Investigating The Causes of Frequent Failures on Maintained Pavement Roads

Rishi Kumar Dhakariya[1], Prof. Rajesh Joshi[2]
[1, 2] Rajeev Gandhi Proudyogiki Mahavidyalaya, Bhopal, Madhyapradesh

Abstract- *This work summarizes regarding the defects in versatile pavement and therefore the maintenance in flexible pavements. Within the past, many researchers have already studied the defects and issues of maintaining the versatile pavements. Varied defects in versatile pavements are known since the existence of flexible pavement. Pavement structure may be destroyed in an exceedingly single season because of water penetration. Defects in versatile pavements could be a downside of multiple dimensions, fantastic growth of vehicle traffic (in terms of no. of shaft loading of economic vehicles), the fast growth within the road network, non-availability of appropriate technology, material, equipment, mean labor and poor funds allocation have all adscititious complexities to the matter versatile pavements. Maintenance is ready of activities directed towards keeping a structure in an exceedingly serviceable state throughout its style life. Maintenance of a road network involves a range of operations, i.e., identification of deficiencies and designing, programming and planning for actual implementation within the field and observance. The essential objective ought to be to stay the paved surface and appurtenances in fitness and to increase the lifetime of the road assets to its style life. Broadly, the activities embody identification of defects and therefore the attainable cause there off, determination of acceptable remedial measures; implement these within the field and observance of the results*

Keywords- Frequent failures, Maintained Roads, Pavement, Federal Roads and Road users

I. INTRODUCTION

In this modern world, society uses a variety of engineered objects for several different purposes. The objects are deliberate and assembled for specific functions. These include a range of products (used by households, businesses, and governments daily operations); plants and facilities (used by businesses to deliver goods and services) and a variety of infrastructures (networks like rail, road, water, gas, electricity, dams, buildings) to make sure the graceful functioning of society. Every designed and constructed object may become unreliable within the sense so that it may degrade with age and/or usage and ultimately fails. Merriam Webster definition of catastrophe is- falling short in roughly anticipated, endeavoured, preferred, or in how deficient or lacking. In terms of engineering view, a designed and constructed object is claimed to own failed when it's not ready to do its intended function that it had been designed for. Failures take place in an uncertain manner that are influenced by several factors like design, manufacture (or construction), maintenance, and operation. Additionally, the anthropological factor is additionally important during this context. One of the major causes of road failure occurs within the loss of physical infrastructure due to inadequate maintenance. Bad roads seldom discourage users or curb the quantity of traffic. Instead, they raise the value of road transport which dominates for both people and freight. Insufficient spending for preservation thus exacts hidden costs several times the price of maintaining and refurbishing roads. The users endure the impact of those additional costs, which overshadow the investment funds to a street organization from conceding or disregarding upkeep maintenance. Much of the matter of street support is established in its financial and institutional angles. Deficient motivators and frail responsibility get from the trademark partition of obligations and control between the suppliers and clients of streets. Unlike most other kinds of infrastructure, roads are neither built nor maintained by people who use them to plug output or services. Therefore, road maintenance is important to protect the street in its initially built condition; ensure adjoining assets and client's safety and supply efficient, convenient follow the route. Unfortunately, maintenance is commonly neglected or inadequately performed leading to rapid worsening of the street and inevitable disappointment from both climatic and vehicle use impacts.

1.1 Problem statement

Construction encompasses the problems relevant to the method of building and maintenance, together with the look, getting, implementation, supervising, and maintenance of roads and connected structures. With relevance the factors that have an effect on maintained asphalt pavement road, this includes the condition of maintained roads generally, also because the getting party of maintenance activities. Additionally, problems concerning the world of construction

and also the surroundings are enclosed, resembling construction and maintenance environmental impacts and mitigation, and construction website safety for frequent failure of maintained roads. Asphalt pavement road deterioration extended a lot of quicker than the corresponding maintenance budgets and institutional capacities. Traffic has additionally become a lot of heavier than expected, and shaft loadings have typically exceeded the designed capability of pavements. These patterns are evident nearly every place. New asphalt pavement roads, if inadequately maintained, deteriorate frequently and nearly observably throughout the primary to simple fraction of their service life, betting on the traffic and weather. At that time grace amount, which can last 10 to fifteen years, the pavements deteriorate far more speedily. While, not timely maintenance, they break apart. As roads become rougher, the prices of operational vehicles-and of transporting goods-begin to increase. The neglect of maintenance continues, however, the vehicle operators that pay these costs-and pass them on if they will. Road authorities don't seem to be directly full of these prices, and that they return underneath no immediate pressure to boost road conditions. Road users are typically slow to visualize the link between road conditions and also the costs of products and transport services and are typically not organized to try to one thing concerning it. One amongst the issues of the Federal Roads is that annually, around half the Federal road network is maintained and still the roads are sorted underneath poor and truthful satiate. Moreover, the value of road maintenance has amplified within the past 10 years. Therefore, the issue moving maintained asphalt pavement roads either negatively or completely are often avoided or increased severally victimization many engineering techniques. This study aims to assess the causes for frequent failures of maintained pavement Federal roads and determine the corresponding positive and negative impacts.

1.2 Objectives of the study

The overall goal of the examination is to evaluate the reasons for successive asphalt disappointments of looked after roads.

II. LITERATURE REVIEW

According to Wada and Surajo (2016), maintained bituminous pavement deterioration generally takes place thanks to combined action of traffic, weather changes, drainage, environmental factors etc.

Flexible pavements generally deteriorate at an awfully rapid rate when put next to rigid pavements thanks to the above factors, however, flexible pavements still deteriorate at a slow rate even without the traffic movement on the surface thanks to the climate and environmental factors (Khanna et al,. 2014). Harral (1988) raised three facts on maintained road deterioration to clarify the issues as follows:
Firstly; because reconstruction costs are three to 5 times the maximum amount as resurfacing or rehabilitation, no road should be allowed to say no into poor condition unless it's to be kept in this condition deliberately (with routine maintenance but no resurfacing or rehabilitation) or abandoned entirely.

Secondly; normally there's a period of about five to eight years during which paved roads in fair condition are often restored by resurfacing or Strengthening. Subsequently time, more costly measures become necessary. The existence of the many roads in fair condition suggests that extensive maintenance is required quickly if roads are to be saved before declining to poor condition.

Thirdly, the costs of working vehicles (particularly huge trucks) ascend as streets disintegrate. This can be on the grounds that, vehicle working expenses are the greatest a piece of transport costs. To take a gander at strategies for interstate upkeep, Abdul Kareem (2010) expressed that the reasons for auxiliary disappointment must be characterized and dissected all together that medicinal estimates will forestall, decrease or right these disappointments. The most reasons for debasement coming about into disappointments of street asphalt are: the activity of traffic with substantial merchandise vehicles having the best hindering impact; the activity of climate, downpour and warmth; insecure ground conditions and helpless waste; types of development materials and strategies; post development exercises like, burrowing of channels along the street. Unloading of building materials and different impediments out and about, uncontrolled road exchanging and so on; helpless workmanship; and deficient support

Rate of decay of maintained bituminous pavement increases rapidly when water is retained within the void spaces of the bituminous pavement layers. Aging and oxidation of bituminous binder also cause the deterioration of the bituminous surfacing (Wada and Surajo, 2016). Many researchers generated several parameters/factors of maintained road deterioration. Among them, Wada and Surajo (2016) considered the subsequent factors: traffic loads, sub-grade soil, climatic factors, pavement component materials, drainage and environmental factors.

They further stated the kinds of bituminous pavement deterioration as: surface deformation, cracking, disintegration, and surface defects.

III. MATERIALS INVESTIGATION

3.1 Acquire Soil

Examination of Borrow territory for development has been administrated to detect the expected wellsprings of bank fill material and sub grade material and to evaluate their overall accessibility, nature and quantum of materials accessible for the undertaking.

3.2 Total Quarry

Total stone is fundamental fixing in development. Examination of quarry zone has been directed to decide the expected wellspring of total which might be utilized for the advancement of different asphalt layers like Bituminous Concrete (BC), Dense Bituminous Macadam (DBM), Bituminous Macadam (BM), Wet Mix Macadam (WMM), Granular Sub-base and Sand for concrete solid works, GSB and so forth

3.3. Granular Material

Granular material is utilized for the Drainage layer (GSB) inside the asphalt outside. This layer is wiped out to the arrangement width level of the asphalt for powerful waste. Granular material used in the GSB layer ought to have fluid breaking point and pliancy file confined to25% and 6%, separately. Just if there should be an occurrence of non-accessibility of appropriate granular material in region of task region inside the sensible lead separation, Soil, Sand and Aggregate are to be mixed with reasonable extent (preferably60:10:30) so on accomplish determined test worth and degree according to the condition 401 of MORTH detail.

3.4. Sand

Sand is generally used in the solid include development. The principle wellspring of sand is that the River Parwati at km 17.50 on the venture street in Shivpuri District. Property of sand fluctuates every once in a while.

3.5. Concrete

There are many concrete delivering industrial facilities situated in State. The ACC Cement plants are situated at Kymore.

3.6. Bitumen

Closest wellspring of Bitumen is Koyali Refinery, Vadodra. Mumbai processing plant in Maharashtra might be utilized as a wellspring of bitumen.

3.7. Steel

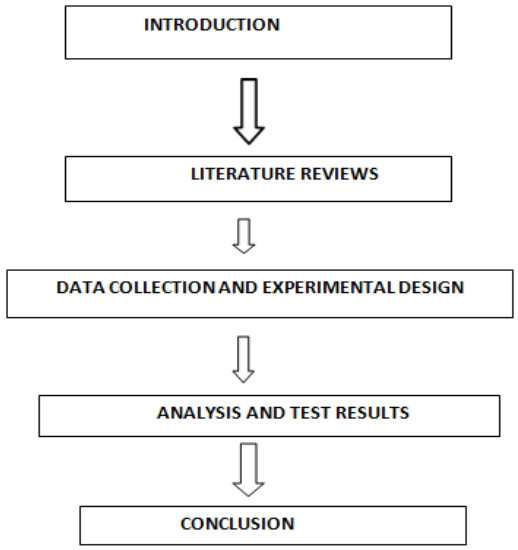
There is assortment of steel moving manufacturing plants in with accessibility of arranged evaluation of steel. The predetermined type of Steel is to be acquired from the open market.

3.8. Water

Ground water and surface water inside the region of the venture street is considered as a wellspring of water. The water for development is regularly made accessible by building bore at plant site with earlier assents from state and local specialists.

IV. RESEARCH METHODOLOGY

The method which we are going to adopt shown by flow diagram mentioned below:



V. TEST RESULT AND DISCUSSION

This section manages the introduction of results got from different tests which are directed on adaptable asphalt deserts. The primary goal of this examination was to watch the various sorts of imperfections happening on the asphalt. So as to accomplish this objective, exploratory program was performed to check this issue. It comprises of testing of the materials of the asphalt which was utilized for development. Different tests were preceded as following

TESTS ON BITUMEN

5.1 Penetration Value Test:

The bitumen sample was collected from the site and then extracted it from bitumen. Remaining sample of bitumen was taken for testing.
Sample taken = 500 gm
Weight of the container = 250 gms Therefore, total weight = 750 gms
The penetration values on bitumen were coming out after testing are

Penetration values of the bitumen

Bitumen Sample	Initial reading (mm)	Final reading (mm)	Penetration value (mm)
1	100	162	62
2	162	229	67
3	229	294	65

Mean penetration value = 64.67 mm

According to BIS prerequisites, the infiltration esteem meets the evaluation of 60/70 of the bitumen. The infiltration worth will be higher if the temperature at which examination is performed will go higher than 25°C.

5.2 Softening Point of bitumen

The softening point of the bitumen was calculated by heating the bitumen sample below 80°C. The temperatures at which the balls touch the bottom are following temperature at which the 1st ball touches the ground= 40°C Temperature at which the 2nd ball touches the ground= 42°C
Therefore, the Softening point of the bitumen = (40+42)/2 = 41°C

As per the BIS requirements, the value of the softening point is meeting the properties of VG10.

5.3 Ductility Test

The flexibility test was determined by pulling the briquette examples from the testing machine which causes us to know how pliable the example is.

Here, we have the qualities which we discovered from testing machine, which was estimated by separation canvassed by examples in cm.

Specimen 1 = 45cm
Specimen 2 = 49cm
Specimen 3 = 52cm

Therefore, the ductility of various samples is calculated by Specimens= (45+49+52)/3 = 48.67cm
As per BIS requirements, the values of ductility is closely equal to 50 meets the limits of VG20.

TEST ON AGGREGATE

Aggregate Impact Value Test

Total weight of the fresh sample w1 = 1000 gms
Weight of the sample after passing from 2.36 mm sieve = w2 = 313 gms
Aggregate Impact value = w2/w1*100 = (313/1000)*100 = 31.3%

By the classification of quality of the material, the value greater than 30% of used sample is weak for roadsurfacing.
4.3.2 Aggregate Crushing Value Test

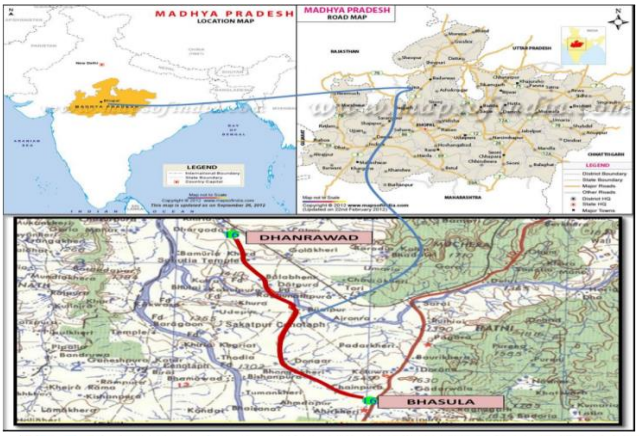
Total weight of the sample = w1 = 1000 gms Weight of the sample after passing from 2.36 mm sieve = w2 = 387 gms Aggregate crushing value = w2/w1*100 = (387/1000)*100 = 38.7% According to BIS, the crushing value should be 30% for cement concrete pavement. The aggregates having size greater than 12.5 will give more crushing value as compare to size less than 12.5 mm

Los Angele's Abrasion Test

Total weight of the oven-dried sample, w1 = 1000 gms
Weight of the material passing from 1.7 mm sieve, w2= 360 gms Aggregate crushing value = (w2/w1)*100 = (360/1000)*100 = 36%

As indicated by BIS, the Los Angele's worth ought to be 40% for the surface coarse of WBM streets. The test is utilized to check the nature of the molecule that how hard the molecule is. it must be sufficiently hard to oppose the gross heap of the traffic.

VI. FIGURES AND TABLES



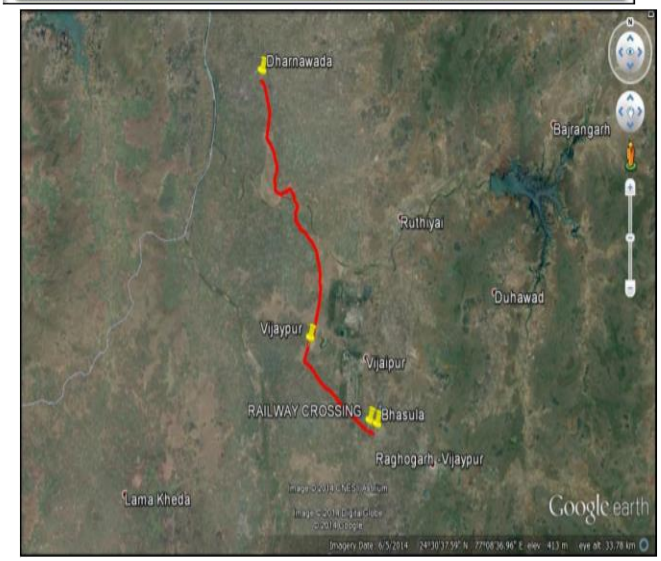


Fig 1: Map of the stretch from bhasula to Dhanrawad

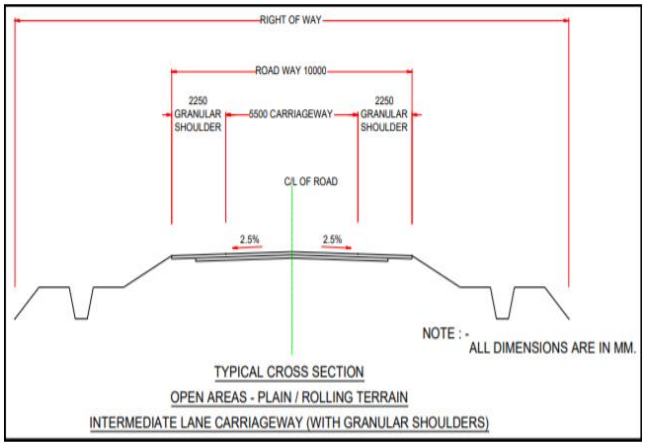


Fig.2: Typical cross section (TCS-1)

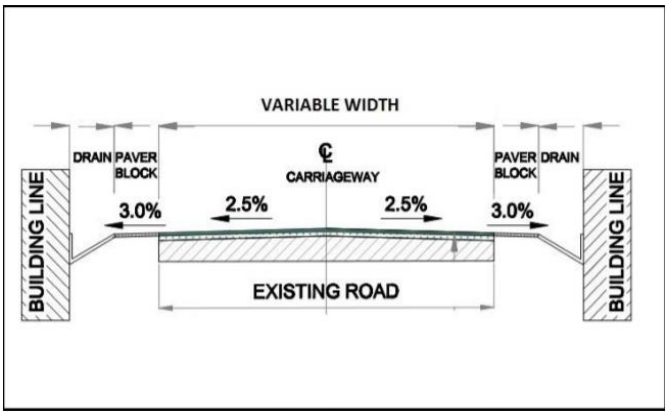


Fig.3: Typical cross section (TCS-2)

Table1 proposed improvement plan for MDRs

Total MDRs in Madhya Pradesh	-	*(Km)* *19,574*
Under construction by MPPWD (Under Central Road Fund Scheme)	-	5,398
(Under Major District Roads Scheme)	-	1,134
Under Construction by MPRDC (Under build operate transfer (BOT) Toll + Annuity & Annuity Scheme)	-	1,992
Total Under Construction	-	8,524
Balance to be constructed	-	11,050
Proposed under the Project a	-	1,600
*The actual estimates will depend on the assessment from the DPRs. Source: MPRDC		

Table 2: Bhasula-Chainpur-Vijaypur-Dhanrawad Road

Roads	District	Surrounding Environment	Length(Km)
Bhasula - Chainpur - Vijaypur - Dhanrawad (BCVD)	Guna District	The entire length of the project road Runs through plain terrain and passing across several agricultural land, villages, and towns.	20.00

Table 3: Summary Road Components and Design Standard

Road Length	20.00 Km length
Alignment	Follow the existing road alignment. Except some of the locations where geometric improvements is required.
Flyovers/overpasses/ ROB	There is no flyovers/overpasses/ ROB in the alignment.
Major Bridges	No Major Bridge
Other Structures	No Minor Bridges, six causeways and sixteen culverts along the Project road. (Replacement of existing structures wherever required, provision of new structure alongside existing structures wherever required)
Embankment Design	Embankment height established for 1m free board on 20 years frequency HFL Embankment height up to 3.0 m with 2H: 1V for embankment height from 3.0 m to 6.0 m with 15H: 1V. Construction of embankment of height more than 3.0 m, using borrow soil is recommended. However high embankment have been restricted within Row providing returning walls
Design Standard	As per IRC Codes and MORSTH Guidelines Vertical Clearance 0.60 m above HFL for bridges upto 30 m length 0.90m above HFL for bridges above 30 m length. The discharges for which the bridge has been designed are maximum flood discharge on record for a period of 100 years for major bridges and 50 years for minor bridges.
Speed	Design : 80 Km/h
	Permissible : 65 Km/h
Horizontal Controls	As per IRC: 73 – 1980
	Maximum value of 7% for super elevation and 15% for side friction factor, the minimum radius for horizontal curves is 230m for design speed 80Km/hr
Vertical Controls	Grade break of 0.5%, vertical curves will be provided . Length of vertical curve will be restricted to minimum 50m
Carriageway	Carriageway:5.5m Cross fall will be 2.5% for pavement and 3% for earthen shoulder.

VII. CONCLUSION

The case study was undertaken to investigate the road failures on the particular stretch (Bhasula to Dhanrawad) and purpose of this research is to analyze and evaluation of the pavement failures. Various results and conclusions are drawn below:

1. The technique relies on the past experiences by keeping literature reviews in mind and selected the straightforward and best suitable method of research.
2. Pavement condition Index (PCI) was discovered to understand the condition of the pavement consistent with its distress sheet as per severity level from ASTM-D6433. From the strategy of pavement condition index, we got know the condition of the pavement which was kicking off to be very poor within the range. The defects having the high severity level was revealed to be alligator cracks.
3. Since the upkeep option is required because the pavement is severe. So various reasonably tests were performed on the sample which was taken from the positioning and that we found that the failures was coming by the various reasons which I have got already mentioned and gave the simplest maintenance option for the pavement failures.

REFERENCES

[1] Manual for design, construction, maintenance of gravel roads by Indian road congress. (2008)

[2] TODD V.SCHOLZ, SATHYANARAYANAN RAJENDRAN (2009) "Investigating Premature pavement failure due to moisture" Kiewit Center for Infrastructure and Transportation.

[3] AHMED IBRAHIM ABU EL-MAATY BEHIRY (2012)- "Fatigue and Rutting lives in Flexible Pavement" Ain Sham Engineering journal3,367-374

[4] CHANDANBASU AND JITENDRA KUMAR SONI (2013)- "Design approach for geocell reinforced flexible pavements" Highway Research journal, Indian Road Congress- Volume 6, No: 2, July-December2013

[5] KA-YEE HO, WING-TAT HUNG, CHUNG-FAI NG, YAT-KEN LAM, RANDOLPH LEUNG, EDDY KAM (2013)"The effect of road surface tyre deterioration on tyre/road noise" Applied acoustics74

[6] MISS APURVA J.CHAVAN (2013)- "Use of plastic waste in flexible pavements" international journal of application or innovation in engineering management (IJAIEM), ISSN 2319- 4847,Vol-2

[7] CARVAJAL E AND ROMANA M. (2013)-"Analysis of the influence of soil depth on the subgrade capacity for the flexible pavements" Proceeding of Int. conference on soil mechanics and Geotech.Paris

[8] MAGDIM.EZUMRAWI(2013)"Surveyandevaluationoffl exiblepavementfailures" International Journal of science and research (IJSR)

[9] Traffic Engineering and Transportation planning by DR. L.R. KADYALI, KHANNA PUBLISHERS (2013) Eighth edition

[10] Highway Engineering by DR. SK KHANNA AND C.E.G. JUSTO scientific engineering (2014) eighth edition

[11] HNIN EI EI KHAING, DR. TIN TIN HTWE (2014) "Study on Failures and Maintenance of Flexible Pavement (Pyay-Aunglan –Koepin Portion)"- International journal of and technology research. ISSN 2319-8885,Vol.03-14

[12] SHARAD S ADILINGE, PROF. A.K GUPTA (2015) "Flexible Pavement deterioration and its causes" IOSR Journal of Mechanical & Civil Engineering (IOSR-JMCE) ISSN: 2278-1684, PP: 09-15 - www.iosrjournals.org

[13] MR.ETIKALA NAGARAJU (2015) "Pavement Rehabilitation and Maintenance"- SSRG International Journal of Civil Engineering (SSRG-IJCE) – volume 2, Issue6

[14] SASANE NEHA .B. GAIKWAD. HARISH, DR. J R PATIL, DR. S D KHANDEKAR (2015) "Application of

waste plastic as an effective construction material in flexible pavement" International Research Journal of Engineering and Technology(IRJET,) Volume: 02 Issue:03/June

[15] JABAR M. RASUL, MICHEAL P.N. BURROW, GURMEL S. GHATAORA (2016)- "consideration of the deterioration of the stabilized sub grade soil in analytical road pavement design"-Transportation Geotechnicsvol.9:96- 109

[16] ASTM-D6433 manual for the calculation of pavement condition index(2016)

[17] http://www.asphaltinstitute.org/asphalt-pavement-distress-summary/

[18] http://nptel.ac.in/courses/105101087/19-Ltexhtml/p7/p.html

[19] AAAS, 1990. American Association for the Advancement of Science. [Online] Availableat:http://www.project2061.org/publications/sfaa/online/chap3.htm [Accessed 13 Oct 2017].

[20] ABDULKAREEM, Y. A. & ADEOTI, &. K. A., 2010. Road maintenance and national development, s.l.: National Road Project