SSRG International Journal of Recent Engineering Science
ISSN: 2349–7157 / https://doi.org/10.14445/23497157/IJRES-V11I4P105

Volume 11 Issue 4, 31-40, Jul-Aug 2024

Original Article

Pavement Condition Evaluation of the Cluster Barangays of Poblacion, Tuburan, Cebu: A Pavement Management System

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Received: 18 May 2024 Revised: 27 June 2024 Accepted: 18 July 2024 Published: 09 August 2024

Abstract *- The evaluation of the present condition of the road pavements at Brgy 1, Brgy 2, Brgy 3, Brgy 4, Brgy5, Brgy 6, Brgy 7, and Brgy 8 of Poblacion, Tuburan, Cebu (10.72654,123.82536), Philippines is aimed to identify their defects and deficiency, and as well as the condition rating of the roads. The data observed will be the basis for the local and municipal officials concerned with assessing the roads and their maintenance and rehabilitation works. The Visual Road Condition (VRoCond) Survey is utilized to gather the data for the evaluation. As per Department Order No. 042 series of 2016, the different defects or deficiencies in a road pavement are being defined, including their codes, unit of measurement, and the process of computing the variables of this research. The Visual Condition Index is computed to determine if the road section is in GOOD, FAIR, POOR, or BAD condition. Results showed that none of the road pavements of the cluster barangays of Poblacion, Tuburan, and Cebu are in poor and bad condition. The majority of the road sections are in GOOD condition, and the rest are in FAIR condition. With the summarized results containing the evaluation of the pavements of the road sections of the barangays in Poblacion, Tuburan, and Cebu, the government will be able to have an outlook of the solutions to the deficiencies in their roads. Recommended Corrective Measures and Treatment are also being provided.*

Keywords *- Highways, Infrastructure, Roads, Pavement Condition Index (PCI), Visual Road Condition, RoCond Survey, Visual Condition Index (VCI).*

1. Introduction

Throughout history, transportation has been essential to humanity, enabling trade, commerce, conquest, and social connections. However, it also requires significant time and resources to maintain. [10]. Efficient roadways and highway facilities are highly correlated with improving human lives and shaping the country's economic competitiveness. Transportation has become vital in peoples' lives. Most human activities involve transportation. May it be traveling from one place to another or the delivery and acquisition of goods and services, transportation is an essential part of making them happen. The main driver for transportation has been economic, encompassing personal travel to find food or jobs, the movement of goods and commodities, exploration, personal satisfaction, and the advancement of communities or nations [10]. Despite its undeniable importance, the maintenance and management of these infrastructures often face significant challenges, particularly in developing regions like the Philippines. That is why it is important to maintain the efficiency and serviceability of our highway and transportation facilities.

[11], in her article Impacts of Highway Facility Improvements On Travel and Regional Development, stressed that transportation facilities have been significant determinants in the location and form of human settlements. This emphasizes how improvements in transportation infrastructure can influence not only travel patterns but also regional development dynamics. The design and location of highways and transportation facilities profoundly impact various sectors of society, from comfort to the economy. Transportation is crucial for economic stability and human settlement in regions and nations. Improving and optimizing transportation not only enhances local quality of life but also spurs economic growth, benefiting governments as well. From this principle, the improvement and efficiency of the highway and transportation will not only affect the lives of the humans living in a certain locale but also affect the government in the form of economic growth.

The basis of the improvement of the highway and transportation facilities of a certain locality is not primarily focused only on the road infrastructures and vehicular machinery but also extends to the principles of highway safety.

In the latest Global Competitiveness Report by the World Economic Forum (WEF) [6], the Philippines ranked 100th out of 142 countries for road quality. According to the report, the country lags behind several neighboring nations in the Association of Southeast Asian Nations (ASEAN) in terms of infrastructure quality, especially regarding roads.

The primary reason for the overall poor condition of the road network is insufficient and inadequate maintenance. A significant issue contributing to this problem is the management of pavement across different road classifications in the country.

The road pavement refers to the section of the road situated directly above the subgrade and below the wearing surface. In urban settings, it is usually flanked by curbs and drainage channels, while in rural areas, it is bordered by road shoulders. This pavement is commonly made from compacted materials like crushed rock. It can also be divided into two main parts: the base and the sub-base.

Multiple regulations and orders have been established regarding the classification of roads in the country. The initial detailed reference is found in **[7]**. This document aimed to categorize public roads, set boundaries, assign responsibilities for their maintenance, and rely on recommendations from the National Transportation Board. After the enactment of [7], which aimed to establish an effective highway administration, redistribute highway funds, and assist provinces, chartered cities, and municipalities in road construction, the [13] was passed. According to Section 26, Article VIII of this law, the road classifications outlined in [7] were updated to address the military highway requirements of the Philippines. This revision also included secondary national systems and "national aid" for provincial and municipal roads to ensure continuity and integration within the overall transportation network.

Hard-surfaced pavement types can be categorized into flexible and rigid groups. Flexible pavements, surfaced with bituminous materials such as asphalt, exhibit a characteristic progression of deterioration. Rigid pavements are constructed using materials like concrete, which provide a more stable and durable surface. Rigid pavements typically exhibit different patterns of distress and require specialized maintenance techniques compared to flexible pavements. Initially, when newly constructed, these pavements show minimal signs of distress and maintain relatively good condition. However, as they age, various types of distress, such as cracking and rutting, begin to manifest. Each distress that develops increases the vulnerability of the pavement to further deterioration, creating a cumulative effect where subsequent distresses become easier to initiate and worsen. This underscores the importance of regular maintenance and timely interventions to prolong the lifespan and performance of hard-surfaced pavements.

According to [12], pavement management with data collection and concludes with the development of maintenance strategies and budget planning to ensure roads are safe, comfortable, and cost-effective for users.

The two main methods for extending pavement life are maintenance and rehabilitation. These methods serve two key purposes: (1) they provide immediate improvements to pavement condition, and (2) they influence the future rate of deterioration.

Generally, maintenance helps slow deterioration by addressing minor defects before they escalate into more serious issues. However, once defects reach a certain size, simple maintenance is no longer sufficient. At this stage, rehabilitation can be employed to comprehensively address multiple significant defects, resulting in a substantial improvement in pavement condition. These strategies are crucial in Barangays 1 to 8, Tuburan, Cebu, to manage and extend the life of their road network effectively, ensuring continued usability and safety for residents and commuters alike.

Different engineering tools are employed to evaluate the needed strategies to address problems in road networks. One of these is the Pavement Condition Index or PCI method. The Pavement Condition Index (PCI) is a standardized method used to assess the condition of pavements based on visual inspection and quantitative data. It provides a numerical rating that reflects the overall health and quality of a pavement section. The PCI evaluation typically involves trained inspectors visually surveying the pavement surface to identify and quantify various distress types such as cracking, rutting, potholes, and surface texture issues. Each distress type is assigned a severity rating based on established criteria. These ratings are then combined and weighted to calculate an overall PCI score, usually on a scale from 0 to 100, where higher values indicate better pavement condition.

In [2], the Pavement Condition Index (PCI) method was utilized to assess the condition of pavement in two sections, following the procedures detailed in [1]. Additionally, the study by [5] identified patches as one of the most common defects. It was observed that similar defects appeared in both vehicle and pedestrian pathways. To enhance the assessment parameters for pavement conditions, [5] adapted the PCI method by including tree root irregularities in the calculation of the Sidewalk Condition Index.

In [9], researchers examined the subjective evaluation of the surface condition of unpaved roads in São Carlos, São Paulo (SP). They assessed two scenarios: (1) 300-meter stretches traveled by vehicle and (2) 30-meter segments assessed on foot. The evaluations showed consistent results among the group, with most individual assessments falling within an acceptable range (absolute deviation of up to 10%). Thus, the subjective evaluations were deemed valid. Generally, individual scores were higher than the average for each sample unit but lower than the mean for the 300-meter stretches, regardless of the road's condition.

In [15], a statistical model was created to assess the Pavement Condition Index (PCI) for flexible paved highways in Bahia (BA). The comparison of objective and subjective PCI values revealed that higher PCI values were often underestimated, while lower values tended to be overestimated.

Meanwhile, [16] investigated the pavement conditions of various road types, including urban and arterial roads, and compared these conditions with accident data (different collision types). The study concluded that better pavement conditions correlated with lower collision rates. Collector roads categorized as "very poor" experienced the highest number of collisions, followed by those rated "fair" and "poor." In contrast, arterial roads in "very poor," "poor," and "fair" categories had fewer collisions. Overall, roads in "very good" condition reported the fewest accidents.

In the Municipality of Tuburan, Cebu, the condition of roads from Barangay 1 to Barangay 8 presents a microcosm of these challenges. While efforts have been made to classify and manage road networks through legislative acts such as the Philippine Highway Act of 1953 [13], the actual maintenance and rehabilitation strategies often fall short, leading to visible defects like potholes, cracks, and poor road markings [16].

In rural areas like Barangay 1 to 8 in Tuburan, Cebu, PCI is particularly relevant for several reasons. Firstly, rural roads often face unique challenges, such as limited budgets for maintenance and rehabilitation, varying traffic volumes, and exposure to environmental factors like weather and terrain. PCI provides local authorities with a systematic and objective tool to prioritize maintenance and investment decisions based on the actual condition of the roads. By conducting periodic PCI assessments, authorities can identify deteriorating sections early, intervene with timely repairs or rehabilitation measures, and effectively allocate resources to extend the life and usability of the road network. This proactive approach helps enhance road safety, reduce vehicle operating costs, and improve overall connectivity for residents, farmers, and businesses relying on these rural roads. Moreover, by leveraging PCI data, Barangays 1 to 8 can implement evidence-based strategies to optimize infrastructure management.

Now, this study is focused on the pavement condition evaluation of the national and local roads of Barangay 1 to Barangay 8 (10.72654,123.82536) of the Municipality of Tuburan, Province of Cebu through the employment of PCI and VCI methods.

Addressing these challenges requires a comprehensive understanding of the current road conditions through systematic assessment methods such as the Pavement Condition Index (PCI) and Visual Condition Index (VCI) [2, 15]. By employing these tools, this study aims to provide critical data to inform the Municipality of Tuburan in its decision-making processes towards effective pavement management and infrastructure improvement strategies.

The Municipality of Tuburan is situated on the northwestern coast of Cebu Province. It is 104 kilometers from Cebu City via the Lugo, Borbon route, 116 kilometers via Toledo City, Balamban, and about 78 kilometers by the Trans-Central Highway. The municipality is divided into fifty-four barangays, including eight Población barangay districts, while the remainder consists of rural barangays, covering a total land area of approximately 29,316 hectares.

The roads in Tuburan are classified as follows: (a) National roads measuring 21.89 kilometers, (b) Provincial roads at 29.50 kilometers, (c) Municipal roads totaling 6.373 kilometers, and (d) Barangay roads extending 111.095 kilometers. Typically, National roads are surfaced with concrete, Provincial roads are asphalted, Municipal roads are also concreted, and Barangay roads are predominantly asphalted, although some are gravel-paved.

The substance of this study leads to the acquisition of the data required by the concerned government agency as one of the components for the Pavement Management System, using HDM-4 Analysis Software of the DPWH.

These could also be a basis for the barangay officials and the Municipality to the improvement of the present road infrastructure by selecting the appropriate solution to the problems: routine maintenance, rehabilitation, or full reconstruction.

Specifically, this study aims to determine the present condition of the highway infrastructure of the roads of Brgy 1 to Brgy 8, Tuburan, Cebu, using a Visual Road Condition (RoCond) Survey in terms of the presence of defects such as (1) Potholes, (2). Alligator Cracks, (3) Major Scaling, (4) Shoving and Corrugation, (5) Pumping and Depression, (6) No/Faded Road Markings, (7) Low/Inverted Shoulders, (8) Lush Vegetation, (9) Clogged Drains, (10) Open Manhole, (11) No/Inadequate Sealant in Joints, (12) Cracks, (13) Raveling, (14) Unmaintained Road Signages, and (15) Unmaintained Bridges.

2. Materials and Methods

This research uses both quantitative and qualitative approaches. The research design that will be used in this paper is descriptive research, specifically, the evaluative type.

Different methods in line with the research design should be employed to gather the information that will be used in the completion of this study. These are the methods standardized by the DPWH. However, in the absence of the materials and machinery such as for deflection testing, frictional and skid tests, permeability tests on soil, and any other tests, the proponents of this research have selected only the methods that are within the range of their resources but could still produce a reliable result to accomplish the research. This is the Visual Road Condition (VRoCond) Survey.

The Visual Condition Index (VCI) Record formula registers all the different road defects gathered with RoCond into a single factor, ranging from 0 to 1, for each pavement type (concrete, asphalt, and gravel earth). The formula applies different weight elements to road distresses to consider their separate effect on the pavement condition.

The evaluation of pavement road conditions through visual inspection is referred to as “visual road condition assessments,” as it involves manually assessing the state of the road. The goals of the RoCond survey include (a) measuring and recording the road condition across the entire system, (b) describing the road condition during the survey, and (c) providing a series of recorded conditions that can be analyzed to identify performance trends.

Assessors need to walk along the roads to visually inspect and measure all defects, ensuring an accurate assessment to maintain the data’s reliability and relevance. Roads are classified as Good, Fair, Poor, or Bad. Good and Fair conditions receive routine maintenance, Poor conditions require rehabilitation, while Bad conditions are recommended for complete reconstruction.

Based on the [8], given are the codes of the different defects of the roadway with corresponding interpretations. Table 1 presents the coding, descriptions, units of measure for each defect or deficiency, and the corresponding weights. The weights will be utilized to compute the value of the Visual Condition Index. For the given rating of a roadway section, there is also an equivalent evaluation of the road condition, which is called the Visual Condition Index. The Visual Condition Index (VCI) is solved by summing up the individual ratings of each Code of Defect or Deficiency.

Table 1. Codes and description of pavement defect/Deficiency

Code	Defects/Deficiencies	Unit of Measure	Weight
01	Potholes	sq.m.	15
02	Alligator Cracks	sq.m.	10
03	Major Scaling	sq.m.	9
04	Shoving and	sq.m.	8
05	Corrugation	sq.m.	8
06	Pumping and	l.m.	8
07	Depression	l.m.	8
08	No/Faded Road	l.m.	3
09	Markings	l.m.	5
10	Low/Inverted	no.	5
11	Shoulders	l.m.	3
12	Lush Vegetation	l.m.	5
13	Clogged Drains	sq.m.	5
14	Open Manhole	no.	3
15	No/Inadequate Sealant	sq.m.	5
	in Joints		
	Cracks		100
	Raveling		
	Unmaintained Road		
	Signages		
	Unmaintained Bridges		
	TOTAL		

$$VCI = \sum(\text{Individual Rating of Each Code})$$

The Computation for the individual rating is also given by the following procedure.

Step 1: Quantity of Inspected Defects based on BOM-MPP-INS(Form PM-l) (See Appendix). From the total quantity of the noted defects indicated in 80MMPP- INS (Form MP-1) and the entire length of paved roads inspected, the Summary of Defects per Kilometer will be derived as follows:

- For Code 01, Code 06-E, 06-C 06-Y, 06- P, Code 07, Code 08, Code 09, Code 10, and Code 12**,** the Inspected Defects per Kilometer is given by

$$\text{Ins/Km} = \frac{\text{Ins: Quantity of Defects}}{\text{Total Length of Paved Roads}}$$

- For Code 02, Code 04, and Code 13

$$\text{Ins/Km} = \frac{\text{Ins: Quantity of Defects}}{\text{Total Length of Asphalt Roads}}$$

- For Code 03, Code 05, and Code 11

$$\text{Ins/Km} = \frac{\text{Ins: Quantity of Defects}}{\text{Total Length of Concrete Roads}}$$

- For Code 14

Ins/Km = No. of unmaintained road signages

- For Code 15

$$\text{Ins/Km} = \frac{\text{Total number of Defective Bridges}}{\text{Total Number of Bridges}} \times 100\%$$

Note: The Inspected Defects per Kilometer will not be computed for codes with no noted defects/deficiencies.

Step 2: Inspected GRADE (%); get the corresponding rating of Inspected Defects per Kilometer using Table 2.

Table 2. The VCI values and corresponding interpretation

Road Condition	Condition Rating (%)	Techniques Required
GOOD	>70-100	Routine
FAIR	>40-70	Maintenance
POOR	>20-40	Routine
BAD	1-20	Maintenance
		Rehabilitation
		Full
		Reconstruction

Compute the percentage weight for each criterion. The solved Visual Condition Index (VCI) from the RoCond Survey will be the basis for assessing the condition of the road section being inspected. Table 2 shows the following VCI value determines the condition of the assessed segment. Furthermore, the ratings of the values for each inspected defect are presented in Table 3.

Table 3. Rating of inspected defects per kilometer

CODE	UNIT	INSPECTION							
		100	75		50		25		0
		≤	>	-	>	-	>	-	>
01	SQM/KM	0.07	0.07	0.14	0.14	0.21	0.21	0.28	0.28
02	SQM/KM	0.9	0.9	1.8	1.8	2.7	2.7	3.6	3.6
03	SQM/KM	5	5	10	10	15	15	20	20
04	SQM/KM	0.3	0.3	0.6	0.6	0.9	0.9	1.2	1.2
05	SQM/KM	3	3	6	6	9	9	12	12
06 - E	SQM/KM	150	150	300	300	450	450	600	600
06 - C	LM/KM	30	30	60	60	90	90	120	120
06 - Y	LM/KM	6	6	12	12	18	18	24	24
06 - P	LM/KM	3	3	6	6	9	9	12	12
07	LM/KM	20	20	40	40	60	60	80	80
08	LM/KM	20	20	40	40	60	60	80	80
09	LM/KM	3	3	6	6	9	9	12	12
10	LM/KM	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4
11	PCS/KM	300	300	600	600	900	900	1200	1200
12	LM/KM	225	225	450	450	675	675	900	900
13	SQM/KM	20	20	40	40	60	60	80	80
14	PCS/KM	50	50	100	100	150	150	200	200
15	PERCENT	15	15	30	30	45	45	60	60

Table 4. Summarized PCI values of the road networks

Barangay	Pavement Network	PCI Rating	Evaluation
Brgy 1	Junction to Gallardo St.	79.75	GOOD
	Junction to Montebon St.	100	GOOD
	Junction to Rizal Park	90.75	GOOD
	Junction to Burgos St.	63	FAIR
Brgy 2	National Road	92.5	GOOD
	Junction to Osmeña St.	73	GOOD
	Junction to Maxilom-Osmeña St.	81.75	GOOD
	Junction to Gallardo St.	76.75	GOOD
Brgy 3	Barangay Road	78	GOOD
	National Road	93	GOOD
Brgy 4	Barangay Road	72	GOOD
	National Road	90	GOOD
Brgy 5	Barangay Road	67	FAIR
Brgy 6	Barangay Road	72	GOOD
Brgy 7	National Road	57	FAIR
	Junction to CDJ	66.5	FAIR
	Junction to Estrella St.	76.5	GOOD
	Junction to Mendoza St.	59.25	FAIR
Brgy 8	National Road	66.75	FAIR

3. Results and Discussion

The Road Condition Inspection and Survey (RoCondIS) was being conducted, thus, providing the data needed for the evaluation of the research. The data is then used to calculate the variables of this research. Following are the detailed results of the computation, as shown in Table 4.

Brgy. 1, Tuburan, Cebu. The road from Brgy.1 Junction to Gallardo Street is in GOOD condition, but some defects need to be taken action. It should undergo maintenance procedures. The road from Brgy.1 Junction to Montebon Street is in GOOD condition, and no defects are noted.Brgy.1 Junction to Rizal Park is in GOOD condition but should still undergo maintenance. The road from Brgy.1 Junction to Burgos Street is in FAIR condition, and some areas are needed to be maintained and repaired.

All roads from Brgy. 2, Tuburan, Cebu, local and national, are in GOOD condition but should still be subjected to maintenance procedures. Some areas that are lacking or have severe defects should also be taken action.

The roads from Brgy.3, Tuburan, Cebu, is in GOOD condition but still needs the appropriate maintenance procedure. Some areas that are lacking or have severe defects that should be taken care of.

The barangay road from Brgy. 4, Tuburan, Cebu is in GOOD condition, as well as the national road. However, they should still be undergoing repair and maintenance for the present defects in some areas involved in the assessment.

The barangay road of Brgy.6, Tuburan, Cebu, is in GOOD condition. It should undergo repair and maintenance procedures to alleviate the condition of the road infrastructure.

The national road at Brgy.7, Tuburan, Cebu, is in FAIR condition. The road Junction to CDJ gained a FAIR evaluation. The road Junction to Mendoza Street also got a FAIR evaluation. All roads must undergo routine maintenance and repair work to improve the serviceability of the road. The road Junction to Estrella St. is in GOOD condition but still requires routine maintenance and repair work in some areas with severe defects.

The national road at Brgy.8 gained a FAIR evaluation during the inspection. As it is a national road, it could be noted that most vehicles use the said road, thus, it is required to undergo routine maintenance and repair works. That is because some defects that are present in the road are already tangible. The defects that are discovered and evaluated for each of the streets of the eight barangays in the Poblacion, Tuburan Cebu are tabulated and shown in Table 5. Recommended corrective measures are then provided in Table 6 Based on the tallied defects that are noted for the different street junctions.

Table 5. Summary of road sections and their code of defects

Barangay	Road Section	Recommendation
Brgy 1	Junction to Gallardo St.	Code 02, Code 03, Code 12
	Junction to Montebon St.	None
	Junction to Rizal Park	Code 06-E, Code 06-C, Code 06-Y, Code 06-P, Code 12
	Junction to Burgos St.	Code 02, Code 03, Code 06-E, Code 06-C, Code 06-Y, Code 06-P, Code 09, Code 12
Brgy 2	National Road	Code 06-Y, Code 09
	Junction to Osmeña St.	Code 02, Code 03, Code 06-C, Code 06-ECode 06-Y, Code 06-P, Code 09
	Junction to Maxilom-Osmeña St.	Code 02, Code 06-C, Code 06-ECode 06-Y, Code 06-P, Code 12
	Junction to Gallardo St.	Code 02, Code 06-C, Code 06-ECode 06-Y, Code 06-P, Code 09
Brgy 3	Barangay Road	Code 06-E. Code 06-C, Code 06-Y, Code 09
	National Road	Code 09
Brgy 4	Barangay Road	Code 03, Code 06-E, Code 06-C, Code 06-Y, Code 07, Code 09
	National Road	Code 09
Brgy 5	Barangay Road	Code 03, Code 06-E, Code 06-C, Code 06-Y, Code 07, Code 09, Code 12
Brgy 6	Barangay Road	Code 03, Code 06-E, Code 06-C, Code 06-Y, Code 07, Code 09
Brgy 7	National Road	Code 01, Code 02, Code 03, Code 06-C, Code 06-P, Code 09
	Junction to CDJ	Code 01, Code 02, Code 03, Code 06-P, Code 09, Code 12
	Junction to Estrella St.	Code 06, Code 09, Code 12
	Junction to Mendoza St.	Code 01, Code 02, Code 06-P, Code 09, Code 12
Brgy 8	National Road	Code 01, Code 02, Code 06-P, Code 09, Code 12

With the given defects of the road sections evaluated, appropriate repair works and maintenance procedure is required for each one. The provision for the required procedures is given as per [8] and is tabulated above in Table 6. Appropriate treatment and measures should be done for each defect or deficiency being evaluated from the road sections of the cluster barangays of Poblacion, Tuburan, and Cebu.

Table 6. Description of Road/Bridge Defects/Deficiencies as per DPWH DO 041 s. 2016

Code	Description/ Associated Defects	Recommended Corrective Measure/ Treatment
01	POTHOLES	In areas requiring bituminous penetration for premix patching, the addition of base materials (hot) is included if no subgrade repair is necessary. This applies to concrete bituminous premix penetration patching as well.
02	ALLIGATOR CRACKS	Bituminous premix pavement (hot) or penetration patching may include the addition of base materials if necessary, provided that no subgrade repair is required.
03	MAJOR SCALING	Re-blocking of Slabs
04	SHOVING AND CORRUGATION	Half or full-width replacement of defective pavement may be necessary. Suppose a defect frequently recurs in a section. In that case, further investigation is required to identify a more suitable intervention, such as (a) scheduling the road section for reconstruction or (b) considering the removal and replacement of the affected area based on engineering judgment.
05	PUMPING AND DEPRESSION	Re-blocking or replacement of concrete pavement, along with base adjustment.
06 - E	Edge Line	Application or reapplication of thermoplastic paint for pavement markings requires that the carriageway width of approximately 6.10 meters be marked with edge and centerline stripes, including repainting of faded lines.
06 - C	Center Line	
06 - Y	Yellow Line (Indudes Yellow Box Lines In major Intersections with traffic lights; Red Box Lines for Metro Manila area)	
06 - P	Pedestrian Lane (In schools, hospitals, government offices and major intersections)	
07	LOW/INVERTED SHOULDERS	Resurfacing or reshaping the unpaved shoulder and reinstating any settled areas is necessary ensuring that the shoulder is stable. Grass should be trimmed to a height that allows water to drain from the pavement surface. To reduce hazards, a lane-to-shoulder transition should be provided.
08	LUSH VEGETATION	Removal of weeds and other vegetation
09	CLOGGED DRAINS	Manual cleaning and unclogging of canals and drainage culverts, along with repairing damaged lined canals or replacing broken culvert sections. This also includes manual cleaning and reshaping of unlined ditches.
10	OPEN MANHOLE	Repair damaged drainage manhole covers and edges, curb inlets, and drainage grates. Replace any missing drainage manhole covers and curb grates.
11	NO/INADEQUATE SEALANT IN JOINTS	Apply sealant on open and under-sealed joints.
12	CRACKS	Seal working cracks with asphalt sealant or pressurized concrete epoxy. For cracks on concrete, consider cross-stitching (Type 1: Staple tie bar or Type 2 diagonal tie bar). See DO 4, s. 2006: Interim Guidelines for the maintenance and rehabilitation of unreinforced concrete roads.
13	RAVELLING	Removal, replacement, or resealing of the affected road section is necessary; if a large area is impacted, monitoring will continue until reconstruction.
14	UNMAINTAINED ROAD SIGNAGES	Repair or replace broken, damaged, or vandalized signs and clean dirty signage.
15	UNMAINTAINED ROAD BRIDGES	Cleaning the bridge deck and drainage, repairing damaged curbs, sidewalks, wing walls, and railings, and painting or repainting the bridge. This also includes installing signage and the bridge name, as well as clearing the waterway. Moderate to severe spalling, scaling, and cracking should be addressed through full or partial depth replacement, including concrete decks with bituminous wearing surfaces.

The Response Time for rectification of the defects is also given by the Department Order, as shown in Table 7. The time provided is the appropriate time needed to carry out the maintenance works for each defect.

Most roads are generally in good condition, which is a positive finding indicating effective initial construction and possibly regular maintenance efforts. Despite being rated as good or fair, nearly all roads require some form of maintenance. This includes addressing defects such as potholes, cracks, or uneven surfaces, which, if left unchecked, can deteriorate further and compromise road safety and usability.

The recommendation for routine maintenance and repair aligns with the concept of proactive management in pavement maintenance systems. Addressing minor issues promptly prevents the escalation of problems that could lead to more extensive repairs and higher costs in the future.

Table 7. Prescribed response time for rectifying each defect/deficiency as per DPWH DO 041 s. 2016

CODE	DESCRIPTION/ ASSOCIATED DEFECTS	Response Time
01	POTHOLES	3 days
02	ALLIGATOR CRACKS	3 days
03	MAJOR SCALING	30 days
04	SHOVING AND CORRUGATION	10 days
05	PUMPING AND DEPRESSION	30 days
06 - E	No/Faded Road Markings - Edge Line	15 days
06 - C	No/Faded Road Markings - Center Line	15 days
06 - Y	No/Faded Road Markings - Yellow Line (Indudes Yellow Box Lines In major Intersections with traffic lights; Red Box Lines for Metro Manila area)	15 days
06 - P	No/Faded Road Markings - Pedestrian Lane (In schools, hospitals, government offices and major intersections)	15 days
07	LOW/INVERTED SHOULDERS	7 days
08	LUSH VEGETATION	3 days
09	CLOGGED DRAINS	3 days
10	OPEN MANHOLE	10 days
11	NO/INADEQUATE SEALANT IN JOINTS	3 days
12	CRACKS	3 days
13	RAVELLING	7 days
14	UNMAINTAINED ROAD SIGNAGES	3 days
15	UNMAINTAINED ROAD BRIDGES	3 days

The use of tables to present defect tallies and recommended corrective measures (as mentioned in Tables 5, 6and 7) indicates a structured approach to data management and decision-making. This systematic approach helps in prioritizing resources and ensuring efficient allocation of maintenance efforts.

This structured approach is invaluable for local authorities and stakeholders responsible for managing road maintenance. Firstly, it facilitates informed decision-making by presenting data in a format that is easy to interpret and analyze. Decision-makers can quickly identify which road segments require immediate attention based on the severity and frequency of reported defects. This prioritization is crucial for optimizing resource allocation, ensuring that limited budgets and manpower are directed where they are most needed, thereby maximizing the effectiveness of maintenance efforts.

4. Conclusion

From the results being presented, it is revealed that none of the road pavements of Poblacion, Tuburan, or Cebu are in poor and bad condition. The majority of the road sections are in GOOD condition, and the rest are in FAIR condition. It is noted that none of the road pavements assessed were categorized as being in poor or bad condition; instead, the majority were found to be in GOOD condition, with the remainder falling into the FAIR condition category. This overall positive assessment suggests that initial construction and maintenance efforts have been generally effective in ensuring road quality thus far.

However, the research also identifies common defects that have been observed across the road sections. These defects range from low to moderate to severe. These include (a) the appearance of alligator cracks, (b) the formation of major scaling, (c) the absence or complete fading of pavement markings, (d) the clogged drainage system, and (e) the formation of cracks in the pavement. These defects range in severity from minor to moderate to severe, including issues such as alligator cracks, major scaling, faded pavement markings, clogged drainage systems, and various types of pavement cracking. The presence of these defects underscores the importance of proactive maintenance and repair. Neglecting these issues could potentially lead to aggravated road deterioration, compromising both user convenience and safety over time.

Sheer neglect of these defects could lead to larger problems because these might compromise not only the convenience of the users but also their safety. This is why it is important to take necessary actions to perform repair works and maintenance procedures.

In line with this, this research could be a great help in becoming the basis for the local and municipal officials in creating a proposal to solve the problems soon and continually improve the status of their transportation infrastructures. With the summarized results containing the evaluation of the pavements of the road sections of the barangays in Poblacion, Tuburan, and Cebu, the concerned person will be able to have an outlook of the solutions to the deficiencies in their roads.

The research advocates for immediate action to address these defects through repair works and ongoing maintenance procedures. It emphasizes the role of local and municipal officials in utilizing the research findings as a basis for developing proposals aimed at resolving these issues promptly. By doing so, officials can ensure continual improvement in the condition of transportation infrastructure throughout Poblacion, Tuburan, and Cebu.

However, continual improvement can only be achieved if there will always be evaluation and inspection procedures to be done by the involved personnel. This is to continually assess the condition of the roads in a certain locality, and be able to come up with excellent action plans to carry on the goal of having a serviceable roadway system.

Continuous assessment of road conditions enables authorities to identify emerging issues early and formulate effective action plans to maintain a serviceable roadway system. This proactive approach not only enhances road safety and usability but also optimizes resource allocation by addressing problems before they escalate into more costly repairs.

In consonance with [8], it is recommended that the appropriate response time for rectifying the defect should be followed and that appropriate sanction or reward should be imposed if it is justified that the rectification works are neglected or done.

In line with these recommendations, the conclusion highlights the importance of adhering to appropriate response times for rectifying identified defects. It suggests that a system of incentives and sanctions may be necessary to ensure that maintenance and repair works are conducted promptly and efficiently. This approach fosters accountability among stakeholders and encourages a culture of responsible infrastructure management.

Funding Statement

This research and publication were funded by the authors personally.

Acknowledgements

The authors would like to acknowledge the support of Cebu Technological University – Tuburan Campus, College of Engineering, in realizing this study.

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