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Performance Evaluation of Routine Maintenance Programs Provided to Existing Old Indian Highways and Its End Results

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Abstract
Under the present guidelines, the road roughness has been considered as prime indicator for selecting the road stretches for maintenance works and first priority is given to worst road sections. It is found that the existing maintenance policies no longer provide the required results, cause discomfort to the road users, and result in various accidents and frequent traffic jams. Various newly road surfaced stretches from recently declared National Highways of Madhya Pradesh: NH 59, NH59-A, State Highway-18 were selected for the analysis purpose and data was collected as per the requirement by carrying out field studies which includes, evaluation of pavement conditions through field work, crust details, road inventory survey, structural evaluation, functional evaluation, traffic volume survey data, evaluation of pavement material through laboratory work, photographic survey for various distress conditions. The study indicates that roads recently surfaced with thin renewals were prematurely failed and could not serve the designed life. Study also suggest that new renewals provided prior major rehabilitation without framing different distress conditions and avoiding mandatory investigations required to find out root causes of failures would result in complete waste of money and leads to disaster. The result also shows that routine maintenance approach with thin renewals prematurely failed with in two years and starts from rating good with initial roughness 1.8 meters/km and ends in completely road failure and required emergency re-construction.

1. Introduction

The accurate pavement condition surveys which assess the pavement's physical distress are vital for identification of pre-overlay rehabilitation effort. Necessary information on distress type, distress severities, distress amount together with drainage survey results the engineer a batter formulation of an appropriate rehabilitation strategy.In India mostly roads are maintained with reactive maintenance approach, which is limited to periodic treatment of applying thin renewals without providing intermediate treatments. This system of maintenance becomes highly expensive in later stages to restore the pavement to the original position and roads ultimately resulted in failure. The study indicates that The reason of inadequate maintenance are non-availability of funds, structural inadequacy of pavements for projected traffic, underestimation of axle load, use of only non-plan funds for maintenance, non-availability of scientific basis for planning of maintenance, poor machinery and use of out dated technologies and use of traditional material and specification which are provided to be ineffective and environmental concerns led to banning certain technologies.

2. Objectives of the Study

- To find out the viability of thin renewals provided under routine road maintenance programs.
- To find out the initial and final road roughness during the design life of thin renewals provided under routine maintenance programs.
- To find out the life of the treatment provided under routine maintenance programs and its end results.

3. Data Collection

Data pertaining to location, background, history, details of the road sections, functional and structural characteristics, soil sub grade values field and laboratory test were collected. Table 1 shows details of traffic count stations and average daily traffic.

Table 1: Average daily traffic

Sr.No	Details of the traffic count station	
1	Name of Road	Indore-Betul road
2	National Highway No	59A
3	Location of the Count Post	Kannod Town
4	Km of Count Station	Km 90/2
5	Month and Year of Census	July 2014
6	Duration of Census in Days	7 Days
7	Average Daily Traffic in Numbers Of Vehicles	(Sum of Both Direction)
8	BUS	300
9	Truck Two/Multi Axle	2330
10	Agriculture Tractor with Trolley	59
11	Total Commercial Vehicle (CVPD)	2689
12	Passenger Car Unit	8545 PCU
13	Traffic Growth Rate per annum	7.5%
14	Vehicle Damage Factor(F)	4.5(for roling/plan Terrain)
15	Lane Distribution factor	1.00
16	Period of Construction	2 Year

3.1 Structural Evaluation of NH-59A

The general practice in India is to use the method of Benkelman Beam deflection to assess the condition of the structure of the flexible pavement. As per IRC:81[1997] and procedure laid down there under, the measurements of the deflection were taken with Benkelman Beam on the entire length of the section from Km24 to Km 92 of NH59-A. Table 2 shows Characteristic deflections of NH 59-A.

Table. 2: Characteristic deflections NH59-A

Chainage (km)	Characteristic Deflection (mm)	Chainage (Km)	Characteristic Deflection (mm)	Chainage (Km)	Characteristic Deflection (mm)
53	2.773	86	3.366	60	3.838
25	2.813	84	3.372	27	3.841
52	2.867	45	3.374	31	3.877
23	2.894	43	3.403	48	3.890
55	2.894	67	3.411	78	3.917
24	2.920	66	3.418	65	3.963
37	2.952	88	3.420	50	4.019
38	2.967	29	3.447	61	4.020
39	3.007	30	3.505	33	4.171
58	3.030	79	3.509	62	4.220
56	3.074	75	3.550	83	4.223
26	3.103	71	3.568	68	4.246
41	3.135	28	3.608	72	4.269
91	3.137	44	3.631	73	4.332
54	3.149	70	3.633	81	4.410
35	3.165	46	3.641	34	4.441
57	3.192	59	3.667	49	4.450
32	3.215	42	3.668	82	4.450
87	3.240	77	3.719	89	4.505
40	3.247	74	3.726	69	4.660
36	3.250	47	3.741		
90	3.257	64	3.757		
51	3.270	63	3.759		
85	3.295	76	3.781		
92	3.328	80	3.791		

4. Methodology and Analysis of Data

The road section performance is predicted by using roughness progression model developed by (Reddy 1996) using extensive field data. The IRC:SP:16:2004 considered for critical values of roughness adopted for the different types of surfacing. Roughness progression model is a function of initial roughness after construction, deflection, CSA. Due to fatigue, the tope asphalt surface starts cracking with the passage of time which resulted in more roughness so model also consider age as one of the parameters. Table 4 shows model for roughness progression.

Table.4: Model for roughness progression. (Reddy 1996)

$$Uit-=UI_0[1+0.3012(N_t \text{ X } DEF_0)^{0.08\ Age}$$

Uit= Roughness at any time, UI0=Initial roughness, N_t= Cumulative traffic at any time t

[N=64, R2=0.7, S.E=0.2067]

4.2 Traffic projections for design life

Traffic volume has been projected for Indore-Betul road NH-59A for design life of Fifteen years from 2014 considering growth rate 7.5% per year as per the IRC guide line. Fig-1 shows the individual projection of different classes of vehicle graphically for the design life of next fifteen years.

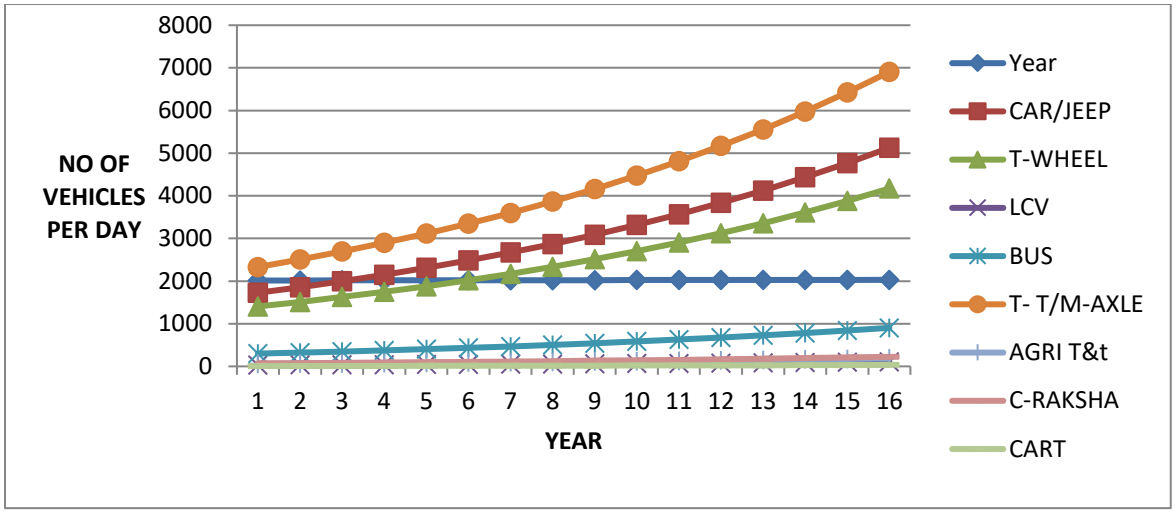

Fig.1: shows Individual projection of different classes of vehicle graphically for the design life

4.3 Analysis for deflection and roughness progressions under corrective maintenance

The selected road sections has been analyzed with periodical renewals, provided each after 5years, whenever roughness exceeds 4000 mm/Km, with provision of 75mm DBM and 40 mm AC. BBD test was done on entire length to know the structural strength of the road before the treatment. Characteristic deflections were computed. Due to fresh renewal the deflection values were reduced. The mean characteristic deflection was worked out as 3.66 mm. The percentage reduction in deflection was computed by using the deflection reduction chart (Arunachalam 1971). The reduction in the deflection value was fiend out 62%. The reduced initial deflection was considered as 1.390 mm and after second renewal it was find out 1.23 mm. Deflection and roughness progression has been worked out for the design life of proposed periodical renewal using extensive field data and traffic projections. The structural condition deterioration models were used for deflection and roughness progression. It was observed that entire pavement is reaching to reconstruction stage in the year 2023 and structurally failed. Table 6showsdeflection and roughness progression under routine maintenance for periodical renewal. Fig 2 and fig3 show deflection and roughness progression under routine maintenance respectively.

Table.6: Deflection and roughness progression under routine maintenance

YEAR	Deflection at any time t (mm)	Roughness at any time t (mm/km)
2014	1.608	1800
2015	1.881	2596.1
2016	2.226	2872.9
2017	2.669	3294.9
2018	3.242	3938.6
2019	3.537	1800
2020	4.43	2530.2
2021	5.644	2811.2
2022	7.32	3234.2
2023	9.683	3878.1
2024	13.079	4870.3

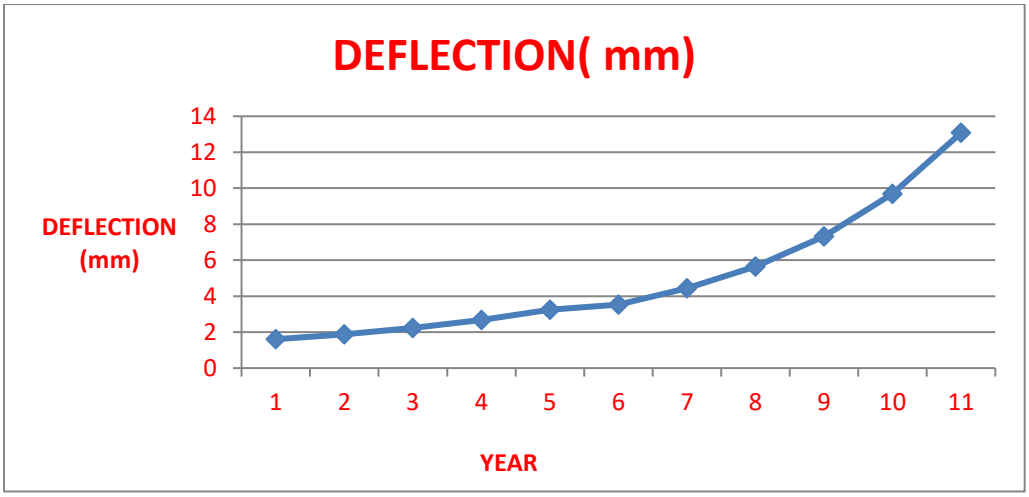

Fig.2: Deflection progression for periodical renewal

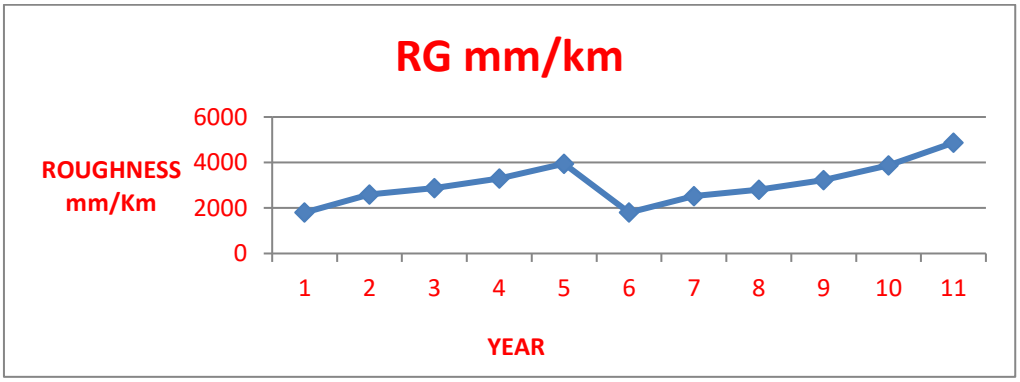

Fig.3: Roughness progression for periodical renewal

5. Conclusions:

- The study shows that routine maintenance approach with thin renewals is not viable and costly.
- The study shows that routine maintenance approach starts from initial roughness with 1.8 meters/km and ends in 8meters/km and resulted in complete road failure.
- The study shows that the treatment provided failed prematurely with in the second year of application hence not recommended.

REFERENCES

1. S. K. Chodhary (2014) "HDM-4: An Innovative tool for prediction of pavement performance and maintenance Decision" Indian Highways, May 2014 pp.No.39-48Newton.

2. Ganzala Rada (2016) "Pavement structural evaluation at the network level FHWA publication no FHWA-HRT-15-075" Federal Highway Administration Washington DC, March 2016

3. The Indian Road congress (2001) "Guidelines for the design of flexible pavements" second revision, IRC37-2001

4. V.KChakravarthi (2015) "Performance Evaluation of Flexible Pavements: A Case Study" International Journal of Engineering Research. Volume No.4, Issue No.10. pp: 569-572

5. S.S.Saraf (2022) "Design of Flexible Pavements for an Existing Road" International Journal of Engineering and Technology(IRJET) Volume 09, Issue 09. pp295-300

6. S.K Khanna and C.E.G Justo" Highway Engineering "