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PAVEMENT MANAGEMENT SYSTEM ON HYDERABAD ROADS

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Abstract:

The primary function of a pavement is to transmit loads to the sub-base and underlying soil. Modern flexible pavements contain sand and gravel or crushed stone compacted with a binder of bituminous material, such as asphalt, tar, or asphaltic oil. Such a pavement has enough plasticity to absorb shock. Pavement management system (PMS) is a planning tool used to aid pavement management decisions, pavement deterioration due to traffic and weather, and recommend maintenance and repairs to the road's pavement based on the type and age of the pavement and various measures of existing pavement quality. Measurements can be made by persons on the ground, visually from a moving vehicle, or using automated sensors mounted to a vehicle. Typical tasks performed by pavement management systems include: Inventory pavement conditions, identifying good, fair and poor pavements, assign importance ratings for road segments, based on traffic volumes, road functional class, and community demand, Schedule maintenance of good roads to keep them in good condition, Schedule repairs of poor and fair pavements as remaining available funding allows. It is far less expensive to keep a road in good condition than it is to repair it once it has deteriorated. Therefore, pavement management systems place the priority on preventive maintenance of roads in good condition, rather than reconstructing roads in poor condition. In terms of lifetime cost and long term pavement conditions, this will result in better system performance.

Keywords — **Repairs, Pavement, Pavement management system, Traffic, Deterioration.**

I. INTRODUCTION

A pavement management system (PMS) is a planning tool used to aid pavement management decisions. PMS software programs model future pavement deterioration due to traffic and weather, and recommend maintenance and repairs to the road's pavement based on the type and age of the pavement and various measures of existing pavement quality.

A. Pavement Distresses

Cracks in flexible pavements are caused by deflection of the surface over an unstable foundation, shrinkage of the surface, thermal expansion and contraction of the surface, poorly constructed lane joints or reflection cracking.

Distortion in flexible pavements is caused by foundation settlement, in sufficient compaction of the pavement courses, lack of stability in the bituminous mix, poor bond between the surface and the underlying layer of the pavement structure, swelling soils or frost action in the sub grade.

Disintegration in flexible pavements is caused by insufficient compaction of the surface, insufficient asphalt in the mix, loss of adhesion between the asphalt coating and aggregate particles or over heating of the mix.

Loss of skid resistance is caused by too much asphalt in the bituminous mix, poor aggregate subject to wear and builds up of contaminants

B. Reconstruction

It occurs by removing the existing pavement and base and installing an entire new road section.

Reconstructed pavements are designed to a 20–year design period.

II. STUDY AREA, HYDERABAD CITY

The aim of this study is to suggest establishment of a new system of pavement management in Hyderabad City. The basic purpose of pavement management system is to achieve best value possible for the available public funds and to provide safe, comfortable and economic transportation. The function of management at all levels involves comparing alternatives, coordinating activities, making decisions

And seeing that they are implemented in an efficient and economical manner.

The intent of this report is to present the development of a PMS for use with Hyderabad city roads in the state of Telangana.

1. Hyderabad sits at the junction of three National Highways linking it to six other states:
2. NH-7 runs 2,369 km (1,472 mi) from Varanasi, Uttar Pradesh, in the north to Kanya kumari, Tamil
   Nadu, in the south.
3. NH-9 runs 841 km (523 mi) east-west between Machilipatnam, Andhra Pradesh, and Pune, Maharashtra; and the 280 km (174 mi).
4. NH-163 links Hyderabad to Bhopal patnam, Chhattisgarh.
5. Five state highways, SH-1, SH-2, SH-4, SH-5 and SH-6, either start from, or pass through, Hyderabad. 32.8 kilometres of State Highways
6. 208.07 kilometres of Major district roads
7. 1,250 km of main Arterial and sub Arterial roads.
8. Other than that outer Ring Road of length 167Km of 8 lanes.
9. 11.6 kilometres of elevated Express highway.

III. DATA COLLECTION & ANALYSIS

A. Road Inventory Survey

TABLE -I
ROAD INVENTORY DATA

Section	Carriage way Width(meters)		Shoulder Width(meters)		Median Width(meters)
	L.H.S.	R.H.S.	L.H.S.	R.H.S.	
Ameertpet	7.31	7.62	0.22	0.33	0.5
Punjagutta	8.71	7.69	0.18	0.27	0.5
Irrumanzil	7.1	7.72	0.	0.22	0.5
Khairathabad	9.81	9.7	0.31	0.27	0.5

B. Maintenance Priority Index (MPI):

There are number of factors that influence the performance of industrial roads. Five factors namely, cracking, ravelling, rutting, pot-holes and edge- breaking are considered for suggesting maintenance index for industrial roads.

TABLE -II
RAVELLING

DEGREE	1	2	3	4	5
SEVERITY	Rough Surface	Surface Pitted	Deeply pitted	Fine Aggregate missing	Worst Condition

Extent	Description
1	Isolated occurrence, i.e. less than 5%of road affected
2	Intermittent occurrence, i.e. between 5% and 15%of road affected
3	Regular occurrence, i.e. between 15%and 30%of road affected
4	Frequent occurrence, between 30%and 60%ofroad affected
5	Extensive occurrence, more than 60%of road affected

TABLE -III
POT HOLES (BASED ON TOTAL AREA OF POTHOLES IN METER SQUARE)

Degree	1	2	3	4	5

Severity	<5 mm	5 mm-10 mm	10 mm-15 mm	15 mm-20 mm	>20 mm

Extent	Description
1	Isolated occurrence, number of potholes up to 5
2	Intermittent occurrence, number of potholes 5-10
3	Regular occurrence, number of potholes 10-15
4	Frequent occurrence, number of potholes 15-20
5	Extensive occurrence, number of potholes 20 and above

TABLE -IV:
RUTTING- (DEGREE CRITERIA:-DEPTH OF RUT)

Degree	1	2	3	4	5
Severity	<1	1-3	3-6	6-9	>

Extent	Description
1	less than 5%of road length affected
2	5-10%of road length affected
3	10-20%of road length affected
4	20-30%of road length affected
5	>30%of road length affected

TABLE -V
ROAD CONDITION INDEX (RCI)

RCI	Condition
1-5	Road is in very good condition
5-8	Road is in good condition, although there are few isolated problems
8-10	Road conditions is inacceptable level but not able short out-comings are present
10-12	Road is deteriorated to such an extent that urgent attention is required
>12	Road is very badly affected and urgent attention is required

Suggested ranges of RCI values and its implications are given in following table and these are decided based upon the discussion with the actual users of the industrial roads.

Traffic Volume (TV) and Traffic Composition (TC)

The priority given for the maintenance of the industrial roads doesn't depend only on the condition of the road. It also depends on number and type of vehicles using the road. Hence two parameters, TV and TC are incorporated into the model.TV indicates the number of vehicles passing on the link in a day. Different ranges for these parameters are suggested in present study are given in table below.

TABLE -VI
TV/TC VALUES

TV/TC values	1	2	3		4	5
Vehicles/day	<100	100-200	200-300		300-400	>400
Composition	Mostly cars	Cars, jeeps, tractors	Cars, jeeps, tractors, truck		Cars, jeeps, tractors, truck, buses	Cars, jeeps, tractors, truck, buses, trailers

Road User Factor (RUF)

A road user factor is calculated by taking into consideration the combined effect of TV and TC, RUF is defined as follows

RUF=TV x TC

A higher value of RUF indicates that the industrial road is being used extensively and is more important to transport needs amongst the industrial road network.

Maintenance Priority Index (MPI)

This is the final index indicating the overall priority associated with the industrial road link. MPI is defined as follows:

MPI=RCI* RUF

Higher value of MPI suggests that the industrial road link is in bad condition and should be given higher maintenance priority while considering the network for maintenance.

Pavement was excavated. No layers found up on excavation only bituminous layers found up to 450

mm and beneath that CC road found casted 20-25 years before at Khairtabad to Mithrivanam Route.

Fig -1: Measurement of Potholes, Drainage Catch Pits Measurement

Fig -2: Raveling Measurement, Rutting Measurement

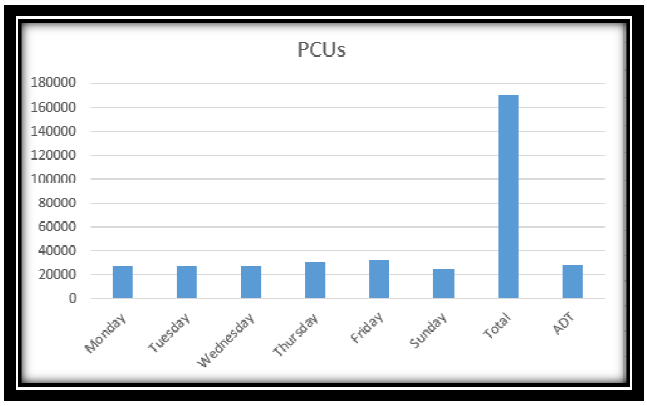

Chart -1: Daily traffic variation

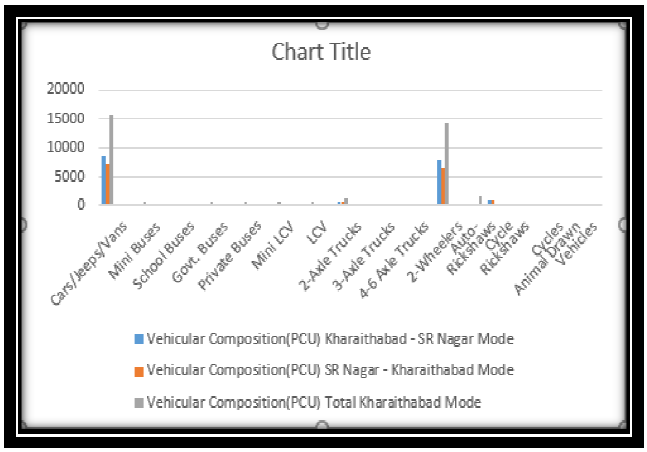

Chart -2: Vehicular Composition

It is observed that higher local passenger traffic because of more number of village's settlement along the existing mid-block

C. Hourly Traffic Variation

It is observed that more traffic movement is during day time that is from 8.00 am to 12.00 noon and 3 to 10pm

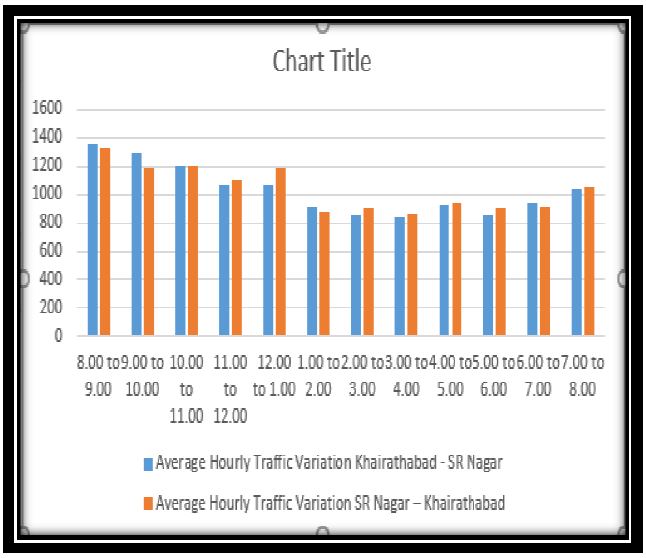

Chart -3: Hourly Traffic Variation

The appreciation of traffic characteristics is essentially to evaluate the potential of the existing network and identify the major issues to develop a rational policy for designing various components of the proposed project.

D.Cost of Reconstruction:

Per the latest circular (no: D-ADM/HDM/Stage-1 rates/2013-14/ 242) released by the Public Works Department, Government of Maharashtra on 16/1/2014, the cost of constructing a MDR or ODR up to WBM, having a Roadway width of 7.5 m on Black- Cotton Soil is Rs.5445000 per Km. Accordingly, the cost of constructing the study area, having a length of 3800 m will be: Rs. 20691000. The cost of Reconstructing over an already existing road is about 30% more than that required for constructing a new pavement. Therefore, the cost of reconstructing the study area will be about Rs.26898300.

Cost of Repair works and Rehabilitation:

The cost of repair works is generally taken as 10% - 15% of the cost of new construction. As seen above, the expenditure required for repairing 1 Km road of width 7.5 m is Rs.8167750. Therefore, the cost of repairing of 3.8 km long study area is about Rs. 3103650.

To sum up:

Cost of reconstructing the study area: Rs. 26898300; and

Cost of repairing the study area: Rs. 3103650

Other than these direct costs, there are several indirect benefits, like vehicle maintenance costs, accident costs, etc. that are gained when the functional efficiency of road is improved. To optimize the funds, the MPI values should be followed to see which section needs to be repaired first. If these steps are followed carefully, we can get an efficient road network with optimum use of resources.

TABLE -7
RATINGS FOR SELECTED STRETCHES IN HYDERABAD ROAD NETWORK

Stretch	OPCI/ Rating	M&R Strategy	Suggested Maintenance Alternative
Ameerpet-Khairathabad	40 (poor)	Reconstruction	Cold in place recycling full depth reconstruction
Balanagar-Bahadurpally	10 (Failed)		
LBNagar-Secunderabad	60 (good)	Rehabilitation	Full depth Reclamation Thick overlays Mill, Full depth Patching premix concept
Abids – Nampally	55 (Fair)		
LB Nagar- MGBS	Fair)		

IV. CONCLUSIONS & RECOMMENDATIONS

Conclusions:

1. The minimum and maximum range of various pavement performance indicators are observed on the study sections are: longitudinal cracking: 8.3% &11.86%; transverse cracking: 2.23% & 6.61%; alligator cracking: 11.44% &16.16%; patching: 4378% &12.0%, Ravelling: 9.58% &29.24%, Deflection: 1mm to1.82mm.
2. Based on the survey Maintenance of pavements is not done regularly, overlays of pavements are going on without testing (i.e. Deflection testing).

Continuous Overlays are done without reconstruction of Stretch.

3. Quality reveals that Quality of materials also not up to the mark. Traffic growth is in high rate while design of overlays is not considering.
4. Due to growth of traffic is more considerations are considering for overlays. Thickness of Overlays also neglected.
5. For Stretch One OPCI/R Reconstruction should do, if not maintenance cost will be too high.
6. Width of the road is also varying from place to place due to this vehicular load is more at stretch and causes deterioration, due to improper drainage facility water get staged on roads and causes damage to roads, in rainy seasons its effect is severe.
7. Pavement structural strength was found to be a crucial pavement condition indicator for changing the pavement performance and deciding the M&R strategy for selected urban pavement sections.
8. The Pavement Management system enables to forecast future needs, conduct pavement performance research and maximize pavement investments.

Recommendations:

1. Proper supervision to be taken on Entire Hyderabad City Road Network
2. Quality of Materials used in the Pavement is not up to the mark, GHMC must control the
3. Quality related Issues as per MORTH.
4. Required Testing's to be done before going for Overlays of Pavement as per IRC.
5. Road widening to be done to control the Heavy traffic as per Standards
6. After completion Of Overlays drainage lids to be brought into the same level of pavement, due to this traffic flow is obstructed.

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