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Inclusive Architecture: Application to Trauma Center Design

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Abstract: ***This research aims to evaluate the application of the concept of inclusive architecture in the Trauma Center of North Sumatra through the lens of universal design principles. Inclusive architecture is defined as a design approach that ensures accessibility and usability for all individuals, regardless of their physical abilities, age, or other factors that may affect their interaction with the built environment. The study employs a qualitative methodology, utilizing case studies and observational analysis to assess the effectiveness of design elements that promote inclusivity. By examining the Trauma Center's architectural features, this research seeks to identify strengths and weaknesses in its design, ultimately providing recommendations for enhancing accessibility and user experience. The findings will contribute to the broader discourse on inclusive design in healthcare facilities, emphasizing the importance of creating environments that cater to the diverse needs of all patients and visitors.***

Keywords: Trauma Center, Architecture Inclusive, Universal Design, Accessibility

1. Introduction

Inclusive design is an approach that views design and space as systems specifically developed to address the unique needs of individuals with disabilities while ensuring seamless integration with other users, thereby avoiding any distinctions. The goal of inclusive design is to create a welcoming and accessible environment for all individuals, regardless of age or limitations [1], [2], [3], [4], [5], [6]. Inclusive architecture prioritizes the diverse needs of users in its implementation, fostering an inclusive atmosphere that accommodates everyone. Overall, the overarching theme of inclusive design is to promote equality and accessibility in the built environment [7].

Inclusive architecture aims to eliminate barriers, allowing everyone to participate in accessing their environment. The primary goal of inclusive architecture is to ensure that all individuals, both disabled and non-disabled, can access and utilize spaces safely, comfortably, and independently [8]. This approach employs the principles of universal design as a framework, ensuring that the design of buildings and public facilities not only meets accessibility standards but also creates spaces that are welcoming and functional for all users [9], [10], [11], [12], [13], [14], [15].

Universal Design is an approach that honors human diversity, emphasizing the right of every individual—from children to the elderly—to access spaces, products, and information in an independent, inclusive, and equitable manner [9], [13], [16], [17], [18], [19], [20]. This concept can be applied across all aspects of design, ensuring that all user groups can fully benefit from it without the need for special adjustments or modifications [18], [21]. By adopting this design philosophy, facilities are created to be more accessible and usable for everyone. According to S.A. Kadir and M. Jamaludin (2012), universal design refers to seven main principles formulated by the College of Design, North Carolina University [11], which includes:

1.1 Equitable Use (Can be used by everyone)

Equitable Use is an inclusive design principle that seeks to ensure facilities are equally accessible to all individuals, regardless of their abilities. This principle aims to prevent isolation, stigma, and discriminatory treatment of specific groups, fostering an environment where everyone can participate fully and equally [21].

1.2 Flexibility in Use

This principle emphasizes the importance of ease and flexibility in use, highlighting the need for designs that facilitate user interaction. Convenience in design refers to the ability to accommodate a diverse range of individual needs and abilities. By implementing this principle, each person can engage in activities seamlessly, allowing them to achieve their goals with greater ease [20].

1.3 Simple and Intuitive Use

This principle aims to create spaces that can be easily utilized by everyone, without requiring special skills, and that are accessible to all individuals without exception [10].

1.4 Perceptible Information

Perceptible Information, as a principle of universal design, refers to the ability of a design to convey information clearly and effectively to users, regardless of individual abilities, environmental conditions, or sensory functions [16].

1.5 Tolerance for Error

Universal design principles aim to minimize the risks and negative impacts associated with actions taken, whether intentional or unintentional [13]. This entails that the design should mitigate the potential for harm or adverse consequences resulting from accidents or unforeseen events caused by user errors [15], [19].

1.6 Low Physical Effort

Low Physical Effort is a universal design principle aimed at facilitating efficient and convenient use without placing a physical burden on the user [19].

1.7 Size and Space for Approach and Use

This principle pertains to the provision of space dimensions that meet the needs of users, ensuring comfort in the utilization of existing facilities. It emphasizes the importance of offering adequate space for movement and convenient access for all individuals [22].

The application of universal design ensures that all individuals, without exception, have equal rights to access their environment. Universal design not only promotes equal access for everyone but also supports individuals in re-engaging with social life by creating a safer and more accommodating environment, thereby facilitating their integration back into society.

In the context of healthcare facilities such as Trauma Centers, the implementation of inclusive architecture is essential, as these facilities serve a diverse range of users with specific needs, including emergency patients, individuals with disabilities, the elderly, and medical personnel. Trauma is often an unexpected event that can inflict profound physical and psychological wounds on victims, sometimes resulting in a combination of both. A Trauma Center is a hub designed to address these critical needs effectively [23], [24].

A Trauma Center enables the provision of medical services more quickly and effectively, thereby increasing the chances of survival and facilitating the recovery of patients suffering from physical and psychological trauma. The Trauma Center plays a crucial role in enhancing the quality of public health and safety services. Support from the hospital can also improve commercial aspects, such as patient volume and reputation, which contribute to financial success and long-term growth. The application of inclusive architecture within these centers further enhances their effectiveness and accessibility.

2. Methodology

This study employs a qualitative method for designing the Trauma Center. The qualitative approach was selected to gather information and data based on real-world observations, enabling an in-depth examination of various factors that influence the design of healthcare facilities, including the needs of patients, medical staff, and site characteristics. This method aims to explore the social, psychological, and functional aspects of the Trauma Center's design by providing insights into how these elements interact and impact overall effectiveness.

Data were collected through direct observation and by analyzing literature related to the principles of inclusive design. The data analysis involved identifying thematic patterns relevant to the research objectives, specifically the creation of an environment that is inclusive and easily accessible to all individuals, including people with disabilities, the elderly, and other vulnerable groups.

This qualitative method enables researchers to explore the social context and direct user experiences related to space design, while also identifying needs that may have been overlooked in conventional design approaches. The findings of this study are anticipated to yield design recommendations that are more inclusive and aligned with the principles of universal design, ultimately enhancing the comfort and operational efficiency of the Trauma Center and supporting social integration.

3. Result and Discussion

3.1 Application of Inclusive Architecture based on Universal Design theory

Based on the principles of Universal Design, inclusive architecture seeks to create environments and spaces that can be accessed and utilized optimally by all individuals, regardless of differences in physical ability, age, or background. Each principle—such as Equitable Use, Flexibility in Use, Simple and Intuitive Use, Perceptible Information, Tolerance for Error, Low Physical Effort, and Size and Space for Approach and Use—serves as a guideline for designing inclusive facilities. The explanation is:

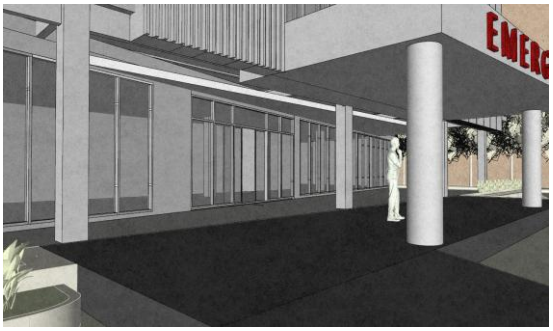
3.1.1 Equitable use (can be used by everyone)

The following outlines the application of the principle of equitable use:

a) Automatic Doors

The main entrance to the Trauma Center is designed to facilitate a smooth flow of entry for patients, families, and medical staff, embodying the principles of inclusivity, efficiency, and safety.

(a)



(b)

Figure 1: (a) Entrance Emergency Trauma Center, (b) Automatic Doors

The automatic doors at the main entrance of the Trauma Center are designed to provide comfort, efficiency, and inclusivity for all users, including those with limited mobility. By eliminating obstacles for individuals who may struggle to open doors manually, these automatic doors enhance accessibility. They are equipped with motion sensors and accessibility buttons, allowing users to enter without physical effort. Additionally, the design of the doors ensures a smooth flow of traffic.

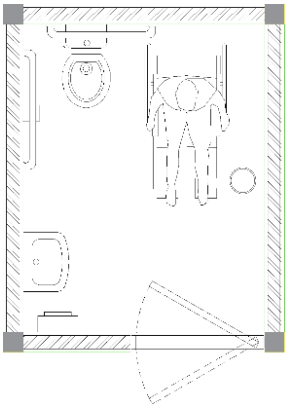
b) Handrail

Figure 2: Handrail at Corridors

The installation of handrails in the corridors of the building ensures accessibility for all individuals, including those with limited mobility. These handrails are designed to be 85-95 cm in height, featuring an ergonomic design with curved ends. They are made from non-slip materials that are durable and easy to maintain, enhancing safety and usability for all users.

c) Inclusive Toilet

Toilets in public spaces, such as Trauma Centers, should be designed to accommodate all individuals, including wheelchair users, the elderly, and those with limited mobility. This includes providing sufficient space for wheelchair maneuverability and installing handrails around toilets and sinks to enhance accessibility and safety.



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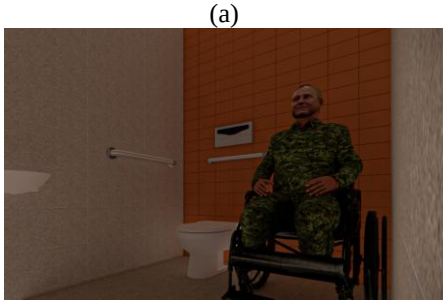


(b)

Figure 3: (a) Toilet Plan, (b) Interior Toilet

Accessible toilets are equipped with strategically placed handrails, wheelchair-friendly heights for toilets and sinks, and ample space for easy access. These features ensure the comfort, safety, and independence of individuals with disabilities, in accordance with accessibility standards.

3.1.2 Flexibility in use

The following outlines the application of the principle of flexibility in use:

a) Flexible Receptionist Table

Figure 4: Receptionis Table

The flexible registration desk is designed to ensure accessibility for all users, including individuals with disabilities. It features an adjustable height, ample space for wheelchair maneuverability, and a wide, barrier-free surface to accommodate various needs.

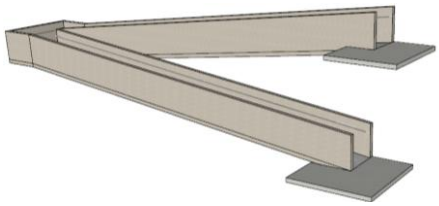
b) Multifunctional Waiting Room

Figure 5: Waiting Room

The multifunctional lounge is designed according to universal design principles, ensuring comfort and accessibility for all users, including individuals with disabilities. It includes ramps, seating at various heights, furniture that facilitates movement, and directional signage in visual, Braille, and auditory formats.

c) Ramp

(a)



(b)

Figure 6: (a) Ramp Plan, (b) Ramp Perspective

Ramps offer accessibility for a diverse range of users, including wheelchair users, individuals with walkers, the elderly, pregnant women, and children, serving as an alternative to stairs. The ramps are equipped with handrails that are 85 cm high and feature curved ends for added support. Each ramp measures 1.5 meters in width and 9 meters in length, designed with a safe slope and a non-slip surface to ensure safety and ease of use.

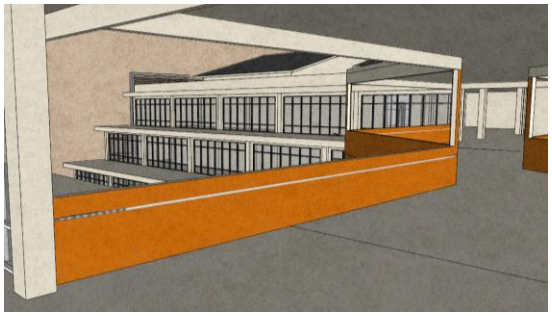
d) Pedestrian

Figure 7: Pedestrian

The pedestrian path is designed with a width of 1.5 meters to facilitate ease of movement for wheelchair users. It is constructed from asphalt, featuring a flat, smooth, and non-slip surface to help prevent accidents.

e) Corridor

(a)



(b)

Figure 8: (a) Corridor, (b) Handrail at Corridor

The corridor connecting the buildings is designed with contrasting colors to enhance navigation. It is equipped with handrails made from durable materials, such as stainless steel, ensuring safety, comfort, and accessibility for all users.

3.1.3 Simple and intuitive use

The following outlines the application of the principle of simple and intuitive use:

a) Tactile

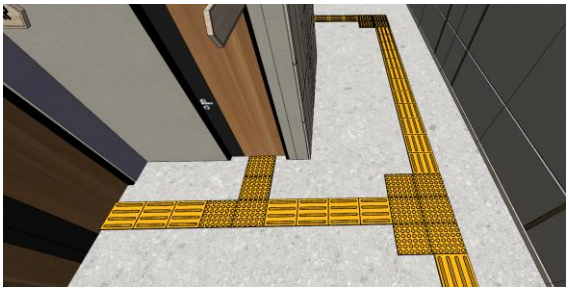


Figure 9: Tactile

Tactile indicators featuring a long line pattern are used to create a guiding path to the main area, while a dot or circle pattern serves as a warning marker in hazardous zones. The strategic placement of these tactile indicators along the corridor enhances orientation, improves comfort, and ensures safety for all users, including individuals with visual impairments.

b) Using an automatic faucet

Figure 10: Wastafel

A water faucet equipped with motion sensors eliminates the need for users to turn a lever or navigate a complicated system. This design simplifies access for all users, including children and individuals with motor disabilities.

c) ATM

Figure 11: ATM

ATMs equipped with touch screens are designed to minimize confusion, particularly for elderly users and individuals who may be less familiar with technology.

3.1.4 Perceptible information (sufficient information)

The following outlines the application of the principle of perceptible information:

a) Clear signage

Clear and inclusive signage is crucial for facilitating easy navigation for individuals with disabilities in various public facilities, including trauma centers and hospitals.

Figure 12: Clear Signage

The placement of signage above doors must adhere to accessibility standards to ensure it is easily visible to wheelchair users. This enhances the accessibility of public facilities and fosters an inclusive environment that respects the rights of all individuals.

Figure 13: Disabilities Signage at the Door

The disability symbol on the toilet door serves as a clear marker for facilities designated for individuals with disabilities, making it easier for wheelchair users to identify. This symbol reflects a commitment to inclusivity and equality, ensuring that public spaces are safer and more functional for everyone. It highlights the importance of providing appropriate accessibility features, such as wider doors and handrails.

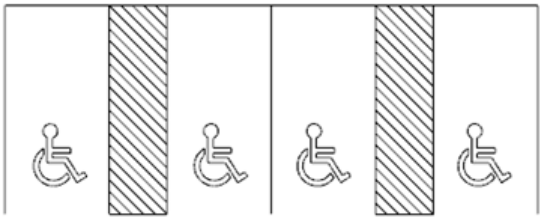


Figure 14: Disabilities Signage at the car park

The disability symbol in the parking area designates a special space for individuals with disabilities, strategically located near the main entrance to facilitate mobility. This parking area is designed to be more spacious, accommodating users of wheelchairs and other assistive devices. It also serves as a reminder to the public to respect the rights of individuals with disabilities and to refrain from using these spaces without a legitimate need.

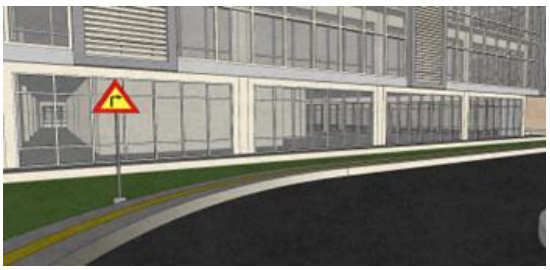


Figure 15: Signage for Direction

Directional signage is crucial for individuals with disabilities, particularly those with visual impairments, as it enables them to navigate safely and independently. These signs should feature clear symbols or text, contrasting colors, and large font sizes. By providing clear signage, individuals with disabilities can avoid confusion, reduce the risk of accidents, and enhance the overall accessibility of public spaces.

b) Use of contrasting colors

Figure 16: The Use of Contrasting Colors

The use of contrasting colors alongside neutral tones, such as gray or beige, is essential for individuals with disabilities, particularly those with visual impairments. This approach facilitates navigation, highlights important elements, and creates a calm atmosphere while reducing excessive visual stimuli. This combination effectively supports accessibility and enhances overall convenience.

c) Optimal lighting

Figure 17: Optimal Lighting

Optimal lighting in universal design enhances comfort, safety, and accessibility by providing bright, even illumination that minimizes glare and reduces shadows.

3.1.5 Tolerance for error

The following outlines the application of the principle of tolerance for error:

a) Linear circulation

Figure 18: Linier Circulation

Linear circulation promotes direct and efficient access to each space, reducing confusion and ensuring a clear flow of movement. This design is particularly effective for the Trauma Center, as it enhances efficiency, speed, and ease of navigation for patients, medical personnel, visitors, and individuals with disabilities.

3.1.6 Low physical effort

The following outlines the application of the principle of low physical effort:

a) Building Shape

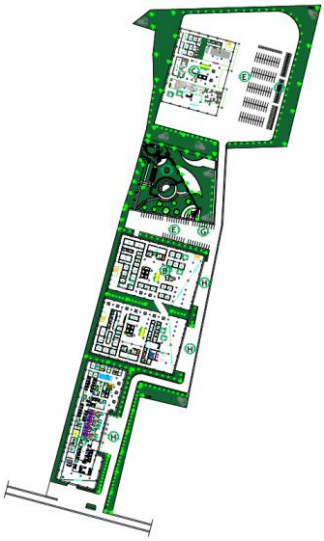


Figure 19: Building Layout

The rectangular shape of the building mass enhances circulation between structures, enabling users to move more freely and efficiently.

b) Use of handrails on stairs

Figure 20: Handrails at the Stairs

Stairs equipped with handrails offer additional support, making it easier and safer for individuals with physical limitations, including those with disabilities and the elderly, to navigate up and down the stairs.

c) Disabilities

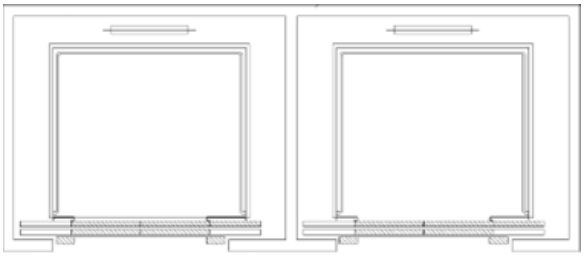
Figure 21: Parking Disabilities

Disabled parking spaces must be near the entrance to facilitate access for motorists and passengers with limited mobility.

3.17 Size and space for approach and use

The following outlines the application of the principle of size and space for approach and use:

a) Lift



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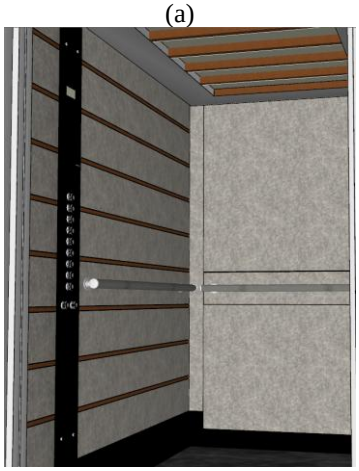

(b)

Figure 22: (a) Elevators Plan, (b) Elevators Perspective

Handrails in elevators offer physical support and comfort for users, particularly for those who rely on them for balance. Additionally, the space surrounding the elevator must be sufficiently large to ensure accessibility for all individuals, including those using mobility aids.

b) Bus Stop

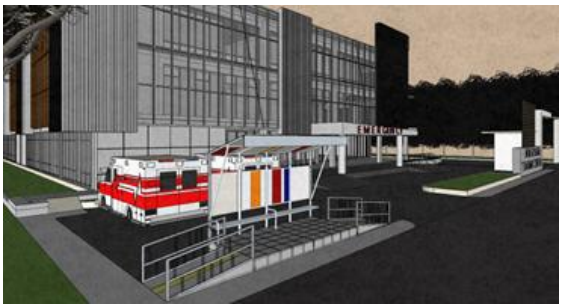

Figure 23: Bus Stop

4. Conclusions and Suggestions

4.1 Conclusions

The application of inclusive architecture based on Universal Design principles seeks to create a Trauma Center environment that is accessible to everyone, including individuals with disabilities, without barriers. Each principle of Universal Design—such as Equal Use, Flexibility of Use, Simple and Intuitive Use, Easily Perceptible Information, Tolerance for Error, Minimal Physical Effort, and Adequate Size and Space for Approach and Use—is implemented through various facilities, including automatic doors, ergonomic handrails, ramps, elevators, inclusive restrooms, flexible registration desks, optimal lighting, contrasting signage, bus stops, building design, and linear circulation. This design approach aims to enhance the comfort, safety, efficiency, and independence of all users while fostering a welcoming and inclusive space for everyone.

4.2 Suggestions

This study recommends emphasizing the implementation of each Universal Design principle through real-world case studies, as well as evaluating the effectiveness of facilities designed to ensure accessibility and comfort for all users. Additionally, involving individuals with disabilities in the planning and design testing process can enhance the research outcomes and ensure that the resulting Trauma Center is genuinely inclusive and responsive to the needs of all groups.

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Author Profile

Aulia Muflih Nasution graduated with a degree in Architecture from North Sumatera University in 2007 and obtained a master's degree in planning-information technology from Universiti Teknologi Malaysia in 2009. Since 2009, Aulia has been a dedicated lecturer and researcher at Medan Area University, where they have made significant contributions to the fields of architecture and urban planning. Aulia has a strong interest in sustainable building design, focusing on Building Information Modeling (BIM), sustainable architecture, and inclusive design. In addition to their academic role, Aulia is also an architect at Syntharch Studio, where they apply their expertise to create innovative and environmentally responsible designs. Aulia is passionate about mentoring students and actively participates in community outreach programs that promote awareness of architectural accessibility and sustainability. Through their work, Aulia strives to create spaces that are not only functional but also inclusive and responsive to the needs of diverse communities.