

Date: February 28, 2022

To

Virescent Infrastructure Investment Manager Private Limited

10th Floor, Parinee Crescenzo

C- 30 'G' Block

Bandra Kurla Complex

Bandra (East),

Mumbai 400051, Maharashtra, India

Dear Sir,

Re: Submission of Final Report of Technical due diligence study for the project "Shillong Expressways Private Limited (SEPL)".

With reference to the captioned matter, we are here with submitting the Final Report of "Technical Diligence for 2-laning of Shillong bypass connecting NH-40 and NH-44 from km 61/800 of NH-40 to km 34/850 on NH-44 in the state of Meghalaya on Build, Operate and Transfer (BOT Annuity) Basis."

Yours faithfully,

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


Authorized Signatory

Kalva Kiran Kumar

**Technical Diligence for 2-laning of Shillong
bypass connecting NH-40 and NH-44 from
km 61/800 of NH-40 to km 34/850 on NH-
44 in the state of Meghalaya on Build,
Operate and Transfer (“BOT Annuity”) Basis.**

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

Final Report

SAMARTH INFRAENGG Technocrats Private Limited



FEBRUARY 2022

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I. INTRODUCTION

Government of India had entrusted to the NHAI, the development, maintenance and management of NH-40 and NH-44 from Km 61.800 of NH-40 to Km 34.850 of NH-44 in the state of Meghalaya.

The Authority has resolved to construct 2 lane Shillong Bypass Connecting NH-40 and NH-44 from km 61+800 on NH-40 (Design Chainage at km 0+600) to km 34+850 on NH-44 (Design Chainage at km 48+766) on the Shillong bypass section of NH-40 and NH-44 in the state of Meghalaya on Build, Operate and Transfer (“BOT Annuity”) Basis.

Accordingly, NHAI invited proposals from the bidders and selected the consortium comprising of **GR Infra projects Ltd.** and **Chetak Enterprises Ltd.** (Collectively referred as **Consortium**). Consequent to this, **Consortium** formed a Special Purpose Vehicle (SPV) in the name of **Shillong Expressway Pvt. Ltd.**, for implementation/execution of the project.

On 31.03.2017, **India Infrastructure Fund II (IIF-II)** acquired control of 90.5% stake of **M/s Shillong Expressway Pvt. Ltd.** and balance 9.5% was acquired on 28.03.2018. Further, on 13.01.2022, **Galaxy Investments II Pte. Ltd.** acquired control of 100% stakes of **M/s SHILLONG EXPRESSWAY PRIVATE LIMITED** from **India Infrastructure Fund-II**.

The project is presently under operation and maintenance by concessionaire, **Shillong Expressways Private Limited (SEPL)**. **Samarth Infraengg Technocrats Pvt. Ltd.** has been engaged as Technical/ Engineering Due Diligence Advisor for Highways Infrastructure Trust purpose.

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

II. PROJECT AT A GLANCE

The project corridor takes off from Km 61.800 of NH 40 near Barapani and ends on NH 44 at km 34/850. The entire project road passes through rural & Forest area with very thin inhabitations. Bhoilymbong, the only town in the area which is bypassed.

The total length of project road is 48.766 kms. The project corridor has flexible pavement in the entire length with 7.0m wide carriageway flanked by 1.5m to 2.5m earthen shoulder on each side.

The project corridor generally runs in rolling/hilly terrain for most of length except in few locations where it is slightly plain. The land use along the project road is mostly Forest.

It passes through small village settlements like Umroi, Nongtrah, Diengpasoh, Thangshalai, Mawryngkneng etc.

- The Project received LOA on 11.05.2010 and the agreement was signed on 14.07.2010.

- Appointed date was declared on 07.02.2011 and the Project received Provisional Certificate on 28.02.2013 (subsequently modified from 25.03.2013 based on Arbitral Award dated 27.06.2018) and received Final Completion Certificate on 30.03.2017.
- As per CA, the Concession Period for the project is 15 Years from Appointed date. i.e., Concession end date is 06.02.2026. Accordingly end date of concession i.e., 06.02.2026 has been considered for costing purpose.

III. SALIENT FEATURES

Sl. No.	Particulars	Length/No
1	Start chainage	0.000
2	End Chainage	48.766
3	Length of the Project Road	48.766 Km
4	No of Major Bridges	3 No's
5	No of Minor Bridges	8 No's
6	No of Culvert	240 No's
7	No of VUP	1 No's
8	No of Toll Plaza	1 No's at Km 24+900
9	Major Junctions	2 No's
10	Minor Junctions	64 No's
11	High Mast Lighting	2 No's
12	RCC Wall	0.090
13	Bus bay with shelter	13 No's
14	Wayside Amenities	0 No's
15	Delineators	754 No's
16	RCC open lined Drain	40.075 km
17	Metal Beam Crash Barrier	19.768 km
18	Concrete Safety barrier	1.220 km
19	Solar Blinkers	29 No's
20	Km Stones	48 No's
21	Hectometer Stone	171 No's
22	Guard Posts	2063 No's
23	Road Signs	1054 No's

IV. IMPORTANT FINDINGS AND CONCLUSION

1. The project corridor takes off from 61.800 of NH 40 near Barapani and ends on NH 44 at km 34/850. The entire project road passes through rural & Forest area with very thin inhabitations.

2. The Total Project length is 48.766 kms and complete length is having two lane width i.e., 7.0m wide carriageway flanked by 1.5m to 2.5m earthen shoulder on each side with Flexible Pavement.
3. The project corridor generally runs in rolling/hilly terrain for most of length except in few locations where it is slightly plain. The land use along the project road is mostly Forest. It passes through small village settlements like Umroi, Nongtrah, Diengpasoh, Thangshalai, Mawryngkneng etc.
4. The Project Road has 2 major junctions and about 64 minor junctions along the project road and the condition of these junctions is good
5. All together the Project road has about 13 No. of Bus Bays with Bus shelters and the condition of these is fair to good
6. About 4 numbers of High mast lighting is observed along the project road. Two numbers are located at Major Junctions, one Toll Plaza location and one at Minor Junction. Concessionaire informed that, Maintenance of only Two High mast lights, one near Km 10+120 and the other one near Km 48+766 is under Concessionaire’s scope.
7. The present condition of pavement is fair along the project road. Cracking and raveling has developed on some part of the Carriageway. These are mainly surface related distresses and the cracking appears to be top-down cracking. Crocodile cracking is noted at few locations.
8. Crack sealing is also being done / in progress at some of the locations along the project corridor. The present surface condition appears slightly dry surface; because of which the cracking might have initiated at most of the locations. No potholes are seen along the project. Remedial treatment at distressed locations carried out with BC material.
9. There are no major undulations or depressions observed along the corridor indicating good Subgrade quality.
10. Roughness data indicates that the Average Roughness values along the project road is 1915 mm/Km and the maximum Roughness Values is 2064 mm/Km. From Roughness consideration, Overlay is not required for the project road as the unevenness Index (UI) is less than Permissible Value of 2500 mm/km
11. Test pit surveys indicated average crust of 564mm consisting of 140 mm blacktop and 438 mm of granular layers over subgrade.
12. The remaining concession period is 5 years; however, requirement of overlay has been verified by considering the 10th year design MSA. The estimated 10th year Design traffic loading is 38 MSA. FWD Analysis indicates that the remaining life of the existing pavement is less than 38 MSA for a length of 17.20km and remaining length of the project road is having remaining life more than 38 MSA.
13. From FWD consideration, overlay is required for a length of 17.2 Km. For all the 17.2 Km 40mm Overlay is sufficient except for a length of 1.40km where the overlay requirement is 30mm BC+50mm DBM apart from this another 4Kms of lengths where roughness is more

than 2000 mm/km is also considered with 30mm BC + 50mm DBM. For remaining length where there is no structural overlay requirement, it may be prudent to consider at least 40mm BC considering the age of the pavement.

14. Majority of road furniture items are intact with very few damages. Regular maintenance being carried out at site like replacement of MCB / Studs and relaying of lane marking etc.
15. As per site condition, it appears that, no overlay done since project completion. Concessionaire confirmed that, not done any major maintenance for total Project Length except patch work and crack sealing works
16. The project Road has 3 Major bridges and 8 Minor bridges and 1 VUP. There 240 number of Culverts exists along the project road.
17. All CD structures along the project road are having good condition except 1 Major bridge near Km 12+865 (which was constructed by PWD). Bridge at Km 12+865 is having developed Vertical Flexural and Shear cracks due to overloading of Heavy Vehicular Traffic.
18. On the side of existing old bridge at Km 12+865, bailey bridge construction is completed and this bridge is operational.
19. Bailey Bridge launching was completed and the approach road was completed by the Concessionaire under COS. Concessionaire informed that Bailey Bridge was inaugurated on 25.03.2021 in presence of Hon’ble deputy Chief Minister Meghalaya
20. At Km 38+500 (LHS) land slide occurred earlier and is one of the crucial locations. However, Client informed that there was no land slide in the project highway after that.
21. The Project Road has 25 number of ECBs along the Project Road.
22. The Project road has one Toll plaza along the project road. Toll plaza @ km.24+900 is having 6 lanes (BHS). All lanes are provided with rigid pavement and the tapering portions of the Toll plaza are provided with flexible pavement.
23. The Project road has 1 number of Highway Patrolling Vehicle, 1 number of Ambulance and 1 number of recovery van with 20 Metric Ton capacity
24. For this project, a Project specific Manual is provided in Schedule-D. The allowable threshold value of roughness is 2500 mm/km as per Schedule-K.
25. As per CA, there is no requirement of mandatory overlay during the Concession Period
26. Couple of works under COS were executed such as Highway Mini Nest at Toll Plaza and bio toilet apart from Bailey Bridge.
27. As on today, Concessionaire could not complete three pending punch list items as land is not handed over to Concessionaire by NHAI; One Punch list item is flaring of Airport Junction and the second one is widening of Curve for visibility at 3 locations and the third one is construction of RCC Drain for a length of 470m near between Km 0+650 and 1+120 on LHS.

V. COST ABSTRACT

S. No	FY	Abstract of Cost Without escalation		
		Immediate Repair's Cost +Routine and Operational Cost	Periodic Maintenance Cost	Total Cost
1	2023	6.29	31.83	38.11
2	2024	6.29	-	6.29
3	2025	6.29	-	6.29
4	2026	5.36	1.48	6.85
	Total:	24.22	33.31	57.53

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

TECHNICAL DUE DILIGENCE REPORT

1.1 INTRODUCTION

Government of India had entrusted to the NHAI, the development, maintenance and management of NH-40 and NH-44 from Km 61.800 of NH-40 to Km 34.850 of NH-44 in the state of Meghalaya.

The Authority has resolved to construct 2 lane Shillong Bypass Connecting NH-40 and NH-44 from km 61+800 on NH-40 (Design Chainage at km 0+600) to km 34+850 on NH-44 (Design Chainage at km 48+766) on the Shillong bypass section of NH-40 and NH-44 in the state of Meghalaya on Build, Operate and Transfer (“BOT Annuity”) Basis.

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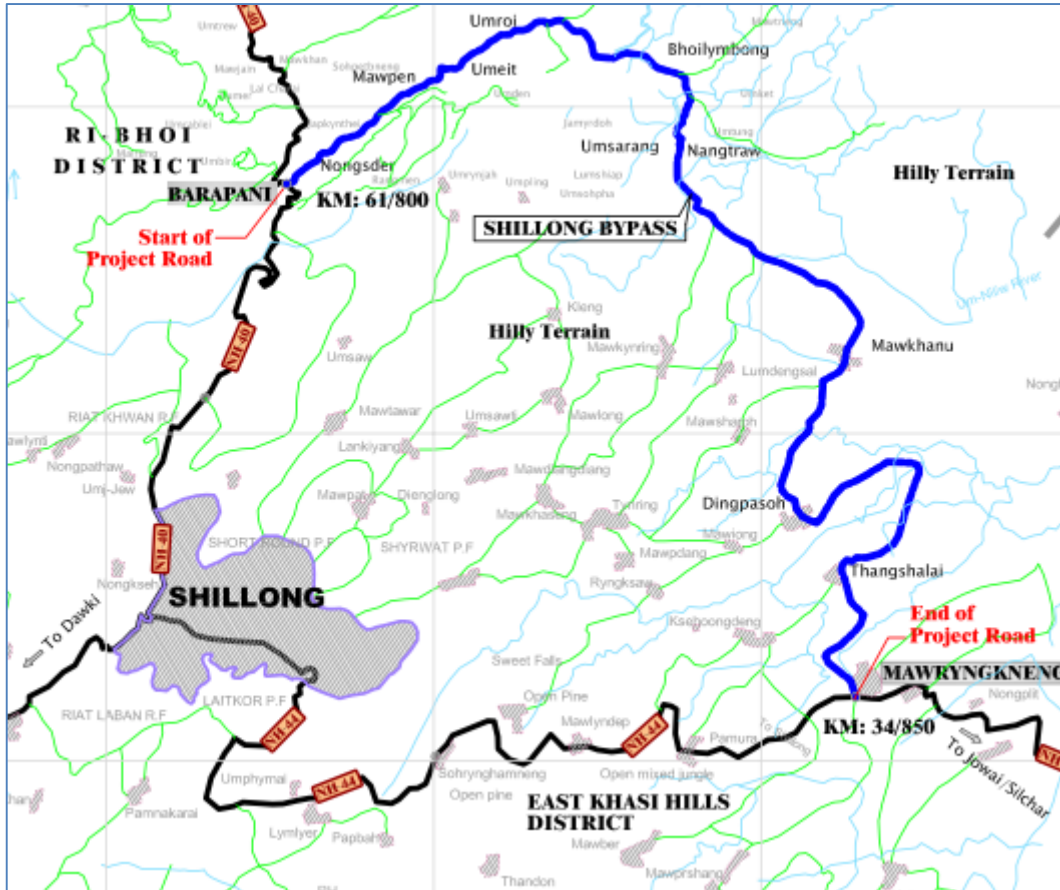
The Concessionaire obtained PCOD on 28.02.2013 (Revised from 25.03.2013) as per Arbitral award dated 27.06.2018. Final COD has been achieved on 30.03.2017.

The project is presently under operation and maintenance by concessionaire, **Shillong Expressways Private Limited (SEPL)**. Samarth Infraengg Technocrats Pvt. Ltd. has been engaged as Technical/ Engineering Due Diligence Advisor for Highways Infrastructure Trust purpose.

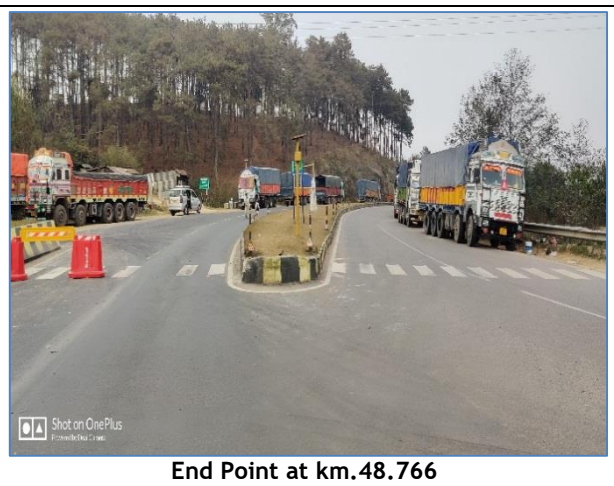
This report highlights the findings of due diligence study undertaken by consultants on the project

1.2 PROJECT AT A GLANCE

The project corridor takes off from Km 61.800 of NH 40 near Barapani and ends on NH 44 at km 34/850. The entire project road passes through rural & Forest area with very thin inhabitations. Bhoilymbong, the only town in the area which is bypassed. The entire corridor runs through rolling or hilly terrain. The total length of project road is about 48.766 kms.



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



Following Table highlights the total project at a glance:

SI No.	Description	Date
1.	Letter of Award (LOA) Issued on	11.05.2010
2.	Date of Signing the Concession Agreement	14.07.2010
3.	Appointment Date	07.02.2011
4.	Construction Period	3 years from Appointed date
5.	Scheduled Project completion	06.02.2014
6.	Concession Period	15yrs from Appointed date
7.	Scheduled End of Concession	06.02.2026
8.	Date of issue of Provisional Completion Certificate	28.02.2013
9.	Date of Issue of Final Completion Certificate	30.03.2017

Table 1:Salient Features of Project Corridor

SI. No.	Particulars	Length/No
1	Start chainage	0.000
2	End Chainage	48.766
3	Length of the Project Road	48.766 Km
4	No of Major Bridges	3 No's
5	No of Minor Bridges	8 No's
6	No of Culvert	240 Nos
7	No of VUP	1 No's
8	No of Toll Plaza	1 No's at Km 24+900
9	Major Junctions	2 No's
10	Minor Junctions	64 No's
11	High Mast Lighting	2 No's
12	RCC Wall	0.090
13	Bus bay with shelter	13 No's
14	Wayside Amenities	0 No's
15	Delineators	366 No's
16	RCC open lined Drain	48.900 km
17	Metal Beam Crash Barrier	24.300 km
18	Concrete Safety barrier	1.220 km
19	Solar Blinkers	19 No's
20	Km Stones	48 No's
21	Hectometer Stone	171 No's
22	Guard Posts	2063 No's
23	Road Signs	1001 No's

1.3 OBJECTIVE AND SCOPE OF SERVICES - FOR DUE DELIGENCE

The main objective of the study is to review the current status of project corridor including details pertaining to its construction and maintenance. Objective of the study can be broadly defined with following tasks:

1.3.1 General

- Review of all documents related to Project including but not limited to provisional completion certificates, punch list items completion certificate, clearances, monthly IE reports, important correspondence if any.
- Review of Change of Scope/ other Claims submitted and to be submitted to Authority / IC, comment on the veracity of the same and approval status.
- Highlight any non-compliance of the terms of the CA or O&M manual and IC inspection reports etc.
- Review of any pending issues related to Utility shifting, maintenance etc. in accordance with the Concession Agreement.
- Comment on issues including any balance work that may have a potential impact on the maintenance costs going forward and which may warrant a one-time expense in future.
- Review of as built drawings.
- Determine the appropriate level and frequency of routine and major maintenance activities required to keep the road assets in good condition and to meet the performance and O&M standards, specifications and requirements.
- Review the major maintenance work undertaken, and prepare projections for future major maintenance expenses (incl. any hand-back requirements), so as to ensure compliance with the terms of CA.
- Review of condition of SPV assets including all equipment and vehicles etc.
- Report on balance acquisition of land if any and possibility of acquisition.
- Report on current encroachments on the project stretch and future expected problems due to the same.

1.3.2 Assessment of Asset Condition

- i. Assessment of road assets in conformance with specifications, standards and codes stipulated in CA and O&M manual etc.
- ii. A detailed inventory survey of road assets including main carriageway, structures, service roads, lightings, drains, slope protection works, retaining walls, bus bays, bus shelters, truck lay byes, O&M center, road furniture including signages, MCB, guard rails etc. other safety measures, toll collection infrastructure, buildings, plantation, vehicles and other objects.
- iii. Assessment of condition of the structures including but not limited to visual inspections of bearings, expansion joints, superstructure, substructures, foundations, associated components, pre-stress anchorages (if any), review of geotechnical assumptions,

- perform geotechnical due diligence, review as-built design and assess design assumptions and provide a detailed report thereon.
- iv. Assessment of condition of the road pavement including but not limited to visual inspections of the pavement, review as-built design and assess design assumptions and provide a detailed report thereon.
 - v. Assessment of physical dimensions/ condition of the infrastructure to determine useful lives of the materials and equipment requiring rehabilitation and/or replacement.
 - vi. Recommendations for any major repair/ rehabilitation and strengthening based on the condition survey and design reports.
 - vii. To provide a detail photographic report of the infrastructure assets and its condition to withstand till end of concession period. Suggestion and cost evaluation for any additional repair / rectification / modification required.

1.3.3 Investigations to be carried out

- 1.1. Assessing maintenance needs and its valuation according to the level of deterioration.
- 1.2. Evaluation of overall condition of flexible pavement including PQC/ BT at toll plaza, BC, DBM, Base/Sub base and sub grade and drainage condition survey.
- 1.3. Carry out visual condition survey for rigid (toll plaza) and flexible pavement
- 1.4. Carry out drainage survey to assess any potential future problems which will cause by moisture and runoff.
- 1.5. Assessment of variation/ COS orders on the project, if any, and evaluate their impact on expenditure, time to completion, future O&M obligations and tolling revenue.

1.3.4 O&M Assessment and Submission of Report

- Develop a detailed O&M cost forecast for each year of the concession period and a detailed major maintenance cost forecast along with estimation of costs towards handover requirements.
- Provide comprehensive report by covering all scope of work mentioned herein this Engagement Letter.

1.4 SURVEYS AND INVESTIGATIONS

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

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

- Road Inventory Surveys
- Visual Pavement Condition
- FWD Survey (data supplied by Concessionaire)
- Roughness Surveys (data supplied by Concessionaire)
- Test Pits& Subgrade Investigations (data supplied by Concessionaire)
- Structure Inventory and Condition Surveys

1.4.1 Road Inventory

The project corridor has flexible pavement in the entire length with 7.0m wide carriageway flanked by 1.5m to 2.5m earthen shoulder on each side. The project corridor generally runs in rolling/hilly terrain for most of length except in few locations where it is slightly plain. The land use along the project road is mostly Forest. It passes through small village settlements like Umroi, Nongtrah, Diengpasoh, Thangshalai, Mawryngkneng etc.

The Project Road has 2 major junctions and about 64 minor junctions along the project road. Photographs showing the Major & Minor Junctions are presented below:





Towards Shillong Airport at km 10.130RHS



Towards Nongtrah at km 11.270 RHS



Towards Mynsian at km 13.960LHS



Towards Diengpasoh at km 33.530 RHS



Towards Thangashalai at km 41.720RHS



Towards Mawryngkneng at km 47.600 LHS

All together the Project road has about 13 No. of Bus Bays with Bus shelters. Few photos taken at the bus shelters and bus bays are presented below:



Bus Bay with Bus Shelter near km 1.500 LHS



Bus Bay with Bus Shelter near km 4.450 RHS

About 4 numbers of High mast lighting is observed along the project road. Two numbers are located at Major Junctions, one Toll Plaza location and one at Minor Junction. Concessionaire informed that, Maintenance of only Two High mast lights, one near Km 10+120 and the other one near Km 48+766 is under Concessionaire’s scope. Few photos showing High mast lighting are presented below:



High mast lighting near km 24.900

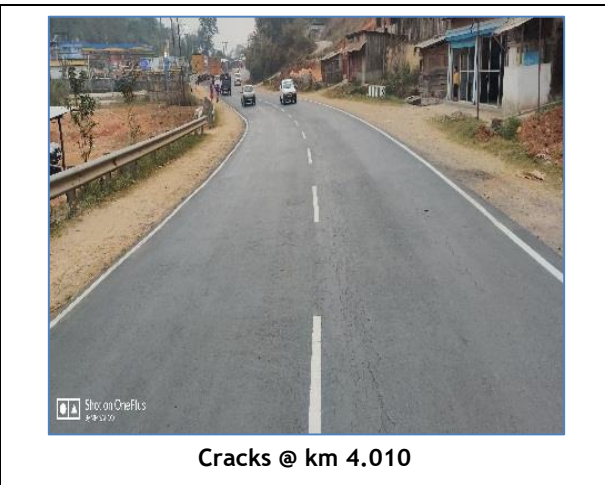


High mast lighting near km 48.600

1.4.2 Visual Pavement Condition Surveys

The present condition of pavement is fair along the project road. Cracking and raveling has developed on Carriageway at some locations. These are mainly surface related distresses and the cracking appears to be top-down cracking. Crocodile cracking is noted at isolated locations. Crack sealing is also being done / in progress at some of the locations along the project corridor. The present surface condition appears slightly dry surface; because of which the cracking might have initiated at most of the locations. Crack sealing is also being done / in progress at some of the locations along the project corridor. The present surface condition appears slightly dry surface; because of which the cracking might have initiated at most of the

locations. No potholes are seen along the project. Remedial treatment at distressed locations carried out with BC material.





Near Km 22.000



Near Km 28.900



Patch work @ km 36.010



Near Km 38.000



Near Km 42.000



Near Km 45.900

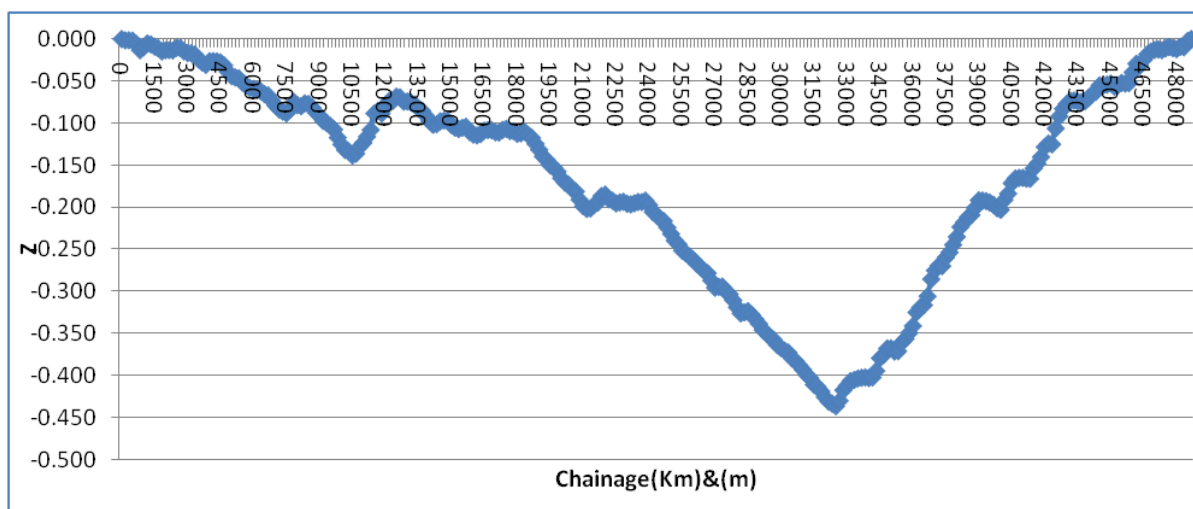
1.4.3 Falling Weight Deflectometer (FWD) Surveys

In order to evaluate the structural strength of the existing pavement, Falling Weight Deflectometer (FWD) survey data has been supplied by the Concessionaire.

The identified homogenous sections for the project stretch have been given in the below table along the graph.

Table 2: Summary of Homogenous Section - BHS

S.No	Side	From	To	Length (km)
1	BHS	0.00	4.20	4.2
2	BHS	4.20	7.30	3.1
3	BHS	7.30	10.30	3.0
4	BHS	10.30	12.50	2.2
5	BHS	12.50	17.80	5.3
6	BHS	17.80	21.00	3.2
7	BHS	21.00	23.60	2.6
8	BHS	23.60	27.80	4.2
9	BHS	27.80	32.20	4.4
10	BHS	32.20	35.20	3.0
11	BHS	35.20	36.60	1.4
12	BHS	36.60	39.00	2.4
13	BHS	39.00	42.60	3.6
14	BHS	42.60	46.00	3.4
15	BHS	46.00	48.766	2.766



Delineation of Homogeneous Section -BHS

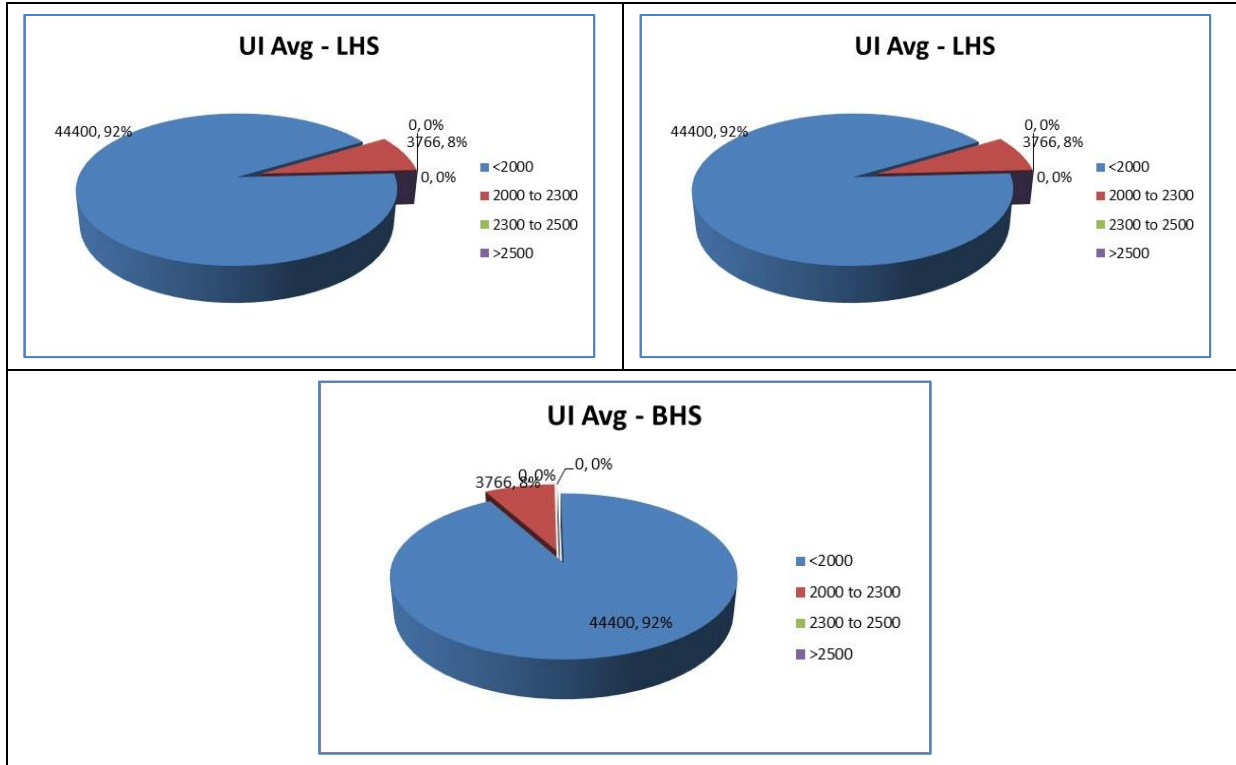
1.4.4 Roughness surveys

Report on Roughness Survey provided by the Concessionaire indicates that the Roughness surveys was carried in the month of August 2021.

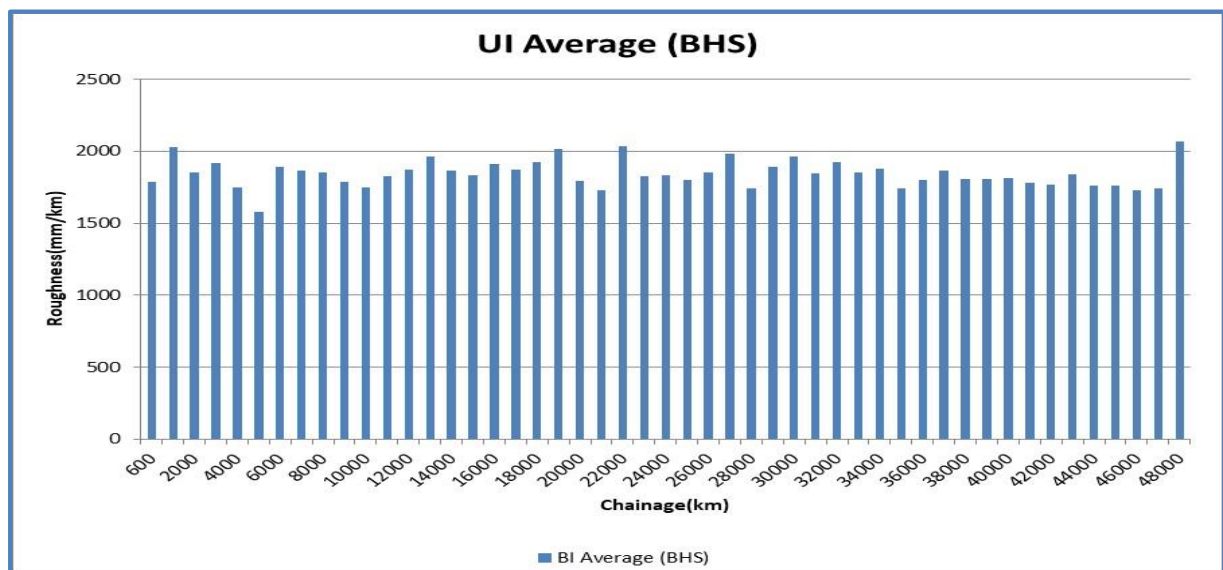
As per IRCSP:16-2004, Bituminous Concrete pavement is surface is considered to be good when its UI value is less than 2000 mm/km and the same is considered to be average for UI values

between 2000 and 3000 mm/km whilst the surface is treated as Poor for UI values greater than 3000 mm/km.

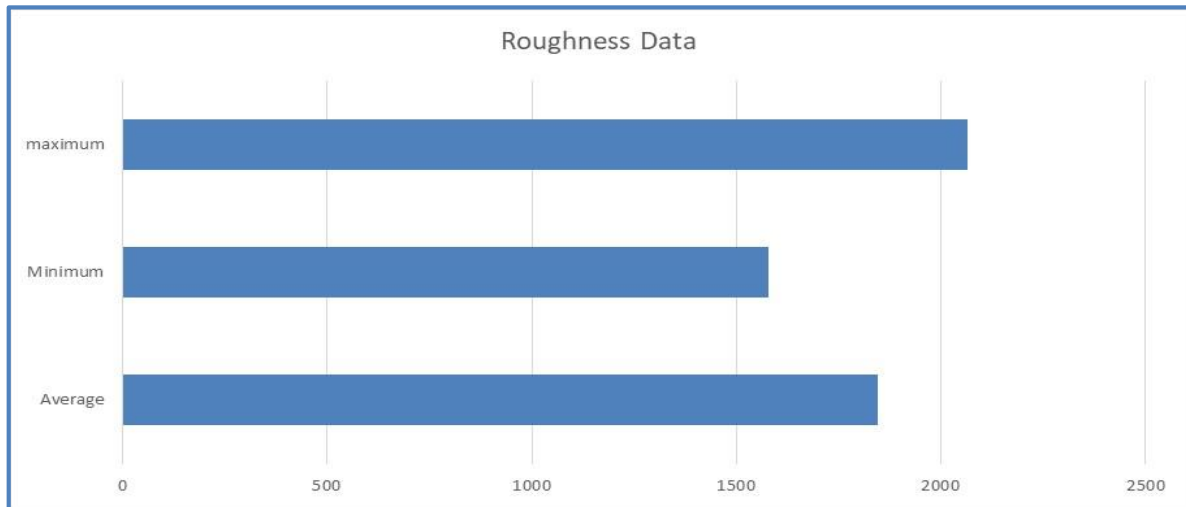
Average UI values along the corridor were grouped in to four categories, Pie chart showing the range of UI values in each carriageway of the project road have been presented below:



It can be seen from the above pie charts that all the kilometers in LHS lane and RHS lane having roughness values less than 2500mm/Km. Even average of both lanes is also indicating that the project road has roughness values within the permissible limits as per the provision of Concession Agreement i.e., less than 2500mm/Km. Bar diagrams showing the Kilometer wise roughness along the project road are presented below:



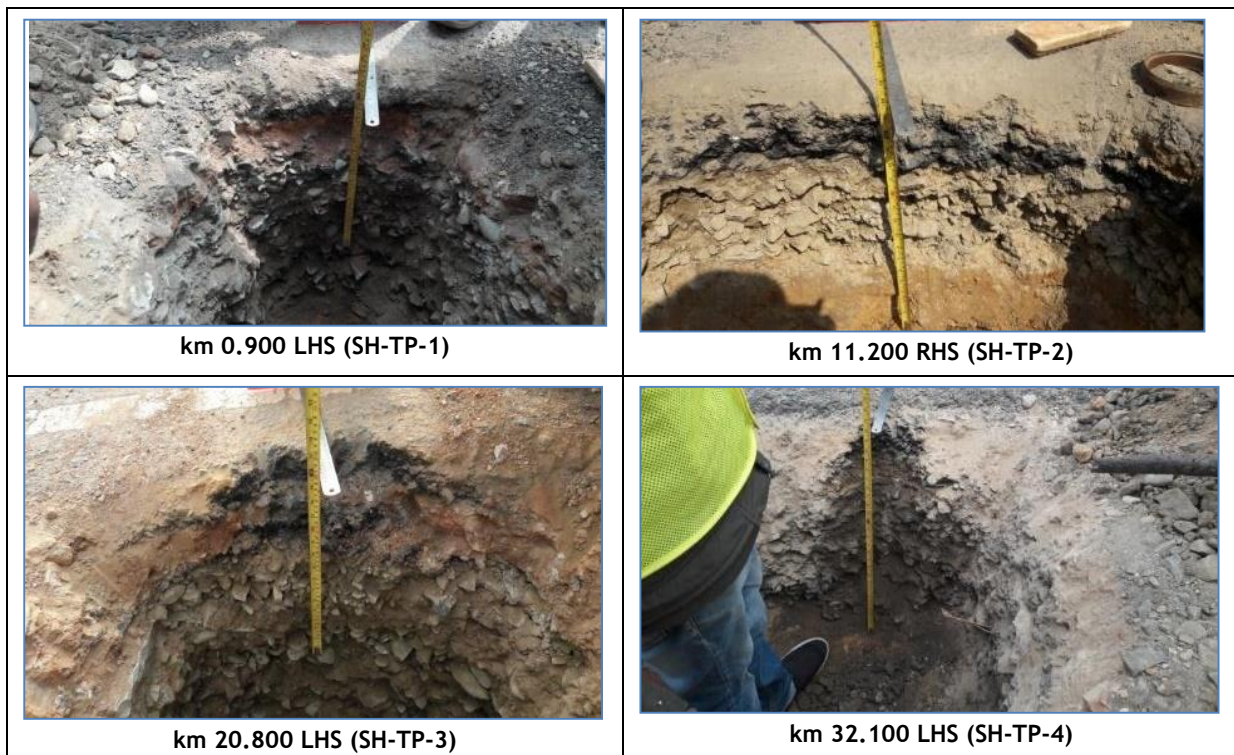
Summary of the Roughness Values analyzed is presented in the following chart

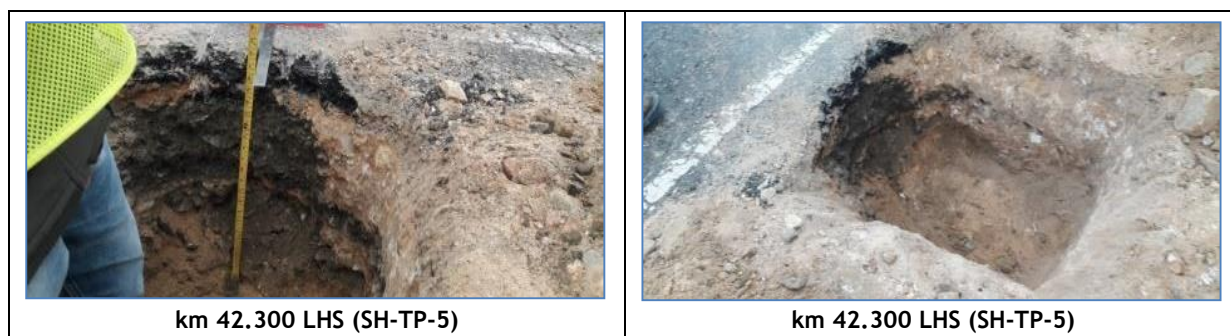


From the above it can be noticed that the Average Roughness values along the project road are 1844 mm/Km. The maximum Roughness Values are around 2065 mm/Km. From the above it can be concluded that none of the section of the project road requires functional overlay as unevenness Index (UI) is less than 2500 mm/km.

1.4.5 Pavement Composition Surveys (Test Pits)

The composition of the existing pavement crust has been provided by concessionaire from test pit surveys. Few photographs of test pits depicting the crust thickness and nature of material in the pavement. Few sample photos taken are presented below:





Results of the test pit survey showing average thickness of pavement layers are presented in the Table below.

Table 3: Pavement Composition

Sl.No	Test Pit Number	Existing Chainage	Direction	BT	WMM	GSB	Total
1	SH-TP-1	0+900	LHS	140	250	190	580
2	SH-TP-2	11+200	RHS	135	200	190	525
3	SH-TP-3	20+800	LHS	150	230	180	560
4	SH-TP-4	32+100	RHS	140	330	200	670
5	SH-TP-5	42+300	LHS	135	220	200	555

Total average crust thickness of the MCW pavement is 578mm. The average thickness of bituminous layer is 140mm. Pavement is mainly composed of a BT layer, WMM & GSB base over subgrade.

1.4.6 Subgrade Investigations & Laboratory Testing

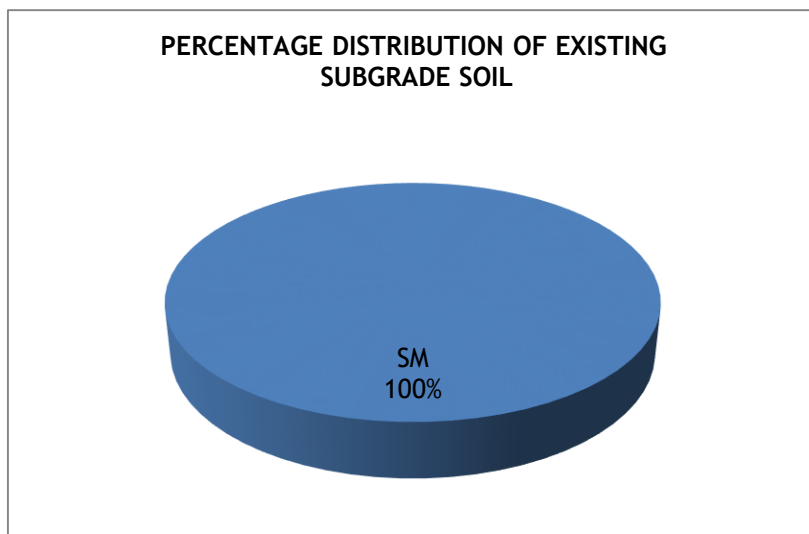
Sub-grade Investigations have been carried out to examine the subgrade soil characteristics along the project road. A total number of 5 Test pits have been carefully dug from the pavement surface up to sub-grade level. Field density tests have been conducted for subgrade samples and a small quantity of sample has also been collected in airtight containers for determining the field moisture content. Upon completion of the field density test, representative sample of sub-grade soil has been collected in bulk, in gunny bags, from each test pit for laboratory testing.

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

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

Soil classification has been done according to IS Classification of Soils (ISC) as detailed in IS 1498-1970. Laboratory test results indicate that all the Subgrade soil samples collected belongs

to Coarse Grained Soil. About 5 Numbers belongs to SM type. Pie Chart showing the percentage distribution of soil classification of existing subgrade sample is presented below:



1.4.7 Axle Load Surveys

Table 4: Adopted VDF Values

Mode Type	Considered VDF
LCV	1.500
2 Axle Truck	4.500
3 Axle Truck	8.000
MAV (4-6 Axle)	10.000
Buses	1.000

Note: In the absence of Axle load data, the above VDF values are assumed. During site visits, it was observed that 3 Axle and multi axle vehicle with heavy loads are plying on the adjoining Road, hence adopted higher VDF for 3-Axles and MAVs.

1.5 VALIDATION OF EXECUTED WORKS

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

1.5.1 Road Works

The project corridor has been constructed with the cross-sectional elements matching to those given in above TCS drawings. The carriageway width of 7.0m and Earthen shoulders of 1.5m to 2.5m on either side of carriageway have also been provided.

Lined open drains exist along the project road on Hill side. The condition of the Drain appears to be good and the cleaning and maintenance of the drain shall be undertaken in routine maintenance activities for its proper functioning. The open lined drain locations are presented in the Table below:

Table 5: RCC Open Drain Locations

S.No	Chainage		Length	Side	Drain Type	Remarks
	From	To				
1	1.120	1.620	0.500	LHS	Lined Drain	
2	1.720	1.740	0.020	LHS	Lined Drain	
3	1.900	2.100	0.200	LHS	Lined Drain	
4	2.190	2.745	0.555	LHS	Lined Drain	
5	2.830	2.980	0.150	LHS	Lined Drain	
6	3.280	4.530	1.250	LHS	Lined Drain	
7	4.640	6.165	1.525	LHS	Lined Drain	
8	6.330	6.380	0.050	LHS	Lined Drain	
9	6.480	6.550	0.070	LHS	Lined Drain	
10	6.610	6.970	0.360	LHS	Lined Drain	
11	7.050	7.210	0.160	LHS	Lined Drain	
12	7.300	7.600	0.300	LHS	Lined Drain	
13	7.690	8.700	1.010	LHS	Lined Drain	
14	8.900	9.129	0.229	LHS	Lined Drain	
15	9.250	9.390	0.140	LHS	Lined Drain	
16	10.290	10.370	0.080	RHS	Lined Drain	
17	10.405	10.650	0.245	LHS	Lined Drain	
18	10.450	10.650	0.200	RHS	Lined Drain	
19	11.535	11.640	0.105	LHS	Lined Drain	
20	12.320	12.665	0.345	LHS	Lined Drain	
21	12.870	13.180	0.310	RHS	Lined Drain	
22	14.160	14.445	0.285	LHS	Lined Drain	
23	14.730	14.780	0.050	LHS	Lined Drain	
24	14.820	14.940	0.120	LHS	Lined Drain	
25	15.870	16.035	0.165	LHS	Lined Drain	
26	16.080	16.260	0.180	RHS	Lined Drain	
27	16.080	16.260	0.180	LHS	Lined Drain	
28	16.300	16.550	0.250	LHS	Lined Drain	
29	16.650	16.720	0.070	RHS	Lined Drain	
30	16.650	16.690	0.040	LHS	Lined Drain	

S.No	Chainage		Length	Side	Drain Type	Remarks
31	16.750	16.900	0.150	LHS	Lined Drain	
32	17.030	17.260	0.230	LHS	Lined Drain	
33	17.150	17.200	0.050	RHS	Lined Drain	
34	17.380	17.900	0.520	LHS	Lined Drain	
35	17.400	17.578	0.178	RHS	Lined Drain	
36	18.400	18.600	0.200	LHS	Lined Drain	
37	18.400	18.600	0.200	RHS	Lined Drain	
38	18.650	18.680	0.030	LHS	Lined Drain	
39	18.650	18.990	0.340	RHS	Lined Drain	
40	19.400	19.760	0.360	LHS	Lined Drain	
41	19.400	19.620	0.220	RHS	Lined Drain	
42	19.680	19.970	0.290	RHS	Lined Drain	
43	19.970	20.200	0.230	LHS	Lined Drain	
44	20.200	20.300	0.100	RHS	Lined Drain	
45	20.500	20.600	0.100	LHS	Lined Drain	
46	20.650	20.750	0.100	RHS	Lined Drain	
47	20.780	20.820	0.040	LHS	Lined Drain	
48	20.950	21.000	0.050	LHS	Lined Drain	
49	21.070	21.580	0.510	LHS	Lined Drain	
50	21.550	22.580	1.030	RHS	Lined Drain	
51	22.520	22.580	0.060	LHS	Lined Drain	
52	22.730	23.410	0.680	RHS	Lined Drain	
53	23.350	25.370	2.020	LHS	Lined Drain	
54	25.425	25.900	0.475	LHS	Lined Drain	
55	25.670	25.790	0.120	RHS	Lined Drain	
56	25.980	26.290	0.310	RHS	Lined Drain	
57	25.270	26.778	1.508	LHS	Lined Drain	
58	26.860	27.100	0.240	LHS	Lined Drain	
59	26.860	27.100	0.240	RHS	Lined Drain	
60	27.240	27.340	0.100	RHS	Lined Drain	
61	27.500	27.600	0.100	RHS	Lined Drain	
62	27.530	27.550	0.020	LHS	Lined Drain	
63	27.712	28.330	0.618	LHS	Lined Drain	
64	27.800	28.120	0.320	RHS	Lined Drain	
65	28.510	28.560	0.050	LHS	Lined Drain	
66	28.420	28.510	0.090	RHS	Lined Drain	
67	28.850	29.240	0.390	LHS	Lined Drain	
68	28.900	30.080	1.180	RHS	Lined Drain	
69	29.540	29.600	0.060	LHS	Lined Drain	
70	29.715	30.010	0.295	LHS	Lined Drain	
71	30.210	30.400	0.190	RHS	Lined Drain	

S.No	Chainage		Length	Side	Drain Type	Remarks
72	30.380	30.440	0.060	LHS	Lined Drain	
73	30.610	30.770	0.160	LHS	Lined Drain	
74	30.670	30.800	0.130	RHS	Lined Drain	
75	30.830	31.280	0.450	RHS	Lined Drain	
76	30.900	31.142	0.242	LHS	Lined Drain	
77	31.190	31.400	0.210	LHS	Lined Drain	
78	31.500	32.220	0.720	RHS	Lined Drain	
79	32.100	32.630	0.530	LHS	Lined Drain	
80	32.600	32.890	0.290	RHS	Lined Drain	
81	32.930	33.550	0.620	RHS	Lined Drain	
82	32.970	33.820	0.850	LHS	Lined Drain	
83	33.570	33.880	0.310	RHS	Lined Drain	
84	33.900	34.040	0.140	RHS	Lined Drain	
85	34.180	34.490	0.310	RHS	Lined Drain	
86	34.230	34.530	0.300	LHS	Lined Drain	
87	34.530	35.000	0.470	RHS	Lined Drain	
88	35.570	37.010	1.440	RHS	Lined Drain	
89	37.025	37.600	0.575	RHS	Lined Drain	
90	37.700	38.750	1.050	RHS	Lined Drain	
91	38.300	38.550	0.250	LHS	Lined Drain	
92	38.900	39.970	1.070	RHS	Lined Drain	
93	39.670	41.185	1.515	LHS	Lined Drain	
94	41.190	42.370	1.180	RHS	Lined Drain	
95	42.390	43.700	1.310	RHS	Lined Drain	
96	43.780	45.375	1.595	RHS	Lined Drain	
97	45.860	46.900	1.040	LHS	Lined Drain	
98	47.000	47.200	0.200	RHS	Lined Drain	
99	47.080	47.200	0.120	LHS	Lined Drain	
100	47.440	47.780	0.340	RHS	Lined Drain	
101	48.200	48.600	0.400	RHS	Lined Drain	
102	48.700	48.760	0.060	LHS	Lined Drain	
Total Length (km)			4.1075			

Details of Solar Blinkers including the locations and working condition is presented in the following table:

Table 6: Details of Solar Blinkers

S.no	Chainage	Side	Remarks
1	0.000	RHS	Working
2	1.100	RHS	Working
3	1.150	RHS	Working

S.no	Chainage	Side	Remarks
4	1.740	LHS	Working
5	1.830	RHS	Working
6	9.250	RHS	Working
7	10.110	LHS	Working
8	10.450	RHS	Working
9	11.300	RHS	Working
10	11.350	RHS	Working
11	13.950	RHS	Working
12	17.830	LHS	Working
13	17.920	RHS	Working
14	33.510	LHS	Working
15	33.600	RHS	Working
16	38.900	RHS	Working
17	47.580	LHS	Working
18	47.670	RHS	Working
19	48.600	Median	Working

Safety barriers have been provided along the project road on valley side, at sharp curve locations, cross drainage Structures. Details of safety barriers provided along the corridor include the following:

Table 7: Metal Beam Crash Barrier Locations

S.NO	Chainage		Length	Side	Damage	Remarks
	From	To				
1	0.160	0.360	0.200	LHS	-	Good
2	4.500	4.600	0.100	LHS	-	Good
3	6.270	6.300	0.030	LHS	-	Good
4	6.970	7.030	0.060	LHS	-	Good
5	7.600	7.740	0.140	LHS	-	Good
6	9.180	9.270	0.090	LHS	-	Good
7	9.770	9.870	0.100	LHS	-	Good
8	9.900	10.120	0.220	LHS	-	Good
9	10.270	10.400	0.130	LHS	-	Good
10	10.900	11.230	0.330	LHS	-	Good
11	11.240	11.370	0.130	LHS	-	Good
12	11.380	11.530	0.150	LHS	-	Good
13	11.900	12.100	0.200	LHS	-	Good
14	13.860	13.950	0.090	LHS	2	Good
15	14.530	14.660	0.130	LHS	5	Good
16	14.930	15.070	0.140	LHS	-	Good
17	15.730	15.770	0.040	LHS	-	Good
18	16.100	16.140	0.040	LHS	-	Good

S.NO	Chainage		Length	Side	Damage	Remarks
19	16.650	16.750	0.100	LHS	-	Good
20	17.350	17.380	0.030	LHS	-	Good
21	18.000	18.150	0.150	LHS	-	Good
22	18.990	19.000	0.010	LHS	-	Good
23	19.090	19.110	0.020	LHS	-	Good
24	19.930	19.980	0.050	LHS	-	Good
25	20.200	20.350	0.150	LHS	-	Good
26	20.390	20.480	0.090	LHS	-	Good
27	20.650	20.750	0.100	LHS	-	Good
28	21.000	21.080	0.080	LHS	-	Good
29	21.590	25.720	4.130	LHS	-	Good
30	21.750	21.800	0.050	LHS	-	Good
31	21.810	21.900	0.090	LHS	-	Good
32	21.950	22.030	0.080	LHS	-	Good
33	22.250	22.350	0.100	LHS	-	Good
34	22.600	22.620	0.020	LHS	-	Good
35	22.710	22.720	0.010	LHS	-	Good
36	23.300	23.350	0.050	LHS	-	Good
37	24.000	24.120	0.120	LHS	-	Good
38	25.900	26.100	0.200	LHS	-	Good
39	26.110	26.150	0.040	LHS	-	Good
40	26.270	26.300	0.030	LHS	-	Good
41	27.110	27.280	0.170	LHS	3	Good
42	27.470	27.580	0.110	LHS	3	Good
43	28.800	28.840	0.040	LHS	-	Good
44	30.050	30.080	0.030	LHS	-	Good
45	30.170	30.200	0.030	LHS	-	Good
46	30.470	30.610	0.140	LHS	-	Good
47	30.780	30.800	0.020	LHS	-	Good
48	31.380	31.400	0.020	LHS	-	Good
49	31.500	31.560	0.060	LHS	-	Good
50	31.630	31.800	0.170	LHS	-	Good
51	31.850	31.880	0.030	LHS	-	Good
52	32.000	32.090	0.090	LHS	-	Good
53	32.730	32.850	0.120	LHS	-	Good
54	32.880	32.900	0.020	LHS	-	Good
55	34.800	35.040	0.240	LHS	-	Good
56	35.220	35.280	0.060	LHS	-	Good
57	35.330	35.400	0.070	LHS	-	Good
58	35.410	35.490	0.080	LHS	-	Good
59	35.410	35.550	0.140	LHS	-	Good

S.NO	Chainage		Length	Side	Damage	Remarks
60	35.750	35.810	0.060	LHS	-	Good
61	36.280	36.350	0.070	LHS	-	Good
62	36.770	36.830	0.060	LHS	-	Good
63	37.000	37.020	0.020	LHS	-	Good
64	37.050	37.070	0.020	LHS	-	Good
65	37.100	37.200	0.100	LHS	5	Good
66	37.210	37.230	0.020	LHS	-	Good
67	37.310	37.330	0.020	LHS	-	Good
68	37.600	37.620	0.020	LHS	-	Good
69	37.670	37.700	0.030	LHS	-	Good
70	38.040	38.250	0.210	LHS	-	Good
71	38.570	38.600	0.030	LHS	-	Good
72	38.630	38.780	0.150	LHS	-	Good
73	38.800	38.830	0.030	LHS	-	Good
74	39.010	39.030	0.020	LHS	-	Good
75	39.080	39.100	0.020	LHS	-	Good
76	39.200	39.220	0.020	LHS	-	Good
77	39.450	39.470	0.020	LHS	-	Good
78	39.580	39.600	0.020	LHS	-	Good
79	41.170	41.200	0.030	LHS	-	Good
80	41.400	41.600	0.200	LHS	-	Good
81	42.570	42.570	0.000	LHS	-	Good
82	42.590	43.290	0.700	LHS	-	Good
83	43.330	43.350	0.020	LHS	10	Good
84	43.450	43.580	0.130	LHS	-	Good
85	43.610	43.910	0.300	LHS	-	Good
86	44.000	44.070	0.070	LHS	-	Good
87	44.100	44.120	0.020	LHS	-	Good
88	44.150	44.180	0.030	LHS	-	Good
89	44.450	44.460	0.010	LHS	-	Good
90	44.610	44.780	0.170	LHS	-	Good
91	44.800	44.900	0.100	LHS	-	Good
92	44.980	45.100	0.120	LHS	-	Good
93	45.550	45.570	0.020	LHS	-	Good
94	45.650	45.790	0.140	LHS	-	Good
95	46.900	46.960	0.060	LHS	-	Good
96	47.020	47.120	0.100	LHS	-	Good
97	47.280	47.400	0.120	LHS	-	Good
98	47.650	47.800	0.150	LHS	-	Good
99	48.010	48.260	0.250	LHS	-	Good
100	48.390	48.420	0.030	LHS	-	Good

S.NO	Chainage		Length	Side	Damage	Remarks
101	48.570	48.600	0.030	LHS	-	Good
102	48.200	48.100	0.100	RHS	2	Good
103	48.090	48.000	0.090	RHS	3	Good
104	47.890	47.780	0.110	RHS	-	Good
105	47.380	47.250	0.130	RHS	-	Good
106	46.900	46.590	0.310	RHS	-	Good
107	46.350	46.120	0.230	RHS	-	Good
108	46.070	45.990	0.080	RHS	-	Good
109	45.900	45.800	0.100	RHS	-	Good
110	45.670	45.500	0.170	RHS	-	Good
111	42.500	42.480	0.020	RHS	-	Good
112	42.420	42.400	0.020	RHS	-	Good
113	41.330	41.300	0.030	RHS	-	Good
114	41.180	41.100	0.080	RHS	-	Good
115	41.080	40.880	0.200	RHS	-	Good
116	40.600	40.440	0.160	RHS	-	Good
117	40.420	40.400	0.020	RHS	-	Good
118	40.300	40.250	0.050	RHS	-	Good
119	40.100	40.070	0.030	RHS	20	Good
120	38.880	38.860	0.020	RHS	-	Good
121	38.800	38.780	0.020	RHS	-	Good
122	37.730	37.710	0.020	RHS	-	Good
123	37.650	37.630	0.020	RHS	-	Poor
124	37.120	37.100	0.020	RHS	-	Good
125	37.020	37.000	0.020	RHS	-	Good
126	35.550	35.450	0.100	RHS	-	Good
127	35.430	35.300	0.130	RHS	-	Good
128	35.150	34.990	0.160	RHS	-	Good
129	32.600	32.200	0.400	RHS	-	Good
130	31.580	31.560	0.020	RHS	-	Good
131	31.400	31.300	0.100	RHS	-	Good
132	30.210	30.150	0.060	RHS	-	Good
133	28.890	28.800	0.090	RHS	-	Good
134	28.750	28.600	0.150	RHS	-	Good
135	28.550	28.500	0.050	RHS	-	Good
136	28.420	28.300	0.120	RHS	-	Good
137	27.850	27.750	0.100	RHS	-	Good
138	27.570	27.490	0.080	RHS	-	Good
139	27.210	27.100	0.110	RHS	-	Good
140	26.860	26.790	0.070	RHS	-	Good
141	26.500	26.470	0.030	RHS	-	Good

S.NO	Chainage		Length	Side	Damage	Remarks
142	25.980	25.870	0.110	RHS	-	Good
143	25.650	25.600	0.050	RHS	-	Good
144	25.430	25.350	0.080	RHS	-	Good
145	25.280	25.250	0.030	RHS	-	Good
146	24.550	23.490	1.060	RHS	-	Good
147	22.730	22.720	0.010	RHS	-	Good
148	22.630	22.600	0.030	RHS	-	Good
149	21.600	21.500	0.100	RHS	-	Good
150	21.420	21.250	0.170	RHS	-	Good
151	21.200	21.000	0.200	RHS	-	Good
152	20.990	20.900	0.090	RHS	-	Good
153	20.890	20.870	0.020	RHS	-	Good
154	20.650	20.550	0.100	RHS	3	Good
155	20.450	20.370	0.080	RHS	-	Good
156	20.180	19.940	0.240	RHS	-	Good
157	19.690	19.600	0.090	RHS	-	Good
158	19.400	19.350	0.050	RHS	-	Good
159	19.060	19.040	0.020	RHS	-	Good
160	19.000	18.980	0.020	RHS	3	Good
161	18.130	18.080	0.050	RHS	-	Good
162	17.910	17.850	0.060	RHS	-	Good
163	17.400	17.200	0.200	RHS	3	Good
164	16.850	16.730	0.120	RHS	-	Good
165	16.330	16.240	0.090	RHS	-	Good
166	16.090	16.050	0.040	RHS	-	Good
167	15.870	15.790	0.080	RHS	-	Good
168	15.070	14.930	0.140	RHS	-	Good
169	14.650	14.600	0.050	RHS	-	Good
170	14.530	14.400	0.130	RHS	-	Good
171	13.820	13.780	0.040	RHS	-	Good
172	12.910	12.890	0.020	RHS	3	Good
173	12.750	12.660	0.090	RHS	-	Good
174	12.600	12.520	0.080	RHS	-	Good
175	12.510	12.420	0.090	RHS	-	Good
176	12.390	12.360	0.030	RHS	-	Good
177	12.090	11.920	0.170	RHS	-	Good
178	10.590	10.530	0.060	RHS	-	Good
179	10.350	10.320	0.030	RHS	-	Good
180	9.800	9.650	0.150	RHS	-	Good
181	9.240	9.130	0.110	RHS	-	Good
182	7.700	7.680	0.020	RHS	-	Good

S.NO	Chainage		Length	Side	Damage	Remarks
183	7.440	7.310	0.130	RHS	-	Good
184	7.060	6.950	0.110	RHS	5	Good
185	6.730	6.290	0.440	RHS	5	Good
186	6.020	5.670	0.350	RHS	-	Good
187	5.660	5.550	0.110	RHS	-	Good
188	5.480	5.350	0.130	RHS	-	Good
189	5.240	5.150	0.090	RHS	-	Good
190	5.110	4.950	0.160	RHS	-	Good
191	4.880	4.700	0.180	RHS	-	Good
192	4.570	4.470	0.100	RHS	-	Good
193	4.150	4.120	0.030	RHS	-	Good
194	4.000	3.900	0.100	RHS	-	Good
195	3.680	3.650	0.030	RHS	-	Good
196	3.490	3.390	0.100	RHS	2	Good
197	2.730	2.620	0.110	RHS	-	Good
198	2.350	2.290	0.060	RHS	-	Good
199	2.210	2.100	0.110	RHS	-	Good
200	1.950	1.900	0.050	RHS	-	Good
201	1.800	1.700	0.100	RHS	-	Good
202	1.680	1.650	0.030	RHS	-	Good
203	1.490	1.460	0.030	RHS	-	Good
204	1.340	1.250	0.090	RHS	-	Good
205	0.810	0.790	0.020	RHS	-	Good
206	0.210	0.190	0.020	RHS	-	Good
Total Length (Kms)			24.300		80	

Table 8: Concrete Crash Barrier Locations

S.No	From	To	Length(m)	Side	Remarks
1	7.770	7.790	0.020	Both Sides	Good
2	11.890	11.910	0.020	Both Sides	Good
3	12.820	12.900	0.080	Both Sides	Good
4	15.730	15.740	0.010	Both Sides	Good
5	18.970	19.030	0.060	Both Sides	Good
6	22.590	22.690	0.100	Both Sides	Good
7	31.350	31.490	0.140	Both Sides	Good
8	32.580	32.620	0.040	Both Sides	Good
9	37.010	37.030	0.020	Both Sides	Good
10	37.570	37.640	0.070	Both Sides	Good
11	38.730	38.760	0.030	Both Sides	Good
12	42.390	42.410	0.020	Both Sides	Good
Total Length			1.220		

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

Table 9: List of Major Junctions

S.No	Chainage	Junction Type	Surface Type	Side	Carriageway width(M)	Remarks
1	0+000	3-Arm	BT	RHS	7	Shillong
2	48+600	3-Arm	BT	RHS	7	Shillong

Table 10: List of Minor Junctions

S.NO	Chainage	Surface Type	Side	Intersecting Road	Carriage way width(m)	Remarks
1	1.110	Bituminous	RHS	Agriculture College Road	3.0	
2	1.450	Bituminous	RHS	Agriculture College Road	3.0	
3	1.770	Bituminous	BHS	Nonster	5.0	LHS-3m B.T
4	1.920	Bituminous	LHS	Village Road	3.0	
5	2.285	Bituminous	BHS	Village Road	3.0	LHS-3.5m B.T
6	3.350	Bituminous	LHS	Village Road	3.0	
7	3.450	Bituminous	RHS	Military Station (Umroi)	5.5	
8	4.130	Earthen	LHS	Village Road	3.0	
9	4.200	Earthen	LHS	Village Road	3.0	
10	4.470	Bituminous	LHS	Mawpun	3.0	
11	4.520	Earthen	LHS	Village Road	3.5	
12	4.620	Earthen	LHS	Hill Road	3.5	
13	4.650	Earthen	LHS	Village Road	3.0	
14	6.170	Bituminous	LHS	Mawthai	3.5	
15	6.800	Earthen	RHS	Village Road	3.0	
16	7.030	Earthen	LHS	Village Road	3.0	
17	8.710	Bituminous	BHS	Umroi	3.0	LHS-3m CC
18	8.800	Bituminous	RHS	Village Road	3.0	
19	8.850	Bituminous	RHS	Village Road	3.0	
20	8.920	Bituminous	LHS	Village Road	3.0	
21	9.080	Bituminous	BHS	Village Road	3.0	LHS-3m Earthen
22	9.220	Bituminous	LHS	Umroi Madan	7.0	
23	9.380	Bituminous	BS	Umroi	3.5	
24	9.610	Bituminous	LHS	Umroi	3.0	
25	9.760	Bituminous	BHS	Umroi	3.0	RHS-3m Earthen
26	10.130	Bituminous	BHS	Umroi	5.5	RHS-5.5m B.T
27	10.260	Bituminous	LHS	Umroi	3.0	
28	10.530	Bituminous	RHS	Nongtraw	5.5	
29	10.690	Bituminous	BHS	Umsawriang	3.5	RHS-5.5m B.T
30	11.270	Bituminous	RHS	Village Road	5.5	
31	11.350	Bituminous	LHS	Umktich	5.5	
32	11.420	Bituminous	RHS	Village Road	3.0	
33	12.200	Bituminous	RHS	Lumkshlama	3.5	
34	12.250	Bituminous	RHS	Village Road	3.0	
35	13.090	Bituminous	RHS	Madan	3.0	

S.NO	Chainage	Surface Type	Side	Intersecting Road	Carriage way width(m)	Remarks
36	13.960	Bituminous	LHS	Mynsian	3.5	
37	14.730	Bituminous	LHS	Bhoirymbong	5.5	
38	16.460	Bituminous	LHS	Nongtraw	3.5	
39	17.250	Bituminous	LHS	Nongtraw	3.5	
40	17.580	Bituminous	LHS	Nongtraw	3.0	
41	17.850	Earthen	RHS	Nongtraw	3.0	
42	18.000	Bituminous	LHS	Nongtraw	3.5	
43	18.450	Bituminous	LHS	Nongtraw	3.5	
44	19.350	Earthen	LHS	Village Road	3.0	
45	19.700	Earthen	LHS	Village Road	3.0	
46	19.790	Bituminous	LHS	Lumrit	3.5	
47	20.800	Bituminous	RHS	Village Road	3.5	
48	20.910	Earthen	LHS	Village Road	3.0	
49	21.830	Bituminous	LHS	Kyrdeng	3.0	
50	22.020	Earthen	RHS	Village Road	3.0	
51	24.840	Earthen	RHS	Village Road	3.0	
52	25.150	Earthen	LHS	Village Road	3.0	
53	27.670	Earthen	LHS	Village Road	3.0	
54	28.380	Earthen	LHS	Village Road	3.0	
55	29.080	Earthen	RHS	Village Road	3.0	
56	30.770	Bituminous	RHS	Village Road	3.0	
57	33.530	Bituminous	RHS	Diengpasoh	5.5	
58	34.180	Earthen	RHS	Village Road	3.0	
59	41.720	Bituminous	RHS	Thangshalai	3.0	
60	43.080	Earthen	RHS	Village Road	3.5	
61	43.700	Earthen	RHS	Hill Road	3.0	
62	43.750	Earthen	RHS	Hill Road	3.0	
63	44.950	Earthen	LHS	Village Road	3.0	
64	47.600	Bituminous	LHS	Mawkeliang	5.0	

Details of high mast lighting locations are presented in the following table

Table 11: Locations of Lighting

S. No	From	Side	No's	Location	Remarks
1	0.000	RHS	High mast Lights - 6 No's	Major Junction	Not in Concessionaire Scope
2	10.130	LHS	High mast Lights - 6 No's	Major Junction	
3	24.900	Median	High mast Lights - 12 No's	Toll plaza	Not in Concessionaire Scope
4	48.600	RHS	High mast Lights - 6 No's	Major Junction	

Concessionaire informed that, the lighting at Toll Plaza and at Km 0.000 are not in Concessionaire's scope.

The project Road has 13 number of bus shelters with Bus bays. The details of the Bus shelter and Bus Bays are provided below

Table 12: Details of Bus Bays and Bus Shelters

S.No	Chainage	Side	Type	Condition	Remarks
1	1.500	LHS	Bus Bay with Shelter	Good	
2	3.450	LHS	Bus Bay with Shelter	Good	
3	3.800	RHS	Bus Bay with Shelter	Good	
4	4.470	RHS	Bus Bay with Shelter	Good	
5	4.750	LHS	Bus Bay with Shelter	Good	
6	6.660	LHS	Bus Bay with Shelter	Good	
7	6.920	RHS	Bus Bay with Shelter	Good	
8	9.230	LHS	Bus Shelter	Good	Extra
9	9.850	RHS	Bus Bay with Shelter	Good	
10	9.940	LHS	Bus Bay with Shelter	Good	
11	10.130	LHS	Bus Shelter	Good	Extra
12	10.140	LHS	Bus Shelter	Good	Extra
13	10.700	RHS	Bus Shelter	Good	Extra
14	14.860	RHS	Bus Bay with Shelter	Good	
15	14.910	LHS	Bus Bay with Shelter	Good	
16	43.100	LHS	Bus Bay with Shelter	Good	
17	43.210	RHS	Bus Bay with Shelter	Good	

Note: Concessionaire informed that, 4 number of extra bus shelters found pertains to Villagers and the same are not in Concessionaire scope

1.5.2 Bridge Works

The project Road has 3 numbers of major bridges, 8 numbers of minor bridges and 1 number of VUP along the project road apart from Culverts.

Details of the structures excluding the culverts is presented in the following table

Table 13: List of Structures excluding Culverts

S.No.	Chainage as Per CA	Chainage as Per Site	Type of Str	Span as per Schedule	Span as per Site	Deck width as per site	Structure in Schedule	Structure on Site	Skew angle
1	7+780	7+780	MNB	1 x 11.6	1 x 11.6	1 x 8.4	Yes	Yes	-
2	12+025	11+900	MNB	1 x 11.6	1 x 10.0	1 x 10	Yes	Yes	-
3	12+865	12+865	MJB	3 x 18.0	3 x 25.5	1 x 11	Yes	Yes	-
4	-	15+740	MNB	NA	1 x 7 (SQ) 1 x 8.3(SK)	1 x 12.2(SQ) 1 x 14(SK)	No	Yes	15
5	18+885	19+000	MNB	1 x 12 + 1 x 20+ 1 x 12	1 x 10.3 + 1 x 20+ 1 x 12	1 x 12	Yes	Yes	
6	22+640	22+640	MJB	1 x 20+1 x 40+1 x	1 x 15+1 x 45+1 x 25	1 x 12	Yes	Yes	-

				20					
7	31+270	31+420	MJB	3 x 40	1 x 30 + 2 x 45	1x 12	Yes	Yes	-
8	32+045	32+868	MNB	1 x 8.0	1 x 24	1 x 12	Yes	Yes	-
9	35+950	37+020	MNB	1 x 15.0	1 x 15.0	1 x 12	Yes	Yes	-
10	36+580	37+600	MNB	2 x 25.5	2 x 25.3	1 x 8.5	Yes	Yes	-
11	-	38+480	VUP	NA	1 x 18	1 x 12	No	Yes	-
12	-	42+400	MNB	NA	1 x 7.75(SQ) 1 x 9.8(SK)	1 x 12.9(SQ) 1 x 13.1(SK)	No	Yes	15

1.6 QUALITY AUDIT

1.6.1 Embankment & Subgrade

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

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

Table 14: Existing Subgrade Test Results

Lab Sample No	Location (km) / Up/Dn		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	Soaked CBR 97% MDD	Free Swelling Index (%)
			Percentage passing from					LL	PL	PI					
			4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %								
TP-1	0+900	LHS	100	41	27	0	73	31	29	3	SM	1.76	15.10	10.80	0.00
TP-2	11+200	RHS	100	59	26	0	74	27	NP	NP	SM	1.82	13.70	9.30	10.00
TP-3	20+800	LHS	100	37	19	0	81	19	NP	NP	SM	1.97	11.10	9.20	20.00
TP-4	32+100	RHS	100	76	20	0	80	19	NP	NP	SM	1.75	11.40	10.20	6.80
TP-5	42+300	LHS	100	89	24	0	76	23	NP	NP	SM	1.76	11.00	10.80	6.00

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

- Liquid limit for existing subgrade samples varies between 19 and 31. All the samples satisfying the liquid limit criterion ($LL \leq 50$).
- Plasticity Index for 1 out of 5 samples subgrade samples is 3 and remaining 4 are not plastic.
- Maximum Dry Density for all subgrade samples varies between 1.75 and 1.97 gm/cc. All the samples satisfying the MDD criterion ($MDD \geq 1.75$ gm/cc).
- OMC for existing subgrade samples varies between 11.0 to 15.10
- Free Swelling Index for existing subgrade samples varies between 0.00 and 20.00 All samples satisfying the FSI criterion ($FSI \leq 50\%$).

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

1.6.2 Pavement Condition

Concessionaire informed that, after Construction, till date not done any major maintenance or periodic Overlay on the pavement surface. For the last 8 years, Concessionaire is maintaining the project road in traffic worthy condition with good riding quality., however surface related distresses such as narrow cracking and Ravelling is observed on the project road. crack sealing/fog seal is noticed along at some distressed locations. Patching also seen along the project road. Due to oxidization undergone for the last 8 years, the surface appears dry surface.

1.6.3 FWD Analysis and Assessment of Overlay Requirement

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

Table 15: Summary of Design Moduli of different layers - BHS

Sl.No	From	To	Length (km)	15th Percentile MR values		
				MR for BT	MR for Granular	MR for Subgrade
1	0.00	4.20	4.2	2263	178	77
2	4.20	7.30	3.1	2264	301	77
3	7.30	10.30	3.0	2270	250	77
4	10.30	12.50	2.2	2160	185	77
5	12.50	17.80	5.3	2178	214	77
6	17.80	21.00	3.2	2171	298	77
7	21.00	23.60	2.6	2149	218	77
8	23.60	27.80	4.2	2210	362	77
9	27.80	32.20	4.4	2227	365	77
10	32.20	35.20	3.0	2086	234	77
11	35.20	36.60	1.4	2383	61	77
12	36.60	39.00	2.4	2382	128	77
13	39.00	42.60	3.6	2447	171	77
14	42.60	46.00	3.4	2427	162	77
15	46.00	48.766	2.766	2443	190	77

1.6.3.1 Observations on FWD Results

It can be noticed from the above table that the layer moduli for the three layers are varying along the length and direction. The MR value for BT layer is 2086 Mpa to 2447 Mpa in BHS Carriageway. The MR value for Granular Layers is 61 Mpa to 365 Mpa in BHS Carriageway. Similarly, the MR value for Subgrade Layer is 77 Mpa BHS Carriageway.

1.6.4 Pavement Composition

As per approved pavement thickness, as per IRC 37, for 55 MSA and 10% subgrade CBR, the recommended pavement thickness for new flexible pavement is given below:

S.No	Layer	Thickness
1	BC	50mm
2	DBM	100mm
3	WMM	250mm
4	GSB	200mm
5	Subgrade	500mm (CBR 10%)

However, from the test pits dug at five locations along the project road, the average Bituminous layer thickness observed is 140 mm and the average granular layer thickness is 438mm. Variation may be due to Secondary Compaction over the period.

1.6.5 CD Structures

The CD structures along the corridor appear to be as per the standards and specifications. Presently, all structures appear new and seem to be in good condition without any major distress. Structure wise conditions along the project corridor are presented below:

Details of Major Structure as per Schedule and as on site:

List of Structures	As Per Site
Major Bridge	3
Minor Bridge	8
Cattle/Pedestrian Underpass	0
Railway Over Bridge	0
Vehicular Underpass	1
Culverts	240

BR. NO. 7+780(MNB)

GENERAL DESCRIPTION

- Chainage : Km 7+780
- Type of structure : Minor Bridge
- Span Arrangement : 1 x 11.6m
- Total outer width of structure : 8.4 m
- Skew angle : NA
- Type of Foundation : Open
- Type of Substructure : RCC wall type
- Type of Superstructure : RCC 3 girder system and Deck slab
- Type of Bearing : Elastomeric
- Type of Railing : RCC Crash barrier
- Method of Inspection : Visual

OBSERVATIONS

Visual Observations on condition of the bridge are as below:

- Overall structure appears to be good in good condition
- Honey combs are observed on soffit of the slab.
- In wing wall minor cracks observed at some locations.



Km 7+780



Km 7+780

BR. NO. 11+900 (MNB)

GENERAL DESCRIPTION

- Chainage : Km 11+900
- Type of structure : Minor Bridge
- Span Arrangement : 1 x 10m
- Total outer width of structure : 10 m
- Skew angle : NA
- Type of Foundation : Open
- Type of Substructure : RCC wall type
- Type of Superstructure : LHS- RCC 4 girder system and RHS- RCC Solid slab
- Type of Bearing : No Bearings
- Type of Railing : RCC Crash barrier
- Method of Inspection : Visual

OBSERVATIONS

Visual Observations on condition of the bridge are as below:

- Overall structure appears to be in good condition
- Weep holes are not provided on wing walls.



Km 11+900

Km 11+900

BR. NO. 12+865 (MJB)**GENERAL DESCRIPTION**

- Chainage : Km 12+865
- Type of structure : MJB
- Span Arrangement : 3 x 25.5 m
- Deck width of bridge : 11 m
- Skew Angle : NA
- Type of Foundation : Open
- Type of Substructure : RCC Wall type
- Type of Superstructure : RCC 3 Girder system and Deck slab
- Type of Bearing : No Bearings
- Type of Railing : RCC Crash barrier
- Method of Inspection : Visual

OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Expansion joint rubber seals are damaged.
- In third span major cracks are observed on girders.
- Weep holes are not provided in abutment wall.
- Honeycombs are observed on the pier walls
- Bearing are not provided.
- In second span, bottom of the girder damaged, spalling of concrete & reinforcement is exposed.

NOTE:

During site visit, this Bridge was opened only for light vehicular traffic. Heavy vehicles were not allowed. The distress affecting the capacity of the bridge are shown in the photographs. Such as cracks in the bottom flange propagating on to the web as well are shown.

1. Bridge at Km 12+865 is having developed Vertical Flexural and Shear cracks due to overloading of Heavy Vehicular Traffic.
2. As per NHAI instructions, presently, heavy vehicles are not allowed on this bridge and the traffic is being diverted through Shillong Town.
3. On the side of existing old bridge, bailey bridge construction was under progress. Bailey bridge fabrication and support work of pier p1 and p2 was being executed by New India Construction (BRO nominated Contractor). The Concessionaire got COS approval for construction of Bailey bridge with the ancillary support and approach roads for this bailey bridge.
4. Bailey Bridge launching was completed by the BRO and the approach road was completed by the Concessionaire under COS. Concessionaire informed that Bailey Bridge was inaugurated on 25.03.2021 in presence of Hon’ble deputy Chief Minister Meghalaya.
5. As per information by the Concessionaire, NHAI has taken up the construction of new bridge independently.



12+865

Km



Km 12+865



Km 12+865



Km 12+865

BR. NO. 15+740 (MNB) (Extra)

GENERAL DESCRIPTION

- | | |
|----------------------------------|------------------------------|
| • Chainage | : Km 15+740 |
| • Type of structure | : Minor Bridge |
| • Span Arrangement | : 1 x 7m (SQ), 1 x 8.3m (SK) |
| • Total outer width of structure | : 12.2m(SQ), 14m(SK) |
| • Skew angle | : Nearly 15° |
| • Type of Foundation | : Open |
| • Type of Substructure | : RCC wall type abutment. |
| • Type of Superstructure | : RCC Solid Slab |
| • Type of Bearing | : No Bearings |
| • Type of Railing | : RCC Crash barrier |
| • Method of Inspection | : Visual |

OBSERVATIONS

Visual Observations on condition of the bridge are as below:

- Overall Structure Condition is good
- Drainage spout down take pipe is not provided.



Km 15+740



Km 15+740



BR. NO. 19+000 (MNB)

GENERAL DESCRIPTION

- Chainage : Km 19+000
- Type of structure : MNB
- Span Arrangement : 1 x 10.3 +1 x 20 + 1 x 12 m
- Total outer width of structure :12 m
- Skew angle : NA
- Type of Foundation : Open
- Type of Substructure :RCC Wall type
- Type of Superstructure :RCC 4 Girder system
- Type of Bearing : Pot PTFE, Pin Bearings
- Type of Railing :RCC Crash barrier
- Method of Inspection :Visual

OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Overall Structure Condition is good
- Floor apron damaged at first span.
- Minor Cracks are observed on approach slab.
- Expansion joints rubber are damaged.
- Cracks observed on crash barrier at some locations.
- Steel pipe hand railing is damaged.
- Minor damage on second span, third girder.



Km 19+000



Km 19+000



Km 19+000



Km 19+000



Km 19+000



Km 19+000



Km 19+000



Km 19+000

BR. NO. 22+640 (MJB)

GENERAL DESCRIPTION

- | | |
|----------------------------------|---|
| • Chainage | : Km 22+640 |
| • Type of structure | : MJB |
| • Span Arrangement | : 1 x 15 + 1 x 45 + 1 x 25 m |
| • Total outer width of structure | : 12 m |
| • Skew angle | : NA |
| • Type of Foundation | : Open |
| • Type of Substructure | :RCC Column type piers and wall type abutment |
| • Type of Superstructure | :RCCGirder system and composite steel structure |
| • Type of Bearing | : Pot PTFE, Pin Bearings |
| • Type of Railing | :RCC Crash barrier |
| • Method of Inspection | :Visual |

OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Overall Structure Condition is good
- Expansion joint rubber joints are damaged.
- Drainage spout down take pipe is not provided.
- Minor Cracks are observed on beside of the expansion joint.



Km 22+640



Km 22+640



Km 22+640



Km 22+640

BR. NO. 31+420 (MJB)

GENERAL DESCRIPTION

• Chainage	: Km 31+420
• Type of structure	: MJB
• Span Arrangement	: 1 x 30 + 2 x 45 m
• Deck width of bridge	: 12 m
• Skew Angle	: NA
• Type of Foundation	: Open
• Type of Substructure	: RCC column type piers and wall type abutment
• Type of Superstructure	: Composite steel structure
• Type of Bearing	: POT PTFE, Pin Bearings
• Type of Railing	: RCC Crash barrier
• Method of Inspection	: Visual

OBSERVATIONS

Visual Observations on condition of the structure are as below:

- Overall Structure Condition is good
- Expansion joint rubber selling is damaged.
- Drainage spout down take pipe is not provided.
- Minor Crack observed on crash barrier at some locations.



Km 31+420



Km 31+420



Km 31+420



Km 31+420

BR. NO. 32+868 (MNB)

GENERAL DESCRIPTION

- Chainage: : Km 32+868
- Type of structure : Minor Bridge
- Span Arrangement : 1 x 24 m
- Total outer width of structure : 12m
- Skew Angle : NA
- Type of Foundation : Open
- Type of Substructure : RCC wall type abutment.
- Type of Superstructure : RCC 4 Girder system and Deck slab
- Type of Bearing : Pot PTFE & Pin bearings
- Type of Railing : RCC Crash barrier
- Method of Inspection : Visual

OBSERVATIONS

Visual Observations on condition of the bridge are as below:

- Overall Structure Condition is good
- Expansion joint rubber joints are damaged.
- Floor apron is damaged.



Km 32+868



Km 32+868



Km 32+868



Km 32+868

BR. NO. 37+020 (MNB)

GENERAL DESCRIPTION

- | | |
|----------------------------------|-------------------------------------|
| • Chainage: | : Km 37+020 |
| • Type of structure | : Minor Bridge |
| • Span Arrangement | : 1 x 15 m |
| • Total outer width of structure | : 12 m |
| • Skew Angle | : NA |
| • Type of Foundation | : Open |
| • Type of Substructure | : RCC wall type abutment. |
| • Type of Superstructure | : RCC 4 Girder system and Deck slab |
| • Type of Bearing | : Pot PTFE & Pin Bearings |
| • Type of Railing | : RCC Crash barrier |
| • Method of Inspection | : Visual |

OBSERVATIONS

Visual Observations on condition of the bridge are as below:

- Overall Structure Condition is good
- Minor Crack observed on crash barrier wall at some locations.
- Minor Cracks observed on expansion joints sides.



Km 37+020



Km 37+020



Km 37+020



Km 37+020

BR. NO. 37+600 (MNB)

GENERAL DESCRIPTION

- Chainage: : Km 37+600
- Type of structure : Minor Bridge
- Span Arrangement : 2 x 25.30 m
- Total outer width of structure : 8.5 m
- Skew Angle : NA
- Type of Foundation : Open
- Type of Substructure : RCC wall type pier and abutments
- Type of Superstructure : RCC Girder system
- Type of Bearing : NA
- Type of Railing : RCC Head wall
- Method of Inspection : Visual

OBSERVATIONS

Visual Observations on condition of the bridge are as below:

- Overall Structure Condition is good
- Expansion joints rubber joints sealing is damaged.
- Minor damage on head wall at small portion



Km 37+600



Km 37+600



Km 37+600



Km 37+600

BR. NO. 38+480 (VUP) (Extra)

GENERAL DESCRIPTION

• Chainage	: Km 38+750
• Type of bridge	: VOP/VUP
• Span Arrangement	: 1 x 18 m
• Total outer width of bridge	: 12 m
• Median Width	:-
• Skew Angle	: NA
• Type of Foundation	: Open
• Type of Substructure	: RCC Circular type Abutment
• Type of Superstructure	: RCC 4 Girder system and deck slab.
• Type of Bearing	: Pot PTFE, Pin Bearings
• Type of Railing	: RCC Crash barrier
• Method of Inspection	: Visual

OBSERVATIONS

Visual Observations on condition of the bridge are as below:

- Overall Structure Condition is good
- Drainage spout down take pipes are not provided.
- Expansion joints are buried with debris
- Minor crack observed on RCC crash barrier at some locations



Km 38+750



Km 38+750



Km 38+750



Km 38+750

BR. NO. 42+400 (MNB) (Extra)

GENERAL DESCRIPTION

• Chainage	: Km42+400
• Type of bridge	: MNB
• Span Arrangement	: 1 x 7.75m(SQ) and 1 x 9.8m (SK)
• Total outer width of bridge	: 12.9 m (SQ) and 13.1 m (SK)
• Skew Angle	: Nearly 15°
• Type of Foundation	: Open
• Type of substructure	: RCC wall type Abutment
• Type of Superstructure	: RCC Solid Slab
• Type of Bearing	: NA
• Type of Railing	: RCC Crash barrier
• Method of Inspection	: Visual

OBSERVATIONS

Visual Observations on condition of the bridge are as below:

- Overall Structure Condition is good
- Drainage spout down take pipes are not provided
- Minor Crack observed on footpath location at 1 location.



Km 42+400



Km 42+400

Photos depicting the existing culvert are presented below :





Km 0+735



Km 4+150



Km 4+570



Km 6+284



Km 8+053



Km 44+820

Table 16:Details of Culverts:

For most of the culverts, Quadrant pitching and slope protection is not Visible

S.No	Structure type	Chainage	Span arrangement (No.x length)	Vertical clearance (m)	Slab thickness (m)	CW width (m)	Existing deck width	Remarks
1	Pipe	0+365	1 x 1.2	0.0(LHS) & 0.0(RHS)		7	10.3	
2	Pipe	0+465	1 x 1.2	0.0(LHS) & 0.0(RHS)		7	15.1	
3	Box	0+655	1 x 1.5 x 1.5					
4	Box	0+735	1 x 1.5 x 1.5	1.3	0.3	7	15.1	
5	Pipe	0+802	1x1.0	0.4(LHS) & 0.3(RHS)		7	14.1	Minor cracks on head wall.
6	Pipe	1+120	1 x 1.2 (skew angle is 15 ⁰)	0.4(LHS) & 0.4(RHS)		7	17.7	Minor damage on head wall.
7	Pipe	1+359	1 x 1.0	0.3(LHS) & 0.5(RHS)		7	16.5	
8	Pipe	1+450	2 x 1.2 (skew angle is 15 ⁰)	0.5(LHS) & 0(RHS)		7	12.8	
9	Pipe	1+570	1x1.0	1 (LHS)		7	15.3	1.RHS side house is constructed
10	Pipe	1+773	1x1.0					
11	Pipe	1+951	1x 1.0	Buried with bushes		7	17.4	
12	Pipe	2+160	2x1.20	1m (BHS)		7	16.2	
13	Pipe	2+230	1x 1.0	1m (LHS) & 0.3 (RHS)		7	14.3	
14	Pipe	2+330	1x1.2	Buried with bushes		7	16.7	
15	Pipe	2+446	1x1.0	1m (LHS) & 0.3 (RHS)		7	15.7	
16	Pipe	2+745	1 x 1.0	0.4m (LHS) & 0.3 (RHS)		7	17.3	

S.No	Structure type	Chainage	Span arrangement (No. x length)	Vertical clearance (m)	Slab thickness (m)	CW width (m)	Existing deck width	Remarks
17	Pipe	2+883	1x1.0	0.9(BHS)		7	15.4	
18	Pipe	3+071	1x1.0	0.3(LHS) 0.2(RHS)		7	13.6	
19	Pipe	3+250	1 x 1.0	Buried with bushes (LHS) 0.3m(RHS)		7	20.9	
20	Pipe	3+280	2 x 1.0	0.3(LHS) 0.4(RHS)		7	12.8	
21	Pipe	3+388	1x1.0	Buried with bushes		7	15.4	
22	Pipe	3+495	1x1.0	Buried (LHS) & 0.3 (RHS)		7	14.3	
23	Pipe	3+600	1x1.0	0.4 (LHS) Buried with Bushes (RHS)		7	15.9	
24	Pipe	3+675	1x1.0	0.3 (LHS) & 0.6 (RHS)		7	13.2	
25	Pipe	3+833	1x 1.2	0.4(BHS)		7	16.8	
26	Pipe	3+965	1x1.0	Buried with sand		7	13.1	
27	Box	4+150	1 x 3.0 x 3.0	2.5	0.4	8.5	17.5	
28	Pipe	4+316	1x1.0	0.9 (LHS) & 0 (RHS)		8.5	13.2	
29	Pipe	4+540	1 x 1.2 (skew angle is 10°)	0.4 (RHS)		7	16.8	
30	Box	4+570	1 x 3.0 x 4.0	2	0.3	7	13.1	
31	Box	4+598	1 x 1.5x1.5 (skew angle is 20°)	1.5	0.3	7	17.5	
32	Pipe	4+655	1x1.2	0.0(LHS) & 0.0(RHS)		7	13.2	
33	Pipe	4+700	1x1.2	0.4 (LHS) & 0.3 (RHS)		9	17.6	
34	Pipe	4+838	1x 1.0	0.3 (LHS) & 0.0 (RHS)		9	10.3	

S.No	Structure type	Chainage	Span arrangement (No.x length)	Vertical clearance (m)	Slab thickness (m)	CW width (m)	Existing deck width	Remarks
35	Pipe	5+010	1 x 1.0	0.3 (LHS) & 0.0 (RHS)		9	12.5	
36	Pipe	5+234	1 x 1.0	0.3 (LHS) & Closed (RHS)		9	15.5	
37	Pipe	5+334	1x1.0	Closed (LHS) & 0.3(RHS)		7	14	
38	Pipe	5+425	1x1.0	Closed (LHS) & 0.4(RHS)		7	13.9	
39	Pipe	5+540	1x1.2	0.9 (LHS) & closed (RHS)		7	16.2	
40	Pipe	5+605	1x1.0	0.4 (LHS) & 0.5 (RHS)		7	15	
41	Pipe	5+691	1 x 1.0	0.6 (LHS) & 0.6 (RHS)		7	14.4	
42	Pipe	5+920	1 x 1.20	0.5 (LHS) Closed with bushes (RHS)		7	16.2	
43	Pipe	6+102	1 x 1.2	1m (LHS) & Closed with bushes (RHS)		7	17.2	
44	Pipe	6+166	1 x 1.0	0.0 (LHS) & 0.0 (RHS)		7	17	
45	Pipe	6+225	1 x 1.2	0.0 (LHS) & 0.2 (RHS)		7	17.6	
46	Box	6+284	1x3.0x3	2	0.6	7	14.6	
47	Pipe	6+681	1x1.2	0.0 (LHS) 7 0.2 (RHS)		7	17.9	
48	Pipe	7+025	1x1.0	0.0 (LHS) & 0.0 (RHS)		7	16.7	
49	Pipe	7+300	1 x 1.20	1.2 (LHS) & 1 (RHS)		7	21.7	
50	Pipe	7+450	1x1.20	0.4 (BHS)		7	20.7	
51	Pipe	7+525	1 x 1.20	0.3 (LHS) & 0.0 (RHS)		7	14.5	
52	Box	7+600	1 x 1.5 x 1.5	1	0.3	7	15.7	

S.No	Structure type	Chainage	Span arrangement (No.x length)	Vertical clearance (m)	Slab thickness (m)	CW width (m)	Existing deck width	Remarks
53	Pipe	7+690	1x 1.2 (skew angle is 15 ⁰)	1(LHS) & closed with bushes(RHS)		7	13	
54	Pipe	7+710	1x1.2	1(LHS) & 0.5 (RHS)		7	14.4	
55	Pipe	7+940	1 x 1.0	0.2(LHS) & 0.2 (RHS)		7	14.5	
56	Box	8+053	1x 1.5x1.5 (skew angle is 20 ⁰)	1.5	0.3	7	16.1	
57	Pipe	8+149	1 x 1.0	1 m(BHS)		7	15.3	
58	Pipe	8+333	1x1.2	0.5(LHS) & 0.9 (RHS)		7	15.9	
59	Box	8+417	1 x 1.5 x 1.5	1.3	0.3	7	12.6	
60	Pipe	8+537	1x1.2	1.2 (LHS) & 0.6 (RHS)		7	15.8	
61	Pipe	8+605	1x1.2	0.3 (LHS) & 0.1 (RHS)		7	12.7	
62	Pipe	8+653	1 x 1.2	0.3 (LHS) & 0.0 (RHS)		7	12.6	
63	Pipe	8+910	1x1.2	0.3 (LHS) & 0.5 (RHS)		7	15.7	
64	Pipe	9+130	1 x 1.2	0.3 (LHS) & 0.3 (RHS)		7	15.8	
65	Pipe	9+190	3x1.2	0.4 (LHS) & 0.2 (RHS)		7	10.6	
66	Pipe	9+210	1x1.2	0.0 (LHS) & 0.0 (RHS)		7	16.3	
67	Pipe	9+230	2x1.2	0.0 (LHS) & 0.0 (RHS)		7	10.2	Shop is constructed on LHS side and RHS side buried.
68	Pipe	9+625	2x1.2	0.0 (LHS) & 0.0 (RHS)		7	18	
69	Pipe	9+770	1x1.2	0.5 (LHS) & 0.0 (RHS)		7	18.7	
70	Pipe	9+940	1x1.2	Buried		7	18.1	
71	Pipe	10+261	1 x 1.0	0.0 (LHS) & 0.0 (RHS)		8.5	12.2	

S.No	Structure type	Chainage	Span arrangement (No.x length)	Vertical clearance (m)	Slab thickness (m)	CW width (m)	Existing deck width	Remarks
72	Pipe	10+405	1 x 1.0 (skew angle is 10 ⁰)	0.2 (LHS) & 0.3 (RHS)		7	16.7	
73	Pipe	10+765	1x1.2	0.2 (LHS) & Buried (RHS)		7	15.2	
74	Pipe	10+950	2x1.2	1 m (LHS) & 1.2 m (RHS)		7	13.3	
75	Pipe	11+170	1x 1.2	0.0 (LHS) & 0.0 (RHS)		7	14.7	
76	Pipe	11+275	2 x 1.2	0.0 (LHS) & 0.0 (RHS)		7	17.4	
77	Pipe	11+535	1x1.0	0.3 (LHS) & 0.3 (RHS)		7	14.2	
78	Pipe	11+660	1 x 1.0	0.5 (LHS) & 0.4 (RHS)		7	15.4	
79	Pipe	11+935	1x1.2	Buried		7	16.1	Buried
80	Box	12+049	1 x 3.0 x 3.0	2.5	0.4	7	15.5	
81	Pipe	12+435	1 x 1.2	0.4 (LHS) & 0.5 (RHS)		7	13.6	
82	Pipe	12+515	1 x 1.2	0.4 (LHS) & 0.5 (RHS)		7	13.6	
83	Pipe	12+610	1 x 1.2	0.3 (LHS) & 0.0 (RHS)		7	13.2	
84	Pipe	12+657	1 x 1.2	0.0 (LHS) & 0.4 (RHS)		7	13.7	
85	Pipe	13+815	1x1.2	0.4 (LHS) & 0.5 (RHS)		7	15.2	
86	Pipe	13+861	1 x 1.2	0.2 (LHS) & 0.3 (RHS)		7	16.1	
87	Pipe	13+946	1x1.2	Buried		7	16.7	Buried
88	Pipe	13+994	1 x 1.2	Buried		7	15.8	Buried
89	Pipe	14+060	1x1.2	0.2 (LHS) & 0.3 (RHS)		7	16.1	
90	Pipe	14+272	1 x 1.2	0.2 (LHS) & 0.3 (RHS)		9	16	
91	Pipe	14+452	1x 1.2	1 (LHS) & 0.6 (RHS)		7	15.4	

S.No	Structure type	Chainage	Span arrangement (No.x length)	Vertical clearance (m)	Slab thickness (m)	CW width (m)	Existing deck width	Remarks
92	Pipe	14+573	2x1.2	0.5 (LHS) 7 Buried (RHS)		7	17.9	RHS side fire station is constructed
93	Pipe	14+610	1 x 1.2	0.6 (LHS) & 0.5 (RHS)		7	13.2	
94	Pipe	14+645	2x1.2	0.0 (LHS) & 0.0 (RHS)		7	16.7	
95	Pipe	14+780	1 x 1.2	0.4 (LHS) & 0.0 (RHS)		7	15.5	
96	Pipe	14+950	1 x 1.2	0.0 (LHS) & 0.0 (RHS)		7	15.9	
97	Pipe	15+010	1x1.2	0.4 (LHS) & 0.0 (RHS)		7	16.2	
98	Pipe	15+065	1x1.2	0.3 (LHS) & 0.2 (RHS)		7	15.7	
99	Pipe	15+460	1 x 1.2	0.9 (LHS) & 0.6 (RHS)		7	16.5	
100	Pipe	15+730 (Extra)	1 x 1.2	1m(LHS) Buried (RHS)		7	16	
101	Pipe	15+870	1x1.2	0.3 (LHS) & 0.4 (RHS)		7	16.2	
102	Pipe	16+080	1 x 1.2	0.3 (LHS) & 0.4 (RHS)		7	15.1	
103	Pipe	16+260	1x 1.2	0.5 (LHS) & 0.5 (RHS)		7	15.1	
104	Pipe	16+385	1 x 1.2	0.3 (LHS) & 0.4 (RHS)		7	19.3	
105	Pipe	16+970	1x1.2	1.0 (LHS) & 0.3 (RHS)		7	18.1	
106	Pipe	17+265	1x1.2	0.0 (LHS) & 0.3 (RHS)		7	14.6	
107	Pipe	17+360	2x1.2	0.0 (LHS) & 1.0 (RHS)		7	14.8	
108	Pipe	17+578	1 x 1.2	1.0 (LHS) & 0.9 (RHS)		7	13.8	
109	Pipe	17+658	1x1.2	0.2 (LHS) & 0.5 (RHS)		7	14.1	
110	Pipe	17+956	1 x 1.2	0.4 (LHS) & 0.2(RHS)		7	17.7	
111	Pipe	18+222	1x1.2	0.4 (LHS) & 0.5(RHS)		7	17.1	

S.No	Structure type	Chainage	Span arrangement (No.x length)	Vertical clearance (m)	Slab thickness (m)	CW width (m)	Existing deck width	Remarks
112	Pipe	18+633	1x1.2	0.3 (LHS) & 0.4 (RHS)		7	12.3	
113	Pipe	18+680	1x1.2	0.1 (LHS) & 0.3 (RHS)		7	16.2	
114	Pipe	18+800	1 x 1.2	1.1 (LHS) & 1.0 (RHS)		7	16.4	
115	Pipe	18+980	1x1.2	0.4 (LHS) & 1.0 (RHS)		7	18.4	
116	Pipe	19+070	1x1.2	1.2 (LHS) & 1.0 (RHS)		7	13.3	
117	Pipe	19+230	1 x 1.2	1.0 (LHS) & 0.6 (RHS)		7	14.2	
118	BOX	19+400	1 x 2 (skew angle is 10 ⁰)	1.0 (LHS) & 0.6 (RHS)		7	9.3	
119	Pipe	20+035	1x1.2	0.4 (LHS) & 0.3 (RHS)		7	11.4	
120	Pipe	21+135	1 x 1.2	0.2 (LHS) & 0.3 (RHS)		7	12.5	
121	Pipe	21+230	1x 1.2	1.2 (LHS) & 0.3 (RHS)		7	13.1	
122	Pipe	21+717	1 x 1.2	1.0 (LHS) & 0.3 (RHS)		7	13.5	
123	Pipe	21+900	1x1.2	0.4 (LHS) & 0.3 (RHS)		9	12.3	
124	Pipe	21+910	1 x 1.2	0.3 (LHS)& 1.2 (RHS)		9	13.9	
125	Pipe	22+230	1x1.2	1.1 (LHS) & 0.4 (RHS)		7	12.3	
126	Pipe	22+500	1x1.2	1.1 (LHS) & 0.9 (RHS)		7	12	
127	Pipe	22+954	2 x 1.2	0.6 (LHS) & 0.5 (RHS)		7	12.9	
128	Pipe	23+170	2x1.2	1.2 (LHS) & 1.2 (RHS)		7	21.3	
129	Pipe	23+480	1x1.2	0.5 (LHS) & 0.3 (RHS)		7	15.5	

S.No	Structure type	Chainage	Span arrangement (No.x length)	Vertical clearance (m)	Slab thickness (m)	CW width (m)	Existing deck width	Remarks
130	Pipe	23+690	1x1.2	1.0 (LHS) & 1.2 (RHS)		7	15.2	
131	Pipe	23+810	1 x 1.2	1.0 (LHS) & 1.2 (RHS)		7	13.6	
132	Pipe	24+160	1x1.2	0.5 (LHS)& Closed (RHS)		7	36.9	
133	Pipe	24+590	1 x 1.2	0.3 (LHS) 0.1 (RHS)		7	16.1	
134	Pipe	24+730	1 x 1.2	1.0 (LHS) & 0.4 (RHS)		7	15.4	
135	Pipe	24+940	1x1.2	0.3 (LHS) & Closed (RHS)		7	13.1	
136	Pipe	25+170	1x 1.2	0.2 (LHS) & 0.9 (RHS)		7	12.1	
137	Pipe	25+425	1 x 1.2	0.4 (LHS) & 0.3 (RHS)		7	13.8	
138	Pipe	25+503	1x1.2	0.6 (LHS) & 0.5 (RHS)		7	12.7	
139	Pipe	25+868	1 x 1.2	1.1 (LHS) & 0.3 (RHS)		7	13.5	
140	Pipe	25+982	1x1.2	0.2 (LHS) & 0.3 (RHS)		7	14.5	
141	Pipe	26+452	1 x 1.2	1.2 (LHS) & 0.3 (RHS)		7	13.8	
142	Pipe	26+592	1 x 1.2	0.9 (LHS) & 0.5 (RHS)		7	16	
143	Pipe	26+680	1x1.2	0.6 (LHS) & 0.3 (RHS)		7	13.2	
144	Pipe	26+778	1x1.2	0.7 (LHS) & 1.0 (RHS)		7	16.8	
145	Pipe	26+860	1 x 1.2	1.0 (LHS) & 1.0 (RHS)		7	13.8	
146	Pipe	27+712	1x1.2	1.0 (LHS) & 1.0 (RHS)		7	12.4	
147	Pipe	27+830	2 x 1.2	1.0 (LHS) & 0.3 (RHS)		7	12.5	
148	Pipe	28+205	1 x 1.2	0.5 (LHS) & 0.9 (RHS)		7	13.2	
149	Pipe	28+295	1x1.2	0.5 (LHS) & 0.3 (RHS)		7	11.6	

S.No	Structure type	Chainage	Span arrangement (No.x length)	Vertical clearance (m)	Slab thickness (m)	CW width (m)	Existing deck width	Remarks
150	Pipe	28+510	1x 1.2	1.1 (LHS) & 0.9 (RHS)		7	16.5	
151	Pipe	28+900	1 x 1.2	0.6 (LHS) & 1.2 (RHS)		7	15.7	
152	Pipe	29+130	1 x 1.2	0.2 (LHS) & 0.3 (RHS)		7	14.1	
153	Pipe	29+260	1 x 1.2	0.2 (LHS) & 0.3 (RHS)		7	15.6	
154	Pipe	29+440	1 x 1.2	0.2 (LHS) & 0.3 (RHS)		7	14.5	
155	Pipe	29+540	1x1.2	0.5 (LHS) & 0.6 (RHS)		7	13.4	
156	Pipe	29+715	1x1.2	0.2 (LHS) & 0.3 (RHS)		7	17.1	
157	Pipe	29+780	1 x 1.2 (skew angle is 25°)	0.2 (LHS) & 0.0 (RHS)		7	17.5	
158	Pipe	29+935	1 x 1.2	0.2 (LHS) & 0.2(RHS)		7	14.3	
159	Pipe	30+050	1x1.2	0.2 (LHS) & 0.0 (RHS)		7	14.6	
160	Pipe	30+180	2 x 1.2	1.2(BHS)		7	16	
161	Pipe	30+337	1x1.2	0.1 (BHS)		7	16	
162	Pipe	30+400	1x 1.2	0.5 (LHS) & 0.6 (RHS)		7	14.4	
163	Pipe	30+770	1 x 1.2	0.3 (LHS) & 0.6 (RHS)		7	22.2	
164	Pipe	30+900	1x1.2	0.0 (LHS) & 0.4 (RHS)		7	13.4	
165	Pipe	31+132	2 x 1.2	0.6 (LHS) & 0.4 (RHS)		7	11.9	
166	Pipe	31+680	2 x 1.2 (skew angle is 25°)	1.2 (LHS) & 1.0 (RHS)		7	15.8	
167	Pipe	31+860	2 x 1.2	0.0 (LHS) & 0.3 (RHS)		7	15	
168	Pipe	32+300	1 x 1.2	0.3 (LHS) & 0.3 (RHS)		9	16.1	
169	Pipe	33+780	1x1.2	0.5 (LHS) & 0.4 (RHS)		7	14.7	

S.No	Structure type	Chainage	Span arrangement (No. x length)	Vertical clearance (m)	Slab thickness (m)	CW width (m)	Existing deck width	Remarks
170	Pipe	34+050	1 x 1.2	1.1 (LHS) 0.2 (RHS)		7	15.8	
171	Pipe	34+160	1 x 1.2	0.4 (LHS) & 0.6 (RHS)		7	17.2	
172	Pipe	34+530	2x1.2	0.3 (LHS) & 0.3 (RHS)		7	15.7	
173	Pipe	34+700	1 x 1.2	0.3 (LHS) & 0.0 (RHS)		7	14.6	
174	Pipe	34+840	1 x 1.2	0.3 (LHS) & 0.3 (RHS)		7	16.1	
175	Pipe	35+390	1 x 1.2	1.2 (LHS) & 0.2 (RHS))		7	13.1	
176	pipe	35+497	2x1.2	1.0 (LHS) & 1.2 (RHS)		7	12.7	Head wall is not provided
177	Pipe	35+780	1 x 1.2	0.4 (LHS) & 1.2 (RHS)		7	13.7	
178	Box	35+960	1 x 1.5 x 1.5	1.5	0.3	7	14.5	
179	Pipe	36+045	1 x 1.2	0.4 (LHS) & 1.2 (RHS)		7	11.7	
180	Pipe	36+195	2x1.2	0.9 (LHS) & 1.2 (RHS)		7	13.5	
181	Pipe	36+410	2x1.2	0.9 (LHS) & 1.2 (RHS)		7	14.4	
182	Pipe	36+575	2x1.2	0.3 (LHS) & 0.4 (RHS)		7	18.3	
183	Pipe	36+780	2x1.2	0.6 (LHS) & 0.6 (RHS)		7	16.6	
184	Pipe	36+900	1x1.2	0.1 (LHS) & 0.2 (RHS)		7	15.2	
185	Pipe	37+216	1x 1.2	0.3 (LHS) & 0.4 (RHS)		7	15	
186	Box	37+261	1x2x2.5					
187	Pipe	37+360	2x1.2	0.3 (LHS) & 0.4 (RHS)		7	12.9	
188	Pipe	37+700	1 x 1.2	1.1 (LHS) & 1.0 (RHS)		7	23.5	
189	Pipe	37+860	1x1.2	0.0 (LHS) & 0.3 (RHS)		7	14.9	

S.No	Structure type	Chainage	Span arrangement (No. x length)	Vertical clearance (m)	Slab thickness (m)	CW width (m)	Existing deck width	Remarks
190	Pipe	38+062	2x1.2	0.3 (LHS) & 0.4 (RHS)		7	13.5	
191	Pipe	38+220	1x1.2	0.4 (LHS) & 0.4 (RHS)		7	11.4	
192	Pipe	38+340	1x1.2	0.3 (LHS) & 0.0 (RHS)		7	13.2	
193	Pipe	38+812	1x1.2	1.2 (LHS) & 1.0 (RHS)		7	12.3	
194	Pipe	39+020	1x1.2	0.3 (LHS) & 0.3 (RHS)		7	14	Minor damages on head wall
195	Pipe	39+120	1x1.2	0.3 (LHS) & 0.3 (RHS)		7	16.3	
196	Pipe	39+210	1x1.2	1.0 (LHS) & 1.0 (RHS)		7	13.2	
197	Pipe	39+450	1 x 1.2	0.6 (LHS) & 0.4 (RHS)		7	15.4	
198	Box	39+590	1 x 3.0 x 3.0	2	0.4	7	15.3	1.Minor damages on slope apron
199	Pipe	39+970	1x1.2	0.6 (LHS) & 0.6 (RHS)		7	12.2	
200	Pipe	40+080	1x1.2	Closed (LHS) 0.6 (RHS)		7	14.3	1.LHS side is closed with cement mortar
201	Pipe	40+410	1x1.2	0.2 (LHS) & 0.4 (RHS)		7	11.9	
202	Pipe	40+755	1x1.2	0.3 (LHS) & 0.4 (RHS)		7	11.6	
203	Pipe	40+940	1x1.2	0.3 (LHS) Closed (RHS)		7	9.6	
204	Box	41+185	1 x 3.0 x 3.0	2	0.3	7	11.8	
205	Pipe	41+300	1x1.2	0.3 (LHS) & 0.4 (RHS)		7	12.8	
206	Box	41+400	1 x 3.0 x 3.0	2	0.3	7	16.6	
207	Box	41+810	1 x 1.5 x 1.5	2	0.4	7	15.8	
208	Box	42+070	1 x 2.0 x 2.0 (skew angle is 15°)	2	0.5	7	14.8	Minor damages on head wall at some location
209	Box	42+300	1 x 2.0 x 2.0	0.2 (LHS) & 0.3 (RHS)	0.3	7	17	Minor damages on head

S.No	Structure type	Chainage	Span arrangement (No.x length)	Vertical clearance (m)	Slab thickness (m)	CW width (m)	Existing deck width	Remarks
								wall at some location
210	Pipe	42+630	1x1.2	0.3 (LHS) & 0.3 (RHS)		7	14	
211	Pipe	42+820	1 x 1.2	0.4 (LHS) Buried (RHS)		7	16	Minor damages on head wall at some location
212	Box	42+860	1 x 1.5 x 1.5	0.3 (LHS) & 0.6 (RHS)		7	16.6	Minor damages on head wall at some location
213	Pipe	43+080	1 x 1.2	0.5 (LHS) & 0.6 (RHS)		7	13.3	apron is damaged.
214	Pipe	43+190	1 x 1.2	1.2 (LHS) & 1.2 (RHS)		7	16.7	
215	Pipe	43+375	1 x 1.2	Closed (LHS) 0.4 (RHS)		7	14.35	Minor damages on head wall at some location
216	Pipe	43+622	1x1.2	Buried		9	14	1.Both sides buried.
217	Pipe	43+700	1 x 1.2	40. (LHS) & 0.5 (RHS)		7	12.3	Slope apron is damaged.
218	Pipe	44+020	1 x 1.2	0.2 (LHS) & 0.3 (RHS)		7	15.2	
219	Pipe	44+110	1x1.2	0.5(LHS) & 0.2(RHS)		7	14	Slope apron is damaged.
220	Pipe	44+190	1 x 1.2	0.2 (LHS) & 0.3 (RHS)		7	17.9	Slope and Floor apron damaged.
221	Pipe	44+300	1x1.2	0.3 (LHS) & 0.4 (RHS)		7	13.7	Slope and Floor apron damaged.
222	Pipe	44+390	1 x 1.2	0.2 (LHS) & 0.3 (RHS)		7	13.1	Slope and Floor apron damaged.
223	Box	44+470	1 x 1.5 x 1.5	1m		7	15.6	Slope and Floor apron damaged.
224	Pipe	44+543	1x1.2	0.2 (LHS) & 0.3 (RHS)		7	13.6	Slope and Floor apron damaged.
225	Pipe	44+670	1 x 1.2	0.3 (LHS) & 0.4 (RHS)		7	10.1	Slope and Floor apron damaged.
226	Box	44+820	1 x 1.5 x 1.5	0.0 (LHS) & 0.3 (RHS)		7	15	Slope and Floor apron damaged.

S.No	Structure type	Chainage	Span arrangement (No. x length)	Vertical clearance (m)	Slab thickness (m)	CW width (m)	Existing deck width	Remarks
227	Pipe	44+975	1x1.2	0.6 (LHS) & 0.9 (RHS)		7	10.9	Slope and Floor apron damaged.
228	Pipe	45+155	1x 1.2	1.2 (LHS) & 0.6 (RHS)		7	18.6	Slope and Floor apron damaged.
229	Pipe	45+375	1x1.2	0.5 (LHS) & 0.6 (RHS)		7	16.5	
230	Pipe	45+900	1x1.2	0.2 (LHS) & 0.1 (RHS)		7	15.5	
231	Box	46+034	1 x 1.5 x 1.5	0.3 (LHS) & 0.3 (RHS)		7	26.5	
232	Pipe	46+190	1x1.2	0.2 (LHS) & 0.6 (RHS)		7	15	
233	Pipe	46+360	1x1.2	0.2 (LHS) & 0.4 (RHS)		7	15	
234	Pipe	46+605	1 x 1.2	0.0 (LHS) & 0.4 (RHS)		7	15	LHS side buried with sand
235	Pipe	46+745	1 x 1.2	0.3m (BS)		7	15	
236	Pipe	47+820	4x1.2	1.2m (BS)		7	77.5	Head wall is not provided
237	Pipe	48+049	3 x 1.2	1.2m (BS)		7	65	Head wall is damaged
238	Pipe	48+113	2 x 1.2	1.2m (BS)		7	62.5	Minor Crack observed on top of the pipe
239	Pipe	48+400	1 x 1.2	1.0m (BS)		7	15.0	
240	Pipe	48+485	1 x 1.2	1.0m (BS)		7	27.5	

1.6.6 Drainage and Slope Protection

Open lined drains constructed along the corridor appear to be in sound condition for most of length and are functioning well.

1.6.7 Traffic Safety and Road Furniture

Metal beam crash barriers provided along the project road appear to be intact over entire length except for few locations where it got damaged and are being repaired in the routine maintenance.

Roadway delineators installed along the length of corridor appear to be good condition. Emergency Call Boxes are also provided along the project corridor but are locked.

Traffic solar blinkers established along the corridor at major/minor junctions. Two High mast lighting provided are functioning well.

1.7 REHABILITATION PLANS AND DESIGNS

1.7.1 Design Traffic Loading

Design Traffic loading has been estimated by considering the adopted VDFs, the traffic data received from Company with 5% growth rates. The Estimated design traffic for 5 years, 10 years and 15 years design period as below:

Table 17: Estimated Design traffic loading

Year	Design Lane MSA on Existing Carriageway
5 th year from Now	17
10 th year from Now	38
15 th year from Now	65

1.7.2 Pavement Rehabilitation and Strengthening

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

- The existing pavement is considered as a 3-layer system consisting of subgrade, granular and bituminous layer. The remaining life of exiting pavement in terms of Fatigue and Rutting life (MSA) are estimated
- The remaining life is compared with design traffic loading. An overlay with assumed thickness is considered on exiting pavement where required.
- The Total system including the proposed Overlay (Trial thickness) is assumed as a four-layer system and considered the relevant MR values for all the four layers namely New BT layer, existing bituminous surface, total existing Granular layers and Subgrade layers.

- The MR value for the New BT is assumed as 3000 MPA (considering VG40 Bituminous grade) and for all the remaining three layers, the MR Values derived and finalized from the FWD Analysis are considered
- Critical Tensile strains and Vertical strains are found out by using the IIT PAVE Software at the bottom of existing bituminous layer and at the top of the subgrade layer respectively.
- The Fatigue and Rutting equations (equation 16 & 17 given in the IRC: 115) have been used to estimate the Fatigue and Rutting Life of The Pavement system.
- The Obtained Fatigue and Rutting Life are compared with the required life for the assumed trial overlay thickness.
- Analysis is carried out for individual homogeneous sections as well for minimum and Average Modulus Values on each direction separately.

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

Table 18: Remaining life of the existing pavement

Sections	From	To	Length	EBT layer MR value	MR of Granular	MR of Subgrade	Existing BT layer	Existing Granular layer(mm)	Total BT Layer thickness	Total Crust	E- BT layer	ver. Strain(Ev)	tan. Strain(Et)	NF- Fatigue life, MSA	Rutting life,MSA	Critical Life
1	0.00	4.20	4.2	2263	178	77	140	430	140	570	2263	339.9	240.5	36	222	36
2	4.20	7.30	3.1	2264	301	77	140	430	140	570	2264	294.2	184.5	101	426	101
3	7.30	10.30	3.0	2270	250	77	140	430	140	570	2270	311.7	203.7	69	328	69
4	10.30	12.50	2.2	2160	185	77	140	430	140	570	2160	340.2	242.1	37	221	37
5	12.50	17.80	5.3	2178	214	77	140	430	140	570	2178	327.9	224.9	48	261	48
6	17.80	21.00	3.2	2171	298	77	140	430	140	570	2171	297.3	188.8	96	407	96
7	21.00	23.60	2.6	2149	218	77	140	430	140	570	2149	327.1	224.1	50	264	50
8	23.60	27.80	4.2	2210	362	77	140	430	140	570	2210	276.7	167.0	152	563	152
9	27.80	32.20	4.4	2227	365	77	140	430	140	570	2227	275.5	165.7	156	574	156
10	32.20	35.20	3.0	2086	234	77	140	430	140	570	2086	322.6	219.3	55	281	55
11	35.20	36.60	1.4	2383	61	77	140	430	140	570	2383	360.0	347.5	8	171	8
12	36.60	39.00	2.4	2382	128	77	140	430	140	570	2382	354.9	268.0	23	182	23
13	39.00	42.60	3.6	2447	171	77	140	430	140	570	2447	337.1	234.9	37	230	37
14	42.60	46.00	3.4	2427	162	77	140	430	140	570	2427	341.2	241.7	33	218	33
15	46.00	48.766	2.76	2443	190	77	140	430	140	570	2443	329.9	224.5	44	254	44

From the above table it is clear that homogeneous Section 1,4 and 11 to 14 requires strengthening Overlay and remaining sections does not require Overlay as the remaining life of these sections is more than the design MSA i.e., 38 MSA.

Summary of the above analysis is presented in the following tables;

Table 19: Remaining life of the existing pavement

Sections	From	To	Length	Existing - BT layer MR Value	MR of Granular Layer Thickness	MR (or) E- Subgrade	Existing BT layer (mm)	Existing Granular layer (mm)	Proposed BT (mm)	Total Crust	E- BT layer	Ver. Strain (Ev)	tan. Strain (Et)	Nf- Fatigue life, mSA	Rutting life, mSA	Critical Life
1	0.00	4.20	4.2	2263	178	77	140	430	40	610	2263	267.8	185.5	99	653	99
4	10.30	12.50	2.2	2160	185	77	140	430	40	610	2160	267.9	186.8	100	652	100
11	35.20	36.60	1.4	2383	61	77	140	430	80	660	2383	210.9	189.4	87	1928	87
12	36.60	39.00	2.4	2382	128	77	140	430	40	610	2382	275.3	203.7	66	576	66
13	39.00	42.60	3.6	2447	171	77	140	430	40	610	2447	272.6	196.1	75	602	75
14	42.60	46.00	3.4	2427	162	77	140	430	40	610	2427	268.5	185.8	93	645	93

From FWD consideration, overlay is required for a length of 17.2 Km. For all the 17.2 Km 40mm Overlay is sufficient except for a length of 1.40km where the overlay requirement is 30mm BC+50mm DBM apart from this another 4Kms of lengths where roughness is more than 2000 mm/km is also considered with 30mm BC + 50mm DBM. For remaining length where there is no structural overlay requirement, it may be prudent to consider at least 40mm BC considering the age of the pavement.

1.7.3 Structural Rehabilitation

All the structure found to be in good condition except little minor treatment like repair of stone pitching, cleaning of drainage spouts, cleaning of vegetation etc., may be required.

1.7.4 Land Slide Locations

The following table presents locations of Land slide

Land slide Locations		
S. No	Chainage	Side
1	5.250	LHS
2	21.200	LHS
3	22.100	RHS
4	23.500	LHS
5	33.000	BHS
6	38.500	LHS
7	39.210	RHS
8	40.940	LHS
9	44.300	RHS
10	44.540	RHS

Among all the above locations, at Km 38+500 (LHS) is the crucial one, where major land slide occurred on 26.09.2020. After this there were no landslides reported.

1.8 OPERATION AND MAINTENANCE

1.8.1 Introduction

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

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

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

1.8.2 CA specifications for Major Maintenance

- Schedule K of CA species that Roughness values exceeds 2500mm/km in a length of KM, needs to be corrected within 180 days.
- No specific requirement with respect to deflection (BBD) measurement

1.8.3 Inputs for O&M schedule

1.8.3.1 Project Sections

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

- Case 1: Roughness value <2000 mm/Km
- Case 2: Roughness values >2000<2300 mm/Km
- Case 3: Roughness>2300<2500 mm/Km
- Case 4: Roughness>2500 mm/KM

Present corridor does not have roughness values greater than 2300 mm/km and accordingly two cases have been considered in the present project.

As the project Road is two lane road, Average of both the lanes considered as representative parameter for each section and HDM analysis carried out.

1.8.3.2 Traffic (AADT)

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

Vehicle/Mode	Both Direction AADT at 2021 (Vehicles)
LCV	412
2A truck	699
3A truck	242
MAV truck	940
BUS	93

1.8.3.3 Vehicle Damage Factors (VDF)

Adopted VDF values are given below:

Mode Type	Considered VDF
LCV	1.00
2 Axle Truck	4.50
3 Axle Truck	8.00
MAV (4-6 Axle)	10.00
Buses	1.00

1.8.3.4 Deflection (FWD) Values & Roughness Values

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

Both side	Overlay Sections- FY2022/23	
	case-1	case-2
Length	16200	1000
Roughness	1888	2064
IRI	2.66	2.88
Deflection	0.30	0.26
Cracking	23.3%	20.0%
Ravelling	1.7%	4.0%
Patching	4.0%	2.0%

Both side	No Overlay FY2022/23	
	case-1	case-2
Length	27566	4000
Roughness	1909	2033
IRI	2.69	2.85

Both side	No Overlay FY2022/23	
	case-1	case-2
Deflection	0.27	0.25
Cracking	16.5%	9.5%
Ravelling	1.9%	3.8%
Patching	0.9%	0.3%

1.8.4 Options for O&M schedule

Based on the requirements of CA, various options have been considered to be used as responsive overlays triggered at specified level of roughness of 2500mm/km.

Following options were considered in the analysis:

- Base Case: Micro surfacing whenever roughness is >2500mm/KM with regular maintenance
- Case 1: Responsive Overlay of 30mm BC whenever roughness is >2500mm/KM with regular maintenance
- Opt-2: Responsive Overlay of 40mm BC whenever roughness is >2500mm/KM with regular maintenance

1.8.5 Roughness progression

Roughness progression for each section under each alternative maintenance option has been done using the deterioration models in HDM-4. Following graphs represents the roughness progression for each alternative:

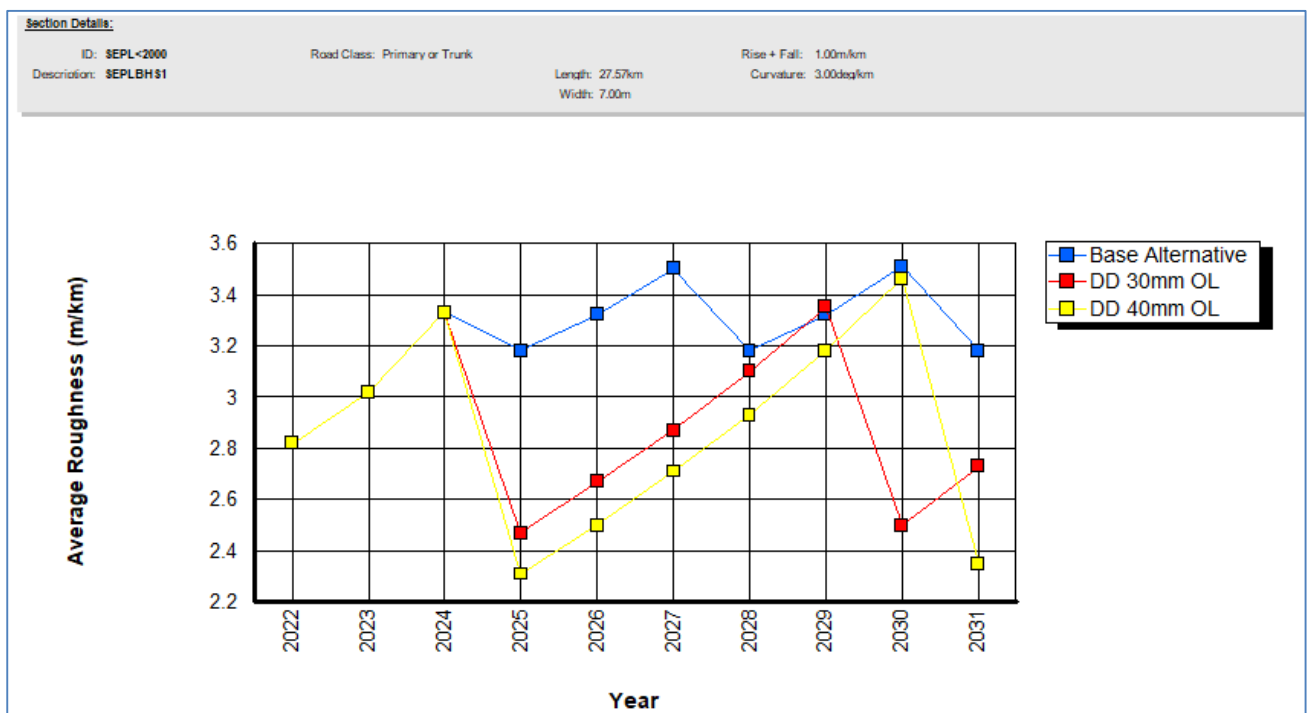


Figure 1: Average Roughness along the Project Road (No OL Section<2000mm/Km)

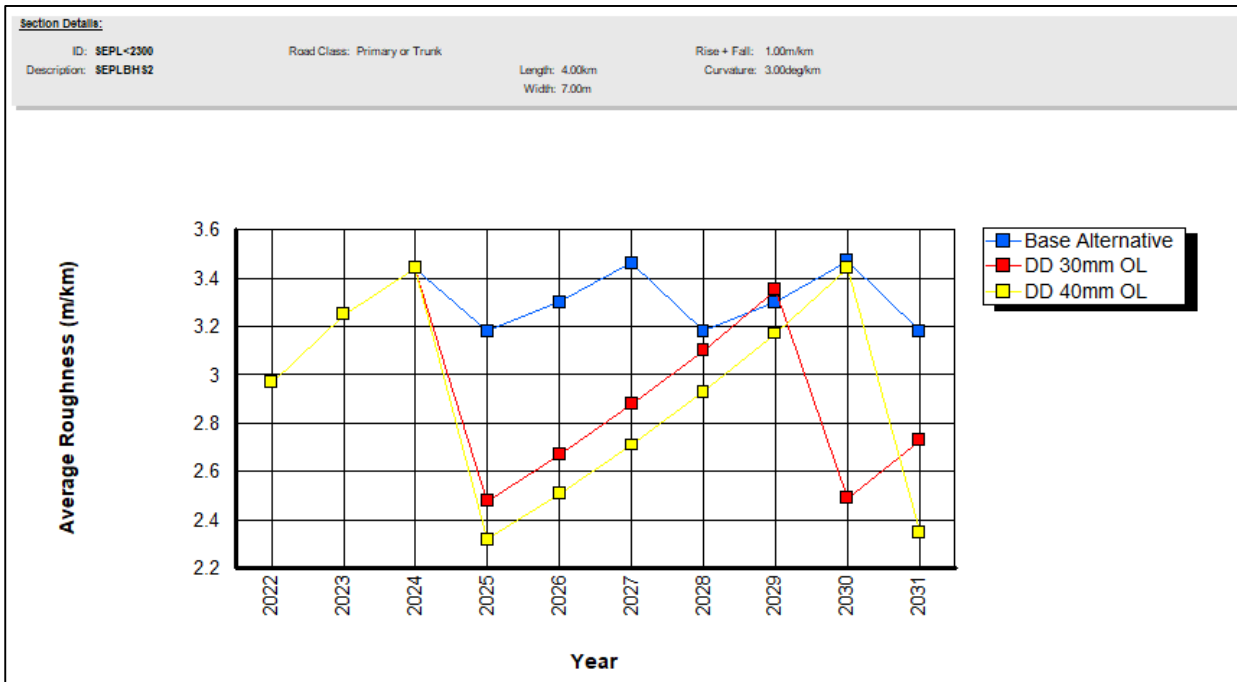


Figure 2: Average Roughness along the Project Road (No OL Section<2300mm/Km)

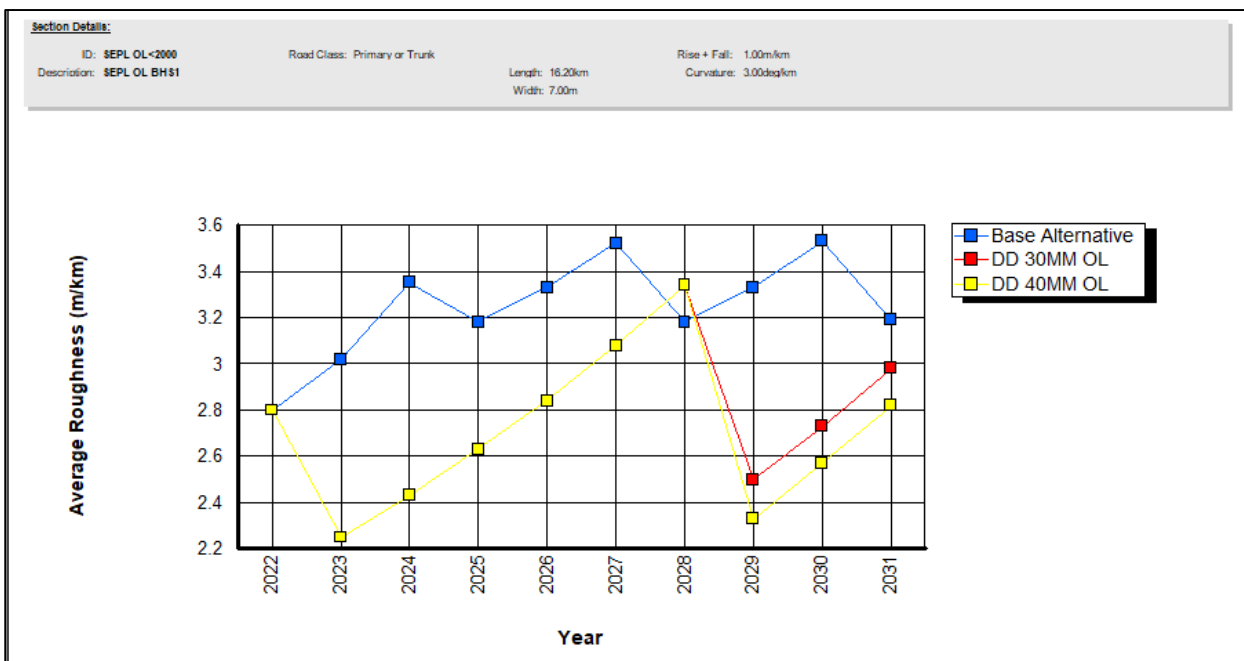


Figure 3: Average Roughness along the Project Road (OL Section<2000mm/Km)

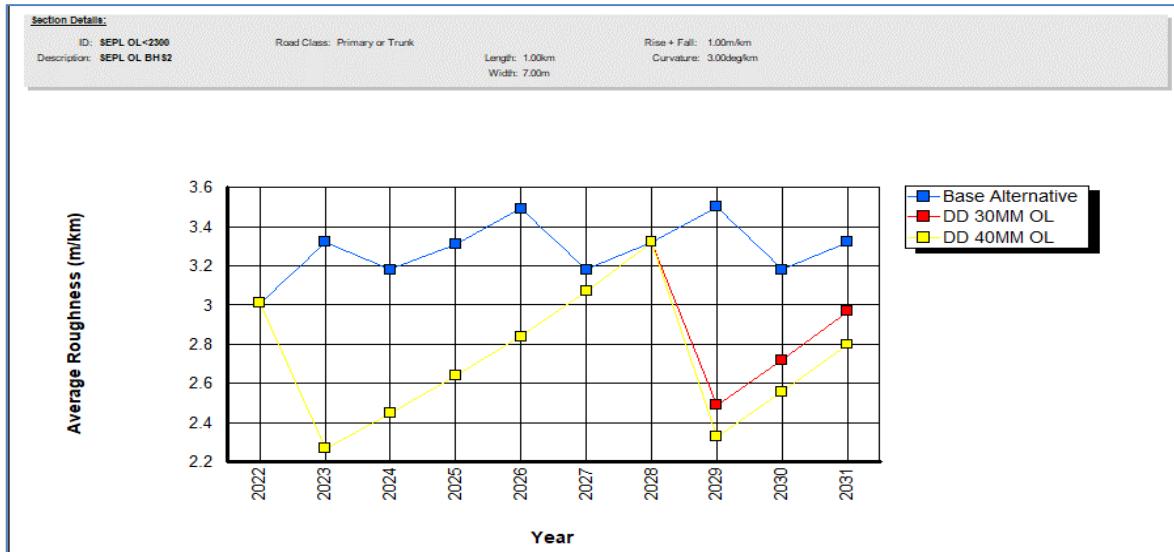


Figure 4: Average Roughness along the Project Road (OL Section<2300mm/Km)

1.8.6 O&M schedule

Based on the forgoing discussions and inputs, the O&M schedule for the project for various options considered above for individual sections have been prepared for varying overlay thickness are as below:

No Overlay Section:

	Overlay Section	
	IRI<2000	2000-2500
Criteria:	IRI<2000	2000-2500
Length:	27.566	4.000
Financial Year	Case-1	Case-2
2023	40mm BC	30mm BC + 50mm DBM
2024		
2025		
2026		

Overlay Section:

	No Overlay section	
	IRI<2000	2000-2500
Criteria:	IRI<2000	2000-2500
Length:	16.200	1.000
Financial Year	Case-1	Case-2
2023	40mm BC	30mm BC + 50mm DBM
2024		
2025		
2026		

1.9 COST

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

- Immediate Repair's Cost
- Routine Maintenance Cost
 - Routine Maintenance of Road
 - Repair and Replacement of various road items
 - Tolling system and HTMS maintenance AMC cost
 - Incident management
 - Routine Maintenance for Structures
 - Electricity bill of lighting areas near cities, I/C and other areas & Fuel expenditure
- Periodic Maintenance Cost
 - Functional +Structural overlay MCW Section I
 - Overlay on Service Road
 - Major Maintenance of Structures (Expansion joint replacement, Bearing replacement etc.)
 - Replacement of Toll Hardware and software & HTMS at later date
- Toll Plaza Operation cost and Highway Patrolling and maintenance supervision staff cost
- Maintenance of utilities and public amenities
- Safety audit and other inspection costs
- Insurance
- I.C for O&M period
- Administrative Cost
- Additional cost Required for capacity augmentation
- Grand Total Cost

Table 20: Abstract of Cost Estimate

S. No	FY	Abstract of Cost Without escalation		
		Immediate Repair's Cost +Routine and Operational Cost	Periodic Maintenance Cost	Total Cost
1	2023	6.29	31.83	38.11
2	2024	6.29	-	6.29
3	2025	6.29	-	6.29
4	2026	5.36	1.48	6.85
	Total:	24.22	33.31	57.53

Notes:

1. Base Cost are arrived for FY2023
2. All the material rates are February 2022 Rates

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

Table 21: Cost Summary Without Escalation

S. No	Year	Routine Maintenance						Periodic Maintenance			Toll Plaza Operation cost & SPV Cost	Maintenance of utilities and public amenities	SPV Cost	Survey Costs	Insurance & Audit charges	IE Fee	Total Recurring cost
		Routine Maintenance	R&R of Road items	Toll and HTMS AMC cost	Incident management	R&R of Structures	Electricity bill of lighting	Functional +Structural overlay MCW+S/R	Replacement of Toll Hardware and software & HTMS at later date	Structure specified repairs							
1	2023	1.67	0.97	0.03	1.18	0.12	0.05	31.521		0.30	0.00	-	0.98	0.05	0.70	0.55	38.11
2	2024	1.67	0.97	0.03	1.18	0.12	0.05	0.000		0.00	0.00	-	0.98	0.05	0.70	0.55	6.29
3	2025	1.67	0.97	0.03	1.18	0.12	0.05	0.000		0.00	0.00	-	0.98	0.05	0.70	0.55	6.29
4	2026	1.43	0.83	0.03	1.00	0.10	0.04	1.250		0.23	0.00	-	0.83	0.05	0.60	0.46	6.85
Total:		6.45	3.74	0.13	4.53	0.45	0.17	32.77	0.00	0.54	0.00	0.00	3.77	0.19	2.70	2.10	57.53

Notes:

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

1.10 CONCLUSIONS

Foregoing discussions on various elements of project highway, following critical issues pertaining to project need careful attention for acquiring the same:

1. The Total Project length is 48.766 kms and complete length is having two lane width i.e., 7.0m wide carriageway flanked by 1.5m to 2.5m earthen shoulder on each side with Flexible Pavement.
2. The project corridor generally runs in rolling/hilly terrain for most of length except in few locations where it is slightly plain. The land use along the project road is mostly Forest. It passes through small village settlements like Umroi, Nongtrah, Diengpasoh, Thangshalai, Mawryngkneng etc.
3. The Project Road has 2 major junctions and about 64 minor junctions along the project road and the condition of these junctions is good
4. All together the Project road has about 13 No. of Bus Bays with Bus shelters and the condition of these is good
5. About 4 numbers of High mast lighting is observed along the project road. Two numbers are located at Major Junctions, one Toll Plaza location and one at Minor Junction. Concessionaire informed that, Maintenance of only Two High mast lights, one near Km 10+120 and the other one near Km 48+766 is under Concessionaire’s scope.
6. The present condition of pavement is fair along the project road. Cracking and raveling has developed on some part of the Carriageway. These are mainly surface related distresses and the cracking appears to be top-down cracking. Crocodile cracking is noted at few locations.
7. Crack sealing is also being done / in progress at some of the locations along the project corridor. The present surface condition appears slightly dry surface; because of which the cracking might have initiated at most of the locations. No potholes are seen along the project. Remedial treatment at distressed locations carried out with BC material.
8. There are no major undulations or depressions observed along the corridor indicating good Subgrade quality.
9. Roughness data indicates that the Average Roughness values along the project road is 1844 mm/Km and the maximum Roughness Values is 2065 mm/Km. From Roughness consideration, Overlay is not required for the project road as the unevenness Index (UI) is less than Permissible Value of 2500 mm/km
10. Test pit surveys indicated average crust of 564mm consisting of 140 mm blacktop and 438 mm of granular layers over subgrade.
11. The remaining concession period is 4 years; however, requirement of overlay has been verified by considering the 10th year design MSA. The estimated 10th year Design traffic loading is 38 MSA. FWD Analysis indicates that the remaining life of the existing

pavement is less than 38 MSA for a length of 17.20Km and remaining length of the project road is having remaining life more than 38 MSA.

12. From FWD consideration, overlay is required for a length of 17.2 Km. For all the 17.2 Km 40mm Overlay is sufficient except for a length of 1.40km where the overlay requirement is 30mm BC+50mm DBM apart from this another 4Kms of lengths where roughness is more than 2000 mm/km is also considered with 30mm BC + 50mm DBM. For remaining length where there is no structural overlay requirement, it may be prudent to consider at least 40mm BC considering the age of the pavement.
13. Majority of road furniture items are intact with very few damages. Regular maintenance being carried out at site like replacement of MCB / Studs and relaying of lane marking etc.
14. As per site condition, it appears that, no overlay done since project completion. Concessionaire confirmed that, not done any major maintenance for total Project Length except patch work and crack sealing works
15. The project Road has 3 Major bridges and 8 Minor bridges and 1 VUP. There 240 number of Culverts exists along the project road.
16. All CD structures along the project road are having good condition except 1 Major bridge near Km 12+865 (which was constructed by PWD). Bridge at Km 12+865 is having developed Vertical Flexural and Shear cracks due to overloading of Heavy Vehicular Traffic.
17. On the side of existing old bridge at Km 12+865, bailey bridge construction is completed and this bridge is operational.
18. Bailey Bridge launching was completed and the approach road was completed by the Concessionaire under COS. Concessionaire informed that Bailey Bride was inaugurated on 25.03.2021 in presence of Hon’ble deputy Chief Minister Meghalaya
19. At Km 38+500 (LHS) land slide occurred earlier and is one of the crucial locations. However, Client informed that there was no land slide in the project highway after that.
20. The Project Road has 25 number of ECBs along the Project Road.
21. The Project road has one Toll plaza along the project road. Toll plaza @ km.24+900 is having 6 lanes (BHS). All lanes are provided with rigid pavement and the tapering portions of the Toll plaza are provided with flexible pavement.
22. The Project road has 1 number of Highway Patrolling Vehicle, 1 number of Ambulance and 1 number of recovery van with 20 Metric Ton capacity
23. For this project, a Project specific Manual is provided in Schedule-D. The allowable threshold value of roughness is 2500 mm/km as per Schedule-K.
24. As per CA, there is no requirement of mandatory overlay during the Concession Period

25. Couple of works under COS were executed such as Highway Mini Nest at Toll Plaza and bio toilet apart from Bailey Bridge.
26. As on today, Concessionaire could not complete three pending punch list items as land is not handed over to Concessionaire by NHAI; One Punch list item is flaring of Airport Junction and the second one is widening of Curve for visibility at 3 locations and the third one is construction of RCC Drain for a length of 470m near between Km 0+650 and 1+120 on LHS.