Pedestrian Walkability Study Along Mcarthur Highway, San Vicente, Apalit, Pampanga

Gabrielle Louisse Lobo [1], Jocelyn Eliza Benito [1], Patricia Carisse Binuya [1], Grace Joy Del Rosario [1], Jose Lorenzo De Ramos [1], Maica Chayne Vitug [1], Rommel C. De Mesa [2], John Vincent G. Tongol [2]

[1]*Student, Department of Civil Engineering, College of Engineering and Architecture, Don Honorio Ventura State University, Bacolor, Pampanga, Philippines.*

[2]*Faculty, Department of Civil Engineering, College of Engineering and Architecture, Don Honorio Ventura State University, Bacolor, Pampanga, Philippines.*

Corresponding Author: gabriellelouissemlobo@gmail.com

Abstract: - Walkability or walking accessibility is a specific type of accessibility that relates to how simple it is to go around and get to places on foot in a given region. PLOS, or pedestrian level of service, gauges the general accessibility of a route, walkway, or facility for pedestrians. This indicates how pedestrians view the facility's pedestrian friendliness and is directly tied to factors. Apalit is a first-class municipality in the province of Pampanga, and Barangay San Vicente which is considered to be the municipality's central barangay was selected as the study area for the research. The study area is exactly 970 meters in length. The number of pedestrians in the segment was estimated using Raosoft Calculator and were sampled using inductive reasoning. Different methodologies were adapted and modified to identify the pedestrian level of service. Six major criteria with their respective sub-factors were used in the questionnaire to identify the level-of-service per sub-section of the two stations. This study suggests that, in addition to periodic walkway maintenance and routine pavement cleaning, improvements and additions of non-continuous pedestrian walkways, identification of pedestrian crossings across all street segments, and easement of traffic control be made.

Key Words: — *Walkability, Traffic Control, Sustainable Mobility, Pedestrian Amenities, Street, Safety.*

I. INTRODUCTION

In recent years, walking has received more attention in urban mobility studies and policies due to its potential as a supplemental tactic to address urban non-sustainability. It is not a coincidence that transportation policies are gradually changing to include new goals where walking can definitely play a role [1].

Manuscript revised June 22, 2023; accepted June 23, 2023. Date of publication June 26, 2023.

This paper available online at www.ijprse.com

ISSN (Online): 2582-7898; SJIF: 5.59

Every journey starts and ends with walking. Whether in a developed city or one that is still developing, almost all trips involve some walking, either to get where you're going or to get to another mode of transportation. The quality and effectiveness of the urban transportation system as a whole, and consequently the overall mobility and accessibility for locals and visitors, will depend on how well the pedestrian environment can support these trips [2].

Walkability is more than just the ability to walk. It is known as the degree to which a built environment supports and promotes walking [3]. The multidimensional walkability study has mostly been used for walking as a travel method in the sector of transportation since the 2000s. Distance is sometimes considered to be a crucial factor in walkability since activities may frequently be too distant to go there on foot. The impact of the built environment on walkability has been well studied and quantified [4]. This support and encouragement come from features like pedestrian comfort and safety, connections to a variety of destinations that take only a reasonable amount of time and effort, and visual interest along the route [5].

According to a proposed walkability policy for Philippine cities, reserving and recovering space for pedestrian traffic is as crucial as creating lanes for cars. It lists the promotion of effective mobility and accessibility for everyone as a tactic for attaining infrastructure development that is both environmentally and socially responsible. The establishment of bike lanes and pedestrian lanes is also mentioned as a method for social fairness and gender perspective. Clearly, many Asian cities require a comprehensive and integrated approach to pedestrian planning in order to achieve complete streets, or streets that enable mobility, safety, and accessibility for people of all ages and abilities [6].

II. PERSONALITY ASSESSMENT THEORY

The researchers adapted and modified the three methodologies—Highway Capacity Manual, Proposed Level of Service Standards for Walkways in Metro Manila (Gerilla et al., 1995), and Gainsville Pedestrian LOS Performance Measures (Dixon, 1996) to provide the most appropriate Pedestrian Level of Service criteria for the study.

2.1 Highway Capacity Manual Method for Determining Pedestrian LOS

The HCM method for assessing pedestrian LOS depends on pedestrians' flow rate and sidewalk space measurements. Assessing the sidewalk level of service based on HCM requires counting pedestrians per minute per meter (ped/min/m) as the basis for LOS classification. Table 1 shows the HCM Standards, including the service measurement of space and the additional standards of unit flow rate, speed, and v/c ratio [7].

Table 1. HCM Level of Service Criteria for Walkways and Sidewalks

LOS	Space (m^2/ped)	Flow Rate (ped/min/m)	Speed (m/s)	v/c Ratio
A	>5.6	≤16	>1.30	≤ 0.19
B	>3.7 – 5.6	>16 – 23	>1.27 – 1.30	>0.20 – 0.44
C	>2.2 – 3.7	>23 – 33	>1.22 – 1.27	>0.45 – 0.69
D	>1.4 – 2.2	>33 – 49	>1.14 – 1.22	>0.70 – 0.84
E	>0.75 – 1.4	>49 – 75	>0.75 – 1.14	>0.85 – 1.00
F	≤ 0.75	variable	≤ 0.75	>1.00

2.2 Proposed Level of Service Standards for Walkways in Metro Manila

Table.2. Proposed LOS Standards by Gerilla et.al.

DESCRIP-TION	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F
Average Flow (ped/m/min)	23	23-24	34-42	42-51	51-76	76 or variable
Ave. Pedestrian Area Occupancy (m^2/ped)	>3.25	2.05-3.25	1.65-2.05	1.25-1.65	0.56-1.25	<0.56
Presence of Information Signs	✓	✓	✓	✓	✓	✓
Width of the Facility	✓	✓	✓	✓	✓	✓
Lighting in the Walking Area	✓	✓	✓	✓	✓	✓
Air Quality	✓	✓	✓	✓	✓	✓
Presence of Guards	✓	✓	✓			
Surface Condition of the Facility	✓	✓	✓			
Pedestrian- Car Conflict	✓	✓	✓			
Presence of Trees and Shrubs	✓					

Presence of Furniture	✓					
Availability of Pedestrian Signal	✓					
Presence of Guardrails or Fencing	✓					

Gerilla et. al., (1995) proposed a method for evaluating pedestrian LOS in Central Business Districts (CBD) of Makati, Metro Manila. Table 2 demonstrates their proposed Pedestrian LOS Design Standards. Gerilla et al. applied the Photographic Technique Survey, the Pedestrian Behavior Questionnaire Survey, and the Pedestrian Preference Facility Survey to collect their data. Six criteria were used to evaluate the facilities: safety, system coherence, convenience, comfort, continuity, and congestion level [8].

The level of service (LOS) is a term closely related to the capacity; where capacity tries to give a quantitative measure, LOS provides a qualitative measure regarding measures of effectiveness (MOE). MOE which may change with the type of facility, are the key measurable parameters (such as speed, flow, density, delay, etc.) which indicate the quality of service. LOS helps in relating traffic service quality to a given flow rate and is a term which designates a range of operating conditions on a particular type of facility. LOS A defines excellent service (i.e., a free flow speed at low density), while LOS F defines very poor service (i.e., congested conditions with high jam density). Defining LOS not only helps in understanding the existing pedestrian facilities but also helps in developing new facilities. Table 2 shows the pedestrian level of service under different flow levels as per HCM 2010. LOS concept on one side tries to address a wide range of operating conditions, while on the other side the limitations on data collection and the availability make it impractical to treat a full range of operational parameters for every type of facility.

The six factors were broken down into subfactors. After combining the survey results, they developed their proposed Pedestrian Level of Service standards, as shown in Table 2.

Notably, they designated respective weights to the factors based on the preferences of the users, which were acquired from the conducted surveys.

2.3 Gainesville Pedestrian LOS Performance Measures

Dixon used a pointing system, as shown in Table 3, for this method. The LOS rating corresponds to the total number of assigned points. Table 3 shows the respective rating score ranges for LOS. Ratings for LOS are directly proportional to the level of pedestrian encouragement for using the pedestrian facility [9].

Table.3. Pedestrian Level-of-Service (Dixon, 1996)

CATEGORY	CRITERIA	POINTS
PEDESTRIAN FACILITY Maximum Value = 10	Not continuous or non-existent	0
	Continuous on one side	4
	Continuous on both sides	6
	Minimum 1.53 m (5’) wide & barrier free	2
	Sidewalk width > 1.53 (5’)	1
	Off-sheet parallel alternative facility	1
CONFLICTS Maximum Value = 10	Driveway & side streets	1
	Pedestrian Signal delay 40 sec. or less	0.5
	Reduced turn conflict implementation	0.5
	Crossing width 18.3 m (60’) or less	0.5
	Posted Speed	0.5
	Medians Present	1
AMENITIES Maximum Value = 2	Buffer not less than 1 m (3’5”)	1
	Benches or pedestrian scale lighting	0.5
	Shade trees	0.5
MOTOR VEHICLE LOS Maximum Value = 2	LOS = E, F, or 6+ travel lanes	0
	LOS = D, & < 6 travel lanes	1

	LOS = A, B, C, & < 6 travel lanes	-2
MAINTENANCE Maximum Value = 2	Major or frequent problems	-1
	Minor or infrequent Problems	0
	No Problems	2
TDM / MULTI MODAL Maximum Value = 1	No Support	0
	Support exists	1

Dixon's evaluation was primarily based on pedestrian safety and the level of automobile-oriented development along the corridor.

III. METHODOLOGY

The researchers have utilized three methodologies to develop the proposed standards for Level of Service (LOS). These methodologies are as follows:

- Highway Capacity Manual Pedestrian LOS (2000)
- Proposed LOS Walkways in Metro Manila (Gerilla et. al, 1995)
- Gainesville Pedestrian LOS Performance Measures (Dixon, 1996)

From the "Proposed LOS Walkways in Metro Manila" method, the researchers incorporated six main criteria for evaluating pedestrian facilities: Level of Congestion, Safety, Convenience, Comfort, Continuity, and System Coherence. Each criterion consists of specific sub-factors that provide further details for evaluation. The researchers considered the relevance and importance of these sub-factors to generate a list for evaluating pedestrian facilities in the study area. The finalized list of six major criteria and their corresponding sub-factors can be found in Table 7.

One of the major criteria, Level of Congestion, was assessed using the HCM standards. This involved calculating the volume-capacity ratio of pedestrian facilities and considering parameters such as sidewalk space and pedestrian flow rate. A detailed discussion on the assessment of this factor will be provided in subsequent sections.

Finally, the concept of scoring presented in the "Gainesville Pedestrian LOS Performance Measures" was adopted by the researchers to establish a final scoring system and define the range of values for each LOS grade.

The figure below provides a summary of the different approaches from these methods that the researchers have incorporated:

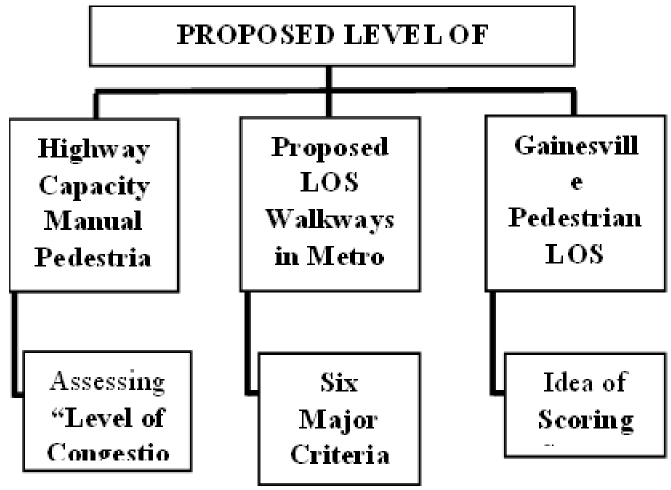

Fig.1. Summary of the Adapted Approaches for the Proposed LOS Standards

3.1 Rating the Sub-Factors Used in Evaluating Pedestrian Facilities

The Survey that was distributed to the target sample size was consisted of a list of the sub-factors in evaluating the pedestrian facilities, grouped into their six major criteria. The respondents were asked to rate these sub-factors from one to five (i.e., 1 to 5), where five being the highest, in terms of their importance (based on the pedestrians 'personal preference).

3.2 Computation of the Standard Score of Each Sub-Factor

When results of the survey were collected, the mean and standard deviation of the ratings (from respondents) for all the factors were then computed. The following formulas were used to compute for the important statistical parameters.

Mean,

$$\mu = \frac{\sum_{i=1}^{N} x_i}{N}$$

Standard Deviation,

$$\sigma = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \mu)^2}{N-1}}$$

Where μ: mean
σ: standard deviation
xi: rate of the factor
N: total number of respondents

$$Z_i = \frac{S_i - \mu_i}{\sigma_i}$$

Where **Z: standard score**
S: score or assigned weight, depends on the rank of the sub-factor
μ: mean
σ: standard deviation
i: ranging from 1 to 15, pertains to the sub-factor's assigned number

In order to normalize the gathered data and obtain their standard score, the researchers utilized the Z-score statistical concept. Knowing the mean and standard deviation of each sub-factor, the standard score per sub-factor was computed using the following equation.

3.3 Computation of the Standard Score of Each Sub-Factor

To determine the range of points per LOS rating, the computed standard score of each sub-factor was then multiplied to the designated points of their individual sub-criteria, which varies from zero to five. Then the total sum of the product per factor was calculated. Once the sums were obtained, the average of two successive points was then computed. These values defined the limit or boundaries of the range of points for the proposed LOS standards.

3.4 Assessment of Selected Pedestrian facilities

The survey questionnaire yielded outcomes that allowed us to establish the assigned weights or standard scores for each of the sub-factors. This section provides the specific points attributed to the selected route sections based on each sub-factor. It's important to note that a set of criteria was identified for each sub-factor, and these criteria were assigned points ranging from one to six. The Level of Service of the selected walkways was determined as follows:

- Route sections were scored (with corresponding points) per factor based on what criteria they satisfy.
- Points were then multiplied to the factor 's respective standard score.
- Finally, the sum of the points multiplied to weight determined the LOS Grade of the route section.

Through the integration of the pointing system and the standard scores of the factors, the researchers successfully derived the ultimate table for the Pedestrian Level of Service (LOS) Standards, which will be presented.

IV. Results And Discussion

4.1 Target Sample Size

The target sample size for the initial survey was calculated to be at least 365 respondents. The researchers were able to obtain a total number of 372 valid survey forms.

4.2 Evaluation of General Information and Rank and Standard Scores of the Sub-Factors in Evaluating Pedestrian Facilities

This part shows the following figures of the general information of the respondents according to length of time of walking, reason of walking, and time of cruising in the area.

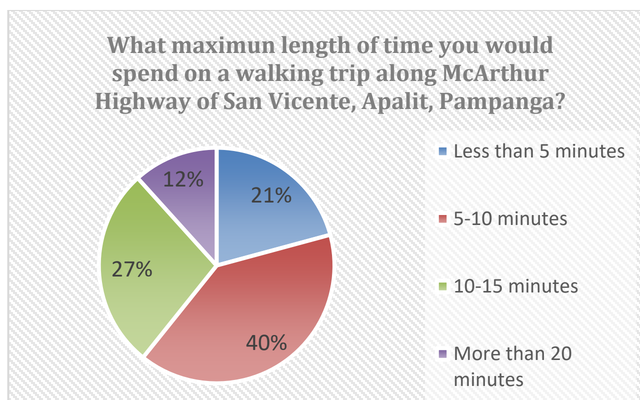

Fig.2. Length of Time of Walking

Figure 2 shows the respondents' evaluation to the maximum length of time people wound spend in walking along Mc Arthur Highway of San Vicente, Apalit, Pampanga. The time "5 - 10 minutes", got the highest response which is 40% of the majority of the respondent. This result shows that walking is essential and it is the basic transportation. All users of non-motorized and motorized modes of transport must walk at some point during their journeys. For instance, people walk to a public transportation station or from a garage or parking lot to the entrance of a building [10].

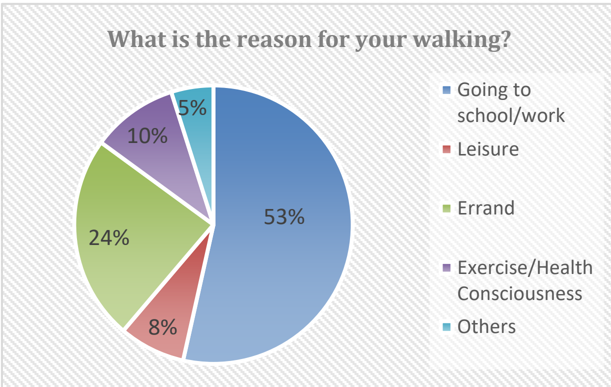

Fig.3. Reason of Walking

From the figure 3, it can be seen that most of the respondent walk for the reason of going to school/work. With the highest response of 54% in total. A study conducted was observed that students tend to cover greater distances on foot as compared to other individuals [11]. Individuals in managerial positions exhibited higher levels of physical activity in the form of walking as compared to those in intermediate or routine occupations [11][12].

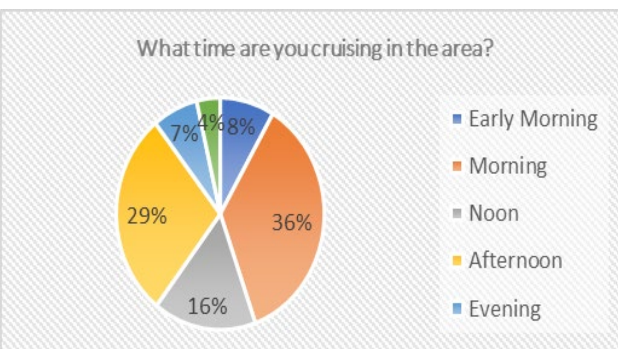

Fig.4. Time of Cruising in the Area

The figure 4 shows the results of a survey conducted to determine the preferred time for cruising or traveling along McArthur Highway in Brgy. San Vicente, Apalit, Pampanga, as reported by the respondents. According to the survey results, a minority of 8% of the participants expressed a preference for cruising in the vicinity during the early hours of the morning, whereas a majority of 36% reported a preference for cruising during the morning hours. It was observed that morning walking trips frequently serve the purpose of commuting to work or school. The study found that a significant proportion of individuals choose walking as a mode of transportation during the morning hours to reach their workplaces or educational institutions [13].

4.3 Evaluation Pedestrian Facilities

Table 4.1 Evaluation of Route Section's Pedestrian Facility

ROUTE SECTION	ASSIGNED POINTS PER SUB-FACTOR WITH MEAN, STANDARD DEVIATION, AND STANDARD SCORE						
	1	**2**	**3**	**4**	**5**	**6**	**7**
STATION 1							
1S1	234	248	239	238	228	191	212
1S2	227	241	244	209	188	182	152
1S3	254	225	237	192	209	188	160
STATION 2							
2S1	214	202	236	195	204	188	189
2S2	163	186	222	204	188	155	147
2S3	200	216	232	200	165	149	180
MEAN	177	219.67	235	206.33	197	175.5	173.33
STAND. DEVI.	16.58	52.40	16.73	37.27	48.37	41.44	55.78
Z SCORE	**15.22**	**18.33**	**14.04**	**14.25**	**16.67**	**14.26**	**20.33**

Table 4.2 Evaluation of Route Section's Pedestrian Facility

ROUTE SECTION	ASSIGNED POINTS PER SUB-FACTOR WITH MEAN, STANDARD DEVIATION, AND STANDARD SCORE							
	8	**9**	**10**	**11**	**12**	**13**	**14**	**15**
STATION 1								
1S1	201	154	159	183	189	210	235	251
1S2	147	139	122	164	151	184	190	227
1S3	177	150	123	163	178	216	228	261
STATION 2								
2S1	188	170	146	187	195	209	210	268
2S2	179	104	90	138	173	184	210	243
2S3	170	148	134	140	149	195	212	227
MEAN	215.33	144.17	129	162.5	172.5	199.67	214.17	246.17
STAND. DEVIA.	70.39	49.53	53.10	46.15	42.70	31.20	35.34	38.27
Z SCORE	**23**	**14.14**	**17.33**	**16.17**	**14.83**	**12**	**13.58**	**7.93**

Table 4.1 and Table 4.2 shows the standard score per sub-factor this standard score will be used to determine the range point of the proposed pedestrian facilities level of service standards by getting the summation of it.

Table.5. Ranking of the Sub-Factors in Evaluating Pedestrian Facilities

Rank	Sub-Factors	Sum of Rating	Standard Score
1	**Presence of Shade**	**1477**	**23**

2	Vegetation or Landscaping along road side	1410	20.33
3	Pedestrian conflict	1318	18.33
4	Vegetation or Landscape along road side	1292	17.33
5	Separation between sidewalk and roadway	1285	16.67
6	Lighting in the Walking Area	1238	16.17
7	Surface condition of the sidewalk	1198	14.83
8	Architectural relation of sidewalk & nearby building	1182	14.26
9	Air Quality	1062	14.25
10	Absence of obstacles	1053	14.25
11	Presence of information signs	1040	14.14
12	Presence of traffic enforcers	1035	14.05
13	Presence of Informative/Regulatory Signs	975	13.57
14	Noise Quality	865	12
15	**Eyepoint or Landmark**	**774**	**7.93**

Table 5 displays the order and numerical values assigned to the 15 factors employed for assessing pedestrian amenities. As per the table, the factor with the greatest significance is the 'Presence of Shade.' This indicates that among all the sub-factors, individuals who utilize pedestrian facilities prefer an area for walking that offers ample shade to shield them from the sun's heat or keep them dry during the rainy season, mainly due to the considerable distances between buildings.

4.4 Computation for the Range of Values per LOS Grade of the Proposed Standards in Evaluating Pedestrian Facilities

Table 6 is the calibrated Level of Service Standards of Pedestrian Facilities specifically for the Along McArthur Highway in San Vicente, Apalit, Pampanga. These ranges of points were used in determining the Level of Service of the selected pedestrian facilities of the commonly used route sections in the study area. LOS A is considered as the ideal Level of Service of the pedestrian facilities while LOS F is the worst.

Table.6. Proposed Pedestrian Facilities Level of Service Standards

LOS	DESCRIPTION	RANGE OF POINTS
A	These roadways are highly pedestrian oriented and will tend to attract pedestrian trips.	928.32 - 1134.6
B	These roadways provide many pedestrian safety and comfort features that can attract pedestrian trips.	772.03 - 928.31
C	These roadways are adequate for pedestrian use, but may not necessarily attract pedestrian trips.	515.74 - 722.02
D	These roadways are adequate for pedestrian use, but will not attract pedestrian trips.	309.45 - 515.73
E	These roadways are inadequate for pedestrian use. These roadways may or may not provide a pedestrian facility.	103.15 - 309.44
F	These roadways are inadequate for pedestrian use. These roadways do not provide any continuous pedestrian facilities.	0 - 103.14

LOS A is assigned to roadways that have scores between 1134.6 and below, but greater than 928.32. These roadways are designed with a strong focus on pedestrians and are likely to attract a significant number of people traveling on foot. They will have wide sidewalks, pedestrian-friendly intersections, and generally experience lower speeds and less traffic from vehicles. Additionally, these roadways will offer various amenities such as shaded areas and benches to enhance pedestrian comfort. The design of both the road and sidewalk will prioritize human-scale dimensions to ensure maximum comfort for pedestrians. This level of pedestrian accommodation is commonly found in central-city areas, tourist destinations, and college campuses. Pedestrians can expect a minimal level of interaction with motor vehicles in these areas.

LOS B Scores ranging from 772.03 to 928.31 are classified as LOS B. These roadways offer various pedestrian safety measures and amenities that make them appealing for pedestrians. Although they share many characteristics with an LOS A pedestrian facility, they might have slightly fewer amenities or design elements that prioritize pedestrian comfort.

Pedestrians can expect a moderate level of interaction with motor vehicles on these roads.

LOS C rating is assigned to scores ranging from 515.74 to 722.02 or lower. These roads are suitable for pedestrians to use, but they may not necessarily be appealing for pedestrians to travel on. They have a standard sidewalk, but there might be some issues with maintenance or intersection design. Additionally, these roads might be situated in areas with fast-moving and high-traffic motor vehicles, or they may have a sidewalk on only one side of the street. Pedestrians should expect a moderate level of interaction with motor vehicles on these roads.

LOS D rating is given to roadways with scores between 309.45 and 515.73. While these roadways are suitable for pedestrians to use, they are not likely to attract many pedestrians. Pedestrian safety and comfort features on these roadways may have more frequent issues. There might be instances where the sidewalk system has gaps along this roadway. Pedestrians will encounter intersections more frequently, and crossing them may be more challenging. Expect moderate to high levels of interaction with motor vehicles as a pedestrian on these roadways.

LOS E rating is assigned to roadways that have a score ranging from 103.15 to 309.44. These roadways are considered unsuitable for pedestrians, and they may or may not have designated pedestrian paths. Even if a sidewalk is present, it will not meet the necessary standards in terms of width, clearance, continuity, and intersection design. Roadways falling into this category, without a designated pedestrian facility, are typically found in urban fringe or rural areas with moderate motor-vehicle traffic. Pedestrians using these roadways should expect a significant level of interaction with vehicles.

LOS F rating is given to roadways with scores of 103.15 and lower, indicating their inadequacy for pedestrian usage. These roadways lack continuous pedestrian facilities and are dominated by heavy motor-vehicle traffic and car-centered development. They are primarily designed to accommodate high volumes of motor vehicles, resulting in frequent conflicts at turning points and high speeds.

Table.7. Passenger car unit per hour

VEHICLE TYPE		PCEF
No.	Description	
1	Motor - Tricycle	2.5
2	Passenger Car	1.0
3-5	Passenger and good utility and Small Bus	1.5
6	Large Bus	2.0
7	Rigid Truck, 2 axies	2.0
8	Rigid Truck, 3+ axies	2.5
9	Truck Semi – Trailer, 3 and 4 axies	2.5
10	Truck Semi – Trailer, 5+ axies	2.5
11	Truck Trailers, 4 axies	2.5
12	Truck Trailers, 5+ axies	2.5

Table 7 contains data related to the pattern counting of vehicles in the study area. This data, combined with the pedestrian counts, can provide a comprehensive understanding of the overall transportation dynamics in the area and help researchers and planners make informed decisions.

The researchers conducted pedestrian counts using the HCM method for seven consecutive days in the study area. These counts allowed them to collect data on the number of pedestrians passing through the area during different hours of the day. By analyzing this data, they could identify the peak hour, which represents the time period with the highest pedestrian activity.

Table.8. Basic Hourly Capacity in Passenger Car Units

CARRIAGEWAY WIDTH	RURAL	URBAN
Single less than 4 meters	600	600
4.0 – 5.0 meters	1,200	1,200
5.1 – 6.0 meters	1,900	1,600
6.1 – 6.7	2,000	1,700
6.8 – 7.3 meters	2,400	1,800
2 x 6.7 or 2 x 7.3 meters	7,200	6,200

Table 8 shows the Basic Hourly Capacity in Passenger Car Units. The researchers used this table to determine the peak hour of the study area. The study area has a carriageway width of 2 x 7.3 meters and an urban capacity of 6,200 passenger units per hour. To identify the peak hours, the researchers compared the average data of each hour over seven days. If the average data for a specific hour exceeded 6,200 passenger units, then that hour was considered a peak hour.

Table.9. Peak Hours of 60-minutes Time Interval

AM	PM
7:00-8:00 8:00-9:00	4:00-5:00 5:00-6:00 6:00-7:00

Table 9 shows the peak hours obtained from a whole day pedestrian count along the most commonly used route section. These peak hours were the ones used in conducting the pedestrian count related in determining the pedestrian flow rate and eventually level of congestion of the facilities.

Table.10. Level of Service of the Selected Pedestrian Facilities

Sub-Station	Description	Level of Service
Station 1 starting point to mid (520mm)		
S1	Adjacent to Jelexie Bakeshop	**LOS C**
S2	Between entrance of RCBC and OMG Clothing	**LOS D**
S3	Adjacent to Jeepney Stop for SM/Intersection	**LOS C**
Station 1 starting point to mid (450mm)		
S1	Adjacent to Crown Bank Apalit	**LOS D**
S2	In front of 7Mart	**LOS D**
S3	Adjacent to Southstart Apalit	**LOS D**

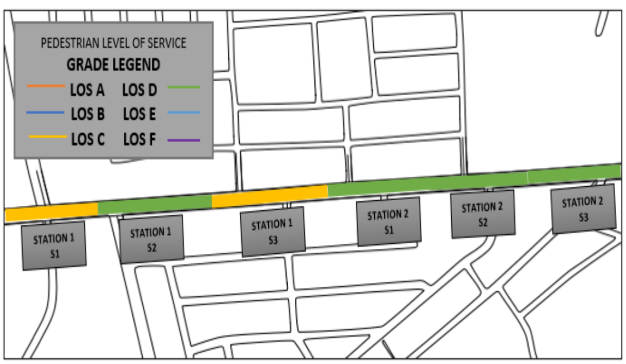

Fig.5. Level of Service of the Selected Pedestrian Facilities

The selected pedestrian facilities or route sections were further divided into sub-sections. The reason is that certain part of a route section still differs in their physical condition. In addition, pedestrian users do not use the entire length of the facility since entrances of certain buildings are located along the mid-length of the route section. The researchers identified these physical differences and the different destination points along the route section; then, distinguished their various sub-sections, if there are any. The following figure shows the sub-sections.

Then the researchers assessed these sub-sections depending on what criteria per sub-factor do they satisfy. The assigned points per criteria were multiplied to the standard score of the sub-factor, and then obtained the sum total of the scores to determine the LOS of that facility. Table 10 shows the computation while the Figure 5 shows the LOS of the pedestrian facilities evaluated.

4.5 Proposed Improvement Pedestrian Facilities

All then provision on the proposed improvement pedestrian facilities are under in the law and standards of Department of Public Works and Highways (DPWH) [14][15][16].

This is the Elevation Section of the proposed plan by the researchers. The measurements were based on the Table 5. Were it contained the Philippine National Highways of Design Standards where it is based on the Average Daily Traffic of an area. The researchers get the Average Daily Traffic of their setting area by counting the vehicles by four in the morning until twelve midnight in seven consecutive days. The Table 11 was the summary of the vehicle count per day.

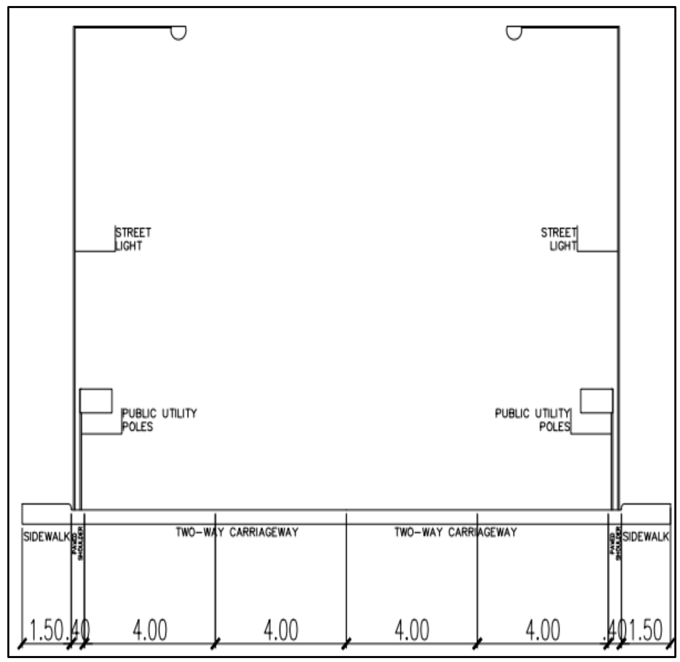

Fig.6. Elevation Section

Table.11. Average Daily Traffic of Brgy. SanVicente Along McArthur Highway

Average Daily Traffic	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	vpd (vehicles per day)
VEHICLE COUNT	3,150	2513	2,985	3,685	3,895	4,985	4,125	3,063.29

The Average Daily Traffic of Brgy. SanVicente Along McArthur Highway falls to traffic lane width 2x3.35/6.70 (m) and shoulder width (m) 3.0(1.5 paved). The researchers fixed the traffic lane into 2x4.0/8.0 (m) because the area was able to maximize on that size. The wider the traffic lane, the more the vehicle will be far to shoulder.

The researcher put a level on sidewalk or called barrier curb, this curb helps to keep vehicular traffic in the area and off sidewalks where they could injure a pedestrian. Also, according to DPWH, barrier curb is suited for the edge of the traveled way where it is generally considered that drivers should not mount the curb or sidewalk, since the researchers got a data in LGU Apalit of minor pedestrian accident, this can help to prevent this accident and prevent the vehicles to park on sidewalk because it is elevated.

The researchers added buffer between the carriageway and sidewalk to isolate pedestrian from moving vehicles.
The streets light dimension was based in the DPWH provision where it falls in the Major Road with 20 meters width with Opposite Arrangement. Table 11 shows what are the dimension of the study area of the researchers.

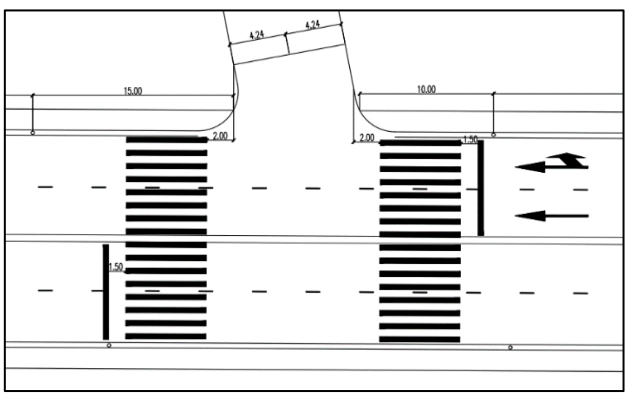

Fig.7. Top View for Pedestrian Crossing Plan

The current state of the roads and sidewalks along McArthur Highway at Brgy. San Vicente, Apalit falls below average in terms of level-of-service which is very challenging for the officials and engineering professionals to deal with and causes great concern among the drivers, pedestrians, as well as the commuters. Despite being cost-effective, it may not be pedestrian-safe because the current road plan didn't really adhere to the standards and provisions set by the Department of Public Works and Highways (DPWH). Public complaints are being made more frequently on social media platforms as well as through the DPWH's feedback centers.

The area falls under LOS C and LOS D which means there is enough room for normal walking speeds and for primarily unidirectional streams of pedestrians to pass. The streets have a standard sidewalk, but there may be maintenance issues or poor intersection design, or the sidewalk may only be on one side of the street or be near a road with heavy motor vehicle traffic. Within this roadway corridor, sidewalk gaps could exist. Crossings at intersections are probably going to be more frequent and challenging. Pedestrians are more likely to have interaction with motor vehicles on a moderate to high level.

This prompted the researcher to develop an alternative plan (unofficial plan) that adheres to the DPWH's provisions for the improvement of amenities, pedestrian, sidewalks, and roads. The plan is a suggestion that, for the safety of the general public, will significantly improve the traffic system and be pedestrian-friendly. The plan is based on calculated results derived from respondents' opinions, taking into account the standards that must be strictly adhered to. Compared to the existing plan, this new plan falls under an excellent level of service if evaluated and assessed. The plan was created with the intention of putting the public and pedestrian-users' safety first.

V. CONCLUSION

Apalit is considered a central business district. Walking is a widely used form of transportation, especially for students from school to home, laborers from work to home, and community members going for errands, leisure, exercise, and others. Consequently, pedestrian amenities play an essential function in the Apalit. This study assessed these facilities based on a proposed standard by adapting several established methodologies.

The proposed methodology for evaluating the Level of Service of pedestrian facilities combines a quantitative measure in terms of the level of congestion and a qualitative measure of other factors considered important by the pedestrian users such as safety, comfort, and convenience, and the facilities 'continuity and system coherence. The proposed standards adapted and integrated mainly three different methods, namely, Proposed Level of Service Standards for Walkways in Metro Manila (Gerilla et. al 1995), Gainsville Pedestrian LOS Performance Measures (Dixon 1996), and Highway Capacity Manual Method. From Gerilla et. al. 's method, the proposed methodology adapted the factors for evaluating Pedestrian LOS. These factors were assigned with respective weights, in relation to the pedestrians ‘preferences that were obtained through surveys. The Level of congestion, which is one of the major factors in evaluating the facilities was determined and assessed by employing the HCM standards. The rest of the factors were evaluated through a scoring system similar to Dixon‘s method.

The study focused on the evaluation of the commonly used walkways, sidewalks, trails, and shoulders, in the campus. The results showed that the selected pedestrian facilities inside the campus were mostly graded as LOS B and C. Only one facility was graded with LOS A. The HCM LOS grades of the evaluated routes were also obtained, and all of them were graded LOS A. The difference between the results showed at the Pedestrian LOS differs when preferences of users and other important parameters such as their safety, convenience, and comfort are considered. This proves that the proposed method that is partially based on HCM standards and also considers other factors, provides different results. Note that the consideration of the choice of users is very important when it comes to evaluating pedestrian facilities because unlike motor vehicles, pedestrians are very vulnerable to the surrounding environment, and to the other physical features of the facility.

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