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STUDY OF HIGHWAY FAILURE AND THEIR MAINTENANCE

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ABSTRACT

Awell-developed transportation infrastructure is essential for the economic, industrial, social, and cultural development of a country. Due to this need, human beings have developed three modes of transport, i.e., by land, by water and by air. The road network has expanded from 4 lakh km in 1947 to 20 lakh km in 1993 and almost 62 lakh kms as on 31 March 2020. India has less than 5.13 kms of road per 1000 people; including all its paved and unpaved road According to the research, the flexible pavement defects and its causes are defined in terms of decrease in serviceability which was caused by the development of different types of deteriorations like cracks, surface defects, disintegration etc. on the flexible pavement.

This study focuses on the primary objective is to determine the various factors which are responsible for the failure of the rigid pavement and be applied the proper method of maintenance to avoid the failure problem of the road and be evaluating the engineering properties of material used in pavement.

Keywords: Failure, Causes, Investigation, Maintenance.

I. INTRODUCTION

The development of a country depends upon transportation system and the transportation system should be well developed in roads, railway, waterways, and air ways Developed transportation systems are not only essential for the development of a country but also for reducing the cost of communication and arrival of daily commodities. People depend on roads and highways for the movement of goods, for travel from one place to another, for service, for social and recreational purposes and many other activities necessary to the functioning of our complex society but roads are not free from failure. The maintenance of these failures is required not only to repair but also to increase the life of the road to reduce operating vehicle and maintenance cost, and to keep the road in serviceable condition.

In present Indian scenario the construction of rigid concrete pavement is widely adopted. The main disadvantage in the rigid concrete pavement is its initial construction cost and the consumption of resources is very high. The rigid concrete pavement has a wide range of applications starting from pedestrian walking pavement to the movement of heavy vehicular transportation. One of the main purposes of Highway failure and its maintenance is to provide a better road surface for the road users and carry traffic smoothly and safely with minimum cost.

Proper maintenance is essential for longer life of the road surface. In this thesis work, describe a maximum possible cause of failure in Rigid Pavement and also be discussed maintenance technique to repair the road surface using different pavement maintenance materials to avoid the chances of the pavement failure and accidental cases.

Failure may be caused by

- Inadequate Stability
- Excessive application of stresses
- Plastic deformation Failures in subbase or Base course.
- Loss of binding action
- Loss of bearing course materials
- Inadequate wearing course
- Rutting due to high variation in ambient temperature.

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- Uncontrolled heavy axle loads.
- Limitation of pavement design procedures to meet local environmental conditions.

II. LITERATURE REVIEW

1. Zulufqar Bin Rashid1, Dr. Rakesh Gupta emphasized the parameters influencing the performance of pavements and identified them. For efficient maintenance of road pavements, the deficiencies in our existing highway system need to be clearly understood. Proper design, regular inspection and maintenance of pavement is of utmost importance in preserving the investment made on highway system and in providing comfort and safety to the road user.

2. DR. NDEFO OKIGBO studied the conditions of the roads in Nigeria and their effects to the citizen, government, and the economy of the country. Some of the identified causes were poor design and construction, poor maintenance of already built highways, use of low-quality materials in construction, poor workmanship, and poor supervision of construction work. Some of the recommendations to remedy the situation are Use of the appropriate design of the roads, avoiding unnecessary congestion of the roads especially heavy traffics that were not meant for the roads in the first place, prompt maintenance of the roads, application of

3. Mr. Devidas Chavade, Mr. Kedarnath worked on the on-going research into the defects in Flexible and Rigid pavements and the maintenance in Flexible and Rigid pavements. The essential objective should be to keep the road surface and appurtenances in good condition and to extend the life of the road assets to its design life. Broadly, the activities include identification of defects and the possible cause there off, determination of appropriate remedial measures, implementing these in the field and monitoring of the results.

4. Surajo Abubakar Wada worked on road detoriation. Road deterioration is a critical situation for road sector because of the high cost for construction of new roads and maintenance of existing roads and routes. Therefore, better funding and management should be provided to keep the pavements in good condition and from getting damaged due to the distress's suitable construction material in the construction.

III. METHODOLOGY

Different types of road failures are identified within Lucknow City which are given as alligator cracking, block cracking, slippage cracking, longitudinal cracking, transverse cracking, potholes, raveling, water bleeding, corrugation and shoving, depression, and rutting. The causes of failures and their maintenance procedures are collected by field investigation, information collection from respective authorities as Lucknow City corporation and roads and highway department and consideration of public opinion. Here, public opinion was collected by group discussion with people to achieve an idea about the causes of failure.

1. The failures are classified as-

a) Longitudinal cracking
b) Fatigue cracking
c) Block cracking
d) Edge cracking
e) Rutting cracking
f) Transverse cracking
g) Reflection cracking
h) Corrugation
i) Delamination
j) Depression

a) Longitudinal Cracking: The loss of moisture content in the clay soil and its volume change will cause cracks in a direction parallel to the paved edge of the pavement.

Figure a) longitudinal cracking

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b) Fatigue Cracking: Cracks in asphalt layers that are caused by repeated traffic loadings. The cracks indicate fatigue failure of the asphalt layer. When cracking is characterized by interconnected cracks, the cracking pattern resembles that of an alligator's skin or chicken wire. Therefore, it is also referred to as alligator cracking.

Figure b) fatigue cracking

c) Block Cracking: These cracks appear as interconnected cracks forming blocks of square or rectangular shape on pavement surface. The size of the block cracking varies from 1000 sq.cm to 10000 sq.cm (1 sq ft to 10 sq ft). Block cracking is shown inphotographs below.

Figure c) block cracking

d) Edge Cracking: Edge Cracks travel along the inside edge of a pavement surface within one or two feet. The most common cause for this type of crack is poor drainage conditions and lack of support at the pavement edge.

Figure d) edge cracking

e) Rutting: Rutting is a longitudinal surface depression or groove in the wheel path. If the rutting is accompanied by adjacent bulging, it may be sign of subgrade movement. This phenomenon takes place when either pavement thickness is inadequate or there is heavy channelized traffic.

Figure e) rutting

f) Transverse Cracking: Cracks that are predominately perpendicular to pavement centerline and are not located over Portland cement concrete joints. Thermal cracking is typically in this category.

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Figure f) transverse cracking

g) Reflection Cracking: Cracks in HMA overlay surfaces that occur over joints in concrete or over cracks in HMA pavements.

Figure g) reflection cracking

h) Corrugation Cracking: Transverse undulations appear at regular intervals due to the unstable surface course caused by stop-and-go traffic.

Figure h) corrugation cracking

i) Delamination: Loss of a large area of pavement surface Usually there is a clear separation of the pavement surface from the layer below. Slippage cracking may often occur as a result of poor bonding or adhesion between layers.

Figure i) Delamination

j) Depression: Small, localized surface settlement that can cause a rough, even hazardous ride to motorist.

Figure j) depression

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2. Highway Maintenance-

highway maintenance consider.

1. Surface maintenance
2. Roadside and drainage maintenance
3. Shoulder and approaches maintenance
4. Snow and ice control
5. Bridges maintenance
6. Traffic service

1. Surface maintenance of road: Pavement maintenance and rehabilitation programs restore riding quality and maintain the structural integrity of the pavement over its full design life.

General maintenance

- For maintenance of gravel roads blading and occasional resurfacing is required.
- For surface treatments of low type bituminous surface in maintenance of roads; Patching, seal coating or possible loosening oiling, re mixing and relaying are involved.
- For high type bituminous concrete and Portland cement concrete, the Removal and replacement of failure areas and resurfacing are approximate treatment methods for highway maintenance.
- Use the same material and methods for road surface maintenance as far as possible.
- Highway Maintenance must be planned for rapid performance and to cause the least possible disruption or hazard to traffic.

2. Roadside and drainage maintenance: Drainage maintenance is the maintenance of drainage system by keeping ditch, culvert, and other drainage structure, clean and ready to carry next flow water as well as removing sediments deposited during period of heavy flow. This helps to ensure the roadway achieves its designed service life.

3. Shoulder and approaches maintenance: Shoulders are to be maintained reasonably smooth, free of holes and ruts and slope away from the pavement edge to provide surface drainage.

4. Snow and ice control: Snow and ice control: Ice forming on the roadway reduces coefficient of friction between tires and surface, which makes vehicle control almost impossible In highway maintenance we can apply abrasive to heavily travelled roadway and street Suitable materials that can be used are clean and sharp sand, cinders and washed stone screening.

5. Bridge maintenance: Bridges maintenance is a major part of highway maintenance Bridges can be maintained in good condition by following the below guidelines.

- Exposed steel work must be cleaned by sand blasting flame or other means followed by repainting.
- Deck joints may extrude or become filled with dirt so cleaning and resealing is necessary.
- Out of control vehicle, causing damage to guard rail, must be Repaired, and strengthened.
- If the bridge deck becomes rough resurfacing is required.
- Remedial measures to correct serious scours around and under piers and abutments.

6. Traffic services: Include stripping, sign repair and maintenance (particularly needed for repair after stormy weather.

IV. CONCLUSION

Engineers have been always with open mind to adopt any material available to them for its use for construction purposes. It is logical to see that the purpose of highway construction is to provide a firm and even surface for the carriageway or the pavement which could stand the stress caused due to number of load applications.

Following conclusions have been drawn based on the present study:

Proper design, regular inspection and maintenance of drainage system is of utmost importance in preserving the investment made on highway system and in providing comfort and safety to the road user.

The classifications of all types of distresses have been identified. The cause and treatment are different for different severity levels of each distress.

The defects in the existing highway system and in maintenance practices must be clearly understood and eradicated.

The influencing parameters considered in this study are cracks and cracking pattern, roughness, potholes, and deflections. The above parameters have been classified according to their severity levels.

Maintenance decision can be taken based on the criteria of reaching any one or all the influencing parameters to their maximum acceptable limits.

The small distress (cracking, potholes, shoving, rutting, etc.) must be repaired before any major maintenance (overlay, renewal coat) is done. Even reduced thickness of overlay will show better results if minor defects are repaired before overlays are done.

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