



FINAL REPORT

**Periodic Study Report of 8-Lane
Vadodara Kim Expressway from Km.
292+000 to Km. 323+000 (Manubar
to Sanpa Section of Vadodara
Mumbai Expressway) in the State of
Gujarat under NHDP Phase-VI on
Hybrid Annuity Mode (Phase IA –
Package-III) : PVKEPL**

**SAMARTH INFRAENGG Technocrats
Private Limited**



AUGUST 2025

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LIST OF ABBREVIATIONS AND SYMBOLS

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 Under pass
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
MoRTH	- 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 Under pass
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 Under pass
WBM	-Water Bound Macadam
WMM	-Wet Mix Macadam
WPI	-Wholesale Price Index

CHAPTER 1. INTRODUCTION

1.1 INTRODUCTION

The Government of India had entrusted to the National Highways Authority of India (the “Authority”) the development, maintenance and management of Vadodara Mumbai Expressway including the section from Km 292.000 to Km 323.00 (approx. 31 km). The Authority had resolved for the construction of Eight lane Vadodara Kim Expressway from Km 292.00 to Km 323.00 (Manubar to Sanpa section of Vadodara Mumbai Expressway) in the State of Gujarat under NHDP Phase VI on Hybrid Annuity Mode (Phase IA-Package III). The Authority had accordingly invited the bid proposals and upon the evaluation of received bids, the Authority has awarded the Project to M/s Patel Infrastructure Limited.

Consequent to this, M/s Patel Infrastructure Limited, formed a Special Purpose Vehicle (SPV) in the name of M/s Patel Vadodara-Kim Expressway Private Limited (the “Concessionaire”) for implementation/execution of the project.

The Concessionaire has achieved Provisional Certificate for a length of 30.036 Kms out of 31 Kms w.e.f 29.05.2022 vide Independent Engineer Letter no. AA/HW/NHAI/2205/22-23/4274 dt 22.09.2022 and Final Completion achieved on 10.01.2024 for full length of 31km.

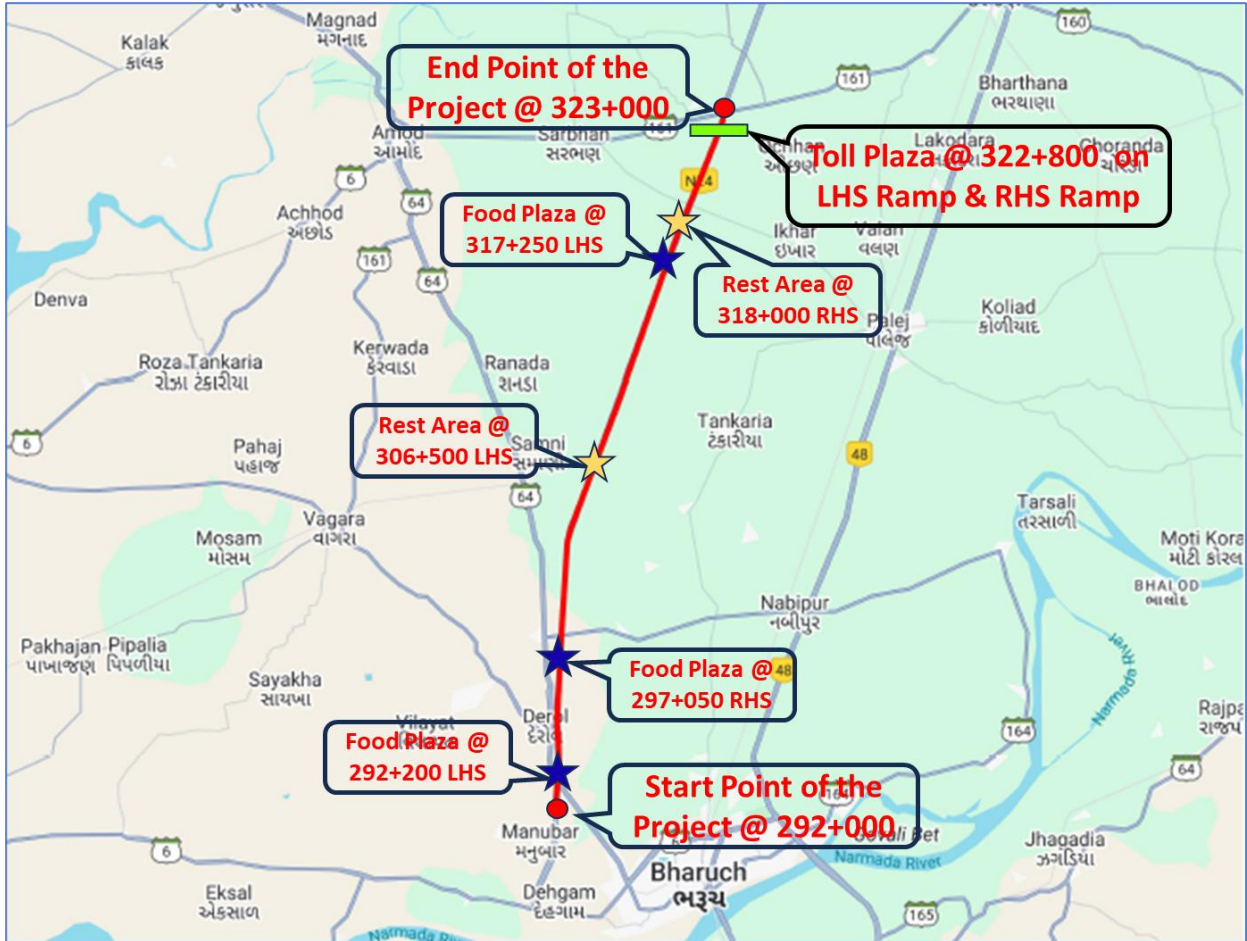
The project is presently under operation and maintenance by concessionaire (Vendor). The M/s Actis GP LLP intends to acquire the said project between Manubar to Sanpa.

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

Under the National Highways Development Project (NHDP) Phase-VI, 1000 km of expressways and including the construction of about 379 km long Vadodara-Mumbai Expressway (VM Expressway) proposed for implementation under the Public Private Partnership mode. The proposed VM Expressway passes through the states of Maharashtra, Gujarat and union territory of Dadra & Nagar Haveli. The total length of the proposed Vadodara Mumbai expressway is about 379 km. The VM Expressway Project can be categorized as a Greenfield project as the construction is entirely on a new alignment passing through new area.

The present project ie., Vadodara-Kim Expressway from Km 292.000 (Manubar) to Km 323.000 (Sanpa) is a section of Vadodara Mumbai expressway. The Project Corridor runs through the settlements like Manubar, Derol, Dayadara, Kelod, Karela, Kurchan, Dora, Danda & Sanpa. Map Showing Project Corridor is presented below.



Map Showing the Project Corridor

As per the CA, the design Chainage at start point of the project road shall be km 292.000 and the design Chainage at end point of the project road shall be km 323.000. With a total length of 31.000 km.

Table 1: Project Corridor Chainage System

Referencing system	Project Corridor Start Point (km)	Project Corridor End Point (km)	Length (km)
Existing Chainage	292.000	323.000	31.000
Design Chainage	292.000	323.000	31.000

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



Following Table highlights the total project at a glance:

Table 2: Project Details

SI No.	Description	Date
1.	Date of Signing the Concession Agreement	11 th May 2018
2.	Appointment Date	8 th March 2019
3.	Scheduled Project completion	7 th March 2021
4.	Scheduled End of Concession	17 yrs from Appointed date (i.e., 6 th Mar 2036)
5.	Revised Project completion	26 th June 2022
6.	Revised End of Concession	28 th May 2037
7.	Date of issue of Provisional Completion Certificate	29 th May 2022
8.	Date of Commencement of Commercial Operation	Started
9.	Date of Issue of Final Completion Certificate	10.01.2024

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 provide requisite technical information for processing the acquisition of said project by client.

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 (12 on VKEPL) 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

Consultants have collected various data and records from concessionaire with the help of client. The information collected by consultants is highlighted in table below:

Consultants have collected various data and records from Concessionaire with the help of client. The major information collected by consultants is highlighted as below:

- Concession Agreement/Settlement Agreement
- Review of Central Vigilance Commission (CVC) report
- COS/EOT details
- Pavement design report
- Geotechnical Investigation Reports
- IE/SPV Monthly Reports
- IE Fee/ Electrical Bills/Lightings
- Detailed Drawings for Highway/Structure
- O&M/EPC Agreement
- NDT and other Test reports/warranty certificates
- ATMS/TMS workorders
- RPV/Ambulance/Crane details
- Other correspondence etc

1.5 REVIEW OF CONCESSION AGREEMENT

- 1) Concession Parties and date of execution of Agreement: NHAI and PVKEPL entered into the Concession Agreement on 11th May, 2018.
- 2) Appointed Date, Commercial Operation Date & Concession Period (Article 4, Article 15 & Article 3): The Concession Agreement was signed on 11th May, 2018. NHAI vide its letter No. NHAI/11033/Hybrid/FC/CGM/(FA) 2019-2019/(File No.81) Dt 06.02.2019 has acknowledged that the Financial Closure occurred on 20th Nov 2018 and the Appointed Date has been declared with the approval of the competent authority as 8th March 2019 vide Authority's letter no. NHAI/VME Phase IA/HAM/Pkg-III/2018/131837. The Concession Period is 17 years from the Appointed Date.
- 3) Concession Period (Article 3): As the Appointed Date is declared on 08.03.2019 and accordingly the expiry date of the Concession Period appears to be 06.03.2036. Due to COVID-19 outbreak under Force Majeure head in accordance with the Article 28.6.2 of the Concession Agreement the concessionaire is supposed to receive an extension of time. Inference can be drawn from IE Letter no. AA/VKE/NHAI/PVKEPL/974/22-23/EOT/4815 dt 20.04.2022, that the EOT is divided into 3 parts, where the EOT-1 is for 180 days which is approved by Authority vide letter no. NHAI/PIU-Godhra/2020/11087/VME-III/Cons.Patel.Vol.1/D-3857 dt.19.03.2021 as an interim measure, EOT-2 and EOT-3 are recommended to the Authority for 165 days and 131 days respectively. The approval/grant status of EOT-2 & EOT-3 from Authority is to be ascertained from the Concessionaire. From the available information it can be concluded that the revised Concession period end date shall be 28.05.2037.

- 4) Condition Precedent (Article 4): By definition “Appointed Date” means “*the date on which Financial Close is achieved and every Condition Precedent is satisfied, in accordance with the provisions of the Agreement and such date shall be the date of commencement of the Concession Period;*”. The Authority vide letter no. NHAI/VME Phase IA/HAM/Pkg-III/2018/131837 specifies that the appointed date is declared w.e.f 08.03.2019 without any financial implication/damages/ penalty on either parties pursuant to Minutes of Meeting of signing of joint memorandum by NHAI & Concessionaire dated 30.01.2019. Thereof, it is acknowledged that the Concessionaire and the Authority have fulfilled the Conditions Precedent as per Article 4.
- 5) Obligations of Concessionaire & Authority (Article 5 & 6): The Concessionaire and Authority might have fulfilled most of their obligations as the Concessionaire has received Provisional Certificate. However, waiving off the damages, if any, by either party in respect of the non fulfilment of each other’s obligations by the way of signing a Supplementary Agreement is to be sought from the Concessionaire as details of the Supplementary Agreement were not made available.
- 6) Change in Ownership (Article 5.3 read with Article 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 is Rs 85.60 Cr. The requisite details were not made available to reaffirm the same by the Concessionaire. It is also to be seen whether the Performance Security has been released or not as Article 9.3 states that the Performance Security shall remain in force and effect for a period of one year from the Appointed Date, but shall be released earlier upon the Concessionaire expending on Project construction an aggregate sum that is not less than 30% (thirty per cent) of the Bid Project Cost.
- 8) Right of Way (Article 10): As per Article 10.3.2, the Parties hereto agree that on or prior to the Appointed Date the Authority shall have granted vacant access and Right of Way to the Concessionaire for undertaking construction of the Project to the extent of at least 80% (eighty per cent) of the length. Since the Appointed date is declared w.e.f 08.03.2019 by the Authority it is evident that the land corresponding to at least 80% of the length of Project is made available to the concessionaire. IE letter no. AA/VKE/NHAI/PVKEPL/974/22-23/EOT/4815 dt 20.04.2022 that clearly states there has been a delay in hand over of land as on 30.11.2021 by the Authority due to which IE has recommended an EOT-2 of 95 days. As per Article 10.3.4 “The Authority shall make best efforts to procure and grant, no later than 90 (ninety) days from the Appointed Date, the Right of Way to the Concessionaire in respect of all land included in the Appendix, and in the event of delay for any reason other than Force Majeure or breach of this Agreement by the Concessionaire, it shall pay to the Concessionaire Damages in a sum calculated at the rate of Re. 1 (Rupee one) per day for every 10 (ten) square meters or part thereof, commencing from the 91st (ninety first) day of the Appointed Date and until such Right of Way is procured or 180 (one hundred and eighty) days from the Appointed Date whichever is earlier. The Damages payable in terms of this clause shall be the sole remedy available to the Concessionaire and the Authority shall not be liable for any consequential loss or damage to the Concessionaire. In the event, the Authority is unable to provide the remaining Site within 180 (one hundred and eighty days) from the Appointed Date, the remaining Site of the Project Highway shall be removed from the scope of the work under the provision of Change of Scope.” From the available correspondence it could be not ascertained whether the Concessionaire has received any damages from the Authority.
- 9) Scheduled Completion Date & Termination (Schedule-G, Article 12 & Article 31): Construction period is 730 days from the appointed date i.e schedule date of completion is 07.03.2021. The Concessionaire could not achieve the scheduled completion date due to Force Majeure event, delay in handing over of encumbrance free ROW and delay in approval of the altered GAD of ROB by the Railways. The inference is drawn from the IE letter no. AA/VKE/NHAI/PVKEPL/974/22-23/EOT/4815 dt 20.04.2022. Termination clause has not been necessitated so far. The Status of Mile stone achievements as per schedule G is as below

S. No.	Description	Scheduled Date	Revised Date (Approved EOT)	Modified Date for achievement	Status of Achievement
1	Project Milestone – I	05.08.2019	-	-	03.11.2019
2	Project Milestone-II	01.02.2020	-	-	04.03.2020
3	Project Milestone-III	11.05.2020	27.12.2020	15.05.2021*	15.05.2021
4	Schedule Completion Date	17.01.2021	03.09.2021	26.06.2022*	To be achieved

- 10) Provisional Completion Certificates, Final Completion Certificate and Punch List Items (Article 14 & Article 37): The Concessionaire has received Provisional Certificate for a length of 30.036 Kms out of 31 Kms. The Concessionaire has achieved Provisional Certificate for a length of 30.036 Kms out of 31 Kms w.e.f 29.05.2022 vide Independent Engineer Letter no. AA/HW/NHAI/2205/22-23/4274 dt 22.09.2022. The Provisional Certificate is duly appended with the Punch List (List-A), containing the list of outstanding works, which shall be completed by the Concessionaire within 90 days of date of issue of Provisional Certificate and List-B with due diligence and without delay, soon after the land in such stretches is made available for construction, within a reasonable time as determined by the Independent Engineer.
- 11) Entry into Commercial Service (Article 15): The Project shall be deemed to be complete when the Completion Certificate or the Provisional Certificate. The Concessionaire has achieved Provisional Certificate for a length of 30.036 Kms out of 31 Kms w.e.f 29.05.2022. The delay damages as per Article 15.2 shall not be applicable to the Concessionaire as he has received the Provisional Certificate well before the revised Project completion date 26.06.2022
- 12) Change of Scope (Article 16): The Concessionaire has executed certain works under change of scope. The approved positive COS amounts to 9.73 Cr and the negative COS is 10.56 Cr. Net Financial implication is - 0.83 Cr. The details regarding the adjustment of the net financial implication is to be known from the Concessionaire.
- 13) O&M Obligations of the Concessionaire (Article 17): The Concessionaire has been fulfilling this obligation since the beginning of the operations.
- 14) Remuneration of IE (Article 21): One half of the IE Fee shall be borne by Concessionaire.
- 15) Financial Close (Article 22): Article 22.1.1, states that “The Concessionaire hereby agrees and undertakes that it shall achieve Financial Close within 150 (one hundred and fifty) days from the date of this Agreement In the event of delay in achieving the Financial Close. the Concessionaire shall be entitled to a further period not exceeding 120 (one hundred twenty) days. subject to payment of Damages to the Authority in a sum calculated at the rate of 0.05% (zero point zero five per cent) of the Performance Security for each day of delay.....”. Given that the Concession Agreement was executed on 11.05.2018 June 2015, the Financial Close was required to be achieved on or before 08.10.2018. NHAI vide its letter No. NHAI/11033/Hybrid/FC/CGM/(FA) 2019-2019/(File No.81) Dt 06.02.2019 has acknowledged that the Financial Closure occurred on 20th Nov 2018. There has been a delay of 43 days in achieving the Financial Close for the Project. Clarification is to be sought from the Concessionaire wrt payment of damages to the Authority for the delay achieving the Financial Close. However, the Authority vide letter no. NHAI/VME Phase IA/HAM/Pkg-III/2018/131837 intimated the Concessionaire that the appointed date is declared w.e.f 08.03.2019 without any financial implication/ damages/ penalty on either parties

pursuant to Minutes of Meeting of signing of joint memorandum by NHAI & Concessionaire dated 30.01.2019.

- 16) Payment of Bid Project Cost (Article 23): As per Clause 23.1, the cost of construction of the Project, as on the Bid Date, which is due and payable by the Authority to the Concessionaire, shall be deemed to be Rs.1,712.00 Crore. The Bid Project Cost specified in Clause 23,1 shall be revised from time to time in accordance with the provisions of this Clause 23.2 to reflect the variation in Price Index occurring after the Reference Index Date immediately preceding the Bid Date. The Bid Project Cost adjusted for variation between the Price Index occurring between the Reference Index Date preceding the Bid Date and the Reference Index Date immediately preceding the Appointed Date shall be deemed to be the Bid Project Cost at commencement of construction.

As per Clause 23.3, 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 percent) each during the Construction Period in accordance with the provisions of Clause 23.4, The remaining Bid Project Cost, adjusted for the Price Index Multiple, shall be due and payable in 30 (thirty) biannual installments commencing from the 180th (one hundred and eightieth) day of COD in accordance with the provisions of Clause 23.6.

As per Clause 23.7, all O&M Expenses shall be borne by the Concessionaire and in lieu thereof; a lump sum financial support in the form of biannual payments shall be due and payable by the Authority, which shall be computed on Rs. 7.50 Crore

- 17) Insurance (Article 26): The Concessionaire has been fulfilling this obligation.
- 18) Account and Audit (Article 27): The Concessionaire shall appoint, and have during the subsistence of this Agreement as its Statutory Auditors, a firm chosen by it from the mutually agreed list of 5 (five) reputable firms of chartered accountants (the "Panel of Chartered Accountants"), such list to be prepared substantially in accordance with the criteria set forth in Schedule-P. All fees and expenses of the Statutory Auditors shall be borne by the Concessionaire.
- 19) Force Majeure and Termination (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 shall be entitled to receive Annuity payments plus interests due and payable under this agreement (CA).

Allocation of Costs arising out of Force Majeure in accordance with Clause 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.

IE upon the request of the Concessionaire has recommended to the Authority for extension of time for 476 days based on the events like Force Majeure, delay in hand over of land and revised ROB GAD approvals from railways which are impacting the progress of construction of works. Authority vide letter no. NHAI/PIU-Godhra/2020/11087/VME-III/Cons.Patel Vol.1/D-3857 dt.19.03.2021 as an interim measure granted an EOT-1 for 180 days. The approval/grant status of EOT-2 (165 days) & EOT-3 (131 days) from Authority is to be ascertained from the Concessionaire

Termination clause on the outbreak of Force Majeure event was not exercised by both the parties

- 20) Compensation for Breach of Agreement (Article 29): From the available correspondence it could not be furnished whether, either of the party has claimed for Compensation on the other.
- 21) Suspension Concessionaire's Rights (Article 30): There was no necessity of any invocation of this clause.

- 22) Termination (Article 31): There was no necessity of any invocation of this clause
- 23) Defects and liability after termination (Article 33): There was no necessity of any invocation of this clause
- 24) Change in Law (Article 35): Change in law occurred due to eruption of COVID-19 and its impact by way of change in legislations by both the Central Government and respective State Governments.
- 25) Liability and Indemnity (Article 36): This Clause was not operated so far.
- 26) Dispute resolution (Article 38): Dispute Resolution shall be, at the first instance by the way of amicable settlement with the mediation of IE. Failing which, either party shall refer the dispute to the Chairman of the Authority and the Chairman of the Board of Directors of the Concessionaire for an amicable settlement. Any dispute which could not be resolved by way of amicable settlement shall finally be referred to arbitration. Arbitration shall be held in accordance with the Rules of Society for Affordable Redressal of Disputes ("SAROD"), New Delhi (the "Rules"), or such other rules as may be mutually agreed by the Parties, and shall be subject to the provisions of the Arbitration and Conciliation Act, 1996.
- 27) Miscellaneous-Governing Law and Jurisdiction (Article 41): This Agreement shall be construed and interpreted in accordance with and governed by the laws of India, and the courts in New Delhi shall have exclusive jurisdiction over matters arising out of or relating to this Agreement.

1.6 REVIEW OF DOCUMENTS/ CORRESPONDENCES

There are several correspondences/ agreements/reports which are reviewed. Following are the some of the major documents/correspondences that are reviewed for ready reference:

- 1) Concession Agreement with NHAI, dated 11.05.2018.
- 2) EPC Agreement with Patel Infrastructure Ltd, dated 08.03.2019
- 3) NHAI vide its letter No. NHAI/11033/Hybrid/FC/CGM/(FA) 2019-2019/(File No.81) Dt 06.02.2019 has acknowledged that the Financial Closure occurred on 20th Nov 2018.
- 4) Authority vide letter no. NHAI/VME Phase IA/HAM/Pkg-III/2018/131837 has declared the appointed date w.e.f 08.03.2019
- 5) Authority vide letter no. NHAI/PIU-Godhra/2020/11087/VME-III/Cons.Patel.Vol.1/D-3857 dt.19.03.2021 has granted EOT-1 for 180 days as an interim measure on the outbreak of Force Majeure event.
- 6) Routine Maintenance Agreement with Patel Infrastructure Ltd., dated 20.08.2022.
- 7) Provision Completion certificate for a length of 30.036 Km from IE vide Ltr Letter no. AA/HW/NHAI/2205/22-23/4274 dt 22.09.2022.
- 8) Reviewed the As-built drawings
- 9) Pre COD report submitted by Road safety consultant M/s Road Link Consultancy services.
- 10) Status & Inspection Reports of IE and Monthly Progress Reports of EPC contractor
- 11) Monthly Inspection Reports of Lender's Engineer

1.7 REVIEW OF EPC/MAINTENANCE CONTRACTS

(A) EPC CONTRACT:

- 1) Concession Parties and date of execution of Agreement: Patel Vadodara Kim Expressway Pvt Ltd PVKEPL (Client) and Patel Infrastructure Ltd (Contractor) entered into the EPC Agreement on 08 March 2019.
- 2) Effective Date and Term (Clauses 2.1& 2.2): After issuance of the letter of award by the Client to the Contractor, the Contractor shall commence pre-construction activities including fulfillment of the Conditions Precedent set out in Clause 4, within the timelines therefor set out in such Clause. The Client shall issue a 'Notice to Proceed' to the Contractor (the "Notice to Proceed"), on the declaration of the Appointed Date, notifying the date from which the Contractor shall commence the Works. The commencement date is 24.07.2015 and the contract shall be valid and subsisting from the date of execution hereof until the Termination date.
- 3) Scope of Work (Clause 3): The Contractor shall construct the Project Highway on the Site set forth in Schedule A, B, C & D of the Concession Agreement and shall include the scope of work as set out in Clause 3 of EPC Agreement.
- 4) The EPC Contractor (Clause 4): The Contractor shall at Its own cost and expense observe, undertake, comply with and perform, in addition to and not in derogation of its obligations elsewhere set out in the EPC agreement and the Concession Agreement.
- 5) Documentation (Clause 5): The Contractor shall be fully responsible for the design of the Works. Design work shall be undertaken by qualified designers who are Consultants or other professionals. The Contractor warrants that its designers and its Subcontractor's designers shall have the experience and capability necessary for the design of the Works. The Contractor shall procure that the designers shall be available to attend discussions with the Concessionaire's Representative at all reasonable times. The Contractor shall furnish to the copies of "as built" Drawings and other documents/ manuals, including Maintenance manuals in such numbers and form as required under the Concession Agreement. One additional set would be made available for the use of the Concessionaire. Intellectual Property in all documents and materials issued by the Concessionaire or the Concessionaire's Representative to the Contractor shall (as between the parties) remain the property of the Concessionaire. The Contractor may, at his cost, copy, use and communicate any such documents for the purposes of this Contract. They shall not, without the Concessionaire's Representative's consent, be used, copied or communicated to a third party by the Contractor, except as necessary for the purposes of the Project Agreements.
- 6) Staff and Labour (Clause 6): The Contractor shall make his own arrangements for the engagement of all personnel and labour. The Contractor shall obtain all relevant labour registrations and comply with all relevant labour laws applying to his employees, sub-contractors etc. and shall duly pay them and afford to them all their legal rights.
- 7) Plants, Materials and Workmanship (Clause 7): All work shall be executed in the manner required to comply with the Concession Agreement and all Applicable Laws and Permits. Where the manner of execution is explicitly set out, the work shall be executed in a proper, workmanlike and careful manner, with properly equipped facilities and non-hazardous Materials, and in accordance with Good Industry Practice. All matters relating to Testing, Inspection and Rejection shall be executed in the manner required to comply with the Concession Agreement and all Applicable Laws and Permits.
- 8) Commencement, Delays and Suspension (Clause 8): The Commencement Date of works for the Contract shall be the date of signing of this EPC Contract Agreement between Concessionaire & EPC Contractor. The EPC Contractor shall comply with the requirements set forth in Clause 8.2.1 for each of the completion milestones for EPC Contract Works ("Completion Milestones") and the Scheduled Construction Completion Date set forth in Clause 8.2.2. Within 15 (fifteen) days of the date of each Completion Milestone, the EPC Contractor shall notify the Concessionaire of such compliance along with necessary particulars thereof. The status of achievement of Milestones as described in Clause 8.2.1 of EPC is as below
 Milestone-I: Achieved on 03.11.2019 (As per EPC Agreement Scheduled Completion Date is 05.08.2019 i.e., 150th day from Notice to Proceed Date)

Milestone-II: Achieved on 04.03.2020 (As per EPC Agreement, Scheduled Completion Date is 01.02.2020 i.e., 330th day from Notice to Proceed Date)

Milestone-III: Achieved on 15.05.2021 (As per EPC Agreement, Scheduled Completion Date is 11.05.2020 i.e., 480th day from Notice to Proceed Date)

The EPC Contractor shall complete all Works, as required under the Concession Agreement, to obtain the Completion Certificate or the Provisional Certificate to achieve COD (all the terms are as defined under Concession Agreement) within a period of 730 Days from the Appointed Date. The Schedule Completion date is 17.01.2021 and the revised Completion date is 26.06.2022. However, The Concessionaire has achieved Provisional Certificate for a length of 30.036 Kms out of 31 Kms w.e.f 29.05.2022 and final completion 10.01.2024.

- 9) Liquidated Damage, Bonus (clause 8.5 & 8.6): If the Project Completion as well as Completion Milestones as specified in EPC Agreement is not achieved within the stipulated Time Period for its achievement, the EPC Contractor shall be liable to pay to the Concessionaire 0.2% (Zero point Two percent) of the amount of 5% of EPC Contract Price per day for each day delay or part thereof until COD is achieved or such damages as are payable by the Concessionaire to the Authority under the Concession Agreement, whichever is higher. The EPC Contractor acknowledges that the damages payable by the Concessionaire to the Authority under the Concession Agreement will be payable on a back to back basis by the EPC Contractor to the Concessionaire.
- 10) In the event that the Contractor shall achieve COD on or more than 30 (thirty) days prior to the Scheduled Completion Date, the Concessionaire shall pay to the Contractor a bonus equal to 0.50% (Zero point five zero per cent) of 60 % (Sixty per cent) of the Bid Project Cost for the first 30 (thirty) days by which COD shall precede the Scheduled Completion Date and thereafter the said bonus shall be calculated on the pro-rata basis for each day preceding the said 30 (thirty) days period. The Bonus shall be due and payable to the Contractor subject to there being no event of default/potential event of default under the Transaction documents and shall be paid only once the bonus amount is received from NHAI.
- 11) Construction Defects liability Period: Construction Defects Liability Period for this Contract shall be 24 months commencing from date of Final Completion. 90 days prior to expiry of the Construction Defects Liability Period, the Concessionaire and the Contractor shall conduct a joint inspection of the Project Site and all Project Facilities and not less than 60 days from the completion of the Construction Defects Liability period, the EPC Contractor shall provide to the Concessionaire a report for condition of Project Site and Project Facilities.
- 12) EPC Contract Price, Payment and Claims (Clause 11): The Contractor after assessing the Scope of Work is agreeable to execute the same on Lump. The Total Lumpsum Contract Price of Rs.1545 Cr is payable to the Contractor for the Works and its obligations under the Contract shall not increase and the Contractor is not entitled to additional payment except for the lumpsum price as agreed.

Any variation in the Cost during Construction Period shall be borne by EPC Contractor except Change of Scope as per the terms of the Concession Agreement. As per the provision of Concession Agreement stipulated under Clause 23 .2, the Bid Project Cost shall be revised time to time w.r.t. variation in Price Index and 40% of Bid Project Cost shall be payable during Construction Period in predefined installment equal to 8% of BPC as per provision of Concession Agreement duly adjusted for the Price Index Multiple as applicable on Reference Index Date

The Concessionaire will pay after Appointed Date an interest-bearing Mobilization advance amounting to 5% of the Bid project Cost to EPC Contractor as and when received from the Authority. The advance payment shall be deducted by the Concessionaire in 4 (four) equal installments from the EPC Payment upon the achievement of each Milestones. The rate of interest on the mobilization advance shall be equal to the Bank Rate, compounded annually and shall be deducted from the 5th (fifth) installment from the EPC Payment upon the achievement of 90% Physical Progress of Construction work.

The EPC Contractor shall submit Running Account bills (i.e. R.A, Bill) for the work completed by them and the Concessionaire will deduct an amount equivalent to 3% (three percent) of gross value of each IPC towards cash retention. After Completion of Work 50% Retention Money to be released and Remaining 50% of the balance Retention money to be released after Defect Liability Period. EPC Contractor allows replacing the Security Deposit by a BG amounting as & when exceeds 5 Cr. Such a Bank Guarantee shall be valid until a date, 28 days beyond the Scheduled date of completion. For balance retained Retention Money, at the final Completion of the Works, the EPC Contractor may be allowed to replace the 90% of retained Retention Money by a Bank Guarantee, which shall be valid until a date 28 Days beyond the initial 24 months of Construction Defect Liability Period. Such Bank Guarantees against Retention Money shall be released after issuance of Final Completion Certificate after successful completion of Construction Defect liability Period. Such bank guarantee shall be in a form and manner acceptable to the Lenders and shall contain provisions with respect to assignment of such guarantees in favour of the Lenders.

From the above it to seen whether the Concessionaire has deducted the interest bearing Mobilization advance and whether the EPC has submitted any BG against the Retention Money

- 13) Change of Scope (Clause 12): Change of Scope as required by the Authority shall be initiated at any time during the Contract Period, either by instruction or by a request for the EPC Contractor to submit a proposal and as specified under the Concession Agreement. The Change of Scope shall be dealt with as per the procedure set out in Article 16 of the Concession Agreement and only with the consent of the Concessionaire as regards to the Amounts to be claimed. The 100% of the additional cost of work to be carried out under Change of Scope as approved & on receipt from Authority shall be payable additional amount to EPC Contractor The amount against the Reduction in Scope of the Project, shall be deducted from EPC Contractor payable amount by the Concessionaire and the EPC Contract Price shall be reduced accordingly.
- 14) Default of the EPC Contractor (Clause 13): If the Contractor fails to carry out any of his obligations under the EPC Contract, or is not executing the Works in accordance with this EPC Contract, the Concessionaire's Representative may give Preliminary notice to the Contractor requiring him to make good such failure and remedy the same within a specified reasonable time as per the provisions of EPC Contract Agreement.
There is no correspondence available whether there is any default on the EPC contractor
- 15) Default of the EPC Concessionaire (Clause 14): if the Dissolution of the Concessionaire is commenced, then the Contractor may issue preliminary notice to the Concessionaire and if the Concessionaire fails to remedy or to take effective steps, to the satisfaction of the Contractor, to remedy the same within 60 days of receipt of notice, then the Contractor is entitled to terminate the Contract forthwith, by issuing the Termination Notice to the Concessionaire. Provided that such right of Contractor shall commence only after the Concessionaire has been substituted by the Senior Lenders. There is no correspondence available whether there is any default on the Concessionaire.
- 16) Force Majeure (Clause 17): In this Contract, "Force Majeure" or "Force Majeure Event" shall mean occurrence in India of any or all of Non Political Event and / or Indirect Political Event and / or Political Event as defined in Section 17.2, 17.3 and 17.4 respectively hereinafter and / or any such event that results in force majeure under the Concession Agreement, which prevent the Party claiming Force Majeure (hereinafter referred to as the "Affected Party") from performing its obligations under this Agreement. There no Correspondence available whether the EPC contractor invoked this clause. However as discussed earlier, Concessionaire has got the EOT under the Force Majeure Event.
- 17) Termination of Contract (Clause 17.7): If the Concession Agreement is terminated in accordance with provisions of the Concession Agreement, the Concessionaire shall terminate EPC Contract by giving 30 (thirty) days Termination Notice to the EPC Contractor; or

If a Force Majeure Event subsists for a period of 180 (one hundred and eighty) days or more within a continuous period of 365 (three hundred sixty-five) days, either Party may in its sole discretion terminate this Agreement by giving 30 (thirty) days termination Notice to the other Party;

Upon Termination as per Sub clause hereinabove, the Concessionaire shall pay to the EPC Contractor the amounts payable for any part of the Construction Works carried out accepted & approved by the Senior Lender for which a price is stated in the EPC Contract Save and except as Specified hereinabove, the Concessionaire shall not be liable to make any other payment whatsoever to the Contractor.

However, there is no termination notice issued either by the Concessionaire or the Contractor to the other.

- 18) Claims, Disputes and Arbitration (Clause 18): The EPC Contract shall be governed by the laws of India. Dispute Resolution shall be, at the first instance be resolved by the way of amicable settlement between the two parties. If the Dispute is not amicably settled it shall be referred to and finally and exclusively resolved by arbitration in accordance with the Arbitration and Conciliation Act of 1996 or any statutory modification or re-enactment thereof for the time being in force. The arbitration shall be held at Vadodara and all proceedings in any such arbitration shall be conducted in English. One arbitrator shall be appointed by the Concessionaire. One arbitrator shall be appointed by the EPC Contractor, Both Arbitrators will appoint the Presiding Arbitrator. The decision of the majority of the Arbitrators shall be final and binding on both the parties, shall not be subject to appeal, and shall be enforceable in any competent court having jurisdiction

There were no documents/records made available to assess claims/disputes if any between the Client and the Contractor.

- 19) Remedies and wavier, Deductions (Clause 21.1 & 21.2): There were no documents/records made available to assess remedies and waiver, deductions if any made by the Concessionaire.

(B) ROUTINE MAINTENANCE WORKS CONTRACT:

- 1) Agreement for Routine Maintenance works was signed on 20th Aug 2022 between M/s PVKEPL (Concessionaire) and M/s Patel Infrastructure Ltd (Contractor)
- 2) Scope of Work, Contract Price: The scope of the Contracted Work is described in detail in the Annexure- A to this Agreement read with the Concession Agreement and various Schedules attached to the said Concession Agreement. In consideration of the execution of the Contracted Work, PVKEPL shall pay to the Contractor an amount calculated at the mutually agreed rates mentioned in Annexure-A to this Agreement. The Total Contract Price is Rs. 4,07,66,867.40 (excluding GST thereon) as per the Annexure-A and the same shall be subject to the provisions of this agreement. This Contract Price as per Annexure-A is applicable for the one-year period from the date of PCOD (Provisional Completion) of the Project Expressway. For the measurement and subsequent payment against the above tabulated maintenance work, the actual length will be considered as per PCOD issued by NHAI.

The clauses/provisions & schedule Concession Agreement relevant to routine maintenance work shall be part of this Agreement also. It is also agreed by and between the parties to this agreement that Annexure-A to this agreement are also part and parcel of this Agreement.

- 3) Obligations of the Contractor: The Contractor further confirms that they mobilize adequate Men, Machineries and Material and other additional resources as required and/ or as directed by PVKEPL representative to carry out routine maintenance of the Project Expressway.

The Contractor shall carry out the work as per maintenance program submitted and getting approved from NHAI/Independent Engineer and PVKEPL representatives in accordance with completion schedule given in Concession Agreement.

The Royalty payable on the construction materials would be paid by Contractor and the relevant document showing payment of Royalty shall be submitted to PVKEPL. After completion of work contract, Contractor shall provide "NO DUES CERTIFICATE" as per theoretical quantities used in contract obtain from Mines and Minerals Department.

The Contractor will be responsible for maintaining all the records required under different acts and laws of the Government including labour laws. The Contractor will pay minimum wages as per minimum Wage Act, maintain all necessary registers as per various Acts I Laws and will comply with various provisions of Law including Income Tax, Sales Tax, Royalty, GST, Octroi. Labour Welfare and all other applicable Acts/Laws, etc. The Contractor shall pay all applicable taxes/ revenue as per the prevailing Acts, Rules and Regulations and/or Laws prevailing in the Country.

- 4) Obligations of the Concessionaire: Concessionaire will be responsible for taking insurance, paying fee of Independent Consultant, electrical charges and also bear administrative charges as per the terms and conditions of Concession Agreement and it shall do the same at its own cost
- 5) Breach of Contract by Contractor: The Contractor confirms that in case of any breach and/or failure and/or negligence on its part in executing the contracted work in accordance with the relevant portion/s of the Tender documents and/or to the satisfaction of NHAI/PVKEPL/Independent Engineer or their authorized representatives, Contractor shall indemnify and hold PVKEPL harmless against any claims or costs or damages or whatever kind suffered or incurred by PVKEPL, the same shall be borne by the Contractor

In case of breach of contract, PVKEPL reserves the right to take over pending work and carry out the same by its own or by any other party at the risk, cost and consequences of the Contractor.

- 6) Governing Laws: This agreement shall be subject to jurisdiction of Competent Courts in Vadodara only.

Scope of works as described in Annexure-1 are as below

- 1) Carrying out routine maintenance and repairs to pot holes/ patches, repair of shoulders, cleaning of drains/culverts and bridges, cleaning/clearing of roadway, clearing/removal of vegetation, New plantation and maintenance, Sign ages repairing, metal beam crash barrier repairing, rain cut restoration, whitewash, kerb painting etc. as per technical specification and directed by Site incharge.
- 2) Carrying out the routine maintenance of automatic Toll Collection system (TMS/ hybrid ETC lane system) along with Automatic Vehicle Classification Systems complete in all respect on Toll Plazas @ Ch. 323+000 and Advanced Traffic Management System (ATMS) complete in all respect as per technical specification and directed by Site incharge.
- 3) Carrying out the routine maintenance to Thermoplastic paint for road marking, joint sealing of PQC and texturing of PQC, replacement of PQC panels as per technical specification and directed by Site incharge.
- 4) Carrying out Network Survey at every 6 months, deployment of Ambulance, crane of required capacity and Petrol vehicle as per requirement stipulated in concession agreement and as directed by Site incharge.

(C) MAJOR/PERIODIC MAINTENANCE WORK ORDER:

No Major/Periodic maintenance work order is available from the data provided.

(D) TMS, HYBRID ETC Lane System and ATMS AGREEMENT:

From the available data it can be seen that the Authority/IE has recommend the provision of TMS, Hybrid ETC lane and ATMS works under COS to the Concessionaire. The said work is awarded to M/s

Vaaan Infra Pvt Ltd. The work order was issued on 16th Feb 2021 to Vaaan Infra Pvt Ltd by M/s Patel Infrastructure Ltd (PIL).

No agreement between the Authority and the Concessionaire is available for review.

1.8 REVIEW OF PAVEMENT DESIGN

1.8.1 REVIEW OF CA STIPULATIONS FOR PAVEMENT DESIGN

- i. The Schedule D states that eight laning of the Expressway shall conform to the “**Manual of Specifications and Standards for Expressways IRC SP 99-2013**”.
- ii. Clause 5.4.1 (i) of IRC SP: 99-2013 stipulates that the flexible pavement shall be designed for a minimum design period of 20 years or operation period, whichever is more.
- iii. Clause 5.4.1 (ii) of IRC SP: 99-2013 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”.
 - a. Indicates that, the pavement shall be designed to resist specific distresses in each layer and the choice of materials and mixes shall be such that the pavement remains structurally serviceable throughout the operation period without requiring any major structural strengthening. The requirement and frequency of resurfacing should not be closer than 10 years. A longer period will be desirable. The resurfacing process will be milling the existing layer to the depth of distress and replacing the same by the material that meets the characteristics of the original surface.
 - b. Indicates the pavement strengthening when required shall incorporate the consideration of i) strength of existing layers as evaluated using deflection test by FWD, ii) Design period for strengthening to extend five years beyond the period of concession and iii) specified performance requirements.
- iv. Clause 5.7.5 (ii) of the same manual also stipulates that the initial strengthening shall be done as per 5.4.1 Section.
- v. Clause 5.7.6 (iv) of the same manual also stipulates that the for bituminous overlay for pavement strengthening shall not be less than 50mm bituminous concrete.
- vi. Clause 5.4.2 states that rigid pavement shall be designed for a minimum design period of 30 years.

1.8.2 REVIEW OF CONCESSIONAIRE’S PAVEMENT DESIGN

1.8.2.1 Homogenous Sections

Project road section from Manubar-Sanpa has been Considered as the single homogenous section from Km 292.000 to Km 323.000.

1.8.2.2 Design Period

Rigid pavement shall be designed for minimum design period of 30 years. Stage construction shall not be permitted.

1.8.2.3 Design CBR

As per the approved Pavement design report, the Subgrade material having CBR value of 8 % is used in the pavement design.

1.8.2.4 Design Loading for Rigid Pavement

A. Base Year Design Traffic

Classified Traffic Volume Counts have been conducted At Km 178+500 and established base year traffic.

B. Growth Rates

The growth rate adopted for the pavement design is summarized in Table below

Year	Car	Bus	LCV	Truck		
				2-Axle	3-Axle	MAV (4 to 6)
FY18 – FY23	7%	7%	7%	7%	7%	7%
FY23 – FY28	7%	7%	7%	7%	7%	7%
FY28 – FY33	7%	7%	7%	7%	7%	7%
FY33 – FY38	7%	7%	7%	7%	7%	7%
FY38 – FY43	7%	7%	7%	7%	7%	7%
FY43 – FY48	7%	7%	7%	7%	7%	7%

C. Vehicle Damage Factors

Axle load surveys have been carried out at Km178+500 for 48hrs. Axle load spectrum has been used for Rigid pavement design.

Annual Average Daily Traffic (AADT) has been worked out using seasonal variation factor, are as presented in Tables below.

Type of Vehicle	AADT AT Km 178+500
Car/Jeep/Van/Taxi	18954
Bus	1450
LCV	5152
2AT	3186
3AT	5227
MAV	9184

1.8.2.5 Design Parameters of New Rigid Pavement for Main carriageway

Rigid Pavement Design with tied concrete shoulder with doweled transverse joints has been worked out as per the methodology recommended in IRC: 58-2015, the parameters used for the design of rigid pavement for the main carriageway is given in Table below.

Design Parameters	Adopted values
Subgrade CBR %	8%
Transverse joint spacing (m)	4.5
Lane Width (m)	4.25/4.0/3.75 (As per cross-section)
Cumulative No. of commercial Axles during design period (Year 2048)	1110590726 Axles
Modulus of subgrade MPa/m	50.33
Effective modulus of subgrade reaction of foundation MPa/m	285
Traffic factor for BUC analysis (for 12-hour period during day)	0.56
Traffic factor for TUC analysis (for 12-hour period during night)	0.44
Max. day-time Temperature Differential in slab, 0°C (for bottom-up cracking)	15.8
Night-time Temperature Differential in slab, 0°C (for top-down cracking) = day-time diff/2 + 5	12.9
Elastic Modulus of Concrete, Ec (MPa)	30000
Poisson's ratio	0.15
Input data for design of Tie Bars	
Coefficient of friction, f	1.5
Density of concrete, W (KN/cu.m)	24
Allowable Tensile Stress in Tie Bars	200 (deformed bars)
Allowable Bond Stress for Tie Bars	2.46 (deformed bars)

The Calculated value of proposed thickness of PQC based on above assumption comes to 240mm which is less than proposed 300mm thickness stipulated in the Schedule - B of the Concession Agreement. The Proposed thickness of the new rigid pavement in accordance with design and Clause 5.3.3 of Schedule B is shown below.

S. No.	Panel Size (m)	PQC (M40 Grade)	DLC (M10 Grade)	Sub-Base (GSB)	Sub-grade
For Expressways					
1	4.5x4.25	300 mm	150 mm	150 mm	500 mm

However, the same has been further analyzed with the axle load spectrum available at the same location in different time duration and with projected AADT obtained from pavement design report.

The obtained pavement thicknesses on either direction as given below:

S. No.	Side	PQC, mm	DLC, mm	GSB, mm	Remarks
1	LHS	275	150	150	
2	RHS	270	150	150	

It is to conclude from the above table, that the recommended 300mm PQC thickness is sufficient enough for the project.

1.8.2.6 Pavement Design for Connecting Roads, and Overpass Cross Roads

The Recommended Pavement Composition for the Connecting Roads and Overpass Cross Roads is shown in Tables below. All the three options are suitable and can be used as per the site condition.

Option 1 Bituminous Surfacing with Granular Base and Granular Sub-base

CBR	MSA	BC (mm)	DBM (mm)	WMM (mm)	GSB (mm)
8%	10	40	50	250	200
10%	10	30	50	250	200

OPTION-2: Bituminous Surfacing with Wet Mix Macadam Base and Cemented Sub-base

CBR	MSA	BC (mm)	DBM (mm)	WMM (mm)	CTSB (mm)
8%	10	30	50	100	150
10%	10	30	50	100	150

OPTION-3: Cemented Base and Granular Sub-base with Crack Relief Layer of Aggregate Interlayer above the Cemented Base

CBR	MSA	BC (mm)	Aggregate Layer (mm)	Cemented base (mm)	GSB (mm)
8%	10	40	100	200	150
10%	10	40	100	190	150

1.9 REVIEW OF O&M REQUIREMENTS

As per Schedule-K, maintenance requirements, maximum roughness allowable is 2750mm/km and frequency of testing twice in a year. However, as per applicable expressway manual IRC SP: 99-2013, structural evaluation of the pavement shall be made by taking deflection measurements every 3 years as per procedure given in IRC. No specific Handing Over (Divestment) requirements are mentioned under CA.

1.10 REVIEW OF SCHEDULES

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

Table 3: Salient Features of Project Corridor

Sl. No.	Particulars	Length/ Nos.	As per Schedule-B	Remarks
1	Start Chainage (Km)	Km	292	
2	End chainage (Km)	Km	323	
3	Length of the Project Corridor	Kms	31	
4	Toll Plaza	Nos.	2	On Entry & Exit
5	No.of Lanes (Both side)	Nos.	Entry - 5+2+1 Exit - 1+2+1	Under construction

Sl. No.	Particulars	Length/ Nos.	As per Schedule-B	Remarks
6	ROBs	Nos.	1	
7	Flyovers	Nos.	1	
8	Over Passes	Nos.	1	
9	VUPs	Nos.	3	
10	LVUP's	Nos.	7	
11	PUP's/CUP's	Nos.	30	
12	Major Bridges	Nos.	3	
13	Minor Bridges	Nos.	11	2 Nos descoped
14	Culverts (Pipe)	Nos.	35	3 Pipe culverts were constructed under COS
15	Culvert (Slab/Box)	Nos.	27	2 Box culverts were constructed under COS
16	Major Junctions	Nos.	1	1 Major Intersection As per Sch-B is COS
17	High Embankments	Kms	-	
18	RCC Wall	Kms	1.205	
19	Full Height RE Wall	Kms	3.468	
20	Toe Wall	Kms	0.685	
21	Rest Areas (Service Areas)	Nos.	As per Sch-C, Clause 2.4.1	2 for Truck Parking & 3 Small Parking Areas (Under Construction)
22	High Mast Lights	Nos.	As per Sch-D, IRC: SP: 99-2013	
23	Highway Lighting (length only)	Kms	As per Sch-D, IRC: SP: 99-2013	
24	Single Arm Lightnings	Nos.	As per Sch-D, IRC: SP: 99-2013	239 Nos need to be installed
25	Double Arm Lightnings	Nos.	As per Sch-D, IRC: SP: 99-2013	155 Nos need to be installed
26	Lights below underpass/FO	Nos.	As per Sch-D, IRC: SP: 99-2013	345 Underpass lights are need to be installed
27	Chutes	Nos	-	
28	Median Opening	Nos	As per Sch-B, Clause 4.32	
29	Median Plantation Functional	Kms	As per Sch-C, Clause 2.8	
30	Median Plantation Non-Functional	Kms	-	
31	Road Markings	Kms	As per Sch-D, IRC: SP: 99-2013	3.400 Km. length of Road Marking is need to be painted
32	W-Beam Safety Barriers	Kms	-	17.223 Km. of length need to be installed & 5.542 Km. is under construction
33	Rigid Concrete Barriers	Kms	As per Sch-C, Clause 2.2.8	1.133 Km. of length is need to be Constructed
34	Delineators	Nos.	As per Sch-D, IRC: SP: 99-2013	Delineators need to be installed as per Sch-D
35	Kilometer Stones	Nos.	As per Sch-D, IRC: SP: 99-2013	64 Kilo Meter Stones need to be installed
36	Hectometer Stones	Nos.	As per Sch-D, IRC: SP: 99-2013	558 Hectometer Stones need to be installed

Sl. No.	Particulars	Length/ Nos.	As per Schedule-B	Remarks
37	Boundary Stones	Nos.	As per Sch-D, IRC: SP: 99-2013	1240 Boundary Stones need to be installed As per Sch-D
38	Boundary Fencing	Kms	As per Sch-D, IRC: SP: 99-2013	9.510 km. of Fencing need to be installed
39	Road Signs	Nos.	As per Sch-D, IRC: SP: 99-2013	128 need to be installed
40	Gantry Sign Boards	Nos.	As per Sch-B, Appendix B-XXIV	4 need to be installed
41	Cantilever Sign Boards	Nos.	As per Sch-B, Appendix B-XXIV	1 need to be installed
42	Varying Message Signs(VMS)	Nos.	As per Sch-D, IRC: SP: 99-2013	VMS need to be installed As per Sch-D
43	Emergency Call Box	Nos.		Only Barriers are provided at 24 no. locations, with no ECB
44	Advanced Traffic Management System(ATMS)	Nos.	As per Sch-B, Appendix B-XXII	ATMS need to be installed
45	Utility Ducts	Nos.	As per Sch-C, Clause 2.11	
46	Rain water Harvesting pits	Nos.	As per Sch-C, Clause 2.12	50 nos need to be installed
47	Connecting Roads	Kms	1.495	1.357 km. length of connecting roads are in under construction
48	Trapezoidal Drain	Kms	As per Sch-D, IRC: SP: 99-2013	15.530 Km. length of Toe Drain is need to constructed
49	Utility Pipes	Nos.	As per Sch-C, Clause 2.12	
50	Chute Drain	Kms	-	
51	Shoulder Drain	Kms	As per Sch-D, IRC: SP: 99-2013	5.344 Km. length of Shoulder drain is need to be construct
52	Solar Studs	Nos.	As per Sch-D, IRC: SP: 99-2013	7589 nos of Studs need to be installed
53	Noise Barriers	Kms	As per Sch-C, Clause 2.10	0.454 Km. of length is provided only with poles without sheet & 1.970 Km. length is need to be installed

1.11 SITE OBSERVATIONS

- ✓ Embankment damages have been observed at various locations on both sides of the carriageway. However, repair works are currently underway at some of these locations. Notably, it has been observed that geocells are being utilized as part of the embankment repair works.
- ✓ It has been observed that at certain embankment locations, chute drains on either side of the carriageway are damaged.
- ✓ At a few locations, a slight gap has been observed between the paved shoulder and the utility duct. Water seepage through this gap has been noted, which is resulting to soil erosion beneath the rigid panels, utility ducts, lined open drains, and chute drains in certain areas.
- ✓ Cracking in the form of multiple, transverse, and longitudinal cracks has been observed at various locations. At some of these locations, sealing and stapling treatments have been

carried out. Ravelling, popouts, and corner breaks have been noted at various locations along the project corridor. In a few locations, wide longitudinal joints are also observed.

- ✓ Settlement of rigid panels has been observed at structure approach locations, which have been overlaid with Bituminous Concrete.
- ✓ Traffic attenuators have been provided at the entry points of the Food Plaza, Rest Area, and Toll Plaza locations. However, at one location, the traffic attenuator has been found to be damaged.
- ✓ Open lined drain is observed along the project corridor on either side of the carriageway. At few of these locations, damage to lined open drains has been noted.
- ✓ Trapezoidal shaped toe RCC drain is observed along the project corridor on either side of the carriageway. At few of these locations, damage to Trapezoidal shaped toe RCC drain is noted.
- ✓ Median plantation is done along the length require maintenance/redoing at some locations
- ✓ Drip irrigation system is installed all along expressway in median. It is said ground water bore is done at every 5 Km interval for providing water supply. However, function of drip system is not yet seen.
- ✓ Emergency median Openings are observed at 5 locations along the project corridor.
- ✓ Thrie-beam crash barriers (MBCBs) have been provided along the project corridor on the shoulder side and on the median on either carriageway. At a few of these locations, damages to the crash barriers have been observed.
- ✓ Boundary Fencing has been provided along the project corridor either side of the carriageway. At a few of these locations, damages to the Fencing have been noted.
- ✓ Highway lighting in the form of Double arm, single arm and Highmast are provided along the project corridor. At few of these locations light pole damages are noted.

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
- Visual Pavement Condition
- Roughness Surveys using NSV
- Pavement Composition surveys (from previous studies)
- Subgrade Investigations & Laboratory testing (from previous studies)
- Material Investigations
- Cores Investigations
- Structure Inventory and Condition Surveys

These surveys have been performed in the month of May 2025.

2.2 ROAD INVENTORY

The project corridor has rigid pavement with 8-lane divided carriageway for the entire length including Structure approach's locations. In general, the project road has 15m (4x3.75m) wide carriageway plus 3.0m paved shoulder and flanked by 0.6m Utility corridor, 0.6m open lined drain & 0.6m earthen shoulder on either side of median. Majority of the project length has 4.5m median which includes 0.75m shyness. The project corridor generally runs in Plain terrain. The land use along the project road is agricultural. It passes through villages like Manubar, Derol, Dayadara, Kelod, Karela, Kurchan, Dora, Danda & Sanpa. In general, road embankments are in the range of 3m-5m height. Embankments higher than 6m are observed mainly in the approaches of CD structures and Underpass locations.

Typical View of Project Road is shown below:



A view of the Project Corridor at Km 292.000



A view of the Project Road at km293.000



A view of the Project Road at km 302.000



A view of the Project Road at km 306.000



A view of the Project Road at km 316.000



A view of the Project Road at km 320.000

The project road includes seven connecting roads with a total length of 1.357 km. Each connecting road has a carriageway width of 5.5 meters. Photographs showing the Connecting roads are presented below.



Connecting Road at km 317.500 LHS



Connecting Road at km 318.980 RHS

Approaches to the Grade separator structures are provided with RE wall/RCC wall. High embankments are provided with grouting on soil embankment along with chutes. At some locations damages to Embankment and Chute drains are observed. At some of these Damage location Repair works are in progress. Photographs showing the Approaches are presented below.



RE Blocks at km 299.350 LHS



RE Blocks at km 299.350 LHS



Chute Drain Damage at km 301.700 LHS



Repair works of Embankment at km 318.440 RHS

RCC open lined drains have been provided along the project corridor on either side of the main carriageway edge. Trapezoidal toe drains are provided at the bottom of the embankments on both sides of the corridor. Sample photographs of these drainage provisions are presented below.



Lined Drain at km 302.900 LHS



Trapezoidal Drain at km 292.600 LHS

Road user facilities such as Food Plazas and Rest Areas have been provided along the project corridor, with paved surfaces finished using paver blocks. The Rest Areas are equipped with amenities including Dhaba's, Toilet blocks, Fuel stations, Truck parking, Dormitories, Static Weigh Bridge and other user conveniences. Few photos showing Food Plaza and Rest areas are presented below.



Food Plaza at km 292.200 LHS



Food Plaza at km 297.050 RHS



Rest Area at km 306.500 LHS



Rest Area at km 318.000 RHS



Food Plaza at km 317.250 LHS



Dhaba at km 306.500 LHS Rest Area

Highway lighting in the form of Single/double arms are provided along the project corridor at Food Plaza, Rest Area, Toll Plaza and Major Structure approach locations whereas High-masts are provided at Toll Plazas and Rest Areas. Few photos showing High mast and highway lighting are presented below:

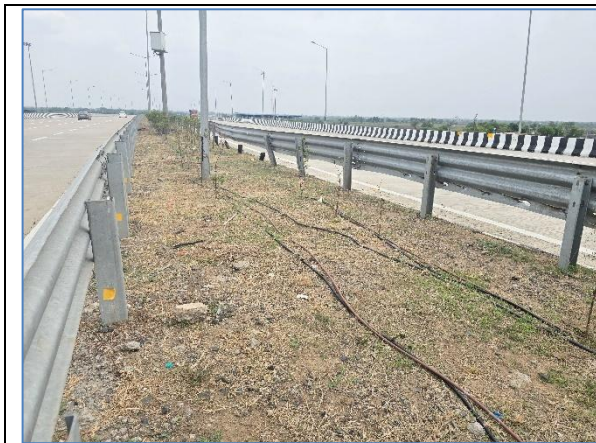


Single Arm at km 317.000 LHS



High mast at km 306.530 LHS

Drip irrigation system is provided in the median for a length of 29.570Km along the project corridor with 6 numbers of Pumps. Few photos depicting the Drip irrigation are presented below:



Drip Irrigation @ Km 322.900



Drip Irrigation Pump @ Km 313.940

At the endpoint of the project near Sanpa village, two toll plazas have been provided on the ramp sections. One toll plaza, located on the left-hand side (LHS) ramp, consists of 8 lanes and serves as the exit plaza. The other toll plaza, located on the right-hand side (RHS) ramp, consists of 4 lanes and functions as the entry plaza. Admin buildings are provided on both the toll plazas. Only one Static Weigh Bridge is provided at RHS Entry Plaza. Few photos depicting the Toll Plaza on Ramp locations are presented below:



Exit Toll Plaza at Km322.800 @ LHS Ramp



Entry Toll Plaza at Km322.800 @ RHS Ramp



Admin Building at Km322.800 @ LHS Ramp



Static weigh Bridge at Km322.800 @ RHS Ramp

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.



Transverse Cracking @ Km 292.400 LHS



Longitudinal Cracking @ Km 293.450 LHS



Multiple Cracking @ Km 294.080 LHS



Longitudinal Cracking @ Km 310.100 RHS



Longitudinal Wide Joint Repair work in progress @ km 310.480 RHS



Transverse Cracking @ km311.840 RHS



Multiple Cracking @ Km 311.800 RHS



Panel Repair works Done @ Km 310.800 RHS



Settlement of Panels @ 308.300 RHS



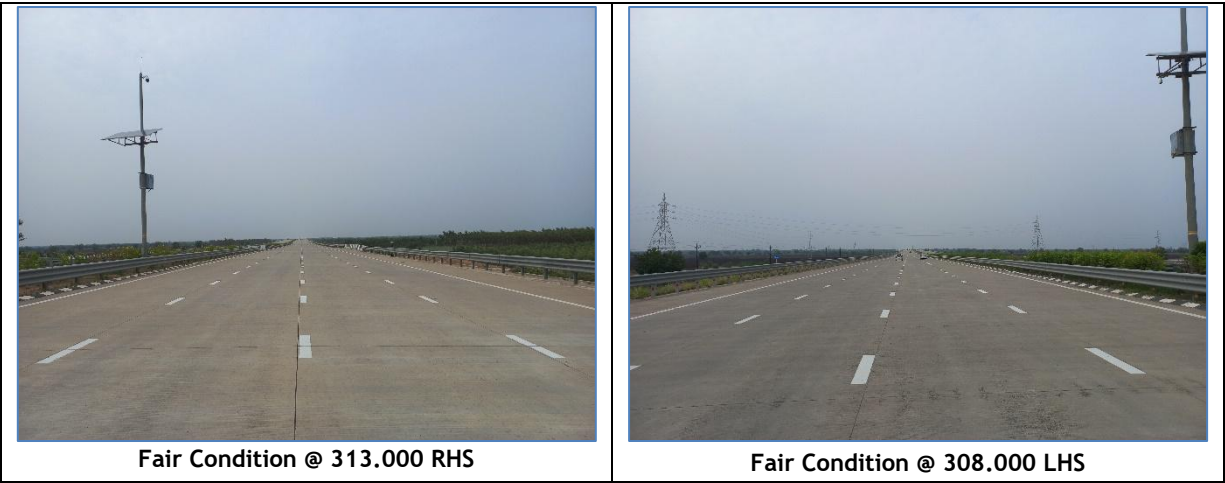
Multiple Cracking @ 298.200 LHS



Multiple Cracking @ Km 312.380 LHS



Fair Condition @ Km 322.000 RHS



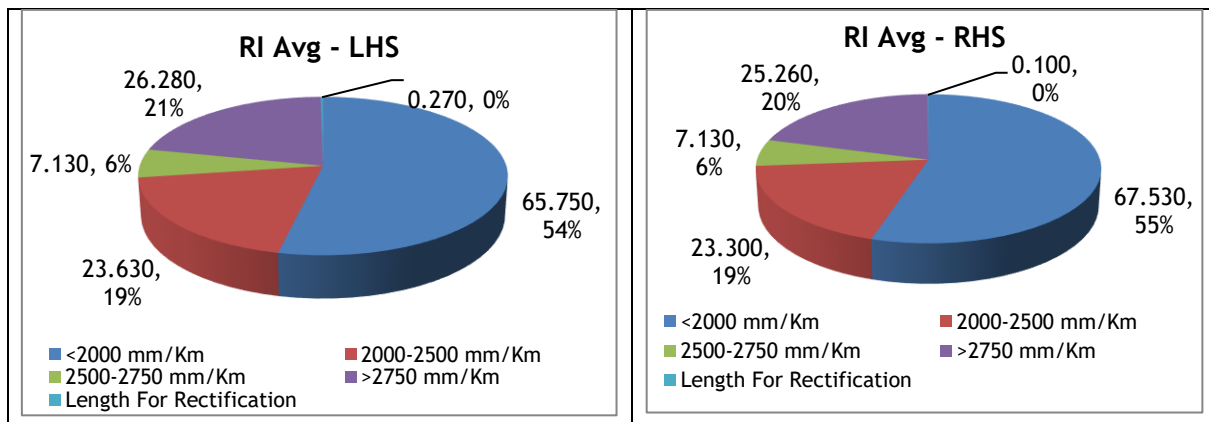
2.4 ROUGHNESS SURVEYS

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 2750 mm/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 270m in LHS & 100m 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 has been taken from previous DD studies. The extracted details are reproduced in the table below.

Table 4: Pavement Composition of Existing Pavement along Project Road

Sl No	Test Pit No	Chainage	Direction	PQC, mm	DLC, mm	GSB, mm	Total mm
1	MS-TP-1	297+700	RHS	310	150	145	605
2	MS-TP-2	302+810	LHS	310	150	160	620
3	MS-TP-3	312+200	LHS	330	150	150	630
4	MS-TP-4	322+400	LHS	340	150	150	640
5	MS-TP-5	321+900	LHS	310	150	150	610
6	MS-TP-6	317+340	LHS	310	145	165	620

2.6 MATERIAL INVESTIGATIONS

2.6.1 SUBGRADE INVESTIGATIONS & LABORATORY TESTING

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

2.6.2 BORROW AREA SAMPLES

From Previous DD Findings it is noted that few sources identified as potential borrow areas shown are as presented below.

S No	Borrow Area No	Chainage	Side	Offset	Village and contact person	Quantity	Rate	Remarks	Co-ordinate
1	MS-BP-1	302+810	LHS	100 M	Vill- Kedol Patel Infrastructure	50 Bigha* 5 feet	Not Told	Pvt. Land (Purchased By Patel Infrastructure)	21.832087 72.941518
2	MS-BP-2	321+200	LHS	100 M	Vill- Suthodra Patel Infrastructure	100 Bigha* 5 feet	Not Told	Pvt. Land (Purchased By Patel Infrastructure)	21.989764 72.999179
3	MS-BP-3	313+250	RHS	200 M	Vill- Amarpur Patel Infrastructure	50 Bigha* 5 feet	Not Told	Pvt. Land (Purchased By Patel Infrastructure)	21.929548 72.971782

S No	Borrow Area No	Chainage	Side	Offset	Village and contact person	Quantity	Rate	Remarks	Co-ordinate
4	MS-BP-4	309+400	LHS	100 M	Vill- Kurchan Patel Infrastructure	100 Bigha* 3 feet	Not Told	Pvt. Land (Purchased By Patel Infrastructure)	21.891300 72.959578
5	MS-BP-5	298+000	RHS	100 M	Vill- Dayadara Patel Infrastructure	10 Bigha* 5 feet	Not Told	Pvt. Land (Purchased By Patel Infrastructure)	21.791669 72.940066

2.6.3 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.

Table 5: Aggregate Samples Details

Samp le No.	Ex.Chain age (Km.)	Left/ Right	Name of Village	Name of Source/ Crusher	Lead from Nearest Ex.Chain age (Km.)	Appro ximate Quanti ty (ton)	Basic cost of the material (Rs.)	Remarks	Co- ordin ate
MS-AQ-1	299+000	RHS	Rajpardi	Crusher - Mauni Mineral Name: Vipul Bhai Village - Natenag Mob no- 9913444433	70 km	Plenty	40mm-Rs 625/- Per ton 20mm-Rs 700/- Per ton 10mm-Rs 500/- Per ton 6mm - Rs 450/- Per ton Dust - Rs 250/- Per ton Including Royalty	Extra: GST 5%	21.67 4327 73.31 2601
MS-AQ-2	299+000	RHS	Rajpardi	Crusher - J. P. Mineral Name: Jaswanth Bhai Patel Village - Kadwali Mob no- 7359843555	62.5 km	Plenty	40mm-Rs 550/- Per ton 20mm-Rs 700/- Per ton 10mm-Rs 500/- Per ton Dust - Rs 300/- Per ton Including Royalty	Extra: GST 5%	21.72 6222 73.29 0858
MS-AQ-3	299+000	RHS	Rajpardi	Crusher - Mahadev Mineral Name: Ramesh Bhai Village - Kadwali Mob no- 9824047195	62.5 km	Plenty	40mm-Rs 650/- Per ton 20mm-Rs 700/- Per ton 10mm-Rs 450/- Per ton Dust - Rs 250/- Per ton Boulder - Rs 500/- Per ton Including Royalty	Royalty: Rs 50/- Per ton and Extra: GST 5%	21.72 7845 73.28 4532

2.6.4 SAND SAMPLES

River Sand sample (1 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

SI No	Sand Source	Village & Name	Name of river & Village	Chainage	side	Offset	Rate	Remarks	Co-ordinate
1	MS-SQ-1	Vill -Nareshwar Shiv Shakthi Enterprises Name - Sathish Bhai Mob- 9586007071	Narmada	299+000	RHS	45 km	Rs 450/- Per ton Including Royalty	Royalty Rs - 115/- Per ton & Extra GST 5%	21.868434 73.242148

2.7 CORE INVESTIGATION

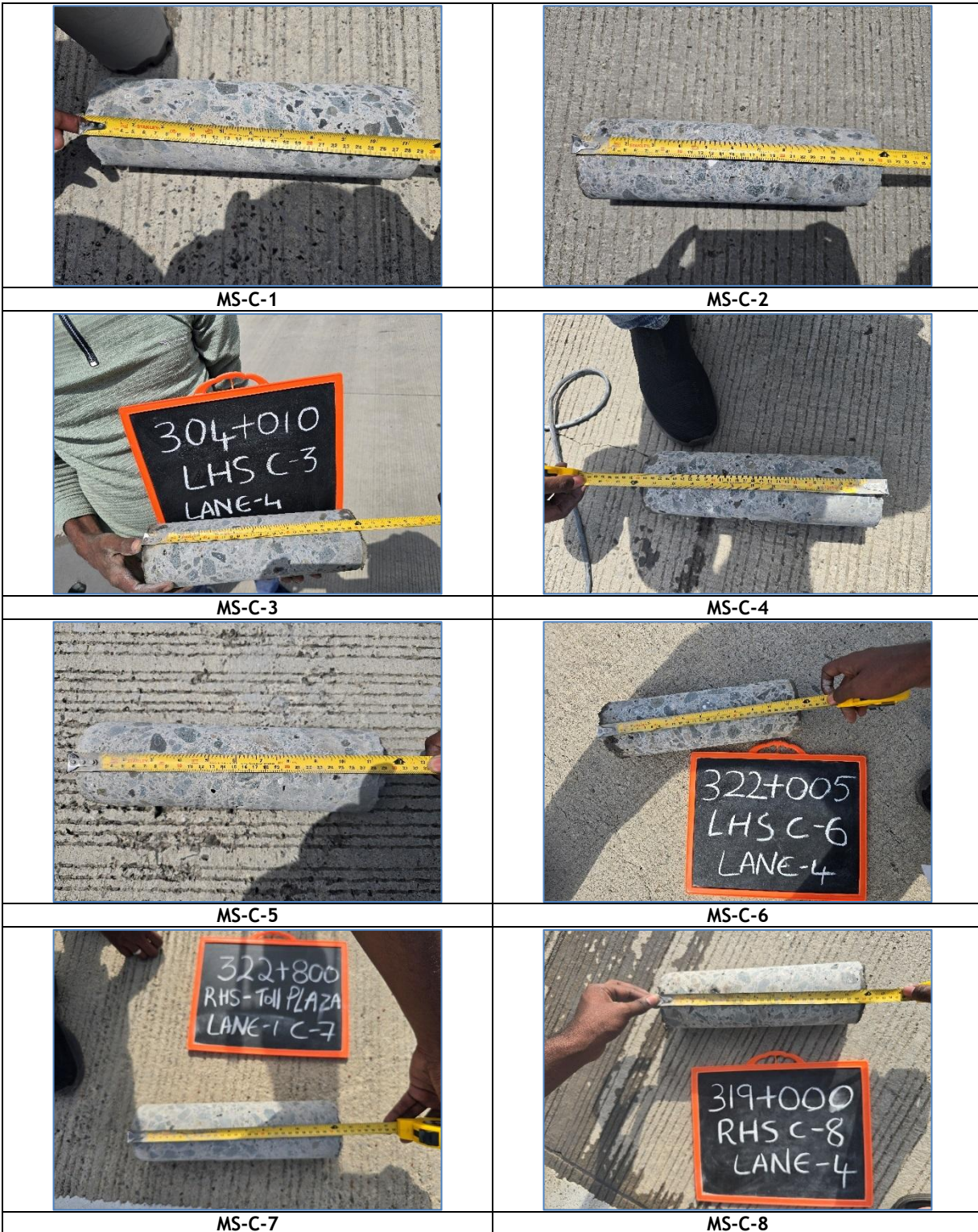
The objective of the core cutting is to examining the engineering properties of the materials relevant to the project as per specifications. Accordingly, 13 Nos. of cores were taken carefully from the project corridor, in which on LHS: 6 Nos, on RHS :7 Nos.






Table 7: Core Cutting Samples Details

Chainage	Side	Carriageway Lane	MCW/SR	Distance from Median Kerb in Meters	Condition of Road	Core Height of MM	Depth of core hole MM	Depth of Crack	Observations
292+007	LHS	Lane-4	MCW	14.5	Fair	295	300	Nil	Fair
298+002	LHS	Lane-4	MCW	13.8	Fair	305	310	Nil	Fair
304+010	LHS	Lane-4	MCW	14.0	Fair	300	305	Nil	Fair
310+002	LHS	Lane-4	MCW	13.5	Shrinkage Cracks	295	298	Nil	Fair
316+000	LHS	Lane-4	MCW	13.4	Fair	295	298	Nil	Fair
322+005	LHS	Lane-4	MCW	13.9	Fair	295	300	Nil	Fair
322+800	RHS	Lane-1	Toll Plaza	17.8	Fair	315	317	Nil	Fair
319+000	RHS	Lane-4	MCW	14.2	Fair	305	310	Nil	Fair
318+000	RHS	Lane-2	Rest Area	5.5	Fair	280	300	Nil	Fair
313+000	RHS	Lane-4	MCW	13.8	Fair	280	282	Nil	Fair
307+003	RHS	Lane-4	MCW	13.8	Fair	275	280	Nil	Fair
301+415	RHS	Lane-4	MCW	13.4	Multiple Cracks	285	285	285	Full Depth Crack
295+015	RHS	Lane-4	MCW	14.9	Transverse Cracks	290	292	230	Partial Depth Crack

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

The Photos depicting the above are presented below:



 <p>REST AREA L-2</p>	
<p>MS-C-9</p>	<p>MS-C-10</p>
	 <p>301+415 RHS-C-12 LANE-4</p>
<p>MS-C-11</p>	<p>MS-C-12</p>
	
<p>MS-C-13</p>	

CHAPTER 3. VALIDATION OF EXECUTED WORKS

3.1 ROAD WORKS

The project road has been closely inspected to verify the executed works on ground. The scope works to be executed by the Concessionaire/Contractor as envisaged in CA is compared with the executed work on the Ground. As a part of the validation, the available as-built drawings and the 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: Project Features

S. No.	Particulars	Length/ Nos	As per Site
1	Start Chainage (Km)	Km	292.000
2	End Chainage (Km)	Km	323.000
3	Length of the Project Corridor	Kms	31.00
4	Service Road / Slip Road (Including Taper Length)	Kms	-
5	Connecting Roads	Kms	1.36
6	ROBs	Nos	1
7	VOP	Nos	1
8	VUPs	Nos	3
9	LVUP's	Nos	7
10	PUP's/CUP's	Nos	30
11	Major Bridges	Nos	3
12	Minor Bridges	Nos	9
13	Culverts (Pipe)	Nos	38
14	Culvert (Box)	Nos	29
15	Utility Pipes	Nos	62
16	Major Junctions	Nos	1
17	High Embankments	Kms	58.800
18	RCC Wall-Full Height	Kms	1.165
19	RE Blocks - Full height	Kms	4.04
20	Toe Wall	Kms	0.685
21	RCC Open Lined Drain	Kms	55.32
22	Trapezoidal Toe Drain	Kms	56.66
23	Toll Plaza	Nos	2
24	No.of Lanes (Both side)8lane+12lanes	Nos	12
25	ECB - Emergency Call Box	Nr	30
26	Advanced Traffic Management System (ATMS)	Kms	31
27	Route Patrolling Vehicle	Nos	1
28	Ambulance	Nos	1
29	Cranes	Nos	1
30	SWB	Nos	3
31	High Mast Lights	Nos	216
32	Low Mast Lights	Nos	-
33	Highway Lighting (length only)	Kms	18.40
34	Single Arm Lightnings poles	Nos	779
35	Double Arm Lightnings poles	Nos	90
36	Solar Blinkers	Nos	7
37	Rest Areas	Nos	5
38	Toilet Block	Nos	5
39	Median Opening	Nos	5
40	Median Plantation_Functional	Kms	23.49

S. No.	Particulars	Length/ Nos	As per Site
41	Median Plantation-Functional	Kms	5.56
42	Road Markings	Kms	31.00
43	Kilometer Stones	Nos	62
44	Hectometer Stones	Nos	533
45	Rigid Concrete Barriers	Kms	14.421
46	Metal Beam Crash Barriers	Kms	122.258
47	Boundary Fencing	Kms	56.13
48	Traffic Impact Attenuator	Nos	6
49	Thrie beam crash barrier	Kms	122.26
50	Noise Barriers	Kms	2.58
51	Road Signs	Nos	190
52	4-Lane Gantry Sign Boards	Nos	7
53	Cantilever Sign Boards	Nos	19
54	Varying Message Signs (VMS)	Nr	1
55	PTZ camera's	Nr	30
56	Toll Plaza Sign Boards	Nos	22
57	Drip Irrigation Water Pumps	Nos	6
58	Drip Irrigation	Kms	29.18

Drip irrigation pipe is provided at Median in entire length of the project corridor. Length wise details are presented in **Appendix-5** of this report. Summary of Drip irrigation is presented in table below.

Table 9: Summary of Drip Irrigation

Summary	Length (Kms)	Remarks
As Per Site	29.182	
Total	29.182	

RCC open lined drains have been provided along the project corridor on either side of the main carriageway edge. Trapezoidal toe drains are provided at the bottom of the embankments on both sides of the project corridor. The summary of the drains table is presented below. The location wise details are presented in the **Appendix-5** of this report.

Table 10: Summary of Drains

Summary	LHS	RHS	Total Length (km)
RCC Open Line Drain	27.453	27.863	55.316
Trapezoidal Drain	28.145	28.515	56.7
No Drain	0.285	0.030	0.315
Damage (km)	5	200	0.205

Approaches to the grade separator structures are constructed using Reinforced Earth (RE) walls or RCC retaining walls. For high embankments, soil embankment construction has been adopted, integrated with chute drains for proper drainage. However, embankment and chute drain damages have been observed at certain locations along the corridor. Repair works are currently in progress at some of these damaged locations. The summary of the slope protection table is presented below. The location wise details are presented in the **Appendix-5** of this report.

Table 11: Summary of Slope Protection along Project Road

Approach Type	Length (Km)
Embankment	58.800
Toe wall	0.685
RE Blocks	4.040
RCC wall	1.165
Total	64.690

In general, the median width is 4.5m all along the project road. 5 No of Emergency Median openings are observed in the project corridor with Normal lanes. The location wise details are presented in the table below.

Table 12: Summary of Median Openings

Summary	No's
Normal Lane	5

Safety barriers in the form of Thrie-Beam Crash Barriers and Concrete Crash Barriers have been provided throughout the length of the project corridor. These barriers are installed on both sides of the shoulder and the median to enhance road safety. Noise barriers have been installed at Rest Area locations to mitigate the impact of traffic noise on surrounding areas. Additionally, boundary fencing has been provided on both sides of the corridor for the entire project length to restrict unauthorized access and enhance overall security. A summary of these safety features is presented in the table below. The location wise details is presented in the **Appendix-5** of this report:

Table 13: Summary of Safety Barriers

S. No.	Description	Length (Kms)
1	Thrie-Beam Crash Barriers	122.258
2	Concrete Crash Barriers	14.421
3	Noise Barriers	2.584
4	Boundary Fencing	56.130

Rest Areas have been provided at designated locations along the project corridor to cater to the needs of road users and enhance travel convenience. The Location details is Presented in the **Appendix-5** of this report.

Table 14: Summary of Rest Area along Project Road

Summary	No's
Total	5

Road furniture, including street lighting and sign boards, has been installed along the entire project road to enhance road safety, visibility, and user guidance. The tables below provide a summary of the road furniture items. The location wise details are presented in the **Appendix-5** of this report:

Table 15: Summary of Highway Lighting

Description	Remarks
Length of Highway Lighting as per Site	18.400
No of 1-arm Poles as per Site	779
No of 2-arm Poles as per Site	90
No of poles Damaged	4
Highmast	15

Table 16: Summary of Road Signs along Project Road

Description	LHS	RHS	Total
Octagonal	8	4	12
Circular	24	26	50
Triangular	11	10	21
Rectangular	30	28	58
Facility informatory	15	15	30
Hazard	12	7	19
Toll Boards	13	9	22
Cantilever Gantry	10	9	19
Over Head Gantry	4	3	7
Total	127	111	238

3.2 STRUCTURES

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

Table 17: SUMMARY OF MAJOR STRUCTURES

S. No	Type of Structure	No. of Str's as per schedule	No. of Str's as per site	Deviations and Remarks
1	ROB	1	1	-
2	MJB	3	3	-
3	MNB	11	9	2 No's of Minor bridges at ch: 296+450 and 304+450 were deleted under negative change of scope as per letter NHAI/PIU-Godhra/2020/11093/VME-III/cons. Patel/Vol.7/D-6924 dated 30.05.2022.
4	Flyover	1	1	-
5	VUP	3	3	-
6	LVUP	7	7	-

S. No	Type of Structure	No. of Str's as per schedule	No. of Str's as per site	Deviations and Remarks
7	CUP/PUP	30	30	-
8	VOP	1	1	-
9	BOX CULVERTS	27	29	2 No's of Box culverts at ch: 315+214 and 317+480 were constructed under change of scope as per letter NHAI/PIU-Godhra/2020/11093/VME-III/cons.Patel/Vol.7/D-6924 dated 30.05.2022.
10	PIPE CULVERTS	35	38	3 No's of Pipe culverts at ch: 295+159, 311+071 and 321+687 were constructed under change of scope as per letter NHAI/PIU-Godhra/2020/11093/VME-III/cons.Patel/Vol.7/D-6924 dated 30.05.2022.
11	UTILITY PIPES	62	62	-
Total No's		181	184	

Table 18: Age of Structures

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	1
2	MJB	-	3	-	3	-	-	-	6	3
3	MNB	-	9	-	9	-	-	-	18	9
4	Flyover	-	1	-	1	-	-	-	2	1
5	VUP	-	3	-	3	-	-	-	6	3
6	LVUP	-	7	-	7	-	-	-	14	7
7	CUP/PUP	-	30	-	30	-	-	-	60	30
8	VOP	-	-	-	-	-	1	-	1	1
9	BC	-	-	-	-	-	29	-	29	29
10	PC	-	-	-	-	-	38	-	38	38
11	UT	-	-	-	-	-	62	-	62	62
Total No's		0	54	0	54	0	130	0	238	184

Table 19: Summary of Expansion Joints & Bearings

SUMMARY OF EXPANSION JOINTS & BEARINGS (Numbers)							
S. No	Type of Str	Expansion joints		Bearings			
				Pot PTFE		Elastomeric	
		Old	New	Old	New	Old	New
1	ROB	-	20	-	584	-	-
2	MJB	-	12	-	288	-	-
3	MNB	-	28	-	40	-	212
4	Flyover	-	4	-	108	-	-
5	VOP	-	3	-	4	-	16
Total No's		0	67	0	1024	0	228

Table 20: Summary of Super Structure

SUMMARY OF SUPERSTRUCTURES									
S. No	Type of Str	RCC Box	RCC Girder	RCC Slab	PSC Girder & Steel Girder	PSC Girder	PSC & RCC Girder	RCC, PSC Girder & Steel Girder	Total No. of Str's
1	ROB	-	-	-	-	-	-	2	2
2	MJB	-	-	-	-	4	2	-	6
3	MNB	4	6	2	2	4	-	-	18
4	Flyover	-	-	-	-	-	2	-	2
5	VUP	6	-	-	-	-	-	-	6
6	LVUP	14	-	-	-	-	-	-	14
7	CUP/PUP	63	-	-	-	-	-	-	63
8	VOP	-	-	-	-	1	-	-	1

SUMMARY OF SUPERSTRUCTURES									
S. No	Type of Str	RCC Box	RCC Girder	RCC Slab	PSC Girder & Steel Girder	PSC Girder	PSC & RCC Girder	RCC, PSC Girder & Steel Girder	Total No. of Str's
Total No's		87	6	2	2	9	4	2	112

Table 21: Summary of Sub Structure

SUMMARY OF SUBSTRUCTURES									
S. No	Type of Str	ABUTMENT				PIER			
		RCC wall type	Multiple column frame	Single Column	RCC wall type	RCC wall type	Single Column	RCC wall type & Multiple column frame	RCC wall type
1	ROB	-	2	-	-	-	-	2	-
2	MJB	6	-	-	-	6	-	-	-
3	MNB	12	2	-	-	-	-	-	-
4	Flyover	-	-	-	2	-	-	-	2
5	VOP	-	-	1	-	-	1	-	-
Total No's		18	4	1	2	6	1	2	2

Table 22: Details of ROB's

S.No.	Skew (Yes/No)	Site Chainage (Km)	Type of Str	Side	Stron	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
											Abutment	Pier		
1	YES	293+014	ROB	LHS	MCW	New	6 x 30 + 1 x 24.75 + (2 x 8.75 to 30) + 1 x 38 + 1 x 44 + 1 x 33.75 + 5 x 33	21.25	20.25	Not visible	Multiple column frame	RCC wall type & Multiple column frame	RCC, PSC Girder & Steel Girder	Pot PTFE
2	YES	293+014	ROB	RHS	MCW	New	6 x 30 + 1 x 24.75 + (2 x 8.75 to 30) + 1 x 38 + 1 x 44 + 1 x 33.75 + 5 x 33	21.25	20.25	Not visible	Multiple column frame	RCC wall type & Multiple column frame	RCC, PSC Girder & Steel Girder	Pot PTFE

Table 23: Details of Major Bridge

S. No.	Skew (Yes/No)	Site Chainage (Km)	Type of Str	Side	Stron	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
											Abutment	Pier		
1	YES	302+713	MJ B	LH S	MC W	New	2 x 37.847 + 1x 38.048	21.25	20.25	Not visible	RCC wall type	RCC wall type	PSC Girder	Pot PTFE
2	YES	302+713	MJ B	R HS	MC W	New	2 x 37.847 + 1x 38.048	21.25	20.25	Not visible	RCC wall type	RCC wall type	PSC Girder	Pot PTFE
3	NO	318+870	MJ B	LH S	MC W	New	2 x 32.20 + 1x 15.85	21.25	20.25	Not visible	RCC wall type	RCC wall type	PSC & RCC Girder	Pot PTFE
4	NO	318+870	MJ B	R HS	MC W	New	2 x 32.20 + 1x 15.85	21.25	20.25	Not visible	RCC wall type	RCC wall type	PSC & RCC Girder	Pot PTFE
5	YES	321+253	MJ B	LH S	MC W	New	2 x 37.658	21.25	20.25	Not visible	RCC wall type	RCC wall type	PSC Girder	Pot PTFE
6	YES	321+253	MJ B	R HS	MC W	New	2 x 37.658	21.25	20.25	Not visible	RCC wall type	RCC wall type	PSC Girder	Pot PTFE

Table 24: Details of Minor Bridge's

S. No.	Skew (Yes/No)	Site Chainage (Km)	Type of Str	Side	Stron	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
											Abutment	Pier		
1	NO	294+085	MN B	LH S	MC W	New	1 x 12	21.25	20.25	-	-	-	RCC Box	-
2	NO	294+085	MN B	R HS	MC W	New	1 x 12	21.25	20.25	-	-	-	RCC Box	-

S. No	Ske w (Yes/ No)	Site Chainage (Km)	Type of Str	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
											Abutment	Pier		
3	YES	297+472	MNB	LHS	MCW	New	1 x 17.688	21.25	20.25	Not visible	RCC wall type	-	RCC Girder	Elastomeric & Pot PTFE
4	YES	297+472	MNB	RHS	MCW	New	1 x 17.688	21.25	20.25	Not visible	RCC wall type	-	RCC Girder	Elastomeric & Pot PTFE
5	YES	297+562	MNB	LHS	MCW	New	1 x 37.4	21.25	20.25	Not visible	RCC wall type	-	PSC Girder	Elastomeric & Pot PTFE
6	YES	297+562	MNB	RHS	MCW	New	1 x 37.4	21.25	20.25	Not visible	RCC wall type	-	PSC Girder	Elastomeric & Pot PTFE
7	YES	307+733	MNB	LHS	MCW	New	1 x 36.540	21.25	20.25	Not visible	RCC wall type	-	PSC Girder	Elastomeric & Pot PTFE
8	YES	307+733	MNB	RHS	MCW	New	1 x 36.540	21.25	20.25	Not visible	RCC wall type	-	PSC Girder	Elastomeric & Pot PTFE
9	YES	309+074	MNB	LHS	MCW	New	1 x 45.2	21.25	20.25	Not visible	Multiple column frame	-	PSC Girder & Steel Girder	Elastomeric
10	YES	309+074	MNB	RHS	MCW	New	1 x 45.2	21.25	20.25	Not visible	Multiple column frame	-	PSC Girder & Steel Girder	Elastomeric
11	YES	309+840	MNB	LHS	MCW	New	1 x 23.74	21.25	20.25	Not visible	RCC wall type	-	RCC Girder	Elastomeric & Pot PTFE
12	YES	309+840	MNB	RHS	MCW	New	1 x 23.74	21.25	20.25	Not visible	RCC wall type	-	RCC Girder	Elastomeric & Pot PTFE
13	YES	310+720	MNB	LHS	MCW	New	1 x 21.35	21.25	20.25	Not visible	RCC wall type	-	RCC Slab	-
14	YES	310+720	MNB	RHS	MCW	New	1 x 21.35	21.25	20.25	Not visible	RCC wall type	-	RCC Slab	-
15	YES	313+809	MNB	LHS	MCW	New	1 x 24.410	21.25	20.25	Not visible	RCC wall type	-	RCC Girder	Elastomeric & Pot PTFE

S. No.	Skew (Yes/No)	Site Chainage (Km)	Type of Str	Side	Stron	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
											Abutment	Pier		
16	YES	313+809	MNB	RHS	MCW	New	1 x 24.410	21.25	20.25	Not visible	RCC wall type	-	RCC Girder	Elastic & Pot PTFE
17	YES	314+314	MNB	LHS	MCW	New	3 x 4.8	21.25	20.25	-	-	-	RCC Box	-
18	YES	314+314	MNB	RHS	MCW	New	3 x 4.8	21.25	20.25	-	-	-	RCC Box	-

Table 25: Details of Flyover's:

S.No.	Skew (Yes/No)	Site Chainage (Km)	Type of Str	Side	Stron	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
											Abutment	Pier		
1	YES	299+354	FLYOVER	LHS	MCW	New	1 x 12.877 + 1 x 36.208 + 1 x 16.817	21.25	20.25	Not visible	RCC wall type	RCC wall type	PSC & RCC Girder	Pot PTFE
2	YES	299+354	FLYOVER	RHS	MCW	New	1 x 12.877 + 1 x 36.208 + 1 x 16.817	21.25	20.25	Not visible	RCC wall type	RCC wall type	PSC & RCC Girder	Pot PTFE

Table 26: Details of Major Structures along Project Road

S. No.	Chainage, km	Type of Structure	Side	location	Age	Span	Deck Width, m
1	292+400	PUP	LHS	MCW	New	1 x 12 x 4	21.25
2	292+400	PUP	RHS	MCW	New	1 x 12 x 4	21.25
3	293+014	ROB	LHS	MCW	New	6 x 30 + 1 x 24.75 + (2 x 8.75 to 30) + 1 x 38 + 1 x 44 + 1 x 33.75 + 5 x 33	21.25
4	293+014	ROB	RHS	MCW	New	6 x 30 + 1 x 24.75 + (2 x 8.75 to 30) + 1 x 38 + 1 x 44 + 1 x 33.75 + 5 x 33	21.25
5	293+875	LVUP	LHS	MCW	New	1 x 12 x 4	21.25
6	293+875	LVUP	RHS	MCW	New	1 x 12 x 4	21.25
7	294+085	MNB	LHS	MCW	New	1 x 12	21.25
8	294+085	MNB	RHS	MCW	New	1 x 12	21.25
9	294+520	LVUP	LHS	MCW	New	1 x 12 x 4	21.25
10	294+520	LVUP	RHS	MCW	New	1 x 12 x 4	21.25
11	295+151	PUP	LHS	MCW	New	1 x 12 x 4	21.25
12	295+151	PUP	RHS	MCW	New	1 x 12 x 4	21.25
13	295+554	VUP	LHS	MCW	New	1 x 12 x 5.5	21.25
14	295+554	VUP	RHS	MCW	New	1 x 12 x 5.5	21.25
15	295+990	PUP	LHS	MCW	New	1 x 12 x 4	21.25

S. No.	Chainage, km	Type of Structure	Side	location	Age	Span	Deck Width, m
16	295+990	PUP	RHS	MCW	New	1 x 12 x 4	21.25
17	297+220	PUP	LHS	MCW	New	1 x 12 x 4	21.25
18	297+220	PUP	RHS	MCW	New	1 x 12 x 4	21.25
19	297+472	MNB	LHS	MCW	New	1 x 17.688	21.25
20	297+472	MNB	RHS	MCW	New	1 x 17.688	21.25
21	297+562	MNB	LHS	MCW	New	1 x 37.4	21.25
22	297+562	MNB	RHS	MCW	New	1 x 37.4	21.25
23	297+900	PUP	LHS	MCW	New	1 x 12 x 4	21.25
24	297+900	PUP	RHS	MCW	New	1 x 12 x 4	21.25
25	298+380	PUP	LHS	MCW	New	1 x 12 x 4	21.25
26	298+380	PUP	RHS	MCW	New	1 x 12 x 4	21.25
27	299+079	PUP	LHS	MCW	New	1 x 12 x 4	21.25
28	299+079	PUP	RHS	MCW	New	1 x 12 x 4	21.25
29	299+354	FLYOVER	LHS	MCW	New	1 x 12.877 + 1 x 36.208 + 1 x 16.817	21.25
30	299+354	FLYOVER	RHS	MCW	New	1 x 12.877 + 1 x 36.208 + 1 x 16.817	21.25
31	300+725	PUP	LHS	MCW	New	1 x 12 x 4	21.25
32	300+725	PUP	RHS	MCW	New	1 x 12 x 4	21.25
33	301+214	LVUP	LHS	MCW	New	1 x 12 x 4	21.25
34	301+214	LVUP	RHS	MCW	New	1 x 12 x 4	21.25
35	301+790	PUP	LHS	MCW	New	1 x 12 x 4	21.25
36	301+790	PUP	RHS	MCW	New	1 x 12 x 4	21.25
37	302+055	PUP	LHS	MCW	New	1 x 12 x 4	21.25
38	302+055	PUP	RHS	MCW	New	1 x 12 x 4	21.25
39	302+713	MJB	LHS	MCW	New	2 x 37.847 + 1x 38.048	21.25
40	302+713	MJB	RHS	MCW	New	2 x 37.847 + 1x 38.048	21.25
41	303+220	PUP	LHS	MCW	New	1 x 12 x 4	21.25
42	303+220	PUP	RHS	MCW	New	1 x 12 x 4	21.25
43	303+808	VUP	LHS	MCW	New	1 x 12 x 5.5	21.25
44	303+808	VUP	RHS	MCW	New	1 x 12 x 5.5	21.25
45	304+170	PUP	LHS	MCW	New	1 x 12 x 4	21.25
46	304+170	PUP	RHS	MCW	New	1 x 12 x 4	21.25
47	305+058	PUP	LHS	MCW	New	1 x 12 x 4	21.25
48	305+058	PUP	RHS	MCW	New	1 x 12 x 4	21.25
49	305+850	PUP	LHS	MCW	New	1 x 12 x 4	21.25
50	305+850	PUP	RHS	MCW	New	1 x 12 x 4	21.25
51	306+060	PUP	LHS	MCW	New	1 x 12 x 4	33
52	306+060	PUP	RHS	MCW	New	1 x 12 x 4	21.25
53	306+820	PUP	LSR	SR	New	1 x 12 x 4	12.5
54	306+820	PUP	LHS	MCW	New	1 x 12 x 4	21.25
55	306+820	PUP	RHS	MCW	New	1 x 12 x 4	21.25
56	307+170	VOP	BHS	MCW	New	2 x 41.325	12
57	307+733	MNB	LHS	MCW	New	1 x 36.540	21.25
58	307+733	MNB	RHS	MCW	New	1 x 36.540	21.25
59	308+550	LVUP	LHS	MCW	New	1 x 12 x 4	21.25
60	308+550	LVUP	RHS	MCW	New	1 x 12 x 4	21.25
61	309+074	MNB	LHS	MCW	New	1 x 45.2	21.25
62	309+074	MNB	RHS	MCW	New	1 x 45.2	21.25
63	309+550	PUP	LHS	MCW	New	1 x 12 x 4	21.25
64	309+550	PUP	RHS	MCW	New	1 x 12 x 4	21.25
65	309+840	MNB	LHS	MCW	New	1 x 23.74	21.25
66	309+840	MNB	RHS	MCW	New	1 x 23.74	21.25
67	310+480	PUP	LHS	MCW	New	1 x 12 x 4	21.25
68	310+480	PUP	RHS	MCW	New	1 x 12 x 4	21.25
69	310+720	MNB	LHS	MCW	New	1 x 21.35	21.25
70	310+720	MNB	RHS	MCW	New	1 x 21.35	21.25
71	311+047	LVUP	LHS	MCW	New	1 x 12 x 4	21.25
72	311+047	LVUP	RHS	MCW	New	1 x 12 x 4	21.25
73	311+650	PUP	LHS	MCW	New	1 x 12 x 4	21.25
74	311+650	PUP	RHS	MCW	New	1 x 12 x 4	21.25
75	312+243	PUP	LHS	MCW	New	1 x 12 x 4	21.25

S. No.	Chainage, km	Type of Structure	Side	location	Age	Span	Deck Width, m
76	312+243	PUP	RHS	MCW	New	1 x 12 x 4	21.25
77	312+695	VUP	LHS	MCW	New	1 x 12 x 5.5	21.25
78	312+695	VUP	RHS	MCW	New	1 x 12 x 5.5	21.25
79	313+075	PUP	LHS	MCW	New	1 x 12 x 4	21.25
80	313+075	PUP	RHS	MCW	New	1 x 12 x 4	21.25
81	313+809	MNB	LHS	MCW	New	1 x 24.410	21.25
82	313+809	MNB	RHS	MCW	New	1 x 24.410	21.25
83	314+314	MNB	LHS	MCW	New	3 x 4.8	21.25
84	314+314	MNB	RHS	MCW	New	3 x 4.8	21.25
85	314+850	PUP	LHS	MCW	New	1 x 12 x 4	21.25
86	314+850	PUP	RHS	MCW	New	1 x 12 x 4	21.25
87	315+850	PUP	LHS	MCW	New	1 x 12 x 4	21.25
88	315+850	PUP	RHS	MCW	New	1 x 12 x 4	21.25
89	316+536	LVUP	LHS	MCW	New	1 x 12 x 4	21.25
90	316+536	LVUP	RHS	MCW	New	1 x 12 x 4	21.25
91	316+960	PUP	LHS	MCW	New	1 x 12 x 4	28.75
92	316+960	PUP	RHS	MCW	New	1 x 12 x 4	21.25
93	317+460	PUP	LHS	MCW	New	1 x 12 x 4	28.75
94	317+460	PUP	RHS	MCW	New	1 x 12 x 4	28.75
95	318+400	PUP	LHS	MCW	New	1 x 12 x 4	21.25
96	318+400	PUP	RHS	MCW	New	1 x 12 x 4	28.75
97	318+870	MJB	LHS	MCW	New	2 x 32.20 + 1x 15.85	21.25
98	318+870	MJB	RHS	MCW	New	2 x 32.20 + 1x 15.85	21.25
99	319+580	PUP	LHS	MCW	New	1 x 12 x 4	21.25
100	319+580	PUP	RHS	MCW	New	1 x 12 x 4	21.25
101	320+330	PUP	LHS	MCW	New	1 x 12 x 4	21.25
102	320+330	PUP	RHS	MCW	New	1 x 12 x 4	21.25
103	320+825	PUP	LHS	MCW	New	1 x 12 x 4	21.25
104	320+825	PUP	RHS	MCW	New	1 x 12 x 4	21.25
105	321+253	MJB	LHS	MCW	New	2 x 37.658	21.25
106	321+253	MJB	RHS	MCW	New	2 x 37.658	21.25
107	321+673	LVUP	LHS	MCW	New	1 x 12 x 4	21.25
108	321+673	LVUP	RHS	MCW	New	1 x 12 x 4	21.25
109	322+550	PUP	LSR	SR	New	1 x 12 x 4	19
110	322+550	PUP	LHS	MCW	New	1 x 12 x 4	21.25
111	322+550	PUP	RHS	MCW	New	1 x 12 x 4	21.25
112	322+550	PUP	RSR	SR	New	1 x 12 x 4	12.6

CHAPTER 4. QUALITY AUDIT

4.1 MATERIAL INVESTIGATIONS

4.1.1 SUBGRADE

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

Table 27: Details of Soaked CBR Values of Subgrade Samples

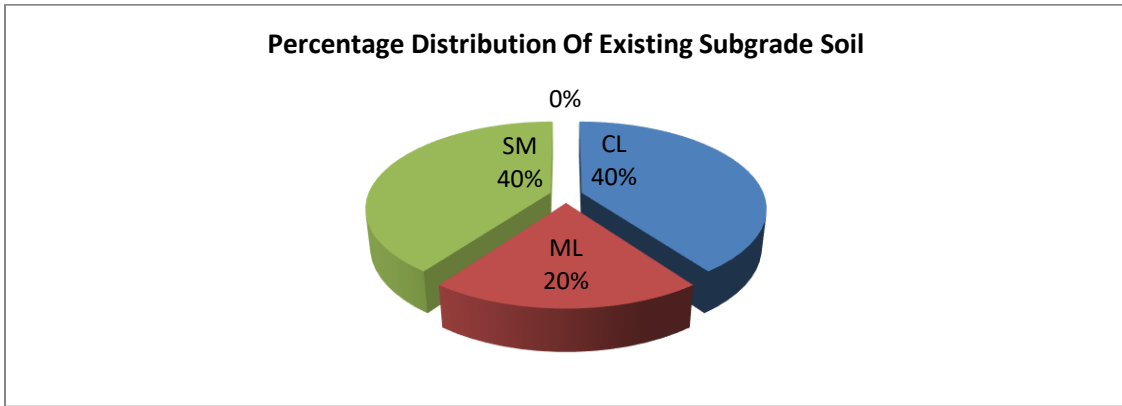
Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	Dry density At 97%	Soaked CBR 97% MDD	Free Swelling Index (%)
	Location (km)	Up/Dn	Percentage passing from					LL	PL	PI						
			4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %									
MS-TP-3	312+200	LHS	96.53	83.92	79.54	3.47	16.99	32	23	9	CL	1.87	11.80	1.81	7.10	13.60
MS-TP-4	320+800	RHS	98.02	58.17	22.66	1.98	75.36	-	NP	NP	SM	2.03	10.40	1.97	19.03	-
MS-TP-5	321+900	LHS	96.90	82.94	77.26	3.1	19.64	32	24	8	CL	1.88	13.10	1.82	6.42	13.60
MS-TP-5A	321+200	LHS	99.16	64.54	29.71	0.84	69.45	-	NP	NP	SM	2.08	9.80	2.02	25.85	-
MS-TP-6	317+340	LHS	97.31	92.44	78.83	2.69	18.48	-	NP	NP	ML	1.89	13.40	1.83	9.09	4.80

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

- *Liquid Limit: All the samples are within the limits (less than 50%).*
- *Plasticity Index: All samples are having PI Values within the limits. (less than 25%) and non-plastic in nature.*
- *Maximum Dry Density for all subgrade samples varies between 1.87 and 2.08 gm/cc. All 5 samples satisfying the MDD criterion (MDD \geq 1.75 gm./cc)*
- *OMC for existing subgrade samples varies in between 9.80% to 13.40%.*
- *Free Swelling Index for existing subgrade samples varies between 0.00 to 13.60. All 5 samples satisfying the FSI criterion (FSI \leq 50%)*

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 AREAS

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

Table 28: Details of Soaked CBR Values 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 (%)
	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 %									
MS-BP-1	302+810	LHS	98.77	94.94	84.19	1.23	14.58	32	24	8	CL	1.82	13.40	1.77	5.12	9.09
MS-BP-2	321+200	LHS	96.64	89.57	75.3	3.36	21.34	26	17	9	CL	1.93	13.80	1.87	5.68	10.00

4.1.3 Aggregates

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

Table 29: Test Results of Aggregate Samples Details

S. No	Sample	Location (km)	Side	AIV, %	Water Absorption %	Specific Gravity, %	Remarks
1	MS-AQ-1	299+000	RHS	12.26	0.27	2.88	
2	MS-AQ-2	299+000	RHS	15.88	0.42	2.77	
3	MS-AQ-3	299+000	RHS	14.02	0.38	2.74	

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 30: Test Results of Sand Samples Details

S No	Sample No	CHAINAGE	SIDE	10 mm Passing %	4.75 mm Passing %	2.36 mm Passing %	1.18mm Passing %	600mm Passing %	300mm Passing %	150m m Passin g %	FM	ZONE
1	MS-SQ-1	299+000	RHS	100	95	88	76	57	11	1	2.72	ZONE -II

Note: The sample belong to zone-II.

4.2 CORE STRENGTH

Based on the extracted core samples obtained from the designated 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 core strength of the samples is presented below

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/mm ²)		L/D Ratio	Correction Factor (L/D Ratio) 0.11*(Height/ D+0.78)	Corrected Strength of core	Equivalent Cube Strength (N/mm ²) Fx1.25.	F _{ck}
									L ≤ Ø75±5 mm C=b/a*1.08*1000	L ≥ Ø75±5 mm C=b/a*1000					
1	C-1	292+007	LHS	95.07	176	2844	7100	204.80		28.85	1.85	0.98	28.37	35.47	4.2
2	C-2	298+002	LHS	95.57	154	2652	7174	211.10		29.42	1.61	0.96	28.17	35.21	4.2
3	C-3	304+010	LHS	95.04	175	3016	7095	265.10		37.36	1.84	0.98	36.71	45.89	4.7
4	C-4	310+002	LHS	94.86	177	3049	7068	249.40		35.28	1.87	0.99	34.76	43.46	4.6
5	C-5	316+000	LHS	94.66	145	2475	7038	249.40		35.43	1.53	0.95	33.61	42.01	4.5
6	C-6	322+005	LHS	94.87	173	3000	7070	217.90		30.82	1.82	0.98	30.22	37.78	4.3
7	C-7	322+800	RHS	94.77	173	2992	7055	205.20		29.09	1.83	0.98	28.53	35.66	4.2
8	C-8	319+000	RHS	94.79	133	2298	7058	207.10		29.34	1.40	0.93	27.42	34.27	4.1
9	C-9	318+000	RHS	94.94	176	3056	7080	210.10		29.67	1.85	0.98	29.20	36.50	4.2
10	C-10	313+000	RHS	94.38	176	3036	6997	192.30		27.48	1.86	0.99	27.07	33.84	4.1
11	C-11	307+003	RHS	94.55	173	2984	7022	185.10		26.36	1.83	0.98	25.87	32.33	4.0
12	C-12	301+415	RHS	Broken											
13	C-13	295+015	RHS	94.77	95	1656	7055	228.40		32.37	1.00	0.89	28.82	36.03	4.2

Note: The above table indicates that concrete core strength(fck) is more than 4.0 Mpa

4.3 PAVEMENT CONDITION

The distresses in rigid surface have been captured on the project corridor for each lane separately by using NSV survey.

The project corridor has been provided with rigid pavement over entire length and flexible surface on connecting roads. Presently the surface appears to be intact without any major distresses. However, at various locations cracking, raveling and corner breaks are observed.

➤ 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 31: Panel Repair based on Pavement Condition

		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	42	60	1500	1514	639	10
2	RHS	137	92	1290	1301	786	13
Total		179	152	2790	2815	1425	23

Note:-1. Patel Infrastructure Private Limited is currently undertaking pavement repairs and associated maintenance works. after completion, it will be transferred to ACTIS-

4.4 ROUGHNESS

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 32: Lane-wise Roughness rectification lengths

Roughness Limit		LHS				RHS			
>=	<	L1 (Km)	L2 (Km)	L3 (Km)	L4 (Km)	R1 (Km)	R2 (Km)	R3 (Km)	R4 (Km)
	2000	14.830	16.590	16.750	17.580	15.050	17.080	17.520	17.880
2000	2500	6.740	5.980	5.530	5.380	6.740	6.030	5.020	5.510
2500	2750	2.080	1.810	1.600	1.640	2.020	1.770	1.820	1.520
2750		7.000	6.370	6.800	6.110	6.950	6.020	6.420	5.870
Length for Rectification		0.090	0.030	0.090	0.060	0.040	0.030	0.030	0.000
No Data		0.110	0.160	0.050	0.050	0.140	0.040	0.120	0.160
Rectification required on Structures		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Structures		0.150	0.060	0.180	0.180	0.060	0.030	0.070	0.060
Total Length in lane Km		31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000

By attending the rectification of 0.270 lane-km length in LHS 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 0.100 lane-km length in RHS, 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 PAVEMENT COMPOSITION

As per Pavement Design Report and schedules crust composition for the main carriageway is as below:

Length (Km)	Pavement Layer	Design Period	Pavement Thickness as per Design	Adopted as per Schedule
31.000	Pavement Quality Concrete (PQC)	30 Years	240 mm	300 mm
	Dry Lean Concrete (DLC)		150 mm	150 mm
	Granular Sub Base (GSB)		150 mm	150 mm
	Subgrade		500 mm	500 mm

***Main Carriageway Crust from the test pit survey**

	PQC mm	DLC mm	GSB mm
Maximum	340	150	165
Minimum	310	145	145
Average	318	149	153

The pavement composition of the rigid pavement is observed to be higher than the design pavement thickness.

4.6 STRUCTURES

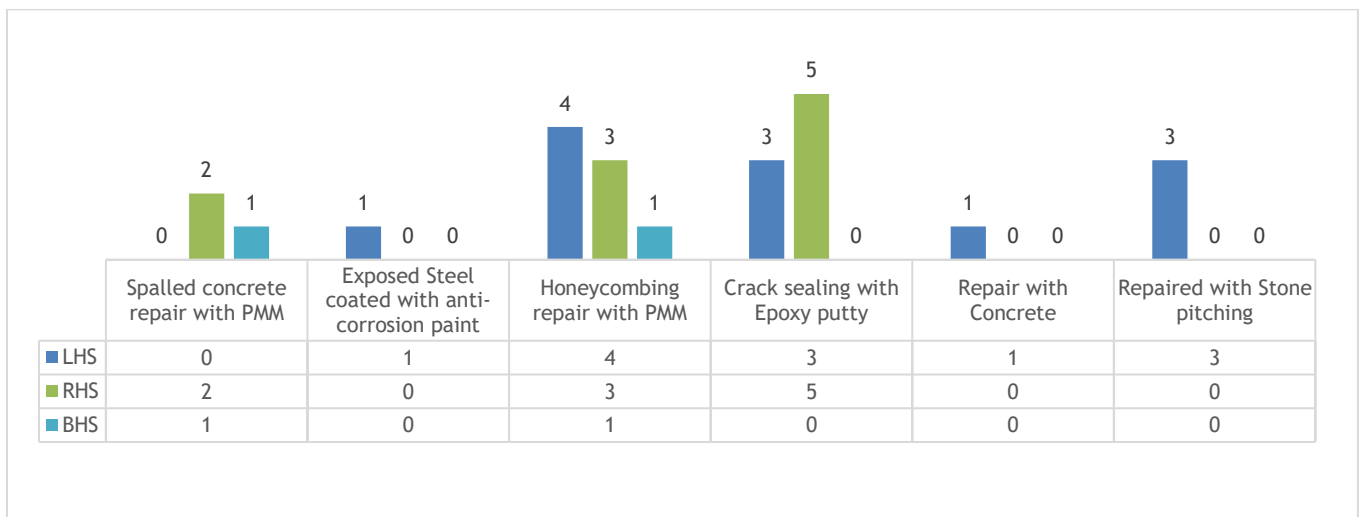
Inventory and asset condition of all the existing structures falling within project road have been verified as per IRC: SP-35 procedures and guidelines with following field surveys

- 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.

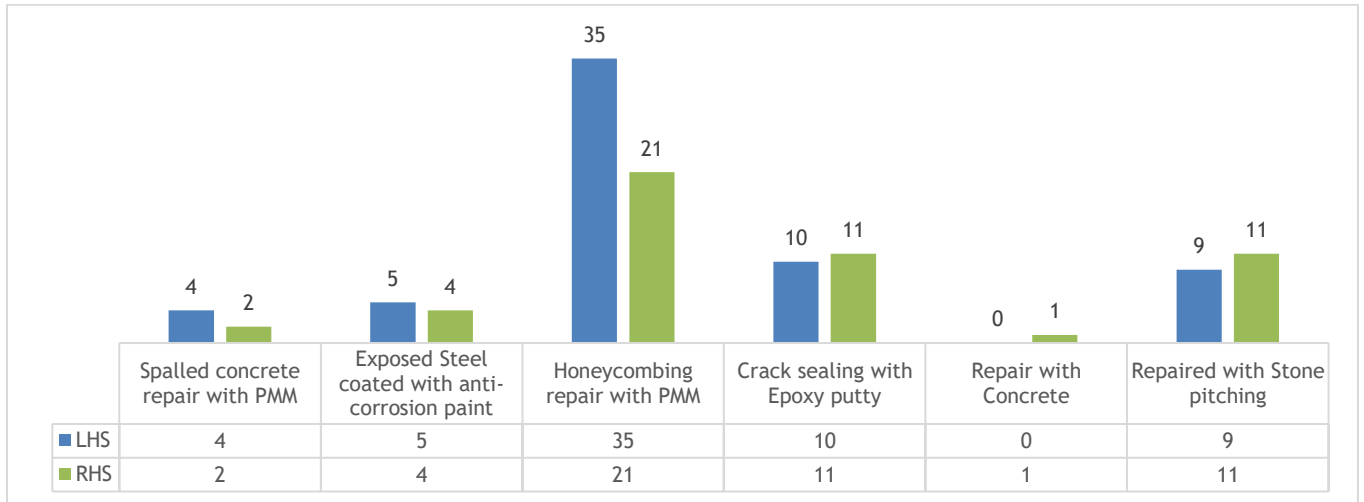
Maintenance of Major and Minor structures includes the following:

Major Structures: (L>60m):



The defects include repair of spalled concrete, Reinforcement exposed, Honeycomb, Cracks, Concrete portion damage, Quadrant pitching.

Minor Structures (L<60m):



The defects include spalled concrete, Reinforcement exposed, Honeycomb, Cracks, Concrete portion, Concrete portion damage, repair of stone pitching etc

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: 293+014

General Description

LHS MCW (New)

- | | |
|--|--|
| • Type of Structure | : ROB |
| • Span Arrangement | : 6 x 30 + 1 x 24.75 + (2 x 8.75 to 30) + 1 x 38 + 1 x 44 + 1 x 33.75 + 5 x 33 m |
| • Total length of Structure | : 524.07 m |
| • Total deck width of Structure | : 21.25 m |
| • Type of Foundation | : Not visible |
| • Type of Substructure (Abutment & Pier) | : Multiple column frame & RCC wall type |
| • Type of Superstructure | : RCC Girder, PSC Girder & Steel Girder |
| • Type of Bearing | : Pot PTFE |
| • Type of Railing / Crash Barrier | : Crash barrier |
| • Method of Inspection | : Visual |

Observations

Visual Observations on condition of the structure are as below:

- ✓ Honeycomb observed on the soffit of the girder G3 in span -3.
- ✓ Cracks and Leaching observed on the soffit of the deck slab in span-2,4,6,12,13,14 & 15.
- ✓ Honeycomb observed on the pier P15.
- ✓ Quadrant pitching partially damaged.





Chainage: 293+014**General Description****RHS MCW (New)**

- | | |
|--|--|
| • Type of Structure | : ROB |
| • Span Arrangement | : 6 x 30 + 1 x 24.75 + (2 x 8.75 to 30) + 1 x 38 + 1 x 44 + 1 x 33.75 + 5 x 33 m |
| • Total length of Structure | : 524.07 m |
| • Total deck width of Structure | : 21.25 m |
| • Type of Foundation | : Not visible |
| • Type of Substructure (Abutment & Pier) | : Multiple column frame & RCC wall type |
| • Type of Superstructure | : RCC Girder, PSC Girder & Steel Girder |
| • Type of Bearing | : Pot PTFE |
| • Type of Railing / Crash Barrier | : Crash barrier |
| • Method of Inspection | : Visual |

Observations

Visual Observations on condition of the structure are as below:

- ✓ Cracks and Leaching observed on the soffit of the deck slab in span-17.
- ✓ Honeycomb observed on the cross girder in span -2.



Chainage: 302+713**General Description****LHS MCW (New)**

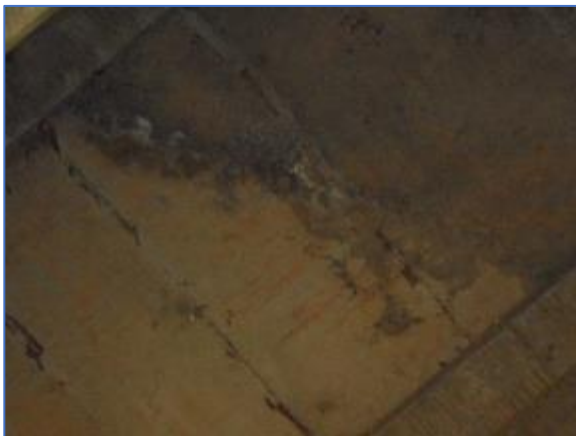
• Type of Structure	: MJB
• Span Arrangement	: 2 x 37.847 + 1x 38.048 m
• Total length of Structure	: 113.739 m
• Total deck width of Structure	: 21.25 m
• Type of Foundation	: Not visible
• Type of Substructure (Abutment & Pier)	: RCC wall type
• Type of Superstructure	: PSC Girder
• Type of Bearing	: Pot PTFE
• Type of Railing / Crash Barrier	: Crash barrier
• Method of Inspection	: Visual

Observations

Visual Observations on condition of the structure are as below:

- ✓ Honeycomb observed on intermediate cross girders in span-1, 2, and 3.
- ✓ Honeycomb observed on the soffit of the deck slab in span 1 & 3.
- ✓ Honeycomb and Reinforcement exposed on soffit of the Girder G3 at bearing location.
- ✓ Reinforcement exposed in Girder G1 in span-1.
- ✓ Cracks and Leaching observed on the soffit of the deck slab in span-2.





Chainage: 302+713

General Description

RHS MCW (New)

- | | |
|--|----------------------------|
| • Type of Structure | : MJB |
| • Span Arrangement | : 2 x 37.847 + 1x 38.048 m |
| • Total length of Structure | : 113.739 m |
| • Total deck width of Structure | : 21.25 m |
| • Type of Foundation | : Not visible |
| • Type of Substructure (Abutment & Pier) | : RCC wall type |
| • Type of Superstructure | : PSC Girder |
| • Type of Bearing | : Pot PTFE |
| • Type of Railing / Crash Barrier | : Crash barrier |
| • Method of Inspection | : Visual |

Observations

Visual Observations on condition of the structure are as below:

- ✓ Honeycomb observed on the soffit of the Girder G2 in span-3.
- ✓ Honeycomb observed on intermediate cross girders in span-1, 2, and 3.
- ✓ Cracks and Leaching observed on the soffit of the deck slab in span-2.
- ✓ Concrete spalling observed on cantilever portion.





Chainage: 297+472

General Description

LHS MCW (New)

- Type of Structure : MNB
- Span Arrangement : 1 x 17.688 m
- Total length of Structure : 17.668 m
- Total deck width of Structure : 21.25 m
- Type of Foundation : Not visible
- Type of Substructure (Abutment & Pier) : RCC wall type
- Type of Superstructure : RCC Girder
- Type of Bearing : Elastomeric & Pot PTFE
- Type of Railing / Crash Barrier : Crash barrier
- Method of Inspection : Visual

Observations

Visual Observations on condition of the structure are as below:

- ✓ Honeycomb and Reinforcement exposed on side wall A1.
- ✓ Cracks and Leaching observed on soffit of deck slab.
- ✓ Crack observed on crash barrier at shoulder side.



Chainage: 297+472**General Description****RHS MCW (New)**

• Type of Structure	: MNB
• Span Arrangement	: 1 x 17.688 m
• Total length of Structure	: 17.668 m
• Total deck width of Structure	: 21.25 m
• Type of Foundation	: Not visible
• Type of Substructure (Abutment & Pier)	: RCC wall type
• Type of Superstructure	: RCC Girder
• Type of Bearing	: Elastomeric & Pot PTFE
• Type of Railing / Crash Barrier	: Crash barrier
• Method of Inspection	: Visual

Observations

Visual Observations on condition of the structure are as below:

- ✓ Honeycomb observed on side wall A1.
- ✓ Leaching observed on side wall A1 & A2.
- ✓ Quadrant pitching is partially damaged.
- ✓ Weep holes not provided properly on side walls.



Chainage: 299+354

General Description

LHS MCW (New)

- | | |
|--|--|
| • Type of Structure | : Flyover |
| • Span Arrangement | : 1 x 12.877 + 1 x 36.208 + 1 x 16.817 m |
| • Total length of Structure | : 65.902 m |
| • Total deck width of Structure | : 21.25 m |
| • Type of Foundation | : Not visible |
| • Type of Substructure (Abutment & Pier) | : RCC wall type |
| • Type of Superstructure | : PSC Girder & RCC Girder |
| • Type of Bearing | : Pot PTFE |
| • Type of Railing / Crash Barrier | : Crash barrier |
| • Method of Inspection | : Visual |

Observations

Visual Observations on condition of the structure are as below:

- ✓ Honeycomb observed on the Crash barrier and Gap slab at A1 location.
- ✓ Honeycomb observed on the Crash barrier and Coping beam at A2 location.
- ✓ Approach slab concrete portion damage observed.
- ✓ Quadrant pitching partially damaged.





Chainage: 299+354

General Description

RHS MCW (New)

- | | |
|--|--|
| • Type of Structure | : Flyover |
| • Span Arrangement | : 1 x 12.877 + 1 x 36.208 + 1 x 16.817 m |
| • Total length of Structure | : 65.902 m |
| • Total deck width of Structure | : 21.25 m |
| • Type of Foundation | : Not visible |
| • Type of Substructure (Abutment & Pier) | : RCC wall type |
| • Type of Superstructure | : PSC Girder & RCC Girder |
| • Type of Bearing | : Pot PTFE |
| • Type of Railing / Crash Barrier | : Crash barrier |
| • Method of Inspection | : Visual |

Observations

Visual Observations on condition of the structure are as below:

- ✓ Cracks and Leaching observed on soffit of the slab.



Chainage: 295+554**General Description****LHS MCW (New)**

- | | |
|--|------------------|
| • Type of Structure | : VUP |
| • Span Arrangement | : 1 x 12 x 5.5 m |
| • Total length of Structure | : 12 m |
| • Total deck width of Structure | : 21.25 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:

- ✓ Honeycomb observed on crash barrier and on Median wall.
- ✓ Drainage spouts are not provided.



Chainage: 295+554

General Description

RHS MCW (New)

- | | |
|--|------------------|
| • Type of Structure | : VUP |
| • Span Arrangement | : 1 x 12 x 5.5 m |
| • Total length of Structure | : 12 m |
| • Total deck width of Structure | : 21.25 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 is in fair condition.
- ✓ Drainage spouts are not provided.



Chainage: 293+875

General Description

LHS MCW (New)

- Type of Structure : LVUP
- Span Arrangement : 1 x 12 x 4 m
- Total length of Structure : 12 m
- Total deck width of Structure : 21.25 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 is in fair condition.
- ✓ Drainage spouts are not provided.



Chainage: 293+875

General Description

RHS MCW (New)

- Type of Structure : LVUP
- Span Arrangement : 1 x 12 x 4 m
- Total length of Structure : 12 m
- Total deck width of Structure : 21.25 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:

- ✓ Crack observed on Crash barrier.
- ✓ Drainage spouts are not provided.



Chainage: 292+400

General Description

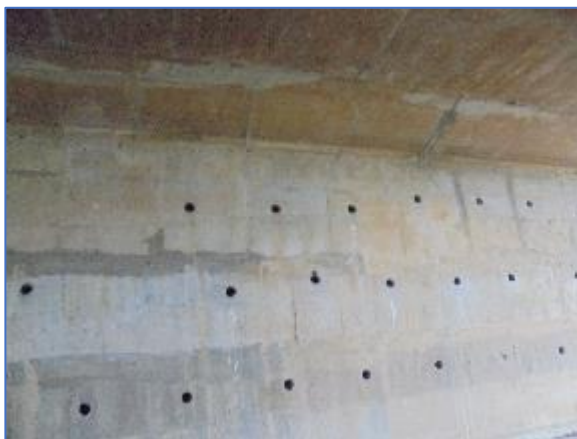
LHS MCW (New)

- Type of Structure : PUP
- Span Arrangement : 1 x 12 x 4 m
- Total length of Structure : 12 m
- Total deck width of Structure : 21.25 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 is in fair condition.
- ✓ Drainage spouts are not provided.



Chainage: 292+400**General Description****RHS MCW (New)**

- | | |
|--|------------------|
| • Type of Structure | : PUP |
| • Span Arrangement | : 1 x 12 x 4 m |
| • Total length of Structure | : 12 m |
| • Total deck width of Structure | : 21.25 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 is in fair condition.
- ✓ Drainage spouts are not provided.



Sample photos of Box culverts:

		
Box Culvert at Km 292+450	Box Culvert at Km 300+148	Box Culvert at Km 305+437
		
Box Culvert at Km 307+778	Box Culvert at Km 315+214	Box Culvert at Km 316+558

Sample photos of Pipe culverts:



General Observations on Structures: -

- The Project Stretch having different types of super structure for various structures such as PSC Girders, RCC Girders, Steel girders, RCC portal type & RCC Box.
- The project stretch has 1 No of Flyover; This structure is having PSC & RCC girder type super structure.
- The project stretch has 1 No of ROB; This structure is having RCC, PSC Girder & Steel Girder type super structure.
- The project stretch has 1 No of VOP; This structure is having PSC girder type super structure.
- The project stretch has 3 Nos of MJBs; These structures are having PSC & RCC girder type super structure.
- The project stretch has 09 No's of MNBs, out of which 2 No's of MNBs having PSC Girder type super structure, 3 No's of MNBs having RCC Girder type super structure, 1 No of MNB having PSC, Steel Girder type super structure, 1 No of MNB having RCC portal type super structure and 2 No's of MNBs having RCC box type super structure.
- Underpasses which are of 03 VUPs, 20 CUP/PUPs, 07 LVUPs are having RCC Box type 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.
- Structures are having 67 No's of Strip Seal Expansion joints.
- In this project it is observed that Pot PTFE Bearings (1024 No's) and Elastomeric bearings (228) are provided for all girder type structures wherever required.
- Cleaning of expansion joints, drainage spouts need to be done regularly.
- Construction of all the utility pipe culverts (62 Nos) completed, out of which few of the utilities are not visible and may be buried under the soil.
- As per availability of provided drawings & design in data room, GFC Drawings are provided for all major structures and Box Culverts and verified the same. Design notes and as Built Drawings are not available for are not available for all structures mentioned above.

4.7 DRAINAGE AND SLOPE PROTECTION

- ✓ Trapezoidal Lined drains at toe and Open lined drains adjacent to the carriageway are observed all along the corridor except at structure portion. They are in fair condition.
- ✓ At high embankments chutes, and geocell in embankments are provided.

4.8 TRAFFIC SAFETY AND ROAD FURNITURE

- ✓ Thrie beam crash barriers provided along the project road appear to be intact over entire length except for few locations where it got damaged.
- ✓ Noise barriers are installed Food Plaza and Rest area locations. These appear to be fair except for few locations where it got damaged.
- ✓ Emergency Median Opening locations appear to be in fair condition. These are presently closed with temporary barricading.
- ✓ Traffic blinkers and attenuators are exit locations for Food Plaza and Rest area locations.
- ✓ Street lightings and High masts are provided at toll plaza, rest area and food plaza locations are in fair condition.

4.9 ROAD USER FACILITIES

Road user facilities such as Food Plazas and Rest Areas have been provided along the project corridor and are equipped with amenities including Dhaba's, Toilet blocks, Fuel stations, Truck parking, Dormitories, Static Weigh Bridge and other user conveniences.

CHAPTER 5. REHABILITATION PLANS AND DESIGNS

5.1 AVERAGE ANNUAL DAILY TRAFFIC

From the previous DD studies, AADT has been estimated by considering the July 2018 traffic survey and projected to the YR 2023 with Growth rate (5%) as tabulated below:

Table 33: Traffic Volume (AADT)

Vehicle type	At Km 178+500
Bus	1762
LCV	6262
Truck / 2A	3874
3A	6352
MAV	11164

*Note: 50:50 Direction Distribution

The axle load spectrum taken from the PDR report is given below:

Rear Single Axle			Rear Tandem Axle			Rear Tridem Axle		
Load Group (kN)	Mid-Point of Load Group (kN)	Frequency (%)	Load Group (kN)	Mid-Point of Load Group (kN)	Frequency (%)	Load Group (kN)	Mid-Point of Load Group (kN)	Frequency (%)
185-195	190	0.00	380-400	390	0.00	530-560	545	0.00
175-185	180	0.00	360-380	370	0.00	500-530	515	0.00
165-175	170	0.00	340-360	350	0.00	470-500	485	0.00
155-165	160	0.08	320-340	330	0.39	440-470	455	1.15
145-155	150	0.58	300-320	310	0.29	410-440	425	1.39
135-145	140	0.89	280-300	290	2.34	380-410	395	2.08
125-135	130	1.59	260-280	270	5.56	350-380	365	2.31
115-125	120	1.87	240-260	250	10.05	320-350	335	7.62
105-115	110	2.68	220-240	230	20.88	290-320	305	6.47
95-105	100	4.39	200-220	210	15.80	260-290	275	14.32
85-95	90	4.08	180-200	190	16.39	230-260	245	29.10
<85	80	83.83	<180	170	28.29	<230	215	35.57
		100			100			100

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 condition except little minor treatment like 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 / Shotcreting 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 HDH-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 10th and 20th year and includes main criterion of maintaining roughness at 2750mm/Km as per Schedule K.

6.2 CA SPECIFICATIONS FOR MAJOR MAINTENANCE

- Schedule K of CA species that Roughness values exceeding 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-K 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 7 years apart from routine maintenance activities:

Description	%	Unit	Rate	Quantity	Amount
Length of Rigid Pavement		Kms		32.170	
PQC Qty		Cum		352606	
Total Area		Sqm		1230407	
No of Transverse Joints		no		7149	
No of Panels		no		78121	
Length of Transverse Joints		m		273424	
Longitudinal Joint		m		257360	
Repair of Transverse Joint Sealant	75.0%	m	73.50	205068	15072480
Repair of Longitudinal Joint Sealant	75.0%	m	73.50	193020	14186970
Replacement of Transvrese Joint@ 7years	2.0%	m	845.00	5468	4620860
Replacement of Longitudinal Joint@ 7years	2.0%	m	845.00	5147	4349384
Ravelling surface @7years	2.0%	Sqm	963	24608	23685325
Crack sealing Surface @ 7years	5.0%	m	449	6434	2890668
Repair of Panels @ 7years	0.50%	No	9029	391	3530312
Removal of Panels @ 7years	1.0%	No	3781	781	2952672
Relaying of Panels @ 7years	1.0%	No	35572	781	27781342
Retexturing@ 7years	20%	Sqm	100	246081	24608130
Regrinding and Retexturing@ 7years	10%	Sqm	500	123041	61520325
7th year periodic maintenance cost in Crores					18.520
Add GST (18%)					3.334
Total Periodic Cost with GST in Rs. Crores					21.853

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

Longitudinal Cracks more than 1.5m	Lin.m	0.5%
Longitudinal Cracks less than 1.5m	Lin.m	0.5%
Transverse Cracks less than 1.5m	Lin.m	0.5%
Transverse Cracks more than 1.5m	Lin.m	0.5%
Longitudinal Crack full Depth	Cum	0.10%
Pothole	Sq.m	0.10%
Corner Cracks	cum	0.10%
Condition of Joints	Lin.m	1%
Diagonal Cracking	Lin.m	0.5%
Raveling of panel	Sq.m	0.50%

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		
			2029	2033	2037	2029 & 33	2037	
New	Super structure lifting with Pot bearings	Pot	0%	0%	0%	5%	95%	
New	Super structure lifting with Elastomeric bearings	Ela	0%	0%	0%	10%	90%	
New	Super structure lifting with Roacker bearings	Rocker	0%	0%	0%	0%	100%	
Old	Super structure lifting with Pot bearings	Pot	100%	100%	0%	0%	0%	
Old	Super structure lifting with Elastomeric bearings	Ela	100%	100%	0%	0%	0%	
Old	Super structure lifting with Rocker bearings	Rocker	100%	100%	0%	0%	0%	
New	Pot bearing cost	Pot	0%	0%	0%	5%	95%	
New	Elastomeric bearing cost	Ela	0%	0%	0%	10%	90%	
New	Rocker bearing cost	0	0%	0%	0%	0%	100%	
Old	Pot bearing cost	Pot	100%	100%	0%	0%	0%	
Old	Elastomeric bearing cost	Ela	100%	100%	0%	0%	0%	
Old	Rocker bearing cost	0	100%	100%	0%	0%	0%	
New	Expansion joint Replacement	0	0%	0%		25%	75%	
Old	Expansion joint Replacement	0	100%	100%		0%	0%	

Note: OLD- retained at the time of

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 surveillance 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 gist 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 34: Basic Material Rates

S No	Description	Units	Source	Basic rate excluding Transportation & GST	Lead in Kms
1	Good earth	Cum	BA	67	2.80
2	40 mm	Cum	Crusher	706	55.83
3	20 mm	Cum	Crusher	861	55.83
4	12 mm	Cum	Crusher	552	55.83
5	6 mm	Cum	Crusher	474	55.83
6	Dust	Cum	Crusher	397	55.83
7	M sand	Cum	Crusher	437	55.83
8	Boulders	Cum	Quarry	263	7.00
9	Sand source to Plant	Cum	River	433	57.00
10	Sand source to working site	Cum	Stock yard	433	48.00
11	Bitumen 60/70	MT	Koyali	41861	99.00
12	Bitumen 80/100	MT	Koyali	42951	99.00
13	VG-40	MT	Koyali	46666	99.00
14	CRMB-55	MT	Koyali	49512	99.00
15	PMB	MT	Koyali	57122	99.00
16	SS1	MT	Koyali	45000	99.00
17	Steel	MT	Vadodara	59000	71.00
18	HTS Strands	MT	Vadodara	75000	71.00
19	Cement	MT	Vadodara	6840	71.00
20	Structural Steel	MT	Vadodara	61000	71.00

Table 35: Summary of Unit Rates

S No	Item	Unit	Rate (INR)
1	Embankment - borrow	Cum	329
2	Embankment - Excavation	Cum	77
3	SG	Cum	335
4	GSB G-2	Cum	2289
5	WMM	Cum	2410
6	Prime Coat	Sqm	48
7	Tack coat on granular	Sqm	16
8	DBM G-1	Cum	8789
9	Tack coat on bituminous surface	Sqm	15
10	BC - G1	Cum	9857
11	Road Marking	Sqm	583
12	RE wall	Sqm	4956
13	Select Fill	Cum	368
14	Filter Media	Cum	1840
15	M15	Cum	6305
16	M20	Cum	7015
17	M25	Cum	7620
18	M30	Cum	7583
19	M35	Cum	7835
20	M40	Cum	7974
21	PSC M45	Cum	9597
22	HYSD	MT	85845
25	HT strand	MT	150235

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 IMMEDIATE REPAIRS 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:

- Scope which is not executed
- Road work items
- Bridge Work Items
- Pavement Rehabilitation works
- Structural Rehabilitation works
- Drainage Works
- Slope Protection works
- Safety Works

Summary of Immediate costs are included in table below:

Table 36: Summary of immediate Repairs Cost

S.no	Description	Unit	Amount (Rs.)
1	Immediate Repair's (Highway)	LS	1,96,32,881
2	Immediate Repair's - Structures	LS	7,86,784
3	TMS	LS	5,75,300
4	ATMS	LS	-
5	Pavement Repair Cost	LS	4,85,81,062
6	*Deduct Costs covered under DLP as informed by the Company	LS	-4,75,70,592
Total Cost			2,20,05,435
Total Cost including GST (18 %)			2,59,66,413

Note: * Considering the DLP, repair cost has been deducted from the total cost of Pavement Rehabilitation works

The Immediate Repair cost for Highway works is as follows

S.no	Description	Unit	Quantity	Rate (Rs.)	Amount (Rs.)	Remarks
1	Open Lined Drains	m	80.00	7958	6,36,677	Damage
2	Light Poles	No	4.00	16907	67,627	Pole Damage
3	Median Plantation-Non-Functional	Km	5.56	200000	11,12,400	
4	MCB - Tri Beam	m	97.00	4511	4,37,567	Damage
5	Hectometer Stone	No	33.00	962	31,746	Missing & Damage
6	Road Signs	No	2.00	4803	9,606	Missing & Damage
7	Chutes	m	125.00	8884	11,10,503	Damage
8	Hectometer Stones-Faded	No	6	132	792	
9	Embankment damages	Cu.m	20,175	657.40	1,32,63,045	Damage
10	Attenuators	No. s	1.00	100000	1,00,000	
11	Trapezoidal Drain	m	520.00	2121	11,02,794	Damage
12	Fencing	m	880.00	2000	17,60,000	
13	Noise Barrier	m	0.05	2500	125	
Total Cost :					1,96,32,881	

The cost for Structure works is as follows:

S. No.	Description	Amount in Rs
1	Structures Cracks, Anti corrosion paint on exposed, reinforcement exposed & spalling, Honeycomb etc	7,86,784
Immediate repair for Structures excluding GST (18%)		7,86,784

The cost of pavement rehabilitation works is as follows:

Sl.No	Item	Units	Total	Rate	Amount, Rs
1	Replacement of Panels	Cum	906	9970	90,34,871
2	Part 0.5m width replacement of Panel	Cum	103	9970	10,22,943
3	Cornor Break	Cum	2	9970	17,199
4	Stapple & stitching	m	12553	2000	2,51,05,500
5	Crack seal	m	6333	400	25,33,050
6	Ravelling	Sqm	12023	800	96,18,750
7	Diamand Grinding	Sqm	1388	900	12,48,750
Total pavement Rehabilitation cost (excluding GST)					4,85,81,062

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:

- 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	Providing 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

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 50 to 60 mm 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, safety 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 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 Toll Equipment's & Software

Table 37: Major Maintenance Cost

S. No	Financial Year	MM - Flexible Pavement	MM- Rigid Pavement	Replacement of ATMS	Replacement of TMS	MM - Structures
1	2026	-	-			-
2	2027	-	5.38		1.61	-
3	2028	-	6.72			-
4	2029	4.19	6.72	2.62		2.08
5	2030	-	8.07			-
6	2031	-	-			-
7	2032	-	2.50		1.61	-
8	2033	-	-			2.08
9	2034	-	-			-
10	2035	-	5.38			-
11	2036	4.19	6.72	2.62		7.31
12	2037	-	6.72		1.61	7.31
13	2038	-	8.07			-
-	Total:	8.38	56.27	5.24	4.84	18.77

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 28.05.2037

7.5 OPERATIONS COSTS

Cost towards Operations include the following:

- Electricity Bill of lighting
- Operation and management costs of TAP & MAP
- SPV Costs
- Survey Costs
- Insurance Charges
- Audit Charges
- IE Fee
- Administrative Cost

Table 38: Summary of 1st Year O&M Cost

SI No	Description	Amount in Crs.
SPV - Expenditure		
1	SPV staff	1.15
2	Highway lighting	1.78
3	Tolling and ATMS AMC/ Spare Parts	0.33
4	Surveys & Investigations (BBD, Roughness)	0.18
5	IE fees	0.97
6	Insurance Charges	3.07
7	Audit Charges	0.45
8	Admin cost - Board Meeting Expenses, valuation etc.	0.22
Agency - Expenditure		
9	Toll Operation - Agency	0.00
10	Route patrolling	0.97
11	TAP & MAP	0.84
12	Routine maintenance	1.90
13	Repair of Road - BoQ Items	1.84
14	Repair of Structures	0.31
Total Amount in CRs		14.03

- 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 28.05.2037

7.6 TOTAL OPERATION & MAINTENANCE COSTS

Year on year operation cost is summation of following:

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

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

Table 39: Cost Abstract

Project Years	Calendar Year	SUMMARY OF VARIOUS EXPENSES in Rs. Crs				
		Immediate Repair's Cost	Toll Operation Expenses	Routine Maintenance Expenses	Periodic Maintenance (Functional +Struc Overlay+ TMS/ATMS)	Total Cost (Rs. Cr.)
1	2025-2026	2.60	-	14.03	-	16.62
2	2026-2027		-	14.03	6.99	21.02
3	2027-2028		-	14.03	6.72	20.75
4	2028-2029		-	14.03	15.60	29.63
5	2029-2030		-	14.03	8.07	22.09
6	2030-2031		-	14.03	-	14.03
7	2031-2032		-	14.03	4.11	18.14
8	2032-2033		-	14.03	2.08	16.10
9	2033-2034		-	14.03	-	14.03
10	2034-2035		-	14.03	5.38	19.40
11	2035-2036		-	14.03	20.84	34.86
12	2036-2037		-	14.03	15.64	29.67
13	2037-2038		-	3.65	8.07	11.72
	Total Cost:	2.60	-	171.97	93.49	268.06

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 28.05.2037