

CHAPTER 3
UNIVERSAL DESIGN AND DISABILITIES

CHAPTER 3: Universal design and disabilities

3.1 The definition of Universal design:

Universal design is a design concept that recognizes, respects, values and attempts to accommodate the broadest possible spectrum of human ability in the design of all products, environments and information systems. It requires sensitivity to and knowledge about people of all ages and abilities. Sometimes referred to as "lifespan design" or "transgenerational design," universal design encompasses and goes beyond the accessible, adaptable and barrier-free design concepts of the past. It helps eliminate the need for special features and spaces, which for some people, are often stigmatizing, embarrassing, different looking and usually more expensive. Universal design has its origins in both the disability and design communities. The disability community has long been frustrated by the lack of commercially-available products, by the misconceptions of disability, and



Figure3-1 (lifespan design)

by discrimination often fostered by specialized and stigmatizing design solutions. People with disabilities look to universal design to increase the accessibility and usability of the built environment, as well as to enhance opportunities for participation and social integration in everyday life. Universal design is an effective marketing tool as well as a design concept since products and spaces that are more universally usable are marketable to nearly everyone. Thus, the application of universal design principles can create a greater market for consumer products and spaces. And, as more universally-designed products become mass-produced, they become available at lower cost to all users, thus minimizing the need for special products or some assistive technology. When well implemented, universal design is virtually invisible, safe and physically and emotionally accessible to most users. In simple terms, universal design is user-based "good design." It might be called "more inclusive user-based design" because it includes the abilities and needs of the widest range of people. (Labour Force Survey, Jan-Mar 2009)

3.1.1 Comparisons to Accessible Design:

Frequently, confusion arises regarding the difference between the terms "universal" and "accessible" design. Universal design is not a euphemism for accessibility and does not carry the connotation of the term "barrier free design." It is not a catchy phrase or a substitute for the ADA (Americans with Disabilities Act) Standards for Accessible Design, which are enforceable and prescriptive design standards. Such standards establish minimum requirements that when followed allow many individuals the opportunity to access programs and activities, but may not support their active and full participation. Such standards also do not address the subtleties of sensory and cognitive differences, nor do they address the changes experienced by the human body over time. However, designers may use the minimums of codes and standards as a



Figure3-2 (Comparisons to Accessible Design)

benchmark, and then must go beyond them to achieve universal design. (Lang, S. S. (2002, March). Universal design places increased emphasis on the critical goal of meeting the needs of as many users as possible. Designs may be inherently accommodating or may be adjustable or adaptable to meet varied personal requirements. For this reason, it is important that universal design be included in all phases of the design process. By increasing the number of people whose needs are being addressed in a single design solution, universal design encourages an integrative approach rather than multiple separate solutions. It is this integrated approach that makes universal design cost effective and results in the inclusive involvement of more people in the activities of society. (Lang, S. S. (2002, March).

3.1.2 Who Benefits from Universal Design:

Universal design ultimately benefits everyone. People who do not have an immediate need may not value universal design, even though at some point in their life they may find universal design beneficial. This includes everyday products that become easier to use, such as kitchen appliances and automobiles, as well as web sites with text-only options. For most people, universal design is unnoticeable, except that it is more convenient. Most people are surprised that universal design provides safer, more comfortable and more usable products, spaces or information. (Robert Rock, 2006) People with disabilities benefit dramatically from the effective adoption of the universal design concept. Benefits include, but are not limited to:

- availability of more usable products at regular prices and from existing local commercial sources.
- unprecedented accessibility to public and commercial facilities.
- improved access to services including services offered electronically. (Ability magazine. 2003)
- a recognition that disability is part of the natural human condition-people with disabilities become customers and participants, not just patients, clients or service recipients



Figure3-3 (accessibility)

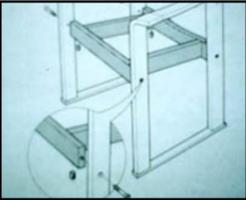
Other consumers benefit from universal design through safer, more comfortable and usable products and environments, as well as the ability to confidently remain in place at times of temporary disability and as abilities change over time. Producers benefit from an expanded market for fewer products. Universal design improves independence, affordability, marketability, and user image and identity. It is a multidimensional and interdisciplinary issue that requires change in the knowledge, strategies and procedures of designers, manufacturers, builders and marketers in all industries. (Michael Papp 2012)

3.2 The Principles of Universal Design:

As part of the project "Studies to Further the Development of Universal Design" (funded by the National Institute on Disability and Rehabilitation Research), The Center for Universal Design led the development of the Principles of Universal Design. These Principles were developed by a team of expert researchers from across the country and across design disciplines, based on their experiences researching and practicing in the field. The Principles were reviewed independently by additional researchers and practitioners to critique, validate and refine them. This process resulted in the seven Principles of Universal Design now in use. (H.D.S. 2014)

The Principles are a valuable tool for designers and educators, and they are being referenced and used worldwide with several foreign translations now available. (Michael Papp 2012)

Table 3- 1 Principles of universal design

Principles of universal design	Guidelines	Examples
<p>1. Equitable Use: The design is useful and marketable to people with diverse abilities.</p> 	<ol style="list-style-type: none"> 1. Provide the same means of use for all users: identical whenever possible; equivalent when not. 2. Avoid segregating or stigmatizing any users. 3. Provisions for privacy, security, and safety should be equally available to all users. 4. Make the design appealing to all users. 	<ol style="list-style-type: none"> 1. Power doors with sensors at entrances that are convenient for all users. 2. Integrated, dispersed, and adaptable seating in assembly areas such as sports arenas and theaters.(Glenn, Eddie.1995)
<p>2. Flexibility in Use: The design accommodates a wide range of individual preferences and abilities.</p> 	<ol style="list-style-type: none"> 1. Provide choice in methods of use. 2. Accommodate right- or left-handed access and use. 3. Facilitate the user's accuracy and precision. 4. Provide adaptability to the user's pace. 	<ol style="list-style-type: none"> 1. Scissors designed for right- or left-handed users 2. An automated teller machine (ATM) that has visual, tactile, and audible feedback, a tapered card opening, and a palm rest
<p>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.</p> 	<ol style="list-style-type: none"> 1. Eliminate unnecessary complexity. 2. Be consistent with user expectations and intuition. 3. Accommodate a wide range of literacy and language skills. 4. Arrange information consistent with its importance. 5. Provide effective prompting and feedback during and after task completion..(Glenn, Eddie.1995) 	<ol style="list-style-type: none"> 1. An instruction manual with drawings and no text 2. A moving sidewalk or escalator in a public space..(Glenn, Eddie.1995)
<p>4. Perceptible Information: The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.</p> 	<ol style="list-style-type: none"> 1. Use different modes (pictorial, verbal, tactile) for redundant presentation of essential information. 2. Provide adequate contrast between essential information and its surroundings. 3. Maximize "legibility" of essential information. 4. Differentiate elements in ways that can be described (i.e., make it easy to give instructions or directions). 5. Provide compatibility with a variety of techniques or devices used by people with sensory limitations..(Glenn, Eddie.1995) 	<ol style="list-style-type: none"> 1. Tactile, visual, and audible cues and instructions on a thermostat 2. Redundant cueing (e.g., voice communications and signage) in airports, train stations, and subway cars

Principles of universal design	Guidelines	Examples
<p>5. Tolerance for Error: The design minimizes hazards and the adverse consequences of accidental or unintended actions.</p> 	<ol style="list-style-type: none"> 1. Arrange elements to minimize hazards and errors: most used elements, most accessible; hazardous elements eliminated, isolated, or shielded. 2. Provide warnings of hazards and errors. 3. Provide fail-safe features. 4. Discourage unconscious action in tasks that require vigilance. 	<ol style="list-style-type: none"> 1. An "undo" feature in computer software that allows the user to correct mistakes without penalty 2. A double-cut car key easily inserted into a recessed keyhole in either of two ways
<p>6. Low Physical Effort: The design can be used efficiently and comfortably and with a minimum of fatigue.</p> 	<ol style="list-style-type: none"> 1. Allow user to maintain a neutral body position. 2. Use reasonable operating forces. 3. Minimize repetitive actions. 4. Minimize sustained physical effort. 	<ol style="list-style-type: none"> 1. Lever or loop handles on doors and faucets 2. Touch lamps operated without a switch
<p>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.</p> 	<ol style="list-style-type: none"> 1. Provide a clear line of sight to important elements for any seated or standing user. 2. Make reach to all components comfortable for any seated or standing user. 3. Accommodate variations in hand and grip size. 4. Provide adequate space for the use of assistive devices or personal assistance 	<ol style="list-style-type: none"> 1. Wide gates at subway stations that accommodate all users 2. Controls on the front and clear floor space around appliances, mailboxes, garbage dumpsters, and other building elements

3.3 Models for the application of Universal Design:

3.3.1 Model 1 - Art House:

- **Project Synopsis:** This spacious house, with a 3,450 square foot first floor and a 750 square foot second floor, allows effortless maneuvering, easy livability and ample space for both work and entertaining. Doorways and hallways are wide, living spaces are open and all areas are easy to reach and filled with natural and artificial light. The house includes two bedrooms and a study on each floor, an elevator and stairs to travel between floors, a circular aquarium, a large kitchen, and an elegant, curbless roll-in shower. The house integrates aesthetics and incorporates accessible and universal features in a seamless and unobtrusive manner.

▪ **Background:** The owner/occupant of the "Art House," a man who uses a wheelchair, was determined to see that his new house was designed to "fit" him. In addition, he wanted to design a home that worked equally well for people with abilities different from his own. Driven by a desire to create an aesthetic environment that also adhered to the concept of universal design, he created a flexible home that accommodates people with a diverse range of abilities.



Figure3-4 This story and a half house, with its open plan, delights the senses and because accessible and universal features are so aesthetically integrated into the house they are invisible.

- Year of Project Completion: 1998
- Location of Project: Shelby Township, Michigan, USA (Andrea Gabriel, 2008)

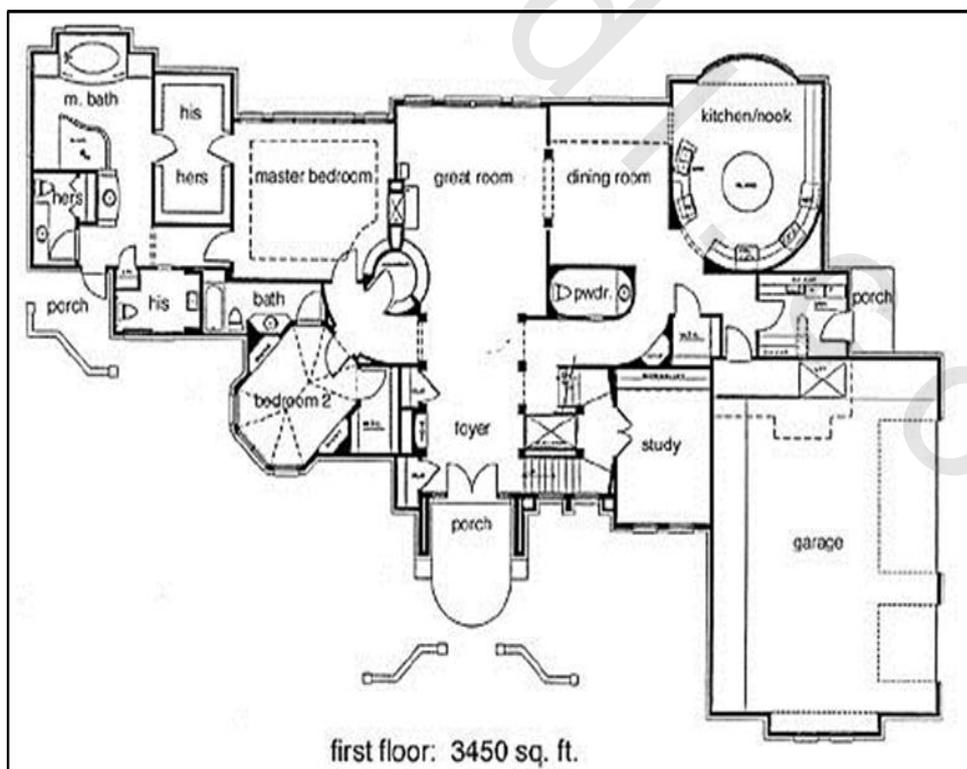
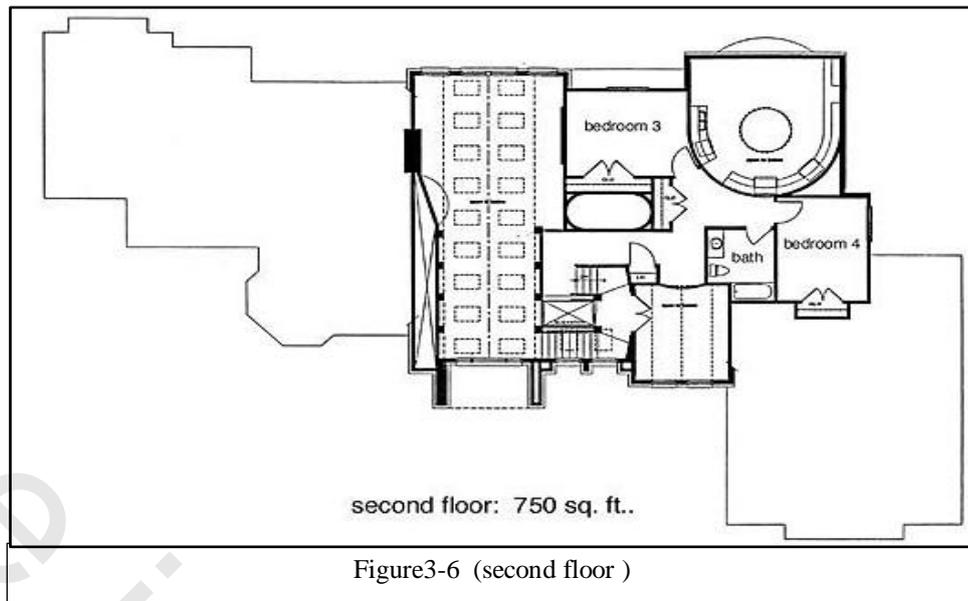


Figure3-5 (first floor)



- **Features:**

1. **General:**

- Multiple grade level entrances offer easy access into the house.
- The primary entrance features glazing in the door and sidelights for light infiltration, design appeal, and to allow quick recognition of approaching guests . (Look Figure7)
- The garage, with an interior lift to bridge a change in level from the garage floor into the house, has two different sized bays, one for a van and the second for a car .
- The study, and rooms on the second floor, can be reached via the elevator or the stairs that wrap around the elevator .
- All floor surfaces, either low, tightly woven, dense carpet or slip-resistant tile, are easy to roll or walk across.
- The front-loading washer and dryer, with up-front controls, are elevated on a platform, facilitating reach into each appliance by bothstanding and seated users and minimizing stooping and bending for standing users.

(Ian Langtree 2010)



Figure4-7 The glass in the door and the sidelights create viewing opportunities for people of any height.

2. **Kitchen:**

1. The kitchen, with eat-in area, has work tasks grouped in a circular pattern to facilitate food flow. Some counters are mounted at 36 inches while others are lower for seated and shorter users.(Vicki VanStavern, IIDA, LEED AP, President, VanStavern Design Group Inc).
- The combination eating and food preparation island features a dual height table, with a lower section that accommodates children, people of short stature, and seated people .
- Set below 36 inches, the sink and cooktop both have extra countertop work surface at the same height as the sink and cooktop .(Axel Leblois . 2010)

- The smooth surface cooktop, equipped with side-mounted controls, makes it easy to slide hot or full pots. Burner locations should be identified for users.
- An aesthetically integrated generous knee space is created below the cooktop by stepping the base cabinets back.(Look Figure8)
- The wide basin shallow sink with rear drain has ample knee space for a seated user. The sink faucet is easy to operate with one hand and requires no twisting and grasping .
- The rounded countertop edges project forward beyond the cabinet faces to provide a gripping surface usable during food preparation by a person in a wheelchair wishing to realign themselves without grasping wheelchair handrims.(Look Figure9)
- Overhead cabinets have articulating, pull-down, interior storage units to bring cabinet contents within easy reach.(Persons with Disabilities Initiative)
- Large stylish loop handles are easy to grasp and complement the room décor.(Figure10)
- Variable height storage has been created with pullout racks that place some dry goods storage within reach of all people.(Look Figure11)
- Refrigerated items are stored in a combination cold storage unit equipped with pullout drawers and a vertical chest with swinging door. Frozen food is stored in low drawers, allowing the user to pull the contents into the room for easy access.(Look Figure12)
- The side-opening microwave and conventional ovens are installed so their lowest racks are at countertop height. The microwave oven has a pullout shelf directly below that facilitates, from a seated position, safe transfer of hot and/or heavy dishes into and out of both units.(Look Figure13) (National Council for Interior Design Qualification, Inc.2004)
- Overall, an adequate level of contrast exists between floor, cabinet faces, countertops, and sink to aid in navigation for people with low vision. Some potential dark areas, e.g., at the back of the counter, are illuminated with supplemental lighting.

Describe	Figure
<p>A knee space, larger than the minimum specified in most codes and standards, greatly facilitates comfortable maneuvering for a wheelchair user and allows, for example, a parent in a wheelchair to assist a child who might be seated on a stool.</p>	 <p>(Figure3-8A knee space)</p>
<p>The sink contrasts markedly with the surrounding counter and backsplash making it easier to locate for people with low vision.</p>	 <p>(Figure3-9 The sink)</p>

Well-balanced, pivoting interior shelving units bring items within reach of seated or short users and help to maintain a unified appearance for kitchen wall cabinets.



(Figure3-10Well-balanced)

Wire shelving on full-extension glides facilitates access to items at the back of cabinets. Such shelving also allows viewing stored items from below.



(Figure3-11Wire shelving)

Well-lighted, cold food storage at a variety of heights and in drawers eliminates the need to lift heavy items for users who may have limited strength and/or reach.



(Figure3-12Well-lighted)

The bottom of both the microwave and conventional oven are installed at 36 inches above the finished floor, making them easy for most standing and seated people to use safely.



(Figure3-13microwave and conventional oven)

3. Bathroom:

- The master bathroom features two bathing fixtures: a curbless glass block shower enclosure with wall-hung seat and a whirlpool tub with transfer deck and suspended transfer support. Combined they offer a wide variety of bathing options.(Look Figure14)
- 2. The shower area features seat and grab bars. The seat adjusts in height and the backrest can be adjusted up and down to suit individual preferences. The entire seat assembly slides along a wall-mounted track to allow the user to bring the seat closer to the controls, allow an assistant to be on either side, and gives a wheelchair user the option from which side to execute a safe transfer. The grab bars attached to the seat can be raised to allow a

sliding transfer or remain in the lowered position to provide support when standing and sitting or while bathing.(Look Figure15). (complications of amputation)

- Of the two master vanities, one features knee space for a seated user. The sink edge projects beyond the vanity face and brings the faucet and single-lever control closer to the user for easier reach. The clear undecorated surface of the mirror is at 40 inches above the floor. The drawer hardware can be used without tight grasping or twisting of the wrist. Receptacles are wired into the cabinet sidewall so electrical cords do not trail across wetsurface.(Look Figure16) (ADA 1990)

Describe	Figure
<p>The raised deck allows a bather to sit anywhere along the side before lowering into the tub and provides a safe transfer surface for a wheelchair user.</p>	 <p>(Figure4-14)</p>
<p>This curbless shower relies on floor slope for drainage and works well for users who wish to sit to bathe. Because the shower seat folds up against the wall, ample room is available for standing users, for someone who wishes to use a shower wheelchair, or to bathe the family dog.</p>	 <p>(Figure4-15)</p>
<p>Aesthetics combined with function have been rigorously applied in all the rooms. The lavatory basin, extending forward of the countertop allows a seated user to more conveniently perform grooming tasks.</p>	 <p>(Figure4-16)</p>

4. Master Bedroom

- This room is provided with generous clear floor space so a person using a wheelchair may approach the bed from any one of three sides and execute their preferred style of safe transfer.(Look Figure17)
- Incorporated into the design of the bed is a wide solid surface at wheelchair seat height that is decorative and acts as a secure transfer surface.



Figure4-17 :The recessed base gives the bed a floating quality and doubles as a high toe space, allowing the user to get closer to the bed and execute a safe transfer.

3.3.2 Model 2 - ShougaiJuutaku Life-long Housing:

- Project Synopsis:

Sekisui House, Ltd. is one of Japan's major industrialized homebuilders and manufactures more than 70,000 houses a year. Of the few large housing manufacturers, Sekisui House, Ltd. is the first to offer a variety of detached housing styles featuring universal design. The company has designed and built more than 1,000 houses for people with disabilities. (Look Figure18)

Sekisui House, Ltd. maintains a research and development institute in a research park shared by 13 companies in the center of Kansai Science City, near Kyoto, Japan. The Comprehensive R&D Institute works on developing concepts in housing for the future and includes an Institute of Building Science, the Natoku Kobo (the Satisfaction Studio), and the TOUCH-1 Center. Building Science



Figure4-18; Sekisui House, Ltd. Comprehensive Housing R&D Institute.

conducts multi-faceted research and development programs in building technology, including studies on human comfort, lifestyle, and energy efficient sustainable design. At the Nattoku Kobo anyone interested in housing--the public, manufacturers, and researchers--may share innovative ideas. While at the Nattoku Kobo, through hands-on experience, prospective homebuyers may try products and features for themselves. Additional conference facility amenities for companies and their guests are provided at the TOUCH-1 Center.

Sekisui House, Ltd. has been researching, designing, and building accessible housing for people with disabilities since 1975. Ten years later, in 1985, to better describe its housing and publicize the company's philosophy, the company named its housing "Life-long Housing" or "ShougaiJuutaku." For Sekisui House, Ltd. a "home should remain comfortable throughout the lifetime of its occupants and be able to adapt to changes in the mind, body, and lifestyle of the resident". (Look Figure19) (Physical Disability D. A. K.2009)

Because Sekisui House, Ltd. has been researching and building housing for over 25 years, this review focuses on only a few examples of the company's work. Contact the Sekisui House, Ltd. for more complete information and additional examples.

▪ Background:

- Several factors combined to put Sekisui House, Ltd. in the forefront of universally designed industrialized housing. First, the population in Japan, as in other developing nations, is rapidly aging. Because of improved health care and wellness programs people are living longer, and are likely to experience diminished ability to adapt physically and/or cognitively to their environment. In the 1980's, the Japanese Ministry of Construction embarked on a major national research program to encourage development of housing to accommodate an aging population and people with disabilities.

- Second, throughout Japan, particularly in urban centers, home building lots are quite small and are very different in shape when compared to lots in the United States. For this reason, a house design cannot be replicated easily on a Japanese lot as is more

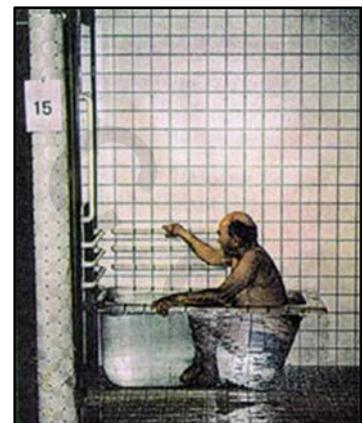


Figure4-19 : Careful ergonomic studies revealed that grab bar locations commonly prescribed by physicians were not as beneficial as locations established by the Institute's own research.

typically done in the United States. In Japan, it is necessary to design a unique and specific plan to fit each site and to accommodate the composition and lifestyle of the homeowner.

- Third, over 20 years ago, the Sekisui House, Ltd. recognized that research specific to older adults and the population of people with disabilities was minimal. At that point the Institute initiated its own research and development effort, initially with the construction of a model house as a training facility for people who must relearn activities of daily living. The dynamic relationship between the user and the environment was studied intensively. Areas within conventional housing that clearly could benefit from improvement were, including but not limited to, the kitchen, bathing and toileting areas, and stair details. Reflecting data collected, Sekisui House, Ltd. developed a system kitchen, a unit bath, and stair specifications to improve the safety and functionality of these spaces and features. (world health organization)
- Sekisui House, Ltd. continued to explore residential design and constructed additional model homes in housing parks across Japan, where the public could experience and comment on the designs and features. New pilot model homes reflected focus group comments and research data. Designing with increased flexibility is a major shift when considering the design of the built environment. From the inception, each "Life-long House" incorporates support into the foundation, walls, and room layouts that later will accommodate family members if physical or cognitive abilities change.
- **Year of Project Completion:** 1975-present
- **Location of Project:** Over 1,000 accessible/universal homes throughout Japan.

▪ **Features:**

- **General Features of "Life-long Housing":**

The Sekisui House, Ltd. developed a house design with a base level of access that could be modified with little additional construction, should additional environmental The houses have many expected features such as wide doors with long, vertical handles and kitchen and bathing areas with adequate clear floor space to allow someone using a mobility aid, wheelchair, walker, cane, or crutches to comfortably and safely maneuver and approach all fixtures and appliances.

Included are construction details that allow for the later installation of grab bars in bathing and toileting areas, handrails in circulation areas, and reinforcing overhead in certain areas. (Look Figure20)

Included also are sufficient amounts of clear floor space for someone using a mobility aid to maneuver or for someone to assist another person in their self-care.

Additional considerations include aligning rooms so a person could, via an overhead track lift, go from their bed directly to the toilet and then into the bathing area. Lifts and elevators may be included at the time of initial construction or added later if needed.

In instances where a person might need continual care, the floor plans of homes are designed to allow the addition of a suite customized for a family member or for a caregiver. (Jean Martin Charcot (1998)

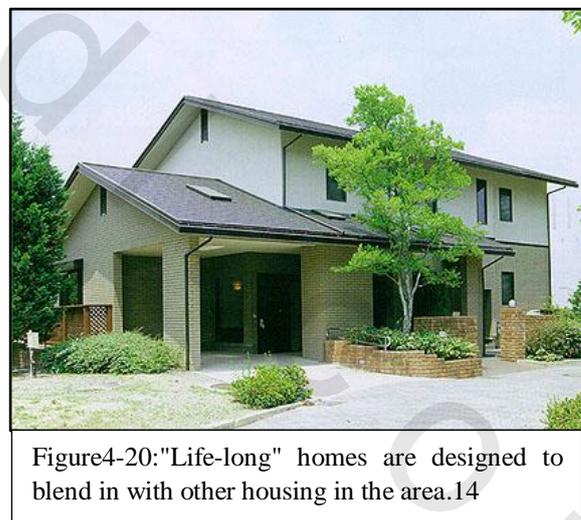


Figure4-20: "Life-long" homes are designed to blend in with other housing in the area.14

■ **Entrances:**

A change in level, generally a single step, is traditionally found just inside the primary or front entrance of most Japanese homes. The step has been maintained and the needs of someone who walks with difficulty or cannot walk are accommodated in some "Life-long Housing" by placing a lift in the entryway. The lift is designed so it recesses into the floor and is invisible when not in use. (Look Figure21)

Another successful design is found in some two-story homes with an attached garage. An elevator is located just inside the house between the house and the garage and doubles as the passageway between the two. The elevator has two doors, one on the house side and the other into the garage. As someone leaves the garage they may enter the elevator to travel to the second floor or pass through the elevator cab on the first floor, using it as a hallway. If the garage must be below the house level, the elevator may take a person up to the main house level, bypassing the step at the front door.

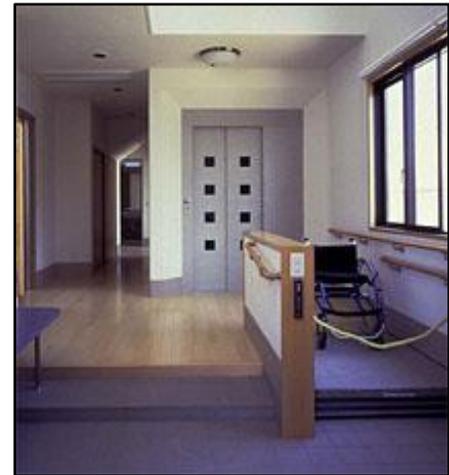


Figure4-21: Front entrances maintain traditional, Japanese cultural elements and still accommodate the needs of a broad

■ **Kitchens:**

- Some of the model kitchens are provided with continuous knee space beneath the countertop, the cooktop, and the sink. To maintain flexibility and retain base cabinet storage, the kitchen is equipped with movable base cabinets that may be positioned where desired. (Look Figure22)
- All exposed plumbing is protected with removable covers.
- Controls are located near the front edge of the fixture or appliance or on the apron (narrow appearance and support panel), within easy reach.



Figure4-22: Test and demonstration kitchen .

- Kitchens are designed to support sitting and standing users.
- Pedestal tables with a recessed base provide knee space for diners or meals. The traditional Japanese style of dining, seated on a cushion on tatami mats was carefully examined to create a dining area that combines the cultural needs with the functional needs of a person in a wheelchair. A table with uneven legs is one solution. The end of the table with the shorter legs (approximately 12 inches long) rests on a 17-inch high platform with tatami mats. The end with the longer legs rests on the floor level used by a person sitting in a wheelchair or a Western style dining chair, placing the table height at about 29 inches—within a good range for most seated people. (Look Figure23)



Figure4-23: placing the table height.

▪ **Bathing Areas:**

Since the bathtub is used for soaking and the body washed outside the tub in a tiled shower area, a step at the room entrance has traditionally been used to contain water. This established building practice was changed and a trench drain installed that runs in front of the door, eliminating any step or raised threshold.

- There is sufficient maneuvering space for someone to enter using a mobility aid or for someone to assist. (Look Figure24)
- The controls for the shower and the tub are in close proximity and near the center of the shower area, within easy reach of a seated person.
- Sometimes the bathing and soaking areas share a movable faucet and a single set of controls.
- Bathing fixtures are equipped with antiscald valves.
- Tub controls are mounted on the outside edge of the tub, minimizing reaching, stooping and bending.
- The showerhead has two wall clips, one high and one low, or a slide bar for greater choice in showerhead position.
- The long vertical handrail at the foot of the tub offers a secure grasping surface, anywhere along its length, for people lowering themselves or standing up, and is especially helpful for someone who is unsteady on their feet.
- The large translucent window adds natural light.

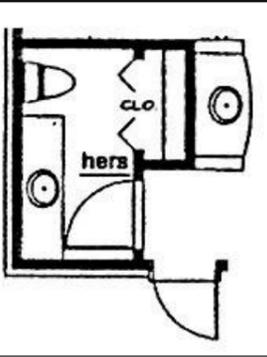


Figure4-24: The combination soaking tub and wet area shower offers multiple bathing options to suit individual user needs and

3.3.3 Differences between the two models :

Table 3- 2 Project Typifies

Principles of universal design	Art House	ShougaiJuutaku Life-long Housing
Equitable Use:	The entrances and well-illuminated interior spaces were carefully designed for use by a wide diversity of people. The elevator encircled by the stairs, the open spaces with no abrupt changes in level, the uncluttered furniture plan, the circular kitchen, and the bath and toilet rooms all contribute to ease of use.	Landscaping and site work are combined to create smooth level entrances. If an unobtrusive integrated platform lift is included, the primary entrance is usable by all people. For houses with elevators, the entrance off the garage is usable by all since someone may disembark from an automobile, protected from the elements, and go directly into the house.
Flexibility in Use:	A house this size inherently includes multiple options for several activities. These were carefully considered and resulted in several bathing options. The curbless, roll-in shower in the Master Bedroom suite offers a variety of bathing options. Users may stand to shower, shower seated in a waterproof shower wheelchair, use a portable plastic bench, or the wall-hung seat provided in this design. Other bathing fixtures have been provided to offer additional choices to meet individual user needs and preferences: the garden/hot tub, a "conventional" tub with a seat at the back. Several of the bedrooms and studies can be transformed easily into a suite for care of an elderly parent, a relative, an older child making a transition from college to employment or accommodate a guest or double as a home office. In the kitchen, the multiple height counters and dual height center island provides flexibility in food preparation and cleanup. Kitchen storage is usable by all, as are the appliances. Two areas of concern are identification of the burner location on the smooth cooktop and what appears to be the smooth control panel on the microwave oven.	Reinforcing is built into the structure of the house for the later addition of grab bars, handrails, and overhead lifts. The knee space at the cooktop and sink may be used as either storage or as knee space and is generated by rolling the base cabinets aside. Appliances may be approached from either side or head on, making it possible for users with either a dominant right or left side to use all fixtures and appliances. Users may stand to shower, shower seated in a waterproof shower wheelchair, or use a portable plastic bench.
Simple and Intuitive Use:		
Perceptible Information:		Contrast between counter tops and cabinet faces help identify spatial relationships. The appliances incorporate visual, audible, and sometimes tactile feedback to assist users with no or low vision or are inattentive. Task lighting and appliance lighting maximizes "legibility" of essential information. Handrails contrast with their surroundings and, in general, tone and contrast are carefully applied to achieve demarcation of items from their surroundings.
Tolerance for Error:		If the integrated lift is installed at the front entrance, the mechanism is recessed into the floor and it's shroud prevents accidents or injury. The removable pipe protection panel under the sink helps guard against potential burns and contact injuries. Antiscald valves are used in the bathing areas to prevent burns.
Low Physical Effort:	All electrical and other operating controls (including window operators) require little effort from the user. Other features are either within the reach range of children and others of short stature as well as standing or seated users or can be brought within that range with minimal effort. For example, the contents of the wall cabinets in the kitchen can be lowered easily and the second floor can be reached via the elevator. The floor surfaces are smooth and raised thresholds and abrupt changes in level are eliminated.	The handrails in the bathing area, sliding doors with long horizontal handles, kitchen base cabinets on easy-to-roll castors, and clear and ample space in the entry, kitchen, and bathing area all contribute to ease of use. Loop handles and hardware minimize twisting of the wrist or grasping. All electrical and other operating controls (including window operators) require little effort from the user. Other features are either within the reach range of children and others of short stature as well as standing or seated users or can be brought within that range with minimal effort. For example, the second floor can be reached via the elevator. The floor surfaces are smooth and the raised thresholds and abrupt changes in level are eliminated.

<p>Size and Space for Approach and Use:</p>	<p>The furniture plan is open and uncluttered, leaving sufficient space to maneuver, reach, and use all elements in the house. Doorway widths and clear floor area at doors allow unrestricted maneuvering and rooms are planned with sufficient floor space to allow easy access by a wheelchair user. Electrical outlets, switches, window operators, appliance controls, and faucet controls all can be approached and operated by standing or seated users. Knee space adds to space for approach and use of sink, lavatory, and cooktop by seated users, including a person who wishes to rest on a stool while performing tasks. Note the "hers" toilet room in the Master Suite on the first floor. If the bi-fold closet doors are removed, the resulting floor space provides an enlarged area in which to maneuver a wheelchair and transfer onto the toilet.</p>	 <p>The "hers" half-bath has built-in flexibility. The closet doors can be removed and the floor space used to improve access to the toilet</p>	<p>Doorway widths and clear floor area at doors allow unrestricted maneuvering and rooms are planned with sufficient floor space to allow easy access by a person who may use a mobility aid permanently or intermittently. Electrical outlets, switches, window operators, appliance controls, and faucet controls all can be approached and operated by standing or seated users. Knee space adds to space for approach and use of sink and cooktop by seated users, including a person who wishes to rest on a stool while performing tasks. Spaces are designed minimizing the number of sharp and tight turns that must be made if a person is using a wheelchair. Bathing areas have sufficient floor space to allow users who may require assistance or use a mobility aid to maneuver.</p>
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3.4 Relationship between Universal Design and residential buildings:

This section covers the design of new housing, including individual dwellings and flats. The guidance is also applicable to residential conversions and refurbishments where every opportunity should be taken to maximise accessibility for occupants and visitors alike.

This section does not cover the design of residential accommodation, such as nursing homes, or the design and adaptation of dwellings to accommodate people with particular disabilities.

The aim for all new housing and, wherever possible, housing conversions and refurbishments should be to construct homes that are universally designed and easily adapted to meet the changing needs of occupants over time. This will provide everyone with greater choice in terms of where they live, and will enable people to remain in their own homes as their needs change. By incorporating features into dwellings that enable convenient and cost-effective adaptation in the future, and with careful consideration as to the layout and provision of adequate space for people to manoeuvre, dwellings will be convenient for as broad a range of households and visitors as possible. The technical guidance Lifetime Homes standards but also covers flats, town houses, and dwellings where there is no living space at the entrance level.

- Ensure all new housing, housing conversions, and refurbishments are universally designed.
- Consider that housing design should meet the changing needs of occupants and visitors.

3.4.1 Entrances:

- Ensure entrances are clearly visible and prominent.
- Make sure all entrances in new buildings are universally designed.
- Design alternative entrances to existing buildings to meet universal requirements.
- Provide adequate space inside and outside entrance doors.
- Establish clear landing space outside entrance of 2440mm x 2440mm.
- Arrange outward-opening doors so that they are recessed or guarded.
- Ensure threshold to entrances are level or no greater than 10mm with chamfered, pencil-rounded or ramped profile.
- Provide canopy or door recess for weather protection.
- Leave a clear space of 600mm adjacent to handle-side of door.

3.4.2 Horizontal circulation in housing:

- Ensure all houses and flats are arranged to provide convenient access throughout.
- Provide sufficient space to enable wheelchair users, those using scooters, parents with strollers, people using walking aids, to move through doorways and turn through 360 degrees.
- Ensure corridors within flats and houses are at least 900mm wide.
- Ensure corridors in communal areas are at least 1200mm wide.
- Make sure all doors within houses and flats have a clear space of at least 300mm adjacent to the leading edge of the door.
- Ensure doors that open into rooms have their hinges adjacent to a return wall.
- Design bathroom and toilet doors so that they can be opened outwards in an emergency.
- Consider wet-room type showers in new houses.
- Consider reinforced or solid walls in bathroom/bedroom to take grab bars.
- Consider reinforced ceiling to provide for future hoist.

3.4.3 Vertical circulation:

- Design steps and stairs in accordance with the guidance
- Provide one or more passenger lifts (preferably evacuation lifts) in the communal areas of blocks of flats of three or more storeys.
- Ensure lifts serve all floors, including underground car parks and other facilities.
- Provide an enclosed vertical rise platform lift in blocks of flats of two or three storeys.
- Where a platform lift is not installed at the outset, provide space, services, and structural support to facilitate easy installation in the future.
- Design individual houses to facilitate the future installation of a platform lift, homelift or stairlift.

3.4.4 Services:

- Provide sufficient fused spurs or capped outlets to facilitate the future installation of equipment and additional lighting.
- Position consumer units and meters at a height between 1200mm and 1400mm where they can be easily accessed.
- Provide thermostatic radiator valves to all radiators, 400mm above floor level, except where room thermostats are located.
- Position the mains water stop-tap where it can be easily reached and operated.
- Design outlets, switches and controls.

3.4.5 Individual rooms:

- Provide a range of rooms and facilities in houses and flats.
- Wherever possible, locate the main living room, kitchen, and an accessible toilet at the entrance level.
- Provide an area within the living room that can be used in the future as a temporary sleeping area.
- Provide a toilet or bathroom that can be easily converted to incorporate a level access shower.
- Ensure the kitchen, main living area, and at least one bedroom incorporate an unobstructed turning area for wheelchair users, scooter users and people who use walking aids.