Research Project

"Performance Evaluation of Some Selected PMGSY Road Sections in the State of Chhattisgarh"

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Submitted by

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Project Summary

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Abstract:

This pavement specific study performed on 51 sections of low volume roads constructed in the state of Chhattisgarh under Pradhan Mantri Gram Sadak Yojana (PMGSY). 46 pavement sections of Wet Mix Macadam (WMM) and 5 pavement sections of Water bound macadam (WBM) base layers have been considered for forensic investigations to assess and compare the performance. Forensic investigations include identification of possible reasons for various chronic distresses, assessment of structural and functional performance of pavement sections, measuring pavement composition and material properties. Potential contributing factors for each category of distress was diagnosed by carrying out various field and laboratory investigations for each layer. Light Weight Deflectometer (LWD), Benkelman Beam Deflectometer (BBD), Roughness measuring device, and other conventional field tests were used to identify structural deficiencies of each layer at various locations of pavement sections. Conventional laboratory tests were performed to assess the material characterization. A series of wheel path deformation, block and alligator cracking, depressions, potholes, longitudinal and transverse cracking were diagnosed on various pavement sections. Test pits reveals a combination of both top-down and bottom up cracking exhibiting high to medium severity distress at few locations on test sections and medium to low severity distress at majority of the test pavement sections. Destructive and non-destructive in-situ tests like LWD, BBD and MERLIN represented that structural integrity of granular layers are inadequate at few test sections. Laboratory tests were shown clear indications of poor compaction, grading requirements and improper prediction of moisture variations that lead to the dramatic pavement distress at few test sections. Thus, based on the detailed forensic investigations, the structural performance of WBM and WMM base layers upon thin bituminous layers is adequate. However, the functional performance in terms of riding comfort for WMM base pavement sections is superior as compared with WBM base pavement sections.

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List of Acronyms

AASHO	:	American Association of State Highway Officials
AASHTO	:	American Association of State Highway Transport Officials
ASTM	:	American Society of Testing and Materials
BBD	:	Benkelman Beam Deflectometer
CG	:	Chhattisgarh
CGRRDA	:	Chhattisgarh Rural Road Development Agency
CI	:	Condition Index
CRRI	:	Central Road Research Institute
DCPT	:	Dynamic Cone Penetration Test
FDD	:	Field Dry Density
FHWA	:	Federal Highway Administration
FWD	:	Falling Weight Deflectometer
GSB	:	Granular Sub base
IH	:	Interstate Highway
IIT	:	Indian Institute of Technology
IRC	:	Indian Road Congress
IRI	:	International Roughness Index
IS	:	Indian Standards
Km	:	Kilo Meter
kN	:	Kilo Newton
LTPP	:	Long-Term Pavement Performance
LWD	:	Light Weight Deflectometer
MDD	:	Maximum Dry Density
MERLIN	:	Machine for Evaluating Roughness using Low-cost Instrumentation

MPa	:	Mega Pascal
NCHRP	:	National Cooperative Highway Research Program
NDT	:	Non-Destructive Testing
NRRDA	:	National Rural Road Development Agency
OGPC	:	Open Graded Premix Carpet
OPCI	:	Overall Pavement Condition Index
PCI	:	Pavement Condition Index
PIU	:	Project Implementing Unit
PMGSY	:	Pradhan Mantri Gram Sadak Yojana
PRM	:	Priority Ranking Model
PSI	:	Present Serviceability Index
PSR	:	Present Serviceability Rating
RCI	:	Riding Comfort Index
SAI	:	Structural Adequacy Index
SDI	:	Surface Distress Index
SPS	:	Specific Pavement Study
TS	:	Test Section
WBM	:	Water Bound Macadam
WMM	:	Wet Mix Macadam

Chapter 1. Introduction

1.1. Background

Pavement recurring distresses is daunting task for the engineers and policy makers that costs billions of rupees in preservation of road infrastructure. Despite of advancements in pavement design, construction and maintenance technology for the past few decades various contributing variables escalating the frequency of maintenance activities like low tender process, (2) question on level of skill and competence of manpower (3) improper selection of appropriate materials, (4) lack of reliable information on pavement condition (5) lack of awareness of pavement construction technologies (6) other miscellaneous issues during design, construction and maintenance phases (Chen, 2008). Forensic studies on distressed in-service pavements often proven to be the promising technique in resolving the conflicts with good science and engineering ability (Lacasse, 2016). Thus, the significant variables for technical forensic investigation involve data collection, problem diagnosing and characterization, analysis of failure hypotheses, a robust backward calculation and detailed field investigations. However, in the developing countries, current maintenance practices recommend the structural evaluation using Benkelman Beam Deflectometer (BBD) or Falling Weight Deflectometer (FWD) and functional evaluation by expert visual observation for defining the maintenance strategy rather than presentation of the facts and issues by conducting detailed laboratory and field investigations.

Numerous forensic studies were carried out by various researchers and made an attempt in defining the approach to represent the potential cause of various distresses. Recently, National Cooperative Highway Research Program, USA (NCHRP 747, 2013) suggested a methodology for forensic investigations. However, the methodology needs to be addressed with mechanistic performance analysis. One of the largest pavement performance program that collects and maintain database of various research studies is long-term pavement performance (LTPP) program. The principal objective of these programs is to identify and understand principal underlying factors that affect the in-service pavement performance to optimize the pavement design and maintenance strategies and thereby extending the service life of pavement (Zelew, 2012). Chen and John (2003) performed forensic evaluation of premature failures on asphalt in-service distressed pavement section located in South Texas.

Maintenance of rural roads is very important because lack of maintenance of these roads increases the time for access to markets and other social infrastructure to rural community. If present performance of pavement is not evaluated properly then it is difficult to take correct decision for repair and maintenance work in future. Due to limited financial resources for maintenance of rural roads, there is always need to have decision making tool which will decide the priority of particular road for repair and maintenance. Various Pavement deteriorating models as a decision tool are available in literature. Swarup and Agarwal (2012) evaluated the pavement performance for rural roads. However, Investigators did not consider the distress parameters of the roads in study which contribute significantly in rural road performance. Sunitha et al. (2012) found visual condition index for rural roads, but Investigators did not consider all distress factors like rut depth, raveling and patching. Saranya et al. (2013) evaluated the pavement performance of rural roads by considering the pavement construction history data, structural condition data and functional condition data. Due to limitations on getting past data because of poor record keeping at government departments poses practical difficulty in using the study. Similarly, Shah et al. (2013) found out the individual indices of distress, roughness, structural and skid resistance to find overall pavement condition index (OPCI). Reddy and Veeraragavan (2001) developed the priority ranking model (PRM) based on cracked area, unevenness, area of potholes, patched area and rut depth. Alexandru et al. (2013) calculated a set of singular performance indices for each parameter by using cost 354 method to find weightage. However, all these three studies omitted the parameters like condition of the shoulders and drainage characteristics.

Various distresses predominantly rutting associated in Asphalt layer were diagnosed due to improper material selection in asphalt layer. Chen and Scullion (2005) carried out forensic investigation on concrete pavement section of interstate highway 30 (IH-30). Various distresses like mid-depth transverse cracks, longitudinal cracks, punchouts were diagnosed and the corresponding rehabilitation measures latex modified chip seal or asphalt rubber seal were suggested to the district authorities. Wu and Tia (2007) carried out forensic evaluation of ultrathin white-topping for asphalt pavement rehabilitation. High severity cracking was diagnosed and possible cause was identified to be inadequate design. Chen and Scullion (2008) illustrated an integrated approach with various destructive and non-destructive testing tools to carryout forensic investigations of distressed in-service pavement. Functional distress like stripping and structural distress like highly susceptible to moisture with insufficient stiffness was identified and was completely replaced. Si (2008) performed forensic investigation of premature failure in the pavement due to excessive cracking and soil sulfate induced heave from lime stabilized subgrade soil. Various field and laboratory investigations were carried out to validate these failures and rehabilitation measures were suggested. Gopalakrishnan (2009) carried out forensic studies by field and laboratory investigation on failed airfield pavements. Both structural and functional failures were diagnosed. Veearagavan (2010), forensic investigations of premature failure of national highway by using conventional structural evaluation techniques like Benkelman beam deflectometer (BBD) and laboratory investigations. Various distresses were diagnosed during and field and laboratory tests and the same were validated by estimating the pavement responses using MICHPAVE computer program. The computed pavement responses were used to predict the field performance and there by remedial measures were suggested. Chen and Scullion, (2011), carried out forensic investigations by performing field and laboratory investigations on various pavement sections to evaluate the base materials and their susceptibility to moisture. The study recommends the base moduli for both unbound and bound materials that help in minimizing the premature failures. Zelelew (2012) performed forensic investigation of Arizona distress pavement sections by destructive and non-destructive testing tools. Various functional distresses like fatigue cracking, longitudinal cracking, and transverse cracking structural distress like rutting, block cracking and pumping was diagnosed and potential root cause of these distresses was presented. Majority of these forensic studies made an attempt in identifying the root cause of various premature failures in the context of respective test sections. Very few studies were focused on establishing the generalized approach for forensic investigations as these studies anticipates reliable substantial judgments. Thus, there is need for robust technique/methodology to diagnose the potential root cause of these chronic distresses and thereby defining optimal maintenance strategy and reducing the frequency of maintenance activities (Chen, 2007).

1.2. Problem Statement

Construction of low volume Pradhan Mantri Gram Sadak Yojana (PMGSY) roads in the state of Chhattisgarh using Water Bound Macadam (WBM) base layer is a traditional practice being implemented right from the inception of PMGSY Indian Road Congress (IRC SP 20 2002 and IRC SP 72 2005). However, few low volume PMGSY roads in the state of Chhattisgarh were constructed by replacing Water Bound Macadam (WBM) with Wet Mix Macadam (WMM) layer as a base layer due to shortage of manpower and hand broken aggregates.

Although WMM as a base layer is being implemented as a traditional practice in medium and heavy traffic volume roads as recommended by Indian standards (IRC 37). However, use of WMM as a base layer for low volume roads in India is not standard practice till now. Therefore, this triggered numerous questions in the minds of field engineers regarding its performance as a base layer in thin surfaced bituminous pavements.

Various researchers stated that WMM being the close graded granular mix is considered to be superior quality in terms of material properties as compared with WBM granular mix. Subsequently, field engineers from Chhattisgarh Rural Road Development Agency (CGRRDA) have also confirmed better performance of pavement sections constructed using WMM as base layer on thin surface bituminous pavements. Therefore, although WMM granular mix shown better performance over a period of time, but there is a immediate requirement of thorough performance study on WMM base pavement sections to establish the use of WMM base layer in thin surface bituminous pavements as a standard practice.

1.3. Study Objectives

The primary objective of this study is to assess the performance of WMM granular mix as a base layer in replacement of WBM granular mix on some selected PMGSY low volume road pavement sections.

In order to fulfill the above mentioned primary objective the following sub objectives had been defined as follows:

i. Assessment and comparison of the functional performance of WBM and WMM base selected pavement sections by diagnosing various chronic distresses for estimating the pavement condition index.

ii. Assessment and comparison of the functional performance of selected WBM and WMM base pavement sections by measuring roughness index.

iii. Assessment and comparison of the structural performance of selected WBM and WMM base pavement sections by measuring deflections of pavement sections using static and dynamic load devices.

iv. Validation of various distresses diagnosed by measuring various physical, volumetric and strength properties of various layers of selected WBM and WMM base pavement sections.

v. Assessment of suitability of WMM base layer in thin surface bituminous pavement sections.

1.4. Scope of Work as per Proposal

The scope of project work is defined in order to fulfill the above mentioned objectives as discussed below:

The entire scope of project is bifurcated in two stages:

I. Stage-I evaluation includes visual condition survey for the road length of 75 Km constructed with WMM base layer and road length of 25 Km constructed with WBM base layer as per the guidelines suggested by IRC 82 -2015 and ASTM D 6433-11 for determining pavement condition index.

II. Stage–II evaluation includes detailed field investigations and laboratory investigations as shown in Table 1-1 for the selected road length of 15 Km constructed with WMM base layer and road length of 5 Km constructed with WBM base layer identified from Stage-I evaluation, for assessing and comparing the performance and material properties of WBM and WMM base layers on thin surface bituminous pavements.

Table 1-1 Scope of experimental program for stage-II evaluation

Sl. No.	Name of the test	Type of the test	Property	IS/IRC/ ASTM standard
Laboratory Investigations				
1	**Subgrade**			
a	Modified Proctor Test	Laboratory	Dry density	IS 2720 (Part – 8) 1983
b	Soaked CBR at MDD	Laboratory	Bearing capacity	IS 2720 (Part – 16) 1983
2	**Granular subbase/Base layers**			

Sl. No.	Name of the test	Type of the test	Property	IS/IRC/ ASTM standard
a	Sieve Analysis	Laboratory	Grading Requirements	IS 2386 (Part – I) 1963
b	Modified Proctor Test	Laboratory	Dry density	IS 2386 (Part – III) 1963
c	10% Fines value	Laboratory	Strength	IS 2386 (Part – IV) 1963
d	Aggregate Impact value	Laboratory	Toughness	IS 2386 (Part – IV) 1963
3	**Bituminous layer**			
a	Binder Content	Laboratory	Bitumen content	IRC: SP 11 –1988, IS 13826 (Part 7) 1993, ASTM 2172-05/2172M-11
b	Sieve Analysis	Laboratory	Grading Requirements	IS 2386 (Part – 1) 1963
c	Aggregate Impact value	Laboratory	Toughness	IS 2386 (Part – IV) or IS:5640
d	Bitumen adhesion stripping value of aggregates	Laboratory	stripping value	IS 6241- 1971
Field Investigations				
1	Portable falling Weight deflectometer test	In-situ	Structural evaluation (Dynamic)	ASTM E 2583-07a
2	Benkelman beam deflection test	In-situ	Structural evaluation (Static)	IRC 81-1997
3	Roughness measurement by MERLIN	In-situ	Roughness Measurement (IRI value)	IRC SP:16-2004
4	Sand replacement test	In-situ	In-situ density assessment	IS: 2720 (Part-28) 1983
5	Test Pit	In-situ	Pavement thickness and Soil sample collection for Laboratory testing	

1. The matrix of evaluation for the defined road length is identified according to the age of road from the date of completion. The road stretches were identified according the age for evaluation as per the list of the roads provided by Chhattisgarh rural road development authority (CGRRDA) vide letter vide letter no. 10058/6961/WMM/RC-5/ADB/CGRRDA/2014 dated 09-09-2014 which includes list of PMGSY roads sections according to the date of completion in Chhattisgarh state where WMM base layer is executed instead of WBM base layer. The summary table of WMM base layer

roads according to the date of completion as provided by CGRRDA is shown in Table 1-2.

Table 1-2 Details of completion period of WMM roads as on 31-08-2014

S. No.	No: of Roads	1 Year completed 31-8-13 to 31-8-14	2 Year completed 31-8-12 to 31-8-13	3 Year completed 8-8-11 to 31-8-12	4 Year completed 8-8-10 to 31-8-11	5 Year completed 31-8-09 to 31-8-10	Above 5 Years
1	386	217	35	3	10	93	28

Total No. of WMM replaced roads selected for both the stages of this study are 30 No's to cover a length of 75 Km with WMM base layer. Therefore, the No. of WMM replaced roads selected for the current study according to the age is summarized in Table.1-3.

Table 1-3. Selected WMM replaced roads for the study

S. No.	No: of Roads	1 Year completed 31-8-13 to 31-8-14	2 Year completed 31-8-12 to 31-8-13	3 Year completed 8-8-11 to 31-8-12	4 Year completed 8-8-10 to 31-8-11	5 Year completed 31-8-09 to 31-8-10	Above 5 Years
1	30	9	3	2	5	7	4

Similarly, the total No. of Water bound macadam (WBM) base roads are estimated to be 6 no's to cover a length of 25 Km. Therefore, the 6 No's of WBM base roads selected for the current study according to the age.

1.5. Work Flow

1.5.1. Stage-I Evaluation

Visual condition survey (Stage-I evaluation) was carried out covering an overall length of 165.59 Km (136.24 Km with WMM and 29.35 Km with WBM) as shown in Table 1-4. Figure 1-1 and Figure 1-2 shows the percentage of WMM and WBM base pavement sections selected for stage-I evaluation according to the age of the pavement section.

Table 1-4. Visual condition survey for WMM and WBM base roads

Sl. No	Type of Pavement		Year of Completion							Total
			2008	2009	2010	2011	2012	2013	2014	
1	WMM base	Length Covered Km	34.14	1.60	44.70	3.20	4.00	28.20	20.40	**136.24**
		No. of Roads	9	1	18	1	1	9	6	**45**
2	WBM	Length	11.36	0	1.80	3.4	0	5.7	7.45	**29.71**

Sl. No	Type of Pavement		Year of Completion							Total
			2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	
	base	Covered Km								
		No. of Roads	1	0	1	1	0	1	2	**6**
Total length Covered, Km			**45.50**	**1.60**	**46.50**	**6.60**	**4.00**	**33.90**	**27.85**	**165.95**
Total No. of Roads			**10**	**1**	**19**	**2**	**1**	**10**	**8**	**51**

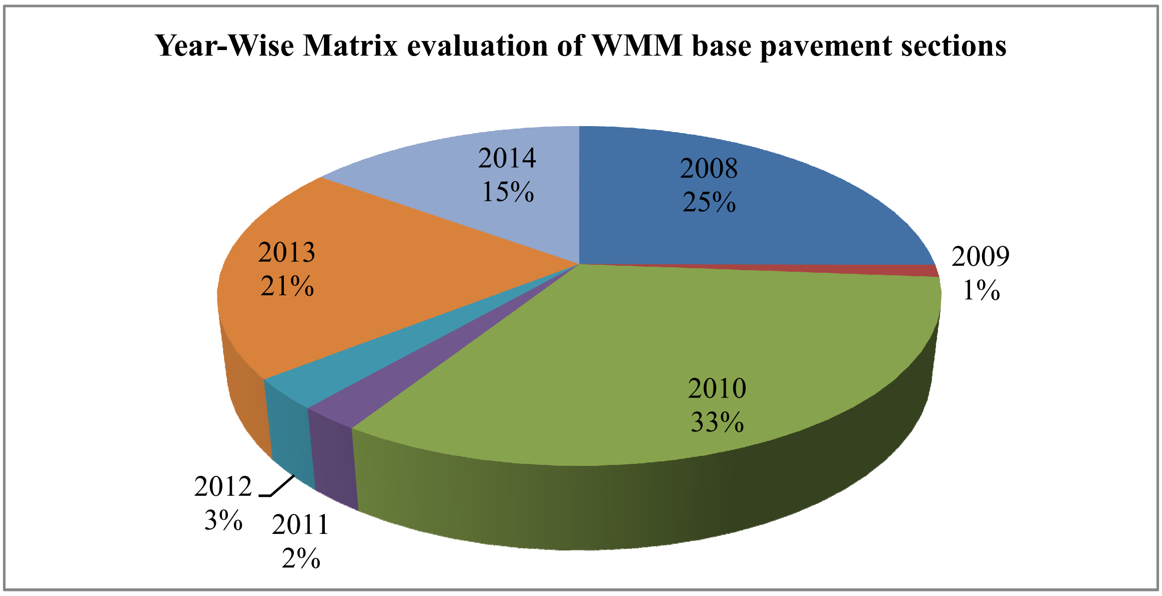


Figure 1-1. Year-Wise Matrix evaluation of WMM base pavement sections

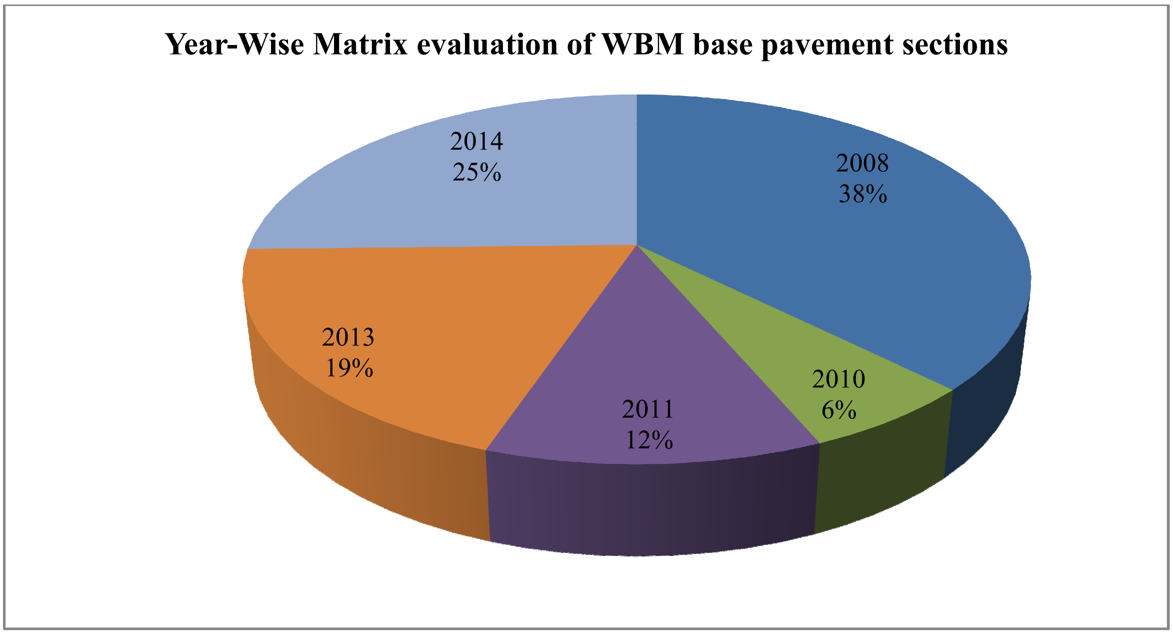


Figure 1-2. Year-Wise Matrix evaluation of WBM base pavement sections

1.5.2. Stage-II Evaluation

Stage-II evaluation comprises of field investigations such as (1) Structural evaluation using Light weight deflectometer (LWD) and Benkleman beam deflectometer (BBD). (2) Functional evaluation using MERLIN (Roughness). Conventional laboratory investigations such as volumetric and strength properties of pavement layers from the collected samples by test pits were carried out. Therefore, total length of roads covered for stage-II evaluation is shown in Table 1-5.

Table 1-5. Stage-II evaluation for WMM and WBM base pavement sections

TS. No.	Name of the Road, PIU and Package No.	Length of the road, (Km)	Year of Completion
A. WMM base pavement sections			
29	Belgaon to Kolendra PIU - Rajnandgaon (CG 15-83)	4.20	2010
28	Mohara Road to Takurtola PIU - Rajnandgaon (CG 15-84)	4.60	2010
30	Belgaon to Kathili PIU - Rajnandgaon (CG 15-83)	2.35	2010
42	Dongargarh to Karwari PIU - Rajnandgaon (CG 15-84)	3.00	2010
40	T05 to Khallari PIU - Rajnandgaon (CG 15-83)	1.01	2010
	A. Total length covered, Km	**15.16**	
B. WBM base pavement sections			
40	Devkatta to Kanhargaon PIU - Rajnandgaon (CG 15-50)	4.10	2014
50	Dhara to Gotiya PIU - Rajnandgaon (CG 15-25)	11.36	2008
51	Kalkasa to Bhaisara PIU - Rajnandgaon (CG 15-85)	1.80	2010
	B. Total length covered, Km	**17.26**	
	Grand Total length covered for Stage-II evaluation (A+B)	**32.42**	

1.6. Study Methodology

This research study is intended to assess the performance of open graded premix carpet (OGPC) laid on WMM base layer against the traditional practice of WBM base layer for PMGSY road stretches. The detailed flow chart of the study methodology is shown in Figure 1-1. In order to fulfill the objectives, the following steps are defined in two stages:

1.6.1. Stage-I

Stage-I comprises of following steps:

1. Identification of surface defects like cracks, disintegration, depression etc. to determine the distress intensity along the project corridor stretch of WMM and WBM base pavement sections.
2. Deriving conclusions based on the findings and results obtained.

1.6.2. Stage-II

Stage-II comprises of following steps:

1. Collecting the information about surface defects like cracks, disintegration, depression etc. to determine the distress intensity along the project corridor stretch obtained from stage-I.
2. Performing static structural evaluation using Benkelman Beam Deflection Test to measure the deflections of WBM and WMM base pavement sections.
3. Performing dynamic structural evaluation using Portable Falling Weight Deflection Test to measure the deflections of WBM and WMM base pavement sections.
3. Performing roughness measurement test using MERLIN along the project stretches of WMM and WBM base roads.
4. Laboratory investigations based on the samples collected from the test pits, for the identification of material characteristics and thereby latent defects.
5. Deriving conclusions based on the findings and results obtained.

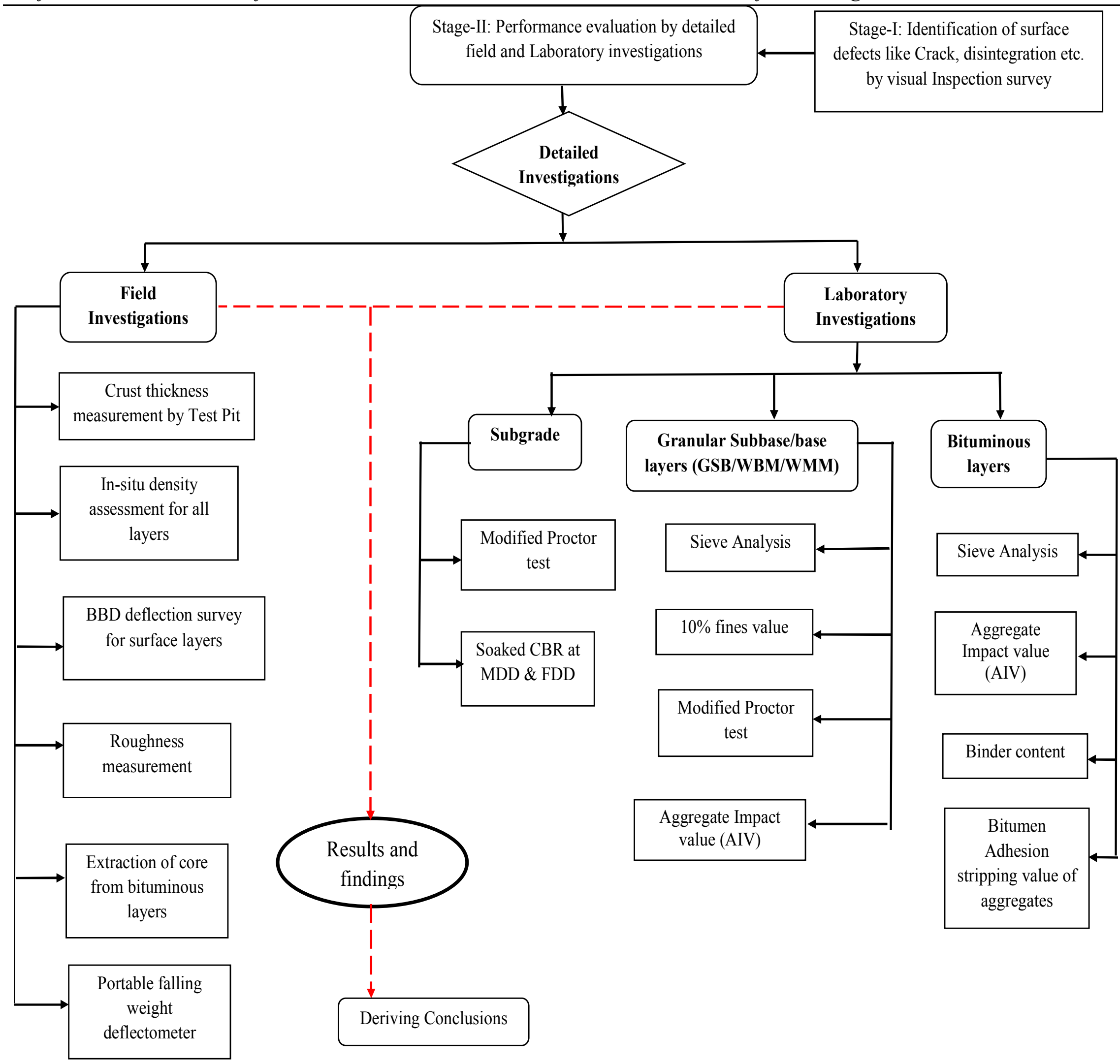


Figure 1-3 Study methodology

1.7. Study Contributions

This study contributes to the area of pavement performance evaluation as discussed in detail:

This study addresses three significant issues (1) Uncertainty in selection of appropriate technique for estimating Pavement condition Index for assessing the functional performance of WMM and WBM base pavement sections. This issue was addressed by comparing types of distresses considered and the corresponding PCI values estimated by using IRC and ASTM methods. (2) Ambiguity in selection of base layer material (WBM or WMM) for low volume roads. This issue was addressed by comparing the functional and structural performance of in-service WBM and WMM base pavement sections by using destructive and Non-destructive testing practices. (3) Robustness of

LWD device for evaluating the dynamic structural performance of in-service low volume pavement sections. This study made an attempt in establishing LWD device for evaluating the dynamic structural performance of WBM and WMM base pavement sections in the state of Chhattisgarh.

1.8. Study Limitations and Constraints

This study is limited to only functional and structural performance of in-service WMM and WBM base pavement sections selected from central region of Chhattisgarh state only. As per the proposal, Road roughness survey was to be carried out by using Bump integrator; however, this survey was carried out with MERLIN due to unavailability of experimental setup.

1.9.Report organization

This report comprises of seven chapters followed by future scope of work along with references and appendix. The outline of the report is summarized as follows

Chapter 1 presents a brief background of performance evaluation techniques followed by problem statement, objectives, scope and study methodology that was defined for the entire research work. This chapter also discusses regarding the contributions of the research work to the society.

Chapter 2 discusses the detailed literature review which is bifurcated into three sections according to the objectives defined. Section-I describes about various techniques being Pavement condition survey. Section-II focused on the forensic studies on Pavement sections and section-III is focused on state of art performance evaluation techniques for both highways and low volume road pavement sections.

Chapter 3 describes the comprehensive study area selection, experimental program, soil sampling, soil sample collection methods, soil sample handling and labeling procedure for performing laboratory investigations.

Chapter 4 discusses about the stage-I evaluation that includes visual inspection survey performed on WBM and WMM base pavement sections. This chapter also discusses about comparative analysis and findings derived from the stage-I evaluation.

Chapter 5 emphasizes on stage-II evaluation that includes both field and laboratory investigations performed on the selected stretches of WBM and WMM base pavement sections. This chapter also discusses about comparative analysis and findings derived from the stage-II evaluation.

Chapter 6 discusses about results obtained from stage-I and Stage-II evaluation. This chapter also explores about the summarizing and interpreting the key findings of stage-I and stage-II evaluation.

Chapter 7 comprises of conclusions and recommendations derived from stage-I and stage-II analysis.

The detailed data tables of the stage-I evaluation is provided in the Appendix-I, the data tables of the Stage-II field investigations were provided in Appendix-II and the data tables of the Stage-II laboratory investigations were provided in Appendix-III .

Chapter 2. Literature Review

2.1. Introduction

Detailed forensic investigation of in service pavements plays a significant role in the pavement management systems. Realistic performance evaluation can only be possible with these detailed forensic investigations. The significant prerequisite for this realistic performance evaluation involves robust methods/techniques for forensic evaluation. The need to account for variability in pavements has been understood since the AASHO Road Test. Effective handling of variability in such a way to achieve meaningful conclusions have more significance in the current scenario. Quantifiable variability information related to instrumented pavements, especially thin flexible pavements, is not well established in literature.

Many researchers have carried out extensive research work and made several attempts in understanding and predicting the realistic behavior of pavement systems in distinct ways.

- Few researchers attempted in analyzing the performance of pavement sections based on the engineering subjective judgment through visual inspection surveys.
- Some researchers made several attempt to interpret and predict the performance of various layers based on the laboratory material characterization.
- Efforts were also made by few researchers to understanding the realistic in-situ behavior of various pavement layers under transient vehicular loadings by developing non-destructive testing (NDT) devices such as falling weight deflectometer (FWD) and Lightweight deflectometer (LWD).

Thus, this literature review is primarily focused on identifying the significant gaps in the above discussed directions and fulfills the objectives discussed in the preceding chapter. The entire literature review is bifurcated into three distinct parts.

First part focused on addressing the significant research work carried out by various researchers in evaluating the pavement condition by estimating the Pavement Condition Index (PCI) using various analytical, numerical and statistical techniques.

Second part is focused on discussion about the research studies conducted for evaluation of pavement based on the material characterization of each layer from laboratory investigations. Third part is focused on addressing the research work carried out for performance evaluation of in service pavements using static and dynamic deflection devices.

2.2. Pavement condition indices

The pavement structural and material condition is affected by the type, severity, and density (i.e., extent of occurrence) of exhibited distresses (Shahin et al. 1978 and 1980). The main challenge is how to combine these characteristics into a single index. The development of an overall condition index (CI) is even more challenging because the pavement's surface roughness is also considered, adding an extra dimension to the index.

Early efforts in developing pavement condition indexes used direct panel ratings. This approach involves a panel of raters that drives the surveyed pavement (normally at posted speed) and subjectively rates the pavement sections either using a numeric scale or verbal descriptions such as good, fair, poor etc. based on observed distress types and ride quality. Subjective panel ratings date back to the American Association of State Highway Officials (AASHO) road tests in the 1950s (Carey and Irick 1960). A panel subjectively rated sections of different pavement types near Ottawa, Illinois on a 0–5 scale known as the Present Serviceability Rating (PSR). Since the PSR depends on the passenger perception of ride quality, it generally has a stronger correlation with road roughness measurements than with distress measurements. Currently, direct panel ratings are used on a limited basis to supplement other indexes such as Oregon DOT's Good-Fair-Poor (GFP) rating method and Michigan DOT's Sufficiency Rating (SR) method. While panel ratings have the advantage of being simple and representative of the perception of roadway users, they are inherently subjective and do not provide sufficient engineering data that can be used to identify effective repair strategies.

Researchers and transportation agencies around the country have developed a host of indexes to measure the structural and material integrity of pavements. These indexes are an aggregation of several distress types (e.g., cracking, rutting, bleeding, etc. in asphalt pavement; spalling, cracking, faulting, etc. in concrete pavement) and other physical measurements (such as surface roughness and friction) (McKay et al. 1999).

Traditionally, condition indexes have been used by engineers to describe the current quality of pavement networks and determine maintenance and repair needs and priorities as discussed in (Saito 1997). The monitoring of these indexes over time enables the development of deterioration models, which permit early identification of maintenance and rehabilitation requirements and estimation of future funding needs (McNeil et al. 1992; AASHTO 2002). Pavement condition indexes, however, are increasingly being used for comparing infrastructure performance among different states or among different jurisdictions within a state (e.g., performance of city maintained roadways versus performance of state-maintained roadways). These comparisons can influence strategic policies such as establishing goals for infrastructure performance levels and allocating funds to transportation agencies. Additionally, as interest in using performance based management techniques continues to increase (Neumann and Markow 2004), the temptation to compare pavement conditions across different jurisdictions is likely to increase.

There are currently several indices that are used to describe pavement conditions, such as the Pavement Condition Index (PCI), Present Serviceability Index (PSI), International Roughness Index (IRI) and Present Serviceability Rating (PSR). All of these indices convert pavement distresses to a more practical index (Huang 2004). The PCI is one of the most common indices for pavement evaluation based on visual observation and inspection and was developed by the U.S. Army Corps of Engineers for the PAVER (PAVER is an acronym that was selected since the system is for the management of pavement maintenance and rehabilitation) system (Shahin and Kohn 1981). In the PCI calculation procedure, different types of distress with various severities are incorporated into a single PCI value. Each distress that causes the pavement to deteriorate has a unit of length or area with a different severity (i.e., low, medium, and high). The PCI ranges from 100 to 0, in which 100 is newly constructed pavement and 0 is the worst condition possible.

Although manual PCI calculation may not be a tedious operation for a single sample unit, a database gathered from a survey is generally quite large and the PCI calculation process for a database can be time-consuming. MicroPAVER, commonly used software developed by the U.S. Army Corps of Engineers, can automatically calculate the PCI value once the distress information is entered into the program (Shahin 2005). Several alternative computer-aided data mining techniques that may be applicable to PCI calculation have been proposed for solving various problems because of recent developments in computational software and hardware,. Pattern recognition systems, for instance, learn adaptively from experiences and extract various discriminators.

AASHO had undertaken pavement performance study for 123 test sections (74 flexible and 49 rigid pavement sections) to develop Present Serviceability Index (PSI) model based on subjective rating Present Serviceability Rating (PSR) and objective ground measurements. Through multiple regression analysis a mathematical index was derived and validated through which pavement ratings can be satisfactorily estimated from objective measurements taken on the pavements (Cary 1960). The pavement condition index (PCI) has been developed by the U.S. Army Corps of Engineers in 1982. The PCI value is decreased by a cumulative deduct value score based upon the type, quantity and severity level of distress and type of pavement. Karan et al., (1983) gave an approach of Pavement Quality Index (PQI) for statistically capturing information from an expert panel. It was developed from an analysis of 40 sections rated for Riding Comfort Index (RCI), Structural Adequacy Index (SAI) and Surface Distress Index (SDI), each on a scale 0 to 10. FHWA (1990) described an index representing an overall aggregation of the different measures of pavement condition. Juang and Amirkhanian (1992) documented the development of Unified Pavement Distress Index (UPDI) using the theory of fuzzy sets. Zhang (1993) developed a comprehensive ranking index for flexible pavements called the Overall Acceptability Index (OAI) based on fuzzy set theory. Four parameters viz. roughness, surface distress, structural capacity and skid resistance were considered for OAL. Shoukry et al. (1997) adopted a fuzzy logic approach to derive a universal pavement distress evaluator defined as Fuzzy Distress Index (FDI) and based on this pavement sections were ranked for maintenance needs. Thube et al., (2007) developed a PSI and PCI based composite pavement deterioration models for low volume roads of India. Gharaibeh et al., (2010) compared the pavement condition indexes from five DOTs in United States and the results showed significant differences among seemingly similar pavement condition indexes, which may be due to different distress types considered, weighting factors and the mathematical forms of the indexes, as concluded by the author.

Thus, this study is focused on pavement condition indices estimated using various standard and other statistical techniques and thereby discusses the results of their comparative analysis.

2.3. Performance evaluation using Laboratory and Conventional Field investigations

The probability of recurring premature pavement failures, the root causes of problems need to be identified and the lessons learned incorporated into future project designs. This can be challenging, as sometimes the information obtained is incomplete and resources are limited. Forensic investigations of pavement failures are critical, as the information gained can be used to identify the underlying cause of the problem, to develop an optimal rehabilitation strategy and to resolve construction disputes.

Texas Department of Transportation (TxDOT) has had a formalized forensic team approach for over 10 years. In conducting forensic studies, a thorough review and analysis of existing construction records and tests is required. Also, nondestructive testing methods such as ground-penetrating radar (GPR) and falling weight deflectometer (FWD) are essential to identify problematic areas (Chen and Scullion 2007). Field tests such as dynamic cone penetration (DCP), coring, trenching and laboratory testing are also conducted, as needed, to validate/confirm the initial hypothesis. From time to time, the results from forensic studies have been used both to validate or modify the existing design plan and to resolve disputes involving construction claims.

The long-term pavement performance (LTPP) program was established to answer the questions of how and why pavements perform the way they do, with the objective of using those answers to optimize pavement designs and extend pavement life. Established in the mid-1980s, the LTPP program collects and stores data on over 2,500 test sections throughout the United States and Canada. Under management from the Federal Highway Administration (FHwA), the LTPP database is the world’s largest research quality pavement performance database and has been used in hundreds of research studies worldwide. Data collection and analysis activities remain active for LTPP sites and the program is evolving with changes in technologies and pavement materials.

Specific Pavement Study (SPS) experiments were developed under the LTPP program primarily to assess the effect of various structural parameters on pavement performance. There is widespread agreement that forensic investigations of LTPP test sections should be pursued, especially for those SPS test sections going out of study or scheduled for rehabilitation; however, funding limitations precluded pursuing these as part of normal LTPP operations.

In 2008, utilizing Focus Area Leadership and Coordination funds, the FHWA initiated forensic evaluations at one LTPP SPS project in each of the four regions. In the western region, four sections from the Arizona SPS-5 were selected. This selection was based on the pavement condition and Arizona's outstanding agency support to perform the forensic activities.

Eight sections were constructed as part of the standard LTPP SPS-5 experimental design. The Arizona SPS-5 test site also included a control section and two supplemental test sections designed by the Arizona Department of Transportation (ADOT). The standard sections followed the LTPP guidelines for preconstruction maintenance and subsequent rehabilitation activities.

The primary objectives of the forensic investigation were developed in consultation among the ADOT, FHWA and LTPP Western Regional Support Contractor and included the following:

- Identifying the causes of pavement failures and investigating the distress mechanisms;
- Examining the pavement structural and functional performances; and
- Measuring within-section layer thicknesses and material properties.

2.3.1. Static structural evaluation using Benkelman Beam Deflectometer

Structural evaluation using Benkelman Beam Deflectometer (BBD) for low volume roads is current regular practice in India as per the guidelines suggested by IRC 81 1997 (Guzzarlapudi et.al 2016). Significant limitations and various comparative studies are discussed by researchers focusing on identifying the limitations of static devices, such as:

1. Stress condition evaluation in pavement layers from measured rebound deflection data is questionable;
2. Variations in profile and magnitude of rebound deflection bowls from point to point (Rajagopal and Justo, 1989);
3. Difficulty in extrapolating the deflections at transient loadings generating due to higher speeds of vehicles;

4. Lack of stable zero reference led to erroneous values that resulted in underestimation of pavement deflections and unrealistic assessment of structural integrity (Meier and Rix, 1995);
5. Slow performance, data uncertainty, and low reliability of results (Feo and Urrego, 2013).

Various forensic studies were carried out both regionally and globally by using Conventional BBD to evaluate the in service pavement sections. Veeragavan and Grover (2010) carried out forensic investigations of premature failure of a section of a national highway pavement due to poor sub-surface drainage. Forensic investigation to ascertain the cause for the failure was carried out by testing the different pavement layers in the field and through laboratory tests on core samples of various pavement component layer materials. The contributing factors for the pre-mature failure were identified as inadequate compaction of subgrade/ embankment, excess fines and high plasticity index in the Granular Sub-Base (GSB) layers, low binder content in the bituminous layers, etc. The laboratory tests on GSB layer materials and permeability tests indicate that the dramatic pavement failures may be attributable to poor sub-surface drainage and also due to the heavy commercial traffic allowed on the dense bituminous macadam layers. Benkelman Beam Deflection (BBD) survey was carried out for structural evaluation of the pavement. Dynamic Cone Penetration (DCP) test data was used in the analysis.

2.4. Performance evaluation using Field investigations (Non destructive impulse devices

Preservation of transport infrastructure is significant assignment, which plays a vital role in the growth in economy of the developing countries like India. One such primary element of the transport infrastructure, which provides a sustainable connectivity to the rural areas in order to alter the economic transform of the rural people, is rural roads, which were revolutionized by the Pradhan Mantri Gram Sadak Yojana (PMGSY) under the National Rural Road development Agency (NRRDA) in the year 2000. However, these low volume roads/ rural roads constructed are to be preserved with appropriate maintenance activities or strategies. Appropriate preservation of PMGSY roads is only possible based on robust and reliable maintenance strategy and is further depending on the realistic understanding of pavement behavior under loading in addition to the material characterization.

The evaluation of the degree and uniformity of compaction at varying moisture content and saturation levels which eventually reflects on the structural performance parameter viz. resilient modulus is the significant part in the Quality Assurance of flexible pavements prior to the defining road maintenance / rehabilitation phases of the pavement layers. Traditionally, acceptance quality testing of the flexible pavements involved the use of in-situ testing of the density in conjunction with conventional methods. These methods are time consuming, usually destructive in nature and labor intensive. There is a need of the hour to use, portable, quick and reliable non-destructive techniques.

Non-destructive field investigation tools such as the Falling Weight Deflectometer (FWD), Light Weight Deflectometer (LWD) have gained popularity and recognition over the last few decades (Fleming et. al. 2007). Recently, the revised Indian Road congress (IRC) codes (IRC: 37-2012 & IRC: 115-2014) recommend the use of resilient modulus to characterize the performance of flexible pavement layers carrying high traffic volumes. With the increased emphasis on the new mechanistic-empirical (M-E) - based design procedures, generalized equations have been developed to estimate the resilient modulus of layers as a function of conventional strength properties such as CBR, DCP values as discussed in IRC: 37-2012 & IRC: 115-2014.

In this regard over the past decade, few researchers have made an attempt in introducing and implementing the advance mechanistic approaches and non-destructive techniques in both design and evaluation practices of the pavements. (Pandey et.al. 2003) has developed non-destructive testing tool viz. Falling Weight Deflectometer (FWD) for the structural evaluation of the pavements and structural evaluation was carried out in the eastern part of India. Estimation of appropriate pavement layer moduli is a significant component for the mechanical design of pavements. Various in-situ non-destructive devices such as Geo gauge, Light weight deflectometer (LWD) and falling weight deflectometer (FWD) are used globally.

Although in India, non-destructive techniques are gaining the popularity in Road construction practices. However, it requires intensive study to verify the feasibility of NDT in Indian context. At present, experimental procedure and analysis of in-situ resilient modulus of the pavement components is a daunting task, which requires non-destructive equipment like LWD, NDG and FWD, which make the task simple and fast.

Conventional testing procedures and methodologies are insufficient for the realistic assessment of the Pavement. High laboratory and in-situ testing costs results in the Quality assurance of material of subgrade layer is assessed by various strength parameters such as bearing capacity/shear strength, modulus of subgrade reaction, Unconfined compressive strength. These parameters play a crucial role in the design of pavement crust thickness and assessment of quality control/quality assurance of the pavement. These parameters are essential to estimate for pavement construction and rehabilitation and play a crucial role in the design of pavement crust thickness. The performance of a pavement system depends on the accurate and timely estimation of its in-situ subgrade strength. Lack of timely availability in-situ strength parameters results delay in the project schedule and poor workmanship. This also compounded to a loss of valuable revenue of stakeholder. It becomes essential to develop methods and equipment to estimate in-situ strength parameter of the given subgrade soil from the cumbersome procedure for reliable and quick.

This is being conventionally adopted by the specifications based on the density or compaction levels and moisture content of each layer. However, Density and Moisture content do not relate to pavement design or performance input parameters. Additional problems with the specified density method arise from the pavement performance perspective. While relatively easy to understand, a material's density can be a poor indicator of performance compared to parameters such as stiffness and strength, which are sensitive to both moisture content and stress state. Variations in density can have relatively large effects on the properties that determine pavement performance. Hence, the errors that accumulate during the specified density procedure have the potential to greatly influence the load bearing capacity of the pavement foundation materials. Design engineers would be better equipped to adapt pavement designs to differing conditions, soil classifications, construction methods and other innovations if stiffness and strength parameters were used in place of density. These properties do not represent the actual response of the pavement layers under vehicular traffic loadings. Recognizing this deficiency, the current, and the 2002 mechanistic–empirical guide for design of pavement structures recommended the use of fundamental material properties such as elastic and resilient modulus for characterizing the base and subgrade soil and for the design of flexible pavements

2.4.1. International status

The concept of a resilient modulus of a material was originally introduced by (Seed et. al. 1962). The "resilient modulus" was defined as the ratio of applied dynamic deviatoric stress to the resilient or recovered strain under a transient dynamic pulse load (Witczak. et. al. 1995). The concept of resilient modulus soon gained popularity in the pavement community because a large amount of evidence was being gathered that the resilient pavement deflection possessed a better correlation to field performance than the total pavement deflection of BBD. In the last several decades, the resilient modulus has become a well-recognized mode of material characterization for all pavement material layers (subgrade, sub-base and base). The resilient modulus of soils is influenced by many factors, such as soil type, moisture content, dry unit weight and in-situ stresses (Fredlund et. al. 1977, Mohammad et. al. 1994 & 1998, and Titi et. al. 2002).

The 1986 AASHTO guide has been stipulated and reaffirmed (2002) that the resilient modulus should be the parameter for characterizing subgrade materials. Consequently, AASHTO Tests (laboratory) T274-87 and TP292-91 were proposed, the latest being the provisional standard TP46-94 and the "harmonized" M_R test protocol developed in the NCHRP 1-28A study. The complexity of the laboratory test procedures has prompted highway agencies to explore other test methods, primarily nondestructive deflection tests and subsequent back calculation of layer moduli of pavement (Newcomb et. al. 1995). Some of the impulse devices currently in use are Falling Weight Deflectometer, Loadman and TRL Foundation Tester (TFT).

The guide for design of pavement structures of the American Association of State Highway and Transportation Officials (AASHTO) recommends the use of resilient modulus (M_R) of subgrade soils as an important material property in characterizing pavements for their structural analysis and design (AASHTO 1993). In 2002, the new pavement design guide was released, which was based on the Mechanistic-Empirical (ME) design. The M-E procedures for pavement design require comprehensive material characterization incorporating changes in material properties as a function of the state of stress (stress dependency), environmental conditions (temperature and moisture), aging and continual deterioration under traffic loading (Ali 1999). The determination of the resilient modulus of paving materials is essential for the design and analysis of pavement structure in the implementation of the 2002 M-E guide for the design of the pavement structure.

Nondestructive testing (NDT) of pavements, especially deflection testing, has been a vital part evaluating the structural capacity of pavement (Newcomb, et. al. 1999). Various in-situ equipment were being used for the structural evaluation of pavements such as Benkelman Beam, the LaCroix Deflectograph, and the Curviameter apply static or slow moving loads. Vibratory loads are applied by the Dynaflect, the Road Rater, the Corps of Engineers 71-kN (16-kip) Vibrator and the Federal Highway Administration's Cox Van. "Near field" impulse loads, a term which will be explained subsequently are applied by the Dynatest, KUAB and Phoenix falling weight deflectometer.

Small-scale impulse test devices include Loadman Gros (1993), German Dynamic Plate Bearing Test (GBP) Kudla. et.al. (1991), and TRL Foundation Tester (TFT) (Rogers et.al. 1995). The analytical methods covered in this review are categorized as follows:

(a) Closed form multilayered solution,

(b) Back calculation of moduli, and

(c) Impulse methods for near-field measurements.

The first closed-form, multilayer solution for the back calculation of layer moduli was developed by (Hou et. al. 1977). The central feature of this method was the least squares method (Newton method) used for searching for the set of moduli that will reduce the sum of the squared differences between the calculated and measured deflections to a minimum. An algorithm based on the modified Newton method was employed by Harichandran et. al. (1993) to obtain the least squares solution of an over-determined set of equations. Back calculation procedure is widely employed for analyzing deflection data from FWD.

There are three general techniques into which these methods may be grouped.

1. A traditional back calculation technique matches measured deflections against those calculated from theory. Some of the programs that make use of this technique include Lee et.al. (1988), Modcomp Irwin et. al. (1988), and Cawlaert et. al. (1989).

2. A pattern search technique is employed in Modulus Ujan et. al. (1988) to obtain a match between measured and calculated deflections.
3. Haiping et. al. (1990) and Ulitdz P et. al. (1995) is examples of a technique based on an equivalent layer method.

The traditional back calculation technique uses deflection test conditions (i.e., load, plate geometry and layer thicknesses) and estimated layer moduli to generate a theoretical deflection basin. The theoretical deflections are compared with the measured deflections and the error is computed. If the error is not within a specified tolerance, the process is repeated with revised layer modulus values until the two deflection basins are considered to be sufficiently close or until the modulus for any given layer reaches a given limit. The determination of pavement moduli using the static layer elastic back calculation method is, by far, the most widely used procedure (Bush, 1980; Lytton, et. al., 1985; Uzan et. al. 1988). The application of layered theory for in-situ material characterization requires the estimation of only one unknown parameter, the modulus of each layer. Liu and Scullion (2001) is an example of a back calculation tool used by several agencies including TXDOT. An equivalent layer method of special mention here is the one developed by Ullidtz (2000) that permits the use of a stress-softening nonlinear stress-strain relation in the subgrade. Calculations of rutting and fatigue life of test pavements, using strains and deflections computed using this method, have proven to be realistic. Back calculation of layer moduli also appears to give reasonable results for pavements in which the layer decreases in stiffness with depth.

Flexible pavements are constructed in layers with high quality materials at the surface of the pavements where the loading stresses are higher and lower quality materials deeper into the pavement structure, as loading stresses diminish with depth. The lowermost layers of a flexible pavement structure are often layers of unbound materials (e.g., granular bases or compacted fill) above the existing soil material. These materials are employed to protect the subgrade from stresses capable of causing rutting or pumping of fines (Huang 2004). The resilient moduli of unbound paving materials often exhibit non-linear stress dependent behavior with varying stress-states within the material (Irwin 2002). This behavior can either be stress-hardening (increasing stiffness with increasing stress) or stress-softening (decreasing stiffness with increasing stress) (Irwin 2002).

Fleming et al. (2007) found several factors affecting LWD data quality have been investigated. Buffer temperature is not considered a significant issue. There was some influence due to non-uniformity of plate contact with material under test and this to be improved by the application of a thin layer of uniform sized sand. Regardless of buffer temperature the stiffness remained effectively constant; the only readily observable change was in the reported length of the load pulse, which was seen to increase with buffer temperature from 18 to 20 milliseconds. This would be expected as the buffers soften slightly when heated. It was also observed that permanent deformation was recorded during an impact. It may be sensible to use a larger diameter geophone 'foot' for weaker materials. Whereby a 25mm diameter foot was found to be appropriate (early versions of the LWD also had a larger foot).

Kavussi et al. (2010) PFWD moduli were increased with increasing the drop weights. Also found that the moduli remained almost the same regardless of the drop height variations In fact, the coefficient of variation (CV) of the moduli were small in different drop heights ($CV<6.4\%$) E_0 modulus determined from 100 mm loading plate was almost 1.85 times greater than that from 300 mm loading plate. In fact, the contact pressure for the 100 mm diameter loading plate is about 9 times greater than that from a 300 mm diameter. Hence, the contact area has a pronounced effect on elastic modulus results. In this paper two additional geophones were used and a test conducted on a two layers. It was found that the upper layer moduli are independent to the position of the additional geophones and lower layer modulus varies to some extent with the changing position of the second geophone. In short the upper layer modulus does not change appreciably upon changing the positions of the additional geophones. However, the lower layer modulus varies to some extent with changing the position of the second geophone.

Singh et al. (2010) the depth of influence of the LWD is 1.5 to 2 times the plate diameter, the LWD provides information about deeper zones; and increase in stiffness with increasing soil density, i.e. lower deflection and higher dynamic modulus of denser material.

Lin et al. (2006) concluded that the most important factor affecting the E_0 modulus is the size of the loading plate. The contact pressure for the 100 mm diameter loading plate was about 8 to 9 times higher than that of the 300 mm diameter loading plate. The E_0 moduli from the 100 mm loading plate were about 1.5 times higher than those from the 300 mm loading plate. The effects of drop height on PFWD moduli were small. The test results illustrated that the moduli remained about the same regardless of the drop heights.

Mooney & Miller (2009), determined measurement depths agree with reported values of 1.0 D but were less than other reported values ranging from 1.25 to 2.0 D. The depth to which different contact stress distributions affect in situ stress is approximately 1.0D–1.5D, encompassing the entire influence depth of the LWD test.

2.4.2. National status

Realistic Structural evaluation of pavements is a daunting task in the developing countries like India. This process is the most significant task of defining the optimum maintenance strategies of the pavements. Unfortunately, India is the country where huge investments were being allocated for the maintenance of developed road infrastructure. In order to optimize or reduce maintenance cost in a process of preservation of road infrastructure it is obligatory to have advanced technology in understanding the realistic behavior of the pavement under transient responses generated by the dynamic vehicular loadings. India has adopted conventional Benkelman Bean Deflectometer (BBD) test technique over the past three decades for the structural evaluation of the pavements.

However, considering the huge investments in the road infrastructure few researchers have made an attempt in adopting the advance design and testing approaches like Mechanistic empirical design approach and NDT tools for the design and structural evaluation of the pavements.

In this regard, IIT Kharagpur has made an significant effort in developing the NDT tool viz. Falling weight deflectometer (FWD) and developing the detailed methodology for the back calculation approaches for determining the significant design parameter resilient modulus which can be used for the design and analysis of the pavements in the during the year 2003. Over the last decade, Central Road Research Institute (CRRI) and the other research institutes and researchers are carrying extensive research studies in incorporating the Mechanistic –Design approach in the codal provisions and standardize the design approach of developing various back calculation approaches for deriving the resilient design parameter on various soils. IRC 37 (2012), have incorporated the significant mechanistic design approach partially in the design and analysis of the pavements. Further IRC published the codal provisions IRC 115 (2014) related to the structural evaluation of flexible pavements using NDT techniques viz. FWD. However, it is required to fully incorporate, standardize and calibrate the mechanistic design approach for the Indian conditions and further to extend the feasibility of NDT devices at various in-situ conditions.

In order to standardize the design approaches it is required to have a database related to the design parameters like in-situ resilient modulus, which is very susceptible to the various climatic and traffic loading conditions. Further study on Light weight deflectometer has been carried out by Varghese et. al. (2009) and developed empirical Correlation between CBR and DCP for laterite soils of Silty sand (SM) and Clayey Sand (SC). Correlations were also developed between CBR and geotechnical properties such as Dry density (γ_d), Plasticity Index (PI), moisture content (w) and liquid limit (w_L) by performing in-situ an laboratory tests. It was also stated that Dry density has a significant influence on the prediction of CBR.

Recently, Guzzarlapudi et.al (2016) carried out comparative study to establish Light weight deflectometer (LWD) as subgrade strength valuating tool specifically for low volume roads. Umashankar et al. (2015) carried out extensive field study to assess the feasibility of using a LWD for the compaction QC of base and surface layers.

2.5. Summary

The literature review covered in this chapter aimed to look at various forensic investigation techniques being implemented for distinct types of flexible pavements by using various conventional and state of art equipment both in regional and global perspective. The key findings for the review brought in this chapter were summarized below:

1. Numerous methods were being implemented for estimating pavement condition index for evaluating the pavement condition. Each method gives unique results that subsequently govern the maintenance strategy.
2. Numerous studies reported that performing detailed laboratory and field investigations is the significant prerequisite for the realistic assessment of in service pavement condition rather than limited to visual inspection based subjective judgements.
3. Various studies recommended the state of the art mechanistic empirical based performance evaluation practice by using non destructive impulse load deflection devices rather than conventional BBD based performance evaluation. Limited

studies were reported in Indian scenario regarding the use of impulse load based non destructive devices for evaluating in service pavement sections.

4. Very few studies were reported on performance evaluation of in service highway pavements and almost no study was reported on performance evaluation of low volume pavement sections in Indian scenario.
5. Very limited studies were reported on performance evaluation of low volume roads specifically on behavioural analysis of WMM and WBM base layers on thin surface bituminous pavement sections. However, this is primary being addressed in the subsequent chapters.

Thus, it must be highlighted that although this research study attempted to cover a wide literature review, it is yet restrict to some extent to the available knowledge used the research described in the further chapters.

Chapter 3. Selection of Pavement sections and Experimental Program

3.1. Introduction

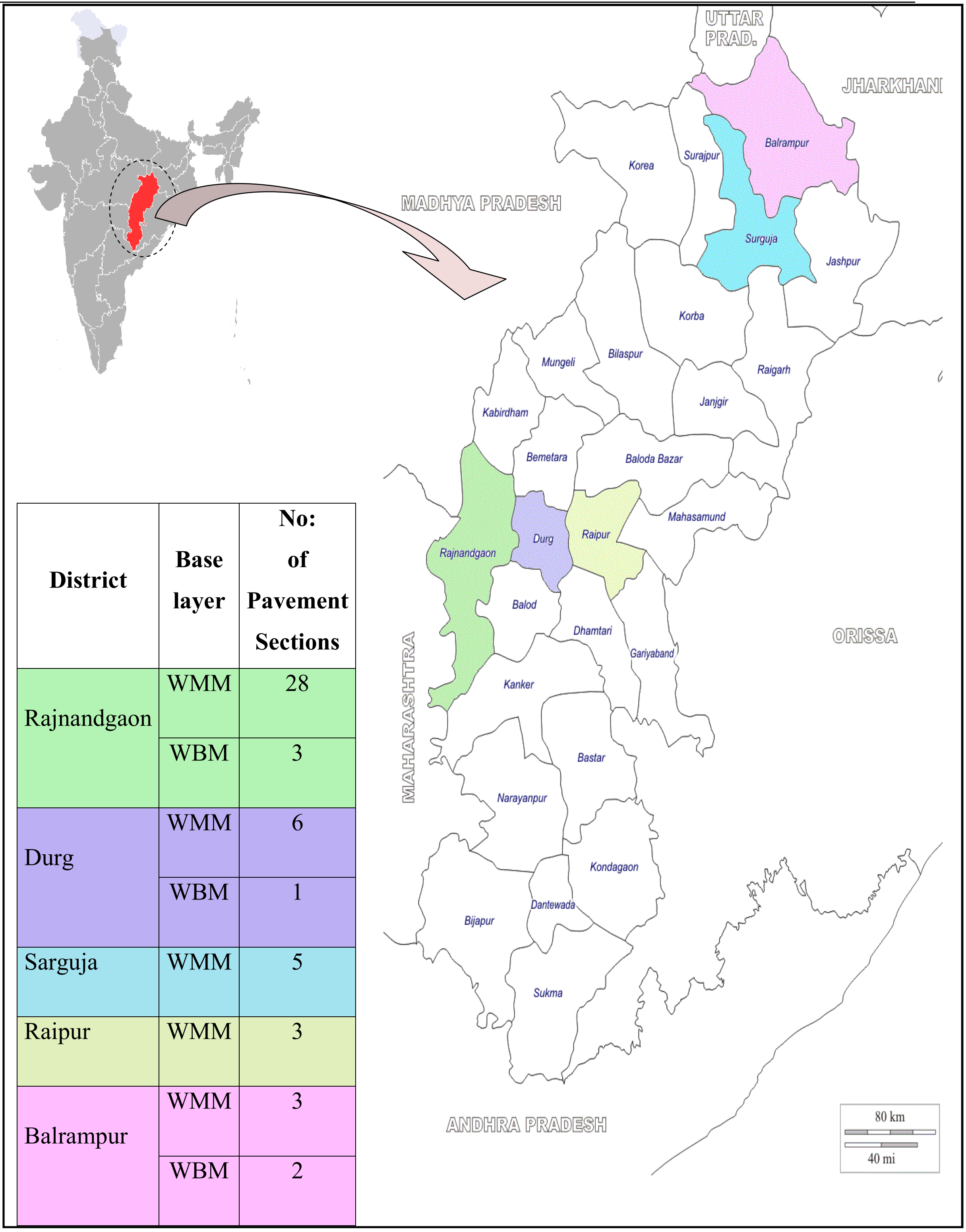
Realistic performance assessment of in service pavement sections primarily relies on appropriate selection of representative pavement sections with diverse traffic characteristics, age/service life of the pavement section, climatic conditions, and drainage conditions. In this chapter, details of various WBM and WMM base pavement sections selected for the study were discussed. This chapter also discusses about the detailed experimental program for carrying out various field and laboratory investigations.

3.2. Selection of Pavement Sections

Selection of appropriate pavement section for carrying out detailed forensic investigation and performance evaluation was based on the defined criteria. The basic aim of criteria was to ensure to understand the realistic behavior of various pavement sections with diversified characteristics. The basic criterion for the selection of pavement section is defined as follows:

i. Traffic Characteristics
ii. Soil Characteristics
iii. Service life of Pavement
iv. Climatic conditions
v. Drainage conditions

The preliminary objective of selection of pavement sections in various districts of Chhattisgarh is to assess the performance of WMM and WBM base pavement section under diverse characteristics fulfilling the defined objective and scope of the study. Preliminary site selection was carried out based on the preliminary information provided by the officials of CGRRDA and based on the visual inspection. 51 different pavement sections were selected for this study in which 45 are of WMM base pavement sections and 6 are of WBM pavement sections from 5 different districts in the state of Chhattisgarh as shown in Figure 3-1. The details of the selected pavement sections along with completion date are shown in Table 3-1. Each pavement section shown in Table 3-1 is designated with a unique ID as shown in Table 3-1 and hereafter all the pavement sections in the graphs and tables are referred with these unique IDs only.



District	Base layer	No: of Pavement Sections
Rajnandgaon	WMM	28
	WBM	3
Durg	WMM	6
	WBM	1
Sarguja	WMM	5
Raipur	WMM	3
Balrampur	WMM	3
	WBM	2

Figure 3-1 Study area

Table 3-1 Selection of WMM base pavement sections

TS**	Name of the Road Sections	PIU (District) & Package No.	Year of Completion	Total length of the road, Km
1	Main Road T07 to Potiya (Nagpura)	Durg & CG 05-62	2013	3.10
2	Kanharpuri to Silli	Durg & CG 05-62	2014	4.10
3	T04 to Tilaibhat	Rajnandgaon & CG 15-86	2010	1.20
4	Dara-Telkadih T04 to Charbhata	Rajnandgaon & CG 15-52	2009	1.60
5	Sirssahi T04 to Sikaritola	Rajnandgaon & CG 15-86	2010	4.0
6	T05 to Boirdih	Rajnandgaon & CG 15-87	2010	2.50
7	Tumnibodih to Nathunagaon	Rajnandgaon-2 & CG 15-72	2010	1.80
8	Machandapur to Dhourabhata	Rajnandgaon-2 & CG 15-72	2010	1.40
9	Diwanjitiya to Godri	Rajnandgaon-2 & CG 15-72	2010	1.80
10	Arjuni to Pairi	Rajnandgaon-2 & CG 15-72	2010	1.80
11	Arjuni to Salikjhitiya	Rajnandgaon-2 & CG 15-72	2010	0.93
12	R.D.C. Road to Farhadh	Rajnandgaon-2 & CG 15-63	2010	1.60
13	Ahiwara to Dor (Malpuri) Road	Durg & CG 05-63	2014	8.20
14	Main road T011 to Bharani	Durg & CG 05-62	2013	1.05
15	Main road T05 to Khilora Mandir	Durg & CG 05-62	2013	4.35
16	Main road to Godeghat	Durg & CG 05-62	2014	1.00
17	RehadaKhaspara to Chandranagar Khaspara	Rajpur (Balrampur) & CG 16-159	2014	2.70
18	Shankargarh Kusmi road (Km 34) to Kotalu Amerapat	Rajpur (Balrampur) & CG 16-159	2014	3.50
19	Shankargarh Kusmi road (Km 34) to Girjapur Khaspara	Rajpur (Balrampur) & CG 16-160	2014	0.90
20	Kosaga to Parsapara	Ambikapur-1 & CG 16-55	2013	1.80
21	Beldagih to Beldagih uparpara	Ambikapur-1 & CG 16-55	2013	1.90
22	Chando to Amdala	Ambikapur-1 & CG 16-55	2013	2.90
23	Sojdha to Tunguri	Ambikapur-1 & CG 16-55	2013	3.40
24	Kusu to Pratappur	Ambikapur-1 & CG 16-55	2013	7.60
25	Korsi to Pirdah	Raipur & CG 14-53	2011	3.20

TS**	Name of the Road Sections	PIU (District) & Package No.	Year of Completion	Total length of the road, Km
26	Amsena to Karela	Raipur & CG 14-53	2010	5.40
27	Gorbhat to Bhalera	Raipur & CG 14-53	2012	4.00
28	Mohara Road T02 to Thakurtola	Rajnandgaon & CG 15-84 (L036)	2010	4.60
29	Belgaon to Kolendra	Rajnandgaon & CG 15-83 (L041)	2010	4.20
30	Belgaon to Kathili	Rajnandgaon & CG 15-83 (L040)	2010	2.35
31	T02 to Sehaspur	Rajnandgaon & CG 15 (L037)	2008	3.00
32	T01 to Pendrikurd	Rajnandgaon & CG 15-37	2008	4.04
33	T01 to Kamtarai	Rajnandgaon & CG 15-37	2008	3.30
34	T01 to atekhasa	Rajnandgaon & CG 15-37	2008	9.10
35	T01 to Bori	Rajnandgaon & CG 15-37	2008	2.65
36	Bori to Achola	Rajnandgaon & CG 15-37	2008	1.55
37	L032 to Kusmi	Rajnandgaon & CG 15-37	2008	1.00
38	T01 to Dullapur	Rajnandgaon & CG 15-37	2008	4.50
39	Athariya to Junwani	Rajnandgaon & CG 15-37	2008	4.50
40	Dongargarh Mundgaon road T05 To Khalari	Rajnandgaon & CG 15 (L052)	2009	1.01
41	Dongargarh T01 to Haransinghi	Rajnandgaon & CG 15 (L049)	2010	2.70
42	Dongargarh to Karwari	Rajnandgaon & CG 15 (L026)	2010	3.20
43	Dongargarh Chichola road T08 To Motipur	Rajnandgaon & CG 15 (L065)	2010	2.40
44	Mudpur to Jamri	Rajnandgaon & CG 15 (L050)	2010	2.00
45	Navagaon to Kareli	Rajnandgaon & CG 15	2013	2.10
A	**Total length covered for WMM Pavement sections, Km**			**136.24**

Table 3-2 Selection of WBM base pavement sections

TS**	Name of the Road Sections	PIU (District) & Package No.	Year of Completion	Total length of the road, Km
46	Kodiya Dongariya	Durg	2013	5.70
47	Dipadih Kurd road to Bijadih Khaspara	Rajpur (Balrampur) CG-16-160	2014	3.35
48	Madha Bantola to Udhasey (observed)	Rajpur (Balrampur) CG 16	2011	3.40
49	Devkatta to Kanhargaon	Rajnandgaon & CG 15-50 (L027)	2014	4.10

TS**	Name of the Road Sections	PIU (District) & Package No.	Year of Completion	Total length of the road, Km
50	Dhara-Gotiya	Rajnandgaon & CG 15-25 (L029)	2008	11.36
51	Kalkasa-Bhaisara	Rajnandgaon& CG 15-85 (L024)	2010	1.80
B	**Total length covered for WBM Pavement sections, Km**			**29.71**

Note: ** TS – Test Section

3.3. Experimental Program

Detailed experimental program is prepared to fulfill the aforementioned objectives for both the stages on selected WMM and WBM base pavement sections. Table 3-3 shows total no. of pavement sections selected for each stage and total length covered for each stage. Table 3-4 and Table 3-5 shows detailed surveys, Field and laboratory investigations performed in each stage.

Table 3-3 Pavement sections and length covered for each stage of evaluation

Sl.No.	Stages of evaluation	No. of pavement sections		Total length covered (Km)	
		Wet Mix Macadam (WMM)	Water Bound Macadam (WBM)	Wet Mix Macadam (WMM)	Water Bound Macadam (WBM)
1	Stage-I	45	6	136.24	29.71
2	Stage-II	5	3	15.16	17.26

Table 3-4 Field surveys for Stage-I evaluation

Sl. No.	Name of the Survey	Type of the test	Property	IS/IRC/ ASTM standard
1	Pavement condition survey	In situ	Distress measurement and quantification	IRC 82 2015 & ASTM D6433-11

Table 3-5 Details of Field and laboratory tests for stage-II evaluation

Sl. No.	Name of the test	Type of the test	Property	IS/IRC/ ASTM standard
Laboratory Investigations				
1	**Subgrade**			
a	Modified Proctor Test	Laboratory	Dry density	IS 2720 (Part – 8) 1983
b	Soaked CBR at MDD	Laboratory	Bearing capacity	IS 2720 (Part – 16) 1983

Sl. No.	Name of the test	Type of the test	Property	IS/IRC/ ASTM standard
2	**Granular subbase/Base layers**			
a	Sieve Analysis	Laboratory	Grading Requirements	IS 2386 (Part – I) 1963
b	Modified Proctor Test	Laboratory	Dry density	IS 2386 (Part – III) 1963
c	10% Fines value	Laboratory	Strength	IS 2386 (Part – IV) 1963
d	Aggregate Impact value	Laboratory	Toughness	IS 2386 (Part – IV) 1963
3	**Bituminous layer**			
a	Binder Content	Laboratory	Bitumen content	IRC: SP 11 –1988, IS 13826 (Part 7) 1993,
b	Sieve Analysis	Laboratory	Grading Requirements	IS 2386 (Part – 1) 1963
c	Aggregate Impact value	Laboratory	Toughness	IS 2386 (Part – IV) or IS:5640
d	Bitumen adhesion stripping value of aggregates	Laboratory	stripping value	IS 6241- 1971
Field Investigations				
1	Portable Falling Weight Deflectometer test	In-situ	Structural evaluation (Dynamic)	ASTM E 2583-07a
2	Benkelman beam deflection test	In-situ	Structural evaluation (Static)	IRC 81-1997
3	Roughness measurement by MERLIN	In-situ	Roughness Measurement (IRI value)	IRC SP:16-2004
4	Sand replacement test	In-situ	In-situ density assessment	IS: 2720 (Part-28) 1983
5	Test Pit	In-situ	Pavement thickness and sample collection of pavement layers for Laboratory testing	

Thus based on the defined criteria for the site selection, appropriate locations for the sample collection was chosen and soil samples were collected. The collected samples were shipped to the laboratory for detailed laboratory investigations. The detailed experimental procedures and the corresponding results by the conventional and state of art equipment is discussed in the chapter 4.

Chapter 4. Stage-I Evaluation: Pavement Condition Survey and Analysis

4.1. Introduction

The objective of the road and pavement condition surveys is to identify defects and sections with similar characteristics. All defects systematically referenced, recorded and quantified for the purpose of determining the optimum design/maintenance alternative. The pavement condition surveys carried out using visual observations, supplemented by actual measurements and in accordance with the widely accepted methodology as per the guidelines suggested by IRC 82 2015 and ASTM D 6433-11. The measurement of rut depth measured using standard straight edges. The shoulder and embankment conditions evaluated by visual means and the existence of distress modes (cuts, erosion marks, failure, drops) and extent (none, moderate, frequent and very frequent) of such distress manifestations are recorded. Various distresses were measured and recorded in the developed visual condition survey format that bifurcated 18 different types of distresses as per the guidelines suggested by ASTM D 6433-11. The typical visual condition survey format is provided in Appendix-I. Each road section is divided into various subsections of 50m interval each. Subsequently, the distresses were recorded for each road section by using Handy Cam travelling at a speed of 20 KMPH. The detailed video files and photographs of each pavement section are provided in DVD disc file. However, sample photographs of distress identified at each road section is provided in Appendix-I. The detailed quantification of each type of distress was carried out as per the guidelines suggested by IRC 82-2015 and ASTM D 6433-11.

The pavement was diagnosed with patch work, depressions, pot holes, cracks, bleeding and raveling etc. All the above distresses were represented in percentages of total area. Table 3-1 describes about the details of the visual condition survey carried out at selected WBM and WMM base pavement sections along with major distress diagnosed. Typical photographs of visual condition survey encircled with the distresses identified on selected WMM and WBM base pavement sections are shown in Figure 4-1 and Figure 4-2.

Some of the critical observations were:

- Heavy depressions and settlement
- A lot of patch work was observed.
- Mostly the surface was found to be hungry and raveled

- Alligator cracks were observed
- Very poor drainage conditions were prevailing almost along the entire stretch
- Road side drains were blocked.
- Rain water cuts were observed at shoulders and at start and end of box culverts

	
Plate 1: Longitudinal Cracking	Plate 2: Longitudinal Cracking/Patching/rutting
	
Plate 3: Series of Longitudinal cracking/ Initial stages of rutting	Plate 4: Longitudinal cracking

Plate 5: Pothole

Plate 6: Alligator Cracking

Plate 6: High severity rutting

Plate 8: High severity longitudinal cracks

Plate 9: Medium severity pothole

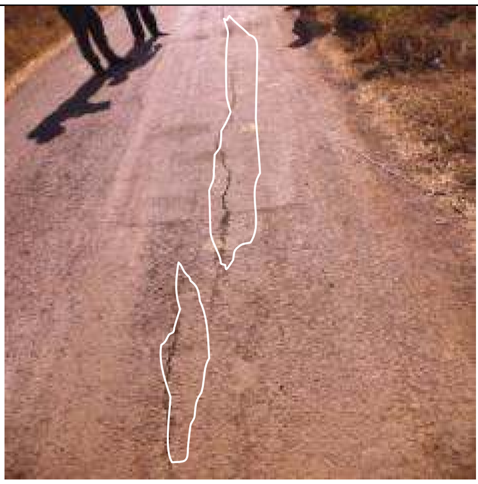


Plate 10: Medium severity Longitudinal crack and Patching

	
Plate 11: High severity block cracking/ pothole	Plate 12: High severity Longitudinal cracking
	
Plate 12: High severity Alligator cracking	Plate 13: High severity Alligator cracking and rutting
	
Plate 14: High severity Longitudinal cracking	Plate 15: High severity Edge cracking

	
Plate 16: Medium severity Longitudinal cracking	Plate 17: Medium severity Rutting
	
Plate 18: High severity Longitudinal cracking	Plate 19: Medium severity Longitudinal cracking

Figure 4-1. Visual condition survey photographs of WMM pavement sections

	
Plate 1: Weathering (High Severity)	Plate 2: Potholes and Weathering (High severity)
	
Plate 3: Edge Cracking	Plate 4: Depression

Plate 5: Shoulder dropoff and Rain Cuts	Plate 6: High Severity Weathering and potholes

Plate 7: Weathering Low Severity	Plate8: Edge Depression (High Severity)

Figure 4-2. Visual condition survey photographs of WBM pavement sections

Table 4-1. Visual condition survey on WMM base pavement sections

TS**	Year of Completion	Total length of the road, Km	Key observations
1	2013	3.10	Few sections were diagnosed with Rutting, Longitudinal Cracks and patching with low medium severity level.
2	2014	4.10	Series of Longitudinal cracks, Initial stages of rutting were diagnosed at few sections
3	2010	1.20	Low severity Longitudinal and Alligator cracks at one location. No sign of any major structural distress

TS**	Year of Completion	Total length of the road, Km	Key observations
4	2009	1.60	Low severity Block and Alligator cracks at one location. No sign of any major structural distress
5	2010	4.0	Entire pavement stretch is raveled. Few sections were undergone with Medium to high severity potholes, rutting, Alligator cracking. Series of Low severity Longitudinal, edge cracks and patching was observed
6	2010	2.50	First 1.5 Km stretch were undergone with medium to high severity potholes, longitudinal cracks, edge cracks, Rutting and patching. Beyond 1.5Km no sign of any structural distress except raveling/weathering.
7	2010	1.80	Low to Medium severity Potholes and longitudinal cracks at few sections and at near culverts. No sign of any structural distress like rutting and alligator cracking.
8	2010	1.40	No sign of any structural distress like rutting and alligator cracking. First 500m stretch is raveled.
9	2010	1.80	0 to 1.0Km stretch undergone with medium to high severity failure combination of alligator longitudinal and block cracking, Potholes. Initial stages of rutting were also observed.
10	2010	1.80	No sign of any structural distress like rutting and alligator cracking. Few stretches were raveled.
11	2010	0.93	No sign of any structural distress like rutting and alligator cracking.
12	2010	1.60	Entire stretch is distressed with high severity. Series of alligator and block cracking were diagnosed. Medium to high severity rutting was identified at few locations. Adjacent areas were water logged.
13	2014	8.20	No sign of any structural distress like rutting and alligator cracking. Longitudinal and edge cracks with low to medium severity were identified at few sections.
14	2013	1.05	No sign of any structural distress like rutting and alligator cracking. Only raveling at few sections
15	2013	4.35	Series of Longitudinal and edge cracks with low to medium severity on entire stretch. Rutting was diagnosed at few sections with medium to high severity.
16	2014	1.00	No sign of any structural distress like rutting and alligator cracking. Longitudinal cracks with low severity were identified at few sections.
17	2014	2.70	No sign of any structural distress like rutting and alligator cracking. Weathering is observed at few sections

TS**	Year of Completion	Total length of the road, Km	Key observations
18	2014	3.50	Entire stretch is diagnosed with ravelling/weathering medium to High severity. No sign of any structural distress like rutting and alligator cracking. Low severity Longitudinal cracks were observed.
19	2014	0.90	Entire stretch is diagnosed with ravelling/weathering medium to High severity. No sign of any structural distress like rutting and alligator cracking.
20	2013	1.80	No sign of any structural distress like rutting and alligator cracking. One section is diagnosed with medium to High severity longitudinal cracks.
21	2013	1.90	Few sections are diagnosed with low to medium severity longitudinal Block, Alligator and edge cracks. No sign of any rutting. Few sections are diagnosed with medium to high severity longitudinal Block, Alligator and edge cracks.
22	2013	2.90	No sign of any structural distress like rutting and alligator cracking
23	2013	3.40	No sign of any structural distress like rutting and alligator cracking
24	2013	7.60	Few sections were diagnosed with series of Alligator, block, longitudinal and edge cracking at medium to high severity levels. Few locations were identified with low to medium severity level rutting.
25	2011	3.20	Entire stretch is diagnosed with medium to high severity longitudinal cracking, few sections were diagnosed with low to medium severity potholes. Few sections were identified with medium to high severity rutting. Few sections were diagnosed with edge cracking.
26	2010	5.40	Entire is section is damaged completely with medium to high severity, longitudinal and alligator cracks, rutting and potholes.
27	2012	4.00	Few sections were diagnosed with medium to high severity, longitudinal and alligator cracks, rutting and potholes. Few sections patching was identified.
28	2010	4.60	Chainage 2.40 to 3.80 : (completely damaged sections were diagnosed with medium to High severity potholes. Few sections were diagnosed with medium to high severity rutting, alligator cracking, longitudinal cracks and patchwork. Entire section is reveled. Approach road at bridges were identified with high severity cracks and settlements.
29	2010	4.20	All sections were diagnosed with medium to High

TS**	Year of Completion	Total length of the road, Km	Key observations
			severity potholes, longitudinal cracks. Few sections were diagnosed with medium to high severity rutting, alligator cracking, and patchwork, settlements. Entire section is reveled.
30	2010	2.35	Few sections were diagnosed with series of Alligator, block, and longitudinal cracking at low to medium severity levels. Few locations were identified with low to medium severity level patching, rutting and potholes.
31	2008	3.00	All sections were diagnosed with medium to High severity potholes. Few sections were diagnosed with low to medium severity rutting, alligator cracking, and patchwork. Entire section is reveled. Approach road at bridges were identified with high severity cracks and settlements.
32	2008	4.04	Few sections were diagnosed with series of longitudinal and edge cracking at medium to high severity levels. Few locations were identified with medium to high severity level rutting, undulations and depressions.
33	2008	3.30	Few sections were diagnosed with series of longitudinal, and Alligator cracking, potholes at medium to high severity levels. Few locations were identified with low to medium severity level rutting
34	2008	9.10	Few sections were diagnosed with series of Alligator, block, and longitudinal cracking at medium to high severity levels. Few locations were identified with medium to high severity level rutting and potholes.
35	2008	2.65	Few sections were diagnosed with series of Alligator, block, longitudinal and edge cracking at medium to high severity levels. Few locations were identified with medium to high severity level rutting and patching.
36	2008	1.55	Few sections were diagnosed with series of Alligator, block, and longitudinal cracking at medium to high severity levels. Few locations were identified with medium to high severity level rutting and potholes. Major portion is covered with habitation
37	2008	1.00	0 to 300 m distance: High severity Rutting, Depression, longitudinal crack, Embankment is adjacent to the water body accompanied with habitation, Undergone high severity depression and rutting.
38	2008	4.50	Few sections were diagnosed with series of Alligator, block, longitudinal and edge cracking at medium to

TS**	Year of Completion	Total length of the road, Km	Key observations
			high severity levels. Few locations were identified with medium to high severity level rutting and patching.
39	2008	4.50	Few sections were diagnosed with series of Alligator, block, longitudinal and edge cracking at medium to high severity levels. Few locations were identified with medium to high severity level rutting and patching.
40	2010	1.01	Series of Patchworks, depressions were diagnosed at few sections. No sign of any structural distress like longitudinal cracks, Alligator cracks and rutting were identified.
41	2010	2.70	Few sections were diagnosed with series of Alligator, block, longitudinal and edge cracking at medium to high severity levels. Few locations were identified with medium to high severity level rutting and patching
42	2010	3.20	No sign of any structural distress like rutting and alligator cracking. Longitudinal cracks with low severity were identified at few sections.
43	2010	2.40	Few sections were diagnosed with series of Alligator, block, longitudinal and edge cracking at medium to high severity levels. Few locations were identified with medium to high severity level rutting and patching
44	2010	2.00	Series of patchworks, potholes and depressions were diagnosed at few sections; No sign of any rutting and longitudinal cracks.
45	2013	2.10	No sign of any structural distress like rutting and alligator cracking. Longitudinal cracks with low severity were identified at few sections.

Table 4-2. Visual condition survey on WBM base pavement sections

TS**	Year of Completion	Total length of the road, Km	Key observations
46	2013	5.70	Few sections were diagnosed with longitudinal cracks with low to medium severity..
47	2014	3.35	No sign of any structural/functional distress like rutting and alligator cracking.
48	2011	3.40	Entire stretch is structurally distressed with high severity level. Series of Potholes, Alligator and block cracking, Rutting were observed. Base layer is totally exposed at

TS**	Year of Completion	Total length of the road, Km	Key observations
			few sections. As per the stated preference survey, Initial 2 to 2.5 years after opening the traffic the pavement experienced heavy traffic. Currently no sign of any traffic.
49	2014	4.10	No sign of any structural/functional distress like rutting and alligator cracking.
50	2008	11.36	Few sections were diagnosed with series of Alligator, block, longitudinal and edge cracking at medium to high severity levels. Few locations were identified with medium to high severity level rutting and patching. Few sections were diagnosed with medium to High severity Weathering.
51	2010	1.80	No sign of any structural/functional distress like rutting and alligator cracking.

4.2. Estimation of Pavement condition index (PCI)

The pavement condition index (PCI) was estimated by using both IRC 82-2015 and ASTM D 6433-11 standard methods for each subsection of selected 45 WMM pavement sections and 6 WBM pavement sections at an interval of 50m each. The primary input for both the methods is percentage contribution of each type distress in each subsection. Therefore, estimation of this percentage contribution of each type distress in each subsection involves following steps:

1. Diagnosing and measuring the similar type of distress in each subsection.
2. Identifying the severity levels of each type of distress in each subsection for estimating the PCI as per ASTM D 6433-11.
3. Estimating the percentage contribution of similar type of distress to total area of subsection in each subsection.

4.2.2. PCI as per IRC: 82-2015

PCI value for each subsection is estimated based on the percentage contribution of each distress from the total area of each subsection as per the guidelines suggested by the IRC 82-2015. Default weights have been assigned for each type of distress to estimate estimated the final PCI value from the calculated percentage contribution of each distress. Table 4-3 shows recommended typical PCI rating scale of 0 to 3 for a range of each distress of major district roads (MDR), other district roads (ODR) and Village roads

(VR). Therefore the mean PCI value is estimated for each pavement section from the estimated PCI value for each subsection of the selected pavement section. The final estimated mean PCI values for each of WMM and WBM base pavement sections is shown in Figure 4.3 and Figure 4.4. The detailed calculation sheets of distress intensity and PCI values for each subsection of each WBM and WMM pavement section is provided in Appendix-I.

Table 4-3. Pavement Distress Based Rating for MDR(s) and Rural Roads (ODR and VR)

Defects	Range of Distress			Weights
Cracking (%)	>20	10-20	<10	1.00
Raveling (%)	>20	10-20	<10	0.75
Pothole (%)	>1	0.5 to 1	<0.5	0.50
Patching (%)	>20	5-20	<5	0.75
Settlement and depression (%)	>5	2 to 5	<2	0.75
Rating	1	1.1 - 2	2.1 - 3	
Condition	**Poor**	**Fair**	**Good**	

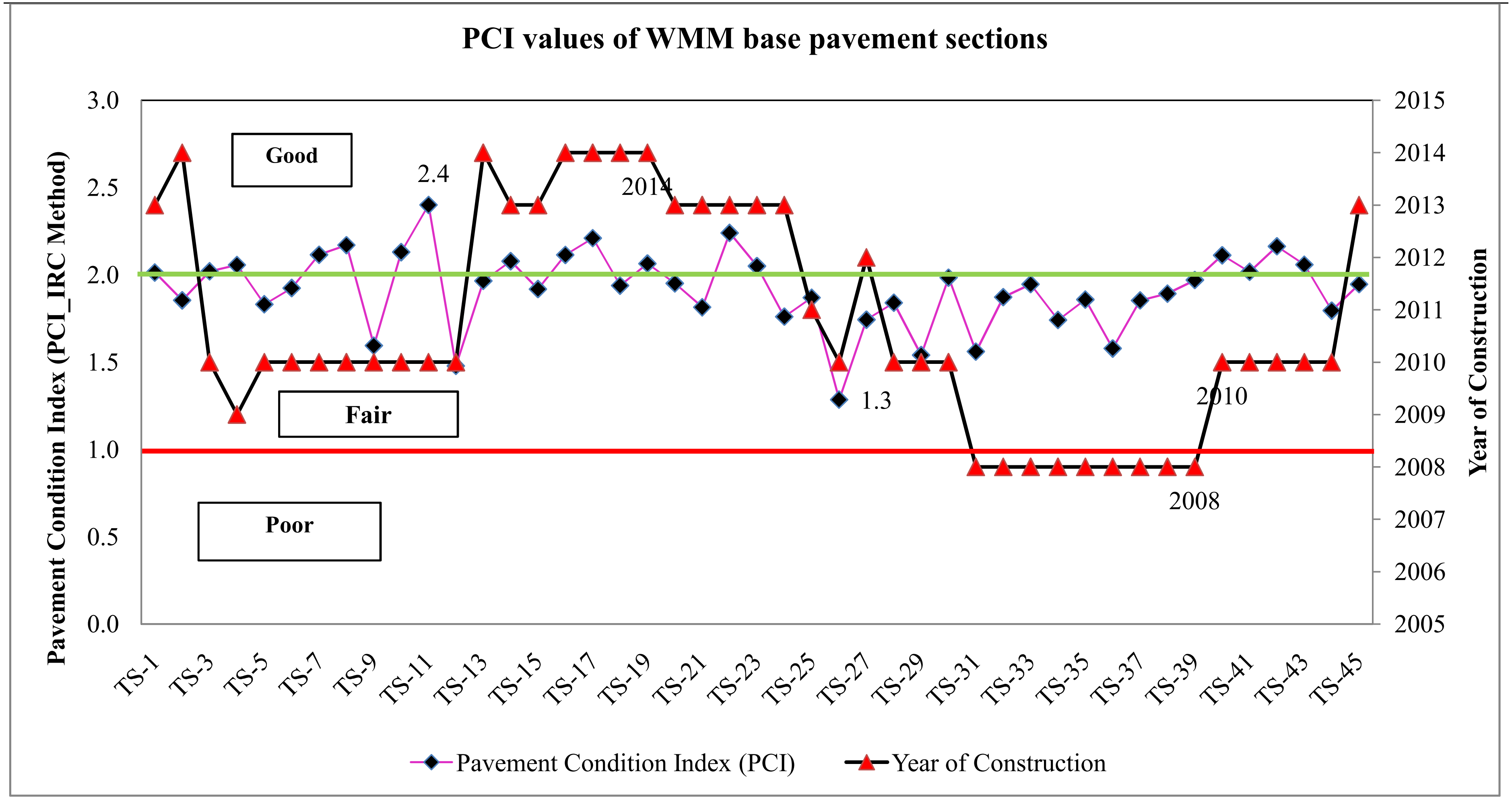


Figure 4-3. PCI values of WMM base pavement sections as per IRC method

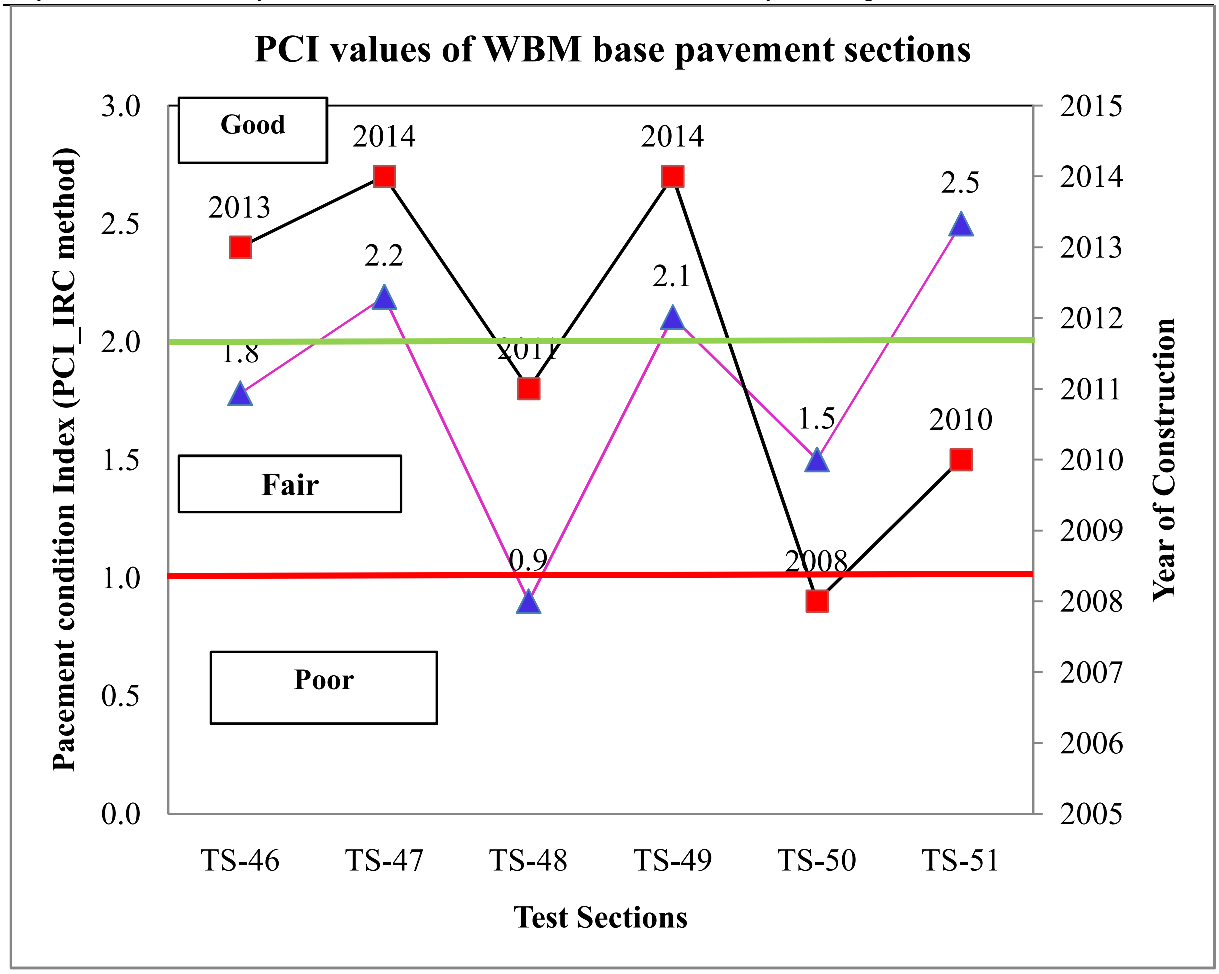


Figure 4-4. PCI values of WBM base pavement sections as per IRC method

4.2.3. Estimation of PCI as per ASTM D6433-11

PCI value for each subsection is estimated based on the percentage contribution of each distress from the total area of each subsection as per the guidelines suggested by the IRC ASTM D 6433-11. The severity level of each distress is designated in three categories (i.e., low, medium, and high) based on the unit length and area. Figure 4-5 shows recommended typical PCI rating scale of 0 to 100. Each distress has been assigned by a deduct value according to the severity and intensity levels as shown in Figure 4-6. The generic procedure adopted for the calculation of PCI value from the calculated percentage contribution of each distress for each subsection of the selected pavement section is discussed below. Therefore the mean PCI value is estimated for each pavement section from the estimated PCI value for each subsection of the selected pavement section. The final estimated mean PCI values for each of WBM and WBM base pavement sections is shown in Figure 4.7 and Figure 4.8. The detailed calculation sheets of distress intensity and PCI values for each subsection of each WBM and WMM pavement section is provided in Appendix-I.

The calculation procedure summarized in following steps:

1. Determination of pavement distresses and their severity, which can be low, medium, or high.
2. Determination of deduct values from the deduct value curves for each distress. Figure 1-4 shows typical deduct value curve for Longitudinal cracking.
3. Calculation of maximum number of deduct values from the maximum allowable deduct number, by using Eq. (1):

   $$m_i = 1 + (9/98)\ (100 - HDV) \qquad \text{(Eq. 1)}$$

   Where, m_i = maximum allowable number of deduct values and HDV = greatest individual deduct value.
4. Determination of q, for the number of deducts values greater than 2.
5. Determination of the total deduct value (TDV), which is the summation of all deduct values.
6. Determination of the corrected deduct value (CDV) based on the correction curves using q and the TDV
7. Reductions of the smallest deduct value greater than 2 to exactly 2.
8. Repetition of steps 4 through 7 until q is equal to 1.
9. Determination of the maximum CDV ($CDV_{max)}$ and computation of the PCI using Eq. (2):

   $$PCI = 100 - CDV_{max} \qquad \text{(Eq.2)}$$

Figure 4-5. Pavement Condition Index (PCI), Rating Scale as per ASTM D 6433-11

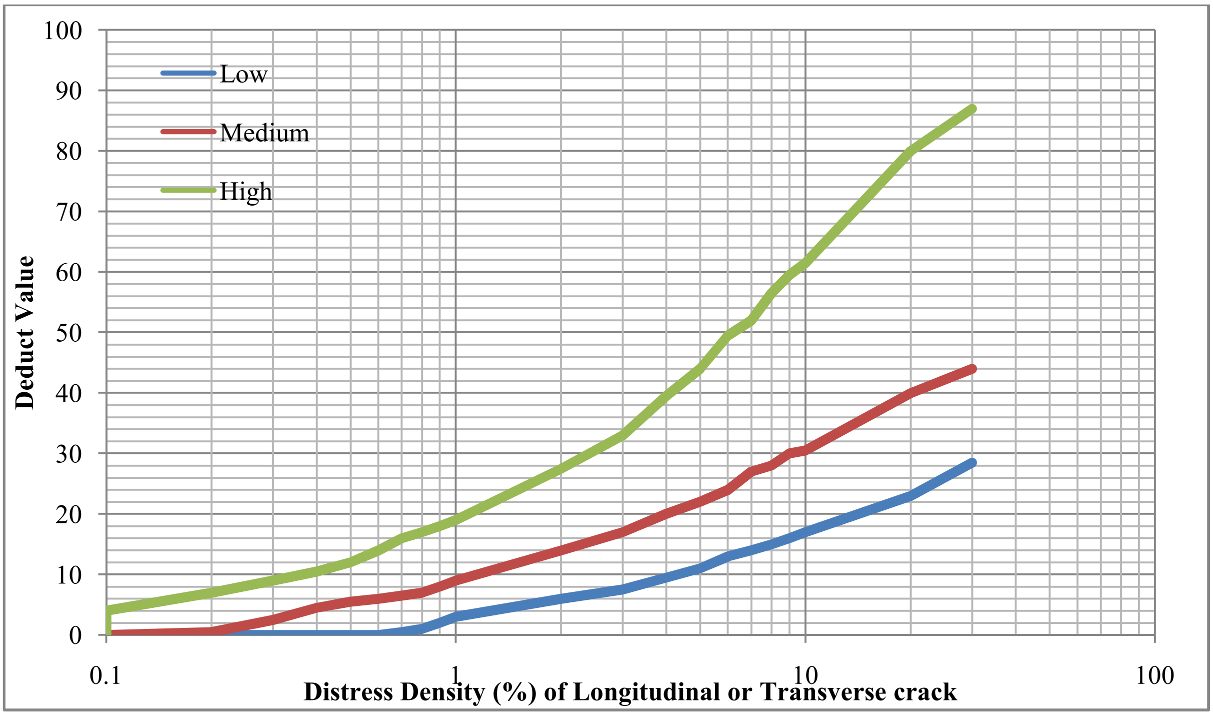


Figure 4-6. Typical deduct value curves for Longitudinal or Transverse crack

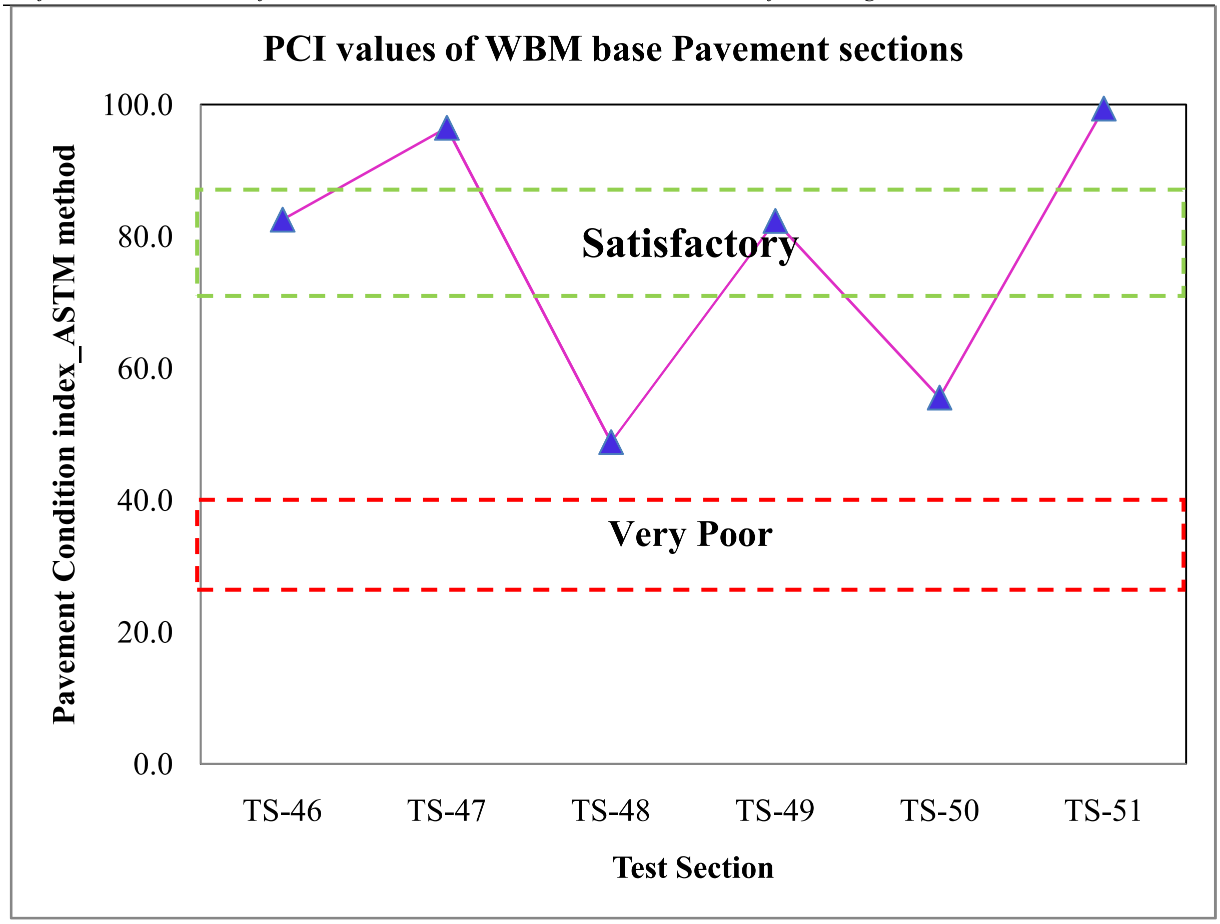


Figure 4-7. PCI values of WBM base pavement sections as per ASTM method

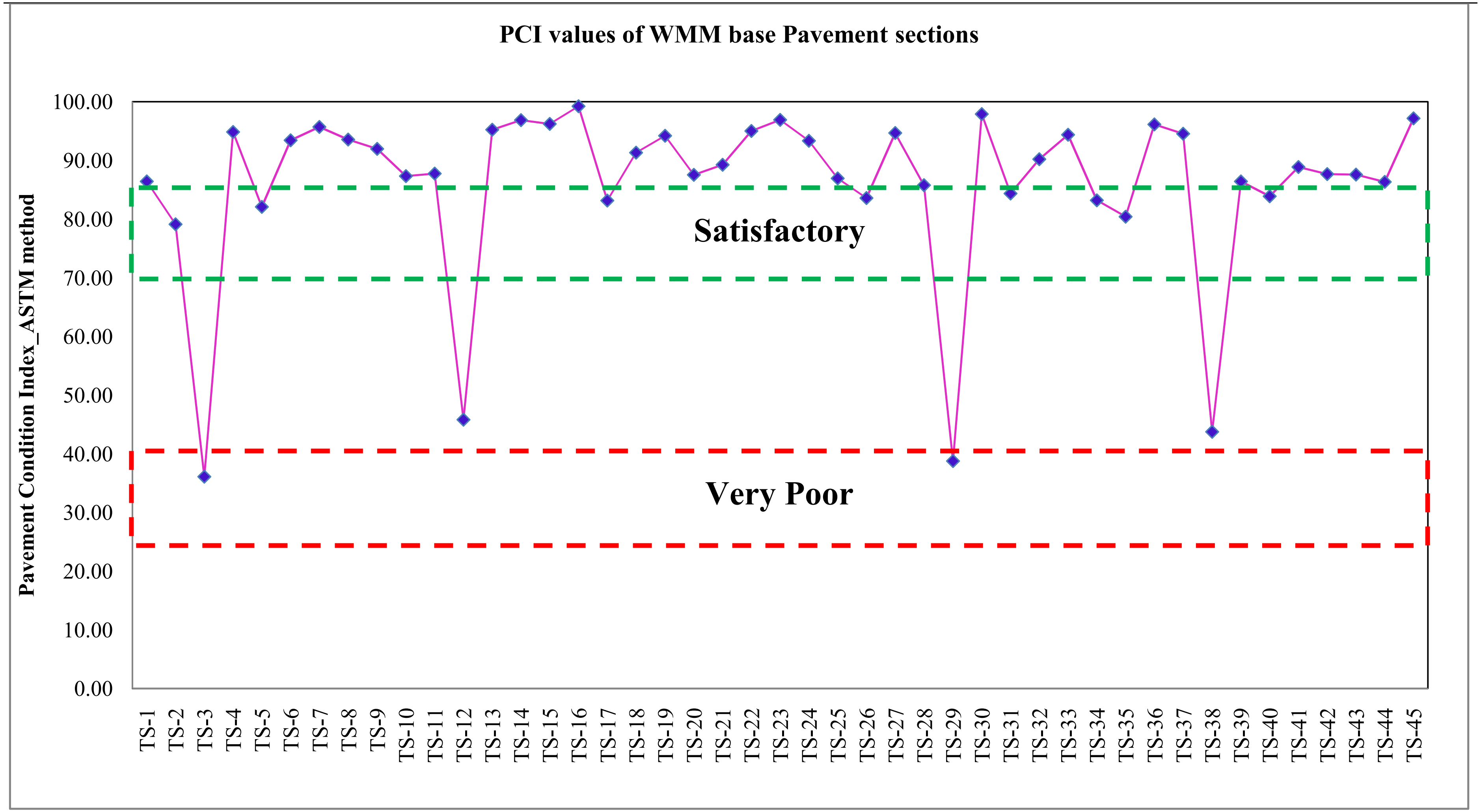


Figure 4-8. PCI values of WMM base pavement sections as per ASTM method

4.3. Observations on Pavement condition from PCI Analysis

Key observations are summarized based on the PCI analysis using IRC and ASTM methods among WBM and WMM base pavement sections.

1. WBM and WMM pavement sections have been diagnosed with longitudinal cracks, transverse cracks, rutting, depression, alligator cracking, potholes, shoulder dropoff, rain cuts and Weathering at few sections of WBM and WMM pavement sections.
2. WBM aggregates have been found exposed due to high severity weathering at few WBM base pavement sections such as TS-49 and TS-50. Whereas in WMM pavement sections, no such behavior have been diagnosed.
3. As per the PCI analysis of IRC method, 31 WMM base pavement sections have shown in fair condition and the remaining 14 WMM base pavement sections have shown in good condition.
4. As per the PCI and rating analysis of IRC method, 1 WBM base pavement section have shown in poor condition, 2 WBM pavement sections have shown in fair condition and the remaining 3 WBM pavement sections have shown in good condition.
5. As per the PCI analysis of ASTM method, 8 WMM base pavement sections have shown in satisfactory condition, 2 sections have shown in very poor condition, 2 sections have shown in poor condition, and the remaining 33 WMM base pavement sections have shown in good condition.
6. As per the PCI and rating analysis of ASTM method, 2 WBM base pavement sections have shown in poor condition, 2 WBM pavement sections have shown in satisfactory condition and the remaining 2 WBM pavement sections have shown in good condition.
7. Although overall PCI values of WMM pavement sections depicts fair to good conditions. Few subsections are diagnosed with high severity structural distresses. Whereas, in the case of WBM pavement sections very few subsections are diagnosed with structural distress.
8. Few subsections of WBM pavement sections have diagnosed with exposure of granular aggregates to surface layers at different severity levels. However, this condition has not diagnosed in WMM base pavement sections.

Chapter 5. Stage-II Evaluation: Field and Laboratory Investigations

5.1. Introduction

Pavement investigations play a significant role in the assessment of pavement condition. The preliminary objective of these investigations is to identify the distressed status, strength, physical and mechanical properties of the pavement layers.

Pavement investigations were categorized as follows,

- Field investigations
- Laboratory investigations

5.2. Field investigations

Field investigations were very significant for assessment of the in-situ pavement strength characteristics as well as the material properties of the pavement layers. Following were the tests performed on selected WBM and WMM pavements sections.

- Test pit
- In-Situ density assessment
- Core extraction for bituminous layers
- Benkelman Beam Deflection test
- Light Weight Deflectometer test

5.2.1. Test pit

Test pits were taken to ascertain the pavement composition. A test pit was dug along each homogeneous road section and was immediately filled and compacted up after the necessary testing had been completed. The test performing photographs of WMM and WBM base pavement sections is shown in Figure 5-1 and Figure 5-2.

For each test pit, the following information was recorded:

- Test pit reference (Identification number, Chainage)
- Pavement composition (material type and thickness)

The crust thickness measured at various chainage of each WMM and WBM base pavement sections is shown in Figure 5-3 to Figure 5-5. Two distinct types of Granular subbase material were diagnosed on the pavement sections, 1) Stone aggregates of different composition and (2) Soil –aggregate morrum. These materials were difficult to identify during field investigations because, as it may be replicate WBM/WMM layer or modified subgrade soil. Therefore, GSB layer thickness and WMM/WBM layer is considered as Granular layer.

The detailed data sheets of the test pit were provided in the Appendix-II.

Plate-1: TS-49

Plate-1: TS-49

Plate-3: TS-51

Plate-4: TS-51

Plate-5: TS-50

Plate-6: TS-50

Figure 5-1: Test pit at WBM pavement sections

Plate-1: TS-42

Plate-2: TS-42

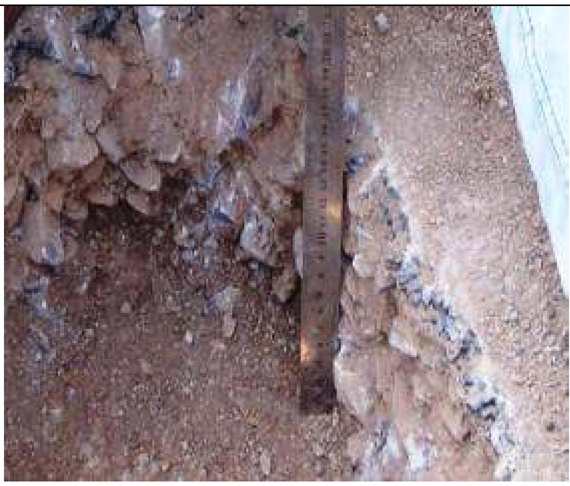


Plate-3: TS-28

Plate-4: TS-28

Figure 5-2: Test pit at WMM pavement sections

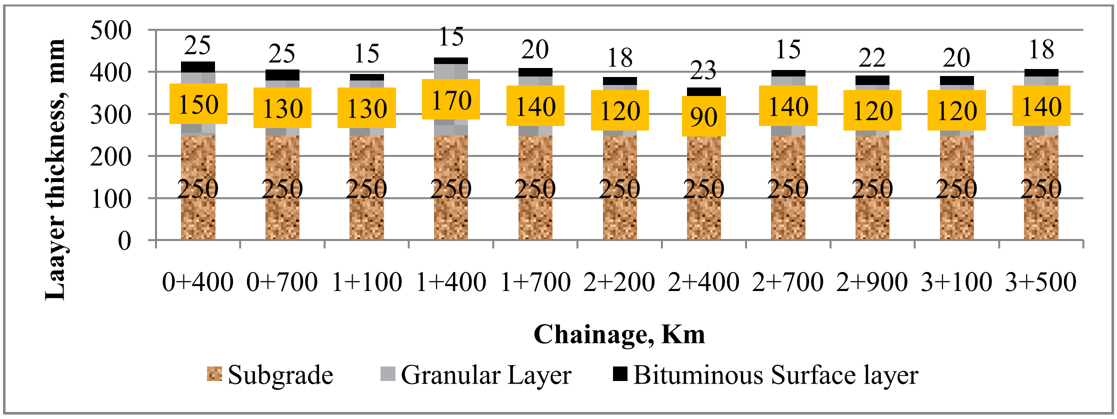


Figure 5-3: Crust thickness at various chainage of WMM pavement section (TS-29)

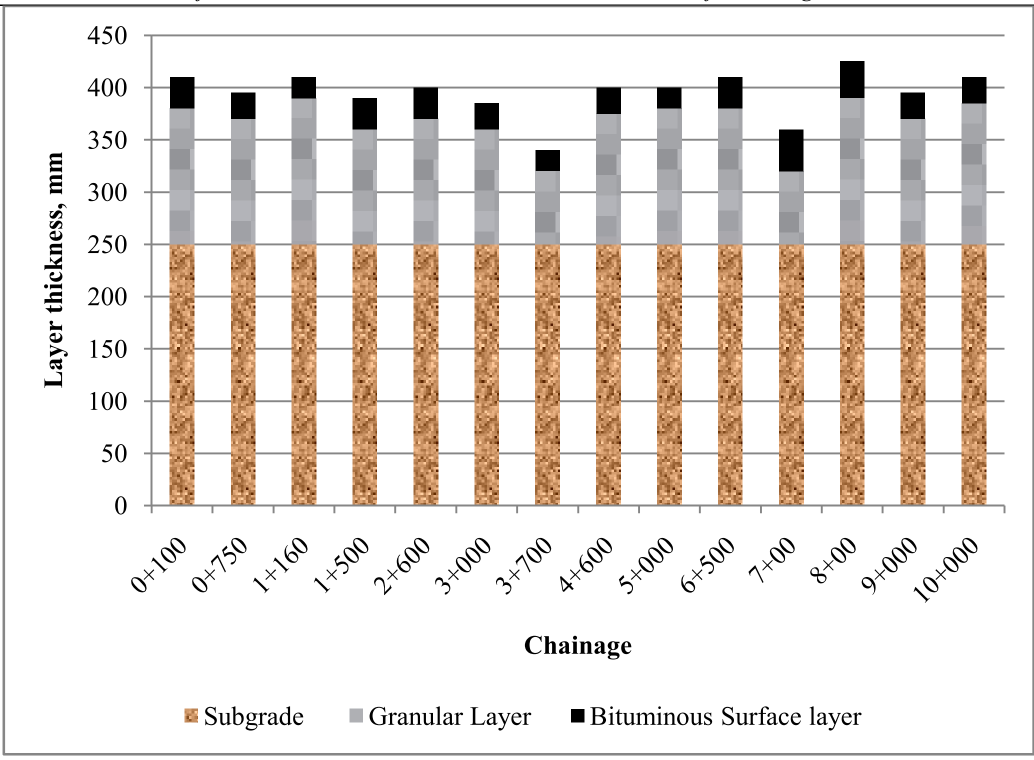


Figure 5-4: Crust thickness at various chainage of typical WBM pavement section (TS-50)

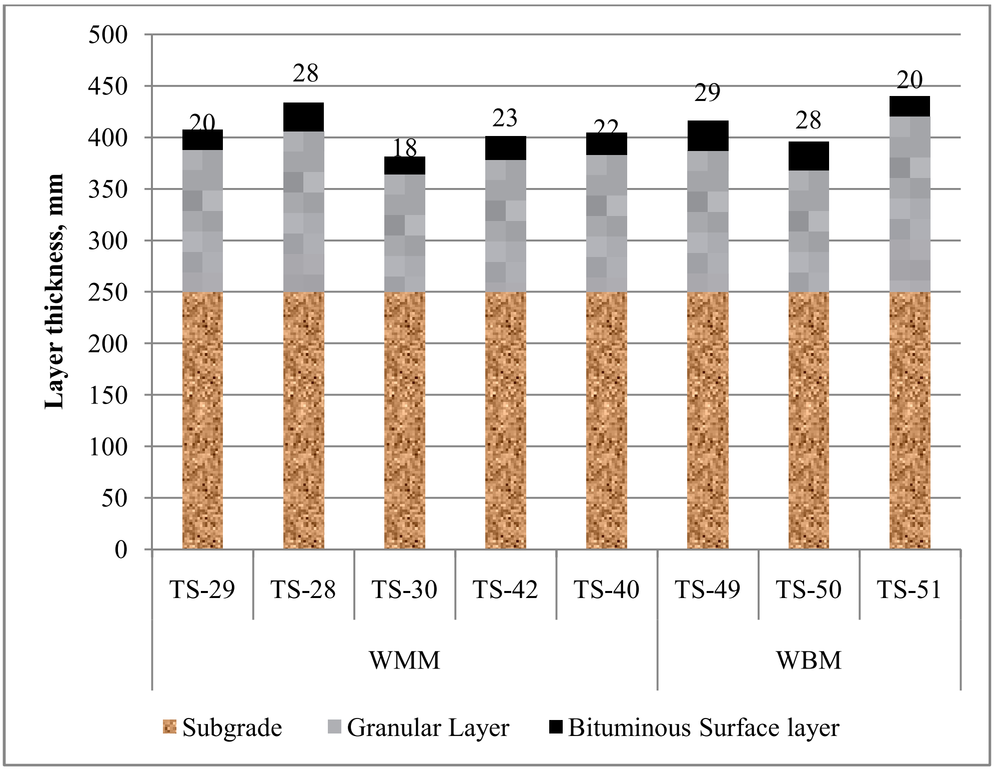


Figure 5-5: Average Crust thickness at WMM and WBM pavement sections

5.2.2. In-Situ Density Assessment

Assessment of in-situ density of subgrade, and Granular layer is a common measure of compaction achieved in the field. For the assessment of field density sand replacement method was preferred and test was carried out at various subsections of selected each WBM and WMM base pavement sections. The photographs of the test performed at WBM and WMM base pavement sections were shown in Figure 5-6 and Figure 5-7. The in-situ density measured at various chainage of each WMM and WBM base pavement sections for subgrade and granular layer is shown in Figure 5-9 to Figure 5-11. The detailed data sheets of the test pit were provided in the Appendix-II.

	
Plate-1: TS-49	Plate-1: TS-49
	
Plate-3: TS-50	Plate-4: TS-50

Plate-5: TS-51

Figure 5-6: Photographs of In-situ density measurement at WBM pavement sections

Plate-1: TS-42

Plate-2: TS-42

Plate-3: TS-28

Plate-4: TS-28

Figure 5-7: Photographs of In-situ density measurement at WMM pavement sections

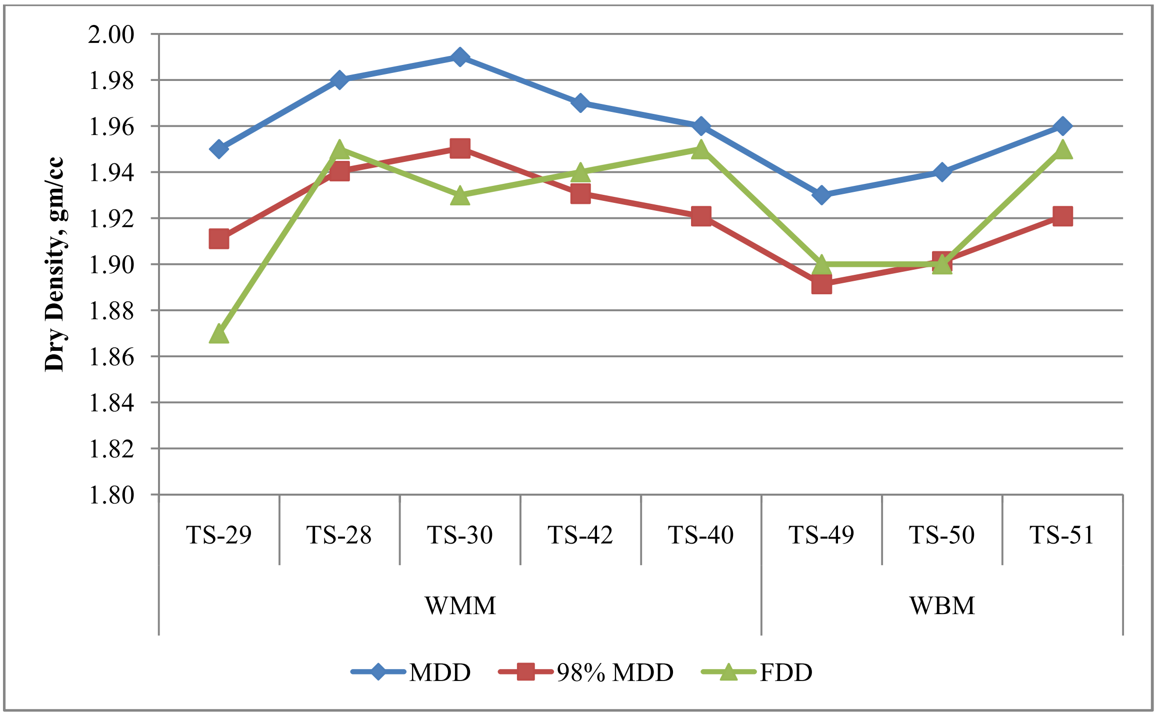


Figure 5-8: Average In-situ density at each WMM and WBM pavement section (Subgrade)

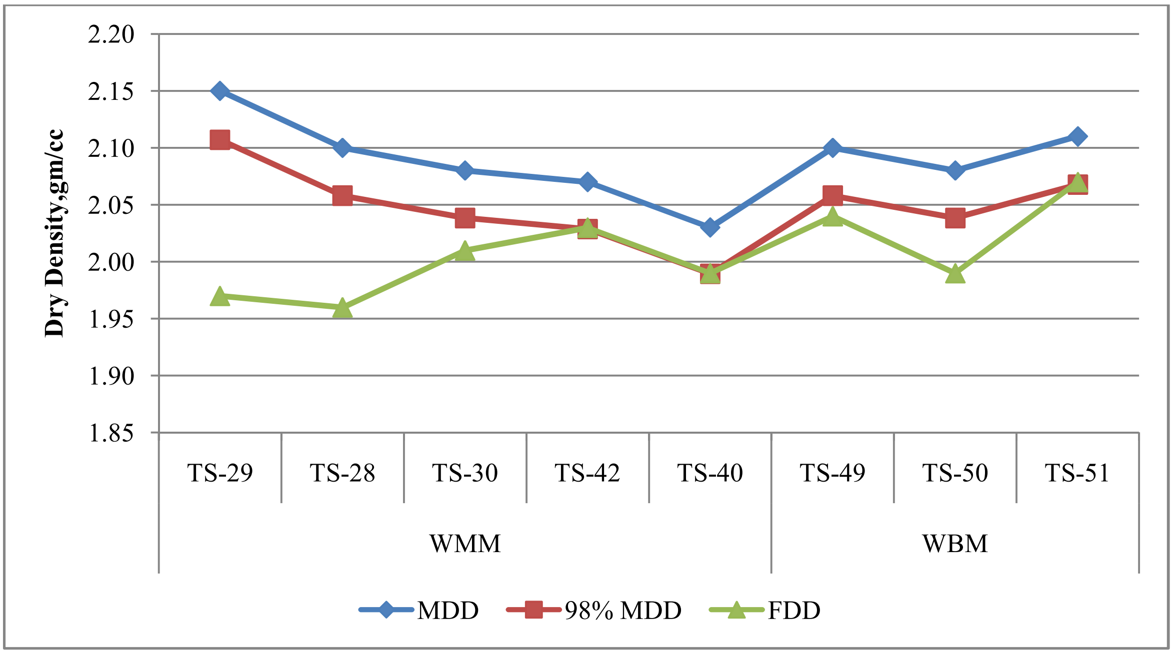


Figure 5-9: Average In-situ density at each WMM and WBM pavement section (Granular layer)

5.2.3. Roughness survey (MERLIN)

Roughness is characterized as the longitudinal unevenness of road surface. It is a great factor which measures road condition vehicle operating cost and ride quality. Roughness index was carried out as per Indian Road congress code and it has been observed that the overall roughness parameter in terms of (IRI) is adapted to the road usage according to the guidelines given in IRC SP: 16-2004.

The maximum permissible value of roughness (mm /Km) for road surface as per IRC SP:16- 2004 Table 3 given below.

S.No	Type of Surface	Condition of Road Surface		
		Good	Average	Poor
1	Surface Dressing	< 3500	3500-4500	>4500
2	Open graded premix carpet	< 3000	3000- 4000	>4000
3	Mix seal surfacing	< 3000	3000-4000	>4000
4	Semi- Dense Bituminous concrete	< 2500	2500-3500	>3500
5	Bituminous concrete	< 2000	2000-3000	>3000
6	Cement Concrete	< 2200	2200-3000	>3000

Plate-1: TS-49

Plate-2: TS-28

Plate-3: TS-29	Plate-4: TS-30

Figure 5-10: Photographs of Roughness (MERLIN) survey of the WMM and WBM pavement sections at various chainage

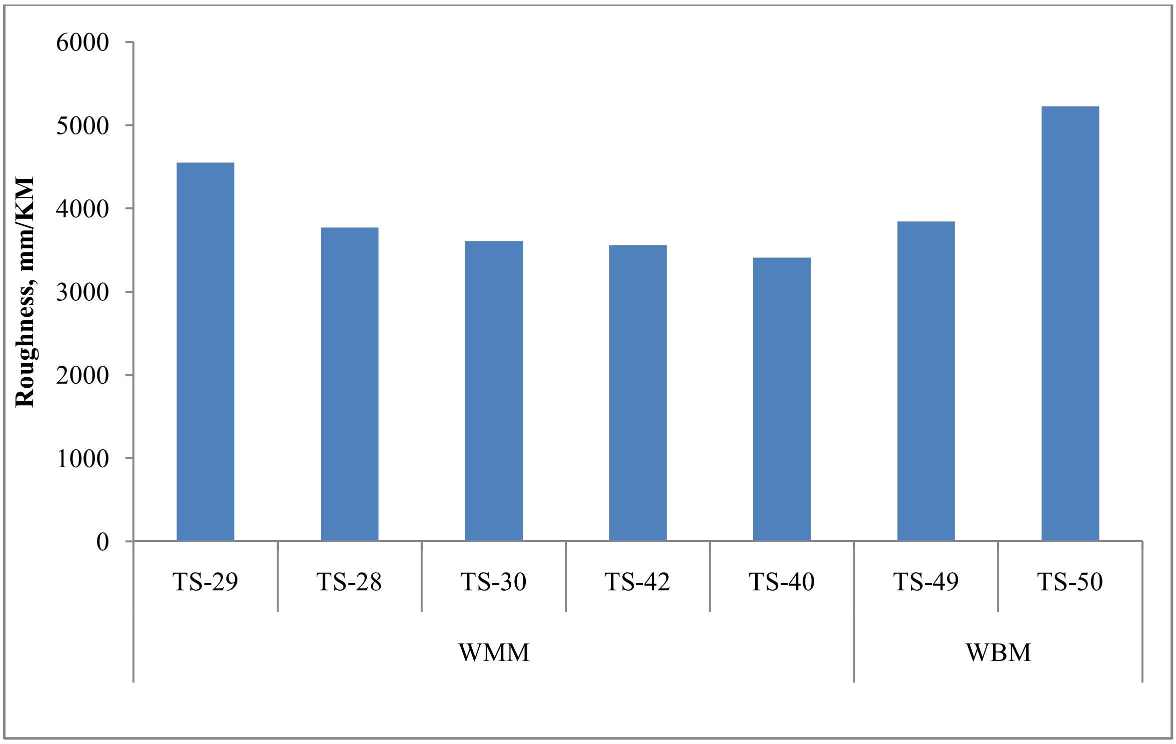


Figure 5-11: Average IRI of each WMM and WBM pavement section

5.2.4. Evaluation of structural condition

The structural condition was assessed by carrying out pavement structural response surveys. The surveys were carried out by measuring the pavement deflections using BBD (static) and LWD (dynamic) deflectometer.

The deflection data obtained from the static and dynamic deflectometer was used to evaluate the strength parameters of the pavement and to provide likely design strategies for the existing pavement. Following were the surveys carried out,

- Benkelman Beam Deflection (BBD) Survey
- Light Weight Deflectometer (LWD) Survey

5.2.4.1. BBD Survey

Pavement deflection survey for the entire stretch of project road was carried out using the static BBD technique in accordance with the requirements stipulated in IRC: 81-1997, to evaluate the evaluation of strengthening requirements of the pavement. BBD test was carried out in the month of September 2012 as per the IRC standards (IRC: 81-1997).

The CGRA static load test procedure was adopted for the measurement of pavement deflections. In this method a standard truck having a rear axle weighing 8160 kg fitted with dual tyres inflated to a pressure of 5.6 kg/sq.cm was used for loading the pavement. During the tests the total load and the tyre pressure was maintained within the stipulated tolerances. Based on the in-situ pavement deflection data obtained from the BBD test, characteristic deflection was estimated as per IRC: 81-1997 and the variation of characteristic deflection for a typical WBM and WMM base pavement section is shown in Figure 5-13 to Figure 5-14. The photographs of the test performed are shown in Figure 5-12. The detailed BBD test data for the project road stretch were provided in the Appendix-II.

Figure 5-12: Photographs of BBD survey of the WMM and WBM pavement sections at various chainage

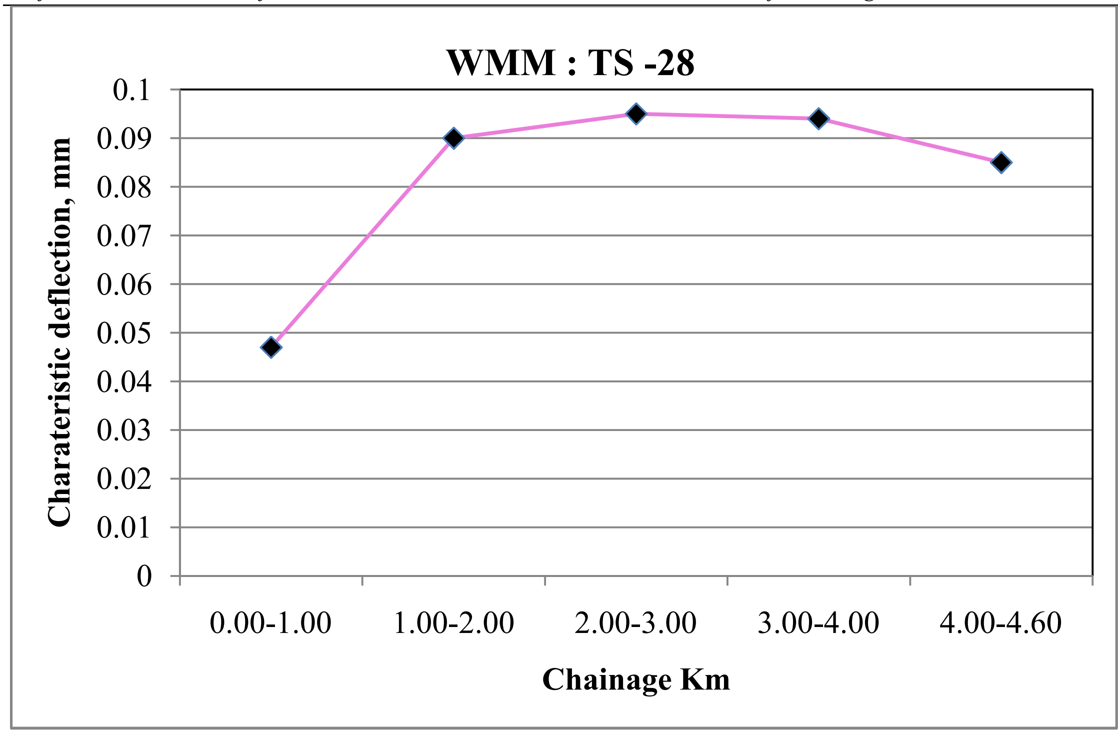


Figure 5-13: Deflections at various chainage of typical WMM pavement section (TS-30)

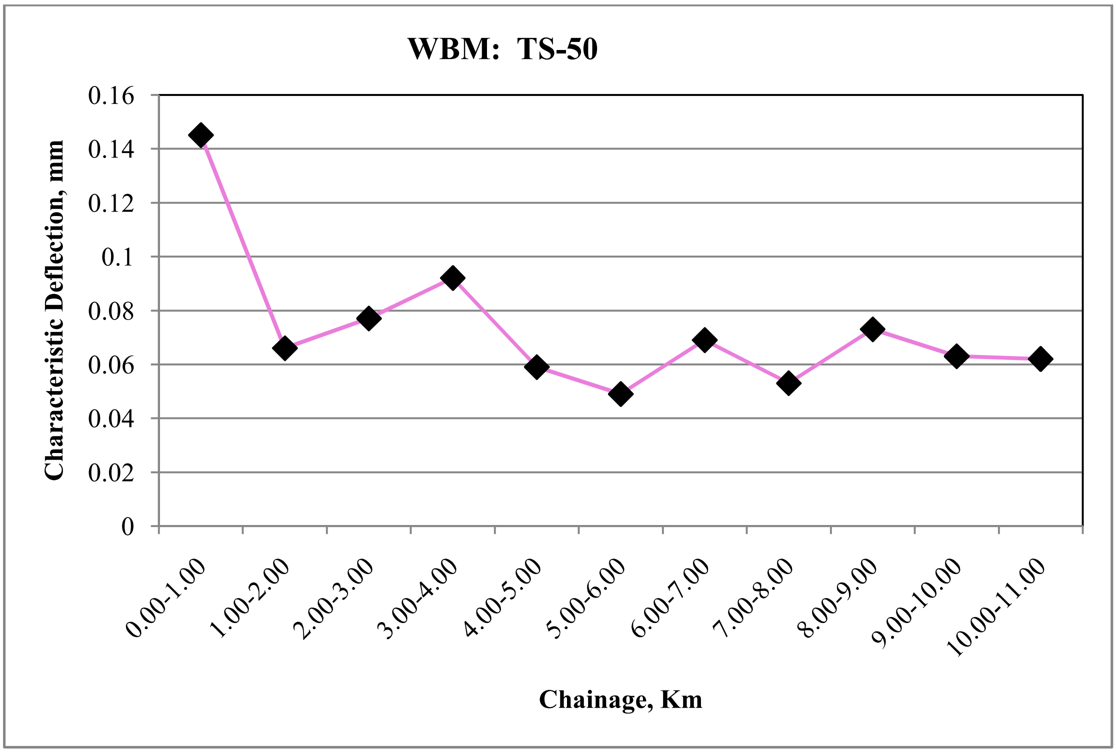


Figure 5-14: Deflections at various chainage of typical WBM pavement section (TS-50)

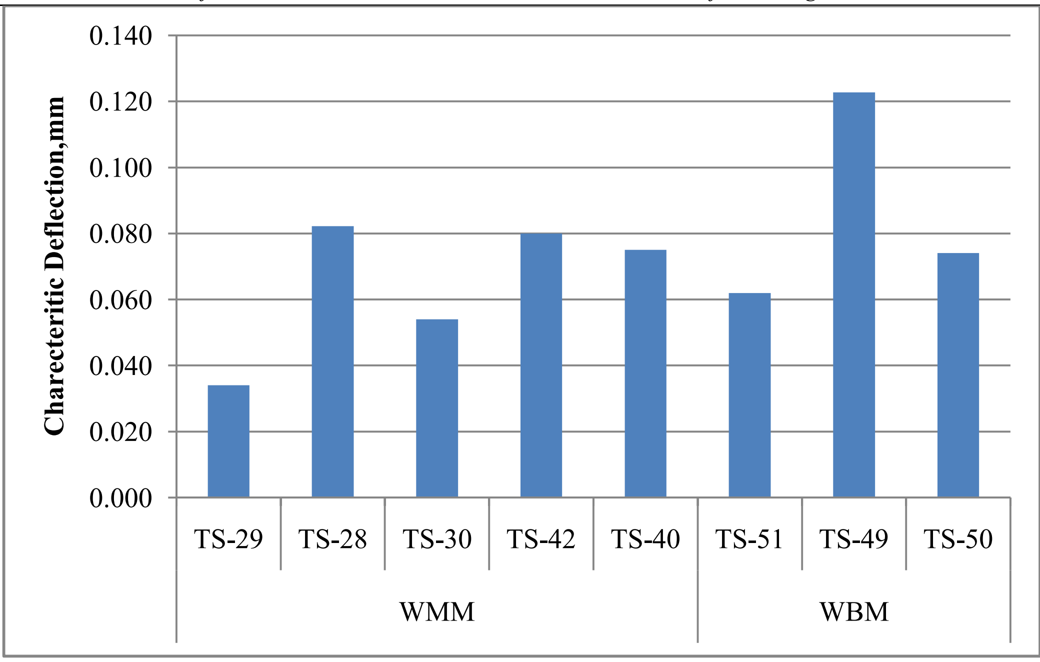


Figure 5-15: Average deflection of each WMM and WBM pavement sections

5.2.4.2. LWD survey

Dynatest 3031 LWD test was performed on selected pavement test locations by generating impulse load using 20 kg drop mass, from a maximum drop height on top of circular plate having a 300 mm plate diameter as ASTM protocols (ASTM, 2007). The drop of 20 kg induced an impulse load of 13.2-16.5 kN was observed on the pavement surface. The drop mass of weight of 15 kg was used in this study. Various researchers carried out extensive studies on identifying the inherent factors influencing the LWD measurements, these factors were categorized in two distinct ways, such as: (a) LWD equipment characteristics such as drop height, plate size, radial sensor spacing and drop weight (Benedetto et al., 2012; Stamp and Mooney, 2013), (b) soil index and volumetric properties susceptible to environmental conditions (Tehrani and Meehan, 2010). Thus, the maximum drop height, drop mass and plate diameter induced an average stress range of 185-235 kPa on the pavement surface. This average contact stress range simulated the stress level when induced due to the standard vehicular loading (Fleming, 2001). As the LWD load influence depth was governed by two important cases, (a) for plate diameter, depth of influence was approximately 1.5 times the plate diameter (Nazzal et al., 2007), (b) influence depth of LWD with radial geophones was 1.8 times of plate diameter whereas, depth of influence of LWD without geophones was 1.0-1.5 times of plate diameter (Senseney and Mooney, 2010). Thus the selected plate diameter and LWD with radial geophones in this study affirms appropriate load influence depth for the pavement stretch to estimate backcalculated layer moduli in a multilayer system.

The responses were collected using three transducers, including center and offset velocity transducer geophones fixed at distances of 0, 300, and 600 mm and were mounted to the load plate which was also isolated from direct impact force. The 300 or 600 geophone configuration captured deflections and produced most reliable layer moduli backcalculation results (Senseney and Mooney, 2010). The frequency ranges of geophones used were 0.2-300 Hz with a resolution of 1 µm (Pavana and David, 2009). Deflections obtained from all transducers were recorded and compared using personal data assistant (PDA). In this study, the mean load impulse time history was varying from 17 to 25 ms. However, the only center transducer was selected for the analysis of measured deflections as center transducer generates maximum deflection beneath the load. In this study, LWD test was performed at top of the bituminous layer to estimate layer moduli of Subgrade, Granular subase layer and WMM layer with surface layer by adopting backcalculated techniques. LWD test was repeated at each test location by dropping six multiple drops (deflections) of which three drops were considered as seating drops and remaining were used for backcalculating pavement layer moduli for all the selected WBM and WMM base pavement sections. Figure. 5-16 shows the LWD setup along with transducers employed in this study. Figure 5-17 to Figure 5-19 depicts LWD deflections and Layer wise moduli for each WBM and WMM base pavement section. The detailed BBD test data for the project road stretch were provided in the Appendix-II.

Figure 5-16: Light weight Deflectometer test at pavement sections

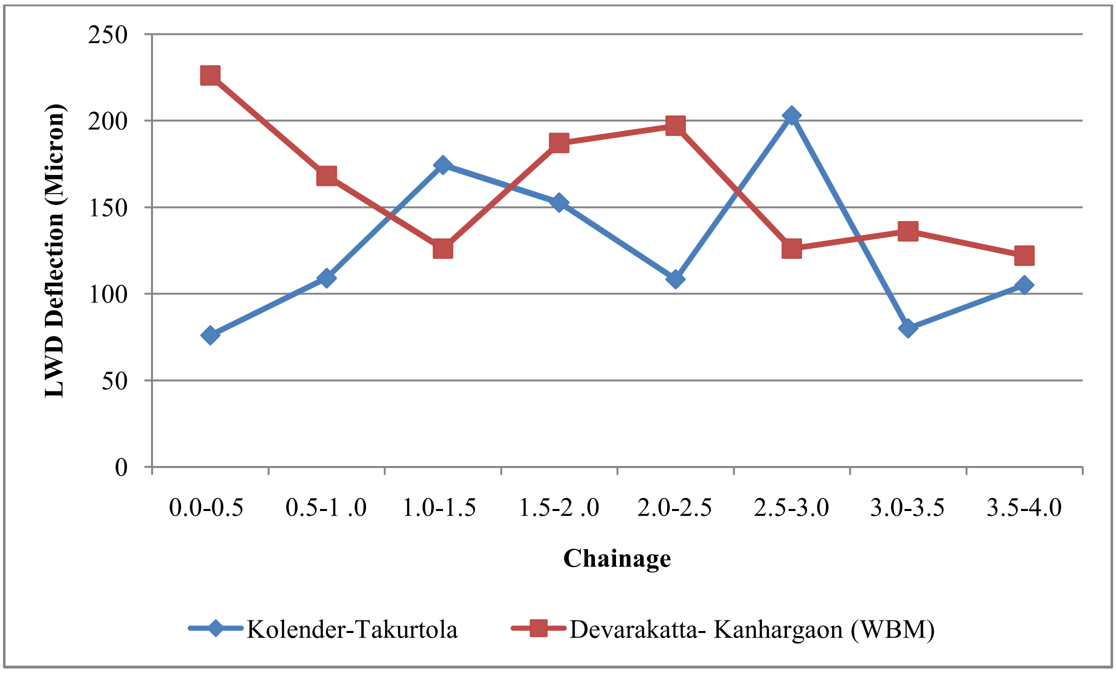


Figure 5-17: LWD deflections on typical WBM and WMM pavement sections

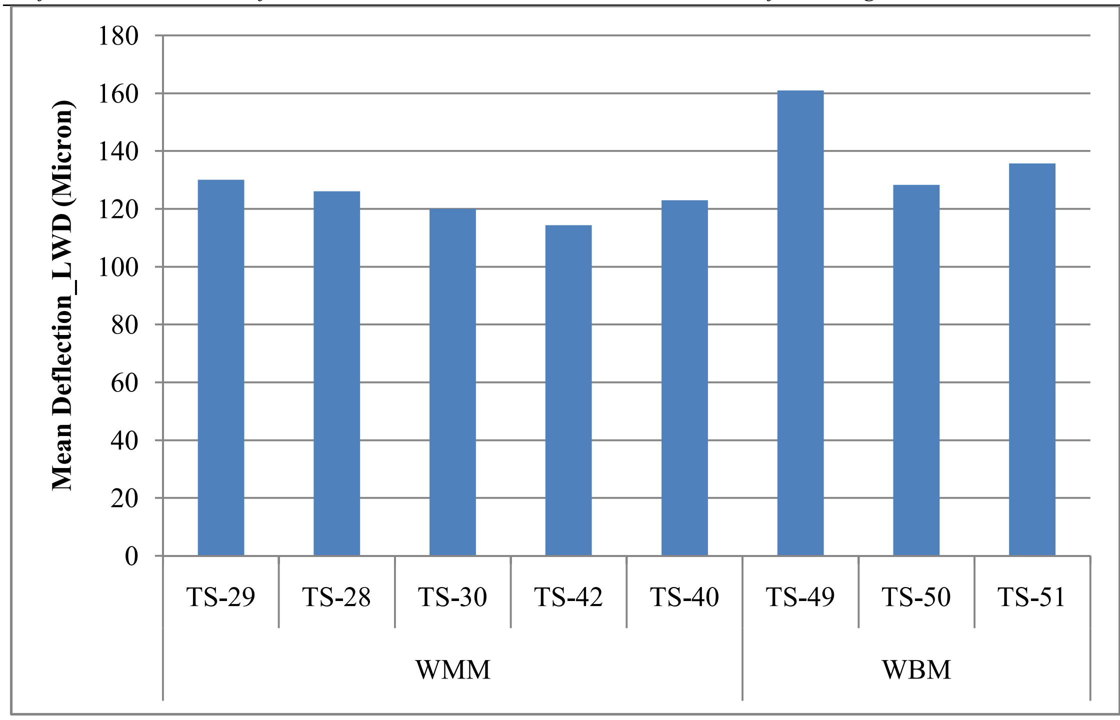


Figure 5-18: Mean LWD deflections on each WBM and WMM pavement sections

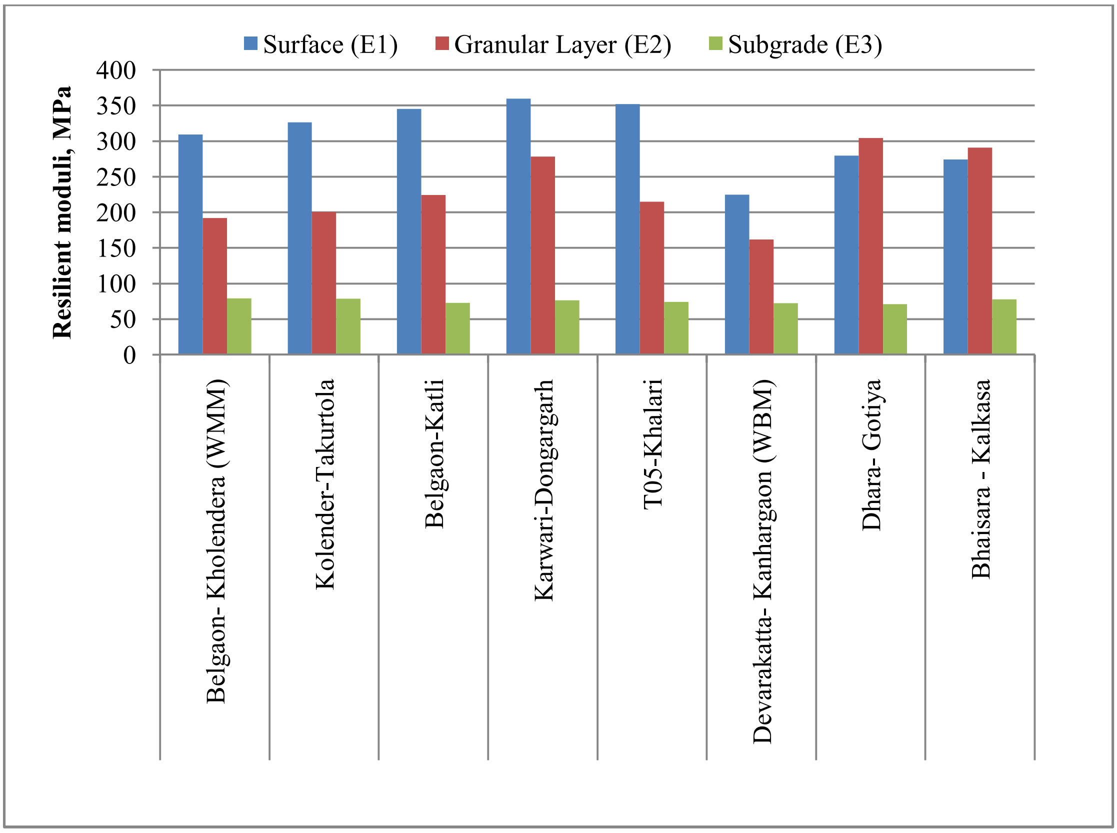


Figure 5-19: Mean LWD layer moduli on each WBM and WMM pavement section

5.2.5. Key observations

Based on the various detailed field investigations following key observations are identified on WBM and WMM base pavement sections.

1. WBM and WMM base pavement sections the thickness of granular layer and thin bituminous surface layers have been found to be inadequate at few subsections.
2. At few subsections of WBM and WMM base pavement sections the in-situ density values of subgrade and granular layers have been found to be less as compared to the 98% of laboratory density.
3. The mean roughness values of WMM base pavement sections TS-28, TS-30 and TS-42 shown average condition and TS-29 has shown poor condition. Whereas, for WBM pavement sections TS-50 and TS-51 had shown poor condition and TS-49 has shown average (closer to poor) condition. Therefore, comparing roughness values of both WMM and WBM base pavement sections, WMM base pavement sections has shown better performance with better riding comfort condition.
4. The mean BBD deflections of WBM base pavement sections varies from 0.062 to 0.123 mm. Whereas, for WMM base pavement sections the mean BBD deflections varies from 0.034 mm to 0.082 mm.
5. The mean LWD deflections of WBM base pavement sections varies from 128 to 161 microns. Whereas, for WMM base pavement sections the mean BBD deflections varies from 114 to 138 microns. The range of deflections on WBM base pavement sections have been observed higher than the WMM base pavement sections.
6. The mean LWD estimated WMM + surface layer moduli varies from 309 MPa to 360 MPa, Granular subbase layer varies from 192 MPa to 278 MPa and Subgrade layer moduli varies from 73 MPa to 79 MPa. Whereas for WBM base pavement sections, the mean LWD estimated WBM + surface layer moduli varies from 225 MPa to 280 MPa, Granular subbase layer varies from 162 MPa to 304 MPa and Subgrade layer moduli varies from 71 MPa to 78 MPa.

5.2.6. Laboratory Investigations

Laboratory investigations plays a significant role in performance evaluation of the in service pavement sections. The in situ distress diagnosed from the field investigations can be validated from the physical, volumetric and strength properties of each layer of the selected WBM and WMM base pavement sections.

Laboratory investigations were performed in the laboratory with samples collected from the test pits at various subsections of each WBM and WMM base pavement sections. Following layer-wise laboratory tests were performed to identify the physical, volumetric and strength properties.

Table 5-1: Laboratory tests

Sl. No.	Name of the test	Type of the test	Property	IS/IRC/ ASTM standard
Laboratory Investigations				
1	**Subgrade**			
a	Modified Proctor Test	Laboratory	Dry density	IS 2720 (Part – 8) 1983
b	Soaked CBR at MDD	Laboratory	Bearing capacity	IS 2720 (Part – 16) 1983
2	**Granular subbase/Base layers**			
a	Sieve Analysis	Laboratory	Grading Requirements	IS 2386 (Part – I) 1963
b	Modified Proctor Test	Laboratory	Dry density	IS 2386 (Part – III) 1963
c	10% Fines value	Laboratory	Strength	IS 2386 (Part – IV) 1963
d	Aggregate Impact value	Laboratory	Toughness	IS 2386 (Part – IV) 1963
3	**Bituminous layer**			
a	Binder Content	Laboratory	Bitumen content	IRC: SP 11 –1988, IS 13826 (Part 7)
b	Sieve Analysis	Laboratory	Grading Requirements	IS 2386 (Part – 1) 1963
c	Aggregate Impact value	Laboratory	Toughness	IS 2386 (Part – IV) or IS:5640

Sl. No.	Name of the test	Type of the test	Property	IS/IRC/ ASTM standard
d	Bitumen adhesion stripping value of aggregates	Laboratory	stripping value	IS 6241- 1971

5.2.6.1. Subgrade

Volumetric properties such as Maximum Dry Density (MDD), and strength property of the subgrade such as California Bearing Ratio (CBR) tests were performed for the samples collected from the test pits dug at the regular intervals of the subsections of each WBM and WMM base pavement sections. The mean density and CBR values of each WBM and WMM base pavement section is shown in Figure 5-20 and Figure 5-21.

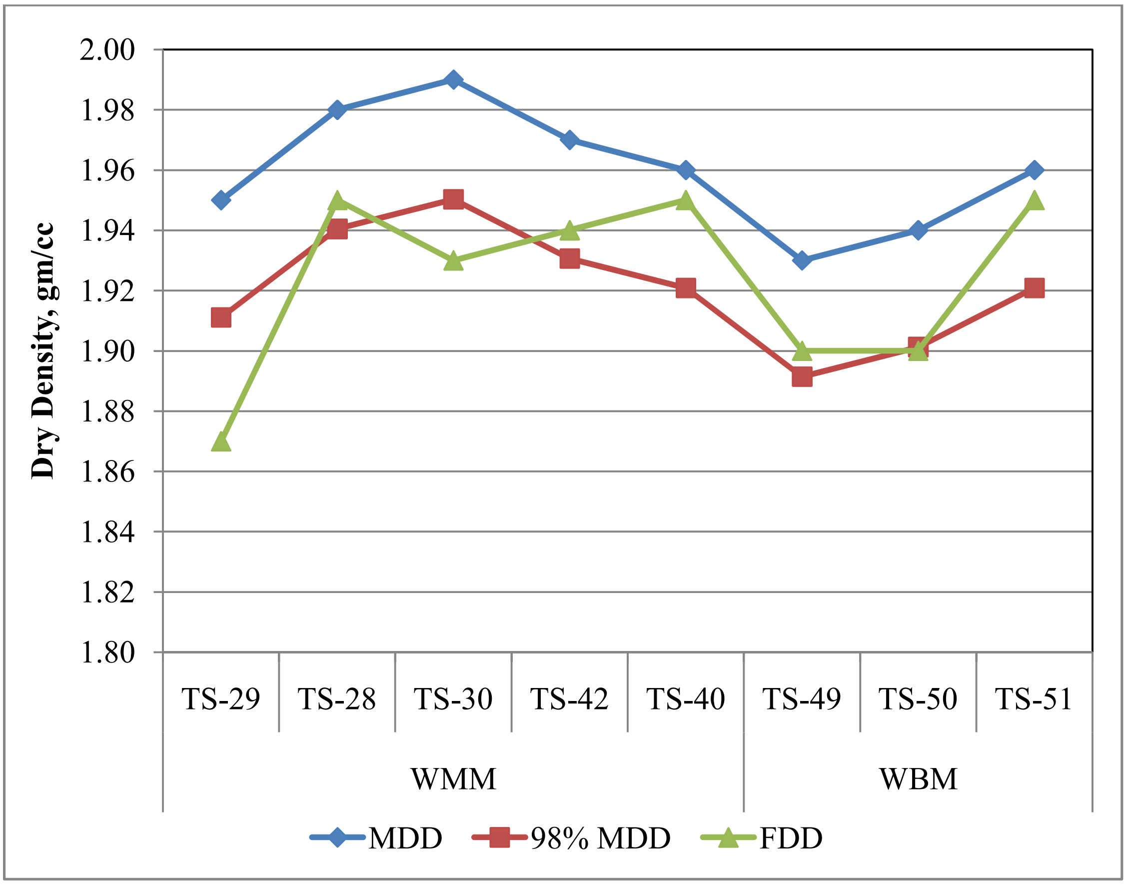


Figure 5-20: Average FDD and MDD for Subgrade layer of WMM and WBM pavement sections

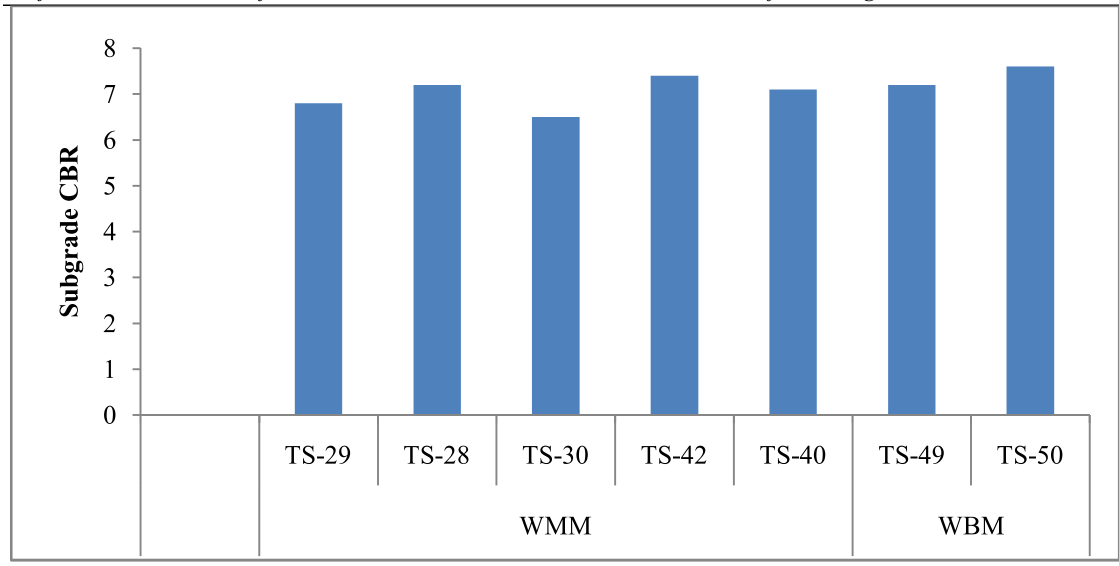


Figure 5-21: Average CBR for Subgrade layer of each WMM and WBM pavement section

5.2.6.2. Granular layer investigations

Physical, Volumetric and strength properties of Granular layers as shown in Table 5-1 were performed for the samples collected from the test pits dug at the regular intervals of the subsections of each WBM and WMM base pavement sections. The mean values of physical, volumetric and strength properties of each WBM and WMM base pavement section is shown in Figure 5-22 to Figure 5-27.

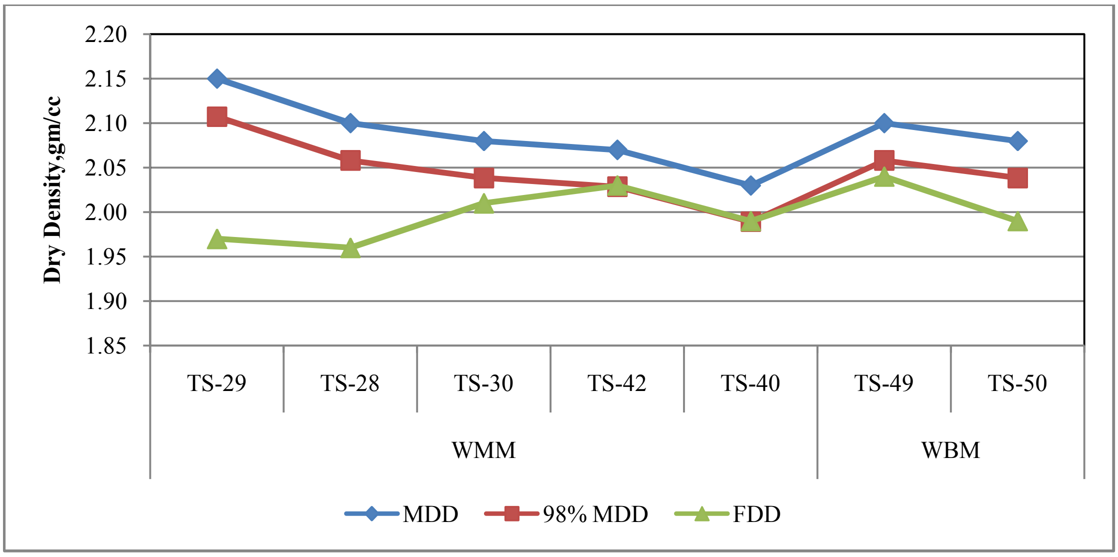


Figure 5-22: Average FDD and MDD for Granular layer of WMM and WBM base pavement sections

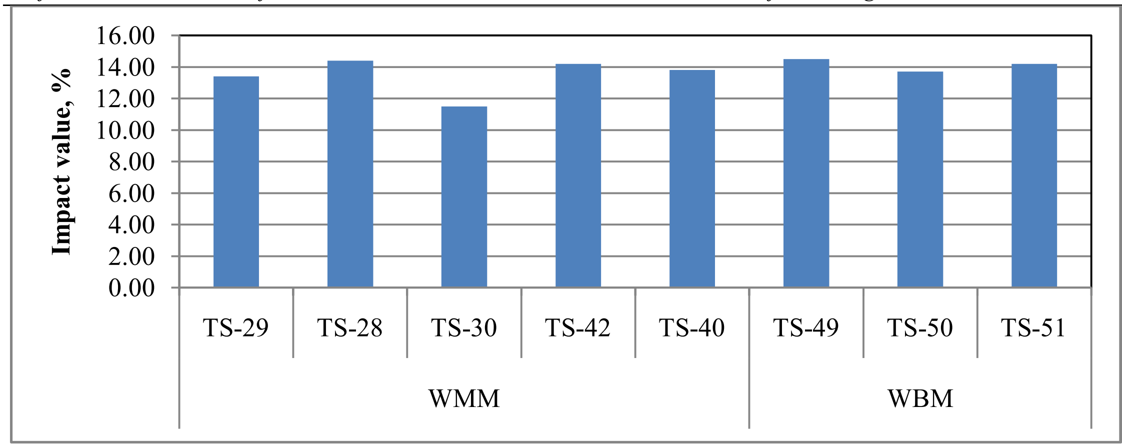


Figure 5-23: Average Impact value for Granular layer of WMM and WBM base pavement sections

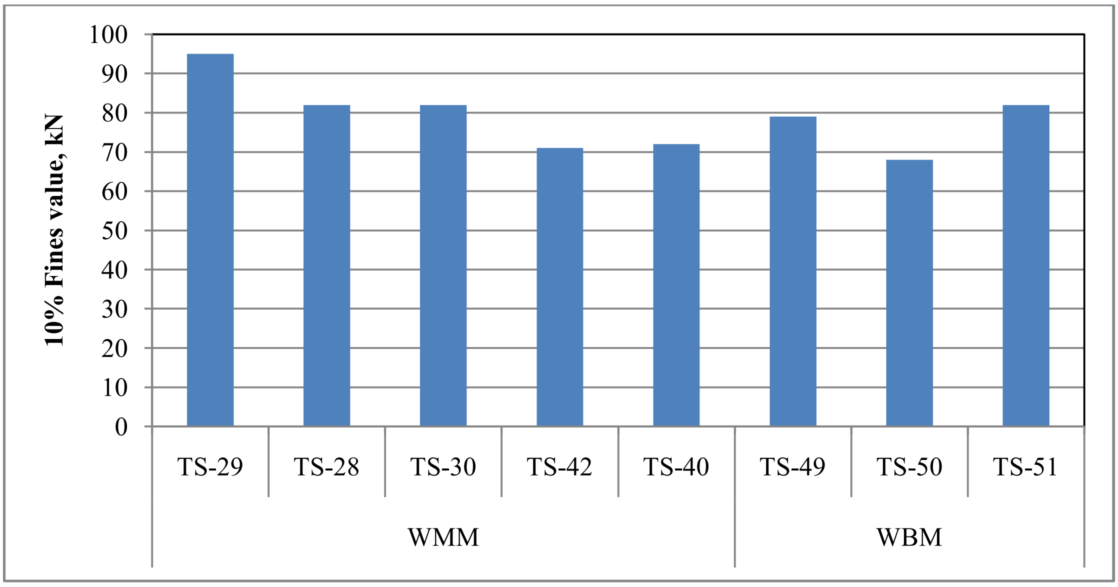


Figure 5-24: Average 10% Fines values for Granular layer of WMM and WBM base pavement sections

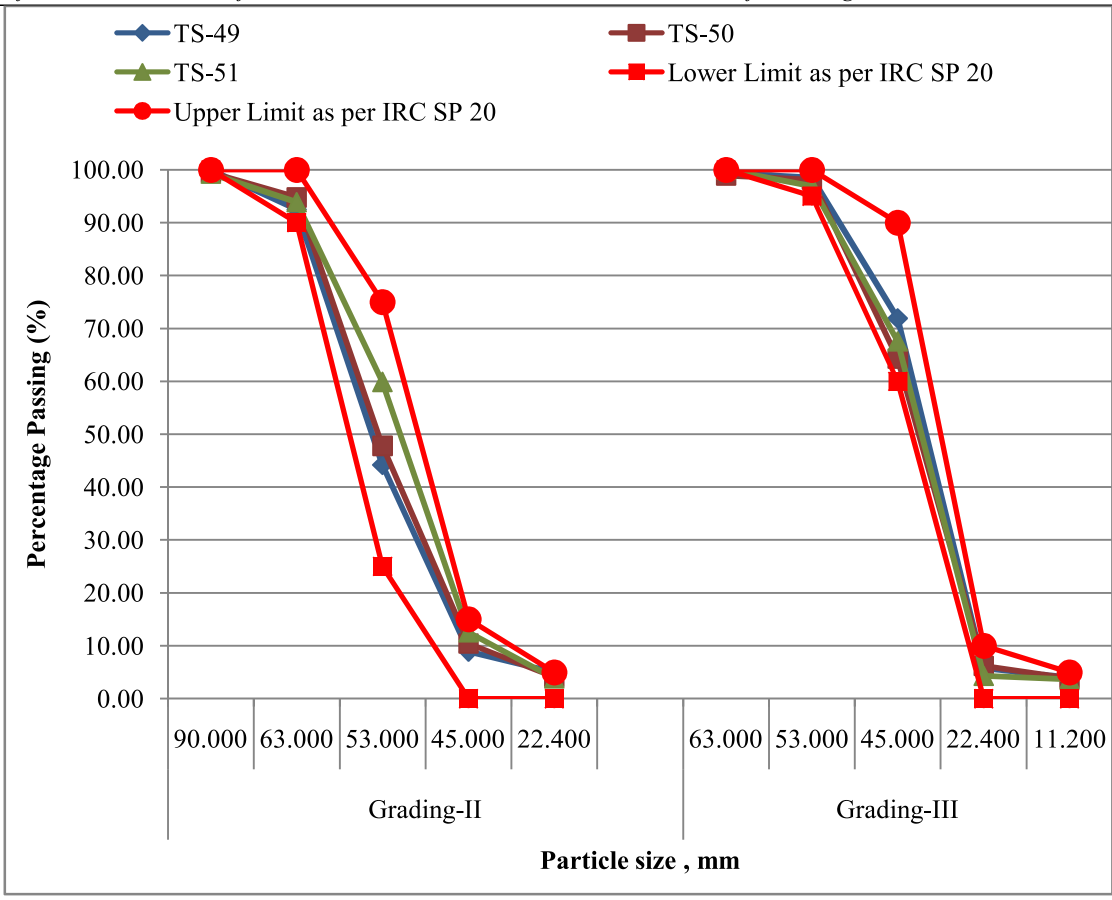


Figure 5-25: Mean gradation of coarse aggregates of granular of WBM pavement sections

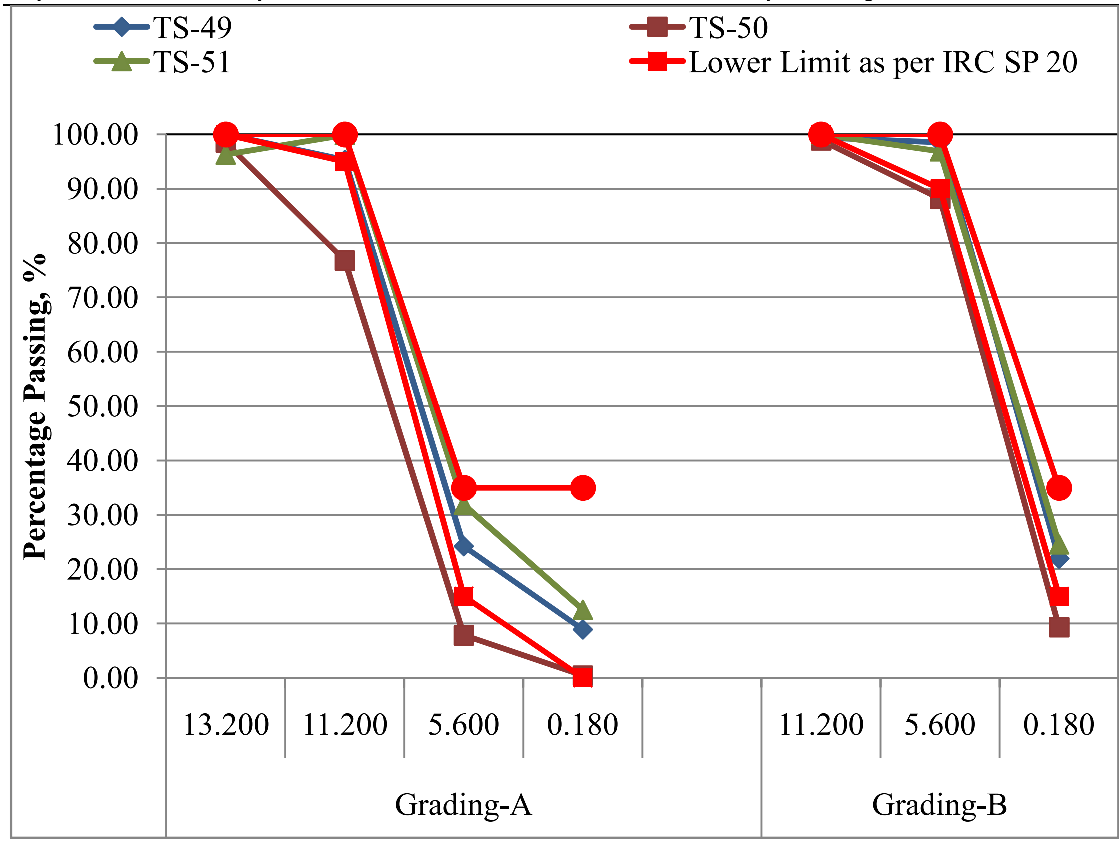


Figure 5-26: Mean gradation of screenings of granular layer of WBM pavement sections

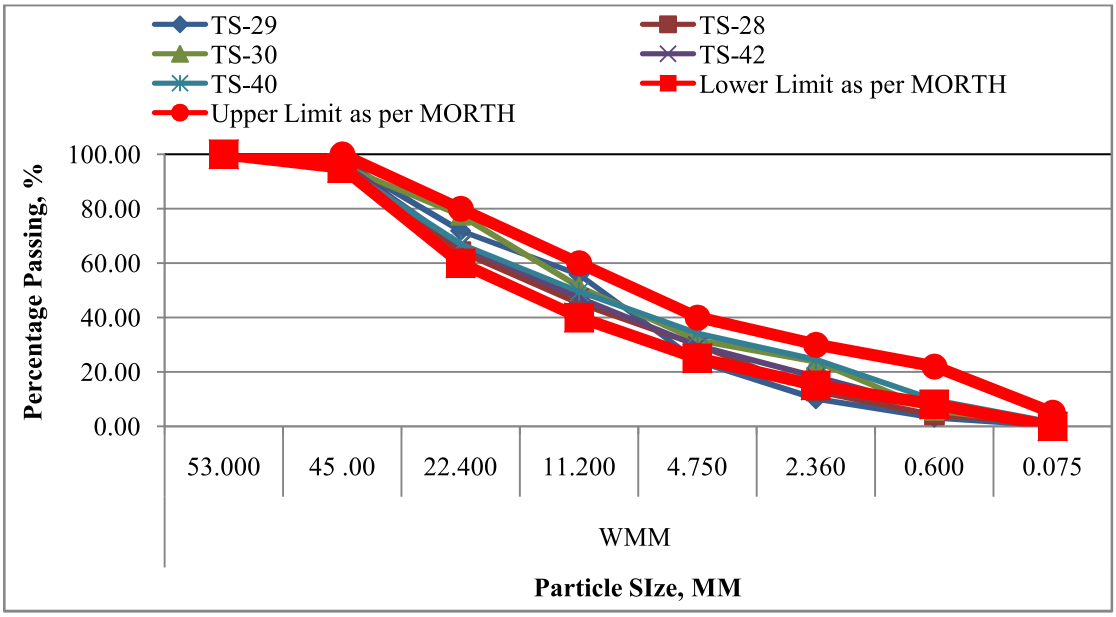


Figure 5-27: Mean gradation of screenings of granular layer of WBM pavement sections

5.2.6.3. Bituminous layer

Strength properties of Bituminous layer aggregates as shown in Table 5-1 were performed for the samples collected from the test pits dug at the regular intervals of the subsections of each WBM and WMM base pavement sections. The mean values of physical, strength properties along with binder content of each WBM and WMM base pavement sections is shown in Figure 5-28 to Figure 5-29.

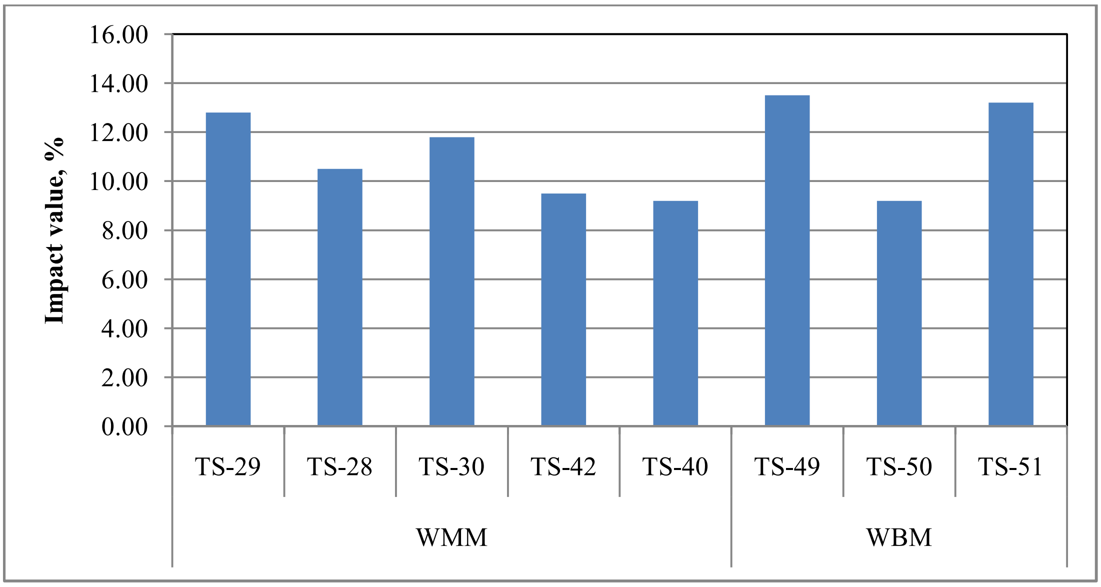


Figure 5-28: Average Impact value for Bituminous layer of WMM and WBM base pavement sections

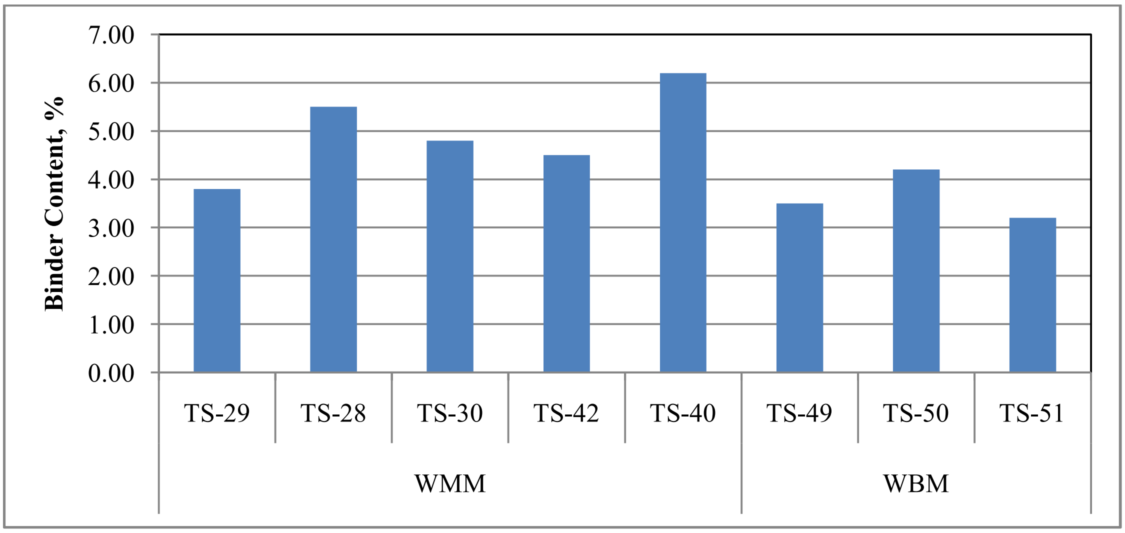


Figure 5-29: Binder Content for Bituminous layer of WMM and WBM base pavement sections

5.2.7. Key observations

Based on the laboratory investigations, the significant material properties of each layer of WBM and WMM base pavement sections were measured in the laboratory. Some of the key observations have been summarized and compared.

- The mean subgrade MDD of WBM pavement sections varies from 1.93 gm/cc to 1.96 gm/cc. Whereas, the mean MDD of WMM pavement sections varies from 1.95 gm/cc to 1.99 gm/cc.
- The Mean CBR value of subgrade of WBM pavement sections varies from 7.2% to 7.9%. Whereas, the mean CBR of WMM pavement sections varies from 6.5% to 7.4%.
- The mean MDD of granular layer of WBM pavement sections varies from 2.08 gm/cc to 2.11 gm/cc. Whereas, the mean MDD of WMM pavement sections varies from 2.03 gm/cc to 2.15 gm/cc.
- The mean impact value of granular layer of WBM pavement sections varies from 13.7 % to 14.50%. Whereas, the mean MDD of WMM pavement sections varies from 11.50% to 14.40%.
- The mean impact value of bituminous layer of WBM pavement sections varies from 9.20 % to 13.50%. Whereas, the mean MDD of WMM pavement sections varies from 9.20% to 12.80%.
- The Binder content of OGPC layer on various pavement sections was measured and is varying between 3.2% to 6.2%.

Chapter 6. Results and Discussions

This chapter is primarily focusing on aggregating and interpreting the results obtained from the stage-I and stage-II investigations. The chapter also focuses on summarizing the key discussions based on the results and investigations.

6.1. Stage-I evaluation: PCI Analysis

Most of WBM and WMM base pavement sections depicts fair to good condition from PCI analysis. However, few subsections of WBM and WMM pavement sections have been diagnosed with high severity structural failures. Further, these structural failures have been validated from detailed laboratory investigations that described inadequate material properties in terms of density and gradation of granular and subgrade layers.

Similarly, majority subsections of WBM base pavement sections have been diagnosed with high severity weathering that resulted in the WBM mix aggregates expose to the surface. This alters the functional requirements of pavement in terms of roughness. However, this behavior has not been diagnosed in WMM base pavement sections. It is known that WMM being a close graded granular mix and is more sensitive towards volumetric and physical properties of aggregates. The strength characteristics of WMM mix have been better as compared with WBM mix. Quality control parameters in terms of density/compaction requirements, gradation, Construction technique (Manual/Paver) and movement of traffic on WMM layer during construction are the significant prerequisites for the durability of the pavement. Therefore, WMM granular layer provides adequate support to the thin surface bituminous layers subjective to the accomplishing the necessary quality control requirements as stated earlier.

6.2.Stage-II evaluation: Field Investigations

1. Observed variations in thicknesses of granular and bituminous layer, based on the test pit measurements at various subsections of each WBM and WMM base pavement sections, have validated the premature structural distresses on WMM and WBM base pavement sections. Variations in layer thicknesses along a specific pavement section directly govern the structural integrity of the pavement section irrespective of type of base layer.

2. In-situ density assessment is the significant quality control parameter that primarily governs stiffness characteristics of each layer. The observed variations from laboratory density at few subsections of each WBM and WMM pavement sections have validated the chronic distresses diagnosed during pavement condition survey. Inadequate density of each layer is the potential cause of various premature distresses. Therefore, Inadequate in-situ density, variations in layer thicknesses, Inadequate material properties compounded to premature failures irrespective of type of base layer.

6.3.Stage-II evaluation: Functional and Structural evaluation

1. Roughness is significant serviceability indicator of functional performance of in service pavements. The roughness values measured for each WBM and WMM pavement sections demonstrated that WMM base pavement section gives better riding quality as compared with the WBM base pavement sections.
2. Structural evaluation using BBD technique on WBM and WMM base pavement sections assess the structural integrity of pavement section in terms deflections. The Deflections observed on WBM base pavement sections are higher than the already distressed WMM base pavement sections. The observed deflections on WMM pavement sections may likely to be further minimal if all other material properties are adequate. Therefore, this is due to adequate base support on thin surface bituminous pavement sections. Hence, WMM base layer is suitable for thin surface bituminous pavements subjective to the fulfilling the quality control aspects for materials and construction.
3. Structural evaluation using portable falling weight deflectometer test most commonly termed as Light weight deflectometer (LWD) on WBM and WMM base pavement sections assess the mechanistic empirical based stiffness characteristics in terms of deflections and thereby in situ layer moduli at each subsection of WBM and WMM pavement sections. The observed surface deflections on WBM base pavement sections are higher than existing distressed WMM base pavement sections. Further the stiffness moduli calculated for all the WMM base pavement sections have shown better performance as compared to the stiffness moduli calculated for all the WBM base pavement sections. The

observed deflections on WMM pavement sections may likely to be further minimized if all other material properties are adequate. Therefore, this is due to adequate base support on thin surface bituminous pavement sections. Hence WMM base layer is suitable for thin surface bituminous pavements subjective to the fulfilling the quality control aspects.

Chapter 7. Conclusions and Recommendations

7.1. Conclusions

Efforts have been made to assess the suitability of WMM base layer in thin surface bituminous pavement sections by performing various field and laboratory investigations on selected WBM and WMM base in service pavement sections. Following conclusions have been drawn based on the analysis and interpretation of various investigation results.

1. PCI analysis and laboratory test results have illustrated that WMM base pavement section performs better subjective to the maintaining quality control parameters as compared with WBM base pavement sections. The identified structural distresses have been validated with the material properties measured from the laboratory investigations.
2. Roughness survey results have demonstrated that WMM base pavement sections provided better riding quality as compared to the WBM base pavement sections. Hence, the WMM base pavement section is suitable for thin surface bituminous pavement sections in terms of functional performance.
3. BBD test results have shown that (structural performance in terms of pavement deflections) distressed WMM base pavement sections depicts lesser deflections as compared to WBM base pavement sections.
4. LWD test results have described (structural performance in terms of pavement deflections) distressed WMM base pavement sections undergoes lesser deflections as compared to WBM base pavement sections. Further, the stiffness moduli of each layer of WMM base pavement sections have indicated better performance as compared to WBM base pavement sections. Hence, the WMM base pavement section is suitable for thin surface bituminous pavement sections in terms of functional performance also.

Thus, the functional and structural performance of the WMM base pavement sections have been validated and compared with WBM base pavement sections. It is observed that performance of thin layered bituminous surface over WMM base layer is suitable in terms of both functional and structural adequacy.

7.2. Recommendations

Following aspects have been recommended from this study,

1. The PCI values estimated from ASTM method is considered to be more reliable as compared to the PCI values estimated using IRC methods. This may be due to consideration of various types of distresses in ASTM method. Hence, the PCI values estimated by using ASTM method are recommended for performance assessment.

Future Scope of Work

This study may be further extended in the following directions,

1. Exploring the ambiguity in selection of appropriate robust technique for estimating pavement condition index. This may be analyzed by comparing PCI values estimated by using various standard methods globally being implemented.
2.

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1. "Evaluation study on harmony of pavement condition indexes estimated using various techniques in pavement maintenance" submitted to **Journal of Transportation Geotechnics journal.**

2. Estimating in situ resilient moduli of agranular layers using a lightweight deflectometer with lateral geophones" submitted to **Construction and Building Materials.**

3. Feasibility study of granular layer materials on overall structural performance of low volume roads using a lightweight deflectometer" submitted to **Journal of Pavement Engineering.**

Appendix-I

Form.1: Visual pavement condition survey form

National Institute of Technology Raipur, G.E Road, Raipur, India (Pin-code: 492010)

Bituminous Pavement Condition Survey data sheet

Name of Project: "Performance evaluation of some selected PMGSY roads in the state of Chhattisgarh" funded by NRRDA, New Delhi

NRRDA

Name of Road: **Date of Survey:** ___/___/______

Length of the Road: **Width of Carriageway:** **Package Number:** ______________

Type of road New/ Upgradation **Type of construction** Retendering/General

Type of Distress and Code

1. Alligator Cracking
2. Bleeding
3. Block cracking
4. Bumps and sags
5. Corrugation
6. Depression
7. Edge Cracking
8. Jt. Reflection Cracking
9. Lane/Shoulder Drop Off
10. Long & Trans Cracking
11. Patching & Util Cut Patching
12. Polished Aggregate
13. Potholes
14. Rutting
15. Shoving
16. Slippage Cracking
17. Swell
18. Weathering/Ravelling

Chainage		Dist. code	UOM	Qty.	Dist. code	UOM	Qty.	Dist. code	UOM	Qty.	Dist. code	UOM	Qty.	TOTAL Qty.	SKETCH
			L (m)			L (m)			L (m)			L (m)			
			B (mm)			B (mm)			B (mm)			B (mm)			
			D (mm)			D (mm)			D (mm)			D (mm)			
			L (m)			L (m)			L (m)			L (m)			
			B (mm)			B (mm)			B (mm)			B (mm)			
			D (mm)			D (mm)			D (mm)			D (mm)			
			L (m)			L (m)			L (m)			L (m)			
			B (mm)			B (mm)			B (mm)			B (mm)			
			D (mm)			D (mm)			D (mm)			D (mm)			
			L (m)			L (m)			L (m)			L (m)			
			B (mm)			B (mm)			B (mm)			B (mm)			
			D (mm)			D (mm)			D (mm)			D (mm)			
			L (m)			L (m)			L (m)			L (m)			
			B (mm)			B (mm)			B (mm)			B (mm)			
			D (mm)			D (mm)			D (mm)			D (mm)			
			L (m)			L (m)			L (m)			L (m)			
			B (mm)			B (mm)			B (mm)			B (mm)			
			D (mm)			D (mm)			D (mm)			D (mm)			
			L (m)			L (m)			L (m)			L (m)			
			B (mm)			B (mm)			B (mm)			B (mm)			
			D (mm)			D (mm)			D (mm)			D (mm)			
			L (m)			L (m)			L (m)			L (m)			
			B (mm)			B (mm)			B (mm)			B (mm)			
			D (mm)			D (mm)			D (mm)			D (mm)			
			L (m)			L (m)			L (m)			L (m)			
			B (mm)			B (mm)			B (mm)			B (mm)			
			D (mm)			D (mm)			D (mm)			D (mm)			
			L (m)			L (m)			L (m)			L (m)			
			B (mm)			B (mm)			B (mm)			B (mm)			
			D (mm)			D (mm)			D (mm)			D (mm)			
			L (m)			L (m)			L (m)			L (m)			
			B (mm)			B (mm)			B (mm)			B (mm)			
			D (mm)			D (mm)			D (mm)			D (mm)			
			L (m)			L (m)			L (m)			L (m)			
			B (mm)			B (mm)			B (mm)			B (mm)			
			D (mm)			D (mm)			D (mm)			D (mm)			
			L (m)			L (m)			L (m)			L (m)			
			B (mm)			B (mm)			B (mm)			B (mm)			
			D (mm)			D (mm)			D (mm)			D (mm)			

Pavement Condition Survey Analysis and Photographs

TS-1: Main Road T07 to Potiya (Nagpura)

Sample Photographs

	
Longitudinal Cracking (medium severity)	Patching (high severity)
	
Longitudinal Cracking (medium severity)	Weathering (high severity)

	
Longitudinal Cracking (medium severity)	Longitudinal Cracking (low severity)

IRC PCI Analysis

FROM	TO	total distress	TOTAL AREA	PCI	CONDITION
0.00	0.05	0.00	0.00	2.25	Good
0.05	0.10	11.04	19.32	2.01	Good
0.10	0.15	1.62	2.83	2.20	Good
0.15	0.20	1.33	2.33	2.23	Good
0.20	0.25	0.40	0.70	2.24	Good
0.25	0.30	3.47	6.07	2.20	Good
0.30	0.35	1.60	2.80	2.20	Good
0.35	0.40	0.08	0.14	2.25	Good
0.40	0.45	0.00	0.00	2.25	Good
0.45	0.50	0.27	0.47	2.23	Good
0.50	0.55	0.00	0.00	2.25	Good
0.55	0.60	0.23	0.41	2.25	Good
0.60	0.65	5.33	9.33	2.17	Good
0.65	0.70	0.00	0.00	2.25	Good

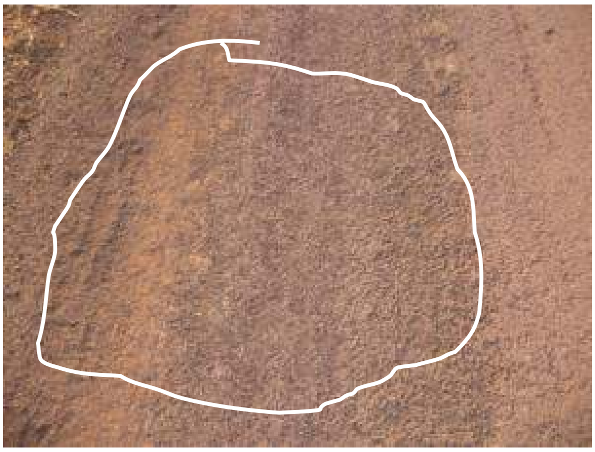
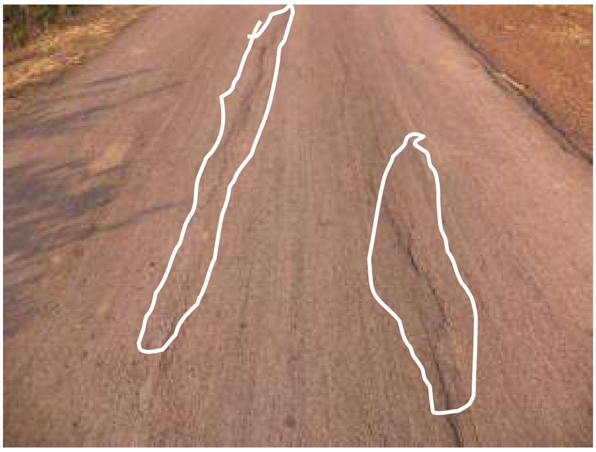
FROM	TO	total distress	TOTAL AREA	PCI	CONDITION
0.70	0.75	3.20	5.60	2.16	Good
0.75	0.80	0.00	0.00	2.25	Good
0.80	0.85	0.02	0.04	2.25	Good
0.85	0.90	0.00	0.00	2.25	Good
0.90	0.95	0.00	0.00	2.25	Good
0.95	1.00	0.00	0.00	2.25	Good
1.00	1.05	0.00	0.00	2.25	Good
1.05	1.10	0.00	0.00	2.25	Good
1.10	1.15	0.00	0.00	2.25	Good
1.15	1.20	16.00	28.00	2.02	Good
1.20	1.25	4.67	8.17	2.12	Good
1.25	1.30	0.00	0.00	2.25	Good
1.30	1.35	0.00	0.00	2.25	Good
1.35	1.40	0.00	0.00	2.25	Good
1.40	1.45	0.01	0.01	2.25	Good
1.45	1.50	0.00	0.00	2.25	Good
1.50	1.55	0.03	0.06	2.25	Good
1.55	1.60	2.00	3.50	2.19	Good
1.60	1.65	0.00	0.00	2.25	Good
1.65	1.70	0.00	0.00	2.25	Good
1.70	1.75	0.00	0.00	2.25	Good
1.75	1.80	0.00	0.00	2.25	Good
1.80	1.85	0.00	0.00	2.25	Good
1.85	1.90	0.33	0.58	2.24	Good
1.90	1.95	0.03	0.06	2.25	Good
1.95	2.00	2.67	4.67	2.21	Good
2.00	2.05	0.00	0.00	2.25	Good
2.05	2.10	0.00	0.00	2.25	Good

FROM	TO	total distress	TOTAL AREA	PCI	CONDITION
2.10	2.15	0.00	0.00	2.25	Good
2.15	2.20	0.00	0.00	2.25	Good
2.20	2.25	0.00	0.00	2.25	Good
2.25	2.30	0.01	0.01	2.25	Good
2.30	2.35	0.00	0.00	2.25	Good
2.35	2.40	0.00	0.00	2.25	Good
2.40	2.45	0.03	0.05	2.25	Good
2.45	2.50	0.00	0.00	2.25	Good
2.50	2.55	0.00	0.00	2.25	Good
2.55	2.60	1.28	2.24	2.23	Good
2.60	2.65	0.03	0.05	2.25	Good
2.65	2.70	6.31	11.04	2.09	Good
2.70	2.75	0.00	0.00	2.25	Good
2.75	2.80	0.00	0.00	2.25	Good
2.80	2.85	0.00	0.00	2.25	Good
2.85	2.90	0.00	0.00	2.25	Good
2.90	2.95	0.00	0.00	2.25	Good
2.95	3.00	0.00	0.00	2.25	Good
Total		**61.975333**		**2.229113**	

TS-2: Kanharpuri to Silli

Sample Distress Photographs

	
Potholes (low severity)	Weathering (low severity)
	
Longitudinal Cracking (medium severity)	Weathering (medium severity)

	
Weathering (low severity)	Longitudinal Cracking (low severity)

TS-3: T04 to Tilaibhat

Sample Distress photographs

	
Patching (medium severity)	Shoulder Edge Drop off (medium severity)

Alligator Cracking (low severity)

Edge Cracking (high severity)

Edge Cracking (high severity)

Longitudinal Cracking (low severity)

PCI Analysis (IRC & ASTM)

Name of Road		**T04 To Tilaibhat**				
Chainage			**IRC**		**ASTM**	
From	**To**	**Total Distress**	**PCI**	**Condition**	**PCI**	**Condition**
0.00	0.05	20.57	1.68	Fair	56.04	Fair
0.05	0.10	13.23	1.79	Fair	17.23	Serious
0.10	0.15	41.09	1.55	Fair	0.00	Failed

Name of Road		**T04 To Tilaibhat**				
Chainage			**IRC**		**ASTM**	
From	**To**	**Total Distress**	**PCI**	**Condition**	**PCI**	**Condition**
0.15	0.20	19.38	1.90	Fair	78.81	Satisfactory
0.20	0.25	28.78	2.10	Good	53.25	Poor
0.25	0.30	28.80	1.83	Fair	39.90	Very Poor
0.30	0.35	114.53	1.68	Fair	25.78	Very Poor
0.35	0.40	72.77	1.81	Fair	19.75	Serious
0.40	0.45	13.64	1.98	Fair	26.58	Very Poor
0.45	0.50	16.65	1.95	Fair	26.34	Very Poor
0.50	0.55	11.29	1.95	Fair	0.00	Failed
0.55	0.60	3.70	2.02	Good	53.94	Poor
0.60	0.65	0.00	2.25	Good	89.95	Good
0.65	0.70	0.95	2.18	Good	38.13	Very Poor
0.70	0.75	44.40	1.95	Fair	14.00	Serious
0.75	0.80	0.00	2.25	Good	88.43	Good
0.80	0.85	0.00	2.25	Good	5.90	Failed
0.85	0.90	12.38	2.01	Good	81.43	Satisfactory
0.90	0.95	5.74	1.95	Fair	0.00	Failed
0.95	1.00	25.61	1.68	Fair	9.90	Failed
1.00	1.05	1.71	2.05	Good	5.71	Failed
1.05	1.10	0.19	2.24	Good	33.96	Very Poor
1.10	1.15	35.26	1.56	Fair	14.58	Serious
1.15	1.20	13.64	1.93	Fair	84.34	Satisfactory

TS-4: Dara Telkadih T04 to charbhata

Sample Distress Photographs

	
Shoulder Drop-off (Medium Severity)	Edge Cracking (Medium Severity)
	
Edge Cracking (High Severity)	Weathering (High Severity)

	
Alligator Cracks (Medium Severity)	Weathering (Medium Severity)

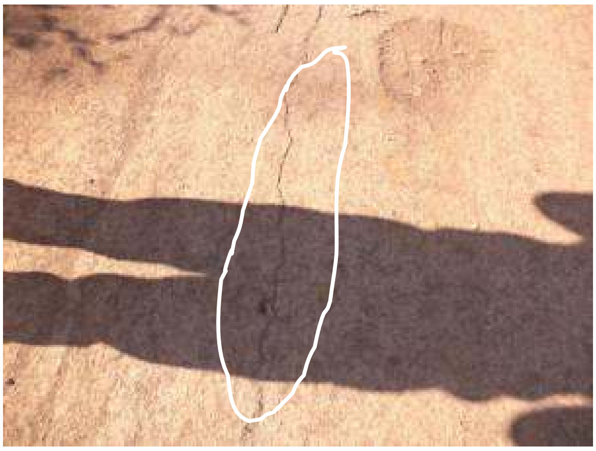
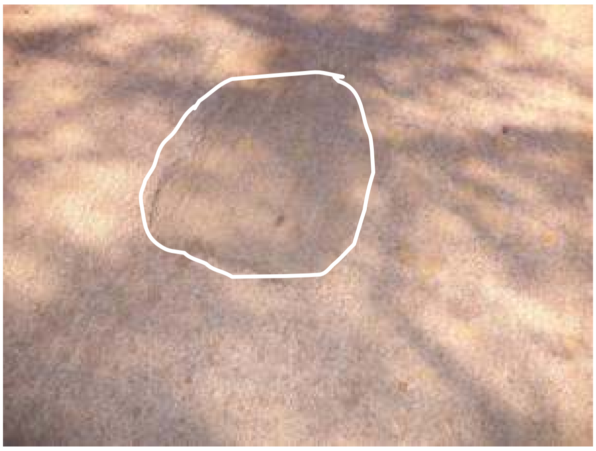
PCI Analysis (IRC & ASTM)

Name of Road		Dara Telkadih T04 to Charbhata				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0.00	0.05	0.00	2.25	Good	100.00	Good
0.05	0.10	3.73	2.20	Good	97.15	Good
0.10	0.15	0.08	2.25	Good	100.00	Good
0.15	0.20	0.00	2.25	Good	100.00	Good
0.20	0.25	0.00	2.24	Good	100.00	Good
0.25	0.30	1.68	2.22	Good	89.07	Good
0.30	0.35	2.67	2.20	Good	97.86	Good
0.35	0.40	0.00	2.25	Good	100.00	Good
0.40	0.45	0.00	2.25	Good	100.00	Good
0.45	0.50	6.48	2.16	Good	95.80	Good
0.50	0.55	0.00	2.25	Good	100.00	Good
0.55	0.60	0.28	2.24	Good	100.00	Good
0.60	0.65	0.00	2.25	Good	100.00	Good

Name of Road		Dara Telkadih T04 to Charbhata				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0.65	0.70	0.00	2.25	Good	100.00	Good
0.70	0.75	0.64	2.24	Good	91.18	Good
0.75	0.80	0.72	2.24	Good	91.23	Good
0.80	0.85	13.12	2.03	Good	77.55	Satisfactory
0.85	0.90	10.07	2.08	Good	59.84	Fair
0.90	0.95	44.41	1.85	Fair	38.30	Very Poor
0.95	1.00	0.00	2.25	Good	100.00	Good
1.00	1.05	1.60	2.05	Good	100.00	Good
1.05	1.10	6.48	2.24	Good	100.00	Good
1.10	1.15	3.49	2.24	Good	100.00	Good
1.15	1.20	0.00	2.25	Good	100.00	Good
1.20	1.25	0.00	2.25	Good	100.00	Good
1.25	1.30	0.00	2.25	Good	100.00	Good
1.30	1.35	0.00	2.25	Good	100.00	Good
1.35	1.40	2.13	2.22	Good	97.49	Good
1.40	1.45	0.00	2.25	Good	100.00	Good
1.45	1.50	0.00	2.25	Good	100.00	Good
1.50	1.55	0.00	2.25	Good	100.00	Good
1.55	1.60	0.00	2.25	Good	100.00	Good

TS-5: Sirsahi T04 to Sikaritola

Sample Distress Photographs

	
Longitudinal Cracking (low severity)	Longitudinal Cracking (low severity)
	
Longitudinal Cracking (low severity)	Patching (low severity)

	
Alligator Cracking (low severity)	Potholes (medium severity)

8.T05 to Boirdih

Sample Distress Photographs

Longitudinal Cracking (medium severity)

Longitudinal Cracking (high severity)

Depression (medium severity)

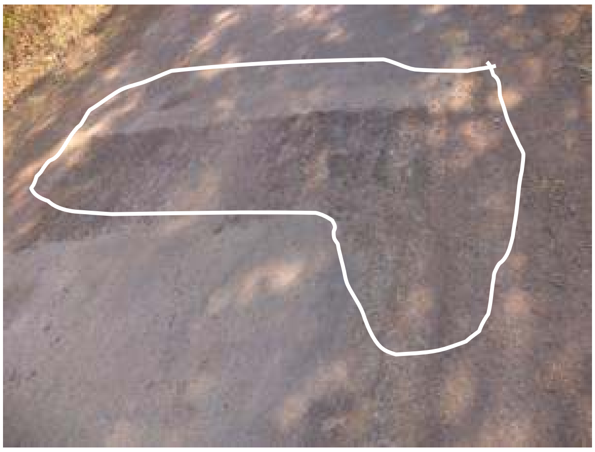
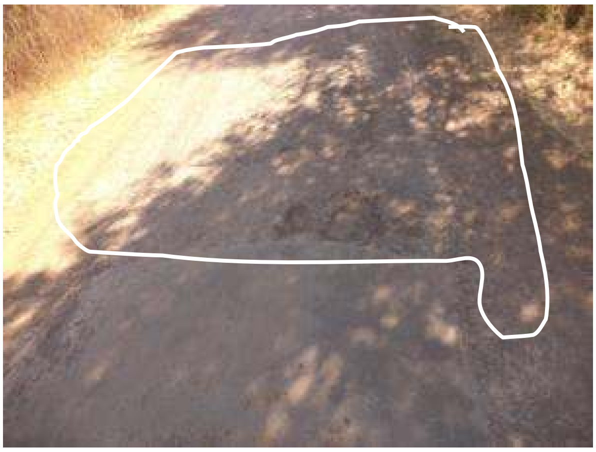
Patching (low severity)

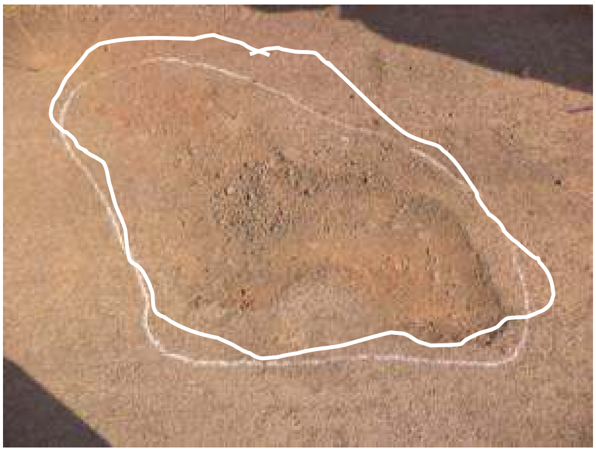
Potholes (medium severity)

Weathering (high severity)

Tumnibodh to Nathungaon

Sample Distress Photographs

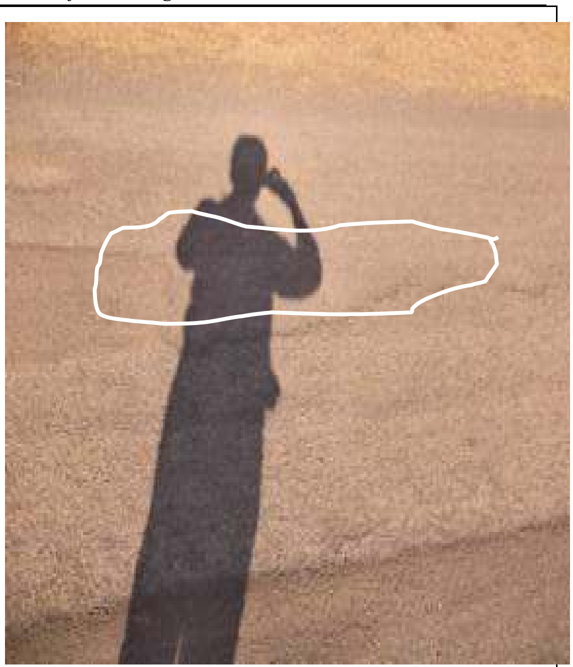
	
Weathering (low severity)	Weathering (low severity)
	
Longitudinal Cracking (low severity)	Weathering (low severity)

	
Weathering (low severity)	Patching (low severity)

10.Machandpur to Dhourbhata

Sample Distress Photographs

	
Patching (high severity)	Patching (medium severity)

	
Weathering (low severity)	Weathering (Low Severity)
	
Weathering (low severity)	Weathering (low severity)

11.Diwanjitiya to Godri

Potholes (low severity)

Shoulder Edge Drop off (high severity)

Potholes (high severity) Potholes (low severity)

Potholes (low severity) Alligator Cracking (low severity)

12.Arjuni to Pairi

	
Shoulder Drop-off (High Severity)	Weathering (Low Severity)

	
Shoulder Drop-off (High Severity)	Weathering (Low Severity)
	
Edge Cracking (High Severity)	Alligator Cracks (Low Severity)

13.Arjuni to Salikhjitiya

Weathering (Low Severity)

Patching (Low Severity)

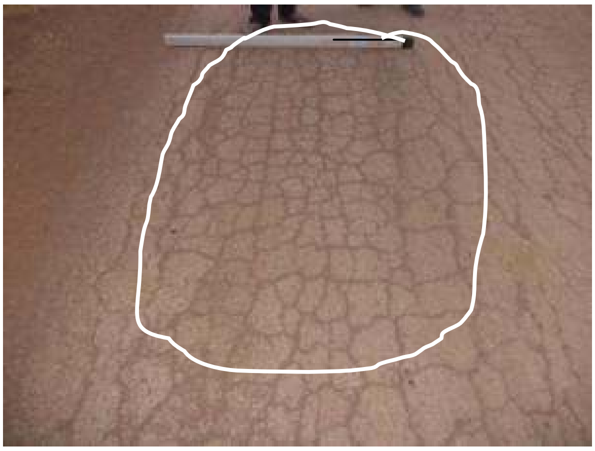
14.RDC Road to farhadh

Alligator Cracking (low severity)

Depression (medium severity)

Weathering (medium severity)

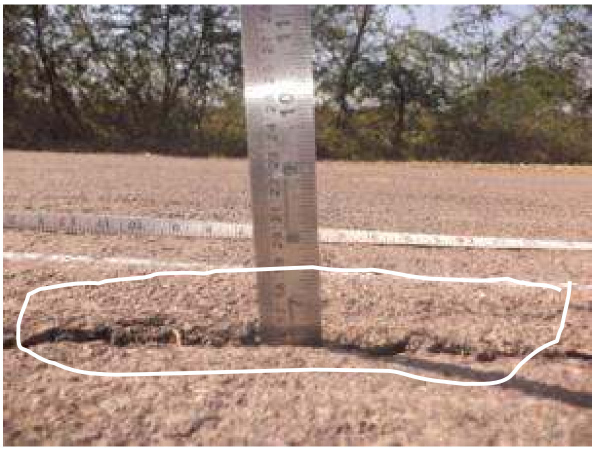
Alligator Cracking (low severity)



Alligator Cracking (low severity)

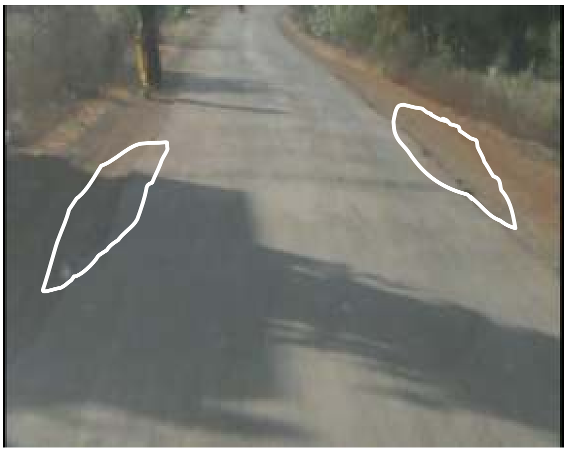
Patching (medium severity)

15.Ahirwara to Dor

	
Longitudinal Cracking (high severity)	Depression (medium severity)
	
Longitudinal Cracking (high severity)	Longitudinal Cracking (high severity)

	
Longitudinal Cracking (high severity)	Longitudinal Cracking (high severity)

16.T011 to Bharani



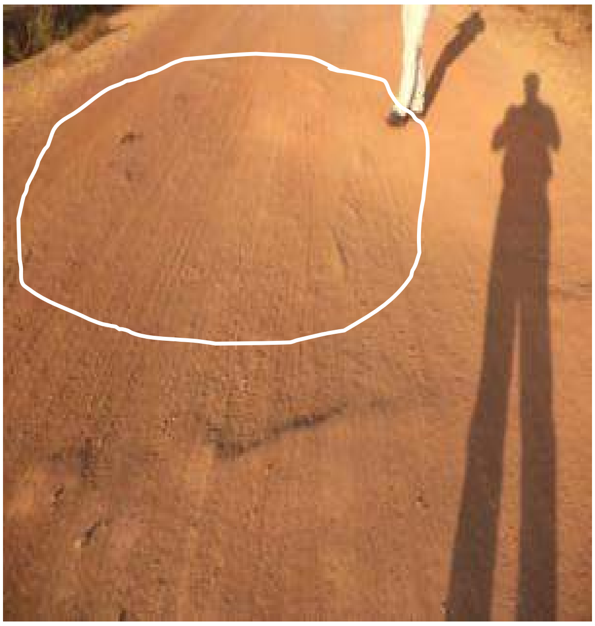
Edge cracking (Medium Severity)

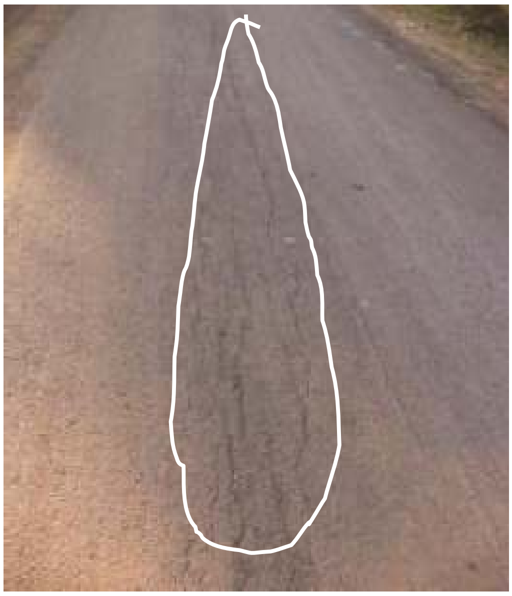
Weathering (low severity)

17.Main Road T05 to Khilora Mandir

Longitudinal Cracking (low severity)

Weathering (high severity)





Weathering (high severity)

Alligator Cracking (low severity)

Alligator Cracking (low severity)

Longitudinal Cracking (low severity)

18. Main Road to Godeghat

Weathering (High Severity)

Weathering (High Severity)

Weathering (High Severity)

19.Rehada Khaspara to Chandranagar Khaspara

Potholes (Medium severity)

20.Shankargarh Kusmi Road to Kotalu Amerpat

Longitudinal Cracking (medium severity)

Longitudinal Cracking (medium severity)

Edge Cracking (low severity)

Longitudinal Cracking (medium severity)

21. Shankargarh Kusmi Road To Girjapur Khaspara

Weathering (Medium Severity)

Weathering (Medium Severity)

Weathering (Medium Severity)

Weathering (Low Severity)

22. Kosaga to Parsapara

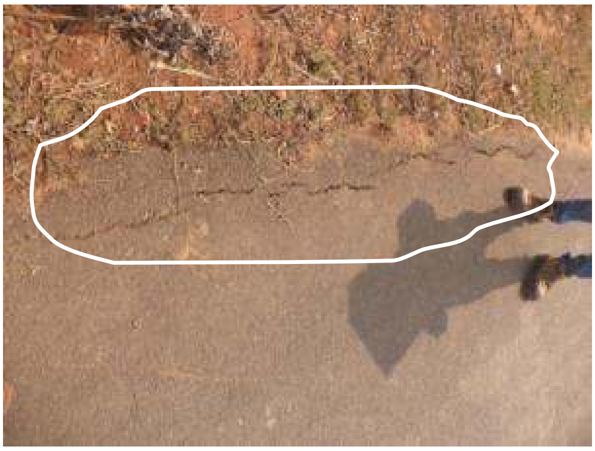
Longitudinal Cracks (Low Severity)

Weathering (Medium Severity)

Alligator Cracks (Low Severity)

Alligator cracks (Low Severity)

23. Beldagih to Beldagih Uparpara

	
Lonitudinal Cracks (Medium Severity)	Alligator Cracks (Low Severity)
	
Edge Cracking (Medium Severity)	Longitudinal Cracks (Low Severity)

	
Alligator Cracks (Medium Severity)	Alligator Cracks (Medium Severity)

24. Chando to Amdala

	
Weathering (Medium Severity)	Weathering (low Severity)

25. Sojdha to Tunguri

Weathering (Low Severity)

Weathering (Low Severity)

26. Kusu to Pratappur

Lonitudinal Cracks (Medium Severity)

Lonitudinal Cracks (low Severity)

Alligator Cracks (low Severity)

27. Korsi to Pirdah

Longitudinal Cracks (Low Severity) and Weathering (Low Severity)

Weathering (Medium Severity)

Pothole (Medium Severity)

Weathering (Medium Severity)

Weathering (High Severity)

Edge Cracking (High Severity)

28. Amsena to Kerla

Edge Cracking (High Severity)

Alligator Cracks (Medium Severity)

Shoulder Drop-off (High Severity)

Alligator Cracks (High Severity)

Alligator Cracks (High Severity)

Weathering (High Severity)

29. Gorbhat to Bhalera

Weathering (Medium Severity)

Alligator Cracks (High Severity)

Alligator cracks (High Severity) and Pothole (Low Severity)

Alligator cracks (High Severity) and Weathering (Medium Severity)

Weathering (High Severity)

Alligator cracks (Low Severity) and Pothole (High Severity)

34. Mohara Road to Takurtola

Edge cracking (Medium Severity)

Potholes(high severity)

35. Belgaon to Kolendra

Potholes (medium severity)

Weathering (high severity)

42. R.K.P. Road (T03) to Baldevpur

Patching (High severity)

Potholes (medium severity)

43. T02 to Sehaspur

Weathering (Medium Severity) and Patching (Medium Severity)

Weathering (Low Severity)

Weathering (High Severity)

Weathering (Low Severity)

44. T01 to Pendrikurd

Weathering (High Severity)

Alligator Cracks (Medium Severity)

Patching (High Severity)

Longitudinal Cracks (Medium Severity)

Rutting (Medium Severity)

Longitudinal Cracks (Medium Severity)

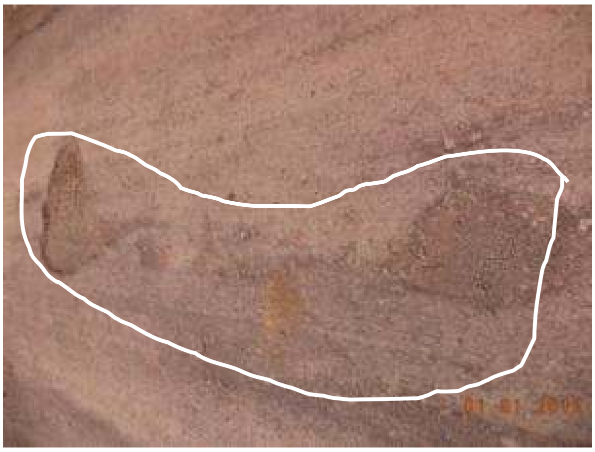
45. T01 to Kamtarai

Alligator Cracks (Low Severity)

Alligator Cracks (High Severity)

Weathering (Medium Severity)

Weathering (High Severity) and Longitudinal Cracks (Low Severity)



Weathering (High Severity)

Weathering (Medium Severity)

46. T01 to Atekhasa

Weathering (Low Severity)

Weathering (Low Severity) and Alligator cracks (High Severity)

Depression (High Severity) and Alligator Cracks (Medium Severity)

Alligator cracks (High Severity)

Weathering (Low Severity)

Weathering (Low Severity)

48. T01 to Bori

Alligator cracks (High Severity)

Shoulder drop-off (High Severity)

Patching (Medium Severity)

Weathering (Low Severity)

Weathering (Medium Severity)

Alligator cracks (Low Severity) and Weathering (Low Severity)

49. Bori to Achola

Longitudinal crack (Medium Severity)

Longitudinal cracks (Medium Severity)

Longitudinal cracks (Medium Severity)

Potholes (Medium Severity)

Shoulder drop-off (Medium Severity)

Weathering (Medium Severity)

50. L032 to Kusmi

Shoulder Drop-off (High Severity)

Alligator cracks (Medium Severity) and

Weathering (Low Severity)

Rutting (High Severity)

Weathering (High Severity)

Potholes (High Severity)

Longitudinal cracks (High Severity)

51. T01 to Dullapur

Alligator cracks (Medium Severity) and Weathering (Medium Severity)

Shoulder drop-off (High Severity)

Alligator Cracks (Medium Severity)

Longitudinal Cracks (High Severity)

Longitudinal Cracks (High Severity)

Alligator cracking (High Severity)

52. Athariya to Junwani

Shoulder drop-off (Medium Severity) and Edge cracking (Medium Severity)

Alligator cracks (Low Severity) and Weathering (Medium Severity)

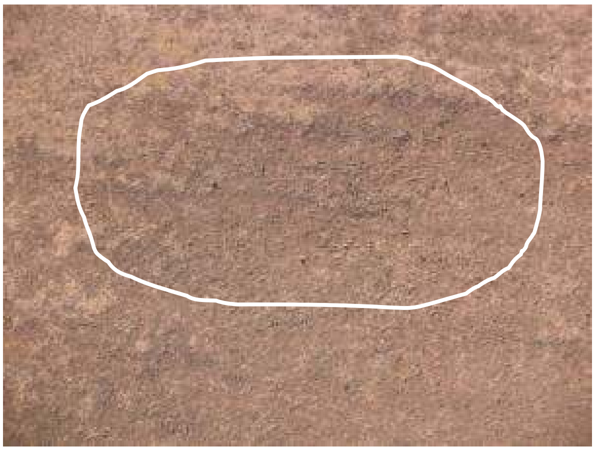
Edge cracking (High Severity) and Shoulder drop-off (Medium Severity)

Alligator cracks (Low Severity) and Weathering (Medium Severity)

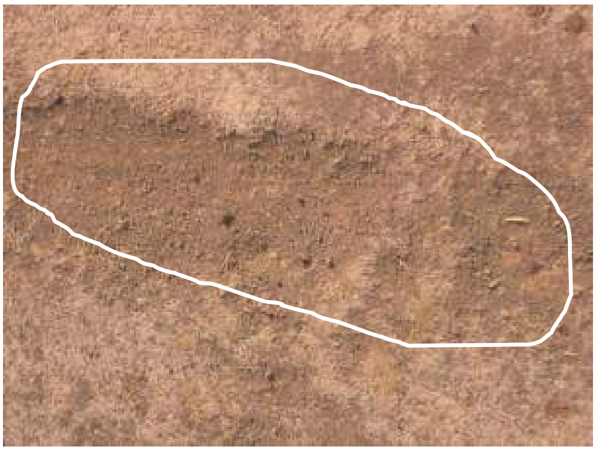
Longitudinal cracks (Medium Severity)

Shoulder drop-off (Medium Severity)

53. Navagaon to Kareli



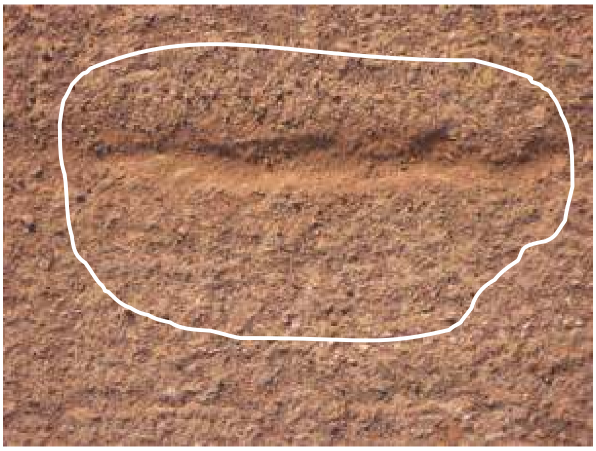
Weathering (Medium Severity)



Weathering (High Severity)

Edge cracking (High Severity)

Weathering (Medium Severity) and Edge cracking (High Severity)



Weathering (Low Severity) Weathering (Medium Severity)

54. Dongargarh to Haransinghi

Edge Cracking(medium severity)

Depression(medium severity)

55. T05 to Khallari

Patching (medium severity)

Weathering (medium severity)

56. Dongargarh to Karwari

Edge cracking (medium severity)

Shoulder drop off (low severity)

57. Dongargarh to Motipur

Patching (medium severity)

Potholes (medium severity)

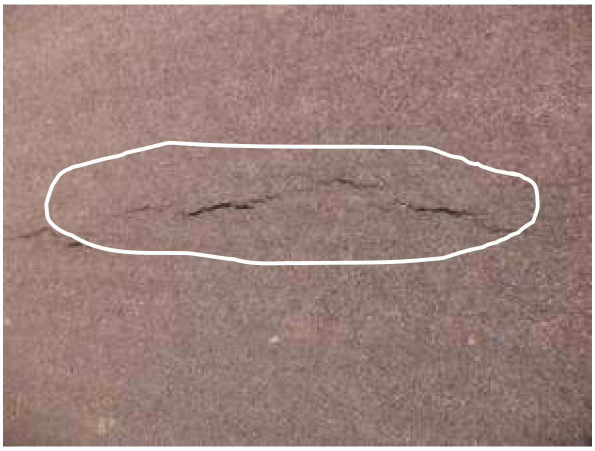
58. Mudapur to Jamri

Patching (medium severity)

Rutting (medium severity)

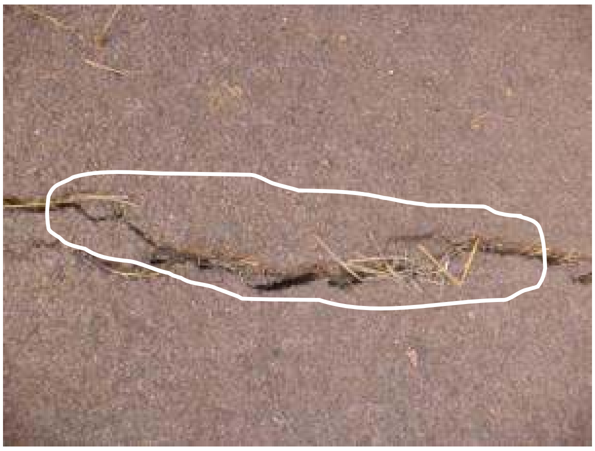
WBM Roads

01.Kodiya Dongariya



Longitudinal cracks (Medium Severity)

Edge cracking (High Severity)



Longitudinal cracks (High Severity)

Longitudinal cracks (High Severity)

2.Shankargarh dipadih Khurd road to Bijadih khaspara

Edge cracking (medium Severity)

Weathering (high severity)

3.Madha Bantola to Udaseh

Weathering (low severity)

Shoulder drop off (low severity)

4.Devkatta to Kanhargaon

Depression (high severity)

Shoulder Drop Off(low severity)

5.Dharaghotiya

Weathering (low severity)

Weathering (medium severity)

PCI Analysis

Name of Road		Kusu to Pratappur				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	0	2.25	Good	100	Good
0.05	0.1	0.010666667	2.249796825	Good	97.26666667	Good
0.1	0.15	0	2.25	Good	100	Good
0.15	0.2	0	2.25	Good	100	Good
0.2	0.25	0	2.217238095	Good	100	Good
0.25	0.3	0	2.25	Good	100	Good
0.3	0.35	0	2.25	Good	100	Good
0.35	0.4	0	2.25	Good	100	Good
0.4	0.45	0	2.25	Good	100	Good
0.45	0.5	0.458666667	2.241263492	Good	34.84	Very Poor
0.5	0.55	0	2.25	Good	100	Good
0.55	0.6	0	2.25	Good	100	Good
0.6	0.65	0.48	2.236285714	Good	86.05	Good
0.65	0.7	0.010666667	2.249796825	Good	97.26666667	Good
0.7	0.75	0.728	2.241771429	Good	93.63	Good
0.75	0.8	1.173333333	2.25	Good	100	Good

0.8	0.85	0	2.25	Good	100	Good
0.85	0.9	0	2.25	Good	100	Good
0.9	0.95	0	2.25	Good	100	Good
0.95	1	0.000266667	2.249980952	Good	75.22	Satisfactory
1	1.05	16	1.95	Fair	100	Good
1.05	1.1	0	2.25	Good	100	Good
1.1	1.15	0	2.25	Good	100	Good
1.15	1.2	0	2.25	Good	100	Good
1.2	1.25	0	2.25	Good	100	Good
1.25	1.3	0	2.25	Good	100	Good
1.3	1.35	0	2.25	Good	100	Good
1.35	1.4	0	2.25	Good	100	Good
1.4	1.45	0	2.25	Good	100	Good
1.45	1.5	0	2.25	Good	100	Good
1.5	1.55	0	2.25	Good	100	Good
1.55	1.6	0	2.25	Good	100	Good
1.6	1.65	0	2.25	Good	100	Good
1.65	1.7	0	2.25	Good	100	Good
1.7	1.75	0	2.25	Good	100	Good
1.75	1.8	0	2.25	Good	100	Good
1.8	1.85	0	2.25	Good	100	Good
1.85	1.9	0	2.25	Good	100	Good
1.9	1.95	1.934666667	2.213149206	Good	71.024	Satisfactory
1.95	2	0.024	2.249542857	Good	86.46666667	Good

2	2.05	5.148	2.151942857	Good	61.704	Fair
2.05	2.1	0	2.25	Good	82.28	Satisfactory
2.1	2.15	9.3072	2.070281905	Good	50.03093333	Poor
2.15	2.2	0	2.25	Good	100	Good
2.2	2.25	2.458666667	2.179752381	Good	68.84357	Fair
2.25	2.3	0.213333333	2.25	Good	100	Good
2.3	2.35	6.933333333	2.12047619	Good	62.026	Fair
2.35	2.4	0.034666667	2.249339683	Good	82.2	Satisfactory
2.4	2.45	0	2.25	Good	100	Good
2.45	2.5	16.032	2.000712	Good	47.12888	Poor
2.5	2.55	0	2.25	Good	100	Good
2.55	2.6	0.864	2.25	Good	90	Good
2.6	2.65	0	2.25	Good	100	Good
2.65	2.7	0.048	2.249085714	Good	78.6	Satisfactory
2.7	2.75	0	2.25	Good	100	Good
2.75	2.8	0.225333333	2.241726984	Good	64.98666667	Fair
2.8	2.85	0.085333333	2.248374603	Good	80.46667	Satisfactory
2.85	2.9	0.048	2.249085714	Good	86.5	Good
2.9	2.95	0	2.25	Good	100	Good
2.95	3	0.96	2.231714286	Good	87.7	Good
3	3.05	0	2.25	Good	100	Good
3.05	3.1	0.0064	2.249542857	Good	100	Good
3.1	3.15	0	2.25	Good	100	Good
3.15	3.2	0	2.25	Good	100	Good

3.2	3.25	6.634666667	2.113466667	Good	26.168	Very Poor
3.25	3.3	9.386666667	2.071206349	Good	51.72666667	Poor
3.3	3.35	3.36	2.186	Good	66.56	Fair
3.35	3.4	0	2.25	Good	100	Good
3.4	3.45	0	2.25	Good	100	Good
3.45	3.5	0	2.25	Good	100	Good
3.5	3.55	0	2.25	Good	100	Good
3.55	3.6	0.504	2.249542857	Good	87.4	Good
3.6	3.65	2.533333333	2.082	Good	90.916	Good
3.65	3.7	0	2.25	Good	100	Good
3.7	3.75	0.256	2.244209524	Good	54.6	Poor
3.75	3.8	0.192	2.246342857	Good	90.24	Good
3.8	3.85	0.133333333	2.25	Good	100	Good
3.85	3.9	0	2.25	Good	100	Good
3.9	3.95	0	2.25	Good	100	Good
3.95	4	0	2.25	Good	100	Good
4	4.05	0	2.25	Good	100	Good
4.05	4.1	0	2.25	Good	100	Good
4.1	4.15	1.066666667	2.22968254	Good	78.53333	Satisfactory
4.15	4.2	0	2.25	Good	100	Good
4.2	4.25	13.86666667	2.128095238	Good	51.29326667	Poor
4.25	4.3	0	2.25	Good	100	Good
4.3	4.35	0	2.25	Good	100	Good
4.35	4.4	0	2.25	Good	100	Good

4.4	4.45	0.864	2.225314286	Good	97.7992	Good
4.45	4.5	0	2.25	Good	100	Good
4.5	4.55	0.064	2.249085714	Good	100	Good
4.55	4.6	0.266666667	2.25	Good	100	Good
4.6	4.65	2.24	2.25	Good	93.3716	Good
4.65	4.7	0	2.25	Good	100	Good
4.7	4.75	6.72	2.08452	Good	84.6232	Satisfactory
4.75	4.8	0	2.25	Good	100	Good
4.8	4.85	0	2.25	Good	97.86666667	Good
4.85	4.9	14.448	2.014485714	Good	79.0684	Satisfactory
4.9	4.95	0	2.25	Good	100	Good
4.95	5	0	2.25	Good	100	Good
5	5.05	5.12	2.25	Good	69.64	Fair
5.05	5.1	0	2.25	Good	100	Good
5.1	5.15	0.533333333	2.23984127	Good	100	Good
5.15	5.2	0	2.25	Good	85.0744	Good
5.2	5.25	0	2.25	Good	100	Good
5.25	5.3	0	2.25	Good	100	Good
5.3	5.35	0	2.25	Good	100	Good
5.35	5.4	0.96	2.231714286	Good	89.7	Good
5.4	5.45	0	2.25	Good	100	Good
5.45	5.5	0	2.25	Good	62.6508	Fair
5.5	5.55	0	2.25	Good	100	Good
5.55	5.6	0	2.25	Good	100	Good

5.6	5.65	3.2	2.189047619	Good	100	Good
5.65	5.7	2.24	2.207333333	Good	71.04	Satisfactory
5.7	5.75	0	2.25	Good	100	Good
5.75	5.8	0	2.25	Good	100	Good
5.8	5.85	0	2.25	Good	100	Good
5.85	5.9	0	2.25	Good	100	Good
5.9	5.95	0	2.25	Good	100	Good
5.95	6	0	2.25	Good	100	Good
6	6.05	0	2.25	Good	100	Good
6.05	6.1	0	2.25	Good	100	Good
6.1	6.15	0	2.25	Good	100	Good
6.15	6.2	0	2.25	Good	100	Good
6.2	6.25	0	2.25	Good	100	Good
6.25	6.3	0	2.25	Good	100	Good
6.3	6.35	0	2.25	Good	100	Good
6.35	6.4	0	2.25	Good	100	Good
6.4	6.45	0	2.25	Good	100	Good
6.45	6.5	0	2.25	Good	100	Good
6.5	6.55	0	2.25	Good	100	Good
6.55	6.6	0	2.25	Good	100	Good
6.6	6.65	0	2.25	Good	100	Good
6.65	6.7	0	2.25	Good	100	Good
6.7	6.75	0	2.25	Good	100	Good
6.75	6.8	0	2.25	Good	100	Good

6.8	6.85	0	2.25	Good	100	Good
6.85	6.9	0	2.25	Good	100	Good
6.9	6.95	0	2.25	Good	100	Good
6.95	7	0	2.25	Good	100	Good
7	7.05	0	2.25	Good	100	Good
7.05	7.1	0	2.25	Good	100	Good
7.1	7.15	0	2.25	Good	100	Good
7.15	7.2	0	2.25	Good	100	Good
7.2	7.25	0.277333333	2.24471746	Good	95	Good
7.25	7.3	0	2.25	Good	100	Good
7.3	7.35	1.813333333	2.215460317	Good	72.50133	Satisfactory
7.35	7.4	0.023466667	2.249553016	Good	100	Good
7.4	7.45	0	2.25	Good	100	Good
7.45	7.5	0	2.25	Good	100	Good
7.5	7.55	0	2.25	Good	100	Good
7.55	7.6	0.037333333	2.247333333	Good	100	Good
7.6	7.65	0	2.25	Good	100	Good
7.65	7.7	0	2.25	Good	100	Good
7.7	7.75	0	2.25	Good	100	Good
7.75	7.8	0	2.25	Good	100	Good
7.8	7.85	0	2.25	Good	100	Good
7.85	7.9	0	2.25	Good	100	Good
7.9	7.95	0	2.25	Good	100	Good
7.95	8	0.016	2.249695238	Good	100	Good

8	8.05	0	2.25	Good	100	Good
8.05	8.1	0	2.25	Good	100	Good
8.1	8.15	0	2.25	Good	100	Good
8.15	8.2	0	2.25	Good	85.556	Good
8.2	8.25	0.48	2.240857143	Good	85.684	Good
8.25	8.3	0	2.25	Good	100	Good
8.3	8.35	0	2.25	Good	100	Good
8.35	8.4	0	2.25	Good	100	Good
8.4	8.45	0	2.25	Good	100	Good
8.45	8.5	0	2.25	Good	100	Good
8.5	8.55	0	2.25	Good	100	Good
8.55	8.6	0	2.25	Good	88.28	Good
8.6	8.65	0	2.25	Good	100	Good
8.65	8.7	0	2.25	Good	100	Good
8.7	8.75	0	2.25	Good	100	Good
8.75	8.8	0	2.25	Good	100	Good
8.8	8.85	0	2.25	Good	91.176	Good
			2.236047262		93.95875469	

Name of Road		Takurtola to Mohara				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	0	2.25	Good	100	Good

0.05	0.1	0	2.25	Good	100	Good
0.1	0.15	0	2.25	Good	100	Good
0.15	0.2	6.657142857	2.074463946	Good	100	Good
0.2	0.25	8.637142857	2.221918367	Good	100	Good
0.25	0.3	2.628571429	2.17	Good	100	Good
0.3	0.35	2.228571429	2.159659864	Good	100	Good
0.35	0.4	0.45	2.241428571	Good	89.071	Good
0.4	0.45	0	2.25	Good	100	Good
0.45	0.5	0.891428571	2.197102041	Good	96.187	Good
0.5	0.55	1.697142857	2.201510204	Good	100	Good
0.55	0.6	0.384571429	2.243980952	Good	92.0741	Good
0.6	0.65	8.228571429	2.121564626	Good	67.9363	Fair
0.65	0.7	0.371428571	2.192204082	Good	100	Good
0.7	0.75	0	2.25	Good	100	Good
0.75	0.8	0.206857143	2.246059864	Good	100	Good
0.8	0.85	3.56	2.075306122	Good	75.92	Satisfactory
0.85	0.9	0.805142857	2.234663946	Good	100	Good
0.9	0.95	3.782857143	2.143115646	Good	100	Good
0.95	1	27.36857143	2.212544218	Good	70.286	Satisfactory
1	1.05	3.214285714	2.012408163	Good	80.886	Satisfactory
1.05	1.1	4.5	2.203673469	Good	83.915	Satisfactory
1.1	1.15	0.714285714	2.236394558	Good	91.857	Good
1.15	1.2	0	2.25	Good	100	Good
1.2	1.25	0	2.25	Good	100	Good

1.25	1.3	0	2.25	Good	100	Good
1.3	1.35	0	2.25	Good	100	Good
1.35	1.4	0	2.25	Good	100	Good
1.4	1.45	6.994285714	2.115469388	Good	71.29	Satisfactory
1.45	1.5	0.253142857	2.233210884	Good	100	Good
1.5	1.55	0.154285714	2.247795918	Good	100	Good
1.55	1.6	0.017142857	2.246734694	Good	100	Good
1.6	1.65	0.001142857	2.249978231	Good	100	Good
1.65	1.7	18.528	2.249738776	Good	53.47	Poor
1.7	1.75	18.28571429	2.25	Good	53.788	Poor
1.75	1.8	16.71428571	2.07662449	Good	62.717	Fair
1.8	1.85	3.657142857	2.181156463	Good	62.06	Fair
1.85	1.9	1.714285714	2.133537415	Good	100	Good
1.9	1.95	0.502857143	2.236503401	Good	100	Good
1.95	2	0.057142857	2.248911565	Good	97.145	Good
2	2.05	10.00514286	2.168269388	Good	62.609	Fair
2.05	2.1	18.94285714	2.219387755	Good	55.98	Fair
2.1	2.15	0.042857143	2.249183673	Good	100	Good
2.15	2.2	0	2.012921088	Good	66.691	Fair
2.2	2.25	10.28571429	2.052428571	Good	100	Good
2.25	2.3	6.302857143	2.097020408	Good	80.04	Satisfactory
2.3	2.35	0	2.25	Good	100	Good
2.35	2.4	0.04	2.245319728	Good	100	Good
2.4	2.45	34.488	2.25	Good	52.319	Poor

2.45	2.5	1.828571429	2.215170068	Good	100	Good
2.5	2.55	12.44457143	2.12654966	Good	81.292	Satisfactory
2.55	2.6	29.43428571	1.956522449	Fair	63.26	Fair
2.6	2.65	8.434285714	2.246081633	Good	89.55	Good
2.65	2.7	22.65742857	1.939446408	Fair	36.9532	Very Poor
2.7	2.75	16.36571429	2.068422857	Good	55.1232	Fair
2.75	2.8	21.37142857	1.869771429	Fair	70.6856	Satisfactory
2.8	2.85	0.685714286	2.236938776	Good	100	Good
2.85	2.9	65.14285714	1.697142857	Fair	37.61	Very Poor
2.9	2.95	0	2.25	Good	100	Good
2.95	3	0	2.25	Good	100	Good
3	3.05	0	2.25	Good	100	Good
3.05	3.1	3.154285714	2.204938776	Good	96.85	Good
3.1	3.15	13.28571429	2.092721088	Good	68.601	Fair
3.15	3.2	0	2.25	Good	100	Good
3.2	3.25	0	2.25	Good	100	Good
3.25	3.3	10.49628571	2.23227483	Good	63.898	Fair
3.3	3.35	7.977142857	2.201346939	Good	73.248	Satisfactory
3.35	3.4	33.2	1.95	Fair	83.09	Satisfactory
3.4	3.45	0.628571429	2.241020408	Good	100	Good
3.45	3.5	1.521428571	2.194387755	Good	82.0032	Satisfactory
3.5	3.55	0.194285714	2.212993197	Good	100	Good
3.55	3.6	9.802285714	2.106092517	Good	86.912	Good
3.6	3.65	0	2.25	Good	100	Good

3.65	3.7	1.714285714	2.210816327	Good	-4.97	Failed
3.7	3.75	32.07428571	1.929428571	Fair	-9.23	Failed
3.75	3.8	18.94285714	2.241836735	Good	100	Good
3.8	3.85	13.82857143	2.048314286	Good	67.145	Fair
3.85	3.9	24.34285714	1.86292517	Fair	74.88	Satisfactory
3.9	3.95	0	2.25	Good	100	Good
3.95	4	1.371428571	2.230408163	Good	97.63	Good
4	4.05	1.371428571	2.230408163	Good	97.63	Good
4.05	4.1	0	2.25	Good	100	Good
4.1	4.15	0	2.25	Good	100	Good
4.15	4.2	27.07142857	1.734693878	Fair	97.06	Good
4.2	4.25	30	2.12755102	Good	48.48	Poor
4.25	4.3	7.928571429	2.118571429	Good	75.4983	Satisfactory
4.3	4.35	0	2.25	Good	100	Good
4.35	4.4	5.028571429	2.161836735	Good	94.5714	Good
4.4	4.45	0	2.25	Good	100	Good
4.45	4.5	4.685714286	2.077346939	Good	97.63	Good
4.5	4.55	0.142857143	2.247959184	Good	100	Good
4.55	4.6	0	2.25	Good	100	Good
4.6	4.65	0.994285714	2.230435374	Good	95.4856	Good
4.65	4.7	67.6	1.95	Fair	70.19	Satisfactory
4.7	4.75	2.057142857	2.220612245	Good	97.063	Good
4.75	4.8	0.685714286	2.236938776	Good	94.6643	Good
4.8	4.85	1.371428571	2.230408163	Good	97.63	Good

4.85	4.9	12.34285714	2.171632653	Good	69.17	Fair
4.9	4.95	8.914285714	2.122653061	Good	95.26	Good
4.95	5	8.091428571	2.024040816	Good	66.298	Fair
5	5.05	3.428571429	2.152040816	Good	92.355	Good
5.05	5.1	1.014285714	2.2	Good	92.9541	Good
5.1	5.15	20.57142857	2.049857143	Good	69.17	Fair
5.15	5.2	24.45714286	2.192312925	Good	49.063	Poor
5.2	5.25	23.02857143	1.880972789	Fair	72.032	Satisfactory
5.25	5.3	2.885714286	2.247959184	Good	88.2988	Good
5.3	5.35	0	2.25	Good	100	Good
5.35	5.4	14.24	1.944336054	Fair	73.02	Satisfactory
5.4	5.45	20.64285714	1.879455782	Fair	61.8744	Fair
5.45	5.5	0	2.25	Good	100	Good
			2.163179677		85.23791364	

Name of Road		Belgaon to Kolendra				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	0	2.25	Good	100	Good
0.05	0.1	0	2.25	Good	100	Good
0.1	0.15	0	2.25	Good	100	Good

0.15	0.2	1.725714286	2.215170068	Good	78.808	Satisfactory
0.2	0.25	1.828571429	2.195578231	Good	53.2488	Poor
0.25	0.3	0.137142857	2.223877551	Good	39.9	Very Poor
0.3	0.35	0.091428571	2.232585034	Good	25.775	Very Poor
0.35	0.4	8.708571429	2.041734694	Good	19.7472	Serious
0.4	0.45	25.71428571	1.95	Fair	26.58	Very Poor
0.45	0.5	8.777142857	2.028673469	Good	26.335	Very Poor
0.5	0.55	37.22857143	1.633673469	Fair	0	Failed
0.55	0.6	19.65714286	1.729462585	Fair	53.936	Poor
0.6	0.65	0.034285714	2.243469388	Good	89.95	Good
0.65	0.7	0.102857143	2.230408163	Good	38.1315	Very Poor
0.7	0.75	0.171428571	2.217346939	Good	14	Serious
0.75	0.8	0.011428571	2.247823129	Good	88.428	Good
0.8	0.85	1.085714286	2.150952381	Good	5.904	Failed
0.85	0.9	3.268571429	2.09	Good	81.429	Satisfactory
0.9	0.95	23.30285714	1.810680272	Fair	0	Failed
0.95	1	27.59428571	1.802789116	Fair	9.904	Failed
1	1.05	14.06	1.686734694	Fair	5.71	Failed
1.05	1.1	15.81142857	1.706897959	Fair	33.9565	Very Poor
1.1	1.15	1.297142857	2.149863946	Good	14.58	Serious
1.15	1.2	0.16	2.245428571	Good	84.344	Satisfactory
1.2	1.25	3.428571429	2.001020408	Good	3.70324	Failed
1.25	1.3	10.65714286	1.973809524	Fair	57.94592	Fair
1.3	1.35	0.514285714	2.152040816	Good	2.31994	Failed

1.35	1.4	15.46857143	1.821571429	Fair	17.1364	Serious
1.4	1.45	20.99428571	1.673	Fair	27.268	Very Poor
1.45	1.5	13.98857143	1.930897959	Fair	10.4624	Serious
1.5	1.55	0	2.25	Good	100	Good
1.55	1.6	43.54285714	1.95	Fair	93.9658	Good
1.6	1.65	12.85714286	1.95	Fair	81.8	Satisfactory
1.65	1.7	0	2.25	Good	100	Good
1.7	1.75	0	2.25	Good	100	Good
1.75	1.8	0.32	2.189047619	Good	16.5	Serious
1.8	1.85	0.034285714	2.243469388	Good	83.4	Satisfactory
1.85	1.9	5.497142857	1.947823129	Fair	47.51	Poor
1.9	1.95	12.45714286	1.76870068	Fair	0	Failed
1.95	2	0.091428571	2.232585034	Good	89.24	Good
2	2.05	27.92	1.920612245	Fair	11.628	Serious
2.05	2.1	3.48	2.031605442	Good	40.967	Poor
2.1	2.15	40.02857143	1.944557823	Fair	20	Serious
2.15	2.2	0	2.25	Good	100	Good
2.2	2.25	42.85714286	1.95	Fair	100	Good
2.25	2.3	71.14285714	1.628231293	Fair	75.136	Satisfactory
2.3	2.35	0.4	2.173809524	Good	61.43	Fair
2.35	2.4	5.714285714	2.093571429	Good	39.829	Very Poor
2.4	2.45	0.085714286	2.233673469	Good	12.18	Serious
2.45	2.5	3.514285714	2.16292517	Good	11.933	Serious
2.5	2.55	5.714285714	2.141156463	Good	76.571	Satisfactory

2.55	2.6	0.068571429	2.236938776	Good	25.43	Very Poor
2.6	2.65	36.91428571	1.674771429	Fair	23.424	Serious
2.65	2.7	6.320285714	2.081895388	Good	12.39	Serious
2.7	2.75	0	2.25	Good	100	Good
2.75	2.8	6.885714286	1.974142857	Fair	0	Failed
2.8	2.85	9.245714286	2.043122449	Good	14.553	Serious
2.85	2.9	1.828571429	2.097619048	Good	0	Failed
2.9	2.95	22.62857143	1.554714286	Fair	31.58	Very Poor
2.95	3	3.428571429	2.035714286	Good	62.19	Fair
3	3.05	0.16	2.21952381	Good	0	Failed
3.05	3.1	0	2.25	Good	26.06	Very Poor
3.1	3.15	8.571428571	1.75	Fair	0	Failed
3.15	3.2	2.571428571	2.05	Good	2.04	Failed
3.2	3.25	2.571428571	2.05	Good	30.152	Very Poor
3.25	3.3	1.171428571	2.047823129	Good	6.42	Failed
3.3	3.35	17.21142857	1.936938776	Fair	17.243	Serious
3.35	3.4	0.068571429	2.236938776	Good	20.74	Serious
3.4	3.45	0	2.25	Good	34.12	Very Poor
3.45	3.5	0.285714286	2.195578231	Good	28.765	Very Poor
3.5	3.55	11.42857143	2.05	Good	14.8	Serious
3.55	3.6	33.14285714	1.75	Fair	0	Failed
3.6	3.65	0	2.25	Good	23.8	Serious
3.65	3.7	0	2.25	Good	52.898	Poor
3.7	3.75	6.914285714	2.012721088	Good	14.702	Serious

3.75	3.8	9.011428571	1.963741497	Fair	2.863	Failed
3.8	3.85	0.228571429	2.206462585	Good	27.2	Very Poor
3.85	3.9	3.445714286	2.05	Good	12.524	Serious
3.9	3.95	2.942857143	2.045102041	Good	13.92	Serious
3.95	4	5.428571429	2.05	Good	58.29	Fair
4	4.05	0.274285714	2.197755102	Good	29.435	Very Poor
4.05	4.1	0.114285714	2.228231293	Good	46.026	Poor
4.1	4.15	3.805714286	2.013755102	Good	52.87	Poor
4.15	4.2	34.74285714	1.754081633	Fair	0	Failed
			2.053033691		38.76223452	

Name of Road		T01 to Bori				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0.000	0.050	2.285714286	2.217346939	Good		
0.050	0.100	12.62285714	2.026761905	Good		
0.100	0.150	6.857142857	2.11122449	Good		
0.150	0.200	5.714285714	2.143877551	Good		
0.200	0.250	30.28571429	1.843877551	Fair		
0.250	0.300	28.42857143	1.870408163	Fair		
0.300	0.350	4	2.135714286	Good		
0.350	0.400	10.57142857	2.070408163	Good		
0.400	0.450	13.57142857	2.041020408	Good		

0.450	0.500	4.851428571	2.154380952	Good		
0.500	0.550	5.285714286	2.164285714	Good		
0.550	0.600	0.857142857	2.225510204	Good		
0.600	0.650	23.85714286	1.905102041	Fair		
0.650	0.700	14.85714286	2.025816327	Good		
0.700	0.750	23	1.858714286	Fair		
0.750	0.800	11.14285714	2.033673469	Good		
0.800	0.850	8.571428571	2.049734694	Good		
0.850	0.900	22	1.883142857	Fair		
0.900	0.950	20.28571429	1.923163265	Fair		
0.950	1.000	14.85714286	1.938469388	Fair		
1.000	1.050	24.85714286	1.821428571	Fair		
1.050	1.100	29.42857143	1.785857143	Fair		
1.100	1.150	38.57142857	1.876530612	Fair		
1.150	1.200	10.85714286	2.070408163	Good		
1.200	1.250	13.71428571	2.036938776	Good		
1.250	1.300	44.28571429	1.82755102	Fair		
1.300	1.350	29.14285714	1.802142857	Fair		
1.350	1.400	29.14285714	1.767857143	Fair		
1.400	1.450	22.45142857	1.894959184	Fair		
1.450	1.500	30	1.95	Fair		
1.500	1.550	24.45714286	1.941292517	Fair		
1.550	1.600	35	1.891496599	Fair		
1.600	1.650	24.77142857	1.850442177	Fair		

1.650	1.700	46.28571429	1.675285714	Fair		
1.700	1.750	54.85714286	1.690714286	Fair		
1.750	1.800	51.14285714	1.672714286	Fair		
1.800	1.850	53.88571429	1.715435374	Fair		
1.850	1.900	22.31428571	1.839897959	Fair		
1.900	1.950	12.14285714	2.052721088	Good		
1.950	2.000	41.02857143	1.684578231	Fair		
2.000	2.050	13.71428571	2.021571429	Good		
2.050	2.100	20.28571429	1.959557823	Fair		
2.100	2.150	34.28571429	1.95	Fair		
2.150	2.200	3.428571429	2.196938776	Good		
2.200	2.250	17.82857143	1.990510204	Fair		
			1.946432502			

Name of Road		L032 to Kusmi				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0.000	0.050	0	2.250	Good		
0.050	0.100	0	2.250	Good		
0.100	0.150	0	2.250	Good		
0.150	0.200	0	2.250	Good		
0.200	0.250	0	2.250	Good		
0.250	0.300	11.42857143	2.081	Good		

0.300	0.350	0.885714286	2.237	Good		
0.350	0.400	1.371428571	2.224	Good		
0.400	0.450	4.571428571	2.119	Good		
0.450	0.500	0.114285714	2.248	Good		
0.500	0.550	0.845714286	2.227	Good		
0.550	0.600	0	2.250	Good		
0.600	0.650	2	2.209	Good		
0.650	0.700	0.571428571	2.234	Good		
0.700	0.750	7.314285714	2.146	Good		
0.750	0.800	3.177142857	2.205	Good		
0.800	0.850	3.177142857	2.205	Good		
0.850	0.900	0.651428571	2.238	Good		
0.900	0.950	1.194285714	2.231	Good		
0.950	1.000	1.345714286	2.228	Good		
1.000	1.050	0	2.250	Good		
1.050	1.100	0	2.250	Good		
1.100	1.150	0.051428571	2.249	Good		
1.150	1.200	0	2.250	Good		
1.200	1.250	0.1	2.248	Good		
1.250	1.300	0	2.250	Good		
1.300	1.350	0	2.250	Good		
1.350	1.400	0.051428571	2.249	Good		
1.400	1.450	0.571428571	2.239	Good		
1.450	1.500	10.05714286	2.099	Good		

1.500	1.550	3.810285714	2.019	Good		
1.550	1.600	12.05714286	1.938	Fair		
1.600	1.650	0	2.250	Good		
1.650	1.700	28.57142857	1.950	Fair		
			2.201			

Name of Road		T01 to Dullapur				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0.000	0.050				100	Good
0.050	0.100				100	Good
0.100	0.150				78.6881	Satisfactory
0.150	0.200				0	Failed
0.200	0.250				0	Failed
0.250	0.300				0	Failed
0.300	0.350				0	Failed
0.350	0.400				0	Failed
0.400	0.450				0	Failed
0.450	0.500				0	Failed
0.500	0.550				14.772	Serious
0.550	0.600				0	Failed
0.600	0.650				0	Failed

0.650	0.700				0	Failed
0.700	0.750				0	Failed
0.750	0.800				0	Failed
0.800	0.850				0	Failed
0.850	0.900				0	Failed
0.900	0.950				0	Failed
0.950	1.000				0	Failed
1.000	1.050				22.6705	Serious
1.050	1.100				0	Failed
1.100	1.150				0	Failed
1.150	1.200				0	Failed
1.200	1.250				0	Failed
1.250	1.300				0	Failed
1.300	1.350				0	Failed
1.350	1.400				0	Failed
1.400	1.450				0	Failed
1.450	1.500				0	Failed
1.500	1.550				0	Failed
1.550	1.600				0	Failed
1.600	1.650				0	Failed
1.650	1.700				0	Failed
1.700	1.750				0	Failed
1.750	1.800				19.74355	Serious
1.800	1.850				0	Failed

1.850	1.900				34.89245	Very Poor
1.900	1.950				52.73001	Poor
1.950	2.000				52.73001	Poor
2.000	2.050				52.73001	Poor
2.050	2.100				52.7301	Poor
2.100	2.150				86.09286	Good
2.150	2.200				86.09286	Good
2.200	2.250				86.09286	Good
2.250	2.300				86.09286	Good
2.300	2.350				64.382	Fair
2.350	2.400				76.93029	Satisfactory
2.400	2.450				84.09286	Satisfactory
2.450	2.500				82.09286	Satisfactory
2.500	2.550				86.09286	Good
2.550	2.600				100	Good
2.600	2.650				99.3143	Good
2.650	2.700				100	Good
2.700	2.750				100	Good
2.750	2.800				100	Good
2.800	2.850				100	Good
2.850	2.900				100	Good
2.900	2.950				88.37333	Good
2.950	3.000				48	Poor
3.000	3.050				76.82674	Satisfactory

3.050	3.100				84.52172	Satisfactory
3.100	3.150				100	Good
3.150	3.200				79.15226	Satisfactory
3.200	3.250				24.948	Serious
3.250	3.300				56.87	Fair
3.300	3.350				14.19	Serious
3.350	3.400				18.80564	Serious
3.400	3.450				17.05096	Serious
3.450	3.500				37.1355	Very Poor
3.500	3.550				30.39975	Very Poor
3.550	3.600				10.892	Serious
3.600	3.650				13.4315	Serious
3.650	3.700				43.268	Poor
3.700	3.750				57.3	Fair
3.750	3.800				95.2143	Good
3.800	3.850				50.1398	Poor
3.850	3.900				43.08622	Poor
3.900	3.950				90.190296	Good
3.950	4.000				72.744	Satisfactory
4.000	4.050				71.49	Satisfactory
4.050	4.100				81.29	Satisfactory
4.100	4.150				84.36	Satisfactory
4.150	4.200				100	Good
4.200	4.250				100	Good

4.250	4.300				86.05944	Good
4.300	4.350				21.93895	Serious
4.350	4.400				21.1408	Serious
4.400	4.450				39.7409	Very Poor
4.450	4.500				74.4055	Satisfactory
4.500	4.550				71.69858	Satisfactory
4.550	4.600				90.378578	Good
4.600	4.650				22.74	Serious
4.650	4.700				22.74	Serious
4.700	4.750				22.74	Serious
4.750	4.800				22.74	Serious
4.800	4.850				22.74	Serious
4.850	4.900				35.83222	Very Poor
4.900	4.950				56.87	Fair
4.950	5.000				100	Good
5.000	5.050				100	Good

43.76641905

Name of Road		Athariya to Junwani				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0.000	0.050	100	1.95	Fair		
0.050	0.100	100	1.95	Fair		

0.100	0.150	100.3142857	1.944013605	Fair		
0.150	0.200	100	1.95	Fair		
0.200	0.250	76.71428571	1.95	Fair		
0.250	0.300	12	2.073	Good		
0.300	0.350	3.085714286	2.205918367	Good		
0.350	0.400	2.057142857	2.220612245	Good		
0.400	0.450	0.011428571	2.249782313	Good		
0.450	0.500	15.42857143	2.026714286	Good		
0.500	0.550	1.285714286	2.194081633	Good		
0.550	0.600	0.114285714	2.247823129	Good		
0.600	0.650	0.457142857	2.241292517	Good		
0.650	0.700	0.342857143	2.243469388	Good		
0.700	0.750	4	2.192857143	Good		
0.750	0.800	0	2.25	Good		
0.800	0.850	0	2.25	Good		
0.850	0.900	0	2.25	Good		
0.900	0.950	0.4	2.242380952	Good		
0.950	1.000	0	2.25	Good		
1.000	1.050	0	2.25	Good		
1.050	1.100	0	2.25	Good		
1.100	1.150	0	2.25	Good		
1.150	1.200	0	2.25	Good		
1.200	1.250	2.857142857	2.195578231	Good		
1.250	1.300	0.857142857	2.233673469	Good		

1.300	1.350	2.857142857	2.195578231	Good		
1.350	1.400	0.057142857	2.248367347	Good		
1.400	1.450	0.172857143	2.245061224	Good		
1.450	1.500	0.457142857	2.241292517	Good		
1.500	1.550	0.228571429	2.245646259	Good		
1.550	1.600	5.714285714	2.141156463	Good		
1.600	1.650	5.714285714	2.141156463	Good		
1.650	1.700	0	2.25	Good		
1.700	1.750	19.42857143	1.908857143	Fair		
1.750	1.800	4.571428571	2.119387755	Good		
1.800	1.850	5.714285714	2.141156463	Good		
1.850	1.900	5.714285714	2.141156463	Good		
1.900	1.950	0.857142857	2.233673469	Good		
1.950	2.000	1.714285714	2.217346939	Good		
2.000	2.050	0	2.25	Good		
2.050	2.100	3.428571429	2.184693878	Good		
2.100	2.150	32.57142857	1.95	Fair		
2.150	2.200	5.714285714	2.141156463	Good		
2.200	2.250	17.14285714	1.95	Fair		
2.250	2.300	17.14285714	1.95	Fair		
2.300	2.350	17.14285714	1.95	Fair		
2.350	2.400	1.028571429	2.230408163	Good		
2.400	2.450	23.14285714	1.944557823	Fair		
2.450	2.500	0	2.25	Good		

2.500	2.550	11.42857143	2.045918367	Good		
2.550	2.600	17.14285714	1.800340136	Fair		
2.600	2.650	6.171428571	2.108503401	Good		
2.650	2.700	0	2.25	Good		
2.700	2.750	2.365714286	2.185782313	Good		
2.750	2.800	0	2.25	Good		
2.800	2.850	0	2.25	Good		
2.850	2.900	2.857142857	2.195578231	Good		
2.900	2.950	0	2.25	Good		
2.950	3.000	0	2.25	Good		
3.000	3.050	5.714285714	2.168367347	Good		
3.100	3.150	11.88571429	1.859659864	Fair		
3.150	3.200	6.171428571	1.941292517	Fair		
3.200	3.250	2.857142857	2.195578231	Good		
3.250	3.300	1.428571429	2.222789116	Good		
3.300	3.350	2.857142857	2.195578231	Good		
3.350	3.400	0	2.25	Good		
3.400	3.450	5.714285714	2.25	Good		
3.450	3.500	0	2.007006803	Good		
3.500	3.550	0	2.25	Good		
3.550	3.600	0	2.25	Good		
3.600	3.650	0	2.25	Good		
3.650	3.700	0	2.25	Good		
3.700	3.750	0	2.25	Good		

3.750	3.800	2.285714286	2.206462585	Good		
3.800	3.850	0	2.25	Good		
3.850	3.900	1.142857143	2.228231293	Good		
3.900	3.950	1.714285714	2.217346939	Good		
3.950	4.000	0	2.25	Good		
4.000	4.050	1.714285714	2.217346939	Good		
4.050	4.100	1.142857143	2.233673469	Good		
4.100	4.150	0	2.25	Good		
4.150	4.200	2.742857143	2.197755102	Good		
4.200	4.250	0	2.25	Good		
4.250	4.300	1.428571429	2.228231293	Good		
4.300	4.350	0	2.25	Good		
4.350	4.400	0.685714286	2.230408163	Good		
4.400	4.450	0.571428571	2.239115646	Good		
4.450	4.500	0	2.25	Good		
4.500	4.550	0.685714286	2.230408163	Good		
4.550	4.600	0	2.25	Good		
4.600	4.650	5.714285714	2.093571429	Good		
4.650	4.700	85.71428571	1.95	Fair		
4.700	4.750	85.71428571	1.95	Fair		
4.750	4.800	37.94285714	1.945646259	Fair		
4.800	4.850	0	2.25	Good		

2.163296273

Name of Road		Navagaon to Kareli				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	0	2.25	Good	100	Good
0.05	0.1	0	2.25	Good	100	Good
0.1	0.15	0	2.25	Good	79.14238857	Satisfactory
0.15	0.2	1.725714286	2.215170068	Good	98.43571429	Good
0.2	0.25	1.828571429	2.195578231	Good	100	Good
0.25	0.3	0.137142857	2.223877551	Good	79.88	Satisfactory
0.3	0.35	0.091428571	2.232585034	Good	100	Good
0.35	0.4	8.708571429	2.041734694	Good	97.28428571	Good
0.4	0.45	25.71428571	1.95	Fair	100	Good
0.45	0.5	8.777142857	2.028673469	Good	100	Good
0.5	0.55	37.22857143	1.633673469	Fair	100	Good
0.55	0.6	19.65714286	1.729462585	Fair	100	Good
0.6	0.65	0.034285714	2.243469388	Good	100	Good
0.65	0.7	0.102857143	2.230408163	Good	85.00628571	Good
0.7	0.75	0.171428571	2.217346939	Good	100	Good
0.75	0.8	0.011428571	2.247823129	Good	100	Good
0.8	0.85	1.085714286	2.150952381	Good	100	Good
0.85	0.9	3.268571429	2.09	Good	100	Good
0.9	0.95	23.30285714	1.810680272	Fair	100	Good
0.95	1	27.59428571	1.802789116	Fair	100	Good

1	1.05	14.06	1.686734694	Fair	100	Good
1.05	1.1	15.81142857	1.706897959	Fair	100	Good
1.1	1.15	1.297142857	2.149863946	Good	100	Good
1.15	1.2	0.16	2.245428571	Good	47.23	Poor
1.2	1.25	3.428571429	2.001020408	Good	94.74571429	Good
1.25	1.3	10.65714286	1.973809524	Fair	94.23342857	Good
1.3	1.35	0.514285714	2.152040816	Good	100	Good
1.35	1.4	15.46857143	1.821571429	Fair	100	Good
1.4	1.45	20.99428571	1.673	Fair	100	Good
1.45	1.5	13.98857143	1.930897959	Fair	100	Good
1.5	1.55	0	2.25	Good	100	Good
1.55	1.6	43.54285714	1.95	Fair	100	Good
1.6	1.65	12.85714286	1.95	Fair	100	Good
1.65	1.7	0	2.25	Good	100	Good
1.7	1.75	0	2.25	Good	100	Good
1.75	1.8	0.32	2.189047619	Good	100	Good
1.8	1.85	0.034285714	2.243469388	Good	100	Good
1.85	1.9	5.497142857	1.947823129	Fair	100	Good
1.9	1.95	12.45714286	1.76870068	Fair	100	Good
1.95	2	0.091428571	2.232585034	Good	100	Good
2	2.05	27.92	1.920612245	Fair	100	Good
2.05	2.1	3.48	2.031605442	Good	100	Good
2.1	2.15	40.02857143	1.944557823	Fair	100	Good
2.15	2.2	0	2.25	Good	100	Good

2.052588435 97.18085948

Name of Road		Dongargarh to Haransinghi				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	0.634857143	2.237907483	Good	100	Good
0.05	0.1	6.115428571	2.133515646	Good	86.3888	Good
0.1	0.15	6.164571429	2.108993197	Good	88	Good
0.15	0.2	6.5	2.085034014	Good	89.8901	Good
0.2	0.25	9.541028571	2.065953197	Good	76.17628	Satisfactory
0.25	0.3	7.5	2.013605442	Good	87.667	Good
0.3	0.35	1.350857143	2.153510204	Good	90.4784	Good
0.35	0.4	6.658857143	2.001575918	Good	74.7	Satisfactory
0.4	0.45	5.714285714	2.141156463	Good	95.36	Good
0.45	0.5	1.678857143	2.185156463	Good	91.762	Good
0.5	0.55	19.28342857	1.863197279	Fair	62.61	Fair
0.55	0.6	2.096571429	2.115480272	Good	90	Good
0.6	0.65	0.468571429	2.24107483	Good	100	Good
0.65	0.7	0	2.25	Good	100	Good
0.7	0.75	2.925714286	2.190680272	Good	94.07	Good
0.75	0.8	0.308571429	2.244122449	Good	100	Good
0.8	0.85	3.374285714	2.182734694	Good	93.7111	Good
0.85	0.9	1.535714286	2.220748299	Good	97.4034	Good

0.9	0.95	0	2.25	Good	100	Good
0.95	1	1.434285714	2.222380952	Good	95.4034	Good
1	1.05	4.291714286	2.093273469	Good	71.22	Satisfactory
1.05	1.1	2.868571429	2.194761905	Good	94.07	Good
1.1	1.15	3.445714286	2.183469388	Good	94.26203	Good
1.15	1.2	0.628571429	2.220068027	Good	95	Good
1.2	1.25	3.085714286	2.179251701	Good	93	Good
1.25	1.3	1.454285714	2.220952381	Good	95.4034	Good
1.3	1.35	5.537714286	1.977877687	Fair	91	Good
1.35	1.4	3.146285714	2.17492517	Good	93	Good
1.4	1.45	0.211428571	2.241482993	Good	100	Good
1.45	1.5	77.22857143	1.948367347	Fair	41.4	Poor
1.5	1.55	104.7142857	1.95	Fair	40.113	Poor
1.55	1.6	52.39428571	1.895578231	Fair	57.56	Fair
1.6	1.65	13.94285714	1.95	Fair	77.69	Satisfactory
1.65	1.7	1.538133333	2.140133333	Good	82.017	Satisfactory
1.7	1.75	0.232	2.233428571	Good	86.748	Good
1.75	1.8	5.978666667	1.95	Fair	67.93208	Fair
1.8	1.85	0.4	2.229809524	Good	88	Good
1.85	1.9	2.833066667	2.17	Good	69.2526	Fair
1.9	1.95	11.32026667	1.95	Fair	54.41295	Poor
1.95	2	11.30133333	1.867714286	Fair	66.37178	Fair
2	2.05	5.450666667	2.102764444	Good	78.27574	Satisfactory
2.05	2.1	5.119466667	2.14008254	Good	78.9692	Satisfactory

2.1	2.15	18.59973333	1.928666667	Fair	42.8444	Poor
2.15	2.2	5.5328	1.965246222	Fair	72.0408	Satisfactory
2.2	2.25	0.03152	2.247748571	Good	100	Good
2.25	2.3	0.128	2.240857143	Good	95	Good
2.3	2.35	0.015466667	2.248895238	Good	100	Good
2.35	2.4	0.3	2.228571429	Good	85.736	Good
2.4	2.45	0.4168	2.220228571	Good	90	Good
2.45	2.5	0.0816	2.244171429	Good	93.008	Good
2.5	2.55	0.032	2.247714286	Good	97.456	Good
2.55	2.6	0.445866667	2.218152381	Good	92	Good
2.6	2.65	0.112	2.242	Good	93.144	Good
2.65	2.7	14.32170667	1.95	Fair	63.819	Fair
2.7	2.75	0.023466667	2.24832381	Good	100	Good
2.75	2.8	1.645333333	2.13247619	Good	79.6952	Satisfactory
2.8	2.85	0.765333333	2.195333333	Good	82.143	Satisfactory
2.85	2.9	0.341333333	2.225619048	Good	90	Good
2.9	2.95	5.146133333	1.95	Fair	68.0056	Fair
2.95	3	0.5632	2.209771429	Good	85.457	Good
3	3.05	25.08	1.75	Fair	73.597	Satisfactory
3.05	3.1	10.2704	1.870995556	Fair	80.74877	Satisfactory
3.1	3.15	4.945333333	1.96746	Fair	69.1402	Fair
3.15	3.2	5.010666667	1.95	Fair	76.6356	Satisfactory
3.2	3.25	4.864	1.97112	Fair	73.6688	Satisfactory
3.25	3.3	0.174666667	2.23752381	Good	92	Good

3.3	3.35	3.634666667	2.02644	Good	76.66392	Satisfactory
3.35	3.4	1.242933333	2.161219048	Good	79.25	Satisfactory
3.4	3.45	2.197866667	2.105413333	Good	79.1073	Satisfactory
3.45	3.5	0.24	2.243333333	Good	96.3527	Good
3.5	3.55	1.36704	2.152354286	Good	90.5706	Good
3.55	3.6	0.4144	2.2204	Good	92	Good
			2.118344489		83.88058542	

Name of Road		Dongargarh to Karwari				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	0	2.25	Good	100	Good
0.05	0.1	0	2.25	Good	100	Good
0.1	0.15	0	2.25	Good	100	Good
0.15	0.2	2.914285714	2.191496599	Good	78.808	Satisfactory
0.2	0.25	3.068571429	1.966734694	Fair	53.2488	Poor
0.25	0.3	0	2.25	Good	39.9	Very Poor
0.3	0.35	2.8572	2.195577143	Good	25.775	Very Poor
0.35	0.4	2.967142857	2.17462585	Good	19.7472	Serious
0.4	0.45	2.876914286	2.191812245	Good	26.58	Very Poor
0.45	0.5	2.951428571	2.177619048	Good	26.335	Very Poor
0.5	0.55	4.317142857	2.079387755	Good	0	Failed
0.55	0.6	3.268571429	2.183823129	Good	53.936	Poor

0.6	0.65	2.988571429	2.170544218	Good	89.95	Good
0.65	0.7	2.857142857	2.195578231	Good	38.1315	Very Poor
0.7	0.75	2.857142857	2.195578231	Good	14	Serious
0.75	0.8	2.964285714	2.195578231	Good	88.428	Good
0.8	0.85	2.857142857	2.195578231	Good	5.904	Failed
0.85	0.9	2.875714286	2.192040816	Good	81.429	Satisfactory
0.9	0.95	2.857142857	2.195578231	Good	0	Failed
0.95	1	2.857142857	2.195578231	Good	9.904	Failed
1	1.05	5.085714286	1.995578231	Fair	5.71	Failed
1.05	1.1	2.857142857	2.195578231	Good	33.9565	Very Poor
1.1	1.15	2.874285714	2.192312925	Good	14.58	Serious
1.15	1.2	2.857142857	2.195578231	Good	84.344	Satisfactory
1.2	1.25	2.857142857	2.195578231	Good	3.70324	Failed
1.25	1.3	2.857142857	2.195578231	Good	57.94592	Fair
1.3	1.35	2.857142857	2.195578231	Good	2.31994	Failed
1.35	1.4	2.857142857	2.195578231	Good	17.1364	Serious
1.4	1.45	2.857142857	2.195578231	Good	27.268	Very Poor
1.45	1.5	2.857142857	2.195578231	Good	10.4624	Serious
1.5	1.55	3.928571429	2.164965986	Good	100	Good
1.55	1.6	6.457142857	2.092721088	Good	93.9658	Good
1.6	1.65	2.857142857	2.195578231	Good	81.8	Satisfactory
1.65	1.7	2.857142857	2.195578231	Good	100	Good
1.7	1.75	6.071428571	2.103741497	Good	100	Good
1.75	1.8	2.857142857	2.195578231	Good	16.5	Serious

1.8	1.85	2.857142857	2.195578231	Good	83.4	Satisfactory
1.85	1.9	3.057142857	2.157482993	Good	47.51	Poor
1.9	1.95	2.857142857	2.195578231	Good	0	Failed
1.95	2	2.857142857	2.195578231	Good	89.24	Good
2	2.05	2.857142857	2.195578231	Good	11.628	Serious
2.05	2.1	2.857142857	2.195578231	Good	40.967	Poor
2.1	2.15	2.857142857	2.195578231	Good	20	Serious
2.15	2.2	0	2.195578231	Good	100	Good
2.2	2.25	2.874285714	2.192312925	Good	100	Good
2.25	2.3	5.03	2.128639456	Good	75.136	Satisfactory
2.3	2.35	3.147142857	2.160748299	Good	61.43	Fair
2.35	2.4	3.964285714	2.167006803	Good	39.829	Very Poor
2.4	2.45	0	2.25	Good	12.18	Serious
2.45	2.5	0	2.25	Good	11.933	Serious
2.5	2.55	0	2.25	Good	76.571	Satisfactory
2.55	2.6	0	2.25	Good	25.43	Very Poor
2.6	2.65	0	2.25	Good	23.424	Serious
2.65	2.7	0	2.25	Good	12.39	Serious
2.7	2.75	0	2.25	Good	100	Good
2.75	2.8	0	2.25	Good	0	Failed
2.8	2.85	0	2.25	Good	14.553	Serious
2.85	2.9	0	2.25	Good	0	Failed
2.9	2.95	0	2.25	Good	31.58	Very Poor
2.95	3	0	2.25	Good	62.19	Fair

Name of Road		T04 To Tilaibhat				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	20.56671429	1.679932857	Fair	56.036	Fair
0.05	0.1	13.22571429	1.793693878	Fair	17.2324	Serious
0.1	0.15	41.09464286	1.55	Fair	0	Failed
0.15	0.2	19.37742857	1.89804898	Fair	78.808	Satisfactory
0.2	0.25	28.78071429	2.09822449	Good	53.2488	Poor
0.25	0.3	28.79657143	1.829183673	Fair	39.9	Very Poor
0.3	0.35	114.5342857	1.678	Fair	25.775	Very Poor
0.35	0.4	72.76528571	1.809761905	Fair	19.7472	Serious
0.4	0.45	13.63714286	1.984531429	Fair	26.58	Very Poor
0.45	0.5	16.65	1.95	Fair	26.335	Very Poor
0.5	0.55	11.29028571	1.95	Fair	0	Failed
0.55	0.6	3.701057143	2.023452429	Good	53.936	Poor
0.6	0.65	0	2.25	Good	89.95	Good
0.65	0.7	0.951428571	2.182040816	Good	38.1315	Very Poor
0.7	0.75	44.4	1.95	Fair	14	Serious
0.75	0.8	0	2.25	Good	88.428	Good
0.8	0.85	0	2.25	Good	5.904	Failed
0.85	0.9	12.375	2.00725	Good	81.429	Satisfactory
0.9	0.95	5.740285714	1.95	Fair	0	Failed

0.95	1	25.60928571	1.68025	Fair	9.904	Failed
1	1.05	1.714285714	2.05	Good	5.71	Failed
1.05	1.1	0.190285714	2.236408163	Good	33.9565	Very Poor
1.1	1.15	35.25928571	1.564197619	Fair	14.58	Serious
1.15	1.2	13.63714286	1.933697959	Fair	84.344	Satisfactory
			1.939528092		35.99730833	

Name of Road		Dara Telkadih T04 to Charbhata				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	0	2.25	Good	100	Good
0.05	0.1	3.733333333	2.196666667	Good	97.15	Good
0.1	0.15	0.08	2.24847619	Good	100	Good
0.15	0.2	0	2.25	Good	100	Good
0.2	0.25	0	2.244285714	Good	100	Good
0.25	0.3	1.68	2.218	Good	89.072	Good
0.3	0.35	2.666666667	2.199206349	Good	97.863	Good
0.35	0.4	0	2.25	Good	100	Good
0.4	0.45	0	2.25	Good	100	Good
0.45	0.5	6.48	2.157047619	Good	95.798	Good
0.5	0.55	0	2.25	Good	100	Good
0.55	0.6	0.28	2.244666667	Good	100	Good
0.6	0.65	0	2.25	Good	100	Good

0.65	0.7	0	2.25	Good	100	Good
0.7	0.75	0.64	2.237809524	Good	91.176	Good
0.75	0.8	0.72	2.236285714	Good	91.228	Good
0.8	0.85	13.12	2.030571429	Good	77.55	Satisfactory
0.85	0.9	10.0736	2.08351873	Good	59.84	Fair
0.9	0.95	44.41333333	1.85	Fair	38.302	Very Poor
0.95	1	0	2.25	Good	100	Good
1	1.05	1.6	2.05	Good	100	Good
1.05	1.1	6.48	2.239333333	Good	100	Good
1.1	1.15	3.493333333	2.239333333	Good	100	Good
1.15	1.2	0	2.25	Good	100	Good
1.2	1.25	0	2.25	Good	100	Good
1.25	1.3	0	2.25	Good	100	Good
1.3	1.35	0	2.25	Good	100	Good
1.35	1.4	2.133333333	2.21952381	Good	97.493	Good
1.4	1.45	0	2.25	Good	100	Good
1.45	1.5	0	2.25	Good	100	Good
1.5	1.55	0	2.25	Good	100	Good
1.55	1.6	0	2.25	Good	100	Good
			2.209210159		94.8585	

Name of Road		T05 to Boirdih				
Chainage			IRC		ASTM	

From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	1.826666667	2.124730159	Good	97.4277	Good
0.05	0.1	13.38933333	1.948933333	Fair	100	Good
0.1	0.15	1.542666667	2.21695873	Good	100	Good
0.15	0.2	0.32	2.248984127	Good	100	Good
0.2	0.25	2.438666667	2.198533333	Good	92.92856	Good
0.25	0.3	1.2	2.187142857	Good	92.2428	Good
0.3	0.35	0.128	2.247561905	Good	100	Good
0.35	0.4	0.234666667	2.245530159	Good	100	Good
0.4	0.45	2.293333333	2.090952381	Good	89.4814	Good
0.45	0.5	1.666666667	2.147650794	Good	72.252	Satisfactory
0.5	0.55	7.208	1.949847619	Fair	100	Good
0.55	0.6	3.906666667	2.249238095	Good	100	Good
0.6	0.65	1.034666667	2.144349206	Good	63.07	Fair
0.65	0.7	4.704	2.020336508	Good	100	Good
0.7	0.75	2.901333333	2.233746032	Good	100	Good
0.75	0.8	0.632	2.245580952	Good	100	Good
0.8	0.85	0.36	2.236438095	Good	100	Good
0.85	0.9	0.096	2.248171429	Good	100	Good
0.9	0.95	0.042666667	2.249187302	Good	100	Good
0.95	1	3.248	2.045085714	Good	100	Good
1	1.05	1.68	2.04847619	Good	100	Good
1.05	1.1	26.74666667	2.24847619	Good	92.171434	Good
1.1	1.15	26.78666667	2.247714286	Good	92.171434	Good

1.15	1.2	26.8	2.247460317	Good	92.171434	Good
1.2	1.25	26.77333333	2.247968254	Good	92.171434	Good
1.25	1.3	40	2.25	Good	91.22001	Good
1.3	1.35	40.008	2.249847619	Good	91.22001	Good
1.35	1.4	42.56	2.201238095	Good	87.22001	Good
1.4	1.45	32.032	2.249390476	Good	98.632	Good
1.45	1.5	32	2.25	Good	90.88	Good
1.5	1.55	32	2.25	Good	92.98572	Good
1.55	1.6	26.66666667	2.25	Good	94.14143	Good
1.6	1.65	26.74666667	2.24847619	Good	94.14143	Good
1.65	1.7	27.46666667	2.234761905	Good	87.25714	Good
1.7	1.75	26.66666667	2.25	Good	94.14143	Good
1.75	1.8	0.533333333	2.148412698	Good	24.5713	Serious
1.8	1.85	26.74666667	2.24847619	Good	94.14143	Good
1.85	1.9	26.66666667	2.25	Good	94.14143	Good
1.9	1.95	26.66666667	2.25	Good	94.14143	Good
1.95	2	26.66666667	2.25	Good	94.14143	Good
2	2.05	0	2.25	Good	100	Good
2.05	2.1	0	2.25	Good	100	Good
2.1	2.15	0	2.25	Good	100	Good
2.15	2.2	0	2.247968254	Good	100	Good
2.2	2.25	0	2.25	Good	100	Good
2.25	2.3	0	2.25	Good	100	Good
			2.204296204		93.45792165	

Name of Road		Tumnibodh to Nathungaon				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0.000	0.050		2.25	Good		
0.050	0.100		2.25	Good		
0.100	0.150		2.25	Good		
0.150	0.200		2.25	Good		
0.200	0.250		2.25	Good		
0.250	0.300		2.25	Good		
0.300	0.350		2.25	Good		
0.350	0.400		2.235387755	Good		
0.400	0.450		2.25	Good		
0.450	0.500		2.240204082	Good		
0.500	0.550		2.150408163	Good		
0.550	0.600		2.106598639	Good		
0.600	0.650		2.227034014	Good		
0.650	0.700		2.236285714	Good		
0.700	0.750		2.121836735	Good		
0.750	0.800		2.1	Good		
0.800	0.850		2.066326531	Good		

0.850	0.900		2.25	Good		
0.900	0.950		2.245646259	Good		
0.950	1.000		2.184693878	Good		
1.000	1.050		2.241292517	Good		
1.050	1.100		2.192857143	Good		
1.100	1.150		2.25	Good		
			2.210807453			

Name of Road		Diwanjitiya to Godri				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0.000	0.050	0.0699965	2.248421848	Good		
0.050	0.100	11.428	2.080722	Good		
0.100	0.150	26.7306634	1.94579885	Fair		
0.150	0.200	25.730142	1.772220441	Fair		
0.200	0.250	1.565636	2.206464762	Good		
0.250	0.300	0.034284	2.243469714	Good		
0.300	0.350	3.462684	2.194492571	Good		
0.350	0.400	15.19924	2.025258107	Good		
0.400	0.450	0.022856	1.949673486	Fair		
0.450	0.500	24.815902	2.249673486	Good		
0.500	0.550	0.3925518	2.23865907	Good		

0.550	0.600	2.982708	2.162929524	Good		
0.600	0.650	26.295828	1.942816686	Fair		
0.650	0.700	17.187712	2.002712295	Good		
0.700	0.750	25.713	1.95	Fair		
0.750	0.800	4.754048	2.128808781	Good		
0.800	0.850	3.6163906	2.165008331	Good		
0.850	0.900	1.7142	2.217348571	Good		
0.900	0.950	0.02857	2.248476267	Good		
0.950	1.000	4.2855	2.188778571	Good		
1.000	1.050	0.982808	2.226926324	Good		
1.050	1.100	23.244552	1.94259901	Fair		
1.100	1.150	1.48564	2.225783524	Good		
1.150	1.200	79.996	1.95	Fair		
1.200	1.250	0.5714	2.23911619	Good		
1.250	1.300	0.68568	2.240204571	Good		
1.300	1.350	0.25713	2.245102286	Good		
1.350	1.400	1.08566	2.228341219	Good		
1.400	1.450	1.039948	2.228232381	Good		
1.450	1.500	2.862714	2.235578952	Good		
1.500	1.550	0.868528	2.077904762	Good		
			2.129081374			

Name of Road	Arjuni to Pairi

Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	0.314285714	2.21952381	Good	58.99	Fair
0.05	0.1	0.48	2.229102041	Good	99.171	Good
0.1	0.15	0.291428571	2.22877551	Good	67.58	Fair
0.15	0.2	0.857142857	2.184693878	Good	35.57	Very Poor
0.2	0.25	0.542857143	2.217619048	Good	75.87	Satisfactory
0.25	0.3	2.925714286	2.173809524	Good	49.39	Poor
0.3	0.35	4.771428571	2.164829932	Good	76.43	Satisfactory
0.35	0.4	0.342857143	2.243469388	Good	99.7428	Good
0.4	0.45	0.571428571	2.239115646	Good	95.372	Good
0.45	0.5	8.274285714	2.04755102	Good	65.7499	Fair
0.5	0.55	9.6	2.083469388	Good	81.286	Satisfactory
0.55	0.6	11.54285714	2.027414966	Good	71.86	Satisfactory
0.6	0.65	17.2	1.946904762	Fair	91.7633	Good
0.65	0.7	28.05714286	1.824829932	Fair	58.363	Fair
0.7	0.75	8.742857143	2.124285714	Good	95.26	Good
0.75	0.8	0.194285714	2.242380952	Good	67.32	Fair
0.8	0.85	0.571428571	2.239115646	Good	95.372	Good
0.85	0.9	0.217142857	2.245863946	Good	100	Good
0.9	0.95	0.285714286	2.244557823	Good	100	Good
0.95	1	0.457142857	2.234108844	Good	93	Good
1	1.05	2.125714286	2.042163265	Good	99.7858	Good
1.05	1.1	0.285714286	2.244557823	Good	100	Good

1.1	1.15	0.285714286	2.244557823	Good	100	Good
1.15	1.2	2.605714286	2.211251701	Good	63.32	Fair
1.2	1.25	0	2.25	Good	100	Good
1.25	1.3	0.011428571	2.247823129	Good	92.44	Good
1.3	1.35	0	2.25	Good	100	Good
1.35	1.4	0	2.25	Good	100	Good
1.4	1.45	0.857142857	2.233673469	Good	91.1754	Good
1.45	1.5	0.171428571	2.246734694	Good	100	Good
1.5	1.55	0.457142857	2.241292517	Good	99.7729	Good
1.55	1.6	0.857142857	2.233673469	Good	93.8673	Good
1.6	1.65	0.8	2.234761905	Good	100	Good
1.65	1.7	0	2.25	Good	100	Good
1.7	1.75	0	2.25	Good	100	Good
1.75	1.8	0	2.25	Good	100	Good
1.8	1.85	0	2.25	Good	100	Good
1.85	1.9	0	2.25	Good	100	Good
			2.193208199		87.32766842	

Name of Road		Arjuni to Salikjhitiya				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0.000	0.050	0	2.25	Good		
0.050	0.100	0	2.25	Good		
0.100	0.150	0.034284	2.243469714	Good		

0.150	0.200	0.011428	2.247823238	Good		
0.200	0.250	3.434114	2.199934476	Good		
0.250	0.300	0	2.25	Good		
0.300	0.350	0.019999	2.248149752	Good		
0.350	0.400	63.9968	1.95	Fair		
0.400	0.450	79.996	1.95	Fair		
0.450	0.500	79.996	1.95	Fair		
0.500	0.550	79.996	1.95	Fair		
0.550	0.600	25.713	1.85	Fair		
0.600	0.650	0.011428	2.247823238	Good		
			2.12209234			

Name of Road		R.D.C. Road to Farhadh				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0.000	0.050	28.59428571	1.945646259	Fair		
0.050	0.100	94.71428571	1.492857143	Fair		
0.100	0.150	27.97142857	1.753537415	Fair		
0.150	0.200	81.92	1.495142857	Fair		
0.200	0.250	115.7142857	1.25	Fair		
0.250	0.300	53.50285714	1.357619048	Fair		
0.300	0.350	82.45142857	1.25	Fair		
0.350	0.400	115.1428571	0.988142857	POOR		

0.400	0.450	60.8	1.621122449	Fair		
0.450	0.500	53.94285714	1.209183673	Fair		
0.500	0.550	87.71428571	1.42755102	Fair		
0.550	0.600	26.50285714	1.683155102	Fair		
0.600	0.650	3.502857143	2.016802721	Good		
0.650	0.700	77.66285714	1.849591837	Fair		
0.700	0.750	0	2.25	Good		
0.750	0.800	24.17142857	1.91	Fair		
0.800	0.850	63.08571429	1.25	Fair		
0.850	0.900	46.62857143	1.643779592	Fair		
0.900	0.950	10.4	1.989319728	Fair		
0.950	1.000	7.428571429	2.018707483	Good		
1.000	1.050	9.2	2.033673469	Good		
1.050	1.100	2.885714286	2.075714286	Good		
1.100	1.150	84.57142857	1.497619048	Fair		
1.150	1.200	67.62857143	1.25	Fair		
1.200	1.250	55.66285714	1.612734694	Fair		
1.250	1.300	29.71428571	1.785306122	Fair		
1.300	1.350	23.85714286	1.684585034	Fair		
1.350	1.400	39.51428571	1.444387755	Fair		
1.400	1.450	2.285714286	2.087142857	Good		
1.450	1.500	65.94285714	1.035714286	Fair		
1.500	1.550	100.2857143	2.077904762	Good		
			1.644740048			

Name of Road		Ahirwara to Dor (Malpuri road)				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	0	2.25	Good		
0.05	0.1	0	2.25	Good		
0.1	0.15	0	2.25	Good		
0.15	0.2	0	2.25	Good		
0.2	0.25	0	2.25	Good		
0.25	0.3	0	2.25	Good		
0.3	0.35	0	2.25	Good		
0.35	0.4	0	2.25	Good		
0.4	0.45	0	2.25	Good		
0.45	0.5	0	2.25	Good		
0.5	0.55	0	2.25	Good		
0.55	0.6	0	2.25	Good		
0.6	0.65	0	2.25	Good		
0.65	0.7	0	2.25	Good		
0.7	0.75	0	2.25	Good		
0.75	0.8	0	2.25	Good		
0.8	0.85	0	2.25	Good		
0.85	0.9	0	2.25	Good		
0.9	0.95	0.015714286	2.24970068	Good		

0.95	1	0	2.25	Good		
1	1.05	0.031428571	2.249401361	Good		
1.05	1.1	0.095714286	2.248176871	Good		
1.1	1.15	0.062857143	2.248802721	Good		
1.15	1.2	0.205714286	2.246081633	Good		
1.2	1.25	0.062857143	2.248802721	Good		
1.25	1.3	0.142857143	2.247278912	Good		
1.3	1.35	0.095228571	2.248186122	Good		
1.35	1.4	0.031428571	2.249401361	Good		
1.4	1.45	0.158571429	2.246979592	Good		
1.45	1.5	0	2.25	Good		
1.5	1.55	0	2.25	Good		
1.55	1.6	0	2.25	Good		
1.6	1.65	0	2.25	Good		
1.65	1.7	0	2.25	Good		
1.7	1.75	0.142857143	2.247278912	Good		
1.75	1.8	0	2.25	Good		
1.8	1.85	0	2.25	Good		
1.85	1.9	0	2.25	Good		
1.9	1.95	0	2.25	Good		
1.95	2	0	2.25	Good		
2	2.05	0	2.25	Good		
2.05	2.1	0	2.25	Good		
2.1	2.15	0	2.25	Good		

2.15	2.2		2.25	Good		
2.2	2.25	0	2.25	Good		
2.25	2.3	0	2.25	Good		
2.3	2.35	0	2.25	Good		
2.35	2.4	0	2.25	Good		
2.4	2.45	0	2.25	Good		
2.45	2.5	0.031428571	2.249401361	Good		
2.5	2.55	0	2.25	Good		
2.55	2.6	0	2.25	Good		
2.6	2.65	0	2.25	Good		
2.65	2.7	0	2.25	Good		
2.7	2.75	0	2.25	Good		
2.75	2.8	0	2.25	Good		
2.8	2.85	0	2.25	Good		
2.85	2.9	0.031428571	2.249401361	Good		
2.9	2.95	0	2.25	Good		
2.95	3	0	2.25	Good		
3	3.05	0	2.25	Good		
3.05	3.1	0.015714286	2.24970068	Good		
3.1	3.15	15.71428571	2.022857143	Good		
3.15	3.2	0	2.25	Good		
3.2	3.25	0	2.25	Good		
3.25	3.3	0	2.25	Good		
3.3	3.35	0	2.25	Good		

3.35	3.4	1.857142857	2.117346939	Good		
3.4	3.45	0	2.25	Good		
3.45	3.5	0	2.25	Good		
3.5	3.55	0	2.25	Good		
3.55	3.6	0	2.25	Good		
3.6	3.65	0	2.25	Good		
3.65	3.7	0	2.25	Good		
3.7	3.75	0	2.25	Good		
3.75	3.8	0	2.25	Good		
3.8	3.85	0	2.25	Good		
3.85	3.9	0	2.25	Good		
3.9	3.95	0	2.25	Good		
3.95	4	0.062857143	2.248802721	Good		
4	4.05	0	2.25	Good		
4.05	4.1	0	2.25	Good		
4.1	4.15	0	2.25	Good		
4.15	4.2	0.031428571	2.247755102	Good		
4.2	4.25	0	2.25	Good		
4.25	4.3	0	2.25	Good		
4.3	4.35	0	2.25	Good		
4.35	4.4	0.031428571	2.249401361	Good		
4.4	4.45	0	2.25	Good		
4.45	4.5	0	2.25	Good		
4.5	4.55	0	2.25	Good		

4.55	4.6	0	2.25	Good		
4.6	4.65	0	2.25	Good		
4.65	4.7	0.125714286	2.247605442	Good		
4.7	4.75	0.062857143	2.248802721	Good		
4.75	4.8	0	2.25	Good		
4.8	4.85	0	2.25	Good		
4.85	4.9	0	2.25	Good		
4.9	4.95	0.014285714	2.249727891	Good		
4.95	5	0	2.25	Good		
5	5.05	0	2.25	Good		
5.05	5.1	0.095257143	2.248185578	Good		
5.1	5.15	0.380914286	2.24274449	Good		
5.15	5.2	0.031428571	2.249401361	Good		
5.2	5.25	0.345714286	2.243414966	Good		
5.25	5.3	0	2.25	Good		
5.3	5.35	0	2.25	Good		
5.35	5.4	0	2.25	Good		
5.4	5.45	0	2.25	Good		
5.45	5.5	0	2.25	Good		
5.5	5.55	0	2.25	Good		
5.55	5.6	0.188571429	2.246408163	Good		
5.6	5.65	0.125714286	2.247605442	Good		
5.65	5.7	0.125714286	2.247605442	Good		
5.7	5.75	0.125714286	2.247605442	Good		

5.75	5.8	0	2.25	Good		
5.8	5.85	0.125714286	2.247605442	Good		
5.85	5.9	0.126857143	2.247583673	Good		
5.9	5.95	0.014285714	2.249727891	Good		
5.95	6	0	2.25	Good		
6	6.05	0	2.25	Good		
6.05	6.1	0	2.25	Good		
6.1	6.15	0.062857143	2.248802721	Good		
6.15	6.2	0	2.25	Good		
6.2	6.25	0.062857143	2.248802721	Good		
6.25	6.3	0.062857143	2.248802721	Good		
6.3	6.35	0	2.25	Good		
6.35	6.4	0	2.25	Good		
6.4	6.45	0	2.25	Good		
6.45	6.5	0	2.25	Good		
6.5	6.55	0	2.25	Good		
6.55	6.6	0	2.25	Good		
6.6	6.65	0	2.25	Good		
6.65	6.7	0	2.25	Good		
6.7	6.75	0.031428571	2.249401361	Good		
6.75	6.8	0	2.25	Good		
6.8	6.85	0.062857143	2.248802721	Good		
6.85	6.9	0	2.25	Good		
6.9	6.95	0	2.25	Good		

6.95	7	0	2.25	Good		
7	7.05	0	2.25	Good		
7.05	7.1	0	2.25	Good		
7.1	7.15	0	2.25	Good		
7.15	7.2	0	2.25	Good		
7.2	7.25	28.28571429	1.95	Fair		
7.25	7.3	0	2.25	Good		
7.3	7.35	18.85714286	1.888428571	Fair		
7.35	7.4	0	2.25	Good		
7.4	7.45	2.357142857	2.05	Good		
7.45	7.5	3.142857143	2.05	Good		
7.5	7.55	2.357142857	2.05	Good		
7.55	7.6	0	2.25	Good		
7.6	7.65	0	2.25	Good		
7.65	7.7	0.062857143	2.248802721	Good		
7.7	7.75	0	2.25	Good		
7.75	7.8	0	2.25	Good		
7.8	7.85	0.062857143	2.248802721	Good		
7.85	7.9	0	2.25	Good		
7.9	7.95	0	2.25	Good		
7.95	8	0	2.25	Good		
8	8.05	0	2.25	Good		
8.05	8.1	9.428571429	2.115306122	Good		
8.1	8.15	0	2.25	Good		

8.15	8.2	0	2.25	Good		
8.2	8.25	33	1.95	Fair		
8.25	8.3	99	1.95	Fair		
8.3	8.35	23.57142857	1.95	Fair		
8.35	8.4	99	1.95	Fair		
8.4	8.45	89	1.95	Fair		
8.45	8.5	6.285714286	2.160204082	Good		
8.5	8.55	0	2.25	Good		
8.55	8.6	0	2.25	Good		
8.6	8.65	0.015714286	2.24970068	Good		
8.65	8.7	0	2.25	Good		
8.7	8.75	76.28571429	1.95	Fair		
8.75	8.8	67.71428571	1.95	Fair		
8.8	8.85	3.142857143	2.05	Good		
8.85	8.9	0	2.25	Good		
8.9	8.95	1.571428571	2.05	Good		
8.95	9	0.011428571	2.249782313	Good		
9	9.05	0	2.25	Good		
9.05	9.1	0	2.25	Good		
9.1	9.15	0	2.25	Good		
9.15	9.2	0	2.25	Good		
9.2	9.25	0	2.25	Good		
9.25	9.3	0	2.25	Good		
9.3	9.35	0.031428571	2.249401361	Good		

9.35	9.4	0	2.25	Good		
9.4	9.45	0	2.25	Good		
9.45	9.5	0.031428571	2.249401361	Good		
9.5	9.55	3.142857143	2.190136054	Good		
9.55	9.6	0	2.25	Good		
9.6	9.65	0	2.25	Good		
9.65	9.7	0	2.25	Good		
9.7	9.75	0	2.25	Good		
9.75	9.8	0	2.25	Good		
9.8	9.85	0	2.25	Good		
9.85	9.9	38.09142857	1.95	Fair		
9.9	9.95	25.48857143	1.948204082	Fair		
9.95	10	0	2.25	Good		
10	10.05	0.031428571	2.249401361	Good		
10.05	10.1	12.82285714	2.060496599	Good		
10.1	10.15	0	2.25	Good		
			2.22404661			

Name of Road		Main road T011 to Bharani				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0.000	0.050	0	2.25	Good		
0.050	0.100	6.857142857	2.071802721	Good		

0.100	0.150	0.714285714	2.236394558	Good		
0.150	0.200	1.428571429	2.226190476	Good		
0.200	0.250	0	2.25	Good		
0.250	0.300	5.714285714	1.95	Fair		
0.300	0.350	5.714285714	1.95	Fair		
0.350	0.400	2.857142857	2.061428571	Good		
0.400	0.450	0	2.139795918	Good		
0.450	0.500	7.571428571	2.25	Good		
0.500	0.550	5.714285714	1.95	Fair		
0.550	0.600	85.71428571	1.95	Fair		
0.600	0.650	43.78571429	1.932312925	Fair		
0.650	0.700	0	2.25	Good		
0.700	0.750	6.857142857	2.119387755	Good		
0.750	0.800	0	2.25	Good		
0.800	0.850	0.071428571	2.248639456	Good		
0.850	0.900	0	2.25	Good		
0.900	0.950	1.714285714	2.217346939	Good		
0.950	1.000	0	2.25	Good		
1.000	1.050	0	2.25	Good		
1.050	1.100	0	2.25	Good		
1.100	1.150	0	2.25	Good		
1.150	1.200	0	2.25	Good		
1.200	1.250	0	2.25	Good		
			2.162131973			

Name of Road		T05 to Khilora Mandir				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0.000	0.050	0	2.25	Good	100	Good
0.050	0.100	8.571428571	2.086734694	Good	70	Satisfactory
0.100	0.150	2.977142857	2.059142857	Good	96	Good
0.150	0.200	5.714628571	1.949993469	Fair	100	Good
0.200	0.250	91.66857143	1.945428571	Fair	23.11	Serious
0.250	0.300	0	2.25	Good	100	Good
0.300	0.350	7.374285714	2.14355102	Good	95.9	Good
0.350	0.400	0	2.25	Good	100	Good
0.400	0.450	0	2.25	Good	100	Good
0.450	0.500	0	2.25	Good	100	Good
0.500	0.550	0.154285714	2.247061224	Good	95	Good
0.550	0.600	0.2	2.235714286	Good	97.6	Good
0.600	0.650	0.051428571	2.249020408	Good	97.6	Good
0.650	0.700	0	2.25	Good	100	Good
0.700	0.750	0	2.25	Good	100	Good
0.750	0.800	0.051428571	2.249020408	Good	95	Good
0.800	0.850	0	2.25	Good	100	Good

0.850	0.900	0	2.25	Good	100	Good
0.900	0.950	0	2.25	Good	100	Good
0.950	1.000	0.257142857	2.245102041	Good	100	Good
1.000	1.050	1.714285714	2.05	Good	100	Good
1.050	1.100	0.005142857	2.249902041	Good	100	Good
1.100	1.150	0	2.25	Good	100	Good
1.150	1.200	0.064285714	2.24877551	Good	96.976	Good
1.200	1.250	28.57142857	1.85	Fair	85	Good
1.250	1.300	0.045714286	2.249129252	Good	97.831	Good
1.300	1.350	0.057142857	2.248911565	Good	97.335	Good
1.350	1.400	0.057142857	2.248911565	Good	97.335	Good
1.400	1.450	0.057142857	2.248911565	Good	97.335	Good
1.450	1.500	0.057142857	2.248911565	Good	97.335	Good
1.500	1.550	0	2.25	Good	100	Good
1.550	1.600	0	2.25	Good	100	Good
1.600	1.650	0	2.25	Good	100	Good
1.650	1.700	0.571428571	2.239115646	Good	100	Good
1.700	1.750	71.42857143	1.95	Fair	0	Failed
1.750	1.800	0	2.25	Good	100	Good
1.800	1.850	0.071428571	2.247891156	Good	100	Good
1.850	1.900	0.071428571	2.248639456	Good	100	Good
1.900	1.950	0.071428571	2.248639456	Good	100	Good
1.950	2.000	0	2.25	Good	100	Good
2.000	2.050	100.2571429	1.85	Fair	71	Satisfactory

2.050	2.100	28.57142857	1.85	Fair	85	Good
2.100	2.150	0	2.25	Good	100	Good
2.150	2.200	0	2.249455782	Good	100	Good
2.200	2.250	0	2.25	Good	100	Good
2.250	2.300	0.042857143	2.249183673	Good	100	Good
2.300	2.350	0	2.25	Good	100	Good
2.350	2.400	0.205714286	2.246081633	Good	95	Good
2.400	2.450	0	2.25	Good	100	Good
2.450	2.500	0	2.25	Good	100	Good
2.500	2.550	0	2.25	Good	100	Good
2.550	2.600	0.028571429	2.249455782	Good	100	Good
2.600	2.650	0	2.25	Good	100	Good
2.650	2.700	6.286	2.088426	Good	100	Good
2.700	2.750	0	2.25	Good	100	Good
2.750	2.800	6.44	2.085489796	Good	95	Good
2.800	2.850	0	2.25	Good	100	Good
2.850	2.900	0	2.25	Good	100	Good
2.900	2.950	0	2.25	Good	100	Good
2.950	3.000	0	2.25	Good	100	Good
3.000	3.050	0	2.25	Good	100	Good
3.050	3.100	0	2.25	Good	100	Good
3.100	3.150	0.257142857	2.245102041	Good	95	Good
3.150	3.200	0	2.25	Good	100	Good
3.200	3.250	0	2.25	Good	100	Good

3.250	3.300	0.045714286	2.249129252	Good	100	Good
3.300	3.350	0	2.25	Good	100	Good
3.350	3.400	0	2.25	Good	100	Good
3.400	3.450	0	2.25	Good	100	Good
3.450	3.500	0	2.25	Good	100	Good
3.500	3.550	0.205714286	2.246081633	Good	100	Good
3.550	3.600	0.154285714	2.247061224	Good	95	Good
3.600	3.650	0	2.25	Good	100	Good
3.650	3.700	0.171428571	2.246734694	Good	95	Good
3.700	3.750	0	2.25	Good	100	Good
3.750	3.800	0	2.25	Good	100	Good
3.800	3.850	0	2.25	Good	100	Good
3.850	3.900	0	2.25	Good	100	Good
3.900	3.950	0	2.25	Good	100	Good
3.950	4.000	0	2.25	Good	100	Good
4.000	4.050	0	2.25	Good	100	Good
4.050	4.100	0	2.25	Good	100	Good
4.100	4.150	0.205714286	2.246081633	Good	100	Good
4.150	4.200	0	2.25	Good	100	Good
4.200	4.250	0	2.25	Good	100	Good
4.250	4.300	0	2.25	Good	100	Good
4.300	4.350	0	2.25	Good	100	Good
4.350	4.400	0	2.25	Good	100	Good
			2.214054442		96.25405682	

Name of Road		Main Road to Godeghat				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	0.002285714	2.249956463	Good	100	Good
0.05	0.1	0.008571429	2.249836735	Good	99.57142857	Good
0.1	0.15	0	2.25	Good	100	Good
0.15	0.2	0.029428571	2.249439456	Good	99.95714286	Good
0.2	0.25	8.5	2.086258503	Good	100	Good
0.25	0.3	0	2.25	Good	100	Good
0.3	0.35	0.006857143	2.249869388	Good	99.65714286	Good
0.35	0.4	0	2.25	Good	100	Good
0.4	0.45	0	2.25	Good	100	Good
0.45	0.5	0.025714286	2.249510204	Good	100	Good
0.5	0.55	0.002857143	2.249945578	Good	99.85714286	Good
0.55	0.6	0	2.25	Good	100	Good
0.6	0.65	0	2.25	Good	100	Good
0.65	0.7	0	2.25	Good	100	Good
0.7	0.75	2.571428571	2.201020408	Good	86.61857143	Good
0.75	0.8	0	2.25	Good	100	Good
0.8	0.85	0.002571429	2.24995102	Good	99.87142857	Good
0.85	0.9	0	2.25	Good	100	Good

0.9	0.95	0.005142857	2.249902041	Good	99.74285714	Good
0.95	1	0	2.25	Good	100	Good
			2.23928449		99.26378571	

Chainage		Rehadakhaspara to Chandranagar Khaspara				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	5.55	2.144285714	Good	58.9	Fair
0.05	0.1	15.4	1.9528	Fair	9.0624	Failed
0.1	0.15	0	2.25	Good	50.7327	Poor
0.15	0.2	1.725714286	2.215170068	Good	83.6768	Satisfactory
0.2	0.25	1.828571429	2.113945578	Good	54.229	Poor
0.25	0.3	2.708571429	2.174897959	Good	62.7	Fair
0.3	0.35	0.091428571	2.232585034	Good	83	Satisfactory
0.35	0.4	15.45142857	1.91329932	Fair	63.66	Fair
0.4	0.45	25.71428571	1.95	Fair	89.72865	Good
0.45	0.5	9.92	2.006904762	Good	100	Good
0.5	0.55	37.3873	1.630650068	Fair	66.95446	Fair
0.55	0.6	19.65714286	1.729462585	Fair	39.94784943	Very Poor
0.6	0.65	0.034285714	2.243469388	Good	39.53220343	Very Poor
0.65	0.7	0.102857143	2.230408163	Good	52.740712	Poor
0.7	0.75	1.428571429	2.193401361	Good	31.38262857	Very Poor
0.75	0.8	9.534857143	2.06642449	Good	80.43771	Satisfactory

0.8	0.85	1.085714286	2.150952381	Good	94.140479	Good
0.85	0.9	3.268571429	2.09	Good	76.47623	Satisfactory
0.9	0.95	23.30285714	1.810680272	Fair	94.140579	Good
0.95	1	27.59428571	1.802789116	Fair	96.41536	Good
1	1.05	53.42148571	1.286734694	Fair	18.112	Serious
1.05	1.1	15.81142857	1.706897959	Fair	96.4136	Good
1.1	1.15	1.297142857	2.149863946	Good	96.66674286	Good
1.15	1.2	0.16	2.245428571	Good	100	Good
1.2	1.25	3.428571429	2.001020408	Good	94.1404792	Good
1.25	1.3	10.65714286	1.973809524	Fair	96.03617143	Good
1.3	1.35	0.514285714	2.152040816	Good	100	Good
1.35	1.4	15.46857143	1.821571429	Fair	100	Good
1.4	1.45	23.8514	1.621571943	Fair	55.05108057	Fair
1.45	1.5	13.98857143	1.930897959	Fair	100	Good
1.5	1.55	0	2.25	Good	85.3	Good
1.55	1.6	43.54285714	1.95	Fair	86.47664286	Good
1.6	1.65	12.85714286	1.95	Fair	100	Good
1.65	1.7	4.761428571	2.159306122	Good	51.1859255	Poor
1.7	1.75	0	2.25	Good	60.55337	Fair
1.75	1.8	0.32	2.189047619	Good	100	Good
1.8	1.85	0.034285714	2.243469388	Good	83.57154286	Satisfactory
1.85	1.9	5.497142857	1.947823129	Fair	44.70683705	Poor
1.9	1.95	12.45714286	1.76870068	Fair	64.17714286	Fair
1.95	2	0.091428571	2.232585034	Good	49.2	Poor

2	2.05	27.92	1.920612245	Fair	86.37211	Good
2.05	2.1	9.0355	1.925786395	Fair	56.889	Fair
2.1	2.15	40.02857143	1.944557823	Fair	85.722	Good
2.15	2.2	0	2.25	Good	55.187014	Fair
2.2	2.25	42.85714286	1.95	Fair	52.42857143	Poor
2.25	2.3	71.14285714	1.628231293	Fair	100	Good
2.3	2.35	0.4	2.173809524	Good	82.64701842	Satisfactory
2.35	2.4	5.714285714	2.093571429	Good	59	Fair
2.4	2.45	0.085714286	2.233673469	Good	81.2522296	Satisfactory
2.45	2.5	3.514285714	2.16292517	Good	100	Good
2.5	2.55	5.714285714	2.141156463	Good	90.20573292	Good
2.55	2.6	0.068571429	2.236938776	Good	66.39909913	Fair
2.6	2.65	36.91428571	1.674771429	Fair	53.19129778	Poor
			2.020168481		73.18383717	

Name of Road		Shankargarh to Kotalu Amerapat				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	0	2.25	Good	100	Good
0.05	0.1	0	2.25	Good	87.87657143	Good
0.1	0.15	0	2.25	Good	82.57142857	Satisfactory
0.15	0.2	1.725714286	2.215170068	Good	85.65028571	Good
0.2	0.25	1.828571429	2.195578231	Good	76.409	Satisfactory

0.25	0.3	0.48	2.217346939	Good	82.43542857	Satisfactory
0.3	0.35	0.182857143	2.231714286	Good	100	Good
0.35	0.4	8.754285714	2.041734694	Good	82.25857143	Satisfactory
0.4	0.45	25.71428571	1.95	Fair	100	Good
0.45	0.5	8.777142857	2.028673469	Good	80.46856	Satisfactory
0.5	0.55	37.26285714	1.633673469	Fair	100	Good
0.55	0.6	19.69142857	1.729462585	Fair	85.63768	Good
0.6	0.65	0.068571429	2.243469388	Good	84.598824	Satisfactory
0.65	0.7	0.102857143	2.230408163	Good	86.67654857	Good
0.7	0.75	0.182857143	2.217346939	Good	100	Good
0.75	0.8	0.011428571	2.247823129	Good	97.15	Good
0.8	0.85	1.131428571	2.150952381	Good	97.14286	Good
0.85	0.9	3.268571429	2.09	Good	81.780963	Satisfactory
0.9	0.95	23.30285714	1.810680272	Fair	100	Good
0.95	1	27.59428571	1.802789116	Fair	81.40456	Satisfactory
1	1.05	14.06	1.686734694	Fair	48.5618	Poor
1.05	1.1	15.92571429	1.706897959	Fair	90.61571	Good
1.1	1.15	1.342857143	2.149863946	Good	83.5754	Satisfactory
1.15	1.2	0.502857143	2.238897959	Good	86.00912	Good
1.2	1.25	3.428571429	2.001020408	Good	82.49428571	Satisfactory
1.25	1.3	10.77142857	1.971632653	Fair	97.15	Good
1.3	1.35	0.514285714	2.152040816	Good	89.25714	Good
1.35	1.4	15.46857143	1.821571429	Fair	100	Good
1.4	1.45	21.05142857	1.671971429	Fair	90.12340571	Good

1.45	1.5	13.98857143	1.930897959	Fair	97.63	Good
1.5	1.55	0.114285714	2.247823129	Good	88.40912	Good
1.55	1.6	43.62285714	1.95	Fair	86.6571	Good
1.6	1.65	12.96	1.95	Fair	97.15	Good
1.65	1.7	0.342857143	2.25	Good	86.0114	Good
1.7	1.75	0.457142857	2.25	Good	84.6571	Satisfactory
1.75	1.8	0.777142857	2.189047619	Good	86.0114	Good
1.8	1.85	0.148571429	2.243469388	Good	95.15	Good
1.85	1.9	5.725714286	1.947823129	Fair	94.88143	Good
1.9	1.95	12.62857143	1.76870068	Fair	85.70744	Good
1.95	2	0.32	2.232585034	Good	100	Good
2	2.05	28.83428571	1.920612245	Fair	86.65714286	Good
2.05	2.1	4.165714286	2.031605442	Good	88.01142857	Good
2.1	2.15	40.14285714	1.944557823	Fair	86.11428571	Good
2.15	2.2	0	2.25	Good	88.01142857	Good
2.2	2.25	43.08571429	1.95	Fair	86.91196571	Good
2.25	2.3	71.25714286	1.628231293	Fair	87.99540571	Good
2.3	2.35	0.457142857	2.173809524	Good	100	Good
2.35	2.4	5.885714286	2.093571429	Good	97.15	Good
2.4	2.45	1.114285714	2.233673469	Good	89.6343	Good
2.45	2.5	4.085714286	2.16292517	Good	86.84685714	Good
2.5	2.55	5.914285714	2.140612245	Good	70.98282286	Satisfactory
2.55	2.6	0.525714286	2.236938776	Good	100	Good
2.6	2.65	37.2	1.674771429	Fair	85.33710857	Good

2.65	2.7	7.234571429	2.081895388	Good	100	Good
2.7	2.75	0.514285714	2.25	Good	95.21857	Good
2.75	2.8	7.171428571	1.974142857	Fair	84.6571	Satisfactory
2.8	2.85	9.474285714	2.043122449	Good	88.44571	Good
2.85	2.9	1.942857143	2.097619048	Good	93.49286	Good
2.9	2.95	22.68571429	1.554714286	Fair	97.15	Good
2.95	3	4.114285714	2.035714286	Good	90.69642714	Good
3	3.05	0.16	2.21952381	Good	88.0114	Good
3.05	3.1	0	2.25	Good	98.22714	Good
3.1	3.15	8.571428571	1.75	Fair	98.22714	Good
3.15	3.2	3.485714286	2.05	Good	100	Good
3.2	3.25	2.571428571	2.05	Good	100	Good
3.25	3.3	1.171428571	2.047823129	Good	97.63	Good
3.3	3.35	17.32571429	1.936938776	Fair	100	Good
3.35	3.4	0.64	2.236938776	Good	97.63	Good
3.4	3.45	0.114285714	2.25	Good	97.15	Good
3.45	3.5	0.285714286	2.195578231	Good	100	Good
3.5	3.55	11.42857143	2.05	Good	99.45429	Good
3.55	3.6	33.14285714	1.75	Fair	99.45429	Good
3.6	3.65	0.685714286	2.25	73)'!E9	97.63	Good
3.65	3.7	0	2.25	Good	74.18054857	Satisfactory
3.7	3.75	6.914285714	2.012721088	Good	97.15	Good
3.75	3.8	9.125714286	1.963741497	Fair	100	Good
3.8	3.85	0.342857143	2.206462585	Good	97.15	Good

3.85	3.9	3.445714286	2.05	Good	100	Good
3.9	3.95	2.942857143	2.045102041	Good	74.18054857	Satisfactory
3.95	4	5.428571429	2.05	Good	97.15	Good
4	4.05	0.388571429	2.197755102	Good	100	Good
4.05	4.1	0.114285714	2.228231293	Good	97.15	Good
4.1	4.15	3.805714286	2.013755102	Good	100	Good
4.15	4.2	35.08571429	1.754081633	Fair	96.88142857	Good
			2.052797281		91.34146823	

Name of Road		Shankargarh Kusmi road to Girijapur Khaspara				
Chainage			IRC			
From	To	Total Distress	PCI	Condition		
0.000	0.050	0	2.25	Good		
0.050	0.100	0	2.25	Good		
0.100	0.150	0	2.25	Good		
0.150	0.200	0	2.25	Good		
0.200	0.250	0	2.25	Good		
0.250	0.300	0	2.25	Good		
0.300	0.350	0	2.25	Good		
0.350	0.400	0	2.25	Good		
0.400	0.450	0	2.25	Good		
0.450	0.500	4.571428571	1.984285714	Fair		
0.500	0.550	0	2.25	Good		

0.550	0.600	0	2.25	Good		
0.600	0.650	0	2.25	Good		
0.650	0.700	0	2.25	Good		
0.700	0.750	0.022857143	2.248367347	Good		
0.750	0.800	10	2.1	Good		
0.800	0.850	0	2.25	Good		
0.850	0.900	0	2.25	Good		
0.900	0.950	0	2.25	Good		
0.950	1.000	0	2.25	Good		
1.000	1.050	0	2.25	Good		

2.230126336

Name of Road		Kosaga to Parsapara				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0.000	0.050	0	2.25	Good		
0.050	0.100	0	2.25	Good		
0.100	0.150	0	2.25	Good		
0.150	0.200	40	1.95	Fair		
0.200	0.250	0.011428571	2.249673469	Good		
0.250	0.300	0	2.25	Good		
0.300	0.350	12	2.073	Good		
0.350	0.400	36.34285714	1.943469388	Fair		

0.400	0.450	12.57142857	1.95	Fair		
0.450	0.500	30.85714286	1.797619048	Fair		
0.500	0.550	11.8	2.058979592	Good		
0.550	0.600	55.11428571	1.510136054	Fair		
0.600	0.650	1.828571429	2.215170068	Good		
0.650	0.700	0	2.25	Good		
0.700	0.750	0	2.25	Good		
0.750	0.800	0	2.25	Good		
0.800	0.850	0	2.25	Good		
0.850	0.900	0	2.25	Good		
0.900	0.950	13.71428571	2.049857143	Good		
0.950	1.000	14.74285714	1.98377551	Fair		
1.000	1.050	8	2.135714286	Good		
1.050	1.100	1.342857143	2.224421769	Good		
1.100	1.150	37.71428571	1.95	Fair		
1.150	1.200	2.914285714	2.208095238	Good		
1.200	1.250	0.514285714	2.240204082	Good		
1.250	1.300	22.11428571	1.93585034	Fair		
1.300	1.350	0	2.25	Good		
1.350	1.400	88.6	1.938571429	Fair		
1.400	1.450	54.85714286	1.906462585	Fair		
1.450	1.500	0	2.25	Good		
1.500	1.550	0	2.25	Good		
1.550	1.600	0	2.25	Good		

1.600	1.650	0	2.25	Good		
1.650	1.700	24.8	1.945918367	Fair		
1.700	1.750	0.514285714	2.235306122	Good		
1.750	1.800	9.142857143	2.07585034	Good		
1.800	1.850	1.285714286	2.225510204	Good		
1.850	1.900	0.571428571	2.239115646	Good		
1.900	1.950	0	2.25	Good		
1.950	2.000	86.4	1.936938776	Fair		
2.000	2.050	85.71428571	1.95	Fair		
2.050	2.100	0	2.25	Good		
2.100	2.150	2.285714286	2.187414966	Good		
2.150	2.200	1.714285714	2.217346939	Good		
2.200	2.250	0	2.25	Good		
2.250	2.300	0	2.25	Good		
2.300	2.350	0	2.25	Good		
			2.129455348			

Name of Road		Beldagih to Beldagih Uparpara				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0.000	0.050	0	2.25	Good		
0.050	0.100	0	2.25	Good		
0.100	0.150	0	2.25	Good		

0.150	0.200	28.85714286	1.845918367	Fair		
0.200	0.250	28.57142857	1.85	Fair		
0.250	0.300	28.57142857	1.85	Fair		
0.300	0.350	28.57142857	1.85	Fair		
0.350	0.400	34.91428571	1.85	Fair		
0.400	0.450	20.45714286	1.867077551	Fair		
0.450	0.500	0	2.25	Good		
0.500	0.550	0	2.25	Good		
0.550	0.600	19.02857143	2.05	Good		
0.600	0.650	0	2.25	Good		
0.650	0.700	0	2.25	Good		
0.700	0.750	0	2.25	Good		
0.750	0.800	0	2.25	Good		
0.800	0.850	0	2.25	Good		
0.850	0.900	66.68571429	1.95	Fair		
0.900	0.950	0	2.25	Good		
0.950	1.000	0	2.25	Good		
1.000	1.050	0	2.25	Good		
1.050	1.100	0	2.25	Good		
1.100	1.150	0	2.25	Good		
1.150	1.200	0	2.25	Good		
1.200	1.250	0	2.25	Good		
1.250	1.300	22.22857143	1.85	Fair		
1.300	1.350	85.71428571	1.95	Fair		

1.350	1.400	85.71428571	1.95	Fair		
1.400	1.450	85.71428571	1.95	Fair		
1.450	1.500	85.71428571	1.95	Fair		
1.500	1.550	85.71428571	1.95	Fair		
1.550	1.600	85.71428571	1.95	Fair		
1.600	1.650	165.0857143	1.501657143	Fair		
1.650	1.700	114.3428571	1.45	Fair		
1.700	1.750	85.71428571	1.95	Fair		
1.750	1.800	85.71428571	1.95	Fair		
1.800	1.850	76.28571429	1.95	Fair		
1.850	1.900	19.02857143	1.887485714	Fair		
1.900	1.950	82.51428571	1.528095238	Fair		
1.950	2.000	152.4	1.95	Fair		
2.000	2.050	104.7428571	1.95	Fair		
2.050	2.100	85.71428571	1.95	Fair		
2.100	2.150	57.08571429	1.95	Fair		
2.150	2.200	12.68571429	2.063742857	Good		
2.200	2.250	57.14285714	1.95	Fair		
2.250	2.300	50.74285714	1.75	Fair		
2.300	2.350	69.82857143	1.85	Fair		
2.350	2.400	0	2.25	Good		
2.400	2.450	0	2.25	Good		
2.450	2.500	0	2.25	Good		

2.025879537

Name of Road		Chando to Amdala				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	0	2.25	Good	97.63	Good
0.05	0.1	0	2.25	Good	97.63	Good
0.1	0.15	0	2.25	Good	97.831429	Good
0.15	0.2	1.725714286	2.215170068	Good	97.63	Good
0.2	0.25	1.828571429	2.195578231	Good	97.15	Good
0.25	0.3	0.337142857	2.220068027	Good	84.97142857	Satisfactory
0.3	0.35	0.091428571	2.232585034	Good	99.782857	Good
0.35	0.4	8.708571429	2.041734694	Good	100	Good
0.4	0.45	25.71428571	1.95	Fair	82.65286	Satisfactory
0.45	0.5	8.777142857	2.028673469	Good	100	Good
0.5	0.55	37.22857143	1.633673469	Fair	100	Good
0.55	0.6	21.37142857	1.696809524	Fair	84.85718	Satisfactory
0.6	0.65	2.034285714	2.20537415	Good	99.742857	Good
0.65	0.7	0.102857143	2.230408163	Good	97.15	Good
0.7	0.75	0.171428571	2.217346939	Good	97.63	Good
0.75	0.8	4.725714286	2.158027211	Good	75.57143	Satisfactory
0.8	0.85	7.44	2.097945578	Good	70.57142857	Satisfactory
0.85	0.9	5.84	2.041020408	Good	84.53097143	Satisfactory
0.9	0.95	25.17142857	1.775088435	Fair	100	Good

0.95	1	28.16571429	1.802789116	Fair	91.741911	Good
1	1.05	14.23142857	1.683469388	Fair	95	Good
1.05	1.1	15.81142857	1.706897959	Fair	100	Good
1.1	1.15	1.297142857	2.149863946	Good	83.20914286	Satisfactory
1.15	1.2	0.16	2.245428571	Good	87.82228571	Good
1.2	1.25	3.428571429	2.001020408	Good	100	Good
1.25	1.3	10.65714286	1.973809524	Fair	100	Good
1.3	1.35	0.514285714	2.152040816	Good	100	Good
1.35	1.4	15.46857143	1.821571429	Fair	100	Good
1.4	1.45	20.99428571	1.673	Fair	96	Good
1.45	1.5	13.98857143	1.930897959	Fair	96.038857	Good
1.5	1.55	0	2.25	Good	100	Good
1.55	1.6	43.54285714	1.95	Fair	95.63	Good
1.6	1.65	12.85714286	1.95	Fair	97.01571429	Good
1.65	1.7	0	2.25	Good	100	Good
1.7	1.75	0	2.25	Good	100	Good
1.75	1.8	0.32	2.189047619	Good	100	Good
1.8	1.85	0.034285714	2.243469388	Good	100	Good
1.85	1.9	5.497142857	1.947823129	Fair	100	Good
1.9	1.95	12.45714286	1.76870068	Fair	86.07485714	Good
1.95	2	0.091428571	2.232585034	Good	100	Good
2	2.05	27.92	1.920612245	Fair	97.63	Good
2.05	2.1	3.48	2.031605442	Good	100	Good
2.1	2.15	40.02857143	1.944557823	Fair	95.834743	Good

2.15	2.2	0	2.25	Good	95.43908343	Good
2.2	2.25	42.85714286	1.95	Fair	100	Good
2.25	2.3	71.14285714	1.628231293	Fair	100	Good
2.3	2.35	0.4	2.173809524	Good	95	Good
2.35	2.4	8.885714286	2.033163265	Good	77.75977143	Satisfactory
2.4	2.45	3.891428571	2.161183673	Good	75.99428571	Satisfactory
2.45	2.5	4.2	2.149863946	Good	100	Good
2.5	2.55	5.714285714	2.141156463	Good	100	Good
2.55	2.6	0.068571429	2.236938776	Good	100	Good
2.6	2.65	36.91428571	1.674771429	Fair	100	Good
2.65	2.7	6.320285714	2.081895388	Good	100	Good
			2.041476067		95.02820543	

Name of Road		Sojdha to Tunguri				
Chainage			IRC		ASTM	
From	To	Total Distress	PCI	Condition	PCI	Condition
0	0.05	0	2.25	Good	100	Good
0.05	0.1	0	2.25	Good	100	Good
0.1	0.15	0	2.25	Good	100	Good
0.15	0.2	1.725714286	2.215170068	Good	100	Good
0.2	0.25	1.828571429	2.195578231	Good	100	Good
0.25	0.3	0.137142857	2.223877551	Good	100	Good
0.3	0.35	0.091428571	2.232585034	Good	100	Good

0.35	0.4	8.708571429	2.041734694	Good	93.76428571	Good
0.4	0.45	25.71428571	1.95	Fair	100	Good
0.45	0.5	8.777142857	2.028673469	Good	100	Good
0.5	0.55	37.22857143	1.633673469	Fair	100	Good
0.55	0.6	19.65714286	1.729462585	Fair	100	Good
0.6	0.65	0.034285714	2.243469388	Good	100	Good
0.65	0.7	0.102857143	2.230408163	Good	100	Good
0.7	0.75	0.171428571	2.217346939	Good	100	Good
0.75	0.8	0.011428571	2.247823129	Good	100	Good
0.8	0.85	1.085714286	2.150952381	Good	95	Good
0.85	0.9	3.268571429	2.09	Good	100	Good
0.9	0.95	23.30285714	1.810680272	Fair	100	Good
0.95	1	27.59428571	1.802789116	Fair	100	Good
1	1.05	14.06	1.686734694	Fair	100	Good
1.05	1.1	15.81142857	1.706897959	Fair	87.07142857	Good
1.1	1.15	1.297142857	2.149863946	Good	100	Good
1.15	1.2	0.16	2.245428571	Good	77.24714286	Satisfactory
1.2	1.25	3.428571429	2.001020408	Good	100	Good
1.25	1.3	10.65714286	1.973809524	Fair	100	Good
1.3	1.35	0.514285714	2.152040816	Good	100	Good
1.35	1.4	15.46857143	1.821571429	Fair	100	Good
1.4	1.45	20.99428571	1.673	Fair	100	Good
1.45	1.5	13.98857143	1.930897959	Fair	97.56142857	Good
1.5	1.55	0	2.25	Good	100	Good

1.55	1.6	43.54285714	1.95	Fair	100	Good
1.6	1.65	12.85714286	1.95	Fair	100	Good
1.65	1.7	0	2.25	Good	100	Good
1.7	1.75	0	2.25	Good	90.37857143	Good
1.75	1.8	0.32	2.189047619	Good	84.36	Satisfactory
1.8	1.85	0.034285714	2.243469388	Good	91.05571429	Good
1.85	1.9	5.497142857	1.947823129	Fair	100	Good
1.9	1.95	12.45714286	1.76870068	Fair	100	Good
1.95	2	0.091428571	2.232585034	Good	97.63	Good
2	2.05	27.92	1.920612245	Fair	100	Good
2.05	2.1	3.48	2.031605442	Good	100	Good
2.1	2.15	40.02857143	1.944557823	Fair	100	Good
2.15	2.2	0	2.25	Good	79.78571429	Satisfactory
2.2	2.25	42.85714286	1.95	Fair	100	Good
2.25	2.3	71.14285714	1.628231293	Fair	100	Good
2.3	2.35	0.4	2.173809524	Good	100	Good
2.35	2.4	5.714285714	2.093571429	Good	100	Good
2.4	2.45	0.085714286	2.233673469	Good	100	Good
2.45	2.5	3.514285714	2.16292517	Good	100	Good
2.5	2.55	5.714285714	2.141156463	Good	79.28571429	Satisfactory
2.55	2.6	0.068571429	2.236938776	Good	100	Good
2.6	2.65	36.91428571	1.674771429	Fair	94.78	Good
2.65	2.7	6.320285714	2.081895388	Good	96.2	Good
2.7	2.75	0	2.25	Good	60.8	Fair

2.75	2.8	6.885714286	1.974142857	Fair	90.37857143	Good
2.8	2.85	9.245714286	2.043122449	Good	100	Good
2.85	2.9	2.114285714	2.092176871	Good	95	Good
2.9	2.95	22.62857143	1.554714286	Fair	100	Good
2.95	3	3.428571429	2.035714286	Good	88.62	Good
3	3.05	0.16	2.21952381	Good	100	Good
3.05	3.1	0	2.25	Good	100	Good
3.1	3.15	8.571428571	1.75	Fair	100	Good
3.15	3.2	2.571428571	2.05	Good	84.36	Satisfactory
3.2	3.25	2.571428571	2.05	Good	100	Good
3.25	3.3	1.171428571	2.047823129	Good	100	Good
3.3	3.35	17.21142857	1.936938776	Fair	100	Good
3.35	3.4	0.068571429	2.236938776	Good	97.21857143	Good
3.4	3.45	0	2.25	Good	100	Good
3.45	3.5	0.285714286	2.195578231	Good	100	Good
3.5	3.55	11.42857143	2.05	Good	100	Good

Appendix-II

Test Pit excavation and In-situ density assessment

Photos

	
Plate-1: TS-42	Plate-2: TS-42
	
Plate-3: TS-28	Plate-4: TS-28

Plate-1: TS-49

Plate-1: TS-49

Plate-3: TS-50

Plate-4: TS-50

Plate-5: TS-51

Plate-1: TS-49

Plate-1: TS-49

Plate-3: TS-51

Plate-4: TS-51

Plate-5: TS-50

Plate-6: TS-50

Plate-1: TS-42

Plate-2: TS-42

Plate-3: TS-28

Plate-4: TS-28

National Institute of Technology Raipur

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Civil Engineering Department

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Test Pit and In-situ density assessment

Test Section No.	Name of the Road Sections	PIU (District) & Package No.	Year of Completion	Total length of the road, Km	Chainage	Crust Thickness Details			In-situ Density	
						Bituminous layer	Granular Layer	Total Thickness	Granular Layer	Subgrade
WMM Base pavement sections										
29	Belgaon to Kolendra	Rajnandgaon & CG 15-83 (L041)	2010	4.2	0+400	25	150	175	1.95	1.91
					0+700	25	130	155	1.98	1.94
					1+100	15	130	145	1.98	1.93
					1+400	15	170	185	1.98	1.80
					1+700	20	140	160	1.90	1.80
					2+200	18	120	138	1.92	1.90
					2+400	23	90	113	1.90	1.78
					2+700	15	140	155	1.92	1.87
					2+900	22	120	142	2.06	1.83
					3+100	20	120	140	2.04	1.91
					3+500	18	140	158	1.99	1.89
					Average	**20**	**132**	**151**	**1.97**	**1.87**
28	Mohara Road T02 to Thakurtola	Rajnandgaon & CG 15-84 (L036)	2010	4.6	2+800	20	170	190	1.97	1.98
					3+00	25	140	165	1.92	1.98
					3+200	35	140	175	2.06	1.90
					3+400	40	140	180	1.94	1.94
					3+800	15	130	145	1.91	1.95
					4+100	20	160	180	2.05	1.98
					4+400	25	130	155	1.90	1.93

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Test Pit and In-situ density assessment

Test Section No.	Name of the Road Sections	PIU (District) & Package No.	Year of Completion	Total length of the road, Km	Chainage	Crust Thickness Details			In-situ Density	
						Bituminous layer	Granular Layer	Total Thickness	Granular Layer	Subgrade
					4+600	30	210	240	2.01	1.92
					4+800	40	150	190	1.93	1.93
					4+900	30	150	180	1.91	1.95
					Average	**28**	**152**	**180**	1.96	1.95
30	Belgaon to Kathili	Rajnandgaon & CG 15-83 (L040)	2010	2.35	0+200	15	140	155	2.03	1.95
					0+500	20	130	150	2.02	1.95
					0+800	15	95	110	2.01	1.93
					1+400	20	115	135	1.98	1.92
					1+600	20	115	135	1.96	1.92
					1+800	15	90	105	2.06	1.93
					Average	**18**	**114**	**132**	2.01	1.93
40	Dongargarh Mundgaon road T05 To Khalari	Rajnandgaon & CG 15 (L052)	2010	1.01	0+120	23	135	158	1.94	1.95
					0+560	20	138	158	2.03	1.94
					0+890	24	126	150	2.01	1.96
					Average	**22**	**133**	**155**	1.99	1.95
42	Dongargarh to Karwari	Rajnandgaon & CG 15 (L026)	2010	3.2	0+460	23	135	158	2.07	1.93
					1+000	20	85	105	2.04	1.90
					1+650	24	145	169	2.06	1.87

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Test Pit and In-situ density assessment

Test Section No.	Name of the Road Sections	PIU (District) & Package No.	Year of Completion	Total length of the road, Km	Chainage	Crust Thickness Details			In-situ Density	
						Bituminous layer	Granular Layer	Total Thickness	Granular Layer	Subgrade
					2+000	20	130	150	1.99	1.91
					2+400	27	140	167	1.99	1.89
					2+700	25	135	160	2.05	1.92
					Average	**23**	**128**	**152**	**2.03**	**1.90**
WBM Base pavement sections										
49	Devkatta to Kanhargaon	Rajnandgaon & CG 15-50 (L027)	2014	4.1	1+400	10	140	150	2.04	1.87
					1+700	30	150	180	2.06	1.89
					2+00	30	140	170	2.01	1.93
					2+200	20	120	140	2.06	1.91
					2+80	35	115	150	2.05	1.90
					3+000	55	125	180	2.00	1.92
					3+200	22	170	192	2.04	1.90
					Average	**29**	**137**	**166**	**2.04**	**1.90**
50	Dhara-Gotiya	Rajnandgaon & CG 15-25 (L029)	2008	11.36	0+100	30	130	160	2.01	1.89
					0+750	25	120	145	1.96	1.89
					1+160	20	140	160	1.94	1.82
					1+500	30	110	140	1.95	1.89
					2+600	30	120	150	1.93	1.90
					3+000	25	110	135	2.01	1.90
					3+700	20	70	90	1.98	1.92

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Test Pit and In-situ density assessment

Test Section No.	Name of the Road Sections	PIU (District) & Package No.	Year of Completion	Total length of the road, Km	Chainage	Crust Thickness Details			In-situ Density	
						Bituminous layer	Granular Layer	Total Thickness	Granular Layer	Subgrade
					4+600	25	125	150	2.04	1.91
					5+000	20	130	150	2.04	1.93
					6+500	30	130	160	2.03	1.93
					7+00	40	70	110	2.04	1.87
					8+00	35	140	175	2.01	1.89
					9+000	25	120	145	1.97	1.89
					10+050	25	135	160	1.99	1.91
					Average	**27**	**118**	**145**	**1.99**	1.90
51	Kalkasa-Bhaisara	Rajnandgaon& CG 15-85 (L024)	2010	1.8	0+700	30	170	200	2.07	1.94
					0+900	10	170	180	2.08	1.95
					1+250	22	175	197	2.07	1.96
					Average	**21**	**172**	**192**	**2.07**	**1.95**

Appendix-III

Benkleman Beam Deflection test Format

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BENKELMAN BEAM DEFLECTION TEST RESULT

Name of road :	**Month of observation :**	**Ave. Rainfall in mm**
Section:	**Climatic conditions :**	**Moisture content % :**
Traffic in CV/Day	**Air temperature in °C :**	**Plasticity (P I)**
Design traffic in msa :	**Pavement Temp. in °C :**	**Seasonal correction factor :**
No. of lane :	**Terrian :**	**Design Life in years :**
Category of Road :		**Date**

Chainage Point	Dial gauge reading			Measured rebound deflection	Correction for temperature in mm	Temp. corrected deflection in mm	Seasonal correction factor	Corrected deflection in mm	Mean deflection in mm	Std. Deviation in mm	Characteristic deflection (10)+(11)x2in mm	Overlay required in Bituminous Macadam in mm	Condition of Test Point	Remarks
	Initial	Intermediate	Final											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	

TESTED BY : SIGN :

Photos

1.Belgaon to Kolendra

2. Devkatta to Kanhargaon

3.Dharaghotiya

4.Dongadgarh to Karwari

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BENKELMAN BEAM DEFLECTION TEST RESULT

Name of road : Belgaon to Kolendra
Section:
Traffic in CV/Day
Design traffic in msa :
No. of lane : 4.2Km
Category of Road :

Month of observation : October
Climatic conditions :
Air temperature in °C :
Pavement Temp. in °C : 38
Terrian :

Ave. Rainfall in mm
Moisture content % :
Plasticity Index (P I)
Seasonal correction factor :
Design Life in years :
Date 01-10-16

chainage			Pavement temperature, ° C	Type of soil & PI	Moisture content %	Dial gauge reading (mm): Initial (0 mts)	Dial gauge reading (mm): Intermediate (2.7 mts)	Dial gauge reading (mm): Final (9 mts)	A-C (mm)	A-B (mm)	B-C (mm)	True Deflection,(mm) X_T= 2(A-C) or 2[(A-C)+2.91(B-C)]	Measured rebound deflection	Correction for temperature in mm	Temp corrected deflection in mm	Seasonal correction factor	Corrected deflection in mm	Mean deflection in mm	(X-X̄)² mm	Std Deviation in mm	Characteristic deflection (X̄+σ) in mm	Overlay required in Bituminous Macadam in mm	Condition of Test Point	Remarks
1	_	_				2	3	4					5	6	7	8	9	10	11		12	13	14	
0	to	50				0.000	-0.049	-0.049	0.049	0.049	0.000	0.098	0.196	-0.030	0.166	1.000	0.030		0.001					
50	to	100				0.000	-0.050	-0.060	0.060	0.050	0.010	0.120	0.240	-0.030	0.210	1.000	0.210		0.044					
100	to	150				0.000	-0.030	-0.050	0.050	0.030	0.020	0.100	0.200	-0.030	0.170	1.000	0.170		0.029					
150	to	200				0.000	-0.007	-0.008	0.008	0.007	0.001	0.016	0.032	-0.030	0.002	1.000	0.002		0.000					
200	to	250		-1		0.000	-0.003	-0.005	0.005	0.003	0.002	0.010	0.020	-0.030	-0.010	1.000	-0.010		0.000					
250	to	300				0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	-0.030	-0.026	1.000	-0.026		0.001					
300	to	350				0.000	-0.003	-0.004	0.004	0.003	0.001	0.008	0.016	-0.030	-0.014	1.000	-0.014		0.000					
350	to	400				0.000	-0.001	-0.003	0.003	0.001	0.002	0.006	0.012	-0.030	-0.018	1.000	-0.018		0.000					
400	to	450		-1		0.000	-0.046	-0.047	0.047	0.046	0.001	0.094	0.188	-0.030	0.158	1.000	0.158		0.025					
450	to	500				0.000	-0.004	-0.005	0.005	0.004	0.001	0.010	0.020	-0.030	-0.010	1.000	-0.010	0.022	0.000	0.012	0.047			
500	to	550				0.000	-0.003	-0.004	0.004	0.003	0.001	0.008	0.016	-0.030	-0.014	1.000	-0.014		0.000					
550	to	600				0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	-0.030	-0.022	1.000	-0.022		0.000					
600	to	650				0.000	-0.003	-0.004	0.004	0.003	0.001	0.008	0.016	-0.030	-0.014	1.000	-0.014		0.000					
650	to	700				0.000	-0.004	-0.005	0.005	0.004	0.001	0.010	0.020	-0.030	-0.010	1.000	-0.010		0.000					
700	to	750				0.000	-0.007	-0.008	0.008	0.007	0.001	0.016	0.032	-0.030	0.002	1.000	0.002		0.000					
750	to	800				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.030	-0.030	1.000	-0.030		0.001					
800	to	850				0.000	-0.006	-0.008	0.008	0.006	0.002	0.016	0.032	-0.030	0.002	1.000	0.002		0.000					
850	to	900				0.000	-0.025	-0.026	0.026	0.025	0.001	0.052	0.104	-0.030	0.074	1.000	0.074		0.005					
900	to	950				0.000	-0.002	-0.003	0.003	0.002	0.001	0.006	0.012	-0.030	-0.018	1.000	-0.018		0.000					
950	to	1000				0.000	-0.002	-0.003	0.003	0.002	0.001	0.006	0.012	-0.030	-0.018	1.000	-0.018		0.000					
																mean	0.022	stdev	0.012					
1000	to	1050				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.030	-0.030	1.000	-0.030		0.001					
1050	to	1100				0.000	-0.017	-0.020	0.020	0.017	0.003	0.040	0.080	-0.030	0.050	1.000	0.050		0.003					
1100	to	1150				0.000	-0.015	-0.016	0.016	0.015	0.001	0.032	0.064	-0.030	0.034	1.000	0.034		0.001					
1150	to	1200				0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	-0.030	-0.026	1.000	-0.026		0.001					
1200	to	1250				0.000	-0.029	-0.030	0.030	0.029	0.001	0.060	0.120	-0.030	0.090	1.000	0.090		0.008					
1250	to	1300				0.000	-0.014	-0.015	0.015	0.014	0.001	0.030	0.060	-0.030	0.030	1.000	0.030		0.001					
1300	to	1350				0.000	-0.022	-0.023	0.023	0.022	0.001	0.046	0.092	-0.030	0.062	1.000	0.062		0.004					
1350	to	1400				0.000	-0.003	-0.004	0.004	0.003	0.001	0.008	0.016	-0.030	-0.014	1.000	-0.014		0.000					
1400	to	1450				0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	-0.030	-0.026	1.000	-0.026		0.001					
1450	to	1500				0.000	-0.023	-0.024	0.024	0.023	0.001	0.048	0.096	-0.030	0.066	1.000	0.066		0.004					
1500	to	1550				0.000	-0.038	-0.039	0.039	0.038	0.001	0.078	0.156	-0.030	0.126	1.000	0.126	0.026	0.016	0.006	0.039			
1550	to	1600				0.000	-0.009	-0.009	0.009	0.009	0.000	0.018	0.036	-0.030	0.006	1.000	0.006		0.000					
1600	to	1650				0.000	-0.002	-0.002	0.002	0.002	0.000	0.004	0.008	-0.030	-0.022	1.000	-0.022		0.000					
1650	to	1700				0.000	-0.042	-0.047	0.047	0.042	0.005	0.094	0.188	-0.030	0.158	1.000	0.158		0.025					
1700	to	1750				0.000	-0.016	-0.017	0.017	0.016	0.001	0.034	0.068	-0.030	0.038	1.000	0.038		0.001					
1750	to	1800				0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	-0.030	-0.022	1.000	-0.022		0.000					
1800	to	1850				0.000	-0.025	-0.026	0.026	0.025	0.001	0.052	0.104	-0.030	0.074	1.000	0.074		0.005					
1850	to	1900				0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	-0.030	-0.026	1.000	-0.026		0.001					
1900	to	1950				0.000	-0.002	-0.004	0.004	0.002	0.002	0.008	0.016	-0.030	-0.014	1.000	-0.014		0.000					
1950	to	2000				0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	-0.030	-0.026	1.000	-0.026		0.001					
																mean	0.026	stdev	0.006					
2000	to	2050				0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	-0.030	-0.026	1.000	-0.026		0.001					
2050	to	2100				0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	-0.030	-0.026	1.000	-0.026		0.001					
2100	to	2150				0.000	-0.017	-0.019	0.019	0.017	0.002	0.038	0.076	-0.030	0.046	1.000	0.046		0.002					
2150	to	2200				0.000	-0.005	-0.005	0.005	0.005	0.000	0.010	0.020	-0.030	-0.010	1.000	-0.010		0.000					
2200	to	2250				0.000	-0.065	-0.066	0.066	0.065	0.001	0.132	0.264	-0.030	0.234	1.000	0.234		0.055					
2250	to	2300				0.000	-0.040	-0.043	0.043	0.040	0.003	0.086	0.172	-0.030	0.142	1.000	0.142		0.020					
2300	to	2350				0.000	-0.008	-0.010	0.010	0.008	0.002	0.020	0.040	-0.030	0.010	1.000	0.010		0.000					
2350	to	2400				0.000	-0.007	-0.008	0.008	0.007	0.001	0.016	0.032	-0.030	0.002	1.000	0.002		0.000					
2400	to	2450				0.000	-0.050	-0.055	0.055	0.050	0.005	0.110	0.220	-0.030	0.190	1.000	0.190		0.036					
2450	to	2500				0.000	-0.025	-0.030	0.030	0.025	0.005	0.060	0.120	-0.030	0.090	1.000	0.090	0.054	0.008	0.017	0.088			
2500	to	2550				0.000	-0.061	-0.062	0.062	0.061	0.001	0.124	0.248	-0.030	0.218	1.000	0.218		0.048					
2550	to	2600				0.000	-0.034	-0.035	0.035	0.034	0.001	0.070	0.140	-0.030	0.110	1.000	0.110		0.012					
2600	to	2650				0.000	-0.020	-0.021	0.021	0.020	0.001	0.042	0.084	-0.030	0.054	1.000	0.054		0.003					
2650	to	2700				0.000	-0.002	-0.003	0.003	0.002	0.001	0.006	0.012	-0.030	-0.018	1.000	-0.018		0.000					
2700	to	2750				0.000	-0.016	-0.018	0.018	0.016	0.002	0.036	0.072	-0.030	0.042	1.000	0.042		0.002					
2750	to	2800				0.000	-0.005	-0.008	0.008	0.005	0.003	0.016	0.032	-0.030	0.002	1.000	0.002		0.000					
2800	to	2850				0.000	-0.005	-0.006	0.006	0.005	0.001	0.012	0.024	-0.030	-0.006	1.000	-0.006		0.000					
2850	to	2900				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.030	-0.030	1.000	-0.030		0.001					
2900	to	2950				0.000	-0.027	-0.030	0.030	0.027	0.003	0.060	0.120	-0.030	0.090	1.000	0.090		0.008					
2950	to	3000				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.030	-0.030	1.000	-0.030		0.001					
																mean	0.054	stdev	0.017					
3000	to	3050				0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	-0.030	-0.022	1.000	-0.022		0.000					
3050	to	3100				0.000	-0.062	-0.064	0.064	0.062	0.002	0.128	0.256	-0.030	0.226	1.000	0.226		0.051					
3100	to	3150				0.000	-0.044	-0.046	0.046	0.044	0.002	0.092	0.184	-0.030	0.154	1.000	0.154		0.024					
3150	to	3200				0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	-0.030	-0.026	1.000	-0.026		0.001					
3200	to	3250				0.000	-0.003	-0.005	0.005	0.003	0.002	0.010	0.020	-0.030	-0.010	1.000	-0.010		0.000					
3250	to	3300				0.000	-0.053	-0.054	0.054	0.053	0.001	0.108	0.216	-0.030	0.186	1.000	0.186		0.035					
3300	to	3350				0.000	-0.005	-0.006	0.006	0.005	0.001	0.012	0.024	-0.030	-0.006	1.000	-0.006		0.000					
3350	to	3400				0.000	-0.027	-0.029	0.029	0.027	0.002	0.058	0.116	-0.030	0.086	1.000	0.086		0.007					
3400	to	3450				0.000	-0.005	-0.007	0.007	0.005	0.002	0.014	0.028	-0.030	-0.002	1.000	-0.002		0.000					
3450	to	3500				0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	-0.030	-0.022	1.000	-0.022		0.000					
3500	to	3550				0.000	-0.050	-0.072	0.072	0.050	0.022	0.144	0.288	-0.030	0.258	1.000	0.258		0.067					
3550	to	3600				0.000	-0.003	-0.005	0.005	0.003	0.002	0.010	0.020	-0.030	-0.010	1.000	-0.010		0.000					
3600	to	3650				0.000	-0.002	-0.003	0.003	0.002	0.001	0.006	0.012	-0.030	-0.018	1.000	-0.018	0.034	0.000	0.018	0.069			
3650	to	3700				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.030	-0.030	1.000	-0.030		0.001					
3700	to	3750				0.000	-0.021	-0.022	0.022	0.021	0.001	0.044	0.088	-0.030	0.058	1.000	0.058		0.003					
3750	to	3800				0.000	-0.003	-0.004	0.004	0.003	0.001	0.008	0.016	-0.030	-0.014	1.000	-0.014		0.000					
3800	to	3850				0.000	-0.002	-0.002	0.002	0.002	0.000	0.004	0.008	-0.030	-0.022	1.000	-0.022		0.000					
3850	to	3900				0.000	-0.013	-0.014	0.014	0.013	0.001	0.028	0.056	-0.030	0.026	1.000	0.026		0.001					
3900	to	3950				0.000	-0.044	-0.045	0.045	0.044	0.001	0.090	0.180	-0.030	0.150	1.000	0.150		0.023					
3950	to	4000				0.000	-0.002	-0.003	0.003	0.002	0.001	0.006	0.012	-0.030	-0.018	1.000	-0.018		0.000					
4000	to	4050				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.030	-0.030	1.000	-0.030		0.001					
4050	to	4100				0.000	-0.008	-0.009	0.009	0.008	0.001	0.018	0.036	-0.030	0.006	1.000	0.006		0.000					
4100	to	4150				0.000	-0.002	-0.003	0.003	0.002	0.001	0.006	0.012	-0.030	-0.018	1.000	-0.018		0.000					
4150	to	4200				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.030	-0.030	1.000	-0.030		0.001					
4200	to	4250				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.030	-0.030	1.000	-0.030		0.001					
																mean	0.034	stdev	0.018					

National Institute of Technology Raipur
G.E Road, Raipur, India 492010
Civil Engineering Department

NRRDA

BENKELMAN BEAM DEFLECTION TEST RESULT

Name of road : Devkatta to Kanhargaon	**Month of observation :** November	**Ave. Rainfall in mm**	
Section:	**Climatic conditions :**	**Moisture content % :**	
Traffic in CV/Day	**Air temperature in °C :**	**Plasticity Index (P I)**	
Design traffic in msa :	**Pavement Temp. in °C :** 31	**Seasonal correction factor :**	
No. of lane : 4.1 Km	**Terrian :** plain	**Design Life in years :**	
Category of Road : PMGSY Road		**Date**	19-11-16

chainage			Pavement temperature, ° C	Type of soil & PI	Moisture content %	Dial gauge reading (mm): Initial (0 mts)	Intermediate (2.7 mts)	Final (9 mts)	A-C (mm)	A-B (mm)	B-C (mm)	True Deflection,(mm) X_T= 2(A-C) or 2[(A-C)+2.91(B-C)]	Measured rebound deflection	Correction for temperature in mm	Temp. corrected deflection in mm	Seasonal correction factor	Corrected deflection in mm	Mean deflection in mm	(X-X̄)² mm	Std. Deviation in mm	Characteristic deflection (10)+(11)x2in mm	Overlay required in Bituminous Macadam in mm	Condition of Test Point	Remarks
1	_	_				2	3	4					5	6	7	8	9	10	11		12	13	14	
__	to	__	31			0.000	-0.008	-0.010	0.010	0.008	0.002	0.020	0.040	0.040	0.080	1.000	0.080		0.006					
__	to	__	31			0.000	-0.048	-0.051	0.051	0.048	0.003	0.102	0.204	0.040	0.244	1.000	0.244		0.060					
__	to	__	31			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.040	0.044	1.000	0.044		0.002					
__	to	__	31			0.000	-0.065	-0.068	0.068	0.065	0.003	0.136	0.272	0.040	0.312	1.000	0.312		0.097					
__	to	__	31	-1		0.000	-0.030	-0.038	0.038	0.030	0.008	0.076	0.152	0.040	0.192	1.000	0.192		0.037					
__	to	__	31			0.000	-0.032	-0.030	0.030	0.032	-0.002	0.060	0.120	0.040	0.160	1.000	0.160	0.151	0.026					
__	to	__	31			0.000	-0.060	-0.060	0.060	0.060	0.000	0.120	0.240	0.040	0.280	1.000	0.280		0.078					
__	to	__	31			0.000	-0.020	-0.022	0.022	0.020	0.002	0.044	0.088	0.040	0.128	1.000	0.128		0.016					
__	to	__	31	-1		0.000	-0.011	-0.013	0.013	0.011	0.002	0.026	0.052	0.040	0.092	1.000	0.092		0.008					
__	to	__	31			0.000	-0.002	-0.002	0.002	0.002	0.000	0.004	0.008	0.040	0.048	1.000	0.048		0.002					
__	to	__	31			0.000	-0.034	-0.037	0.037	0.034	0.003	0.074	0.148	0.040	0.188	1.000	0.188		0.035					
__	to	__	31			0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	0.040	0.048	1.000	0.048		0.002					
__	to	__	31			0.000	-0.004	-0.005	0.005	0.004	0.001	0.010	0.020	0.040	0.060	1.000	0.060		0.004					
__	to	__	31			0.000	-0.021	-0.025	0.025	0.021	0.004	0.050	0.100	0.040	0.140	1.000	0.140		0.020					
__	to	__	31			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.040	0.040	1.000	0.040		0.002					
__	to	__	31			0.000	-0.005	-0.008	0.008	0.005	0.003	0.016	0.032	0.040	0.072	1.000	0.072		0.005					
__	to	__	31			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.040	0.044	1.000	0.044		0.002					
__	to	__	31			0.000	-0.044	-0.046	0.046	0.044	0.002	0.092	0.184	0.040	0.224	1.000	0.224		0.050					
__	to	__	31			0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	0.040	0.048	1.000	0.048		0.002					
__	to	__	31			0.000	-0.020	-0.021	0.021	0.020	0.001	0.042	0.084	0.040	0.124	1.000	0.124	0.112	0.015					
__	to	__	31			0.000	-0.005	-0.010	0.010	0.005	0.005	0.020	0.040	0.040	0.080	1.000	0.080		0.006					
__	to	__	31			0.000	-0.048	-0.050	0.050	0.048	0.002	0.100	0.200	0.040	0.240	1.000	0.240		0.058					
__	to	__	31			0.000	-0.013	-0.015	0.015	0.013	0.002	0.030	0.060	0.040	0.100	1.000	0.100		0.010					
__	to	__	31			0.000	-0.030	-0.032	0.032	0.030	0.002	0.064	0.128	0.040	0.168	1.000	0.168		0.028					
__	to	__	31			0.000	-0.002	-0.002	0.002	0.002	0.000	0.004	0.008	0.040	0.048	1.000	0.048		0.002					
__	to	__	31			0.000	-0.037	-0.039	0.039	0.037	0.002	0.078	0.156	0.040	0.196	1.000	0.196		0.038					
__	to	__	31			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.040	0.044	1.000	0.044	0.123	0.002	0.025	0.172			
__	to	__	31			0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	0.040	0.048	1.000	0.048		0.002					
__	to	__	31			0.000	-0.032	-0.034	0.034	0.032	0.002	0.068	0.136	0.040	0.176	1.000	0.176		0.031					
__	to	__	31			0.000	-0.019	-0.021	0.021	0.019	0.002	0.042	0.084	0.040	0.124	1.000	0.124		0.015					
__	to	__	31			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.040	0.044	1.000	0.044		0.002					
__	to	__	31			0.000	-0.002	-0.002	0.002	0.002	0.000	0.004	0.008	0.040	0.048	1.000	0.048		0.002					
__	to	__	31			0.000	-0.033	-0.036	0.036	0.033	0.003	0.072	0.144	0.040	0.184	1.000	0.184	0.113	0.034					
__	to	__	31			0.000	-0.043	-0.045	0.045	0.043	0.002	0.090	0.180	0.040	0.220	1.000	0.220		0.048					
__	to	__	31			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.040	0.044	1.000	0.044		0.002					
__	to	__	31			0.000	-0.031	-0.034	0.034	0.031	0.003	0.068	0.136	0.040	0.176	1.000	0.176		0.031					
__	to	__	31			0.000	-0.050	-0.053	0.053	0.050	0.003	0.106	0.212	0.040	0.252	1.000	0.252		0.064					
__	to	__	31			0.000	-0.002	-0.003	0.003	0.002	0.001	0.006	0.012	0.040	0.052	1.000	0.052		0.003					
__	to	__	31			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.040	0.044	1.000	0.044		0.002					
__	to	__	31			0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	0.040	0.048	1.000	0.048		0.002					
__	to	__	31			0.000	-0.002	-0.002	0.002	0.002	0.000	0.004	0.008	0.040	0.048	1.000	0.048	0.115	0.002					
__	to	__	31			0.000	-0.056	-0.059	0.059	0.056	0.003	0.118	0.236	0.040	0.276	1.000	0.276		0.076					
__	to	__	31			0.000	-0.006	-0.008	0.008	0.006	0.002	0.016	0.032	0.040	0.072	1.000	0.072		0.005					
__	to	__	31			0.000	-0.027	-0.030	0.030	0.027	0.003	0.060	0.120	0.040	0.160	1.000	0.160		0.026					
__	to	__	31			0.000	-0.004	-0.006	0.006	0.004	0.002	0.012	0.024	0.040	0.064	1.000	0.064		0.004					
__	to	__	31			0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	0.040	0.048	1.000	0.048		0.002					
__	to	__	31			0.000	-0.036	-0.041	0.041	0.036	0.005	0.082	0.164	0.040	0.204	1.000	0.204		0.042					
																Mean	0.123	Stdev	0.025					

National Institute of Technology Raipur
G.E Road, Raipur, India 492010
Civil Engineering Department

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BENKELMAN BEAM DEFLECTION TEST RESULT

Name of road : Dharaghotiya road	**Month of observation :** November	**Ave. Rainfall in mm**
Section:	**Climatic conditions :**	**Moisture content % :**
Traffic in CV/Day	**Air temperature in °C :**	**Plasticity Index (P I)**
Design traffic in msa :	**Pavement Temp. in °C :** 32	**Seasonal correction factor :**
No. of lane : 11 Km	**Terrian :** plain	**Design Life in years :**
Category of Road : PMGSY Road		**Date**

chainage			Pavement temperature, ° C	Type of soil & PI	Moisture content %	Dial gauge reading (mm) Initial (0 mts)	Intermediate (2.7 mts)	Final (9 mts)	A-C (mm)	A-B (mm)	B-C (mm)	True Deflection,(mm) X_T= 2(A-C) or 2[(A-C)+2.91(B-C)]	Measured rebound deflection	Correction for temperature in mm	Temp. corrected deflection in mm	Seasonal correction factor	Corrected deflection in mm	Mean deflection in mm	(X-X̄)² mm	Std. Deviation in mm	Characteristic deflection (10)+(11)x2in mm	Overlay required in Bituminous Macadam in mm	Condition of Test Point	Remarks
1	_	_				2	3	4					5	6	7	8	9	10	11		12	13	14	
__	to	__	32			0.000	-0.010	-0.012	0.012	0.010	0.002	0.024	0.048	0.030	0.078	1.000	0.078		0.006					
__	to	__	32			0.000	-0.046	-0.049	0.049	0.046	0.003	0.098	0.196	0.030	0.226	1.000	0.226		0.051					
__	to	__	32			0.000	-0.030	-0.035	0.035	0.030	0.005	0.070	0.140	0.030	0.170	1.000	0.170	0.145	0.029					
__	to	__	32			0.000	-0.013	-0.018	0.018	0.013	0.005	0.036	0.072	0.030	0.102	1.000	0.102		0.010					
__	to	__	32	-1		0.000	-0.026	-0.030	0.030	0.026	0.004	0.060	0.120	0.030	0.150	1.000	0.150		0.023					
__	to	__	32			0.000	-0.031	-0.033	0.033	0.031	0.002	0.066	0.132	0.030	0.162	1.000	0.162		0.026					
__	to	__	32			0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	0.030	0.038	1.000	0.038		0.001					
__	to	__	32			0.000	-0.004	-0.007	0.007	0.004	0.003	0.014	0.028	0.030	0.058	1.000	0.058	0.066	0.003					
__	to	__	32	-1		0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	0.030	0.038	1.000	0.038		0.001					
__	to	__	32			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.030	0.034	1.000	0.034		0.001					
__	to	__	32			0.000	-0.030	-0.034	0.034	0.030	0.004	0.068	0.136	0.030	0.166	1.000	0.166		0.028					
__	to	__	32			0.000	-0.005	-0.007	0.007	0.005	0.002	0.014	0.028	0.030	0.058	1.000	0.058		0.003					
__	to	__	32			0.000	-0.003	-0.004	0.004	0.003	0.001	0.008	0.016	0.030	0.046	1.000	0.046	0.077	0.002					
__	to	__	32			0.000	-0.002	-0.002	0.002	0.002	0.000	0.004	0.008	0.030	0.038	1.000	0.038		0.001					
__	to	__	32			0.000	-0.011	-0.012	0.012	0.011	0.001	0.024	0.048	0.030	0.078	1.000	0.078		0.006					
__	to	__	32			0.000	-0.002	-0.002	0.002	0.002	0.000	0.004	0.008	0.030	0.038	1.000	0.038		0.001					
__	to	__	32			0.000	-0.002	-0.002	0.002	0.002	0.000	0.004	0.008	0.030	0.038	1.000	0.038		0.001					
__	to	__	32			0.000	-0.022	-0.024	0.024	0.022	0.002	0.048	0.096	0.030	0.126	1.000	0.126	0.092	0.016					
__	to	__	32			0.000	-0.002	-0.003	0.003	0.002	0.001	0.006	0.012	0.030	0.042	1.000	0.042		0.002					
__	to	__	32			0.000	-0.045	-0.046	0.046	0.045	0.001	0.092	0.184	0.030	0.214	1.000	0.214		0.046					
__	to	__	32			0.000	-0.004	-0.006	0.006	0.004	0.002	0.012	0.024	0.030	0.054	1.000	0.054		0.003					
__	to	__	32			0.000	-0.002	-0.003	0.003	0.002	0.001	0.006	0.012	0.030	0.042	1.000	0.042		0.002					
__	to	__	32			0.000	-0.004	-0.004	0.004	0.004	0.000	0.008	0.016	0.030	0.046	1.000	0.046	0.059	0.002					
__	to	__	32			0.000	-0.004	-0.005	0.005	0.004	0.001	0.010	0.020	0.030	0.050	1.000	0.050		0.003					
__	to	__	32			0.000	-0.016	-0.018	0.018	0.016	0.002	0.036	0.072	0.030	0.102	1.000	0.102		0.010					
__	to	__	32			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.030	0.034	1.000	0.034		0.001					
__	to	__	32			0.000	-0.011	-0.013	0.013	0.011	0.002	0.026	0.052	0.030	0.082	1.000	0.082	0.073	0.007	0.011	0.095			
__	to	__	32			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.030	0.034	1.000	0.034		0.001					
__	to	__	32			0.000	-0.008	-0.009	0.009	0.008	0.001	0.018	0.036	0.030	0.066	1.000	0.066	0.049	0.004					
__	to	__	32			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.030	0.030	1.000	0.030		0.001					
__	to	__	32			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.030	0.030	1.000	0.030		0.001					
__	to	__	32			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.030	0.030	1.000	0.030		0.001					
__	to	__	32			0.000	-0.012	-0.014	0.014	0.012	0.002	0.028	0.056	0.030	0.086	1.000	0.086		0.007					
__	to	__	32			0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	0.030	0.038	1.000	0.038	0.069	0.001					
__	to	__	32			0.000	-0.031	-0.033	0.033	0.031	0.002	0.066	0.132	0.030	0.162	1.000	0.162		0.026					
__	to	__	32			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.030	0.034	1.000	0.034		0.001					
__	to	__	32			0.000	-0.013	-0.014	0.014	0.013	0.001	0.028	0.056	0.030	0.086	1.000	0.086		0.007					
__	to	__	32			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.030	0.030	1.000	0.030	0.053	0.001					
__	to	__	32			0.000	-0.010	-0.012	0.012	0.010	0.002	0.024	0.048	0.030	0.078	1.000	0.078		0.006					
__	to	__	32			0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	0.030	0.038	1.000	0.038		0.001					
__	to	__	32			0.000	-0.004	-0.005	0.005	0.004	0.001	0.010	0.020	0.030	0.050	1.000	0.050		0.003					
__	to	__	32			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.030	0.034	1.000	0.034	0.073	0.001					
__	to	__	32			0.000	-0.018	-0.019	0.019	0.018	0.001	0.038	0.076	0.030	0.106	1.000	0.106		0.011					
__	to	__	32			0.000	-0.015	-0.016	0.016	0.015	0.001	0.032	0.064	0.030	0.094	1.000	0.094		0.009					
__	to	__	32			0.000	-0.012	-0.013	0.013	0.012	0.001	0.026	0.052	0.030	0.082	1.000	0.082		0.007					
__	to	__	32			0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	0.030	0.038	1.000	0.038		0.001					
__	to	__	32			0.000	-0.014	-0.015	0.015	0.014	0.001	0.030	0.060	0.030	0.090	1.000	0.090	0.063	0.008					
__	to	__	32			0.000	-0.012	-0.013	0.013	0.012	0.001	0.026	0.052	0.030	0.082	1.000	0.082		0.007					
__	to	__	32			0.000	-0.002	-0.002	0.002	0.002	0.000	0.004	0.008	0.030	0.038	1.000	0.038		0.001					
__	to	__	32			0.000	-0.008	-0.009	0.009	0.008	0.001	0.018	0.036	0.030	0.066	1.000	0.066		0.004					
__	to	__	32			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.030	0.034	1.000	0.034	0.062	0.001					
__	to	__	32			0.000	-0.015	-0.018	0.018	0.015	0.003	0.036	0.072	0.030	0.102	1.000	0.102		0.010					
__	to	__	32			0.000	-0.008	-0.010	0.010	0.008	0.002	0.020	0.040	0.030	0.070	1.000	0.070		0.005					
__	to	__	32			0.000	-0.006	-0.007	0.007	0.006	0.001	0.014	0.028	0.030	0.058	1.000	0.058		0.003					
__	to	__	32			0.000	-0.003	-0.004	0.004	0.003	0.001	0.008	0.016	0.030	0.046	1.000	0.046		0.002					
																Mean	0.073	Stdev	0.011					

National Institute of Technology Raipur
G.E Road, Raipur, India 492010
Civil Engineering Department

NRRDA

BENKELMAN BEAM DEFLECTION TEST RESULT

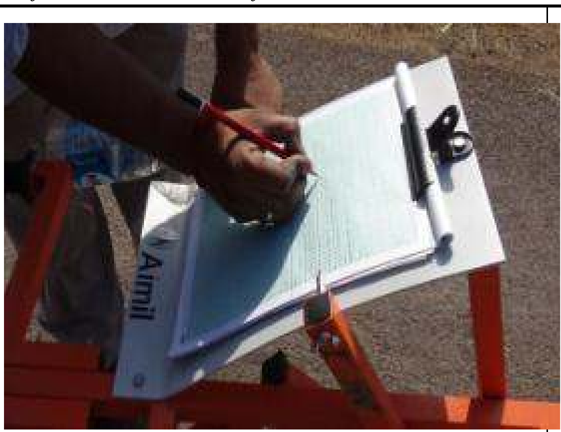
Name of road : Dongargarh to karwani	**Month of observation :** December		**Ave. Rainfall in mm**
Section:	**Climatic conditions** :		**Moisture content %** :
Traffic in CV/Day	**Air temperature in °C** :		**Plasticity Inde: (P I)**
Design traffic in msa :	**Pavement Temp. in °C** : 32		**Seasonal correction factor :**
No. of lane : 3.00 (km)	**Terrian** : plain		**Design Life in years :**
Category of Road : PMGSY Road			**Date** 12-12-16

chainage			Pavement temperature, ° C	Type of soil & PI	Moisture content %	Dial gauge reading (mm) Initial (0 mts)	Intermediate (2.7 mts)	Final (9 mts)	A-C (mm)	A-B (mm)	B-C (mm)	True Deflection,(mm) X_T= 2(A-C) or 2[(A-C)+2.91(B-C)]	Measured rebound deflection	Correction for temperature in mm	Temp. corrected deflection in mm	Seasonal correction factor	Corrected deflection in mm	Mean deflection in mm	(X-Ẍ)² mm	Std. Deviation in mm	Characteristic deflection (10)+(11)x2in mm	Overlay required in Bituminous Macadam in mm	Condition of Test Point	Remarks
1	_	_				2	3	4					5	6	7	8	9	10	11		12	13	14	
__	to	__	32			0.000	-0.010	-0.013	0.013	0.010	0.003	0.026	0.052	0.030	0.082	1.000	0.082		0.000					
__	to	__	32			0.000	-0.039	-0.062	0.062	0.039	0.023	0.124	0.248	0.030	0.278	1.000	0.278		0.077					
__	to	__	32			0.000	-0.020	-0.025	0.025	0.020	0.005	0.050	0.100	0.030	0.130	1.000	0.130		0.017					
__	to	__	32			0.000	-0.003	-0.003	0.003	0.003	0.000	0.006	0.012	0.030	0.042	1.000	0.042		0.002					
__	to	__	32	-1		0.000	-0.015	-0.018	0.018	0.015	0.003	0.036	0.072	0.030	0.102	1.000	0.102		0.010					
__	to	__	32			0.000	-0.012	-0.015	0.015	0.012	0.003	0.030	0.060	0.030	0.090	1.000	0.090		0.008					
__	to	__	32			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.030	0.034	1.000	0.034	0.089	0.001					
__	to	__	32			0.000	-0.003	-0.004	0.004	0.003	0.001	0.008	0.016	0.030	0.046	1.000	0.046		0.002					
__	to	__	32	-1		0.000	-0.004	-0.007	0.007	0.004	0.003	0.014	0.028	0.030	0.058	1.000	0.058		0.003					
__	to	__	32			0.000	-0.012	-0.014	0.014	0.012	0.002	0.028	0.056	0.030	0.086	1.000	0.086		0.007					
__	to	__	32			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.030	0.034	1.000	0.034		0.001					
__	to	__	32			0.000	-0.014	-0.017	0.017	0.014	0.003	0.034	0.068	0.030	0.098	1.000	0.098		0.010					
__	to	__	32			0.000	-0.025	-0.027	0.027	0.025	0.002	0.054	0.108	0.030	0.138	1.000	0.138	0.084	0.019					
__	to	__	32			0.000	-0.022	-0.026	0.026	0.022	0.004	0.052	0.104	0.030	0.134	1.000	0.134		0.018					
__	to	__	32			0.000	-0.002	-0.003	0.003	0.002	0.001	0.006	0.012	0.030	0.042	1.000	0.042		0.002					
__	to	__	32			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.030	0.030	1.000	0.030	0.080	0.001	0.015	0.110			
__	to	__	32			0.000	-0.032	-0.037	0.037	0.032	0.005	0.074	0.148	0.030	0.178	1.000	0.178		0.032					
__	to	__	32			0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	0.030	0.038	1.000	0.038		0.001					
__	to	__	32			0.000	-0.016	-0.020	0.020	0.016	0.004	0.040	0.080	0.030	0.110	1.000	0.110		0.012					
__	to	__	32			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.030	0.034	1.000	0.034		0.001					
__	to	__	32			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.030	0.034	1.000	0.034		0.001					
__	to	__	32			0.000	-0.012	-0.014	0.014	0.012	0.002	0.028	0.056	0.030	0.086	1.000	0.086		0.007					
__	to	__	32			0.000	-0.026	-0.028	0.028	0.026	0.002	0.056	0.112	0.030	0.142	1.000	0.142		0.020					
__	to	__	32			0.000	-0.003	-0.003	0.003	0.003	0.000	0.006	0.012	0.030	0.042	1.000	0.042		0.002					
__	to	__	32			0.000	-0.019	-0.021	0.021	0.019	0.002	0.042	0.084	0.030	0.114	1.000	0.114	0.067	0.013					
__	to	__	32			0.000	-0.002	-0.002	0.002	0.002	0.000	0.004	0.008	0.030	0.038	1.000	0.038		0.001					
__	to	__	32			0.000	-0.001	-0.004	0.004	0.001	0.003	0.008	0.016	0.030	0.046	1.000	0.046		0.002					
__	to	__	32			0.000	-0.001	-0.002	0.002	0.001	0.001	0.004	0.008	0.030	0.038	1.000	0.038		0.001					
__	to	__	32			0.000	-0.010	-0.015	0.015	0.010	0.005	0.030	0.060	0.030	0.090	1.000	0.090		0.008					
__	to	__	32			0.000	-0.001	-0.001	0.001	0.001	0.000	0.002	0.004	0.030	0.034	1.000	0.034		0.001					
__	to	__	32			0.000	-0.002	-0.002	0.002	0.002	0.000	0.004	0.008	0.030	0.038	1.000	0.038		0.001					
																mean	0.080	stdev	0.015					

Road Roughness Survey (MERLIN)



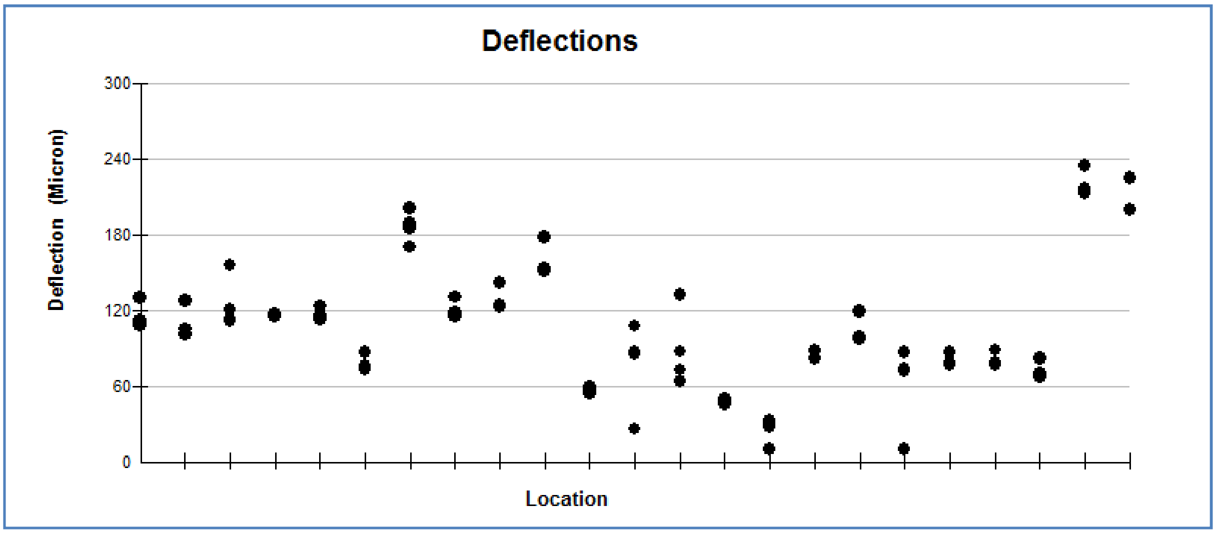


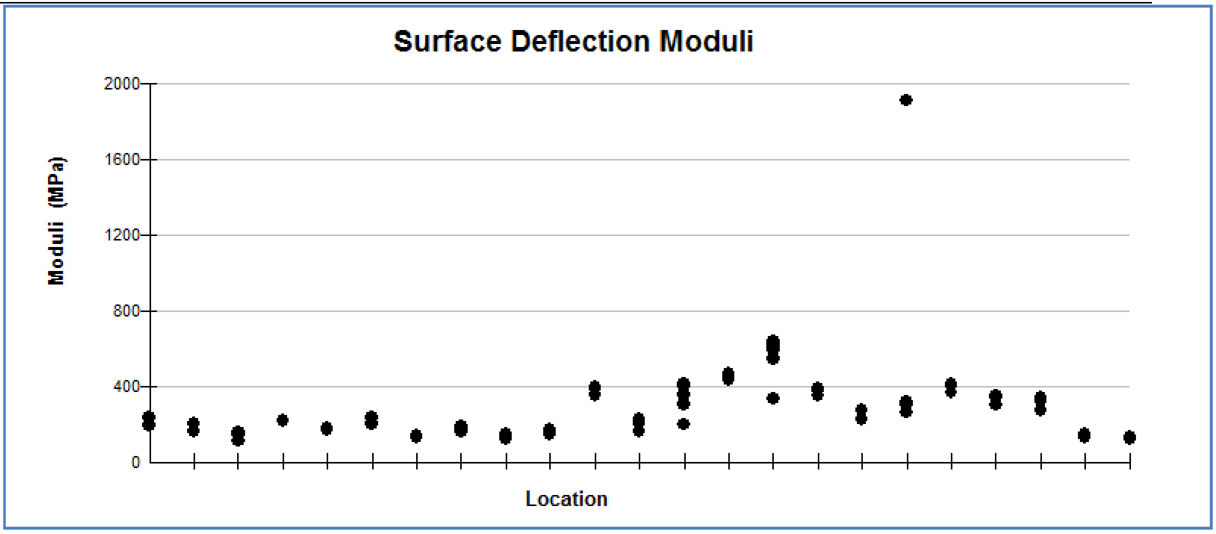


Aimil

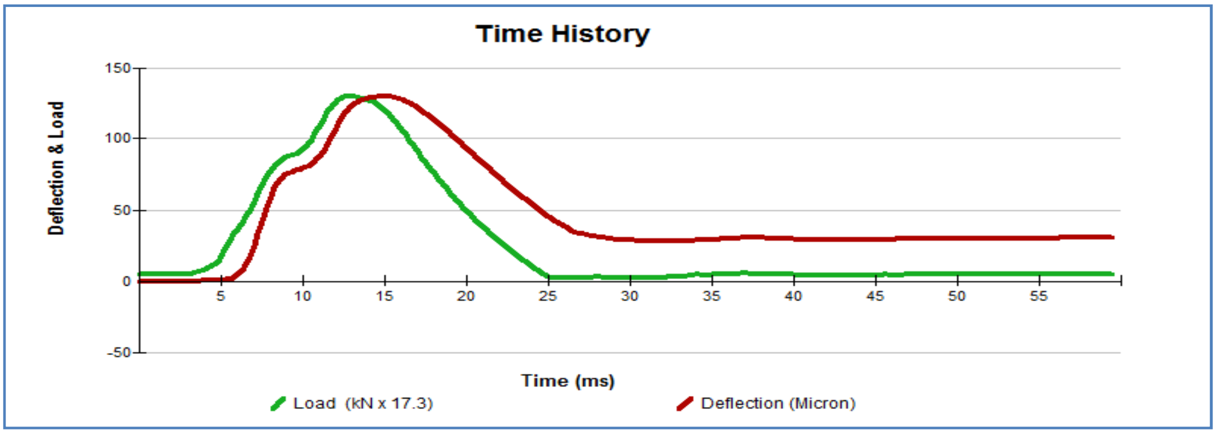
Portable Falling Weight Deflectometer (LWD)

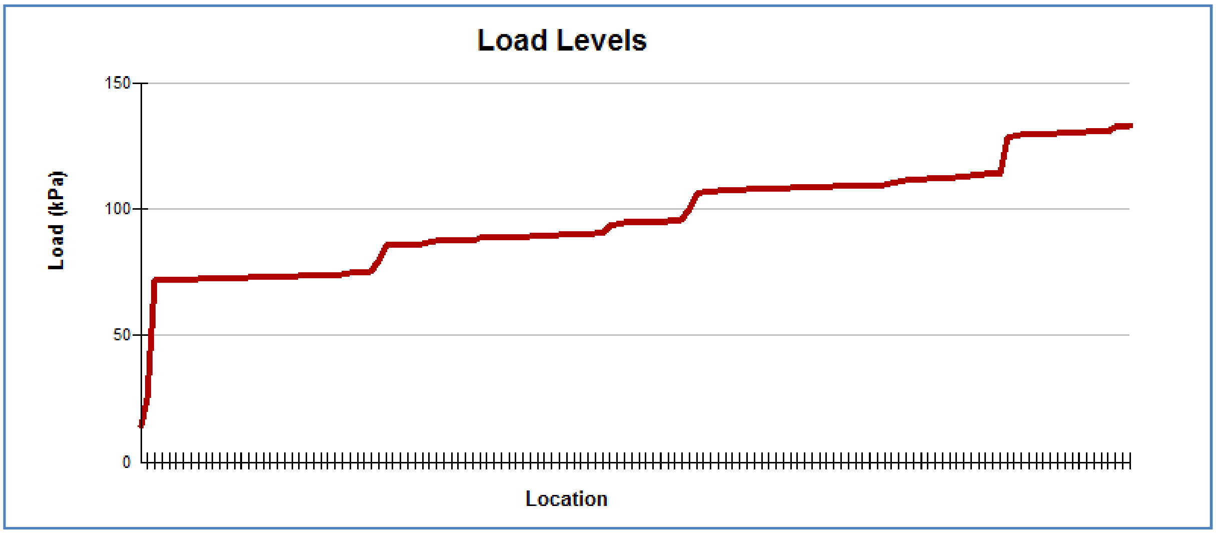
Photos

LWD Analysis




Surface Deflection Moduli
Moduli (MPa)
2000
1600
1200
800
400
0
Location


Time History
Deflection & Load
150
100
50
0
-50
5
10
15
20
25
30
35
40
45
50
55
Time (ms)
Load (kN x 17.3)
Deflection (Micron)


Load Levels
Load (kPa)
150
100
50
0
Location

Stretch name:Dhara- Gotiya					Base layer : WBM											
Chainage	Drop no.	Drop Weight (kg)	Drop Height (in)	Force (kn)	pressure (kpa)	pulse	D1	D2	D3	E1	E2	E3	Avg E1 MPA	Avg E2	Avge E3	Avg. Def Micr
0 - 0.5 km	4	15	21	9.1	128.3	28	139	41	62	242	208	68	242	209	68	140
	5	15	21	9.2	130.6	28	139	41	62	247	211	69				
	6	15	21	9	127.7	28	141	41	63	238	207	67				
0.5-1 km	4	15	21	9.2	129.5	28	155	50	62	220	170	69	218	171	69	156
	5	15	21	9.1	129.4	28	157	50	61	216	171	69				
	6	15	21	9.1	129.4	28	156	50	61	219	172	70				
1 -1.5 km	4	15	21	9.3	131.1	28	142	27	61	244	324	71	247	328	70	139
	5	15	21	9.2	130.1	28	137	26	61	250	330	70				
	6	15	21	9.2	129.8	28	138	26	61	248	331	70				
1.5-2 km	4	15	21	9.1	129.3	28	185	31	60	184	277	71	184	276	71	185
	5	15	21	9.2	129.7	28	185	31	61	184	277	70				
	6	15	21	9.2	129.6	28	185	31	60	185	275	71				
2-2.5 km	4	15	21	9.3	131	28	133	50	60	260	171	71	256	171	72	134
	5	15	21	9.3	131.4	28	135	51	60	255	171	72				
	6	15	21	9.2	130.2	28	135	50	60	253	171	72				
2.5-3 km	4	15	21	9.3	131.8	28	159	34	60	219	252	72	220	251	72	157
	5	15	21	9.3	131.5	28	156	34	60	221	251	72				
	6	15	21	9.3	131.5	28	156	34	60	221	251	72				

Stretch name:Dhara- Gotiya					Base layer : WBM											
Chainage	Drop no.	Drop Weight (kg)	Drop Height (in)	Force (kn)	pressure (kpa)	pulse	D1	D2	D3	E1	E2	E3	Avg E1 MPA	Avg E2	Avge E3	Avg. Def Micr
3-3.5 km	4	15	21	9.2	130.7	28	149	34	61	231	250	71	231	248	71	150
	5	15	21	9.3	131.3	28	151	35	61	230	249	70				
	6	15	21	9.2	130.6	28	149	35	61	231	245	71				
3.5-4 km	4	15	21	9.2	130.2	28	108	24	58	316	355	74	314	351	72	108
	5	15	21	9.1	128.1	28	108	24	59	313	349	71				
	6	15	21	9.1	128.8	28	108	24	59	313	349	72				
4-4.5 km	4	15	21	9.2	130.1	28	108	24	60	317	351	71	320	351	71	107
	5	15	21	9.2	129.5	28	108	24	61	317	349	70				
	6	15	21	9.2	129.6	28	105	24	60	326	353	71				
4.5-5 km	4	15	21	9.2	129.5	28	98	19	60	347	452	71	347	451	71	98
	5	15	21	9.2	129.7	28	98	19	61	347	452	70				
	6	15	21	9.2	130	28	99	19	60	346	450	71				
5-5.5 km	4	15	21	9.1	129	28	83	23	61	409	373	70	407	374	70	83
	5	15	21	9.1	128.7	28	83	23	60	408	373	70				
	6	15	21	9.1	128.4	28	83	22	61	405	377	69				
5.5-6 km	4	15	21	9.3	132.1	28	135	26	60	258	332	73	267	376	71	129
	5	15	21	9.2	130.5	28	129	22	61	266	399	70				
	6	15	21	9.2	130.4	28	124	22	60	277	398	71				

Stretch name:Dhara- Gotiya					Base layer : WBM											
Chainage	Drop no.	Drop Weight (kg)	Drop Height (in)	Force (kn)	pressure (kpa)	pulse	D1	D2	D3	E1	E2	E3	Avg E1 MPA	Avg E2	Avge E3	Avg. Def Micr
6-6.5 km	4	15	21	9.3	131.7	28	150	30	61	232	290	71	227	287	69	151
	5	15	21	9.1	129	28	152	30	62	223	284	69				
	6	15	21	9.1	128.6	28	151	29	62	225	287	68				
6.5-7 km	4	15	21	9.3	130.9	28	138	34	61	251	250	70	251	249	71	137
	5	15	21	9.2	130.4	28	137	34	61	251	250	71				
	6	15	21	9.3	131.2	28	137	35	60	251	248	71				
7-7.5 km	4	15	21	9.2	130.1	28	123	38	61	278	224	70	279	226	70	123
	5	15	21	9.2	130.4	28	123	38	61	278	227	70				
	6	15	21	9.3	131.1	28	123	38	61	281	228	71				
7.5-8 km	4	15	21	9.1	128.7	28	76	25	61	448	343	69	444	342	70	77
	5	15	21	9.2	129.6	28	76	25	60	449	343	71				
	6	15	21	9.2	129.9	28	79	25	60	435	340	71				
8-8.5 km	4	15	21	9.2	130.7	28	112	25	61	307	342	71	307	341	71	112
	5	15	21	9.5	130.7	28	112	25	60	308	342	72				
	6	15	21	9.2	130.9	28	112	25	60	307	339	71				
8.5-9 km	4	15	21	9.2	130.2	28	98	19	60	350	440	72	353	446	72	97
	5	15	21	9.2	130.4	28	97	19	60	355	451	71				
	6	15	21	9.3	131.4	28	97	19	60	355	446	72				

Stretch name:Dhara- Gotiya					Base layer : WBM											
Chainage	Drop no.	Drop Weight (kg)	Drop Height (in)	Force (kn)	pressure (kpa)	pulse	D1	D2	D3	E1	E2	E3	Avg E1 MPA	Avg E2	Avge E3	Avg. Def Micr
9-9.5 km	4	15	21	9	128	28	117	17	60	289	491	70	293	492	70	116
	5	15	21	9.2	129.7	28	116	17	60	293	499	71				
	6	15	21	9.2	129.5	28	114	18	61	298	487	70				
9.5-10 km	4	15	21	9.2	130.2	28	145	25	61	236	348	71	237	338	71	145
	5	15	21	9.2	130.2	28	145	26	61	237	324	70				
	6	15	21	9.2	130.6	28	145	25	60	237	341	71				
10-10.5 km	4	15	21	9.5	134.3	28	140	38	61	253	230	73	254	230	73	139
	5	15	21	9.5	134.2	28	139	38	61	255	229	73				
	6	15	21	9.5	134.3	28	139	38	61	254	231	73				
10.5-11 km	4	15	21	9.4	133	28	138	48	60	255	183	74	252	182	74	139
	5	15	21	9.4	133	28	140	48	60	250	181	73				
	6	15	21	9.4	133.5	28	140	48	60	251	183	74				
												Avg (MPa)	**274**	**304**	**71**	

Stretch name: Belgaon- Kholendera					Base layer : WMM											
Chainage	Drop no.	Drop Weight (kg)	Drop Height (in)	Force (kn)	pressure (kpa)	pulse	D1	D2	D3	E1	E2	E3	Avg E1	Avg E2	Avg E3	Avg Def
0 to 0.5 km	4	15	21	9.4	132.6	28	77	35	58	484	266	80	492	263	80	75
	5	15	21	9.3	131.6	28	74	36	58	498	257	80				
	6	15	21	9.3	132.2	28	75	35	59	495	265	79				
0.5 to 1 km	4	15	21	9.6	136	28	141	54	59	272	176	81	273	177	80	139
	5	15	21	9.4	133.2	27	138	53	59	271	177	79				
	6	15	21	9.5	134.1	27	137	53	59	275	177	80				
1 to 1.5 km	4	15	21	9	127.4	28	140	63	58	256	142	77	257	143	77	140
	5	15	21	9	127	28	139	63	58	257	143	77				
	6	15	21	9	127.6	28	140	63	58	257	143	78				
1.5 to 2 km	4	15	21	9.1	128.8	28	133	51	57	272	178	80	270	176	80	134
	5	15	21	9.1	128.8	28	134	51	57	269	176	80				
	6	15	21	9.1	128.6	28	135	52	57	268	175	80				
2 to 2.5 km	4	15	21	9.1	128.8	27	179	77	59	202	117	77	205	119	78	178
	5	15	21	9.2	130.4	27	178	77	59	207	120	78				
	6	15	21	9.3	131	28	178	77	59	207	120	78				
2.5 to 3 km	4	15	21	9.3	131.4	28	116	39	58	319	237	80	322	237	80	115

Stretch name: Belgaon- Kholendera					Base layer : WMM											
	5	15	21	9.4	132.3	28	116	39	57	320	238	81				
	6	15	21	9.3	131.5	27	114	39	57	326	235	80				
3 to 3.5 km	4	15	21	9.1	128.7	28	176	78	59	206	116	77	207	117	77	175
	5	15	21	9	128	28	175	77	59	206	117	76				
	6	15	21	9.1	129.3	28	174	77	59	209	118	77				
3.5 to 4 km	4	15	21	9.5	134.7	28	85	31	58	447	303	82	446	302	82	85
	5	15	21	9.5	134.8	27	85	31	58	446	302	82				
	6	15	21	9.4	133.3	28	84	31	58	445	300	81				
												Average (MPa)	**289**	**186**	**79**	

Stretch name: Devarakatta- Kanhargaon					Base layer : WBM											
Chainage	Drop no.	Drop Weight (kg)	Drop Height (in)	Force (kn)	pressure (kpa)	pulse	D1	D2	D3	E1	E2	E3	AVg E1	avg E2	avg E3	Avg Def
0 to 0.5 km	4	15	21	9.3	131.1	28	226	88	59	153	98	73	153	98	73	226
	5	15	21	9.4	132.4	28	227	88	59	154	99	73				
	6	15	21	9.2	130.2	28	225	87	60	153	98	72				
0.5 to 1 km	4	15	21	9.2	130.3	28	169	59	59	203	144	72	203	143	72	168
	5	15	21	9.1	129.3	28	168	59	60	202	143	71				
	6	15	21	9.2	129.3	28	167	60	59	205	143	72				
1 to 1.5 km	4	15	21	9.2	129.7	28	126	44	59	272	193	72	271	193	72	126
	5	15	21	9.2	129.8	28	127	44	59	269	193	72				
	6	15	21	9.2	129.8	28	125	44	58	272	193	73				
1.5 to 2 km	4	15	21	9.2	130.8	28	187	57	61	184	151	71	184	151	70	187
	5	15	21	9.2	130.6	28	187	57	61	184	151	70				
	6	15	21	9.2	130.3	28	187	57	61	184	150	70				
2to 2.5 km	4	15	21	9.2	130.3	28	197	64	58	174	134	73	175	134	74	197
	5	15	21	9.3	131	28	197	64	59	175	134	74				
	6	15	21	9.2	130.8	28	197	64	58	175	134	74				
2.5to 3 km	4	15	21	9.3	132.1	28	126	57	60	277	152	73	277	153	73	126
	5	15	21	9.4	132.7	28	126	57	59	277	153	73				
	6	15	21	9.4	132.7	28	126	57	60	277	153	73				
3to 3.5 km	4	15	21	9.4	132.9	28	136	51	60	257	173	73	258	172	73	136

Stretch name: Devarakatta- Kanhargaon					Base layer : WBM												
Chainage	Drop no.	Drop Weight (kg)	Drop Height (in)	Force (kn)	pressure (kpa)	pulse	D1	D2	D3	E1	E2	E3	AVg E1	avg E2	avg E3	Avg Def
	5	15	21	9.4	133	28	136	51	60	258	172	72				
	6	15	21	9.4	132.8	28	135	51	60	259	171	73				
3.5to 4 km	4	15	21	9.1	128.5	28	122	34	59	278	252	71	278	252	72	122
	5	15	21	9.1	128.4	28	122	33	59	277	252	72				
	6	15	21	9.2	130.1	28	123	34	60	279	253	72				

Stretch name: Karwari-Dongargarh					Base layer : WMM											
Chainage	Drop no.	Drop Weight (kg)	Drop Height (in)	Force (kn)	pressure (kpa)	pulse	D1	D2	D3	E1	E2	E3	Avg. E1 (MPa)	Avg. E2 (MPa)	Avg. E3 (MPa)	Avg. Def
0-0.5 KM	4	20	19	10.6	150.4	31	123	39	61	322	254	82	323	254	82	122
	5	20	19	10.5	149.1	31	122	39	60	323	253	82				
	6	20	19	10.5	149	31	121	39	60	324	254	82				
0.5-1 KM	4	20	19	10.4	146.6	31	138	36	61	279	268	80	279	267	80	138
	5	20	19	10.4	146.8	32	138	36	60	280	267	80				
	6	20	19	10.4	146.9	32	139	37	60	279	265	81				
1.5 to 1 km	4	15	21	8.9	126.5	29	106	34	61	336	264	73	336	263	73	106
	5	15	21	9	126.9	29	106	34	62	337	262	72				
	6	15	21	9	127.4	28	107	34	62	335	263	73				
2 to 1.5 km	4	15	21	8.9	125.7	28	154	44	60	230	202	73	245	202	73	145
	5	15	21	8.9	125.5	29	139	44	60	253	202	73				
	6	15	21	8.9	125.8	29	141	44	60	251	203	74				
2.5 to 2 km	4	15	21	9	127.7	28	121	46	61	296	196	73	300	199	75	121
	5	15	21	9.2	129.9	29	121	46	61	302	200	75				
	6	15	21	9.3	131	29	122	46	61	301	200	76				
3 -2.5 km	4	15	21	9.1	128.5	29	54	19	60	675	486	76	675	485	76	54
	5	15	21	9.1	129.1	29	53	19	60	681	485	76				
	6	15	21	9.2	129.7	29	54	19	60	670	483	76				
												AVG (MPa)	**341.875**	**274.75**	**76.16667**	

Stretch name: Bhaisara - Kalkasa					Base layer : WBM								Avg E1	Avg. E2	Avg. E3	
Chainage	Drop no.	Drop Weight (kg)	Drop Height (in)	Force (kn)	pressure (kpa)	pulse	D1	D2	D3	E1	E2	E3				Def
0.5 to 0 km	4	15	21	9.1	129	28	129	24	59	282	372	76	280	370	77	
	5	15	21	9.1	129.2	28	130	25	59	280	370	77				
	6	15	21	9.1	129.2	28	130	25	58	279	369	78				130
1 to 0.5 km	4	15	21	9.2	130.7	28	152	42	59	242	220	78	244	223	79	
	5	15	21	9.4	132.6	28	153	41	59	244	225	79				
	6	15	21	9.4	133.1	28	151	42	59	247	223	79				152
1.5 to 1 km	4	15	21	9.3	131.8	28	147	29	60	252	317	78	252	314	79	
	5	15	21	9.3	131.3	28	149	30	59	248	312	79				
	6	15	21	9.4	133.6	28	147	30	59	256	314	80				148
2 to 1.5 km	4	15	21	9.1	129.4	28	113	35	60	321	258	76	321	257	76	
	5	15	21	9.1	129.1	28	112	35	59	323	257	77				
	6	15	21	9.1	129.3	28	114	36	59	320	255	76				113
												Avg	**275**	**291**	**78**	

Stretch name: Belgaon - Katli					Base layer : WMM								AVG E1	AVG E2	AVG E3	
Chainage	Drop no.	Drop Weight (kg)	Drop Height (in)	Force (kn)	pressure (kpa)	pulse	D1	D2	D3	E1	E2	E3	MPa	MPa	MPa	Def
1.5 - 1 km	4	15	21	8	112.6	29	197	71	59	151	104	63	151	104	63	197
	5	15	21	7.9	112.3	29	197	72	59	150	103	63				
	6	15	21	8	112.7	29	196	72	59	151	104	63				
1 - 0.5 km	4	15	21	9.2	130.5	28	167	71	60	206	121	71	205	121	71	168
	5	15	21	9.2	130.7	28	169	71	61	204	122	71				
	6	15	21	9.2	130.3	28	167	71	61	206	121	71				
0.5 - 0 km	4	15	21	9.2	130.1	28	78	23	58	440	370	73	441	370	73	77
	5	15	21	9.1	128.7	28	77	23	58	438	367	73				
	6	15	21	9.2	129.5	28	76	23	58	446	374	73				
2.0 - 1.5 km	4	15	21	9.2	130.3	28	77	43	58	479	213	79	477	214	79	77
	5	15	21	9.2	129.3	28	77	43	58	474	214	78				
	6	15	21	9.2	129.7	28	76	42	58	477	216	79				
2.5 - 2 km	4	15	21	9.2	130.7	28	81	29	58	452	314	79	451	313	79	81
	5	15	21	9.2	130.5	28	81	29	58	451	312	79				
	6	15	21	9.2	130.4	28	81	29	58	451	314	79				
												AVG (MPa)	**360**	**239**	**74**	

Stretch name: Kolendra- Takurtola					Base layer : WMM											
Chainage	Drop no.	Drop Weight (kg)	Drop Height (in)	Force (kn)	pressure (kpa)	pulse	D1	D2	D3	E1	E2	E3	AVG E1	AVG E2	AVG E3	Def Avg.
0 to 0.5 km	4	15	21	9.4	133.6	28	76	34	60	493	279	78	491	278	78	76
	5	15	21	9.4	132.8	28	76	34	60	489	278	77				
0.5 to 1 km	4	15	21	9.1	128.9	28	109	58	58	332	155	79	332	156	79	109
	5	15	21	9.2	129.6	28	109	58	57	334	157	79				
	6	15	21	9	127.9	28	109	58	57	329	155	79				
1 to 1.5 km	4	15	21	9.3	131.6	28	175	56	60	212	164	78	213	165	78	174.3333
	5	15	21	9.3	132.3	28	174	56	59	213	165	78				
	6	15	21	9.3	131.8	28	174	56	59	213	165	78				
1.5 to 2 km	4	15	21	9.1	129.4	28	153	45	58	238	203	79	240	204	80	152.6667
	5	15	21	9.2	129.7	28	153	45	57	239	205	80				
	6	15	21	9.3	131.2	28	152	45	57	243	205	81				
2 to 2.5 km	4	15	21	9.3	131.1	28	109	47	60	338	195	77	339	195	77	108.3333
	5	15	21	9.2	130.4	28	109	47	59	336	195	77				
	6	15	21	9.2	130.6	28	107	47	60	343	195	77				
2.5 to 3 km	4	15	21	9.3	131.1	28	202	72	61	182	128	75	182	128	76	203
	5	15	21	9.3	131.5	28	200	72	61	185	129	76				
	6	15	21	9.3	131.2	28	207	72	61	178	128	76				

Stretch name: Kolendra- Takurtola					Base layer : WMM											
Chainage	Drop no.	Drop Weight (kg)	Drop Height (in)	Force (kn)	pressure (kpa)	pulse	D1	D2	D3	E1	E2	E3	AVG E1	AVG E2	AVG E3	Def Avg.
3 to 3.5 km	4	15	21	9.5	133.9	28	81	37	61	463	256	78	470	258	78	80
	5	15	21	9.5	133.8	28	80	37	60	470	257	78				
	6	15	21	9.5	134.2	28	79	36	60	476	260	78				
3.5 to 4 km	4	15	21	9.1	128.9	28	105	41	54	345	220	83	345	221	84	105
	5	15	21	9.1	128.9	28	105	41	54	344	221	84				
	6	15	21	9.1	128.6	28	105	41	54	345	221	83				
						28						avg	**326**	**200**	**79**	