

# Low Cost Maintenance Strategy for Road by Spraying Emulsion and Sprinkling Sand – A Case Study

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**Abstract** – Road network created in our country has resulted in increased social and economic benefits all around. However, these benefits would be reduced due to poor maintenance of these created assets. Thus, in order to reap the benefits of created assets it is essential to maintain the Road network in India. This study highlights some basic issues for low cost maintenance of roads. This Study is of the Road where Semi Dense Bituminous Concrete (SDBC), Mix Seal Surface(MSS), Seal Coat (SC) is done and when road have hungry surface there is no need of Black topping the Surface one can only Spray the Emulsion and Sprinkle Sand and leave it to traffic which increases, the life of Road. It is expected that the finding of this study will be useful to preserve the benefits of huge rural road assets created recently in India including Nagar Nigam Roads and Colony's roads.

**Keywords:-** SDBC - Semi Dense Bituminous Concrete, MSS - Mix Seal Surface, SC - Seal Coat, MORTH – Ministry of Road Transport and Highways, CAGR- Compound Annual Growth Rate, NHs - National Highways, SHs - State Highways, OPWD – Other Public Work Department, MPSEB – Madhya Pradesh State Electricity Board

## I. INTRODUCTION

For a rapid Economic, Industrial and Cultural growth of any country a good system of transportation is very much essential. It plays an important role for the development of a country. There are three basic modes of transport - land, water and air. However, road is the first mode which lead us to the origin points of other transports viz. railway station, harbor or airport. Hence it can be said that out of all the types of transport systems road is the most essential transport system needed for us. Transportation by road is the only mode which could give maximum services to one and all. The road network is needed not only to serve as feeder system for other modes of transportation but also to provide independent facility for road travel by a well-planned network of road throughout the country.

A robust road network is a key element of inclusive growth and socio-economic development. Road networks provide the crucial link between products and markets and ensure access to employment, health, education and other services.

India has one of the largest road networks in the world of over 5.4 million km as of Financial Year 2015. The country's road network consists of national highways, state highways, major and other district roads and village and rural roads. Over the years, there has been consistent improvement in accessibility and mobility through the construction of new roads and the upgradation of the existing roads.

In recent years, transportation by roads has scored over other modes of transport because of easy accessibility, flexibility of operations, door-to-door service and reliability. Consequently, the share of road in freight and passenger movement has been increasing vis-a-vis other transport modes.

## II. OVERVIEW OF ROAD NETWORK IN INDIA

As per the "Basic Road Statistics of India 2013-14 and 2014-15" of MORTH, New Delhi the total road length of our country increased significantly from 3.99 lakh km in 1951 to 54.02 lakhs km in 2014 and further

to 54.72 lakh km in 2015, growing at a Compound Annual Growth Rate (CAGR) of 4.2% up to 2015 from 1951. The break-up of road length as on 31<sup>st</sup> March 2014 and 2015 are given in Table 1.1 below:

Table 1.1:

Break-up of Road length in India

Category of Road	As on 31 <sup>st</sup> March 2014		As on 31 <sup>st</sup> March 2015	
	Length of Road (km)	Share in total Road Length (%)	Length of Road (km)	Share in total Road Length (%)
National Highways(NHs)	91,287	1.69	97,991	1.79
State Highways(SHs)	1,70,818	3.16	1,67,109	3.05
Other PWD(OPWD) Roads	10,82,267	20.03	11,01,178	20.12
Rural Roads	33,04,328	61.16	33,37,255	61.00
Urban Roads	4,57,467	8.47	4,67,106	8.54
Project Roads	2,96,319	5.49	3,01,505	5.50
Total	54,02,486	100.00	54,72,144	100.00

The largest share in the road network as on 31<sup>st</sup> March 2014 and as on 31<sup>st</sup> March 2015 was that of rural roads (61%). Other PWD Roads accounted for the second highest share (20.12%), followed by Urban Roads by (8.4%), Project Roads (5.5%), SHs (3.05%) and NHs (1.79%).

As on 31<sup>st</sup> March 2015, India’s road density at 1.66 kms/sq.km of area was higher than that of Japan (0.91 km/ sqkm), USA (0.67 km/ sqkm), China (0.46 km/ sq. km), Brazil (0.18 km/sq.km) and Russian Federation (0.08 km/ sqkm). The surfaced road length in India was 61.05 per cent of the total road length which was much lower as compared to United Kingdom (100.00), Korea (82.51) Russia (70.54) and China (67.89). NHs in India, which accounted for 1.79 % of the total length as on 31<sup>st</sup> March, 2015 was much lower than that of some of the developed countries of the world such as Japan, Korea Republic, Russian Federation, UK and Brazil.

Road network is vital for sustained and inclusive growth of the economy. It facilitates the movement of passengers and freight across the country. It promotes efficiency in the economy by minimizing total transportation cost in terms of economies of production, distribution and consumption. The role of road transport among the different modes of transport is dominant because of its last mile connectivity or feeder service. In comparison to other modes of transport, the movement of passenger and freight in India over the years has increasingly shifted towards road transport sector.

The road network of our country consists of National Highways (NH), State Highways (SH), Other Public Works Departments (OPWD) Roads, Rural Roads, Urban Roads and Project Roads. Table 1.2 shows the progress of road length under different categories

during the period 31<sup>st</sup> March, 1951 to 31<sup>st</sup> March, 2014 and 31<sup>st</sup> March, 2015.

Table 1.2:

Road Network by Categories (in kilometers) – 1950-51 to 2013-14 and 2014-2015

Road Category	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2010-11	2013-14	2014-15
National Highways	19,811	23,798	23,838	31,671	33,650	57,737	70,934	91,287	97,991
State Highways	0	0	56,765	94,359	1,27,311	1,32,100	1,63,898	1,70,818	1,67,109
OPWD Roads	1,73,723	257,125	2,76,833	4,21,895	5,09,435	7,36,001	9,98,895	10,82,267	11,01,178
Rural Roads	2,06,408	197,194	3,54,530	6,28,865	12,60,430	19,72,016	27,49,804	33,04,328	33,37,255
Urban Roads	0	46,361	72,120	123,120	1,86,799	2,52,001	4,11,679	4,57,467	4,67,106
Project Roads	0	0	1,30,893	1,85,511	2,09,737	2,23,665	2,81,628	2,96,319	3,01,505
Total	3,99,942	5,24,478	9,14,979	14,85,421	23,27,362	33,73,520	46,76,838	54,02,486	54,72,144

Table 1.2 shows that from year 1950 to 2015 Rural roads has increased from 2 lacs to 33 lacs i.e. 61% of total roads in our country. Rural Roads consist of (1) Road constructed under PanchayatiRaj (ZillaParishad roads, Village Panchayat roads and Community Development/Panchayat Samiti roads) (2) Roads constructed under JawaharRozgarYojana (JRY) and (3) Roads constructed under Pradhan Mantri Gram SadakYojana(PMGSY).The total length of Rural Roads is shown in Table 1.2. –Length of PanchayatiRaj Roads were 18,31043 kms- Length of PMGSY Roads were 6,06,212 kms and the remaining length of 9 lakhs kms of roads were constructed under JawaharRozgarYojana (JRY).

III. ROAD MAINTENANCE – A KEY ISSUE

Maintenance has always been a most important factor for any structure so as to have its prolonged serviceability and also to prevent its deterioration which shorten its service life. In reality, however, maintenance works are not given the prime attention due to prior budget allocated for maintenance work.

Structures, as stated, not only include buildings, but also include other structures such as bridges, roads, harbours, drainages and any other kind of engineering structures. Maintenance on these structures may differ in various ways, but all of it must be carried out in a strategic and systematic way. In the case of roads the funds for new road construction are easier to mobilize while funds for road maintenance have to compete with number of other priorities. Lack of understanding regarding the economic consequences of poor maintenance further complicates the efforts to raise sufficient maintenance funds. As a “Thumb-Rule”, 2 to 3 percent of cost of construction or up gradation is required for routine and periodic maintenance. Due to negligence or

insufficient maintenance, there could be a minimum erosion of 5 percent in asset base of rural roads. Studies have shown that one million rupees spent in routine maintenance saves two million rupees in periodic maintenance. Two million rupees spent in periodic maintenance saves four million rupees in rehabilitation, besides causing avoidable carbon footprint by way of burden on extraction of aggregates from quarries and their transportation over long distances. It would, therefore, make good economic sense, for state governments to invest in maintenance of roads.

According to "An analysis of road transport: Budget 2017-18" allocations in Union Budget 2017-18, the total budgeted expenditure on the Ministry of Road Transport and Highways for 2017-18 is Rs 64,900 crore and out of which Rs 3,108 crore (nearly 5%) has been allocated for Maintenance of Roads and Highways.

#### **IV. OBJECTIVES OF THE STUDY**

The rural roads which have the largest length amongst the roads in India are one of the important road network connecting billions of people. Poor condition of these roads not only obviates feature of the serviceability of the road network but also results in increase in cost of road transportation. Presently strong need is, therefore, been felt to develop and put in practice the appropriate Maintenance Strategies for Maintenance of Roads.

The government spends lot of money to maintain and repair the roads. In 2017-18 the Ministry of Road Transport and Highways has allocated Rs 3,108 crore towards maintenance of roads and highways. So, from the present study about road maintenance management system, it will help the government as to how to reduce the cost for maintenance and also to make sure the road in maintained good condition with minimum maintenance cost.

#### **V. MAINTENANCE STRATEGIES**

- (a) **Preventive** - Planned strategy to extend the life of the pavement (b) Preserves the system, retards deterioration, and maintains or improves the functional condition of the system (without increasing structural capacity)
- (b) **Rehabilitation** - renews the life of the pavement (b) work undertaken to restore serviceability and improve an existing pavement to a condition of structural or functional adequacy.
- (c) **Reconstruction** - removal and replacement of the existing pavement structure.

- (d) **Holding** - strategy that prolongs the life of an asset (for a planned period of time). Strategy employed to maintain acceptable levels of functionality or safety (b) until full rehabilitation or reconstruction can be completed.

#### **Preventive Strategies are as follows –**

- (1) Crack sealing (2) Slurry Seal (3) Micro surfacing (4) Warm Mix Asphalt / Stone Matrix Asphalt (5) Thin surfacing (6) Hot mix patching / Single lift mill and pave (7) Hot In-place Recycling (8) Crack sealing

#### **VI. CASE STUDY**

In this Study we have taken the Preventive Strategies strategy to extend the life of the pavement. This is for the Road Portion or reach where Sub grade, Sub base & Base Course is firm and only top BT surface is damaged.

In the old surface if it is damage the potholes & ruts are repaired and total surface is sprayed by Emulsion & fine sand is sprinkled and leave to traffic it fills the hungry Surface and top surface becomes smooth.

For the ease of work and Judgement the nearby road is selected for the case study.

- (a) The Road is situated from MPSEB Barrier to Tee junction Near Jal Pari via Shakti Bhawan Jabalpur (MP) for about 2km in length for the subject case study. It ranged from Latitude N23°8'32.9674" Longitude E79°54'57.7901" to Latitude N23°8'3.7726" Longitude E79°54'46.6279".
- (b) Initially the Road was constructed by Contractor M/s Gammon India (1984); both Rigid and flexible Pavement are there and are, in general, in good condition.
- (c) It required Periodic Maintenance for repairing of pot holes in flexible pavement parts, for which Overlay has been done by another Contractor in the year 2011 and later on in the year 2013, also. The rigid pavement part has been in good condition and no needs of even preventive measures were required.
- (d) After inspecting the condition of the road in the year 2014, wherein some portion the top surface was damaged due to traffic and hungry spot appears; on Sample basis the low cost Maintenance Strategy work i.e. spraying Emulsion and sprinkling of sand has been done and studied for a period of 3 years i.e. up to 2017. The details of conditions of roads and other observations are depicted

through the photographs as in Plate 1, as under –

**PLATE 1 :Road from MPEB Barrier to Tee Near Jal Pari via Shakti Bhawan Jabalpur (MP)**



**Image No 1 :Emulsion & Sand Sprinkling**



**Image No 2 :**After 3 years it is observed that the portion where Emulsion is sprayed is well good and on the other side where it is not done (at that time it was in good condition) is damaged which require maintenance (overlay).



**Image No 3 :**In Dec 2014 Patch repair is being required & done in middle portion at portion where preventive measures has not done. Latitude 23.135624 Longitude 79.912663.



**Image No 4 :**In Dec 2014 Patch repair is being required & done. Latitude 23.138357 Longitude 79.912673.



**Image No 5 :**Emulsion Sprayed portion is Safe and firm.



**Image No 6 :**Emulsion Sprayed portion is Safe and firm.



**Image No 7** :Patch repairing work done in Right Sideportion where preventive measures has not done.



**Image No 10** :Patch work done in portion where preventive measures has not done.



**Image No 8** :Overlay in PQC (Damaged)



**Image No 9** :In this portion Emulsion is not Sprayed Properly so, that portion is also damaged.

## VII. ANALYSIS, DISCUSSIONS AND FINDINGS

The following findings have been made from the road –

- (a) For the ease of work and Judgement the nearby road is selected.
- (b) With the verbal permission of Civil Wing of Madhya Pradesh State Electricity Board the some hungry portion of the road is been sprayed by Emulsion and sand is sprayed so as to make the surface smooth.
- (c) After one year it is observed that in the portion where preventive strategies of low cost maintenance with spraying emulsion and sprinkling sand is being done that portion is stiff and smooth and other portion is damaged and required patch work which is shown in Images in Plate 1
- (d) In Image No 6 where Emulsion roles down that portion is also firm.
- (e) In third and fourth year also it is observed that in the portion where emulsion is sprayed and sand being sprinkled is smooth and firm.
- (f) The remaining portion of roads shows pot holes at many place which if not maintained in time results into large size and thus becomes more prone to accidents.

## VIII. CONCLUSION

The important conclusions drawn from the present study can be summarized as follows:

- (a) Where Sub grade, Sub base & Base Course is firm no need to Overlay or over top the Surface.
- (b) It is clear that in Rural Roads, Nagar Nigam Roads and Colony's roads where traffic is not more this is very cheap process to maintain the road by doing preventive strategies.
- (c) This study identifies some strategies for sustainable preventive measures of maintenance rural roads, Nagar Nigam roads, Colony's roads in India to provide huge level of funding for maintenance in future. Absence of timely maintenance results in severe damages.

#### IX. FUTURE SCOPE OF WORK

- (a) The above work can be further verified experimentally for NHs and SHs and strategies be planned accordingly.
- (b) Other Preventive Strategies such as (1) Slurry Seal (2) Micro surfacing can also be verified and maintenance strategies be planned accordingly.

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