actis

# FINAL REPORT

## Construction of 4-Lane Road on NH-12(New NH-52) from km 299.000 to km 346.540 (Design Chainage from km 9.860 to km 58.740) (Darah-Jhalawar-Teendhar Section) in the State of Rajasthan under NHDP Phase-III on Hybrid annuity Mode (Length 48.880km) – Package-II

**SAMARTH INFRAENGG Technocrats Private Limited**

SAMARTH
committed competence

**August 2025**

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| | |
|---|---|
| AADT | -Average Annual Daily Traffic |
| AE | -Authority Engineer |
| AMC | -Annual Maintenance Contract |
| ATMS | -Advanced Traffic Management System |
| BC | -Bituminous Concrete |
| BOQ | -Bill of Quantities |
| BOT | -Build, Operate & Transfer |
| CA | -Concession Agreement |
| CBR | -California Bearing Ratio |
| CCB | -Concrete Crash Barrier |
| CCR | -Cement Concrete Railing |
| COD | -Commercial Operation Date |

| | |
|---|---|
| COS | -Change of scope |
| CPI | -Consumer Price Index |
| CUP | -Cattle Underpass |
| CVC | -Classified Volume Count |
| CVPD | -Commercial Vehicles per Day |
| DBM | -Dense Bituminous Concrete |
| DPR | -Detailed Project Report |
| ECB | -Emergency Call Box |
| EPC | -Engineering, Procurement and Construction |
| ESI | - Employees' State Insurance |
| FDD | -Filed Dry Density |
| FOB | -Foot Over Bridge |
| FRL | -Finished Road Level |
| FSI | -Free Swell Index |
| FWD | -Falling Weight Deflectometer |
| FY | -Financial Year |
| GOI | - Government of India |
| GR | -Growth Rates |
| GS | -Grade Separated |
| GSB | -Granular Sub Base |
| GST | -Goods and Services Tax |
| HCPT | -Half cell Potential Test |
| HPC | -Hume Pipe Culvert |
| HR | - Human Resources |
| HTMS | -Highway Traffic Management Systems |
| IE | -Independent Engineer |
| IRC | - Indian Roads Congress |
| IRC SP | - Indian Roads Congress Special Publications |
| IRI | -International Roughness Index |
| Km | -kilometer |
| LHS | -Left Hand Side |
| LL | -Liquid Limit |
| LS | -Lumpsum |
| m | -Meter |
| MBIU | -Mobile Bridge Inspection Unit |
| MCB | -Metal Beam Crash Barrier |
| MCS | -Micro Surfacing |
| MCW | -Main Carriageway |
| MDD | -Maximum Dry Density |
| MHR | -Metallic Hand Rail |
| MJB | -Major Bridge |
| mm | -Millimeter |

| | |
|---|---|
| MM | -Major Maintenance |
| MNB | -Minor Bridge |
| MoRT&H | - Ministry of Road Transport & Highways |
| MPa | -Mega Pascal |
| MR | -Resilient Modulus |
| MSA | -Million Standard Axle |
| NDT | -Non-Destructive Testing |
| NHAI | - National Highways Authority of India |
| NSV | -Network survey Vehicle |
| O&M | - Operation and Maintenance |
| OL | -Overlay |
| PF | -Provident Fund |
| PGR | -Pedestrian Guard Rail |
| PI | -Plasticity Index |
| PL | -Plastic Limit |
| PM | -Periodic Maintenance |
| PUP | -Pedestrian Underpass |
| R&R | -Repair and Rehabilitation |
| RCC | -Reinforced Cement Concrete |
| RE Wall | -Reinforced Earth Wall |
| RHS | -Right Hand Side |
| RHT | -Rebound Hammer Test |
| RM | -Routine Maintenance |
| ROB | -Road Over Bridge |
| RPO | -Route Patrol Officer |
| RUB | -Road Under Bridge |
| SDBC | -Semi-Dense Bituminous Concrete |
| SPV | -Special Purpose Vehicle |
| SR | -Service Road |
| SWB | -Static Weigh Bridge |
| TCS | -Typical cross Section |
| TDRT | -Transient Dynamic Response test |
| TMS | -Toll Management System |
| UI | -Unevenness Index |
| UPVT | -Ultra Pulse Velocity test |
| VDF | -Vehicle Damage Factor |
| VG | -Viscosity Grade |
| VUP | -Vehicular Underpass |
| WBM | -Water Bound Macadam |
| WMM | -Wet Mix Macadam |
| WPI | -Wholesale Price Index |

# CHAPTER 1. INTRODUCTION

## 1.1 INTRODUCTION

The Ministry of Road Transport & Highways (MORT&H), Government of India decided to take up the development of various National Highway corridors to 4 laning with paved shoulders with provision of capacity augmentation under National Highway Development Program (NHDP) –III, under the Hybrid Annuity Mode (HAM) in the different states.

Government of India had entrusted to the Authority (National Highways Authority of India) the development maintenance and management of National Highway No.52 including the section from km 9.860 (After Amjhar River) to km 58.740 (after Teendhar Junction) (approx. 48.880 km) on Darah – Jhalawar - Teendhar section in the state of Rajasthan by Four Laning under NHDP Phase-III on Hybrid Annuity Mode.

Consequent to this, NHAI has selected M/s Patel Infrastructure Private Limited (PIPL) as successful bidder and issued LOA on 4th October 2017. Accordingly, PIPL promoted a Special Purpose Vehicle (SPV) in the name of M/s Patel Darah-Jhalawar Highway Private Limited, PDJHPL (Concessionaire) for implementation/execution of the project.

The Concessionaire has achieved PCOD on 08th June 2022 for 48.88 kms length (except km 26+400 to 27+330 and km 43+700 to km 44+900). Then, Final Completion certificate received on 31st July 2023 for 48.88 kms.

The project is presently under maintenance by Concessionaire (Vendor) and M/s ACTIS intends to acquire the said project.

The Actis GP LLP Ltd has engaged M/s Samarth Infraengg Technocrats to undertake a periodic study for the said project. This report highlights the findings of study undertaken by consultants to estimate initial improvement cost (EPC) including immediate requirements for repair & rehabilitation of various elements and make an assessment of Operation & Maintenance costs for entire concession period.

## 1.2 PROJECT AT A GLANCE

The new NH-52, takes off from NH-7 junction near Sangrur, Punjab and terminates at junction with NH-66 near Ankola, Karnataka. It connects Narwana, Hisar in the state of Haryana. Fatehpur, Jaipur, Tonk, Kota, Aklera in the state of Rajasthan. Rajgarh, Biora, Dewas, Indore, Sendhwa in the state of Madhya Pradesh. Dhule, Aurangabad, bed, Osmanabad, Solapur in the state of Maharastra.

The Project stretch Darah-Teendhar is connected to Jaipur at one end and it is connected to Bhopal at the other end. The project highway is very important highway as it connects the Capital of Rajasthan states and National capital of country through Jaipur- Delhi Highway.

The Project Highway traverses through two districts viz. Kota and Jhalawar in Rajasthan State. The Project Corridor passes through five major towns Darah, Sarvada, Dabadeh, Suket and Jhalawar, and it ends at Teendhar.

The Project Corridor is Runs through the settlments like Kamalpura, Atraliya, Deegasi and Bypass Locations of Dabadeh-Sahrawada &Suket-Jhalawar-Jhalrapatan.


**Map Showing the Project Corridor**

As per the CA, the design Chainage and existing Chainage of the project are shown below.

**Table 1: Project Corridor Chainage System**

| Referencing system | Project Corridor Start Point (km) | Project Corridor End Point (km) | Length (km) |
|---|---|---|---|
| Chainage with reference old NH-12 | 306.660 | 355.540 | 48.880 |
| Present Design Chainage On new NH-52 | 9.860 | 58.740 | 48.880 |

Photograph showing the start and end point of the project road are presented below

**A view of the Start Point of Project Road at km 9.860**


**A view of the End Point of Project Road at km 58.740**

Following Table highlights the total project at a glance:

**Table 2: Project Details**

| S. No | Description | Date |
|---|---|---|
| 1 | Date of Signing the Concession Agreement | 16-11-2017 |
| 2 | Appointment Date | 24-05-2018 |
| 3 | Scheduled Project completion (910 days) | 23-11-2020 |
| 4 | EOT approval as per settlement agreement excluding RUB/ including RUB | 28-02-2022/ 31-05-2022 |
| 5 | Date of issue of Provisional Completion Certificate (Date of PCOD) | 08-06-2022 |
| 6 | Date of Issue of Final Completion Certificate | 31-07-2023 |
| 7 | Scheduled End of Concession (15 years) from COD | 23-11-2035 |
| 8 | Approved End of Concession from Competent Authority | 04-06-2037 |

## 1.3 OBJECTIVE AND SCOPE OF SERVICES

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 carryout requisite surveys and investigations and finalize the Major Maintenance and estimate the Strategy and estimate the Operation and Maintenance Costs. Finally required to provide Y-O-Y Costs till end of Concession Period:

Scope of work can mainly be divided into following major activities:

- Desktop review of project documents such as CA, project schedules, latest MPR's, COS works, As-built drawings of highway and structures, any other technical documents pertaining to project.
- Undertaking detailed reconnaissance, inventory of Highway & Structures, preparation of O&M cost.
- Following field investigations are considered as per the scope mentioned in your ToR
    - Pavement condition survey and Roughness survey using Network Survey Vehicle (NSV) along main carriageway
    - Collection and Testing of Borrow Areas for Earthwork and few samples of Aggregates and Sand from quarries (Approximately 4nos)
    - Undertaking cores on Rigid Pavement along the existing pavement
- Assessment Major Maintenance schedule subjected to the requirement of CA and Schedules for the balance concession period based on the results of above investigations and using HDM analysis for each homogeneous section.
- Conducting Visual inspection of all the existing structure for the assessment of residual life of structures & rehabilitation measures requirement if any other than mentioned in schedules, costing as per applicable Manual & IRC.
- Based on preliminary visual observation of structures, if required detailed inspection of structures using MBIU along with necessary tests such as NDT testing, UPV etc., shall be taken up upon confirmation from client at mutually agreed quantity and price.
- Review of TMS equipment and functionality at all the toll plaza locations, and also ATMS along the project highway if any. A detailed cost estimate shall be presented w.r.to any deficiencies in TMS & ATMS in comparison with Schedules requirements.
- Verification of balance works, punch list items, etc. (if any) and preparation of an estimate of the cost/ time required to complete the balance works
- Preparation of details O&M cost estimate.

Risk & opportunity analysis of the projects for the concession period.

## 1.4 DATA COLLECTION AND REVIEW

In brief, following were covered

- ✓Review of Concession Agreement & Schedules,
- ✓Review of Detailed Project Report prepared by NHAI
- ✓ Review of As-built drawings, Plan and profiles, Structural drawings & Detailed Project Reports and Designs where available
- ✓Review of O&M costs as presented in DPR reports
- ✓Review of MPR provided by NHAI
- ✓Review of Latest NSV, FWD, MBIU etc data provided by PIU, NHAI

## 1.5 REVIEW OF CONCESSION AGREEMENT

1. Concession Parties and date of execution of Agreement: NHAI and M/s PATEL DARAH-JHALAWAR HIGHWAY PRIVATE LIMITED, PDJHPL entered into the Concession Agreement on 16/11/2017.

   Further, Settlement Agreement signed on 17-11-2021 between the Authority and Concessionaire to complete 42.88 km length except one side of RUB (RHS side) by 28.02.2022 to enable the Authority to commence Commercial Service on the Project and collect Users Fee (Toll from the users of the Project Highway). The complete scope of work including remaining one side of RUB (RHS) will be completed by 31.05.2022 and accordingly Extension of Time granted by the Authority to concessionaire till 31.5.2022.

2. Appointed Date, Commercial Operation Date & Concession Period (Article 4, Article 15 & Article 3): As the Concession Agreement was signed on 16$^{th}$ Nov, 2017, the Appointed Date as per the definition in the Concession Agreement would be required to be achieved by 16$^{th}$ Apr 2018. The same has been declared as 24$^{th}$ May 2018 with the approval of the competent authority vide letter NHAI/19030/Dara-Teen/Raj/2016/1/120723 dated 09$^{th}$ July 2018. The Financial Closure occurred on 13.04.2018. Commercial Operations date Scheduled is 19$^{th}$ Nov 2020, however tolling started on 8$^{th}$ June 2022 at 4 PM after PCOD.

3. Concession Period (Article 3): As the Appointed Date is declared on 24$^{th}$ May 2018 and PCOD is achieved on 08.6.2022 accordingly the expiry date of the Concession Period would be 07.6.2037. EOT is said to be grated till 31.10.2022. Thus, end of Concession period may be 31.10.2037

4. Condition Precedent (Article 4): The Concessionaire and the Authority have agreed for mutual waiver of financial implications on either parties to fulfill the Condition Precedent and same is stated in the appointed date letter issued on 24.05.2018.

5. Obligations of Concessionaire & Authority (Article 5 & 6): The Concessionaire and Authority have fulfilled most of the obligations.

6. Change in Ownership (Clause 5.3 read with Clause 7.1(k)): The Concessionaire shall not undertake or permit any Change in Ownership except with the prior approval of the Authority.

7. Performance Security (Article 9): The performance security in the form of irrevocable and unconditional bank guarantee for the sum of Rs. 56.19 Cr. The Concessionaire has fulfilled this condition.

8. Right of Way (Article 10): ROW granted within 90days of the appointed date shall be completed before project completion date. In the event of delay other than Force Majeure or breach of this agreement by concessionaire, Authority shall pay to the Concessionaire damages in the sum calculated at a rate of Rs.1 per day for every 10sqm commencing from 91$^{st}$ day of the Appointed Date.

9. Scheduled Completion Date (Schedule-G, Article12 & Article 37): Construction period is 910 days from the appointed date i.e., schedule date of completion is 19th Nov 2020. As per settlement Agreement, Construction period extended 31st May 2022.

   Provisional Certificates, Completion Certificate and Punch List Items (Article 14): The Concessionaire has achieved PCOD for length for a length of 48.880 km on 08/06/2022 and Completion Certificate yet to be received as below:

| Certificate | Completed length | Date of Issue |
|---|---|---|
| Provisional Certificate-1 | 48.880 | 08$^{th}$ June 2022<br>With punch list items |
| Completion Certificate | 48.880 | 31$^{st}$ July 2023 |

10. Change of Scope (Article 16): Concessionaire shall be entitled to nullify any Change of Scope Order if it causes the cumulative costs relating to all the Change of Scope Orders to exceed 10% (ten per cent) of the Bid Project Cost in any continuous period of 3 (three) years immediately preceding the date of such Change of Scope Order or if such cumulative costs exceed 25% (twenty five per cent) of the Bid Project Cost at any time during the Concession Period.

    If the COS leads to reduction or increase in the length of the project highway, the O&M Payments as provided in clause 23.7 shall be reduced or increased in proportion to reduction or increase in length of project highway,

11. O&M Obligations of the Concessionaire (Article 17): The Concessionaire has been fulfilling this obligation since the beginning of the operations.

12. Traffic Aid Posts and Medical Aid posts (Article 20): One Jeep or similar vehicle in good working condition shall be provided to state police department along with chauffeurs for the round-the-clock patrolling and shall meet operation cost of vehicles including the salaries and allowances of chauffeurs.

Medical aid post building and 2 residential quarters shall be constructed and handover to State Medical department or Authority. Towards recurring expenditure, one ambulance in good working condition along with chauffeurs for the round-the-clock ambulance services shall meet operation cost of ambulance including the salaries and allowances of chauffeurs.

13. Remuneration of IE (Article 21): The remuneration, cost and expenses do not exceed 3% of BPC(Bid Project Cost), One-half of the IE Fee shall be borne by Concessionaire as per Schedule-M and expenses above 3% of BPC, shall fully borne entirely by the Authority.

    IE Fee during operation period shall be borne equally by Authority and Concessionaire.

14. Payment of Bid Cost (Article 23): 40% (forty per cent) of the Bid Project Cost, adjusted for the Price Index Multiple, shall be due and payable to the Concessionaire in 5 (five) equal installments of 8% (eight per cent) each during the Construction Period in accordance with the Mile stones.

    - I (first) Payment Milestone - On achievement of 10% Physical Progress
    - II (second) Payment Milestone - On achievement of 30%% Physical Progress
    - III (third) Payment Milestone-On achievement of 50% Physical Progress
    - IV (Forth)Payment Milestone - On achievement of 75% Physical Progress
    - V (fifth) Payment Milestone-On achievement of 90% Physical Progress

15. Insurance (Article 26): The Concessionaire has been fulfilling this obligation.

16. Force Majeure (Article 28): The effect of Force Majeure Event on the Concession period in accordance with Clause 28.6.2, at any time after the Appointed Date, if any Force Majeure Event occurs (a) before COD, the Concession Period and the dates set forth in the Project Completion Schedule shall be extended by a period equal in length to the duration for which such Force Majeure Event subsists; or (b) after COD, the Concessionaire entitled to receive Annuity Payments plus interest due & payable under this agreement.

17. Allocation of Costs arising out of Force Majeure in accordance with Clause 28.7.2 and 28.7.2 (a), upon the occurrence of any Force Majeure Event (a Non-Political Event in the present case) after the Appointed date, the parties shall bear their respective Force Majeure Cost and neither party shall be required to pay the other any costs.

18. Compensation for Breach of Agreement (Article 29): This Clause was not operated so far.

19. Suspension Concessionaire's Rights (Article 30): There was no necessity of any invocation of this clause.

20. Termination (Article 31): There was no necessity of any invocation of this clause

21. Termination Payment (Clause 31.3): The clause refers to the termination during Operation Period. This clause was not operated.

22. Defects and liability after termination (Article 33): There was no necessity of any invocation of this clause

23. Change in Law (Article 35): if impacts financial burden to Concessionaire by way of change in legislations by both the Central Government and respective State Governments with an aggregate financial effect exceeding Rs 1.93Cr or 2% of the total annuity payments in any accounting year, Concessionaire to notify the same to Authority to pay the amount. If Concessionaire benefits as a result of Change-in-law, Authority may notify the Concessionaire to pay the amount. Any dispute in claim shall be settled as per Dispute Resolution Procedure.

24. Liability and Indemnity (Article 36): This Clause was not operated so far.

25. As per Schedule-L, Safety measures during O&M period: The Concessionaire shall establish Highway Safety Management Unit, HSMU to be functional after COD, and one officer to be in-charge shall have training in road safety from reputed organization.

## 1.6 REVIEW OF PAVEMENT DESIGN

### 1.6.1 REVIEW OF CA STIPULATIONS FOR PAVEMENT DESIGN

i. The Schedule B, Clause 5.1 says rigid pavement shall be provided on entire project length and at toll plaza locations. Flexible pavement shall be provided on service road/slip road sections. The minimum thickness for PQC is 300mm. However, Schedule D suggests that Four-Laning with paved shoulders of the Project Highway shall conform to Manual of Specifications and Standards for Four-Laning of Highways through PPP IRC: SP:84-2014.

**A) Rigid Pavement**

Clause 5.3.1 of IRC SP: 84-2014 stipulate that the new pavement shall be designed in accordance with the IRC: 58 Guidelines for the Design of Plain Jointed Rigid Pavements for Highways.

Clause 5.4.2 (i) of IRC SP: 84-2014 stipulates that the rigid pavement shall be designed for a minimum design period of 30 years. Stage Construction shall not be permitted.

Clause 5.4.2 (ii) of IRC SP: 84-2014 specifies that the Pavement Quality Concrete (PQC) shall rest over Dry lean Concrete (DLC) sub base of 150mm thickness.

Clause 5.4.2 (iii) of IRC SP: 84-2014 specifies that "A separation membrane shall be used between the PQC & DLC as per Clause 602.5 of MORTH Specifications".

Clause 5.4.2 (iv) of IRC SP: 84-2014 specifies that the DLC shall meet the minimum cement and comprehensive strength requirement as prescribed in IRC: SP: 49. The DLC shall extend beyond the PQC (including that in shoulder, if any) by 0.75m on either side.

Clause 5.4.2 (v) of IRC SP: 84-2014 specifies that Below DLC layer, a properly designed drainage layer Granular Sub Base (GSB) of 150mm thickness shall be provided throughout the road width. It shall be designed to obtain a drainage coefficient of not less than 30m per day.

**B) Flexible Pavement**

ii. Clause 5.3.1 of IRC SP: 84-2014 stipulate that the new pavement shall be designed in accordance with the IRC: 37 Guidelines for the Design of Flexible Pavement.

iii. Clause 5.4.1 (i) of IRC SP: 84-2014 stipulates that the flexible pavement shall be designed for a minimum design period of 15 years or operation period, whichever is more. Stage Construction will be permissible subject to the requirements specified in para (ii) below.

iv. Clause 5.4.1 (ii) of IRC SP: 84-2014 specifies that "Alternative strategies or combination of initial design, strengthening and maintenance can be developed by the Concessionaire to provide the specified level of pavement performance over the operation period subject to satisfying the following minimum design requirements".

v. Clause 5.4.1 (ii) (a) indicates that, the thickness of sub-base and base of pavement section is designed for a minimum design period of 15 years or the operation period, whichever is more and the initial bituminous surfacing for a minimum design period of 10 years.

vi. Clause 5.4.1 (ii-(b)) indicates that, the pavement shall be strengthened by bituminous overlay as and when required to extend the pavement life to full operation period. The thickness of bituminous overlay shall be determined on the basis of relevant IRC code.

vii. Clause 5.5.5 indicates that, the design traffic in case of Service Road shall be 10 MSA. The crust composition shall be provided accordingly.

viii. Clause 5.9.6 (i) of IRC SP: 84-2014 stipulate the thickness of the bituminous overlay shall be determined on the basis of FWD(IRC:115-2014) method and design traffic as per the procedure outlined in IRC: 81 as also from structural numbers of existing pavement layers.

ix. Clause 5.9.6 (ii) of the same manual also stipulates that the initial strengthening shall be done for a minimum design period of 10 years. Subsequent strengthening to extend the pavement to full operation period shall be implemented at the end of initial design period or earlier, in case of any structural distress in the pavement or if the surface roughness exceeds the value specified in Schedule-K of the CA.

x. Clause 5.9.6 (iv) of the same Section stipulate that the thickness of Bituminous Overlay for pavement strengthening shall not be less than 50 mm Bituminous concrete, after attending to the requirements of profile corrective course".

### 1.6.2 REVIEW OF CONCESSIONAIRE'S PAVEMENT DESIGN

As per Section 5 of Schedule B, the scope of Pavement Improvement for the project road includes:

a) Flexible pavement design shall be carried out in accordance with IRC: 37-2012 and Rigid Pavement design shall be carried out in accordance with IRC: 58-2015.

b) The New Rigid pavement shall be provided for the entire length of Four-lane Project Highway for the main carriageways and paved shoulder. Rigid pavement shall also be provided for proposed toll plaza. Flexible payment shall be provided for Slip Road and realignment of the parallel road and crossroad for connecting project highway and existing roads.

c) Rigid pavement shall be designed for minimum design period of 30 years.

The design of Pavement is based on the data provided by the Traffic report. ADT adopted for design of Pavement as per Traffic Report is presented below

- ✓ **Adopted ADT**

Table 1.4: Summary of Average Daily Traffic at Km 25+000

| Type of Vehicles | Jhalawar to Kota | | Kota to Jhalawar | | Both Direction | |
|---|---|---|---|---|---|---|
| | ADT | PCU | ADT | PCU | ADT | PCU |
| Two-Wheeler | 2154 | 1077 | 2199 | 1100 | 4353 | 2176 |
| Three-Wheeler/Auto-Rickshaw | 41 | 41 | 36 | 36 | 77 | 77 |
| Car/Jeep/ Van/ Taxi | 1011 | 1011 | 1177 | 1177 | 2187 | 2187 |
| Mini BUS | 12 | 19 | 11 | 17 | 24 | 36 |
| BUS | 93 | 280 | 102 | 306 | 195 | 586 |
| Goods Pick Up | 164 | 245 | 166 | 250 | 330 | 495 |
| LCV | 117 | 176 | 130 | 196 | 247 | 371 |
| 2 - Axle Truck | 287 | 861 | 277 | 831 | 564 | 1692 |
| 3 - Axle Trucks | 428 | 1928 | 486 | 2188 | 915 | 4116 |
| 4 + 6 Axle (MAV) | 392 | 1762 | 397 | 1788 | 789 | 3551 |
| 7 ++ Axle & Others | 0 | 0 | 0 | 0 | 0 | 0 |
| Tractor without Trailer | 6 | 9 | 7 | 11 | 13 | 19 |
| Tractor with Trailer | 31 | 140 | 34 | 152 | 65 | 292 |
| Cycle | 137 | 69 | 122 | 61 | 259 | 130 |
| Cycle Rickshaw | 0 | 0 | 0 | 0 | 0 | 0 |
| Animal Hand Cart | 0 | 1 | 0 | 1 | 0 | 2 |
| Toll Exempted Car | 15 | 15 | 13 | 13 | 28 | 28 |
| Toll Exempted Bus | 1 | 3 | 2 | 5 | 3 | 9 |
| Toll Exempted LCV | 0 | 0 | 0 | 0 | 0 | 0 |
| Toll Exempted Truck | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 4889 | 7636 | 5160 | 8130 | 10049 | 15766 |

✓ **New Construction of Rigid Pavement**

Design of New construction was carried out in accordance with IRC 58-2015. The pavement layer for new construction has been designed for 30-year design traffic for the PQC layers. The Pavement layer thickness proposed for new construction is as

| Length (Km) | Pavement Layers | Design Period | Pavement Thicknesses as per Design |
|---|---|---|---|
| 48.880 | Pavement Quality Concrete (PQC) | 30 years | 300 |
| | Dry Lean Concrete (DLC) | | 150 |
| | Granular Sub Base (GSB) | | 200 |
| | Subgrade | | 500 |

✓ New Construction of Flexible Pavement

There are 3 options of varying thicknesses with different pavement compositions of flexible pavement is given in the pavement design report to adopt 10 msa, 15-year design life and suggested effective design 8% CBR.

Altogether three pavement composition options have been proposed Concessionaire is approved by IE for service/slip road except for R.E. wall approaches of VUP@ km12+100, VUP@ km19+970,LVUP@km23+065 & km23+687,LVUP & VUP @ km24+547/25+100,VUP@ km54+605 and Flyover@km58+100.The reviewed pavement options are

Option 1 :40mm BC+50mm DBM+25Omm WMM+250mm GSB
Option 2: 30mm BC+4Omm DBM+150mm WMM+200mm CTSB
Option 3: 40mm BC+1OOmm WMM+2OOmm CTB+250mm GSB

And any one of the three options may be adopted as per site preference.

The proposed pavement composition for service road/slip road for R.E. wall approaches of VUP-12+100,VUP-19+970,LVP-23+065 &23+687,LVUP & VUP-24+547/25+I00,VUP-54+605 and Flyover-58+100 is as follows

BC 4Omm+70mm DBM+25Omm WMM+200mm GSB.

## 1.7 REVIEW OF O&M CONTRACT

Routine Maintenance and Incident Management service contract was awarded to Uni-builders Infratech, referred as "**Contractor**" entered into contract on 27th Feb 2024 for one year routine maintenance works to carry out road repairs, cleaning of bridges/signs/Crash barriers/removal of vegetation/routine maintenance and including incident Management Services.

The annual Contract for Routine Maintenance and Incident Management agreed for 27.03 lakhs per month excluding GST.

The Comprehensive AMC for ATMS/TMS for period from 01/04/2024 to 31/03/2025 was awarded to M/s LogicMo systems Pvt Ltd. for the amount Rs 35.90 lakhs (excl. GST)

## 1.8 REVIEW OF FEE

As per Article-21 and Schedule-M, during Development period and Construction stage, Full Fee of the IE Fee shall be equally borne by Authority and Concessionaire not exceeding 3% of BPC and any payments in excess of 3% shall be borne entirely by Authority.

During Operation period, all payments towards fee and expenses shall be equally borne by Authority and Concessionaire.

In the month of May 2025, Concessionaire has reimbursed a sum of Rs.2,53,192 towards expenditure against IE Services.

## 1.9 REVIEW OF SCHEDULES

The following table depicts the project scope for major items as given is schedule- B&C at a glance:

**Table 3: Salient Features of Project Corridor**

| S No. | Particulars | Length/ Nos. | Remarks |
|---|---|---|---|
| 1 | Start Chainage (Km) | Km | 9.86 |
| 2 | End Chainage (Km) | Km | 58.74 |
| 3 | Length of the Project Corridor | Kms | 48.88 |
| 4 | Service Road / Slip Road | Kms | 28.38 |
| 5 | Toll Plaza | Nos. | 1 |
| 6 | ROBs | Nos. | 1 |
| 7 | RUB's | Nos. | 1 |
| 8 | Interchange /Grade Separators | Nos. | - |
| 9 | Flyovers | Nos. | 4 |
| 10 | Uni Directional Flyovers | Nos. | - |
| 11 | Over Passes | Nos. | - |
| 12 | VUPs | Nos. | 9 |
| 13 | LVUP's | Nos. | 13 |
| 14 | PUP's/CUP's | Nos. | - |
| 15 | Major Bridges | Nos. | 2 |
| 16 | Minor Bridges | Nos. | 11 |
| 17 | Culverts (Pipe) | Nos. | 16 |
| 18 | Culvert (Slab/Box) | Nos. | 21 |
| 19 | Major Junctions | Nos. | 24 |
| 20 | Minor junctions | Nos. | 25 |
| 21 | Bus Bays with Shelter | Nos. | 10 |
| 22 | Truck Lay bye | Nos. | 2 |

| S No. | Particulars | Length/ Nos. | Remarks |
|---|---|---|---|
| 23 | Rest Areas | Nos. | 1 |
| 24 | W-Beam Safety Barriers | Kms | 9 |
| 25 | Pedestrian Guard Rails | Kms | 0 |
| 26 | Boundary Stones | Nos. | 1955 |
| 27 | Utility Ducts | Nos. | 98 |
| 28 | Rain water Harvesting pits | Nos. | 195 |

## 1.10 O&M REQUIREMENTS

The O&M requirements for the Project Road are as follows:

- Applicable Manual----------IRC: SP:84-2014, (Four-Lane Manual)
- Applicable Schedule for O&M-------Schedule-K and Manual
- Maximum Roughness Allowed ------2750 mm/km
- Mandatory Overlay—----------NA
- Frequency of Roughness Test-------2 Times in a Year
- BBD/FWD deflection Test (as per manual) for flexible pavement -------every 5 years
- Allowable Characteristic deflection (as per manual) ----------1.2mm
- No specific Handing Over (Divestment) requirements are mentioned under CA. It shall be same as Schedule-K.

# CHAPTER 2. SURVEYS AND INVESTIGATIONS

## 2.1 INTRODUCTION

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 required inputs 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*
- *Pavement Condition using NSV*
- *Roughness Surveys using NSV*
- *Pavement Composition surveys (Test Pits)- from Previous studies*
- *Core Cutting*
- *Subgrade Investigations & Laboratory testing- from Previous studies*
- *Material Investigations- from Previous studies*
- *Structure Inventory and Condition Surveys*

The surveys are conducted in the month of May-2025.

## 2.2 ROAD INVENTORY

The project corridor primarily consists of a rigid pavement with a 4-lane divided carriageway throughout its length. However, at structure approaches, a 6-lane divided carriageway is provided. Typically, the cross-section comprises a 7.0 m wide carriageway with a 1.5 m paved shoulder and 0.5m shyness on each side of the median, flanked by 2.0 m earthen shoulders. In general, the median width is 4.0 m.

The project corridor predominantly traverses through plain terrain, with the surrounding land use primarily comprising agricultural areas. The alignment passes through several villages, including Kamalpura, Atraliya, and Deegasi. Generally, the road embankments range in height from 0.7 m to 2.0 m. Embankments exceeding 2.0 m are typically observed near approaches to cross-drainage (CD) structures and underpasses.

Typical View of Project Road is shown below:

**A view of the Project Road at km 25.000 LHS**


**A view of the Project Road at km 24.600**

**A view of the Project Corridor at Km 32.000**

**A view of the Project Road at km 42.500**

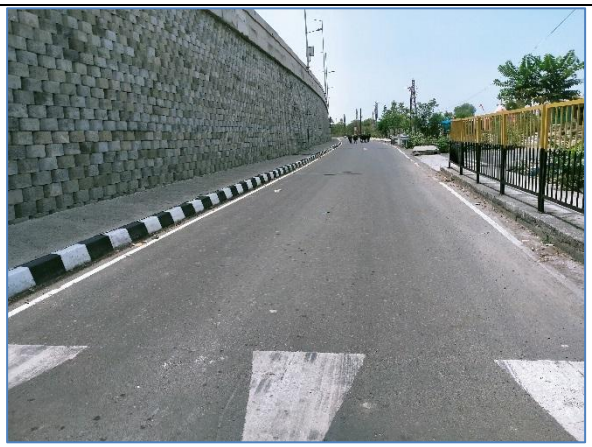
**A view of the Project Road at km 52.000 LHS**

**A view of the Project Road at km 57.000 RHS**

Photos depicting the service/slip road pavement surface type, condition and the other associated features like drain. Few photos taken at service/slip road locations are presented below:

**Service road at km 50.100 LHS**

**Service road at km 38.500 RHS**



**Service road at km 24.600 LHS**

**Service road at km 45.800 RHS**

The Project Road has both major junctions and minor junctions. Photographs showing the Major Junctions and minor junctions are presented below:

**Minor Junction at km 19.900 BHS**

**Major Junction at km 27.000 BHS**

**Minor Junction at km 32.550 BHS**

**Major Junction at km 58.050 BHS**

Approaches to the Grade separator structures are provided with RE wall/RCC wall. High embankments are provided with stone pitching on soil embankment along with chutes are as presented below:

**RE Blocks at Km – 15+700 LHS**

**RE Blocks at Km 23+550 RHS**

**RCC Wall at km-32+600 RHS**

**Stone Pitching at km-56+900 RHS**

RCC-cover drains are provided in the project road adjacent to slip roads. Open Lined Drain are provided in forest section at sharp curve location and Median drains provided at curves followed by median cuts. The sample photos are as presented below.

**RCC Cover Drain at Km 12+550 LHS**

**RCC Open Lined Drain at Km 52+300 LHS**

Highway lighting in the form of Single/double arms are provided near structure approaches, whereas High-masts are provided at Toll Plazas and Major Junction locations. Few photos showing High mast and highway lighting are presented below:

**A view of Single Arm lighting at km 18.200 RHS**

**A view of High Mast Lighting at km 27.700**

**A view of Double Arm lighting at km 42.000**

**A view of double arm Lighting BHS at km 58.000**

The road user facilities such as Bus Bay with shelter & Truck lay-byes are provided along the corridor. Bus-bays are provided with Flexible pavement. Whereas Truck lay-byes are provided with rigid pavement and are equipped with Toilet blocks. A separator is provided between the main carriageway and the truck lay-bye area for safety and functional segregation. Few photos are presented below:

**Bus Bay with Bus shelter @ Km 13.550 RHS**

**Bus Bay with Bus shelter @ 22.000 LHS**

A view of Truck Lay Bye at Km 18.100 LHS

A view of Truck Lay Bye at Km 18.100 RHS

The Project Road has a Toll Plaza at Km 27.700 with Rigid pavement. The condition of the toll plaza appears to be fair. It has 18 lanes including reversible lanes. High mast lights and double arm lighting has been provided at Toll Plaza.

The details of Toll Plaza are as follows.

| Toll plaza details | | | | |
|---|---|---|---|---|
| **S.No** | **Type** | **Units** | **TP1** | **Remarks** |
| 1 | Chainage | Km | 27.700 | (Design. 27.335 to 28.000) |
| 2 | Toll plaza name | | Beer Mandi Toll Plaza | |
| 3 | No of lanes | Nos | 18 | Includes 2nos reversible lane |
| 4 | Canopy | | Present | |
| 5 | Toll office (Admin Building) | | Yes | |
| 6 | Toll booths | | 16 | |
| 7 | Fast tag lanes | Nos | 16 | Includes 2nos reversible lane |
| 8 | Total Toll Plaza length | m | 600 | |
| 9 | Toll plaza width | m | 85 | |
| 10 | Toll lanes width | m | 3.5 | |
| 11 | Extra Wide Lane width | m | 4.5 | |
| 12 | Bike Lane width | m | 2 | |
| 13 | Separator width at Toll booths | m | 1.5 | |
| 14 | Static Weigh bridges | Nos | 2 | |
| 15 | WIMS | Nos | 16 | |
| 16 | High mast Poles | Nos | 5 | |
| 17 | Ambulances | Nos | 1 | |
| 18 | Cranes | Nos | 1 | |
| 19 | Highway Patrolling Vehicles | Nos | 1 | |
| 20 | Toeing Vehicle | Nos | 1 | |
| 21 | Elevated walk Way | | NA | |

| Toll plaza details | | | | |
|---|---|---|---|---|
| **S.No** | **Type** | **Units** | **TP1** | **Remarks** |
| 22 | Tunnel | | Yes | |
| 23 | Toilets | No | 2 | |

Few photos of Toll Plaza are as below:


**A view of the Existing Toll Plaza near km 549.200 (Madai Toll Plaza)**

**Static Weigh Bridge @ km 27.700**

**Toll Admin Building @ km 27.700**

The collected Road Inventory Data is presented in **Appendix 1** of this Report

## 2.3 PAVEMENT CONDITION SURVEYS

The present Pavement condition data has been collected in the month of May-2025 using **Network Survey Vehicle (NSV)**. The Pavement Condition data collected in each lane and in each direction has been presented in **Appendix 2** of this Report.

The photographs showing the pavement condition of the Project Road is presented below.

| | | |
|---|---|---|
|  Ravelling @ 50.500 LHS |  Epoxy Layer Damaged @ Km 13.420 RHS |  Longitudinal Cracking @ 34.240 LHS |
|  Epoxy Layer Damaged @ km 38.890 LHS |  Fair Pavement @ Km 42.000 RHS |  Ravelling @ km 44.880 LHS |
|  Cracking @ Km 56.250 RHS |  Fair Condition @ km 53.800 LHS |  Stitch & Staple @ Km 22.030 RHS |

## 2.4 ROUGHNESS SURVEYS

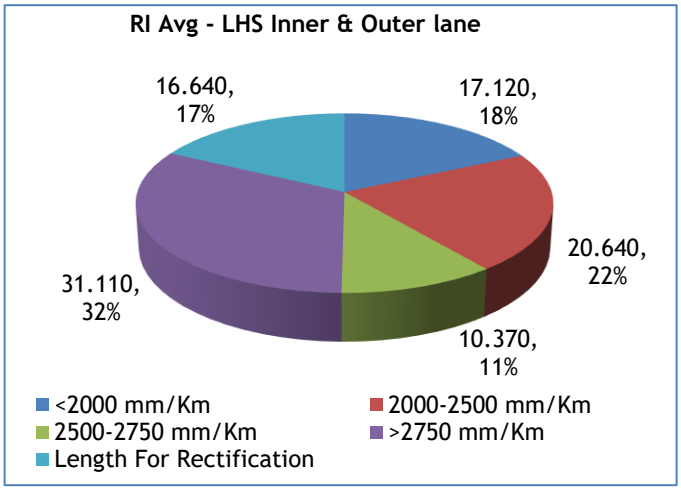
The Roughness data has been collected in the month of May-2025 using **Network Survey Vehicle** and analyzed in terms in terms of International Roughness Index (IRI), separately for each lane in 10m interval, for both direction of travel. To ensures more accurate, fair, and true representative assessment of pavement performance, the roughness values recorded at Expansion Joints and TBM

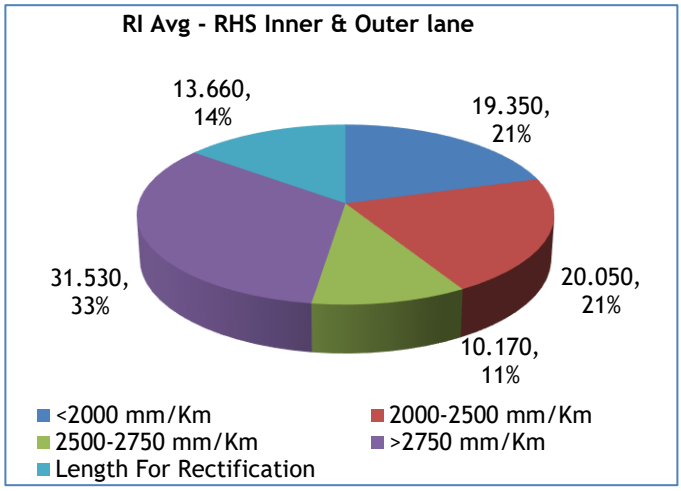
locations were excluded from analysis. These features can lead to distorted or inflated roughness readings, misrepresenting true pavement performance. This data is presented in **Appendix 3** of this Report.

As per Schedule-K, maintenance requirements, maximum roughness allowable is 2750mm/km and frequency of testing twice in a year.

- **Rigid Pavement Roughness (Moving Average Method):**

Moving average method has been adopted considering 10m point interval data for the analysis of rigid pavement roughness is as follows




From the above graph, about 16.640 km in LHS & 13.660 km in RHS of the rigid pavement requires rectifications to be bring the roughness threshold limit (<2750 mm/km).

## 2.5 PAVEMENT COMPOSITION SURVEYS (TEST PITS)

The composition of the existing pavement crust for main carriageway and service road has been taken from previous DD studies. The extracted details are reproduced in the table below.

**Table 4: Pavement Composition of Existing Pavement**

| S.No | Test Pit No | Design Chainage | Direction | PQC (mm) | DLC (mm) | GSB (mm) | Total (mm) |
|---|---|---|---|---|---|---|---|
| 1 | DJ-TP-1 | 10+250 | LHS | 310 | 150 | 200 | **660** |
| 2 | DJ-TP-2 | 14+900 | RHS | 320 | 160 | 200 | **680** |
| 3 | DJ-TP-3 | 20+810 | LHS | 300 | 150 | 150 | **600** |
| 4 | DJ-TP-4 | 26+300 | RHS | 310 | 150 | 180 | **640** |
| 5 | DJ-TP-5 | 30+650 | LHS | 305 | 155 | 215 | **675** |
| 6 | DJ-TP-6 | 35+400 | RHS | 300 | 150 | 200 | **650** |
| 7 | DJ-TP-7 | 40+250 | LHS | 300 | 150 | 190 | **640** |
| 8 | DJ-TP-8 | 45+200 | RHS | 300 | 150 | 200 | **650** |
| 9 | DJ-TP-9 | 50+520 | LHS | 340 | 110 | 200 | **650** |
| 10 | DJ-TP-10 | 55+500 | RHS | 295 | 150 | 200 | **645** |

Total average crust thickness of the MCW pavement is 650mm. The average thickness of PQC layer is 310mm. Pavement is mainly composed of a PQC layer, DLC & GSB base over subgrade.

The service road pavement composition having flexible pavement is as follows.

| S No | Test Pit No | Design Chainage km | Direction | BC (mm) | WMM (mm) | GSB (mm) | Total (mm) |
|---|---|---|---|---|---|---|---|
| 1 | DJ-SR-TP-1 | 38+250 | LHS | 100 | 250 | 200 | **550** |
| 2 | DJ-SR-TP-2 | 51+980 | RHS | 120 | 250 | 200 | **570** |

## 2.6 MATERIAL INVESTIGATIONS

### 2.6.1 SUBGRADE & BORROW INVESTIGATIONS

Subgrade and Borrow area related test results are considered from previous DD studies and presented in Chapter-4 of this report.

### 2.6.2 AGGREGATE SAMPLES

From previous DD studies, the same aggregate source locations are re-verified and obtained the present market rates. The same locations, estimated quantity, basic cost of material and the approximate distance from each source to the nearest point on the project corridor are compiled in Tables below.

**DJ-AQ-1**

**DJ-AQ-2**

**DJ-AQ-3**

**Table 5: Aggregate Samples Details**

| sample No. | Ex.Chainage (Km.) | Left/ Right | Name of Village | Name of Source/ Crusher | Lead from Nearest Ex.Chainage (Km.) | Approximate Quantity (CFT) | Basic cost of the material (Rs.) | Remarks | Co-ordinate |
|---|---|---|---|---|---|---|---|---|---|
| DJ-AQ-1 | 42+250 | LHS | Ralayiti | Crusher: Maa Gayathri Stone Crusher Cont. Person: Amit Yadav Cont. No: 9509708850 | 100 M | Plenty | 40mm-14/- per CFT 20mm-Rs 15/- per CFT 10mm-Rs 15/- per CFT 6mm - Rs 20/- per CFT Dust - Rs 24/- per CFT | Extra :GST 5% Royality Included (Rs. 39/- per ton) | 24.561851 76.130693 |
| DJ-AQ-2 | 30+100 | RHS | Julmi | Crusher: Chouhan Stone Crusher Cont. Person: Surender Singh Cont. No: 6376891356 | 8.5 Km | Plenty | 40mm-14/- per CFT 20mm-Rs 15/- per CFT 10mm-Rs 15/- per CFT 6mm - Rs 20/- per CFT Dust - Rs 22/- per CFT GSB- Rs. 16/- per CFT WMM- Rs. 16/- per CFT | Extra :GST 5% Royality Included (Rs. 39/- per ton) | 24.577131 75.999805 |
| DJ-AQ-3 | 58+100 | LHS | Teendhar | Crusher: Sri Sai Stone Crusher Cont. Person: Shubham Patidar Cont. No: 6367037139 | 500 M | Plenty | 40mm-340/- per Ton 20mm-Rs 360/- per Ton 10mm-Rs 360/- per Ton Dust - Rs 600/- per Ton WMM- Rs. 350/- per Ton | Extra :GST 5% Royality Included (Rs. 39/- per ton) | 24.502886 76.251081 |

### 2.6.3 SAND SAMPLES

M Sand samples of 2 Nos. have been collected from the source and tested. The location of this sand quarry along with lead to the Project Road is presented in the following table.

**Table 6: Sand Samples Details**

| Sand Source | Crusher Name and Details | Village Name | Chainage | Side | Offset | Rate | Co-ordinate |
|---|---|---|---|---|---|---|---|
| DJ-SQ-1 | Crusher: Maa Gayathri Stone Crusher Cont. Person: Amit Yadav Cont. No: 9509708850 | Ralayiti | 42+250 | LHS | 100 M | Rs. 26/- per CFT | 24.561851 76.130693 |
| DJ-SQ-2 | Crusher: Chouhan Stone Crusher Cont. Person: Rajender Singh Cont. No: 8302089064 | Julmi | 30+100 | RHS | 8.5 Km | Rs. 28/- per CFT | 24.577131 75.999805 |

## 2.7 CORE INVESTIGATIONS

The objective of the core cutting is to examining the engineering properties of the materials relevant to the project as per specifications. Accordingly, 20 Nos. of cores were taken carefully from the project corridor, in which on LHS(MCW): 10 Nos, on RHS(MCW) :10 Nos.

**Table 7: Core Cutting Samples Details**

| S No | Core No. | Chainage | Side | Carriage Way Lane | Distance from Median Kerb in Metres | Condition of Road | Core Height of MM | Depth of core hole MM | Observations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | DJ-C-1 | 10+000 | LHS | Inner Lane | 1.0 | Fair, Minor Ravelling | 285 | 285 | |

| S No | Core No. | Chainage | Side | Carriage Way Lane | Distance from Median Kerb in Metres | Condition of Road | Core Height of MM | Depth of core hole MM | Observations |
|---|---|---|---|---|---|---|---|---|---|
| 2 | DJ-C-2 | 16+050 | LHS | Outer Lane | 6.4 | Ravelling | 297 | 297 | Str Approach |
| 3 | DJ-C-3 | 22+010 | LHS | Inner Lane | 1.6 | Longitudinal Cracking | 312 | 312 | Crack Depth 233mm |
| 4 | DJ-C-4 | 27+800 | LHS | Outer Lane | 7.0 from Sh. Outer Edge | Fair | 287 | 288 | Toll Approach |
| 5 | DJ-C-5 | 33+980 | LHS | Inner Lane | 1.0 | Fair | 300 | 300 | |
| 6 | DJ-C-6 | 39+960 | LHS | Outer Lane | 6.4 | Ravelling | 295 | 295 | |
| 7 | DJ-C-7 | 46+100 | LHS | Inner Lane | 1.5 | Fair | 315 | 315 | |
| 8 | DJ-C-8 | 52+100 | LHS | Outer Lane | 7.1 | Fair | 287 | 287 | |
| 9 | DJ-C-9 | 57+900 | LHS | Inner Lane | 1.3 | Fair | 253 | 254 | |
| 10 | DJ-C-10 | 55+300 | RHS | Outer Lane | 7.1 | Fair | 312 | 312 | |
| 11 | DJ-C-11 | 53+000 | RHS | Paved Shoulder | 8.2 | Fair | 294 | 295 | Super Elevation |
| 12 | DJ-C-12 | 49+000 | RHS | Inner Lane | 1.2 | Fair | 314 | 315 | |
| 13 | DJ-C-13 | 43+010 | RHS | Outer Lane | 6.5 | Fair | 310 | 310 | |
| 14 | DJ-C-14 | 36+950 | RHS | Inner Lane | 1.4 | Fair | 305 | 306 | |
| 15 | DJ-C-15 | 31+020 | RHS | Outer Lane | 6.2 | Fair | 310 | 311 | |
| 16 | DJ-C-16 | 28+600 | LHS | Paved Shoulder | 8.1 | Fair | 300 | 300 | |
| 17 | DJ-C-17 | 24+980 | RHS | Inner Lane | 1.5 | Fair | 335 | 335 | |
| 18 | DJ-C-18 | 18+930 | RHS | Outer Lane | 7.1 | Ravelling | 291 | 292 | |
| 19 | DJ-C-19 | 18+040 | RHS | Truck Lay Bye | 0.8 From Separator | Fair | 342 | 342 | |
| 20 | DJ-C-20 | 13+000 | RHS | Inner Lane | 1.2 | Fair | 298 | 298 | |

The Photos depicting the above are presented below:

| DJ-C-1 | DJ-C-2 |
|---|---|
|  |  |
| **DJ-C-3** | **DJ-C-4** |
|  |  |
| **DJ-C-5** | **DJ-C-6** |
|  |  |
| **DJ-C-7** | **DJ-C-8** |
|  |  |
| **DJ-C-9** | **DJ-C-10** |

| | |
|---|---|
|  |  |
| **DJ-C-11** | **DJ-C-12** |
|  |  |
| **DJ-C-13** | **DJ-C-14** |
|  |  |
| **DJ-C-15** | **DJ-C-16** |
|  |  |
| **DJ-C-17** | **DJ-C-18** |

| | |
|---|---|
|  |  |
| **DJ-C-19** | **DJ-C-20** |

Core results are presented in **Appendix-4** of this report.

# CHAPTER 3. VALIDATION OF EXECUTED WORKS

## 3.1 ROAD WORKS

The project road has been closely inspected to verify the executed works on ground. As a part of the validation, the available as-built drawings/schedules/inventory data received from the Concessionaire were also referred. Each structure has been inspected to note down its structural configuration and condition. The following table highlights the scope comparison of the executed works on ground.

**Table 8: Scope Comparison of Executed works**

| S. No | Particulars | Length/ Nos. | Total for O&M Estimation | As per Schedule-B | As per Vendor list | As per Site | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | Start Chainage (Km) | Km | 9.860 | 9.860 | 9.860 | 9.860 | |
| 2 | End chainage (Km) | Km | 58.740 | 58.740 | 58.740 | 58.740 | |
| 3 | Length of the Project Corridor | Kms | 48.88 | 48.88 | 48.88 | 48.88 | |
| 4 | Service Road / Slip Road | Kms | 36.775 | 28.380 | | 36.775 | Including Tapper |
| 5 | Bypass Length | Kms | 11.818 | | | 11.818 | |
| 6 | Toll Plaza | Nos | 1 | 1 | | 1 | |
| 7 | No.of Lanes (Both side) | Nos | 18 | | | 18 | Including Reversable Lane |
| 8 | ROBs | Nos | 1 | 1 | | 1 | |
| 9 | RUB's | Nos | 1 | 1 | 1 | 1 | |
| 10 | Flyovers | Nos | 4 | | 1 | 4 | |
| 11 | VUPs | Nos | 9 | 9 | 9 | 9 | |
| 12 | LVUP's | Nos | 13 | 13 | 13 | 13 | |
| 13 | PUP's/CUP's | Nos | 4 | | 4 | 4 | |
| 14 | Major Bridges | Nos | 2 | 2 | 2 | 2 | |
| 15 | Minor Bridges | Nos | 10 | 11 | 10 | 10 | |
| 16 | Culverts (Pipe) | Nos | 47 | 16 | 47 | 47 | |
| 17 | Culvert (Slab/Box) | Nos | 23 | 21 | 23 | 23 | |
| 18 | Major Junctions | Nos | 33 | 24 | 24 | 33 | |
| 19 | Minor junctions | Nos | 38 | 25 | 27 | 38 | |
| 20 | High Embankments | Kms | 15.565 | | | 15.565 | |
| 21 | Concrete Lining | Kms | 0.020 | | | 0.020 | |
| 22 | RCC Wall | Kms | 0.840 | | | 0.84 | |
| 23 | Full Height RE Wall | Kms | 28.543 | | 29.43 | 28.543 | |
| 24 | Toe Wall | Kms | 2.190 | | 0.259 | 2.19 | |
| 25 | Bus Bays with Shelter | Nos | 10 | 10 | 10 | 10 | |

| S. No | Particulars | Length/ Nos. | Total for O&M Estimation | As per Schedule-B | As per Vendor list | As per Site | Remarks |
|---|---|---|---|---|---|---|---|
| 26 | Bus Bays | Nos | 1 | | | 1 | |
| 27 | Truck Lay bye | Nos | 2 | 2 | 2 | 2 | |
| 28 | Rest Areas | Nos | 1 | 1 | 1 | 1 | |
| 29 | High Mast Post | Nos | 5 | | 5 | 5 | |
| 30 | Highway Lighting (length only) | Kms | 36.340 | | | 36.340 | |
| 31 | Single Arm poles | Nos | 255 | | 2682 | 255 | |
| 32 | Double Arm poles | Nos | 1149 | | 17 | 1149 | |
| 33 | Three Arm poles | Nos | 16 | | | 16 | |
| 34 | Lights below underpass/FO | Nos | 6 | | 6 | | |
| 35 | Solar Blinkers | Nos | 31 | | | 31 | |
| 36 | RCC Cover Drain | Kms | 28.343 | | 26.98 | 28.343 | |
| 37 | RCC Open Lined Drain | Kms | 0.230 | | 0.230 | 0.220 | |
| 38 | Earthen Drain | Kms | 69.197 | | | 69.197 | |
| 39 | Median drain | Kms | 0.600 | | | 0.600 | |
| 40 | Median Cuts | Nos | 1457 | | | 1457 | |
| 41 | Chutes | Nos | 786 | | | 786 | |
| 42 | Median Opening | Nos | 14 | | 12 | 14 | |
| 43 | Median Plantation_Functional | Kms | 41.230 | | | 41.23 | |
| 44 | Median Plantation_Non Functional | Kms | 4.490 | | | 4.49 | |
| 45 | Road Markings | Kms | 48.880 | | | 48.88 | |
| 46 | W-Beam Safety Barriers | Kms | 30.010 | 9.000 | 23.68 | 30.010 | |
| 47 | Thrie-Beam Safety Barriers | Kms | 0.880 | | | 0.880 | |
| 48 | Rigid Concrete Barriers | Kms | 34.060 | | 32.83 | 34.060 | |
| 49 | Concrete Railing | Kms | 1.980 | | 1.000 | 1.980 | |
| 50 | Pedestrian Guard Rails | Kms | 3.820 | | 2.124 | 3.82 | |
| 51 | Delineators | Nos | 2000 | | 2000 | 1348 | |
| 52 | Kilometre Stones | Nos | 98 | | | 98 | |
| 53 | Hectometre Stones | Nos | 390 | | | 390 | |
| 54 | Boundary Stones | Nos | 1995 | 1995 | 982 | 978 | |
| 55 | Road Signs | Nos | 2094 | | 2094 | 2064 | |
| 56 | Gantry Sign Boards | Nos | 12 | 12 | 6 | 9 | |
| 57 | Cantilever Sign Boards | Nos | 35 | 30 | 34 | 35 | |
| 58 | Varying Message Signs(VMS) | Nos | 10 | | | 10 | |
| 59 | Emergency Call Box | Nos | 48 | | 48 | 48 | |
| 60 | Advanced Traffic Management System(ATMS) | Nos | 23 | | 19 | 23 | |
| 61 | Edge Kerb in High embankment locations | Kms | 14.10 | | | 14.10 | |

| S. No | Particulars | Length/ Nos. | Total for O&M Estimation | As per Schedule-B | As per Vendor list | As per Site | Remarks |
|---|---|---|---|---|---|---|---|
| 62 | Rain water Harvesting pits | Nos | 196 | 196 | 160 | 160 | |
| 63 | Energy Dispantion Chambers | Nos | 687 | | | 687 | |
| 64 | Connecting Roads | Kms | 0.930 | | | 0.930 | |

The Service/Slip roads having the width varying from 5.5m and 7.0m with flexible. The summary of service roads and slip roads are presented in the table below and the location details are presented in the **Appendix-5** of this report.

**Table 9: Details of Service Roads/Slip Roads along Project Road**

| Width | LHS (Kms) | RHS (Kms) | Total |
|---|---|---|---|
| 5.5m | 15.66 | 15.695 | **31.355** |
| 7m | 2.71 | 2.71 | **5.420** |
| Total | **18.37** | **18.405** | **36.775** |

RCC Lined Covered drains are provided along the project road at service road locations. Cover-slab was missing & damage observed in few locations, cleaning need to be required. The summary of **Drains** is presented in the table below and the location details are presented in the **Appendix-5** of this report.

**Table 10: Summary of Drains**

| Summary | Length (Km) |
|---|---|
| RCC Covered Drain | 28.343 |
| Open Line Drain | 0.220 |
| Median Drain | 0.600 |
| **Total** | **29.163** |

Partial RCC walls, Partial RE walls and Full Height RE walls are found in approaches to the underpasses, at High embankments, at Bridge locations along the Project Corridor. The summary of the slope protection table was presented below and the location details are presented in the **Appendix-5** of this report.

**Table 11: Summary of Slope Protection along Project Road**

| Summary | Length (Km) | Remarks |
|---|---|---|
| High Embankment | 14.430 | |
| RE Wall (Blocks) | 28.54 | |
| RCC wall | 0.84 | |
| Concrete Lining | 0.020 | |
| Stone Pitching | 4.08 | |
| Toe Wall | 2.190 | |
| **Total** | **50.100** | |

In general, the median width is 4m. For the reserve lane locations, the width of the reserved lane is 3.5m. The summary of Median Openings is presented in the table below and the location details are presented in the **Appendix-5** of this report.

**Table 12: Details of Median Openings along Project Road**

| Median Openings | No's |
|---|---|
| With Reserve Lane | 12 |
| With Normal Lane | 2 |
| Total | 14 |

The Project Road has Major & Minor Junctions. The summary of Major Junctions and Minor Junctions is presented in the table below and the location details are presented in the **Appendix-5** of this report.

**Table 13: List of Junctions**

| Summary | No's |
|---|---|
| Major Junctions | 33 |
| Minor Junctions | 38 |

Safety Barriers are provided at High embankment, at Bridges, at Culverts, at Underpasses (VUP, PUP and LVUP etc), approach locations and Built-up areas. The table below shows the summary of Safety Barriers provided along the project corridor and the summary is presented in the table below. The location details is presented in the **Appendix-5** of this report:

**Table 14: Summary of Safety Barriers**

| S. No. | Description | Length (Kms) |
|---|---|---|
| 1 | W-Beam Safety Barriers | 30.010 |
| 2 | Concrete Crash Barriers | 34.060 |
| 3 | Pedestrian Guard Railings | 3.820 |
| 4 | Thrie Beam Crash Barrier | 0.880 |
| 5 | Concrete Railings | 1.980 |

Road furniture in the form of High masts, Highway Lighting and Sign boards have been provided along the project road. The list of all road items has been furnished in **Appendix-5** of this report.

**Table 15: Locations of Highway Lighting**

| S. No. | Description | No's |
|---|---|---|
| 1 | Highmast Post | 5 |
| 2 | Single Arm Pole | 255 |
| 3 | Double Arm Poles | 1149 |
| 4 | Triple Arm Poles | 16 |

**Table 16: Details of Road Signs along Project Road**

| Description | LHS (Nos.) | RHS (Nos.) | Junctions (Nos.) | Total (Nos.) |
|---|---|---|---|---|
| Overhead Gantry | 5 | 4 | 0 | 9 |
| Cantilever Gantry | 19 | 16 | 0 | 35 |
| Toll Boards | 6 | 6 | 0 | 12 |
| ADS/RAS | 5 | 5 | 0 | 10 |

| Description | LHS (Nos.) | RHS (Nos.) | Junctions (Nos.) | Total (Nos.) |
|---|---|---|---|---|
| Rectangular | 59 | 64 | 35 | 158 |
| Triangular | 107 | 97 | 105 | 309 |
| Circular | 94 | 82 | 0 | 176 |
| Octagonal | 21 | 21 | 58 | 100 |
| Flag Type | 18 | 19 | 1 | 38 |
| Chevron | 430 | 348 | 0 | 778 |
| Hazard | 223 | 213 | 7 | 443 |
| Route marker | 17 | 23 | 0 | 40 |
| **Total** | **1004** | **898** | **206** | **2108** |

The project road has Bus Bays & Bus shelters on Highway. Flexible pavement is provided at Bus Bay locations. The summary is presented in the table below:

**Table 17: Details of Bus Bays with Shelters**

| S. No. | Description | No's |
|---|---|---|
| 1 | Bus bay with Shelter | 10 |
| 2 | Bus bay | 1 |

The Project Road has Truck lay byes in one location on either side of Highway. The Truck lay bye has been provided with rigid pavement and the condition appears to be fair to poor. Separator is provided between main carriageway and truck lay bye portion and the summary is presented in the table below. The location details are presented in the **Appendix-5** of this report:

**Table 18: Details of Truck lay byes**

| S. No. | Description | No's |
|---|---|---|
| 1 | Truck Lay Bye | 2 |

In addition to the above, one rest area is provided at km 15+600 with flexible pavement. The amenities such as Toilet blocks, Rest Rooms, water facility, lightings and parking facility are made available.

## 3.2 STRUCTURES

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

**Table 19: Summary of Structures as per Site**

| S. No | Type of Structure | No. of Structures As per CA | As per site | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | No. of Structures | | | Total No.of Str's | Total No.of Locations | |
| | | | LHS | RHS | BHS | | | |
| 1 | ROB | 1 | 1 | 1 | - | 2 | 1 | - |
| 2 | RUB | 1 | 1 | 1 | - | 2 | 1 | - |
| 3 | MJB | 3 | 2 | 2 | - | 4 | 2 | MJB + Flyover are constructed as a single integrated structure,with the spans of theMJB incorporated into the elevated flyover. |
| 4 | MNB | 11 | 13 | 13 | - | 26 | 10 | 1 no. of MNB Negative COS |
| 5 | Flyover | 4 | 4 | 4 | - | 8 | 4 | - |
| 6 | VUP | 9 | 9 | 9 | - | 18 | 9 | - |
| 7 | LVUP | 13 | 13 | 13 | - | 26 | 13 | - |
| 8 | PUP | - | 2 | 2 | - | 4 | 2 | COS Structures |
| 9 | CUP | - | 2 | 2 | - | 4 | 2 | COS Structures |
| 10 | BC | 21 | - | - | 23 | 23 | 23 | 2 no's comes under COS |
| 11 | PC | 16 | - | - | 47 | 47 | 47 | 31 no's comes under COS |

**Table 20: Age of Structures**

| S. No | Type of Str | LHS | | RHS | | BHS | | Total (Nos) | | Total no. of Str's |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Old | New | Old | New | Old | New | Old | New | |
| 1 | ROB | - | 1 | - | 1 | - | - | - | 2 | 2 |
| 2 | RUB | - | 1 | - | 1 | - | - | - | 2 | 2 |
| 3 | MJB | - | 2 | 1 | 1 | - | - | 1 | 3 | 4 |
| 4 | MNB | - | 13 | - | 13 | - | - | - | 26 | 26 |
| 5 | Flyover | - | 4 | - | 4 | - | - | - | 8 | 8 |
| 6 | VUP | - | 9 | - | 9 | - | - | - | 18 | 18 |
| 7 | LVUP | - | 13 | - | 13 | - | - | - | 26 | 26 |
| 8 | PUP | - | 2 | - | 2 | - | - | - | 4 | 4 |
| 9 | CUP | - | 2 | - | 2 | - | - | - | 4 | 4 |
| 10 | BC | - | - | - | - | - | 23 | - | 23 | 23 |
| 11 | PC | - | - | - | - | - | 47 | - | 47 | 47 |

Old : Retained at the time of 4-laning & New: Constructed during 4-laning

## Table 21: Summary of Expansion Joints & Bearings

| S. No | Type of Str | Expansion joints | | Bearings | | | |
|---|---|---|---|---|---|---|---|
| | | | | Pot PTFE | | Elastomeric | |
| | | Old | New | Old | New | Old | New |
| 1 | ROB | - | 8 | - | 76 | | |
| 2 | RUB | - | - | - | - | - | - |
| 3 | MJB | 14 | 42 | - | 169 | 78 | 260 |
| 4 | MNB | - | - | - | - | - | - |
| 5 | Flyover | - | 68 | - | 780 | - | - |
| 6 | VUP | - | 36 | - | 24 | - | 180 |
| Total | | **14** | **154** | - | 1049 | 78 | 440 |
| | | **168** | | **1049** | | **518** | |
| | | | | **1567** | | | |

## Table 22: Summary of Superstructures

| S. No | Type of Str | RCC Girder & Steel Girder | RCC Box | PSC Girder | RCC Girder | Total no. of Structures |
|---|---|---|---|---|---|---|
| 1 | ROB | 2 | - | - | - | 2 |
| 2 | RUB | - | 2 | - | - | 2 |
| 3 | MJB | - | - | 2 | 2 | 4 |
| 4 | MNB | - | 26 | - | - | 26 |
| 5 | Flyover | - | - | - | 8 | 8 |
| 6 | VUP | - | - | - | 18 | 18 |
| 7 | LVUP | - | 26 | - | - | 26 |
| 8 | PUP | - | 4 | - | - | 4 |
| 9 | CUP | - | 4 | - | - | 4 |
| **Total** | | **2** | **62** | **2** | **28** | **94** |

## Table 23: Summary of Substructures

| S. No | Type of Str | ABUTMENT | | | PIER | |
|---|---|---|---|---|---|---|
| | | RCC Twin Circular | RCC Box | RCC Wall | RCC Twin Circular | Single Circular |
| 1 | ROB | 2 | - | - | 2 | - |
| 2 | RUB | - | 2 | - | - | - |
| 3 | MJB | - | - | 4 | 3 | 1 |
| 4 | MNB | - | 26 | - | - | - |
| 5 | Flyover | 8 | - | - | 8 | |
| 6 | VUP | 18 | - | - | - | - |
| 7 | LVUP | - | 26 | - | - | - |
| 8 | PUP | - | 4 | - | - | - |
| 9 | CUP | - | 4 | - | - | - |
| Total | | **28** | **62** | **4** | **13** | **1** |
| | | **94** | | | **14** | |

## Table 24: Details of Structures

| S.No. | Chainage (Km) | Type of Structure | Side | Stron | Age of Structure | Skew | Span Arrangement (No x Length) (m) | No. of Spans | Span Length (m) | No. of Decks | Deck Width (m) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 12+125 | VUP | LHS | MCW | New | No | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 2 | 12+125 | VUP | RHS | MCW | New | No | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 3 | 12+380 | MNB | LHS | SR | New | No | 3 x 9.4 | 3 | 9.4 | 1 | 8.1 | - |
| 4 | 12+380 | MNB | LHS | MCW | New | No | 3 x 9.4 | 3 | 9.4 | 1 | 14.5 | - |
| 5 | 12+380 | MNB | RHS | MCW | New | No | 3 x 9.4 | 3 | 9.4 | 1 | 14.5 | - |
| 6 | 12+380 | MNB | RHS | SR | New | No | 3 x 9.4 | 3 | 9.4 | 1 | 8.1 | - |
| 7 | 12+450 | LVUP | LHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 8 | 12+450 | LVUP | RHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 9 | 15+725 | VUP | LHS | MCW | New | No | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 10 | 15+725 | VUP | RHS | MCW | New | No | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 11 | 16+060 | MNB | LHS | SR | New | No | 5 x 8.23 | 5 | 9.4 | 1 | 8.1 | - |
| 12 | 16+060 | MNB | LHS | MCW | New | No | 5 x 8.23 | 5 | 8.2 | 1 | 14.5 | - |
| 13 | 16+060 | MNB | RHS | MCW | New | No | 5 x 8.23 | 5 | 8.2 | 1 | 14.5 | - |
| 14 | 16+060 | MNB | RHS | SR | New | No | 5 x 8.23 | 5 | 8.2 | 1 | 8.1 | - |
| 15 | 17+353 | LVUP | LHS | MCW | New | Yes | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 16 | 17+353 | LVUP | RHS | MCW | New | Yes | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 17 | 17+890 | MNB | LHS | MCW | New | No | 3 x 9.2 | 3 | 9.2 | 1 | 16 | - |
| 18 | 17+890 | MNB | RHS | MCW | New | No | 3 x 9.2 | 3 | 9.2 | 1 | 16 | - |
| 19 | 19+970 | VUP | LHS | MCW | New | No | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 20 | 19+970 | VUP | RHS | MCW | New | No | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 21 | 21+183 | LVUP | LHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 22 | 21+183 | LVUP | RHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 23 | 23+065 | LVUP | LHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 24 | 23+065 | LVUP | RHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 25 | 23+687 | LVUP | LHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 26 | 23+687 | LVUP | RHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 27 | 24+547 | LVUP | LHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 28 | 24+547 | LVUP | RHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 29 | 25+100 | VUP | LHS | MCW | New | No | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 30 | 25+100 | VUP | RHS | MCW | New | No | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 31 | 26+590 | CUP | LHS | MCW | New | No | 1 x 3.0 | 1 | 3 | 1 | 16 | - |
| 32 | 26+590 | CUP | RHS | MCW | New | No | 1 x 3.0 | 1 | 3 | 1 | 16 | - |
| 33 | 27+029 | VUP | LHS | MCW | New | No | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 34 | 27+029 | VUP | RHS | MCW | New | No | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 35 | 29+600 | MNB | LHS | MCW | New | No | 3 x 9.3 | 3 | 9.3 | 1 | 21 | - |
| 36 | 29+600 | MNB | RHS | MCW | New | No | 3 x 9.3 | 3 | 9.3 | 1 | 21 | - |
| 37 | 30+078 | VUP | LHS | MCW | New | Yes | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 38 | 30+078 | VUP | RHS | MCW | New | Yes | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 39 | 32+574 | PUP | LHS | MCW | New | Yes | 1 x 8.15 | 1 | 8.15 | 1 | 16 | - |
| 40 | 32+574 | PUP | RHS | MCW | New | Yes | 1 x 8.15 | 1 | 8.15 | 1 | 16 | - |
| 41 | 33+000 | MNB | LHS | MCW | New | No | 1 x 9.0 | 1 | 9 | 1 | 15.5 | - |
| 42 | 33+000 | MNB | RHS | MCW | New | No | 1 x 9.0 | 1 | 9 | 1 | 15.5 | - |
| 43 | 33+585 | RUB | LHS | MCW | New | No | 2 x 13.5 | 2 | 13.5 | 1 | 50 | - |
| 44 | 33+585 | RUB | RHS | MCW | New | No | 2 x 13.5 | 2 | 13.5 | 1 | 50 | - |
| 45 | 34+360 | MNB | LHS | MCW | New | No | 1 x 8.8 | 1 | 8.8 | 1 | 13 | - |
| 46 | 34+360 | MNB | RHS | MCW | New | No | 1 x 8.8 | 1 | 8.8 | 1 | 13 | - |
| 47 | 36+070 | MJB | LHS | MCW | New | No | 13 x 25.0 | 13 | 25 | 1 | 16 | - |
| 48 | 36+070 | MJB | RHS | MCW | New | No | 13 x 25.0 | 13 | 25 | 1 | 16 | - |
| 49 | 37+053 | LVUP | LHS | MCW | New | Yes | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 50 | 37+053 | LVUP | RHS | MCW | New | Yes | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 51 | 38+547 | LVUP | LHS | MCW | New | Yes | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 52 | 38+547 | LVUP | RHS | MCW | New | Yes | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 53 | 41+102 | VUP | LHS | MCW | New | Yes | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 54 | 41+102 | VUP | RHS | MCW | New | Yes | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 55 | 41+468 | LVUP | LHS | MCW | New | Yes | 1 x 12 | 1 | 12 | 1 | 16.1 | - |
| 56 | 41+468 | LVUP | RHS | MCW | New | Yes | 1 x 12 | 1 | 12 | 1 | 16.1 | - |
| 57 | 42+263 | LVUP | LHS | MCW | New | Yes | 1 x 12 | 1 | 12 | 1 | 16.1 | - |

| S.No. | Chainage (Km) | Type of Structure | Side | Stron | Age of Structure | Skew | Span Arrangement (No x Length) (m) | No. of Spans | Span Length (m) | No. of Decks | Deck Width (m) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58 | 42+263 | LVUP | RHS | MCW | New | Yes | 1 x 12 | 1 | 12 | 1 | 16.1 | - |
| 59 | 43+670 | LVUP | LHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 60 | 43+670 | LVUP | RHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16 | - |
| 61 | 44+158 | ROB | LHS | MCW | New | Yes | 2 x 25 +1 x 37.28 | 3 | 29.09 | 1 | 16.1 | - |
| 62 | 44+158 | ROB | RHS | MCW | New | Yes | 2 x 25 +1 x 37.28 | 3 | 29.09 | 1 | 16.1 | - |
| 63 | 44+910 | MNB | LHS | MCW | New | No | 1 x 8.4 | 1 | 8.4 | 1 | 20 | - |
| 64 | 44+910 | MNB | RHS | MCW | New | No | 1 x 8.4 | 1 | 8.4 | 1 | 20 | - |
| 65 | 45+876 | LVUP | LHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16.1 | - |
| 66 | 45+876 | LVUP | RHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16.1 | - |
| 67 | 46+950 | Flyover | LHS | MCW | New | No | 4 x 25.0 | 4 | 25 | 1 | 14.5 | - |
| 68 | 46+950 | Flyover | RHS | MCW | New | No | 4 x 25.0 | 4 | 25 | 1 | 14.5 | - |
| 69 | 47+830 | Flyover | LHS | MCW | New | No | 20 x 25.0 | 20 | 25 | 1 | 14.5 | - |
| 70 | 47+830 | Flyover | RHS | MCW | New | No | 20 x 25.0 | 20 | 25 | 1 | 14.5 | - |
| 71 | 48+250 | PUP | LHS | MCW | New | Yes | 1 x 7.0 | 1 | 7 | 1 | 20.5 | - |
| 72 | 48+250 | PUP | RHS | MCW | New | Yes | 1 x 7.0 | 1 | 7 | 1 | 20.5 | - |
| 73 | 49+330 | VUP | LHS | MCW | New | Yes | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 74 | 49+330 | VUP | RHS | MCW | New | Yes | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 75 | 49+785 | MNB | LHS | SR | New | No | 5 x 8.72 | 5 | 8.72 | 1 | 8.1 | - |
| 76 | 49+785 | MNB | LHS | MCW | New | No | 5 x 8.72 | 5 | 8.72 | 1 | 14 | - |
| 77 | 49+785 | MNB | RHS | MCW | New | No | 5 x 8.72 | 5 | 8.72 | 1 | 14 | - |
| 78 | 49+785 | MNB | RHS | SR | New | No | 5 x 8.72 | 5 | 8.72 | 1 | 8.1 | - |
| 79 | 50+099 | Flyover | LHS | MCW | New | No | 3 x 24 | 3 | 24 | 1 | 14.5 | - |
| 80 | 50+099 | Flyover | RHS | MCW | New | No | 3 x 24 | 3 | 24 | 1 | 14.5 | - |
| 81 | 51+450 | CUP | LHS | MCW | New | No | 1 x 3.0 | 1 | 3 | 1 | 22.6 | - |
| 82 | 51+450 | CUP | RHS | MCW | New | No | 1 x 3.0 | 1 | 3 | 1 | 22.6 | - |
| 83 | 51+774 | LVUP | LHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16.1 | - |
| 84 | 51+774 | LVUP | RHS | MCW | New | No | 1 x 12 | 1 | 12 | 1 | 16.1 | - |
| 85 | 54+040 | MNB | LHS | MCW | New | No | 1 x 10.0 | 1 | 10 | 1 | 18 | - |
| 86 | 54+040 | MNB | RHS | MCW | New | No | 1 x 10.0 | 1 | 10 | 1 | 18 | - |
| 87 | 54+072 | MNB | LHS | MCW | New | No | 2 x 9.25 | 2 | 9.25 | 1 | 18.8 | - |
| 88 | 54+072 | MNB | RHS | MCW | New | No | 2 x 9.25 | 2 | 9.25 | 1 | 18.8 | - |
| 89 | 54+605 | VUP | LHS | MCW | New | No | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 90 | 54+605 | VUP | RHS | MCW | New | No | 1 x 24 | 1 | 24 | 1 | 14.5 | - |
| 91 | 57+127 | MJB | LHS | MCW | New | No | 13 x 31.6 | 13 | 31.6 | 1 | 16.0 | - |
| 92 | 57+127 | MJB | RHS | MCW | Old | No | 13 x 31.6 | 13 | 31.6 | 1 | 11.5 | - |
| 93 | 58+128 | Flyover | LHS | MCW | New | No | 3 x 24 | 3 | 24 | 1 | 14.5 | - |
| 94 | 58+128 | Flyover | RHS | MCW | New | No | 3 x 24 | 3 | 24 | 1 | 14.5 | - |

## 4.1 MATERIAL INVESTIGATION INFERENCES

### 4.1.1 SUBGRADE

Subgrade and Borrow area test results are considered from previous DD studies are as follows.

**Table 25: Test Results of Subgrade Samples Details**

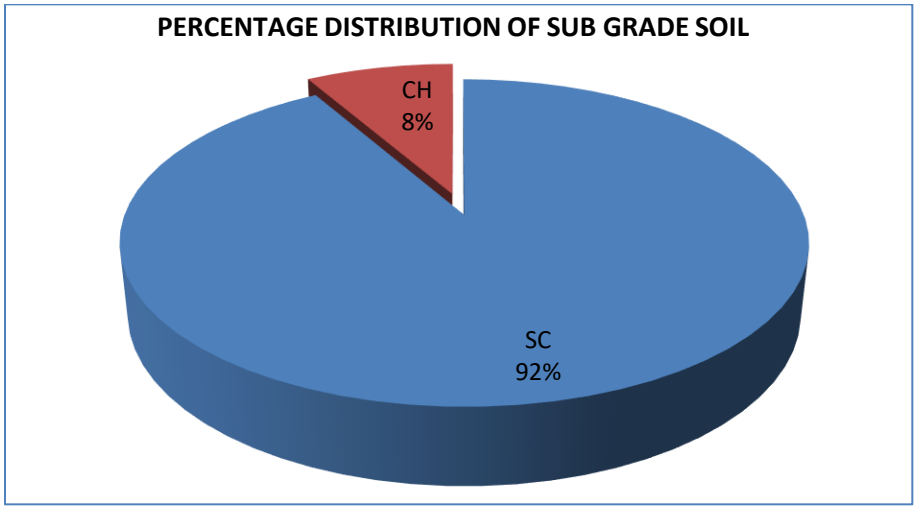
| Lab Sample No | Site Identification | | Grain Size Analysis | | | | | Atterberg Limits (%) | | | Soil Class | MDD (gm/cc) | OMC (%) | Soaked CBR 97% MDD | FDD (gm/cc) | Compaction (%) | Free Swelling Index (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Location (km) | Up/Dn | Percentage passing from | | | | | LL | PL | PI | | | | | | | |
| | | | 4.75 mm IS Sieve | 425 mic IS Sieve | 75 mic IS Sieve | Gravel % | Sand % | | | | | | | | | | |
| DJ-TP-1 | 10+250 | LHS | 78.27 | 40.05 | 33.08 | 21.73 | 45.19 | 34 | 21 | 13 | SC | 2.07 | 8.40 | | | | 21.74 |
| DJ-TP-2 | 14+900 | RHS | 92.18 | 61.31 | 38.78 | 7.82 | 53.4 | 31 | 19 | 12 | SC | 2.07 | 9.00 | 15.34 | 2.04 | 99 | 17.39 |
| DJ-TP-3 | 20+810 | LHS | 76.69 | 37.17 | 27.12 | 23.31 | 49.57 | 29 | 20 | 9 | SC | 2.12 | 9.60 | | 2.06 | 97 | 16.67 |
| DJ-TP-4 | 26+300 | RHS | 73.01 | 42.59 | 30.09 | 26.99 | 42.92 | 32 | 21 | 11 | SC | 2.05 | 11.20 | 12.36 | 2.04 | 100 | 13.04 |
| DJ-TP-5 | 30+650 | LHS | 79.78 | 39.99 | 32.38 | 20.22 | 47.4 | 30 | 17 | 13 | SC | 2.12 | 7.60 | 17.33 | 2.07 | 98 | 39.13 |
| DJ-TP-6 | 35+400 | RHS | 82.14 | 58.75 | 47.65 | 17.86 | 34.49 | 30 | 20 | 10 | SC | 2.10 | 7.60 | | 2.03 | 97 | 18.18 |
| DJ-TP-7 | 40+250 | LHS | 80.04 | 32.71 | 22.2 | 19.96 | 57.84 | 32 | 22 | 10 | SC | 2.21 | 8.80 | 26.13 | | | 17.39 |
| DJ-TP-8 | 45+200 | RHS | 67.00 | 31.93 | 23.96 | 33 | 43.04 | 40 | 27 | 13 | SC | 2.07 | 12.00 | | | | 26.09 |
| DJ-TP-9 | 50+520 | LHS | 91.93 | 72.71 | 57.86 | 8.07 | 34.07 | 63 | 42 | 21 | CH | 1.53 | 21.60 | NA | 1.50 | 98 | 54.17 |
| DJ-TP-10 | 55+500 | RHS | 75.70 | 49.69 | 24.42 | 24.3 | 51.28 | 40 | 27 | 13 | SC | 1.87 | 15.50 | 5.97 | 1.85 | 99 | 18.18 |
| DJ-SR-TP-1 | 38+250 | LHS | 87.79 | 54.37 | 48.84 | 12.21 | 38.95 | 49 | 28 | 21 | SC | 1.94 | 12.40 | 4.12 | 1.92 | 99 | 16.67 |
| DJ-SR-TP-2 | 51+980 | RHS | 80.80 | 31.36 | 15.75 | 19.2 | 65.05 | 32 | 23 | 9 | SC | 2.09 | 12.20 | 22.16 | 2.07 | 99 | 20.00 |

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

- Maximum Dry Density varies between 1.53 and 2.21 gm/cc. only 1 sample is not satisfying the MDD criterion (MDD>=1.75 gm./cc).
- OMC for existing subgrade samples varies between 7.6% to 21.6%.
- Free Swelling Index for existing subgrade samples varies between 13.04% to 54.17%. Out of 12 samples, 11 samples are satisfying the FSI criterion (FSI<=50%).
- Compaction levels are lower than the standard value of 97% of MDD
- Majority of the samples have CBR Values having more than 10% CBR.

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

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



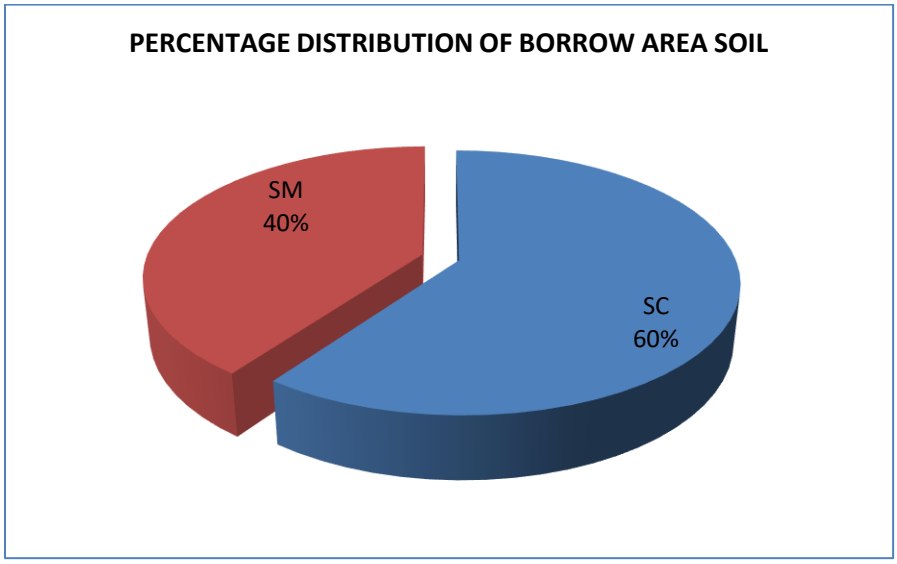

### 4.1.2 Borrow Area

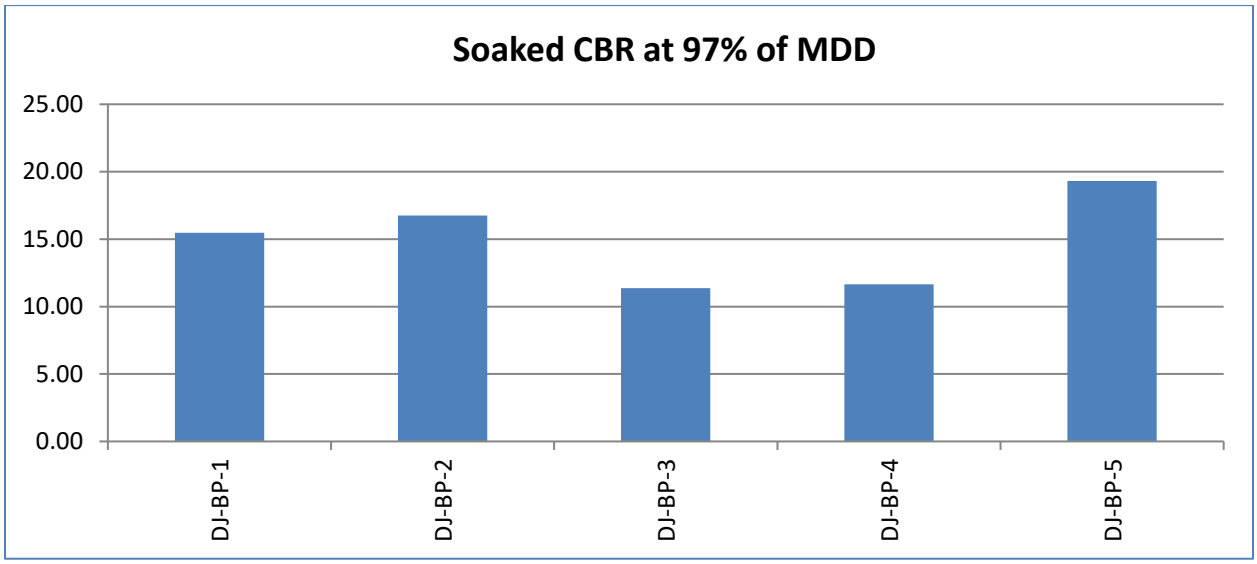
Borrow area test results are considered from previous DD studies are as follows.

**Table 26: Test Results of Borrow area Samples**

| Lab Sample No | Site Identification | | Grain Size Analysis | | | | | Atterberg Limits (%) | | | Soil Class | MDD (gm/cc) | OMC (%) | Dry density At 97% | Soaked CBR 97% MDD | Free Swelling Index (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Percentage passing from | | | | | | | | | | | | | |
| | Location (km) | Up/Dn | 4.75 mm IS Sieve | 425 mic IS Sieve | 75 mic IS Sieve | Gravel % | Sand % | LL | PL | PI | | | | | | |
| DJ-BP-1 | 49+300 | RHS | 83.06 | 50.9 | 31.87 | 16.94 | 51.19 | 32 | 23 | 9 | SC | 2.05 | 12.2 | 1.99 | 15.47 | 18.18 |
| DJ-BP-2 | 46+300 | LHS | 74.19 | 28.31 | 18.42 | 25.81 | 55.77 | 35 | 24 | 11 | SC | 2.21 | 9.20 | 2.14 | 16.76 | 14.29 |
| DJ-BP-3 | 23+700 | LHS | 87.98 | 69.28 | 22.31 | 12.02 | 65.67 | - | NP | NP | SM | 2.08 | 7.80 | 2.02 | 11.36 | 9.52 |
| DJ-BP-4 | 17+300 | LHS | 86.40 | 51.68 | 35.9 | 13.6 | 50.5 | 31 | 21 | 10 | SC | 2.07 | 8.40 | 2.01 | 11.65 | 14.29 |
| DJ-BP-5 | 39+500 | LHS | 87.18 | 24.01 | 13.59 | 12.82 | 73.59 | - | NP | NP | SM | 2.15 | 9.00 | 2.09 | 19.31 | 10.00 |

Pie Chart showing the percentage distribution of soil classification of Borrow area sample is presented below:




### 4.1.3 Aggregates

From Previous DD studies, the extracted test results of aggregate are as follows

**Table 27: Test Results of Aggregate Samples Details**

| S. No | Sample | Location (km) | Up/Dn | A.I.V | Water Absorption | Specific Gravity | Remark |
|---|---|---|---|---|---|---|---|
| 1 | DJ-AQ-1 | 42+250 | LHS | 11.27 | 0.39 | 2.90 | |
| 2 | DJ-AQ-2 | 30+100 | RHS | 10.48 | 0.36 | 2.92 | |
| 3 | DJ-AQ-3 | 58+100 | LHS | 18.19 | 0.28 | 2.56 | |

Note: All Aggregates samples are satisfying MoRTH requirements i.e., AIV (max. limit is 24% for Asphalt layer), Water Absorption (max. limit is 2%)

### 4.1.4 SAND

From Previous DD studies, the extracted test results of M-Sand are as follows

**Table 28: Test Results of Sand Samples Details**

| Sl No | Sample No | CHAINAGE | SIDE | 10 mm Passing % | 4.75 mm Passing % | 2.36 mm Passing % | 1.18mm Passing % | 600mic Passing % | 300mic Passing % | 150mic Passing % | FM | ZONE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | DJ-SQ-1 | 42+250 | LHS | 100 | 83 | 52 | 23 | 9 | 3 | 2 | **4.27** | **NO ZONE** |
| 2 | DJ-SQ-2 | 30+100 | RHS | 100 | 92 | 6 | 0 | 0 | 0 | 0 | **5.01** | **NO ZONE** |

Note: These sample does not belong to any zone.

## 4.2 CORE STRENGTH

Based on the extracted core samples obtained from the designated rigid pavement locations, a detailed assessment of the in-situ material strength was carried out. The compressive strength of each core was determined in accordance with relevant test procedures and standards. The results of the core strength tests provide critical insights into the structural integrity and performance of the existing pavement layers

The test results of the pavement cores are as presented below.

**Table 29: Test Results of Concrete core Details**

| S No. | Core ID | Chainage | Side | Mean Dia of Core (mm) | Core Length (mm) | Weight of Core in grms | Area (mm 2) | Failure Load (KN) | Comp. Strength (N/mm2) | | L/D Ratio | Correction Factor (L/D Ratio) 0.11*(Height/ | Corrected Strength of core | Equivalent Cube Strength (N/mm2) Fx1.25. | $F_{ck}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | L ≤ Ø75±5 mm | L ≥ Ø75±5 mm | | | | | |
| | | | | | | | a | b | C=b/a*1.08*1000 | C=b/a*1000 | D= L / d | E=0.11*D+0.78 | F = E*C | G = 1.25*F | H= 0.7*SQRT(G) |
| 1 | C-1 | 10+000 | LHS | 94.05 | 185 | 3174 | 6948 | 132.70 | | 19.10 | 1.97 | 1.00 | 19.03 | 23.79 | 3.41 |
| 2 | C-2 | 16+050 | LHS | 94.10 | 184 | 3183 | 6955 | 166.60 | | 23.95 | 1.96 | 1.00 | 23.83 | 29.79 | 3.82 |
| 3 | C-3 | 22+010 | LHS | 94.18 | 187 | 3326 | 6967 | 161.60 | | 23.20 | 1.98 | 1.00 | 23.15 | 28.93 | 3.77 |
| 4 | C-4 | 27+800 | LHS | 94.10 | 161 | 2628 | 6955 | 193.00 | | 27.75 | 1.71 | 0.97 | 26.86 | 33.57 | 4.06 |
| 5 | C-5 | 33+980 | LHS | 94.09 | 186 | 3217 | 6954 | 107.50 | | 15.46 | 1.98 | 1.00 | 15.42 | 19.27 | 3.07 |
| 6 | C-6 | 39+960 | LHS | 94.10 | 132 | 2200 | 6955 | 106.80 | | 15.35 | 1.40 | 0.93 | 14.35 | 17.93 | 2.96 |
| 7 | C-7 | 46+100 | LHS | 94.16 | 184 | 3182 | 6964 | 145.00 | | 20.82 | 1.96 | 1.00 | 20.72 | 25.90 | 3.56 |
| 8 | C-8 | 52+100 | LHS | 94.14 | 186 | 3203 | 6961 | 181.90 | | 26.13 | 1.97 | 1.00 | 26.05 | 32.56 | 3.99 |
| 9 | C-9 | 57+900 | LHS | 94.12 | 184 | 3221 | 6958 | 207.80 | | 29.86 | 1.95 | 0.99 | 29.70 | 37.13 | 4.27 |
| 10 | C-10 | 55+300 | RHS | 94.23 | 186 | 3159 | 6974 | 166.80 | | 23.92 | 1.97 | 1.00 | 23.84 | 29.80 | 3.82 |
| 11 | C-11 | 53+000 | RHS | 94.06 | 186 | 3177 | 6950 | 147.30 | | 21.19 | 1.98 | 1.00 | 21.14 | 26.43 | 3.60 |
| 12 | C-12 | 49+000 | RHS | 94.05 | 185 | 3176 | 6948 | 160.00 | | 23.03 | 1.97 | 1.00 | 22.94 | 28.68 | 3.75 |

| S No. | Core ID | Chainage | Side | Mean Dia of Core (mm) | Core Length (mm) | Weight of Core in grms | Area (mm 2) | Failure Load (KN) | Comp. Strength (N/mm2) | | L/D Ratio | Correction Factor (L/D Ratio) 0.11*(Height/ | Corrected Strength of core | Equivalent Cube Strength (N/mm2) Fx1.25. | $F_{ck}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | L ≤ Ø75±5 mm | L ≥ Ø75±5 mm | | | | | |
| | | | | | | | a | b | C=b/a*1.08*1000 | C=b/a*1000 | D= L / d | E=0.11*D+0.78 | F = E*C | G = 1.25*F | H= 0.7*SQRT(G) |
| 13 | C-13 | 43+010 | RHS | 94.14 | 185 | 3134 | 6961 | 127.30 | | 18.29 | 1.96 | 1.00 | 18.22 | 22.77 | 3.34 |
| 14 | C-14 | 36+950 | RHS | 94.09 | 185 | 3270 | 6954 | 250.30 | | 35.99 | 1.97 | 1.00 | 35.86 | 44.82 | 4.69 |
| 15 | C-15 | 31+020 | RHS | 94.24 | 185 | 3274 | 6976 | 306.10 | | 43.88 | 1.96 | 1.00 | 43.70 | 54.63 | 5.17 |
| 16 | C-16 | 28+600 | LHS | 94.09 | 182 | 3136 | 6954 | 215.20 | | 30.95 | 1.93 | 0.99 | 30.71 | 38.39 | 4.34 |
| 17 | C-17 | 24+980 | RHS | 94.15 | 182 | 3136 | 6963 | 215.20 | | 30.91 | 1.93 | 0.99 | 30.67 | 38.33 | 4.33 |
| 18 | C-18 | 18+930 | RHS | 94.19 | 185 | 3193 | 6969 | 165.70 | | 23.78 | 1.96 | 1.00 | 23.68 | 29.60 | 3.81 |
| 19 | C-19 | 18+040 | RHS | 94.09 | 185 | 3240 | 6954 | 190.00 | | 27.32 | 1.97 | 1.00 | 27.22 | 34.02 | 4.08 |
| 20 | C-20 | 13+000 | RHS | 94.08 | 185 | 3190 | 6953 | 116.20 | | 16.71 | 1.97 | 1.00 | 16.65 | 20.81 | 3.19 |

The above table indicates that Flexural strength of concrete core is varying from 2.96 MPa to 5.17 Mpa.

## 4.3 PAVEMENT CONDITION

- **Rigid Pavement**

As per IRC: SP: 83-2018 guidelines, for the identified pavement distresses the following rehabilitation/repair measures for rigid panels have been considered.

**Table 30: Panel Repair based on Pavement Condition**

| Dhara-Jhalawar | | Total Number of Panels observed various Repairs | | | | | |
|---|---|---|---|---|---|---|---|
| S No | Side | Total Panels for replacement | Partial 1m Full Depth Repair | Seal & Staple (in Panels) | Crack Seal | Ravelling in Number of Panels | Corner Break in Panels |
| 1 | LHS | 6 | 4 | 270 | 290 | 279 | 10 |
| 2 | RHS | 9 | 22 | 366 | 398 | 91 | 32 |
| **Total** | | **15** | **26** | **635** | **687** | **370 *** | **42** |

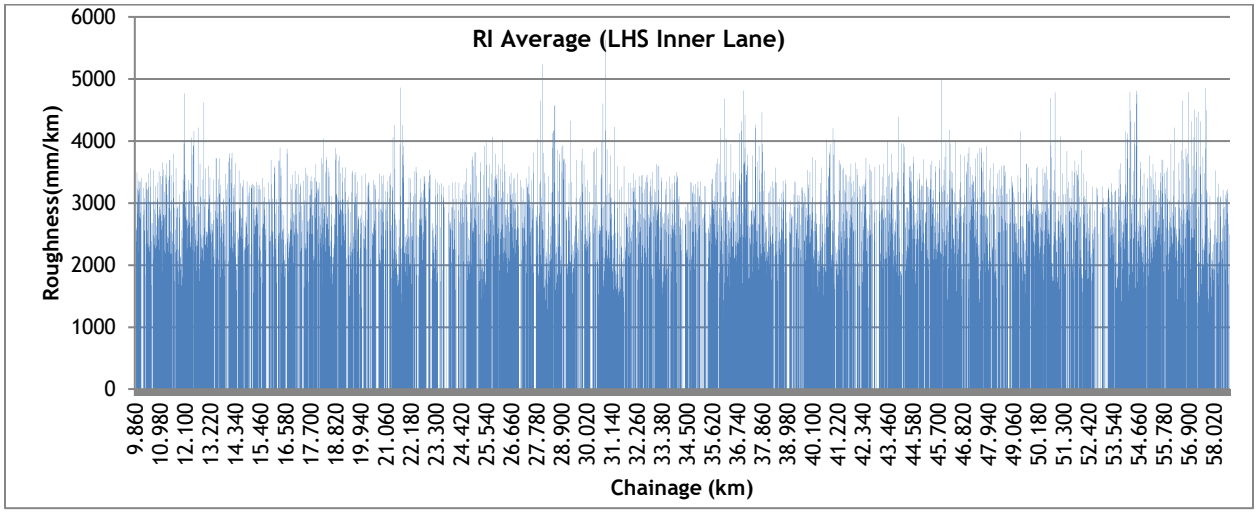
Note-1: * Based on visual identification, a total of 3,439 ravelled panels have been recorded, which is significantly higher compared to the 370 panels reported in the NSV data. For quantification 50% of total panels of 3439 has been considered.

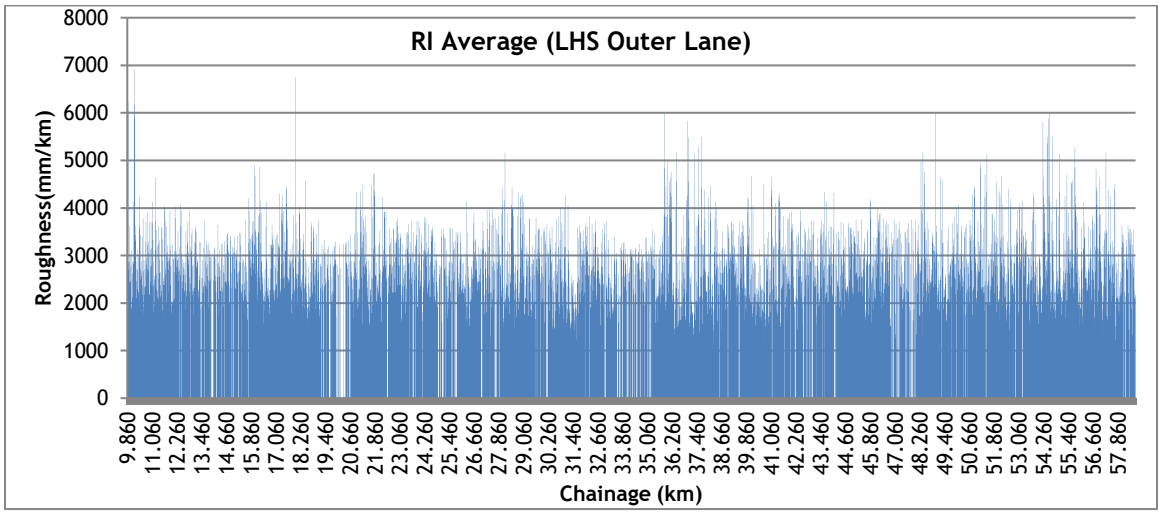
2: Patel Infrastructure Private Limited is currently undertaking pavement repairs and its associated maintenance works. Upon completion, the project will be handed over to ACTIS.

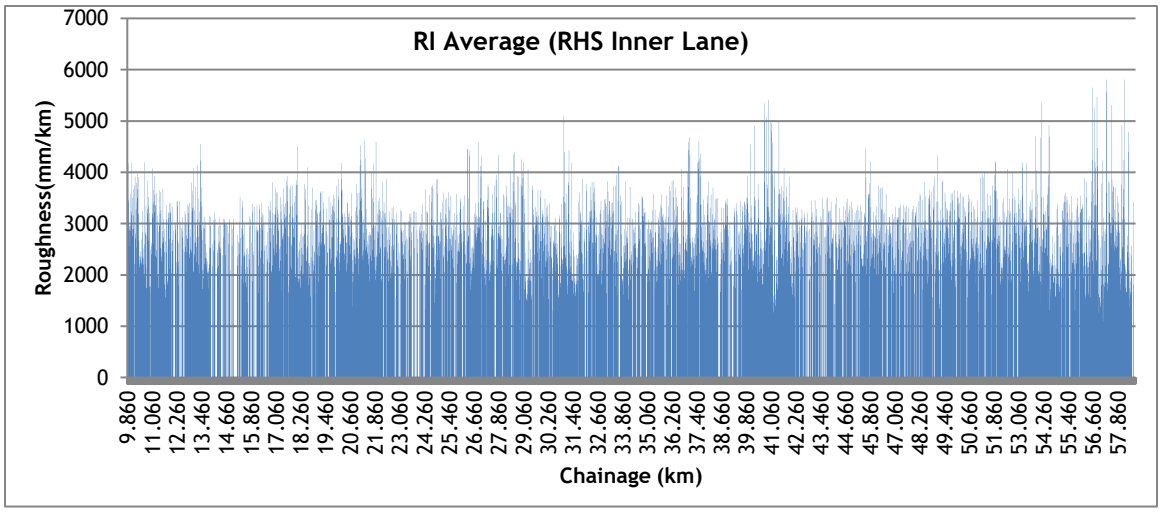
## 4.4 ROUGHNESS

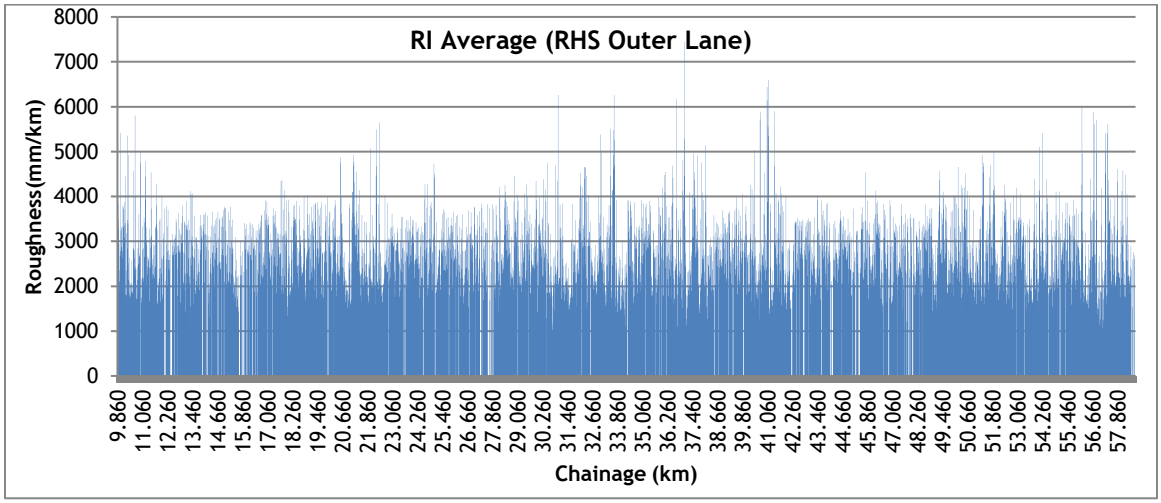
The Roughness represented in Bar charts for the main carriageway are as presented below:

- **Rigid Pavement**


RI Average (LHS Inner Lane)
Roughness(mm/km)
Chainage (km)


RI Average (LHS Outer Lane)
Roughness(mm/km)
Chainage (km)


RI Average (RHS Inner Lane)
Roughness(mm/km)
Chainage (km)




A moving average method has been adopted to analyze roughness data recorded at 10-meter point intervals. Based on this approach and considering a roughness threshold limit of 2750 mm/km, the lane-kilometer lengths corresponding to varying roughness levels are summarized below.

**Table 31: Summary of Roughness length**

| RI (mm/Km) | | Length (Km) | | | |
|---|---|---|---|---|---|
| >= | < | LHS Inner Lane | LHS Outer Lane | RHS Inner Lane | RHS Outer Lane |
| | 2000 | 7.160 | 9.960 | 7.870 | 11.480 |
| 2000 | 2500 | 9.950 | 10.690 | 9.810 | 10.240 |
| 2200 | 2750 | 5.530 | 4.840 | 5.240 | 4.930 |
| 2750 | | 15.330 | 15.780 | 15.360 | 16.170 |
| Rigid Length for Rectification | | 9.400 | 7.240 | 9.350 | 4.960 |
| No Data | | 0.100 | 0.100 | 0.080 | 0.120 |
| Abnormal Data | | 0.040 | 0.030 | 0.030 | 0.020 |
| Rumble Strips | | 0.280 | 0.240 | 0.200 | 0.090 |
| Structures | | 1.090 | 0.000 | 1.340 | 1.120 |
| **Total Length** | | 48.880 | 48.880 | 48.880 | **48.880** |

By attending the rectification 9.400/7.240 lane-km length in LHS inner/outer at identified locations the roughness values can bring down to required threshold value(<2750m/km) by considering moving average method for roughness values in km-length. However, still at scattered points having roughness higher than threshold value (>2750m/km) and these values may have no impact and nullified while considering average in a km-length.

Similarly, in RHS, by attending the rectification of 9.350/4.960 lane-km length in RHS inner/outer, the roughness values can bring down to required threshold value(<2750m/km) by considering moving average method for roughness values in km-length. However, still at scattered points having roughness higher than threshold value (>2750m/km) and these values may have no impact and nullified while considering average in a km-length.

## 4.5 STRUCTURES

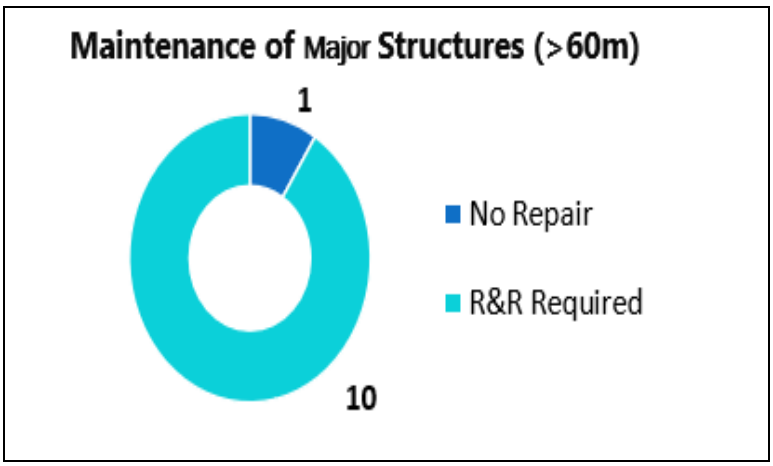
Inventory and asset condition of all the existing structures falling within project road have been verified as per IRC: SP-35 procedures and guidelines with following field surveys

- Inventory of existing highway bridges / structures
- Visual condition survey of existing highway bridges / structures

Each and every structure has been verified at site and detailed inventory and condition survey is presented in **Appendix-6** of this report.

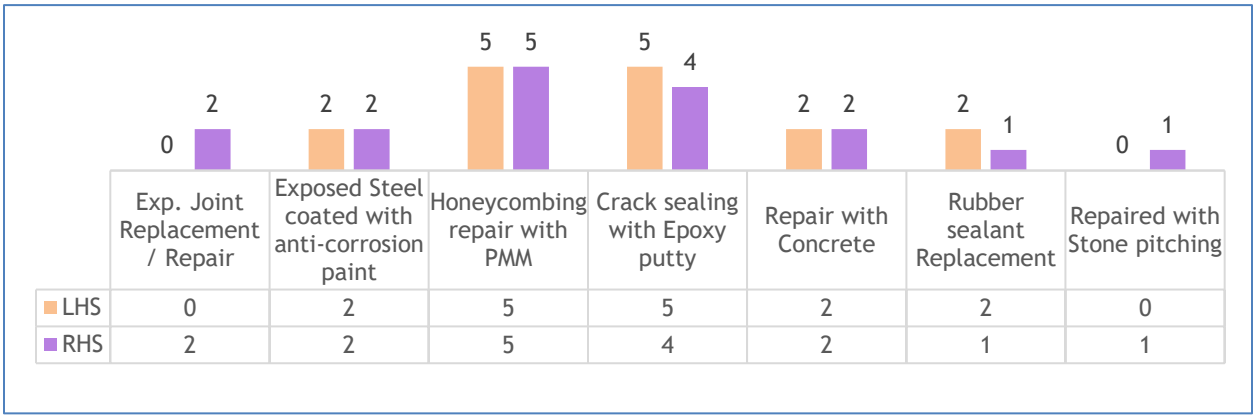
Maintenance of Major and Minor structures includes the following:

**Major Structures:**



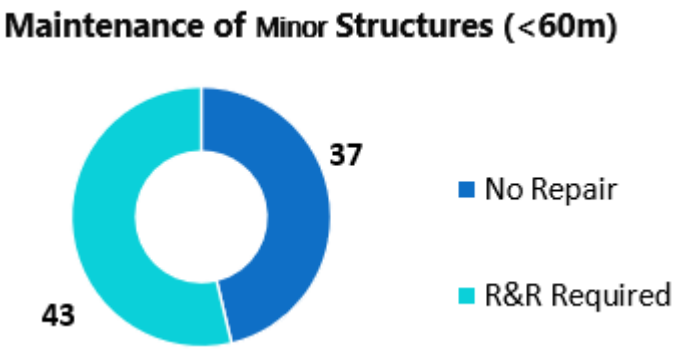

**Repair & Rehabilitation (R&R) measures include the following:**

The defects include Expansion joint damage, Reinforcement exposed, Honeycomb, Cracks, Concrete portion damage, Rubber sealant damaged, Quadrant pitching.



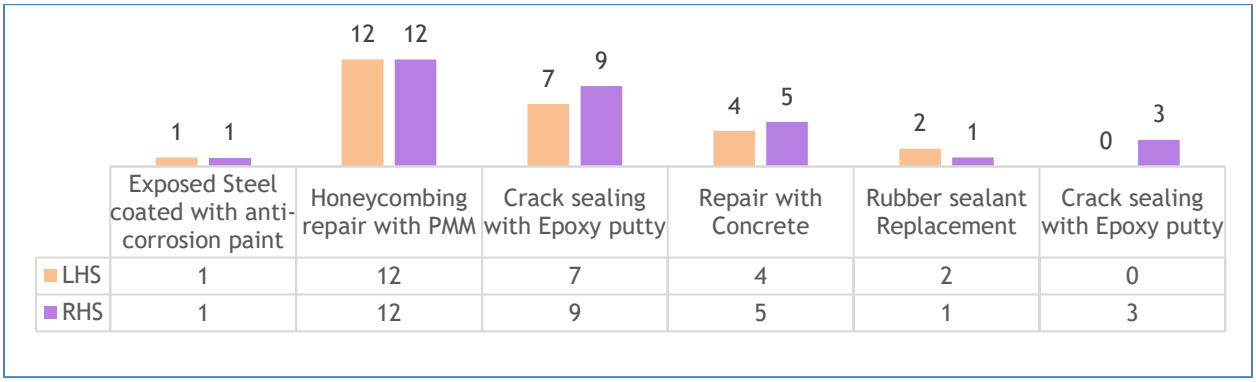

| | Exp. Joint Replacement / Repair | Exposed Steel coated with anti-corrosion paint | Honeycombing repair with PMM | Crack sealing with Epoxy putty | Repair with Concrete | Rubber sealant Replacement | Repaired with Stone pitching |
|---|---|---|---|---|---|---|---|
| LHS | 0 | 2 | 5 | 5 | 2 | 2 | 0 |
| RHS | 2 | 2 | 5 | 4 | 2 | 1 | 1 |

**Minor Structures:**




**Repair & Rehabilitation (R&R) measures include the following:**

The defects include Reinforcement exposed, Honeycomb, Cracks, Concrete portion, Concrete portion damage, Rubber sealant damaged, Minor Cracks.




| | Exposed Steel coated with anti-corrosion paint | Honeycombing repair with PMM | Crack sealing with Epoxy putty | Repair with Concrete | Rubber sealant Replacement | Crack sealing with Epoxy putty |
|---|---|---|---|---|---|---|
| LHS | 1 | 12 | 7 | 4 | 2 | 0 |
| RHS | 1 | 12 | 9 | 5 | 1 | 3 |

Overall condition of few of the major structures are presented on sample basis as below. However, each and every structure detail are presented in **Appendix-6** of this report

**Chainage: 44+158**

**General Description**

**LHS MCW (New)**

- Type of Structure : ROB
- Span Arrangement : 1 x 25 + 37.28 + 1 x 25 m
- Total length of Structure : 87.28 m
- Total deck width of Structure : 16.1 m
- Type of Foundation : Not Visible
- Type of Substructure (Abutment & Pier) : RCC Twin Circular
- Type of Superstructure : RCC Girder & Steel Girder
- Type of Bearing : Pot PTFE
- Type of Railing / Crash Barrier : Crash Barrier & Hand Rail
- Method of Inspection : Visual

**Observations**

Visual Observations on condition of the structure are as below:

- *Leaching through Cracks observed on soffit of deck slab in span-1 & 3.*
- *Honeycomb observed on bottom bulb of girder G1 near Abutment A2.*






**Chainage: 44+158**

**General Description**

**RHS MCW (New)**

- Type of Structure : ROB
- Span Arrangement : 1 x 25 + 37.28 + 1 x 25 m
- Total length of Structure : 87.28 m
- Total deck width of Structure : 16.1 m
- Type of Foundation : Not Visible
- Type of Substructure (Abutment & Pier) : RCC Twin Circular
- Type of Superstructure : RCC Girder & Steel Girder
- Type of Bearing : Pot PTFE
- Type of Railing / Crash Barrier : Crash Barrier & Hand Rail
- Method of Inspection : Visual

**Observations**

Visual Observations on condition of the structure are as below:

- *Honeycomb observed on bottom bulb of girder G3 & G4 near abutment A1.*
- *Honeycomb and Reinforcement exposure observed on soffit of girder G4.*
- *Honeycomb observed on soffit of deck slab between girder G4 & G5 and Cantilever slab near abutment A1.*






**Chainage: 33+585**

**General Description**

**LHS MCW (New)**

- Type of Structure : RUB
- Span Arrangement : 2 x 13.5 m
- Total length of Structure : 27 m
- Total deck width of Structure : 50 m
- Type of Foundation : Raft
- Type of Substructure (Abutment & Pier) : RCC Box
- Type of Superstructure : RCC Box
- Type of Bearing : Not Applicable
- Type of Railing / Crash Barrier : Crash Barrier
- Method of Inspection : Visual

**Observations**

Visual Observations on condition of the structure are as below:

- *Structure condition is good.*




**Chainage: 33+585**

**General Description**

**RHS MCW (New)**

- Type of Structure : RUB
- Span Arrangement : 2 x 13.5 m
- Total length of Structure : 27 m
- Total deck width of Structure : 50 m
- Type of Foundation : Raft
- Type of Substructure (Abutment & Pier) : RCC Box
- Type of Superstructure : RCC Box
- Type of Bearing : Not Applicable
- Type of Railing / Crash Barrier : Crash Barrier
- Method of Inspection : Visual

**Observations**

Visual Observations on condition of the structure are as below:

- *Structure condition is good.*

**Chainage: 36+070**

**General Description**

**LHS MCW (New)**

- Type of Structure : MJB
- Span Arrangement : 13 x 25.0 m
- Total length of Structure : 325 m
- Total deck width of Structure : 16 m
- Type of Foundation : Pile
- Type of Substructure (Abutment & Pier) : RCC Wall & Twin Circular
- Type of Superstructure : RCC Girder
- Type of Bearing : Elastomeric
- Type of Railing / Crash Barrier : Crash Barrier & Hand Rail
- Method of Inspection : Visual

**Observations**

Visual Observations on condition of the structure are as below:

- *Leaching through cracks observed on soffit of slab in span-1 & 2.*
- *Cracks observed on girders flange G1 & G2 in span-2.*
- *Honeycomb observed on soffit of slab between girder G2 & G3 in span-3.*
- *Cracks observed on girders flange G4 & G5 in span-3.*
- *Leaching through cracks observed in span-4.*
- *Honeycomb observed on soffit of girder G2 in span-12.*
- *Cracks observed on girder flange G1 in span-10.*
- *Rubber sealant damaged on expansion joint 7 & 12.*






## CULVERT PHOTOS

**Box Culvert at Km 11+605**

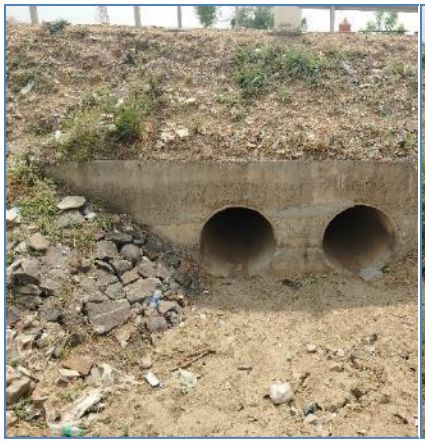
**Box Culvert at Km 13+400**

**Box Culvert at Km 13+980**

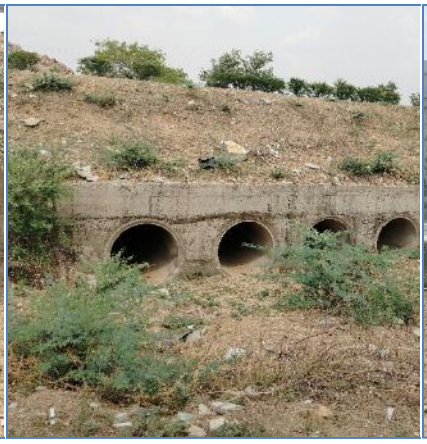
**Box Culvert at Km 25+800**

**Box Culvert at Km 39+162**

**Box Culvert at Km 44+070**



**Pipe Culvert at Km 9+919**



**Pipe Culvert at Km 10+592**

**Pipe Culvert at Km 17+320**

**Pipe Culvert at Km 30+100**

**Pipe Culvert at Km 46+650**

**Pipe Culvert at Km 55+146**

**General Observations on Structures: -**

- The Project stretch have 44 No's of major structures, in that 1 ROB, 1 RUB, 2 MJB's, 10 MNB's, 4 Flyover's, 9 VUP's, 13 LVUP's, 2 PUP's and 2CUP's.
- The Project Road has varieties of superstructure types for various structures such as RCC Girder & Steel Girder, RCC Girder, PSC Girder & RCC Box.
- In this project stretch, a total of 1,567 bearings have been observed in girder-type structures, which including 1,049 new Pot PTFE bearings and 518 Elastomeric bearings (78 old and 440 new).
- Structures are having 618 No's of Expansion joints in that 14 No's on old structures and 154 No's on the new structures.
- Some structures are already repaired and it would be necessary to closely examine these structures for further distress during the maintenance period/Project duration, by way of close inspection and testing.
- Cleaning of expansion joints, drainage spouts need to be done regularly.
- All the structures appear to be fair condition except at few locations having distresses like Cracks, Leaching, Honeycombing and Reinforcement exposure.
- The Rly. Steel Structure at Ch. 55+100 crosses over the project corridor is not to be in considered in Concessionaire's scope. This structure is under jurisdiction of the Railway Authority.
- As per Site Inventory it is understand from the structures, except MJB Ch:57+127 (RHS) is old structure and remaining structures are newly constructed.
- As per the CA, the stretch from km 48+000 to km 48+150 is designated as a Major Bridge (MJB), while the section from km 47+650 to km 48+000 is designated as an Elevated Flyover. However, during the site-visit, it was observed that both the MJB and the Elevated Flyover have been constructed as a single integrated structure, with the spans designated for the MJB incorporated into the overall flyover structure.
- In the project corridor 2 PUP's, 2 CUP, 2 Box Culverts and 31 Pipe Culverts were constructed under COS.

## 4.6 DRAINAGE AND SLOPE PROTECTION

- ✓ Lined Covered drains observed at urban locations and at service road Locations along the corridor.
- ✓ No major damages observed at covered drain locations.

## 4.7 TRAFFIC SAFETY AND ROAD FURNITURE

- ✓ Metal beam crash barriers provided along the project road appear to be intact over entire length except for few locations where it got damaged.
- ✓ Pedestrian guard rails installed on the Separator & appear to be intact and at few locations where it got damaged.
- ✓ Median Opening locations appear to be in good condition. Solar blinkers installed at median openings in the entire project corridor.
- ✓ Street lightings and High masts are observed at urban, Toll Plaza, Junction Locations, at few locations' street lightings are got damaged and not functioning well, and those items are addressed in the initial cost.

## 4.8 ROAD USER FACILITIES

- ✓ The Bus Bay with Shelters and Truck lay-byes were provided along the corridor.

# CHAPTER 5.REHABILITATION PLANS AND DESIGNS

## 5.1 DESIGN TRAFFIC LOADING

From the previous DD studies, at km 25+000 Toll Plaza location, the design traffic estimated in the year-2022 are as follows

| Design Period | MSA with 5% Growth Rate | |
|---|---|---|
| | UP | DN |
| 10 years | 51 | 75 |
| 15 years | 88 | 129 |
| 20 years | 135 | 197 |

## 5.2 PAVEMENT REHABILITATION AND STRENGTHENING

The surface appears to be intact without any major distresses. However, at various locations cracking (Longitudinal & Transverse), raveling and corner breaks are observed. Based on NSV pavement condition, the following pavement rehabilitation measures are considered to rectify the identified distresses and same is quantified under immediate repairs. However, the same are not considered as the Concessionaire will be undertaking these repair works under DLP.

- Total Panels for replacement,
- Partial 1m Full Depth Repair,
- Seal & Staple (in Panels),
- Crack Seal,
- Ravelling in Number of Panels,
- Corner Break in Panels

## 5.3 STRUCTURAL REHABILITATION

All the structure found to be in fair except minor treatment like crack repairs, repair of stone pitching, cleaning of drainage spouts, cleaning of vegetation etc. may be required. Detailed structural rehabilitation quantities have been worked out based on the prevailing condition of existing structures. This methodology describes in detail the procedure for the execution of each item of rehabilitation work of the Existing Bridges of the project.

The scope of this methodology covers the items mentioned below for rehabilitation work of all the existing Bridges.

- *Repair/ Replacement of Existing Bearings*
- *Repair / Replacement of Existing Expansion Joints*
- *Repair / Replacement of Existing Wearing Coat*
- *Profile Correction for Existing Deck Slab by Cement Concrete*
- *Sealing of Cracks for Bridges by Epoxy Resin*
- *Replacement of Spalled Concrete of ECW by Epoxy Mortar*
- *Cement Grouting for Repair of Existing Bridges*

- *Guniting / Shotcrete for Repair of Existing Bridges*
- *Providing & Fixing of Drainage Spouts*
- *Repair of Substructure Component*
- *Repair / Replacement of Railing & Crash Barrier*
- *Epoxy Bonding between New and Old Concrete.*

# CHAPTER 6.OPERATION AND MAINTENANCE

## 6.1 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 $10^{th}$ and $20^{th}$ year and includes main criterion of maintaining roughness at 2750 mm/km as per Schedule-F.

## 6.2 CA SPECIFICATIONS FOR MAJOR MAINTENANCE

- Schedule K of CA species that Roughness values exceed 2750mm/km in a length of KM, needs to be corrected within 180 days.
- No specific requirement with respect to deflection (FWD) measurement

## 6.3 RIGID PAVEMENT PERIODIC MAINTENANCE STRATEGY

Apart from the above requirements of Sch-F and maintaining the roughness and skid number for the rigid pavements, there are several other repair strategies included in Sch-K for rectification of defects in rigid pavement. These include following:

- Crack Seal
- Seal & Stitch
- Staple or Dowel Bar Retrofit
- Partial Depth Repair with Stapling
- Full Depth Repair: Dismantle and reconstruct affected Portion
- Diamond Grinding
- Joint Cleaning & Repair

Looking at the above requirements, it is felt necessary to consider following activities as part of periodic maintenance cycle at every 7th year apart from routine maintenance activities:

| Description | % | Unit | Rate | Quantity | Amount |
|---|---|---|---|---|---|
| Length of Rigid Pavement | | Kms | | 45.692 | |
| PQC Qty | | Cum | | 300353 | |
| Total Area | | Sqm | | 1006043 | |
| No of Transverse Joints | | no | | 10162 | |
| No of Panels | | no | | 63876 | |
| Length of Transverse Joints | | m | | 111783 | |
| Longitudinal Joint | | m | | 210354 | |
| Repair of Transverse Joint @ 7 years | 75.0% | m | 73.50 | 83837 | 6162010 |
| Repair of Longitudinal Joint @ 7 years | 75.0% | m | 73.50 | 157766 | 11595783 |
| Replacement of Transverse Joint @ 7 years | 2.0% | m | 845.00 | 2236 | 1889124 |
| Replacement of Longitudinal Joint @ 7 years | 2.0% | m | 845.00 | 4207 | 3554988 |
| Ravelling surface @ 7 years | 5.0% | Sqm | 963 | 50302 | 48415795 |
| Crack sealing Surface @ 7 years | 5.0% | m | 449 | 9138 | 4105745 |
| Repair of Panels @ 7 years | 0.50% | No | 8961 | 319 | 2858638 |
| Removal of Panels @ 7 years | 0.50% | No | 3781 | 319 | 1206021 |
| Relaying of Panels @ 7 years | 0.50% | No | 35285 | 319 | 11255862 |
| Regrinding @ 7 years | 25% | Sqm | 100 | 251511 | 25151063 |
| Regrinding and Retexturing @ 7years | 10% | Sqm | 500 | 100604 | 50302125 |
| Sub-Total, 7th year periodic maintenance cost in Crores (A) | | | | | 16.64972 |
| GST @ 18% on (A) | | | | | 2.99695 |
| Total Periodic Cost for Rigid Pavement in Rs. Cr. | | | | | 19.647 |

The above are in addition to routine maintenance activities which include following for every year:

| | | |
|---|---|---|
| Longitudinal Cracks more than 1.5m | Li.m | 0.50% |
| Longitudinal Cracks less than 1.5m | Li.m | 0.50% |
| Transverse Cracks less than 1.5m | Li.m | 0.50% |
| Transverse Cracks more than 1.5m | Li.m | 0.50% |
| Longitudinal Crack full Depth | Cum | 0.10% |
| Pothole | Sqm | 0.10% |
| Corner Cracks | Cum | 0.10% |
| Condition of Joints | Li.m | 1.00% |
| Diagonal Cracking | Li.m | 0.50% |
| Raveling of panel | Sqm | 0.15% |

## 6.4 STRUCTURAL PERIODIC MAINTENANCE STRATEGY

**Expansion joints:**

- Visual inspection is shall be carried out to check for seal breakages, Armor angle, Weld failures, cracks between deck & Expansion joints concrete and Joints filled with debris. However, no damages were observed.

- In the absence of records pertaining to Expansion joint replacements it is highly difficult to predict the date of replacement needed for compliance to IRC codal requirements. However, periodic maintenance is considered.

**Bearings:**

- All types of Bearings are considered for periodic maintenance.

**Wearing Coat:**

- Wearing coat is a very weak component on the bridge structure which is subjected to severe deterioration due to Loading, Environment etc. This requires periodic maintenance and is considered in BOQ.

| Age | Description | Item | Old structures | | | | New structures | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | % of Replacement | | | | % of Replacement | | |
| | | | 2028 | 2033 | 2037 | | 2028 & 2033 | 2037 | |
| New | Super structure lifting with Pot bearings | Pot | 0% | 0% | | | 5% | 70% | |
| New | Super structure lifting with Elastomeric bearings | Ela | 0% | 0% | | | 10% | 80% | |
| New | Super structure lifting with Rocker bearings | Rocker | 0% | 0% | | | 0% | 50% | |
| | | | | | | | | | |
| Old | Super structure lifting with Pot bearings | Pot | 100% | 100% | | | 0% | 0% | |
| Old | Super structure lifting with Elastomeric bearings | Ela | 100% | 100% | | | 0% | 0% | |
| Old | Super structure lifting with Rocker bearings | Rocker | 100% | 100% | | | 0% | 0% | |
| | | | | | | | | | |
| New | Pot bearing cost | Pot | 0% | 0% | | | 5% | 70% | |
| New | Elastomeric bearing cost | Ela | 0% | 0% | | | 10% | 80% | |
| New | Rocker bearing cost | 0 | 0% | 0% | | | 0% | 50% | |
| | | | | | | | | | |
| Old | Pot bearing cost | Pot | 100% | 100% | | | 0% | 0% | |
| Old | Elastomeric bearing cost | Ela | 100% | 100% | | | 0% | 0% | |
| Old | Rocker bearing cost | 0 | 100% | 100% | | | 0% | 0% | |
| | | | | | | | | | |
| New | Expansion joint Replacement | 0 | 0% | 0% | | | 20% | 70% | |
| Old | Expansion joint Replacement | 0 | 100% | 100% | | | 0% | 0% | |
| | | | | | | | | | |
| New | Others | 0 | 0% | 0% | | | 20% | 70% | |
| Old | Others | 0 | 100% | 100% | | | 0% | 0% | |

Note: **OLD**- Retained at the time of 4-laning & **NEW**- Constructed during the time of 4-laning

## 6.5 MAJOR MAINTENANCE OF TMS & ATMS

**TMS equipment**: This activity includes Toll Fee collection equipment pertaining to Lane level and plaza level as mentioned below:

- includes Lane Level Equipment - Hybrid ETC Lane such as RFID readers, User fare display (UFD), Automatic Barrier Gate), Over Head Lane Signal (OHLS), Incident Capture Camera with mounting pole, Booth CCTV Camera, License Plate Image Capture Camera with mounting poles, Plaza surveilance PTZ cameras with all accessories etc
- includes Plaza Level Equipment- Plaza Server in hot standby configuration, Workstation for MIS, Cash-up, Audit, POS & LSDU (Lane status Display in Control room), Broadband Internet Connection with Min 2 Mbps Link, UPS System as required for Complete Hybrid ETC Toll Plaza System, 55" LED TV for CCTV monitoring, CCTV cameras for Plaza building surveillance (server room, control room, cash-up room, admin) and Intercom Master Unit in control room - 20 Channel (for > 8 lanes)
- Upon review it is understood that approximately 65% of the Cost contributes electronic equipment and balance for civil works such as foundation, poles etc.

Major maintenance of TMS is planned every 5 years, in line with best industry practices. Accordingly, 3 maintenance cycles are envisaged over the Concession Period. Considering the continuous usage/operation of the TMS equipment, a cumulative cost equivalent to approximately 2.1 times the total TMS cost has been factored in and distributed across these three cycles. Capacity augmentation has no impact on TMS operation/equipment as tolling is a continuous process including its maintenance.

**ATMS equipment:** Includes Automatic Traffic Counter and Classifier (ATCC) with all accessories, Traffic Monitoring Camera System Equipment (TMCS), VMS Systems, Meteorological Data System (MET) with all accessories, RFID readers with antenna, Vehicle Speed Detection System Equipment(VSDS) etc, These equipment spread across the project length such as at junctions, grade separator structures, merging/diverging locations etc, all being controlled from a central monitoring system usually located at Toll Plaza Building.

The following assumptions have been considered while finalizing the MMR cost for ATMS:

- The cost of electronic components typically constitutes 60% of the total ATMS cost, with the remaining balance attributed to civil works.
- Major maintenance of ATMS is planned every 7 years, in line with best industry practices. Accordingly, 2 maintenance cycles are envisaged over the Concession Period. A cumulative cost equivalent to approximately 1-time of the electronic components cost of ATMS equipment has been factored in and distributed across these 2 cycles. In case, where stretches involving capacity augmentation, this cost may vary, as ATMS components will be upgraded under EPC Contract. Accordingly, enhancement of maintenance cost of ATMS equipment need to be considered in line with capacity augmentation requirements. However, no capacity augmentation is envisaged in this project.
- Any change in the Capacity Augmentation year or Concession end period will lead to a variation in the distribution of ATMS/TMS costs.
- It is assumed that the ATMS/TMS equipment is insured against risks such as theft, accident, and loss.
- The calculated MMR cost for ATMS/TMS is in addition to the Annual Comprehensive AMC.

# CHAPTER 7. COST

Cost Component for various items and activities have been worked out by considering the Best Industry practice and most appropriate methods. Detailed quantities for work items have been estimated based on the details presented in previous chapters for various heads.

The List of the cost components considered are presented below:

- *Immediate Repair's Cost*
- *Routine Maintenance Cost*
- *Incident Management Cost*
- *Periodic Maintenance Cost*
- *Operations Cost*
- *Year by Year total O&M Costs*

## 7.1 RATE ANALYSIS

Detailed rate analysis has been carried out based on MORTH guidelines to arrive at the unit rates of various items. Material rates and their leads from the project corridor are considered as per the material investigations done on the project road. Summary of unit rates arrived at are presented in table below:

**Table 32: Unit Rates of Basic material**

| S No | Description | Units | Source | Basic rate excluding Transportation & GST | Lead in Kms |
|---|---|---|---|---|---|
| 1 | Good earth | Cu.m | BA | 5 | 4.20 |
| 2 | 40 mm | Cu.m | Crusher | 483 | 15.35 |
| 3 | 20 mm | Cu.m | Crusher | 520 | 15.35 |
| 4 | 12 mm | Cu.m | Crusher | 520 | 15.35 |
| 5 | 6 mm | Cu.m | Crusher | 780 | 15.35 |
| 6 | Dust | Cu.m | Crusher | 857 | 15.35 |
| 7 | M sand | Cu.m | Crusher | 872 | 15.35 |
| 8 | Boulders | Cu.m | Querry | 215 | 7.00 |
| 9 | Sand source to Plant | Cu.m | River | 1046 | 10.00 |
| 10 | Sand source to working site | Cu.m | Stock yard | 1046 | 8.00 |
| 11 | Bitumen 60/70 | MT | Mathura | 41951 | 463.00 |
| 12 | Bitumen 80/100 | MT | Mathura | 42096 | 463.00 |
| 13 | VG-40 | MT | Mathura | 46647 | 463.00 |
| 14 | CRMB-55 | MT | Mathura | 49612 | 463.00 |
| 15 | PMB | MT | Mathura | 57102 | 463.00 |
| 16 | SS1 | MT | Mathura | 45000 | 463.00 |
| 17 | Steel | MT | Kota | 52000 | 81.00 |
| 18 | HTS Strands | MT | Kota | 75000 | 81.00 |
| 19 | Cement | MT | Kota | 7000 | 81.00 |
| 20 | Structural Steel | MT | Kota | 57000 | 81.00 |

Note: *For future asphalt pavement rehabilitation works, a discount of 10% is applied on Bitumen (VG-40) to the present market rate

**Table 33: Major Material Cost excluding GST**

| S No | Item | Unit | Rate (INR) |
|---|---|---|---|
| 1 | Embankment - borrow | Cum | 297 |
| 2 | Embankment - Excavation | Cum | 82 |
| 3 | Subgrade | Cum | 305 |
| 4 | GSB G-2 | Cum | 2045 |
| 5 | WMM | Cum | 2100 |
| 6 | Prime Coat | Sqm | 52 |
| 7 | Tack coat on granular | Sqm | 17 |
| 8 | DBM G-1 | Cum | 8875 |
| 9 | Tack coat on bituminous surface | Sqm | 16 |
| 10 | BC - G1 | Cum | 10427 |
| 11 | Road Marking | Sqm | 535 |
| 12 | RE wall | Sqm | 4882 |
| 13 | Select Fill | Cum | 336 |
| 14 | Filter Media | Cum | 1869 |
| 15 | M15 | Cum | 5983 |
| 16 | M20 | Cum | 6739 |
| 17 | M25 | Cum | 7359 |
| 18 | M30 | Cum | 7305 |
| 19 | M35 | Cum | 7580 |
| 20 | M40 | Cum | 7721 |
| 21 | PSC M45 | Cum | 9,291 |
| 22 | HYSD | MT | 76246 |
| 23 | HT strand | MT | 150454 |

NOTE: 1. Item rates are considered for medium projects

2. Labour: Central Minimum Wages as on April'2025 for "C Area" Category of construction workers

## 7.2 INITIAL IMPROVEMENT COSTS

Costs associated with immediate repairs are estimated based on the detailed asset inventory and condition assessment surveys, Pavement condition and structural condition assessment surveys. Items which are not executed as part of scope or in damaged condition have been considered for immediate costs as a part of 1-year capex. Following items are mainly considered for immediate costs:

- Road work items
- Bridge Work Items
- Pavement Rehabilitation works
- Structural Rehabilitation works
- Drainage Works
- Slope Protection works
- Safety Works

**Table 34: Summary of Initial Improvement Cost**

| S.no | Description | Unit | Quantity | Amount (Rs.) |
|---|---|---|---|---|
| 1 | Immediate Repair's (Highway) | LS | 1 | 47,82,068 |
| 2 | Immediate Repair's - Structures | LS | 1 | 15,34,765 |
| 3 | TMS | LS | 1 | 22,12,779 |
| 4 | Pavement Repair Cost | LS | 1 | 7,55,94,382 |
| 5 | Deduct the Costs covered under DLP as informed by the Company | | | -6,02,00,909 |
| Initial Improvement Cost (without GST) in Rs | | | | 2,39,23,085 |
| Initial Improvement Cost (with GST) in Rs * | | | | **2,82,29,085**<br>**Say 2.82 Cr.** |

*Note: As informed by company, Patel Infrastructure Private Limited is currently undertaking pavement repairs associated maintenance works. Upon completion, the responsibility will be handed over to ACTIS.

The table below presents the Summary of Immediate Repair Costs for the Highway components:

| S.no | Description | Unit | Quantity | Rate (Rs.) | Amount (Rs.) |
|---|---|---|---|---|---|
| 1 | RCC Covered Drain Slab | Rmt | 109 | 2350 | 256150 |
| 2 | Median Plantation-Non Functional | Km | 4.490 | 200000 | 898000 |
| 3 | Km Stones | No | 3 | 3565 | 10781 |
| 4 | Hectometer Stone | No | 48 | 1019 | 48893 |
| 5 | Cantilever Gantry | No | 4 | 15000 | 60000 |
| 6 | Kerb - To be Rise | Rmt | 14095 | 240 | 3382800 |
| 7 | Transverse Bar Marking-Poor marking | Sq.m. | 31.5 | 589 | 18538 |
| 8 | Pedestrian Crossing Marking | Sq.m. | 16 | 589 | 9416 |
| 9 | Toll Boards | Nos | 1 | 3000 | 3000 |
| 10 | ADS/RAS | Nos | 1 | 4346 | 4346 |
| 11 | Recangular - Damage | Nos | 5 | 4346 | 21731 |
| 12 | Triangular - Damage | Nos | 4 | 2076 | 8305 |
| 13 | Flag Type | Nos | 1 | 4346 | 4346 |
| 14 | Chevron - Damage | Nos | 7 | 3775 | 26426 |
| 15 | Hazard - Damage | Nos | 1 | 3146 | 3146 |
| 16 | Route marker - Damage | Nos | 1 | 3775 | 3775 |
| 17 | Lights | Nos | 2 | 2000 | 4000 |
| 18 | Rain water Harvesting-Filled with Vegetation | Nos | 37 | 500 | 18500 |
| Immediate Repair cost (Highways) without GST | | | | | 47,82,068 |

The table below presents the Summary of Immediate Repair Costs for Structure components:

| S. No. | Description | Amount in Rs |
|---|---|---|
| 1 | Structures<br>RCC Crash barrier,Cracks, Concrete Dismantling, Approach slab settlement, Honeycomb, Cutting of Groove, Weed removal, Epoxy, etc | 4,48,118 |
| 2 | Protection works | 10,86,647 |
| Immediate repair for Structures excluding GST (18%) | | **15,34,765** |

The table below presents the Summary of Immediate Repair Costs of TMS works for shortage/non-functional components:

| Sl. No. | Activity | Cost of shortage / recommended items cost in INR (Ex tax) |
|---|---|---|
| 1 | TMS works of toll plaza | 2,212,779 |

The table below presents the Summary of Immediate Repair Cost of Rigid pavement to attend panel distresses and roughness correction:

| S No | Item | Units | Total | Rate | Amount |
|---|---|---|---|---|---|
| 1 | Replacement of Panels | Cum | 71 | 9808 | 6,95,172 |
| 2 | Part 0.5m width replacement of Panel | Cum | 18 | 9808 | 1,72,138 |
| 3 | Corner Break | Cum | 3 | 9808 | 30,897 |
| 4 | Stapple & stitching | m | 2858 | 2000 | 57,15,000 |
| 5 | Crack Seal | m | 1546 | 400 | 6,18,300 |
| 6 | Ravelling | Sqm | 27082 | 800 | 2,16,65,700 |
| 7 | Diamand Grinding | Sqm | 51886 | 900 | 4,66,97,175 |
| Immediate repair cost for Rigid pavement in Rs (without GST) | | | | | 7,55,94,382 |

However, present Concessionaire is under taking these repairs and will maintain until its end of DLP

## 7.3 ROUTINE MAINTENANCE & INCIDENT MANAGEMENT COSTS

Routine maintenance costs include general maintenance costs of road elements, bridge elements and road furniture and appurtenances. This can be mainly divided into two parts as:

- ✓ General Maintenance of Works
- ✓ Repairs to Highway & Bridge Elements

### 7.3.1 General Routine Maintenance

General Routine Maintenance of Roads generally include following items:

- Maintenance of noise barriers along AUP approach locations

- Cleaning of Project facilities
- Structures cleaning,
- Cleaning of ROW
- Cleaning and Maintenance of Toll Plaza
- Unlined Drain Maintenance
- Lined Drain Maintenance
- Maintenance of Highway Lighting at Toll Plaza and other project locations
- Median Plantation maintenance & Avenue plantation maintenance:
- Maintenance of Road Furniture
- Maintenance of Road Safety Items

The above items are estimated by considering the detailed break-up of following items:

- Manpower including Managers/Labour etc.
- Vehicles for Labour Transport/Water Tankers/Sweeping Machines etc.
- Resources/Equipment's such as grass cutters, tools, jet sprayers, hydraulic trimmers etc.

### 7.3.2 Repairs to Highway & Bridge Works

Repairs to highway and bridge works have been estimated based on the assumed quantities (Percentage basis) of execution for every year.

These items include the following:

| | |
|---|---|
| 1 | Providing treatment for sealing of road surface / isolated cracks at scattered locations |
| | i) Covered with 6.7 mm size stone chipping @ 0.1 cum/ 10 sqm. |
| | ii) covered with dry coarse sand passing through 2.36 mm sieve and retained on 180-micron sieve @ 0.03 cum/10 sqm heated to 600 C |
| | iii) filling discrete cracks with slow curing bitumen emulsion as per Technical Specification Clause 3004.3.3 |
| 2 | Providing treatment to bleeding bituminous surface at scattered locations |
| 3 | Providing localized repair to rutted portion and edge breaking of bituminous surface |
| 4 | Providing treatment and repair to pot-holes and patch work |
| 5 | Providing and laying dense bituminous macadam using bitumen grade VG 40 complete as per Technical Specification Clause 507 |
| 6 | Proving and laying bituminous concrete (asphaltic concrete) |
| | (a) Using bitumen (VG-40) as per IRC: SP: 53 |
| 7 | Road Roughness survey |
| 8 | Turfing on embankment slopes and at all other Project Facilities |
| 9 | Providing repair to stone pitching/apron at scattered locations |
| 10 | Rain Cuts Maintenance: Restoration of rain cuts soil, moorum, gravel or a mixture of these |
| 11 | Providing and laying apron/ stone pitching on slopes of guide bunds/ road embankment / other location |
| 12 | Providing and laying stone aggregate filter material (150 mm compacted thickness) underneath pitching |
| 13 | Unlined drain |
| 14 | Filling in median island with approved materials with all leads and lifts complete as per TS Clause No. 407 |
| 15 | Replacing damaged / broken railing with new pre-cast / cast-in-situ, concrete railing to match with existing design and pattern. |
| 24 | Carrying out repair to road signs including strengthening resetting or otherwise repairing signs and delineators |
| | a) Road sign board mounted on single post |
| | b) Road sign board mounted on double post |
| | c) Overhead/ Gantry Sign boards |

| | |
|---|---|
| | d) Delineator |
| 25 | Supplying and fixing at site retro-reflectorized type **sign boards/signs** |
| | 90cm Equilateral triangle |
| | 60cm circular |
| | 90 cm circular |
| | 90cm high octagon |
| | 80cm x 60cm rectangle |
| | Chevron signs 60cm x 45cm |
| | Place identification signs (Fig 15.7 of IRC 67) |
| | Providing and fixing Object Markers |
| | Providing and fixing of retro-reflectorized Route Marker signs (size 450mm x 600mm) |
| 26 | **Hazard Marker Sign:** |
| | a) size 90 x 30 cm |
| | b) size 30cm triangular side cluster of red reflectors (screen printed) |
| 27 | Cats Eyes/Raised pavement marker (NMC Nails Less) |
| 28 | Painting two coats on old surface after minor repairs to give an even and smooth surface and printing letters and figures with synthetic enamel paint |
| | a) Hectometer stones |
| | b) Kilometer Stone |
| | c) 5 Kilometer stone |
| | d) Boundary stone |
| | e) Guard stone |
| 29 | Providing painting lettering and fixing of distance measurement stones including dismantling of old damaged/ broken ones, confirming to TS Clause 804 |
| | a) Hectometer stones |
| | b) Kilometer Stone |
| | c) 5 Kilometer stone |
| | d) Boundary stone |
| | e) Guard stone |
| 30 | Providing and fixing road delineators conforming to TS Clause No. 805 as directed by the Engineer. |
| 31 | Repainting the kerb stones and separation barrier with first quality synthetic enamel paint of approved brand |
| 32 | Painting all types of pavement markings including lines, dashes, arrows etc. on roads as per relevant IRC/MOST standards after cleaning the surface complete in all respects as directed by the Engineer. |
| | a) Hot applied Thermoplastic compound |
| | (i) Lane / Centre Line / Edge Line |
| | (ii) Direction Arrows |
| | (iii) Diagonal Chevrons Markings |
| 33 | Supplying and laying cast-in-situ cement concrete kerb without channel section |
| | a) by Manual/machine including formwork |
| 34 | Major repair / replacement of metal beam crash barrier (W profile guard rails) |
| 35 | Providing and fixing chain link/ welded mesh fencing / square bars fencing |
| 36 | Dismantling the old damaged chain link/welded mesh / square bars fencing and replacing it with new chain link/ welded mesh/square bars fencing |
| 37 | Provision of rumble strips |
| 38 | Shoulder Maintenance: |
| 39 | synthetic enamel paint of approved brand on metal pedestrian guard rail |
| 40 | Dismantling of wearing course |
| 41 | Repair and maintenance of noise barriers in forest area |

**B. Structures**

1. Wearing coat comprising of 50 mm thick BC.
2. Cleaning and adding rubber sealant near expansion joints.
3. Modular Expansion joints.
4. Replacement of Damaged Concrete Railing all complete as per technical specifications and as directed by the Engineer
5. Provision of an RCC crash barrier (0.35sqm cross sectional area) constructed with M-40 grade concrete including reinforcement
6. Cleaning of rocker & roller bearing using high pressure water jet, free from rust scales, re-setting & greasing the bearings using graphite grease including cost of materials, labour etc., complete.
7. POT PTF Bearings greasing and maintaining (sand plastering).
8. Elastomeric Bearings and maintaining.
9. Cutting of groove of 15 mm x 15 mm along crack and sealing the same with epoxy putty including cost of material, labour etc.
10. Carrying out 50mm to 60mm thick short sheeting using a mix proportion of 1:2:2 (cement: sand:6 mm down aggregate) added with Polypropylene fibers at a dosage rate of 125 gms/bag of cement including cost of labour, material, scaffolding, equipment etc complete.
11. Repair of Floor Aprons, pitching and other protection works
12. Cleaning of Drainage Spouts
13. M-25 Concrete

**7.3.3 Incident Management Cost**

Incident Management & Safety items include the following:

- ✓ ATMS control room operations,
- ✓ Regular patrolling & reaching accident/incident site,
- ✓ providing relief to injured persons including taking them to nearest hospital and attending to the safety requirements at the location (putting cones, safely guide & manage the traffic using signs, safety barricades, etc.),
- ✓ removal of accident /breakdown vehicles, removing of dead animals/birds lying on the highway and loading, unloading, transportation & disposal of surplus material left over by accidental vehicle or otherwise lying on road (on carriageway) and
- ✓ Encroachment prevention & removal with all lead & lifts complete with proper communication equipment,
- ✓ consumables, materials, suitable Towing vehicles, Ambulance, patrolling vehicles and manpower like drivers**, helpers, para-medical staff, labour including deployment of** crane and all works shall be done as per requirement and as directed by Client representative and as per Relevant Specifications as applicable.

## 7.4 OPERATIONS COSTS

Cost towards Operations include the following:

- *Electricity Bill for Highway lighting*
- *ATMS & Toll Plaza Operation cost*
- *Operation and management costs of rest areas and lay byes*
- *Operation and management costs of Traffic & medical aid posts*
- *SPV Costs*
- *Survey Costs*
- *Insurance*
- *IE Fee*
- *Audit Charges*
- *Administrative Cost*

The following Points considered while finalizing the Y-O-Y O&M Costs

Summary of O&M Cost presented in the following table

**Table 35: O&M Cost for FY2026 (including GST)**

| S No | Description | Amount in Crs. |
|---|---|---|
| | **SPV - Expenditure** | |
| 1 | SPV staff | 1.08 |
| 2 | Highway lighting | 3.18 |
| 3 | Tolling and ATMS AMC/ Spare Parts | 0.37 |
| 4 | Surveys & Investigations (BBD, Roughness) | 0.16 |
| 5 | IE fees | 0.77 |
| 6 | Insurance Charges | 0.74 |
| 7 | Professional charges | 0.50 |
| 8 | Admin cost - Board Meeting Expenses, valuation etc. | 0.21 |
| | **Agency - Expenditure** | |
| 9 | Toll Operation - Agency | 0.00 |
| 10 | Route patrolling | 1.47 |
| 11 | TAP & MAP | 0.80 |
| 12 | Routine maintenance | 2.46 |
| 13 | Repair of Road - BoQ Items | 1.40 |
| 14 | Repair of Structures | 0.27 |
| | **Total Amount in CRs** | **13.41** |

Note: 1. The amount is Crores inclusive of GST (18%) and without escalation, considering FY2026 rates

2. No Capacity Augmentation is envisaged and Concession end date is 04-06-2037

## 7.5 PERIODIC MAINTENANCE COSTS

Cost towards major maintenance include following:

- ✓ *Cost of Periodic maintenance of Pavement based on Finalized MM schedule*
- ✓ *Cost of Periodic Maintenance of Structures*
- ✓ *Cost of Periodic replacement of ATMS & Toll Equipment's & Software*

**Table 36: Periodic Maintenance Cost**

| YEAR | Functional +Structural overlay MCW+ S/R | Major Maintenance of Rigid Pavement | Replacement of ATMS @ every 7 Years | Replacement of TMS @ every 5 years | Structure specified repairs |
|---|---|---|---|---|---|
| **2025-2026** | 0.51 | - | | | - |
| **2026-2027** | | - | | 2.92 | - |
| **2027-2028** | | 4.83 | | | 2.28 |
| **2028-2029** | 8.26 | 6.04 | 1.91 | | - |
| **2029-2030** | 8.26 | 6.04 | | | - |
| **2030-2031** | | 7.24 | | | - |
| **2031-2032** | 0.51 | - | | 2.92 | - |
| **2032-2033** | | 2.26 | | | 2.28 |
| **2033-2034** | | - | | | - |
| **2034-2035** | | 4.83 | | | - |
| **2035-2036** | 8.38 | 6.04 | 1.91 | | 7.35 |
| **2036-2037** | 8.38 | 6.04 | | 2.92 | 7.35 |
| **2037-2038** | | 7.24 | | | - |
| **TOTAL** | **34.29** | **50.56** | **3.81** | **8.77** | **19.25** |

Note: 1. The amount is Crores inclusive of GST (18%) and without escalation, considering FY2026 rates

2. No Capacity Augmentation is envisaged and Concession end date is 04-06-2037

## 7.6 TOTAL OPERATION & MAINTENANCE COSTS

Year on year operation cost is summation of following:

- ✓ *Immediate Costs*
- ✓ *Routine Maintenance & Incident Management*
- ✓ *Periodic Maintenance*
- ✓ *Total Operations Cost*

Following table presents the summary of Operations & Maintenance cost for the project

**Table 37: Cost Abstract**

| Project Years | Calendar Year | SUMMARY OF VARIOUS EXPENSES in Rs. Crs | | | |
|---|---|---|---|---|---|
| | | Immediate Repair's Cost | Routine Maintenance Expenses | Periodic Maintenance (Functional +Struc Overlay+ Toll collection system) | Total Cost (Rs. Cr.) |
| 1 | 2025-2026 | 2.82 | 13.41 | 0.51 | 16.74 |
| 2 | 2026-2027 | | 13.41 | 2.92 | 16.33 |
| 3 | 2027-2028 | | 13.41 | 7.11 | 20.52 |
| 4 | 2028-2029 | | 13.41 | 16.20 | 29.61 |
| 5 | 2029-2030 | | 13.41 | 14.30 | 27.71 |
| 6 | 2030-2031 | | 13.41 | 7.24 | 20.65 |
| 7 | 2031-2032 | | 13.41 | 3.43 | 16.84 |
| 8 | 2032-2033 | | 13.41 | 4.54 | 17.95 |
| 9 | 2033-2034 | | 13.41 | - | 13.41 |
| 10 | 2034-2035 | | 13.41 | 4.83 | 18.24 |
| 11 | 2035-2036 | | 13.41 | 23.67 | 37.08 |
| 12 | 2036-2037 | | 13.41 | 24.69 | 38.10 |
| 13 | 2037-2038 | | 3.76 | 7.24 | 11.00 |
| | | | | | |
| | **Total Cost:** | **2.82** | **164.68** | **116.68** | **284.19** |

Note: 1. The amount is Crores inclusive of GST (18%) and without escalation, considering FY2026 rates

2. No Capacity Augmentation is envisaged and Concession end date is 04-06-2037