

Service-Learning Inclusive Design: Adaptive home for Person with Disability with Wheelchair

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Abstract. More than one billion people in the world lived with disabilities, and 200 million experienced heavy functioning difficulties. Persons with Disabilities (PwDs) usually had limited economic participation, faced poverty and limited access to housing. Service Learning Program in Architecture Department (Inclusive Design Course) was created to answer the Persons with Disabilities (PwDs) needs. The course was supported by UBCHEA (<https://unitedboard.org/>) in the program of Service Learning of Inclusive Design for Homes and Schools in Surabaya and Bandung: Participatory Design and Campaign. It was started with accessibility evaluation at PwDs' residence (wheelchair users) in Surabaya. Simulation as PwDs in Petra Campus was conducted to create empathy to users. Later on, an inclusive-and-universal design was proposed. Three participatory workshops in Surabaya and Bandung were conducted to review it. The new design was produced for catering the wheelchair users. In conclusion, role play and participatory design process was the key important of successful program. **Keyword:** Accessibility, Inclusive Design, Design Home Living, Disability.

1 Introduction

1.1 Background

Hartley, et. al. [1] highlighted that more than one billion people in the world live with different disabilities, of whom nearly 200 million experience heavy functioning difficulties. Persons with Disabilities (PwDs) normally had poorer health outcomes, lower education achievements, less economic participation and higher rates of poverty than other people. Therefore, they faced difficulty access to affordable and accessible housing.

An Inclusive Design - Service Learning Program was created in Architecture Program Study to answer the Persons with Disabilities (PwDs) needs especially the housing aspect. UBCHEA (<https://unitedboard.org/>) supported the course in the program named: Service Learning of Inclusive Design for Homes and Schools in Surabaya and Bandung: Participatory Design and Campaign.

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Housings of wheelchair users (Person with Disabilities/ PwDs) were also observed generally by Hayati. The micro-house concept was widely present because the PwDs limited economical capacity and the expensive land price in Surabaya. The micro-house was accessible in the general area but visit-able in other area of the homes because of spatial limitation.

1.2 Literature Review

Steinfeld, & White [2]² explained that Universal Design was to create a more viable building and community for all. Five main aspects of Universal Design were sustainability, marketability, affordability, security, and social interaction. They were summarized as home visit-ability. Visit-ability attempted to make a house more accessible through these three basic requirements: One zero-step entrance (either the front door, sideway door, or backdoor), 32 inches (810 mm) clear opening doorways and corridors shall be at least 36 inches (910 mm) clear width, and half bathroom has to be available in the main/ground floor. Some elements were standardized to assist people with mobility impairment either visiting or living in the house.

First, the Entrance Unit (1006.2): At least one entrance unit should be on circulation path complying Section 1006.5 (Circulation Path) from a public street or sidewalk, dwelling unit driveway, or garage.

Connected and Interior Spaces (1006.3 & 1006.4): A circulation path (as complied on Section 1006.5) should connect the entrance unit located on the circulation path to the following spaces: an entrance level toilet/bathroom, an additional habitable space with an area 70 square meter minimum, and food preparation area when provided on entrance level (complying with Section 1006.7.)

Circulation Path (1006.5), The Components (1006.5.1): A circulation path should include one or more of the following elements, including: walking surface with a slope not steeper than 1:20, doorways, ramps, escalators, and elevators. Ramps (1006.5.4): Ramps should comply with Section 405.

Toilets or Bathrooms (1006.6): Toilets or bathrooms should comply with section 1006.4 (Interior Space) and cover the following feature, namely lavatory and toilet, reinforcement and space clearance for grab bars installation in the future as wide a 455 mm (18 inches) from the centerline of the toilet, lavatory (380 mm /15 inches from the centerline of the toilet), space clearances at the toilet should meet and exceed minimum requirements.

Food Preparation Area (1006.7): When located at entrance level, the food preparation area should include a sink, cooking appliance, and fridge. Clearances between opposing cabinets, countertops, appliance, and walls within the food preparation area should be wider than 40 inches (1015 mm).

Lighting Controls and Receptacle Outlets (1006.8): The centerline of receptacle outlets and operable control parts should be placed at least 15 inches (380 mm) and not more than 48 inches (1220 mm) above the finishing floor.

The standard accessible designs are vital in designing a home for people with disability. However, the application of the designs should also consider the needs of the users, social and economic conditions, and the construction of existing buildings.

On the other hand, some standard were prescribed by D'Souza, et.al. [3]³ on knee and toe clearances for wheeled mobility users. Adequate clearance space under table or tops to the floor was important. Therefore the wheeled mobility users can approach sufficiently close without any obstruction. Such clearance space was critical when using elements like bathroom sinks, kitchen counter-tops etc.

2 Methodology

The Service Learning Inclusive Design Course was started with literature review of the wheelchair users. The documentation of the disabled Persons with Disabilities (PwDs) spectrum in schools (including teachers with disabilities, students with disabilities) was started with database and interviews. Unfortunately, only some PwDs willing to answer this. The PwDs were reluctant to be documented because of sensitivity of the issue. They would like to participate during the process but rejected the data collection.

After understanding the universal design standard, the students were guided to document and evaluate the accessibility of wheelchair user residence (Mr. Abdul Syakur). He was a teacher in Special School for Children with Disability (YPAC) in Surabaya. Unfortunately, his home surveyed and found was partially accessible, therefore it should be redesigned.

Thirdly, the PCU students were asked to simulate as PwDs in Petra to empathize with the wheelchair users. Later on, a design was prepared based on inclusive and universal design theories. Three participatory design workshops in Surabaya and Bandung were conducted to review the design. And new design was produced to cater the accessibility of Mr Syakur that represent the PwDs with wheelchair. In conclusion, role play and participatory design process was the key important of successful program.

Lastly, Creative Campaign for Universal Design application in Surabaya were conducted comprising of: distribution of Living in Dignity Book with PwDs homes design, bulletin of PwDs rights, artistic event and exhibition. The Creative Campaign were conducted in Petra Christian University and in a Surabaya Memory event in Grand City Mall. The events were held with the support of General Education Department (Departemen Mata Kuliah Umum/ DMU) and Petra Christian University Library (the Library@Petra). And the step was found successful in promoting the rights of Persons with Disabilities (PwDs) especially in housing and education to Surabaya's people in general and PCU's Community specifically. [4]



Fig. 1 Accessibility Documentation in PwDs home



Fig. 2 Students' simulation as PwDs



Fig. 3 Students' Design Process



Fig. 4 Discussion Process in the Participatory Design Workshop



Fig. 5 and Fig. 6 The Creative Campaign and Exhibition for PwDs Rights



Fig. 7 and Fig. 8 The Creative Campaign and Exhibition for PwDs Rights

3 Results and Discussion

The results of the design prescribed a 51 square meter home (on 91 square meter parcel). The house case study was adopted from a housing developed a suburban areas of Sidoarjo developed by Jaya Land. The PwDs homes were normally located in the areas because of affordable land price.

The proposed home consisted of the front garden, front porch, living room, master bedroom, child's bedroom, kitchen and dining room, bathroom and back of the garden. The house could accommodate 4 persons, namely Mr. Abdul Syakur, wife, and two children. The smaller house was prescribed because responding the needs of PwDs with limited economic capability.



Fig. 9 Floor Plan

(Explanation: 1. Parking area, 2. Living room, 3. Dining Area and Kitchen, 4. Master Bedroom, 5. Children Bedroom, 6. Bathroom, 7. Front and Back Garden)

The design principles based were implemented to the wheelchair user's house, according to Tanuwidjaja [5]³ such as:

1. **User Centered** principle was implemented through interviews discussions, and workshops with Mr. Abdul Syakur.
2. **Equitable but Reasonable Use** principle was implemented with less level difference and accessible pathways and doors. Several ramps were provided with level of 1:20, so every 10 cm height difference, 200 cm length ramp was provided. The 100 cm width ramp was provided. The furniture were designed for wheelchair users reaching range. Additional wheelchair's rotation space were provided in the kitchen and tables. The windows height were adjusted from 0.6 m to 2.1 m to facilitate wheelchair users viewing range.
3. **Simple and Intuitive Use** principle was implemented with linear circulation space was for simpler and accessibility of wheelchair users.
4. **Low Physical Effort** principle was implemented by the light-sliding doors selection. Besides that, the furniture such as dining tables, kitchen tables, and desks were designed considering reaching range of wheelchair users. The tables' height were designed with 80cm, while the bed was designed with 50 cm height. The wardrobe for wheelchair users were designed ranging from 0.2 m to 1.2 m height. Meanwhile the rest of storage could be used for other non-disability users. The windows were designed with 60 cm height for wheelchair users viewing. The sockets and switches were provided on 1.1 m height also. Railing in bathroom, adjustable shower head, water tap were additional features that aligned with this principle.
5. **Prohibition of Usage Error** principle was implemented with the furniture was designed with rounded edges. Anti-slip ceramics, railings in the bathroom, as well as the steady furniture were selected.

Detail explanation of the design were prescribed in the following paragraphs.

The front garden (size of 4 m by 3 m) was provided to ensure the cooling effect on the home. Meanwhile, 3.85 m by 3 m backyard was also provided to ensure the cross ventilation in the home, relaxing activities and drying clothes.

The house porch and parking lot (3m by 5m) was prescribed. The front porch was designed with anti-slip natural stone. No elevation difference was created in the interior of the house. Ten-cm level difference was present between interior and the parking lot, and it was facilitated with ramp (1:20).

Open-plan Family Room was designed facilitating clear pathway. The linear circulation with 1.10 m was created for wheelchair user movement. The room was also designed with anti-slip ceramics. Adjustable-height furniture with 80 cm height and rounded edges were provided to create users safety. Wheelchair turning space were also provided.

The dining area was equipped with wooden dining table (dimension of 1 m by 1.3 m by 82 cm height). The television was placed close to the dining table for users' social interaction. Because of limited reach of the wheelchair users, switches and sockets (with protectors) were placed at 1.1 m height. And the switches were located in the central area near master bedroom for easier lighting control.

In the kitchen area, the kitchen set for storing cooking utensils, etc. was provided for non - disability person. But all kitchen tabletop was designed accessible with a 80cm height, with rounded edges, spaces for wheelchair users. The L-shaped kitchen was selected for greater space and wheelchair accessibility. The kitchen was located close to the back garden for better ventilation and lighting. Exhaust fan was also prepared to extract cooking fumes and smokes.

The master bedroom were designed (with size of 3.15 m by 3.85 m) and circulation corridor of 1.5 m. The room were equipped with a bed, wardrobe, and a working desk. The wooden-light-90-cm-width-sliding door was also provided here. The door knob with 90cm height was also catered for accessibility of wheelchair users. The anti-slip ceramic was also applied in the room. Besides that, the-lower-height-window was provided to facilitate the wheelchair users to enjoy the back garden view.

The Children's Bedroom was prescribed (with size of 2.3 m by 3.85 m). There is no difference in elevation from the living room to the child's bedroom. Similar wooden-light-sliding-door made and door knob was also provided. The furniture of the room were a bed, wardrobe and a desk. Window and ventilations were provided for air circulation and natural lighting of the room.

The bathroom was provided with total area of 2 meter by 3 meter. It was designed in division for dry area and a wet area (shower area). The clothes and towel hangers were located near the door. There was a 36-cm ramp for 3cm level difference between bathroom and external areas. Besides that, a light-plastic-1m-width-sliding door was provided in the bathroom. Among the bathroom perimeter, railings with were installed with 70 cm height. The edges of the railing were designed with rounded shapes. The light switch for the toilet was placed outside of the bathroom. Sidelight-high-window was also provided to facilitate healthier air quality. The wheeled-shower chair was also provided (40 cm by 40 cm). Meanwhile, the shower head was designed to be adjustable between 1.1 m to 2.1 m. The shower could be controlled with lever tap.



Fig. 10 Front Perspective of the Home

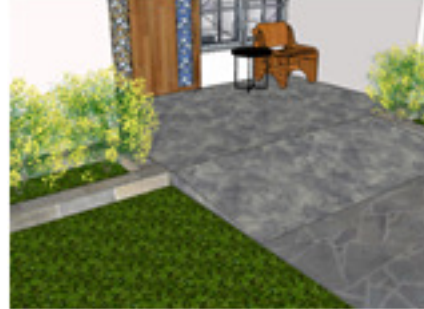


Fig. 11 Perspective of Front Porch with 1:12 ramp and anti-slip flooring.



Fig. 12 The Living Room, Dining Area, with the 1.2 meter clear width passageway and sliding door.

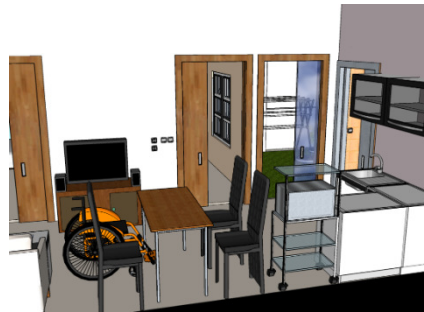


Fig. 13 The Living Room, Dining Area and Kitchen Area



Fig. 14 The Kitchen Area, with clearance for wheelchair, anti-slip flooring and reachable sink and table top.



Fig. 15 The Bathroom, with sliding door, railing, anti-slip flooring, bathing chair and sitting toilet.



Fig. 16 Children Bed Room that only partially accessible because of limited space.



Fig. 17 Master Bed Room that are fully accessible



Fig. 18 Architectural Model provided for discussion



Fig. 19 Professional Architectural Model for Exhibition

The wheelchair user design showed that the visit-able home could be designed within limited area of land. Unfortunately, the cost of the real home need building material selection and innovation.

4 Conclusion

Housing for Persons with Disabilities issue became mandatory because of Indonesian Act no 8 Years 2016, on Persons with Disability (UU no 8 tahun 2016, tentang Penyandang Disabilitas) [6] ⁶ was gazetted. The regulation actually ensured the rights for accessible housing in Section 8 on Privacy rights of PwDs (*Pasal 8 Hak tentang privasi untuk Penyandang Disabilitas*), Section 23 on Rights for PwDs to live indepently (*Pasal 23 tentang Hak hidup secara mandiri dan dilibatkan dalam masyarakat*), and Section 97 & 98 on Infrastructure provision especially housing for PwDs (*Pasal 97 tentang Penyediaan infrastruktur termasuk bangunan gedung atau hunian yang aksesibel*). Therefore the accessible housing provision should be supported by Municipality and Provincial Government, with collaboration with all stakeholders. The existing regulation also could be adjusted to the latest universal design standard and researches adopted from Developed

Countries, meanwhile innovation on design and material application should be pursued for affordability aspect.

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