

Date: February 28, 2022

To

**Virescent Infrastructure Investment Manager Private Limited**

10th Floor, Parinee Crescenzo

C- 30 'G' Block

Bandra Kurla Complex

Bandra (East),

Mumbai 400051, Maharashtra, India

Dear Sir,

**Re: Submission of Final Report of Technical due diligence study for the project "Jodhpur Pali Expressways Pvt. Ltd".**

With reference to the captioned matter, we are here with submitting the Final Report of "Technical Due Diligence for 4 Laning of Jodhpur to Pali Section of NH 65 from Km 308 to Km 366 & includes bypass to Pali starting from Km 366 of NH-65, connecting NH-14 at Km 114 in the State of Rajasthan".

Yours faithfully,

For **Samarth Infraengg Technocrats Pvt. Ltd.**

**Authorized Signatory**

Kalva Kiran Kumar



**Technical Due Diligence for 4 Laning of Jodhpur to Pali Section of NH 65 from Km 308 to Km 366 & includes bypass to Pali starting from Km 366 of NH-65, connecting NH-14 at Km 114 in the State of Rajasthan**

**For Virescent Infrastructure  
Investment Manager Private Limited  
(For the purpose of  
Highways Infrastructure Trust)**

# **Final Report**

**SAMARTH INFRAENGG Technocrats Private Limited**



**FEBRUARY 2022**

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## I. INTRODUCTION

The Govt. of India (GOI) through Ministry of Shipping, Road Transport & Highways is contemplating to enhance the road capacity and safety for efficient transshipment of goods as well as passenger traffic on the heavily trafficked National Highway sections. MoRT&H had identified one such corridor to Design, Construction, Development, Finance, Operation and Maintenance of the Rehabilitation and Upgrading to Four Lane of NH 65 from Km 308 to Km 366 & includes bypass to Pali starting from Km 366 of NH-65, connecting NH-14 at Km 114 (Length 71.535 km) existing 2 lane Highway section of NH-65 between Jodhpur to Pali in the state of Rajasthan south-east Corridor Under (Public private Partnership) on Design, Build, Finance, Operate and Transfer (DBFOT).

The Government of Rajasthan acting through the Chief Engineer, Public Work Department (PWD), Government of Rajasthan has awarded the work of 4 laning of above stretch of highway, on Design, Build, Finance, Operate and Transfer (DBFOT) Toll Basis to the Consortium Company lead by M/s. G.R.INFRA Project Ltd., under Package No: F.7 (269)/pt-IV/BOT/PPP-NH/D-480dt.

Consequent to this, M/S G.R.INFRA Project Ltd., formed a Special Purpose Vehicle (SPV) in the name of Jodhpur- Pali Expressway Ltd., for implementation/execution of the project, registered under the companies act, 1956. The Concession Agreement was signed between PWD and the SPV, M/s. Jodhpur Pali Expressways Pvt. Ltd. (formerly known as Jodhpur Pali Expressways Ltd.).

On 31.03.2017, India Infrastructure Fund II (IIF-II) acquired control of 90.43% stake of M/s Jodhpur Pali Expressway Pvt. Ltd. and balance 9.57% was acquired on 28.03.2018. Further, on 17.12.2021, Galaxy Investments II Pte. Ltd. acquired control of 100% stakes of M/s JODHPUR PALI EXPRESSWAY PRIVATE LIMITED from India Infrastructure Fund-II.

The project is presently under operation and maintenance by concessionaire JODHPUR PALI EXPRESSWAY PRIVATE LIMITED (JPEPL). Samarth Infraengg Technocrats Pvt. Ltd. has been engaged as Technical/ Engineering Due Diligence Advisor for Highways Infrastructure Trust purpose.

This report highlights the findings of due diligence study undertaken by consultants on the project

## II. PROJECT AT A GLANCE

National Highway 65 connects Ambala in Haryana and Pali in Rajasthan. This 690 km road starts from the junction of Grand Trunk Road and National Highway 22 at Ambala. It then traverses south-west for 240 km before entering Rajasthan at Jhumpa; Kaithal, Narwana, Barwala and Hissar are some major towns that lie along the National Highway 62 on the Haryana side. In Rajasthan, the road passes through Rajgarh, Jhunjhunu, Nagaur and Jodhpur before terminating at Pali, 30 km south-east of Rohat.

From Km 308.000 to Km 315.400 the urban area the carriageway width is 7m flanked by paved Shoulder varies from 1.5 to 3m with shyness of 0.25m. From Km 316.500 to Km 323.600 the carriageway width is 7m flanked by paved Shoulder With 1.5 Width and with shyness of 0.25m Plus 1.5m Earthen Shoulder. From Km 324.500 to Km 379.535 the carriageway width is 7m and with shyness of 0.25m Plus 1.5m Earthen Shoulder Except Structure locations and built-up Area.

- The agreement was signed on 28.02.2013 and the Appointed date was taken on 16.09.2013.
- Scheduled Project Completion date was 20.03.2015 considering the construction period of the Project Highway as 550 days (as stipulated in CA). The Scheduled Project Completion date has been further extended up to October 2015.
- Concession period for this project is 25 Years i.e., the original end date of Concession is 15.09.2038. However, as informed by the Concessionaire, the Concessionaire expects 5 years extension in concession period on account of traffic variation as per Article 29 of CA. Based on latest traffic surveys end date of Concession will be 15.09.2043
- First Provisional Completion Certificate for the length of 60.015 Km out of 71.535 Km has been issued on 31.10.2014
- Second Provisional Completion Certificate for the length of 71.093 Km (60.015 Km of First PCC plus additional 10.078 Km after First PCC) out of 71.535 (as per CA length) has been issued on 10.10.2015
- Supplementary Agreement was made on 08.03.2018 indicates that the Concessionaire shall complete the balance works as and when the Land is made available to him by Authority. Most of the works have been completed except small works which are highlighted in Section 1.11 of this Report

### III. SALIENT FEATURES

Sl. No.	Particulars	Length/No
1	No of Grade Separated Structures	2 Nos.
2	Service Roads	11.565
3	ROB (Numbers) and location (chainage)	1 Number at Km 367.473 Km
4	No of Bypass	1 Nos
5	Length of Bypass	Total Bypass Length - 12.352 km
6		1. Pali Bypass km 367.200 - km 379.535 = km 12.353
7	No of Major Bridges	6 Nos
8	No of Minor Bridges	6 Nos.
9	No of Culvert	6 Nos. Box, 8 No. Slab Culverts, 50 Nos. Pipe Culvert
10	No of VUP	1 Nos.
11	No of PUP/Cattle underpass	2 Nos.
12	No of major intersection/Junction	12 Nos.
13	No of Toll Plaza and Locations	2 Nos. (Km 338+350 and Km 365+400)
14	No of Truck Lay bye	1 Nos.
15	No of Bus Bays with Shelter	12 Nos. Bus Bays with Shelter
16	Stone Pitching	5.93 km's _Both Sides
17	RCC Wall	0.0450 km's_ Both Sides
18	RE Wall	6.010 km's Both Sides
19	Delineators	1051 No's
20	RCC Covered Drain	23.25 Km's
21	Lined Drain	0.710 Km's
22	Median drain	8.947m Km's
23	Major and Minor Junctions	12 No's Major and 33 No's Minor junctions
24	High Mast Lighting	5 No's
25	Double Arm Lightning	205 No's excluding the lighting provided by Jodhpur Urban Area (JDA) from 308+460 to 315+400.
26	Single Arm Lightning's	26
27	Median Openings	42 No's
28	Median Plantation_ Functional	71.103 Km's
29	Metal Beam Crash Barrier	11.394 Km's
30	Concrete Safety barrier	12.244 Km's
31	Pedestrian Guard Rails	3 Km's
32	Concrete Railing	0.930 Km's
33	Solar Blinkers	77 No's
34	Guard Posts	521 No's
35	Road Signs	752 No's

#### IV. IMPORTANT FINDINGS AND CONCLUSION

Foregoing discussions on various elements of project highway leads to following Conclusions

1. COS works for 2 VUPs has been awarded. VUP work at Mandia was completed and opened to Traffic in the month of August 2019. Kakani VUP construction work stopped w.e.f. 18th November 2020 due to local villager's agitation. In this regard Concessionaire already represented PWD to resolve the matter at the earliest. But, till date local issue not been resolved by PWD.
2. From Km 308.000 to Km 315.400 the urban area the carriageway width is 7m flanked by paved Shoulder varies from 1.5 to 3m with shyness of 0.25m. From Km 316.500 to Km 323.600 the carriageway width is 7m flanked by paved shoulder with 1.5 width and with shyness of 0.25m plus 1.5m earthen shoulder. From Km 324.500 to Km 379.535 the carriageway width is 7m and with shyness of 0.25m Plus 1.5m earthen shoulder except structure locations and built-up area.
3. The project road in general has good pavement condition except for few surface related distress. The cracking appears to top-down cracking rather than bottom-up cracking.
4. There are no undulations or depressions are observed along the corridor indicating good Subgrade quality.
5. Roughness surveys along corridor indicate at an average roughness is far less than 2500 mm/km and does not require immediate overlay from roughness consideration as the limiting value is 2500mm/Km as per CA.
6. Test pit surveys indicated average crust of 575 mm consisting of 147 mm blacktop and 428mm of granular layers over subgrade.
7. The subgrade quality in the corridor appears to be good with CBR above 8% at all locations.
8. Vehicle damage factors arrived from axle load surveys indicate that VDF for 2-Axle Truck is more in LHS Carriageway than RHS Carriageway but the VDF for 3 Axle trucks and Multi Axle Trucks is more in RHS Carriageway than in LHS Carriageway
9. The Remaining life of the existing pavement is more than the 10 years design MSA, hence no immediate Overlay is required from Structural Consideration; however, it is felt prudent to consider 30mm overlay in the year FY22/F23 as preventive overlay and accordingly the Concessionaire has commenced the work at site.
10. Though Minor distresses were observed; all structures along the project road are having good condition. Some of the distresses observed are of routine in nature and rectification work for the same is in progress.
11. Distresses or deficiencies noticed along the project Road (Pavement/highway/Drainage/Structures) are considered for immediate Repair and the Cost for the same has been considered in FY22.



12. The TMS and WIMs were replaced recently in the month of April'2021 and the next replacement of the same has been considered at every 6 years during the remaining operation period.
13. O&M Costs have been estimated till the end of Revised Concession period i.e., till 15.09.2043 as against 15.09.2038 (original Concession end date)
14. The applicable Manual for this project is IRC: SP:84-2009 and as per this manual, the roughness Survey shall be carried out twice in a year and BBD Survey shall be carried out once in 5 years.
15. As per pavement design report, stage construction has been adopted during initial construction. Accordingly, bituminous layers are designed for 10 years and granular layers are designed for full concession period.
16. There is no Mandatory Functional Overlay prescribed for this project as per CA. the Road has to be maintained as per CA and Roughness values shall be maintained below 2500mm/Km.
17. Even though Overlay is not required now, 30 mm thickness of BC is proposed throughout the project length in the FY22/FY23 by considering the age of the pavement and surface condition. Accordingly, Major Maintenance work for the entire stretch contract awarded and the work is in progress and Client informed that the work is expect to complete on July 2022.
18. Future Overlays have been estimated by using HDM-4 Model. Considering the balance concession period and O&M criteria for MM schedules are evaluated whenever the Roughness value exceeds 2500mm/Km and it is observed that Three Overlays (excluding the recent Overlay work in progress) are required for remaining Concession period.

#### V. COST ABSTRACT:

O&M Cost Abstract schedule is as below:

- 1.1. Cost Abstract (**without escalation**): Three Overlays (excluding the presently proposed Overlay) are required for remaining Concession period with 40mm BC:

S. No	FY	Immediate Repair's Cost +Routine and Operational Cost (in Crores)	Periodic Maintenance Cost (in Crores)	Total Cost (in Crores)
1	2023	14.67	-	14.67
2	2024	14.67	-	14.67
3	2025	14.67	-	14.67
4	2026	14.67	-	14.67
5	2027	14.67	-	14.67
6	2028	14.67	-	14.67
7	2029	14.67	51.40	66.07
8	2030	14.67	62.67	77.34
9	2031	14.67	-	14.67

10	2032	14.67	-	14.67
11	2033	14.67	-	14.67
12	2034	14.67	-	14.67
13	2035	14.67	-	14.67
14	2036	14.67	25.47	40.13
15	2037	14.67	24.80	39.47
16	2038	14.67	-	14.67
17	2039	14.67	-	14.67
18	2040	14.67	-	14.67
19	2041	14.67	-	14.67
20	2042	14.67	50.85	65.51
21	2043	14.67	2.32	16.98
22	2044	6.79	-	6.79
	<b>Total:</b>	<b>314.80</b>	<b>217.50</b>	<b>532.30</b>

**Note:**

1. Base Cost are arrived for FY2023
  2. All the material rates are February 2022 Rates
  3. All labour rates are taken from Central minimum wages (October'2021 cycle) and 2.5% escalation applied on the same to arrive FY2023 Rates
  4. All the costs are without any Escalation.
- All the Cost presented in the above table are excluding Head Office (HQ) Expenses.

# DUEDILIGENCE REPORT

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## 1.1 INTRODUCTION

The Govt. of India (GOI) through Ministry of Shipping, Road Transport & Highways is contemplating to enhance the road capacity and safety for efficient transshipment of goods as well as passenger traffic on the heavily trafficked National Highway sections. MoRTH had identified one such corridor to Design, Construction, Development, Finance, Operation and Maintenance of the Rehabilitation and Upgrading to Four Lane of NH 65 from Km 308 to Km 366 & includes bypass to Pali starting from Km 366 of NH-65, connecting NH-14 at Km 114 (Length 71.535 km) existing 2 lane Highway section of NH-65 between Jodhpur to Pali in the state of Rajasthan south-east Corridor Under (Public private Partnership) on Design, Build, Finance, Operate and Transfer (DBFOT).

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Consequent to this, M/S G.R.INFRA Project Ltd., formed a Special Purpose Vehicle (SPV) in the name of Jodhpur- Pali Expressway Ltd., for implementation/execution of the project, registered under the companies act, 1956. The Concession Agreement was signed between PWD and the SPV, M/s. Jodhpur Pali Expressways Pvt. Ltd. (formerly known as Jodhpur Pali Expressways Ltd.).

The Concessionaire completed the project and obtained PCOD-I on 31.10.2014 for 60.015 km out of 71.535 km with a punch list of items to be completed within 90 days. Subsequently the Concessionaire obtained PCOD-II on 10.10.2015 for 71.093 km out of 71.535 km. Final COD has been achieved on 8<sup>th</sup> March 2018 with a condition that the Concessionaire shall complete the balance works as agreed in supplementary agreement dated on 08.03.2018 between Authority and Concessionaire.

The project is presently under operation and maintenance by concessionaire JODHPUR PALI EXPRESSWAY PRIVATE LIMITED (JPEPL). Samarth Infraengg Technocrats Pvt. Ltd. has been engaged as Technical/ Engineering Due Diligence Advisor for Highways Infrastructure Trust purpose.

This report highlights the findings of due diligence study undertaken by consultants on the project.

## 1.2 PROJECT AT A GLANCE

National Highway 65 connects Ambala in Haryana and Pali in Rajasthan. This 690 km road starts from the junction of Grand Trunk Road and National Highway 22 at Ambala. It then traverses south-west for 240 km before entering Rajasthan at Jhumpa; Kaithal, Narwana, Barwala and Hissar are some major towns that lie along the National Highway 62 on the Haryana side. In Rajasthan, the road passes through Rajgarh, Jhunjhunu, Nagaur and Jodhpur before terminating at Pali, 30 km south-east of Rohat.

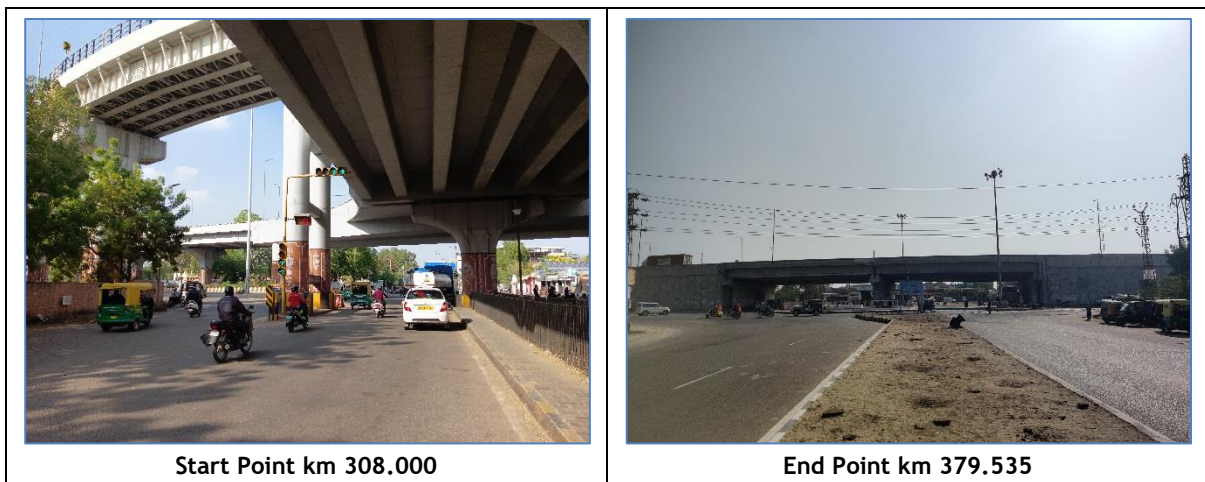
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**Table 1: Project Corridor Chainage System**

Referencing system	Project Corridor Start Point (km)	Project Corridor End Point (km)	Length (km)
Existing Chainage	308.000	12.315 of NH-14	70.315
CA Design Chainage	308.000	379.535	71.535

The Project Corridor section starts from Jodhpur and runs south-east towards (Pali side) and ends on NH-14. Photograph showing the start and end point of the project road are presented below:



Following Table highlights the total project at a glance:

SI No.	Description	Date
1.	Date of Signing the Concession Agreement	28 <sup>th</sup> Feb'2013

2.	Appointment Date	16 <sup>th</sup> September 2013
3.	Scheduled Project completion	20 <sup>th</sup> March 2015
4.	Scheduled End of Concession	25 Years
5.	Date of issue of Provisional Completion Certificate	31 <sup>st</sup> October 2014/10 <sup>th</sup> October 2015
6.	Date of Commencement of Commercial Operation	31 <sup>st</sup> October 2014
7.	Date of Issue of Final Completion Certificate	8 <sup>th</sup> March 2018

**Table 2: Salient Features of Project Corridor**

Sl. No.	Particulars	Length/No
1	No of Grade Separated Structures	2 Nos.
2	Service Roads	11.565
3	ROBs	1Nos.
4	ROB location (chainage)	367.473 Km
5	No of Bypass	1 Nos
6	Length of Bypass	Total Bypass Length - 12.335 km 1. Pali Bypass km 367.200 - km 379.535 = km 12.335
7	No of Major Bridges	6 Nos
8	No of Minor Bridges	6 Nos.
11	No of Culvert	6 Nos. Box, 8 No. Slab Culverts, 50 Nos. Pipe Culvert
9	No of VUP	1 Nos.
10	No of PUP/Cattle underpass	2 Nos.
11	No of major intersection/Junction	12 Nos.
12	No of Toll Plaza	2 Nos.
13	Location of Toll Plaza (change)	338+350,365+400
14	No of Truck Lay bye	1 Nos.
15	No of Bus Bays with Shelter	12 Nos. Bus Bays with Shelter
16	Stone Pitching	5.93 km's _Both Sides
17	RCC Wall	0.0450 km's_ Both Sides
18	RE Wall	6.010 km's Both Sides
19	Delineators	1051 No's
20	RCC Covered Drain	23.25 Km's
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24	Major Junctions	12 No's
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26	High Mast Lighting	5 No's
27	Double Arm Lightning	205 No's excluding the lighting provided by Jodhpur Urban Area (JDA) from 308+460 to 315+400.
28	Single Arm Lightning's	26
29	Median Openings	42 No's
30	Median Chutes	714 No's

Sl. No.	Particulars	Length/No
31	Median Damages	30 Locations
32	Median Plantation_ Functional	71.103 Km's
33	Median Plantation_ Non-Functional	0.45 Km's
34	Metal Beam Crash Barrier	11.394 Km's
35	Concrete Safety barrier	12.244 Km's
36	Pedestrian Guard Rails	3 Km's
37	Concrete Railing	0.930 Km's
38	Service/Slip Roads	11.565 Km's
39	Solar Blinkers	77 No's
40	Km Stones LHS	66 No's
41	Hectometer Stone LHS	228 No's
42	Km Stones RHS	66 No's
43	Hectometer Stone RHS	229 No's
44	Guard Posts	521 No's
45	Road Signs	752 No's

### 1.3 OBJECTIVE AND SCOPE OF SERVICES - FOR DUE DILIGENCE

The main objective of the study is to review the current status of project corridor including details pertaining to its construction and maintenance and to provide requisite technical information for processing the acquisition of said project by client. Objective of the study can be broadly defined with following tasks:

#### 1.3.1 General

- Review of all documents related to Project including but not limited to provisional completion certificates, punch list items completion certificate, clearances, monthly IE reports, important correspondence if any.
- Review of Change of Scope/ other Claims submitted and to be submitted to Authority / IC, comment on the veracity of the same and approval status.
- Highlight any non-compliance of the terms of the CA or O&M manual and IC inspection reports etc.
- Review of any pending issues related to Utility shifting, maintenance etc. in accordance with the Concession Agreement.
- Comment on issues including any balance work that may have a potential impact on the maintenance costs going forward and which may warrant a one-time expense in future.
- In general review the toll plaza systems (incl. AVCC, weigh bridge, sensors, ETC etc.) and the hardware installed therein and comment on the adequacy and level of maintenance of the same to meet the requirements under CA.
- Review of as built drawings.
- Determine the appropriate level and frequency of routine and major maintenance activities required to keep the road assets in good condition and to meet the performance and O&M standards, specifications and requirements.

- Review the major maintenance work undertaken, and prepare projections for future major maintenance expenses (incl. any hand-back requirements), so as to ensure compliance with the terms of CA.
- Review of condition of SPV assets including all equipment and vehicles etc.
- Report on balance acquisition of land if any and possibility of acquisition.
- Report on current encroachments on the project stretch and future expected problems due to the same.
- Review of O&M Contracts

### 1.3.2 Assessment of Asset Condition

- i. Assessment of road assets in conformance with specifications, standards and codes stipulated in CA and O&M manual etc.
- ii. A detailed inventory survey of road assets including main carriageway, structures, service roads, lightings, drains, slope protection works, retaining walls, bus bays, bus shelters, truck lay byes, O&M center, road furniture including signages, MCB, guard rails etc. other safety measures, toll collection infrastructure, buildings, plantation, vehicles and other objects.
- iii. Assessment of condition of the structures including but not limited to visual inspections of bearings, expansion joints, superstructure, substructures, foundations, associated components, pre-stress anchorages (if any), review of geotechnical assumptions, perform geotechnical due diligence, review as-built design and assess design assumptions and provide a detailed report thereon.
- iv. Assessment of condition of the road pavement including but not limited to visual inspections of the pavement, review as-built design and assess design assumptions and provide a detailed report thereon.
- v. Assessment of physical dimensions/ condition of the infrastructure to determine useful lives of the materials and equipment requiring rehabilitation and/or replacement.
- vi. Recommendations for any major repair/ rehabilitation and strengthening based on the condition survey and design reports.
- vii. To provide a detail photographic report of the infrastructure assets and its condition to withstand till end of concession period. Suggestion and cost evaluation for any additional repair / rectification / modification required.

### 1.3.3 Investigations to be carried out

- 1.1. Assessing maintenance needs and its valuation according to the level of deterioration.
- 1.2. Assessing maintenance needs and its valuation according to the level of deterioration.
- 1.3. Evaluation of overall condition of flexible pavement including PQC/ BT at toll plaza, BC, DBM, Base/Sub base and sub grade and drainage condition survey.
- 1.4. Carry out visual condition survey for rigid (toll plaza) and flexible pavement
- 1.5. Reviewed the FWD report provided by Concessionaire and analysed for periodic maintenance schedule .

- 1.6. Review of roughness test reports provided by concessionaire in each lane of carriageway for flexible pavement.
- 1.7. Carry out drainage survey to asses any potential future problems which will cause by moisture and runoff.
- 1.8. Review of subgrade Test pit data provided by concessionaire.
- 1.9. Review of axle load survey report provided by concessionaire for the assessment of axle loading pattern and estimation of VDF. Assessment of traffic loading in terms of MSA based on VDF as obtained & traffic numbers (AADT) and traffic projection (supplied by concessionaire) and comment on the road construction and design on the basis of the same.
- 1.10. Assessment of variation/ COS orders on the project, if any, and evaluate their impact on expenditure, time to completion, future O&M obligations and tolling revenue.
- 1.11. Comment on the pavement crust composition (Design vs. Actual) for PQC/ BT at toll plaza, BC, DBM, overlay and non-bituminous layer etc.

#### **1.3.4 O&M Assessment and Submission of Report**

- Develop a detailed O&M cost forecast for each year of the concession period and a detailed major maintenance cost forecast along with estimation of costs towards handover requirements.

Provide comprehensive report by covering all scope of work mentioned herein this Engagement Letter.

#### **1.4 SURVEYS AND INVESTIGATIONS**

The main objective of undertaking Surveys and Investigations is to appreciate the existing engineering features along the project corridor and to understand the present condition of the various elements of the project road and to prepare inputs required for various rehabilitation and maintenance strategies.

Following Survey and Investigations have been undertaken as a part of study with an objective to understand the present condition of the road and there by access the quality of construction and as well to prepare requisite rehabilitation/corrective designs where necessary.

- Road Inventory Surveys
- Visual Pavement Condition
- Structure Inventory and Condition Surveys

##### **1.4.1 Road Inventory**

The project corridor has flexible pavement in the entire length. Generally, it has 7.25m wide carriageway flanked by 1.5m to 2m wide earthen shoulders. In the initial section, i.e. up to 15.500 km 1.5m paved shoulder on either side in each direction.



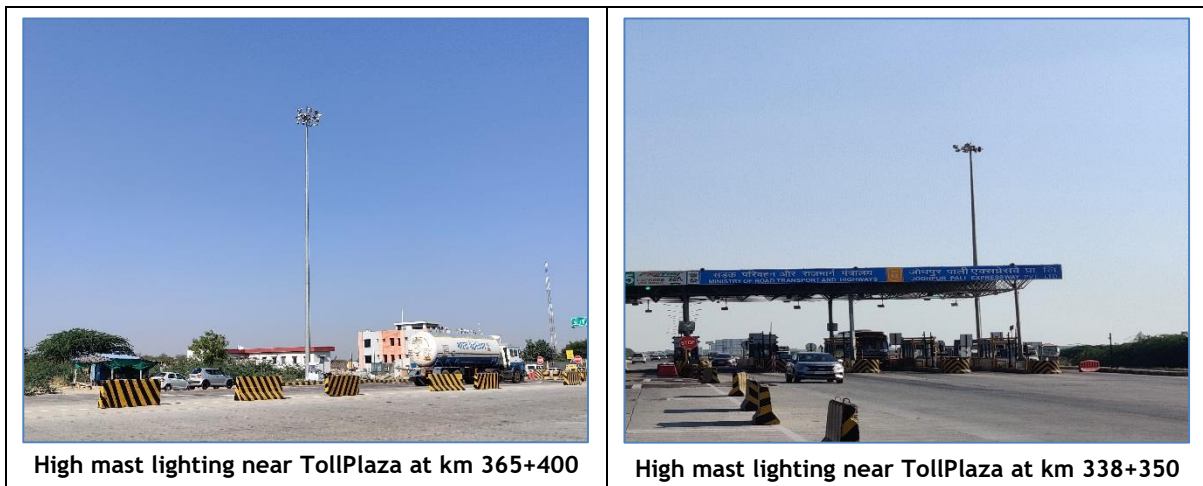
The project corridor generally runs in plain terrain. The predominant land use along the project road is Agricultural. It passes through urban settlements like Jodhpur, Mogra, Kankani, Nimbali, Rohat, Gajangarh.

In general, road embankments are in the range of 0.5m-1.5m height. Embankments higher than 1.5m are observed mainly in the approaches of CD structures and Grade Separate locations. Maximum embankment height is observed near ROBs and Grade Separate locations.

The Project Road has twelve (12) major junctions. Further, it has about 33 minor junctions along its length. Photographs showing the Four Major Junctions are presented below:



About 5 numbers of High mast lighting is observed along the project road. Two numbers are located at Major Junctions and Two nos. at each Toll Plaza location. Few photos showing High mast lighting are presented below:



Altogether, the Project road has about Twelve (12) Bus Bay with shelters. Few photos taken at the bus shelters and bus bays are presented below:



Bus shelter near km 346+450, RHS



Bus Bay with Shelter near km 346.500, LHS



Bus Bay With Shelter near km : 336+450, RHS MC



Bus Bay With Shelter near km 336+500, LHS MC

The Project Road has one Truck lay Bye at km 350.500 on LHS side. It has been provided with Flexible Pavement and the condition appears to be good. Truck lay bye provided with Toilet Blocks. Separator is provided between main carriageway and Truck lay bye portion. Lighting in the form of single arm and Double arm poles have been provided on outer edge of the truck lay. 5 Single Arm & 4 Double arm lights are observed and almost all are found to be in good condition.

Few photos depicting the truck lay bye portion are presented below:



Truck Lay bye on LHS km 350.400



Toilet Block at Truck Lay bye on LHS km 350.400

Service road/slip roads have been observed between km 315+300 to 316+650, at km 323+300 to km 324+700, at km 332+280 to 333+100(New), 346+680 to 347.450 & 372.510 to 373.448(New) which covers a small built-up area and a Flyover. Few photos depicting the service road pavement surface type, condition and the other associated features like covered drain, pedestrian guard railing are presented below.

Service Roads exist only at Flyover and Built-Up Area.



#### 1.4.2 Visual Pavement Condition Surveys

The present condition of pavement appears to be good except minor surface related distresses such as minor cracking and raveling is observed along the project road at few locations and the riding quality is satisfactory. These are mainly surface related distresses and the cracking appears to be top-down cracking. Longitudinal cracking is noted at few locations. No potholes are seen along the project. Patches have been observed at few locations. Rutting is seen between km: 346 to km: 347 (i.e., Rohet village section) along the wheel paths in LHS carriageway. During site visit it is observed that major maintenance work is in progress. Few photos are presented below showing existing pavement condition:



### 1.4.3 Falling Weight Deflectometer (FWD) Surveys

#### 1.4.3.1 Falling Weight Deflectometer Survey

In order to evaluate the structural strength of the existing pavement, Falling Weight Deflectometer (FWD) survey has been carried out by the Concessionaire and same was shared with consultant for the analysis.

Few photos taken during the progress of FWD Surveys are presented below:



Deflection Measurement in progress



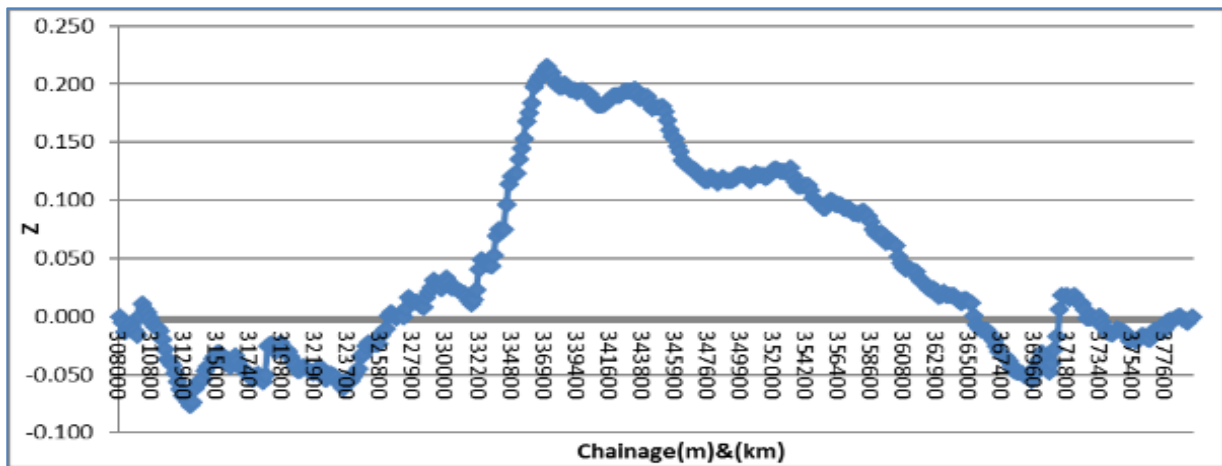
Deflection Measurement in progress

The identified homogenous sections in each direction (i.e., LHS & RHS) for the project stretch have been given in the below table along the graph.

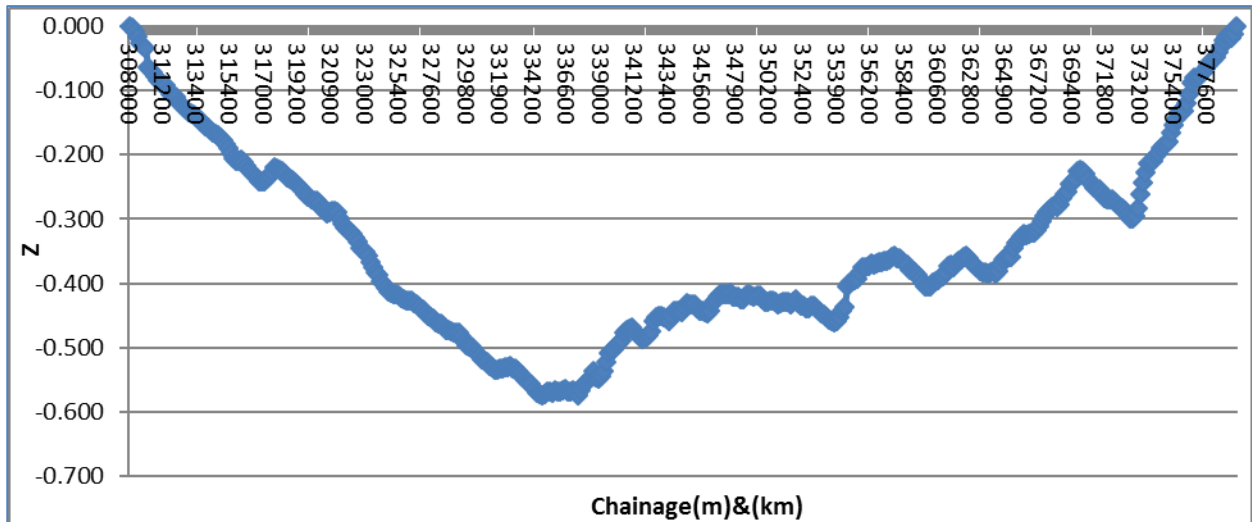
**Table 3: Summary of Homogenous Section - LHS & RHS**

S. No	Side	From	To	Length (km)
1	LHS	308.00	310.60	2.6
2	LHS	310.60	313.80	3.2
3	LHS	313.80	318.20	4.4
4	LHS	318.20	323.30	5.1
5	LHS	323.30	326.20	2.9
6	LHS	326.20	331.80	5.6
7	LHS	331.80	336.20	4.4
8	LHS	336.20	340.80	4.6
9	LHS	340.80	345.40	4.6
10	LHS	345.40	348.40	3.0
11	LHS	348.40	351.40	3.0
12	LHS	351.40	355.40	4.0
13	LHS	355.40	359.40	4.0
14	LHS	359.40	361.80	2.4
15	LHS	361.80	364.80	3.0
16	LHS	364.80	368.60	3.8
17	LHS	368.60	371.80	3.2
18	LHS	371.80	373.60	1.8
19	LHS	373.60	375.80	2.2
20	LHS	375.80	379.40	3.6
<b>Separator</b>				
1	RHS	308.00	311.20	3.2
2	RHS	311.20	314.90	3.7
3	RHS	314.90	318.20	3.3
4	RHS	318.20	320.80	2.6
5	RHS	320.80	324.40	3.6
6	RHS	324.40	326.60	2.2
7	RHS	326.60	328.80	2.2
8	RHS	328.80	333.60	4.8
9	RHS	333.60	336.90	3.3
10	RHS	336.90	340.60	3.7
11	RHS	340.60	343.40	2.8
12	RHS	343.40	347.00	3.6
13	RHS	347.00	351.40	4.4

S. No	Side	From	To	Length (km)
14	RHS	351.40	353.70	2.3
15	RHS	353.70	357.60	3.9
16	RHS	357.60	360.80	3.2
17	RHS	360.80	364.20	3.4
18	RHS	364.20	366.80	2.6
19	RHS	366.80	370.90	4.1
20	RHS	370.90	372.70	1.8
21	RHS	372.70	375.60	2.9
22	RHS	375.60	379.40	3.8



**Delineation of Homogeneous Section - LHS**



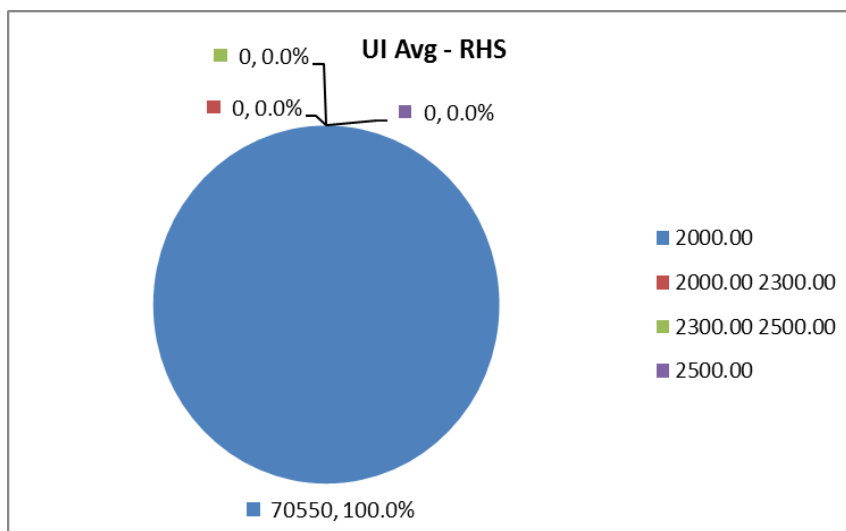
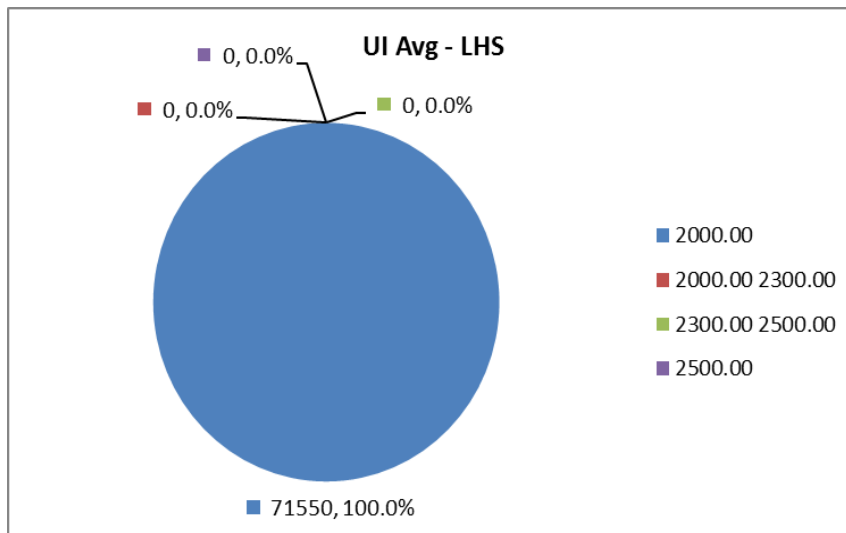
**Delineation of Homogeneous Section - RHS**

#### 1.4.4 Roughness surveys

The Roughness data received indicates that the roughness has been collected using 5<sup>th</sup> wheel bump integrator (SETCO-366) in the month of October 2021 and analyzed the data in terms of Unevenness Index (UI), separately for each lane, for both direction of travel.

As per IRCP:16-2004, Bituminous Concrete pavement surface is considered to be good when its UI value is less than 2000 mm/km and the same is considered to be average for UI values between 2000 and 3000 mm/km whilst the surface is treated as Poor for UI values greater than 3000 mm/km.

Average UI values along the corridor were grouped in to four categories, Pie chart showing the range of UI values in each carriageway of the project road have been presented below:

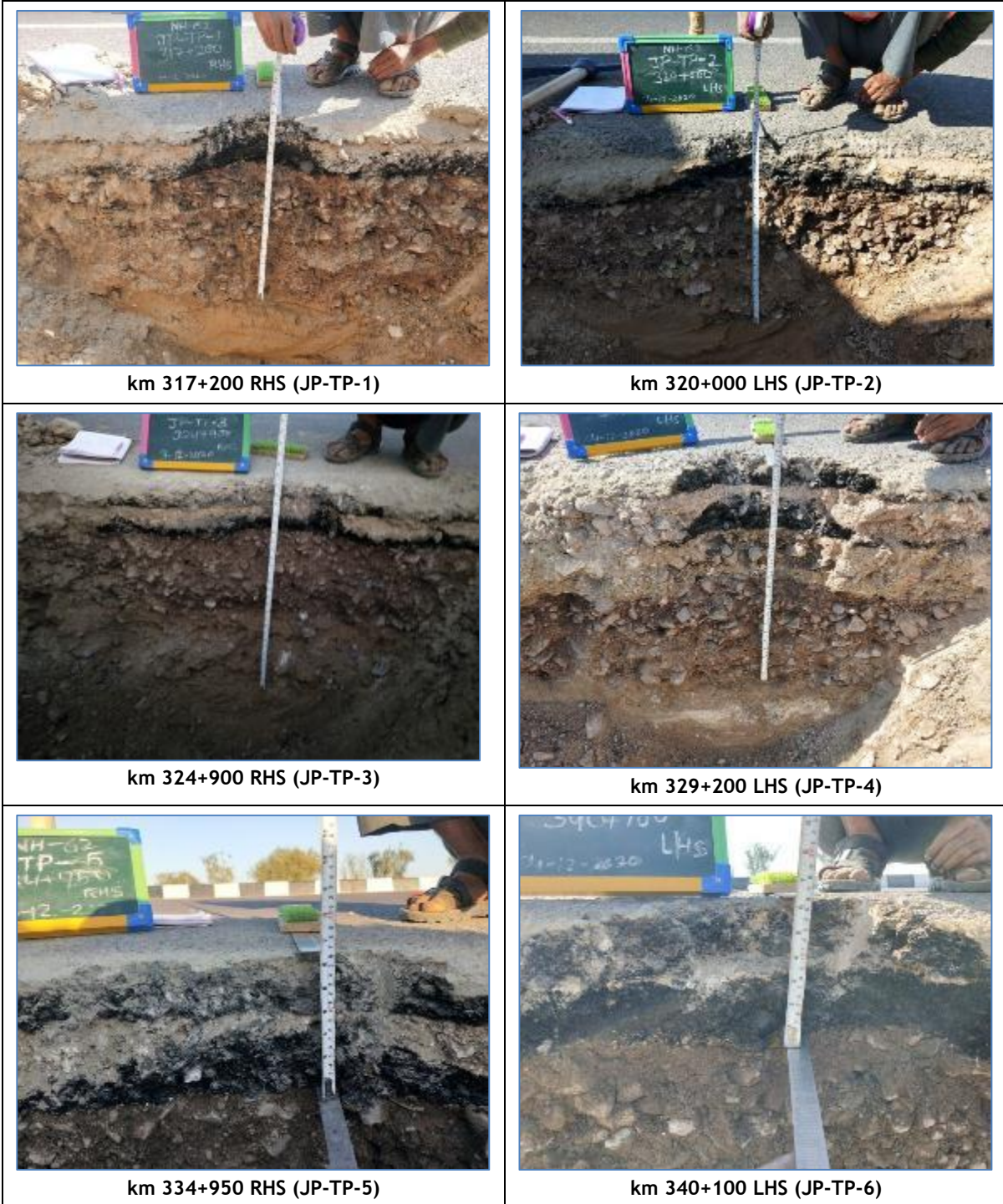


It can be seen from the above charts that entire length of the Project Road has good riding quality (UI<2000 mm/km) in LHS and RHS carriageway.

#### 1.4.5 Pavement Composition Surveys (Test PITS)

The composition of the existing pavement crust has been noted from test pit surveys. Test pits have been undertaken at an interval of 5.0 km (staggered Interval) along the project road. Thus, a total of 18 pits have been dug along the corridor and the data on composition of pavement has

been noted. Sixteen out of 18 pits done on Main Carriageway edge and remaining two test pits done on Service road edge. Photographs have been taken at all test pit locations depicting the crust thickness and nature of material in the pavement. Few sample photos taken are presented below:







km 345+000 RHS (JP-TP-7)



km 350+200 LHS (JP-TP-8)



km 355+600 RHS (JP-TP-9)



km 360+200 LHS (JP-TP-10)



km 365+000 RHS (JP-TP-11)



km 369+300 LHS (JP-TP-12)



Review of the test pit survey showing average thickness of pavement layers and same is presented in the Table below.

**Table 4: Pavement Composition**

S. No	Test Pit Number	Design Chainage	Direction	BT, mm	WMM, mm	GSB, mm	Total
1	JP-TP-1	317+200	RHS	150	210	200	560
2	JP-TP-2	320+200	LHS	140	240	200	580
3	JP-TP-3	324+900	RHS	150	270	270	690
4	JP-TP-4	329+200	LHS	145	270	130	545
5	JP-TP-5	334+900	RHS	150	190	190	530
6	JP-TP-6	340+100	LHS	155	200	230	585
7	JP-TP-7	345+000	RHS	150	220	190	560
8	JP-TP-8	350+200	LHS	150	230	200	580
9	JP-TP-9	355+600	RHS	150	220	210	580
10	JP-TP-10	360+200	LHS	120	250	200	570
11	JP-TP-11	365+000	RHS	150	230	180	560
12	JP-TP-12	369+300	LHS	145	200	210	555
13	JP-TP-13	375+200	RHS	150	240	200	590
14	JP-TP-14	378+700	LHS	150	230	180	560
15	JP-SR-TP-1	324+600	RHS	100	250	170	520
16	JP-SR-TP-2	372+600	LHS	70	230	160	460

Total average crust thickness of the MCW pavement is 575mm. The average thickness of bituminous layer is 147mm. Pavement is mainly composed of a BT layer, WMM & GSB base over subgrade.

**Table 5: Pavement Composition at Toll Plaza locations**

S. No	Test Pit Number	Design Chainage	Direction	PQC, mm	DLC, mm	GSB, mm	Total
1	JP-TP-15 TOLL-1	338+200	LHS	300	150	200	650
2	JP-TP-16 TOLL-2	365+250	LHS	300	150	200	650

#### 1.4.6 Subgrade Investigations & Laboratory Testing

Sub-grade Investigations have been carried out to examine the subgrade soil characteristics along the project road. A total number of 18 Test pits have been carefully dug from the pavement surface up to sub-grade level. Sixteen out of 18 pits done on Main Carriageway edge and remaining two test pits done on Service road edge. Field density tests have been conducted for subgrade samples and a small quantity of sample has also been collected in airtight containers for determining the field moisture content. Upon completion of the field density test, representative sample of sub-grade soil has been collected in bulk, in gunny bags, from each test pit for laboratory testing.

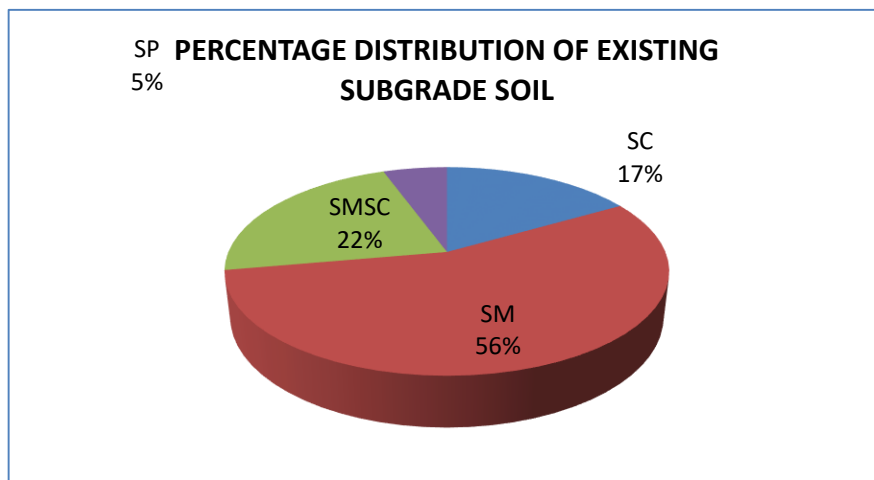
The soil samples collected have been tested for the following properties to assess the existing sub-grade soil properties.

- Sieve analysis
- Atterberg limits
- Heavy compaction

- Four (4) days soaked CBR as per IS standards at 97% of MDD as applicable for sub-grade (Heavy Compaction)
- Free swelling index

Soil classification has been done according to IS Classification of Soils (ISC) as detailed in IS 1498 - 1978. Laboratory test results indicate that all the Subgrade soil samples collected belongs to Coarse Grained Soil. About 10 samples belong to SM, 3 samples belong to SC, 4 samples belongs to SM-SC and one sample belongs to SP.

Pie Chart showing the percentage distribution of soil classification of existing subgrade sample is presented below:



#### 1.4.7 Axle Load Surveys

Traffic loading has a significant impact on pavement performance and design. This is because the damage that vehicles create to a road depends very strongly on the axle loads of the vehicles. The exact relationship is influenced by the type of road structure and the way the road deteriorates but a “fourth power” damage law gives a good approximation.

Concessionaire has shared the Axle load survey data and the same was reviewed and Vehicle Damage Factors have been calculated using the standard axle loadings given in IRC: 37-2018. The standard axle loadings adopted have been presented in the following table

**Table 6: Details of Standard Axles Used**

Axle Configuration	Standard Axle load (Tonnes)*	Remarks
Single Wheel, Single Axle	6.60	As per IRC 37-2018
Dual Wheel, Single Axle	8.16	As per IRC 37-2018
Dual Wheel, Tandem Axle group	15.10	As per IRC 37-2018
Dual Wheel, Tridem Axle group	22.90	As per IRC 37-2018

Direction wise VDF for each mode of commercial traffic has been estimated. Results of axle load surveys have been presented in the following table.

**Table 7: VDF Values Estimated at the Toll Plaza Location (Near km 338+400)**

Mode Type	UP	DOWN
LCV	0.995	1.569
2 Axle Truck	7.756	3.477
3 Axle Truck	6.157	6.669
MAV (4-6 Axle)	9.629	11.519
Buses*	1.000	1.000

**Table 8: VDF Values Estimated at the Toll Plaza Location (Near km 365+400)**

Mode Type	UP	DOWN
LCV	1.093	1.454
2 Axle Truck	6.655	3.205
3 Axle Truck	6.001	6.996
MAV (4-6 Axle)	11.060	12.744
Buses*	1.000	1.000

## 1.5 VALIDATION OF EXECUTED WORKS

The project road has been closely inspected to verify the executed works on ground vis-à-vis the scope envisaged in CA. The as-built drawings made available have been studied in detail before examining them on ground. Each and every structure has been inspected to note down its structural configuration and condition. The following works highlight the findings on executed works on ground.

### 1.5.1 Road Works

The project corridor appears to have been constructed with the cross-sectional elements matching to those given in above TCS drawings. From Km 308.000 to Km 315.400 the urban area the carriageway width is 7m flanked by paved Shoulder varies from 1.5 to 3m with shyness of 0.25m. From Km 316.500 to Km 323.600 the carriageway width is 7m flanked by paved Shoulder With 1.5 Width and with shyness of 0.25m Plus 1.5m Earthen Shoulder. From Km 324.500 to Km 379.535 the carriageway width is 7m and with shyness of 0.25m Plus 1.5m Earthen Shoulder Except Structure locations and built-up Area

Service roads/Slip roads are constructed to a width as shown in TCS. Location of service roads and slip roads as constructed are as below

**Table 9: Service Road/Slip Road Locations**

S. No.	Chainage		Side	Pavement Type	Length(km)	Width (m)	Remarks
	From (km)	To (km)					
1	308.000	308.490	LHS	BT	0.490	7.0	

S. No.	Chainage		Side	Pavement Type	Length(km)	Width (m)	Remarks
	From (km)	To (km)					
2	308.000	308.420	RHS	BT	0.420	7.0	
3	315.300	315.800	LHS	BT	0.500	14.5	
4	315.300	315.800	RHS	BT	0.500	10.5	
5	315.800	316.650	LHS	BT	0.850	7.0	
6	315.800	316.620	RHS	BT	0.820	7.0	
7	323.300	324.700	LHS	BT	1.400	5.5	
8	323.475	324.600	RHS	BT	1.125	5.5	
9	332.280	333.100	LHS	BT	0.820	5.5	COS
10	332.280	333.100	RHS	BT	0.820	5.5	COS
11	346.680	347.450	LHS	BT	0.770	5.5	Poor Condition
12	346.680	347.650	RHS	BT	0.970	5.5	
13	372.510	373.550	LHS	BT	1.040	5.5	COS
14	372.510	373.550	RHS	BT	1.040	5.5	COS
As per Site Total Length on both sides (Km)					<b>11.565</b>		
As per Schedule (Km) on both sides					<b>11.540</b>		

Lined Covered drains exist only at service road locations and Built-up Area along the project road where these are presented between the service road and main carriageway. Cleaning is needed to require for flow of water from service road and these sections are presented in the Table below:

**Table 10: Lined Covered Drain Locations**

S. No.	Chainage		Side	Type	Length (Km)	Width	Depth
	From (km)	To (km)					
1	308.020	308.380	LHS	Lined	0.360	0.55	0.43
2	308.380	316.500	LHS	Covered	8.120	1.3	0.8
3	308.030	308.380	RHS	Lined	0.350	0.55	0.43
4	308.380	316.485	RHS	Covered	8.105	1.30	0.80
5	323.150	324.450	LHS	Covered	1.300	1.50	0.95
6	323.540	324.450	RHS	Covered	0.910	1.50	0.95
7	332.280	332.900	LHS	Covered	0.620	1.50	0.90
8	332.280	332.900	RHS	Covered	0.620	1.50	0.90
9	346.900	347.500	LHS	Covered	0.600	1.30	0.85
10	346.720	347.700	RHS	Covered	0.980	1.30	0.85
11	372.510	373.448	LHS	Covered	0.938	1.50	0.90
12	372.520	373.580	RHS	Covered	1.060	1.50	0.90
Total Length of Covered (Km)					<b>23.253</b>		
Total Lined Drain (KM)					<b>0.710</b>		

Unlined drains existing majority of length of project road and the locations are as listed in Table below:

**Table 11: Earthen Drains**

S. No.	Chainage		Side	Type	Length (Km)
	From (km)	To (km)			
1	325.000	329.000	LHS	Earthen	4.000
2	325.000	329.000	RHS	Earthen	4.000
3	338.000	339.000	RHS	Earthen	1.000
4	340.000	344.000	RHS	Earthen	4.000
5	342.000	343.000	LHS	Earthen	1.000
6	348.000	349.000	LHS	Earthen	1.000
7	349.000	351.000	RHS	Earthen	2.000
8	352.000	354.000	LHS	Earthen	2.000
9	352.000	353.000	RHS	Earthen	1.000
10	354.000	355.000	RHS	Earthen	1.000
11	355.000	367.000	LHS	Earthen	12.000
12	357.000	362.000	RHS	Earthen	5.000
13	368.000	374.000	LHS	Earthen	6.000
14	367.000	376.000	RHS	Earthen	9.000
15	375.000	376.000	LHS	Earthen	1.000
<b>Total Length(km)</b>					<b>54.000</b>

On curved sections with super-elevation, median chutes were provided and are presented in table below:

**Table 12: Median Chutes**

S.No.	Chainage		Length (Km)	No of Chutes	Condition	Remarks
	From (km)	To (km)				
1	318.150	318.550	0.400	41	Good	
2	318.600	318.772	0.172	7	Good	
3	319.280	319.550	0.270	22	Good	
4	319.590	319.700	0.110	10	Good	
5	323.000	323.450	0.450	27	Good	
6	325.150	325.410	0.260	19	Good	
7	326.600	326.920	0.320	27	Good	
8	333.920	334.000	0.080	0	Good	
9	334.080	334.375	0.295	0	Good	
10	334.650	334.830	0.180	0	Good	
11	346.140	346.600	0.460	41	Good	
12	347.780	348.400	0.620	57	Good	
13	348.690	349.000	0.310	29	Good	
14	351.680	352.180	0.500	47	Good	
15	353.360	353.750	0.390	37	Good	
16	353.920	354.410	0.490	51	Good	

S.No.	Chainage		Length (Km)	No of Chutes	Condition	Remarks
	From (km)	To (km)				
17	355.260	355.600	0.340	35	Good	
18	358.920	359.300	0.380	26	Good	
19	359.700	360.220	0.520	45	Good	
20	365.800	366.300	0.500	39	Good	
21	366.870	367.240	0.370	40	Good	
22	369.030	369.320	0.290	21	Good	
23	370.290	370.460	0.170	14	Good	
24	371.600	372.200	0.600	56	Good	
25	378.250	378.720	0.470	23	Good	
Total Length & Cuts			8.947	714		

Stone Pitching is found in approaches of some of the Grade-Separators/ROB/Major Bridges along the Project. Side kerb and chutes are also observed in the approaches whereas the dissipation chambers are covered with garbage and soil. Slope Protection details and side kerb details are listed in the tables below.

**Table 13: Slope Protection Details**

S. No	Chainage		Length	Side	Embankment	Stone Pitching	RE Wall	RCC Wall	Toe Wall	Chutes	Remarks
	From	To									
1	308.120	308.380	0.520	BHS	-	-	YES	-	-	-	
2	315.500	315.840	0.680	BHS	-	-	YES	-	-	-	
3	315.950	316.360	0.820	BHS	-	-	YES	-	-	-	
4	318.545	318.590	0.045	LHS	-	-	-	YES	-	-	
5	318.705	318.745	0.040	LHS	-	YES	-	-	-	1	
6	318.510	318.590	0.080	RHS	-	YES	-	-	-	-	
7	318.710	318.745	0.035	RHS	-	YES	-	-	-	-	
8	323.200	323.500	0.300	RHS	-	-	-	-	YES	-	stone masonry wall
9	323.540	323.900	0.720	BHS	-	-	YES	-	-	-	
10	324.000	324.400	0.800	BHS	-	-	YES	-	-	-	
11	325.545	325.610	0.065	LHS	-	YES	-	-	-	8	
12	325.540	325.610	0.070	RHS	-	YES	-	-	-	10	
13	325.615	325.660	0.045	LHS	-	YES	-	-	-	5	
14	325.615	325.665	0.050	RHS	-	YES	-	-	-	6	
15	326.500	326.608	0.108	LHS	YES	-	-	-	-	-	
16	326.608	326.618	0.010	LHS	-	YES	-	-	-	-	
17	326.622	326.632	0.010	LHS	-	YES	-	-	-	-	
18	326.500	326.618	0.118	RHS	YES	-	-	-	-	-	
19	326.622	326.820	0.198	RHS	YES	-	-	-	-	-	
20	328.019	328.028	0.009	LHS	-	YES	-	-	-	-	
21	328.032	328.041	0.009	RHS	-	YES	-	-	-	-	
22	333.473	333.963	0.490	LHS	-	YES	-	-	-	39	
23	334.068	334.698	0.630	LHS	-	YES	-	-	-	24	



S. No	Chainage		Length	Side	Embankment	Stone Pitching	RE Wall	RCC Wall	Toe Wall	Chutes	Remarks
	From	To									
24	334.962	334.997	0.035	LHS	-	YES	-	-	-	-	
25	333.873	333.963	0.090	Median	-	YES	-	-	-	-	
26	334.068	334.698	0.630	Median	-	-	-	-	YES	-	cement lining at median
27	334.960	335.030	0.070	Median	-	YES	-	-	-	-	
28	333.751	333.963	0.212	RHS	-	YES	-	-	-	17	
29	334.068	334.698	0.630	RHS	-	YES	-	-	-	29	
30	334.962	335.072	0.110	RHS	-	YES	-	-	-	10	
31	338.580	338.716	0.272	BHS	YES	-	-	-	-	-	
32	338.746	339.000	0.508	BHS	YES	-	-	-	-	-	
33	339.527	339.532	0.010	BHS	-	YES	-	-	-	-	
34	339.550	339.555	0.010	BHS	-	YES	-	-	-	-	
35	339.400	339.532	0.132	RHS	YES	-	-	-	-	-	
36	339.550	339.600	0.050	RHS	YES	-	-	-	-	-	
37	343.239	343.243	0.004	RHS	-	YES	-	-	-	-	
38	343.255	343.259	0.004	RHS	-	YES	-	-	-	-	
39	343.100	343.243	0.143	LHS	YES	-	-	-	-	-	
40	343.255	343.350	0.095	LHS	YES	-	-	-	-	-	
41	345.996	346.002	0.006	RHS	-	YES	-	-	-	-	
42	346.036	346.042	0.006	RHS	-	YES	-	-	-	-	
43	348.995	349.155	0.160	LHS	-	YES	-	-	-	15	
44	349.305	349.380	0.075	LHS	-	YES	-	-	-	6	
45	349.045	349.155	0.110	RHS	-	YES	-	-	-	10	
46	349.305	349.380	0.075	RHS	-	YES	-	-	-	4	
47	350.650	350.790	0.140	LHS	-	YES	-	-	-	12	
48	350.650	350.790	0.140	RHS	-	YES	-	-	-	12	
49	354.395	354.610	0.215	LHS	-	YES	-	-	-	18	
50	354.770	355.100	0.330	LHS	-	YES	-	-	-	30	
51	354.500	354.610	0.110	RHS	-	YES	-	-	-	13	
52	354.770	355.100	0.330	RHS	-	YES	-	-	-	32	
53	358.780	359.010	0.230	LHS	-	YES	-	-	-	18	
54	358.700	359.030	0.330	RHS	YES	-	-	-	-	-	
55	358.780	359.010	0.230	LHS	-	YES	-	-	-	18	
56	358.700	359.030	0.330	RHS	YES	-	-	-	-	-	
57	360.551	360.556	0.005	LHS	-	YES	-	-	-	-	
58	360.560	360.565	0.005	LHS	-	YES	-	-	-	-	
59	360.551	360.556	0.005	RHS	-	YES	-	-	-	-	
60	360.560	360.565	0.005	RHS	-	YES	-	-	-	-	
61	366.845	367.425	0.580	Median	-	YES	-	-	-	-	
62	367.545	367.955	0.410	Median	-	YES	-	-	-	-	
63	367.175	367.425	0.250	LHS	-	-	YES	-	-	-	

S. No	Chainage		Length	Side	Embankment	Stone Pitching	RE Wall	RCC Wall	Toe Wall	Chutes	Remarks
	From	To									
64	367.545	367.875	0.330	LHS	-	-	YES	-	-	-	
65	366.900	367.425	0.525	RHS	-	-	YES	-	-	-	
66	367.545	367.950	0.405	RHS	-	-	YES	-	-	-	
67	371.229	371.239	0.010	LHS	-	YES	-	-	-	-	
68	371.507	371.542	0.035	LHS	-	YES	-	-	-	-	
69	371.159	371.239	0.080	RHS	YES	-	-	-	-	-	
70	371.507	371.602	0.095	RHS	YES	-	-	-	-	-	
71	372.820	373.300	0.480	LHS	-	-	YES	-	-	-	
72	372.820	373.300	0.480	RHS	-	-	YES	-	-	-	
		Total	15.374							337	

**Table 14: Side Kerb and chute Details**

S.no	Chainage		Length (Km)	Side	No. of Chutes	Remarks
	From	To				
1	318.705	318.745	0.040	LHS	1	
2	325.545	325.610	0.065	LHS	8	
3	325.540	325.610	0.070	RHS	10	
4	325.615	325.660	0.045	LHS	5	
5	325.615	325.665	0.050	RHS	6	
6	333.473	333.963	0.490	LHS	39	
7	334.068	334.698	0.630	LHS	24	
8	333.751	333.963	0.212	RHS	17	
9	334.068	334.698	0.630	RHS	29	
10	334.962	335.072	0.110	RHS	10	
11	348.995	349.155	0.160	LHS	15	
12	349.305	349.380	0.075	LHS	6	
13	349.045	349.155	0.110	RHS	10	
14	349.305	349.380	0.075	RHS	4	
15	350.650	350.790	0.140	LHS	12	
16	350.650	350.790	0.140	RHS	12	
17	354.395	354.610	0.215	LHS	18	
18	354.770	355.100	0.330	LHS	30	
19	354.500	354.610	0.110	RHS	13	
20	354.770	355.100	0.330	RHS	32	
21	358.780	359.010	0.230	LHS	18	
22	358.780	359.010	0.230	LHS	18	
			<b>Total</b>		<b>337</b>	

Median width of 4.5m was generally adopted along the project road. Median opening and Solar Blinkers are presenting Tables below:

**Table 15: Locations of Median Openings**

S. No.	Chainage (km)	Width (m)	Length (m)	Reserve lane	Remarks
1	308.700	1.1	20	No	

S. No.	Chainage (km)	Width (m)	Length (m)	Reserve lane	Remarks
2	309.090	1.1	15	No	
3	309.180	1.0	25	No	
4	309.450	1.0	20	No	
5	310.100	1.0	20	No	
6	310.350	1.0	30	No	
7	311.450	1.5	50	No	
8	311.800	1.0	20	No	
9	312.380	1.0	20	No	
10	312.900	1.0	30	No	
11	313.800	1.5	30	No	
12	314.600	1.1	10	No	
13	314.810	1.1	10	No	
14	315.100	1.1	10	No	
15	317.550	1.0	30	yes	
16	319.560	1.0	30	yes	
17	322.170	1.0	30	yes	
18	325.140	1.0	30	yes	
19	327.160	1.0	30	yes	
20	328.200	1.0	30	yes	
21	329.300	1.0	30	yes	
22	332.550	1.0	30	yes	
23	332.810	1.0	30	yes	
24	333.400	4.5	10	No	
25	336.050	1.0	30	yes	
26	340.550	1.0	30	yes	
27	342.000	4.5	20	No	
28	344.050	1.0	30	yes	
29	345.820	1.0	30	yes	
30	346.650	1.0	30	yes	
31	347.750	2.5	30	yes	
32	350.730	1.0	30	yes	
33	352.520	1.0	30	yes	
34	355.800	1.0	30	yes	
35	357.010	1.0	30	yes	
36	360.600	1.0	30	yes	
37	361.780	1.0	30	yes	
38	368.050	1.0	30	yes	
39	369.550	1.0	30	yes	
40	370.800	4.5	25	Yes	
41	375.900	1.0	30	yes	
42	377.890	1.0	30	yes	

Median openings and cross road locations with Solar Blinkers are presented below:

**Table 16: Details of Solar Blinkers**

S. No	Chainage (km)	Location	No. of Solar Blinker's	Condition
1	308.700	Median	2	Working
2	309.090	Median	2	Working
3	309.180	Median	2	Working
4	309.450	Median	2	Working
5	310.100	Median	4	Working
6	310.350	Median	4	Working
7	312.380	Median	2	Working
8	312.900	Median	2	Working
9	313.800	Median	2	Working
10	314.350	Median	3	Working
11	317.550	Median	2	Working
12	319.450	Median	2	Working
13	322.170	Median	2	Working
14	325.140	Median	1	Working
15	327.160	Median	2	Working
16	328.200	Median	1	Working
17	329.300	Median	2	Working
18	332.550	Median	2	Working
19	332.810	Median	2	Working
20	333.400	Median	2	Working
21	336.050	Median	2	Working
22	340.550	Median	2	Working
23	344.050	Median	2	Working
24	345.850	Median	2	Working
25	346.650	Median	2	Working
26	347.750	Median	2	Working
27	350.730	Median	2	Working
28	352.520	Median	2	Working
29	355.800	Median	2	Working
30	357.010	Median	2	Working
31	360.600	Median	2	Working
32	361.780	Median	1	Working
33	368.050	Median	2	Working
34	369.550	Median	2	Working
35	370.800	Median	2	Working
36	372.650	Median	1	Working
37	375.900	Median	2	Working
38	377.890	Median	2	Working
<b>Total</b>			<b>77</b>	

There are few unauthorized median cuts and damaged medians exist along the project corridor and are presented in Table below:

**Table 17: Median Damaged Locations**

S. No	Chainage (Km)	Description	Length (m)
1	321.35	Unauthorized	0.5
2	325.8	Unauthorized	20
3	333.42	Unauthorized	20
4	349.65	Unauthorized	0.5
5	351.46	Unauthorized	23
6	356.65	Unauthorized	150
7	363.56	Unauthorized	0.5
8	374.36	Unauthorized	10
		Total damaged length	224.50 m

Safety barriers have been provided along the project road at high embankments where embankment height is >3m at sharp curve locations, at approaches of grade separated and cross drainage Structures. Details of safety barriers provided along the corridor include the following

**Table 18: Metal Beam Crash Barrier Locations**

S. No.	Chainage		Side	Length (m)	Condition	Remarks
	From (Km)	To (Km)				
1	315.380	315.840	Median	0.460	Good	
2	315.930	316.470	Median	0.540	Good	
3	318.300	318.750	RHS	0.450	Good	
4	318.520	318.545	LHS	0.025	Good	
5	318.700	318.735	LHS	0.035	Good	
6	323.470	323.900	Median	0.430	Good	
7	323.900	324.380	Median	0.480	Good	
8	325.498	325.594	LHS	0.096	Good	
9	325.500	325.750	RHS	0.250	Good	
10	325.616	325.760	LHS	0.144	Good	
11	326.550	326.610	LHS	0.060	Good	
12	328.220	328.290	LHS	0.070	Good	
13	333.770	334.800	RHS	1.030	Good	
14	333.786	333.980	LHS	0.194	Good	
15	333.920	333.980	Median	0.060	Good	
16	334.000	334.390	Median	0.390	Good	
17	334.630	334.690	Median	0.060	Good	
18	334.630	334.650	LHS	0.020	Good	
19	335.150	335.220	LHS	0.070	Good	
20	335.200	335.600	RHS	0.400	Good	
21	335.300	335.570	LHS	0.270	Good	
22	336.200	336.400	RHS	0.200	Good	
23	336.230	336.260	LHS	0.030	Good	
24	336.280	336.300	LHS	0.020	Good	
25	338.600	338.800	RHS	0.200	Good	
26	338.600	338.800	LHS	0.200	Good	

S. No.	Chainage		Side	Length (m)	Condition	Remarks
	From (Km)	To (Km)				
27	339.450	339.510	RHS	0.060	Good	
28	339.480	339.560	LHS	0.080	Good	
29	343.180	343.200	LHS	0.020	Good	
30	343.200	343.300	RHS	0.100	Good	
31	343.250	343.290	LHS	0.040	Good	
32	345.850	345.900	RHS	0.050	Good	
33	345.920	346.100	LHS	0.180	Good	
34	345.950	346.050	RHS	0.100	Good	
35	346.500	346.550	RHS	0.050	Good	
36	349.000	349.080	RHS	0.080	Good	
37	349.000	349.090	LHS	0.090	Good	
38	349.230	349.300	RHS	0.070	Good	
39	349.250	349.300	LHS	0.050	Good	
40	350.030	350.100	LHS	0.070	Good	
41	350.050	350.150	RHS	0.100	Good	
42	350.650	350.700	RHS	0.050	Good	
43	351.500	351.600	RHS	0.100	Good	2
44	351.520	351.580	LHS	0.060	Good	
45	352.450	352.500	RHS	0.050	Good	
46	353.200	353.320	LHS	0.120	Good	
47	353.200	353.400	RHS	0.200	Good	
48	354.300	354.500	RHS	0.200	Good	
49	354.420	354.580	LHS	0.160	Good	
50	354.750	355.000	LHS	0.250	Good	
51	354.800	355.000	RHS	0.200	Good	
52	355.310	355.340	RHS	0.030	Good	
53	356.310	356.340	LHS	0.030	Good	
54	356.850	356.900	RHS	0.050	Good	
55	358.760	359.000	LHS	0.240	Good	
56	358.800	359.000	RHS	0.200	Good	
57	360.500	360.530	LHS	0.030	Good	
58	360.500	360.700	RHS	0.200	Good	
59	365.050	365.100	RHS	0.050	Good	
60	365.700	365.800	LHS	0.100	Good	
61	365.700	365.800	RHS	0.100	Good	
62	366.350	366.420	LHS	0.070	Good	
63	366.400	366.500	RHS	0.100	Good	
64	366.930	367.400	Median	0.470	Good	
65	367.140	367.190	LHS	0.050	Good	
66	367.490	367.950	LHS	0.460	Good	
67	367.900	367.950	RHS	0.050	Good	
68	370.910	370.970	LHS	0.060	Good	5

S. No.	Chainage		Side	Length (m)	Condition	Remarks
	From (Km)	To (Km)				
69	370.910	370.970	RHS	0.060	Good	
70	371.130	371.200	LHS	0.070	Good	
71	371.480	371.510	LHS	0.030	Good	
72	371.660	371.730	LHS	0.070	Good	
73	371.700	371.740	RHS	0.040	Good	
74	374.240	374.300	LHS	0.060	Good	
75	374.240	374.300	RHS	0.060	Good	
<b>Total Length</b>				11.394		

**Table 19: Concrete Crash Barrier Locations**

S.No.	Chainage		Length (Km)	Side	Remarks
	From (Km)	To (Km)			
1	315.350	316.400	1.050	LHS	
2	315.580	315.974	0.394	Median	
3	315.580	316.300	0.720	RHS	
4	318.550	318.600	0.050	LHS	
5	318.550	318.600	0.050	Median	
6	318.560	318.680	0.120	RHS	
7	318.670	318.710	0.040	LHS	
8	318.670	318.710	0.040	Median	
9	323.550	324.380	0.830	RHS	
10	323.940	324.010	0.070	Median	
11	323.540	324.370	0.830	LHS	
12	325.580	325.620	0.040	RHS	
13	325.600	325.610	0.010	RHS	
14	325.600	325.610	0.010	LHS	
15	335.150	335.210	0.060	RHS	
16	335.150	335.210	0.060	LHS	
17	335.150	335.210	0.060	Median	
18	336.200	336.280	0.080	RHS	
19	336.200	336.280	0.080	LHS	
20	338.640	338.690	0.050	RHS	
21	338.640	338.690	0.050	LHS	
22	338.640	338.690	0.050	Median	
23	338.740	338.770	0.030	RHS	
24	338.740	338.770	0.030	LHS	
25	338.740	338.770	0.030	Median	
26	339.090	339.100	0.010	RHS	
27	339.090	339.100	0.010	LHS	
28	339.500	339.550	0.050	RHS	
29	339.500	339.550	0.050	LHS	
30	343.210	343.250	0.040	LHS	
31	343.210	343.250	0.040	Median	

S.No.	Chainage		Length (Km)	Side	Remarks
	From (Km)	To (Km)			
32	343.310	343.330	0.020	LHS	
33	343.310	343.350	0.040	Median	
34	346.680	347.450	0.770	RHS	
35	346.680	347.450	0.770	LHS	
36	346.680	347.730	1.050	Median	
37	348.900	349.200	0.300	RHS	
38	348.900	349.200	0.300	LHS	
39	348.990	349.200	0.210	Median	
40	349.960	349.990	0.030	LHS	
41	349.960	349.990	0.030	Median	
42	350.030	350.060	0.030	LHS	
43	350.030	350.060	0.030	Median	
44	354.590	354.750	0.160	LHS	
45	359.000	359.040	0.040	RHS	
46	360.500	360.540	0.040	RHS	
47	360.540	360.550	0.010	LHS	
48	366.450	366.500	0.050	RHS	
49	366.450	366.500	0.050	LHS	
50	367.000	368.000	1.000	RHS	
51	367.200	367.500	0.300	RHS	
52	367.400	367.460	0.060	LHS	
53	367.150	367.800	0.650	LHS	
54	367.150	367.850	0.700	Median	
55	371.200	371.480	0.280	LHS	
56	371.200	371.480	0.280	Median	
57	374.270	374.280	0.010	LHS	
<b>Total Length</b>			12.244		

**Table 20: Concrete Railing Locations**

S.No.	Chainage		Side	Length (Km)	Condition	Remarks
	From (Km)	To (Km)				
1	318.600	318.670	LHS	0.070	Good	
2	318.600	318.670	Median	0.070	Good	
3	333.980	334.100	LHS	0.120	Good	
4	333.980	334.100	Median	0.120	Good	
5	334.330	334.700	LHS	0.370	Good	
6	338.700	338.740	LHS	0.040	Good	
7	338.700	338.740	Median	0.040	Good	
8	343.280	343.310	Median	0.030	Good	
9	343.280	343.310	LHS	0.030	Good	
10	349.990	350.030	LHS	0.040	Good	
<b>Total Length</b>				0.930		



Pedestrian Guard Rails are observed at only the Bus bay locations and are presented in Table below:

**Table 21: Details of Pedestrian Guard Rails**

S. No.	Chainage		Side/Location	Length (km)	Condition
	From (km)	To (km)			
1	308.000	308.140	Median	0.140	Good
2	313.100	314.260	Median	1.160	Good
3	314.360	315.310	Median	0.950	Good
4	318.540	318.660	LHS	0.120	Good
5	318.540	318.660	Median	0.120	Good
6	340.700	340.740	LHS	0.040	4m Damage
7	340.700	340.740	Median	0.040	Good
8	356.810	356.850	RHS	0.040	Good
9	357.010	357.050	LHS	0.040	2m Damage
10	360.720	360.760	LHS	0.040	Good
11	371.480	371.720	RHS	0.240	Good
12	371.130	371.200	RHS	0.070	Good
Total Length				3.000	6M Damage

List of major and minor junctions developed are presented in table below:

**Table 22: List of Major Junctions**

S. No.	Design Chainage	Category of Road	Type of Junction	Width of the access Road	Remarks
1	310.100	Railway Station Road	T	4-lane	
2	311.500	Basni	Y	4-lane	
3	311.800	Urban Road	T	4-lane	
4	314.350	Jalamand circle	rotary	14.0/4-lane	
5	315+900	Dangiyawas Bypass	X	7.0/7.0	
6	316.950	Salawas	T	4-lane	
7	323.950	boranada	X	7.0/4-lane	
8	325.140	Mogra	Y	4-lane	
9	332.810	Luni	Y	7	
10	347.750	State highway	Y	7	
11	367.100	pali Bypass	Y	9	
12	373.000	MDR	X	9.0/9.0	

**Table 23: List of Minor Junctions**

S.No.	Design Chainage(Km)	Side (Left / Right)	Carriageway Width (m)	Category
1	309.090	Left/Right	6.0/10.0	U.R
2	309.180	Left/Right	7.0/6.0	U.R
3	309.450	Left	9.0/-	U.R
4	310.350	Left	4lane/-	Collage road

S.No.	Design Chainage(Km)	Side (Left / Right)	Carriageway Width (m)	Category
5	312.380	Right	-/7	U.R
6	312.900	Right	-/5	U.R
7	313.800	Left/Right	5.0/5.0	U.R
8	315.000	Left	4.0/-	V.R
9	317.000	Left	7	V.R
10	317.550	Right	-/7	V.R
11	318.460	Left	7.0/-	V.R
12	318.950	Left	4.5/-	V.R
13	319.450	Left	4lane/-	Industrial Road
14	325.140	Left	3/-	V.R
15	326.420	Left/Right	4.5/4.5	V.R
16	327.250	Left	5.5	V.R
17	328.200	Left	3.5/-	V.R
18	329.050	Left	3.5/-	V.R
19	329.150	Right	3.5	Quarry Road
20	329.300	Left/Right	3.5/3.5	Quarry Road
21	332.550	Left/Right	4.5/4.5	V.R
22	336.050	Left/Right	4.5/3.5	V.R
23	340.550	Right	-/3.5	V.R
24	345.800	Left/Right	3.5/3.5	V.R
25	346.650	Left	3.5/-	V.R
26	346.740	Left	6.0/-	Street Road
27	346.755	Left	3.5/-	Street Road
28	350.730	Right	-/3.5	V.R
29	351.460	Right	3.5	V.R
30	352.420	Left	3.5/-	V.R
31	355.800	Left/Right	4.5/3.5	V.R
32	359.800	Left	3.5/-	V.R
33	360.600	Left/Right	3.5/3.5	V.R
34	361.780	Left/Right	4.5/4.5	V.R
35	368.050	Left/Right	9.0/7.0	V.R
36	369.550	Right	-/4.5	V.R
37	370.800	Left	9.0/-	V.R
38	373.400	Left	5.0/-	V.R
39	374.000	Left/Right	5.0/4.0	V.R

Road furniture in the form of Signs/Markings, Gantry signs and traffic safety blinkers, lighting, high mast lights have been provided along the project road at few locations and are presented in the Tables below:

**Table 24: Locations of High mast Lighting**

S. No	Chainage	Location	Remarks	As per site	Condition
1	338.400	Shoulder	Toll Plaza	2	Functional
2	365.400	Shoulder	Toll Plaza	2	Functional

S. No	Chainage	Location	Remarks	As per site	Condition
3	367.100	Median	Major Junction	1	Functional
Total				5	

**Table 25: Locations of Highway Lighting along Main Carriageway**

S.no	Chainage		1-arm	2-arm	3-arm	Location	Remarks
	From	To					
1	308.500	315.400	-	213	-	Median	Provided by JDA (Not in Scope)
2	315.500	316.450	-	29	-	LHS Shoulder	
3	315.500	316.450	-	29	-	RHS Shoulder	
4	323.460	324.500	-	34	-	LHS Shoulder	
5	323.550	324.500	-	29	-	RHS Shoulder	
6	337.950	338.900	-	24	-	Median	
7	346.650	347.500	-	32	-	Median	
8	350.250	350.740	9	4	-	LHS Shoulder	
9	364.900	365.850	-	24	-	Median	
Total			9	205			Under Concessionaire's Scope

**Table 26: Locations of Highway Lighting along Service Roads**

S.No.	Chainage (Km)		Side	1-arm	2-arm	3-arm	Location	Damaged
	From	To						
1	308.000	308.400	LHS	1	-	-	Shoulder	-
2	316.450	316.650	LHS	8	-	-	LHS Shoulder	-
3	316.450	316.650	LHS	8	-	-	RHS Shoulder	-
Total				17				

### 1.5.2 Bridge Works

List of Bridges found during the inventory surveys along the corridor are as follows:

**Table 27: Details of CD & Other Structures**

S. No.	Chainage as Per CA	Chainage as Per Site	Type of Structure	Span as per Schedule	Span as per Site	Deck width as per site	Structure in Schedule	Structure on Site	Skew angle
1	-	315+886	Flyover	-	2 x 15 + 1 x 44	2 x 10	-	Yes	-
2	-	346+019	MNB	-	5 x 6.9	2 x 12	-	Yes	-
3	-	318+642	MJB	-	LHS 11 x 8.8 RHS 6 x 17.65	2 x 12	-	Yes	-
4	-	323+988	Flyover	-	2 x 15 + 1 x 44	2 x 10	-	Yes	-
5	-	325+600	CUP	-	1 x 4 x 3.5	2 x 12	-	Yes	-
6	-	333+998	MJB	-	LHS 8 x 8.8 RHS 4 x 17.6	2 x 12	-	Yes	-
7	-	334+830	MJB	-	LHS 30 x 8.8 RHS 15 x 17.6	2 x 12	-	Yes	-
8	-	335+285	MNB	-	3 x 6.8	2 x 12	-	Yes	-
9	-	335+324	MNB	-	3 x 6.8	2 x 12	-	Yes	-

S. No.	Chainage as Per CA	Chainage as Per Site	Type of Structure	Span as per Schedule	Span as per Site	Deck width as per site	Structure in Schedule	Structure on Site	Skew angle
10	-	335+736	MNB	-	6 x 6.8	2 x 12	-	Yes	-
11	-	339+541	MNB	-	3 x 5.8	2 x 12	-	Yes	-
12	-	343+249	MNB	-	2 x 6.7	2 x 12	-	Yes	-
13	-	349+230	MJB	-	10 x 15	2 x 11	-	Yes	-
14	-	354+690	MJB	-	9 x 17.5	2 x 11	-	Yes	-
15	-	360+500	CUP	-	1 x 4 x 3.5	2 x 12	-	Yes	-
16	-	367+485	ROB	-	1 x 18.57 + 1 x 41.1	2 x 16.5	-	Yes	-
17	-	371+373	MJB	-	12 x 22	2 x 12	-	Yes	-

## 1.6 QUALITY AUDIT

### 1.6.1 Embankment & Subgrade

The embankment for project road has been constructed with available soils from nearby areas. The soil appears to be sandy clay in nature and embankment appears to be in good condition over the entire length of project. No settlements or depressions have been noted even at high embankment locations. There are no marshy/water logging areas along the length of project road.

The subgrade of the project road appears to be in good condition as revealed by test pit investigations. Laboratory results conducted on subgrade indicates that most of subgrade soils are of SM (Silty Sand) type with Non-Plasticity Index. Condition of subgrade appears to intact as no major evidence of subsidence or depressions exists along the corridor. CBR of subgrade soils for lab testing indicates a good value greater than 10% at all the locations. Results of Subgrade CBR are as follows:

**Table 28: Details of Soaked CBR values**

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	Soaked CBR 97% MDD	Free Swelling Index (%)
	Location (km)	Up/Dn	Percentage passing from					LL	PL	PI					
			4.75 mm IS Sieve	425 mics IS Sieve	75 mics IS Sieve	Gravel %	Sand %								
JP-TP-1	317+200	RHS	100	99	4	0	96	-	NP	NP	SP	1.64	14.40	NA	0.00
JP-TP-2	320+200	LHS	100	95	15	0	85	-	NP	NP	SM	1.78	12.20	6.52	10.00
JP-TP-3	324+900	RHS	93	79	27	7	66	-	NP	NP	SM	2.12	8.00	17.71	14.29
JP-TP-4	329+200	LHS	90	41	23	10	67	-	NP	NP	SM	2.15	8.60	17.71	10.00
JP-TP-5	334+900	RHS	100	59	16	0	84	-	NP	NP	SM	2.05	9.00	15.23	10.00
JP-TP-6	340+100	LHS	93	75	43	7	50	24	15	9	SC	2.01	10.00	12.36	27.27
JP-TP-7	345+000	RHS	88	44	27	12	61	-	NP	NP	SM	2.14	9.60	17.71	10.00
JP-TP-8	350+200	LHS	100	96	19	0	81	-	NP	NP	SM	1.94	9.00	9.73	20.00

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	Soaked CBR 97% MDD	Free Swelling Index (%)
	Location (km)	Up/Dn	Percentage passing from					LL	PL	PI					
			4.75 mm IS Sieve	425 mics IS Sieve	75 mics IS Sieve	Grave l %	Sand %								
JP-TP-9	355+600	RHS	100	96	16	0	84	-	NP	NP	SM	1.93	10.30	9.73	10.00
JP-TP-10	360+200	LHS	100	92	22	0	78	-	NP	NP	SM	2.05	9.20	15.23	9.09
JP-TP-11	365+000	RHS	100	45	33	0	67	38	31	7	SM-SC	2.01	12.10	12.26	20.00
JP-TP-12	369+300	LHS	77	48	40	23	37	33	28	5	SM-SC	2.12	8.60	15.91	25.00
JP-TP-13	375+200	RHS	82	42	25	18	57	40	31	9	SC	2.06	9.00	12.36	25.00
JP-TP-14	378+700	LHS	94	57	29	6	65	31	26	5	SM-SC	2.05	9.60	12.26	20.00
JP-TP-15 TOLL-1	338+200	LHS	87	63	25	13	62	-	NP	NP	SM	1.99	9.40	12.19	9.09
JP-TP-16 TOLL-2	365+250	LHS	68	21	16	32	52	36	32	4	SM-SC	2.15	8.60	15.91	25.00
JP-SR-TP-1	324+600	RHS	99	77	20	1	79	-	NP	NP	SM	1.77	9.20	6.52	10.00
JP-SR-TP-2	372+600	LHS	90	62	43	10	47	28	18	10	SC	2.09	8.60	12.36	0.00

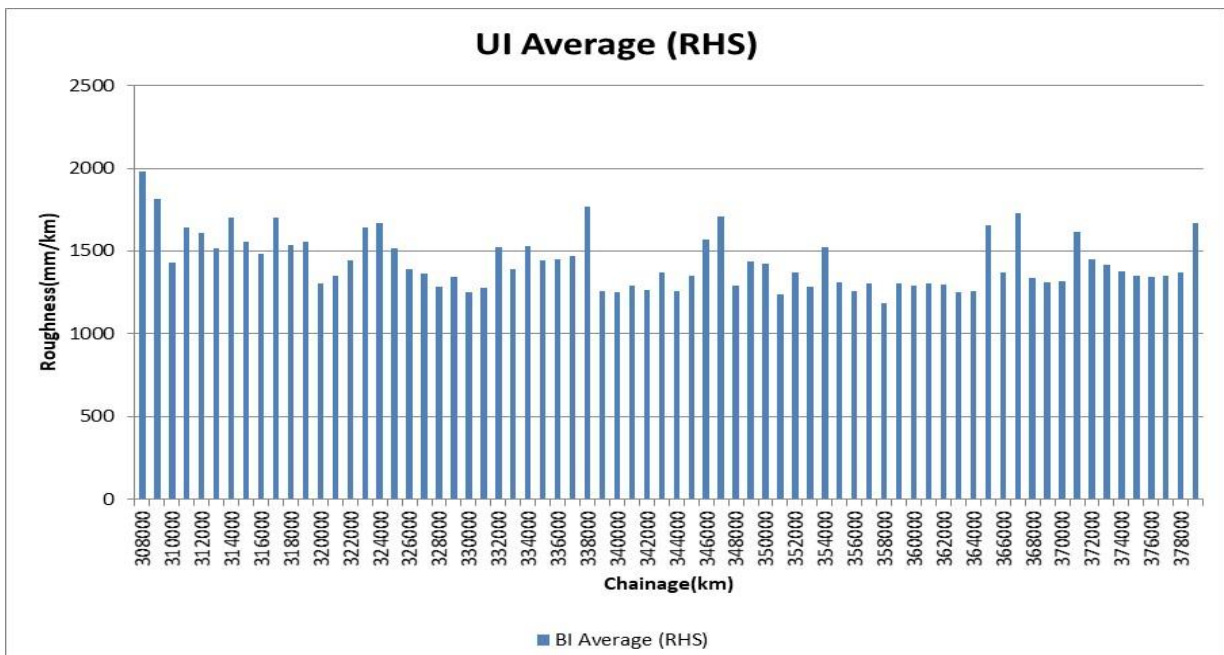
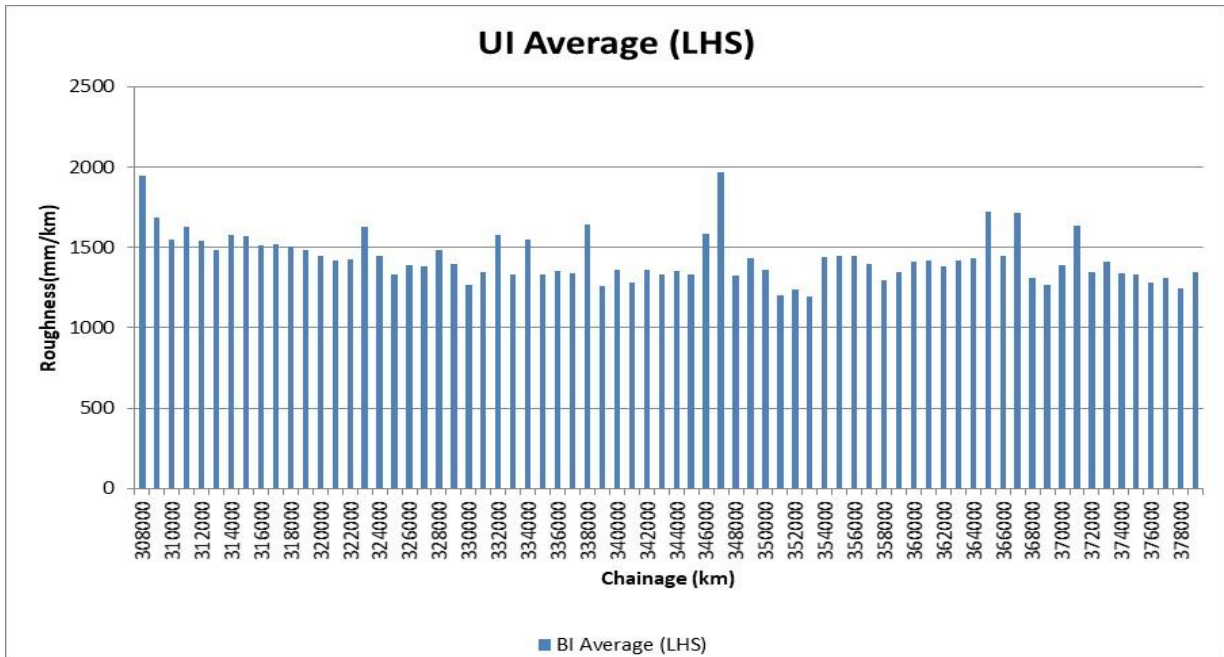
The following observations can be made from the above test results conducted on of existing subgrade samples

- Liquid limit for seven existing subgrade samples varies between 24 and 40. Eleven samples are non-plastic. All samples satisfying the liquid limit criterion ( $LL \leq 50$ ).
- Plasticity Index for seven out of Eighteen Subgrade samples varies between 4 and 10. All samples satisfying the Plasticity Index criterion ( $PI \leq 25$ ).
- Maximum Dry Density for all subgrade samples varies between 1.64 and 2.15 gm/cc. Most of the samples except one sample satisfying the MDD criterion ( $MDD \geq 1.75$  gm/cc).
- OMC for existing subgrade samples varies between 8.00 and 14.0
- Free Swelling Index for existing subgrade samples varies between 0.0 and 27.27 All samples satisfying the FSI criterion ( $FSI \leq 50\%$ ).

*On the whole, it can be concluded that the existing subgrade is in good condition.*

### 1.6.2 Roughness

The roughness surveys data received from client indicates that, the survey conducted along the corridor in the month of October 2021. The summary of Roughness data indicates good riding quality over the length of project corridor. Bar diagrams showing the Kilometer wise roughness along the project road are presented below:



From the above charts, the entire project road appears good riding quality and No functional overlay requires as unevenness Index (UI) is below 2500 mm/km.

### 1.6.3 FWD Analysis and Assessment of Overlay Requirement

The FWD data collected has been analyzed as per IRC guidelines and presented in the tables below.

**Table 29: Summary of Design Moduli of different layers - LHS**

S.No.	From	To	Length (km)	15 <sup>th</sup> Percentile MR values		
				MR for BT	MR for Granular	MR for Subgrade
1	308.00	310.60	2.6	2038	237	87
2	310.60	313.80	3.2	2061	206	87
3	313.80	318.20	4.4	2085	192	87
4	318.20	323.30	5.1	2722	164	87
5	323.30	326.20	2.9	2716	180	83
6	326.20	331.80	5.6	3515	162	87
7	331.80	336.20	4.4	3517	182	87
8	336.20	340.80	4.6	3580	189	73
9	340.80	345.40	4.6	3555	173	67
10	345.40	348.40	3.0	2890	177	80
11	348.40	351.40	3.0	2899	162	87
12	351.40	355.40	4.0	2894	154	71
13	355.40	359.40	4.0	3075	182	87
14	359.40	361.80	2.4	3286	185	69
15	361.80	364.80	3.0	2798	161	75
16	364.80	368.60	3.8	2755	169	68
17	368.60	371.80	3.2	2275	175	87
18	371.80	373.60	1.8	2292	171	80
19	373.60	375.80	2.2	2171	181	76
20	375.80	379.40	3.6	2167	193	75

**Table 30: Summary of Design Moduli of different layers - RHS**

S.No.	From	To	Length (m)	15 <sup>th</sup> Percentile MR values		
				MR for BT	MR for Granular	MR for Subgrade
1	308.00	311.20	3.2	2050	193	85
2	311.20	314.90	3.7	2062	185	87
3	314.90	318.20	3.3	2040	185	87
4	318.20	320.80	2.6	2273	169	84
5	320.80	324.40	3.6	2131	188	87
6	324.40	326.60	2.2	2242	172	86
7	326.60	328.80	2.2	2370	166	86
8	328.80	333.60	4.8	2326	166	87
9	333.60	336.90	3.3	2315	171	87
10	336.90	340.60	3.7	2345	166	87
11	340.60	343.40	2.8	2591	162	87
12	343.40	347.00	3.6	2609	152	87
13	347.00	351.40	4.4	2660	163	87
14	351.40	353.70	2.3	2730	169	87
15	353.70	357.60	3.9	2703	164	87
16	357.60	360.80	3.2	2731	158	87
17	360.80	364.20	3.4	2769	156	87
18	364.20	366.80	2.6	2750	181	87
19	366.80	370.90	4.1	2539	175	82

S.No.	From	To	Length (m)	15th Percentile MR values		
				MR for BT	MR for Granular	MR for Subgrade
20	370.90	372.70	1.8	2539	173	74
21	372.70	375.60	2.9	2511	169	87
22	375.60	379.40	3.8	2536	175	87

#### 1.6.3.1 Observations on FWD Results

It can be noticed from the above table that the layer moduli for the three layers are varying along the length and direction. The MR value for BT layer is 2038 Mpa to 3580Mpa in LHS & 2040Mpa to 2769Mpa in RHS Carriageway. The MR value for Granular Layers is 154 Mpa to 237Mpa in LHS & 152Mpa to 193Mpa in RHS Carriageway. Similarly, the MR value for Subgrade Layer is 67Mpa to 87Mpa in LHS & 74Mpa to 87Mpa in RHS Carriageway.

The MR value of BT layers is moderated in Overlay design and considered 3000Mpa where it is more than 3000 Mpa as the suggested upper limit in IRC 115 is 3000MPA.

#### 1.6.4 Pavement Composition

TCS drawing shows crust composition for the main carriageway and service road is as:

Main carriageway		Service Road	
BC, mm	50	BC, mm	30
DBM, mm	80	DBM, mm	50
WMM, mm	250	WMM, mm	250
GSB, mm	200	GSB, mm	150
Total mm above Subgrade	580	Total mm above Subgrade	480

However, from the test pits data it indicates the following

##### a) Main Carriageway Crust

	BT, mm	WMM, mm	GSB, mm	Total Crust, mm
Average	147	229	199	575

##### b) Service Road Crust

	BT, mm	WMM, mm	GSB, mm	Total Crust, mm
Average	85	240	165	490

#### 1.6.5 CD Structures

The CD structures along the corridor are constructed appears to be as per the standards and specifications. Presently, all structures appear new and seem to be in fair condition without any major distress.

##### Major Structures List including COS

List of Structures	As Per Schedule	As Per Site
Grade separator	2	2
Major Bridge	6	6
Minor Bridge	6	6



List of Structures	As Per Schedule	As Per Site
Cattle/Pedestrian Underpass	2	2
Railway Over Bridge	1	1
Vehicular Underpass	-	1
Foot Over Bridge	-	-

**Culverts List including COS**

List of Structures	As Per Schedule	As Per Site
Box Culvert	5	7
Slab Culvert	9	8
Pipe Culvert	30	49
Extra Pipe Culvert	-	4
Not Found at Site	-	2

**Age of Structures:**

Sl.no.	Structure (2Lane)	LHS		RHS		Total (Nos)	
		Old	New	Old	New	Old	New
1	MJB	3	1	1	7	4	8
2	MNB	6	0	0	6	6	6
3	ROB	1	0	0	1	1	1
4	Flyover	0	2	0	2	0	4
5	VUP	0	1	0	1	0	2
6	CUP	0	2	0	2	0	4

**Summary of Expansion joints and Bearings:**

S.No.	Structure	Expansion joints		No. of Bearings					
				Rocker Roller		Elastomeric		POT PTFE	
		Old	New	Old	New	Old	New	Old	New
1	MJB	-	82	-	-	-	450	-	-
2	MNB	-	-	-	-	-	-	-	-
3	ROB	3	3	-	-	16	6	-	8
4	Flyover	0	16	-	-	-	64	-	-
5	VUP	-	-	-	-	-	-	-	-
6	CUP	-	-	-	-	-	-	-	-
<b>Total No's</b>		<b>3</b>	<b>101</b>	<b>0</b>	<b>0</b>	<b>16</b>	<b>520</b>	<b>0</b>	<b>8</b>

**Summary of Super Structures:**

S.No.	Type of Super structure	MJB	MNB	FLYOVER	ROB	VUP	PUP/CUP	Total No's
1	Steel girder	-	-	-	1	-	-	1
2	PSC Box Girder	-	-	2	-	-	-	2
3	PSC girder	-	-	-	1	-	-	1
4	RCC Girder	8	-	2	2	-	-	12
5	RCC Box Type	-	6	-	-	1	2	9
6	Solid Slab	5	6	-	-	-	-	11
<b>Total no. of Structures</b>		<b>13</b>	<b>12</b>	<b>4</b>	<b>4</b>	<b>1</b>	<b>2</b>	<b>36</b>

**Deviations from Schedule:**

- Pipe Culverts as per Schedule -B are 30 No's & as per Site are 53 No's.
- Box Culverts as per Schedule -B are 05 No's & as per Site are 07 No's.
- Slab Culverts as per Schedule -B are 09 No's & as per Site are 08 No's.
- 1 VUP was constructed under COS.

BR. NO.315+886

### GENERAL DESCRIPTION

• Chainage	:	Km 315+886 LHS
• Type of structure	:	Flyover
• Span Arrangement	:	2 x 15 + 1 x 44 m
• Total outer width of structure	:	2 x 10 m
• Men Width	:	-
• Type of Foundation	:	-
• Type of substructure	:	RCC Circular type
• Type of Superstructure	:	RCC girder and PSC box girder
• Type of Bearing	:	Elastomeric
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Minor Honey comb observed on girders, cross girders and Dirt walls at couple of locations.
- Corrosion stains were observed on A1 to P1 location.
- When heavy vehicles are passing vibrations observed.



BR. NO.315+886

### GENERAL DESCRIPTION

• Chainage	:	Km 315+886 RHS
• Type of structure	:	Flyover
• Span Arrangement	:	2 x 15 + 1 x 44 m
• Total outer width of structure	:	1 x 10.5 m
• Median Width	:	-
• Type of Foundation	:	-
• Type of substructure	:	RCC Circular Type
• Type of Superstructure	:	RCC girder and PSC Box
• Type of Bearing	:	Elastomeric
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Corrosion stains were observed soffit of Deck and Girders.
- Minor Honey combing observed on girders.



BR. NO.323+988

### GENERAL DESCRIPTION

• Chainage	:	km 323+988 LHS
• Type of structure	:	Flyover
• Span Arrangement	:	2 x 15 + 1 x 44 m
• Total outer width of structure	:	2 x 10 m
• Type of Foundation	:	-
• Type of substructure	:	RCC Circular Type
• Type of Superstructure	:	RCC girder and PSC box
• Type of Bearing	:	Elastomeric
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Corrosion stains were observed on bottom of the girder.
- Minor honey combing observed in soffit of girder & slab.
- Steel observed on top slab at P2 to A2 location.



BR. NO.323+988

### GENERAL DESCRIPTION

• Chainage	:	Km 323+988 RHS
• Type of structure	:	Flyover
• Span Arrangement	:	2 x 15 + 1 x 44 m
• Total outer width of structure	:	1 x 10.5 m
• Type of Foundation	:	-
• Type of substructure	:	RCC Circular Type
• Type of Superstructure	:	RCC girder and PSC box girder
• Type of Bearing	:	Elastomeric
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Honeycomb observed on soffit girders.
- Corrosion stains were observed on bottom of girder.
- Rubber sealant damaged at P2 expansion joint.



BR. NO.318+642

### GENERAL DESCRIPTION

• Chainage	:	Km 318+642 LHS
• Type of structure	:	MJB
• Span Arrangement	:	11 x 8.8
• Total outer width of structure	:	1 x 12.2 m
• Type of Foundation	:	-
• Type of substructure	:	Stone masonry
• Type of Superstructure	:	Solid Slab
• Type of Bearing	:	-
• Type of Railing	:	RCC Hand Rail
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Minor Cracks were observed on pier cap at some locations.
- Spalling and Reinforcement exposing on Deck slab in Span-3.
- Minor Cracks were observed on substructure.



BR. NO.318+642

### GENERAL DESCRIPTION

• Chainage	:	Km 318+642 RHS
• Type of structure	:	MJB
• Span Arrangement	:	5 x 17.65 + 1 x 8.85
• Total outer width of structure	:	1 x 10.25 m
• Type of Foundation	:	-
• Type of substructure	:	RCC Circular Type
• Type of Superstructure	:	RCC Girders
• Type of Bearing	:	Elastomeric
• Type of Railing	:	RCC Crash Barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Sealant rubber damaged in expansion joint at P3 and P4 location.
- Hair line Cracks observed on top slab & Girder bottom.
- Minor Corrosion stain and Minor Honey comb observed on girders.





BR. NO.333+998

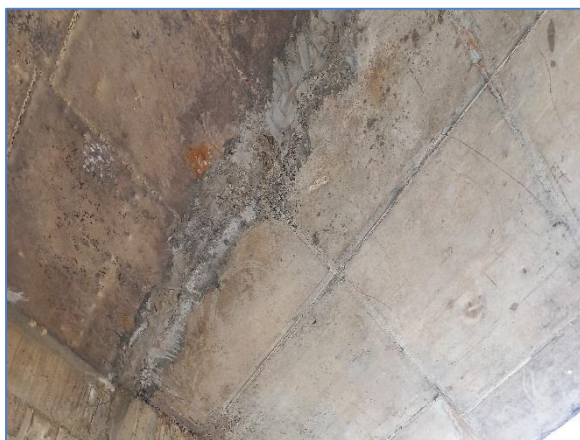
### GENERAL DESCRIPTION

• Chainage	:	Km 333+998 LHS
• Type of structure	:	MJB
• Span Arrangement	:	8 x 8.8
• Total outer width of structure	:	1 x 10.8 m
• Type of Foundation	:	-
• Type of substructure	:	Stone masonry & RCC
• Type of Superstructure	:	Solid Slab
• Type of Bearing	:	-
• Type of Railing	:	Hand rail
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Minor Cracks observed on top slab, side walls and pier cap.
- Previous repair works are done.
- Structure is in fair condition.



BR. NO.333+998

### GENERAL DESCRIPTION

• Chainage	:	Km 333+998 RHS
• Type of structure	:	MJB
• Span Arrangement	:	4 x 17.6
• Total outer width of structure	:	1 x 10.25 m
• Type of Foundation	:	-
• Type of substructure	:	RCC Circular Type
• Type of Superstructure	:	RCC Girders
• Type of Bearing	:	Elastomeric
• Type of Railing	:	Crash Barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Minor Cracks observed on top slab, Girders and Pier cap.
- Honey comb observed on girders and cross girders.
- Corrosion stains were observed on bottom of girders and pier cap.



BR. NO.334+830

### GENERAL DESCRIPTION

• Chainage	:	Km 334+830 LHS
• Type of structure	:	MJB
• Span Arrangement	:	30 x 8.8
• Total outer width of structure	:	1 x 10.9 m
• Type of Foundation	:	-
• Type of substructure	:	Stone masonry & RCC
• Type of Superstructure	:	Solid Slab
• Type of Bearing	:	-
• Type of Railing	:	Hand railing
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Honey comb and spalling on top slab and Cracks observed on side wall and pier cap.
- Small portion Steel exposed on top slab near P3 and P4.
- Minor Spalling & Reinforcement exposed on Hand Railing.
- Shotcrete work done for top slab and pier cap.



**BR. NO.334+830**

**GENERAL DESCRIPTION**

• Location of structure	:	-
• Chainage	:	Km 334+830 RHS
• Type of structure	:	MJB
• Span Arrangement	:	15 x 17.6
• Total outer width of structure	:	1 x 10.25 m
• Median Width	:	-
• Type of Foundation	:	-
• Type of substructure	:	RCC circular type
• Type of Superstructure	:	RCC girders
• Type of Bearing	:	Elastomeric
• Type of Railing	:	RCC Crash Barrier
• Method of Inspection	:	Visual

**OBSERVATIONS**

Visual Observations on condition of the structure are as below:

- Corrosion stains observed on bottom of girders.
- Rubber sealant damaged in all Expansion joints & Filled with Silt.



BR. NO.349+230

**GENERAL DESCRIPTION**

• Chainage	:	Km 349+230 LHS
• Type of structure	:	MJB
• Span Arrangement	:	10 x 15
• Total outer width of structure	:	1 x 10.25 m
• Type of Foundation	:	-
• Type of substructure	:	RCC Circular type
• Type of Superstructure	:	RCC girders
• Type of Bearing	:	Elastomeric
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

**OBSERVATIONS**

Visual Observations on condition of the structure are as below:

- Steel exposed on dirt wall at A1 side and P4 pier cap.
- Honey combing & Corrosion stains are observed on bottom of the girders.
- Rubber sealant damaged in Expansion joint on P2, P3, P6, P7, P9, A2 locations.



BR. NO.349+230

**GENERAL DESCRIPTION**

• Chainage	:	Km 349+230 RHS
• Type of structure	:	MJB
• Span Arrangement	:	10 x 15
• Total outer width of structure	:	1 x 10.25 m
• Type of Foundation	:	-
• Type of substructure	:	RCC Circular type
• Type of Superstructure	:	RCC girders
• Type of Bearing	:	Elastomeric
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

**OBSERVATIONS**

Visual Observations on condition of the structure are as below:

- Honey comb observed on bottom of the girder.
- Minor Corrosion stains were observed on bottom of the girders.
- Rubber sealant damaged in Expansion joint on A1, P5 locations.



BR. NO.354+690

#### GENERAL DESCRIPTION

• Chainage	:	Km 354+690 LHS
• Type of structure	:	MJB
• Span Arrangement	:	9 x 17.85
• Total outer width of structure	:	1 x 10.25 m
• Type of Foundation	:	-
• Type of substructure	:	RCC Circular type
• Type of Superstructure	:	RCC girders
• Type of Bearing	:	Elastomeric
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

#### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Hair line cracks were observed on top slab and bottom of girders.
- Corrosion stains were observed on bottom of the girders.
- Rubber sealant damaged in Expansion joint on P4, P6, P7, P8 locations.
- Spalling & steel observed on girder bottom.



BR. NO.354+690

**GENERAL DESCRIPTION**

• Chainage	:	Km 354+690 RHS
• Type of structure	:	MJB
• Span Arrangement	:	9 x 17.85
• Total outer width of structure	:	1 x 10.25 m
• Type of Foundation	:	-
• Type of substructure	:	RCC Circular type
• Type of Superstructure	:	RCC girders
• Type of Bearing	:	Elastomeric
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

**OBSERVATIONS**

Visual Observations on condition of the structure are as below:

- Steel exposed on P5 cross girder.
- Hair line cracks were observed on top slab.
- Corrosion stains were observed on bottom of the girders.
- Rubber sealant damaged in Expansion joint on P4, P6, P7, P8 locations.





BR. NO.371+373

**GENERAL DESCRIPTION**

• Chainage	:	Km 371+373 LHS
• Type of structure	:	MJB
• Span Arrangement	:	12 x 22.4
• Total outer width of structure	:	1 x 10.25 m
• Type of Foundation	:	-
• Type of substructure	:	RCC Circular type
• Type of Superstructure	:	RCC girders
• Type of Bearing	:	Elastomeric
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

**OBSERVATIONS**

Visual Observations on condition of the structure are as below:

- Corrosion stains were observed on bottom of the girders.
- Rubber sealant damaged in Expansion joint on P1, P3, P4, P7, A2 locations.
- Vibrations observed while heavy vehicles were moving on structure.



BR. NO.371+373

### GENERAL DESCRIPTION

• Chainage	:	Km 371+373 RHS
• Type of structure	:	MJB
• Span Arrangement	:	24 x 11.2
• Total outer width of structure	:	1 x 12.10 m
• Type of Foundation	:	-
• Type of substructure	:	Stone masonry
• Type of Superstructure	:	Solid slab
• Type of Bearing	:	-
• Type of Railing	:	Steel Hand rails
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Minor Cracks & Honey comb observed on top slab.
- Previous repair works are observed.
- Minor Corrosion stains were observed girders at A2 side.



BR. NO.335+285

### GENERAL DESCRIPTION

• Chainage	:	Km 335+285 LHS
• Type of structure	:	MNB (Old construction)
• Span Arrangement	:	3 x 6.8
• Total outer width of structure	:	1 x 10.2 m
• Type of Foundation	:	-
• Type of substructure	:	Stone masonry & RCC
• Type of Superstructure	:	Solid Slab
• Type of Bearing	:	NA
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Hair line cracks observed on deck slab & pier cap.
- Delamination observed on pier cap.
- Spalling and steel observed on top slab.



BR. NO.335+285

### GENERAL DESCRIPTION

• Chainage	:	Km 335+285 RHS
• Type of structure	:	MNB
• Span Arrangement	:	3 x 6.8
• Total outer width of structure	:	1 x 10.5 m
• Type of Foundation	:	-
• Type of substructure	:	RCC Box type
• Type of Superstructure	:	RCC Box type
• Type of Bearing	:	NA
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Minor Honey comb observed on side wall and bottom of top slab.
- Hair line cracks observed on top slab.
- Steel Exposed on top slab at drainage spout location.
- Structure is in good condition.



BR. NO.335+324

### GENERAL DESCRIPTION

• Chainage	:	Km 335+324 LHS
• Type of structure	:	MNB
• Span Arrangement	:	3 x 6.8
• Total outer width of structure	:	1 x 10.2 m
• Type of Foundation	:	-
• Type of substructure	:	Stone masonry & RCC
• Type of Superstructure	:	Solid Slab
• Type of Bearing	:	NA
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Minor Honey comb and minor spalling observed on top slab.
- Steel exposed on the top slab.



BR. NO.335+324

### GENERAL DESCRIPTION

• Chainage	:	Km 335+324 RHS
• Type of structure	:	MNB
• Span Arrangement	:	3 x 6.8
• Total outer width of structure	:	1 x 10.5 m
• Type of Foundation	:	-
• Type of substructure	:	RCC Box type
• Type of Superstructure	:	RCC Box type
• Type of Bearing	:	NA
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Steel exposed at the down take pipe.
- Structure condition good.



BR. NO.338+736

### GENERAL DESCRIPTION

• Chainage	:	Km 338+736 LHS
• Type of structure	:	MNB
• Span Arrangement	:	6 x 6.8
• Total outer width of structure	:	1 x 12 m
• Type of Foundation	:	-
• Type of substructure	:	Stone masonry
• Type of Superstructure	:	Solid Slab
• Type of Bearing	:	NA
• Type of Railing	:	RCC Hand Rails
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Quadrant stone pitching not provided.
- Spalling & reinforcement exposed on deck slab.
- Honey comb observed on top slab and also steel exposed.
- Steel exposed on Pier and RCC hand rails.



BR. NO.338+736

### GENERAL DESCRIPTION

• Chainage	:	Km 338+736 RHS
• Type of structure	:	MNB
• Span Arrangement	:	6 x 6.8
• Total outer width of structure	:	1 x 10.2 m
• Type of Foundation	:	-
• Type of substructure	:	RCC Box type
• Type of Superstructure	:	RCC Box type
• Type of Bearing	:	NA
• Type of Railing	:	RCC Crash Barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Minor honey comb observed on top slab.
- Hair line cracks observed on every top slab and side walls.





BR. NO.339+541

### GENERAL DESCRIPTION

• Chainage	:	Km 339+541 LHS
• Type of structure	:	MNB
• Span Arrangement	:	3 x 5.8
• Total outer width of structure	:	1 x 12 m
• Type of Foundation	:	-
• Type of substructure	:	Stone masonry
• Type of Superstructure	:	Solid Slab
• Type of Bearing	:	NA
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Minor honey comb observed on top slab.
- Structure is in good condition.



BR. NO.339+541

### GENERAL DESCRIPTION

• Chainage	:	Km 339+541 RHS
• Type of structure	:	MNB
• Span Arrangement	:	2 x 6.8 + 1 x 6.0
• Total outer width of structure	:	1 x 10.25 m
• Type of Foundation	:	-
• Type of substructure	:	RCC Box Type
• Type of Superstructure	:	RCC Box Type
• Type of Bearing	:	NA
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Steel exposed on P1 side wall.
- Structure is in good condition.



BR. NO.343+249

### GENERAL DESCRIPTION

• Chainage	:	Km 343+249 LHS
• Type of structure	:	MNB
• Span Arrangement	:	2 x 6.7
• Total outer width of structure	:	1 x 12.0 m
• Type of Foundation	:	-
• Type of substructure	:	RCC wall type
• Type of Superstructure	:	Solid Slab
• Type of Bearing	:	NA
• Type of Railing	:	RCC Hand rail
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Recent repair works noticed on top slab.
- Structure is in fair condition.



BR. NO.343+249

**GENERAL DESCRIPTION**

• Chainage	:	Km 343+249 RHS
• Type of structure	:	MNB
• Span Arrangement	:	2 x 6.7
• Total outer width of structure	:	1 x 10.25 m
• Type of Foundation	:	-
• Type of substructure	:	RCC Box type
• Type of Superstructure	:	RCC Box type
• Type of Bearing	:	NA
• Type of Railing	:	RCC Hand rail
• Method of Inspection	:	Visual

**OBSERVATIONS**

Visual Observations on condition of the structure are as below:

- Minor Cracks observed on top slab and side walls.
- Structure is in good condition.



BR. NO.346+000

### GENERAL DESCRIPTION

• Chainage	:	Km 346+000 LHS
• Type of structure	:	MNB
• Span Arrangement	:	5 x 6.9
• Total outer width of structure	:	1 x 12 m
• Type of Foundation	:	-
• Type of substructure	:	RCC wall type
• Type of Superstructure	:	Solid Slab
• Type of Bearing	:	NA
• Type of Railing	:	RCC Hand rail
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Honey comb observed and Steel exposed on top slab.
- Structure condition fair.



BR. NO.346+000

### GENERAL DESCRIPTION

• Chainage	:	Km 346+000 RHS
• Type of structure	:	MNB
• Span Arrangement	:	5 x 6.9
• Total outer width of structure	:	1 x 10.25 m
• Type of Foundation	:	-
• Type of substructure	:	RCC Box Type
• Type of Superstructure	:	RCC Box Type
• Type of Bearing	:	NA
• Type of Railing	:	RCC Hand rail
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Hair line cracks observed on bottom of top slab and side walls.
- Structure is in fair condition.



BR. NO.325+600

### GENERAL DESCRIPTION

• Chainage	:	Km 325+600
• Type of structure	:	CUP
• Span Arrangement	:	1.0 x 4.0 x 3.5 m
• Total outer width of structure	:	2 x 12.0 m
• Median Width	:	4.5
• Type of Foundation	:	Raft
• Type of substructure	:	RCC Box Type
• Type of Superstructure	:	RCC Box Type
• Type of Bearing	:	NA
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Minor Honey comb observed on side walls.
- Structure is in good condition.



BR. NO.360+500

### GENERAL DESCRIPTION

• Chainage	:	Km 360+500
• Type of structure	:	CUP
• Span Arrangement	:	1.0 x 4.0 x 3.5 m
• Total outer width of structure	:	2 x 12.0 m
• Median Width	:	4.5
• Type of Foundation	:	Raft
• Type of substructure	:	RCC Box Type
• Type of Superstructure	:	RCC Box Type
• Type of Bearing	:	NA
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Honey comb and cracks were observed on side walls.
- Structure condition good.





BR. NO.372+980

### GENERAL DESCRIPTION

• Chainage	:	Km 372+980
• Type of structure	:	VUP
• Span Arrangement	:	1.0 x 12.5 x 5.5 m
• Total outer width of structure	:	2 x 12.0 m
• Median Width	:	4.5
• Type of Foundation	:	Raft
• Type of substructure	:	RCC Box Type
• Type of Superstructure	:	RCC Box Type
• Type of Bearing	:	NA
• Type of Railing	:	RCC Crash barrier
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Structure is in good condition.



BR. NO.367+485

### GENERAL DESCRIPTION

• Chainage	:	Km 367+485 LHS
• Type of bridge	:	ROB
• Span Arrangement	:	1 x 18.0 + 1 x 41.1 m
• Total outer width of bridge	:	1 x 12.0 m
• Type of Foundation	:	Open
• Type of substructure	:	RCC wall
• Type of Superstructure	:	RCC & PSC girder
• Type of Bearing	:	Elastomeric.
• Type of Railing	:	RCC Crash barrier.
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the bridge are as below:

- Corrosion stains were observed on pier cap.
- Rubber sealant damaged in Expansion joint on A1, P1, A2 locations.



BR. NO.367+485

### GENERAL DESCRIPTION

• Chainage	:	Km 367+485 RHS
• Type of bridge	:	ROB
• Span Arrangement	:	1 x 18.0 + 1 x 41.1 m
• Total outer width of bridge	:	1 x 10.25 m
• Type of Foundation	:	Open
• Type of substructure	:	RCC wall
• Type of Superstructure	:	RCC & Steel girder
• Type of Bearing	:	POT-PTFE & Elastomeric
• Type of Railing	:	RCC Crash barrier.
• Method of Inspection	:	Visual

### OBSERVATIONS

Visual Observations on condition of the bridge are as below:

- Three RCC girders for P1 to A2 and are in good condition.
- Crash barrier damaged and also steel exposed.



Photos of some culverts at site



Km 28+030



Km 350+100



Km 366+400



Km 371+701



Km 339+090



Km 367+970



Km 374+042



Km 376+217

**Details of Culverts**

S. No	Type as per CA	Type as per site	Proposed chainage	Proposed chainage as per site	Proposed span arrangement (No.× Length) (m)	Proposed span arrangement as per site (No.× Length) (m)	Existing deck width as per site	Skew angle	Vertical clearance (m)	Slab thickness (m)	Remarks
1	-	Pipe Culverts	-	316+600	-	1 x 1.2	31.8	No	-	-	1. Merged into drain at both sides
2	-	Pipe Culverts	-	318+305	-	1 x 1.2	33.9	No	-	-	1. Structure is in good condition 2. Not visible at LHS
3	-	Pipe Culverts	-	319+720	-	1 x 0.6	18.25	No	-	-	1. Median drain culvert available at RHS
4	-	Pipe Culverts	-	323+220	-	1 x 0.6	16.65	No	-	-	1. Median drain culvert available at LHS
5	-	Pipe Culverts	-	325+390	-	1 x 0.6	18.05	No	-	-	1. Median drain culvert available at RHS 2. No stone pitching at LHS
6	Slab Culverts	-	325+619	-	1 x 2	-	-	-	-	-	1. Not found at site
7	Box Culverts	Box Culverts	326+620	326+622	1 x 2	1 x 2	24.5	No	2	-	1. Structure is in good condition
8	Box Culverts	Box Culverts	328+030	328+278	1 x 2	1 x 2	26.3	No	2	-	1. Hair line cracks were observed on slab 2. Honey comb on side walls
9	Slab Culverts	Slab Culverts	336+302	336+306	2 x 2.5	1 x 3.5	27.3	No	1.031	0.3	1. No stone protection at RHS
10	Pipe Culverts	Pipe Culverts	339+090	339+040	3 x 0.9	3 x 0.9	28.3	No	-	-	1. Parapet wall damaged 2. Steel exposed on pipe

S. No	Type as per CA	Type as per site	Proposed chainage	Proposed chainage as per site	Proposed span arrangement (No.× Length) (m)	Proposed span arrangement as per site (No.× Length) (m)	Existing deck width as per site	Skew angle	Vertical clearance (m)	Slab thickness (m)	Remarks
11	-	Pipe Culverts	-	346+630	-	1 x 0.6	15.95	No	-	-	
12	Slab Culverts	Slab Culverts	346+772	346+772	1 x 1.9	1 x 1.2	29	No	1.2	0.3	1. Vegetation on stone pitching.
13	-	Pipe Culverts	-	347+560	-	2 x 0.9	22.2	No	-	-	1.Stone protection at BHS required.
14	-	Pipe Culverts	-	347+610	-	2 x 0.9	22.2	No	-	-	
15	-	Pipe Culverts	-	348+045	-	1 x 0.6	16.35	No	-	-	
16	-	Pipe Culverts	-	348+870	-	1 x 0.6	13.35	No	-	-	
17	-	Box Culverts	-	350+075	-	1 x 2	25.8	No	2	-	1. Structure is in good condition.
18	Box Culverts	Box Culverts	350+680	350+710	1 x 2	1 x 2	32.85	No	2.5	-	1. Structure is in good condition.
19	-	Pipe Culverts	-	351+720	-	1 x 0.6	14.25	No	-	-	
20	-	Box Culverts	-	351+780	-	1 x 2	23.8	No	2.5	-	1. Structure is in good condition.
21	-	Pipe Culverts	-	352+200	-	1 x 0.6	14.05	No	-	-	

S. No	Type as per CA	Type as per site	Proposed chainage	Proposed chainage as per site	Proposed span arrangement (No.× Length) (m)	Proposed span arrangement as per site (No.× Length) (m)	Existing deck width as per site	Skew angle	Vertical clearance (m)	Slab thickness (m)	Remarks
22	Box Culverts	Box Culverts	353+310	353+310	1 x 2	1 x 2	24.9	No	2	-	1. Hair line cracks observed on slab 2. Honey comb observed on slab and side walls
23	-	Pipe Culverts	-	353+730	-	1 x 0.6	16.85	No	-	-	
24	-	Pipe Culverts	-	354+240	-	1 x 0.6	14.05	No	-	-	
25	-	Pipe Culverts	-	355+280	-	1 x 0.6	16.35	No	-	-	
26	Slab Culverts	Slab Culverts	356+349	356+344	1 x 2.8	1 x 2.1	23.6	Yes	1.188	0.3	1. Structure is in good condition.
27	-	Pipe Culverts	-	358+200	-	1 x 1.2	33.6	No	-	-	1. Structure is in good condition.
28	-	Pipe Culverts	-	358+940	-	1 x 1.2	34.1	No	-	-	
29	-	Pipe Culverts	-	360+220	-	1 x 0.6	14.05	No	-	-	
30	-	Pipe Culverts	-	361+735	-	1 x 1.2	27.2	No	-	-	1. Structure is in good condition.
31	-	Pipe Culverts	-	363+520	-	1 x 1.2	25.6	No	-	-	1. Structure is in good condition.

S. No	Type as per CA	Type as per site	Proposed chainage	Proposed chainage as per site	Proposed span arrangement (No.× Length) (m)	Proposed span arrangement as per site (No.× Length) (m)	Existing deck width as per site	Skew angle	Vertical clearance (m)	Slab thickness (m)	Remarks
32	Box Culverts	Box Culverts	365+100	365+110	1 x 2	1 x 2	25.2	No	1.5	-	1. Structure is in good condition.
33	Slab Culverts	Slab Culverts	365+781	365+772	2 x 3.8	2 x 3.2	23.9	No	1.2	0.3	1. Minor damage on parapet wall at RHS 2. Stone apron partially damaged
34	Slab Culverts	Slab Culverts	366+463	366+447	1 x 3.6	1 x 3	23.8	No	1.984	0.3	1. Crack observed on parapet wall 2. Structure is in good condition.
35	-	Pipe Culverts	-	366+980	-	1 x 0.6	17.4	No	-	-	
36	Pipe Culverts	Pipe Culverts	367+778	367+839	1 x 1.2	1 x 1.2	22.3	Yes	-	-	Old structure at LHS
37	-	Pipe Culverts	-	368+009	-	1 x 0.6	15.45	No	-	-	1. Structure is in good condition.
38	Pipe Culverts	Pipe Culverts	368+104	368+070	1 x 1.2	1 x 1.2	29	No	-	-	1. Structure is in good condition.
39	Pipe Culverts	Pipe Culverts	368+126	368+150	1 x 1.2	1 x 1.2	30.7	No	-	-	1. Structure is in good condition.
40	-	Pipe Culverts	-	369+325	-	1 x 0.6	16.35	No	-	-	
41	Pipe Culverts	Pipe Culverts	369+621	369+662	1 x 1.2	1 x 1	30.15	No	-	-	1. Structure is in good condition.
42	-	Pipe Culverts	-	370+460	-	1 x 0.6	16.05	No	-	-	



S. No	Type as per CA	Type as per site	Proposed chainage	Proposed chainage as per site	Proposed span arrangement (No.× Length) (m)	Proposed span arrangement as per site (No.× Length) (m)	Existing deck width as per site	Skew angle	Vertical clearance (m)	Slab thickness (m)	Remarks
43	Slab Culverts	Slab Culverts	370+957	370+944	1 x 2.65	1 x 2	29.5	No	2.057	0.3	1 parapet wall at RHS required
44	Slab Culverts	Slab Culverts	371+707	371+697	1 x 2.4	1 x 1.9	34.85	Yes	3.066	0.3	1 wing walls at RHS required
45	Pipe Culverts	Pipe Culverts	372+244	372+220	1 x 1.2	1 x 1.2	31.1	No	-	-	1. Structure is in good condition.
46	Pipe Culverts	Pipe Culverts	372+472	372+453	1 x 1.2	1 x 1.2	30.7	No	-	-	
47	Pipe Culverts	Pipe Culverts	372+682	372+664	1 x 1.2	1 x 1.2	36.1	No	-	-	1. Merged into drain at both sides
48	Pipe Culverts	Pipe Culverts	373+045	373+000	1 x 1.2	1 x 1.2	31.1	No	-	-	1. Merged into drain at both sides
49	Pipe Culverts	Pipe Culverts	373+071	373+070	1 x 1.2	1 x 1.2	31.1	No	-	-	1. Merged into drain at both sides
50	Pipe Culverts	Pipe Culverts	373+321	373+390	1 x 1.2	1 x 1.2	32.6	No	-	-	1. Merged into drain at both sides
51	Pipe Culverts	Pipe Culverts	373+492	373+476	1 x 1.2	1 x 1.2	33.2	No	-	-	1. Culvert merged into drain at RHS side.
52	Pipe Culverts	Pipe Culverts	373+989	373+972	1 x 1.2	1 x 1.2	30.1	No	-	-	1. wing walls at BHS required
53	Pipe Culverts	Pipe Culverts	374+042	374+025	1 x 1.2	1 x 1.2	30.3	No	-	-	1. Minor damage on wing wall. 2. Structure is in good condition.
54	Slab Culverts	Slab Culverts	374+315	374+298	1 x 2.5	1 x 2.5	23.1	No	1.342	0.3	1. Structure is in good condition.

S. No	Type as per CA	Type as per site	Proposed chainage	Proposed chainage as per site	Proposed span arrangement (No.× Length) (m)	Proposed span arrangement as per site (No.× Length) (m)	Existing deck width as per site	Skew angle	Vertical clearance (m)	Slab thickness (m)	Remarks
55	Pipe Culverts	Pipe Culverts	374+684	374+667	1 x 1.2	1 x 1.2	30.5	No	-	-	1. Structure is in good condition.
56	Pipe Culverts	Pipe Culverts	374+870	374+853	1 x 1.2	1 x 1.2	30.4	No	-	-	1. Structure is in good condition.
57	Pipe Culverts	Pipe Culverts	374+990	374+971	1 x 1.2	1 x 1.2	28.8	Yes	-	-	1. Structure is in good condition.
58	Pipe Culverts	Pipe Culverts	375+259	375+242	1 x 1.2	1 x 1.2	30.25	No	-	-	1. Minor damage on wing wall 2. Structure is in good condition.
59	Pipe Culverts	Pipe Culverts	375+598	375+583	1 x 1.2	1 x 1.2	30.55	No	-	-	1. Structure is in good condition.
60	Pipe Culverts	Pipe Culverts	375+780	375+764	1 x 1.2	1 x 1.2	30.65	No	-	-	1. Wing wall partially damaged at LHS.
61	Pipe Culverts	Pipe Culverts	376+122	376+102	1 x 1.2	1 x 1.2	30.9	Yes	-	-	1. Structure is in fair condition.
62	Pipe Culverts	Pipe Culverts	376+217	376+200	1 x 1.2	1 x 1.2	30.35	No	-	-	1. Structure is in fair condition.
63	Pipe Culverts	Pipe Culverts	376+341	376+325	1 x 1.2	1 x 1.2	30.35	No	-	-	1. Structure is in fair condition.
64	Pipe Culverts	Pipe Culverts	376+512	376+433	1 x 1.2	1 x 1.2	33	No	-	-	1. wing walls presented at LHS required
65	Pipe Culverts	Pipe Culverts	377+225	377+208	1 x 1.2	1 x 1.2	30.3	No	-	-	1. Wing wall damaged at LHS side.

S. No	Type as per CA	Type as per site	Proposed chainage	Proposed chainage as per site	Proposed span arrangement (No.× Length) (m)	Proposed span arrangement as per site (No.× Length) (m)	Existing deck width as per site	Skew angle	Vertical clearance (m)	Slab thickness (m)	Remarks
66	Pipe Culverts	Pipe Culverts	377+721	377+780	1 x 1.2	1 x 1.2	32.9	No	-	-	1. wing walls presented at LHS required.
67	Pipe Culverts	Pipe Culverts	377+824	377+888	1 x 1.2	1 x 1.2	37.2	Yes	-	-	1. Minor damage at LHS Wing wall
68	Pipe Culverts	Pipe Culverts	378+306	378+290	1 x 1.2	1 x 1.2	30.8	No	-	-	1. Minor damage at RHS Wing wall
69	Pipe Culverts	Pipe Culverts	378+729	378+707	1 x 1.0	1 x 1.2	30.8	No	-	-	1. Structure is in good condition.
70	Pipe Culverts	-	379+542	-	1 x 1.2	-	-	-	-	-	1. Not found at site.

### 1.6.6 Drainage and Slope Protection

Lined Covered drains observed at urban road and service road Locations along the corridor. Open unlined drains at few locations are not functioning properly and require some attention.

Median drains at curve locations are in good condition except for few locations where they need cleaning. No major distress is observed on the carriageway on downstream side at median drain locations. This will help preventing distress on carriageway in the long run.

Slope protection in the form of Stone pitching has been provided along the corridor. At few locations, the slope protection is not in a proper condition and is mentioned in the tables above.

### 1.6.7 Traffic Safety and Road Furniture

Metal beam crash barriers provided along the project corridor without end treatments which shall be required with proper tapering. Pedestrian guard rails installed only at bus bay foot path location and are appear in good condition.

Four (4) Out of 77 Nos of Solar blinkers were not in working condition along the corridor and street lighting and High Mast Lighting is in good working condition except at couple of locations, where the rectification work is in progress.

### 1.6.8 Road User Facilities

The bus stop and bus bay, Truck lay bye provided along the corridor appear to be good condition.

## 1.7 REHABILITATION PLANS AND DESIGNS

### 1.7.1 Design Traffic Loading

Design Traffic loading has been estimated by considering the latest traffic (given) and VDFs as estimated from the latest axle load survey data and with the 5% growth rates. The Estimated design traffic for 5 years, 10 years and 15 years design period as below:

**Table 31: Estimated Design Traffic loading near (km338+350)**

Year	Design Lane MSA on Existing Carriageway	
	UP	DN
5 <sup>th</sup> year from Now	18.7	18.5
10 <sup>th</sup> year from Now	42.5	42.0
15 <sup>th</sup> year from Now	72.9	72.1

**Table 32: Estimated Design Traffic loading near (km365+400)**

Year	Design Lane MSA on Existing Carriageway	
	UP	DN
5 <sup>th</sup> year from Now	18.8	19.4
10 <sup>th</sup> year from Now	42.9	44.1
15 <sup>th</sup> year from Now	73.6	75.7

Since it is essential to monitor the pavement structural strength every 10 years as per 4 laning manual, design traffic corresponding to 10 years period has been considered for overlay design.

### 1.7.2 Pavement Rehabilitation and Strengthening

For Design the Overlay Thickness the following method as suggested in IRC: 115 has been used

- The existing pavement is considered as a 3-layer system consisting of subgrade, granular and bituminous layer. The remaining life of existing pavement in terms of Fatigue and Rutting life (MSA) are estimated
- The remaining life is compared with design traffic loading. An overlay with assumed thickness is considered on existing pavement where required.
- The Total system including the proposed Overlay (Trial thickness) is assumed as a four-layer system and considered the relevant MR values for all the four layers namely New BT layer, existing bituminous surface, Total existing Granular layers and Subgrade layers.
- The MR value for the New BT is assumed as 3000 MPA (considering VG40 Bituminous grade) and for all the remaining three layers, the MR Values derived and finalized from the FWD Analysis are considered
- Critical Tensile strains and Vertical strains are found out by using the IIT PAVE Software at the bottom of existing bituminous layer and at the top of the subgrade layer respectively.
- The Fatigue and Rutting equations (equation 16 & 17 given in the IRC: 115) have been used to estimate the Fatigue and Rutting Life of The Pavement system.
- The Obtained Fatigue and Rutting Life are compared with the required life for the assumed trial overlay thickness.
- Analysis is carried out for individual homogeneous sections as well for minimum and Average Modulus Values on each direction separately.

Remaining life of the existing pavement from the above analysis is presented in the following tables:

**Table 33: Remaining life of the existing pavement on Both Carriageways**

Sections	From	To	Length	Existing - BT layer MR value	MR of Granular Layer Thickness	MR (or) E-Subgrade	Existing BT layer (mm)	Existing Granular layer (mm)	Total BT Layer thickness	Total Crust	E- BT layer	ver. Strain(Ev)	tan. Strain(Et)	Nf- Fatigue life, %	Rutting life, mSA	Critical Life
LHS																
1	308.00	310.60	2.6	2038	237	87	150	430	150	580	2038	287.9	206.2	72	470	72
2	310.60	313.80	3.2	2061	206	87	150	430	150	580	2061	297.0	219.8	55	408	55
3	313.80	318.20	4.4	2085	192	87	150	430	150	580	2085	300.7	226.0	49	386	49
4	318.20	323.30	5.1	2722	164	87	150	430	150	580	2722	291.1	211.1	51	447	51
5	323.30	326.20	2.9	2716	180	83	150	430	150	580	2716	295.4	203.7	59	419	59
6	326.20	331.80	5.6	3515	162	87	150	430	150	580	3000	284.7	200.8	57	495	57
7	331.80	336.20	4.4	3517	182	87	150	430	150	580	3000	280.1	191.8	68	533	68
8	336.20	340.80	4.6	3580	189	73	150	430	150	580	3000	308.2	190.2	71	345	71
9	340.80	345.40	4.6	3555	173	67	150	430	150	580	3000	329.1	198.0	60	256	60
10	345.40	348.40	3.0	2890	177	80	150	430	150	580	2890	298.5	198.7	61	399	61
11	348.40	351.40	3.0	2899	162	87	150	430	150	580	2899	287.2	204.8	55	476	55
12	351.40	355.40	4.0	2894	154	71	150	430	150	580	2894	327.6	211.0	49	262	49
13	355.40	359.40	4.0	3075	182	87	150	430	150	580	3000	280.1	191.8	68	533	68
14	359.40	361.80	2.4	3286	185	69	150	430	150	580	3000	319.4	192.4	68	294	68
15	361.80	364.80	3.0	2798	161	75	150	430	150	580	2798	317.5	210.8	50	302	50
16	364.80	368.60	3.8	2755	169	68	150	430	150	580	2755	334.6	209.3	52	238	52
17	368.60	371.80	3.2	2275	175	87	150	430	150	580	2275	300.3	226.0	46	388	46
18	371.80	373.60	1.8	2292	171	80	150	430	150	580	2292	316.7	228.1	44	305	44
19	373.60	375.80	2.2	2171	181	76	150	430	150	580	2171	326.7	228.9	45	265	45
20	375.80	379.40	3.6	2167	193	75	150	430	150	580	2167	324.7	222.3	51	273	51
RHS																
1	308.00	311.20	3.2	2050	193	85	150	430	150	580	2050	305.6	227.4	49	359	49
2	311.20	314.90	3.7	2062	185	87	150	430	150	580	2062	303.6	231.3	45	370	45
3	314.90	318.20	3.3	2040	185	87	150	430	150	580	2040	304.3	232.6	45	366	45

Sections	From	To	Length	Existing - BT layer MR value	MR of Granular Layer Thickness	MR (or) E-Subgrade	Existing BT layer (mm)	Existing Granular Layer(mm)	Total BT Layer thickness	Total Crust	E- BT layer	ver. Strain(Ev)	tan. Strain(Et)	Nf- Fatigue life,	Rutting life,mSA	Critical Life
4	318.20	320.80	2.6	2273	169	84	150	430	150	580	2273	308.7	229.9	43	343	43
5	320.80	324.40	3.6	2131	188	87	150	430	150	580	2131	300.6	225.9	48	387	48
6	324.40	326.60	2.2	2242	172	86	150	430	150	580	2242	304.3	229.5	44	366	44
7	326.60	328.80	2.2	2370	166	86	150	430	150	580	2370	302.3	226.5	44	377	44
8	328.80	333.60	4.8	2326	166	87	150	430	150	580	2326	301.4	228.6	43	382	43
9	333.60	336.90	3.3	2315	171	87	150	430	150	580	2315	300.3	226.2	45	388	45
10	336.90	340.60	3.7	2345	166	87	150	430	150	580	2345	300.8	227.7	43	386	43
11	340.60	343.40	2.8	2591	162	87	150	430	150	580	2591	295.0	218.0	47	421	47
12	343.40	347.00	3.6	2609	152	87	150	430	150	580	2609	297.0	222.8	43	408	43
13	347.00	351.40	4.4	2660	163	87	150	430	150	580	2660	292.9	214.3	49	435	49
14	351.40	353.70	2.3	2730	169	87	150	430	150	580	2730	289.7	208.2	54	457	54
15	353.70	357.60	3.9	2703	164	87	150	430	150	580	2703	291.6	211.9	51	444	51
16	357.60	360.80	3.2	2731	158	87	150	430	150	580	2731	292.3	213.8	49	439	49
17	360.80	364.20	3.4	2769	156	87	150	430	150	580	2769	291.8	213.3	48	443	48
18	364.20	366.80	2.6	2750	181	87	150	430	150	580	2750	286.1	201.5	61	484	61
19	366.80	370.90	4.1	2539	175	82	150	430	150	580	2539	303.7	213.8	52	369	52
20	370.90	372.70	1.8	2539	173	74	150	430	150	580	2539	323.4	215.8	50	278	50
21	372.70	375.60	2.9	2511	169	87	150	430	150	580	2511	295.4	217.8	49	419	49
22	375.60	379.40	3.8	2536	175	87	150	430	150	580	2536	293.1	213.5	52	434	52

It can be seen from the above table that remaining life of existing pavement is more than 49 MSA in Section-1 on LHS carriageway and more than 44 MSA in Section-2 on LHS and remaining life of existing pavement is more than 43 MSA on RHS carriageway in Section-1 and more than 48 MSA in Section-2 on RHS carriageway.

From the above table it is clear that no immediate overlay is required for the entire length of the project corridor as the remaining life of the pavement is more than or equal to 10<sup>th</sup> year design MSA of each Homogeneous Section; **however, considering minor cracks and age of pavement 30mm overlay is being carried out at site.**

### 1.7.3 Structural Rehabilitation

All the structure found to be in good condition, only minor distresses noticed and same is suggested for repair. Some of them fall under Routine Maintenance and the work for the same is in progress.

## 1.8 OPERATION AND MAINTENANCE

### 1.8.1 Introduction

Looking at the contractual requirements of maintaining project road under specified level of roughness it is felt that roughness is the most important criterion for finalizing the O&M schedule for the project. Accordingly, the methodology adopted by present consultants includes predicting the roughness year by year under the traffic using a well acknowledged HDM-4 model developed for developing countries like India after lot of research by World Bank. The said model is widely prescribed by MORTH and NHAI during the preparation of detailed project reports for several projects in doing economic analysis for the projects. The economic analysis mainly consists of two parts:

1. Predicting the road deterioration and estimating VOC
2. Estimating Benefits

Considering its importance and present use in India, consultants felt prudent to use the first part, i.e., estimating road deterioration and predicting roughness in HDM 4 model to finalize the O&M schedule for the project. This approach is more scientific as it does not assume hypothetical deflection values at 10<sup>th</sup> and 20<sup>th</sup> year and includes main criterion of maintaining roughness at 2500mm/Km as per Schedule K.

### 1.8.2 CA specifications for Major Maintenance

- Schedule K of CA species that Roughness values exceed 2500 mm/km in a length of KM, needs to be corrected within 180 days.
- No specific requirement with respect to deflection (BBD) measurement
- O&M manual submitted by SPV indicates that strengthening measures will be undertaken whenever deflection values are more than 1.2mm as per IRC SP 84-2014.

### 1.8.3 Inputs for O&M

### 1.8.4 Schedule

#### 1.8.4.1 Project Sections

Since roughness is the main criterion for major maintenance, Project Corridor has been divided in to 4 sections depending the present roughness values:

- Case 1: Roughness value <2000 mm/Km
- Case 1: Roughness values >2000<2300 mm/Km
- Case 3: Roughness>2300<2500 mm/Km



- Case 4: Roughness>2500 mm/KM

Present corridor does not have roughness values more than 2000mm/Km, hence only one case in each homogeneous section for each carriageway is considered in the present case.

Direction wise analysis has been done separately for LHS (UP)/RHS (DN) and each direction length has been divided into sections based on above.

#### 1.8.4.2 Traffic (AADT)

The following traffic data has been used in the analysis is as below:

Vehicle/Mode	AADT at 2021 (Vehicles) Km338+350	AADT at 2021 (Vehicles) Km365+400
LCV	578	434
2A truck	794	683
3A truck	600	582
MAV truck	1311	1335
BUS	478	412

**Note:** 50:50 directional distributions are considered.

#### 1.8.4.3 Vehicle Damage Factors (VDF)

VDF values as obtained from axle load surveys are used for various sections are as given below:

Mode Type	UP	DOWN
LCV	0.995	1.569
2 Axle Truck	7.756	3.477
3 Axle Truck	6.157	6.669
MAV (4-6 Axle)	9.629	11.519
Buses*	1.000	1.000

Mode Type	UP	DOWN
LCV	1.093	1.454
2 Axle Truck	6.655	3.205
3 Axle Truck	6.001	6.996
MAV (4-6 Axle)	11.060	12.744
Buses*	1.000	1.000

#### 1.8.4.4 Deflection (FWD) Values & Roughness Values

FWD and Roughness values are used as obtained from surveys and investigations as below:

LHS: Section-1	Section-1	Section-2	Section-3	Section-4
	<2000	>=2000 and <2300	>=2300 and <2500	>2500

Length (m)	39000	0	0	0
Roughness(mm/KM)	1576	0	0	0
IRI	2.27	0.00	0.00	0.00
Deflection	0.32	0.00	0.00	0.00
Cracking	1.93%	0.00	0.00	0.00
Raveling	0.01%	0.00	0.00	0.00
BT Crust	150	0.00	0.00	0.00

RHS: Section-1	Section-1	Section-2	Section-3	Section-4
	<2000	>=2000 and <2300	>=2300 and <2500	>2500
Length (m)	38000	0	0	0
Roughness(mm/KM)	1629	0	0	0
IRI	2.34	0.00	0.00	0.00
Deflection	0.32	0.00	0.00	0.00
Cracking	6.99%	0.00	0.00	0.00
Raveling	0.00	0.00	0.00	0.00
BT Crust	150	0.00	0.00	0.00

LHS: Section-2	Section-1	Section-2	Section-3	Section-4
	<2000	>=2000 and <2300	>=2300 and <2500	>2500
Length (m)	32550	0	0	0
Roughness(mm/KM)	1610	0	0	0
IRI	2.31	0.00	0.00	0.00
Deflection	0.34	0.00	0.00	0.00
Cracking	1.14%	0.00	0.00	0.00
Raveling	0.00	0.00	0.00	0.00
BT Crust	150	0.00	0.00	0.00

RHS: Section-2	Section-1	Section-2	Section-3	Section-4
	<2000	>=2000 and <2300	>=2300 and <2500	>2500
Length (m)	32550	0	0	0
Roughness(mm/KM)	1654	0	0	0
IRI	2.37	0.00	0.00	0.00
Deflection	0.35	0.00	0.00	0.00
Cracking	0.74%	0.00	0.00	0.00
Raveling	0.00	0.00	0.00	0.00
BT Crust	150	0.00	0.00	0.00

### 1.8.5 Options for O&M schedule

Following options were considered in the analysis:

- Base Case: MCS at Roughness of 2500mm/Km with regular maintenance

- Option-1: Responsive Overlay with BC/BC+DBM whenever roughness is >2500mm/KM with regular maintenance

### 1.8.6 O&M Schedule

Using the HDM-4 deterioration model, roughness progression for each section under each alternative maintenance cases has been evaluated for above options. Accordingly, Year wise O&M schedule is presented below for each homogeneous section on either carriageway:

**Table 34: Adopted Overlay Schedule**

S.No	FY	Section-1 (LHS CW)	Section-1 (RHS CW)	Section-2 (LHS CW)	Section-2 (RHS CW)	Remarks
1	2023					
2	2024					
3	2025					
4	2026					
5	2027					
6	2028					
7	2029		80		80	
8	2030	80		80		
9	2031					
10	2032					
11	2033					
12	2034					
13	2035					
14	2036		30		30	
15	2037	30		30		
16	2038					
17	2039					
18	2040					
19	2041					
20	2042	30	30	30	30	
21	2043					
22	2044					

### 1.9 COST

Cost Component for various items and activities have been worked out by considering the Best Industry practice and most appropriate methods. The gist of the cost components considered are presented below

- Immediate Repair's Cost
- Routine Maintenance Cost

- Routine Maintenance of Road
- Repair and Replacement of various road items
- Tolling system AMC cost
- Incident management
- Routine Maintenance for Structures
- Electricity bill of lighting areas near cities, I/C and other areas & Fuel expenditure
- Periodic Maintenance Cost
  - Functional + Structural overlay MCW Section & service road
  - dismantling existing & relaying wearing coarse over major structures
  - Replacement of Toll Hardware and software at later date
- Toll Plaza Operation cost, Highway Patrolling and maintenance supervision staff cost
- Maintenance of utilities and public amenities
- Operation and management costs of rest areas and lay byes
- Safety audit and other inspection costs @Rs15 Lacs per annum
- Insurance
- I.C for O&M period
- Administrative Cost and Grand Total

Abstracts and summary of cost estimates without escalation are presented below

**Table 35: Abstract of Cost Estimates without escalation**

S. No	FY	Immediate Repair's Cost +Routine and Operational Cost (in Crores)	Periodic Maintenance Cost (in Crores)	Total Cost (in Crores)
1	2023	14.67	-	14.67
2	2024	14.67	-	14.67
3	2025	14.67	-	14.67
4	2026	14.67	-	14.67
5	2027	14.67	-	14.67
6	2028	14.67	-	14.67
7	2029	14.67	51.40	66.07
8	2030	14.67	62.67	77.34
9	2031	14.67	-	14.67
10	2032	14.67	-	14.67
11	2033	14.67	-	14.67
12	2034	14.67	-	14.67
13	2035	14.67	-	14.67
14	2036	14.67	25.47	40.13
15	2037	14.67	24.80	39.47
16	2038	14.67	-	14.67
17	2039	14.67	-	14.67
18	2040	14.67	-	14.67
19	2041	14.67	-	14.67

20	2042	14.67	50.85	65.51
21	2043	14.67	2.32	16.98
22	2044	6.79	-	6.79
	<b>Total:</b>	<b>314.80</b>	<b>217.50</b>	<b>532.30</b>

**Table 36: Summary of Cost Estimates without Escalation**

FY	Routine Maintenance						Periodic Maintenance			Toll Plaza Operation cost	SPV cost	Survey Costs	Insurance & Audit charges	IE Fee	Administrative Cost	Total Recurring cost
	Routine Maintenance	R&R of Road items	Toll and HTMS AMC cost	Incident management	R&R of Structures	Electricity bill of lighting	Functional +Structural overlay MCW+S/R	Major Maintenance of TMS & HTMS	Structure specified repairs							
2023	2.16	1.88	0.30	2.01	0.39	0.88	0.00		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>14.67</b>
2024	2.16	1.88	0.30	2.01	0.39	0.88	0.00		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>14.67</b>
2025	2.16	1.88	0.30	2.01	0.39	0.88	0.00		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>14.67</b>
2026	2.16	1.88	0.30	2.01	0.39	0.88	0.00		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>14.67</b>
2027	2.16	1.88	0.30	2.01	0.39	0.88	0.00		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>14.67</b>
2028	2.16	1.88	0.30	2.01	0.39	0.88	0.00		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>14.67</b>
2029	2.16	1.88	0.30	2.01	0.39	0.88	51.40		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>66.07</b>
2030	2.16	1.88	0.30	2.01	0.39	0.88	53.71	2.90	6.06	3.29	1.90	0.14	0.71	0.82	0.19	<b>77.34</b>
2031	2.16	1.88	0.30	2.01	0.39	0.88	0.00		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>14.67</b>
2032	2.16	1.88	0.30	2.01	0.39	0.88	0.00		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>14.67</b>
2033	2.16	1.88	0.30	2.01	0.39	0.88	0.00		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>14.67</b>
2034	2.16	1.88	0.30	2.01	0.39	0.88	0.00		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>14.67</b>
2035	2.16	1.88	0.30	2.01	0.39	0.88	0.00		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>14.67</b>
2036	2.16	1.88	0.30	2.01	0.39	0.88	22.14	2.90	0.43	3.29	1.90	0.14	0.71	0.82	0.19	<b>40.13</b>
2037	2.16	1.88	0.30	2.01	0.39	0.88	24.80		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>39.47</b>

FY	Routine Maintenance						Periodic Maintenance			Toll Plaza Operation cost	SPV cost	Survey Costs	Insurance & Audit charges	IE Fee	Administrative Cost	Total Recurring cost
	Routine Maintenance	R&R of Road items	Toll and HTMS AMC cost	Incident management	R&R of Structures	Electricity bill of lighting	Functional +Structural overlay MCW+S/R	Major Maintenance of TMS & HTMS	Structure specified repairs							
2038	2.16	1.88	0.30	2.01	0.39	0.88	0.00		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>14.67</b>
2039	2.16	1.88	0.30	2.01	0.39	0.88	0.00		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>14.67</b>
2040	2.16	1.88	0.30	2.01	0.39	0.88	0.00		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>14.67</b>
2041	2.16	1.88	0.30	2.01	0.39	0.88	0.00		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>14.67</b>
2042	2.16	1.88	0.30	2.01	0.39	0.88	44.62	2.90	3.33	3.29	1.90	0.14	0.71	0.82	0.19	<b>65.51</b>
2043	2.16	1.88	0.30	2.01	0.39	0.88	2.32		-	3.29	1.90	0.14	0.71	0.82	0.19	<b>16.98</b>
2044	0.99	0.86	0.13	0.92	0.18	0.40	0.00		-	1.51	0.87	0.14	0.32	0.38	0.09	<b>6.79</b>
<b>Total :</b>	<b>46.28</b>	<b>40.30</b>	<b>6.33</b>	<b>43.24</b>	<b>8.36</b>	<b>18.90</b>	<b>198.99</b>	<b>8.70</b>	<b>9.81</b>	<b>70.66</b>	<b>40.68</b>	<b>3.08</b>	<b>15.20</b>	<b>17.70</b>	<b>4.08</b>	<b>532.30</b>

**Notes:**

1. Base Cost are arrived for FY2023
2. All the material rates are February 2022 Rates
3. All labour rates are taken from Central minimum wages (October'2021 cycle) and 2.5% escalation applied on the same to arrive FY2023 Rates
4. All the costs are without any Escalation.
5. All the Cost presented in the above table are excluding Head Office (HQ) Expenses.

## 1.10 Change of Scope Details as on Dec-2020

Construction of 2 Nos. VUP under COS has been sanctioned by MORT&H letter no: RW/NH-37019/18/2010-NHDP-IV dt. 29.09.2017

The combined revised proposal with change location of VUP at Kakani has been approved by CE cum ROMORT&H Jaipur vide letter No RJ/PPP/AP/2015-16/960/677 dated 06.02.2020.

### 1. VUP at Mandia:

#### A. Drain with cover:

- (i) 854.900 RM (LHS) completed.
- (ii) 1031.000 RM (RHS) completed.

#### B. Service road:

- (i) 785.000 RM (LHS) with 150-meter taper portion completed.
- (ii) 785.000 RM (RHS) with 150-meter taper portion completed.

#### C. Approaches MCW:

- (i) 710.00 RM (Jodhpur side) completed (from start of MCW to centre of desk slab).
- (ii) 710.00 RM (Pali side) completed (from centre of desk slab to end of MCW).

#### E. VUP completed and opened to traffic in the month of August 2019.

### 2. VUP at Kakani:

#### A. Drain with cover:

- (i) 768.000 RM (LHS) completed & 120.000 RM yet to be done.
- (ii) 738.000 RM (RHS) completed & 120.000 RM yet to be done.

#### B. Service road:

- (i) 1040.000 RM (LHS) with 150-meter taper portion completed up to DBM layer.
- (ii) 1040.000 RM (RHS) with 150-meter taper portion completed up to DBM layer.

#### C. Approaches MCW:

- (i) 418 RM (Jodhpur side) not taken up.
- (ii) 452.00 RM (Pali side) not taken up.

#### D. VUP Box at Ch. 332.498: Not taken up.

Kakani VUP construction work stopped on 18th November 2020 due to local villager's Agitation. In this regard Concessionaire already represented PWD to resolve the matter at the earliest. But till date local issue not been resolved by PWD.



### 1.11 Status of Supplementary Agreements Works

S.No.	Supplementary Agreement Items	Current Status
1	Toll plaza Administration Building, Traffic Aid Posts, Medical Aid Posts, Medical Resident Quarters and Vehicle Rescue Post at Km 338+400.	After handing over of land, locals are not allowing to commence the work. Confirmation requested from PWD by JPEPL vide letter dated 08.04.2021 which is pending. As informed by Concessionaire, as soon as land made available by PWD, work will be taken up.
2	Rest area Facilities at Truck Lay Bye at Km 350+500 (LHS)	Rest Area and Toilet blocks construction work completed
3	Construction of balance length of wing wall/return wall on RHS at Km 326+622	Completed
4	Service Road and Drain work in a distance of 50 m on both sides from flaring from Km. 323+475 to Km. 324+500.	Completed
5	Bus bays and bus shelter on both sides at Km 333+485 (Kakani) and 346+400 (LHS) at Rohat.	At km: 333+485 (kakani), due to delay in the completion VUP at Kakani under COS, work is yet to be taken up. At Km: 346+400 (LHS) Bus bay with shelter completed.
6	Bus shelter on LHS at Km 336+500 (Nimbla)	Completed.
7	Median filling and Plantation from Km 336+200 to Km 336+820	Completed.
8	Drain work, median (NJCB) work on LHS from Km 346+750 to Km 347+510 (Rohat)	Median NJCB work completed. Due to the LA issues Drain and Utilities work not able to complete.
9	Fixing boundary stones on both sides from Km 308+000 to Km 328+000	Completed.
10	Unlined drain, avenue plantation and ROW clearance on both sides from Km 308+000 to Km 328+000	Completed.

## 1.12 CONCLUSIONS

Foregoing discussions on various elements of project highway leads to following Conclusions

1. The Appointed Date was declared as 16.09.2013 and scheduled Project Completion date was 20.03.2015 considering the construction period of the Project Highway as 550 days (as stipulated in CA). The Scheduled Project Completion date has been further extended up to October 2015.
2. Concession period for this project is 25 Years i.e., the original end date of Concession is 15.09.2038 however as informed by the Concessionaire, the Concessionaire expects 5 years extension in concession period on account of traffic variation as per Article 29 of CA. Accordingly the latest end date of Concession for future cost analysis is 15.09.2043
3. First Provisional Completion Certificate for the length of 60.015 Km out of 71.535 Km has been issued on 31.10.2014
4. Second Provisional Completion Certificate for the length of 71.093 Km (60.015 Km of First PCC plus additional 10.078 Km after First PCC) out of 71.535 (as per CA length) has been issued on 10.10.2015
5. Supplementary Agreement was made on 08.03.2018 indicates that the Concessionaire shall complete the balance works as and when the Land is made available to him by Authority. Most of the works have been completed except small works which are highlighted in Section 1.11 of this Report
6. COS works for 2 VUPs has been awarded. VUP works at Mandia was completed and opened to Traffic in the month of August 2019. Kakani VUP construction work stopped on dated 18th November 2020 due to local villager's Agitation. In this regard Concessionaire already represented PWD to resolve the matter at the earliest. But, till date local issue not been resolved by PWD.
7. From Km 308.000 to Km 315.400 the urban area the carriageway width is 7m flanked by paved Shoulder varies from 1.5 to 3m with shyness of 0.25m. From Km 316.500 to Km 323.600 the carriageway width is 7m flanked by paved Shoulder With 1.5 Width and with shyness of 0.25m Plus 1.5m Earthen Shoulder. From Km 324.500 to Km 379.535 the carriageway width is 7m and with shyness of 0.25m Plus 1.5m Earthen Shoulder Except Structure locations and built-up Area
8. The project road in general has good pavement condition except for few surface related distress. The cracking appears to top-down cracking rather than bottom-up cracking.
9. There are no undulations or depressions are observed along the corridor indicating good Subgrade quality.
10. Roughness surveys along corridor indicate at an average roughness is far less than 2500 mm/km and does not require Immediate Overlay from Roughness Consideration as the limiting value is 2500mm/Km as per CA.
11. Test pit surveys indicated average crust of 575 mm consisting of 147 mm blacktop and 428mm of granular layers over subgrade.
12. The subgrade quality the corridor appears to be good with CBR above 8% at all locations.

13. Vehicle damage factors arrived from axle load surveys indicate that VDF for 2-Axle Truck is more in LHS Carriageway than RHS Carriageway but the VDF for 3 Axle trucks and Multi Axle Trucks is more in RHS Carriageway than in LHS Carriageway
14. The Remaining life of the existing pavement is more than the 10 years design MSA, hence no immediate Overlay is required from Structural Consideration; however, it felt prudent to consider 30mm overlay in the year FY22/FY23 as preventive overlay and accordingly work is in progress
15. W-beam crash barriers provided along the corridor are in good condition and provided with hazard markers at the ends in the traffic direction.
16. Though Minor distresses were observed; all structures along the project road are having good condition. Some of the distresses observed are of routine in nature and rectification work for the same is in progress.
17. Distresses or deficiencies noticed along the project Road (Pavement/highway/Drainage/Structures) are considered for immediate Repair and the Cost for the same has been considered in FY23.
18. The TMS and WIMs were replaced recently in the month of Apr 2021 and the next replacement of the same has been considered at every 6 years during the remaining operation period.
19. O&M Costs have been estimated till the end of Concession period i.e., till 15.09.2043 as against 15.09.2038 (original Concession end date)
20. The applicable Manual for this project is IRC: SP:84-2009 and as per this manual, the roughness Survey shall be carried out twice in a year and BBD Survey shall be carried out once in 5 years.
21. As per pavement design report, stage construction has been adopted during initial construction. Accordingly, bituminous layers are designed for 10 years and granular layers are designed for full concession period.
22. There is no Mandatory Functional Overlay prescribed for this project as per CA. the Road has to be maintained as per CA and Roughness values shall be maintained below 2500mm/Km.
23. Even though Overlay is not required now, 30 mm thickness of BC is carrying our throughout the project length by considering the age of the pavement and surface condition. Accordingly, Major Maintenance work for the entire stretch contract awarded and the work is in progress and Client informed that the work is expect to complete on July 2022.
24. Future Overlays have been estimated by using HDM-4 Model. Considered 40mm BC whenever the Roughness value exceeds 2500mm/Km. Accordingly Three Overlays (excluding the presently proposed Overlay) are required for remaining Concession period.