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Proposed Pedestrian Facilities of the National Road at Barangay Rawis, Legazpi City

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ABSTRACT

The national road at Rawis, an urban barangay of Legazpi City in Albay Province, is classified as secondary arterial and serves as the main transportation link to the southern part of the Bicol Region. Since the study area has various land use types, this generates daily trips. The safety of road users is important especially the pedestrians. From April, 2014 to March, 2015, the Police blotter has recorded eight cases of vehicle-pedestrian accidents although it does not occur every month, the data reflect how prone pedestrians are to accidents. The study aimed to evaluate the pedestrian facilities along Rawis National Road, focusing on the sidewalk width, curb ramp slope, and crosswalk dimensions. An as-built engineering survey was conducted using total station instrument that provided information for the drafting of a base plan in AutoCAD format.The dimensions of selected pedestrian facility at AUL are as follows: the actual and standard sidewalk width are 1.58 and 2.50 meters respectively; the actual and standard curb ramp slopes are 21% and 8% respectively. After comparing the actual values from local and foreign highway standards, it was found that the existing pedestrian facilities at Rawis National Road significantly do not meet local and foreign standards. A proposed plan for pedestrian facilities was made out of the specifications from highway manuals, PWD guidelines, and considerations to current road improvement works.

Keywords: *Evaluation, Proposed plan, Pedestrian Facilities, As built engineering surveys*

INTRODUCTION

The National Road at Barangay Rawis, Legazpi City, Albay is a portion of national road no. 345 - Pili (Jct N1) -Tigaon-Tiwi-Tabaco C-Legazpi C-Daraga and is classified as Secondary Arterial. A secondary arterial is a national road that connects cities, major ports, ferry terminals, major airports, tourist service, provincial capitals within the same region, and major national government infrastructure to primary arterial roads or other secondary arterial roads. Legazpi City is considered as a major city having a population of at least around 100,000 (Republic Act No. 917, known as the Philippine Highway Act). The National road at Barangay Rawis, Legazpi City is the only land transportation link between the first district and second district of the province of Albay. The land use types (e.g. regional government offices, shopping malls, educational institutions, medical facilities, tourism related, etc.) and major events (e.g. national conventions/conferences) held in the city of Legazpi attracts people to travel to the city. People travelling from the first district of Albay passes through the study area, Barangay Rawis, having a population of 8,868 , with increasing annual population growth rate, and considered an urban area (Census, 2015). The study area have six educational institutions, ten regional offices, and business establishments that requires their students and workers to report between 7:00 to 9:00 AM and be dismissed between 4:00 to

6:00 PM, during these peak hours the National Road at Rawis experiences traffic congestion that results in travel delay, conflicts to road users, loss of time, inconvenience, and discomfort. Reasons of traffic congestion were due to increase in vehicle ownership, increase in population, choosing motorized vehicle as mode of transportation, walking inconvenience, and vehicular and pedestrian-related accidents due to inadequate sidewalks, unsafe walking condition, and difficulty in using pedestrian crossing. The main components of transportation are people (drivers and pedestrians), vehicle, and road. The people component - road user behavior is now the most important single accident contributory factor with 85% of road accidents in the Philippines caused by driver error or violations (Corpuz-Mendoza, 2012). However, the number of accidents can be reduced if the road component is evaluated and highway design made correctly and complies to Highway standards. The road component is composed of road geometry and roadside elements (i.e., road signs and markings, lighting, barriers, pedestrian facilities, etc.). Most studies focused on the relationship between road geometry and car accidents, but little attention was given to the fact that inadequate pedestrian facilities could also contribute to these accidents.

The researcher observed that the national road have gone to series of improvements without considering factors that will affect the demand of different land use and pedestrian satisfaction. The present condition of the national road (e.g., open drainage and potholes along the sidewalk, visible and faded crosswalk markings, discontinued sidewalks, etc) demands proper planning. Planners and decision makers should focus on pedestrian generators such as schools, shops, cultural attractions, and work and play places (Eck, 2011) in order to have an acceptable pedestrian facilities design. Standard pedestrian facilities are the main factor in promoting the walking that can solve problems such as, health problems, energy consumption, and air pollution, (Asadi-Shekari et al, 2014). The researcher evaluated selected pedestrian facilities (crosswalks, sidewalks, and curb ramps) of the one kilometer portion of the National Road at Barangay Rawis, Legazpi City. There was an inconsistency in the implementation of Highway standards at the study area particularly in pedestrian facilities that the researcher intends to have a detailed drawing as base plan. This base plan is an important component in redesigning the road as well as its effect on pedestrian facilities and in determining the cost of road improvements.

The base plan is in AutoCAD format which is the output of an as-built engineering survey. The study differs from other researches in its method of data collection, using the Total station instrument and fieldnotes. This method is the most accurate method of doing an “As Built” survey of roadside features, but it is more costly and time consuming than GPS, videologging and soft photogrammetry (K.Jeyapalan1,.et al, 2000).

The major causes of road accidents can be categorized into four, 1) actions by the driver, 2) vehicle condition, 3) geometric characteristics of the road, and 4) the physical or climatic environment in which the vehicle operates, (Hoel, L.A., et. al., 2008). The study falls mainly on the fourth category but could influence the first category which is the biggest factor that causes road accidents. At Rawis National Road, drivers perceived different existing roadside elements, one group is the pedestrian facility. The pedestrian facilities along the national road at Rawis, such as the crosswalk,(see Appendix A for location) sidewalk, and curb ramp have been built with different dimensions, and not regularly maintained. These lead the drivers to confusion and gave them a reason to violate traffic rules. In addition, the inadequacy and discontinuity of sidewalks, and the PWD guidelines not properly implemented discourage pedestrians to use the existing pedestrian facility and just use the road shoulder instead. There is danger when pedestrians and vehicles share the use of road shoulder. The possibility of vehicle-pedestrian conflict in this situation raised the demand to evaluate such pedestrian facilities.

The paper aims to evaluate the pedestrian facilities of the National Road at Barangay Rawis, City of Legazpi, Albay, Philippines because of the safety issue and to educate the road users by knowing what facility is standard or substandard using the dimensions of selected pedestrian facilities which include, crosswalk (marking length, width, and gap), sidewalk width, and curb ramp (slope and width), as variables of the study.

The paper’s specific objectives are: to obtain an as-built engineering survey of the existing national road at Barangay Rawis, Legazpi City and make an AutoCAD drawing as initial output and base plan; to evaluate the pedestrian facilities using local and foreign highway-related standards(i.e., Department of Public Works and Highways (DPWH), Highway Safety Design Standards, Department Orders (DO), Batasang Pambansa bilang 344 known as Accessibility Law, and *Texas DOT Roadway Design Manual* (2014); and to make a Revised AutoCAD Drawing plan of the selected pedestrian facility that is accessible to persons with disabilities (PWD) using the AutoCAD software as final output based from the data gathered.

The findings of this study would be beneficial to the government and private companies which may help them be equipped with the knowledge of the present status of the National road at Barangay Rawis, Legazpi City in terms of pedestrian facilities. To future researchers on road; to students and teachers, that they may be updated about the present status of the road and how these pedestrian facilities contribute in the road safety issue, and to have public awareness about the demand of upgrading the National Road, and ultimately to promote equal opportunity to all road users especially the vulnerable ones such as children, PWD's, people with luggage, and elderly. The evaluation of other roadside elements such as road signs, speed reduction devices, lighting, bus stop, parking, landscape, and road fixtures are not within the scope of the study.

METHODS

The evaluation of pedestrian facilities of the National Road at Barangay Rawis, City of Legazpi, Albay, Philippines used the dimensions of pedestrian facilities which include, crosswalk marking length, width, and gap, sidewalk width and change in grade, curb ramp slope and width, as variables of the study. The actual road features include pedestrian facilities (crosswalks, sidewalk, curb ramps), storm drainage, structures (shed, fence), road centreline, median, collector roads, land use types. Data was obtained on site, by conducting, (1) as-built engineering survey to the one kilometer portion of the national road at Barangay Rawis, Legazpi City, (2) taking videos on both sides of the national road, and (3) taking pictures on pedestrian facilities, then making AutoCAD drawing as initial output.

The as-built engineering survey is composed of (a) Planning, (b) Fieldwork (c) Survey Computations, and (d) Drafting. Materials and equipment utilized were Total station, prism and pole, 5-meter tape, and circular level (refer to Appendix B) for the specifications and designations of the members of the survey team.

Planning of the procedures to be implemented is a vital aspect of this study which cannot be taken for granted: to office preparations, making sure everything is ready (e.g., complete set of instruments to be used on hand, battery, reflective vest, communication devices, and members of the survey team, fieldnotes, and transport). The researcher also combined the Total station and tape in obtaining the pick-up point, in order to reduce the number of pick-up points needed for every road feature, thereby reducing the time in the field but maintained the completeness and accuracy of measurement.

The Fieldwork was done on a day with fair weather and the recorders were provided with the map of Rawis. The head of the survey team decided which side of the road to occupy for setting the Total station and was advantageous in the pick-up of points of the road features needed. The basic of highway survey is the establishment of survey control. For the purpose of this study, the two-dimensional aspect of the road features was obtained. The horizontal control was established by the open traverse method and chosen an arbitrary horizontal angle orientation of zero azimuth. The researcher also decided to make horizontal control and the pick-up of points simultaneously in order to have a single run of the as-built survey. To avoid errors, measurement of horizontal angles and distances between traverse stations was done twice and some thrice. Traversing is a process of measuring the distances and directions of line connecting two traverse stations to determine the location or coordinates of succeeding traverse station. Distances of traverse stations were chosen as dictated by field conditions. Before the road feature pick up, the Total station (TS) was set up on the first traverse station and performed the following steps, 1. Set-up the TS (position the tripod, attach to the tripod, and level), 2. Make a backsight (BS) by setting the horizontal angle of TS to zero azimuth and sight a permanent point or marker like traffic sign pole, 3. Loosen the horizontal clamp to start the pick-up of points of road features. 4. Place the prism to pick-up point ensuring the pole to be vertical using the circular level as guide. 5. Focus the TS to the center of the prism and press the key to measure. Be sure to set the display mode of TS showing HR-horizontal angle to the right and HD-horizontal distance. 6. Record the data on the field notes as raw data. Repeat steps 3-6 to pick up another point. 7. After measuring the pick-up points adjacent to the traverse station, locate the next traverse station, measure the HR and HD thrice. Bring the TS to the next station and repeat all above steps until the end of the study area.

Computations was done by taking the mean of measured HR and HD between traverse stations. Since the backsight HR from the second to the last traverse station was set to zero HR, a corresponding recalculation was done. Between two traverse stations, the true backsight HR of station occupied was determined by adding or subtracting (to have a positive value) 180 degrees to foresight HR of station observed. The result was the true HR. This value was then added or subtracted to every HR reading of the pick-up points for the measurements made in that traverse station. This step was performed together with the next component, drafting works.

Drafting is the process of making detailed plans or drawings before a road is constructed or improved. The researcher used Autodesk software-AutoCAD. Run the AutoCAD, and made the necessary settings (i.e., 2d drafting workspace, units, layers settings, etc.). Using the computed values, directly input these measurements in drawing the lines for curb, crosswalk, sidewalk, fence line, drainage feature, road centerline, etc. Further editing to make a detailed drawing.

The AutoCAD drawing created (base plan) was the source of information with respect to the dimensions of pedestrian facilities. The dimensions of crosswalks, sidewalks, and curb ramps were compared to highway standards presented in tabular form. In addition, the videos and photos of the study area focused on pedestrian facilities were used to aid in completing the AutoCAD drawing as proof of the physical conditions of the national road at Rawis, Legazpi city. Recommendations were accompanied by AutoCAD drawings to highlight the proposed plan of the pedestrian facility based from local and foreign highway standards.

The research method used in this study was the comparative approach to analyse the data. It made use of the Chi-square distribution as statistical analysis tool.

RESULTS AND DISCUSSIONS

Many different pedestrian facilities and its status greatly affect pedestrian behavior. This his study, focused on the dimensions of the crosswalks, sidewalks, and curb ramps and were compared to that in the standard. Some of which were not stated in the local manual, DPWH Manual. So other manuals were sought for.

An AutoCAD drawing was prepared as an initial output of the as-built engineering survey at the study area with target pedestrian facilities, including surrounding roadside elements. This was necessary for determining the dimensions of crosswalk marking and curb ramps and for the calculation of the effective sidewalk width.

Table 1 shows the sidewalk's actual width and condition (west and east side) and as basis to determine the minimum effective sidewalk width using the AASHTO and Texas Manual. None has been stated in the DPWH Manual. The dimensions of selected pedestrian facility at AUL are as follows: the actual and standard sidewalk width are 1.58 and 2.50 meters respectively. After comparing the actual values from local and foreign highway standards, it was found that the existing pedestrian facilities at Rawis National Road significantly do not meet local and foreign standards. This indicates that the implemented sidewalk width do not conform to the standard.

Table 1
Dimensions of the sidewalks

Location	Actual Width (meters)		Actual condition (Sidewalk is between)		Minimum Effective Sidewalk Width(meters)	
	Westside	Eastside	Westside	Eastside	AASHTO	Texas Manual
DPWH	1.32	1.30	Curb/fence	Curb/guardrail	2.50	1.83
AUL	1.58	0	Curb/fence	none	2.50	2.44
DOST	1.20	0	Curb/fence	none	2.50	1.83
Mariners	1.15	0	Curb/driveway	none	2.50	2.44
Pag-asa	1.28	1.58	Curb/shop	Curb/shop	3.00	2.44
Genecom	1.23	0	Curb/fence	none	2.50	2.44
Rawis Elementary	1.21	0	Curb/fence	none	2.50	2.44

Table 2 displays the dimensions of crosswalks, both visible and faded marks. Results showed to have negligible difference from the indicated standard but it is still evident that an inconsistency in the implementation of the dimensions of the crosswalks. According to the Department of Public Works and Highways (DPWH), Department Order no. 62 series of 2011, stop lines or bars are placed on signalized roads. Given that no signal lights are placed along the Rawis National Road, stop lines are not needed.

Table 2
Dimensions of the crosswalks

Location	Actual (meters)				DPWH (speed <60kph, unsignalized)			
	Length	Width	Gap	Stop line	Length (or greater)	Width	Gap	Stop line
DPWH	3.3	0.3	0.25	yes	4	0.3	0.3	none
AUL	3.5	0.3	0.20	yes	4	0.3	0.3	none
DOST	4	0.3	0.25	yes	4	0.3	0.3	none
Mariners	4	0.3	0.3	none	4	0.3	0.3	none
Pag-asa	4	0.3	0.3	none	4	0.3	0.3	none
Genecom	4	0.3	0.3	none	4	0.3	0.3	none
Rawis Elementary	4	0.3	0.3	none	4	0.3	0.3	none

Table 3 showed the actual and DPWH/BP 344 standard dimensions of curb ramp and dropped sidewalk. The actual and standard curb ramp slopes are 21% and 8% respectively. It revealed great difference when the values were compared. It can be concluded that local highway standards were not implemented. This points out a hazard to road users.

Table 3
Dimensions of the curb ramp and dropped sidewalk

	Actual		DPWH Standard/BP344	
	Width (m)	Slope (%)	Width (m)	Maximum Slope (%)
Regional Center main entrance (curb ramp)	1.26	21.95	0.90	8.33
AUL gate 3- north (dropped sidewalk)	1.40	15.88	1.50	8.33
AUL gate 3-south (dropped sidewalk)	1.50	20.63	1.50	8.33

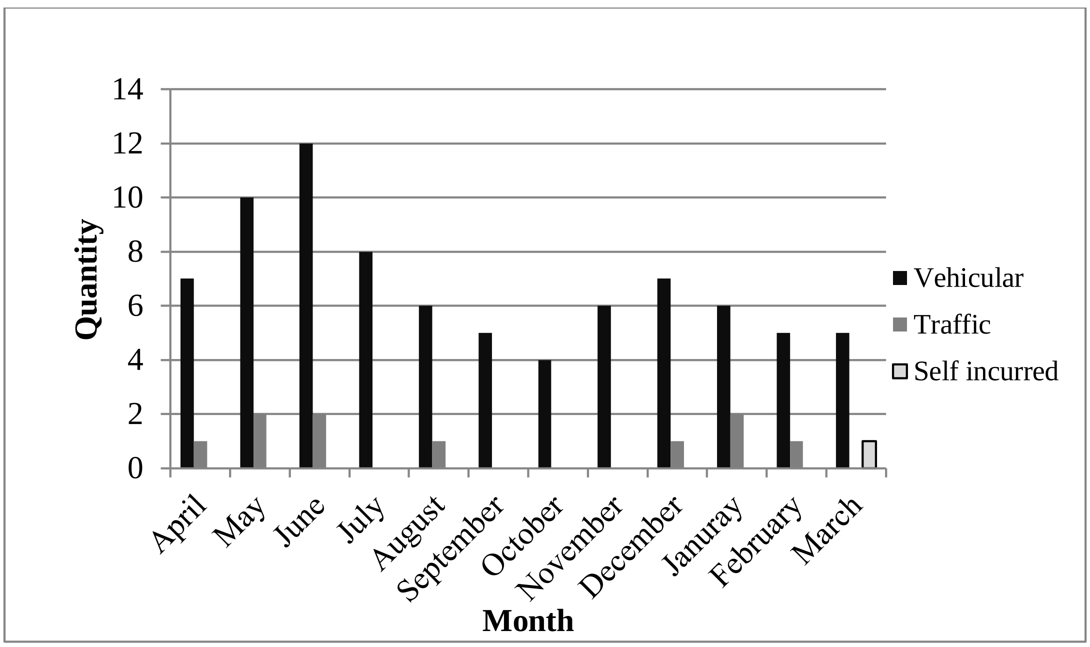

Figure 1 Accident Count Along the National Road
Barangay Rawis, Legazpi City
(April, 2014 to March, 2015)

Figure 1 revealed the accidents reported at the Community Police Assistance substation 5 (CPAC 5), Legazpi City, Albay PPO, Center all of which transpired at Barangay Rawis National Road from April 2014 to March 2015. To translate the categories into transportation terms, vehicular accident is multiple vehicle, traffic accident is vehicle-pedestrian, while self-incurred accident is vehicle-fixed object (Khisty and Lall, 1998). The multiple vehicle (vehicular accident) has the highest count (81 cases) caused mainly by driver behavior errors such as overtaking while front vehicle is turning left, tricycle is hit at the back while making a u-turn, vehicle hit while parked at the side of the road. Only one vehicle-fixed object accident (self-incurred) occurred during the one-year period.

Focusing on the vehicle-pedestrian accidents (traffic accident), eight (8) cases occurred while the pedestrian is crossing the road and the rest were side swept while walking on the sidewalk. Although it doesn't frequently occur every month, the data still reflects how prone pedestrians are to accidents. It is possible also that other cases of accidents involving vehicles were not reported. And accidents without vehicle involvement such as tripping, falling due to potholes, sidewalk hazard, and unexpected change in sidewalk grade were obviously not reported.

In relation to these accidents, the insufficient sidewalk width could be pointed out as the cause. Without enough walking area, the pedestrian would be forced to walk along the shoulder of the road which makes him prone to the side sweeping incident. As for the pedestrians hit while crossing, some observed signs were no longer visible were not crossing at designated regions or the crosswalks, thus the motorist is not properly warned.

Table 4
Summary of Traffic and Pedestrian count at AUL crosswalk

Vehicle type	Route To Tabaco city	Route to Legazpi City	Total
Car	222	303	525
Bus	10	11	21
Jeep	201	232	433
Tricycle	225	313	538
Motorcycle	170	387	557
Truck	8	13	21
Bicycle	5	25	30

Table 4 revealed the number of vehicles per vehicle type and route based from the actual traffic and pedestrian count at AUL crosswalk done on July 8, 2014 (Tuesday) from 7:10A.M. to 8:10 A.M. The total number of vehicles was 2,125 while the total number of pedestrians was 194. This data recommends a highway median as stipulated at the directive of the Department of Public Works and Highways (DPWH), Department Order no. 62 series of 2011 section 6, that a median which serves as a refuge island shall be installed when during peak hours of an average day, the number of vehicles exceeds one thousand (1,000) per hour and there is a history of accident involving pedestrian waiting in the center of the road before completing the crossing.

Proposed Plan of Pedestrian Facilities at AUL Crosswalk

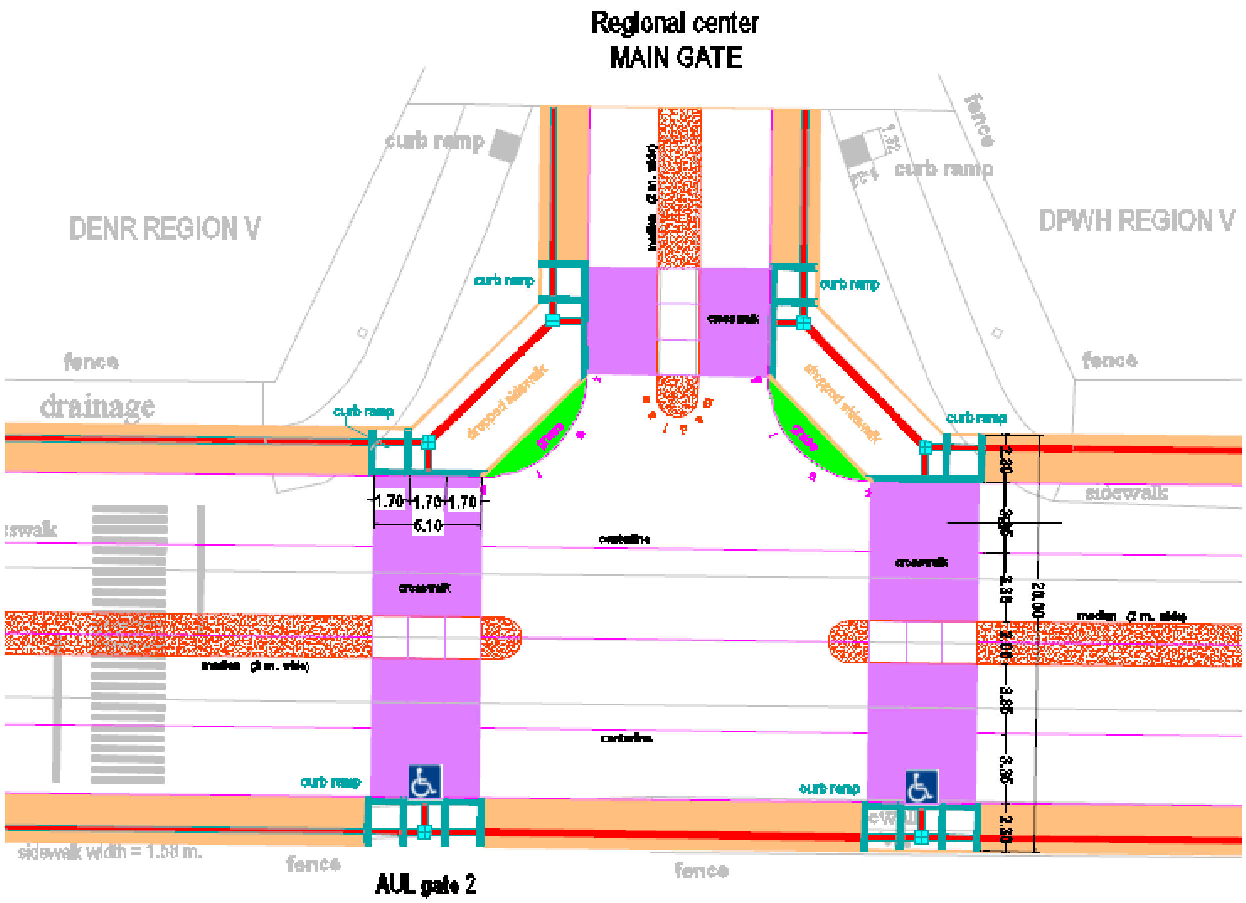

Figure 2

Figure 2 illustrates the proposed plan of the pedestrian facilities located at AUL crosswalk. The gray color objects are the existing roadside elements. The guidelines used as reference for the dimensions were DPWH DO no.37, DPWH DO no.62, IRR BP 344, and HCM 2000 (AASHTO). From existing two-lane traffic, the researcher adopted a four-lane traffic with a two-meter wide median (preferred by IRR BP344) considering the on-going road improvement and the result of the traffic and pedestrian count. The total crosswalk width is the 5.10 meters (from DPWH DO no.62 section 6, 4 to 8 meters). The sidewalk width used was 2.30 meters, the remaining width considering a 20-meters RROW of the national road. The curb ramp adopted is the dropped sidewalk type due to inadequate space requirement (AASHTO specifies a 2.1 meter sidewalk width when there's no buffer zone). The pedestrian crosswalk markings are located close to the corner edge so that pedestrian will be visible to vehicles turning right (DPWH DO no.62 section 3). In order for pedestrian facility be accessible to persons with visual impairment, the researcher included on the plan three types of tactile blocks (i.e., directional, positional, and warning).

SUMMARY AND CONCLUSION

The as-built engineering survey with a digital output in AutoCAD drawing format, of Barangay Rawis National Road was valuable information in road maintenance and improvements. Based on the statistical analysis, the dimensions of the pedestrian facilities (crosswalk, sidewalk, and curb ramp), significantly did not conform to local (DPWH/BP344) and foreign (AASHTO/Texas) highway standards. There were eight cases of pedestrian-related accidents within a year that reflected how pedestrians were prone to accidents. This could be attributed to the inadequate and inconsistent implementation of DPWH/ BP344 guidelines on the construction of pedestrian facilities.

The proposed plan in AutoCAD drawing format was drawn using the dimensions of crosswalk, sidewalk width, and curb ramp from highway standards and PWD guidelines as stated at the review of related literature and made considerations to the current road improvement works.

Future studies can be done by performing as built engineering survey on other roadside elements such as road signs, speed reduction devices, lighting, bus stop, parking, landscape, and road fixtures which are factors that influence pedestrians. Evaluation of these roadside elements could lead to a comprehensive output which used as basis for road improvements that will minimize can be incidence of traffic accidents, can reduce traffic congestion, promote walking as sustainable mode of transportation, and increase road user satisfaction.

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