

# Development of Housing Standards and Spatial Design Guidelines for Mobility Handicaps in Thailand

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## Abstract

The objectives of this research are 1) to compare the standards of housing design for mobility disabled at the domestic and universal levels, 2) to standardize the developing process of housing design guideline for mobility handicapped properly with the context of Thailand, and 3) to evaluate the proficiency of the guideline by employing both qualitative and quantitative research methods. Regarding the guidelines comparison, the results indicated that the available housing design guidelines in Thailand had excluded the spatial allocation standard for supporting the mobility dependency as well as some particular dwelling functions had been abandoned from these guidelines. Furthermore, it appeared that these design guidelines were not constituted based on the participatory of multidisciplinary experts, for instance, medical and architectural professionals. This research had initiated an evaluating process for the guideline's competence by using four indicators, namely, 1) comprehension, 2) completeness, 3) convenience, and 4) composition of design. The rating scale questionnaires were distributed to the two sampling groups comprising the group of 30 experienced Government agencies and the group of 30 mobility handicapped. The data collection consisted of two main steps: 1) the assessment of the comparative study-based guideline and 2) the assessment of the participatory-based guideline. The data retrieved from these two phases were analyzed by the inferential statistics, Paired Sample t-test. The results revealed the differences between these two sampling groups in every design category at the significance level of 0.05. It was clear that the participatory-based guideline was more efficient than the comparative study-based guideline ( $p \leq 0.005$ ). Besides, the evaluating scores addressed by the group of experienced Government agencies and the group of mobility disabled representative were discovered significantly contrary.

**Keywords:** people with disabilities (PWD), accessibility, guideline, multidisciplinary group

## 1. Introduction

### 1.1 People with Mobility Disabilities

Nowadays, the population structure in Thailand has changed and has been dramatically increased from the past concerning numbers and the elderly proportion. In 2558 B.E, there was the total number of the elderly were 10.7 million (Knodel et al., 2015). Thus, it would be led to the elderly society. Their traditional life styles had a great effect on their health with chronic ailments such as diabetes, heart attack, cancer, etc. If they are not properly treated, they will have their health problems, even if physical disabilities in the future. This means that these handicaps will have difficulties in leading their lives both physical and mental conditions. From the handicap data in Thailand, the rate of the disabled people of Thailand in 2559 B.E. was highly gone to 10 percent of the total number of the elderly which was around 1,597,775 (Sukkay, 2016), the highest number of the physical handicaps, for about 765,561 people, resulting in providing them the social welfare and facilities for their better life quality by Thailand government. Hamid et al. (2011) thought that the housing adjustment for mobility handicaps will enhance them to have a better living incongruent with Fang & Iwarsson (2007) which claimed that "housing design was needed for mobility disabilities to use the residential areas easily with convenience led to their better lives". Thus, the housing adjustment was the main issue affecting the life quality of the mobility handicaps to reach and do their daily routine due to having a great number of them as claimed by Saito (2006) that "Designing the environment without considering the physical potential of mobility handicaps would cause some hindrances in doing their daily routine. The cause of this problem resulted from the lack of readiness in housing adjustment as well as no information or guidelines for housing adjustment. There were two forms of housing adjustment; (1) housing adjustment after having one member of the family becoming a mobility handicap from the accident or having a chronic ailment (2) the new residence was built for people with mobility disabilities by birth so the housing design for them should have a manual in adjusting the proper residence and enabled them to do their daily activities conveniently without any obstacles in access to the residential areas conforming to Hogan's concept (1992) that "the housing design for the mobility handicaps should meet their needs of the dwellers in considering the design for doing their daily routine in line with Fange & Iwarsson (2005) about the relationship of housing accessibility by claiming that the physical feature affecting individual factor and body function

and inconsistent with Sukkay & Upala (2015) concluded that the evaluation on the mobility handicap's residence had to used factors affecting accessibility, usability without anybody function obstacles and the ability to use the helping equipment. Thus, finding the information and designing the residence for the mobility handicaps would enhance them to know and understand the housing adjustment.

### *1.2 Previous Aboard Guideline for People with Mobility Disabilities*

There were many problems about accessibility and daily activity performance for people with mobility disabilities as Tongsiri et al. (2017) addressed that designing the environment without considering the physical potentials of mobility handicaps would cause some hindrances in doing their daily routine. The cause of this problem resulted from the lack of readiness in housing adjustment as well as having no information or guidelines for housing adjustment. There were two forms of housing adjustment; (1) housing adjustment after having one member of the family becoming a mobility handicap from the accident or having a chronic ailment (2) the new residence was built for newborn mobility disabilities so the housing design for them should have a manual book in adjusting the proper residence and enabled them to do their daily activities conveniently without any obstacles in access to the residential areas conforming to Hello et al. (2011) supposed that "the housing design for the mobility handicaps should meet their needs of the dwellers in considering the design for doing their daily routine in line with Fange & Iwarsson (2005) about the relationship of housing accessibility by claiming that the physical feature affecting individual factor and body function.

#### *Previous Thailand Guideline for People with Mobility Disabilities*

The guideline for people with mobility disabilities was first created in America called universal design standard of America. Story et al. (1998) proposed that concept for universal design was the concept for all to facilitate them to be access to the areas as well as to promote the protection and safety of the dwellers by considering the facility factors inside and outside the buildings for everyone to apply and reach easily. There were seven topics on the universal design concept; (1) equitable use in different ages and abilities (2) flexible use (3) simple and intuitive use (4) perceptible information (5) durable for error (6) low physical efforts and (7) size and space for accessibility and utility. Topics containing in the guideline were car parking, slope way and entrance to toilet, lift and stairs. The spatial design should be included the mentioned areas, the diameter of using the wheelchairs of people with mobility disabilities which was around 1.50 meters. Later on, in 1990 A. D. one department lay the American Disability Act which its content containing in the guideline was the designing standard identified the minimum area size for the mobility disability people in the use of a wheel chair. According to this guideline, many developed countries saw its importance. In 1999 England developed the manual of housing design of the public buildings and the residence for people with mobility disabilities following the concept for universal design, applied and given its technical term "inclusive design for all" which means designing the environment of the public buildings and the residence for people with mobility disabilities responding to mental and physical needs (Clarkson & Coleman, 2015). From this concept, Imrie (2001) stated that the contents presented in the manual used the citation of the diameter of 1.50 meters in using the wheel chair for the mobility handicaps. Besides, the size of the room area and the furniture installation distance were mentioned in the guideline such as the hand reach distance of male and female handicaps in Europe like Ireland, Norway, Sweden, Denmark and Finland. The governments of those countries had the policy in developing the manual but giving the new technical terms used in it such as the new word "spatial design for all" taken from the words from the former guideline "spatial design for mobility handicaps". Bendixen & Benktzon (2015) claimed that the earlier mentioned manual of housing design of the public buildings and the residence was developed conforming to the universal design. Uden et al. (2013) concluded that the guidelines on housing spatial adjustment for mobility handicaps of each country had the difference in the presentation of the area size and the furniture installation distance by focusing on individual body functions congruent with Fange et al. (2013) they said housing adjustment for mobility handicaps in Sweden had been taken from the analysis on the ability to do their daily routine related to the area requirements from the research identifying the body potentials of the mobility handicaps which influenced the spatial design in their residence.

### *1.3 Previous Thailand Guideline for People with Mobility Disabilities*

Thailand began to set the facilities in the buildings for handicaps or elderly by Ministry of Interior passed ministerial regulation under the Building Control Act, 2548 B.E. (National, 2012) which regulated hospital, nursing home, public health service center, health station, government building and public building with its total area more than 300 square meters as well as private office, hotel, theater and meeting room with the area more than 2000 square meters had to design the facilities for mobility handicaps; sign, slope way, lift, stairs, car park, entrance to the building, corridor, door, toilet and tangible surface. From seven concepts on universal design, distance, area size, presentation technique in the manual, plan writing, side picture and details of furniture in every room. After that, during 2552-2556, the manual was improved but its contents remained the same and designed the area by referring to the diameter size of using the wheelchair of the mobility handicaps with 1.50 meters wide like America. Many government organizations starting from public health organizations, handicap welfare organizations such as Office of Health Promotion Fund, Thai Handicap Foundation, Department of Life Quality of Persons with Disability Promotion and Development, Ministry of Public Health including Engineering and Architectural Professional Offices such as Department of Public Works, Architect Council, Elderly Action Unit, Chulalongkorn University, etc. From the analysis of all guidelines developed from 2548-2556, the same things were the explanation of the utilized areas, a part of the building such as slope way, stairs, lift, entrance, car park, toilet and so on. Also, there was no explanation of the completely utilized areas such as

slope way, living room, dining room, bedroom, bathroom, outside garden, electrical system, emergency equipment system, etc. This led to the repeated contents and the interesting issue was the whole process of the manual development done by a single workplace which resulted in the manual contents not cover the architectural design and the design on physical ability development along with the medical concepts including all former manual developments had no classification of self-assistance of people with mobility disabilities related to the utilized areas. Sukkay (2016) stated that Thailand had never developed the manual via the multidisciplinary participation from medical and architectural professionals in line with Tongsir & Hawusutsima (2013). They claimed that the measurement of the body-functioning ability level in performing daily activities of mobility handicaps was in accordance with the concept on international classification functions (ICF), the medical concept, was important for the design of the utilized area size for mobility handicaps in congruence with the concept of Iwarsson & Slaug (2010) that the classification of their body functions and the convenience in doing their daily activities in the area was the main information for housing design. Thus, it was clearly seen that the manual development for the handicaps in Thailand lacked some information such as size, the distance of every room in the residence, and the manual development from a multidisciplinary group; medical and architectural.

This research consisted of seven parts; (1) Introduction (2) Literature review (3) Research framework (4) Research methodology (5) Research analysis and result (6) Conclusion and discussion (7) Suggestions to private and government sectors including mobility handicaps, their relatives and family, and the hospital.

## 2. Literature Reviews

From the literature reviews, the contents were divided into three groups; the analysis on housing design for people with mobility disabilities in Thailand, the concept on area accessibility of mobility handicaps, the concept on the classification international classification functions (ICF) and the concept on the manual design. The three concepts were the significant information in the manual development as shown in figure 1.

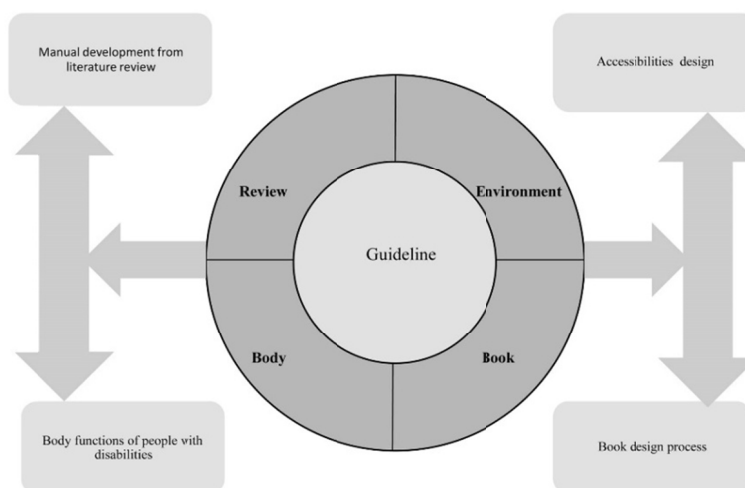


Figure 1. Literature review diagram

### 2.1 Reviews Thailand Disabilities Guideline

The guideline on housing design for mobility handicaps abroad was originated from America, known as universal design standard and its contents was applied from the concept of the design for all and the topics listed in the manual explained about car park, slope way, entrance, door, stairs, lift, corridor, bed room, bath room, electrical system and fire emergency system, covering the spatial design of public and residential buildings. The contents of the manual illustrated the room size and furniture installation distance by citing from the diameter of using the wheelchair of the mobility handicaps at the lowest width 1.50 meters. Then, England created the same manual, that was the inclusive design following the American area topics but different in details of handicap proportion. Meanwhile, Canada had the housing design manual for mobility handicaps like America but the difference was just the details of the utilized areas which were the dining room and the kitchen. Many countries like Ireland, Sweden and Netherland had developed their housing manuals containing the same topics but putting more details of the furniture distance. Moreover, the housing manuals from these countries were divided into two manuals; one was the housing manual for the public buildings, another was the residence for people with mobility disabilities. The concept of accessibility design was applied in the manual (Iwarsson & Stahl, 2003).

The housing design manual for people with mobility disabilities in Thailand started in 2548 B.E., all public buildings for mobility handicaps in Thailand had to provide the facilities by presenting the room size, the areas and the furniture installation distance, the concept taken from universal design with seven topics by focusing on accessibility design for only the mobility handicaps who could help themselves. Later on, from 2552 to 2556 B.E., the housing manuals were continuously developed but the contents in the manuals were still exactly the same as contained in the 2548 manual

and the manual development was done by the sole (Phaholthep et al., 2017).

From the comparison on the difference between foreign countries and Thailand, it was discovered that the housing manual development in Thailand had never been cooperatively done by medical and architectural professionals and had no spatial designs for mobility handicaps who could not help themselves, Most significance of all, there were no complete explanations about the topics on the utilized areas as shown in figure2

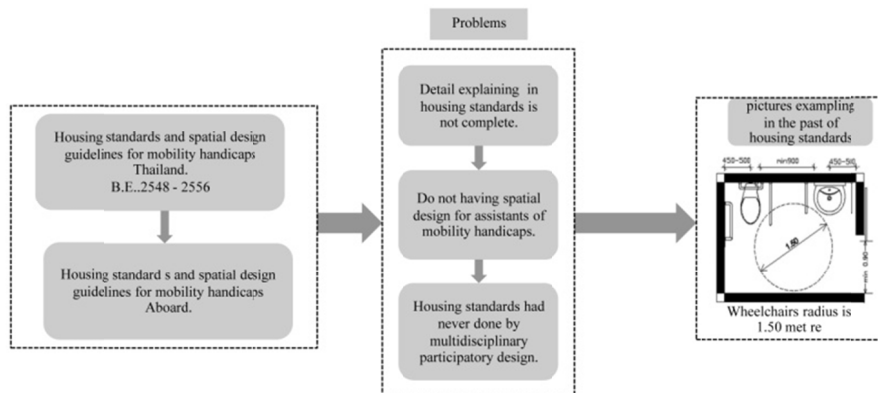


Figure 2. Diagram of the analysis on the housing manual for people with mobility disabilities

Table 1. The comparison of the same topics found in the housing manuals between Thailand and foreign countries

Country	Content of Guideline											
	Check List											
	Parking	Ramp	Entrance	Door	Stairs	Railing	Lift	Corridor	Bed room	Toilet Room	Living	Electrical
1. Barrier Free Design Guide Canada (1998)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2. ADA Standards for accessible Design. USA. (2010)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3. Universal Design Guidelines Home Ireland. (2015)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4. Inclusive Design Standard UK. (2012)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5. Thailand guideline for people mobility disabilities (B.E. 2548)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6. Thailand guideline for people mobility disabilities (B. E. 2556)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	No topic

## 2.2 Accessibility Concept

There were three factors on the concept of accessibility design by considering the provision of the facilities for people with mobility disabilities. (1) Reach the preparation for the mobility handicaps from the outside area to easily reach the inside area. (2) Enter the preparation for the users to enter every utilized area easily and consider doing the activities conveniently. From this concept, it emphasized the accessibility to do all activities without any hindrances as Laura et al (2016) stated that the spatial design must have the room area wide and long by citing from the diameter of using the wheelchair of people with mobility disabilities with self-assistance and having an accessible distance to furniture and facilities in every room like a rail.

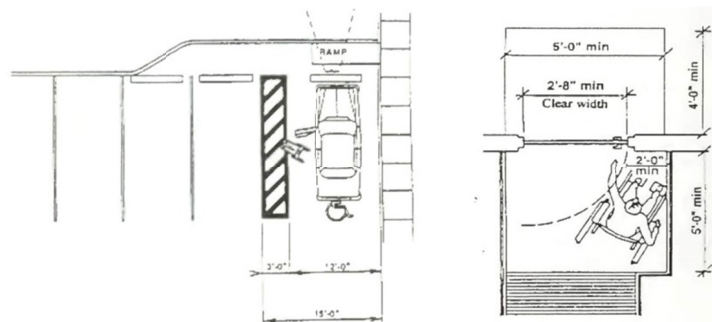


Figure 3. Pictures depicted in housing manual for people with mobility disabilities of England

Source: [www.http://learninglegacy.independent.gov.uk/publications/inclusive-design-standards.php](http://learninglegacy.independent.gov.uk/publications/inclusive-design-standards.php)

## 2.3 Book Design

Book design means planning on the physical structure of the book by considering the factors' placement led to the book's shape and symmetry. The qualitative book contains beauty, readability, interesting as well as having an

appropriateness for the book itself publishing objectives, composed of four factors; function, infographic design process, content comprehension, and comfort. The four factors make the readers comprehend the contents and satisfied with the book design (Laing & Masoondian, 2016).

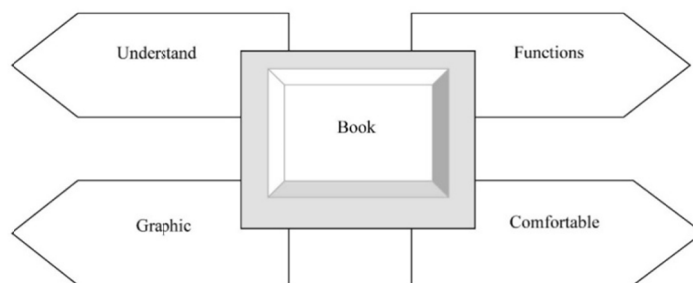


Figure 4. Book design concept

## 2.4 Conceptual Framework

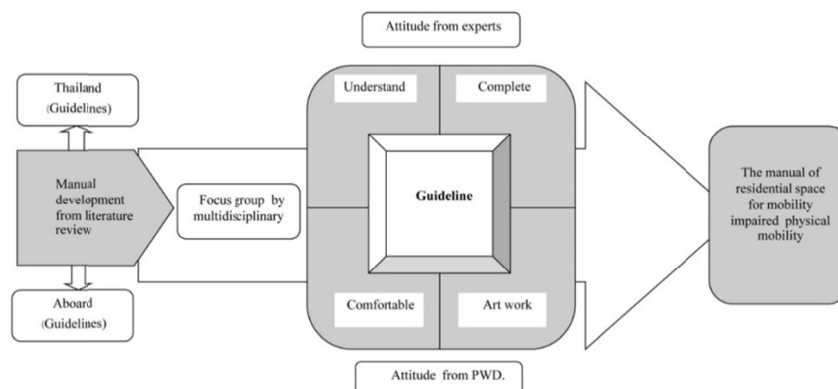


Figure 5. Research conceptual framework

## 3. Method

This research aimed to compare the standards of housing design for mobility handicaps at domestic and universal levels, (2) to improve the process of housing development guidelines meeting the standard requirement and appropriate for Thailand contexts (3) and to examine the guideline quality based on qualitative and quantitative research. Thus, this research has consisted of four steps in accordance with its objectives and framework.

### 3.1 Identify Subsections

The process of the guideline development started from literature review through contrastive analysis on the development of housing guidelines for mobility handicaps between Thailand and foreign countries. Then, information gained from the analysis was taken to develop the manual until the finish and it was checked for its quality by the manual indicators which were the pre-test questionnaire with five rating scales for evaluating its quality in round one with 30 manuals experienced government official's in Thailand and 30 mobility handicaps with self-assistance. Then, the collected data was analyzed and taken into the focus group discussion by 10 experts from the multidisciplinary group; medical and architectural. After the focus group, the manual was tested for its quality via the manual indicators in the second round with the same questionnaire, called post-test, to the same sample group. The two data were concluded for the suggestions on the development of housing guidelines for mobility handicaps as shown in figure 6.

### 3.2 Participant (Subject Characteristics)

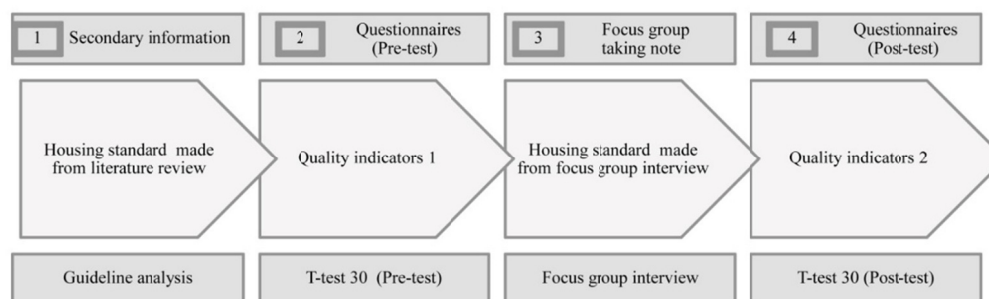


Figure 6. Methodology research mapping

The sample selection of group one was done through purposive sampling from government officials having experience in the development of housing design manual for mobility handicaps at the total number of thirty subjects; twenty

architects and engineers from Office of Public Works in Bangkok and ten officials from Office of Health Promotion. The second group consisted of thirty samples; twenty mobility handicaps from Sirinthorn Center by purposive sampling and ten elderly with mobility disabilities.

### 3.3 Sampling Procedures

The sample selection of group one was done through purposive sampling from government officials having experience in the development of housing design manual for mobility handicaps at the total number of thirty subjects; twenty architects and engineers from Office of Public Works in Bangkok and ten officials from Office of Health Promotion. The second group consisted of thirty samples; twenty mobility handicaps from Sirinthorn Center by purposive sampling and ten elderly with mobility disabilities.

#### 3.3.1 Measures and Covariates

Tools used in this research were a focus group by multidisciplinary professionals in the manual development and a five-scale questionnaire with four indicators concerning the manual quality; comprehension in the manual, the completeness of the manual, the convenience in housing design adjustment and satisfaction towards the art factor in the manual.

#### 3.3.2 Research Design

(1) Literature reviews through synthesizing and analyzing the housing development manual for mobility handicaps in Thailand and foreign countries by the researcher in identifying the problems and the differences found in the manual. Then, data were analyzed and applied for the manual development via presenting size and distance of car park, slope way, door, entrance, living room, bathroom, bedroom, kitchen, outside garden, electrical system and fire prevention system.

(2) Inspecting the manual quality by applying the indicators in the first round through the pretest questionnaire from two sample groups; thirty government officials and thirty mobility handicaps by sending and returning the questionnaire by post.

(3) The focus group done by multidisciplinary professionals followed the suggestions from the pre-test questionnaire and created the second manual. The focus group discussion run by the researcher which consumed three hours at the meeting of Faculty of Architecture along with sound recording and taking pictures and notes. The important contents could be concluded as follows: the added distance of the helper of the mobility handicap in spatial design of the diameter distance of using the wheelchair from 1.50 meters to 1.80 meters by adding the presentation of every plan of car park, slope way, entrance, living room, dining room, kitchen, bathroom, bedroom, outside garden, electrical system and fire emergency system as the depicted pictures in the manual shown in figure 7.

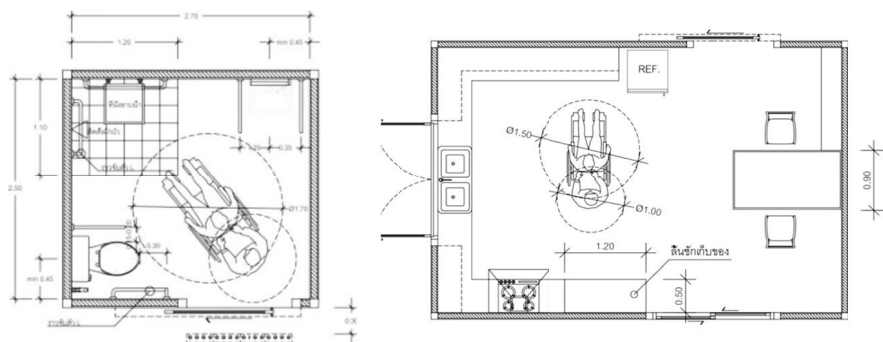


Figure 7. Toilet and dining room plan in guideline

(4) Inspecting the manual quality by applying the indicators in the second time through the post-test questionnaire sent to the same sample groups and returned it by post on the date scheduled by the researcher.

#### 3.3.3 Variables

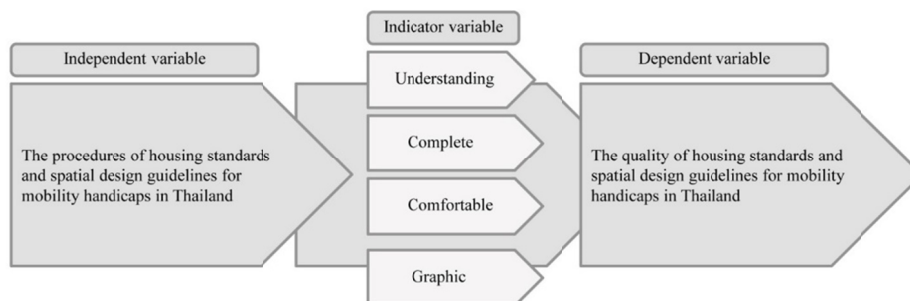


Figure 8. Variable diagram

## 4. Results

### 4.1 Recruitment

The understanding of the four research step 1). Literature reviews through the analysis and the comparison the housing manual for mobility handicap 2). The manual development after literature review 3). Inspecting the manual quality by applying the indicators in the first round with the pre-test questionnaire to two groups; thirty experienced government officials and thirty mobility handicaps 4). Taking the information from the pre-test questionnaire brought into the focus group discussion by ten multidisciplinary groups; five from the medical group and five from the architectural group as the following results.

#### *Result from Focus group interview*

From the focus group results organized by the researcher via an open-ended questionnaire with its question-how does the housing manual for mobility handicaps in Thailand look like? and the results from sound recording and note taking could be concluded as follows.

*The first doctor:* "The manual should classify the mobility handicaps according to the body organ weakness and level of doing an activity from the concept of international classification of functioning".

*The second doctor:* "The housing function design should be taken into consideration in terms of the areas for the disabled assistant such as the area for the family member to push the wheelchair for the handicap from 1.50 meters which were the lowest diameter standard of the mobility person with self-able assistance to 1.80 meters".

*The third interviewer, a physical therapist:* "The manual should add more topics on taking care of the handicaps in long - term care and basically rehabilitating their muscles."

*The fourth informant, a community architecture:* "The principle of housing design should be classified according to the body function of the handicaps; for self-able assisting handicap used the same diameter with the distance of 1.50 meters while the self-unable assisting should be at 1.80".

*The fifth informant, an academic:* "The housing manual design for mobility handicaps should add more details of the materials and their estimated building price".

From five experts' views, they were very useful and congruent with one another. Thus, the researchers applied these suggestions for the development of housing manual design for people with mobility disabilities for the second development of the residential manual.

### 4.2 Statistics and Data Analysis

After the focus group from ten experts, the researcher created the second manual and inspected its quality with the second indicators by distributing the post-test questionnaire to the same sample group as the result shown in table 2. Inspecting the manual quality by using the five-rating scale questionnaire of four variables; (1) content understanding (2) content completeness (3) convenience of the area adjustment (4) Satisfaction towards the art factor. It was found that the results collected from the first sample group (thirty government officials) shown in table 2 and the result from the second group appeared in table 3.

Table 2. Result on the analysis of comprehension, completeness, convenience and satisfaction towards the art factor in the manual from thirty government officials

Topic	Understanding				Complete				Comfortable			
	Mean	SD	t	Sig	Mean	SD	t	Sig	Mean	SD	t	Sig
Pre-parking	2.83	1.02	4.862	0.00	2.53	1.008	6.142	0.000	2.43	0.858	7.710	0.000
Post-parking	3.90	0.923			3.93	0.944			4.13	0.937		
Pre-ramp	3.00	0.974	4.447	0.00	2.83	0.874	4.649	0.000	2.77	0.898	4.858	0.000
Post-ramp	4.03	0.809			3.93	1.015			3.93	1.015		
Pre-entrance	3.07	0.868	3.657	0.001	2.87	0.860	5.570	0.000	2.97	0.890	5.253	0.000
Post-entrance	3.97	0.999			4.03	0.890			4.03	0.890		
Pre-door	3.13	1.167	3.877	0.001	2.93	0.944	5.288	0.000	2.90	0.900	5.676	0.000
Post-door	4.00	0.830			4.13	0.819			4.00	0.802		
Pre-living room	3.23	0.898	3.516	0.001	3.23	0.898	4.267	0.000	2.77	0.898	6.283	0.000
Post-living room	4.00	0.910			4.13	0.860			4.17	0.874		
Pre-kitchen	3.23	0.898	3.635	0.001	2.77	0.898	4.858	0.000	2.77	0.898	7.393	0.000
Post-kitchen	4.10	0.845			3.93	1.015			4.17	0.834		
Pre-bathroom	3.07	0.907	5.321	0.000	2.83	0.848	5.718	0.000	2.73	0.828	7.594	0.000
Post-bathroom	4.20	0.805			4.00	0.802			4.27	0.907		
Pre-bed room	3.37	0.765	4.000	0.000	2.90	0.759	5.356	0.000	2.97	0.928	5.856	0.000
Post-bed room	4.17	0.834			4.00	0.947			4.07	0.907		

Pre-landscape	3.30	0.877	3.699	0.001	3.20	0.961	3.619	0.001	3.07	0.907	4.853	0.000
Post-landscape	4.13	0.819			4.13	0.973			4.17	0.913		
Pre-emergency	3.03	0.850	5.406	0.00	2.87	0.776	7.244	0.00	2.87	0.776	7.102	0.000
Post-emergency	4.10	0.845			4.23	0.858			4.20	0.761		
Pre-electronic	3.13	0.860	4.785	0.00	2.93	0.944	5.288	0.000	2.97	0.765	6.647	0.000
Post-electronic	4.13	0.937			4.13	0.819			4.27	0.944		

\*p<.05 is the level of significance

From table 1, it indicated that the government officials had more understanding of the contents of the manual, felt more completeness and more convenience in the area adjustment from the second manual than the first one at the significantly different level of 0.05 in all topics of the manual. Due to all topics of housing design; car park, slope way, entrance, living room, dining room, kitchen, bathroom, bedroom, outside garden, electrical system and fire emergency system. These areas all rooms were wider than the ones in the first manual from 1.50 meters to 1.80 meters in the case of using the wheelchair. It reflected that the government officials had the understanding of the contents of the manual, perceived the completeness and the convenience in the use of the manual. From the focus group discussion by the multidisciplinary group (the second manual), the interesting results were the bathroom which the government official understood most (4.20) the electrical system, the area the government officials perceived its completeness most (4.13) and followed by the bathroom, the government officials perceived its convenience in adjustment most (4.27).

Table 3. Result on the analysis of comprehension, completeness, convenience and satisfaction towards the art factor in the manual from thirty mobility handicaps

Topic	Understanding				Complete				Comfortable			
	Mean	SD	t	Sig	Mean	SD	t	Sig	Mean	SD	t	Sig
Pre-parking	2.97	1.217	3.890	0.004	3.03	1.217	3.717	0.001	2.97	1.033	4.678	0.000
Post-parking	3.77	0.679			3.77	0.728			3.73	0.691		
Pre-ramp	3.10	1.029	5.221	0.000	2.93	1.202	5.960	0.000	3.23	1.278	3.633	0.001
Post-ramp	3.93	0.624			4.00	0.643			3.93	0.828		
Pre-entrance	3.37	1.129	3.616	0.001	3.00	1.145	4.557	0.000	3.03	1.098	4.397	0.000
Post-entrance	3.93	0.740			3.87	0.730			3.83	0.747		
Pre-door	3.47	0.900	3.294	0.003	2.97	0.999	7.059	0.000	2.90	1.213	6.279	0.000
Post-door	3.93	0.828			4.03	0.765			4.00	0.830		
Pre-living room	3.37	0.926	4.583	0.000	3.13	1.074	5.869	0.000	3.20	0.997	5.835	0.000
Post-living room	4.07	0.785			4.17	0.699			4.10	0.759		
Pre-kitchen	3.27	1.112	2.734	0.011	3.17	1.053	4.097	0.000	3.07	1.112	4.878	0.000
Post-kitchen	3.83	0.791			3.90	0.759			3.93	0.740		
Pre-bathroom	3.20	0.997	4.000	0.000	2.97	0.850	6.500	0.000	2.63	1.098	6.495	0.000
Post-bathroom	4.00	0.743			3.83	0.531			3.87	0.629		
Pre-bed room	3.27	1.015	4.428	0.000	3.17	0.950	4.097	0.000	3.30	0.750	4.039	0.000
Post-bed room	4.00	0.743			3.90	0.845			3.90	0.712		
Pre-landscape	3.23	1.104	4.026	0.000	3.13	0.900	5.215	0.000	2.90	1.029	6.484	0.000
Post-landscape	3.93	0.785			4.17	0.785			4.07	0.868		
Pre-electrical	3.33	0.884	5.869	0.000	3.13	1.042	4.557	0.000	3.23	1.006	4.334	0.000
Post-electrical	4.00	0.830			4.00	0.830			4.07	0.691		
Pre-emergency	3.00	1.050	3.959	0.000	3.00	0.983	5.154	0.000	3.13	1.074	4.983	0.000
Post-emergency	4.03	0.718			4.03	0.809			4.20	0.664		

\*p<. 05 is the level of significance

From table 3, it illustrated that mobility handicaps had more understanding of the contents of the manual, perceived more completeness and convenience for adjustment area in the second manual than the first one at the significant level of difference 0.05 in all topics of the manual ( $p<.05=0.00$ ). This is because there was a classification of the mobility handicaps from focus group interviews into designing for self-able and self-unable assistance. It was discovered that the living room was the room which was the most understanding and feel completeness by the mobility handicaps (4.07) and (4.17) and the emergency system which was the most convenience for adjustment housing by the mobility handicaps. (4.20).



Table 4. Result on data collection from post-test questionnaire of the variable of content understanding in the manual from the two groups

Understanding	People with disabilities N = 30				Employees N = 30			
	Mean	SD	t	Sig	Mean	SD	t	Sig
Pre-parking	2.97	1.202	3.890	0.004	2.80	1.02	4.862	0.00
Post-parking	3.77	0.679			3.90	0.923		
Pre-ramp	3.10	1.029	5.221	0.000	3.00	0.947	4.447	0.00
Post-ramp	3.93	0.640			4.03	0.809		
Pre-entrance	3.37	1.129	3.616	0.001	3.07	0.868	3.657	0.001
Post-entrance	3.93	0.740			3.97	0.999		
Pre-door	3.47	0.900	3.294	0.003	3.13	1.167	3.877	0.001
Post-door	3.93	0.828			4.00	0.830		
Pre-living room	3.37	0.924	4.583	0.000	3.23	0.898	3.516	0.001
Post-living room	4.07	0.785			4.00	0.910		
Pre-kitchen	3.27	1.112	2.734	0.011	3.23	0.898	3.635	0.001
Post-kitchen	3.83	0.791			4.10	0.845		
Pre-bathroom	3.20	0.997	4.000	0.000	3.07	0.907	5.321	0.000
Post-bathroom	4.00	0.743			4.20	0.805		
Pre-bed room	3.27	1.015	4.428	0.000	3.37	0.765	4.000	0.000
Post-bed room	4.00	0.743			4.17	0.834		
Pre-landscape	3.23	1.104	4.026	0.000	3.30	0.877	3.699	0.001
Post-landscape	3.93	0.785			4.13	0.819		
Pre-electrical	3.33	0.884	5.869	0.000	3.13	0.860	5.406	0.00
Post-electrical	4.00	0.830			4.13	0.937		
Pre-emergency	3.00	1.050	3.959	0.000	3.03	0.850	4.785	0.00
Post-emergency	4.03	0.718			4.10	0.845		

\*p<.05 is the level of significance

From Table 4 Result of the comparison on the understanding of the manual contents between two groups, it was revealed that the living room was the only room which the mobility handicaps perceived the content understanding in the manual more than the government officials (4.07) meanwhile the interesting result was that the government official group had the content understanding in the manual nearly all topics except the living room more than the mobility handicap group and the government officials having the understanding most was the bathroom (4.20).

Table 5. Result on the comparison of data collection from the post-test questionnaire on the completeness of manual contents of the two groups

Completeness	People with disabilities N = 30				Employees N = 30			
	Mean	SD	t	Sig	Mean	SD	t	Sig
Pre-parking	3.03	1.217	3.717	0.001	2.53	1.008	6.142	0.000
Post-parking	3.77	0.728			3.93	0.911		
Pre-ramp	2.93	1.202	5.960	0.000	2.83	0.874	4.649	0.000
Post-ramp	4.00	0.643			3.93	1.015		
Pre-entrance	3.00	1.145	4.557	0.000	2.87	0.860	5.570	0.000
Post-entrance	3.87	0.730			4.03	0.890		
Pre-door	2.97	0.999	7.059	0.000	2.93	0.944	5.288	0.000
Post-door	4.03	0.765			4.13	0.819		
Pre-living room	3.13	1.074	5.869	0.000	3.23	0.898	4.267	0.000
Post-living room	4.17	0.699			4.13	0.860		
Pre-kitchen	3.17	1.053	4.097	0.000	2.77	0.898	4.858	0.000
Post-kitchen	3.90	0.759			3.93	1.015		
Pre-bathroom	2.97	0.850	6.500	0.000	2.83	0.848	5.718	0.000
Post-bathroom	3.83	0.531			4.00	0.802		
Pre-bed room	3.17	0.950	4.097	0.000	2.90	0.759	5.356	0.000

Post-bed room	3.90	0.845			4.00	0.947		
Pre-landscape	3.13	0.900			3.20	0.961		
Post-landscape	4.07	0.785	5.215	0.000	4.13	0.973	3.619	0.001
Pre-electrical	3.13	1.042			2.93	0.944		
Post-electrical	4.00	0.830	4.557	0.000	4.13	0.819	5.288	0.000
Pre-emergency	3.00	0.983			2.87	0.776		
Post-emergency	4.03	0.809	5.154	0.000	4.23	0.858	7.244	0.000

\*p<.05 is the level of significance

From Table 5 Result of the comparison on the content completeness in the manual between two groups, it was found that the government official group perceived the content completeness in the manual nearly all topics more than people with mobility disabilities except living room (4.17), slope way (4.00), outside garden (4.07) which the government officials perceived the content completeness less than people with mobility disabilities.

Table 6. Result on the comparison of data collection from the post – test questionnaire on convenience in the area adjustment of the two groups.

Convenience	People with disabilities N = 30				Employees N = 30			
	Mean	SD	t	Sig	Mean	SD	t	Sig
Pre-parking	2.97	1.033	4.678	0.000	2.43	0.858	7.710	0.000
Post-parking	3.73	0.691			4.13	0.937		
Pre-ramp	3.23	1.278	3.633	0.001	2.77	0.890	4.858	0.000
Post-ramp	3.93	0.828			3.93	0.890		
Pre-entrance	3.03	1.098	4.397	0.000	2.97	0.860	5.253	0.000
Post-entrance	3.83	0.747			4.03	0.890		
Pre-door	2.90	1.213	6.279	0.000	2.90	0.900	5.676	0.000
Post-door	4.00	0.83			4.00	0.802		
Pre-living room	3.20	0.997	5.835	0.000	2.77	0.898	6.283	0.000
Post-living room	4.10	0.759			4.17	0.874		
Pre-kitchen	3.07	1.112	4.878	0.000	2.77	0.898	7.393	0.000
Post-kitchen	3.93	0.740			4.17	0.834		
Pre-bathroom	2.63	1.098	6.495	0.000	2.73	0.828	7.594	0.000
Post-bathroom	3.87	0.629			4.27	0.907		
Pre-bed room	3.30	0.750	4.039	0.000	2.97	0.928	5.856	0.000
Post-bed room	3.90	0.712			4.07	0.907		
Pre-landscape	2.90	1.029	6.484	0.000	3.07	0.907	4.853	0.000
Post-landscape	4.07	0.868			4.17	0.913		
Pre-electrical	3.23	1.006	4.334	0.000	2.97	0.765	7.102	0.000
Post-electrical	4.07	0.691			4.27	0.944		
Pre-emergency	3.13	1.074	4.983	0.000	2.87	0.776	6.647	0.000
Post-emergency	4.20	0.664			4.20	0.762		

\*p<.05 is the level of significance

From Table 6 Result of the comparison on the convenience in the area adjustment between two groups, it indicated that the government official group perceived convenience in the area adjustment nearly all topics more than mobility handicaps except the electrical system (4.27) while the interesting results that slope way (3.93) and the door (4.00) were the areas which both groups perceived the same.

Table 7. Result on the analysis on satisfaction towards the art factor in the manual from thirty government officials

(Pre-Post of Satisfaction)	N	Mean	SD	t	Sig
Scale of guideline	30	1.267	0.907	7.648	0.000*
Content in guideline	30	0.233	0.430	2.971	0.006*
Text in guideline	30	0.567	0.971	3.195	0.003*
Picture in guideline	30	0.733	0.868	4.626	0.000*
Color in guideline	30	0.800	0.847	5.174	0.000*

\*p<.05 is the level of significance

From Table 7, it was revealed that the government officials had more satisfaction towards size, content, letter type,

picture and manual color in the second manual than in the first one at the significant level of difference 0.05 ( $p < .05 = 0.00$ ). The interesting result was that the government officials had the least satisfaction towards the content order (0.233) because of the procedure of doing the standard guideline from the focus group with the multidisciplinary group had different attitudes which cause the confusing.

Table 8. Result on the analysis on satisfaction towards the art factor in the manual from thirty mobility handicaps

(Pre-Post of Satisfaction)	N	Mean	SD	t	Sig
Scale of guideline	30	0.573	0.511	0.143	0.000*
Content in guideline	30	0.633	0.490	7.077	0.006*
Text in guideline	30	1.333	1.028	7.902	0.003*
Picture in guideline	30	1.167	0.117	5.722	0.000*
Color in guideline	30	1.167	1.053	6.067	0.000*

\* $p < .05$  is the level of significance

From Table 8, it was revealed that people with mobility disabilities had more satisfaction towards the art factor in the second manual than in the first one at the significant level of difference 0.05 ( $p < .05 = 0.00$ ). The interesting result was that people with mobility disabilities had the least satisfaction towards the manual size (0.573) owing to the first and the second manual sizes were the same, no adjustment for the handicaps. However, they had the satisfaction towards the letter type most (1.333) due to increasing the size of the letter, the highlight color for presenting the details of the materials and dimensions of the room which was obviously and comfortable to read.

## 5. Discussion and Conclusion

From the research objectives were to 1) to compare the standards of housing design for mobility disabled at the domestic and universal levels, 2) to standardize the developing process of housing design guideline for mobility handicapped properly with the context of Thailand, and 3) to evaluate the proficiency of the guideline by employing both qualitative and quantitative research methods. It was discovered that the differences in the guidelines for mobility handicaps of Thailand and foreign countries where the spatial design for people with disabilities, the spatial design for the handicap's assistant, adding more area topics in all rooms and the guideline was never developed by the multidisciplinary group. Thus, the researchers improved the first guideline for mobility handicaps from the information gained from the guideline comparison by adding the designing area for the handicap's assistant and arranged the content order appropriate for Thai people which were car park, slope way, entrance, living room, dining room, kitchen, bathroom, bedroom, outside garden, electrical system, fire emergency system and garden decoration inside the residence. Also, the guideline quality inspection via the research had the interesting results which were the two samples; the government officials and the mobility handicaps perceived the content understanding, the content completeness and the convenience in the area adjustment, and had the satisfaction towards the second guideline more than the first one at the significant level of difference 0.05 ( $p < .05 = 0.00$ ). The important research results were the content understanding of the government officials which was found that the bathroom design was the most understanding because the bathroom was the utilizing area with many details of furniture. From the presentation of the bathroom, it made the official group have more understanding while the mobility handicaps thought that the living room made them have more understanding. In terms of the content completeness, the interesting results were: the official group thought that the kitchen design was most (5.03) meanwhile the mobility handicaps thought that the kitchen design was least (3.90) now that the kitchen was the area with design details. Thus, they thought that the presentation of the area design distance in the kitchen lacked details and did not meet the requirement of the convenience in the use of the area as the design in the guideline. The interesting issues were: the perception on the design of the slope way and the door had the same mean scores (3.93) and (4.00) which meant that the slope way and the door design in the guideline made the two groups satisfied. The last issue, an outstanding point, the satisfaction on the book size design, mobility handicaps had the least satisfaction towards the size of the guideline (0.573) while the official group had the most satisfaction towards the size design of it (1.267) since the size of the guideline (0.21 x 0.16 m) was suitable for general users who wanted the convenience in picking and using but the guideline size was too small for the handicaps to see clearly.



Figure 9. Bed room and living room in guideline

From the research results, it can be concluded that the development of housing guideline for mobility handicaps in Thailand should be participatory done from multidisciplinary professionals with the experience in taking care of people with mobility handicaps such as Ministry of Public Health and Council of Architect in order to create the quality guideline which could be applied for handicaps with ability and disability. The main point is that the awareness of the proportion of mobility handicaps and the design. There should be the classification of the ability levels in doing their daily activities as well as the proportion and the distance of the handicap's assistant because of the cultural difference between Thai and foreign countries. Basically, the family member will be the handicap's assistant. Thus, the proportion addition is the main factor in the development of housing guideline for people with mobility handicaps in Thailand in the future

### Recommendation

From the results of the development of housing guideline for mobility handicaps from multidisciplinary professionals, there are some beneficial suggestions given as follows.

- (1) The government sector should develop the housing guideline according to self-assisting abilities of the mobility handicaps through participation among Ministry of Public Health, Council of Architect and the sectors involving with mobility handicaps to create the appropriate and easily understandable guideline for mobility handicaps to apply.
- (2) The private sector should promote the design of furniture materials suitable for size and shape of mobility handicaps in the development of housing guideline for people with mobility handicaps.
- (3) The hospital should distribute the housing guideline to the patients and their relatives those who come to the hospital for health care service and want to adjust their residence for the certain person.
- (4) The mobility handicaps should check their own residence for the housing adjustment in order to follow the housing design from the guideline.
- (5) Mobility handicap's relative and family should be asked and surveyed for their size and shape as the handicap's helpers across Thailand to gain the information for the manual development in the future.

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