

ANALYSIS OF EXISTING ROAD SURFACE ON THE BASIS OF POTHOLE CHARACTERISTICS



^{#1}Vishal.L.Solanke, ^{#2}Darshan.D.Patil, ^{#3}Aniket.S.Patkar, ^{#4}Gajanan.S.Tamrale,
^{#5}Prof.Amit.G.kale

¹vsolanke655@gmail.com,
²darshanpatil047@gmail.com

^{#5}Assistant Professor at Sinhgad Academy of Engineering,
kondhwa(bk),Pune.

ABSTRACT

This project will help to classify the condition of road pavement surface on the basis of characteristics of pothole namely depth, area and volume. Now a days in India there is no specific criteria for road maintains and road construction. Due to no specific criteria any representatives do unnecessary reconstructions or maintenance and vice versa. There is a need for a specific criterion for limiting the expenses made on this. There is need for developing such classification criteria for making choices regarding the maintenance of roads. In this project firstly we select the road and collected the information about there characteristics such as area, volume, depth and perimeter of pothole by using traditional methods but for area we use the android software in which by taking a photograph it will give us the area and perimeter of pothole. Then we have conducted a survey by using google form. In this survey there are many questions are asked for different ranges of pothole characteristics according to there impact on user. This questionnaire is send to total 35 experts. In which total 20 experts such as engineer, site engineers, road contractors & government contractors and remaining 15 are road users. According to there responses the reaction number is calculated for each pothole scale. By using this then the roads are priorities. according to the answers comes from calculation it is classified in different types such as Tolerable, Discomforting, Intense, Extreme, Very severe. Which will help for road maintains & road construction.

ARTICLE INFO

Article History

Received: 31st May 2019

Received in revised form :
31st May 2019

Accepted: 2nd June 2019

Published online :

3rd June 2019

I. INTRODUCTION

Roads make important contribution to economic development and growth and bring important social benefits. They are of vital importance in order to make a nation grow and develop. In addition, providing access to employment, social, health and education services makes a road network crucial in fighting against poverty. Roads open up more areas and stimulate economic and social development. For those reasons, road infrastructure is the most important of all public assets. A good transport system plays an important role for development of country. Such transport system consists of Asphalt, Concrete or combination of both in proportion. This system may have many defects such as potholes unevenness of manholes with road, skid resistance i.e. friction, improper drainage considerations and deflection. Pavement fail because of many factors, there are four primary reasons pavement fail prematurely. Failure in design, construction, materials and maintenance. There are different types of problems creating

on existing road surfaces like as cracking, rutting, potholes and delimitation. The major impact of the maintenance will be in the form of area improvement, reduction in vehicle operating costs and travel time, performance of certain core sectors (cement, steel, construction equipment) and employment generation.

The formation of potholes is degenerated by low temperatures, as water expands when it freezes to form ice, and puts greater stress on an already cracked pavement or road. Once a pothole forms, it grows through continued removal of broken chunks of pavement. If a pothole fills with water the growth may be accelerated, as the water "washes away" loose particles of road surface as vehicles pass. Potholes can grow to feet in width, though they usually only become a few inches deep, at most. If they become large enough, damage to tires and vehicle suspensions occurs. Serious road accidents can occur as a direct result, especially on motorways where vehicle speed

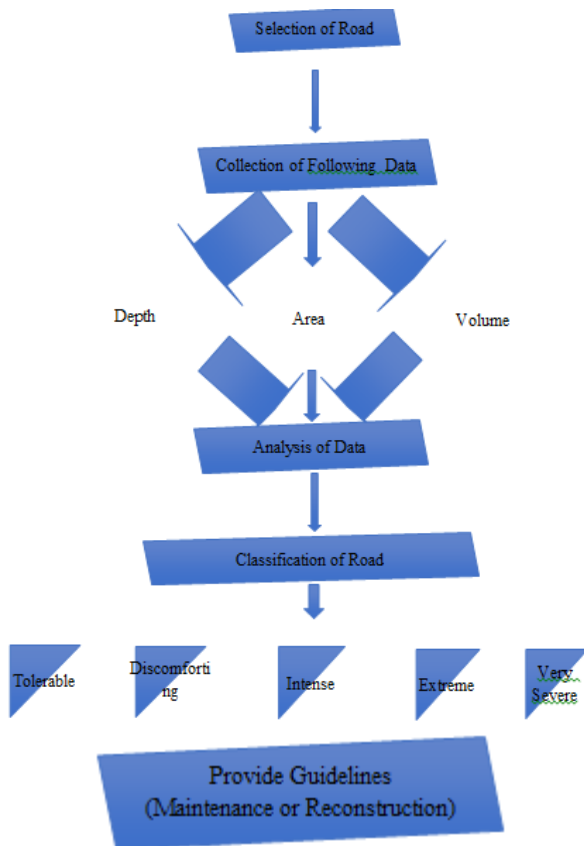
are greater. Potholes begin after snow or rain seeps into the soil below the road surface.

It is important to distinguished the types of potholes in order to choose the most suitable treatment and assign the appropriate property. Some jurisdiction classifies the potholes severity and assign priority levels based solely on their depth. Hence, we are dealing with potholes characteristics such as area, length, volume, depth. There are several reasons for potholes formation such as environmental, traffic loading and road pavement type and materials used for construction

Objective:

- To study the pothole characteristics namely depth, area, volume and according to the characteristics of pothole to classify the road.
- To develop an index on the basis of pothole characteristics which will give guideline for maintenance and reconstruction of road.

II. METHODOLOGY



Potholes have different properties such as its size, depth, area & volume. In this research we are going to analysis it's depth, area, volume and classify them according to collected information and use this for maintenances purpose or for reconstruction.

Firstly, we are going to find the depth of potholes. The method used for its calculation is taking a thread and scale for measuring depth, arrange the thread parallel to the road surface from one end of pothole to other end of pothole and

tight the thread. Then put the scale perpendicular to the thread and note down the depth of it at different position. The position at which we get highest reading of depth is consider as the depth of that pothole.

Secondly, after this we are taking the measurement of volume of potholes. For this we are using two methods for small size potholes we are taking polythene and pouring water in it up to the surface level and taking this water in measuring cylinder to calculate volume of particular pothole, according to the depth of water in cylinder and area we have getting its volume.

Another method used for large size potholes. In this firstly are going to cover this pothole by cloth. And then pour the sand up to the road surface and remove this sand and place in container. Then by using volume container we will get the volume of large pothole.

For area, we are taking the photos of pothole at a fixed level and using android application known as "Sketch and Curves" we will get the accurate area of that pothole. SketchAndCalc is the application capable of calculating areas of uploaded images.

1. To calculate the area of a pothole, import the image from main menu in the top right corner, or paste an image saved in the clipboard.
2. Identify and draw the 'known length' using the rule tool from the toolbar.
3. Enter the known length and chosen measurement system, then submit with the tick.
4. With the scale now set, select 'add to canvas' to begin drawing your area.
5. After completing the drawing, we will get the perimeter of the draw area on field and its field area.
6. By taking the reference from various industry experts, engineers, professors we will assign a reaction number for the specific ranges of area & volume to decide the severity scale for the characteristics of various potholes and assessment of road condition. By combining the area and volume characteristics data to determine the severity index for road pavements.
7. After that we will classify the pothole severity and assign the priority levels which helps to analysis the pavement of existing roads on scale such as tolerable, discomforting, intense, extreme and very severe. Classification of characteristics of pothole and assign them the priority levels will serve as a selection factor for the maintenance and reconstruction of the pavement.

III. ANALYSIS OF DATA

CASE STUDY: -1

Place: Pune

Location: Katraj Kondhwa Flyover- Gujarwadi Rd, Katraj nagar

Description: Dense graded bituminous macadam (DBM)

Collection of data

Sr.no	Shape	Known Length (cm)	Depth (cm)	Area (cm sq.)	Volume (ccs)	Perimeter (cm)
1	Circle	29	3.5	1090.12	3000	125.02
2	Uncategorized	22	3.6	1749.59	3500	164.97
3	Mixed	42	6	2460	7800	310.09
4	Oval	19	2.5	367.28	600	77.24
5	Oval	31	7	5043.07	13100	317.14
6	Mixed	22	3.5	1277.6	1800	142.53
7	Oval	28.5	2.7	2169.14	2900	201.27
8	Circle	19	2.4	260.94	450	74.83
9	Uncategorized	46	4.2	2797.95	11500	198.99
10	Oval	37	4	1020.49	3600	126.07
11	Uncategorized	47	6.2	2784.43	7600	215.73
12	Mixed	66	5.4	2763.64	13500	221.18
13	Circle	26	3.5	693.15	1750	99.79
14	Oval	39	7.5	4607.82	13500	281.6
15	Circle -	37	3.5	1429.01	1400	57.01
16	Oval	22.5	2.7	441.32	900	89.07
17	Uncategorized	29.5	3.2	143.07	3100	149.26

CASE STUDY: -2**Place:** Pune**Location:** Kakade Chowk - Todkar Builders Site_(VIIT College)**Description:** Dense graded bituminous macadam (DBM)**Collection of Data:**

Sr. no	Shape	Known Length (cm)	Depth (cm)	Area (cm sq.)	Volume (ccs)	Perimeter (cm)
1	Circle	18	2.4	349.01	440	72.02
2	Oval	19	2.2	360.4	420	74.83
3	Uncategorized	18	2.3	960.01	1450	127.02
4	Mixed	24	2.4	1177.67	1700	153.33
5	Uncategorized	51	6.5	4103.10	7500	247.12
6	Uncategorized	18	2.3	340.11	460	69.02
7	Circle	19	2.2	355.02	420	79.05
8	Oval	22.6	1.8	401.22	510	89.02
9	Uncategorized	31	3.1	643.05	1100	99.17
10	Circle	15	2	290.30	350	57.90
11	Uncategorized	28	2.5	2049.03	4400	192.07
12	Mixed	29	2.4	346.20	660	73.40
13	Circle	20	2.2	366.20	540	76.03
	Uncategorized	45	6.1	1963.0	8540	166.30

14	orized			2		
15	Oval	21.3	1.7	401.22	680	89.02
16	Mixed	22	3.6	693.13	1250	99.73
17	Oval	18	2.5	470	550	73.26
18	Circle	27	2.4	1943.40	4250	172.11

CASE STUDY: -3**Place:** Pune**Location:** 36, Mukund nagar-11, Shankar Rao Lohane Marg**Description:** Dense graded bituminous macadam (DBM)**Collection of data**

Sr. no	Shape	Known Length (cm)	Depth (cm)	Area (cm sq.)	Volume (ccs)	Perimeter (cm)
1	Uncategorized	22.5	2.4	441.32	900	89.07
2	Uncategorized	25.5	3.1	973.07	3100	129.26
3	Circle	19	2.5	366.23	500	76.83
4	Oval	23.5	2.9	461.32	1000	97.07
5	Oval	57	5.0	1969.02	6900	260.9
6	Mixed	23.5	2.2	903.07	3200	126.27
7	Circle	19	2.4	365.23	450	75.83
8	Uncategorized	45	4.8	2477.08	6100	185.7
9	Uncategorized	29	2.4	643.06	1100	101.87
10	Mixed	33	3.6	1760.12	3600	166.97
11	Oval	16	2.1	270.26	400	270.26
12	Circle	33	2.1	1940.30	3800	179.01
13	Uncategorized	49	6.1	2784.43	8300	215.73

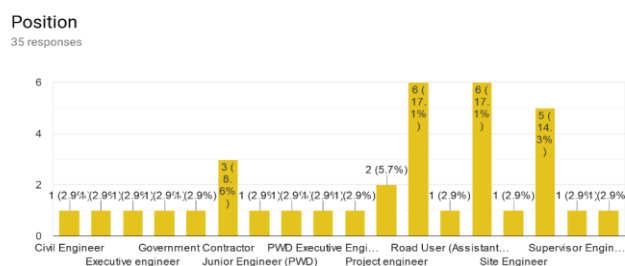
CASE STUDY: -4**Place:** Pune**Location:** Punya Dham Ashram road- sunflower society**Description:** Dense graded bituminous macadam (DBM)**Collection of data**

Sr. no	Shape	Known Length (cm)	Depth (cm)	Area (cm sq.)	Volume (ccs)	Perimeter (cm)
1	Uncategorized	39	3.9	1320.30	3900	145.71
2	Mixed	67	7.1	4560.5	11250	278.52
3	Oval	63	5.1	1970	6900	260.9
4	Uncategorized	32	6.5	1444.72	2200	269.52
5	Mixed	62	7.3	4607	8400	281.6
6	Uncategorized	35	6.2	1200.16	7200	269.25
7	Uncategorized	32	5.2	1515.20	5825	180.25
8	Oval	46	5.8	1600.40	6025	171.25
9	Mixed	42	4.6	1420.45	4700	150.81
10	Uncategorized	18	2.4	370.28	650	79.25
11	Mixed	22	2.5	395.26	690	88.67
12	Oval	36	3.6	1130.20	3200	131.07
13	Mixed	66	7.4	9125.55	12500	370.22
14	Mixed	58	6	2465	7500	320.09
15	Uncategorized	49	4.3	1530.52	5000	160.83
16	Circle	52	6.3	1895.81	5700	223.81
17	Mixed	43	5.9	1500	6246	178.25
18	Circle	67	7.8	4090.8	13500	279.54

CASE STUDY: -5**Place:** Pune**Location:** Sai Sanskruti – Ultimate Power, KJEI Collage**Description:** Dense graded bituminous macadam (DBM)**Collection of data**

Sr.no	Shape	Known Length (cm)	Depth (cm)	Area (cm sq.)	Volume (ccs)	Perimeter (cm)
1	Oval	17	2.3	348.1	450	73.2
2	Mixed	20	2.1	365.2	430	72.85

3	Uncategorized	29.2	2.7	2048.5	2850	193.47
4	Circle	23.1	3.1	1265.8	1900	120.87
5	Oval	44.9	5.2	3005.45	6100	235.85
6	Uncategorized	39.5	6.9	2977.05	9000	280.5
7	Uncategorized	47	6.2	2784.45	8500	215.85
8	Oval	31.5	6.5	2501.45	6950	267.5
9	Mixed	21	1.8	380.25	410	89.25
10	Oval	41	4.5	1980.25	3100	192.91
11	Mixed	38	5.7	2835.85	6200	230.85
12	Oval	43	5.1	2939.05	5900	222.85
13	Uncategorized	28	3.5	1875.85	2500	181.81
14	Uncategorized	34.6	7.2	4875.25	12500	319.04
15	Uncategorized	55	4.9	2525.85	8200	122.25
16	Oval	42	5.4	2545.42	6000	198.05
17	Uncategorized	44.8	6.2	2585.25	8500	215.25
18	Oval	21	3.6	1575.5	2150	126.8
19	Uncategorized	39	7.3	5044.5	13100	175.8
20	Circle	22.1	3.2	1365.8	2100	140.35
21	uncategorized	40.5	6.5	3077.05	9120	290.6
22	Oval	40	4.7	2200	8000	111.25

Responses from questionnaire survey about reaction number

Calculations:

$$X = \frac{N_1R_1 + N_2R_2 + N_3R_3 + N_4R_4 + N_5R_5 + N_6R_6 + N_7R_7 + N_8R_8 + N_9R_9}{\text{TOTAL LENGTH OF ROAD IN KM}}$$

$N_1, N_2, N_3, \dots, N_9$ = Number of potholes for each range, $R_1, R_2, R_3, \dots, R_9$ = Reaction number for each range. According to their responses we find out the reaction number as follows:

Area:

Area ranges	Reaction number
0-1000 sq.cm	1.72
1000-2000 sq.cm	3.21
More than 2000 sq.cm	4.14

Depth:

Depth ranges	Reaction number
0-2.5 cm	1.50
2.5-5.0 cm	2.98
More than 5.0 cm	4.23

Volume:

Volume ranges	Reaction number
0-4000 cu cm	2.23
4000-8000 cu cm	3.64
More than 8000 cu cm	4.58

IV. RESULTS

From the questionnaire survey we get the reaction number

Area:

Area ranges	Reaction number
0-1000 sq.cm	1.72
1000-2000 sq.cm	3.21
More than 2000 sq.cm	4.14

Depth:

Depth ranges	Reaction number
0-2.5 cm	1.50
2.5-5.0 cm	2.98
More than 5.0 cm	4.23

Volume:

Volume ranges	Reaction number
0-4000 cu cm	2.23
4000-8000 cu cm	3.64
More than 8000 cu cm	4.58

According to the calculation by the priority method the results for different roads are as follow:

For case study 1, $X = 157.61$

For case study 2, $X = 125.15$

For case study 3, $X = 95.48$

For case study 4, $X = 187.39$

For case study 5, $X = 226.57$

V. CONCLUSION

From the survey and result, we got the reaction number for the different ranges of area, volume and depth & values for the priority of different roads mentioned in the case studies we have provided the different priority for roads.

Priority order	Range of rating
Tolerable	0-50
Discomforting	50-100
Intense	100-150
Extreme	150-200
Very severe	Greater than 200

Form the above table conclude that

For Case Study 1: $X = 157.61$, the above road is **Extreme** form the priority order.

For Case Study 2: $X = 125.15$, the above road is **Intense** form the priority order.

For Case Study 3: $X = 95.48$, the above road is **Discomforting** form the above order.

For Case Study 4: $X = 187.39$, the above road is **Extreme** form the above order.

For Case Study 5: $X = 226.57$, the above road is **Very Severe** form the order.

REFERENCES

- [1] Amal Jyothi 2016 "Pothole detection and volume estimation using stereoscopic cameras" from IJIEE.
- [2] Aritis Mednis, Girts, Georgijs june-2011 "Real time pothole detection using Android smartphones with accelerometer" from RESEARCH GATE.
- [3] Dr. Rakesh Gupta, Zulufqar Bin Rashid june-2017 "Study of defects in flexible pavement and it's maintenance" from IJERD.
- [4] Dr. Umesh Sharma 2010 "Study of causes of potholes on bituminous road" from CHITKARA UNIVERSITY.
- [5] Giuseppe Iopencipe, Giuseppe Cantisani 2013 "Unified analysis of road pavement profiles for evaluation of surface characteristics" from RESEARCH GATE.
- [6] Juping Yang, Shinji Ozawa 1996 "Road scene analysis from perspective image" from IEEE.
- [7] Simita Biswas, Leila Hashemian, Alireza Bayat 2018 "Investigation of potholes severity and maintenance methods in Canada through questionnaire survey" from ASCE.
- [8] Taehyeong Kim, seung-ki Ryu oct-2014 "A guideline for pothole classification" from IJET.
- [9] Umang Bhatt, Shouvik Mani, Edgar Xi sep-2017 "intelligent pothole detection and road condition assessment" from CHICAGO, IL, USA.
- [10] V.A. Knyaz, A.G. Chibunichev 2016 "Photogrammetric techniques for road surface analysis" from ISPRSARCHIVES.
- [11] Ayush Rajesh Vora, Prof. Leonid Reznik, 2012 "Road pothole classification and the reporting with data quality estimates" from ROCHESTER INSTITUTE OF TECHNOLOGY, ROCHESTER NEW YORK USA.