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Flexible Pavement Evaluation for Muttkur and Harshinakunte Road – A Case Study

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ABSTRACT:In a developing country like India, roads and road transportation play an important role in the economic growth of a country. Due to development of infrastructure many changes has to take place to the design standards of highways. Road administration in India is not having a systematic & scientific method, due to the lack of funds for maintenance of existing roads in desired standards. The flexible pavements consist of a surface layer construction of flexible materials (typically asphalt concrete) over granular base layers placed on the existing, natural soil. Generally these pavements deteriorate under increased traffic and adverse environmental conditions. In addition to the above, pavement deterioration can be attributed to materials properties and inadequate pavement thickness. These factors affect the performance of the pavement in a complex manner. Performance evaluation involves assessment of both functional and structural adequacy of pavement. But in the present study only function has been done. The study was conducted to evaluate and improve the road aspects of an existing selected road stretch of Muttkur and Harshinakunte road. The study includes traffic volume survey, pavement condition survey and road inventory. Using these survey data flexible pavement design has been done as per IRC guidelines. Results indicated that, muttkur road has a PCI of 39.8 and harshinakunte road has a PCI of 35.53 hence according to PCI values both the roads requires rehabilitation.

KEYWORDS: Pavement, Evaluation, Potholes, Rutting, Cracks, Patches.

I. INTRODUCTION

The roadways play a vital role in the economic development of any country. Rapid industrialization and urban growth have led to increased traffic and excessive usage of the roads. Pavements are complex structures involving many variables such as materials, construction methods, loads, environment, maintenance and economics. The problems relating to pavements are still complex due to dynamic nature of road pavements. The elements of road pavement deteriorate with time and to maintain them in good condition requires substantial expenditure. Due to heavy traffic wheel loads of commercial vehicles, all the components of the pavement structure get disturbed and deteriorate. The importance of preserving road network in good condition is widely recognized and therefore, performance evaluation of the existing roads is an essential aspect of road maintenance. Over the last two decades, traffic volume and percentage of heavy traffic have increased enormously demanding stronger and long lasting pavements. Flexible pavements with bituminous surfacing are widely used in India because of the easy in construction and also due to the fact that this technology is in practice for many years and contractors have gained enough experience.

From road user's point of view the road must be safe, comfortable and enable fast movement of the vehicle at reasonable vehicle operation cost and for this the functional and structural condition of the pavement should be in good condition. A strong pavement may not show functional and structural failure in the form of distress like cracks, ruts, potholes, patches, poor ride quality and deflection. But weak pavements will exhibit signs of failure in the form of wide cracks, ruts, poor ride quality and deflection. Because of this reason there is a need to evaluate the structural and functional deterioration of the flexible pavement periodically. Deterioration of pavement can be attributed to various factors like traffic, environment, materials properties and pavement thickness. Stability of pavement depends on subgrade properties which affect the mechanical characteristics of pavement. These factors affect the performance of the pavement in a complex manner. There are many studies and several recommendations are available for performance evaluation of flexible pavements based on Pavement condition index (Uday Kumar et. al., 2008), (N H Suma 1998), deflection (Rokade et.al., 2010) IRI (Ankit Gupta et.al., 2013) etc. They are developed for the local conditions and are

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mostly suitable for those regions. However, they are also used extensively for pavement evaluation in other areas. It is necessary to validate the applicability of that evaluation technique before they are used. In the present investigation, The Muttukur and Harshinakunte Road is consider for pavement evaluation. Both field and laboratory investigations are carried out to evaluate the pavement performance. The field study consists of road inventory, traffic study, pavement crust details, subgrade characteristics, pavement distress survey. The laboratory study consists of grain size analysis, Atterberg's limit, compaction and CBR test. The following paragraphs provides the outline of the report.

II. LITERATURE REVIEW

Oliver Lin et al. (2014) carry out a study on "Pavement condition modeling by using surface condition data-A vicroads study" in this investigation they concluded that the optimization algorithm developed considers the improvement of the pavement condition after treatment, traffic volume and importance of the network functions in the cost benefit analysis to make best use of the available limited budget". Vinay H N et al. (2014)) carry out a study on "Rehabilitation of low volume flexible pavements by white topping" and they concluded that "Based on PCI, IRC and deflection values pavement rehabilitation measures are considered". Faraj Muftah M Akash et al. (2014) carry out a study on "The use of pavement condition index (PCI) as the consideration of rehabilitation priority" and they concluded that "Each segment of road was observed and measured to identify the type of damage existing and was assessed according to PCI method" and the repair was done based on the type of damage existing in this road.

III. OBJECTIVE

TO EVALUATE THE PERFORMANCE OF IN-SERVICE FLEXIBLE PAVEMENT OF A CHOSEN ROAD NETWORK BY A DETAILED PAVEMENT CONDITION ASSESSMENT STUDY CONSIDERING FUNCTIONAL EVALUATION CRITERIA.

IV. METHODOLOGY

- CARRY OUT ROAD INVENTORY SURVEY FOR THE MUTTKUR & HARSHINAKUNTE ROAD
- CARRY OUT TRAFFIC VOLUME SURVEYS FOR SELECTED ROAD AS PER IRC: 106-1990.
- DETERMINE OF SUBGRADE CHARACTERISTICS (GRAIN SIZE ANALYSIS, LIQUID AND PLASTIC LIMIT, COMPACTION AND CBR) FOR CHOSEN ROAD.
- PAVEMENT EVALUATION BY ROAD SURFACE CONDITION SURVEY FOR RATING AS PER ASTM - D6433 (POTHOLES, PATCHES, CRACKS AND RUT).

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V. RESULTS AND DISCUSSION

Table:1 Details of traffic data in PCU in both directions of MR & HR Road

Road name	Trucks (PCU)			Van/Tempo (PCU)	Buses (PCU)		Cars/Jeeps (PCU)	Motor Cycle (PCU)	Auto (PCU)	Tractors (PCU)	Cycles (PCU)	Total of number vehicles`	Average daily Traffic
	Regular Trucks	MAV	LCV		MIN. Bues	Buses							
MR Road	75	5	61	142	141	132	716	1718	111	18	14	3128	3194
	196	0	13	84	73	101	735	1788	81	13	17	3099	
	194	3	32	172	101	130	695	1842	131	27	31	3356	
HR Road	165	7	21	50	69	97	470	3152	280	18	45	4371	4536
	179	3	16	49	84	66	332	3541	234	14	37	4552	
	179	3	23	56	71	88	433	3514	276	5	40	4684	

Table: 2 Road inventory details of MR & HR Road

No.	Description	Remarks	
		Muttkur road	Harshinakunte road
1.	Length of the road	1000m	1000m
2.	Width of the carriage way	5.5 m	6 m
3.	Type of pavement	Bituminous	Bituminous
4.	Number of lanes	Intermediate	Intermediate
5.	Divided / Undivided	Undivided	Undivided
6.	Type of shoulder and width	Earthen shoulder on either side 2m	
7.	Median width	Median not present	
8.	Terrain	Plain	
9.	Drainage condition	Poor	
10.	Land use pattern	Industrial / Residential	

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Table:3 Sub grade soil properties of Mutkkur road

PARTICILARS	Properties of Subgrade soil									
	Grain size distribution			Atterberg's Limits			Compaction characteristics		Soil classification	CBR (%)
	Gravel (%)	Sand (%)	Silt and Clay (%)	LL (%)	PL (%)	PI (%)	MDD gm\cc	OMC (%)	HRB classification	
Sample 1	4.8	45.2	50	32	17	13	2.02	8.5	A-6	7
Sample 2	3.8	45.1	51.1	29	18	15	1.90	8.2	A-6	7
Sample 3	2.2	45.5	52.3	30	15	14	2.02	8.4	A-6	7

Table:4 Sub grade soil properties of Harshinakunte road

PARTICILARS	Properties of Subgrade soil									
	Grain size distribution			Atterberg's Limits			Compaction characteristics		Soil classification	CBR (%)
	Gravel (%)	Sand (%)	Silt and Clay (%)	LL (%)	PL (%)	PI (%)	MDD (%)	OMC (%)	HRB classification	
Sample 1	5.8	43	51.2	37	20	17	2.02	8.72	A-6	7
Sample 2	2.4	44.6	53	38	20	18	2.07	8.5	A-6	7
Sample 3	2.76	41.64	55.6	34	18	16	2.07	8.7	A-6	7

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Table 5: Commercial vehicle count of Muttukur road

Road name	Vehicle type					commercial vehicles per day	Average total number of commercial vehicles per day
	Regular trucks	MAV	LCV	Minibus/tempo	Govt buses/ Other buses		
Day 1	278	88	60	283	132	841	1013
Day 2	250	100	75	250	201	1126	
Day 3	375	200	55	273	169	1072	

Table 6: Commercial vehicle count of Harshinakunte road

Road name	Vehicle type					commercial vehicles per day	Average total number of commercial vehicles per day
	Regular trucks	MAV	LCV	Minibus/tempo	Govt buses/ Other buses		
Day 1	375	173	145	200	256	1149	1210
Day 2	295	150	230	250	205	1130	
Day 3	317	195	289	275	240	1316	

Average PCI index for Muttukur road according to Potholes, Patching, Rutting & Cracking as per ASTM-D6433 = 39.8

Average PCI index for Harshinakunte road according to Potholes, Patching, Rutting & Cracking as per ASTM-D6433 = 35.53

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Table:7 Design Thickness details of Muttkur road

Road name	Soaked CBR (%)	Million Standard Axles (msa)	Design thickness as per IRC:37 – 2012 (mm)	
MR Road	7	20	Bituminous Concrete (BC)	40
			Dense bituminous macadam (DBM)	90
			Base (wet mix macadam)	250
			Sub base (Granular sub base)	230
			TOTAL THICKNESS	580

Table:8 Design Thickness details of Harshinakunte road

Road name	Soaked CBR (%)	Million Standard Axles (msa)	Design thickness as per IRC:37 – 2012 (mm)	
HR Road	7	31	Bituminous Concrete (BC)	40
			Dense bituminous macadam (DBM)	111
			Base (wet mix macadam)	250
			Sub base (Granular sub base)	230
			TOTAL THICKNESS	631

VI.CONCLUSIONS

1. According to the ASTM D6433 code book the PCI values for Muttkur and Harshinakunte road obtained as 39.8 and 35.53.
2. For the obtained PCI values both roads requires rehabilitation as per ASTM D6433.

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