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Applying Universal Design concept in interior design to reinforce the Social dimension of Sustainability

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Abstract: *Universal Design (UD), is "design for all people". Its focus is not specifically on people with disabilities, but targets all people at different ages. Children, the elderly, the disabled, people with different sizes and forms, sick or injured people and people with discomfort are in this range. The main aim of the universal design is not to make people fit to space but to make the space fit to people. This paper provides an overview of universal design applications in interior design promising results for a better future for social sustainability. Universal Design is a concept that is applied to designing of anything or any place that affects people. The term is now recognized and accepted internationally as a framework for good design. There are many theories regarding its basic principles. Primarily, Universal Design addresses safety, facility in use, understanding and redoing, adaptability, feasibility, marketability and profitability. It does not address everyone's ability. Nothing can. But it does level the playing field for more people.*

Keywords: *Design for all, inclusive design, Principles of Universal design, social sustainability, Universal Design.*

I. Introduction

The root of universal design was deep and strong throughout the twentieth century due to the demographic, legislative, economic and social changes among older adults and people with disabilities. The move towards universal design has developed due to the expanding population of people with varying degree of abilities and advancing years, their demands for recognition and desire for independent living. Designing any product or environment involves the consideration of many factors, including aesthetics, engineering options, environmental issues, industry standards, safety concerns, and cost. Often, products and environments are designed for the average user. In contrast, when designers apply UD principles, their products and environments meet the needs of potential users with a variety of characteristics. Disability is just one of many characteristics that an individual might possess [1]. This study is important in prioritizing 'design for all' factors among diverse user groups that would both ensure the inclusiveness of different needs and quicken the design process.

II. Problem of research

The research question of this study is the Lack of awareness of the concept of universal design (UD) and the features of its applications in the field of interior design.

III. Research Objectives

The objective of the current study is to highlight the importance of Universal Design and its benefits, guide designers in the decision-making process through the principles of Universal Design. Raise awareness about the value of universal design. Provide practical examples of how universal design can be implemented.

IV. Methodology

The paper is divided into five sections: the first explains some fundamental concepts about Universal Design. The second includes the seven Principles of Universal Design and their guidelines. The third section shows the Universal City and its features. The fourth section gives the relationship between Universal design and social sustainability. The last section is an application of the Universal design in a public library. The researcher follow the inductive approach through access to the latest scientific literature and websites related to the subject of research and the analytical approach by the study and the analysis of some applications of Universal design.

V. Concepts about Universal design

A. A Brief History of Universal Design

The term universal design was first used in 1970's and reinterpreted by the American architect Ronald Mace in 1985. Since then, universal design has been widely accepted and expressed all over the world [1]. The 'design for all' approach has also been extensively studied under the concept of universal design (often referenced in Europe as 'inclusive design') [2].

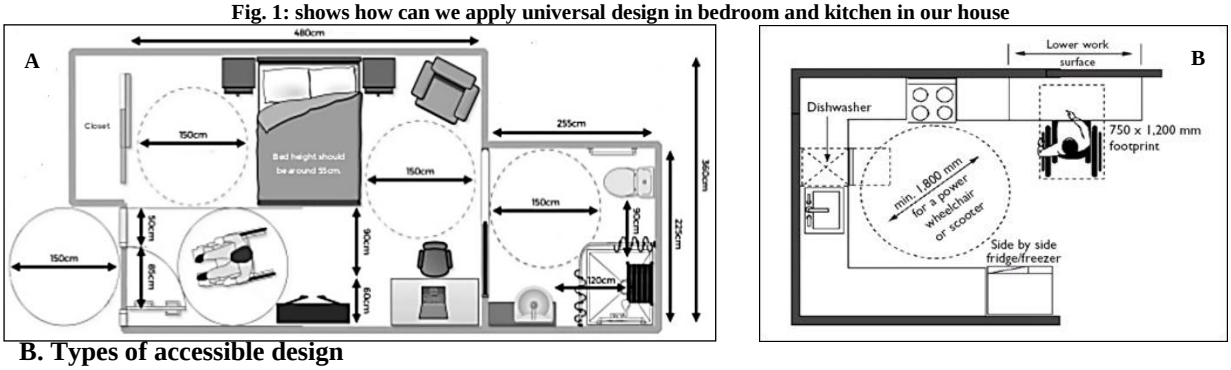
A.1 Ronald L. Mace and the Evolution of the Universal Design concept

Ronald L. Mace (1941 - 1998), creator of the term "universal design," was an articulate architect and determined advocate who influenced international thinking about design. He used a wheelchair and understood what it was to try to participate in a world that was not designed to include him. Even though Ron died at the age of 56, he impacted architecture, interior design .and the perceptions of many in how they view people with disabilities [3]. In 1988, Mace defined it as an approach for creating products and built environments accessible, usable and understandable for everyone. Mace, Hardie & Place (1991) described universal design as follows: "It includes not just people in wheelchairs, but also people with mobility impairments, speech and hearing impairments, cognitive impairments, and with other inabilities that can be occurred over a person's life span". The Centre for Universal Design states that "universal design is the best way to integrate access for everyone into any effort to serve people well in any field" [4].

A.2. Defenition and Philosophy of Universal Design

Under the leadership of Ron Mace, the Center for Universal Design at North Carolina State University defined universal design as :"The design of products and environment to be useable by all people, to the greatest extent possible, without the need for adaptation or specialized design"[5]. This philosophy poses the condition that products, physical environment and services should reach people and that people should be able to use them in the widest way possible. Fulfilling this condition, improving the life quality of the spaces, health, safety and welfare of people to the highest level are the task of the planners and designers [6]. Universal Design reflects a type of design allowing all users to be accommodated. Its intent is to simplify life for everyone by making products, communications, and the built environment more useable by as many people as possible at little or no cost" [7]. The idea is to design a room that is functional for any able-bodied individual (regardless of age) and a person who has special needs because of physical limitations[5] "Fig.1" .

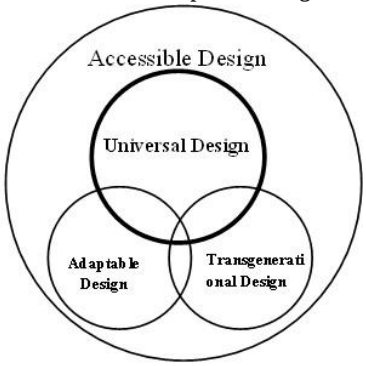
Fig. 1: shows how can we apply universal design in bedroom and kitchen in our house



B. Types of accessible design

Accessible design can be defined as design that meets prescribed code requirements for use by people with disabilities [8] " Fig 2". Because it is often achieved by providing separate design features for "special" user groups, it can segregate people with disabilities from the majority of users and make them feel out of place [9]. Adaptable design features are modifications made to a standard design for the purpose of making the design usable for an individual, as needed [8]. Transgenerational design, sometimes called lifespan design, is design that considers the changes that happen to people as they age[10]. Transgenerational design does not necessarily address the full range of possible disabilities nor other factors that affect usability, such as gender differences, cultural background, and literacy level [1].

Fig.2: shows the relationship between accesible, adaptable,transgenerational, and univesal design .



B. 1. Accessible, adaptable, transgenerational, and universal design

Universal design is always accessible, but because it integrates accessibility from the beginning of the design process, it is less likely to be noticeable. Universal design sometimes employs adaptable strategies for achieving customization, but it is best when all choices are presented equally. Some universal design is transgenerational,

but the approach is inclusive of more than just age-related disabilities. Universal design is sometimes adaptable and sometimes transgenerational but always accessible. Universal design, adaptable design, and transgenerational design are all subsets of accessible design. Sometimes a design can be considered to be two of these subsets, and some designs are all three. Not all accessible design is universal. Universal design is the most inclusive and least stigmatizing of the three types of accessible design because it addresses all types of human variation and accessibility is integrated into design solutions [9].

C. Universal design, human adaptation and abilities

C.1. Defenition of human adaptation

There are three ways to enhance an individual's capabilities: change the person, provide the individual with tools he or she can use, or change the environment. Universal design applies to the third approach, changing the built environment, which includes everyday products, buildings, and outdoor environments. [8].

C.2. Universal Design and the spectrum of Human Abilities

Human abilities can be grouped into categories: cognition, vision, hearing and speech, body function, arm function, hand function, and mobility. They can vary widely according to age, disability, the environment or the particular situation. Universal design means considering the variety of human abilities in: cognition, vision, hearing and speech, body function, arm function, hand function, and mobility [11].

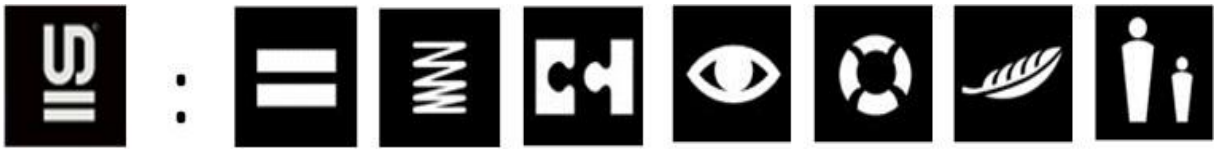
VI. Center for Universal Design and its role in universal design

In 1997, The Center for Universal Design at North Carolina State University (CUD) (by Bettye Rose Connell, Mike Jones, Ron Mace, Jim Mueller, Abir Mullick, Elaine Ostroff, Jon Sanford, Ed Steinfeld, Molly Story & Gregg Vanderheiden) has developed a set of seven Principles of Universal Design that may be used to guide the design process, to evaluate existing or new designs, and to teach students and practitioners. The Principles of Universal Design helped to articulate and describe the different aspects of universal design. They have proved useful in shaping projects of various types all over the world [12]. The Principles established a valuable language for explaining the characteristics of Universal Design. [13].

A.The seven Principles of Universal Design

The seven principles are: Principle 1: Equitable Use, Principle 2: Flexibility in Use, Principle 3: Simple and Intuitive, Principle 4: Perceptible Information, Principle 5: Tolerance for Error, Principle 6: Low Physical Effort, Principle 7: Size and Space for Approach and Use [14] "Fig.3". The Features of Universal Design consist of : increase accessibility, or the ability to access regular activities in our home, enhance visitability, or the ability for friends to visit our home , promote more independent lifestyles, for our self, family and guests, 'universally' support people's diverse needs and abilities , provide greater safety in our home; and encourage "Aging in Place" [15].

Fig. 3: Pictograms shows respectively the symbol of Universal Design and its seven principles.(Source:[14])



B. Universal design by Steinfeld and Maisel

In 2012, Steinfeld and Maisel cited the definition of universal design as 'a process that enables and empowers a diverse population by improving human performance, health and wellness and social participation' [16]. steinfeld and Maisel proposed the following eight goals of universal design: Body fit : accommodating a wide range of body sizes and abilities; Comfort: keeping demands within desirable limits of body function and perception; Awareness: insuring that critical information for use is easily perceived ;Understanding: making methods of operation and use intuitive, clear, and unambiguous; Wellness: contributing to health promotion, avoidance of disease, and prevention of injury; Social integration: treating all groups with dignity and respect; Personalization: incorporating opportunities for choice and the expression of individual preferences; and, Appropriateness: respecting and reinforcing cultural values and the social and environmental context of any design project [17].

C. Explaining the seven Principles of Universal design and their Guidelines

Table 1: The Principles of Universal Design

The Principles of Universal Design	
Principle 1: Equitable Use The design is useful and marketable to people with diverse abilities. Guidelines: 1a. Provide the same means of use for all users: identical whenever possible; equivalent when not. 1b. Avoid segregating or stigmatizing any users. 1c. Make provisions for privacy, security, and safety equally available to all users. 1d. Make the design appealing to all users.	The building's design should make it equally usable by everyone. Ideally, the means by which people use the building should be the same (e.g., providing one means of entry to the building that works well for everyone). If it cannot be identical, the several means provided must be equivalent in terms of their privacy, security, safety and convenience. The building must never employ means that isolate or stigmatize any group of users or privilege one group over another[12]

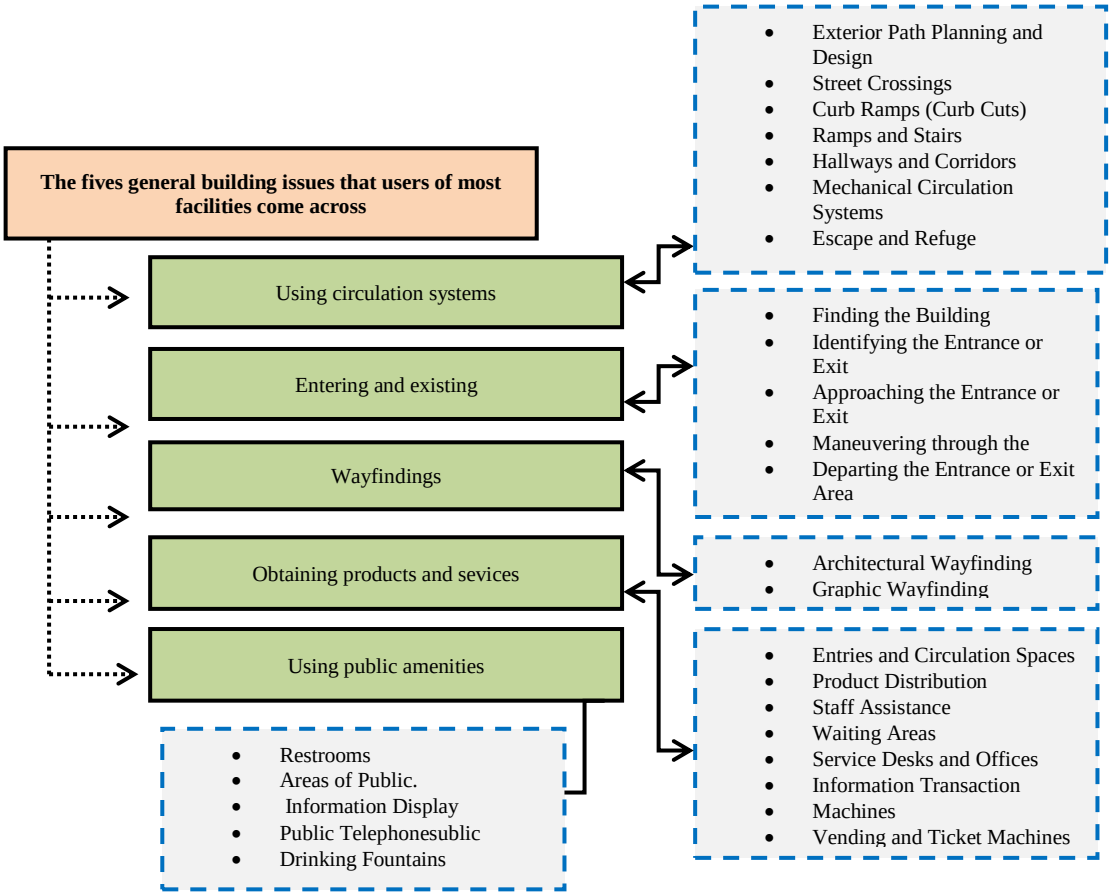
Principle 2: Flexibility in Use The design accommodates a wide range of individual preferences and abilities. Guidelines: 2a. Provide choice in methods of use. 2b. Accommodate right- or left-handed access and use. 2c. Facilitate the user's accuracy and precision. 2d. Provide adaptability to the user's pace.	The building's design should allow people to use its design features in more than one prescribed way (e.g., providing a countertop orientation map that is viewable from either a seated or standing position). It should accommodate both right-and left-handed use and be adaptable to the individual pace. The building's design should have the built-in flexibility to be usable even when it is employed in an unconventional or unanticipated manner [5].
Principle 3: Simple and Intuitive Use Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level. Guidelines: 3a. Eliminate unnecessary complexity. 3b. Be consistent with user expectations and intuition. 3c. Accommodate a wide range of literacy and language skills. 3d. Arrange information consistent with its importance. 3e. Provide effective prompting and feedback during and after task completion.	The building should make it easy for everyone to understand the purpose of each design feature and how to use it (e.g., providing washroom lavatory faucets that make their method of operation readily apparent and relatively easy) Moreover, its means of use should be intuitively obvious so that it operates as anticipated and, therefore, can be used spontaneously[11].
Principle 4: Perceptible Information The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities. Guidelines: 4a. Use different modes (pictorial, verbal, tactile) for redundant presentation of essential information. 4b. Maximize "legibility" of essential information. 4c. Differentiate elements in ways that can be described (i.e., make it easy to give instructions or directions). 4d. Provide compatibility with a variety of techniques or devices used by people with sensory limitations.	The building should provide all essential information in a variety of modes (e.g., written, symbolic, tactile, verbal) to ensure effective communication with all users regardless of their sensory abilities. The information provided must be presented with sufficient contrast to surrounding conditions so that it is distinguishable from its context and decipherable in all its various modes of presentation [5].
Principle 5: Tolerance for Error The design minimizes hazards and the adverse consequences of accidental or unintended actions. Guidelines: 5a. Arrange elements to minimize hazards and errors: most used elements, most accessible; hazardous elements eliminated, isolated, or shielded. 5b. Provide warnings of hazards and errors. 5c. Provide fail-safe features. 5d. Discourage unconscious action in tasks that require vigilance.	Ideally, the building's design should eliminate, isolate or shield any design features that could prove hazardous to or inconvenience any user. When potentially dangerous conditions are unavoidable, users should receive warnings as they approach the design feature (e.g., providing proximity warnings in a variety of sensory modes near the top of stairs.) The building's design should also anticipate accidental or unintended actions by any user to minimize the inconvenience and/or protect the user from harm [12].
Principle 6: Low Physical Effort The design can be used efficiently and comfortably and with a minimum of fatigue. Guidelines: 6a. Allow user to maintain a neutral body position. 6b. Use reasonable operating forces. 6c. Minimize repetitive actions. 6d. Minimize sustained physical effort.	The building's design should employ design features that require little or no physical force to use them (e.g., replacing a traditional door knob with a lever handle that does not require the ability to grasp and turn the wrist). If a low level of force is required,any user should be able to engage the feature without assuming an awkward or hazardous body position (e.g., providing a smooth travel surface with minimal slope along the path of travel leading to the entrance) [12]. Doors to a lecture hall open automatically for people with a wide variety of physical characteristics[18].
Principle 7: Size and Space for Approach and Use Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility. Guidelines: 7a. Provide a clear line of sight to important elements for any seated or standing user. 7b. Make reach to all components comfortable for any seated or standing user."Fig 4" 7c. Accommodate variations in hand and grip size. 7d. Provide adequate space for the use of assistive devices or personal assistance.[5],[11]	A building's design features should provide an adequate amount of space that is appropriately arranged to enable anyone to use them (e.g., providing knee space under a washroom lavatory to enable use by someone in a seated position). In addition, the space needs to be arranged to provide a clear path of travel to and from important design features for all users[12].

Fig. 4: Fig. 4a shows : Wide gate at subway station accommodates wheelchair users as well as commuters with packages or luggage, Fig .4b, 4C show different level of countertop in the kitchen for people on wheelchair.

VII. Features of the Universal City

A universal city is, a city of inclusion where everyone is welcome to participate and contribute [14]. The features that the universal city should have: Pathways, street crossings, and plazas would be free of hazards and barriers to the flow of movement "Fig. 5". It would be planned to provide opportunities for employment, childcare, education and recreation in close proximity to residential areas. Public buildings would accommodate the diverse needs of the population in a cost-effective yet dignified and pleasant manner. Goods and services in these buildings would be easy to find and access. This would contribute to improving economic development and the standard of living of the population. Tourists would want to visit the city because of its convenience. Older people would want to remain in the city after retirement because it provided a more convenient, safe and secure environment than other places they could live [19]. Although each country has its own building regulations, standards, references and norms, designers should not perceive these data merely as a set of rules for applying them in the design process. Effective and efficient knowledge is crucial for the 'design for all' approach in the design process[20].Today universal design supports market mechanisms as a primary means to design accessible environments although it was used as the basis for rehabilitation before[21].

Fig. 5: Schematics Diagram of the elements of the universal city used to have a universal design



A. Using circulation systems

Moving around outdoors and inside buildings is the quintessential activity of urban life. Accessibility of resources, in its broadest sense, and the mobility required for that access is what cities are all about.

A.1. Exterior Path Planning and Design, Street Crossings and Curb Ramps

The layout of path systems should establish a pattern that is safe and accommodates the needs of people on the site and in buildings. Planning should give consideration to the needs and references of people have varying abilities. Travel surfaces and dimensions should support comfortable and easy movement without hazards or barriers, except in locations where challenge is part of a recreational experience. People should not encounter unexpected obstacles on a path. Street Crossings, Curb Ramps (Curb Cuts) should provide continuity in the accessible path of travel [22].Curb ramps should provide a smooth transition in level changes within the pedestrian environment and be designed and located to reduce hazards [14].

A.2. Ramps and Stairs

It is important to ensure that ramps, stairs, steps and handrails are designed and constructed so that all pedestrians can use them safely [19]. Ramps and stairways should be wide enough to accommodate the expected traffic flow which may exceed minimum required width. Provide handrail extensions at the top and bottom of stairs and ramps to help people identify the change in grade and make the necessary adjustments in gait.

Handrail extensions should be turned down or returned to the wall for protection. Wall surfaces adjacent to handrails should be non-abrasive. Provide multi-sensory indicators to identify the beginning and end of a set of stairs, a change in direction, or the location of facilities. Ramps and stairs should be marked and lighted evenly throughout their length. Illuminate travel surfaces with low lighting to reduce shadows. Mark and secure the underside of freestanding stairs to prevent users from inadvertently moving [14].

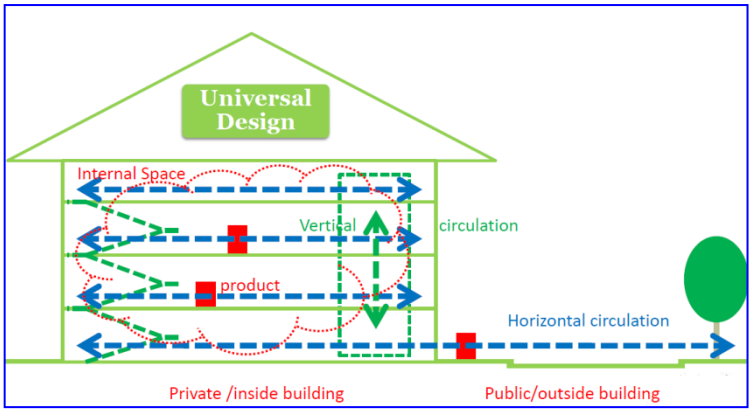
A.3. Hallways and Corridors

Indoor circulation should be convenient, safe and comfortable" Fig. 6". Stairways kept out of the direct path of travel.Ramps running in the direction of normal travel .Hallways and corridors wide enough for two people traveling in the opposite direction to pass each other. All corridors and hallways evenly Illuminated .Gradual transitions from dark to bright spaces, especially those that have high levels of natural illumination. Paths of travel distinguished with material, floor textures or color differences to assist in orientation [19].

A.4. Mechanical Circulation Systems

Mechanical devices are used extensively in multi-story buildings. In large buildings, provide escalators from the main entries to key attractions to reduce congestion. Escalators cannot be used in place of elevators. Provide detectable floor surface changes at approaches to escalators and moving pedestrian pathways or keep them out of the direct path of travel. Moving pedestrian pathways should be wide enough and safe for use by all people whether standing or sitting. Elevator panels should have high contrast signs and labels and be well lighted. Elevator cabs should have enough room to allow all users, whether standing or sitting, to enter, turn around and exit. Both verbal and visual announcements of floor levels are recommended. Plan mechanical circulation systems so that the people are not inconvenienced or unduly separated from the main pattern of building use [14].

Fig 6: Schematics Diagram of Universal Design Application in the Built Environment . (Source [22]).



A.5. Escape and Refuge

In the event of an emergency, all users should be provided routes of escape or safe places to wait for rescue. Refuges should be provided so that people with mobility difficulties are not placed at a greater risk from fire than other occupants. This will usually require an assessment of the number of people likely to require the use of a refuge space and assistance with vertical evacuation of the building [23]. Provide two means of stairless egress when the topography makes it feasible to have entries at different grade levels. Plan at least one approved place of refuge during emergencies on every floor in strategic locations. Vestibules leading to fire stairs or elevator lobbies that are also served by stairways can be used for this purpose if they are large enough. Provide labeling and instructions for use of refuge areas. Develop an evacuation plan for people who cannot get out of a building on their own in an emergency "Fig. 7".Provide public address announcements in both verbal and visual formats during emergencies to inform everyone of the situation. (e.g., underground facilities) [14].

Fig.7 : Fig .7a :Provide comfortable and easy movement throughout the building., Fig .7b: Escalators cannot be used in place of elevators , Fig .7c: Provide signaling systems and signs that can help people escape from complex buildings where the way out is not easy to understand.(Source: [19])

The rest of a building's features do not matter to the person who cannot get in or out. Therefore, it is imperative that the design of entry and exit conditions ensures their ready use by everyone [19].

B.1. Finding the Building, Identifying, Approaching and Maneuvering through the Entrance or Exit

Before people can enter a building, they first must be able to find it. The use of external landmarks that distinguish the building from other nearby facilities can help people locate it **[**24].For Identifying the Entrance or Exit: When faced with multiple doors or panels that imitate the appearance of doors at the entrance or exit of a building, a person should be able to tell the difference between the ones that are doorways and those that are not. Provide perceptible multi-sensory cues (e.g., visual, informational and tactile design properties) to help the person tell the difference between entrance and exit doors "Fig .8". For Approaching the Entrance or Exit: After identifying the entrance or exit, the next task involves the approach. A primary path of travel to the entrance or exit should be provided that is readily perceptible by anyone. It should be free of level changes and obstructions that could impede access or make access hazardous. For Maneuvering through the Entrance or Exit**:** Designing entrance and exit conditions that permit anyone to get through the doorways is a challenge that is often underestimated**.** Where possible, employ automated doors that accommodate people whose hands or arms are otherwise occupied. The controls of automated doors should accommodate differing speeds and styles of movement through the doorway **[**14],[19],[25].

B.2. Departing the Entrance or Exit Area

Successfully entering or exiting a building includes a person's ability to move away after passing through the doorway **.** Primary paths of travel leading away from the entrance and exit should be provided that are readily perceptible by anyone and free of level changes and obstructions that could impede movement **[**25].

Fig . 8 :This entrance in Fig . 8aThe fountain and high canopy in front of the building clearly mark the entrance,This entrance in Fig.8b is virtually impossible to distinguish from adjacent window panels (Source: [14])

C. Wayfinding

Wayfinding is the organization and communication of our dynamic relationship to space and the environment [26].It is how people get from one location to another, including their information-gathering and decision-making processes for orientation and movement through space [27]. Wayfinding allows people to: determine their location within a setting, determine their destination and develop a plan that will take them from their location to their destination[1].The design of wayfinding systems should include: identifying and marking spaces, grouping spaces, and linking and organizing spaces through both architectural and graphic means [14].A decade ago, the professional practice of wayfinding design simply involved devising sign systems. Today, the field is much broader and continues to expand to address technological developments kinetic media, GPS systems, web connectivity, smart materials as well as cultural changes in areas such as branding and environmental awareness. [28].Difficulty with wayfinding causes humans to feel frustrated and stressed and decreases a building's functional efficiency, accessibility, and safety in the event of an emergency [29].Exterior wayfinding obstacles are common, including poor identification of building entrances and lack of clear access from parking facilities or mass transportation. Common interior wayfinding obstacles include the failure to make spaces within a facility look unique, connecting corridors at acute or obtuse angles, and failure to provide sufficient lighting at intersections, entrances to major destinations, and landmarks [27]. Principles for effective wayfinding include: Create an identity at each location, different from all others. Use landmarks to provide orientation cues and memorable locations. Create well-structured paths. Create regions of differing visual character. Don't give the user too many choices in navigation. Use survey views (give navigators a vista or map). Provide signs at decision points to help wayfinding decisions.Use sight lines to show what ahead [30] is. In sum, good wayfinding promotes: Reduction of stress and frustration for the visitor.Functional efficiency. Visitor accessibility, Safety, Patient empowerment, improving cognitive skills in spatial understanding.Improved bottom line [31]. There are two kinds of wayfindings: architectural wayfinding and graphic wayfinding [14].

C.1. Architectural Wayfinding

There are five primary architectural wayfinding elements: (1)paths/ circulation, (2)markers,(3) nodes, (4)edges, and (5)zones/districts .Architectural wayfinding systems use the design and organization of landscaping, urban amenities, and buildings as spatial indicators[19].

(a). Paths/Circulation

People use circulation systems to develop a mental map [26]. Paths, including walkways, hallways and corridors, generally define the circulation system in a building or a site. Develop a focal point and a system of circulation paths to help people understand where they are in the system. In multi-story buildings, organize elements such as restrooms,elevators, and exits in the same location on each floor. Use circulation systems that lead people from node to node. Use circulation systems that lead people from node to node[14]. In complex buildings and sites there are usually two orders of pathways: main pathways that connect major spaces, and secondary pathways that lead from primary paths to less important destinations.[19]

(b). Markers

In wayfinding, a marker is an object that marks a locality. Markers such as arches, monuments, building entrances, kiosks, banners, artwork and natural features give strong identities to various parts of a site or building. They act as mental landmarks in the wayfinding process and break a complex task into manageable parts**[**32].

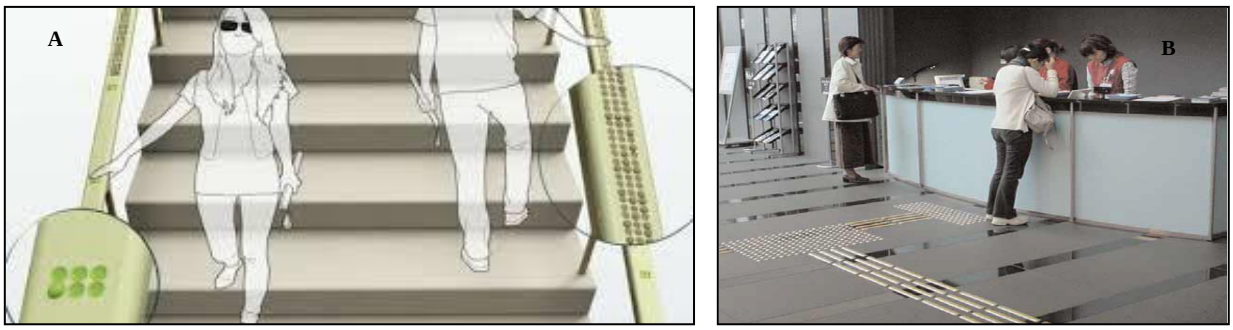
(c). Nodes

A node is a point at which subsidiary parts originate. People make decision points at nodes in paths. As a result, nodes should contain graphic and architectural information to assist with those decisions **[**26].

(d). Edges

Wayfinding edges determine where an area begins or ends. Edges include features of the built environment like the walls of buildings, the wall of a hallway or corridor or a handrail. An edge provides a boundary that people use to orient themselves in space and to keep themselves moving in the right direction "Fig .9". Since every path has an edge, it can be used to carry information to users **[**19].

Fig. 9: Fig .9a :The Braille Staircase Handrail Helps the Blind Navigate Buildings .Fig.9b: Design edges to help in orientation and in wayfinding.Incorporate strong edges to provide shorelines for navigation.Reinforce edges in more than one sensory mode.(Source : [19])



(e). Zones/Districts

Wayfinding zones and districts are regions (either outside or within buildings) with a distinguishing character that assists in the general identification of place [26].Identify each zone to be unique and memorable in its context.If possible, reinforce the identifying characteristics of the zone with signage prior to arrival in the zone. Identify zones in buildings with a letter prefix such as "A" or with the cardinal points of the compass (e.g., N-101 for North wing, room 101)[19].

C.2. Graphic Wayfinding

There are four main categories of graphic wayfinding elements: (1) orientation, (2) directional information, (3) destination identification, and (4)situation and object identification. Graphic information is the most direct way for people to find their location "Fig. 10". Typical graphic wayfinding information includes systems made up of text, pictograms, maps, photographs, models, and diagram **[**14].

Fig. 10: shows different methodes for graphic wayfindings.


C

D

Orientation devices such as maps, site plans, floor plans, building and floor directories are used to help people to develop a mental map of a large complex**[**19]. Directional information: guides people along a route to a destination,and is given after they have had the chance to orient themselves to the general setting. This includes signs with arrows and elevator button panels. Destination identification: is provided at the point of destination. It includes building signage, floor numbers, and room identifiers. Situation and object identification: informs visitors about situations such as local hazards, changes of status (e.g., train schedules) and identifies objects such as fire extinguishers [14], [33].

D. Obtaining products and services

Buildings includes commercial facilities, service centers, bill payment locations, libraries and offices handling applications and forms **.** Entries and Circulation Spaces should provide a sense of openness improves knowledge of the facility's spatial layout and social organization**.** Product Distribution:Displays expose visitors to the range of products available. Space and illumination are critical concerns for access and product selection **[**25]. Staff Assistance: Where assistance is necessary to provide access to all products, (e.g., books on a top shelf) this can be a universal service provided and available to everyone **[**14]. Waiting Areas: It is inevitable that people sometimes will have to wait where services are provided to the public. Service Desks and Offices: It is important to establish an equitable relationship between the visitor and the person at service desks where a variety of activities take place **[**19]. Information Transaction Machines: an increasing amount of information services is being provided through computer-based equipment like ATMs, ticket machines and internet terminals. All ITMs should be simple to use and easy to perceive. Vending and Ticket Machines: Vending machines, ticket machines, change machines, vend-a-card systems and related equipment should be usable by everyone. These should include the types and design of machines and the location and arrangement of machines in the spaces provided **[**25].

E. Using public amenities

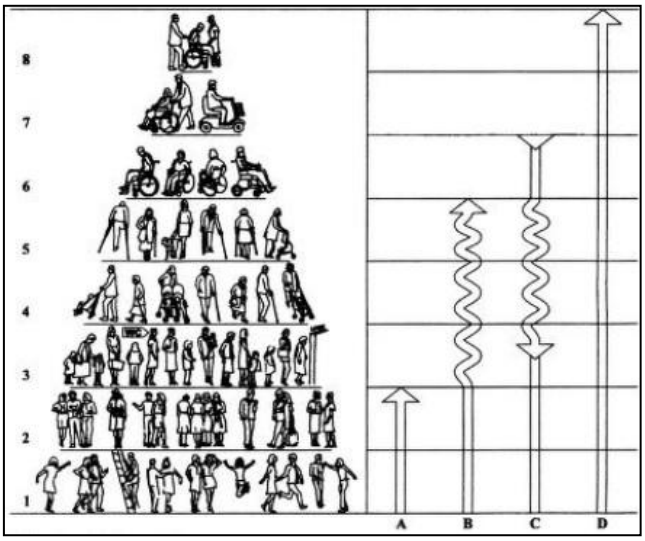
Public amenities are restrooms, information displays, public telephones, rain shelters, drinking fountains, etc. Several key that should be integrated into all public amenities to ensure universal usability: location, interactivity and safety. [14], [19].

VIII. Social sustainability and its relation to Universal Design

The goal of Universal Design is to make our human-made world as accessible and usable as possible [34]. (UD) can be related to social sustainable development (SSD). There exist associations between UD and social sustainability **[**35]. A growing emphasis has been placed on providing equal opportunities for all people, particularly people with disabilities [36]. Universal or inclusive design is characterized by the Institute for Human Centred Design as:" a framework that accepts diversity of ability and age as the most ordinary reality of being human" and it revitalizes "design as intrinsic to social sustainability [37]. Accredited interior design programs should consider UD principles as the basis for their design projects in order to enhance the function and quality of interiors [38]. The route to universal design is illustrated by a pyramid with its building users "Fig11". The interior designer and architect, moving up from one row to the next, looks to expand the accommodation parameters of normal provision, and by doing so minimise the need for special provision to be made for people with disabilities. In row 1, are fit and agile people. In row 2 are the generality of normal adult able-bodied people, those who, while not being athletic, can walk wherever needs or wishes may take them, with flights of stairs not troubling them. There are no small children in rows 1 and 2. The people in row 3 are also normal able-bodied people. These are women. In row 4 are elderly people who, going around with a walking stick, do not regard themselves as being disabled. With them are people with infants in pushchairs. In row 4 are elderly people who, going around with a walking stick, do not regard themselves as being disabled. With them are people with infants in pushchairs. In row 5 are ambulant people who have disabilities. One in this row is a blind person led by a guidedog. The others, either ambulant disabled or wheelchair users, are all people with locomotor impairments. Broadly, the building users who are in rows 3, 4 and 5 are people who would not be architecturally disabled if normal provision in buildings were suitable for them, if it were standard practice

for architects to design buildings to the precepts of universal design. The people in row 6 are independent wheelchair users. In row 7 are wheelchair users who need another person to help them when they use public buildings, and those disabled people who drive electric scooters. In row 8, are wheelchair users who need two people to help them when they go out [39]. For the crucial agenda of the 21st century design, sustainability, can be categorized to three main aspects; environmental, economic and social [40]. The third set of factors inherent in sustainability issues are those related to social sustainability [22]. Much emphasis has been given to the environmental and economic aspects of sustainability; however, the social sustainability which is equally important has often been neglected [40]. The criteria for social sustainability which are related to sustainable life of an individual include well-being, safety, and access to facilities and amenities .These factors relate to the distribution of wealth and services within and between generations as well as the distribution of rights to use environmental services contained within a given ecosystem. In additional, legal issues pertaining to property rights and the treatment of common law resources are factors of social sustainability. Social sustainability reflects the relationship between development and current social norms. An activity is socially sustainable if it conforms to social norms or does not stretch them beyond the community's tolerance for change. Social norms are based on religion, tradition, and custom; they are rooted in values attached to human health and well-being [22].These criteria for sustainable life can be achieved through UD implementation in the planning and design process of housing and neighbourhood areas. Within adaptable private living spaces, an individual may develop sustainable well-being and a safe place to live in. People needs are never static, and everyone experiences changing abilities throughout their life cycle, a more universally designed environment is what the world needs in order to sustain everybody's quality of life. Considering UD's prospect of diverse users throughout life changing abilities, there exist associations between UD and social sustainability [40].Universal design and sustainability go hand in hand for creating a smarter, greener and more livable future. [41].

Fig 11: The Universal Design Pyramid demonstrate the bottom up methodology of universal design.(Source:[39])



IX. Applying Universal Design Principles in the interior design of a public Library

The public library attract diverse groups of users, citizens and visitors of all ages, sizes, abilities and cultures .It is particularly important to acknowledge this diversity and ensure usability by everyone.

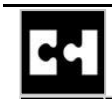
Site Design	
Public library facilities should be easily accessible from public transit, parking and public pathways. This creates a good introductory experience for the first time visitor. Many of these facilities are attended by tours, but there is a need to provide sufficient space for small or large groups.	
	Locate the main building entrance in closest proximity to the major points of public access. This may be a transit stop, a pedestrian pathway or a parking lot. Study each site to determine the priorities based on expected visitor volume.
	Design outdoor attractions so that people of all statures, whether standing or seated, can have an unobstructed appreciation of the attraction. Provide more than one choice.
	Use pathways on the site to enable pedestrians to anticipate the attractions inside. Windows, small display cases and signboards with current attractions will provide an orientation to the building's activities prior to entry and entice passing pedestrians to visit.
	On large sites, strategically locate restrooms to be within about a two-minute travel distance from all locations.

Provide space and locations for groups of different numbers to unload from vehicles, assemble and gather prior to entry.

Orient and design outdoor activity spaces to protect people from prevailing winds, hot sun and precipitation.

Entrances

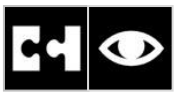
The entry to a cultural facility is the point of main introduction. Most cultural facilities have important transitional areas through which access is controlled and where ticketing, coat check and other activities take place.



It may be desirable to have two main entry points (e.g.,one for people arriving by vehicle and one for those arriving on foot or by public transit).

Provide space and seating for individuals who are waiting for others. Such spaces should be in a location easily detectable rom main entries but out of the way of busy traffic.

In large facilities, provide a separate waiting space for groups to assemble and queue up. This space should have some seating for people who need to rest.



Provide amenities like restrooms, drinking fountains and public telephones on the public side of the security perimeter and near waiting spaces.

If facilities are provided for night use by the public when the rest of the building is closed, the entry and exit to that part of the building should be accessible to everyone.

Spatial Organization

The main visitor entry should be detectable from public access ways. This is particularly important if the institution has more than one building or is situated on a campus. Provide an information desk immediately inside the entry or in a strategic location in an entry hall. Ensure that crowd control devices are detectable by everyone.

Group amenities like restrooms, drinking fountains, and telephones together. The groupings will serve as important landmarks in the building.

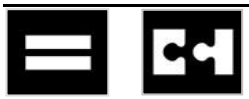
Signage Systems

Develop a pictogram system to associate with different parts of the building. In a library, it might use images related to the type of literature in an area.

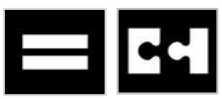
Signs should be in at least two languages common to the region.

Use a graphic identity scheme to distinguish one area from another. This could include color family differences and/or display graphics like photographs or banners.

Exhibits and Collections



Provide alternate media for wayfinding information, exhibits, presentations and background material using Braille, audio, text and captions. Audio presentation controls should be well marked and easy for anyone to activate.



The information desk should have materials available in the alternate media and languages. This may include audioguided tours, tactile maps, Braille information and text scripts of audio presentations.

Design exhibits to enable all people to experience them. Where exhibits are interactive, access should be provided at different heights and with knee clearance if approached from the front. The paths through exhibits should be spaced to accommodate wider patterns of use (e.g., adults pushing children in strollers).

Eliminate deep shadows in exhibits that block access to content. The placement of lighting and design of exhibit enclosures are both critical.

X. Results

Universal design (UD) is as an opportunity to enrich our design perspective to design effectively. By understanding the human diversity, (UD) integrates access for everyone into any effort to serve people well in any field. The concept of Universal Design is a significant aspect of social sustainability, it may cater the needs of diverse users over a life time, therefore be able to sustain one's life throughout life changing abilities and support social development among all members of the society.(UD) is a critical approach to design practices so design professions, principally architecture and interior design.

XI. Conclusion

In conclusion, the study demonstrates the importance of activating the role of Universal design philosophy in architecture and interior design. Furthermore, it shows the inevitability of the application of its seven principles in all types of private and public buildings to promote the sustainable development.

XII. Recommendations

The students in all schools of architecture, interior design, landscape architecture and urban design should become aware of the values, concepts and philosophy of universal design at every level of their education program, beginning from the early stages of design education to the graduate and also post-graduate level. Use techniques to create the understanding and demand of Universal Design concepts by educating the politicians of the need to create environments that encourage independence.

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