International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 05 Issue: 07 | July - 2021 ISSN: 2582-3930

Highway Failure and Their Maintenance

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Abstract - Developing and Developed Countries have lost hundreds of Crores during last decade due to failure and maintenance of their Highway. A lot of researchers, engineers have studied the defects, failure and problem faced during maintaining the Flexible and Rigid pavement of roads all over the world. Indian roads network has expanded from Four lakh km in 1947 from Twenty lakh km in 1993 and nearly Fifty-Five lakh km as on 2015. In this paper we conducted case study on Ghori Canal service road in Mirzapur, Uttar Pradesh to analyze and improve road maintenance practices in developing countries such as India. Maintenance of a road network involves a different kind of operations, i.e., identification of defects such as cracking, rutting and planning, programming and scheduling for actual application in the field and keeping track of the condition of road. This project summarizes the detailed representation of ongoing research about Highway failure and their maintenance. Efforts have been made to refer some of the publication related to the topic. Various defects in Flexible and Rigid pavement of highway have been identified and recorded since the existence of Flexible and Rigid pavement.

***Key words*:** Failure, Causes, Maintenance**.**

1.INTRODUCTION

From the point of view of any country's economic, social and cultural development, an efficient transportation system is very much needed. Compromise of efficient and excellent network transport systems of road, rail, fully developed waterways, air routes. Domestically, transport requires an excellent and efficient system road and rail network.

The highway system is a system composed of natural soil grade natural materials, and its main function is to distribute the added vehicle load to the soil on the road side. Light reaction properties and low noise pollution. The main damage of flexible pavement can be classified as fatigue cracking, buried cracking, thermal cracking. Fatigue cracking of flexible pavement occurs due to the occurrence of horizontal tensile strain on the asphalt concrete floor. Underarms only occur in flexible packaging to show permanent deformation with the depth of the arm or the load path of the wheel. Two design methods are being used to control the armpit. One is to limit the vertical compressive deformation of the top of the hearth, and the other is to limit the breaking front to a permissible amount (typically 12 mm). Thermal cracks include cold cracks and thermal fatigue cracks.

1.1. TYPES OF HIGHWAY FAILURE

1. Longitudinal Cracking
2. Alligator Cracking
3. Block Cracking
4. Edge Cracking
5. Transverse Cracking
6. Reflection Cracking
7. Pothole
8. Rutting
9. Raveling
10. Stripping
11. Edge Break

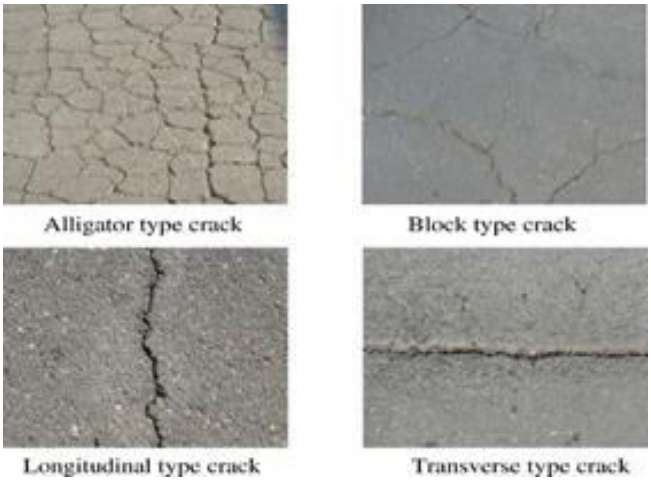

Fig. 1: Types of Failure

2.LITERATURE REVIEW

- **Kunal Jain, Sukhvir Singh Jain et-al. (April 2013), "Selection of Optimum Maintenance and Rehabilitation Strategy for Multilane Highways"**

This article specifically explains flexible pavements, including multi-lane highways in northern India. The research involves using the analysis component of the HDM-4 program to collect data on selected road sections and select the best M&R strategy. Pavements that are left to deteriorate without timely maintenance are likely to require major repairs and reconstructions before they can be properly maintained. In a developing country like India, traffic volume and axle load are increasing logarithmically, and roads are deteriorating very rapidly. This increases the traffic demand on multi-lane highways that are properly maintained from time to time. During the maintenance and repair of the road network, the road management department strives to select the best maintenance strategy from a variety of alternatives.

- **Praveen Kumar, Ankit Gupta et al. (June, 2010), "Case Studies on Failure of Bituminous Pavements"**

The purpose of this study is to assess the causes of packaging distresses and recommend remedies to minimize pavement distresses. Asphalt pavement failures can occur for several or many reasons. Applying corrections to existing surfaces extends the life of maintenance work and the life of reinforcement layers. This paper describes the lessons learned from pavement failures and problems experienced in several projects in India over the past few years. Based on past experience, various pavement preservation techniques and countermeasures are discussed to help extend the life of pavement.

- **Dr. L. B. Zala, Dr. F. S. Umrigar, et al. (May, 2011), "Pavement Deterioration 'A Case Study on National Highway 8b Section Rajkot-Bamanbore (Km 185/0- Km 216/8)"**

The purpose of this article is to analyze the NH8-b state survey (Rajkot-Bamanbore section (km 185/0-km216 / 8)). It Present ideas about road surface degradation and road surface conditions. The pavement is a complex structure that involves many materials, structures, methods, loads, environment, maintenance and economy. Therefore, several factors must be understood to design, build, and maintain better pavements. Furthermore, due to the dynamic characteristics of road pavement, in which pavement elements are constantly changing, adding or removing, the problems related to road maintenance remain very complicated. These components will degrade over time, so keeping them in good condition requires a lot of expense.

- **Aditya Singh et al. (2005)," Case study on HDM 4 for a life cycle of 15 years"**

In this article, they used HDM-4 for program analysis and a 15-year life cycle analysis. The budget requirements of the plan are not subject to any restrictions. The optimized timetable is formulated for three situations, which are 75%, 50%, and 35% of the required budget. HDM-4 contains PPM for all major road problems such as cracks, potholes, ruts and rough edges. The initiation stage is separated from the development stage, and the initiation and development mode of cracking is developed. Pavement conditions and changes in conditions are predicted annually for each relief mode in the order listed below (Attoh-Okine and Paris, 2005).
a) The age at which all cracks began and the increase in all cracked areas.
b) The onset and increase of all potholes,
c) The increase in the depth of the furrow (mean and standard deviation)
d) The increase in roughness.

3.METHODOLOGY

3.1. HIGHWAY MAINTENANCE:

Safeguarding and keeping each sort of street, side of the road, structures as almost as conceivable in its unique condition as built or as therefore improved and the activity of roadway offices and administrations to give acceptable and safe transportation, is called upkeep of Expressways.
The different support capacities include:
1. Surface support
2. Side of the road and waste support
3. Shoulder and approaches support.
4. Traffic assistance
5. Bridges upkeep

3.2. SURFACE MAINTENANCE OF ROAD

➢ **Bituminous Surface Treatment**

A bituminous surface treatment (BST), notwithstanding called a seal coat or chip seal, is a powerless protective wearing surface that is applied to the dull top or base course.
BSTs can give all the going with:

- A waterproof layer to get the underlying dark top
- Increase slip opposition
- A filler for existing break or raveled surface

Chip seals are created by impartially appropriating a modest base of hot tar, bitumen or dark top onto an ebb and flow black-top and subsequently embedding finely audited complete into it. The complete is fairly appropriated over the hot seal shower, then moved into the bitumen using strong versatile tired rollers making a cleared surface. A chip-seal-surfaced black-top can then again be fixed with a top layer, which is suggested as a murkiness seal or upgrade. It can keep extraordinary black-top in incredible condition through fixing out water, anyway invigorates no essential and will fix simply minor breaks.

3.3. DRAINAGE SYSYTEM MAINTENANCE

Waste designs should be kept liberated from trash and obstacles. On recently built streets, or in upstream regions where hefty earth moving is occurring (e.g., metropolitan turn of events, logging, mining, and so forth), cleaning may must be more continuous.

The goal in "pulling a trench" is to level the trench to clean it of trash that could redirect stream from the trench on to the street surface. Hand clearing with a digging tool is powerful and modest when the responsibility is light or the presence of constructions (e.g., cross channels or duct deltas) make it illogical to utilize substantial gear. With a grader, the accompanying strategy is followed:

1. Banner all courses and cross channels
2. Eliminate obstacles, rocks, and different dangers prior to reviewing starts
3. Cut just the trench base and shoulder; try not to undermine the cut incline; don't review the cut slant
4. Spread fines into the street with surface revising
5. Abstain from working around ducts or other channel crossing structures to limit harm to bays

3.4. SHOULDERS MAINTENANCE

Shoulder of street offer a sidelong help to the asphalt and give space to a vehicle when intersection and surpassing on limited asphalts. On the off chance that shoulders are not all around kept up, it might harm the asphalt and vehicles when utilizing the street.

The support of shoulders relies upon the surface character of the space where the upkeep and fix are performed. Rock and earth bear that leaves a drop off at the asphalt edges makes a genuine mishap danger, henceforth, ought to be remedied by recreation, reemerging or other suitable methods.

3.5. BRIDGE MAINTENANCE

Augmentation support is a huge piece of roads upkeep. Platforms can be kept up in incredible condition by observing the underneath rules:

- Uncovered steel work ought to be cleaned by sand affecting fire or various strategies followed by repainting.
- Deck joint may oust or get stacked up with earth so that cleaning and resealing is essential.
- Wild vehicle, making hurt screen rail, ought to be fixed and invigorated.
- In case framework deck become horrendous reappearing is required
- Restorative measures to address real scour around and under wharfs and projections.

4.CASE STUDY OF GHORI CANAL SERVICE ROAD

Ghori Canal originate from Ghori Dam which was constructed in 1915 in Lalganj block, Mirzapur district, Uttar Pradesh. Ghori dam was constructed on Ghori river. It has containment area of 4106 Hectare. Ghori Dam an earthen dam whose Length is 1.584 km, width is 6.095 m, top is at 193.24m. One main canal originates from the dam whose length is 29.337 km. It is flanked by road whose name is Ghori Canal service road whose length is 19.3 km.

The original dirt road along the east side of the dug-canal was upgraded to asphalt top more than 20 years ago. Due to an increase in traffic volume and land development in the area in early 2000s. Road Condition of Ghori canal service road is not good due to seepage of water from Canal due to failure and percolation of water, high traffic active load due to travel of heavy load vehicle.

Table –1: Abstract of Quantity

Estimate for Patch Repairing of Ghori canal service road from Km. 12.610 to Km. 12.900.

Sl.	Particular	Unit	Qty.
1	2	3	4
1	Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with smooth wheel roller 80-100 kN in stages to proper grade and camber, applying and brooming, stone screening/binding materials to fill-up the interstices of coarse aggregate, watering and compacting to the required density **Grading 2** as per Technical Specification Clause 405.	**Cum**	234.00
2	Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with three wheel 80-100 kN static roller in stages to proper grade and camber, applying and brooming, crushable screening to fill-up the interstices of coarse aggregate, watering and compacting to the required density **Grading 3** as per Technical Specification Clause 405. in km. 1,2,3,4(300)	Cum	343.13
3	Providing and applying primer coat with bitumen Emulsion (SS) on prepared surface of granular base including cleaning of road surface and spraying primer at the rate of 0.70 kg/sqm using mechanical means as per Technical Specification Clause 502	sqm	8295.00
4	Providing and applying tack coat with Bitumen VG-10) using Bitumen distributor at the rate of 0.25kg per sqm on the prepared bituminous surface cleaned with Hydraulic broom as per Technical Specification Clause 503.	sqm	8295.00
5	Providing, laying and rolling of open-graded premix carpet of 20 mm thickness composed of 13.2 mm to 5.6 mm aggregates either using penetration grade bitumen or emulsion to required line, grade and level to serve as wearing course on a previously prepared base, including mixing in a suitable plant, laying and rolling with a three wheel 80-100 kN static roller capacity, finished to required level and grades to be followed by seal coat of Type C as per Technical Specification Clause 508.	sqm	8295.00
6	Providing and laying seal coat sealing the voids in a bituminous surface laid to the specified levels, grade and cross fall using Type C as per Technical Specification Clause 510	sqm	8295.00

Table –2: Details of Measurement

Estimate for Patch Repairing of Ghori canal service road from Km. 12.610 to Km. 12.900

Sl.	Particular	No.	L	B	H/D	Qty.	
1	2	3	4	5	6	7	
1	Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with three wheel 80-100 kN static roller in stages to proper grade and camber, applying and brooming, crushable screening to fill-up the interstices of coarse aggregate, watering and compacting to the required density **Grading 3** as per Technical Specification Clause 405. in km. 1,2,3,4(300)						
		1X1	3.10	1.50	0.075	0.35	Cum.
		1X1	2.60	2.10	0.075	0.41	Cum.
		1X1	3.10	2.60	0.075	0.60	Cum.
		1X1	2.10	1.50	0.075	0.24	Cum.
		1X1	2.60	2.10	0.075	0.41	Cum.
		1X1	2.10	2.60	0.075	0.41	Cum.
		1X1	1.90	1.50	0.075	0.21	Cum.
		1X1	2.10	2.60	0.075	0.41	Cum.
		1X1	3.60	1.50	0.075	0.41	Cum.
		1X1	2.50	2.10	0.075	0.39	Cum.
		1X1	2.40	2.60	0.075	0.47	Cum.
					Total	**4.85**	**Cum.**
2	Providing and applying primer coat with bitumen Emulsion (SS) on prepared surface of granular base including cleaning of road surface and spraying primer at the rate of 0.70 kg/sqm using mechanical means as per Technical Specification Clause 502.						
		1X1	3.10	1.50	-	4.65	
		1X1	2.60	2.10	-	5.46	
		1X1	3.10	2.60	-	8.06	
		1X1	2.10	1.50	-	3.15	
		1X1	2.60	2.10	-	5.46	
		1X1	2.10	2.60	-	5.46	
		1X1	1.90	1.50	-	2.85	
		1X1	2.10	2.60	-	5.46	
		1X1	3.60	1.50	-	5.40	
		1X1	2.50	2.10	-	5.25	
		1X1	2.40	2.60	-	6.24	

					Total	**64.64**	**Sqm.**

3	Providing and applying tack coat with Bitumen VG-10) using Bitumen distributor at the rate of 0.25kg per sqm on the prepared bituminous surface cleaned with Hydraulic broom as per Technical Specification Clause 503.						
		1X1	290	3.00	-	870.00	
					Total	**870.00**	**Sqm.**
4	Providing, laying and rolling of open-graded premix carpet of 20 mm thickness composed of 13.2 mm to 5.6 mm aggregates either using penetration grade bitumen or emulsion to required line, grade and level to serve as wearing course on a previously prepared base, including mixing in a suitable plant, laying and rolling with a three wheel 80-100 kN static roller capacity, finished to required level and grades to be followed by seal coat of Type C as per Technical Specification Clause 508.						
		1X1	290	3.00	-	870.00	
					Total	**870.00**	**Sqm.**
5	Providing and laying seal coat sealing the voids in a bituminous surface laid to the specified levels, grade and cross fall using Type C as per Technical Specification Clause 510						
		1X1	290	3.00	-	870.00	
					Total	**870.00**	**Sqm.**

For Measurement Metallic Tape of X=30m is used

5.CONCLUSION

The Outline and assessment suggest that there are different types of defects that are occurred in Ghori canal service road which happen due to saturation of water from irrigation canal which flanked the road into the sub-grade of Bituminous Pavement, heavy traffic load, poor weather condition, percolation of water from canal due to damage of lining of canal, bad quality control, and every so often people tunneling the road to make channel for water from canal to irrigate their farm and field. Other problems like potholes, edge breaking, and stripping are also the main defects found in this road. While various other minor defects are present but former mentioned defects are more frequent and cause subsequent amount of damage the road. The respective authorities state that these problems could be overcome by properly maintaining the design and material used in the construction of pavement.

We have provided exact and official estimate of exact amount of work should be done and how work has been done by following specification provided by Sirsi Dam Division organization. Investigation also show that Urgent maintenance is more important than routine maintenance and periodic maintenance in Ghori canal service load because it can create problem of Ghori canal.

6. RECOMMANDATION

The following recommendations are prepared after the completion of investigation, which are:

i) The respective authorities should construct the roads and highways with proper planning and designing, required fund, best quality materials, adequate workers, professionals, technical and skilled inspectors and manager to make the roads serviceable according to design years of the roads.

ii) After the completion of road construction, skilled inspectors should be appointed to examine the roads at time of year when there is no water in Ghori Canal to be able to perform a repair if failures occur.

iii) The authorities should operate an action against the road failures by taking proper maintenance procedures using decent materials, machineries and skilled workers and supervisors to establish an effective maintenance.

iv) The authorities should also check for seepage loss from canal and should be equipped to maintain lining of canal.

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