

# COMPARATIVE STUDY OF DEVELOPMENT OF OVERALL PAVEMENT CONDITION INDEX FOR DIFFERENT CITIES OF INDIA

Deepak Mittal<sup>1</sup>, Akhilesh Nautiyal<sup>2</sup>, Sunil Sharma<sup>3</sup>

<sup>1</sup>M.Tech Research Scholar, <sup>2</sup>M.Tech Research Scholar, <sup>3</sup>Assistant Professor  
Transportation Engineering, Civil Engineering  
NIT Hamirpur, Hamirpur-177005, India

**Abstract:** Urban roads are the major assets for infrastructure development of a country. Expressways, arterial roads, sub arterial roads and collector roads comes in urban roads. These roads are the mostly busiest roads. It needs to find out surface characteristics of these roads as these roads connects residential areas to commercial areas and to some other major places in the cities. Therefore it is very important to maintain these roads frequently because these are subjected to heavy traffic loads and in monsoon or poor drainage, these urban roads deteriorates at faster rate. So these roads requires timely maintenance and cost rehabilitation. A tool which can access the deterioration of roads is Pavement Condition Index (PCI). PCI gives the rates the condition of the surface of a road network from 0 to 5, where 0 is the worst and 5 is the best surface condition of roads. It Measures the type, extent and severity of pavement surface distresses (typically cracks and rutting) and also the smoothness and ride comfort of the roads. With using this tool, one can determine the condition of road and give the maintenance frequently which makes it cost effective. Therefore, this paper aims at bringing the methodology used for various surveys like data collection of roads which include length and width of road, surface distresses and roughness of the road which collectively used to determine the Overall Pavement Condition Index (OPCI) of roads and accordingly maintenance strategy is provided for the given section.

**Keywords –** PCI, pothole, ravelling, rutting, cracks, traffic loads, OPCI

## 1. INTRODUCTION

Road maintenance is one the most important component in the entire road system because it directly affects the total cost of the project. The maintenance operation involves the pavement inventory, identify the surface distress, functional evaluation of surface distress and roughness of roads and finally adopting the appropriate method for the maintenance. To carry out the design of pavement rehabilitation, condition of existing pavement must be evaluated. Evaluation of existing pavement can be done by assessment of pavement surface distress, roughness indicators and rutting which collectively give the overall PCI of the road.

In past studies, pavement management system (PMS) has been adopted for different cities in India (e.g. Noida, Hyderabad and Bangalore). This paper aims to compare the study these cities. It is very important to maintain these roads very frequently as it deteriorates at faster rate due to heavy traffic and poor drainage during monsoon season.

### 1.1 Need for study

There is need for the study in hilly areas as all the work has been done on plains till now. With the help of this study, proper maintenance procedure can be evaluated which result in cost effective project.

## 2. LITERATURE REVIEW

Pavement distress and failure is considered as factors which are responsible for the pavement deterioration. Past studies has been done on various urban cities which are located in plains. In 2013, Vishwanath maldev *et.al* studied on the “development of pavement management strategies for arterial roads”. It studied on the arterial roads of Bangalore city and it concluded that potholes, weathering and ravelling, alligator cracking, polished aggregate and rutting were the major distress identified on urban stretches and it also concluded that higher the value of PCI, lesser will be the need for maintenance of the road. The development of overall pavement condition indicators for urban road section (yogesh U shah *et al.* 2013). He took 10 road section of Noida city for determining the maintenance and rehabilitation strategies for the cost effectiveness of the project. It gave the various range of PCI for four indicator which helps in deciding the maintenance strategies for the Noida city. The pavement condition was rated based these values as 0-10: Failed; 10-25: Very Poor; 25-40: Poor; 40-55: Fair; 55-70: Good; 70-85: Very Good; 85-100: Excellent. The study in Hyderabad city has been done on “development of pavement management system on urban road network” in 2016 by D.Prachallaja *et.al.* and he concluded that the cost of repair works is generally taken as 10% - 15% of the cost of new construction i.e. Cost of reconstructing the study area: Rs. 26898300; and Cost of Repairing the study area: Rs. 3103650.

## 3. METHODOLOGY

The methodology obtained for this paper consists of selection of pavement road section, data collection for calculation of surface distress, details of pavement i.e. length and width of road sections, roughness indicator, evaluation of various indicators based on distresses, roughness, skid resistance and structure of the road. The study areas consists of road sections of NOIDA, Hyderabad City and Bangalore. After calculation of various indicators, overall PCI is calculated by giving certain weightage to each indicator. Based on OPCI, selection of maintenance and rehabilitation strategies has to be adopted.

Table 1. Road Sections in Bangalore

S.No.	Road Name	Length(Kms)	Pavement type	Divided way	Carriage	Width (Mtr.)	No. of Sections Made
1.	Magadi Road	9.5	Flexible	Yes		15	5
2.	Uttarahalli Road	17	Flexible	No		10	9
3.	Subramanyapura Vasantapura Main Road	3.7	Flexible	No		10	2
4.	Muddinapalya Road	6.3	Flexible	No		10	4

Table 2. Road Sections in Hyderabad

Sections	Carriageway Width	Shoulder Width	Median Width
Ameertpet	22.92	0.55	0.5
Punjagutta	23.4	0.45	0.5
Irrumanzil	16.8	0.32	0.5
Khairathabad	30.5	0.58	0.5

Table 3. Road Sections of NOIDA

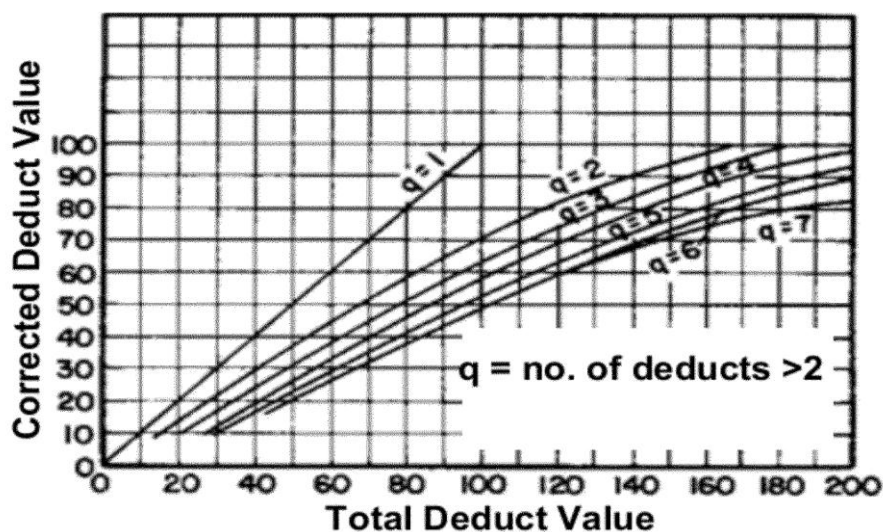
S.no.	Name of Roads	Length(Kms)	No. of Lanes
1	Jamnalal Bajaj Marg (MP Road No 1)	3.5	6
2	Maharaja Agrasen Marg & Ashok Marg (MP Road No 2)	6	6
3	Amrapali Marg & Golf Marg (MP Road No 3)	7.5	6
4	Udhyog Marg	3.2	6
5	Vindayachal Marg & Shivalik Marg	2.2	6
6	Nithari Road	2.4	6
7	Kamal Marg	3	6
8	Amity University Road	0.7	4
9	Lotus Valley School Road (Between Sector 126 & 127)	0.7	4
10	Road between Sector 7 & 8 (Near Vasundhara Enclave)	0.7	4

#### 4. RESULTS & DISCUSSION

##### Bangalore Region

To calculate PCI value, a term called deducted value is introduced that represents the amount of distress that a pavement has undergone or is subjected to.

Figure 1. Corrected deduct value V/S Total deduct value



In case of Bangalore case study, the PCI value is determined by calculating corrected deduct value (CDV) from CDV v/s TDV curve. Then the overall PCI is determined by:

$$PCI = 100 - CDV$$

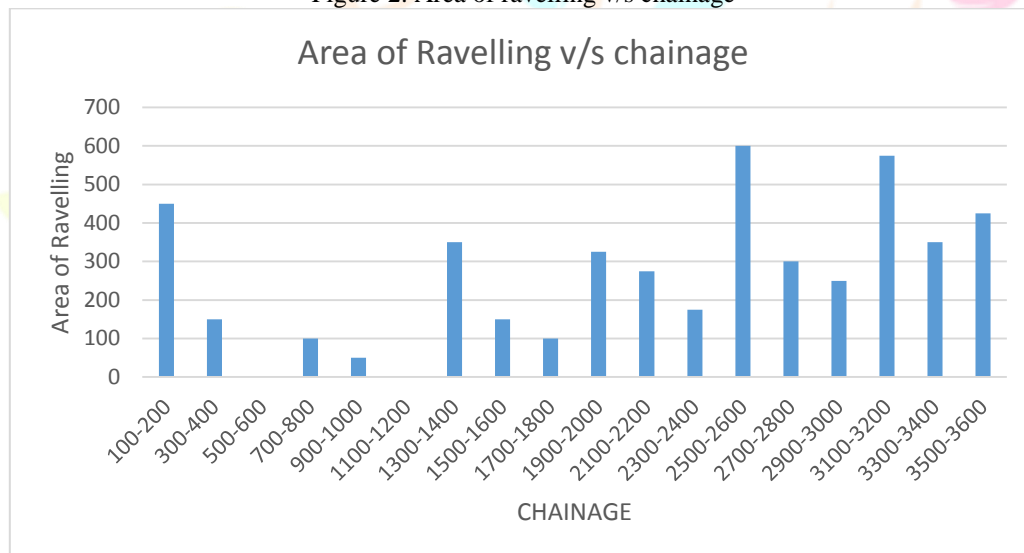
It give appropriate measure with the PCI value of roads:-

PCI RANGE	Rating	Maintenance Measures
86-100	Excellent	No maintenance required
71-85	V. Good	Little or no maintenance
56-70	Good	Routine maintenance, crack sealing and minor patching
41-55	Fair	Preservative treatments (seal coating or thin non-structural overlay 2" or more)
26-40	Poor	Needs patching and repair prior to major overlay Milling
		and removal of deterioration extends the life of overlay
11-25	V. Poor	Needs reconstruction with extensive base repair.
0-10	Failed	Total Reconstruction

### Hyderabad Region

As per the survey, the data was revealed in the form of graph which shows the area of ravelling versus chainage length for every 100m. The graph is shown as below:-

Figure 2. Area of ravelling v/s chainage



This study found that maintenance cost is about 10-15% of new construction cost of road. It found that other than direct cost, various indirect cost such as vehicle maintenance cost, accident costs etc. that are gained when the road is improved. In order to optimise funds, roads which have low PCI value should be repaired first with appropriate material and method. By doing so, we can optimise the funds by using optimise resources.

### NOIDA Region

The study determined the required treatment on the road depends on several factors such as road class, surface type, pavement condition index etc. The maintenance and rehabilitation strategies is adopted based on overall pavement condition index and it is shown in the table given below:-

PCI RANGE	Rating	M&R strategy	Suggested Maintenance Alternatives
85-100	Excellent	Routine Maintenance	Patching, Pothole filling, Crack sealing
70-85	V. Good	Preventive Measures	Chip Seal, Micro-Surfacing, Thin Overlays, Fog Seal
55-70	Good		
40-55	Fair	Rehabilitation	Thick overlays, Mill & Overlays, Full depth patching, Premix Carpet
25-40	Poor	Reconstruction	Cold in-place recycling, Full depth Reconstruction
10-25	V. Poor		
0-10	Failed		

The distribution of maintenance strategies is based on overall pavement condition index and the various indicators which were observed in the study area. It was observed that 70% of the pavement section in need of “premix carpeting” whereas 30% of the section in need of “thick overlay” based on  $PCI_{\text{distress}}$ . In case of  $PCI_{\text{distress+roughness}}$  10% of section were in need for “premix carpet”, 50% were in need of “thick overlay” and remaining 40% were in need of “mill & overlay”. There was no change observed in maintenance alternative when skid resistance factor was considered. It was found that structural strength of pavement have great impact on the condition rating and therefore, it provides appropriate measure for maintenance.

## CONCLUSION & DISCUSSION

- It was concluded that the better the condition of the road, more will be the pavement condition index.
- The urban sections that have higher pavement condition index do not require maintenance or very less maintenance whereas the roads which have lower pavement condition index do require proper maintenance or sometimes full depth reconstruction is required.
- Maintenance work cost is only 10-15% of the reconstruction cost of the road. Therefore, there is need to adopt proper maintenance before going for new construction of road.
- Potholes, ravelling, rutting and alligator cracking are the most common distress which can be seen on the surface of pavement. So, it was seen that wearing course is completely damage in Bangalore city which require immediate maintenance.
- Skid resistance indicator is very crucial indicator in those areas which are exposed to frequent rain weather conditions. But it can be avoided where rainfall is scarce.
- It can be stated from the study that multiple indices condition indicators are much more reliable in considering riding quality and structural integrity, and it is much efficient for selecting the appropriate method for maintenance of road.
- It was concluded from the study that quality of the material effects the quality of road, if the quality of material is not appropriate then the road will be deteriorate at faster rate.
- The average  $PCI_{\text{Distress}}$ ,  $PCI_{\text{Distress+Roughness}}$ ,  $PCI_{\text{Distress+Roughness+Structure}}$  and OPCI values of selected urban road sections were found to be in a range of 69-77 (good to very good pavement condition), 51-63 (fair to good pavement condition), 37-57 (poor to good pavement condition) and 33-51 (poor to good pavement condition) respectively.

## REFERENCES

- [1] Yogesh U.Shah, S.S. Jain, Devesh Tiwari, M.K. Jain “Development of Overall Pavement Condition Index for Urban Road Network”, Conference of Transportation Research Group of India.
- [2] Vishwanath G, Mahdev, M. R. Archana, Krishna Prapoorna Biligiri,” development of pavement management strategies for arterial roads”, International Journal of Research in Engineering and Technology eISSN: 2319-1163.
- [3] D.Prachallaja, A.NagaSaibaba, Dr.M.Kameswara Rao, “development of pavement management system on urban road network” International Journal For Technological Research in Engineering Volume 4 Issue 3 November 2016.
- [4] Shah, Y.U., Jain, S.S. and Parida, M. (2012). Evaluation of prioritization methods for effective pavement maintenance of urban roads. International Journal of Pavement Engineering, <http://www.tandfonline.com/doi/full/10.1080/10298436.2012.657798>
- [5] U.S, Army (1982). Pavement Maintenance Management, Technical Manual TM 5-623.
- [6] L. Udayakumar, R. Vivan Robert and M. S. Amarnath, “Ranking Technique for Prioritisation of Arterial and Sub Arterial Roads for Maintenance Management”, *Journal of Indian Highways*, Vol. 36, No.11, (2008) pp.41-51
- [7] Reddy, B.B. (1996). Development of failure criteria for flexible pavements, Ph. D.Thesis, Bangalore University, Bangalore

