Assessment of Mobility of Persons with Disabilities (PWDs) in Cainta, Rizal

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Abstract: This study aims to address the problems on the mobility of PWDs. Set in Cainta as the location, it involves both qualitative (survey questionnaires for PWD and non-PWD, as respondents) and quantitative assessment (pedestrian facilities and public transportation vehicles). The researchers determined from these methods that the respondents gave more importance to safety than the other factors affecting mobility. Common problems encountered in using transportation vehicles and facilities were also enumerated. Results show that the transportation facilities and vehicles are poorly designed for PWDs. PWDs have limited choices on their use of transportation vehicles and facilities and have experienced difficulties in boarding and alighting vehicles. There are many obstructions on transportation facilities, especially on sidewalks, that impede seamlessness of their travel from one point to another. The researchers gave recommendations on the designs and layouts of transportation vehicles and facilities in order to improve mobility of PWDs in the municipality.

Keywords: Mobility, PWDs, Transportation Facilities, Transportation Vehicles, Urban Setting

1. INTRODUCTION

In a country with rapidly increasing population like the Philippines, transportation plays a major role in the development of the society. Whenever transport systems are designed, persons with disabilities (PWDs) are often neglected. Roughly 10% of the world's population (650 million people) have disability and 80% of those are from low income countries where they experience denial of rights and different social and economic disadvantages (WHO, 2011). In 2010, according to the National Statistics Office (NSO) there are 1,442,586 PWDs or roughly 1.6% of the population. Different transportation vehicles like buses, jeepneys, taxis, tricycles and trains are often not designed for easy access of PWDs. Accessibility is defined as having no criteria that impede the use of facilities either by handicapped or non-disabled citizens (BP 344). PWD is defined to be "those suffering from restriction of different abilities, as a result of a mental, physical or sensory impairment, to perform an activity in the manner or within the range considered normal for a human being" (RA 7277).

According to Republic Act (RA) 7277 Chapter 6 Section 25, "the State shall ensure a barrier free environment for PWDs in private, public buildings and other establishments mentioned in Batas Pambansa 344 or Accessibility Law".

According to United Nations (UN) Standard Rules for Equalization of Opportunities for Persons with Disabilities 1994 Section II Rule 5, "the state shall introduce programmes of action to make the physical environment accessible" and other considerations that must be made to guarantee maximum accessibility for PWDs.

The current status of accessible transportation in the country is limited to transportation facilities (e.g. ramps and some pedestrian overpass) and few vehicles (e.g. Point-to-Point buses). There are current efforts in the country to provide easy access for PWDs. In Marikina City, PWD friendly tricycles were provided. These tricycles have a ramp and a space enough for a wheelchair to board without unfolding it. The Department of Transportation and Communication (now DOTr) and Land Transportation Franchising and Regulatory Board (LTFRB) launched Point-to-Point buses that are PWD-friendly. These buses have low floors, ramps and wider aisles for easy access. These buses are currently operating from Makati to Quezon City. Pedestrian overpasses either with long ramps or elevators are also being built across Metro Manila to help PWDs cross wide roads. Different malls are also being designed to be accessible for PWDs in the country.

This study aims to assess the mobility of PWDs in an urban setting – Cainta, Rizal. Cainta is a highly urbanized municipality in the country with a population of 332,128 (NSO, 2015). It is also the richest municipality in the country with an equity of ₱1.893 billion (COA Annual Financial Report, 2015). In a municipality of high income and population with thriving commercial establishments (*e.g. Puregold, Robinsons, etc.*), PWD accessibility should be considered.

1.1 PWDs in Cainta

Persons with Disabilities are a common sight in Cainta. Table 1 shows the statistics per disability type according to Municipal Social Welfare and Development – Persons with Disability Affairs Office (MSWD – PDAO) of Cainta as of 2016.

Table 1. PWD Statistics per Barangay

	San Andres	San Isidro	San Juan	San Roque	Sto. Domingo	Sto. Niño	Sta. Rosa
Speech	31	19	35	5	11	1	0
Intellectual	71	77	109	13	44	7	4
Learning	27	48	45	9	30	1	1
Orthopedic	189	252	268	38	232	21	5
Hearing	68	46	76	9	26	4	1
Visual	42	58	116	11	27	8	6
Mental	7	1	3	1	3	0	1
Pyschosocial	91	95	106	15	44	4	2
Chronic Illness	56	67	87	14	17	4	0
Multiple	7	17	17	1	4	1	1
No Answer	10	7	8	2	16	1	0
TOTAL	**599**	**687**	**870**	**118**	**454**	**52**	**21**

In Cainta, there are 13 registered Non-Government Organizations, Disabled People's Organization and Cooperatives that aims to help PWDs – some of which are Tahanang Walang Hagdanan Inc. (TWH), National Federation of Cooperatives of Persons with Disability and Cainta Federation of Persons with Disabilities. TWH was the location where PWD respondents were obtained. These organizations support the PWDs in their everyday life.

TWH is a place for the PWDs, more particularly the physically challenged persons, has been established. Tahanang Walang Hagdanan Inc. "Strengthen the social enterprise thru viable economic activities without compromising the core thrust of empowering persons with disability and care for the environment", TWH helps these people and provide services such as Community-Based Rehabilitation programs, Educational Training, Job Placement, Micro Finance, Mobility Aid Assistance and many more.

1.2 National and Local Laws and Ordinances

Rights of PWDs in Cainta are protected by the laws the local government has passed. Some of which are anti-ridicule, free hospitalization and express lanes in different public and private establishments.

Different laws and ordinances are passed, both national and local, in order to set minimum standard designs for accessibility, to protect the rights and give additional benefits to PWDs.

Table 2. Key PWD Mobility Related Laws and Ordinances

	Laws and Ordinances	Summary
National	Batas Pambansa 344*	Known as "Accessibility Law", this law sets the minimum requirements for accessibility of PWDs in buildings, public transportation and facilities (e.g. sidewalks, ramps, elevators).
	Memorandum Circular No. 2010 – 103	Establishment of Persons with Disability Affairs Office in every province, city and municipality that will ensure policies, plans, and programs, and ensure implementation of RA 10070, BP 344 at local level all for the benefit of PWDs.
	Presidential Decree 1509	A decree that creates the National Commission Concerning Disabled Persons under the Office of the President that will propose policies, conduct comprehensive and continuing studies, prepare and adopt long-term plans and ensure participation and involvement all for the benefit of PWDs.
	Republic Act 7277	Known as "Magna Carta for Disabled Persons", this act states the different rights of PWDs in employment, health, and education, political and civil rights and the compliance with BP 344.
	Republic Act 9442	An act amending Republic Act 7277. Some of its provisions are granting PWDs with at least 20 per cent discount on public transportation and all services in all establishments, additional benefits for retirees with disabilities, and prohibitions in mockery of any PWD in any form.
Local	Ordinance 2011 – 003	An ordinance requiring all public and private establishments within Cainta to provide Express Lanes for Senior Citizens and PWDs.
	Ordinance 2012 – 003	An ordinance organizing and establishing a Persons with Disability Affairs Office in the Municipality of Cainta.

* Some of the provisions to be discussed in review of related literature.

1.3 Transportation Vehicles and Facilities

There are five major public transportation vehicles in Cainta:

1. Buses – transportation vehicles with routes commonly on major roads capable of transporting at least 50 people with a minimum fare of ₱10.
2. Jeepneys – American jeepney inspired vehicles but significantly longer capable of transporting at least 18 people. This is also the most popular mode of transportation with a minimum fare of ₱7.
3. Taxis – sedan-type cars converted to be used as a mode of public transportation capable of transporting people on special trips with a flag-down rate of ₱40.
4. Tricycles – motorcycles attached with sidecars that are capable of transporting 1-5 people on special trips on shorter distances and lower cost compared to taxis.
5. UV Express – vans and utility vehicles converted to be used as a mode of public transportation capable of transporting at least 10 people.

Table 3. List of Registered Units

Vehicles	Routes	Registered Units
Buses	4	268
Jeepneys	58	--
Tricycles	45	4,363
UV Express	24	1,274

The different transportation facilities in Cainta are (*all of which were evaluated in this study based on different national and international standards and the best practices from around the world*):

1. Footbridges – overhead bridges that allows pedestrians to cross wide roads or those with high vehicular volume; can be equipped with ramps or elevators.
2. Pedestrian Lanes/Crossings – lanes painted with zebra markings that allows pedestrians to cross smaller or local roads.
3. Sidewalks – footways along both sides of the road where people can walk without using the road itself.

1.4 Scope and Limitation

This study was conducted in order to improve the quality of transportation, encompassing every citizen of the country especially PWDs. This study is intended not only for these people but also to those who are having difficulty with the existing transportation system. These include but are not limited to pregnant women, senior citizens and person(s) with children. In addition, this study will help with the proper implementation of the codes and standards provided by the government. Facilities not included in the study are bus stops, jeepney stops, and other public transportation stops as they were not observed to be present in the municipality. Vehicles not included in the study are trains, passenger vessels/ships and airplanes as they were not observed to be present in the municipality. PWD respondents were only limited to people with physical disabilities excluding deaf and visually impaired.

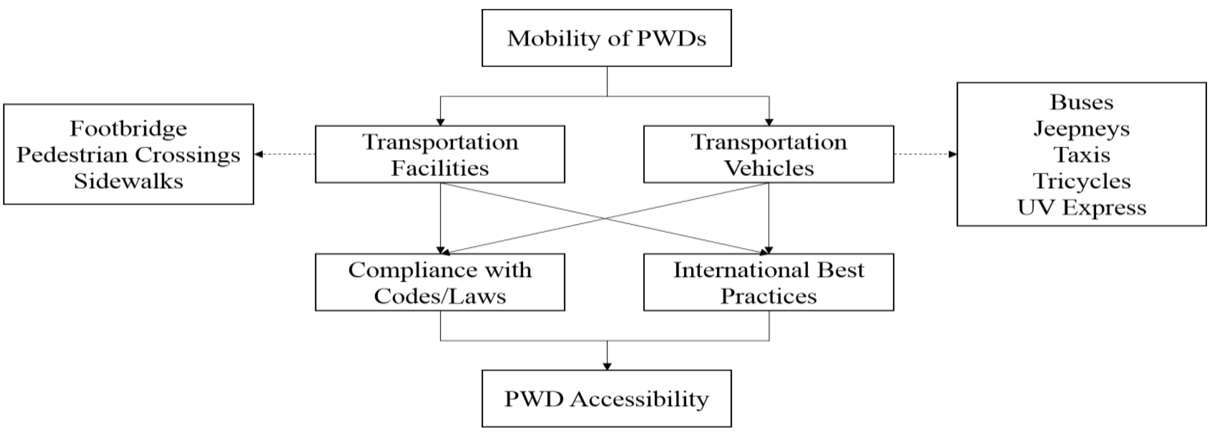

Figure 1. Conceptual Framework

2. REVIEW OF RELATED LITERATURE

2.1 Transportation Facilities

2.1.1 Overview

Transportation facilities were constructed in order to provide pedestrians the pathways to use in walking along and across the streets considering safety of both motorists and pedestrians. However due to continuous road expansions, minimum accessibility requirements for PWDs are often left out and for some, sidewalks were totally removed.

Inadequate infrastructure design presents major structural barriers to accessibility of disabled persons (Venter, *et.al*, 2002). Transportation facilities commonly have problems especially for accessibility for PWDs. Odak, *et.al.* (2016) listed some of those.

Table 4. Problems Encountered for Transportation Facilities*

Transportation Facilities	**Problems Encountered**
Footbridges	- Poorly lit at night making it unsafe for use. - Poorly maintained with most have street families dwelling. - Have not prioritized well the high and difficult pedestrian crossing areas (*usually only to the interest of nearby commercial establishment*)
Pedestrian Crossings	- Crossing markings are faded and not visible on surface. - There are no methods of informing visually impaired pedestrians on where and when it is safe to cross. - There are no ramps that provide accessibility from sidewalk to pedestrian crossings. - Street crossings have not prioritized well the high pedestrian areas. - In places where crossings are signalized, crossing time is not adequate for pedestrians to cross.
Sidewalks	- There are sections not properly separated from vehicular traffic (*no sidewalk at all*). - Some segments are characterized with open man holes, street works and constructions making them possible accident areas and reducing carriageway width. - Full of obstacles (*e.g. parked vehicles, electric posts, plants, etc.*) - In most sidewalks, there was no provision for uninterrupted access.

*Only same problems for Nairobi and Cainta were listed.

In the country, people usually don't use the sidewalks when walking along the streets. Bee (2016) enumerated that: a) cars use them as parking spaces, b) vendors put up stalls on it, c) houses or properties extend towards it, d) where trashes are dumped, and e) motorcycles use them.

Footbridges and pedestrian crossings were made for people to safely cross the street and avoid jaywalking or crossing anywhere. However, in the country, people still tend to jaywalk and ignore these facilities with the risk of being hit by a vehicle. In 2015, 19% of total road traffic deaths in the country involved pedestrians (WHO, 2015). Reports have shown that footbridges are unsafe especially at night with incidences of robberies and sexual harassment (Sarne, 2015). Another reason why people won't use the footbridge is because of obstructions. A certain footbridge in Libis has electrical wires passing through it making it unsafe for use.

Figure 2. Footbridge with electrical wires through it in Libis, Quezon City (© Takayama)

There are provisions done worldwide to include accessibility in different transportation facilities. In Birmingham (United Kingdom), Wayfinder was introduced. It is a small fob carried by visually impaired users that uses audio information to help them find their way around (Worsfold, *et.al*, 2010). In Helsinki (Finland), the "Helsinki for All Project" was introduced in 2002 wherein a new type of curb is developed for wheelchair users and visually impaired people (Frye, 2013). Tactile and audible signals are widely used in other countries such as United Kingdom, Latin America, Europe and North America to provide better guidance especially for the visually impaired. In São Paolo (Brazil), an agency that manages transport introduced a pedestrian program on 2010 that aims to reduce pedestrian fatalities by 50 per cent at the end of 2012 with cooperation from different units (e.g. Department of Communications, Labour Secretariat, etc.).

2.1.2 Minimum design requirements for accessibility

Different local standards are made to include accessibility of PWDs in different transportation facilities.

Batas Pambansa 344 sets requirements for sidewalks (i.e. curb height, carriageway width, longitudinal and cross gradients, lip height, and obstructions), ramps (i.e. slope, handrails, width, and intermediate landings), stairs (i.e. risers, treads, width, and handrails), and elevators (i.e. depth, width, button configurations, and handrails).

DPWH Department Order (DO) 65 (series 2013) sets the requirements for pedestrian crossings for national roads (i.e. length, width, and spacing of zebra markings, location, and dimensions of stop lines, offset/set-back from corners, and provisions for use of median island.

There are also different international standards that complement and provide lacking provisions in our local standards. The "Design Manual for a Barrier Free Environment" (UN, 2003-2004) lists the complete usage of tactile markings, and guide strips. The "Pedestrian Crossing Specification and Guidance" (NRA, 2011) illustrates the different pavement markings, and tactile markings to be used in pedestrian crossings. "Designing Sidewalks and Trails for Access: Best Practices Design Guide" (US DOT-FHA, 2016) enumerated selection of curb ramp designs, sidewalks level, and slope changes, and procedures of providing information to pedestrians.

2.2 Transportation Vehicles

From a study conducted by Odeyale et al. (2013), they evaluated the different modes of transportation in Lagos State Metropolis in Nigeria. Using the procedure of fuzzy logic, each mode of transportation was evaluated based on the following criteria:

1. Accessibility – commuter can easily get inside the vehicle without much effort.
2. Comfort – the commuter can sit and move with ease inside the vehicle.
3. Cost – transportation fare (*usually based on minimum fares and cost of succeeding distances*)
4. Destination – a place where people would go.
5. Faster Journey Time – travel time of the commuter from origin to destination.
6. Reliability – the commuter can ride the vehicle with no or less waiting time.
7. Safety – the vehicle has safety devices and equipment (*e.g. seat belts, poles as handles*).

Fuzzy logic is not a suitable method to use in choosing among the modes of transportation to be evaluated in the study due to its complexity.

Buses operate on major roads in the Philippines. Like in other countries, buses here have the same problems when regarding PWD accessibility. Frye (2013) enumerated that: a) buses have no physical provisions that will enable disabled person to board the vehicle, b) bus operators and the local government that maintains the pedestrian facilities have no coordination at all and c) during rush hours, crowded buses are often a scenario which pose additional safety and security issues. Odak, *et.al* (2016) further enumerated: a) there were no reserved spaces for wheelchair users to remain seated in their wheelchairs, b) boarding using the steps was very difficult for PWDs and c) handrails were not design with PWD considerations.

Taxis are a common door-to-door mode of transportation in the country. For a higher fare, taxis offer the convenience of using only one mode of transportation from origin to destination. Getting a taxi in the Philippines is often a problem. Brown (2015) stated that taxi drivers openly choose passengers they want and would be a major concern especially for PWDs. He further added that taxi drivers often negotiate for a higher fare.

Jeepneys are the most common mode of transportation in the Philippines constituting around 40 per cent of all passenger trips (Cervero, 2000). It has been remodeled from American military jeep left after World War II with increased length to accommodate more passengers. Jeepneys have a lower cost of 16 per cent per seat mile compared to buses (Roth, *et.al*, 1982). Insufficient seating capacity and difficulty in getting in and out of the vehicle are the most common problems based on passengers' perspective (Bacero, *et.al*, 2009). The current dimensions limit the passengers' comfort (Dela Cruz, *et.al*, 2013).

Tricycles accounts for 67.9 per cent of the total for-hire vehicles as of 2012 (Taruc, 2015). Tricycles are the most popular door-to-door mode of transportation in the country due to its cheaper fare compared to taxis. Unlike other vehicles, tricycle units currently have no standards specifying minimum requirements. Tricycles are often regulated by local government units. Compared to other modes of transportation, tricycles are the slowest. Cervero (2000) stated that "With maximum speeds of 40 kilometers per hour, a tricycle is a 'fish out of water' when it enters a highway stream." Safety is also an issue because of lacks of standards. "Because it is small and may be obscured by bigger vehicles or concealed by a driver's blind spot, a tricycle is more vulnerable to collision than is a passenger car", Cervero further added. Most of the passengers said that entering, leaving and riding the tricycles is uncomfortable and inconvenient in some points (Dorado, *et.al*, 2015).

FX are commercial vans and are the newest mode of transportation in the country with its introduction in 1994 (Cervero, 2000). It easily became a popular mode of transportation with 20,000 units in 1998 because it is more convenient, faster and more comfortable than buses and jeepneys, Cervero further added. Its name was changed to Garage to Terminal (GT) during the Arroyo administration and was later renamed again to Utility Vehicle (UV) Express during the Aquino administration (Regidor, 2014).

Specific requirements for public transportation are also mandated by the government and are stated in BP 344 or Accessibility Law. Some of the provisions are:

- owners and operators shall modify or renovate their units to accommodate disabled persons;
- posters and stickers with the note "Please vacate the designated seats for disabled passengers" must be displayed inside the units;
- shall have minimum designated seats as follows: 5 seats for regular buses and should be near entrance/exit and 4 seats for air-conditioned buses; and
- seats shall be identified using the International Symbol of Access (see Figure 3).

Figure 3. International Symbol of Access

There are provisions done worldwide to include PWD accessibility in design consideration for vehicles. United Kingdom is the only country in the world that requires all taxi units to be PWD-accessible for most of its cities (Frye, 2013). Also, even from the early 1980's Australia has introduced Wheelchair Accessible Taxis (WATs) and is of considerable number in its taxi fleet (ACG, 2009). In Singapore by 2020, the whole bus fleet is expected to be wheelchair accessible (Singapore LTMP, 2008).

3. METHODOLOGY

3.1 Data Collection

The researchers conducted both qualitative and quantitative assessment. The qualitative assessment is a survey focused on the perception of PWDs and non-PWDs on the different transportation facilities and vehicles in their area. The questionnaire given to the respondents are written in Filipino to be able to relay the study to the respondents better. The questionnaires involved multiple choice and rating scales (Likert Scale was used). It aims to answer the following questions:

- What are the problems encountered by PWDs and non-PWDs in using transportation facilities and vehicles?

- What is the key factor considered by PWDs and non-PWDs in choosing the mode of transportation to use?
- How often do PWDs and non-PWDs use different transportation facilities and vehicles?

There are 50 PWD respondents all from Tahanang Walang Hagdanan Inc and 63 non-PWD respondents all working at Cainta Municipal Hall.

On the other hand, the quantitative assessment involves the assessment of the different facilities and vehicles with their compliance with the minimum requirements of BP 344, National Building Code of the Philippines, United Nations and other PWD accessibility related codes.

Transportation facilities were assessed based on the minimum accessibility requirements set by the local codes. Instruments used were LOTUS measuring wheel, steel measuring tape and digital inclinometer. The method of selection of pedestrian facilities evaluated are as follows:

- Footbridges – all footbridges along Ortigas Avenue Extension (there were 3 footbridges although the newly constructed one was not yet open to public for use);
- Pedestrian Crossing – all pedestrian crossings along Ortigas Avenue extension from entrance of Marick Subdivision to entrance of St. Anthony Subdivision, along A. Bonifacio Avenue from Cainta Junction to Cainta Plaza, along Felix Avenue from Cainta Junction to entrance of Riverside II Subdivision; and
- Sidewalk segments – sidewalk directly in front of the pedestrian crossings with length extending to a minimum of 2 meters from each side of pedestrian crossings.

Table 5. Number of Assessed Transportation Facilities

Facilities	**Total**
Footbridges	2
Pedestrian Crossings	16
Sidewalks *(segments)*	41

Table 6. Parameters Assessed in Transportation Facilities

Facilities	**Parameters**
Footbridges	Riser height, Tread width, Railing dimensions, Railing height, Presence of ramps and elevators
Pedestrian Crossings	Carriageway width, Crossing width, Zebra marking dimensions, Hold Lines
Sidewalks	Carriageway width, Ramp slope, Longitudinal gradient, Cross Gradient , Obstructions, Curb Height, Lip Height

To evaluate seamlessness of travel, sidewalks were also evaluated based on the obstructions using a three-classification scheme. The classification was based on the difficulty wheelchair users (most of the PWD population in Cainta) experience when using the sidewalk. Sidewalks segments of minimum 25 meters were used. Distance were measured using a LOTUS measuring wheel. Sidewalks evaluated for obstructions are as follows:

- Ortigas Avenue Extension from LF Logistics to entrance of St. Anthony Subdivision;
- A. Bonifacio Avenue from Cainta Junction to Cainta Plaza;
- Felix Avenue from Cainta Junction to entrance of Riverside II Subdivision; and
- Gloria Drive, Marick Drive, Aida Street and Vicenta Street of Marick Subdivision.

Vehicles (i.e. buses, taxis, and UV express) passing through Cainta were observed to identify common models. Tricycles were evaluated based on the stepboard height which was measured from random tricycle units. The study of Dorado, et.al (2015) on tricycle sidecars would be used as supplementary data for the evaluation of tricycles. Dimensions (i.e. floor to ceiling height, seat edge to seat edge, vertical distance of ground to stepboard, and width of stepboard) for jeepneys were obtained from study of Dela Cruz, et.al (2013). Anthropometric measurements are based on study of Del Prado-Lu (2007).

3.2 Data Analysis
3.2.1 Questionnaire

Likert scoring in the questionnaire used the following scoring: **5** – Always/Strongly Agree, **4** – Frequently/Agree, **3** – Sometimes/Not Applicable, **2** – Rarely/Disagree, and **1** – Never/Strongly Disagree.

In analyzing the results of the survey conducted for both PWDs and non-PWDs, descriptive statistics and the ANOVA test were used. Descriptive statistics included only the mean and standard deviation; these were used alongside with the ANOVA test. The ANOVA test, on the other hand, determines if the means of factors are different. The null and alternative hypotheses are listed in Table 7. The researchers used a level of significance, α = 0.05, thus having 95% confidence level on the results of the test.

Table 7. Analysis of Variance (ANOVA) Test

Hypothesis	**Interpretation**
Null Hypothesis (H_o)	The means of factors are equal
Alternative Hypothesis (H_a)	The means of factors are different and not equal

3.2.2 Assessment
Classification of sidewalks based on obstructions present are explained in Table 8. This classification was used to evaluate the seamlessness of travel from one origin to destination.

Table 8. Obstruction Classification Scheme

Color	**Description**
Red	No sidewalk, obstructions placed such that carriageway width is too small for a wheelchair user to use, sidewalks suddenly cut off without ramps with no other provisions for wheelchair users to use the sidewalk.
Yellow	There are obstructions but carriageway width is still usable by a wheelchair user with some difficulty.
Green	No obstructions, or if present – the carriageway width is still more than prescribed minimum width.

Measurements obtained for different transportation vehicles were analyzed if they passed the minimum requirements as recommended by the study of Del Prado-Lu (2007) and the minimum space requirements for using different mobility aids (primarily wheelchairs).

4. RESULTS AND DISCUSSIONS

4.1 PWD and Non-PWD Respondents

Among the 50 PWD and 63 non-PWD respondents, their personal information such as gender, age, monthly salary and educational attainment were obtained. For PWD respondents, information regarding their type/s of disability and use of mobility aids were also included.

4.2 Transportation Facilities

An inventory of footbridges in Cainta was undertaken and the assessment is summarized in Table 9.

Table 9. Footbridges

COMPONENTS	**Footbridge 1**	**Footbridge 2**	**Passing Value**	**Passed**	**Failed**
Location	Robinsons Cainta	St. Anthony Subdivision			
***Ramps?** (Y/N)	N	N	**-**	**0**	**2**
***Lifts / Elevators?** (Y/N)	N	N	**-**	**0**	**2**
Staircase? (Y/N)	Y	Y	-	-	-
Risers (mm)	170	200	**150 (max.)**	**0**	**2**
Treads (mm)	295	300	**300 (min.)**	**1**	**1**
**Handrail Height (mm)	1.13	0.99	**900 (max.)**	**0**	**2**
Width (mm)	2.4	1.59	**900 (min.)**	**2**	**0**
Footbridge Width (m)	3.38	2.38	**3.5 (min.)**	**0**	**2**
Slanted Nosings? (Y/N)	Y	N	**-**	**1**	**1**
Leading edge of every step in contrast to surrounding? (Y/N)	Y	N	**-**	**1**	**1**

*See recommendations for list of parameters checked.
** Handrails can also be installed at an intermediate height of 700 mm

Based on the assessment, footbridges in Cainta are not PWD-friendly. Both have no provisions that would enable wheelchair-bound PWDs to use them. Risers in staircase are higher than permissible and would add to difficulty of PWDs with crutches, walking canes, and other mobility aids.

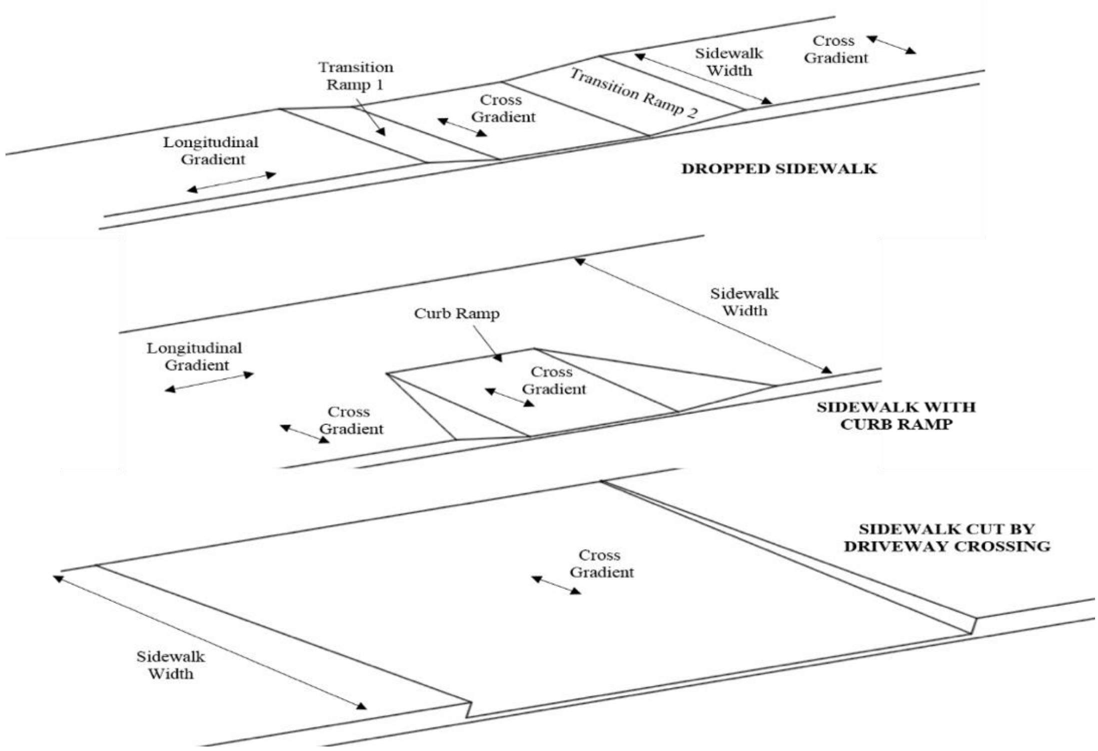

Figure 4. Types of Sidewalks and Its Components (Not to Scale)

Table 10. Sidewalks

COMPONENTS	Passing Value	Passed	Failed
Main Elements			
Sidewalk Width	1.5 m (min.)[a] 3.072 m (min.)[b]	1	36
Curb Height	0.15 m (max.)	7	20
Lip Height	15 mm (max.)	1	12
Ramp Width	900 mm (min.)	3	0
Slopes/Gradients			
Longitudinal	1:12 (max.)	34	1
Cross	1:100 (max.)	6	29
Driveway Crossings and Dropped Sidewalks			
Cross Gradient	2% change (max)	1	13
Transition Ramp 1 (Dropped Sidewalk)	1:12 (max.)	1	6
Transition Ramp 2 (Dropped Sidewalk)	1:12 (max.)	0	6

[a]For segments without curb ramps, [b]For segments with curb ramps.

The different components of sidewalk are shown in Table 10, including the number of those that passed and failed the standard requirement. Ramp width is only measured if it is aligned with a pedestrian crossing. The ramp width is measured in meters, while the sidewalk ramp measures the longitudinal slope of the ramp. Both lip height and curb height are measured in millimeters. Among these sidewalk components, only the ramp width has a 100% passing requirement while other components have more than 50% failing requirement.

Thirty five (35) segments of sidewalk are measured with their longitudinal slope and cross gradient. While only 1 segment whose longitudinal slope failed to meet the standard requirement, only 6 passed for the cross gradient parameter.

For driveway crossings and dropped sidewalks, their cross gradients were measured, including the longitudinal slopes of the transition ramps available on the segments.

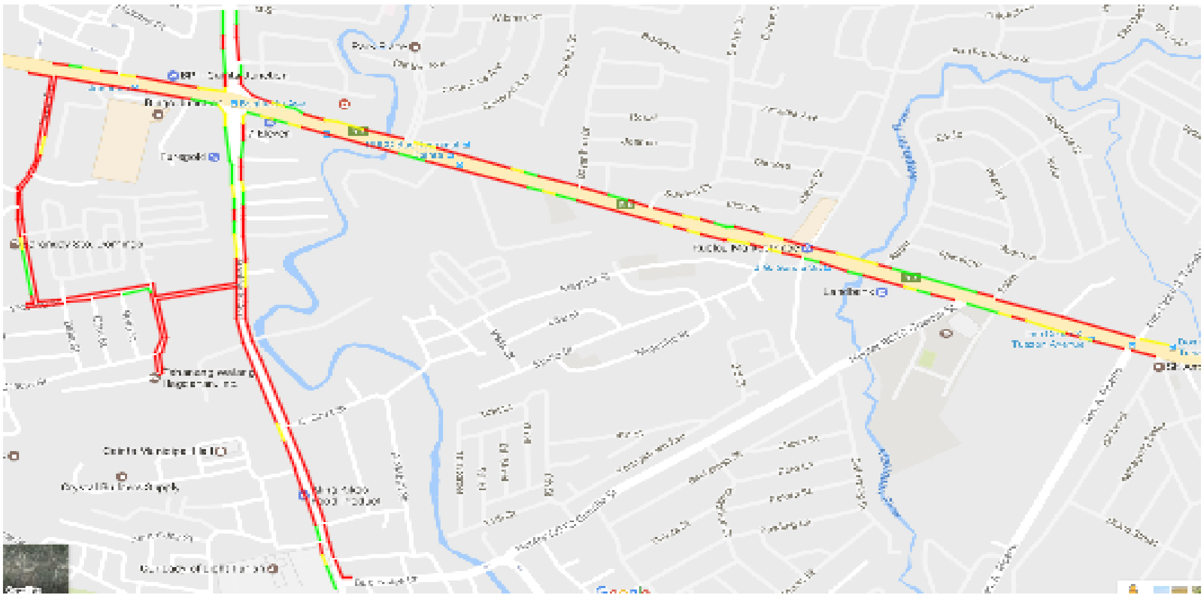

Figure 5. Sidewalk Obstructions

Almost the entire length of measured sidewalk is categorized as red because of obstructions. Also, referring to Figure 5, it can be observed that almost the entire length of the sidewalks for local roads are categorized as red. In addition, there are sections along the national road (highlighted in yellow) where there are no available sidewalks. Observed obstructions along sidewalks can be categorized as permanent and temporary. Permanent obstruction are public utilities related such as electric posts and water valves. Temporary obstructions are parked cars, construction materials, plants, and obstructions caused by human activities such as small businesses (e.g. *sari-sari* stores, vulcanizing shop, eatery, etc.). These obstructions would force PWDs to use the road instead of the sidewalk. Based on this assessment, it would be hard for PWDs to travel from one place to another seamlessly.

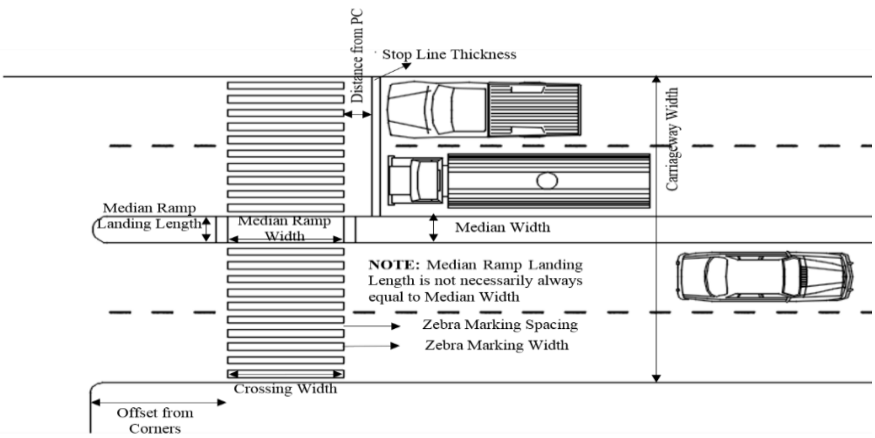

Figure 6. Components of a Pedestrian Crossing (Not to Scale)

Pedestrian crossings evaluated all failed in terms of having a median. A median is an important safety aspect that provide place for pedestrians to stop in the middle of the road without being hit by a motorist. The zebra markings all passed in the maximum spacing but four failed in the minimum width. Having specified dimensions for zebra markings would enable the driver to see it better and to stop whenever there are crossing pedestrians. Offset from corners is also a must for pedestrian crossings near intersections. It would give enough distance especially for turning vehicles and also a safety aspect for pedestrians. Only one has a stop line (where the vehicles would stop whenever near the pedestrian crossing). It is also observed that for a very long road length, only few pedestrian crossings are present.

Table 11. Frequency of Use of Transportation Facilities

	PWD	Non-PWD
Footbridge		
Mean	1.837	2.621
Variance	1.140	1.292
P- Value (α)	0.0006669	
Pedestrian Crossing		
Mean	3.239	3.948
Variance	1.608	1.383
P- Value (α)	0.0039421	
Sidewalk		
Mean	3.596	3.983
Variance	1.724	1.386
P- Value (α)	0.115	

For transportation facilities, there is no difference between how PWDs and non-PWDs use sidewalks. There is, however, a difference when it comes to usage of footbridges and pedestrian crossings. Mean scores of 1.83 and 2.62 for use of footbridges and mean scores of 3.24 and 3.95 for use of pedestrian crossings were obtained by PWDs and non-PWDs, respectively. Thus, on average, PWDs rarely use footbridges and sometimes use pedestrian crossings while non-PWDs sometimes use jeepneys and frequently use pedestrian crossings.

4.3 Transportation Vehicles

4.3.1 Model Design

Table 12 enumerates the different parameters and dimensions evaluated in each vehicle.

Table 12. Vehicle Dimensions for Evaluation

Parameters (cm)	Minimum Dimensions	Source
Standing Height	167.01 (male), 153.92 (female)	[1]
Minimum width for a wheelchair-bound PWD	90	[2]
Step height	27.67 (male), 25.63 (male)	[1]
Minimum height for a wheelchair-bound PWD	132.5	[2]

[1] Del Prado-Lu (2007)
[2] Guidelines and Space Standards for Barrier Free Built Environment for Disabled and Elderly Persons

There are four bus companies operating in Cainta (i.e. RRCG, EMBC, G-Liner, and Rizal Metrolink).

Table 13. Bus Measurements

Dimensions (mm)	Daewoo[a]	Hino[b]	Higer[c]
Vertical Distance Ground to Stepboard	469	435	387
Aisle Width	440	398	550
Door Width	850	867	802

Door Height	2174	2484	2126

[a]Daewoo BH116 (49+1 Seater), [b]Hino 500 (Commuter Bus 65 Seater), [c]Higer Roadboss (57 seater)

Checking the door heights of buses, standing height of males and females (as listed in Table 12) is more than enough. The door width is sufficient but the aisle width is too small when compared to a standard wheelchair width. However, having a sufficient door width isn't enough. It has been observed in buses in the country that there are additional steps inside making it harder for PWDs to ride the bus without getting help from others. Also, the vertical distance from ground to stepboard is too high even if non-PWDs are concerned with a mean step height of 27.67 cm for males and 25.63 cm for females.

Table 14. Jeepney Measurements

Dimensions (cm)	Median*
Floor to Ceiling Height	129
Vertical Distance Ground to Stepboard	46.5
Width of Rear Stepboard	27
Seat Edge to Seat Edge (legroom)	72

*Median is used because outliers are present. These outliers would greatly affect the mean and standard deviation. Source: Dela Cruz, et.al (2013)

With same values (from bus analysis) are to be used, floor to ceiling height would be too low (considering PWDs using other mobility aids such as crutches, walkers, etc.), the vertical distance ground to stepboard would be too high and the seat edge to seat edge measurement might give difficulty for wider wheelchairs (with widths reaching 75 cm). The width of the stepboard can be evaluated the same as stair treads with a minimum width of 30 cm. It is assumed that door width is equal to seat edge to seat edge distance.

Table 15. Tricycle Measurements

Dimensions (cm)	Mean	Std. Dev.
*Vertical Distance Ground to Stepboard	27	4.34
Door Width	44.01	1.81
Door Height	93.22	2.27
Floor Length (legroom)	58.55	1.88

*As measured from Cainta tricycle units. Source: Dorado, et.al (2015)

The vertical distance from ground to stepboard might be within reach of a non-PWD but a ramp would be needed for PWDs. The door width is too small for a normal size wheelchair to fit in. The door height is sufficient only if a wheelchair can fit (thus wouldn't require the PWD to stand and enter the tricycle like other people) but it is low considering average standing height of Filipinos.

Table 16. UV Express Measurements

Dimensions (mm)		Isuzu Crosswind[a]	Nissan Urvan[b]	Toyota HiAce[c]
Side	Vertical Distance Ground to Stepboard	412	329	178
	Door Width	807	1343	1458
	Door Height	1299	1621	1813
Rear	Vertical Distance Ground to Stepboard	350	481	391
	Door Width	1314	1545	1647
	Door Height	1194	1494	1541

[a]Isuzu Crosswind XL (2013), [b]Nissan Urvan Diesel Toldo Alto (2010), [c]Toyota HiAce 200 Super GL (2010)

Measurements are based on a scaled drawing showing the overall length, width, and height. Internal measurements were not obtained. The vertical distance from ground to stepboard is too high. Door widths are sufficient just by looking at the dimensions but space inside must still be considered. It has been observed that for SUV-type UV Express units, the seat edge to seat edge distance at the rear is smaller compared to a jeepney and the legroom in the middle and front would just be enough to accommodate normal sitting (wheelchairs wouldn't fit in). There are some observed modification done by UV Express operators such as rear seats are changed to accommodate 4 passengers at the back, additional stepboards (estribo) are installed in the sides and rear to help passengers in boarding and alighting, and additional seats are installed in vans to increase passenger capacity.

Table 17. Taxi Measurements

Dimensions (mm)	Toyota Vios
Vertical Distance Ground to Stepboard	293
Door Width (Front)	1105
Door Width (Back)	596
Door Height	1143

The vertical distance from ground to stepboard might be within reach of a non-PWD but a ramp would be needed for PWDs. Door width in the back is insufficient while the door width in front is wide enough. However, legroom is still a must to be considered and it has been observed that an unfolded wheelchair wouldn't fit.

4.3.2 Trip Purposes of PWDs and non-PWDs

Two of the most used transportation vehicles among PWDs are taxis and tricycles. For spiritual, work, school, home and other purposes, PWDs are more favored to use tricycles. Tahanang Walang Hagdanan is located inside a subdivision (Marick Subdivision) where tricycle is the most common transportation residents use to get inside. Furthermore, many PWDs live and work inside TWH and a church is not really far from their location. For medical, shopping, social and personal business, on the other hand, they use taxis the most among other transportation vehicles.

For non-PWDs, jeepneys and tricycles are the most used transportation vehicles. Jeepneys and tricycles are the most common public transportation vehicles in the municipality of Cainta, particularly along Bonifacio Avenue, Felix Avenue and Ortigas Extension.

Table 18 shows the frequency of use of transportation vehicles of PWDs and non-PWDs. There is no difference between how PWDs and non-PWDs use buses (rarely-sometimes), UV Express (rarely) and tricycles (frequently). There is, however, a difference when it comes to usage of jeepneys and taxis. Mean scores of 2.94 and 3.86 for use of jeepneys and mean scores of 3.27 and 2.31 for use of taxis were obtained by PWDs and non-PWDs, respectively. Thus, on average, PWDs sometimes use jeepneys and taxis while non-PWDs frequently use jeepneys and rarely use taxis.

Table 18. Frequency of Use of Transportation Vehicles

	PWD	Non-PWD
Buses		
Mean	2.703	2.397
Variance	0.881	0.770
P- Value (α=0.05)	0.110	
UV Express		
Mean	2.216	2.224

Variance	1.285	0.914
P- Value (α=0.05)	0.971	
Jeepney		
Mean	2.949	3.862
Variance	1.629	1.525
P- Value (α=0.05)	0.0006552	
Taxi		
Mean	3.273	2.310
Variance	1.273	0.990
P- Value (α=0.05)	1.481E-05	
Tricycle		
Mean	3.561	3.914
Variance	1.652	1.203
P- Value (α=0.05)	0.145	

4.4 Factors Affecting Mobility

The surveys revealed the perceptions of PWDs and non-PWDs of transportation facilities and vehicles. The surveys also allowed for obtaining the factors affecting mobility. Table 19 show how PWDs give importance the different factors affecting mobility. Considering the mean, safety has a higher importance compared to accessibility which makes it the most important factor for PWDs. The two least important factors, on the other hand for PWDs, are destination and faster journey time.

Table 19. Mean Scores of Factors of Mobility

	Accessibility	Comfort	Cost	Destination	Time	Reliability	Safety
PWDs	5.425	4.595	3.042	2.936	3	3.531	5.468
Non-PWDs	4.490	3.962	3.056	3.339	4.113	3.679	5.358

For non-PWDs, safety is also the most important factor, having the most respondents ranking it as their most important factor and obtaining the highest mean. While the least important factor is cost having the lowest mean among the factors.

To determine whether the means of the factors are different with one another, the ANOVA test with a 95% confidence interval (level of significance, $\alpha=0.05$) was used, as seen in Table 20. Having a p-value of less than α shows that the mean scores are not equal and different for both PWDs and non-PWDs.

Table 20. ANOVA Test

ANOVA Test	PWD	Non-PWD
P- Value (α=0.05)	1.446E-20	6.469E-09

4.5 Problems Encountered on Vehicles and Transportation Facilities

Problems encountered by PWDs and non-PWDs as they used vehicles and transportation facilities are shown in Table 21.

Table 21. Problems Encountered by PWDs and non-PWDs

Transportation Facilities	
Footbridges	No ramps; no elevator (or not working); vendors obstructing the path; steep ramps; inadequate security at night

Sidewalks	Obstructions (cracks, holes, vendors, etc.) present; sidewalk too high and too narrow; no ramps for boarding/alighting
Pedestrian Crossing	Pavement markings not visible; dysfunctional stoplight; vehicles blocking the path
Public Transportation Vehicles	
Jeepneys	Difficulty in boarding/alighting; jeep driver running immediately; passengers not giving space near stepboard
UV Express	Difficulty in boarding/alighting; expensive; overcrowded
Tricycles	Difficulty in boarding/alighting; uncomfortable seats; very slow speed
Taxis	Difficulty in boarding/alighting; drivers choosing passengers; too expensive
Buses	Difficulty in boarding/alighting; no ramps available; no space for PWDs; overcrowded

ANOVA Tests were also used in order to determine whether the mean scores of PWD and non-PWD on each transportation vehicle/ facility are equal or different.

Among the different problems encountered on using sidewalks, PWDs agree more than non-PWDs regarding the height of the sidewalk. The mean scores of PWDs on every question is slightly higher than those of the non-PWDs. It can be said that PWDs noticeably experiences these problems compared to non-PWDs. On the other hand, both PWDs and non-PWDs agree (on the same level) regarding the problems they encounter when using pedestrian crossings (range of estimated mean scores = 3.2-3.5) and footbridges. In addition, for footbridges, both have estimated mean score of 3.2 on the occurrence of vendor blocking the path of the pedestrians and range of 3.3 - 3.8 on other problems.

For UV express, PWDs agree more than non-PWDs on their difficulty in boarding and/or alighting the vehicle. On other problems (costs and space), both groups of respondents have agreed on the same level. For buses, PWDs agree (estimated mean score = 4.0) that they are having difficulties on boarding and/or alighting the vehicle while non-PWDs agree on lesser level (estimated mean score = 3.4). For jeepneys, PWDs agree more than non-PWDs on their difficulty in boarding and/or alighting the vehicle. On the other hand, both groups of respondents agreed on the problem of the attitude of the jeepney drivers when loading and unloading passengers and of the passengers who do not give seats near the stepboard. For taxis, both PWDs and non-PWDs have the same response on every problem listed down. Both groups, on average, slightly disagree (estimated means score = 2.8) on their difficulty in boarding and alighting the vehicle, agree (estimated mean score = 4.0) on the attitude of the taxi drivers on accepting passengers and on the cost of the trip. Both PWDs and non-PWDs agree (on the same level) regarding the problems they encounter when using tricycles. Mean scores of PWD and non-PWD on each problem range from 3.0 - 3.2. Having a mean score of 3.0 - 3.2 shows that half of the PWDs (non-PWDs), agree while the other half disagree.

5. CONCLUSIONS AND RECOMMENDATIONS

The findings of the study determine the different issues that impede the mobility of PWDs in Cainta, Rizal.

Results from the survey show that both PWDs and non-PWDs most consider safety among the other factors that affect their mobility.Furthermore, there is a difference between the PWDs and non-PWDs’ choice of transportation vehicle and facility. The choice of PWDs becomes limited because of the problems they experience on some vehicles and facilities.

The problems mostly experienced by PWDs, compared to non-PWDs, are related to absence of ramps and markings on transportation facilities and their difficulty of boarding and alighting on transportation vehicles. On the other hand, problems of non-PWDs are more related to the behavior of the drivers.

All transportation vehicles failed to include PWD accessibility in their design. The results from the survey show that PWDs have experienced more difficulty in boarding and/or alighting vehicles compared to non-PWDs. Commonly, door widths are sufficient but the other parameters of their design would give PWDs a hard time boarding and alighting the vehicle especially for those wheelchair-bound. Thus redesigning of vehicles is a must to include PWD accessibility as a design factor. As a short-term goal, inclusion of important PWD-friendly provisions (ramps, widening of entry/exit points and stepboards) must be carried out to immediately provide accessible public transport vehicles in Cainta. As a long-term goal, every new vehicle unit must already include PWD accessibility as a design factor. Recommended designs for each transportation vehicle that are PWD-friendly are enumerated below.

Last January 2016, the Marikina City government rolled out a PWD-friendly tricycle. The PWD-friendly tricycle has wide door, has a ramp to enable PWDs to board and alight the tricycle easily, an extra space for companions, and safety handrails to hold on to.

Figure 8. Marikina PWD-friendly Tricycle (© Montegrande)

PWD-friendly buses were introduced by the government last February 2016. It is bus with low floors, wide aisle to fit a wheelchair, allocated space for PWDs, and foldable ramps among its other new features. It currently serves as Point-to-Point (P2P) buses on routes like Trinoma - Park Square Ayala Center, SM North Edsa - Glorietta 5, and SM Megamall – Park Square Ayala Center.

Figure 9. PWD-friendly Buses (© Bonalos – left, © Froehlich Tours – right)

All London taxis are wheelchair accessible. These taxis have wheelchair ramps, large colored grab handles, low level floor lighting, hearing aid, and intercom (for people with hearing impairments). With the current type of taxis existing in the country have (sedan type), it might be impossible to include these features to be included. A small SUV-type (e.g. Toyota Avanza) taxi would be more suitable to include these features.

Figure 10. London PWD-friendly Taxi (© www.alamy.com)

UV express units can be modified such that PWD passengers are at the back with foldable wheelchair lifts, and grab bars to serve as safety handles. Foldable seats can also be installed at the back for non-PWDs to sit in case no passenger is a PWD.

Jeepney units can be modified such that PWD passengers can seat near the door. Foldable wheelchair lifts, grab bars and foldable seats in case no passenger is PWD must be installed to provide accessibility for PWDs.

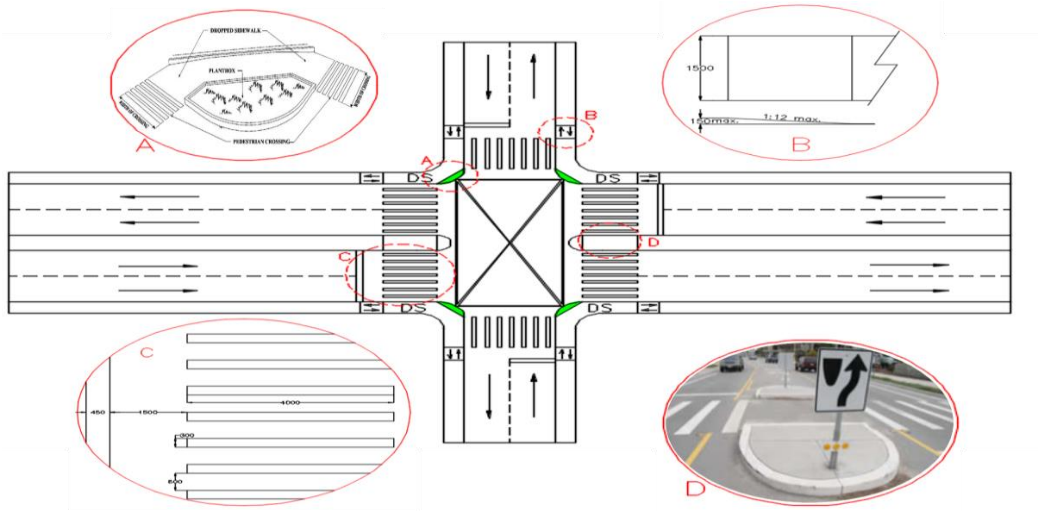

Figure 11. Sample Recommended Facilities Layout

Midblock pedestrian crossings should be made to facilitate easier movement in the pedestrian environment. Maintenance of pedestrian crossings should be consistent because some of the zebra markings are not visible anymore. Footbridges are recommended to be installed in the junction and other places where high pedestrian traffic are present as not to interfere with high vehicle traffic. Also, footbridges should be equipped with elevators so that it would be easier not only for PWDs but also for non-PWD to use the footbridge and avoid jaywalking. It has been mentioned to us by the municipal engineer that roads in Cainta are narrow. The researchers therefore recommend dropped sidewalks throughout the entire road network because it is the type of sidewalk that requires the least width. Minor details such as curb height, lip height and other parameters evaluated in this study should be considered.

For future researches, it is recommended to manually measure the different dimensions of vehicles to have actual statistics. Modal change can also be included in the factors to be considered in choosing mode of transportation to evaluate seamlessness in travel.

With the recommended public transportation vehicle design and facilities layout, mobility of PWDs in Cainta would significantly improve. PWD accessible vehicles would give them a wider range for the mode of transportation to choose from. The designs and layouts also consider safety and is intended not only for PWDs but also for all users.

REFERENCES

Bacero, R., Vergel, K (2009) Assessment of jeepney's components, systems and separate technical units for the development of standards. *17th Annual Conference of the Transportation Science Society of the Philippines*, 15 pp.

Bee, J. (2016) Sidewalks in the Philippines: A myth. Retrieved from twobeesinablog.wordpress.com

BP 344 (2013) Accessibility law implementing rules and regulations amendments.

Brown, M. (2015) The trouble with taxis. Retrieved from www.rappler.com

Cervero, R. (2000) *Informal Transport in the Developing World*. United Nations Center for Human Settlements, Nairobi.

Dela Cruz, R. C., Marabut, A. D. (2013) *Compliance of Philippine Jeepneys with Selected National Vehicle Regulations and Standards*. University of the Philippines, College of Engineering, Quezon City.

Del Prado-Lu, J. L. (2007) Anthropometric measurement of Filipino manufacturing workers. *International Journal of Industrial Ergonomics 37*, pp. 497-503.

Dorado, N. J., Fabros, P. D., Rupisan, C. A. (2015) An ergonomic analysis of tricycle sidecars in Quezon City. *6th International Conference on Applied Human Factors and Ergonomics and the Affiliated Conferences*, pp 2816 – 2823.

DPWH Department Order 65 (2013) Revised guidelines on the installation of pedestrian crossing markings along national roads.

Frye, A. (2013) Disabled and older persons and sustainable urban mobility. *United Nations Global Report on Human Settlements*, 64 pp.

National Roads Authority (2011) Pedestrian crossing specification and guidance, 73 pp.

Odak, P., Opiyo, R. (2016) An assessment of non-motorized and public transport challenges for people with disabilities in Nairobi City. *International Conference on Transport and Road Research*, 32 pp.

Odeyale, S. O., Alamu, O. J., Odeyale, E. O. (2013) Performance evaluation and selection of best mode of transportation in Lagos State Metropolis. *International Journal of Traffic and Transportation Engineering Vol. 4(1).06*, pp 76 – 89.

Philippine Law Gazette (2007) *The National Building Code of the Philippines with its Revised Implementing Rules and Regulations*, 273 pp.

Regidor, J. R. (2014) From FX to UV express – a story of evolution. Retrieved from d0ctrine.com

Roth, G., Wynne, G. (1982) *Learning from Abroad: Free Enterprise Urban Transportation.* Transaction Books, New Jersey.

Sarne, V. (2015) The footbridge puzzle pedestrians face in PH. Retrieved from www.topgear.com.ph

United Nations (2003-2004) Accessibility for the disabled design manual for a barrier free environment. Retrieved from www.un.org/esa/socdev/enable

United States Department of Transportation Federal Highway Administration (2016) Designing sidewalks and trails for access: Best practices design guide. Retrieved from www.fhwa.dot.gov

Venter, C., Savill, T., Rickert, T., Bogopane, H., Venkatesh, A. (2002) Enhanced accessibility for people with disabilities living in urban areas, 64 pp.

World Health Organization (2015) Global status report on road safety, 340 pp.
Worsfold, F., Chandler, E., (2010) Wayfinding project: Final report of initial project work. *Royal National Institute of Blind People Innovation Unit,* 76 pp.