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Evaluation of Pavement Section between Udalpur Crossing to Sevaliya Thashra

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ABSTRACT: Highway pavements are deteriorating fast due to lack of timely maintenance, leading to higher vehicle operating costs, increasing number of accidents etc. Thus, timely maintenance of the highway pavement is essential. Because, once pavements start to deteriorate; they deteriorate rapidly beyond the point where maintenance will be ineffective. Thus, there is an urgent need to develop a strategy for maintenance of pavement in a huge highway network. Maintenance priority of the pavement is based on importance of the road sections, present road conditions, and future road conditions. The paper describes a strategy for maintenance of highway pavement. In this paper consists of detailed analysis of all aspects of pavement condition resulting in the identification of specific problems and their causes. The data type required for analysis range from simple data such as pavement design features and pavement geometrics, to detailed data obtained from destructive testing and non-destructive testing Firstly, failure patterns are classified between Udalpur crossing to sevaliya thashra highway in existing pavement by visual inspection. Secondly, pavement serviceability index was determined. For structural maintenance, stress and deflection of Udalpur crossing to sevaliya, thashra Highway are determined by using the various methods.

Keywords-* Highway *Pavement, pavement Serviceability Index, Pavement visual inspection

I. INTRODUCTION

1.1 General

The importance of roads in connecting the urban areas of India to form the national market and economy cannot be overstated. Connectivity provided by roads is perhaps the single most important determinant for the well-being and the quality of life of people living in an urban area. The efficiency of the innumerable government programs aimed at urban development, employment generation, and local industrialization is, to a large extent, determined by the connectivity provided by roads. There is a considerable body of evidence that demonstrates the links between urban road Development and improvement in the quality of life in India.

The main objective of this ongoing study is to develop a strategy to select the most appropriate activities to be carried out at pavement sections of a highway network considering their maintenance. By providing appropriate maintenance treatment at appropriate time, the rate of deterioration can be deferred to a great extent and this will reduce the maintenance cost of roads. If timely maintenance is not provided, the reconstruction will become unavoidable. Therefore pavement maintenance is one of the most important components of the entire road system. There are different type of distresses can occur on the pavement like cracks, rutting, potholes, shallow depressions, hungry Surfaces etc. Pavement deterioration causes for accidents on roads and which will increase the loss of life and properties.

It has been established routine maintenance standards such as crack sealing every year, seal coat every four years etc., but the main problem is how to establish the major maintenance programs under restricted budget.

Pavement evaluation is an integral part of the Pavement Management System (PMS). Evaluating functional condition of existing, in-service pavements constitutes annually a major part of the maintenance and rehabilitation activities undertaken by State Highway Agencies. The functional condition of the pavements changes with passage of time due to the combined effects of its structural adequacy, composition and loading characteristics of traffic, environment conditions and the maintenance inputs provided. The process of accumulation of damage is called deterioration and the failure of pavement is said to have reached at the limiting stage of serviceability level. The physical sign of internal damage, for example cracking, rutting, potholes etc. are known as distress, which are the indicators of the pavement condition. Pavement visual condition surveys are used for the measurement of pavement distresses. Pavement condition index and pavement roughness are used as indices for representing pavement functional condition. Roughness has been universally accepted as a measure of functional condition of a pavement. The riding quality of the road pavement, major indicator of its service performance, was determined using the international roughness index (IRI).

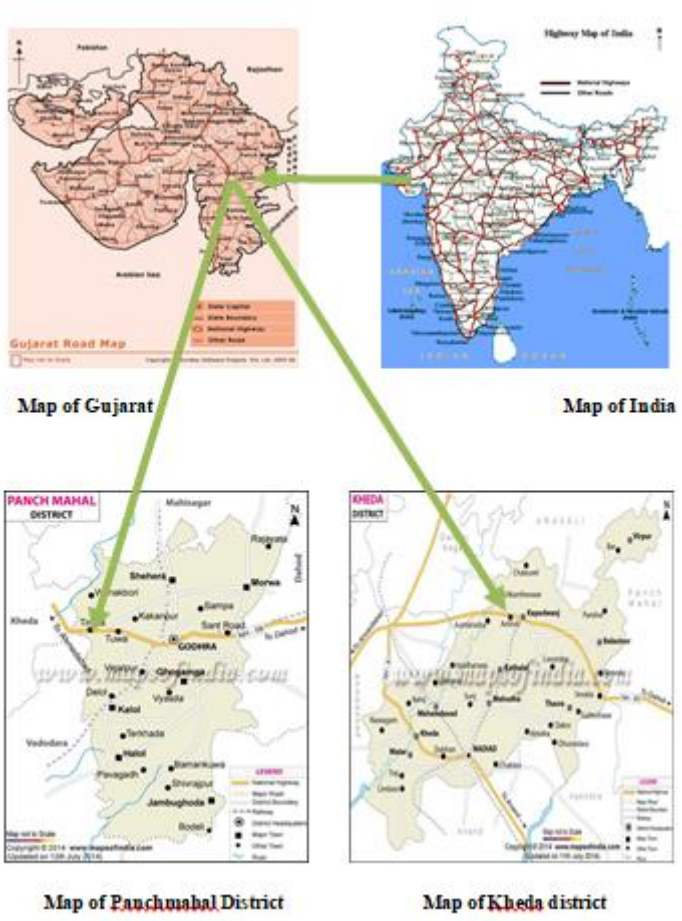

Figure 1 Route Location of Selected Stretch

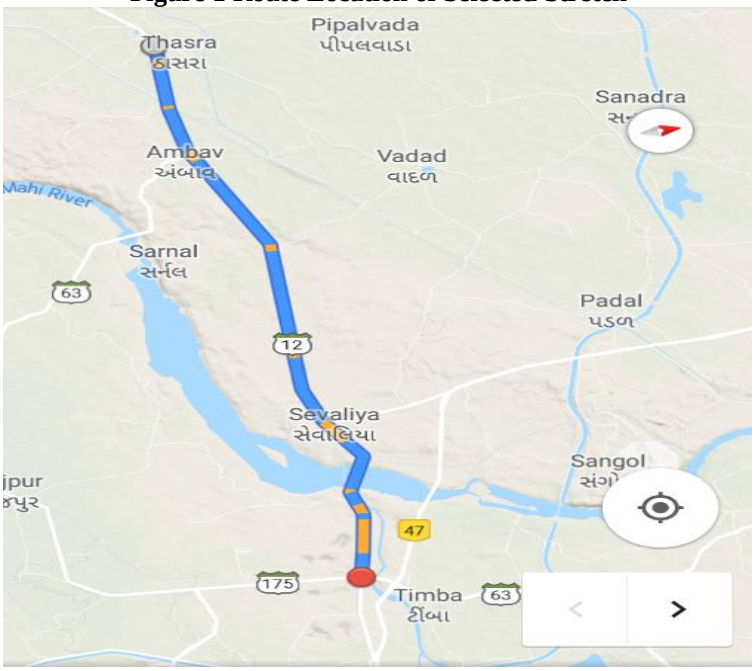

Figure 2 . Road Network to Udalpur Crossing to Sevaliya Thashra

II. Review of Literature

Shah ET. al. (2013) represents their study Maintenance and rehabilitation of these pavements to the desired level of serviceability is one of the challenging problems faced by pavement engineers and administration in the highway sector. The evaluation of pavement performance using pavement condition indicators is a basic component of any Pavement Management System. Various indicators like Pavement Condition Index (PCI), Present Serviceability Rating (PSR), Roughness Index (RI), etc. have been commonly used to assign a maintenance strategy for the existing pavements. The present paper is an effort in the similar direction, to develop a combined Overall Pavement Condition Index (OPCI) for the selected network of Noida urban roads.
The study area consists of 10 urban road sections constituting 29.92 km of Noida city. The methodology includes identification of urban road sections, pavement distress data collection, development of individual distress index and finally developing a combined OPCI for the network. The four performance indices viz. Pavement Condition Distress Index ($PCI_{Distress}$), Pavement Condition Roughness Index ($PCI_{Roughness}$), Pavement Condition Structural Capacity Index ($PCI_{Structure}$) and Pavement Condition Skid Resistance Index (PCISkid) are developed individually. Then all these indices are combined together to form an OPCI giving importance of each indicator. The proposed index is expected to be a good indicative of pavement condition and performance. The developed OPCI was used to select the maintenance strategy for the pavement section.

Minu P K at. Al (2014) have developed a Maintenance Priority Index (MPI) for the sections of the State Highway (SH-1) using certain factors affecting pavement maintenance. The factors considered in this study were pavement condition, riding quality, traffic characteristics, land use characteristics and characteristic deflection of the pavement. A relationship between pavement roughness and distress parameters like area of raveling, cracked area etc. also developed. The pavement distress data was collected on SH stretching. Roughness survey was conducted using Bump integrator and Benkelman beam was used for the measurement of deflections in the pavement. Pavement Condition Indexes (PCI) for section was determined. The relation between pavement distress and pavement roughness was modelled using Multiple Linear Regression (MLR) analysis. The models were significant as the forecasting errors were within the limits. Detailed pavement evaluation surveys were conducted. The main distresses identified on the roads were raveling, potholes and cracking. Pavement Condition Index for selected road stretches was calculated. Multiple linear regression models were developed for pavement roughness in each section in the study stretch.
Independent variables selected for the models were found to be statistically significant. The developed models were validated and the performance was evaluating Maintenance priority index was developed by composite index method. The factors affecting maintenance considered in the study were traffic volume, pavement roughness, pavement deflection; land use, pavement condition etc.

Patel & Lad (2015) represent their study on highways, pavements, bridges, parking garages and other exposed structures are becoming functionally obsolete or deteriorating due to repeated application of vehicular loads and due to the effect of climatic parameters. Non-destructive structural evaluation of pavements is an important part of the pavement management. In the structural evaluation of flexible pavement the pavement deflection is measured by the Benkelman Beam. Rebound deflection is used for overlay design. A detailed pavement condition survey is done on State Highway 158 (Waghodiya crossing to Limda) and the road condition is evaluated structurally. The present study is evaluates the overlay thickness for State Highway 158 Waghodiya crossing to Limda.

Patel ET. Al. (2016) Developed study represents a concept of "dynamic passenger car unit' ('DPCU'), appropriate for the heterogeneous traffic on Indian roads, and shows that the PCU factor for a vehicle type is not a static factor as it is usually assumed. Various relationships will be developed between speed-flow. By using three different methods of estimating PCU, PCU value of different category of vehicles should be found. This PCU factor is the ratio of the projected rectangular area of the vehicle type to the speed of the vehicle type, with respect to car. Factors influencing PCU value are classified volume of vehicles and Average speed .PCU values of different types of vehicles is determined on Urban Road by different methods and suggest the reliable method.

Modi ET. Al. (2017) developed Over loading commercial trucks in India is a serious problem. Traffic load is dominant function on flexible pavement design because the main function of pavement is to resist traffic load. Some roads are not designed for carry heavy load. In functional behavior visual observed by measuring cracking, rutting, potholes, reveling, patching in deterioration pavement. Traffic volume count is required for calculate the load on road. In the structural evaluation of flexible pavement the pavement deflection is measured by the Benkelman beam. The objective of the present study to evaluate the sub-grade soil parameter, traffic volume, requirement of overlay design for future traffic conditions.

III. Methodology

3.1 Methodology Chart

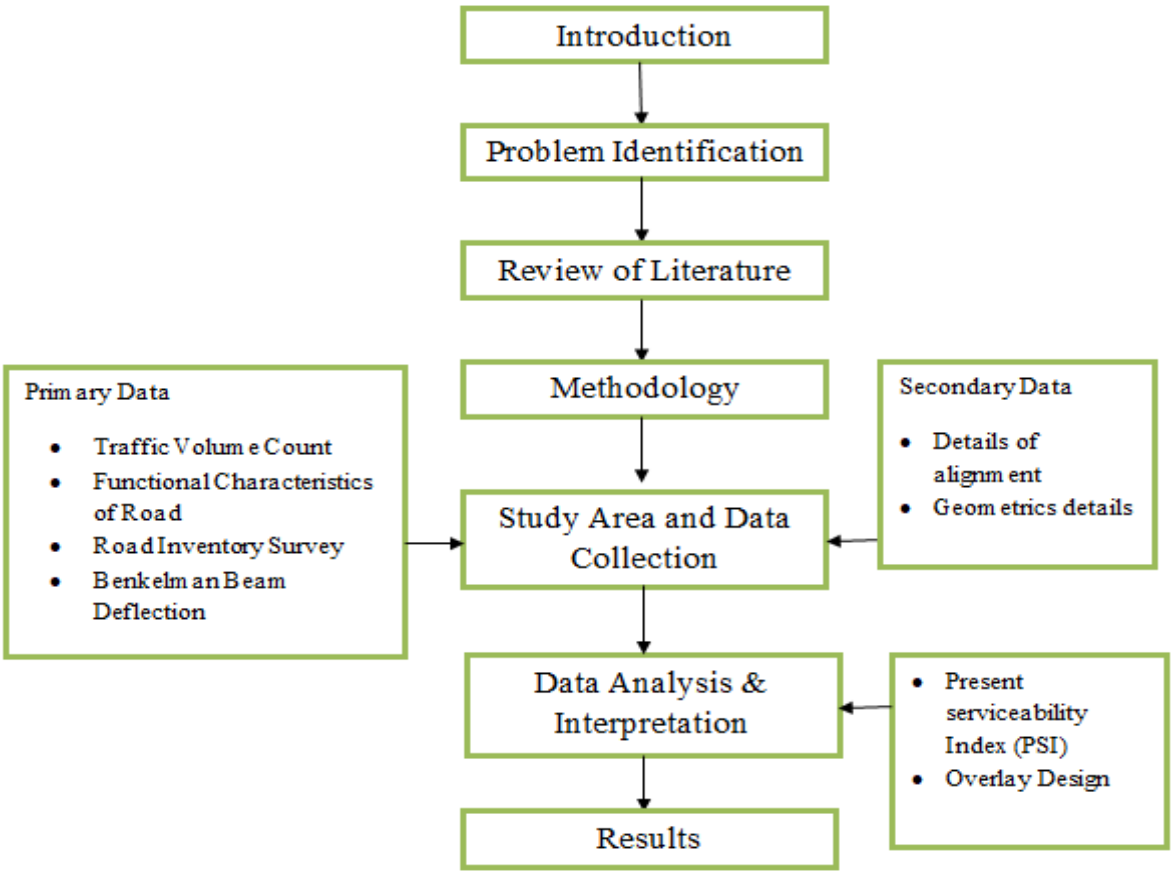

Figure 3 Methodology Chart

IV. Study Area & Data Collection

4.1 General

Panchmahal and kheda district are districts state of Gujarat in India that Panchmahal comes lies at 22^0 45' N, 73^0 40' E In western zone in India. And Kheda comes lies at 22^0 45' N, 72^0 45' E in western zone in India. The panchmahal district is consists of Godhra, Kalol, Halol, Shehera, Ghoghamba, Morva (hadaf), jambughoda etc. The Kheda District is consists of Thashra, Dakar, Kapadvanj, Kathlal, Nadiad, Matar, Kheda, Mehmedabad, Mahuda etc. In this study 12 km stretch of SH 12 is intersect in panchmahal district and 8 km stretch of SH 12 is intersect in Kheda district.

Data collection

4.3.1 Traffic volume count

Table 1. Total number of vehicle for 3 days on pavement section

Number of Total vehicle for 3 days on pavement section									
Time Period	2W	3W	Car/ Jeep	Tempo /Lcv	Std. Bus	Truck	Tractor with trailer	Cycle	Tipper/ Dumper
1st day 12 hr	6385	2114	2507	480	462	785	214	106	971
2nd day 12 hr	6393	2066	2185	556	470	772	292	110	1012
3rd day 12 hr	6426	2044	2345	584	500	750	395	108	1196
Total of 3 Days	19204	6424	7037	1620	1432	2307	901	324	3179
ADT of 3 Days	6402	2142	2346	540	478	769	301	108	1060

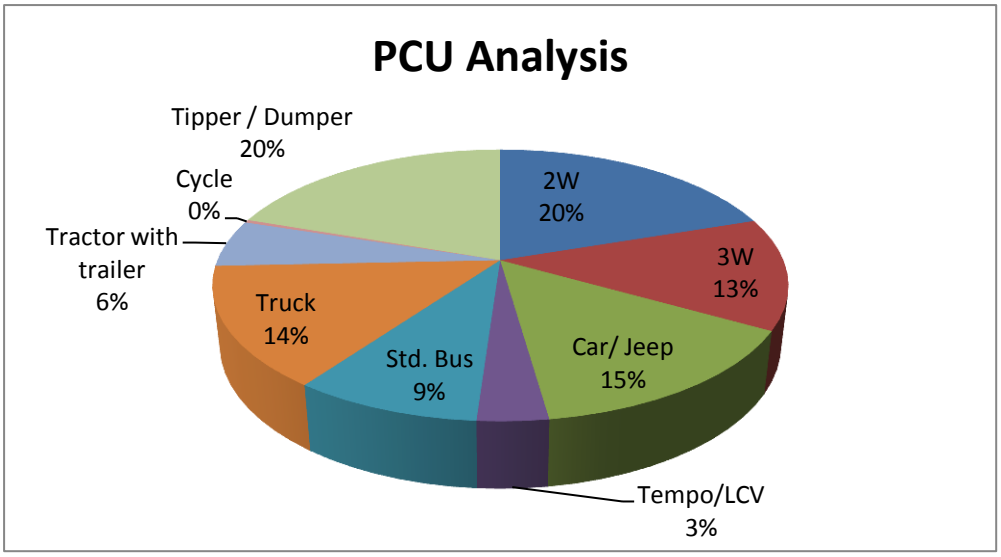

Figure 4. Volume of Vehicle

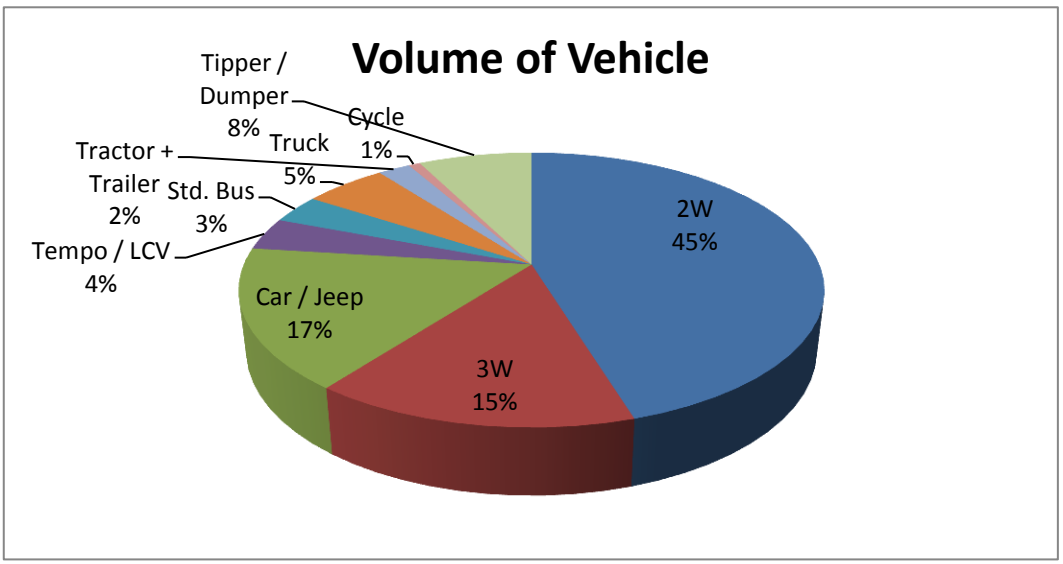

Figure 5 PCU Analysis

Table 2. PCU Analysis

No.	Type of Vehicle	Number of vehicle	Standard PCU of vehicle(As per IRC)	Total PCU
1	2W	6402	0.5	3201
2	3W	2142	1	2142
3	Car/ Jeep	2346	1	2346
4	Tempo/LCV	540	1	540
5	Std. Bus	478	3	1434
6	Truck	769	3	2307
7	Tractor with trailer	301	3	903
8	Cycle	108	0.5	54
9	Tipper / Dumper	1060	3	3180
			Total PCU of Vehicles	**16107**

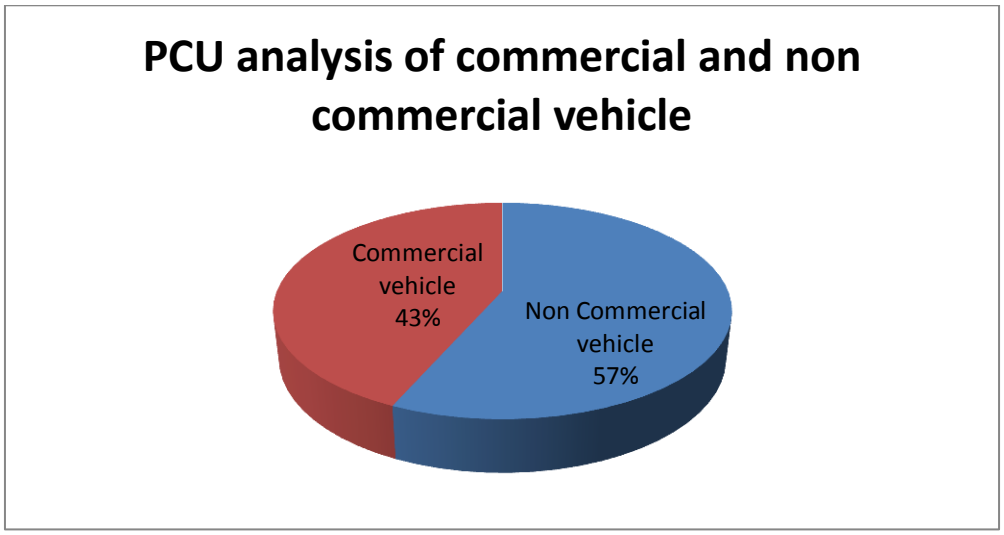

Figure 6 PCU analysis of Commercial and Non Commercial Vehicle

Table 3. CVPD Analysis

No.	Type of Vehicle	Number of vehicle
1	Tempo/LCV	540
2	Truck	769
3	Tractor with trailer	301
4	Tipper / Dumper	1060
	C.V.P.D.	**2670**

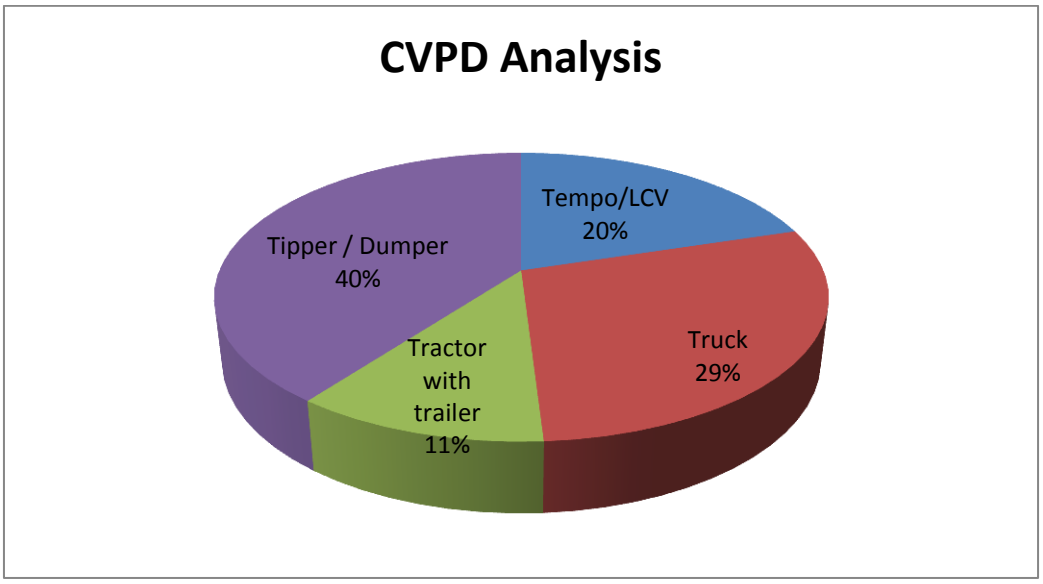

Figure 7. CVPD Analysis

4.3.2 Pavement Visual inspection survey

Data on pavement surface condition collected for a road provides a preliminary insight about the pavement's construction quality and its likely performance on long term basis. It also assists in making an assessment about the user's comfort in terms of safety as well as in establishing Maintenance and rehabilitation (M & R) strategies. The basic measurements in evaluating the pavement surface condition are to determine the level of existing surface distress, based on the visual inspection of pavement surface. Uses of such data are primarily based on the engineering experience and judgement.
Pavement surface condition surveys are generally conducted by any one of the following two methods:

I. Walk survey
II. Drive survey

Table 4. Pavement Visual Inspection Survey

Chainage (KM)	Pavement Condition				
	Excellent	Very Good	Good	Average	Bad / Deteriorate
0 – 1					✓
1 – 2			✓		
2 – 3				✓	
3 – 4					✓
4 – 5				✓	
5 – 6					✓
6 – 7			✓		
7 – 8				✓	
8 – 9		✓			
9 – 10				✓	
10 – 11			✓		
11 – 12		✓			
12 – 13					✓
13 – 14				✓	
14 – 15			✓		
15 – 16			✓		
16 – 17				✓	
17 – 18				✓	
18 – 19					✓
19 – 19.5			✓		

Figure 8 Surface Uneveness (Chainage 2.800 km)

Figure 9 Map Cracking (Chainage 8.600 km)

Figure 10 Pot Holes (Chainage 1.200 km)

Figure 11 Longitudinal Crack (Chainage 13.700 km)

Figure 12 Aligator Crack (Chainage 10.700 km)

Figure 13 Surface Up Heave (Chainage 17.200 km)

V. Pavement Serviceability Index

5.1 Pavement Serviceability Index (PSI)

The pavement serviceability index (PSI) is based on the original AASTHO Road Test PSR. Basically, the PSR was a ride quality rating that required a panel of observers to actually ride in an automobile over the pavement in question. Since this type of rating is not practical for large-scale pavement networks, a transition to a non-panel based system was needed.

Measures of distress can be either subjective or objective. A simple example of a subjective measurement may be rating of each type of defect based on visual inspection on a scale of 0-5 as Very Poor, Poor, Fair, Good and Very Good as in PSR.

Older techniques, used teams of individuals who drove across every km of pavement to be measured. The measurements were made using simple instruments and by visual estimation. The rut depths were measured using straight edge and the area of cracking; patching, raveling, etc. were visually estimated. Based on the objective measurements the Pavement Serviceability Index (PSI) could be obtained using the AASHTO equation. The Old technique is used for measure the PSI of the road link.

The Final Rating Value is calculated by taking the average of the Weighted Rating Values of all parameter viz. cracking, Raveling, potholes, shoving, patching, settlement and rut depth.

Table 5.: Final Rating Value of road link between 3.5 km to 4.5 km

DISTRESS TYPE	(%)	RATING AS PER TABLE 5.1	WEIGHTAGE	WEIGHTAGE RATING VALUE
Fatigue Crack	3.49	1.1	1	1.10
Rutting	12.00	1	1	1.00
Potholes	0.68	1.5	0.5	0.75
FINAL RATING VALUE				**0.95**
CONDITION				**POOR**

Table 6 : Final Rating Value of road link between 5.0 km to 6.0 km

DISTRESS TYPE	(%)	RATING AS PER TABLE 5.1	WEIGHTAGE	WEIGHTAGE RATING VALUE
Fatigue Crack	7.48	1.1	1	1.10
Rutting	12.00	1	1	1.00
Potholes	1.01	1.3	0.5	0.65
FINAL RATING VALUE				**0.92**
CONDITION				**POOR**

From the final rating values of table 5.3 to 5.4 the road stretch pavement condition of the three different stretches on the road link which is chainage of 2.5 km to 3.5 km & 5 km to 6 km have pavement condition is poor which is required maintenance and overlay design.

VI. CONCLUSION

1. The Pavement Section of Udalpur Crossing to Sevaliya Thashra is not designed for the over loading commercial Truck load.
2. Udalpur crossing to Sevaliya Thashra is one of the main inter connected road which is highly overloaded CVPD and PCU/Day is more than the IRC recommendation.
3. The pavement serviceability index of the selected stretches on the link is observed as in poor condition, which exhibits presence of heavy commercial vehicles on the selected link
4. The state highway no 12 has very heavy traffic volume especially commercial vehicle and loaded trucks. Due to presence of quarry industry around sevaliya is responsible for heavy traffic of overloaded trucks with quarry material
5. The road is a non-toll road while NH 47 is passing adjacent to the road which is a toll road so some of the traffic is diverted on the selected road section which ads extra amount of traffic on the road stretch which results in further deterioration of the pavement.

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