future Housing Policy. Technical Report, Paris: Organisation for Economic Co-operation and Development (OECD).

[30] Pittini, A. (2012). Social housing in the European Union. *TECHNE-Journal of Technology for Architecture and Environment*, 21-34.

[31] De Azevedo, N. J. D., Silva, J. J., & Silva, P. M. W. (2010). DEFINITION OF INDICATORS FOR SUSTAINABLE SOCIAL HOUSING: IN SEARCH OF A MODEL. *International Journal for Housing Science & Its Applications, 34*(2).

[32] Zimmer, M. A. (2012). Universal Design in Higher Education: From Principles to Practice–Edited by Sheryl E. Burgstahler and Rebecca C. Cory.

[33] World Health Organization. (2016). World Health Statistics 2016 [OP]: Monitoring Health for the Sustainable Development Goals (SDGs). World Health Organization.

[34] Khasanova, R. R., & Makarentseva, A. O. (2018). Poverty of disabled people and households. *Всероссийский экономический журнал ЭКО, 3*(525), 44-59.

[35] Goeppel, C., Frenz, P., Grabenhenrich, L., Keil, T., & Tinnemann, P. (2016). Assessment of universal health coverage for adults aged 50 years or older with chronic illness in six middle-income countries. *Bulletin of the World Health Organization, 94*(4), 276.

[36] World Health Organization. (2013). World Health Report 2013: Research for universal health coverage. World Health Organization.

[37] Theis, K. A., Steinweg, A., Helmick, C. G., Courtney-Long, E., Bolen, J. A., & Lee, R. (2019). Which one? What kind? How many? Types, causes, and prevalence of disability among US adults. *Disability and Health Journal, 12*(3), 411–421.

[38] Pan, W., Dainty, A. R., & Gibb, A. G. (2012). Establishing and weighting decision criteria for building system selection in housing construction. *Journal of Construction Engineering and Management, 138*(11), 1239–1250.

[39] Neufert, E., & Neufert, P. (2012). Architects' data. John Wiley & Sons.

[40] Duman, Ü., & Uzunoğlu, K. (2021). The importance of universal design for the disabled in public buildings: a public building in Northern Cyprus as a case study. *Civ. Eng. Archit*, 9, 690-707.

[41] Kusnierz-Krupa, D. (2019, September). Historical Buildings and the Issue of their Accessibility for the Disabled. In IOP Conference Series: *Materials Science and Engineering 603*(5), 052007). IOP Publishing.

[42] Duman, Ü., & Uzunoğlu, K. (2021). The importance of universal design for the disabled in public buildings: a public building in Northern Cyprus as a case study. *Civ. Eng. Archit*, 9, 690-707.

[43] Nour, M. S. (2010). Adaptable housing for low income groups in Northern Cyprus (Doctoral dissertation, Eastern Mediterranean University (EMU).