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Rating to Existing Highway Sections According to Distresses with Network Survey Vehicle

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Abstract - *As per recent Ministry guideline, Ministry imposed new technologies for maintenance of existing highways. This paper presents new technique for existing road distress data collection. This distress collection is very important parameter for identification of future maintenance requirements for existing highway section. Visual inspection of pavement was the earlier method for identification of various defects of existing pavement which is important for identifying sections having worst road conditions. In this paper distress detection done for existing flexible pavement section of National Highway-53. The bad condition of pavement produces impact on various parameters like comfort zone of passengers travelling through vehicles, safety, VOC, speed of vehicle and time of journey, emissions/pollution etc. This Network Survey Vehicle obtains highway pavement information such as roughness, rutting, cracking, ravelling, bleeding, texture depth, edge cracking, potholes, geometric data, etc. at every location with images and accurate distance measurements. In this study Dynatest Denmark make model of Network Survey Vehicle is used. The main objective of this research is to find out various pavement distresses on existing flexible pavement. The study was conducted for 17.750km national highway length. The data obtained from Network Survey Vehicle is analysed with Microsoft excel for distress rating of highway section.*

Key Words: **Distress rating[1], Network Survey Vehicle[2], Flexible Pavement[3], VOC (Vehicle operating cost)[4], Roughness[5], Rutting[6], Cracking[7], Ravelling[8], Bleeding[9], Texture Depth[10], Edge Cracking[11], Potholes[12], LCMS (Laser Crack Measurement System)[13]**

1. INTRODUCTION

Road surface condition is a most important factor for the development of the nation. Pavement distresses are dangerous to moving traffic on surface of pavements. This produces deterioration of pavement structures. Once the distress data collected from a network survey vehicle, maintenance requirements and costing can be determined. Inspection of road surface after construction, severity of damage and identifying the cause of the damage and lastly deciding the treatments and its priorities as per need. Each type of distress is the result of one or more variables, which provides great insight into the causes of pavement deterioration. Thus, for each pavement type, the proper pavement evaluation program and procedure should include the identification of pavement distress types, severity, and the number of distresses. Pavement distress information is usually converted into a rating in terms of number. This number denoted to all the distress types, severities, and quantities. This number can be used at the network level to define the condition state, identify when treatments are needed, rank or prioritize, and to derive the number used to forecast pavement condition.

Network Survey Vehicle is an innovative technology to inspect the existing pavement surface and collecting pavement high resolution imagery data, cracking, roughness, rutting, ravelling, bleeding, texture depth, edge cracking, potholes measurement with LCMS, accurate distance measurement with distance measurement unit fitted at rear wheel, etc.

2. STUDY AREA LOCATION

The highway section between Nagpur towards Chhattisgarh on NH 53 to is selected for this study. Starts from design chainage 0/000 km and ends at design chainage 17/750 km. The total length of study stretch is 17.750 km. Figure 1 shows the map view of study area. The area under study is in Nagpur district of Maharashtra state. This national highway was constructed in 2013.

Figure -1: Study Area Location

3. DATA COLLECTION

Pavement condition survey carried out with Network Survey Vehicle. Network Survey Vehicle collected all distress data. Refer following sample data-

Design Chainage		Cracking Area (sq.m)	Potholes Area (Sq.m)	Ravelling Area (Sq.m)
From	To			
0	500	8.184	0	6.949
500	1000	0	0	1.595
1000	1500	51.558	0	3.759
1500	2000	302.031	0	124.374
2000	2500	0	0	103.178
2500	3000	10.388	0	193.743
3000	3500	28.334	0	41.817
3500	4000	1.215	0	35.018
4000	4500	35.814	0	25.96
4500	5000	46.489	0	90.435
5000	5500	29.662	0	237.266
5500	6000	51.029	0	651.617
6000	6500	0	0	62.29
6500	7000	1.234	0	5.981
7000	7500	9.286	0	4.424
7500	8000	105.095	0	37.81
8000	8500	1.557	1.348	16.711
8500	9000	3.304	0	7.975
9000	9500	10.122	0	5.298
9500	10000	1.443	0	131.433
10000	10500	23.926	0	8.601
10500	11000	4.101	0	7.368
11000	11500	28.427	0	26.795
11500	12000	0	0	44.702
12000	12500	14.356	0	46.544
12500	13000	16.16	0	77.198
13000	13500	11.773	0	16.768
13500	14000	13.236	0	24.385

Design Chainage		Cracking Area (sq.m)	Potholes Area (Sq.m)	Ravelling Area (Sq.m)
From	To			
14000	14500	56.17	0	26.662
14500	15000	97.855	0	16.294
15000	15500	8.774	0	24.972
15500	16000	50.402	0	8.052
16000	16500	20.643	0	1.652
16500	17000	47.816	0	4.291
17000	17500	21.022	0	4.31
17500	18000	7.69	0	1.196

Design Chainage		Bleeding Area (Sq.m)	Rutting depth (mm)	Texture Depth (mm)	Roughness (IRI (m/km))
From	To				
0	500	3.589	7.7	0.74	2.51
500	1000	5.545	7.69	0.58	2.37
1000	1500	3.456	8.48	0.51	2.51
1500	2000	10.406	7.19	0.62	2.7
2000	2500	0	7.6	0.89	3.64
2500	3000	0	7.1	0.6	3
3000	3500	0	6.52	0.78	3.06
3500	4000	0	12.84	0.59	2.69
4000	4500	0	9.2	0.55	2.48
4500	5000	0	7.83	0.84	2.47
5000	5500	0	7.71	0.82	3.07
5500	6000	0	7.45	0.66	3.37
6000	6500	17.529	6.9	0.74	3.73
6500	7000	0	9.17	0.44	2.49
7000	7500	0	8.08	0.56	2.87
7500	8000	0	13.36	0.86	2.79
8000	8500	18.82	8.2	0.65	2.77

Design Chainage		Bleeding Area (Sq.m)	Rutting depth (mm)	Texture Depth (mm)	Roughness (IRI (m/km))
From	To				
8500	9000	18.666	8.59	0.69	2.63
9000	9500	0	8.84	0.59	2.6
9500	10000	0	9	0.67	2.44
10000	10500	7.937	7.92	0.77	2.91
10500	11000	15.096	9.43	0.57	2.64
11000	11500	22.998	7.94	0.74	2.6
11500	12000	0	8.23	0.65	2.91
12000	12500	0	8.03	0.7	2.62
12500	13000	0	7.09	0.83	2.65
13000	13500	0	7.24	0.75	2.9
13500	14000	0	6.73	0.62	2.57
14000	14500	0	7.54	0.51	2.54
14500	15000	0	8.11	0.8	2.88
15000	15500	0	7.1	0.66	2.81
15500	16000	8.982	8.81	0.72	2.56
16000	16500	0	7.33	0.6	2.6
16500	17000	0	7.56	0.6	2.66
17000	17500	0	6.72	0.67	2.63
17500	18000	3.039	7.46	0.68	2.55

Table -1: Pavement Condition Survey Data

4. DATA ANALYSIS

The collected data from Network Survey Vehicle is analyzed with the help of Microsoft excel. After getting survey work done, decided criteria for rating to various distresses with respect to severity of each distress.

Distress	Pavement Condition-Rating
Cracking Area	Percent of pavement area affected by cracking, which is converted to the following rating scale: 1 - Very Poor (> 30%); 2 - Poor (21-30%); 3 - Fair (11-20%); 4 - Good (5-10%); 5 - Very Good (<5%)
Potholes Area	No. of potholes, which is converted to the following rating scale: 1 - Very Poor (> 5); 2 - Poor (3-5); 3 - Fair (2); 4 - Good (1); 5 - Very Good (0)
Ravelling	Percent of pavement area affected by ravelling, which is converted to the following rating scale:1 - Very Poor (> 30%); 2 - Poor (11-30%); 3 - Fair (6-10%); 4 - Good (1-5%); 5 -Very Good (0%)
Bleeding Area	Percent of pavement area affected by bleeding, which is converted to the following rating scale: 1 - Very Poor (> 50%); 2 - Poor (20-50%); 3 – Fair (10-20%); 4 - Good (1-10%); 5 - Very Good (<1%)

Table -2: Criteria for Classification of Pavement Sections

The process followed in obtaining failure percentages of the first section (0/000 km – 0/500km) is described below in which only the 1st sub section has been considered for the sample calculation.

Length of one sub section = 500 m

Width of one sub section = 3.8 m

Area of one sub section = 1900 m2

Total failure area = 8.184 m2

Failure percentage = 0.004307 x 100= 0.43%

5. RESULTS

As a result, the pavement surface distress data expressed through ratings from 0 to 5 as a number format, which shows severity of distresses and pavement condition. Following results obtained from calculations.

Start Chainage	End Chainage	Cracking	Pothole	Ravelling
0	500	5	5	4
500	1000	5	5	4
1000	1500	5	5	4
1500	2000	3	5	3
2000	2500	5	5	3
2500	3000	5	5	2
3000	3500	5	5	4
3500	4000	5	5	4
4000	4500	5	5	4
4500	5000	5	5	3

Start Chainage	End Chainage	Cracking	Pothole	Ravelling
5000	5500	5	5	2
5500	6000	5	5	1
6000	6500	5	5	4
6500	7000	5	5	4
7000	7500	5	5	4
7500	8000	4	5	4
8000	8500	5	4	4
8500	9000	5	5	4
9000	9500	5	5	4
9500	10000	5	5	3
10000	10500	5	5	4
10500	11000	5	5	4
11000	11500	5	5	4
11500	12000	5	5	4
12000	12500	5	5	4
12500	13000	5	5	4
13000	13500	5	5	4
13500	14000	5	5	4
14000	14500	5	5	4
14500	15000	4	5	4
15000	15500	5	5	4
15500	16000	5	5	4
16000	16500	5	5	4
16500	17000	5	5	4
17000	17500	5	5	4
17500	18000	5	5	4

Start Chainage	End Chainage	Bleeding	Rutting Depth	Texture Depth	Roughness
0	500	5	5	5	5
500	1000	5	5	5	5
1000	1500	5	5	5	5
1500	2000	5	5	5	5
2000	2500	5	5	5	5
2500	3000	5	5	5	5
3000	3500	5	5	5	5
3500	4000	5	5	5	5
4000	4500	5	5	5	5
4500	5000	5	5	5	5
5000	5500	5	5	5	5
5500	6000	5	5	5	5
6000	6500	4	5	5	5
6500	7000	5	5	5	3
7000	7500	5	5	5	4
7500	8000	5	5	5	5
8000	8500	4	5	5	5
8500	9000	4	5	5	5
9000	9500	5	5	5	5
9500	10000	5	5	5	5
10000	10500	5	5	5	5
10500	11000	5	5	5	5
11000	11500	4	5	5	5
11500	12000	5	5	5	5
12000	12500	5	5	5	5

Start Chainage	End Chainage	Bleeding	Rutting Depth	Texture Depth	Roughness
12500	13000	5	5	5	5
13000	13500	5	5	5	5
13500	14000	5	5	5	5
14000	14500	5	5	5	5
14500	15000	5	5	5	5
15000	15500	5	5	5	5
15500	16000	5	5	5	5
16000	16500	5	5	5	5
16500	17000	5	5	5	5
17000	17500	5	5	5	5
17500	18000	5	5	5	5

Table -3: Result of Survey as a Rating

6. CONCLUSION

This paper presents the study of existing pavement distresses and its severity from a recently completed survey at section of NH-53 for flexible pavement using Network Survey Vehicle. Total 17.750 km section is selected for study. NSV tests were conducted on these road segment to determine the pavement conditions of the existing pavement. Accordingly, with collected various distress data at every 500m interval, distress rating allocated with respect to severity of destress to decide the type of pavement condition such as very poor to very good.

REFERENCES

[1] IRC:82-2015, "Code of Practice for Maintenance of Bituminous Surface of Highways", Indian Roads Congress, New Delhi, 2015.
[2] Antonella Ragnoli et al. (2018), "Pavement Distress Detection Methods: A Review".
[3] E. Salari (2011), "Pavement Distress Detection and Severity Analysis".
[4] IRC: 37-2018, "Guidelines for Design of Flexible Road Pavements", Indian Roads Congress, New Delhi, India, 2012.
[5] Antonio Pantuso et. al. (2019) "Analysis of Pavement Condition Survey Data for Effective Implementation of a Network Level Pavement Management Program for Kazakhstan".
[6] M Mubaraki (2014), "Identification of Pavement Distress Types and Pavement Condition Evaluation Based on Network Level Inspection for Jazan City Road Network".
[7] K.V.D. Perera et al. (2016), "Performance of a Sensitivity Analysis on the Multi-Function Network Survey Vehicle (MFNSV)".

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